

DATE	JOB NO.	PURCHASE ORDER NO.
19/02/2015	407014-00120	ME-POD-0023
<b>VTRI-2696</b>	DEVON MR. NO.	
	FE-CPF-M023	
EQUIP. NO.	WORLEYPARSONS VP. NO	REV.
	407014-00120-ME-POD-0023-0121	2

**OPERATING MANUAL  
FOR THE  
COB CLOSED HYDROCARBON DRAIN PACKAGE**

**FOR**

**CNRL**


*Refer to attached Discrepancy List*

**LSD: 11-02-039-08 W5M  
LOCATION: FERRIER CPF**

**BY**

**ALCO GAS & OIL PRODUCTION EQUIPMENT LTD.**

**ALCO S.O.: 2013-8440-50**

	<b>WorleyParsons</b> resources & energy <b>REVIEW STAMP</b>
PROJECT NO. _____	
1. REVIEWED & ACCEPTED	<input type="checkbox"/>
MANUFACTURE MAY PROCEED.	
2. REVIEWED & ACCEPTED AS MARKED, REVISE & RE-SUBMIT	<input checked="" type="checkbox"/>
MANUFACTURE MAY PROCEED.	
3. REVISE AS MARKED AND RE-SUBMIT	<input type="checkbox"/>
MANUFACTURE SHALL NOT PROCEED.	
4. REVIEW NOT REQUIRED.	<input type="checkbox"/>
FOR INFORMATION ONLY. MANUFACTURE MAY PROCEED.	
Acceptance in any of these categories in no way relieves the Contractor/Supplier of its responsibility for the size and proper performance of the works in accordance with the Contract/Purchase Order.	
NAME:	<i>G. LANDRY</i>
SIGNED:	<i>[Signature]</i>
DATE:	<i>23 / Feb / 2015</i>

**ALCO GAS & OIL PRODUCTION EQUIPMENT LTD.**

Project Title:	CNRL, Ferrier Central Processing Facility	Date:	February 23, 2015
WP Project No.	407014-00120	Rev.	1
Devon Project No.	MR-0023		
MR Title:	COB CHD package 001-PK-10-1000		
WP MR No.	407014-00120-ME-POD-0023		
Data book Doc No.	Operating Manual		

### Final Data Books Discrepancy List

Item	Description	Reference	Remarks
1	Section A Update index according to comments below		
2	Page 4 of PDF file. The safety relief valve model provided in the instrument datasheet file is 1905-00F-1-CC-MS-31-RF-LA or a 1900 series safety relief valve is provided on this package. The safety relief valve catalogue provided is for a 19000 series safety relief valve and not the 1900 series provided on the instrument datasheet. Please provide the correct catalogue for the safety relief valve.		Not Implemented / Incomplete.  Replace Series 19000 Document with Series 1900 Operations / Maintenance Manual.
3	Page 73 of PDF file. The first page of the Federal Signal Model 191XL Series Beacon Installation and Maintenance Manual is not book marked in the PDF file.		Not Implemented / Incomplete.
4	Page 842 of PDF file. The wrong pressure gauge catalogue is attached. The model number for the pressure gauges is 233.34 per the instrument datasheets. Please attached the correct pressure gauge catalogue.		Not Implemented / Incomplete.  Replace Wika 233.54 datasheet with Wika 233.34 datasheet.
5	Missing vendor catalogue for - motor, - exhaust fan, - air intake levers, - horn - indoor and outdoor light fixture and - strainer. Please add.		Not Implemented / Incomplete.  Add Vendor Catalogue / IOM for Horn. Federal Signal 300GCS-120 Horn.
6	Section B D-2013-8440-50A-001/003 revision 1 is not the latest revision. The latest version includes the location of the center of gravity with a P.Eng. Stamp. Please resubmit the current version for this operating manual.		Done -  Stamped Drawings with COG provided in Lifting
7	D-2013-8440-50A-002/003 revision 2 is not the latest revision. The latest version includes the location of the center of gravity with a P.Eng. Stamp. Please resubmit with the correct version for this operating manual.		Done -  Stamped Drawings with COG provided in Lifting

Project Title:	CNRL, Ferrier Central Processing Facility	Date:	February 23, 2015
WP Project No.	407014-00120	Rev.	1
Devon Project No.	MR-0023		
IMR Title:	COB CHD package 001-PK-10-1000		
WP MR No.	407014-00120-ME-POD-0023		
Data book Doc No.	Operating Manual		

### Final Data Books Discrepancy List

Item	Description	Reference	Remarks
8	D-2013-8440-50A-003/003 revision 0 is not the latest revision. The latest version includes the location of the center of gravity with a P.Eng. Stamp. Please resubmit with the correct version for this operating manual.		Done - Stamped Drawings with COG provided in Lifting Diagram - COG Section of Manual.
9	D-2013-8440-50F-001/001. The latest revision of this P&ID in WorleyParsons' document control is revision 3 with P.Eng. Stamp. Please resubmit with the correct version for this operating manual.		Not Implemented / Incomplete. Provide Stamped version of P&ID.
10	Add all instrument datasheets.		Done - Instrument Datasheet provided in Section C.
11	Add line list		Done - Line List / LDT provided in Section B.
12	Add all junction box wiring diagrams		Done - Wiring Diagrams provided in Section B.
13	Add vessel datasheets		Done - Datasheet provided in Section D.
14	Add pump datasheets		Done - Datasheet provided in Section D.
15	Add building drawing and datasheets		Done - Datasheet provided in Section D. Drawings Provided in Section B.
	Items that were never submitted and need to be added to IOM.		
16	Cable and conduit schedule		Not Implemented / Incomplete. Provide Cable Schedule (if available).
17	Motor datasheet		Done. Provided in Section A.
18	Spare parts list		Done. Provided in Section G.
19	CRN numbers for vessels, valves, etc. where required.		Not Implemented / Incomplete. This information may be provided in IOM or MRB.
20	Preservation and storage procedure		Done. Provided in Section E.
21	This is only the operating manual. The balance of the documents identified in the SDR must be included in the manufacturer's record book.		

# DEVON CANADA CORPORATION

COB CLOSED  
HYDROCARBON  
DRAIN PACKAGE

## ACCESSORIES

Doc. No.: 2013-8440-50  
Rev.: 1  
Rev. Date: Feb.4, 2015  
Page No.: 1 of 2

## INDEX

### SECTION A: ACCESSORIES

CONSOLIDATED  
DETRONICS  
FISHER

GENERAL MONITORS  
NETZSCH  
PENBERTHY

ROSEMOUNT

RUFFNECK  
WIKA

FEDERAL SIGNAL  
KILLARK  
ALTA STRAINER TECO  
WESTINGHOUSE  
ENERTECH

19000 SERIES SAFETY RELIEF VALVES  
X3301 MULTISPECTRUM IR FLAME DETECTOR  
67 REGULATORS, D4 CONTROL VALVE, i2P-100  
ELECTRO-PNEUMATIC TRANSDUCER  
S4000C SENSOR  
NEMO-PUMP  
330 GAUGE COCKS, L SERIES FLAT GLASS  
GAUGES  
5300 GWR, 644 TEMPERATURE TRANSMITTER,  
RTD SENSOR WIRING  
AH GLYCOL BUILDING HEATER  
233.54 PRESSURE GAUGE, TI.50 BIMETAL  
THERMOMETER

191XL BEACONS  
VM4L LED NYF150  
STRAINER  
AEHH8R MOTOR  
ET-12 FAN

### SECTION B: BILL OF MATERIALS & DRAWINGS

#### MECHANICAL FLOWSHEET

D-2013-8440-50F SHEET 001 TO 001

#### LAYOUT/ASSEMBLY

D-2013-8440-50A SHEET 001 TO 003

#### BILL OF MATERIALS

B-2013-8440-50B SHEETS 001 TO 007

#### LINE LIST

8440-50 COB HC DRAIN-LDT

#### JUNCTION BOX WIRING DIAGRAMS

1928NE-ELC-5562 TO 5565

#### BUILDING DRAWINGS

LIFTING DIAGRAM - COG

**ALCO GAS & OIL PRODUCTION EQUIPMENT LTD.**

# DEVON CANADA CORPORATION

COB CLOSED  
HYDROCARBON  
DRAIN PACKAGE

## INDEX

Doc. No.:	2013-8440-50
Rev.:	1
Rev. Date:	Feb.4, 2015
Page No.:	2 of 2

### SECTION C: INSTRUMENT DATASHEETS

### SECTION D: EQUIPMENT DATASHEETS

### SECTION E: STORAGE & PRESERVATION PROCEDURES

FISHER CONTROL VALVES  
ROSEMOUNT TRANSMITTERS  
ANSIMAG PUMPS

### SECTION F: CALCULATIONS

@; <HB; 'GHI 8M  
: I ; #H9 '9A ISSION STUDY

### SECTION G: SHIPPING

SHIPPING RELEASE CERTIFICATE  
PACKING SLIP  
SPARE PARTS

**ALCO GAS & OIL PRODUCTION EQUIPMENT LTD.**

## **SECTION A**

## **ACCESSORIES**

# 19000

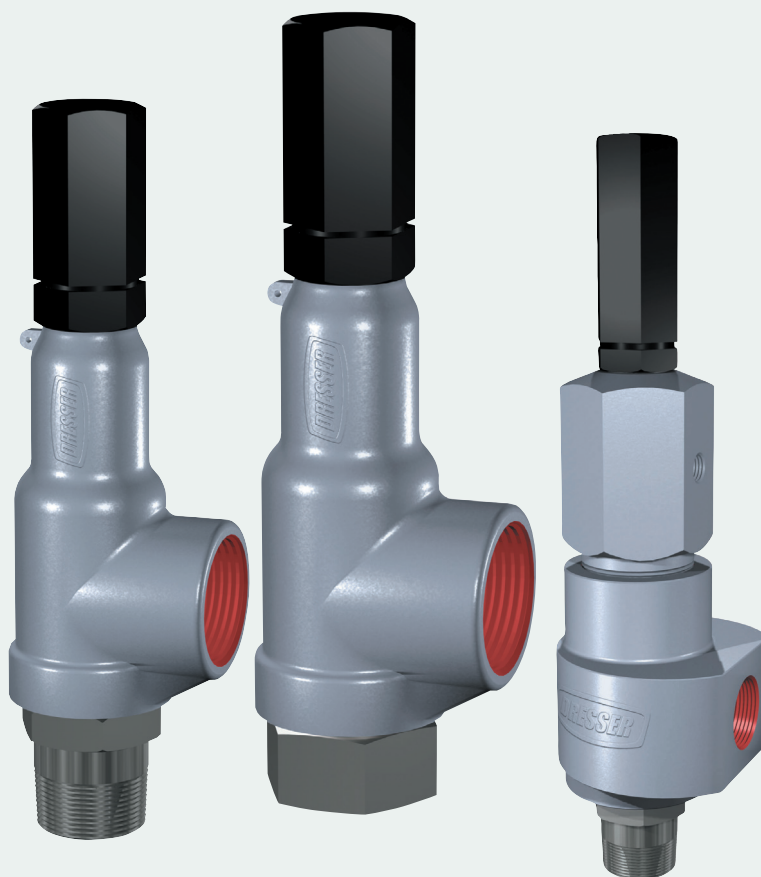
• Safety Relief Valve



Consolidated®

## Table of Contents

Introduction .....	19000.2
19000 Scope of Design .....	19000.3
Materials .....	19000.5
19000 DA (Soft Seat) .....	19000.7
19000 MBP (Back Pressure Compensation) .....	19000.9
Corrosive Service Material Selection .....	19000.11
Dimensions & Weights .....	19000.15
Threaded Connections .....	19000.15
Socket Weld Connections .....	19000.17
Flanged Connections .....	19000.19
Pressure Temperature Limits .....	19000.23
O-Ring Selection Procedure .....	19000.23
Pressure Temperature Ratings .....	19000.24
Capacities .....	19000.26
Air .....	19000.26
Steam .....	19000.27
Water .....	19000.28

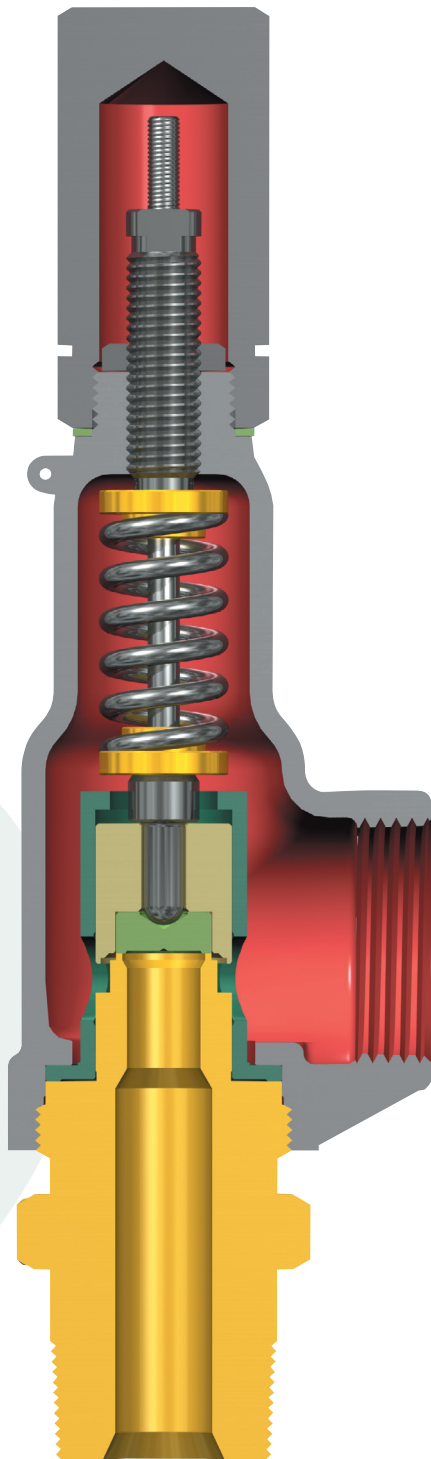


**19000 Series Threaded Safety Relief Valve**



## Introduction

The 19000 Series valves are designed and manufactured in compliance with ASME B & PVC, Section VIII and Section III (Class I, II and III) as well as being CE compliant to the European Pressure Equipment Directive 97/23/EC. Seat tightness, blowdown and capacity on all types of media meets the industry needs for overpressure protection in chemical, petrochemical, refinery, power generation (nuclear and conventional) and other commercial applications.



**19000-2**  
**Valve Closed**

### General Information

The 19000 Series threaded safety relief valve has 316 stainless steel trim as standard material. Reliable performance and easy maintenance procedures are characteristics of this valve (when properly installed in suitable applications for its design).

The 19000 Series valves has three pressure classes, 19000L (5 through 290 psig), 19000M (291 through 2000 psig), and 19000H (2001 psig and up). Standard 19000 parts are used for both liquid applications and gas applications. It is designed for short blowdown on all medias, typically less than 10%.

All 19000 Series valves have fixed blowdown. This means that the parts are designed so that there is no blowdown adjustment required when setting or testing the valve.

### Design Options

#### a. O-Ring seat seal valves

All 19000 Series valves are available with an O-Ring seat seal, as a design option. This optional design provides a bubble tightness in excess of 97% of the valve set pressure, in order to meet application requirements beyond the normal capabilities of metal to metal seat valves. 19000 Series valves with the O-Ring seat seal option are identified by the suffix DA (e.g., 1-19096L-DA).

#### b. Lifting Levers, Caps and Gags

All 19000 Series valves are designed so that field conversion from the standard screwed cap to a plain lifting lever cap, or to a packed lifting lever cap (or vice versa) does not require valve assembly during resetting. The lifting lever option is designed to open the valve at 75% of the valve set pressure, in compliance with ASME B & PVC, Section VIII. Further, all available 19000 Series valve caps may be equipped with a gag, upon customer request.

#### c. Inlet/Outlet Connections

All 19000 Series valves can be provided by CONSOLIDATED with flanges, threaded or socket weld inlet/outlet connections upon customer request.

# 19000 Standard Valves

This product is normally supplied with threaded inlet and outlet connections. Socket weld or flanged end connections are available as well.

Product type designations change depending on connection sizes, orifice sizes, pressure range, and whether connections are male or female.

Unless otherwise specified, the valve is always supplied with a screwed cap. The exception to this would be where ASME requires levers for steam, air and water service over 140°F (60°C).

Springs of precipitation hardened stainless steel are specified for -75°F to 800°F (-59°C to 426.6°C) and the valves carry a "c" suffix in that case. Inconel springs are used for temperatures 801°F to 1100°F (427.2°C to 593.3°C) and the valve carries a "t" suffix.

When selecting valves for back pressure applications, the following limits apply.

- Constant back pressure: 400 psig maximum
- Variable back pressure (superimposed or built-up): 400 psig or 10% of set pressure whichever is smaller.

Product variations consist of:

- 19000SG - Sour Gas Trim
- 19000DA - Soft Seat
- 19000MBP - Back Pressure Compensation

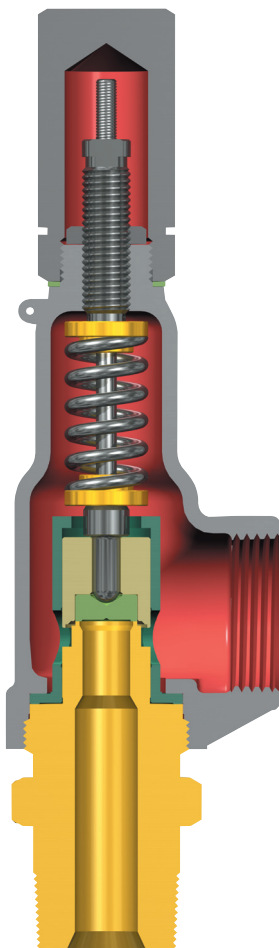
Product material variations include:

- 316 Stainless Steel
- Monel
- Hastelloy
- Alloy 20

Pressure/Temperature ratings may vary from those for standard valves when other than standard materials are selected. Consult factory if you need assistance.

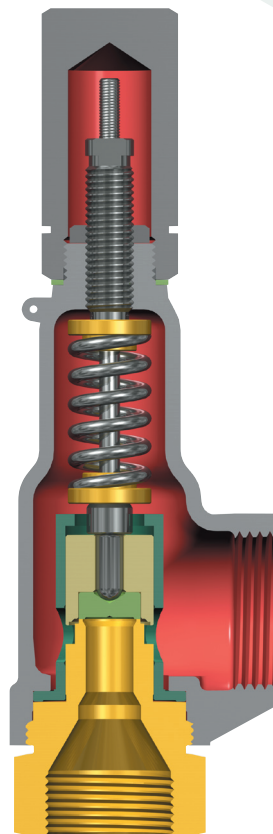
Orifice	Pressure Range (psig)	Standard Valve Type	Standard Connections (in.)
.096 Sq. in. 61.9 Sq. mm	5 to 290	1/2-19096L	1/2 - MNPT x 1 - FNPT
		3/4-19096L	3/4 - MNPT x 1 - FNPT 3/4 - FNPT x 1 - FNPT
		1-19096L	1 - MNPT x 1 - FNPT
	291 to 2000	1/2-19096M	1/2 - MNPT x 1 - FNPT
		3/4-19096M	3/4 - MNPT x 1 - FNPT 3/4 - FNPT x 1 - FNPT
		1-19096M	1 - MNPT x 1 - FNPT
2001 to 5000	3/4-19096H	3/4 - FNPT x 1 - FNPT	
.096 Sq. in. 61.9 Sq. mm	50 to 2000	1/2-19096MBP	1/2 - MNPT x 1 - FNPT
		3/4-19096MBP	3/4 - MNPT x 1 - FNPT
		1-19096MBP	1 - MNPT x 1 - FNPT
.110 Sq. in. 70.9 Sq. mm	5 to 290	1/2-19110L	1/2 - MNPT x 1 - FNPT
		3/4-19110L	3/4 - MNPT x 1 - FNPT 3/4 - FNPT x 1 - FNPT
		1-19110L	1 - MNPT x 1 - FNPT
	291 to 2000	1/2-19110M	1/2 - MNPT x 1 - FNPT
		3/4-19110M	3/4 - MNPT x 1 - FNPT 3/4 - FNPT x 1 - FNPT
		1-19110M	1 - MNPT x 1 - FNPT
2001 to 5000	3/4-19110H	3/4 - FNPT x 1 - FNPT	
.126 Sq. in. 81.3 Sq. mm	5 to 290	3/4-19126L	3/4 - MNPT x 1 - FNPT 3/4 - FNPT x 1 - FNPT
		1-19126L	1 - MNPT x 1 - FNPT
	291 to 2000	3/4-19126M	3/4 - MNPT x 1 - FNPT 3/4 - FNPT x 1 - FNPT
		1-19126M	1 - MNPT x 1 - FNPT
	2001 to 8000	3/4-19126H	3/4 - FNPT x 1 - FNPT
.226 Sq. in. 145.8 Sq. mm	5 to 290	1-19226L	1 - MNPT x 1-1/2 - FNPT 1 - FNPT x 1-1/2 - FNPT
	291 to 2000	1-19226M	1 - MNPT x 1-1/2 - FNPT 1 - FNPT x 1-1/2 - FNPT
	2001 to 6400	1-19226H	1 - FNPT x 1-1/2 - FNPT
.357 Sq. in. 230.3 Sq. mm	5 to 290	1 1/2-19357L	1-1/2 - FNPT x 2 - FNPT
	291 to 1500	1 1/2-19357M	1-1/2 - FNPT x 2 - FNPT
.567 Sq. in. 365.8 Sq. mm	5 to 290	2-19567L	2 - FNPT x 2-1/2 - FNPT
	291 to 1000	2-19567M	2 - FNPT x 2-1/2 - FNPT

## 19000 Standard Valves



### 19000-2 Male NPT Inlet

19096L, 19110L, 19126L, 19226L,  
19096M, 19110M, 19126M, 19226M



### 19000-2 Female NPT Inlet

19096L, 19110L, 19126L, 19226L, 19357L, 19567L,  
19096M, 19110M, 19126M, 19226M, 19357M,  
19567M, 19096H, 19110H, 19126H, 19226H

### 19000SG (Sour Gas)

The standard 19000 valve has component materials selected which comply with NACE MR0103-2003 requirements (except the valve spring).

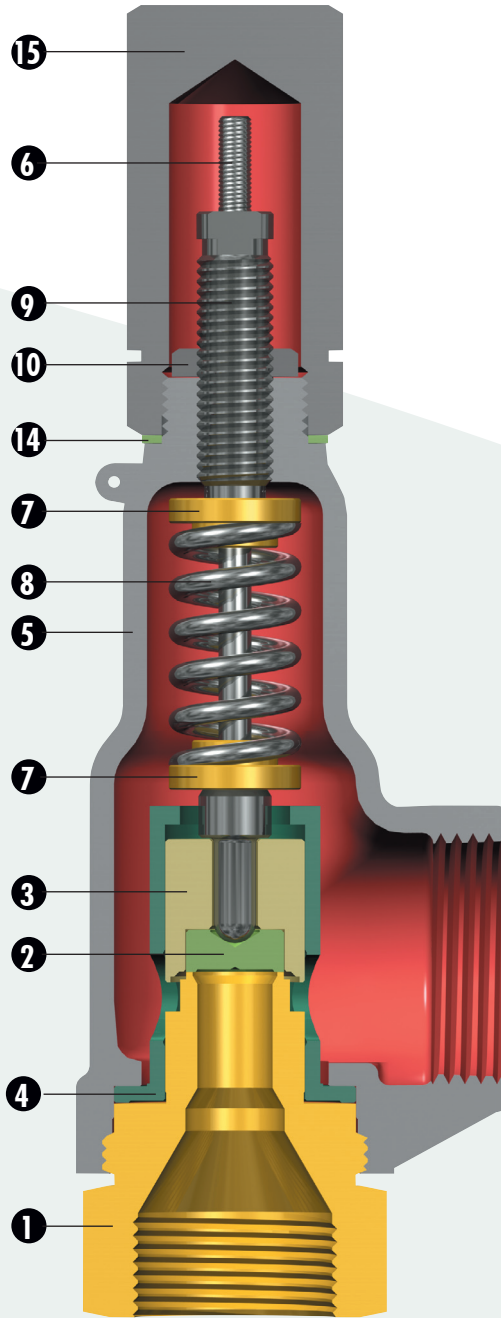
To fully comply with MR0103-2003, utilize the standard valve and specify an Inconel X750 spring.

When service temperature exceeds 250°F an Inconel X750 disc will be the standard component material meeting the requirements of MR0103-2003. Under 250°F the standard component material for the disc is 316SS.

The Inconel X750 disc, Inconel disc holder, Stellite® faced base and Inconel spindle used in high pressure valves will meet the requirements of MR0103-2003 when supplied with an Inconel X750 spring.

19000 SG also has components which comply with NACE MR0175-2002 and prior editions. For compliance with NACE MR0175-2003, media and materials evaluation is required. Please contact factory sales.

# Materials



**19000-2**

## Threaded End Connection

Extension, flange and nipples for flanged and socket-weld connections are not shown.

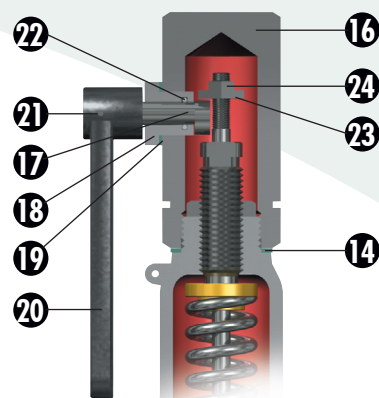
# Materials

	Part	Material
1	Base L & M	316 SS
	Base H	316 SS/Stellite Hardfaced Seat
2	Disc L & M	316 SS
	Disc L & M (Steam)*	616 SS
	Disc H	Inconel X750
3	Disc Holder	316 SS
4	Guide	316 SS
5	Bonnet	SA216 WCC Carbon Steel (phosphated)
6	Spindle L & M	316 SS
	Spindle H	Inconel
7	Spring Washer	Carbon Steel (phosphated)
8	Spring 19000c	17-7 PH SS
	Spring 19000t	Inconel X750
9	Adjusting Screw	316 SS
10	Adjusting Screw Locknut	316 SS
11	Gag Bolt	Carbon Steel
12	Sealing Plug	Carbon Steel
13	Sealing Plug Gasket	Soft Iron
14	Cap Gasket	Soft Iron
15	Screwed Cap	Carbon Steel (phosphated)
16	Packed Cap	Carbon Steel (phosphated)
17	Cam Shaft	410 SS
18	Bushing	416 SS
19	Bushing Gasket	Soft Iron
20	Lever (Packed)	Malleable Iron
21	Drive Pin	Steel (Ni-Plated)
22	O-Ring	Viton 70
23	Release Nut	Carbon Steel
24	Release Lock Nut	Carbon Steel
25	Plain Lever Cap	Malleable Iron
26	Lifting Lever (Plain)	Malleable Iron
27	Cap Screw	Carbon Steel
28	Lever Pin	Carbon Steel

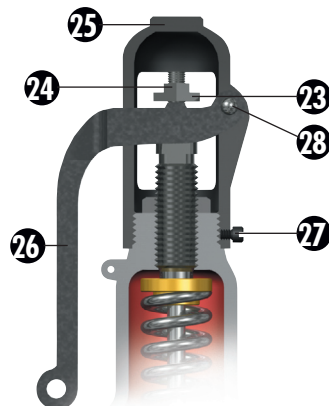
\* Supplied for steam service above 251°F (121.7°C)

## Sour Gas (SG) or NACE applications

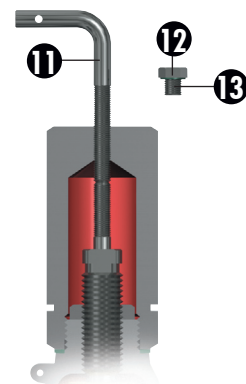
The 19000 valve materials are standard except for the spring, which will be Inconel X750, and for service temperatures that exceed 250°F, an Inconel X750 disc will be provided.



**Packed Lever**



**Plain Lever**



**Cap with Gag**

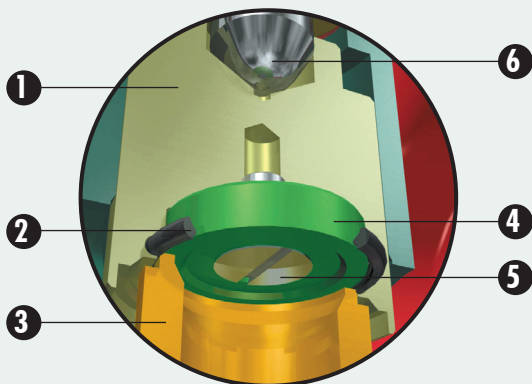
# 19000 Soft Seats (DA)

## Tightness

CONSOLIDATED O-Ring seat valves are bubble tight at **97%** of set pressures over 100 psig.

Percent of set pressure (popping pressure) at which valve will be bubble tight on air.	
Set Pressure (psig)	Percent of Set Pressure
5 to 30	90%
31 to 50	92%
51 to 100	94%
101 to Max rating of valve	<b>97%</b>

CONSOLIDATED O-Ring seat seals provide positive seat tightness at service pressures closer to the set pressure than is possible with metal-to-metal seats assuring continuous, trouble-free service, and complete valve closure after numerous "pops".



### Soft Seat Material Temperature Limits (°F)

Material	Temperature Limits (°F)
Nitrile	-45 to +350°
Ethylene/Propylene	-70 to +500°
Fluoro-Carbon	-15 to +400°
Fluoro-Silicone	-100 to +350°
Neoprene	-45 to +300°
Silicone	-65 to +437°
Teflon	-300 to +505°

NOTE: Contact factory for other O-Ring materials and the respective temperature limitations.

## Applications

The O-Ring design can be used for improved product performance in the same manner as that stated for the 1900 Flanged Series.

## Features

- Leak tight seats
- Tight seats at high operating pressures
- Simple replacement of soft seat
- Large selection of soft seat materials
- Soft seats are in standard O-Ring sizes
- Proven seat design

## Benefits

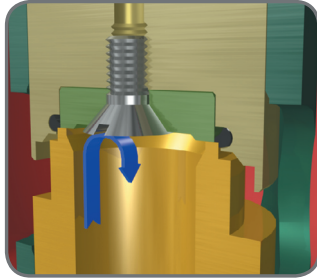
- Potential loss of system pressure and process media reduced
- Maximizes process efficiency and product output
- Reduces maintenance costs
- Suitable for varied process applications
- Replacement seats readily available
- Dependable performance

	Part	Material
1	Disc Holder 19000L	316 SS
	Disc Holder 19000M & H	Inconel
2	O-Ring Seat Seal	Select
3	Base	316 SS
4	O-Ring Retainer 19000L & M	316 SS
	O-Ring Retainer 19000H	Inconel X750
5	Retainer Lockscrew	316 SS
6	Spindle 19000L	316 SS
	Spindle 19000M & H	Inconel

## Sour Gas (SG) or NACE applications

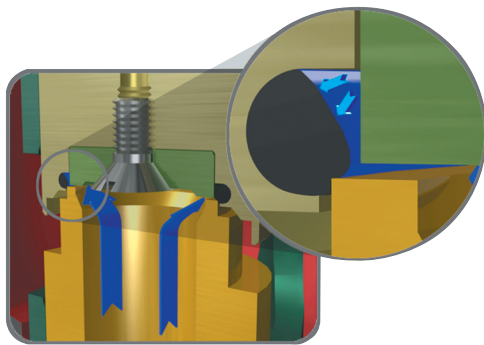
The 19000(DA) valve materials are standard except for the spring which will be Inconel X750.

## Operation and Performance



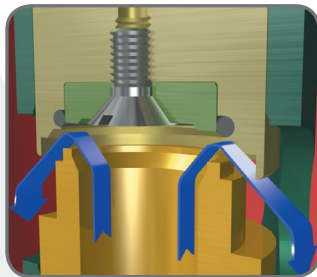
### Valve in Closed Position

- 90% of set pressure  
Metal seat contains media  
No leakage - bubble tight



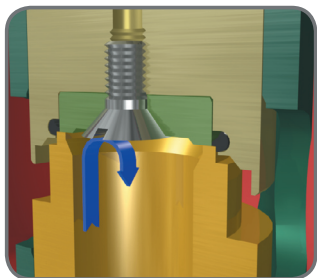
### Valve at Greater than 90% of set pressure

- Metal seats separate
- System pressure acts on O-Ring, pressure forces the O-Ring against the lip of the nozzle and curved recess of the disc holder. As the pressure within the valves rises to the set point, the O-Ring is pressed tightly against the nozzle to maintain maximum sealing force until break-away pressure is reached.
- Bubble tight seat to **97%** of set pressure



### Valve Flowing

- Full lift
- Flowing rated capacity
- O-Ring is protected from blowouts as the encapsulating retainer prevents the O-Ring from being pulled from its seat by the high velocity, low pressure discharge inside the valve.



### Valve Returns to Closed Position

- 90% of set pressure  
Metal seat contains media  
No leakage - bubble tight
- Seat tightness maintained at pressures above 90% after initial closure

Set Pressure (psig)	Percent of Set Pressure
5 to 30	90%
31 to 50	92%
51 to 100	94%
100 to max rating of valve	<b>97%</b>

# 19096MBP

The 19096MBP Series balanced design safety relief valve provides back pressure compensation characteristics that meet the needs of various plant operating systems in today's industrial markets. This design is in compliance with ASME B & PVC, Section VIII requirements. The 19096MBP's versatile design is for use in both compressible and incompressible services.

## Features and Benefits

Blowdown performance is typically less than 7% on compressible fluids and typically 15% for fixed blowdown on incompressible applications. This performance minimizes the loss of process fluids during an overpressure excursion and assists in the reduction of operating costs.

An O-Ring seat design provides for leak-tight seals during normal system operation and after cycling during a pressure-relieving mode. Media loss due to seat leakage is eliminated, resulting in savings from the cost of lost product.

A simple design that is easily maintained contributes to reduced maintenance costs and parts inventory.

## Versatile Service Conditions

- Compressible and incompressible media
- Upper spring chamber not exposed to process media
- Corrosion resistant stainless steel trim
- Special alloy construction available

## Increased Operating Efficiency

- Soft seat design provides maximum seat tightness
- Reduces product loss due to leakage
- Consistent fixed blowdown



### 19096MBP Performance Criteria

Typical Blowdown as a percent of set pressure	1/2" through 1" in either threaded, socket weld or 1" flanged design
Allowable total Backpressure (The sum of the variable and constant backpressure, superimposed and built-up).	1" threaded, socket weld or flanged design .096 Sq. in. (61.9 Sq. mm) 50 psig to 2000 psig -60°F to 600°F (-51°C to 315°C)
Seat Tightness Bubble Tight	ASME B & PVC, Section VIII 400 psig - Variable and/or Constant

### Scope of Design

Inlet Sizes	1/2" through 1" in either threaded, socket weld or 1" flanged design
Outlet Sizes	1" threaded, socket weld or flanged design
Orifice Size	.096 Sq. in. (61.9 Sq. mm)
Set Pressure Range	50 psig to 2000 psig
Temperature Range	-60°F to 600°F (-51°C to 315°C)
Certification	ASME B & PVC, Section VIII
Backpressure	400 psig - Variable and/or Constant

Orifice	Pressure Range (psig)	Standard Valve Type (in.)	Standard Connections (in.)
.096 Sq. in. (61.9 Sq. mm)	50 to 2000	1/2-19096M-BP	1/2 - MNPT x 1 - FNPT
		3/4-19096M-BP	3/4 - MNPT x 1 - FNPT 3/4 - FNPT x 1 - FNPT
		1-19096M-BP	1 - MNPT x 1 - FNPT

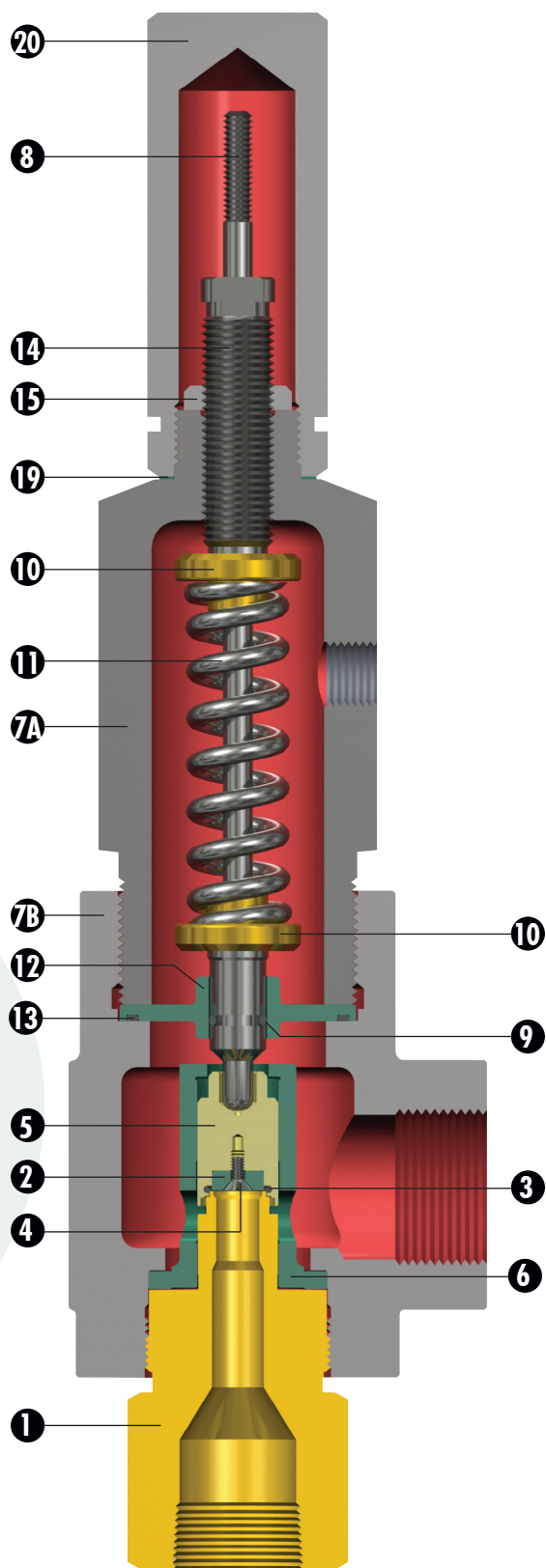
### Soft Seat Material Temperature Limits (°F)

Material	Temperature Limits (°F)
Nitrile	-45 to +350°
Ethylene/Propylene	-70 to +500°
Fluoro-Carbon	-15 to +400°
Fluoro-Silicone	-100 to +350°
Neoprene	-45 to +300°
Silicone	-65 to +437°
Teflon	-300 to +505°

NOTE: Contact factory for other O-Ring materials and the respective temperature limitations.



# Materials



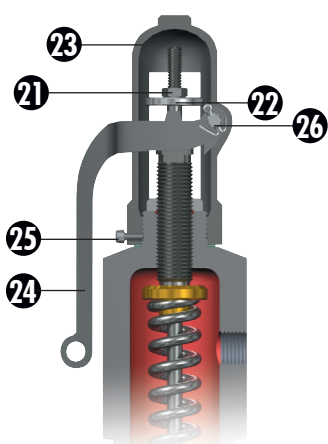
**19096MBP**

Part	Material	
1	Base	316 SS
2	O-Ring Retainer	316 SS
3	Seat O-Ring	(See O-Ring Seal Selection Table*)
4	Retainer Lockscrew	316 SS
5	Disc Holder	Inconel
6	Guide	316 SS
7A	Bonnet Top	SA105 Carbon Steel (Phosphated)
7B	Bonnet Bottom	SA105 Carbon Steel (Phosphated)
8	Spindle	Inconel
9	Spindle O-Ring	(See O-Ring Selection*)
10	Spring Washer	Carbon Steel (Phosphated)
11	Spring	
	19096c-BP	17-7 PH SS
	19096t-BP	Inconel X750
12	Backup Plate	316 SS
13	Backup Plate O-Ring	(See O-Ring Selection*)
14	Adjusting Screw	316 SS
15	Adj. Screw Locknut	316 SS
16	Gag Bolt	Carbon Steel
17	Sealing Plug	Carbon Steel
18	Sealing Plug Gasket	Soft Iron
19	Cap Gasket	Soft Iron
20	Screwed Cap	Carbon Steel (Phosphated)
21	Release Nut	Carbon Steel
22	Release Locknut	Carbon Steel
23	Plain Lever Cap	Malleable Iron
24	Lifting Lever	Malleable Iron
25	Cap Screw	Carbon Steel
26	Lever Pin	Carbon Steel

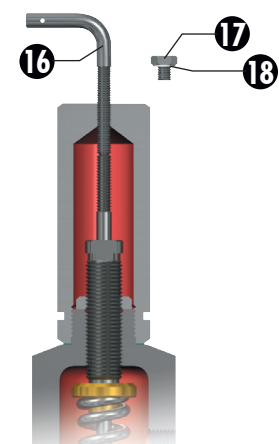
\* Backup Plate and Spindle O-Ring material will be the same as the O-Ring material selected for Seat O-Ring.

### Sour Gas (SG) or NACE applications

The 19096/MBP valve materials are standard except for the spring, which will be Inconel X750.



**Plain Lever**



**Cap with Gag**

Standard and 316 Stainless Steel Variations

Part	Standard Valve	316 Stainless Steel Variations			
		S2	S3	S4	C1
Base 19000L	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS
Base 19000M	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS
Base 19000H	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS	SA479 Type 316SS
Inlet Nipple	Stellite Seats 316SS	Stellite Seats 316SS	Stellite Seats 316SS	Stellite Seats 316SS	Stellite Seats 316SS
Outlet Nipple	Carbon Steel	Carbon Steel	316SS	316SS	316SS
Inlet Extension	316SS	316SS	316SS	316SS	316SS
Inlet Flange	Carbon Steel	Carbon Steel	316SS	316SS	316SS
Outlet Extension	316SS	316SS	316SS	316SS	316SS
Outlet Flange	Carbon Steel	Carbon Steel	316SS	316SS	316SS
Disc 19000 L & M	316SS	316SS	316SS	316SS	316SS
Disc 19000 L & M (Steam)*	616SS	616SS	616SS	616SS	616SS
Disc 19000H	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
O-Ring Retainer 19000L	316SS	316SS	316SS	316SS	316SS
O-Ring Retainer 19000M	316SS	316SS	316SS	316SS	316SS
O-Ring Retainer 19000H	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Retainer Lock Screw	316SS	316SS	316SS	316SS	316SS
O-Ring Disc Holder 19000L	316SS	316SS	316SS	316SS	316SS
O-Ring Disc Holder 19000M	Inconel	Inconel	Inconel	Inconel	Inconel
O-Ring Disc Holder 19000H	Inconel	Inconel	Inconel	Inconel	Inconel
MS Disc Holder 19000L	316SS	316SS	316SS	316SS	316SS
MS Disc Holder 19000M	316SS	316SS	316SS	316SS	316SS
MS Disc Holder 19000H	316SS	316SS	316SS	316SS	316SS
O-Ring Seat Seal	Select	Select	Select	Select	Select
Guide	316SS	316SS	316SS	316SS	316SS
Bonnet	SA216, WCC CS	SA216, WCC CS	SA351, CF8M	SA351, CF8M	SA352, LCC
O-Ring Spindle 19000L	316SS	316SS	316SS	316SS	316SS
O-Ring Spindle 19000M	Inconel	Inconel	Inconel	Inconel	Inconel
O-Ring Spindle 19000H	Inconel	Inconel	Inconel	Inconel	Inconel
MS Spindle 19000L	316SS	316SS	316SS	316SS	316SS
MS Spindle 19000M	316SS	316SS	316SS	316SS	316SS
MS Spindle 19000H	Inconel	Inconel	Inconel	Inconel	Inconel
Spring Washer	Carbon Steel	Carbon Steel	Carbon Steel	316SS	316SS
Spring 19000Lc	17-7PH	17-7PH	17-7PH	316SS	17-7PH
Spring 19000Lt	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Spring 19000Mc	17-7PH	17-7PH	17-7PH	Inconel X750	17-7PH
Spring 19000Mt	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Spring 19000Hc	17-7PH	17-7PH	17-7PH	Inconel X750	17-7PH
Spring 19000Ht	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Adjusting Screw	316SS	316SS	316SS	316SS	316SS
Adj. Screw Lock Nut	316SS	316SS	316SS	316SS	316SS
Cap Gasket	Soft Iron	Soft Iron	Monel	Monel	Soft Iron
Screwed Cap	Carbon Steel	Carbon Steel	316SS	316SS	316SS
Packed Cap	Carbon Steel	Carbon Steel	316SS	316SS	316SS
Cam Shaft	410SS	410SS	316SS	316SS	410SS
Bushing	416SS	416SS	316SS	316SS	416SS
Bushing Gasket	Soft Iron	Soft Iron	Monel	Monel	Soft Iron
Packed Lifting Lever	Malleable Iron	Malleable Iron	316SS	316SS	Malleable Iron
Drive Pin	Steel (Ni-Plated)	Steel (Ni-Plated)	303SS	303SS	Steel (Ni-Plated)
O-Ring (Packed Cap)	Viton 70	Viton 70	Viton 70	Viton 70	EPR-70
Release Nut	Carbon Steel	Carbon Steel	316SS	316SS	Carbon Steel
Release Lock Nut	Carbon Steel	Carbon Steel	316SS	316SS	Carbon Steel
Plain Lever Cap	Malleable Iron	Malleable Iron	316SS	316SS	Malleable Iron
Plain Lifting Lever	Malleable Iron	Malleable Iron	316SS	316SS	Malleable Iron
Cap Screw	Carbon Steel	Carbon Steel	316SS	316SS	Carbon Steel
Lever Pin	Carbon Steel	Carbon Steel	316SS	316SS	Carbon Steel
Gag Bolt	Carbon Steel	Carbon Steel	316SS	316SS	Carbon Steel
Sealing Plug	Carbon Steel	Carbon Steel	316SS	316SS	Carbon Steel
Sealing Plug Gasket	Soft Iron	Soft Iron	Monel	Monel	Soft Iron
Bottom Bonnet 19096MBP	SA105, CS	SA105, CS	SA316, SS	SA316, SS	SA316, SS
Top Bonnet 19096MBP	SA105, CS	SA105, CS	SA316, SS	SA316, SS	SA316, SS
Backup Plate 19096MBP	316SS	316SS	316SS	316 SS	316SS
Backup Plate O-Ring 19096MBP	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat
Spindle O-Ring 19096MBP	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat

\* Supplied for steam service above 251°F (121.7°C)

Monel Variations

Part	Monel				
	M1	MB	M2	M3	M4
Base 19000L	Monel	Monel	Monel	Monel	Monel
Base 19000M	Monel	Monel	Monel	Monel	Monel
Base 19000H	Inconel 625	Inconel 625	Inconel 625	Inconel 625	Inconel 625
	Stellite Seats	Stellite Seats	Stellite Seats	Stellite Seats	Stellite Seats
Inlet Nipple	Monel	Monel	Monel	Monel	Monel
Outlet Nipple	316SS	316SS	316SS	Monel	Monel
Inlet Extension	Monel	Monel	Monel	Monel	Monel
Inlet Flange	Carbon Steel	Carbon Steel	Carbon Steel	Monel	Monel
Outlet Extension	316SS	316SS	316SS	Monel	Monel
Outlet Flange	Carbon Steel	Carbon Steel	Carbon Steel	Monel	Monel
Disc 19000 L & M	Monel	Monel	Monel	Monel	Monel
Disc 19000 L & M (Steam)*	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Disc 19000H	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
O-Ring Retainer 19000L	Monel	Monel	Monel	Monel	Monel
O-Ring Retainer 19000M	Monel	Monel	Monel	Monel	Monel
O-Ring Retainer 19000H	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Retainer Lock Screw	Monel	Monel	Monel	Monel	Monel
O-Ring Disc Holder 19000L	Monel	Monel	Monel	Monel	Monel
O-Ring Disc Holder 19000M	Inconel	Inconel	Inconel	Inconel	Inconel
O-Ring Disc Holder 19000H	Inconel	Inconel	Inconel	Inconel	Inconel
MS Disc Holder 19000L	316SS	Monel	Monel	Monel	Monel
MS Disc Holder 19000M	316SS	Monel	Monel	Monel	Monel
MS Disc Holder 19000H	316SS	Monel	Monel	Monel	Monel
O-Ring Seat Seal	Select	Select	Select	Select	Select
Guide	316SS	Monel	Monel	Monel	Monel
Bonnet	SA216, WCC CS	SA216, WCC CS	SA216, WCC CS	A494 M35-1 Nickel Copper Alloy	A494 M35-1 Nickel Copper Alloy
O-Ring Spindle 19000L	316SS	316SS	Monel	Monel	Monel
O-Ring Spindle 19000M	Inconel	Inconel	Inconel	Inconel	Inconel
O-Ring Spindle 19000H	Inconel	Inconel	Inconel	Inconel	Inconel
MS Spindle 19000L	316SS	316SS	Monel	Monel	Monel
MS Spindle 19000M	316SS	316SS	Monel	Monel	Monel
MS Spindle 19000H	Inconel	Inconel	Inconel	Inconel	Inconel
Spring Washer	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel	Monel
Spring 19000Lc	17-7 PH	17-7 PH	17-7 PH	17-7 PH	Inconel X750
Spring 19000Lt	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Spring 19000Mc	17-7 PH	17-7 PH	17-7 PH	17-7 PH	Inconel X750
Spring 19000Mt	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Spring 19000Hc	17-7 PH	17-7 PH	17-7 PH	17-7 PH	Inconel X750
Spring 19000Ht	Inconel X750	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Adjusting Screw	316SS	316SS	316SS	Monel	Monel
Adj. Screw Lock Nut	316SS	316SS	316SS	Monel	Monel
Cap Gasket	Soft Iron	Soft Iron	Soft Iron	Monel	Monel
Screwed Cap	Carbon Steel	Carbon Steel	Carbon Steel	Monel	Monel
Packed Cap	Carbon Steel	Carbon Steel	Carbon Steel	-	-
Cam Shaft	410SS	410SS	410SS	-	-
Bushing	416SS	416SS	416SS	-	-
Bushing Gasket	Soft Iron	Soft Iron	Soft Iron	-	-
Packed Lifting Lever	Malleable Iron	Malleable Iron	Malleable Iron	-	-
Drive Pin	Steel (Ni-Plated)	Steel (Ni-Plated)	Steel (Ni-Plated)	-	-
O-Ring (Packed Cap)	Viton 70	Viton 70	Viton 70	-	-
Release Nut	Carbon Steel	Carbon Steel	Carbon Steel	-	-
Release Lock Nut	Carbon Steel	Carbon Steel	Carbon Steel	-	-
Plain Lever Cap	Malleable Iron	Malleable Iron	Malleable Iron	-	-
Plain Lifting Lever	Malleable Iron	Malleable Iron	Malleable Iron	-	-
Cap Screw	Carbon Steel	Carbon Steel	Carbon Steel	-	-
Lever Pin	Carbon Steel	Carbon Steel	Carbon Steel	-	-
Gag Bolt	Carbon Steel	Carbon Steel	Carbon Steel	316SS	316SS
Sealing Plug	Carbon Steel	Carbon Steel	Carbon Steel	Monel	Monel
Sealing Plug Gasket	Soft Iron	Soft Iron	Soft Iron	Monel	Monel
Bottom Bonnet 19096MBP	SA105, CS	SA105, CS	SA105, CS	Monel	Monel
Top Bonnet 19096MBP	SA105, CS	SA105, CS	SA105, CS	Monel	Monel
Backup Plate 19096MBP	Same as O-Ring Seat	Monel	Monel	Monel	Monel
Backup Plate O-Ring 19096MBP	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat
Spindle O-Ring 19096MBP		Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat

\* Supplied for steam service above 251°F (121.7°C)

Hastelloy Variations

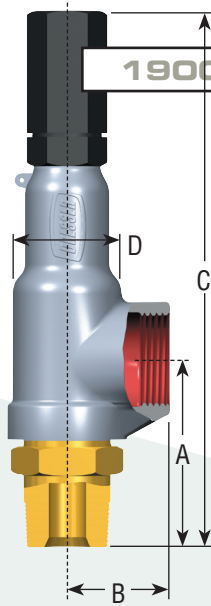
Part	Hastelloy			
	H1	H2	H3	H4
Base 19000L	Hastelloy	Hastelloy	Hastelloy	Hastelloy
Base 19000M	Hastelloy	Hastelloy	Hastelloy	Hastelloy
Base 19000H	Inconel 625	Inconel 625	Inconel 625	Inconel 625
Inlet Nipple	Stellite Seats	Stellite Seats	Stellite Seats	Stellite Seats
Outlet Nipple	Hastelloy	Hastelloy	Hastelloy	Hastelloy
Inlet Extension	316SS	316SS	Hastelloy	Hastelloy
Inlet Flange	Hastelloy	Hastelloy	Hastelloy	Hastelloy
Outlet Extension	Carbon Steel	Carbon Steel	Hastelloy	Hastelloy
Outlet Flange	316SS	316SS	Hastelloy	Hastelloy
Disc 19000 L & M	Carbon Steel	Carbon Steel	Hastelloy	Hastelloy
Disc 19000 L & M (Steam)*	Hastelloy	Hastelloy	Hastelloy	Hastelloy
Disc 19000H	Inconel X750	Inconel X750	Inconel X750	Inconel X750
O-Ring Retainer 19000L	Inconel X750	Inconel X750	Inconel X750	Inconel X750
O-Ring Retainer 19000M	Hastelloy	Hastelloy	Hastelloy	Hastelloy
O-Ring Retainer 19000H	Hastelloy	Hastelloy	Hastelloy	Hastelloy
Retainer Lock Screw	Inconel X750	Inconel X750	Inconel X750	Inconel X750
O-Ring Disc Holder 19000L	Hastelloy	Hastelloy	Hastelloy	Hastelloy
O-Ring Disc Holder 19000M	Hastelloy	Hastelloy	Hastelloy	Hastelloy
O-Ring Disc Holder 19000H	Inconel	Inconel	Inconel	Inconel
MS Disc Holder 19000L	Inconel	Inconel	Inconel	Inconel
MS Disc Holder 19000M	316SS	Hastelloy	Hastelloy	Hastelloy
MS Disc Holder 19000H	316SS	Hastelloy	Hastelloy	Hastelloy
O-Ring Seat Seal	316SS	Hastelloy	Hastelloy	Hastelloy
Guide	Select	Select	Select	Select
Bonnet	316SS	Hastelloy	Hastelloy	Hastelloy
O-Ring Spindle 19000L	SA216, WCC	SA216, WCC	SA494 CW12 MW	SA494 CW12 MW
O-Ring Spindle 19000M	CS	CS	Nickel Alloy	Nickel Alloy
O-Ring Spindle 19000H	316SS	Hastelloy	Hastelloy	Hastelloy
MS Spindle 19000L	Inconel	Inconel	Inconel	Inconel
MS Spindle 19000M	Inconel	Inconel	Inconel	Inconel
MS Spindle 19000H	Inconel	Inconel	Inconel	Inconel
Spring Washer	316SS	Hastelloy	Hastelloy	Hastelloy
Spring 19000Lc	Inconel	Inconel	Inconel	Inconel
Spring 19000Lt	316SS	Hastelloy	Hastelloy	Hastelloy
Spring 19000Mc	316SS	Hastelloy	Hastelloy	Hastelloy
Spring 19000Mt	Inconel	Inconel	Inconel	Inconel
Spring 19000Hc	Inconel X750	Inconel X-750	Inconel X-750	Inconel X750
Spring 19000Ht	17-7 PH	17-7 PH	17-7 PH	Inconel X750
Adjusting Screw	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Adj. Screw Lock Nut	316SS	316SS	Hastelloy	Hastelloy
Cap Gasket	316SS	316SS	Hastelloy	Hastelloy
Screwed Cap	Soft Iron	Soft Iron	Monel	Monel
Packed Cap	Carbon Steel	Carbon Steel	Hastelloy	Hastelloy
Cam Shaft	Carbon Steel	Carbon Steel	-	-
Bushing	410SS	410SS	-	-
Bushing Gasket	416SS	416SS	-	-
Packed Lifting Lever	Soft Iron	Soft Iron	-	-
Drive Pin	Malleable Iron	Malleable Iron	-	-
O-Ring (Packed Cap)	Steel (Ni-Plated)	Steel (Ni-Plated)	-	-
Release Nut	Viton 70	Viton 70	-	-
Release Lock Nut	Carbon Steel	Carbon Steel	-	-
Plain Lever Cap	Carbon Steel	Carbon Steel	-	-
Plain Lifting Lever	Malleable Iron	Malleable Iron	-	-
Cap Screw	Malleable Iron	Malleable Iron	-	-
Lever Pin	Carbon Steel	Carbon Steel	-	-
Gag Bolt	Carbon Steel	Carbon Steel	316SS	316SS
Sealing Plug	Carbon Steel	Carbon Steel	Hastelloy	Hastelloy
Sealing Plug Gasket	Carbon Steel	Carbon Steel	Hastelloy	Hastelloy
Bottom Bonnet 19096MBP	Soft Iron	Soft Iron	Monel	Monel
Top Bonnet 19096MBP	SA105, CS	SA105, CS	Hastelloy	Hastelloy
Backup Plate 19096MBP	SA105, CS	SA105, CS	Hastelloy	Hastelloy
Backup Plate O-Ring 19096MBP	Same as O-Ring Seat	Hastelloy	Hastelloy	Hastelloy
Spindle O-Ring 19096MBP	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat

\* Supplied for steam service above 251°F (121.7°C)

**Alloy 20 Variations**

Part	Alloy 20			
	A1	A2	A3	A4
Base 19000L	Alloy 20	Alloy 20	Alloy 20	Alloy 20
Base 19000M	Alloy 20	Alloy 20	Alloy 20	Alloy 20
Base 19000H	Inconel 625	Inconel 625	Inconel 625	Inconel 625
	Stellite Seats	Stellite Seats	Stellite Seats	Stellite Seats
Inlet Nipple	Alloy 20	Alloy 20	Alloy 20	Alloy 20
Outlet Nipple	316SS	316SS	Alloy 20	Alloy 20
Inlet Extension	Alloy 20	Alloy 20	Alloy 20	Alloy 20
Inlet Flange	Carbon Steel	Carbon Steel	Alloy 20	Alloy 20
Outlet Extension	316SS	316SS	Alloy 20	Alloy 20
Outlet Flange	Carbon Steel	Carbon Steel	Alloy 20	Alloy 20
Disc 19000 L & M	Alloy 20	Alloy 20	Alloy 20	Alloy 20
Disc 19000 L & M (Steam)*	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Disc 19000H	Inconel X750	Inconel X750	Inconel X750	Inconel X750
O-Ring Retainer 19000L	Alloy 20	Alloy 20	Alloy 20	Alloy 20
O-Ring Retainer 19000M	Alloy 20	Alloy 20	Alloy 20	Alloy 20
O-Ring Retainer 19000H	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Retainer Lock Screw	Alloy 20	Alloy 20	Alloy 20	Alloy 20
O-Ring Disc Holder 19000L	Alloy 20	Alloy 20	Alloy 20	Alloy 20
O-Ring Disc Holder 19000M	Inconel	Inconel	Inconel	Inconel
O-Ring Disc Holder 19000H	Inconel	Inconel	Inconel	Inconel
MS Disc Holder 19000L	316SS	Alloy 20	Alloy 20	Alloy 20
MS Disc Holder 19000M	316SS	Alloy 20	Alloy 20	Alloy 20
MS Disc Holder 19000H	316SS	Alloy 20	Alloy 20	Alloy 20
O-Ring Seat Seal	Select	Select	Select	Select
Guide	316SS	Alloy 20	Alloy 20	Alloy 20
Bonnet	SA216, WCC CS	SA216, WCC CS	SA351 CN7M	SA351 CN7M
O-Ring Spindle 19000L	316SS	Alloy 20	Alloy 20	Alloy 20
O-Ring Spindle 19000M	Inconel	Inconel	Inconel	Inconel
O-Ring Spindle 19000H	Inconel	Inconel	Inconel	Inconel
MS Spindle 19000L	316SS	Alloy 20	Alloy 20	Alloy 20
MS Spindle 19000M	316SS	Alloy 20	Alloy 20	Alloy 20
MS Spindle 19000H	Inconel	Inconel	Inconel	Inconel
Spring Washer	Carbon Steel	Carbon Steel	Carbon Steel	Alloy 20
Spring 19000Lc	17-7 PH	17-7 PH	17-7 PH	Alloy 20
Spring 19000Lt	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Spring 19000Mc	17-7 PH	17-7 PH	17-7 PH	Inconel X750
Spring 19000Mt	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Spring 19000Hc	17-7 PH	17-7 PH	17-7 PH	Inconel X750
Spring 19000Ht	Inconel X750	Inconel X750	Inconel X750	Inconel X750
Adjusting Screw	316SS	316SS	Alloy 20	Alloy 20
Adj. Screw Lock Nut	316SS	316SS	Alloy 20	Alloy 20
Cap Gasket	Soft Iron	Soft Iron	Monel	Monel
Screwed Cap	Carbon Steel	Carbon Steel	Alloy 20	Alloy 20
Packed Cap	Carbon Steel	Carbon Steel	-	-
Cam Shaft	410SS	410SS	-	-
Bushing	416SS	416SS	-	-
Bushing Gasket	Soft Iron	Soft Iron	-	-
Packed Lifting Lever	Malleable Iron	Malleable Iron	-	-
Drive Pin	Steel (Ni-Plated)	Steel (Ni-Plated)	-	-
O-Ring (Packed Cap)	Viton 70	Viton 70	-	-
Release Nut	Carbon Steel	Carbon Steel	-	-
Release Lock Nut	Carbon Steel	Carbon Steel	-	-
Plain Lever Cap	Malleable Iron	Malleable Iron	-	-
Plain Lifting Lever	Malleable Iron	Malleable Iron	-	-
Cap Screw	Carbon Steel	Carbon Steel	-	-
Lever Pin	Carbon Steel	Carbon Steel	-	-
Gag Bolt	Carbon Steel	Carbon Steel	316SS	316SS
Sealing Plug	Carbon Steel	Carbon Steel	Alloy 20	Alloy 20
Sealing Plug Gasket	Soft Iron	Soft Iron	Monel	Monel
Bottom Bonnet 19096MBP	SA105	SA105	Alloy 20	Alloy 20
Top Bonnet 19096MBP	SA105	SA105	Alloy 20	Alloy 20
Backup Plate 19096MBP	Alloy 20	Alloy 20	Alloy 20	Alloy 20
Backup Plate O-Ring 19096MBP	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat
Spindle O-Ring 19096MBP	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat	Same as O-Ring Seat

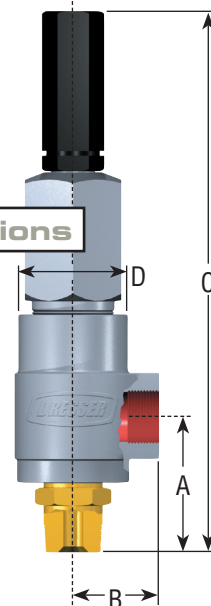
\* Supplied for steam service above 251°F (121.7°C)



**19000 Threaded Connections**

**CAUTION**  
Do not seal weld inlet and outlet connections.

**19096MBP Threaded Connections**



The key to selecting the appropriate dimensions is to use the numbers in the column named "Type". The "Size" column defines the valve by inlet size and connection type, then by outlet size and connection type.

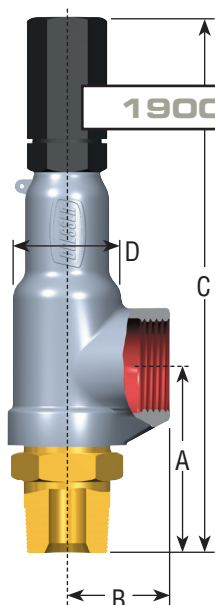
Example: 1/2 - MNPT x 1 - FNPT

Inlet size is 1/2" with a male NPT pipe thread and the outlet is 1" size with a female NPT pipe thread. "SW" indicates socket weld. "Flanged Connections" show size of flange and pressure rating.

- NOTES: 1 "USCS" Units refers to "U.S. Customary System" Units, the adopted U.S. Standard formerly recognized as "English" Units.  
2 Valves are provided with a male pipe threaded (MNPT) or a female pipe threaded (FNPT) inlet connection as specified in the table below.

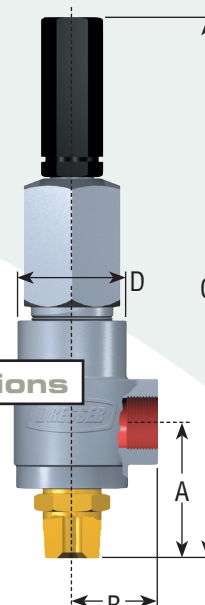
**Threaded Connections (Inches & Pounds)**

Size (in.)	Type	A	B	C		D		Approx. Weight	
				19000	MBP	19000	MBP	19000	MBP
3/4 - FNPT x 1 - FNPT	19096L	3-1/8	1-7/8	10-1/4	N/A	2	N/A	4-1/2	N/A
1/2 - MNPT x 1 - FNPT	19096L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	4-3/4	N/A
3/4 - MNPT x 1 - FNPT	19096L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	4-3/4	N/A
1 - MNPT x 1 - FNPT	19096L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	4-3/4	N/A
3/4 - FNPT x 1 - FNPT	19096M	3-1/8	2	12-1/16	12-3/4	2-9/16	3-3/4	6-1/2	11-1/2
1/2 - MNPT x 1 - FNPT	19096M	3-1/4	2	12-3/16	12-7/8	2-9/16	3-3/4	6-1/2	11-1/2
3/4 - MNPT x 1 - FNPT	19096M	3-1/4	2	12-3/16	12-7/8	2-9/16	3-3/4	6-1/2	11-1/2
1 - MNPT x 1 - FNPT	19096M	3-1/4	2	12-3/16	12-7/8	2-9/16	3-3/4	6-1/2	11-1/2
3/4 - FNPT x 1 - FNPT	19096H	3-1/8	2-3/8	12-1/2	N/A	3-1/8	N/A	11-1/2	N/A
3/4 - FNPT x 1 - FNPT	19110L	3-1/8	1-7/8	10-1/4	N/A	2	N/A	4-1/2	N/A
1/2 - MNPT x 1 - FNPT	19110L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	4-3/4	N/A
3/4 - MNPT x 1 - FNPT	19110L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	4-3/4	N/A
1 - MNPT x 1 - FNPT	19110L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	4-3/4	N/A
3/4 - FNPT x 1 - FNPT	19110M	3-1/8	2	12-1/16	N/A	2-9/16	N/A	6-1/2	N/A
1/2 - MNPT x 1 - FNPT	19110M	3-1/4	2	12-3/16	N/A	2-9/16	N/A	6-1/2	N/A
3/4 - MNPT x 1 - FNPT	19110M	3-1/4	2	12-3/16	N/A	2-9/16	N/A	6-1/2	N/A
1 - MNPT x 1 - FNPT	19110M	3-1/4	2	12-3/16	N/A	2-9/16	N/A	6-1/2	N/A
3/4 - FNPT x 1 - FNPT	19110H	3-1/8	2-3/8	12-1/2	N/A	3-1/8	N/A	11-1/2	N/A
3/4 - FNPT x 1 - FNPT	19126L	3-1/8	1-7/8	10-1/4	N/A	2	N/A	5	N/A
3/4 - MNPT x 1 - FNPT	19126L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	5-1/4	N/A
1 - MNPT x 1 - FNPT	19126L	3-1/4	1-7/8	10-3/8	N/A	2	N/A	5-1/4	N/A
3/4 - FNPT x 1 - FNPT	19126M	3-1/8	2	12-1/16	N/A	2-9/16	N/A	6-1/2	N/A
3/4 - MNPT x 1 - FNPT	19126M	3-1/4	2	12-3/16	N/A	2-9/16	N/A	6-1/2	N/A
1 - MNPT x 1 - FNPT	19126M	3-1/4	2	12-3/16	N/A	2-9/16	N/A	6-1/2	N/A
3/4 - FNPT x 1 - FNPT	19126H	3-1/8	3-1/8	15-15/16	N/A	4-5/8	N/A	30	N/A
1 - FNPT x 1-1/2 - FNPT	19226L	3-3/8	2-1/4	11-3/8	N/A	2-3/8	N/A	6-1/2	N/A
1 - MNPT x 1-1/2 - FNPT	19226L	3-5/8	2-1/4	11-5/8	N/A	2-3/8	N/A	6-3/4	N/A
1 - FNPT x 1-1/2 - FNPT	19226M	3-3/8	2-3/8	12-3/4	N/A	3-1/8	N/A	11-1/2	N/A
1 - MNPT x 1-1/2 - FNPT	19226M	3-5/8	2-3/8	13	N/A	3-1/8	N/A	11-1/2	N/A
1 - FNPT x 1-1/2 - FNPT	19226H	3-1/8	3-1/8	15-15/16	N/A	4-5/8	N/A	30	N/A
1-1/2 - FNPT x 2 - FNPT	19357L	4-1/16	3-1/8	15-1/16	N/A	3-5/8	N/A	18	N/A
1-1/2 - FNPT x 2 - FNPT	19357M	4-1/16	3-1/8	16-7/8	N/A	4-5/8	N/A	30	N/A
2 - FNPT x 2-1/2 - FNPT	19567L	4-1/16	3-1/8	15-1/16	N/A	3-5/8	N/A	19	N/A
2 - FNPT x 2-1/2 - FNPT	19567M	4-1/16	3-1/8	16-7/8	N/A	4-5/8	N/A	30	N/A



19000 Threaded Connections

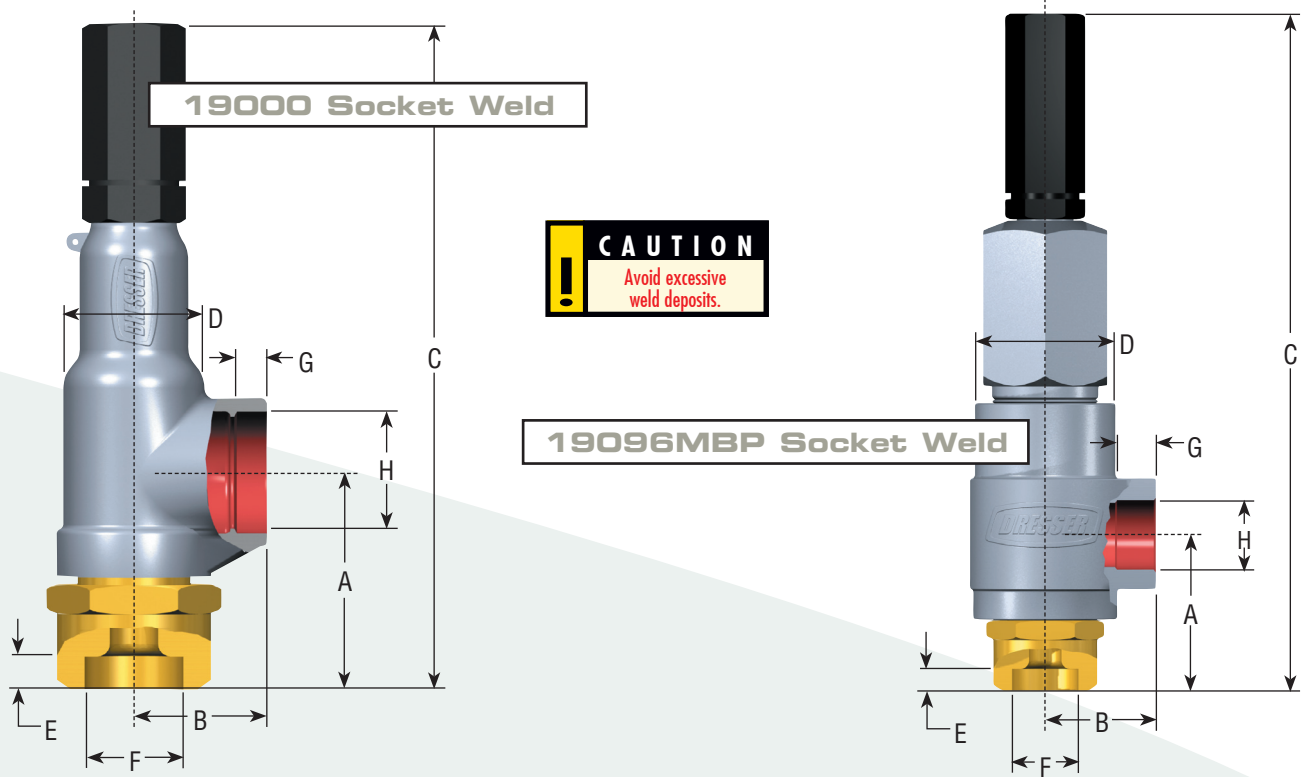
**CAUTION**  
Do not seal weld inlet and outlet connections.



19096MBP Threaded Connections

**Threaded Connections (Millimeters & Kilograms)**

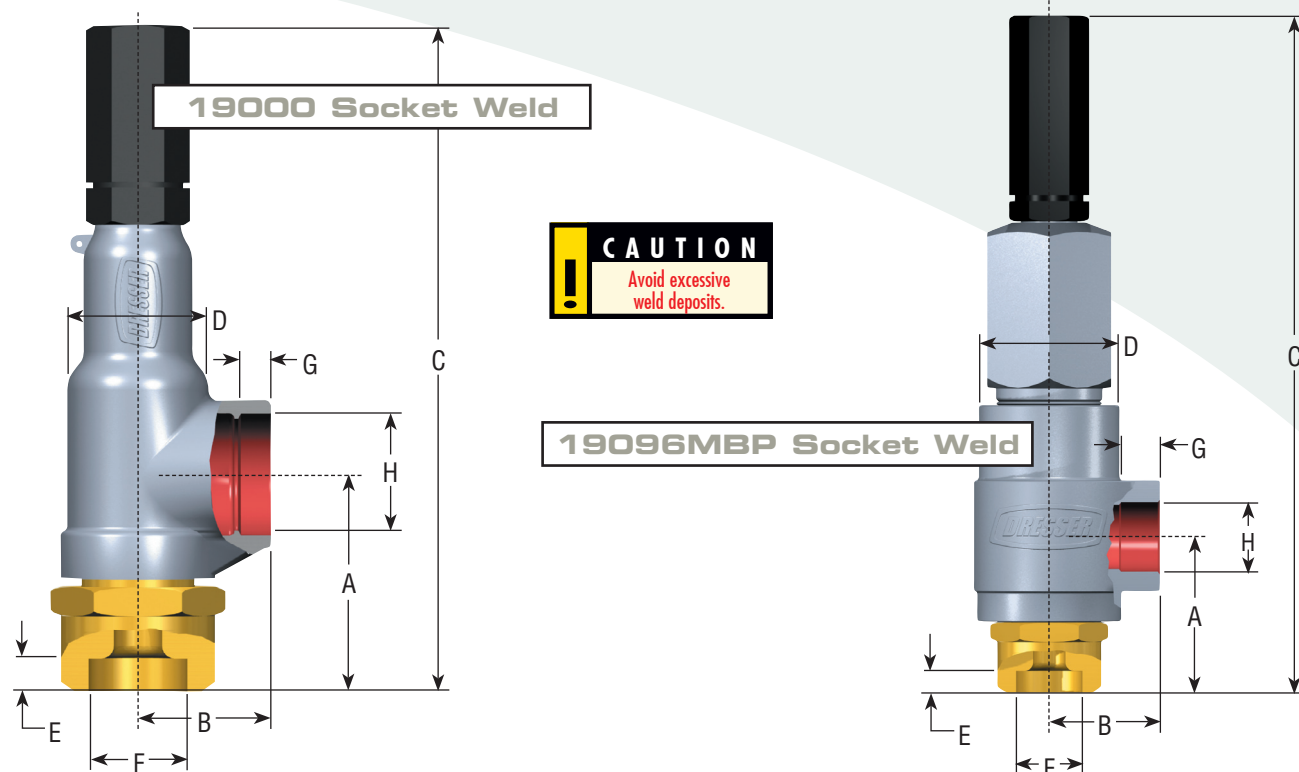
Size (mm)	Type	A	B	C		D		Approx. Weight	
				19000	MBP	19000	MBP	19000	MBP
3/4 - FNPT x 1 - FNPT	19096L	79.4	47.6	260.4	N/A	50.8	N/A	2.0	N/A
1/2 - MNPT x 1 - FNPT	19096L	82.6	47.6	263.5	N/A	50.8	N/A	2.2	N/A
3/4 - MNPT x 1 - FNPT	19096L	82.6	47.6	263.5	N/A	50.8	N/A	2.2	N/A
1 - MNPT x 1 - FNPT	19096L	82.6	47.6	263.5	N/A	50.8	N/A	2.2	N/A
3/4 - FNPT x 1 - FNPT	19096M	79.4	50.8	306.4	323.9	65.1	95.3	2.9	5.2
1/2 - MNPT x 1 - FNPT	19096M	82.6	50.8	309.6	327.0	65.1	95.3	2.9	5.2
3/4 - MNPT x 1 - FNPT	19096M	82.6	50.8	309.6	327.0	65.1	95.3	2.9	5.2
1 - MNPT x 1 - FNPT	19096M	82.6	50.8	309.6	327.0	65.1	95.3	2.9	5.2
3/4 - FNPT x 1 - FNPT	19096H	79.4	60.3	317.5	N/A	79.37	N/A	5.2	N/A
3/4 - FNPT x 1 - FNPT	19110L	79.4	47.6	260.4	N/A	50.8	N/A	2.0	N/A
1/2 - MNPT x 1 - FNPT	19110L	82.6	47.6	263.5	N/A	50.8	N/A	2.2	N/A
3/4 - MNPT x 1 - FNPT	19110L	82.6	47.6	263.5	N/A	50.8	N/A	2.2	N/A
1 - MNPT x 1 - FNPT	19110L	82.6	47.6	263.5	N/A	50.8	N/A	2.2	N/A
3/4 - FNPT x 1 - FNPT	19110M	79.4	50.8	306.4	N/A	65.1	N/A	2.9	N/A
1/2 - MNPT x 1 - FNPT	19110M	82.6	50.8	309.6	N/A	65.1	N/A	2.9	N/A
3/4 - MNPT x 1 - FNPT	19110M	82.6	50.8	309.6	N/A	65.1	N/A	2.9	N/A
1 - MNPT x 1 - FNPT	19110M	82.6	50.8	309.6	N/A	65.1	N/A	2.9	N/A
3/4 - FNPT x 1 - FNPT	19110H	79.4	60.3	317.5	N/A	79.4	N/A	5.2	N/A
3/4 - FNPT x 1 - FNPT	19126L	79.4	47.6	260.4	N/A	50.8	N/A	2.3	N/A
3/4 - MNPT x 1 - FNPT	19126L	82.6	47.6	263.5	N/A	50.8	N/A	2.4	N/A
1 - MNPT x 1 - FNPT	19126L	82.6	47.6	263.5	N/A	50.8	N/A	2.4	N/A
3/4 - FNPT x 1 - FNPT	19126M	79.4	50.8	306.4	N/A	65.1	N/A	2.9	N/A
3/4 - MNPT x 1 - FNPT	19126M	82.6	50.8	309.6	N/A	65.1	N/A	2.9	N/A
1 - MNPT x 1 - FNPT	19126M	82.6	50.8	309.6	N/A	65.1	N/A	2.9	N/A
3/4 - FNPT x 1 - FNPT	19126H	79.4	79.4	404.8	N/A	117.5	N/A	13.6	N/A
1 - FNPT x 1-1/2 - FNPT	19226L	85.7	57.2	288.9	N/A	60.3	N/A	2.9	N/A
1 - MNPT x 1-1/2 - FNPT	19226L	92.1	57.2	295.3	N/A	60.3	N/A	3.1	N/A
1 - FNPT x 1-1/2 - FNPT	19226M	85.7	60.3	323.9	N/A	79.4	N/A	5.2	N/A
1 - MNPT x 1-1/2 - FNPT	19226M	92.1	60.3	330.2	N/A	79.4	N/A	5.2	N/A
1 - FNPT x 1-1/2 - FNPT	19226H	79.4	79.4	404.8	N/A	117.5	N/A	13.6	N/A
1-1/2 - FNPT x 2 - FNPT	19357L	103.2	79.4	382.6	N/A	92.08	N/A	8.2	N/A
1-1/2 - FNPT x 2 - FNPT	19357M	103.2	79.4	428.6	N/A	117.5	N/A	13.6	N/A
2 - FNPT x 2-1/2 - FNPT	19567L	103.2	79.4	382.6	N/A	92.08	N/A	8.6	N/A
2 - FNPT x 2-1/2 - FNPT	19567M	103.2	79.4	428.6	N/A	117.5	N/A	13.6	N/A



Socket Weld Connections (Inches & Pounds)

Size (in.)	Type	A	B	C		D		E	F Dia.	G	H Dia.	Approx. Weight	
				19000	MBP	19000	MBP					19000	MBP
1/2 - SW x 1 - SW	19096L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	.855	5/8	1.330	5-1/2	N/A
3/4 - SW x 1 - SW	19096L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	1.065	5/8	1.330	5-1/2	N/A
1 - SW x 1 - SW	19096L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	1.330	5/8	1.330	6-1/4	N/A
1/2 - SW x 1 - SW	19096M	3-1/2	2	12-7/16	13-1/8	2-9/16	3-3/4	1/2	.855	5/8	1.330	7	12
3/4 - SW x 1 - SW	19096M	3-1/2	2	12-7/16	13-1/8	2-9/16	3-3/4	1/2	1.065	5/8	1.330	7-1/2	12-1/2
1 - SW x 1 - SW	19096M	3-1/2	2	12-7/16	13-1/8	2-9/16	3-3/4	1/2	1.330	5/8	1.330	8	13
3/4 - SW x 1 - SW	19096H	4	2-3/8	13-3/8	N/A	3-1/8	N/A	1/2	1.065	5/8	1.330	12	N/A
1/2 - SW x 1 - SW	19110L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	.855	5/8	1.330	5-1/2	N/A
3/4 - SW x 1 - SW	19110L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	1.065	5/8	1.330	5-1/2	N/A
1 - SW x 1 - SW	19110L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	1.330	5/8	1.330	6-1/4	N/A
1/2 - SW x 1 - SW	19110M	3-1/2	2	12-7/16	N/A	2-9/16	N/A	1/2	.855	5/8	1.330	7	N/A
3/4 - SW x 1 - SW	19110M	3-1/2	2	12-7/16	N/A	2-9/16	N/A	1/2	1.065	5/8	1.330	7-1/2	N/A
1 - SW x 1 - SW	19110M	3-1/2	2	12-7/16	N/A	2-9/16	N/A	1/2	1.330	5/8	1.330	8	N/A
3/4 - SW x 1 - SW	19110H	4	2-3/8	13-3/8	N/A	3-1/8	N/A	1/2	1.065	5/8	1.330	12	N/A
3/4 - SW x 1 - SW	19126L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	1.065	5/8	1.330	6	N/A
1 - SW x 1 - SW	19126L	3-1/2	1-7/8	10-5/8	N/A	2	N/A	1/2	1.330	5/8	1.330	6-3/4	N/A
3/4 - SW x 1 - SW	19126M	3-1/2	2	12-7/16	N/A	2-9/16	N/A	1/2	1.065	5/8	1.330	7	N/A
1 - SW x 1 - SW	19126M	3-1/2	2	12-7/16	N/A	2-9/16	N/A	1/2	1.330	5/8	1.330	8	N/A
3/4 - SW x 1 - SW	19126H	4-1/2	3-1/8	17-5/16	N/A	4-5/8	N/A	5/8	1.065	5/8	1.330	32	N/A
1 - SW x 1-1/2 - SW	19226L	3-15/16	2-1/4	11-15/16	N/A	2-3/8	N/A	1/2	1.330	5/8	1.915	8	N/A
1 - SW x 1-1/2 - SW	19226M	3-15/16	2-3/8	13-5/16	N/A	3-1/8	N/A	1/2	1.330	5/8	1.915	12-1/2	N/A
1 - SW x 1-1/2 - SW	19226H	4-1/2	3-1/8	17-5/16	N/A	4-5/8	N/A	5/8	1.330	5/8	1.915	32	N/A
1-1/2 - SW x 2 - SW	19357L	4-3/4	3-1/8	15-3/4	N/A	3-5/8	N/A	5/8	1.915	5/8	2.406	18-1/4	N/A
1-1/2 - SW x 2 - SW	19357M	4-3/4	3-1/8	17-9/16	N/A	4-5/8	N/A	5/8	1.915	5/8	2.406	31	N/A
2 - SW x 2-1/2 - SW	19567L	5-3/8	3-1/8	16-3/8	N/A	3-5/8	N/A	5/8	2.406	5/8	2.906	24	N/A
2 - SW x 2-1/2 - SW	19567M	5-3/8	3-1/8	18-3/16	N/A	4-5/8	N/A	5/8	2.406	5/8	2.906	34	N/A





Socket Weld Connections (Millimeters & Kilograms)

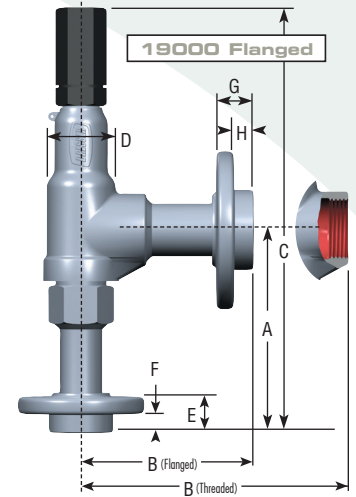
Size (mm)	Type	A	B	C		D		E	F Dia.	G	H Dia.	Approx. Weight	
				19000	MBP	19000	MBP					19000	MBP
1/2 - SW x 1 - SW	19096L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	21.7	15.9	33.8	2.5	N/A
3/4 - SW x 1 - SW	19096L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	27.1	15.9	33.8	2.5	N/A
1 - SW x 1 - SW	19096L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	33.8	15.9	33.8	2.8	N/A
1/2 - SW x 1 - SW	19096M	88.9	50.8	315.9	333.4	65.1	95.3	12.7	21.7	15.9	33.8	3.2	5.4
3/4 - SW x 1 - SW	19096M	88.9	50.8	315.9	333.4	65.1	95.3	12.7	27.1	15.9	33.8	3.4	5.6
1 - SW x 1 - SW	19096M	88.9	50.8	315.9	333.4	65.1	95.3	12.7	33.8	15.9	33.8	3.6	5.9
3/4 - SW x 1 - SW	19096H	101.6	60.3	339.7	N/A	79.4	N/A	12.7	27.1	15.9	33.8	5.4	N/A
1/2 - SW x 1 - SW	19110L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	21.7	15.9	33.8	2.5	N/A
3/4 - SW x 1 - SW	19110L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	27.1	15.9	33.8	2.5	N/A
1 - SW x 1 - SW	19110L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	33.8	15.9	33.8	2.8	N/A
1/2 - SW x 1 - SW	19110M	88.9	50.8	315.9	N/A	65.1	N/A	12.7	21.7	15.9	33.8	3.2	N/A
3/4 - SW x 1 - SW	19110M	88.9	50.8	315.9	N/A	65.1	N/A	12.7	27.1	15.9	33.8	3.4	N/A
1 - SW x 1 - SW	19110M	88.9	50.8	315.9	N/A	65.1	N/A	12.7	33.8	15.9	33.8	3.6	N/A
3/4 - SW x 1 - SW	19110H	101.6	60.3	339.7	N/A	79.4	N/A	12.7	27.1	15.9	33.8	5.4	N/A
3/4 - SW x 1 - SW	19126L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	27.1	15.9	33.8	2.7	N/A
1 - SW x 1 - SW	19126L	88.9	47.6	269.9	N/A	50.8	N/A	12.7	33.8	15.9	33.8	3.1	N/A
3/4 - SW x 1 - SW	19126M	88.9	50.8	315.9	N/A	65.1	N/A	12.7	27.1	15.9	33.8	3.2	N/A
1 - SW x 1 - SW	19126M	88.9	50.8	315.9	N/A	65.1	N/A	12.7	33.8	15.9	33.8	3.6	N/A
3/4 - SW x 1 - SW	19126H	114.3	79.4	439.7	N/A	117.5	N/A	15.9	27.1	15.915.	33.8	14.5	N/A
1 - SW x 1-1/2 - SW	19226L	100.0	57.2	303.2	N/A	66.3	N/A	12.7	33.8	915.915	48.6	3.6	N/A
1 - SW x 1-1/2 - SW	19226M	100.0	60.3	338.1	N/A	79.4	N/A	12.7	33.8	.915.91	48.6	5.7	N/A
1-SW x 1-1/2 - SW	19226H	114.3	79.4	439.7	N/A	117.5	N/A	15.9	33.8	5.915.9	48.6	14.5	N/A
1-1/2 - SW x 2 - SW	19357L	120.7	79.4	400.1	N/A	92.08	N/A	15.9	48.6	15.9	61.1	8.3	N/A
1-1/2 - SW x 2 - SW	19357M	120.7	79.4	446.1	N/A	117.5	N/A	15.9	48.6		61.1	14.1	N/A
2 - SW x 2-1/2 - SW	19567L	136.5	79.4	415.9	N/A	92.08	N/A	15.9	61.1		73.8	10.9	N/A
2 - SW x 2-1/2 - SW	19567M	136.5	79.4	462.0	N/A	117.5	N/A	15.9	61.1		73.8	15.4	N/A

19000 Flanged Connections (Inches & Pounds)

Size (in.)	Type	Inlet (RF or RJ) ANSI Standard Except Thickness	Outlet		A (in.)	B		C (in.)	D (in.)	E (in.)	F (in.)	G		H (in.)	Approx. Weight					
			Female NPT (in.)	(RF or RJ) ANSI Standard Except Thickness		NPT (in.)	Flange (in.)					Class 150#	Class 300#		RF or RJ	RF or RJ	Threaded Outlet (lbs.)	Flanged Outlet (lbs.)		
																			RF or RJ	RF or RJ
																			(in.)	(in.)
1/2	19096L	1/2 - 150	1	1 - 150	6	1-7/8	4-7/8	13-1/8	2	7/8	7/16	1-1/16	—	1/2	6-1/4	9-1/4				
	19110L	1/2 - 300													7-1/4	10-1/4				
3/4	19096L	3/4 - 150	1	1 - 150	6-1/4	1-7/8	4-7/8	13-3/8	2	1	1/2	1-1/16	—	1/2	7	10				
	19110L	3/4 - 300													8-1/2	11-1/2				
1	19096L	1 - 150	1	1 - 150	6-1/2	1-7/8	4-7/8	13-5/8	2	1-1/16	1/2	1-1/16	—	1/2	7-3/4	10-3/4				
	19110L	1 - 300													9-1/4	12-1/4				
3/4	19126L	3/4 - 150	1	1 - 150	6-1/4	1-7/8	4-7/8	13-3/8	2	1	1/2	1-1/16	—	1/2	7-1/2	10-1/2				
	19110L	3/4 - 300													9	12				
1	19126L	1 - 150	1	1 - 150	6-1/2	1-7/8	4-7/8	13-5/8	2	1-1/16	1/2	1-1/16	—	1/2	8-1/4	11-1/4				
	19110L	1 - 300													9-3/4	12-3/4				
1	19226L	1 - 150	1-1/2	1-1/2 - 150	6-1/4	2-1/4	6-1/8	14-1/4	2-3/8	1-1/16	1/2	1-3/16	—	1/2	9-3/4	14-3/4				
	19110L	1 - 300													11-1/4	16-1/4				
1-1/2	19357L	1-1/2 - 150	2	2 - 150	7-1/8	3-1/8	6-1/8	18-1/8	3-5/8	1-3/16	1/2	1-3/8	—	5/8	22-3/4	30-1/4				
	19110L	1-1/2 - 300													26-1/4	33-3/4				
2	19567L	2 - 150	2-1/2	2-1/2 - 150	7-1/8	3-1/8	6-1/8	18-1/8	3-5/8	1-3/8	5/8	1-1/2	—	5/8	26-3/4	38-1/4				
	19110L	2 - 300													28-3/4	40-1/4				
1/2	19096M 19110M	1/2 - 300	1	1 - 150	6	2	4-7/8	14-15/16	2-9/16	1	7/16	1-1/16	—	1/2	9	12				
		1/2 - 600		6	14-15/16			1		7/16	1-1/16	—	9		12					
		1/2 - 900		6-1/2	15-7/16			1-1/2		5/8	—	1-3/16	13-1/4		17-3/4					
		1/2 - 1500		6-1/2	15-7/16			1-1/2		5/8	—	1-3/16	13-1/4		17-3/4					
3/4	19096M 19110M	3/4 - 300	1	1 - 150	6-1/4	2	4-7/8	15-3/16	2-9/16	1-1/8	1/2	1-1/16	—	1/2	10-1/4	13-1/4				
		3/4 - 600		6-1/4	15-3/16			1-1/8		1/2	1-1/16	—	10-1/4		13-1/4					
		3/4 - 900		6-3/4	15-11/16			1-5/8		5/8	—	1-3/16	13-1/2		18					
		3/4 - 1500		6-3/4	15-11/16			1-5/8		5/8	—	1-3/16	13-1/2		18					
1	19096M 19110M	1 - 300	1	1 - 150	6-1/2	2	4-7/8	15-7/16	2-9/16	1-3/16	1/2	1-1/16	—	1/2	11	14				
		1 - 600		6-1/2	15-7/16			1-3/16		1/2	1-1/16	—	11		14					
		1 - 900		7-1/2	16-7/16			1-3/4		5/8	—	1-3/16	15-1/2		20					
		1 - 1500		7-1/2	16-7/16			1-3/4		5/8	—	1-3/16	15-1/2		20					
3/4	19126M	3/4 - 300	1	1 - 150	6-1/4	2	4-7/8	15-3/16	2-9/16	1-1/8	1/2	1-1/16	—	1/2	10-1/4	13-1/4				
		3/4 - 600		6-1/4	15-3/16			1-1/8		1/2	1-1/16	—	10-1/4		13-1/4					
		3/4 - 900		6-3/4	15-11/16			1-5/8		5/8	—	1-3/16	13-1/2		18					
		3/4 - 1500		6-3/4	15-11/16			1-5/8		5/8	—	1-3/16	13-1/2		18					
1	19126M	1 - 300	1	1 - 150	6-1/2	2	4-7/8	15-7/16	2-9/16	1-3/16	1/2	1-1/16	—	1/2	11	14				
		1 - 600		6-1/2	15-7/16			1-3/16		1/2	1-1/16	—	11		14					
		1 - 900		7-1/2	16-7/16			1-3/4		5/8	—	1-3/16	15-3/4		20-1/4					
		1 - 1500		7-1/2	16-7/16			1-3/4		5/8	—	1-3/16	15-3/4		20-1/4					

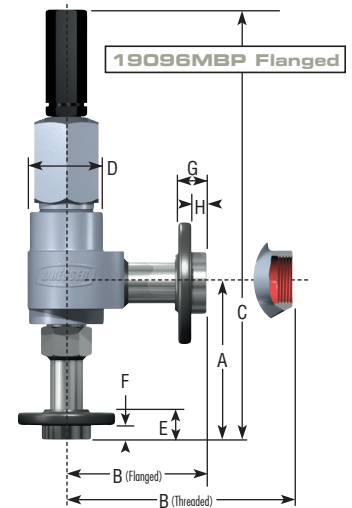
**19000 Flanged Connections (Inches & Pounds)**

Size (in.)	Type	Inlet (RF or RJ) ANSI Standard Except Thickness	Outlet		A (in.)	B (in.)		C (in.)	D (in.)	E (in.)	F (in.)	G (in.)		H (in.)	Approx. Weight (lbs.)	
			Female NPT (in.)	(RF or RJ) ANSI Standard Except Thickness		NPT (in.)	Flange (in.)					Class 150#	Class 300#		Threaded Outlet	Flanged Outlet
1	19226M	1 - 300	1-1/2	1-1/2 - 150	6-1/4	2-3/8	6-1/8	15-5/8	3-1/8	1-3/16	1/2	1-3/16	—	1/2	16	21
		1 - 600		1-1/2 - 150	6-1/4		15-5/8	1-3/16		1/2	1-3/16	—	16		21	
		1 - 900		1-1/2 - 300	7-1/4		16-5/8	1-3/4		5/8	—	1-5/16	20-1/2		29	
		1 - 1500		1-1/2 - 300	7-1/4		16-5/8	1-3/4		5/8	—	1-5/16	20-1/2		29	
1-1/2	19357M	1-1/2 - 300	2	2 - 150	7-1/8	3-1/8	6-1/8	19-15/16	4-5/8	1-5/16	1/2	1-3/8	—	5/8	38-1/4	45-3/4
		1-1/2 - 600		2 - 150	7-1/8		19-15/16	1-3/8		1/2	1-3/8	—	38-1/4		45-3/4	
		1-1/2 - 900		2 - 300	8-1/4		21-1/16	1-7/8		5/8	—	1-1/2	46-3/4		56-1/4	
		1-1/2 - 1500		2 - 300	8-1/4		21-1/16	1-7/8		5/8	—	1-1/2	46-3/4		56-1/4	
2	19567M	2 - 300	2-1/2	2-1/2 - 150	7-1/8	3-1/8	6-1/8	19-15/16	4-5/8	1-1/2	—	1-1/2	—	5/8	39-3/4	51-1/4
		2 - 600		2-1/2 - 150	7-1/8		19-15/16	1-5/8		—	1-1/2	—	40-3/4		52-1/4	
		2 - 900		2-1/2 - 300	8-1/4		21-1/16	2-1/8		—	1-5/8	—	55-1/4		68-3/4	
		2 - 1500		2-1/2 - 300	8-1/4		21-1/16	2-1/8		—	1-5/8	—	55-1/4		68-3/4	
3/4	19096H/19110H	3/4 - 1500	1	1 - 300	6-1/2	2-3/8	6-1/4	15-5/8	3-1/8	1-5/8	—	1-3/16	—	1/2	18-1/2	23
		3/4 - 2500		1 - 300	6-1/2		15-5/8	1-7/8		—	1-3/16	—	20-3/4		25-1/4	
3/4	19126H	3/4 - 1500	1	1 - 300	6-1/2	3-1/8	6-1/4	19-1/16	4-5/8	1-5/8	—	1-3/16	—	1/2	37	41-1/2
		3/4 - 2500		1 - 300	6-1/2		19-1/16	1-7/8		—	1-3/16	—	39		43-1/2	
1	19226H	1 - 1500	1-1/2	1-1/2 - 300	7-1/4	3-1/8	6-1/8	16-3/8	4-5/8	1-3/4	—	1-5/16	—	1/2	39	47
		1 - 2500		1-1/2 - 300	7-1/4		16-3/8	1-3/4		—	1-5/16	—	43-1/2		51-1/2	



**19096MBP Flanged Connections (Inches & Pounds)**

Size (in.)	Type	Inlet (RF or RJ) ANSI Standard Except Thickness	Outlet		A (in.)	B (in.)		C (in.)	D (in.)	E (in.)	F (in.)	G (in.)		H (in.)	Approx. Weight (lbs.)	
			Female NPT (in.)	(RF or RJ) ANSI Standard Except Thickness		NPT (in.)	Flange (in.)					Class 150#	Class 300#		Threaded Outlet	Flanged Outlet
1/2	19096M	1/2 - 150	1	1 - 150	6	2	4-7/8	15-5/8	3-3/4	7/8	7/16	1-1/16	—	1/2	13	16
		1/2 - 300		1 - 150	6		15-5/8	1		7/16	1-1/16	—	14		17	
		1/2 - 600		1 - 150	6		15-5/8	1		7/16	1-1/16	—	14		17	
		1/2 - 900		1 - 300	6-1/2		16-1/8	1-1/2		5/8	—	1-3/16	18-1/4		22-3/4	
		1/2 - 1500		1 - 300	6-1/2		16-1/8	1-1/2		5/8	—	1-3/16	18-1/4		22-3/4	
3/4	19096M	3/4 - 150	1	1 - 150	6-1/4	2	4-7/8	15-7/8	3-3/4	1	1/2	1-1/16	—	1/2	13-3/4	16-3/4
		3/4 - 300		1 - 150	6-1/4		15-7/8	1-1/8		1/2	1-1/16	—	15-1/4		18-1/4	
		3/4 - 600		1 - 150	6-1/4		15-7/8	1-1/8		1/2	1-1/16	—	15-1/4		18-1/4	
		3/4 - 900		1 - 300	6-3/4		16-3/8	1-5/8		5/8	—	1-3/16	20		23	
		3/4 - 1500		1 - 300	6-3/4		16-3/8	1-5/8		5/8	—	1-3/16	20		23	
1	19096M	1 - 150	1	1 - 150	6-1/2	2	4-7/8	16-1/8	3-3/4	1-1/16	1/2	1-1/16	—	1/2	14-1/2	17-1/2
		1 - 300		1 - 150	6-1/2		16-1/8	1-3/16		1/2	1-1/16	—	16		19	
		1 - 600		1 - 150	6-1/2		16-1/8	1-3/16		1/2	1-1/16	—	16		19	
		1 - 900		1 - 300	7-1/2		17-1/8	1-3/4		5/8	—	1-3/16	22		25	
		1 - 1500		1 - 300	7-1/2		17-1/8	1-3/4		5/8	—	1-3/16	22		25	

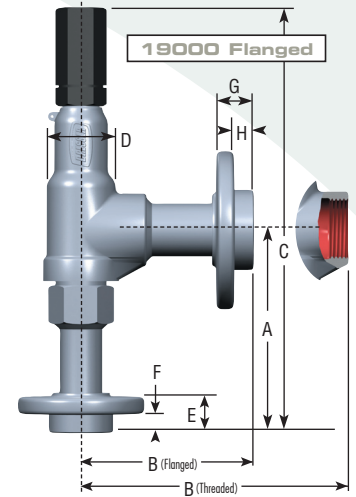


**19000 Flanged Connections (Millimeters & Kilograms)**

Size (in.)	Type	Inlet (RF or RJ) ANSI Standard Except Thickness	Outlet		A (mm)	B		C (mm)	D (mm)	E (mm)	F (mm)	G		H (mm)	Approx. Weight							
			Female NPT (in.)	(RF or RJ) ANSI Standard Except Thickness		NPT (mm)	Flange (mm)					RF or RJ (mm)	RF or RJ (mm)		Class 150# (mm)	Class 300# (mm)	RF or RJ (mm)	RF or RJ (mm)	Threaded Outlet (Kg)	Flanged Outlet (Kg)		
																					Approx. Weight	
																					Threaded Outlet (Kg)	Flanged Outlet (Kg)
1/2	19096L	1/2 - 150	1	1 - 150	152.4	47.6	123.8	333.4	50.8	22.2	11.1	27.0	—	12.7	2.8	4.2						
	19110L	1/2 - 300													3.3	4.6						
3/4	19096L	3/4 - 150	1	1 - 150	158.8	47.6	123.8	339.7	50.8	25.4	12.7	27.0	—	12.7	3.2	4.5						
	19110L	3/4 - 300													3.9	5.2						
1	19096L	1 - 150	1	1 - 150	165.1	47.6	123.8	346.1	50.8	27.0	12.7	27.0	—	12.7	3.5	4.9						
	19110L	1 - 300													4.2	5.6						
3/4	19126L	3/4 - 150	1	1 - 150	158.8	47.6	123.8	339.7	50.8	25.4	12.7	27.0	—	12.7	3.4	4.8						
		3/4 - 300													4.1	5.4						
1	19126L	1 - 150	1	1 - 150	165.1	47.6	123.8	346.1	50.8	30.2	12.7	27.0	—	12.7	3.7	5.1						
		1 - 300													4.4	5.8						
1	19226L	1 - 150	1-1/2	1-1/2 - 150	158.8	57.2	155.6	362.0	60.3	27.0	30.2	12.7	30.2	—	12.7	4.4	6.7					
		1 - 300														5.1	7.4					
1-1/2	19357L	1-1/2 - 150	2	2 - 150	181.0	79.4	155.6	460.4	92.1	30.2	12.7	34.9	—	15.9	10.3	13.7						
		1-1/2 - 300													11.9	15.3						
2	19567L	2 - 150	2-1/2	2-1/2 - 150	181.0	79.4	155.6	460.4	92.1	34.9	15.9	38.1	—	15.9	12.1	17.4						
		2 - 300													13.0	18.3						
1/2	19096M 19110M	1/2 - 300	1	1 - 150	152.4	50.8	123.8	379.4	65.1	25.4	11.1	27.0	—	12.7	4.1	5.4						
		1/2 - 600		379.4				4.1							5.4							
		1/2 - 900		392.1				6.0							8.1							
		1/2 - 1500		392.1				6.0							8.1							
3/4	19096M 19110M	3/4 - 300	1	1 - 150	158.8	50.8	123.8	385.8	65.1	28.6	12.7	27.0	—	12.7	4.6	6.0						
		3/4 - 600		385.8				4.6							6.0							
		3/4 - 900		398.5				6.1							8.2							
		3/4 - 1500		398.5				6.1							8.2							
1	19096M 19110M	1 - 300	1	1 - 150	165.1	50.8	123.8	392.1	65.1	30.2	12.7	27.0	—	12.7	5.0	6.4						
		1 - 600		392.1				5.0							6.4							
		1 - 900		417.5				7.0							9.1							
		1 - 1500		417.5				7.0							9.1							
3/4	19126M	3/4 - 300	1	1 - 150	158.8	50.8	123.8	385.8	65.1	28.6	12.7	27.0	—	12.7	4.6	6.0						
		3/4 - 600		385.8				4.6							6.0							
		3/4 - 900		398.5				6.1							8.2							
		3/4 - 1500		398.5				6.1							8.2							
1	19126M	1 - 300	1	1 - 150	165.1	50.8	123.8	392.1	65.1	30.2	12.7	27.0	—	12.7	5.0	6.4						
		1 - 600		392.1				5.0							6.4							
		1 - 900		417.5				7.1							9.2							
		1 - 1500		417.5				7.1							9.2							

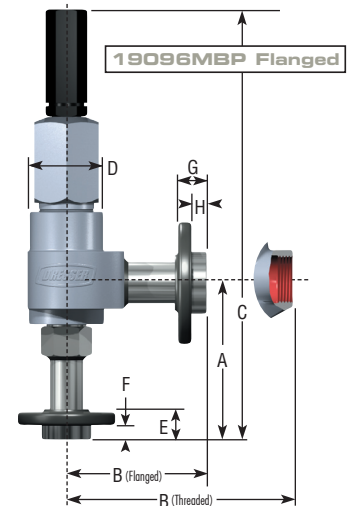
**19000 Flanged Connections (Millimeters & Kilograms)**

Size (in.)	Type	Inlet (RF or RJ) ANSI Standard Except Thickness	Outlet		A (mm)	B (mm)		C (mm)	D (mm)	E (mm)	F (mm)	G (mm)		H (mm)	Approx. Weight (Kg)			
			Female NPT (in.)	(RF or RJ) ANSI Standard Except Thickness		NPT (mm)	Flange (mm)					RF or RJ	RF or RJ		Class 150#	Class 300#	Threaded Outlet	Flanged Outlet
1	19226M	1 - 300	1-1/2	1-1/2 - 150	158.8	60.3	155.6	396.9	79.4	30.2	12.7	30.2	—	12.7	7.3	9.5		
		1 - 600		1-1/2 - 150	158.8			396.9		30.2	12.7	30.2	—		7.3	9.5		
		1 - 900		1-1/2 - 300	184.2			422.3		44.5	15.9	—	33.3		9.3	13.2		
		1 - 1500		1-1/2 - 300	184.2			422.3		44.5	15.9	—	33.3		9.3	13.2		
1-1/2	19357M	1-1/2 - 300	2	2 - 150	181.0	79.4	155.6	506.4	117.5	33.3	12.7	34.9	—	15.9	17.4	20.8		
		1-1/2 - 600		2 - 150	181.0			506.4		34.9	12.7	34.9	—		17.4	20.8		
		1-1/2 - 900		2 - 300	209.6			535.0		47.6	15.9	—	38.1		21.2	25.5		
		1-1/2 - 1500		2 - 300	209.6			535.0		47.6	15.9	—	38.1		21.2	25.5		
2	19567M	2 - 300	2-1/2	2-1/2 - 150	181.0	79.4	155.6	506.4	117.5	38.1	15.9	38.1	—	15.9	18.0	23.2		
		2 - 600		2-1/2 - 150	181.0			506.4		41.3	15.9	38.1	—		18.5	23.7		
		2 - 900		2-1/2 - 300	209.6			535.0		54.0	15.9	—	41.3		25.1	31.2		
		2 - 1500		2-1/2 - 300	209.6			535.0		54.0	15.9	—	41.3		25.1	31.2		
3/4	19096H/19110H	3/4 - 1500	1	1 - 300	165.1	60.3	158.8	396.9	79.4	41.3	15.9	—	30.2	12.7	8.4	10.4		
		3/4 - 2500		1 - 300	165.1			396.9		47.6	15.9	—	30.2		9.4	11.5		
3/4	19126H	3/4 - 1500	1	1 - 300	165.1	79.4	158.8	484.2	114.3	41.3	15.9	—	30.2	12.7	16.8	18.8		
		3/4 - 2500		1 - 300	165.1			484.2		47.6	15.9	—	30.2		17.7	19.7		
1	19226H	1 - 1500	1-1/2	1-1/2 - 300	184.2	79.4	155.6	415.9	114.3	44.5	15.9	—	33.3	12.7	17.7	21.3		
		1 - 2500		1-1/2 - 300	184.2			415.9		50.8	15.9	—	33.3		19.7	23.4		



**19096MBP Flanged Connections (Millimeters & Kilograms)**

Size (in.)	Type	Inlet (RF or RJ) ANSI Standard Except Thickness	Outlet		A (mm)	B (mm)		C (mm)	D (mm)	E (mm)	F (mm)	G (mm)		H (mm)	Approx. Weight (Kg)			
			Female NPT (in.)	(RF or RJ) ANSI Standard Except Thickness		NPT (mm)	Flange (mm)					RF or RJ	RF or RJ		Class 150#	Class 300#	Threaded Outlet	Flanged Outlet
1/2	19096M	1/2 - 150	1	1 - 150	152.4	50.8	123.8	396.9	95.3	22.2	11.1	27.0	—	12.7	5.9	7.3		
		1/2 - 300		1 - 150	152.4			396.9		25.4	11.1	27.0	—		6.4	7.7		
		1/2 - 600		1 - 150	152.4			396.9		25.4	11.1	27.0	—		6.4	7.7		
		1/2 - 900		1 - 300	165.1			409.6		38.1	15.9	—	30.2		8.3	10.3		
3/4	19096M	1/2 - 1500	1	1 - 300	165.1	50.8	123.8	409.6	95.3	38.1	15.9	—	30.2	12.7	8.3	10.3		
		3/4 - 150		1 - 150	158.8			403.2		25.4	12.7	27.0	—		6.2	7.6		
		3/4 - 300		1 - 150	158.8			403.2		28.6	12.7	27.0	—		6.9	8.3		
		3/4 - 600		1 - 150	158.8			403.2		28.6	12.7	27.0	—		6.9	8.3		
1	19096M	3/4 - 900	1	1 - 300	171.5	50.8	123.8	415.9	95.3	41.3	15.9	—	30.2	12.7	9.1	10.4		
		3/4 - 1500		1 - 300	171.5			415.9		41.3	15.9	—	30.2		9.1	10.4		
		1 - 150		1 - 150	165.1			409.6		27.0	12.7	27.0	—		6.5	7.9		
		1 - 300		1 - 150	165.1			409.6		30.2	12.7	27.0	—		7.3	8.6		
		1 - 600		1 - 150	165.1			409.6		30.2	12.7	27.0	—		7.3	8.6		
1	19096M	1 - 900	1	1 - 300	190.5	50.8	123.8	435.0	95.3	44.5	15.9	—	30.2	12.7	10.0	11.3		
		1 - 1500		1 - 300	190.5			435.0		44.5	15.9	—	30.2		10.0	11.3		



# O-Ring Selection Procedure

In addition to the rating of the valve based on materials and temperatures, it is possible that if the valve is equipped with O-Rings (soft seats), the O-Ring may limit the range of valve application.

The following selection process is simple and straight forward and should yield a satisfactory valve selection.

Use the following steps in the O-Ring selection process:

1. Refer to the Technical Information section in this catalog to select appropriate O-Ring material for service media.

2. Refer to "Table A" (O-Ring Selection - Durometer). Using the valve set pressure, determine the durometer hardness which will be needed.

3. Refer to "Table B". Utilizing the material selected and the durometer hardness selected check the temperature limits of the material.

4. If the selected material is not adequate, select another material and repeat the procedure.

NOTE: For fire applications use the operating temperature when selecting a material.

**O-Ring Selection - Durometer  
Table A**

Valve Type	O-Ring Durometer			Teflon	
	50 <sup>1</sup> Set Press. (psig)	70 <sup>1</sup> Set Press. (psig)	90 <sup>2</sup> Set Press. (psig)	-300 to 200°F Set Press. (psig)	201 to 500°F Set Press. (psig)
19096	15 to 300	100 to 500	300 to 2500	1400 to 5000	15 to 5000
19110	15 to 300	100 to 500	300 to 2500	1400 to 5000	15 to 5000
19126	15 to 250	30 to 500	250 to 2250	1000 to 6000	15 to 6000
19226	15 to 200	15 to 450	200 to 2000	1000 to 6000	15 to 6000
19357	15 to 150	15 to 400	150 to 1500	—	15 to 1500
19567	15 to 150	15 to 400	100 to 1000	—	15 to 1000

- NOTES: 1 Maximum set pressure for silicone compounds is half of the maximum value.  
2 The E9 62-90D O-Ring can be used in steam service to a lower pressure limit of 15 psig.

**O-Ring Temperature Limits  
Table B**

Material	Durometer	Description	Temperature Limits	
			°F	°C
Nitrile	50	N299-50 OR N1009-50	-45 to +225°	-43 to +107°
	70	N674-70	-40 to +250°	-40 to +121°
	90	N552-90	-40 to +350°	-40 to +177°
	70 <sup>4</sup>	N1173-70	-25 to +300°	-31 to +149°
Ethylene/Propylene	50	E981-50	-65 to +212°	-53 to +100°
	70	E603-70	-65 to +212°	-53 to +100°
	75 & 80 <sup>2</sup>	E740-75 & E515-80	-70 to +250°	-57 to +121°
	90	E962-90 <sup>1</sup>	-70 to +500°	-57 to +260°
Fluorocarbon	75	E962-75	-60 to +250/400°	-51 to +121/204°
	50	V986-50	-15 to +400°	-26 to +204°
	75	V747-75 OR V884-75	-15 to +400°	-26 to +204°
Neoprene	90	V894-90 OR V709-90	-15 to +400°	-26 to +204°
	50	C267-50	-45 to +300°	-43 to +149°
Silicone	70	C944-70 OR C873-70	-45 to +300°	-43 to +149°
	50	S595-50	-65 to +437°	-53 to +225°
Teflon	70	S604-70	-65 to +437°	-53 to +225°
	N/A	Teflon	-300 to +500°	-184 to +260°
Kalrez <sup>3</sup>	82	1050LF	-42 to +550°	-41 to +288°
Kalrez <sup>3</sup>	75	4079	-58 to +600°	-50 to +315°
Kalrez <sup>3</sup>	91	3018	-35 to +550°	-37 to +288°
Kalrez <sup>3</sup>	65	1058	-40 to +500°	-40 to +260°

- NOTES: 1 EPR962-90D can be used in steam service to a lower pressure limit of 15 psig.  
2 Set Pressure Ranges per "Table B" For durometer shall apply to these compounds (For Nuclear Service, Radiation Environment.)  
3 Consult Factory before selecting. (4079 - Not for use in hot water or steam applications.)  
4 Consult Factory before using. For use with Freon 134A/Ester Oil Service.

## General Information

### 19000 & 19096MBP Series

These ratings apply to threaded or socket weld end connections.

When the valves are supplied with flanged connections the flange ratings may govern the range of valve pressure/temperature rating.

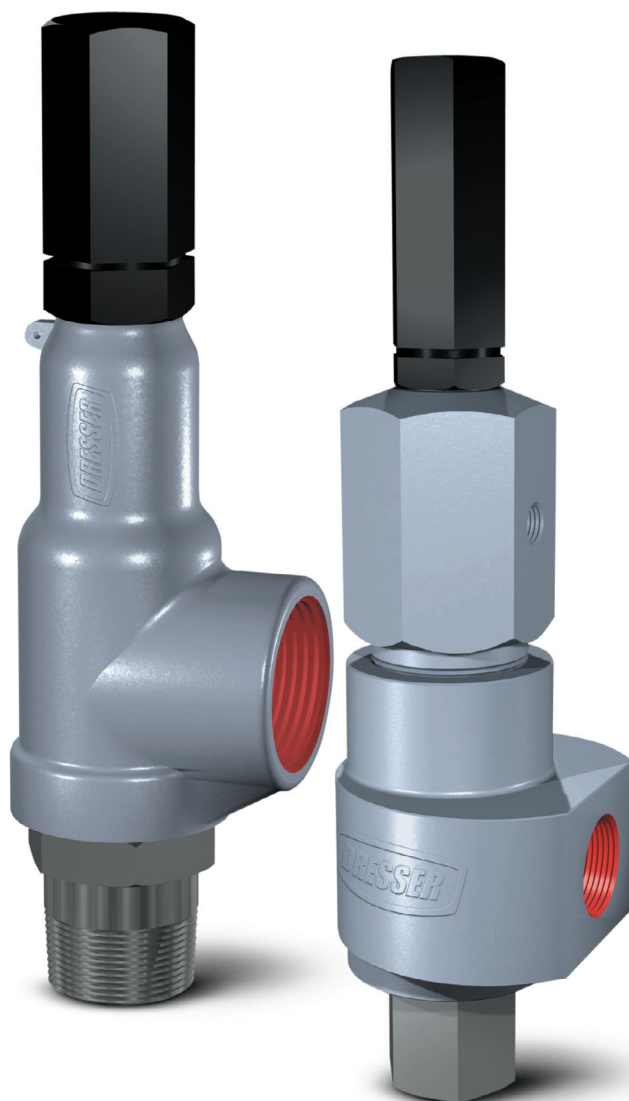
When selecting valves for back pressure applications the following limits apply:

- Constant back pressure - 400 psig
- Variable back pressure (superimposed or built-up) - 400 psig or 10% of set pressure whichever is smaller.

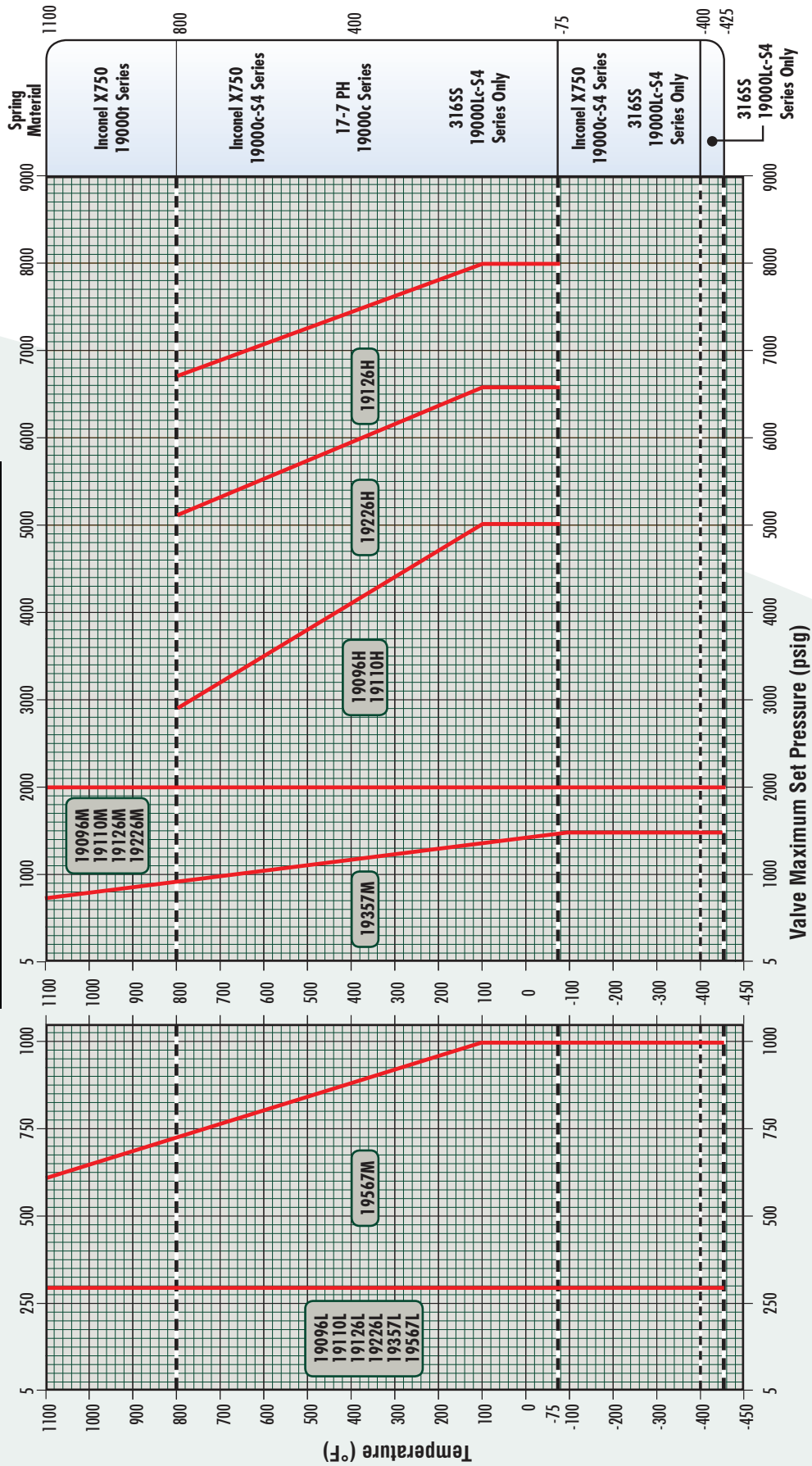
Valves with set pressures less than 15 psig cannot be stamped with the ASME Code stamp.

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NOTE: When soft seats are used Elastomer material may govern the valve pressure/temperature rating.



Pressure / Temperature Rating of 19000 Series Valves





**ORIFICE CAPACITIES - AIR**  
(USCS Units) ASME B & PVC, Section VIIISet Pressure plus 10% overpressure or 3 psig,  
whichever is greater. SCFM Air @ 60°F.

Set Press. (psig)	Orifice Area (Sq. in.)					
	19096 & MBP .096 <sup>1</sup>	19110 .110	19126 .126	19226 .226	19357 .357	19567 .567
15	51	58	66	119	188	299
20	58	66	77	137	217	344
30	74	84	97	174	274	436
40	91	104	119	214	338	536
50	108	123	142	254	401	637
60	125	143	164	294	464	737
70	142	162	186	334	528	838
80	159	182	209	374	591	938
90	176	201	231	414	654	1039
100	193	221	253	454	717	1139
120	227	260	298	534	844	1340
140	261	299	343	614	971	1541
160	295	338	387	695	1097	1743
180	329	377	432	775	1224	1944
200	363	416	477	855	1350	2145
220	397	455	521	935	1477	2346
240	431	494	566	1015	1603	2547
260	465	533	611	1095	1730	2748
280	499	572	655	1175	1857	2949
300	533	611	700	1255	1983	3150
320	567	650	745	1336	2110	3351
340	601	689	789	1416	2236	3552
360	635	728	834	1496	2363	3753
380	669	767	879	1576	2489	3954
400	704	806	923	1656	2616	4155
420	737	845	968	1736	2743	4356
440	772	884	1013	1816	2869	4557
460	806	923	1057	1896	2996	4758
480	840	962	1102	1977	3122	4959
500	874	1001	1147	2057	3249	5160
600	1044	1196	1370	2457	3882	6165
700	1214	1391	1593	2858	4514	7170
750	1299	1489	1705	3058	4831	7673
800	1384	1586	1817	3259	5147	8175
900	1554	1781	2040	3659	5780	9180
1000	1725	1976	2264	4060	6413	10186
1100	1895	2171	2487	4460	7046	-
1200	2065	2366	2710	4861	7679	-
1300	2235	2561	2934	5262	8312	-
1400	2405	2756	3157	5662	8945	-
1500	2575	2951	3380	6063	9577	-
1600	2745	3146	3603	6463	-	-
1700	2915	3341	3827	6864	-	-
1800	3086	3536	4050	7264	-	-
1900	3256	3731	4273	7665	-	-
2000	3426	3926	4497	8066	-	-
2500	4277	4901	5614	10069	-	-
3000	5128	5876	6731	12072	-	-
3500	5979	6851	7848	14076	-	-
4000	6830	7826	8964	16078	-	-
4500	7681	8801	10081	18082	-	-
5000	8532	9776	11198	20085	-	-
5500	-	-	12315	22088	-	-
6000	-	-	13432	24091	-	-
6400	-	-	14325	25694	-	-
6500	-	-	14548	-	-	-
7000	-	-	15665	-	-	-
7500	-	-	16782	-	-	-
8000	-	-	17899	-	-	-

SIZING: Refer to the sizing section for formulas for both ASME and API sizing. Valves may be sized for either ASME or API applications.

NOTE 1: 19096MBP set pressure limit 50 to 2000 psig.

**ORIFICE CAPACITIES - STEAM**  
(USCS Units) ASME B & PVC, Section VIII

Set Pressure plus 10% overpressure  
or 3 psig, whichever is greater,  
lbs. per hour saturated steam

Set Press. (psig)	Orifice Area (Sq. in.)					
	19096 & MBP .096 <sup>1</sup>	19110 .110	19126 .126	19226 .226	19357 .357	19567 .567
15	142	162	186	334	527	838
20	164	187	215	385	609	967
30	207	237	272	487	770	1223
40	255	292	334	600	948	1505
50	303	346	397	712	1125	1787
60	350	401	460	825	1303	2069
70	398	456	522	937	1480	2351
80	446	510	585	1049	1658	2633
90	494	565	648	1162	1835	2915
100	541	620	710	1274	2013	3197
120	637	729	836	1499	2368	3761
140	732	839	961	1724	2723	4325
160	828	948	1086	1949	3078	4889
180	923	1057	1212	2174	3434	5453
200	1019	1167	1337	2398	3789	6017
220	1114	1276	1463	2623	4144	6581
240	1210	1386	1588	2848	4499	7145
260	1305	1495	1713	3073	4854	7709
280	1401	1605	1839	3298	5209	8273
300	1496	1714	1964	3523	5564	8837
320	1592	1824	2089	3747	5919	9401
340	1687	1933	2215	3972	6275	9966
360	1783	2043	2340	4197	6630	10530
380	1878	2152	2465	4422	6985	11094
400	1974	2262	2591	4647	7340	11658
420	2069	2371	2716	4871	7695	12222
440	2165	2480	2841	5096	8050	12786
460	2260	2590	2967	5321	8405	13350
480	2356	2699	3092	5546	8761	13914
500	2451	2809	3217	5771	9116	14478
600	2929	3356	3844	6895	10891	17298
700	3406	3903	4471	8019	12667	20118
750	3645	4177	4784	8581	13555	21528
800	3884	4450	5097	9143	14443	22938
900	4361	4997	5724	10267	16218	25759
1000	4839	5544	6351	11391	17994	28579
1100	5316	6091	6978	12515	19770	-
1200	5794	6639	7604	13639	21545	-
1300	6271	7186	8230	14763	23321	-
1400	6748	7733	8857	15887	25096	-
1423	6858	7859	9002	16146	25505	-
1500	7261	8320	9530	17093	27001	-
1600	7792	8928	10227	18343	-	-
1700	8334	9549	10938	19619	-	-
1800	8888	10184	11665	20923	-	-
1900	9455	10835	12410	22260	-	-
2000	10039	11503	13176	23634	-	-
2500	13285	15222	17437	31275	-	-
2903*	16611	19034	21803	39106	-	-

\* 2903 psig is maximum allowable set pressure for steam. 3000 psig capacities are provided for interpolation purposes only.  
SIZING: Refer to the sizing section for formulas for both ASME and API sizing. Valves may be sized for either ASME or API applications.  
NOTE 1: 19096/MBP set pressure limit 50 to 1528 psig saturated steam.

**ORIFICE CAPACITIES - WATER**  
(USCS Units) ASME B & PVC, Section VIII

Set Pressure plus 10% overpressure  
or 3 psig, whichever is greater,  
zero psig back pressure, GPM water @ 70°F.

Set Press. (psig)	Orifice Area (Sq. in.)					
	19096 & MBP .096 <sup>1</sup>	19110 .110	19126 .126	19226 .226	19357 .357	19567 .567
15	10	11	14	25	39	62
20	12	13	15	28	44	70
30	14	16	19	33	52	83
40	16	18	21	38	61	96
50	18	20	24	43	68	108
60	20	22	26	47	74	118
70	22	24	28	51	80	127
80	23	26	30	54	86	136
90	24	28	32	58	91	144
100	26	29	34	61	96	152
120	28	32	37	66	105	167
140	30	34	40	72	113	180
160	33	37	43	77	121	192
180	35	39	45	81	128	201
200	36	41	48	86	135	215
220	38	43	50	90	142	226
240	40	45	52	94	148	236
260	42	47	54	98	154	245
280	43	49	57	101	160	254
300	45	51	59	105	166	263
320	46	52	60	108	171	272
340	47	54	62	112	177	280
360	49	56	64	115	182	289
380	50	57	66	118	187	296
400	51	59	68	121	192	304
420	53	60	69	124	196	312
440	54	62	71	127	201	319
460	55	63	72	130	205	326
480	56	64	74	133	210	333
500	58	66	76	136	214	340
600	63	72	83	148	235	373
700	68	78	89	160	253	402
750	71	81	93	166	262	416
800	73	83	96	171	271	430
900	77	89	101	182	287	456
1000	81	93	107	192	303	481
1100	85	98	112	201	318	-
1200	89	102	117	210	332	-
1300	93	106	122	219	345	-
1400	96	110	126	227	358	-
1500	100	114	131	235	371	-
1600	103	118	135	242	-	-
1700	106	122	139	249	-	-
1800	109	125	143	257	-	-
1900	112	129	147	264	-	-
2000	115	132	151	271	-	-
2500	129	148	169	303	-	-
3000	141	162	185	332	-	-
3500	152	175	200	359	-	-
4000	163	187	214	383	-	-
4500	173	199	227	407	-	-
5000	182	208	239	429	-	-
5500	-	-	251	450	-	-
6000	-	-	262	470	-	-
6400	-	-	270	485	-	-
6500	-	-	272	-	-	-
7000	-	-	283	-	-	-
7500	-	-	293	-	-	-
8000	-	-	302	-	-	-

SIZING: Refer to the sizing section for formulas for both ASME and API sizing. Valves may be sized for either ASME or API applications.  
NOTE 1: 19096MBP set pressure limit 50 to 2000 psig.

# Instructions

**95-8527**

Protect•IR® Multispectrum IR Flame Detector  
X3301



# Table of Contents

DESCRIPTION . . . . .	1	TROUBLESHOOTING . . . . .	13
Outputs . . . . .	1		
LED . . . . .	2	MAINTENANCE . . . . .	14
Optical Integrity ( <b>oi</b> ) . . . . .	2	Cleaning Procedure . . . . .	14
Communication . . . . .	3	<b>oi</b> Plate Removal and Replacement . . . . .	14
Data Logging . . . . .	3	Periodic Checkout Procedure . . . . .	15
Integral Wiring Compartment . . . . .	3	Clock Battery . . . . .	15
GENERAL APPLICATION INFORMATION . . . . .	3	FEATURES . . . . .	15
Response Characteristics . . . . .	3		
Important Application Considerations . . . . .	3	SPECIFICATIONS . . . . .	16
IMPORTANT SAFETY NOTES . . . . .	4	REPLACEMENT PARTS . . . . .	18
INSTALLATION . . . . .	4	DEVICE REPAIR AND RETURN . . . . .	18
Detector Positioning . . . . .	4		
Detector Orientation . . . . .	5	ORDERING INFORMATION . . . . .	18
Protection Against Moisture Damage . . . . .	5	Accessories . . . . .	18
Wiring Procedure . . . . .	5		
Setting Device Network Addresses (EQP Model Only) . . . . .	12	APPENDIX A – FM APPROVAL AND PERFORMANCE REPORT . . . . .	20
STARTUP PROCEDURE . . . . .	13	APPENDIX B – CSA APPROVAL . . . . .	30
Fire Alarm Test . . . . .	13	APPENDIX C – ATEX / CE APPROVAL . . . . .	31
		APPENDIX D – IECEx APPROVAL . . . . .	33
		APPENDIX E – VdS APPROVAL . . . . .	34
		APPENDIX F – OFFSHORE APPROVALS . . . . .	35
		APPENDIX G – ADDITIONAL APPROVALS . . . . .	36
		APPENDIX H – APPROVED ACCESSORIES . . . . .	37



Protect•IR®

## Multispectrum IR Flame Detector

X3301

**IMPORTANT**

Be sure to read and understand the entire instruction manual before installing or operating the flame detection system. Any deviation from the recommendations in this manual may impair system performance and compromise safety.

**ATTENTION**

The X3301 includes the Automatic Optical Integrity (oi®) feature — a calibrated performance test that is automatically performed once per minute to verify complete detector operation capabilities. **No testing with an external test lamp is required.**

**DESCRIPTION**

The X3301 Protect•IR® is a multispectrum infrared (IR) flame detector. It provides unsurpassed detection of fires from light to heavy hydrocarbon fuels combined with the highest degree of false alarm rejection. The detector has Division and Zone explosion-proof ratings and is suitable for use in indoor and outdoor applications.

The X3301 contains three IR sensors with their associated signal processing circuitry. The standard output configuration includes fire, fault and auxiliary relays. Output options include:

- 0 to 20 mA output (in addition to the three relays)
- Pulse output for compatibility with existing controller based systems (with fire and fault relays)
- Eagle Quantum Premier® (EQP) compatible model (no analog or relay outputs).
- HART communication.

X3301 technology advancements are covered under the following U.S. Patents: 5,995,008, 5,804,825 and 5,850,182.



A tricolor LED on the detector faceplate indicates normal condition and notifies personnel of fire alarm or fault conditions.

Microprocessor controlled heated optics increase resistance to moisture and ice.

The X3301 housing is available in copper-free aluminum or stainless steel, with NEMA 4X and IP66 rating.

**OUTPUTS****Relays**

The standard detector is furnished with fire, fault and auxiliary relays. All three relays are rated 5 amperes at 30 Vdc.

The Fire Alarm relay has redundant terminals and normally open / normally closed contacts, normally de-energized operation, and latching or non-latching operation.

The Fault relay has redundant terminals and normally open contacts, normally energized operation, and latching or non-latching operation.

The Auxiliary relay has normally open / normally closed contacts, and is configurable for energized or de-energized operation, and latching or non-latching operation.

### 0 to 20 mA Output

A 0 to 20 mA output is available as an option (in addition to the three relays). This option provides a 0 to 20 mA dc current output for transmitting detector status information to other devices. The circuit can be wired in either an isolated or non-isolated configuration and can drive a maximum loop resistance of 500 ohms from 18 to 19.9 Vdc and 600 ohms from 20 to 30 Vdc. Table 1 indicates the detector status conditions represented by the various current levels. The output is calibrated at the factory, with no need for field calibration. A model with relays and 0-20 mA with HART is also available. Refer to Addendum number 95-8577 for complete details.

#### NOTE

*The output of the 0 to 20 mA current loop is not monitored by the fault detection circuitry of the X3301. Therefore, an open circuit on the loop will not cause the fault relay to change state or the detector status LED to indicate a fault. The status of the LED always follows the status of the relays.*

An alarm condition will normally over-ride a fault condition, unless the nature of the fault condition impairs the ability of the detector to generate or maintain an alarm output, i.e. loss of operating power.

Table 1—Detector Status Conditions Indicated by Current Level

Current Level ( $\pm 0.3$ mA)	Detector Status
0 mA	Power Fault
1 mA	General Fault
2 mA	<b>oi</b> Fault
3 mA	Hi Background IR
4 mA	Normal Operation
20 mA	Fire Alarm

### LON/SLC Output

The EQP model is designed for use exclusively with Detector Electronics Corporation's (Det-Tronics®) Eagle Quantum Premier system. The detector communicates with the system controller over a digital communication network or LON/SLC (Local Operating Network / Signaling Line Circuit). The LON/SLC is a fault tolerant, two wire digital communication network arranged in a loop configuration. Analog and relay outputs are not available on this model.

### LED

A tricolor LED on the detector faceplate indicates normal condition and notifies personnel of fire alarm or fault conditions. Table 2 indicates the condition of the LED for each status.

### OPTICAL INTEGRITY (oi)

#### Automatic oi

The X3301 includes the Automatic Optical Integrity (**oi**) feature — a calibrated performance test that is automatically performed once per minute to verify complete detector operation capabilities. No testing with an external test lamp is required. The detector automatically performs the same test that a maintenance person with a test lamp would perform — once every minute, 60 times per hour. However, a successful automatic **oi** test does not produce an alarm condition.

The Protect•IR signals a fault condition when less than half of the detection range remains. This is indicated by the Fault relay and is evident by the yellow color of the LED on the face of the detector. See the "Troubleshooting" section for further information.

#### Magnetic oi / Manual oi

The detector also incorporates both magnetic **oi** and manual **oi** features that provide the same calibrated test as the automatic **oi**, and in addition actuates the Alarm relay to verify output operation for preventive maintenance requirements. These features can be performed at any time and eliminate the need for testing with a non-calibrated external test lamp.

#### CAUTION

*These tests require disabling of all extinguishing devices to avoid release resulting from a successful test.*

Table 2—Detector Status Indicator

Detector Status	LED Indicator
Power On/Normal Operation (no fault or fire alarm)	Green
Fault	Yellow
Fire (Alarm)	Red
Low Sensitivity	One Yellow Flash During Power-up
Medium Sensitivity	Two Yellow Flashes During Power-up
Very High Sensitivity	Four Yellow Flashes During Power-up

The magnetic **o<sub>i</sub>** test is performed by placing a magnet by the marked location (mag **o<sub>i</sub>**) on the outside of the detector. The manual **o<sub>i</sub>** test is accomplished by connecting the **o<sub>i</sub>** lead (terminal 22) to power supply minus via an external switch. The magnet or switch must be held in place for a minimum of 6 seconds to complete the test. Either of these test methods activates the calibrated IR emitters. If the resulting signal meets the test criteria, indicating that greater than half of the detection range remains, the Alarm relay changes state, the indicating LED changes to red, and the 0-20 mA current output goes to 20 mA. This condition remains until the magnet is removed or the switch is released, regardless of whether the relays are set for latching or non-latching operation.

If less than half of the detection range remains, no alarm is produced and a fault is generated. The fault indication can be reset by momentarily applying the magnet or manual **o<sub>i</sub>** switch.

**NOTE**

*Refer to Appendix A for FM verification of Det-Tronics' Optical Integrity **o<sub>i</sub>** function.*

**COMMUNICATION**

The X3301 is furnished with an RS-485 interface for communicating status and other information with external devices. The RS-485 supports MODBUS protocol, with the detector configured as a slave device.

**NOTE**

*The EQP model uses LON/SLC communication. RS-485 communication is not available on the EQP model.*

**DATA LOGGING**

Data logging capability is also provided. Status conditions such as normal, power down, general and **o<sub>i</sub>** faults, pre-alarm, fire alarm, time and temperature are recorded. Each event is time and date stamped, along with the temperature and input voltage. Event data is stored in non-volatile memory when the event becomes active, and again when the status changes. Data is accessible using the RS-485 port or the EQP controller.

**INTEGRAL WIRING COMPARTMENT**

All external wiring to the device is connected within the integral junction box. The screw terminals accept wiring from 14 to 24 AWG. The detector is furnished with four conduit entries, with either 3/4 inch NPT or 25 mm threads.

**GENERAL APPLICATION INFORMATION**

**RESPONSE CHARACTERISTICS**

Response is dependent on distance, type of fuel, temperature of the fuel, and time required for the fire to come to equilibrium. As with all fire tests, results must be interpreted according to an individual application. See Appendix A for fire test results.

**IMPORTANT APPLICATION CONSIDERATIONS**

In applying any type of sensing device as a fire detector, it is important to know of any conditions that can prevent the device from responding to fire, and also to know what other sources besides fire can cause the device to respond.

**Welding**

Arc welding should not be performed within 40 feet of the very high sensitivity detector, 10 feet of the medium sensitivity detector, or 5 feet of the low sensitivity detector. It is recommended that the system be bypassed during welding operations in situations where the possibility of a false alarm cannot be tolerated. Gas welding mandates system bypass, since the gas torch is an actual fire. Arc welding rods can contain organic binder materials in the flux that burn during the welding operation and are detectable by the X3301. Welding rods with clay binders do not burn and will not be detected by the X3301. However, system bypass is always recommended, since the material being welded may be contaminated with organic substances (paint, oil, etc.) that will burn and possibly trigger the X3301.

**Artificial Lighting**

The X3301 should not be located within 3 feet of artificial lights. Excess heating of the detector could occur due to heat radiating from the lights.

**EMI/RFI Interference**

The X3301 is resistant to interference by EMI and RFI, and is EMC Directive compliant. It will not respond to a 5 watt walkie-talkie at distances greater than 1 foot. Do not operate a walkie-talkie within 1 foot of the X3301.

**Non-Carbon Fires**

The X3301 is a multiple spectrum IR device with detection limited to carbonaceous fuels. It should not be used to detect fires from fuels that do not contain carbon, such as hydrogen, sulfur and burning metals.



## IMPORTANT SAFETY NOTES

### WARNING

Do not open the detector assembly in a hazardous area when power is applied. The detector contains limited serviceable components and should never be opened. Doing so could disturb critical optical alignment and calibration parameters, possibly causing serious damage. This type of damage could be undetected and could result in failure to see a fire and/or false alarm.

### CAUTION

The wiring procedures in this manual are intended to ensure proper functioning of the device under normal conditions. However, because of the many variations in wiring codes and regulations, total compliance to these ordinances cannot be guaranteed. Be certain that all wiring complies with the NEC as well as all local ordinances. If in doubt, consult the authority having jurisdiction before wiring the system. Installation must be done by a properly trained person.

### CAUTION

To prevent unwanted actuation or alarm, extinguishing devices must be disabled prior to performing system tests or maintenance.

### CAUTION

The multispectrum IR flame detectors are to be installed in places where the risk of mechanical damages is low.

### ATTENTION

Remove the protective cap from the front of the detector before activating the system.

### ATTENTION

Observe precautions for handling electrostatic sensitive devices.

## INSTALLATION

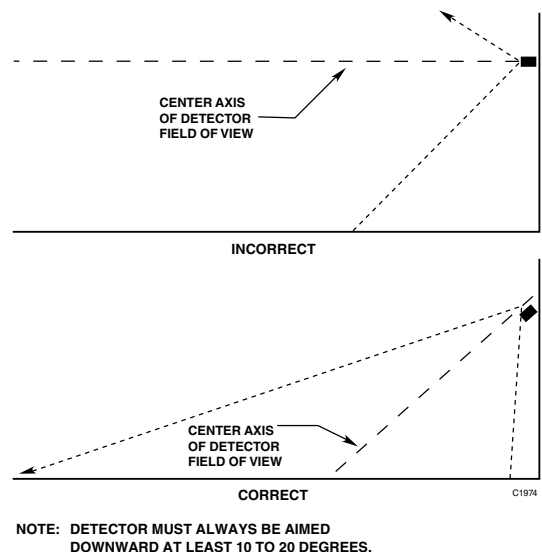
### NOTE

The recommended lubricant for threads and O-rings is a silicone free grease (part number 005003-001) available from Detector Electronics. Under no circumstances should a lubricant containing silicone be used.

## DETECTOR POSITIONING

Detectors should be positioned to provide the best unobstructed view of the area to be protected. The following factors should also be taken into consideration:

- Identify all high risk fire ignition sources.
- Be sure that enough detectors are used to adequately cover the hazardous area.
- Be sure that the unit is easily accessible for cleaning and other periodic servicing.
- Locate and position the detector so that the fire hazard(s) are within both the field of view and detection range of the device. Refer to Appendix A for specific information.
- The detector should be aimed downward at least 10 to 20 degrees to allow lens openings to drain. See Figure 1. **The detector should be positioned so that its field of view does not cover areas outside the hazardous area.** This will minimize the possibility of false alarms caused by activities outside the area requiring protection.
- For best performance, the detector should be mounted on a rigid surface in a low vibration area.
- Dense fog, rain or ice can absorb IR radiation and reduce the sensitivity of the detector.



- Although IR detectors are less affected by smoke than other detectors, the X3301 should not be placed where rising combustion products can obscure its vision. If smoke is expected before fire, smoke or other alternative detectors should be used in conjunction with the X3301. For indoor applications, if dense smoke is expected to accumulate at the onset of a fire, mount the detector on a side wall at least a few feet (approximately 1 meter) down from the ceiling.
- If possible, fire tests should be conducted to verify correct detector positioning and coverage.
- For ATEX installations, the X3301 detector housing must be electrically connected to earth ground.

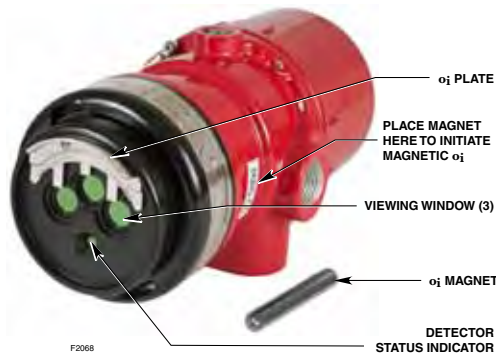


Figure 2—Front View of the X3301

## DETECTOR ORIENTATION

Refer to Figure 2 and ensure that the **oi** plate will be oriented as shown when the X3301 is mounted and sighted. This will ensure proper operation of the **oi** system and will also minimize the accumulation of moisture and contaminants between the **oi** plate and the viewing windows.

### IMPORTANT

*The **oi** plate must be securely tightened to ensure proper operation of the **oi** system (40 oz./inches recommended).*

## PROTECTION AGAINST MOISTURE DAMAGE

It is important to take proper precautions during installation to ensure that moisture will not come in contact with the electrical connections or components of the system. The integrity of the system regarding moisture protection must be maintained for proper operation and is the responsibility of the installer.

If conduit is used, we recommend installing drains, according to local codes, at water collection points to automatically drain accumulated moisture.

It is also recommended to install at least one breather, according to local codes, at upper locations to provide ventilation and allow water vapor to escape.

Conduit raceways should be inclined so that water will flow to low points for drainage and will not collect inside enclosures or on conduit seals. If this is not possible, install conduit drains above the seals to prevent the collection of water or install a drain loop below the detector with a conduit drain at the lowest point of the loop.

Conduit seals are not required for compliance with explosion-proof installation requirements, but are highly recommended to prevent water ingress in outdoor applications. Units with M25 thread must use an IP66 washer to prevent water ingress.

## WIRING PROCEDURE

### Wire Size and Type

The system should be wired according to local codes. The wire size selected should be based on the number of detectors connected, the supply voltage and the cable length. Typically 14 AWG (2.08 mm<sup>2</sup>) or 16 AWG (1.31 mm<sup>2</sup>) shielded cable is recommended. Wires should be stripped 3/8 inch (9 mm). A minimum input voltage of 18 Vdc must be present at the X3301.

### NOTE

*Refer to “Power Consumption” in the “Specifications” section of this manual.*

The use of shielded cable is required to protect against interference caused by EMI and RFI. When using cables with shields, terminate the shields as shown in Figures 7 through 12, and Figure 14. Consult the factory if not using shielded cable.

In applications where the wiring cable is installed in conduit, the conduit must not be used for wiring to other electrical equipment.

If disconnection of power is required, separate disconnect capability must be provided.

### CAUTION

*Installation of the detector and wiring should be performed only by qualified personnel.*

## Detector Mounting

Install the swivel mounting bracket assembly on the wall. The installation surface should be free of vibration and suitable to receive 1/4 inch (M6) screws with a length of at least 1 inch (25 mm), and have sufficient capacity to hold the detector and bracket weight. Refer to Figure 3 for dimensions.

## Relay and 0-20 mA Output Models

Follow the instructions below to install the X3301.

1. Make field connections following local ordinances and guidelines in this manual.
  - Figure 4 shows the wiring terminal strip located inside the detector's integral junction box.
  - Figure 5 shows the wiring terminal identification for the X3301 detector.
  - Figure 6 shows an EOL resistor installed within the integral wiring compartment of the detector (refer to "EOL Resistors" for details).
  - Figures 7 and 8 provide examples of typical installations with a X3301 wired to a fire alarm panel.
  - If the detector is equipped with a 0 to 20 mA output, refer to Figures 9 through 12.
2. Check all field wiring to be sure that the proper connections have been made.

### IMPORTANT

*Do not test any wiring connected to the detector with a meg-ohmmeter. Disconnect wiring at the detector before checking system wiring for continuity.*

3. Make the final sighting adjustments and ensure that the mounting bracket hardware is tight.

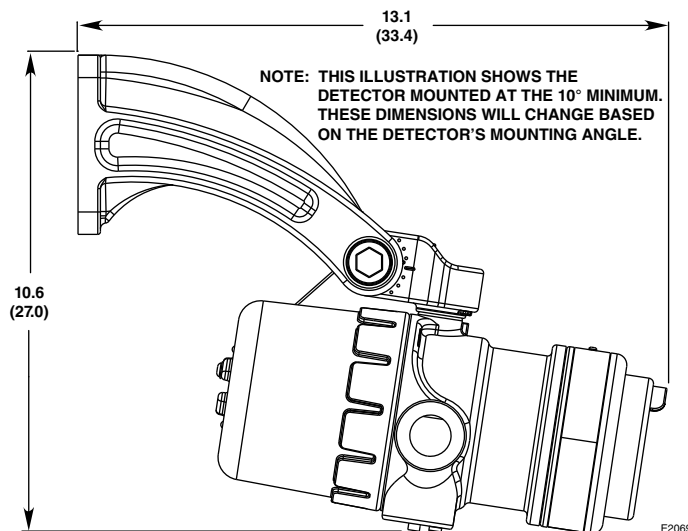
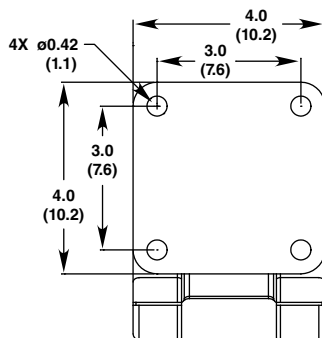


Figure 3—Q9033 Mounting Bracket Dimensions in Inches (cm)  
(See Figure 1 for Correct Detector Orientation.)

## EOL Resistors (Not Used with EQP Model)

To ensure that the insulating material of the wiring terminal block will not be affected by the heat generated by EOL resistors, observe the following guidelines when installing the resistors.

1. Required EOL resistor power rating must be 5 watts minimum.

### NOTE

*EOL resistors must be ceramic, wirewound type, rated 5 watts minimum, with actual power dissipation not to exceed 2.5 watts. This applies to ATEX/IEC installations only.*

2. Resistor leads should be cut to a length of approximately 1 1/2 inches (40 mm).
3. Bend the leads and install the EOL resistor as shown in Figure 6.
4. Maintain a 3/8 inch (10 mm) minimum gap between the resistor body and the terminal block or any other neighboring parts.

### NOTE

*The EOL resistor can only be used within the flameproof terminal compartment. Unused apertures shall be closed with suitable blanking elements.*



Figure 4—X3301 Terminal Block

9	4-20 mA +	19	4-20 mA -	SPARE	29
8	4-20 mA + REF	18	4-20 mA - REF	SPARE	28
7	COM FIRE	17	COM FIRE	COM AUX	27
6	N.O. FIRE	16	N.O. FIRE	N.O. AUX	26
5	N.C. FIRE	15	N.C. FIRE	N.C. AUX	25
4	COM FAULT	14	COM FAULT	RS-485 A	24
3	N.O. FAULT	13	N.O. FAULT	RS-485 B	23
2	24 VDC +	12	24 VDC +	MAN O <sub>i</sub>	22
1	24 VDC -	11	24 VDC -	24 VDC -	21

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Figure 5—X3301 Wiring Terminal Identification

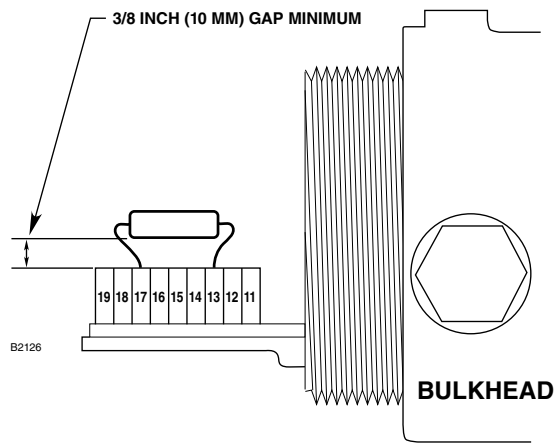


Figure 6—EOL Resistor Installation (For Ex d Wiring only)

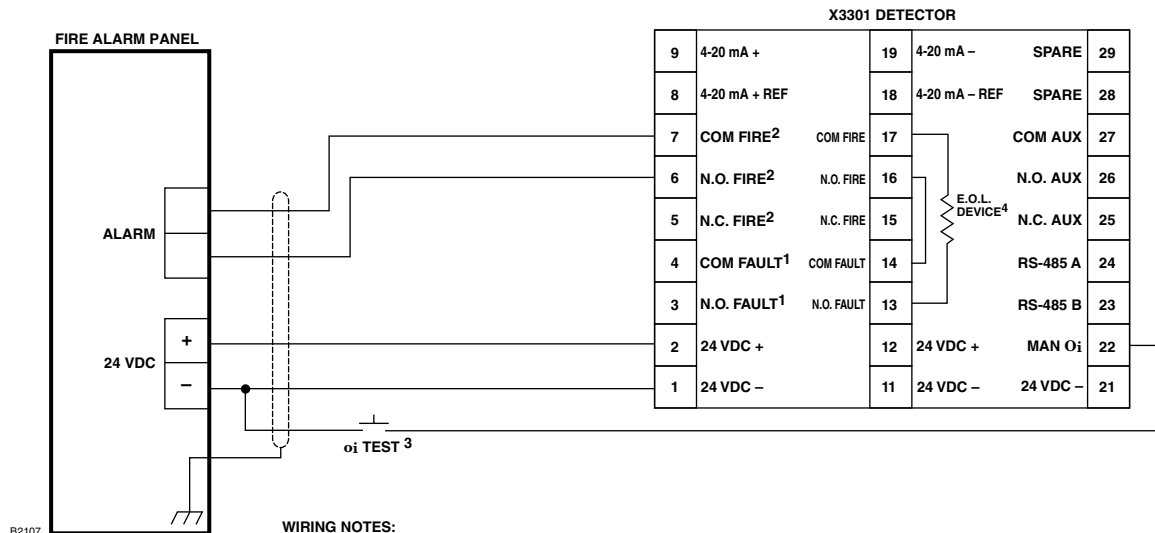


Figure 7—Ex d Wiring Option

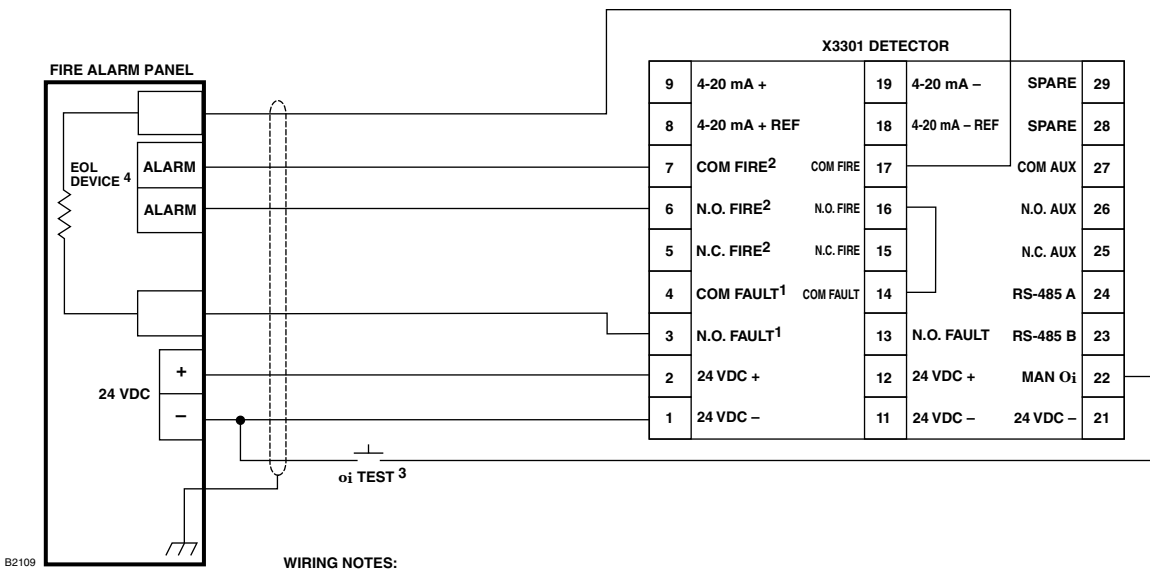


Figure 8—Ex d e Wiring Option

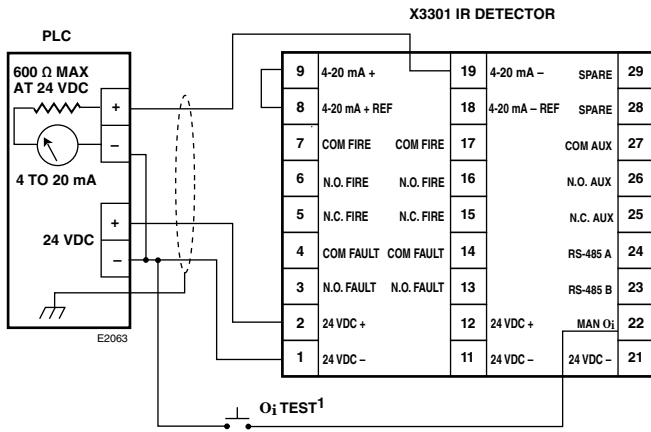


Figure 9—X3301 Detector Wired for Non-Isolated 0 to 20 mA Current Output (Sourcing)

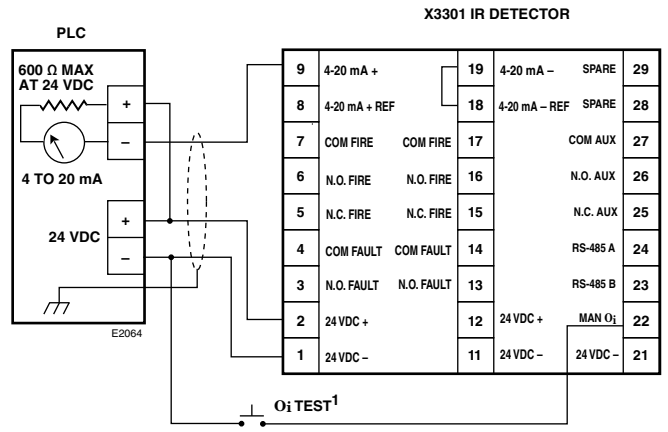


Figure 10—X3301 Detector Wired for Non-Isolated 0 to 20 mA Current Output (Sinking)

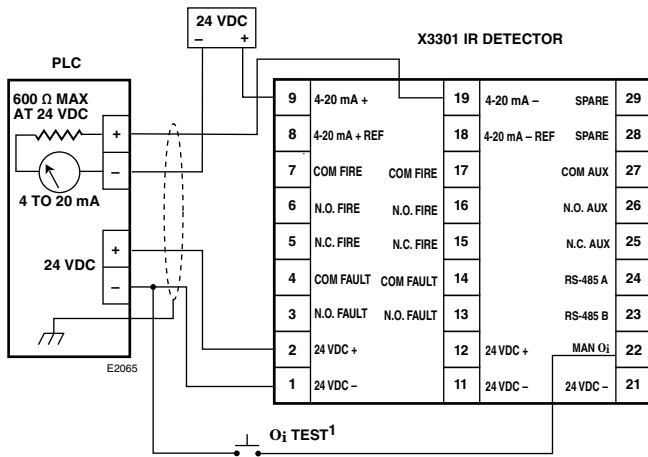


Figure 11—X3301 Detector Wired for Isolated 0 to 20 mA Current Output (Sourcing)

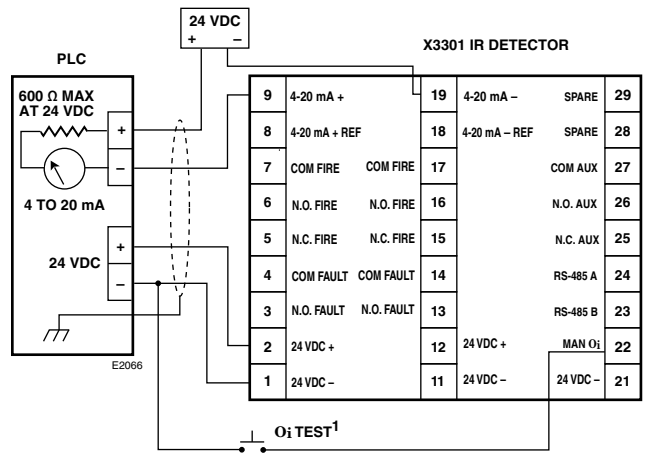


Figure 12—X3301 Detector Wired for Isolated 0 to 20 mA Current Output (Sinking)

**NOTES: 1. INDIVIDUAL MANUAL  $O_i$  TEST SWITCHES CAN BE INSTALLED REMOTELY OR A DETECTOR SELECTOR AND ACTIVATION SWITCH CAN BE INSTALLED AT THE FIRE PANEL. TEST SWITCHES ARE NOT SUPPLIED.**

**EQP Model**

1. Connect external wires to the appropriate terminals inside the device junction box. (See Figure 13 for terminal identification.)
2. Connect the shield of the power cable to “earth ground” at the power source.
3. Connect shields for the LON cable as indicated. See Figure 14.

**NOTE**

*DO NOT ground any shields at the detector housing.*

4. Set the device network address. (See “Setting Device Network Addresses” section of this manual for switch setting procedure.)

5. Check all field wiring to be sure that the proper connections have been made.
6. Replace the device cover.
7. Make the final sighting adjustments and ensure that the mounting bracket hardware is tight.

**NOTE**

*Refer to the Eagle Quantum Premier system manual 95-8533 for information regarding power and network communication cable requirements.*

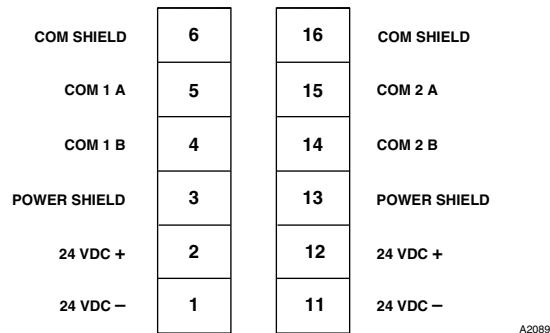


Figure 13—Wiring Terminal Identification for X3301 EQP Model

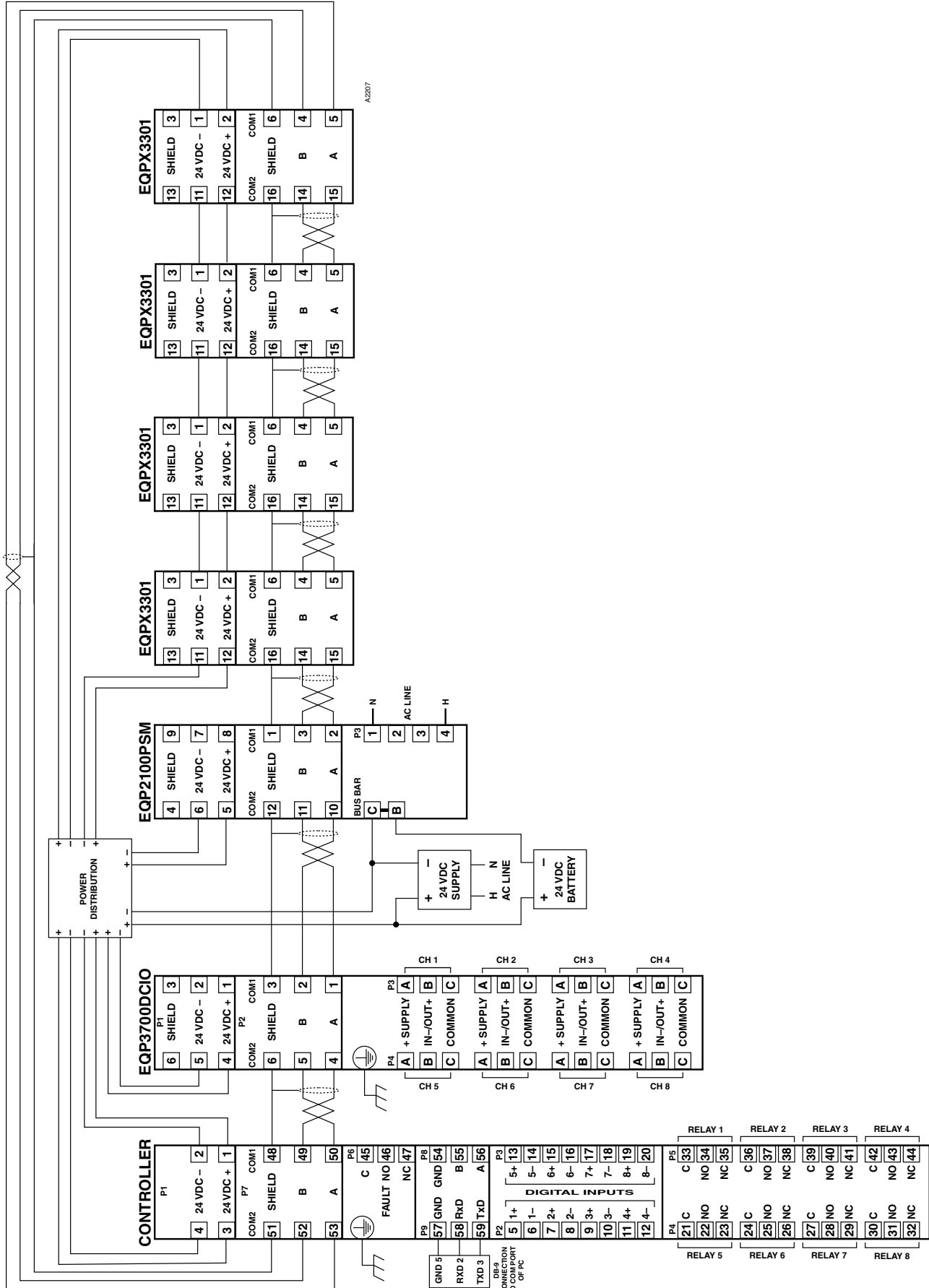


Figure 14—A Typical EQP System



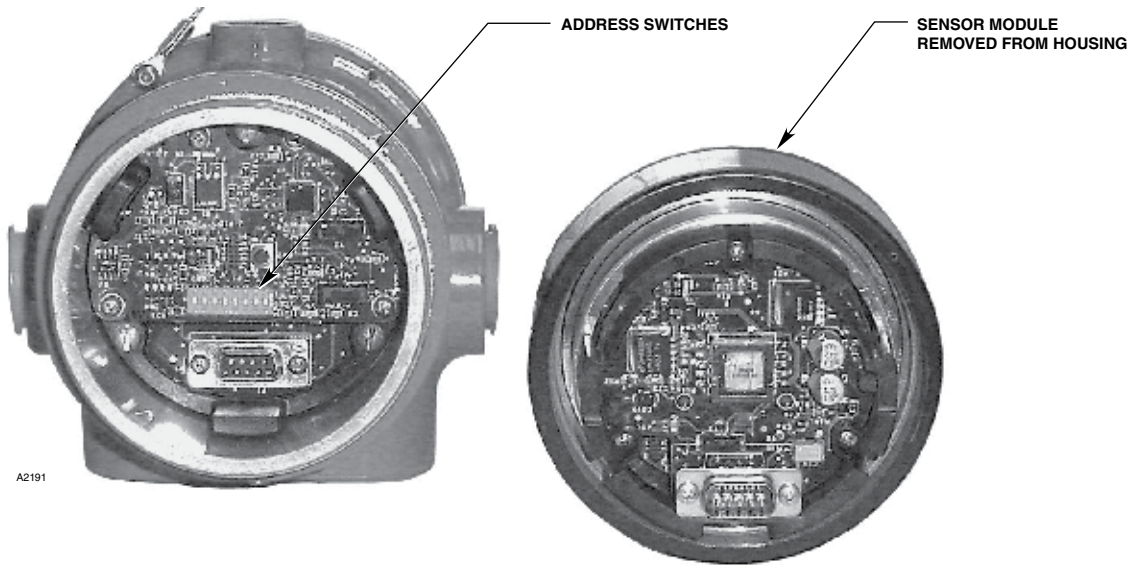


Figure 15—Location of Address Switches

## SETTING DEVICE NETWORK ADDRESSES (EQP Model Only)

### Overview of Network Addresses

Each device on the LON must be assigned a unique address. Addresses 1 to 4 are reserved for the controller. Valid addresses for field devices are from 5 to 250.

#### IMPORTANT

*If the address is set to zero or an address above 250, the switch setting will be ignored.*

Duplicated addresses are not automatically detected. Modules given the same address will use the number given and report to the controller using that address. The status word will show the latest update, which could be from any of the reporting modules using that address.

### Setting Field Device Addresses

Selection of the node address is done by setting rocker switches on an 8 switch “DIP Switch Assembly” within the detector’s housing. Refer to Figure 15 for switch location.

#### WARNING

*The network address switches are located within the detector housing. Disassembly of the detector head that contains powered electrical circuits is required to gain access to the network address switches. For hazardous areas, the area must be de-classified before attempting disassembly of the device. Always observe precautions for handling electrostatic sensitive devices.*

The address number is binary encoded with each switch having a specific binary value with switch 1 being the LSB (Least Significant Bit). (See Figure 16) The device’s LON address is equal to the added value of all closed rocker switches. All “Open” switches are ignored.

**Example:** for node No. 5, close rocker switches 1 and 3 (binary values 1 + 4); for node No. 25, close rocker switches 1, 4 and 5 (binary values 1 + 8 + 16).

#### NOTE

*The field device sets the LON address only when power is applied to the device. Therefore, it is important to set the switches **before** applying power. If an address is ever changed, system power must be cycled before the new address will take effect.*

After setting address switches, record the address number and device type.

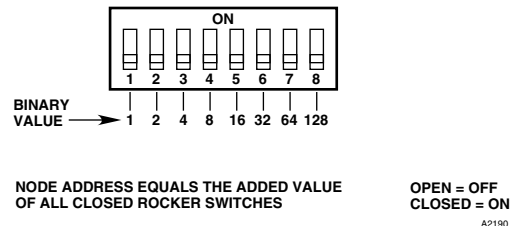


Figure 16—Address Switches for X3301

## STARTUP PROCEDURE

When installation of the equipment is complete, perform the “Fire Alarm Test” below.

### FIRE ALARM TEST

1. Disable any extinguishing equipment that is connected to the system.
2. Apply input power to the system.
3. Initiate an **oi** test. (See “Magnetic **oi** / Manual **oi**” under Optical Integrity in the Description section of this manual.)
4. Repeat this test for all detectors in the system. If a unit fails the test, refer to the “Troubleshooting” section.
5. Verify that all detectors in the system are properly aimed at the area to be protected. (The Det-Tronics Q1201C Laser Aimer is recommended for this purpose.)
6. Enable extinguishing equipment when the test is complete.

## TROUBLESHOOTING

### WARNING

*The sensor module (“front” half of the detector) contains no user serviceable components and should never be opened. The terminal compartment is the only part of the enclosure that should be opened by the user in the field.*

1. Disable any extinguishing equipment that is connected to the unit.
2. Inspect the viewing windows for contamination and clean as necessary. The detector is relatively insensitive to airborne contaminants, however, thick deposits of ice, dirt, or oil will reduce sensitivity. (Refer to the “Maintenance” section for complete information regarding cleaning of the detector viewing windows.)

Table 3—Current Level Output Troubleshooting Guide

Current Level (±0.3 mA)	Status	Action
0 mA	Power Fault	Check system wiring.
1 mA	General Fault	Cycle power. <sup>1</sup>
2 mA	<b>oi</b> Fault	Clean windows. <sup>2</sup>
3 mA	Hi Background IR	Remove IR source or aim detector away from IR source.
4 mA	Normal Operation	
20 mA	Fire Alarm	

<sup>1</sup>If fault continues, return device to factory for repair.

<sup>2</sup>See “Maintenance” section for cleaning procedure.

3. Check input power to the unit.
4. If the fire system has a logging function, check the fire panel log for output status information. See Table 3 for information regarding 0 to 20 mA output.
5. Turn off the input power to the detector and check all wiring for continuity. **Important: Disconnect wiring at the detector before checking system wiring for continuity.**
6. If all wiring checks out and cleaning of the **oi** plate/window did not correct the fault condition, check for high levels of background IR radiation by covering the detector with the factory supplied cover or aluminum foil. If the fault condition clears within 6 minutes or less, extreme background IR is present. Re-adjust the view of the detector away from the IR source or relocate the detector.

If none of these actions corrects the problem, return the detector to the factory for repair.

### NOTE

*It is highly recommended that a complete spare be kept on hand for field replacement to ensure continuous protection.*

## MAINTENANCE

### IMPORTANT

Periodic flamepath inspections are not recommended, since the product is not intended to be serviced and provides proper ingress protection to eliminate potential deterioration of the flamepaths.

### WARNING

The sensor module (“front” half of the detector) contains no user serviceable components and should never be opened. The terminal compartment is the only part of the enclosure that should be opened by the user in the field.

### NOTE

Refer to the X3301 Safety Manual 95-8582 for specific requirements and recommendations applicable to the proper installation, operation, and maintenance of all SIL-Certified X3301 flame detectors.

To maintain maximum sensitivity and false alarm resistance, the viewing windows of the X3301 must be kept relatively clean. Refer to the following procedure for cleaning instructions.

## CLEANING PROCEDURE

### CAUTION

Disable any extinguishing equipment that is connected to the unit to prevent unwanted actuation.

To clean the windows and **oi** plate, use Det-Tronics window cleaner (part number 001680-001) and a soft cloth, cotton swab or tissue and refer to the following procedure:

1. **Disable any extinguishing equipment that is connected to the unit.**
2. Since the X3301 is less affected by contamination than other detectors, removal of the **oi** plate is needed only under extreme conditions. In addition, it is not necessary to achieve perfect cleanliness, because IR is not significantly absorbed by slight films of oil and/or salt. If a fault condition is still indicated after cleaning, remove and clean the **oi** plate using the **oi** Plate Removal and Replacement procedure.
3. In all environments, clean all three viewing windows and reflector surfaces thoroughly. Use a cotton swab and Det-Tronics window cleaning solution. Use Isopropyl alcohol for contaminations that the Det-Tronics window cleaning solution can not remove.

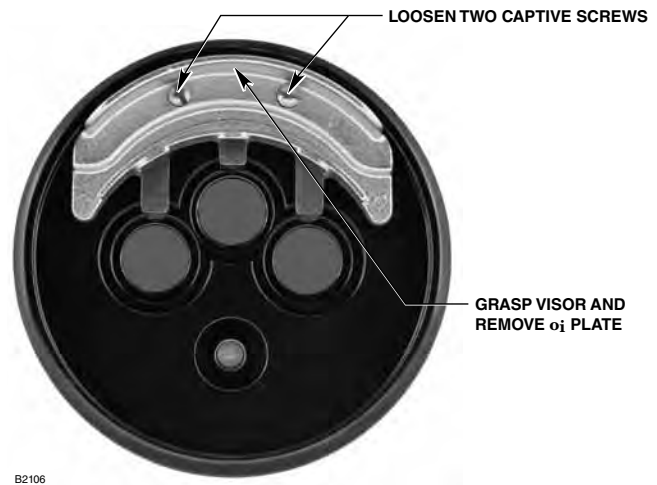


Figure 17—**oi** Plate Removal

### IMPORTANT

When used in extreme environments, the reflective surface of the detector **oi** plate may eventually deteriorate, resulting in reoccurring **oi** faults and the need for **oi** plate replacement.

## **oi** PLATE REMOVAL AND REPLACEMENT

1. **Disable any extinguishing equipment that is connected to the unit.**
2. Loosen the two captive screws, then grasp the **oi** plate by the visor and remove it from the detector. See Figure 17.
3. Install the new (or cleaned) **oi** plate.

### NOTE

When installing the stainless steel plate, ensure that the gasket is present and correctly seated to prevent moisture or contaminants from penetrating behind the plate. To ensure even seating, tighten both screws equally.

4. Re-calibrate the detector's **oi** system. Refer to the Inspector Monitor manual, 95-8581, for instructions regarding **oi** plate replacement and **oi** system recalibration.

### CAUTION

**Do not replace the **oi** reflector plate without also recalibrating the **oi** system.**

Recalibration of the **oi** system requires the use of the Inspector Connector Cable and Inspector Monitor Software. These two items are included in the **oi** replacement kit, or they can be purchased separately. See Ordering Information for details.

Refer to the Inspector Monitor manual, 95-8581, for instructions regarding **oi** plate replacement and **oi** system recalibration.

### **X3301 Reflector Plates**

X3301 models are supplied with either a black or a stainless steel reflector plate. These plates are **not** interchangeable. Order the replacement that matches the reflector plate on your X3301 detector.

### **PERIODIC CHECKOUT PROCEDURE**

A checkout of the system using the manual or magnetic **oi** feature should be performed on a regularly scheduled basis to ensure that the system is operating properly. To test the system, perform the “Fire Alarm Test” as described in the “Startup Procedure” section of this manual.

### **CLOCK BATTERY**

**(Not used with EQP Model)**

The real time clock has a backup battery that will operate the clock with no external power for nominally 10 years. It is recommended that the battery be replaced every 7 years. Return the device to the factory for battery replacement.

#### **NOTE**

*If the backup battery is depleted, there is no effect on the operation of the flame detector, but the time stamping of the data log may be affected.*

## **FEATURES**

- Long detection range to carbonaceous fires.
- Unequaled false alarm rejection.
- Responds to a fire in the presence of modulated blackbody radiation (i.e. heaters, ovens, turbines) without false alarm.
- Microprocessor controlled heated optics for increased resistance to moisture and ice.
- Automatic, manual or magnetic optical integrity (**oi**) testing.
- Easily replaceable **oi** plate.
- Fire, fault and auxiliary relays standard.
- 0 to 20 mA isolated output (optional).
- Eagle Quantum Premier LON/SLC output (optional).
- A tricolor LED on the detector faceplate indicates normal condition and notifies personnel of fire alarm or fault conditions.
- Operates under adverse weather conditions and in dirty environments.
- Mounting swivel allows easy sighting.
- Integral wiring compartment for ease of installation.
- Explosion-proof/flame-proof detector housing. Meets FM, CSA, ATEX Directive and CE certification requirements.
- Class A wiring per NFPA-72.
- Meets NFPA-33 response requirement for under 0.5 second (available when model selected).
- 5 year warranty.
- RFI and EMC Directive compliant.

## **ASSOCIATED MANUALS**

List of X3301 related manuals:

<b>TITLE</b>	<b>FORM NUMBER</b>
Pulse	95-8528
EQP	95-8533
SIL 2 (Safety)	95-8582
HART Addendum	95-8577
Automotive Addendum	95-8534
Hangar	95-8548

## SPECIFICATIONS

### OPERATING VOLTAGE—

24 Vdc nominal (18 Vdc minimum, 30 Vdc maximum).  
Maximum ripple is 2 volts peak-to-peak.

### POWER CONSUMPTION—

Without heater: 4 watts at 24 Vdc nominal;  
5.2 watts at 24 Vdc in alarm.  
4.5 watts at 30 Vdc nominal;  
6.5 watts at 30 Vdc in alarm.

Heater only: 8 watts maximum.

Total power: 17 watts at 30 Vdc with EOL resistor installed  
and heater on maximum.

EOL resistor must be ceramic, wirewound type, rated  
5 watts minimum, with actual power dissipation not to  
exceed 2.5 watts.

For HART model, refer to Addendum number 95-8577.

### POWER UP TIME—

Fault indication clears after 0.5 second; device is ready  
to indicate an alarm condition after 30 seconds.

### OUTPUT RELAYS—

Fire Alarm relay, Form C, 5 amperes at 30 Vdc:

The Fire Alarm relay has redundant terminals and  
normally open / normally closed contacts, normally  
de-energized operation, and latching or non-  
latching operation.

Fault relay, Form A, 5 amperes at 30 Vdc:

The Fault relay has redundant terminals and normally  
open contacts, normally energized operation, and  
latching or non-latching operation.

Auxiliary relay, Form C, 5 amperes at 30 Vdc:

The auxiliary relay has normally open/normally  
closed contacts, normally energized or de-energized  
operation, and latching or non-latching operation.

### CURRENT OUTPUT (OPTIONAL)—

0 to 20 milliampere ( $\pm 0.3$  mA) dc current, with a maximum  
loop resistance of 500 ohms from 18 to 19.9 Vdc and 600  
ohms from 20 to 30 Vdc.

### LON OUTPUT—

Digital communication, transformer isolated (78.5 kbps).

### TEMPERATURE RANGE—

Operating:  $-40^{\circ}\text{F}$  to  $+167^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$ ).

Storage:  $-67^{\circ}\text{F}$  to  $+185^{\circ}\text{F}$  ( $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ).

Hazardous location ratings from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

### HUMIDITY RANGE—

0 to 95% relative humidity, can withstand 100%  
condensing humidity for short periods of time.

### CONE OF VISION—

The detector has a  $90^{\circ}$  cone of vision (horizontal) with  
the highest sensitivity lying along the central axis.  
Unlike conventional detectors, the X3301 provides full  
coverage at a minimum of 70% of the maximum detection  
distance.

Perfect cone of vision for methane fire detection — 100  
feet on and off axis on “very high” setting.

Refer to Appendix A for FM Approved cone of vision  
data.

### RESPONSE TIME—

Typical response times are under 10 seconds. Models  
are available that can respond to automotive paint  
gun fires in under 0.5 seconds. See Appendix A and  
“Automotive Addendum” (95-8534) for actual response  
times.

### DIMENSIONS—

See Figure 18.

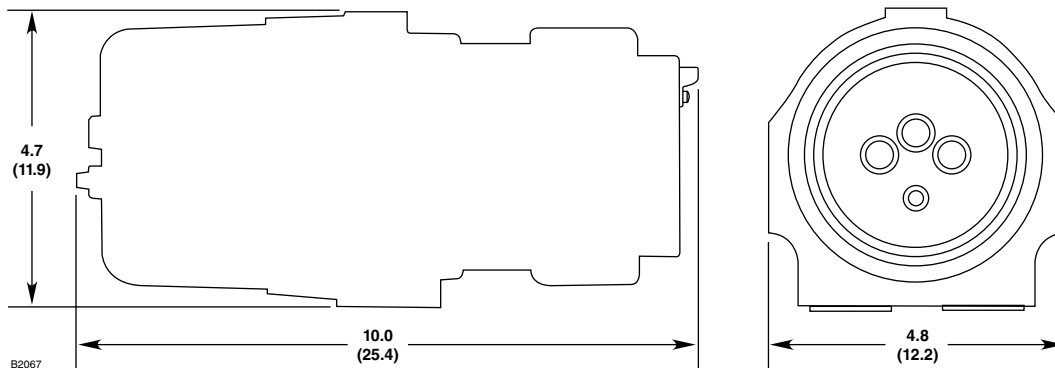


Figure 18—X3301 Dimensions in Inches (cm)

#### ENCLOSURE MATERIAL—

Copper-free aluminum (painted) or 316 stainless steel.

#### VIBRATION—

Conformance per FM 3260: 2000, MIL-STD 810C (Curve AW), DNV Note 2.4 (Class B).

#### WIRING—

Field wiring screw terminals are UL/CSA rated for up to 14 AWG wire, and are DIN/VDE rated for 2.5 mm<sup>2</sup> wire. Screw terminal required torque range is 3.5–4.4 in.-lbs. (0.4-0.5 N·m).

14 AWG (2.08 mm<sup>2</sup>) or 16 AWG (1.31 mm<sup>2</sup>) shielded cable is recommended.

**Important:** 18 Vdc minimum must be available at the detector. For ambient temperatures below –10°C and above +60°C use field wiring suitable for both minimum and maximum ambient temperature.

#### THREAD SIZE—

Conduit connection: Four entries, 3/4 inch NPT or M25.  
Conduit seal not required.

#### SHIPPING WEIGHT (Approximate)—

Aluminum: 6 pounds (2.75 kilograms).

Stainless Steel: 10 pounds (4.5 kilograms).

Swivel Mount (AL): 6 pounds (2.75 kilograms).

Swivel Mount (SS): 14 pounds (6.4 kilograms).

#### WARRANTY PERIOD—

**5 years.**

#### CERTIFICATION—



For complete approval details, refer to the appropriate Appendix:

Appendix A - FM

Appendix B - CSA

Appendix C - ATEX/CE

Appendix D - IECEx

Appendix E - VdS

Appendix F - Offshore

Appendix G - Additional approvals.

## REPLACEMENT PARTS

The detector is not designed to be repaired in the field. If a problem should develop, refer to the Troubleshooting section. If it is determined that the problem is caused by an electronic defect, the device must be returned to the factory for repair.

## DEVICE REPAIR AND RETURN

Prior to returning devices, contact the nearest local Detector Electronics office so that a Return Material Identification (RMI) number can be assigned. **A written statement describing the malfunction must accompany the returned device or component to assist and expedite finding the root cause of the failure.**

Pack the unit properly. Always use sufficient packing material. Where applicable, use an antistatic bag as protection from electrostatic discharge.

### NOTE

*Det-Tronics reserves the right to apply a service charge for repairing returned product damaged as a result of improper packaging.*

Return all equipment transportation prepaid to the factory in Minneapolis.

### NOTE

*It is highly recommended that a complete spare be kept on hand for field replacement to ensure continuous protection.*

## ORDERING INFORMATION

When ordering, please specify:

X3301 IR Flame Detector

Refer to the X3301 Model Matrix for details

Q9033 mount is required:

Q9033A for aluminum detectors only.

Q9033B for aluminum and stainless steel detectors.

## X-SERIES FLAME DETECTOR ACCESSORIES

Part Number	Description
000511-029	Converter RS485 to RS232
103881-001	Converter RS485 to USB
007819-001	W6300B1002 Serial Inspector Connector (Inspector Monitor software included)
007819-002	W6300B1003 USB Inspector Connector (Inspector Monitor software included)
009207-001	Flame Inspector Monitor CD
103922-001	Model 475 HART Communicator
102740-002	Magnet
008082-001	Magnet and Adapter for Extension Pole
007739-001	Magnet and Extension Pole
009208-001	o <sub>i</sub> Replacement kit for X3301 (5 Black reflector plates) with Inspector Connector and Monitor
010831-001	o <sub>i</sub> Replacement kit for X3301 (5 Stainless Steel reflector plates) with Inspector Connector and Monitor
009208-003	o <sub>i</sub> Replacement kit for X3302 (5 Black reflector plates) with Inspector Connector and Monitor
010831-002	o <sub>i</sub> Replacement kit for X3302 (5 Stainless Steel reflector plates) with Inspector Connector and Monitor
009208-002	o <sub>i</sub> Replacement kit for X52/X22/X98 (5 reflector plates) with Inspector Connector and Monitor
007307-001	Replacement o <sub>i</sub> reflector plate for X3301 with Black plate (requires inspector connector to calibrate)
010830-001	Replacement o <sub>i</sub> reflector plate for X3301 with Stainless Steel plate (requires inspector connector to calibrate)
007307-003	Replacement o <sub>i</sub> reflector plate for X3302 with Black plate (requires inspector connector to calibrate)
010830-002	Replacement o <sub>i</sub> reflector plate for X3302 with Stainless Steel plate (requires inspector connector to calibrate)
007307-002	Replacement o <sub>i</sub> reflector plate for X52/X22/X98 (requires inspector connector to calibrate)
007240-001	Q1116A1001, Air Shield (AL)
007818-001	Q1118A1001 Aluminum Air Shield/Flange Mount (AL)
007818-002	Q1118S1001 Stainless Steel Air Shield/Flange Mount (SS)
009177-001	Q1120A1001 Paint shield mounting ring (AL)
010857-001	Q1130A1001 Flange Mount Assembly for X3301 & X3302
009199-001	Q1198A1001 Dual Air Shield/Flange Mount (X9800 only)/(AL)
006097-001	Q1201 Laser
102871-001	Laser Battery, 3V Lithium (laser)
007255-001	Q1201C1001 X-Series Laser Holder (AL/Plastic)
007338-001	Q2000A1001 X-Series Weather Shield (AL)
007338-010	Q2033A10R X3301/X3302 FOV Limiter 10° (AL)
007338-020	Q2033A20R X3301/X3302 FOV Limiter 20° (AL)
007338-030	Q2033A30R X3301/X3302 FOV Limiter 30° (AL)
007912-010	Spare Restrictor Plate 10° (AL)
007912-020	Spare Restrictor Plate 20° (AL)
007912-030	Spare Restrictor Plate 30° (AL)
007290-001	Q9033B Stainless Steel Swivel Mount Assembly is for aluminum and stainless steel detectors
007290-002	Q9033A Aluminum Swivel Mount Assembly is for aluminum detectors only
011385-001	Q9033 Collar Attachment
101197-001	Stop Plug, 3/4 NPT, AL
101197-004	Stop Plug, 3/4 NPT, SS
103517-001	Stop Plug, AL, IP66, Ex d e, M25
101197-003	Stop Plug, SS, IP66, Ex d e, M25
010816-001	Stop Plug, 20PK, 3/4NPT, AL
010817-001	Stop Plug, 20PK, 3/4NPT, SS
010818-001	Stop Plug, 20PK, M25, AL
010819-001	Stop Plug, 20PK, M25, SS
103363-001	14 mm Hex Wrench (Steel)
103406-001	Screwdriver
107427-040	O-ring - Rear Cover (Viton)
005003-001	1 oz grease for detectors (non-silicon)
001680-001	Window cleaner (6 pack)

**X3301 MODEL MATRIX**

MODEL	DESCRIPTION	
<b>X3301</b>	Multispectrum IR Flame Detector	
	TYPE	MATERIAL
	<b>A</b>	Aluminum
	<b>S</b>	Stainless Steel (316)
	TYPE	THREAD TYPE
	<b>4M</b>	4 PORT, METRIC M25
	<b>4N</b>	4 PORT, 3/4" NPT
	TYPE	OUTPUTS
	<b>11</b>	Relay
	<b>13</b>	Relay and 4-20 mA
	<b>14</b>	Eagle Quantum Premier (EQP)
	<b>15</b>	Relay and Pulse
	<b>16</b>	Addressable Module Only (Third Party Type)*
	<b>21</b>	Relay-Automotive
<b>22</b>	EQP Automotive	
<b>23</b>	HART, Relay and 4-20 mA	
TYPE	APPROVALS	
<b>A</b>	FM/CSA	
<b>T</b>	SIL/FM/CSA/ATEX/CE/IECEX	
<b>W</b>	FM/CSA/ULC**/ATEX/CE/IECEX	
TYPE	CLASSIFICATION	
<b>1</b>	Division/Zone Ex d e	
<b>2</b>	Division/Zone Ex d	

\*The Addressable Module Only (Type 16) is not FM approved.

\*\*ULC approval applies to output types 11, 13, 15, 21, and 23.



# APPENDIX A

## FM APPROVAL AND PERFORMANCE REPORT

THE FOLLOWING ITEMS, FUNCTIONS AND OPTIONS DESCRIBE THE FM APPROVAL:

- Explosion-proof for Class I, Div. 1, Groups B, C and D (T4A) Hazardous (Classified) Locations per FM 3615.
- Dust-ignition proof for Class II/III, Div. 1, Groups E, F and G (T4A) Hazardous (Classified) Locations per FM 3615.
- Nonincendive for Class I, Div. 2, Groups A, B, C and D (T3C) Hazardous (Classified) Locations per FM 3611.
- Nonincendive for Class II, Div. 2, Groups F and G (T3C) Hazardous (Classified) Locations per FM 3611.
- Enclosure rating NEMA/Type 4X per NEMA 250.
- Ambient Temperature Limits:  $-40^{\circ}\text{F}$  to  $+167^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$ ).
- Automatic Fire Alarm Signaling Performance verified per FM 3260 (2000).

The following performance criteria were verified:

### **AUTOMATIC OPTICAL INTEGRITY TEST:**

The detector generated an optical fault in the presence of contamination on any single or combination of lens surfaces resulting in a loss of approximately 50% of its detection range, verifying that the detector performs a calibrated Automatic Optical Integrity (**oi**) test for each sensor. Upon removal of the contamination, the detector fault was cleared and the detector was verified to detect a fire.

### **MANUAL OPTICAL INTEGRITY TEST:**

The Manual / Magnetic **oi** performs the same calibrated test as the Automatic **oi**, and additionally actuates the alarm relay to verify output operation. If there is a 50% loss of its detection range, an alarm signal is not generated.

The Optical Integrity test procedure, as described in the "Magnetic **oi** / Manual **oi**" section of this instruction manual, is the approved external optical test method for this detector to verify end-to-end detector function. This test replaces the function and need of a traditional external test lamp.

**FM Approval and Performance Report – Continued**

**RESPONSE CHARACTERISTICS**

**Very High Sensitivity**

<b>Fuel</b>	<b>Size</b>	<b>Distance feet (m)</b>	<b>Average Response Time (seconds)***</b>
n-Heptane	1 x 1 foot	210 (64)*	11
n-Heptane**	1 x 1 foot	210 (64)*	6
n-Heptane	1 x 1 foot	100 (30.5)	3
n-Heptane	6 in. x 6 in.	80 (24.4)	3
Isopropanol	6 in. x 6 in.	70 (21.3)	4
Diesel**	1 x 1 foot	150 (45.7)*	14
Ethanol	1 x 1 foot	210 (64)	11
Methanol	6 in. x 6 in.	40 (12.2)	3
Methanol	1 x 1 foot	150 (45.7)*	18
Methanol**	1 x 1 foot	150 (45.7)*	7
Methane	30 inch plume	100 (30.5)	3
JP-5**	1 x 1 foot	150 (45.7)*	2
JP-5**	2 x 2 feet	210 (64)*	4
JP-5**	2 x 2 feet	100 (30.5)	2
Office Paper 0.5 lb.	19" x 19" x 8"	100 (30.5)	4
Corrugated Panel	18" x 36"	100 (30.5)	8

\* Outdoor test condition.

\*\* Pre-burn from ignition.

\*\*\* Add 2 seconds for EQP Model.

**Medium Sensitivity**

<b>Fuel</b>	<b>Size</b>	<b>Distance feet (m)</b>	<b>Average Response Time (seconds)***</b>
n-Heptane	1 x 1 foot	100 (30.5)	12
n-Heptane	1 x 1 foot	50 (15.2)	2
Diesel**	1 x 1 foot	70 (21.3)	4
Ethanol	1 x 1 foot	85 (25.9)	13
Methanol	1 x 1 foot	70 (21.3)	10
Methane	30 inch plume	65 (19.8)	3
Methane	30 inch plume	55 (16.8)	2
JP-5**	2 x 2 feet	100 (30.5)	3
Office Paper 0.5 lb.	19" x 19" x 8"	50 (15.2)	6
Corrugated Panel	18" x 36"	50 (15.2)	2

\*\* Pre-burn from ignition.

\*\*\* Add 2 seconds for EQP Model.

**Low Sensitivity**

<b>Fuel</b>	<b>Size</b>	<b>Distance feet (m)</b>	<b>Average Response Time (seconds)***</b>
n-Heptane	1 x 1 foot	50 (15.2)	10
Methanol	1 x 1 foot	20 (6.1)	10
Methane	32 inch plume	15 (4.6)	9

\*\*\* Add 2 seconds for EQP Model.

**FM Approval and Performance Report – Continued**

**RESPONSE CHARACTERISTICS IN THE PRESENCE OF FALSE ALARM SOURCES**

**Very High Sensitivity**

<b>False Alarm Source</b>	<b>Distance feet (m)</b>	<b>Fire Source</b>	<b>Distance feet (m)</b>	<b>Average Response Time (seconds)***</b>
Sunlight, direct, modulated, reflected	—	6-inch propane	6 (1.8)	< 10
Vibration	N/A	3-inch propane	10.5 (3.2)	< 10
Radio frequency interference	1 (0.3)	3-inch propane	12 (3.7)	< 10
Arc welding, #7014	40 (12.2)	1 x 1 foot n-Heptane	40 (12.2)	4
6 kw heater, modulated	80 (24.4)	1 x 1 foot n-Heptane	80 (24.4)	2
6 kw heater, unmodulated	10 (3)	1 x 1 foot n-Heptane	80 (24.4)	3
250 w vapor lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	80 (24.4)	2
300 w incandescent lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	80 (24.4)	7
500 w shielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	80 (24.4)	2
500 w unshielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	80 (24.4)	3
1500 w electric radiant heater, modulated	10 (3)	1 x 1 foot n-Heptane	80 (24.4)	5
Two 34 w fluorescent lamps, modulated	3 (0.9)	1 x 1 foot n-Heptane	80 (24.4)	3

\*\*\* Add 2 seconds for EQP Model.

**Medium Sensitivity**

<b>False Alarm Source</b>	<b>Distance feet (m)</b>	<b>Fire Source</b>	<b>Distance feet (m)</b>	<b>Average Response Time (seconds)***</b>
Sunlight, direct, modulated, reflected	—	6-inch propane	6 (1.8)	< 4
Vibration*	N/A	N/A	N/A	N/A
Radio frequency interference	1 (0.3)	6-inch propane	6 (1.8)	< 1
Arc welding, #7014	10 (3)	1 x 1 foot n-Heptane	40 (12.2)	4
6 kw heater, modulated	60 (18.3)	1 x 1 foot n-Heptane	60 (18.3)	2
6 kw heater, unmodulated	10 (3)	1 x 1 foot n-Heptane	60 (18.3)	2
250 w vapor lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	60 (18.3)	1
300 w incandescent lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	60 (18.3)	1
500 w shielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	60 (18.3)	1
500 w unshielded quartz halogen lamp, modulated	8 (2.4)	1 x 1 foot n-Heptane	60 (18.3)	1
1500 w electric radiant heater, modulated	10 (3)	1 x 1 foot n-Heptane	60 (18.3)	6
Two 34 w fluorescent lamps, modulated	3 (0.9)	1 x 1 foot n-Heptane	60 (18.3)	2

\* Fire was verified with very high sensitivity only.

\*\*\* Add 2 seconds for EQP Model.

**FM Approval and Performance Report – Continued**

**Low Sensitivity**

<b>False Alarm Source</b>	<b>Distance feet (m)</b>	<b>Fire Source</b>	<b>Distance feet (m)</b>	<b>Average Response Time (seconds)***</b>
Sunlight, direct, unmodulated, reflected*	—	1 x 1 foot n-Heptane	35 (10.7)	< 13
Sunlight, direct, modulated, reflected*	—	1 x 1 foot n-Heptane	15 (4.6)	< 14
Arc welding, steady, #7014	5 (1.5)	1 x 1 foot n-Heptane	50 (15.2)	11
Arc welding, modulated, #7014	5 (1.5)	1 x 1 foot n-Heptane	30 (9.1)	10
70 w sodium vapor, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	16
250 w vapor lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	18
300 w incandescent lamp, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	18
500 w shielded quartz halogen lamp, unmodulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	12
500 w shielded quartz halogen lamp, modulated	10 (3)	1 x 1 foot n-Heptane	50 (15.2)	11
1500 w electric radiant heater, unmodulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	12
1500 w electric radiant heater, modulated	10 (3)	1 x 1 foot n-Heptane	30 (9.1)	11
Two 34 w fluorescent lamps, modulated	3 (0.9)	1 x 1 foot n-Heptane	50 (15.2)	14

\* Outdoor test conditions.

\*\*\* Add 2 seconds for EQP Model.

## FM Approval and Performance Report – Continued

### FALSE ALARM IMMUNITY

#### Very High Sensitivity

False Alarm Source	Distance feet (m)	Modulated Response	Unmodulated Response
Sunlight, direct, reflected	—	No alarm	No alarm
Vibration	N/A	No alarm	N/A
Radio frequency interference	1 (0.3)	No alarm (keyed)	No alarm (steady)
Arc welding	40 (12.2)	No alarm	No alarm
6 kw heater	3 (0.9)	No alarm	No alarm
250 w vapor lamp	3 (0.9)	No alarm	No alarm
300 w incandescent lamp	3 (0.9)	No alarm	No alarm
500 w unshielded quartz halogen lamp	8 (2.4)	No alarm	No alarm
500 w shielded quartz halogen lamp	8 (2.4)	No alarm	No alarm
1500 w electric radiant heater	3 (0.9)	No alarm	No alarm
Two 34 w fluorescent lamps	3 (0.9)	No alarm	No alarm

#### Medium Sensitivity

False Alarm Source	Distance feet (m)	Modulated Response	Unmodulated Response
Sunlight, direct, reflected	—	No alarm	No alarm
Vibration	N/A	No alarm	N/A
Radio frequency interference	1 (0.3)	No alarm (keyed)	No alarm (steady)
Arc welding	10 (3)	No alarm	No alarm
6 kw heater	3 (0.9)	No alarm	No alarm
250 w vapor lamp	3 (0.9)	No alarm	No alarm
300 w incandescent lamp	3 (0.9)	No alarm	No alarm
500 w unshielded quartz halogen lamp	8 (2.4)	No alarm	No alarm
500 w shielded quartz halogen lamp	3 (0.9)	No alarm	No alarm
1500 w electric radiant heater	3 (0.9)	No alarm	No alarm
Two 34 w fluorescent lamps	3 (0.9)	No alarm	No alarm

#### Low Sensitivity

False Alarm Source	Distance feet (m)	Modulated Response	Unmodulated Response
Sunlight, direct, reflected	—	No alarm	No alarm
Vibration	—	No alarm	No alarm
Radio frequency interference	N/A	No alarm	N/A
Arc welding	5 (1.5)	No alarm	No alarm
6 kw heater	3 (0.9)	No alarm	No alarm
250 w vapor lamp	3 (0.9)	No alarm	No alarm
300 w incandescent lamp	3 (0.9)	No alarm	No alarm
500 w shielded quartz halogen lamp	3 (0.9)	No alarm	No alarm
1500 w electric radiant heater	3 (0.9)	No alarm	No alarm
Two 34 w fluorescent lamps	3 (0.9)	No alarm	No alarm

**FM Approval and Performance Report – Continued**

**FIELD OF VIEW**

**Very High Sensitivity**

<b>Fuel</b>	<b>Size</b>	<b>Distance feet (m)</b>	<b>Horizontal (degrees)</b>	<b>Avg. Horiz. Response Time (seconds)***</b>	<b>Vertical (degrees)</b>	<b>Avg. Vert. Response Time (seconds)***</b>
n-Heptane	1 x 1 foot	150* (45.7)	+45 -45	12 14	+45 -30	13 5
n-Heptane	1 x 1 foot	100 (30.5)	+45 -45	6 3	+45 -30	3 2
n-Heptane	6 in. x 6 in.	80 (24.4)	+45 -45	5 6	+45 -30	4 4
Isopropanol	6 in. x 6 in.	70 (21.3)	+45 -45	5 5	+45 -30	4 6
Diesel**	1 x 1 foot	100 (30.5)	+45 -45	2 3	+45 -30	4 3
Ethanol	1 x 1 foot	150 (45.7)	+45 -45	13 10	+45 -30	10 8
Methanol	6 in. x 6 in.	40 (12.2)	+45 -45	4 6	+45 -30	3 3
Methanol	1 x 1 foot	110 (33.5)	+45 -45	9 7	+45 -30	9 3
Methane	30 inch plume	100 (30.5)	+45 -45	7 3	+45 -30	2 2
JP-5**	1 x 1 foot	100 (30.5)	+45 -45	2 4	+45 -30	3 2
JP-5**	2 x 2 feet	180* (54.9)	+45 -45	2 5	+45 -30	3 2
JP-5**	2 x 2 feet	90 (27.4)	+45 -45	2 3	+45 -30	1 2
Office Paper 0.5 lb.	19" x 19" x 8"	80 (24.4)	+45 -45	4 2	+45 -30	2 1
Corrugated Panel	18" x 36"	80 (24.4)	+45 -45	1 1	+45 -30	3 2

\* Outdoor test condition.

\*\* Pre-burn from ignition.

\*\*\* Add 2 seconds for EQP Model.

**FM Approval and Performance Report – Continued**

**Medium Sensitivity**

<b>Fuel</b>	<b>Size</b>	<b>Distance feet (m)</b>	<b>Horizontal (degrees)</b>	<b>Avg. Horiz. Response Time (seconds)***</b>	<b>Vertical (degrees)</b>	<b>Avg. Vert. Response Time (seconds)***</b>
n-Heptane	1 x 1 foot	75 (22.9)	+45 -45	9 6	+45 -30	10 7
n-Heptane	1 x 1 foot	50 (15.2)	+45 -45	4 3	+45 -30	3 3
Diesel**	1 x 1 foot	60 (18.3)	+45 -45	4 4	+45 -30	4 2
Ethanol	1 x 1 foot	60 (18.2)	+45 -45	12 9	+45 -30	12 9
Methanol	1 x 1 foot	50 (15.2)	+45 -45	9 3	+45 -30	9 1
Methane	32 inch plume	45 (13.7)	+45 -45	3 3	+45 -30	7 1
JP-5**	2 x 2 feet	90 (27.4)	+45 -45	4 2	+45 -30	2 2
Office Paper 0.5 lb.	19" x 19" x 8"	40 (12.2)	+45 -45	2 1	+45 -30	1 1
Corrugated Panel	18" x 36"	40 (12.2)	+45 -45	2 1	+45 -30	1 1

\*\* Pre-burn from ignition.

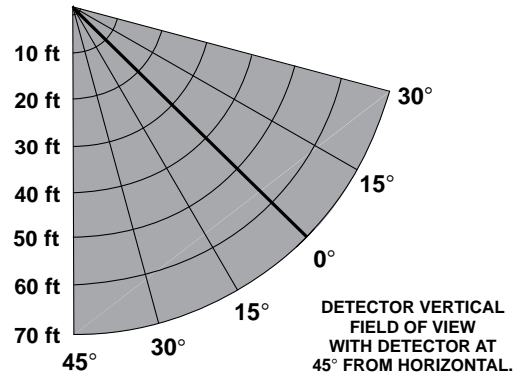
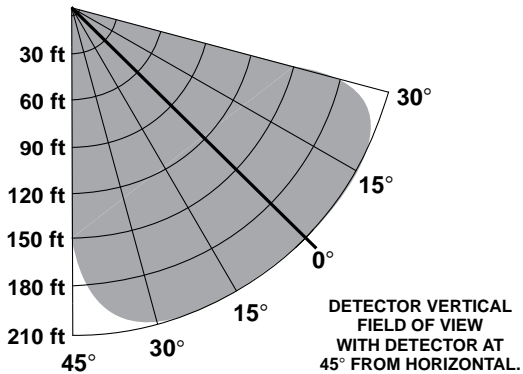
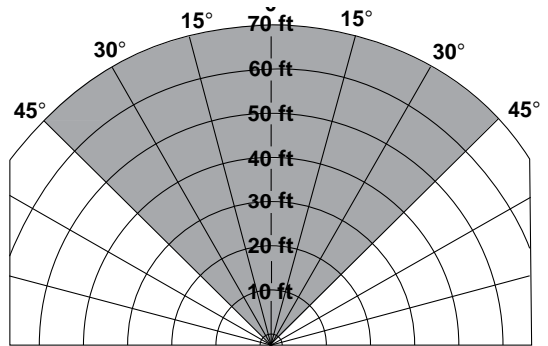
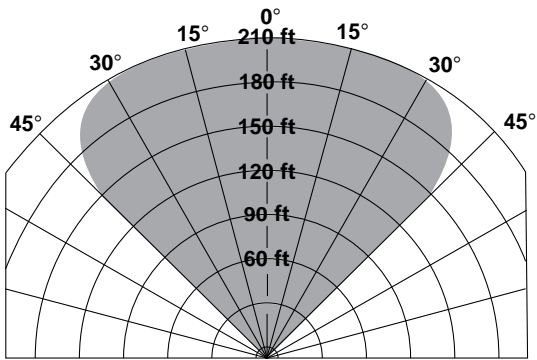
\*\*\* Add 2 seconds for EQP Model.

**Low Sensitivity**

<b>Fuel</b>	<b>Size</b>	<b>Distance feet (m)</b>	<b>Horizontal (degrees)</b>	<b>Avg. Horiz. Response Time (seconds)***</b>	<b>Vertical (degrees)</b>	<b>Avg. Vert. Response Time (seconds)***</b>
n-Heptane	1 x 1 foot	35 (10.7)	+45 -45	13 13	+45 -30	9 18
Methanol	1 x 1 foot	15 (4.6)	+45 -45	14 12	+45 -30	10 8
Methane	32 inch plume	15 (4.6)	+45 -45	10 11	+45 -30	8 10

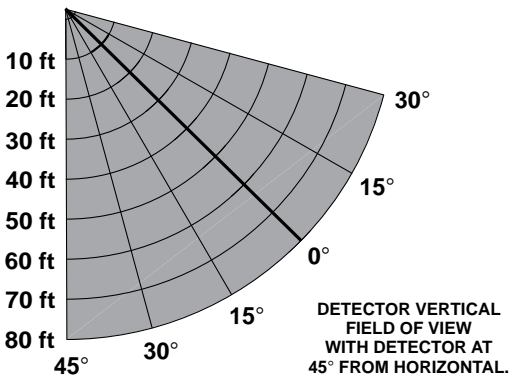
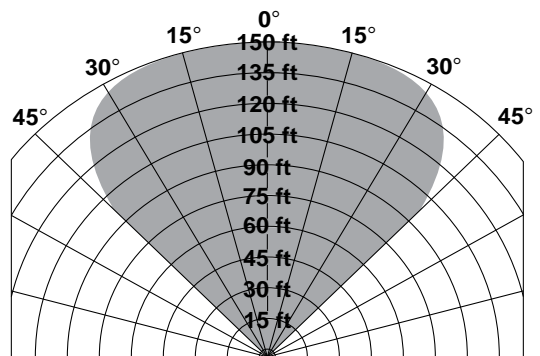
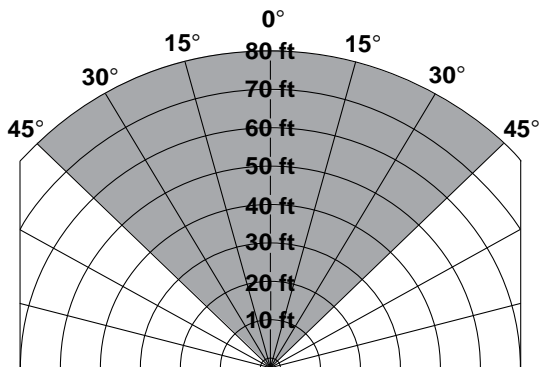
\*\*\* Add 2 seconds for EQP Model.

**HIGH RESOLUTION FIELD OF VIEW**



Field of View at Indicated Distance in Feet for  
**n-Heptane** at **Very High Sensitivity** (1 x 1 foot)

Field of View at Indicated Distance in Feet for  
**Isopropanol** at **Very High Sensitivity** (6 in. x 6 in.)

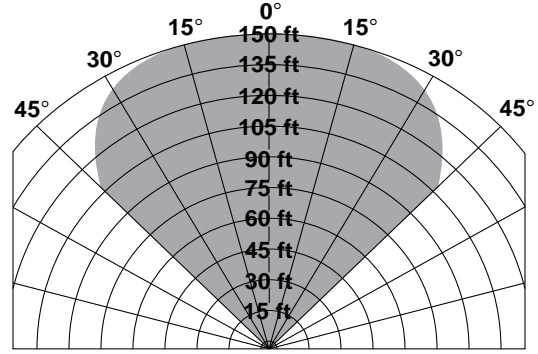
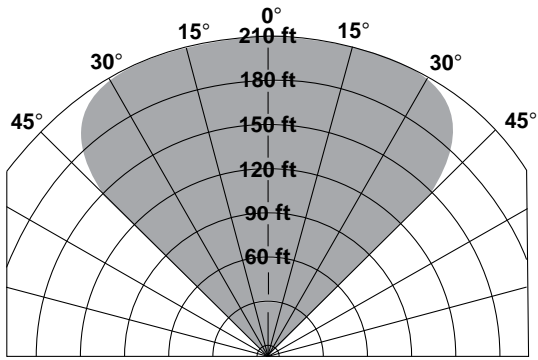


Field of View at Indicated Distance in Feet for  
**Diesel** at **Very High Sensitivity** (1 x 1 foot)

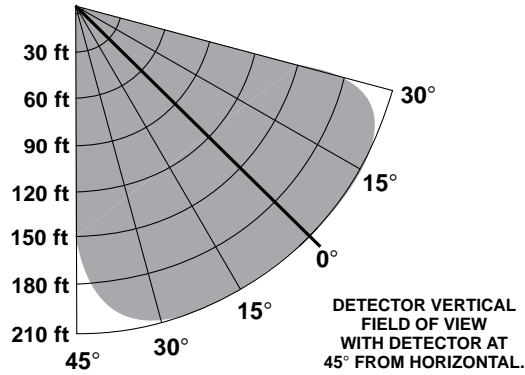
Field of View at Indicated Distance in Feet for  
**n-Heptane** at **Very High Sensitivity** (6 in. x 6 in.)



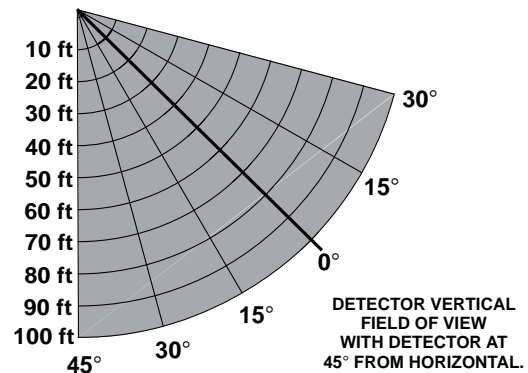
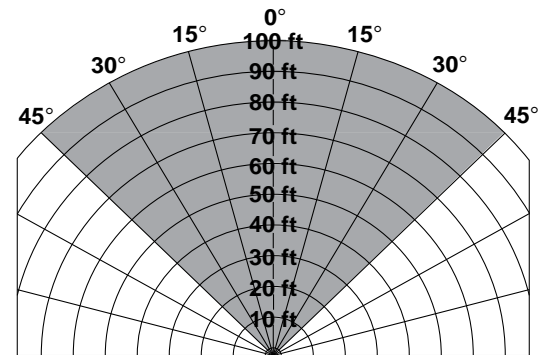
FM Approval and Performance Report – Continued



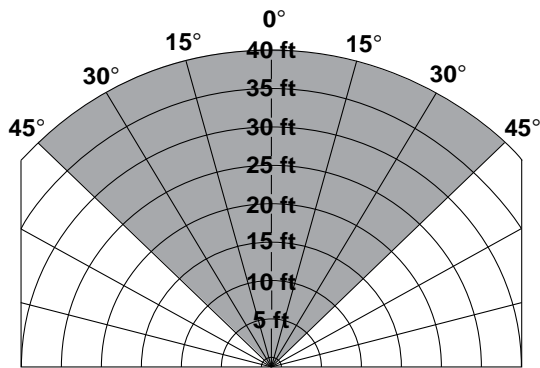
Field of View at Indicated Distance in Feet for Methanol at Very High Sensitivity (1 x 1 foot)



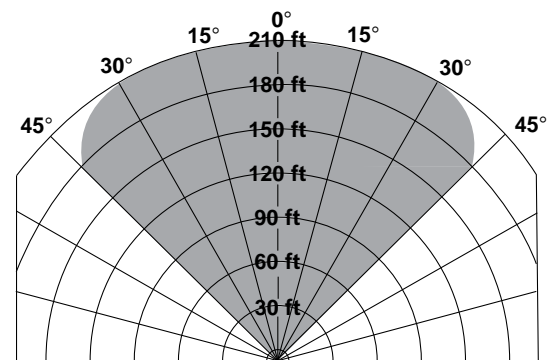
Field of View at Indicated Distance in Feet for Ethanol at Very High Sensitivity (1 x 1 foot)



Field of View at Indicated Distance in Feet for Methane at Very High Sensitivity (30 inch plume)

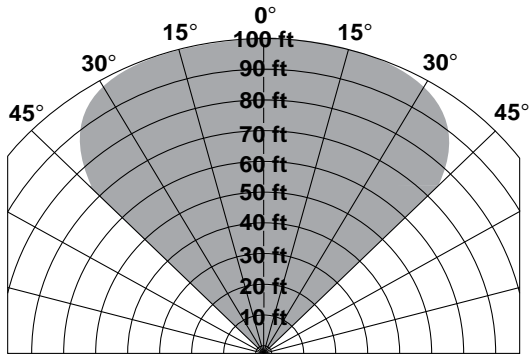


Field of View at Indicated Distance in Feet for Methanol at Very High Sensitivity (6 in. x 6 in.)

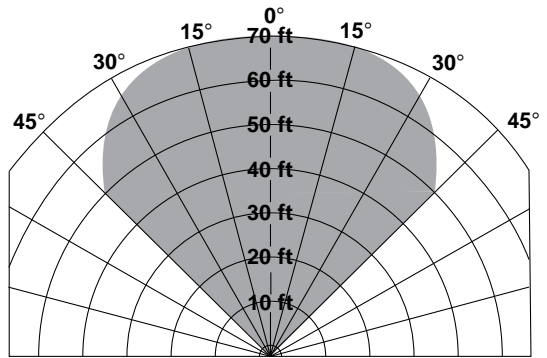


Field of View at Indicated Distance in Feet for JP-5 at Very High Sensitivity (2 x 2 feet)

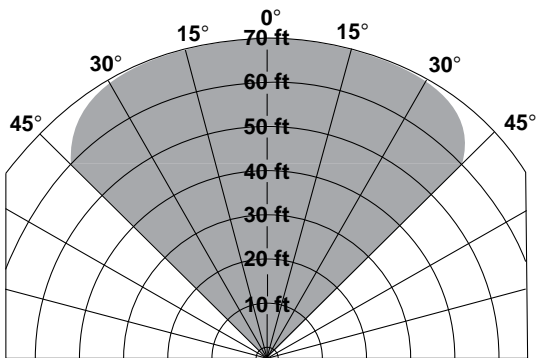
**FM Approval and Performance Report – Continued**



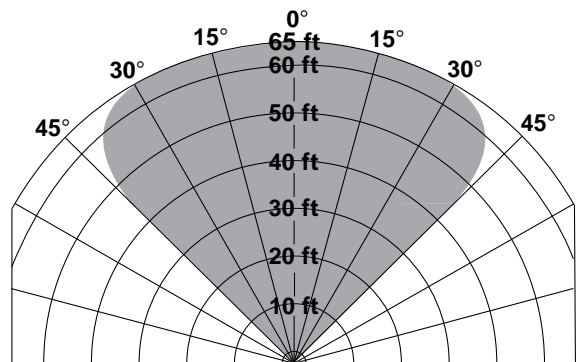
Field of View at Indicated Distance in Feet for  
**n-Heptane at Medium Sensitivity (1 x 1 foot)**



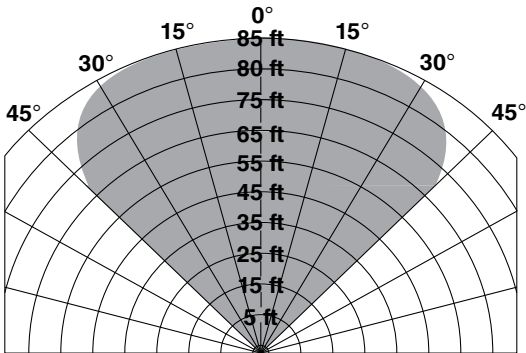
Field of View at Indicated Distance in Feet for  
**Methanol at Medium Sensitivity (1 x 1 foot)**



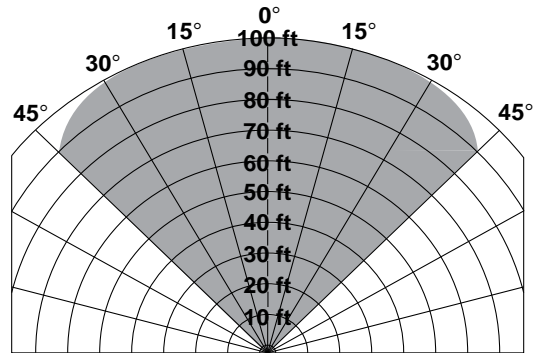
Field of View at Indicated Distance in Feet for  
**Diesel at Medium Sensitivity (1 x 1 foot)**



Field of View at Indicated Distance in Feet for  
**Methane at Medium Sensitivity (30 inch plume)**



Field of View at Indicated Distance in Feet for  
**Ethanol at Medium Sensitivity (1 x 1 foot)**



Field of View at Indicated Distance in Feet for  
**JP-5 at Medium Sensitivity (2 x 2 foot)**

**NOTE**

*FM Approvals minimum requirements are response distance measurements at 0° (on axis) and the limits of the field of view. These high resolution field of view diagrams show the measured response distances at all the indicated angles in the horizontal plane.*

# APPENDIX B

## CSA APPROVAL

### PRODUCTS

**CLASS 4818 04** - SIGNAL APPLIANCES - Systems - For Hazardous Locations

Class I, Division 1, Groups B, C, and D (T4A); Class II, Division 1, Groups E, F, and G (T4A);

Class I, Division 2, Groups A, B, C, and D (T3C); Class II, Division 2, Groups F and G (T3C);

Class III; Enclosure Type 4X;

Multispectrum IR Flame Detector/Controller X3301 Series, rated 18-30 Vdc, 4.6 Watts to 17 Watts.

Relay contacts rated 30 Vdc, 5 Amps.

### NOTE

*Hazardous location testing has been successfully completed on the Model X3301 series from an ambient temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ; however, the detector label marking indicates  $-40^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$ .*

### APPLICABLE REQUIREMENTS

- CSA Std C22.2 No. 25-1966 – Enclosures for use in Class II Groups E, F & G Hazardous Locations.
- CSA Std C22.2 No. 30-M1986 – Explosion-Proof Enclosures for use in Class I Hazardous Locations.
- CAN/CSA C22.2 No. 94-M91 – Special Purpose Enclosures.
- CSA Std C22.2 No. 142-M1987 – Process Control Equipment.
- CSA Std C22.2 No. 213-M1987 – Nonincendive Electrical Equipment for use in Class I, Division 2 Hazardous Locations.


# APPENDIX C

## ATEX / CE APPROVAL

### EC-TYPE EXAMINATION CERTIFICATE

#### DEMKO 01 ATEX 130204X

##### Increased Safety Model

CE 0539 

Ex d e IIC T5–T6 Gb

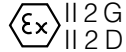
Ex tb IIIC T130°C

T6 (Tamb –50°C to +60°C)

T5 (Tamb –50°C to +75°C)

IP66/IP67.

##### Flameproof Model

CE 0539 

Ex d IIC T4–T6 Gb

Ex tb IIIC T130°C

T6 (Tamb –55°C to +60°C)

T5 (Tamb –55°C to +75°C)

T4 (Tamb –55°C to +125°C)

IP66/IP67.

#### Compliance with:

EN 60079-0: 2009

EN 60079-1: 2007

EN 60079-7: 2007

EN 60079-31: 2009

EN / IEC 60529: 2001.

### INSTALLATION INSTRUCTIONS

The field wiring connections in the terminal compartment are ATEX certified and accepts wiring diameter from 14 AWG (2.08 mm<sup>2</sup>) to 22 AWG (0.33 mm<sup>2</sup>).

The Multispectrum infrared (IR) flame detector type X3301 shall be installed according to the instructions given by the manufacturer.

The cable entry devices shall be certified in type of explosion protection flameproof enclosure "d" for use with the terminal compartment in type of explosion protection flameproof enclosure "d", or in type of explosion protection increased safety "e" for use with the terminal compartment in type of explosion protection increased safety "e". They shall be IP66/IP67 rated, suitable for the conditions of use and correctly installed.

Unused entries shall be closed with suitable certified blanking elements.

The metal housing for the Multispectrum infrared (IR) flame detector type X3301 must be electrically connected to earth ground.

For ambient temperatures below –10°C and above +60°C use field wiring suitable for both minimum and maximum ambient temperature.

#### Special conditions for safe use:

The front window assembly contains a special cemented joint construction. In accordance with EN60079-1 clause 5.1.c, all inspections, repair and/or adjustments to this front window assembly shall be done by Detector Electronics Corporation only.

The EOL resistor can only be used within the flameproof terminal compartment.

EOL resistors must be ceramic, wirewound type, rated 5 watts minimum, with actual power dissipation not to exceed 2.5 watts.

The Multispectrum infrared (IR) flame detector type X3301 is to be installed in places where there is a low risk of mechanical damage.

**NOTE**

*Operational performance verified from -40°C to +75°C.*

**NOTE**

*An optional third party addressable module can only be used within the Ex d flameproof model unless the addressable module is component certified as Ex e for use within the Ex d e increased safety model.*

**NOTE**

*Refer to "EOL Resistors" section for installation details. All cable entry devices and blanking elements shall be certified to "E-generation" or "ATEX" standards, in type of explosion protection increased safety "e" or flameproof enclosure "d" (as applicable), suitable for the conditions of use and correctly installed. They shall maintain the degree of ingress protection IP66 for the apparatus. Unused apertures shall be closed with suitable blanking elements.*

**NOTE**

*For ATEX installations, the X3301 detector housing must be electrically connected to earth ground.*

# APPENDIX D

## IECEX APPROVAL

### IECEX CERTIFICATE OF CONFORMITY

#### DEMKO

IECEX ULD 06.0017X

Ex d e IIC T5-T6 Gb

Ex tb IIIC T130°C

T6 (Tamb = -50°C to +60°C) or

T5 (Tamb = -50°C to +75°C)

IP66/IP67.

Ex d IIC T4-T6 Gb

Ex tb IIIC T130°C

T6 (Tamb = -55°C to +60°C)

T5 (Tamb = -55°C to +75°C)

T4 (Tamb = -55°C to +125°C)

IP66/IP67.

#### Compliance with:

IEC 60079-0: 2007, Ed. 5

IEC 60079-1: 2007, Ed. 6

IEC 60079-7: 2006, Ed. 4

IEC 60079-31: 2008, Ed. 1

EN/IEC 60529: 2001.

#### INSTALLATION INSTRUCTIONS

The field wiring connections in the terminal compartment are suitably certified and accepts wiring diameter from 14 AWG (2.08 mm<sup>2</sup>) to 22 AWG (0.33 mm<sup>2</sup>).

The Multispectrum infrared (IR) flame detector type X3301 shall be installed according to the instructions given by the manufacturer.

The cable entry devices shall be certified in type of explosion protection flameproof enclosure "d" for use with the terminal compartment in type of explosion protection flameproof enclosure "d" or in type of explosion protection increased safety "e" for use with the terminal compartment in type of explosion protection increased safety "e". They shall be IP66/IP67 rated, suitable for the conditions of use and correctly installed.

Unused entries shall be closed with suitable certified blanking elements.

The metal housing for the Multispectrum infrared (IR) flame detector type X3301 must be electrically connected to earth ground.

For ambient temperatures below -10°C and above +60°C use field wiring suitable for both minimum and maximum ambient temperature.

#### Special conditions for safe use:

The front window assembly contains a special cemented joint construction. In accordance with IEC 60079-1 clause 5.1.c, all inspections, repair and/or adjustments to this front window assembly shall be done by Detector Electronics Corporation only.

The EOL resistor can only be used within the flameproof terminal compartment.

EOL resistors must be ceramic, wirewound type, rated 5 watts minimum, with actual power dissipation not to exceed 2.5 watts.

The Multispectrum infrared (IR) flame detector type X3301 is to be installed in places where there is a low risk of mechanical damage.

# APPENDIX E

## VdS Schadenverhütung GmbH APPROVAL



CE 0786

Performance per EN54-10,  
Certificate of Approval G-202136.

EC-Certificate of Conformity  
08 0786 – CPD – 20453  
EN54-10 Flame detectors - Point detectors.

### **SUBJECT MATTER OF THE APPROVAL**

IR Flame Detector Type X3301 for use in Automatic Fire Detection and Fire Alarm Systems.

### **BASIS OF APPROVAL**

DIN EN 54, Part 10 (05/02) - Flame Detectors.

### **INSTRUCTIONS FOR THE APPLICATION OF THE APPROVAL COMPONENT/SYSTEM**

The installation shall take into account, that the orientation arrow on the flame detector is directed upwards, as the view angle in this direction is  $<90^\circ$ .

The IR-flame detector corresponds to class 1.

# APPENDIX F

## OFFSHORE APPROVALS

### DNV

Type Approval Certificate No. A-11022.

### SUBJECT MATTER OF THE APPROVAL

IR Flame Detector Type X3301 for use in Ships, High Speed & Light Craft, and Offshore Applications.

### Application Location Classes:

Location classes for X3301 IR Flame Detector with Mounting Bracket Q9033B / Q9033A (Shaded areas indicate Det-Tronics approved location classes)

COLUMN 1		COLUMN 2				
TYPE	LOCATION WITHIN MAIN AREA	MAIN AREAS ON BOARD				
		Machinery spaces	Control room, Accommodation	Bridge	Pump room, Holds, Rooms with no heating	Open Deck
Temperature	Inside cubicles, desks, etc. with temperature rise of 5°C or more	B	B	B	D	D
	All other locations	A	A	A	C	D
Humidity	Locations where special precautions are taken to avoid condensation	A	A	A	A	A
	All other locations	B	B	B	B	B
Vibration	On machinery such as internal combustion engines, compressors, pumps, including piping on such machinery	B	—	—	B	B
	Masts	—	—	—	—	—
	All other locations	A	A	A	A	A
EMC (Electromagnetic compatibility)	All locations within specified main areas	A	A	B	A	B
Enclosure	Submerged application	D	—	—	D	D
	Below floor plates in engine room	C	—	—	—	—
	All other locations	B	A	A	B	C

### MED

Certificate No. MED-B-5872.

Is found to comply with the requirements in the following Regulations / Standards:

Annex A.1, item No. A.1/3.51 and Annex B, Module B in the Directive. SOLAS 74 as amended, Regulation II-2/7 & X/3, 2000 HSC Code 7, FSS Code 9 and IMO MSC.1/Circ. 1242.

The equipment are found to comply with following location / application dependent requirements (for definition of each of the location classes, see below the table):

MODEL	TEMPERATURE	VIBRATION	EMC	ENCLOSURE
X3301	TEM-D	VIB-B	EMC-B	ENC-C

Definition of the location classes with reference to relevant standards:

Temperature

TEM-D Location (-25°C–70°C) (ref. IEC 60092-504 (2001) table 1 item 6-7)

Vibration

VIB-D For eq. on reciprocating machines etc. (ref IEC 60092-504 (2001) table 1 item 10)

EMC

EMC-B Bridge and open deck zone (ref. IEC 60092-504 (2001) table 1 item 19-20)

Enclosure

ENC-C Open deck (IP56) (ref. IEC 60092-201 table 5)

Conformity to Module D, E and F.

### Lloyd's Register

Type Approval Certificate No. 09/00027.

Models Available: Relay output, relay 0-20 mA output, and EQP LON output versions.



# **APPENDIX G**

## **ADDITIONAL APPROVALS**

### **SIL 2**



#### **IEC 61508**

Certified SIL 2 Capable. Certificate DET070417 COO1

Applies to specific models – refer to the SIL 2 Certified X3301 Safety Manual (95-8582) for details.

### **FRENCH**



NF-SSI

AFNOR Identification No: LIR 007 A0.

[www.marque-nf.com](http://www.marque-nf.com)

## APPENDIX H

### APPROVED ACCESSORIES



#### **Q9033A/B MOUNTING ARM**

**(for use with FM/CSA/ATEX/CE/IECEX/DNV certified X-Series Detectors)**

The Q9033A (Aluminum) and the Q9033B (Stainless Steel) Mounting Arms are designed for all Det-Tronics X-Series flame detectors. They allow for mounting to walls or immovable objects, enabling the detector to be installed in virtually any location. For additional information, refer to instruction manual 95-8686.



#### **Q9033 COLLAR ATTACHMENT**

**(for use with FM/CSA/ATEX/CE/IECEX certified X-Series Detectors)**

The Q9033 Collar Attachment is designed for all Det-Tronics X-Series flame detectors and is used in conjunction with the Q9033A/B Mounting Arm. The Collar Attachment adds versatility to the mounted detector by allowing a wider (3-dimensional) range of motion and improved viewing angles. For additional information, refer to instruction manual 95-8686.



#### **Q1130 FLANGE MOUNT ASSEMBLY**

**(for use with FM/CSA/ATEX/CE/IECEX certified X3301 and X3302 Detectors)**

The Q1130 Flange Mount Assembly is designed specifically for Det-Tronics X3301 and X3302 Flame Detectors, and allows the detector to be mounted directly to a wall or panel in order to monitor an enclosed process or geodome tank. For additional information, refer to instruction manual 95-8662.



95-8527



X3301 Multispectrum  
IR Flame Detector



PointWatch Eclipse®  
IR Combustible Gas Detector



FlexVu® Universal Display  
w/ GT3000 Toxic Gas Detector



Eagle Quantum Premier®  
Safety System

Detector Electronics Corporation  
6901 West 110th Street  
Minneapolis, MN 55438 USA

T: 952.941.5665 or 800.765.3473

F: 952.829.8750

W: <http://www.det-tronics.com>

E: [det-tronics@det-tronics.com](mailto:det-tronics@det-tronics.com)



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**FEDERAL SIGNAL**

Safety and Security Systems / Industrial

*Advancing security and well-being.*

## **Model 191XL Series Beacon for Use in Hazardous Conditions**



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### ***Installation and Maintenance Manual***

2561421G  
REV. G 513  
Printed in U.S.A.

*français.....page 21*  
*español.....página 41*



**Warranty** – Seller warrants all goods for five years on parts and 2-1/2 years on labor, under the following conditions and exceptions: Seller warrants that all goods of Seller's manufacture will conform to any descriptions thereof for specifications which are expressly made a part of this sales contract and at the time of sale by Seller such goods shall be commercially free from defects in material or workmanship. Seller reserves the right at the Seller's discretion to "Repair and Return" or "Replace" any item deemed defective during the warranty period. This warranty does not cover travel expenses, the cost of specialized equipment for gaining access to the product, or labor charges for removal and reinstallation of the product. This warranty shall be ineffective and shall not apply to goods that have been subjected to misuse, neglect, accident, damage, improper maintenance, or to goods altered or repaired by anyone other than Seller or its authorized representative, or if five years have elapsed from the date of shipment of the goods by Seller with the following exceptions: lamps and strobe tubes are not covered under this warranty. Outdoor warning sirens and controllers manufactured by Federal Warning Systems are warranted for two years on parts and one year on labor. No agent, employee, representative or distributor of Seller has any authority to bind the Seller to any representation, affirmation, or warranty concerning the goods and any such representation, affirmation or warranty shall not be deemed to have become a part of the basics of the sales contract and shall be unenforceable. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OR MERCHANTABILITY, FITNESS FOR PURPOSE AND OF ANY OTHER TYPE, WHETHER EXPRESS OR IMPLIED. These warranties shall not apply unless Seller shall be given reasonable opportunity to investigate all claims for allegedly defective goods. Upon Seller's instruction a sample only of allegedly defective goods shall be returned to Seller for its inspection and approval. The basis of all claims for alleged defects in the goods not discoverable upon reasonable inspection thereof pursuant to paragraph 8 hereof must be fully explained in writing and received by Seller within thirty days after Buyer learns of the defect or such claim shall be deemed waived.



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# Contents

<b>Safety Messages to Installers .....</b>	<b>5</b>
<b>An Overview of the 191XL Series.....</b>	<b>6</b>
<b>Unpacking the Beacon.....</b>	<b>7</b>
<b>Pipe-Mounting the Beacon (191XL) .....</b>	<b>8</b>
<b>Surface-Mounting the Beacon (191XL-S).....</b>	<b>10</b>
<b>Wiring the Beacon .....</b>	<b>11</b>
Wiring 120-240 Vac, 277 Vac Models.....	12
Wiring 24 Vac/dc Models.....	12
<b>Safety Message to Maintenance Personnel .....</b>	<b>12</b>
<b>Changing from Flash Mode to Steady Mode.....</b>	<b>13</b>
<b>Cleaning the Fixture .....</b>	<b>16</b>
<b>Lubricating the Threaded Joint.....</b>	<b>17</b>
<b>Ordering Replacement Parts .....</b>	<b>17</b>
<b>Getting Repair Service and Technical Assistance .....</b>	<b>18</b>
<b>Returning the Product for Credit .....</b>	<b>18</b>

## Tables

<b>Table 1</b> Electrical ratings.....	<b>7</b>
<b>Table 2</b> Installation environment ratings.....	<b>7</b>
<b>Table 3</b> Ambient and operating temperature range.....	<b>8</b>
<b>Table 4</b> Replacement parts .....	<b>17</b>

**Figures**

**Figure 1** Pipe-mounted beacon ..... 9

**Figure 2** Surface-mounted beacon ..... 10

**Figure 3** PCB removed from housing ..... 15

**Figure 4** Location of jumper J3 on PCB..... 16

## **Safety Messages to Installers**

### **WARNING**

It is important to follow all instructions shipped with this product. This device is to be installed by a trained electrician who is thoroughly familiar with the National Electrical Code and/or Canadian Electrical Code and will follow the NEC and/or CEC Guidelines as well as all local codes. This beacon should be considered a part of the warning system and not the entire warning system.

The selection of the mounting location for the beacon, its controls and the routing of the wiring are to be accomplished under the direction of the facilities engineer and the safety engineer. In addition, listed below are some other important safety instructions and precautions you should follow:

- Read and understand all instructions before installing or operating this beacon.
- Do not connect this beacon to the system when power is on.
- Do not disconnect the beacon while circuit is live or unless the area is known to be free of ignitable concentrations. Keep the beacon tightly closed when in operation.
- After installation, make sure that all set screws and threaded joints are properly tightened.
- Never alter the unit in any manner. Safety in hazardous locations may be endangered if additional openings or other alterations are made in units specifically designed for use in these locations.
- To be an effective warning device, this product produces bright beacon that can be hazardous to your eyesight when viewed at a close range. Do not stare directly into this lighting product at a close range or permanent damage to your eyesight may occur.



## ***Installation and Service Instructions***

---

- After installation, test the beacon to make sure that it is operating properly.
- Keep the unit tightly closed when in operation.
- After testing is complete; provide a copy of this instruction booklet to all personnel.
- Establish a procedure to routinely check the beacon for proper activation and operation.

Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death.

### **An Overview of the 191XL Series**

This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D; Class II, Division 1, Groups E, F & G; Class III OR non-hazardous locations only.

This strobe light can be mounted to a Federal Signal Model LHWB bracket. If installed in this way, the entire assembled device is suitable only for Class I, Div. 2, Groups A, B, C, and D; Class II, Div. 2, Groups F and G; Class III locations.

The Model 191XL LED Beacon is a UL listed visual signal for operation in harsh environments and hazardous locations and has been investigated by UL as meeting Type 4X and IP66 enclosure requirements. The unit is rated for operation on 100 Vac to 265 Vac, 50/60 Hz, 0.21 A; 277 Vac, 50/60 Hz, 0.13A; or 24 Vdc/ ac 50/60 Hz, 0.40 A. The 191XL can be supplied with colors of red, amber, green, blue, and clear. The 191XL is factory-set to operate 60 flashes/minute. There is an option to operate the LED Beacon in Steady Mode. (See “Changing from Flash Mode to Steady Mode” on page 13). Models are available for pipe mounting (191XL) or surface mounting (191XL-S).

These devices are intended for permanent installation and operation in accordance with Title 46, Code of Federal Regulations, Parts 110–113, or Title 33, Code of Federal Regulations, Part 183, Sub-part I, Section 183.410, and the

applicable requirements of the American Boat and Yacht Council, Inc., and/or ANSI/NFPA 302, “Fire Protection Standard for Pleasure and Commercial Motor Craft.”

## Unpacking the Beacon

**⚠ WARNING**

**EXPLOSION HAZARD—Damaged domes can lead to explosions that could result in serious injury or death.**

After unpacking the beacon, examine it for damage that may have occurred in transit. If the beacon has been damaged, do not attempt to install or operate it. File a claim immediately with the carrier, stating the extent of the damage. Carefully check all envelopes, shipping labels, and tags before removing or discarding them. Disposal of all shipping materials must be carried out in accordance with national and local codes and standards. If any parts are missing, please call Federal Signal Customer Support at 708-534-4756 or 877-289-3246.

**Table 1** Electrical ratings

Operating Voltage:	24 Vdc/ac	100–265, 277 Vac	277 Vac
Flashes/Minute:	60 FPM	60 FPM	60 FPM
Maximum Operating Current:	380 mA	210 mA	130 mA
Frequency:	DC/50/60	50/60	50/60
DC In-Rush Current:	1.75 A at 24 Vdc for 5 ms		
AC In-Rush Current:	2.0 A at 85 Vac and 1.5 A at 265 and 277 Vac for 0.25 ms		

**Table 2** Installation environment ratings

Ambient Storage Rating: –55 °C to +70 °C
Ambient Operating Rating: –50 °C to +66 °C
Type 4X (water-tight and corrosion resistant) and indoor/outdoor use
IP66 (dust-tight and protection against heavy seas) and outside type (saltwater)

**Table 3** Ambient and operating temperature range

	Temperature Code or Maximum Temperature, °C								
	40 °C Ambient			55 °C Ambient			66 °C Ambient		
<b>Hazardous Locations</b>	24 V	100–265 Vac	277 Vac	24 V	100–265 Vac	277 Vac	24 V	100–265 Vac	277 Vac
Class I, Div 2, Groups A, B, C, and D	T6	T6	T5	T5	T5	T5	T4A	T4A	T5
Class II, Div 1, Groups E, F, and G	T6	T6	T6	T6	T6	T6	T6	T6	T6
Class III	T6	T6	T6	T6	T6	T6	T6	T6	T6

## Pipe-Mounting the Beacon (191XL)

**⚠ WARNING**

**EXPLOSION HAZARD**—To reduce the risk of fire or explosion, do not install the beacon in a hazardous location if the operating temperature exceeds the hazardous atmosphere’s ignition temperature. Before proceeding, consult the product nameplate and determine the operating temperature of the beacon.

**NOTE:** To comply with NEC Section 300-14, which requires a minimum of 6 inches (15.25 cm) of free conductor at a junction, when mounting the Model 191XL, the mounting pipe used to join the unit to a splice box should be no longer than 10 inches (25.4 cm).

The Model 191XL has provisions for mounting a 3/4" pipe and can be mounted in any position.

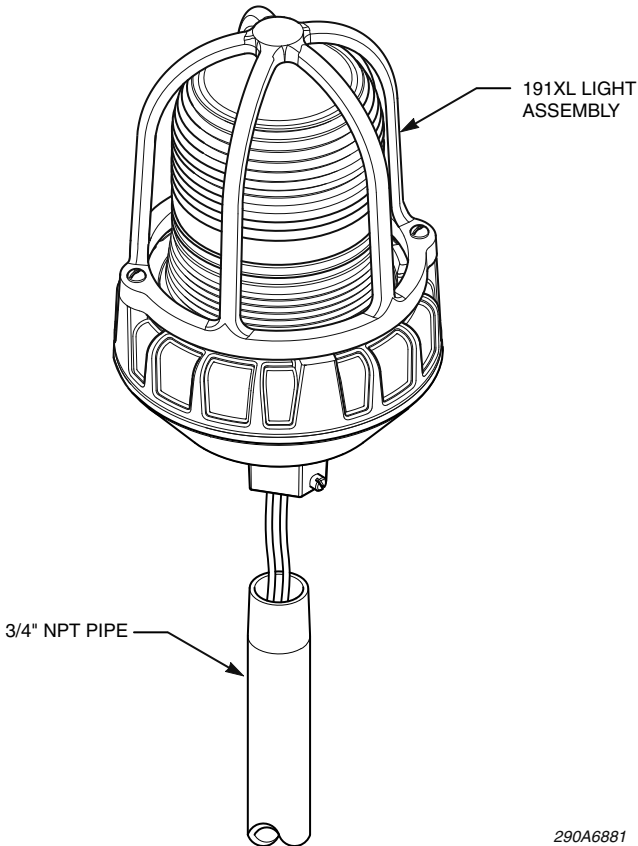
1. Before mounting the beacon, ensure that the mating threads are clean.
2. To prevent the ingress of water and dust, apply conductive sealant to the conduit threads prior to mounting. If non-conductive sealant is used, the enclosure must be earthed via the provided internal grounding wire/grounding screw to ensure proper grounding continuity.

3. In high-humidity environments when units are mounted dome down, condensation may occur in the conduit system. Use properly rated conduit seals/drains to prevent moisture from entering the fixture.

**IMPORTANT:** To prevent the connection from loosening, tighten the fixture to a MINIMUM torque of 5 ft-lb (6.8 N·m) after threading it onto the pipe.

4. Thread the fixture onto the 3/4" pipe and secure it with the set screw.

**Figure 1** Pipe-mounted beacon



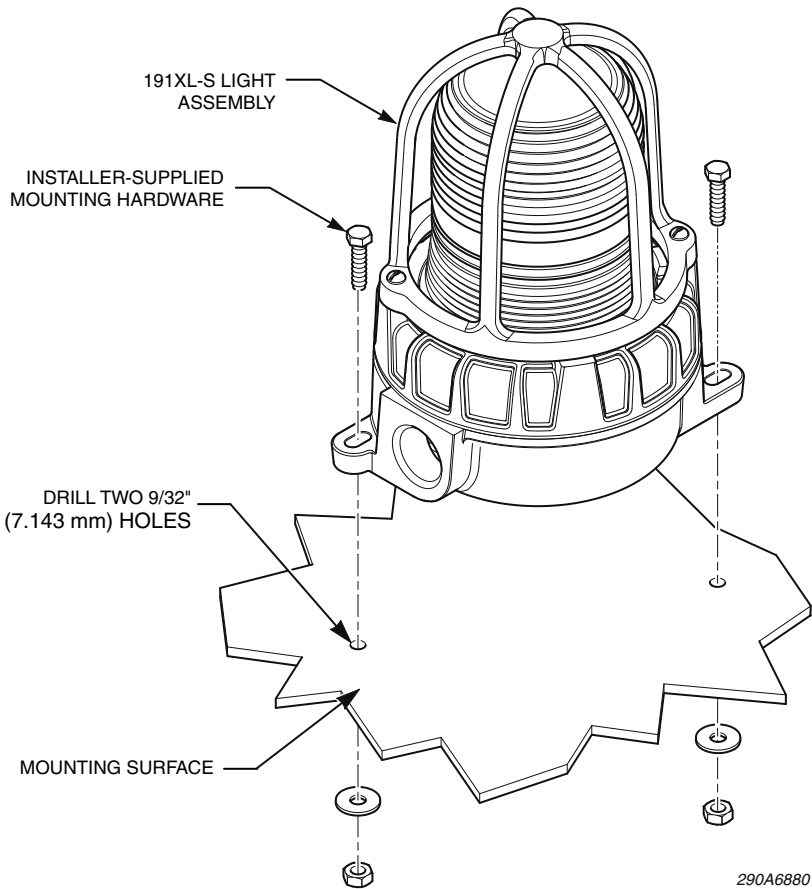
290A6881

## Surface-Mounting the Beacon (191XL-S)

To surface mount the beacon:

1. Use the mounting base as a template to mark the location of the two mounting holes.
2. Drill a 9/32 inch (7.143 mm) hole at each mark.
3. Secure the beacon to the mounting surface with installer supplied hardware.

**Figure 2** Surface-mounted beacon



290A6880

## Wiring the Beacon

### **⚠ WARNING**

**SHOCK HAZARD**—*To avoid electrical shock hazards, do not connect wires while power is applied.*

### **⚠ WARNING**

#### **EXPLOSION HAZARD**

**Do not disconnect the beacon while the circuit is live or unless the area is known to be free of ignitable concentrations. Keep the beacon tightly closed when in operation.**

Wiring must comply with the National Electrical Code or Canadian Electrical Code and the local authority having jurisdiction.

The Model 191XL Series LED Beacon should be installed per the NEC or CEC, STATE and LOCAL CODES. Alternate installation locations and/or orientations should only be performed with the approval of the authority having jurisdiction. In addition, the unit can be mounted using an optional ceiling mount or optional wall mount.

### **⚠ WARNING**

**SHOCK HAZARD**—*To avoid electrical shock hazards, do not connect wires while power is applied.*

**NOTE:** 191XL beacons that are 24 V models are designed to operate on AC and DC supply voltages. The 120-240 Vac model is designed to operate 100 Vac to 265 Vac at 50/60 Hz. See Table 1 on page 7 for electrical ratings.

### **NOTICE**

**REVERSE POLARITY/MISWIRING**—*The 191XL is not polarity sensitive, but MAY BE DAMAGED by incorrect electrical hookup. Damage will result if the voltage rating of the particular model is exceeded.*

## ***Installation and Service Instructions***

---

**NOTE:** Field terminations made inside of the surface mount enclosure will require the printed circuit board (PCB) assembly to be removed from the housing. See Figure 3 on page 15 and follow steps 1–4 and 6–8 of “Changing from Flash Mode to Steady Mode” on page 13 for the PCB removal and installation process.

The surface mount enclosure is not suitable for feed-through branch-circuit conductors.

### ***Wiring 120-240 Vac, 277 Vac Models***

The 120-240 Vac and 277 Vac models are supplied with three 24-inch leads: white, black, and green/yellow. Connect the black lead to the phase (hot) side of the power source and the white lead to the common (neutral) side of the power source. If required, the green/yellow lead in the housing is provided for connection to an earth ground.

### ***Wiring 24 Vac/dc Models***

The 24 Vac/dc models are supplied with two 24" leads, one red and one black. Connect the red (+) lead to the positive or phase (hot) side of the power source and the black (–) lead to the negative or common (neutral) side of power source.

## **Safety Message to Maintenance Personnel**

### **⚠ WARNING**

Listed below are some important safety instructions and precautions you should follow:

- Read and understand all instructions before operating this system.
- Any maintenance to the light system must be done with power turned off.
- Any maintenance to the light system must be performed by a trained electrician who is thoroughly familiar with all applicable national and local codes in the country of use.
- Do not connect this beacon to the system when power is on.

- Do not disconnect the beacon while circuit is live or unless the area is known to be free of ignitable concentrations. Keep the beacon tightly closed when in operation.
- Never alter the unit in any manner. Safety of the unit may be affected if additional openings or other alterations are made to the internal components or housing.
- The nameplate should NOT be obscured, as it contains cautionary and/or other information of importance to maintenance personnel. Ensure the nameplate remains readable if the housing exterior is painted.
- If the dome is damaged in any way, it MUST be replaced.
- After performing any maintenance, test the light system to ensure that it is operating properly.

Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death to you or others.

### Changing from Flash Mode to Steady Mode

#### **WARNING**

***EXPLOSION HAZARD—To prevent ignition of hazardous atmospheres, disconnect the fixture from the supply circuit before opening it.***

#### **WARNING**

***EXPLOSION HAZARD—Do not disconnect the beacon while circuit is live or unless the area is known to be free of ignitable concentrations. Keep the beacon tightly closed when in operation.***

#### **WARNING**

***EXPLOSION HAZARD—To maintain the vapor-tight enclosure, do not damage the dome or threads while disassembling or reassembling the unit. Lubricated threaded joints exposed for long periods of time may attract small particles of dirt or other foreign materials. Housing and cover joints should be reassembled immediately, with all the threads fully engaged.***



## ***Installation and Service Instructions***

---

To change from the default Steady Mode to Flashing Mode.

1. Disconnect power to the beacon.
2. See Figure 3 on page 15. Remove the threaded dome assembly by twisting it counterclockwise.
3. Using a No. 2 Phillips screwdriver, remove two #8-32 pan-head screws holding the printed circuit board assembly to the die-cast housing. Be sure to retain the two nylon screw bushings isolating the bracket from the screws.
4. Gently lift the printed circuit board (PCB) assembly from the housing and turn the assembly over to access the component side of the printed circuit board.
5. See Figure 4 on page 16. Locate jumper J3 and lift the jumper to remove it from “Flash” setting. Re-seat the jumper over the pins labeled “Steady.”
6. Place the printed circuit board assembly back into housing, making sure that four insulating pads are seated between the metal bracket and die-cast housing. The bracket must be oriented so that the notch in the bracket is aligned with the ground screw in the die-cast housing. This step must be carefully followed to prevent arcing and dielectric failure.
7. Slide two #8-32 pan-head screws into the screw bushings and tighten screws to secure the printed circuit board assembly to the die-cast housing.
8. Thread the dome assembly back onto the housing by turning it clockwise to tighten.

** WARNING**

***SHOCK HAZARD—To avoid electrical shock hazards, do not connect wires while power is applied.***

9. Reconnect the beacon to power.

10. Test the device by applying power and verifying the steady operation of the LED lamp.

**Figure 3** PCB removed from housing

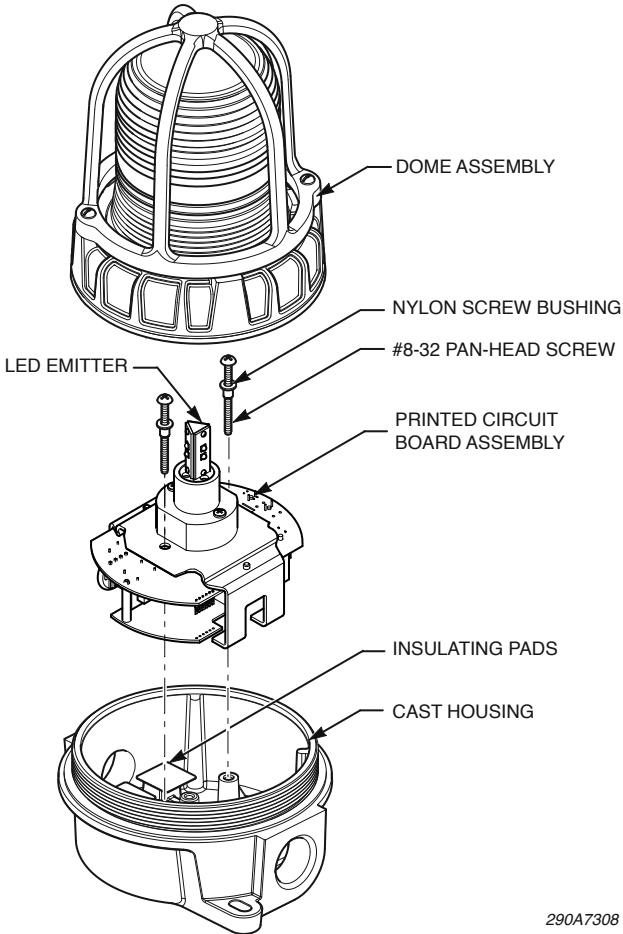
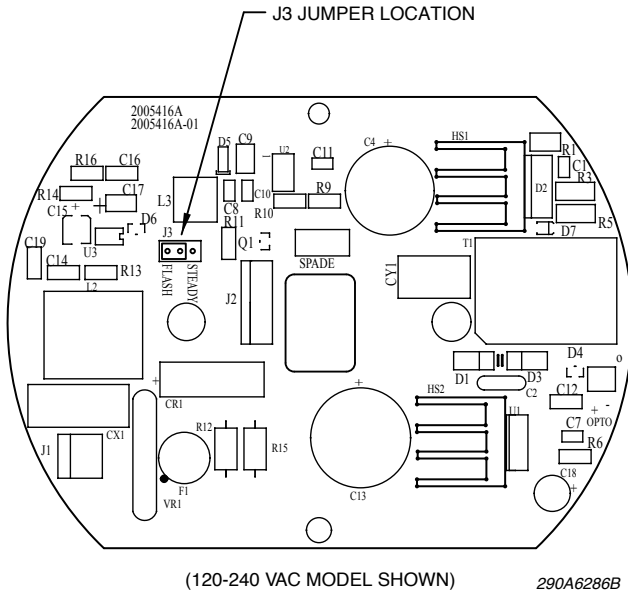


Figure 4 Location of jumper J3 on PCB



## Cleaning the Fixture

### **⚠ WARNING**

**EXPLOSION HAZARD**—Never use an abrasive material or file to remove corrosive materials from threaded surfaces. In extremely corrosive locations, equipment should be periodically inspected to guard against unusual deterioration and possible porosity, since this may weaken the enclosure structurally.

Maintenance procedures sometimes require fixtures to be hosed down for good housekeeping. The circuit should be turned off prior to hosing down the fixture.

The fixture should be cleaned periodically to maintain maximum light output. Only mild, non-abrasive cleaning agents should be used. The glass dome should be regularly inspected for scratches and chips, and if damaged, MUST be replaced.

## Lubricating the Threaded Joint

The threaded joint on the cover should be kept well lubricated with a corrosion inhibiting grease such a petrolatum or soap-thickened mineral oil. If corrosive materials have accumulated on the threaded joints and cannot be removed with solvents, the parts should be discarded and replaced.

## Ordering Replacement Parts



**EXPLOSION HAZARD—Substitution of components may impair suitability for Class I, Division 2.**

Typical spare parts are listed Table 4. Due to certification, certain component parts are not available for field replacement. Units with this type of damage must be either replaced entirely or returned to Federal Signal for service. To order replacement parts, please call Federal Signal Customer Support at 708-534-4756 or 877-289-3246.

**Table 4** Replacement parts

Description	Part Number
Dome Assy., Amber	K8449078-01
Dome Assy., Blue	K8449078-06
Dome Assy., Clear	K8449078-04
Dome Assy., Green	K8449078-07
Dome Assy., Red	K8449078
Gasket	K8449080
Grease, 8 oz Tube	KR81-05-01
Dome Guard	K8449090
LED Emitter, Amber	K14700030-A
LED Emitter, Blue	K14700030-B
LED Emitter, Green	K14700030-G
LED Emitter, Red	K14700030-R
LED Emitter, White	K14700030-W

## **Getting Repair Service and Technical Assistance**

Products returned for repair require a Return Authorization form. To obtain repair service or technical assistance for the product, call Federal Signal at 708-534-4756 or 877-289-3246. For instruction manuals and information on related products, visit:  
<http://www.federal-signal-indust.com>

## **Returning the Product for Credit**

Product returns for credit require a return authorization from your local distributor prior to returning the product to Federal Signal. Please contact your distributor for assistance.

A product is qualified to be returned for credit when the following conditions are met:

- Product is resalable and in the original cartons
- Product has not been previously installed
- Product is the current revision
- Product has not been previously repaired
- Product is a standard product
- Product is not a service part

All returns are subject to a re-stock fee.

Defective products that are returned within the warranty period will be repaired or replaced at Federal Signal's sole discretion. Defective products do not include those products with lamp failure.

Circumstances other than those listed above will be addressed on a case-by-case basis.





Federal Signal Corporation  
Industrial Products  
2645 Federal Signal Drive  
University Park, IL 60484-3167  
Phone: +1 877 289 3246 • +1 708-534-4756 • Fax: +1 708 534 4887  
[www.federal-signal-indust.com](http://www.federal-signal-indust.com) • [www.fs-isys.com](http://www.fs-isys.com)



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## La lumière DEL 191XL pour les endroits dangereux



---

### *Instructions d'installation et d'entretien*

2561421G  
REV. G 513  
Imprimé aux États-Unis





**Garantie** – Le vendeur offre pour tous les produits une garantie de cinq ans sur les pièces et de 2,5 ans sur la main-d’oeuvre, selon les conditions et exceptions suivantes : le vendeur garantit que tous les produits qu’il fabrique seront conformes aux descriptions correspondant aux spécifications qui font expressément partie de ce contrat de vente et qu’au moment de la vente par le vendeur, de tels produits devront être exempts de défauts de matériel et de fabrication. Le vendeur se réserve le droit, à sa discrétion, de « réparer et renvoyer » ou de « remplacer » tout article jugé défectueux durant la période de garantie. Cette garantie ne couvre pas les frais de voyage, le coût de l’équipement spécialisé pour avoir accès au produit ou les frais de main-d’oeuvre liés au retrait et à la réinstallation du produit. Cette garantie sera inopérante et ne s’appliquera pas aux produits qui ont subi un mauvais usage, une négligence, un accident, des dommages ou un entretien inapproprié, ou aux produits modifiés ou réparés par toute personne autre que le vendeur ou son représentant autorisé, ou si cinq ans se sont écoulés depuis la date de l’envoi des produits par le vendeur avec les exceptions suivantes : les lampes et les tubes stroboscopiques ne sont pas couverts par cette garantie. Les sirènes d’alarme extérieures et les appareils de contrôle fabriqués par Federal Warning Systems sont couverts par une garantie de deux ans sur les pièces et de un an sur la main-d’oeuvre. Aucun agent, employé, représentant ou distributeur du vendeur n’a autorité pour lier celui-ci à une représentation, affirmation ou garantie relative aux produits et une telle représentation, affirmation ou garantie ne pourra pas être considérée comme faisant partie des généralités du contrat de vente et sera inexécutable. LES GARANTIES CI-DESSUS SONT EXCLUSIVES ET TIENNENT LIEU DE TOUTES LES AUTRES GARANTIES DE QUALITÉ MARCHANDE, DE COMPATIBILITÉ À UN USAGE PARTICULIER OU D’UN AUTRE TYPE, QU’ELLES SOIENT EXPRESSES OU IMPLICITES. Ces garanties ne s’appliqueront pas si le vendeur n’a pas la possibilité raisonnable d’enquêter sur toutes les réclamations de produits présumés défectueux. À la demande du vendeur, un seul échantillon des produits présumés défectueux lui sera renvoyé pour inspection et approbation. La raison de toute réclamation pour des défauts présumés dans les produits ne pouvant être découverts après une inspection raisonnable en vertu du paragraphe 8 ci-contre doit être entièrement expliquée par écrit et reçue par le vendeur dans les trente jours après que l’acheteur a pris connaissance du défaut. Sinon, une telle réclamation sera considérée comme nulle.



### **Industrial Systems**

2645 Federal Signal Drive • University Park, IL 60484-3167  
Phone: 1-877-289-3246 • 1-708-534-4756 • Fax: 1-708-534-4887  
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## Contenu

<b>Messages de sécurité destinés aux installateurs .....</b>	<b>25</b>
<b>Tour d'horizon de la gamme 191XL .....</b>	<b>26</b>
<b>Déballage de la lumière.....</b>	<b>27</b>
<b>Installation de la lumière sur un tuyau (191XL).....</b>	<b>28</b>
<b>Installation de la lumière sur une surface (191XL-S) .....</b>	<b>30</b>
<b>Câblage de la lumière.....</b>	<b>31</b>
Schémas de câblage de 120-240 V à 277 V c.a.....	32
Schémas de câblage de 24 V c.a./c.c.....	32
<b>Messages de sécurité destinés au personnel d'entretien .....</b>	<b>32</b>
<b>Passer du mode clignotant au mode continu.....</b>	<b>34</b>
<b>Nettoyage de l'appareil .....</b>	<b>37</b>
<b>Lubrification du joint fileté .....</b>	<b>38</b>
<b>Commander des pièces de rechange.....</b>	<b>38</b>
<b>Faire appel au service de réparations et à l'assistance technique.....</b>	<b>39</b>
<b>Renvoi du produit pour obtention d'un crédit.....</b>	<b>39</b>

## Tableaux

<b>Tableau 1</b> Valeurs électriques.....	<b>27</b>
<b>Tableau 2</b> Données liées à l'environnement lors de l'installation.....	<b>28</b>
<b>Tableau 3</b> Plage de températures ambiantes et de fonctionnement.....	<b>28</b>
<b>Tableau 4</b> Pièces de rechange .....	<b>38</b>

**Figures**

**Figure 1** Lumière fixée sur un tuyau .....29

**Figure 2** Lumière fixée sur une surface .....30

**Figure 3** Retrait de la carte de circuit imprimé du boîtier .....35

**Figure 4** Emplacement du cavalier J3 sur la carte de circuit imprimé ...37

## **Messages de sécurité destinés aux installateurs**

### **⚠️ AVERTISSEMENT**

Bien suivre toutes les instructions fournies avec ce produit. Cet appareil doit être installé par un électricien qualifié qui connaît parfaitement le Code national de l'électricité et/ou le Code canadien de l'électricité, et suivra les directives du CNE et/ou du CCE, ainsi que des codes locaux. Cette lumière doit être considérée comme faisant partie du système d'avertissement et non comme le système lui-même.

Le choix du lieu d'installation de la lumière, de ses commandes et le passage des câbles doivent s'effectuer sous la direction de l'ingénieur des installations et de l'ingénieur de la sécurité. De plus, d'autres précautions et instructions importantes relatives à la sécurité et à observer figurent dans la liste ci-dessous :

- Bien lire et comprendre toutes les instructions avant d'installer ou d'utiliser cette lumière.
- Ne pas connecter cette lumière au système lorsque ce dernier est sous tension.
- Ne débrancher la lumière que si le circuit est sous tension ou si vous avez vérifié qu'il n'y a pas de concentrations de produits inflammables dans la zone. Lors du fonctionnement, la lumière doit être hermétiquement fermée.
- Après l'installation, s'assurer que toutes les vis de fixation et tous les joints filetés sont correctement serrés.
- Ne jamais modifier cet appareil de quelque façon que ce soit. Le fait de ménager d'autres ouvertures ou d'apporter d'autres modifications à des appareils spécialement conçus pour des emplacements dangereux peut compromettre la sécurité.
- Pour être un avertisseur efficace, ce produit émet une lumière vive pouvant être dangereuse pour la vue si elle est regardée de près. Ne pas regarder fixement et de près cet appareil lumineux car cela pourrait endommager de façon permanente la vision.

## ***Instructions d'installation et d'entretien***

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- Après l'installation, tester la lumière pour vérifier son bon fonctionnement.
- Maintenir l'appareil hermétiquement fermé pendant son fonctionnement.
- Une fois le test complété, distribuer une copie de ce livret d'instructions à tous les membres du personnel.
- Établir une procédure de vérification régulière de l'activation correcte et du bon fonctionnement de la lumière.

Le non-respect de toutes les précautions et instructions de sécurité peut provoquer des dommages à la propriété, des blessures graves voire la mort.

### **Tour d'horizon de la gamme 191XL**

Cet appareil ne convient qu'aux emplacements de la classe I, division 2, groupes A, B, C et D; de la classe II, division 1, groupes E, F et G; de la classe III OU aux emplacements non dangereux.

Cette lumière stroboscopique peut être montée sur un support LHWB de Federal Signal. Dans ce cas, l'installation finale n'est destinée qu'à des emplacements de la classe I, division 2, groupes A, B, C et D; de la classe II, division 2, groupes F et G; de la classe III.

La lumière DEL 191XL est un signal visuel homologué UL, conçu pour les conditions difficiles et les endroits dangereux. UL a effectué des tests concluants sur la protection 4X et IP66 de son boîtier. L'appareil est conçu pour être alimenté par un circuit de 100 V c.a. à 265 V c.a. à 50/60 Hz et 0,21 A, de 277 V c.a. à 50/60 Hz et 0,13 A, ou de 24 V c.c./V c.a. à 50/60 Hz et 0,40 A. Le modèle 191XL est proposé en rouge, ambre, vert, bleu et transparent. Par ailleurs, le 191XL est réglé en usine sur un rythme de 60 flashes par minute. Une option permet de placer la lumière DEL en mode continu. (Voir « Passer du mode clignotant au mode continu », page 34). Certains modèles se fixent sur un tuyau (191XL).

Ces appareils sont conçus pour être installés de manière permanente et être utilisés conformément aux dispositions du titre 46 du Code of Federal Regulations, parties 110 à 113, ou du titre 33 du même document, partie 183, sous-partie I, section 183.410, ainsi que des dispositions applicables de l'American Boat and Yacht Council, Inc. et/ou de la norme ANSI/NFPA 302 intitulée « Fire Protection Standard for Pleasure and Commercial Motor Craft ».

## Déballage de la lumière

### **⚠ AVERTISSEMENT**

***RISQUE D'EXPLOSION – S'ils sont abîmés, les dômes peuvent provoquer des explosions susceptibles d'entraîner des blessures graves, voire la mort.***

Après avoir déballé la lumière, l'inspecter pour vérifier qu'aucun dommage n'est survenu lors du transport. Si la lumière a été endommagée, ne pas essayer de l'installer ou de l'utiliser.

Déposer immédiatement une réclamation auprès du transporteur en précisant l'étendue des dégâts. Vérifier avec soin toutes les enveloppes, étiquettes d'expédition et autres étiquettes avant de les retirer ou de les détruire. La mise au rébus de tout matériel de transport doit être effectuée conformément aux normes et codes locaux et nationaux. En cas de pièces manquantes, communiquer avec le Service à la clientèle de Federal Signal au 708-534-4756 ou 877-289-3246.

**Tableau 1** Valeurs électriques

Tension de fonctionnement :	24 V c.c./c.a.	100-265, 277 V c.a.	277 V c.a.
Flash/minute :	60 FPM	60 FPM	60 FPM
Courant de fonctionnement maximum :	380 mA	210 mA	130 mA
Fréquence :	DC/50/60	50/60	50/60
Courant d'appel DC :	1,75 A à 24 V c.c. pour 5 ms		
Courant d'appel AC :	2,0 A à 85 V c.a. et 1,5 A à 265 et 277 V c.a. pour 0,25 ms		

## Instructions d'installation et d'entretien

**Tableau 2** Données liées à l'environnement lors de l'installation

Températures ambiantes de stockage : - 55 °C à + 70 °C
Type 4X (étanche à l'eau et résistant à la corrosion) et utilisation à l'intérieur/à l'extérieur
IP66 (protection anti-poussière et protection contre les fortes mers) et utilisation extérieure (eau de mer)
IP66 (protection anti-poussière et protection contre les fortes mers) et utilisation extérieure (eau de mer)

**Tableau 3** Plage de températures ambiantes et de fonctionnement

	Code de température ou température maximale, °C								
	40 °C ambiants			55 °C ambiants			66 °C ambiants		
Endroits dangereux	24 V	100–265 V c.a.	277 V c.a.	24 V	100–265 V c.a.	277 V c.a.	24 V	100–265 V c.a.	277 V c.a.
Classe I, division 2, groupes A, B, C et D	T6	T6	T5	T5	T5	T5	T4A	T4A	T5
Classe II, division 1, groupes E, F, et G	T6	T6	T6	T6	T6	T6	T6	T6	T6
Classe III	T6	T6	T6	T6	T6	T6	T6	T6	T6

## Installation de la lumière sur un tuyau (191XL)

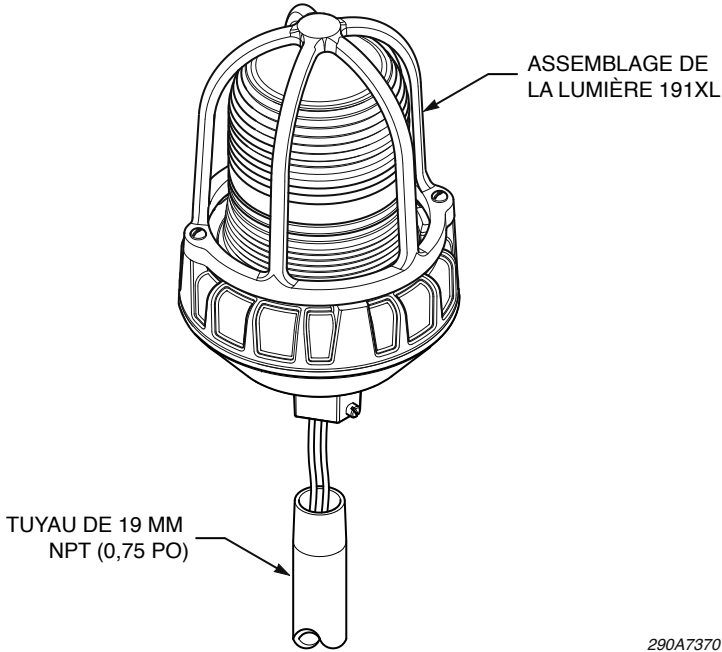
### **⚠ AVERTISSEMENT**

**RISQUES D'EXPLOSION** — *Pour réduire les risques d'incendie ou d'explosion, ne pas installer la lumière dans un endroit dangereux si la température de fonctionnement dépasse le point d'inflammation de l'atmosphère dangereuse. Avant toute chose, consulter la plaque signalétique du produit pour connaître la température de fonctionnement de la lumière.*

**REMARQUE** : Conformément à la section 300-14 du NEC, qui exige une longueur minimale de 15,25 cm (6 po) de conducteur libre au raccordement, le tuyau utilisé pour raccorder l'appareil au boîtier de branchement lors de l'installation du modèle 191XL ne doit pas dépasser 25,4 cm (10 po).

Le modèle 191XL est conçu pour être fixé sur un tuyau de 19 mm (0,75 po), dans n'importe quelle position.

**Figure 1** Lumière fixée sur un tuyau



1. Avant l'installation de la lumière, vérifier que les filets correspondants sont propres.
2. Pour empêcher l'eau et la poussière d'entrer dans l'appareil, appliquer du produit d'étanchéité aux filets du conduit avant l'installation. Si le produit d'étanchéité utilisé n'est pas conducteur, le boîtier doit être mis à la terre grâce au fil ou à la vis de mise à la terre interne prévu à cet effet, afin d'assurer la continuité correcte de la mise à la terre.
3. En cas d'installation du dôme vers le bas dans des milieux très humides, de la condensation peut apparaître dans les conduits. Utiliser des évacuations ou des joints pour conduits correctement adaptés afin que l'humidité ne puisse pas pénétrer dans l'appareil.



## Instructions d'installation et d'entretien

**IMPORTANT :** Pour éviter que le raccord ne se desserre, serrer l'appareil à un couple **MINIMUM** de 6,8 N·m (5 pi-lb) après le filetage dans le tuyau.

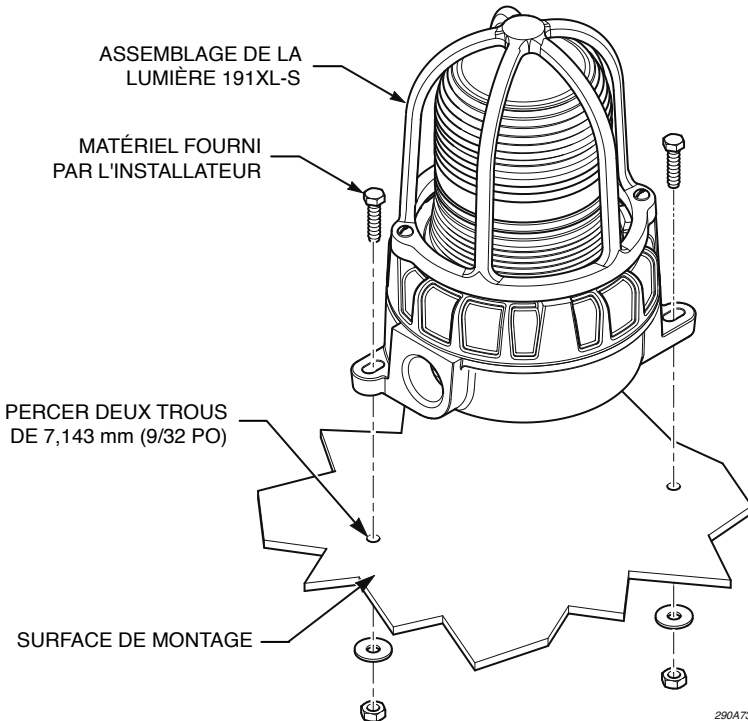
4. Visser l'appareil sur le tuyau de 19 mm (0,75 po) et le fixer à l'aide de la vis de fixation.

## Installation de la lumière sur une surface (191XL-S)

Pour fixer la lumière sur une surface :

1. Se servir de la base comme d'un modèle pour marquer l'emplacement des deux trous de fixation.
2. Percer un trou de 7,143 mm (9/32 po) à chaque emplacement.
3. Fixer la lumière sur la surface de montage à l'aide du matériel fourni par l'installateur.

**Figure 2** Lumière fixée sur une surface



## Câblage de la lumière

### **⚠️ AVERTISSEMENT**

**RISQUE DE CHOC ÉLECTRIQUE** — Afin d'éviter les dangers de chocs électriques, ne pas brancher de fil tant que l'alimentation est activée.

### **⚠️ AVERTISSEMENT**

**RISQUES D'EXPLOSION** — Ne débrancher la lumière que si le circuit est sous tension, ou si vous avez vérifié qu'il n'y a pas de concentration de produits inflammables dans la zone. Lors du fonctionnement, la lumière doit être hermétiquement fermée.

Le câblage doit être conforme aux dispositions du Code national de l'électricité ou du Code canadien de l'électricité et des dispositions des autorités locales compétentes.

La lumière à DEL de la gamme 191XL doit être installée conformément au Code national de l'électricité ou au Code canadien de l'électricité, aux CODES PROVINCIAUX et aux CODES LOCAUX. Pour procéder à l'installation à un autre endroit et/ou dans un autre sens, il vous faut l'approbation de l'autorité compétente. En outre, il est possible de fixer l'appareil à l'aide d'un montant pour plafond ou pour mur, offert en option.

### **⚠️ AVERTISSEMENT**

**RISQUE DE CHOC ÉLECTRIQUE** — Pour éviter les chocs électriques, ne pas brancher les fils lorsque l'appareil est sous tension.

**REMARQUE** : Le modèle 191XL qui est un modèle de 24 V est conçu pour fonctionner sous des tensions d'alimentation CA et CC. Le modèle de 120 à 240 V c.a. est conçu pour fonctionner sous des tensions comprises entre 100 V c.a. et 265 V c.a.

### **AVIS**

**POLARITÉ INVERSÉE/MAUVAIS BRANCHEMENT** — Bien qu'il ne soit pas polarisé, l'appareil 191XL PEUT S'ABÎMER s'il est mal branché. En particulier, il peut subir des dégâts en cas de dépassement de la tension nominale du modèle particulier.

**REMARQUE :** Pour effectuer des connexions sur le terrain à l'intérieur du boîtier de montage en surface, il faut retirer la carte de circuit imprimé du boîtier. Voir figure 3 page 35 et suivre les étapes 1 à 4 et 6 à 8 du chapitre « Passer du mode clignotant au mode continu » page 34, pour la procédure de retrait et d'installation de la carte de circuit imprimé.

Le boîtier de montage en surface ne convient pas aux conducteurs raccordés à une dérivation en passage continu.

### ***Schémas de câblage de 120-240 V à 277 V c.a.***

Les modèles de 120-240 V c.a. et 277 V c.a. sont fournis avec trois fils de 61 cm (24 po) : blanc, noir et vert/jaune. Connecter le fil noir au côté (chaud) de la phase de la source d'alimentation et le fil blanc au côté (neutre) commun de la source d'alimentation. Au besoin, le fil vert/jaune se trouvant à l'intérieur du boîtier est prévu pour la mise à la terre.

### ***Schémas de câblage de 24 V c.a./c.c.***

Les modèles de 24 V c.a./c.c. sont fournis avec deux fils de 61 cm (24 po), un rouge et un noir. Connecter le fil rouge (+) au côté positif ou (chaud) de la phase de la source d'alimentation et le fil noir (-) au côté négatif ou (neutre) commun de la source d'alimentation.

## **Messages de sécurité destinés au personnel d'entretien**

### **⚠ AVERTISSEMENT**

Les précautions et instructions de sécurité à suivre sont listées ci-dessous :

- Bien lire et comprendre toutes les instructions avant d'utiliser ce système.
- L'entretien du système lumineux doit s'effectuer lorsque l'alimentation est coupée.

- L'entretien de la lumière doit être exécuté par un électricien formé qui connaît bien les codes nationaux et locaux en vigueur du pays d'utilisation.
- Ne pas connecter cette lumière au système lorsque ce dernier est sous tension.
- Ne débrancher la lumière que si le circuit est sous tension ou si vous avez vérifié qu'il n'y a pas de concentrations de produits inflammables dans la zone. Lors du fonctionnement, la lumière doit être hermétiquement fermée.
- Ne jamais modifier cet appareil de quelque façon que ce soit. La sûreté de l'appareil peut être compromise si des composants internes ou le boîtier sont percés ou modifiés.
- La plaque signalétique NE DOIT PAS être masquée, car elle comporte des avertissements et/ou d'autres données importantes pour le personnel d'entretien. Si le boîtier extérieur est peint, veiller à ce que la plaque signalétique reste lisible.
- Si le dôme est abîmé d'une manière ou d'une autre, il FAUT le remplacer.
- Après avoir effectué l'entretien, tester le système lumineux pour s'assurer du bon fonctionnement de la lumière.

Le non-respect de toutes les précautions et instructions de sécurité peut provoquer des dommages à la propriété, des blessures graves voire la mort, à vous ou aux autres personnes.

## **Passer du mode clignotant au mode continu**

### **⚠️ AVERTISSEMENT**

**RISQUES D'EXPLOSION** — *Pour éviter l'inflammation en cas d'atmosphère dangereuse, débrancher l'appareil du circuit d'alimentation avant de l'ouvrir.*

### **⚠️ AVERTISSEMENT**

**RISQUES D'EXPLOSION** — *Ne débrancher la lumière que si le circuit est sous tension ou si vous avez vérifié qu'il n'y a pas de concentrations de produits inflammables dans la zone. Lors du fonctionnement, la lumière doit être hermétiquement fermée*

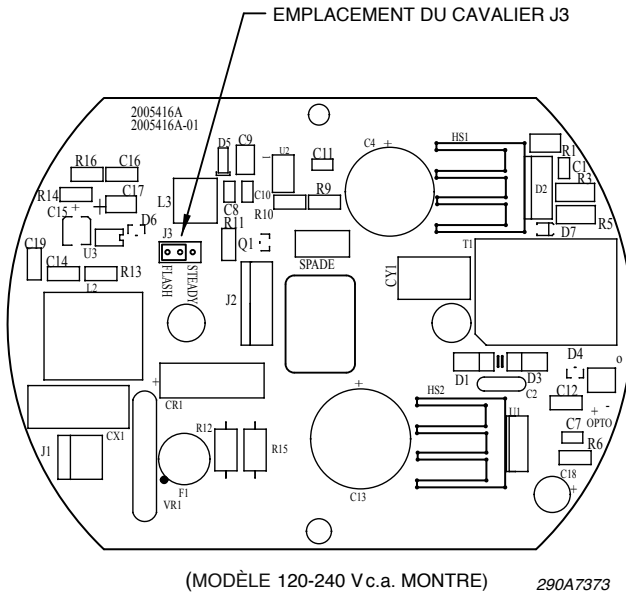
### **⚠️ AVERTISSEMENT**

**RISQUES D'EXPLOSION** — *Pour que le boîtier reste étanche à la vapeur, éviter d'abîmer le dôme ou les filets lors du démontage ou de l'assemblage de l'appareil. Lorsque les joints filetés lubrifiés restent longtemps exposés, ils peuvent attirer de petites particules de poussière ou d'autres matières. Les joints du boîtier et du couvercle doivent être remontés immédiatement et les filets vissés jusqu'au bout.*

Pour passer du mode continu par défaut au mode clignotant.

1. Débrancher la lumière.
2. Voir la figure 3 page 35. Désassembler le dôme fileté en le tournant dans le sens antihoraire.
3. À l'aide d'un tournevis cruciforme n° 2, retirer les deux vis à tête tronconique 8-32 en insérant la carte de circuit imprimé dans le boîtier moulé. S'assurer de serrer les deux douilles de vissage en nylon en isolant le support des vis.
4. Soulever doucement la carte de circuit imprimé du boîtier et la retourner pour accéder au côté composant de la carte de circuit imprimé.
5. Voir figure 4 page 37. Localiser le cavalier J3 et le soulever pour le retirer du réglage « Clignotant ». Repositionner le cavalier au-dessus des broches marquées « Continu ».

Figure 3 Retrait de la carte de circuit imprimé du boîtier



6. Replacer la carte de circuit imprimé dans le boîtier, en s'assurant que les quatre coussinets isolants sont placés entre le support en métal et le boîtier moulé. Le support doit être orienté de manière à ce que l'encoche dans le support soit alignée avec la vis de mise à la terre dans le boîtier moulé. Il faut suivre attentivement cette étape pour empêcher les arcs électriques et les ruptures électriques.
7. Glisser deux vis à tête tronconique 8-32 dans les douilles de vissage et serrer les vis pour bien fixer la carte de circuit imprimé dans le boîtier moulé.
8. Fileter de nouveau le dôme dans le boîtier en le tournant dans le sens horaire afin de le serrer.

**⚠ AVERTISSEMENT**

**RISQUE DE CHOC ÉLECTRIQUE** – Afin d'éviter les dangers de chocs électriques, ne pas brancher de fil tant que l'alimentation est activée

## Instructions d'installation et d'entretien

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- Rebrancher la lumière.
- Tester l'appareil en branchant l'alimentation et en vérifiant le fonctionnement continu de la lampe à DEL.

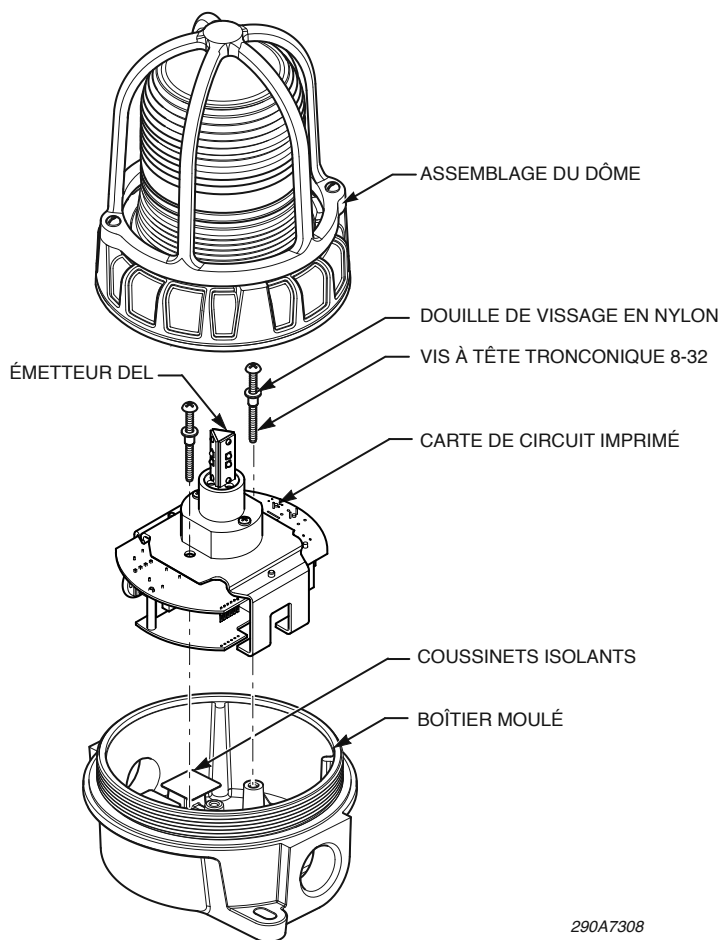
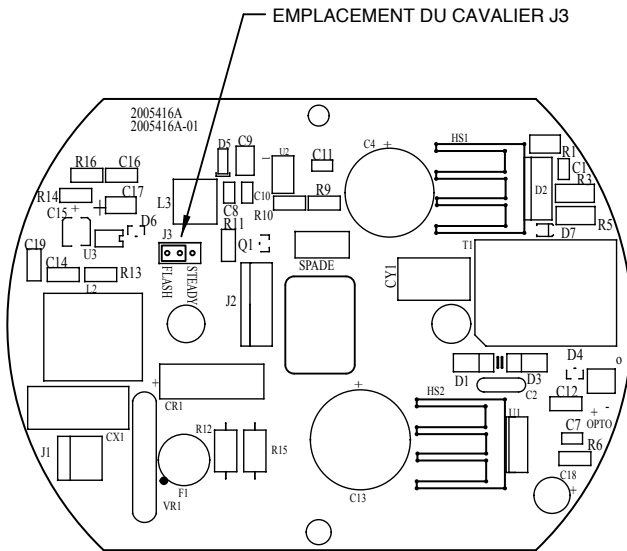


Figure 4 Emplacement du cavalier J3 sur la carte de circuit imprimé



(MODÈLE 120-240 V c.a. MONTRE)

290A7373

## Nettoyage de l'appareil

### ⚠ AVERTISSEMENT

**RISQUES D'EXPLOSION**—*Ne jamais utiliser une matière ou une lime abrasive pour éliminer des substances corrosives sur les surfaces filetées. En cas de très forte corrosion, il faut inspecter régulièrement l'équipement pour le protéger d'une détérioration anormale et éviter qu'il devienne poreux, ce qui pourrait affaiblir la structure du boîtier.*

Il est parfois nécessaire de laver les appareils d'éclairage au jet d'eau pour bien les nettoyer. Dans ce cas, il faut couper le circuit d'alimentation électrique avant de procéder au nettoyage.

Pour conserver une émission lumineuse maximale, il faut nettoyer l'appareil périodiquement. Seuls les produits de nettoyage doux et non abrasifs sont autorisés. Il faut inspecter régulièrement le dôme de verre à la recherche d'éraflures et d'éclats. S'il est abîmé, il FAUT le remplacer.



## **Lubrification du joint fileté**

Le joint fileté du couvercle doit toujours rester bien lubrifié à l'aide d'une graisse anticorrosion, comme de la gelée de pétrole ou de l'huile minérale épaissie par un savon. Si le solvant ne suffit pas à retirer la corrosion accumulée sur les joints filetés, il faut jeter les pièces et les remplacer.

## **Commander des pièces de rechange**

### **⚠ AVERTISSEMENT**

***RISQUES D'EXPLOSION – Il se peut qu'un appareil dont les composants ont été remplacés ne convienne plus à l'utilisation de classe I, division 2.***

Les pièces de rechange courantes sont énumérées au tableau 4. Pour des raisons de certification, les pièces de certains composants ne peuvent pas être remplacées sur place. Dans ce cas, l'appareil au complet doit être remplacé ou renvoyé à Federal Signal pour y être réparé. Pour commander des pièces de rechange, communiquer avec le Service à la clientèle de Federal Signal au 708-534-4756 ou au 877-289-3246.

**Tableau 4** Pièces de rechange

<b>Description</b>	<b>Numéro de pièce</b>
Dôme, ambre	K8449078-01
Dôme, bleu	K8449078-06
Dôme, transparent	K8449078-04
Dôme, vert	K8449078-07
Dôme, rouge	K8449078
Joint statique	K8449080
Graisse, tube de 226 g (8 oz)	KR81-05-01
Protecteur de dôme	K8449090
Émetteur DEL, ambre	K14700030-A
Émetteur DEL, bleu	K14700030-B
Émetteur DEL, vert	K14700030-G
Émetteur DEL, rouge	K14700030-R
Émetteur DEL, blanc	K14700030-W

## **Faire appel au service de réparations et à l'assistance technique**

Les produits renvoyés pour réparation doivent être accompagnés d'un formulaire d'autorisation de renvoi. Pour obtenir le service de réparations ou l'assistance technique pour ce produit, communiquer avec Federal Signal au 708-534-4756 ou au 877-289-3246. Pour des manuels d'instruction et des données relatives aux produits connexes, visiter le site : <http://www.federal-signal-indust.com>

## **Renvoi du produit pour obtention d'un crédit**

Les produits renvoyés doivent être accompagnés d'une autorisation de renvoi accordée par le distributeur local avant le renvoi du produit chez Federal Signal. Communiquer avec le distributeur pour obtenir de l'aide.

Un produit peut être renvoyé avec obtention d'un crédit si les conditions suivantes sont remplies :

- Le produit est revendable et est renvoyé dans son emballage d'origine
- Le produit n'a pas encore été installé
- Le produit est le modèle le plus récent
- Le produit n'a jamais été réparé
- Le produit est un produit standard
- Le produit n'est pas une pièce détachée

Tous les renvois de produits font l'objet de frais de restockage.

Les produits défectueux renvoyés au cours de la période de garantie seront réparés ou remplacés à la seule discrétion de Federal Signal. Les produits dont la lampe est défectueuse ne sont pas considérés comme des produits défectueux.

Toute demande autre que celle citée ci-dessus sera examinée au cas par cas.



**Industrial Products**

2645 Federal Signal Drive

University Park, IL 60484-3167

Phone: 1-877-289-3246 • 1-708-534-4756 • Fax: 1-708-534-4887

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**FEDERAL SIGNAL**

Safety and Security Systems / Industrial

*Advancing security and well-being.*

## **Baliza LED Modelo 191XL para operación en ubicaciones peligrosas**



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### ***Manual de instalación y mantenimiento***

2561421G  
REV. G 513  
*Impreso en los EE. UU.*



**Garantía:** El vendedor garantiza todos los productos por cinco años para las piezas y por 2-1/2 años para la mano de obra, bajo las siguientes condiciones y excepciones: El Vendedor garantiza que todos los productos fabricados por el Vendedor se ajustarán a las descripciones de los mismos para especificaciones que expresamente forman parte de este contrato de venta y en el momento de la venta por parte del Vendedor tales productos estarán comercialmente libres de defectos en material o mano de obra. El Vendedor se reserva el derecho, a criterio del Vendedor, de “Reparar y devolver” o “Reemplazar” cualquier elemento considerado defectuoso durante el período de garantía. Esta garantía no cubre gastos de viaje, el costo de equipos especializados para obtener acceso al producto ni los cargos de mano de obra por la extracción y la nueva instalación del producto. Esta garantía no tendrá validez y no será de aplicación a productos que hayan sido sometidos a uso incorrecto, descuido, accidente, daño, mantenimiento incorrecto o productos alterados o reparados por otra persona que no sea el Vendedor o su representante autorizado, o si han transcurrido cinco años desde la fecha de envío del producto por parte del Vendedor, con las excepciones siguientes: las lámparas y los tubos estroboscópicos no están cubiertos por esta garantía. Las sirenas de advertencia y los controladores externos fabricados por Federal Warning Systems cuentan con garantía de dos años sobre las piezas y de un año sobre la mano de obra. Ningún agente, empleado, representante o distribuidor del Vendedor tiene autorización de obligar al Vendedor frente a ninguna declaración, afirmación o garantía relacionada con los productos y tal declaración, afirmación o garantía no se considerará parte de los elementos básicos del contrato de venta y no será exigible. LAS GARANTÍAS ANTERIORES SON EXCLUSIVAS Y REEMPLAZAN TODA OTRA GARANTÍA DE COMERCIALIZACIÓN, DE IDONEIDAD PARA UN PROPÓSITO Y DE CUALQUIER TIPO, YA SEA EXPRESA O IMPLÍCITA. Estas garantías no serán de aplicación a menos que el Vendedor reciba una oportunidad razonable de investigar todos los reclamos por mercaderías supuestamente defectuosas. Ante la indicación del Vendedor, se devolverá una sola muestra de los productos defectuosos al Vendedor para su inspección y aprobación. La base de todos los reclamos por supuestos defectos en los productos que no se descubra ante la inspección razonable de los mismos en virtud del párrafo 8 del presente debe explicarse totalmente por escrito y debe ser recibida por el Vendedor dentro de los treinta días posteriores a que el Comprador tome conocimiento del defecto o tal reclamo se considerará caducado.



### **Industrial Systems**

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# Contenido

<b>Mensajes de seguridad para los instaladores</b> .....	<b>45</b>
<b>Descripción de la Serie 191XL</b> .....	<b>46</b>
<b>Desembalaje de la baliza</b> .....	<b>47</b>
<b>Montaje de la baliza en tubo (191XL)</b> .....	<b>48</b>
<b>Montaje de la baliza en superficie (191XL-S)</b> .....	<b>50</b>
<b>Cableado de la baliza</b> .....	<b>51</b>
Cableado Modelos de 120-240 Vca et 277 Vca .....	52
Cableado Modelos de 24 Vca/cc .....	52
<b>Mensaje de seguridad para el personal de mantenimiento</b> .....	<b>52</b>
<b>Cambio de modo de parpadeo al modo de encendido permanente</b> .....	<b>53</b>
<b>Limpieza del artefacto</b> .....	<b>57</b>
<b>Lubricación de la unión roscada</b> .....	<b>57</b>
<b>Pedido de piezas de repuesto</b> .....	<b>57</b>
<b>Obtención de servicio de reparación y asistencia técnica</b> .....	<b>58</b>
<b>Devolución del producto para obtener crédito</b> .....	<b>59</b>

## Tablas

<b>Tabla 1</b> Clasificación eléctrica.....	<b>47</b>
<b>Tabla 2</b> Clasificación ambiental de la instalación.....	<b>48</b>
<b>Tabla 3</b> Rango de temperatura ambiente y de funcionamiento .....	<b>48</b>
<b>Tabla 4</b> Piezas de repuesto.....	<b>58</b>

**Figuras**

**Figura 1** Baliza montada en tubo.....49

**Figura 2** Baliza montada en superficie .....50

**Figura 3** PCB extraído de la carcasa.....55

**Figure 4** Ubicación del puente J3 en el PCB.....56

## **Mensajes de seguridad para los instaladores**

### **⚠️ ADVERTENCIA**

Es importante seguir todas las instrucciones enviadas con este producto. Este dispositivo debe ser instalado por un electricista capacitado completamente familiarizado con el Código Eléctrico Nacional y/o el Código Eléctrico de Canadá y que siga los lineamientos NEC y/o CEC y todos los códigos locales. Esta baliza debe considerarse parte del sistema de advertencia y no el sistema de advertencia completo.

La selección de la ubicación de montaje de la baliza, sus controles y la colocación del cableado deben realizarse bajo la dirección del ingeniero de la planta y del ingeniero de seguridad. Asimismo, a continuación se incluyen algunas instrucciones y precauciones importantes de seguridad que debe seguir:

- Lea y comprenda todas las instrucciones antes de instalar y poner en funcionamiento esta baliza.
- No conecte esta baliza al sistema cuando esté encendido.
- No desconectar la baliza mientras el circuito esté vivo o a menos que se conozca que el área está libre de concentraciones inflamables. Mantenga la baliza bien cerrada durante la operación.
- Después de la instalación, asegúrese de que todos los tornillos de fijación y las uniones roscadas estén debidamente ajustadas.
- No altere nunca la unidad de ninguna forma. La seguridad en sitios peligrosos puede estar en riesgo si se realizan aberturas adicionales u otras alteraciones en unidades específicamente diseñadas para usarse en estas ubicaciones.
- Para ser un dispositivo de advertencia efectivo, este producto produce una baliza brillante que puede ser peligrosa para la vista si se mira desde una distancia corta. No mire directamente hacia este producto de iluminación desde una distancia corta, ya que pueden producirse daños permanentes a la visión.



## ***Instrucciones de instalación y mantenimiento***

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- Después de la instalación, pruebe la baliza para asegurarse de que funcione correctamente.
- Mantenga la unidad bien cerrada durante la operación.
- Una vez que haya finalizado la prueba, entregue una copia de este cuadernillo de instrucciones a todo el personal.
- Establezca un procedimiento para verificar periódicamente la baliza a fin de comprobar la activación y el funcionamiento apropiados.

Si todas estas precauciones de seguridad e instrucciones no se observan, pueden ocasionarse daños a los bienes, lesiones graves o incluso la muerte.

### **Descripción de la Serie 191XL**

Este equipo es adecuado para usar solamente en ubicaciones de Clase I, División 2, Grupos A, B, C y D; Clase II, División 1, Grupos E, F y G; Clase III O ubicaciones no peligrosas.

Esta luz estroboscópica puede montarse en un soporte Modelo LHWB de Federal Signal. Si se instala de esta forma, todo el dispositivo ensamblado es adecuado solo para ubicaciones de Clase I, Div. 2, Grupos A, B, C y D; Clase II, Div. 2, Grupos F y G; Clase III.

La baliza LED Modelo 191XL es una señal visual homologada por UL para operación en entornos difíciles y ubicaciones peligrosas; ha sido investigada por UL y cumple con los requisitos de unidad de Tipo 4X e IP66. La unidad cuenta con una clasificación de operación de 100 Vca a 265 Vca, 50/60 Hz; 0,21 A, 277 Vca, 50/60 Hz; 0,13 A o 24 Vcc/ca 50/60 Hz, 0,40 A. El 191XL puede incluir los colores rojo, ámbar, verde, azul y transparente. El 191XL está configurado de fábrica para funcionar a 60 parpadeos/minuto. Existe la opción de operar la baliza LED en el modo de encendido permanente. (Ver “Cambio del modo de parpadeo al modo de encendido permanente” en la página 53). Los modelos están disponibles para montaje en tubo (191XL) o montaje en superficie (191XL-S).

Estos dispositivos están destinados para su instalación permanente y operación de acuerdo con el Título 46, Código de Reglamentaciones Federales, Partes 110–113, o el Título 33, Código de Reglamentaciones Federales, Parte 183, Subparte I, Sección 183.410, y los requisitos correspondientes de American Boat and Yacht Council, Inc., y/o ANSI/NFPA 302, “Norma de Protección contra Incendios para Vehículos de Placer y Comerciales”.

### Desembalaje de la baliza

#### **▲ ADVERTENCIA**

**RIESGO DE EXPLOSIONES:** *Las cúpulas dañadas pueden ocasionar explosiones que podrían resultar en lesiones serias o la muerte.*

Después de desembalar la baliza, examínela para detectar daños que puedan haber ocurrido durante el tránsito. Si la baliza se ha dañado, no intente instalarla ni ponerla en funcionamiento. Presente un reclamo de inmediato al transportista, indicando la medida de los daños. Con cuidado, inspeccione todos los sobres, las etiquetas de envío y los rótulos antes de retirarlos o descartarlos. El desecho de todos los materiales de envío debe realizarse de acuerdo con los códigos y normas nacionales y locales. Si falta alguna pieza, contacte al Servicio de Asistencia al Cliente de Federal Signal al 708-534-4756 o 877-289-3246.

**Tabla 1** Clasificación eléctrica

Voltaje de funcionamiento:	24 Vcc/ca	100–265, 277 Vca	277 Vca
Parpadeos/minuto:	60 FPM	60 FPM	60 FPM
Corriente máxima de funcionamiento:	380 mA	210 mA	130 mA
Frecuencia:	CC/50/60	50/60	50/60
Corriente CC de entrada:	1,75 A a 24 Vcc por 5 ms		
Corriente CA de entrada:	2,0 A a 85 Vca y 1,5 A a 265 y 277 Vca por 0,25 ms		

**Instrucciones de instalación y mantenimiento**

**Tabla 2** Clasificación ambiental de la instalación

Clasificación de almacenamiento a temperatura ambiente: -55 °C a + 70 °C
Clasificación de funcionamiento a temperatura ambiente: -50 °C a + 66 °C
Tipo 4X (impermeable y resistente a la corrosión) y uso en interiores/ exteriores
IP66 (a prueba de polvo y con protección contra mares agitados) y tipo externo (agua salada)

**Tabla 3** Rango de temperatura ambiente y de funcionamiento

	Código de temperatura o temperatura máxima, °C								
	40 °C Ambiente			55 °C Ambiente			66 °C Ambiente		
<b>Hazardous Locations</b>	24 V	100–265 Vca	277 Vca	24 V	100–265 Vca	277 Vca	24 V	100–265 Vca	277 Vca
Clase I, Div. 2, Grupos A, B, C y D	T6	T6	T5	T5	T5	T5	T4A	T4A	T5
Clase II, División 1, Grupos E, F y G	T6	T6	T6	T6	T6	T6	T6	T6	T6
Clase III	T6	T6	T6	T6	T6	T6	T6	T6	T6

**Montaje de la baliza en tubo (191XL)**

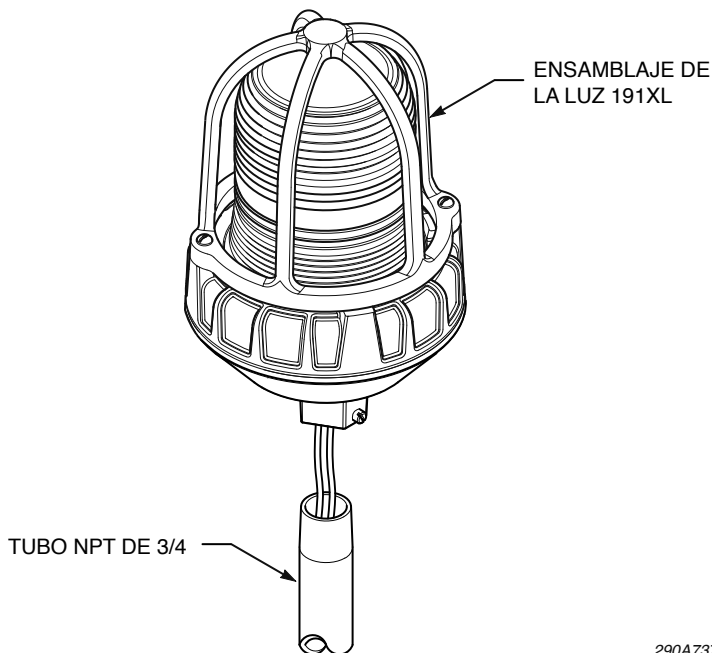
**⚠ ADVERTENCIA**

**RIESGO DE EXPLOSIONES:** Para reducir el riesgo de incendio o explosión, no instale la baliza en una ubicación peligrosa si la temperatura de funcionamiento excede la temperatura de ignición de atmósferas peligrosas. Antes de continuar, consulte la placa de identificación del producto y determine la temperatura de funcionamiento de la baliza.

**NOTA:** Para cumplir con la Sección 300-14 del NEC que requiere un mínimo de 15,25 cm (6 pulgadas) de conductor libre en las conexiones, al montar el Modelo 191XL, el tubo de montaje usado para unir la unidad a una caja de empalme no debe tener más de 25,4 cm (10 pulgadas).

El Modelo 191XL puede montarse en un tubo de 3/4" y puede montarse en cualquier posición.

**Figura 1** Baliza montada en tubo



290A7375

1. Antes de montar la baliza, asegúrese de que las roscas de acople estén limpias.
2. Para prevenir el ingreso de agua y de polvo, aplique sellador conductivo en las roscas de los conductos antes de montar. Si se usa sellador no conductivo, el gabinete debe conectarse a tierra a través del cable interno de tierra/tornillo de puesta a tierra para asegurar una continuidad correcta de la conexión a tierra.
3. En ambientes de alta humedad, cuando las unidades se montan con la cúpula hacia abajo, puede producirse condensación en el sistema de conductos. Use sellos/drenajes de conductos de la clasificación correcta para impedir que la humedad ingrese en el artefacto.

## Instrucciones de instalación y mantenimiento

**IMPORTANTE:** Para impedir que la conexión se afloje, ajuste el artefacto a una torsión MÍNIMA de 5 ft-lb (6,8 N·m) después de enroscarlo en el tubo.

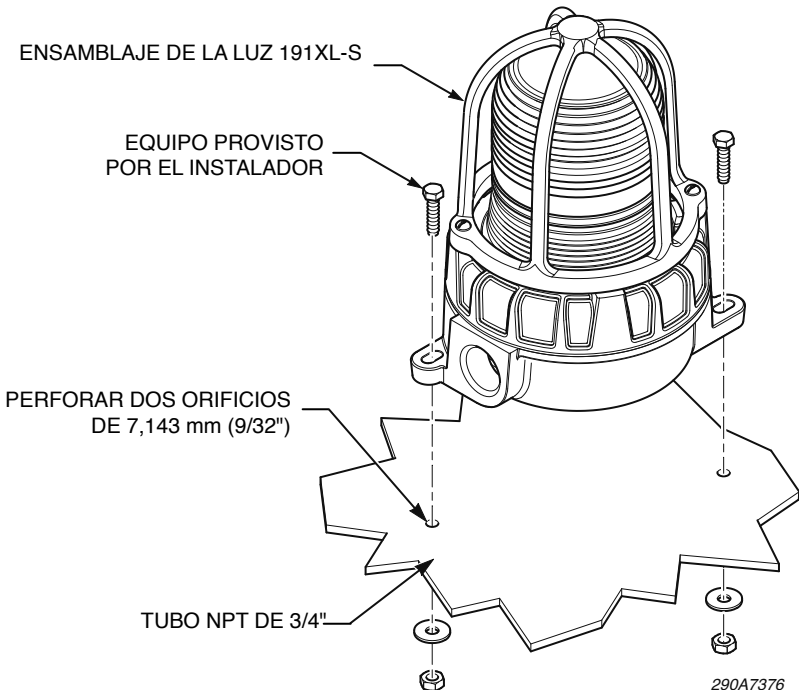
4. Enrosque el artefacto en el tubo de 3/4" y sujételo con el tornillo de fijación.

### Montaje de la baliza en superficie (191XL-S)

Para montar la baliza en superficie:

1. Use la base de montaje como plantilla para marcar la ubicación de los dos orificios de montaje.
2. Perfore un orificio de 7,143 mm (9/32 pulgadas) en cada marca.
3. Sujete la baliza a la superficie de montaje con el equipo provisto por el instalador.

**Figura 2** Baliza montada en superficie



## Cableado de la baliza

### **⚠ ADVERTENCIA**

**RIESGO DE DESCARGA ELÉCTRICA:** Para evitar riesgos de descarga eléctrica, no conecte los cables mientras se recibe corriente.

### **⚠ ADVERTENCIA**

**RIESGO DE EXPLOSIONES:** No desconectar la baliza mientras el circuito esté vivo o a menos que se conozca que el área está libre de concentraciones inflamables. Mantenga la baliza bien cerrada durante la operación.

El cableado debe cumplir con el Código Eléctrico Nacional o el Código Eléctrico Canadiense y la autoridad local con jurisdicción.

La baliza LED Modelo 191XL debe instalarse según el código NEC o CEC, y los CÓDIGOS ESTATALES y LOCALES. La elección de sitios y/u orientaciones de instalación alternativa solo debe realizarse con la aprobación de la autoridad con jurisdicción. Asimismo, la unidad puede montarse usando un montaje opcional en cielo raso o un montaje opcional en muro.

### **⚠ ADVERTENCIA**

**RIESGO DE DESCARGA ELÉCTRICA:** Para evitar riesgos de descarga eléctrica, no conecte los cables mientras se recibe corriente.

**NOTA:** Los Modelos 191XL de 24 V están diseñados para operar con voltaje de corriente CA y CC. El modelo de 120-240 Vca debe operar de 100 Vca a 265 Vca a 50/60 Hz. Vea la Tabla 1 en la página 47 para conocer la clasificación eléctrica.

### **AVISO**

**POLARIDAD INVERSA/CABLEADO INCORRECTO:** El 191XL no es sensible a la polaridad, pero PUEDE DAÑARSE por una conexión eléctrica incorrecta. Se producirán daños si se excede la clasificación de voltaje del modelo en particular.

**NOTA:** Las terminaciones en campo dentro de la unidad de montaje en superficie requerirán retirar la unidad del circuito impreso (PCB, por sus siglas en inglés) de la carcasa. Vea la Figura 3 en la página 55 y siga los pasos 1–4 y 6–8 de “Cambio de modo de parpadeo a modo de encendido permanente” en la página 53 para conocer el proceso de extracción e instalación del PCB.

La unidad de montaje en superficie no es adecuada para usar con conductores de circuito derivado pasante.

### ***Cableado Modelos de 120-240 Vca et 277 Vca***

Los modelos de 120-240 Vca y 277 Vca cuentan con tres cables de 24 pulgadas: blanco, negro y verde/amarillo. Conecte el cable negro al lado de la fase (caliente) de la fuente de alimentación y el cable blanco al lado común (neutro) de la fuente de alimentación. De ser necesario, el cable verde/amarillo en la carcasa se incluye para la conexión a tierra.

### ***Cableado Modelos de 24 Vca/cc***

Los modelos de 24 Vca/cc cuentan con dos cables de 24", uno rojo y uno negro. Conecte el cable rojo (+) al lado positivo o de la fase (caliente) de la fuente de alimentación y el cable negro (–) al lado negativo o común (neutro) de la fuente de alimentación.

## **Mensaje de seguridad para el personal de mantenimiento**

### **▲ ADVERTENCIA**

A continuación se incluyen algunas instrucciones y precauciones importantes de seguridad que debe seguir:

- Lea y comprenda todas las instrucciones antes de poner en funcionamiento este sistema.
- Cualquier mantenimiento del sistema de luces debe realizarse con la unidad apagada.

- Todo mantenimiento del sistema de luces debe ser realizado por un electricista capacitado que conozca en detalle todos los códigos nacionales y locales de aplicación en el país de uso.
- No conecte esta baliza al sistema cuando esté encendido.
- No desconectar la baliza mientras el circuito esté vivo o a menos que se conozca que el área está libre de concentraciones inflamables. Mantenga la baliza bien cerrada durante la operación.
- No altere nunca la unidad de ninguna forma. La seguridad de la unidad puede verse afectada si se realizan aberturas adicionales u otras alteraciones a los componentes internos o a la carcasa.
- La placa de identificación NO debe quedar oculta, ya que contiene información de precaución u otra información de importancia para el personal de mantenimiento. Asegúrese de que la placa de identificación se pueda leer si se pinta la carcasa exterior.
- Si la cúpula se daña de alguna manera, DEBE reemplazarse.
- Después de realizar trabajos de mantenimiento, pruebe el sistema de la luz para asegurarse de que funcione correctamente.

Si todas estas precauciones de seguridad e instrucciones no se observan, pueden ocasionarse daños a los bienes, lesiones graves o incluso la muerte a usted o a los demás.

### **Cambio de modo de parpadeo al modo de encendido permanente**

#### **⚠ ADVERTENCIA**

***RIESGO DE EXPLOSIONES: Para prevenir la ignición de atmósferas peligrosas, desconecte el artefacto del circuito de alimentación antes de abrirlo.***



### **⚠️ ADVERTENCIA**

**RIESGO DE EXPLOSIONES:** *No desconectar la baliza mientras el circuito esté vivo o a menos que se conozca que el área está libre de concentraciones inflamables. Mantenga la baliza bien cerrada durante la operación.*

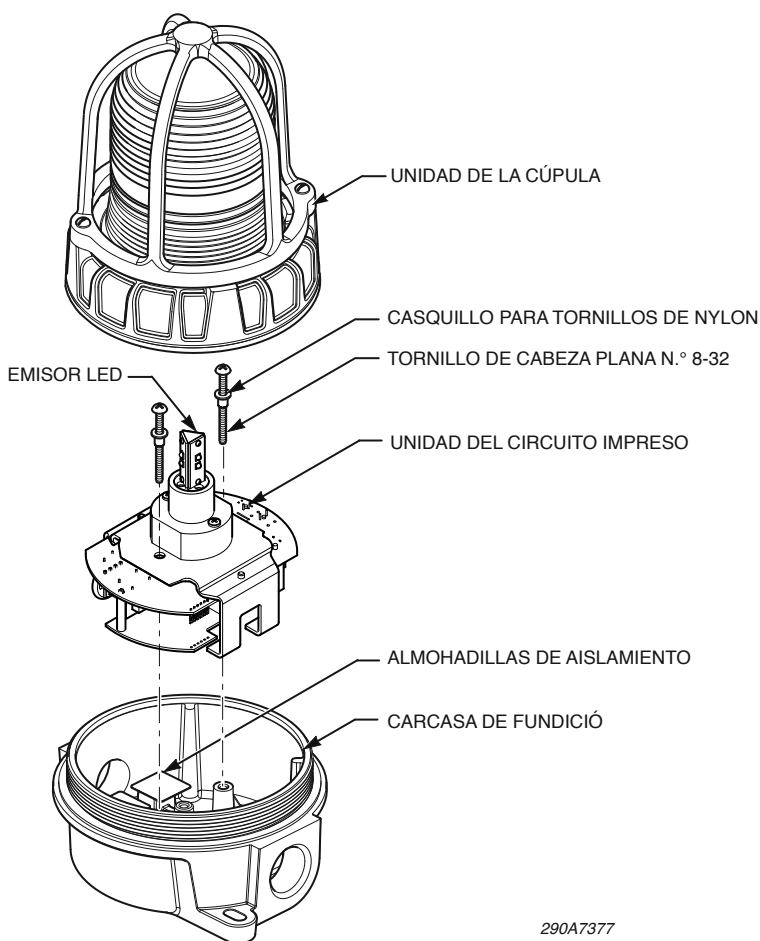
### **⚠️ ADVERTENCIA**

**RIESGO DE EXPLOSIONES:** *Para mantener la unidad impermeable al vapor, no dañe la cúpula ni las roscas mientras desensambla o vuelve a ensamblar la unidad. Las uniones roscadas lubricadas expuestas por períodos prolongados de tiempo pueden atraer pequeñas partículas de polvo u otros materiales extraños. La carcasa y las uniones de la cubierta deben volver a ensamblarse de inmediato, con todas las roscas totalmente acopladas.*

Para cambiar del modo de encendido permanente predeterminado al modo de parpadeo.

1. Desconecte la corriente eléctrica de la baliza.
2. Vea la Figura 3 en la página 56. Retire la unidad de la cúpula roscada girándola en sentido antihorario.
3. Con un destornillador Phillips N.º 2, retire los dos tornillos de cabeza plana N.º 8-32 que sujetan la unidad del circuito impreso a la carcasa de fundición. Asegúrese de sujetar los dos casquillos para tornillos de nylon que aíslan el soporte de los tornillos.
4. Levante suavemente la unidad del circuito impreso (PCB) de la carcasa y gire la unidad para acceder al lado de los componentes del circuito impreso.
5. Vea la Figura 4 en la página 56. Ubique el puente J3 y levante el puente para quitarlo de la configuración “Flash” [Parpadeo]. Vuelva a colocar el puente sobre las clavijas denominadas “Steady” [Encendido permanente].

**Figura 3** PCB extraído de la carcasa



6. Coloque la unidad del circuito impreso nuevamente en la carcasa, asegurándose de que las cuatro almohadillas de aislamiento se asienten entre el soporte de metal y la carcasa de fundición. El soporte debe orientarse de tal forma que la muesca en el soporte se alinee con el tornillo de puesta a tierra en la carcasa de fundición. Este paso debe seguirse atentamente para impedir la formación de arco eléctrico y la falla dieléctrica.

## Instrucciones de instalación y mantenimiento

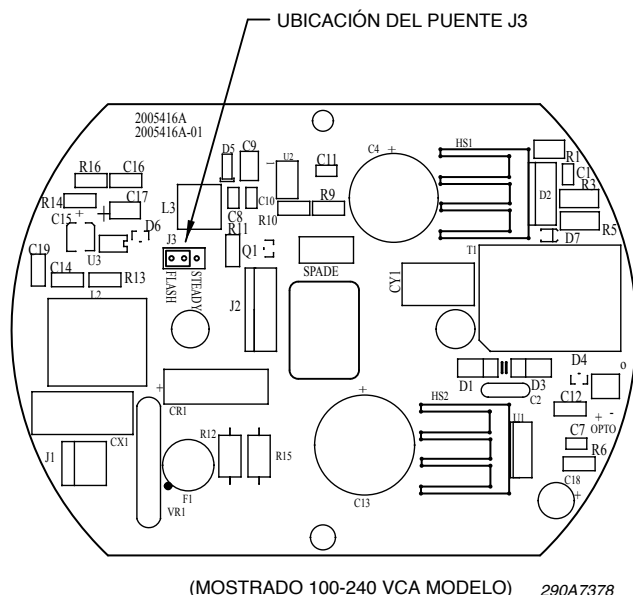
7. Deslice dos tornillos de cabeza plana N.º 8-32 en los casquillos para tornillos y ajuste los tornillos para sujetar la unidad del circuito impreso a la carcasa de fundición.
8. Enrosque la unidad de la cúpula nuevamente en la carcasa girándola en el sentido horario, y ajústela.

### ⚠ ADVERTENCIA

**RIESGO DE DESCARGA ELÉCTRICA:** Para evitar riesgos de descarga eléctrica, no conecte los cables mientras se recibe corriente.

9. Vuelva a conectar la corriente eléctrica de la baliza.
10. Pruebe el dispositivo aplicando energía y verificando la operación permanente de la lámpara LED.

**Figure 4** Ubicación del puente J3 en el PCB



## **Limpieza del artefacto**

### **⚠️ ADVERTENCIA**

***RIESGO DE EXPLOSIONES: Nunca use un material abrasivo ni una lima para retirar materiales corrosivos de las superficies roscadas. En ubicaciones extremadamente corrosivas, deben inspeccionarse periódicamente los equipos para protegerlos contra el deterioro inusual y la posible porosidad, ya que esto puede debilitar el gabinete estructuralmente.***

Los procedimientos de mantenimiento en ocasiones requieren que los artefactos se limpien con una manguera para un buen mantenimiento. El circuito debe apagarse antes de desconectar los cables del artefacto.

El artefacto debe limpiarse periódicamente para mantener una salida máxima de luz. Solo deben usarse agentes de limpieza neutros, no abrasivos. La cúpula de vidrio debe inspeccionarse periódicamente para detectar rayones y muescas y, si está dañada, DEBE reemplazarse

## **Lubricación de la unión roscada**

La unión roscada en la cubierta debe mantenerse bien lubricada con grasa que inhiba la corrosión, tal como aceite mineral de petrolato o espesado con jabón. Si se acumularon materiales corrosivos en las uniones roscadas y no se pueden retirar con solventes, las piezas deben desecharse y reemplazarse.

## **Pedido de piezas de repuesto**

### **⚠️ ADVERTENCIA**

***RIESGO DE EXPLOSIONES: El reemplazo de componentes puede perjudicar la idoneidad para Clase I, División2.***

Las piezas de repuesto típicas se enumeran en la Tabla 4, en la página 58. Debido a la certificación, ciertas piezas de componentes no están disponibles para su reemplazo en el campo. Las unidades con este tipo de daño debe ser reemplazadas totalmente o devueltas a Federal Signal para su servicio. Para pedir piezas de repuesto, contacte al Servicio de Asistencia al Cliente de Federal Signal al 708-534-4756 o al 877-289-3246.

## **Obtención de servicio de reparación y asistencia técnica**

### **⚠️ ADVERTENCIA**

**RIESGO DE EXPLOSIONES: El reemplazo de componentes puede perjudicar la idoneidad para Clase I, División 2.**

Los productos devueltos para reparación requieren un formulario de Autorización de devolución. Para obtener un servicio de reparación o asistencia técnica para el producto, llame a Federal Signal al 708-534-4756 o al 877-289-3246.

Para obtener manuales de instrucciones e información sobre productos relacionados, visite: <http://www.federalsignal-indust.com>.

**Tabla 4** Piezas de repuesto

<b>Descripción</b>	<b>Número de pieza</b>
Unidad de la cúpula, ámbar	K8449078-01
Unidad de la cúpula, azul	K8449078-06
Unidad de la cúpula, transparente	K8449078-04
Unidad de la cúpula, verde	K8449078-07
Unidad de la cúpula, rojo	K8449078
Junta	K8449080
Grasa, tubo de 8 oz (227 g)	KR81-05-01
Protección de la cúpula	K8449090
Emisor LED, ámbar	K14700030-A
Emisor LED, azul	K14700030-B
Emisor LED, verde	K14700030-G
Emisor LED, rojo	K14700030-R
Emisor LED, blanco	K14700030-W

## **Devolución del producto para obtener crédito**

Las devoluciones de productos para obtener crédito requieren una autorización de devolución de su distribuidor local antes de devolver el producto a Federal Signal. Contacte a su distribuidor para obtener asistencia.

Un producto está calificado para su devolución a fin de obtener crédito cuando se cumplen las condiciones siguientes:

- El producto puede volver a venderse y se encuentra en su envase original
- El producto no ha sido instalado previamente
- El producto es la revisión actual
- El producto no ha sido reparado previamente
- El producto es un producto estándar
- El producto no es una pieza de servicio

Todas las devoluciones están sujetas a un arancel de reposición de inventario.

Los productos defectuosos devueltos dentro del período de garantía serán reparados o reemplazados a exclusivo criterio de Federal Signal. Los productos defectuosos no incluyen los productos con fallas de la lámpara.

Otras circunstancias no incluidas anteriormente se tratarán según cada caso en particular.



**Industrial Products**

2645 Federal Signal Drive

University Park, IL 60484-3167

Phone: 1-877-289-3246 • 1-708-534-4756 • Fax: 1-708-534-4887

[www.federal-signal-indust.com](http://www.federal-signal-indust.com) • [www.fs-isys.com](http://www.fs-isys.com)

July 2010

# 67C Series Instrument Supply Regulators



Figure 1. 67C Series Regulators

## Introduction

### Scope of the Manual

This manual provides instructions and parts lists for 67C Series instrument supply regulators. Instructions and parts lists for other equipment mentioned in this instruction manual, as well as for other 67 Series regulators, are found in separate manuals.

### Product Descriptions

The 67C Series direct-operated regulators are typically used to provide constantly controlled, reduced pressures to pneumatic and electropneumatic controllers and other instruments. They are suitable for most air or gas applications. Other applications include providing reduced pressures to air chucks, air jets, and spray guns.

- The Types 67C and 67CS are the standard instrument supply regulators without a filter or internal relief.
- The Types 67CF and 67CFS are equipped with a filter for removing particles from the supply gas.
- The Types 67CR and 67CSR have an internal relief valve with a soft seat for reliable shutoff with no discernible leakage.
- The Types 67CFR and 67CFSR have a filter and internal relief valve with a soft seat for reliable shutoff with no discernible leakage.

### Specifications

Some general 67C Series ratings and other specifications are given on page 2. A label on the spring case gives the control spring range for a given regulator as it comes from the factory.



[www.fisherregulators.com](http://www.fisherregulators.com)





# 67C Series

## Specifications

**Body Size, Inlet and Outlet Connection Style**  
1/4 NPT

**Maximum Inlet Pressure (Body Rating)<sup>(1)</sup>**  
**All except Types 67CS and 67CSR:**  
250 psig (17,2 bar)  
**Types 67CS and 67CSR:** 400 psig (27,6 bar)

**Outlet Pressure Ranges**  
See Table 1

**Maximum Emergency Outlet Pressure<sup>(1)</sup>**  
50 psi (3,4 bar) over outlet pressure setting

**Wide-Open Flow Coefficients**  
**Main Valve:**  $C_d$ : 11.7;  $C_v$ : 0.36;  $C_r$ : 32.2  
**Internal Relief Valve:**  $C_d$ : 1.45;  $C_v$ : 0.045;  $C_r$ : 32.8

**IEC Sizing Coefficients**  
**Main Valve:**  $X_T$ : 0.66;  $F_L$ : 0.89;  $F_D$ : 0.50

**Accuracy**  
**Inlet Sensitivity:** Less than 0.2 psig (14 mbar) change in outlet pressure for every 25 psig (1,7 bar) change in inlet pressure  
**Repeatability:** 0.1 psig (7 mbar)<sup>(2)</sup>  
**Air Consumption:** Testing repeatedly shows no discernible leakage

**Types 67CR, 67CSR, 67CFR, and 67CFSR Internal Relief Performance**  
Low capacity for minor seat leakage only; other overpressure protection must be provided if inlet pressure can exceed the maximum pressure rating of downstream equipment or exceeds maximum outlet pressure rating of the regulator.

**Approximate Weights**  
**Types 67C, 67CR, 67CF, and 67CFR:**  
1 pound (0,5 kg)  
**Types 67CS and 67CSR:**  
2.5 pounds (1 kg)  
**Types 67CFS and 67CFSR:**  
4 pounds (2 kg)

**Temperature Capabilities<sup>(1)</sup>**  
**With Nitrile (NBR)**  
*Standard Bolting:* -20° to 180°F (-29° to 82°C)  
*Stainless Steel Bolting:* -40° to 180°F (-40° to 82°C)

**With Fluorocarbon (FKM):**  
*Polyethylene Filter<sup>(3)</sup> (Standard):*  
0° to 180°F (-18° to 82°C)  
*Polyvinylidene (PVDF), SST, or Glass Filter (Optional):*  
0° to 300°F (-18° to 149°C)  
**With Silicone (VMQ)<sup>(3)</sup> Diaphragm and Low Temperature bolting:** -60° to 180°F (-51° to 82°C)  
**With Gauges:** -20° to 180°F (-29° to 82°C)

**Smart Bleed™ Check Valve Setpoint**  
6 psi (0,41 bar) differential

**Types 67CF, 67CFR, 67CFS, and 67CFSR Filter Capabilities**

**Free Area:** 12 times pipe area  
**Micron Rating:**  
*Polyethylene Filter<sup>(3)</sup> (Standard):* 5 microns  
*Glass Fiber Filter (Optional):* 5 microns  
*PVDF or Stainless Steel Filter (Optional):* 40 microns

**Drain Valve and Spring Case Vent Location**  
Aligned with inlet standard, other positions optional

**Pressure Registration**  
Internal

### Options

- All Types**
- Handwheel adjusting screw
  - Inlet screen
  - NACE MR0175 or NACE MR0103 construction<sup>(4)</sup>
  - Panel mount (includes spring case with 1/4 NPT vent, handwheel, and panel mounting nut)
  - Closing cap (available on spring case with 1/4 NPT vent)
  - Fluorocarbon (FKM) elastomers for high temperatures and/or corrosive chemicals
  - Silicone (VMQ) elastomers for cold temperatures
  - Fixed Bleed Restriction
  - Triple scale outlet pressure gauge (brass or stainless steel)
  - Stainless steel stem on the valve plug
  - Tire valve or pipe plug in second outlet
- Types 67CFR and 67CFSR only**
- Smart Bleed™ internal check valve
  - Large dripwell with manual or automatic drain
- Types 67CF and 67CFR only**
- Stainless steel drain valve

1. The pressure/temperature limits in this instruction Manual and any applicable standard or code limitation should not be exceeded.  
2. Repeatability is the measure of the regulator's ability to return to setpoint consistently when traveling from steady state to transient to steady state.  
3. Silicone (VMQ) is not compatible with hydrocarbon gas.  
4. Product complies with the material requirements of NACE MR0175. Environmental limits may apply.  
5. Do not use in high aromatic hydrocarbon service.

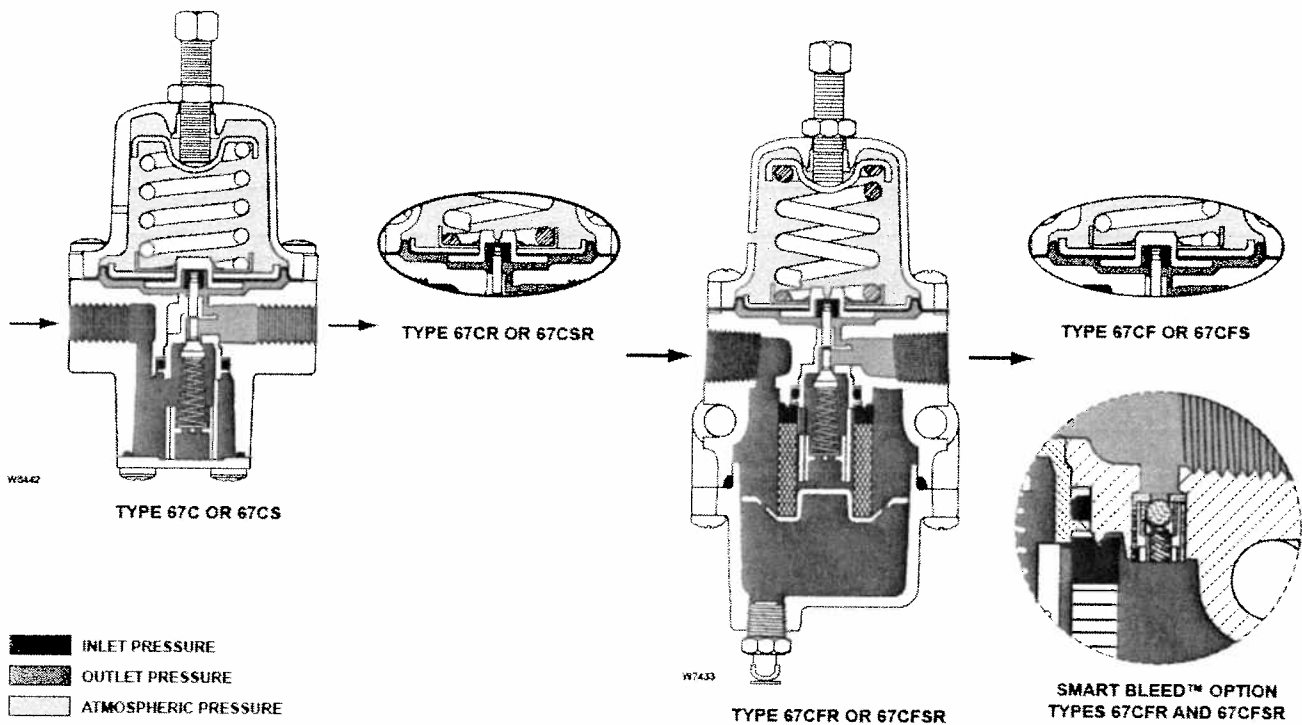


Figure 2. 67C Series Operational Schematics

## Principle of Operation

Downstream pressure is registered internally on the lower side of the diaphragm. When the downstream pressure is at or above the set pressure, the valve plug is held against the orifice and there is no flow through the regulator. When demand increases, downstream pressure drops slightly allowing the spring to extend, moving the stem down and the valve plug away from the orifice. This allows flow through the regulator.

## Internal Relief (Types 67CR, 67CSR, 67CFR, and 67CFSR)

If for some reason, outside of normal operating conditions, the downstream pressure exceeds the setpoint of the regulator, the force created by the downstream pressure will lift the diaphragm until the diaphragm is lifted off the relief seat. This allows flow through the token relief. The relief valve on the Type 67CR, 67CSR, 67CFR, or 67CFSR is an elastomer plug that prevents leakage of air from the downstream to atmosphere during normal operation, thereby conserving plant air.

## Smart Bleed™ Airset

In some cases, it is desired to exhaust downstream pressure if inlet pressure is lost or drops below the setpoint of the regulator. For example, if the regulator is installed on equipment that at times has no flow demand but is expected to backflow on loss of inlet pressure. The Types 67CFR and 67CFSR can be ordered with the Smart Bleed™ option which includes an internal check valve for this application. During operation, if inlet pressure is lost, or decreases below the setpoint of the regulator, the downstream pressure will back flow upstream through the regulator and check valve. This option eliminates the need for a fixed bleed downstream of the regulator, thereby conserving plant air.

## Overpressure Protection

The 67C Series regulators have maximum outlet pressure ratings that are lower than their maximum inlet pressure ratings. A pressure relieving or pressure limiting device is needed if inlet pressure can exceed the maximum outlet pressure rating.

# 67C Series

**Table 1. Outlet Pressure Ranges and Control Spring Data**

TYPES	OUTLET PRESSURE RANGES, PSIG (bar)	CONTROL SPRING DATA					
		Color	Material	Part Number	Wire Diameter, Inch (mm)	Free Length, Inch (mm)	
67C, 67CR, 67CF, 67CFR	0 to 20 (0 to 1,4) 0 to 35 (0 to 2,4) 0 to 60 (0 to 4,1) 0 to 125 (0 to 8,6)	Green stripe	Music Wire	GE07809T012	0.135 (3,43)	1.43 (36,2)	
		Silver		T14059T0012			0.156 (3,96)
		Blue stripe		T14058T0012			0.170 (4,32)
		Red stripe		T14060T0012			0.207 (5,26)
	0 to 35 (0 to 2,4) 0 to 60 (0 to 4,1) 0 to 125 (0 to 8,6)	Silver stripe	Inconel®	T14113T0012	0.156 (3,96)	1.43 (36,2)	
		Blue		T14114T0012			0.172 (4,37)
		Red		T14115T0012			0.207 (5,26)
	67CS, 67CSR, 67CFS, 67CFSR	0 to 20 (0 to 1,3) 0 to 35 (0 to 2,4)	Green	Inconel®	10C1729X012	0.135 (3,43)	1.50 (38,1)
Silver stripe			T14113T0012		0.156 (3,96)		
0 to 60 (0 to 4,1) 0 to 125 (0 to 8,6)		Blue	T14114T0012		0.172 (4,37)	1.43 (36,2)	
		Red	T14115T0012		0.207 (5,26)		
0 to 150 (0 to 10,3)		Black	10C1730X012		0.250 (6,35)	1.77 (44,9)	

Inconel® is a marked own by Special Metals Corporation

Types 67CR, 67CSR, 67CFR, and 67CFSR have a low capacity internal relief valve for minor seat leakage only. Other overpressure protection must be provided if the maximum inlet pressure can exceed the maximum pressure rating of the downstream equipment or exceeds the maximum outlet pressure rating of the regulator.

**exceeds maximum pressure ratings of the downstream equipment or exceeds maximum allowable outlet pressure of the regulator, additional overpressure protection is required.**

**A regulator may vent some gas to the atmosphere. In hazardous or flammable gas service, vented gas may accumulate and cause personal injury, death, or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous area. The vent line or stack opening must be protected against condensation or clogging.**

## Installation

### Note

If the regulator is shipped mounted on another unit, install that unit according to the appropriate Instruction Manual.



### WARNING

**Personal injury, property damage, equipment damage, or leakage due to escaping gas or bursting of pressure-containing parts may result if this regulator is overpressured or is installed where service conditions could exceed the limits given in the Specifications section, or where conditions exceed any ratings of the adjacent piping or piping connections. To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by the appropriate code, regulation, or standard) to prevent service conditions from exceeding those limits.**

The internal relief valve of the Type 67CR, 67CSR, 67CFR, or 67CFSR does not provide full overpressure protection. The internal relief valve is designed for minor seat leakage only. If maximum inlet pressure to the regulator

Before installing a Type 67C, 67CR, 67CS, 67CSR, 67CF, 67CFR, 67CFS, or 67CFSR regulator, be sure the installation complies with the following installation guidelines:

1. Regulator operation within ratings does not preclude the possibility of damage from debris in the lines or from external sources. Regulators should be inspected for damage periodically and after any overpressure condition.
2. Only personnel qualified through training and experience should install, operate, and maintain a regulator. Make sure that there is no damage to or foreign material in the regulator. Also ensure that all tubing and piping is free of debris.
3. Install the regulator so that flow is from the IN to the OUT connection as marked on the regulator body.
4. For best drainage, orient the drain valve (key 2) to the lowest possible point on the dripwell (key 5). This orientation may be improved by rotating the dripwell with respect to the body (key 1).

5. A clogged spring case vent hole may cause the regulator to function improperly. To keep this vent hole from being plugged (and to keep the spring case from collecting moisture, corrosive chemicals, or other foreign material) orient the vent to the lowest possible point on the spring case or otherwise protect it.

Inspect the vent hole regularly to make sure it is not plugged. Spring case vent hole orientation may be changed by rotating the spring case with respect to the body. A 1/4 NPT spring case vent may be remotely vented by installing obstruction-free tubing or piping into the vent. Protect the remote vent by installing a screened vent cap on the remote end of the vent pipe.

6. For use in regulator shutdown, install upstream block and vent valves and downstream block and vent valves (if required), or provide some other suitable means of properly venting the regulator inlet and outlet pressures. Install a pressure gauge to monitor instruments on startup.
7. Apply a good grade of pipe compound to the external pipe threads before making connections, making sure not to get the pipe compound inside the regulator.
8. Install tubing fitting or piping into the 1/4 NPT inlet connection on the body (key 1) and into the 1/4 NPT body outlet connection.
9. The second 1/4 NPT outlet can be used for a gauge or other use. If not used, it must be plugged.

## Installing a 67CF Series Regulator in an Existing Installation

When installing a 67CF Series regulator in an existing installation, it may be necessary to use spacers (key 34, Figure 13) to adapt the installation. If the mounting bolts are too long, place a spacer on the bolt (see Figure 13). To be sure the regulator is secure, the bolts should have at least two full threads of engagement.

## Startup and Adjustment

Key numbers are referenced in Figures 3 through 9.

1. With proper installation completed and downstream equipment properly adjusted, slowly open the upstream and downstream shutoff valve (when used) while using pressure gauges to monitor pressure.



## WARNING

To avoid personal injury, property damage, or equipment damage caused by bursting of pressure containing parts or explosion of accumulated gas, never adjust the control spring to produce an outlet pressure higher than the upper limit of the outlet pressure range for that particular spring. If the desired outlet pressure is not within the range of the control spring, install a spring of the proper range according to the diaphragm parts maintenance procedure.

2. If outlet pressure adjustment is necessary, monitor outlet pressure with a gauge during the adjustment procedure. The regulator is adjusted by loosening the locknut (key 18), if used, and turning the adjusting screw or handwheel (key 19) clockwise to increase or counterclockwise to decrease the outlet pressure setting. Retighten the locknut to maintain the adjustment position.

## Shutdown

First, close the nearest upstream block valve and then close the nearest downstream block valve (when used). Next, open the downstream vent valve. Since the regulator remains open in response to the decreasing downstream pressure, pressure between the closed block valves will be released through the open vent valve.

## Maintenance

Regulator parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement of parts depends on the severity of service conditions and applicable codes and government regulations. Open the Type 67CF, 67CFR, 67CFS, or 67CF SR drain valve (key 2) regularly to empty accumulated liquid from the dripwell (key 5).

### Note

If sufficient clearance exists, the body (key 1) may remain mounted on other equipment or in a line or panel during maintenance unless the entire regulator will be replaced.

# 67C Series



## WARNING

To avoid personal injury, property damage, or equipment damage caused by sudden release of pressure or explosion of accumulated gas, do not attempt any maintenance or disassembly without first isolating the regulator from system pressure and relieving all internal pressure from the regulator.

## Types 67C, 67CR, 67CS, and 67CSR

### Trim Maintenance

Key numbers are referenced in Figures 3, 4, and 12.

1. Remove four bottom plate screws (key 3) from the bottom plate (key 39) and separate the bottom plate and O-ring (key 4) from the body (key 1).
2. Inspect the removed parts for damage and debris. Replace any damaged parts.
3. To remove the valve cartridge assembly, grasp the end of cartridge (key 10) and pull it straight out of body (key 1). Replace with new cartridge assembly. The cartridge assembly may be disassembled and parts may be cleaned or replaced. If the soft seat (key 15) was removed, make sure it is properly snapped into place before installing the valve cartridge assembly.
4. Check O-ring (key 14) for wear and replace, if necessary. Apply lubricant to the O-ring and place in the body. Align cartridge key to keyway in body and insert. Reinstall the O-ring (key 4), secure the bottom plate (key 39) with screws (key 3), and torque to 15 to 30-inch-pounds (1,7 to 3,4 N·m).

### Diaphragm Maintenance

Key numbers are referenced in Figures 3 and 4.

1. Back out the adjusting screw or handwheel (key 18) until compression is removed from the spring (key 17).
2. Remove the spring case screws (key 3) to separate the spring case (key 7) from the body (key 1). Remove the upper spring seat (key 20) and spring (key 17).
3. Remove the diaphragm assembly (key 16), inspect the diaphragm, and replace the assembly, if necessary.

4. Place the diaphragm assembly (key 16) on the body (key 1) as shown in Figure 3 or 4. Push down on the diaphragm assembly to make sure the valve plug (key 11) strokes smoothly and approximately 1/16-inch (1,6 mm).

### Note

In step 5, if installing a control spring of a different range, be sure to delete the spring range originally appearing on the label and indicate the new spring range.

5. Stack the control spring (key 17) and upper spring seat (key 20) onto the diaphragm assembly (key 16).
6. Install the spring case (key 7) on the body (key 1) with the vent oriented to prevent clogging or entrance of moisture. Install the six spring case screws (key 3) using a crisscross pattern and torque to 15 to 30-inch-pounds (1,7 to 3,4 N·m).

### Note

On Types 67CS and 67CSR, lubricate the adjusting screw (key 18) thread to reduce galling of the stainless steel.

7. When all maintenance is complete, refer to the Startup and Adjustment section to put the regulator back into operation and adjust the pressure setting. Tighten the locknut (key 19) if used, and install the closing cap (key 33) if used.

## Types 67CF, 67CFR, 67CFS, and 67CFSR

### Filter Element and Trim Maintenance

Key numbers are referenced in Figures 5, 6, and 12.

1. Remove four dripwell screws (key 3) from the dripwell (key 5) and separate the dripwell and O-ring (key 4) from the body (key 1). The filter retainer (key 9), thrust washer (key 37), filter element (key 6), and gasket (key 26) may come off with dripwell. If not, remove these parts.
2. Inspect the removed parts for damage and debris. Replace any damaged parts. If a replacement is not available, the filter element may be cleaned.
3. To remove the valve cartridge assembly, grasp the end of cartridge and pull it straight out of body (key 1). Replace with new cartridge assembly. The cartridge assembly may be disassembled and parts may be cleaned or replaced. If the soft seat (key 15) was removed, make sure it is properly snapped into place before installing the valve cartridge assembly.

4. Check O-ring (key 14) for wear and replace, if necessary. Apply lubricant to the O-ring (key 14), then align cartridge key to keyway in body and insert. Reinstall the gasket (key 26), filter element (key 6), thrust washer (key 37), and filter retainer (key 9). Reinstall the O-ring (key 4), secure the dripwell with screws (key 3), and torque to 15 to 30-inch-pounds (1,7 to 3,4 N•m).

## Diaphragm Maintenance

Key numbers are referenced in Figures 5 and 6.

1. Back out the adjusting screw or handwheel (key 18) until compression is removed from the spring (key 17).
  2. Remove the six spring case screws (key 3) to separate the spring case (key 7) from the body (key 1). Remove the upper spring seat (key 20) and spring (key 17).
  3. Remove the diaphragm assembly (key 16), inspect the diaphragm, and replace the assembly, if necessary.
  4. Place the diaphragm assembly (key 16) on the body (key 1) as shown in Figure 5. Push down on the diaphragm assembly to make sure the valve plug (key 11) strokes smoothly and approximately 1/16-inch (1,6 mm).
- Note**
- In step 5, if installing a control spring of a different range, be sure to delete the spring range originally appearing on the label and indicate the new spring range.**
5. Stack the control spring (key 17) and upper spring seat (key 20) onto the diaphragm assembly (key 16).
  6. Install the spring case (key 7) on the body (key 1) with the vent oriented to prevent clogging or entrance of moisture. Install the six spring case screws (key 3) using a crisscross pattern and torque to 15 to 30-inch-pounds (1,7 to 3,4 N•m).

### Note

**On Types 67CFS and 67CFSR, lubricate the adjusting screw (key 18) thread to reduce galling of stainless steel.**

7. When all maintenance is complete, refer to the Startup and Adjustment section to put the regulator

back into operation and adjust the pressure setting. Tighten the locknut (key 19) if used, and install the closing cap (key 33) if used.

## Parts Ordering

When corresponding with the local Sales Office about this regulator, include the type number and all other pertinent information printed on the label. Specify the eleven-character part number when ordering new parts from the following parts list.

## Parts List

Key	Description	Part Number
<b>Parts Kits</b>		
	<b>Types 67C, 67CR, 67CS, and 67CSR</b> - Includes valve cartridge assembly (contains keys 10, 11, 12, 13, 14, and 15), O-ring (key 4), diaphragm assembly (key 16), and four screws (key 3)	
	Type 67C (without relief)	
	Brass stem with Nitrile (NBR) plug	R67CX000012
	Aluminum stem with Nitrile (NBR) plug (NACE)	R67CX000N12
	Type 67CR (with relief)	
	Brass stem with Nitrile (NBR) plug	R67CRX00012
	Aluminum stem with Nitrile (NBR) plug (NACE)	R67CRX00N12
	Type 67CS (without relief)	
	Stainless steel stem with Nitrile (NBR) plug (NACE)	R67CSX00012
	Type 67CSR (with relief)	
	Stainless steel stem with Nitrile (NBR) plug (NACE)	R67CSRX0012
	<b>Types 67CF, 67CFR, and 67CFSR</b> - Includes valve cartridge assembly (contains keys 10, 11, 12, 13, 14, and 15), diaphragm assembly (key 16), O-ring (key 4), filter element (key 6), filter gasket (key 26), thrust washer (key 37), and four screws (key 3)	
	Type 67CF (without relief)	
	Brass stem with Nitrile (NBR) plug	R67CFX00012
	Aluminum stem with Nitrile (NBR) plug (NACE)	R67CFX00N12
	Type 67CFR (with relief)	
	Brass stem with Nitrile (NBR) plug	R67CFRX0012
	Aluminum stem with Nitrile (NBR) plug (NACE)	R67CFRX0N12
	Type 67CFSR (with relief)	
	Stainless steel stem with Nitrile (NBR) plug (NACE)	R67CFSRX012
	<b>Valve Cartridge Assembly Only<sup>1</sup>*</b>	
	Type 67C, 67CR, 67CF, or 67CFR	
	Brass stem with Nitrile (NBR) plug	
	with Nitrile (NBR) O-ring	T14121T0012
	with Silicone (VMQ) O-ring	T14121T0032
	Aluminum stem	
	with Fluorocarbon (FKM) plug	T14121T0022
	with Nitrile (NBR) plug	T14121T0042
	Aluminum stem (NACE)	
	with Nitrile (NBR) plug	T14121T0052
	with Fluorocarbon (FKM) plug	T14121T0062
	Stainless steel stem	
	with Nitrile (NBR) plug	T14121T0072
	Type 67CS, 67CSR, 67CFS, or 67CFSR	
	316 Stainless steel stem	
	with Nitrile (NBR) plug and O-rings (NACE)	T14121T0092
	with Fluorocarbon (FKM) plug and O-rings	T14121T0102
	with Nitrile (NBR) plug and	
	Silicone (VMQ) O-rings	T14121T0112

<sup>1</sup> Valve cartridge assembly includes keys 10, 11, 12, 13, 14, and 15.  
\*Recommended Spare Part.

# 67C Series

Key	Description	Part Number
<b>Automatic Drain Conversion Kits</b>		
Types 67CF, 67CFR, 67CFS, 67CFSR - Includes auto-drain (key 2), four flange screws (key 3), dripwell O-ring (key 4), and dripwell (key 5). Note: Temperature rating is 40° to 175°F (4° to 79°C).		
Types 67CF and 67CFR		
Nitrile (NBR)		R67ADNX0012
Fluorocarbon (FKM)		R67ADFX0012
Types 67CFS and 67CFSR		
Nitrile (NBR)		R67ADNX0022
Fluorocarbon (FKM)		R67ADFX0022
1	<b>Body</b>	
	Type 67C or 67CR, Aluminum	T40643T0RG2
	Type 67CS or 67CSR, CF3M/CF8M Stainless Steel	GE00909X012
	Type 67CF or 67CFR, Aluminum	T80510T0012
	Type 67CFS or 67CFSR, CF3M/CF8M Stainless steel	40C1887X012
	Type 67CFR with Smart Bleed™, Aluminum	GE03477X012
2	<b>Drain Valve</b>	
	Manual Type 67CF or 67CFR	
	Brass	1K418918992
	18-8 Stainless steel	AH3946X0012
	Type 67CFS or 67CFSR	
	316 Stainless steel	AH3946X0032
	18-8 Stainless steel	AH3946X0012
	Automatic (only used with large capacity dripwell)	
	Type 67CFS or 67CFSR	
	Nitrile (NBR)	GG00554X012
	Fluorocarbon (FKM)	GG00554X022
3	<b>Flange Screw</b>	
	Type 67C, 67CR, 67CF, or 67CFR	
	Standard spring case and spring case with 1/4 NPT vent (10 required)	T13526T0012
	For wire seal	
	Zinc-plated steel (9 required)	T13526T0012
	Steel (with hole) (1 required)	14B3987X012
	Type 67CS, 67CSR, 67CFS or 67CFSR (10 required)	T13526T0042
4*	<b>O-ring</b>	
	Type 67C, 67CR, 67CS, or 67CSR	
	Nitrile (NBR)	T14380T0012
	Fluorocarbon (FKM)	T14380T0022
	Silicone (VMQ)	T14380T0032
	Type 67CF, 67CFR, 67CFS, or 67CFSR	
	Nitrile (NBR)	T14057T0042
	Fluorocarbon (FKM)	T14057T0022
	Silicone (VMQ)	T14057T0032
5	<b>Dripwell</b>	
	Type 67CF or 67CFR, Aluminum	
	<b>Standard</b>	T21040T0012
	Large Capacity, manual drain	GE34605X012
	Large Capacity, automatic drain	GE34606X012
	Type 67CFS or 67CFSR, CF3M/CF8M Stainless Steel	
	<b>Standard</b>	20C1726X012
	Large Capacity, manual drain	GE34607X012
	Large Capacity, automatic drain	GE31792X012
6*	<b>Filter Element</b>	
	(Types 67CF, 67CFR, 67CFS, 67CFSR)	
	Polyethylene (5 microns) (standard)	GE32761X012
	Glass fiber (5 microns)	17A1457X012
	Polyvinylidene fluoride (PVDF) (40 microns)	GE32762X012
	316 Stainless steel (40 microns)	15A5967X022
7	<b>Spring Case Assembly</b>	
	Type 67C, 67CR, 67CF, or 67CFR, Aluminum/Steel	
	Drilled hole vent (standard)	T14070T0012
	Single hole vent	T14070T0022
	Type 67CS, 67CSR, 67CFS, or 67CFSR, CF3M/CF8M Stainless steel	20C1727X012

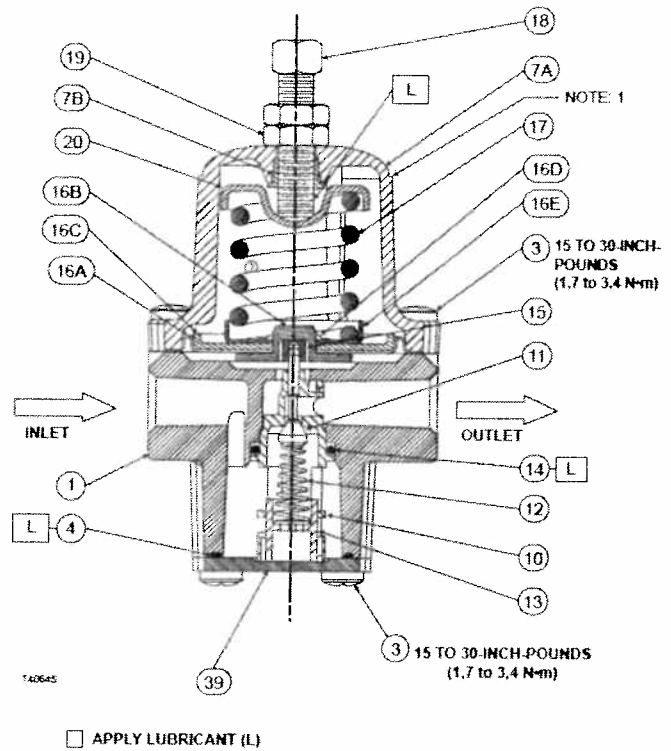


Figure 3. Type 67C or 67CR Assembly

Key	Description	Part Number
9	<b>Filter Retainer</b>	
	Type 67CF or 67CFR, Zinc-plated	T14052T0012
	Type 67CFS or 67CFSR, 316 Stainless steel	T14052T0022
10 <sup>(1)</sup>	<b>Valve Cartridge</b>	T80434T0012
11 <sup>(1)</sup>	<b>Valve Plug</b>	
	Type 67C, 67CR, 67CF, or 67CFR	
	Brass stem, Nitrile (NBR) plug	T14053T0012
	Aluminum stem, Fluorocarbon (FKM) plug	T14053T0022
	Aluminum stem, Nitrile (NBR) plug	T14053T0032
11 <sup>(1)</sup>	<b>Valve Plug (continued)</b>	
	Type 67CS, 67CSR, 67CFS, or 67CFSR	
	Stainless steel stem, Nitrile (NBR) plug	T14053T0042
	Stainless steel stem, Fluorocarbon (FKM) plug	T14053T0052
12 <sup>(1)</sup>	<b>Valve Spring</b>	
	Type 67C, 67CR, 67CF, or 67CFR	
	302 Stainless steel	T14105T0012
	Inconel® (NACE)	T14116T0012
	Type 67CS, 67CSR, 67CFS, or 67CFSR,	
	Inconel® (NACE)	T14116T0012
13 <sup>(1)</sup>	<b>Valve Retainer, Rynite®</b>	T14071T0012
14 <sup>(1)</sup>	<b>O-ring</b>	
	Nitrile (NBR)	T14063T0012
	Fluorocarbon (FKM)	T14063T0022
	Silicone (VMQ)	T14063T0032
15 <sup>(1)</sup>	<b>Soft Seat</b>	
	Nitrile (NBR)	T14055T0012
	Fluorocarbon (FKM)	T14055T0022
16*	<b>Diaphragm Assembly</b>	
	Type 67C or 67CF (without relief)	
	Nitrile (NBR)	T14119T0022
	Fluorocarbon (FKM)	T14119T0042
	Type 67CR or 67CFR (with relief)	
	Nitrile (NBR)	T14119T0012

\*Recommended Spare Part.

<sup>1</sup> Valve cartridge assembly includes keys 10, 11, 12, 13, 14, and 15.

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Rynite® is a marked owned by E.I. du Pont de Nemours and Co.

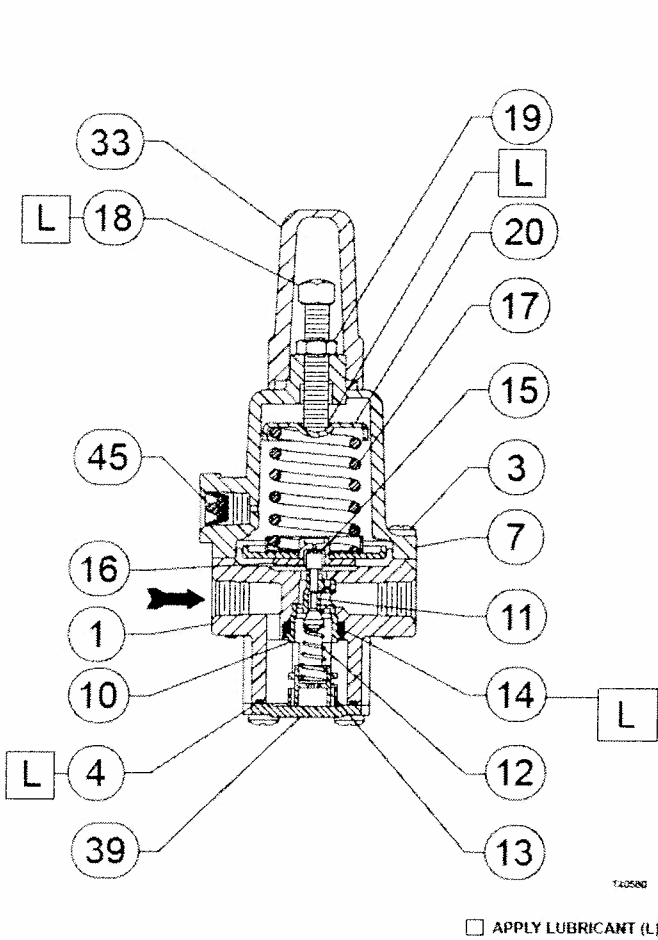


Figure 4. Type 67CS or 67CSR Assembly

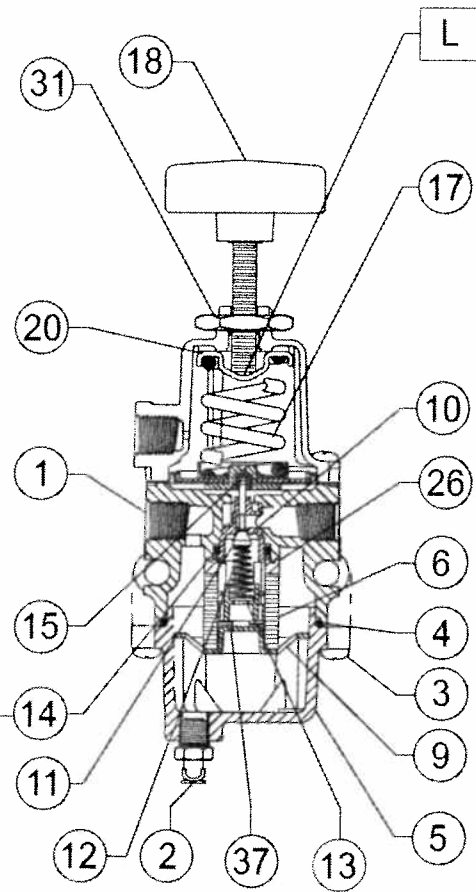


Figure 5. Type 67CF or 67CFR Assembly

Key	Description	Part Number
16*	Diaphragm Assembly (continued)	
	Fluorocarbon (FKM)	T14119T0032
	Silicone (VMQ)	T14119T0052
	Type 67CS or 67CFS (without relief)	
	Nitrile (NBR)	T14119T0062
17	Spring	
	Type 67C, 67CR, 67CF, or 67CFR, Plated steel (standard)	
	0 to 20 psig (0 to 1,4 bar), Green stripe	GE07809T012
	0 to 35 psig (0 to 2,4 bar), Silver	T14059T0012
	0 to 60 psig (0 to 4,1 bar), Blue stripe	T14058T0012
0 to 125 psig (0 to 8,6 bar), Red stripe	T14060T0012	
Type 67CR or 67CFR (NACE), Inconel® (NACE)		
0 to 35 psig (0 to 2,4 bar), Silver stripe	T14113T0012	
0 to 60 psig (0 to 4,1 bar), Blue	T14114T0012	
0 to 125 psig (0 to 8,6 bar), Red	T14115T0012	
Type 67CS, 67CSR, 67CFS or		

Key	Description	Part Number
17	Spring (continued)	
	67CFSR, Inconel® (NACE)	
	0 to 20 psig (0 to 1,3 bar), Green	10C1729X012
	0 to 35 psig (0 to 2,4 bar), Silver stripe	T14113T0012
	0 to 60 psig (0 to 4,1 bar), Blue	T14114T0012
18	Adjusting Screw	
	Type 67C, 67CR, 67CF, or 67CFR, Zinc-plated steel	
	For standard spring case	
	Square head (standard)	T14061T0012
	Handwheel	T14102T0012
	Wire seal (not shown)	T14104T0012
	For spring case with 1/4 NPT vent, Zinc-plated steel	
	Square head for closing cap, Handwheel	T14101T0012
	Wire seal (not shown)	T14198T0012
	Type 67CS, 67CSR, 67CFS, or 67CFSR	
Square head with or without closing cap, 316 Stainless steel	T14101T0022	
Handwheel, Zinc-plated steel	T14103T0012	

\*Recommended Spare Part.  
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# 67C Series

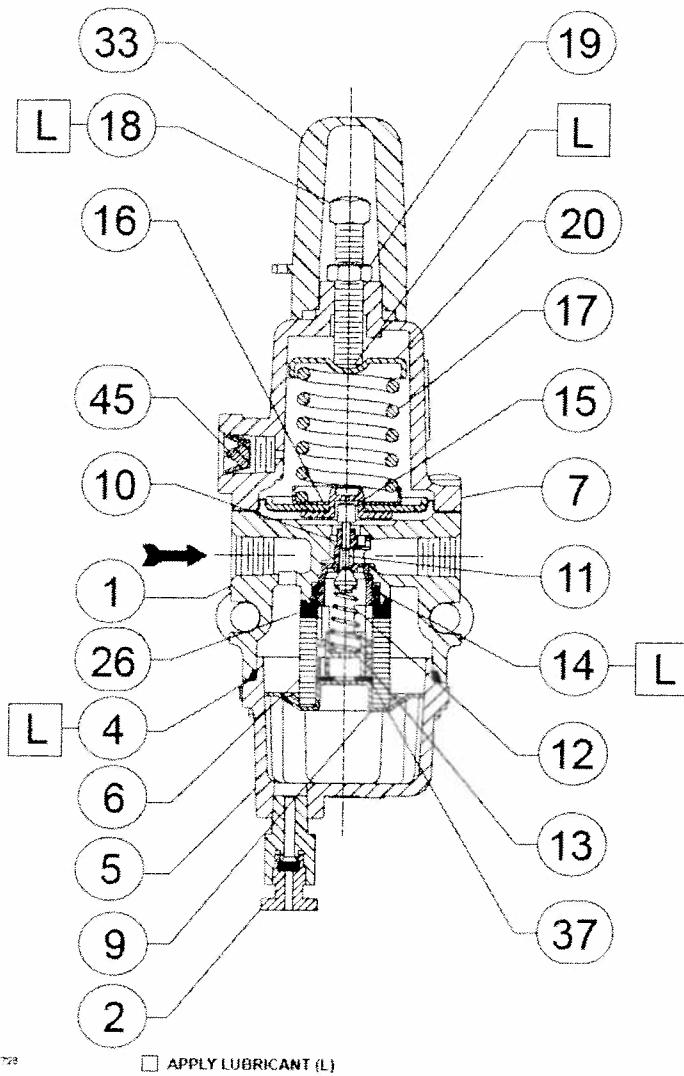


Figure 6. Type 67CFS or 67CF SR Assembly

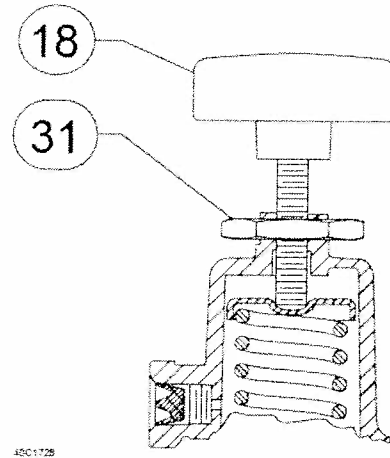


Figure 7. 67C Series Optional Panel Mount

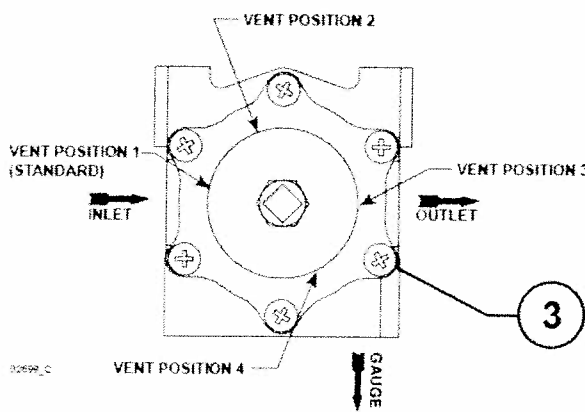


Figure 8. 67C Series Spring Case Vent Positions

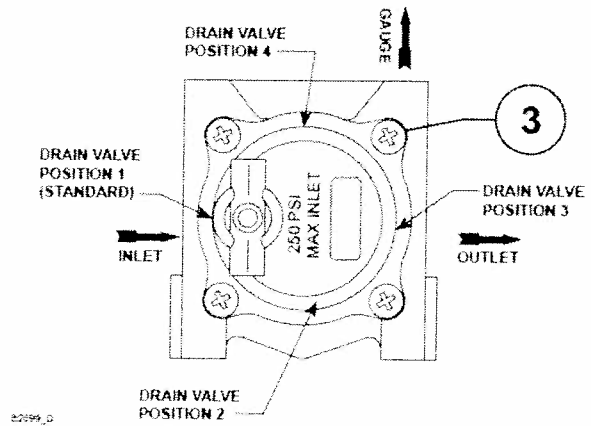


Figure 9. Types 67CF, 67CFR, 67CFS, and 67CF SR Drain Valve Positions

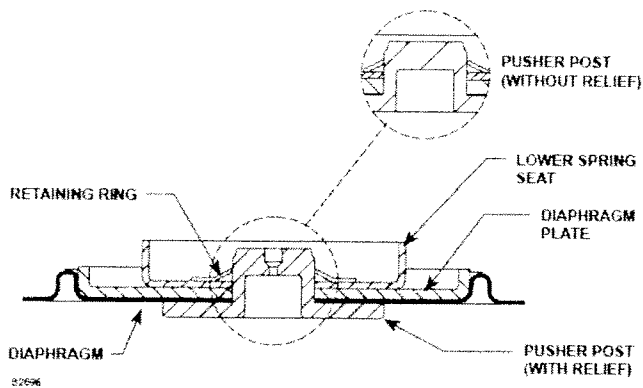


Figure 10. Diaphragm Assembly (Key 16)

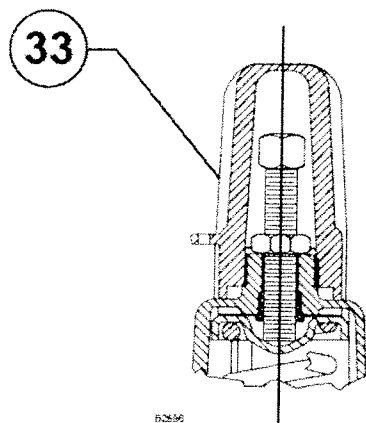


Figure 11. Optional Closing Cap  
[Only Available with the 1/4-inch (6,4 mm) Spring Case Vent]

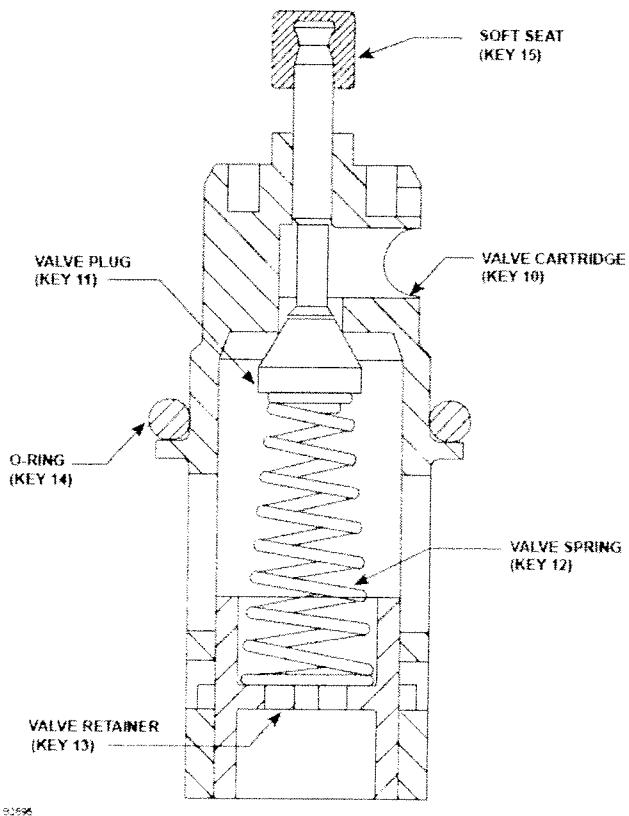


Figure 12. Valve Cartridge Assembly

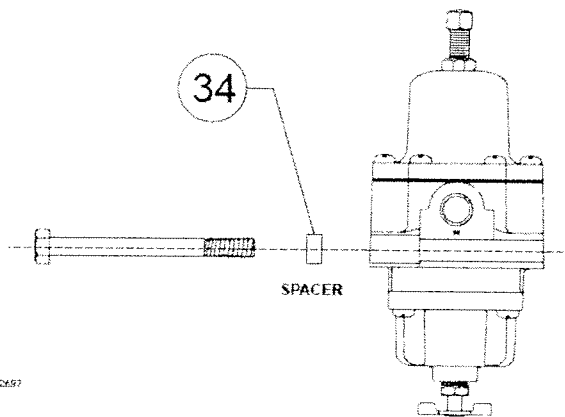
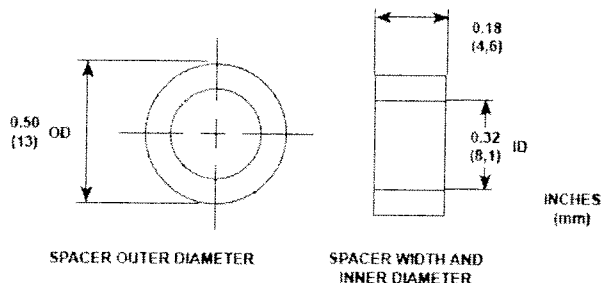


Figure 13. Spacer Diameter and Assembly  
(For Installing in an Existing Installation  
if the Mounting Bolts are too Long)

# 67C Series

Key	Description	Part Number	Key	Description	Part Number
19	Locknut Type 67C, 67CR, 67CF, or 67CFR Zinc-plated steel 316 Stainless steel Type 67CS, 67CSR, 67CFS, or 67CFSR 316 Stainless steel	1A946324122 1A9463X0042 1A9463X0042	30	NACE Tag (not shown), 18-8 Stainless steel	19A6034X012
20	Upper Spring Seat Type 67C, or 67CR only 1/4 NPT Vent Type 67C, 67CR, 67CF, or 67CFR <b>Standard</b>	T14051T0042 T14051T0012	31	Panel Mounting Nut, 303 Stainless steel	10B2657X012
22	Pressure Gauge (not shown) Type 67C, 67CR, 67CF, or 67CFR, Brass 0 to 30 psig/0 to 2,1 bar/0 to 0,2 MPa 0 to 60 psig/0 to 4,1 bar/0 to 0,4 MPa 0 to 160 psig/0 to 11,0 bar/0 to 1,1 MPa For all types, Stainless Steel 0 to 30 psig/0 to 2,1 bar/0 to 0,2 MPa 0 to 60 psig/0 to 4,1 bar/0 to 0,4 MPa 0 to 160 psig/0 to 11,0 bar/0 to 1,1 MPa	11B8579X022 11B8579X032 11B8579X042 11B9639X012 11B9639X022 11B9639X032	32	Wire Seal (not shown) Type 67C or 67CR 304 Stainless steel	1U7581000A2 23B9152X012
23	1/4-inch (6,4 mm) Pipe Plug (not shown) Type 67C, 67CR, 67CF, or 67CFR Socket head, Steel For all types Hex head, Stainless steel	1C333528992 1A767535072	33	Closing Cap, Resin	
24	Tire Valve (not shown) Type 67C, 67CR, 67CF, or 67CFR	1H447089022	34	Spacer (2 required) (Figure 13) Type 67CF or 67CFR, Steel Type 67CFS or 67CFSR, 18-8 Stainless steel	T14123T0012 T14123T0022
26*	Filter Gasket Type 67CF, 67CFR, 67CFS, or 67CFSR with Nitrile (NBR) O-ring with Fluorocarbon (FKM) O-ring	T14081T0012 T14081T0022	37*	Thrust Washer (Type 67CF, 67CFR, 67CFS, or 67CFSR) with Nitrile (NBR) O-rings with Fluorocarbon (FKM) O-rings	T14196T0012 T14196T0022
			39	Bottom Plate, 316 Stainless steel Type 67C or 67CR Type 67CS or 67CSR	GE03520XR62 GE03520X012
			45	Screen Vent, 18-8 Stainless steel Type 67CS, 67CSR, 67CFS, or 67CFSR	0L078343062

## Parts for Mounting on Fisher® 2500 Series Controller (Type 67CF or 67CFR)

Key	Description	Part Number
35	Mounting adaptor plate, Steel (not shown)	T21043T0012
36	O-ring, Nitrile (NBR) (not shown)	1E591406992
38	Gasket, Neoprene (CR) (not shown)	1C898603012

\*Recommended Spare Part.

### Industrial Regulators

#### Emerson Process Management Regulator Technologies, Inc.

USA - Headquarters  
McKinney, Texas 75069-1872 USA  
Tel: 1-800-558-5853  
Outside U.S. 1-972-548-3574

Asia-Pacific  
Shanghai, China 201206  
Tel: +86 21 2892 9000

Europe  
Bologna, Italy 40013  
Tel: +39 051 4190611

Middle East and Africa  
Dubai, United Arab Emirates  
Tel: +971 4811 8100

### Natural Gas Technologies

#### Emerson Process Management Regulator Technologies, Inc.

USA - Headquarters  
McKinney, Texas 75069-1872 USA  
Tel: 1-800-558-5853  
Outside U.S. 1-972-548-3574

Asia-Pacific  
Singapore, Singapore 128461  
Tel: +65 6777 8211

Europe  
Bologna, Italy 40013  
Tel: +39 051 4190611  
Gallardon, France 28320  
Tel: +33 (0)2 37 33 47 00

### TESCOM

#### Emerson Process Management Tescom Corporation

USA - Headquarters  
Elk River, Minnesota 55330-2445 USA  
Tel: 1-763-241-3238

Europe  
Selmsdorf, Germany 23923  
Tel: +49 (0) 38823 31 0

For further information visit [www.fisherregulators.com](http://www.fisherregulators.com)

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# Design D4 Control Valve Assembly

## Contents

Introduction .....	1
Scope of Manual .....	1
Description .....	1
Specifications .....	1
Installation .....	4
Spring Adjustment .....	5
Maintenance .....	6
Valve Plug and Seat Ring .....	6
Valve Packing .....	7
Actuator .....	9
Parts Ordering .....	11
Repair Kits .....	11
Parts List .....	12



W8531/IL

Figure 1. Design D4 Control Valve

## Introduction

### Scope of Manual

This instruction manual provides installation, maintenance, and parts information for the Design D4 control valve.

No person may install, operate, or maintain a Design D4 control valve without first ● being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and ● carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Emerson Process Management™ sales office before proceeding.

#### Note

**Neither Emerson®, Emerson Process Management, nor any of their affiliated entities assumes responsibility for the selection, use and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.**

### Description

The Design D4 control valve is a compact, rugged valve designed primarily for high-pressure throttling applications. This valve is ideal for use on pressure and flow control applications within the oil and gas production industry. The Design D4 valve also makes an excellent dump valve for high-pressure separators and scrubbers.

The Design D4 control valve meets the metallurgical requirements of NACE MR0175/ISO 15156 without environmental limits for temperatures below 135°C (275°F). If the temperature is above 135°C (275°F), the N07718 Belleville washers will impose some limits, as shown in table 3.

### Specifications

Table 1 lists specifications for the Design D4 control valve. Some of the specifications for a given control valve as it originally comes from the factory are stamped on a nameplate located on the actuator spring barrel.



# D4 Valve

Table 1. Specifications

<p><b>Available Configurations</b> Spring-to-Close Spring-to-Open</p> <p><b>Valve Body Sizes and End Connection Styles<sup>(1)</sup></b> See table 2</p> <p><b>Maximum Inlet Pressures and Temperatures<sup>(1)</sup></b> If the valve nameplate shows an ASME pressure-temperature class, maximum inlet pressure and temperature is consistent with the applicable class per ASME B16.34. If the nameplate does not show an ASME class, it will show a maximum cold working pressure at 38°C (100°F) (for example, 293 bar [4250 psi])</p> <p><b>Maximum Pressure Drops<sup>(1)</sup></b> See tables 4, 5, 6, and 7</p> <p><b>Input Signal to Actuator</b> See tables 4, 5, 6, and 7</p> <p><b>Actuator Maximum Casing Pressure<sup>(1)</sup></b> 3.4 bar (50 psig)</p> <p><b>Shutoff Classification per ANSI/FCI 70-2 and IEC 60534-4</b> Class IV</p>	<p><b>Material Temperature Capabilities<sup>(1)</sup></b> <b>Actuator Assembly:</b> -40 to 93°C (-40 to 200°F) <b>Valve Body Assembly:</b> <i>Standard Bonnet O-Ring:</i> -46 to 149°C (-50 to 300°F) <i>Optional Fluoroelastomer Bonnet O-Ring:</i> -23 to 204°C (-10 to 400°F)</p> <p><b>Flow Characteristic</b> Equal percentage</p> <p><b>Flow Direction</b> Flow up only</p> <p><b>Port Diameters</b> See table 2</p> <p><b>Valve Plug Travel</b> 19 mm (0.75 inch)</p> <p><b>Valve Plug Style</b> Micro-Form valve plug</p> <p><b>Actuator Diaphragm Effective Area</b> 452 cm<sup>2</sup> (69 inches<sup>2</sup>)</p> <p><b>Actuator Pressure Connection Size</b> 1/4 inch NPT female</p>
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1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.

Table 2. Valve Sizes and Connection Styles

VALVE SIZE, INCHES	PORT DIAMETER, (INCHES)	SCREWED	RAISED FACE (RF) FLANGED				RING TYPE JOINT (RTJ) FLANGED	
		4250 psi	Class 150	Class 300	Class 600	Class 900 and 1500	Class 600	Class 900 and 1500
1	0.25, 0.375, 0.5, 0.75	X	X	X	X	X	X	X
2	0.25, 0.375, 0.5, 0.75, 1, 1.25	X	X	X	X	X	X	X

X = Available construction.

Table 3. Design D4 Environmental Limits for NACE MR0175/ISO 15156 with Sour Trim

MAXIMUM TEMPERATURE		MAXIMUM H <sub>2</sub> S PARTIAL PRESSURE		COMPATIBLE WITH ELEMENTAL SULFUR?
°C	°F	MPa	psia	
204	400	1.4	200	No
199	390	2.3	330	No
191	375	2.5	360	No
149	300	2.8	400	No
135	275	No Limit		Yes

Table 4. Maximum Shutoff Pressure Drops<sup>(1)</sup> for Design D4 Control Valves (Spring-to-Close) When Used with Typical Control Instrumentation<sup>(2)</sup>

INPUT SIGNAL TO ACTUATOR		0 to 1.2 Bar (0 to 18 Psig)		0 to 1.4 Bar (0 to 20 Psig)		0 to 2.0 Bar (0 to 30 Psig)		0 to 2.3 Bar (0 to 33 Psig)		0 to 2.4 Bar (0 to 35 Psig)		0 to 3.4 Bar (0 to 50 Psig)	
SPRING		Light Rate						Heavy Rate					
INITIAL SPRING SETTING		0.77 Bar (11.2 Psig)		0.77 Bar (11.2 Psig)		0.85 Bar (12.4 Psig)		1.05 Bar (15.3 Psig)		1.18 Bar (17.1 Psig)		1.18 Bar (17.1 Psig)	
PORT DIAMETER		Maximum Pressure Drop											
mm	Inches	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi
6.4	0.25	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293	4250	293	4250	293	4250	293	4250
9.5	0.375	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293	4250	293	4250	293	4250	293	4250
12.7	0.5	191	2765	191	2765	219	3180	288	4180	293	4250	293	4250
19.1	0.75	80	1160	80	1160	92	1340	123	1785	143	2080	143	2080
25.4	1	42	610	42	610	49	715	67	965	78	1130	78	1130
31.8	1.25	25	365	25	365	30	430	41	590	48	700	48	700

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.  
 2. For example, use the column marked 0-1.4 bar (0-20 psig) for a 0.21-1.0 bar (3-15 psig) pneumatic controller with 1.4 bar (20 psig) supply pressure.  
 3. For applications with downstream pressure in excess of 196 bar (2845 psig), use 196 bar (2845 psig) for Maximum Shutoff Pressure.

Table 5. Maximum Shutoff Pressure Drops<sup>(1)</sup> for Design D4 Control Valves (Spring-to-Close) When Used with Instrumentation with Restricted Output Range<sup>(2)</sup>

INPUT SIGNAL TO ACTUATOR		0.4 to 2.0 Bar (6 to 30 Psig)				0.14 to 2.3 Bar (2 to 33 Psig)			
SPRING		Heavy Rate				Heavy Rate			
INITIAL SPRING SETTING		0.97 Bar (14.0 Psig)				1.17 Bar (17.0 Psig)			
PORT DIAMETER		Maximum Pressure Drop							
mm	Inches	Bar		Psi		Bar		Psi	
6.4	0.25	259 <sup>(3)</sup>		3750 <sup>(3)</sup>		293		4250	
9.5	0.375	210 <sup>(3)</sup>		3045 <sup>(3)</sup>		293		4250	
12.7	0.5	113		1635		282		4095	
19.1	0.75	45		655		120		1750	
25.4	1	23		330		65		945	
31.8	1.25	13		185		39		580	

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.  
 2. For example, an Electro-Pneumatic Transducer calibrated for 0.4-2.0 bar (6-30 psig) output pressure.  
 3. For applications with downstream pressure in excess of 118 bar (1715 psig), use 118 bar (1715 psig) for Maximum Shutoff Pressure.

# D4 Valve

Table 6. Maximum Shutoff Pressure Drops<sup>(1)</sup> for Design D4 Control Valves (Spring-to-Open)  
When Used with Typical Control Instrumentation<sup>(2)</sup>

INPUT SIGNAL TO ACTUATOR		0 to 1.2 Bar (0 to 18 Psig)		0 to 1.4 Bar (0 to 20 Psig)		0 to 2.0 Bar (0 to 30 Psig)		0 to 2.3 Bar (0 to 33 Psig)		0 to 2.4 Bar (0 to 35 Psig)		0 to 3.4 Bar (0 to 50 Psig)	
SPRING		Light Rate						Heavy Rate					
INITIAL SPRING SETTING		0.23 Bar (3.4 Psig)		0.23 Bar (3.4 Psig)		0.28 Bar (4.0 Psig)		0.28 Bar (4.0 Psig)		0.28 Bar (4.0 Psig)		0.28 Bar (4.0 Psig)	
PORT DIAMETER		Maximum Pressure Drop											
mm	Inches	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi
6.4	0.25	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293	4250	293	4250	293	4250	293	4250
9.5	0.375	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293 <sup>(3)</sup>	4250 <sup>(3)</sup>	293	4250	293	4250	293	4250	293	4250
12.7	0.5	187	2715	233	3380	293	4250	293	4250	293	4250	293	4250
19.1	0.75	78	1135	99	1430	147	2130	178	2575	198	2875	293	4250
25.4	1	41	600	53	765	80	1160	97	1410	109	1575	195	2830
31.8	1.25	24	355	32	465	49	715	60	875	68	985	123	1785

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.  
 2. For example, use the column marked 0-1.4 bar (0-20 psig) for a 0.21-1.0 bar (3-15 psig) pneumatic controller with 1.4 bar (20 psig) supply pressure.  
 3. For applications with downstream pressure in excess of 190 bar (2760 psig), use 190 bar (2760 psig) for Maximum Shutoff Pressure.

Table 7. Maximum Shutoff Pressure Drops<sup>(1)</sup> for Design D4 Control Valves (Spring-to-Open)  
When Used with Instrumentation with Restricted Output Range<sup>(2)</sup>

INPUT SIGNAL TO ACTUATOR		0.4 to 2.0 Bar (6 to 30 Psig)				0.14 to 2.3 Bar (2 to 33 Psig)			
SPRING		Heavy Rate				Heavy Rate			
INITIAL SPRING SETTING		0.69 Bar (10.0 Psig)				0.42 Bar (6.1 Psig)			
PORT DIAMETER		Maximum Pressure Drop							
mm	Inches	Bar		Psi		Bar		Psi	
6.4	0.25	259 <sup>(3)</sup>		3750 <sup>(3)</sup>		293		4250	
9.5	0.375	259 <sup>(3)</sup>		3750 <sup>(3)</sup>		293		4250	
12.7	0.5	196		2845		293		4250	
19.1	0.75	82		1195		156		2265	
25.4	1	43		630		85		1235	
31.8	1.25	26		380		52		765	

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.  
 2. For example, an Electro-Pneumatic Transducer calibrated for 0.4-2.0 bar (6-30 psig) output pressure.  
 3. For applications with downstream pressure in excess of 202 bar (2925 psig), use 202 bar (2925 psig) for Maximum Shutoff Pressure.

## Installation

### WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations to avoid personal injury.

To avoid personal injury or property damage caused by bursting of pressure-retaining parts or by uncontrolled process fluid, be certain the service conditions do not exceed the limits shown on the valve nameplate and in tables 1, 4, 5, 6, and 7. Use pressure-relieving devices required by government or accepted industry codes and good engineering practices.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

### WARNING

When ordered, the valve configuration and construction materials were selected to meet particular pressure, temperature, pressure drop, and controlled fluid conditions. Responsibility for the safety of process media and compatibility of valve materials with process media rests solely with the purchaser and

**end-user. Since some body/trim material combinations are limited in their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your Emerson Process Management sales office.**

## **CAUTION**

**To avoid product damage, inspect the valve before installation for any damage or any foreign material that may have collected in the valve body. Also remove any pipe scale, welding slag, or other foreign material from the pipeline.**

1. Before installing the control valve assembly, inspect it for any damage and for any foreign material that may have collected in the valve body.
2. Remove any pipe scale, welding slag, and other foreign material from the pipeline.
3. The control valve can be installed in any position, but normally the actuator is vertical above the valve. Install the valve so the flow direction arrow on the side of the valve indicates the direction of the process flow.
4. Install the valve following local and national piping codes when they apply to the application. For screwed connections, treat the male pipe threads with a good grade pipe compound. For flanged valves, use suitable gaskets between valve and pipeline flanges.
5. If continuous operation is required during maintenance and inspection, install a conventional three-valve bypass around the valve.
6. Connect loading pressure for the Spring-to-Open configuration to the 1/4-18 NPT connection in the upper casing assembly (key 23) as shown in figure 4. The Spring-to-Close configuration loading

pressure connection is in the lower casing assembly (key 39) as shown in figure 3.

## **Spring Adjustment**

The spring has a fixed pressure span over which loading pressure will stroke the valve. Adjustment of the spring compression shifts the span so that more or less loading pressure is required to start travel. Since the span does not change, there will be a corresponding increase or decrease in the pressure requirements at the end of the valve stroke.

In order to maximize shutoff pressure drop values, the actuator spring must be accurately adjusted for each Input Signal Pressure Range. If the actuator has been disassembled or pressure conditions have changed, the spring may require adjustment. Refer to tables 2 and 4 to determine the Initial Spring Set values based on the Input Signal range that is available to the actuator. These values include packing friction.

### **Spring-to-Close**

Refer to figure 3.

1. Loosen the adjusting screw nut (key 44).
2. Turn the adjusting screw (key 31) clockwise to compress the spring or counterclockwise to decrease spring compression.
3. After adjustment, tighten the adjusting screw nut (key 44).

### **Spring-to-Open**

Refer to figure 4.

1. Unscrew the spring case assembly (key 27).
2. Turn the adjusting stem nut (key 44) clockwise to compress the spring or counterclockwise to decrease spring compression.
3. After adjustment, replace the spring case assembly (key 27).



# D4 Valve

## Maintenance

Refer to figure 3.

Valve parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and maintenance depends on the severity of the service conditions.

### WARNING

**Avoid personal injury from sudden release of process pressure or bursting of parts. Before performing any maintenance operations:**

- **Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.**
- **Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.**
- **Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure on both sides of the valve. Drain the process media from both sides of the valve.**
- **Vent the power actuator loading pressure and relieve any actuator spring precompression.**
- **Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.**
- **The valve packing box may contain process fluids that are pressurized, even when the valve has been removed from the pipeline. Process fluids may spray out under pressure when removing the packing hardware or packing rings.**
- **Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**

## Valve Plug and Seat Ring

The Design D4 control valve is designed to allow easy access to the valve plug and seat ring without disturbing the packing. Refer to other sections of this instruction manual if additional maintenance is required.

### Disassembly

1. Remove the loading pressure tubing and any accessories that may hamper disassembly.
2. Break the hammer nut (key 6) loose with a hammer. Continue turning the hammer nut by using a hammer or a large adjustable wrench, tightened around one ear of the hammer nut. If the bonnet is stuck on the valve, continue to unscrew the hammer nut. The hammer nut will contact the spring pins (key 7) and will force the bonnet out of the valve. Carefully lift the actuator, bonnet, and valve plug assembly from the valve body.

### WARNING

**The spring pins must always be in place during valve operation. They provide a safeguard against injury when the unit is being disassembled.**

3. Use a socket wrench to loosen the seat ring (key 3).
4. Remove the seat ring (key 3) and seat ring gasket (key 9) from the valve body.
5. Inspect parts for wear or damage that would prevent proper operation of the valve body. Carefully clean the seat ring gasket surfaces and seat ring threads.

### WARNING

**Be careful to avoid damaging the seating surface on the valve plug or seat ring as damage in these areas will allow excessive leakage at shutoff. Avoid damaging the highly polished valve stem surface. A damaged valve stem could cut the packing and allow process fluid to leak to the atmosphere.**

*Table 8. Torque for Seat Ring (Key 3)*

VALVE SIZE		RECOMMENDED TORQUE	
mm	Inches	N•m	Lbf•ft
25.4	1	407	300
50.8	2	698	515

**6. For spring-to-close only:** To remove the valve plug (key 2), drive out the groove pin (key 4) and unscrew the valve plug from the stem (key 47). If the groove pin (key 4) is not exposed, verify that downward movement of the stem is not restricted by instrument linkages attached to the stem (key 47).

If the valve plug cannot be easily unscrewed from the stem, use a punch to keep the stem from turning as the plug is removed.

**7. For spring-to-open only:** To remove the valve plug (key 2), first remove the spring case assembly (key 27). Remove the adjustment screw nut (key 44), the upper spring seat (key 29), and the spring (key 30). Push the adjustment stem (key 31) fully downward until the diaphragm plate (key 40) contacts the cap screws (key 38), exposing the groove pin (key 4) in the plug. If the groove pin (key 4) is not exposed, verify that downward movement of the stem is not restricted by instrument linkages attached to the stem (key 47). Drive out the groove pin (key 4) and unscrew the valve plug from the stem (key 47).

If the valve plug cannot be easily unscrewed from the stem, use a punch to keep the stem from turning as the plug is removed.

**Assembly**

1. Make sure the bonnet O-ring (key 8) is on the bonnet and lubricated with lithium grease (key 49).
2. Install the plug (key 2) on the stem (key 47) and insert a new groove pin (key 4).
3. Thoroughly clean the seat ring and bonnet threads in the valve body (key 1). Also clean the valve body seat ring gasket surfaces.
4. Apply anti-seize lubricant (key 54) to the threads of the seat ring (key 3), and its mating threads in the valve body.
5. Apply anti-seize lubricant (key 54) to the seat ring gasket (key 9) and install into the valve body.

6. Screw the seat ring into the valve body. Use a socket wrench to tighten the seat ring to the torque values shown in table 8. Remove all excess lubricant after tightening.

7. Lubricate (key 54) the threads on the valve body and hammer nut and the contact surfaces of the bonnet and hammer nut flange. Install the bonnet and actuator assembly with pinned valve plug onto the valve body. Tighten the hammer nut using an adjustable wrench until the nut stops turning. A few hammer blows will be required to ensure that the assembly is tight.

8. See the actuator assembly and spring adjustment sections of this manual.

**Valve Packing**



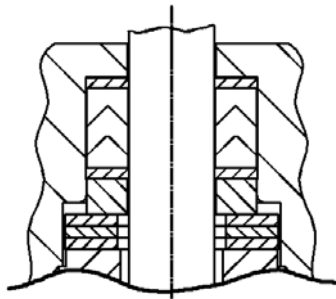
**Observe the warning at the start of the Maintenance section.**

The valve stem packing can only be accessed from within the valve body. If packing maintenance is required, first disassemble per steps 1, 2, and 6 or 7 in the Valve Plug and Seat Ring Disassembly section of this document.

**Disassembly**

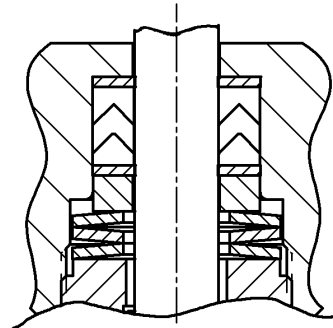
1. Loosen the packing retainer locknut (key 22) with a spanner wrench or with a punch and hammer.
2. Unscrew the packing retainer (key 10) from the bonnet (key 5).
3. Remove the three Belleville springs (key 11), packing spacer (key 14), packing (key 13), and two anti-extrusion rings (key 12) from the bonnet, using a formed wire hook.
4. Clean and inspect the packing box wall to ensure that the packing surfaces are not damaged. If the surface condition is damaged, and cannot be improved by light sanding, replace the bonnet by contacting your Emerson Process Management sales office.
5. Inspect the valve stem for scratches or wear, and valve plug for wear or damage. Replace if necessary.

# D4 Valve



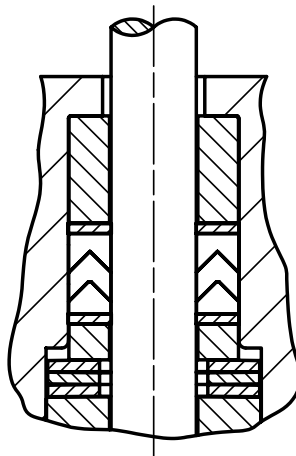
E0862

BELLEVILLE SPRINGS REASONABLY  
TIGHT TO SEAT THE PACKING



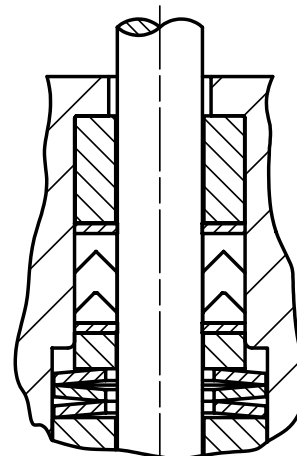
BELLEVILLE SPRINGS FINGER TIGHT, THEN  
TIGHTEN 5/6 TURN (5 FLATS ON THE RETAINER)

BONNET DESIGN PRE 2006



E1024

BELLEVILLE SPRINGS REASONABLY  
TIGHT TO SEAT THE PACKING



BELLEVILLE SPRINGS FINGER TIGHT, THEN  
TIGHTEN 5/6 TURN (5 FLATS ON THE RETAINER)

BONNET DESIGN 2006 AND NEWER

NOTE: RECOMMENDED SPARE PARTS, INCLUDING PACKING  
KITS, ARE THE SAME FOR BOTH BONNET DESIGNS.

Figure 2. Design D4 Belleville Spring Procedure

## Assembly

Refer to figures 2, 3, and 4.

1. Install new packing and Belleville springs according to the packing arrangement shown in figure 2.
2. Apply a light film of lubricant (key 54) to the threads of the packing retainer (key 10).
3. Install the packing retainer into the bonnet and tighten until the Belleville springs (key 11) are reasonably tight to fully seat the packing and anti-extrusion rings.
4. Completely loosen the packing retainer to relieve all Belleville spring compression.
5. Retighten the packing retainer by hand until the packing retainer firmly contacts the Belleville springs.

6. Tighten the packing retainer clockwise 5/6 turn (5 flats on the retainer).
7. Lock the packing retainer (key 10) solidly in place by tightening the packing retainer locknut (key 22) using a spanner wrench, or a hammer with a punch or chisel.

## Actuator (Spring-to-Close)



### WARNING

**Observe the warning at the start of the Maintenance section.**

Refer to figure 3.

Before disassembling the actuator, disassemble the valve plug, seat ring, and packing according to instructions in this manual.

### Disassembly

1. Loosen the adjusting screw nut (key 44) and turn the adjusting screw (key 31) counterclockwise to remove all spring compression.
2. Unscrew the casing cap screws and hex nuts (keys 45 and 46), and remove the upper casing assembly (key 23) from the lower casing (key 39).
3. Remove the spring seat (key 29) and actuator spring (key 30).
4. Lift out the diaphragm, diaphragm plate, and stem assembly. Remove the travel indicator (key 32) when the bottom of the stem enters the yoke window.
5. To replace the diaphragm (key 15), separate the diaphragm assembly by using a wrench on the hex nuts (key 42) to unscrew the assembly.
6. Separate the parts--diaphragm washer, actuator O-ring (keys 41 and 25), diaphragm, and diaphragm plate, (keys 15 and 40).
7. Inspect the diaphragm and the actuator O-ring for damage or deterioration, and replace if necessary. If the diaphragm is replaced, a new O-ring should also be installed.
8. Inspect the stem O-ring (key 19) and bonnet bushing (key 20); replace if necessary. To inspect the casing O-ring (key 18), remove the cap screws (key 38) and lift off the lower casing (key 39). Replace the O-ring if necessary.

9. If the hammer nut needs to be removed from the bonnet, the spring pins (key 7) can be removed with locking pliers.

### Assembly

1. Before starting assembly, make sure all parts are clean and in good condition. There should be no burrs or sharp edges on any threads or surfaces that might cut or damage an O-ring, bushing, the packing, or the diaphragm. When replacing O-rings and bushings, be sure the O-ring or bushing groove is clean and undamaged. Using a general purpose lubricant (key 49), lubricate all bushings and O-rings and the threads of parts that have to pass through the bushings and O-rings.

### CAUTION

**The threads on factory-produced valve stems have been specially machined to avoid O-ring, bushing, or packing damage during trim maintenance. Use of other than a factory-produced valve stem may result in early stem O-ring, bushing, and packing failure.**

#### Note

**Do not lubricate cap screws (key 38) before inserting them in the following procedure.**

2. Place the hammer nut and spring pins on the bonnet, if removed. Install the casing O-ring (key 18), the stem O-ring (key 19), and the bonnet bushing (key 20). Position the lower casing (key 39) on the bonnet. Insert the nonlubricated cap screws (key 38), and torque to 49 N•m (36 lbf•ft).



### WARNING

**The spring pins must always be in place during valve operation. They provide a safeguard against injury when the unit is being disassembled.**

3. Assemble the diaphragm plate assembly. Place the patterned side of the diaphragm (key 15) against the diaphragm plate (key 40). Be sure to turn the diaphragm washer (key 41) so that the side that is beveled on the inside diameter is against the O-ring (key 25). Also, make sure that it is assembled for installation with the diaphragm on the loading pressure side and the lockwasher (key 43) and lower spring seat (key 28) are on the spring side.

# D4 Valve

4. Fasten the diaphragm and diaphragm plate assembly on the stem with hex nuts (key 42). Place the diaphragm and diaphragm plate, and stem assembly into the lower casing and bonnet. Install the travel indicator (key 32) on the stem as the bottom of the stem enters the yoke window.

## CAUTION

**Over-tightening the diaphragm casing cap screws and nuts (keys 45 and 46) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.**

5. Replace the spring (key 30) on the diaphragm plate (key 40). Replace the upper spring seat (key 29). Position the upper casing (key 23) on the lower casing (key 39). Insert the cap screws (key 45) and tighten the hex nuts (key 46). Torque the casing cap screws evenly to 27 N•m (20 lbf•ft) using a crisscross pattern.
6. Adjust the initial spring set per the Spring Adjustment section in this manual.

## Actuator (Spring-to-Open)

### WARNING

**Observe the warning at the start of the Maintenance section.**

Refer to figure 4.

Before disassembling the actuator, disassemble the valve plug, seat ring, and packing according to instructions in this manual.

### Disassembly

1. Unscrew the spring case assembly (key 27). Turn the adjusting screw nut (key 44) counterclockwise to remove all spring compression. Remove the adjusting screw nut, upper spring seat, and spring (keys 44, 29, and 30).
2. Unscrew the casing cap screws and hex nuts (keys 45 and 46), and remove the upper casing assembly (key 23) from the lower casing (key 39). Remove the cotter pin (key 36) and unscrew the adjusting stem (key 31).
3. Lift out the diaphragm (key 15), diaphragm plate (key 40), and stem assembly. Remove the travel

indicator (key 32) when the bottom of the stem enters the yoke window.

4. To replace the diaphragm (key 15), separate the diaphragm assembly by using a wrench on the hex nuts (key 42) to unscrew the assembly.
5. Separate the parts--diaphragm washer, actuator O-ring (keys 41 and 25), diaphragm, and diaphragm plate, (keys 15 and 40).
6. Inspect the diaphragm and the actuator O-ring for damage or deterioration, and replace if necessary. If the diaphragm is replaced, a new O-ring should also be installed.
7. Inspect the stem O-ring (key 19) and bonnet bushing (key 20); replace if necessary. To inspect the casing O-ring (key 18), remove the cap screws (key 38) and lift off the lower casing (key 39). Replace the O-ring if necessary. Inspect the adjusting stem bushing (key 26) and actuator stem O-ring (key 53). Replace if necessary.
8. If the hammer nut needs to be removed from the bonnet, the spring pins (key 7) can be removed with locking pliers.

### Assembly

1. Before starting assembly, make sure all parts are clean and in good condition. There should be no burrs or sharp edges on any threads or surfaces that might cut or damage an O-ring, bushing, the packing, or the diaphragm. When replacing O-rings and bushings, be sure the O-ring or bushing groove is clean and undamaged. Using a general purpose lubricant (key 49), lubricate all bushings and O-rings and the threads of parts that have to pass through the bushings and O-rings.

## CAUTION

**The threads on factory-produced valve stems have been specially machined to avoid O-ring, bushing, or packing damage during trim maintenance. Use of other than a factory-produced valve stem may result in early stem O-ring, bushing, and packing failure.**

### Note

**Do not lubricate cap screws (key 38) before inserting them in the following procedure.**

2. Place the hammer nut and spring pins on the bonnet, if removed. Install the casing O-ring

(key 18), the stem O-ring (key 19), and the bonnet bushing (key 20). Position the lower casing (key 39) on the bonnet. Insert the nonlubricated cap screws (key 38), and torque to 49 N•m (36 lbf•ft).

3. Assemble the diaphragm plate assembly. Place the patterned side of the diaphragm (key 15) against the diaphragm plate (key 40). Be sure to turn the diaphragm washer (key 41) so that the side that is beveled on the inside diameter is against the O-ring (key 25). Also, make sure that it is assembled for installation with the diaphragm on the loading pressure side and the lockwasher (key 43) and diaphragm washer (key 41) are on the upper side.

 **WARNING**

**The spring pins must always be in place during valve operation. They provide a safeguard against injury when the unit is being disassembled.**

4. Fasten the diaphragm and diaphragm plate assembly on the stem with hex nuts (key 42). Place the diaphragm and diaphragm plate, and stem assembly into the lower casing and bonnet. Install the travel indicator (key 32) on the stem as the bottom of the stem enters the yoke window.
5. Screw the adjusting stem (key 31) onto the stem (key 47) and secure the cotter pin (key 36). Make sure the bushing and O-ring are in place in the upper casing.

**CAUTION**

**Over-tightening the diaphragm casing cap screws and nuts (keys 45 and 46) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.**

6. Position the upper casing (key 23) on the lower casing (key 39). Insert the cap screws (key 45) and tighten the hex nuts (key 46). Torque the casing cap screws evenly to 27 N•m (20 lbf•ft) using a crisscross pattern.
7. Replace the spring (key 30), spring seat (key 29), and adjusting stem nut (key 44) over the adjusting stem. Replace the spring case assembly (key 27).
8. Adjust the initial spring set per the Spring Adjustment section in this manual.

**Parts Ordering**

Each Design D4 control valve is assigned a serial number, which can be found on the nameplate. Refer to the number when contacting your Emerson Process Management sales office for assistance or when ordering replacement parts.

 **WARNING**

**Use only genuine Fisher® replacement parts. Components that are not supplied by Emerson Process Management should not, under any circumstances, be used in any Fisher valve, because they will void your warranty, might adversely affect the performance of the valve, and could give rise to personal injury and property damage.**

**Note**

**Neither Emerson, Emerson Process Management, nor any of their affiliated entities assumes responsibility for the selection, use and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.**

**Repair Kits**

**Note**

**All repair kits are supplied with hydrogenated nitrile bonnet O-ring. FKM (fluorocarbon) bonnet O-ring must be ordered separately when required.**

Description	Part Number
* Packing Repair Kit Includes key numbers 4, 8, 12 (2 req'd), and 13	RD4X0000012
* Actuator Repair Kit Includes key numbers 4, 8, 12 (2 req'd), 13, 15, 18, 19, 20, 25, 26, 36, and 53	RD4X0000022

### Parts List

Key	Description	Part Number
<b>Note</b>		
<b>For part numbers not shown, contact your Emerson Process Management sales office.</b>		
1	Valve Body	
2*	Valve Plug	
	S41000 / S41600 HT	
	1-inch valve	
	0.25 inch port diameter	20C3692X012
	0.375 inch port diameter	20C3693X012
	0.5 inch port diameter	20C3694X012
	0.75 inch port diameter	GE01557X012
	2-inch valve	
	0.25 inch port diameter	GE00992X012
	0.375 inch port diameter	GE00993X012
	0.5 inch port diameter	GE00994X012
	0.75 inch port diameter	GE01558X012
	1-inch port diameter	GE01561X012
	1.25 inch port diameter	GE01555X012
	S17400 H1150 Dbl	
	1-inch valve	
	0.25 inch port diameter	20C3692X032
	0.375 inch port diameter	20C3693X032
	0.5 inch port diameter	20C3694X032
	0.75 inch port diameter	GE01557X032
	2-inch valve	
	0.25 inch port diameter	GE00992X032
	0.375 inch port diameter	GE00993X032
	0.5 inch port diameter	GE00994X032
	0.75 inch port diameter	GE01558X032
	1-inch port diameter	GE01561X032
	1.25 inch port diameter	GE01555X032
	Tungsten Carbide	
	1-inch valve	
	0.25 inch port diameter	20C3696X012
	0.375 inch port diameter	20C3697X012
	0.5 inch port diameter	20C3698X012
	0.75 inch port diameter	20C3699X012
	2-inch valve	
	0.25 inch port diameter	20C3682X012
	0.375 inch port diameter	20C3683X012
	0.5 inch port diameter	20C3685X012
	0.75 inch port diameter	20C3686X012
	1-inch port diameter	20C3687X012
	1.25 inch port diameter	20C3688X012
3*	Seat Ring	
	S17400 H1150 Dbl	
	1-inch valve	
	0.25 inch port diameter	GE00982X032
	0.375 inch port diameter	GE00983X032
	0.5 inch port diameter	GE00984X032
	0.75 inch port diameter	GE00985X032
	2-inch valve	
	0.25 inch port diameter	GE00986X032
	0.375 inch port diameter	GE00987X032
	0.5 inch port diameter	GE00988X032
	0.75 inch port diameter	GE00989X032
	1-inch port diameter	GE00990X032
	1.25 inch port diameter	GE00991X032
	Tungsten Carbide	
	1-inch valve	
	0.25 inch port diameter	GE07347X012
	0.375 inch port diameter	GE07363X012
	0.5 inch port diameter	GE07364X012
	0.75 inch port diameter	GE07365X012
	2-inch valve	
	0.25 inch port diameter	GE07389X012
	0.375 inch port diameter	GE07394X012
	0.5 inch port diameter	GE07397X012
	0.75 inch port diameter	GE07398X012
	1-inch port diameter	GE07399X012
	1.25 inch port diameter	GE07406X012
4*	Groove Pin	GE01163X012
5	Bonnet	
6	Hammer Nut	
7	Spring Pin	
8*	Bonnet O-ring	
	Hydrogenated Nitrile	
	-46 to 149°C (-50 to 300°F)	10C3680X012
	FKM, -23 to 204°C (-10 to 400°F)	10C3680X022
9*	Seat Ring Gasket	
	For 1-inch valve	1B198636042
	For 2-inch valve	1B198836042
10	Packing Retainer	
11	Belleville Springs	
12*	Anti-Extrusion Washer, 2 req'd	12B6335X022
13*	Packing Set	12B6667X012
14	Packing Spacer	
15*	Diaphragm	22B3521X012
16	Nameplate	
17	Drive Screw	
18*	Casing O-ring	1F9141X0142
19*	Stem O-ring	1K7561X0072
20*	Bonnet Bushing	17A7112X012
22	Locknut	
23	Upper Casing Assembly	
25*	Actuator O-ring	1K7561X0072

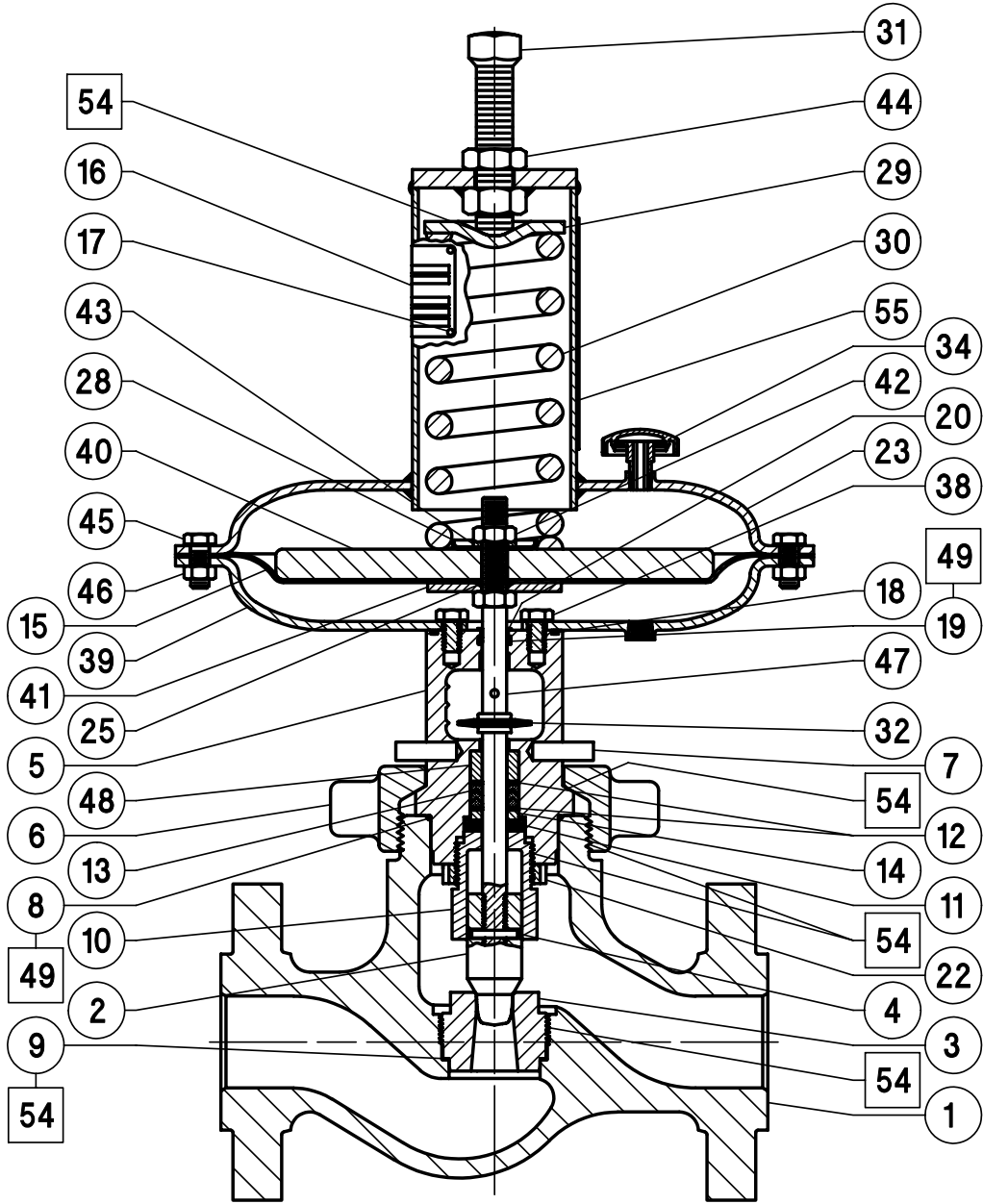
# Instruction Manual

Form 5755  
October 2006

# D4 Valve

Key	Description	Part Number	Key	Description	Part Number
26*	Adjusting Stem Bushing (spring-to-open only)	17A4059X012	40	Diaphragm Plate	
27	Spring Case Assembly		41	Diaphragm Washer	
28	Lower Spring Seat		42	Hex Nut	
29	Upper Spring Seat		43	Lockwasher	
30	Spring		44	Adjustment Screw Nut	
	Spring-to-Close, Light Rate	1F176827092	45	Cap Screw	
	Spring-to-Close, Heavy Rate	1E792427082	46	Hex Nut	
	Spring-to-Open, Light Rate	1F176727032	47*	Valve Stem	
	Spring-to-Open, Heavy Rate	1F714327092		S20910, Reverse Acting	20C3681X022
31	Adjustment Screw or Stem			S20910, Direct Acting	20C3716X022
32	Travel Indicator		49	Lubricant (lithium grease)	
34	Vent Assembly		51	Drive Screw	
36*	Cotter Pin (spring-to-open only)	1C608035022	53*	Actuator Stem O-ring (spring-to-open only)	1C7821X0182
37	Pipe Plug		54	Lubricant (anti-seize)	
38	Cap Screw		55	Spring Setting Label (not shown)	
39	Lower Casing				

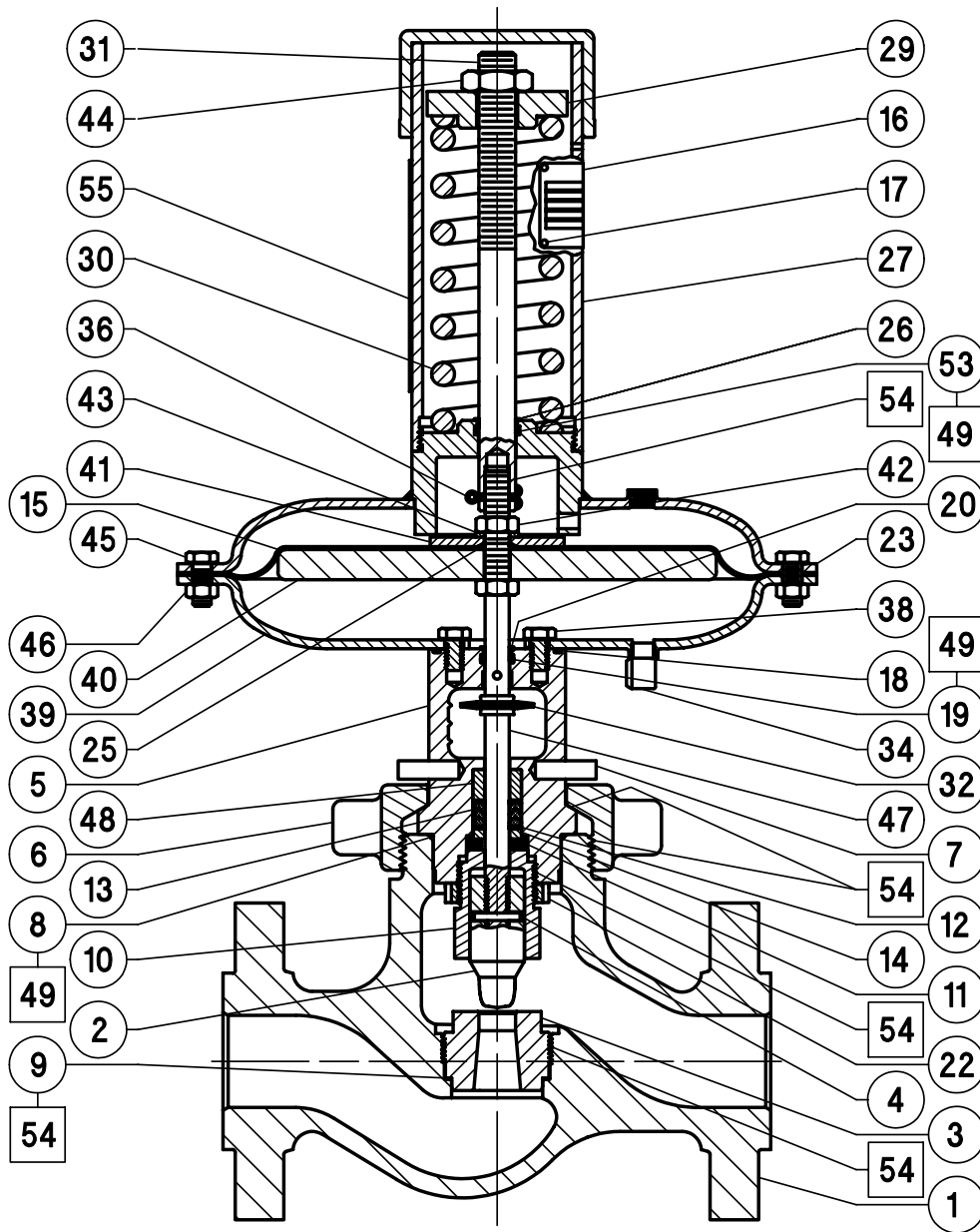




GE02332-B

 **APPLY LUB**

Figure 3. Design D4 Valve Assembly (Spring-to-Close)



□ APPLY LUB

GE02334-D

Figure 4. Design D4 Valve Assembly (Spring-to-Open)

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**Emerson Process Management**

Marshalltown, Iowa 50158 USA

Cernay 68700 France

Sao Paulo 05424 Brazil

Singapore 128461

[www.Fisher.com](http://www.Fisher.com)



# Type i2P-100 Electro-Pneumatic Transducers

## Contents

Introduction .....	1
Scope of Manual .....	1
Description .....	1
Specifications .....	4
Educational Services .....	4
Installation .....	4
Special Instructions for Safe-Use and	
Installation in Hazardous Locations .....	5
CSA .....	6
FM .....	6
ATEX All approvals .....	6
ATEX Intrinsic Safety .....	7
ATEX Flameproof .....	8
ATEX Type n .....	8
IECEX Intrinsic Safety, Type n,	
Flameproof .....	8
Mounting .....	8
Pneumatic Connections .....	9
Supply Pressure Requirements .....	9
Diagnostic Connections .....	10
Vent .....	10
Electrical Connections .....	11
Operating Information .....	12
Calibration .....	12
Equipment Required .....	12
Calibration Procedure .....	13
Principle of Operation .....	14
Maintenance .....	14
Troubleshooting .....	15
Converter Module Replacement .....	16
Electronics Module Replacement .....	16
Relay Maintenance .....	16
Parts Ordering .....	17
Parts List .....	18
Loop Schematics / Nameplates .....	21
CSA Loop Schematic .....	21
CSA and FM Approvals Nameplate .....	21
FM Loop Schematic .....	22
ATEX and IECEX Approvals Nameplate .....	23

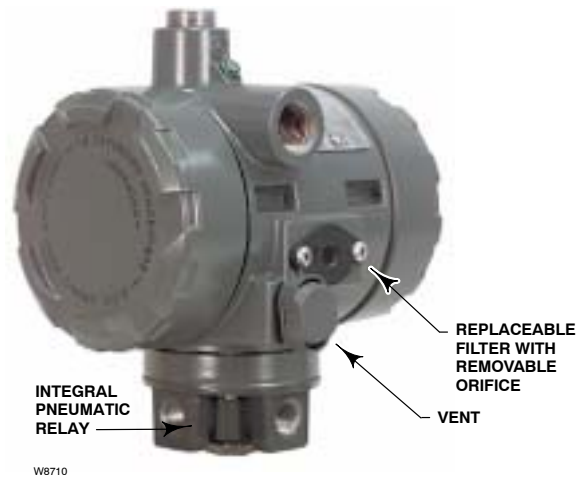


Figure 1. Type i2P-100 Electro-Pneumatic Transducer

information for the Type i2P-100 transducer (see figure 1). Refer to separate manuals for instructions covering equipment used with the transducer.

No person may install, operate or maintain a Type i2P-100 electro-pneumatic transducer without first ● being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance, and ● carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Emerson Process Management™ sales office.

## Introduction

### Scope of Manual

This instruction manual provides installation, operation, maintenance, and parts ordering

### Description

The transducer, shown in figure 3, receives a 4 to 20 milliamper dc input signal and transmits a proportional user field-configurable pneumatic output pressure to a final control element. The pneumatic



# i2P-100 Transducer

Table 1. Specifications

## Input Signal<sup>(1)</sup>

Available as standard with 4–20 mA.  
User configurable by dip switch for split ranging, see table below.

## Output Signal<sup>(1,6)</sup>

Available as standard 0.2 to 1.0 bar (3 to 15 psig) or 0.4 to 2.0 bar (6 to 30 psig). User configurable by dip switch selection and zero and span potentiometer adjustment, see table below.

INPUT SIGNAL	OUTPUT PRESSURE	
	BAR	PSIG
4 to 20 mA dc	0.2 to 1.0	3 to 15
	0.4 to 2.0	6 to 30
4 to 12 mA dc	0.2 to 1.0	3 to 15
12 to 20 mA dc	0.2 to 1.0	3 to 15

## Equivalent Circuit

The Type i2P-100 equivalent circuit is a series circuit consisting of a constant voltage drop (battery) of approximately 4 V dc and a total resistance of 40 ohms. Input is shunted by two 6.8 V zener diodes (see figure 9).

## Supply Pressure<sup>(1,5)</sup>

**Recommended:** 0.3 bar (5 psi) higher than upper range limit of output signal  
**Maximum:** 3.4 bar (50 psig)

**Medium:** Air or Natural Gas<sup>(4)</sup>

## Average Steady State Flow Rate<sup>(1,2)</sup>

OUTPUT RANGE							
0.2 to 1.0 bar (3–15 psig)				0.4 to 2.0 bar (6–30 psig)			
SUPPLY PRESSURE							
1.5 bar (20 psig)				2.4 bar (35 psig)			
OUTPUT		FLOW RATE		OUTPUT		FLOW RATE	
Bar	Psig	Normal m <sup>3</sup> /h	Scfh	Bar	Psig	Normal m <sup>3</sup> /h	Scfh
0.2	3	0.08	3.0	0.4	6	0.09	3.6
0.6	9	0.12	4.5	1.2	18	0.19	7.0
1.0	15	0.17	6.3	2.1	30	0.27	10.2

## Maximum Output Air Capacity<sup>(2)</sup>

8.0 m<sup>3</sup>/hr (5.0 scfm) at 1.4 bar (20 psig) supply pressure

## Performance<sup>(3)</sup>

**Reference Accuracy:** ±1.0% of full scale output span; includes combined effects of hysteresis, linearity, and deadband

**Independent Linearity<sup>(1)</sup>:** ±0.75% of full scale output span

**Hysteresis<sup>(1)</sup>:** 0.4% of full scale output span

**Frequency Response<sup>(1)</sup>:** Gain is attenuated 3 dB at 6 Hz with transducer output signal piped to a typical instrument input

**Temperature Effect:** ±0.14% per degrees Celsius (±0.75% per degrees Fahrenheit) of span

**Supply Pressure Effect:** 0.2% of full scale output span per bar supply pressure change (0.2% of full scale output span per psi supply pressure change)

**Vibration Effect:** Less than 1% of full scale output span when tested to ISA S75.13

**Electromagnetic Interference (EMI)<sup>(1)</sup>:** Tested per IEC 61326-1 (Edition 1.1). Conforms to the European EMC Directive. Meets emission levels for Class A equipment (industrial locations) and Class B equipment (domestic locations). Meets immunity requirements for industrial locations (Table A.1 in the IEC specification document). Immunity performance shown in table 2.

## Operating Ambient Temperature Limits<sup>(5)</sup>

–40 to 85°C (–40 to +180°F)

## Electrical Classification

### Hazardous Area:



Explosion proof, Dust-Ignition proof, Intrinsic Safety



Explosion proof, Non-incendive, Dust-Ignition proof, Intrinsic Safety

ATEX

Intrinsic Safety, Type n and Flameproof

IECEX

Intrinsic Safety, Type n and Flameproof

Refer to Special Instructions for Safe-Use and Installation in Hazardous Locations, tables 3 and 4, and figures 15, 16, 17, and 18 for specific approval information.

Approved for use with natural gas<sup>(4)</sup>

(continued)

Table 1. Specifications (continued)

<p><b>Electrical Housing:</b></p> <p>NEMA 4X, CSA enclosure 4X &amp; IP66 when remote vented, otherwise</p> <p>NEMA 3, CSA enclosure 3 &amp; IP64</p> <p><b>Connections</b></p> <p><b>Supply and Output Pressure:</b> 1/4-inch NPT female connection</p> <p><b>Vent:</b> 1/4-inch NPT female</p> <p><b>Electrical:</b> Standard 1/2-inch NPT</p> <p><b>Wire Size:</b> 18 to 22 AWG</p> <p><b>Adjustments<sup>(6)</sup></b></p> <p><b>Zero and Span:</b> Trim potentiometers (20 turn) for zero and span adjustments are located under the housing cap (see figure 10).</p> <p><b>Switch:</b> Allows input signal split range and user-configurable 0.2 to 2 bar (3 to 30 psig) output.</p>	<p><b>Mounting Position</b></p> <p>■ Actuator ■ pipestand or ■ surface</p> <p><b>Approximate Weight (Transducer Only)</b></p> <p>2.5 kg (5.5 lbs)</p> <p><b>Actuator Stroking Time</b></p> <p>See figure 2</p> <p><b>Declaration of SEP</b></p> <p>Fisher Controls International LLC declares this product to be in compliance with Article 3 paragraph 3 of the Pressure Equipment Directive (PED) 97 / 23 / EC. It was designed and manufactured in accordance with Sound Engineering Practice (SEP) and cannot bear the CE marking related to PED compliance.</p> <p>However, the product <i>may</i> bear the CE marking to indicate compliance with <i>other</i> applicable EC Directives.</p>
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1. These terms are defined in ISA Standard S51.1.  
 2. Normal m<sup>3</sup>/hr—Normal cubic meters per hour (0°C and 1.01325 bar, absolute). Scfh—Standard cubic feet per hour (60°F and 14.7 psia).  
 3. Performance values are obtained using a transducer with a 4 to 20 mA dc input signal and a 0.2 to 1.0 bar (3 to 15 psig) output signal at an ambient temperature of 24°C (75°F).  
 4. This product is approved for use with Natural Gas. Natural gas to contain no more than 20 ppm of hydrogen sulphide.  
 5. The pressure and temperature limits in this document and any applicable standard or code limitation should not be exceeded.  
 6. For other ranges, zero and span adjustments are needed.

Table 2. Immunity Performance

Port	Phenomenon	Basic Standard	Performance Criteria <sup>(1)</sup>
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	A
	Radiated EM field	IEC 61000-4-3	A
	Rated power frequency magnetic field	IEC 61000-4-8	A
I/O signal/control	Burst (fast transients)	IEC 61000-4-4	A
	Surge	IEC 61000-4-5	A
	Conducted RF	IEC 61000-4-6	A

Specification limit = ±1% of span  
 1. A=No degradation during testing. B = Temporary degradation during testing, but is self-recovering.

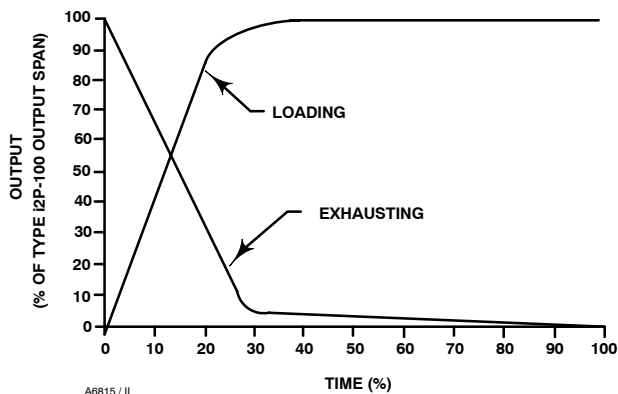


Figure 2. Output-Time Relationships for Type i2P-100 Transducer

output ranges are typically 0.2 to 1.0 bar (3 to 15 psig) and 0.4 to 2.0 bar (6 to 30 psig). A typical application is in electronic control loops where the final control element is a control valve assembly that is pneumatically operated. The input signal and output pressure range of the transducer is indicated on the nameplate, attached to the housing.

**CAUTION**

**Dropping or rough handling of the transducer can cause damage to the converter module resulting in a shifted output or a minimum output.**

# i2P-100 Transducer

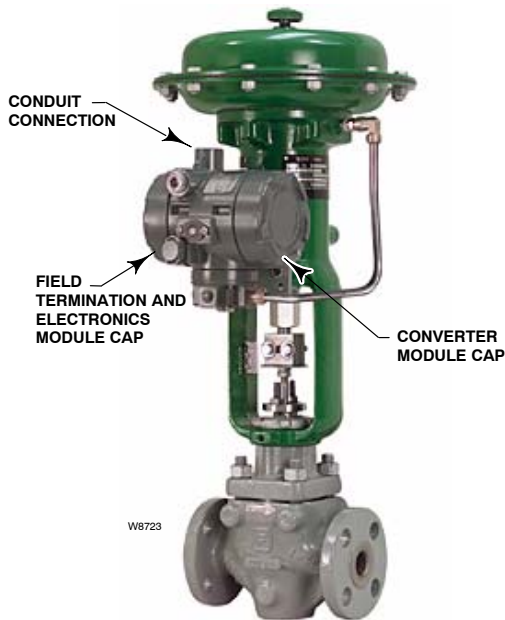


Figure 3. Type i2P-100 Electro-Pneumatic Transducer Mounted on a Size 30 667 Sliding-Stem Actuator

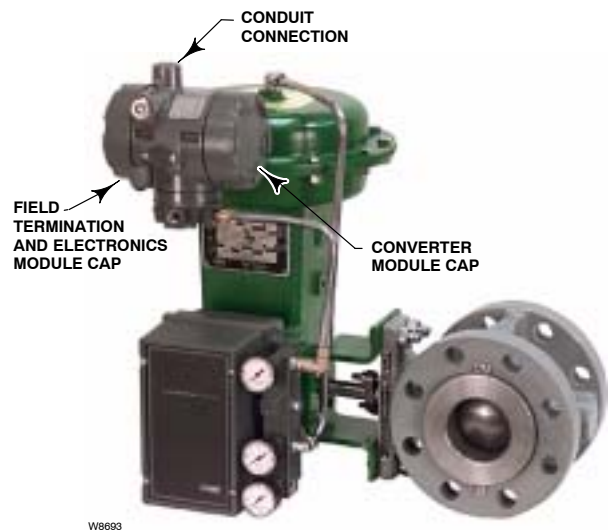


Figure 4. Type i2P-100 Electro-Pneumatic Transducer Mounted on a Size 33 1052 Rotary Actuator, 3610J Positioner and V300B Rotary Valve.

## Specifications

Specifications for the Type i2P-100 transducer are listed in table 1.



### WARNING

**This product is intended for a specific current range, temperature range and other application specifications. Applying different current, temperature and other service conditions could result in malfunction of the product, property damage or personal injury.**

## Educational Services

For information on available courses for the Type i2P-100 electro-pneumatic transducer, as well as a variety of other products, contact:

Emerson Process Management  
 Educational Services, Registration  
 P.O. Box 190; 301 S. 1st Ave.  
 Marshalltown, IA 50158-2823  
 Phone: 800-338-8158 or  
 Phone: 641-754-3771  
 FAX: 641-754-3431  
 e-mail: education@emersonprocess.com

## Note

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## Installation

The i2P-100 transducer has been designed and approved for use with either air or natural gas as the supply medium. If using natural gas as the pneumatic supply medium, natural gas will be used in the pneumatic output connections of the transducer to any connected equipment. In normal operation the unit will vent the supply medium into the surrounding atmosphere unless it is remotely vented. When using natural gas as the supply medium, in a non-hazardous location in a confined area, remote venting of the unit is required. Failure to do so could result in personal injury, property damage, and area re-classification. For hazardous locations remote venting of the unit may be required,

depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations. Failure to do so when necessary could result in personal injury, property damage, and area re-classification.

Additional information for installation and safe-use in hazardous locations can be found in Special Instructions for Safe-Use and Installation in Hazardous Locations.

 **WARNING**

**To avoid personal injury or property damage from the sudden release of pressure, air, or natural gas:**

- Always wear protective clothing, gloves, and eyewear when performing any installation operations.
- If installing into an existing application, also refer to the **WARNING** at the beginning of the Maintenance section of this instruction manual.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

 **WARNING**

**This unit vents the supply medium into the surrounding atmosphere. When installing this unit in a non-hazardous (non-classified) location in a confined area, with natural gas as the supply medium, you must remotely vent this unit to a safe location. Failure to do so could result in personal injury or property damage from fire or explosion, and area re-classification.**

**When installing this unit in a hazardous (classified) location remote venting of the unit may be required, depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations.**

**Failure to do so when necessary could result in personal injury or property damage from fire or explosion, and area re-classification.**

**Vent line piping should comply with local and regional codes and should be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.**

When received from the factory, the set screws (key 8), which provide a locking feature for the housing caps (key 2), are backed off approximately 1 turn. When using the i2P-100 transducer in explosive atmospheres these set screws must be fully engaged.

 **WARNING**

**When using this unit in explosive atmospheres, the set screws (key 8) must be fully engaged to lock/secure the housing caps. Failure to fully engage these set screws could result in unauthorized opening of the unit, which may result in personal injury or property damage caused by fire or explosion.**

**Special Instructions for Safe-Use and Installation in Hazardous Locations**

Certain nameplates may carry more than one approval, and each approval may have unique installation requirements and/or conditions of safe-use. Special instructions are listed by agency/approval below.

After reading and understanding these special conditions of use, proceed with standard installation procedures.

 **WARNING**

**Failure to follow these conditions of safe-use could result in personal injury or property damage from fire or explosion, and area re-classification.**



Table 3. Hazardous Area Classifications for North America (CSA and FM Approvals)

CERTIFICATION BODY	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
CSA	(Intrinsic Safety) Zone •Ex ia IIC T3/T4/T5 per drawing GE07471 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07471	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 5 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ( $T_{amb} \leq 85^\circ\text{C}$ ) T4 ( $T_{amb} \leq 81^\circ\text{C}$ ) T5 ( $T_{amb} \leq 46^\circ\text{C}$ )	4X*
	(Explosion Proof) Zone •Ex d IIC T5/T6 Class/Division •Class I, Division 1 GP, A, B, C, D	---	T5 ( $T_{amb} \leq 85^\circ\text{C}$ ) T6 ( $T_{amb} \leq 75^\circ\text{C}$ )	4X*
	(Type n) Zone •Ex nC IIC T5/T6	---	T5 ( $T_{amb} \leq 85^\circ\text{C}$ ) T6 ( $T_{amb} \leq 75^\circ\text{C}$ )	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 1, GP E, F, G Class III, Division 2 GP F, G Class III	---	T5 ( $T_{amb} \leq 85^\circ\text{C}$ ) T6 ( $T_{amb} \leq 75^\circ\text{C}$ )	4X*
FM	(Intrinsic Safety) Zone •Class I Zone 0 AEx ia IIC T3/T4/T5 per drawing GE07470 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07470	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 0 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ( $T_{amb} \leq 85^\circ\text{C}$ ) T4 ( $T_{amb} \leq 81^\circ\text{C}$ ) T5 ( $T_{amb} \leq 46^\circ\text{C}$ )	4X*
	(Explosion Proof) Zone •Class I Zone 1 AEx d IIC T5/T6 Class/Division •Class I, Division 1, GP A, B, C, D	---	T5 ( $T_{amb} \leq 85^\circ\text{C}$ ) T6 ( $T_{amb} \leq 75^\circ\text{C}$ )	4X*
	(Type n) Zone •Class I Zone 2 AEx nC IIC T5/T6	---	T5 ( $T_{amb} \leq 85^\circ\text{C}$ ) T6 ( $T_{amb} \leq 75^\circ\text{C}$ )	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 1, GP E, F, G Class II, Division 2, GP F, G Class III	---	T5 ( $T_{amb} \leq 85^\circ\text{C}$ ) T6 ( $T_{amb} \leq 75^\circ\text{C}$ )	4X*

\* When remotely vented.

## CSA

### Special Conditions of Use

None stated.

Refer to table 3 for additional information, figure 15 for the CSA loop schematic and figure 16 for the CSA and FM approvals nameplate.

## FM

### Special Conditions of Use

1. When product is used with natural gas as the pneumatic medium, the maximum working pressure of the natural gas supply is limited to 50 psi.
2. When product is used with natural gas as the pneumatic medium the product shall be provided

with the proper remote venting, as described on page 10 of this instruction manual.

Refer to table 3 for additional information, figure 17 for the FM loop schematic, and figure 16 for the CSA and FM approvals nameplate.

### ATEX All Approvals

All ATEX approved units come with a combined nameplate which carries multiple approvals (intrinsic safety and dust, flameproof and dust, and Type n and dust), as shown in figure 18. During installation, only one type of protection method is allowed. The unit shall be marked as to which protection method it was installed as and shall not be changed or utilized in any other manner than was originally marked by the end-user.

Table 4. Hazardous Area Classifications for ATEX and IECEx Approvals

CERTIFICATE	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
ATEX	⊕ II 1 GD Gas •EEx ia IIC T3/T4/T5 —Intrinsic Safety Dust •T95°C (T <sub>amb</sub> ≤ 85°C)	U <sub>i</sub> = 30 Vdc I <sub>i</sub> = 150 mA P <sub>i</sub> = 1.0 W C <sub>i</sub> = 0 nF L <sub>i</sub> = 0 mH	T3 (T <sub>amb</sub> ≤ 85°C) T4 (T <sub>amb</sub> ≤ 81°C) T5 (T <sub>amb</sub> ≤ 46°C)	IP66*
	⊕ II 2 GD Gas •EEx d IIC T5/T6 —Flameproof Dust •T95°C (T <sub>amb</sub> ≤ 85°C)	---	T5 (T <sub>amb</sub> ≤ 85°C) T6 (T <sub>amb</sub> ≤ 75°C)	IP66*
	⊕ II 3 GD Gas •EEx nC II T5/T6 —Type n Dust •T95°C (T <sub>amb</sub> ≤ 85°C)	---	T5 (T <sub>amb</sub> ≤ 85°C) T6 (T <sub>amb</sub> ≤ 75°C)	IP66*
IECEx	Gas •Ex ia IIC T3/T4/T5 —Intrinsic Safety	U <sub>i</sub> = 30 Vdc I <sub>i</sub> = 150 mA P <sub>i</sub> = 1.0 W C <sub>i</sub> = 0 nF L <sub>i</sub> = 0 mH	T3 (T <sub>amb</sub> ≤ 85°C) T4 (T <sub>amb</sub> ≤ 81°C) T5 (T <sub>amb</sub> ≤ 46°C)	IP66*
	Gas •Ex d IIC T5/T6 —Flameproof	---	T5 (T <sub>amb</sub> ≤ 85°C) T6 (T <sub>amb</sub> ≤ 75°C)	IP66*
	Gas •Ex nC IIC T5/T6 —Type n	---	T5 (T <sub>amb</sub> ≤ 85°C) T6 (T <sub>amb</sub> ≤ 75°C)	IP66*

\* When remotely vented.



**WARNING**

**For ATEX approvals only, end-user must select and mark only one protection method upon installation. Once marked it shall not be changed. Failure to follow these instructions will jeopardize the explosion safety of the transducer, and may result in personal injury or property damage.**

**ATEX Intrinsic Safety**

**Special Conditions for Safe-Use**

1. Before putting in service, the user shall permanently cross out the areas on the nameplate with the types of protection that are not applicable (EEx ia IIC T3... T5, KEMA 05ATEX1109 X or EEx nA II T5/T6, KEMA 05ATEX1119) or mark the selected type of protection. Once determined the type of protection may not be changed.

2. Because the enclosure of the Type i2P-100 transducer is made of aluminum, if it is mounted in

an area where the use of category 1 G apparatus is required, it must be installed such, that, even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

**3. Ambient temperature range:**

- 40°C – + 46°C for temperature class T5
- 40°C – + 81°C for temperature class T4
- 40°C – + 85°C for temperature class T3

**Electrical data:**

Unit must be installed with appropriate I.S barrier with maximum entity ratings as follows:

- U<sub>i</sub> = 30 V
- I<sub>i</sub> = 150 mA (resistively limited)
- P<sub>i</sub> = 1 W
- C<sub>i</sub> = 0 nF
- L<sub>i</sub> = 0 mH

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

# i2P-100 Transducer

## **ATEX Flameproof**

### **Special Conditions for Safe-Use**

1. Before putting in service, the user shall permanently cross out the areas on the nameplate with the types of protection that are not applicable (EEx ia IIC T3... T5, KEMA 05ATEX1109 X or EEx nA II T5/T6, KEMA 05ATEX1119) or mark the selected type of protection. Once determined the type of protection may not be changed.

2. Electrical connections are typically made using either cable or conduit.

- If using a cable connection, the cable entry and closing devices shall be certified in type of protection flameproof enclosure “d”, suitable for the conditions of use and correctly installed. For ambient temperatures over 70°C, suitable heat resistant cables and cable glands shall be used.

- If using a rigid conduit connection, a certified sealing device in type of protection flameproof enclosure “d”, such as a conduit seal with setting compound shall be provided immediately to the entrance of the valve housing. For ambient temperature over 70°C, suitable heat resistant wiring and setting compound for the conduit seal shall be used.

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

## **ATEX Type n**

### **Special Conditions for Safe-Use**

1. Before putting in service, the user shall permanently cross out the areas on the nameplate with the types of protection that are not applicable (EEx ia IIC T3... T5, KEMA 05ATEX1109 X or EEx nA II T5/T6, KEMA 05ATEX1119) or mark the selected type of protection. Once determined the type of protection may not be changed.

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

## **IECEx Intrinsic Safety, Type n, Flameproof**

### **Conditions of Certification**

The Intrinsically Safe version has the following Entity Parameters:

$$U_i = 30 \text{ V}$$

$$I_i = 150 \text{ mA}$$

$$P_i = 1.0 \text{ W}$$

$$C_i = 0 \text{ uF}$$

$$L_i = 0 \text{ uH}$$

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

## **Mounting**

When a transducer is ordered as part of a control valve assembly, the factory mounts the transducer on the actuator and connects the necessary tubing, then adjusts the transducer as specified on the order. See figures 3 and 4 for typical mounting configurations.

Transducers also can be ordered separately for mounting on a control valve assembly already in service, or for mounting on a 2-inch diameter pipestand, or a flat surface. The transducer may be ordered either with or without mounting parts.

Mounting parts include a mounting plate and bolts and, if ordered for pipestand mounting, a pipe clamp. Tubing is not included if the transducer is not factory mounted. Use 3/8-inch diameter tubing for all input and output connections. The length of tubing between the transducer output and the final control element should be as short as possible. Transducer overall dimensions are shown in figure 5. If weatherproofing is required, mount the transducer so that the vent can drain. Do not allow moisture or condensate to collect in the vent.

## **CAUTION**

**Do not mount the vent in a downward position, as the vent will not drain properly, and may become blocked with ice or debris, resulting in process instability.**

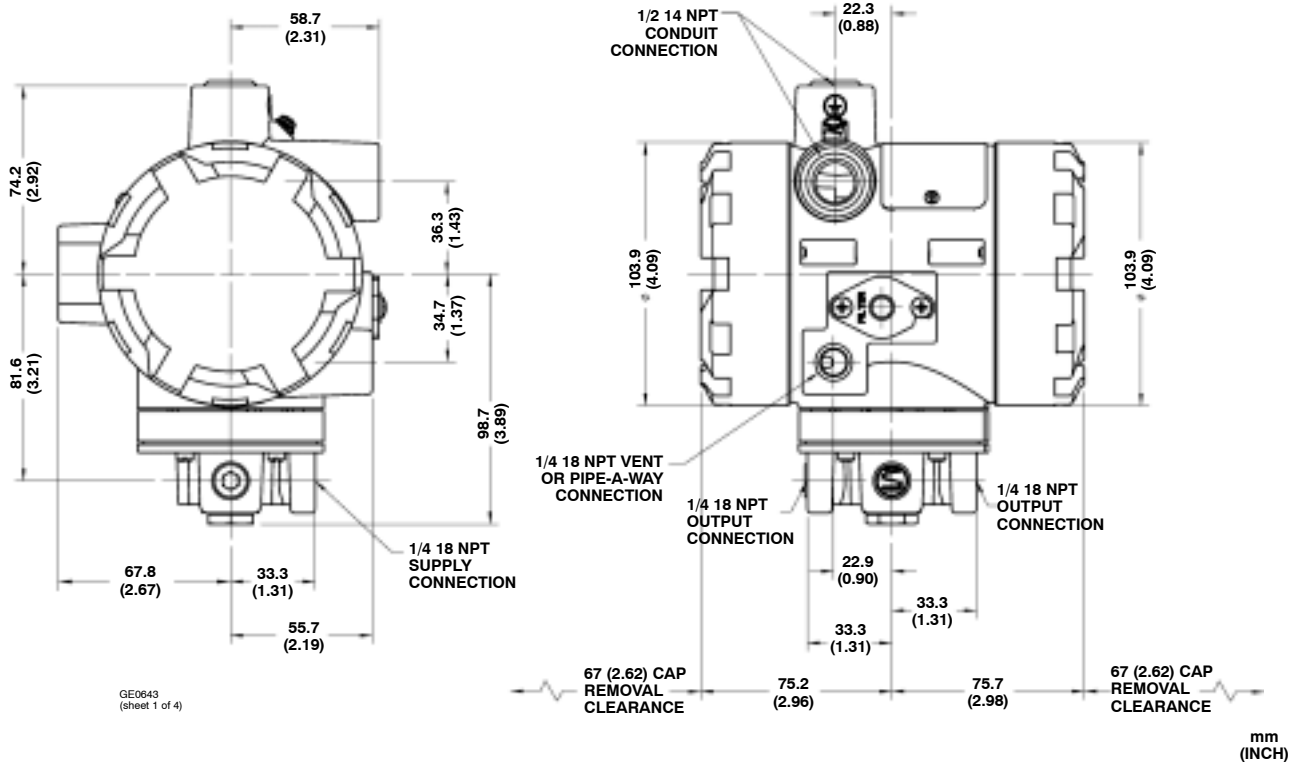


Figure 5. Dimensions and Connections

### Pneumatic Connections

As shown in figure 5, all pressure connections on the transducer are 1/4-inch NPT female connections. Use 3/8-inch tubing for all pressure connections. Refer to the vent subsection below for remote vent connections.

**office and Industry Instrument air quality standards for use with corrosive air or if you are unsure about the proper amount or method of air filtration or filter maintenance.**

### Supply Pressure Requirements



**Severe personal injury or property damage could result from an unstable process if the instrument supply medium is not clean, dry, oil-free and noncorrosive. While use and regular maintenance of a filter that removes particles larger than 40 microns in diameter will suffice in most applications, check with a Fisher Field**

Supply pressure must be clean, dry air or noncorrosive gas. Use a Fisher Type 67CFR Filter Regulator, or equivalent, to filter and regulate supply air. The filter regulator can be mounted on a bracket with the transducer as shown in figure 6 or mounted on the actuator mounting boss. An output pressure gauge may be installed on the regulator to indicate the supply pressure to the transducer. Also, as an aid for calibration, a second gauge may be installed on the transducer to indicate transducer output pressure.

Connect the nearest suitable supply source to the 1/4-inch NPT IN connection on the filter regulator (if furnished) or to the 1/4-inch NPT SUPPLY connection on the transducer case (if the filter regulator is not attached).

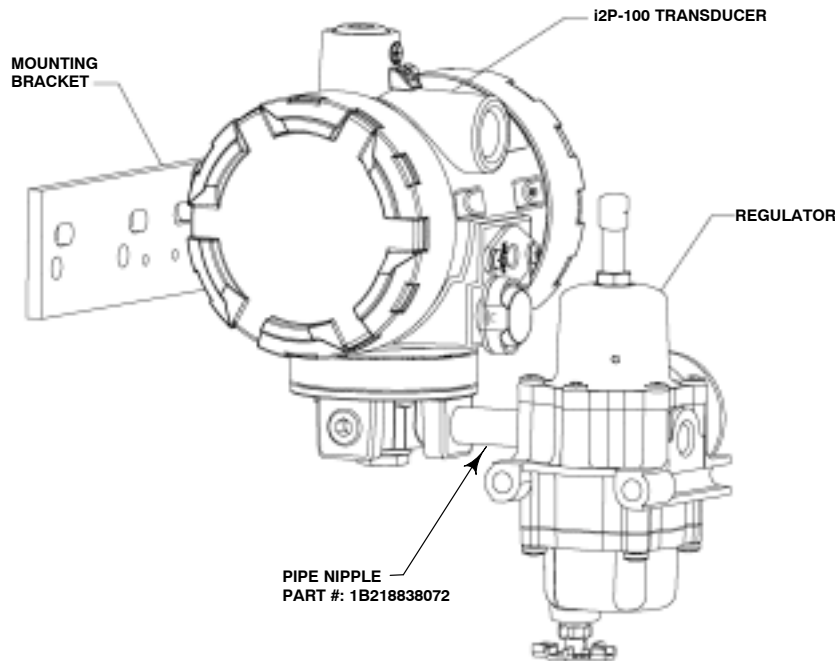


Figure 6. Typical Type i2P-100 Mounting With Type 67CFR Filter Regulator

## Diagnostic Connections

To support diagnostic testing of valve/actuator/positioner packages, special connectors and hardware are available. Typical connector installations are shown in figure 7. The hardware used includes a 1/4-inch NPT pipe nipple and pipe tee with a 1/8-inch NPT pipe bushing for the connector. The connector consists of a 1/8-inch NPT body and body protector.

### Note

**If the Type i2P-100 transducer is used in a valve assembly with a positioner, no hook-up for diagnostic testing is required for the Type i2P-100. The hook-up for diagnostic testing should be installed at the positioner.**

Install the connectors and hardware between the Type i2P-100 transducer and the actuator.

1. Before assembling the pipe nipple, pipe tee, pipe bushings, actuator piping, and connector body, apply sealant to all threads.

2. Turn the pipe tee to position the connector body and body protector for easy access when doing diagnostic testing.

## Vent

When using natural gas as the supply medium ensure that the following warnings are read and understood. Contact your Emerson Process Management sales office if you have any questions regarding the information contained in this section.



**This unit vents the supply medium into the surrounding atmosphere. When installing this unit in a non-hazardous (non-classified) location in a confined area, with natural gas as the supply medium, you must remotely vent this unit to a safe location. Failure to do so**

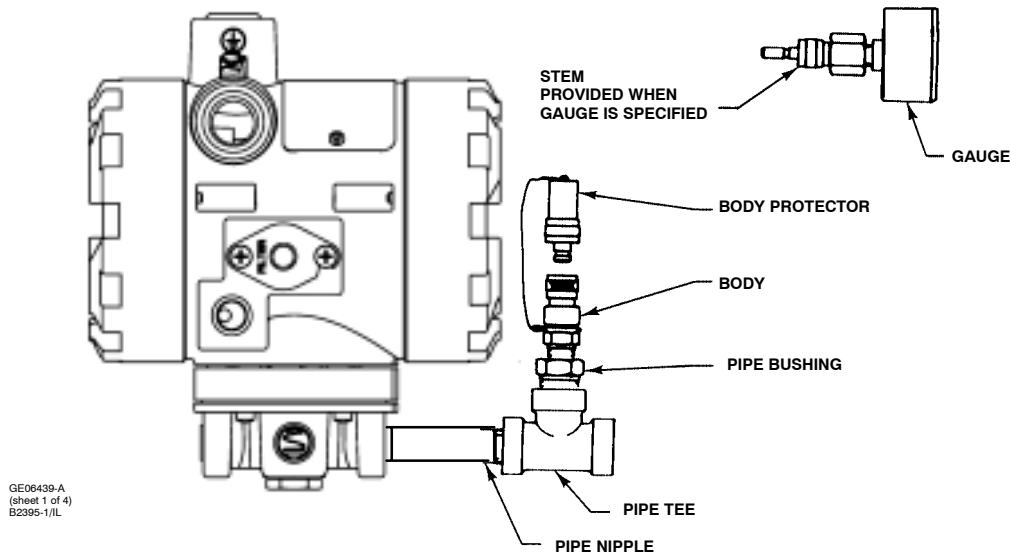


Figure 7. Diagnostics Hookup for Type i2P-100 Transducer

could result in personal injury or property damage from fire or explosion, and area re-classification.

When installing this unit in a hazardous (classified) location remote venting of the unit may be required, depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations. Failure to do so when necessary could result in personal injury or property damage from fire or explosion, and area re-classification.

Vent line piping should comply with local and regional codes and should be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.

If a remote vent is required, the vent line must be as short as possible with a minimum number of bends and elbows. To connect a remote vent, remove the plastic vent (key 71, figure 13). The vent connection is 1/4-inch NPT female. Use 3/8-inch tubing to provide a remote vent.

## Electrical Connections

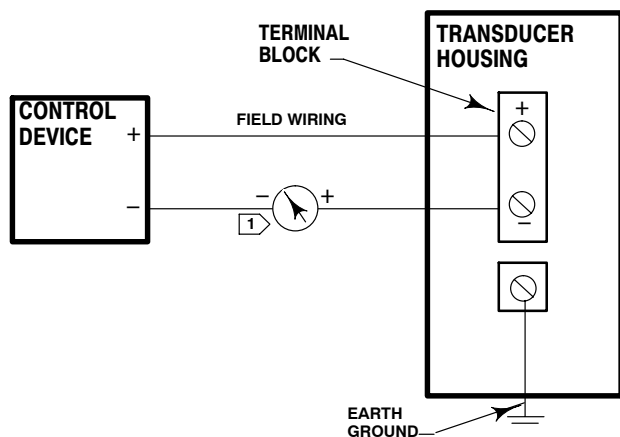
### WARNING

For explosion-proof applications, or when using natural gas as the supply medium, disconnect power before removing the housing cap. Personal injury or property damage from fire or explosion may result if power is not disconnected before removing the cap.

For intrinsically safe installations, refer to the nameplate or to instructions provided by the barrier manufacturer, for proper wiring and installation.

#### Note

For North American explosion-proof applications in the Class/Division system, the i2P-100 has been designed such that a conduit seal is not required. For all other applications install the product as per local, regional, or national code, rules, and regulations.



**NOTE:**

1 FOR TROUBLESHOOTING OR MONITORING OPERATION, AN INDICATING DEVICE CAN BE A VOLTMETER ACROSS A 250 OHM RESISTOR OR A CURRENT METER.

A3875/IL

Figure 8. Typical Field Wiring Diagram

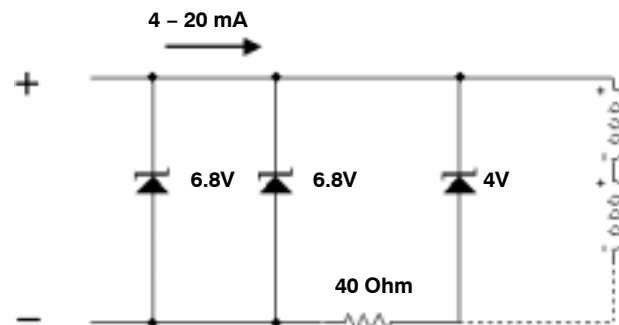


Figure 9. Equivalent Circuit

## Calibration

### WARNING

Select wiring and/or cable glands that are rated for the environment of use (hazardous location, ingress protection, and temperature). Failure to use properly rated wiring and/or cable glands can result in personal injury or property damage from fire or explosion.

Use the 1/2-inch NPT conduit connection, shown in figure 5, for installation of field wiring.

Refer to figures 8, 9, and 10 when connecting field wiring from the control device to the transducer. Connect the positive wire from the control device to the transducer “+” terminal and, the negative wire from the control device to the transducer “-” terminal. Do not overtighten the terminal screws. Maximum torque is 0.45 N•m (4 lbf•in.). Connect the transducer grounding terminal to earth ground.

Grounding terminals are provided both inside and outside the transducer housing.

## Operating Information

During normal operation, the output of the Type i2P-100 transducer is connected to the final control element.

### WARNING

On explosion-proof instruments, or when using natural gas as the supply medium, remove electrical power before removing either of the the housing caps in a hazardous area. Personal injury or property damage may result from fire or explosion if power is applied to the transducer with the cap removed in a hazardous area.

For intrinsically safe areas, current monitoring during operation must be with a meter approved for use in hazardous areas.

## Equipment Required

Choose a current or voltage source that is capable, without switching ranges, of driving the transducer through its entire input range. Switching ranges on a current or voltage source will produce spikes or mid-scale reverses in the input signal presented to the transducer, causing errors. The current source should be capable of delivering 30 mA with 30 V dc maximum compliance voltage.

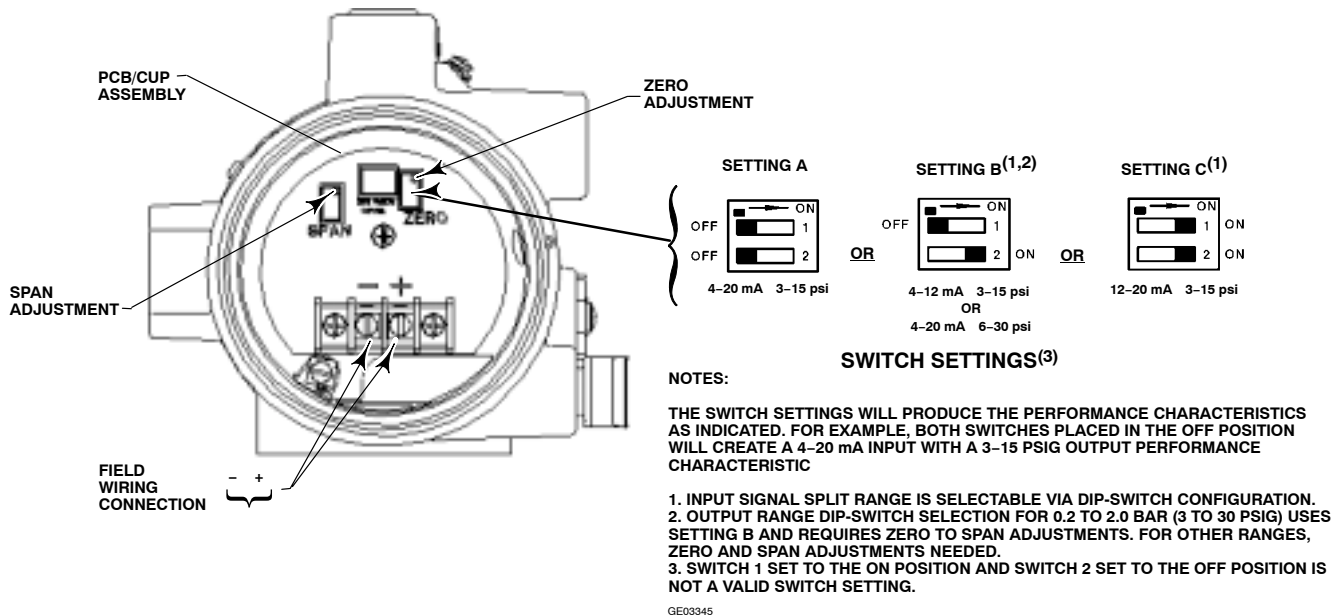


Figure 10. Zero and Span Adjustments and Switch Settings

**Calibration Procedure**

**WARNING**

To avoid personal injury or property damage due to an uncontrolled process provide some temporary means of process control before beginning the calibration procedure.

Refer to figure 10 for adjustment locations.

**Note**

The following steps are for a 4-20 mA, 0.2 to 1.0 bar (3 to 15 psig) configured unit. The same procedure is used for other configurations.

1. Remove electronics module cover (cover adjacent to conduit entry, see figure 3 and 4).

**CAUTION**

Do not attempt to remove either of the housing caps if the locking set screws (key 8) are engaged. Removing

housing caps without disengaging the set screws can cause damage to the housing caps.

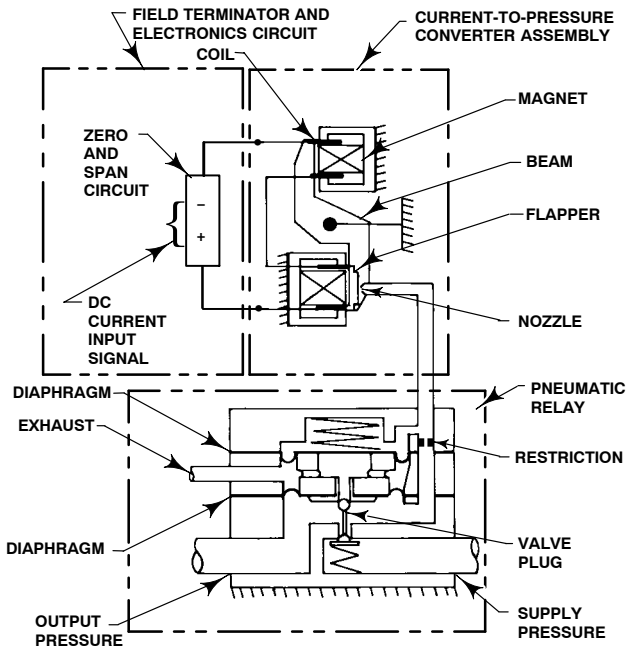
2. Input and output ranges are selectable by dip switch selection. Refer to figure 10 for dip switch settings. Adjust dip switch settings and zero and span as necessary to achieve the desired input/output range.
3. If a current source other than the control device is used as the input source, disconnect the control device and connect the current source positive terminal to the transducer “+” terminal and the current source negative terminal to the transducer “-” terminal.

If an external meter is used, connect the current source positive terminal to the transducer “+” terminal. Connect the meter positive terminal to the transducer “-” terminal and the meter negative terminal to the current source negative terminal as shown in figure 8.

4. Check the supply pressure to ensure it is at the recommended pressure. Refer to table 1, the Specifications table, for supply pressure recommendations.
5. Adjust the input current to the low milliamperes dc.



# i2P-100 Transducer



A3877-2/IL

Figure 11. Type i2P-100 Transducer Schematic

6. The output pressure should be 0.2 bar (3 psig). If not, adjust the ZERO potentiometer until the output pressure is 0.2 bar (3 psig).
7. Adjust the input current to the high milliamperes dc.
8. The output pressure should be 1.0 bar (15 psig). If not, adjust the SPAN potentiometer until the output pressure is 0.8 bar (15 psig).
9. Repeat steps 5 through 8 until the output pressure is within the referenced accuracy requirements without further adjustment.
10. If a current source other than the control device was used, disconnect the current source and reconnect the control device.

## Principle of Operation

The converter module receives a standard dc current input signal from a control device to operate coils in a force balanced beam system which in turn, controls bleed air through an integral nozzle/flapper arrangement. The nozzle pressure provides the input signal to operate the relay as shown in figure 11. Relay output pressure is applied, through tubing, directly to the final control element or valve/actuator assembly.

## Maintenance

Due to normal wear or damage from external sources such as debris in the supply medium, periodic maintenance or repair of the transducer may be necessary. Maintenance of the transducer consists of troubleshooting, removal for inspection, and replacement of component parts, as well as removal and inspection of the external removable filter/restriction and cleaning or replacing as necessary (see figure 1).

### WARNING

To avoid personal injury or property damage from the sudden release of pressure, air or natural gas:

- Always wear protective clothing, gloves, and eyewear when performing any maintenance operations.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure on both sides of the valve.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

### WARNING

When using natural gas as the supply medium, or for explosion proof applications, the following warnings also apply:

- Remove electrical power before removing either housing cap. Personal injury or property damage from fire or explosion may result if power is not disconnected before removing either cap.
- Remove electrical power before disconnecting any of the pneumatic

connections or removing the external removeable filter/restriction.

When disconnecting any of the pneumatic connections or the external removeable filter/restriction, natural gas will seep from the unit and any connected equipment into the surrounding atmosphere. Personal injury or property damage may result from fire or explosion if preventative measures are not taken, such as adequate ventilation and the removal of any nearby ignition sources.

### CAUTION

Do not attempt to remove either of the housing caps if the locking set screws (key 8) are engaged. Removing housing caps without disengaging the set screws can cause damage to the housing caps.

### CAUTION

When replacing components, use only components specified by the factory. Always use proper component replacement techniques, as presented in this manual. Improper techniques or component selection may invalidate the approvals and the product specifications, as indicated in table 1. It may also impair operations and the intended function of the device

The converter module and the electronics module are non-repairable. If troubleshooting or alignment attempts indicate a faulty converter or electronics module, replace the module or return the transducer to your Emerson Process Management sales office for repair.

## Troubleshooting

### WARNING

Refer to the WARNING at the beginning of this section.

### *Electrical*

The following procedures require taking the control valve/actuator assembly out of service. Provide some temporary means of process control before taking the control valve out of service.

1. Ensure terminal lug connections from the control device to the transducer are of the correct polarity (refer to the electrical connection procedures in the Installation section of this manual).
2. At the transducer, ensure that the milliampere dc signal is applied, and ensure that it is within the 4 to 20 milliampere range.
3. Check switches and ensure that they are properly set. Refer to figure 10.
4. If the problem has not been resolved, see Electronics Module Replacement in this manual.

### *Pneumatic*

Provide a 4 to 30 milliampere dc current source, supply pressure, and a gauge to monitor the output pressure when checking transducer operation. Refer to figure 13 for key number locations.

1. Ensure that supply pressure to the transducer meets your requirements [0.3 bar (5 psi) higher than upper range limit of output signal, with a maximum of 3.4 bar (50 psi)].
2. Ensure that the filter (key 11) and restrictor (key 10) are open and clean. Remove the two screws (key 14), the filter cap (key 13) and the O-ring (key 12) to access the filter and restrictor.
3. If a filter/regulator is used, ensure that it is working correctly. If not, ensure the dripwell is not plugged because of excessive moisture accumulation. If necessary, drain off any moisture, and clean or replace the filter element.
4. Force the converter module to maximum output pressure with a 30 milliampere dc signal. Output pressure should build up to the approximate value of the supply pressure [maximum of 3.4 bar (50 psi)].
5. When the input current is removed, the transducer output pressure should drop to less than 0.14 bar (2 psig). If it does not, check to ensure the vent and exhaust air passageway is free from foreign material.
6. To inspect the relay assembly, refer to the Relay Maintenance procedures in this manual.
7. If the problem has not been resolved, see Converter Module Replacement in this manual.

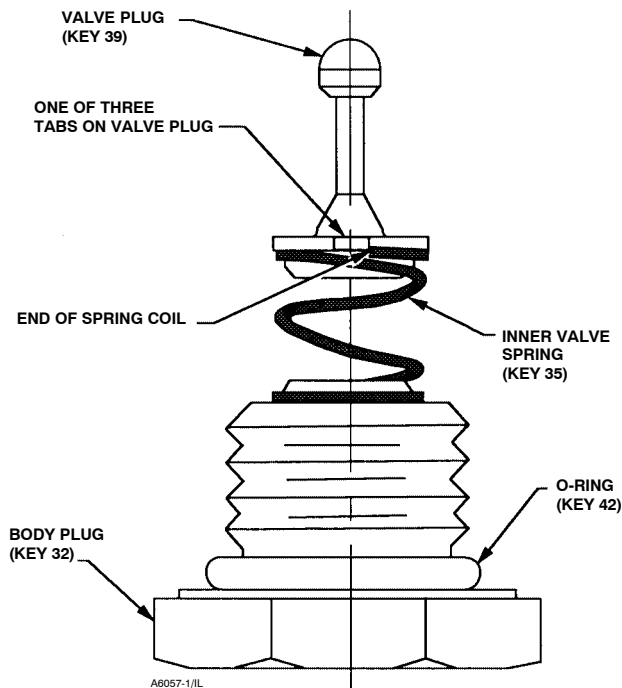


Figure 12. Valve Plug, Inner Valve Spring and Body Plug Assembly

2. Insert the converter module into position in the housing (key 1). Replace the two screws (key 52) and tighten them.
3. Replace the housing cap (key 2), making sure to re-tighten the set screw (key 8).
4. Electrically calibrate the unit using the procedure in the Calibration section of this manual.

## Electronics Module Replacement

### **WARNING**

Refer to the **WARNING** at the beginning of this section.

### Removal

Refer to figure 13 for key number locations.

1. Remove the housing cap (key 2) (the cap closest to the conduit). Note that the set screw (key 8) associated with this housing cap needs to be loosened to remove the cap.
2. Note the location of the wires, then remove the electrical wiring from the terminal block.
3. Remove the three screws (key 26) and remove the electronics module from the housing.

### Replacement

1. Insert the electronics module into position in the housing (key 1). Replace the three screws (key 26) and tighten them.
2. Replace the electrical wiring removed in step 1 of the removal procedures. Do not overtighten the terminal screws. Maximum torque is 0.45 N•m (4 lbf•in).
3. Electrically calibrate the unit using the procedure in the Calibration section of this manual.
4. Replace the housing cap (key 2), making sure to re-tighten the set screw (key 8).

## Converter Module Replacement

### **WARNING**

Refer to the **WARNING** at the beginning of this section.

### Removal

Refer to figure 13 for key number locations.

1. Remove the housing cap (key 2) (the cap farthest away from the conduit). Note that the set screw associated with this housing cap (key 8) needs to be loosened to remove the cap.
2. Unscrew the two captive screws (key 52) and remove the converter module from the housing.
3. Inspect the O-ring (key 55) and replace if necessary.

### Replacement

1. Lubricate the O-ring (key 55) with a silicone sealant before replacing the converter module in the housing.

## Relay Maintenance

### **WARNING**

Refer to the **WARNING** at the beginning of this section.

Refer to figures 12 and 14 for key number locations.

## Removal

1. Remove the four mounting screws (key 36, shown in figure 14) and remove the relay from the transducer. Be careful not to lose the bias spring (key 34) and input diaphragm (key 38).
2. Remove the body plug (key 32) that holds the inner valve spring (key 35) and valve plug (key 39) in place from the relay body assembly.
3. Remove the exhaust port assembly (key 33) from the relay assembly.
4. Inspect the springs, exhaust seat, valve plug, and other parts for wear or damage; replace as necessary. Note: the valve plug supply seat is an insert in the relay body (key 41). If this insert is bad, replace the relay body.
5. Make sure all parts of the relay are clean and that all passages are clear of foreign matter.

## Assembly

1. Assemble the inner valve spring (key 35) onto the body plug (key 32) and fit the valve plug (key 39) onto the inner valve spring as shown in figure 12. To assure best alignment between the valve plug, inner valve spring, and body plug; fit the valve plug onto the inner valve spring so that one of the three tabs at the base of the valve plug sets at the end of the last coil of the inner valve spring.
2. Lubricate the O-ring (key 42) with a silicone sealant (key 37). Insert the assembled valve plug, inner valve spring, and body plug into the relay body (key 41). Compress the spring and thread the body plug (key 5) into place. Then, tighten the body plug.
3. Insert two of the mounting screws (key 36) into two opposite holes of the relay body (key 41). Hold the screws in place while assembling the following parts on the relay body. The screws serve as studs to align the parts as they are being assembled.
4. When replacing the exhaust port assembly (key 33), make sure all passages and screw holes are aligned and that the hole in the center of the exhaust port assembly fits over the valve plug (key 39). Place the exhaust port assembly on the relay body (key 41). Hold assembled parts in place.
5. Make sure the tabs on the body block (key 40) align with the tabs on the relay body (key 41) and that the side with 5 holes faces the relay body. Place the body block on the assembled parts. Hold assembled parts in place.
6. When replacing the input diaphragm (key 38), make sure all passages and screw holes are

aligned. Place the input diaphragm on the body block (key 40). Hold assembled parts in place.

7. Install the bias spring (key 34) into the transducer housing assembly (key 1). Make sure the tabs on the body block and relay body align with the tab on the transducer housing assembly. Place the assembled parts onto the transducer housing assembly. Thread the two mounting screws (key 36) into the transducer housing assembly. Install the remaining two mounting screws. Tighten all mounting screws to 2 N•m (20 lbf•in).
8. Perform the procedure in the Calibration section of this manual.

## Parts Ordering

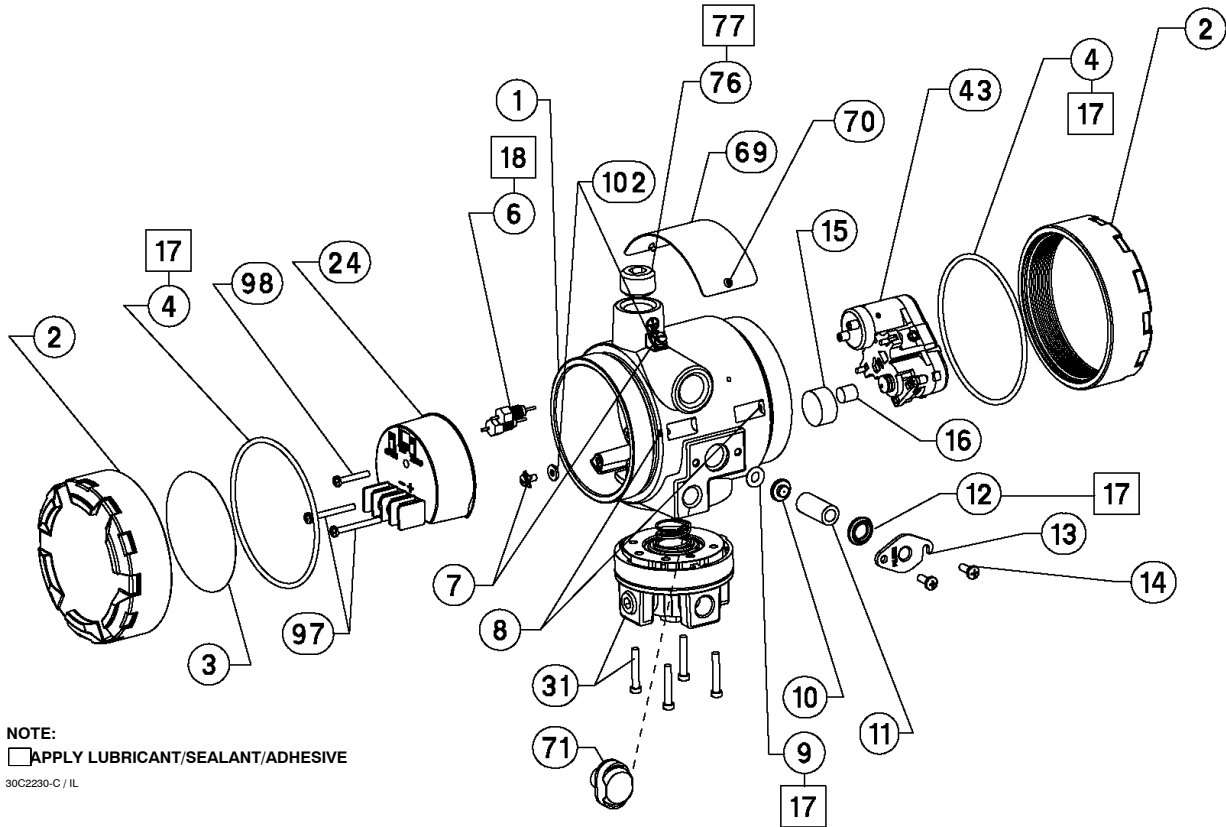
A serial number is assigned to each transducer and stamped on the nameplate. Always refer to this serial number when corresponding with your Emerson Process Management sales office regarding spare parts or technical information. When ordering replacement part, also specify the complete 11-character part number from the Parts list.

### Note

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Process Management should not, under any circumstances, be used in any Fisher instrument. Use of components not supplied by Emerson Process Management will void your warranty, might adversely affect the performance of the instrument, and might jeopardize worker and workplace safety.**

### Note

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NOTE:  
 APPLY LUBRICANT/SEALANT/ADHESIVE  
 30C2230-C / IL

Figure 13. Type i2P-100 Transducer Assembly

### Parts Kits

Description	Part Number
Repair Kit for Type i2P-100 electro-pneumatic transducer Contains O-rings (keys 4, 9, 12, and 55) and Filter (key 11)	R2P100X0012

Key	Description	Part Number
8	Set Screw (2 req'd)	1B4556X0012
9*	O-Ring <sup>(1)</sup>	
10	Restrictor, Primary	10C2233X012
11*	Filter <sup>(1)</sup>	
12*	O-Ring <sup>(1)</sup>	
13	Filter Cap	GB0122X0012
14	Machine Screw (2 req'd)	19B0821X012
15	Flame Arrestor	GE06959X012
16	Flame Arrestor	GE02963X012
17	Lubricant, silicone sealant (not furnished with transducer)	
18	Thread locking adhesive, high strength (not furnished with transducer)	
55	O-Ring <sup>(1)</sup>	
69	Nameplate, aluminum	---
70	Screw (2 req'd)	1P426928982
71	Vent Assembly	GE06162X012
76	Pipe Plug	1H5137X0012
102	Washer	1C332928982

### Parts List (see figure 13)

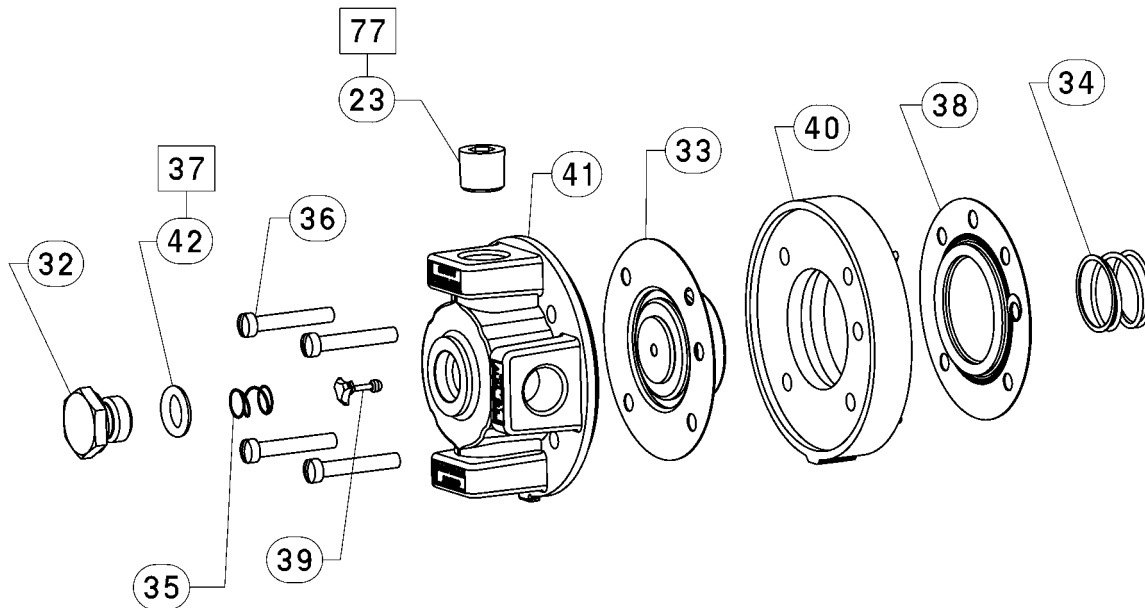
#### Housing

Key	Description	Part Number
1	Housing, Aluminum	
2	Cover (2 req'd)	48B6515X022
3	Configuration Label	GE03345X012
4*	O-Ring <sup>(1)</sup> (2 req'd)	
6	Feed Thru (2 req'd)	
7	Wire Retainer (2 req'd)	16A2821X012

#### PWB/Cup Assembly

24*	PWB/Cup Assembly	GE10168X012
97	Machine Screw (2 req'd)	GE11776X012
98	Machine Screw	GE11777X012

\*Recommended spare parts  
 1. Available in the Repair Kit



**NOTE:**  
 APPLY LUBRICANT/SEALANT/ADHESIVE

30C2258-B/IL

Figure 14. Type i2P-100 Relay Assembly

Key	Description	Part Number	Key	Description	Part Number
<b>Relay Assembly (see figure 14)</b>					
41	Relay / Body Assembly	GE03512X012			
42	O-Ring	1E5477X0062			
36	Machine Screw, fill hd (4 req'd)	1H1581X0012			
32	Body Plug	11B2363X012			
33	Exhaust Port Assembly	11B2364X012			
34	Spring	11B2369X012			
35	Spring	11B6843X012			
37	Lubricant, silicone sealant (not furnished with relay)				
38	Upper Diaphragm	21B2362X012			
39	Valve Plug	21B2370X012			
40	Body Block	31B2356X012			
77	Anti-Seize Sealant (not furnished with relay)				

**I/P Converter Assembly**

43*	I/P Converter Assembly	30C2218X012
-----	------------------------	-------------

**Gauge/Pipe Plug**

23	Pipe plug, use when gauge is not specified (not shown)	
	Alloy steel pl	1C333528992
	Stainless steel	1C3335X0032
23	Gauge, (not shown)	
	0-30 psig/0-0.2 MPa/0-2 bar	11B8579X022
	0-60 psig/0-0.4 MPa/0-4 bar	11B8579X032

**Diagnostic Connections**

FlowScanner™ diagnostic system hook-up

Includes pipe tee, pipe nipple, pipe bushings, connector body, and body protector. See figure 7 for part identification. Also, part number provides correct quantities of each item.

**Note**

**If the Type i2P-100 Transducer is used in a valve assembly with a positioner, no hook-up for diagnostic testing is required for the Type i2P-100. The hook-up for diagnostic testing should be installed at the positioner.**

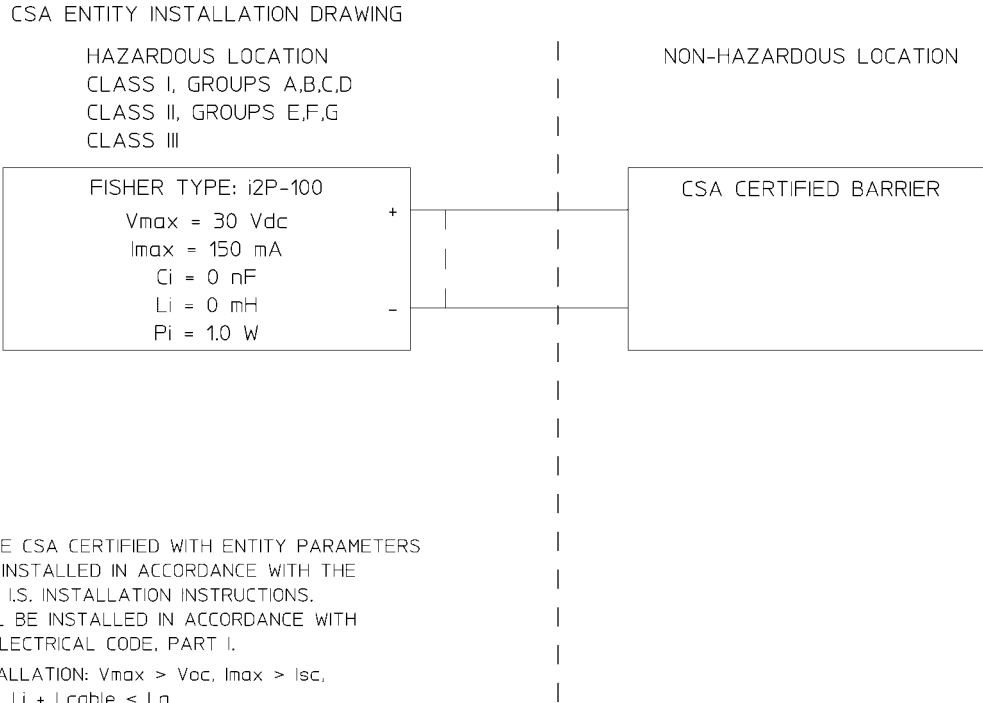
**Side Output**

For units with gauges	
SST fittings	12B8040X052
Brass fittings	12B8040X062
For units without gauges	
SST fittings	12B8040X072
Brass fittings	12B8040X082

\*Recommended spare parts

Key	Description	Part Number	Key	Description	Part Number
<b>Mounting Parts</b>					
<b>Yoke Mounting</b>					
<b>Type 470 size 23 through 64</b>					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
<b>480 Series actuator boss</b>					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
83	Screw, steel pl (2 req'd)	1C5958X0022			
85	Mounting Bracket, Steel	3L276725092			
86	Hex Nut, steel pl (2 req'd)	1A352724122			
<b>Type 585C size 25 and 50</b>					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
83	Screw, steel pl (2 req'd)	1A352624052			
<b>Type 585C (470) size 60, 68, 100, and 130 ; Type 657 and 667 size 30, 34, 40, 45, 50, 60, 70, 80 &amp; 87; Type 1051 and 1052 size 40, 60 and 70; Type 1061 all sizes</b>					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
83	Screw, steel pl (2 req'd)	1C870224052			
84	Spacer	1K766824092			
<b>Casing Mounting</b>					
<b>Type 657 and 667 size 30, 34, 40, 45, 50 and 60</b>					
80	Mounting Bracket, steel			1F401225072	
81	Washer, steel pl (2 req'd)			1B865928982	
82	Cap Screw, steel pl (2 req'd)			1A381624052	
83	Screw (req'd)			1A582824052	
<b>Type 657 and 667 size 70</b>					
80	Mounting Bracket, steel			1F401225072	
81	Washer, steel pl (2 req'd)			1B865928982	
82	Cap Screw, steel pl (2 req'd)			1A381624052	
83	Screw (2 req'd)			1A368324052	
<b>Type 1051 and 1052 size 20, 33, 40, 60 and 70</b>					
80	Mounting Bracket, steel			1F401225072	
81	Washer, steel pl (2 req'd)			1B865928982	
82	Cap Screw, steel pl (2 req'd)			1A381624052	
83	Screw (req'd)			1A582824052	
<b>Type 1250 and 1250R all sizes</b>					
80	Mounting Bracket, steel			30B1265X022	
81	Washer, steel pl (2 req'd)			1B865928982	
82	Cap Screw, steel pl (2 req'd)			1A381624052	
87	Washer			10B6610X012	
91	U-Bolt (2 req'd)			19A7930X012	
92	Hex Nut (req'd)			19A4838X012	
<b>Pipestand Mounting</b>					
80	Mounting Bracket, steel			3P426825022	
81	Washer, steel pl (4 req'd)			1B865928982	
82	Cap Screw, steel pl (2 req'd)			1A381624052	
88	Pipe Clamp, steel pl			1P427028982	
<b>Surface Mounting</b>					
80	Mounting Bracket, Steel			GE07077X012	
82	Cap Screw			1B6098X0012	

### Loop Schematics/Nameplates



GE07471

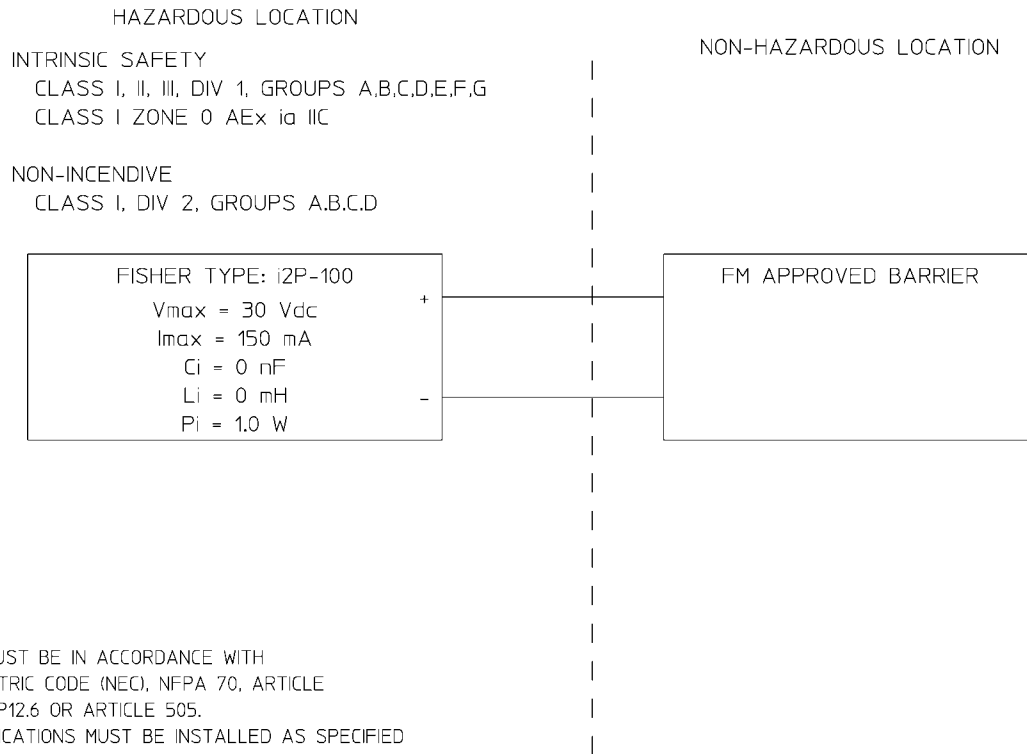
Figure 15. CSA Loop Schematic

<b>TYPE i2P-100</b>	20 mADC == MAX, 30 VDC == MAX, 50 PSI MAX AMB. TEMP: -40 TO 85°C	APPROVED FOR NATURAL GAS AS SUPPLY MEDIUM. CSA ENCLOSURE 3, NEMA 3	FISHER CONTROLS INTL LLC MARSHALLTOWN, IOWA, USA MFG LOCATION
SERIAL NO. <input style="width: 80%;" type="text"/>	FACTORY CALIBRATED AS: INPUT: 4-20 mADC OUTPUT: 3-15 PSI <input type="checkbox"/> 6-30 PSI <input type="checkbox"/>	SEAL NOT REQUIRED	
	FIELD CALIBRATED AS: INPUT: _____ mA OUTPUT: _____ PSI	IS: CL I, II, III DIV 1, 2 GP ABCDEFG T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C) WHEN INSTALLED PER DWG GE07470	
	SEAL NOT REQUIRED	XP: CL I DIV 1 GP ABCD T5(Tamb≤85°C)/T6(Tamb≤75°C)	
CL I DIV 1 GP ABCD T5; CL I DIV 2 GP ABCD T5 CL II DIV 1 GP EFG T5; CL II DIV 2 GP FG T5	US PATENTS - 4836011 - 4595029 OTHER PATENTS PENDING	NI: CL I DIV 2 GP ABCD T5(Tamb≤85°C)/T6(Tamb≤75°C)	
Ex ia INTRINSICALLY SAFE CL I, II, III DIV 1 GP ABCDEFG T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C) WHEN INSTALLED PER DRAWING GE07471		DIP: CL II DIV 1 GP EFG T5(Tamb≤85°C)/T6(Tamb≤75°C)	
Ex ia IIC T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C) Ui, Vmax=30V Ii, Imax=150mA Pi=1.0W Ci=0nF Li=0uH		S: CL II DIV 2 GP FG T5(Tamb≤85°C)/T6(Tamb≤75°C)	
Ex d IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)		CLASS I ZONE 0 AEx ia IIC T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C)	
Ex nC IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)		Ui, Vmax=30V Ii, Imax=150mA Pi=1.0W Ci=0nF Li=0mH	
		CLASS I ZONE 1 AEx d IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)	
		CLASS I ZONE 2 AEx nC IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)	
WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. OPEN CIRCUIT BEFORE REMOVING COVER. WHEN OPERATING OVER 70°C USE SUITABLE CABLING/WIRING.			
		GE13955	

Figure 16. CSA and FM Approvals Nameplate



# i2P-100 Transducer



NOTES:

1. THE INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), NFPA 70, ARTICLE 504 AND ANSI/ISA RP12.6 OR ARTICLE 505.
2. CLASS 1, DIV 2 APPLICATIONS MUST BE INSTALLED AS SPECIFIED IN NEC ARTICLE 501-4(B). EQUIPMENT AND FIELD WIRING IS NON-INCENDIVE WHEN CONNECTED TO APPROVED BARRIERS WITH ENTITY PARAMETERS.
3. LOOPS MUST BE CONNECTED ACCORDING TO THE BARRIER MANUFACTURER'S INSTRUCTIONS.
4. MAXIMUM SAFE AREA VOLTAGE SHOULD NOT EXCEED 250 Vrms.
5. RESISTANCE BETWEEN BARRIER GROUND AND EARTH GROUND MUST BE LESS THAN ONE OHM.
6. NORMAL OPERATING CONDITIONS 30 Vdc 20 mADC.
7. FOR ENTITY INSTALLATION (U.S. AND N.I.):
  - $V_{max} > V_{oc}$ , or  $V_t$      $C_i + C_{cable} < C_a$
  - $I_{max} > I_{sc}$ , or  $I_t$        $L_i + L_{cable} < L_a$
  - $P_i > P_o$ , or  $P_t$

GE07470

Figure 17. FM Loop Schematic

**ATEX INTRINSIC SAFETY APPROVAL INFORMATION**

**ATEX FLAMEPROOF APPROVAL INFORMATION**

**ATEX TYPE n APPROVAL INFORMATION**

**TYPE i2P-100** | US PATENTS - 4836011 - 4595029 | 20 mADC == MAX, 30 VDC == MAX, 50 PSI MAX  
 OTHER PATENTS PENDING | AMB TEMP: -40 TO 85°C, IP64 | APPROVED FOR NATURAL GAS AS SUPPLY MEDIUM | FISHER CONTROLS INTL LLC  
 MARSHALLTOWN, IOWA, USA  
 MFG LOCATION:

SERIAL NO  | FACTORY CALIBRATED AS:  
 INPUT: 4-20 mADC == OUTPUT: 3-15 PSI  6-30 PSI   
 FIELD CALIBRATED AS: INPUT \_\_\_\_\_ mADC == OUTPUT \_\_\_\_\_

<p><input type="checkbox"/> KEMA 05 ATEX 1109X  II 1 G D                  EEx ia IIC T3(Tamb≤85°C)                  T4(Tamb≤81°C) T5(Tamb≤46°C)                  Ui = 30V li = 150mA Pi = 1.0W                  Ci = 0F Li = 0H                  USE ONLY WITH A LINEAR BARRIER                  MAXIMUM ENCLOSURE SURFACE TEMPERATURE                  T95°C(Tamb≤85°C)</p>	<p><input type="checkbox"/> KEMA 05 ATEX 2099X  II 2 G D                  EEx d IIC T5(Tamb≤85°C)                  T6(Tamb≤75°C)</p>	<p><input type="checkbox"/> KEMA 05 ATEX 1119   11 3 GD EEx nC II                  T5(Tamb≤85°C) T6(Tamb≤75°C)</p>
MAXIMUM ENCLOSURE SURFACE TEMPERATURE T95°C(Tamb≤85°C)	MAXIMUM ENCLOSURE SURFACE TEMPERATURE T95°C(Tamb≤85°C)	MAXIMUM ENCLOSURE SURFACE TEMPERATURE T95°C(Tamb≤85°C)

IECEX CSA 05.0010X  
 Ex ia IIC T3(Tamb≤85°C) T4(Tamb≤81°C) T5(Tamb≤46°C)  
 Ui=30V li=150mA Pi=1.0W Ci=0F Li=0H  
 Ex d IIC T5(Tamb≤85°C) T6(Tamb≤75°)  
 Ex nC IIC T5(Tamb≤85°C) T6(Tamb≤75°C)

**CAUTION/WARNINGS:**

- ELECTROSTATIC CHARGE HAZARD - DO NOT RUB OR CLEAN WITH SOLVENTS. TO DO SO COULD RESULT IN AN EXPLOSION.
- WHEN OPERATING OVER 70°C, USE SUITABLE CABLING/WIRING.
- FOR ATEX APPROVALS ONLY - USER MUST SELECT AND MARK ONLY ONE PROTECTION METHOD UPON INSTALLATION. ONCE MARKED IT SHALL NOT BE CHANGED. NOT FOLLOWING THESE INSTRUCTIONS WILL JEOPARDIZE THE EXPLOSION SAFETY.

GE06337

**IECEX APPROVAL INFORMATION**

Figure 18. ATEX and IECEx Approvals Nameplate

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### **Emerson Process Management**

#### **Fisher**

Marshalltown, Iowa 50158 USA

Cernay 68700 France

Sao Paulo 05424 Brazil

Singapore 128461

[www.Fisher.com](http://www.Fisher.com)





**GENERAL MONITORS**

# **Model S4000C**

Intelligent Sensor for  
Combustible Gas Detection



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**Instruction Manual** **10-05**

General Monitors reserves the right to change published specifications and designs without prior notice.



**Part No.**  
**Revision**

**MANS4000C**  
**F/10-05**

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# Table of Contents

<b>TABLE OF FIGURES</b> .....	<b>VI</b>
<b>TABLE OF TABLES</b> .....	<b>VII</b>
<b>QUICK START GUIDE</b> .....	<b>1</b>
Mounting and Wiring .....	1
Tools Required.....	1
Terminal Connections .....	1
<b>1.0 INTRODUCTION</b> .....	<b>3</b>
1.1 Protection for Life .....	3
1.2 Special Warnings .....	3
1.3 System Integrity Verification .....	3
<b>2.0 PRODUCT DESCRIPTION</b> .....	<b>5</b>
2.1 General Description .....	5
<b>3.0 INSTALLATION</b> .....	<b>6</b>
3.1 Receipt of Equipment.....	6
3.2 Tools Required.....	6
3.3 Choosing Product Locations .....	6
3.3.1 Remote Mounting of the Sensor from the Electronics .....	7
3.4 Mounting and Wiring .....	7
3.5 Terminal Connections .....	9
3.5.1 Terminal Block TB1 – Sensor Connections .....	9
3.5.2 Terminal Block TB2 – Power and Signal Connections .....	9
3.5.3 DC Power and Ground Connections.....	10
3.5.4 Analog Signal Connections.....	11
3.5.5 Terminal Block TB3 – Relay Connections .....	12
3.5.6 European Union (EU) Approved Applications.....	13
3.5.7 Cable Termination in the Non-Hazardous Area.....	13
3.6 Maintaining the X/P Integrity .....	14
<b>4.0 OPERATION</b> .....	<b>15</b>
4.1 Start-Up Checklist .....	15
4.2 Start-Up .....	15
4.3 Relay Reset.....	15
4.4 User Selectable Options .....	16
4.4.1 Model S4000C User Menu Structure .....	17
4.4.2 Calibration Level .....	17
4.4.3 Warning Relay Settings .....	18
4.4.4 Alarm Relay Settings.....	18
4.4.5 MODBUS Channel 1 Settings.....	19
4.4.6 MODBUS Channel 2 Settings.....	19
4.5 Gas Check Mode .....	20
4.5.1 Procedure for Checking the Calibration .....	20

4.6	Calibration .....	20
4.6.1	Calibration Procedure .....	21
4.6.2	Aborting Calibration.....	22
4.6.3	Adjustable Calibration Level .....	22
4.6.4	Remaining Sensor Life.....	22
4.6.5	Initializing the Remaining Sensor Life.....	22
4.7	Calibration Equipment.....	23
4.7.1	Portable Purge Calibrator .....	23
<b>5.0</b>	<b>MAINTENANCE .....</b>	<b>24</b>
5.1	General Maintenance.....	24
5.2	Storage.....	24
<b>6.0</b>	<b>TROUBLESHOOTING .....</b>	<b>25</b>
6.1	Fault Codes & Their Remedies .....	25
6.1.1	F2 Failed to Complete Calibration .....	25
6.1.2	F3 EEPROM Checksum Error .....	25
6.1.3	F4 Sensor Error.....	25
6.1.4	F5 Unused.....	25
6.1.5	F6 Low Supply Voltage .....	26
6.1.6	F7 EEPROM Verification Failure .....	26
6.1.7	F8 Failure to Complete Setup .....	26
6.1.8	F9 Gas Check Period Exceeded.....	26
6.1.9	F10 Switch Error .....	26
<b>7.0</b>	<b>CUSTOMER SUPPORT .....</b>	<b>27</b>
7.1	General Monitors' Offices.....	27
<b>8.0</b>	<b>MODBUS INTERFACE .....</b>	<b>28</b>
8.1	Baud Rate .....	28
8.2	Data Format .....	28
8.3	MODBUS Read Status Protocol (Query/Response).....	28
8.3.1	MODBUS Read Query Message .....	28
8.3.2	MODBUS Read Response Message.....	28
8.4	MODBUS Write Command Protocol (Query/Response) .....	29
8.4.1	MODBUS Write Query Message .....	29
8.4.2	MODBUS Write Response Message .....	29
8.5	Function Codes Supported .....	29
8.6	Exception Responses and Exception Codes .....	29
8.6.1	Exception Response .....	29
8.6.2	Exception Code.....	30
8.7	S4000C Command Register Locations.....	31
8.8	S4000C Command Register Details .....	32
8.8.1	Analog .....	32
8.8.2	Mode .....	32
8.8.3	Status/Error .....	32
8.8.4	Unit Type.....	33
8.8.5	Software Revision .....	33
8.8.6	Status Block .....	33
8.8.7	Alarm Settings.....	33

8.8.8	Warn Settings.....	34
8.8.9	Com1 Address .....	34
8.8.10	Com1 Baud Rate.....	35
8.8.11	Com1 Data Format.....	35
8.8.12	Com2 Address .....	35
8.8.13	Com2 Baud Rate.....	35
8.8.14	Com2 Data Format.....	36
8.8.15	Cal Level .....	36
8.8.16	Reset Alarms.....	36
8.8.17	Sensor Life .....	36
8.8.18	HazardWatch (Co – Calibration Output) .....	36
8.8.19	Total Receive Errors .....	36
8.8.20	Bus Activity Rate %.....	36
8.8.21	Function Code Errors.....	37
8.8.22	Starting Address Errors.....	37
8.8.23	Number of Register Errors .....	37
8.8.24	RXD CRC Hi Errors.....	37
8.8.25	RXD CRC Low Errors .....	37
8.8.26	Clear Comm Errors .....	37

**9.0 APPENDIX..... 38**

9.1	Warranty.....	38
9.2	Principle of Operation.....	38
9.3	Specifications .....	39
9.3.1	System Specifications .....	39
9.3.2	Mechanical Specifications.....	39
9.3.3	Electrical Specifications .....	39
9.3.4	Environmental Specifications.....	40
9.4	Approvals .....	41
9.5	Sensitivities To Other Gases .....	41
9.6	Spare Parts and Accessories.....	43
9.6.1	Sensors .....	43
9.6.2	Sensor Housing.....	43
9.6.3	Sensor Accessories .....	43
9.6.4	Calibration Equipment.....	43
9.6.5	Intelligent Transmitter (S4000C) Replacement Parts .....	44
9.6.6	Recommended Spare Parts for One (1) Year .....	44
9.7	FMRC Approval.....	45



## Table of Figures

Figure 1: Outline and Mounting Dimensions .....	1
Figure 2: Terminal Block Operation .....	2
Figure 3: Model S4000C Intelligent Sensor .....	5
Figure 4: Outline and Mounting Dimensions .....	8
Figure 5: Terminal Block Operation .....	10
Figure 6: Wire Strip Length .....	10
Figure 7: Relay Protection for DC and AC Loads .....	13
Figure 8: Relay Reset .....	16
Figure 9: User Menu Structure .....	17
Figure 10: Calibration Check .....	20
Figure 11: Automatic Calibration Mode .....	21
Figure 12: Calibration In Progress Mode .....	21
Figure 13: Calibration Complete Mode .....	21

## Table of Tables

Table 1: TB2 Power and Signal Connections.....	9
Table 2: Ground or Common Connections.....	11
Table 3: Power Connections .....	11
Table 4: Analog Signal Connections .....	12
Table 5: Alarm Relay Connections .....	12
Table 6: Warn Relay Connections.....	12
Table 7: Fault Relay Connections .....	12
Table 8: GM Locations.....	27
Table 9: Data Format.....	28
Table 10: Exception Codes .....	30
Table 11: Command Register Locations .....	31
Table 12: Command Register Locations Cont. ....	32
Table 13: Com1 Baud Rate .....	35
Table 14: Com1 Data Format .....	35
Table 15: Com2 Baud Rate .....	35
Table 16: Com2 Data Format .....	36
Table 17: 24VDC Cable Lengths.....	40
Table 18: Analog Output Cable Lengths .....	40
Table 19: Sensor Cable Lengths.....	40

# Quick Start Guide

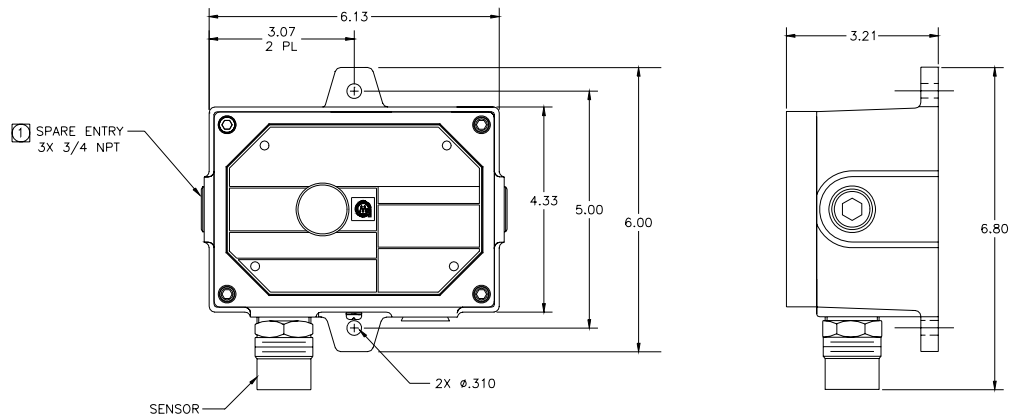
## Mounting and Wiring

### Tools Required

1. "5mm" Allen head wrench to remove enclosure lid (included with gas detector).
2. Flat-head screwdriver maximum 3/16" (5 mm) width for terminal block connections (included with gas detector).
3. Adjustable wrench for conduit or cable gland connections (not included).

It is not necessary to seal the Model S4000C housing to maintain its explosion-proof integrity; however, conduit runs containing wires attached to the Model S4000C's relay contacts must be sealed.

Information on Class I location seals can be found in the NEC, Article 501-5.



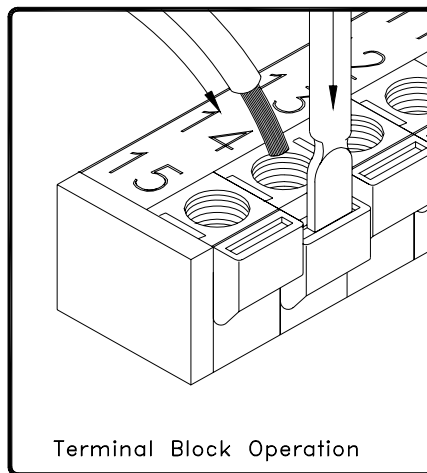
**Figure 1: Outline and Mounting Dimensions**

## Terminal Connections

The terminal blocks (TB) are located inside the housing and can be accessed by removing the cover. A label on the inside of the housing cover provides details of all the terminal connections.

**WARNING:** Do not connect +24VDC to TB1. Damage to the electronics, or sensor may result.

It is recommended that shielded cable be used to make power and signal connections to the Model S4000C. The terminal block accepts 14 AWG to 20 AWG stranded or solid wire. Each wire should be stripped before wiring the Model S4000C Intelligent Sensor. To connect wiring to the terminal block, insert a screwdriver into the orange tab and press down (Figure 2), opening the terminal. Insert the wire into the terminal and release the orange tab, clamping the wire in the terminal. Check the hold of the wire by GENTLY tugging it to ensure it is locked in.



**Figure 2: Terminal Block Operation**

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**NOTE:** Power must remain disconnected until all other wiring connections have been made.

---

The maximum distance between the Model S4000C and the power supply is 3000 feet or 910 meters (each cable run should be as short as possible). See Section 9.3.3 for cable length specifications. Connect +24VDC to TB2, position 9. Connect the ground or common to TB2, position 8.

The instrument is now ready to operate. Please consult the manual for more information on the instrument's many features.

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**NOTE:** If you have any problems in the set-up or testing of the detector, please refer to the "Trouble Shooting Section", or call the factory direct.

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**Worldwide service is available by calling:**

<b>Lake Forest, California (24 hr. service)</b>	Toll Free: +1-800-446-4872 Phone: +1-949-581-4464 Fax: +1-949-581-1151
<b>Houston, Texas</b>	Phone: +1-281-855-6000 Fax: +1-281-855-3290
<b>Ireland</b>	Phone: +353-91-751175 Fax: +353-91-751317
<b>Singapore</b>	Phone: +65-6748-3488 Fax: +65-6748-1911
<b>United Arab Emirates</b>	Phone: +971-4-8815751 Fax: +971-4-8817927
<b>United Kingdom</b>	Phone: +44-1625-619583 Fax: +44-1625-619098

# 1.0 Introduction

## 1.1 Protection for Life

General Monitors' mission is to benefit society by providing solutions through industry leading safety products, services, and systems that save lives and protect capital resources from the dangers of hazardous flames, gases, and vapors.

This manual provides instruction for installing and operating General Monitors' Model S4000C for Combustible Gas Detection. While the S4000C is easy to install and operate, this manual should be read in full and the information contained herein understood before attempting to place the system in service.

The safety products you have purchased should be handled carefully and installed, calibrated, and maintained in accordance with the respective product instruction manual. Remember these products are for your safety.



## 1.2 Special Warnings

The Model S4000C Intelligent Sensor contains components, which can be damaged by static electricity. Special care must be taken when wiring the system to ensure that only the connection points are touched.

Toxic, combustible and flammable gases and vapors are very dangerous. Extreme caution should be used when these hazards are present.

## 1.3 System Integrity Verification

### Commissioning Safety Systems

Before power up, verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

After the initial application of power (and any factory specified warm-up period) to the safety system, verify that all signal outputs, to and from devices and modules, are within the manufacturers' specifications. Initial testing should be performed per the manufacturers' recommendations and instructions.

Proper system operation should be verified by performing a full, functional test of all component devices of the safety system, ensuring that the proper levels of alarming occur. Fault/Malfunction circuit operation should be verified.

### **Periodic Testing of Field Devices**

Periodic testing/calibrating should be performed per the manufacturer's recommendations and instructions. Testing/Calibrating procedures should include, but not be limited to:

- Verify integrity of all optical surfaces and devices
- For flame detectors, use the appropriate test lamp

When testing produces results outside of the manufacturer's specifications, replacement of the suspect device(s) should be performed as necessary. Maintenance intervals should be independently established through a documented procedure, including a maintenance log maintained by plant personnel or third party testing services.

### **Periodic System Verification**

The following system verifications should be performed at least annually:

Verify wiring, terminal connections and stability of mounting for all integral safety equipment including, but not limited to:

- Power supplies
- Control modules
- Field detection devices
- Signaling / output devices
- Accessories connected to field and signaling devices

## 2.0 Product Description

### 2.1 General Description

The Model S4000C is an intelligent sensor for the detection of combustible gases and vapors. The microprocessor-based electronics processes information at the sensor site, within an explosion-proof housing.

A digital display provides indications and display codes that can be viewed through a window in the cover. A red LED above the digital display signifies an ALARM condition, while a red LED below the digital display signifies a WARN condition. Analog signal (4-20mA) and optional Dual Redundant MODBUS communications and relays, provide remote and/or discrete indications of the sensor's operation.

The Model S4000C Intelligent Sensor is rated explosion-proof for use in the following hazardous areas:

- CSA/FM: Class I, Division 1, Groups B, C, D and Class I, Zone 1, Ex d IIB+H<sub>2</sub>, T6
- ATEX: II 2 G EEx d IIB T5 (T<sub>amb</sub>=-40°C to +70°C) EN 61779-1



Figure 3: Model S4000C Intelligent Sensor

## 3.0 Installation

### 3.1 Receipt of Equipment

All equipment shipped by General Monitors is pre-packed in shock absorbing containers, which provide protection against physical damage (original containers should be kept for future shipping or storage needs).

Shipping container contents should be carefully removed and checked against the packing list. If any damage has occurred, or there is any discrepancy in the order, please notify General Monitors as soon as possible.

All correspondence with General Monitors must specify the equipment part number and serial number.

The factory tests each unit; however, a complete system checkout is suggested upon initial installation to ensure system integrity.



**WARNING:** Installation and Maintenance must be carried out by suitably skilled and competent personnel only.

### 3.2 Tools Required

1. "5 mm" Allen head wrench to remove enclosure lid (included with gas detector).
2. Flat-head screwdriver maximum 3/16" (5 mm) width for terminal block connections (included with gas detector).
3. Adjustable wrench for conduit or cable gland connections (not included).

### 3.3 Choosing Product Locations

There are no standard rules for sensor placement, since the optimum sensor location is different for each application. The customer must evaluate conditions at the facility to make this determination. Generally, the Model S4000C Intelligent Sensor should be easily accessible for calibration checks.

- The transmitter should be mounted pointing down to prevent water build-up on the sensor head.
- The transmitter should not be placed where contaminating substances may coat it.
- Although the Model S4000C is RFI resistant, it should not be mounted in close proximity to radio transmitters or similar equipment.
- Locate the Model S4000C where prevailing air currents contain the maximum concentration of gas.
- Locate the Model S4000C near possible sources of gas leaks.
- Observe the Model S4000C's temperature specification and locate the unit away from concentrated sources of heat.



- Transmitters should be mounted in an area that is as free from wind, dust, water, shock, and vibration as possible. See Section 9.3.4 for the environmental specifications of the unit. If the sensor cannot be located away from dust and rain, then we recommend the use of our splash guard GM P/N 10395-1 to help protect the sensor.

Sensors may be adversely affected by prolonged exposure to certain materials. Loss of sensitivity or corrosion may be gradual if such materials are present in low concentrations, or it may be rapid at high concentrations. The more important materials adversely affecting sensors are:

- Constant presence of high concentrations of Hydrogen Sulfide (H<sub>2</sub>S) gas
- Silicones (often contained in greases and aerosols)
- Halides, compounds containing Fluorine, Chlorine, Bromine and Iodine
- Heavy metals, e.g. Tetraethyl Lead
- Caustic and acidic liquids and vapors

The presence of poisons and contaminants in an area does not necessarily preclude the use of a Model S4000C Intelligent Sensor. The feasibility of using a sensor in such areas must be determined by an analysis of the specific factors in each application and General Monitors should be consulted before attempting any such installation.

Sensors used in these areas usually require more frequent calibration checks than normal, and typically have a shorter life. In many such applications, the standard two-year warranty would not apply.



**WARNING:** General Monitors discourages the painting of sensor assemblies. If the sensor head is painted over, the gas will not be able to diffuse into the sensor. If the assembly cover is painted over, the digital display cannot be read.

### 3.3.1 Remote Mounting of the Sensor from the Electronics

If it is necessary to remotely mount the sensor from the electronics and the housing, the maximum distance can be no greater than 7600 feet, using 14 AWG wire. Sensors that are remotely mounted must be placed in an explosion-proof rated sensor housing (GM P/N 10252-1), and the cable run must be contained in conduit running from the sensor housing to the electronics. See Section 9.7 for FMRC approval requirements.

## 3.4 Mounting and Wiring



**WARNING:** The conduit entries should be sealed per the NEC 500-3d or Canadian Electrical Code Handbook (Part 1, Section 18-154). Additional benefit of conduit seals is the prevention of water entering the housing through the conduit entry.

**WARNING:** Unused cable entry holes must be sealed with an approved explosion-proof stopping plug. Red caps supplied by General Monitors are for dust protection only, and must not be left on the unit when installed.

The overall and mounting dimensions for the Model S4000C (Figure 4) should be used when making installation determinations. A complete list of the mechanical specifications can be found in Section 9.3.2.

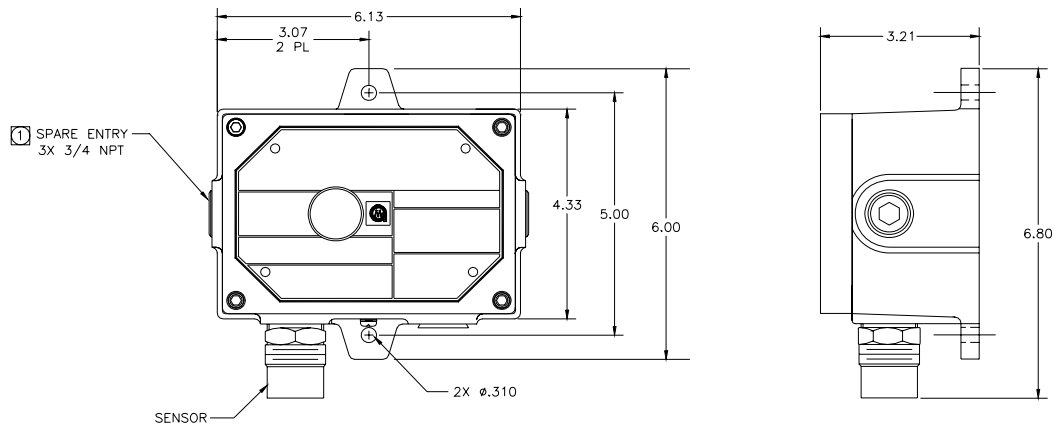
To prevent possible corrosion due to moisture or condensation, it is recommended that the conduit connected to the Model S4000C housing be sealed, or contain a drain loop. Each conduit run from a hazardous location to a non-hazardous location should be sealed so that gases, vapors, and/or flames cannot pass beyond the seal. The purpose of seals in a Class I hazardous location is to prevent the passage of gases, vapors, or flames from one electrical installation to another through the conduit system.

It is not necessary to seal the Model S4000C housing to maintain its explosion-proof integrity; however, conduit runs containing wires attached to the Model S4000C's relay contacts must be sealed (Section 3.5).

Information on Class I location seals can be found in the NEC, Article 501-5.



**WARNING:** Acetic acid will cause damage to metal components, metal hardware, ceramic IC's, etc. If damage results from the use of a sealant that outgases acetic acid (RTV silicone), the warranty will be void.



**Figure 4: Outline and Mounting Dimensions**

Once correctly installed, the Model S4000C requires little or no maintenance, other than periodic calibration checks to ensure system integrity. General Monitors recommends that a schedule be established and followed.

---

**NOTE:** The system's full two-year warranty will be voided if customer personnel or third parties damage the system during repair attempts.

---

Sensor heads exposed to the elements may require the accessory mounting threads to be lubricated. Grease must not be used. As an alternate, PTFE (Teflon) tape may be used on sensor accessory threads.

---

**NOTE:** Do not use any material or substance on threads that contact the sensor housing.

---

The removal of particulate matter from sensor accessories may be done through the use of an appropriate halogen-free solvent. Water or ethanol are examples of suitable solvents. The accessories should be thoroughly dried with compressed air, if necessary, before refitting to the sensor body.

### 3.5 Terminal Connections

The terminal blocks (TB) are located inside the housing and can be accessed by removing the cover. A label on the inside of the housing cover provides details of all the terminal connections.

#### 3.5.1 Terminal Block TB1 – Sensor Connections

TB1 contains the three sensor connections, white (W), black (B), and red (R). Remove the display board by loosening the two captive screws on the board and lifting it straight up. Connect the color-coded wires from the combustible sensor to the matching colored terminals on TB1. The label on the inside of the cover can serve as a guide. Replace the display board by pressing it into place, and tightening the two captive screws.



**WARNING:** Do not connect +24VDC to TB1. Damage to the electronics may result.

#### 3.5.2 Terminal Block TB2 – Power and Signal Connections

TB2 contains the connections for Power, Relay Reset, Remote Calibration, MODBUS and 0-20mA Output Signal. The terminal connections are as follows:

TB2 position	Function
1	0-20mA Output
2	CH1 MODBUS -
3	CH1 MODBUS +
4	CH2 MODBUS -
5	CH2 MODBUS +
6	Remote Calibration
7	Relay Reset
8	Ground
9	+24VDC Power

Table 1: TB2 Power and Signal Connections

It is recommended that a three-wire (red, black, white) shielded cable be used for making power and output signal connections on the Model S4000C. The terminal block accepts 14 AWG to 20 AWG stranded or solid wire. Each wire should be stripped before wiring the Model S4000C Intelligent Sensor. To connect wiring to the terminal block, insert a screwdriver into the orange tab and press down (Figure 5), opening the terminal. Insert the wire into the terminal and release the orange tab, clamping the wire in the terminal. Check the hold of the wire by GENTLY tugging it to ensure it is locked in.

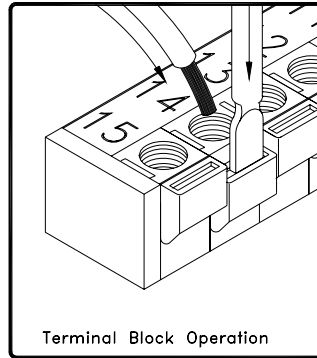


Figure 5: Terminal Block Operation

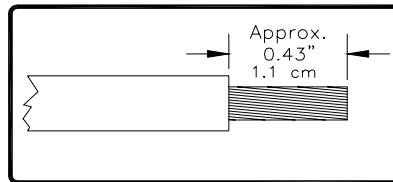


Figure 6: Wire Strip Length

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**NOTE:** Up to 14 AWG wire can be used if it is carefully stripped (Figure 6).

---

### 3.5.3 DC Power and Ground Connections

The customer must provide primary DC power unless one of the following General Monitors Modules is being used with the Model S4000C:

- DC130 Dual-Channel Readout/Relay Display Module
- TA102A Trip Amplifier Module with a PS002 Power Supply & Relay Module

The following General Monitors Modules provide power connections for the Model S4000C, but need a customer supplied DC source:

- DC110 Eight-Channel Readout/Relay Display Module
- TA102A Trip Amplifier Module without a PS002

Since the Model S4000C is designed to operate continuously, a power switch is not included, in order to prevent accidental system shutdown.

---

**NOTE:** Power must remain disconnected until all other wiring connections have been made.

---

The maximum distance between the Model S4000C and the power supply is 3000 feet or 910 meters (each cable run should be as short as possible). See Section 9.3.3 for cable length specifications. To connect +24VDC to the Model S4000C, connect the red wire to TB2, position 9. Connect the black wire to TB2, position 8. For making power and ground connections to display devices see Table 2 and Table 3.

FROM		TO	
Model S4000C	Model DC110	Model DC130	Model TA102A
TB2-8 "COM"	Rear COMMON	Rear Pin 3 or 6 "COM"	Rear Pin 30d or 30z

**Table 2: Ground or Common Connections**

FROM		TO	
Model S4000C	Model DC110	Model DC130	Model TA102A
TB2-9 "+24 VDC"	Rear CH 1 – 8 24V	Rear Pin 4 or 7 "DC OUT"	Rear Pin 28d or 28z

**Table 3: Power Connections**

### 3.5.4 Analog Signal Connections

The Model S4000C Intelligent Sensor provides a 4 to 20mA output signal. It can be sent up to 9000 feet (2740 meters) to a General Monitors' readout/relay display module, or an industrial analog to digital converter, or a computer-based monitor, a PLC, a DCS, etc. The 4 to 20mA signal provides for control room or other locations remote to the Model S4000C to display indications of operation and alarm conditions. To connect the 4 to 20mA output signal with another unit, connect the wire into TB2, position 1, labeled 4-20mA OUT. For making output signal connections to display devices (Table 4), refer to the specific manual for that device.

FROM		TO		
Model S4000C	Model DC110	Model DC120	Model DC130	Model TA102A
TB2-1 4-20mA Output	Rear CH 1 – 8 4-20mA	Rear TB1 Pin 8 or 9	Rear Pin 2 or 5 Analog In	Rear Pin 26d or 26z

**Table 4: Analog Signal Connections**

If a device other than a General Monitors' readout/relay display module is being used, the DC ground, COM, of both systems must be connected together.

### 3.5.5 Terminal Block TB3 – Relay Connections

TB3 contains the connections for the Relay Contacts (optional). The function for the Warn and Alarm Relay connections vary according to the normal state of the relay. Use the following as a guide for determining the Normally Open (NO) and the Normally Closed (NC) contact:

TB3 position	Relay Contact (De-Energized)	Relay Contact (Energized)
1	Normally Closed	Normally Open
2	Common	Common
3	Normally Open	Normally Closed

**Table 5: Alarm Relay Connections**

TB3 position	Relay Contact (De-Energized)	Relay Contact (Energized)
4	Normally Closed	Normally Open
5	Common	Common
6	Normally Open	Normally Closed

**Table 6: Warn Relay Connections**

TB3 position	Relay Contact (Energized)
7	Normally Open
8	Common
9	Normally Closed

**Table 7: Fault Relay Connections**

---

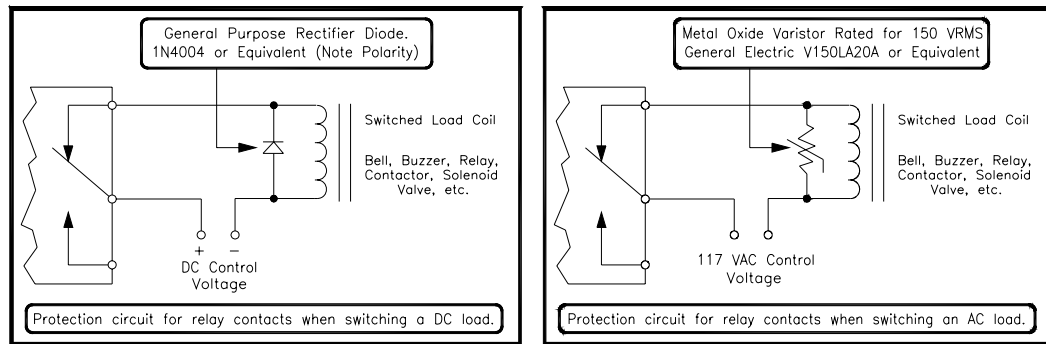
**\*NOTE:** Fault relay is normally energized. Relay will change state after power up.

---



**WARNING:** Contact with PCB components should be avoided to prevent damage by static electricity. All wire connections are made to the Terminal Blocks.

**WARNING:** Relay contacts must be protected against transient and over voltage conditions (Figure 7).



**Figure 7: Relay Protection for DC and AC Loads**

*European Union (EU) Approved Applications:* The ALARM relay contact ratings are 8A, 30 V RMS/42.4 V peak or 8A @ 30 VDC resistive max.

*North American Approved Applications:* The ALARM relay contact ratings are 8A @ 250 VAC and 8A @ 30 VDC resistive max.

### 3.5.6 European Union (EU) Approved Applications

Interconnecting cables must have an overall screen or screen and armor. Cables BS5308 Part 2, Type 2, or equivalent are suitable. Note that the terms 'screen' and 'shield' are equivalent for the purpose of this manual. The cable armor must be terminated in a suitable cable gland, at the detector, to ensure a positive electrical connection.

### 3.5.7 Cable Termination in the Non-Hazardous Area

- The cable **armor** must be connected to **safety earth** in the safe area.
- The cable **screen** (drain wire) must be connected to an **instrument earth** in the safe area.
- The power supply **OV return** must be connected to an **instrument earth** in the safe area.
- The interconnecting cables should be segregated from power and other noisy cables. Avoid proximity to cables associated with radio transmitters, welders, switch mode power supplies, inverters, battery chargers, ignition systems, generators, switch gear, arc lights and other high frequency or high power switching process equipment. In general, maintain separation of at least 1 meter between instrument and other cables. Greater separations are required where long parallel cable runs are unavoidable. Avoid running instrument cable trenches close to lightning conductor earthing pits.
- Complete all cable insulation testing before connecting the cable at either end.



**WARNING:** Under **NO** circumstances should equipment be connected or disconnected when under power. This is contrary to hazardous area regulations and may lead to serious damage to the equipment. Equipment damaged in this manner is not covered under warranty.

### 3.6 Maintaining the X/P Integrity

The Model S4000C Intelligent Sensor is rated explosion-proof for use in the following hazardous locations:

- CSA/FM: Class I, Division 1, Groups B, C, D and Class I, Zone 1, Ex d IIB+H<sub>2</sub>, T6
- ATEX: II 2 G EEx d IIB T5 (T<sub>amb</sub>=-40°C to +70°C) EN 61779-1

Some of the factors that influence the explosion-proof integrity of the Model S4000C housing are:

- Strength of the enclosure material
- Thickness of the enclosure walls
- Flame path between the housing and cover
- Flame path of threaded joints

The acceptable limits for explosion-proof housings that are used in Class I hazardous locations are defined in CSA Standard C22.2 No.30-M1986, FM 3615, and EN50014.

Anytime the cover of the Model S4000C housing is removed, or the cover bolts are loosened, the flame path between the lid and the housing is affected. If power is to be left on while removing the cover or loosening the cover bolts on the Model S4000C, it will be necessary to declassify the area.

When replacing the cover, the gap between the lid and the housing should be less than .0015 inch (.038 mm). Make sure that the flame-path is clear of dirt and debris before replacing the cover. This can be verified by tightening the cover bolts to a torque setting of 50 inch-pounds or by using a feeler gauge to ensure the gap between the cover and the housing is less than .0015 inch (.038 mm).

There are four entry holes, one each on the left and right sides, and two on the bottom of the Model S4000C housing. These holes are dedicated for the sensor, the reset switch and conduit. Each hole is tapped for 3/4" NPT threads. If a particular entry hole is not used, it must be plugged during operation in the field. The factory installs plugs in the unused entry holes, except one. A red plastic cap is placed into the remaining hole and must be removed before conduit can be attached to the housing.

The Model S4000C will have the following items placed in the three remaining entry holes, at the factory:

- A sensor, if present (otherwise a red plastic cap)
- A reset switch, if present (otherwise an aluminum housing plug - optional)
- An aluminum-housing plug

The sensor, reset switch, and aluminum-housing plug have seven threads. Each of these components is screwed into the housing using five to seven turns. If it becomes necessary to replace the sensor, reset switch and/or the aluminum-housing plug, the user must use five to seven turns to ensure the explosion-proof integrity of the housing is maintained.



## 4.0 Operation

### 4.1 Start-Up Checklist

Prior to starting the system, verify the following:

1. Inhibit any external devices, such as Trip Amplifiers, PLC's, or DCS systems.
2. Verify that the optional settings are set for the desired configuration.
3. Verify that the unit is properly mounted. Ensure the conduit/cable gland entries are pointed downward.
4. Verify that the signal wiring is correct.
5. Verify that the power supply is connected properly. The Model S4000C is powered by +24VDC (20 to 36 VDC voltage range). The detector will output a low voltage (F6) fault at 18.5 VDC or below.
6. Make sure the lid is securely installed or the area has been declassified.

### 4.2 Start-Up

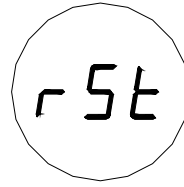
Before applying power to the system for the first time, all wiring connections should be checked for correctness and the housing cover replaced. Upon first power-up the sensor may take up to fifteen minutes to stabilize.

At the initial application of power, the unit will test all of the LED segments by displaying "88.8". The software revision letter will then be displayed for a few seconds. The unit will then enter a fifty second Start-Up mode. During this period, the display will read "SU". The unit will then enter Operational Mode, and the current gas concentration at the sensor will be displayed. For details of Calibrating and Gas Checking the unit, see Sections 4.5 and 4.6.

### 4.3 Relay Reset

If the Warn and Alarm relays are configured as latching, they must be manually reset, after an alarm occurs. This can be accomplished by three different methods:

1. The relays can be reset via the MODBUS Interface (Section 8.8.16).
2. The relays can be reset via the magnetic switch using a magnet. Place the magnet over the GM Logo on the cover of the unit. After three seconds, the display will show "rSt". Remove the magnet at this time and the relays will be reset (Figure 8).



**Figure 8: Relay Reset**

3. The relays can be reset via the Remote Reset input terminals on TB2. Connect a normally open switch between terminal TB2-7 and TB2-8. Closing the switch momentarily will reset the relays. General Monitors explosion-proof switch, P/N 30051-1, can be used for this purpose. See Section 9.6 for ordering instructions.

---

**NOTE:** Red LED's above and below the digital display indicate that the Alarm and Warn relays are active. Latching relays can only be reset if the gas concentration has fallen below the respective relay set point.

---

#### 4.4 User Selectable Options

The Model S4000C Intelligent Sensor includes many selectable options to provide the user with the most flexible combustible gas detector possible. These options include Adjustable Calibration Level, Warn and Alarm Relay Set Points and Configuration, and MODBUS Communications Settings. These allow the unit to operate with a wide variety of PLC and DCS Systems. The following sections explain the available options and how they can be customized.

A flow diagram is included to help the user in understanding the process of reviewing and changing the available options (Figure 9).

---

**NOTE:** If the unit was ordered without relays or MODBUS communications, changing relay or MODBUS settings will have no effect on the operation of the unit.

---

### 4.4.1 Model S4000C User Menu Structure

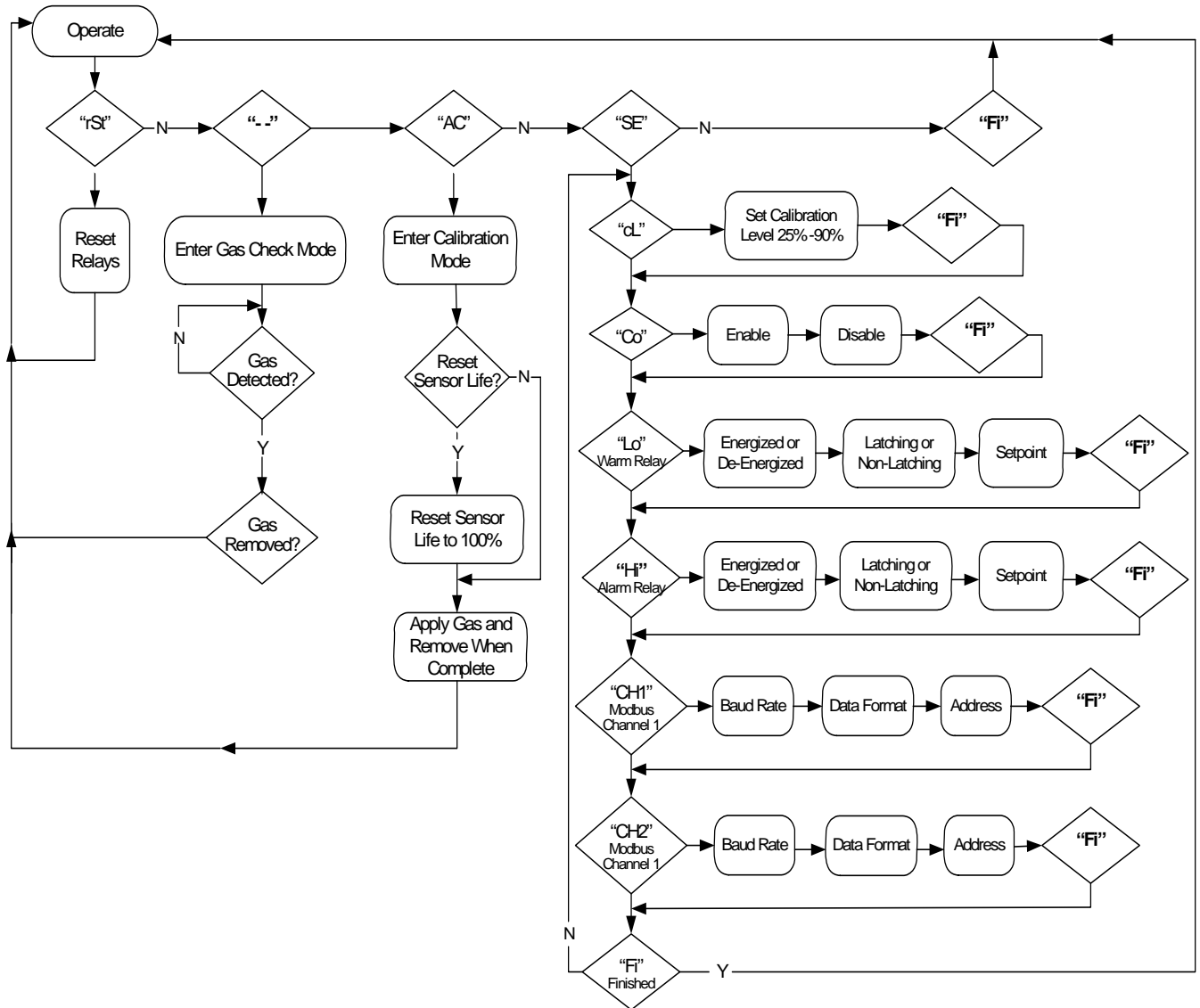


Figure 9: User Menu Structure

**NOTE:** "Co" represents Calibration Output. When "Co" is enabled and calibration is successful, the analog output goes from 1.5 mA to 3.2 mA for 5 seconds, settling at the desired value of 4mA.

### 4.4.2 Calibration Level

To adjust the calibration level of the Model S4000C, apply the magnet to the GM Logo on the cover of the unit, until "SE" is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds "cL" will be displayed. Apply and remove the magnet to adjust the calibration level. The current calibration level will be displayed. To change the calibration level, apply and remove the magnet repeatedly, until the desired level is displayed. Holding the

magnet in place will cause the display to advance rapidly after a few seconds. Once the desired value is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet to return to normal operation. **The default calibration level is 50% LEL.**

#### 4.4.3 Warning Relay Settings

To adjust the Warning Relay Settings of the Model S4000C, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “Lo” will be displayed. Apply and remove the magnet to change the Warning or “Low” alarm settings.

First, the Energized/De-Energized state of the relay is shown by either “En” or “dE” being displayed, respectively. Apply and remove the magnet until the desired state is displayed.

After a few seconds, the Latching/Non-Latching state of the relay is shown by either “La” or “nL”. Apply and remove the magnet, until the desired state is displayed.

After a few seconds, the current Warning relay set point is displayed. Apply and remove the magnet, until the desired set point is displayed. Once the desired set point value is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet, to return to normal operation.

**The default Warning relay settings are: non-latching, de-energized, 30% LEL set point.**

---

**NOTE:** The Warn relay set point cannot be set higher than the Alarm Relay set point, or higher than 60% LEL.

---

#### 4.4.4 Alarm Relay Settings

To adjust the Alarm Relay Settings of the Model S4000C, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “Hi” will be displayed. Apply and remove the magnet to change the Alarm or “High” alarm settings.

First, the Energized/De-Energized state of the relay is shown by either “En” or “dE” being displayed respectively. Apply and remove the magnet, until the desired state is displayed.

After a few seconds, the Latching/Non-Latching state of the relay is shown by either “La” or “nL”. Apply and remove the magnet, until the desired state is displayed.

After a few seconds, the current Alarm relay set point is displayed. Apply and remove the magnet until the desired set point is displayed. Once the desired set point value is shown, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet to return to normal operation.

**The default Alarm relay settings are: latching, de-energized, 60% LEL set point.**

---

**NOTE:** The Alarm relay set point cannot be set lower than the Warning Relay set point, or higher than 60% LEL.

---

#### 4.4.5 MODBUS Channel 1 Settings

To change the MODBUS Channel 1 settings of the Model S4000C, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “CH1” will be displayed. Apply and remove the magnet to change the MODBUS Channel 1 settings.

First, the current Baud Rate MODBUS Channel 1 is displayed. If another baud rate is to be selected, apply and remove the magnet until the desired baud rate is displayed. The choices are: 19.2k baud “19.2”, 9600 baud “96”, 4800 baud “48”, or 2400 baud “24”.

After a few seconds, the current Data Format for MODBUS Channel 1 is displayed. If another data format is to be selected, apply and remove the magnet until the desired data format is displayed. The choices are: 8-N-1 “8n1”, 8-N-2 “8n2”, 8-E-1 “8E1”, or 8-O-1 “8O1”.

After a few seconds, the current address for MODBUS Channel 1 is displayed. Apply and remove the magnet until the desired address is displayed. Once the desired address is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet to return to normal operation.

**Default settings for Channel 1 are: address 1, 19.2k baud, 8-N-1.**

---

**NOTE:** The address can be adjusted from 1 - 247. Channel 1 and Channel 2 addresses may be the same.

---

#### 4.4.6 MODBUS Channel 2 Settings

To change the MODBUS Channel 2 Settings of the Model S4000C, apply the magnet to the GM Logo on the cover of the unit until “SE” is displayed, then remove the magnet. This puts the unit into Setup Mode. After a few seconds “CH2” will be displayed. Apply and remove the magnet to change the MODBUS Channel 2 settings.

First, the current Baud Rate MODBUS Channel 2 is displayed. If another baud rate is to be selected, apply and remove the magnet until the desired baud rate is displayed. The choices are: 19.2 kbaud “19.2”, 9600 baud “96”, 4800 baud “48”, or 2400 baud “24”.

After a few seconds, the current Data Format for MODBUS Channel 2 is displayed. If another data format is to be selected, apply and remove the magnet until the desired data format is displayed. The choices are: 8-N-1 “8n1”, 8-N-2 “8n2”, 8-E-1 “8E1”, or 8-O-1 “8O1”.

After a few seconds, the current address for MODBUS Channel 2 is displayed. Apply and remove the magnet until the desired address is displayed. Once the desired address is displayed, wait 3 seconds and “Fi” will be displayed. Apply and remove the magnet to return to the next level of the Setup menu. When “Fi” is displayed again, apply and remove the magnet to return to normal operation.

**Default settings for Channel 2 are: address 2, 19.2 kbaud, 8-N-1.**

---

**NOTE:** The address can be adjusted from 1 - 247. Channel 1 and Channel 2 addresses may be the same.

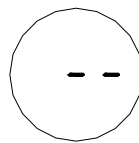
---

## 4.5 Gas Check Mode

The sensor response can be checked without activating external alarms by placing the Model S4000C in Gas Check Mode. In this Mode, the alarm relays are inhibited and the analog output is fixed at 1.5mA.

### 4.5.1 Procedure for Checking the Calibration

Place the magnet over the GM Logo on the cover of the Model S4000C. Remove the magnet when a flashing pair of bars, “- -” (Figure 10), appears on the display (about ten seconds). Apply the test gas to the sensor; the value of the gas concentration will be indicated by the flashing display, and should stabilize in one to two minutes.



**Figure 10: Calibration Check**

When the reading has stabilized and the test is complete, remove the gas and the unit will return to normal operation when the concentration drops below 5% full-scale.

If, after the reading has stabilized, the sensor is to be calibrated, simply apply the magnet to the GM Logo on the housing cover, and the unit will enter Calibration Mode.

Gas Check Mode can be aborted if gas has not been applied to the sensor. Simply reapply the magnet to the GM Logo on the cover and the unit will return to normal operation.

---

**NOTE:** The test gas concentration must be at least 10% full-scale before the unit will complete the gas check sequence. If the Model S4000C is placed in the Gas Check Mode and no gas is applied for six minutes, the unit will revert to a Fault condition. Re-applying the magnet over the GM Logo will return the unit to normal operation.

---

## 4.6 Calibration

General Monitors recommends that the Model S4000C Intelligent Sensor be calibrated one hour after start-up, and that the calibration be checked at least every ninety (90) days to ensure system integrity. Frequent calibration checks ensure the integrity of the life protecting equipment.

The above statement is not intended to discourage the customer from checking calibration more frequently. Frequent calibration checks are recommended for environments that have problems, such as mud collecting on the sensor head, sensors accidentally being painted over, etc.

General Monitors recommends that a calibration schedule be established and followed. A logbook should also be kept, showing calibration dates and dates of sensor replacement.

#### 4.6.1 Calibration Procedure

If it is suspected that gases are present, it will be necessary to purge the sensor environment with Zero Air. If Zero Air is not available, cover the sensor for about thirty seconds before applying the calibration gas. Zero Air is air that is hydrocarbon free.

Entering Calibration Mode automatically disables the alarm circuits by sending a 1.5mA output signal and disabling the Warn and Alarm relays, if present. This will also prevent activation of the remote relay contacts when using a General Monitors Readout/Relay Display Module with the Model S4000C.

To enter Calibration Mode, place the magnet over the GM Logo on the cover of the unit (Figure 3) and hold it there until “AC” (Figure 11) appears on the display (about ten seconds). The display will flash the remaining sensor life (Section 4.6.4) for about ten seconds, while the unit acquires the zero reading. Ensure that the sensor is seeing clean air during this time.



Figure 11: Automatic Calibration Mode

Apply the calibration gas concentration to the sensor (usually 50% LEL of the desired gas). The display will change from “AC” (Automatic Calibration) to “CP” (Calibration in Progress), indicating that the sensor is responding to the calibration gas (Figure 12).



Figure 12: Calibration In Progress Mode

After one or two minutes, the display will change from “CP” to “CC” (Figure 13), indicating that the calibration is complete.

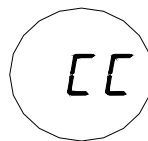


Figure 13: Calibration Complete Mode

Remove the gas and wait for the unit to return to normal operation. The display will indicate a few percent full-scale and then drop to “0”.

The unit is now calibrated and the new ZERO and SPAN values have been stored in the non-volatile memory (EEPROM).

#### 4.6.2 Aborting Calibration

If calibration is to be aborted, and gas has not been applied, wait ninety seconds and reapply the magnet. The unit will return to normal operation with the previous calibration values unchanged.

---

**NOTE:** Once gas has been applied, it is not possible to abort a calibration.

---

If the Model S4000C is placed in the Calibration Mode and no gas is applied for six minutes, the unit will revert to a Fault condition. Re-applying the magnet over the GM Logo will return the unit to operational mode with the previous calibration values unchanged.

#### 4.6.3 Adjustable Calibration Level

The Model S4000C provides the user with the ability to adjust the calibration level from 25% LEL to 90% LEL. The default value from the factory is 50% LEL. This allows the user to utilize gas already available at their installation, that is not 50% LEL of the gas being detected, or to perform cross-calibration to a similar gas. Adjusting the Calibration Level is performed in Setup Mode.

---

**NOTE:** %LEL to %Volume Fraction is converted by using 325 Guide to Fire Hazard properties of Flammable Liquids, Gases, and Volatile Solids. For example, 100% LEL CH<sub>4</sub> is shown in NFPA to be 5% Volume, Calibration is at 50% LEL or 2.5% Volume.

---



**WARNING:** General Monitors recommends calibrating the Model S4000C with 50% LEL of the gas being detected. This provides the most accurate calibration, since the Model S4000C is optimized for this concentration. The accuracy of the calibration may be reduced by using a different calibration level, and this inaccuracy will increase as the calibration level varies from 50% LEL.

#### 4.6.4 Remaining Sensor Life

The Model S4000C Intelligent Sensor provides an estimate of remaining sensor life, in percent remaining, to provide the user with an early warning of the need for sensor replacement. The remaining sensor life is updated each time the unit is calibrated. The current remaining sensor life estimate is displayed during the zeroing portion of a calibration sequence. It can also be read via the MODBUS interface (Section 8.8.17).

---

**NOTE:** The remaining sensor life provides an estimate of the amount of life remaining for the sensor. Many factors including, environmental conditions, poisons, etc can affect this estimate. It should be used only as an estimate for preventive maintenance and logistic purposes.

---

#### 4.6.5 Initializing the Remaining Sensor Life

The remaining sensor life estimate must be initialized each time a new Hydrocarbon Sensor is installed. The initialization should be done during the first calibration of a newly installed sensor. After the sensor has been on power for a minimum of one hour, enter calibration mode as



described in Section 4.6.1. While the display is flashing the remaining sensor life estimate during zeroing, apply the magnet to the GM Logo on the cover. The flashing number will change to “100”, indicating the sensor has 100% of remaining sensor life. Complete the calibration per Section 4.6.1.

## 4.7 Calibration Equipment

### 4.7.1 Portable Purge Calibrator

The portable purge calibrator is a compact, accurate and safe system containing a non-explosive gas concentration. The lecture bottle is filled with a standard 50% LEL mixture of gas/air. Using a known gas/air mixture reduces the likelihood of error in field calibration. The hose and cup adapter included, allow for quick calibrations and gas checks.

Pre-mixed calibration gases at approximately 50% LEL are available, in lecture bottles, at 1200 psia, 8.3 MPa maximum pressure.

Hydrogen       $H_2$

Methane       $CH_4$

Propane       $C_3H_8$

Please specify the gas upon ordering. Spare bottles containing these gases may be ordered. Methane and Hydrogen lecture bottles may be returned to General Monitors for refilling.

## 5.0 Maintenance

### 5.1 General Maintenance



**WARNING:** Disconnect or inhibit external devices such as Trip Amplifiers, PLC's, or DCS systems before performing any maintenance.

*European Union (EU) Approved Applications:* The following grease compound is recommended for use: PBC Polybutylcuprysil, (or equivalent), which has BASEEFA Health & Safety Executive component approval No. 1051U for use as a jointing compound on flameproof electrical enclosures. This is available from General Monitors.

The neoprene rubber gasket, if it is found dry should also be lubricated with Type P80 lubricant, available from General Monitors (P/N 610-010).

### 5.2 Storage

The Model S4000C Combustible Gas Detector should be stored in a clean, dry area, and within the temperature and humidity ranges quoted in the Appendix under Environmental Specifications.

Insert red dust caps into any vacant cable entry holes.

## 6.0 Troubleshooting



**CAUTION:** Component level repair must be undertaken either by General Monitors' personnel, or by competent authorized service engineers. SMT PCB repair shall only be performed at a General Monitors facility. Failure to comply with this requirement will invalidate the warranty.

Be sure to inhibit or disconnect external alarm wiring before making any check, which might send the unit into alarm, if an alarm condition will cause a problem.

### 6.1 Fault Codes & Their Remedies

The Model S4000C has self-diagnostics incorporated into the microprocessor's program. If a Fault is detected, the output signal will drop to 0mA, the Fault relay will de-energize and a Fault code will be displayed. The output signal will inform a remote display module that the Model S4000C is in the Fault Mode. The display will indicate a Fault code that can be viewed at the sensor site.

There are nine Fault conditions that are monitored by the microprocessor, as follows:

#### 6.1.1 F2 Failed to Complete Calibration

This Fault will occur if the unit is placed in the calibration mode and no gas has been applied within six minutes, or if gas has been left on for more than six minutes.

**ACTION** – Remove gas, if present. Apply the magnet to the GM Logo on the cover to clear the fault. Attempt to calibrate.

#### 6.1.2 F3 EEPROM Checksum Error

This fault indicates that the contents of the Model S4000C's program memory have changed. This usually occurs, when powering the unit up after a lightning strike or large voltage transient on the power or signal lines to the unit.

**ACTION** - The unit must be returned to the factory or authorized service center for repair.

#### 6.1.3 F4 Sensor Error

This fault indicates that either one of the remote sensor leads is open or shorted, or that the sensor has drifted greater than -10%.

**ACTION** - Check the integrity of all sensor connections, and ensure that the cable from the Model S4000C to the remote sensor is not damaged. If all sensor leads are connected properly, attempt to re-calibrate the unit. If calibration fails, replace the sensor and re-calibrate.

#### 6.1.4 F5 Unused

---

### 6.1.5 F6 Low Supply Voltage

This fault occurs if the supply voltage at the S4000C drops below +18.5VDC.

ACTION - Ensure that the supply voltage is at least +20VDC at the Model S4000C.

---

**NOTE:** With long supply leads, a considerable voltage drop may occur, due to the electrical resistance of the leads. The maximum cable resistance, which the Model S4000C can tolerate, is dependent on the supply voltage: a maximum of 20 ohms per conductor (40 ohms loop), at +24VDC minimum, or a maximum of 10 ohms per conductor (20 ohms loop), at +20VDC minimum.

---

### 6.1.6 F7 EEPROM Verification Failure

This fault occurs when an attempt to verify the setup/calibration parameters just written to the EEPROM memory fails.

ACTION - The unit must be returned to the factory or authorized service center for repair.

### 6.1.7 F8 Failure to Complete Setup

This fault occurs if the unit is left in setup mode for more than 6 minutes.

ACTION - Exit setup mode. Enter setup mode again if it is necessary to change any user selectable options.

### 6.1.8 F9 Gas Check Period Exceeded

If the Model S4000C is left in the gas check mode for more than six minutes without a Test Gas being applied or if test gas is left on the gas check mode for more than 6 minutes, this fault will occur.

ACTION - Place the magnet over the GM Logo on the cover to return the unit to normal operation.

---

**NOTE:** Anytime a sensor is replaced, the unit should be disconnected from all alarms, as the unit may go upscale upon power-up.

---

### 6.1.9 F10 Switch Error

This fault occurs if the remote reset, remote calibrate, or the magnetic switch are closed for more than two minutes.

ACTION – Check the wiring on the remote reset and remote calibrate switches. Once the short circuit is cleared, the unit will return to normal operation. If the magnetic switch is shorted, the unit must be returned to the factory or authorized service center for service.

## 7.0 Customer Support

### 7.1 General Monitors' Offices

Area	Phone/Fax/Email
<b>UNITED STATES</b>	
Corporate Office: 26776 Simpatica Circle Lake Forest, CA 92630	Toll Free: +1-800-446-4872 Phone: +1-949-581-4464 Fax: +1-949-581-1151 Email: info@generalmonitors.com
9776 Whithorn Drive Houston, TX 77095	Phone: +1-281-855-6000 Fax: +1-281-855-3290 Email: gmhou@generalmonitors.com
<b>UNITED KINGDOM</b>	
Heather Close Lyme Green Business Park Macclesfield, Cheshire, United Kingdom, SK11 0LR	Phone: +44-1625-619-583 Fax: +44-1625-619-098 Email: info@generalmonitors.co.uk
<b>IRELAND</b>	
Ballybrit Business Park Galway, Republic of Ireland	Phone: +353-91-751175 Fax: +353-91-751317 Email: info@gmil.ie
<b>SINGAPORE</b>	
No. 2 Kallang Pudding Rd. #09-16 Mactech Building Singapore 349307	Phone: +65-6-748-3488 Fax: +65-6-748-1911 Email: genmon@gmpacifica.com.sg
<b>MIDDLE EAST</b>	
LOB12, #G20 P.O. Box 61209 Jebel Ali, Dubai United Arab Emirates	Phone: +971-4-8815751 Fax: +971-4-8817927 Email: gmme@emirates.net.ae

**Table 8: GM Locations**

## 8.0 MODBUS Interface

### 8.1 Baud Rate

The Baud Rate is selectable via the MODBUS Communications Interface. The selectable baud rates are 19200, 9600, 4800, or 2400 bits per second.

### 8.2 Data Format

The Data Format is selectable via the MODBUS Communications Interface. The selectable data formats are as follows:

Data Bits	Parity	Stop Bit	Format
8	None	1	8-N-1
8	Even	1	8-E-1
8	Odd	1	8-O-1
8	None	2	8-N-2

Table 9: Data Format

### 8.3 MODBUS Read Status Protocol (Query/Response)

#### 8.3.1 MODBUS Read Query Message

<u>Byte</u>	<u>MODBUS</u>	<u>Range</u>	<u>Referenced to S4000C</u>
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	S4000C ID (Address)
2 <sup>nd</sup>	Function Code	03	Read Holding Registers
3 <sup>rd</sup>	Starting Address Hi**	00	Not Used by S4000C
4 <sup>th</sup>	Starting Address Lo**	00-FF (Hex)	S4000C Commands
5 <sup>th</sup>	No. of Registers Hi	00	Not Used by S4000C
6 <sup>th</sup>	No. of Registers Lo	01	No. of 16 Bit Registers
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

**\*NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

**\*\*NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E).

#### 8.3.2 MODBUS Read Response Message

<u>Byte</u>	<u>MODBUS</u>	<u>Range</u>	<u>Referenced to S4000C</u>
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	S4000C ID (Address)
2 <sup>nd</sup>	Function Code	03	Read Holding Registers
3 <sup>rd</sup>	Byte Count	02	No. of Data Bytes
4 <sup>th</sup>	Data Hi	00-FF (Hex)	S4000C Hi Byte Status Data
5 <sup>th</sup>	Data Lo	00-FF (Hex)	S4000C Lo Byte Status Data
6 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
7 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

## 8.4 MODBUS Write Command Protocol (Query/Response)

### 8.4.1 MODBUS Write Query Message

<u>Byte</u>	<u>MODBUS</u>	<u>Range</u>	<u>Referenced to S4000C</u>
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	S4000C ID (Address)
2 <sup>nd</sup>	Function Code	06	Preset Single Register
3 <sup>rd</sup>	Register Address Hi	00	Not Used by S4000C
4 <sup>th</sup>	Register Address Lo	00-FF (Hex)	S4000C Commands
5 <sup>th</sup>	Preset Data Hi	00-FF (Hex)	S4000C Hi Byte Command Data
6 <sup>th</sup>	Preset Data Lo	00-FF (Hex)	S4000C Lo Byte Command Data
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

**\*NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

**\*\*NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E)

### 8.4.2 MODBUS Write Response Message

<u>Byte</u>	<u>MODBUS</u>	<u>Range</u>	<u>Referenced to S4000C</u>
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	S4000C ID (Address)
2 <sup>nd</sup>	Function Code	06	Preset Single Register
3 <sup>rd</sup>	Register Address Hi	00	Not Used by S4000C
4 <sup>th</sup>	Register Address Lo	00-FF (Hex)	S4000C Commands
5 <sup>th</sup>	Preset Data Hi	00-FF (Hex)	S4000C Hi Byte Command Data
6 <sup>th</sup>	Preset Data Lo	00-FF (Hex)	S4000C Lo Byte Command Data
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

## 8.5 Function Codes Supported

Function Code 03 (Read Holding Registers) will be used to read status from the slave unit.

Function Code 06 (Preset Single Register) will be used to write a command to the slave unit.

## 8.6 Exception Responses and Exception Codes

### 8.6.1 Exception Response

In a normal communications query and response, the master device sends a query to the S4000C and the S4000C receives the query without a communications error and handles the query normally within the master device's allowable timeout. The S4000C then returns a normal response to the master. An abnormal communications query produces one of four possible events:

1. If the S4000C does not receive the query due to a communications error, then no response is returned from the S4000C and the master device will eventually process a timeout condition for the query.
2. If the S4000C receives the query, but detects a communication error (CRC, etc.), then no response is returned from the S4000C and the master device will eventually process a timeout condition for the query.

3. If the S4000C receives the query without a communications error, but cannot process the response to the master within the master's timeout setting, then no response is returned from the S4000C. The master device will eventually process a timeout condition for the query. **In order to prevent this condition from occurring, the maximum response time for the S4000C is 200 milliseconds. Therefore the master's timeout setting should be set to 200 milliseconds or greater.**
4. If the S4000C receives the query without a communications error, but cannot process it due to reading or writing to a non-existent S4000C command register, then the S4000C will return an exception response message informing the master of the error.

<u>Byte</u>	<u>MODBUS</u>	<u>Range</u>	<u>Referenced to S4000C</u>
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	S4000C ID (Address)
2 <sup>nd</sup>	Function Code	83 or 86 (Hex)	MSB is set with Function Code
3 <sup>rd</sup>	Exception Code	01 - 06 (Hex)	Appropriate Exception Code (See Below)
4 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
5 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

The exception response message (ref. No. 4 above) has two fields that differentiate it from a normal response:

### 8.6.2 Exception Code

**Exception Code Field:** In a normal response, the S4000C returns data and status in the data field, which was requested in the query from the master. In an exception response, the S4000C returns an exception code in the data field, which describes the S4000C condition that caused the exception. Below is a list of exception codes that are supported by the S4000C:

<u>Code</u>	<u>Name</u>	<u>Description</u>
01	Illegal Function	The function code received in the query is not an allowable action for the S4000C.
02	Illegal Data Address	The data address received in the query is not an allowable address for the S4000C.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the S4000C.
04	Slave Device Failure	An unrecoverable error occurred while the S4000C was attempting to perform the requested action.
05	Acknowledge	The S4000C has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master.
06	Device Busy	The S4000C is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

Table 10: Exception Codes



## 8.7 S4000C Command Register Locations

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
Analog	0-20mA Current Output	Value	16-Bit	R	0000	40001
Mode	Indicates and Controls Mode	Bit		R/W	0001	40002
Status/Error	Indicates Errors	Bit		R	0002	40003
Not Used	N/A					40004
Unit Type	Identifies the S4000C in Decimal	Value	16-Bit	R	0004	40005
Software Rev	Indicates the Software Revision	ASCII	2-Char	R	0005	40006
Status Block	Returns Analog, Mode, Status, Error, and Sensor Life	Multi	6-bytes	R	0006	40007
Not Used	N/A					40008-40013
Alarm Settings	Read or change settings for the high alarm	Bit	(0-15)	R/W	000D	40014
Warn Settings	Read or change settings for the low alarm	Bit	(0-15)	R/W	000E	40015
Com1 Addr	Read or change settings for the Com1 Address	Value	8-Bit	R/W	000F	40016
Com1 Baud	Read or change settings for the Com1 Baud Rate	Bit	(0-7)	R/W	0010	40017
Com1 Data Format	Read or change settings for the Com1 Data Format	Bit	(0-7)	R/W	0011	40018
Com2 Addr	Read or change settings for the Com2 Address	Value	8-Bit	R/W	0012	40019
Com2 Baud	Read or change settings for the Com2 Baud Rate	Bit	(0-7)	R/W	0013	40020
Com2 Data Format	Read or change settings for the Com2 Data Format	Bit	(0-7)	R/W	0014	40021
Cal Level	Read or change settings for the calibration level	Value	8-Bit	R/W	0015	40022
Reset Alarms	Reset any latched alarms	Bit	(0)	W	0016	40023
Sensor Life	Read the Remaining Sensor Life	Bit	(0)	R	0017	40024
HazardWatch (Co)	Indicate Calibration Success	Value	8-bit	R/W	0019	40026
Not Used	N/A					40025, 40027-40032
Total Receive Errors	Total # of Receive Errors	Value	8-Bit	R	0020	40033
Bus Activity Rate %	Bus Activity Rate in % of This Addressed Node vs. Other Addressed Nodes	Decimal		R	0021	40034
Function Code Errors	Total # of Function Code Errors	Value	8-Bit	R	0022	40035
Starting Addr Errors	Total # of Starting Address Errors	Value	8-Bit	R	0023	40036
No of Register Errors	Total # of Register Errors	Value	8-Bit	R	0024	40037

**Table 11: Command Register Locations**

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
RXD CRC Hi Errors	Total # of RXD CRC Hi Errors	Value	8-Bit	R	0025	40038
RXD CRC Low Errors	Total # of RXD CRC Low Errors	Value	8-Bit	R	0026	40039
Not Used	N/A				0027 002C	40040 - 40045
Clear Comm Errors	Clear All Comm Errors	Bit	(0)	W	002D	40046

**Table 12: Command Register Locations Cont.**

## 8.8 S4000C Command Register Details

### 8.8.1 Analog

A read returns a value, which is proportional to the 0-20mA output current. The current is based on a 16-bit value. The scaling is 0 - 65535 decimal which corresponds to 0 - 21.7mA.

### 8.8.2 Mode

A read returns the present mode of the S4000C. A write command changes the mode to the requested mode.

Exception: Returns an Exception Code 01 (illegal function) if an illegal write is requested.

A calibrate command returns an Exception Code 01 (Acknowledge 05). The operation will take a long time to complete.

<u>Function</u>	<u>Bit Position</u>	<u>Access</u>
Calibration Complete	7 MSB	Read
Spanning	6	Read
Zero Complete, Waiting for Gas	5	Read
Zeroing	4	Read
Calibration Mode	3	Read/Write
Calibration Check Mode	2	Read/Write
Run Mode	1	Read
Startup Mode	0 LSB	Read

### 8.8.3 Status/Error

A read returns the Alarm state and Errors that are occurring at the present time, which are indicated, by bit position.

<u>Function</u>	<u>Bit Position</u>	<u>Access</u>
Alarm	15 MSB	Read
Warn	14	Read
Fault	13	Read

Not Used	12	Read
Not Used	11	Read
Not Used	10	Read
Not Used	9	Read
Switch Error	8	Read
Setup Error	7	Read
Calibration Check Timeout	6	Read
EEPROM Error	5	Read
EPROM Error	4	Read
Sensor Error	3	Read
Fail to Calibrate	2	Read
Low Supply Voltage	1	Read

### 8.8.4 Unit Type

A read returns the Decimal Value 4000. This identifies the S4000C.

A read returns the Decimal Value 4001. This identifies the S4000T.

### 8.8.5 Software Revision

A read returns the software revision of the S4000C in 2 ASCII characters.

### 8.8.6 Status Block

A read returns a 6-byte message containing the analog (2 bytes), Mode (1 byte), Status/Error (2 bytes), and Sensor Life (1 byte) in that order. For the format of each byte, refer to the appropriate individual commands.

### 8.8.7 Alarm Settings

A read returns the present Alarm settings of the S4000C. A write command changes the settings to the requested values. The set points are programmable in 5% FS steps.

**NOTE:** The maximum alarm setting for the S4000C is 60%.

A 1 in the 9<sup>th</sup> bit position means the output is latching, a 0 means it is Non-Latching. A 1 in the 8<sup>th</sup> bit position means the output is normally energized a 0 means it is normally De-Energized. The Alarm set point cannot be set below the Warn set point.

**Factory default is 60%FS, latching, de-energized.**

Exception: Returns an Exception Code 01 (Illegal Function) if an illegal write is requested.

<u>Byte</u>	<u>Function</u>	<u>Bit Position</u>	<u>Access</u>
High	Not Used	15 MSB	Read
	Not Used	14	Read
	Not Used	13	Read
	Not Used	12	Read
	Not Used	11	Read
	Not Used	10	Read
	Latching/Non-Latching	9	R/W
	Energized/De-Energized	8	R/W
Low	Set point	(7-0)	R/W

### 8.8.8 Warn Settings

A read returns the present Warn settings of the S4000C. A write command changes the settings to the requested values. The set points are programmable in 5% FS steps.

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**NOTE:** The maximum warn setting for the S4000C is 60%.

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A 1 in the 9<sup>th</sup> bit position means the output is latching, a 0 means it is Non-Latching. A 1 in the 8<sup>th</sup> bit position means the output is normally energized, a 0 means it is normally De-Energized. The Warn set point cannot be set above the Alarm set point.

**Factory default is 30% FS, non-latching, de-energized.**

Exception: Returns an Exception Code 01 (Illegal Function) if an illegal write is requested.

<u>Byte</u>	<u>Function</u>	<u>Bit Position</u>	<u>Access</u>
High	Not Used	15 MSB	Read
	Not Used	14	Read
	Not Used	13	Read
	Not Used	12	Read
	Not Used	11	Read
	Not Used	10	Read
	Latching/Non-Latching	9	R/W
	Energized/De-Energized	8	R/W
Low	Set point	(7-0)	R/W

### 8.8.9 Com1 Address

A read command returns the current address for Com1. A write command changes the address to the requested value. Valid addresses are 1-247 decimal. **Factory default is 1.**

Exception: If the address is not in range, an illegal data value (03) is returned.

### 8.8.10 Com1 Baud Rate

A read command returns the current baud rate for Com1. A write command changes the baud rate to the requested values. Valid settings are shown in the table below. **Factory default is 19,200.**

Baud Rate	Value	Access
2400	24	Read/Write
4800	48	Read/Write
9600	96	Read/Write
19,200	192	Read/Write

**Table 13: Com1 Baud Rate**

Exception: If the baud rate is not in range, an illegal data value (03) is returned.

### 8.8.11 Com1 Data Format

A read command returns the current data format for Com1. A write command changes the data format to the requested values. Valid settings are shown in the table below. **Default format is 8-N-1.**

Data	Parity	Stop	Format	Data(Bits 9-8)	Access
8	None	1	8-N-1	0	Read/Write
8	Even	1	8-E-1	1	Read/Write
8	Odd	1	8-O-1	2	Read/Write
8	None	2	8-N-2	3	Read/Write

**Table 14: Com1 Data Format**

Exception: If the data format is not in range, an illegal data value (03) is returned.

### 8.8.12 Com2 Address

A read command returns the current address for Com2. A write command changes the address to the requested values. Valid addresses are 1-247 decimal. **Factory default is 2.**

Exception: If the address is not in range, an illegal data value (03) is returned.

### 8.8.13 Com2 Baud Rate

A read command returns the current baud rate for Com2. A write command changes the baud rate to the requested values. Valid settings are shown in the table below. **Factory default is 19,200.**

Baud Rate	Value	Access
2400	24	Read/Write
4800	48	Read/Write
9600	96	Read/Write
19,200	192	Read/Write

**Table 15: Com2 Baud Rate**

Exception: If the baud rate is not in range, an illegal data value (03) is returned.

### 8.8.14 Com2 Data Format

A read command returns the current data format for Com2. A write command changes the data format to the requested values. Valid settings are shown in the table below. **Factory default is 8-N-1.**

Data	Parity	Stop	Format	Data(Bits 9-8)	Access
8	None	1	8-N-1	0	Read/Write
8	Even	1	8-E-1	1	Read/Write
8	Odd	1	8-O-1	2	Read/Write
8	None	2	8-N-2	3	Read/Write

**Table 16: Com2 Data Format**

Exception: If the data format is not in range, an illegal data value (03) is returned.

### 8.8.15 Cal Level

A read returns the current settings for the Calibration Level. A write changes the Calibration Level that will be used during the next and subsequent calibrations. Valid levels are 25 to 90.

### 8.8.16 Reset Alarms

A write to this register with a data value of 1 will reset any latched alarms provided the current gas level is below the alarm set point.

On the S4000C it will also reset the latching over-range function provided the gas level is below 100% LEL.

### 8.8.17 Sensor Life

A read returns the current estimate of remaining sensor life in percentage.

### 8.8.18 HazardWatch (Co – Calibration Output)

A read to this register will return the status of the HazardWatch Option.

0x01 enables this option, 0x00 disables this option, similar to the write.

**NOTE:** Only Com1 can support read/write to this register.

### 8.8.19 Total Receive Errors

A read indicates the total MODBUS Comm Receive Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again. The total errors are an accumulation of the individual communication errors listed below.

### 8.8.20 Bus Activity Rate %

A read indicates the Bus Activity Rate in percent of this Slave's addressed node versus other addressed nodes. Range of this value is in hex (0-64), which translates to decimal (0-100%).

### **8.8.21 Function Code Errors**

A read indicates the number of Function Code Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

### **8.8.22 Starting Address Errors**

The counter is incremented for each address that does not equal the device address.

A read indicates the number of Starting Address Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

### **8.8.23 Number of Register Errors**

A read indicates the Number of Register Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

### **8.8.24 RXD CRC Hi Errors**

A read indicates the number of RXD CRC Hi Byte Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

### **8.8.25 RXD CRC Low Errors**

A read indicates the number of RXD CRC Low Byte Errors that occurred in the slave device. The maximum count is 255 and then the counter will rollover to zero and begin counting again.

### **8.8.26 Clear Comm Errors**

A Read or Write resets all the MODBUS Comm Error counters to zero.

## 9.0 Appendix

### 9.1 Warranty

General Monitors warrants the Model S4000C to be free from defects in workmanship or material under normal use and service within two years from the date of shipment.

General Monitors will repair or replace without charge any such equipment found to be defective during the warranty period. Full determination of the nature of, and responsibility for, defective or damaged equipment will be made by General Monitors' personnel.

Defective or damaged equipment must be shipped to the General Monitors' plant, or representative from which the original shipment was made. In all cases, this warranty is limited to the cost of the equipment supplied by General Monitors. The customer will assume all liability for the misuse of this equipment by its employees, or other personnel.

All warranties are contingent upon proper use in the application for which the product was intended and do not cover products which have been modified or repaired without General Monitors' approval or which have been subjected to neglect, accident, improper installation or application, or on which the original identification marks have been removed or altered.

Except for the express warranty stated above, General Monitors disclaims all warranties with regard to the products sold, including all implied warranties of merchantability and fitness, and the express warranties stated herein are in lieu of all obligations or liabilities on the part of General Monitors for damages including, but not limited to, consequential damages arising out of, or in connection with, the performance of the product.

### 9.2 Principle of Operation

Many gases and vapors are combustible. General Monitors uses a low temperature catalytic bead to detect the presence of combustible gases and vapors. The catalytic bead converts the combustible materials to heat. A change in heat is then converted to a change in resistance, which can be measured.

Taking a matched pair of catalytic beads and coating one so that it does not respond to the presence of combustible gases can compare the change in resistance between the two beads. The bead that is coated is called the reference bead and the other is called the active bead. Because the beads are a matched pair, they will respond equally to changes in ambient temperature, humidity, and pressure. This makes the sensor virtually immune to changing environmental conditions.

By connecting one end of each catalytic bead together, a series circuit is formed. This circuit is supplied with a constant current. The voltage drop across each of the beads will be identical in the absence of combustible gases. As combustible material is converted to heat, the resistance of the active bead increases, causing the voltage drop across each bead to be different. This difference is proportional to the amount of combustible gas that is present.

The voltage from the sensor is amplified and fed to an Analog to Digital (A/D) converter and then made available to the microprocessor. The baseline and the gain for the amplifier are set using digital potentiometers. They are adjusted by the microprocessor during calibration.



## 9.3 Specifications

### 9.3.1 System Specifications

<b>Sensor Type:</b>	Continuous diffusion, low temperature catalytic bead
<b>Sensor Life:</b>	3 to 5 years typical
<b>Accuracy:</b>	±3% LEL up to 50% LEL ±5% LEL ≥ 51% LEL
<b>Zero Drift:</b>	Less than 5% of full scale per year
<b>Response Time:</b>	T50<10 sec. T90<30 sec. with 100% LEL methane applied
<b>Measuring Ranges:</b>	0-100% LEL
<b>Modes:</b>	Calibration, gas check, setup
<b>Electrical Classification:</b>	CSA/FM: Class I, Division 1, Groups B, C, D and Class I, Zone 1, Ex d IIB+H <sub>2</sub> , T6. ATEX: II 2 G EEx d IIB T5 (Tamb=-40°C to +70°C) EN 61779-1
<b>Pressure Limits:</b>	Up to 3 Atmospheres, sensor requires 15 minutes from start up to stabilize
<b>Warranty:</b>	Two years

### 9.3.2 Mechanical Specifications

<b>Length:</b>	6.4 inches (161mm)
<b>Height:</b>	3.4 inches (86mm)
<b>Width:</b>	4.1 inches (104mm)
<b>Weight:</b>	5.5 lbs. (2.5 kg)
<b>Mounting Holes:</b>	5.0 inches (127mm) (center to center)

### 9.3.3 Electrical Specifications

<b>Input Power:</b>	24 VDC nominal, 20 to 36 VDC, 250mA max.
<b>Relay Ratings:</b>	8A @ 250 VAC/8A @ 30 VDC resistive max.
<b>(Optional)</b>	(3x) SPDT - Warning, Alarm & Fault
<b>Analog Signal:</b>	0-20mA (650 ohms max. load)
	Malfunction 0mA
	Calibration 1.5mA
	Gas Check 1.5mA
	Setup mode 1.5mA
	Startup 4mA±0.2mA
	Zero reading 4mA±0.2mA
	0-100% LEL 4-20mA
	Over-range 20-22mA
<b>Status Indicators:</b>	Three-digit digital display with gas concentration, Warn and Alarm LED's, calibration prompts, fault codes, and setup options
<b>RS-485 Output:</b>	Dual Redundant MODBUS RTU, suitable for linking
<b>(Optional)</b>	Up to 128 units or up to 247 units with repeaters
<b>Baud Rate:</b>	2400, 4800, 9600, or 19200 BPS
<b>Faults Monitored:</b>	Calibration error, open AO, sensor error, low DC supply, EEPROM, EPROM, setup error, gas check time exceeded, switch error
<b>RFI/EMI Protection:</b>	Complies with EN50081-2, EN50082-2

**Cable Requirements:**

3-wire shielded cable. Max. distance between S4000C and power source @ 24 VDC nominal (20 ohm loop):

AWG	FEET	METERS
14	3000	910
16	1900	580
18	1500	460
20	1000	300

**Table 17: 24VDC Cable Lengths**

Max. distance for analog output (650 ohms max):

AWG	FEET	METERS
14	9000	2740
16	5200	1585
18	3800	1160
20	2400	730

**Table 18: Analog Output Cable Lengths**

Max. Distance between the transmitter and sensor with one-way resistance of 20 Ohms (40-Ohm loop):

AWG	FEET	METERS
14	7600	2320
16	4800	1460
18	3000	910
20	1900	580

**Table 19: Sensor Cable Lengths**

*European Union (EU) Approved Applications:* PSU noise and ripple voltage 1.0Vpp max. The customer supplied PSU must comply with IEC 1010-1, limiting current to 8A under Fault conditions, in order to comply with CE Marking requirements.

**9.3.4 Environmental Specifications**

**Operating Temperature Range:**

**CSA/FM/ATEX:**

Electronics -40°F to 167°F (-40°C to +75°C)  
 Standard Sensor -65°F to 200°F (-55°C to +93°C)  
 High Temp Sensor -65°F to 400°F (-55°C to +200°C)

**ATEX:**

Electronics (T5) -40° F to 158° F (-40°C to +70°C)

**Storage Temperature Range:**

-58°F to 185°F (-50°C to +85°C)

**Operating Humidity Range:**

5% to 100% RH, non-condensing

**Atmosphere:**

Will not operate in <5% Oxygen  
 Oxygen enriched reading may be slightly higher

## 9.4 Approvals

CSA, FM, ATEX approved.

Complies with ANSI/ISA-12.13.01-2000 performance requirements

## 9.5 Sensitivities To Other Gases

The S4000C responds to the following list of hydrocarbons up to C10

Gases	%LEL	M.W.	Density	Injection volumes		Cal Ratio	
				50%lel/3L	50%lel/5L	Methane	Propane
Acetylene	2.5	26.0	***	37.5 ml	62.5 ml	0.8	1.1
Ammonia	15.0	17.0	***	225.0 ml	375.0 ml	1.3	1.7
1,3- Butadiene	2.0	54.1	***	30.0 ml	50.0 ml	0.8	1.1
Butane	1.9	58.1	***	28.5 ml	47.5 ml	0.7	0.9
iso-Butane	1.8	58.1	***	27.0 ml	45.0 ml	0.6	0.8
1-Butene (Butylene)	1.6	56.1	***	24.0 ml	40.0 ml	0.7	0.9
cis-Butene-2	1.7	56.1	***	25.5 ml	42.5 ml	0.7	0.9
trans-Butene-2	1.8	56.1	***	27.0 ml	45.0 ml	0.7	0.9
iso-Butylene	1.8	56.1	***	27.0 ml	45.0 ml	0.7	0.9
Carbon Monoxide	12.5	28.0	***	187.5 ml	312.5 ml	0.9	1.2
Dimethylamine	2.8	45.1	***	42.0 ml	70.0 ml	0.6	0.8
Ethane	3.0	30.1	***	45.0 ml	75.0 ml	0.8	1.1
Ethylene Oxide	3.0	44.0	***	45.0 ml	75.0 ml	1.0	1.3
Ethylene (Ethene)	2.7	28.1	***	40.5 ml	67.5 ml	0.8	1.1
Hydrogen	4.0	2.0	***	60.0 ml	100.0 ml	0.8	1.1
Methane	5.0	16.0	***	75.0 ml	125.0 ml	1.0	1.3
Propane	2.1	44.1	***	31.5 ml	52.5 ml	0.8	1.0
Propylene (Propene)	2.0	42.1	***	30.0 ml	50.0 ml	0.8	1.0
Trimethylamine	2.0	59.1	***	30.0 ml	50.0 ml	0.6	0.8
Vinyl Chloride (Chloroethylene)	3.6	62.5	***	54.0 ml	90.0 ml	0.7	0.9
Liquids	%LEL	M.W.	Density	Injection volumes		Cal Ratio	
				50%lel/3L	50%lel/5L	Methane	Propane
Acetaldehyde	4.0	44.1	0.8	136 ul	228 ul	0.7	0.9
Acetic Acid	4.0	60.1	1.0	140 ul	234 ul	0.5	0.7
Acetone	2.5	58.1	0.8	112 ul	187 ul	0.6	0.8
Acetonitrile	3.0	41.1	0.8	96 ul	160 ul	0.7	0.9
Acrylonitrile	3.0	53.1	0.8	120 ul	201 ul	0.8	1.1
Amyl Acetate	1.1	130.2	0.9	100 ul	167 ul	0.3	0.4
Benzene	1.2	78.1	0.9	65 ul	109 ul	0.6	0.8
Butyl Acetate	1.7	116.2	0.9	137 ul	228 ul	0.5	0.7
Butyl Alcohol (1- Butanol)	1.4	74.1	0.8	78 ul	131 ul	0.4	0.5
sec-Butyl Alcohol (2-Butanol)	1.7	74.1	0.8	95 ul	159 ul	0.4	0.5
tert- Butyl Alcohol	2.4	74.1	0.8	138 ul	231 ul	0.7	1.0
Butyraldehyde	1.9	72.1	0.8	102 ul	171 ul	0.5	0.7
Cyclohexane	1.3	84.2	0.8	86 ul	143 ul	0.6	0.8
Diethyl Ketone (3-Pentanone)	1.6	86.1	0.8	103 ul	173 ul	0.5	0.7
p-Dioxane	2.0	88.1	1.0	104 ul	174 ul	0.5	0.6

Ethanol (Ethyl Alcohol)	3.3	46.1	0.8	118 ul	198 ul	0.7	1.0
Ethyl Acetate	2.0	88.1	0.9	119 ul	199 ul	0.6	0.8
Ethyl Amine	3.5	45.1	0.7	140 ul	234 ul	0.5	0.6
Ethyl Benzene	0.8	106.2	0.9	60 ul	100 ul	0.5	0.6
Ethyl Ether	1.9	72.2	0.7	120 ul	200 ul	0.7	0.9
Gasoline	1.4	100.2	0.8	107 ul	179 ul	0.5	0.7
Heptane	1.1	100.2	0.7	94 ul	157 ul	0.5	0.6
Hexane	1.1	86.2	0.7	86 ul	144 ul	0.5	0.6
Isopentane (2-Methylbutane)	1.4	72.2	0.6	99 ul	166 ul	0.6	0.8
Isoprene (2-Methyl-1, 3-Butadiene)	1.5	68.1	0.7	89 ul	149 ul	0.6	0.8
JP-4 (Jet fuel mainly Kerosene)	1.3	184.4	0.8	183 ul	306 ul	0.3	0.4
Methanol (Methyl Alcohol)	6.0	32.0	0.8	148 ul	248 ul	0.8	1.1
Methyl Ethyl Ketone (2-Butanone)	1.4	72.1	0.8	76 ul	128 ul	0.6	0.8
Methyl Methacrylate	1.70	100.1	0.9	111 ul	186 ul	0.6	0.7
Methyl-t-Butyl Ether(MTBE)	1.5	88.2	0.7	109 ul	182 ul	0.6	0.8
Naphtha (Petroleum Ether)	1.1	86.2	0.6	96 ul	161 ul	0.6	0.8
Octane	1.0	114.2	0.7	99 ul	166 ul	0.5	0.6
Pentane	1.5	72.2	0.6	105 ul	176 ul	0.6	0.8
2-Propanol (Isopropyl Alcohol)	2.0	60.1	0.8	93 ul	156 ul	0.6	0.8
Propanol (Propyl Alcohol)	2.2	60.1	0.8	100 ul	168 ul	0.6	0.7
Propylacetate	1.7	102.1	1.0	106 ul	177 ul	0.5	0.7
Propylamine	2.0	59.1	0.7	103 ul	172 ul	0.6	0.8
Propylene Oxide	2.3	58.1	0.8	98 ul	164 ul	0.7	1.0
Styrene (Vinyl Benzene)	0.9	104.2	0.9	63 ul	105 ul	0.5	0.6
Tetrahydrofuran	2.0	72.1	0.9	99 ul	166 ul	0.7	0.9
1,1,1-Toluene (Methylbenzene, Toluol)	1.1	101.2	0.9	78 ul	131 ul	0.5	0.7
Triethylamine	1.2	101.2	0.7	102 ul	171 ul	0.6	0.8
o-Xylene	0.9	106.2	0.9	68 ul	113 ul	0.4	0.5
p- Xylene	1.1	106.2	0.9	83 ul	139 ul	0.4	0.5
m- Xylene	1.1	106.2	0.9	83 ul	139 ul	0.4	0.5
Xylenes	1.1	106.2	0.9	83 ul	139 ul	0.4	0.5

**Table 20: Chemical List from 1994 NFPA**

## 9.6 Spare Parts and Accessories

To order spare parts and/or accessories, please contact your nearest General Monitors Representative, or General Monitors directly, and give the following information:

- Part Number of Spare Part or Accessory
- Description of Spare Part or Accessory
- Quantity of Spare Part or Accessory

### 9.6.1 Sensors

10001-1	Standard Industrial Hydrocarbon
10001-1R	Poison Resistant
10014-1	Standard Industrial Hydrocarbon High Temp
10014-1R	Poison Resistant High Temp
10015-1	Standard Industrial Hydrocarbon High Temp Export Version
10022-1	Standard Industrial Hydrocarbon High Temp PTB
10022-1R	Standard Industrial Hydrocarbon High Temp PTB, Poison Resistant
10058-1	Standard Industrial Stainless Steel, Hydrocarbon
10058-1R	Standard Industrial Stainless Steel, Hydrocarbon, Poison Resistant
10391-1	High Temp, Stainless Steel
10391-1R	High Temp, Stainless Steel, Poison Resistant
10387-4	Sensor Assembly, Standard Hydrocarbon, Super Poison Resistant
10164-1	Sensor Assembly, Hydrogen Specific
11159-1L	General Purpose, SST, Sintered Steel Arrestor
11159-2L	General Purpose, SST, High Temp, Sintered Steel Arrestor
10102-1	Dummy Sensor

### 9.6.2 Sensor Housing

B13-020 or B13-021	Sensor Housing
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### 9.6.3 Sensor Accessories

10460-2	Test Gas Applicator
10041-1	Duct Mounting Plate
10044-1	Dust Guard Kit - 1 Guard, 12 Replaceable Screens
10042-1	Replaceable Screens, Box of 12
10395-1	Splash Guard Assembly
50060-1	H <sub>2</sub> S Guard Filter
50061-1	Purafil Insert Assembly
10110-1	Dust Guard Assembly
1800822	Dust Guard, Sintered SST
10066	Flow Block

### 9.6.4 Calibration Equipment

10543-1	3-Liter Calibration Chamber with 250 $\mu$ L Syringe
928-700	Dish for the 3- Liter Chamber
928-715	250 $\mu$ L microliter syringe
1400150-M	Portable Purge Calibrator, Methane @ 50% LEL
1400150-H	Portable Purge Calibrator, Hydrogen @ 50% LEL
1400150-BD	Portable Purge Calibrator, Butadiene @ 50% LEL
1400150-PR	Portable Purge Calibrator, Propane @ 50% LEL
1400155-M	Replacement Cylinder, Methane @ 50% LEL
1400155-H	Replacement Cylinder, Hydrogen @ 50% LEL

1400155-BD	Replacement Cylinder, Butadiene @ 50% LEL
1400155-PR	Replacement Cylinder, Propane @ 50% LEL

Cylinder refills are available for Methane and Hydrogen only. Replacement cylinders must be ordered for the other gases.

922-009	Pressure Regulator Gauge
1400152-1	Small Calibration Cup
1400154	Large Calibration Cup
925-026	Tubing

### **9.6.5 Intelligent Transmitter (S4000C) Replacement Parts**

31146-1	Control Board Electronics
31151-1	Output Board Electronics
31156-1	Display Board Electronics
31170-1	Enclosure Cover Assembly with Window
31195-2	Enclosure Base Assembly
30060-1	Calibration Magnet
925-5007	Cover Assy. O-Ring

### **9.6.6 Recommended Spare Parts for One (1) Year**

30060-1	Extra Calibration Magnet (Qty. 1)
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## 9.7 FMRC Approval

Factory Mutual Research Corporation

1151 Boston-Providence Turnpike

Norwood, Massachusetts 02062

Approval of the transmitter does not include, or imply, approval of apparatus to which the transmitter may be connected and which processes the electronic signal for the eventual end use. In order to maintain FMRC approved system, the control instrument, to which the subject instrument is connected, must be FMRC approved.

The following sensors have been FMRC approved for use with the Model S4000C:

- 10001-1 Aluminum Body General Purpose Combustible Gas Sensor
- 10058-1 Stainless Steel Body General Purpose Combustible Gas Sensor

The following apparatus have been FMRC approved (although they have not been verified as part of a Model S4000C system):

- Model DC110 Eight Channel Readout/Relay Display Module
- Model DC130 Dual Channel Readout/Relay Display Module

Factory Mutual Research Corporation has tested the Model S4000C according to the criteria listed under the FMRC Approval Standards for Combustible Gas Detectors, Class Numbers 6310 & 6320.

FMRC has tested the Model S4000C using the specifications listed in Section 9.2. This permits an operating temperature of -40°F to +167°F (-40°C to +75°C), a general purpose sensor (10001-1 or 10058-1) attached to the housing (i.e. not remoted), calibration performed with a General Monitors' Portable Purge Calibrator using 50% LEL gas (Methane, Hydrogen, Butadiene, Butane, Ethane or Propane) and the procedure listed in Section 4.5. The conduit containing wires connected to the relay contacts must be sealed. If the non-latching relay option has been selected from the relay options, the user must provide alternate means of latching the relay output.



**ADDENDUM**  
**Product Disposal Considerations**

This product may contain hazardous and/or toxic substances.

EU Member states shall dispose according to WEEE regulations. For further General Monitors' product WEEE disposal information please visit:

[www.generalmonitors.com/customer\\_support/faq\\_general.html](http://www.generalmonitors.com/customer_support/faq_general.html)

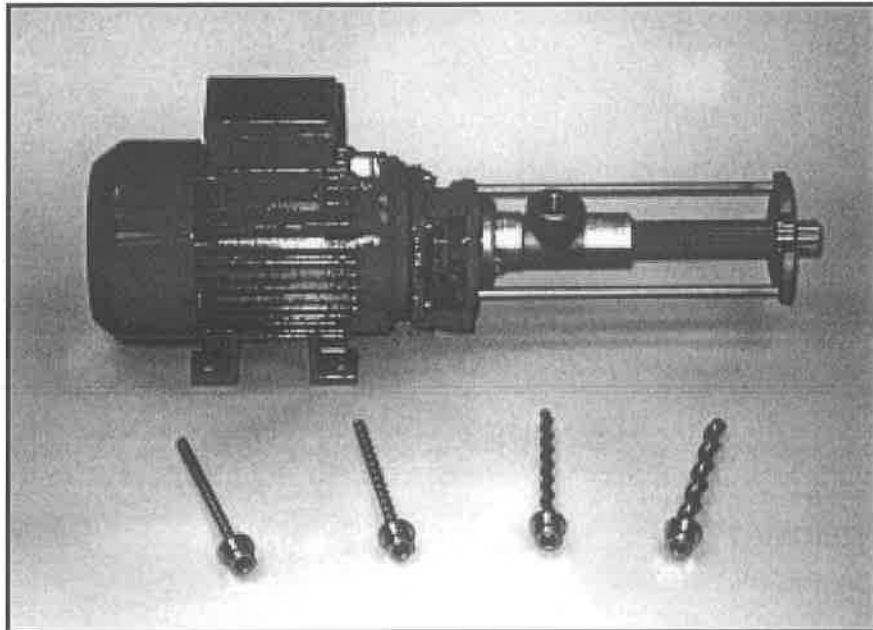
All other countries or states: please dispose of in accordance with existing federal, state and local environmental control regulations.



# Operating and Maintenance Instructions



## NEMO®-Pump



Model Number

Sales Order/Job Number

Machine Number

Date of issue

### Important Note

**These operating instructions are designed to familiarize the user with the machine and its designated use.**

#### The Instruction Manual

- Contains important information on how to operate the machine safely, properly and efficiently. Observing these instructions help to avoid danger, to reduce repair costs and downtimes and to increase the reliability and life of the machine;
- Must always be available wherever the machine is in use.

- Must be read and applied by any **person in charge** of carrying out work with and on the machine, such as:

**Operation** including setting up, troubleshooting in the course of work, evacuation of production waste, care and disposal of fuels and consumables

**Maintenance** (servicing, inspection, repair) and/or

**Transport;** shall be completed by the end user and authorized personnel with

the national requirements in force for the prevention of accidents and the environmental protection.

In addition to the operating instructions and to the mandatory rules and regulations for accident prevention and environmental protection in the country and place of use of the machine, the generally recognized technical rules for safe and proper working must also be observed.

1.)	Safety Precautions	1
2.)	Description	2
3.)	Packing, Transportation, Storage	3
4.)	Installation Instructions	4
5.)	Start-Up	5
6.)	Temporary Shutdown	6
7.)	Maintenance	7
8.)	Trouble-Shooting and Solutions	8
9.)	Disassembly and Assembly of the Pump Housing	9
10.)	Disassembly and Assembly of the Rotating Parts	10
11.)	Disassembly and Assembly of the Bearings	11
12.)	Disassembly and Assembly of the Shaft Sealing	12
13.)	Disassembly and Assembly of Special Units	13
14.)	Recommended Spare Parts	14
15.)	Parts List and Sectional Drawing	15

### 1 Safety Precautions

These operating instructions contain essential information which should be observed during installation, operation and maintenance. These operating instructions should be read and understood by the engineer, as well as other responsible operators before assembly and operation. Operating instructions should always be readily available wherever the machine is being used.

The general safety rules detailed under "Safety Precautions", plus the safety precautions set by the end user, must be followed.

#### 1.1 Symbols Relating to Safety Precautions in the Operating Instructions

Personal injury, damage to machines or contamination of the environment can result if the safety precautions contained in this document are not strictly enforced. Following are signs commonly used to signify areas of danger:



Safety Sign  
Danger to General Public



Safety Sign  
Electrical Hazard



Danger from Possible Injury by Machinery



Danger from Suspended Loads



Damage to Machinery

Warning or indication plates attached to the pump which show the correct direction of rotation (or fluid connections) must always be kept in readable condition.

## **1.2 Qualifications and Training of Personnel**

All personnel responsible for service, maintenance, inspection, installation and operation must have the appropriate training. Responsibility and supervision of personnel must be strictly enforced by the end user. If training of personnel is required, it can be provided by the manufacturer/representative. Furthermore, it is the responsibility of the end user to ensure that personnel fully understands the operating instructions.

## **1.3 Non-Observance of Safety Precautions**

Non-observance of the safety rules can result in personal injury, damage to machines or contamination of the environment. Non-observance can void product warranty.

Non-observance can also result in the following:

- ◆ Premature failure of components or machine/equipment malfunction.
- ◆ Danger to personnel from electrical, mechanical or chemical hazards.
- ◆ Danger to the environment from leakage of dangerous materials.

## **1.4 Safe Operation**

The safety precautions outlined in these operating instructions, the existing national regulations on accident prevention and the end user's own operating and safety regulations **must be observed**.

## **1.5 Safety Precautions**

- ◆ Hot or cold machine components must be insulated or shielded.
- ◆ Guards covering moving parts (i.e. shafts, couplings) must not be removed while machines are in operation.
- ◆ Leakage of dangerous materials (i.e. explosives, toxins or hot materials) from the shaft sealing area should be properly contained.
- ◆ In order to prevent electrical hazards, applicable local and/or federal regulations must be adhered to.

## 1.6 Safety Precautions for Maintenance, Inspection and Installation Work

The end user must ensure that all maintenance, inspection and installation work is performed by authorized and qualified personnel who understand the operating instructions and are properly trained.

Work on a pump/machine should only be performed when it is disconnected from its power source, pressure has been relieved, and the complete unit has returned to room temperature. It is imperative that these procedures are adhered to before attempting work on the machine.

Pumps or units which transfer dangerous substances must be decontaminated.

Immediately following maintenance work, all safety and protection equipment must be re-installed and safety trips must be tested.

Refer to Section 5.0, "Start-up," before restarting machine/pump.

## 1.7 Unauthorized Use of Spare Parts and/or Modifications to the Pump

Modifications to the machines and/or its components are permitted only with the manufacturer's consent. Original spare parts and accessories authorized by the manufacturer ensure safety. The use of other components revokes any warranty and liability for consequences which may result.

## 1.8 Improper Application

Machinery is only guaranteed safe for the use specified.

This machinery was manufactured in accordance to the specifications and the conditions specified by the end user. The machine should not be operated in any way that exceeds design capacities.

## 1.9 Specific Points for the Use of NEMO® Pumps

NEMO® Pumps should only be used for the application for which they were sold.

If you wish to change the pumping medium, you should check with either the supplier or manufacturer to ensure that the pump will be suitable for the new medium. This is especially important with aggressive, poisonous or otherwise dangerous media.

Criteria for the selection of a pump includes:

1. Compatibility between the medium to be pumped and the materials of all wetted pump parts.
2. Compatibility between elastomeric components and mechanical seal faces.
3. The pressure and temperature rating of the pump.

NEMO® Pumps are of positive displacement progressing cavity design, and have the potential to generate very high pressure.

## **1 SAFETY PRECAUTIONS**

A blockage or closure of a valve in the discharge line can cause a pressure rise **higher than the installation can withstand**. A substantial pressure increase can result in the bursting of pipes and/or damage to other components of pump or drive systems. Extreme caution must be used, especially when dangerous media is present.

Appropriate safety equipment must be installed (i.e.: an emergency stop button, a pressure relief valve or rupture disc).

During maintenance and repair work on the pump, please note the following:

1. No one other than those involved with maintenance and repair should have access to power supply.
2. When dismantling the pump, follow the instructions for handling the medium (e.g.: protective clothing, no smoking, etc.)
3. Before putting the pump back into operation, ensure that all guards and other safety devices (e.g.: drive belt and coupling protection) are properly re-installed.

**Always keep safety in mind during operation, maintenance and installation of equipment. Please adhere to applicable federal and local rules and regulations.**

## 1.10 Notes on Inspection and Repair

It is the responsibility and obligation of all commercial businesses to enforce safety in the workplace, regulations governing dangerous materials, accident prevention and environmental protection at all times.

People along with the environment must be protected from adverse effects caused by contact with dangerous materials.

The procedures for proper handling, containment and/or disposal of all hazardous materials, including wastewater, must be strictly enforced.

### **Important:**

A Material Safety Data Sheet must accompany any machine/part and a Safety Conformity Certificate must be completed prior to inspection or repair. Please make a duplicate copy and leave the original in the Operation and Maintenance manual.

Where special safety precautions are necessary, in addition to careful emptying and cleaning of the machinery, the necessary information must be given.

Inspection or repair of machinery containing radioactive medium will only be performed by authorized personnel under protection and supervision of the owner.

The Safety Conformity Certificate is part of the inspection/repair service. We reserve the right to refuse acceptance of this order/service for other reasons.



### Safety Conformity Certificate

This completed Safety Conformity Certificate and a Material Safety Data Sheet must accompany the machine and its accessories when returned to the manufacturer for repair/inspection services.

Pump Model Number \_\_\_\_\_  
Job Number \_\_\_\_\_  
Date of Manufacture \_\_\_\_\_ Equipment Return Authorization # \_\_\_\_\_  
Machine Number \_\_\_\_\_

Was carefully emptied and cleaned, both inside and out, in preparation for shipment.  Yes  No

Precautions with regard to health and the environment are to be observed.  Yes  No

This machine came into contact with media hazardous to health and the environment.  Yes  No

The following additional precautions are necessary with regard to the handling of media and the disposal of waste: \_\_\_\_\_  
\_\_\_\_\_

We confirm the above information is accurate and complete, and shipment will be in accordance with legal requirements:

Company \_\_\_\_\_ Telephone No.: \_\_\_\_\_  
\_\_\_\_\_ Fax No.: \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Name \_\_\_\_\_ Date: \_\_\_\_\_

Position: \_\_\_\_\_

\_\_\_\_\_  
Company Stamp/Signature



### 2 Description

The Nemo® Pump is a positive displacement, progressing cavity-type pump.

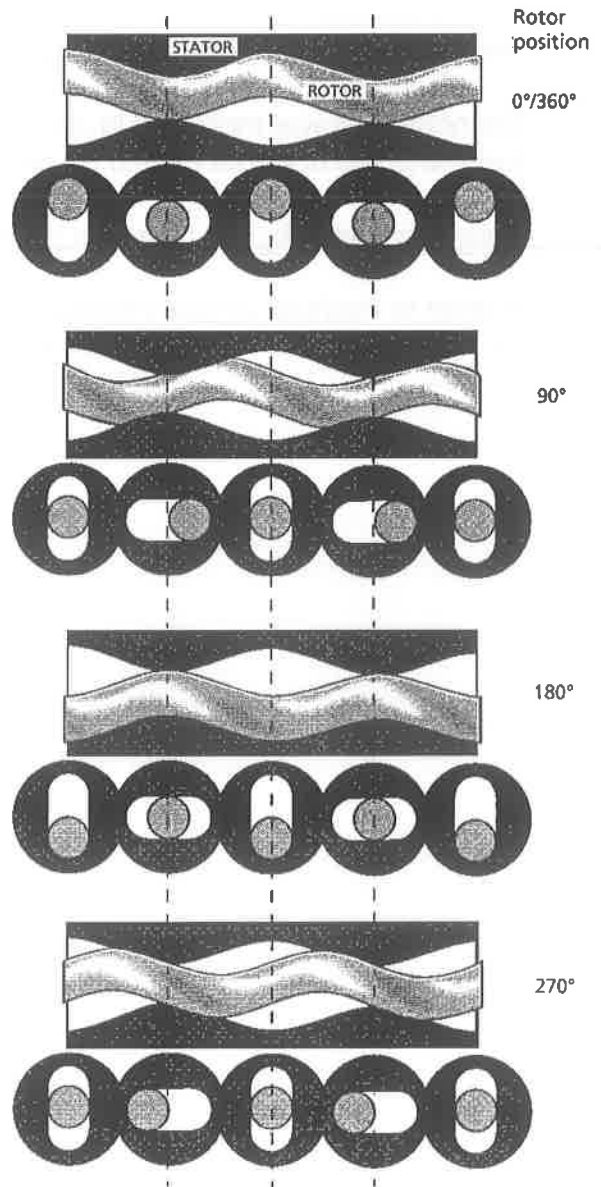
The main components of the pump (which was invented by Professor Rene' Moineau) are: a rotating part, called the rotor; and a stationary part, called the stator.

The rotor has a single helix shape and is normally made of a metallic material. The stator is formed as a double-helix with twice the pitch of the rotor and is normally an elastomer. The interference (compression) fit between the rotor and stator creates a series of sealed chambers called cavities. When the rotor turns inside the stator, the medium moves continuously from the inlet to the outlet of the cavities.

The NEMO® Pump principle utilizes many positive characteristics of other pump types:

- ◆ Like centrifugal pumps, NEMO® Pumps have no suction or pressure valves, but do have a stable flow rate in proportion to the number of revolutions.
- ◆ Like piston pumps, NEMO® Pumps have a suction lift up to 28'. Vacuum capacity is 24-25'.
- ◆ Like membrane and peristaltic pumps, NEMO® Pumps can transport all types of media including inhomogeneous, gaseous and abrasive media; as well as those that are not of a liquid consistency, or contain solids and/or fibrous material.
- ◆ Like gear pumps and screw pumps, NEMO® Pumps are capable of handling high-viscosity media.

- ◆ Like piston, membrane, gear or screw pumps, NEMO® Pumps can be used for metering applications.



*Length and cross-sections of the rotor and stator during a rotation.*

## **2.2 General Data**

### **Noise Emissions:**

The maximum noise emission level permitted at a workplace is 85 dB (A).

The noise level was measured in accordance with OSHA CFR 1910.95 to assure that the pump does not exceed 85 dB (A).

Noises generated by the drive and pipes are not included in the above emission value.

In order to maintain a noise emission level of  $\leq 85$  dB (A), the pump must be securely mounted and not allowed to cavitate.

### 3 Packaging, Transportation, Storage

#### 3.1 Packaging and Transportation

NEMO® Pumps are shipped on skid-mounted wood-framed cardboard enclosures, unless the customer specifies otherwise.

The packages are labeled with any special handling instructions.

Upon receipt, inspect the pump for any transportation damage.

Claims for damages should be reported to the **freight carrier immediately.**

Uncrated horizontal pumps should be lifted using the bolt holes of the frame or the lifting lugs attached to the baseplate.

Vertical pumps should be lifted by using the bolt-down holes, or lifting lugs attached to the mounting plate.



Use caution when lifting top-heavy pumps. The center of gravity may be above the points where the lifting gear is attached. If this is the case, secure additionally to **prevent tipping over!**

Vertical pumps should be stored horizontally **only**, unless they are secured vertically. **This will prevent hazards of tipping!**



Avoid suspending the complete pump unit by the eye bolts of the motor or gear box. These eye bolts should be used for lifting the motor and/or the gear box only.

**As when operating any type of equipment, exercise caution and adhere to all applicable instructions, rules and regulations.**

Due to the variety of possible pump designs and applications, only general instructions can be given here. These should be adequate for experienced assembly or transportation personnel.

When in doubt, contact the supplier for more detailed information.

When moving the pump or unit on wheels, strictly adhere to the following:

- ◆ Lock out the motor drive to protect against unintended start-up.
- ◆ Move the pump unit carefully and slowly, especially where the ground is uneven.  
**Hazards of tipping!**
- ◆ The pump should be stored in a stable position with wheels or rollers locked or otherwise secured.
- ◆ Be careful not to allow flexible piping to bend or become kinked. Obstruction of flow will cause excessive discharge pressure.
- ◆ Where necessary, secure the pump unit with additional support blocks.

### 3.2 Storage

Pumps are packaged for transportation and short-term storage. In cases of prolonged storage, the pumps should be protected as follows until installation:

- ◆ **Stator:**  
When stored for a long period, the elastomer along the contact line between the rotor and stator may become temporarily distorted (compression-set). This will increase the required starting torque. For this reason, the stator should be removed and stored in a cool, dry place in an air-tight package and protected from light.
- ◆ **Shaft Sealing by packing gland:**  
Remove the packing gland and protect the exposed shaft surface with protective grease or oil.
- ◆ **Pump parts in stainless steel:** No protection necessary.
- ◆ **Other non-protected pump parts:** Protect with grease or oil.
- ◆ **Drives:** Observe the instructions of the drive supplier.

### *Store Room*

*The environment in which rubber products are being kept must be cool, dry, free of dust and well ventilated, and must not be stored in the open.*

*Rubber products should be kept in surroundings not having less than minus 10° C and not more than plus 15° C.*

*Store rooms should not be damp, and it must be ensured that there will be no condensation.*

*Recommended relative humidity is < 65%.*

*Rubber products must be protected against light, particularly direct sunlight or artificial light having a high UV portion.*

*Rubber products should be kept in a sealed package.*

*As ozone is very aggressive and harmful there should be no store room used which houses equipment likely to produce ozone, i.e. electric motors or other equipment which might bring about sparks or other electrical discharges.*

*There must be no solvents, oil, grease, lubricants or any chemicals kept in the store room.*

#### ◆ **Rotor**

Support with wooden blocks and protect against damage from mechanical impact. For tool steel rotors (material number 1.2436): coat the surfaces with protective grease to avoid rusting.

#### ◆ **Shaft Sealing by packing gland**

Remove the gland and coat exposed shaft surface with grease or oil.

#### ◆ **Pump parts in stainless steel**

No grease coating necessary.

#### ◆ **Other, non-coated pump parts**

Protect with grease or oil.

#### ◆ **Drives**

Observe instructions of the drive supplier.

### 4 Installation

If the NEMO® Pump was stored and the rotor grease protected:  
Remove the grease before installing the stator.

Clean the rotor thoroughly in order to avoid contamination of the stator  
and the pumping medium.

Verify all hardware has been properly installed and fastened.

#### 4.1 Direction of Rotation

The direction of rotation of the pump is given on the name plate.

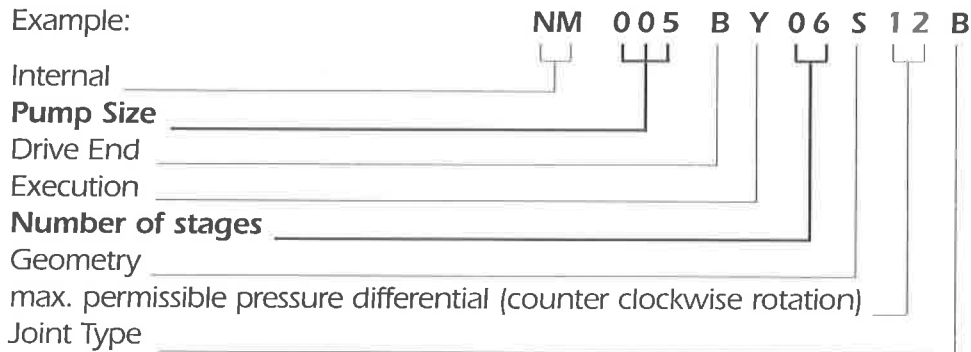
#### 4.2 Pressure

Maximum permissible pressure inside the pump housing (A) is 6 bar.

The maximum permissible pressure inside the end flange (B) is 12 bar.

#### Type key

Example:

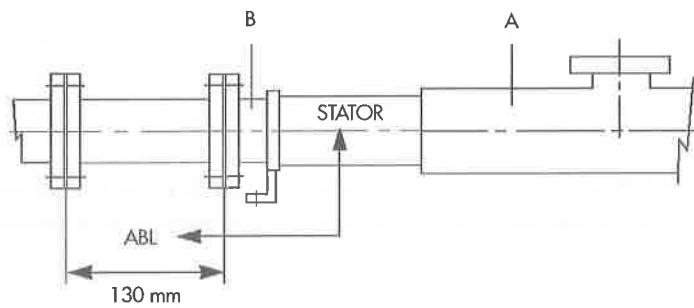


#### 4.3 Shaft Sealing

- ◆ Where applicable, ensure that adequate supply lines for the buffer, flushing or quenching fluid for the shaft seals are connected **before** the pump is put into **operation**. For more details see Section 7.4!

#### 4.4 Piping System

- ◆ Arrange suction and discharge pipes so that when the pump is not running, the medium is still present. Sufficient media should remain inside in order to lubricate the pump during restart.
- ◆ Clean the pipe work and rinse thoroughly before installing the pump.
- ◆ The installation of a removable distance piece with a length of 130 mm between the end flange (B) and the pipe work is recommended for stator removal.



### 5 Start-up

NEMO® Progressing Cavity Pumps must be operated with the following precautions:



**Never run the pump dry!**

Even a few rotations in dry condition will damage the stator.



**If the rotor was protected with grease for long-term storage:**

Thoroughly clean the rotor to prevent damage caused by interaction of the grease, stator material and medium.

- ◆ Before initial start-up, regardless of rotation, make sure the pump housing and suction piping are filled with medium. If medium is high in viscosity, it may be necessary to prime the pump with a compatible liquid. Priming of the pump is necessary to lubricate the stator.



**NEMO® Pumps are positive displacement progressing cavity pumps and have the potential to generate very high pressure capable of bursting vessels or pipes.**



**Excessive pressure can overload the drive train (shaft, connecting rod, joints, rotor) or exceed pressure limitations of the housings and their connections, resulting in damage or breakage. Refer to Section 4.4 of this manual for housing pressure limitations.**

**Never run the pump with an inlet or outlet valve closed.**

- ◆ Open valves and vents before starting the pump!
- ◆ Turn pump motor on and off briefly to check direction of rotation.



## 6 Temporary Shutdown



- ◆ Following the temporary shutdown, the pump should be emptied and rinsed when:
  - the pump is installed in a location inside or outside where the medium has the potential to freeze.
  - the medium has a tendency to solidify or harden.
  - the medium tends to build up or become tacky on the shaft sealing area.

- ◆ **Stator:**

When stored for an extended period, the elastomer along the contact line between the rotor and stator may become temporarily distorted (compression-set).

This will increase the required starting torque. For this reason, the stator should be removed and stored in a cool, dry place in an air-tight package and protected from light.

- ◆ **Rotor:**

Support with wooden blocks and cover to protect from mechanical damage, after the stator has been removed.

Rotors made with Tool Steel (Material number 1.2436)  
Should be protected against corrosion with protective grease.



**Prior to installation, thoroughly clean rotor to prevent damage caused by interaction of the grease, stator material and medium.**

- ◆ **Stand-by Pump:**

A stand-by pump is sometimes installed to eliminate downtime. Stand-by pumps should be operated occasionally to keep properly conditioned for use.

## **7 Maintenance**

### **7.1 Pumps in General**

- ◆ The pumps should be regularly rinsed or cleaned if deposits of medium are likely to build up.



If the pump needs to be disassembled, ensure that the pump and motor are switched off and cannot be turned on accidentally (eg. by removing the fuse).



### **7.2 Lubrication**

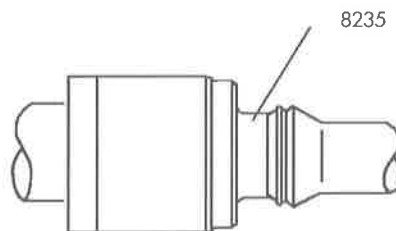
The NEMO® Pump does not require frequent lubrication.

- ◆ Maintenance and lubrication of the drive should be carried out according to the drive manufacturers instructions.

**7.3 Lubricating the Pin Joints with SM-Pin Joint Seals**

- ◆ It is advisable to change the oil and check the seals of the pin joints:
  - when replacing worn joint parts
  - when disassembling the pump for any reason

Joint basic size series NM	Quantity of oil per joint in cm <sup>3</sup>
NM 003-011	1
NM 015	1.5
NM 021	2
NM 031	5
NM 038	15
NM 045	22
NM 053	36
NM 063	78
NM 076	165
NM 090	205
NM 105	450



**Lubricating Oil:**

Industrial Application	Designation DIN 51502	Permitted Product	
General Industry	<table border="1"><tr><td>CLP 460</td></tr></table>	CLP 460	"SHELL" Omala 460
	CLP 460		
with SM-pin joint seal (8235) of EPDM <table border="1" style="margin-left: auto; margin-right: auto;"><tr><td>CLP PG</td></tr><tr><td>320</td></tr></table>	CLP PG	320	prescribed: KLUBERSYNTH GH 6-320
CLP PG			
320			

#### 7.4 Shaft Sealing through Single Mechanical Seal

- ◆ The seal specification of a NEMO® Pump is noted on the order acknowledgement.
- ◆ Pumps fitted with direction dependent seals should **never** be run in the opposite direction of the rotation arrow.
- ◆ If excessive leaks occur the spring tension and the seal surfaces should be checked, replace the seal, if necessary.

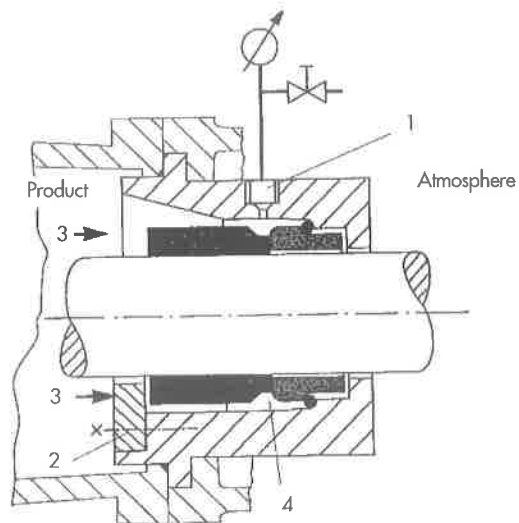
Single mechanical seals usually work without any additional equipment. Their application range can be increased by operating them with a flushing or cooling system.

##### Flushing

Medium containing high solids should be flushed as follows:

A clear rinse (1) is fed in near the area of the sliding surface. An additional throttle seal (2) can be built in. This keeps the contaminated medium (3) away from the seals (4) if:

- sufficient flush (1) is added
- the pressure of the flush (1) is greater than the pressure of the medium (3).



## **8 Trouble-Shooting**

### **8.1 Trouble-Shooting Guide**

The following chart lists possible problems and corresponding solutions:

### **8.2 Determining the Kind of Problem and the Possible Cause**

- The column describing a possible problem shows one or more boxes marked with a cross.
- On the corresponding lines, you will find the possible reasons/causes and some hints how to handle the problem. Thus, the actual cause of the problem can be narrowed down and eventually detected.
- ◆ The table helps to identify the problem and offers a possible solution. For more complicated problems, consult the manufacturer.

Possible Problem										TROUBLE-SHOOTING GUIDE		
Pump will not start	No suction capability	Discharge output low	Discharge pressure low	Discharge output fluctuates	Pump is noisy	Pump jammed	Drive overloaded	Stator service life too short	Rotor service life too short	Shaft seal leaks	A good service life can be expected if the pump is used in accordance with your specified application and maintained in accordance with this manual. If operating problems arise, use this chart as a guide in locating the problem.	
											POSSIBLE CAUSE	See Next Page for Corrective Action.
X							X				Pump or stator is new, too much static friction.	1
X		X	X				X				Power supply incorrect; drive not properly wired.	2
		X					X	X	X		Discharge pressure too high.	3
X						X	X				Foreign matter or debris in pump.	4
X						X	X	X	X		Temperature of pumped liquid too high; stator swells.	5
X						X	X	X			Stator swells due to chemical attack, unsuitable elastomer.	6
X						X	X	X			Liquid contains too many solids, causing blockages.	7
X						X	X	X	X	X	Liquid settles and hardens at pump shut-down.	8
		X	X	X							Air in suction piping.	9
	X	X	X	X							Suction pipe leaks.	10
	X	X	X	X							Shaft sealing leaks.	11
		X	X								Pump speed too low.	12
	X	X	X								Undersized rotor; operating temperature not reached.	13
		X	X	X	X			X	X		Discharge too high or suction head too low (cavitation).	14
		X	X		X	X	X	X	X		Pump running dry.	15
	X	X	X		X						Stator worn out.	16
	X	X	X		X			X	X		Stator material brittle.	17
	X	X	X		X			X			Rotor worn out.	18
					X						Joints worn.	19
					X						Pump and drive out of alignment.	20
					X						Elastomer in coupling worn out.	21
					X					X	Pump bearings worn.	22
						X					Pump speed too high.	23
						X					Viscosity too high.	24
						X					Specific gravity too high.	25
						X				X	Stuffing box not properly tightened.	26
										X	Incorrect packing.	27
										X	Wrong direction of rotation.	28
	X									X	Stationary or rotating face of mechanical seal worn.	29
										X	O-Rings in mechanical seal worn or damaged.	30



## 8 TROUBLE-SHOOTING

### CORRECTIVE ACTION

1	Fill pump and turn by hand. If necessary, use glycerine to lubricate stator.
2	Check motor nameplate data. Test voltage, phase and frequency.
3	Measure actual discharge pressure and compare to your specification.
4	Remove debris and correct any damage.
5	If liquid temperature cannot be reduced, use an undersized rotor.
6	Check specified application, If necessary, change stator material.
7	Increase liquid-to-solids ratio.
8	Clean pump and rinse out after each use.
9	Increase NPSHA; eliminate leaks (see No. 10).
10	Check seals; tighten piping connections.
11	Packing: tighten stuffing box or replace packing. Mech. seal: replace rings or seals; remove deposits.
12	If drive is variable speed, increase speed at pump.
13	Heat pump (stator) to operating temperature.
14	Reduce suction losses; lower liquid temperature; install pump at lower elevation.
15	Fill pump; provide dry run protection; relocate suction piping.
16	Replace stator.
17	Replace stator, check specified application; change stator material of construction if necessary.
18	Replace rotor; determine cause; change rotor material of construction if necessary.
19	Replace necessary parts; seal and refit carefully.
20	Re-align pump and drive.
21	Replace coupling elastomer; re-align.
22	Replace bearings, lubricate and seal. For high temperature, check bearing tolerances and lubrication.
23	If drive is variable, set at lower speed.
24	Measure viscosity and compare to specified viscosity.
25	Measure specific gravity and compare to specified specific gravity.
26	Service stuffing box; replace worn shafts.
27	Change packing material.
28	Reverse polarity of drive motor.
29	Rework or replace seal faces.
30	Replace o-rings; check specified application. Change o-ring material of construction if necessary.





## 9 Removal and Assembly of End Flange, Stator and Pump Housing

The pump with attached pipework should be empty and must have cooled off!

- ◆ Disconnect the pipework on the suction side and pressure side of the pump.
- ◆ Remove the hex nuts (2030) with spring washers (2025).
- ◆ Take off the retaining plate (2555).
- ◆ Remove the end flange (2005) from the stator (3005).
- ◆ Remove the stator (3005).
- ◆ Remove the pump housing (2010) from drive stool (0085) or bearing housing (0005).

Reassemble in reverse order.

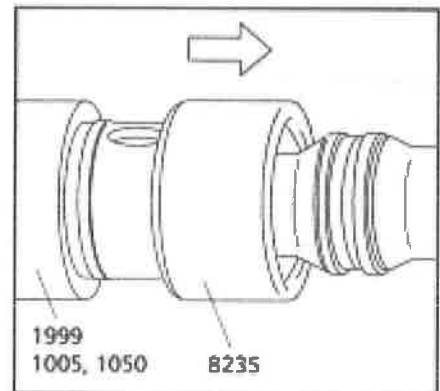
- ◆ Installing the stator (3005) will be easier when using glycerine as a lubricant.
- ◆ Ensure during refitting that gasket (8110) is in perfect condition and will seat properly.

## 10 Disassembly and Assembly of the Rotating Parts with Pin Joints with SM-Pin Joint Seal

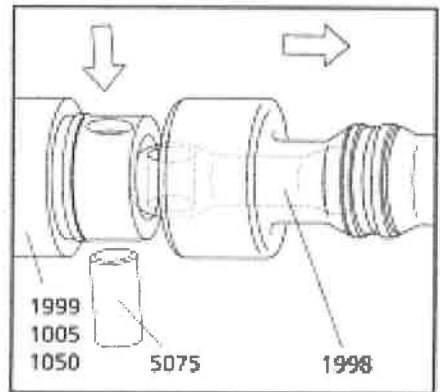
For removal and assembly of the rotor (1999) and coupling rod (1998)  
the pin joints should be disassembled and assembled as follows:

### Disassembly:

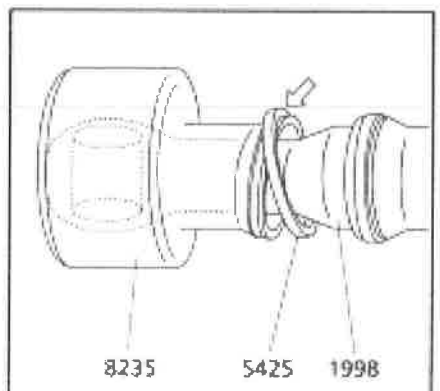
- ◆ Push the SM-pin joint seal (8235) away from the rotor (1999), drive shaft (1005) or connecting shaft (1050) exposing the pin (5075).



- ◆ Press the pin (5075) out of the rotor (1999), connecting shaft (1050) or drive shaft (1005). Remove the coupling rod (1998) from the rotor (1999), connecting shaft (1050) or drive shaft (1005).



- ◆ Push the SM-pin joint seal (8235) towards the head of coupling rod (1998). In the narrow coupling rod section press the clamp ring (5425) out of the groove of the seal. Then slip the SM-pin joint seal (8235) and clamp ring (5425) off over the head of the coupling rod (1998).

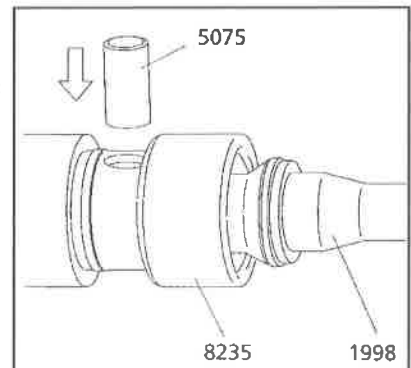
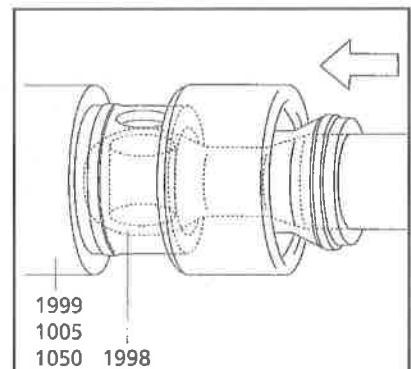
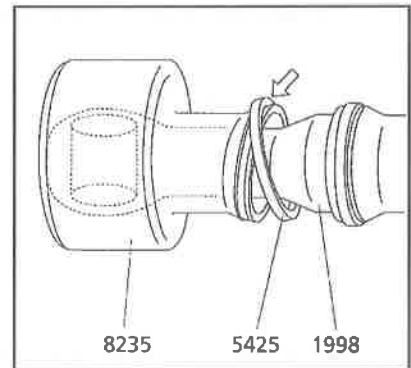
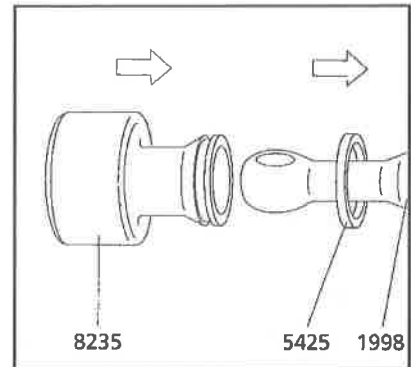


Continued on Page 10.0R

**Assembly:**

- ◆ Slip the clamp ring (5425) and the SM-pin joint seal (8235) on over the head of the coupling rod (1998).
- ◆ Push the SM-pin joint seal (8235) towards the narrow section on the head of coupling rod (1998) and place the clamp ring (5425) back into the groove of the SM-pin joint seal (8235). Then move the SM-pin joint seal (8235) up to the coupling rod (1998) shoulder.
- ◆ Place the head of coupling rod (1998) into of the rotor (1999), drive shaft (1005) or connecting shaft (1050).
- ◆ Join the rotor (1999), drive shaft (1005) or connecting shaft (1050) and coupling rod (1998) by the pin (5075). Then push the SM-pin joint seal (8235) up to the shoulder of the rotor (1999), drive shaft (1005) or connecting shaft (1050).

Assemble the second pin joint in the same manner.



## **11 Removal and Installation of the Connecting Shaft with Shaft Seal**

### **Removal:**

- ◆ Remove pin (1055).
- ◆ If the shaft seal housing (W) is connected tightly to the drive stool (0085), then pull off the connecting shaft (1050) from the drive shaft.  
If the shaft seal housing (W) is a separate part, then remove it from the drive stool (0085) together with the connecting shaft (1050).
- ◆ If a mechanical seal is installed, see description  
"Removal and Installation of Mechanical Seal" after Page 12.0.

### **Installation:**

- ◆ Apply grease into the bore of the connecting shaft (1050) to avoid rust.
- ◆ If the shaft seal housing (W) is connected tightly to the drive stool (0085), then insert connecting shaft (1050) into the shaft seal housing (W) and push connecting shaft (1050) on to the drive shaft.  
If the shaft seal housing (W) is a separate part, then place it into the drive stool (0085) together with the connecting shaft (1050) and push connecting shaft (1050) on to the drive shaft.
- ◆ If a mechanical seal is installed, see description  
"Removal and Installation of Mechanical Seal" after Page 12.0.
- ◆ Apply some grease or oil, into the pin (1055) and insert.

## 12 Removal and Installation of the Mechanical Seal



Cleanliness must be observed for removal and installation.  
Please avoid any damage to the sealing surfaces and gaskets.  
The sealing unit is dismantled **on** the shaft.

- ◆ Remove all visible connecting screws and pull apart the seal housing on the shaft. The seal housing can be made up of several parts, depending on the seal construction.  
Compare the attached Sectional Drawing W...!
- ◆ **Carefully** remove the housing parts from the shaft together with the seal counter face parts, one after the other.
- ◆ **Carefully** push the seal counter face parts out of the housing parts.
- ◆ Special care must be taken when fitting double PTFE-coated gaskets: the joint of the outer coating must point away from the seal assembly direction, otherwise the coating may open or be pulled off!

Re-install in reverse order.

- ◆ To reduce frictional forces during seal assembly, apply some glycerine to the shaft and the seal housing in the area of the gaskets.



Ensure that the distribution of pressure is uniform when inserting the pressure sensitive counter rings. When inserting larger rings, use a suitable mandrel.

Do not allow any foreign matter between the seal faces.

- ◆ Important: Ensure that the sealing faces are correctly installed (see Manufacturer's catalog).

## 14 Recommended Spare Parts (Pump with pin joints with SM-seal)

In general, we have all spare parts subject to wear in stock. Our subsidiaries and exclusive representatives also hold a certain stock. We recommend to keep an amount of spare parts, corresponding to the pump, in stock on site as follows:

Pieces		Position Number	Designation
Large Set	Small Set		
1	1	3005	stator
1	–	1998	coupling rod
2	–	5075	pin
2	–	8235	SM-seal
1	–	1999	rotor
2	–	5425	clamp ring

To ensure that you receive the part quickly, please provide the following information with your order. Also, please specify the model number of your pump.

- Either:
1. a. Part number per the parts drawing
  - b. Job number (see pump nameplate)
- or:
2. a. Part number per the parts drawing
  - b. Pump machine number. The machine number is stamped on both the pump nameplate and the bearing housing (0005) or drive stool (0085).
- or:
3. Identification number of part (Note: The I.D. Number is a six digit number which describes the part, pump size, and materials of construction).

---

Netzsch Incorporated  
119 Pickering Way ▪ Exton, PA 19341  
610.363.8010 ▪ Fax: 610.363.0971  
e-mail: [nemopump@netzschusa.com](mailto:nemopump@netzschusa.com)

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Quality Pays  
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**NETZSCH**  

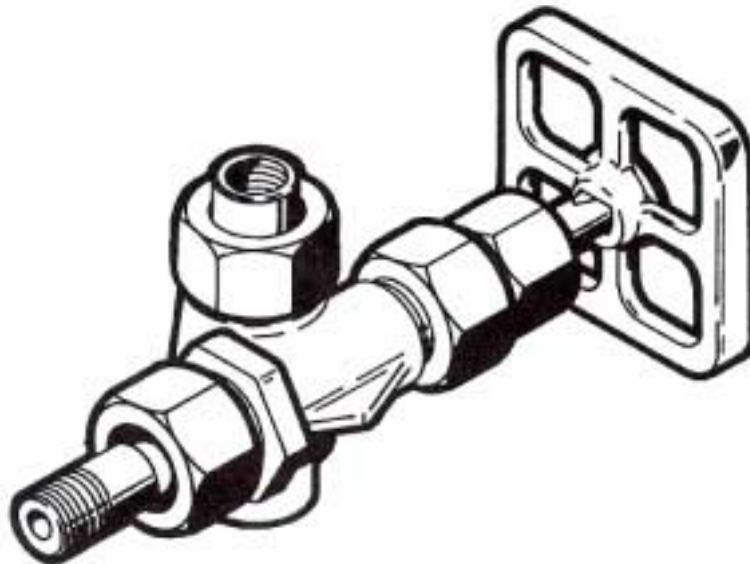





PENBERTHY®

# Armored Gagecocks

Series 100, 200, 300 and 400



Installation, Operation and Maintenance Instructions

# TABLE OF CONTENTS

Product Warranty . . . . .	iii
1.0 About the Manual . . . . .	1
2.0 Introduction . . . . .	1
2.1 System Description . . . . .	2
3.0 Available Models . . . . .	2,3
3.1 Design Ratings at Max. and Min. Operating Temperatures . . . . .	3
3.2 Steam Application . . . . .	3
4.0 Inspection . . . . .	4
4.1 User Rating Inspection . . . . .	4
5.0 Installation . . . . .	4
5.1 Piping Strain . . . . .	4
5.2 Differential Thermal Expansion . . . . .	4
5.3 Mounting . . . . .	5
6.0 Operation . . . . .	5
6.1 Hydrostatic Test . . . . .	5
7.0 Maintenance . . . . .	6
7.1 Preventative Maintenance . . . . .	6
7.2 Ball Check Shut-Off . . . . .	6,7
7.3 Troubleshooting . . . . .	7
8.0 Removal - Disassembly and Reassembly . . . . .	8
8.1 Disassembly . . . . .	8
8.2 Reassembly . . . . .	8
9.0 Disposal at End of Useful Life . . . . .	8
10.0 Telephone Assistance . . . . .	9
11.0 Exploded Parts Drawing . . . . .	10

<u>TABLES AND FIGURES</u>		<u>page</u>
Table 1	Armored Gagecock Standard Features . . . . .	2
Table 2	Armored Gagecock Standard Features . . . . .	3
Table 3	Design Ratings for Threaded or Welded Connections. . . . .	3
Figure 1	Teflon® Tape Wrapping . . . . .	5
Figure 2	Exploded Parts Drawing . . . . .	10
Figure 3	Optional Gasket Union Connection . . . . .	10

## **PENBERTHY PRODUCT WARRANTY**

Tyco Valves & Controls Prophetstown warrants its Penberthy products as designed and manufactured by TV&C Prophetstown to be free of defects in the material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. TV&C Prophetstown will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to TV&C Prophetstown and obtain written authorization to return the product. Thereafter, the product shall be returned to TV&C in Prophetstown, Illinois, with freight paid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or otherwise altered outside of TV&C Prophetstown factory, or if it has been subject to misuse, neglect or accident.

The responsibility of TV&C Prophetstown hereunder is limited to repairing or replacing the product at its expense. TV&C Prophetstown shall not be liable for loss, damage or expenses related directly or indirectly to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that TV&C Prophetstown is not responsible for damage or injury caused to other products, buildings, personnel or property, by reason of the installation or use of its products.

**THIS IS TV&C PROPHETSTOWN'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of TV&C Prophetstown unless made in writing and signed by the General Manager or Director of Engineering of TV&C Prophetstown.

# INSTALLATION, OPERATION and MAINTENANCE MANUAL FOR PENBERTHY SERIES 100, 200, 300 and 400 GAGECOCKS

## 1.0 About the Manual

This manual has been prepared as an aid and guide for personnel involved installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance.

## SAFETY INSTRUCTIONS

**Penberthy does not have any control over the manner in which its gagecocks are handled, installed or used. Penberthy cannot and will not guarantee that a gagecock is suitable or compatible for the user's specific application.**



## WARNING

**Vessel fluids may be pressurized and can unexpectedly exit vessel connections due to apparatus or material failure. Safety glasses should be worn when installing a gagecock. Failure to follow *any* instruction could possibly result in a malfunction of the gagecock with resulting sudden release of pressure, severe physical injury or property damage.**

## 2.0 Introduction

Penberthy armored gagecocks are used to isolate gage glass, magnetic gages or other apparatus from the holding or pressure vessel when it becomes necessary to drain and service the gage. Penberthy Series 100, 200, 300 and 400 gagecocks are supplied in pairs, (upper and lower), and are available with socketweld, flanged and NPT connections.

These gagecocks are equipped, as a standard feature, with a floating shank union vessel connection, which permits up to 3/8" (10 mm) variation in center to center distance and with ball check shut-offs to prevent leakage of contained fluid in case of accidental gage glass breakage.

Series 100, 200, 300 and 400 gagecocks for process use should include ball check shut-off feature. Gagecocks without the ball check shut-off feature will not automatically stop leakage of contained fluid in the event of accidental gage glass breakage.

## 2.1 System Description

Penberthy armored gagecocks are comprised of six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gagecock. Use the exploded parts view in Section 11.0 as additional reference material.

Body- a pressure retaining structure through which liquid passes to enter a gage glass or other apparatus. Provides a rigid, union, or spherical union connection to the vessel and seating surfaces for most gagecock components. Series 100 and 200 are straight pattern bodies; Series 300 and 400 are offset pattern bodies.

Ball Checks- sphere installed loosely within the body of the gagecock that seats to prevent significant leakage when a differential pressure surge occurs (e.g., mechanical failure). Ball checks for ASME steam service incorporate a vertically rising lower and leaky horizontal upper or omit ball checks completely. "Reverse acting" ball checks are available for vacuum service.

Trim- wetted parts that mechanically control the liquid path from the vessel to the gage glass or other apparatus. The ball and stem act to seal and release the liquid. In the event of mechanical failure, the ball will seat to prevent large quantities of the contained fluid from exiting the vessel. Liquid is allowed to exit the vessel into the gage glass or other apparatus when the stem is screwed away from its seated position. The liquid is sealed when the stem is screwed into its seated position.

The stem packing retainer provides a compression surface between the process liquid and the stem packing. A stem packing gland is used to compress the packing against the retainer and around the stem to prevent leakage.

Stem Packing- under compression the stem packing is forced to mold around the stem and prevent leakage of media during operation.

Gage Connection- provides connection between the gagecock and the gage glass or other apparatus. A union, spherical union or rigid connection may be used. A union connection can move in a plane parallel to the vessel connection.

Handwheel/Lever- rotated to engage threads and provide screw action of stem.

## 3.0 Available Models

Armored gagecock standard features are listed in chart below.

Features	Model Number							
	120	130	220	230	320	330	420	430
Straight Pattern	x	x	x	x				
Offset Pattern					x	x	x	x
Integral Bonnet	x	x			x	x		
Union Bonnet			x	x			x	x
Union Gage Connection	x		x		x		x	
Rigid Gage Connection		x		x		x		x
Union Vessel Connection	x	x	x	x	x	x	x	x
Screwed in Seat			x	x			x	x

**Table 1**

Additional gagecock models are available with gasketed union connections. The gaskets are a spiral wound style, stainless steel/graphite, which are inserted into the body at the union connection to provide a gasketed seal between the body and tailpipe as opposed to the standard metal-to-metal joint. These gaskets provide a seal even with small angular misalignments and with less closure force than the standard metal-to-metal seals.

Features	Model Number															
	121	122	123	131	221	222	223	231	321	322	323	331	421	422	423	431
Straight Pattern	x	x	x	x	x	x	x	x								
Offset Pattern									x	x	x	x	x	x	x	x
Integral Bonnet	x	x	x	x					x	x	x	x				
Union Bonnet					x	x	x	x					x	x	x	x
Metal Union Gage Connection	x				x				x				x			
Rigid Gage Connection				x				x				x				x
Metal Union Vessel Connection		x				x				x				x		
Screwed in Seat					x	x	x	x					x	x	x	x
Gasket Union Gage Connection		x	x			x	x			x	x			x	x	
Gasket Union Vessel Connection	x		x	x	x		x	x	x		x	x	x		x	x

Table 2

### 3.1 Design Ratings at Maximum and Minimum Operating Temperatures

To determine the maximum allowable working pressure for a specific temperature within the design limits stated below, the user must refer to Penberthy Application Reports, or when provided, the specifically stated design limits on a Penberthy product proposal.

#### DESIGN RATINGS FOR THREADED OR WELDED CONNECTIONS

Gagecock Series	Material of Construction	Maximum Allowable Working Pressure	
		Teflon® packing	Grafoil® packing
100 200 300 400	Carbon Steel	4000 psig [27580 kPa] at -20°F [-29°C] to +100°F [38°C] 3525 psig [24300 kPa] at 500°F [260°C]	4000 psig [27580 kPa] at -20°F [-29°C] to +100° [38°C] 2620 psig [18060 kPa] at 750°F [399°C]
	316 STS Construction	4000 psig [27580 kPa] at -300°F [-184°C] to +100°F [38°C] 3525 psig [24300 kPa] at 500°F [260°C]	4000 psig [27580 kPa] at -300°F [-184°C] to +100°F [38°C] 2755 psig [18990 kPa] at 750°F [399°C]
For other materials or connections consult factory			

Table 3



**NEVER exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of gagecock components resulting in serious personal injury or property damage.**

### 3.2 Steam Application

Penberthy series 100, 200, 300 and 400 gagecocks are designed for process conditions. In low pressure steam/water applications ( $\leq 350$  psig [2410 kPa] at 434°F [223°C]), Penberthy allows the use of 300 and 400 series gagecocks because the potential mechanical stress imposed on the gagecock assembly by the thermodynamic steam environment is relatively small. Request Penberthy Application Reports for more detailed information.

## 4.0 Inspection

Upon receipt of a gagecock set, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt any installation. Notify carrier immediately and request damage inspection. Refer to exploded view drawing in Section 11.0 to inventory parts.

### 4.1 User Rating Inspection

The user should confirm that:

1. The gagecock set model number and pressure/temperature rating stamped on nameplate conforms to the description on the user's purchase order
2. The operating conditions described in the purchase order agree with the actual operating conditions at the installation site
3. The actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to previously
4. The materials of construction of the gagecock set are compatible with both the contained fluid and the surrounding atmosphere in the specific application.

# SAFETY INSTRUCTIONS

**If the size, model or performance data of the gagecock set as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for assistance. The incorrect gagecock can result in unacceptable performance and potential damage to the gage.**

## 5.0 Installation

Installation should only be undertaken by qualified personnel who are familiar with this equipment. They should have read and understood all of the instructions in this manual. The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for specific size and model gagecock.

Penberthy recommendations on gagecock installations are not necessarily related to the installation of flat glass liquid level gages. The number of different types of gage and gagecock installations is too great to adequately explain in an installation manual. Therefore, it is the user's responsibility to assure that knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the guidelines that should be employed.

### 5.1 Piping Strain

The gagecock should be mounted and connected so that it can support the gage without binding. Torsional stresses can make it difficult or impossible to seal tailpipes. Although union connections will allow marginal errors in piping alignment, misalignment can still create unusual strain on connectors. Gages not properly supported by brackets may subject the gagecock to stresses that can cause leaks or mechanical failure. Typical gage load should NOT exceed 50 lbs (22.7kg) per gagecock.

### 5.2 Differential Thermal Expansion

High mechanical loading may be imposed on a gagecock by expanding and contracting gages due to hot or cold service. Such mechanical loads on the gagecock must be minimized by controlling process conditions in the system or by using expansion loops.

### 5.3 Mounting

1. Prior to installation, turn the handwheel of each gagecock clockwise until the stem closes against the seat.
2. Remove union vessel connections from gagecocks, where applicable, and apply heavy grease (where allowable) to tailpipe seat. (The grease minimizes galling of the seat surfaces when tightening the coupling nuts.)
3. Wrench tighten tailpipes of upper and lower gagecocks to the vessel using Teflon® tape, or equivalent, on all male tapered pipe thread connections as shown in Figure 1. If the gagecock is flanged or weld mount, use proper industry standard procedures.
4. If installing with a flat glass gage, follow all installation instructions for the specific liquid level gage as there are many points to consider on gage installation; among them, piping strain, differential thermal expansion, weight and bolt torque.
5. Install gage tailpipes to union gage connections, where applicable, making sure that the coupling nuts are in place.

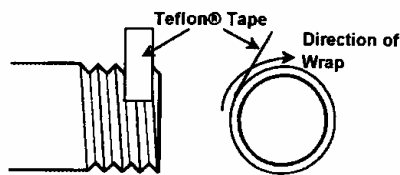


Figure 1

### 6.0 Operation

Before initializing gagecock operation, check that all installation procedures have been completed. Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight.



**Gagecock installations should be brought into service slowly. Gagecocks should be opened slightly, and the gagecock assembly temperature and pressure allowed to slowly equalize. If the gagecocks are equipped with ball checks, the gagecocks must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball check in the event of gage glass failure. Failure to follow the recommended operating procedures can result in severe personal injury or property damage.**

#### 6.1 Hydrostatic Test

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatic pressure test all installations to 100 psig (690 kPa) and correct any leakage before proceeding.



## 7.0 Maintenance



**Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the gagecock assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.**

The user must create maintenance schedules, safety manuals and inspection details for each gagecock. These will be based upon the users own operating experience with their specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situations involved.

During system shutdown, the gagecocks should be left open to permit the gage to lose pressure and cool with the rest of the system. Failure to leave the gagecock open during system shutdown may trap high-pressure fluid in the gage.

### 7.1 Preventative Maintenance

On all installations the following items should be regularly evaluated by the user for purposes of maintenance:

1. Leakage around stem area
2. Internal stem leak
3. Leakage around union connections
4. Internal or external corrosion

The user must determine, upon evaluation of his or her own operating experience, an appropriate maintenance schedule necessary for his or her own specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

### 7.2 Ball Check Shut-Off



**Ball checks, when installed, may fail to seat due to corrosion of the ball or seat, foreign material in ball chamber or viscous material in the ball chamber. A routine operational test of the ball check can prevent significant seepage of liquid in the event of glass breakage.**

An operational check can be performed on the gagecock ball check by closing both the upper and lower gagecock stems completely. Drain contents from and relieve pressure on liquid gage to an appropriate safe container/area. **NOTE:** Some loss of process fluid to the drain line is expected with this test procedure.



## WARNING

**Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the gagecock assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.**

With drain line in place, open **BOTTOM** gagecock as rapidly as possible. Listen for "click" sound, which will indicate that the ball has seated. If possible, observe the quantity of flow from the drain line. Flow should either stop completely or be no greater than single drips (no solid stream). Close lower gagecock. Repeat above procedure for **UPPER** gagecock. There must be a pressure differential of at least 5 psig (35 kPa) for the above procedure to work properly.

If the above procedure is not successful, the only alternative is to isolate the gage and gagecock assembly from the vessel or to shut the process down completely. Disassemble the gagecock as outlined in section 8.1 using the exploded parts drawing in Section 11.0 as a reference. Visibly inspect ball check and ball seats in the gagecock body. Remove any foreign matter and/or replace with new ball checks if inspection indicates this is required. If the ball seat is damaged, consider replacing the gagecock or the seat (if it is removable). Reassemble gagecocks as outlined in Section 8.2.

### 7.3 Troubleshooting

**STEM PACKING LEAKAGE** can often be stopped by tightening the stem packing nut. If leak persists, the stem packing should be replaced by following steps 1) through 5) of the Disassembly and 1) through 7) of the Reassembly instructions

**INTERNAL SEAT LEAKAGE** is an indication of a worn or damaged stem or seat. To replace the stem follow steps 1) through 5) of the Disassembly and 1) through 7) of the Reassembly instructions. To renew the seat surface, follow steps 1) and 2) of the Disassembly instructions. Renew the seats by using a fine lapping compound and a mandrel the same size, shape and seat angle as the stem. Flush the gagecock body clean and reassemble by following steps 4) and 5) of the Reassembly instructions.

Renewable Threaded Seats (Series 200 and 400). Remove the seat by inserting a 1/4" (6 mm) square driver in the seat and turning it counterclockwise. Install the new seat by turning it clockwise using the square driver, making sure that the ball check, if used, is replaced in the body. Tighten the seat in place.

**LEAKAGE AROUND UNION** connections can often be stopped by tightening union coupling nut or remake connection using Teflon<sup>®</sup> tape, or equivalent on all male pipe threads as shown in Figure 1.

**INTERNAL OR EXTERNAL CORROSION** could be an indication of a misapplication. An investigation should immediately be carried out to determine the cause of the problem. It is the user's responsibility to choose a material of construction compatible with both the contained fluid and the surrounding atmosphere.

## 8.0 Removal - Disassembly - Reassembly



**Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the gagecock assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.**

### 8.1 Disassembly

Refer to the exploded parts drawing in Section 11.0 for additional reference during disassembly and reassembly of the gagecocks.

- 1) Remove handwheel nut (30), nameplate (163) and handwheel (28) or lever (261) from stem.
- 2) Loosen and remove stem packing nut (26)
- 3) Remove stem by turning counterclockwise, along with stem packing gland (19), stem packing (25) and stem packing retainer (18).
- 4) Slip the stem packing gland (19), stem packing (25) and stem packing retainer (18) off stem (17).
- 5) On Series 200 and 400 gagecocks, remove bonnet nut (21) and bonnet (20).
- 6) To replace seat on Series 200 and 400 gagecocks, follow instructions as described in maintenance procedures, section 7.3.

### 8.2 Reassembly

Refer to the exploded parts drawing in Section 11.0 for additional reference during disassembly and reassembly of the gagecocks.

- 1) Prepare for installation of new packing by cleaning all packing chambers and glands of upper and lower gagecocks.
- 2) On Series 200 and 400 gagecocks, replace bonnet (20) and bonnet nut (21) and tighten securely in place.
- 3) Slip packing retainer (18) on stem (17)
- 4) Install new stem packing (25) and stem packing gland (19)
- 5) Thread stem assembly into gagecock by turning clockwise until stem seats and then back off one turn (1/8 turn with quick close stem)
- 6) Assemble stem packing nut (26) and tighten in place
- 7) Assemble handwheel (28) or lever (261), nameplate (163) and handwheel nut (30) on stem and tighten securely in place.
- 8) Close both gagecocks by turning handwheel or lever clockwise until stem seats.

Refer to Section 6.0 for operation of the gagecock when returned to service.

## 9.0 Disposal at End of Useful Life

Penberthy Series 100, 200, 300 and 400 gagecocks are used in a variety of fluid applications. By following the appropriate federal and industry regulations, the user must determine the extent of preparation and treatment the Series 100, 200, 300 and 400 gagecocks must incur before their disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metal, glass and polymers should be recycled whenever possible. Refer to order and TV&C - Prophetstown Material Specification sheets for materials of construction.

## 10.0 Telephone Assistance

If you are having difficulty with your Penberthy Series 100, 200, 300 and 400 gagecocks, contact your local Penberthy distributor. You may also contact the factory direct at (815) 537-2311 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information available as possible when you call:

Model #

Name of the company from whom you purchased the Penberthy Series 100, 200, 300 and 400 gagecocks

Invoice # and date

Process conditions (pressure, flow rates, tank shape, etc)

A brief description of the problem

Trouble shooting procedures that failed

If attempts to solve your problem fail, you may request to return your Penberthy Series 100, 200, 300 and 400 gagecocks to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from TV&C Prophetstown before returning anything. Failure to do so will result in the unit being returned to you without being tested, freight collect. To obtain an R.A. number, the following information (in addition to that above) is needed:

Reason for return

Person to contact at your company

"Ship To" address

There is a minimum charge for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit under warranty, but is not defective, the minimum charge will apply.

## 11.0 Exploded Parts Drawing

### SPARE PARTS

Ref. No.	Item	Min. Qty.
18	Retainer, Stem Packing	1
19	Gland, Stem Packing	1
25	Packing, Stem	1
30	Nut, Handwheel	1

RECOMMENDED MAXIMUM QUANTITIES SHOULD PROVIDE SPARE PARTS FOR 10% OF THE GAGCOCKS IN SERVICE

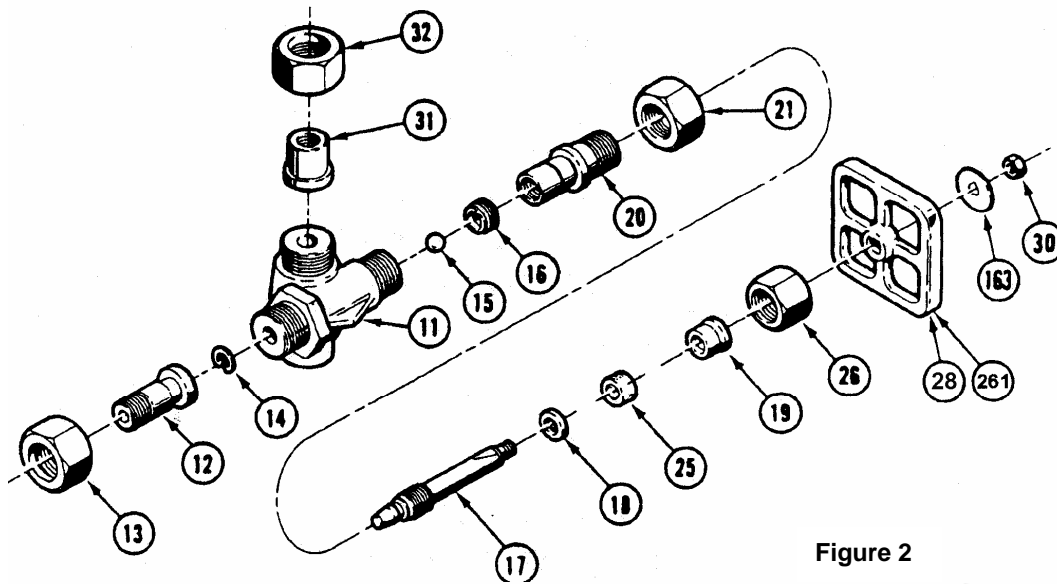


Figure 2

- 7 Gasket
- 11 Body
- 12 Tailpipe
- 13 Nut, Vessel Coupling
- 14 Retainer, Ball Check
- 15 Ball
- 16 Seat
- 17 Stem
- 18 Retainer, Stem Packing
- 19 Gland, Stem Packing
- 20 Bonnet
- 21 Nut, Bonnet
- 25 Packing, Stem
- 26 Nut, Stem Packing
- 28 Handwheel
- 30 Nut, Handwheel
- 31 Tailpipe, Gage
- 32 Nut, Gage Coupling
- 163 Nameplate
- 261 Lever

**Note:** Seat (16), Bonnet (20) and Nut (21) are to be used on Series 200 and 400 gagecocks only.

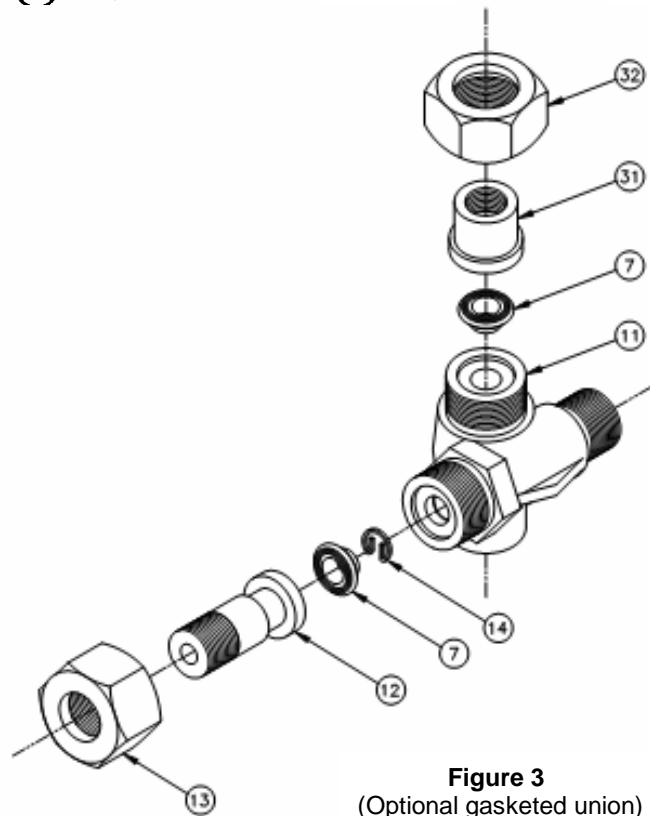


Figure 3  
(Optional gasketed union)

## NOTES

# NOTES



Tyco Valves & Controls, L.P. Prophetstown  
320 Locust St., Prophetstown, Illinois 61277  
Phone: 815-537-2311  
FAX: 815-537-5764  
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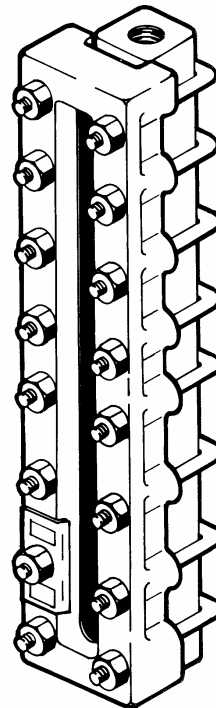
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PENBERTHY®

# Flat Glass Gages

Series L



Installation, Operation and Maintenance Instructions

## TABLE OF CONTENTS

Product Warranty . . . . .	iii
1.0 About the Manual . . . . .	1
2.0 Introduction . . . . .	1
2.1 System Description . . . . .	1
3.0 Available Models . . . . .	2
3.1 Design Ratings at Max. & Min. Operating Temperatures . . . . .	2,3
4.0 Inspection . . . . .	3
4.1 Glass Inspection . . . . .	3
4.2 User Rating Inspection . . . . .	3,4
5.0 Installation . . . . .	4
5.1 Piping Strain . . . . .	4
5.2 Differential Thermal Expansion . . . . .	4
5.3 Mirror Viewing . . . . .	4
5.4 Nut Retorquing . . . . .	4,5
5.5 Belleville Washers . . . . .	5
6.0 Operation . . . . .	6
6.1 Hydrostatic Test . . . . .	6
7.0 Maintenance . . . . .	6,7
7.1 Maintenance Procedures. . . . .	7
7.2 Troubleshooting . . . . .	7
8.0 Removal - Disassembly - Reassembly . . . . .	8
8.1 Disassembly . . . . .	8
8.2 Inspection of Glass Seating Surfaces . . . . .	9
8.3 Reassembly . . . . .	9,10
9.0 Disposal at End of Useful Life . . . . .	10
10.0 Telephone Assistance . . . . .	11
11.0 Exploded Parts Drawing . . . . .	12

<b>TABLES AND FIGURES</b>	<b>page</b>
---------------------------	-------------

Table 1	Design Ratings of RL Gage . . . . .	2
Table 2	Design Ratings of TL Gage . . . . .	2
Table 3	Bolt Torque Values . . . . .	5
Figure 1	Nut Tightening Sequence . . . . .	4
Figure 2	Belleville Washer Position . . . . .	5
Figure 3	Nut Loosening Sequence . . . . .	8
Figure 4	Exploded Parts Drawing of Transparent Gage . . . . .	12
Figure 5	Exploded Parts Drawing of Reflex Gage . . . . .	12

## **PENBERTHY PRODUCT WARRANTY**

Tyco Gagecocks & Controls Prophetstown warrants its Penberthy products as designed and manufactured by TV&C Prophetstown to be free of defects in the material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. TV&C Prophetstown will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to TV&C Prophetstown and obtain written authorization to return the product. Thereafter, the product shall be returned to TV&C in Prophetstown, Illinois, with freight paid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or otherwise altered outside of TV&C Prophetstown factory, or if it has been subject to misuse, neglect or accident.

The responsibility of TV&C Prophetstown hereunder is limited to repairing or replacing the product at its expense. TV&C Prophetstown shall not be liable for loss, damage or expenses related directly or indirectly to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that TV&C Prophetstown is not responsible for damage or injury caused to other products, buildings, personnel or property, by reason of the installation or use of its products.

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This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of TV&C Prophetstown unless made in writing and signed by the General Manager or Director of Engineering of TV&C Prophetstown.

# INSTALLATION, OPERATION and MAINTENANCE MANUAL FOR PENBERTHY SERIES L FLAT GLASS GAGES

## 1.0 About the Manual

This manual has been prepared as an aid and guide for personnel involved installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation or maintenance.

# SAFETY INSTRUCTIONS

**Penberthy does not have any control over the manner in which its liquid level gage is handled, installed or used. Penberthy cannot and will not guarantee that a liquid level gage is suitable or compatible for the user's specific application.**



## WARNING

**Contained fluids may be pressurized and can unexpectedly exit vessel connections due to apparatus or material failure. Safety glasses should be worn when installing a liquid level gage. Failure to follow instructions could result in serious physical injury or property damage.**

## 2.0 Introduction

Penberthy liquid level gages are used to allow direct visualization of liquid level in vessels. By peering through the glass, it is possible to monitor color, clarity and level of a gas/liquid interface. Gages are available in varying lengths and configurations (end connect, side connect, multiple sections, NPT or flange connections, etc.). Visual indication can be enhanced by using reflex glass or illuminators (accessory).

### 2.1 System Description

Penberthy gages are comprised of six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gage. Use the exploded parts view in Section 11.0 as additional reference material.

- Chamber- provides a pressure retaining metallic channel for the liquid to enter and be viewed. Slot(s) are machined into the chamber to provide direct visualization of the process fluid.
- Gaskets- seal the gap and prevent leakage between the chamber and the glass. Gaskets are available in a variety of materials for compatibility with the media in the gage.
- Glass- allows for visual observation of the process fluid in the chamber.
- Cushion- acts as a protective buffer between the glass and the cover. For proper sealing, cushions must be as hard as or harder than the gasket material.
- Cover- protects the glass assembly from external hits and provides a flat, rigid surface that is used to evenly compress the gage assembly.
- Bolting- compresses the components between the covers (transparent gages) or cover and chamber (reflex gages).
- Shield - (optional on transparent gages) used to prevent the process media from contacting the glass.

### 3.0 Available Models

Penberthy low pressure (Series L) liquid level gages are designed for applications other than steam/water where the physical and mechanical properties of a ductile iron cover are sufficient to meet the pressure and temperature needs of the application.

#### 3.1 Design Ratings at Maximum and Minimum Operating Temperatures

Gasket Material	Glass Size	Model RL Reflex	
		Wetted Parts Material Steel or Stainless Steel w/B7 Bolting	
		-20°F [-29°C] to 100°F [38°C]	600°F [316°C]
Grafoil® (standard) or Non-Asbestos	1	2400 psig [16550 kPa]	1780 psig [12270 kPa]
	2	2335 psig [16100 kPa]	1720 psig [11860 kPa]
	3	2250 psig [15510 kPa]	1670 psig [11510 kPa]
	4	2175 psig [15000 kPa]	1600 psig [11030 kPa]
	5	2100 psig [14480 kPa]	1550 psig [10690 kPa]
	6	2025 psig [13960 kPa]	1500 psig [10340 kPa]
	7	1950 psig [13440 kPa]	1440 psig [ 9930 kPa]
	8	1875 psig [12930 kPa]	1390 psig [ 9580 kPa]
	9	1800 psig [12410 kPa]	1340 psig [ 9240 kPa]
Top-Chem 2000®	1	2400 psig [16550 kPa]	100 psig [690 kPa] at 500°F [260°C]
	2	2335 psig [16100 kPa]	
	3	2250 psig [15510 kPa]	
	4	2175 psig [15000 kPa]	
	5	2100 psig [14480 kPa]	
	6	2025 psig [13960 kPa]	
	7	1950 psig [13440 kPa]	
	8	1875 psig [12930 kPa]	
	9	1800 psig [12410 kPa]	
25% glass filled PTFE	1 - 9	650 psig [4480 kPa] at -20°F [-29°C] to 100°F [38°C]	150 psig [1030 kPa] at 500°F [260°C]
NBR/Buna N	1 - 9	300 psig [2070 kPa] at -20°F [-29°C] to 100°F [38°C]	225 psig [1550 kPa] at 250°F [121°C]
FKM/Viton®	1 - 9	300 psig [2070 kPa] at -20°F [-29°C] to 100°F [38°C]	180 psig [1240 kPa] at 400°F [204°C]
PTFE/Teflon®	1 - 9	300 psig [2070 kPa] at -20°F [-29°C] to 100°F [38°C]	150 psig [1030 kPa] at 500°F [260°C]

Table 1

Gasket Material	Glass Size	Model TL Transparent	
		Wetted Parts Material Steel or Stainless Steel w/B7 Bolting	
		-20°F (-29°C) to 100°F (38°C)	600°F (316°C)
Grafoil® (standard) or Non-Asbestos	1	2000 psig [13790 kPa]	1480 psig [10200 kPa]
	2	1815 psig [12510 kPa]	1340 psig [ 9240 kPa]
	3	1630 psig [11240 kPa]	1210 psig [ 8340 kPa]
	4	1440 psig [ 9930 kPa]	1060 psig [ 7310 kPa]
	5	1250 psig [ 8620 kPa]	920 psig [ 6340 kPa]
	6	1065 psig [ 7340 kPa]	790 psig [ 5450 kPa]
	7	875 psig [ 6030 kPa]	645 psig [ 4450 kPa]
	8	690 psig [ 4760 kPa]	510 psig [ 3520 kPa]
	9	500 psig [ 3450 kPa]	370 psig [ 2550 kPa]
Top-Chem 2000®	1	2000 psig [13790 kPa]	100 psig [690 kPa] at 500°F [260°C]
	2	1815 psig [12510 kPa]	
	3	1630 psig [11240 kPa]	
	4	1440 psig [ 9930 kPa]	
	5	1250 psig [ 8620 kPa]	
	6	1065 psig [ 7340 kPa]	
	7	875 psig [ 6030 kPa]	
	8	690 psig [ 4760 kPa]	
	9	500 psig [ 3450 kPa]	
25% glass filled PTFE	1 - 9	650 psig [4480 kPa] at -20°F [-29°C] to 100°F [38°C]	150 psig [1030 kPa] at 500°F [260°C]
NBR/Buna N	1 - 9	300 psig [2070 kPa] at -20°F [-29°C] to 100°F [38°C]	225 psig [1550 kPa] at 250°F [121°C]
FKM/Viton®	1 - 9	300 psig [2070 kPa] at -20°F [-29°C] to 100°F [38°C]	180 psig [1240 kPa] at 400°F [204°C]
PTFE/Teflon®	1 - 9	300 psig [2070 kPa] at -20°F [-29°C] to 100°F [38°C]	150 psig [1030 kPa] at 500°F [260°C]
PCTFE/(Kel-F®) Shields 0.063" (1.6mm) thick	1 - 9	300 psig [2070 kPa] at -20°F [-29°C] to 100°F [38°C]	180 psig [1240 kPa] at 400°F [204°C]

Table 2

The pressure and temperature ratings may deviate from the previous tables if the gasketing materials of construction and/or bolting are other than those specified.

To determine the maximum allowable working pressure for a specific temperature within the design limits stated in the tables, the user should refer to Penberthy application reports, or when provided, the specifically stated design limits on a Penberthy product proposal.

NOTE: under no circumstances should shields be used in reflex style gages. Installation of shields in reflex style gages will keep the liquid from coming in contact with the refractive prisms, thereby prohibiting visualization of the liquid level in the gage.



**NEVER exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of gage components resulting in death, serious personal injury or property damage.**

#### 4.0 Inspection

Upon receipt of a liquid level gage, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

Penberthy's standard 1 section TL gage consists of: (1) chamber, (2) gaskets, (2) borosilicate flat glass, (2) rubber bands, (2) cushions, (2) covers, (1) washer, (1) nameplate and (6-14) bolting sets, depending on the size.

#### 4.1 Glass Inspection

The self stick caution tape was applied at the factory to protect the glass during shipping, handling and installation. Do not remove the tape from the glass until all installation procedures have been completed, except during receiving inspection to momentarily inspect glass for shipping damage. Glass that is not protected will be vulnerable to dust, grit, tools and any other objects which may scratch, chip or break the glass.



**DO NOT use glass that is chipped or even slightly scratched. Glass surface defects weaken the glass, which may result in glass breakage and fluid loss under pressure resulting in serious personal injury and property damage.**

#### 4.2 User Rating Inspection

The user should confirm that:

1. the Series L liquid level gage model and assembly number stamped on the nameplate conforms to the description on the user's purchase order,
2. the operating conditions described in the purchase order agree with the actual operating conditions at the installation site,
3. the actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above, and
4. the materials of construction of the liquid level gage are compatible with both the contained media and surrounding atmosphere in the specific application.

# SAFETY INSTRUCTIONS

If the size, model or performance data of the liquid level gage as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for assistance. The incorrect gage can result in unacceptable performance and potential damage to the gage.

## 5.0 Installation

Installation should only be undertaken by qualified, experienced personnel who are familiar with equipment of this type. They should have read and understood all of the instructions in this manual. The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for the specific size and model liquid level gage.

Penberthy recommends that all liquid level gage installations be provided with gagecock sets equipped with ball check shut-off. Gagecock sets are designed to isolate the gages from the pressure vessel when it becomes necessary to drain or service the gages. The ball check shut-off is designed to retard leakage of the contained fluid in the event of gage glass breakage. Ball checks are available for both positive and negative vessel pressures.

The number of different types of gage and gagecock installations is too great to adequately detail in an installation manual. It is, therefore, the user's responsibility to assure that the knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the installation guidelines that should be employed.

### 5.1 Piping Strain

The gage should be mounted and connected so that it does not support any piping weight. Piping not properly supported, independent of the gage, may subject the gage to stresses that can cause leaks or glass breakage. Support brackets are available as an accessory.

### 5.2 Differential Thermal Expansion

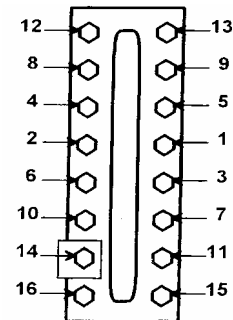
High mechanical loads may be imposed on a gage by expanding and contracting pipes due to hot or cold service. Such mechanical loads on the gage must be minimized by the use of expansion loops in the system. Failure to allow for expansion or contraction can result in leaks or glass breakage.

### 5.3 Mirror Viewing

For added safety, a system of indirect viewing by means of mirrors should be installed to protect personnel from the hazards of possible gage failure.

### 5.4 Nut Retorquing

Nut retorque is vital to the operation of a liquid level gage because gaskets take permanent set under initial bolt loading at assembly. Tightening of nuts before installation to values specified in Table 3 is necessary to insure pressure retaining capabilities of liquid level gage to specific design ratings. The user must refer to the liquid level gage model and assembly number and to the purchase order or tag to determine materials of construction.



Nut Tightening Sequence  
Figure 1

# SAFETY INSTRUCTIONS

Before placing liquid level gage into initial operation, torque values must be verified. From factory testing to installation, gasketing may take “set” reducing closure force. Retorquing before operation reduces chance of leakage or gasket “blow out”.

### BOLT TORQUE VALUES

GAGE MODELS & GASKET MATERIAL	ft-lb	N-m
RL, TL w/Grafoil® (standard)	20 to 25	27 to 34
RL, TL w/Non-asbestos (optional)	25 to 30	34 to 41
Top-Chem 2000®	20 to 25	27 to 34
25% glass filled PTFE	19 to 22	26 to 30
PTFE and PCTFE (Kel-F®)	20 to 25	27 to 34
All models with Vitor® or elastomeric (optional)	10 to 15	14 to 20
TL with PCTFE(Kel-F®) Shields (optional) 0.063" [1.6 mm]	20 to 25	27 to 34

**Table 3**

Using a torque wrench, tighten nuts in 5 ft-lb (7 N-m) increments following the "Z" pattern sequence in Figure 1, until the torque values shown in Table 3 above for the specific liquid level gage are reached. For multiple section gages, torque the center section(s) and progressively work toward the ends of the gage.

If bolting, gasketing or glass on any or repaired section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued as necessary.

## WARNING

**Failure to comply with the proper torquing sequence or force value can lead to leakage, gasket blow-out or glass breakage resulting in gage failure, serious injury or property damage.**

NOTE: Depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow "Z" pattern outward to the limit of bolting on a specific gage.

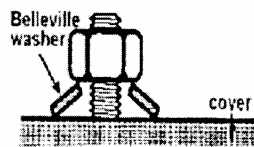
### 5.5 Belleville Washers

Belleville washers are used to reduce the need to retorque nuts. This is especially important for gages subject to pressure and/or thermal cycling. The conical washers allow for material expansion and contraction while maintaining axial bolt loading and, therefore, compression on the gasket.

Model RL gages require 3 washers per nut, model TL gages require 2 washers per nut (4 per bolt). Washers should be assembled with the cupped side facing the gage cover. Refer to Figure 2 for proper washer assembly.

Note: the following procedure is to be done on only one side of a transparent gage.

Using a torque wrench, tighten nuts in 5 ft-lb (7 N-m) increments following the "Z" pattern sequence in Figure 1 until the torque values shown in Table 3 are reached.



**Belleville Washer Position  
Figure 2**



## 6.0 Operation

Before initializing liquid level gage operation, check that all installation procedures have been completed. Use only qualified experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight. Assure that nuts have been retorqued to their proper values as specified in Table 3. Remove self stick caution tape from the glass and inspect to be sure that glass is clean and free of any damage such as cracks, scratches, pits and chips.

### 6.1 Hydrostatic Test



**Liquid level gage installations should be brought into service slowly to avoid excessive shock or stress on the glass. Rapid pressurization or sudden changes in temperature may cause glass breakage. To avoid excessive thermal shock or mechanical stress on glass, the connecting gagecocks should be opened slightly, and the gage temperature and pressure allowed to slowly equalize. If the gagecocks are equipped with ball checks, the gagecocks must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball checks in the event of failure. Failure to follow the recommended operating procedures can result in death, severe personal injury and/or property damage.**

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatically pressure test all installations to at least 100 psig (690 kPa) but less than the design pressure and correct any leakage before proceeding.

## 7.0 Maintenance



**Use only qualified experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to follow instructions can cause serious personal injury and property damage.**

The rate at which components degrade is dependent upon a variety of conditions. Pressure, temperature and process media all influence the rate at which gage components deteriorate. Higher temperatures can accelerate the deterioration of gaskets, cushions, glass and metals. Acids and similar chemicals can break down the integrity of almost any material. Concentration of chemicals can accelerate the corrosion rate. Penberthy cannot create a blanket maintenance schedule for every application.

The end user is the most familiar with the process media and conditions and must be responsible for creating a maintenance schedule. The user must create maintenance schedules, safety manuals and inspection details for each liquid level gage. Realistic maintenance schedules can only be determined with full knowledge of the services and application situations involved. These will be based upon the user's own operating experience with their specific application.

If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued or repaired as necessary.

On all installations the following items should be regularly evaluated by the user for purposes of maintenance:

1. glass, for cleanliness and signs of damage or wear,
2. shields, if used, for signs of clouding, wear or deterioration,
3. gage, for signs of leakage around gaskets or at connections and
4. gage, for signs of internal or external corrosion.

### 7.1 Maintenance Procedures

**GLASS** should be given regular and careful attention. Keep glass clean using a commercial glass cleaner and a soft cloth. Inspect the surface of the glass for any clouding, etching or scratching or physical damage such as bruises, checks or corrosion. Glass that is damaged is weakened and may break under pressure. Shining a light at approximately a 45° angle will aid in detecting some of these conditions. Typical damaged areas will glisten more brightly than the surrounding glass because the light is reflected.

Detection of any damage, problem areas or surface wear is sufficient evidence to take the liquid level gage out of service. DO NOT proceed with operation of the liquid level gage until the glass has been replaced with a glass replacement kit following the disassembly - reassembly instructions in Section 8.0.

**SHIELDS** showing any signs of clouding, wear or deterioration are an indication that the gage glass has been exposed, or could soon be exposed to the contained fluid. Immediately take liquid level gage out of service. DO NOT proceed with operation of the liquid level gage until shields and glass have been replaced by following the disassembly-reassembly instructions in Section 8.0.

**GASKET LEAKS** must be repaired immediately. DO NOT proceed with operation of a liquid level gage until gaskets have been replaced by following Section 8.0 disassembly-reassembly instructions.

**CONNECTION LEAKS** at a flanged or threaded connection should be corrected by tightening the bolting at the connection or by taking the liquid level gage out of service and wrapping the connection threads with Teflon<sup>®</sup> tape on all male pipe threads.

**CORROSION** may occur if the user has selected an improper material for the liquid level gage application. It is the responsibility of the user to choose a material of construction compatible with both the contained fluid and the surrounding environment. If internal or external corrosion is present, an investigation must immediately be performed by the user. It may be necessary to contact an authorized Penberthy distributor to better determine the origin of the corrosion.

### 7.2 Troubleshooting

Problem: glass becomes prematurely etched or clouded in service  
Cause: fluid being handled is not compatible with the glass or shields  
Solution: replace the glass and install shields which will not be affected by contained fluid

Problem: glass continually breaks in service despite careful attention to maintenance procedures  
Cause: thermal shock, hydraulic shock, mechanical loads, exceeding design ratings or a combination of these  
Solution: check entire system to determine possible sources of loads. Check application to determine actual operating conditions and contact an authorized Penberthy distributor on how to proceed.

## 8.0 Removal - Disassembly - Reassembly

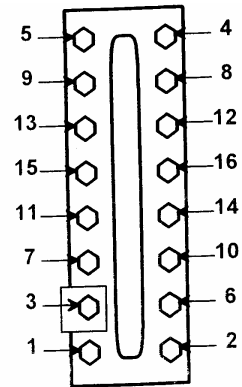


Use only qualified experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. **DO NOT** proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to follow instructions can cause serious personal injury and property damage.

### 8.1 Disassembly

Secure workbench longer than the liquid level gage, and sufficiently wide to lay out parts as they are removed.

1. Lay gage on bench so nut side of fastener is up.
2. Hold gage firmly; loosen nuts starting at both ends of each section and then proceeding from both ends to the center of each section as shown in Figure 3.
3. Nut Loosening Sequence
  - remove nuts, washer, belleville washers (if any) and nameplate
  - tap covers with rubber hammer as needed to loosen and remove
  - for belleville washer assemblies: to remove covers, studs may need to be removed by laying the assembly on its side and knocking the stud/U-bolts through the cover with a hammer and punch
  - remove cushions, glass, shields (if any) and gaskets
  - tap liquid chamber or remaining covers as necessary with rubber hammer to break loose and remove remaining components
  - remove, destroy and dispose of all glass, cushions, gaskets and shields. Under no circumstances should these components be re-used or installed on a gage.



**Nut Loosening Sequence  
Figure 3**

NOTE: If size of gage is smaller than shown, follow spiraling sequence from the ends until all bolting is loosened.



Once used, cushions, gaskets and shields are permanently deformed by compression and if re-used, may cause leaks and high stress points resulting in glass breakage. Glass may contain hidden damage and internal stresses caused by previous usage. If re-used, the glass may break under pressure causing severe personal injury or property damage.

## 8.2 Inspection of Glass Seating Surfaces

Clean the glass seating surfaces on the liquid chamber and cover with a soft metal scraper (preferably brass) to remove all burrs, rust and remnants of the previous gaskets and cushions. Exercise extreme care to avoid gouging or scarring gasket and cushion seating surfaces.

Use a known flat piece of metal the same approximate length as the glass or a new piece of glass and a thickness gage to check flatness of each glass seating surface on liquid chamber and under cover. Surface must be flat within 0.002 inch (0.05 mm). If any one surface is found to be beyond a tolerance of 0.002 inch (0.05 mm), the entire gage must be disposed of and replaced. Gasket seating surface must have a final surface finish of 450 to 500 AARH.



**Flatness of glass seating surfaces outside 0.002 inch (0.05 mm) tolerance specified is an indication of the gage having been overstressed through repeated exposure to mechanical, thermal or hydraulic shock during its previous service. Operation of a liquid level gage which has been overstressed will result in abnormal stresses on the glass which may cause glass to break. If surface finish is not in the 450-500 AARH range, gasket may extrude under pressure with resulting sudden release of pressure, leakage of contained fluid, serious personal injury or property damage.**

Glass seating surfaces should NOT be machined to achieve seating tolerance. The chamber and cover are designed for a critical thickness to achieve the pressure/temperature ratings. Machining glass seating surfaces may result in non-compliance to the necessary critical thickness due to material removal.

## 8.3 Reassembly

If all glass seating surfaces are found to be within the 0.002 inch (0.05 mm) tolerance described in the previous section, proceed to obtain new glass, gaskets, cushions and shields (if used) and proceed to reassemble as follows (refer to exploded parts view in Section 11.0 if needed):

1. Clean threads on bolt and nuts to remove all paint, rust and scale. Apply a light coat of oil to the threads.
2. For transparent gages, insert bolts through half the cover and lay out covers along the bench, side by side, with the liquid chamber. Use chamber to space covers and line them up with vision slots.
3. For reflex style and belleville reflex style gages, lay out covers along bench, side by side, with liquid chamber. Use chamber to space covers and line them up with vision slots.
4. For transparent belleville style gages, thread nuts on stud, place two belleville washers under nut with pointed end toward the nut (see Figure 2), insert stud through each cover and lay out covers along bench, side by side, with liquid chamber. Use chamber to space covers and line them up with vision slots.
5. Install one cushion inside each cover.



**Separate installation instructions are supplied with replacement glass. All instructions supplied with the glass must be followed, as there are precautions to be taken when handling gage glass. Among the precautions is avoidance of bumping or sliding glass against any surface and inspection of individual pieces. Failure to follow any of the replacement gage glass installation instructions could result in glass breakage with resulting sudden release of pressure, severe personal injury or property damage.**

6. Install rubber band around each piece of glass, then place glass centered inside each cover.
7. Install shields, if used, and gasket on glass being careful to keep components centered.
8. Place liquid chamber on the gaskets making sure all components are aligned with vision slot.
9. For reflex gage, install U-bolts in place by tapping as needed with rubber hammer, being careful not to lose alignment with vision slot.
10. For reflex gage, quickly turn over assembly onto backside of U-bolts. Assemble nameplate, washer and nuts to U-bolts. Tighten nuts with fingers. Using a torque wrench, tighten nuts in 5 ft-lb (7 N·m) increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.

NOTE: Depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow "Z" pattern outward to the limit of bolting on a specific gage.

11. For transparent gage, install gaskets and shields, if used, centered on vision slot.
12. Install rubber band around each piece of glass, then place glass centered on gasket or shields, if used.
13. Install one cushion on each piece of glass.
14. Install covers in place being careful to maintain components alignment inside.
15. Install nameplate, washer and nuts to bolts. Tighten nuts with fingers. Using a torque wrench, tighten nuts in 5 ft-lb (7 N·m) increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.
- 15A. For transparent belleville style gages: install nameplate and two belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.

NOTE: the following procedure is to be done on only one side of the gage.

- 15B. For reflex belleville style gages: install nameplate and three belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.
16. Using a torque wrench, tighten nuts in 5 ft-lb (7 N·m) increments, following the sequence in Figure 1, until the torque values shown in Table 3 are reached.

Refer to Section 5.0 for installation and Section 6.0 for operation of liquid level gage when returning to service.

### **9.0 Disposal at End of Useful Life**

Penberthy gages are used in a variety of fluid applications. By following the appropriate federal and industry regulations, the user must determine the extent of preparation and treatment the gage must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metal, glass and polymers should be recycled whenever possible. Refer to order and TV&C - Prophetstown Material Specification sheets for materials of construction.

## 10.0 Telephone Assistance

If you are having difficulty with your liquid level gage, contact your local Penberthy distributor. You may also contact the factory direct at (815) 537-2311 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information available as possible when you call:

- Model #
- Name of the company from whom you purchased your liquid level gage
- Invoice # and date
- Process conditions (pressure, flow rates, tank shape, etc)
- A brief description of the problem
- Trouble shooting procedures that failed

If attempts to solve your problem fail, you may request to return your liquid level gage to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from TV&C Prophetstown before returning anything. Failure to do so will result in the unit being returned to you without being tested, freight collect. To obtain an R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- Person to contact at your company
- "Ship To" address

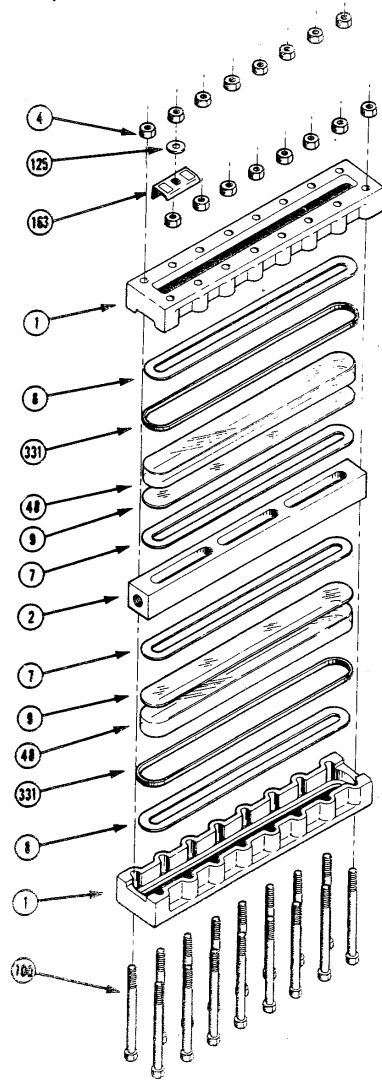
There is a minimum charge for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit under warranty, but is not defective, the minimum charge will apply.

Grafoil® is a registered trademark of Graftech, Inc.  
Top Chem 2000® is a registered trademark of Klinger  
Viton® and Teflon® are registered trademarks of E.I. du Pont de Nemours and Company  
PCTFE (formerly known as Kel-F®), a registered trademark of 3M is manufactured by Daikin

11.0 Exploded Parts Drawing

Recommended Spare Parts		
REF #	ITEM	QTY.
100	Bolt/U-bolt	2/1 per sect.
4	Nut	2 per sect.
48	Glass	1
7	Gasket	2
8	Cushion	2
9	Shield (if used)	2

Transparent



- 1 Cover
- 2 Chamber
- 4 Nut
- 48 Glass
- 7 Gasket
- 8 Cushion
- 9 Shield
- 100 Bolt/U-Bolt
- 125 Washer
- 163 Nameplate
- 331 Band

Reflex

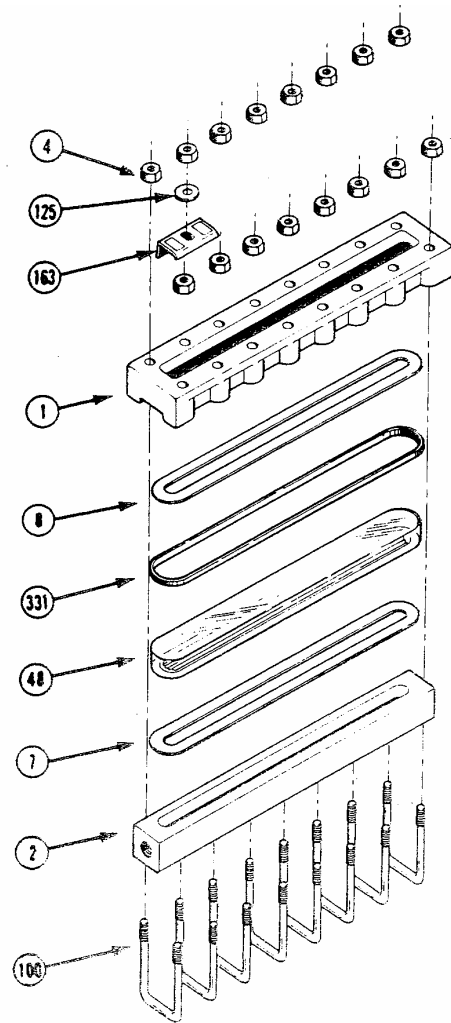


Figure 4

Figure 5

NOTE: size 9 shown - actual gage may be shorter and require fewer bolting components.

# PENBERTHY

## DECLARATION of CONFORMITY

In conformance with ISO/IEC Guide 22 - 96  
LLG.DC r C

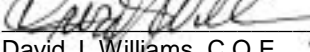
Manufacturer's Name: Tyco Valves & Controls  
Manufacturer's Address: 320 Locust Street  
Prophetstown, IL 61277-1147 U.S.A.

Product:  
Type of Equipment: Pressure Vessel - Liquid Level Gage Glass  
Equipment Class: Industrial Instrumentation - Hazardous Area  
Model Designations: RL, TL, RM, RMR, TM, TMR, RH, RHR, TH, THR, RMW, TMW, RLC, TLC

The product described above is in conformity with:

92/59/EEC	General product safety	1992
87/404/EEC	Simple pressure vessel	1987
89/392/EEC	Machinery	1989
EN 10213-1:4	Technical delivery conditions for steel castings	1996
ISO 7-1	Pipe threads where pressure-tight joints are made	1996
BS 10	Flanges and bolting for pipes, gagecocks and fittings	1962
BS 21	Pipe threads for tubes and fittings where pressure tight	1985
BS 759	Gagecocks, gauges and other safety fittings for application	1984
BS 970 Part 1	Wrought steels for mechanical and allied engineering	1996
BS 970 Part 3	Wrought steel for mechanical and allied engineering	1991
BS 1501 Part 3	Steels for pressure purposes	1990
BS 1502	Steels for fired and unfired pressure vessels	1982
BS 1506	Carbon, low alloy and stainless steel bars and billets	1990
BS 1560	Circular flanges for pipes, gagecocks and fittings	1989
BS 1640 Part 1	Steel butt-welding pipe fittings	1962
BS 1640 Part 2	Steel butt-welding pipe fittings	1962
BS 1965	Butt-welding pipe fittings	1963
BS 3076	Nickel and nickel alloys: bar	1989
BS 3463	Observation and gauge glasses for pressure vessels	1975
BS 3602 Part 1	Steel pipes and tubes for pressure purposes	1987
BS 3605	Austenitic stainless steel pipes and tubes	1991
BS 3643	ISO metric screw threads	1981
BS 3799	Steel pipe fittings, screwed and socket-welding	1974
BS 4504	Circular flanges for pipes, gagecocks and fittings	1989
ASME B&PV Code Section VIII	Rules for construction of pressure vessels	1995
ANSI/ASME B1.1	Unified screw inch threads un and unr thread form	1982
ANSI/ASME B1.20.1	Pipe threads, general purpose (inch)	1983
ANSI/ASME B16.5	Pipe flanges and flanged fittings	1988
ANSI/ASME B18.2.1	Square and hex nuts and screw inch series	1981
ANSI/ASME B18.2.2	Square and hex nuts	1972
ANSI/ASME B31.3	Process piping	1996

Date: 28 May 2004  
Prophetstown, IL U.S.A.

Signature:   
Name: David J. Williams, C.Q.E.  
Position: Quality Assurance Manager

Technical Construction File is available at stated address. Signatory is contact person.



## NOTES

## NOTES

## NOTES

**tyco** / *Flow Control* / **Tyco Valves  
& Controls**

**Penberthy**

Tyco Valves & Controls, L.P. Prophetstown  
320 Locust St., Prophetstown, Illinois 61277  
Phone: 815-537-2311  
FAX: 815-537-5764  
Printed in USA  
Part No. 18R65-009

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# Rosemount 644 Temperature Transmitter with HART<sup>®</sup> Protocol





# Rosemount 644 Temperature Transmitter

Rosemount 644 Hardware Revision	30	1	1
Device Revision	7	8	9
HART® Revision	5	5	7

## ⚠ CAUTION

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure to thoroughly understand the contents before installing, using, or maintaining this product.

The United States has two toll-free assistance numbers and one international number.

Customer Central  
1-800-999-9307 (7:00 a.m. to 7:00 p.m. CST)

National Response Center  
1-800-654-7768 (24 hours a day)

Equipment service needs

International  
1-(952)-906-8888

## ⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact a Emerson Process Management Sales Representative.





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# Contents

## Section 1: Introduction

1.1 Safety Messages .....	1
1.2 Overview .....	2
1.2.1 Manual .....	2
1.2.2 Transmitter overview .....	3
1.3 Considerations .....	3
1.3.1 General .....	3
1.3.2 Commissioning .....	4
1.3.3 Mechanical .....	4
1.3.4 Electrical .....	4
1.3.5 Environmental .....	4
1.4 Return of Materials .....	5
1.5 Transmitter Security .....	6
1.5.1 Available Security Options .....	6

## Section 2: Configuration

2.1 Overview .....	7
2.2 Safety Messages .....	7
2.3 System readiness .....	9
2.3.1 Confirm correct device driver .....	9
2.3.2 Surges/Transients .....	9
2.4 Configuration Methods .....	10
2.4.1 Configuring on the bench .....	10
2.4.2 Choosing a configuration tool .....	11
2.4.3 Setting the Loop to Manual .....	13
2.4.4 Failure Mode .....	13
2.4.5 HART Software Lock .....	14
2.5 Verify configuration .....	14
2.5.1 Verify and review configuration with Field Communicator .....	14
2.5.2 Verify and review configuration with AMS Device Manager .....	15
2.5.3 Verify and review configuration with Local Operator Interface .....	15
2.5.4 Checking transmitter output .....	15
2.6 Basic Configuration of the transmitter .....	16
2.6.1 Mapping the HART® Variables .....	17
2.6.2 Configuring the Sensor(s) .....	18

---

2.6.3	Setting Output Units .....	20
2.7	Configure Dual Sensor Options .....	22
2.7.1	Differential Temperature Configuration .....	22
2.7.2	Average Temperature Configuration .....	23
2.7.3	Hot Backup Configuration .....	25
2.7.4	Sensor Drift Alert Configuration .....	27
2.8	Configure Device Outputs .....	28
2.8.1	Rerange the transmitter .....	28
2.8.2	Damping .....	29
2.8.3	Configure Alarm and Saturation Levels .....	31
2.8.4	Configuring the LCD Display .....	33
2.9	Inputting device information .....	35
2.9.1	Tag, date, descriptor and message .....	35
2.10	Configure measurement filtering .....	36
2.10.1	50/60 Hz filter .....	36
2.10.2	Resetting the device .....	37
2.10.3	Intermittent sensor detection .....	37
2.10.4	Open sensor holdoff .....	38
2.11	Diagnostics and service .....	39
2.11.1	Performing a loop test .....	39
2.11.2	Simulate digital signal (Digital Loop Test) .....	40
2.11.3	Thermocouple Degradation Diagnostic .....	41
2.11.4	Minimum/Maximum tracking diagnostic .....	43
2.12	Establishing multidrop communication .....	44
2.12.1	Changing a transmitter address .....	45
2.13	Using the transmitter with the HART Tri-Loop .....	46
2.13.1	Set the transmitter to Burst Mode .....	46
2.13.2	Set Process Variable Output Order .....	46

## Section 3: Hardware installation

3.1	Overview .....	49
3.2	Safety Messages .....	49
3.3	Considerations .....	51
3.3.1	Installation considerations .....	51
3.3.2	Environmental considerations .....	51
3.4	Installation procedures .....	52
3.4.1	Set the Alarm switch .....	52

3.4.2 Mount the transmitter . . . . .	54
3.4.3 Install the device . . . . .	55
3.4.4 Multichannel installations . . . . .	59
3.4.5 LCD Display Installation . . . . .	59

## Section 4: Electrical Installation

4.1 Overview . . . . .	61
4.2 Safety Messages . . . . .	61
4.3 Wiring and powering the transmitter . . . . .	62
4.3.1 Sensor connections . . . . .	62
4.3.2 Power the transmitter . . . . .	64
4.3.3 Ground the transmitter . . . . .	66
4.3.4 Wiring with a Rosemount 333 HART Tri-Loop (HART / 4–20 mA only) . . . . .	69

## Section 5: Operation and maintenance

5.1 Overview . . . . .	71
5.2 Safety messages . . . . .	71
5.3 Calibration overview . . . . .	72
5.3.1 Trimming . . . . .	72
5.4 Sensor input trim . . . . .	73
5.4.1 Recall Factory Trim—Sensor trim . . . . .	75
5.4.2 Active Calibrator and EMF Compensation . . . . .	75
5.5 Trim the analog output . . . . .	76
5.5.1 Analog output trim or Scaled Analog Output Trim . . . . .	76
5.5.2 Analog output trim . . . . .	76
5.5.3 Scaled output trim . . . . .	77
5.6 Transmitter-Sensor Matching . . . . .	78
5.7 Switching HART Revision . . . . .	80
5.7.1 Switching HART revision using the Generic Menu . . . . .	80
5.7.2 Switching HART revision using a Field Communicator . . . . .	80
5.7.3 Switching HART revision with AMS Device Manager . . . . .	80
5.7.4 Switching HART revision with Local Operator Interface . . . . .	80

---

## Section 6: Troubleshooting

6.1 Overview .....	83
6.2 Safety messages.....	83
6.3 Troubleshooting the 4-20 mA/HART output .....	85
6.4 Diagnostic messages.....	86
6.4.1 Diagnostic messages: Failed.....	87
6.4.2 Diagnostic messages: Warning .....	89
6.4.3 Other LCD messages .....	90

## Section 7: Safety Instrumented Systems (SIS) Certification

7.1 Safety Instrumented Systems (SIS) certification .....	93
7.2 644 safety certified identification .....	93
7.3 Installation.....	94
7.4 Commissioning.....	94
7.5 Configuration .....	94
7.5.1 Damping.....	95
7.6 Alarm and saturation levels .....	95
7.7 644 SIS operation and maintenance.....	96
7.7.1 Proof Test.....	96
7.7.2 Abbreviated proof test.....	96
7.7.3 Extended proof test .....	97
7.8 Specifications .....	98
7.8.1 Failure rate data .....	98
7.8.2 Failure values.....	98
7.8.3 Product life.....	99

## Appendix A: Specifications and Reference Data

A.1 Specifications .....	101
A.1.1 Functional.....	101
A.1.2 Physical.....	102
A.1.3 Performance .....	104
A.2 4–20 mA / HART Specifications.....	106
A.3 Dimensional Drawings .....	114
A.4 Ordering Information .....	119
A.4.1 Configuration .....	124
A.4.2 Tagging.....	124
A.4.3 Considerations .....	125
A.5 Specifications and Reference Data for 644 HART Head Mount.....	127
A.5.1 Functional Specifications.....	127
A.5.2 Physical Specifications.....	128
A.5.3 Performance Specifications .....	130
A.5.4 4–20 mA / HART Specifications .....	131

## Appendix B: Product Certifications

B.1 Approved manufacturing locations .....	135
B.2 European Union Directive Information .....	135
B.2.1 Ordinary Location Certification from FM Approvals.....	135
B.2.2 Hazardous Locations Certifications.....	135

## Appendix C: Field Communicator Menu Trees and Fast Keys

C.1 Field Communicator menu trees.....	153
C.2 Field Communicator fast keys .....	159

## Appendix D: Local Operator Interface (LOI)

D.1 Number entry .....	161
D.2 Text entry.....	162
D.2.1 Scrolling .....	162
D.3 Timeout .....	163
D.4 Saving and canceling.....	163
D.5 LOI menu tree.....	165
D.6 LOI menu tree – extended menu.....	166



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# Section 1 Introduction

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Safety Messages .....	page 1
Overview .....	page 2
Considerations .....	page 3
Return of Materials .....	page 5

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## 1.1 Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

### Warnings

#### WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting HART in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-intrinsic field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.
-

---

## 1.2 Overview

### 1.2.1 Manual

This manual is designed to assist in the installation, operation, and maintenance of Rosemount 644 head mount and 644 rail mount transmitters with the HART protocol.

#### [Section 2: Configuration](#)

This section provides instruction on the commissioning and operating of the Rosemount 644 HART transmitter. The information explains how to configure software functions and many configuration parameters on an Asset Management System, a Field Communicator, and the Local Operator Interface display option.

#### [Section 3: Hardware installation](#)

This section contains mechanical installation instructions for the transmitter.

#### [Section 4: Electrical Installation](#)

This section contains electrical installation instructions and considerations for the transmitter.

#### [Section 5: Operation and maintenance](#)

This section contains common operation and maintenance techniques for the transmitter.

#### [Section 6: Troubleshooting](#)

This section provides troubleshooting techniques for the most common transmitter operating problems.

#### [Section 7: Safety Instrumented Systems \(SIS\) Certification](#)

This section provides identification, installation, configuration, operation and maintenance, and inspection information for Safety Instrumented Systems as it pertains to the Rosemount 644 Head mount Temperature Transmitter.

#### [Appendix A: Specifications and Reference Data](#)

This section supplies transmitter specifications and reference data as well as transmitter ordering information.

#### [Appendix B: Product Certifications](#)

This section contains the approved manufacturing locations, Hazardous Location Product Certification information, European Union Directive information and Installation Drawings.

#### [Appendix C: Field Communicator Menu Trees and Fast Keys](#)

This section contains Field Communicator menu trees and Field Communicator fast keys.

#### [Appendix D: Local Operator Interface \(LOI\)](#)

This section contains instructions for number entry, text entry, as well as the LOI menu tree and LOI extended menu tree.



## 1.2.2 Transmitter overview

The Rosemount 644 Head mount Temperature Transmitter supports the follow features:

- HART configuration with Selectable HART revision capability ( Revisions 5 or 7)
- Accepts either 1 or 2 inputs from a wide variety of sensor types (2, 3, and 4-wire RTD, Thermocouple, mV and Ohm)
- A compact transmitter size with electronics completely encapsulated in protective silicone and enclosed in a plastic housing ensuring long-term transmitter reliability
- Optional Safety Certification Option (IEC 61508 SIL 2)
- Optional Enhanced accuracy and stability performance
- Optional LCD Display with extended temperature ratings of -40°C to 85°C
- Optional advanced LCD display with local operator interface (LOI) with extended temperature ratings of -40°C to 80°C
- Two housing materials (Aluminum and SST) and various housing style options that allow for mounting flexibility in a variety of environmental conditions
- Special dual-sensor features include Hot Backup®, Sensor Drift Alert, first good, differential and average temperature measurements, and four simultaneous measurement variable outputs in addition to the analog output signal
- Additional advanced features include: Thermocouple Degradation Diagnostic, which monitors thermocouple health, and process and transmitter Minimum/Maximum Temperature Tracking

The Rosemount 644 Rail mount Temperature Transmitter supports the following features:

- 4-20mA/HART protocol (Revision 5)
- Accepts 1 sensor input from a wide variety of sensor types (2, 3, and 4-wire RTD, Thermocouple, mV and Ohm)
- Completely encapsulated electronics to ensure long term transmitter reliability

Refer to the following literature for a full range of compatible connection heads, sensors, and thermowells provided by Emerson Process Management.

- Temperature Sensors and Assemblies Product Data Sheet, Volume 1 (document number 00813-0100-2654)
- Temperature Sensors and Assemblies Product Data Sheet, Volume 2 (document number 00813-0200-2654)

## 1.3 Considerations

### 1.3.1 General

Electrical temperature sensors such as RTDs and thermocouples produce low-level signals proportional to their sensed temperature. The 644 converts the low-level sensor signal to a standard 4–20 mA DC or digital HART signal that is relatively insensitive to lead length and electrical noise. This signal is then transmitted to the control room via two wires.

---

## 1.3.2 Commissioning

The transmitter can be commissioned before or after installation. It may be useful to commission it on the bench, before installation, to ensure proper operation and to become familiar with its functionality. Make sure the instruments in the loop are installed in accordance with intrinsically safe, or non-incendive field wiring practices.

## 1.3.3 Mechanical

### Location

When choosing an installation location and position, take into account the need for access to the transmitter.

### Special Mounting

Special mounting hardware is available for mounting a 644 head mount transmitter to a DIN rail or assembling a new 644 head mount to an existing threaded sensor connection head (former option code L1).

## 1.3.4 Electrical

Proper electrical installation is necessary to prevent errors due to sensor lead resistance and electrical noise. For best results, shielded cable should be used in electrically noisy environments.

Make wiring connections through the cable entry in the side of the housing. Be sure to provide adequate clearance for cover removal.

## 1.3.5 Environmental

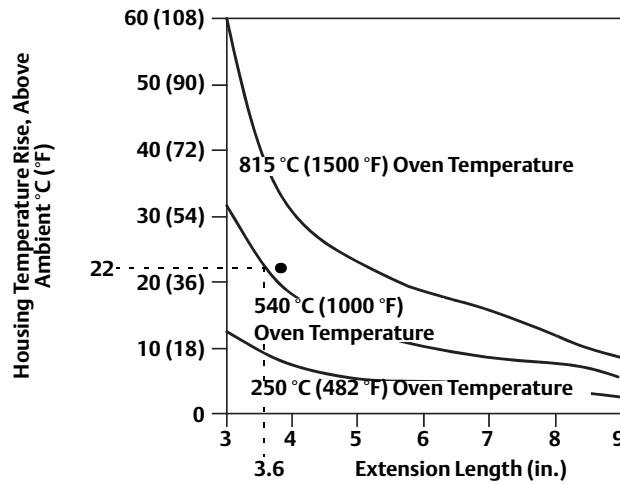
The transmitter electronics module is permanently sealed within a plastic enclosure, resisting moisture and corrosive damage. Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

### Temperature Effects

The transmitter will operate within specifications for ambient temperatures between  $-40$  and  $185$  °F ( $-40$  and  $85$  °C). Heat from the process is transferred from the thermowell to the transmitter housing. If the expected process temperature is near or beyond specification limits, consider the use of additional thermowell lagging, an extension nipple, or a remote mounting configuration to isolate the transmitter from the process.

Figure 1-1 provides an example of the relationship between transmitter housing temperature rise and extension length.

**Figure 1-1. 644 head mount Transmitter Connection Head Temperature Rise vs. Extension Length**



### Example

The maximum permissible housing temperature rise (T) can be calculated by subtracting the maximum ambient temperature (A) from the transmitter’s ambient temperature specification limit (S). For instance, if A = 40 °C.

$$T = S - A$$


$$T = 85\text{ °C} - 40\text{ °C}$$

$$T = 45\text{ °C}$$

For a process temperature of 540 °C (1004 °F), an extension length of 3.6 inches (91.4 mm) yields a housing temperature rise (R) of 22 °C (72 °F), providing a safety margin of 23 °C (73 °F). A 6.0 inch (152.4 mm) extension length (R = 10 °C (50 °F)) offers a higher safety margin (35 °C (95 °F)) and reduces temperature-effect errors but would probably require extra transmitter support. Gauge the requirements for individual applications along this scale. If a thermowell with lagging is used, the extension length may be reduced by the length of the lagging.

## 1.4 Return of Materials

To expedite the return process in North America, call the Emerson Process Management National Response Center toll-free at 800-654-7768. This center, available 24 hours a day, will assist you with any needed information or materials.

 The center will ask for the following information:

- Product model
- Serial numbers
- The last process material to which the product was exposed

The center will provide

- A Return Material Authorization (RMA) number
- Instructions and procedures that are necessary to return goods that were exposed to hazardous substances

For other locations, please contact an Emerson Process Management sales representative.

---

**Note**

If a hazardous substance is identified, a Material Safety Data Sheet (MSDS), required by law to be available to people exposed to specific hazardous substances, must be included with the returned materials.

---

## 1.5 Transmitter Security

### 1.5.1 Available Security Options

There are three security methods to utilize with the Rosemount 644 transmitter.

- Software Security Switch (Write Protect)
- HART Lock
- LOI Password

The **Write Protect** feature allows you to protect the transmitter data from accidental or unwarranted configuration changes. To enable the write protect feature, perform the following procedures.

#### Configuring Write Protect, HART Lock and LOI Password with a Field Communicator

From the *HOME* screen, enter the fast key sequence

Device Dashboard Fast Keys-Write Protect	2, 2, 9, 1
Device Dashboard Fast Keys-HART Lock	2, 2, 9, 2
Device Dashboard Fast Keys- LOI Password	2, 2, 9, 3

#### Configuring Write Protect, HART Lock and LOI Password with AMS Device Manager

Right click on the device and select the **Configure** menu.

1. In the left navigation pane choose **Manual Setup** then chose the **Security tab**.
2. All three parameters can be configured from this screen.
3. Click **Apply** when complete.

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# Section 2 Configuration

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Overview .....	page 7
System readiness .....	page 9
Configuration Methods .....	page 10
Basic Configuration of the transmitter .....	page 16
Configure Dual Sensor Options .....	page 22
Configure Device Outputs .....	page 28
Inputting device information .....	page 35
Configure measurement filtering .....	page 36
Diagnostics and service .....	page 39
Establishing multidrop communication .....	page 44
Using the transmitter with the HART Tri-Loop .....	page 46

---

## 2.1 Overview

This section contains information on commissioning and tasks that should be performed on the bench prior to installation. Field Communicator, AMS Device Manager, and Local Operator Interface (LOI) instructions are given to perform configuration functions. For convenience, Field Communicator fast key sequences are labeled “Fast Keys,” and abbreviated LOI menus are provided for each function below. The Local Operator Interface is only available on the 644 Head mount design and the configuration instructions referencing the interface will not apply to the Rail mount form factor.

Full Field Communicator menu trees and fast key sequences are available in [Appendix C: Field Communicator Menu Trees and Fast Keys](#). Local Operator Interface menu trees are available in [Appendix D: Local Operator Interface \(LOI\)](#).

## 2.2 Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

---

## Warnings

### WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting a Field Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.
-

## 2.3 System readiness

### Confirm HART revision capability

- If using HART based control or asset management systems, please confirm the HART capability of those systems prior to transmitter installation. Not all systems are capable of communicating with HART Revision 7 protocol. This transmitter can be configured for either HART Revision 5 or 7.
- For instructions on how to change the HART revision of your transmitter, see “Switching HART Revision” on page 82.

### 2.3.1 Confirm correct device driver

- Verify the latest Device Driver files are loaded on your systems to ensure proper communications.
- Download the latest Device Driver at [www.emersonprocess.com](http://www.emersonprocess.com) or [www.hartcomm.org](http://www.hartcomm.org)

**Table 2-1. Rosemount 644 Device Revisions and Files**

Software Date	Identify Device		Find Device Driver Files		Review Instructions	Review Functionality
Date	NAMUR Software Revision	HART Software Revision	HART Universal Revision <sup>(1)</sup>	Device Revision <sup>(2)</sup>	Manual Document Number	Changes to Software <sup>(3)</sup>
June 2012	1.1.1	01	5	8	00809-0100-4728	See footnote 3 for list of changes
			7	9		

(1) NAMUR Software Revision is located on the hardware tag of the device. HART Software Revision can be read using a HART communication tool.

(2) Device Driver file names use Device and DD Revision, e.g. 10\_01. HART Protocol is designed to enable legacy device driver revisions to continue to communicate with new HART devices. To access new functionality, the new Device Driver must be downloaded. It is recommended to download the new Device Driver files to ensure full functionality

(3) HART Revision 5 and 7 Selectable. Dual Sensor support, Safety Certified, Advanced Diagnostics (if ordered), Enhanced Accuracy and Stability (if ordered).

### 2.3.2 Surges/Transients

The transmitter will withstand electrical transients of the energy level encountered in static discharges or induced switching transients. However, high-energy transients, such as those induced in wiring from nearby lightning strikes, welding, heavy electrical equipment, or switching gears, can damage both the transmitter and the sensor. To protect against high-energy transients, install the transmitter into a suitable connection head with the Rosemount 470 Transient Protector. Refer to the 470 Transient Protector Product Data Sheet (document number 00813-0100-4191) for more information.

## 2.4 Configuration Methods

### ⚠ CAUTION

Set all transmitter hardware adjustments during commissioning to avoid exposing the transmitter electronics to the plant environment after installation.

The Rosemount 644 can be configured either before or after installation. Configuring the transmitter on the bench using either a Field Communicator, AMS Device Manager, or Local Operator Interface (LOI) ensures all transmitter components are in working order prior to installation.

The 644 transmitter can be configured either on-line or off-line using a Field Communicator, AMS Device Manager or the optional Local Operator Interface (LOI) (Head mount only). During on-line configuration, the transmitter is connected to a Field communicator. Data is entered in the working register of the communicator and sent directly to the transmitter.

Off-line configuration consists of storing configuration data in a Field Communicator while it is not connected to a transmitter. Data is stored in nonvolatile memory and can be downloaded to the transmitter at a later time.

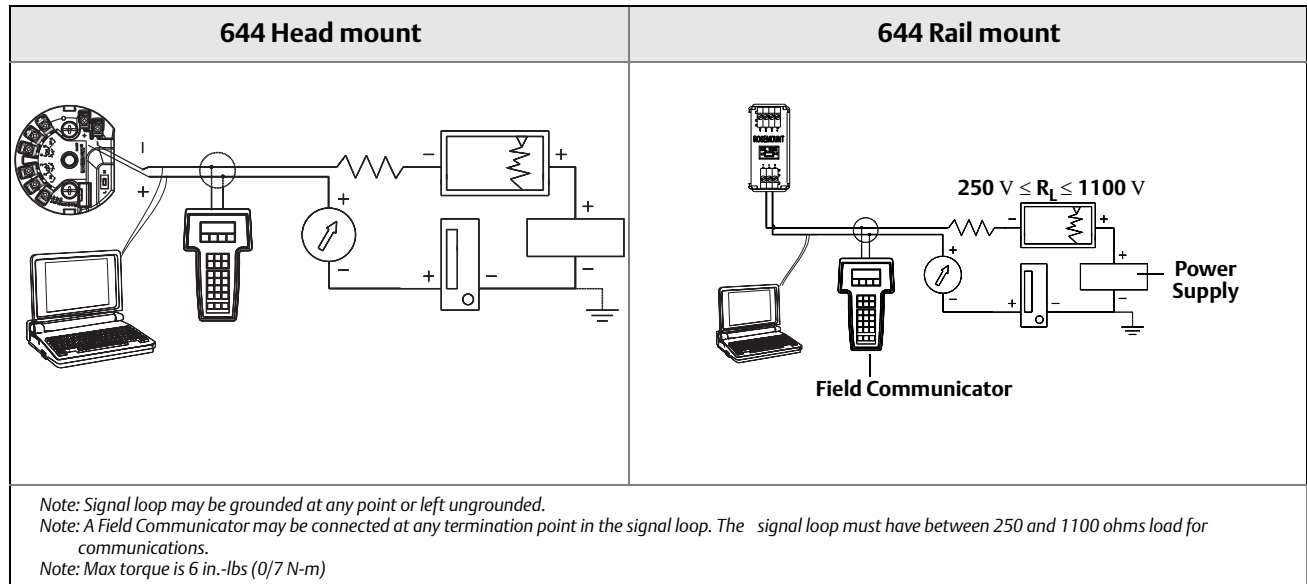
### 2.4.1 Configuring on the bench

To configure on the bench, required equipment includes a power supply, a digital multimeter (DMM), and a Field Communicator, AMS Device Manager, or a Local Operator Interface (LOI – Option M4).

Connect the equipment as shown in [Figure 2-1](#). Connect HART Communication leads at any termination point in the signal loop. To ensure successful HART communication, a resistance of at least 250 ohms must be present between the transmitter and the power supply. Connect the Field Communicator leads to the clips behind the power (+,-) terminals on the top of the device. Avoid exposing the transmitter electronics to the plant environment after installation by setting all transmitter jumpers during the commissioning stage on the bench.



**Figure 2-1. Powering the transmitter for Bench Configuration**



## 2.4.2 Choosing a configuration tool

### Configuring with a Field Communicator

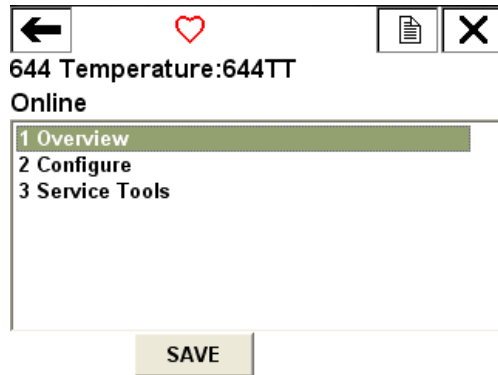
The Field Communicator is a handheld device that exchanges information with the transmitter from the control room, the instrument site, or any wiring termination point in the loop. To facilitate communication, connect the Field Communicator, shown in this manual, in parallel with the transmitter (see Figure 2-1). Use the loop connection ports on the rear panel of the Field Communicator. The connections are non-polarized. Do not make connections to the serial port or the NiCad recharger jack in explosive atmospheres. Before connecting the Field Communicator in an explosive atmosphere make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

There are two interfaces available with the Field Communicator: Traditional and Dashboard interfaces. All steps using a Field Communicator will be using Dashboard interfaces. Figure 2-2 shows the Device Dashboard interface. As stated in “System readiness” on page 9, it is critical that the latest DD’s are loaded into the Field Communicator for optimal transmitter performance.

Visit [www.emersonprocess.com](http://www.emersonprocess.com) to download latest DD library.

Turn on the Field Communicator by pressing the ON/OFF key. The Field Communicator will search for a HART-compatible device and indicate when the connection is made. If the Field Communicator fails to connect, it indicates that no device was found. If this occurs, refer to Section 6: Troubleshooting.

**Figure 2-2. Field Communicator Device Dashboard Interface**



Field Communicator menu trees and fast keys are available in [Appendix C: Field Communicator Menu Trees and Fast Keys](#) Configuring with AMS Device Manager

With an AMS Device Manager software package, you can commission and configure instruments, monitor status and alerts, troubleshoot from the control room, perform advanced diagnostics, manage calibration, and automatically document activities with a single application.

Full configuration capability with AMS Device Manager requires loading the most current Device Descriptor (DD) for this device. Download the latest DD at [www.emersonprocess.com](http://www.emersonprocess.com), or [www.hartcomm.org](http://www.hartcomm.org).

**Note**

All steps listed in this product manual using AMS Device Manager assume the use Version 11.5.

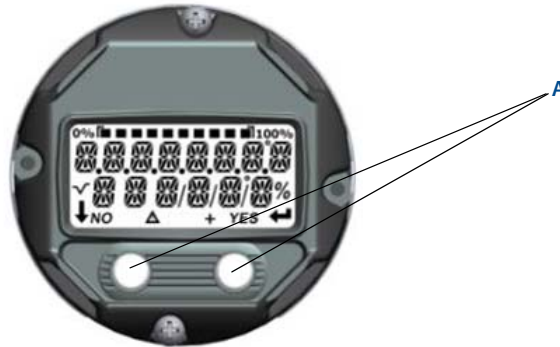
## Configuring with a Local Operator Interface

The LOI requires option code M4 to be ordered. To activate the LOI push either configuration button. Configuration buttons are located on the LCD Display (must remove housing cover to access the interface. See [Table 2-2](#) for configuration button functionality and [Figure 2-3](#) for configuration button location. When using the LOI for configuration, several features require multiple screens for a successful configuration. Data entered will be saved on a screen-by-screen basis; the LOI will indicate this by flashing "SAVED" on the LCD Display each time.

**Note**

Entering into the LOI menu effectively disables the ability to write to the device by any other host or configuration tool. Please make sure this is communicated to necessary personnel before using the LOI for device configuration.

Figure 2-3. LOI configuration buttons



A. Configuration Buttons

Table 2-2. LOI Button Operation

Button	Left	Right
	No	SCROLL
	Yes	ENTER

## Local Operator Interface Password

A Local Operator Interface Password can be entered and enabled to prevent review and modification of device configuration via the LOI. This does not prevent configuration from HART or through the control system. The LOI password is a 4 digit code that is to be set by the user. If the password is lost or forgotten the master password is “9307”. The LOI password can be configured and enabled/disabled by HART communication via a Field Communicator, AMS Device Manager, or the LOI.

Local Operator Interface menu trees are available in [Appendix D: Local Operator Interface \(LOI\)](#).

### 2.4.3 Setting the Loop to Manual

**⚠** When sending or requesting data that would disrupt the loop or change the output of the transmitter, set the process application loop to manual. The Field Communicator, AMS Device Manager or LOI will prompt you to set the loop to manual when necessary. Acknowledging this prompt does not set the loop to manual. **The prompt is only a reminder; set the loop to manual as a separate operation.**

### 2.4.4 Failure Mode

As part of normal operation, each transmitter continuously monitors its own performance. This automatic diagnostics routine is a timed series of checks repeated continuously. If diagnostics detect an input sensor failure or a failure in the transmitter electronics, the transmitter drives its output to low or high depending on the position of the failure mode switch. If the sensor

temperature is outside the range limits, the transmitter saturates its output to 3.9 mA for standard configuration on the low end (3.8 mA if configured for NAMUR-compliant operation) and 20.5 mA on the high end (or NAMUR-compliant). These values are also custom configurable by the factory or using the Field Communicator. The values to which the transmitter drives its output in failure mode depend on whether it is configured to standard, NAMUR-compliant, or custom operation. See “[Hardware and Software Failure Mode](#)” on page 108 for standard and NAMUR-compliant operation parameters.

## 2.4.5 HART Software Lock

The HART Software Lock prevents changes to the transmitter configuration from all sources; all changes requested via HART by the Field Communicator, AMS Device manager or the LOI will be rejected. The HART Lock can only be set via HART communication, and is only available in HART Revision 7 mode. The HART Lock can be enabled or disabled with a Field Communicator or AMS Device Manager.

### Configuring HART Lock using a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 2, 1
-----------------------------------	---------

### Configuring HART Lock using AMS Device Manager

1. Right click on the device and select **Configure**.
2. Under *Manual Setup* select the **Security** tab.
3. Click **Lock/Unlock** button under *HART Lock (Software)* and follow the screen prompts.

## 2.5 Verify configuration

It is recommended that various configuration parameters are verified prior to installation into the process. The various parameters are detailed out for each configuration tool. Depending on what configuration tool(s) are available follow the steps listed relevant to each tool.

### 2.5.1 Verify and review configuration with Field Communicator

Configuration parameters listed in [Figure 2-4](#) below are the basic parameters that should be reviewed prior to transmitter installation. A full list of configuration parameters that can be reviewed and configured using a Field Communicator are located in [Appendix C: Field Communicator Menu Trees and Fast Keys](#). A Rosemount 644 Device Descriptor (DD) must be installed on the Field Communicator to verify configuration.

1. Verify device configuration using fast key sequences in [Figure 2-4](#).

- a. From the *HOME* screen, enter the fast key sequences listed in Figure 2-4.

**Figure 2-4. 644 Device Dashboard Fast Key sequences**

Function	Fast Key Sequence	
	HART 5	HART 7
Alarm Values	2, 2, 5, 6	2, 2, 5, 6
Damping Values	2, 2, 1, 5	2, 2, 1, 6
Lower Range Value (LRV)	2, 2, 5, 5, 3	2, 2, 5, 5, 3
Upper Range Value (URV)	2, 2, 5, 5, 2	2, 2, 5, 5, 2
Primary Variable	2, 2, 5, 5, 1	2, 2, 5, 5, 1
Sensor 1 Configuration	2, 1, 1	2, 1, 1
Sensor 2 Configuration <sup>(1)</sup>	2, 1, 1	2, 1, 1
Tag	2, 2, 7, 1, 1	2, 2, 7, 1, 1
Units	2, 2, 1, 5	2, 2, 1, 4

(1) Available only if option code (S) is ordered

## 2.5.2 Verify and review configuration with AMS Device Manager

Right click on the device and select **Configuration Properties** from the menu. Navigate the tabs to review the transmitter configuration data.

## 2.5.3 Verify and review configuration with Local Operator Interface

Press any configuration button to activate the LOI. Select **VIEW CONFIG** to review the below parameters. Use the configuration buttons to navigate through the menu. The parameters to be reviewed prior to installation include:

- Tag
- Sensor Configuration
- Units
- Alarm and Saturation Levels
- Primary Variable
- Range Values
- Damping

## 2.5.4 Checking transmitter output

Before performing other transmitter on-line operations, review the 644 digital output parameters to ensure that the transmitter is operating properly and is configured to the appropriate process variables.

## Checking or setting process variables

The **Process Variables** menu displays process variables, including sensor temperature, percent of range, analog output, and terminal temperature. These process variables are continuously updated. The default primary variable is Sensor 1. The secondary variable is the transmitter terminal temperature by default.

### Checking process variables with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 2, 1
-----------------------------------	---------

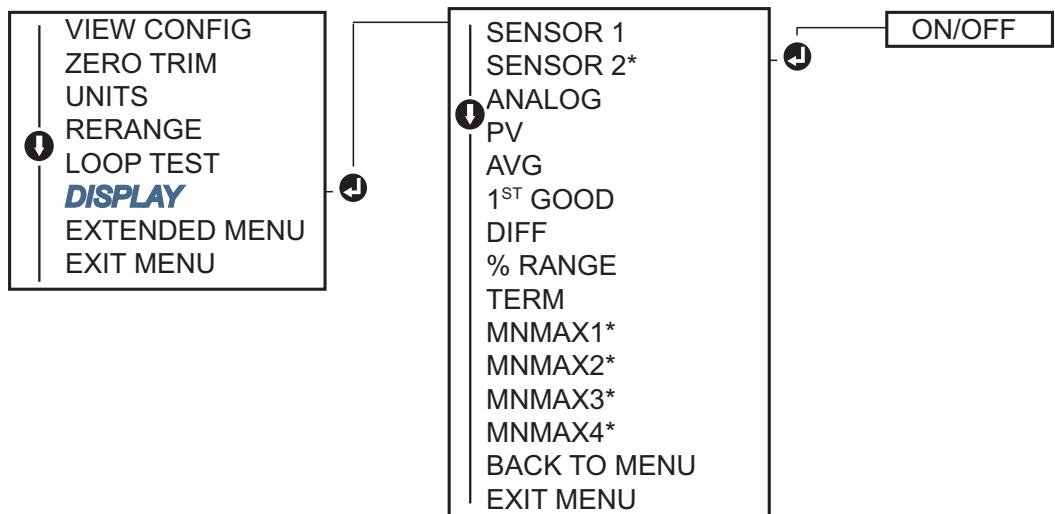
### Checking process variables with AMS Device Manager

Right click on the device and select **Service Tools** from the menu. The *Variables* tab displays the following process variables:

- Primary, Second, Third and Fourth variables, as well as the Analog Output.

### Checking process variables with Local Operator Interface

To check the process variables from the LOI, the user must first configure the display to show the desired variables (see “[Configuring the LCD Display](#)” on page 33). Once the desired device variables are chosen, simply EXIT the LOI menu and view the alternating values on the display screen.



## 2.6 Basic Configuration of the transmitter

The 644 must be configured for certain basic variables in order to be operational. In many cases, all of these variables are pre-configured at the factory. Configuration may be required if the transmitter is not configured or if the configuration variables need revision.

## 2.6.1 Mapping the HART® Variables

### Mapping the HART® Variables with a Field Communicator

The Variable Mapping menu displays the sequence of the process variables. Select the sequence below to change this configuration. The 644 single sensor input configuration screens allow selection of the primary variable (PV) and the secondary variable (SV). When the Select PV screen appears Snsr 1 must be selected.

The 644 dual-sensor option configuration screens allow selection of the primary variable (PV), secondary variable (SV), tertiary variable (TV), and quaternary variable (QV). Variable choices are Sensor 1, Sensor 2, Differential Temperature, Average Temperature, Terminal Temperature, and Not Used. The 4-20 mA analog signal represents the Primary Variable.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 8, 6
-----------------------------------	------------

### Mapping the HART® Variables with AMS Device Manager

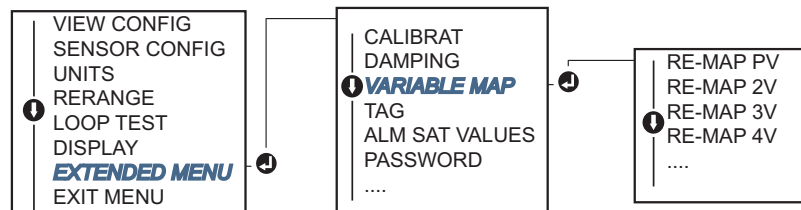
Right click on the device and select the **Configure** menu.

1. In the left navigation pane choose **Manual Setup** then on the **HART tab**.
2. Map each variable individually or use the **Re-map Variables** method to guide you through the re-mapping process.
3. Click **Apply** when complete.

### Mapping the HART® Variables with the Local Operator Interface

Follow flow chart to select the desired mapped variables. Use the **SCROLL** and **ENTER** buttons to select each variable. Save by selecting **SAVE** as indicated on the LCD screen when prompted. See [Figure 2-5 on page 17](#) for an example of a mapped variable with the LOI.

**Figure 2-5. Mapping Variables with LOI**



## 2.6.2 Configuring the Sensor(s)

Sensor configuration includes setting the information for:

- Sensor Type
- Connection Type
- Units
- Damping values
- Sensor Serial Number
- RTD 2-Wire Offset

### Configuring the Sensor(s) with a Field Communicator

The Configure Sensors method will guide you through the configuration of all necessary settings associated with configuring a sensor including:

For a full list of Sensor Types available with the 644 and their associated levels of accuracy, please see [Table A-2 on page 110](#).

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 1, 1
-----------------------------------	---------

### Configuring Sensor(s) with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup** and choose the **Sensor 1** or **Sensor 2** tab depending on the need.
2. Individually select the Sensor Type, Connection, Units and other sensor related information as desired from the drop down menus on the screen.
3. Click **Apply** when complete.

### Configuring the Sensor(s) with the Local Operator Interface

Reference the below image for guidance on where to find Sensor Configuration in the LOI menu.



Figure 2-6. Configuring Sensors with LOI



\* Available only if option code (S) is ordered.

Contact a Emerson Process Management representative for information on the temperature sensors, thermowells, and accessory mounting hardware that is available through Emerson Process Management.

## 2-Wire RTD Offset

The 2-wire Offset feature allows the measured lead wire resistance to be input and corrected for, which results in the transmitter adjusting its temperature measurement for the error caused by this added resistance. Because of a lack of lead wire compensation within the RTD, temperature measurements made with a 2-wire RTD are often inaccurate.

This feature can be configured as a subset of the **Sensor Configuration** process in the Field Communicator, AMS Device Manager, and the Local Operator Interface.

To utilize this feature properly perform the following steps:

1. Measure the lead wire resistance of both RTD leads after installing the 2-Wire RTD and 644.
2. Navigate to the 2-Wire RTD Offset parameter:
3. Enter the total measured resistance of the two RTD leads at the *2-Wire Offset* prompt to ensure proper adjustment. The transmitter will adjust its temperature measurement to correct the error caused by lead wire resistance.

### Enter 2-Wire Offset with Field Communicator:

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 1, 1
-----------------------------------	---------

### Enter 2-Wire Offset with AMS Device Manager:

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup** and choose the **Sensor 1** or **Sensor 2** tab depending on the need. Find the 2-Wire Offset text field and enter the value.
2. Click **Apply** when complete.

## 2.6.3 Setting Output Units

The Units can be configured for a number of different parameters in the 644. Individual Units can be configured for:

- Sensor 1
- Sensor 2
- Terminal Temperature
- Differential Temperature
- Average Temperature
- First Good Temperature

Each of the base parameters and calculated outputs from those values can have a Unit of measure associated with it. Set the transmitter output to one of the following engineering units:

- Degrees Celsius
- Degrees Fahrenheit
- Degrees Rankine
- Kelvin
- Ohms
- Millivolts

### Setting Output Units with a Field Communicator

From the *HOME* screen, enter the fast key sequence

	HART 5	HART 7
<b>Device Dashboard Fast Keys</b>	2, 2, 1, 4	2, 2, 1, 5

### Setting Output Units with AMS Device Manager

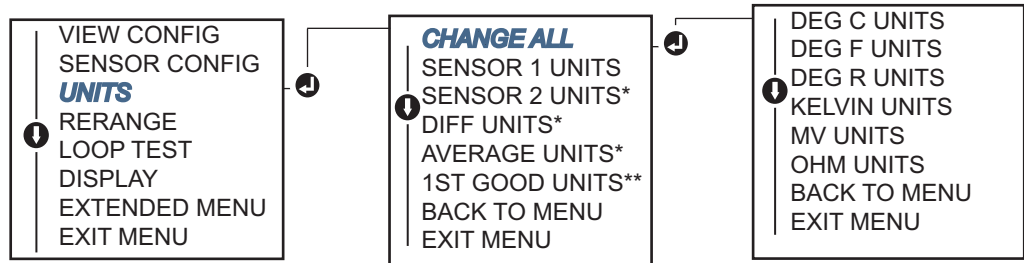
Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**. The unit fields for various variables are spread over the Manual Setup tabs, please click through the tabs and change the desired units.
2. Click **Apply** when complete.

### Setting Output Units with the Local Operator Interface

Reference the below image for where to find the **Units** configuration in the LOI menu.

Figure 2-7. Configuring Units with LOI



\* Available only if option code (S) is ordered.

\*\* Available only if option Codes (S) and (DC) are both ordered.

**Note**

The list of choices available for Units after the primary menu is dependent on your Sensor configuration settings.

## 2.7 Configure Dual Sensor Options

Dual-sensor configuration deals with the functions that can be used with a transmitter ordered with Dual Sensor inputs. In the Rosemount 644 these functions include:

- Differential Temperature
- Average Temperature
- Hot Backup and Sensor Drift Alert Diagnostics (requires option code DC)
  - First Good Temperature (requires options S and DC)

### 2.7.1 Differential Temperature Configuration

The 644 ordered and configured for dual-sensors can accept any two inputs then display the differential temperature between them. Use the following procedures to configure the transmitter to measure differential temperature.

#### Note

This procedure assumes the Differential Temperature is a calculated output of the device but does not re-assign it as the Primary Variable. If it desired for Differential to be the transmitter's primary variable please see Section 2.6.1 Mapping the HART® Variables to set it to PV.

### Differential Temperature Configuration with Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 3, 1
-----------------------------------	------------

### Differential Temperature Configuration with AMS Device Manager

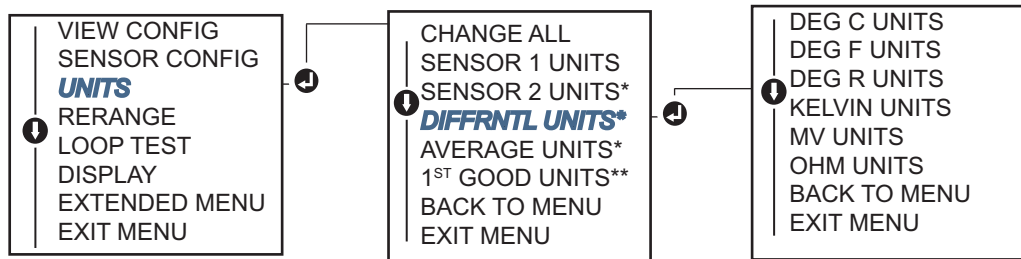
Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Calculated Output Tab** find the **Differential Temperature** group box.
3. Choose Units and Damping settings then click **Apply** when complete.

### Differential Temperature Configuration with Local Operator Interface

To configure the Differential Temperature on the Local Operator Interface you will have to set the Units and Damping values separately. Reference [Figure 2-8](#) and [Figure 2-9](#) below for where to find these in the menu.

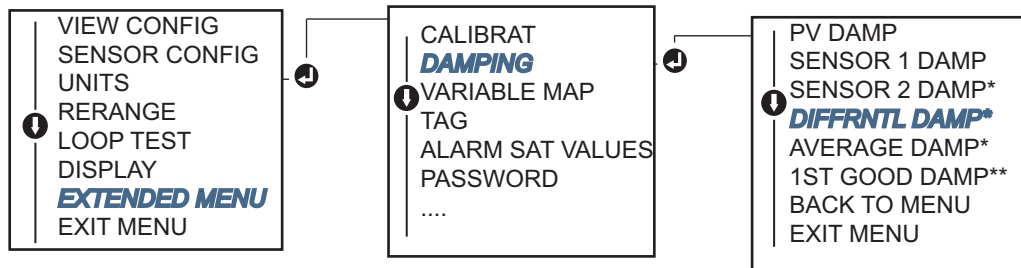
Figure 2-8. Configuring Differential Units with LOI



\* Available only if option code (S) is ordered.

\*\* Available only if option codes (S) and (DC) are both ordered.

Figure 2-9. Configuring Differential Damping with LOI



\* Available only if option code (S) is ordered.

\*\* Available only if option codes (S) and (DC) are both ordered.

## 2.7.2 Average Temperature Configuration

The 644 transmitter ordered and configured for dual-sensors can output and display the Average temperature of any two inputs. Use the following procedures to configure the transmitter to measure the Average temperature:

### Note

This procedure assumes the Average Temperature is a calculated output of the device but does not re-assign it as the Primary Variable. If it desired for Differential to be the transmitter's primary variable please see Section 2.6.1 Mapping the HART® Variables to set it to PV.

## Average Temperature Configuration with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 3, 3
-----------------------------------	------------

## Average Temperature Configuration with AMS Device Manager

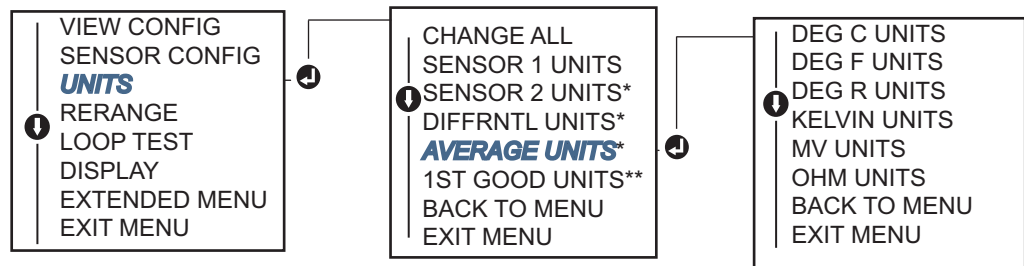
Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Calculated Output Tab** find the *Average Temperature* group box.
3. Choose Units and Damping settings then click **Apply** when complete.

## Average Temperature Configuration with Local Operator Interface

To configure Average Temperature on the Local Operator Interface you will have to set the Units and Damping values separately. Reference [Figure 2-10](#) and [Figure 2-11](#) below for where to find these in the menu.

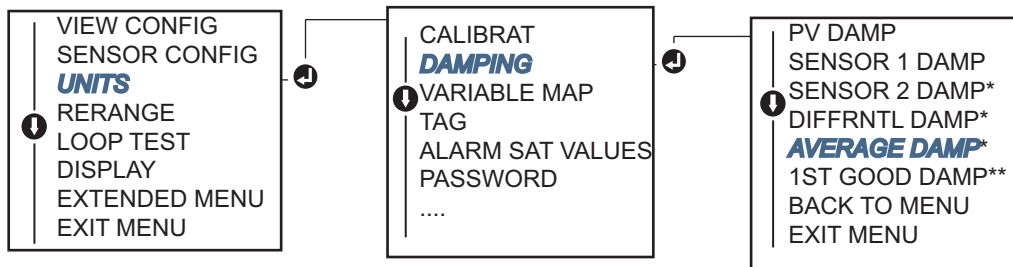
**Figure 2-10. Configuring Average Units with LOI**



\* Available only if option code (S) is ordered.

\*\* Available only if option codes (S) and (DC) are both ordered.

Figure 2-11. Configuring Average Damping with LOI



\* Available only if option code (S) is ordered.

\*\* Available only if option codes (S) and (DC) are both ordered

#### Note

If Sensor 1 and/or Sensor 2 should fail while PV is configured for average temperature and Hot Backup is not enabled, the transmitter will go into alarm. For this reason, it is recommended when PV is Sensor Average, that Hot Backup be enabled when dual-element sensors are used, or when two temperature measurements are taken from the same point in the process. If a sensor failure occurs when Hot Backup is enabled, while PV is Sensor Average, three scenarios could result:

- If Sensor 1 fails, the average will only be reading from Sensor 2, the working sensor
- If Sensor 2 fails, the average will only be reading from Sensor 1, the working sensor
- If both sensors fail simultaneously, the transmitter will go into alarm and the status available (via HART) states that both Sensor 1 and Sensor 2 have failed

In the first two scenarios, the 4-20 mA signal is not disrupted and the status available to the control system (via HART) specifies which sensor has failed.

## 2.7.3 Hot Backup Configuration

The Hot Backup feature configures the transmitter to automatically use Sensor 2 as the primary sensor if Sensor 1 fails. With Hot Backup enabled, the primary variable (PV) must either be First Good or Average. See the “NOTE” directly above for details on using Hot Backup when the PV is set to Average.

Sensors 1 or 2 can be mapped as the secondary variable (SV), tertiary variable (TV), or quaternary variable (QV). In the event of a primary variable (Sensor 1) failure, the transmitter enters Hot Backup mode and Sensor 2 becomes the PV. The 4–20 mA signal is not disrupted, and a status is available to the control system through HART that Sensor 1 has failed. An LCD display, if attached, displays the failed sensor status.

While configured to Hot Backup, if Sensor 2 fails but Sensor 1 is still operating properly, the transmitter continues to report the PV 4–20 mA analog output signal, while a status is available to the control system through HART that Sensor 2 has failed.

## Resetting Hot Backup:

In Hot Backup mode, if Sensor 1 does fail and Hot Backup is initiated, the transmitter will not revert back to Sensor 1 to control the 4–20 mA analog output until the Hot Backup mode is reset by re-enabling through HART, re-setting it through the LOI or by briefly powering down the transmitter.

## Hot Backup Configuration with a Field Communicator

The field communicator will walk you through a method to correctly configure the necessary elements of the Hot Backup feature.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 1, 5
-----------------------------------	---------

## Hot Backup Configuration with AMS Device Manager

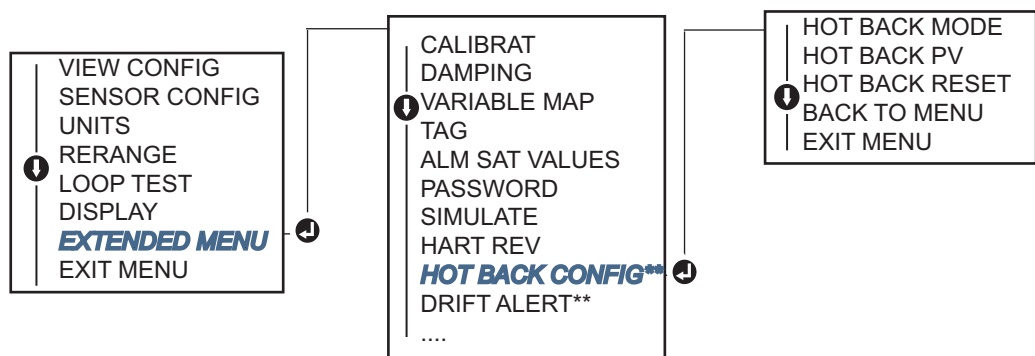
Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the *Diagnostics Tab* find the **Hot Backup** group box.
3. Choose the button “Configure Hot Backup” or “Reset Hot Backup” depending on the desired function and walk through the guided steps.
4. Click **Apply** when complete.

## Hot Backup Configuration with Local Operator Interface

To configure Hot Backup on the Local Operator Interface, you will have to Enable the Mode and set the PV values. Reference [Figure 2-12](#) below for where to find these in the menu.

**Figure 2-12. Configuring Hot Backup with LOI**



\* Available only if option code (S) is ordered.

\*\* Available only if option Codes (S) and (DC) are both ordered.



For information on using Hot Backup in conjunction with the HART Tri-Loop see “Using the transmitter with the HART Tri-Loop” on page 46.

## 2.7.4 Sensor Drift Alert Configuration

The Sensor Drift Alert command allows the transmitter to set a warning flag (through HART), or go into analog alarm when the temperature difference between Sensor 1 and Sensor 2 exceeds a user-defined limit.

This feature is useful when measuring the same process temperature with two sensors, ideally when using a dual-element sensor. When Sensor Drift Alert mode is enabled, the user sets the maximum allowable difference, in engineering units, between Sensor 1 and Sensor 2. If this maximum difference is exceeded, a Sensor Drift Alert warning flag will be set.

Though it defaults to WARNING, when configuring the transmitter for Sensor Drift Alert, the user also has the option of specifying that the analog output of the transmitter go into ALARM when sensor drifting is detected.

### Note

Using dual sensor configuration in the 644, the temperature transmitter supports the configuration and simultaneous use of Hot Backup and Sensor Drift Alert. If one sensor fails, the transmitter switches output to use the remaining good sensor. Should the difference between the two sensor readings exceed the configured threshold, the AO will go to alarm indicating the sensor drift condition. The combination of Sensor Drift Alert and Hot Backup improves sensor diagnostic coverage while maintaining a high level of availability. Refer to the 644 FMEDA report for the impact on safety.

## Sensor Drift Alert Configuration with a Field Communicator

The field communicator will walk you through a method to correctly configure the necessary elements of a Sensor Drift Alert feature.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 1, 6
-----------------------------------	---------

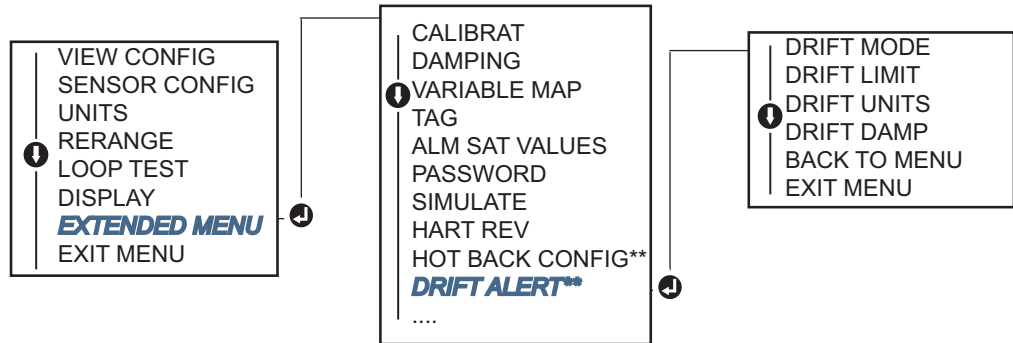
## Sensor Drift Alert Configuration with AMS Device Manager

1. Right click on the device and select **Configure**.
2. On the **Diagnostics Tab** find the **Sensor Drift Alert** group box.
3. Choose to **Enable** the **Mode** and fill in the **Units**, **Threshold** and **Damping** values from the drop downs provided or click the “**Configure Sensor Drift Alert**” button and walk through the guided steps.
4. Click **Apply** when complete.

## Sensor Drift Alert Configuration with Local Operator Interface

To configure Sensor Drift Alert on the Local Operator Interface you will have to Enable the Mode, set the PV, set the Drift Limit and set a value for Drift Alert Damping all separately. Reference [Figure 2-13](#) below for where to find these in the menu.

Figure 2-13. Configuring sensor drift alert with LOI



\* Available only if option code (S) is ordered.

\*\* Available only if option Codes (S) and (DC) are both ordered.

**Note**

Enabling the Drift Alert Option to WARNING will set a flag (through the HART communications) whenever the maximum acceptable difference between Sensor 1 and Sensor 2 has been exceeded. For the transmitter's analog signal to go into ALARM when Drift Alert is detected, select Alarm during the configuration process.

## 2.8 Configure Device Outputs

### 2.8.1 Rerange the transmitter

⚠ Reranging the transmitter sets the measurement range to the limits of the expected readings for a certain application. Setting the measurement range to the limits of expected readings maximizes transmitter performance; the transmitter is most accurate when operated within the expected temperature range for the application.

The range of expected readings is defined by the Lower Range Value (LRV) and Upper Range Value (URV). The transmitter range values can be reset as often as necessary to reflect changing process conditions. For a complete listing of Range & Sensor limits, refer to [Table A-2 on page 110](#).

**Note**

The rerange functions should not be confused with the trim functions. Although the rerange function matches a sensor input to a 4–20 mA output, as in conventional calibration, it does not affect the transmitter's interpretation of the input.

Select from one of the methods below to rerange the transmitter.

## Rerange the transmitter with a Field Communicator

From the *HOME* screen, enter the fast key sequence **Lower Range Value** **Upper Range Value**

Device Dashboard Fast Keys	Lower Range Value	Upper Range Value
	2, 2, 5, 5, 3	2, 2, 5, 5, 2

## Rerange the transmitter with AMS Device Manager

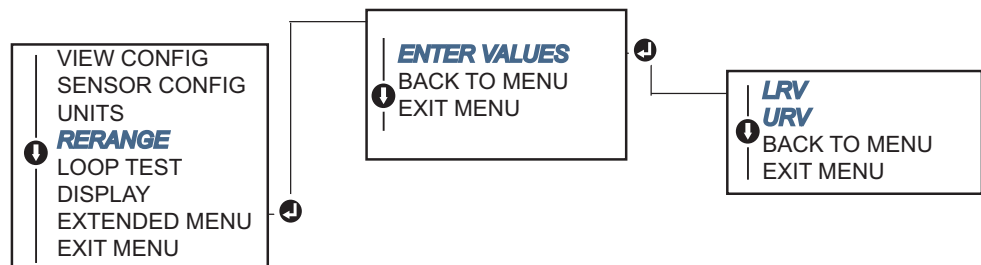
Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Analog Output Tab** find the Primary Variable Configuration group box.
3. Change the **Upper Range Value** and **Lower Range Value** to their desired settings.
4. Click **Apply** when complete.

## Rerange the transmitter with Local Operator Interface

Please reference the image below to find the Range Value configuration path on the LOI.

Figure 2-14. Reranging the transmitter with LOI



### 2.8.2

## Damping

The Damping function changes the response time of the transmitter to smooth variations in output readings caused by rapid changes in input. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the loop dynamics of the system. The default damping value is 5.0 seconds and can be reset to any value between 1 and 32 seconds.

The value chosen for damping affects the response time of the transmitter. When set to zero (disabled), the damping function is off and the transmitter output reacts to changes in input as quickly as the intermittent sensor algorithm allows. Increasing the damping value increases transmitter response time.

With damping enabled, if the temperature change is within 0.2% of the sensor limits, the transmitter measures the change in input every 500 milliseconds (for a single sensor device) and outputs values according to the following relationship:

$$\text{Damped Value} = (N - P) \times \left( \frac{2T - U}{2T + U} \right) + P$$

P = previous damped value

N = new sensor value

T = damping time constant

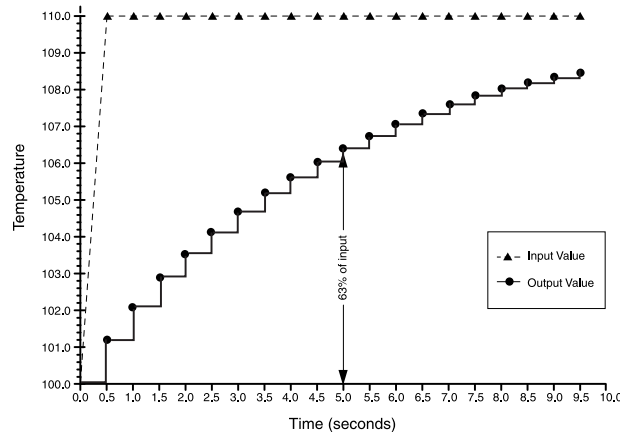
U = update rate

At the value to which the damping time constant is set, the transmitter output is at 63% of the input change and it continues to approach the input according to the damping equation above.

For example, as illustrated in [Figure 2-15](#), if the temperature undergoes a step change—within 0.2% of the sensor limits—from 100 degrees to 110 degrees, and the damping is set to 5.0 seconds, the transmitter calculates and reports a new reading every 500 milliseconds using the damping equation. At 5.0 seconds, the transmitter outputs 106.3 degrees, or 63% of the input change, and the output continues to approach the input curve according to the equation above.

For information regarding the damping function when the input change is greater than 0.2% of the sensor limits, refer to [“Intermittent sensor detection”](#) on page 37.

**Figure 2-15. Change in Input vs. Change in Output with Damping Set to 5 Seconds**



Damping can be applied to a number of parameters in the 644 transmitter. Variables that can be damped are:

- Primary Variable (PV)
- Sensor 1
- Sensor 2
- Differential Temperature
- Average Temperature
- 1st Good Temperature

**Note**

The instructions below only refer to the damping of the Primary Variable (PV).

## Damping the transmitter with a Field Communicator

From the *HOME* screen, enter the fast key sequence

	HART 5	HART 7
<b>Device Dashboard Fast Keys</b>	2, 2, 1, 5	2, 2, 1, 6

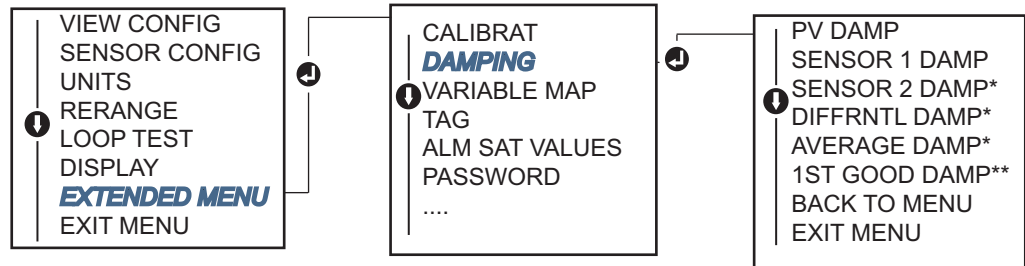
## Damping the transmitter with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Sensor 1** Tab find the Setup group box.
3. Change the **Damping Value** to the desired setting.
4. Click **Apply** when complete.

## Damping the transmitter with Local Operator Interface

Please reference the figure below to find the Damping configuration path on the LOI.



### 2.8.3 Configure Alarm and Saturation Levels

In normal operation, the transmitter will drive the output in response to measurements between the lower to upper saturation points. If the temperature goes outside the sensor limits, or if the output would be beyond the saturation points, the output will be limited to the associated saturation point.

The 644 transmitter automatically and continuously performs self-diagnostic routines. If the self-diagnostic routines detect a failure, the transmitter drives the output to configured alarm value based on the position of the alarm switch. The Alarm and Saturation settings allow the alarm settings (Hi or Low) and saturation values to be viewed and changed.

Failure mode alarm and saturation levels can be configured using a Field Communicator, AMS Device Manager, and the LOI. The following limitations exist for custom levels:

- The low alarm value must be less than the Low Saturation level.
- The high alarm value must be higher than the High Saturation level.
- Alarm and Saturation levels must be separated by at least 0.1 mA

The configuration tool will provide an error message if the configuration rule is violated.

Please see [Table 2-3](#), [Table 2-4](#), and [Table 2-5](#) below for the common Alarm and Saturation levels.

**Table 2-3. Rosemount alarm and saturation values**

Level	4–20 mA saturation	4–20 mA alarm
Low	3.9 mA	≤ 3.75 mA
High	20.5 mA	≥ 21.75 mA

**Table 2-4. NAMUR-Compliant alarm and saturation values**

Level	4–20 mA saturation	4–20 mA alarm
Low	3.8 mA	≤ 3.6 mA
High	20.5 mA	≥ 22.5 mA

**Table 2-5. Custom Alarm and Saturation Values**

Level	4–20 mA saturation	4–20 mA alarm
Low	3.7 mA - 3.9 mA	3.6 mA - 3.8 mA
High	20.1 mA - 22.9 mA	20.2 mA - 23.0 mA

**Note**

Transmitters set to HART multidrop mode send all saturation and alarm information digitally; saturation and alarm conditions will not affect the analog output.

## Configuring Alarm and Saturation Levels with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 5, 6
-----------------------------------	------------

## Configuring Alarm and Saturation Levels with AMS Device Manager

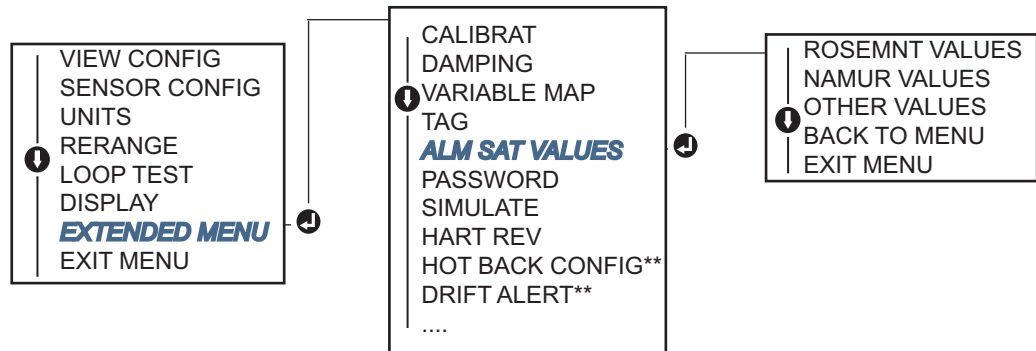
Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Analog Output** Tab find the Alarm and Saturation Levels group box.
3. Enter the High Alarm, High Saturation, Low Saturation and Low Alarm levels to the desired vales.
4. Click **Apply** when complete.

## Configuring Alarm and Saturation Levels with the Local Operator Interface

Please reference the figure below to find the Alarm and Saturation value configuration path on the LOI.

Figure 2-16. Configuring Alarm and Saturation Values with LOI



\* Available only if option code (S) is ordered.

\*\* Available only if option Codes (S) and (DC) are both ordered.

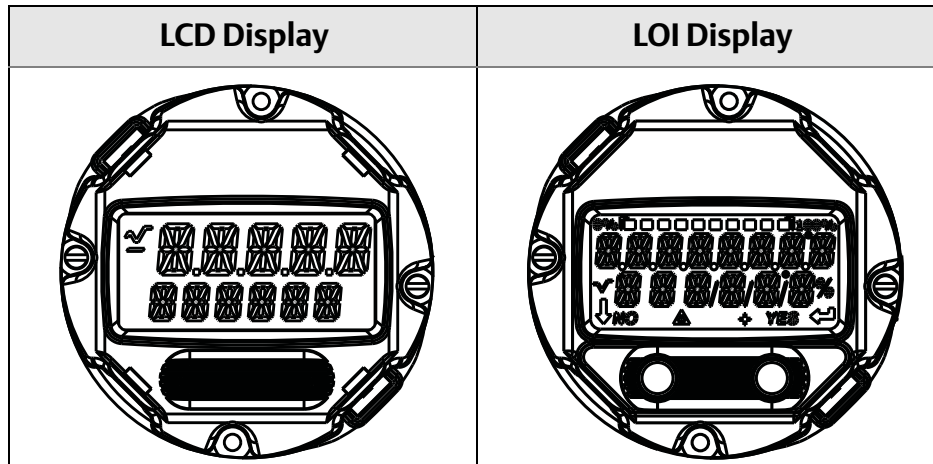
### 2.8.4 Configuring the LCD Display

The LCD Display configuration command allows customization of the LCD to suit application requirements. The LCD will alternate between the selected items with each item displaying for a 3 second interval.

- Sensor 1
- Sensor 2
- Analog Output
- Primary Variable
- Average Temperature
- First Good Temperature
- Differential Temperature
- Percent of Range
- Terminal Temperature
- Min and Max 1
- Min and Max 2
- Min and Max 3
- Min and Max 4

Reference [Figure 2-17](#) to view the differences between the LCD and Local Operator Interface display options available with the 644.

Figure 2-17. LCD Display and Local Operator Interface Display



## Configuring LCD Display with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 1, 4
-----------------------------------	---------

## Configuring LCD Display with AMS Device Manager

Right click on the device and select **Configure**.

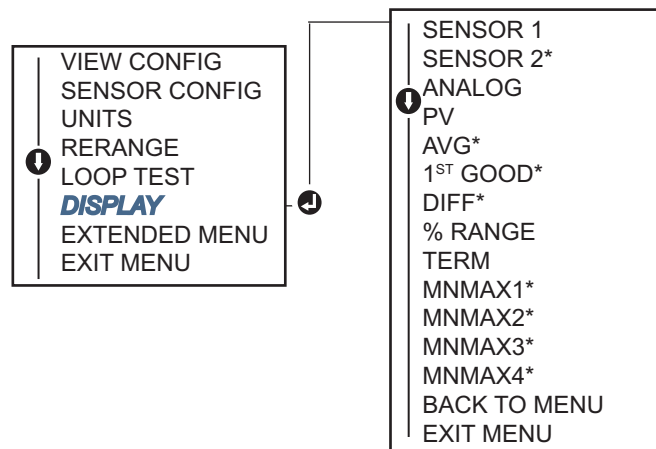
1. In the left navigation pane choose **Manual Setup**.
2. On the **Display** Tab there will be a group box with all available variables that can be displayed.
3. Check and un-check the desired display variables, with a checked box indicating that the variable will be displayed.
4. Click **Apply** when complete.

## Configuring LCD Display with the Local Operator Interface

Please reference the figure below to find the Alarm and Saturation value configuration path on the LOI.



Figure 2-18. Configuring the LCD Display with the LOI



\* Available only if option code (S) is ordered.

## 2.9 Inputting device information

Access the transmitter information variables online using the Field Communicator or other suitable communications device. The following is a list of transmitter information variables, including device identifiers, factory-set configuration variables, and other information.

### 2.9.1 Tag, date, descriptor and message

The *Tag*, *Date*, *Descriptor* and *Message* are parameters that provide transmitter identification in large installations. See below for a description and a process to enter these pieces of configurable device information.

The **Tag** variable is the easiest way to identify and distinguish between different transmitters in multi-transmitter environments. It is used to label transmitters electronically according to the requirements of the application. The defined Tag is automatically displayed when a HART-based communicator establishes contact with the transmitter at power-up. The Tag is up to 8 characters and the Long Tag (a parameter introduced with the HART 6 and 7 protocol) was extended to 32 characters long. Neither parameter has any impact on the primary variable readings of the transmitter, it is only for information.

The **Date** is a user-defined variable that provides a place to save the date of the last revision of configuration information. It has no impact on the operation of the transmitter or the HART-based communicator.

The **Descriptor** variable provides a longer user-defined electronic label to assist with more specific transmitter identification than is available with tag. The descriptor may be up to 16 characters long and has no impact on the operation of the transmitter or the HART-based communicator.

The **Message** variable provides the most specific user-defined means for identifying individual transmitters in multi-transmitter environments. It allows for 32 characters of information and is

stored with the other configuration data. The message variable has no impact on the operation of the transmitter or the HART-based communicator.

## Configuring Device Information with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	1, 8
-----------------------------------	------

## Configuring Device Information with AMS Device Manager

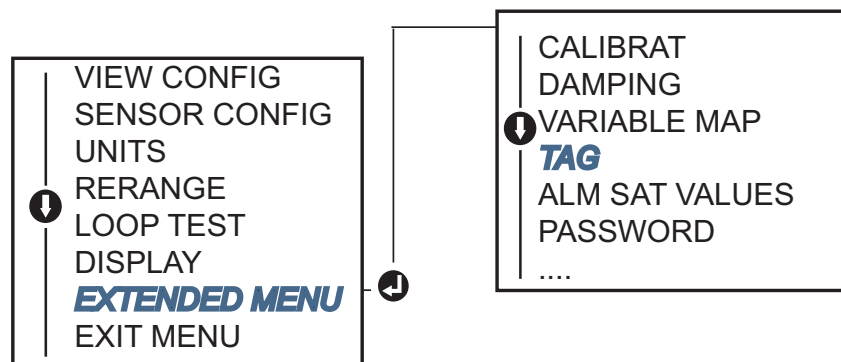
Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Device** Tab there will be a group box called Identification, in the box find the fields **Tag**, **Date**, **Descriptor** and **Message**, and enter the desired characters.
3. Click **Apply** when complete.

## Configuring Tag with the Local Operator Interface

Please reference the figure below to find the Tag configuration path in the LOI.

Figure 2-19. Configuring the Tag with LOI



## 2.10 Configure measurement filtering

### 2.10.1 50/60 Hz filter

The 50/60 Hz Filter (also known as Line Voltage Filter or AC Power Filter) function sets the transmitter electronic filter to reject the frequency of the AC power supply in the plant. The 60 Hz or 50 Hz mode can be chosen. The factory default for this setting is 60 Hz.

---

**Note**

In high noise environments, normal mode is recommended.

---

## Configuring 50/60 Hz filter with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 7, 4, 1
-----------------------------------	---------------

## Configuring 50/60 Hz filter with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Device** Tab there will be a group box called **Noise Rejection**, in the box **AC Power Filter** choose from the drop down menu.
3. Click **Apply** when complete.

### 2.10.2 Resetting the device

**Processor Reset** function resets the electronics without actually powering down the unit. It does not return the transmitter to the original factory configuration.

## Performing a Processor Reset with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 4, 6, 1
-----------------------------------	------------

## Performing a Processor Reset AMS Device Manager

Right click on the device and select **Service Tools**.

1. In the left navigation pane choose **Maintenance**.
2. On the **Reset/Restore** Tab click the **Processor Reset** button.
3. Click **Apply** when complete.

### 2.10.3 Intermittent sensor detection

The **Intermittent Sensor Detection** feature (also known as the Transient Filter) is designed to guard against erratic process temperature readings caused by intermittent open sensor conditions. An intermittent sensor condition is an open sensor condition that lasts less than one update. By default, the transmitter is shipped with the Intermittent Sensor Detection feature switched **ON** and the threshold value set at 0.2% of sensor limits. The Intermittent Sensor Detect feature can be switched **ON** or **OFF** and the threshold value can be changed to any value between 0 and 100% of the sensor limits with a Field Communicator.

When the Intermittent Sensor Detection feature is switched **ON**, the transmitter can eliminate the output pulse caused by intermittent open sensor conditions. Process temperature changes

(T) within the threshold value will be tracked normally by the transmitter's output. A (T) greater than the threshold value will activate the intermittent sensor algorithm. True open sensor conditions will cause the transmitter to go into alarm.

The threshold value of the 644 should be set at a level that allows the normal range of process temperature fluctuations; too high and the algorithm will not be able to filter out intermittent conditions; too low and the algorithm will be activated unnecessarily. The default threshold value is 0.2% of the sensor limits.

When the Intermittent Sensor Detection feature is switched **OFF**, the transmitter tracks all process temperature changes, even from an intermittent sensor. (The transmitter in effect behaves as though the threshold value had been set at 100%.) The output delay due to the intermittent sensor algorithm will be eliminated.

## Configure Intermittent Sensor Detection with a Field Communicator

The following steps indicate how to turn the Intermittent Sensor Detect or Transient Filter feature **ON** or **OFF**. When the transmitter is connected to a Field Communicator, use the fast key sequence and choose **ON** (normal setting) or **OFF**.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 7, 4, 2
-----------------------------------	---------------

The threshold value can be changed from the default value of 0.2%. Turning the Intermittent Sensor Detect feature **OFF** or leaving it **ON** and increasing the threshold value above the default does not affect the time needed for the transmitter to output the correct alarm signal after detecting a true open sensor condition. However, the transmitter may briefly output a false temperature reading for up to one update in either direction up to the threshold value (100% of sensor limits if Intermittent Sensor Detect is **OFF**). Unless a rapid response rate is necessary, the suggested setting is **ON** with 0.2% threshold.

## Configure Intermittent Sensor Detection with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Device** Tab there will be a group box called Noise Rejection, in the box **Transient Filter Threshold**, enter the desired percent.
3. Click **Apply** when complete.

### 2.10.4 Open sensor holdoff

The **Open Sensor Holdoff** option, at the normal setting, enables the 644 to be more robust under heavy EMI conditions. This is accomplished by the software having the transmitter perform additional verification of the open sensor status prior to activating the transmitter alarm. If the additional verification shows that the open sensor condition is not valid, the transmitter will not go into alarm.

For users of the 644 that desire a more vigorous open sensor detection, the Open Sensor Holdoff option can be changed to a fast setting where the transmitter will report an open sensor condition without additional verification of whether or not the open condition is valid.

## Configure open sensor hold off with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 7, 3
-----------------------------------	------------

## Configure Open Sensor Hold Off with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup**.
2. On the **Device** Tab there will be a group box called Open Sensor Hold Off. Change the Mode to either **Normal** or **Fast**.
3. Click **Apply** when complete.

## 2.11 Diagnostics and service

### 2.11.1 Performing a loop test

The Analog **Loop Test** verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. To initiate a loop test, follow the steps below.

The host system may provide a current measurement for the 4-20 mA HART output. If not, connect a reference meter to the transmitter by either connecting the meter to the test terminals on the terminal block, or shunting transmitter power through the meter at some point in the loop.

### Performing a loop test with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 5, 1
-----------------------------------	---------

### Performing a loop test with AMS Device Manager

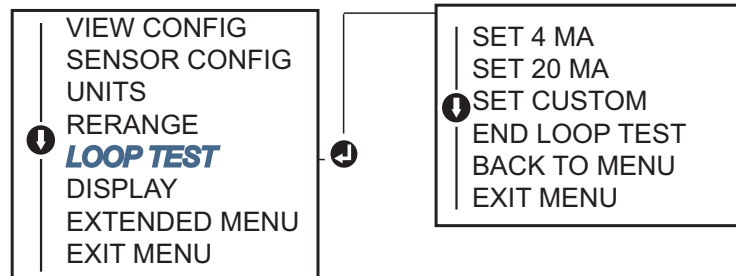
Right click on the device and select **Service Tools**.

1. In the left navigation pane choose **Simulate**.
2. On the **Simulate** Tab find the **Perform Loop Test** button in the **Analog Output Verification** group box.
3. Follow the guided instructions and click **Apply** when complete.

## Performing a loop test with the Local Operator Interface

Please reference the figure below to find the path to the Loop Test in the LOI menu.

Figure 2-20. Performing a Loop Test with the LOI



### 2.11.2 Simulate digital signal (Digital Loop Test)

The **Simulate Digital Signal** function adds to the analog loop test by confirming the HART output values are outputting correctly. Digital Loop Test is only available in HART Revision 7 mode.

#### Simulate digital signal with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 5, 2
-----------------------------------	---------

#### Simulate digital signal with AMS Device Manager

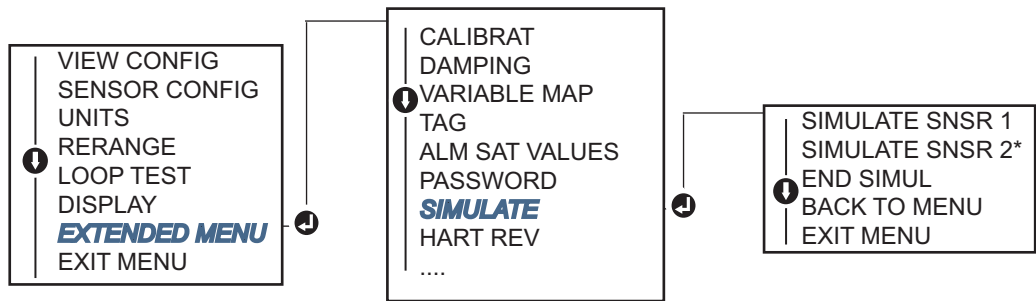
Right click on the device and select **Service Tools**.

1. In the left navigation window select **Simulate**.
2. In the group box labeled **Device Variables** choose the variable to simulate.
  - a. Sensor 1 Temperature
  - b. Sensor 2 Temperature (only available with option S)
3. Follow the screen prompts to simulate selected digital value.

#### Simulate digital signal with the Local Operator Interface

Please reference the figure below to find the path to the Simulate Digital Signal in the LOI menu.

Figure 2-21. Simulating the Digital Signal with LOI



\* Available only if option code (S) is ordered.

### 2.11.3 Thermocouple Degradation Diagnostic

Thermocouple Degradation Diagnostic acts as a gauge of the general health of the thermocouple and is indicative of any major changes in the status of the thermocouple or the thermocouple loop. The transmitter monitors the resistance of the thermocouple loop to detect drift conditions or wiring condition changes. The transmitter uses a baseline and threshold Trigger value and reports the suspected status of the thermocouple based off the difference between these values. This feature is not intended to be a precise measurement of thermocouple status, but is a general indicator of thermocouple and thermocouple loop health.

Thermocouple diagnostic must be Enabled as well as connected and configured to read a thermocouple type sensor. Once the diagnostic has been activated, a Baseline Resistance value is calculated. Then a Trigger threshold must be selected, which can be two, three, or four times the Baseline resistance, or the default of 5000 ohms. If the thermocouple loop resistance reaches the Trigger Level, a maintenance alert is generated.

#### **CAUTION**

The Thermocouple Degradation Diagnostic monitors the health of the entire thermocouple loop, including wiring, terminations, junctions, and the sensor itself. Therefore, it is imperative that the diagnostic baseline resistance be measured with the sensor fully installed and wired in the process, and not on the bench.

#### **Note**

The thermocouple resistance algorithm does not calculate resistance values while the active calibrator mode is enabled.

## Configure T/C Diagnostic with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 4, 3, 4
-----------------------------------	---------------

## Configure T/C Diagnostic with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation window select **Manual Setup**.
2. On the Diagnostics tab, there is a group box labeled **Sensor and Process Diagnostics**; choose the button for **Configure Thermocouple Diagnostic**.
3. Follow the screen prompts to Enable and set the values for the diagnostic.

### *Glossary of AMS Terms*

**Resistance:** This is the existing resistance reading of the thermocouple loop.

**Resistance Threshold Exceeded:** The check box indicates if the sensor resistance has passed the Trigger Level.

**Trigger Level:** Threshold resistance value for the thermocouple loop. The Trigger Level may be set for 2, 3, or 4 x Baseline or the default of 5000 Ohms. If the resistance of the thermocouple loop surpasses the Trigger Level, a maintenance alert will be generated.

**Baseline Resistance:** The resistance of the thermocouple loop obtained after installation, or after resetting the Baseline value. The Trigger Level may be calculated from the Baseline Value.

**Reset Baseline Resistance:** Launches a method to recalculate the Baseline value (which may take several seconds).

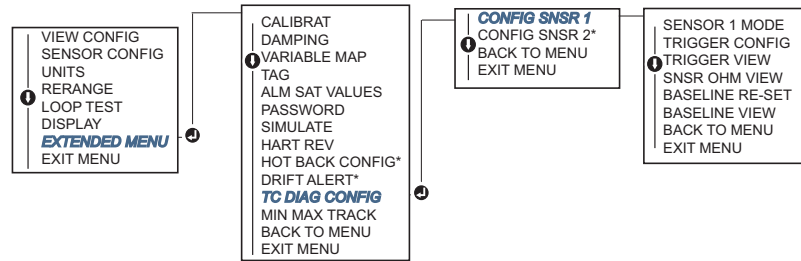
**TC Diagnostic Mode Sensor 1 or 2:** This field will read either Enabled or Disabled indicating when the Thermocouple Degradation Diagnostic is on or off for that sensor.

## Configure T/C Diagnostic with the Local Operator Interface

Please reference the figure below to find the path to the Thermocouple Diagnostic in the LOI menu.



Figure 2-22. Configuring T/C Diagnostic with LOI



\* Available only if option code (S) is ordered.

## 2.11.4 Minimum/Maximum tracking diagnostic

Minimum and Maximum Temperature Tracking (Min/Max Tracking) when enabled records minimum and maximum temperatures with date and time stamps on Rosemount 644 HART Head mount Temperature Transmitters. This feature records values for Sensor 1, Sensor 2, Differential, Average, First Good and Terminal temperatures. Min/Max Tracking only records temperature maxima and minima obtained since the last reset, and is not a logging function.

To track maximum and minimum temperatures, Min/Max Tracking must be enabled using a Field Communicator, AMS Device Manager, Local Operator Interface, or other communicator. While enabled, this feature allows for a reset of information at any time, and all variables can be reset simultaneously. Additionally, each of the individual parameter's minimum and maximum values may be reset individually. Once a particular field has been reset, the previous values are overwritten.

### Configure min/max tracking with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 4, 3, 5
-----------------------------------	---------------

### Configure min/max tracking with a AMS Device Manager

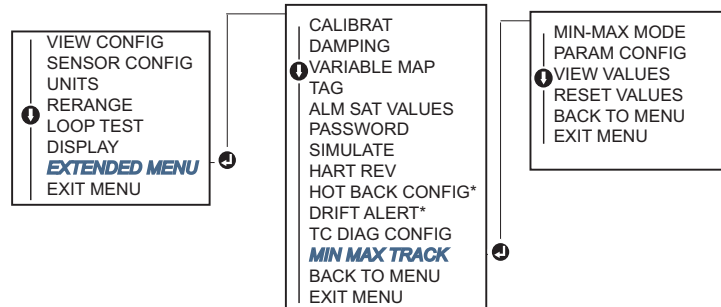
Right click on the device and select **Configure**.

1. In the left navigation window select **Manual Setup**.
2. On the Diagnostics tab, there is a group box labeled **Sensor and Process Diagnostics**; choose the button for **Configure Min/Max Tracking**.
3. Follow the screen prompts to Enable and configure the settings for the diagnostic.

## Configure Min/Max with the Local Operator Interface

Please reference the figure below to find the path to the Thermocouple Diagnostic in the LOI menu.

Figure 2-23. Configuring Min/Max Tracking with LOI



\* Available only if option code (S) is ordered.

## 2.12 Establishing multidrop communication

*Multidropping* refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated.

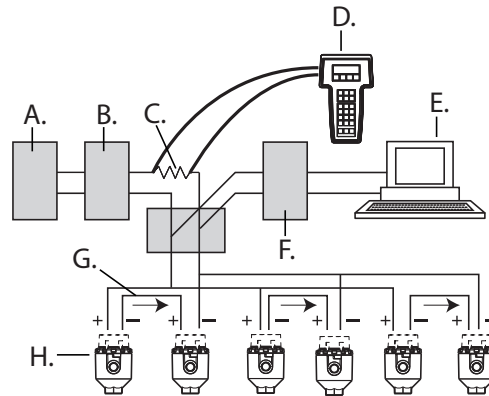
Many Rosemount transmitters can be multidropped. With the HART communications protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines.

A Field Communicator can test, configure, and format a multidropped 644 transmitter in the same way as in a standard point-to-point installation. The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Each transmitter is identified by a unique address (1–15) and responds to the commands defined in the HART protocol. A HART-based communicator can test, configure, and format a multidropped 644 transmitter the same as in a standard point-to-point installation.

### Note

Multidrop is not suitable for safety-certified applications and installations.

Figure 2-24. Typical Multidropped Network



- A. Power supply
- B. Power supply impedance
- C. 250  $\Omega$
- D. Handheld terminal
- E. Computer or DCS
- F. HART Interface
- G. 4-20 mA
- H. 644 HART transmitter

**Note**

644 transmitters are set to address 0 at the factory, allowing them to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter address must be changed to a number between 1 and 15. This change deactivates the 4–20 mA analog output, sending it to 4 mA. The failure mode current also is disabled.

## 2.12.1 Changing a transmitter address

To activate multidrop communication, the transmitter poll address must be assigned a number from 1 to 15 for HART Revision 5, and 1-63 for HART Revision 7. Each transmitter in a multidropped loop must have a unique poll address.

### Changing transmitter address with a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	1, 2, 1
-----------------------------------	---------

### Changing transmitter address with AMS Device Manager

Right click on the device and select **Configuration Properties** from the menu.

1. In HART Revision 5 mode:
  - a. In the HART tab, enter poll address into the **Polling Address** box, click **Apply**.
2. In HART Revision 7 mode:
  - a. In the HART tab, click the **Change Polling Address** button.

## 2.13 Using the transmitter with the HART Tri-Loop

To prepare the 644 transmitter with dual-sensor option for use with a Rosemount 333 HART Tri-Loop, the transmitter must be configured to Burst Mode and the process variable output order must be set. In Burst Mode, the transmitter provides digital information for the four process variables to the HART Tri-Loop. The HART Tri-Loop divides the signal into separate 4–20 mA loops for up to three of the following choices:

- Primary Variable (PV)
- Secondary Variable (SV)
- Tertiary Variable (QV)
- Quaternary Variable (QV)

When using the 644 transmitter with dual-sensor option in conjunction with the HART Tri-Loop, consider the configuration of the differential, average, first good temperatures, Sensor Drift Alert, and Hot Backup features (if applicable).

---

### Note

The procedures are to be used when the sensors and transmitters are connected, powered, and functioning properly. Also, a Field Communicator must be connected and communicating to the transmitter control loop. For communicator usage instructions, see “[Configuring with a Field Communicator](#)” on page 11.

---

### 2.13.1 Set the transmitter to Burst Mode

To set the transmitter to burst mode, follow the steps below with the Fast Key sequence:

#### Setting the Burst Mode with a Field Communicator

From the *HOME* screen, enter the fast key sequence

	HART 5	HART 7
<b>Device Dashboard Fast Keys</b>	2, 2, 8, 4	2, 2, 8, 5

#### Setting the Burst Mode with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation window select **Manual Setup**.
2. On the **HART** tab find the Burst Mode Configuration group box and fill in the necessary content.
3. Click **Apply** when complete.

### 2.13.2 Set Process Variable Output Order

To set the process variable output order, follow the steps in one of the methods outlined in “[Mapping the HART® Variables](#)” on page 17 .

---

**Note**

Take careful note of the process variable output order. The HART Tri-Loop must be configured to read the variables in the same order.

---

## Special Considerations

To initiate operation between a 644 transmitter with dual-sensor option and the HART Tri-Loop, consider the configuration of both the differential, average and first good temperatures, Sensor Drift Alert, and Hot Backup features (if applicable).

## Differential Temperature Measurement

To enable the differential temperature measurement feature of a dual-sensor 644 operating in conjunction with the HART Tri-Loop, adjust the range end points of the corresponding channel on the HART Tri-Loop to include zero. For example, if the secondary variable is to report the differential temperature, configure the transmitter accordingly (see [“Mapping the HART® Variables” on page 17](#)) and adjust the corresponding channel of the HART Tri-Loop so one range end point is negative and the other is positive.

## Hot Backup

To enable the Hot Backup feature of a 644 transmitter with dual-sensor option operating in conjunction with the HART Tri-Loop, ensure that the output units of the sensors are the same as the units of the HART Tri-Loop. Use any combination of RTDs or thermocouples as long as the units of both match the units of the HART Tri-Loop.

## Using the Tri-Loop to Detect Sensor Drift Alert

The dual-sensor 644 transmitter sets a failure flag (through HART) whenever a sensor failure occurs. If an analog warning is required, the HART Tri-Loop can be configured to produce an analog signal that can be interpreted by the control system as a sensor failure.

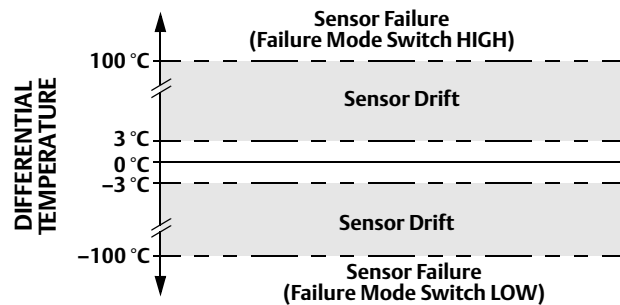
Use these steps to set up the HART Tri-Loop to transmit sensor failure alerts.

1. Configure the dual-sensor 644 variable map as shown.

Variable	Mapping
PV	Sensor 1 or Sensor Average
SV	Sensor 2
TV	Differential Temperature
QV	As Desired

2. Configure Channel 1 of the HART Tri-Loop as TV (differential temperature). If either sensor should fail, the differential temperature output will be +9999 or -9999 (high or low saturation), depending on the position of the Failure Mode Switch (see “Alarm Switch (HART)” on page 15).
3. Select temperature units for Channel 1 that match the differential temperature units of the transmitter.
4. Specify a range for the TV such as -100 to 100 °C. If the range is large, then a sensor drift of a few degrees will represent only a small percent of range. If Sensor 1 or Sensor 2 fails, the TV will be +9999 (high saturation) or -9999 (low saturation). In this example, zero is the midpoint of the TV range. If a  $\Delta T$  of zero is set as the lower range limit (4 mA), then the output could saturate low if the reading from Sensor 2 exceeds the reading from Sensor 1. By placing a zero in the middle of the range, the output will normally stay near 12 mA, and the problem will be avoided.
5. Configure the DCS so that  $TV < -100\text{ }^{\circ}\text{C}$  or  $TV > 100\text{ }^{\circ}\text{C}$  indicates a sensor failure and, for example,  $TV \leq -3\text{ }^{\circ}\text{C}$  or  $TV \geq 3\text{ }^{\circ}\text{C}$  indicates a drift alert. See Figure 2-25.

Figure 2-25. Tracking Sensor Drift and Sensor Failure with Differential Temperature



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# Section 3 Hardware installation

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<b>Safety Messages</b> .....	<b>page 49</b>
<b>Considerations</b> .....	<b>page 51</b>
<b>Installation procedures</b> .....	<b>page 52</b>

---

**Note**  
Each transmitter is marked with a tag indicating the approvals. Install the transmitter according to all applicable installation codes, and approval and installation drawings (see [Appendix B Product Certifications](#)). Verify that the operating atmosphere of the transmitter is consistent with the hazardous location certifications. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any of the other labeled approval types. To ensure this, the approval label should be permanently marked to distinguish the approval type(s) used.

---

## 3.1 Overview

The information in this section covers installation considerations for the Rosemount 644 Temperature Transmitter with HART protocol. A Quick Installation Guide (document number 00825-0200-4728) is shipped with every transmitter to describe recommended mounting and wiring procedures for initial installation. Dimensional drawings for 644 mounting configurations are included in [Appendix A: Specifications and Reference Data](#).

## 3.2 Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

---

## Warnings

### WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting a Field Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.
-



## 3.3 Considerations

### 3.3.1 Installation considerations

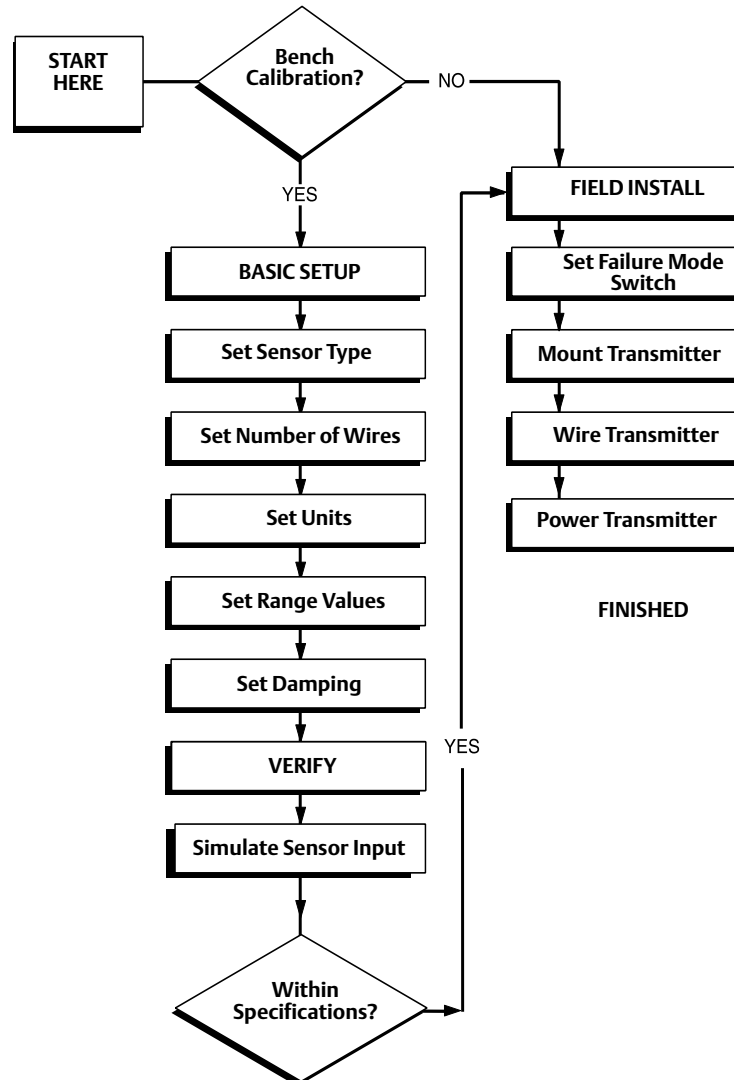
Measurement accuracy depends upon proper installation of the transmitter. Mount the transmitter close to the process and use minimum wiring to achieve best accuracy. Keep in mind the need for easy access, personnel safety, practical field calibration, and a suitable transmitter environment. Install the transmitter to minimize vibration, shock, and temperature fluctuation.

### 3.3.2 Environmental considerations

Best practice is to mount the transmitter in an environment that has minimal ambient temperature change. The transmitter electronics temperature operating limits are  $-40$  to  $185$  °F ( $-40$  to  $85$  °C). Refer to [Appendix A: Specifications and Reference Data](#) for sensing element operating limits. Mount the transmitter so that it is not susceptible to vibration and mechanical shock and does not have external contact with corrosive materials.

## 3.4 Installation procedures

Figure 3-1. Installation Flowchart



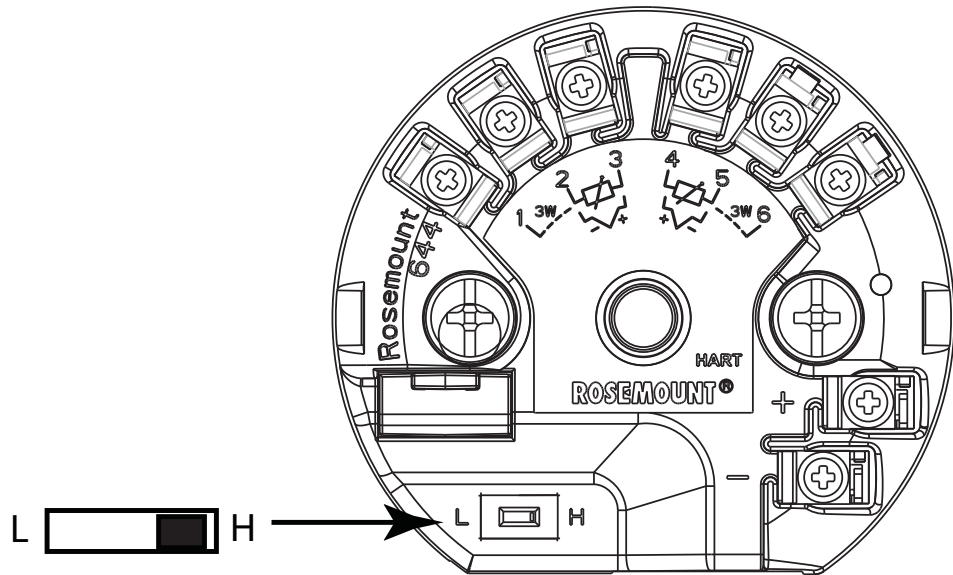
### 3.4.1 Set the Alarm switch

Make certain that the Alarm Switch is set to the desired position before putting the device into operation to ensure correct function in the instance of a failure.

## Without a LCD Display

1. Set the loop to manual (if applicable) and disconnect the power.
2. Remove the housing cover.
3. Set the physical hardware alarm switch to the desired position. **H** indicates High, **L** indicates Low. Then reattach the housing cover. Please see [Figure 3-2](#) below for alarm switch location.
4. Apply power and set the loop to automatic control.

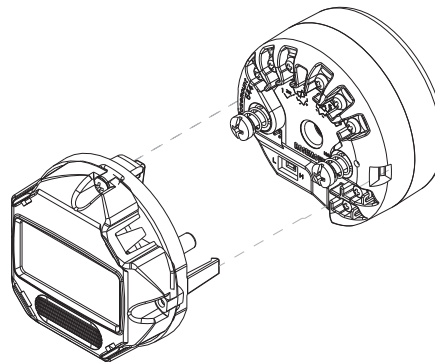
**Figure 3-2. Failure switch location**



### Note

If using an LCD Display or Local Operator Interface, first remove the display by detaching it from the top of the 644 device, set the switch to the desired position and reattach the display. See [Figure 3-3](#). Display Connection for proper display orientation.

**Figure 3-3. Display connection**



## 3.4.2 Mount the transmitter

Mount the transmitter at a high point in the conduit run to prevent moisture from draining into the transmitter housing.

The 644 head mount installs

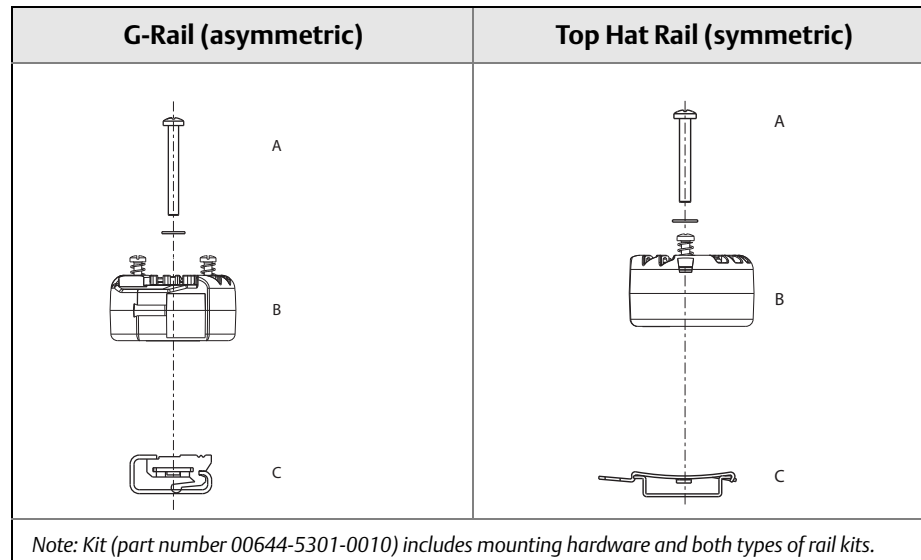
- In a connection head or universal head mounted directly on a sensor assembly.
- Apart from a sensor assembly using a universal head.
- To a DIN rail using an optional mounting clip.

The 644 rail mount attaches directly to a wall or to a DIN rail.

### Mounting a 644 to a DIN Rail

To attach a head mount transmitter to a DIN rail, assemble the appropriate rail mounting kit (part number 00644-5301-0010) to the transmitter as shown in [Figure 3-4](#). Follow the procedure under “[Rail Mount Transmitter and Sensor](#)”.

**Figure 3-4. Assembling Rail Clip Hardware to a 644**






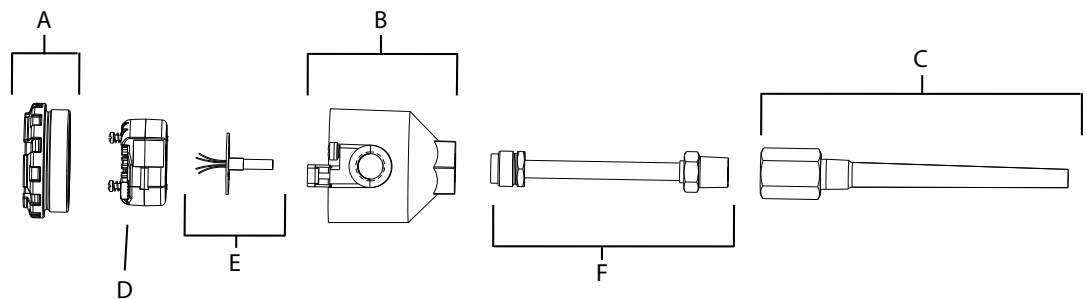
- A. Mounting hardware
- B. Transmitter
- C. Railclip

### 3.4.3 Install the device

#### Typical connection head installation

##### Head Mount Transmitter with DIN Plate Style Sensor

1.  Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying process pressure.
2. Verify the transmitter failure mode switch position.
3. Assemble the transmitter to the sensor<sup>(1)</sup>. Push the transmitter mounting screws through the sensor mounting plate.
4. Wire the sensor to the transmitter (see [“Wiring and powering the transmitter” on page 64](#)).
5. Insert the transmitter-sensor assembly into the connection head. Thread the transmitter mounting screw into the connection head mounting holes. Assemble the extension to the connection head by tightening the threaded connections of the extension to the housing. Insert the assembly into the thermowell and tighten the threaded connections.
6. If using a cable gland for power wiring, properly attach the cable gland to a housing conduit entry.
7. Insert the shielded cable leads into the connection head through the conduit entry.
8.  Connect the shielded power cable leads to the transmitter power terminals. Avoid contact with sensor leads and sensor connections. Connect and tighten the cable gland.
9.  Install and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.





A = Connection Head cover  
B = Connection Head  
C = Thermowell

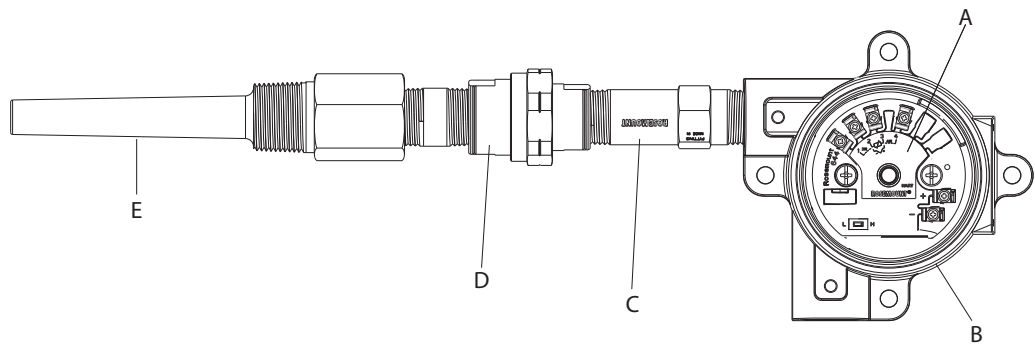
D = 644 Transmitter  
E = Integral Mount Sensor with Flying Leads  
F = Extension

(1) If using a Threaded type sensor with a connection head, Please reference steps 1-6 below in [“Head Mount Transmitter with Threaded Sensor” on page 56](#)

## Typical Universal Head Installation

### Head Mount Transmitter with Threaded Sensor

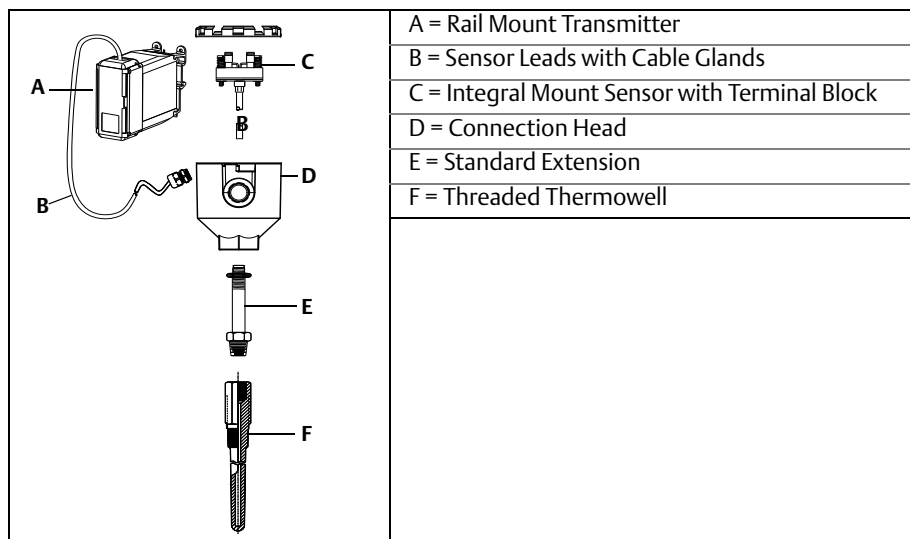
1.  Attach the thermowell to the pipe or process container wall. Install and tighten thermowells before applying process pressure.
2. Attach necessary extension nipples and adapters to the thermowell. Seal the nipple and adapter threads with silicone tape.
3. Screw the sensor into the thermowell. Install drain seals if required for severe environments or to satisfy code requirements.
4. Verify the transmitter failure mode switch is in the desired position.
5. Pull the sensor wiring leads through the universal head and transmitter. Mount the transmitter in the universal head by threading the transmitter mounting screws into the universal head mounting holes.
6. Seal adapter threads with thread sealant.
7. Pull the field wiring leads through the conduit into the universal head. Wire the sensor and power leads to the transmitter (see [“Wiring and powering the transmitter” on page 64](#)). Avoid contact with other terminals.
8.  Install and tighten the universal head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.



A = 644 Transmitter	D = Extension
B = Universal Junction Box	E = Threaded Thermowell
C = Threaded Style Sensor	

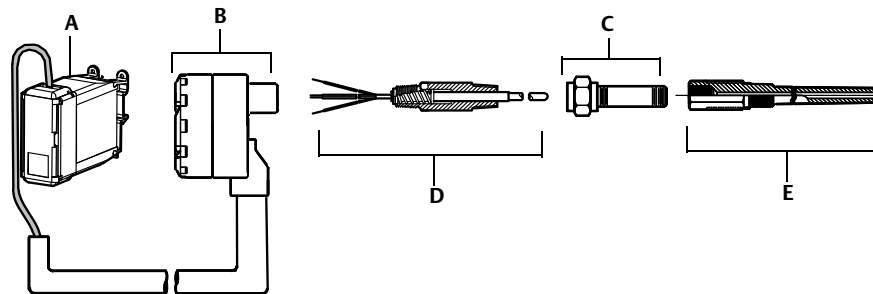
## Rail Mount Transmitter and Sensor

- ⚠ 1. Attach the transmitter to a suitable rail or panel.
2. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell, according to plant standards, before applying pressure.
3. Attach the sensor to the connection head and mount the entire assembly to the thermowell.
4. Attach and connect sufficient lengths of sensor lead wire from the connection head to the sensor terminal block.
- ⚠ 5. Tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.
6. Run sensor lead wires from the sensor assembly to the transmitter.
7. Verify the transmitter failure mode switch.
- ⚠ 8. Attach the sensor wires to the transmitter.



## Rail Mount Transmitter with Threaded Sensor

1. ⚠ Attach the transmitter to a suitable rail or panel.
2. Attach the thermowell to the pipe or process container wall. Install and tighten the thermowell before applying pressure.
3. Attach necessary extension nipples and adapters. Seal the nipple and adapter threads with thread sealant.
4. Screw the sensor into the thermowell. Install drain seals if required for severe environments or to satisfy code requirements.
5. Screw the connection head to the sensor.
6. Attach the sensor lead wires to the connection head terminals.
7. Attach additional sensor lead wires from the connection head to the transmitter.
8. ⚠ Attach and tighten the connection head cover. Enclosure covers must be fully engaged to meet explosion-proof requirements.
9. Set the transmitter failure mode switch.
10. ⚠ Attach the sensor wires to the transmitter.



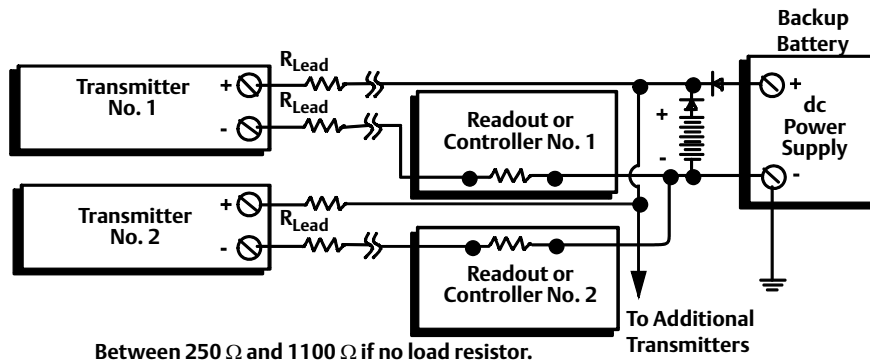
A = Rail Mount Transmitter	C = Standard Extension
B = Threaded Sensor Connection Head	D = Threaded Style Sensor
	E = Threaded Thermowell



### 3.4.4 Multichannel installations

In a HART installation, several transmitters can be connected to a single master power supply, as shown in Figure 3-5. In this case, the system may be grounded only at the negative power supply terminal. In multichannel installations where several transmitters depend on one power supply and the loss of all transmitters would cause operational problems, consider an uninterrupted power supply or a back-up battery. The diodes shown in Figure 3-5 prevent unwanted charging or discharging of the back-up battery.

Figure 3-5. Multichannel Installations

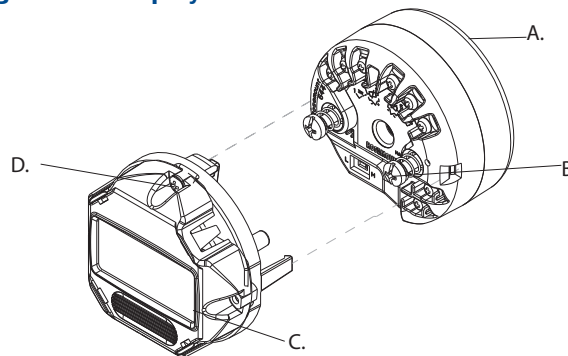


### 3.4.5 LCD Display Installation

The LCD display provides local indication of the transmitter output and abbreviated diagnostic messages governing transmitter operation. Transmitters ordered with the LCD display are shipped with the meter installed. After-market installation of the meter can be performed. After-market installation requires the meter kit (part number 00644-7630-0011), which includes:

- LCD display assembly (includes LCD display, meter spacer, and 2 screws)
- Meter cover with O-ring in place

Figure 3-6. Installing the LCD Display



- A. 644 Transmitter
- B. Mounting Screws and springs
- C. LCD Display
- D. LCD Rotation Screws

---

Use the following procedure to install the meter.

1. If the transmitter is installed in a loop, secure the loop and disconnect the power. If the transmitter is installed in an enclosure, remove the cover from the enclosure.
2. Decide meter orientation (the meter can be rotated in 90° increments). To change meter orientation, remove the screws located above and below the display screen. Lift the meter off the meter spacer. Rotate the display top and re-insert it in the location that will result in the desired viewing orientation.
3. Reattach the meter to the meter spacer using the screws. If the meter was rotated 90° from its original position it will be necessary to remove the screws from their original holes and re-insert them in the adjacent screws holes.
4. Line up the connector with the pin socket and push the meter into the transmitter until it snaps into place.
5. Attach the meter cover. The cover must be fully engaged to meet explosion-proof requirements.
6. Use a Field Communicator, AMS software tool to configure the meter to the desired display. Refer to “[LCD Meter Options \( 644H Only\)](#)” for information on configuring the LCD display.

---

**Note**

Observe the following LCD display temperature limits:

Operating: -4 to 185 °F (-20 to 85 °C)

Storage: -50 to 185 °F (-45 to 85 °C)

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# Section 4 Electrical Installation

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Overview .....	page 61
Safety Messages .....	page 61
Wiring and powering the transmitter .....	page 62

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## 4.1 Overview

The information in this section covers installation considerations for the Rosemount 644. A Quick Installation Guide is shipped with every transmitter to describe mounting, wiring, and basic configuration procedures for initial installation.

## 4.2 Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol () . Please refer to the following safety messages before performing an operation preceded by this symbol.

### Warnings

#### WARNING

Explosions could result in death or serious injury:

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the 644 reference manual for any restrictions associated with a safe installation.

- In an Explosion-Proof/Flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.
-

## 4.3 Wiring and powering the transmitter

All power to the transmitter is supplied over the signal wiring. Use ordinary copper wire of sufficient size to ensure that the voltage across the transmitter power terminals does not drop below 12.0 Vdc.

If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

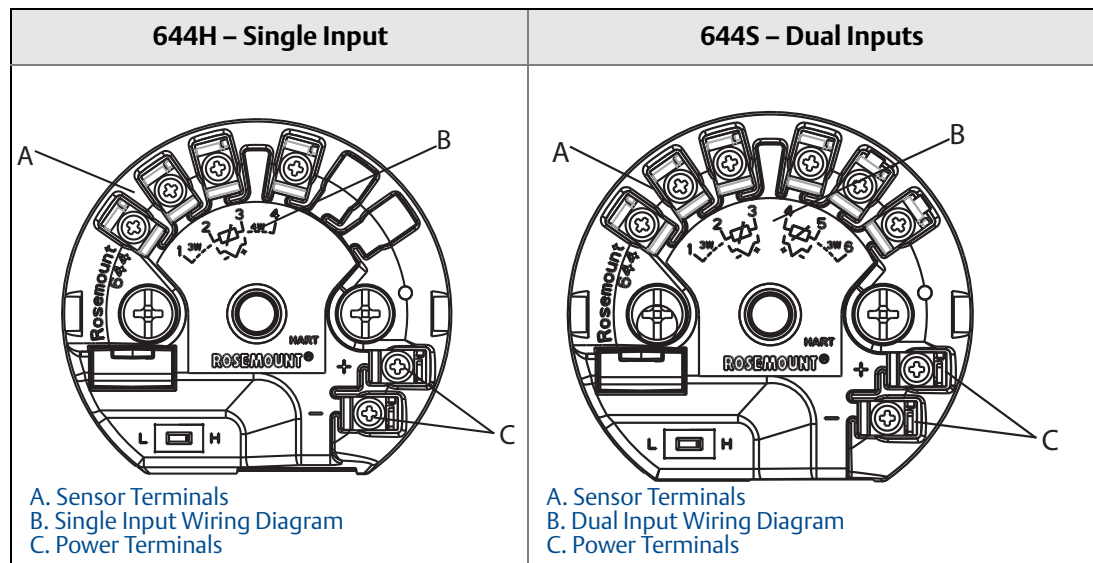
### Note

Do not apply high voltage (e.g., ac line voltage) to the transmitter terminals. Abnormally high voltage can damage the unit. (Sensor and transmitter power terminals are rated to 42.4 Vdc. A constant 42.4 volts across the sensor terminals may damage the unit.)

For multichannel HART installations, see above. The transmitters will accept inputs from a variety of RTD and thermocouple types. Refer to [Figure 2-6 on page 19](#) when making sensor connections.

The sensor Wiring Diagram is located on the device's top label below the terminal screws. See [Figure 4-1](#) and [Figure 4-2](#) for where to find and how to correctly wire all sensor types to the 644 transmitter.

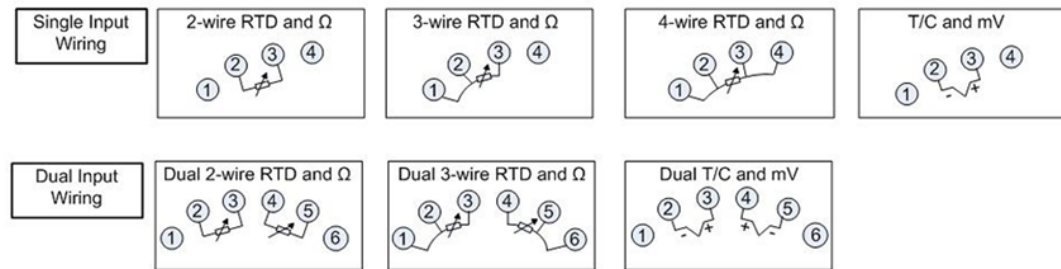
**Figure 4-1. Wiring Diagram Location**



### 4.3.1 Sensor connections

- ⚠ The 644 is compatible with a number of RTD and thermocouple sensor types. [Figure 2-8](#) shows the correct input connections to the sensor terminals on the transmitter. To ensure a proper sensor connection, anchor the sensor lead wires into the appropriate captive terminals and tighten the screws.

**Figure 4-2. Sensor Wiring Diagrams**



\*The transmitter must be configured for at least a 3-wire RTD in order to recognize an RTD with a compensation loop.

\*\* Rosemount Inc. provides a 4-wire sensors for all single element RTDs. Use these RTDs in 3-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.

## Thermocouple or Millivolt Inputs

The thermocouple can be connected directly to the transmitter. Use appropriate thermocouple extension wire if mounting the transmitter remotely from the sensor. Make millivolt inputs connections with copper wire. Use shielding for long runs of wire.

## RTD or Ohm Inputs

The transmitters will accept a variety of RTD configurations, including 2-wire, 3-wire or 4-wire. If the transmitter is mounted remotely from a 3-wire or 4-wire RTD, it will operate within specifications, without recalibration, for lead wire resistances of up to 60 ohms per lead (equivalent to 6,000 feet of 20 AWG wire). In this case, the leads between the RTD and transmitter should be shielded. If using only two leads, both RTD leads are in series with the sensor element, so significant errors can occur if the lead lengths exceed three feet of 20 AWG wire (approximately 0.05 °C/ft). For longer runs, attach a third or fourth lead as described above.

## Sensor Lead Wire Resistance Effect– RTD Input

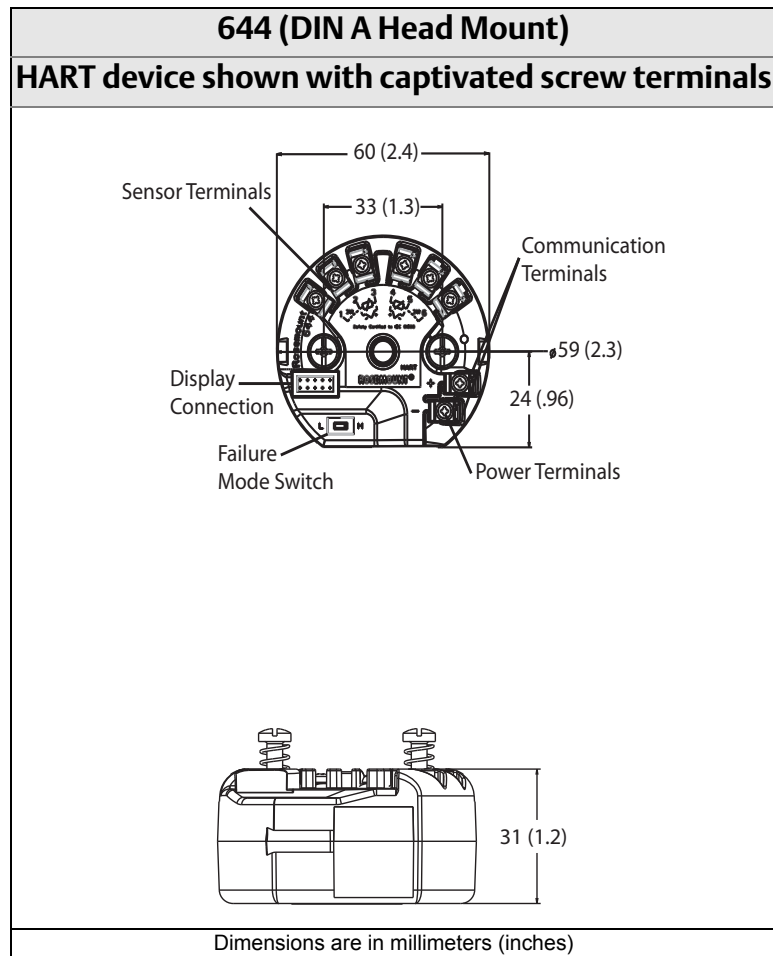
When using a 4-wire RTD, the effect of lead resistance is eliminated and has no impact on accuracy. However, a 3-wire sensor will not fully cancel lead resistance error because it cannot compensate for imbalances in resistance between the lead wires. Using the same type of wire on all three lead wires will make a 3-wire RTD installation as accurate as possible. A 2-wire sensor will produce the largest error because it directly adds the lead wire resistance to the sensor resistance. For 2- and 3-wire RTDs, an additional lead wire resistance error is induced with ambient temperature variations. The table and the examples shown below help quantify these errors.

### Note

For HART transmitters, the use of two grounded thermocouples with a dual option Rosemount 644 transmitter is not recommended. For applications in which the use of two thermocouples is desired, connect either two ungrounded thermocouples, one grounded and one ungrounded thermocouple, or one dual element thermocouple.

## 4.3.2 Power the transmitter

1. An external power supply is required to operate the transmitter.
2. Remove the housing cover (if applicable).
3. Connect the positive power lead to the “+” terminal. Connect the negative power lead to the “-” terminal.
4. Tighten the terminal screws. When tightening the sensor and power wires, the max torque is 6.5 in.-lbs (0.73 N-m).
5. Reattach and tighten the cover (if applicable).
6. Apply power (12 – 42 Vdc).



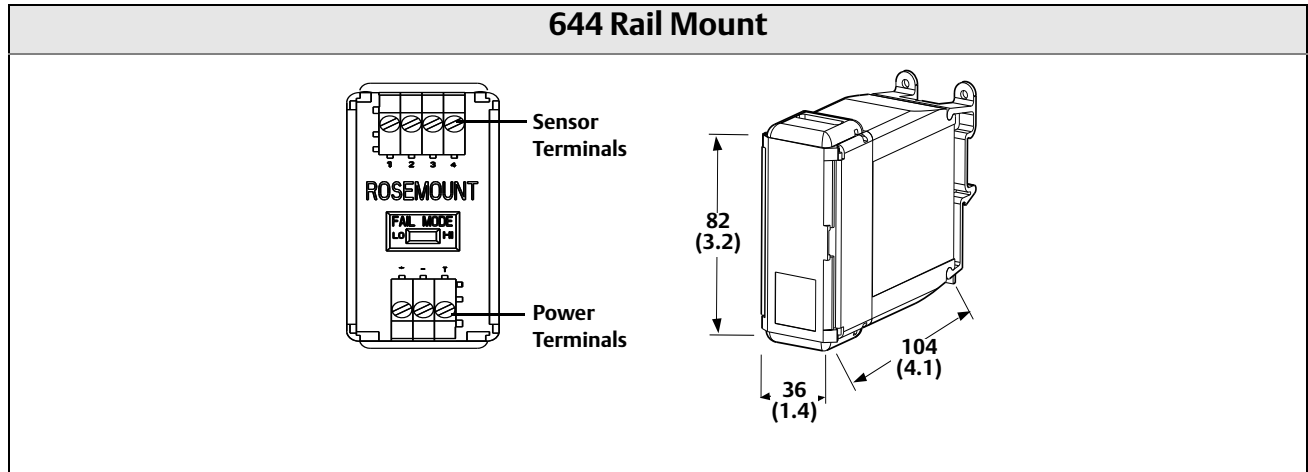
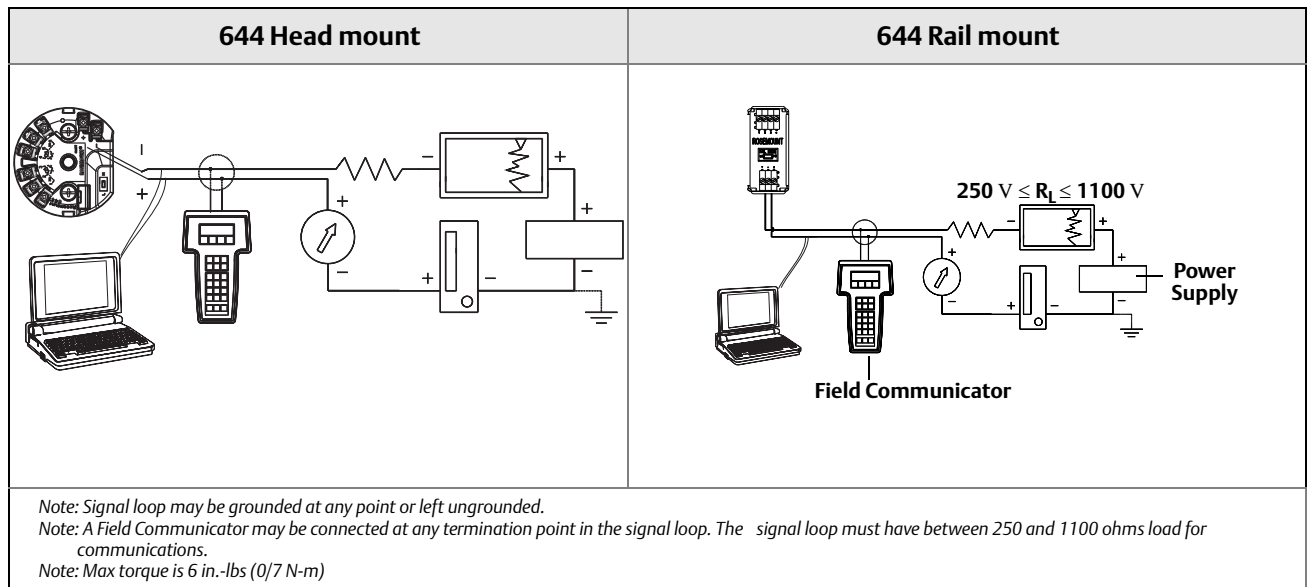


Figure 4-3. Powering the transmitter for Bench Configuration



## Load limitation

The power required across the transmitter power terminals is 12 to 42.4 Vdc (the power terminals are rated to 42.4 Vdc). To prevent damaging the transmitter, do not allow terminal voltage to drop below 12.0 Vdc when changing the configuration parameters.

## 4.3.3 Ground the transmitter

### Sensor Shielding

The currents in the leads induced by electromagnetic interference can be reduced by shielding. Shielding carries the current to ground and away from the leads and electronics. If the ends of the shields are adequately grounded, only a small amount of current will actually enter the transmitter. If the ends of the shield are left ungrounded, voltage is created between the shield and the transmitter housing and also between the shield and earth at the element end. The transmitter may not be able to compensate for this voltage, causing it to lose communication and/or go into alarm. Instead of the shield carrying the currents away from the transmitter, the currents will now flow through the sensor leads into the transmitter circuitry where it will interfere with the circuit operation.

### Shielding Recommendations

The following are recommended practices from API Standard 552 (Transmission Standard) section 20.7, and from field and laboratory testing. If more than one recommendation is given for a sensor type, start with the first technique shown or the technique that is recommended for the facility by its installation drawings. If the technique does not eliminate the transmitter alarms, try another technique. If all of the techniques do not eliminate or prevent the transmitter alarms because of high EMI, contact an Emerson Process Management representative.

To ensure proper grounding, it is important that the instrument cable shield be:

- Trimmed close and insulated from touching the transmitter housing
- Connected to the next shield if cable is routed through a junction box
- Connected to a good earth ground at the power supply end

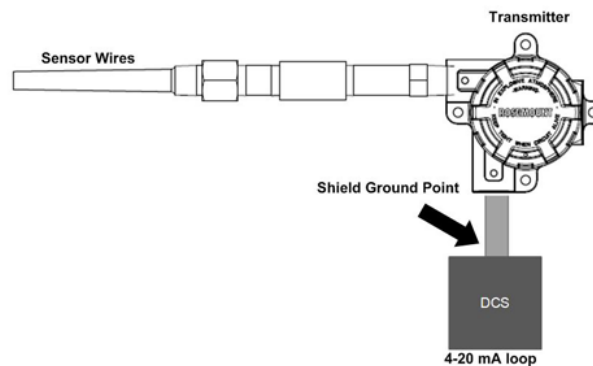
### Ungrounded Thermocouple, mV, and RTD/Ohm Inputs

Each process installation has different requirements for grounding. Use the grounding options recommended by the facility for the specific sensor type, or begin with grounding **Option 1:** (the most common).



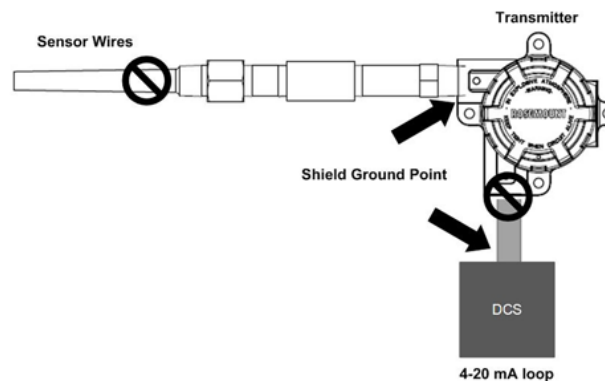
### Option 1:

1. Connect sensor wiring shield to the transmitter housing.
2. Ensure the sensor shield is electrically isolated from surrounding fixtures that may be grounded.
3. Ground signal wiring shield at the power supply end.



### Option 2:

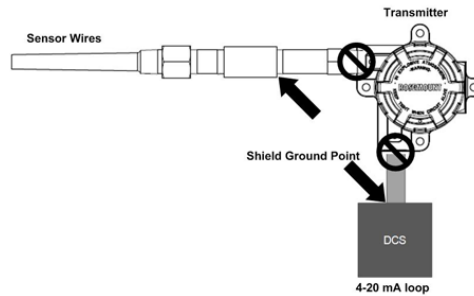
1. Connect signal wiring shield to the sensor wiring shield.
2. Ensure the two shields are tied together and electrically isolated from the transmitter housing.
3. Ground shield at the power supply end only.
4. Ensure that the sensor shield is electrically isolated from the surrounding grounded fixtures.



Connect shields together, electrically isolated from the transmitter.

### Option 3:

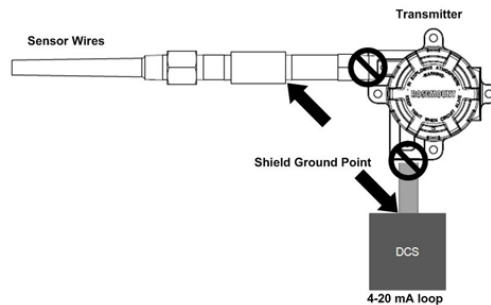
1. Ground sensor wiring shield at the sensor, if possible.
2. Ensure that the sensor wiring and signal wiring shields are electrically isolated from the transmitter housing.
3. Do not connect the signal wiring shield to the sensor wiring shield.
4. Ground signal wiring shield at the power supply end.



## Grounded thermocouple inputs

### Option 1:

1. Ground sensor wiring shield at the sensor.
2. Ensure that the sensor wiring and signal wiring shields are electrically isolated from the transmitter housing.
3. Do not connect the signal wiring shield to the sensor wiring shield.
4. Ground signal wiring shield at the power supply end.



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### 4.3.4 Wiring with a Rosemount 333 HART Tri-Loop (HART / 4–20 mA only)

Use the dual-sensor option 644 transmitter that is operating with two sensors in conjunction with a 333 HART Tri-Loop® HART-to-Analog Signal Converter to acquire an independent 4–20 mA analog output signal for each sensor input. The 644 transmitter can be configured to output four of the six following digital process variables:

- Sensor 1
- Sensor 2
- Differential temperature
- Average temperature
- First good temperature
- Transmitter terminal temperature

The HART Tri-Loop reads the digital signal and outputs any or all of these variables into as many as three separate 4–20 mA analog channels. Refer to [Figure 2-6 on page 19](#) for basic installation information. Refer to the 333 HART Tri-Loop HART-to-Analog Signal Converter Reference Manual (document number 00809-0100-4754) for complete installation information.

#### Power supply

An external power supply is required to operate the 644 and is not included. The input voltage range of the transmitter is 12 to 42.4 Vdc. This is the power required across the transmitter power terminals. The power terminals are rated to 42.4 Vdc. With 250 ohms of resistance in the loop, the transmitter requires a minimum of 18.1 Vdc for communication.

The power supplied to the transmitter is determined by the total loop resistance and should not drop below the lift-off voltage. The lift-off voltage is the minimum supply voltage required for any given total loop resistance. If the power drops below the lift-off voltage while the transmitter is being configured, the transmitter may output incorrect information.

The DC power supply should provide power with less than 2% ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of any controller, indicator, or related piece of equipment in the loop. Note that the resistance of intrinsic safety barriers, if used, must be included.

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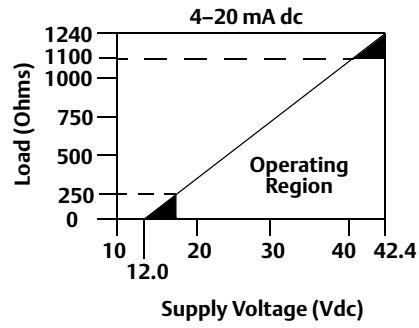
#### Note

Permanent damage to the transmitter could result if the voltage drops below 12.0 Vdc at the power terminals, when changing transmitter configuration parameters.

---

**Figure 4-4. Load limits**

Maximum Load =  $40.8 \times (\text{Supply Voltage} - 12.0)$



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# Section 5      Operation and maintenance

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Overview .....	page 71
Safety messages .....	page 71
Calibration overview .....	page 72
Sensor input trim .....	page 73
Trim the analog output .....	page 76
Transmitter-Sensor Matching .....	page 78
Switching HART Revision .....	page 80

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## 5.1      Overview

This section contains information on calibrating Rosemount 644 Temperature Transmitter. Field Communicator, AMS, and Local Operator Interface (LOI) instructions are given to perform all functions.

## 5.2      Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol () . Please refer to the following safety messages before performing an operation preceded by this symbol.

## Warnings

### WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Do not remove the connection head cover in explosive atmospheres when the circuit is live.
- Before connecting a Field Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- All connection head covers must be fully engaged to meet explosion-proof requirements.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure.

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

## 5.3 Calibration overview

Calibrating the transmitter increases the measurement precision by allowing corrections to be made to the factory-stored characterization curve by digitally altering the transmitter's interpretation of the sensor input.

To understand calibration, it is necessary to understand that smart transmitters operate differently from analog transmitters. An important difference is that smart transmitters are factory-characterized, meaning that they are shipped with a standard sensor curve stored in the transmitter firmware. In operation, the transmitter uses this information to produce a process variable output, in engineering units, dependent on the sensor input.

Calibration of the 644 may include the following procedures:

- **Sensor Input Trim:** digitally alter the transmitter's interpretation of the input signal
- **Transmitter Sensor Matching:** generates a special custom curve to match that specific sensor curve, as derived from the Callendar-Van Dusen constants
- **Output Trim:** calibrates the transmitter to a 4–20 mA reference scale
- **Scaled Output Trim:** calibrates the transmitter to a user-selectable reference scale.

### 5.3.1 Trimming

The trim functions should not be confused with the rerange functions. Although the rerange command matches a sensor input to a 4–20 mA output—as in conventional calibration—it does not affect the transmitter's interpretation of the input.

One or more of the trim functions may be used when calibrating. The trim functions are as follows:

- Sensor Input Trim
- Transmitter-Sensor Matching
- Output Trim
- Output Scaled Trim

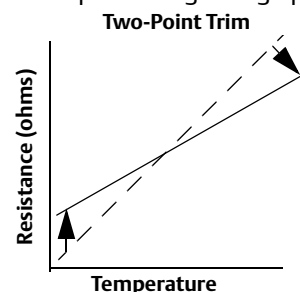
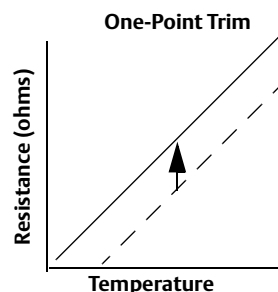
## 5.4 Sensor input trim

The Sensor Trim command allows for alteration of the transmitter’s interpretation of the input signal. The sensor trim command trims, in engineering (°F, °C, °R, K) or raw (ohms, mV) units, the combined sensor and transmitter system to a site standard using a known temperature source. Sensor trim is suitable for validation procedures or for applications that require profiling the sensor and transmitter together.

Perform a sensor trim if the transmitter’s digital value for the primary variable does not match the plant’s standard calibration equipment. The sensor trim function calibrates the sensor to the transmitter in temperature units or raw units. Unless the site-standard input source is NIST-traceable, the trim functions will not maintain the NIST-traceability of your system.

**Figure 5-1. Trim**

<p><i>Application:</i> Linear Offset</p> <p><i>Solution:</i> Single-Point Trim</p> <p><i>Method:</i></p> <ol style="list-style-type: none"> <li>1. Connect sensor to transmitter. Place sensor in bath between range points.</li> <li>2. Enter known bath temperature using the Field Communicator.</li> </ol>	<p><i>Application:</i> Linear Offset and Slope Correction</p> <p><i>Solution:</i> Two-Point Trim</p> <p><i>Method:</i></p> <ol style="list-style-type: none"> <li>1. Connect sensor to transmitter. Place sensor in bath at low range point.</li> <li>2. Enter known bath temperature using the Field Communicator.</li> <li>3. Repeat at high range point.</li> </ol>
--	--



Transmitter System Curve ———  
Site-Standard Curve ———

Use the following procedures to perform a sensor trim on the 644:

## Performing a Sensor Trim using a Field Communicator

1. Connect the calibration device or sensor to the transmitter. (If using an active calibrator, please see “Active Calibrator and EMF Compensation” on page 75)
2. Connect the communicator to the transmitter loop.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 4, 4, 1
-----------------------------------	------------

The communicator will ask “Are you using an active calibrator?”

- a. Select “**No**” if a sensor is connected to the transmitter
- b. Select “**Yes**” if using a calibration device. By selecting yes, the transmitter will switch into active calibration mode (see “Active Calibrator and EMF Compensation”). This is critical if the calibrator requires constant sensor current for calibration. If using a calibration device that can accept pulsed current, select “No.”

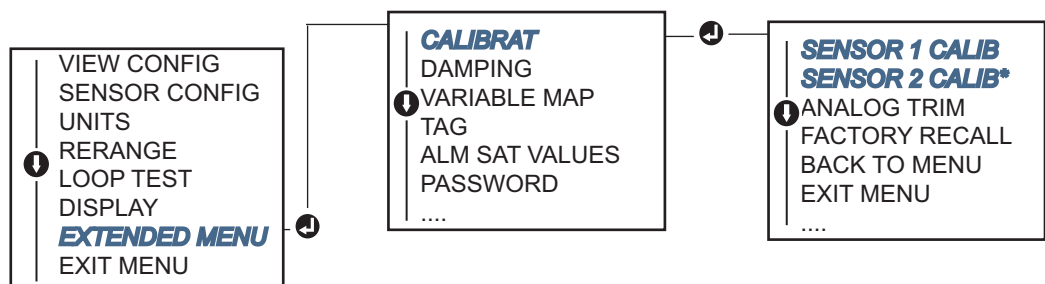
## Performing a Sensor Trim using AMS Device Manager

1. Right click on the device and select **Overview**.
2. On the main Overview tab, click on the **Calibrate Sensor(s)** button near the bottom of the window.
3. Follow the screen prompts that will guide you through the Sensor Trimming process.

## Performing a Sensor Trim using the Local Operator Interface

Reference the below image for guidance on where to find Sensor Calibration in the LOI menu.

Figure 5-2. Trimming the sensor with the LOI





## 5.4.1 Recall Factory Trim—Sensor trim

The Recall Factory Trim—Sensor Trim feature allows the restoration of the as-shipped factory settings of the analog output trim. This command can be useful for recovering from an inadvertent trim, incorrect Plant Standard or faulty meter.

### Recall Factory Trim – Sensor, using a Field Communicator

From the *HOME* screen, enter the fast key sequence and follow the steps within the Field Communicator to complete the Sensor Trim.

<b>Device Dashboard Fast Keys</b>	3, 4, 4, 2
-----------------------------------	------------

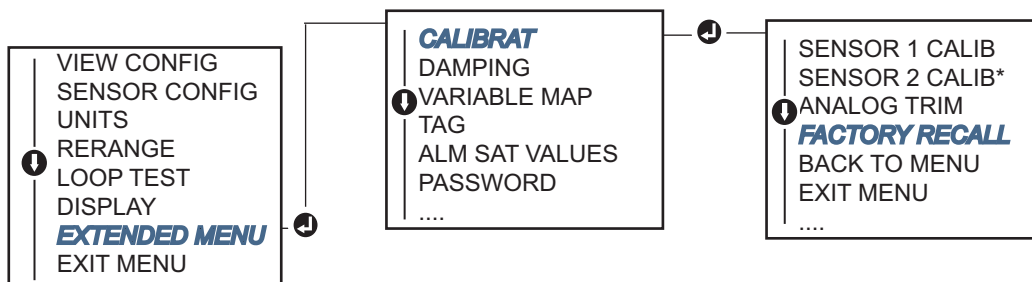
### Recall Factory Trim – Sensor, using AMS Device Manager

1. Right click on the device and select **Service Tools**.
2. On the Sensor Calibration tab, click on the **Restore Factory Calibration**.
3. Follow the screen prompts that will guide you through the restoring of the calibration settings.

### Recall Factory Trim – Sensor, using the Local Operator Interface

Reference the below image for where to find Recall Sensor Trim in the LOI menu.

**Figure 5-3. Recalling the Sensor Trim with the LOI**



## 5.4.2 Active Calibrator and EMF Compensation

The transmitter operates with a pulsating sensor current to allow EMF compensation and detection of open sensor conditions. Because some calibration equipment requires a steady sensor current to function properly, the “Active Calibrator Mode” feature should be used when an Active Calibrator is connected. Enabling this mode temporarily sets the transmitter to provide steady sensor current unless two sensor inputs are configured.

Disable this mode before putting the transmitter back into the process to set the transmitter back to pulsating current. “Active Calibrator Mode” is volatile and will automatically be disabled when a Master Reset is performed (through HART) or when the power is cycled.

EMF compensation allows the transmitter to provide sensor measurements that are unaffected by unwanted voltages, typically due to thermal EMFs in the equipment connected to the transmitter, or by some types of calibration equipment. If this equipment also requires steady sensor current, the transmitter must be set to “Active Calibrator Mode.” However, the steady current does not allow the transmitter to perform EMF compensation and as a result, a difference in readings between the Active Calibrator and actual sensor may exist.

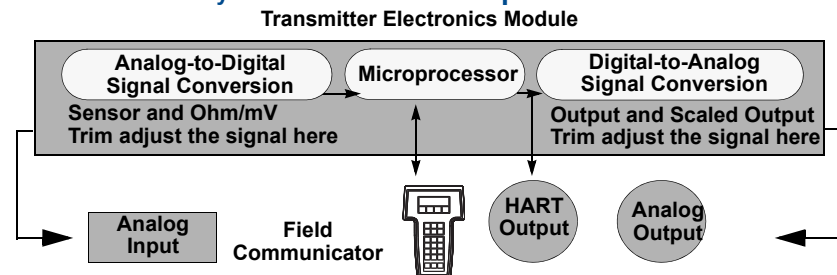
If a reading difference is experienced and is greater than the plant’s accuracy specification allows, perform a sensor trim with “Active Calibrator Mode” disabled. In this case, an active calibrator capable of tolerating pulsating sensor current must be used or the actual sensors must be connected to the transmitter. When the Field Communicator, AMS or the LOI asks if an Active Calibrator is being used when the sensor trim routine is entered, select **No** to leave the “Active Calibrator Mode” disabled.

## 5.5 Trim the analog output

### 5.5.1 Analog output trim or Scaled Analog Output Trim

Perform an Output Trim or a Scaled Output Trim if the digital value for the primary variable matches the plant’s standards but the transmitter’s analog output does not match the reading on the output device. The output trim function calibrates the transmitter to a 4–20 mA reference scale; the scaled output trim function calibrates to a user-selectable reference scale. To determine the need for an output trim or a scaled output trim, perform a loop test (“Performing a loop test” on page 39).

Figure 5-4. Measurement Dynamics of a Smart Temperature transmitter



### 5.5.2 Analog output trim

The *Analog Output Trim* allows the transmitter’s conversion of the input signal to a 4–20 mA output to be altered (Figure 5-4). Adjust the analog output signal at regular intervals to maintain measurement precision. To perform a digital-to-analog trim, perform the following procedure with Traditional Fast Key sequence:

#### Performing a Analog Output Trim using a Field Communicator

1. Connect an accurate reference meter to the transmitter at the **CONNECT REFERENCE METER** prompt by shunting the power to the transmitter through the reference meter at some point in the loop.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 4, 5, 1
-----------------------------------	------------

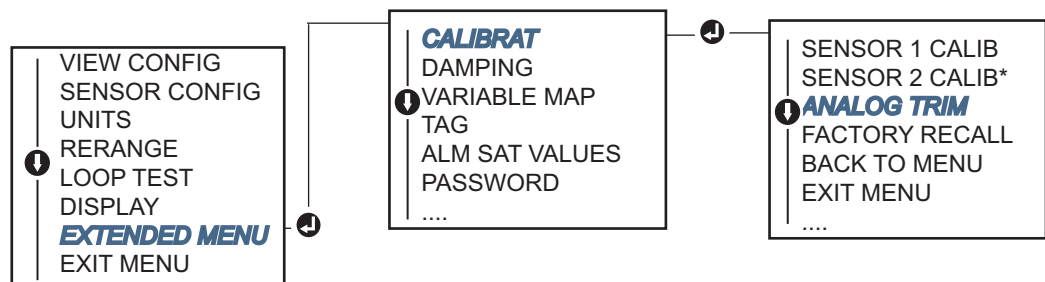
## Performing a Analog Output Trim using AMS Device Manager

1. Right click on the device and select **Service Tools**.
2. In the left navigation pane click on **Maintenance**.
3. Find the **Analog Calibration** tab and click on the **Analog Trim** button.
4. Follow the screen prompts that will guide you through the Analog Trimming process.

## Performing an Analog Output Trim using the Local Operator Interface

Reference the below image for guidance on where to find Analog Trim in the LOI menu.

Figure 5-5. Trimming the Analog Output with the LOI



### 5.5.3 Scaled output trim

The *Scaled Output Trim* matches the 4 and 20mA points to a user-selectable reference scale other than 4 and 20 mA (2–10 volts, for example). To perform a scaled D/A trim, connect an accurate reference meter to the transmitter and trim the output signal to scale as outlined in the “Trim the analog output” procedure.

## Performing a Analog Output Trim using a Field Communicator

1. Connect an accurate reference meter to the transmitter at the **CONNECT REFERENCE METER** prompt by shunting the power to the transmitter through the reference meter at some point in the loop.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	3, 4, 5, 2
-----------------------------------	------------

## Performing a Analog Output Trim using AMS Device Manager

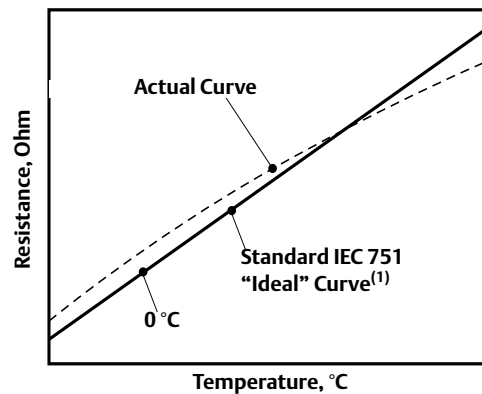
1. Right click on the device and select **Service Tools**.
2. In the left navigation pane click on **Maintenance**.
3. Find the **Analog Calibration** tab and click on the **Scaled Trim** button.
4. Follow the screen prompts that will guide you through the Analog Trimming process.

## 5.6 Transmitter-Sensor Matching

Use *Transmitter-Sensor Matching* to enhance the temperature measurement accuracy of the system and if you have a sensor with Callendar-Van Dusen constants. When ordered from Emerson Process Management, sensors with Callendar-Van Dusen constants are NIST-traceable.

The 644 accepts Callendar-Van Dusen constants from a calibrated RTD schedule and generates a special custom curve to match that specific sensor Resistance vs. Temperature performance. [Figure 5-6](#).

**Figure 5-6. Standard vs. Actual sensor curve**



(1) The Actual Curve is identified from the Callendar-Van Dusen equation.

Matching the specific sensor curve with the transmitter significantly enhances the temperature measurement accuracy. See the comparison below in [Table 5-1](#).

**Table 5-1. Standard RTD vs. RTD with matched CVD constants with standard transmitter accuracy**

System Accuracy Comparison at 150 °C Using a PT 100 ( $\alpha=0.00385$ ) RTD with a Span of 0 to 200 °C			
Standard RTD		Matched RTD	
644H	±0.15 °C	644H	±0.15 °C
Standard RTD	±1.05 °C	Matched RTD	±0.18 °C
Total System <sup>(1)</sup>	±1.06 °C	Total System <sup>(1)</sup>	±0.23 °C

(1) Calculated using root-summed-squared (RSS) statistical method

$$\text{TotalSystemAccuracy} = \sqrt{(\text{TransmitterAccuracy})^2 + (\text{SensorAccuracy})^2}$$

**Table 5-2. Standard RTD vs. RTD with matched CVD constants with Enhanced transmitter accuracy option P8**

System Accuracy Comparison at 150 °C Using a PT 100 ( $\alpha=0.00385$ ) RTD with a Span of 0 to 200 °C			
Standard RTD		Matched RTD	
644	±0.10 °C	644	±0.10 °C
Standard RTD	±1.05 °C	Matched RTD	±0.18 °C
Total System <sup>(1)</sup>	±1.05 °C	Total System <sup>(1)</sup>	±0.21 °C

(1) Calculated using root-summed-squared (RSS) statistical method

$$\text{TotalSystemAccuracy} = \sqrt{(\text{TransmitterAccuracy})^2 + (\text{SensorAccuracy})^2}$$

### Callendar-Van Dusen equation:

The following input variables, included with specially-ordered Rosemount temperature sensors, are required:

$$R_t = R_0 + R_0\alpha [t - \delta(0.01t-1)(0.01t) - \beta(0.01t - 1)(0.01t)^3]$$

R<sub>0</sub> = Resistance at Ice Point

Alpha = Sensor Specific Constant

Beta = Sensor Specific Constant

Delta = Sensor Specific Constant

To input Callendar-Van Dusen constants, perform one the following procedures:

## Entering CVD Constants using a Field Communicator

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 1, 9
-----------------------------------	------------

## Entering CVD Constants using AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup** and choose the **Sensor 1** or **Sensor 2** tab depending on the need.
2. Find the **Transmitter Sensor Matching (CVD)** group box and enter in the required CVD constants. Or click the “Set CVD Coefficients” button to be guided through steps. You may also click on the “Show CVD Coefficients” button to see the current coefficients loaded into the device.
3. Click **Apply** when complete.

### Note

When the transmitter-senor matching is disabled, the transmitter reverts to either user or factory trim, whichever was used previously. Make certain the transmitter engineering units default correctly before placing the transmitter into service.

## 5.7 Switching HART Revision

Some systems are not capable of communicating with HART Revision 7 devices. The following procedures list how to change HART revisions between HART Revision 7 and HART Revision 5.

### 5.7.1 Switching HART revision using the Generic Menu

If the HART configuration tool is not capable of communicating with a HART Revision 7 device, it should load a Generic Menu with limited capability. The following procedures allow for switching between HART Revision 7 and HART Revision 5 from a Generic Menu in any HART compliant configuration tool.

1. Locate "Message" field
  - a. To change to HART Revision 5, Enter: **HART5** in the message field
  - b. To change to HART Revision 7, Enter: **HART7** in the message field

### 5.7.2 Switching HART revision using a Field Communicator

From the HOME screen, enter the fast key sequence and follow steps within the FieldCommunicator to complete the HART revision change.

From the *HOME* screen, enter the fast key sequence

<b>Device Dashboard Fast Keys</b>	2, 2, 8, 3
-----------------------------------	------------

### 5.7.3 Switching HART revision with AMS Device Manager

Right click on the device and select **Configure**.

1. In the left navigation pane choose **Manual Setup** and click on the **HART** tab.
2. Click on the **Change HART Revision** button and follow the prompts.

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#### Note

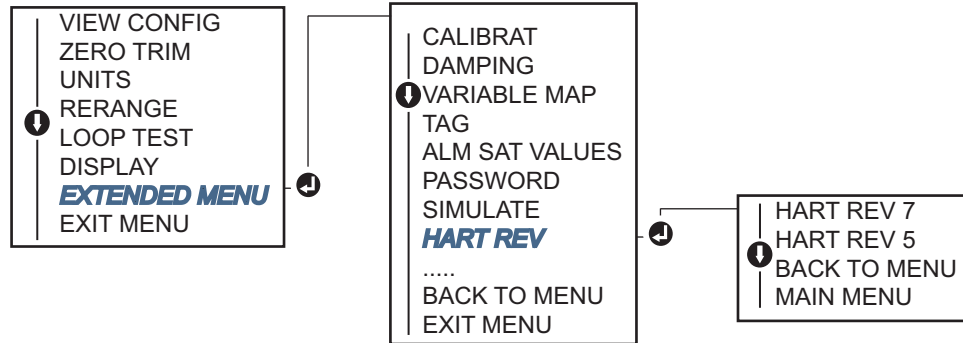
HART Revision 7 is only compatible with AMS Device Manager 10.5, and greater. AMS Device Manager version 10.5 requires a software patch to be compatible.

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### 5.7.4 Switching HART revision with Local Operator Interface

Reference the below image for where to find HART Rev in the LOI menu.

Figure 5-7. Switching the HART Revision with the LOI







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# Section 6 Troubleshooting

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Overview .....	page 83
Safety messages .....	page 83
Troubleshooting the 4-20 mA/HART output .....	page 85
Diagnostic messages .....	page 86


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## 6.1 Overview

Table 6-1 on page 85 provides summarized maintenance and troubleshooting suggestions for the most common operating problems.

If you suspect malfunction despite the absence of any diagnostic messages on the Field Communicator display, follow the procedures described in Table 6-1 on page 85 to verify that transmitter hardware and process connections are in good working order. Under each of four major symptoms, specific suggestions are offered for solving problems. Always deal with the most likely and easiest-to-check conditions first.

## 6.2 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol () . Refer to the following safety messages before performing an operation preceded by this symbol.

## WARNING

Explosions could result in death or serious injury:

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the 644 reference manual for any restrictions associated with a safe installation.

- Before connecting a Field Communicator in an explosive atmosphere, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In an Explosion-Proof/Flameproof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

## 6.3 Troubleshooting the 4-20 mA/HART output

Table 6-1. Rosemount 644 troubleshooting table for 4-20 mA output

Symptom or Issue	Potential Source	Corrective Action
Transmitter Does Not Communicate with Field Communicator	Loop Wiring	<ul style="list-style-type: none"> <li>Check the revision level of the transmitter device descriptors (DDs) stored in your communicator. The communicator should report Dev v4, DD v1 (improved), or reference “Field Communicator” on page 3-2 for previous versions. Contact Emerson Process Management Customer Central for assistance.</li> <li>Check for a minimum of 250 ohms resistance between the power supply and Field Communicator connection.</li> <li>Check for adequate voltage to the transmitter. If a Field Communicator is connected and 250 ohms resistance is properly in the loop, then the transmitter requires a minimum of 12.0 V at the terminals to operate (over entire 3.5 to 23.0 mA operating range), and 12.5 V minimum to communicate digitally.</li> <li>Check for intermittent shorts, open circuits, and multiple grounds.</li> </ul>
High Output	Sensor Input Failure or Connection	<ul style="list-style-type: none"> <li>Connect a Field Communicator and enter the transmitter test mode to check for a sensor failure.</li> <li>Check for a sensor open or short circuit.</li> <li>Check the process variable to see if it is out of range.</li> </ul>
	Loop Wiring	<ul style="list-style-type: none"> <li>Check for dirty or defective terminals, interconnecting pins, or receptacles</li> </ul>
	Power Supply	<ul style="list-style-type: none"> <li>Check the output voltage of the power supply at the transmitter terminals. It should be 12.0 to 42.4 Vdc (over entire 3.75 to 23 mA operating range).</li> </ul>
	Electronics	<ul style="list-style-type: none"> <li>Connect a Field Communicator and enter the transmitter status mode to isolate module failure.</li> <li>Connect a Field Communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.</li> </ul>
Erratic Output	Loop Wiring	<ul style="list-style-type: none"> <li>Check for adequate voltage to the transmitter. It should be 12.0 to 42.4 Vdc at the transmitter terminals (over entire 3.75 to 23 mA operating range).</li> <li>Check for intermittent shorts, open circuits, and multiple grounds.</li> <li>Connect a Field Communicator and enter the Loop test mode to generate signals of 4 mA, 20 mA, and user-selected values.</li> </ul>
	Electronics	<ul style="list-style-type: none"> <li>Connect a Field Communicator and enter the transmitter test mode to isolate module failure.</li> </ul>

Symptom or Issue	Potential Source	Corrective Action
Low or No Output	Sensor Element	<ul style="list-style-type: none"> <li>■ Connect a Field Communicator and enter the Transmitter test mode to isolate a sensor failure.</li> <li>■ Check the process variable to see if it is out of range.</li> </ul>
	Loop Wiring	<ul style="list-style-type: none"> <li>■ Check for adequate voltage to the transmitter. It should be 12.0 to 42.4 Vdc (over entire 3.75 to 23 mA operating range).</li> <li>■ Check for shorts and multiple grounds.</li> <li>■ Check for proper polarity at the signal terminal.</li> <li>■ Check the loop impedance.</li> <li>■ Connect a Field Communicator and enter the Loop test mode.</li> <li>■ Check wire insulation to detect possible shorts to ground.</li> </ul>
	Electronics	<ul style="list-style-type: none"> <li>■ Connect a Field Communicator and check the sensor limits to ensure calibration adjustments are within the sensor range.</li> </ul>

## 6.4 Diagnostic messages

Listed in the below sections are detailed tables of the possible messages that will appear on either the LCD/LOI Display, a Field Communicator, or an AMS system. Use the tables below to diagnose particular status messages.

- Failed
- Maintenance
- Advisory

## 6.4.1 Diagnostic messages: Failed

Table 6-2. Status: Failed – Fix now

Alert Name	LCD Screen	LOI Screen	Problem	Recommended Action
<b>Electronics Failure</b>	ALARM DEVICE . . . ALARM FAIL	ALARM DEVICE . . . ALARM FAIL	Essential electronics in the device have failed. For example, the transmitter may have experienced an electronics failure while attempting to store information. If diagnostics indicate an electronics failure.	<ol style="list-style-type: none"> <li>Restart the transmitter.</li> <li>If condition persists, replace the transmitter. Contact the nearest Emerson Process Management Field Service Center if necessary.</li> </ol>
<b>Sensor Open<sup>(1)</sup></b>	ALARM SNSR 1 . . . ALARM FAIL	ALARM SNSR 1 . . . ALARM FAIL	This message indicates that the transmitter has detected an open sensor condition. The sensor may be disconnected, connected improperly, or malfunctioning.	<ol style="list-style-type: none"> <li>Verify the sensor connection and wiring. Refer to the wiring diagrams found on the transmitter label to ensure proper wiring.</li> <li>Verify the integrity of the sensor and sensor lead wires. If the sensor is faulty, repair or replace the sensor.</li> </ol>
<b>Sensor Short<sup>(1)</sup></b>	ALARM SNSR 1 . . . ALARM FAIL	ALARM SNSR 1 . . . ALARM FAIL	This message indicates that the transmitter has detected a shorted sensor condition. The sensor may be disconnected, connected improperly, or malfunctioning.	<ol style="list-style-type: none"> <li>Verify the process temperature is within the specified sensor's range. Use the Sensor Information button to compare with the process temperature.</li> <li>Verify the sensor is properly wired and connected to the terminals.</li> <li>Verify the integrity of the sensor and sensor lead wires. If the sensor is faulty, repair or replace the sensor.</li> </ol>
<b>Terminal Temperature Failure</b>	ALARM TERM . . . ALARM FAIL	ALARM TERM . . . ALARM FAIL	The Terminal Temperature is outside the internal RTD's specified operating range.	<ol style="list-style-type: none"> <li>Verify the ambient temperature is within the device specified operating range using the Terminal Temperature Information Button.</li> </ol>

Alert Name	LCD Screen	LOI Screen	Problem	Recommended Action
<b>Invalid Configuration</b>	CONFIG SNSR 1 . . WARN ERROR	CONFIG SNSR 1 . . WARN ERROR	The Sensor Configuration (type and/or connection) does not match the sensor output and is invalid.	<ol style="list-style-type: none"> <li>1. Verify sensor type and number of wires matched the Sensor Configuration of the device.</li> <li>2. Reset the device.</li> <li>3. If error persists, download the transmitter configuration.</li> <li>4. If error still present, replace the transmitter.</li> </ol>
<b>Field Device Malfunction</b>	ALARM DEVICE . . ALARM FAIL	ALARM DEVICE . . ALARM FAIL	The device has malfunctioned or needs immediate attention.	<ol style="list-style-type: none"> <li>1. Perform a processor reset.</li> <li>2. View other alerts to see if the transmitter indicates a specific problem.</li> <li>3. If the condition persists, replace the device.</li> </ol>

(1) Sensor 1 is used here as an example. If Dual Sensors are ordered this alert can apply to either sensor.

## 6.4.2 Diagnostic messages: Warning

Alert Name	LCD Screen	LOI Screen	Problem	Recommended Action
<b>Hot Backup Active</b>	HOT BU SNSR 1 . . HOT BU FAIL	HOT BU SNSR 1 . . HOT BU FAIL	Sensor 1 has failed (open or shorted) and Sensor 2 is now the primary process variable output.	<ol style="list-style-type: none"> <li>1. Replace Sensor 1 at your earliest convenience.</li> <li>2. Reset Hot Backup feature in the device software.</li> </ol>
<b>Sensor Drift Alert Active<sup>(1)</sup></b>	WARN DRIFT . . WARN ALERT	WARN DRIFT . . WARN ALERT	The difference between Sensor 1 and 2 has gone beyond the user-configured Drift Alert Threshold.	<ol style="list-style-type: none"> <li>1. Verify sensor connections are valid on the transmitter.</li> <li>2. If necessary, check calibration of each sensor.</li> <li>3. Verify process conditions match sensor outputs.</li> <li>4. If calibration fails, one of the sensors has failed. Replace it at your earliest convenience.</li> </ol>
<b>Sensor Degraded<sup>(1)</sup></b>	WARN SNSR 1 . . DEGRA SNSR 1	WARN SNSR 1 . . DEGRA SNSR 1	The resistance of the thermocouple loop has exceeded the configured threshold. This could be caused by excess EMF.	<ol style="list-style-type: none"> <li>1. Check terminal connections on the 644 terminal screws for corrosion.</li> <li>2. Check the thermocouple loop for any signs of corrosion in terminal blocks, wire thinning, wire breaks, or faulty connections.</li> <li>3. Verify the integrity of the sensor itself. Harsh process conditions may cause long-term sensor failures.</li> </ol>
<b>Calibration Error</b>	[none]	[none]	The value entered for the user trim point was not acceptable.	<ol style="list-style-type: none"> <li>1. Re-trim the device, make sure the user entered calibration points are close to the applied calibration temperature.</li> </ol>

Alert Name	LCD Screen	LOI Screen	Problem	Recommended Action
<b>Sensor Out of Operating Limits<sup>(1)</sup></b>	SAT SNSR 1 . XX.XXX °C	SAT SNSR 1 . XX.XXX °C	Sensor # readings are outside the sensor's specified range.	<ol style="list-style-type: none"> <li>Verify the process temperature is within the specified sensor's range. Use the Sensor Information button to compare with the process temperature.</li> <li>Verify the sensor is properly wired and connected to the terminals.</li> <li>Verify the integrity of the sensor and sensor lead wires. If the sensor is faulty, repair or replace the sensor.</li> </ol>
<b>Terminal Temperature Out of Operating Limits</b>	SAT TERM . DEGRA WARN	SAT TERM . DEGRA WARN	The Terminal Temperature is outside the on-board RTD specified operating range	<ol style="list-style-type: none"> <li>Verify the ambient temperature is within the device specified operating range using the Terminal Temperature Information Button.</li> </ol>

(1) Sensor 1 is used here as an example. If Dual Sensors are ordered this alert can apply to either sensor.

### 6.4.3 Other LCD messages

Alert Name	LCD Screen	LOI Screen	Problem	Recommended Action
<b>LCD is not displaying correctly or at all</b>	644 HART 7	644 HART 7	The display may not be functioning or it may be stuck on Home screen	If the meter does not appear to function, make sure the transmitter is configured for the meter option you desire. The meter will not function if the LCD Display option is set to Not Used.
<b>Analog Output Fixed</b>	WARN LOOP . WARN FIXED	WARN LOOP . WARN FIXED	The analog output is set to a fixed value and is not currently tracking the HART Primary Variable.	<ol style="list-style-type: none"> <li>Verify that it was intended for the transmitter to be operating in "Fixed Current Mode."</li> <li>Disable "Fixed Current Mode" in Service Tools to have the analog output operate normally.</li> </ol>



Alert Name	LCD Screen	LOI Screen	Problem	Recommended Action
<b>Simulation Active</b>	[none]	[none]	The device is in simulation mode and may not be reporting actual information.	<ol style="list-style-type: none"> <li>1. Verify that simulation is no longer required.</li> <li>2. Disable simulation mode in service tools.</li> <li>3. Perform a Device Reset.</li> </ol>



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# Section 7 Safety Instrumented Systems (SIS) Certification

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Safety Instrumented Systems (SIS) certification .....	page 93
644 safety certified identification .....	page 93
Installation .....	page 94
Commissioning .....	page 94
Configuration .....	page 94
Alarm and saturation levels .....	page 95
644 SIS operation and maintenance .....	page 96
Specifications .....	page 98

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## 7.1 Safety Instrumented Systems (SIS) certification

The 644 Temperature transmitter is a two wire, 4-20 mA smart device. For safety instrumented systems usage it is assumed that the 4-20 mA output is used as the primary safety variable. The transmitter can be equipped with or without the display. The 644 Temperature transmitter is classified as a Type B device according to IEC61508, having a hardware fault tolerance of 0.

The 644 HART Head Mount transmitter is certified to IEC 61508 for single transmitter use in Safety Instrumented Systems up to SIL 2 and redundant transmitter use in Safety Instrumented Systems up to SIL 3.

## 7.2 644 safety certified identification

All 644 HART Head mount transmitters must be identified as safety certified before installing into SIS systems.

To identify a safety certified 644, make sure the device satisfies number 1 below as well as at least one of the options in 2, 3 or 4.

1. Verify the transmitter was ordered with Output Option code "A". This signifies that it is a 4-20mA/HART device.
  - a. For Example: MODEL 644HA.....
2. See a Yellow Tag affixed to the top of the transmitter face, a yellow Tag affixed to the outside of the enclosure if preassembled, or the option code QT in the transmitter model string.

3. Check the Namur Software Revision located on the adhesive transmitter tag.  
"SW \_.\_.\_".  
If the Device label software revision is 1.1.1 or higher, the device is safety certified.

Namur Software Revision Number	
SW <sup>(1)</sup>	1.1.x

(1) Namur Software Revision: Located on the adhesive device tag.

4. You can also identify a certified 644 by its Device Revision which can be found using any HART compliant communicator.

For the 644, certified device revisions are as follows:

- Device Revision 8.x (HART 5)
- Device Revision 9.x (HART 7)

## 7.3 Installation

No special installation is required in addition to the standard installation practices outlined in this document. Always ensure a proper seal by installing the electronics housing cover(s) so that metal contacts metal.

The loop should be designed so the terminal voltage does not drop below 12 Vdc when the transmitter output is 24.5 mA.

Environmental limits are available in the 644 Product Data Sheet (Document No. 00813-0100-4728). This document can be found at <http://www2.emersonprocess.com/en-US/documentation/Pages/DocSearch.aspx>.

## 7.4 Commissioning

The 644 Safety Certified Transmitter can be commissioned by a person with average knowledge of Rosemount temperature transmitters and the configuration device being used. Please refer to "System readiness" on page 9 to confirm your system's HART Revision capability and to confirm the installation of the correct device drivers (separate drivers required for HART 5 and HART 7).

To commission the 644 Safety Certified Transmitter using a 375/475 Field Communicator, use the Table C-1 on page 155.

For more information on the Field Communicator visit <http://www2.emersonprocess.com/en-US/brands/fieldcommunicator/Pages/fieldcommunicators.aspx>.

## 7.5 Configuration

Use any HART capable configuration tool or the optional Local Operator Interface to communicate with and verify the initial configuration or any configuration changes made to the 644 prior to operating in Safety Mode. All configuration methods outlined in Section 3 are the same for the safety certified 644 temperature transmitter with any differences noted.

Software Lock must be used in order to prevent unwanted changes to the transmitter configuration.

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**Note**

Transmitter output is not safety-rated during the following: Configuration changes, Multidrop operation, Simulation, Active Calibrator mode, and loop tests. Alternative means should be used to ensure process safety during transmitter configuration and maintenance activities.

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## 7.5.1 Damping

User-adjustable damping affects the transmitter's ability to respond to changes in the applied process. The **damping value + response time** should not exceed the loop requirements.

If using a Thermowell assembly, please make sure to also take into account the added response time due to thermowell material.

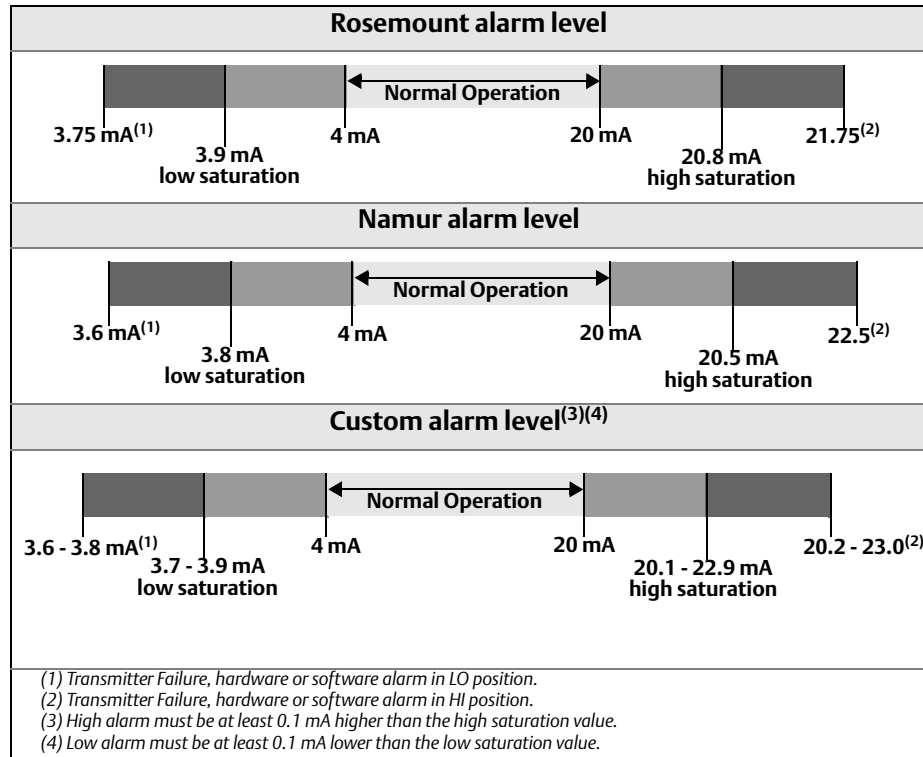
## 7.6 Alarm and saturation levels

The 644 features software driven alarm diagnostics. The independent circuit is designed to provide backup alarm output if the microprocessor software fails. The transmitter will go to a high or low output current for internally detected failures. The connected PLC must monitor the transmitter current for the high and low output current values beyond the normal range. The alarm directions (HI/LO) are user-selectable using the failure mode hardware switch found on the top face of the device. If failure occurs, the position of the switch determines the direction in which the output is driven (HI or LO). The switch feeds into the digital-to-analog (D/A) converter, which drives the proper alarm output even if the microprocessor fails. The values at which the transmitter drives its output in failure mode depends on whether it is configured to Standard, Custom, or NAMUR-compliant (NAMUR recommendation NE 43, June 1997) operation. [Figure 7-1 on page 96](#) shows the alarm ranges available for the device to be configured to. The DCS, or safety logic solver, should be configured to match transmitter configuration.

Setting the alarm values is a two step process:

1. With a Field Communicator, select the alarm and saturation levels using the following Fast key sequence 1, 3, 4, 2.
2. Position the Alarm switch to the required HI or LO position.

Figure 7-1. Alarm levels



## 7.7 644 SIS operation and maintenance

### 7.7.1 Proof Test

The following proof tests are recommended. In the event that an error is found in the safety functionality, proof test results and corrective actions taken must be documented at [www.rosemount.com/safety](http://www.rosemount.com/safety). Use [Table C-1 on page 155](#) to perform Loop Test, Review – Device Variables, and view Status.

The required proof test intervals depends upon the transmitter configuration and the temperature sensor(s) in use. Guidance is available in [Table 7-1 on page 98](#). Refer to the Rosemount 644 FMECA report for further information.

### 7.7.2 Abbreviated proof test

Conducting the Abbreviated Proof Test detects approximately 63% of transmitter DU failures, and approximately 90% of temperature sensor(s) DU failures, not detected by the 644 safety-certified automatic diagnostics, for a typical overall assembly coverage of 67%.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. Using Loop Test, enter the milliampere value representing a high alarm state.
3. Check the reference meter to verify the mA output corresponds to the entered value. This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.
4. Using Loop Test, enter the milliampere value representing a low alarm state. This tests for possible dormant current related failures.
5. Check the reference meter to verify the mA output corresponds to the entered value.
6. Use a Field Communicator to view detailed device status to ensure no alarms or warnings are present in the transmitter.
7. Check that sensor value(s) are reasonable in comparison to a basic process control system (BPCS) value.
8. Restore the loop to full operation. Remove the bypass from the safety PLC or otherwise restore normal operation.
9. Document the test results per the plant's requirements.

### 7.7.3 Extended proof test

Conducting the Extended Proof Test, which includes the Abbreviated Proof Test, detects approximately 96% of transmitter DU failures and approximately 99% of temperature sensor(s) DU failures, not detected by the 644 safety-certified automatic diagnostics, for a typical overall assembly coverage of 96%.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip.
2. Execute the Abbreviated Proof Test.
3. Perform a minimum two point sensor verification check. If two sensors are used, repeat for each sensor. If calibration is required for the installation, it may be done in conjunction with this verification.
4. Verify that the housing temperature value is reasonable.
5. Restore the loop to full operation. Remove the bypass from the safety PLC or otherwise restore normal operation.
6. Document the test results per the plant's requirements.

**Table 7-1. Proof test intervals**

Sensors	Abbreviated Proof Test	Extended Proof Test
4-wire RTD	10 years	10 years
Thermocouple	1 year	10 years
	2 years	2 years
Dual Thermocouple	10 years	10 years
Dual 3-wire RTD	10 years	10 years
Thermocouple & 3-wire RTD	10 years	10 years

Proof test intervals are based on sensor failure rates from the “*Electrical and Mechanical Component Reliability Handbook, Second Edition*”, *exida, 2008*. A low stress environment is assumed, with 30% of SIL 2 PFDavg limit budgeted for the transmitter and sensor element. See the FMEDA report for additional details or references.

### Visual Inspection

Not required

### Special Tools

Not required

### Product Repair

The 644 is repairable by replacement only.

All failures detected by the transmitter diagnostics or by the proof-test must be reported. Feedback can be submitted electronically at <http://www.emersonprocess.com/rosemount/safety/safetyCertTemp.htm> (Contact Us button).

## 7.8 Specifications

The 644 must be operated in accordance to the functional and performance specifications provided in the Rosemount 644 Product Data Sheet (document number 00813-0100-4728).

### 7.8.1 Failure rate data

The FMEDA report includes failure rates and common cause Beta factor estimates.

The report is available at <http://www2.emersonprocess.com/en-US/brands/rosemount/Safety-Products/Pages/index.aspx>.

### 7.8.2 Failure values

Safety accuracy:  $\pm 2.0$  percent  
Transmitter response time: 1.5 second  
Self-diagnostics Test: At least once every 60 minutes



### 7.8.3 Product life

50 years - based on worst case component wear-out mechanisms - not based on wear-out of process sensors.

Report any safety related product information at: [http://rosemount.d1asia.ph/rosemount/safety/ReportAFailure\\_newweb.asp](http://rosemount.d1asia.ph/rosemount/safety/ReportAFailure_newweb.asp)



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# Appendix A Specifications and Reference Data

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Specifications .....	page 101
4–20 mA / HART Specifications .....	page 106
Dimensional Drawings .....	page 114
Ordering Information .....	page 119
Specifications and Reference Data for 644 HART Head Mount .....	page 127

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## A.1 Specifications

### A.1.1 Functional

#### Inputs

User-selectable; sensor terminals rated to 42.4 Vdc. See “Accuracy” on page 108 for sensor options.

#### Output

Single 2 wire device with 4-20 mA/HART (Revision 5 or 7 Selectable), linear with temperature or input.

#### Isolation

Input/output isolation tested to 620 Vrms (876.8 Vpp) at 50/60 Hz

#### Local Display

The optional five-digit integral LCD Display includes a floating or fixed decimal point. It can also display engineering units (°F, °C, °R, K, Ω, and millivolts), mA, and percent of span. The display can be configured to alternate between selected display options. Display settings are preconfigured at the factory according to the standard transmitter configuration. They can be reconfigured in the field using HART communications.

The device also supports the use of a two-line, 14 digit Local Operator Interface display supporting the same functionality as the basic display with the added capability to perform multiple configuration tasks on the Rosemount 644. The LOI also has optional password protection for secure operations.

For more information on the LOI configuration options or further functionality that the LOI offers, see [Appendix D Local Operator Interface \(LOI\)](#).

#### Humidity Limits

0–95% relative humidity

## Update Time

≤ 0.5 seconds per sensor

## Accuracy (default configuration) PT 100

HART (0-100 °C): ±0.18 °C

±0.1 °C (when ordered with option P8)

## A.1.2

## Physical

### Electrical Connections

Model	Power and Sensor Terminals
644H	Compression screws permanently fixed to terminal block
644R	Compression screw permanently fixed to front panel

### Field Communicator Connections

Communication Terminals	
644H	Clips permanently fixed to terminal block
644R	Clips permanently fixed to front panel

### Materials of Construction

Electronics Housing and Terminal Block	
644H	Noryl® glass reinforced
644R	Lexan® polycarbonate
Enclosure (Options J5, J6, R1, and R2)	
Housing	Low-copper aluminum
Paint	Polyurethane
Cover O-ring	Buna-N

### Materials of Constructions (Stainless Steel Housing for Biotechnology, Pharmaceutical Industries, and Sanitary Applications)

Housing and Standard Meter Cover

- 316 SST

Cover O-Ring

- Buna-N

## Mounting

The 644R attaches directly to a wall or a DIN rail. The 644H installs in a connection head or universal head mounted directly on a sensor assembly, apart from a sensor assembly using a universal head, or to a DIN rail using an optional mounting clip.

## Weight

Code	Options	Weight
644	HART, Head Mount Transmitter	96 g (3.39 oz)
644R	HART, Rail Mount Transmitter	174 g (6.14 oz)
M5	LCD Display	38 g (1.34 oz)
J5, J6	Universal Head, Standard Cover	577 g (20.35 oz)
J5, J6	Universal Head, Meter Cover	667 g (23.53 oz)
J7, J8	SST Universal Head, Std. Cover	1620 g (57.14 oz)
J7, J8	SST Universal Head, Meter Cover	1730 g (61.02 oz)
R1, R2	Aluminum Connection Head, Std. Cover	523 g (18.45 oz)
R1, R2	Aluminum Connection Head, Meter Cover	618 g (21.79 oz)
R3, R4	Cast SST Connection Head, Std Cover	1615 g (56.97 oz)
R3, R4	Cast SST Connection Head, Meter Cover	1747 g (61.62 oz)

## Weight (Stainless Steel Housing for Biotechnology, Pharmaceutical Industries, and Sanitary Applications)

Option Code	Standard Cover	Meter Cover
S1	840 g (27 oz)	995 g (32 oz)
S2	840 g (27 oz)	995 g (32 oz)
S3	840 g (27 oz)	995 g (32 oz)
S4	840 g (27 oz)	995 g (32 oz)

## Enclosure Ratings (644H)

All available enclosures are Type 4X, IP66, and IP68.

## Sanitary Housing Surface

Surface finish is polished to 32 RMA. Laser etched product marking on housing and standard covers.

## A.1.3 Performance

### EMC (ElectroMagnetic Compatibility)

#### NAMUR NE 21 Standard

The Rosemount 644 meets the requirements for the NAMUR NE 21 rating.

Susceptibility	Parameter	Influence
		HART
ESD	■ 6 kV contact discharge	None
	■ 8 kV air discharge	
Radiated	■ 80 MHz to 2.7 GHz at 10 V/m	< 1.0%
Burst	■ 1 kV for I.O.	None
Surge	■ 1 kV line-ground	None
Conducted	■ 10 kHz to 80 MHz at 10 V	< 1.0%

#### CE Electromagnetic Compatibility Compliance Testing

The 644 is compliant with Directive 2004/108/EC. Meets the criteria under IEC 61326:2006.

#### Power Supply Effect

Less than  $\pm 0.005\%$  of span per volt

#### Stability

RTDs and thermocouples have a stability of  $\pm 0.15\%$  of output reading or  $0.15\text{ }^{\circ}\text{C}$  (whichever is greater) for 24 months.

When ordered with the P8 option code:

- RTDs:  $\pm 0.25\%$  of reading or  $0.25\text{ }^{\circ}\text{C}$ , whichever is greater, for 5 years
- Thermocouples:  $\pm 0.5\%$  of reading or  $0.5\text{ }^{\circ}\text{C}$ , whichever is greater, for 5 years

#### Self Calibration

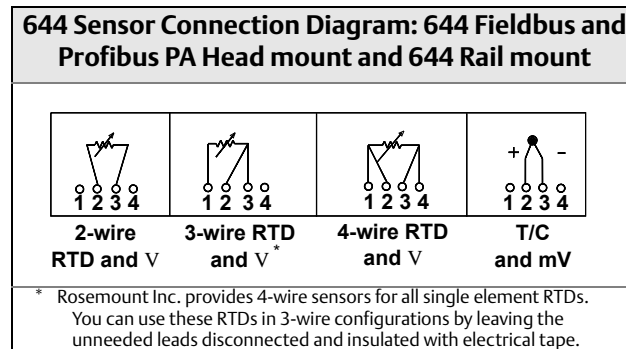
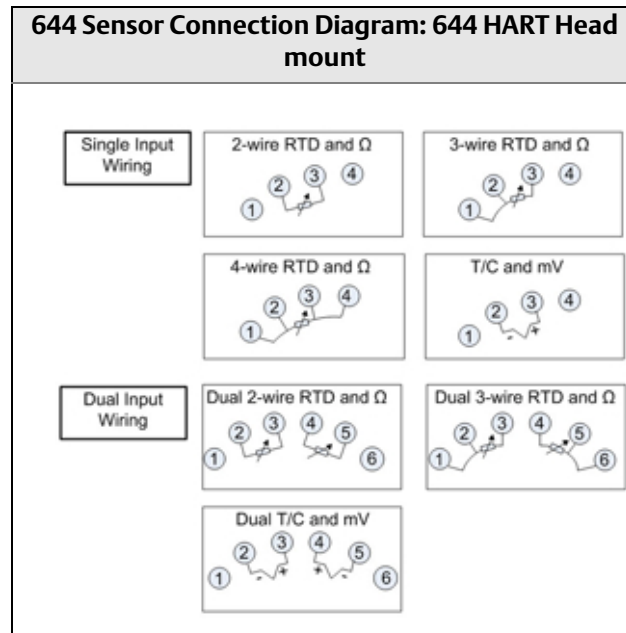
The analog-to-digital measurement circuitry automatically self-calibrates for each temperature update by comparing the dynamic measurement to extremely stable and accurate internal reference elements.

#### Vibration Effect

The 644 HART is tested to the following specifications with no effect on performance per IEC 60770-1, 2010:

Frequency	Vibration
10 to 60 Hz	0.35 mm displacement
60 to 1000 Hz	5 g ( $50\text{ m/s}^2$ ) peak acceleration

## Sensor Connections



**Rosemount Conformance to Specifications**

A Rosemount product not only meets its published specifications, but most likely exceeds them. Advanced manufacturing techniques and the use of Statistical Process Control provide specification conformance to at least  $\pm 3\sigma$ <sup>(1)</sup>. Our commitment to continual improvement ensures that product design, reliability, and performance will improve annually.

For example, the Reference Accuracy distribution for the 644 is shown to the right. Our Specification Limits are  $\pm 0.15^\circ\text{C}$ , but, as the shaded area shows, approximately 68% of the units perform three times better than the limits. Therefore, it is very likely that you will receive a device that performs much better than our published specifications.

Conversely, a vendor who “grades” product without using Process Control, or who is not committed to  $\pm 3\sigma$  performance, will ship a higher percentage of units that are barely within advertised specification limits.

*Accuracy distribution shown is for the 644, Pt 100 RTD sensor, Range 0 to 100 °C*

(1) Sigma ( $\sigma$ ) is a statistical symbol to designate the standard deviation from the mean value of a normal distribution.

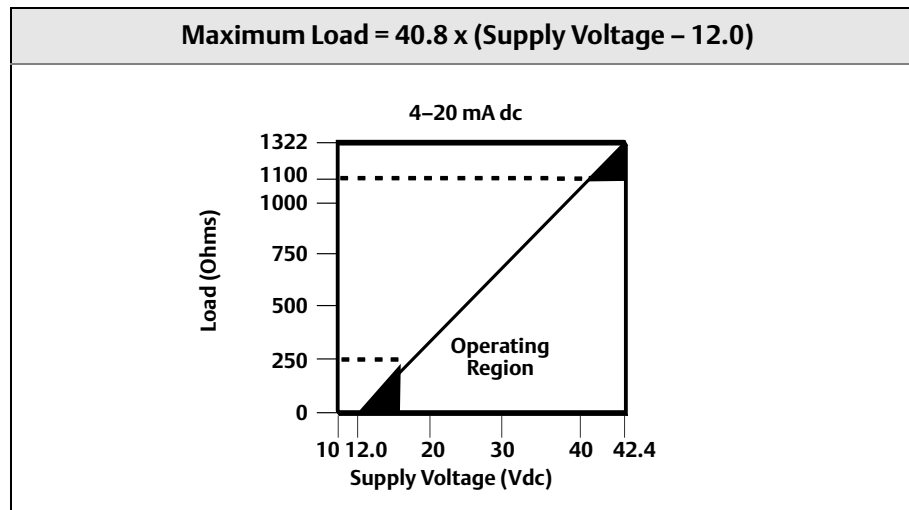
## A.2 4–20 mA / HART Specifications

### Communication Requirements

Transmitter power terminals are rated to 42.4 Vdc. A Field Communicator requires a loop resistance between 250 – 1100 ohms. The 644 HART device does not communicate when power is below 12 Vdc at the transmitter terminals.

### Power Supply

An external power supply is required for HART devices. The transmitter operates on 12.0 to 42.4 Vdc transmitter terminal voltage with load resistance between 250 and 660 ohms. A minimum of 17.75 Vdc power supply is required with a load of 250 ohms. Transmitter power terminals are rated to 42.4 Vdc.



### Temperature Limits

	Operating Limit	Storage Limit
With LCD Display <sup>(1)</sup>	–40 to 185 °F –40 to 85 °C	–50 to 185 °F –45 to 85 °C
Without LCD Display	–40 to 185 °F –40 to 85 °C	–60 to 248 °F –50 to 120 °C

(1) LCD may not be readable and display updates will be slower at temperature below -4 °F (-20 °C).

### Hardware and Software Failure Mode

The 644 features software driven alarm diagnostics. The independent circuit is designed to provide backup alarm output if the microprocessor software fails. The alarm directions (HIGH/LO) are user-selectable using the failure mode switch. If failure occurs, the position of the switch determines the direction in which the output is driven (HI or LO). The switch feeds into the digital-to-analog (D/A) converter, which drives the proper alarm output even if the microprocessor fails. The values at which the transmitter drives its output in failure mode depends on whether it is configured to standard, custom, or NAMUR-compliant (NAMUR recommendation NE 43, June 1997) operation. Table A-1 shows the alarm ranges available for the device to be configured to.



**Table A-1. Available Alarm Range<sup>(1)</sup>**

	<b>Standard</b>	<b>NAMUR- NE 43 Compliant</b>
Linear Output:	$3.9 \leq I^{(2)} \leq 20.5$	$3.8 \leq I \leq 20.5$
Fail High:	$21 \leq I \leq 23$	$21 \leq I \leq 23$
Fail Low:	$3.5 \leq I \leq 3.75$	$3.5 \leq I \leq 3.6$

(1) Measured in milliamperes.

(2) I = Process Variable (current output).

## Custom Alarm and Saturation Level

Custom factory configuration of alarm and saturation level is available with option code C1 for valid values. These values can also be configured in the field using a Field Communicator.

## Turn-on Time

Performance within specifications in less than 6.0 seconds after power is applied, when damping value is set to 0 seconds.

## External Transient Protection

The Rosemount 470 prevents damage from transients induced by lightning, welding, or heavy electrical equipment. For more information, refer to the 470 Product Data Sheet (document number 00813-0100-4191).

## Accuracy

Table A-2. Rosemount 644 Input Options and Accuracy

Sensor Options	Sensor Reference	Input Ranges		Recommended Min. Span <sup>(1)</sup>		Digital Accuracy <sup>(2)</sup>		D/A Accuracy <sup>(3)</sup>
		°C	°F	°C	°F	°C	°F	
2-, 3-, 4-wire RTDs		°C	°F	°C	°F	°C	°F	
Pt 100 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	-328 to 1562	10	18	± 0.15	± 0.27	±0.03% of span
Pt 200 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	-328 to 1562	10	18	± 0.15	± 0.27	±0.03% of span
Pt 500 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	-328 to 1562	10	18	± 0.19	± 0.34	±0.03% of span
Pt 1000 ( $\alpha = 0.00385$ )	IEC 751	-200 to 300	-328 to 572	10	18	± 0.19	± 0.34	±0.03% of span
Pt 100 ( $\alpha = 0.003916$ )	JIS 1604	-200 to 645	-328 to 1193	10	18	± 0.15	± 0.27	±0.03% of span
Pt 200 ( $\alpha = 0.003916$ )	JIS 1604	-200 to 645	-328 to 1193	10	18	± 0.27	± 0.49	±0.03% of span
Ni 120	Edison Curve No. 7	-70 to 300	-94 to 572	10	18	± 0.15	± 0.27	±0.03% of span
Cu 10	Edison Copper Winding No. 15	-50 to 250	-58 to 482	10	18	±1.40	± 2.52	±0.03% of span
Pt 50 ( $\alpha = 0.00391$ )	GOST 6651-94	-200 to 550	-328 to 1022	10	18	± 0.30	± 0.54	±0.03% of span
Pt 100 ( $\alpha = 0.00391$ )	GOST 6651-94	-200 to 550	-328 to 1022	10	18	± 0.15	± 0.27	±0.03% of span
Cu 50 ( $\alpha = 0.00426$ )	GOST 6651-94	-50 to 200	-58 to 392	10	18	±1.34	± 2.41	±0.03% of span
Cu 50 ( $\alpha = 0.00428$ )	GOST 6651-94	-185 to 200	-301 to 392	10	18	±1.34	± 2.41	±0.03% of span
Cu 100 ( $\alpha = 0.00426$ )	GOST 6651-94	-50 to 200	-58 to 392	10	18	±0.67	± 1.20	±0.03% of span
Cu 100 ( $\alpha = 0.00428$ )	GOST 6651-94	-185 to 200	-301 to 392	10	18	±0.67	± 1.20	±0.03% of span
Thermocouples <sup>(4)</sup>								
Type B <sup>(5)</sup>	NIST Monograph 175, IEC 584	100 to 1820	212 to 3308	25	45	± 0.77	± 1.39	±0.03% of span
Type E	NIST Monograph 175, IEC 584	-50 to 1000	-58 to 1832	25	45	± 0.20	± 0.36	±0.03% of span
Type J	NIST Monograph 175, IEC 584	-180 to 760	-292 to 1400	25	45	± 0.35	± 0.63	±0.03% of span
Type K <sup>(6)</sup>	NIST Monograph 175, IEC 584	-180 to 1372	-292 to 2501	25	45	± 0.50	± 0.90	±0.03% of span
Type N	NIST Monograph 175, IEC 584	-200 to 1300	-328 to 2372	25	45	± 0.50	± 0.90	±0.03% of span
Type R	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.75	± 1.35	±0.03% of span
Type S	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.70	± 1.26	±0.03% of span
Type T	NIST Monograph 175, IEC 584	-200 to 400	-328 to 752	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type L	DIN 43710	-200 to 900	-328 to 1652	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type U	DIN 43710	-200 to 900	-328 to 1112	25	45	± 0.35	± 0.63	±0.03% of span
Type W5Re/W26Re	ASTM E 988-96	0 to 2000	32 to 3632	25	45	± 0.70	± 1.26	±0.03% of span
GOST Type L	GOST R 8.585-2001	-200 to 800	-328 to 1472	25	45	± 1.00	± 1.26	±0.03% of span

**Table A-2. Rosemount 644 Input Options and Accuracy**

Sensor Options	Sensor Reference	Input Ranges	Recommended Min. Span <sup>(1)</sup>	Digital Accuracy <sup>(2)</sup>	D/A Accuracy <sup>(3)</sup>
Other Input Types					
Millivolt Input		-10 to 100 mV		±0.015 mV	±0.03% of span
2-, 3-, 4-wire Ohm Input		0 to 2000 ohms		±0.45 ohm	±0.03% of span

- (1) No minimum or maximum span restrictions within the input ranges. Recommended minimum span will hold noise within accuracy specification with damping at zero seconds.
- (2) The published digital accuracy applies over the entire sensor input range. Digital output can be accessed by HART or FOUNDATION fieldbus Communications or Rosemount control system.
- (3) Total Analog accuracy is the sum of digital and D/A accuracies. This is not applicable for FOUNDATION fieldbus.
- (4) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.5 °C. (cold junction accuracy).
- (5) Digital accuracy for NIST Type B T/C is ±3.0 °C (±5.4 °F) from 100 to 300 °C (212 to 572 °F).
- (6) Digital accuracy for NIST Type K T/C is ±0.70 °C (±1.26 °F) from -180 to -90 °C (-292 to -130 °F).

## Accuracy Example

When using a Pt 100 ( $\alpha = 0.00385$ ) sensor input with a 0 to 100 °C span:

- Digital accuracy = ±0.15 °C
- D/A accuracy = ±0.03% of 100 °C or ±0.03 °C
- Total accuracy = ±0.18 °C.

**Table A-3. Ambient Temperature Effect**

Sensor Options	Sensor Reference	Input Range (°C)	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature <sup>(1)</sup>	Range	D/A Effect <sup>(2)</sup>
<b>2-, 3-, 4-wire RTDs</b>					
Pt 100 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 200 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Pt 500 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 1000 ( $\alpha = 0.00385$ )	IEC 751	-200 to 300	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 100 ( $\alpha = 0.003916$ )	JIS 1604	-200 to 645	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Pt 200 ( $\alpha = 0.003916$ )	JIS 1604	-200 to 645	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Ni 120	Edison Curve No. 7	-70 to 300	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Cu 10	Edison Copper Winding No. 15	-50 to 250	0.03 °C (0.054 °F)	Entire Sensor Input Range	0.001% of span
Pt 50 ( $\alpha = 0.00391$ )	GOST 6651-94	-200 to 550	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
Pt 100 ( $\alpha = 0.00391$ )	GOST 6651-94	-200 to 550	0.003 °C (0.0054 °F)	Entire Sensor Input Range	0.001% of span
Cu 50 ( $\alpha = 0.00426$ )	GOST 6651-94	-50 to 200	0.008 °C (0.0144 °F)	Entire Sensor Input Range	0.001% of span
Cu 50 ( $\alpha = 0.00428$ )	GOST 6651-94	-185 to 200	0.008 °C (0.0144 °F)	Entire Sensor Input Range	0.001% of span
Cu 100 ( $\alpha = 0.00426$ )	GOST 6651-94	-50 to 200	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span

**Table A-3. Ambient Temperature Effect**

Sensor Options	Sensor Reference	Input Range (°C)	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature <sup>(1)</sup>	Range	D/A Effect <sup>(2)</sup>
Cu 100 ( $\alpha = 0.00428$ )	GOST 6651-94	-185 to 200	0.004 °C (0.0072 °F)	Entire Sensor Input Range	0.001% of span
<b>Thermocouples</b>					
Type B	NIST Monograph 175, IEC 584	100 to 1820	0.014 °C	$T \geq 1000$ °C	0.001% of span
			0.032 °C – (0.0025% of (T – 300))	$300$ °C $\leq T < 1000$ °C	0.001% of span
			0.054 °C – (0.011% of (T – 100))	$100$ °C $\leq T < 300$ °C	0.001% of span
Type E	NIST Monograph 175, IEC 584	-200 to 1000	0.005 °C + (0.0043% of T)	All	0.001% of span
Type J	NIST Monograph 175, IEC 584	-180 to 760	0.0054 °C + (0.00029% of T)	$T \geq 0$ °C	0.001% of span
			0.0054 °C + (0.0025% of absolute value T)	$T < 0$ °C	0.001% of span
Type K	NIST Monograph 175, IEC 584	-180 to 1372	0.0061 °C + (0.0054% of T)	$T \geq 0$ °C	0.001% of span
			0.0061 °C + (0.0025% of absolute value T)	$T < 0$ °C	0.001% of span
Type N	NIST Monograph 175, IEC 584	-200 to 1300	0.0068 °C + (0.00036% of T)	All	0.001% of span
Type R	NIST Monograph 175, IEC 584	0 to 1768	0.016 °C	$T \geq 200$ °C	0.001% of span
			0.023 °C – (0.0036% of T)	$T < 200$ °C	0.001% of span
Type S	NIST Monograph 175, IEC 584	0 to 1768	0.016 °C	$T \geq 200$ °C	0.001% of span
			0.023 °C – (0.0036% of T)	$T < 200$ °C	0.001% of span
Type T	NIST Monograph 175, IEC 584	-200 to 400	0.0064 °C	$T \geq 0$ °C	0.001% of span
			0.0064 °C + (0.0043% of absolute value T)	$T < 0$ °C	0.001% of span
DIN Type L	DIN 43710	-200 to 900	0.0054 °C + (0.00029% of T)	$T \geq 0$ °C	0.001% of span
			0.0054 °C + (0.0025% of absolute value T)	$T < 0$ °C	0.001% of span
DIN Type U	DIN 43710	-200 to 600	0.0064 °C	$T \geq 0$ °C	0.001% of span
			0.0064 °C + (0.0043% of absolute value T)	$T < 0$ °C	0.001% of span
Type W5Re/W26Re	ASTM E 988-96	0 to 2000	0.016 °C	$T \geq 200$ °C	0.001% of span
			0.023 °C – (0.0036% of T)	$T < 200$ °C	0.001% of span
GOST Type L	GOST R 8.585-2001	-200 to 800	0.007 °C	$T \geq 0$ °C	0.001% of span
			0.007 °C – (0.003% of absolute value T)	$T < 0$ °C	0.001% of span

**Table A-3. Ambient Temperature Effect**

Sensor Options	Sensor Reference	Input Range (°C)	Temperature Effects per 1.0 °C (1.8 °F) Change in Ambient Temperature <sup>(1)</sup>	Range	D/A Effect <sup>(2)</sup>
<b>Other Input Types</b>					
Millivolt Input		-10 to 100 mV	0.0005 mV	Entire Sensor Input Range	0.001% of span
2-, 3-, 4-wire Ohm		0 to 2000 Ω	0.0084 Ω	Entire Sensor Input Range	0.001% of span

(1) Change in ambient is with reference to the calibration temperature of the transmitter 68 °F (20 °C) from factory.

(2) Does not apply to FOUNDATION fieldbus.

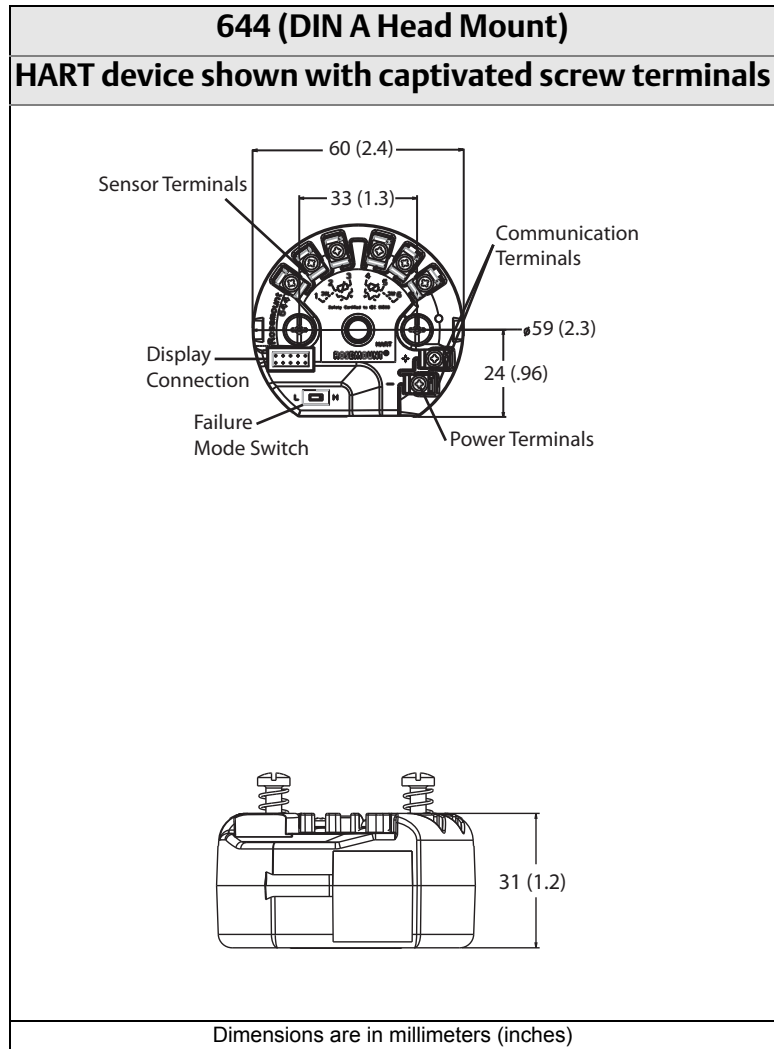
**Table A-4. Transmitter Accuracy when ordered with option code P8**

Sensor Options	Sensor Reference	Input Ranges		Minimum Span <sup>(1)</sup>		Digital Accuracy <sup>(2)</sup>		D/A Accuracy <sup>(3)(4)</sup>
		°C	°F	°C	°F	°C	°F	
2-, 3-, 4-wire RTDs								
Pt 100 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	-328 to 1562	10	18	± 0.10	± 0.18	±0.02% of span
Pt 200 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	-328 to 1562	10	18	± 0.22	± 0.40	±0.02% of span
Pt 500 ( $\alpha = 0.00385$ )	IEC 751	-200 to 850	-328 to 1562	10	18	± 0.14	± 0.25	±0.02% of span
Pt 1000 ( $\alpha = 0.00385$ )	IEC 751	-200 to 300	-328 to 572	10	18	± 0.10	± 0.18	±0.02% of span
Pt 100 ( $\alpha = 0.003916$ )	JIS 1604	-200 to 645	-328 to 1193	10	18	± 0.10	± 0.18	±0.02% of span
Pt 200 ( $\alpha = 0.003916$ )	JIS 1604	-200 to 645	-328 to 1193	10	18	± 0.22	± 0.40	±0.02% of span
Ni 120	Edison Curve No. 7	-70 to 300	-94 to 572	10	18	± 0.08	± 0.14	±0.02% of span
Cu 10	Edison Copper Winding No. 15	-50 to 250	-58 to 482	10	18	± 1.00	± 1.80	±0.02% of span
Pt 50 ( $\alpha=0.00391$ )	GOST 6651-94	-200 to 550	-328 to 1022	10	18	±0.20	±0.36	±0.02% of span
Pt 100 ( $\alpha=0.00391$ )	GOST 6651-94	-200 to 550	-328 to 1022	10	18	±0.10	±0.18	±0.02% of span
Cu 50 ( $\alpha=0.00426$ )	GOST 6651-94	-50 to 200	-58 to 392	10	18	±0.34	±0.61	±0.02% of span
Cu 50 ( $\alpha=0.00428$ )	GOST 6651-94	-185 to 200	-301 to 392	10	18	±0.34	±0.61	±0.02% of span
Cu 100 ( $\alpha=0.00426$ )	GOST 6651-94	-50 to 200	-58 to 392	10	18	±0.17	±0.31	±0.02% of span
Cu 100 ( $\alpha=0.00428$ )	GOST 6651-94	-185 to 200	-301 to 392	10	18	±0.17	±0.31	±0.02% of span
Thermocouples <sup>(5)</sup>								
Type B <sup>(6)</sup>	NIST Monograph 175, IEC 584	100 to 1820	212 to 3308	25	45	± 0.75	± 1.35	±0.02% of span
Type E	NIST Monograph 175, IEC 584	-200 to 1000	-328 to 1832	25	45	± 0.20	± 0.36	±0.02% of span
Type J	NIST Monograph 175, IEC 584	-180 to 760	-292 to 1400	25	45	± 0.25	± 0.45	±0.02% of span
Type K <sup>(7)</sup>	NIST Monograph 175, IEC 584	-180 to 1372	-292 to 2501	25	45	± 0.25	± 0.45	±0.02% of span
Type N	NIST Monograph 175, IEC 584	-200 to 1300	-328 to 2372	25	45	± 0.40	± 0.72	±0.02% of span
Type R	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.60	± 1.08	±0.02% of span
Type S	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.50	± 0.90	±0.02% of span
Type T	NIST Monograph 175, IEC 584	-200 to 400	-328 to 752	25	45	± 0.25	± 0.45	±0.02% of span
DIN Type L	DIN 43710	-200 to 900	-328 to 1652	25	45	± 0.35	± 0.63	±0.02% of span
DIN Type U	DIN 43710	-200 to 600	-328 to 1112	25	45	± 0.35	± 0.63	±0.02% of span

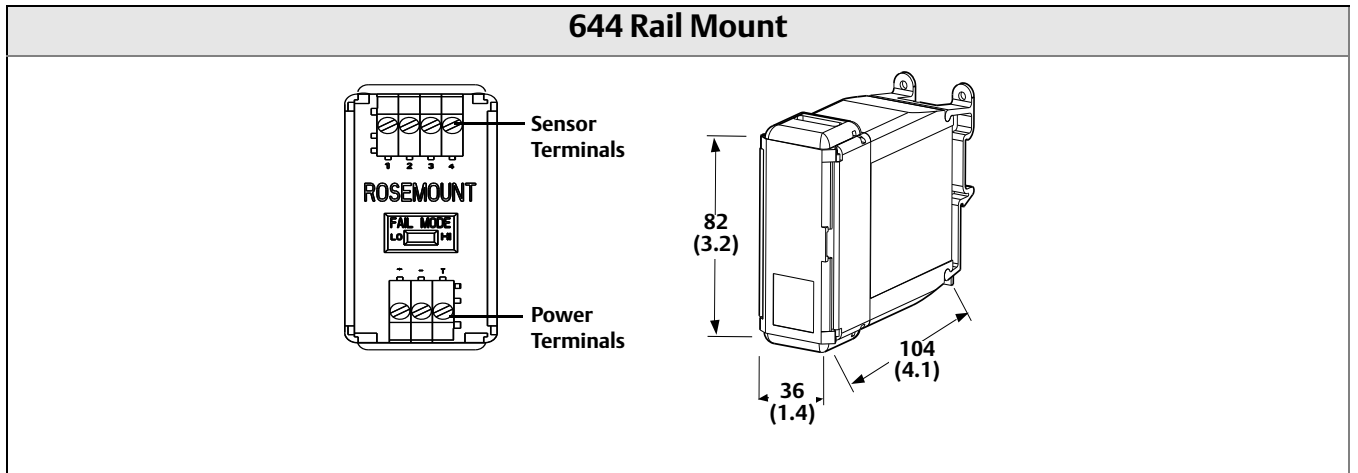
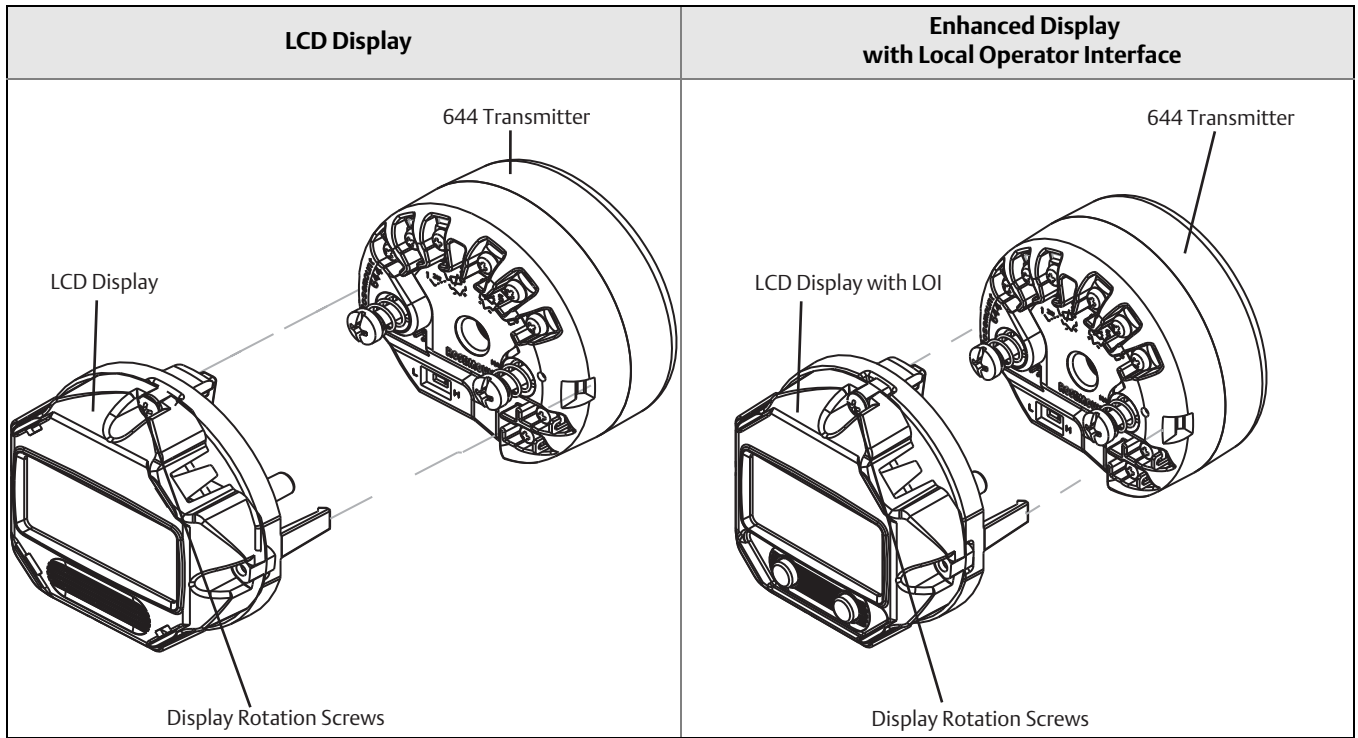
Type W5Re/W26Re	ASTM E 988-96	0 to 2000	32 to 3632	25	45	± 0.70	± 1.26	±0.02% of span
GOST Type L	GOST R 8.585-2001	-200 to 800	-392 to 1472	25	45	± 0.25	± 0.45	±0.02% of span
Other Input Types								
Millivolt Input		-10 to 100 mV		3 mV		±0.015 mV		±0.02% of span
2-, 3-, 4-wire Ohm Input		0 to 2000 ohms		20 ohm		±0.35 ohm		±0.02% of span

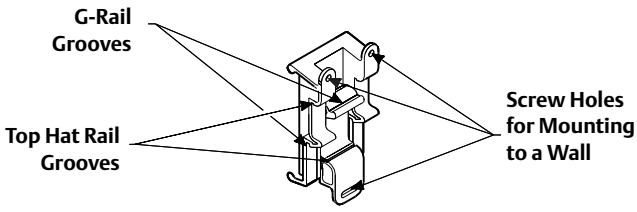
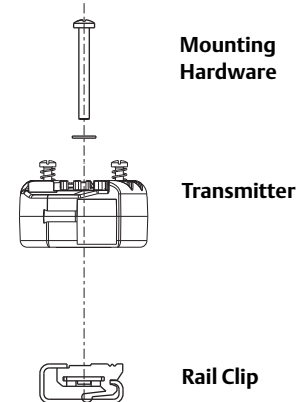
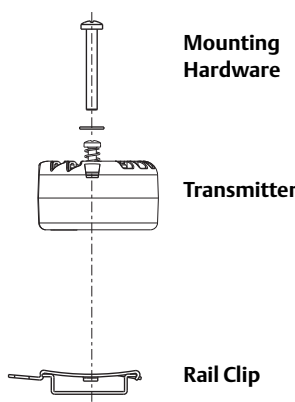
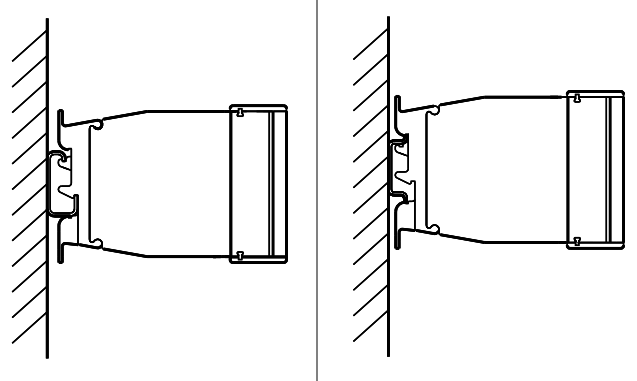
- (1) No minimum or maximum span restrictions within the input ranges. Recommended minimum span will hold noise within accuracy specification with damping at zero seconds.
- (2) Digital accuracy: Digital output can be accessed by the Field Communicator.
- (3) Total Analog accuracy is the sum of digital and D/A accuracies.
- (4) Applies to HART / 4-20 mA devices.
- (5) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.25 °C (0.45 °F) (cold junction accuracy).
- (6) Digital accuracy for NIST Type B is ±3.0 °C (±5.4 °F) from 100 to 300 °C (212 to 572 °F).
- (7) Digital accuracy for NIST Type K is ±0.50 °C (±0.9 °F) from -180 to -90 °C (-292 to -130 °F).

## A.3 Dimensional Drawings



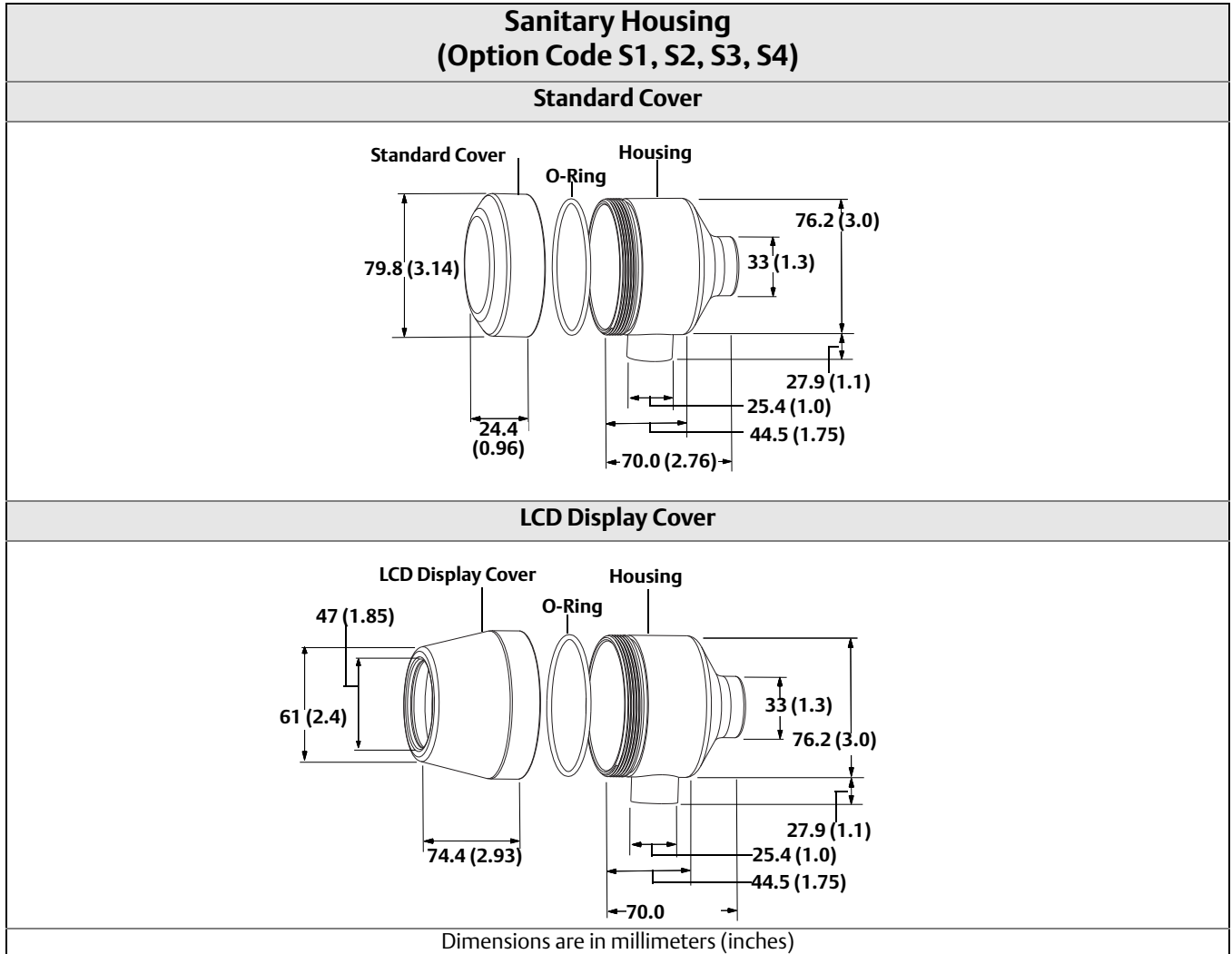




Mounting Kits for 644 Head Mount		
644R Rail & Walls Clips	644H Rail Clips	
	G-Rail (asymmetric)	Top Hat Rail (symmetric)
		
	<p>Note: Kit (part number 00644-5301-0010) includes mounting hardware and both types of rail kits.</p>	
<p>(part number 03044-4103-0001)</p>		

Threaded-Sensor Universal Head (Option code J5, J6, J7 or J8)	DIN Style Sensor Connection Head (Option code R1, R2, R3 or R4)
<p>Label</p> <p>LCD Display</p> <p>Meter Cover</p> <p>Standard Cover</p> <p>75 (2.93)</p> <p>103 (4.03) with LCD Display</p> <p>316 SST "U" Bolt Mounting, 2-inch Pipe</p>	<p>104 (4.09)</p> <p>78 (3.07)</p> <p>128 (5.04) with LCD Display</p> <p>100 (3.93)</p>
<p>Note: A "U" Bolt is shipped with each universal head unless assembly option XA is ordered.</p>	
<p>Dimensions are in millimeters (inches)</p>	

## Stainless Steel Housing for Biotechnology, Pharmaceutical Industries, and Sanitary Applications



## A.4 Ordering Information

The Rosemount 644 is a versatile temperature transmitter that delivers field reliability and advanced accuracy and stability to meet demanding process needs.



Transmitter features include:

- HART/4-20 mA with Selectable Revisions 5 and 7 (Option Code A), FOUNDATION fieldbus (Option Code F) or PROFIBUS PA (Option Code W)
- DIN A or Rail Mount mounting styles
- Dual Sensor Input (Option Code S)
- SIS SIL 2 Safety Certification (Option Code QT)
- LCD display suite
  - Local Operator Interface (Option Code M4)
  - LCD Display (Option Code M5)
- Advanced Diagnostics (Option Codes DC and DA1)
- Enhanced Transmitter Accuracy and Stability (Option Code P8)
- Transmitter-Sensor Matching (Option Code C2)

**Table A-5. Rosemount 644 Smart Temperature Transmitter Ordering Information**

★ The Standard offering represents the most common models and options. These options should be selected for best delivery. The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.

		● = Available - = Not Available		
Model	Product Description			
644	Temperature Transmitter			
<b>Transmitter Type</b>				
Standard				Standard
H	DIN A Head Mount - Single Sensor Input			★
R	Rail Mount - Single Sensor Input			★
S	DIN A Head Mount - Dual Sensor Input (HART only)			★
<b>Output</b>		Head	Rail	
Standard				Standard
A	4-20 mA with digital signal based on HART protocol	●	●	★
F	FOUNDATION fieldbus digital signal (includes 2 AI function blocks and Backup Link Active Scheduler)	●	-	★
W	Profibus PA digital signal	●	-	★

**Table A-5. Rosemount 644 Smart Temperature Transmitter Ordering Information**

★ The Standard offering represents the most common models and options. These options should be selected for best delivery.  
The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.

● = Available – = Not Available
------------------------------------

Product Certifications		A	F	W	A	
Hazardous Locations Certificates (consult factory for availability)		A	F	W	A	
Standard						Standard
NA	No approval	●	●	●	●	★
E5	FM Explosion-proof; Dust Ignition-proof	●	●	●	–	★
I5	FM Intrinsically Safe; Non-incendive	●	●	●	●	★
K5	FM Explosion-proof; Intrinsically Safe; Non-incendive; Dust Ignition-proof	●	●	●	–	★
NK	IECEX Dust	●	–	–	–	★
KC	FM and CSA Intrinsically Safe and Non-incendive	–	–	–	●	★
KB	FM and CSA: Explosion-proof; Intrinsically Safe; Non-incendive; Dust Ignition-proof	●	–	–	–	★
KD	FM, CSA and ATEX Explosion-proof, Intrinsically Safe	●	●	●		★
I6	CSA Intrinsically Safe	●	●	●	●	★
K6 <sup>(1)</sup>	CSA Explosion-proof; Intrinsically Safe; Non-incendive; Dust Ignition-proof	●	●	●	–	★
I3	China Intrinsic Safety	●	–	–	–	★
E3	China Flameproof	●	●	●	–	★
N3	China Type n	●	–	–	–	★
E1	ATEX Flameproof	●	●	●	–	★
N1	ATEX Type n	●	●	●	–	★
NC <sup>(2)</sup>	ATEX Type n Component	●	●	●	●	★
K1	ATEX Flameproof; Intrinsic Safety; Type n; Dust	●	●	●		★
ND	ATEX Dust Ignition-Proof	●	●	●	–	★
KA	CSA and ATEX: Explosion-proof; Intrinsically Safe; Non-incendive	●	–	–	–	★
I1	ATEX Intrinsic Safety	●	●	●	●	★
E7	IECEX Flameproof	●	●	●	–	★
I7	IECEX Intrinsic Safety	●	●	●	●	★
N7	IECEX Type n	●	●	●	–	★
NG <sup>(2)</sup>	IECEX Type n Component	●	●	●	●	★
K7	IECEX Flameproof; Intrinsic Safety; Type n; Dust	●	–	–	–	★
I2	INMETRO Intrinsic Safety	●	–	–	–	
I4	TIIS Intrinsic Safety					★
E2	INMETRO Flameproof	●	●	●	–	★

### Options

		A	F	W	A	
<b>PlantWeb Control Functionality</b>						
Standard						Standard
A01	FOUNDATION fieldbus Advanced Control Function Block Suite	–	●	–	–	★
<b>PlantWeb Standard Diagnostic Functionality</b>						
Standard						Standard
DC	Diagnostics: Hot Backup and Sensor Drift Alert	●	–	–	–	★
<b>PlantWeb Advanced Diagnostic Functionality</b>						
Standard						Standard
DA1	HART Sensor and Process Diagnostic Suite: Thermocouple Diagnostic and Min/Max Tracking	●	–	–	–	★

**Table A-5. Rosemount 644 Smart Temperature Transmitter Ordering Information**

★ The Standard offering represents the most common models and options. These options should be selected for best delivery.  
The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.

● = Available			
- = Not Available			
A	F	W	A

<b>Enclosure Options</b>						
Standard					Standard	
J5 <sup>(3)(4)</sup>	Universal Head (junction box), aluminum alloy with 50.8 mm (2-in.) SST pipe bracket (M20 entries)	●	●	●	-	★
J6 <sup>(3)</sup>	Universal Head (junction box), aluminum alloy with 50.8 mm (2-in.) SST pipe bracket (1/2-14 NPT entries)	●	●	●	-	★
R1	Rosemount Connection Head, Aluminum alloy (M20 x 1.5 conduit and entries)	●	●	●	-	★
R2	Rosemount Connection Head, Aluminum alloy (1/2-14 NPT entries)	●	●	●	-	★
Expanded						
R3	Rosemount Connection Head, cast SST (M20 x 1.5 conduit and entries)	●	●	●	-	
R4	Rosemount Connection Head, cast SST (1/2-14 NPT entries)	●	●	●	-	
J7 <sup>(3)(4)</sup>	Universal Head (junction box), cast SST with 50.8 mm (2-in.) SST pipe bracket (M20 entries)	●	●	●	-	
J8 <sup>(3)</sup>	Universal Head (junction box), cast SST with 50.8 mm (2-in.) SST pipe bracket (1/2-14 NPT entries)	●	●	●	-	
S1	Connection Head, Polished Stainless Steel (1/2-14 NPT entries)	●	●	●	-	
S2	Connection Head, Polished Stainless Steel (1/2-14 NPSM entries)	●	●	●	-	
S3	Connection Head, Polished Stainless Steel (M20 x 1.5 conduit and entries)	●	●	●	-	
S4	Connection Head, Polished Stainless Steel (M20 x 1.5 conduit entries, M24 x 1.5 head entry)	●	●	●	-	
<b>Display and Interface Options</b>						
Standard					Standard	
M4	LCD Display with Local Operator Interface	●	-	-	-	★
M5	LCD Display	●	●	●	-	★
<b>Software Configuration</b>						
Standard					Standard	
C1	Custom Configuration of Date, Descriptor and Message (Requires CDS with order)	●	●	●	●	★
<b>Enhanced Performance</b>						
Standard					Standard	
P8	Enhanced Transmitter Accuracy and Stability	●	-	-	-	★
<b>Alarm Level Configuration</b>						
Standard					Standard	
A1	NAMUR alarm and saturation levels, high alarm	●	-	-	●	★
CN	NAMUR alarm and saturation levels, low alarm	●	-	-	●	★
C8	Low Alarm (Standard Rosemount Alarm and Saturation Values)	●	-	-	●	★
<b>Line Filter</b>						
Standard					Standard	
F5	50 Hz Line Voltage Filter	●	●	●	●	★
F6	60 Hz Line Voltage Filter	●	●	●	●	★
<b>Sensor Trim</b>						
Standard					Standard	
C2	Transmitter-Sensor Matching - Trim to Specific Rosemount RTD Calibration Schedule (CVD constants)	●	●	●	●	★

**Table A-5. Rosemount 644 Smart Temperature Transmitter Ordering Information**

★ The Standard offering represents the most common models and options. These options should be selected for best delivery.  
The Expanded offering is manufactured after receipt of order and is subject to additional delivery lead time.

		● = Available – = Not Available				
		A	F	W	A	
<b>5-Point Calibration Option</b>						
Standard						Standard
C4	5-point calibration. Use option code Q4 to generate a calibration certificate	●	●	●	●	★
<b>Calibration Certificate</b>						
Standard						Standard
Q4	Calibration certificate. 3-Point calibration with certificate	●	●	●	●	★
QP	Calibration Certification & Tamper Evident Seal	●	●	●	–	★
<b>Quality Certification for Safety</b>						
Standard						Standard
QT	Safety Certified to IEC 61508 with certificate of FMEDA data (HART only)	●	–	–	–	★
<b>External Ground</b>						
Standard						Standard
G1	External ground lug assembly	●	●	●	–	★
<b>Cable Gland Option</b>						
Standard						Standard
G2 <sup>(5)</sup>	Cable gland (7.5 mm - 11.99 mm)	●	●	●	–	★
G7	Cable gland, M20x1.5, Ex e, Blue Polyamide (5 mm - 9 mm)	●	●	●	–	★
<b>Cover Chain Option</b>						
Standard						Standard
G3	Cover chain	●	●	●	–	★
<b>Conduit Electrical Connector</b>						
Standard						Standard
GE <sup>(6)</sup>	M12, 4-pin, Male Connector (eurofast <sup>®</sup> )	●	●	●	–	★
GM <sup>(6)</sup>	A size Mini, 4-pin, Male Connector (minifast <sup>®</sup> )	●	●	●	–	★
<b>External Label</b>						
Standard						Standard
EL	External label for ATEX Intrinsic Safety	●	●	●	–	★
<b>HART Revision Configuration</b>						
Standard						Standard
HR7 <sup>(7)</sup>	Configured for HART Revision 7	●	–	–	–	★
<b>Assemble To Options</b>						
Standard						Standard
XA	Sensor Specified Separately and Assembled to Transmitter	●	●	●	–	★
<b>Typical Rail Mount Model Number: 644 R A I5</b>						
<b>Typical Head Mount Model Number: 644 S A I5 DC DA1 J5 M5</b>						

- (1) Requires housing option R2, R4, J6 or J8.
- (2) Approval not valid if ordered with a housing.
- (3) Suitable for remote mount configuration.
- (4) When ordered with XA, 1/2-in. NPT enclosure will come equipped with an M20 adapter with the sensor installed as process ready.
- (5) Requires housing option J6, J8, R2, or R4.
- (6) Available with Intrinsically Safe approvals only. For FM Intrinsically Safe or non-incendive approval (option code I5), install in accordance with Rosemount drawing 03151-1009 to maintain NEMA 4X rating.
- (7) Configures the HART output to HART Revision 7. The device can be field configured to HART Revision 5 if needed.



**Note**

For additional options (e.g. “K” codes), please contact your local Emerson Process Management representative.

**Table A-6. Transmitter Accessories**

Part Description	Part Number
Aluminum Alloy Universal Head, Std Cover - M20	00644-4420-0002
Aluminum Alloy Universal Head, Meter Cover - M20	00644-4420-0102
Aluminum Alloy Universal Head, Std Cover - 1/2 - 14 NPT	00644-4420-0001
Aluminum Alloy Universal Head, Meter Cover - 1/2 - 14 NPT	00644-4420-0101
SST Universal Head, Std Cover - M20	00644-4433-0002
SST Universal Head, Meter Cover - M20	00644-4433-0102
SST Universal Head, Std Cover - 1/2 - 14 NPT	00644-4433-0001
SST Universal Head, Meter Cover - 1/2 - 14 NPT	00644-4433-0101
Aluminum Alloy Conn Head, Std Cover - M20 X 1/2 ANPT	00644-4410-0021
Aluminum Alloy Conn Head, Std Cover - 1/2 - 14 NPT x 1/2 2 ANPT	00644-4410-0011
Aluminum Alloy Conn Head, Meter Cover - M20 X 1/2 ANPT	00644-4410-0121
Aluminum Alloy Conn Head, Meter Cover - 1/2 - 14 NPT X 1/2 ANPT	00644-4410-0111
SST Conn Head, Std Cover - M20 X 1/2 ANPT	00644-4411-0021
SST Conn Head, Std Cover - 1/2 - 14 NPT x 1/2 ANPT	00644-4411-0011
SST Conn Head, Meter Cover - M20 X 1/2 ANPT	00644-4411-0121
SST Conn Head, Meter Cover - 1/2 - 14 NPT X 1/2 ANPT	00644-4411-0111
Polished SST Connection Head, Standard Cover - 1/2-14 NPT entries	00079-0312-0011
Polished SST Connection Head, Meter Cover - 1/2-14 NPT entries	00079-0312-0111
Polished SST Connection Head, Standard Cover - 1/2-14 NPSM entries	00079-0312-0022
Polished SST Connection Head, Meter Cover - 1/2-14 NPSM entries	00079-0312-0122
Polished SST Connection Head, Standard Cover - M20 x 1.5 entries	00079-0312-0033
Polished SST Connection Head, Meter Cover -M20 x 1.5 entries	00079-0312-0133
Polished SST Connection Head, Standard Cover - M20 x 1.5 / M24 x 1.5 entries	00079-0312-0034
Polished SST Connection Head, Meter Cover - M20 x 1.5 / M24 x 1.5 entries	00079-0312-0134
Ground Screw Assembly Kit	00644-4431-0001
Mounting Screws and Springs	00644-4424-0001
Hardware for Mounting a Rosemount 644H to a DIN rail	00644-5301-0010
Hardware for Retrofitting a Rosemount 644H in an existing Threaded Sensor Connection Head (former option code L1)	00644-5321-0010
U-Bolt kit for Universal Housing	00644-4423-0001
Universal Clip for Rail or Wall Mount	03044-4103-0001
24 Inches of symmetric (Top Hat) Rail	03044-4200-0001
24 Inches of asymmetric (G) Rail	03044-4201-0001
Ground Clamp for symmetric or asymmetric Rail	03044-4202-0001
Snap Ring Kit	00644-4432-0001
Cover Clamp Assembly	00644-4434-0001
O-ring Kit (Qty 12)	03031-0232-0001

**Table A-7. Display Accessories**

	Display only	Display and Aluminum Housing Cover <sup>(1)</sup>	Display and SST Housing Cover <sup>(1)</sup>
644 HART LCD Display (M5)	00644-7630-0001	00644-7630-0011	00644-7630-0021
644 HART Local Operator Interface (M4)	00644-7630-1001	00644-7630-1011	00644-7630-1021
644 FOUNDATION Fieldbus LCD Display (M5)	00644-4430-0002	00644-4430-0001	00644-4430-0011
644 Profibus PA LCD Display (M5)	00644-4430-0002	00644-4430-0001	00644-4430-0011

(1) Covers provided are compatible with the Universal Junction Box and Rosemount Connection Head enclosure styles.

## A.4.1 Configuration

### Transmitter Configuration

The transmitter is available with standard configuration settings for HART. The configuration settings may be changed in the field with DeltaV<sup>®</sup>, with AMS Device Manager, or with any field communicator.

### Standard HART Configuration

Unless specified, the transmitter will be shipped as follows:

Sensor Type	RTD, Pt 100 ( $\alpha=0.00385$ , 4-wire)
4 mA Value	0 °C
20 mA Value	100 °C
Output	Linear with temperature
Saturation Levels	3.9 / 20.5 mA
Damping	5 sec.
Line Voltage Filter	50 Hz
Alarm	High (21.75 mA)
LCD (when installed)	Engineering Units and mA
Tag	See “Tagging” on page 124.
HART Revision	5

## A.4.2 Tagging

### Hardware Tag

- 13 characters total
- Tags are located on adhesive labels permanently affixed to the transmitter

### Software Tag

#### HART Revision 5

A HART Revision 5 transmitter can store up to 8 characters for the HART software tag and defaults to the first 8 characters of the Hardware Tag.

#### HART Revision 7

A HART Revision 7 transmitter can store the same 8 character tag as the Revision 5 but has an additional and separate Long Software Tag that can be configured for up to 32 characters. Long Software Tag is available when option code HR7 is ordered.

## A.4.3 Considerations

### Special Mounting Considerations

See “Mounting Kits for 644 Head Mount” on page 116 for the special hardware that is available to:

- Mount a 644H to a DIN rail. (see Table A-6 on page A-123)
- Retrofit a new 644H to replace an existing 644H transmitter in an existing threaded sensor connection head. (see Table A-6 on page A-123)

### External Ground Screw Assembly

The external ground screw assembly can be ordered by specifying code G1 when an enclosure is specified. However, some approvals include the ground screw assembly in the transmitter shipment, hence it is not necessary to order code G1. The table below identifies which approval options include the external ground screw assembly and which do not.

Approval Type	External Ground Screw Assembly Included?
E5, I1, I2, I5, I6, I7, K5, K6, NA, KB, I3	No—Order option code G1
E1, E2, E3, E4, E7, K7, N1, N7, ND, K1, K2, KA, NK	Yes

### Custom Configuration

Custom configurations are to be specified when ordering. This configuration must be the same for all sensors. The following table lists the necessary requirements to specify a custom configuration.

	Option Code	Customization Available
HART	<p><b>C1:</b> Factory Configuration Data (CDS required)</p> <p>Also needs option code:</p> <p style="text-align: right;">...DC ...DC ...M4 or M5</p>	<ul style="list-style-type: none"> <li>■ <b>Date:</b> day/month/year</li> <li>■ <b>Descriptor:</b> 8 alphanumeric characters</li> <li>■ <b>Message:</b> 32 alphanumeric characters</li> <li>■ <b>Hardware Tag:</b> 13 Characters</li> <li>■ <b>Software Tag:</b> 8 Characters</li> <li>■ Sensor Type and Connection</li> <li>■ Measurement Range and Units</li> <li>■ Damping Value</li> <li>■ <b>Failure Mode:</b> High or Low</li> <li>■ <b>Hot Backup:</b> Mode and PV</li> <li>■ <b>Sensor Drift Alert:</b> Mode, Limit and Units</li> <li>■ <b>Display Configuration:</b> Choose what will be shown on the LCD display</li> <li>■ <b>Custom Alarm and saturation levels:</b> Choose custom High and Low Alarm and Saturation levels</li> <li>■ <b>Security information:</b> Write Protection, HART Lock and Local Operator Interface Password</li> </ul>
	<p><b>C2:</b> Transmitter – Sensor Matching</p>	<ul style="list-style-type: none"> <li>■ The transmitters are designed to accept Callendar-Van Dusen constants from a calibrated RTD. Using these constants, the transmitter generates a custom curve to match the sensor-specific curve. Specify a Series 65, 65, or 78 RTD sensor on the order with a special characterization curve (V or X8Q4 option). These constants will be programmed into the transmitter with this option.</li> </ul>
	<p><b>A1, CN, or C8:</b> Alarm Level Configuration</p>	<ul style="list-style-type: none"> <li>■ <b>A1:</b> NAMUR Alarm and Saturation Levels, with High Alarm configured</li> <li>■ <b>CN:</b> NAMUR Alarm and Saturation Levels, with Low Alarm configured</li> <li>■ <b>C8:</b> Low Alarm (Standard Rosemount Alarm and Saturation Values)</li> </ul>
	<p><b>Q4:</b> Three-Point Calibration with Certificate</p>	<ul style="list-style-type: none"> <li>■ Calibration certificate. Three-Point calibration at 0, 50 and 100% with certificate.</li> </ul>
	<p><b>C4:</b> Five-Point Calibration</p>	<ul style="list-style-type: none"> <li>■ Will include five-point calibration at 0, 25, 50, 75, and 100% analog and digital output points. Use with Calibration Certificate Q4</li> </ul>
	<p><b>HR7:</b> HART Revision configuration</p>	<ul style="list-style-type: none"> <li>■ Your 644 Head mount device is HART revision selectable. Order the HR7 code to configure your device to operate in HART Revision 7 mode. Your device is also configurable in the field. Refer to the 644 Quick Installation Guide or Reference Manual for more instructions.</li> <li>■ <b>Long Software Tag:</b> 32 Characters</li> </ul>

## A.5 Specifications and Reference Data for 644 HART Head Mount

(Device Revision 7 or previous)

### A.5.1 Functional Specifications

#### Inputs

User-selectable; sensor terminals rated to 42.4 Vdc. See “Accuracy” on page 108 for sensor options.

#### Output

Single 2-wire device with either 4-20 mA/HART, linear with temperature or input. Device supports protocol revision HART 5.

#### Isolation

Input/output isolation tested to 600 Vrms.

#### Local Display

The optional five-digit integral LCD Display includes a floating or fixed decimal point. It can also display engineering units (°F, °C, °R, K, W, and mV), mA, and percent of span. The display can be configured to alternate between selected display options. Display settings are preconfigured at the factory according to the standard transmitter configuration. They can be reconfigured in the field using a compliant Field Communicator.

#### Humidity Limits

0–95% relative humidity

#### Update Time

≤ 0.5 sec.

**Accuracy** (default configuration) PT 100

HART (0-100 °C): ±0.18 °C

## A.5.2 Physical Specifications

### Electrical Connections

Model	Power and Sensor Terminals
644H	Compression screws permanently fixed to terminal block

### Field Communicator Connections

Communication Terminals	
644H	Clips permanently fixed to terminal block

### Materials of Construction

Electronics Housing and Terminal Block	
644H	Noryl® glass reinforced
Enclosure (Options J5, J6)	
Housing	Low-copper aluminum
Paint	Polyurethane
Cover O-ring	Buna-N

### Materials of Constructions (Stainless Steel Housing for Biotechnology, Pharmaceutical Industries, and Sanitary Applications)

Housing and Standard Meter Cover

- 316 SST

Cover O-Ring

- Buna-N

### Mounting

The 644H installs in a connection head or universal head mounted directly on a sensor assembly, apart from a sensor assembly using a universal head, or to a DIN rail using an optional mounting clip.

## Special Mounting Considerations

See “Mounting Kits for 644 Head Mount” on page 116 for the special hardware that is available to:

- Mount a 644H to a DIN rail. (see page 114)
- Retrofit a new 644H to replace an existing 644H transmitter in an existing threaded sensor connection head.(see Table A-6 on page A-123)

## Weight

Code	Options	Weight
644H	HART, Head Mount Transmitter	95 g (3.39 oz)
644H	FOUNDATION fieldbus, Head Mount Transmitter	92 g (3.25 oz)
644H	Profibus PA Head Mount Transmitter	92 g (3.25 oz)
644R	HART, Rail Mount Transmitter	174 g (6.14 oz)
M5	LCD Display	35 g (1.34 oz)
J5, J6	Universal Head, Standard Cover	577 g (20.35 oz)
J5, J6	Universal Head, Meter Cover	667 g (23.53 oz)
J7, J8	SST Universal Head, Std. Cover	1620 g (57.14 oz)
J7, J8	SST Universal Head, Meter Cover	1730 g (61.02 oz)

## Weight (Stainless Steel Housing for Biotechnology, Pharmaceutical Industries, and Sanitary Applications)

Option Code	Standard Cover	Meter Cover
S1	840 g (27 oz)	995 g (32 oz)
S2	840 g (27 oz)	995 g (32 oz)
S3	840 g (27 oz)	995 g (32 oz)
S4	840 g (27 oz)	995 g (32 oz)

## Enclosure Ratings (644H)

All available enclosures are Type 4X, IP66, and IP68.

## Sanitary Housing Surface

Surface finish is polished to 32 RMA. Laser etched product marking on housing and standard covers.

## A.5.3 Performance Specifications

### EMC (ElectroMagnetic Compatibility) NAMUR NE 21 Standard

The 644H HART meets the requirements for NAMUR NE 21 Rating.

Susceptibility	Parameter	Influence
		HART
ESD	<ul style="list-style-type: none"> <li>■ 6 kV contact discharge</li> <li>■ 8 kV air discharge</li> </ul>	None
Radiated	<ul style="list-style-type: none"> <li>■ 80 – 1000 MHz at 10 V/m AM</li> </ul>	< 1.0%
Burst	<ul style="list-style-type: none"> <li>■ 1 kV for I.O.</li> </ul>	None
Surge	<ul style="list-style-type: none"> <li>■ 0.5 kV line–line</li> <li>■ 1 kV line–ground (I.O. tool)</li> </ul>	None
Conducted	<ul style="list-style-type: none"> <li>■ 100 kHz to 80 MHz at 10 V</li> </ul>	< 1.0%

### CE Electromagnetic Compatibility Compliance Testing

The 644 is compliant with Directive 2004/108/EC. Meets the criteria under IEC 61326:2006

### Power Supply Effect

Less than  $\pm 0.005\%$  of span per volt

### Stability

RTDs and thermocouples have a stability of  $\pm 0.15\%$  of output reading or  $0.15\text{ }^{\circ}\text{C}$  (whichever is greater) for 24 months

### Self Calibration

The analog-to-digital measurement circuitry automatically self-calibrates for each temperature update by comparing the dynamic measurement to extremely stable and accurate internal reference elements.

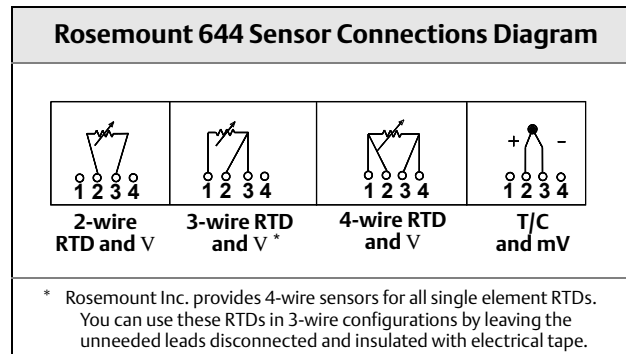
### Vibration Effect

The 644 is tested to the following specifications with no effect on performance per IEC 60770-1, 1999:

Frequency	Vibration
10 to 60 Hz	0.21 mm displacement
60 to 2000 Hz	3 g peak acceleration



## Sensor Connections



## Tagging

### Hardware

- 13 characters total
- Tags are adhesive labels affixed to the side of the transmitter
- Permanently attached to transmitter
- Character height is 1/16-in (1.6 mm)

### Software

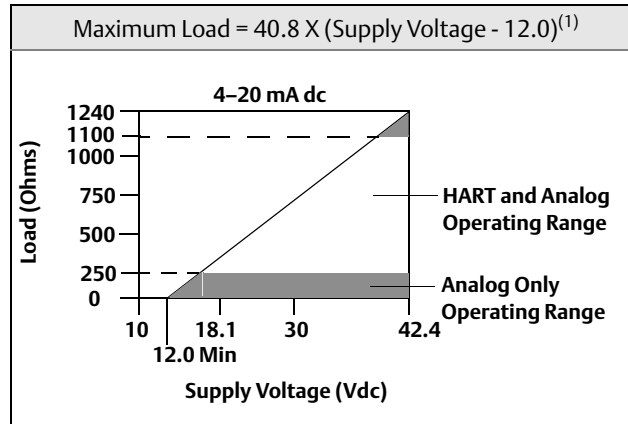
- The transmitter can store up to 8 characters for the HART protocol
- Order Software Tag with C1 option code

## A.5.4 4–20 mA / HART Specifications

### Power Supply

External power supply required. Transmitters operate on 12.0 to 42.4 Vdc transmitter terminal voltage (with 250 ohm load, 18.1 Vdc power supply voltage is required). Transmitter power terminals rated to 42.4 Vdc.

## Load Limitations



(1) Without transient protection (optional).

### Note

HART Communication requires a loop resistance between 250 and 1100 ohms. Do not communicate with the transmitter when power is below 12 Vdc at the transmitter terminals.

## Temperature Limits

	Operating Limit	Storage Limit
With LCD <sup>(1)</sup>	-40 to 185 °F -20 to 85 °C	-50 to 185 °F -45 to 85 °C
Without LCD	-40 to 185 °F -40 to 85 °C	-60 to 248 °F -50 to 120 °C

(1) LCD may not be readable and display updates will be slower at temperatures below -4 °F (-20 °C).

## Hardware and Software Failure Mode

The 644 features software driven alarm diagnostics and an independent circuit which is designed to provide backup alarm output if the microprocessor software fails. The alarm direction (HI/LO) is user-selectable using the failure mode switch. If failure occurs, the position of the switch determines the direction in which the output is driven (HI or LO). The switch feeds into the digital-to-analog (D/A) converter, which drives the proper alarm output even if the microprocessor fails. The values at which the transmitter software drives its output in failure mode depends on whether it is configured to standard, custom, or NAMUR-compliant (NAMUR recommendation NE 43, June 1997) operation. [Table A-1 on page A-107](#) shows the configuration alarm ranges.

	Standard	NAMUR- NE 43 Compliant
Linear Output:	$3.9 \leq I^{(1)} \leq 20.5$	$3.8 \leq I \leq 20.5$
Fail High:	$21.75 \leq I \leq 23$	$21.5 \leq I \leq 23$
Fail Low:	$3.5 \leq I \leq 3.75$	$3.5 \leq I \leq 3.6$

(1) I = Process Variable (current output).

## Custom Alarm and Saturation Level

Custom factory configuration of alarm and saturation level is available with option code C1 for valid values. These values can also be configured in the field using a Field Communicator.

## Turn-on Time

Performance within specifications in less than 5.0 seconds after power is applied, when damping value is set to 0 seconds.

## External Transient Protection

The Rosemount 470 prevents damage from transients induced by lightning, welding, or heavy electrical equipment. For more information, refer to the 470 Product Data Sheet (document number 00813-0100-4191).

## Configuration

For standard configuration information, see “Configuration” on page 124.

**Table A-8. 644 HART legacy display kits**

	Kit Part number
Display Only	00644-4430-0002
Display and Aluminum, Housing Cover <sup>(1)</sup>	00644-4430-0001
Display and SST Housing Cover <sup>(1)</sup>	00644-4430-0011

(1) Covers provided are compatible with the 3 in (76mm) Universal Junction Box and Rosemount Connection Head enclosure styles.



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# Appendix B Product Certifications

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Approved manufacturing locations .....	page 135
European Union Directive Information .....	page 135
Hazardous Locations Certifications .....	page 135

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## B.1 Approved manufacturing locations

Emerson Process Management Rosemount Division. – Chanhassen, MN  
Emerson Process Management Asia Pacific Limited – Singapore  
Emerson Process Management GmbH & Co. - Karlstein, Germany  
Emerson Process Management (India) Private Ltd. – Mumbai, India  
Emerson Process Management Brazil - Sorocaba, Brazil  
Emerson Process Management, Dubai - Emerson FZE  
Beijing Rosemount Far East Instrument Co., Limited. - Beijing, China

## B.2 European Union Directive Information

The EC declaration of conformity for all applicable European directives for this product can be found at [www.emersonprocess.com](http://www.emersonprocess.com).

### B.2.1 Ordinary Location Certification from FM Approvals

As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by FM Approvals, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

### B.2.2 Hazardous Locations Certifications

#### North American Certifications

##### FM Approvals

- 15 Intrinsically Safe and Non-Incendive  
Certificate No: 3044581  
Applicable Standards: FM Class 3600 – 1998, FM Class 3610 – 2010, FM Class 3611 – 2004,  
FM Class 3810 – 2005, ANSI/NEMA 250 - 2003  
Markings (without enclosure):  
INT. SAFE CL I, GP ABCD, T4  
IS CL I Zone 0, AEX ia IIC; T4 Ga  
NI CL I, DIV.2, GP ABCD T5  
INSTALL PER DRAWINGS 00644-2071

Markings (with enclosure):  
IS CL I,II,III, GP ABCDEFG T4/T5/T6  
NI CL I, DIV.2, GP ABCD  
INSTALL PER DRAWINGS 00644-2071  
ENCLOSURE TYPE 4X

**Special Conditions for Safe Use (X)**

- The surface resistivity of the non-metallic enclosure materials is greater than one gigaohm. Care must be taken to avoid electrostatic charge build-up. Do not rub or cleaned with solvents or a dry cloth.
- The Model 644 optional enclosures may contain aluminum and are considered a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact and friction.

E5 Explosion-Proof and Dust Ignition Proof  
Certificate No: 3006278  
Applicable Standards: FM Class 3600 – 1998, FM Class 3615 – 2006, FM Class 3810 – 2005, ANSI/NEMA 250 - 2003  
Markings:EXPLOSIONPROOF FOR CL. I, DIV. 1, GP BCD  
DUST-IGNITIONPROOF FOR CL. II & III, DIV. 1, GP EFG  
NON-INCENDIVE FOR CL. I, DIV 2, GP ABCD  
WHEN INSTALLED PER ROSEMOUNT DRAWING 00644-1049  
CONDUIT SEAL NOT REQUIRED;  
ENCLOSURE TYPE 4X

**Special Conditions for Safe Use (X)**

- The surface resistivity of the non-metallic enclosure materials is greater than one gigaohm. Care must be taken to avoid electrostatic charge build-up. Do not rub or cleaned with solvents or a dry cloth.
- The Rosemount 644 optional enclosures may contain aluminum and are considered a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact and friction.


**CSA Group**

I6 Intrinsically Safe  
Certificate No.: 1091070  
Applicable Standards: CSA Std. C22.2 No. 142 – M1987, CSA Std. C22.2 No. 157 – 92  
Markings (without enclosure):  
Ex ia  
INTRINSICALLY SAFE, CLASS I, GROUPS A, B, C, D, T4/T5/T6 CLASS I, ZONE 0, IIC  
SUITABLE FOR CLASS I DIV 2, GROUPS A, B, C, D  
INSTALL PER DRAWING 00644-2072.  
Markings (with enclosure):  
Ex ia  
CLASS I, GRPS A,B,C,D, T4/T6, CLASS I, ZONE 0, IIC  
WHEN INSTALL PER DRAWING 00644-1064 or 0644-2072  
SUITABLE CLASS I DIV 2, WITH NON-INCENDIVE OUTPUT WHEN INSTALL PER DRAWING  
00644-2072  
ENCLOSURE TYPE 4X

K6 Explosion-Proof, Dust Ignition Proof, Intrinsically Safe and Suitable for Class I Division 2  
Certificate No.: 1091070  
Applicable Standards: CSA Std. C22.2 No. 142 – M1987, CSA Std. C22.2 No. 30 – M1986,  
CSA std. C22.2 No 157-92, CSA Std. C22.2 No. 213 – M1987

Markings: CL I, GRPS. B,C,D;  
DUST-IGNITION PROOF, CL II, GRPS E,F, CL. III;  
SUITABLE FOR CL I, DIV. 2, GROUPS A,B,C,D, WITH NON-INCENDIVE OUTPUT  
INSTALL PER DRAWING 00644-1059  
ENCLOSURE TYPE 4X; CONDUIT SEAL NOT REQUIRED, Ex ia CLASS I, GROUPS A, B, C, D,  
T4/T5/T6 CLASS I, ZONE 0, IIC. INSTALL PER DRAWING 00644-1064 or 00644-2072.  
SUITABLE FOR CLASS I DIV 2, GROUPS A, B, C, D, WITH NON-INCENDIVE OUTPUT  
INSTALL PER DRAWING 00644-2072.

### European Certifications

- I1 ATEX Intrinsic Safety  
Certificate No.: Baseefa 12ATEX0101X  
Applicable Standards: IEC 60079-0: 2011, EN60079-11: 2007  
Markings:  II 1 G, Ex ia IIC T6...T4 Ga;  
See Certificate ([Table B-1](#))  
CE 1180

### Special Conditions for Safe Use (X)


The apparatus must be installed in an enclosure which affords a degree of protection of at least IP20.

Non-metallic enclosures must have a surface resistance of less than 1 Gohm.

Light alloy or zirconium enclosures must be protected from impact and friction when installed.

**Table B-1. Input Parameters**

Loop	
$U_i = 30 \text{ V}$	
$I_i = 150 \text{ mA}$	$T_a < 80^\circ$
$= 170 \text{ mA}$	$T_a < 70^\circ$
$= 190 \text{ mA}$	$T_a < 60^\circ$
$P_i = 0.67 \text{ W}$	T6 ( $-60^\circ\text{C} \leq T_a \leq 40^\circ\text{C}$ ), T5 ( $-60^\circ\text{C} \leq T_a \leq 50^\circ\text{C}$ )
$= 0.8 \text{ W}$	T5 ( $-60^\circ\text{C} \leq T_a \leq 40^\circ\text{C}$ ), T4 ( $-60^\circ\text{C} \leq T_a \leq 80^\circ\text{C}$ )
$C_i = 3.3 \text{ nF}$	
$L_i = 0$	
Sensor	
$U_o = 13.6 \text{ V}$	
$I_o = 80 \text{ mA}$	
$P_o = 80 \text{ mW}$	
$C_i = 0.075 \mu\text{F}$	$C_o = 0.816 \mu\text{F}$ Group IIC
	$C_o = 5.196 \mu\text{F}$ Group IIB
	$C_o = 18.596 \mu\text{F}$ Group IIA
$L_i = 0$	$L_o = 5.79 \text{ mH}$ Group IIC
	$L_o = 23.4 \text{ mH}$ Group IIB
	$L_o = 48.06 \text{ mH}$ Group IIA

- N1 ATEX Type n (with enclosure)  
Certification No.: BAS 00ATEX3145  
Applicable Standards: EN 60079-0: 2006, EN60079-15: 2005  
Markings:  II 3 G, Ex nA IIC T5 Gc ( $-40^\circ\text{C} \leq T_a \leq 70^\circ\text{C}$ )

### Specific Conditions for Safe Use (X):

- The apparatus is not capable of withstanding the 500 V insulation test required by Clause 6.8.1 of EN 60079-15:2005. This must be taken into account when installing the apparatus.

- NC ATEX Type n (without enclosure)  
Certificate No.: Baseefa12ATEX0102U  
Applicable Standards: IEC 60079-0: 2011, EN60079-15: 2005  
Markings: Ⓢ II 3 G, Ex nA IIC T6...T5 Gc  
 $V_{\max} = 45$  volts max

Temperature limitations – T6 ( $-60\text{ °C} \leq T_a \leq 40\text{ °C}$ ), T5 ( $-60\text{ °C} \leq T_a \leq 85\text{ °C}$ )

**Special Conditions for safe use (x):**

The component must be installed in a suitably certified enclosure such that it is afforded a degree of protection of at least IP54 in accordance with IEC 60529, IEC 60079-0 & EN 60079-15.

- E1 ATEX Flameproof  
Certification No.: KEMA 99ATEX8715X  
Applicable Standards: EN60079-0: 2006, EN60079-1: 2007  
Markings: Ⓢ II 2 G, Ex d IIC T6 Gb ( $-50\text{ °C} \leq T_a \leq 65\text{ °C}$ )  
CE1180

**Special Conditions for Safe Use (X):**

For information on the dimensions of the flameproof joints the manufacture shall be contacted.

- ND ATEX Dust  
Certification No.: KEMA 99ATEX8715X  
Applicable Standards: EN 61241-0:2006, EN 61241-1:2004  
Markings: Ⓢ II 1 D, Ex tD A20 IP66 T95°C  
CE1180

**Special Conditions for Safe Use (X): None**

**IECEX Certifications**

- I7 IECEX Intrinsic Safety  
Certificate No.: IECEX BAS 12.0069X  
Applicable Standards: IEC 60079-0: 2011, IEC 60079-11: 2007  
Markings: Ex ia IIC T6...T4 Ga  
See Certificate ([Table B-1](#))

**Special Conditions for Safe Use (X)**

The apparatus must be installed in an enclosure which affords a degree of protection of at least IP20

Non-metallic enclosures must have a surface resistance of less than 1Gohm

Light alloy or zirconium enclosures must be protected from impact and friction when installed

- N7 IECEX Type n (with enclosure)  
Certification No.: IECEX BAS 07.0055  
Applicable Standards: IEC 60079-0: 2004, EN60079-15: 2005  
Markings: Ex nA IIC T5 Gc ( $-40\text{ °C} \leq T_a \leq 70\text{ °C}$ )
- NG IECEX Type n (without enclosure)  
Certification No.: IECEX BAS 12.0070X  
Applicable Standards: IEC 60079-0: 2011, IEC 60079-15: 2010  
Markings: Ex nA IIC T6...T5 Gc  
 $V_{\max} = 45$  volts max

Temperature limitations – T6 ( $-60\text{ °C} \leq T_a \leq 40\text{ °C}$ ), T5 ( $-60\text{ °C} \leq T_a \leq 85\text{ °C}$ )

**Special Conditions for safe use (x):**

The component must be installed in an enclosure which meets the impact test requirements of IEC 60079-15:2005 and provides the component with a degree of protection of at least IP54.



- E7 IECEx Flameproof  
Certification No.: IECEx KEM 09.0015X  
Applicable Standards: IEC 60079-0: 2004, IEC 60079-1: 2007  
Markings: Ex d IIC T6 Gb (-40 °C ≤ Ta ≤ 65 °C)

**Special Conditions for Safe Use (X):**

For information on the dimensions of the flameproof joints the manufacture shall be contacted.

- NK IECEx Dust  
Certification No.: IECEx KEM 09.0015X  
Applicable Standards: IEC 61241-0:2004, IEC 61241-1:2004  
Markings: Ex tD A20 IP66 T95°C

**Special Conditions for Safe Use (X): None**

**Brazil Certifications**

- E2 INMETRO Flameproof  
Certification No.: CEPEL 02.0095X  
Applicable Standards: ABNT NBR IEC 60079-0:2008, ABNT NBR IEC 60079-1:2009,  
ABNT NBR IEC 60079-26: 2008, ABNT NBR IEC 60529:2009,  
Markings: d IIC T6 Ga/Gb IP66\* Tamb : -20 °C a +65 °C

**Chinese Certifications**

- E3 NEPSI Flameproof and Dust Ignitionproof  
Certification No.: GYJ111385X  
Applicable Standards: GB3836.1-2000, GB3836.2-2000, GB12476.1-2000  
Markings: Ex d IIC T6  
DIP A20 TA 95°C IP66\*

**Special Conditions for Safe Use (X):**

(See Manual)

**Japanese Certifications**

- E4 TIIS Flameproof  
Certification No.: TC15744 – 644H with meter, no sensor  
TC15745 – 644H without meter, no sensor  
TC15910 – 644H without meter, thermocouple sensor  
TC15911 – 644H with meter, thermocouple sensor  
TC15912 – 644H without meter, RTD sensor  
TC15913 – 644H with meter, RTD sensor  
Markings: (TC 1591x) d IIB+H2 T4  
(TC1574x) IIC T6

**Combinations of Certifications**

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

- K1 Combination of E1, I1, N1, and ND  
K2 Combination of E2 and I2  
K5 Combination of E5 and I5  
K6 Combination of E6 and I6  
K7 Combination of E7, I7, and N7  
KA Combination of E1, I1, E6, and I6

KB Combination of E5, I5, I6, and E6

KC Combination of E5, E1, I5, and I1

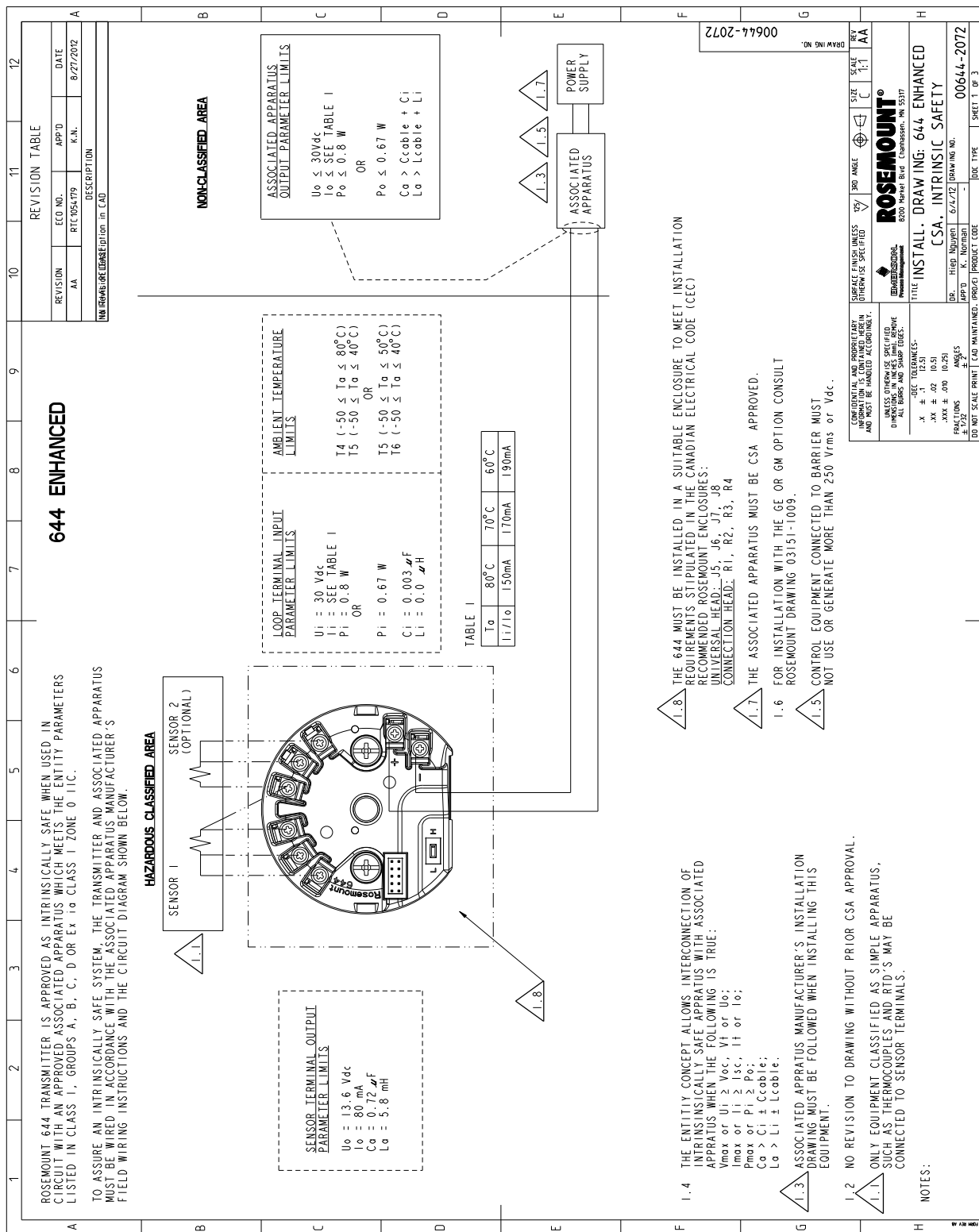
KD Combination of E5, I5, E6, I6, E1, and I1

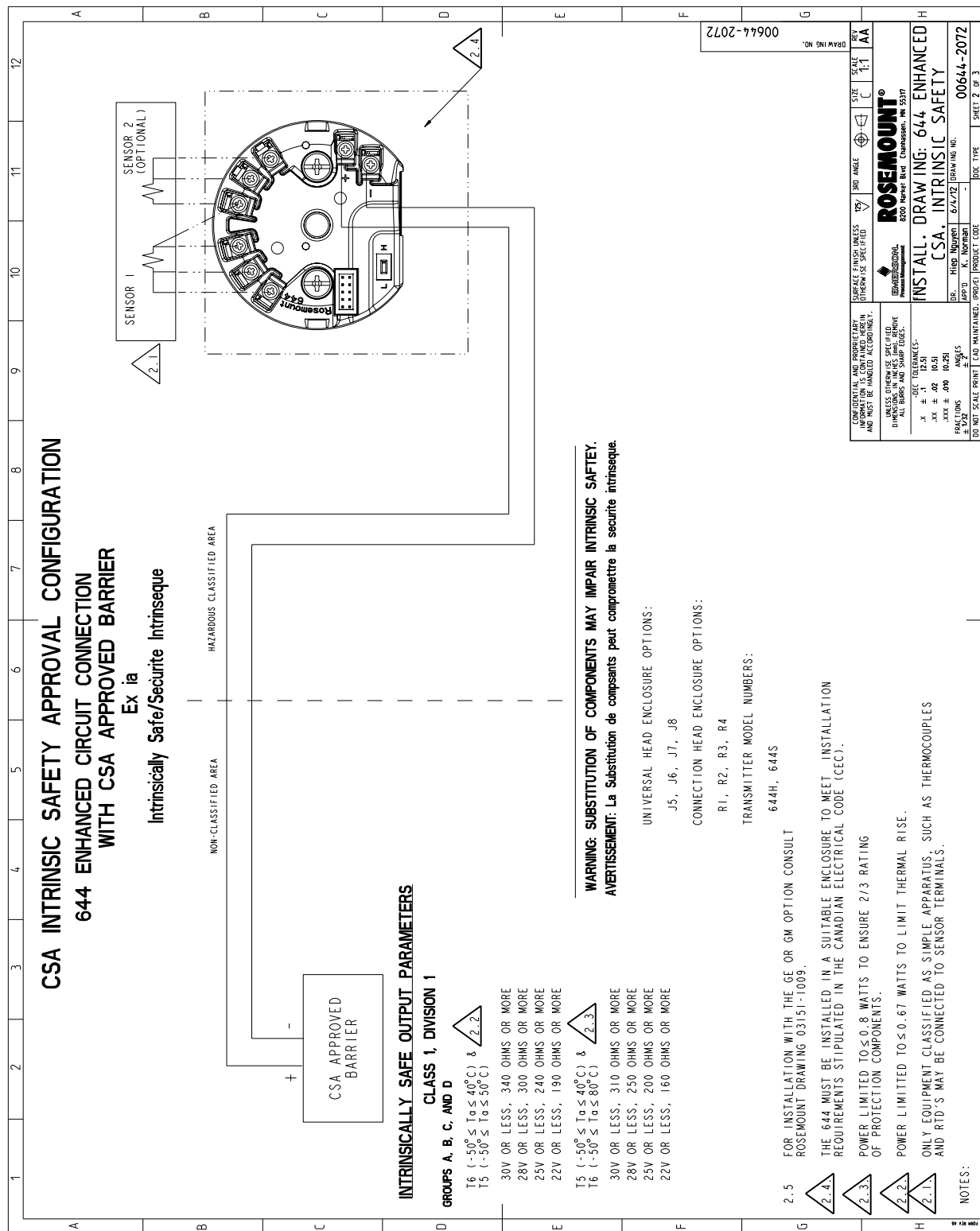
## **Other Certifications**

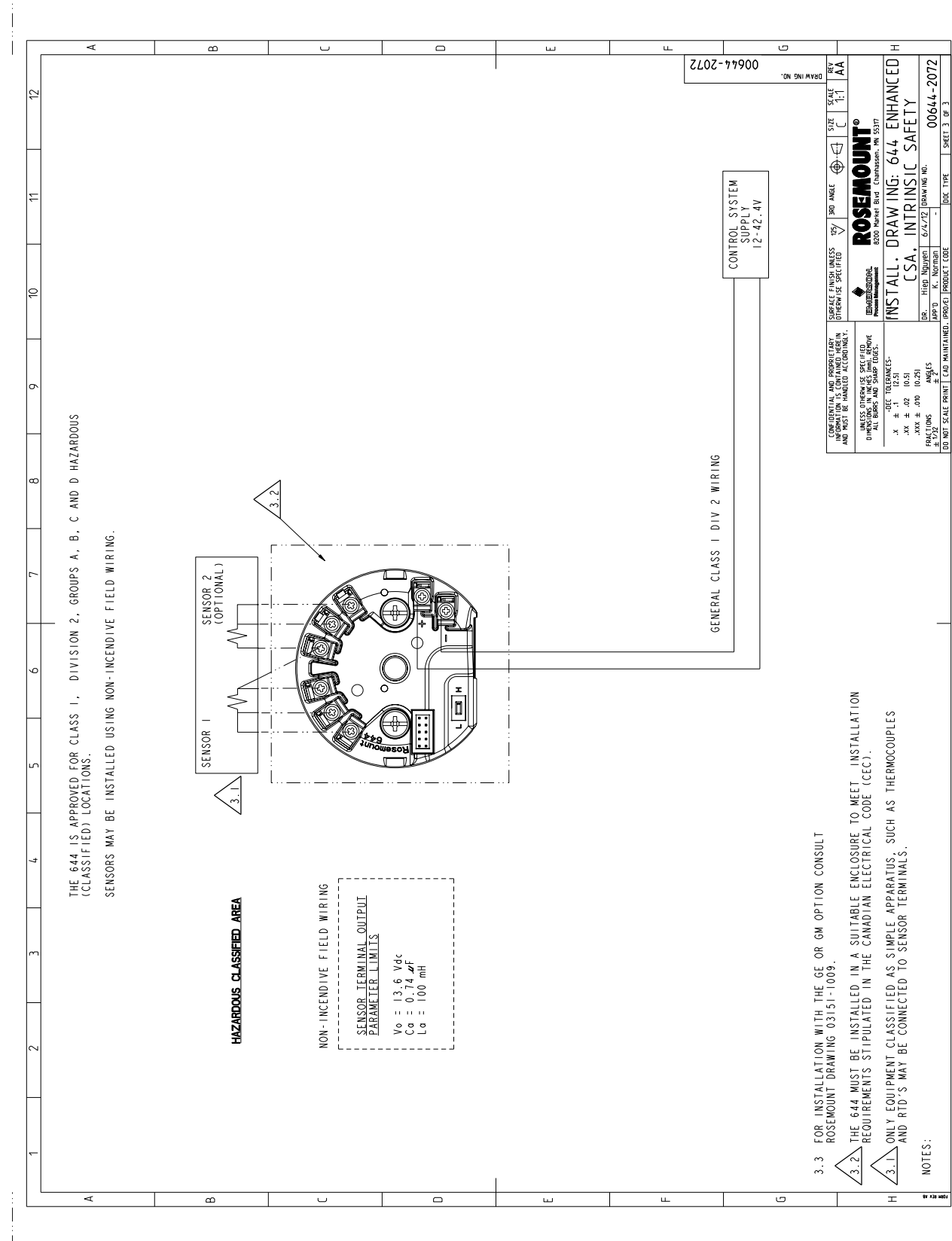
### ***Shipboard***

SBS American Bureau of Shipping (ABS)  
Certificate No.: 00-HS145383/1-PDA  
Applicable Standards: ABS Rules:2008 Steel Vessels Rules 1-1-4/7.7, 4-8-3/1.7  
Intended Service: Measurement of Pressure, Flow and Level for Liquid, Gas and Vapor  
Applications on ABS Classed Vessels, Marine and Offshore Installations

Figure B-1. CSA Intrinsic Safety Installation Drawing 00644-2072. Rev AA







3.3 FOR INSTALLATION WITH THE GE OR GM OPTION CONSULT ROSEMOUNT DRAWING 03151-1009.

3.2 THE 644 MUST BE INSTALLED IN A SUITABLE ENCLOSURE TO MEET INSTALLATION REQUIREMENTS STIPULATED IN THE CANADIAN ELECTRICAL CODE (CEC).

3.1 ONLY EQUIPMENT CLASSIFIED AS SIMPLE APPARATUS, SUCH AS THERMOCOUPLES AND RTD'S MAY BE CONNECTED TO SENSOR TERMINALS.

**NOTES:**

Figure B-2. CSA Intrinsic Safety Installation Drawing 00644-1064, Rev. AB

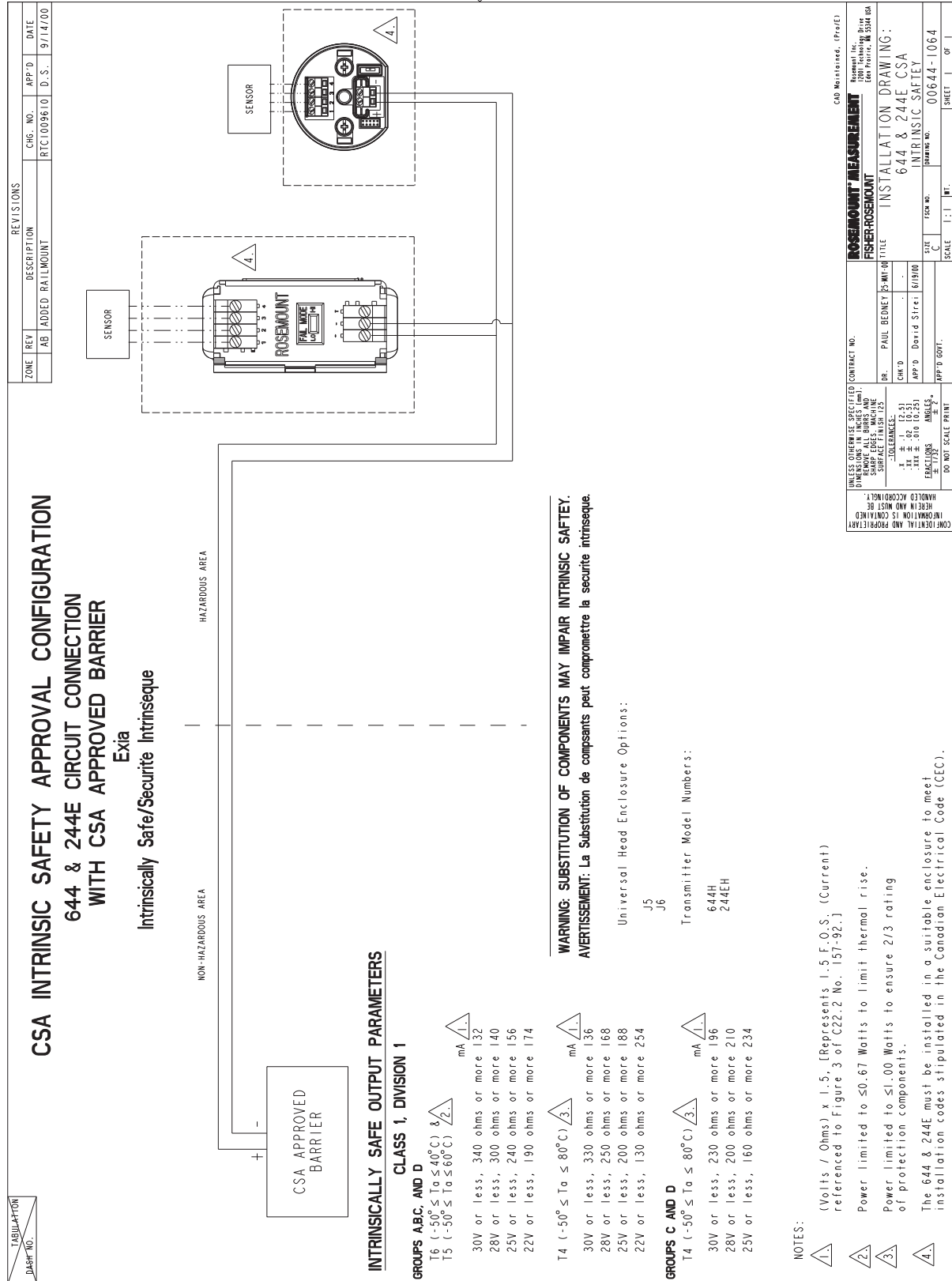
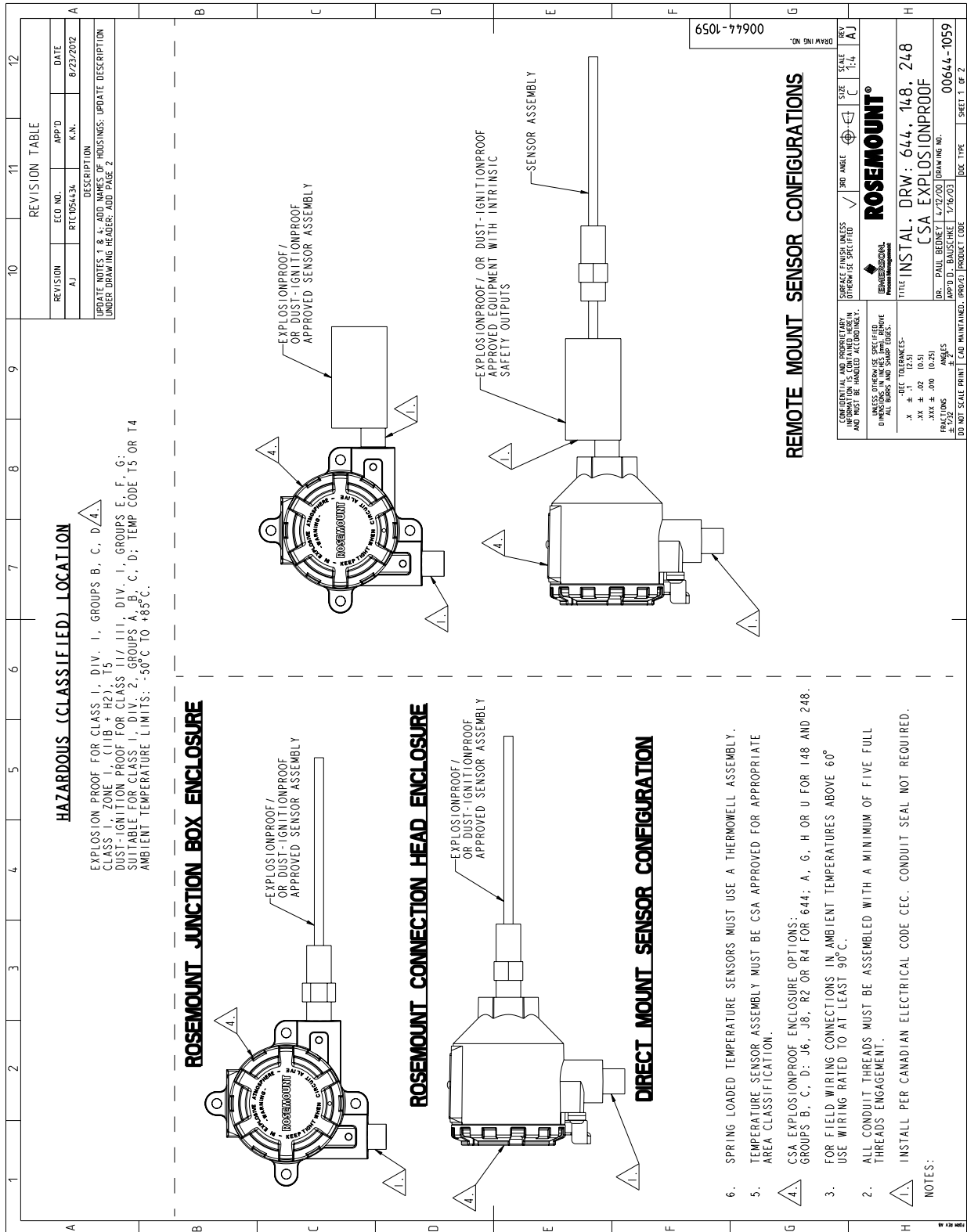
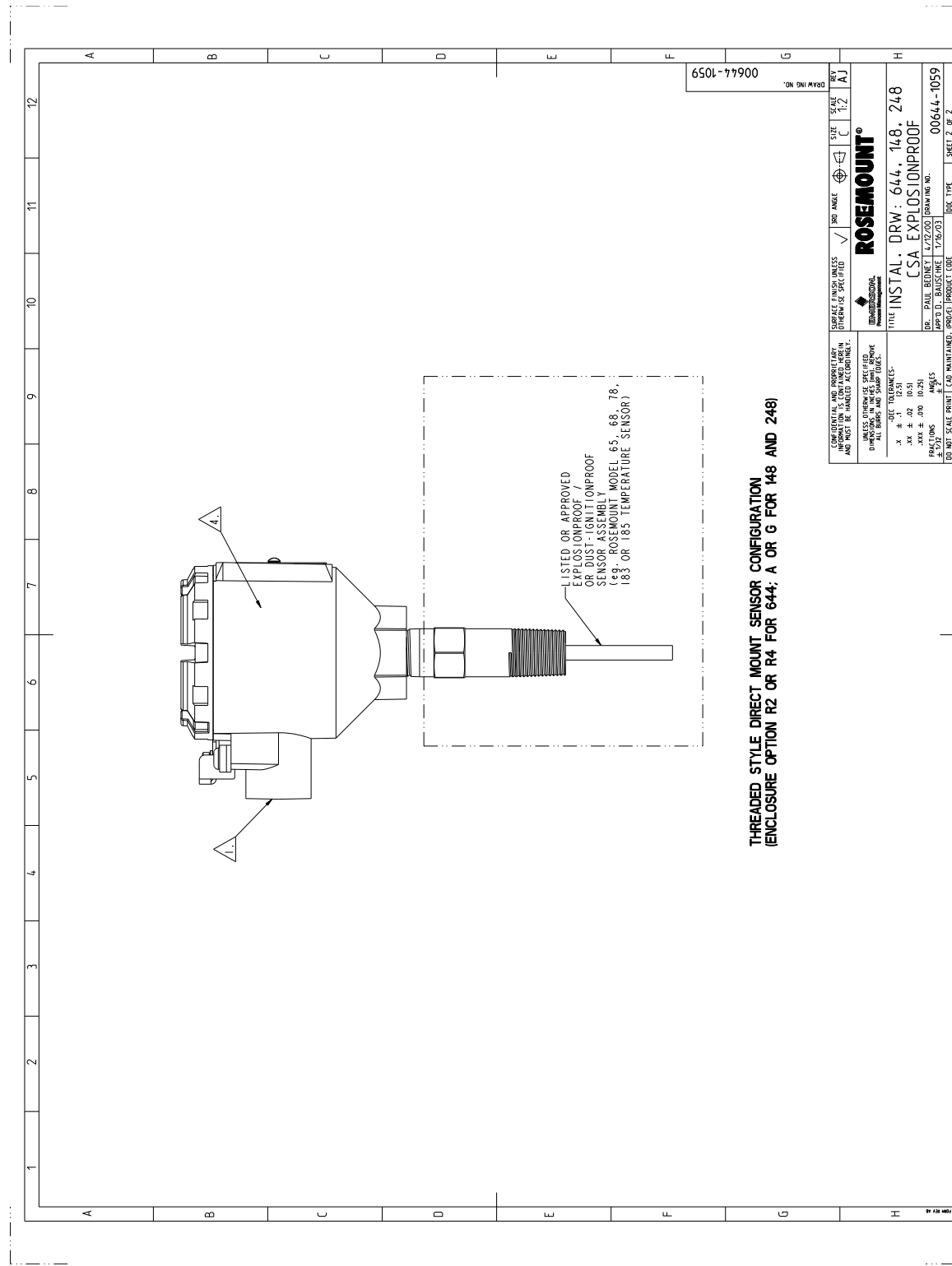


Figure B-3. CSA Explosion-Proof Installation Drawing 00644-1059, Rev. AJ

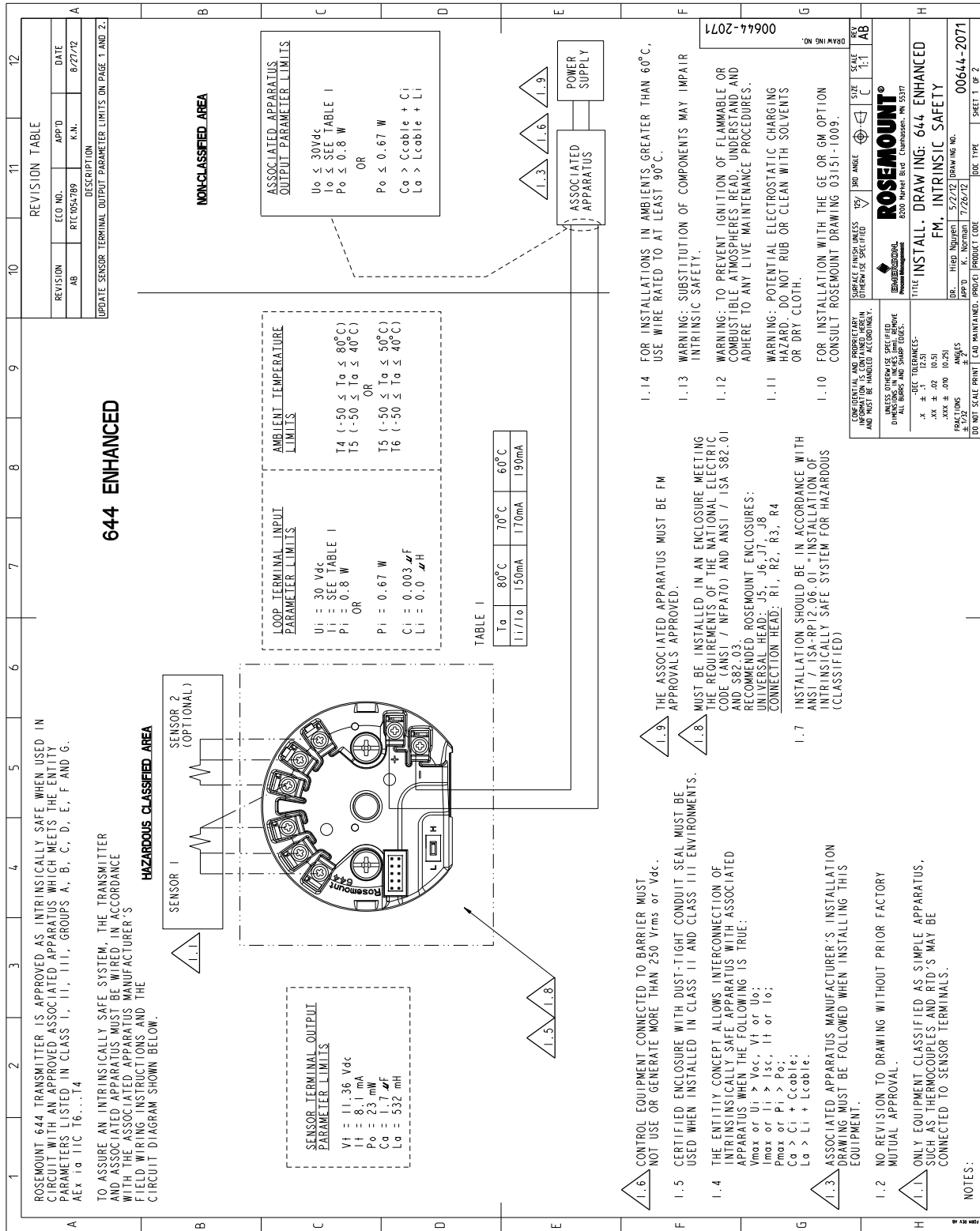




**THREADED STYLE DIRECT MOUNT SENSOR CONFIGURATION  
(ENCLOSURE OPTION R2 OR R4 FOR 644; A OR G FOR 148 AND 248)**



Figure B-4. FM Intrinsic Safety Installation Drawing 00644-2071. Rev AB



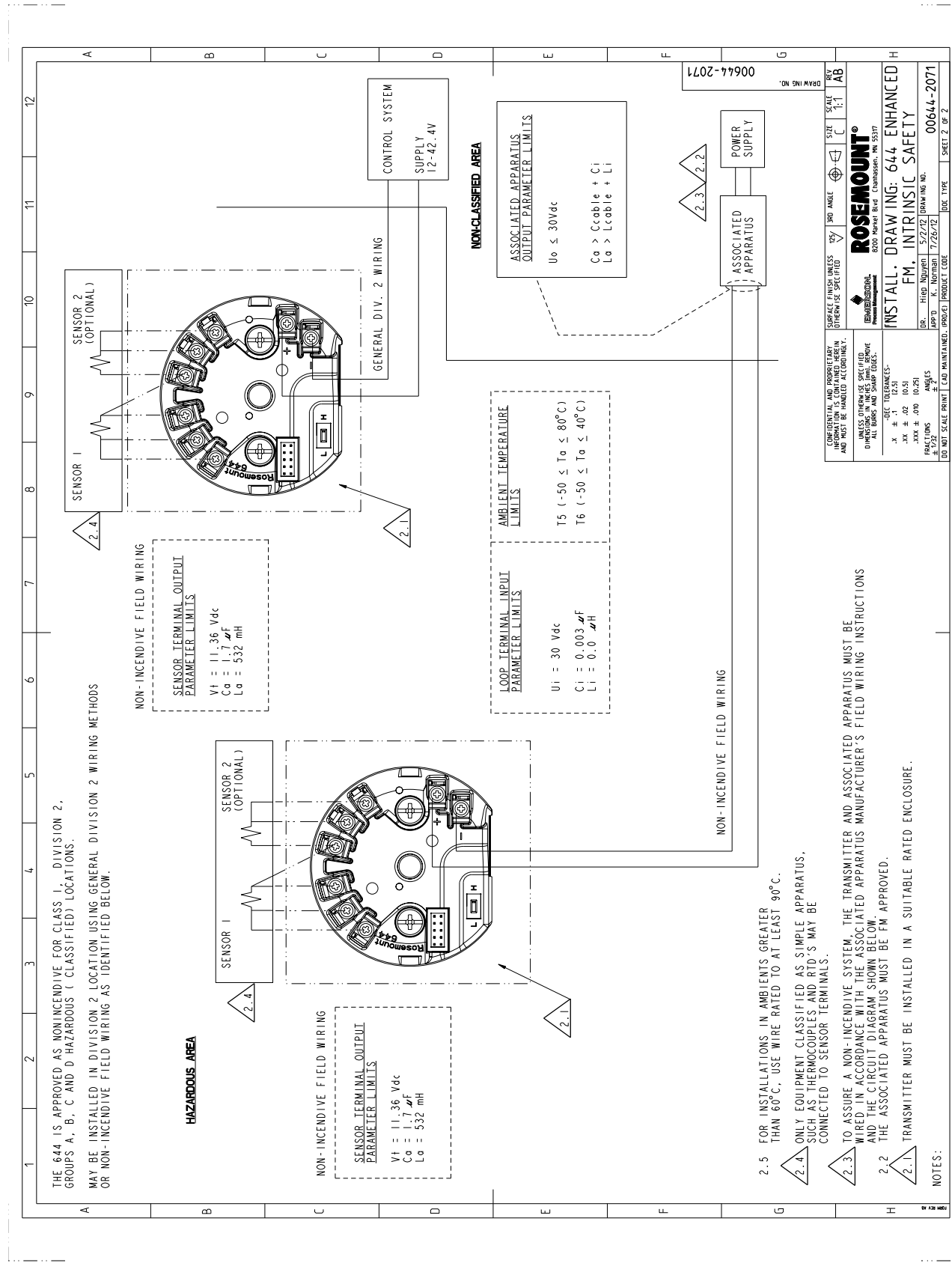
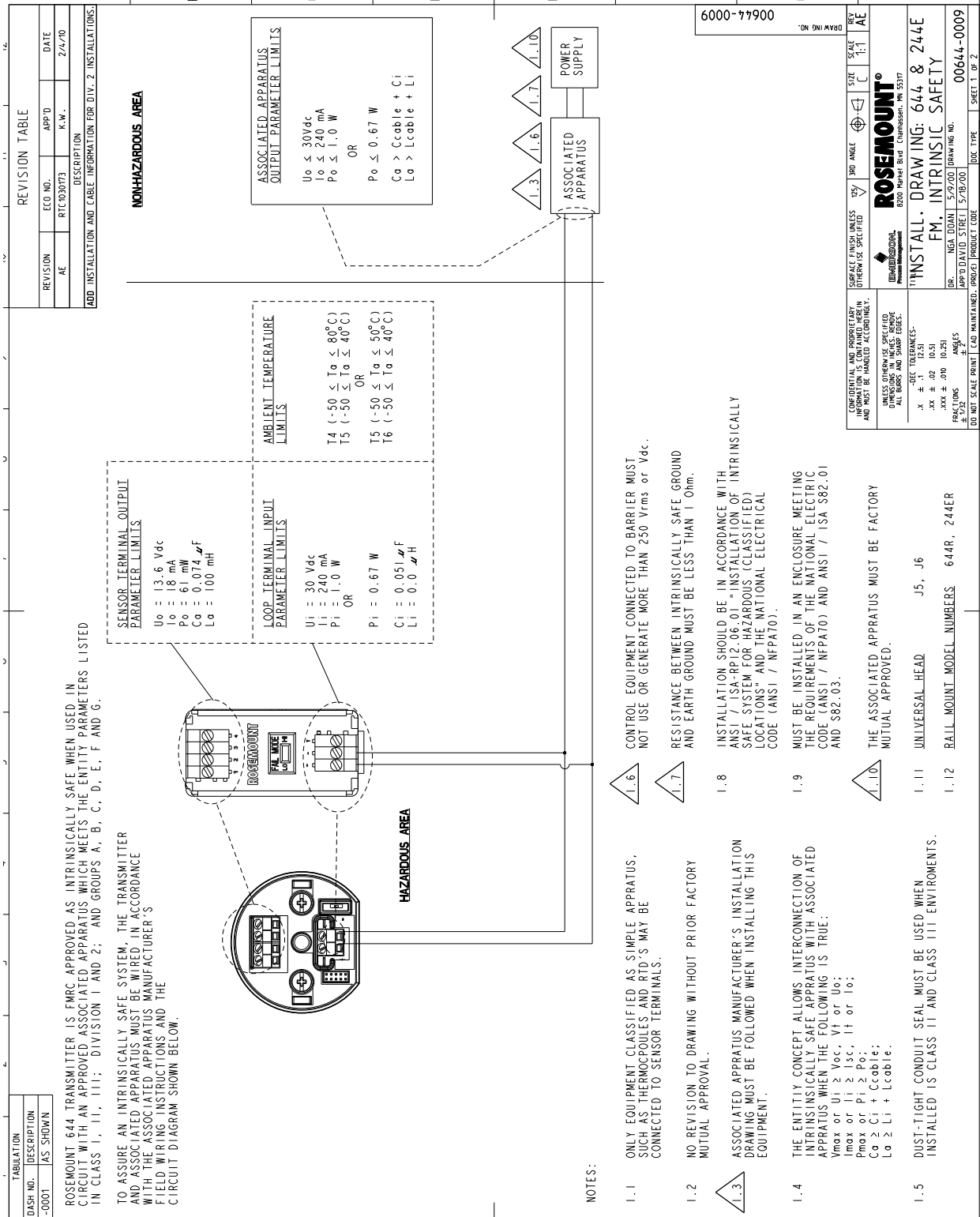
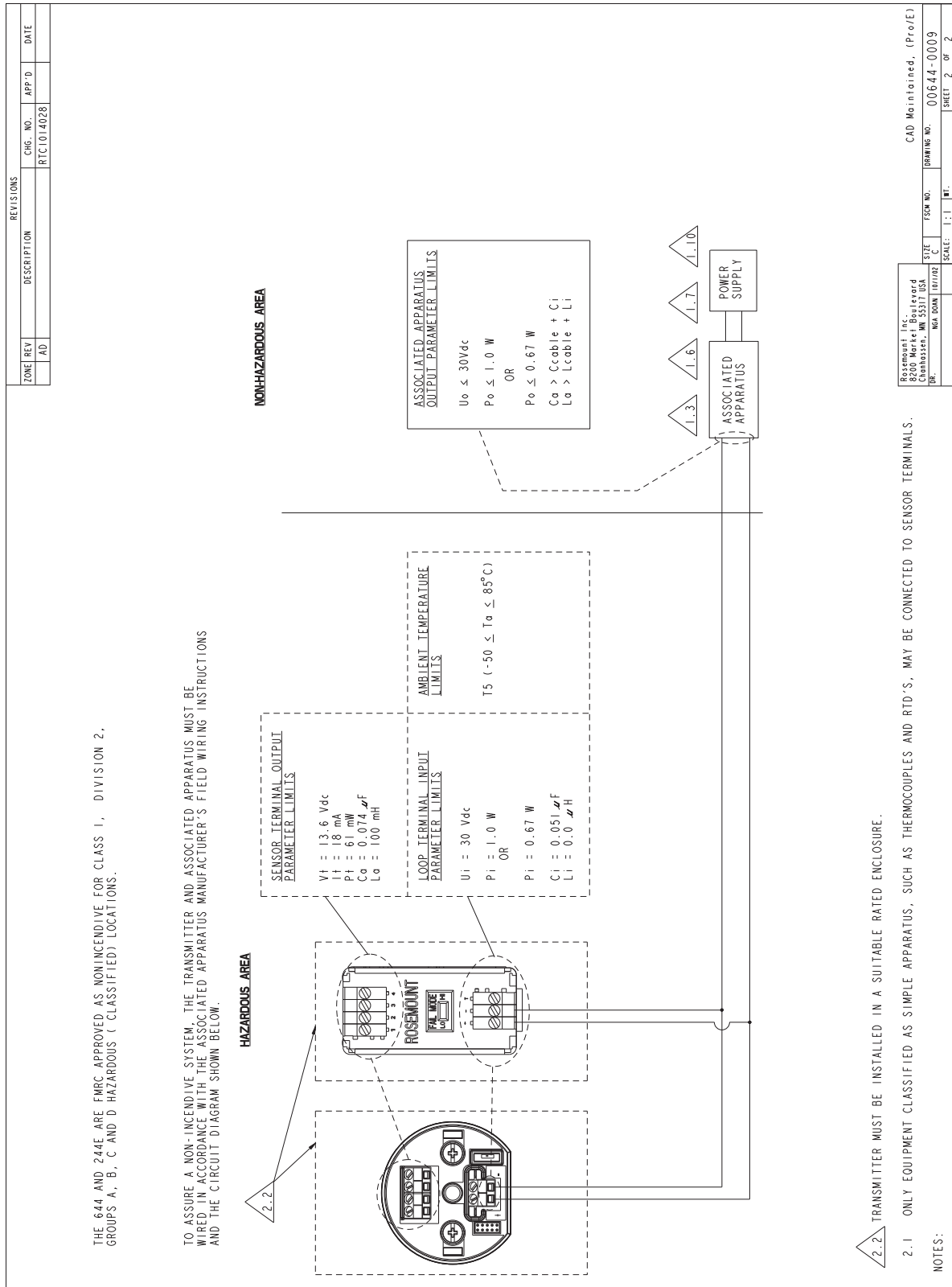


Figure B-5. FM Intrinsic Safety Installation Drawing 00644-0009, Rev. AE Sheet 1 of 2



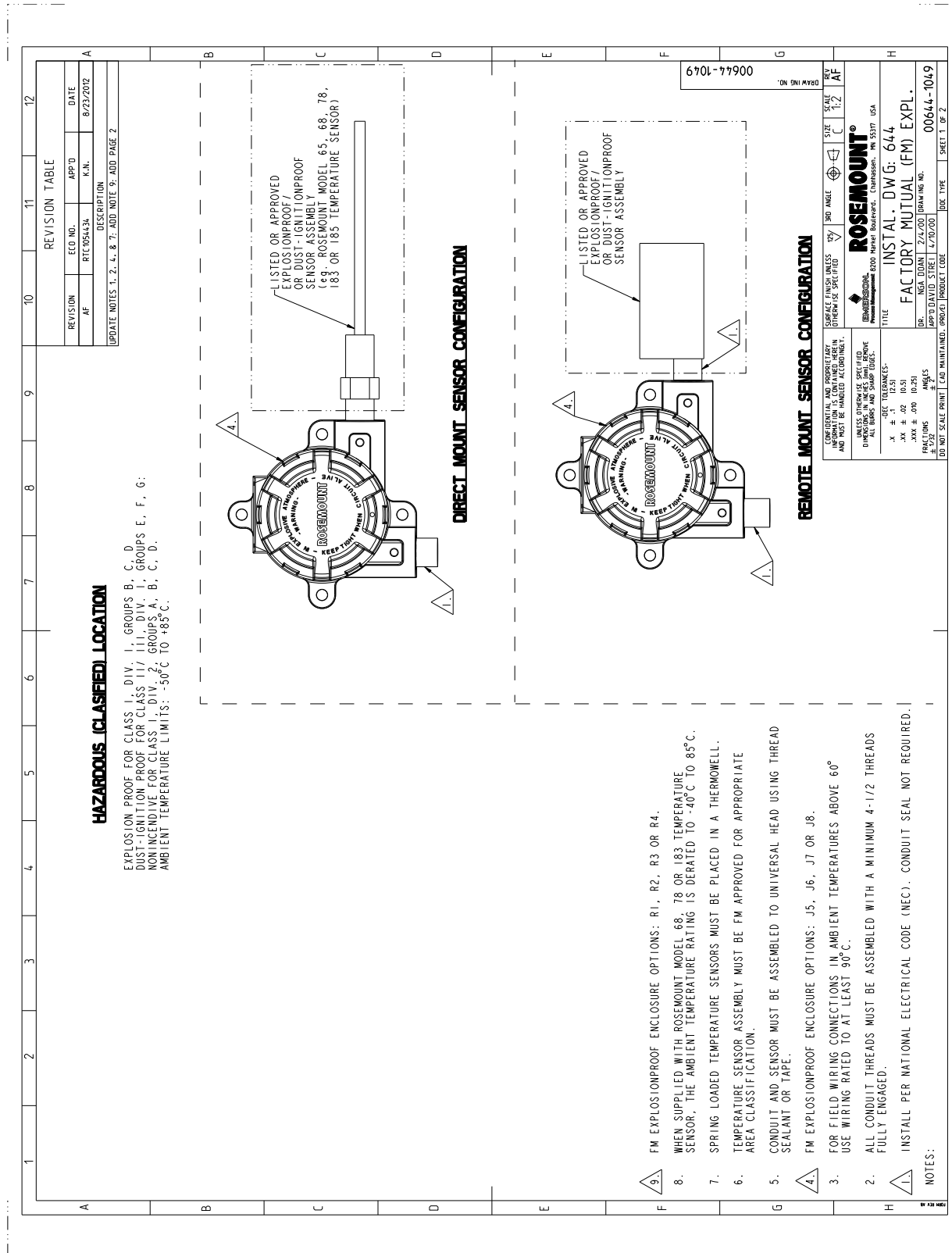
Sheet 2 of 2

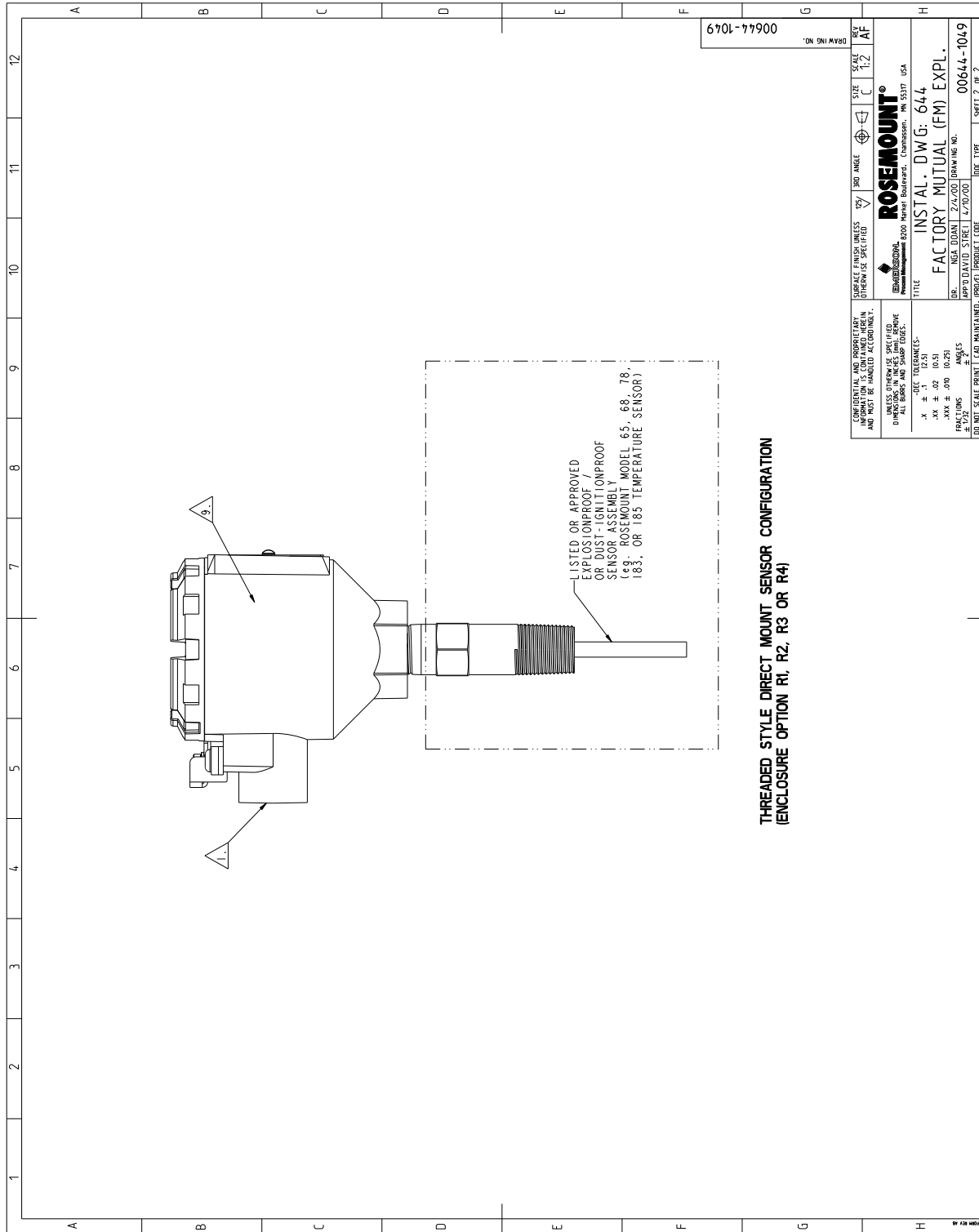


Rosemount Inc. 8200 Market Boulevard Houston, TX 77036 USA	SIZE	TCOM NO.	CAD Maintained, (P/0/E)
REV 3004 (01/02)	SCALE: 1:1	DRAWING NO.	00644-0009
			SHEET 2 OF 2

644-0009A01A

Figure B-6. FM Explosion-Proof Installation Drawing 00644-1049, Rev. AF





COMPENSATE AND PROBABLY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY.		SURFACE FINISH UNLESS OTHERWISE SPECIFIED		3RD ANGLE	SCALE 1:2	REV AF
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE TO BE TO ALL BORES AND SHARP EDGES.		ROSEMOUNT Precision Instrumentation 8200 North Boulevard, Chambers, MN 55317 USA		DRAWING NO. 6701-77900		
DEC TOLERANCES: # .01 # .03 # .05 # .10 # .15 # .20 # .25 # .30 # .35 # .40 # .45 # .50 # .55 # .60 # .65 # .70 # .75 # .80 # .85 # .90 # .95 # 1.00		TITLE		INSTAL. DWG: 644		
FRACTIONS # 1/32 # 1/16 # 1/8 # 3/16 # 1/2 # 5/8 # 3/4 # 7/8 # 1		DR.		FACTORY MUTUAL (FM) EXPL.		
DIM. UNIT SCALE PRINT   LEAD MAINTAINED.   PRODUCT CODE		DR.		00644-104.9		
		DR.		SHEET 2 OF 2		

# Appendix C Field Communicator Menu Trees and Fast Keys

## C.1 Field Communicator menu trees

Figure C-1. Rosemount 644 HART Revision 5 Field Communicator menu tree - Overview

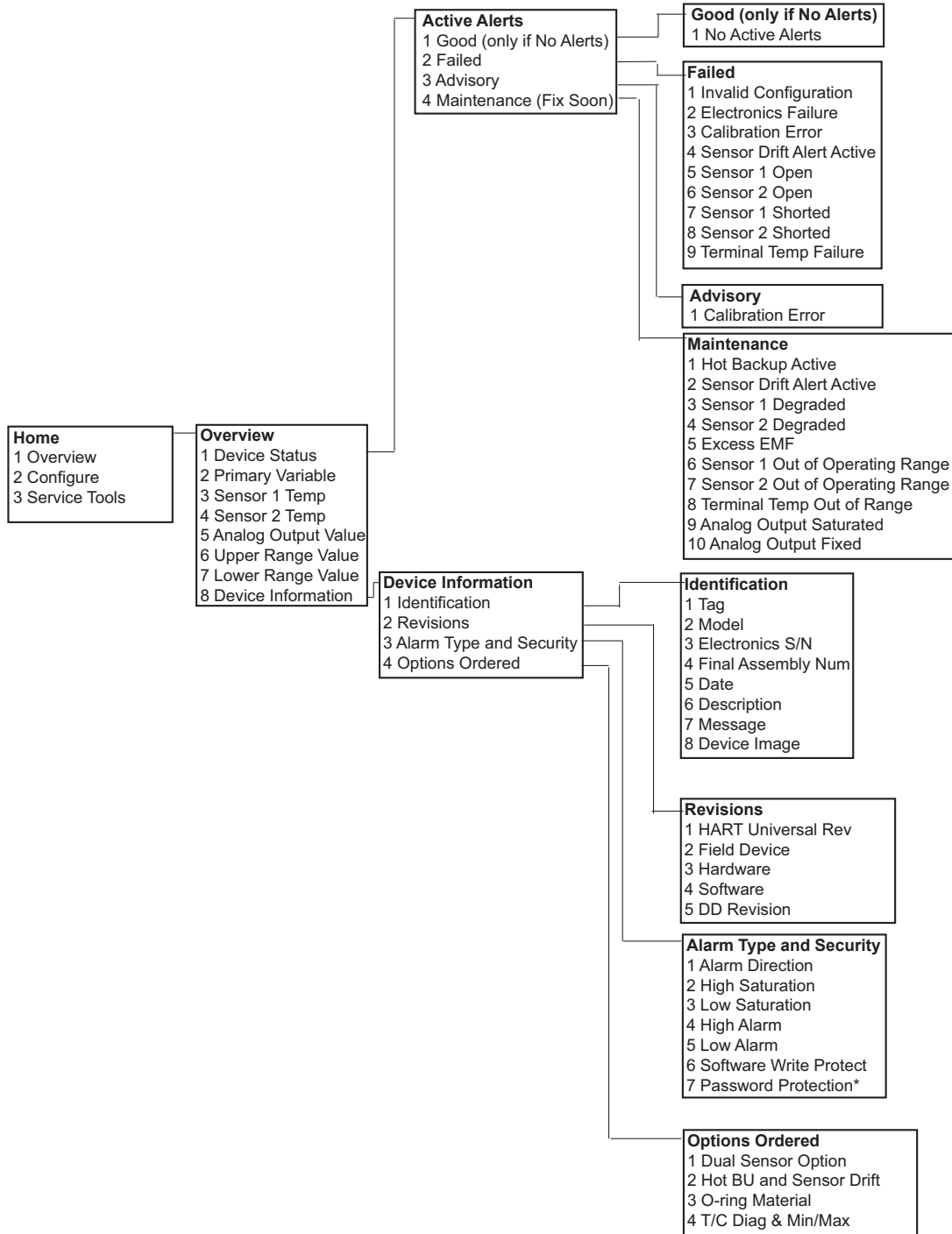


Figure C-2. Rosemount 644 HART Revision 5 Field Communicator menu tree - Configure

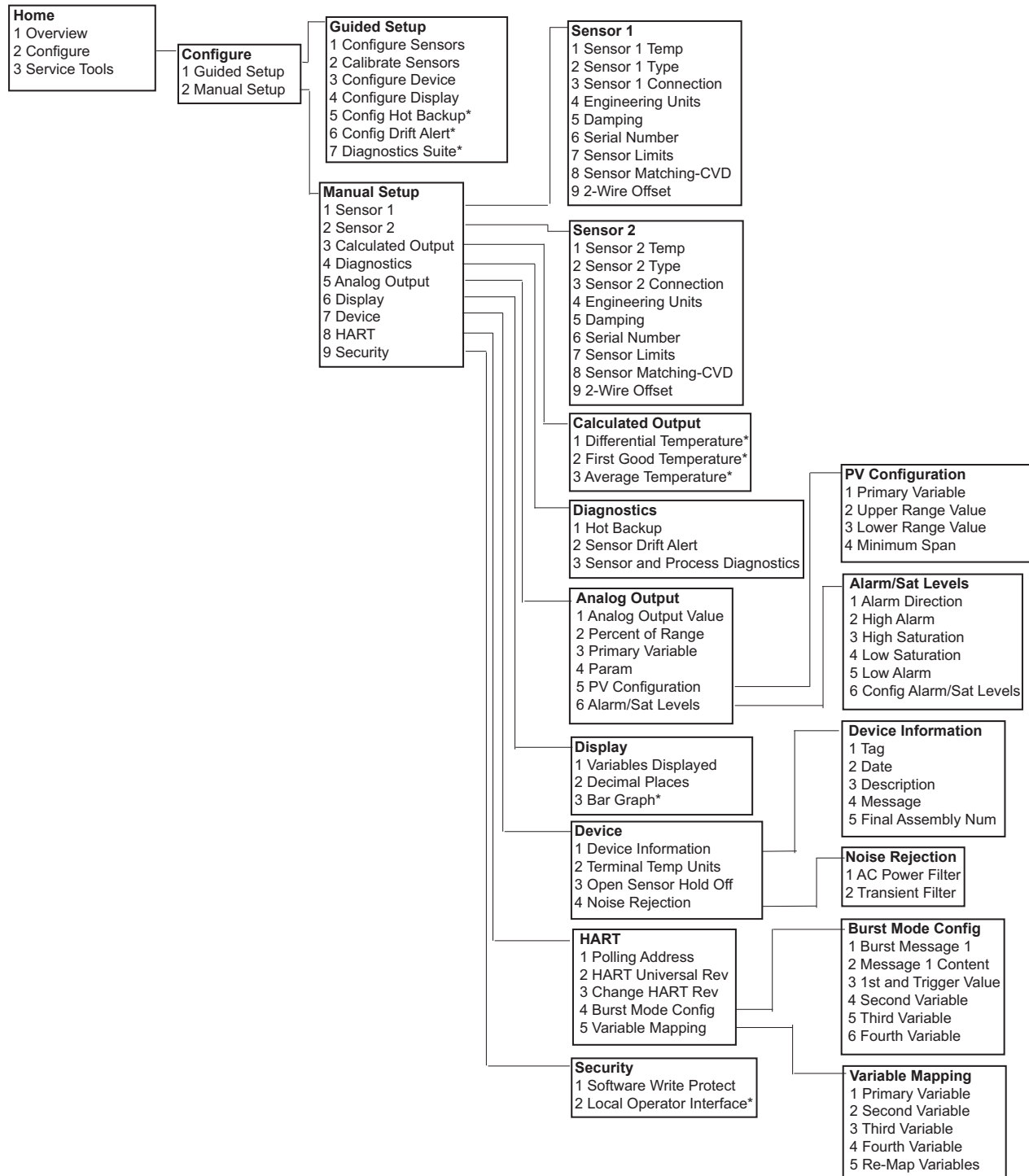




Figure C-3. Rosemount 644 HART Revision 5 Field Communicator menu tree – Service Tools

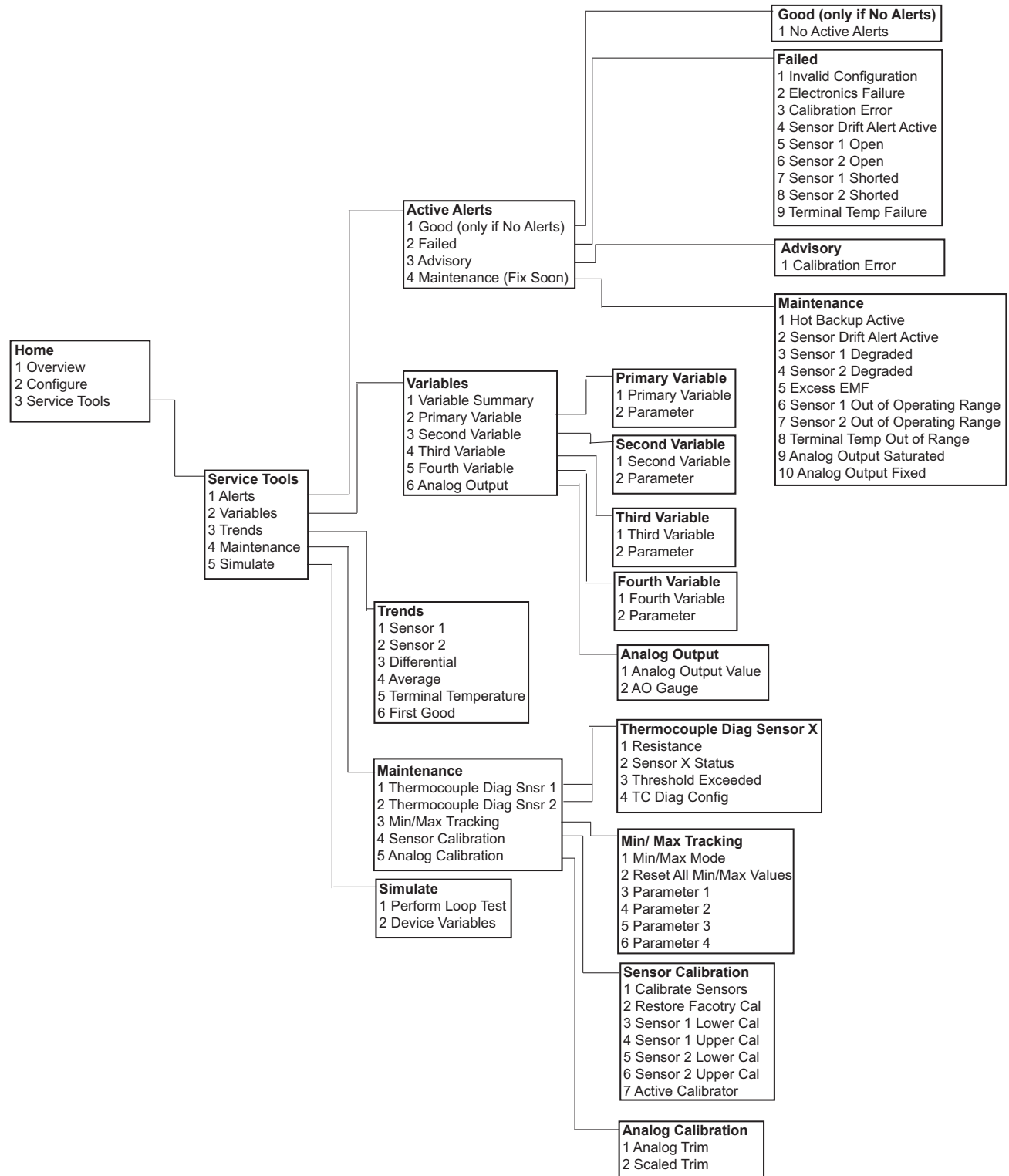


Figure C-4. Rosemount 644 HART Revision 7 Field Communicator menu tree – Overview

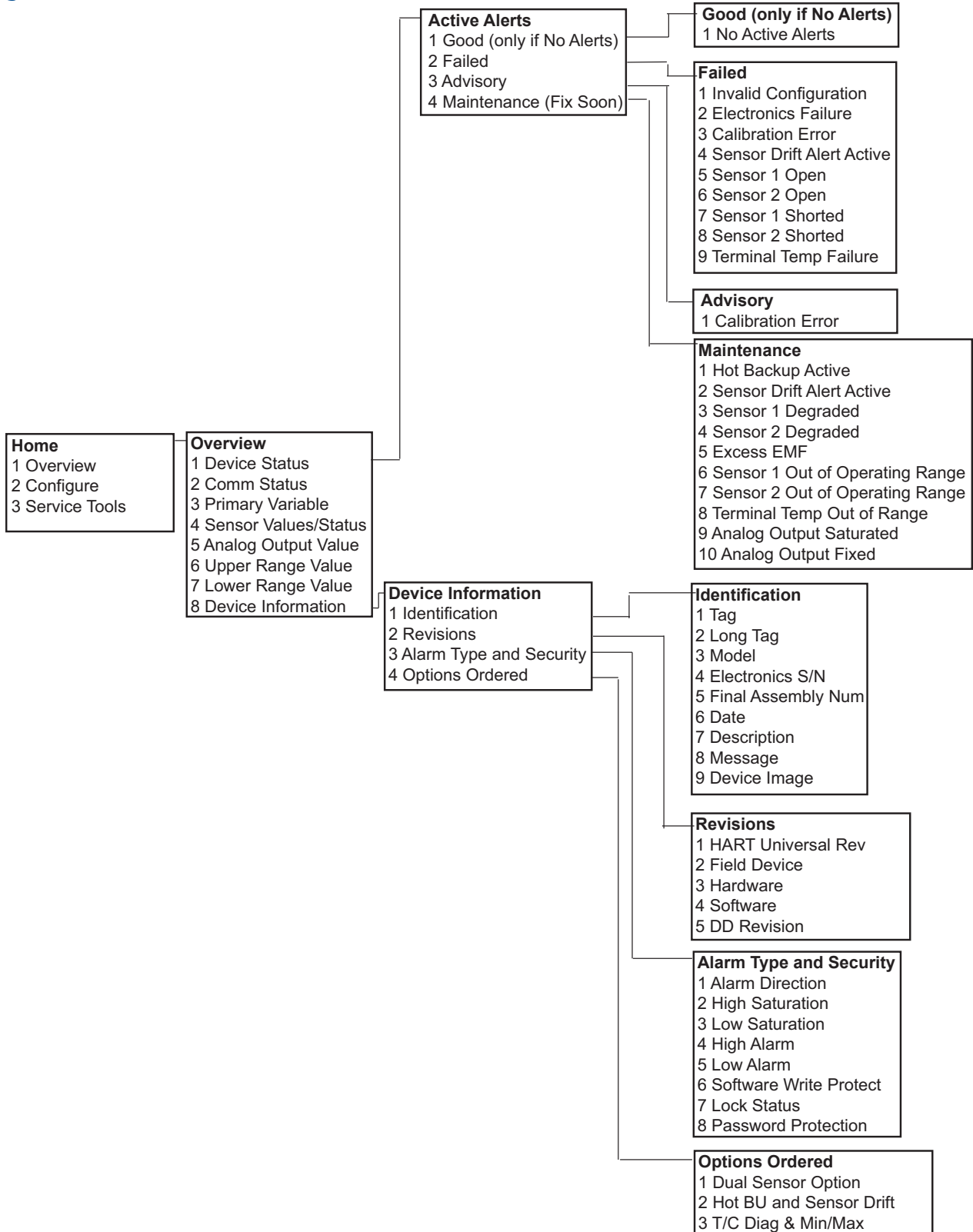


Figure C-5. Rosemount 644 HART Revision 7 Field Communicator menu tree - Configure

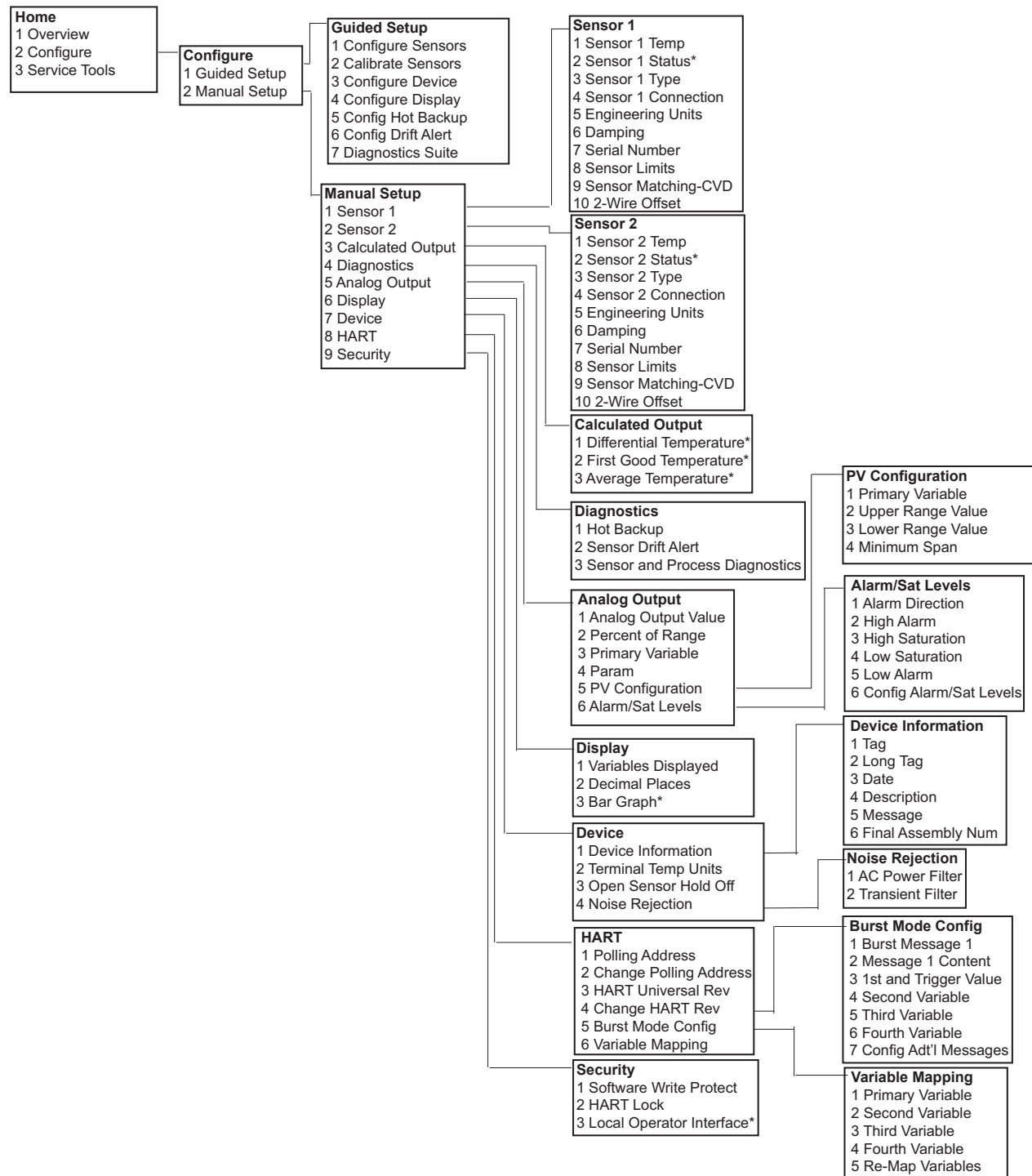
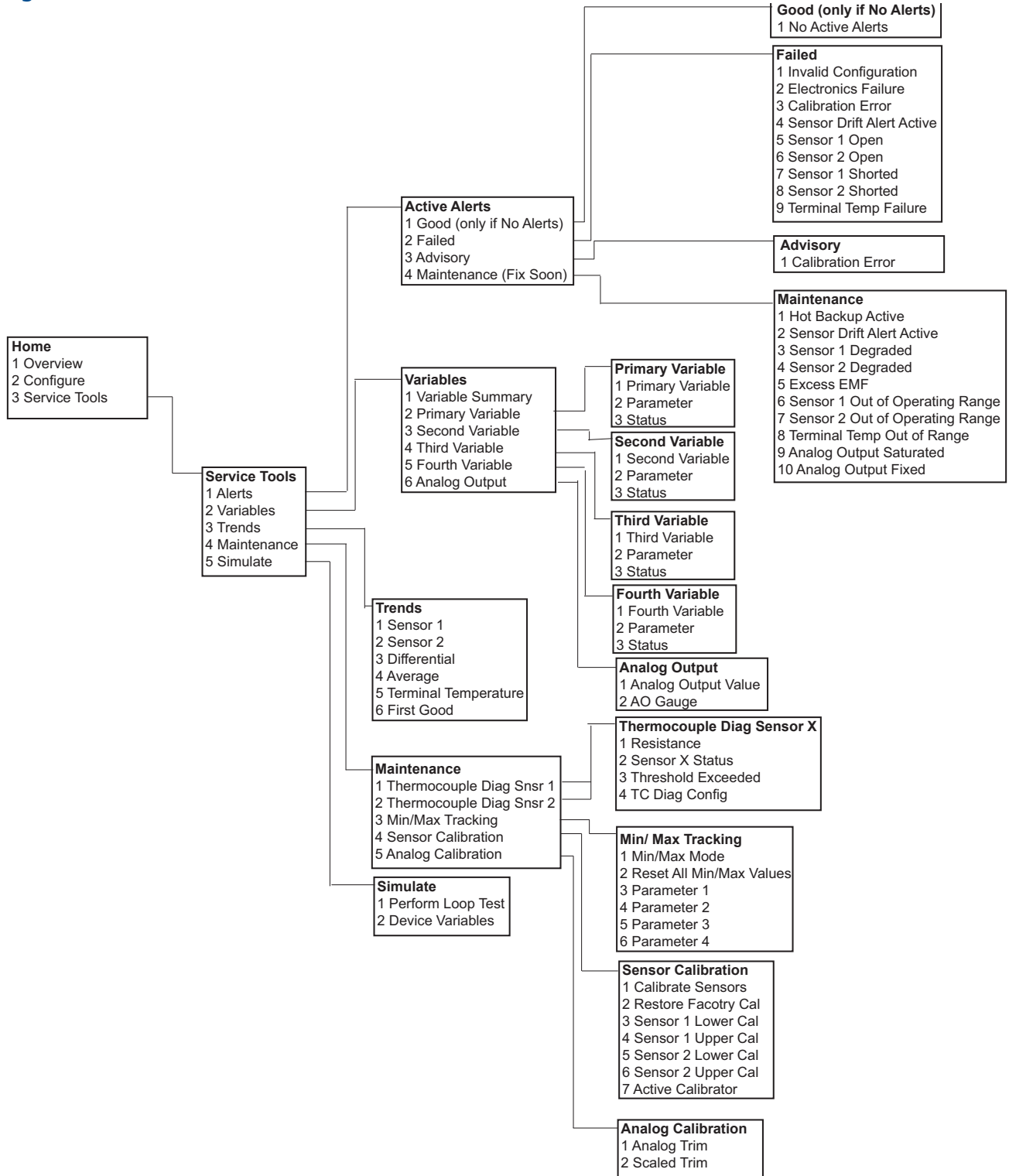


Figure C-6. Rosemount 644 HART Revision 7 Field Communicator menu tree – Service Tools



## C.2 Field Communicator fast keys

**Table C-1. Device Revision 8 and 9 (HART 5 and 7) Field Communicator Device Dashboard Fast Key Sequences**

Function	HART 5	HART 7
Alarm Values	2, 2, 5, 6	2, 2, 5, 6
Analog Calibration	3, 4, 5	3, 4, 5
Analog Output	2, 2, 5, 1	2, 2, 5, 1
Average Temperature Setup	2, 2, 3, 3	2, 2, 3, 3
Burst Mode	2, 2, 8, 4	2, 2, 8, 4
Comm Status		1, 2
Configure additional messages		2, 2, 8, 4, 7
Configure Hot Backup	2, 2, 4, 1, 3	
D/A Trim	3, 4, 4, 1	2, 2, 4, 1, 3
Damping Values	2, 2, 1, 5	3, 4, 4, 1
Date	2, 2, 7, 1, 2	2, 2, 1, 6
Display Setup	2, 1, 4	2, 2, 7, 1, 3
Descriptor	2, 2, 7, 1, 4	2, 1, 4
Device Information	1, 8, 1	2, 2, 7, 1, 5
Differential Temperature Setup	2, 2, 3, 1	1, 8, 1
Drift Alert	2, 2, 4, 2	2, 2, 3, 1
Filter 50/60 Hz	2, 2, 7, 4, 1	2, 2, 4, 2
First Good Temperature Setup	2, 2, 3, 2	2, 2, 7, 4, 1
Hardware Revision	1, 8, 2, 3	2, 2, 3, 2
HART Lock		1, 8, 2, 3
Intermittent Sensor Detect	2, 2, 7, 4, 2	2, 2, 9, 2
Loop Test	3, 5, 1	2, 2, 7, 4, 2
Locate Device		3, 5, 1
Lock Status		3, 4, 6, 2
LRV (Lower Range Value)	2, 2, 5, 5, 3	1, 8, 3, 8
LSL (Lower Sensor Limit)	2, 2, 1, 7, 2	2, 2, 5, 5, 3
Message	2, 2, 7, 1, 3	2, 2, 1, 8, 2
Open Sensor Holdoff	2, 2, 7, 3	2, 2, 7, 1, 4
Percent Range	2, 2, 5, 2	2, 2, 7, 3
Sensor 1 Configuration	2, 1, 1	2, 2, 5, 2
Sensor 2 Configuration	2, 1, 1	2, 1, 1
Sensor 1 Serial Number	2, 2, 1, 6	2, 1, 1
Sensor 2 Serial Number	2, 2, 2, 7	2, 2, 1, 7
Sensor 1 Type	2, 2, 1, 2	2, 2, 2, 8
Sensor 2 Type	2, 2, 2, 2	2, 2, 1, 3
Sensor 1 Unit	2, 2, 1, 4	2, 2, 2, 3
Sensor 2 Unit	2, 2, 2, 4	2, 2, 1, 5
Sensor 1 Status		2, 2, 2, 5
Sensor 2 Status		2, 2, 1, 2
Simulate Digital Signal		2, 2, 2, 2
		3, 5, 2

Function	HART 5	HART 7
Software Revision	1, 8, 2, 4	1, 8, 2, 4
Tag	2, 2, 7, 1, 1	2, 2, 7, 1, 1
Long Tag		2, 2, 7, 1, 2
Terminal Temperature	2, 2, 7, 1	2, 2, 8, 1
URV (Upper Range Value)	2, 2, 5, 5, 2	2, 2, 5, 5, 2
USL (Upper Sensor Limit)	2, 2, 1, 7, 2	2, 2, 1, 8, 2
Variable Mapping	2, 2, 8, 5	2, 2, 8, 5
2-wire Offset Sensor 1	2, 2, 1, 9	2, 2, 1, 10
2-wire Offset Sensor 2	2, 2, 2, 9	2, 2, 2, 10

**Table C-2. Device Revision 7 Field Communicator Traditional Fast Key Sequences**

Function	Fast Keys	Function	Fast Key
Active Calibrator	1, 2, 2, 1, 3	Num Req Preams	1, 3, 3, 3, 2
Alarm/Saturation	1, 3, 3, 2	Open Sensor Holdoff	1, 3, 5, 3
AO Alarm Type	1, 3, 3, 2, 1	Percent Range	1, 1, 5
Burst Mode	1, 3, 3, 3, 3	Poll Address	1, 3, 3, 3, 1
Burst Option	1, 3, 3, 3, 4	Process Temperature	1, 1
Calibration	1, 2, 2	Process Variables	1, 1
Callendar-Van Dusen	1, 3, 2, 1	PV Damping	1, 3, 3, 1, 3
Configuration	1, 3	PV Unit	1, 3, 3, 1, 4
D/A Trim	1, 2, 2, 2	Range Values	1, 3, 3, 1
Damping Values	1, 1, 10	Review	1, 4
Date	1, 3, 4, 2	Scaled D/A Trim	1, 2, 2, 3
Descriptor	1, 3, 4, 3	Sensor Connection	1, 3, 2, 1, 1
Device Info	1, 3, 4	Sensor 1 Setup	1, 3, 2, 1, 2
Device Output Configuration	1, 3, 3	Sensor Serial Number	1, 3, 2, 1, 4
Diagnostics and Service	1, 2	Sensor 1 Trim	1, 2, 2, 1
Filter 50/60 Hz	1, 3, 5, 1	Sensor 1 Trim-Factory	1, 2, 2, 1, 2
Hardware Rev	1, 4, 1	Sensor Type	1, 3, 2, 1, 1
Hart Output	1, 3, 3, 3	Software Revision	1, 4, 1
Intermittent Detect	1, 3, 5, 4	Status	1, 2, 1, 4
LCD Display Options	1, 3, 3, 4	Tag	1, 3, 4, 1
Loop Test	1, 2, 1, 1	Terminal Temperature	1, 3, 2, 2,
LRV (Lower Range Value)	1, 1, 6	Test Device	1, 2, 1
LSL (Lower Sensor Limit)	1, 1, 8	URV (Upper Range Value)	1, 1, 7
Measurement Filtering	1, 3, 5	USL (Upper Sensor Limit)	1, 1, 9
Message	1, 3, 4, 4	Variable Mapping	1, 3, 1
Meter Configuring	1, 3, 3, 4, 1	Variable Re-Map	1, 3, 1, 5
Meter Decimal Point	1, 3, 3, 4, 2	Write Protect	1, 2, 3
		2-Wire Offset	1, 3, 2, 1, 2, 1

## Appendix D Local Operator Interface (LOI)

### D.1 Number entry

Floating-point numbers can be entered with the LOI. All eight number locations on the top line can be used for number entry. Refer to [Table 2-2 on page 2-13](#) for LOI button operation. Below is a floating-point number entry example for changing a value of “-0000022” to “000011.2”

**Table D-1. LOI Number Entry**

Step	Instruction	Current Position (indicated by underline)
1	When the number entry begins, the left most position is the selected position. In this example, the negative symbol, “-”, will be flashing on the screen.	<u>-</u> 0000022
2	Press the scroll button until the “0” is blinking on the screen in the selected position.	0 <u>0</u> 000022
3	Press the enter button to select the “0” as an entry. The second digit from the left will be blinking.	00 <u>0</u> 00022
4	Press the enter button to select “0” for second digit. The third digit from the left will be blinking.	000 <u>0</u> 0022
5	Press the enter button to select “0” for the third digit. The fourth digit from the left will now be blinking.	0000 <u>0</u> 022
6	Press the enter button to select “0” for the fourth digit. The fifth digit from the left will now be blinking.	00000 <u>0</u> 22
7	Press scroll to navigate through the numbers until the “1” is on the screen.	00001 <u>0</u> 22
8	Press the enter button to select the “1” for the fifth digit. The sixth digit from the left will now be blinking.	000010 <u>2</u> 2
9	Press scroll to navigate through the numbers until the “1”, is on the screen.	000011 <u>2</u> 2
10	Press the enter button to select the “1” for the sixth digit. The seventh digit from the left will now be blinking.	000011 <u>2</u> 2
11	Press scroll to navigate through the numbers until the decimal, “.”, is on the screen.	000011. <u>2</u>
12	Press the enter button to select the decimal, “.”, for the seventh digit. After pressing enter, all digits to the right of the decimal will now be zero. The eighth digit from the left will now be blinking.	000011. <u>0</u>
13	Press the scroll button to navigate through the numbers until the “2”, is on the screen.	000011. <u>2</u>
14	Press the enter button to select the “2” for the eighth digit. The number entry will be complete and a “SAVE” screen will be shown.	000011.2

Usage notes:

- It is possible to move backwards in the number by scrolling to the left and pressing enter. The left arrow appears as such in the LOI: ↵;
- The negative symbol is only allowed in the left most position.
- The *Over score* character “ ¯ ” is used in the LOI to enter a blank space for Tag entry.

## D.2 Text entry

Text can be entered with the LOI. Depending on the edited item, up to eight locations on the top line can be used for text entry. Text entry follows the same rules as the number entry rules in “Number entry” on page 161, except the following characters are available in all locations: A-Z, 0-9, -, /, space.

### D.2.1 Scrolling

When it is desired to move more quickly through the list of menu choices or alpha numeric characters without individual button presses, a faster scrolling technique is available. Scrolling functionality allows the user to walk through any menu in forward or reverse order, enter text or digits easily and quickly.

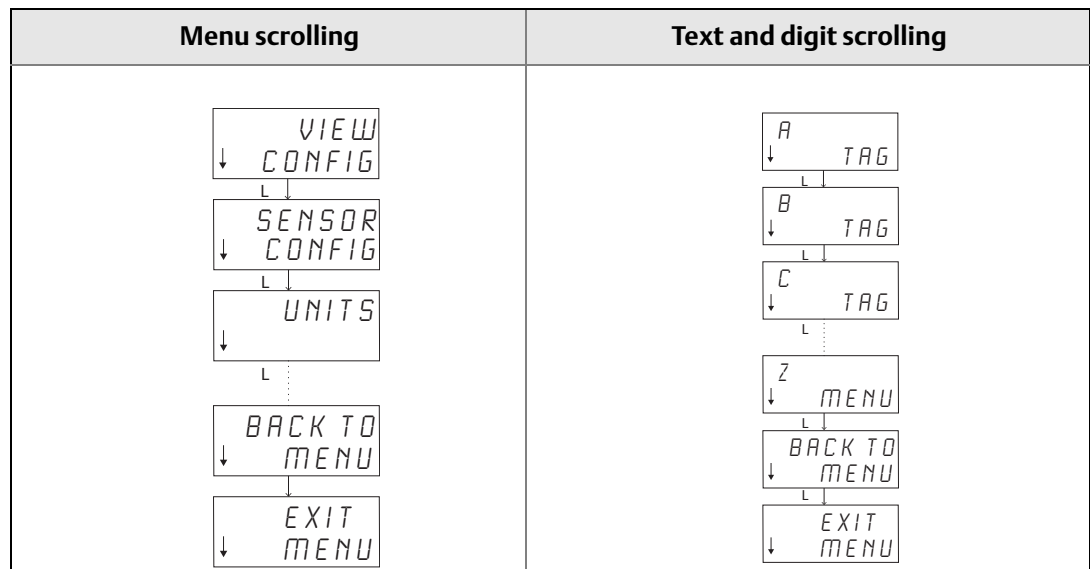
#### Menu scrolling:

- Simply hold down the left button after it brings you to the next menu item, each of the proceeding menus will be shown one after another while the button is pressed down. For an example, please see Figure D-1 below.

#### Text or digit entry scrolling:

- Quickly navigate through number and text menu lists by holding down the left button the same as in Menu

Figure D-1. Menu scrolling/text and digit scrolling

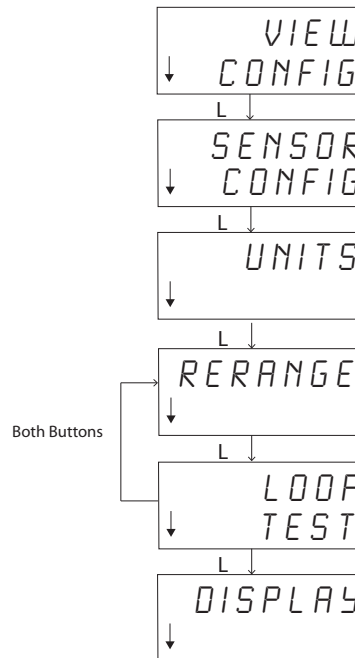




## Scrolling Backwards:

- Moving backwards during digit or text entry was described above in Digit Entry “Usage Notes”. During regular menu navigation it is possible to go back to the previous screen by pressing both buttons at the same time.

Figure D-2. Scrolling backwards



## D.3 Timeout

The LOI in standard operation will Time Out and return to the home screen after 15 minutes of inactivity. To re-enter into the LOI menu press either button.

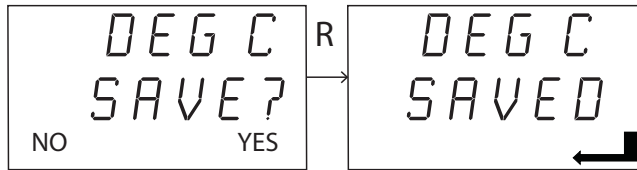
## D.4 Saving and canceling

The Save and Cancel functionality implemented at the end of a series of steps allows the user to save the change or exit the function without saving any of the changes. The way these functions are shown should always look as follows:

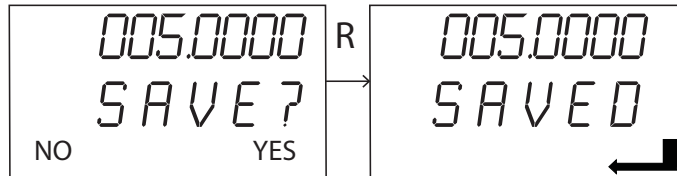
### Saving

Whether you're choosing a setting from a list of choices or entering digits or text the first screen shall show “SAVE?” to ask the user if they want to save the information just entered. You can select the cancel function (choose NO) or the save function (choose YES). After the save function is selected, “SAVED” shall appear on the screen.

**Saving a setting:**



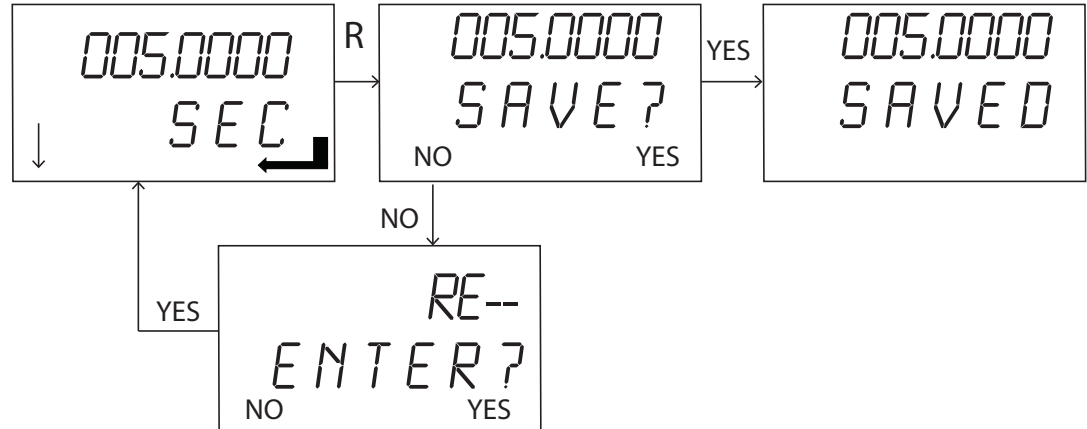
**Saving text or values:**



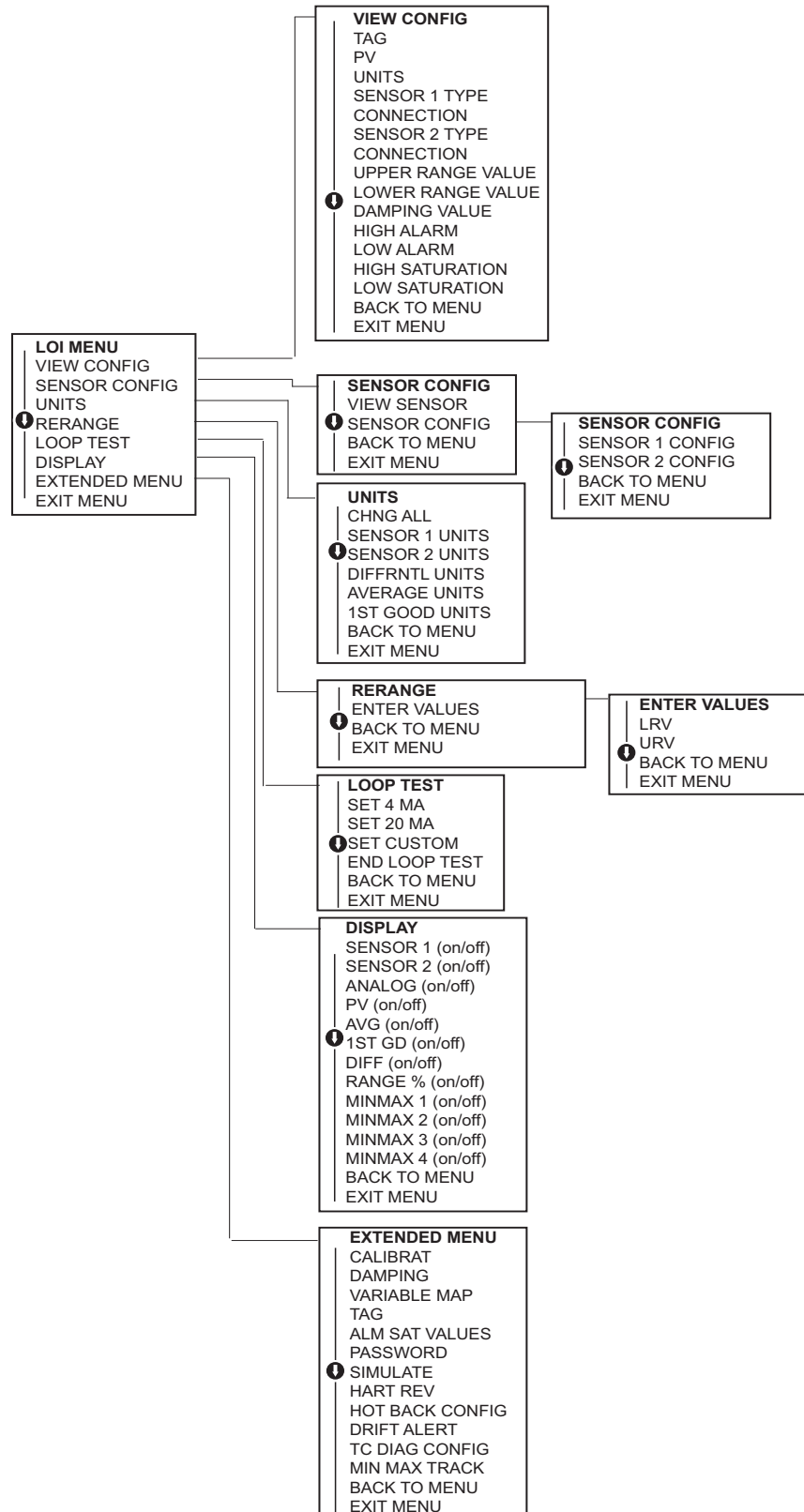
## Canceling

When a value or text string is being entered into the transmitter via the LOI and the function is cancelled, the LOI menu can offer the user a means to re-enter the value without losing the information entered. Examples of a value being entered are the Tag, Damping, and Calibration values. If you do not want to Re-Enter the value and desire to continue cancelling, select the NO option when prompted.

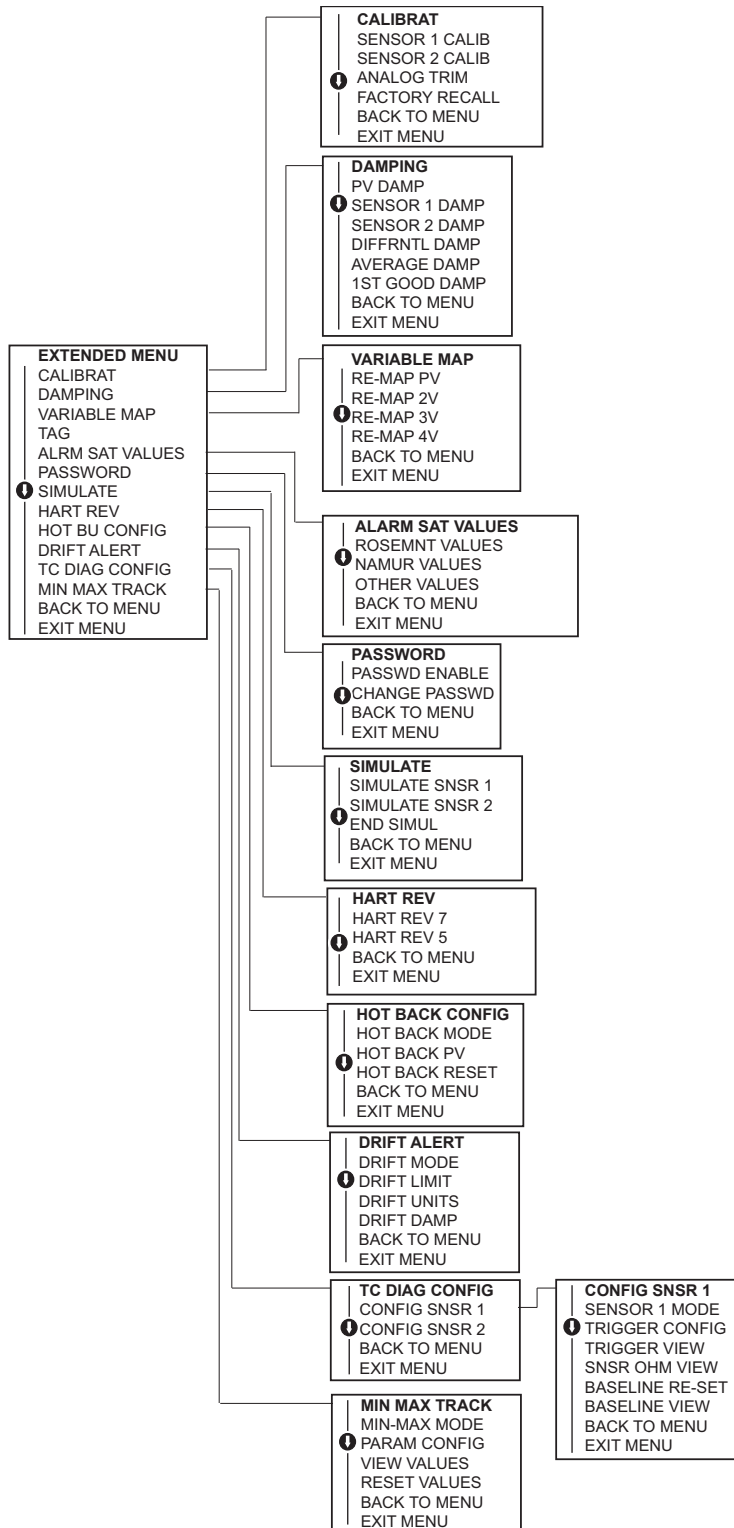
**Canceling:**



## D.5 LOI menu tree



## D.6 LOI menu tree – extended menu



# Index

## C

Considerations .....	3
Commissioning .....	4
Electrical .....	4
Environmental .....	4
Temperature .....	4
General .....	3
Mechanical .....	4
Location .....	4
Special Mounting .....	4

## D

Diagram	
Sensor Wiring .....	17

## I

Installation .....	10, 55
European .....	10
Head Mount .....	55
Flowchart .....	9, 51
LCD Display .....	14, 59
Multichannel .....	15
North American	
Head Mount .....	56
Rail Mount .....	13, 57, 58

## L

LCD Display	
Installation .....	14, 59

## M

Mounting .....	9, 54
Model 644H	
DIN Rail .....	54
Multichannel	
Installation .....	15

## O

Overview .....	2
Manual .....	2
Transmitter .....	3

## P

Performance specifications .....	104
Power Supply .....	22

## R

Return of Materials .....	5
---------------------------	---

## S

Sensor	
Connection	
Diagram .....	17
Wiring .....	17
Specifications	
Performance .....	104

## W

Wiring .....	16
Sensor Connection .....	17
Diagram .....	17





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**Emerson Process Management  
Rosemount Measurement**  
8200 Market Boulevard  
Chanhassen MN 55317 USA  
Tel (USA) 1 800 999 9307  
Tel (International) +1 952 906 8888  
Fax +1 952 906 8889

**Emerson Process Management  
GmbH & Co.**  
Argelsrieder Feld 3  
82234 Wessling  
Germany  
Tel 49 (8153) 9390  
Fax 49 (8153) 939172

**Emerson Process Management Asia  
Pacific Private Limited**  
1 Pandan Crescent  
Singapore 128461  
T (65) 6777 8211  
F (65) 6777 0947  
Enquiries@AP.EmersonProcess.com

**Beijing Rosemount Far East  
Instrument Co., Limited**  
No. 6 North Street,  
Hepingli, Dong Cheng District  
Beijing 100013, China  
T (86) (10) 6428 2233  
F (86) (10) 6422 8586

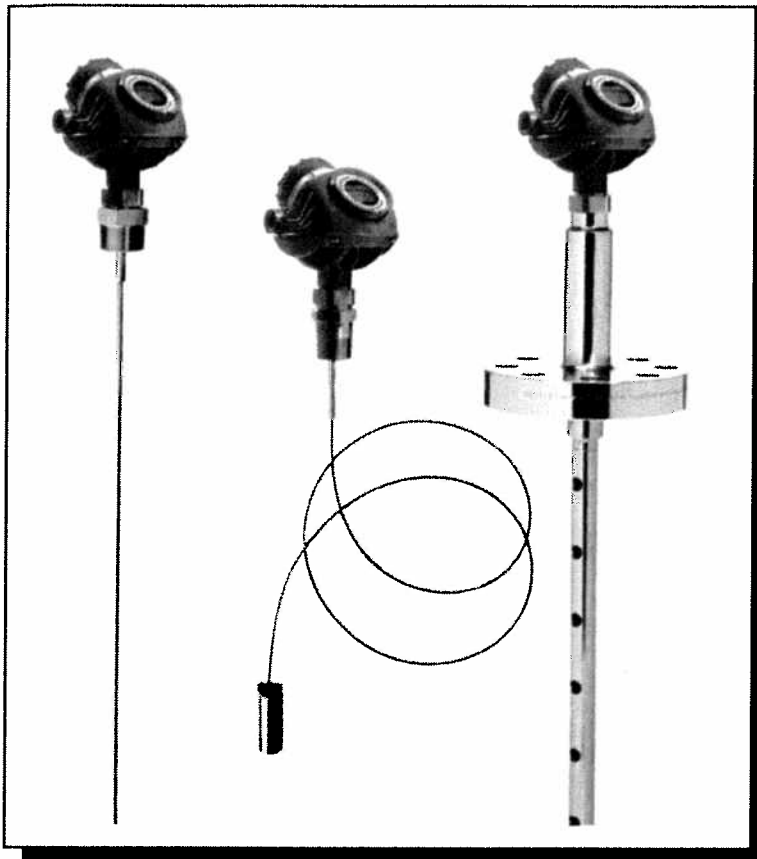
**ROSEMOUNT**





# Rosemount 5300 Series

## Superior Performance Guided Wave Radar



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# Rosemount 5300 Series

## Guided Wave Radar Level and Interface Transmitters

### NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

Within the United States, Emerson Process Management has two toll-free assistance numbers.

**Customer Central:** 1-800-999-9307 (7:00 a.m. to 7:00 p.m. CST)

Technical support, quoting, and order-related questions.

**North American Response Center:**

Equipment service needs.

1-800-654-7768 (24 hours a day – Includes Canada)

For equipment service or support needs outside the United States, contact your local Emerson Process Management representative.

### ⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Emerson Process Management Sales Representative.

This product is designed to meet FCC and R&TTE requirements for a non-intentional radiator. It does not require any licensing whatsoever and has no tank restrictions associated with telecommunications issues.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Cover Photo: 5300\_coverphoto.tif



## Table of Contents

<b>SECTION 1</b>	
<b>Introduction</b>	
	Safety Messages . . . . . 1-1
	Manual Overview . . . . . 1-2
	Service Support . . . . . 1-3
	Product Recycling/Disposal . . . . . 1-4
<b>SECTION 2</b>	
<b>Transmitter Overview</b>	
	Theory of Operation . . . . . 2-1
	Applications . . . . . 2-2
	Components of the Transmitter . . . . . 2-5
	System Architecture . . . . . 2-7
	Probe Selection Guide . . . . . 2-9
	Transition Zones . . . . . 2-10
	Process Characteristics . . . . . 2-11
	Coating . . . . . 2-11
	Bridging . . . . . 2-11
	Foam . . . . . 2-11
	Vapor . . . . . 2-11
	Boiling Hydrocarbons . . . . . 2-11
	Measuring Range . . . . . 2-12
	Interface . . . . . 2-12
	Vessel Characteristics . . . . . 2-14
	Heating Coils, Agitators . . . . . 2-14
	Tank Shape . . . . . 2-14
	Installation Procedure . . . . . 2-15
<b>SECTION 3</b>	
<b>Mechanical Installation</b>	
	Safety messages . . . . . 3-1
	Mounting Considerations . . . . . 3-3
	Process Connection . . . . . 3-3
	Installation of Single Lead Probes in Non-metallic Vessels . . . . . 3-5
	Installation in Concrete Silos . . . . . 3-6
	Considerations for Solid Applications . . . . . 3-6
	Mounting in Chamber/ Still Pipe . . . . . 3-7
	Replacing a Displacer in an Existing Displacer Chamber . . . . . 3-10
	Free Space . . . . . 3-11
	Recommended Mounting Position for Liquids . . . . . 3-12
	Recommended Mounting for Solids . . . . . 3-13
	Insulated Tanks . . . . . 3-14
	Mounting . . . . . 3-15
	Flange Connection . . . . . 3-15
	Threaded Connection . . . . . 3-16
	Tri-Clamp Connection . . . . . 3-17
	Bracket Mounting . . . . . 3-18
	Shortening the Probe . . . . . 3-19
	Anchoring . . . . . 3-22
	Mounting a Centering Disc for Pipe Installations . . . . . 3-25

# Rosemount 5300 Series

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## SECTION 4 Electrical Installation

Safety messages . . . . .	4-1
Cable/conduit entries . . . . .	4-3
Grounding . . . . .	4-3
Cable Selection . . . . .	4-3
Hazardous Areas . . . . .	4-3
HART . . . . .	4-4
Power Requirements . . . . .	4-4
Maximum Loop Resistance . . . . .	4-4
Connecting the Transmitter . . . . .	4-5
Non-Intrinsically Safe Output . . . . .	4-6
Intrinsically Safe Output . . . . .	4-7
FOUNDATION Fieldbus . . . . .	4-8
Power Requirements . . . . .	4-8
Connecting the Transmitter . . . . .	4-8
Non-Intrinsically Safe Output . . . . .	4-11
Intrinsically Safe Output . . . . .	4-12
Optional Devices . . . . .	4-13
Tri-Loop HART to analog converter . . . . .	4-13
751 Field Signal Indicator . . . . .	4-14

## SECTION 5 Configuration

Safety messages . . . . .	5-1
Overview . . . . .	5-2
Basic Configuration . . . . .	5-2
Echo Tuning . . . . .	5-2
LCD Configuration . . . . .	5-2
Advanced Configuration . . . . .	5-2
Configuration Tools . . . . .	5-2
Basic Configuration Parameters . . . . .	5-4
Measurement Units . . . . .	5-4
Tank and Probe Geometry . . . . .	5-4
Tank Environment . . . . .	5-6
Volume Configuration . . . . .	5-7
Analog Output (HART) . . . . .	5-9
Basic Configuration Using a 375 Field Communicator . . . . .	5-11
Basic Configuration Using Rosemount Radar Master . . . . .	5-13
System Requirements . . . . .	5-13
Help In RRM . . . . .	5-13
Installing the RRM software for HART communication . . . . .	5-14
Specifying the COM Port . . . . .	5-15
To set the COM port buffers . . . . .	5-15
Installing the RRM Software for FOUNDATION Fieldbus . . . . .	5-16
Specifying Measurement Units . . . . .	5-17
Using the Setup Functions . . . . .	5-18
Guided Setup . . . . .	5-19
Device Properties . . . . .	5-20
General Information . . . . .	5-20
Probe . . . . .	5-21
Geometry . . . . .	5-22
Tank Environment . . . . .	5-23
Volume . . . . .	5-25
Analog Output (HART) . . . . .	5-26
Finish Configuration Wizard . . . . .	5-26

	Device Specific Configuration . . . . .	5-27
	Restart the Transmitter . . . . .	5-28
	View Measured Values . . . . .	5-28
	Backup . . . . .	5-28
	Basic Configuration Using AMS Suite (HART) . . . . .	5-30
	Basic Configuration Using DeltaV . . . . .	5-31
	FOUNDATION Fieldbus Overview . . . . .	5-36
	Assigning Device Tag and Node Address . . . . .	5-36
	Foundation Fieldbus Block Operation . . . . .	5-37
	Configure the AI Block . . . . .	5-39
	Application Example 1 . . . . .	5-42
	Application Example 2 . . . . .	5-43
	Application Example 3 . . . . .	5-44
	Tri-Loop HART to Analog Converter . . . . .	5-45
	HART Multi-drop Configuration . . . . .	5-47
<b>SECTION 6</b>		
<b>Operation</b>	Safety Messages . . . . .	6-1
	Viewing Measurement Data . . . . .	6-2
	Using the Display Panel . . . . .	6-2
	Specifying Display Panel Variables . . . . .	6-3
	Viewing Measurement Data in RRM . . . . .	6-7
	Viewing Measurement Data in AMS Suite . . . . .	6-8
	Viewing Measurement Data in DeltaV . . . . .	6-9
<b>SECTION 7</b>		
<b>Service and Troubleshooting</b>	Safety messages . . . . .	7-1
	Analyzing the Measurement Signal . . . . .	7-3
	Surface Pulse Not Found . . . . .	7-5
	Probe End Projection . . . . .	7-6
	Disturbance Echo Handling . . . . .	7-7
	Amplitude Threshold Curve . . . . .	7-7
	Disturbances at the Top of the Tank . . . . .	7-7
	Interface Pulse not Found . . . . .	7-8
	Signal Quality Metrics . . . . .	7-9
	Using the Echo Curve Analyzer . . . . .	7-10
	Using the Rosemount Radar Master . . . . .	7-10
	The Configuration Mode Tab . . . . .	7-11
	The View/Record ModeTab . . . . .	7-12
	The File ModeTab . . . . .	7-13
	Using the Echo Curve Analyzer with a 375 Field Communicator . . . . .	7-13
	Interface Measurements with Fully Submerged Probes . . . . .	7-15
	Analog Output Calibration . . . . .	7-16
	Level and Distance Calibration . . . . .	7-17
	Logging Measurement Data . . . . .	7-19
	Backing up the Transmitter Configuration . . . . .	7-20
	Configuration Report . . . . .	7-21
	Reset to Factory Settings . . . . .	7-22
	Diagnostics . . . . .	7-23
	Using the Simulation Mode . . . . .	7-25
	Write Protecting a Transmitter . . . . .	7-26
	Enter Service Mode in RRM . . . . .	7-26
	Viewing Input and Holding Registers . . . . .	7-27
	Removing the Transmitter Head . . . . .	7-28

	Changing a Probe . . . . .	7-29
	Probe and Firmware Compatibility . . . . .	7-29
	Check Firmware and Probe Version. . . . .	7-30
	Changing the Probe . . . . .	7-31
	Diagnostic Messages. . . . .	7-33
	Troubleshooting . . . . .	7-33
	Device Status . . . . .	7-35
	Errors . . . . .	7-36
	Warnings . . . . .	7-37
	Measurement Status . . . . .	7-38
	Interface Status . . . . .	7-40
	Volume Calculation Status . . . . .	7-40
	Analog Output Status . . . . .	7-41
	LCD Error Messages . . . . .	7-42
	LED Error Messages . . . . .	7-43
	Foundation Fieldbus Error Messages . . . . .	7-44
	Resource Block . . . . .	7-44
	Transducer Block . . . . .	7-45
	Analog Input (AI) Function Block . . . . .	7-45
<b>SECTION 8</b>	Safety Messages . . . . .	8-1
<b>Safety Instrumented</b>	Overview . . . . .	8-3
<b>Systems (4-20 mA only)</b>	Applicable Models . . . . .	8-3
	Skill Level of Personnel . . . . .	8-3
	Functional Specifications . . . . .	8-4
	Installation . . . . .	8-4
	Configuration . . . . .	8-4
	Damping . . . . .	8-4
	Alarm and Saturation Levels . . . . .	8-5
	Write Protection . . . . .	8-5
	Site Acceptance . . . . .	8-5
	Operation and Maintenance . . . . .	8-5
	General . . . . .	8-5
	Inspection . . . . .	8-7
	References . . . . .	8-7
	Specifications . . . . .	8-7
	Failure Rate Data . . . . .	8-7
	Useful Lifetime . . . . .	8-7
	Spare Parts . . . . .	8-7
	Terms and Definitions . . . . .	8-7
<b>APPENDIX A</b>	Specifications . . . . .	A-1
<b>Reference Data</b>	Process Temperature and Pressure Rating . . . . .	A-4
	Flange Connection Rating . . . . .	A-6
	Flange Rating Standards . . . . .	A-6
	Ambient Temperature. . . . .	A-7
	Remote Housing Measuring Range . . . . .	A-8
	Dimensional Drawings . . . . .	A-9
	Ordering Information . . . . .	A-21
	Spare Parts . . . . .	A-30



---

<b>APPENDIX B</b>	
<b>Product Certifications</b>	
	Safety messages . . . . . B-1
	EU Conformity . . . . . B-2
	European ATEX Directive Information . . . . . B-3
	Intrinsic Safety . . . . . B-3
	Flameproof . . . . . B-6
	National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) Approvals . . . . . B-8
	Factory Mutual (FM) Approvals . . . . . B-11
	Intrinsic Safety . . . . . B-11
	Explosion Proof . . . . . B-13
	Canadian Standards Association (CSA) Approval . . . . . B-14
	Intrinsic Safety . . . . . B-14
	Explosion Proof . . . . . B-16
	IECEx Approval . . . . . B-17
	Intrinsic Safety . . . . . B-17
	Flameproof . . . . . B-20
	Combination Approvals . . . . . B-22
	Approval Drawings . . . . . B-22
<b>APPENDIX C</b>	
<b>Advanced Configuration</b>	
	Safety messages . . . . . C-1
	User Defined Upper Reference Point . . . . . C-3
	Handling of Disturbances from Nozzle . . . . . C-4
	Trim Near Zone . . . . . C-4
	Changing the Upper Null Zone . . . . . C-7
	Threshold Settings . . . . . C-8
	Probe End Projection . . . . . C-10
	Echo Tracking . . . . . C-12
	Dielectric Constant Settings . . . . . C-14
	Static Vapor Compensation . . . . . C-14
	Lower Product . . . . . C-14
	Dynamic Vapor Compensation . . . . . C-15
	Installation Setup . . . . . C-18
	Signal Quality Metrics . . . . . C-20
	Viewing Signal Quality Metrics in RRM . . . . . C-21
<b>APPENDIX D</b>	
<b>Remote Mounting</b>	
	Remote Housing, New Units . . . . . D-1
	Remote Connection, Field Retrofit . . . . . D-3
	Remote Housing Configuration . . . . . D-4
<b>APPENDIX E</b>	
<b>Performing Proof Test</b>	
	Performing Proof Test . . . . . E-1
	375 Field Communicator . . . . . E-1
	Rosemount Radar Master (RRM) . . . . . E-3
	AMS Suite . . . . . E-5
<b>APPENDIX F</b>	
<b>Level Transducer Block</b>	
	Overview . . . . . F-1
	Definition . . . . . F-1
	Channel Definitions . . . . . F-2
	Parameters and Descriptions . . . . . F-2
	Supported Units . . . . . F-8
	Unit Codes . . . . . F-8
	Diagnostics Device Errors . . . . . F-9

# Rosemount 5300 Series

---

<b>APPENDIX G</b>	Overview . . . . .	G-1
<b>Register Transducer Block</b>	Register Access Transducer Block Parameters . . . . .	G-1
<b>APPENDIX H</b>	Overview . . . . .	H-1
<b>Advanced Configuration Transducer Block</b>	Advanced Configuration Transducer Block Parameters . . . . .	H-1
<b>APPENDIX I</b>	Overview . . . . .	I-1
<b>Resource Transducer Block</b>	Parameters and Descriptions . . . . .	I-1
	PlantWeb™ Alerts . . . . .	I-5
	Alarm Priority . . . . .	I-7
	Process Alarms . . . . .	I-7
	Recommended Actions for PlantWeb Alerts . . . . .	I-7
<b>APPENDIX J</b>	Simulation . . . . .	J-3
<b>Analog-Input Block</b>	Damping . . . . .	J-4
	Signal Conversion . . . . .	J-5
	Block Errors . . . . .	J-6
	Modes . . . . .	J-6
	Alarm Detection . . . . .	J-7
	Status Handling . . . . .	J-8
	Advanced Features . . . . .	J-8
	Configure the AI Block . . . . .	J-9

# Section 1 Introduction

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Safety Messages .....	page 1-1
Manual Overview .....	page 1-2
Service Support .....	page 1-3
Product Recycling/Disposal .....	page 1-4

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## SAFETY MESSAGES

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury.**

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

**Explosions could result in death or serious injury.**

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

**Electrical shock could cause death or serious injury.**

- Use extreme caution when making contact with the leads and terminals.

**⚠ WARNING**

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson Process Management. Any continued use of product that has been damaged or modified without prior written authorization is at the customer's sole risk and expense.

## **MANUAL OVERVIEW**

This manual provides installation, configuration and maintenance information for the Rosemount 5300 Series Radar Transmitter.

### **Section 2: Transmitter Overview**

- Theory of operation
- Description of the transmitter
- Process and vessel characteristics

### **Section 3: Mechanical Installation**

- Mounting considerations
- Mounting

### **Section 4: Electrical Installation**

- Grounding
- Cable selection
- Power requirements
- Wiring
- Optional devices

### **Section 5: Configuration**

- Basic configuration
- Configuration using the 375 Field Communicator
- Configuration using the RRM software
- Configuration using AMS Suite
- Configuration using DeltaV
- Foundation™ Fieldbus

### **Section 6: Operation**

- Viewing measurement data
- Display functionality

### **Section 7: Service and Troubleshooting**

- Service functions
- Diagnostic messages
- Error messages

### **Section 8: Safety Instrumented Systems (4-20 mA only)**

- Functional specifications
- Installation
- Configuration
- Operation and maintenance
- Spare parts

### **Appendix A: Reference Data**

- Specifications
- Dimensional drawings
- Ordering information

**Appendix B: Product Certifications**

- Labels
- European ATEX Directive information
- NEPSI approvals
- FM approvals
- CSA approvals
- IECEx approvals
- Combination approvals
- Approval drawings

**Appendix C: Advanced Configuration**

- Advanced Tank Geometry
- Advanced Transmitter Configuration
- Dynamic Vapor Compensation
- Signal Quality Metrics

**Appendix D: Remote Housing**

- Remote Housing, New Units
- Remote Housing, Field Retrofit
- Remote Housing Configuration

**Appendix E: Performing Proof Test**

- Describes the process of performing proof test.

**Appendix F: Level Transducer Block**

Describes the operation and parameters of the Level transducer block.

**Appendix G: Register Transducer Block**

Describes the operation and parameters of the Register transducer block.

**Appendix H: Advanced Configuration Transducer Block**

Describes the operation and parameters of the Advanced Configuration transducer block.

**Appendix I: Resource Transducer Block**

Describes the operation and parameters of the Resource transducer block.

**Appendix J: Analog-Input Transducer Block**

Describes the operation and parameters of the Analog Input transducer block.

**SERVICE SUPPORT**

To expedite the return process outside of the United States, contact the nearest Emerson Process Management representative.

Within the United States, call the Emerson Process Management Instrument and Valves Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

## Rosemount 5300 Series

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The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the process material to which the product was last exposed.

Emerson Process Management Instrument and Valves Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substance can avoid injury if they are informed of and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

### **PRODUCT RECYCLING/DISPOSAL**

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation/regulations.

## Section 2 Transmitter Overview

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Theory of Operation .....	page 2-1
Applications .....	page 2-2
Components of the Transmitter .....	page 2-5
System Architecture .....	page 2-7
Probe Selection Guide .....	page 2-9
Process Characteristics .....	page 2-11
Vessel Characteristics .....	page 2-14
Installation Procedure .....	page 2-15

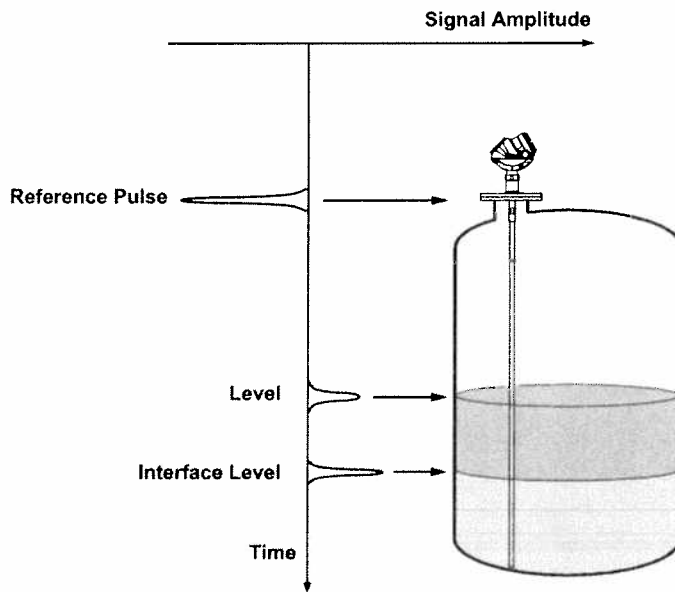
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### THEORY OF OPERATION

The Rosemount 5300 Series Radar Transmitter is a smart, two-wire continuous level transmitter based on Time Domain Reflectometry (TDR) principles. Low power nano-second-pulses are guided along an immersed probe. When a pulse reaches the surface, part of the energy is reflected back to the transmitter, and the time difference between the generated and reflected pulse is converted into a distance, which calculates the total level or interface level (see below).

The reflectivity of the product is a key parameter for measurement performance. Media with a high dielectric constant gives better reflection and a longer measuring range.

Figure 2-1. Measurement Principle.



# Rosemount 5300 Series

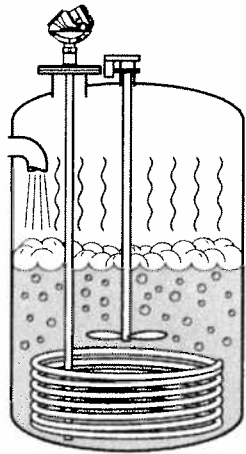
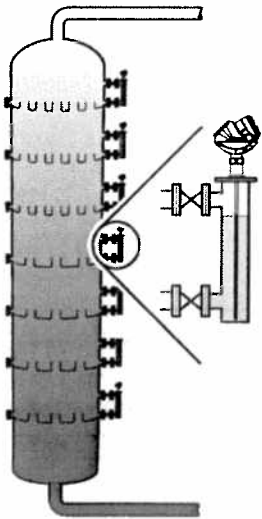
## APPLICATIONS

The Rosemount 5300 Series Radar Transmitter series is suited for aggregate (total) level measurements on most liquids, semi-liquids, solids, and liquid/liquid interfaces.

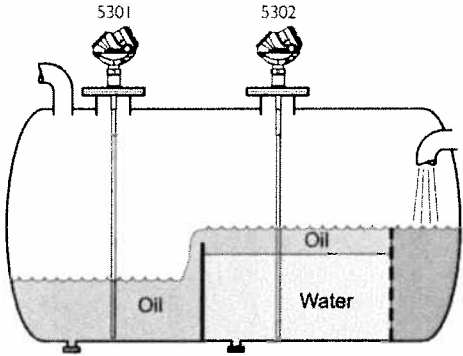
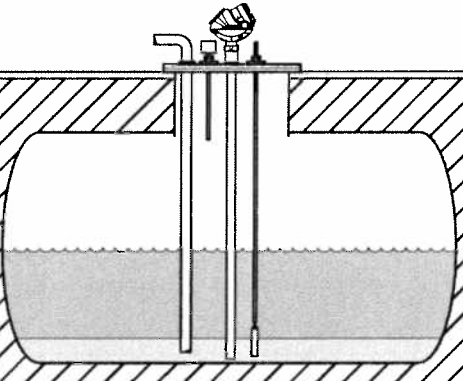
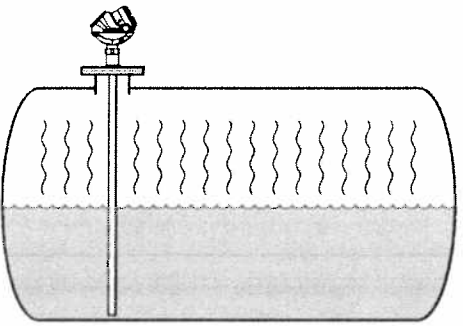
Guided microwave technology offers the highest reliability and precision to ensure measurements are virtually unaffected by temperature, pressure, vapor gas mixtures, density, turbulence, bubbling/boiling, low level, varying dielectric media, pH, and viscosity.

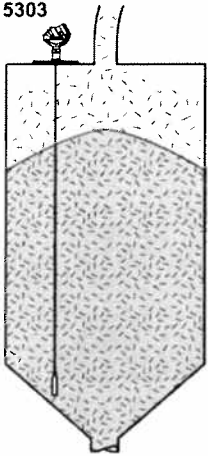
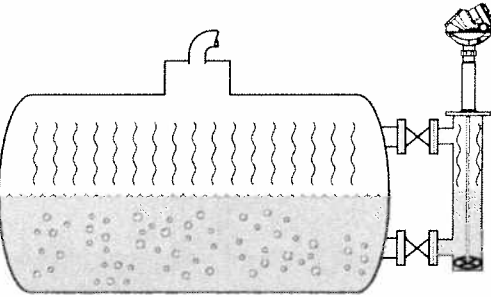
Guided wave radar technology in combination with advanced signal processing makes the Rosemount 5300 transmitters suitable for a wide range of applications:

Figure 2-2. Application examples

	<p>The Rosemount 5300 transmitter works well in boiling conditions with vapor and turbulence. If there are disturbing objects in the vicinity of the transmitter, the coaxial probe is particularly suitable.</p>
	<p>The Rosemount 5300 Series is well suited for chamber applications, such as distillation columns.</p>



 <p>The diagram shows a cross-section of a separator tank. On the left, a probe labeled '5301' is installed in a section containing 'Oil'. On the right, a probe labeled '5302' is installed in a section containing 'Water'. The tank has an inlet on the left and an outlet on the right.</p>	<p>The Rosemount 5302 measures both level and interface level in a separator tank.</p>
 <p>The diagram shows a cross-section of an underground tank. A Rosemount 5300 Series probe is installed on top of the tank, with its radar pulse concentrated near the liquid surface. The tank is surrounded by a hatched ground area.</p>	<p>The Rosemount 5300 Series is a good choice for underground tanks. It is installed on the top of the tank with the radar pulse concentrated near the probe. It can be equipped with probes that are unaffected by high and narrow openings or nearby objects.</p>
 <p>The diagram shows a cross-section of a tank. A Rosemount 5300 Series probe is installed on top of the tank. Wavy lines represent the guided wave radar technology used for level measurement.</p>	<p>Guided wave radar technology provides reliable measurements in ammonia, LNG and LPG tanks.</p>

 <p>5303</p> <p>The diagram shows a cross-section of a hopper-shaped container. A flexible probe, labeled '5303', is inserted from the top. The probe's tip is positioned in a layer of granular material. Above the granules is a layer of dust. The probe is shown measuring the level of the granules.</p>	<p>Model 5303, with a flexible single lead probe, is the solution for solids, powders and granules. It measures independently of dust, angled surfaces etc.</p>
 <p>The diagram shows a horizontal cylindrical tank partially filled with liquid. The liquid contains numerous small bubbles. A probe is connected to the tank via a vertical pipe with two valves. The probe has a specialized tip for measuring liquid level in the presence of vapor.</p>	<p>The Rosemount 5300 with Dynamic Vapor Compensation will automatically compensate for dielectric changes in high pressure steam applications and maintain the level accuracy.</p>

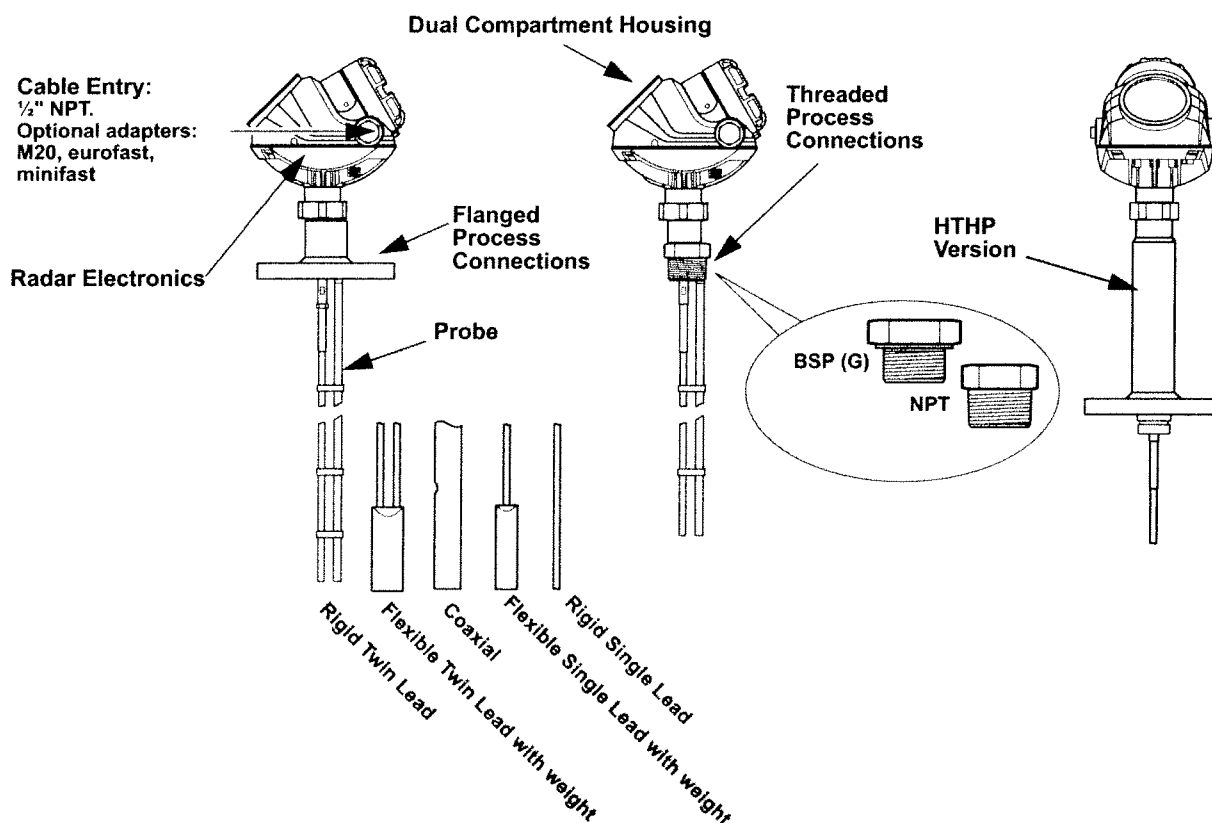
**COMPONENTS OF THE TRANSMITTER**

The Rosemount 5300 Series Radar Transmitter has an aluminum or stainless steel (SST) *transmitter housing* containing advanced electronics and software for signal processing. SST housing is preferred for harsh environment applications, such as off-shore platforms or other locations where the housing can be exposed to corrosives, such as salt solutions and caustics.

The *radar electronics* produces an electromagnetic pulse that is guided by the *probe*. It comes with flange, threaded or Tri-Clamp process connection.

There are different probe types available for various applications: Rigid Twin Lead, Flexible Twin Lead, Rigid Single Lead, Flexible Single Lead, and Coaxial.

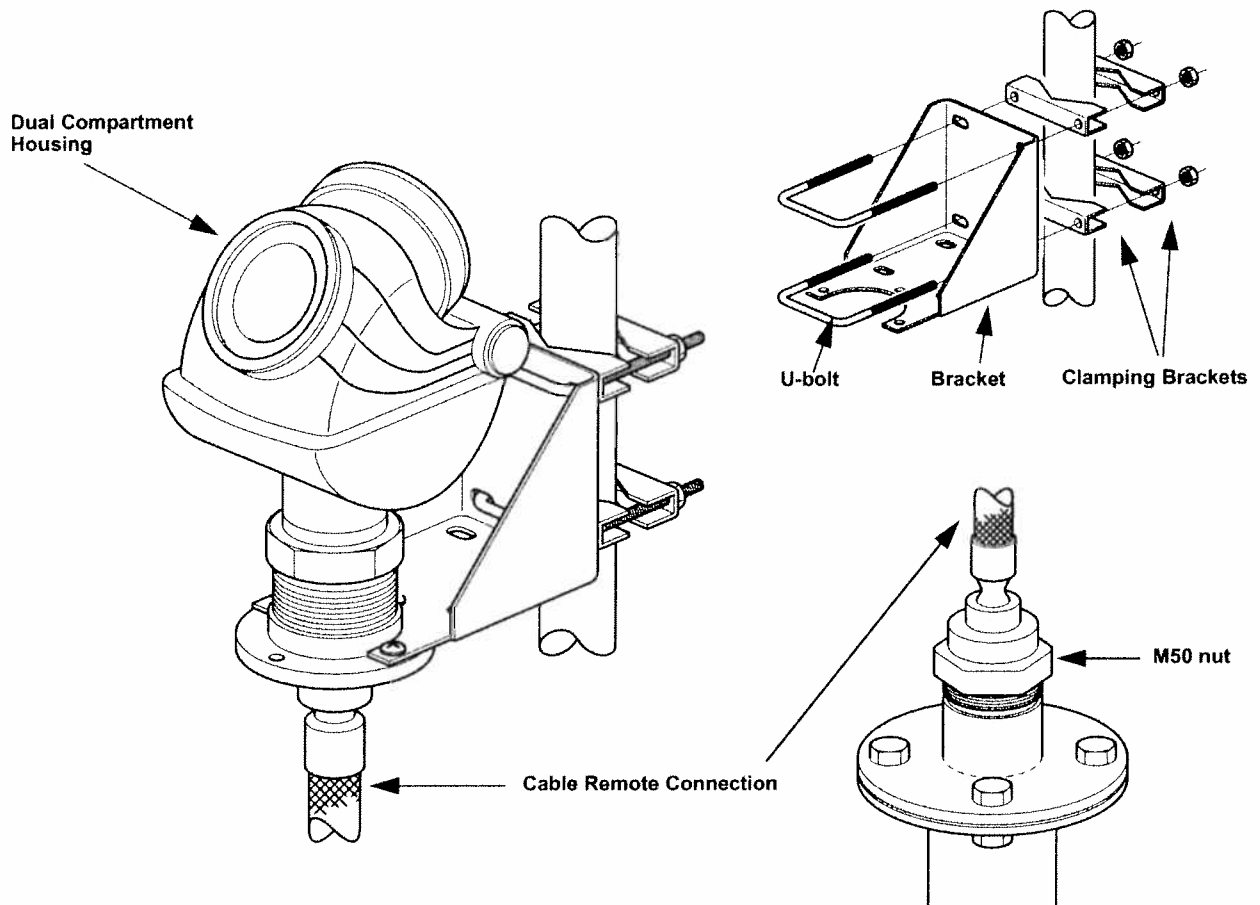
Figure 2-3. Transmitter components.



# Rosemount 5300 Series

Figure 2-4. Remote Housing components.

Remote Housing allows for the transmitter head to be mounted separately from the probe.



## SYSTEM ARCHITECTURE

The Rosemount 5300 Series Radar Transmitter is loop-powered, and it uses the same two wires for both power supply and output signal. The output is a 4-20 mA analog signal superimposed with a digital HART® or FOUNDATION™ Fieldbus signal.

By using the optional Rosemount 333 HART Tri-loop, the HART signal can convert up to three additional 4-20 mA analog signals.

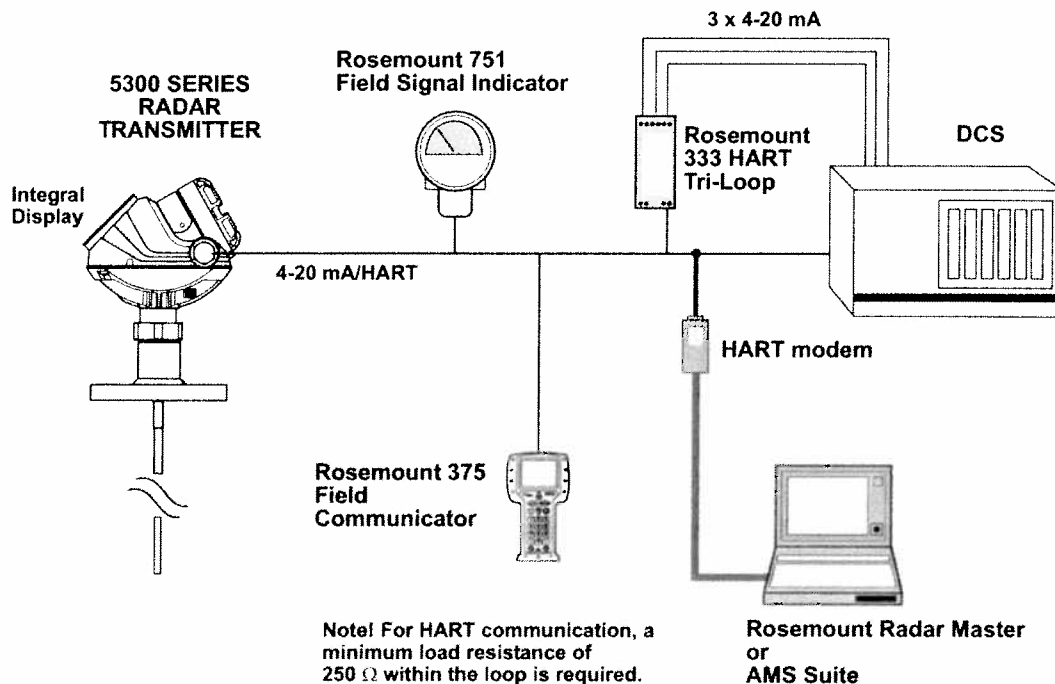
With the HART protocol multidrop configuration is possible. In this case, communication is restricted to digital, since current is fixed to the 4 mA minimum value.

The transmitter can be connected to a Rosemount 751 Field Signal Indicator, or it can be equipped with an integral display.

The transmitter can easily be configured using a Rosemount 375 Field Communicator or a PC with the Rosemount Radar Master software. Rosemount 5300 Series transmitters can also be configured with the AMS® Suite and DeltaV™ software, and other tools supporting Electronic Device Description Language (EDDL) functionality.

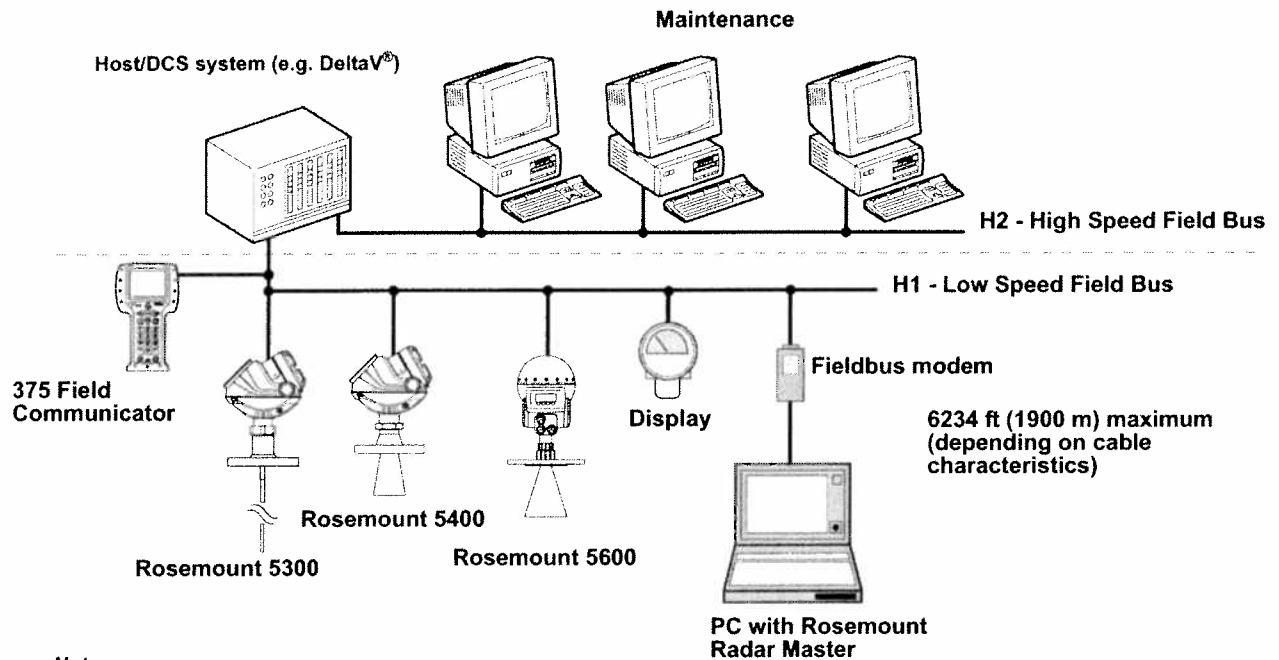
For HART communication a minimum load resistance of 250 Ω within the loop is required.

Figure 2-5. HART system architecture



# Rosemount 5300 Series

Figure 2-6. FOUNDATION  
Fieldbus system architecture


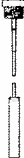


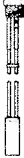


**Note:**  
Intrinsically safe  
installations may  
allow fewer devices  
per I.S. barrier due to  
current limitations.

**PROBE SELECTION  
GUIDE**

The following guidelines should be used to choose the appropriate probe for the Rosemount 5300 transmitter:

Table 2-1. Probe selection guide.

	Rigid Single Lead	Flexible Single Lead	Coaxial	Rigid Twin Lead	Flexible Twin Lead
G=Good NR=Not Recommended AD=Application Dependent (consult your local Emerson Process Management representative)					
<b>Measurements</b>					
Level	G	G	G	G	G
Interface (liquid/liquid)	G	G	G	G	G
<b>Process Medium Characteristics</b>					
Changing density	G	G	G	G	G
Changing dielectric <sup>(1)</sup>	G	G	G	G	G
Wide pH variations	G	G	G	G	G
Pressure changes	G	G	G	G	G
Temperature changes	G	G	G	G	G
Condensing vapors	G	G	G	G	G
Bubbling/boiling surfaces	G	AD	G	G	G
Foam (mechanical avoidance)	NR	NR	AD	NR	NR
Foam (top of foam measurement)	AD	AD	NR	AD	AD
Foam (foam and liquid measurement)	AD	AD	NR	AD	AD
Clean liquids	G	G	G	G	G
Liquid with very low dielectric constants, see also Table 2-4.	G	G <sup>(2)</sup>	G	G	G <sup>(2)</sup>
Coating/sticky liquids	AD	AD	NR	NR	NR
Viscous liquids	AD	G	NR	AD	AD
Crystallizing liquids	AD	AD	NR	NR	NR
Solids, granules, powders	AD	G	NR	NR	NR
Fibrous liquids	G	G	NR	NR	NR
<b>Tank Environment Considerations</b>					
Probe is close (<12 in./30 cm) to tank wall / disturbing objects	AD	AD	G	G	G
Probe might touch tank wall, nozzle or disturbing objects	NR	NR	G	NR	NR
Turbulence	G	AD	G	G	AD
Turbulent conditions causing breaking forces	NR	AD	NR	NR	AD
Tall, narrow nozzles	AD	AD	G	AD	AD
Angled or slanted surface (viscous or solids materials)	G	G	NR	AD	AD
Liquid or vapor spray might touch probe above surface	NR	NR	G	NR	NR
Disturbing Electromagnetic interference in tank	AD	AD	G	AD	AD
Cleanability of probe	G	G	NR	AD	AD

(1) For overall level applications, a changing dielectric has no effect on the measurement. For interface measurements, a changing dielectric for the top fluid will degrade the accuracy of the interface measurement.

(2) Limited measuring range.

# Rosemount 5300 Series

## Transition Zones

The measuring range depends on probe type and product properties, and is limited by the Upper and Lower Transition Zones. In these zones, measurement accuracy may be reduced. The **Upper Transition Zone** is the minimum measurement distance between the upper reference point and the product surface. At the end of the probe, the measuring accuracy is reduced in the **Lower Transition Zone**. The Transition Zones vary depending on probe type and product.

Figure 2-7 illustrates how the measuring range is related to the Transition Zones:

Figure 2-7. Transition Zones

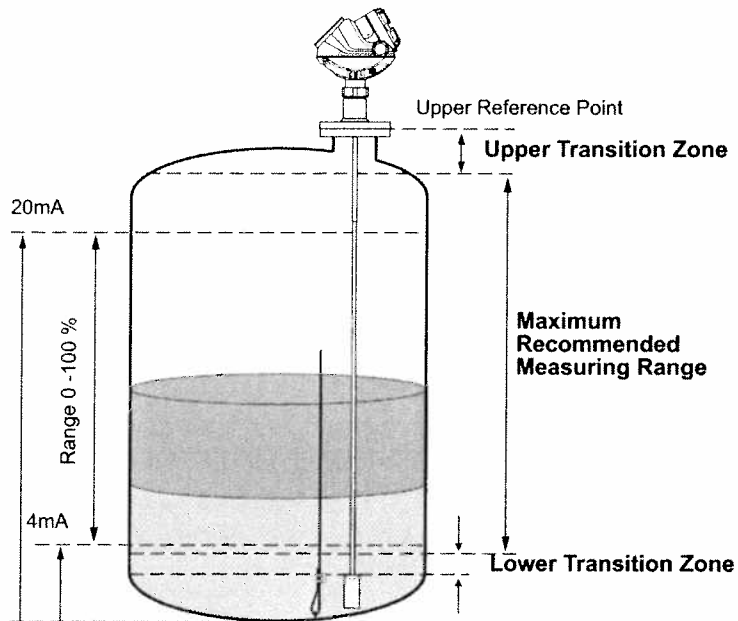


Table 2-2. Transition Zones for different probe types and dielectric constants

	Dielectric Constant	Rigid Single Lead	Flexible Single Lead	Coaxial	Rigid Twin Lead	Flexible Twin Lead
Upper <sup>(1)</sup> Transition Zone	80	4.3 in. (11 cm)	4.3 in. (11 cm)	4.3 in. (11 cm)	4.3 in. (11 cm)	4.7 in. (12 cm)
	2	6.3 in. (16 cm)	7.1 in. (18 cm)	4.3 in. (11 cm)	5.5 in. (14 cm)	5.5 in. (14 cm)
Lower <sup>(2)</sup> Transition Zone	80	2 in. (5 cm)	0 in. (0 cm) <sup>(4)(3)</sup>	0.4 in. (1 cm)	1.2 in. (3 cm)	2 in. (5 cm) <sup>(4)</sup>
	2	2.8 in. (7 cm) <sup>(5)</sup>	2 in. (5 cm) - long weight <sup>(4)</sup> 3.2 in. (8 cm) - short weight <sup>(4)</sup>	2 in. (5 cm)	4 in. (10 cm)	5.5 in. (14 cm) <sup>(4)</sup>

(1) The distance from the upper reference point where measurements have reduced accuracy, see picture above.

(2) The distance from the lower reference point where measurements have reduced accuracy, see picture above.

(3) The measuring range for the PTFE covered Flexible Single Lead probe includes the weight. For low dielectric media, special configuration may be required.

(4) Note that the weight length adds to non-measurable area and is not included in the table. See "Dimensional Drawings" on page A-9.

(5) If using a metal centering disc, the lower transition zone is up to 8 in. (20 cm). If using a PTFE centering disc, the lower transition zone is not affected.

### NOTE!

Measurements in the Transition Zones may be non-linear, or have reduced accuracy. It is recommended the 4-20 mA points be set between the Transition Zones.



**PROCESS CHARACTERISTICS**

The Rosemount 5300 Series has high sensitivity because of its advanced signal processing and high signal to noise ratio. This makes it able to handle various disturbances, however, the following circumstances should be considered before mounting the transmitter.

**Coating**

Heavy coating of the probe should be avoided since it may decrease the sensitivity of the transmitter and lead to measurement errors. In viscous or sticky applications, periodic cleaning may be required.

For viscous or sticky applications, it is important to choose a suitable probe:

Table 2-3. Probe type guide for different product viscosity

Coaxial	Twin Lead	Single Lead
<b>Maximum viscosity</b>		
500 cP	1500 cP	8000 cP <sup>(1)(2)</sup>
<b>Coating/Build-up</b>		
Coating not recommended	Thin coating allowed, but no bridging	Coating allowed

- (1) Consult your local Emerson Process Management representative for agitation/turbulence and high viscous products.
- (2) Be precautionous in HTHP viscous or crystallizing media applications where temperature at instrument connection is significantly lower than process temperature with risk of coating in the upper part of probe that may reduce the measurement signal. Consider using HP or STD probes in such applications.

Maximum measurement error due to coating is 1-10% depending on probe type, dielectric constant, coating thickness and coating height above product surface.

Signal Quality Metrics (SQM) diagnostic option can give an indication of how good the surface signal is compared to the noise, and when to clean the probe.

**Bridging**

Heavy product coating results in bridging between the two probes in a twin lead version, or between the pipe and inner rod for coaxial probes, and may cause erroneous level readings, so it must be prevented. A single lead probe is recommended in these situations.

**Foam**

The Rosemount 5300 Series Radar Transmitter measurement in foamy applications depends on the foam properties; light and airy or dense and heavy, high or low dielectrics, etc. If the foam is conductive and creamy, the transmitter may measure the surface of the foam. If the foam is less conductive the microwaves may penetrate the foam and measure the liquid surface.

**Vapor**

In some applications, such as high pressure boiling water, there is a heavy vapor above the product surface that could influence the level measurement. The Rosemount 5300 Series Radar Transmitter can be configured to compensate for the influence of vapor.

**Boiling Hydrocarbons**

For products with very low dielectric constants, such as boiling hydrocarbons and solids, the threshold may need to be lowered, and/or the Probe End Projection (PEP) function activated.

# Rosemount 5300 Series

## Measuring Range

The measuring range differs depending on probe type and characteristics of the application. *Table 2-4* can be used as a guideline for clean liquids.

See Appendix A: Reference Data for the measuring range when using Remote Housing.

Table 2-4. Measuring Range

Rigid Single Lead	Flexible Single Lead <sup>(1)</sup>	Coaxial	Rigid Twin Lead	Flexible Twin Lead
<b>Maximum Measuring Range</b>				
9 ft 10 in. (3 m) - for 8 mm probes 14 ft 9 in. (4.5 m) - for 13 mm probes	164 ft (50 m)	19 ft 8 in. (6 m)	9 ft 10 in. (3 m)	164 ft (50 m)
<b>Minimum Dielectric Constant at Maximum Measuring Range</b>				
1.4 (1.25 if installed in a metallic bypass or stilling well) <sup>(1)(2)</sup>	1.4, up to 49 ft (15 m) <sup>(1)</sup> 1.8, up to 82 ft (25 m) <sup>(1)</sup> 2.0, up to 115 ft (35 m) <sup>(1)</sup> 3, up to 138 ft (42 m) 4, up to 151 ft (46 m) 6, up to 164 ft (50 m)	1.2 (Standard) 1.4 (HP/C) 2.0 (HTHP)	1.4	1.4, up to 82 ft (25 m) <sup>(1)</sup> 2.0, up to 115 ft (35 m) <sup>(1)</sup> 2.5, up to 131 ft (40 m) <sup>(1)</sup> 3.5, up to 148 ft (45 m) 6, up to 164 ft (50 m)

(1) The probe end projection software function will improve the minimum dielectric constant. Consult you local Emerson Process Management representative for details.

(2) Measuring range may be lower depending on installation.

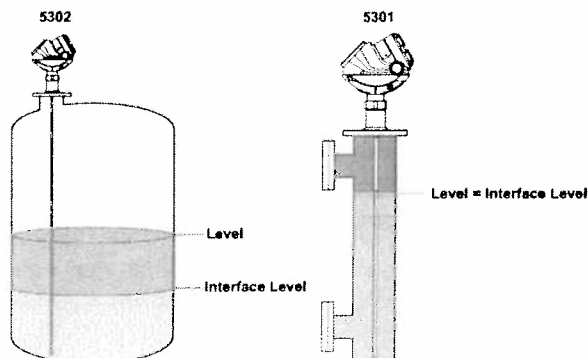
The maximum measuring range differs based on application according to:

- Disturbing objects close to the probe
- Media with higher dielectric constant ( $\epsilon_r$ ) has better reflection and a longer measuring range
- Surface foam and particles in the tank atmosphere might affect measuring performance
- Heavy coating / contamination on the probe may reduce the measuring range and cause erroneous level readings
- Disturbing EMC environment in tank
- Tank material (e.g. concrete or plastic) for measurements with single lead probes

## Interface

Rosemount 5302 is the ideal choice for measuring the level of oil, and the interface of oil and water, or other liquids with significant dielectric differences. Rosemount 5301 can also be used for interface measurement in applications where the probe is fully submerged in the liquid.

Figure 2-8. Interface measurement with a Rosemount 5302 and a Rosemount 5301 (fully submerged probe).



For measuring interface level, the transmitter uses the residual wave of the first reflection. Part of the wave, not reflected at the upper product surface, continues until it is reflected at the lower product surface. The speed of this wave depends fully on the dielectric constant of the upper product.

To measure interface, the following criteria have to be fulfilled:

- The dielectric constant of the upper product must be known and should be constant. The Rosemount Radar Master software has a built-in dielectric constant calculator to assist in determining the dielectric constant of the upper product. (see "Dielectric Constant/Dielectric Range" on page 5-23)
- The upper product must have a lower dielectric constant than the lower product to have a distinct reflection
- The difference between the dielectric constants for the two products must be greater than 6
- The maximum dielectric constant for the upper product: 10 for the coaxial probe, 7 for the twin lead, and 8 for the single lead probes
- The upper product thickness must be greater than 5.1 in. (0.13 m) for all probes, except the HTHP coaxial probe, which requires 8 in. (0.2 m), to distinguish the echoes of the two liquids

The maximum allowable upper product thickness/measuring range is primarily determined by the dielectric constants of the two liquids.

Target applications include interfaces between oil / oil-like and water / water-like liquids with a low (<3) dielectric constant for the upper product and a high (>20) dielectric constant for the lower product.

For such applications, the maximum measuring range is limited by the length of the coaxial, rigid twin, and rigid single lead probes.

For flexible probes, the maximum measuring range is reduced by the maximum upper product thickness, according to the diagram below. However, characteristics may vary between the different applications.

Figure 2-9. Maximum Upper Product thickness for the Flexible Single Lead probe.

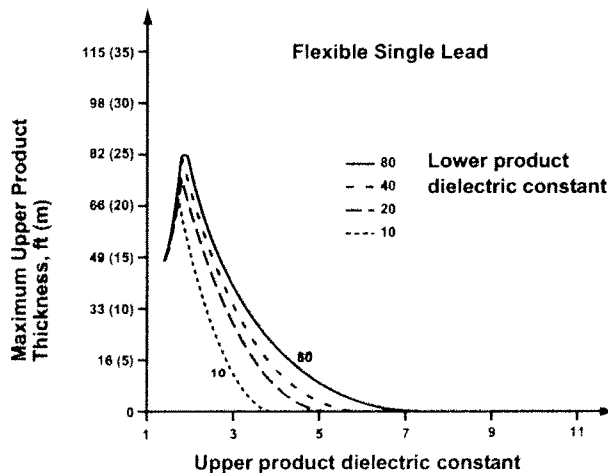
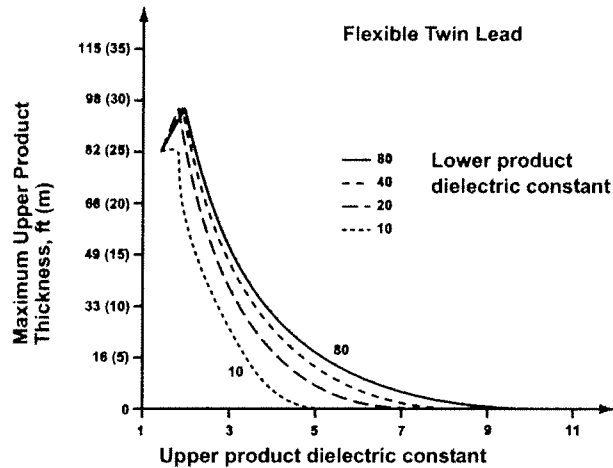


Figure 2-10. Maximum Upper Product thickness for the Flexible Twin Lead probe.



**NOTE!**

Maximum distance to the interface = 164 ft.(50 m) - Maximum Upper Product Thickness.

**Emulsion Layers**

Sometimes an emulsion layer (mix of the products) forms between the two products and can affect interface measurements. For assistance with emulsion applications, consult your local Emerson Process Management representative.

**VESSEL CHARACTERISTICS**

**Heating Coils, Agitators**

Because the radar signal is transmitted along a probe, the Rosemount 5300 Radar transmitter is generally not affected by objects in the tank. Avoid physical contact with metallic objects when Twin Lead or Single Lead probes are used.

Avoid physical contact between probes and agitators, as well as applications with strong fluid movement, unless the probe is anchored. If the probe is able to move 1 ft. (30 cm) from any object, such as an agitator, during operation, the probe tie-down is recommended.

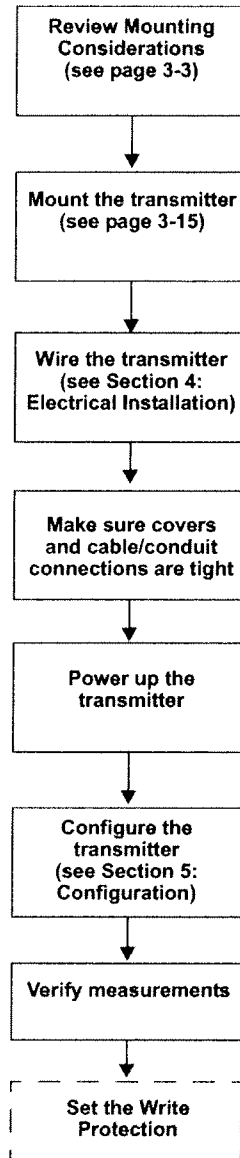
To stabilize the probe for side forces, a weight may be hung at the probe end (flexible probes only) or fix/guide the probe to the tank bottom.

**Tank Shape**

The guided wave radar transmitter is insensitive to tank shape. Since the radar signal travels along a probe, the shape of the tank bottom has virtually no effect on the measurement performance. The transmitter can handle flat or dish-bottom tanks.

**INSTALLATION  
PROCEDURE**

Follow these steps for proper installation:



# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

## Section 3 Mechanical Installation

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Safety messages .....	page 3-1
Mounting Considerations .....	page 3-3
Mounting .....	page 3-15

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### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

#### WARNING

**Failure to follow safe installation and servicing guidelines could result in death or serious injury:**

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any services other than those contained in this manual unless you are qualified.

**Process leaks could result in death or serious injury.**

Make sure that the transmitter is handled carefully. If the Process Seal is damaged, gas might escape from the tank if the transmitter head is removed from the probe.

#### WARNING

**High voltage that may be present on leads could cause electrical shock:**

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

**⚠ WARNING**

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson Process Management. Any continued use of product that has been damaged or modified without prior written authorization is at the customer's sole risk and expense.



## MOUNTING CONSIDERATIONS

Before installing the Rosemount 5300 Series Radar Transmitter, consider specific mounting requirements, vessel and process characteristics.

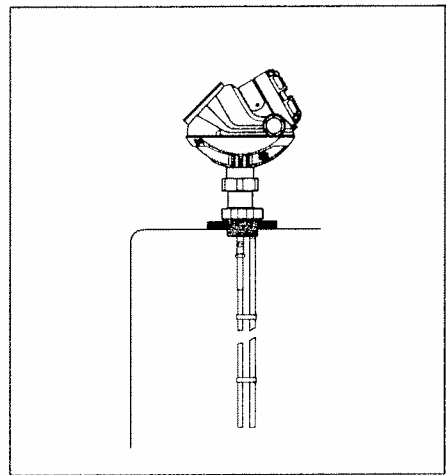
For **Remote Housing** installation see Appendix D: Remote Mounting.

### Process Connection

The Rosemount 5300 Series has a threaded connection for easy mounting on a tank roof. It can also be mounted on a nozzle by using different flanges.

#### Threaded Connection

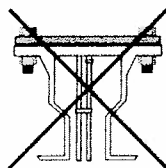
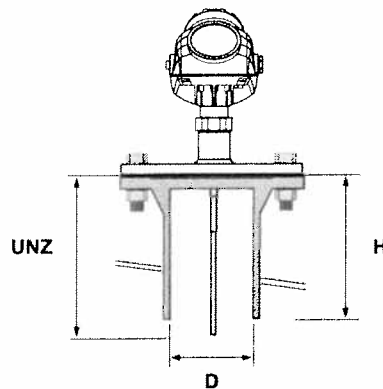
Figure 3-1. Mounting on tank roof using threaded connection.



Mounting on tank roof.

#### Flange Connection on Nozzles

Figure 3-2. Mounting in nozzles



Avoid nozzles with reducer  
(unless using Coaxial probe)

# Rosemount 5300 Series

The transmitter can be mounted in nozzles by using an appropriate flange. The nozzle sizes given in *Table 3-1* show the recommended dimensions. For small nozzles, it may be necessary to increase the Upper Null Zone (UNZ) to reduce the measuring range in the upper part of the tank. Amplitude Threshold adjustments may also be needed in this case. A Trim Near Zone is recommended in most nozzle installations, for example, when there are disturbing obstacles in the near zone. See Appendix C: Handling of Disturbances from Nozzle on page C-4.

**NOTE!**

The probe should not contact the nozzle, with the exception of the Coaxial Probe. If the nozzle diameter is less than recommended, the measuring range may be reduced.

Table 3-1. Nozzle considerations

	Single (Rigid/Flexible)	Coaxial	Twin (Rigid/Flexible)
<b>Recommended Nozzle Diameter (D)</b>	6 in. (150 mm)	> Probe Diameter	4 in. (100 mm)
<b>Minimum Nozzle Diameter (D)<sup>(1)</sup></b>	2 in. (50 mm)	> Probe Diameter	2 in. (50 mm)
<b>Recommended Nozzle Height (H)<sup>(2)</sup></b>	4 in. + Nozzle Diameter <sup>(3)</sup>	N/A	4 in. + Nozzle Diameter

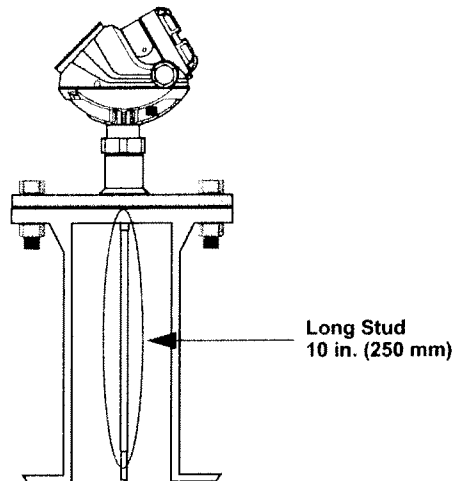
(1) The Trim Near Zone function may be necessary or an Upper Null Zone setup may be required to mask the nozzle.

(2) Longer nozzles may be used in certain applications. Consult your local Emerson Process Management representative for details.

(3) When using single flexible probes in tall nozzles, it is recommended to use the Long Stud (LS).

A long stud - 10 in. (250 mm) - is recommended for single flexible probes in a tall nozzle.

Figure 3-3. A single flexible probe with a long stud.



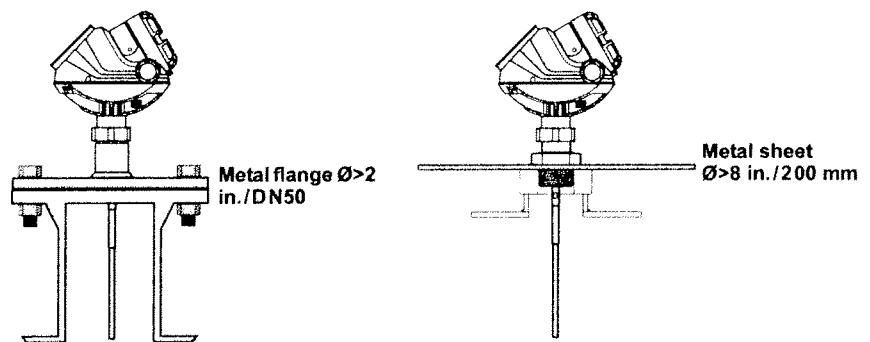
**NOTE!**

For single lead probes, avoid 10-in. (250 mm)/DN250 or larger diameter nozzles, especially in applications with low dielectric constant. An alternative is to install a smaller nozzle inside the nozzle.

**Installation of Single Lead Probes in Non-metallic Vessels**

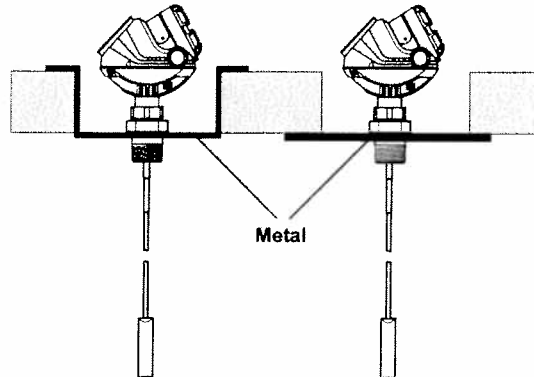
For optimal single lead probe performance in non-metallic (plastic) vessels, the probe must be mounted with a metal flange, or screwed in to a metal sheet ( $d > 8$  in./200 mm), if the threaded version is used.

Figure 3-4. Mounting in non-metallic vessels.



Electromagnetic disturbances should be kept to a minimum since they may affect measurement performance.

## Installation in Concrete Silos



## Considerations for Solid Applications

The flexible single lead probe is recommended for solids and is available in two versions to handle different loads and lengths:

- 0.16 in. (4 mm) diameter  
Tensile strength is minimum 2698 lb (12 kN)  
Collapse load is maximum 3597 lb (16 kN)
- 0.24 in. (6 mm) diameter  
Tensile strength is minimum 6519 lb (29 kN)  
Collapse load is maximum 7868 lb (35 kN)

Keep the following in mind when planning installation of the Rosemount 5300 in solid applications:

- There might be considerable down-pull forces on silo roofs caused by the media, so the silo roof must withstand the maximum probe tensile load
- The tensile load depends on silo size, material density, and the friction coefficient. Forces increase with the buried length, the silo, and probe diameter
- In critical cases, such as for products with a risk for build-up, use a 0.24 in. (6 mm) probe
- Depending on position, forces on probes are two to ten times greater on probes with tie-down, than on probes with ballast weights<sup>(1)</sup>

Guidelines for the tensile load from free-flowing solids acting on a suspended probe without any tie-down or weight in a smooth metallic wall silo as shown in Table 3-2. A safety factor of 2 is included for the figures. Consult your local Emerson Process Management representative for more information.

(1) The weight should not be fixed for probe 100 ft (30 m) or longer.

Table 3-2. Pulling force on probe installed in tanks with different products

Material	Tensile load for 0.16 in. (4 mm) flexible single lead probe, lb (kN)				Tensile load for 0.24 in. (6 mm) flexible single lead probe, lb (kN)			
	Probe length 49 ft (15 m)		Probe length 115 ft (35 m)		Probe length 49 ft (15 m)		Probe length 115 ft (35 m)	
	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)	Tank Ø= 10 ft (3 m)	Tank Ø= 39 ft (12 m)
Wheat	670 (3)	1120 (5)	1800 (8)	4500 (20) Exceeds tensile strength limit	900 (4)	1690 (7.5)	2810 (12.5)	6740 (30) Exceeds tensile strength limit
Polypropylene Pellets	340 (1.5)	670 (3)	810 (3.6)	2360 (10.5)	450 (2)	920(4.1)	1190 (5.3)	3510 (15.6)
Cement	900 (4)	2020 (9)	2470 (11)	7310 (32.5) Exceeds tensile strength limit	1350 (6)	2920 (13)	3600 (16)	10790 (48) Exceeds tensile strength limit

**NOTE!**

For environments where electrostatic discharges (plastics) are likely to occur, it is recommended that the probe end is grounded.

**Mounting in Chamber/  
Still Pipe**

The chamber is also known as bridle, side pipe, bypass pipe, and cage. Dimensioning the chamber correctly and selecting the appropriate probe is key to the success in these applications.

To prevent the probe from contacting the wall, centering discs are available for the Rigid Single, Flexible Single, and Flexible Twin Lead Probes. The disc is attached to the end of the probe, and thus keeps the probe centered in the chamber. See also "Mounting a Centering Disc for Pipe Installations" on page 3-25.

Make sure that the probe does not come into contact with the chamber wall, e.g. by using a centering disk.

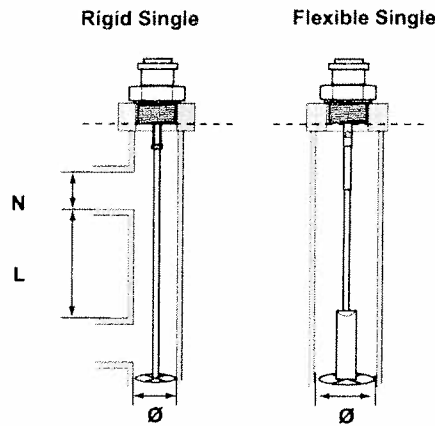


**NOTE!**

To avoid disturbances from object near the pipe, metal-pipes are preferred, especially in applications with low dielectric constant.

# Rosemount 5300 Series

Figure 3-5. Mounting Single Probe in Chamber/Still Pipe



Inlet pipe diameter  $N < \text{Ø}$ . Effective measuring range  $L \geq 12$  in. (300 mm).

Table 3-3. Recommended and minimum chamber/still pipe diameters for different probes.

Probe Type	Recommended Diameter	Minimum Diameter
Rigid Single	3 or 4 in. (75 or 100 mm)	2 in. (50 mm)
Flexible Single	4 in. (100 mm)	Consult your local Emerson Process Management representative
Rigid Twin <sup>(1)</sup>	3 or 4 in. (75 or 100 mm)	2 in. (50 mm)
Flexible Twin <sup>(1)</sup>	4 in. (100 mm)	Consult your local Emerson Process Management representative
Coaxial	3 or 4 in. (75 or 100 mm)	1.5 in. (37.5 mm)

(1) The center rod must be placed more than 0.6 in. (15 mm) away from the pipe wall.

The recommended chamber diameter is 3 in. (75 mm) or 4 in. (100 mm). Chambers with a diameter less than 3 in. (75 mm) may cause problems with build-up and it may also be difficult to avoid contact between chamber wall and probe. Chambers larger than 6 in. (150 mm) can be used but provide no advantages for radar measurement.

It is recommended that single probes are used with the Rosemount 5300 Series. Other probe types are more susceptible to build-up and are not recommended.<sup>(1)</sup> An exception is with liquefied gas > 40 bar when the coaxial probe should be used.

The probe must not touch the chamber wall, should extend the full height of the chamber, but not touch the bottom of the chamber. Probe type selection depends on probe length:

**Less than 14.7 ft (4.5 m):** Rigid Single Probe is recommended. Use a centering disc for a probe > 3.3 ft. (1 m). If installation requires less head-space, use a Flexible Single Probe with a weight and centering disc.<sup>(2)</sup>

**More than 14.7 ft (4.5 m):** Use Flexible Single Probe with a weight and centering disc.

(1) The single probe creates a virtual coaxial probe with the chamber as the outer tube. The extra gain provided by the twin and coaxial probes is not necessary; the electronics in the Rosemount 5300 Series is very sensitive and is not a limiting factor.

(2) The transition zones and the height of the weight limit the use of single flexible probes shorter than 3 ft. (1 m). If using the flexible probe, the short weight is recommended.

A short weight for the single flexible 0.16 in. (4 mm) SST probe can be used for measuring close to the probe end. The height is 2 in. (50 mm) and the diameter is 1.5 in. (37.5 mm). Option code W2.

For hot applications, the chamber should always be insulated to prevent personal injuries and to reduce the amount of energy needed for heating. See Figure 3-6. It is often an advantage, and sometimes even required, for the radar measurement:

- In hot applications, insulation reduces the amount of condensation, since it prevents the upper part of the chamber from becoming a cold spot
- Insulation prevents product solidification inside the chamber, and clogging of the inlet-pipes

Figure 3-6. Insulated Chamber.



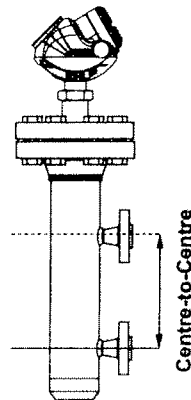
See page 3-14 for more information.

When mounting in a Rosemount 9901 chamber, the probe length to use can be calculated with these formulas:

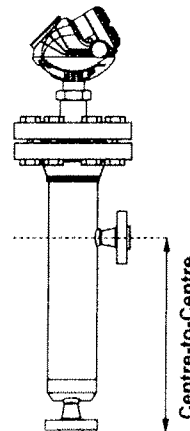
**Side-and-Side dimension:** Probe length = Centre-to-Centre dimension + 19 in. (48 cm)

**Side-and-Bottom dimension:** Probe length = Centre-to-Centre dimension + 4 in. (10 cm)

Side-and-Side dimension



Side-and-Bottom dimension

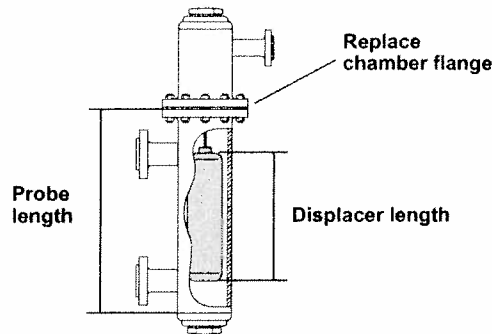


**NOTE!**

The formulas are not valid when using Dynamic Vapor Compensation probes.

## Replacing a Displacer in an Existing Displacer Chamber

A Rosemount 5300 Series transmitter is the perfect replacement for an existing displacer chamber. To simplify installation, proprietary flanges are offered to allow for using the same chambers.



### Rosemount 5300 benefits

- No moving parts: Less maintenance - dramatically reduced costs, and as a result, improved measurement availability
- Reliable measurement, that is independent of density, turbulence, and vibrations

### Considerations when changing to Rosemount 5300

When changing from a displacer to a Rosemount 5300 Series transmitter, make sure to correctly match the 5300 Series flange choice and probe length to the chamber. Both standard ANSI and EN (DIN), as well as proprietary chamber flanges are available.

Table 3-4 shows probe length guidelines.

Table 3-4. Required Probe Length Depending on Chamber Manufacturers

Chamber Manufacturer	Probe Length <sup>(1)</sup>
Major torque-tube manufacture (249B, 249C, 2449K, 249N, 259B)	Displacer + 9 in. (229 mm)
Masoneilan (Torque tube operated), proprietary flange	Displacer + 8 in. (203 mm)
Others - torque tube <sup>(2)</sup>	Displacer + 8 in. (203 mm)
Magnetrol (spring operated) <sup>(3)</sup>	Displacer + between 7.8 in. (195 mm) to 15 in. (383 mm)
Others - spring operated	Displacer + 19.7 in. (500 mm)

(1) If flushing ring is used, add 1 in. (25 mm).

(2) For other manufacturers, there are small variations. This is an approximate value, actual length should be verified.

(3) Lengths vary depending on model, SG and rating, and should be verified.



**Free Space**

For easy access to the transmitter, make sure it is mounted with sufficient service space. For maximum measurement performance, the transmitter should not be mounted close to the tank wall or near other objects in the tank.

If the probe is mounted close to a wall, nozzle or other tank obstruction, noise may appear in the level signal. The minimum clearance shown in Table 3-5 and Table 3-6 is recommended:

Figure 3-7. Free Space Requirement

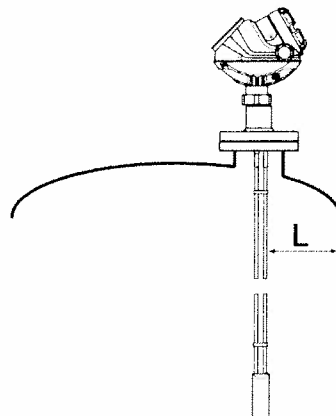


Table 3-5. Recommended minimum free space **L** to tank wall or other objects in the tank

Coaxial	Rigid Twin	Flexible Twin
0 in. (0 mm)	4 in. (100 mm)	4 in. (100 mm)

Table 3-6. Recommended minimum free space **L** to tank wall or other objects in the tank for Single Lead probes

Rigid Single/Flexible Single	
4 in. (100 mm)	Smooth metal wall.
20 in. (500 mm) <sup>(1)</sup>	Disturbing objects such as pipes and beams, concrete or plastic tank walls, rugged metal tank walls.

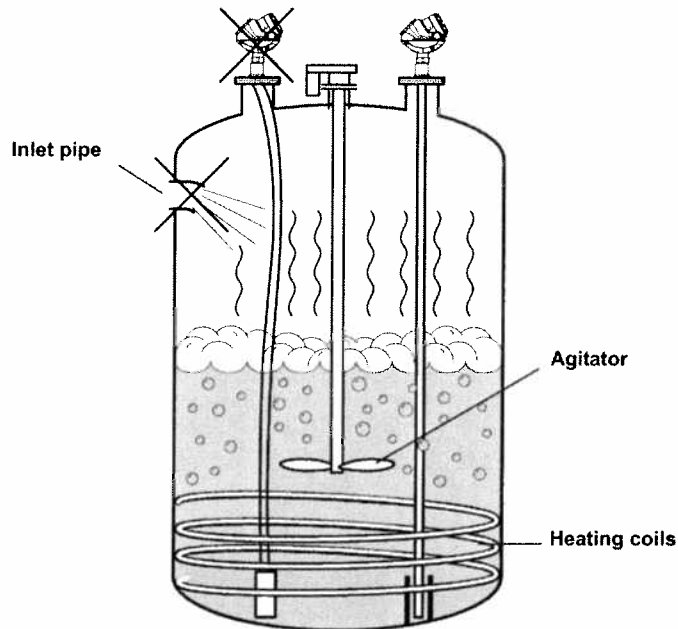
(1) When measuring in low DC (around 1.4). For higher DC, the recommended free space is lower.

## Recommended Mounting Position for Liquids

Tank conditions are recommended to be carefully considered when finding the appropriate mounting position for the transmitter. The transmitter should be mounted so the influence of disturbing objects is reduced to a minimum.

In case of turbulence, the probe may need to be anchored to the bottom. See "Anchoring" on page 3-22 for more information.

Figure 3-8. Mounting Position



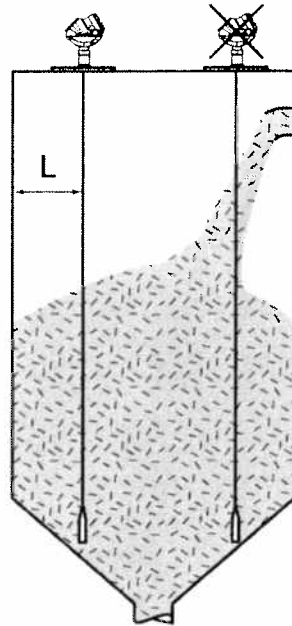
When mounting the transmitter the following guidelines should be considered:

- Do not mount close to inlet pipes
- Do not mount close to agitators. If the probe can move to within 30 cm away from an agitator, a probe tie-down is recommended
- If the probe tends to sway from the turbulent conditions in the tank, the probe should be anchored to the tank bottom
- Avoid mounting near heating coils
- The nozzle should not extend into the tank
- The probe should not come into contact with the nozzle or other objects in the tank
- Position the probe so it is subject to a minimum of lateral force

### NOTE!

Violent fluid movements can cause forces that could break rigid probes.

**Recommended Mounting  
for Solids**



Consider the following guidelines when mounting the transmitter:

- Do not mount near inlet pipes in order to avoid product filling on the probe
- Regularly check the probe for defects
- It is recommended that the vessel be empty during installation
- For concrete vessels, the distance (L) between the probe and the wall should be at least 20 in. (500 mm)
- Stabilize the probe for side forces, by attaching the probe to the tank bottom.  
For solids, use the 0.24 in. (6 mm) probe, because of the higher tensile strength. The probe should have a sag of  $\geq 1$  in./100 in. (1 cm/m) to prevent probe damage. See "Anchoring" on page 3-22 for more information
- Avoid anchoring in solids tanks over 98 ft (30 m) in height since tensile loads are much stronger for anchored probes, see "Considerations for Solid Applications" on page 3-6
- Product build-up on the silo walls near the probe may interfere with measurements. Choose a mounting position where the probe is not in contact with, or close to, the product build-up

# Rosemount 5300 Series

## Insulated Tanks

When the Rosemount 5300 is installed in high temperature applications, consider the maximum ambient temperature. Tank insulation should not exceed 4 in. (10 cm).

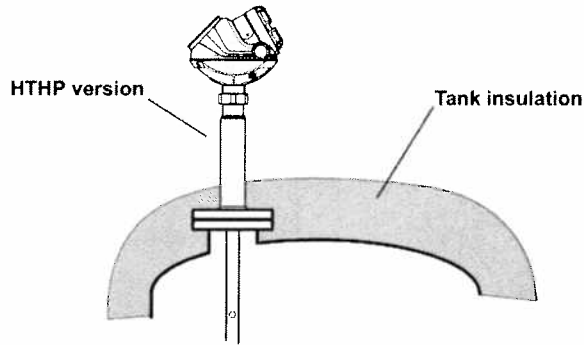
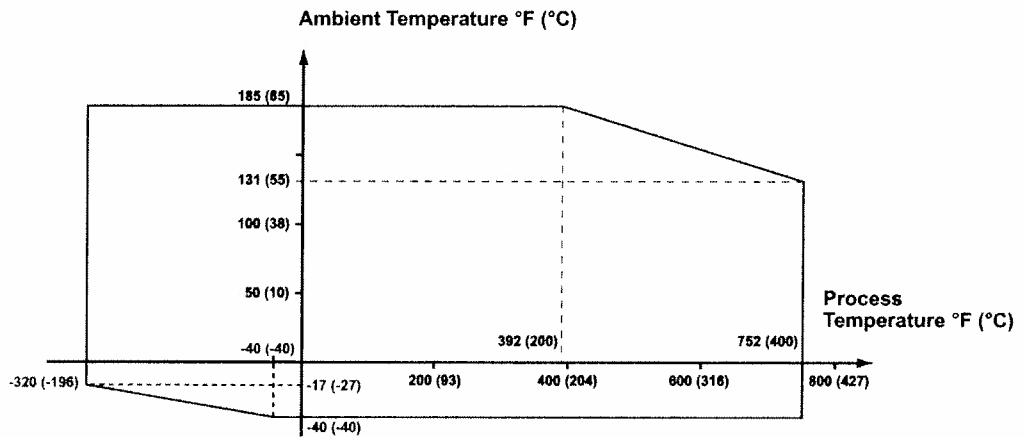


Figure 3-9. Ambient temperature vs. process temperature.



**MOUNTING**

Mount the transmitter with flange on a nozzle on top of the tank. The transmitter can also be mounted on a threaded connection. Make sure only qualified personnel perform the installation.

**NOTE!**

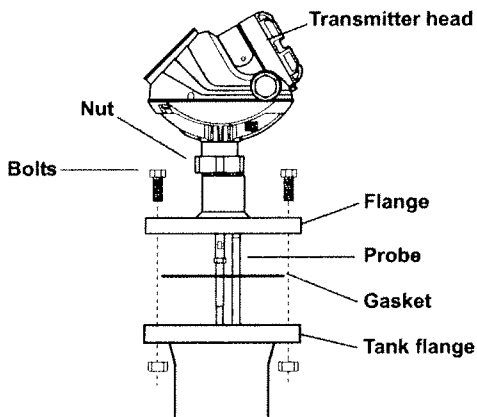
If you need to remove the transmitter head from the probe, make sure that the Process Seal is carefully protected from dust and water. See *“Removing the Transmitter Head”* on page 7-28 for further information.

**NOTE!**

PTFE covered probes must be handled carefully to prevent damage to the coating.

**Flange Connection**

Figure 3-10. Tank connection with flange.

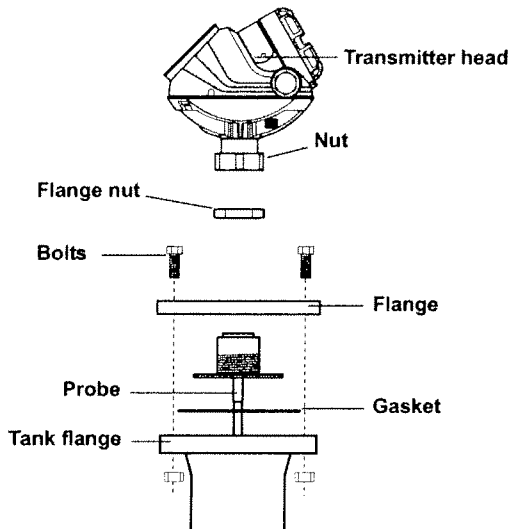


The transmitter is delivered with head, flange, and probe assembled into one unit.

1. Place a gasket on top of the tank flange.
2. Lower the transmitter and probe with flange into the tank.
3. Tighten the bolts.
4. Loosen the nut that connects the transmitter housing to the probe slightly.
5. Rotate the transmitter housing so the cable entries/display face the desired direction.
6. Tighten the nut.

## Rosemount 5300 Series

Figure 3-11. Tank connection with loose flange ("plate design").



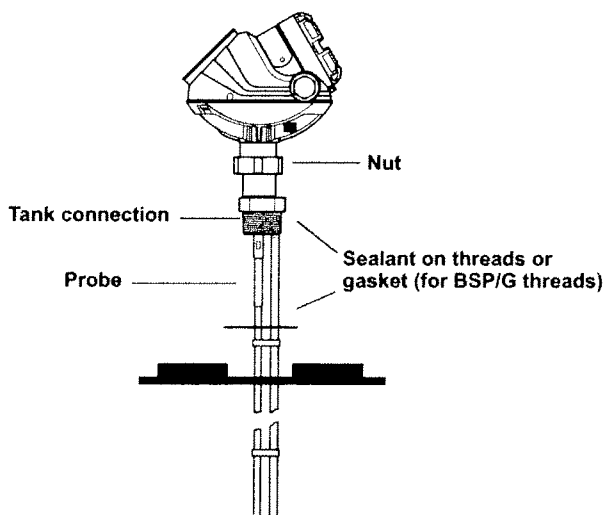
Transmitters delivered with Alloy probes featuring plate design are mounted as described below:

1. Place a gasket on top of the tank flange.
2. Mount<sup>(1)</sup> the flange on the probe and tighten the flange nut.
3. Mount<sup>(1)</sup> the transmitter head.
4. Lower the transmitter and probe with flange into the tank.
5. Tighten the bolts.
6. Loosen the nut that connects the transmitter housing to the probe slightly.
7. Rotate the transmitter housing so the cable entries/display face the desired direction.
8. Tighten the nut.

<sup>(1)</sup> Flange and transmitter head are normally mounted at the factory.

## Threaded Connection

Figure 3-12. Threaded tank connection.



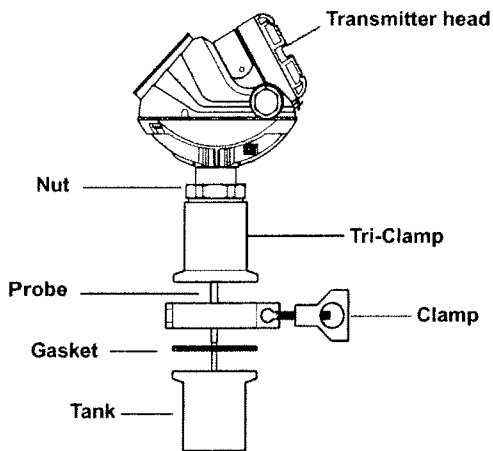
1. For tank connections with BSP/G threads, place a gasket on top of the tank flange, or use a sealant on the threads of the tank connection.
2. Lower the transmitter and probe into the tank.
3. Screw the adapter into the process connection.
4. Loosen the nut that connects the transmitter housing to the probe slightly.
5. Rotate the transmitter housing so the cable entries/display face the desired direction.
6. Tighten the nut.

### NOTE!

For adapters with NPT threads, pressure-tight joints require a sealant.

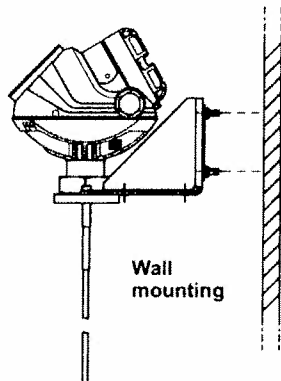
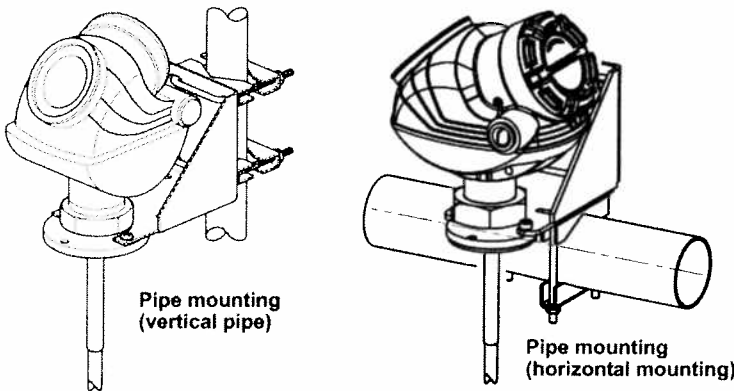
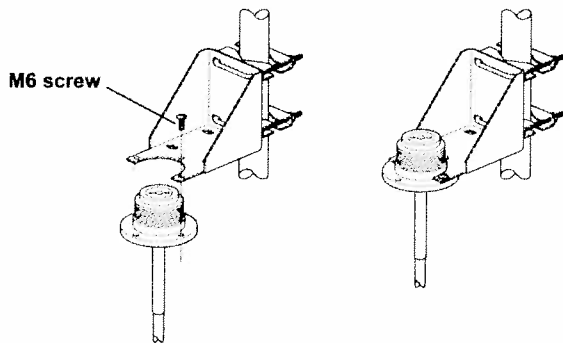
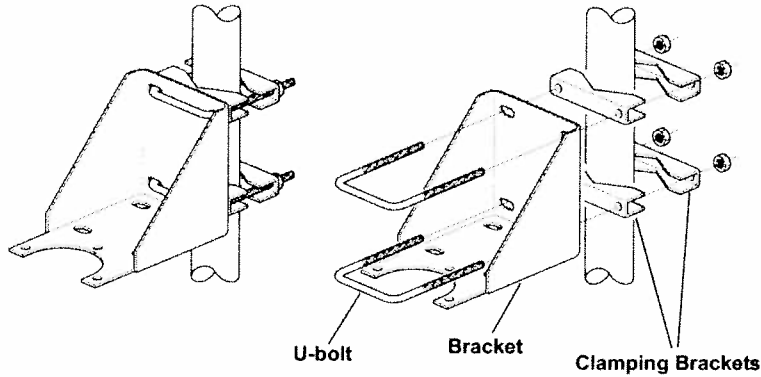
**Tri-Clamp Connection**

Figure 3-13. Tri-Clamp tank connection.



1. Place a gasket on top of the tank flange.
2. Lower the transmitter and probe into the tank.
3. Fasten the Tri-Clamp to the tank with a clamp.
4. Loosen the nut that connects the transmitter housing to the probe slightly.
5. Rotate the transmitter housing so the cable entries/display face the desired direction.
6. Tighten the nut.

## Bracket Mounting



### Mount the bracket to the pole

1. Put the two U-bolts through the holes of the bracket. Several holes are available for vertical/horizontal pipe mounting.
2. Put the clamping brackets on the U-bolts and around the pipe.
3. Use the supplied nuts to fasten the bracket to the pipe.

### Fasten the housing support to the bracket

Fasten the housing support to the bracket using the M6 screws. The screws are threaded through the top of the mounting bracket and into the housing support.

### Connect the transmitter head on the probe

Connect the transmitter head on the probe, making sure that the M50 nut is properly tightened.

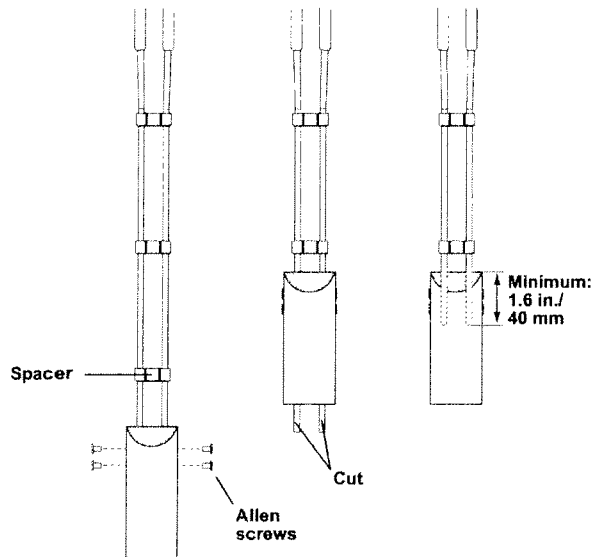


## Shortening the Probe

### NOTE!

HHP Coaxial and PTFE probes must not be shortened.

### Flexible Twin/Single Lead



1. Mark off the required probe length. Add at least 1.6 in. (40 mm) to the required probe length to be inserted into the weight.
2. Loosen the Allen screws.
3. Slide the weight upwards as much as needed in order to cut the probe.
4. Cut the probe. If necessary, remove a spacer to make room for the weight.
5. Slide the weight down to the required cable length.
6. Tighten the screws. Required torque:
  - M6: 7 Nm
  - M8: 15 Nm
  - M10: 25 Nm
7. Update the transmitter configuration to the new probe length, see "Tank and Probe Geometry" on page 5-4 and "Probe" on page 5-21.

If the weight was removed from the cables when cutting, make sure that at least 1.6 in. (40 mm) of the cable is inserted when the weight is replaced.

### NOTE!

If the screws are not tightened according to the required torque, the weight may fall off. This is especially important for solid applications with high tensile loads on the probe.

### Rigid Single Lead

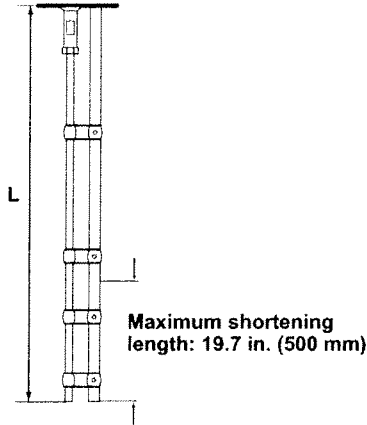
1. Cut the Single Lead probe to the desired length. The minimum probe length is 15.7 in. (400 mm).
2. If a centering disc is used, follow the instructions on page 3-26.
3. Update the transmitter configuration to the new probe length, see "Tank and Probe Geometry" on page 5-4 and "Probe" on page 5-21.

## Rigid Twin Lead

The spacers are put closer together at the probe end. The maximum amount that can be cut is related to the ordering length **L**.

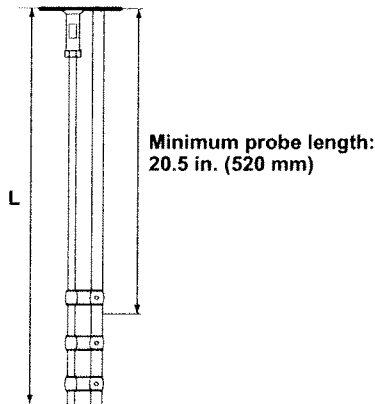
To cut a Rigid Twin Lead probe:

**$L > 46.5$  in. (1180 mm)**



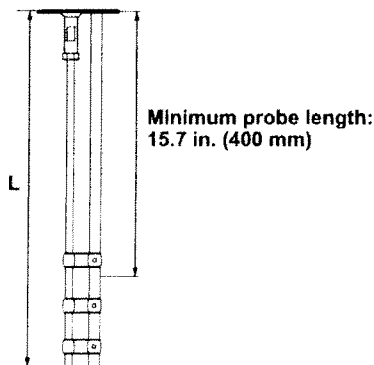
1. Cut the rods to the desired length:
  - You may cut up to 19.7 in. (500 mm) from the probe end for probe length **L** above 46.5 in. (1180 mm)
  - For probe length 20.5 to 46.5 in. (520 to 1180 mm) the minimum length is 20.5 in. (520 mm)
  - For probe length 15.7 to 20.5 in. (400 to 520 mm) the minimum length is 15.7 in. (400 mm)

**$20.5 < L < 46.5$  in.  
(520 mm <  $L$  < 1180 mm)**

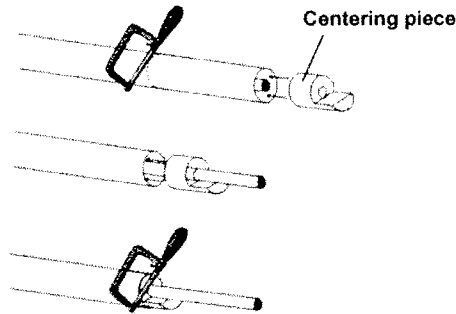


2. Update the transmitter configuration to the new probe length, see "Tank and Probe Geometry" on page 5-4 and "Probe" on page 5-21.

**$15.7 < L < 20.5$  in.  
(400 <  $L$  < 520 mm)**



Coaxial

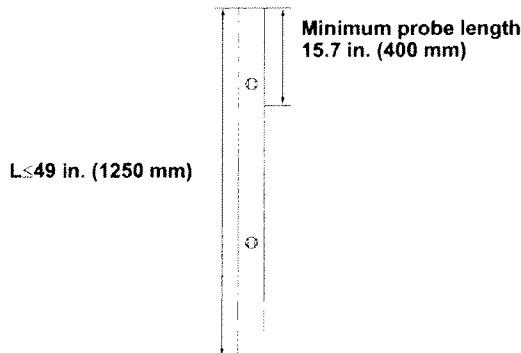
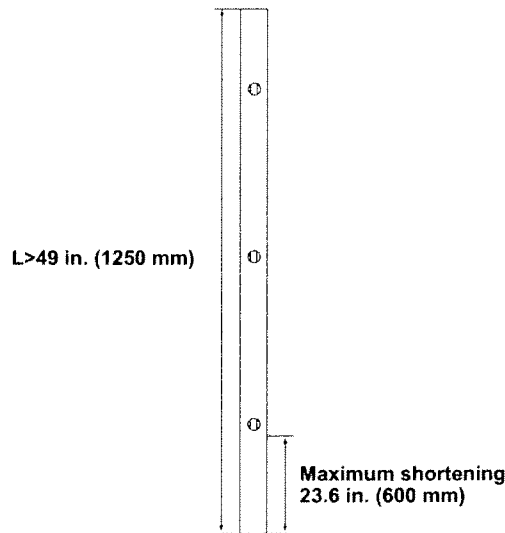


To cut a coaxial probe:

**NOTE!**

The HTHP coaxial probe must not be cut in field.

1. Insert the centering piece.  
(The centering piece is delivered from factory and should be used to prevent the spacers centering the rod from coming loose).
2. Cut the tube to the desired length.
3. Move the centering piece.
4. Cut the rod inside the tube. Make sure that the rod is fixed with the centering piece while cutting.
  - Pipes longer than 49 in. (1250 mm) can be shortened by as much as 23.6 in. (600 mm)
  - Pipes shorter than 49 in. (1250 mm) can be cut as long as the remaining length is not less than 15.7 in. (400 mm)

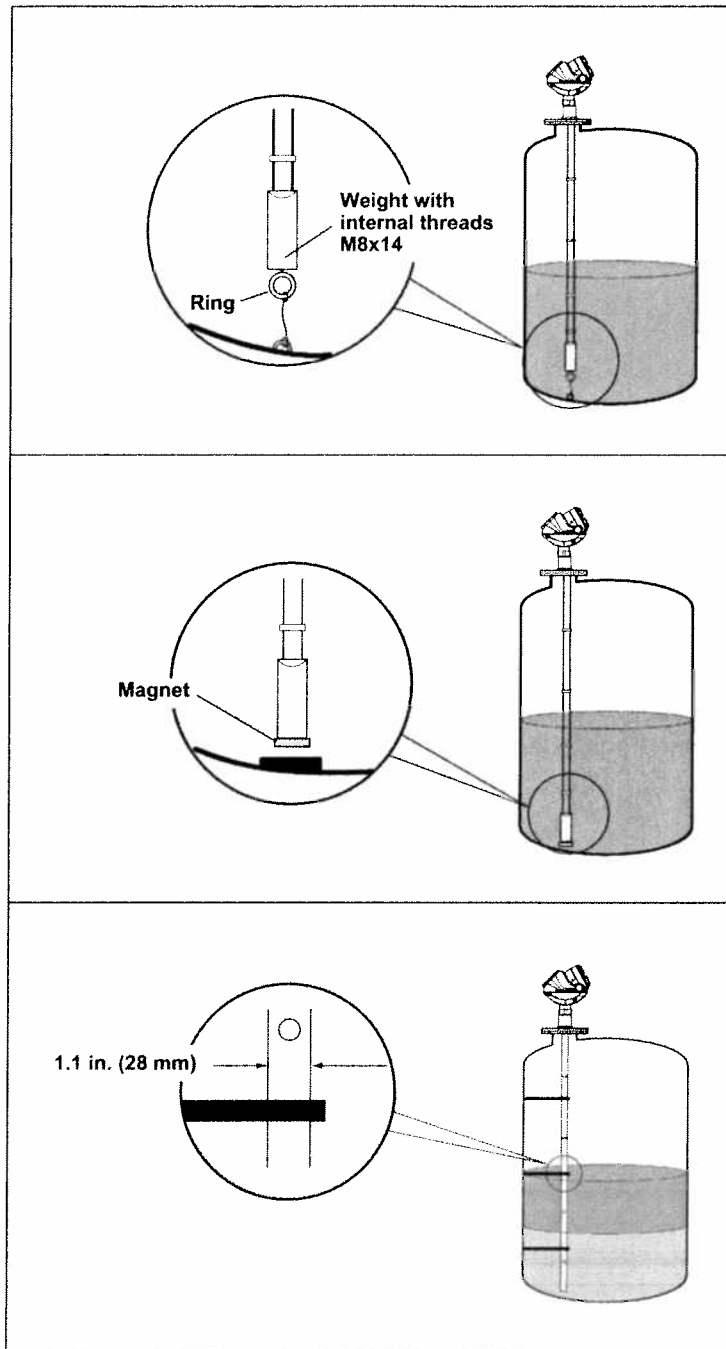


5. Update the transmitter configuration to the new probe length, see "Tank and Probe Geometry" on page 5-4 and "Probe" on page 5-21.

# Rosemount 5300 Series

## Anchoring

In turbulent tanks, it may be necessary to fix the probe. Depending on the probe type, different methods can be used to guide the probe to the tank bottom. This may be needed to prevent the probe from hitting the tank wall or other objects in the tank, as well as preventing a probe from breaking.



**Flexible Twin/Single Lead** probe with weight and ring.

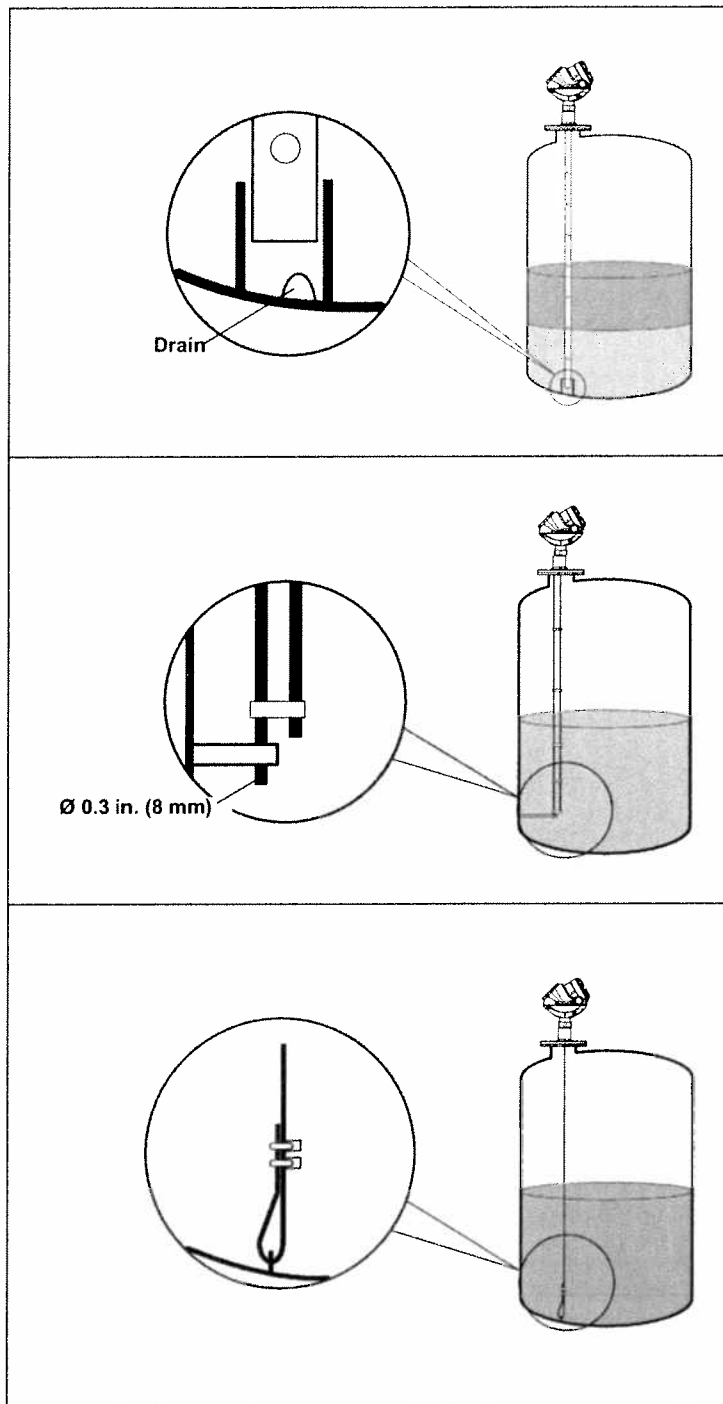
A ring (customer supplied) can be attached to the weight in a threaded (M8x14) hole at the end of the weight. Attach the ring to a suitable anchoring point.

**Flexible Twin/Single Lead** probe with weight and magnet.

A magnet (customer supplied) can be fastened in a threaded (M8x14) hole at the end of the weight. The probe can then be guided by placing a suitable metal plate beneath the magnet.

**Coaxial** probe fixed to the tank wall.

The coaxial probe can be guided to the tank wall by fixtures fastened to the tank wall. Fixtures are customer supplied. Make sure the probe can move freely due to thermal expansion without getting stuck in the fixture.



**Coaxial probe.**

The Coaxial probe can be guided by a tube welded on the tank bottom. Tubes are customer supplied. Make sure that the probe can move freely in order to handle thermal expansion.

**Rigid Twin Lead probe.**

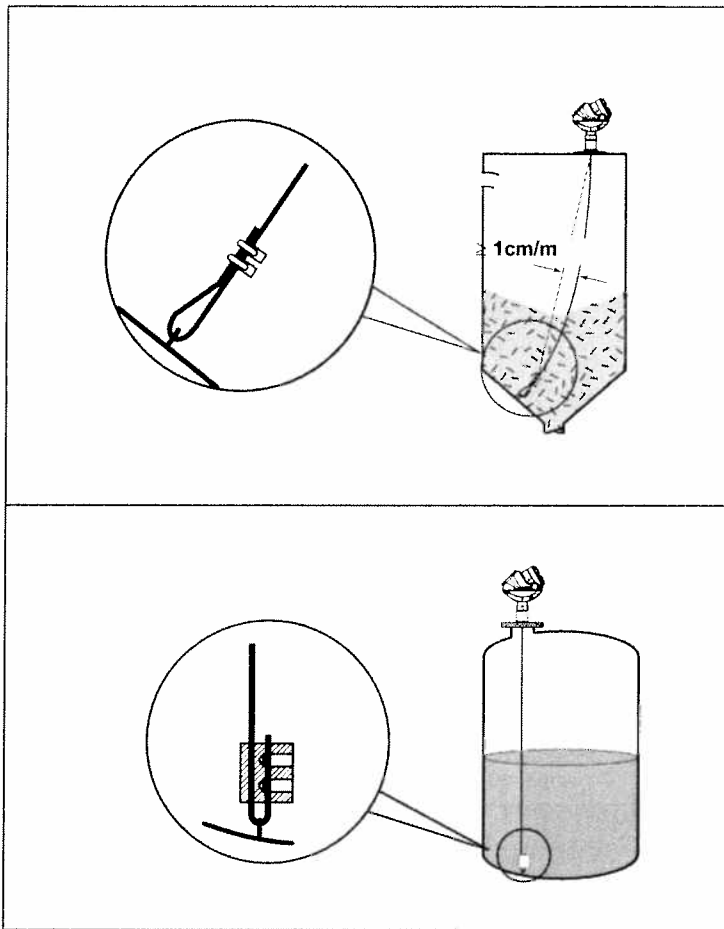
The Rigid Twin Lead probe can be secured to the tank wall by cutting the center rod and putting a fixture at the end of the outer rod.

The fixture is customer supplied. Make sure the probe is only guided and not fastened in the fixture to be able to move freely for thermal expansion.

**Flexible Single Lead probe.**

The probe rope itself can be used for anchoring. Pull the probe rope through a suitable anchoring point, e.g. a welded eye and fasten it with two clamps.

The length of the loop will add to the transition zone. The location of the clamps will determine the beginning of the transition zone. The probe length should be configured as the length from the underside of the flange to the top clamp. See section "Transition Zones" on page 2-10 for further information on Transition Zones.



### Solid Applications

Pull the probe rope through a suitable anchoring point, e.g. a welded eye and fasten it with two clamps. It is recommended that the probe is slack in order to prevent high tensile loads.

The sag should be at least 1.5 in./10 ft (1 cm/m) of the probe length.

### Alternative chuck for Flexible Single Lead probes

Loosen the screws. Pull the probe rope through a suitable anchoring point, e.g. a welded eye.

Tighten the screws. The required torque and hex key dimensions:  
4 mm wire: 15 Nm, 4 mm  
6 mm wire: 25 Nm, 5 mm

### Mounting a Centering Disc for Pipe Installations

To prevent the probe from contacting the bridle wall when replacing displacers or installing in pipes, centering discs are available for rigid single, flexible single, and flexible twin lead probes. The disc is attached to the end of the probe and thus keeps the probe centered in the bridle. The discs are made of stainless steel, Alloy C-276, or PTFE.

When mounting a centering disc, it is important that it fits correctly in the pipe. See Table 3-7 for the appropriate disc diameters.

Table 3-7. Choose the right centering disc diameter for a particular Pipe Schedule.

Pipe Size	Pipe Schedule					
	5s,5	10s,10	40s,40	80s,80	120	160
2 in.	2 in.	2 in.	2 in.	2 in.	NA <sup>(1)</sup>	NA <sup>(2)</sup>
3 in.	3 in.	3 in.	3 in.	3 in.	NA <sup>(1)</sup>	2 in.
4 in.	4 in.	4 in.	4 in.	4 in.	4 in.	3 in.
5 in.	4 in.	4 in.	4 in.	4 in.	4 in.	4 in.
6 in.	6 in.	6 in.	6 in.	6 in.	4 in.	4 in.
7 in.	NA <sup>(1)</sup>	NA <sup>(1)</sup>	6 in.	6 in.	NA <sup>(1)</sup>	NA <sup>(1)</sup>
8 in.	8 in.	8 in.	8 in.	8 in.	6 in.	6 in.

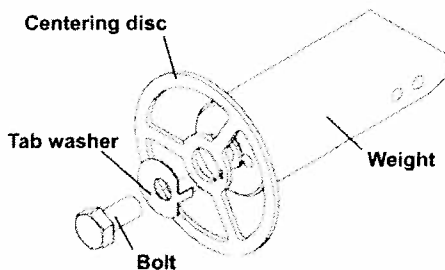
(1) Schedule is not available for pipe size.  
(2) No centering disc is available.

This table shows the actual outer diameter for discs.

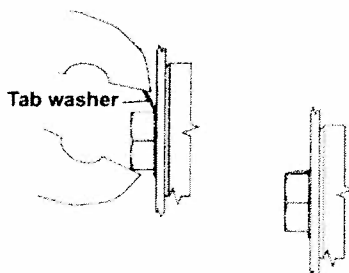
Table 3-8. Outer diameter for discs according to disc size.

Disc Size	Actual Disc Diameter
2 in.	1.8 in. (45 mm)
3 in.	2.7 in. (68 mm)
4 in.	3.6 in. (92 mm)
6 in.	5.55 in. (141 mm)
8 in.	7.4 in. (188 mm)

### Mounting a Centering Disc on Flexible Single Probes



1. Mount the centering disc at the end of the weight.
2. Make sure that the tab washer is properly inserted in the centering disc.
3. Fasten the centering disc with the bolt.



4. Secure the bolt by folding the tab washer.

**NOTE!**

When using centering discs made of PTFE, note that the maximum temperature is 392 °F (200 °C).

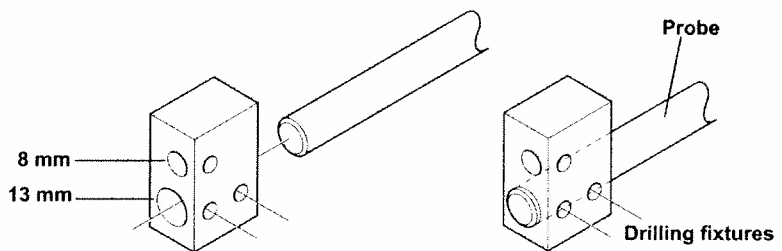
### Mounting a Centering Disc on Rigid Single Probes

The mounting of a centering disc on a rigid single lead probe requires one hole (8 mm probe) or two holes (13 mm probe) at certain distances from the end of the lead. The drilling fixture included in your shipment should be used to make the hole(s) according to Figure 3-14.

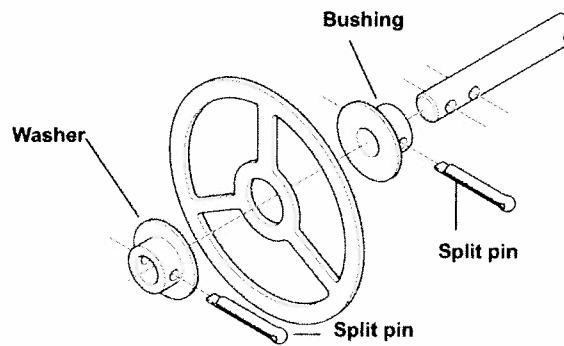
Table 3-9. Hole requirements on probes for mounting a centering disc.

Probe	Minimum distance to hole from probe end	Number of holes	Hole diameter
8 mm	5 mm	1	3.5 mm
13 mm	7 mm (first hole)	2	3.5 mm

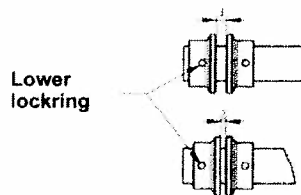
Figure 3-14. Use drill template for proper holes.



### Rigid Single Lead probe (13 mm)

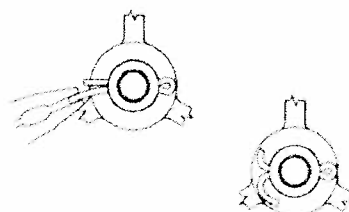


1. Mount the centering disc at the end of the probe.
2. Fasten the disc by inserting the split pins through the bushings and the probe.



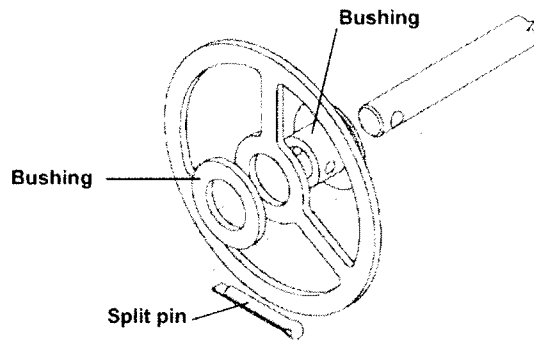
3. Adjust distance by shifting hole for split pin in lower locking.

4. Secure the split pin.

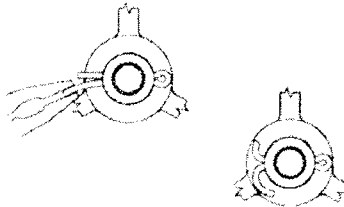




**Rigid Single Lead probe (8 mm)**



1. Mount the centering disc at the end of the probe.
2. Fasten the disc by inserting the split pin through the bushing and the probe.



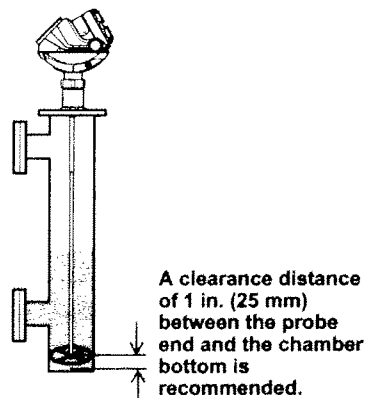
3. Secure the split pin.

**NOTE!**

The washer should not be used if the disc material is C-276.

**NOTE!**

Centering discs may not be used with PTFE covered probes.



To avoid bending the probe (rigid probes), or twisting and coming into contact with the chamber wall (flexible probes), a small clearance distance between centering disc and chamber bottom is recommended. The clearance distance of 1 in. (25 mm) is selected with a dome shaped chamber bottom in mind, which may prevent the centering disc from reaching the bottom.

# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

## Section 4 Electrical Installation

Safety messages . . . . .	page 4-1
Cable/conduit entries . . . . .	page 4-3
Grounding . . . . .	page 4-3
Cable Selection . . . . .	page 4-3
Hazardous Areas . . . . .	page 4-3
HART . . . . .	page 4-4
FOUNDATION Fieldbus . . . . .	page 4-8
Optional Devices . . . . .	page 4-13

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

**⚠ WARNING**

**Explosions could result in death or serious injury:**

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

**⚠ WARNING**

**Failure to follow safe installation and servicing guidelines could result in death or serious injury:**

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

**Process leaks could result in death or serious injury.**

Make sure that the transmitter is handled carefully. If the Process Seal is damaged, gas might escape from the tank if the transmitter head is removed from the probe.

**⚠ WARNING**

**High voltage that may be present on leads could cause electrical shock:**

Avoid contact with leads and terminals.

Make sure the main power to the Rosemount 5300 transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

## CABLE/CONDUIT ENTRIES

The electronics housing has two entries for ½ - 14 NPT. Optional M20×1.5, minifast and eurofast adapters are also available. The connections are made in accordance with local or plant electrical codes.

Make sure that unused ports are properly sealed to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.


---

### NOTE!

Use the enclosed metal plug to seal the unused port. The orange plastic plugs mounted at delivery are not sufficient as seal!

---

## GROUNDING

The housing should always be grounded in accordance with national and local electrical codes. Failure to do so may impair the protection provided by the equipment. The most effective grounding method is direct connection to earth ground with minimal impedance. There are two grounding screw connections provided. One is inside the Field Terminal side of the housing and the other is located on the housing. The internal ground screw is identified by a ground symbol: .

---

### NOTE!

Grounding the transmitter via threaded conduit connection may not provide sufficient ground.

---

---

### NOTE!

In the Explosion-proof/Flameproof version, the electronics is grounded via the transmitter housing. After installation and commissioning make sure that no ground currents exist due to high ground potential differences in the installation.

---

## CABLE SELECTION

Use shielded twisted pair wiring for the Rosemount 5300 Series to comply with EMC regulations. The cables must be suitable for the supply voltage and approved for use in hazardous areas, where applicable. For instance, in the U.S., explosion-proof conduits must be used in the vicinity of the vessel. For the ATEX flameproof and the IECEx approval versions of the Rosemount 5300 Series, suitable conduits with sealing device or flameproof (EEx d) cable glands must be used depending on local requirements.

Use 18 AWG to 12 AWG to minimize the voltage drop to the transmitter.

## HAZARDOUS AREAS

When the Rosemount 5300 transmitter is installed in a hazardous area, local regulations and specifications in applicable certificates must be observed.

## HART

### Power Requirements

Terminals in the transmitter housing provide connections for signal cables. The Rosemount 5300 transmitter is loop-powered and operates with the following power supplies:

Hazardous approval	Current	
	3.75 mA	21.75 mA
	Minimum input voltage ( $U_i$ )	
Non-Hazardous installations and Intrinsically Safe Installations	16 Vdc	11 Vdc
Explosion-proof / Flameproof Installations	20 Vdc	15.5 Vdc

The input voltage for HART is 16-42.4 Vdc (16-30 Vdc in IS applications, and 20-42.4 Vdc in Explosion-proof / Flameproof applications).

### Maximum Loop Resistance

Figure 4-1. Explosion-proof /Flameproof installations.

The maximum current loop resistance (see Figure 4-5 and Figure 4-6) is given by the following diagrams:

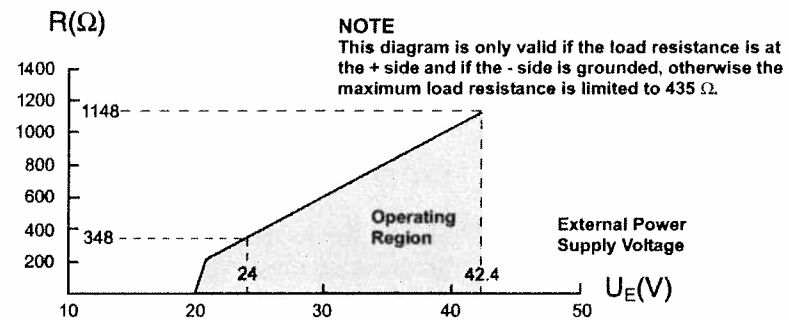


Figure 4-2. Non-hazardous installations.

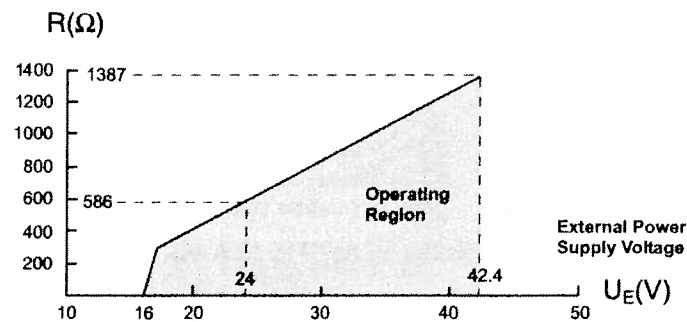
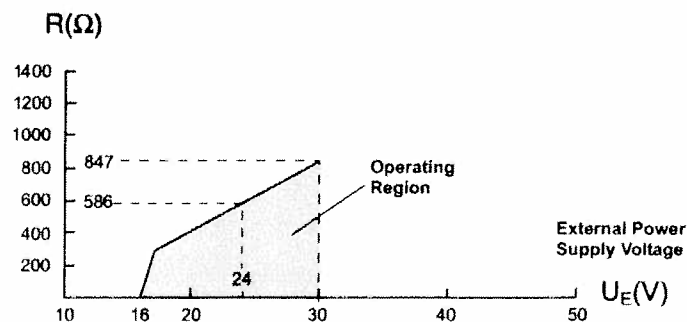


Figure 4-3. Intrinsically Safe installations.



## Connecting the Transmitter

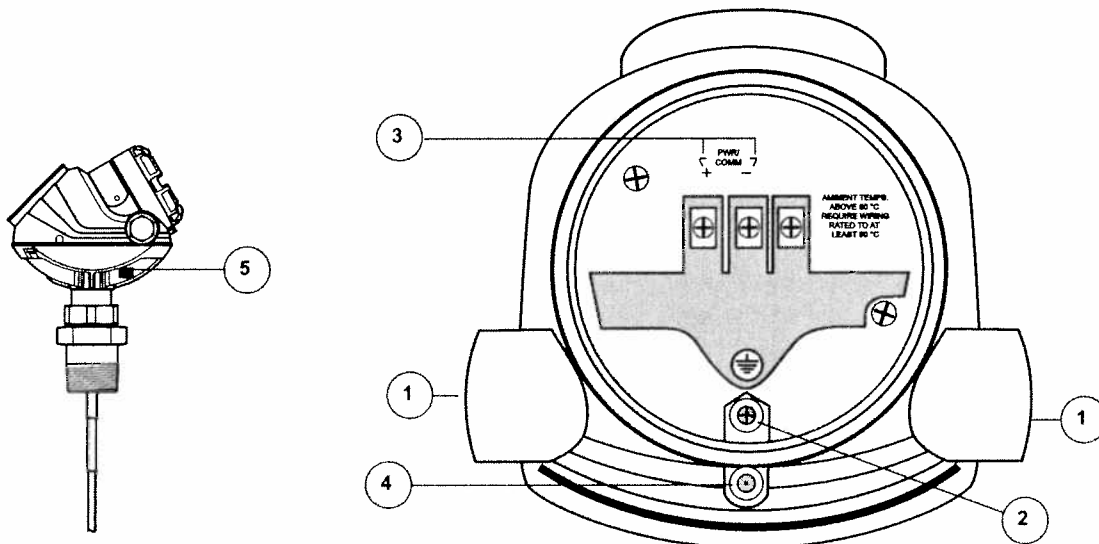
To connect the Rosemount 5300 Series transmitter:

1. Make sure the power supply is switched off.
2. Remove the terminal block cover.
3. Pull the cable through the cable gland/conduit. Install wiring with a drip loop. The bottom of the loop must be lower than the cable/conduit entry.
4. Connect wires according to Figure 4-5 for non-intrinsically safe power supplies and according to Figure 4-6 for intrinsically safe power supplies.
5. Use the enclosed metal plug to seal any unused port.
- ⚠ 6. Mount the cover and tighten the cable gland making sure the cover is secure to meet explosion-proof requirements.
7. For ATEX, IECEx and NEPSI installations, lock the cover with the Locking Screw ④.
8. Connect the power supply.

### NOTE!

Use PTFE tape or other sealant at the NPT threads in the Cable Entries.

Figure 4-4. Terminal compartment and external ground screw.



- ① Cable entries.
- ② Internal Ground screw.
- ③ Terminals for signal and power supply.
- ④ Locking screw.
- ⑤ External Ground screw

# Rosemount 5300 Series

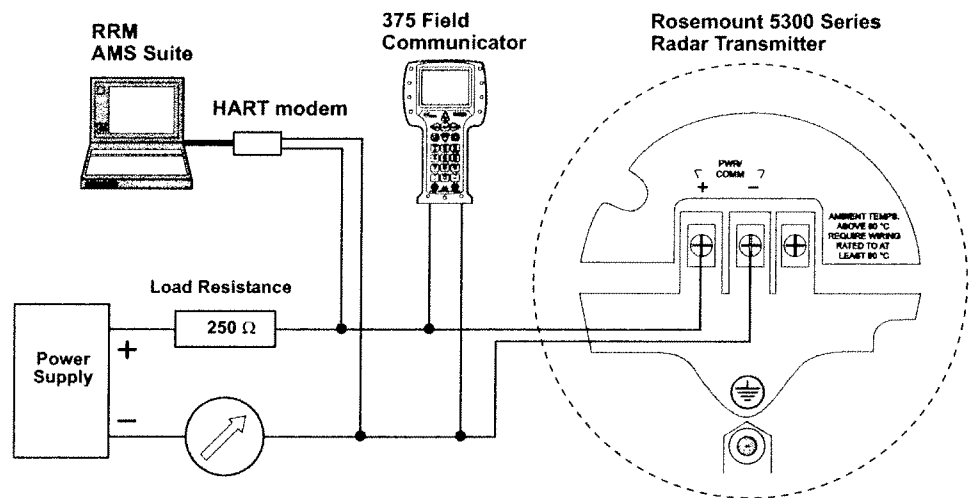
## Non-Intrinsically Safe Output

With non-intrinsically safe power supply in non-hazardous installations or Explosion-proof/Flameproof installations, wire the transmitter as shown in Figure 4-5.

### NOTE!

Make sure that the power supply is off when connecting the transmitter.

Figure 4-5. Wiring diagram for non-intrinsically safe installations (HART).



For HART communication a minimum load resistance of 250 Ω within the loop is required. For maximum load resistance. See Figure 4-1 (Explosion/Flameproof) and Figure 4-2 (Non-hazardous installations).

For Explosion-proof/Flameproof applications the resistance between the negative terminal on the transmitter and the power supply must not exceed 435 Ohm.

### NOTE!

For Explosion-proof/Flameproof installations, make sure the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.



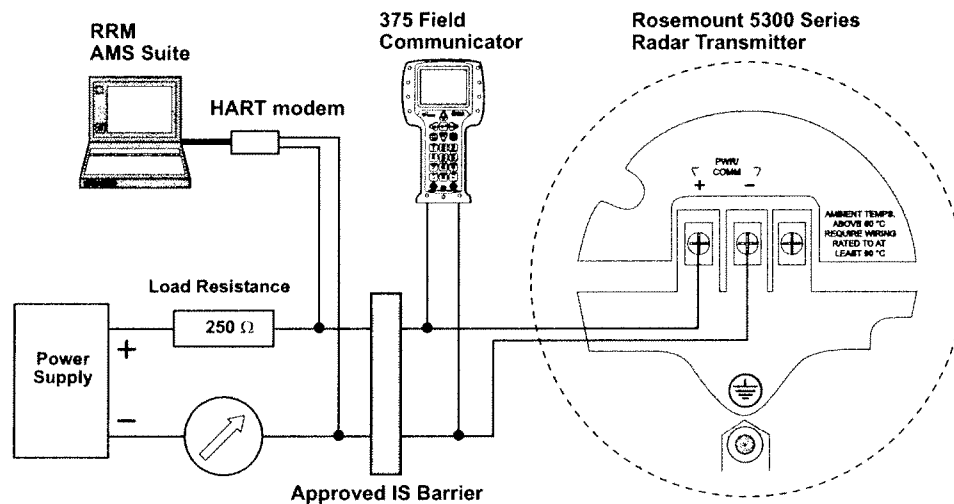
**Intrinsically Safe Output**

For intrinsically safe installations wire the transmitter as shown in Figure 4-6.

**NOTE!**

Make sure the instruments in the loop are installed in accordance with intrinsically safe field wiring practices and System Control Drawings when applicable.

Figure 4-6. Wiring diagram for intrinsically safe installations (HART).



For HART communication, a minimum load resistance of 250  $\Omega$  within the loop is required. For maximum load resistance see Figure 4-3.

The power supply voltage ranges from 16 Vdc to 30 Vdc.

**IS parameters<sup>(1)</sup>**

$U_i=30$  V.

$I_i=130$  mA.

$P_i=1$  W.

$C_i=7.26$  nF.

$L_i=0$ .

(1) See Section B: Product Certifications for more information.

# Rosemount 5300 Series

## FOUNDATION FIELDBUS




### Power Requirements

Terminals in the transmitter housing provide connections for signal cables. The Rosemount 5300 transmitter is powered over FOUNDATION Fieldbus with standard fieldbus power supplies. The transmitter operates with the following power supplies:

Approval Type	Power Supply (Vdc)
IS	9 - 30
Explosion-Proof/Flameproof	16 - 32
None	9 - 32
FISCO; IS	9 - 17.5

### Connecting the Transmitter

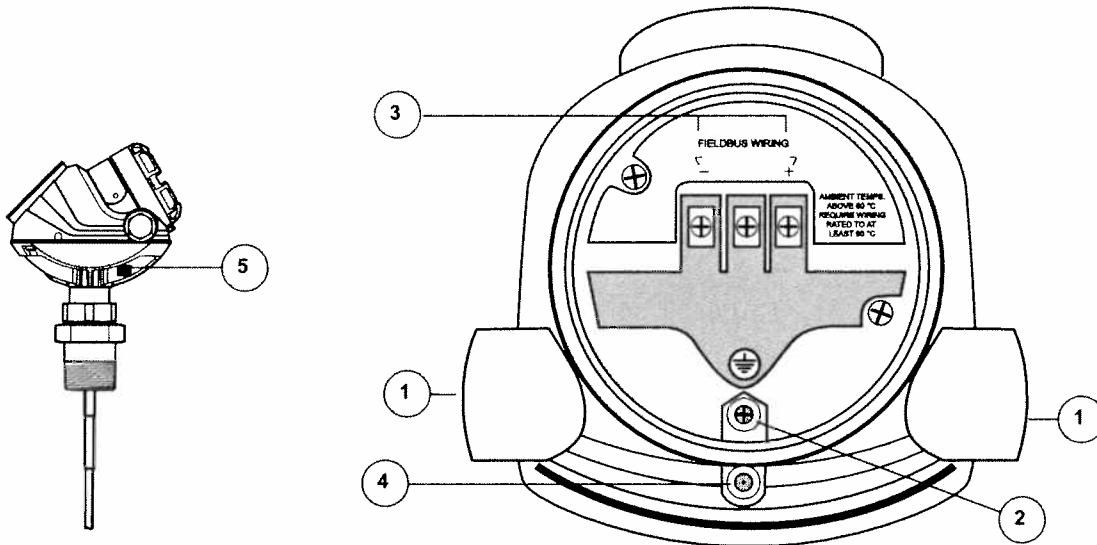
To connect the transmitter:

1. Make sure the power supply is switched off.
-  2. Remove the terminal block cover.
3. Pull the cable through the cable gland/conduit. Install wiring with a drip loop. The bottom of the loop must be lower than the cable/conduit entry.
4. Connect wires according to Figure 4-9 for non-intrinsically safe power supplies, and according to Figure 4-10 for intrinsically safe power supplies.
5. Use the enclosed metal plug to seal any unused port.
-  6. Mount the cover and tighten the cable gland making sure the cover is secure to meet explosion-proof requirements.
7. For ATEX, IECEx and NEPSI installations, lock the cover with the Locking Screw .
8. Connect the power supply.

#### NOTE!

Use PTFE tape or other sealant at the NPT threads in the Cable Entries.

Figure 4-7. Terminal compartment and external ground screw.



- ① Cable entries.
- ② Internal Ground screw.
- ③ Terminals for signal and power supply.
- ④ Locking screw.
- ⑤ External Ground screw

#### Grounding - Foundation Fieldbus

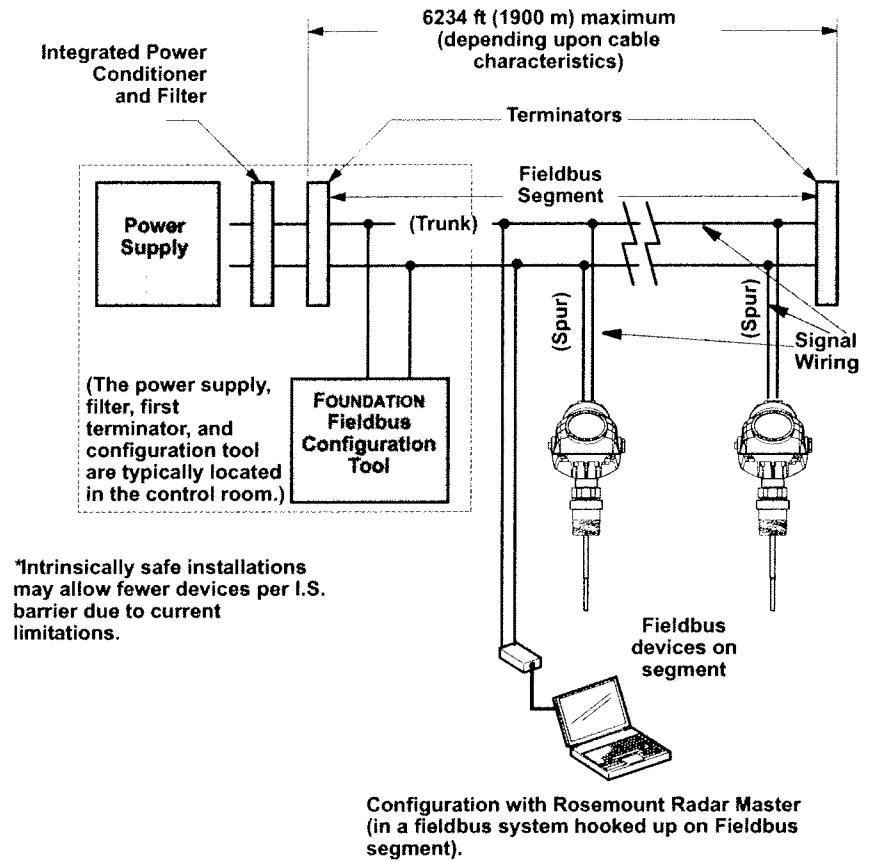
Signal wiring of the fieldbus segment cannot be grounded. Grounding out one of the signal wires will shut down the entire fieldbus segment.

#### Shield Wire Ground

To protect the fieldbus segment from noise, grounding techniques for shield wire usually require a single grounding point for shield wire to avoid creating a ground loop. The ground point is typically at the power supply.

## Connecting Fieldbus Devices

Figure 4-8. Rosemount 5300 Radar Transmitter field wiring.



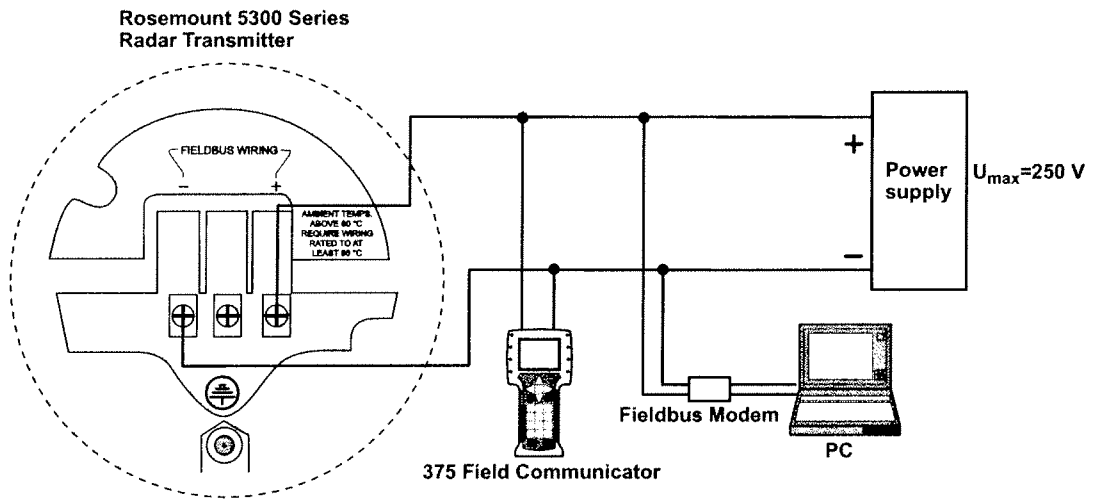
**Non-Intrinsically Safe Output**

With non-intrinsically safe power supply in Non-hazardous installations or Explosion-proof/Flameproof installations, wire the transmitter as shown in Figure 4-9.

**NOTE!**

Make sure that the power supply is off when connecting the transmitter.

Figure 4-9. Wiring for non-intrinsically safe power supply (Foundation Fieldbus).



**NOTE!**

For Explosion Proof/Flameproof installations, make sure the transmitter is grounded to the internal ground terminal inside the terminal compartment in accordance with national and local electrical codes.

# Rosemount 5300 Series

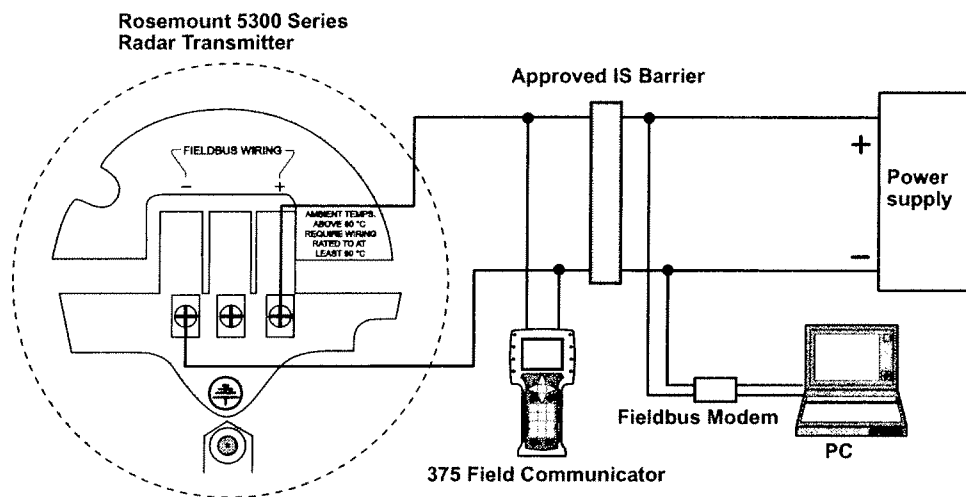
## Intrinsically Safe Output

When your power supply is intrinsically safe, wire the transmitter as shown in Figure 4-10.

### NOTE!

Make sure the instruments in the loop are installed in accordance with intrinsically safe field wiring practices.

Figure 4-10. Wiring diagram for intrinsically safe power supply (Foundation Fieldbus).



### IS parameters<sup>(1)</sup>

$U_i=30$  V.

$I_i=300$  mA.

$P_i=1.5$  W (ATEX), 1.3 W (FM)

$C_i=7.26$  nF.

$L_i=0$ .

### FISCO IS parameters

$U_i=17.5$  V.

$I_i=380$  mA.

$P_i=5.32$  W.

$C_i=0$ .

$L_i=0$ .

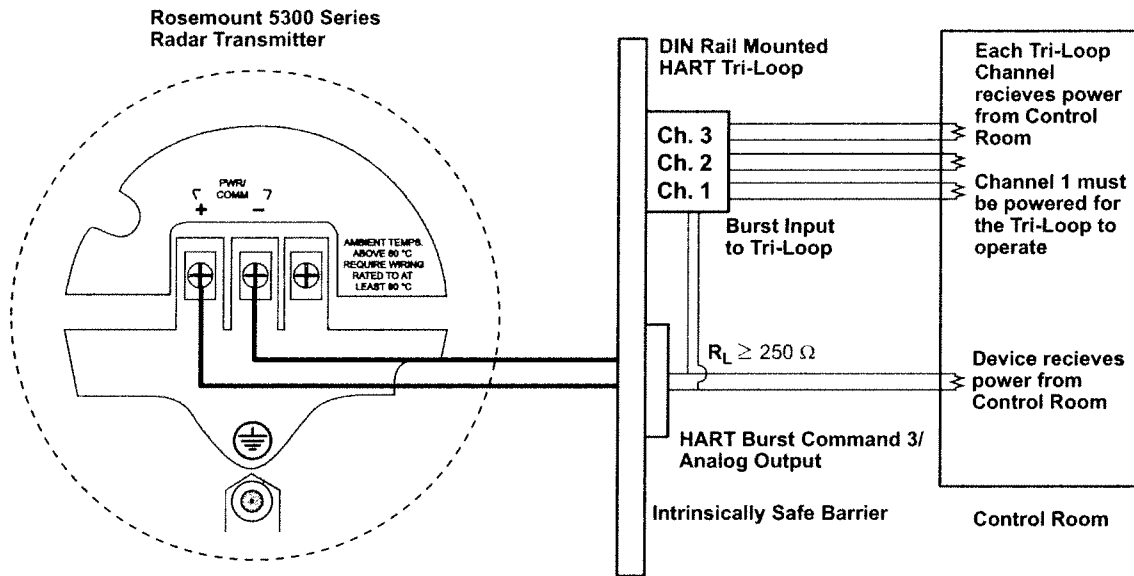
(1) See Section B: Product Certifications for more information.

OPTIONAL DEVICES

Tri-Loop HART to analog converter

The Rosemount 5300 transmitter outputs a HART signal with four process variables. By using the Model 333 HART Tri-Loop, up to three additional analog 4-20 mA outputs are provided.

Figure 4-11. Wiring diagram for HART Tri-Loop.

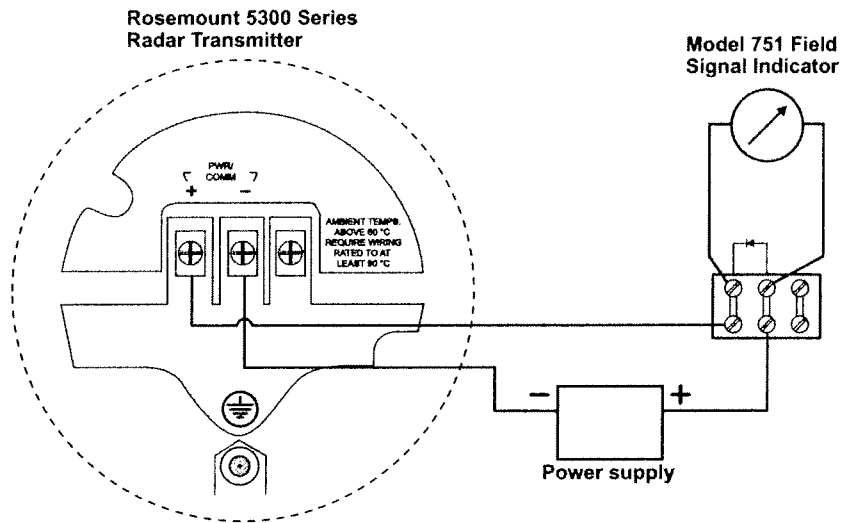


Configure Channels 1, 2, and 3 to reflect the units as well as Upper Range Values and Lower Range Values for your secondary, tertiary and fourth variables (variable assignment is configured in the Rosemount 5300). It is also possible to enable or disable a channel from this menu. See "Tri-Loop HART to Analog Converter" on page 5-45 for further information on how to install a Tri-Loop.

# Rosemount 5300 Series

## 751 Field Signal Indicator

Figure 4-12. Wiring diagram for a Rosemount 5300 transmitter with 751 Field Signal Indicator.





## Section 5 Configuration

Safety messages .....	page 5-1
Overview .....	page 5-2
Basic Configuration Parameters .....	page 5-4
Basic Configuration Using a 375 Field Communicator ..	page 5-11
Basic Configuration Using Rosemount Radar Master ..	page 5-13
Basic Configuration Using AMS Suite (HART) .....	page 5-30
Basic Configuration Using DeltaV .....	page 5-31
FOUNDATION Fieldbus Overview .....	page 5-36
Configure the AI Block .....	page 5-39
Tri-Loop HART to Analog Converter .....	page 5-45
HART Multi-drop Configuration .....	page 5-47

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

#### ⚠ WARNING

**Explosions could result in death or serious injury:**

Verify that the operating environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

#### ⚠ WARNING

**Failure to follow safe installation and servicing guidelines could result in death or serious injury:**

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

# Rosemount 5300 Series

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## OVERVIEW

The configuration of a Rosemount 5300 transmitter is normally a simple and straight-forward task. The complete configuration of a Rosemount 5300 transmitter includes Basic Configuration, Echo Tuning and Advanced Configuration. This section describes Basic Configuration.

If the transmitter is pre-configured at the factory according to the ordering specifications in the Configuration Data Sheet, no further Basic Configuration is required unless tank conditions have changed. The Rosemount 5300 Series supports a set of advanced configuration options as well, which can be used to handle special tank conditions and applications.

## Basic Configuration

The Basic Configuration includes parameters for a standard configuration which is sufficient in most cases. The Basic Configuration comprises the following items:

- Measurement Units
- Tank Configuration
  - Tank Geometry
  - Environment
  - Volume
- Analog Output

## Echo Tuning

Amplitude thresholds can be adjusted in order to handle special situations when, for example, objects in the tank cause disturbing echoes that are stronger than the surface echo. A useful function is the so called *Amplitude Threshold Curve (ATC)* which lets you filter out single disturbing echoes. See *Section 7: Service and Troubleshooting*, and *Appendix C: Advanced Configuration* for more information.

## LCD Configuration

It is possible to specify the variables to be presented on the Display Panel. See also *Section 6: Operation*.

## Advanced Configuration

For some applications, further device specific configuration is needed in addition to the Basic Configuration. This may be due to product properties or tank shape. See *Appendix C: Advanced Configuration* for more information.

## Configuration Tools

There are several tools available for the configuration of a Rosemount 5300 transmitter:

- Rosemount Radar Master (RRM). Note that RRM is recommended for advanced configuration features.  
See "Basic Configuration Using Rosemount Radar Master" on page 5-13 for information on how to use RRM for configuration of the 5300 Series
- Rosemount 375 Field Communicator.  
See "Basic Configuration Using a 375 Field Communicator" on page 5-11 for the Field Communicator Menu Tree
- AMS Suite software (for HART). See "Basic Configuration Using AMS Suite (HART)" on page 5-30
- DeltaV (only for Foundation Fieldbus). See "Basic Configuration Using DeltaV" on page 5-31
- Other tools that support Electronic Device Description Language (EDDL) functionality

RRM is a user-friendly, Windows® based software package including waveform plots, off-line/on-line configuration Wizard, logging, and extensive on-line help.

To communicate with the transmitter using RRM, a HART modem (part number 03300-7004-0001 or 03300-7004-0002) or a FOUNDATION Fieldbus modem (part number 03095-5108-0001 for PCMCIA) is required. For FOUNDATION Fieldbus communication you will also need the *National Instruments Communication Manager* software (see "Installing the RRM Software for FOUNDATION Fieldbus" on page 5-16).

# Rosemount 5300 Series

## BASIC CONFIGURATION PARAMETERS

This section describes basic configuration parameters for a Rosemount 5300 transmitter. Basic configuration is only needed for the 5300 Series transmitters which are not pre-configured at the factory. Factory configuration is normally specified in the Configuration Data Sheet.

## Measurement Units

Measurement units can be specified for presentation of Level/Interface Level, Level Rate, Volume, and Temperature values.

## Tank and Probe Geometry

The basic transmitter configuration includes setting the tank geometry parameters.

Figure 5-1. Tank Geometry

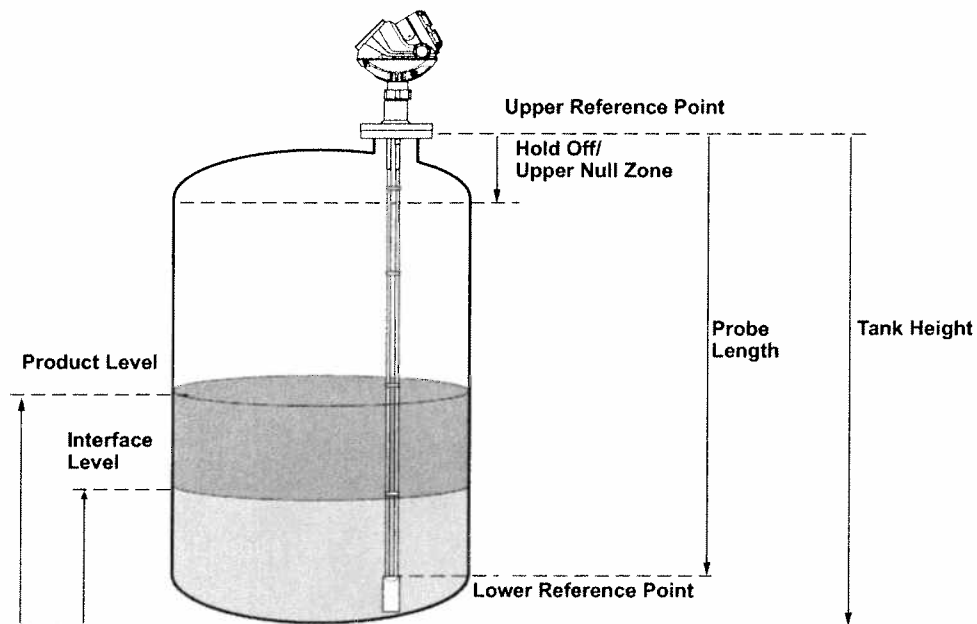
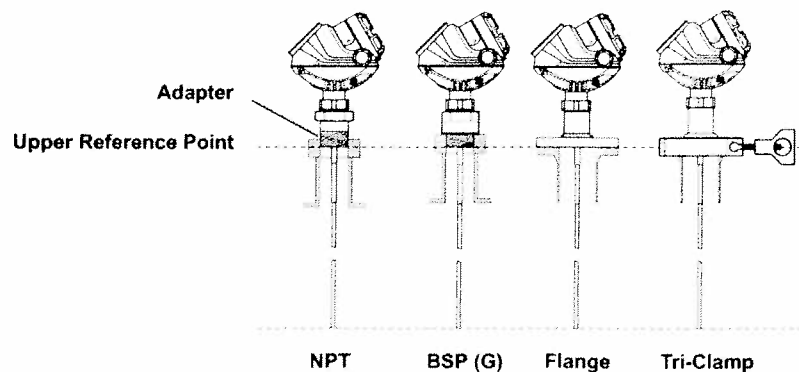


Figure 5-2. Upper Reference Point

For the different tank connections the Upper Reference Point is located at the underside of the threaded adapter or at the underside of the welded flange, as illustrated in Figure 5-2:



## **Tank Height**

The Tank Height is defined as the distance from the Upper Reference Point to the Lower Reference Point. The transmitter measures the distance to the product surface and subtracts this value from the Tank Height to determine the product level. The Lower Reference Point can be set to any position in the tank simply by adjusting the Tank Height.

## **Mounting Type**

Enter the type of mounting for the device. This configuration optimizes the device for the respective mounting type.

- Unknown – default factory setting for mounting type, and can also be used if the mounting type is unknown
- Pipe/Chamber – select this option if the device is mounted on a chamber/bride or in a pipe. When selecting this alternative enter the corresponding Inner Diameter as well
- Nozzle – select this if the device is installed on a nozzle. When selecting this alternative, configure the Inner Diameter and the Nozzle Height as well
- Direct/Bracket – when the device is mounted directly on the tank roof with no traditional nozzle, this is the alternative to use. With this selection no inner diameter or height is required, thus those selections are disabled

## **Inner Diameter**

Using with pipe, chamber - and nozzle installations.

## **Nozzle Height**

For nozzle installations.

## **Probe Length**

The probe length is the distance between the Upper Reference Point and the end of the probe. If a weight is used at the end of the probe, it should not be included.

For Flexible Single Lead probes anchored with clamps, the probe length should be configured as the distance between the underside of the flange and the upper clamp (see "Anchoring" on page 3-22).

This parameter is pre-configured at the factory. It must be changed if the probe is shortened.

## **Probe Type**

The transmitter is designed to optimize measurement performance for each probe type.

This parameter is pre-configured at the factory. This value needs to be changed if the probe type is changed.

### Hold Off/Upper Null Zone

This parameter should only be changed if there are measurement problems in the upper part of the tank. Such problems may occur if there are disturbing objects, such as a narrow nozzle with rough walls, close to the probe. By adjusting the Hold Off/Upper Null Zone, the measuring range is reduced. See "Handling of Disturbances from Nozzle" on page C-4 for further information.

## Tank Environment

Table 5-1. List of Measurement Modes which can be used for different 5300 models

### Measurement Mode

Normally, the Measurement Mode does not need to be changed. The transmitter is pre-configured according to the specified model:

Model	Measurement Mode
5301	<ul style="list-style-type: none"> <li>• <i>Liquid Product Level</i><sup>(1)</sup></li> <li>• <i>Interface Level with Submerged probe</i></li> </ul>
5302	<ul style="list-style-type: none"> <li>• <i>Liquid Product Level</i></li> <li>• <i>Product Level and Interface Level</i><sup>(1)</sup></li> <li>• <i>Interface Level with Submerged probe</i></li> <li>• <i>Solid Product Level</i></li> </ul>
5303	<ul style="list-style-type: none"> <li>• <i>Solid Product Level</i><sup>(1)</sup></li> </ul>

<sup>(1)</sup> Default setting

*Submerged* is used for applications where the probe is fully submerged in liquid. In this mode, the transmitter ignores the upper product level. See "Interface Measurements with Fully Submerged Probes" on page 7-15" for more information.

### NOTE!

Only use *Submerged* for applications where the interface is measured with a fully submerged probe.

### Rapid Level Changes

Optimize the transmitter for measurement conditions where the level changes quickly due to filling and emptying of the tank. As a default standard, a Rosemount 5300 transmitter is able to track level changes of up to 1.5 in./s (40 mm/s). When the Rapid Level Changes check box is marked, the transmitter can track level changes of up to 8 in./s (200 mm/s).

The Rapid Level Changes check-box should not be used in normal conditions when the product surface moves slowly.

### Dielectric Constant

For interface measurements, the dielectric constant of the upper product is essential to obtain good accuracy. See "Interface" on page 2-12 for further information on dielectric constants. If the dielectric constant of the lower product is significantly smaller than the dielectric constant of water, you may need to make special adjustments, see Appendix C: Advanced Configuration for further information.

For level measurements, the **Upper Product Dielectric** parameter corresponds to the actual dielectric constant of the product in the tank.

## Volume Configuration

Normally, this parameter does not need to be changed even if the actual dielectric constant of the product deviates from the Upper Product Dielectric parameter value. However, for some products, measurement performance can be optimized by setting the proper product dielectric constant.

For volume calculations, you can choose one of the standard tank shapes or the strapping option. Choose None if volume calculation is not used. For the standard tanks, a Volume Offset parameter can be specified which can be used for a non-zero volume that corresponds to the zero level. This may be useful, for example, if the user wants to include the product volume below the zero level.

### Tank Type

You can choose one of the following options:

- Strap table
- Vertical Cylinder
- Horizontal Cylinder
- Vertical Bullet
- Horizontal Bullet
- Sphere
- None

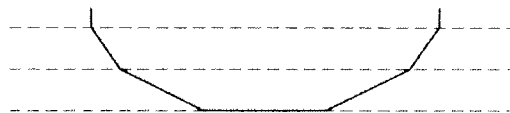
### Strapping Table

Use a strapping table if a standard tank type does not provide sufficient accuracy. Use most of the strapping points in regions where the tank shape is non-linear. A maximum of 20 points can be added to the strapping table.

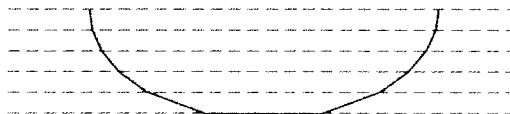
Figure 5-3. Strapping points



Actual tank bottom may look like this.



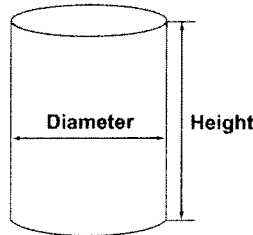
Using only 3 strapping points results in a level-to-volume profile that is more angular than the actual shape.



Using 10-15 of the points at the bottom of the tank yields a level-to-volume profile that is similar to the actual tank bottom.

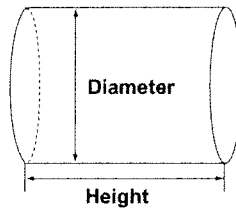
## Standard Tank Shapes

Figure 5-4. Standard tank shapes



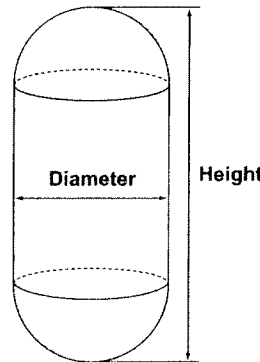
### Vertical Cylinder

Vertical Cylinder tanks are specified by Diameter, Height, and Volume Offset.



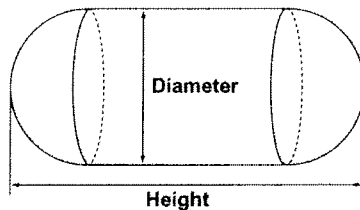
### Horizontal Cylinder

Horizontal Cylinders are specified by Diameter, Height, and Volume Offset.



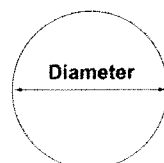
### Vertical Bullet

Vertical Bullet tanks are specified by Diameter, Height and Volume Offset. The volume calculation model for this tank type assumes that the radius of the bullet end is equal to the Diameter/2.



### Horizontal Bullet

Horizontal Bullets are specified by Diameter, Height, and Volume Offset. The volume calculation model for this tank type assumes that the radius of the bullet end is equal to the Diameter/2.



### Sphere

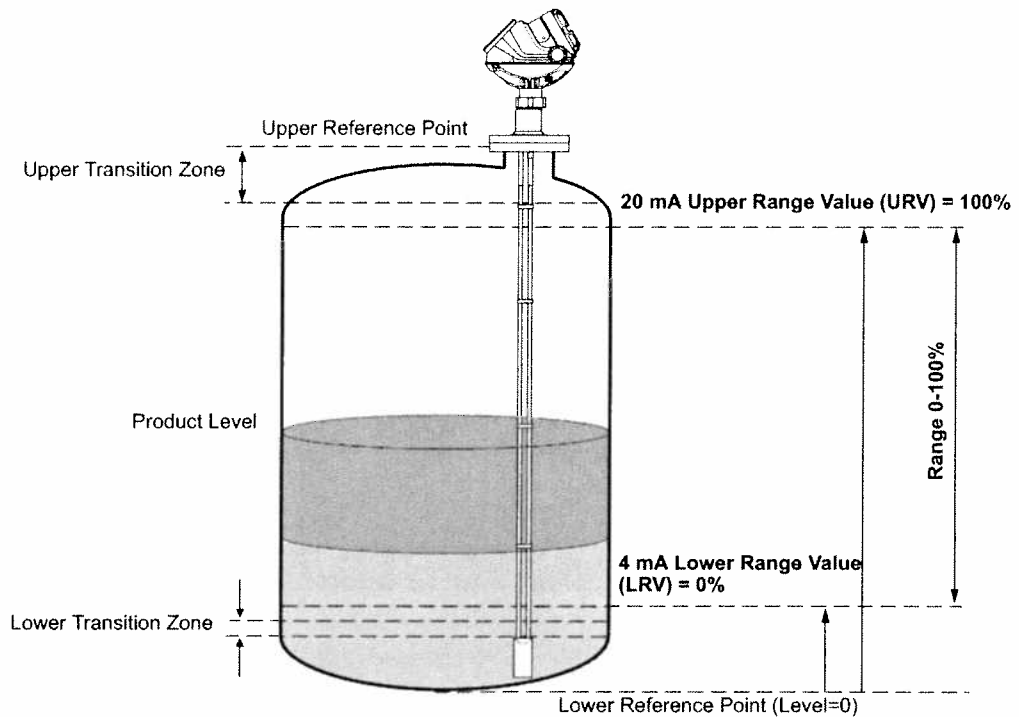
Spherical tanks are specified by Diameter and Volume Offset.



**Analog Output (HART)**

The Output Source (Primary Value), Range Values and Alarm Mode are specified for the analog output.

Figure 5-5. Example of Range Value settings

**Output Source/Primary Variable**

Specify the source to control the analog output. Typically, the Primary Value is configured to be the Product Level.

**Upper/Lower Range Value**

Enter the range values that correspond to the analog output values 4 and 20 mA. It is recommended that the 4 mA and 20 mA values are set outside the Transition Zones. See "Transition Zones" on page 2-10 for more information.

If a measured value goes beyond the measurement range, the transmitter enters saturation mode (limit alarm is disabled) or alarm mode depending on the current configuration.

Also make sure that the 20 mA value is below the Upper Null Zone (UNZ). (This parameter may be used if there are measurement problems in the upper part of the tank, see "Handling of Disturbances from Nozzle" on page C-4). The UNZ is equal to zero in the default configuration.

### Alarm Mode

The Alarm mode specifies the analog output state when there is a failure or a measurement error:

**High:** the output current is set to the High Alarm Limit.

**Low:** the output current is set to the Low Alarm Limit.

**Freeze Current:** the output current is set to the last valid value at the time when the error occurs.

Default settings for alarm mode:

- Measurement errors: Output current=High.
- Measured value out of range: transmitter enters saturation mode (if Limit Alarm is disabled).

Table 5-2. Analog Output:  
Standard Alarm Values vs.  
Saturation Values

Level	4–20 mA Saturation Values	4–20 mA Alarm Value
Low	3.9 mA	3.75 mA
High	20.8 mA	21.75 mA

Table 5-3. Analog Output:  
NAMUR-Compliant Alarm  
Values vs. Saturation Values

Level	4–20 mA Saturation Values	4–20 mA Alarm Value
Low	3.8 mA	3.6 mA
High	20.5 mA	22.5 mA

## BASIC CONFIGURATION USING A 375 FIELD COMMUNICATOR

This section describes how to configure the 5300 transmitter by using a 375 Field Communicator.

The menu tree with the various configuration parameters is shown in *Figure 5-7 on page 5-12*. Section "Basic Configuration Parameters" on page 5-4 presents a description of the basic configuration parameters.

For information on all the capabilities, refer to the 375 Field Communicator Product Manual (Document No. 00809-0100-4276).

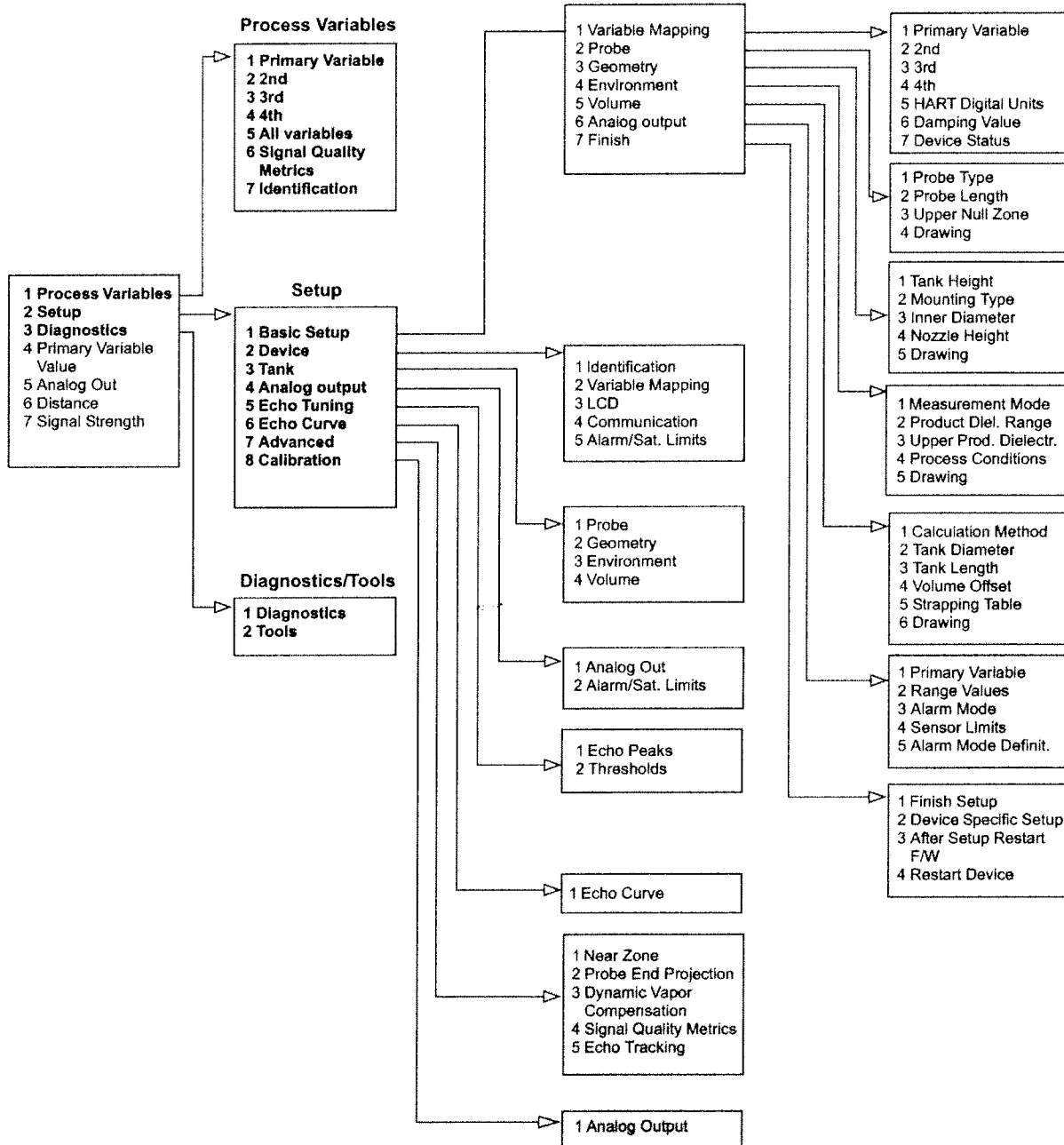
Figure 5-6. The 375 Field Communicator.



1. Check that the desired Measurement Units are selected.
2. Open the Process Variable menu and select Primary Variable. HART command: [1, 1]. Select the desired parameter.
3. Open the Basic Setup menu. HART command: [2, 1]. This menu includes Probe, Tank Geometry, Environment, Volume, and Analog Output settings.
4. Select Finish, Device Specific Setup to see if there is any additional configuration that needs to be done.
5. Restart the transmitter. HART command: [3, 2, 1, 1].

See also "Guided Setup" on page 5-19 for further information on configuration of the Rosemount 5300 transmitter.

Figure 5-7. HART Communicator Menu Tree corresponding to Device Revision 3.



**BASIC CONFIGURATION  
USING ROSEMOUNT  
RADAR MASTER**

The *Rosemount Radar Master* (RRM) is a user-friendly software tool that allows the user to configure the Rosemount 5300 Series transmitter. Choose either of the following methods to configure a Rosemount 5300 Series transmitter with RRM:

- Guided Setup if you are unfamiliar with the 5300 transmitter (see page 5-19).
- Setup functions if you are already familiar with the configuration process or for changes to the current settings (page 5-18).

**System Requirements**

**Hardware**

Processor (minimum/recommended): Pentium 200 MHz/1 GHz

Memory (minimum/recommended): 64/128 MB RAM

COM Port: 1 serial COM port or 1 USB port

Graphical Card (minimum/recommended):  
screen resolution 800 x 600/1024 x 768

Hard drive space: 100 MB

**Software**

Operating Systems supported:

Windows 2000 - Service Pack 3

Windows XP - Service Pack 2

**Help In RRM**

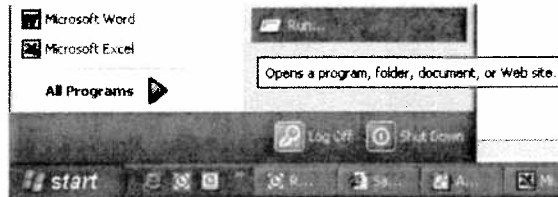
Help is accessed by selecting the Contents option from the Help menu. Help is also available from a Help button in most windows.

# Rosemount 5300 Series

## Installing the RRM software for HART communication

To install the Rosemount Radar Master:

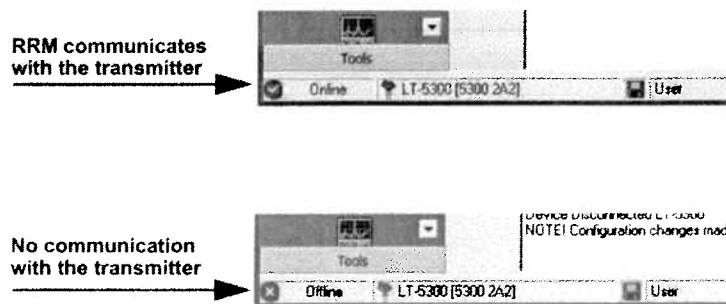
1. Insert the installation CD into your CD-ROM drive.
2. If the installation program is not automatically started, choose Run from the Windows Start bar.



3. Type D:\RRM\Setup.exe, where D is the CD-ROM drive.
4. Follow the instructions on the screen.
5. Make sure that HART is chosen as default protocol.
6. For Windows 2000/XP set COM Port Buffers to 1, see page 5-15.

### Getting Started

1. From the Start menu click *Programs>Rosemount>Rosemount Radar Master* or click the RRM icon in the Windows workspace.
2. If the *Search Device* window did not appear automatically, choose menu option *Device>Search*.
3. In the *Search Device* window, choose communication protocol HART, and click the Start Scan button (click the Advanced button if you want to specify start and stop address).  
Now RRM searches for the transmitter.
4. After a while the *Search Device* window presents a list of found transmitters.
5. Select the desired transmitter and press OK to connect. If communication does not work, check that the correct COM port is connected to the computer and that the COM port is properly configured, see "Specifying the COM Port" on page 5-15. You may also check in the *Communication Preferences* window that HART communication is enabled.
6. In the RRM Status Bar verify that RRM communicates with the transmitter:

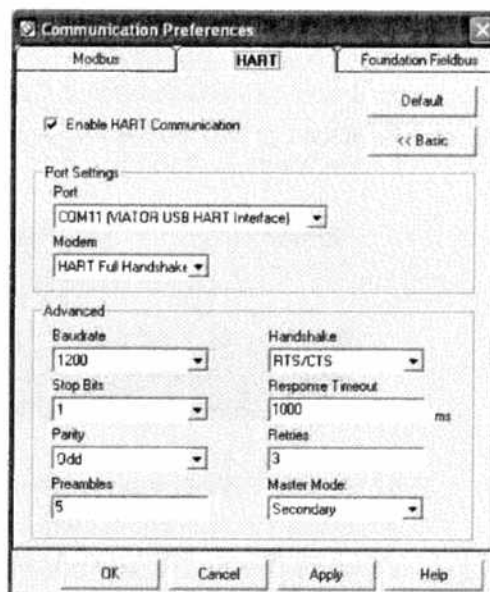


## Specifying the COM Port

Figure 5-8. Communication Preferences.

If communication is not established, open the *Communication Preferences* window and check that the correct COM Port is selected:

1. From the **View** menu select Communication Preferences in RRM.



2. Select the HART tab.
3. Make sure that HART communication is enabled.
4. Check which COM port the modem is connected to.
5. Choose the COM Port option that matches the actual COM Port on the PC that the transmitter is connected to.

## To set the COM port buffers

For Windows 2000/XP the COM port **Receive Buffer** and **Transmit Buffer** need to be set to 1. To set the COM port buffers:

1. In the MS Windows Control Panel open the **System** option.
2. Choose the **Hardware** tab and click the **Device Manager** button.
3. Expand the **Ports** node in the tree view.
4. Click the right mouse button on the selected COM port and choose **Properties**.
5. Select the **Port Settings** tab and click the **Advanced** button.
6. Drag the *Receive Buffer* and *Transmit Buffer* slides to 1.
7. Click the **OK** button.
8. **Restart the computer.**

## Installing the RRM Software for FOUNDATION Fieldbus

To install the Rosemount Radar Master for FOUNDATION Fieldbus communication:

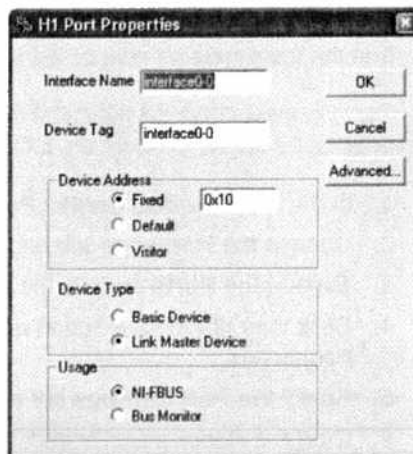
1. Start by installing the *National Instruments Communication Manager* software. See National Instruments manual (*Getting started with your PCMCIA-FBUS and the NI-FBUS™ software*) for more information.
2. Insert the RRM installation CD into your CD-ROM drive.
3. If the installation program is not automatically started, choose Run from the Windows Start bar.



4. Type D:\RRM\Setup.exe where D is the CD-ROM drive.
5. Follow the instructions on the screen.
6. Make sure that FOUNDATION Fieldbus is chosen as default protocol.

### Getting Started

1. Before starting RRM make sure that appropriate settings are made with the *National Instruments Interface Configuration Utility*:



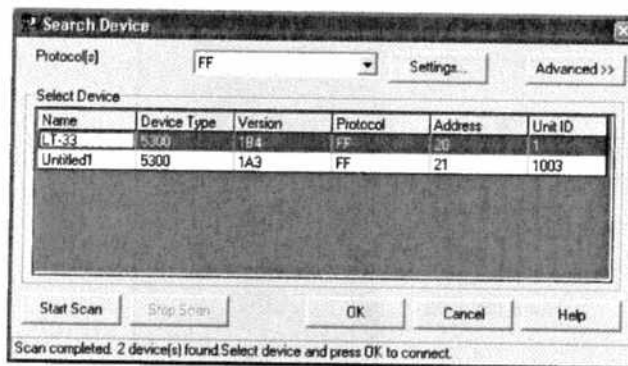
If only Rosemount Radar Master is connected to the bus:  
Device address=Fixed  
Device Type=Link Master Device  
Usage=NI-FBUS

If other host systems are connected to the bus:  
Device address=Visitor  
Device Type=Basic Device  
Usage=NI-FBUS

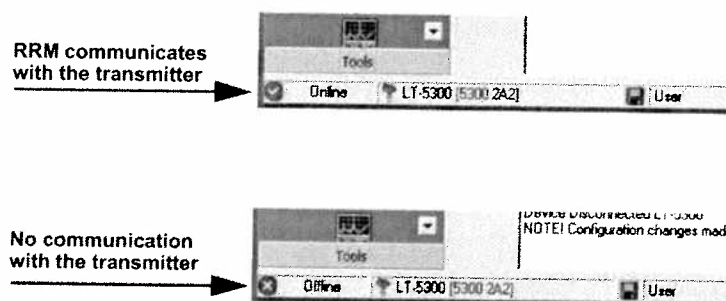


2. Start Rosemount Radar Master (RRM): from the Start menu click *Programs>Rosemount>Rosemount Radar Master* or click the RRM icon in the MS Windows workspace.
3. If the *National Instruments Communication Manager* server is not running, click Yes when RRM displays a request for starting the server.
4. If the *Search Device* window did not appear automatically choose menu option *Device>Search*.
5. In the *Search Device* window choose communication protocol FOUNDATION Fieldbus (if not already selected) and click the Start Scan button (click the Advanced button if you want to specify start and stop stress).

Now RRM searches for the transmitter. After a while RRM shows the transmitters found on the bus:



6. Select the desired transmitter and click OK to connect. In the RRM Status Bar verify that RRM communicates with the transmitter:



## Specifying Measurement Units

Measurement units for data presentation in RRM can be specified when the RRM program is installed. Units can also be changed as follows:

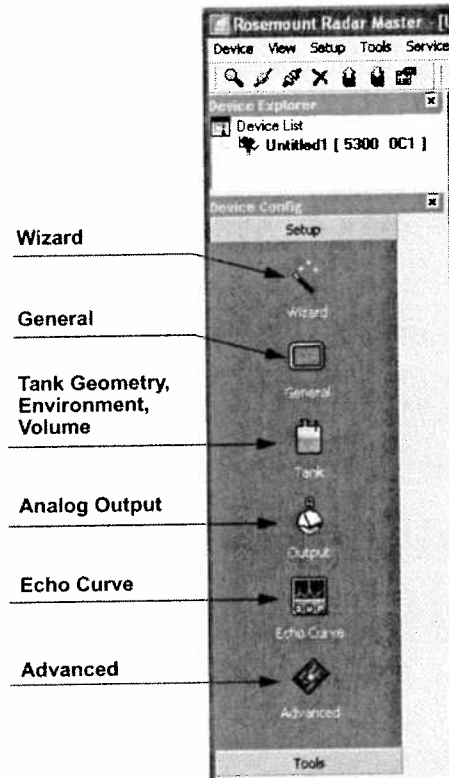
1. From the View menu, choose the Application Preferences option.
2. Select the **Measurement Units** tab.
3. Choose the desired units for Length, Level Rate, Volume, and Temperature.

# Rosemount 5300 Series

## Using the Setup Functions

Use the **Setup** function if you are already familiar with the configuration process for the Rosemount 5300 Series transmitter or for changes to the current settings:

Figure 5-9. Setup functions in RRM.



1. Start the RRM software.
2. In the RRM workspace choose the appropriate icon for the configuration of transmitter parameters:

- **Wizard:** the Wizard is a tool that guides you through the basic configuration procedure of a Rosemount 5300 Series transmitter
- **General:** configuration of general settings such as measurement units and communication parameters. This window also lets you configure which LCD variables to be displayed, see *Section 6: Operation*
- **Tank:** configuration of Tank Geometry, Tank Environment, and Volume
- **Output:** configuration of Analog Output
- **Echo Curve:** disturbance echo handling
- **Advanced:** advanced configuration

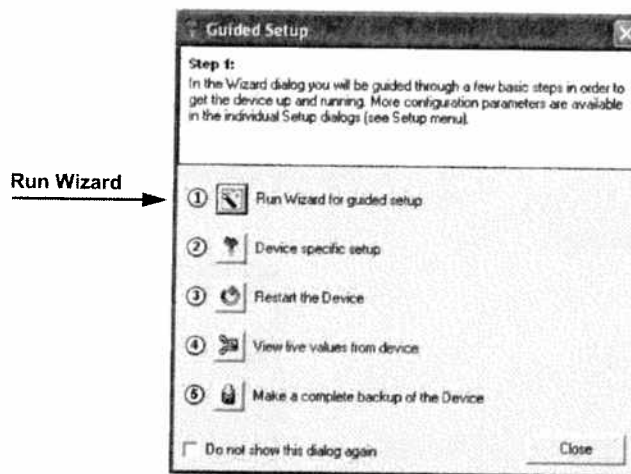
## Guided Setup

The following description shows how to use the RRM Guided Setup. The corresponding HART commands (375 Field Communicator Fast Key Sequence) and FOUNDATION Fieldbus parameters are also shown.

The Guided Setup is useful if you are unfamiliar with the Rosemount 5300 Series transmitter.

### 1. Start the Guided Setup

Start RRM. It automatically presents a list of available transmitters. Select the desired transmitter. Now the transmitter is connected and the *Guided Setup* window appears automatically:



### 2. Start the Configuration Wizard

In the *Guided Setup* window, click the **Run Wizard...** button and follow the instructions.

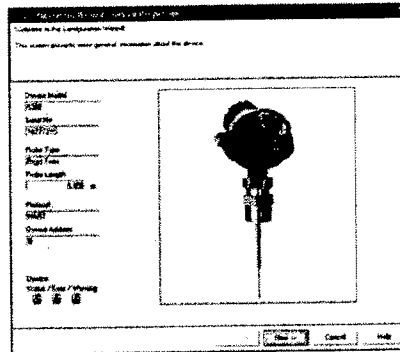
Now you will be guided through a short transmitter installation procedure.

#### NOTE!

The *Guided Setup* is an extended installation guide that includes more than just the configuration Wizard. It can be disabled by deselecting the *Show Introduction Dialog after Connect* check box in the *Application Settings* window (see menu option View>Application Preferences).

# Rosemount 5300 Series

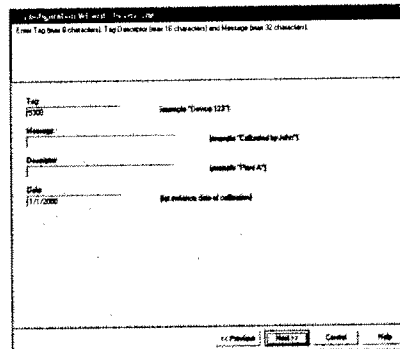
## Device Properties



3. Check the device properties

The first window in the configuration wizard presents general information stored in the transmitter database such as device model, serial number, probe type, probe length, communication protocol and device address. Check that the information complies with the ordering information.

## General Information

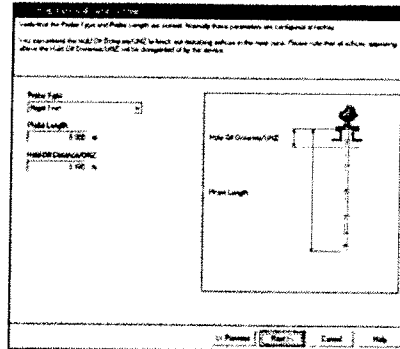


4. Enter Device Information

HART command: [2, 2, 1].

This window lets the user enter Tag, Message, Descriptor, and Date. The information is not required for the operation of the transmitter and can be left out if desired.

## Probe



### 5. Probe settings

HART command: [2, 1, 2].

FOUNDATION Fieldbus parameters:

```
TRANSDUCER 1100>PROBE_TYPE  
TRANSDUCER 1100>PROBE_LENGTH  
TRANSDUCER 1100>GEOM_HOLD_OFF_DIST
```

Check that the correct Probe Type is chosen. Normally, the Probe Type is pre-configured at the factory, but if the current configuration does not match the actual probe, choose the correct **Probe Type** from the list.

The Rosemount 5300 Series transmitter automatically makes some initial calibrations based on the chosen **Probe Type**. The following Probe Types are available:

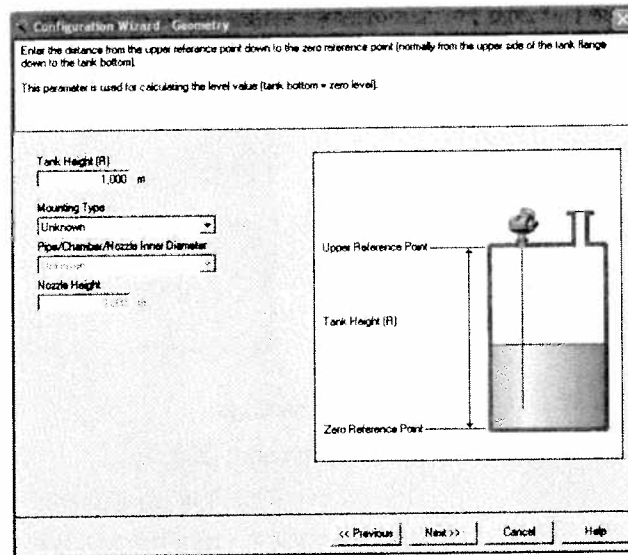
- Rigid Twin
- Flexible Twin
- Coaxial, Coaxial HP, Coaxial HTHP
- Rigid Single, Rigid Single HTHP/HP/C, Rigid Single PTFE
- Flexible Single, Flexible Single HTHP/HP/C, Flexible Single PTFE

The **Probe Length** is the distance from the Upper Reference Point to the end of the probe, see Figure 5-1. If the probe is anchored to a weight, do not include the height of the weight. The Probe Length needs to be changed if, for example, the probe is shortened.

The **Hold Off Distance/Upper Null Zone (UNZ)** should not be changed unless there are disturbances at the top of the tank. By increasing the Upper Null Zone, measurements in this region are avoided. See *"Handling of Disturbances from Nozzle"* on page C-4 for more information on how to use the UNZ. The UNZ is set to zero in the factory configuration.

# Rosemount 5300 Series

## Geometry



### 6. Geometry

HART command: [2, 1, 3].

FOUNDATION Fieldbus parameter:

```
TRANSDUCER 1100>GEOM_TANK_HEIGHT  
TRANSDUCER 1100>MOUNTING_TYPE  
TRANSDUCER 1100>PIPE_DIAMETER  
TRANSDUCER 1100>NOZZLE_HEIGHT
```

**Tank Height** is the distance from the Upper Reference Point to the Lower Reference Point (see Figure 5-1 on page 5-4 and Figure 5-2 on page 5-4). The Upper Reference Point is located at the bottom part of the threaded adapter, or at the underside of the welded flange.

Make sure the Tank Height is as accurate as possible, since a Tank Height error results in a corresponding Level value offset error.

When specifying the Tank Height, keep in mind that this value is used for all level and volume measurements performed by the Rosemount 5300 Series transmitter.

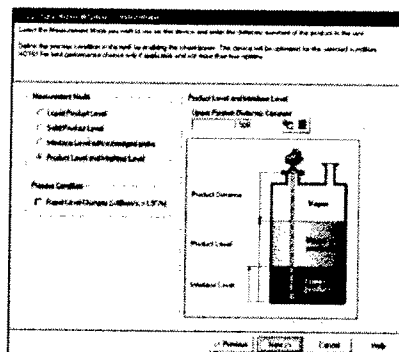
The Tank Height must be set in linear (level) units, such as feet or meters, regardless of primary variable assignment.

Select the **Mounting Type** used.

Select **Inner Diameter** if using pipe, chamber or nozzle.

Type **Nozzle Height** if using nozzle.

## Tank Environment



### 7. Specify Tank Environment

HART command: [2, 1, 4].

FOUNDATION Fieldbus parameter:

```
TRANSDUCER 1100>MEAS_MODE  
TRANSDUCER 1100>PRODUCT_DIELEC_RANGE  
TRANSDUCER 1100>UPPER_PRODUCT_DC  
TRANSDUCER 1100>ENV_ENVIRONMENT
```

#### Measurement Mode

Normally, the Measurement Mode does not need to be changed. The transmitter is pre-configured according to the specified model. See “Basic Configuration Parameters” on page 5-4 for more information.

#### Process Conditions

Select the *Rapid Level Changes* check-box only if the surface is moving quickly up or down at rates over 1.5 in./s (40 mm/s).

#### Dielectric Constant/Dielectric Range

The dielectric constant of the product is used for setting the appropriate signal amplitude thresholds, see *Section 7: Service and Troubleshooting* for more information on amplitude threshold settings. Normally, this parameter does not need to be changed for level measurements. However, for some products, measurement performance can be optimized by setting the proper product dielectric constant.




For **Interface Level** measurements, the dielectric constant of the upper product is essential for calculating interface level and the upper product thickness. By default, the **Upper Product Dielectric** parameter is about 2.


Set the **Upper Product Dielectric Constant** to a value that corresponds to the current product.

## Rosemount 5300 Series

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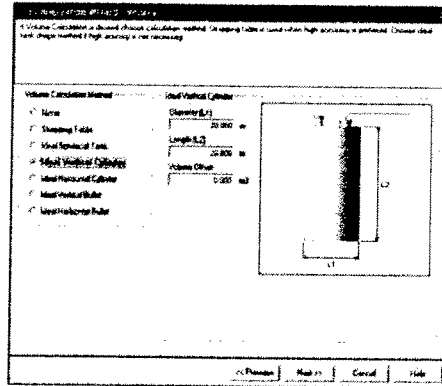
*Rosemount Radar Master (RRM)* includes tools to estimate the dielectric constant of the current product:

- The **Dielectric Chart** lists the dielectric constant of a large number of products. The Dielectric Chart can be opened with one of the following methods:
  - Choose the *View>Dielectric Constant Chart* menu option
  - Click the Dielectric Chart button  in the *Configuration Wizard - Environment* window
  - Choose the *Setup>Tank* menu option and click the Dielectric Chart button  in the *Tank/Environment* window
- The **Dielectric Calculator**  lets you calculate the dielectric constant of the Upper Product based on the following input:
  - actual upper product thickness,
  - the dielectric constant value stored in the transmitter, and
  - the upper product thickness presented by the transmitter.

The **Dielectric Calculator** is available via the Dielectric Calculator button  in the *Configuration Wizard - Environment* window or the *Tank/Environment* window.



Volume



8. Choose Volume Calculation Method

HART command: [2, 1, 5].

FOUNDATION Fieldbus parameters:

Calculation method:

TRANSDUCER 1300>VOL\_VOLUME\_CALC\_METHOD

Tank Diameter:

TRANSDUCER 1300>VOL\_IDEAL\_DIAMETER

Tank Length:

TRANSDUCER 1300>VOL\_IDEAL\_LENGTH

Volume Offset:

TRANSDUCER 1300>VOL\_VOLUME\_OFFSET

To use volume calculation, choose a pre-defined calculation method based on the tank shape that best corresponds to the actual tank. See "Volume Configuration" on page 5-7.

Use the Strapping Table option if the actual tank does not match any of the available options for pre-defined tanks, or if higher calculation accuracy is desired.

Choose None if volume calculation is not desired at all.

The following standard tank shapes are available:

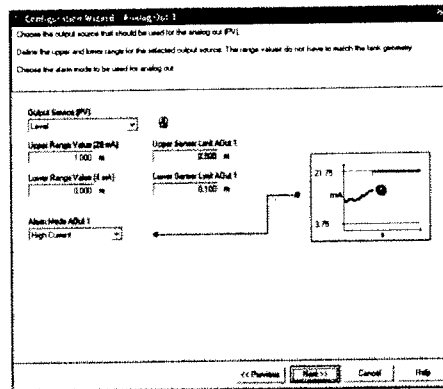
- Vertical Cylinder
- Horizontal Cylinder
- Vertical Bullet
- Horizontal Bullet
- Sphere
- None

The following parameters must be entered for a standard tank shape:

- Tank diameter
- Tank height/length (not for spherical tanks)
- Volume Offset: use this parameter if you do not want zero volume and zero level to match (for example if you want to include a volume below the zero level)

# Rosemount 5300 Series

## Analog Output (HART)



### 9. Configure the Analog Output

HART command: [2, 1, 6].

Analog Output is not available for FOUNDATION Fieldbus.

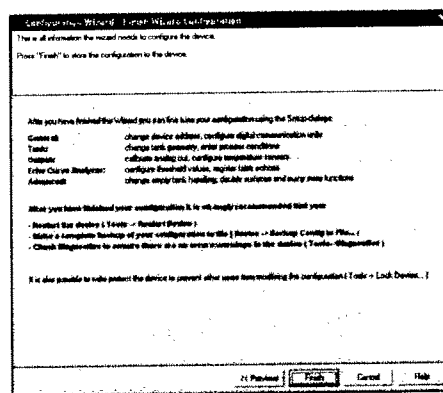
Typically, the **Primary Variable (PV)** is configured to be Product Level, Interface Level, or Volume. Other variables like Product Distance, Interface Distance, Upper Product Thickness, etc. are available as well.

Specify the analog output range by setting the **Lower Range Value** (4 mA) and the **Upper Range Value** (20 mA) to the desired values.

The Alarm Mode specifies the output state when a measurement error occurs.

See also “Analog Output (HART)” on page 5-9 for information on Analog Output configuration.

## Finish Configuration Wizard



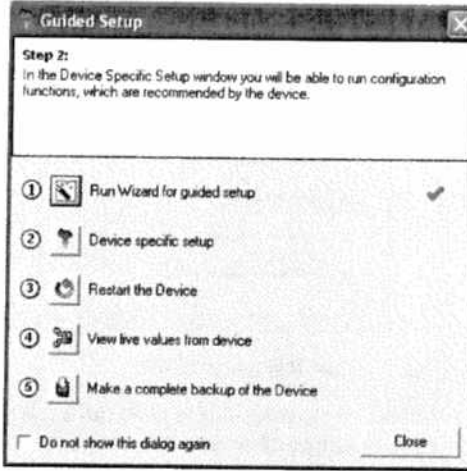
### 10. Finish the Configuration Wizard

This is the last window in the Configuration Wizard concluding the basic configuration. The current configuration can be changed at any time by using the Setup windows (General, Tank, Output etc., see “Using the Setup Functions” on page 5-18).

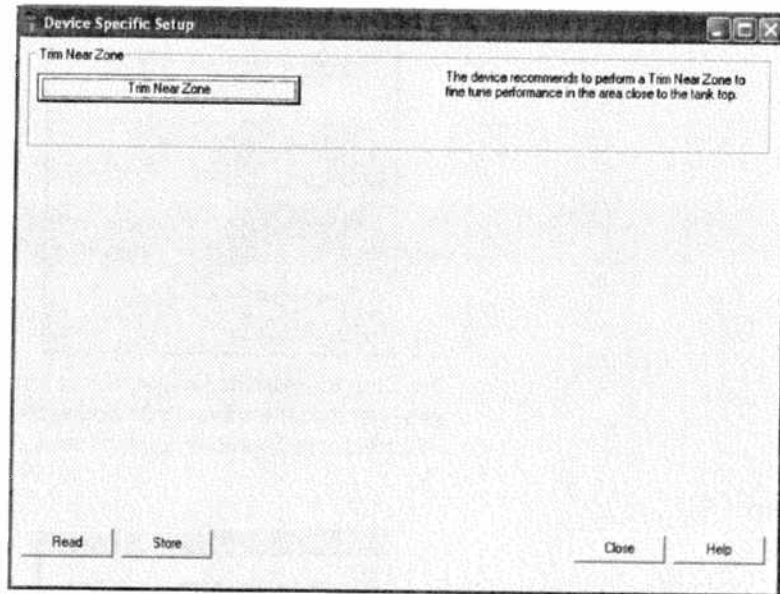
The Setup windows contain further options not available in the configuration wizard.

Click the Finish button and continue with the next step in the Guided Setup.

## Device Specific Configuration



11. Click the Device specific setup button



12. This window will show if any additional configuration is needed. Proceed to step 13 if no configuration is needed.

**Trim Near Zone** is described further in "Handling of Disturbances from Nozzle" on page C-4.

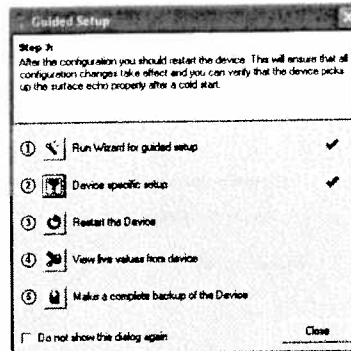
**Probe End Projection** is described further in "Probe End Projection" on page C-10.

**Vapor Compensation** is described further in "Dielectric Constant Settings" on page C-14.

Choose the **Tank Material** if recommended.

# Rosemount 5300 Series

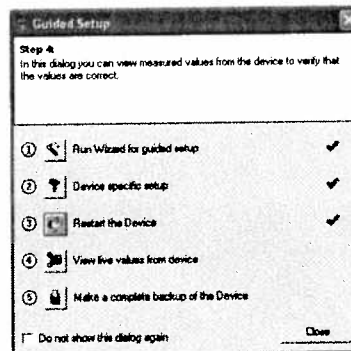
## Restart the Transmitter



### 13. Restart the transmitter

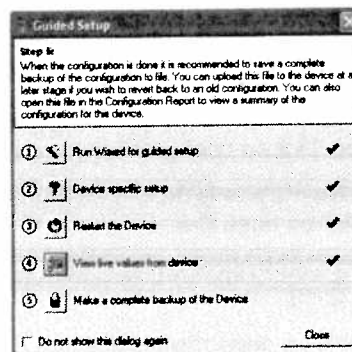
When the transmitter is configured, it should be restarted to make sure that all configuration changes are properly activated and the transmitter performs as expected. It may take up to 60 seconds after the restart button is pressed until measurement values are updated.

## View Measured Values



14. Step three in the Guided Setup lets you view measurement values in order to verify that the transmitter works correctly. If the measured values seem incorrect, configuration settings may need to be adjusted.

## Backup



15. When configuration is finished, it is recommended that the configuration is saved to a backup file.

This information may be useful for:

- installing another 5300 in a similar tank since the file can be directly uploaded to a new device
- restoring the configuration, if for any reason, configuration data is lost or accidentally modified making the device inoperable

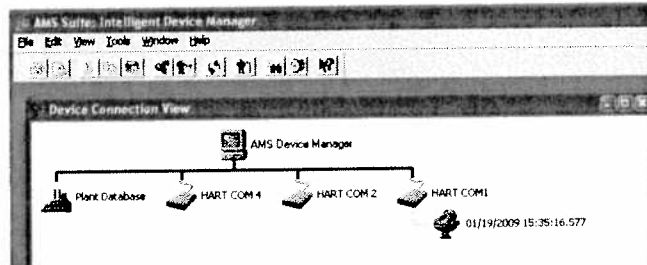
The *Configuration Report* window appears automatically when the backup is completed.

# Rosemount 5300 Series

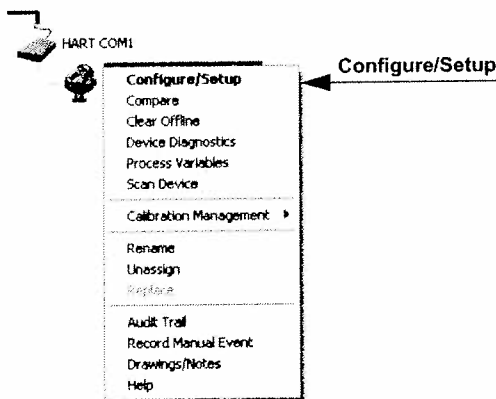
## BASIC CONFIGURATION USING AMS SUITE (HART)

The Rosemount 5300 transmitter can be configured by using the AMS Suite software.

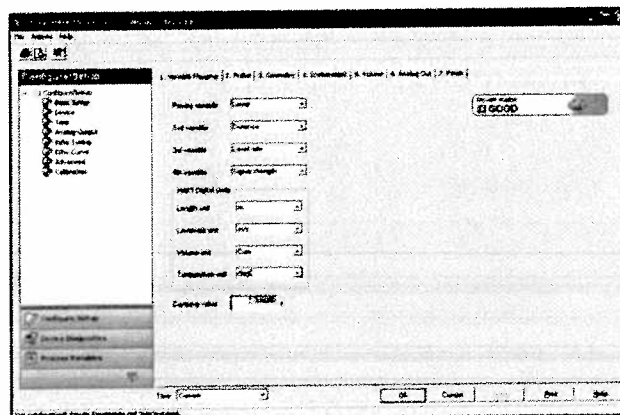
1. Start the *AMS Device Manager* and make sure that the transmitter connects.



2. In the *Device Connection View*, click the right mouse button on the transmitter icon.



3. Choose the **Configure/Setup** option.



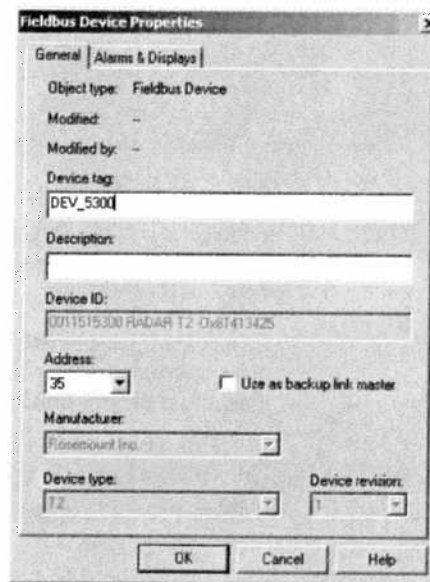
4. Choose the **Basic Setup** option.
5. Configure the transmitter by selecting the appropriate tab. See "Basic Configuration Parameters" on page 5-4 for information on the various configuration parameters.

## BASIC CONFIGURATION USING DELTAV

The Rosemount 5300 Series supports DD Methods for DeltaV to facilitate transmitter configuration. The following description shows how to use DeltaV with the AMS application to configure the Rosemount 5300 Series. The corresponding FOUNDATION Fieldbus commands are also shown.

To configure the Rosemount 5300 with DeltaV:

1. Select DeltaV>Engineering>DeltaV Explorer from the Start menu.
2. Navigate through the file structure to find the 5300 transmitter
3. Click the right mouse button on the 5300 transmitter icon and choose Properties.



4. The Fieldbus Device Properties window lets you enter Device Tag and Description. This information is not required for the operation of the transmitter and can be left out if desired. General information such as device type (5300), manufacturer, device ID are presented. The Rosemount 5300 Series device ID consists of the following components:

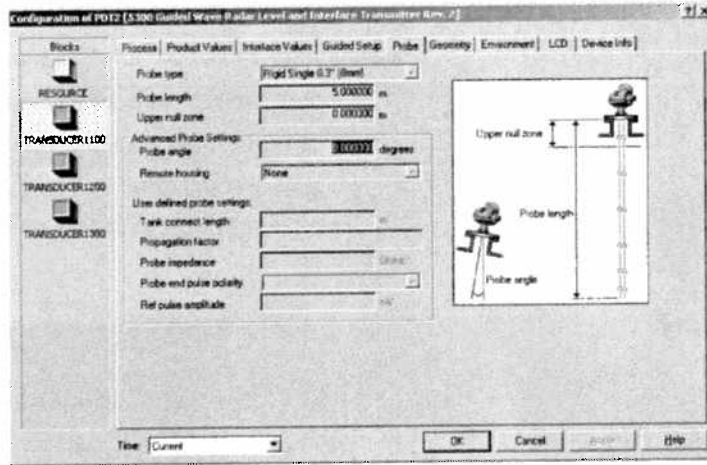
*Manufacturer ID-Model-Serial Number.*

Example: 0011515300 Radar T2-0x81413425.

Check that the information complies with the ordering information.

5. Select the desired transmitter in the **DeltaV Explorer** and choose the **Configure** option.

6. Select the TRANSDUCER1100 block and choose the **Probe** tab.



FOUNDATION Fieldbus parameters:

```
TRANSDUCER 1100>PROBE_TYPE
TRANSDUCER 1100>PROBE_LENGTH
TRANSDUCER 1100>GEOM_HOLD_OFF_DIST
```

Check that the correct **Probe Type** is chosen. Normally, the Probe Type is pre-configured at the factory, but if the current configuration does not match the actual probe, choose the correct Probe Type from the list.

The Rosemount 5300 Series transmitter automatically makes some initial calibrations based on the chosen Probe Type. The following probes are available:

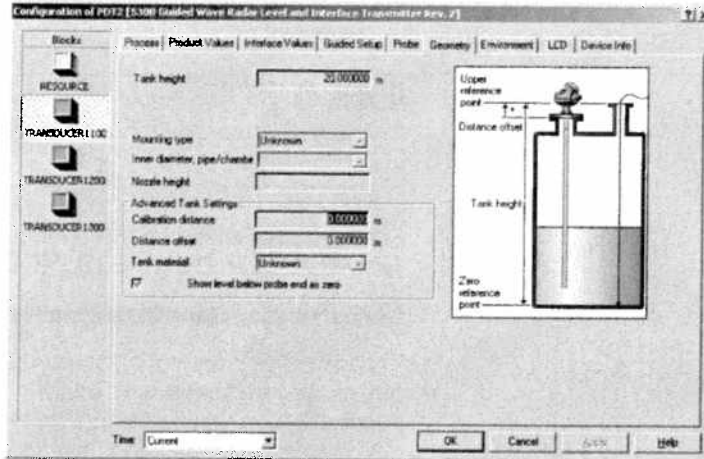
- Rigid Twin
- Flexible Twin
- Coaxial, Coaxial HP, Coaxial HTHP
- Rigid Single, Rigid Single HTHP/HP/C, Rigid Single PTFE
- Flexible Single, Flexible Single HTHP/HP/C, Flexible Single PTFE

The **Probe Length** is the distance from the Upper Reference Point to the end of the probe, see Figure 5-1. If the probe is anchored to a weight do not include the height of the weight. The Probe Length needs to be changed if, for example, the probe is shortened.

The **Hold Off Distance/Upper Null Zone (UNZ)** should not be changed unless there are disturbances at the top of the tank. By increasing the Upper Null Zone, measurements in this region are avoided. See *“Handling of Disturbances from Nozzle” on page C-4* for more information on how to use the UNZ. The UNZ is equal to zero in the factory configuration.



7. Select the TRANSDUCER1100 block and choose the **Geometry** tab.

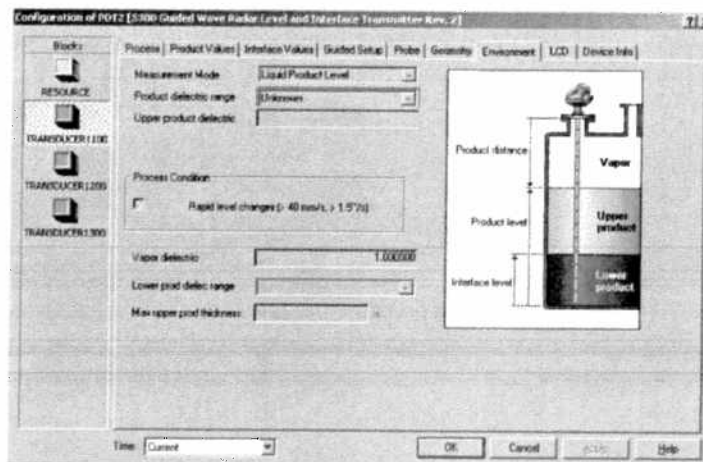


8. **Tank Height** is the distance from the Upper Reference Point to the tank bottom (see "Tank and Probe Geometry" on page 5-4). Make sure that this number is as accurate as possible.
9. Select the **Mounting Type** used.
10. Select **Inner Diameter** if using pipe, chamber, or nozzle.
11. Type **Nozzle Height** if using nozzle.

FOUNDATION Fieldbus parameter:

```
TRANSDUCER 1100>GEOM_TANK_HEIGHT  
TRANSDUCER 1100>MOUNTING_TYPE  
TRANSDUCER 1100>PIPE_DIAMETER  
TRANSDUCER 1100>NOZZLE_HEIGHT
```

12. Select the **Environment** tab.



13. Normally, the **Measurement Mode** does not need to be changed. The transmitter is pre-configured according to the specified model.

## Rosemount 5300 Series

*Submerged* is used for applications where the probe is fully submerged in liquid. In this mode, the transmitter ignores the upper product level. See “Section 7: Interface Measurements with Fully Submerged Probes” for more information.

### NOTE!

Only use *Submerged* for applications where the interface is measured with a fully submerged probe.

FOUNDATION Fieldbus parameter:  
TRANSDUCER 1100>MEAS\_MODE

### Dielectric Constant/Dielectric Range

The dielectric constant of the product is used for setting the appropriate signal amplitude thresholds, see *Section 7: Service and Troubleshooting* for more information on amplitude threshold settings. Normally, this parameter does not need to be changed for level measurements. However, for some products, measurement performance can be optimized by setting the proper product dielectric constant.

For **Interface Level** measurements, the dielectric constant of the upper product is essential for calculating interface level and the upper product thickness. By default, the **Upper Product Dielectric** parameter is about 2.

Set the **Upper Product Dielectric Constant** to a value that corresponds to the current product.

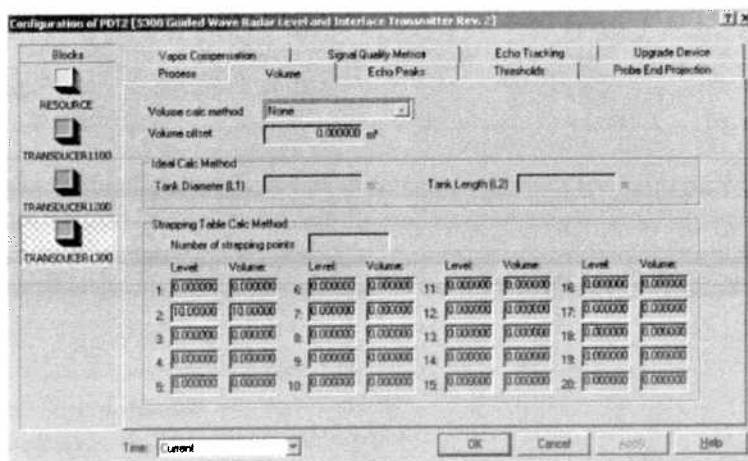
FOUNDATION Fieldbus parameters:  
TRANSDUCER 1100>PRODUCT\_DIELEC\_RANGE  
TRANSDUCER 1100>UPPER\_PRODUCT\_DC

### Process Conditions

Select the *Rapid Level Changes* check-box only if the surface is moving quickly up or down at rates over 1.5 in./s (40 mm/s).

FOUNDATION Fieldbus parameter:  
TRANSDUCER 1100>ENV\_ENVIRONMENT

14. To configure volume calculation, select the TRANSDUCER1300 block and choose the Volume tab.



15. Choose a pre-defined calculation method based on a tank shape that corresponds to the actual tank. Choose None if volume calculation is not desired.

Use Volume Offset if you do not want zero volume and zero level to match (for example if you want to include the product volume below the zero level).

The Strapping Table option is used if the actual tank does not match any of the available options for pre-defined tanks or if a higher calculation accuracy is desired.

Calculation Method:

FOUNDATION Fieldbus parameter:

TRANSDUCER 1300>VOL\_VOLUME\_CALC\_METHOD

Diameter:

FOUNDATION Fieldbus parameter:

TRANSDUCER 1300>VOL\_IDEAL\_DIAMETER

Tank Length:

FOUNDATION Fieldbus parameter:

TRANSDUCER 1300>VOL\_IDEAL\_LENGTH

Volume Offset:

FOUNDATION Fieldbus parameter:

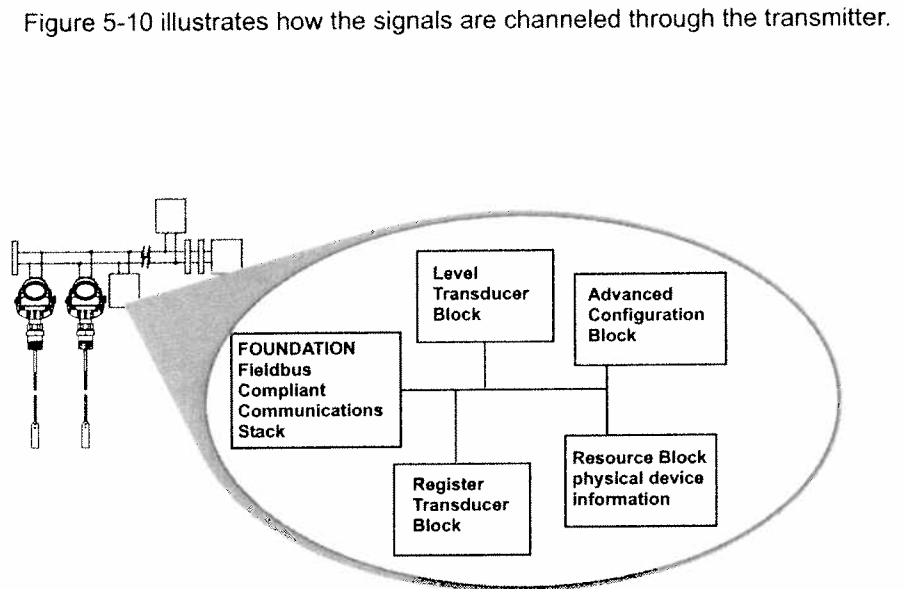
TRANSDUCER 1300>VOL\_VOLUME\_OFFSET

See "Volume Configuration" on page 5-7 for more information.

# Rosemount 5300 Series

## FOUNDATION FIELDBUS OVERVIEW

Figure 5-10. Function Block Diagram for the Rosemount 5300 Series Radar Level Transmitters with FOUNDATION Fieldbus.



### NOTE!

It is highly recommended that you limit the number of periodic writes to all static or non-volatile parameters such as HI\_HI\_LIM, LOW\_CUT, SP, TRACK\_IN\_D, OUT, IO\_OPTS, BIAS, STATUS\_OPTS, SP\_HI\_LIM, and so on. Static parameter writes increment the static revision counter, ST\_REV, and are written to the device's non-volatile memory. Fieldbus devices have a non-volatile memory write limit. If a static or non-volatile parameter is configured to be written periodically, the device can stop its normal operation after it reaches its limit or fail to accept new values.

This section provides a brief overview of FOUNDATION Fieldbus block operation with the Rosemount 5300 Series Level Transmitter.

For detailed information about FOUNDATION Fieldbus technology and function blocks used in the Rosemount 5300 Series, refer to the FOUNDATION Fieldbus Block Manual (Document No. 00809-0100-4783).

## Assigning Device Tag and Node Address

A Rosemount 5300 Series transmitter is shipped with a blank tag and a temporary address (unless specifically ordered with both) to allow a host to automatically assign an address and a tag. If the tag or address need to be changed, use the features of the configuration tool. The tool basically does the following:

1. Changes the address to a temporary address (248-251).
2. Changes the tag to a new value.
3. Changes the address to a new address.

When the transmitter is at a temporary address, only the tag and address can be changed or written to. The resource, transducer, and function blocks are all disabled.

## FOUNDATION Fieldbus Block Operation

**Function blocks** within the fieldbus device perform the various functions required for process control. Function blocks perform process control functions, such as analog input (AI) functions, as well as proportional-integral derivative (PID) functions. The standard function blocks provide a common structure for defining function block inputs, outputs, control parameters, events, alarms, and modes, and combining them into a process that can be implemented within a single device or over the fieldbus network. This simplifies the identification of characteristics that are common to function blocks.

In addition to function blocks, fieldbus devices contain two other block types to support the function blocks. These are the **Resource block** and the **Transducer block**.

Resource blocks contain the hardware specific characteristics associated with a device; they have no input or output parameters. The algorithm within a resource block monitors and controls the general operation of the physical device hardware. There is only one resource block defined for a device.

Transducer blocks connect function blocks to local input/output functions. They read sensor hardware and write to effector (actuator) hardware.

### **Level Transducer Block**

The Level Transducer block contains transmitter information including diagnostics and the ability to configure, set to factory defaults and restarting the transmitter.

### **Register Transducer Block**

The Register Transducer Block allows a service engineer to access all database registers in the device.

### **Advanced Configuration Transducer Block**

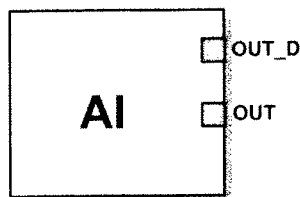
The Advanced Configuration Transducer Block contains functions such as amplitude threshold settings for filtering of disturbing echoes and noise, simulation of measurement values, and strapping table for volume measurements.

### **Resource Block**

The Resource block contains diagnostic, hardware, electronics, and mode handling information. There are no linkable inputs or outputs to the Resource Block.

## Analog Input Block

Figure 5-11. Analog-Input Block



OUT=The block output value and status  
OUT\_D=Discrete output that signals a selected  
alarm condition

The Analog Input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes and passes on to linked blocks. For further information refer to Appendix J: Analog-Input Block.

For more information on the different function blocks refer to *Appendix F: Level Transducer Block*, *Appendix G: Register Transducer Block*, *Appendix H: Advanced Configuration Transducer Block*, *Appendix I: Resource Transducer Block* and *Appendix J: Analog-Input Block*.

### Function Block Summary

The following function blocks are available for the Rosemount 5300 Series:

- Analog Input (AI)
- Proportional/Integral/Derivative (PID)
- Input Selector (ISEL)
- Signal Characterizer (SGCR)
- Arithmetic (ARTH)
- Output Splitter (OS)

For detailed information about FOUNDATION Fieldbus technology and function blocks used in the Rosemount 5300 Series, refer to the FOUNDATION Fieldbus Block Manual (Document No. 00809-0100-4783).

## CONFIGURE THE AI BLOCK

⚠ A minimum of four parameters are required to configure the AI Block. The parameters are described below with example configurations shown at the end of this section.

### CHANNEL

Select the channel that corresponds to the desired sensor measurement. The Rosemount 5300 measures Level (channel 1), Distance (channel 2), Level Rate (channel 3), Signal Strength (channel 4), Volume (channel 5), Internal Temperature (channel 6), Upper Product Volume (channel 7), Lower Product Volume (channel 8), Interface Distance (channel 9), Upper Product Thickness (channel 10), Interface Level (channel 11), Interface Level Rate (channel 12), Interface Signal Strength (channel 13), Signal Quality (channel 14), Surface/Noise Margin (channel 15), and Vapor DC (channel 16).

AI Block	TB Channel Value	Process Variable
Level	1	CHANNEL_RADAR_LEVEL
Ullage	2	CHANNEL_RADAR_ULLAGE
Level Rate	3	CHANNEL_RADAR_LEVELRATE
Signal Strength	4	CHANNEL_RADAR_SIGNAL_STRENGTH
Volume	5	CHANNEL_RADAR_VOLUME
Internal Temperature	6	CHANNEL_RADAR_INTERNAL_TEMPERATURE
Upper Product Volume	7	CHANNEL_UPPER_PRODUCT_VOLUME
Lower Product Volume	8	CHANNEL_LOWER_PRODUCT_VOLUME
Interface Distance	9	CHANNEL_INTERFACE_DISTANCE
Upper Product Thickness	10	CHANNEL_UPPER_PRODUCT_THICKNESS
Interface Level	11	CHANNEL_INTERFACE_LEVEL
Interface Level Rate	12	CHANNEL_INTERFACE_LEVELRATE
Interface Signal Strength	13	CHANNEL_INTERFACE_SIGNALSTRENGTH
Signal Quality	14	CHANNEL_SIGNAL_QUALITY
Surface/Noise Margin	15	CHANNEL_SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

### L\_TYPE

The L\_TYPE parameter defines the relationship of the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature) to the desired output of the AI Block. The relationship can be direct or indirect root.

#### Direct

Select direct when the desired output will be the same as the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Internal Temperature).

#### Indirect

Select indirect when the desired output is a calculated measurement based on the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Internal Temperature). The relationship between the transmitter measurement and the calculated measurement will be linear.

### **Indirect Square Root**

Select indirect square root when the desired output is an inferred measurement based on the transmitter measurement and the relationship between the sensor measurement and the inferred measurement is square root (e.g. level).

### **XD\_SCALE and OUT\_SCALE**

The XD\_SCALE and OUT\_SCALE each include three parameters: 0%, 100%, and engineering units. Set these based on the L\_TYPE:

#### **L\_TYPE is Direct**

When the desired output is the measured variable, set the XD\_SCALE to represent the operating range of the process. Set OUT\_SCALE to match XD\_SCALE.

#### **L\_TYPE is Indirect**

When an inferred measurement is made based on the sensor measurement, set the XD\_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD\_SCALE 0 and 100% points and set these for the OUT\_SCALE.

#### **L\_TYPE is Indirect Square Root**

When an inferred measurement is made based on the transmitter measurement and the relationship between the inferred measurement and sensor measurement is square root, set the XD\_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD\_SCALE 0 and 100% points and set these for the OUT\_SCALE.



**Engineering Units**

**NOTE!**

To avoid configuration errors, only select Engineering Units for XD\_SCALE and OUT\_SCALE that are supported by the device.

The supported units are:

Table 5-4. Length

Display	Description
m	meter
cm	centimeter
mm	millimeter
ft	feet
in	inch

Table 5-5. Level Rate

Display	Description
m/s	meter per second
m/h	meter per hour
ft/s	feet per second
in/m	inch per minute

Table 5-6. Temperature

Display	Description
°C	Degree Celsius
°F	Degree Fahrenheit

Table 5-7. Signal Strength

Display	Description
mV	millivolt

Table 5-8. Volume

Display	Description
m <sup>3</sup>	Cubic meter
L	Liter
in <sup>3</sup>	Cubic inch
ft <sup>3</sup>	Cubic feet
Yd <sup>3</sup>	Cubic yard
Gallon	US gallon
ImpGall	Imperial gallon
Bbl	Barrel (oil, 42 US gallons)

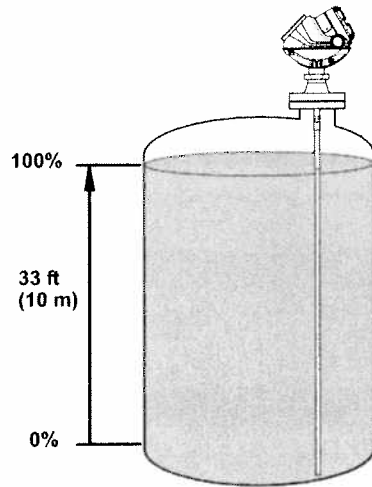
# Rosemount 5300 Series

## Application Example 1

### Radar Level Transmitter, Level Value

A level transmitter is measuring the level in a 33 ft. (10 m) high tank.

Figure 5-12. Situation Diagram



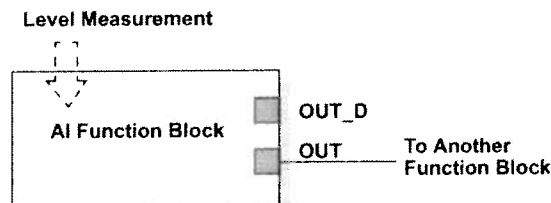
### Solution

Table 5-9 lists the appropriate configuration settings, and Figure 5-13 illustrates the correct function block configuration.

Table 5-9. Analog Input Function Block Configuration for a typical Level Transmitter

Parameter	Configured Values
L_TYPE	Direct
XD_SCALE	Not Used
OUT_SCALE	Not Used
CHANNEL	CH1: Level

Figure 5-13. Analog Input Function Block Diagram for a typical Level Transmitter

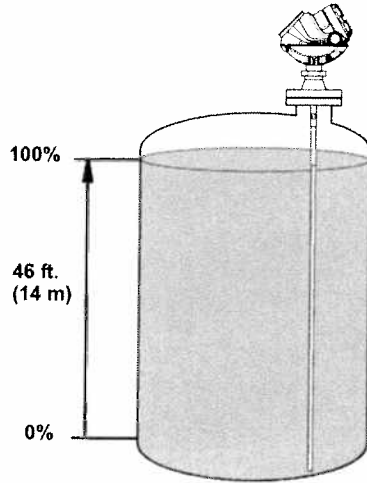


**Application Example 2**

**Radar Level Gauge, Level value in percent (%)**

The maximum level in the tank is 46 ft. (14 m). The level value is displayed in percentage of the full span (see Figure 5-14).

Figure 5-14. Situation Diagram



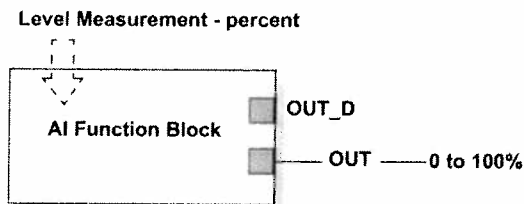
**Solution**

Table 5-10 lists the appropriate configuration settings, and Figure 5-15 illustrates the correct function block configuration.

Table 5-10. Analog Input Function Block Configuration for a Level Transmitter where level output is scaled between 0-100%

Parameter	Configured Values
L_TYPE	Indirect
XD_SCALE	0 to 14 m
OUT_SCALE	0 to 100%
CHANNEL	CH1: Level

Figure 5-15. Function Block Diagram for a Level Transmitter where level output is scaled between 0-100%

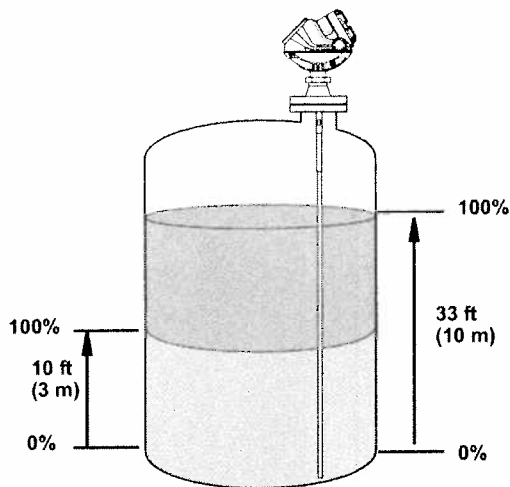


## Application Example 3

### Radar Level Transmitter, Product Level and Interface Level Value

A level transmitter is measuring the product level and the interface level in a 33 ft. (10 m) high tank. The maximum interface level is 10 ft. (3 m).

Figure 5-16. Situation Diagram



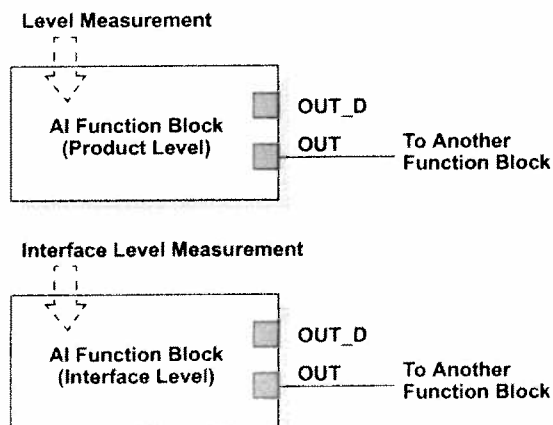
### Solution

Table 5-11 lists the appropriate configuration settings, and Figure 5-17 illustrates the correct function block configuration.

Table 5-11. Analog Input Function Block Configuration for a Level and Interface Transmitter

AI Function Block Product Level		AI Function Block Interface Level	
Parameter	Configured Values	Parameter	Configured Values
L_TYPE	Direct	L_TYPE	Direct
XD_SCALE	Not Used	XD_SCALE	Not Used
OUT_SCALE	Not Used	OUT_SCALE	Not Used
CHANNEL	CH1: Level	CHANNEL	CH11: Interface Level

Figure 5-17. Analog Input Function Block Diagram for a Level and Interface Transmitter



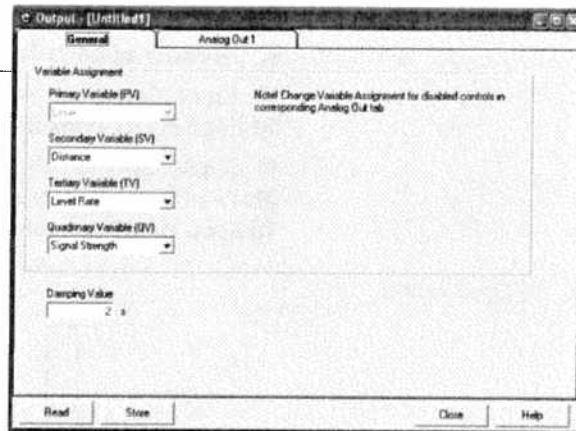
## TRI-LOOP HART TO ANALOG CONVERTER

The Rosemount 333 HART Tri-Loop HART-to-Analog Signal Converter is capable of converting a digital HART burst signal into three additional 4-20 mA analog signals.

To set the Rosemount 5300 transmitter up for the HART Tri-Loop:

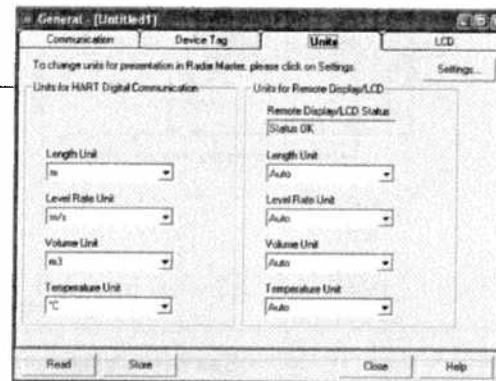
1. Make sure the Rosemount 5300 transmitter is properly configured.
2. Assign transmitter variables Primary Variable, Secondary Variable etc. HART command [2,1,1].  
RRM: Setup>Output/General.

Variables Assignment



3. Configure variable units: Length, Level Rate, Volume and Temperature. HART command [2,2,2,5].  
RRM: Setup>General/Units.

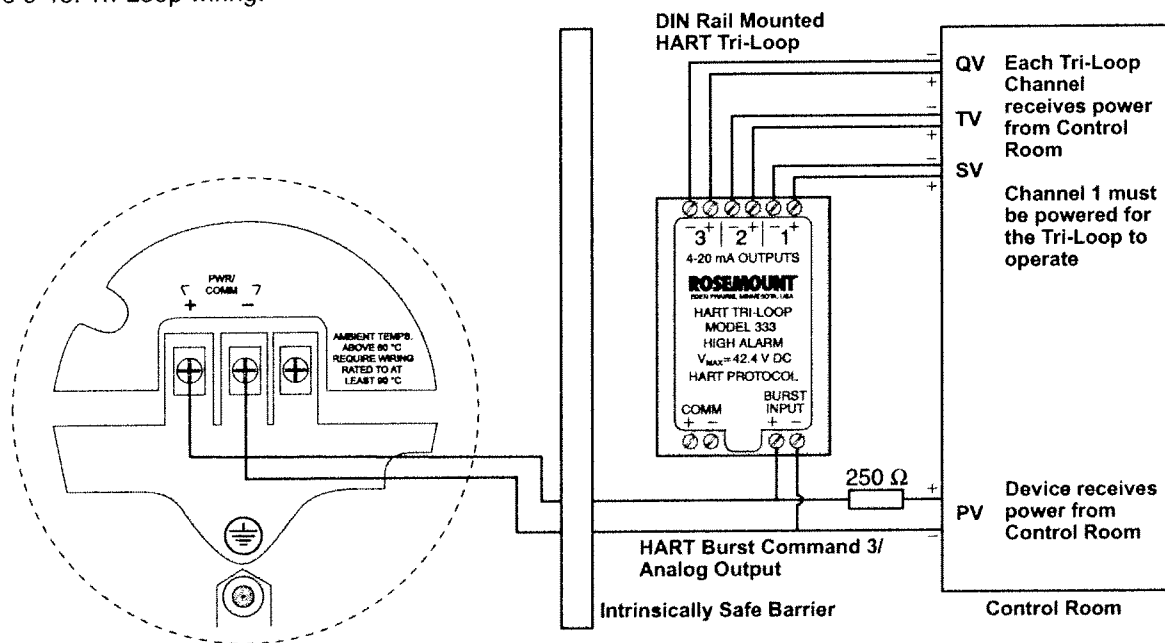
Variable Units



4. Set the 5300 in Burst mode.  
HART command [2,2,4,2].  
RRM: Setup>General/Communication.
5. Select Burst option 3=Process variables and current (Process vars/cmt).  
HART command [2,2,4,2,2].
6. Install the Tri-Loop. Connect Channel 1 wires, and optionally wires for Channel 2 and Channel 3.

7. Configure Tri-Loop Channel 1:
  - a. Assign variable: Tri-Loop HART command [1,2,2,1,1].  
Make sure that the SV, TV, and QV match the configuration of the 5300 transmitter.
  - b. Assign units: Tri-Loop HART command [1,2,2,1,2]. Make sure that the same units are used as for the 5300 transmitter.
  - c. Set the Upper Range Value and the Lower Range Value: Tri-Loop HART command [1,2,2,1,3-4].
  - d. Enable the channel. Tri-Loop HART command [1,2,2,1,5].
8. (Optional) Repeat steps a-d for Channels 2 and 3.
9. Connect wires to Tri-Loop Burst Input.
10. Enter the desired tag, descriptor, and message information:  
Tri-Loop HART command [1,2,3].
11. (Optional) If necessary, perform an analog output trim for Channel 1 (and Channel 2 and 3 if they are used).  
Tri-Loop HART command [1,1,4].

Figure 5-18. Tri-Loop wiring.



See the reference manual for the *Model 333 HART Tri-Loop HART-to-Analog Signal Converter* for further information on how to install and configure the Tri-Loop.

### To turn off the Burst Mode

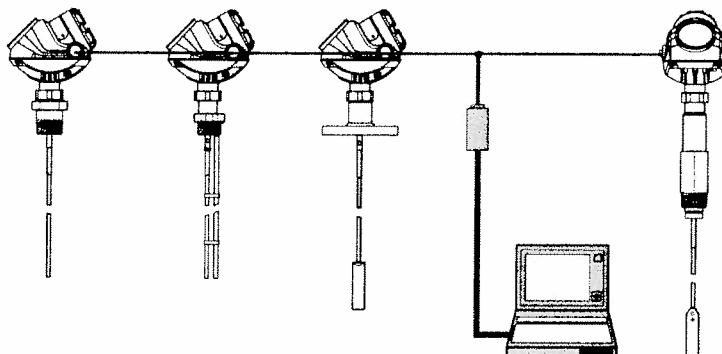
To turn off the Burst Mode, use one of the following options:

- The RRM program
- The Rosemount Burst Mode Switch software
- A 375 Field Communicator
- The AMS software

### HART MULTI-DROP CONFIGURATION

The 5300 transmitter can be run in multidrop mode. In the multidrop mode each transmitter has a unique HART address.

Figure 5-19. Multidrop connection

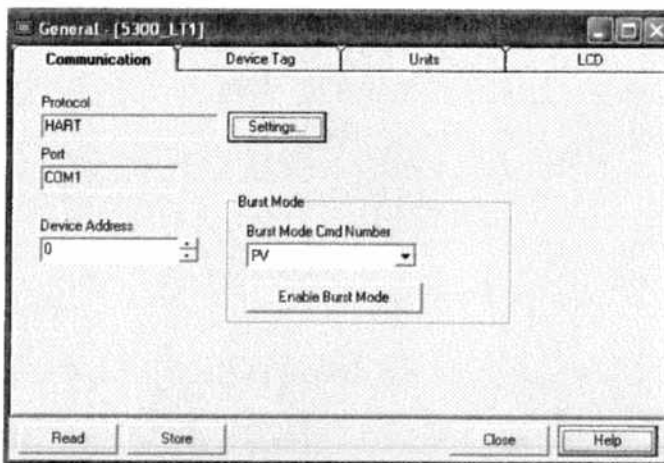


The poll address can be changed by using a 375 Field Communicator or by using the Rosemount Radar Master software.

To change the poll address using a 375 Field Communicator, choose HART command [2, 2, 4, 1].

To change the poll address using the Rosemount Radar Master (RRM) software:

1. Choose the Setup>General option.



2. Select the *Communication* tab.
3. Set the desired address (between 1 and 15 for multidrop operation).
4. Click the Store button to save the new address.

# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009



## Section 6 Operation

Safety Messages .....	page 6-1
Viewing Measurement Data .....	page 6-2

### SAFETY MESSAGES

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

#### ⚠ WARNING

**Failure to follow these installation guidelines could result in death or serious injury.**

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

**Explosions could result in death or serious injury.**

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

**Electrical shock could cause death or serious injury.**

- Use extreme caution when making contact with the leads and terminals.

**High voltage that may be present on leads could cause electrical shock:**

- Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

#### ⚠ WARNING

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson Process Management. Any continued use of product that has been damaged or modified without prior written authorization is at the customer's sole risk and expense.

# Rosemount 5300 Series

## VIEWING MEASUREMENT DATA

### Using the Display Panel

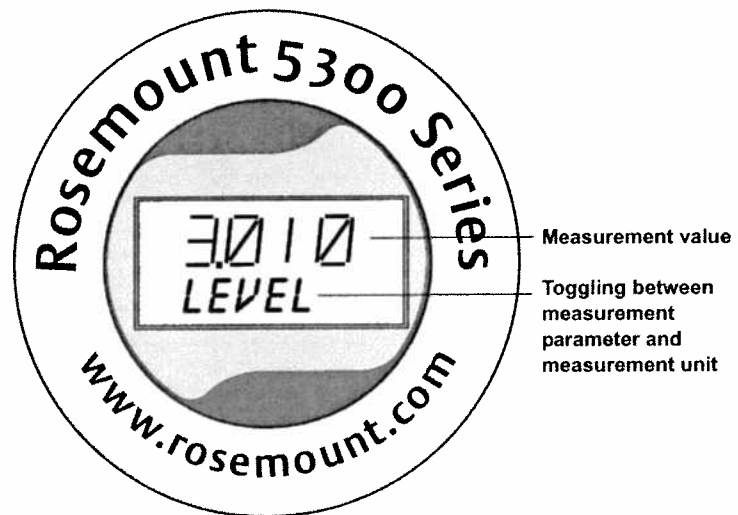
The Rosemount 5300 transmitter uses an optional Display Panel for presentation of measurement data. When the transmitter is switched on, the Display Panel presents information such as transmitter model, measurement frequency, software version, communication type (HART, FF), serial number, HART identification tag, setting of write protection switch, and Analog Output settings.

When the transmitter is up and running, the Display Panel presents Level, Signal Amplitude, Volume, and other measurement data depending on the Display Panel configuration (see "Specifying Display Panel Variables" on page 6-3). The available LCD parameters are listed in Table 6-1 on page 6-6.

The display has two rows, the upper row shows the measurement value and the lower row shows the parameter name and measurement unit. It toggles between the different measurement values every 2 seconds. The lower row toggles between parameter name and measurement unit each second.

Variables to be presented are configurable by using a 375 Handheld Communicator, AMS, DeltaV or the Rosemount Radar Master software.

Figure 6-1. The 5300 Display Panel.



Error messages are listed in section "LCD Error Messages" on page 7-42.

### Specifying Display Panel Variables

It is possible to specify the variables to be presented on the Display Panel (LCD).

#### Using a Handheld Communicator

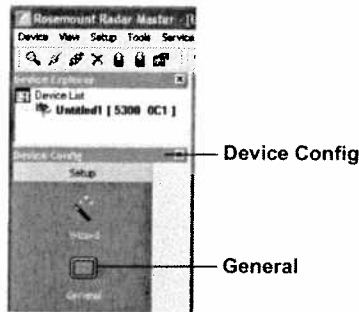
For a 375 Handheld Communicator, the LCD settings are available with: HART command [2, 2, 3].

FOUNDATION Fieldbus parameters:  
TRANSDUCER 1100>LCD\_PARAMETERS.

#### Using Rosemount Radar Master (RRM)

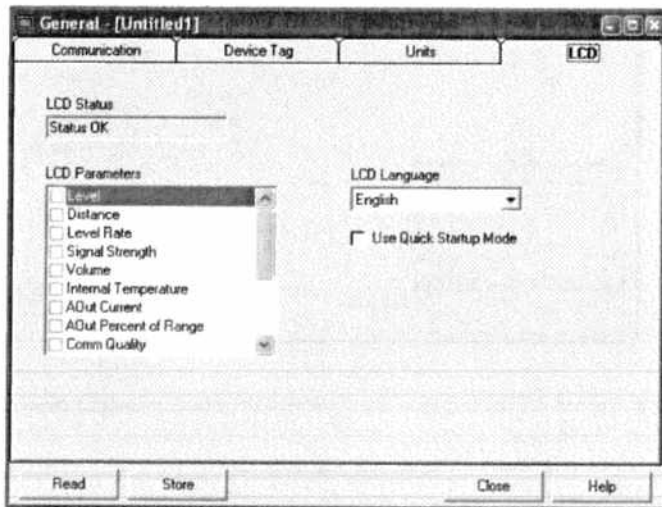
The LCD tab in the *General* window lets you specify which variables to view on the Display Panel screen:

1. Choose the **General** option from the **Setup** menu, or click the General icon in the Device Configuration window.



2. Select the **LCD** tab.

Figure 6-2. RRM lets you specify variables for the 5300 Display Panel.



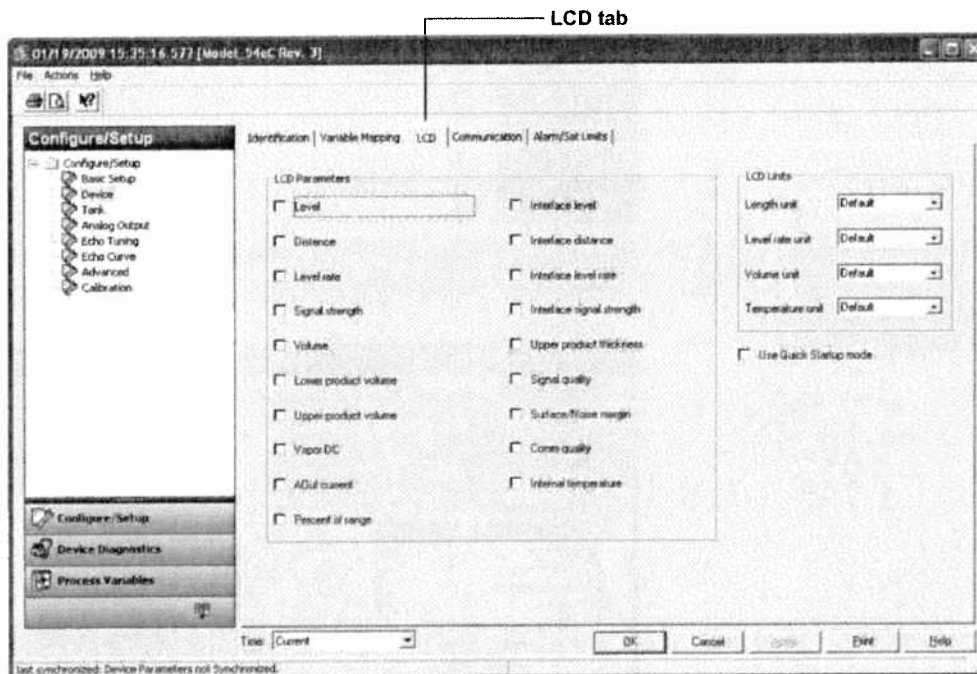
3. Select the variables to be shown on the display panel. The LCD will alternate between the selected items.  
The available LCD parameters are listed in Table 6-1 on page 6-6.
4. Click the **Store** button to save the LCD settings in the transmitter database.

## Using AMS

The LCD tab in the *Configure/Setup* window lets you specify which variables to view on the Display Panel screen:

1. Select the transmitter icon in the AMS Suite *Device Connection View* window.
2. Click the right mouse button and choose the **Configure/Setup/Device** option.
3. Select the LCD tab and choose the desired LCD parameters and LCD measurement units. The available LCD parameters are listed in Table 6-1 on page 6-6.
4. Click the OK button to save the configuration and close the window.

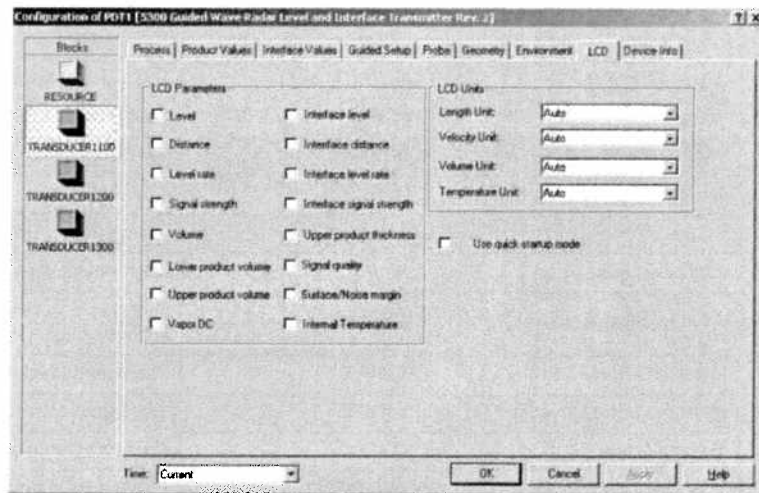
Figure 6-3. The LCD tab in the AMS Suite configuration window lets you configure parameters to be presented on the Display Panel.



**Using DeltaV**

1. Click the right mouse button on the transmitter icon and choose the **Properties** option.
2. Select the **Transducer1100** block.
3. Select the **LCD** tab.

Figure 6-4. The Transducer 1100 block lets you specify variables for the 5300 Display Panel.



4. Choose the variables you want to appear on the Display Panel and the corresponding measurement units.  
You can specify the same measurement units as selected in the *Product Values* tab and in the *Interface Values* tab by choosing the **Auto** option for the LCD Unit.  
The LCD will alternate between the selected display parameters.  
The available LCD parameters are listed in Table 6-1 on page 6-6.
5. Click the OK button to save the LCD settings in the transmitter database.

## LCD Parameters

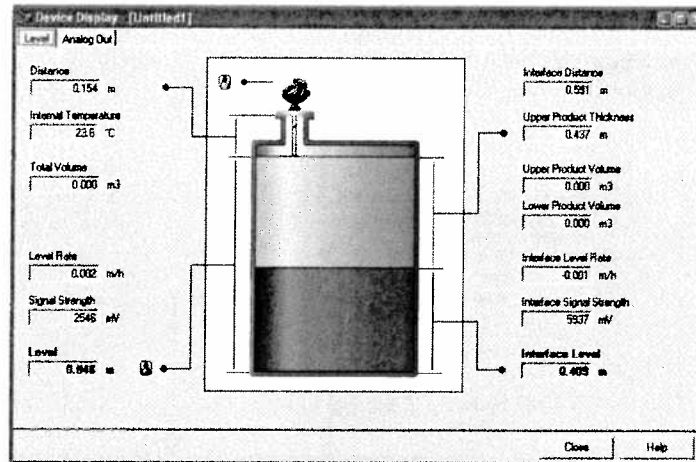
Table 6-1. LCD parameters and presentation on display

Parameter	Presentation on display	Description
Level	LEVEL	Product level.
Distance	DIST	Distance from the upper reference point to the product surface.
Level Rate	LRATE	The speed of level movement up or down.
Signal Strength	AMPL	The signal amplitude of the surface echo.
Volume	VOUME	Total product volume.
Internal Temperature	INTEMP	Temperature inside the transmitter housing.
Analog Output Current	ANOUT	4 -20 mA current.
Percent Range	%RANGE	Level value in percent of total measurement range.
Interface Level	IFLVL	Level of the lower product.
Interface Distance	IFDIST	Distance between the upper reference point and the interface between the upper and lower product.
Interface Level Rate	IFRATE	The speed of interface level movement up or down.
Interface Signal Strength	IFAMPL	The signal amplitude of the interface echo.
Volume Lower	VOL LO	Product volume of lower product.
Volume Upper	VOL UP	Product volume of upper product.
Upper Product Thickness	UPTKNS	Thickness of the upper product.
Signal Quality	SIG Q	The signal quality.
Surface/Noise Margin	SNM	The relationship between the surface peak amplitude and the strongest noise peak amplitude.
Vapor DC	VAP DC	The vapor dielectric constant.

### Viewing Measurement Data in RRM

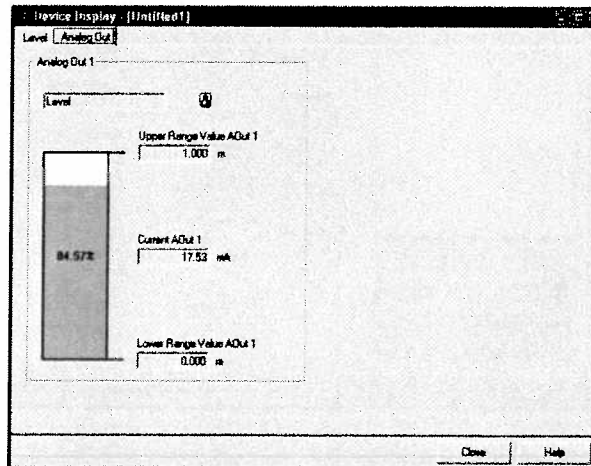
To view measurement data such as Level, Signal Strength, etc. in Rosemount Radar Master, choose the **Tools>Device Display** option and select the Level tab:

Figure 6-5. Presentation of measurement data in RRM.



To view the Analog Output signal, choose the **Tools>Device Display** option and select the Analog Out tab:

Figure 6-6. Presentation of Analog Output value in RRM.



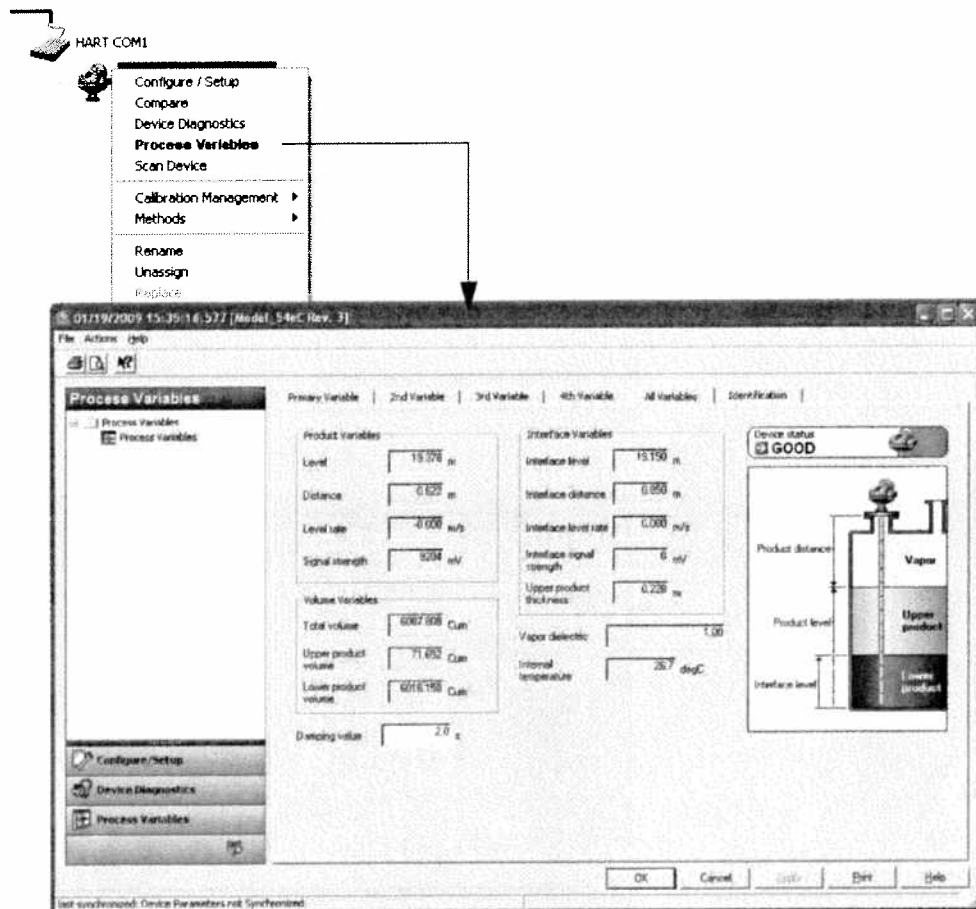
# Rosemount 5300 Series

## Viewing Measurement Data in AMS Suite

To view measurement data such as Level, Signal Strength, etc. in the AMS Suite:

1. Select the transmitter icon in the AMS Suite *Device Connection View* window.
2. Click the right mouse button and choose the **Process Variables** option.

Figure 6-7. Presentation of measurement data in AMS Suite.



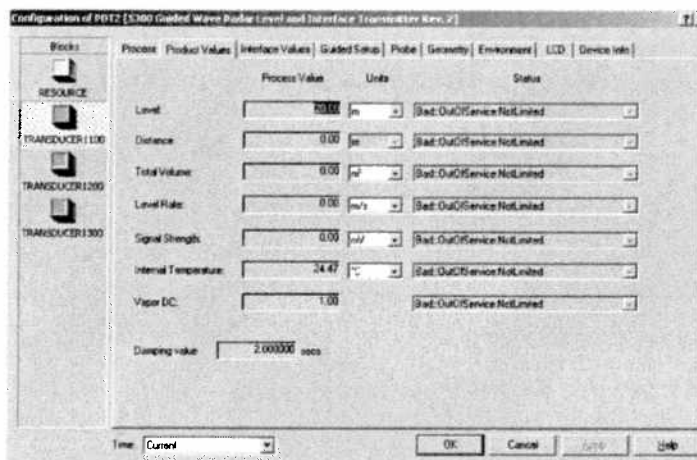


**Viewing Measurement Data in DeltaV**

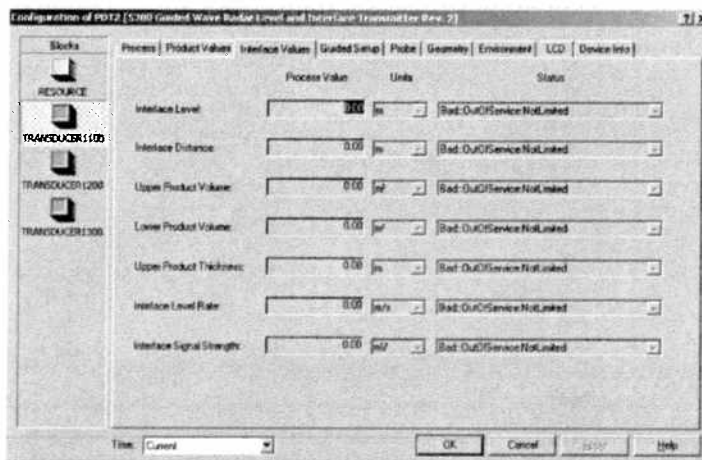
1. Click the right mouse button on the transmitter icon and choose the **Properties** option.
2. Select the **Transducer1100** block.
3. Select the **Product Values** tab.  
 For interface measurement, select the **Interface Values** tab.

Figure 6-8. Presentation of measurement data in DeltaV for the Rosemount 5300.

**Level values**



**Interface Level values**



# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

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## Section 7 Service and Troubleshooting

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Safety messages .....	page 7-1
Analyzing the Measurement Signal .....	page 7-3
Surface Pulse Not Found .....	page 7-5
Disturbance Echo Handling .....	page 7-7
Interface Pulse not Found .....	page 7-8
Using the Echo Curve Analyzer .....	page 7-10
Interface Measurements with Fully Submerged Probes ..	page 7-15
Analog Output Calibration .....	page 7-16
Level and Distance Calibration .....	page 7-17
Logging Measurement Data .....	page 7-19
Backing up the Transmitter Configuration .....	page 7-20
Configuration Report .....	page 7-21
Reset to Factory Settings .....	page 7-22
Diagnostics .....	page 7-23
Using the Simulation Mode .....	page 7-25
Write Protecting a Transmitter .....	page 7-26
Enter Service Mode in RRM .....	page 7-26
Viewing Input and Holding Registers .....	page 7-27
Removing the Transmitter Head .....	page 7-28
Changing a Probe .....	page 7-29
Diagnostic Messages .....	page 7-33
LCD Error Messages .....	page 7-42
LED Error Messages .....	page 7-43
Foundation Fieldbus Error Messages .....	page 7-44

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### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

**⚠ WARNING**

**Explosions could result in death or serious injury.**

Verify that the operating environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

**Failure to follow safe installation and servicing guidelines could result in death or serious injury.**

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

**High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the Rosemount 5300 Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

**Process leaks could result in death or serious injury.**

Make sure that the transmitter is handled carefully. If the Process Seal is damaged, gas might escape from the tank if the transmitter head is removed from the probe.

**⚠ WARNING**

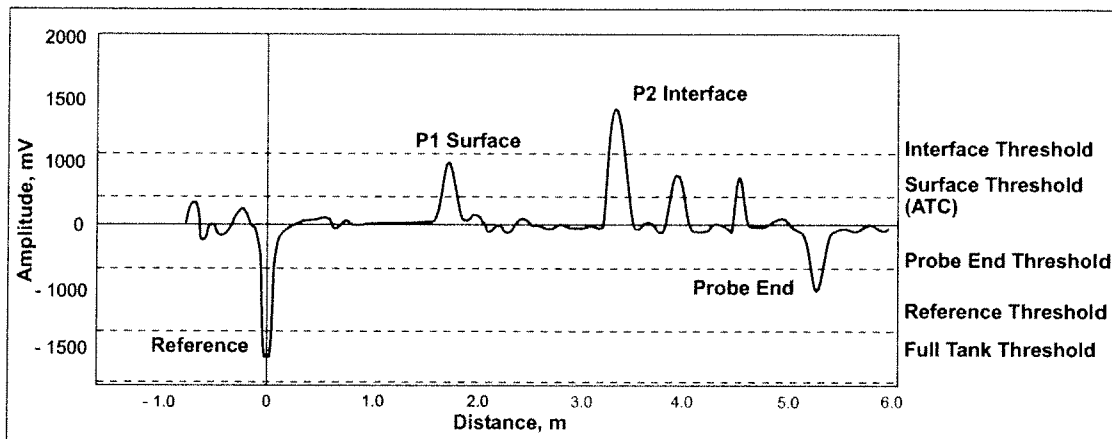
Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson Process Management. Any continued use of product that has been damaged or modified without prior written authorization is at the customer's sole risk and expense.

## ANALYZING THE MEASUREMENT SIGNAL

Rosemount Radar Master (RRM) and other tools using enhanced EDDL has powerful functions for advanced troubleshooting. Using the Echo Curve plot function, an instant view of the tank signal is shown. Measurement problems can be solved by studying the position and amplitude of the different pulses.

Figure 7-1. The Echo Curve presents all visible echoes



In a typical measurement situation, the following pulses appear in the diagram:

**Reference.** This pulse is caused by the transition between transmitter head and probe. It is used by the transmitter as a reference at level measurements. The pulse amplitude depends on the probe type and installation geometry.

**Product surface.** This pulse is caused by a reflection on the product surface.

**Interface.** This pulse is caused by reflection on the interface between an upper product and a bottom product with a relatively high dielectric constant. This pulse is shown when the transmitter is in Measurement Mode=Level & Interface.

**Probe End.** It is caused by reflection on the probe end. If the probe is grounded, the pulse will be positive.

Different amplitude thresholds are used to filter out unwanted signals and to pick up the different pulses. The transmitter uses certain criteria to decide which type of pulse that is detected.

For example, counting from the top of the tank, the first echo found above the Surface Threshold is considered as the product surface. Other pulses further away from the top, although above the Surface Threshold, are ignored.

When the surface echo is found, the next pulse below the product surface and with a signal strength above the Interface Threshold, is considered as the Interface.

The following amplitude thresholds are used for the Rosemount 5300 Series transmitter:

**Reference Threshold** - amplitude threshold for detection of the Reference pulse.

## Rosemount 5300 Series

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**Surface Threshold** - amplitude threshold for detection of the Product level peak. The surface threshold is designed as a number of individually adjustable amplitude threshold points, the *Amplitude Threshold Curve* (ATC), see "Amplitude Threshold Curve" on page 7-7.

**Interface Threshold** - amplitude threshold for detection of the Interface level peak.

**Full Tank Threshold** - amplitude threshold that can be used to detect whether the probe is fully submerged in the upper product or not.

**Probe End Threshold** - amplitude threshold for detection of the Probe End peak.

Thresholds are recommended to be set to approximately 50% of the signal peak amplitude. To adjust the **Amplitude Thresholds** see "Using the Echo Curve Analyzer" on page 7-10.

## SURFACE PULSE NOT FOUND

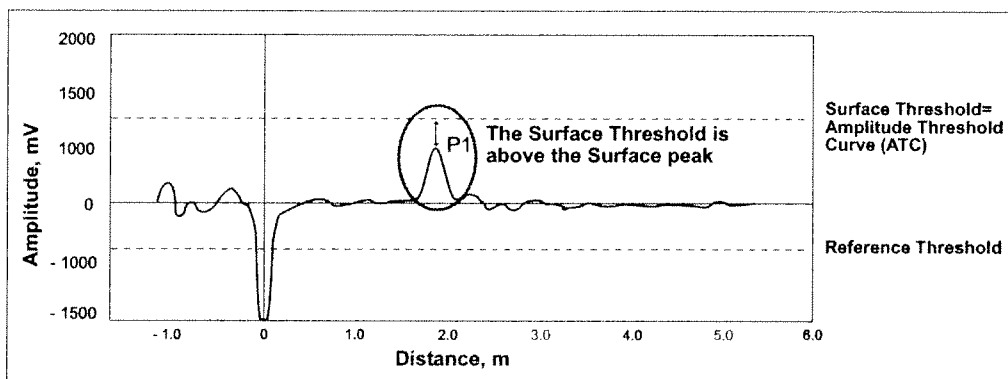
The amplitude thresholds are automatically adjusted to appropriate values to filter out noise and other non-valid measurements from the measurement signal.

The amplitude of the measurement signal, i.e. the amplitude of the signal that is reflected by the product surface, is related to the actual dielectric constant of the product. The amplitude threshold that is used by the transmitter is based on the parameter configuration of the current product dielectric constant (see *"Basic Configuration Parameters"* on page 5-4). Normally no other threshold adjustment is needed, but if the transmitter still does not track the product surface correctly, it may be necessary to adjust the threshold values.

Rosemount Radar Master (RRM) has a plot function showing the reflections along the probe (see *"Using the Echo Curve Analyzer"* on page 7-10).

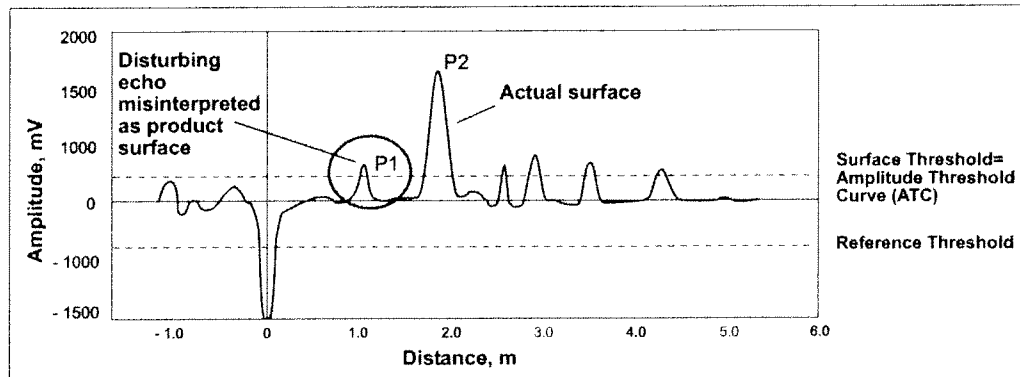
If the amplitude threshold is too high, the product level will not be detected as illustrated in Figure 7-2. In a situation like this, the amplitude threshold has to be lowered so that the Surface peak is not filtered out.

Figure 7-2. Example 1: surface threshold is too high.



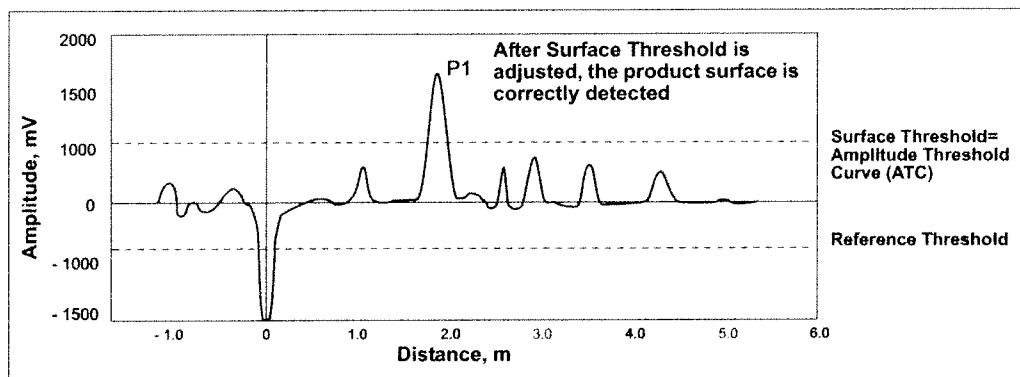
If there are disturbing objects in the tank, the threshold must be carefully set to avoid locking on the wrong amplitude peak. In Figure 7-3, the transmitter has locked on a peak above the actual product surface, i.e. a disturbance was interpreted as the product surface, whereas the actual product surface was interpreted as the interface or the probe end.

Figure 7-3. Example 2: surface threshold is too low.



By adjusting the surface threshold the product surface is properly detected as illustrated in Figure 7-4:

Figure 7-4. Echo Curve after surface threshold was adjusted



To adjust the amplitude thresholds, see “Using the Echo Curve Analyzer” on page 7-10.

In the *Echo Curve Analyzer* in RRM, the amplitude thresholds can be easily dragged to the desired values.

The surface and interface thresholds should be set to about 50% of the measured signal amplitude of the product surface and the interface peaks, respectively.

**NOTE!**

For interface measurements, check that the Upper Dielectric Constant parameter setting is set to the actual dielectric constant value of the upper product before changing the amplitude thresholds.

## Probe End Projection

Probe End Projection allows you to measure product level when the surface pulse is too weak to be detected. For example, long measuring range and products with very poor reflectivity (low dielectric constant).

See *Appendix C: Advanced Configuration* for information on how to use the Probe End Projection function in *Rosemount Radar Master*.



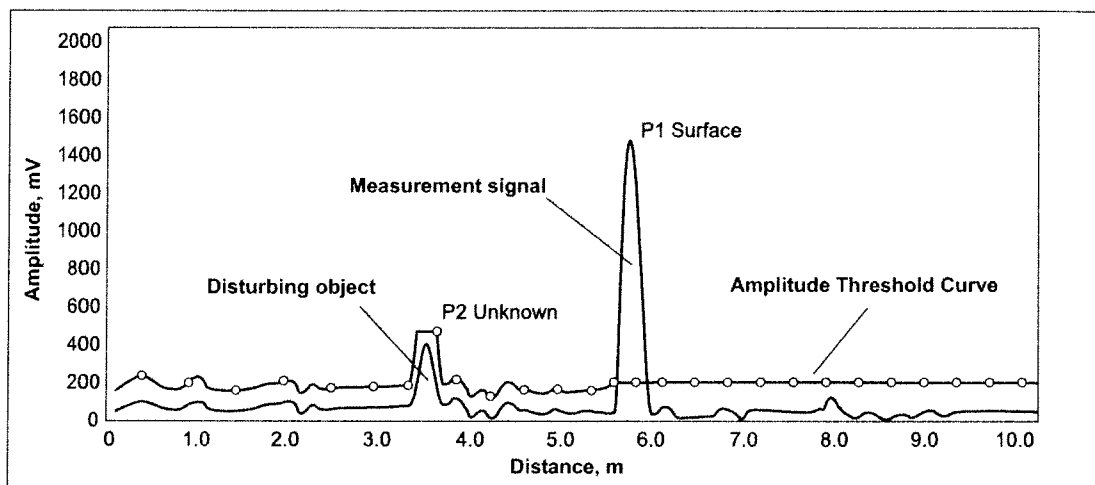
## DISTURBANCE ECHO HANDLING

When the Basic Configuration is done, the transmitter may need a fine-tuning to handle disturbing objects in the tank. The Amplitude Threshold Curve (ATC) function can be used for disturbance echo handling with the Rosemount 5300 Series transmitter.

### Amplitude Threshold Curve

As shown in Figure 7-5, the ATC can be designed to filter out single disturbing echoes by adapting the curve around the corresponding amplitude peak. It is important in this case that the disturbance is fixed at a certain tank level. Disturbing echoes which may appear different from time to time can be filtered out by raising the whole ATC.

Figure 7-5. Disturbing echoes can be filtered out by creating an amplitude threshold.



### Disturbances at the Top of the Tank

In addition to using the ATC, the Rosemount 5300 transmitter supports alternative methods to filter out disturbances at the top of the tank, such as the *Trim Near Zone* and the *Upper Null Zone* functions, which can be used to handle disturbances from narrow nozzles or nozzles with rough edges. See "Handling of Disturbances from Nozzle" on page C-4 for more information.

**INTERFACE PULSE NOT FOUND**

In interface applications where the bottom product has a relatively low dielectric constant (<40), or if the signal is attenuated in the upper product, the amplitude of the reflected signal is relatively low and difficult for the transmitter to detect. In such cases, it may be possible to detect the reflected signal if the corresponding amplitude threshold is adjusted.

The Rosemount Radar Master (RRM) lets you view a waveform plot to analyze the measurement signal. The plot shows the signal and the thresholds used for the different amplitude peaks. By adjusting the Interface Threshold, it is possible to detect even weak interface signals.

Guidelines for amplitude threshold settings:

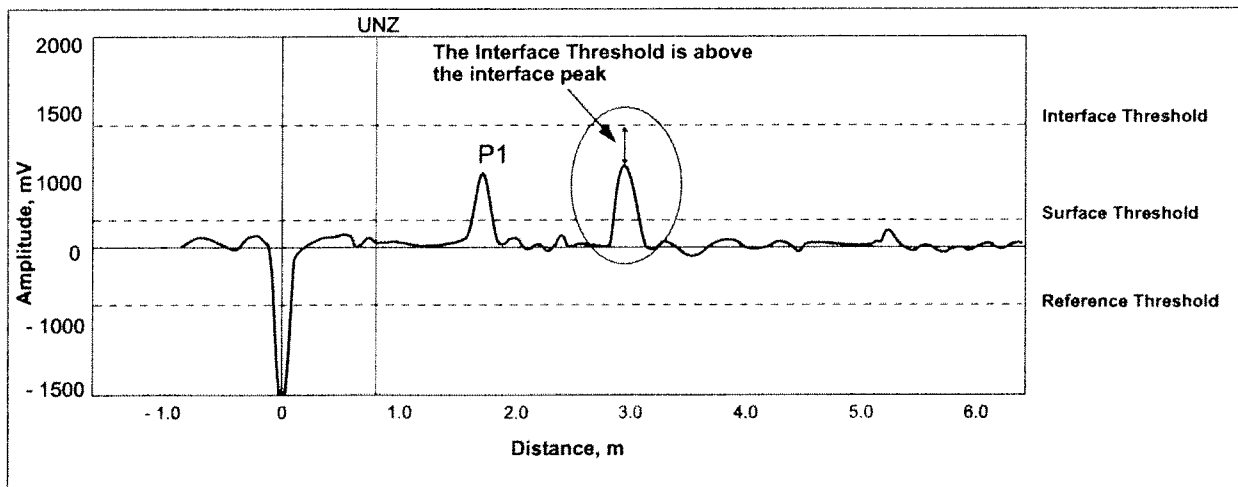
- The Interface Threshold should be approximately 50% of the interface signal amplitude.
- If possible, the Interface Threshold should be higher than the Surface Threshold.

You can use the RRM software or a 375 Field Communicator to change the amplitude thresholds. See "Using the Echo Curve Analyzer" on page 7-10 for more information.

If the Lower Product Dielectric Constant is known, the corresponding configuration parameter can be changed as an alternative to adjusting the amplitude thresholds. See also "Dielectric Constant Settings" on page C-14.

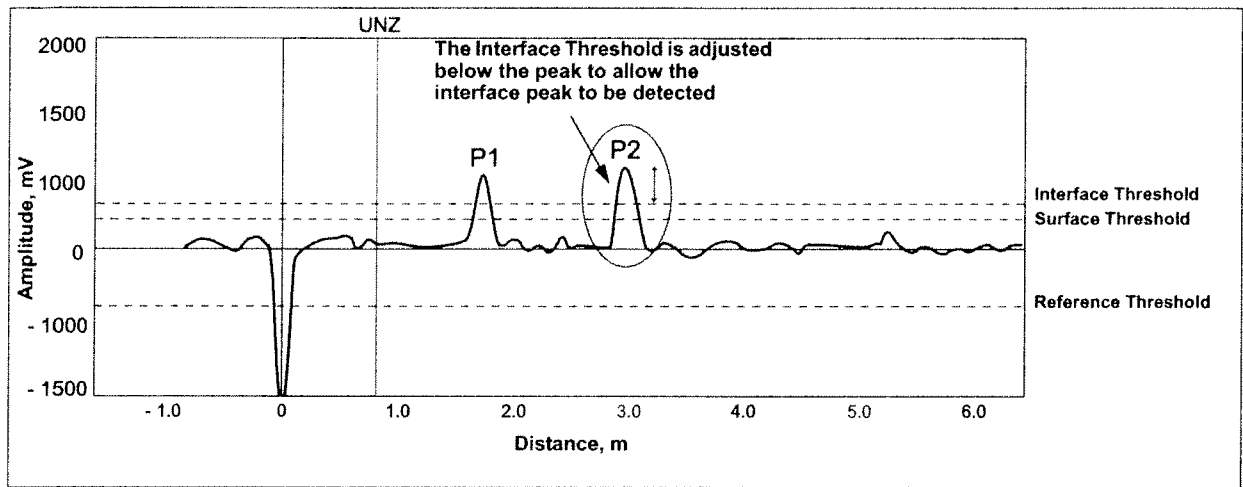
Figure 7-6 illustrates a situation where the Interface Threshold is too high. The signal amplitude peak at the interface between the upper and lower products is not detected in this case.

Figure 7-6. Echo Curve plot indicating that the amplitude threshold for the interface peak is too high.



By adjusting the Interface Threshold, the peak at the interface between the upper and lower products is detected as illustrated in Figure 7-7:

Figure 7-7. After changing the amplitude threshold the transmitter detects the interface



**Signal Quality Metrics**

Build up on the probe and different surface conditions are factors that can affect signal and noise levels. Signal Quality Metrics can give an indication of how good the surface signal is compared to the noise. See Signal Quality Metrics page C-18 in Appendix C: Advanced Configuration.

# Rosemount 5300 Series

## USING THE ECHO CURVE ANALYZER

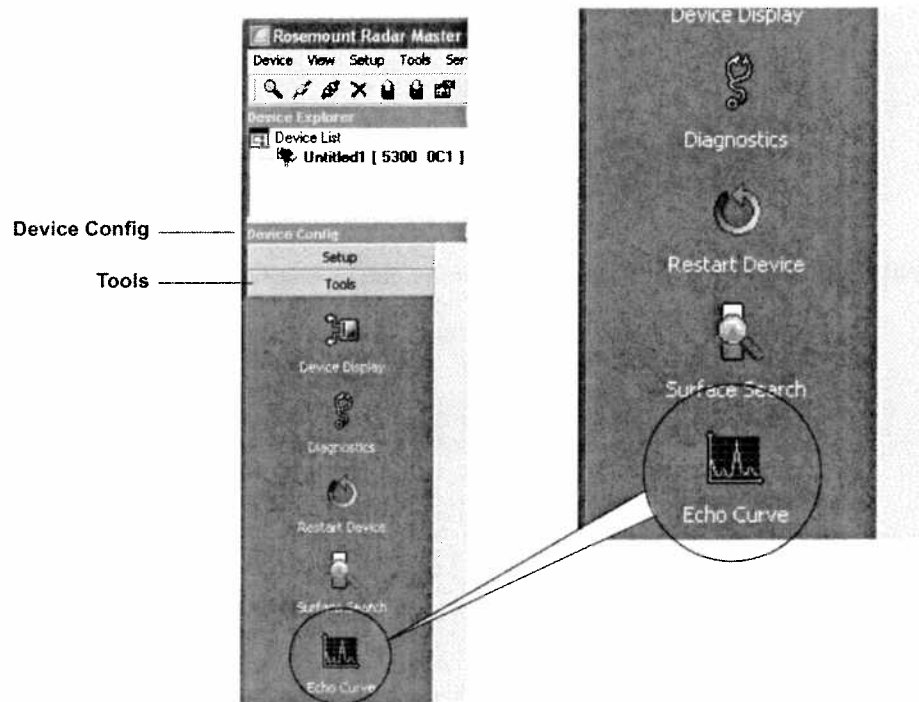
The *Echo Curve Analyzer* in *Rosemount Radar Master* (RRM) shows the measurement signal amplitude from the top to the bottom of the tank. It includes functions for viewing and recording the Echo Curve, and advanced functions for configuration of amplitude thresholds

### Using the Rosemount Radar Master

To plot the measurement signal:

1. Start RRM.
2. Open Device Config/Tools (or Device Config/Setup).
3. Click the Echo Curve icon (see Figure 7-8).

Figure 7-8. The Echo Curve function is a useful tool for signal analysis.

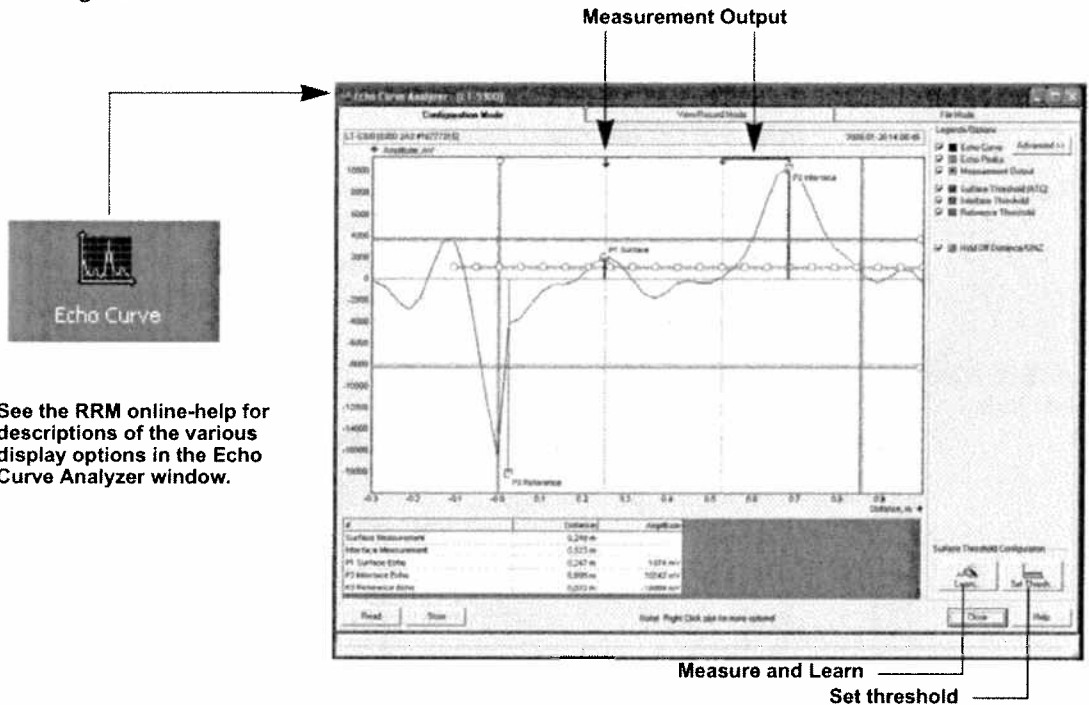


4. The *Echo Curve Analyzer* window appears with the **View/Record Mode** tab (or the **Configuration Mode** tab) selected.

**The Configuration Mode Tab**

The Configuration Mode tab lets you adjust the different amplitude thresholds. When clicking the **Echo Curve** icon under Device Config/Setup, the *Echo Curve Analyzer* window appears with the **Configuration Mode** tab selected:

Figure 7-9. Echo Curve Analyzer plot in Configuration mode.



See the RRM online-help for descriptions of the various display options in the Echo Curve Analyzer window.

The **Measure and Learn** function in *RRM* automatically creates an Amplitude Threshold Curve (ATC) which is used by the Rosemount 5300 transmitter to find the surface pulse. The ATC is adapted to the shape of the measurement signal as described in "Disturbance Echo Handling" on page 7-7.

To create an Amplitude Threshold Curve (ATC), click the **Learn** button in the *Echo Curve Analyzer/Configuration Mode* window. By clicking the **Learn** button, the Measure and Learn function is activated, which creates an ATC that filters out all disturbing echoes. The ATC can also be manually edited if further fine tuning is needed.

The *Configuration Mode* window also allows you to manually change the amplitude thresholds simply by dragging the corresponding anchoring points in the plot to the desired positions. This option can be used to change the Interface Threshold.

Note that by manually changing the amplitude thresholds in the Echo Curve plot, the Automatic mode is disabled for the corresponding threshold (see "Threshold Settings" on page C-8 for more information).

See "Surface Pulse Not Found" on page 7-5 for more information on threshold settings.

The **Set Thresholds** button allows you to set the ATC to a fixed value based on the configured Dielectric Constant of the product.

See also "Threshold Settings" on page C-8 for more information on how to adjust amplitude thresholds.

# Rosemount 5300 Series

The current level **Measurement Output** from the device is presented with an arrow at the top of the plot.

Normally, the measurement output points directly at the surface echo peak, but if, for instance, the tank is empty, and there is no surface echo peak detected, the Measurement Output is still presented indicating the distance to the tank bottom.

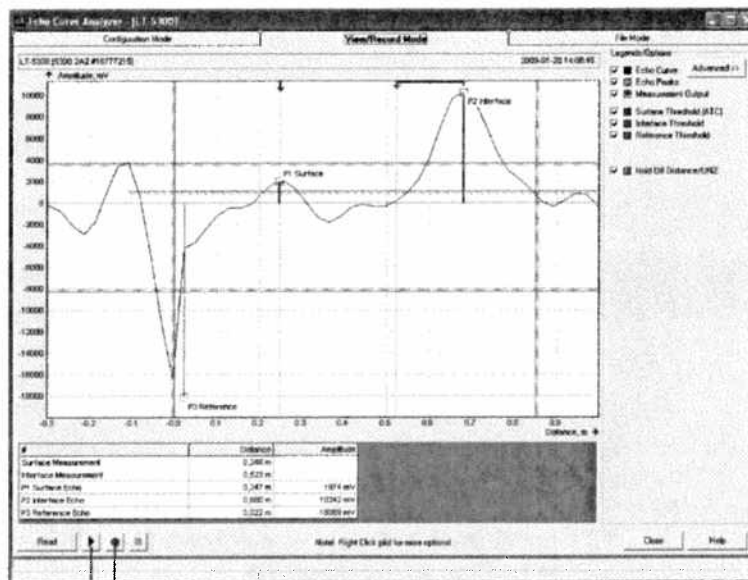
In Figure 7-10, the interface output peak is pointing to the linear distance based on corrections for the dielectric of the material. The actual interface peak is at the electrical distance.

## The View/Record ModeTab

The View/Record Mode tab presents a plot of the current tank conditions. Each radar echo is displayed as a peak in the signal plot.

When clicking the **Echo Curve** icon under Device Config/Tools, the *Echo Curve Analyzer* window appears with the **View/Record Mode** tab selected:

Figure 7-10. An Echo Curve plot in View/Record mode.



Record tank spectra  
 Play (continuously updates the spectrum)

### Advanced

The Advanced button opens a list below the Echo Curve plot with information about all echoes in the tank such as signal amplitude and position in the tank.

### Play

When the Play button is clicked, the tank spectrum is continuously updated without being stored.

### Record Tank Spectra

This function allows you to record tank spectra over time. This can be a useful function if, for example, you want to study the tank signal when filling or emptying the tank.

### The File ModeTab

The **File Mode** tab lets you open files with saved snapshots/movies to be presented in the spectrum plot. A movie file can be played to view the amplitude plot at the desired update rate.

### Using the Echo Curve Analyzer with a 375 Field Communicator

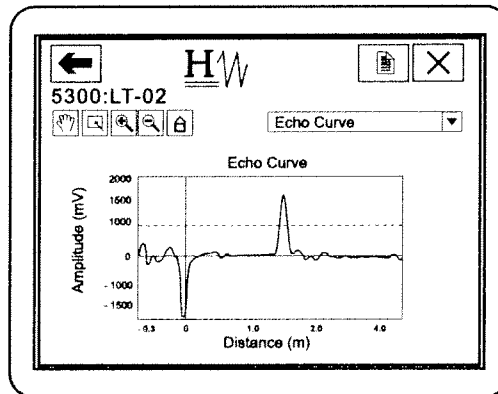
The 375 Field Communicator supports the Electronic Device Description Language (EDDL) with enhancements that allows you to view the Echo Curve, create an Amplitude Threshold Curve (ATC) and specify amplitude thresholds such as the Surface Threshold, Interface Threshold, and Reference Threshold.

#### Viewing the Echo Curve

To view the Echo Curve:

1. Select HART command [2, 6, 1].  
FOUNDATION Fieldbus parameter:  
TRANSDUCER 1300>AMPLITUDE\_THRESHOLD\_CURVE

The Echo Curve appears on the display:



2. Use the Hand and Zoom tools to view specific parts of the Echo Curve. The drop down list allows you choose items, such as the different amplitude thresholds, to be displayed in the plot.

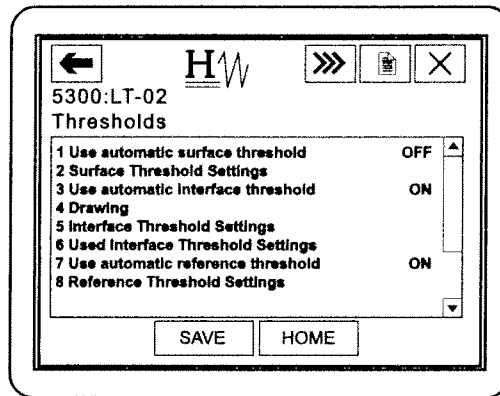
The Echo Curve plot also shows an ATC if available. See *“Threshold Settings”* on page 7-13 for information on how to create an ATC with the *Measure and Learn* function.

#### Threshold Settings

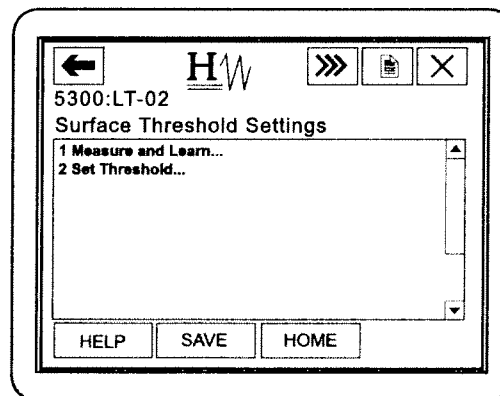
To adjust the amplitude thresholds:

1. Select HART command [2, 5, 2].  
FOUNDATION Fieldbus parameter:  
TRANSDUCER 1300>PROBE\_END\_THRESH  
TRANSDUCER 1300>REFERENCE\_THRESH  
TRANSDUCER 1300>INTERFACE\_THRESH  
TRANSDUCER 1300>FULL\_TANK\_THRESH\_OFFSET

The different threshold options appear on the display:



2. Open the desired option. For example, choosing option 2 *Surface Threshold Settings* displays the following screen:



3. Option 1 *Measure and Learn* lets you create an Amplitude Threshold Curve (ATC), see “*Amplitude Threshold Curve*” on page 7-7 for more information.  
Option 2 *Set Threshold* lets you specify a constant Surface Threshold.

See also “Analyzing the Measurement Signal” on page 7-3 and “Surface Pulse Not Found” on page 7-5 for more information on how to use the amplitude thresholds.

4. Click the SAVE button to store the new settings in the transmitter database.



## INTERFACE MEASUREMENTS WITH FULLY SUBMERGED PROBES

The Rosemount 5300 series has a measurement option which makes it possible to handle interface measurements when the probe is fully submerged into the upper product, see Figure 7-11, and only the interface level is detected by the transmitter. Even if the upper product level drops, it is ignored by the transmitter which continues to measure only the interface level, but the measurement accuracy is reduced since the transmitter does not take into account the influence of the air gap above the product surface. To achieve high accuracy in this measurement mode, the probe must be fully submerged, or a 5302 for Level and Interface measurements should be used.

The Measurement Mode parameter is available via the HART command [2, 3, 3].

FOUNDATION Fieldbus parameter: TRANSDUCER 1100>MEAS\_MODE

Choose the *Interface Level with Submerged Probe* option.

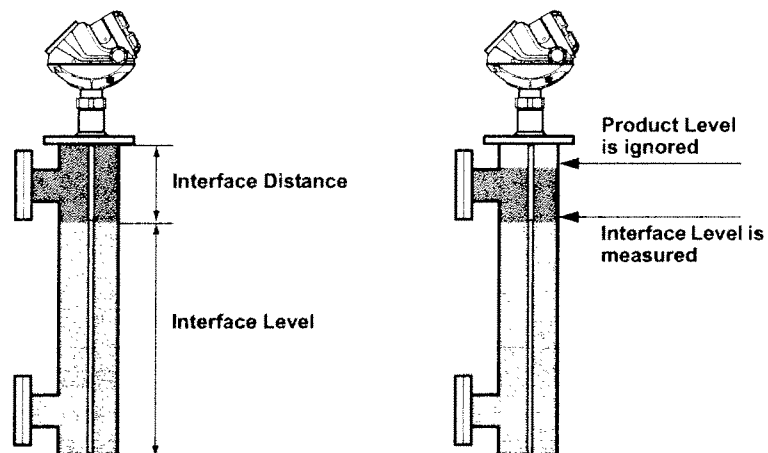
Measurement mode *Interface Level with Submerged Probe* can also be activated in the RRM software:

1. In the RRM workspace, click the Tank icon.
2. Select the Environment tab.
3. Select the Measurement Mode *Interface Level with Submerged Probe* option.
4. Click the OK button.

### NOTE!

Do not use Measurement Mode *Interface Level with Submerged Probe* in applications when both Interface Level and Product Level are available.

Figure 7-11. Interface Level measurements in a full chamber.



### NOTE!

Adjust Surface Threshold if the interface level pulse is not detected. Note that in Submerged Mode the interface is picked up by the Surface Threshold. See also "Using the Echo Curve Analyzer" on page 7-10.

# Rosemount 5300 Series

## ANALOG OUTPUT CALIBRATION

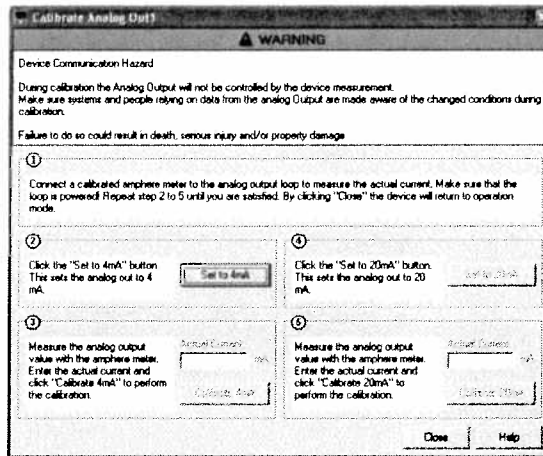
This function lets you calibrate the Analog Output by comparing the actual output current with the nominal 4 mA and 20 mA currents. Calibration is done at the factory and normally the transmitter does not need to be recalibrated.

The Analog Output Calibration function is available via the HART command [2, 8, 1].

In RRM, this function is available via Setup>Output.

To calibrate the Analog Output current:

1. Start RRM and make sure that the transmitter communicates with the PC (see Section 5: Basic Configuration Using Rosemount Radar Master).
2. Click the **Output** icon in the Device Config/Setup toolbar.
3. Select the **Analog Out** tab in the *Output* window.
4. Click the Calibrate DAC button.



5. Follow the instructions to calibrate the 4 mA and the 20 mA outputs.

## LEVEL AND DISTANCE CALIBRATION

Level and distance calibration may be necessary when using a nozzle or pipe or if there are disturbances in the near zone caused by a physical object.

Non-metallic (e.g. plastic) vessels and installation geometry may introduce an offset for the zero reference point. This offset may be up to  $\pm 25$  mm. The offset can be compensated for using Distance Calibration.

When calibrating the transmitter, it is important that the product surface is calm and that the tank is not being filled or emptied.

A complete calibration is performed in two steps:

1. Calibrate the Distance measurement by adjusting the Calibration Offset parameter.
2. Calibrate the Level measurement by adjusting the Tank Height.

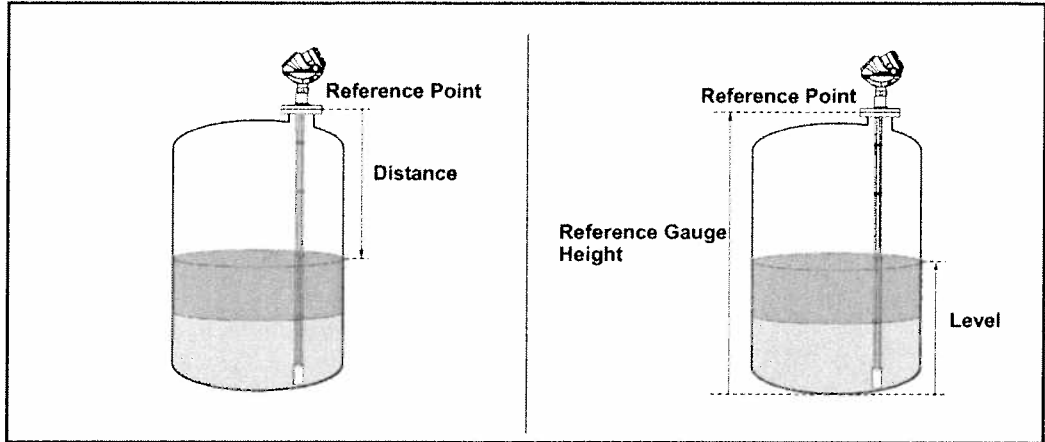
### Distance calibration

1. Measure the actual distance between the Upper Reference Point and the product surface.
2. Adjust the **Calibration Distance** so that the Distance measured by the transmitter corresponds to the actual distance.  
The Calibration Distance parameter is available via HART command [2, 3, 2, 4, 1],  
or  
RRM:
  - a. Click the **Tank** icon under Device Config/Setup in the RRM workspace.
  - b. In the *Tank* window, select the *Geometry* tab.
  - c. Click the **Advanced** button.
  - d. Enter the desired value in the **Calibration Distance** field and click the Store button.

### Level calibration

1. Measure the actual Product Level.
2. Adjust the **Tank Height** so the product level measured by the transmitter corresponds to the actual product level.

Figure 7-12. Distance and Level calibration

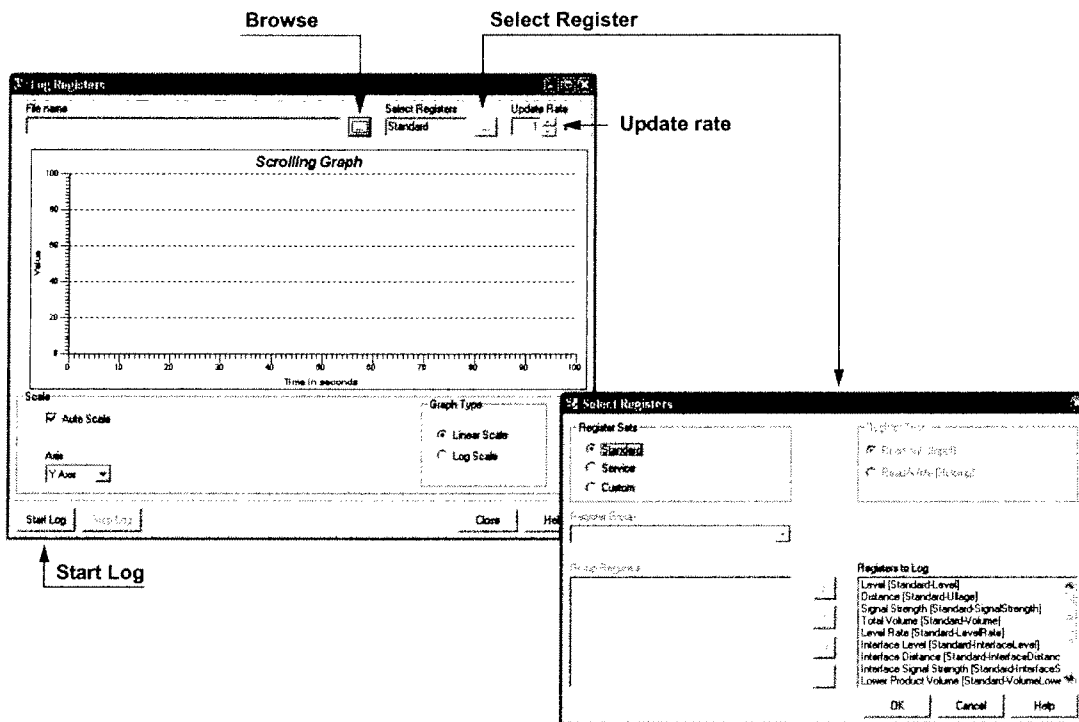


### LOGGING MEASUREMENT DATA

By using the Log Device Registers function in the RRM software, you can log Input and Holding registers over time. It is possible to choose from different pre-defined sets of registers. This function is useful for verifying that the transmitter works properly.

To log device registers, choose the **Tools>Log Device Registers** option to open the *Log Registers* window:

Figure 7-13. The Log Registers function can be used to verify that the transmitter works properly.



To start logging:

1. Click the Browse button, select a directory to store the log file, and type a log file title.
2. Click the Select Register button and choose register type to be logged.
3. Select the desired registers to be logged. There are three options available: Standard, Service, and Custom. Standard and Service refer to pre-defined sets of registers. The Custom option lets you choose the desired range of registers.
4. Enter the update rate. An update rate of for example 10 seconds means that the plot will be updated every 10 seconds.
5. Click the Start Log button. The logging will proceed until stopped by clicking the Stop Log button.

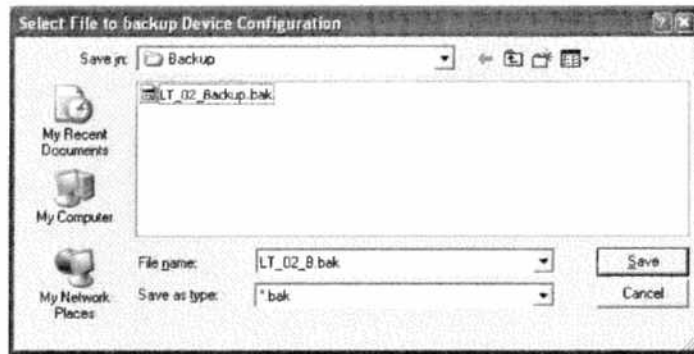
## BACKING UP THE TRANSMITTER CONFIGURATION

Use this RRM option to make a backup copy of the configuration parameters in the transmitter database. The backup file can be used to restore the transmitter configuration. It can also be used for configuration of a transmitter in a similar application. Parameters in the saved file can be uploaded directly to the new device.

The backup function is available from the *Device* menu in RRM:

1. From the **Device** menu, choose the **Backup Config to File** option.
2. Browse to the desired directory:

Figure 7-14. It is recommended that the transmitter configuration is stored in a backup file.



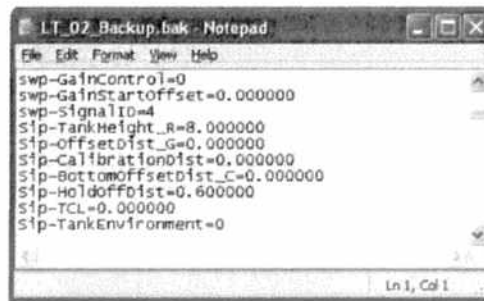
3. Type a name of the backup file and click the **Save** button. Now the transmitter configuration is stored. The backup file can be used at a later stage to restore a configuration which has been accidentally changed. The backup file can also be used to quickly configure transmitters which are installed on similar tanks. To upload a backup configuration, choose the **Upload Config to Device** option from the **Device** menu.

The backup file can be viewed by using the **Backup File Reader** which is installed with the RRM software:



4. The backup file can also be viewed as a text file in a word processing program such as the Notepad:

Figure 7-15. The configuration backup file can be viewed in a word processor program.



See also "Configuration Report" on page 7-21 for further information on viewing backup files.

**CONFIGURATION REPORT**

This function in RRM shows what configuration changes have been done to the transmitter compared to the factory configuration. The report compares a specified backup file with the default transmitter configuration.

To open the Configuration Report, choose the **Tools>Configuration Report** menu option:

Figure 7-16. The Configuration Report window in RRM.

Parameter	Value	Unit
<b>Device Information</b>		
Protocol		HART
Address		0
Device Tag		LT-02
Device Type		5300
Version		0C2
Unit ID		16777215
<b>Factory Setup</b>		
MyAddress1		-1
Tst		1.814 m
Rel Impulse Ampl		16.299999
Timing Calb		205
Nom Ref Pulse Dist		1.960 m
Nom Ref Pulse Ampl		807 mV
Mainboard Serial No		-1
NL Gain Fac		7.5
<b>Protected parameters</b>		
Probe Type		Rigid Twin
Probe Length		1.070 m
<b>HART Specific Setup</b>		
Date		2007-05-07
Message		MSG
Descriptor		DESC
Tag		LT-02

Information on probe type, software versions, software and hardware configuration, and unit code is presented.

# Rosemount 5300 Series

## RESET TO FACTORY SETTINGS

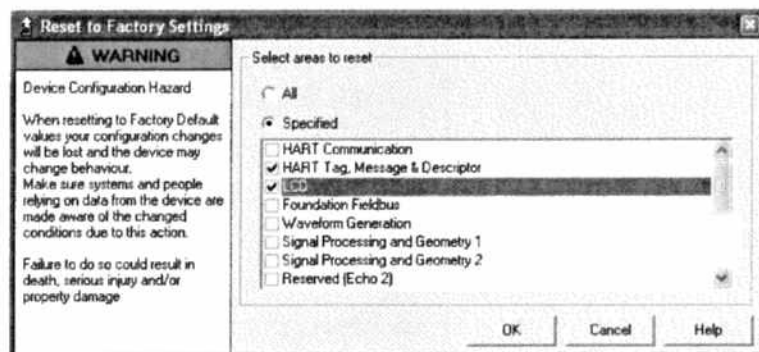
This function resets all or a specific part of the holding registers to factory settings.

### NOTE!

It is recommended that a backup of the configuration is done before the factory reset. Then the old transmitter configuration can be loaded if necessary.

RPM: choose menu option **Tools>Factory Settings**:

Figure 7-17. The Reset to Factory Settings window in RPM.

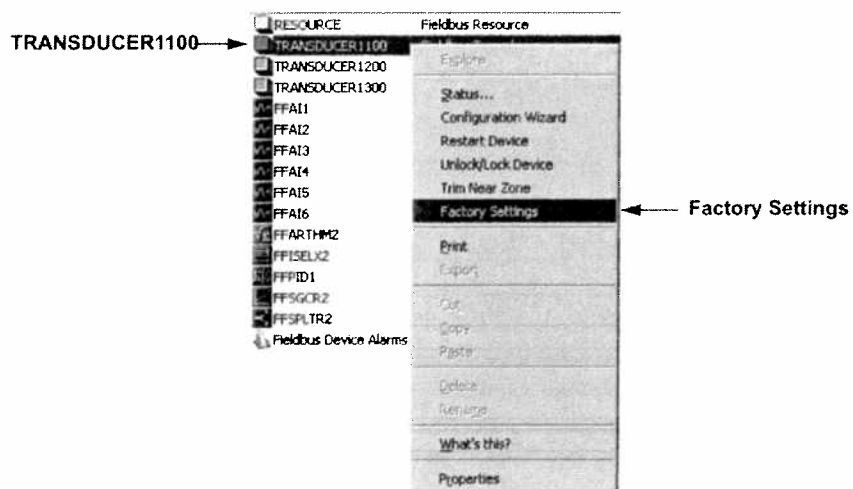


AMS Suite: Tools/Service>Factory Settings.

HART Command: [3, 2, 1, 2].

DeltaV:

1. In the DeltaV Explorer, select the desired transmitter icon, and click the right mouse button on the **Transducer 1100** block icon:



2. Choose the **Factory Settings** option.



## DIAGNOSTICS

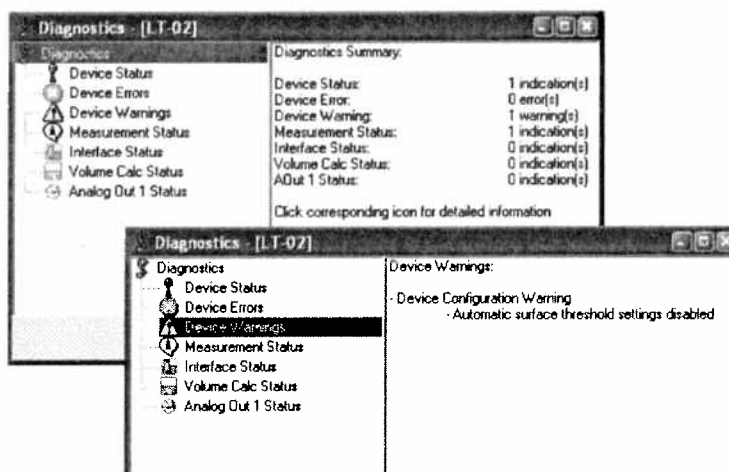
The following information about the device can be retrieved:

- device status, see “Device Status” on page 7-35.
- device errors, see “Errors” on page 7-36.
- device warnings, see “Warnings” on page 7-37.
- measurement status, see “Measurement Status” on page 7-38.
- volume status, see “Volume Calculation Status” on page 7-40.
- analog output status, see “Analog Output Status” on page 7-41.

### Rosemount Radar Master

To open the *Diagnostics* window in RRM, choose the **Diagnostics** option from the **Tools** menu:

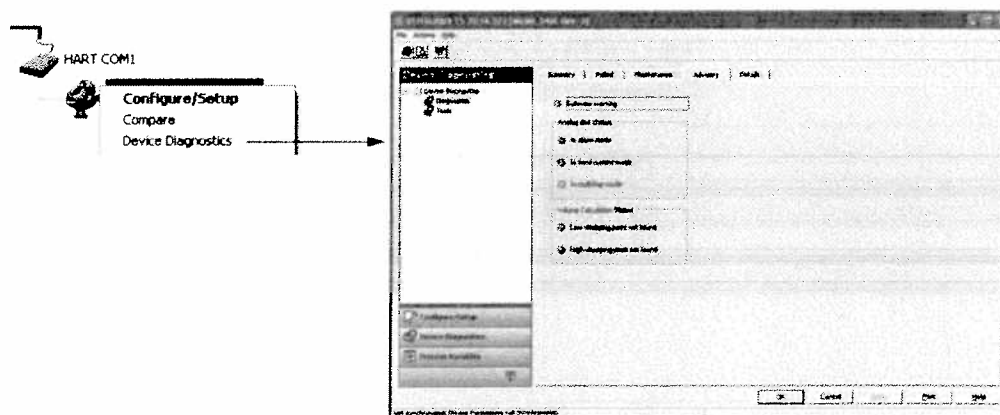
Figure 7-18. The Diagnostics window in RRM.



### AMS

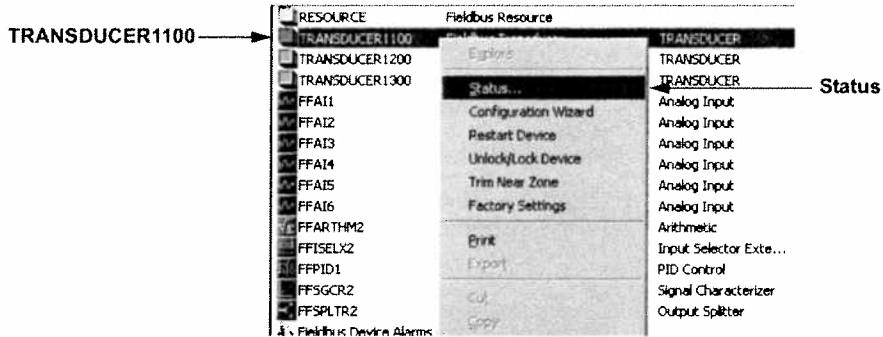
To view the Diagnostics window in AMS Suite, click the right mouse button on the desired transmitter, and choose the **Device Diagnostics** option:

Figure 7-19. Device Diagnostics window in AMS Suite.



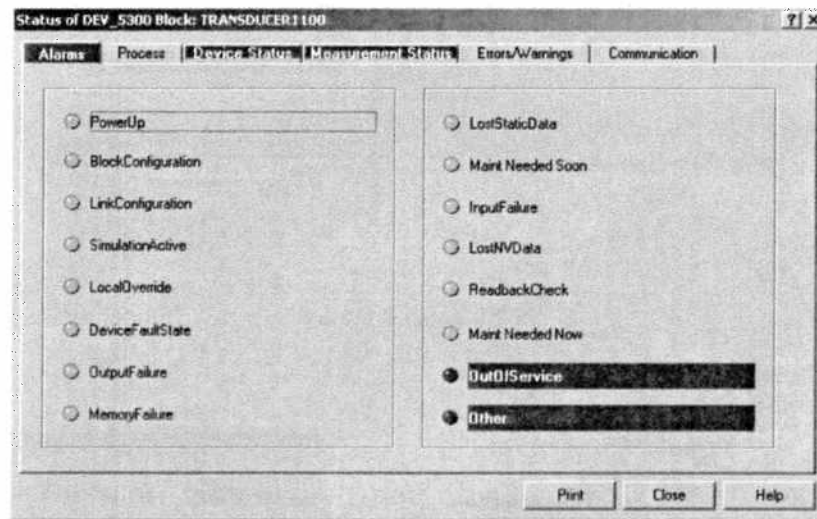
**DeltaV**

1. In the DeltaV Explorer, select the desired transmitter icon, and click the right mouse button on the **Transducer 1100** block icon:



2. Choose the **Status** option.
3. Select the Device Status tab for information on measurement status. Select the Errors/Warnings tab for information on errors and warnings.

Figure 7-20. The Status window in DeltaV shows various status information.



**HART command**

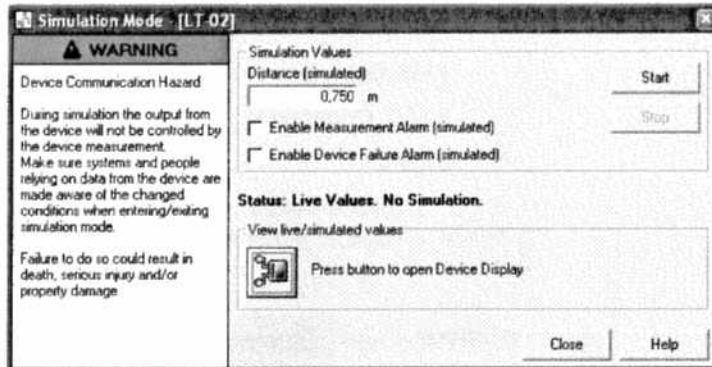
For a 375 Field Communicator, the corresponding HART command for the Diagnostics option is [3, 1].

**USING THE SIMULATION MODE**

This function can be used to simulate measurements and alarms.

RRM: choose menu option **Tools>Simulation Mode**:

Figure 7-21. The Simulation Mode window in RRM.

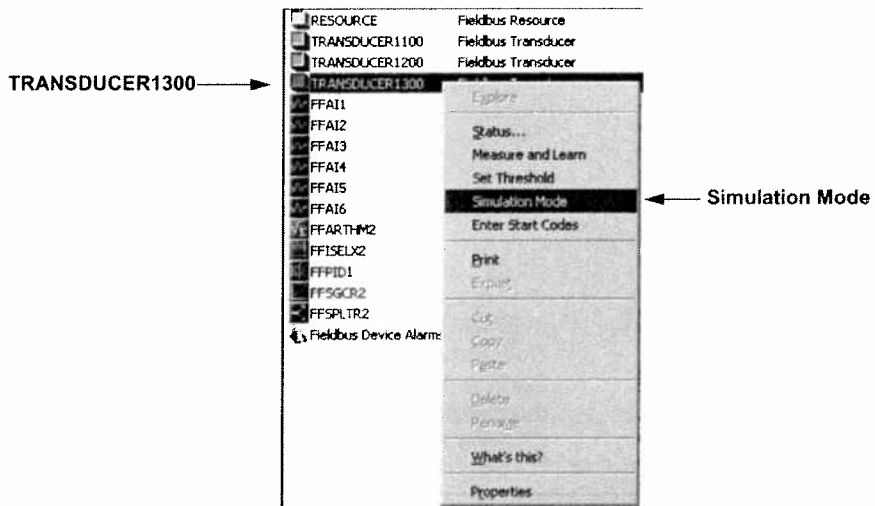


AMS Suite: Tools>Service>Simulation Mode.

HART Command: [3, 2, 1, 3].

DeltaV:

1. In the DeltaV Explorer, select the desired transmitter icon, and click the right mouse button on the **Transducer 1300** block icon:



2. Choose the **Simulation Mode** option.

# Rosemount 5300 Series

## WRITE PROTECTING A TRANSMITTER

A Rosemount 5300 Series transmitter can be protected from unintentional configuration changes by a password protected function. The default password is **12345**. It is recommended that this password is not changed to facilitate service and maintenance of the transmitter.

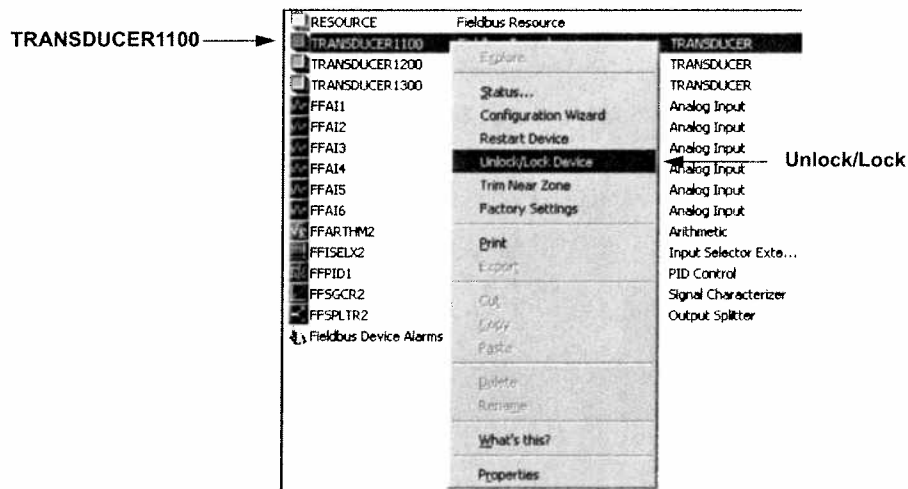
RRM: Tools>Lock/Unlock Configuration Area.

AMS Suite: Tools>Service>Lock/Unlock Device.

HART Command: [3, 2, 1, 2].

DeltaV:

1. In the DeltaV Explorer, select the transmitter icon, and click the right mouse button on the **Transducer 1100** block icon.



2. Choose the **Unlock/Lock Device** option.

## ENTER SERVICE MODE IN RRM

In RRM, service functions for advanced users are available for the Rosemount 5300 Series transmitter. Setting RRM into Service Mode, all the Service menu options in RRM are enabled. The default password for enabling the Service Mode is "admin". The password can be changed by selecting the *Change Password* option from the Service menu.

## VIEWING INPUT AND HOLDING REGISTERS

Measured data is continuously stored in the **Input Registers**. Viewing the contents of the Input Registers, advanced users can check that the transmitter works properly.

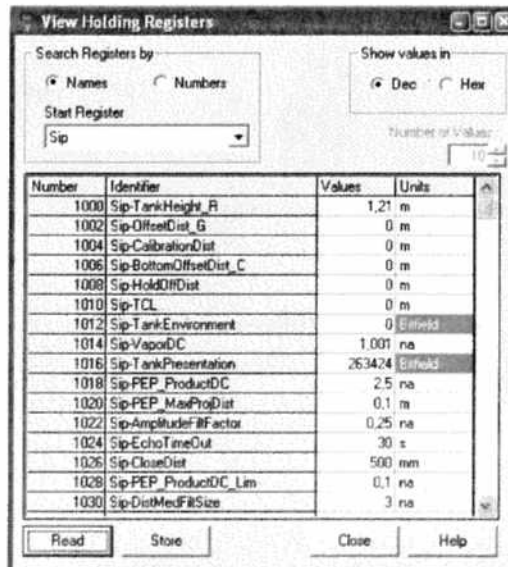
The **Holding Registers** store various transmitter parameters, such as configuration data, used to control the measurement performance.

Using RRM, most Holding Registers can be edited by simply typing a new value in the appropriate Value input field. Some Holding Registers can be edited in a separate window. In this case, you can change individual data bits.

To be able to view the Input/Holding registers in RRM, the Service Mode must be activated:

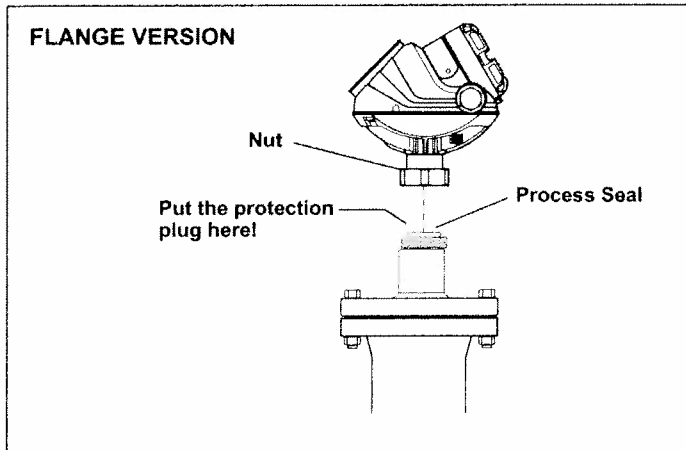
1. Choose the **Enter Service Mode** option from the **Service** menu.
2. Type the password (default password is "admin"). Now the View Input and View Holding Registers options are available.
3. Choose the **View Input/Holding Registers** option from the **Service** menu.
4. Click the Read button. To change a Holding register value, just type a new value in the corresponding Value field. The new value is not stored until the Store button is clicked.

Figure 7-22. Holding and Input Registers can be viewed in RRM.

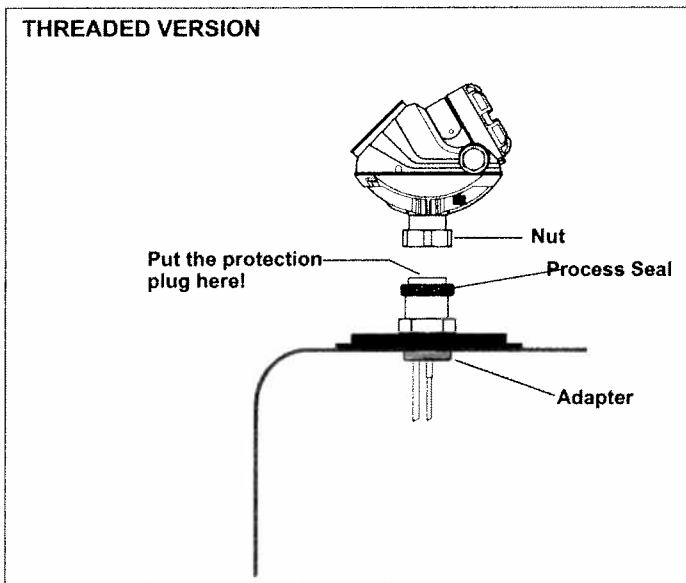


# Rosemount 5300 Series

## REMOVING THE TRANSMITTER HEAD



1. Loosen the nut that connects the transmitter housing to the Process Seal.
2. ⚠ Carefully lift the transmitter head.
3. Make sure the upper surface of the Process Seal is clean and the spring-loaded pin at the center of the Process Seal is properly inserted (the pin should move back when pushed into the hole).
4. Attach the protection plug to the Process Seal.



**NOTE!**

Do not remove the Process Seal from the adapter!

**CHANGING A PROBE**

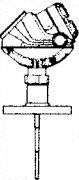

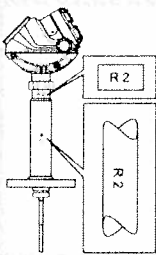
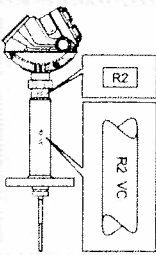
**Probe and Firmware Compatibility**

Transmitter heads with a firmware version earlier than 1.A4 (manufacturing date before 2008-06-18) are not compatible with HP/HTHP/C probes marked with R2.

Transmitter heads with a firmware version 1.A4 or later are compatible with HP/HTHP probes without the R2 marking when the Trim Near Zone function is performed, as illustrated below.

Only probes with the VC marking are compatible with the Dynamic Vapor Compensation function. See Appendix C: Advanced Configuration to determine if the Dynamic Vapor Compensation function is supported by the transmitter head.

Table 7-1. Compatibility between probe type and firmware version

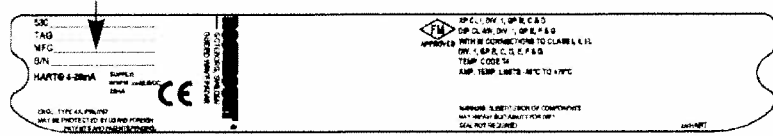
Compatibility Between Probe Types and Firmware Versions				
Firmware Version	Probe Type			
	Standard	HP / HTHP without R2 marking	HP / HTHP / C with R2 marking only <sup>(1)</sup>	HTHP with both R2 and VC marking <sup>(1)</sup>
				
Firmware version earlier than 1.A4	Yes	Yes	No	No
Firmware version 1.A4	Yes	Yes <sup>(2)</sup>	Yes	No
Firmware version 2.A2 or later	Yes	Yes <sup>(2)</sup>	Yes <sup>(3)</sup>	Yes <sup>(4)</sup>

(1) The R2 marking is on the housing seal or the adapter as seen in the figure.  
 (2) Trim Near Zone function is required.  
 (3) When Dynamic Vapor Compensation is not used.  
 (4) The probe requires that Dynamic Vapor Compensation is activated in the device for full functionality.

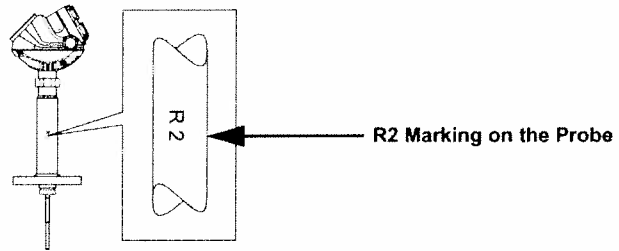
## Check Firmware and Probe Version

1. Check the manufacturing date on the transmitter head label.

Manufacturing Date Before 080618 (YYMMDD)

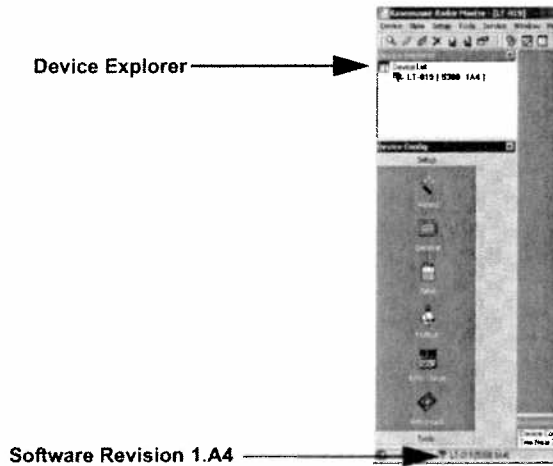


2. Check the R2, VC marking on the probe.



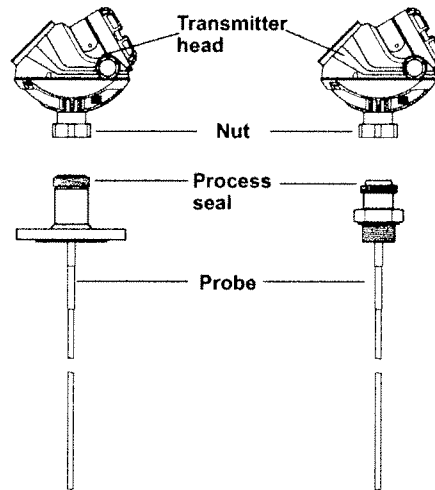
### NOTE!

In RRM, the software revision number can be checked either in Device Explorer, or at the bottom of the RRM window, as shown in the screenshot below.





## Changing the Probe



1. Loosen the nut.
- ⚠ 2. Remove the transmitter head from the old probe.
3. On the new probe, make sure that the protection plug is removed and the upper surface of the Process Seal is clean. Also make sure that the spring-loaded pin at the center of the Process Seal is properly inserted.
4. Mount the transmitter head on the new probe.
5. Fasten the nut again.
6. If the new probe is not of the same type as the old one, update the transmitter configuration by setting the **Probe Type** parameter to the appropriate value:  
HART Fast Key sequence [2, 1, 2]  
or  
in RRM, click the **Tank** icon in the Device Config/Setup toolbar.
7. Measure the **Probe length** and enter the measured value:  
HART Fast Key sequence [2, 1, 2],  
or  
in RRM, click the **Tank** icon in the Device Config/Setup toolbar, and select the **Probe** tab in the *Tank* window.
8. In certain cases, a fine tune by using the Trim Near Zone function is necessary.  
In RRM **Guided Setup > Device specific setup** can be seen if it is needed.  
For 375, use HART Fast Key Sequence [2, 1, 7, 2].  
When using the Trim Near Zone function, product level in the vessel must be lowered beneath the Near Zone to get precise measurement data (see Figure 7-23).

Figure 7-23. Product level lowered beneath the Near Zone.

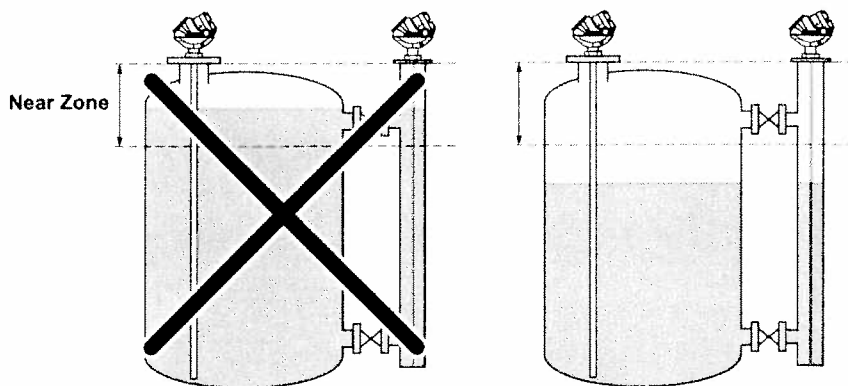


Table 7-2. Near Zone definitions depending on software releases and probe type

5300 GWR Series Near Zone		
Firmware Version	Rigid Probes	Flexible Probes
Firmware version earlier than 1.A4	15 in. (0.37 m)	
Firmware version 1.A4 or 2.A2	40 in. (1 m)	

- Verify that the transmitter measures correct product level, otherwise see "Level and Distance Calibration" on page 7-17.

**DIAGNOSTIC  
 MESSAGES**

**Troubleshooting**

If there is a malfunction despite the absence of diagnostic messages, see Table 7-3 for information on possible causes.

Table 7-3. Troubleshooting chart

Symptom	Possible cause	Action
No level reading	<ul style="list-style-type: none"> <li>Power disconnected</li> <li>Data communication cables disconnected</li> <li>Probe is not connected</li> </ul>	<ul style="list-style-type: none"> <li>Check the power supply</li> <li>Check the cables for serial data communication</li> <li>View the Diagnostic window, see "Diagnostics" on page 7-23 in order to check active status messages</li> <li>Check if "Probe Missing" is active. If it is, check the probe connection</li> </ul>
No HART communication.	<ul style="list-style-type: none"> <li>COM Port configuration does not match the connected COM Port</li> <li>Cables may be disconnected</li> <li>Wrong HART address is used</li> <li>Hardware failure</li> <li>HART resistor</li> </ul>	<ul style="list-style-type: none"> <li>Check that correct COM Port is selected in the HART server (see "Specifying the COM Port" on page 5-15)</li> <li>Check wiring diagram</li> <li>Verify that the 250 Ω resistor is in the loop.</li> <li>Check cables</li> <li>Make sure that correct HART short address is used. Try address=0</li> <li>Check Analog Output current value to verify that transmitter hardware works</li> <li>Check that the correct settings are used in RRM. Select Device, Search from the menu. Click Settings and HART tab. Make sure the values are properly chosen. The standard values are shown on page 5-10</li> </ul>
Analog Out is set in Alarm.	Measurement or transmitter failure.	View the Diagnostic window, see "Diagnostics" on page 7-23 to check active error and status messages.
Both Surface pulse and Interface Pulse are detected, but Interface Level is reported as unknown in the Echo Curve plot.	Measurement Mode is set to "Level Only".	Set Measurement Mode to "Level and Interface" (see "Basic Configuration Parameters" on page 5-4).
Both Surface pulse and Interface pulse are detected, but Interface Level is reported as unknown in the Echo Curve plot.	<ul style="list-style-type: none"> <li>Interface pulse is identified as a double bounce</li> <li>Surface pulse and Interface pulse are very close</li> </ul>	No action required. Use the Echo Curve plot to verify that the surface and interface are close, see "Analyzing the Measurement Signal" on page 7-3.
Surface pulse is detected, but Level is incorrectly reported as Full or Empty.	<ul style="list-style-type: none"> <li>Wrong Probe Type set</li> <li>Bad Reference Threshold value</li> </ul>	View the Diagnostics window, see "Diagnostics" on page 7-23, to check active messages and check if the warning "Full Tank/Empty Tank" is active. If this is the case, check that: <ul style="list-style-type: none"> <li>the transmitter is configured with correct probe type</li> <li>the reference pulse is below the reference amplitude threshold. If not, adjust reference threshold to an appropriate value</li> </ul>

Symptom	Possible cause	Action
The reference pulse is not detected.	<ul style="list-style-type: none"> <li>The tank is full</li> <li>The transmitter is configured with wrong probe type</li> <li>Reference Amplitude Threshold is incorrect</li> </ul>	<ul style="list-style-type: none"> <li>Check the product level</li> <li>Check that correct probe type is configured</li> <li>Check Reference Amplitude Threshold</li> </ul>
Incorrect Interface Level reading.	<ul style="list-style-type: none"> <li>Interface threshold incorrect</li> <li>Upper Product Dielectric constant incorrect</li> </ul>	<ul style="list-style-type: none"> <li>Adjust Interface threshold, see "Interface Pulse not Found" on page 7-8</li> <li>Check the Upper Product Dielectric constant, see "Basic Configuration Parameters" on page 5-4</li> </ul>
Incorrect level reading.	<ul style="list-style-type: none"> <li>Configuration error</li> <li>Disturbing objects in the tank</li> </ul>	<ul style="list-style-type: none"> <li>Check the Tank Height parameter</li> <li>Check status information and diagnostic information</li> <li>Check that the transmitter has not locked on an interfering object, see "Disturbance Echo Handling" on page 7-7</li> <li>Adjust the Surface amplitude threshold, see "Surface Pulse Not Found" on page 7-5</li> </ul>
Integral display does not work.		<ul style="list-style-type: none"> <li>Check the display configuration</li> <li>Check loop power</li> <li>Check Display connection</li> <li>Contact Emerson Process Management Service Department<sup>(1)</sup></li> </ul>
FOUNDATION Fieldbus Card to Transmitter Communication Fault		<ul style="list-style-type: none"> <li>Verify Device Mode setting, should be FOUNDATION Fieldbus (Parameter: ENV_DEVICE_MODE)</li> <li>Restart method from Resource Block</li> <li>Reboot gauge (Cycle Power)</li> </ul>
Level Measurement Failure		<ul style="list-style-type: none"> <li>Check Power Supply</li> <li>Check the gauge configuration (Transducer Block)</li> <li>Check that the mechanical installation is correct</li> </ul>
Temperature Measurement Failure		<ul style="list-style-type: none"> <li>Check ambient temperature<sup>(2)</sup></li> <li>Restart gauge</li> <li>Contact Emerson Process Management Service Department</li> </ul>
Volume Measurement Failure		<ul style="list-style-type: none"> <li>Restart gauge</li> <li>Check gauge configuration using PC Based configuration tool</li> </ul>
No surface echo		<ul style="list-style-type: none"> <li>Check signal strength</li> <li>Restart transmitter</li> <li>See "Surface Pulse Not Found" on page 7-5</li> </ul>
DB Error/ Microwave Unit Error/ Configuration Error/ Other Error		<ul style="list-style-type: none"> <li>Restart transmitter</li> <li>Set database to default; load default Database</li> <li>Download Application Software</li> <li>Call Service Center</li> </ul>
SW Error/ Display Error/ Analog Out Error		<ul style="list-style-type: none"> <li>Restart transmitter</li> <li>Call Service Center</li> </ul>

(1) A malfunctioning display panel may only be replaced by service personnel at the Emerson Process Management Service Department. A display must not be replaced when the transmitter is in operation.

(2) If the 5300 transmitter has been exposed to temperatures outside the specified limits, the device may stop its normal operation.

**Device Status**

Device Status messages that may appear on the Integral Display, on the 375 Field Communicator, or in RMM are shown in Table 7-4:

Table 7-4. Device status.

Message	Description	Action
Running Boot Software	The application software could not be started.	Contact Emerson Process Management Service Department.
Device Warning	A device warning is active.	See Warning Messages for details.
Device Error	A device error is active.	See Error Messages for details.
Sim Mode 0 Active	The simulation mode is active.	Turn off the simulation mode in RRM, select Tools, Simulation Mode, and click the Stop button.
Advanced Simulation Mode Active	The advanced simulation mode is active.	To turn off the Advanced Simulation mode, set Holding Register 3600=0 (see "Viewing Input and Holding Registers" on page 7-27).
Interface Invalid	The interface measurement is invalid.	Check the Error Messages, Warning Messages, and the Interface Status for details.
Invalid Measurement	The level measurement is invalid.	Check Error Messages, Warning Messages, and Measurement Status for details.
User Register Area Write Protected	The configuration registers are write protected.	Use the Lock/Unlock function to turn off the write protection (see "Write Protecting a Transmitter" on page 7-26).
Write Protected Jumper Set	Write protection jumper on the display is enabled.	Remove the write protection jumper.
Factory Settings Used	The factory default configuration is used.	The transmitter has lost its calibration. Contact Emerson Process Management Service Department.
Probe missing	Probe is not detected.	Check that the probe is correctly mounted. Check the connection between probe and transmitter head.

# Rosemount 5300 Series

## Errors

Error messages that may be displayed on the Integral Display, on a 375 Handheld Communicator, in AMS, or in RRM are shown in Table 7-5. Errors normally result in Analog Output alarm.

Errors are indicated in RRM in the *Diagnostics* window.

Table 7-5. Error messages.

Message	Description	Action
RAM error	An error in the gauge data memory (RAM) has been detected during the startup tests. Note: this automatically resets the gauge.	Contact Emerson Process Management Service Department.
FEPROM error	An error in the gauge program memory (FEPROM) has been detected during the startup tests. Note: this automatically resets the gauge.	Contact Emerson Process Management Service Department.
Database (Hreg) error	An error in the transmitter configuration memory (EEPROM) has been detected. The error is either a checksum error that can be solved by loading the default database or a hardware error. NOTE: the default values are used until the problem is solved.	Load default database and restart the transmitter. Contact Emerson Process Management Service Department if the problem persists.
Microwave Module error	An error in the microwave module.	Contact Emerson Process Management Service Department.
LCD error	An error in the LCD is detected.	Contact Emerson Process Management Service Department.
Modem error	An error in the modem used for digital communication has been detected.	Contact Emerson Process Management Service Department.
Analog out error	An error in the Analog Out Module.	Contact Emerson Process Management Service Department.
Internal temperature error	An error in the internal temperature measurement. -40 °C<Internal Temperature<85 °C.	Contact Emerson Process Management Service Department.
Other hardware error	An unspecified hardware error has been detected.	Contact Emerson Process Management Service Department.
Measurement error	A serious measurement error has been detected.	Contact Emerson Process Management Service Department.
Configuration error	At least one configuration parameter is outside allowed range. NOTE: the default values are used until the problem is solved.	<ul style="list-style-type: none"> <li>• Load the default database and restart the transmitter (see "Reset to Factory Settings" on page 7-22)</li> <li>• Configure the transmitter or upload a backup configuration file (see "Backing up the Transmitter Configuration" on page 7-20)</li> <li>• Contact Emerson Process Management Service Department if the problem persists</li> </ul>
Software error	An error has been detected in the transmitter software.	Contact Emerson Process Management Service Department.

## Warnings

Table 7-6 shows a list of diagnostic messages that may be displayed on the Integral Display, on the 375 Handheld Communicator, or in RRM. Warnings are less serious than errors and in most cases do not result in Analog Output alarms.

In RRM, warnings are indicated in the *Diagnostics* window.

Table 7-6. Warning messages.

Message	Description	Action
RAM warning	See Diagnostics (RRM: Tools>Diagnostics) for further information on a warning message. See also "Diagnostics" on page 7-23.	
FEPROM warning		
Hreg warning		
MWM warning		
LCD warning		
Modem warning		
Analog out warning		
Internal temperature warning		
Other hardware warning		
Measurement warning		
Config warning		
SW warning		

# Rosemount 5300 Series

## Measurement Status

Measurement Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, in DeltaV, or in RRM are shown in Table 7-7:

Table 7-7. Measurement status.

Message	Description	Action
Full tank	The level measurement is in Full Tank state. The transmitter waits for the surface echo to be detected at the top of the tank.	No action needed.
Empty tank	The level measurement is in Empty Tank state. The transmitter waits for the surface echo to be detected at the bottom of the tank.	No action needed.
Probe missing	Probe is not detected.	Check that the probe is correctly mounted. Check the connection between probe and transmitter head.
Seal contaminated	Suspected contamination of the seal has been detected.	Check if the seal connection with the probe is contaminated.
Reference pulse calculated	The position of the reference pulse is calculated from the internal reference pulse.	No action needed.
Reference pulse invalid	An error in the reference pulse in the last sampled tank signal.	Check Warning messages. If MicroWave Module (MWM) Warning is active, this might indicate a transmitter error. Contact Emerson Process Management Service Department.
DeltaF not at setpoint	The DeltaF is not correctly regulated.	Check Warning Messages. If MicroWave Module (MWM) Warning is active, this might indicate a transmitter error. Contact Emerson Process Management Service Department.
Tank signal clip warning	The last Tank Signal was clipped.	Check Warning Messages. If MWM Warning is active, this might indicate a transmitter error. Contact Emerson Process Management Service Department.
No surface echo found	The Surface Echo Pulse cannot be detected. Possible cause: <ul style="list-style-type: none"> <li>• Wrong surface threshold</li> <li>• Liquid level in Transition Zone or below probe end</li> </ul>	Check if the configuration can be changed so that the surface echo can be tracked in this current region. View the Echo Curve plot and check surface threshold.
Predicted level	The presented level is predicted. The surface echo could not be detected.	Check if the configuration can be changed so that the surface echo can be tracked in this current region. View the Echo Curve plot and check surface threshold.
No reference echo	The Surface Echo Pulse cannot be detected.	Check if the configuration can be changed so that the surface echo can be tracked in this current region.
Reduced reference echo	The reference echo has been found with reduced amplitude.	No action needed.
In full tank state	The level measurement is in the full tank state, waiting for a surface echo detection at the top of the tank.	No action needed.
Sampling failed	The sampling of the last tank signal failed.	Check Warning Messages.
Invalid volume value	The given volume value is invalid. The given measurements are simulated.	Check Volume Status for details.



Message	Description	Action
Sim mode 0 active	The simulation mode is active. The given measurements are simulated.	Turn off the simulation mode.
Advanced Simulation Mode active	The advanced simulation mode is active.	To turn off the Advanced Simulation mode, set Holding Register 3600=0 (see "Viewing Input and Holding Registers" on page 7-27).
Invalid Lower Volume Value	The given lower volume value is invalid.	Check Lower Volume Status for details.
Invalid Upper Volume Value	The given upper volume value is invalid.	Check Upper Volume Status for details.
Using probe end projection measurement	The probe end projection is active in the transmitter software.	No action needed.
Reference echo present	An echo has been detected in the reference zone.	No action needed.
Sudden level jump detected	This may result from various measurement problems, such as: 1. Rapid level changes 2. Surface level within transition zone 3. Disturbing echo	Check the tank to find out what causes problem to track the surface. 1. Set the Rapid Level Changes parameter, see "Tank Environment" on page 5-6. 2. In the Transition Zones, the level may jump to Full Tank/End of Probe, see "Transition Zones" on page 2-10. 3. See "Disturbance Echo Handling" on page 7-7.
Nearzone echo present	An echo has been detected in the nearzone.	No action needed.
Nonlinear gain used	The nonlinear gain is enabled.	No action needed.
Nearzone measurement	The current sweep can be used as a measurement of the nearzone.	No action needed.

# Rosemount 5300 Series

## Interface Status

Interface Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, in DeltaV, or in RRM are shown in Table 7-8:

Table 7-8. Interface status.

Message	Description	Action
Interface not OK	The interface measurement is not OK.	Check other interface status messages for reason.
Interface not found	No interface available Interface threshold to high	No action needed. Adjust Interface threshold, see "Interface Pulse not Found" on page 7-8.
Can't measure interface on horizontal probe	Interface cannot be measured when the probe is horizontally mounted.	Change the probe mounting or turn off interface measurement by changing the measurement mode.
Can't handle max possible interface thickness	With the current configuration, the maximum measurement range is too short to guarantee that the interface echo can always be found.	Accept the limitation or change the tank environment and device configuration.
Interface thickness close to max range	The interface is close to the limit where it will be lost due to the limited maximum measurement range.	No action needed but the interface echo may be lost if the upper product thickness increases.
Interface set to max thickness	No interface echo found. The upper product thickness is set the maximum value of the current level measurement.	No action needed.
Interface thickness greater than probe length	The interface was found below the probe end.	The Upper Product Dielectric Constant is probably incorrect.

## Volume Calculation Status

Volume Calculation Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, or in RRM are shown in Table 7-9:

Table 7-9. Volume status.

Message	Description	Action
Level is below lowest strapping point.	The measured level is below the lowest point in the given strapping table.	For a correct volume calculation in this region, change the strapping table.
Level is above highest strapping point.	The measured level is above the highest point in the given strapping table.	For a correct volume calculation in this region, change the strapping table.
Level out of range.	The measured level is outside the given tank shape.	Check if the correct tank type is chosen and check the configured Tank Height.
Strap table length not valid.	The configured strap table length is too small or too large.	Change the strapping table size to a valid number of strapping points. A maximum number of 20 strapping points can be entered.
Strap table not valid.	The strapping table is not correctly configured.	Check that both level and volume values in the strapping table are increasing with strapping table index.
Level not valid.	The measured level is not valid. No volume value can be calculated.	Check Measurement Status, Warning and Error Messages.
Volume configuration missing.	No volume calculation method is chosen.	Do a volume configuration.
Volume not valid.	The calculated volume is not valid.	Check the other volume status messages for the reason.

**Analog Output Status**

Analog Output Status messages that may appear on the Integral Display, on the 375 Handheld Communicator, or in RRM are shown in Table 7-10:

Table 7-10. Analog Output status.

Message	Description	Action
Not connected	Analog output hardware is not connected.	
Alarm Mode	The analog output is in Alarm Mode.	Check Error and Warning Messages to find the reason for the Alarm.
Saturated	The analog output signal value is saturated, i.e. equal to the saturation value.	No action needed.
Multidrop	The transmitter is in Multidrop Mode. The analog output is fixed at 4 mA.	This is the normal setting when a device is used in Multidrop configuration.
Fixed Current mode	The analog output is in fixed current mode.	This mode is used when calibrating the Analog Output channel.
PV out of Limits	The Primary variable is out of range.	Check the Upper and Lower Range Value
Span Too Small	The configured span is too small.	Check the Upper and Lower Range Value.
Invalid Limits	The given Upper and Lower Sensor Limits are invalid.	Check that the difference between the Upper and Lower Sensor Limits is greater than the Minimum Span.

# Rosemount 5300 Series

## LCD ERROR MESSAGES

Figure 7-24. The 5300 Display Panel displaying an error message.

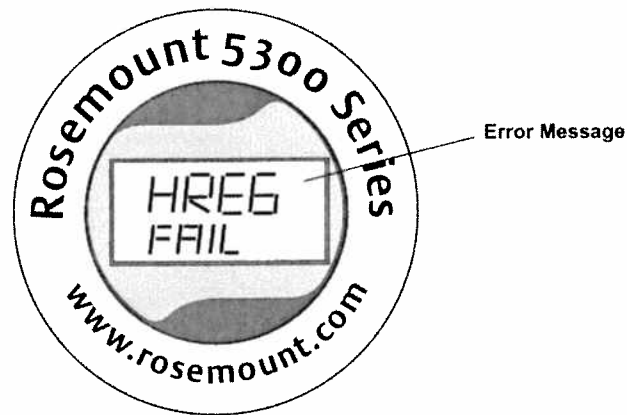


Table 7-11. Error messages displayed on the 5300 Display Panel.

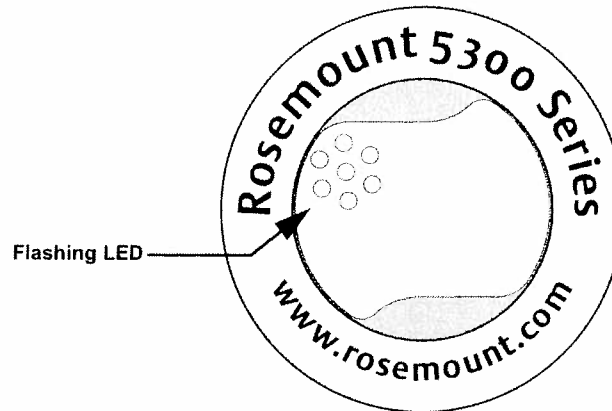
Error Message	Description
RAM FAIL	An error in the gauge data memory (RAM) has been detected during the startup tests. Note: this resets the gauge automatically.
FEPROM FAIL	An error in the gauge program memory (FEPROM) has been detected during the startup tests. Note: this resets the gauge automatically.
HREG FAIL	An error in the transmitter configuration memory (EEPROM) has been detected. The error is either a checksum error that can be solved by loading the default database, or a hardware error. NOTE: the default values are used until the problem is solved.
OMEM FAIL	
MWM FAIL	An error in the microwave module.
DPLY FAIL	An error in the LCD.
MODEM FAIL	Modem hardware failure.
AOUT FAIL	An error in the Analog Out Module.
OHW FAIL	An unspecified hardware error has been detected.
ITEMP FAIL	An error in the internal temperature measurement.
MEAS FAIL	A serious measurement error has been detected.
CONFIG FAIL	At least one configuration parameter is outside the allowed range. NOTE: the default values are used until the problem is solved.
SW FAIL	An error has been detected in the transmitter software.

For more information on errors, see "Errors" on page 7-36.

**LED ERROR MESSAGES**

For Rosemount 5300 transmitters without display, a flashing Light Emitting Diode (LED) is used for presentation of error messages.

Figure 7-25. Rosemount 5300 transmitters without display use a LED for presentation of error messages.



In normal operation, the LED flashes once every other second. When an error occurs, the LED flashes a sequence that corresponds to the Code number followed by a five second pause. This sequence is continuously repeated.

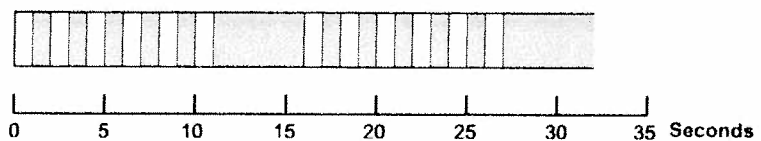
The following errors can be displayed:

Table 7-12. LED error codes.

Code	Error
0	Ram Failure
1	FEPROM
2	HREG
4	Microwave Module
5	Display
6	Modem
7	Analog Out
8	Internal Temperature
11	Hardware
12	Measurement
14	Configuration
15	Software

**Example**

Modem error (code 6) is displayed as the following flash sequence:



# Rosemount 5300 Series

## FOUNDATION FIELDBUS ERROR MESSAGES

### Resource Block

This section describes error conditions found in the Resource block. Read Table 7-13 through Table 7-15 to determine the appropriate corrective action.

#### Block Errors

Table 7-13 lists conditions reported in the BLOCK\_ERR parameter.

Table 7-13. Resource Block  
BLOCK\_ERR messages

Condition Name and Description
<b>Other</b>
<b>Simulate Active:</b> This indicates that the simulation switch is in place. This is not an indication that the I/O blocks are using simulated data
Device Fault State Set
Device Needs Maintenance Soon
<b>Memory Failure:</b> A memory failure has occurred in FLASH, RAM, or EEPROM memory
<b>Lost Static Data:</b> Static data that is stored in non-volatile memory has been lost
<b>Lost NV Data:</b> Non-volatile data that is stored in non-volatile memory has been lost
Device Needs Maintenance Now
<b>Out of Service:</b> The actual mode is out of service

Table 7-14. Resource Block  
SUMMARY\_STATUS messages

Condition Name
Uninitialized
No repair needed
Repairable
Call Service Center

Table 7-15. Resource Block  
DETAILED\_STATUS with  
recommended action messages

Condition Name	Recommended Action
LOI Transducer block error	1. Restart processor 2. Check display connection 3. Call service center
Sensor Transducer block error	1. Restart processor 2. Check Rosemount 5300 cable 3. Call service center
Mfg. Block integrity error	1. Restart processor 2. Call service center
Non-Volatile memory integrity error	1. Restart processor 2. Call service center
ROM integrity error	1. Restart processor 2. Call service center

**Transducer Block**

This section describes error conditions found in the Sensor Transducer Block.

Table 7-16. Transducer Block BLOCK\_ERR messages

Condition Name and Description
Other
<b>Out of Service:</b> The actual mode is out of service

Table 7-17. Transducer Block XD\_ERR messages

Condition Name and Description
<b>Electronics Failure:</b> An electrical component failed
<b>I/O Failure:</b> An I/O failure occurred
<b>Data Integrity Error:</b> Data stored in the device is no longer valid due to a non-volatile memory checksum failure, a data verify after write failure, etc.
<b>Algorithm Error:</b> The algorithm used in the transducer block produced an error due to overflow, data reasonableness failure, etc.

**Analog Input (AI) Function Block**

This section describes error conditions that are supported by the AI Block. Read Table 7-19 to determine the appropriate corrective action.

Table 7-18. AI BLOCK\_ERR Conditions

Condition Number	Condition Name and Description
0	Other
1	<b>Block Configuration Error:</b> the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero
3	<b>Simulate Active:</b> Simulation is enabled and the block is using a simulated value in its execution
7	<b>Input Failure/Process Variable has Bad Status:</b> The hardware is bad, or a bad status is being simulated
14	<b>Power Up</b>
15	<b>Out of Service:</b> The actual mode is out of service

# Rosemount 5300 Series

Table 7-19. Troubleshooting the AI block

Symptom	Possible Causes	Recommended Actions
Bad or no level readings (Read the AI "BLOCK_ERR" parameter)	BLOCK_ERR reads OUT OF SERVICE (OOS)	1. AI Block target mode set to OOS. 2. Resource Block OUT OF SERVICE.
	BLOCK_ERR reads CONFIGURATION ERROR	1. Check CHANNEL parameter (see "CHANNEL" on page 5-39). 2. Check L_TYPE parameter (see "L_TYPE" on page 5-39). 3. Check XD_SCALE engineering units. (see "XD_SCALE and OUT_SCALE" on page 5-40).
	BLOCK_ERR reads POWERUP	Download Schedule into block. Refer to host for downloading procedure.
	BLOCK_ERR reads BAD INPUT	1. Sensor Transducer Block Out Of Service (OOS). 2. Resource Block Out of Service (OOS).
	No BLOCK_ERR but readings are not correct. If using Indirect mode, scaling could be wrong	1. Check XD_SCALE parameter. 2. Check OUT_SCALE parameter. (see "XD_SCALE and OUT_SCALE" on page 5-40).
OUT parameter status reads UNCERTAIN and substatus reads EngUnitRangViolation	Out_ScaleEU_0 and EU_100 settings are incorrect.	See "XD_SCALE and OUT_SCALE" on page 5-40.
Mode will not leave OOS	Target mode not set	Set target mode to something other than OOS.
	Configuration error	BLOCK_ERR will show the configuration error bit set. The following are parameters that must be set before the block is allowed out of OOS: CHANNEL must be set to a valid value and cannot be left at the initial value of 0. XD_SCALE.UNITS_INDXX must match the units in the transducer block channel value. L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at the initial value of 0.
	Resource block	The actual mode of the Resource block is OOS. See Resource Block Diagnostics for corrective action.
	Schedule	Block is not scheduled and therefore cannot execute to go to Target Mode. Schedule the block to execute.
Process and/or block alarms will not work	Features	FEATURES_SEL does not have Alerts enabled. Enable the Alerts bit.
	Notification	LIM_NOTIFY is not high enough. Set equal to MAX_NOTIFY.
	Status Options	STATUS_OPTS has Propagate Fault Forward bit set. This should be cleared to cause an alarm to occur.
Value of output does not make sense	Linearization Type	L_TYPE must be set to Direct, Indirect, or Indirect Square Root and cannot be left at the initial value of 0.
	Scaling	Scaling parameters are set incorrectly: XD_SCALE.EU0 and EU100 should match that of the transducer block channel value. OUT_SCALE.EU0 and EU100 are not set properly.
Cannot set HI_LIMIT, HI_HI_LIMIT, LO_LIMIT, or LO_LO_LIMIT Values	Scaling	Limit values are outside the OUT_SCALE.EU0 and OUT_SCALE.EU100 values. Change OUT_SCALE or set values within range.



## Section 8 Safety Instrumented Systems (4-20 mA only)

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Safety Messages	page 8-1
Overview	page 8-3
Functional Specifications	page 8-4
Installation	page 8-4
Configuration	page 8-4
Operation and Maintenance	page 8-5
References	page 8-7
Spare Parts	page 8-7
Terms and Definitions	page 8-7

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### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure safety of personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (▲). Refer to the following safety messages before performing an operation preceded by this symbol.

#### ▲ WARNING

**Failure to follow these installation guidelines could result in death or serious injury.**

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

**Explosions could result in death or serious injury.**

- Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a HART<sup>®</sup>-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

**Electrical shock could cause death or serious injury.**

- Use extreme caution when making contact with the leads and terminals.

**⚠ WARNING**

Any substitution of non-authorized parts or repair, other than exchanging the complete transmitter head or probe assembly, may jeopardize safety and is prohibited.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson Process Management. Any continued use of product that has been damaged or modified without prior written authorization is at the customer's sole risk and expense.

**OVERVIEW**

The following section applies to the 4-20 mA Rosemount 5300 Prior-Use option (Special certification: QS) transmitter used in Safety Instrumented Systems (SIS) applications. The 5300 Prior-Use option with analog output provides overflow and empty tank protection to improve the system safety. The transmitter is classified as a Type B device. It contains self-diagnostics and is programmed to send its output to either a high or low failure state upon internal detection of a failure.

An independent FMEDA (hardware assessment) was conducted by *Exida* according to IEC 61508. The FMEDA is performed to determine failure rates, calculate the Safe Failure Fraction (SFF), and the average Probability of Failure on Demand (PFD<sub>AVG</sub>). The hardware assessment is one of the steps taken to achieve functional safety per IEC 61508.

**NOTE:**

Refer to the 5300 FMEDA<sup>(1)</sup> report for failure rate data, assessment details, and assumptions regarding failure rate analysis.

**Applicable Models**

Table 8-1. Rosemount 5300 Series Prior-Use Option Model Codes

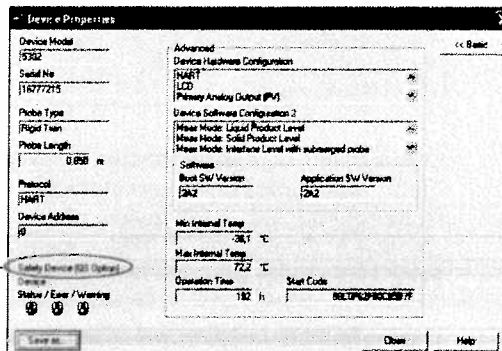
Table 8-1 lists the versions of the Rosemount 5300 Series transmitter that have been considered for the hardware assessment, to which this section applies.

Prior-Use Option Model Codes	
1	Model 5301HxxxxxxxxxxxxxQS
2	Model 5302HxxxxxxxxxxxxxQS
3	Model 5303HxxxxxxxxxxxxxQS

To identify a 5300 Prior-Use option transmitter:

- Verify the option code QS in the model code, on the label affixed to the outside of the transmitter head or
- 375 Field Communicator: HART Sequence [1, 7, 8]. Verify that Prior-Use safety device is ON
- Open Rosemount Radar Master, right click on the device, and select properties. Verify that the Safety Device (QS Option) is present

Safety Device (QS Option)



**Skill Level of Personnel**

It is assumed that the personnel installing, configuring, and operating the system have the knowledge equal or greater than that of a qualified Instrument Technician familiar with safety-related systems, process control applications and general instrument use.

(1) The 5300 FMEDA report is accessible at [www.emersonprocess.com/rosemount/safety/PriorUse.htm](http://www.emersonprocess.com/rosemount/safety/PriorUse.htm).

# Rosemount 5300 Series

**NOTE!**

The Rosemount 5300 transmitter is not safety-rated during maintenance work, configuration changes, multidrop, loop test, or other activity that affects the Safety Function. Alternative means should be used to ensure process safety during such activities.

## FUNCTIONAL SPECIFICATIONS

The Safety Function is based on the analog output 4-20 mA, used as the safety variable. It is configured to activate the alarm function if an error occurs or if the measured value goes beyond the measurement range set by the user.

Only the 4-20 mA output can be used in the Safety Function. The HART protocol can only be used for setup, calibration, and diagnostic purposes, not for safety critical operation. The measurement signal used by the logic solver must be the analog 4-20 mA signal proportional to the level generated.

## INSTALLATION

The device should be installed and configured as a level sensing device per manufacturer's instructions. The materials must be compatible with process conditions and process fluids. No special installation is required in addition to the standard installation practices outlined in this document.

Environmental limits are available in *Appendix A: Reference Data*.

The loop must be designed so the terminal voltage does not drop below the minimum input voltage, see values in Table 8-2, when the transmitter output is 22.5 mA.

Table 8-2. Minimum input voltage ( $U_i$ ) at different currents

Hazardous approval	Current			
	3.60 mA	3.75 mA	21.75 mA	22.50 mA
	Minimum input voltage ( $U_i$ )			
Non-Hazardous Installations and Intrinsically Safe Installations	16 Vdc	16 Vdc	11 Vdc	11 Vdc
Explosion-proof / Flameproof Installations	20 Vdc	20 Vdc	15.5 Vdc	15.5 Vdc

## CONFIGURATION

Use a HART-compliant master, such as Rosemount Radar Master or 375 Field Communicator, to communicate with and verify configuration of the Rosemount 5300. A full review of configuration methods is available in *Section 5: Configuration*. These instructions are applicable to the 5300 Prior-Use option with any differences noted.

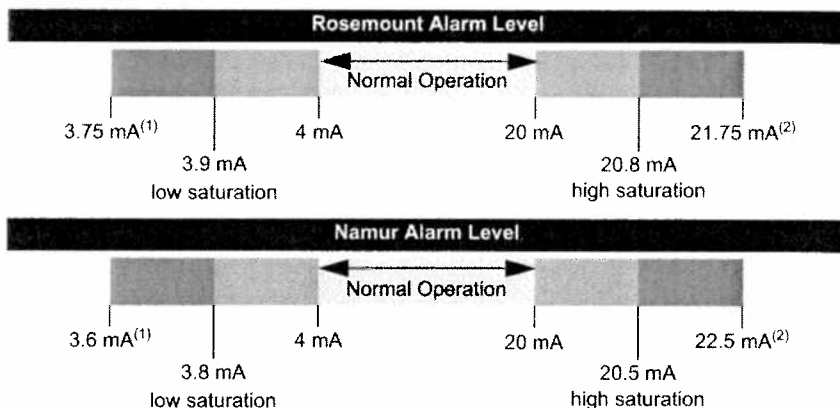
## Damping

User adjusted damping will affect the transmitter's ability to respond to process changes. Therefore, the *damping values + response time* should not exceed the loop requirements. For further information on damping, see "Echo Tracking" on page C-12.

**Alarm and Saturation Levels**

Table 8-3. Alarm levels and operation values

DCS or safety logic solver should be configured to match transmitter configuration. Table 8-3 identifies the alarm levels available and their operation values.<sup>(1)</sup>



(1) Transmitter Failure, hardware or software alarm in Low position.  
(2) Transmitter Failure, hardware or software alarm in High position.

It is assumed that the current output signal is fed to a SIL2-compliant analog input board of a safety logic solver. For instructions on alarm level settings see "Analog Output (HART)" on page 5-9.

**NOTE!**

Only the High or Low Alarm Mode can be used for the Safety Function. Do not choose Freeze Current as an error will not be announced in the current loop.

**Write Protection**

A Rosemount 5300 transmitter can be protected from unintentional configuration changes by a password protected function. It is recommended to use write protection described in "Write Protecting a Transmitter" on page 7-26.

**Site Acceptance**

After the installation and configuration, proper operation of the transmitter should be verified. A site acceptance test is therefore recommended. The proof test outlined in this section can be used for this.

**OPERATION AND MAINTENANCE**

**General**

The Rosemount 5300 Series Prior-Use option must be tested at regular intervals to confirm that the overflow and empty tank protection function result in the desired system response. The required proof test intervals are dependant on the configuration of the transmitter and the process environment. The Rosemount 5300 is designed to have a 5-year proof test interval assuming it represents the typical 35% of the SIF PFD<sub>AVG</sub>. However, it is the responsibility of the operator/owner of the system to determine the sufficient time interval and verify it is followed. See the FMEDA report for additional details or references.

(1) In certain cases, the transmitter does not go into the user defined alarm state. For example, in case of a short circuit, the transmitter goes into High Alarm state even if Low Alarm has been configured.

If the overflow and empty tank protection function cannot be tested by a controlled filling to the response height, suitable simulation of the level or of the physical measuring effect, e.g. by shorting the probe, must be used to make the level sensor respond.

The following proof test is recommended. If an error is found in the safety functionality, the measuring system must be switched out of service and the process held in a safe state by means of other measures. Proof test results and corrective actions taken must be documented at [www.emersonprocess.com/rosemount/safety](http://www.emersonprocess.com/rosemount/safety).

### Proof test

This test detects approximately 95% of the possible Dangerous Undetected (DU) failures of the transmitter including the sensor element, not detected by the transmitter's automatic diagnostics. Instructions for performing the proof test with the 375 Field Communicator, Rosemount Radar Master, or AMS, are available in *Appendix E: Performing Proof Test*. Note that prior to this test, the echo curve should be inspected to ensure that no disturbing echoes affecting the measurement performance are present in the tank.

Required Tools: HART host/communicator and mA meter.

1. Bypass the logic solver or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.
3. Using Loop Test, enter the mA value representing a high alarm current output and verify that the analog current reaches that value using the reference meter.

*This step tests for compliance voltage problems, such as low loop power supply voltage or increased wiring resistance.*

4. Using Loop Test, enter the mA value representing a low alarm current output and verify that the analog current reaches that value using the reference meter.

*This step tests for possible quiescent current related failures.*

5. Perform a two-point calibration check of the transmitter by applying the level to two points on the probe within the measuring range<sup>(1)</sup>. Verify that the current output corresponds to the level input values using a known reference measurement.

*This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.*

6. Enable write protection.
7. Restore the loop to full operation.
8. Remove the bypass from the safety logic solver or otherwise restore normal operation.
9. Document the test result for future reference.

For troubleshooting the transmitter, see "Service and Troubleshooting" on page 7-1.

(1) For best performance, use the 4 - 20 mA range points as calibration points.

**Inspection**

**Visual Inspection**

It is recommended to inspect the probe for possible build up or clogging.

**Special Tools**

Not required.

**Product Repair**

The Rosemount 5300 is repairable by major component replacement. All failures detected by the transmitter diagnostics or by the proof test must be reported. Feedback can be submitted electronically at [www.emersonprocess.com/rosemount/safety](http://www.emersonprocess.com/rosemount/safety) (**Contact Us**).

**REFERENCES**

**Specifications**

The Rosemount 5300 must be operated in accordance with the functional and performance specifications provided in *Appendix A: Reference Data*.

**Failure Rate Data**

The FMEDA report includes failure rates. The full report is accessible at [www.emersonprocess.com/rosemount/safety/PriorUse.htm](http://www.emersonprocess.com/rosemount/safety/PriorUse.htm).

**Useful Lifetime**

The established failure rates of electrical components apply within the useful lifetime, which should be based on experience. According to IEC 61508-2, 7.4.7.4, note 3, the useful lifetime often lies within a range of 8 to 12 years.

**SPARE PARTS**

Additional spare parts are available in *Appendix A: Reference Data*.

**TERMS AND DEFINITIONS**

**FMEDA:** Failure Modes, Effects and Diagnostic Analysis

**HART:** Highway Addressable Remote Transducer

**PFD<sub>AVG</sub>:** Average Probability of Failure on Demand

**SIF:** Safety Instrumented Function

**SIL:** Safety Integrity Level, discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems, where Safety Integrity Level 4 has the highest level of safety integrity, and Safety Integrity Level 1 has the lowest.

**SIS:** Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s)

**SFF:** Safe Failure Fraction

**Type B device:** Complex device (using microcontrollers or programmable logic)

# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009



# Appendix A Reference Data

Specifications .....	page A-1
Dimensional Drawings .....	page A-9
Ordering Information .....	page A-21
Spare Parts .....	page A-30

## SPECIFICATIONS

General	
Product	Rosemount 5300 Series Guided Wave Radar Level and Interface Transmitter; Model 5301, Liquid Level or Interface Transmitter (interface available for fully submerged probe). Model 5302 Liquid Level and Interface Transmitter. Model 5303 Solids Level Transmitter.
Measurement Principle	Time Domain Reflectometry (TDR).
Reference Conditions	Single Standard probe, 77°F (25°C) in water and ambient pressure.
Microwave Output Power	Nominal 300 µW, Max. 45 mW.
CE-mark	Complies with applicable directives (EMC, ATEX).
Safety Integrity Level	5300 FMEDA suitable for SIL2: The 5300 Series has been evaluated by Exida per hardware assessment IEC61508. With a SFF > 90% it is Prior-use SIL2 suitable. For more information, go to: <a href="http://www.emersonprocess.com/rosemount/safety/">http://www.emersonprocess.com/rosemount/safety/</a> . Option code is QS.
Start-up Time	< 40 s
Measuring Performance	
Reference Accuracy	± 0.12 in. (3 mm) or 0.03% of measured distance, whichever is greatest. <sup>(1) (2) (3)</sup>
Repeatability	± 0.04 in. (1 mm).
Ambient Temperature Effect	± 0.008 in. (0.2 mm) /°K or ± 30 ppm/°K of measured value, whichever is greatest.
Update Interval	< 1 per second.
Measuring Range	16 in. (0.4 m) to 164 ft (50 m).
Display / Configuration	
Integral Display	The integral digital display can toggle between: level, distance, volume, internal temperature, interface distance, interface level, peak amplitudes, interface thickness, percentage of range, analog current out. Note! The display cannot be used for configuration purposes.
Output Variables	All models: Level, Distance to Level, Volume, Level Rate, Signal Strength, Internal Temperature, Signal Quality, Surface/Noise Margin, Vapor DC, Analog Output Current <sup>(4)</sup> and % of Range <sup>(4)</sup> . Model 5301 (in addition to the above for the case with fully submerged probe): Interface Level and Interface Distance. Model 5302 (in addition to the above): Interface Level, Interface Level Rate, Interface Distance, Upper Volume, Lower Volume and Upper Product Thickness.
Output Units	Level, Interface and Distance: ft, inches, m, cm or mm. Level Rate: ft/s, m/s, in./min, m/h. Volume: ft <sup>3</sup> , inch <sup>3</sup> , US gals, Imp gals, barrels, yd <sup>3</sup> , m <sup>3</sup> or liters. Temperature: °F and °C.
Configuration Tools	HART: Rosemount Radar Master, Rosemount 375 Field Communicator, AMS Suite or any other DD (Device Description) compatible host system. FOUNDATION Fieldbus: Rosemount Radar Master, 375 Handheld Communicator, DeltaV <sup>®</sup> or any other DD (Device Description) compatible host system.
FOUNDATION Fieldbus Blocks	Resource block, 3 Transducer blocks, 6 AI blocks, PID block, ISEL block, SGCR block, ARTH block, and OS block.

# Rosemount 5300 Series

Display / Configuration (continued)	
FOUNDATION Fieldbus Class (Basic or Link Master)	Link Master (LAS).
FOUNDATION Fieldbus Block Execution Time	AI-block: 30 ms. PID-block: 40 ms. ARTH-, ISEL-, OSPL-block: 65 ms. CHAR-block: 75 ms.
FOUNDATION Fieldbus Instantiation	No.
Conforming FOUNDATION Fieldbus	ITK 5.0.
FOUNDATION Fieldbus PlantWeb® Alert Support	Yes.
Damping	0-60 s (2 s, default value).
Electric	
Power Supply	HART: 16-42.4 Vdc (16-30 Vdc in IS applications, 20-42.4 Vdc in Explosion-proof / Flameproof applications). FOUNDATION Fieldbus: 9-32 Vdc (9-30 Vdc in IS applications, and 16-32 Vdc in Explosionproof / Flameproof applications). FISCO, IS applications: 9-17.5 Vdc.
Internal Power Consumption	< 50 mW in normal operation.
Output	HART 4-20 mA current loop or FOUNDATION Fieldbus.
Quiescent Current Draw (FOUNDATION Fieldbus)	21 mA
Signal on Alarm	Standard : Low = 3.75 mA, High = 21.75 mA. Namur NE 43: Low = 3.60 mA, High = 22.50 mA.
Saturation Levels	Standard: Low = 3.9 mA, High = 20.8 mA. Namur NE 43: Low = 3.8 mA, High = 20.5 mA.
IS Parameters	See Appendix B: Product Certifications.
Cable Entry	½ - 14 NPT for cable glands or conduit entries. Optional: M20 x 1.5 conduit / cable adapter, M12 4-pin male eurofast® connector or A size Mini 4-pin male minifast® connector.
Output Cabling	Twisted shielded pairs, 18-12 AWG.
Mechanical	
Probes	Coaxial: 1.3 ft (0.4 m) to 19.7 ft (6 m). Rigid Twin Lead: 1.3 ft (0.4 m) to 9.8 ft (3 m). Flexible Twin Lead: 3.3 ft (1 m) to 164 ft (50 m). Rigid Single Lead (0.3 in./8 mm): 1.3 ft (0.4 m) to 9.8 ft (3 m) Rigid Single Lead (0.5 in./13 mm): 1.3 ft (0.4 m) to 14.8 ft (4.5 m) Flexible Single Lead: 3.3 ft (1 m) to 164 ft (50 m).
Tensile Strength	4 mm Flexible Single Lead probe (model code 5A, 5B): 2698 lb (12 kN) 6 mm Flexible Single Lead probe (model code 6A, 6B): 6519 lb (29 kN) Flexible Twin Lead probe: 2023 lb (9 kN).
Collapse Load	4 mm Flexible Single Lead probe (model code 5A, 5B): 3597 lb (16 kN) 6 mm Flexible Single Lead probe (model code 6A, 6B): 7868 lb (35 kN)
Sideway Capacity	Coaxial: 73.7 ft lbf or 3.7 lb at 19.7 ft (100 Nm or 1.67 kg at 6 m). Rigid Twin Lead: 2.2 ft lbf or 0.22 lb at 9.8 ft (3 Nm or 0.1 kg at 3 m). Rigid Single Lead: 4.4 ft lbf or 0.44 lb at 9.8 ft (6 Nm or 0.2 kg at 3 m).
Material Exposed to Tank Atmosphere	<ul style="list-style-type: none"> <li>• 316L SST (EN 1.4404), PTFE, PFA<sup>(5)</sup> and O-ring materials (Standard Probe, Material model code 1) or</li> <li>• Alloy C-276 (UNS N10276), PTFE, PFA<sup>(5)</sup> and O-ring materials (Standard Probe, Material model code 2) or</li> <li>• Alloy 400 (UNS N04400), PTFE, PFA<sup>(5)</sup> and O-ring materials (Standard Probe, Material model code 3)</li> <li>• PTFE<sup>(6)</sup> (Standard Probe, Material model code 7) or</li> <li>• PTFE<sup>(6)</sup>, 316 L SST (EN 1.4404) and O-ring materials (Standard Probe, Material model code 8)</li> <li>• 316L SST (EN 1.4404), Ceramic (Al<sub>2</sub>O<sub>3</sub>), Graphite, Inconel (HTHP Probe, Material model code 1)</li> <li>• Alloy C-276 (UNS N10276), Ceramic (Al<sub>2</sub>O<sub>3</sub>), Graphite, Inconel (HTHP Probe, Material model code 2 and H)</li> <li>• 316L SST (EN 1.4404), Ceramic (Al<sub>2</sub>O<sub>3</sub>), Graphite, PFA, PTFE, Inconel (HP Probe, Material model code 1)</li> <li>• Alloy C-276 (UNS N10276), Ceramic (Al<sub>2</sub>O<sub>3</sub>), Graphite, PFA, PTFE, Inconel (HP Probe, Material model code 2 and H)</li> <li>• 316L SST (EN 1.4404), Ceramic (Al<sub>2</sub>O<sub>3</sub>), Graphite, PFA, PTFE, Inconel (C Probe, Material model code 1)</li> </ul> See "Ordering Information" on page A-21.

## Reference Manual

00809-0100-4530, Rev BA

July 2009

## Rosemount 5300 Series

Mechanical (continued)	
Dimensions	See "Dimensional Drawings" on page A-9.
Probe Angle	0 to 90 degrees.
Housing / Enclosure	Polyurethane-covered Aluminum or SST Grade CF8M (ASTM A743).
Flanges, Threads	See "Ordering Information" on page A-21.
Height Above Flange	See "Ordering Information" on page A-21.
Weight	Transmitter Head (TH): 4.4 lbs (2 kg). SST 10.8 lbs (4.9 kg). Flange: depends on flange size. Coaxial probe: 0.67 lbs/ft (1 kg/m). Rigid Single Lead probe (0.3 in./8 mm): 0.27 lbs/ft (0.4 kg/m). Rigid Single Lead probe (0.5 in./13 mm): 0.71 lbs/ft (1.06 kg/m). Rigid Twin Lead probe: 0.40 lbs/ft (0.6 kg/m). Flexible Single Lead probe: 0.05 lbs/ft (0.08 kg/m). Flexible Twin Lead probe: 0.09 lbs/ft (0.14 kg/m). End weight: 0.88 lbs (0.40 kg) for the 4 mm single lead probe, 1.2 lbs (0.55 kg) for the 6 mm single lead probe and 1.3 lbs (0.60 kg) for twin lead probes.
Environment	
Ambient Temperature	Non-Hazardous, HART communication: -40°F to 176°F (-40°C to 80°C). IS/EEEx ia and XP/EEEx d, HART communication: -58°F to 158°F (-50°C to 70°C). IS/EEEx ia and XP/EEEx d, FOUNDATION Fieldbus: -58°F to 140°F (-50°C to 60°C). LCD readable in: -4°F to 158°F (-20°C to 70°C).
Storage Temperature	-58°F to 194°F (-50°C to 90°C). LCD: -40°F to 185°F (-40°C to 85°C).
Process Temperature <sup>(7)</sup>	Standard: -40°F to +302°F (-40°C to +150°C ) HTHP: -76°F to +752°F (-60°C to +400°C ) HP: -76°F to +392°F (-60°C to +200°C ) C: -320°F to +392°F (-196°C to +200 °C) See temperature and pressure diagrams on page A-4.
Process Pressure <sup>(7)</sup>	Standard: Full vacuum to 580 psig (-1 to 40 Bar ). HTHP: Full vacuum to 5000 psig (-1 to 345 Bar). HP: Full vacuum to 5000 psig (-1 to 345 Bar). C: Full vacuum to 5000 psig (-1 to 345 Bar). See temperature and pressure diagrams on page A-4.
Humidity	0 - 100% Relative Humidity.
Ingress Protection	NEMA 4X, IP 66 and IP67.
Telecommunication (FCC and R&TTE)	FCC part 15 (1998) subpart B and R&TTE (EU directive 99/5/EC). Considered to be an unintentional radiator under the Part 15 rules.
Factory Sealed	Yes.
Vibration Resistance	Aluminum housing: IEC 60770-1 Level 1. Stainless Steel housing: IACS E10.
Electromagnetic Compatibility	Emission and Immunity: EMC directive 204/108/EC. EN61326-1: 2006. NAMUR recommendations NE21.
Built-in Lightning Protection	EN61326, IEC 801-5, level 1 kV. T1 option: the transmitter complies with IEEE 587 Category B transient protection and IEEE 472 surge protection
Pressure Equipment Directive (PED)	Complies with 97/23/EC article 3.3.

(1) For probes with spacers, the accuracy may deviate close to the spacers.

(2) If the reference conditions are not met, an offset adjustment for the zero reference point may be necessary. The offset may be up to ± 25 mm.

(3) When using remote housing, the accuracy may be reduced.

(4) Not applicable for FOUNDATION Fieldbus.

(5) PFA is a fluoropolymer with properties similar to PTFE.

(6) 1 mm PTFE cover.

(7) Final rating may be lower depending on flange and O-ring selection.

# Rosemount 5300 Series

## Process Temperature and Pressure Rating

The tank connection consists of a tank seal, a flange<sup>(1)</sup>, Tri-Clamp<sup>(2)</sup> or NPT or BSP/G threads<sup>(3)</sup>. See "Ordering Information" on page A-21).

Flange mating face dimensions follow ANSI B 16.5, JIS B2220, and EN 1092-1 standards for blind flanges. Fisher and Masoneilan flanges are also available.

Certain models of flanged Alloy and PTFE covered probes have a tank connection design with a protective plate of the same material as the probe, to prevent the 316L / EN 1.4404 SST flange from being exposed to the tank atmosphere.

The following diagrams give process temperature (maximum product temperature at the lower part of the flange) and pressure ratings for tank connections:

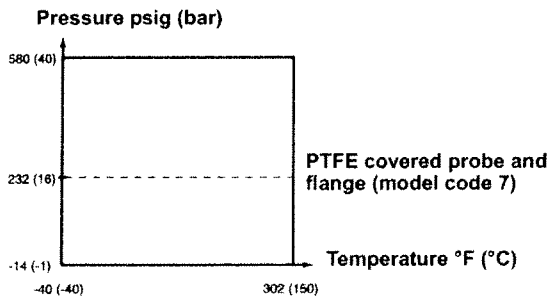
- Standard (Std)
- High Temperature and High Pressure (HTHP)
- High Pressure (HP)
- Cryogenic (C)

### NOTE!

For standard tank connection, the final rating depends on flange and O-ring selection.

The C version can manage lower temperatures (-321 °F/-196 °C) than the Standard, HP, and HTHP versions.

Figure A-1. Maximum process temperature and pressure diagram for standard tank connections.



(1) EN (DIN), ANSI, Fisher or Masoneilan.  
(2) 1.5, 2, 3 or 4 in. for Single Lead probes.  
(3) 1, 1.5, or 2 in. depending on probe type

Figure A-2. Maximum process temperature and pressure diagram for HTHP tank connection.

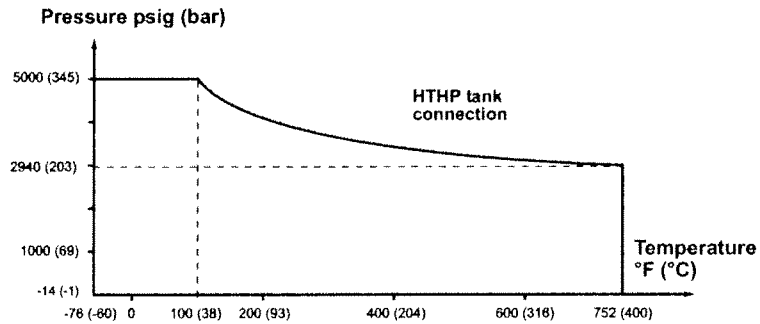


Figure A-3. Maximum process temperature and pressure diagram for HP tank connection.

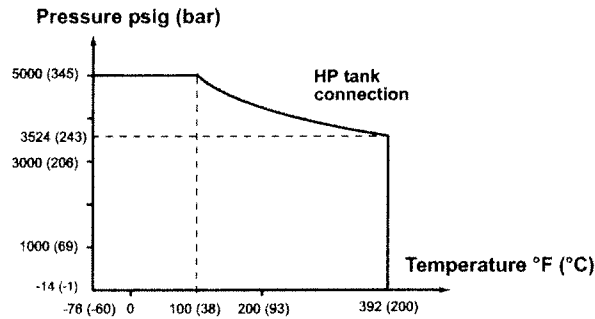
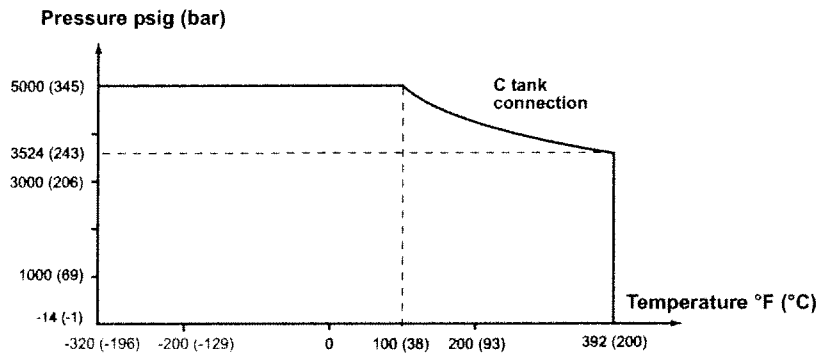


Figure A-4. Process temperature and pressure diagram for C tank connection.



The HTHP, HP, and C versions have a ceramic tank seal, and graphite gaskets - no O-rings are used. The final rating depends on flange selection.

A difference between the HP/C and HTHP coaxial versions is material for some parts; PFA/PTFE for HP/C, and ceramics for HTHP. Ceramic spacers allow for usage in applications with higher temperature.

The following table gives the temperature ranges for tank seal with different O-ring material (applicable for the Standard Tank Connection):

## Rosemount 5300 Series

Table A-1. Temperature range for different tank seal material.

Tank Seal with different O-ring material	Min. Temperature °F (°C) in air	Max. Temperature °F (°C) in air
Viton	5 (-15)	302 (150)
Ethylene Propylene (EPDM)	-40 (-40)	266 (130)
Kalrez 6375	14 (-10)	302 (150)
Buna-N	-31 (-35)	230 (110)

For Tri-Clamps, the maximum pressure is 16 bar for 1.5 in. (37.5 mm) and 2 in. (50 mm) housing; and 10 bar for 3 in. (75 mm) and 4 in. (100 mm) housing. The final rating depends on the clamp and gasket you are using. Tri-Clamp is available for the Standard Temperature and Pressure seal.

### Flange Connection Rating

Flange strength calculations are made with the following conditions:

- For 316L SST:

	Bolting material	Gasket		Flange material	Hub material
		Standard/HHTP	HP/HHTP/C		
<b>ANSI</b>	Stainless steel SA193 B8M C1.2	Soft (1a) with min. thickness 1.6 mm.	Spiral wound gasket with nonmetallic filler (1b)	Stainless steel A182 Gr. F316L and EN 10222-5-1.4404.	Stainless steel A479M 316L or EN 10272-1.4404.
<b>EN</b>	EN 1515-1/-2 group 13E0, A4-70.	Soft (EN 1514-1) with min. thickness 1.6 mm.	Spiral wound gasket with nonmetallic filler (EN 1514-2)		

- For Alloy C-276:

	Bolting material	Gasket		Flange material	Hub material
		HHTP	HP/HHTP/C		
<b>ANSI</b>	UNS N10276	Soft (1a) with min. Thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (1b)	SB462 Gr. N10276 (solution annealed condition) or SB575 Gr. N10276 (solution annealed condition)	SB574 Gr. N10276
<b>EN</b>		Soft (EN 1514-1) with min. Thickness 1.6 mm	Spiral wound gasket with nonmetallic filler (EN 1514-2)		

Calculations show that the following applies.

### Flange Rating Standards

- **ANSI:**  
316L SST Flanges according to ANSI B16.5 Table 2-2.3.  
Standard: Max. 302 °F/580 psig (150 °C/40 Bar).  
HP/HHTP/C: Up to Class 2500.

Alloy C-276 (UNS N10276) flanges according to ANSI B16.5 Table 2-3.8.  
HP: Class 1500 up to max 200 °C or max 100 °F/5000 psig (38 °C/345 bar) and 392 °F/3500 psig (200 °C/243 bar)  
HHTP: Class 1500 up to max 400 °C or max 100 °F/5000 psig (38 °C/345 bar) and 752 °F/2940 psig (400 °C/203 bar).

- **EN:**  
 316L SST according to EN 1092-1 Table 18, material group 13E0.  
 Standard: Max. 302 °F/580 psig  
 (150 °C/40 Bar).  
 HP/HTHP/C: Up to PN 320.  
  
 Alloy C-276 according to EN 1092-1 table 18 material group 12E0.  
 HP/HTHP: Up to PN320.
- **Fisher & Masoneilan:**  
 According to ANSI B16.5 Table 2-2.3.  
 Standard: Max. 302 °F/580 psig  
 (150 °C/40 Bar).  
 HP/HTHP/C: 32 °F/1199 psig (20 °C/82.7 Bar).  
 Up to Class 600, Table 2.3.
- **JIS:**  
 According to JIS B2220 Table 2.3  
 Standard: 10K/20K/150C.  
 HP/C: 10K/20K/200C.  
 HTHP: 10K/20K/400C

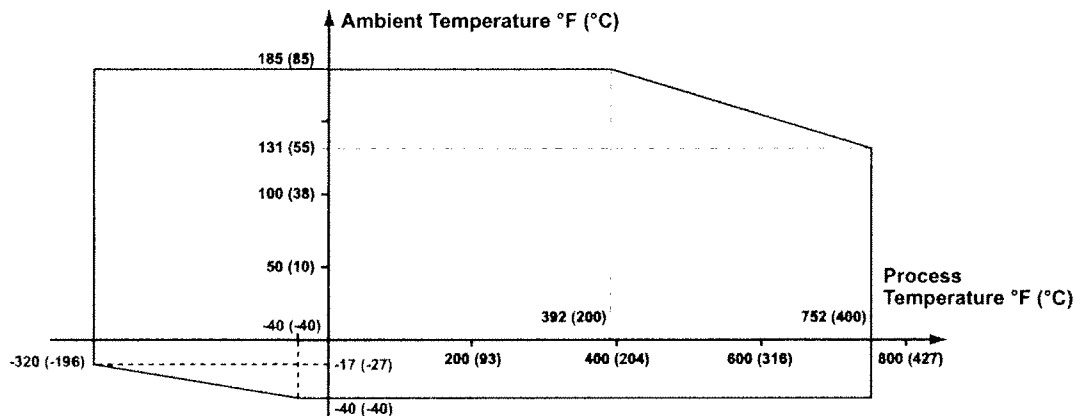
For Alloy C-276 HTHP/HP probes with flange plate design is available up to Class 600/PN 63.

**Ambient Temperature**

When the Rosemount 5300 is installed in high or low temperature applications, it is important that the maximum/minimum ambient temperature is considered. Nozzle insulation for the HTHP version should not exceed 4 in. (10 cm).

The diagram below shows the ambient temperature vs. process temperature:

Figure A-5. Ambient temperature vs. process temperature.



**NOTE!**

The maximum ambient temperature also depends on hazardous locations certifications.

# Rosemount 5300 Series

## Remote Housing Measuring Range

This table shows the maximum recommended measuring range with Remote Housing for different RH lengths, installation types, Dielectric Constants, and probe types.

Table A-2. Remote Housing measuring range

		Dielectric Constant	Rigid Single 8 mm	Rigid Single 13 mm	Flexible Single	Coaxial	Rigid Twin	Flexible Twin	
<b>1 m Remote Housing</b>	Chamber / pipe installations ≤ 4 in. (100 mm)	1.4	4 ft (1.25 m)	15 ft (4.5 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	19 ft (6 m)	10 ft (3 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	
		2	10 ft (3 m) <sup>(1)</sup>	15 ft (4.5 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>		10 ft (3 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	
		80	10 ft (3 m)	15 ft (4.5 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>		10 ft (3 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	
	Tank installations	1.4	4 ft (1.25 m)	4 ft (1.25 m)	4 ft (1.25 m)		4 ft (1.25 m)	4 ft (1.25 m)	4 ft (1.25 m)
		2	4 ft (1.25 m)	4 ft (1.25 m)	4 ft (1.25 m)		4 ft (1.25 m)	98 ft (30 m) <sup>(1)</sup>	98 ft (30 m) <sup>(1)</sup>
		80	10 ft (3 m) <sup>(1)</sup>	10 ft (3 m) <sup>(1)</sup>	159 ft (48.5 m) <sup>(1)</sup>		10 ft (3 m) <sup>(1)</sup>	159 ft (48.5 m) <sup>(1)</sup>	
<b>2 m Remote Housing</b>	Chamber / pipe installations ≤ 4 in. (100 mm)	1.4	9 ft (2.75 m)	15 ft (4.5 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	19 ft (6 m)	10 ft (3 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	
		2	10 ft (3 m) <sup>(1)</sup>	15 ft (4.5 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>		10 ft (3 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	
		80	10 ft (3 m)	15 ft (4.5 m)	33 ft (10 m) <sup>(1) (2)</sup>		10 ft (3 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	
	Tank installations	1.4	9 ft (2.75 m)	9 ft (2.75 m)	9 ft (2.75 m)		9 ft (2.75 m)	9 ft (2.75 m)	9 ft (2.75 m)
		2	9 ft (2.75 m)	9 ft (2.75 m)	9 ft (2.75 m)		9 ft (2.75 m)	98 ft (30 m) <sup>(1)</sup>	98 ft (30 m) <sup>(1)</sup>
		80	10 ft (3 m) <sup>(1)</sup>	10 ft (3 m) <sup>(1)</sup>	154 ft (47 m) <sup>(1)</sup>		10 ft (3 m) <sup>(1)</sup>	154 ft (47 m) <sup>(1)</sup>	
<b>3 m Remote Housing</b>	Chamber / pipe installations ≤ 4 in. (100 mm)	1.4	10 ft (3 m)	15 ft (4.5 m)	33 ft (10 m) <sup>(1) (2)</sup>	19 ft (6 m)	10 ft (3 m) <sup>(1)</sup>	33 ft (10 m) <sup>(1) (2)</sup>	
		2		15 ft (4.5 m)	33 ft (10 m) <sup>(1) (2)</sup>			33 ft (10 m) <sup>(1) (2)</sup>	
		80		15 ft (4.5 m)	33 ft (10 m) <sup>(1) (2)</sup>			33 ft (10 m) <sup>(1) (2)</sup>	
	Tank installations	1.4		14 ft (4.25 m)	14 ft (4.25 m)			14 ft (4.25 m)	14 ft (4.25 m)
		2		14 ft (4.25 m)	14 ft (4.25 m)			14 ft (4.25 m)	98 ft (30 m) <sup>(1)</sup>
		80		15 ft (4.5 m) <sup>(1)</sup>	149 ft (45.5 m) <sup>(1)</sup>			149 ft (45.5 m) <sup>(1)</sup>	

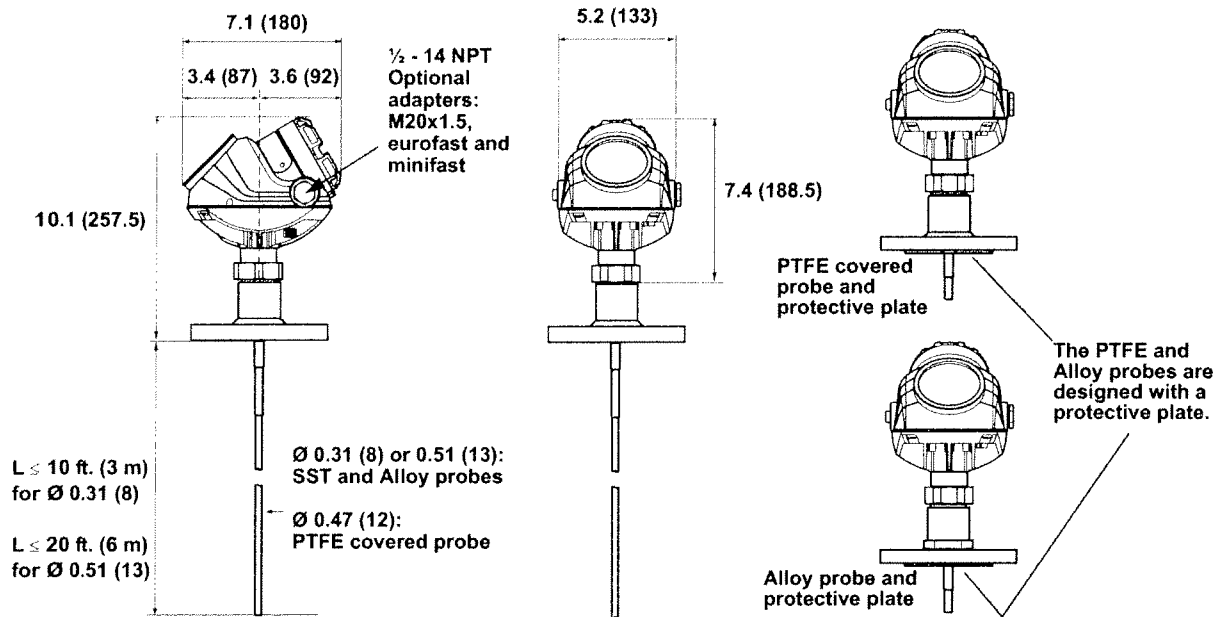
(1) Accuracy may be affected up to ± 1.2 in. (30 mm).  
(2) Required chamber/pipe size is 3 or 4 in. (75 - 100 mm).



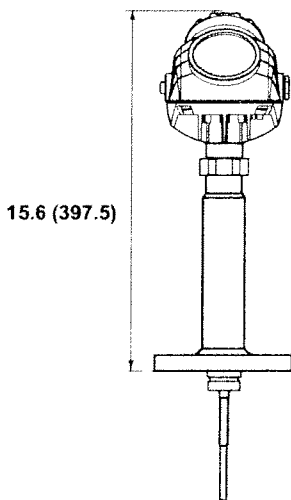
**DIMENSIONAL DRAWINGS**

**Probe Type 4A, 4B**

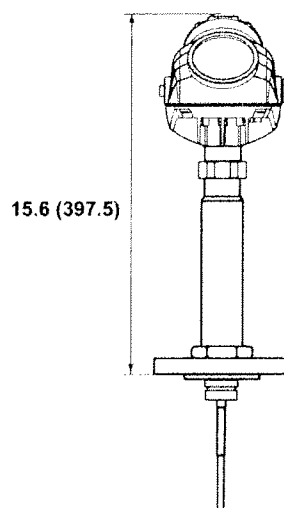
Figure A-6. Rigid Single Lead Probe with Flange Connection



HTHP/HP/C version



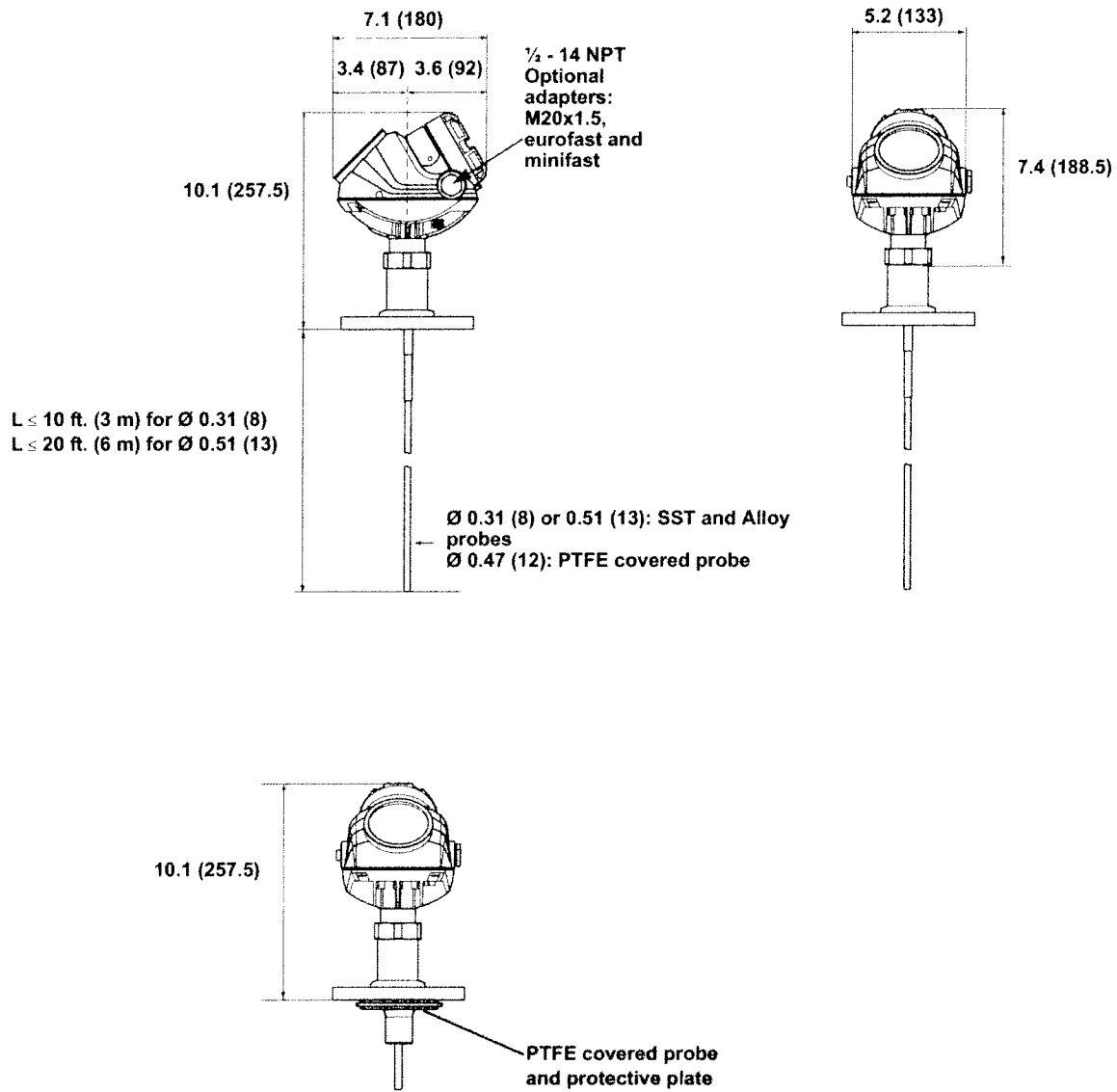
HTHP/HP Plate Design  
(Option for Alloy versions)



Dimensions are in inches (millimeters).

# Rosemount 5300 Series

Figure A-7. Rigid Single Lead  
 Probe with Tri-Clamp  
 Connection



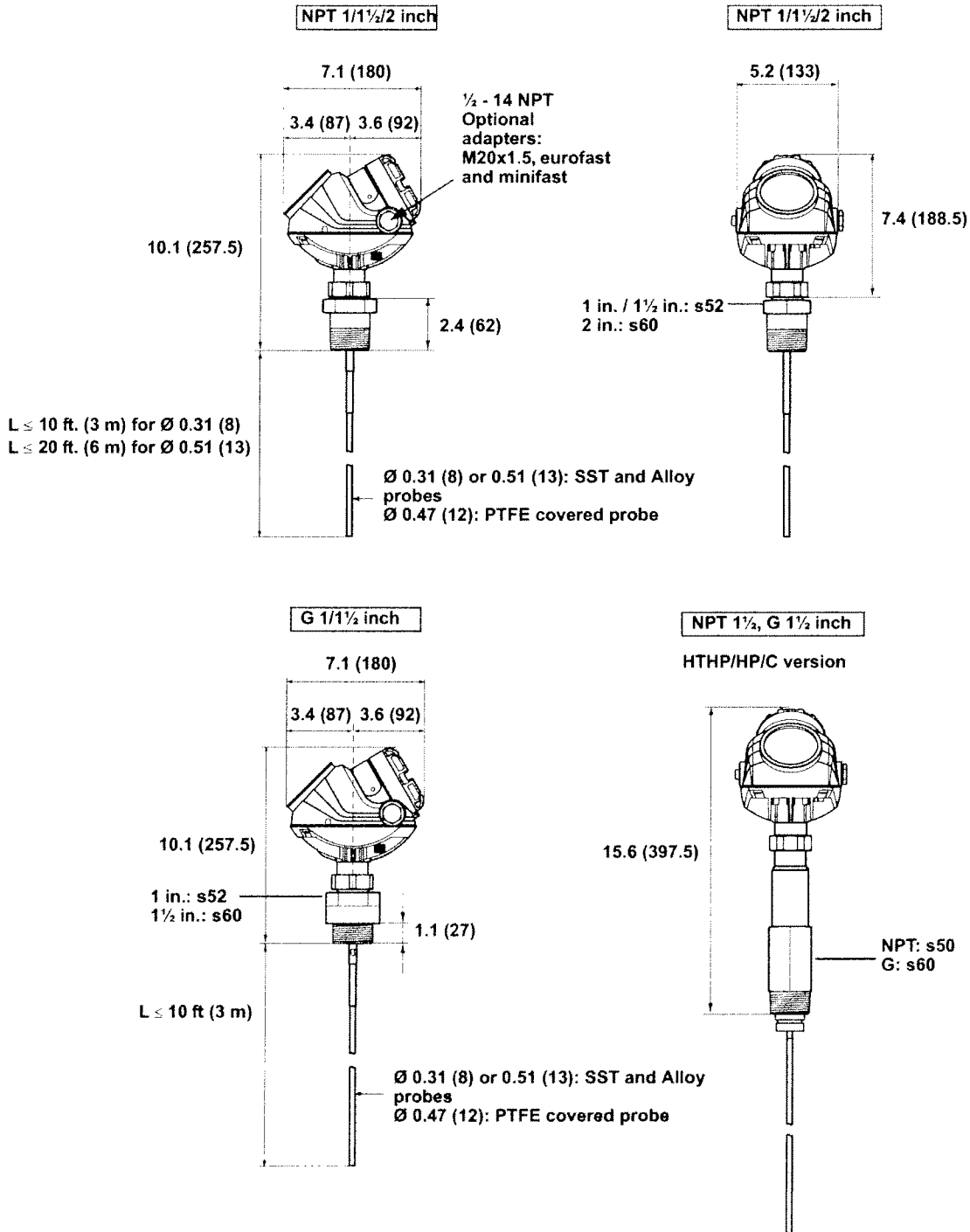
Dimensions are in inches (millimeters).

**Reference Manual**

00809-0100-4530, Rev BA  
July 2009

**Rosemount 5300 Series**

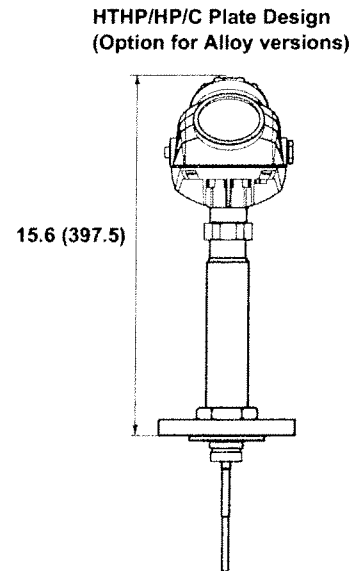
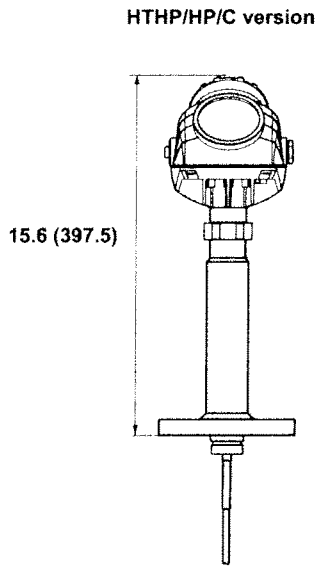
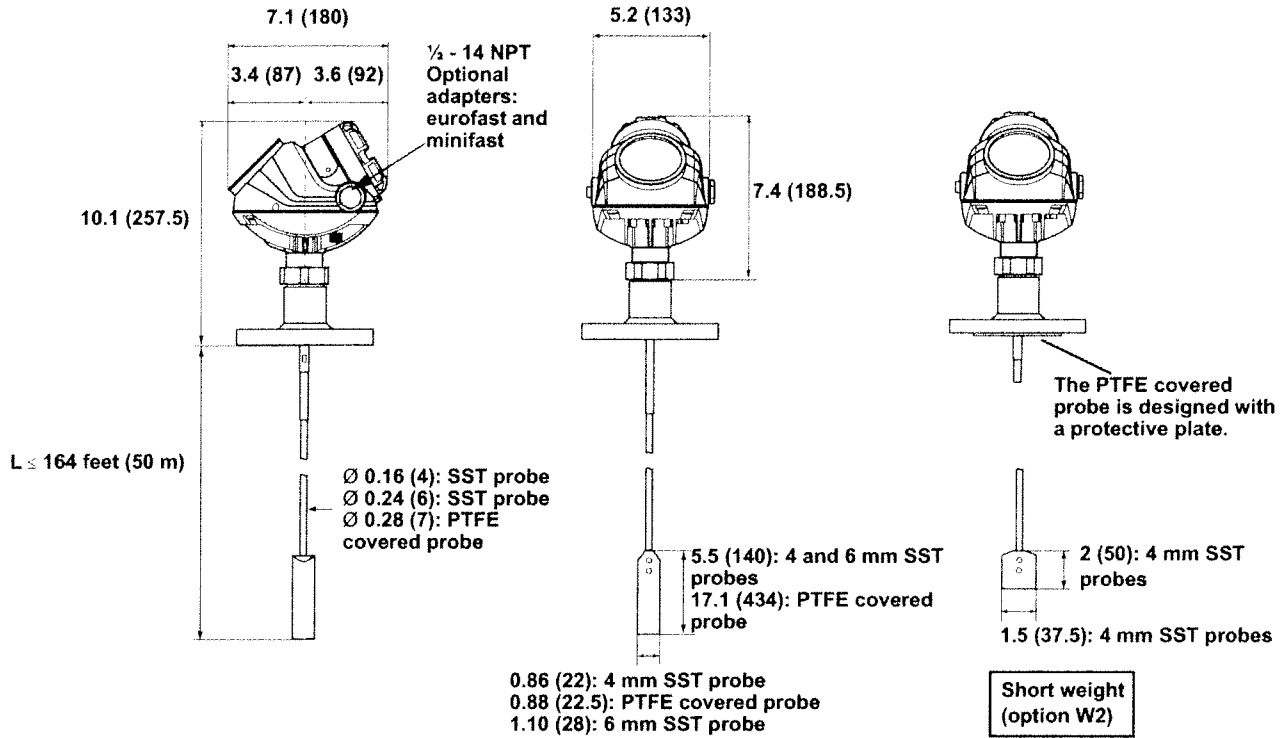
Figure A-8. Rigid Single Lead with threaded connection



Dimensions are in inches (millimeters).

# Rosemount 5300 Series

Figure A-9. Flexible Single Lead Probe Type 5A, 5B  
 Probe with Flange Connection



Dimensions are in inches (millimeters).

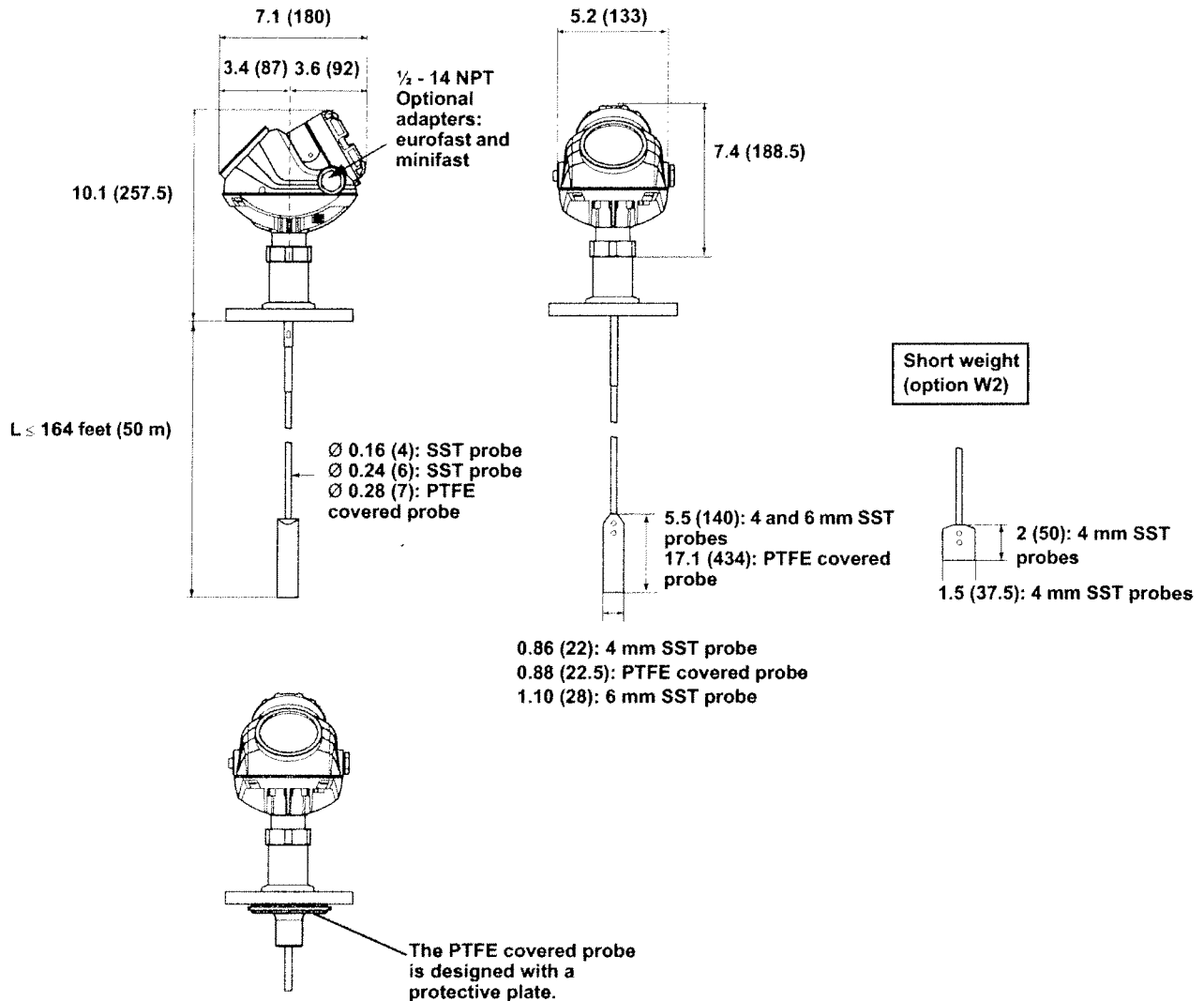
**Reference Manual**

00809-0100-4530, Rev BA

July 2009

**Rosemount 5300 Series**

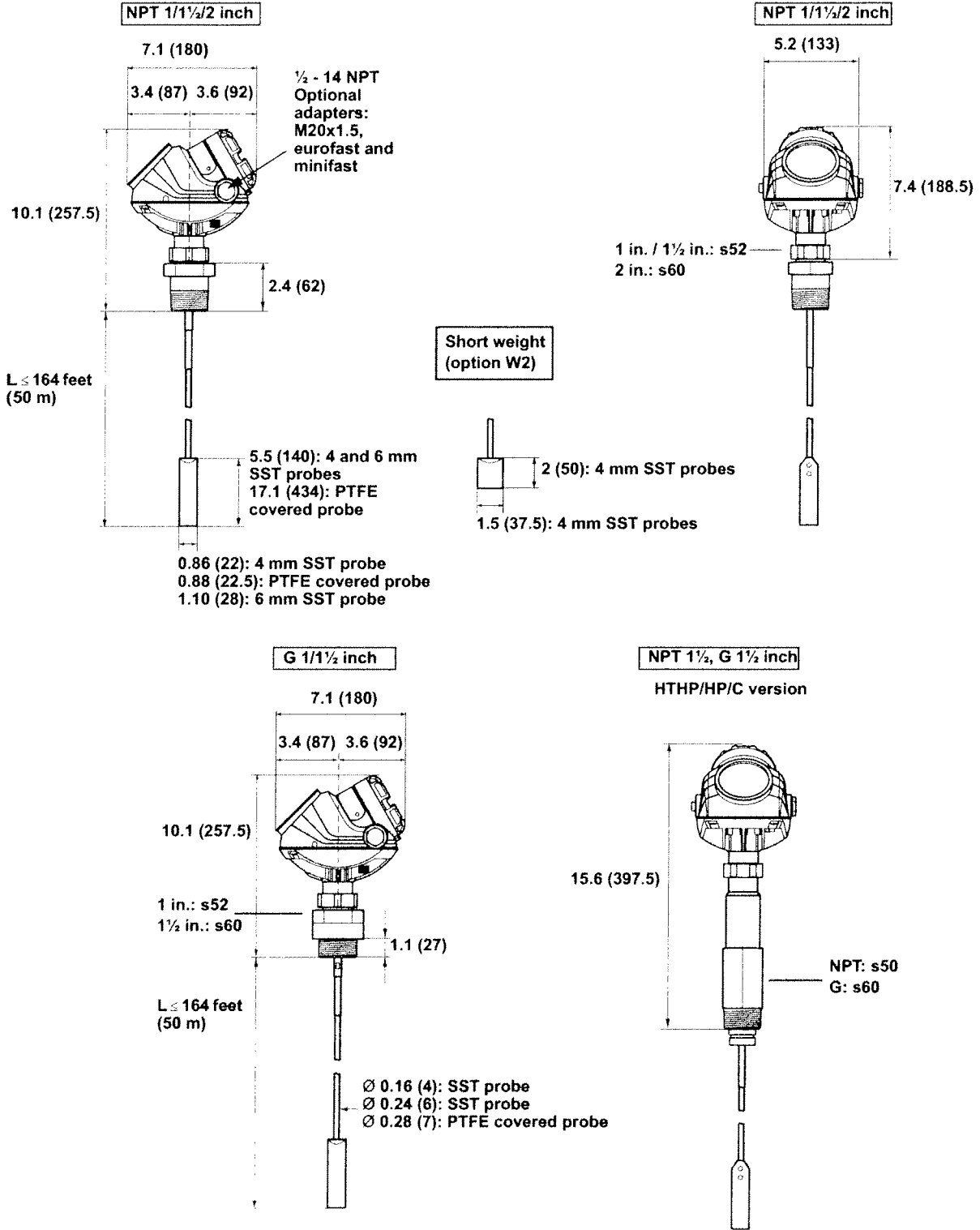
Figure A-10. Flexible Single Lead Probe with Tri-Clamp Connection



Dimensions are in inches (millimeters).

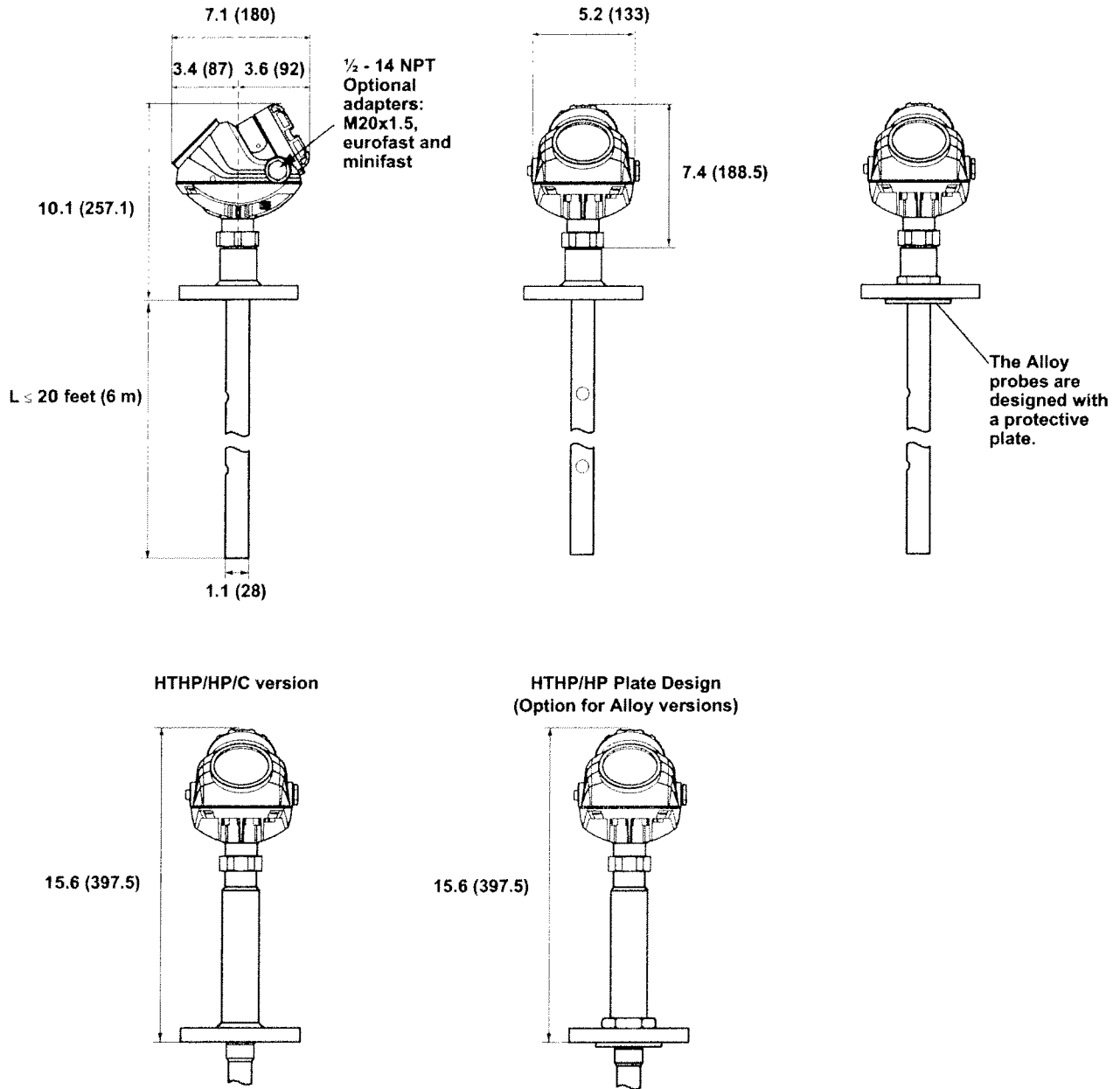
# Rosemount 5300 Series

Figure A-11. Flexible Single Lead with threaded connection



Dimensions are in inches (millimeters).

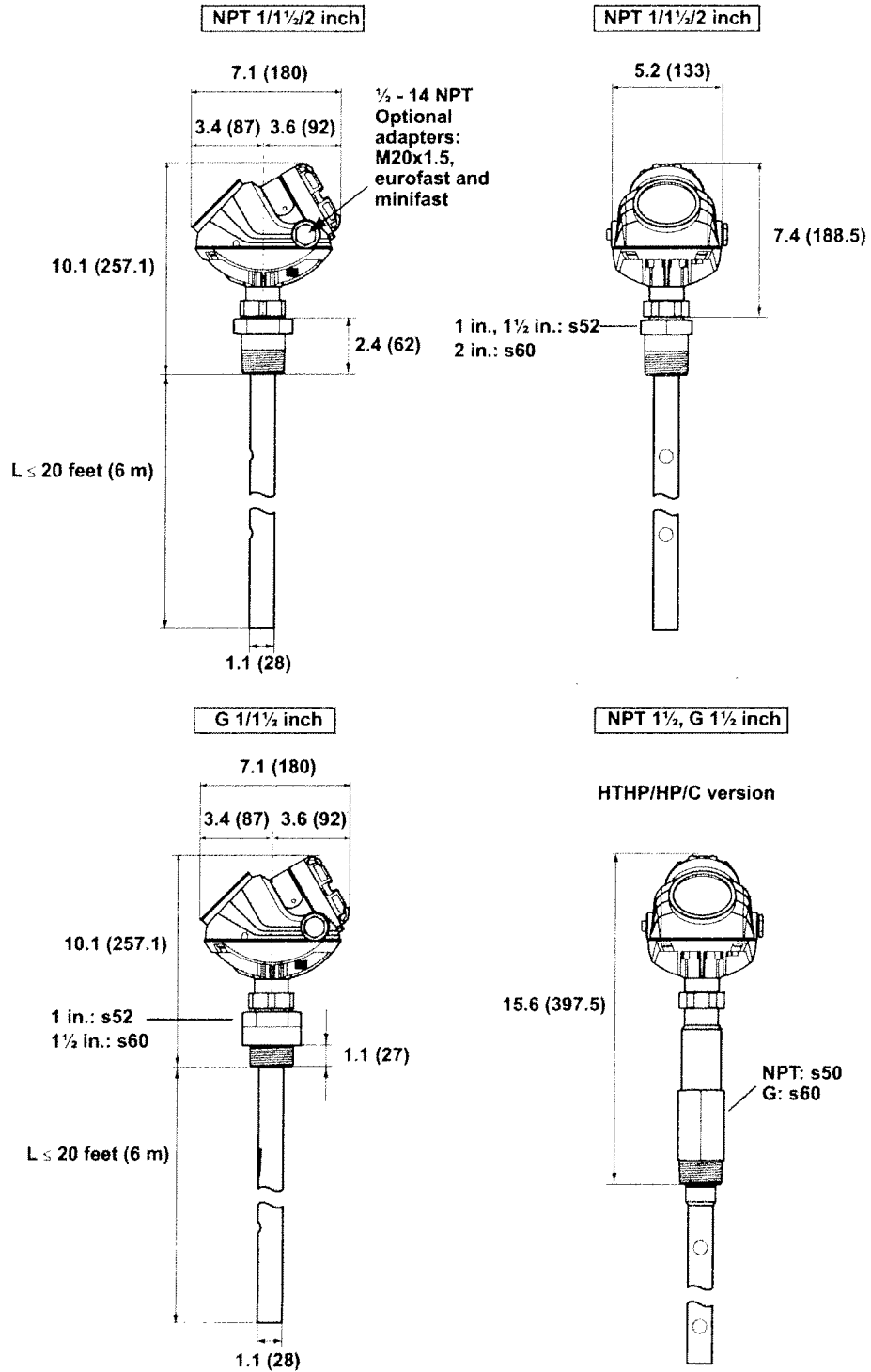
Figure A-12. Coaxial probe with flange connection **Probe Type 3A, 3B**



Dimensions are in inches (millimeters).

# Rosemount 5300 Series

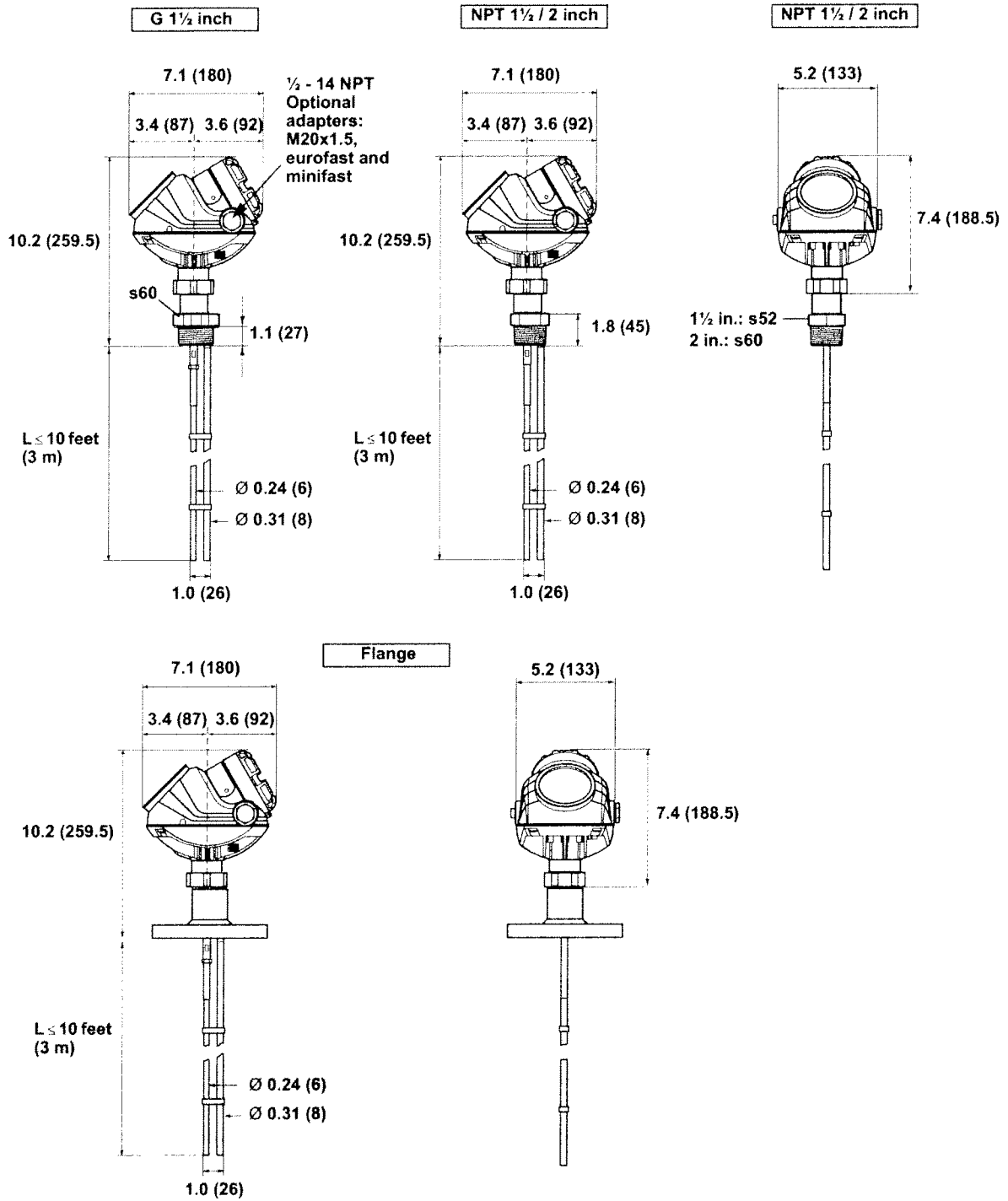
Figure A-13. Coaxial probe with threaded connection



Dimensions are in inches (millimeters).



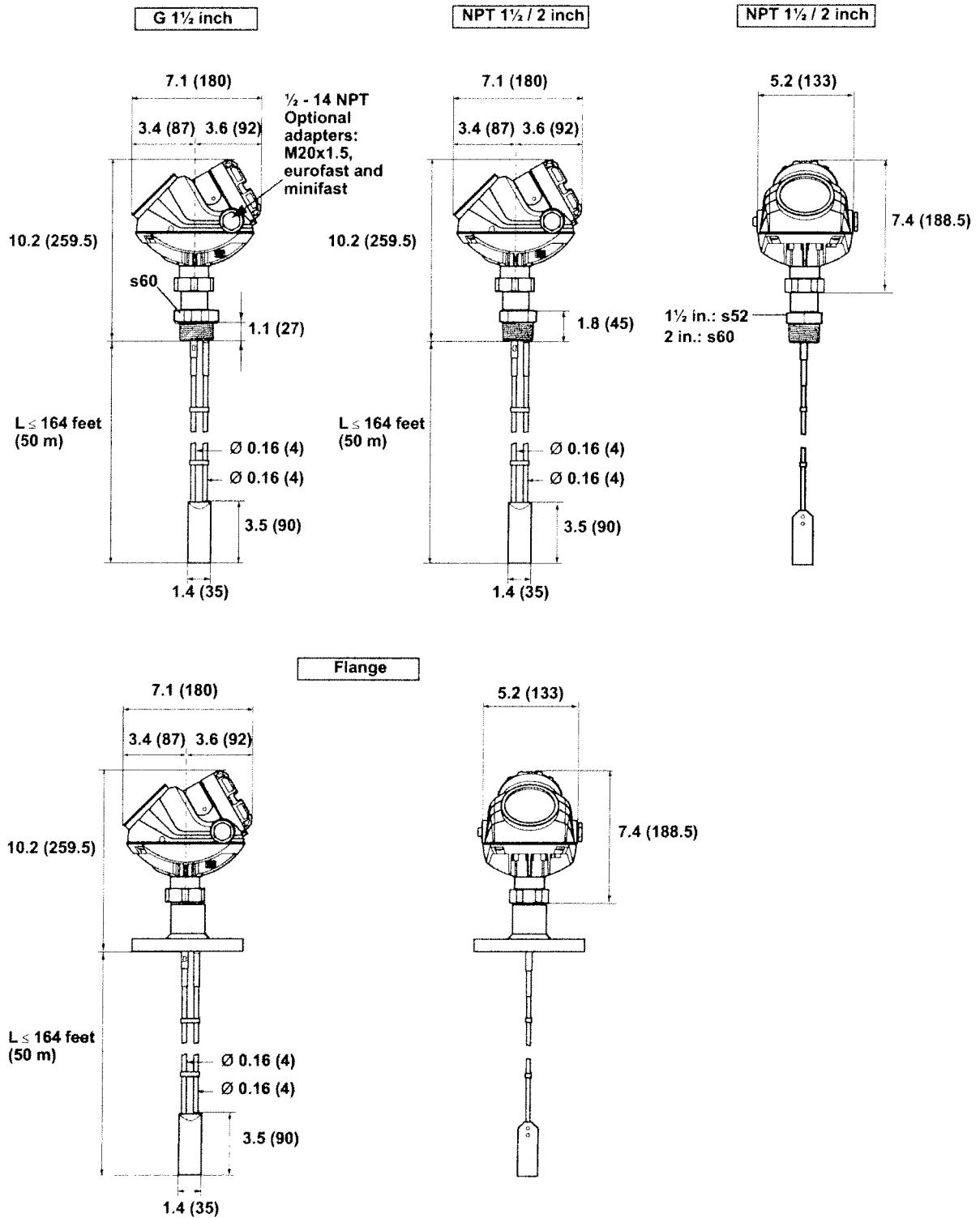
Figure A-14. Rigid Twin Lead Probe Type 1A



Dimensions are in inches (millimeters).

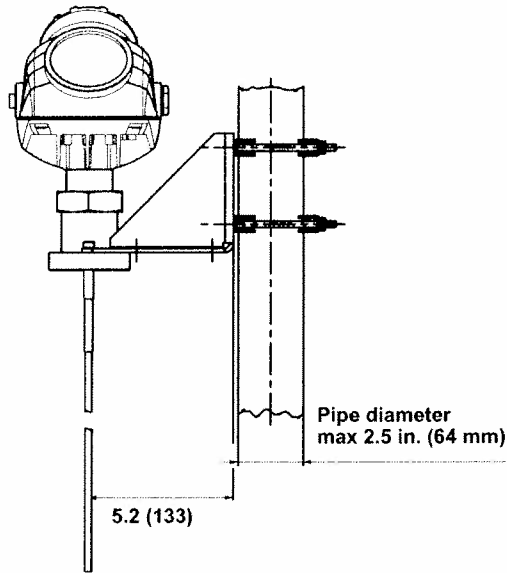
# Rosemount 5300 Series

Figure A-15. Flexible Twin Lead Probe Type 2A

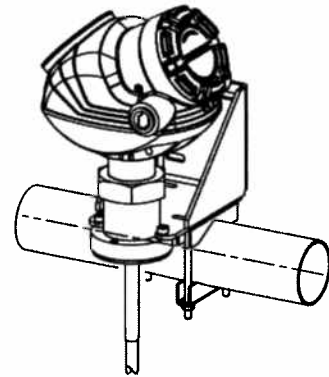


Dimensions are in inches (millimeters).

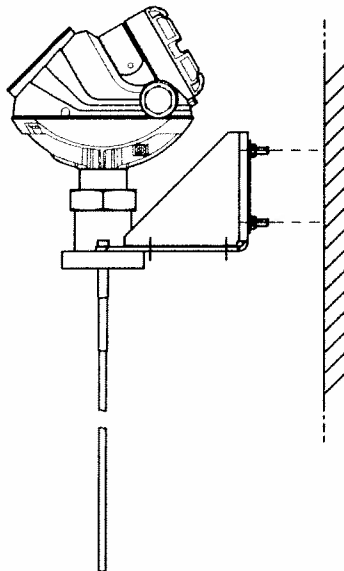
Figure A-16. Bracket mounting.



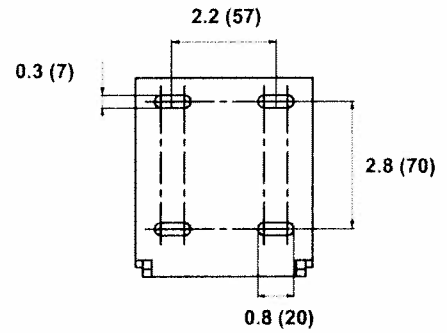
Pipe mounting  
(vertical pipe)



Pipe mounting  
(horizontal pipe)



Wall mounting

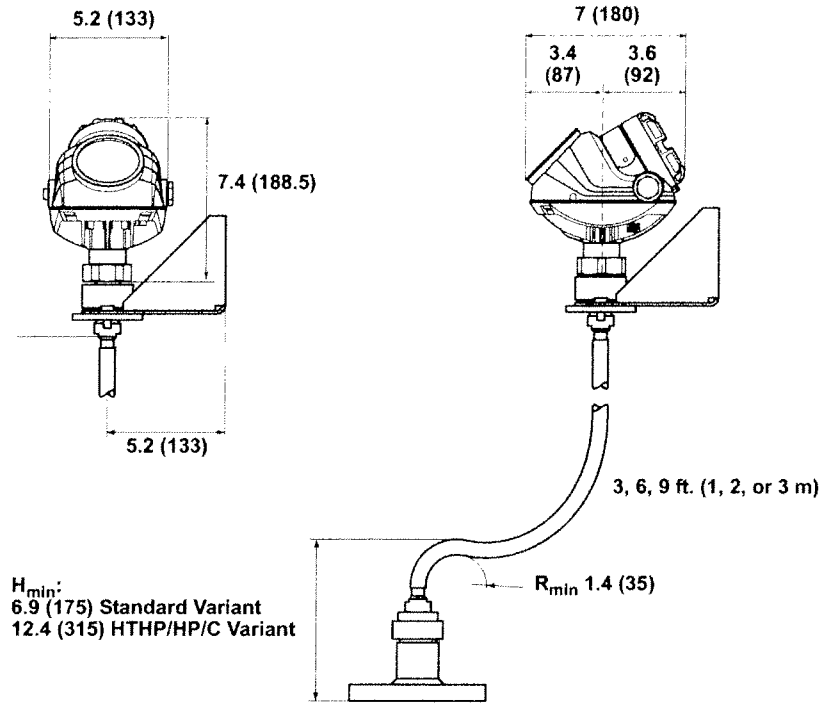


Hole pattern  
wall mounting

Dimensions are in inches (millimeters).

# Rosemount 5300 Series

Figure A-17. Remote housing.



Dimensions are in inches (millimeters).

**ORDERING INFORMATION**

**Model Code 5301 and 5302 Level and/or Interface in Liquids**

Model	Product Description		
5301	Guided Wave Radar Liquid Level or Interface Transmitter (interface available for fully submerged probe)		
5302	Guided Wave Radar Liquid Level and Interface Transmitter		
Code	Signal Output		
H	4-20 mA with HART communication		
F	FOUNDATION fieldbus		
Code	Housing Material		
A	Polyurethane-covered Aluminum		
S	Stainless Steel, Grade CF8M (ASTM A743)		
Code	Conduit / Cable Threads		
1	½ - 14 NPT		
2	M20 x 1.5 adapter		
E	M12, 4-pin, Male connector (eurofast <sup>®</sup> ) <sup>(1)</sup>		
M	A size Mini, 4-pin, Male connector (minifast <sup>®</sup> ) <sup>(1)</sup>		
Code	Operating Temperature and Pressure <sup>(2)</sup>	Probe Type	
S	- 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)	All	
H	High Temperature / High Pressure <sup>(3)</sup> : 2940 psi @ 752 °F and 5000 psi @ 100 °F (203 bar @ 400 °C and 345 bar @ 38 °C) according to ANSI Class 2500	3A, 3B, 4A, 4U, 4V, 5A and 5B	
P	High Pressure <sup>(3)</sup> : Max 392 °F (200 °C): 3500 psi @ 392 °F and 5000 psi @ 100 °F (243 bar @ 200 °C and 345 bar @ 38 °C) according to ANSI Class 2500	3A, 3B, 4A, 5A, and 5B	
C	Cryogenic Temperature <sup>(3) (4)</sup> -321 °F (-196 °C) Max 392 °F (200 °C): 3500 psi @ 392 °F and 5000 psi @ 100 °F (243 bar @ 200 °C and 345 bar @ 38 °C) according to ANSI Class 2500	3A, 3B, 4A, 5A, 5B (only SST)	
Code	Material of Construction <sup>(5)</sup> : Process Connection / Probe	Probe Type	Valid Operation Temperature and Pressure
1	316 L SST (EN 1.4404)	All	S, H, P, C
2	Alloy C-276 (UNS N10276). With plate design if flanged version. Up to class 600, PN 63 for HTHP/HP probes.	3A, 3B, 4A	S, H, P
3	Alloy 400 (UNS N04400). With plate design if flanged version.	3A, 3B, 4A, 5A, 5B	S
7	PTFE covered probe and flange. With plate design.	4A and 5A	S
8	PTFE covered probe	4A and 5A	S
H	Alloy C-276 (UNS N10276) process connection, flange and probe <sup>(6)</sup>	3A, 3B, 4A	H, P
Code	Sealing, O-ring Material (Consult the factory for other o-ring materials)		
N	None <sup>(7)</sup>		
V	Viton <sup>®</sup> fluoroelastomer		
E	Ethylene Propylene		
K	Kalrez <sup>®</sup> 6375 perfluoroelastomer		
B	Buna-N		

# Rosemount 5300 Series

Code	Probe Type	Process Connection	Probe Lengths
1A	Rigid Twin Lead <sup>(9)</sup>	Flange / 1.5 in., 2 in. <sup>(9)</sup> Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
2A	Flexible Twin Lead with weight <sup>(9)</sup>	Flange / 1.5 in., 2 in. <sup>(9)</sup> Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
3A	Coaxial (for level measurement) <sup>(8)</sup>	Flange / 1 in. <sup>(9)</sup> , 1.5 in., 2 in. <sup>(9)</sup> Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
3B	Coaxial, perforated. For level and interface measurement, or easier cleaning.	Flange / 1 in. <sup>(9)</sup> , 1.5 in., 2 in. <sup>(9)</sup> Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
4A	Rigid Single Lead (8 mm)	Flange / 1 in. <sup>(9)</sup> , 1.5 in., 2 in. <sup>(9)</sup> Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
4B	Rigid Single Lead (13 mm) <sup>(10)</sup>	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 14 ft 9 in. (4.5 m)
4U	Vapor Single Rigid Probe for 2 in. pipes <sup>(11)</sup>	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)
4V	Vapor Single Rigid Probe for 3-4 in. pipes <sup>(11)</sup>	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)
5A	Flexible Single Lead with weight	Flange / 1 in. <sup>(9)</sup> , 1.5 in., 2 in. <sup>(9)</sup> Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
5B	Flexible Single Lead with chuck <sup>(12)</sup>	Flange / 1 in. <sup>(9)</sup> , 1.5 in., 2 in. <sup>(9)</sup> Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
Code	Probe Length Units		
E	English (feet, in.)		
M	Metric (meters, centimeters)		
Code	Total Probe Length <sup>(13)</sup> (feet/m)		
xxx	0-164 ft or 0-50 m		
Code	Total Probe Length <sup>(13)</sup> (in./cm)		
xx	0-11 in. or 0-99 cm		
Code	Process Connection - Size / Type (consult factory for other process connections)		
ANSI Flanges <sup>(14)</sup>			
AA	2 in. ANSI, 150 lb		
AB	2 in. ANSI, 300 lb		
AC	2 in. ANSI, 600 lb. HTHP / HP units		
AD	2 in. ANSI, 900 lb. HTHP / HP units		
AE	2 in. ANSI, 1500 lb. HTHP / HP units		
AI	2 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units		
AJ	2 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units		
AK	2 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units		
BA	3 in. ANSI, 150 lb		
BB	3 in. ANSI, 300 lb		
BC	3 in. ANSI, 600 lb. HTHP / HP units		
BD	3 in. ANSI, 900 lb. HTHP / HP units		
BE	3 in. ANSI, 1500 lb. HTHP / HP units		
BI	3 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units		
BJ	3 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units		
BK	3 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units		
CA	4 in. ANSI, 150 lb		
CB	4 in. ANSI, 300 lb		
CC	4 in. ANSI, 600 lb. HTHP / HP units		
CD	4 in. ANSI, 900 lb. HTHP / HP units		
CE	4 in. ANSI, 1500 lb. HTHP / HP units		
CI	4 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units		
CJ	4 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units		
CK	4 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units		
DA	6 in. ANSI, 150 lb		

# Reference Manual

00809-0100-4530, Rev BA

July 2009

# Rosemount 5300 Series

<b>EN (DIN) Flanges<sup>(15)</sup></b>		
HB	DN50, PN40	
HC	DN50, PN63. HTHP / HP units	
HD	DN50, PN100. HTHP / HP units	
HE	DN50, PN160. HTHP / HP units	
HF	DN50, PN250. HTHP / HP units	
IA	DN80, PN16	
IB	DN80, PN40	
IC	DN80, PN63. HTHP / HP units	
ID	DN80, PN100. HTHP / HP units	
IE	DN80, PN160. HTHP / HP units	
IF	DN80, PN250. HTHP / HP units	
JA	DN100, PN16	
JB	DN100, PN40	
JC	DN100, PN63. HTHP / HP units	
JD	DN100, PN100. HTHP / HP units	
JE	DN100, PN160. HTHP / HP units	
JF	DN100, PN250. HTHP / HP units	
KA	DN150, PN16	
<b>JIS Flanges<sup>(15)</sup></b>		
UA	50A, 10K	
UB	50A, 20K	
VA	80A, 10K	
VB	80A, 20K	
XA	100A, 10K	
XB	100A, 20K	
YA	150A, 10K	
YB	150A, 20K	
ZA	200A, 10K	
ZB	200A, 20K	
<b>Threaded Connections<sup>(14)</sup></b>		<b>Probe Type</b>
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
RC	2 in. NPT thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
SA	1 ½ in. BSP (G 1 ½ in.) thread	All
SB	1 in. BSP (G 1 in.) thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
<b>Tri-Clamp Fittings<sup>(14)</sup></b>		<b>Probe Type</b>
FT	1 ½ in. Tri-Clamp	4A, 5A, 5B standard temperature and pressure
AT	2 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
BT	3 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
CT	4 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
<b>Proprietary Flanges</b>		
TF	Fisher - proprietary 316L SST (for 249B cages) Torque Tube Flange	
TT	Fisher - proprietary 316L SST (for 249C cages) Torque Tube Flange	
TM	Masonellan - proprietary 316L SST Torque Tube Flange	

# Rosemount 5300 Series

Code Hazardous Locations Certifications	
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof <sup>(16)</sup>
E3	NEPSI Flameproof <sup>(16)</sup>
E5	FM Explosion-proof <sup>(16)</sup>
E6	CSA Explosion-proof <sup>(16)</sup>
E7	IECEX Flameproof <sup>(16)</sup>
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety <sup>(17)</sup>
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety <sup>(17)</sup>
I5	FM Intrinsic Safety and Non-Incendive
IE	FM FISCO Intrinsic Safety <sup>(17)</sup>
I6	CSA Intrinsic Safety
IF	CSA FISCO Intrinsic Safety <sup>(17)</sup>
I7	IECEX Intrinsic Safety
IG	IECEX FISCO Intrinsic Safety <sup>(17)</sup>
KA	ATEX, FM, CSA Flameproof/Explosion-proof <sup>(16)</sup>
KB	ATEX, FM, IECEX Flameproof/Explosion-proof <sup>(16)</sup>
KC	ATEX, CSA, IECEX Flameproof/Explosion-proof <sup>(16)</sup>
KD	FM, CSA, IECEX Flameproof/Explosion-proof <sup>(16)</sup>
KE	ATEX, FM, CSA Intrinsic Safety
KF	ATEX, FM, IECEX Intrinsic Safety
KG	ATEX, CSA, IECEX Intrinsic Safety
KH	FM, CSA, IECEX Intrinsic Safety
KI	FISCO - ATEX, FM, CSA Intrinsic Safety <sup>(17)</sup>
KJ	FISCO - ATEX, FM, IECEX Intrinsic Safety <sup>(17)</sup>
KK	FISCO - ATEX, CSA, IECEX Intrinsic Safety <sup>(17)</sup>
KL	FISCO - FM, CSA, IECEX Intrinsic Safety <sup>(17)</sup>
Code Options	
M1	Integral digital display
P1	Hydrostatic testing <sup>(18)</sup>
N2	NACE material recommendation per MR-0175 and MR-0103 <sup>(19)</sup>
LS	Long stud <sup>(20)</sup> 9.8 in (250 mm) for flexible single lead probe to prevent contact with wall/nozzle. Standard height is 3.9 in (100 mm) for probes 5A and 5B
W2	Short weight for flexible single lead probe <sup>(21)</sup>
BR	Mounting Bracket for 1.5 in. NPT Process Connection (RA)
T1	Transient Protection Terminal Block (standard with FISCO options)
U1	WHG Overfill Approval (pending, consult factory)
Special Configuration (Software)	
C1	Factory configuration (CDS required with order)
C4	Namur alarm and saturation levels, high alarm
C5	Namur alarm and saturation levels, low alarm
C8	Low alarm <sup>(22)</sup> (standard Rosemount alarm and saturation levels)
Qx - Special Certifications	
Q4	Calibration Data Certification
Q8	Material Traceability Certification per EN 10204 3.1 <sup>(23)</sup>
QG	GOST Primary Verification Certificate
QS	Prior-use certificate of FMEDA Data. Only available with HART 4-20 mA output (output code H).



# Reference Manual

00809-0100-4530, Rev BA

July 2009

# Rosemount 5300 Series

PlantWeb Diagnostic Functionality		
D01	FOUNDATION fieldbus Diagnostics Suite	
DA1	HART Diagnostics Suite	
Centering Discs		Outer Diameter
S2	2 in. Centering disc <sup>(24)</sup>	1.8 in. (45 mm)
S3	3 in. Centering disc <sup>(24)</sup>	2.7 in. (68 mm)
S4	4 in. Centering disc <sup>(24)</sup>	3.6 in. (92 mm)
S6	6 in. Centering disc <sup>(24)</sup>	5.55 in. (141 mm)
S8	8 in. Centering disc <sup>(24)</sup>	7.40 in. (188 mm)
P2	2 in. Centering disc PTFE <sup>(25)</sup>	1.8 in. (45 mm)
P3	3 in. Centering disc PTFE <sup>(25)</sup>	2.7 in. (68 mm)
P4	4 in. Centering disc PTFE <sup>(25)</sup>	3.6 in. (92 mm)
P6	6 in. Centering disc PTFE <sup>(25)</sup>	5.55 in. (141 mm)
P8	8 in. Centering disc PTFE <sup>(25)</sup>	7.40 in. (188 mm)
Remote Housing Mounting		
B1	1 m / 3.2 ft. Remote Housing Mounting Cable and Bracket	
B2	2 m / 6.5 ft. Remote Housing Mounting Cable and Bracket	
B3	3 m / 9.8 ft. Remote Housing Mounting Cable and Bracket	
Consolidate to Chamber		
XC	Consolidate to Chamber <sup>(26)</sup>	

- (1) Not available with Flame/Explosion-proof approvals (E1, E3, E5, E6, E7, KA, KB, KC, and KD)
- (2) Process seal rating. Final rating depends on flange and O-ring selection.
- (3) Requires option None for sealing (no O-ring).
- (4) Welding Procedure Qualification Record Documentation will be supplied.
- (5) For other materials, consult the factory.
- (6) Consult the factory for this option.
- (7) Requires High Temperature High Pressure (code H), High Pressure (code P), or Cryogenic (code C) probe.
- (8) Requires model 5301.
- (9) Only available with standard temperature and pressure (code S).
- (10) Available in SST. Consult the factory for other materials.
- (11) This is an HTHP probe.
- (12) Extra length for fastening is added in factory.
- (13) Probe weight included if applicable. Give the total probe length in feet and inches or meters and centimeters, depending on selected probe length unit. If tank height is unknown, please round up to an even length when ordering. Probes can be cut to exact length in field. Maximum allowable length is determined by process conditions.
- (14) Available in 316L SST. For other materials consult the factory.
- (15) Available in 316L SST (EN 1.4404). For other materials, consult the factory.
- (16) Probes are intrinsically safe.
- (17) Requires Foundation fieldbus signal output (U, parameter listed in Appendix B: Product Certifications).
- (18) For standard tank connection, only available with flange.
- (19) For Material SST, Alloy C-276 and Alloy 400; Probe Type 3A, 3B, 4A, 4B, 4U, and 4V.
- (20) Not available with PTFE covered probes.
- (21) Only for Material of Construction code 1 and 3. For other materials, consult the factory.
- (22) The standard alarm setting is high.
- (23) Certificate includes all pressure retaining wetted parts.
- (24) Available for SST and Alloy C-276 probe, type 2A, 4A, 4B, and 5A. Same disc material as probe material.
- (25) Available for probe types 2A, 4A, 4B, and 5A, except for HTHP.
- (26) Not available for Cryogenic probe.

**Example Model String: 5301-H-A-1-S-1-V-1A-M-002-05-AA-I1-M1C1. E-002-05, means 2 ft and 5 in. probe length. M-002-05, means 2.05 m**

# Rosemount 5300 Series

## Model Code 5303, Level for Solids

Model	Product Description		
5303	Guided Wave Solids Level Transmitter		
Code	Signal Output		
H	4-20 mA with HART communication		
F	FOUNDATION fieldbus		
Code	Housing Material		
A	Polyurethane-covered Aluminum		
S	Stainless Steel, Grade CF8M (ASTM A743)		
Code	Conduit / Cable Threads		
1	½ - 14 NPT		
2	M20 x 1.5 adapter		
E	M12, 4-pin, Male connector (eurofast <sup>®</sup> ) <sup>(1)</sup>		
M	A size Mini, 4-pin, Male connector (minifast <sup>®</sup> ) <sup>(1)</sup>		
Code	Operating Temperature and Pressure	Probe Type	
S	- 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C) <sup>(2)</sup>	All	
Code	Material of Construction <sup>(3)</sup> : Process Connection / Probe	Probe Type	
1	316 L SST (EN 1.4404)	All	
Code	Sealing, O-ring Material (Consult factory for other o-ring materials)		
V	Viton <sup>®</sup> fluoroelastomer		
E	Ethylene Propylene		
K	Kalrez <sup>®</sup> 6375 perfluoroelastomer		
B	Buna-N		
Code	Probe Type	Process Connection	Probe Lengths
5A	Flexible Single Lead with weight, 4 mm	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 115 ft (35 m)
5B	Flexible Single Lead with chuck, 4 mm <sup>(4)</sup>	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 115 ft (35 m)
6A	Flexible Single Lead with weight, 6 mm	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
6B	Flexible Single Lead with chuck, 6 mm <sup>(4)</sup>	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
Code	Probe Length Units		
E	English (feet, in.)		
M	Metric (meters, centimeters)		
Code	Total Probe Length <sup>(5)</sup> (feet/m)		
xxx	0-164 ft or 0-50 m		
Code	Total Probe Length <sup>(5)</sup> (in./cm)		
xx	0-11 in. or 0-99 cm		

# Reference Manual

00809-0100-4530, Rev BA

July 2009

# Rosemount 5300 Series

Code Process Connection - Size / Type (consult the factory for other process connections)		
<b>ANSI Flanges<sup>(6)</sup></b>		
AA	2 in. ANSI, 150 lb	
AB	2 in. ANSI, 300 lb	
BA	3 in. ANSI, 150 lb	
BB	3 in. ANSI, 300 lb	
CA	4 in. ANSI, 150 lb	
CB	4 in. ANSI, 300 lb	
DA	6 in. ANSI, 150 lb	
<b>EN (DIN) Flanges<sup>(7)</sup></b>		
HB	DN50, PN40	
IA	DN80, PN16	
IB	DN80, PN40	
JA	DN100, PN16	
JB	DN100, PN40	
KA	DN150, PN16	
<b>JIS Flanges<sup>(7)</sup></b>		
UA	50A, 10K	
UB	50A, 20K	
VA	80A, 10K	
VB	80A, 20K	
XA	100A, 10K	
XB	100A, 20K	
YA	150A, 10K	
YB	150A, 20K	
ZA	200A, 10K	
ZB	200A, 20K	
<b>Threaded Connections<sup>(6)</sup></b>		<b>Probe Type</b>
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	5A, 5B, 6A, 6B, standard temperature and pressure
RC	2 in. NPT thread	All for standard temperature and pressure
SA	1 ½ in. BSP (G 1 ½ in.) thread	All
SB	1 in. BSP (G 1 in.) thread	5A, 5B, 6A, 6B standard temperature and pressure

# Rosemount 5300 Series

Hazardous Locations Certifications	
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof
E3	NEPSI Flameproof
E5	FM Explosion-proof
E6	CSA Explosion-proof
E7	IECEX Flameproof
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety <sup>(8)</sup>
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety <sup>(8)</sup>
I5	FM Intrinsic Safety and Non-Incendive
IE	FM FISCO Intrinsic Safety <sup>(8)</sup>
I6	CSA Intrinsic Safety
IF	CSA FISCO Intrinsic Safety <sup>(8)</sup>
I7	IECEX Intrinsic Safety
IG	IECEX FISCO Intrinsic Safety <sup>(8)</sup>
KA	ATEX, FM, CSA Flameproof/Explosion-proof
KB	ATEX, FM, IECEX Flameproof/Explosion-proof
KC	ATEX, CSA, IECEX Flameproof/Explosion-proof
KD	FM, CSA, IECEX Flameproof/Explosion-proof
KE	ATEX, FM, CSA Intrinsic Safety
KF	ATEX, FM, IECEX Intrinsic Safety
KG	ATEX, CSA, IECEX Intrinsic Safety
KH	FM, CSA, IECEX Intrinsic Safety
KI	FISCO - ATEX, FM, CSA Intrinsic Safety <sup>(8)</sup>
KJ	FISCO - ATEX, FM, IECEX Intrinsic Safety <sup>(8)</sup>
KK	FISCO - ATEX, CSA, IECEX Intrinsic Safety <sup>(8)</sup>
KL	FISCO - FM, CSA, IECEX Intrinsic Safety <sup>(8)</sup>
Options	
M1	Integral digital display
P1	Hydrostatic testing <sup>(9)</sup>
LS	Long stud 9.8 in (250 mm) for flexible single lead probe to prevent contact with wall/nozzle. Standard height is 3.9 in (100 mm) for probes 5A and 5B; 5.9 in. (150 mm) for probes 6A and 6B.
T1	Transient Protection Terminal Block (standard with FISCO options)
BR	Mounting Bracket for 1.5 in. NPT Process Connection (RA) <sup>(10)</sup>
U1	WHG Overfill Approval (pending, consult the factory)
Special Configuration (Software)	
C1	Factory configuration (CDS required with order)
C4	Namur alarm and saturation levels, high alarm
C5	Namur alarm and saturation levels, low alarm
C8	Low alarm <sup>(11)</sup> (standard Rosemount alarm and saturation levels)
Special Certifications	
Q4	Calibration Data Certification
Q8	Material Traceability Certification per EN 10204 3.1 <sup>(12)</sup>
QG	GOST Primary Verification Certificate
QS	Prior-use certificate of FMEDA Data. Only available with HART 4-20 mA output (output code H).

## Reference Manual

00809-0100-4530, Rev BA

July 2009

# Rosemount 5300 Series

PlantWeb Diagnostic Functionality	
D01	FOUNDATION fieldbus Diagnostics Suite
DA1	HART Diagnostics Suite
Remote Housing Mounting	
B1	1 m / 3.2 ft. Remote Housing Mounting Cable and Bracket
B2	2 m / 6.5 ft. Remote Housing Mounting Cable and Bracket
B3	3 m / 9.8 ft. Remote Housing Mounting Cable and Bracket

- (1) Not available with Flame/Explosion-proof approvals (E1, E3, E5, E6, E7, KA, KB, KC, and KD)
- (2) Process seal rating. Final rating depends on flange and O-ring selection.
- (3) For other materials, consult factory.
- (4) Extra length for fastening is added in the factory.
- (5) Probe weight included if applicable. Give the total probe length in feet and inches or meters and centimeters, depending on selected probe length unit. If tank height is unknown, please round up to an even length when ordering. Probes can be cut to exact length in field. Maximum allowable length is determined by process conditions. See "Mounting Considerations" on page 3-3 for more probe length guidance.
- (6) Available in 316L SST. For other materials, consult the factory.
- (7) Available in 316L SST (EN 1.4404). For other materials, consult the factory.
- (8) Requires Foundation fieldbus signal output (U, parameter listed in Appendix B: Product Certifications).
- (9) Available for flanged connection.
- (10) Only for Standard Temperature and Pressure.
- (11) The standard alarm setting is high.
- (12) Certificate includes all pressure retaining wetted parts.

**Example Model String: 5303-H-A-1-S-1-V-6A-M-025-50-AA-I1-M1C1. E-025-05, means 25 ft and 5 in. probe length. M-025-50, means 25.5 m.**

# Rosemount 5300 Series

## SPARE PARTS

Spare parts list Transmitter head Model 5301/5302/5303

Model	Product Description
5301	Guided Wave Radar Liquid Level or Interface Transmitter (interface available for fully submerged probe)
5302	Guided Wave Radar Liquid Level and Interface Transmitter
5303	Guided Wave Radar Solid Level Transmitter
Code	Signal Output
H	4-20 mA with HART communication
F	FOUNDATION Fieldbus
Code	Housing Material
A	Polyurethane-covered Aluminum
S	Stainless Steel, Grade CF8M (ASTM A743)
Code	Conduit / Cable Threads
1	½ - 14 NPT
2	M20 x 1.5 adapter
E	M12, 4-pin, Male connector (eurofast <sup>®</sup> ) <sup>(1)</sup>
M	A size Mini, 4-pin, Male connector (minifast <sup>®</sup> ) <sup>(1)</sup>
Code	Operating Temperature and Pressure
N	Not Applicable
Code	Material of Construction: Process Connection / Probe
0	Not Applicable
Code	Sealing, O-ring Material (Consult factory for other o-ring materials)
N	Not Applicable
Code	Probe Type
0N	None
Code	Probe Length Units
N	Not Applicable
Code	Total Probe Length (feet/m)
00	Not Applicable
Code	Total Probe Length (in./cm)
00	Not Applicable
Code	Process Connection - Size / Type (consult the factory for other process connections)
NA	Not Applicable
Code	Hazardous Locations Certifications
NA	No Hazardous Locations Certifications
E1	ATEX Flameproof <sup>(3)</sup>
E3	NEPSI Flameproof <sup>(3)</sup>
E5	FM Explosion-proof <sup>(3)</sup>
E6	CSA Explosion-proof <sup>(3)</sup>
E7	IECEx Flameproof <sup>(3)</sup>
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety <sup>(2)</sup>
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety <sup>(2)</sup>
I5	FM Intrinsic Safety and Non-incendive
IE	FM FISCO Intrinsic Safety <sup>(2)</sup>
I6	CSA Intrinsic Safety

## Reference Manual

00809-0100-4530, Rev BA

July 2009

## Rosemount 5300 Series

<b>Code</b>		<b>Hazardous Locations Certifications (continued)</b>
IF		CSA FISCO Intrinsic Safety <sup>(2)</sup>
I7		IECEX Intrinsic Safety
IG		IECEX FISCO Intrinsic Safety <sup>(2)</sup>
KA		ATEX, FM, CSA Flameproof/Explosion-proof <sup>(3)</sup>
KB		ATEX, FM, IECEX Flameproof/Explosion-proof <sup>(3)</sup>
KC		ATEX, CSA, IECEX Flameproof/Explosion-proof <sup>(3)</sup>
KD		FM, CSA, IECEX Flameproof/Explosion-proof <sup>(3)</sup>
KE		ATEX, FM, CSA Intrinsic Safety
KF		ATEX, FM, IECEX Intrinsic Safety
KG		ATEX, CSA, IECEX Intrinsic Safety
KH		FM, CSA, IECEX Intrinsic Safety
KI		FISCO - ATEX, FM, CSA Intrinsic Safety <sup>(2)</sup>
KJ		FISCO - ATEX, FM, IECEX Intrinsic Safety <sup>(2)</sup>
KK		FISCO - ATEX, CSA, IECEX Intrinsic Safety <sup>(2)</sup>
KL		FISCO - FM, CSA, IECEX Intrinsic Safety <sup>(2)</sup>
<b>Code</b>		<b>Options</b>
M1		Integral digital display
T1		Transient Protection Terminal Block (standard with FISCO options)
<b>Remote Housing Mounting</b>		
B1		1 m / 3.2 ft. Remote Housing Mounting Cable and Bracket
B2		2 m / 6.5 ft. Remote Housing Mounting Cable and Bracket
B3		3 m / 9.8 ft. Remote Housing Mounting Cable and Bracket
<b>Special Configuration (Software)</b>		
C1		Factory configuration (CDS required with order)
C4		Namur alarm and saturation levels, high alarm
C5		Namur alarm and saturation levels, low alarm
C8		Low alarm <sup>(4)</sup> (standard Rosemount alarm and saturation levels)
<b>Special Certifications</b>		
Q4		Calibration Data Certification
QG		GOST Primary Verification Certificate
QS		Prior-use certificate of FMEDA Data. Only available with HART 4-20 mA output (output code H).
<b>PlantWeb Diagnostic Functionality</b>		
D01		FOUNDATION fieldbus Diagnostics Suite
DA1		HART Diagnostics Suite

(1) Not available with Flame/Explosionproof approvals (E1, E3, E5, E6, E7, KA, KB, KC, and KD)

(2) Requires Foundation Fieldbus signal output.

(3) Probes are intrinsically safe.

(4) The standard alarm setting is high.

# Rosemount 5300 Series

## Spare parts list Probe Model 5301/5302/5303

Model	Product Description		
5309	Spare probe		
Code	Signal Output		
N	Not Applicable		
Code	Housing Material		
N	Not Applicable		
Code	Conduit / Cable Threads		
N	Not Applicable		
Code	Operating Temperature and Pressure <sup>(1)</sup>	Probe Type	
S	- 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)	All	
H	High Temp / High Pressure <sup>(2)</sup> : 2940 psi @ 752 °F and 5000 psi @ 100 °F (203 bar @ 400 °C and 345 bar @ 38 °C) according to ANSI Class 2500	3A, 3B, 4A, 4U, 4V, 5A and 5B	
P	High Pressure <sup>(2)</sup> : Max 392 °F (200 °C): 3500 psi @ 392 °F and 5000 psi @ 100 °F (243 bar @ 200 °C and 345 bar @ 38 °C) according to ANSI Class 2500	3A, 3B, 4A, 5A and 5B	
C	Cryogenic Temperature <sup>(2) (3)</sup> -321 °F (-196 °C) Max 392 °F (200 °C): 3500 psi @ 392 °F and 5000 psi @ 100 °F (243 bar @ 200 °C and 345 bar @ 38 °C) according to ANSI Class 2500	3A, 3B, 4A, 5A, 5B (only SST)	
Code	Material of Construction <sup>(4)</sup> : Process Connection / Probe	Probe Type	Valid Operation Temperature and Pressure
1	316 L SST (EN 1.4404)	All	S, H, P, C
2	Alloy C-276 (UNS N10276). With plate design if flanged version. Up to class 600, PN 63 for HTHP/HP probes.	3A, 3B, 4A	S, H, P
3	Alloy 400 (UNS N04400). With plate design if flanged version.	3A, 3B, 4A, 5A, 5B	S
7	PTFE covered probe and flange. With plate design.	4A and 5A	S
8	PTFE covered probe.	4A and 5A	S
H	Alloy C-276 (UNS N10276) process connection, flange and probe <sup>(5)</sup>	3A, 3B, 4A	H, P
Code	Sealing, O-ring Material (Consult factory for other o-ring materials)		
N	None <sup>(6)</sup>		
V	Viton <sup>®</sup> fluoroelastomer		
E	Ethylene Propylene		
K	Kalrez <sup>®</sup> 6375 perfluoroelastomer		
B	Buna-N		
Code	Probe Type	Process Connection	Probe Lengths
1A	Rigid Twin Lead <sup>(7)</sup>	Flange / 1.5 in., 2 in. <sup>(7)</sup> Thread	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
2A	Flexible Twin Lead with weight <sup>(7)</sup>	Flange / 1.5 in., 2 in. <sup>(7)</sup> Thread	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
3A	Coaxial (for level measurement) <sup>(6)</sup>	Flange / 1 in. <sup>(7)</sup> , 1.5 in., 2 in. <sup>(7)</sup> Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
3B	Coaxial, perforated. For level and interface measurement, or easier cleaning.	Flange / 1 in. <sup>(7)</sup> , 1.5 in., 2 in. <sup>(7)</sup> Thread	Min: 1 ft 4 in. (0.4 m). Max: 19 ft 8 in. (6 m)
4A	Rigid Single Lead (8 mm)	Flange / 1 in. <sup>(7)</sup> , 1.5 in., 2 in. <sup>(7)</sup> Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 9 ft 10 in. (3 m)
4B	Rigid Single Lead (13 mm) <sup>(9)</sup>	Flange / 1 in., 1.5 in., 2 in. Thread / Tri-Clamp	Min: 1 ft 4 in. (0.4 m). Max: 14 ft 9 in. (4.5 m)
4U	Vapor Single Rigid Probe for 2 in. pipes <sup>(10)</sup>	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)



Code	Probe Type	Process Connection	Probe Lengths
4V	Vapor Single Rigid Probe for 3-4 in. pipes <sup>(10)</sup>	Flange / 1.5 in. Thread	Min: 2 ft 5 in. (0.76 m). Max: 13 ft (4 m)
5A	Flexible Single Lead with weight	Flange / 1 in. <sup>(7)</sup> , 1.5 in., 2 in. <sup>(7)</sup> Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
5B	Flexible Single Lead with chuck <sup>(11)</sup>	Flange / 1 in. <sup>(7)</sup> , 1.5 in., 2 in. <sup>(7)</sup> Thread / Tri-Clamp	Min: 3 ft 4 in. (1 m). Max: 164 ft (50 m)
Code	Probe Length Units		
E	English (feet, in.)		
M	Metric (meters, centimeters)		
Code	Total Probe Length <sup>(12)</sup> (feet/m)		
xxx	0-164 ft or 0-50 m		
Code	Total Probe Length <sup>(12)</sup> (in./cm)		
xx	0-11 in. or 0-99 cm		
Code	Process Connection - Size / Type (consult factory for other process connections)		
ANSI Flanges <sup>(15)</sup>			
AA	2 in. ANSI, 150 lb		
AB	2 in. ANSI, 300 lb		
AC	2 in. ANSI, 600 lb. HTHP / HP units		
AD	2 in. ANSI, 900 lb. HTHP / HP units		
AE	2 in. ANSI, 1500 lb. HTHP / HP units		
AI	2 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units		
AJ	2 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units		
AK	2 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units		
BA	3 in. ANSI, 150 lb		
BB	3 in. ANSI, 300 lb		
BC	3 in. ANSI, 600 lb. HTHP / HP units		
BD	3 in. ANSI, 900 lb. HTHP / HP units		
BE	3 in. ANSI, 1500 lb. HTHP / HP units		
BI	3 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units		
BJ	3 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units		
BK	3 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units		
CA	4 in. ANSI, 150 lb		
CB	4 in. ANSI, 300 lb		
CC	4 in. ANSI, 600 lb. HTHP / HP units		
CD	4 in. ANSI, 900 lb. HTHP / HP units		
CE	4 in. ANSI, 1500 lb. HTHP / HP units		
CI	4 in. ANSI, 600 lb, RTJ (Ring Type Joint). HTHP / HP units		
CJ	4 in. ANSI, 900 lb, RTJ (Ring Type Joint). HTHP / HP units		
CK	4 in. ANSI, 1500 lb, RTJ (Ring Type Joint). HTHP / HP units		
DA	6 in. ANSI, 150 lb		
EN (DIN) Flanges <sup>(13)</sup>			
HB	DN50, PN40		
HC	DN50, PN63. HTHP / HP units		
HD	DN50, PN100. HTHP / HP units		
HE	DN50, PN160. HTHP / HP units		
HF	DN50, PN250. HTHP / HP units		
IA	DN80, PN16		
IB	DN80, PN40		
IC	DN80, PN64 . HTHP / HP units		

# Rosemount 5300 Series

EN (DIN) Flanges <sup>(14)</sup> (continued)		
ID	DN80, PN100. HTHP / HP units	
IE	DN80, PN160. HTHP / HP units	
IF	DN80, PN250. HTHP / HP units	
JA	DN100, PN16	
JB	DN100, PN40	
JC	DN100, PN64. HTHP / HP units	
JD	DN100, PN100. HTHP / HP units	
JE	DN100, PN160. HTHP / HP units	
JF	DN100, PN250. HTHP / HP units	
KA	DN150, PN16	
JIS Flanges <sup>(13)</sup>		
UA	50A, 10K	
UB	50A, 20K	
VA	80A, 10K	
VB	80A, 20K	
XA	100A, 10K	
XB	100A, 20K	
YA	150A, 10K	
YB	150A, 20K	
ZA	200A, 10K	
ZB	200A, 20K	
Threaded Connections <sup>(15)</sup>		Probe Type
RA	1 ½ in. NPT thread	All
RB	1 in. NPT thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
RC	2 in. NPT thread	All for standard temperature and pressure
SA	1 ½ in. BSP (G 1 ½ in.) thread	All
SB	1 in. BSP (G 1 in.) thread	3A, 3B, 4A, 4B, 5A, 5B, standard temperature and pressure
Tri-Clamp Fittings <sup>(15)</sup>		Probe Type
FT	1 ½ in. Tri-Clamp	4A, 5A, 5B standard temperature and pressure
AT	2 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
BT	3 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
CT	4 in. Tri-Clamp	4A, 4B, 5A, 5B standard temperature and pressure
Proprietary Flanges		
TF	Fisher - proprietary 316L SST (for 249B cages) Torque Tube Flange	
TT	Fisher - proprietary 316L SST (for 249C cages) Torque Tube Flange	
TM	Masoneilan - proprietary 316L SST Torque Tube Flange	
Special Process Connection		
XX	Special Process Connection	
Code	Hazardous Locations Certifications	
NA	Not Applicable	
Code	Options	
P1	Hydrostatic testing <sup>(16)</sup>	
N2	NACE material recommendation per MR 0175 <sup>(17)</sup>	
LS	Long stud <sup>(18)</sup> 9.8 in (250 mm) for flexible single lead probe to prevent contact with wall/nozzle. Standard height is 3.9 in (100 mm) for probes 5A and 5B; 5.9 in. (150 mm) for probes 6A and 6B.	

# Reference Manual

00809-0100-4530, Rev BA

July 2009

# Rosemount 5300 Series

Code	Options (continued)	
W2	Short weight for flexible single lead probe <sup>(19)</sup>	
BR	Mounting Bracket for 1.5 in. NPT Process Connection (RA) <sup>(20)</sup>	
<b>Centering Discs</b>		<b>Outer Diameter</b>
S2	2 in. Centering disc <sup>(21)</sup>	1.8 in. (45 mm)
S3	3 in. Centering disc <sup>(21)</sup>	2.7 in. (68 mm)
S4	4 in. Centering disc <sup>(21)</sup>	3.6 in. (92 mm)
S6	6 in. Centering disc <sup>(21)</sup>	5.55 in. (141 mm)
S8	8 in. Centering disc <sup>(21)</sup>	7.40 in. (188 mm)
P2	2 in. Centering disc PTFE <sup>(22)</sup>	1.8 in. (45 mm)
P3	3 in. Centering disc PTFE <sup>(22)</sup>	2.7 in. (68 mm)
P4	4 in. Centering disc PTFE <sup>(22)</sup>	3.6 in. (92 mm)
P6	6 in. Centering disc PTFE <sup>(22)</sup>	5.55 in. (141 mm)
P8	8 in. Centering disc PTFE <sup>(22)</sup>	7.40 in. (188 mm)
<b>Special Certifications</b>		
Q8	Material Traceability Certification per EN 10204 3.1 <sup>(23)</sup>	

- (1) Process seal rating. Final rating depends on flange and O-ring selection.
- (2) Requires option None for sealing (no O-ring).
- (3) Welding Procedure Qualification Record Documentation will be supplied.
- (4) For other materials, consult the factory.
- (5) Consult the factory for this option.
- (6) Requires High Temperature High Pressure (code H) or High Pressure (code P) probe.
- (7) Only available with standard temperature and pressure (code S).
- (8) Requires model 5301.
- (9) Available in SST. Consult the factory for other materials.
- (10) This is an HTHP probe.
- (11) Extra length for fastening is added in factory.
- (12) Probe weight included if applicable. Give the total probe length in feet and inches or meters and centimeters, depending on selected probe length unit. If tank height is unknown, please round up to an even length when ordering. Probes can be cut to exact length in field. Maximum allowable length is determined by process conditions. See "Mounting Considerations" on page 3-3 for more probe length guidance.
- (13) Available in 316L SST (EN 1.4404). For other materials consult the factory.
- (14) Available in 316L SST (EN 1.4404). For other materials consult the factory.
- (15) Available in 316L SST. For other materials consult the factory.
- (16) For standard tank connection only available with flange.
- (17) For Material SST, Alloy C-276 and Alloy 400; Probe Type 3A, 3B, 4A, 4B, 4U, and 4V.
- (18) Not available with PTFE covered probes.
- (19) Only for Material of Construction code 1. For other materials, consult the factory.
- (20) Only for Standard Temperature and Pressure.
- (21) Available for SST and Alloy C-276 probes, type 2A, 4A, 4B, and 5A. Same disc material as probe material.
- (22) Available for SST probes, type 2A, 4A, 4B, 5A and 6A except for HTHP.
- (23) Certificate includes all pressure retaining wetted metal parts.

# Rosemount 5300 Series

## Spare parts list Other Spares and Accessories Rosemount 5300 Series

Code	Process Connection - Size/Type (consult factory for other process connections)
<b>Other spares</b>	
03300-7001-0002	Weight kit Flexible Twin lead
03300-7001-0003	Weight kit Flexible 4 mm Single lead
03300-7001-0004	Weight kit Flexible 6 mm Single lead
<b>Other accessories</b>	
03300-7004-0001	Viatic HART Modem and cables (RS 232 connection)
03300-7004-0002	Viatic HART Modem and cables (USB connection)
03300-2001-0001	Mounting Bracket for 1.5 in. NPT Process Connection (RA)
<b>Centering discs<sup>(1) (2)</sup></b>	
03300-1655-0001	Kit, 2 in. Centering Disk, SST, Rigid Single
03300-1655-0002	Kit, 3 in. Centering Disk, SST, Rigid Single
03300-1655-0003	Kit, 4 in. Centering Disk, SST, Rigid Single
03300-1655-0004	Kit, 6 in. Centering Disk, SST, Rigid Single
03300-1655-0005	Kit, 8 in. Centering Disk, SST, Rigid Single
03300-1655-0006	Kit, 2 in. Centering Disk, PTFE, Rigid Single
03300-1655-0007	Kit, 3 in. Centering Disk, PTFE, Rigid Single
03300-1655-0008	Kit, 4 in. Centering Disk, PTFE, Rigid Single
03300-1655-0009	Kit, 6 in. Centering Disk, PTFE, Rigid Single
03300-1655-0010	Kit, 8 in. Centering Disk, PTFE, Rigid Single
03300-1655-1001	Kit, 2 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1002	Kit, 3 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1003	Kit, 4 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1004	Kit, 6 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1005	Kit, 8 in. Centering Disk, SST, Single / Twin Flex Lead
03300-1655-1006	Kit, 2 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1007	Kit, 3 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1008	Kit, 4 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1009	Kit, 6 in. Centering Disk, PTFE, Single / Twin Flex Lead
03300-1655-1010	Kit, 8 in. Centering Disk, PTFE, Single / Twin Flex Lead
<b>Remote Housing / Bracket Mounting</b>	
03300-3001-0001	1m / 3.2 ft Remote Housing Mounting Cable and Bracket
03300-3001-0002	2m / 6.5 ft Remote Housing Mounting Cable and Bracket
03300-3001-0003	3m / 9.8 ft Remote Housing Mounting Cable and Bracket
03300-3001-0004	1m / 3.2 ft Remote Housing Mounting Cable
03300-3001-0005	2m / 6.5 ft Remote Housing Mounting Cable
03300-3001-0006	3m / 9.8 ft Remote Housing Mounting Cable
<b>Vented Flanges<sup>(3)</sup></b>	
03300-1811-9001	Fisher 249B
03300-1811-9002	Fisher 249C
03300-1811-9003	Masonellan
<b>Flushing Connection Rings</b>	
DP0002-2111-S6	2 in. ANSI, ¼ in. NPT connection
DP0002-3111-S6	3 in. ANSI, ¼ in. NPT connection
DP0002-4111-S6	4 in. ANSI, ¼ in. NPT connection
DP0002-5111-S6	DN50, ¼ in. NPT connection
DP0002-8111-S6	DN80, ¼ in. NPT connection
<b>Cable Glands</b>	
03300-7000-0001	Cable Gland 8-15mm, 1/2NPT Mo Brass Nickel Plated, KV1
03300-7000-0002	Cable Gland 4-8mm, 1/2NPT Brass, KVE7, EExd
03300-7000-0003	Cable Gland 8-11mm, 1/2NPT Brass, KVE8, EExd
03300-7000-0004	Cable Gland 6-12mm, 1/2 NPT Polyamide Grey

- (1) *If a centering disc is required for a flanged probe the centering disc can be ordered with options CS or CP in the model code. If a centering disc is required for a threaded connection or as a spare part it should be ordered using the item numbers listed below.*
- (2) *To order a centering disc in a different material, consult the factory.*
- (3) *1½ in. NPT threaded connection (RA) is required.*

# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

## Appendix B Product Certifications

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Safety messages .....	page B-1
EU Conformity .....	page B-2
European ATEX Directive Information .....	page B-3
NEPSI Approvals .....	page B-8
Factory Mutual (FM) Approvals .....	page B-11
Canadian Standards Association (CSA) Approval .....	page B-14
IECEX Approval .....	page B-17
Combination Approvals .....	page B-22
Approval Drawings .....	page B-22

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### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

#### WARNING

**Explosions could result in death or serious injury:**

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.

**⚠ WARNING**

**Failure to follow safe installation and servicing guidelines could result in death or serious injury:**

Make sure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

Any substitution of non-recognized spare parts may jeopardize safety. Repair, for e.g. substitution of components etc. may also jeopardize safety and is under no circumstances allowed.

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

**⚠ WARNING**

**High voltage that may be present on leads could cause electrical shock:**

Avoid contact with leads and terminals.

Make sure the mains power to the Radar Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

**EU CONFORMITY**

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at [www.rosemount.com](http://www.rosemount.com). A hard copy may be obtained by contacting our local sales representative.

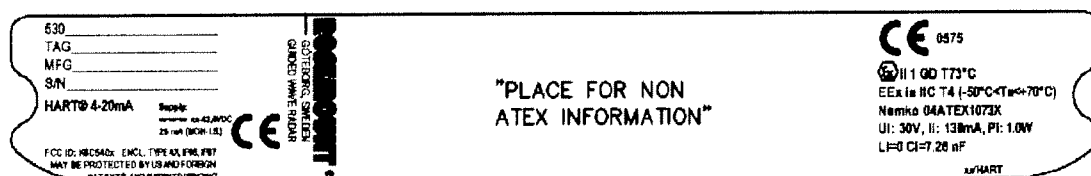


**EUROPEAN ATEX  
DIRECTIVE  
INFORMATION**

**Intrinsic Safety**

The Rosemount 5300 Series Guided Wave Radar Level Transmitter that has the following label attached has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

Figure B-1. Approval Label  
ATEX HART model



11 The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking



- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:



- EEx ia IIC T4 (-50 °C ≤ T<sub>a</sub> ≤ +70 °C)<sup>(1)</sup>
- 4-20 mA/HART model: U<sub>i</sub>=30 V, I<sub>i</sub>=130 mA, P<sub>i</sub>=1.0 W, C<sub>i</sub>=7.26 nF, L<sub>i</sub>=0.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

**Special Conditions for Safe Use (X):**

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm<sup>2</sup>). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

(1) Other temperature restrictions may apply, please refer to "Specifications" on page A-1.

# Rosemount 5300 Series

Figure B-2. Approval Label  
ATEX Foundation Fieldbus  
model



I1 The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

**CE** 0575

- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

**Ex** II 1 GD T63°C

- EEx ia IIC T4 (-50 °C ≤ T<sub>a</sub> ≤ +60 °C)
- FOUNDATION Fieldbus model: U<sub>i</sub>=30 Vdc, I<sub>i</sub>=300 mA, P<sub>i</sub>=1.5 W, C<sub>i</sub>=0 nF, L<sub>i</sub>=0 H.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

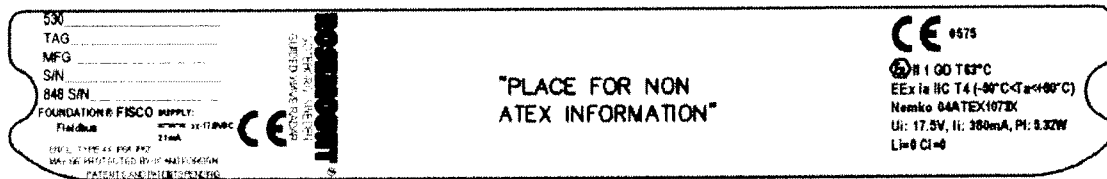
### Special Conditions for Safe Use (X):

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm<sup>2</sup>). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

Figure B-3. Approval Label  
ATEX FISCO model



**IA** The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

**CE** 0575

- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

**Ex** II 1 GD T63°C

- EEx ia IIC T4 (-50 °C ≤ T<sub>a</sub> ≤ +60 °C)
- FISCO model: U<sub>i</sub>=17.5 Vdc, I<sub>i</sub>=380 mA, P<sub>i</sub>=5.32 W, L<sub>i</sub>=C<sub>i</sub>=0.
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- Installation Drawing: 9240 030-938

**Special Conditions for Safe Use (X):**

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm<sup>2</sup>).

Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

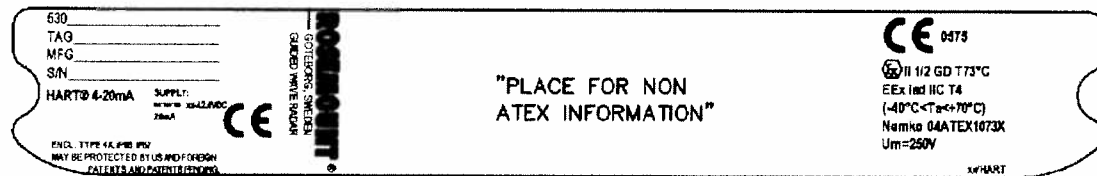
Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

# Rosemount 5300 Series

## Flameproof

The Rosemount 5300 Series Guided Wave Radar Level Transmitter that has the following label attached has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1 on 19-April-1994.

Figure B-4. Approval Label  
ATEX HART model



**E1** The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

**CE** 0575

- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

**Ex** II 1/2 GDT73°C

- EEx iad IIC T4 (-40 °C < T<sub>a</sub> < +70 °C)
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- U<sub>m</sub>=250 VAC

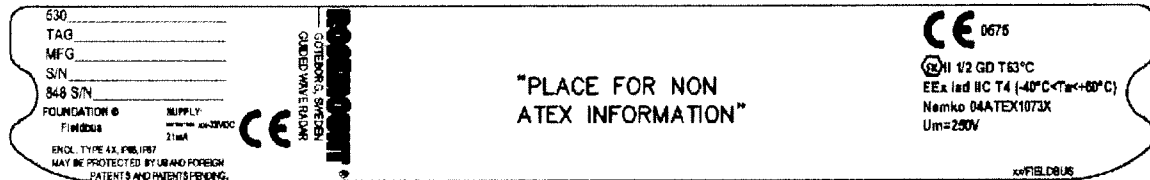
### Special Conditions for Safe Use (X):

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm<sup>2</sup>). Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

Figure B-5. Approval Label  
 ATEX Foundation Fieldbus



**E1** The following information is provided as part of the label of the transmitter:

- Name and address of the manufacturer (Rosemount).
- CE Conformity Marking

**CE** 0575

- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:

**Ex** II 1/2 GD T63°C

- EEx iad IIC T4 (-40 °C < T<sub>a</sub> < +60 °C)
- Nemko ATEX certificate number: Nemko 04ATEX1073X
- U<sub>m</sub>=250 VAC

**Special Conditions for Safe Use (X):**

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible areas for Group IIC and Category II 1G according to EN 50284 clause 4.4.3 (4 cm<sup>2</sup>).

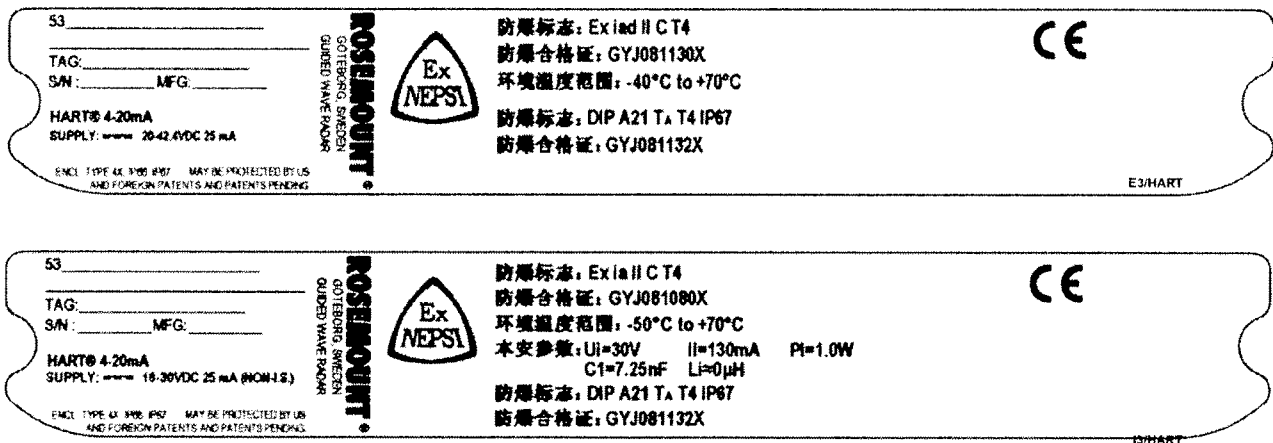
Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to EN 50284 clause 4.3.1 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in category II 1 G.

# Rosemount 5300 Series

## NATIONAL SUPERVISION AND INSPECTION CENTER FOR EXPLOSION PROTECTION AND SAFETY OF INSTRUMENTATION (NEPSI) APPROVALS

Figure B-6. Approval Label  
National Supervision and  
Inspection Center for Explosion  
Protection and Safety of  
Instrumentation (NEPSI)  
HART Model



### E3 Flameproof:

Ex iad IIC T4 (- 40 °C < T<sub>a</sub> < + 70 °C)

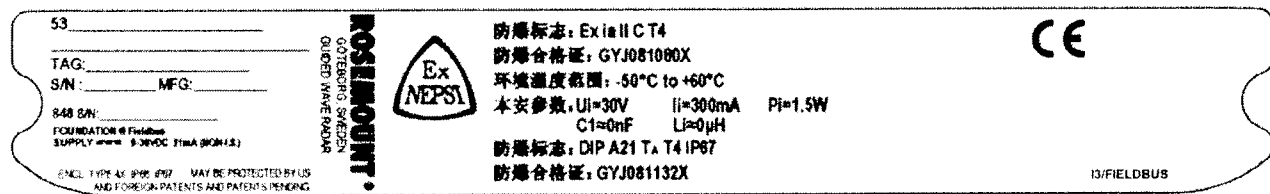
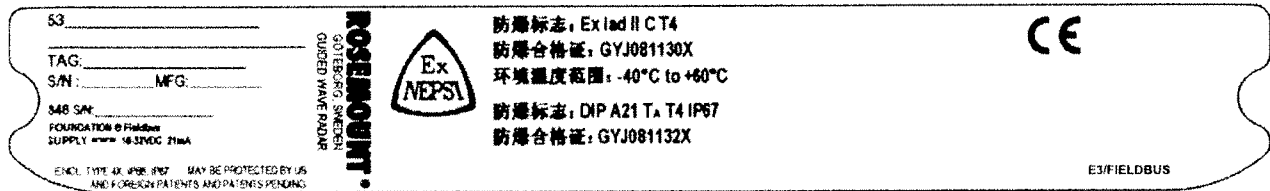
### I3 Intrinsically Safe:

- Ex ia IIC T4 (- 50 °C < T<sub>a</sub> < + 70 °C)
- 4-20 mA / HART model: U<sub>i</sub> = 30 V, I<sub>i</sub> = 130 mA, P<sub>i</sub> = 1.0 W, C<sub>i</sub> = 7.25 nF, L<sub>i</sub> ~ 0 μH

### Special Conditions for Safe Use (X):

Refer to Certificates: GYJ081080X for Ex ia IIC T4 and GYJ081130X for Ex iad IIC T4.

Figure B-7. Approval Label  
National Supervision  
and Inspection Center  
for Explosion Protection  
and Safety of  
Instrumentation (NEPSI)  
Foundation Fieldbus  
Model



**E3 Flameproof:**

- Ex iad IIC T4 (- 40 °C < T<sub>a</sub> < + 60 °C)

**I3 Intrinsically Safe:**

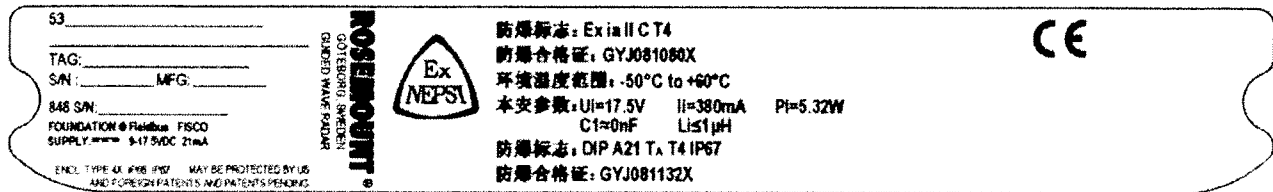
- Ex ia IIC T4 (- 50 °C < T<sub>a</sub> < + 60 °C)
- U<sub>i</sub> = 30 V, I<sub>i</sub> = 300 mA, P<sub>i</sub> = 1.5 W, C<sub>i</sub> ~ 0 nF, L<sub>i</sub> ~ 0 µH

**Special Conditions for Safe Use (X):**

Refer to Certificates: GYJ081080X for Ex ia IIC T4 and GYJ081130X for Ex iad IIC T4.

# Rosemount 5300 Series

Figure B-8. Approval Label  
National Supervision and  
Inspection Center for Explosion  
Protection and Safety of  
Instrumentation (NEPSI)  
FISCO Model



**IC** The following information is provided as part of the label of the transmitter:

- Ex ia IIC T4 (- 50 °C <  $T_a$  < + 60 °C)
- $U_i = 17.5 V$ ,  $I_i = 380 mA$ ,  $P_i = 5.32 W$ ,  $C_i \sim 0 nF$ ,  $L_i \sim 0 \mu H$

**Special Conditions for Safe Use (X):**

Refer to Certificates: GYJ081080X for Ex ia IIC T4 and GYJ081130X for Ex iad IIC T4.

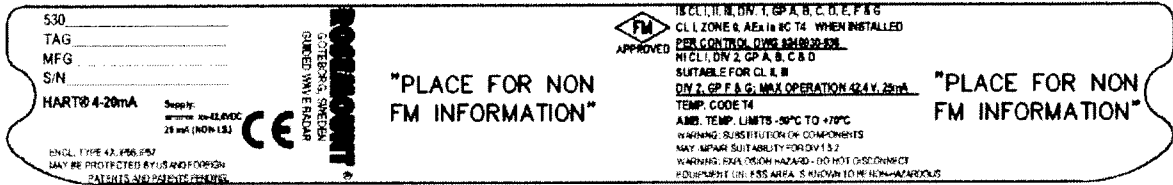


**FACTORY MUTUAL (FM) APPROVALS**

The Rosemount 5300 Series Guided Wave Radar Level Transmitter that have the following labels attached have been certified to comply with the requirements of the approval agencies noted.

**Intrinsic Safety**

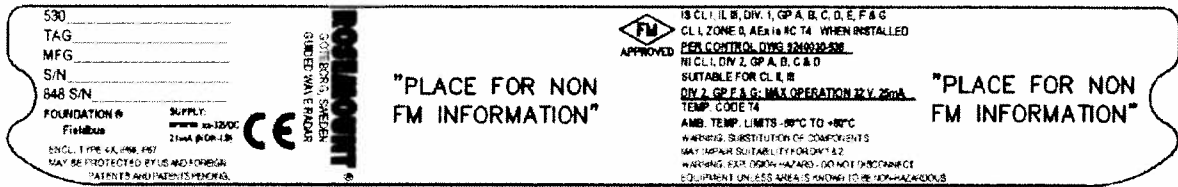
Figure B-9. Approval Labels  
 Factory Mutual (FM) HART  
 model



- 15 Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G.  
 Class I, Zone 0, AEX ia IIC T4 when installed per Control Drawing: 9240030-936.  
 Non-incendive for Class I, Division 2, Groups A, B, C and D.  
 Suitable for Class II, III, Division 2, Groups F and G.  
 4-20 mA/HART model:  $U_i=30$  V,  $I_i=130$  mA,  $P_i=1.0$  W,  $C_i=7.26$  nF,  $L_i=0$ .  
 Max operation 42.4 V, 25 mA.  
 Temperature code T4.  
 Ambient Temperature Limits: -50 °C to + 70 °C.

# Rosemount 5300 Series

Figure B-10. Approval Labels  
Factory Mutual (FM) Foundation  
Fieldbus model



- 15 Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G.

Class I, Zone 0, AEx ia IIC T4 when installed per Control Drawing: 9240030-936.

Non-incendive for Class I, Division 2, Groups A, B, C and D.

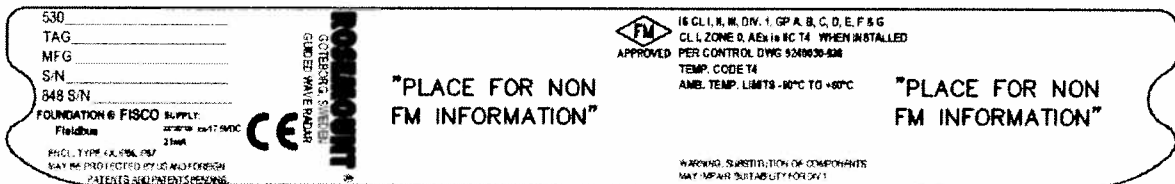
Suitable for Class II, III, Division 2, Groups F and G;

FOUNDATION Fieldbus model:  $U_i=30$  Vdc,  $I_i=300$  mA,  $P_i=1.3$  W,  $C_i=0$  nF,  $L_i=0$  H. Max operation 32 V, 25 mA.

Temperature code T4.

Ambient Temperature Limits: -50 °C to + 60 °C

Figure B-11. Approval Labels  
Factory Mutual (FM) FISCO  
model



- IE Intrinsically Safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F and G.

Class I, Zone 0, AEx ia IIC T4 when installed per Control Drawing: 9240030-936.

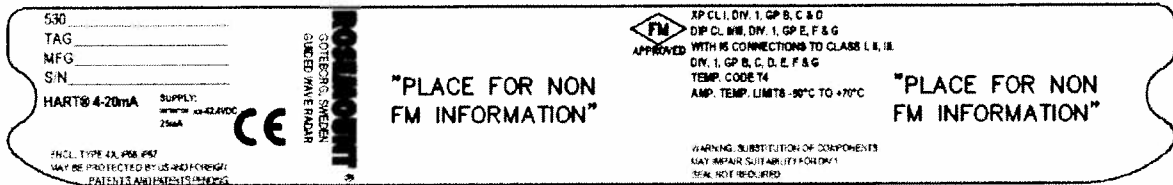
FISCO model:  $U_i=17.5$  Vdc,  $I_i=380$  mA,  $P_i=5.32$  W,  $L_i=C_i=0$ .

Temperature code T4.

Ambient Temperature Limits: -50 °C to + 60 °C

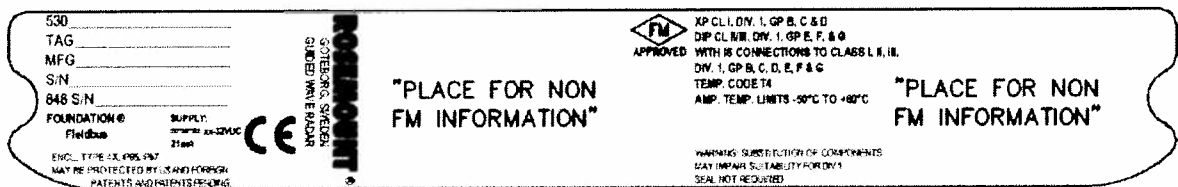
**Explosion Proof**

Figure B-12. Approval Labels  
 Factory Mutual (FM) HART  
 model



- E5** Explosion-Proof for Class I, Division 1, Groups B, C and D.  
 Dust-Ignition proof for Class II/III, Division 1, Groups E, F and G with intrinsically safe connections to Class I, II, III, Div 1, Groups B, C, D, E, F and G.  
 Temperature code T4.  
 Ambient temperature limits: -50 °C to + 70 °C.  
 Seal not required.

Figure B-13. Approval Label  
 Factory Mutual (FM) Foundation  
 Fieldbus model



- E5** Explosion-Proof for Class I, Division 1, Groups B, C and D.  
 Dust-Ignition proof for Class II/III, Division 1, Groups E, F and G with intrinsically safe connections to Class I, II, III, Div 1, Groups B, C, D, E, F and G.  
 Temperature code T4.  
 Ambient temperature limits: -50°C to + 60°C.  
 Seal not required.

# Rosemount 5300 Series

## CANADIAN STANDARDS ASSOCIATION (CSA) APPROVAL

This product meets the Dual Seal Requirements of ANSI/ISA 12.27.01-2003.

### Dual seal annunciation

The breach of the secondary seal is annunciated via product leakage from the antenna's vents. The leakage will be visible and/or audible from the transmitter head's threads.

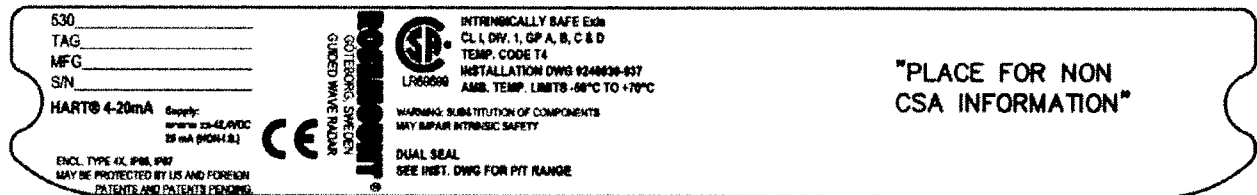
### Dual seal maintenance

No maintenance required. Verify proper operation by keeping leak path free from ice or contamination.

Cert. no. 1514653.

## Intrinsic Safety

Figure B-14. Approval Label  
Canadian Standards Association  
(CSA) HART model



### 16 Intrinsically Safe Ex ia.

Class I, Division 1, Groups A, B, C and D.

Temperature code T4.

4-20 mA/HART model:  $U_i=30$  V,  $I_i=130$  mA,  $P_i=1.0$  W,  $C_i=7.26$  nF,  $L_i=0$  H.

Installation Drawing: 9240 030-937.

Ambient temperature limits:  $-50$  °C to  $+70$  °C.

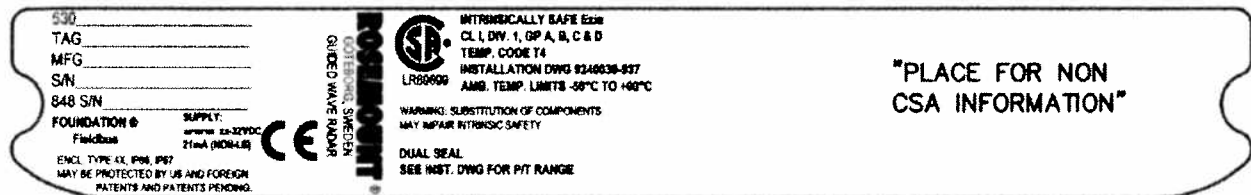
## Reference Manual

00809-0100-4530, Rev BA

July 2009

## Rosemount 5300 Series

Figure B-15. Approval Label  
Canadian Standards Association  
(CSA) Foundation Fieldbus  
model



### 16 Intrinsically Safe Ex ia.

Class I, Division 1, Groups A, B, C and D.

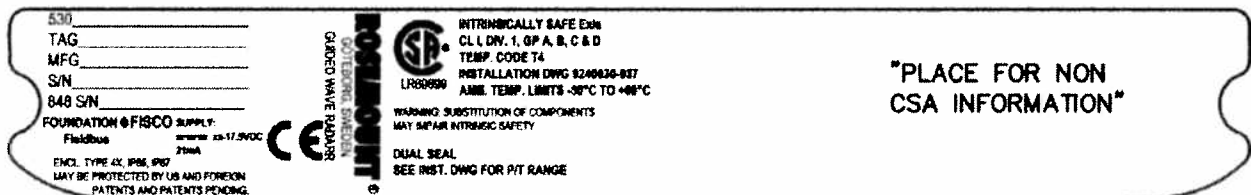
Temperature code T4.

FOUNDATION Fieldbus model:  $U_i=30$  Vdc,  $I_i=300$  mA,  $P_i=1.3$  W,  $C_i=0$  nF,  $L_i=0$  H.

Control Drawing: 9240 030-937.

Ambient temperature limits: -50 °C to + 60 °C

Figure B-16. Approval Label  
Canadian Standards Association  
(CSA) FISCO model



### 16 Intrinsically Safe Ex ia.

Class I, Division 1, Groups A, B, C and D.

Temperature code T4.

FISCO model:  $U_i=17.5$  Vdc,  $I_i=380$  mA,  $P_i=5.32$  W,  $C_i=0$  nF,  $L_i=0$  H.

Control Drawing: 9240 030-937.

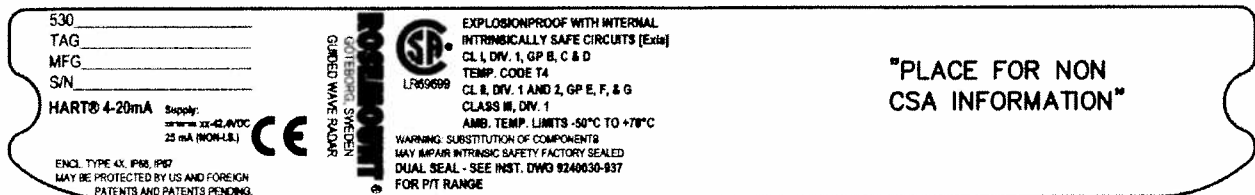
Ambient temperature limits: -50 °C to + 60 °C

# Rosemount 5300 Series

## Explosion Proof

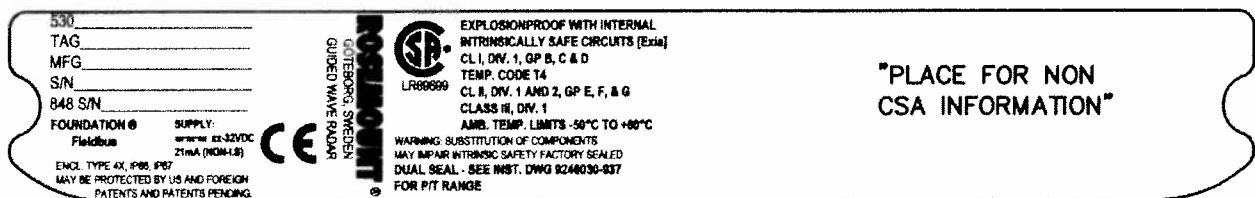
Cert. no. 1514653.

Figure B-17. Approval Label  
Canadian Standards Association  
(CSA) HART model



- E6** Explosion-proof with internal Intrinsically Safe Circuits [Exia].  
Class I, Div. 1, Groups B, C and D.  
Temperature Code T4.  
Class II, Div. 1 and 2, Groups E, F and G;  
Class III, Div. 1  
Ambient temperature limits -50 °C to +70 °C.  
Factory sealed.

Figure B-18. Approval Label  
Canadian Standards Association  
(CSA) Foundation Fieldbus  
model

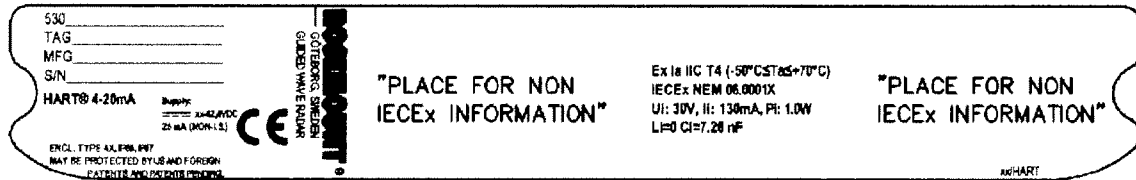


- E6** Explosion-proof with internal Intrinsically Safe Circuits [Exia].  
Class I, Div. 1, Groups B, C and D.  
Temperature Code T4.  
Class II, Div. 1 and 2, Groups E, F and G;  
Class III, Div. 1  
Ambient temperature limits -50 °C to +60 °C.  
Factory sealed.

## IECEX APPROVAL

### Intrinsic Safety

Figure B-19. Approval Label  
IECEX HART model



#### I7 Intrinsically Safe

Ex ia IIC T4 ( $T_{amb} = -50\text{ °C to }+70\text{ °C}$ )<sup>(1)</sup>.

IECEX NEM 06.0001X.

4-20 mA/HART:  $U_i=30\text{ V}$ ,  $I_i=130\text{ mA}$ ,  $P_i=1\text{ W}$ ,  $C_i=7.26\text{ nF}$ ,  $L_i=0\text{ mH}$ .

Installation Drawing: 9240 030-938.

#### Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

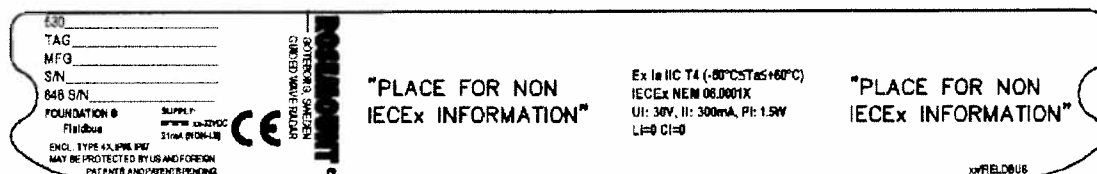
Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC according to IEC 60079-01 clause 7.3: 20 cm<sup>2</sup> for Zone 1 and 4 cm<sup>2</sup> for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

(1) Other temperature restrictions may apply, please refer to "Specifications" on page A-1.

# Rosemount 5300 Series

Figure B-20. Approval Label  
IECEX Foundation Fieldbus  
model



## 17 Intrinsically Safe

Ex ia IIC T4 ( $T_{amb} = -50\text{ °C to }+60\text{ °C}$ ).

IECEX NEM 06.0001X.

FOUNDATION Fieldbus:  $U_i=30\text{ V}$ ,  $I_i=300\text{ mA}$ ,  $P_i=1.5\text{ W}$ ,  $C_i=0\text{ nF}$ ,  
 $L_i=0\text{ mH}$ .

Installation Drawing: 9240 030-938.

## Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC according to IEC 60079-01 clause 7.3: 20 cm<sup>2</sup> for Zone 1 and 4 cm<sup>2</sup> for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.



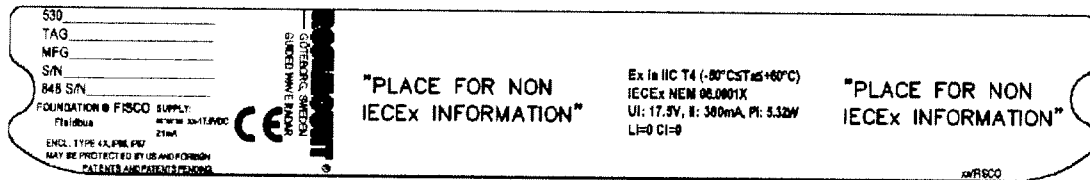
## Reference Manual

00809-0100-4530, Rev BA

July 2009

## Rosemount 5300 Series

Figure B-21. Approval Label  
IECEX FISCO model



### IG Intrinsically Safe

Ex ia IIC T4 ( $T_{amb} = -50\text{ °C to }+60\text{ °C}$ ).

IECEX NEM 06.0001X.

FISCO:  $U_i=17.5\text{ V}$ ,  $I_i=380\text{ mA}$ ,  $P_i=5.32\text{ W}$ ,  $C_i=0\text{ nF}$ ,  
 $L_i=0\text{ mH}$ .

Installation Drawing: 9240 030-938.

### Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

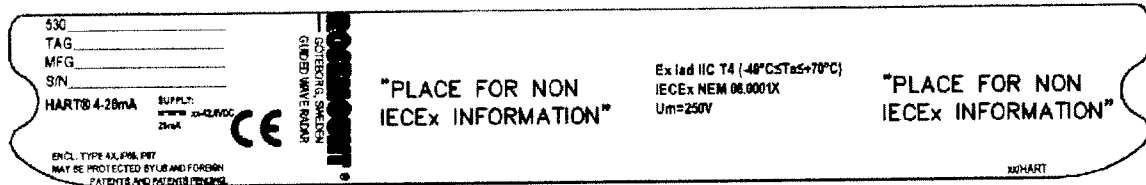
Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC according to IEC 60079-01 clause 7.3: 20 cm<sup>2</sup> for Zone 1 and 4 cm<sup>2</sup> for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

# Rosemount 5300 Series

## Flameproof

Figure B-22. Approval Labels  
 IECEX HART



### E7 Flameproof

Ex iad IIC T4 ( $T_{amb}$  : -40° C to +70 °C).

IECEX NEM 06.0001X.

$U_m=250$  VAC

### Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC according to IEC 60079-01 clause 7.3: 20 cm<sup>2</sup> for Zone 1 and 4 cm<sup>2</sup> for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

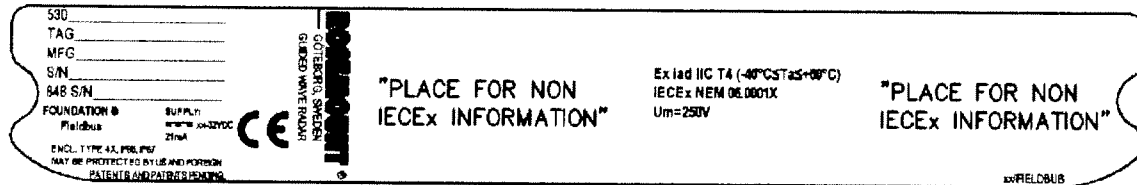
## Reference Manual

00809-0100-4530, Rev BA

July 2009

## Rosemount 5300 Series

Figure B-23. Approval Labels  
IECEX Foundation Fieldbus



### E7 Flameproof

Ex iad IIC T4 ( $T_{amb}$  : -40° C to +60 °C).

IECEX NEM 06.0001X.

$U_m=250$  VAC

### Conditions of Certification

The intrinsically safe circuits do not withstand the 500V AC test as specified in EN 50020 clause 6.4.12.

Probes covered with plastic and/or with plastic discs will have a non-conducting area that exceeds the maximum permissible area for Group IIC according to IEC 60079-01 clause 7.3: 20 cm<sup>2</sup> for Zone 1 and 4 cm<sup>2</sup> for Zone 0. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need then to be considered according to IEC 60079-0 clause 8.1.2 when the transmitter exposed to the exterior atmosphere of the tank is made with light metal alloys and used in Zone 0.

## Rosemount 5300 Series

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### COMBINATION APPROVALS

KA	ATEX, FM, CSA Flameproof/Explosion-proof
KB	ATEX, FM, IECEx Flameproof/Explosion-proof
KC	ATEX, CSA, IECEx Flameproof/Explosion-proof
KD	FM, CSA, IECEx Flameproof/Explosion-proof
KE	ATEX, FM, CSA Intrinsic Safety
KF	ATEX, FM, IECEx Intrinsic Safety
KG	ATEX, CSA, IECEx Intrinsic Safety
KH	FM, CSA, IECEx Intrinsic Safety
KI	FISCO - ATEX, FM, CSA Intrinsic Safety
KJ	FISCO - ATEX, FM, IECEx Intrinsic Safety
KK	FISCO - ATEX, CSA, IECEx Intrinsic Safety
KL	FISCO - FM, CSA, IECEx Intrinsic Safety

### APPROVAL DRAWINGS

This section contains FM Approvals System Control Drawing and Canadian Standards Association and IECEx/ATEX Installation Drawings. You must follow the installation guidelines presented in order to maintain certified ratings for installed transmitters.

This section contains the following drawings:

Rosemount drawing 9240030-936:

System Control Drawing for hazardous location installation of intrinsically safe FM approved apparatus.

Rosemount drawing 9240030-937:

Installation Drawing for hazardous location installation of CSA approved apparatus.

Rosemount drawing 9240030-938:

Installation Drawing for hazardous location installation of ATEX and IECEx approved apparatus.

Figure B-24. System Control Drawing for hazardous location installation of intrinsically safe FM approved apparatus.

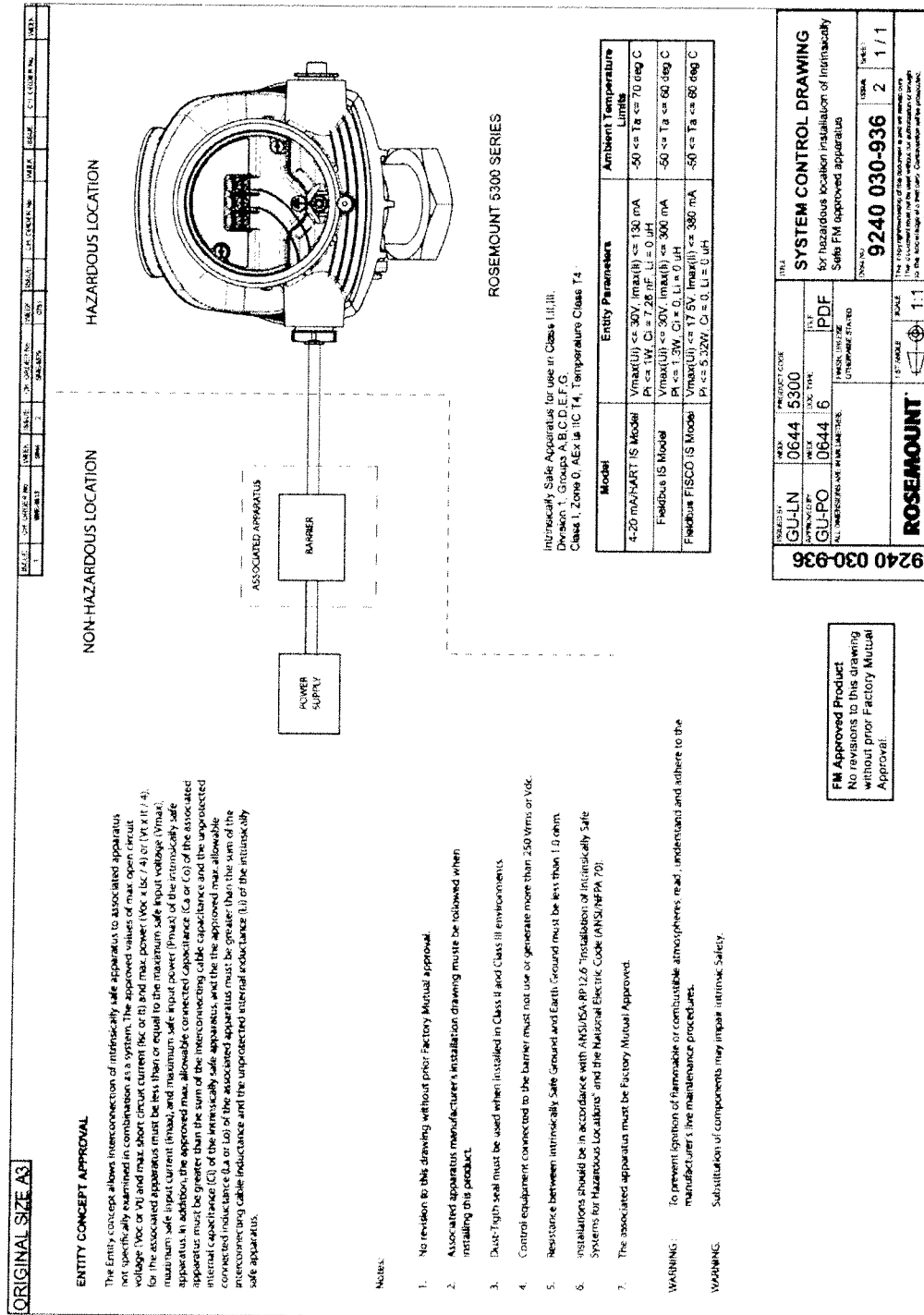


Figure B-25. Installation Drawing for hazardous location installation of intrinsically safe CSA approved apparatus.

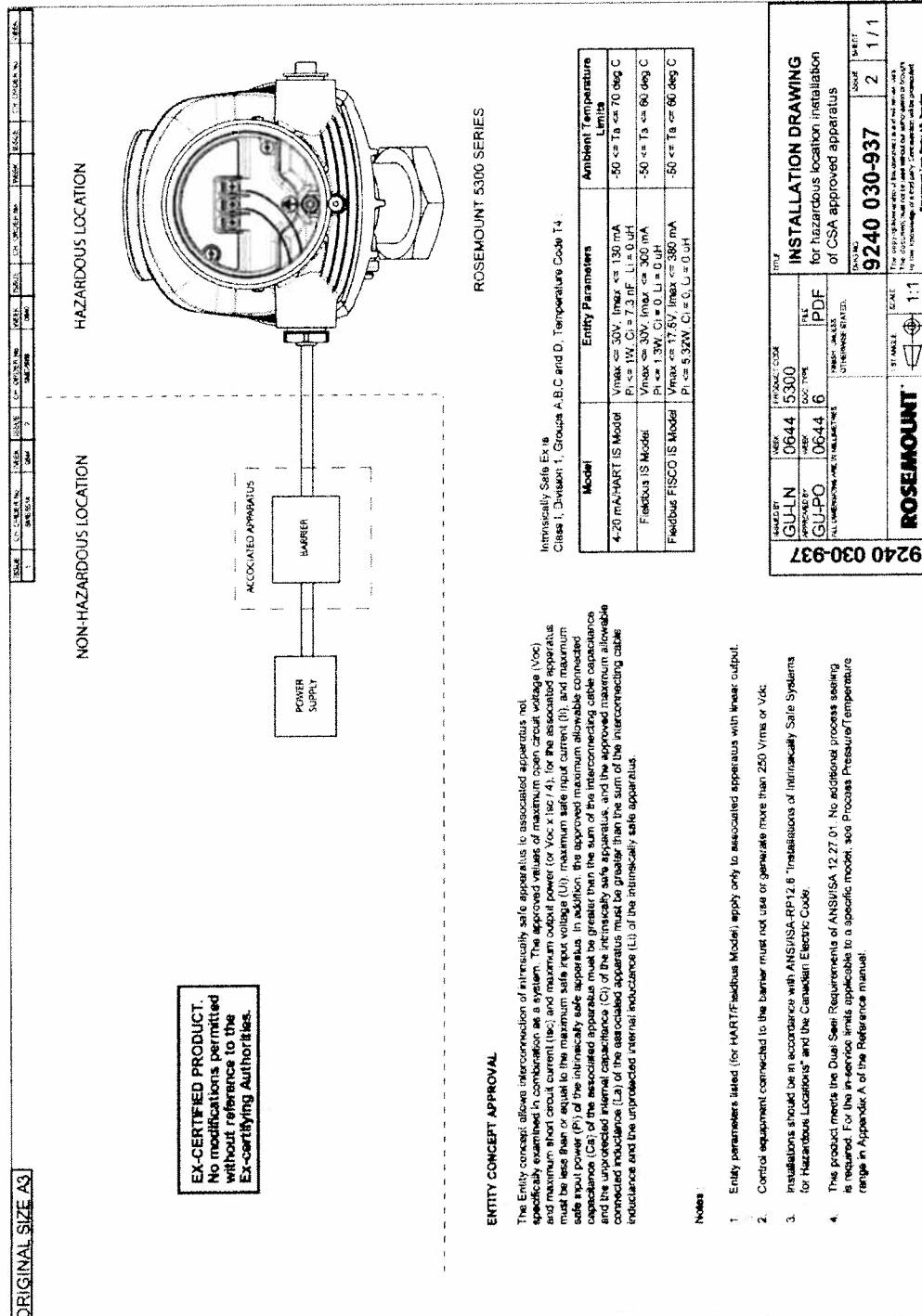
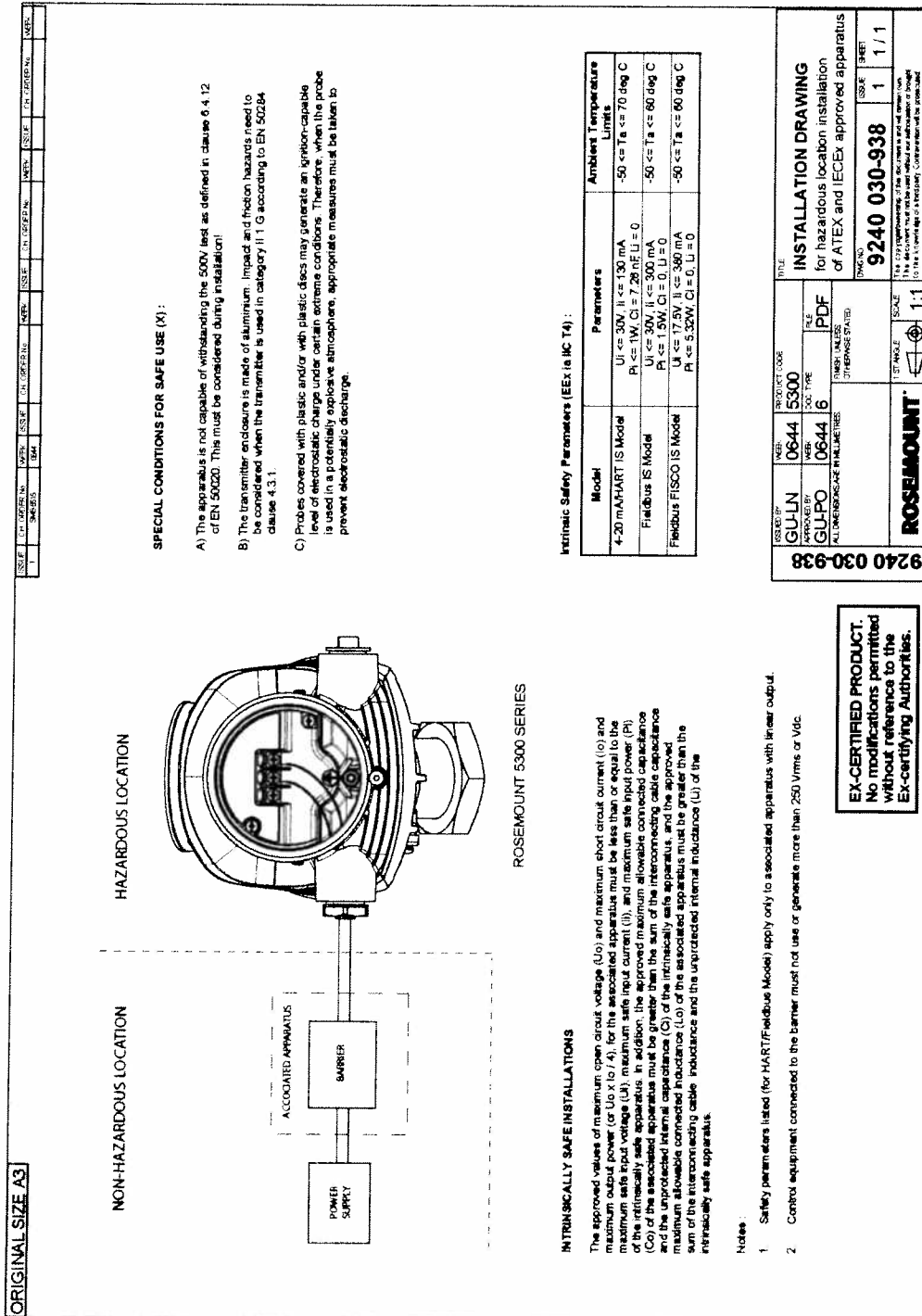


Figure B-26. Installation Drawing for hazardous location installation of intrinsically safe ATEX and IECEx approved apparatus.



# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009



# Appendix C      Advanced Configuration

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Safety messages .....	page C-1
User Defined Upper Reference Point .....	page C-3
Handling of Disturbances from Nozzle .....	page C-4
Threshold Settings .....	page C-8
Probe End Projection .....	page C-10
Echo Tracking .....	page C-12
Dielectric Constant Settings .....	page C-14
Dynamic Vapor Compensation .....	page C-15
Signal Quality Metrics .....	page C-20

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## SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

**⚠ WARNING**

**Explosions could result in death or serious injury:**

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.

## WARNING

**Failure to follow safe installation and servicing guidelines could result in death or serious injury:**

Make sure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

Any substitution of non-recognized spare parts may jeopardize safety. Repair, for e.g. substitution of components etc. may also jeopardize safety and is under no circumstances allowed.

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

## WARNING

**High voltage that may be present on leads could cause electrical shock:**

Avoid contact with leads and terminals.

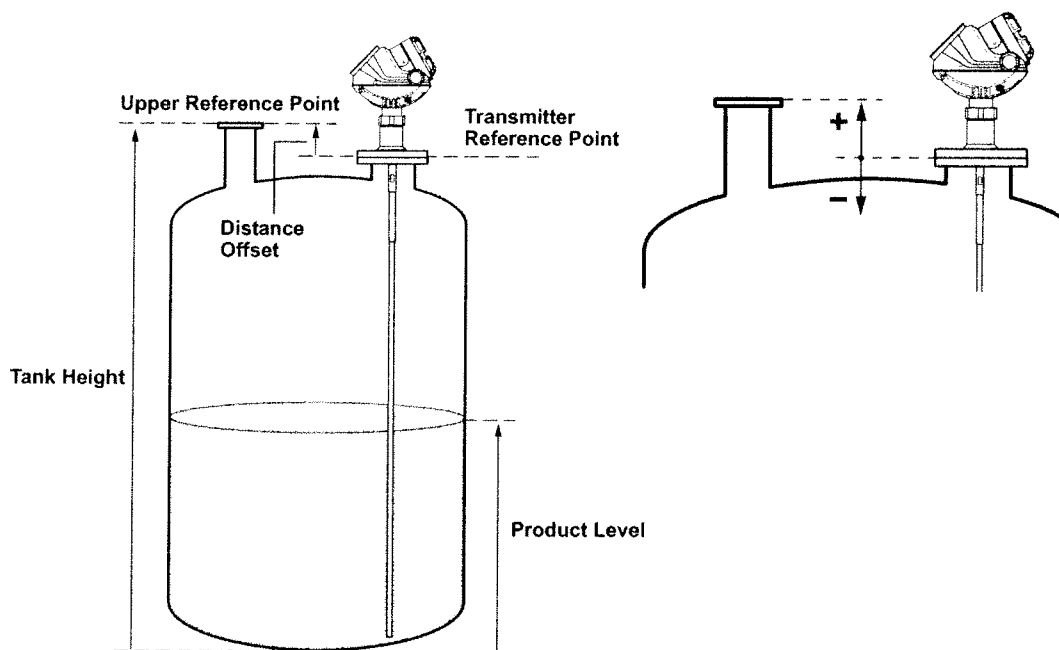
Make sure the mains power to the Radar Transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

## USER DEFINED UPPER REFERENCE POINT

An Upper Reference Point other than the standard Transmitter Reference Point can be specified by setting the *Calibration Offset* parameter as illustrated in Figure C-1:

Figure C-1. The Upper Reference Point can be specified by using the Distance Offset parameter.



To set the desired upper reference point:

1. Adjust the **Tank Height** to the distance from the tank bottom to the desired **Upper Reference Point**.
2. Add the distance between the **Upper Reference Point** and the **Transmitter Reference Point** to the **Distance Offset** value that is stored in the transmitter database.

With a 375 Handheld Communicator the Distance Offset is available as HART Fast Key sequence [2, 3, 2, 4, 2].

FOUNDATION Fieldbus parameter:  
TRANSDUCER 1100>GEOM\_OFFSET\_DIST

The Distance Offset is also available in RRM:

- a. Click the **Tank** icon under Device Config/Setup in the RRM workspace.
- b. In the *Tank* window, select the *Geometry* tab.
- c. Click the **Advanced** button.

# Rosemount 5300 Series

## HANDLING OF DISTURBANCES FROM NOZZLE

### Trim Near Zone

#### Using the Trim Near Zone Function

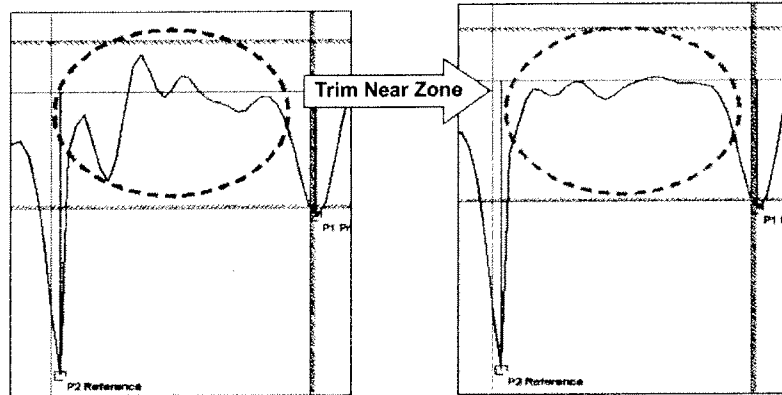
For transmitters using the Guided Wave Radar technology the performance in the Near Zone (referred to as the region between 0-3.3 ft. (0-1 m) below the Upper Reference Point) is normally somewhat limited. However, the Rosemount 5300 transmitter is equipped with a software functionality that minimizes the Upper Transition Zone. The factory setting is normally sufficient and doesn't need to be repeated after installation.

However, since the setting is optimized depending on actual installation, further trimming may be necessary in the case of unfavorable conditions. An example is if there are disturbing obstacles in the Near Zone. Trimming means that the measurement performance in the Near Zone is maintained even under these conditions and prevents false echo indication.

#### NOTE!

Make sure that the product level is below the Near Zone region (0-3.3 ft. (0-1 m) below the Upper Reference Point) before performing the Trim Near Zone.

Figure C-2. Echo Curve before and after Trim Near Zone.



#### NOTE!

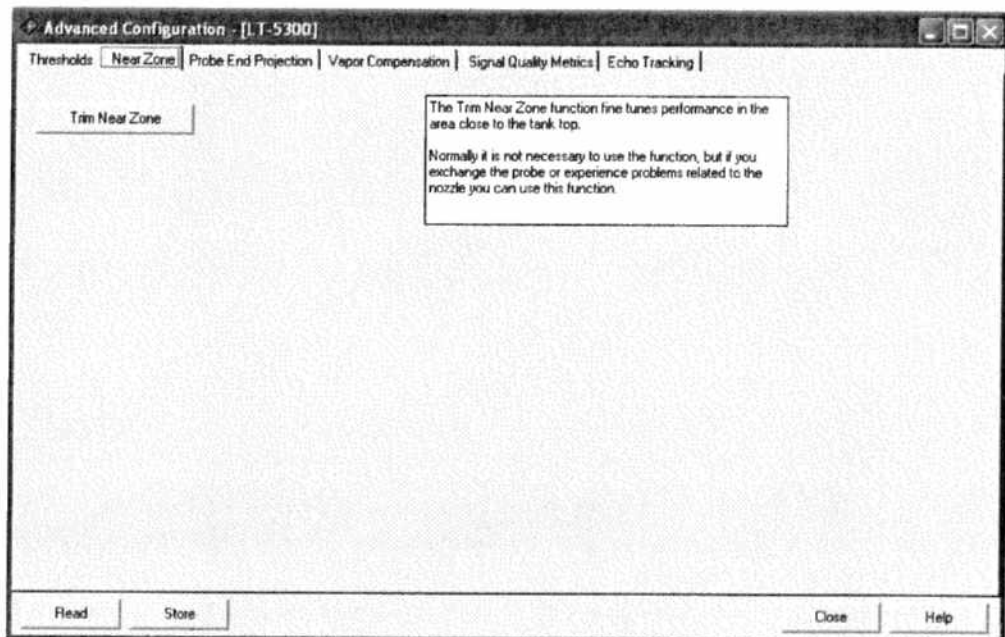
The Trim Near Zone function should only be used for reducing impact from stationary disturbances. It is not suitable for occasional disturbances.

Trim Near Zone can be done in RRM. The function can be reached from **Device Specific Configuration** in the **Guided Setup** (if the command is recommended) or from the **Advanced Configuration** window, *Trim Near Zone* tab.

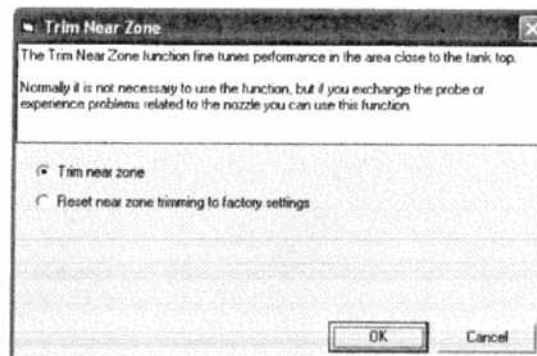
**NOTE!**

Note that for firmware version 2.A2 the Trim Near Zone is not possible in combination with Narrow Nozzles, as defined below:  
50 mm < Nozzle height ≤ 300 mm  
Nozzle diameter ≤ 2 in. for all single probes except 13 mm single rigid  
Nozzle diameter ≤ 3 in. for 13 mm single rigid

Figure C-3. Trim Near Zone using RRM.



1. Click **Trim Near Zone**.



2. Select Trim near zone and click **OK**.
3. Click OK in the appearing dialog.
4. Wait 1 minute.
5. Restart the transmitter.

---

**NOTE!**

The Trim Near Zone function can be reset by selecting *Reset near zone trimming to factory settings* in the previous dialog.

---

In 375 Field Communicator, the Trim Near Zone is reached with the [2, 1, 7, 2] HART sequence (if the command is recommended) or from the [2, 7, 1] HART sequence.

Wait 1 minute and restart the transmitter.

### Changing the Upper Null Zone

Measurements are not performed within the Upper Null Zone (UNZ). By setting the UNZ parameter to zero, measurements can be performed in the region close to the flange (Near Zone).

If there are measurement problems in the upper part of the tank, you may use the Trim Near Zone function as described above.

If the desired measurement range is below the Near Zone, or if disturbing objects are located below the Near Zone, the Upper Null Zone parameter can be used to avoid measurements above a certain level.

To set the Upper Null Zone with a 375 Field Communicator:

1. Select the HART command [2, 1, 2, 3].
2. Select the Upper Null Zone option.
3. Enter the desired value.

To set the Upper Null Zone with RRM:

1. Start RRM.
2. Click the **Tank** icon in the Device Config/Setup toolbar.
3. Select the **Probe** tab in the *Tank* window.
4. Type the desired value in the Upper Null Zone field.
5. Click the OK button. Now the Upper Null Zone is stored in the transmitter memory.

Figure C-4. Upper Null Zone.

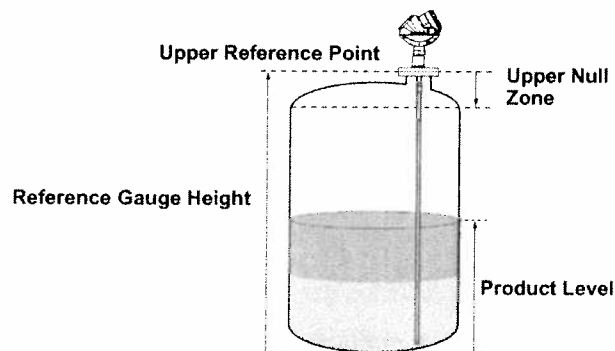
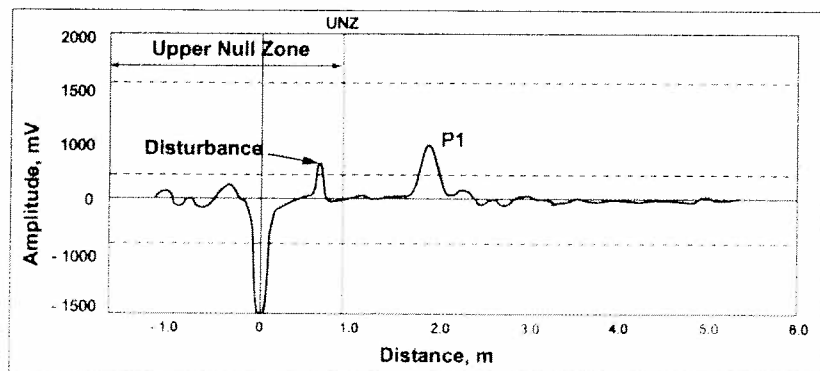


Figure C-5. Identifying the Upper Null Zone in the Echo Curve plot



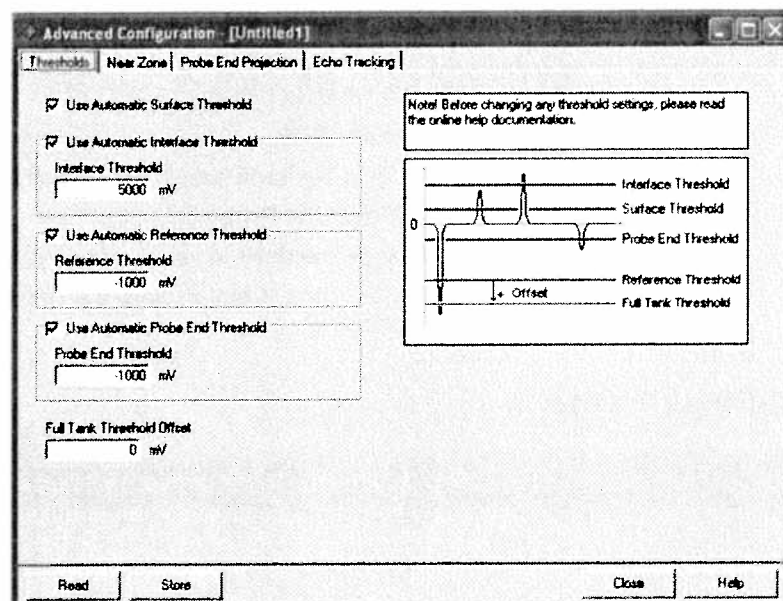
## Rosemount 5300 Series

### THRESHOLD SETTINGS

Measurement with the Rosemount 5300 is based on the fact that the radar signal pulses are reflected by the product surface and the interface between two liquids. Various signal amplitude thresholds are used to separate the measurement signal from disturbing echoes and noise. Normally, the amplitude thresholds are automatically set by the 5300 transmitter, and no manual settings are needed. However, due to the properties of the product, it may in rare cases be necessary to adjust the amplitude thresholds for optimum measurement performance. RRM supports threshold settings in the *Advanced Configuration* window:

1. Click the **Advanced** icon in the Device Config/Setup toolbar.
2. Select the **Thresholds** tab in the *Advanced Configuration* window.

Figure C-6. Threshold settings in RRM.



Automatic threshold settings are enabled by default. In the *Advanced Configuration* window the *Interface*, *Reference*, *Probe End* and *Full Tank* thresholds can also be set manually.

#### Automatic Surface Threshold

When this check-box is selected, the transmitter automatically sets the Surface threshold to a constant value based on the configured Dielectric Constant of the product.

Note that by enabling the Automatic Surface threshold setting, the *Amplitude Threshold Curve (ATC)* is replaced by a constant threshold value. See "Using the Echo Curve Analyzer" on page 7-10 for more information on how to use the ATC.

The Surface threshold can also be manually set by using the **Set Threshold** function in the *Echo Curve Analyzer/Configuration Mode* window (see "The Configuration Mode Tab" on page 7-11).

#### Interface Threshold

Amplitude threshold for detection of the Interface level peak.



### Reference Threshold

Amplitude threshold for detection of the Reference pulse.

### Probe End Threshold

If the Probe End Projection function is used (see "Dielectric Constant Settings" on page C-14), this threshold may need to be adjusted to make sure that the probe end pulse is properly detected.

### Full Tank Threshold Offset

The Full Tank threshold is related to the Reference Threshold, and can be used for detecting that the tank is full. The given offset value determines the gap between the Reference threshold and the Full Tank threshold. The transmitter considers the tank full when the amplitude of the Reference Peak has dropped to a value between the two threshold values.

If the amplitude of the Reference peak is below the Full Tank Threshold (negative amplitude of the Reference peak), the tank is not considered full.

The Full Tank Threshold Offset should normally be set so that the Full Tank Threshold coincides with an amplitude value equal to 90% of the Reference Echo peak amplitude when the tank is not full.

### Example

In the example below, the following assumptions are made (note the negative sign):

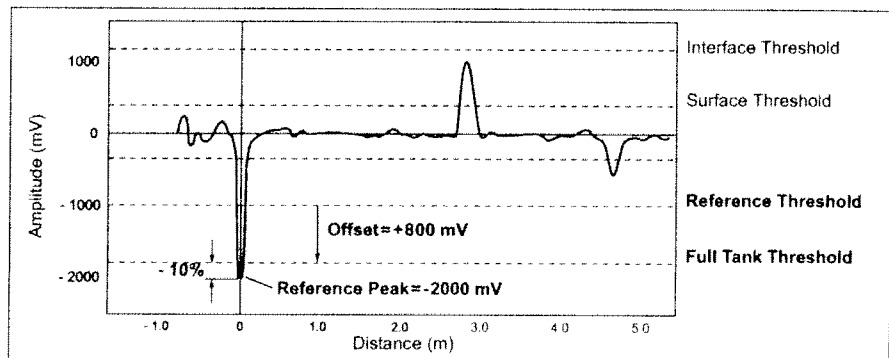
Reference Echo peak amplitude = -2000 mV  
Reference Threshold = -1000 mV

The target position for the Full Tank Threshold is at 10% below the Reference Echo peak amplitude. In this example, it means that the Full Tank Threshold should be located at 10% below the Reference peak at -2000 mV:  
 $-2000 \text{ mV} - (-200 \text{ mV}) = -1800 \text{ mV}$

Since the Full Tank Threshold refers to the Reference Threshold, the resulting offset value has to be expressed in terms of the distance to the Reference Threshold:

Full Tank Threshold Offset =  $-1000 \text{ mV} - (-1800 \text{ mV}) = +800 \text{ mV}$ .

Figure C-7. Example of how to specify the Full Tank Threshold



By default, this value is 0 (function is not used). This is because highly contaminated or condensed tank-seals, and turbulent or boiling surfaces, which can cause splashing, may cause function to be triggered.

# Rosemount 5300 Series

## PROBE END PROJECTION

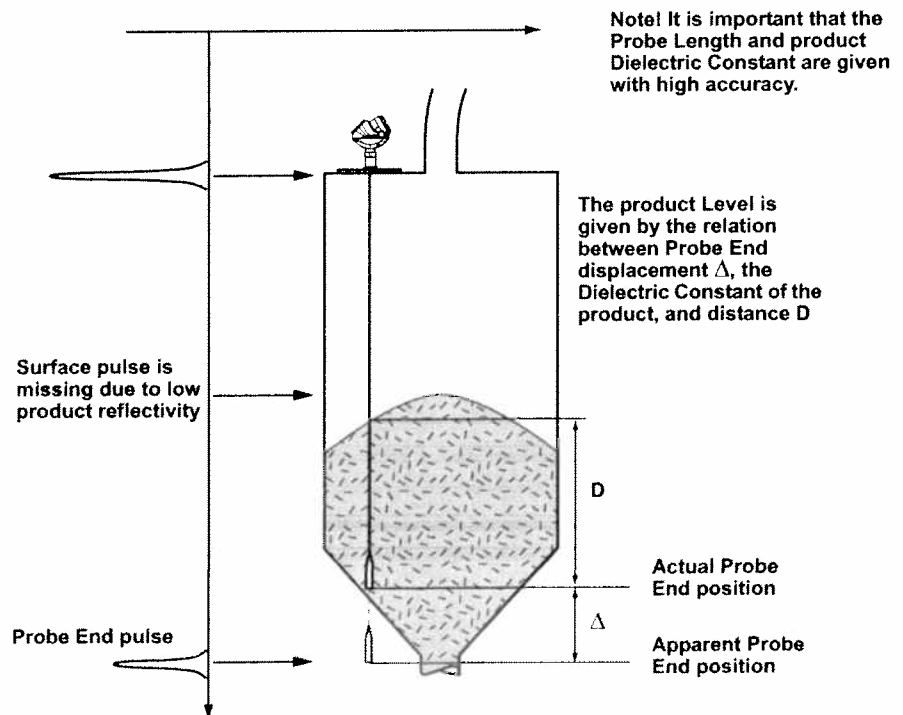
Probe End Projection allows you to measure product level when the surface pulse is too weak to be detected. For example, long measuring range and products with very poor reflectivity (low dielectric constant).

A product with very low reflectivity is characterized by its low dielectric constant. Such a product reflects relatively small amounts of the microwave energy emitted from the Rosemount 5300 transmitter, and most of it is transmitted through the product. Consequently, situations may occur where the surface pulse is invisible to the transmitter at long measuring ranges. The Probe End Projection function in the Rosemount 5300 transmitter makes it possible to carry out accurate measurements even under such circumstances.

When the microwaves emitted by the Rosemount 5300 transmitter propagate through the product in the tank, the Probe End pulse appears to be located below the actual probe end. The apparent displacement of the Probe End pulse is a consequence of the reduced propagation speed of the measurement signal through the product compared to the speed through air. The displacement of the Probe End pulse can be observed by using the Echo Curve Analyzer in the Rosemount Radar Master (see "Using the Echo Curve Analyzer" on page 7-10).

For products with very low dielectric constants the product surface level can be determined by comparing the actual probe end position as given by the Probe Length value, with the apparent position of the Probe End pulse. The difference is related to the properties of the product, i.e. the **Dielectric Constant**, and the distance **D** travelled by the measurement signal through the product, see Figure C-8.

Figure C-8. The properties of the product makes the probe end pulse appear to be below the actual probe end.



Probe End Projection is used to :

- Use the probe end echo as reference, in case the surface echo is lost, to calculate the surface echo position
- Use the probe end echo as reference when the surface echo is close to the probe end to enhance accuracy of the surface echo position

---

**NOTE!**

This function is only available for Liquid/solid product **level** measurement modes (i.e. not available for interface or fully submersed interface measurement modes) and a well defined probe end echo (i.e. ensure that the probe end/centering disc/weight is either always in contact with the tank wall or never in contact with the tank wall).

---

---

**NOTE!**

Assure that the Tank settings; Mounting Type, Probe Type, and Probe Length have been assigned correct values before continuing.

---

Probe End Projection can be configured using a guide. When the tank is empty, the guided setup will be able to accurately calibrate probe end offset and probe end pulse polarity. You will be asked to insert an initial value for the Product DC. This is the value for the product dielectric constant that the device uses as a start point for estimation. This value must be as accurate to the actual value of the dielectric constant as possible.

When the tank is filled, the guided setup will be able to estimate the Product DC. This value is used as an initial value for future estimation of the Product DC.

For best performance, complete the guided setup with an empty tank and then a second time with a filled tank, but do not overwrite the empty tank calibration.

Probe End Projection can be configured in RRM. This function can be reached from the **Device Specific Configuration** in the Guided Setup (if the configuration is recommended) or from the **Advanced Configuration** window, *Probe End Projection* tab. Click **Guided Probe End Projection Setup** to start the configuration.

Figure C-9. Probe End Projection setup.

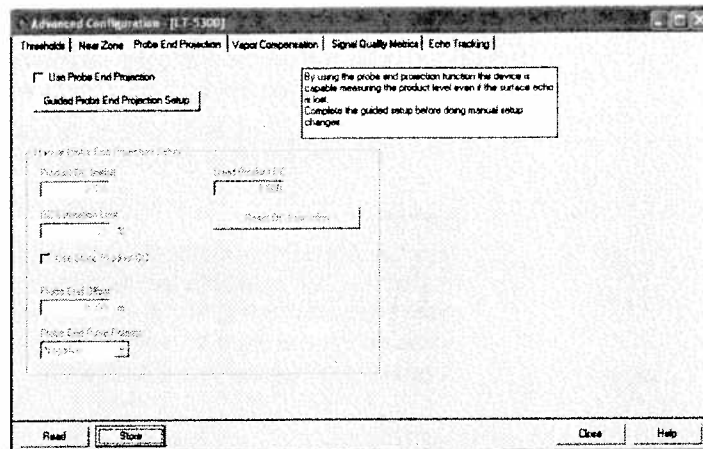
In 375 Field Communicator, the Device Specific Configuration is reached with sequence [2, 1, 7, 2] (if the configuration is recommended) or from the sequence: [2, 7, 2].

**Optional configurations:**

**DC Estimation Limit:** This is a limit for the product dielectric constant estimation. The limit is a percentage, saying how much the estimated product DC is allowed to differ from the initial product DC value. If the estimation goes outside this limit, a warning will be generated.

**Used Product DC:** This is the estimated product dielectric constant that the device will use for Probe End Projection.

# Rosemount 5300 Series



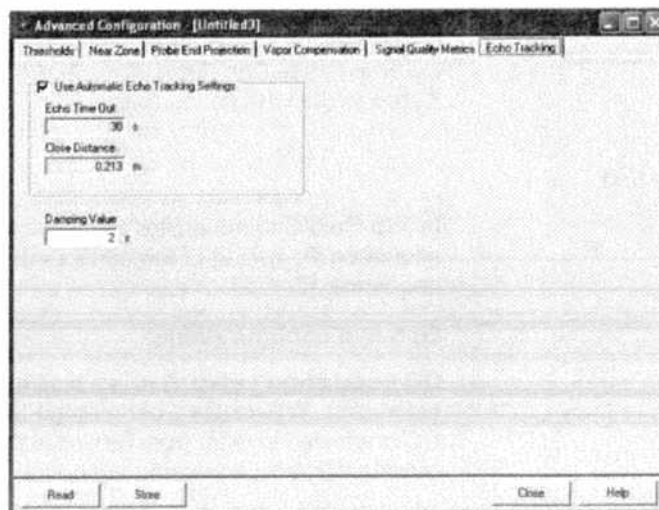
**Reset DC Estimation:** Resets DC estimation to the configured initial value, forcing the device to start over estimating the product DC.

**Use Static Product DC:** Check this setting if you do not want the device to estimate the product DC. This will force the device to use the configured initial product DC.

## ECHO TRACKING

Measurement with the Rosemount 5300 is based on the fact that the radar signal pulses are reflected by the product surface. Different parameters are used to track the measurement signal to achieve a reliable and stable measurement. Normally, the echo tracking parameters are automatically set by the 5300 transmitter, and no manual settings are needed. However, due to the properties of the product, in rare cases it may be necessary to adjust the echo tracking settings for optimum measurement performance. RRM supports echo tracking settings in the **Advanced Configuration** window, *Echo Tracking* tab.

Figure C-10. Echo Tracking in RRM.



Automatic echo tracking settings are enabled by default. In the Advanced Configuration window the Echo Tracking settings Echo Timeout and Close Distance can be also be set manually.

### Use Automatic Echo Tracking Settings

When this check-box is selected, the transmitter automatically sets the echo tracking parameters to a constant value based on the configured tank environment and measurement mode.

**Echo Timeout:** defines the time in seconds before the device should start to search for a surface echo outside the Close Distance window after it was lost. After an echo was lost, the device does not start searching (or set Invalid Level) until the specified time has elapsed. In some applications, especially with solid products or applications with foam, the surface echo may disappear for periods of time. This value can be increased to prevent the device from entering alarm mode too early after the surface is lost.

**Close Distance:** defines a window centred at the current surface position where new surface echo candidates can be selected. The size of the window is  $\pm$ Close Distance. Echoes outside this window will not be considered as surface echoes. The device will without delay jump to the strongest echo within this window. This value can be increased if there are rapid level changes in the tank. If the value is too large the device might select an invalid echo as the surface echo.

### Damping

The Damping parameter defines how fast the device reacts to a change of the level value (step response). A high value makes the level steady but the device reacts slowly to level changes in the tank. A low value makes the device react quickly to level changes but the presented level value can be somewhat jumpy. The default value is 2 seconds. Note that increasing the damping value will also prolong the system response time. The damping value can also be changed from the **Output**, *General* tab.

# Rosemount 5300 Series

## DIELECTRIC CONSTANT SETTINGS

### Static Vapor Compensation

In some applications, there is heavy vapor above the product surface having a significant influence on the level measurement, for example, in the case of saturated water steam under high pressure. In such cases, the vapor dielectric can be entered to compensate for this effect.

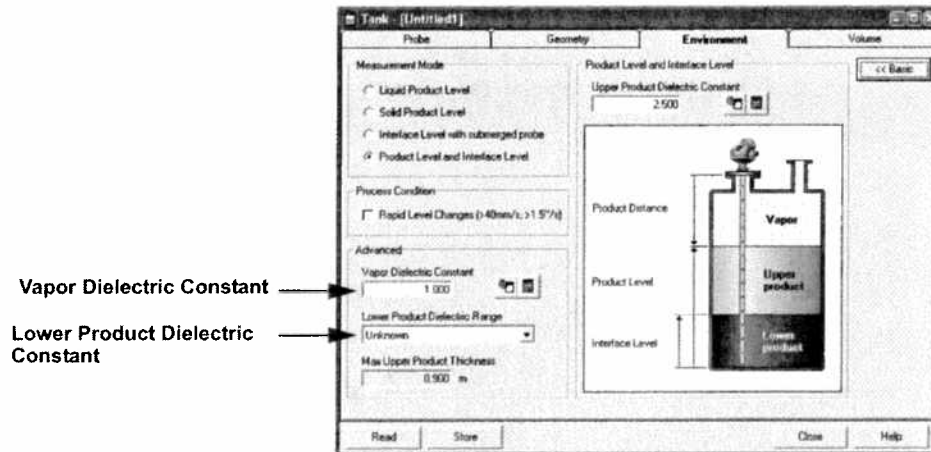
For applications with a varying pressure and/or temperature, certain models of the Rosemount 5300 Series have a built-in function that automatically compensates for varying vapor dielectric constants. See “Dynamic Vapor Compensation” on page C-15.

The default value is equal to 1 which corresponds to the dielectricity of vacuum. Normally this value does not need to be changed since the effect on measurement performance is very small for most vapors.

To change the Vapor Dielectric Constant:

1. Start RRM.
2. Click the Tank icon in the RRM workspace, or choose Tank from the Setup menu.
3. Select the Environment tab and click the Advanced button.

Figure C-11. Dielectric constants can be adjusted in the Tank Environment window.



4. Type the desired value in the Vapor Dielectric Constant field. You may also use the Vapor Dielectric Calculator or the Vapor Dielectric Chart to find the correct value.

### Lower Product

If the dielectric constant of the lower product is significantly smaller than the dielectric constant of water, you may need to adjust the Lower Product Dielectric Range, see Figure C-11.

Special adjustments can also be made by trimming the appropriate amplitude thresholds. See section “Interface Pulse not Found” on page 7-8 for further information.

**DYNAMIC VAPOR  
 COMPENSATION**

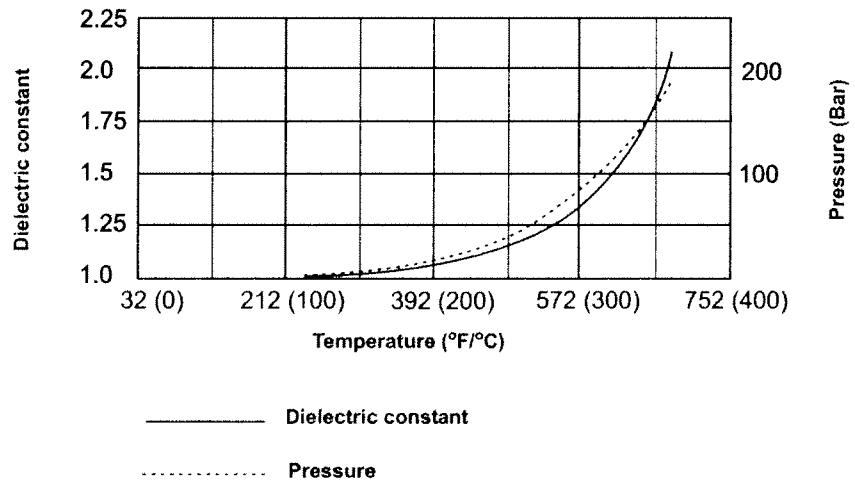
Rosemount 5300 Series is based on the Time Domain Reflectometry (TDR) technology where low power nanosecond microwave pulses are guided down a probe submerged in the process media. When a radar pulse reaches a media with a different dielectric constant, part of the energy is reflected to the transmitter. The time difference between the transmitted pulse and the reflected pulse is converted into a distance from which the total level or interface level is calculated.

For radar level gauging, the actual measured quantity is the propagation time through the empty space between the radar level transmitter and the liquid surface. For typical radar level transmitter accuracy, the propagation speed of the radar signal should be close to the velocity of light in vacuum. However, in some important cases, the deviation is not negligible and must be taken into account for accuracy. High tank pressure in combination with certain gases is an example.

High pressure water steam can influence radar level transmitter measurements. This is due to the high pressure as well as the polar structure of water molecules. In such cases, the Rosemount 5300 Series Level transmitter can be configured for compensation for this effect.

Water has high critical temperature and pressure (705 °F / 374 °C and 140 bar, respectively). Level measurement may not be possible above these limits. However, some applications, such as power plants, may use water near the limits. In a closed vessel containing water liquid and water vapor, existing databases (referred to as a Mollier diagram) have been used to calculate pressure and vapor density, and deduce the dielectric constant of the vapor from this. The dielectric constant changes as given in Figure C-12.

Figure C-12. Dielectric constant versus temperature for saturated water vapor.



The standard version of a Rosemount 5300 Series level transmitter can be configured for static compensation of vapor by manually entering the dielectric constant of vapor, see “Dielectric Constant Settings” on page C-14. For applications with a varying pressure and/or temperature, certain models of the Rosemount 5300 Series have a built-in function (Dynamic Vapor Compensation) that automatically compensates for varying vapor dielectric constants.

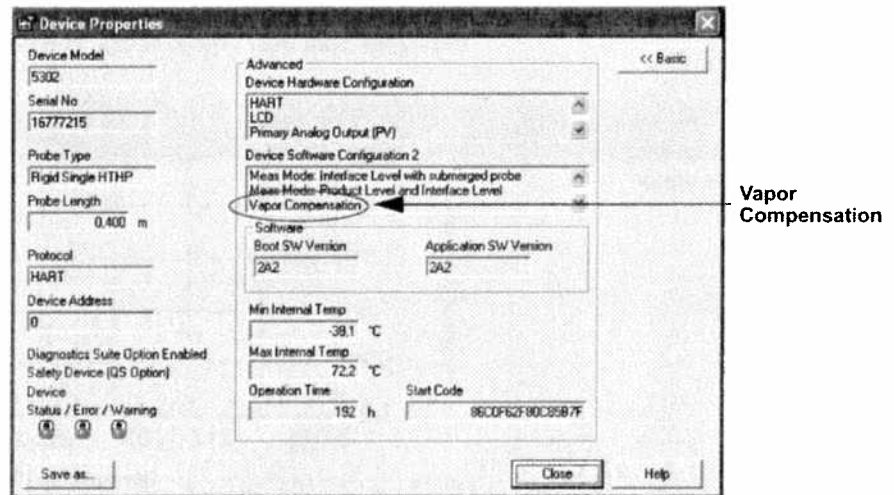
# Rosemount 5300 Series

The Rosemount 5300 uses a reference reflector mounted on the probe at a certain distance to estimate the dielectric constant of the vapor. The transmitter knows where the reference reflector pulse should have been if there were no vapor present. However, since there is vapor in the tank, the reference reflector pulse will appear beyond the actual reflector point. The distance between the actual reflector point and the apparent reflector point will be used to calculate the vapor dielectric constant. The calculated dielectric constant is then dynamically used to compensate for changes in vapor dielectric constant and eliminates the need to do any compensation in the control system.

To check if the Dynamic Vapor Compensation function is supported, do one of the following:

- If probe type 4U or 4V is mentioned in the model code on the label, the device supports Vapor Compensation.  
Model Code: 530xxxxxxx**4U**xxxxxxx or 530xxxxxxx**4V**xxxxxxx
- In RRM:
  1. Connect to the device.
  2. Right click on the device and select **Properties**.

Figure C-13. Check if Dynamic Vapor Compensation is supported.



3. If "Vapor Compensation" is mentioned in the *Device Software Configuration 2* list, the device supports Vapor Compensation.

- In 375 Field Communicator, if Vapor Compensation is supported, it can be found with the [3, 2, 2, 1] HART sequence

**NOTE!**

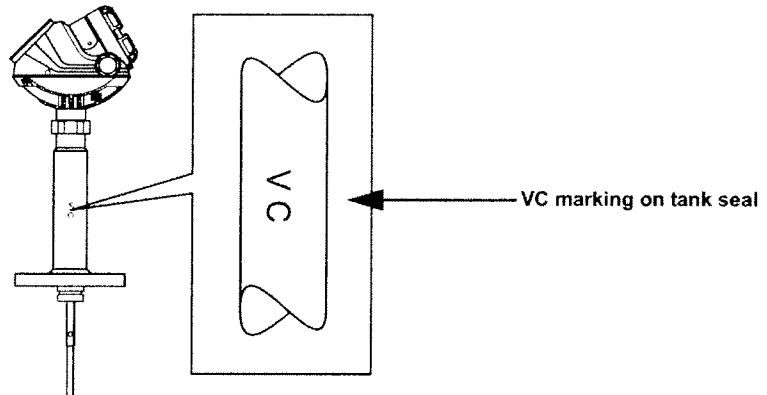
Vapor compensation is supported for Product Level measurement mode only.



**NOTE!**

Single Rigid HTHP equipped with reference reflector is the only probe that supports vapor compensation. The probe is marked "VC" as shown in Figure C-14.

Figure C-14. Single Rigid HTHP with VC marking on the probe.

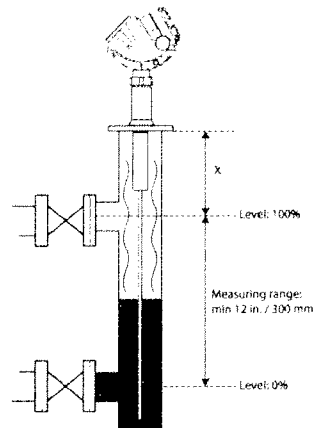


- Probes up to 13.1 ft (4 m) length are supported
- Pipe / Chamber is the only supported mounting type. Supported pipe inner diameters are 2, 3, and 4 in. (5, 7.5, and 10 cm)
- Probe End Projection is disabled when vapor compensation is enabled
- Trim near zone shall not be used when dynamic vapor compensation is used.

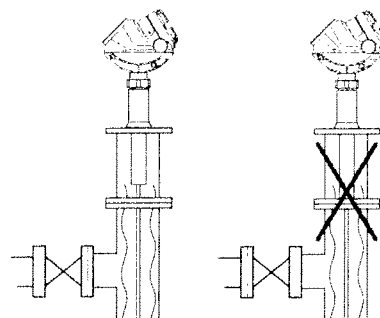
Dynamic Vapor Compensation requires a minimum distance from the flange to the surface level to measure the change in the vapor dielectric constant. If the level rises within this area, the unit switches over to static compensation, using the last known vapor dielectric constant. This minimum distance is 17.3 in. (440 mm) for probe length < 6.6 ft (2 m), and 28 in. (710 mm) for probe length > 6.6 ft (2 m) (see X in figure below), to dynamically compensate up to level 100%. The minimum measuring range for this functionality is 12 in. (300 mm).

## Rosemount 5300 Series

Figure C-15. Minimum requirements.



If a 5300 Series transmitter is ordered from Rosemount together with a 9901 Chamber, these space requirements are met. If an existing chamber is used, which does not meet these space requirements, a spool piece can be added. For an installation with a spool piece, it is important to make sure that the reference reflector and the spool piece do not have the same length. The spool piece needs to be at least 2 in. (50 mm) longer or shorter.



**If a spool piece is used, it is important that the reference reflector and the spool piece do not have the same length.**

### Installation Setup

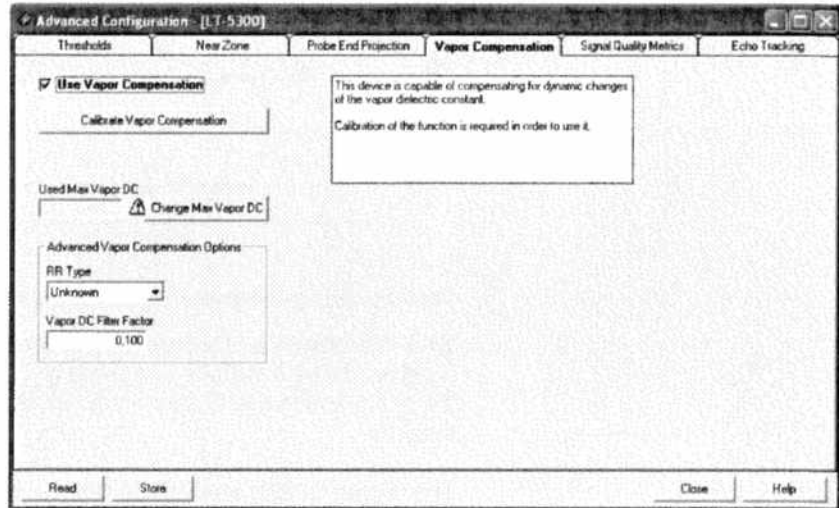
It is important that the vapor compensation function is calibrated after installation. Before calibration:

- The surface level must be at least 19.7 in. (0.5 m) below the end of the reflector (It is recommended to empty the pipe/chamber.)
- Perform the calibration at ambient pressure and temperature conditions, i.e. when the vapor dielectric constant is close to 1.0

**To calibrate Dynamic Vapor Compensation:**

1. Either choose **Device Specific Configuration** in the Guided Setup (if the configuration is recommended) or **Setup, Advanced**.
2. Select the *Vapor Compensation* tab.

Figure C-16. Calibrate Dynamic Vapor Compensation.



3. Click the **Calibrate Vapor Compensation** button.
4. Make sure *Use Vapor Compensation* is selected.
5. The echo from the reference reflector end can be viewed in the Echo Curve in RRM. Probes shorter than 6.6 ft. (2 m) will have the reflector end at 0.75 ft. (0.23 m) distance and probes longer than 6.6 ft. (2 m) will have the reflector end at 1.6 ft. (0.5 m).
6. Cycle power to finish.

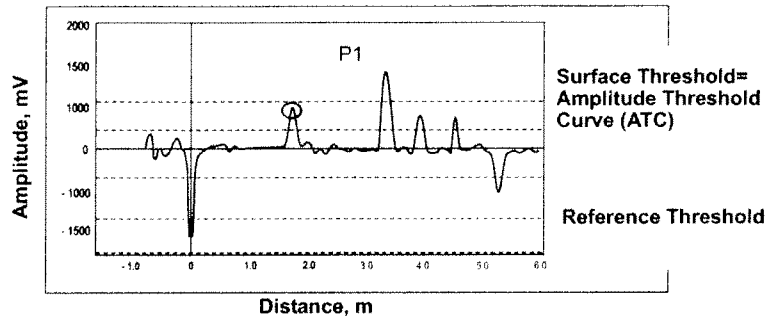
In 375 Field Communicator, the calibration can be done by HART command [2, 7, 3].

# Rosemount 5300 Series

## SIGNAL QUALITY METRICS

Signal Quality Metrics indicates the surface signal integrity compared to the noise. It can be used to schedule maintenance to clean the probe or detect and monitor turbulence, boiling, foam and emulsions.

Figure C-17. Echo curve showing surface peak amplitude, noise peak amplitude, and surface threshold.



The following diagnostics measurements are available:

*Signal Quality* is a measurement of the surface peak amplitude (P1) compared to the surface threshold (ATC) and the smallest marginal between the noise and the ATC above the surface (indicated with a circle) compared to the ATC.

The Signal Quality spans from 0 to 10, where 0 indicates a low margin, and 10 indicates a high margin. It indicates how much margin there is until the noise peak is indicated as the surface level.

*Surface / Noise Margin* is the relationship between surface peak amplitude and the amplitude of the strongest noise peak above the surface. The Surface / Noise Margin spans from 0 to 10, where 0 indicates a low margin, and 10 indicates a high margin. It indicates how much disturbance the device can handle in the tank.

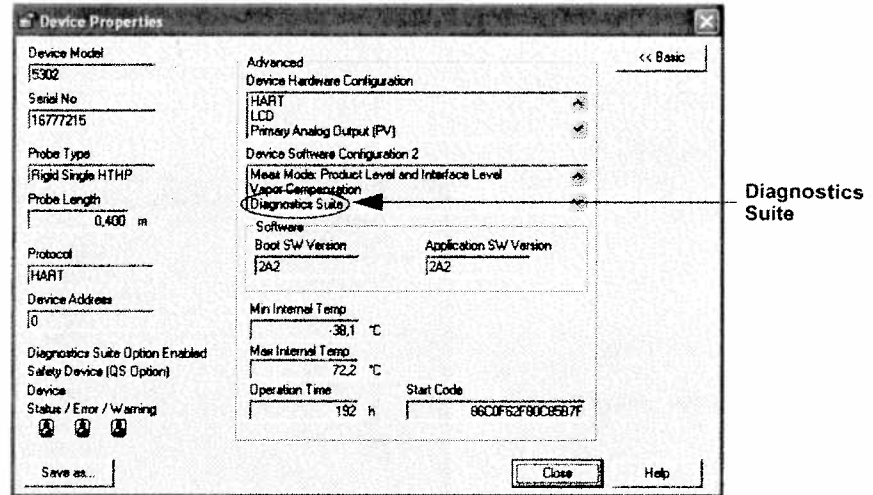
### NOTE!

The signal amplitude and the noise margin depend on probe type and application conditions, as well as the condition of the probe. Even if the probe is clean, Signal Quality and Surface / Noise Margin may not be a 10.

To check if Signal Quality Metrics is supported, do one of the following:

- If "DA1" or "D01" is mentioned in the model code on the label, the device supports Signal Quality Metrics.  
Model Code: 530xxxxxxxxxxxxxxxxDA1 or 530xxxxxxxxxxxxxxxxD01xx
- In RRM:
  1. Connect to the device.
  2. Right click on the device and select **Properties**.

Figure C-18. Check if Signal Quality Metrics is supported.



3. If "Diagnostics Suite" is mentioned in the *Device Software Configuration 2* list, the device supports Signal Quality Metrics.

- In 375 Field Communicator, if Signal Quality Metrics is supported, it can be found with the [3, 2, 2, 1] sequence. Check if "Diagnostics Suite" is present

Signal Quality Metrics can be enabled/disabled in RRM. Choose **Tools**, **Advanced**, *Signal Quality Metrics* tab.

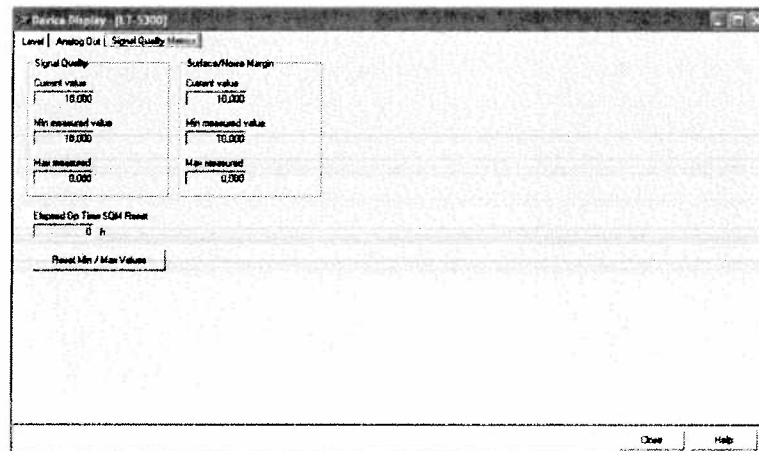
**NOTE!**

If Signal Quality Metrics is not supported or disabled, the Signal Quality and Surface / Noise Margin will always be set to 0.

**Viewing Signal Quality Metrics in RRM**

To view Signal Quality Metrics in RRM, choose the **Tools > Device Display** option and select the *Signal Quality Metrics* tab.

Figure C-19. View Signal Quality Metrics Values.

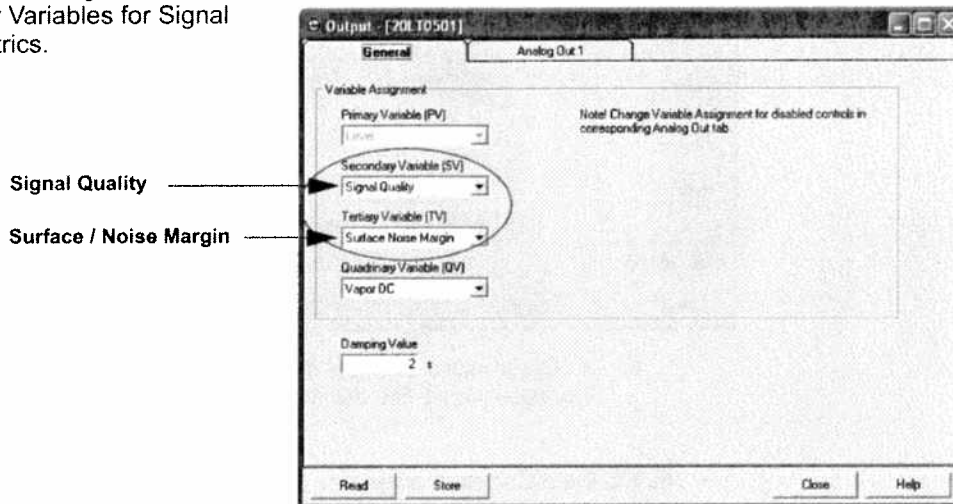


# Rosemount 5300 Series

Signal Quality Metrics can be shown on the LCD panel. See “Operation” on page 6-1.

Signal Quality Metrics can be assigned to Transmitter Variables (SV, TV, or QV). In RRM, this can be done by selecting **Setup, Output** from the menu.

Figure C-20. Configure Transmitter Variables for Signal Quality Metrics.



Variables can be sent to Distributed Control System (DCS) to trigger an alarm. Suitable trigger levels vary from application to application. Guidelines for appropriate values can be determined by logging Signal Quality Metrics over time and viewing minimum/maximum values. The Signal Quality alarm trigger value should be at least 1, but a better guideline is 2-3.

## Appendix D Remote Mounting

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Remote Housing, New Units .....	page D-1
Remote Connection, Field Retrofit .....	page D-3
Remote Housing Configuration .....	page D-4

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### REMOTE HOUSING, NEW UNITS

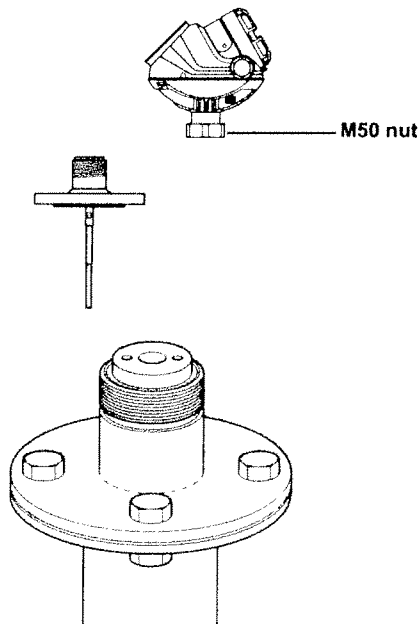
Remote Housing can be used to place the head apart from the probe if it is in a hot or vibrating place. With Remote Housing, you can place the transmitter head in a better position to be able to read the display, for example.

The remote housing assembly is shipped with the transmitter head mounted on the probe and the remote connection in a separate box.

The transmitter head must have the remote connection installed before functioning.

The parts in the shipping unit consist of:

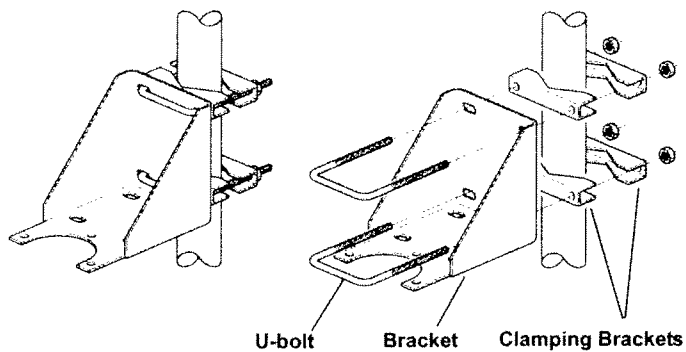
- Transmitter head mounted on probe
- Remote connection
- Bracket kit
  - Bracket (1 pcs)
  - Clamping bracket (4 pcs)
  - U-bolt (2 pcs)
  - M6 screw (3 pcs)
  - M6 nut (4 pcs)



#### Remove the transmitter head from the probe

Remove the transmitter head from the probe by unscrewing the M50 nut.

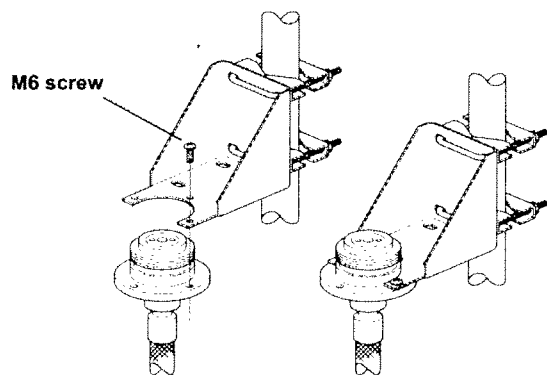
#### Mount the probe in the tank



### Mount the bracket to the pole

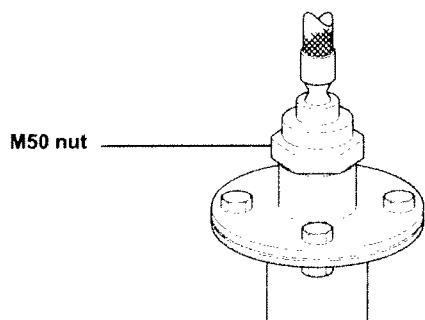
Mount the bracket to the pole, making sure the distance between the probe and bracket does not exceed the length of the remote connection.

1. Put the two U-bolts through the holes of the bracket. Several holes are available for vertical/horizontal pipe mounting.
2. Put the clamping brackets on the U-bolts and around the pipe.
3. Use the supplied nuts to fasten the bracket to the pipe.



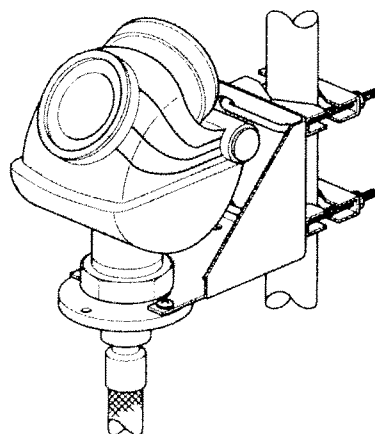
### Fasten the housing support to the bracket

Fasten the housing support to the bracket using the M6 screws. The screws are threaded through the top of the mounting bracket and into the housing support.



### Mount the probe housing on the probe

Mount the probe housing on the probe, making sure that the M50 nut is properly tightened.



### Connect the transmitter head on the housing support

Connect the transmitter head on the housing support, making sure that the M50 nut is properly tightened.

See "Remote Housing Configuration" on page D-4 to check if the transmitter is configured with remote housing.



## REMOTE CONNECTION, FIELD RETROFIT

To upgrade a currently installed Rosemount 5300 transmitter with a remote housing, the embedded software needs revision 2.A2 or later, and the Spare Part Kit (03300-3001-000X) must be ordered.

The Rosemount 5300 transmitter head must be configured for remote housing to work.

The Spare Part Kit consists of:

- Remote connection
- Bracket kit
  - Bracket (1 pcs)
  - Clamping bracket (4 pcs)
  - U-bolt (2 pcs)
  - M6 screw (3 pcs)
  - M6 nut (4 pcs)

### Mount the bracket to the pole

Mount the bracket to the pole, making sure the distance between the probe and bracket does not exceed the length of the remote connection.

1. Put the two U-bolts through the holes of the bracket. Several holes are available for vertical/horizontal pipe mounting.
2. Put the clamping brackets on the U-bolts and around the pipe.

Use the supplied nuts to fasten the bracket to the pipe.

### Fasten the housing support to the bracket

Fasten the housing support to the bracket using the M6 screws. The screws are threaded through the top of the mounting bracket and into the housing support.

### Remove the transmitter head from the probe

Remove the transmitter head from the probe by unscrewing the M50 nut.

### Mount the probe housing on the probe

Mount the probe housing on the probe, making sure that the M50 nut is properly tightened.

### Connect the transmitter head on the housing support

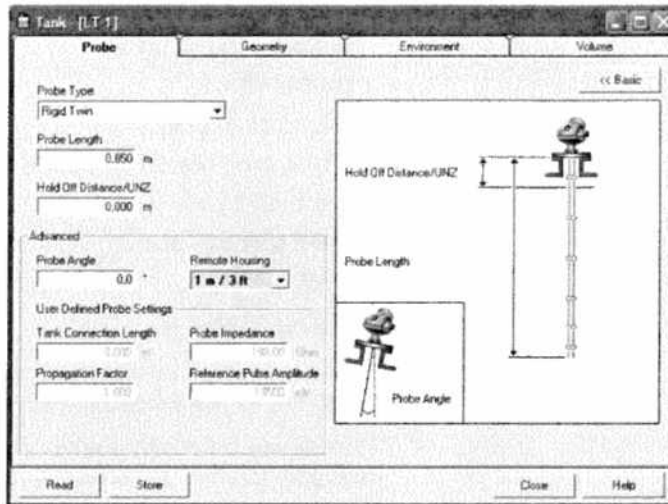
Connect the transmitter head on the housing support, making sure that the M50 nut is properly tightened.

# Rosemount 5300 Series

## REMOTE HOUSING CONFIGURATION

When using remote housing, the remote connection length should be configured. If the Remote Housing is ordered with a transmitter, it is configured in the factory.

In Rosemount Radar Master, select Setup > Tank.



Under the *Probe* tab, Remote Housing length can be selected. Click the Store button to save changes.

In the 375 Field Communicator, Remote Housing can be set with HART command [2, 3, 1, 4, 2].

### NOTE!

When disconnecting a remote housing cable from a probe in low temperatures, -22 °F (-30 °C), Radar Master may not show that the probe is missing.

## Appendix E Performing Proof Test

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Performing Proof Test .....	page E-1
375 Field Communicator .....	page E-1
Rosemount Radar Master (RRM) .....	page E-3
AMS Suite .....	page E-5

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### PERFORMING PROOF TEST

This test detects approximately 95% of the possible DU failures of the transmitter including the sensor element. Here is a description of how to perform the test using a 375 Field Communicator, Rosemount Radar Master (RRM), or AMS Suite. Note that the transmitter is not safety-rated during proof tests. Alternative means should be used to ensure process safety during such activities.

Required tools: HART host/communicator and a mA meter.

### 375 FIELD COMMUNICATOR

Prior to this test, inspect the echo curve to ensure that no disturbing echoes affecting the measurement performance are present.

**375 HART Sequence:** [2, 6, 1]

1. Bypass the safety PLC or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.

**375 HART Sequence:** [3, 2, 1, 2, 1]. Type the password.

3. Using loop test, enter the mA value representing the high alarm current. Verify that the analog output current is correct using the reference meter. *This step tests for compliance voltage problems, such as low power supply voltage or increased wiring resistance.*

**375 HART Sequence:** [2, 4, 1, 7]. Select **3 Other**. Enter the analog output level representing the high alarm current. Press **Enter** and click **OK**.

Verify that the analog output current is correct. Click **Abort** to end loop test.

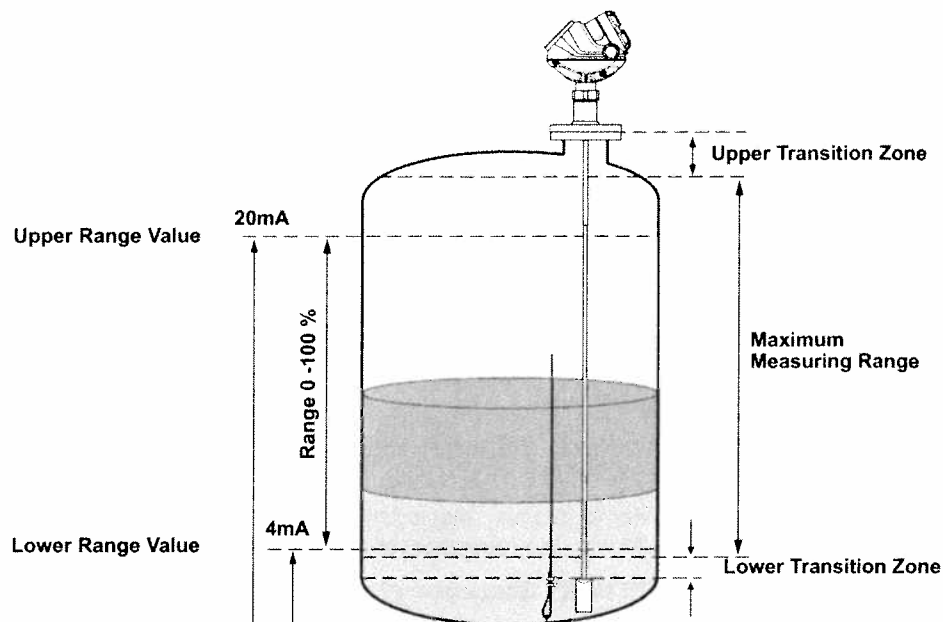
4. Using loop test, enter the mA value representing the low alarm current. Verify that the analog output current is correct using the reference meter. *This step tests for possible quiescent current related failures.*

**375 HART Sequence:** [2, 4, 1, 7]. Select **3 Other**. Enter the analog output level representing the low alarm current. Press **Enter** and click **OK**.

Verify that the analog output current is correct. Click **Abort** to end loop test. Verify that the Current output is restored to the original mode.



Figure E-1. Range Values.



5. Perform a two-point calibration check of the transmitter by applying level to two points on the probe within the measuring range. Verify that the current output corresponds to the level input values using a known reference measurement.

*This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.*

Note that the applied level has to be between the Upper and Lower Range values, otherwise the transmitter enters alarm mode. If the applied level is outside the Maximum Measuring Range, the level reading accuracy may be reduced. For best performance, use the 4-20 mA range points as calibration points. See Figure E-1.

6. Enable write protection.

**375 HART Sequence:** [3, 2, 1, 2, 1].

7. Restore the loop to full operation.
8. Remove the bypass from the safety PLC or otherwise restore normal operation.
9. Document the test results for future reference.

**ROSEMOUNT RADAR  
MASTER (RRM)**

Prior to this test, inspect the echo curve to ensure that no disturbing echoes affecting the measurement performance are present.

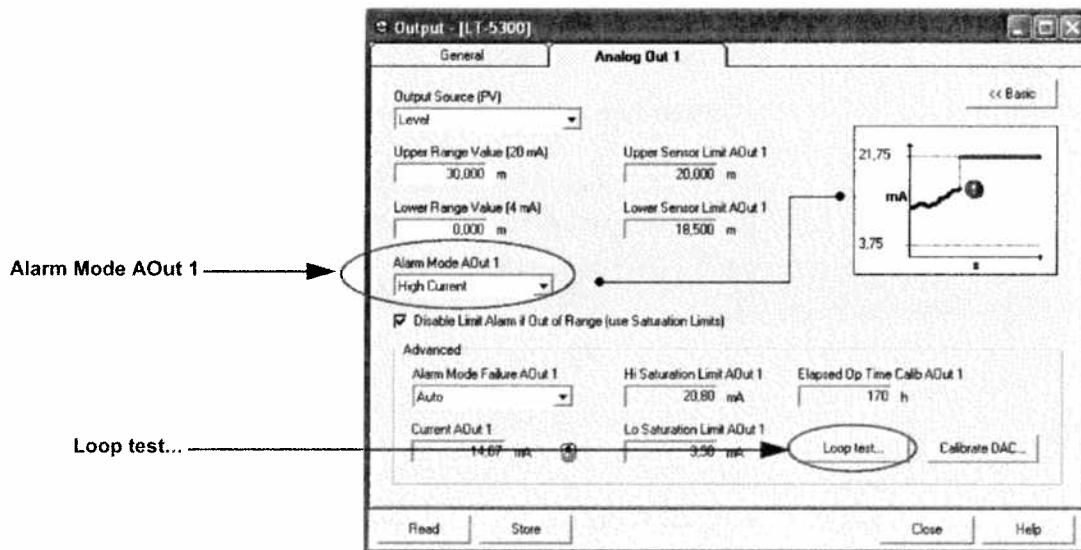
**RRM: Tools / Echo Curve**

1. Bypass the safety PLC or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.

**RRM:** Select **Tools, Lock / Unlock Configuration Area** from the menu. Type the password being used for this device and click **OK**.

3. Set Alarm mode to High Current. Using loop test, enter the mA value representing the high alarm current. Verify that the analog output current is correct using the reference meter.  
*This step tests for compliance voltage problems, such as low power supply voltage or increased wiring resistance.*

**RRM:** Select **Setup, Output** from the menu.



Make sure **Alarm Mode AOut 1** is set to High Current. Click Store to save changes. Click **Loop test...** and enter the **Current AOut 1** value representing the high alarm current. Click **Start** and verify that the output current is correct. Click **Stop** to end loop test.

4. Set Alarm mode to Low Current. Using loop test, enter the mA value representing the low alarm current. Verify that the analog output current is correct using the reference meter.  
*This step tests for possible quiescent current related failures.*

**RRM:** Set **Alarm Mode AOut 1** to Low Current. Click **Store** to save changes. Click **Loop test...** and enter the **Current AOut 1** value representing the low alarm current. Click **Start** and verify that the output current is correct. Click **Stop** to end loop test.

5. Restore the Alarm mode to the original mode used in the loop. Verify that the analog output current is correct.

**RRM:** Set **Alarm Mode AOut 1** to original mode. Click Store to save changes.

Verify that the output current is correct.

6. Perform a two-point calibration check of the transmitter by applying level to two points on the probe within the measuring range. Verify that the current output corresponds to the level input values using a known reference measurement.

*This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.*

Note that the applied level has to be between the Upper and Lower Range values, otherwise the transmitter enters alarm mode. If the applied level is outside the Maximum Measuring Range, the level reading accuracy may be reduced. For best performance, use the 4-20 mA range points as calibration points. See Figure E-1 on page E-2.

7. Enable write protection.

**RRM:** Select **Tools, Lock / Unlock Configuration Area** from the menu.

8. Restore the loop to full operation.
9. Remove the bypass from the safety PLC or otherwise restore normal operation.
10. Document the test results for future reference.

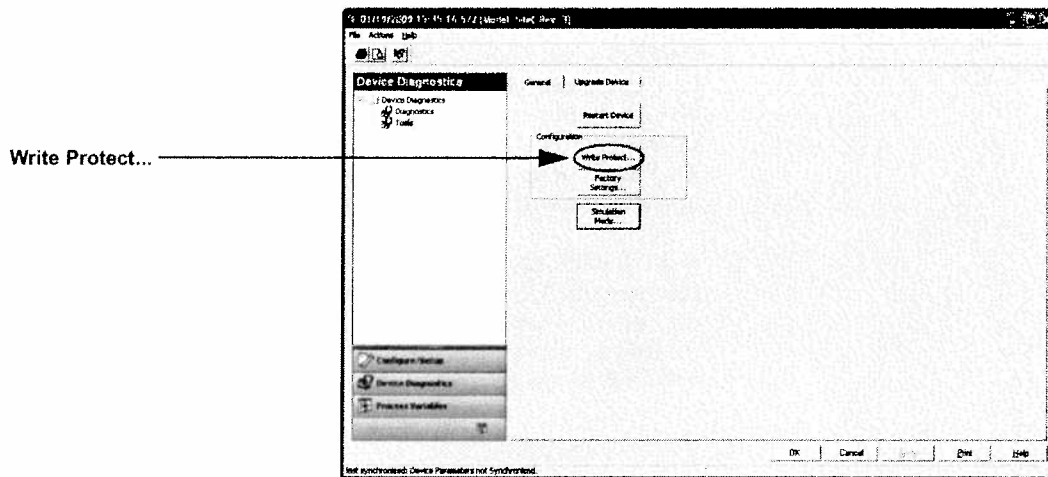
**AMS SUITE**

Prior to this test, inspect the echo curve to ensure that no disturbing echoes affecting the measurement performance are present.

**AMS: Click Configure / Setup / Echo Curve**

1. Bypass the safety PLC or take other appropriate actions to avoid false trip.
2. Disable write protection if the function is enabled.

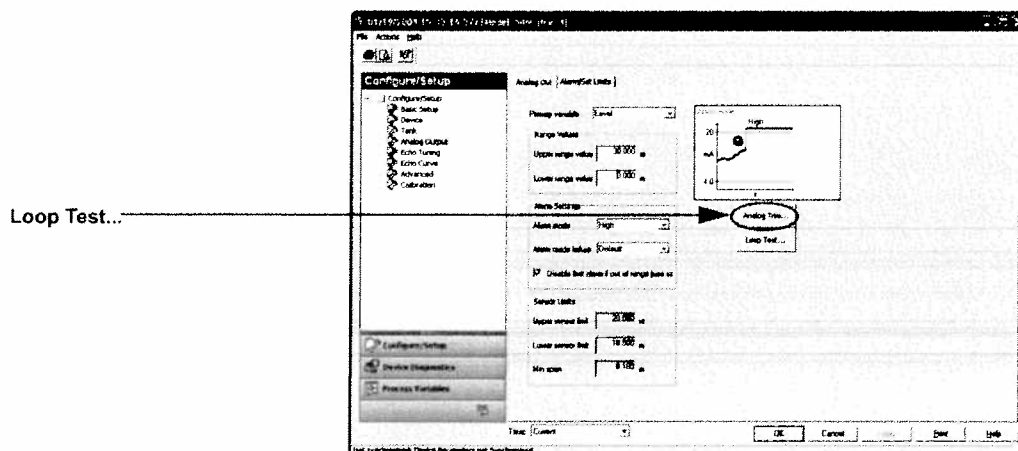
**AMS: Select Device Diagnostics / Tools from the left menu.**



Click **Write Protect...** and follow the instructions. (Note that the password cannot be written with letters.)

3. Using loop test, enter the mA value representing the high alarm current. Verify that the analog output current is correct using the reference meter. *This step tests for compliance voltage problems, such as low power supply voltage or increased wiring resistance.*

**AMS: Select Configure / Setup, Analog Output from the menu.**



Click **Loop Test...** Select **Other** and enter the mA value representing the high **Analog Output Level** and follow the instructions. Verify that the output current is correct.

- Using loop test, enter the mA value representing the low alarm mode. Verify that the analog output current is correct using the reference meter. *This step tests for possible quiescent current related failures.*

**AMS:** Select **Configure / Setup, Analog Output** from the menu. Click **Loop Test...** Select **Other** and enter the mA value representing the low **Analog Output Level** and follow the instructions. Click **OK** to save changes. Verify that the output current is correct. Select **End** to stop loop test. Verify that the Current output is restored to the original mode.

- Perform a two-point calibration check of the transmitter by applying level to two points on the probe within the measuring range. Verify that the current output corresponds to the level input values using a known reference measurement. *This step verifies that the analog output is correct in the operating range and that the Primary Variable is properly configured.*

Note that the applied level has to be between the Upper and Lower Range values, otherwise the transmitter enters alarm mode. If the applied level is outside the Maximum Measuring Range, the level reading accuracy may be reduced. For best performance, use the 4-20 mA range points as calibration points. See Figure E-1 on page E-2.

- Enable write protection.

**AMS:** Select **Device Diagnostics / Tools** from the menu, click **Write Protect...** and follow the instructions. (Note that the password cannot be written with letters.)

- Restore the loop to full operation.
- Remove the bypass from the safety PLC or otherwise restore normal operation.
- Document the test results for future reference.



# Appendix F Level Transducer Block

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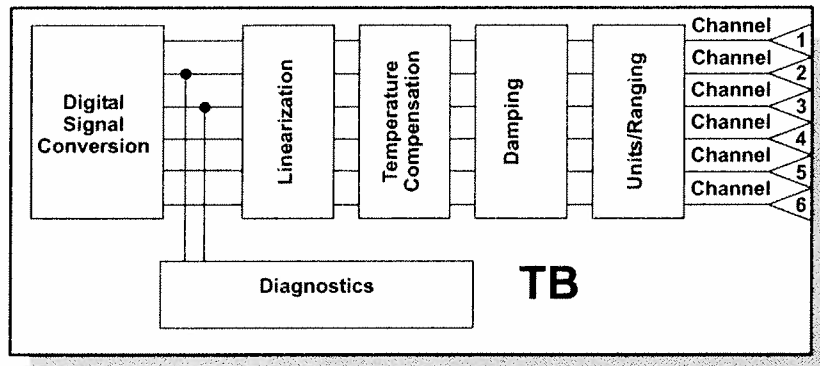
Overview .....	page F-1
Parameters and Descriptions .....	page F-2
Supported Units .....	page F-8
Diagnostics Device Errors .....	page F-9

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## OVERVIEW

This section contains information on the 5300 Level Transducer Block (TB). Descriptions of all Transducer Block parameters, errors, and diagnostics are listed.

Figure F-1. Transducer Block Diagram



## Definition

The transducer block contains the actual measurement data, including a level and distance reading. Channels 1–16 are assigned to these measurements (see Figure F-1). The transducer block includes information about sensor type, engineering units, and all parameters needed to configure the transmitter.

# Rosemount 5300 Series

## Channel Definitions

Each input has an assigned channel which can be linked to the AI block. The channels for the Rosemount 5300 Series are the following:

Table F-1. Channel Assignments

Channel Name	Channel Number	Process variable
Level	1	CHANNEL_RADAR_LEVEL
Ullage	2	CHANNEL_RADAR_ULLAGE
Level Rate	3	CHANNEL_RADAR_LEVELRATE
Signal Strength	4	CHANNEL_RADAR_SIGNAL_STRENGTH
Volume	5	CHANNEL_RADAR_VOLUME
Internal Temperature	6	CHANNEL_RADAR_INTERNAL_TEMPERATURE
Upper Product Volume	7	CHANNEL_UPPER_PRODUCT_VOLUME
Lower Product Volume	8	CHANNEL_LOWER_PRODUCT_VOLUME
Interface Distance	9	CHANNEL_INTERFACE_DISTANCE
Upper Product Thickness	10	CHANNEL_UPPER_PRODUCT_THICKNESS
Interface Level	11	CHANNEL_INTERFACE_LEVEL
Interface Level Rate	12	CHANNEL_INTERFACE_LEVELRATE
Interface Signal Strength	13	CHANNEL_INTERFACE_SIGNALSTRENGTH
Signal Quality	14	CHANNEL_SIGNAL_QUALITY
Surface/Noise Margin	15	CHANNEL_SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

## PARAMETERS AND DESCRIPTIONS

Table F-2. Level Transducer Block Parameters and Descriptions.

Parameter	Index Number	Description
ST_REV	1	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
TAG_DESC	2	The user description of the intended application of the block.
STRATEGY	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
MODE_BLK	5	The actual, target, permitted, and normal modes of the block. Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for target
BLOCK_ERR	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
UPDATE_EVT	7	This alert is generated by any change to the static data.

Parameter	Index Number	Description
BLOCK_ALM	8	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
TRANSDUCER_DIRECTORY	9	Directory that specifies the number and starting indices of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer.
XD_ERROR	11	A transducer block alarm subcode.
COLLECTION_DIRECTORY	12	A directory that specifies the number, starting indices, and DD Item ID's of the data collections in each transducer within a transducer block.
RADAR_LEVEL_TYPE	13	Not used
RADAR_LEVEL	14	Level
RADAR_LEVEL_RANGE	15	See Table J-4
RADAR_ULLAGE	16	Distance (Ullage)
RADAR_LEVELRATE	17	Level Rate
RADAR_LEVELRATE_RANGE	18	See Table J-5
RADAR_LEVEL_SIGNAL_STRENGTH	19	Signal strength
RADAR_LEVEL_SIGNAL_STRENGTH_RANGE	20	See Table J-7
RADAR_VOLUME	21	Volume
RADAR_VOLUME_RANGE	22	See Table J-8
RADAR_INTERNAL_TEMPERATURE	23	Internal Temperature
RADAR_INTERNAL_TEMPERATURE_RANGE	24	Range, unit and number of decimals
VOLUME_UPPER	25	The calculated volume value of the upper product at the current level and interface
VOLUME_LOWER	26	The calculated volume value of the lower product at the current interface
INTERFACE_DISTANCE	27	The distance to the interface (from the upper reference point).
UPPER_PRODUCT_THICKNESS	28	The thickness of the upper product (from the surface value to the interface value).
INTERFACE_LEVEL	29	The current interface level value (from the zero level reference point and up to the interface).
INTERFACE_LEVELRATE	30	The current velocity at which the interface is moving. A positive value indicates the interface is moving up.
INTERFACE_SIGNAL_STRENGTH	31	The current signal strength of the interface echo.
PROBE_TYPE	32	Select the type of probe that is mounted to this device. Use User Defined probe if your probe can not be found in the list or if you have done modifications to a standard probe.
PROBE_LENGTH	33	Enter the length of the probe measured from the device's upper reference point (normally the upper side of the tank flange) down to the probe end. If a weight is used it shall not be included in the length.
PROBE_ANGLE	34	Defines the angle compared to the plumb line at which the device with probe is mounted (0° means that probe is mounted vertically).
PROBE_END_PULSE_POLARITY	35	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
PROBE_IMPEDANCE	36	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information

Parameter	Index Number	Description
TCL	37	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
PROPAGATION_FACTOR	38	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
REF_PULSE_AMPL	39	This parameter is used for User Defined probes only. Please contact Emerson Process Management Service Department for more information
GEOM_TANK_HEIGHT	40	Tank Height (R)
GEOM_HOLD_OFF_DIST	41	Hold off distance
VAPOR_DC	42	Enter the dielectric constant for the vapor gas in the tank. For air at 20 degC and atmospheric pressure the vapor DC is close to 1, but for high pressure/high temperature applications the DC may increase and affect the accuracy of the measurement
UPPER_PRODUCT_DC	43	Enter the Upper Product Dielectric Constant (DC) as dielectric accurate as possible. This value affects the accuracy of the interface level measurement
LOWER_PRODUCT_DC_RANGE	44	Enter the range of the dielectric constant (DC) for the lower product in the tank. If you are uncertain about the value for this parameter or are changing product in the tank on a regular basis choose Unknown
PRODUCT_DIELEC_RANGE	45	Enter the range of the Product DC for the product in the tank. If you are uncertain about the value for this parameter or are changing product in the tank on a regular basis choose Unknown
MEAS_MODE	46	Select the Measurement Mode to use in the device. Some modes require software options to be enabled in the device. You can upgrade the device to enable more software options
DAMP_VALUE	47	Damping value
GEOM_OFFSET_DIST	48	Distance Offset
GEOM_CALIBRATION_DIST	49	Calibration Distance
LCD_SETTINGS	50	
LCD_PARAMETERS	51	Parameters to show
LCD_LANGUAGE	52	Language on display
LCD_LENGTH_UNIT	53	Length unit on display
LCD_VOLUME_UNIT	54	Volume unit on display
LCD_TEMPERATURE_UNIT	55	Temperature unit on display
LCD_VELOCITY_UNIT	56	Velocity unit on display
MAX_INTERNAL_TEMPERATURE	57	The maximum temperature that has been measured inside the device during operation
MIN_INTERNAL_TEMPERATURE	58	The minimum temperature that has been measured inside the device during operation
OPERATION TIME	59	The total number of hours the device has been in operation
ENV_ENVIRONMENT	60	Process Condition
ENV_PRESENTATION	61	Tank Presentation
ENV_DEVICE_MODE	62	Service mode
ENV_WRITE_PROTECT	63	Write protect
DIAGN_DEVICE_ALERT	64	Errors, Warnings, Status, Plant web alerts
DIAGN_VERSION	65	Gauge SW version
DIAGN_REVISION	66	P1451 revision
DIAGN_DEVICE_ID	67	Device ID for the gauge.
DIAGN_DEVICE_MODEL	68	Type of 5300. LF or HF
STATS_ATTEMPTS	69	The total number of messages sent to the transducer A/D board
STATS_FAILURES	70	The total number of failed A/D board message attempts

Parameter	Index Number	Description
STATS_TIMEOUTS	71	The total number of timed out A/D board message attempts
MAX_UPPER_PRODUCT_THICKNESS	72	This is the maximum thickness of the upper product that the device is able to measure through. If the thickness of the upper product is larger than this value, the device will not be able to locate the interface echo
MEAS_STATUS	73	
INTERFACE_STATUS	74	
REMOTE_HOUSING	75	
MEAS_VAPOR_DC	76	Measured Vapor Dielectric Constant
SPEC_CONFIG_TNZ	77	Configure Trim Near Zone
SPEC_CONFIG_PEP	78	Configure Probe End Projection
SPEC_CONFIG_TANK_MATERIAL	79	Configure Tank Material
SPEC_CONFIG_VC	80	Configure Vapor Compensation
VC_WARNING	81	Vapor Compensation Warning
PEP_STATUS	82	Probe End Projection Status
TANK_MATERIAL	83	
SW_SUPPORT2	84	Defines what options are enabled in the device.
MOUNTING_TYPE	85	
PIPE_DIAMETER	86	
NOZZLE_HEIGHT	87	
DEVICE_HW_CONFIG	88	
DEVICE_STATUS	89	
VOLUME_STATUS	90	
MWM_WARNING	91	
MEAS_WARNING	92	
CONFIG_WARNING	93	
VAPOR_COMP_STATUS	94	Vapor Compensation Status

Table F-3. Probe Type

VALUE	PROBE_TYPE
0	User defined
1	Rigid Twin
2	Flexible Twin
3	Coaxial
4	Rigid Single 0.3 in. (8 mm)
5	Flexible Single
10	Coaxial HTHP
11	Coaxial HP/C
12	Rigid Single HTHP/HP 0.3 in. (8 mm)
13	Flexible Single HTHP
20	Rigid Single PTFE
21	Flexible Single PTFE
30	Rigid Single HP/C 0.3 in. (8 mm)
31	Flexible Single HP
32	Flexible Single PA
33	Rigid Single 0.5 in. (13 mm)
40	Rigid Single HTHP 0.5 in. (13 mm)
41	Rigid Single HP/C 0.5 in. (13 mm)

Table F-4. Device Mode

VALUE	ENV_DEVICE_MODE
0	Normal operation
1	Spare
2	Restart device
3	Set to factory default database
4	Trim Near Zone

Table F-5. Environment

Bit Number	Value of ENV_ENVIRONMENT	Description
2	0x00000004	Turbulent
3	0x00000008	Foam
28	0x10000000	Rapid Changes

Table F-6. Presentation

Bit Number	Value of ENV_PRESENTATION	Description
28	0x10000000	Do Not Use Full Tank State
2	0x00000002	Use 3300 Full and Empty Detect Areas
3	0x00000004	Disable PEP PE Sign Change Logic
8	0x00000100	Show Negative Level as Zero
10	0x00000400	Probe End Projection
11	0x00000800	Do Not Use Automatic PEP DC Estimation
12	0x00001000	Do Not Reject Possible Double Bounces
18	0x00040000	Use Jump Filter
22	0x00400000	Show Level below Probe End as Zero
23	0x00800000	Use Vapor Compensation
24	0x01000000	Calculate Signal Quality Metrics

Table F-7. LCD Parameters

Bit Number	Value of LCD_PARAMETERS	Description
28	0x10000000	Level
1	0x00000002	Distance
2	0x00000004	Level Rate
3	0x00000008	Signal Strength
4	0x00000010	Volume
5	0x00000020	Internal Temperature
6	0x00000040	Analog Out Current
7	0x00000080	Percent Of Range
8	0x00000100	Com Quality
9	0x00000200	Interface Level
10	0x00000400	Interface Distance
11	0x00000800	Interface Level Rate
12	0x00001000	Interface Signal Strength
13	0x00002000	Upper Product Thickness
14	0x00004000	Lower Volume
15	0x00008000	Upper Volume

Bit Number	Value of LCD_PARAMETERS	Description
16	0x00010000	Signal Quality
17	0x00020000	Surface Noise Margin
18	0x00040000	Vapor DC

Table F-8. Product Dielectrical Range

VALUE	ENV_DIELECTR_CONST
0	1.4 - 1.9 (e.g. liquified gas, plastics)
1	1.9-2.5 (e.g. Oil Based)
2	2.5-4 (e.g. Oil Based)
3	4-10 (e.g. Alcohol, Acids)
4	>10 (e.g. Waterbased)
5	Unknown

Table F-9. Measurement Mode

VALUE	MEAS_MODE
0	Liquid Product Level
1	Product Level and Interface Level
2	Solid Product Level
3	Interface Level with Submerged Probe

## SUPPORTED UNITS

### Unit Codes

Table F-10. Length

Value	Display	Description
1010	m	meter
1012	cm	centimeter
1013	mm	millimeter
1018	ft	feet
1019	in	inch

Table F-11. Level Rate

Value	Display	Description
1061	m/s	meter per second
1063	m/h	meter per hour
1067	ft/s	feet per second
1069	in/m	inch per minute

Table F-12. Temperature

Value	Display	Description
1001	°C	Degree Celsius
1002	°F	Degree Fahrenheit

Table F-13. Signal Strength

Value	Display	Description
1243	mV	millivolt

Table F-14. Volume

Value	Display	Description
1034	m <sup>3</sup>	Cubic meter
1038	L	Liter
1042	in <sup>3</sup>	Cubic inch
1043	ft <sup>3</sup>	Cubic feet
1044	Yd <sup>3</sup>	Cubic yard
1048	Gallon	US gallon
1049	ImpGall	Imperial gallon
1051	Bbl	Barrel

Table F-15. Time

Value	Display	Description
1054	s	Second

Table F-16. Percent

Value	Display	Description
1342	%	Percent



**DIAGNOSTICS DEVICE ERRORS**

In addition to the BLOCK\_ERR and XD\_ERROR parameters, more detailed information on the measurement status can be obtained via DIAGN\_DEV\_ALERT. Table F-17 lists the potential errors and the possible corrective actions for the given values. The corrective actions are in order of increasing system level compromises. The first step should always be to reset the gauge and then if the error persists, try the steps in Table F-17. Start with the first corrective action and then try the second.

Table F-17. Device Errors Diagnostics

Bit Number	Value of DIAGN_DEV_ALERT	Description	Corrective action
	0	No alarm active	
0	0x00000001	Reserved	
1	0x00000002	FF card to gauge comm fault	Replace gauge
2	0x00000004	Level Measurement Failure	Verify device installation and configuration
3	0x00000008	Temperature Measurement Failure	Check ambient temperature. If ambient temperature ok replace the device.
4	0x00000010	Volume measurement failure	Check volume configuration
5	0x00000020	Database Error	Load default database to the device and reconfigure the device
6	0x00000040	HW Error	Replace device
7	0x00000080	Microwave Unit Error	Replace device
8	0x00000100	Configuration Error	Load default database to the device and reconfigure the device
9	0x00000200	SW Error	Replace device
10	0x00000400	Invalid Strap Table	Check the Strapping Table configuration
11	0x00000800	Internal Temp Warning	Check ambient temperature at installation site
12	0x00001000	Database Warning	Check the device configuration
13	0x00002000	HW Warning	Check device installation and configuration
14	0x00004000	Microwave Unit Warning	Check device installation and configuration
15	0x00008000	Configuration Warning	Check the device configuration
16	0x00010000	SW Warning	Check device installation and configuration
17	0x00020000	Simulation Mode	Use Simulation Method under advanced configuration tool to get the device out of Simulation Mode
18	0x00040000	Volume Range Warning	Verify Strapping Table
19	0x00080000	Software Write Protected	
20	0x00100000	Vapor Compensation Not Calibrated	
21	0x00200000	Vapor DC Estimation Limited	
22	0x00400000	Reference Reflector Not Found	
23	0x00800000	BaseLine too low	
24	0x01000000	BaseLine too high	
25	0x02000000	Gain control	
26	0x04000000	Unsupported Combination of Functions	
27	0x08000000		
28	0x10000000		
29	0x20000000	Probe Missing	Check probe connection
30	0x40000000	Interface Measurement Failure	Check interface measurement configuration
31	0x80000000	Hardware Write Protected	

# Rosemount 5300 Series

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**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

# Appendix G Register Transducer Block

## OVERVIEW

The Register Transducer Block allows access to Database registers and Input registers of the Rosemount 5300 transmitter. This makes it possible to read a selected set of register directly by accessing the memory location.

The Register Transducer Block is only available with advanced service.

⚠ CAUTION
<p>Since this Register Transducer Block allows access to most registers in the transmitter, which includes the registers set by the Methods and Configuration screens, in the Level Transducer Block (see <i>Appendix F: Level Transducer Block</i>) it should be handled with care and ONLY to be changed by trained and certified service personnel, or as guided by Emerson Process Management, Rosemount Division support personnel.</p>

## Register Access Transducer Block Parameters

Table G-1. Register Access Transducer Block Parameters

Parameter	Index Number	Description
ST_REV	1	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
TAG_DESC	2	The user description of the intended application of the block.
STRATEGY	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
MODE_BLK	5	The actual, target, permitted, and normal modes of the block. Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for target
BLOCK_ERR	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
UPDATE_EVT	7	This alert is generated by any change to the static data.
BLOCK_ALM	8	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
TRANSDUCER_DIRECTORY	9	Directory that specifies the number and starting indices of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer.

Parameter	Index Number	Description
XD_ERROR	11	A transducer block alarm subcode.
COLLECTION_DIRECTORY	12	
INP_SEARCH_START_NBR	13	Search start number for input registers
DB_SEARCH_START_NBR	14	Search start number for holding registers
INP_REG_1_TYPE	15	Register type
INP_REG_1_FLOAT	16	If the register contains a float value, it should be displayed here
INP_REG_1_INT_DEC	17	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_2_TYPE	18	Register type
INP_REG_2_FLOAT	19	If the register contains a float value, it should be displayed here
INP_REG_2_INT_DEC	20	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_3_TYPE	21	Register type
INP_REG_3_FLOAT	22	If the register contains a float value, it should be displayed here
INP_REG_3_INT_DEC	23	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_4_TYPE	24	Register type
INP_REG_4_FLOAT	25	If the register contains a float value, it should be displayed here
INP_REG_4_INT_DEC	26	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_5_TYPE	27	Register type
INP_REG_5_FLOAT	28	If the register contains a float value, it should be displayed here
INP_REG_5_INT_DEC	29	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_6_TYPE	30	Register type
INP_REG_6_FLOAT	31	If the register contains a float value, it should be displayed here
INP_REG_6_INT_DEC	32	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_7_TYPE	33	Register type
INP_REG_7_FLOAT	34	If the register contains a float value, it should be displayed here
INP_REG_7_INT_DEC	35	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_8_TYPE	36	Register type
INP_REG_8_FLOAT	37	If the register contains a float value, it should be displayed here
INP_REG_8_INT_DEC	38	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_9_TYPE	39	Register type
INP_REG_9_FLOAT	40	If the register contains a float value, it should be displayed here
INP_REG_9_INT_DEC	41	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
INP_REG_10_TYPE	42	Register type
INP_REG_10_FLOAT	43	If the register contains a float value, it should be displayed here
INP_REG_10_INT_DEC	44	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_1_TYPE	45	Register type
DB_REG_1_FLOAT	46	If the register contains a float value, it should be displayed here
DB_REG_1_INT_DEC	47	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_2_TYPE	48	Register type

Parameter	Index Number	Description
DB_REG_2_FLOAT	49	If the register contains a float value, it should be displayed here
DB_REG_2_INT_DEC	50	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_3_TYPE	51	Register type
DB_REG_3_FLOAT	52	If the register contains a float value, it should be displayed here
DB_REG_3_INT_DEC	53	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_4_TYPE	54	Register type
DB_REG_4_FLOAT	55	If the register contains a float value, it should be displayed here
DB_REG_4_INT_DEC	56	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_5_TYPE	57	Register type
DB_REG_5_FLOAT	58	If the register contains a float value, it should be displayed here
DB_REG_5_INT_DEC	59	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_6_TYPE	60	Register type
DB_REG_6_FLOAT	61	If the register contains a float value, it should be displayed here
DB_REG_6_INT_DEC	62	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_7_TYPE	63	Register type
DB_REG_7_FLOAT	64	If the register contains a float value, it should be displayed here
DB_REG_7_INT_DEC	65	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_8_TYPE	66	Register type
DB_REG_8_FLOAT	67	If the register contains a float value, it should be displayed here
DB_REG_8_INT_DEC	68	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_9_TYPE	69	Register type
DB_REG_9_FLOAT	70	If the register contains a float value, it should be displayed here
DB_REG_9_INT_DEC	71	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
DB_REG_10_TYPE	72	Register type
DB_REG_10_FLOAT	73	If the register contains a float value, it should be displayed here
DB_REG_10_INT_DEC	74	If the register contains a DWORD value, and <i>dec</i> is chosen, it should be displayed here
RM_COMMAND	75	Used to set what will be read or write from a secondary master.
RM_DATA	76	Data read/write from secondary master.
RM_STATUS	77	Status read by a secondary master.

# Rosemount 5300 Series

**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

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# Appendix H      Advanced Configuration Transducer Block

## OVERVIEW

The Advanced Configuration Transducer Block contains functions for the advanced configuration of the Rosemount 5300 transmitter. It includes functions, such as amplitude threshold settings for filtering of disturbing echoes and noise, simulation of measurement values, Empty Tank Handling for optimizing measurements close to the tank bottom, and strapping table for volume measurements.

## Advanced Configuration Transducer Block Parameters

Table H-1. Advanced Configuration Transducer Block Parameters

Parameter	Index Number	Description
ST_REV	1	The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed.
TAG_DESC	2	The user description of the intended application of the block.
STRATEGY	3	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ALERT_KEY	4	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
MODE_BLK	5	The actual, target, permitted, and normal modes of the block. Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for target
BLOCK_ERR	6	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
UPDATE_EVT	7	This alert is generated by any change to the static data.
BLOCK_ALM	8	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
TRANSDUCER_DIRECTORY	9	Directory that specifies the number and starting indices of the transducers in the transducer block.
TRANSDUCER_TYPE	10	Identifies the transducer. 100 = Standard pressure with calibration
XD_ERROR	11	A transducer block alarm subcode.
COLLECTION_DIRECTORY	12	

Parameter	Index Number	Description
AMPLITUDE_THRESHOLD_CURVE	13	ATC: filters out weak disturbance echoes and noise.
SIMULATION_MODE	14	Simulation of measurement values.
SET_CONSTANT_THRESHOLD	15	A constant amplitude threshold can be used to filter out noise.
RADAR_LEVEL_RANGE	16	
RADAR_LEVEL_SIGNAL_STRENGTH H_RANGE	17	
RADAR_VOLUME_RANGE	18	
ENV_PRESENTATION	19	
PROBE_END_THRESH	20	This threshold is used to locate the probe end echo. The probe end echo is used by the device to know when the tank is empty, but is sometimes also useful when no surface echo can be found.
REFERENCE_THRESH	21	This threshold is used to locate the reference echo.
INTERFACE_THRESH	22	This threshold is used to block out disturbing echoes and noise when locating the interface echo.
FULL_TANK_THRESH_OFFSET	23	By adding an offset to the Reference Threshold it is possible for the device to determine when the tank is full. If the reference echo amplitude is between the Reference Threshold and the Full Tank Threshold then the tank is considered full.
PEP_PRODUCT_DC	24	Enter the product dielectric constant for the product in the tank.
AUTO_CONF_MEAS_FUNC	25	
ECHO_TIME_OUT	26	Change this parameter to define the time in seconds before the device should start to search for a surface echo after it has been lost.
CLOSE_DIST	27	This parameter defines a window centered at the current surface position where new surface echo candidates can be selected. The size of the window is +/-Close Distance. Echoes outside this window will not be considered as surface echoes.
USED_PROBE_END_THRESH	28	Probe End Threshold currently used in the device.
USED_REFERENCE_THRESH	29	Reference Threshold currently used in the device.
USED_INTERFACE_THRESH	30	Interface Threshold currently used in the device.
USED_TANK_PRESENTATION	31	
USED_ECHO_TIME_OUT	32	Echo Timeout currently used in the device.
USED_CLOSE_DIST	33	Close Distance currently used in the device.
SW_SUPPORT2	34	Defines what options are enabled in the device.
USED_HOLD_OFF_DIST	35	The upper null zone distance currently used in the device.
USED_PEP_PRODUCT_DC	36	Product Dielectric currently used in the device.
START_CODE	37	This code determines what options are available in your device. Do not change your Start Code unless you have received a valid one. Use Enter Start Codes method to change it.
UNIT_CODE	38	Unit code 1 -4 can be sent to your local Emerson representative in order to receive new Start Codes for upgrading your device.
ENV_SET_START_CODE	39	Set Start Code
PROBE_END_ANCHORING	40	
PEP_PROBE_END_OFFSET	41	
USED_PEP_PROBE_END_OFFSET	42	
VOL_VOLUME_CALC_METHOD	43	Choose what kind of volume calculation method to use.
VOL_IDEAL_DIAMETER	44	Diameter of the tank (only for ideal tank shapes).
VOL_IDEAL_LENGTH	45	Length/height of the tank (only for ideal tank shapes).



Parameter	Index Number	Description
VOL_VOLUME_OFFSET	46	Use this parameter to add a volume to each calculated volume value. The volume can for instance correspond to a sump volume that you wish to add to your calculation.
VOL_STRAP_TABLE_LENGTH	47	Number of points to use in the strapping table.
VOL_STRAP_LEVEL	48	Strap value level 1-20 points
VOL_STRAP_VOLUME	49	Strap value volume 1-20 points
ECHO_REG	50	Read Echo distance, amplitude and class from gauge. The Echo Distance is the distance from the reference echo to the target echo calculated by the radar from the plot and gauge configuration.
ECHO_WRITE	51	Echo Found/False Record
PEP_STATUS	52	Probe End Projection Status
PEP_PRODUCT_DC_LIMIT	53	Probe End Projection Dielectric Constant Limit
PROBE_END_PULSE_POLARITY	54	
USED_MAX_VAPOR_DC	55	
REF_REFLECTOR_TYPE	56	Reference Reflector Type
VAPOR_DC_FILTER_FACTOR	57	Vapor Dielectric Constant Filter Factor
SIGNAL_QUALITY	58	
MIN_SIGNAL_QUALITY	59	
MAX_SIGNAL_QUALITY	60	
TIME_SINCE_LAST_RESET	61	
SURFACE_NOISE_MARGIN	62	Surface/Noise Margin
MIN_SURFACE_NOISE_MARGIN	63	Minimum Surface/Noise Margin
MAX_SURFACE_NOISE_MARGIN	64	Maximum Surface/Noise Margin
VAPOR_COMP_STATUS	65	Vapor Compensation Status
DEVICE_COMMAND	66	
DEVICE_COMMAND_STATUS	67	
RADAR_INTERNAL_TEMPERATURE_RANGE	68	
MAX_PRESSURE	69	
MAX_TEMPERATURE	70	
MAX_VAPOR_DC	71	Maximum Vapor Dielectric Constant
MEAS_STATUS	72	Measurement Status
CENTERING_DISC	73	
PEP_TRIM_EMPTY_FAILURE	74	Probe End Projection - Trim Empty Failure
PEP_TRIM_FILL_FAILURE	75	Probe End Projection - Fill Failure
PEP_RAW_PRODUCT_DC_EST	76	Probe End Projection - Raw Product Dielectric Constant Estimation
PEP_RAW_DC_EST_USED_DISTANCE	77	
USE_PROBE_END_PROJECTION	78	
USE_STATIC_PRODUCT_DC	79	Use Static Product Dielectric Constant
CALCULATE_SIGNAL_QUALITY_METRICS	80	
USE_VAPOR_COMPENSATION	81	
SPEC_CONFIG_PEP	82	Configure Probe End Projection
SPEC_CONFIG_VC	83	Configure Vapor Compensation

# Rosemount 5300 Series

**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

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# Appendix I Resource Transducer Block

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**Overview** ..... page I-1  
**Parameters and Descriptions** ..... page I-1

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## OVERVIEW

This section contains information on the Rosemount 5300 Series Radar Level Transmitter Resource Block. Descriptions of all Resource Block Parameters, errors, and diagnostics are included. Also the modes, alarm detection, status handling, and troubleshooting are discussed.

### Definition

The resource block defines the physical resources of the device. The resource block also handles functionality that is common across multiple blocks. The block has no linkable inputs or outputs.

## PARAMETERS AND DESCRIPTIONS

The table below lists all the configurable parameters of the Resource Block, including the descriptions and index numbers for each.

Parameter	Index Number	Description
ACK_OPTION	38	Selection of whether alarms associated with the function block will be automatically acknowledged.
ADVISE_ACTIVE	82	Enumerated list of advisory conditions within a device.
ADVISE_ALM	83	Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.
ADVISE_ENABLE	80	Enabled ADVISE_ALM alarm conditions. Corresponds bit for bit to the ADVISE_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
ADVISE_MASK	81	Mask of ADVISE_ALM. Corresponds bit of bit to ADVISE_ACTIVE. A bit on means that the condition is masked out from alarming.
ADVISE_PRI	79	Designates the alarming priority of the ADVISE_ALM
ALARM_SUM	37	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
ALERT_KEY	04	The identification number of the plant unit.
BLOCK_ALM	36	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CLR_FSTATE	30	Writing a Clear to this parameter will clear the device FAIL_SAFE if the field condition has cleared.
CONFIRM_TIME	33	The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0.
CYCLE_SEL	20	Used to select the block execution method for this resource. The Rosemount 5300 supports the following: Scheduled: Blocks are only executed based on the function block schedule. Block Execution: A block may be executed by linking to another blocks completion.

# Rosemount 5300 Series

Parameter	Index Number	Description
CYCLE_TYPE	19	Identifies the block execution methods available for this resource.
DD_RESOURCE	09	String identifying the tag of the resource which contains the Device Description for this resource.
DD_REV	13	Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource.
DEFINE_WRITE_LOCK	60	Allows the operator to select how WRITE_LOCK behaves. The initial value is "lock everything". If the value is set to "lock only physical device" then the resource and transducer blocks of the device will be locked but changes to function blocks will be allowed.
DETAILED_STATUS	55	Indicates the state of the transmitter. See Resource Block detailed status codes.
DEV_REV	12	Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource.
DEV_STRING	43	This is used to load new licensing into the device. The value can be written but will always read back with a value of 0.
DEV_TYPE	11	Manufacturer's model number associated with the resource - used by interface devices to locate the DD file for the resource.
DIAG_OPTION	46	Indicates which diagnostics licensing options are enabled.
DISTRIBUTOR	42	Reserved for use as distributor ID. No Foundation enumerations defined at this time.
DOWNLOAD_MODE	67	Gives access to the boot block code for over-the-wire downloads. 0 = Uninitialized 1 = Run mode 2 = Download mode
FAULT_STATE	28	Condition set by loss of communication to an output block, fault promoted to an output block or physical contact. When FAIL_SAFE condition is set, then output function blocks will perform their FAIL_SAFE actions.
FAILED_ACTIVE	72	Enumerated list of failure conditions within a device.
FAILED_ALM	73	Alarm indicating a failure within a device which makes the device non-operational.
FAILED_ENABLE	70	Enabled FAILED_ALM alarm conditions. Corresponds bit for bit to the FAILED_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
FAILED_MASK	71	Mask of FAILED_ALM. Corresponds bit of bit to FAILED_ACTIVE. A bit on means that the condition is masked out from alarming.
FAILED_PRI	69	Designates the alarming priority of the FAILED_ALM.
FB_OPTION	45	Indicates which function block licensing options are enabled.
FEATURES	17	Used to show supported resource block options. The supported features are: SOFT_WRITE_LOCK_SUPPORT, HARD_WRITE_LOCK_SUPPORT, REPORTS, and UNICODE
FEATURES_SEL	18	Used to select resource block options.
FINAL_ASSY_NUM	54	The same final assembly number placed on the neck label.
FREE_SPACE	24	Percent of memory available for further configuration. Zero in a preconfigured device.
FREE_TIME	25	Percent of the block processing time that is free to process additional blocks.
GRANT_DENY	14	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HARD_TYPES	15	The types of hardware available as channel numbers.
HARDWARE_REV	52	Hardware revision of the hardware that has the resource block in it.
HEALTH_INDEX	84	Parameter representing the overall health of the device, 100 being perfect and 1 being non-functioning. The value is based on the active PWA alarms.
ITK_VER	41	Major revision number of the inter operability test case used in certifying this device as interoperable. The format and range are controlled by the Fieldbus Foundation.
LIM_NOTIFY	32	Maximum number of unconfirmed alert notify messages allowed.
MAINT_ACTIVE	77	Enumerated list of maintenance conditions within a device.

Parameter	Index Number	Description
MAINT_ALM	78	Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail.
MAINT_ENABLE	75	Enabled MAINT_ALM alarm conditions. Corresponds bit for bit to the MAINT_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected.
MAINT_MASK	76	Mask of MAINT_ALM. Corresponds bit of bit to MAINT_ACTIVE. A bit on means that the condition is masked out from alarming.
MAINT_PRI	74	Designates the alarming priority of the MAINT_ALM
MANUFAC_ID	10	Manufacturer identification number – used by an interface device to locate the DD file for the resource.
MAX_NOTIFY	31	Maximum number of unconfirmed notify messages possible.
MEMORY_SIZE	22	Available configuration memory in the empty resource. To be checked before attempting a download.
MESSAGE_DATE	57	Date associated with the MESSAGE_TEXT parameter.
MESSAGE_TEXT	58	Used to indicate changes made by the user to the device's installation, configuration, or calibration.
MIN_CYCLE_T	21	Time duration of the shortest cycle interval of which the resource is capable.
MISC_OPTION	47	Indicates which miscellaneous licensing options are enabled.
MODE_BLK	05	The actual, target, permitted, and normal modes of the block: Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for actual
NV_CYCLE_T	23	Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_T, only those parameters which have changed need to be updated in NVRAM.
OUTPUT_BOARD_SN	53	Output board serial number.
PWA_SIMULATE	85	Parameter allowing simulation of PWA alarms.
RB_SFTWR_REV_ALL	51	The string will contains the following fields: Major rev: 1-3 characters, decimal number 0-255 Minor rev: 1-3 characters, decimal number 0-255 Build rev: 1-5 characters, decimal number 0-255 Time of build: 8 characters, xx:xx:xx, military time Day of week of build: 3 characters, Sun, Mon,... Month of build: 3 characters, Jan, Feb. Day of month of build: 1-2 characters, decimal number 1-31 Year of build: 4 characters, decimal Builder: 7 characters, login name of builder
RB_SFTWR_REV_BUILD	50	Build of software that the resource block was created with.
RB_SFTWR_REV_MAJOR	48	Major revision of software that the resource block was created with.
RB_SFTWR_REV_MINOR	49	Minor revision of software that the resource block was created with.
RECOMMENDED_ACTION	68	Enumerated list of recommended actions displayed with a device alert.
RESTART	16	Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following: 1 Run – nominal state when not restarting 2 Restart resource – not used 3 Restart with defaults – set parameters to default values. See START_WITH_DEFAULTS below for which parameters are set. 4 Restart processor – does a warm start of CPU.
RS_STATE	07	State of the function block application state machine.
SAVE_CONFIG_BLOCKS	62	Number of EEPROM blocks that have been modified since last burn. This value will count down to zero when the configuration is saved.

# Rosemount 5300 Series

Parameter	Index Number	Description
SAVE_CONFIG_NOW	61	Allows the user to optionally save all non-volatile information immediately.
SECURITY_IO	65	Status of security switch.
SELF_TEST	59	Instructs resource block to perform self-test. Tests are device specific.
SET_FSTATE	29	Allows the FAIL_SAFE condition to be manually initiated by selecting Set.
SHED_RCAS	26	Time duration at which to give up on computer writes to function block RCas locations. Shed from RCas shall never happen when SHED_ROUT = 0
SHED_ROUT	27	Time duration at which to give up on computer writes to function block ROut locations. Shed from ROut shall never happen when SHED_ROUT = 0
SIMULATE_IO	64	Status of simulate switch.
SIMULATE_STATE	66	The state of the simulate switch: 0 = Uninitialized 1 = Switch off, simulation not allowed 2 = Switch on, simulation not allowed (need to cycle jumper/switch) 3 = Switch on, simulation allowed
ST_REV	01	The revision level of the static data associated with the function block.
START_WITH_DEFAULTS	63	0 = Uninitialized 1 = do not power-up with NV defaults 2 = power-up with default node address 3 = power-up with default pd_tag and node address 4 = power-up with default data for the entire communications stack (no application data)
STRATEGY	03	The strategy field can be used to identify grouping of blocks.
SUMMARY_STATUS	56	An enumerated value of repair analysis.
TAG_DESC	02	The user description of the intended application of the block.
TEST_RW	08	Read/write test parameter - used only for conformance testing.
UPDATE_EVT	35	This alert is generated by any change to the static data.
WRITE_ALM	40	This alert is generated if the write lock parameter is cleared.
WRITE_LOCK	34	When hardware write protection is selected, WRITE_LOCK becomes an indicator of the jumper setting and is unavailable for software write protection. When software write lock is selected, and WRITE_LOCK is set, no writings from anywhere else are allowed, except to clear WRITE_LOCK. Block input will continue to be updated.
WRITE_PRI	39	Priority of the alarm generated by clearing the write lock.
XD_OPTION	44	Indicates which transducer block licensing options are enabled.

## PlantWeb™ Alerts

The Resource Block will act as a coordinator for PlantWeb alerts. There will be three alarm parameters (FAILED\_ALARM, MAINT\_ALARM, and ADVISE\_ALARM) which will contain information regarding some of the device errors which are detected by the transmitter software. There will be a RECOMMENDED\_ACTION parameter which will be used to display the recommended action text for the highest priority alarm, and a HEALTH\_INDEX parameter (0 - 100) indicating the overall health of the transmitter. FAILED\_ALARM will have the highest priority followed by MAINT\_ALARM, and ADVISE\_ALARM will be the lowest priority.

### FAILED\_ALARMS

A failure alarm indicates a failure within a device that will make the device or some part of the device non-operational. This implies that the device is in need of repair and must be fixed immediately. There are five parameters associated with FAILED\_ALARMS specifically, they are described below.

#### *FAILED\_ENABLED*

This parameter contains a list of failures in the device which makes the device non-operational that will cause an alert to be sent. Below is a list of the failures:

1. Level / Interface Measurement Failure
2. Volume / Temperature Measurement Failure
3. Electronics Failure / Transducer Block
4. Probe Missing
5. Input / Output Failure
6. Non-Volatile Memory Failure
7. Electronics Failure / Output Board

#### *Software Incompatibility Error FAILED\_MASK*

This parameter will mask any of the failed conditions listed in FAILED\_ENABLED. A bit on means that the condition is masked out from alarming and will not be reported.

#### *FAILED\_PRI*

Designates the alerting priority of the FAILED\_ALM, see "Alarm Priority" on page I-7. The default is 0 and the recommended values are between 8 and 15.

#### *FAILED\_ACTIVE*

This parameter displays which of the alarms is active. Only the alarm with the highest priority will be displayed. This priority is not the same as the FAILED\_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

#### *FAILED\_ALM*

Alarm indicating a failure within a device which makes the device non-operational.

### MAINT\_ALARMS

A maintenance alarm indicates that the device or some part of the device needs maintenance soon. If the condition is ignored, the device will eventually fail. There are five parameters associated with MAINT\_ALARMS, they are described below.

## Rosemount 5300 Series

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### *MAINT\_ENABLED*

The MAINT\_ENABLED parameter contains a list of conditions indicating that the device or some part of the device needs maintenance soon.

Below is a list of the conditions:

1. Configuration Error
2. Configuration Warning
3. Simulation Mode
4. Volume / Temperature Measurement Warning
5. Vapor Compensation Warning

### *MAINT\_MASK*

The MAINT\_MASK parameter will mask any of the failed conditions listed in MAINT\_ENABLED. A bit on means that the condition is masked out from alarming and will not be reported.

### *MAINT\_PRI*

MAINT\_PRI designates the alarming priority of the MAINT\_ALM, see "Process Alarms" on page I-7. The default is 0 and the recommended values are 3 to 7.

### *MAINT\_ACTIVE*

The MAINT\_ACTIVE parameter displays which of the alarms is active. Only the condition with the highest priority will be displayed. This priority is not the same as the MAINT\_PRI parameter described above. This priority is hard coded within the device and is not user configurable.

### *MAINT\_ALM*

An alarm indicating that the device needs maintenance soon. If the condition is ignored, the device will eventually fail.

## **Advisory Alarms**

An advisory alarm indicates informative conditions that do not have a direct impact on the primary functions of the device. There are five parameters associated with ADVISE\_ALARMS, they are described below.

### *ADVISE\_ENABLED*

The ADVISE\_ENABLED parameter contains a list of informative conditions that do not have a direct impact on the primary functions of the device. Below is a list of the advisories:

1. Non-Volatile Writes Deferred
2. Electronics Warning - Transducer Block
3. PlantWeb Alerts Simulation

### *ADVISE\_MASK*

The ADVISE\_MASK parameter will mask any of the failed conditions listed in ADVISE\_ENABLED. A bit on means the condition is masked out from alarming and will not be reported.

### *ADVISE\_PRI*

ADVISE\_PRI designates the alarming priority of the ADVISE\_ALM, see "Process Alarms" on page I-7. The default is 0 and the recommended values are 1 or 2.



#### *ADVISE\_ACTIVE*

The *ADVISE\_ACTIVE* parameter displays which of the advisories is active. Only the advisory with the highest priority will be displayed. This priority is not the same as the *ADVISE\_PRI* parameter described above. This priority is hard coded within the device and is not user configurable.

#### *ADVISE\_ALM*

*ADVISE\_ALM* is an alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity.

## Alarm Priority

Alarms are grouped into five levels of priority:

Priority Number	Priority Description
0	The alarm condition is not used.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator.
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

## Process Alarms

Process Alarm detection is based on the OUT value. Configure the alarm limits of the following standard alarms:

- High (HI\_LIM)
- High high (HI\_HI\_LIM)
- Low (LO\_LIM)
- Low low (LO\_LO\_LIM)

To avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the *ALARM\_HYS* parameter. The priority of each alarm is set in the following parameters:

- HI\_PRI
- HI\_HI\_PRI
- LO\_PRI
- LO\_LO\_PRI

## Recommended Actions for PlantWeb Alerts

#### **RECOMMENDED\_ACTION**

The *RECOMMENDED\_ACTION* parameter displays a text string that will give a recommended course of action to take based on which type and which specific event of the PlantWeb alerts are active.

Table I-1.  
RB.RECOMMENDED\_ACTION

Alarm Type	Failed/Maint/Advise Active Event	Recommended Action Text String
None	None	No action required
Advisory	Non-Volatile Writes Deferred	Non-volatile writes have been deferred, leave the device powered until the advisory goes away.
	Electronics Warning - Transducer Block	Check device installation and configuration
	PlantWeb Alerts Simulation	Use the switch on the Fieldbus electronics board to turn simulation on or off.
Maintenance	Probe Contamination	Clean the probe.
	Configuration Error	Load default database to the device and reconfigure it.
	Configuration Warning	Check device configuration
	Simulation Mode	Use <b>Start / Stop Device Simulation</b> to enable or disable simulation.
	Vapor Compensation Warning	<ol style="list-style-type: none"> <li>1. Recalibrate vapor compensation.</li> <li>2. Check Vapor DC configuration.</li> <li>3. Check that the correct probe is attached.</li> </ol>
	Volume/Temperature Measurement Warning	<ol style="list-style-type: none"> <li>1. Check volume configuration.</li> <li>2. Check ambient temperature at installation site.</li> <li>3. If the surrounding temperature is OK, it might indicate a hardware error producing heat. Replace the transmitter head.</li> </ol>
Failed	Level / Interface Measurement Failure	<ol style="list-style-type: none"> <li>1. Analyze echo curve for reason and check device configuration.</li> <li>2. Check device physical installation (for instance probe contamination).</li> <li>3. Load default database to the device and reconfigure it.</li> <li>4. If error persists, it might indicate a hardware error. Replace the transmitter head.</li> </ol>
	Volume / Temperature Measurement Failure	<ol style="list-style-type: none"> <li>1. If Level Measurement Failure is active, clear that alert first.</li> <li>2. Check volume configuration.</li> <li>3. Load default database to the device and reconfigure it.</li> <li>4. Check ambient temperature at installation site.</li> <li>5. If error persists, it might indicate a hardware error. Replace the transmitter head.</li> </ol>
	Electronics Failure - Transducer Block	Replace transmitter head.
	Probe Missing	Check that the probe is properly connected.
	Input / Output Failure	Replace the transmitter.
	Non-Volatile Memory Failure	<ol style="list-style-type: none"> <li>1. Load default database to the device to clear the error.</li> <li>2. Download a device configuration.</li> <li>3. If error persists, it may indicate a faulty memory chip. Replace the transmitter head.</li> </ol>
	Electronics Failure - Output Board	Replace the transmitter.
	Software Incompatible Error	Replace the device.

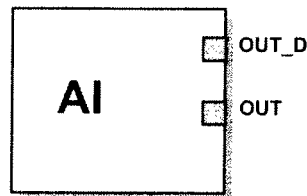
## Appendix J Analog-Input Block

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Simulation .....	page J-3
Damping .....	page J-4
Signal Conversion .....	page J-5
Block Errors .....	page J-6
Modes .....	page J-6
Alarm Detection .....	page J-7
Advanced Features .....	page J-8
Configure the AI Block .....	page J-9

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Figure J-1. Analog-Input Block



OUT=The block output value and status  
OUT\_D=Discrete output that signals a selected  
alarm condition

The Analog Input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes.

The AI block supports alarming, signal scaling, signal filtering, signal status calculation, mode control, and simulation. In Automatic mode, the block's output parameter (OUT) reflects the process variable (PV) value and status. In Manual mode, OUT may be set manually. The Manual mode is reflected on the output status. A discrete output (OUT\_D) is provided to indicate whether a selected alarm condition is active. Alarm detection is based on the OUT value and user specified alarm limits. Figure J-2 on page J-4 illustrates the internal components of the AI function block, and Table J-1 lists the AI block parameters and their units of measure, descriptions, and index numbers.

# Rosemount 5300 Series

Table J-1. Definitions of Analog Input Function Block System Parameters

Parameter	Index Number	Units	Description
ACK_OPTION	23	None	Used to set auto acknowledgment of alarms.
ALARM_HYS	24	Percent	The amount the alarm value must return within the alarm limit before the associated active alarm condition clears.
ALARM_SEL	38	None	Used to select the process alarm conditions that will cause the OUT_D parameter to be set.
ALARM_SUM	22	None	The summary alarm is used for all process alarms in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
ALERT_KEY	04	None	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
BLOCK_ALM	21	None	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
BLOCK_ERR	06	None	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
CHANNEL	15	None	The CHANNEL value is used to select the measurement value. Refer to the appropriate device manual for information about the specific channels available in each device. You must configure the CHANNEL parameter before you can configure the XD_SCALE parameter.
FIELD_VAL	19	Percent	The value and status from the transducer block or from the simulated input when simulation is enabled.
GRANT_DENY	12	None	Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device.
HI_ALM	34	None	The HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_ALM	33	None	The HI HI alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
HI_HI_LIM	26	EU of PV_SCALE	The setting for the alarm limit used to detect the HI HI alarm condition.
HI_HI_PRI	25	None	The priority of the HI HI alarm.
HI_LIM	28	EU of PV_SCALE	The setting for the alarm limit used to detect the HI alarm condition.
HI_PRI	27	None	The priority of the HI alarm.
IO_OPTS	13	None	Allows the selection of input/output options used to alter the PV. Low cutoff enabled is the only selectable option.
L_TYPE	16	None	Linearization type. Determines whether the field value is used directly (Direct) or is converted linearly (Indirect).
LO_ALM	35	None	The LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LIM	30	EU of PV_SCALE	The setting for the alarm limit used to detect the LO alarm condition.
LO_LO_ALM	36	None	The LO LO alarm data, which includes a value of the alarm, a timestamp of occurrence and the state of the alarm.
LO_LO_LIM	32	EU of PV_SCALE	The setting for the alarm limit used to detect the LO LO alarm condition.
LO_LO_PRI	31	None	The priority of the LO LO alarm.

Parameter	Index Number	Units	Description
LO_PRI	29	None	The priority of the LO alarm.
LOW_CUT	17	%	If percentage value of transducer input fails below this, PV = 0.
MODE_BLK	05	None	The actual, target, permitted, and normal modes of the block. Target: The mode to "go to" Actual: The mode the "block is currently in" Permitted: Allowed modes that target may take on Normal: Most common mode for target
OUT	08	EU of OUT_SCALE	The block output value and status.
OUT_D	37	None	Discrete output to indicate a selected alarm condition.
OUT_SCALE	11	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with OUT.
PV	07	EU of XD_SCALE	The process variable used in block execution.
PV_FTIME	18	Seconds	The time constant of the first-order PV filter. It is the time required for a 63% change in the IN value.
SIMULATE	09	None	A group of data that contains the current transducer value and status, the simulated transducer value and status, and the enable/disable bit.
STRATEGY	03	None	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
ST_REV	01	None	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
TAG_DESC	02	None	The user description of the intended application of the block.
UPDATE_EVT	20	None	This alert is generated by any change to the static data.
VAR_INDEX	39	% of OUT Range	The average absolute error between the PV and its previous mean value over that evaluation time defined by VAR_SCAN.
VAR_SCAN	40	Seconds	The time over which the VAR_INDEX is evaluated.
XD_SCALE	10	None	The high and low scale values, engineering units code, and number of digits to the right of the decimal point associated with the channel input value.

## SIMULATION

To support testing, you can either change the mode of the block to manual and adjust the output value, or you can enable simulation through the configuration tool and manually enter a value for the measurement value and its status. In both cases, you must first set the ENABLE jumper on the field device.

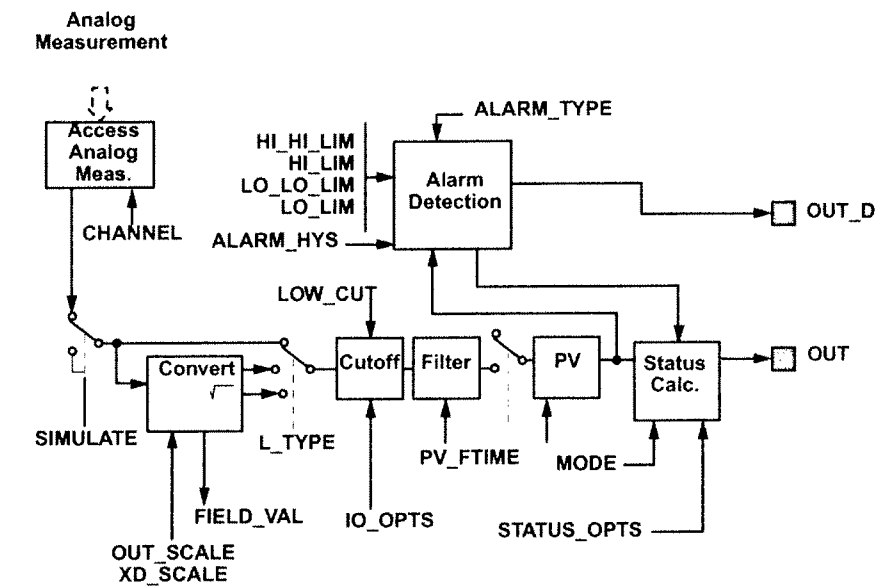
### NOTE!

All fieldbus instruments have a simulation jumper. As a safety measure, the jumper has to be reset every time there is a power interruption. This measure is to prevent devices that went through simulation in the staging process from being installed with simulation enabled.

With simulation enabled, the actual measurement value has no impact on the OUT value or the status.

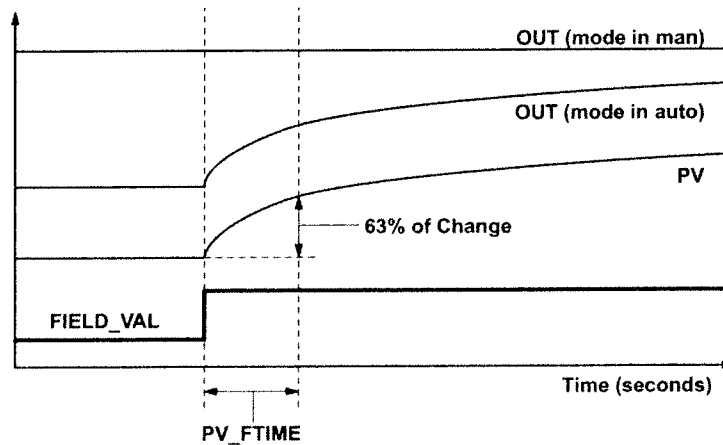
# Rosemount 5300 Series

Figure J-2. Analog Input Function Block Schematic



NOTES:  
OUT = block output value and status.  
OUT\_D = discrete output that signals a selected alarm condition.

Figure J-3. Analog Input Function Block Timing Diagram



## DAMPING

The filtering feature changes the response time of the device to smooth variations in output readings caused by rapid changes in input. You can adjust the filter time constant (in seconds) using the PV\_FTIME parameter. Set the filter time constant to zero to disable the filter feature.

## SIGNAL CONVERSION

You can set the signal conversion type with the Linearization Type (L\_TYPE) parameter. You can view the converted signal (in percent of XD\_SCALE) through the FIELD\_VAL parameter.

$$\text{FIELD\_VAL} = \frac{100 \times (\text{Channel Value} - \text{EU}^*\text{@}0\%)}{(\text{EU}^*\text{@}100\% - \text{EU}^*\text{@}0\%)} \quad * \text{XD\_SCALE values}$$

You can choose from direct or indirect signal conversion with the L\_TYPE parameter.

### Direct

Direct signal conversion allows the signal to pass through the accessed channel input value (or the simulated value when simulation is enabled).

$$\text{PV} = \text{Channel Value}$$

### Indirect

Indirect signal conversion converts the signal linearly to the accessed channel input value (or the simulated value when simulation is enabled) from its specified range (XD\_SCALE) to the range and units of the PV and OUT parameters (OUT\_SCALE).

$$\text{PV} = \left( \frac{\text{FIELD\_VAL}}{100} \right) \times (\text{EU}^{**}\text{@}100\% - \text{EU}^{**}\text{@}0\%) + \text{EU}^{**}\text{@}0\% \quad ** \text{OUT\_SCALE values}$$

### Indirect Square Root

Indirect Square Root signal conversion takes the square root of the value computed with the indirect signal conversion and scales it to the range and units of the PV and OUT parameters..

$$\text{PV} = \sqrt{\left( \frac{\text{FIELD\_VAL}}{100} \right)} \times (\text{EU}^{**}\text{@}100\% - \text{EU}^{**}\text{@}0\%) + \text{EU}^{**}\text{@}0\% \quad ** \text{OUT\_SCALE values}$$

When the converted input value is below the limit specified by the LOW\_CUT parameter, and the Low Cutoff I/O option (IO\_OPTS) is enabled (True), a value of zero is used for the converted value (PV). This option is useful to eliminate false readings when the differential pressure measurement is close to zero, and it may also be useful with zero-based measurement devices such as flowmeters.

### NOTE!

**Low Cutoff** is the only I/O option supported by the AI block. You can set the I/O option in **Manual** or **Out of Service** mode only.

# Rosemount 5300 Series

## BLOCK ERRORS

Table J-2 lists conditions reported in the BLOCK\_ERR parameter.

Table J-2. BLOCK\_ERR Conditions

Condition Number	Condition Name and Description
0	Other
1	<b>Block Configuration Error:</b> the selected channel carries a measurement that is incompatible with the engineering units selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.
2	Link Configuration Error
3	<b>Simulate Active:</b> Simulation is enabled and the block is using a simulated value in its execution.
4	Local Override
5	Device Fault State Set
6	Device Needs Maintenance Soon
7	<b>Input Failure/Process Variable has Bad Status:</b> The hardware is bad, or a bad status is being simulated.
8	<b>Output Failure:</b> The output is bad based primarily upon a bad input.
9	Memory Failure
10	Lost Static Data
11	Lost NV Data
12	Readback Check Failed
13	Device Needs Maintenance Now
14	Power Up
15	<b>Out of Service:</b> The actual mode is out of service.

## MODES

The AI Function Block supports three modes of operation as defined by the MODE\_BLK parameter:

- **Manual (Man)** The block output (OUT) may be set manually
- **Automatic (Auto)** OUT reflects the analog input measurement or the simulated value when simulation is enabled
- **Out of Service (O/S)** The block is not processed. FIELD\_VAL and PV are not updated and the OUT status is set to Bad: Out of Service. The BLOCK\_ERR parameter shows Out of Service. In this mode, you can make changes to all configurable parameters. The target mode of a block may be restricted to one or more of the supported modes.



**ALARM DETECTION**

A block alarm will be generated whenever the BLOCK\_ERR has an error bit set. The types of block error for the AI block are defined above.

Process Alarm detection is based on the OUT value. You can configure the alarm limits of the following standard alarms:

- High (HI\_LIM)
- High high (HI\_HI\_LIM)
- Low (LO\_LIM)
- Low low (LO\_LO\_LIM)

In order to avoid alarm chattering when the variable is oscillating around the alarm limit, an alarm hysteresis in percent of the PV span can be set using the ALARM\_HYS parameter. The priority of each alarm is set in the following parameters:

- HI\_PRI
- HI\_HI\_PRI
- LO\_PRI
- LO\_LO\_PRI

Alarms are grouped into five levels of priority:

Table J-3. Alarm level priority

Priority Number	Priority Description
0	The priority of an alarm condition changes to 0 after the condition that caused the alarm is corrected.
1	An alarm condition with a priority of 1 is recognized by the system, but is not reported to the operator.
2	An alarm condition with a priority of 2 is reported to the operator, but does not require operator attention (such as diagnostics and system alerts).
3-7	Alarm conditions of priority 3 to 7 are advisory alarms of increasing priority.
8-15	Alarm conditions of priority 8 to 15 are critical alarms of increasing priority.

## Rosemount 5300 Series

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### Status Handling

Normally, the status of the PV reflects the status of the measurement value, the operating condition of the I/O card, and any active alarm condition. In Auto mode, OUT reflects the value and status quality of the PV. In Man mode, the OUT status constant limit is set to indicate that the value is a constant and the OUT status is *Good*.

The **Uncertain** - EU range violation status is always set, and the PV status is set high- or low-limited if the sensor limits for conversion are exceeded.

In the STATUS\_OPTS parameter, you can select from the following options to control the status handling:

**BAD if Limited** – sets the OUT status quality to *Bad* when the value is higher or lower than the sensor limits.

**Uncertain if Limited** – sets the OUT status quality to *Uncertain* when the value is higher or lower than the sensor limits.

**Uncertain if in Manual mode** – The status of the Output is set to *Uncertain* when the mode is set to Manual.

---

#### NOTE!

The instrument must be in **Manual** or **Out of Service** mode to set the status option.

The AI block only supports the **BAD if Limited** option. Unsupported options are not grayed out; they appear on the screen in the same manner as supported options.

---

### ADVANCED FEATURES

The AI function block provided with Fisher-Rosemount fieldbus devices provides added capability through the addition of the following parameters:

**ALARM\_TYPE** – Allows one or more of the process alarm conditions detected by the AI function block to be used in setting its OUT\_D parameter.

**OUT\_D** – Discrete output of the AI function block based on the detection of process alarm condition(s). This parameter may be linked to other function blocks that require a discrete input based on the detected alarm condition.

**VAR\_SCAN** – Time period in seconds over which the variability index (VAR\_INDEX) is computed.

**VAR\_INDEX** – Process variability index measured as the integral of average absolute error between PV and its mean value over the previous evaluation period. This index is calculated as a percent of OUT span and is updated at the end of the time period defined by VAR\_SCAN.

**CONFIGURE THE AI BLOCK**

⚠ A minimum of four parameters are required to configure the AI Block. The parameters are described below with example configurations shown at the end of this section.

**CHANNEL**

Select the channel that corresponds to the desired sensor measurement. The Rosemount 5300 measures Level (channel 1), Distance (channel 2), Level Rate (channel 3), Signal Strength (channel 4), Volume (channel 5), Internal Temperature (channel 6), Upper Product Volume (channel 7), Lower Product Volume (channel 8), Interface Distance (channel 9), Upper Product Thickness (channel 10), Interface Level (channel 11), Interface Level Rate (channel 12), and Interface Signal Strength (channel 13).

AI Block	TB Channel Value	Process Variable
Level	1	CHANNEL_RADAR_LEVEL
Ullage	2	CHANNEL_RADAR_ULLAGE
Level Rate	3	CHANNEL_RADAR_LEVELRATE
Signal Strength	4	CHANNEL_RADAR_SIGNAL_STRENGTH
Volume	5	CHANNEL_RADAR_VOLUME
Internal Temperature	6	CHANNEL_RADAR_INTERNAL_TEMPERATURE
Upper Product Volume	7	CHANNEL_UPPER_PRODUCT_VOLUME
Lower Product Volume	8	CHANNEL_LOWER_PRODUCT_VOLUME
Interface Distance	9	CHANNEL_INTERFACE_DISTANCE
Upper Product Thickness	10	CHANNEL_UPPER_PRODUCT_THICKNESS
Interface Level	11	CHANNEL_INTERFACE_LEVEL
Interface Level Rate	12	CHANNEL_INTERFACE_LEVELRATE
Interface Signal Strength	13	CHANNEL_INTERFACE_SIGNALSTRENGTH
Signal Quality	14	CHANNEL_SIGNAL_QUALITY
Surface/Noise Margin	15	CHANNEL_SURFACE_NOISE_MARGIN
Vapor DC	16	CHANNEL_VAPOR_DC

**L\_TYPE**

The L\_TYPE parameter defines the relationship of the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature) to the desired output of the AI Block. The relationship can be direct or indirect root.

**Direct**

Select direct when the desired output will be the same as the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature).

**Indirect**

Select indirect when the desired output is a calculated measurement based on the transmitter measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature). The relationship between the transmitter measurement and the calculated measurement will be linear.

**Indirect Square Root**

Select indirect square root when the desired output is an inferred measurement based on the transmitter measurement and the relationship between the sensor measurement and the inferred measurement is square root (e.g. level).

**XD\_SCALE and OUT\_SCALE**

The XD\_SCALE and OUT\_SCALE each include three parameters: 0%, 100%, and, engineering units. Set these based on the L\_TYPE:

**L\_TYPE is Direct**

When the desired output is the measured variable, set the XD\_SCALE to represent the operating range of the process. Set OUT\_SCALE to match XD\_SCALE.

**L\_TYPE is Indirect**

When an inferred measurement is made based on the sensor measurement, set the XD\_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD\_SCALE 0 and 100% points and set these for the OUT\_SCALE.

**L\_TYPE is Indirect Square Root**

When an inferred measurement is made based on the transmitter measurement and the relationship between the inferred measurement and sensor measurement is square root, set the XD\_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD\_SCALE 0 and 100% points and set these for the OUT\_SCALE.

**NOTE!**

To avoid configuration errors, only select Engineering Units for XD\_SCALE and OUT\_SCALE that are supported by the device. The supported units are:

Table J-4. Length

Display	Description
m	meter
cm	centimeter
mm	millimeter
ft	feet
in	inch

Table J-5. Level Rate

Display	Description
m/s	meter per second
m/h	meter per hour
ft/s	feet per second
in/m	inch/minute

**Reference Manual**

00809-0100-4530, Rev BA

July 2009

**Rosemount 5300 Series**

Table J-6. Temperature

Display	Description
°C	Degree Celsius
°F	Degree Fahrenheit

Table J-7. Signal Strength

Display	Description
mV	millivolt

Table J-8. Volume

Display	Description
m <sup>3</sup>	Cubic meter
L	Liter
in <sup>3</sup>	Cubic inch
ft <sup>3</sup>	Cubic feet
Yd <sup>3</sup>	Cubic yard
Gallon	US gallon
ImpGall	Imperial gallon
bbf	barrel

# Rosemount 5300 Series

**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

---

# Index

## Numerics

- 375 Field Communicator . . . . 5-11
- 751 Field Signal Indicator . . . . 4-14

## A

- Address
  - Temporary Node . . . . . 5-36
- Agitators . . . . . 2-14, 3-12
- AI Block
  - Configuration . . . . . 5-38
  - Parameters
    - ALARM\_TYPE . . . . . J-8
    - BLOCK\_ERR . . . . . J-6
    - IO\_OPTS . . . . . J-5
    - L\_TYPE . . . . . J-5
    - LOW\_CUT . . . . . J-5
    - OUT\_D . . . . . J-8
    - OUT\_SCALE . . . . . J-5
    - PV\_FTIME . . . . . J-4
    - VAR\_INDEX . . . . . J-8
    - VAR\_SCAN . . . . . J-8
    - XD\_SCALE . . . . . J-5
  - Status . . . . . J-8
- Alarm Priority . . . . . I-7
- ALARM\_TYPE
  - AI Block . . . . . J-8
- Alarms
  - Priorety . . . . . I-7
  - Process . . . . . I-7
- Amplitude Thresholds . . . . . 7-4
- AMS Suit . . . . . 2-7, 5-30
- Analog Input (AI) Block 5-38, 7-45, J-1
  - BLOCK\_ERR . . . . . 7-45
  - Troubleshooting . . . . . 7-45
- Analog Input (AI) Function Block 7-45
- Analog Output
  - alarm values . . . . . 5-10
  - saturation values . . . . . 5-10
- Analog Output calibration . . . . 7-16
- Applications . . . . . 2-2
- Approval Drawings . . . . . B-22

## B

- Block Configuration
  - AI Block . . . . . 5-38
- Block Errors . . . . . 7-45

## BLOCK\_ERR

- AI Block . . . . . 7-45, J-6
- Resource Block . . . . . 7-44
- Bracket Mounting . . . . . 3-18
- Bridging . . . . . 2-11
- BSP/G threads . . . . . 3-16
- Burst Mode . . . . . 5-46
- Burst mode . . . . . 5-45
- Burst option . . . . . 5-45

## C

- Cable Selection . . . . . 4-3
- Cable/conduit entries . . . . . 4-3
- Calculation Method . . . . . 5-35
- Calibrating Dynamic Vapor Compensation . . . . . C-18
- Calibration . . . . . 7-17
- Calibration Offset . . . . . C-3
- Canadian Standards Association
  - approval . . . . . B-14
- Centering piece . . . . . 3-21
- Changing the Probe . . . . . 7-29
- Channel . . . . . 5-39, F-2, J-9
- Channel Definitions
  - Level Transducer Block . . . . F-2
- Coating . . . . . 2-11
- COM Port . . . . . 5-15
- Configuration
  - Analog Input (AI) Function Block
    - OUT\_SCALE . . . . . 5-40, J-10
    - XD\_SCALE . . . . . 5-40, J-10
  - basic . . . . . 5-4
  - Channel . . . . . 5-39, J-9
  - Direct . . . . . 5-40, J-10
  - Handheld Communicator . . . . 5-11
  - Indirect . . . . . 5-40, J-10
  - L\_TYPE . . . . . 5-39, J-9
    - Direct . . . . . 5-39, J-9
    - Indirect 5-39, 5-40, J-9, J-10
  - volume . . . . . 5-7
- Current loop resistance . . . . . 4-4

## D

- Device ID . . . . . 5-31
- Device Revision . . . . . 5-12
- Device Tag . . . . . 5-36
- diagnostics measurements . . . . C-20
- Dielectric Chart . . . . . 5-24

- Dielectric Constant . . . . . 5-6, C-14
- Dielectric Constant Calculator . . 5-24
- Direct . . . . . 5-39, 5-40, J-9, J-10
- Direct Signal Conversion . . . . . J-5
- Display
  - presentation . . . . . 6-2
  - variables . . . . . 5-2, 6-2, 6-3
- Display Panel . . . . . 6-2
- Display Panel Variables . . . . . 6-3
- Dynamic Vapor Compensation C-18

## E

- Electrical installation
  - connecting the transmitter 4-5, 4-8
  - Intrinsically Safe Output 4-7, 4-12
  - Non-Intrinsically Safe Output 4-6, 4-11
  - Tri-Loop . . . . . 4-13, 4-14
- Emulsion layers . . . . . 2-14
- European ATEX Directive Information B-3

## F

- Factory Mutual
  - system control drawing . . . . B-23
- Field Communicator . . . . . 5-11
- Filtering
  - AI Block . . . . . J-4
- Flange Connection . . . . . 3-3
- Foam . . . . . 2-11
- Free Space . . . . . 3-11

## G

- Geometry . . . . . 5-33
- Grounding . . . . . 4-3

## H

- HART Communicator Menu Tree 5-12
- Heating Coils . . . . . 2-14
- Heating coils . . . . . 3-12
- HI\_HI\_LIM . . . . . I-7
- HI\_HI\_PRI . . . . . I-7
- HI\_LIM . . . . . I-7
- HI\_PRI . . . . . I-7

<p><b>I</b></p> <ul style="list-style-type: none"> <li>Indirect . . . . . 5-39, 5-40, J-9, J-10</li> <li>Indirect Signal Conversion . . . . . J-5</li> <li>Installation <ul style="list-style-type: none"> <li>cable selection . . . . . 4-3</li> <li>cable/conduit entries . . . . . 4-3</li> <li>flange connection . . . . . 3-3</li> <li>Free Space . . . . . 3-11</li> <li>grounding . . . . . 4-3</li> <li>mounting considerations . . . . . 3-3</li> <li>mounting position . . . . . 3-12</li> <li>power requirements . . . . . 4-4, 4-8</li> <li>procedure . . . . . 2-15</li> <li>shortening the probe . . . . . 3-19</li> <li>threaded connection . . . . . 3-3</li> </ul> </li> <li>Interface . . . . . 2-12 <ul style="list-style-type: none"> <li>low dielectric constants . . . . . 7-8</li> </ul> </li> <li>IO_OPTS <ul style="list-style-type: none"> <li>AI Block . . . . . J-5</li> </ul> </li> </ul> <p><b>L</b></p> <ul style="list-style-type: none"> <li>L_TYPE . . . . . 5-39, J-9 <ul style="list-style-type: none"> <li>. . . . . 5-39, 5-40, J-9, J-10</li> <li>AI Block . . . . . J-5</li> </ul> </li> <li>LCD . . . . . 6-3</li> <li>LCD variables . . . . . 5-18</li> <li>Level and Distance Calibration . . . . . 7-17</li> <li>Level Transducer Block . . . . . 5-37 <ul style="list-style-type: none"> <li>Channel Definitions . . . . . F-2</li> </ul> </li> <li>LO_LIM . . . . . I-7</li> <li>LO_LO_LIM . . . . . I-7</li> <li>LO_LO_PRI . . . . . I-7</li> <li>LO_PRI . . . . . I-7</li> <li>Loop-powered . . . . . 2-7</li> <li>LOW_CUT <ul style="list-style-type: none"> <li>AI Block . . . . . J-5</li> </ul> </li> <li>Lower product <ul style="list-style-type: none"> <li>dielectric constant . . . . . C-14</li> </ul> </li> <li>Lower Transition Zone . . . . . 2-10</li> </ul> <p><b>M</b></p> <ul style="list-style-type: none"> <li>Maximum load resistance . . . . . 4-6, 4-7</li> <li>Measurement Mode . . . . . 5-6, 5-23, 5-33</li> <li>Measurement Principle . . . . . 2-1</li> <li>Measuring range . . . . . 2-12</li> <li>Mounting Position . . . . . 3-12</li> <li>Multidrop connection . . . . . 5-47</li> <li>Multidrop Mode . . . . . 5-47</li> </ul> <p><b>N</b></p> <ul style="list-style-type: none"> <li>NAMUR-Compliant Alarm . . . . . 5-10</li> <li>NEPSI Approvals . . . . . B-8</li> <li>Node Address . . . . . 5-36</li> <li>Non-metallic tanks . . . . . 3-5</li> <li>NPT threads . . . . . 3-16</li> </ul>	<p><b>O</b></p> <ul style="list-style-type: none"> <li>OUT_D <ul style="list-style-type: none"> <li>AI Block . . . . . J-8</li> </ul> </li> <li>OUT_SCALE . . . . . 5-40, J-10 <ul style="list-style-type: none"> <li>AI Block . . . . . J-5</li> <li>L_TYPE <ul style="list-style-type: none"> <li>Direct . . . . . 5-40, J-10</li> <li>Indirect . . . . . 5-40, J-10</li> </ul> </li> </ul> </li> </ul> <p><b>P</b></p> <ul style="list-style-type: none"> <li>Parameter <ul style="list-style-type: none"> <li>BLOCK_ERR . . . . . 7-44, 7-45</li> <li>CHANNEL . . . . . 5-39, J-9</li> <li>HI_HI_LIM . . . . . I-7</li> <li>HI_HI_PRI . . . . . I-7</li> <li>HI_LIM . . . . . I-7</li> <li>HI_PRI . . . . . I-7</li> <li>L_TYPE . . . . . 5-39, 5-40, J-9, J-10</li> <li>LO_LIM . . . . . I-7</li> <li>LO_LO_LIM . . . . . I-7</li> <li>LO_LO_PRI . . . . . I-7</li> <li>LO_PRI . . . . . I-7</li> <li>OUT_SCALE . . . . . 5-40, J-10</li> <li>Resource Block . . . . . I-1</li> <li>XD_SCALE . . . . . 5-40, J-10</li> </ul> </li> <li>Pipe Installations <ul style="list-style-type: none"> <li>Centering Disc . . . . . 3-25</li> </ul> </li> <li>Plate design . . . . . 3-16</li> <li>Poll address . . . . . 5-47</li> <li>Power Requirements . . . . . 4-4, 4-8</li> <li>Power supply . . . . . 4-4</li> <li>Probe <ul style="list-style-type: none"> <li>anchoring . . . . . 3-22</li> <li>changing . . . . . 7-31</li> <li>shortening . . . . . 3-19</li> </ul> </li> <li>Probe End Projection . . . . . C-10</li> <li>Probe Length . . . . . 5-5, 5-21, 5-32</li> <li>Probe Type . . . . . 5-5, 5-21, 5-32</li> <li>Probe types . . . . . 2-5</li> <li>Process Alarms . . . . . I-7</li> <li>Process connection . . . . . 3-3</li> <li>PV_FTIME <ul style="list-style-type: none"> <li>AI Block . . . . . J-4</li> </ul> </li> </ul> <p><b>R</b></p> <ul style="list-style-type: none"> <li>Range Values . . . . . 5-9</li> <li>Rapid Level Changes . . . . . 5-6</li> <li>Recommended mounting position . . . . . 3-12</li> <li>Reference Threshold . . . . . C-20</li> <li>Register Transducer Block . . . . . 5-37</li> <li>Remote Housing . . . . . 3-19</li> </ul>	<ul style="list-style-type: none"> <li>Resource Block . . . . . 5-37, 7-44, I-1 <ul style="list-style-type: none"> <li>Block Errors . . . . . 7-44</li> <li>Detailed Status . . . . . 7-44</li> <li>Parameters . . . . . I-1 <ul style="list-style-type: none"> <li>BLOCK_ERR . . . . . 7-44</li> </ul> </li> <li>PlantWeb Alerts <ul style="list-style-type: none"> <li>Recommended Actions . . . . . I-7</li> </ul> </li> <li>PlantWeb™ Alerts . . . . . I-5 <ul style="list-style-type: none"> <li>advisory alarms . . . . . I-6</li> <li>failed_alarms . . . . . I-5</li> <li>maint_alarms . . . . . I-5</li> </ul> </li> <li>Summary Status . . . . . 7-44</li> </ul> </li> <li>Rosemount 751 . . . . . 2-7</li> <li>Rosemount Radar Master . . . . . 5-13</li> <li>RRM . . . . . 5-13 <ul style="list-style-type: none"> <li>COM Port . . . . . 5-15</li> <li>Setup . . . . . 5-18</li> </ul> </li> </ul> <p><b>S</b></p> <ul style="list-style-type: none"> <li>Signal Conversion <ul style="list-style-type: none"> <li>Direct . . . . . J-5</li> <li>Indirect . . . . . J-5</li> </ul> </li> <li>Signal Quality . . . . . C-20</li> <li>Signal Quality Metrics . . . . . C-20</li> <li>Simulation . . . . . J-3 <ul style="list-style-type: none"> <li>Jumper . . . . . J-3</li> </ul> </li> <li>Spacers . . . . . 3-20</li> <li>Standard Tank Shapes . . . . . 5-8</li> <li>Static Compensation . . . . . C-15</li> <li>static compensation . . . . . C-15</li> <li>Status <ul style="list-style-type: none"> <li>AI Block . . . . . J-8</li> </ul> </li> <li>Strapping Table . . . . . 5-7, 5-35</li> <li>Supported Units . . . . . 5-41, J-10</li> <li>Surface Noise Margin . . . . . C-20</li> <li>surface peak amplitude . . . . . C-20</li> <li>surface threshold (ATC) . . . . . C-20</li> <li>System Architecture . . . . . 2-7</li> </ul> <p><b>T</b></p> <ul style="list-style-type: none"> <li>Tag <ul style="list-style-type: none"> <li>Device . . . . . 5-36</li> </ul> </li> <li>Tank connection . . . . . 3-15 <ul style="list-style-type: none"> <li>flange . . . . . 3-15, 3-16</li> <li>threaded . . . . . 3-16</li> </ul> </li> <li>Tank Environment . . . . . 5-6</li> <li>Tank Geometry . . . . . 5-4</li> <li>Tank Height . . . . . 5-5</li> <li>Tank shape . . . . . 2-14</li> <li>Tank Shapes . . . . . 5-8</li> <li>Tank Type . . . . . 5-7</li> <li>Threaded connection . . . . . 3-3</li> <li>Time Domain Reflectometry . . . . . 2-1</li> <li>Transition Zones . . . . . 2-10</li> <li>Transmitter housing . . . . . 2-5</li> <li>Transmitter Reference Point . . . . . C-3</li> <li>Tri-Loop . . . . . 4-13, 5-45</li> </ul>
---	---	---



## Reference Manual

00809-0100-4530, Rev BA

July 2009

# Rosemount 5300 Series

---

Tri-loop .....	2-7	Upper Transition Zone .....	2-10	<b>W</b>	
Troubleshooting .....	7-33			Waveform plot .....	7-3
Analog Input (AI) Block ..	7-45	<b>V</b>			
Resource Block .....	7-44	Vapor .....	2-11, C-14	<b>X</b>	
Turbulent conditions .....	3-12	VAR_INDEX		XD_SCALE .....	5-40, J-10
		AI Block .....	J-8	AI Block .....	J-5
<b>U</b>		VAR_SCAN		L_TYPE	
UNZ .....	3-4, C-7	AI Block .....	J-8	Direct .....	5-40, J-10
Upper Null Zone 3-4, 5-9, 5-21, 5-32,		Vessel characteristics .....	2-14	Indirect .....	5-40, J-10
C-7		Volume Configuration .....	5-7		
Upper Product Dielectric constant	5-6	Volume Offset .....	5-35		
Upper Reference Point ...	5-4, C-3				

# Rosemount 5300 Series

**Reference Manual**  
00809-0100-4530, Rev BA  
July 2009

---



## Reference Manual

00809-0100-4530, Rev BA

July 2009

# Rosemount 5300 Series

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**Emerson Process Management  
Rosemount Measurement**  
8200 Market Boulevard  
Chanhassen MN 55317 USA  
Tel (USA) 1 800 999 9307  
Tel (International) +1 952 906 8888  
Fax +1 952 949 7001

**Emerson Process Management**  
Blegistrasse 23  
P.O. Box 1046  
CH 6341 Baar  
Switzerland  
Tel +41 (0) 41 768 6111  
Fax + 41 (0) 41 768 6300

**Emerson FZE**  
P.O. Box 17033  
Jebel Ali Free Zone  
Dubai UAE  
Tel +971 4 811 8100  
Fax + 971 4 886 5465

**Emerson Process Management Asia  
Pacific Pte Ltd**  
1 Pandan Crescent  
Singapore 128461  
Tel +65 6777 8211  
Fax +65 6777 0947  
Service Support Hotline: +65 6770 8711  
Email: [Enquiries@AP.EmersonProcess.com](mailto:Enquiries@AP.EmersonProcess.com)

# Sensor Wiring Instructions and Approval Drawings

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Wiring Instructions . . . . .	page 1-1
Approval Drawings for Hazardous Location Installation . . . . .	page 1-3

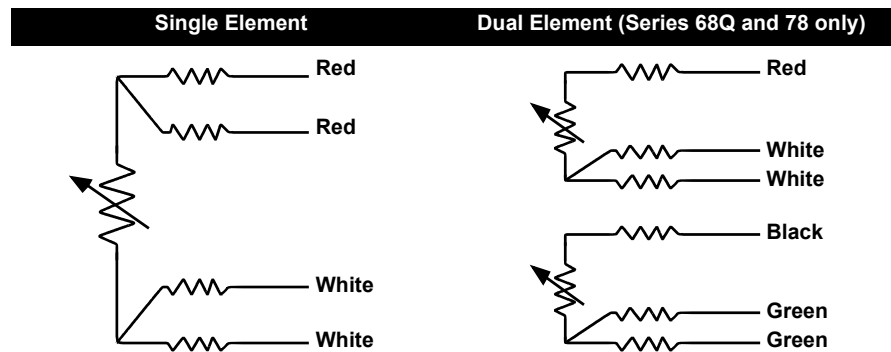
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## WIRING INSTRUCTIONS

### Series 58C, 68, 68Q, and 78 RTDs

Series 58C, 68, 68Q, and 78 temperature sensors are provided with four lead wires and can be used in 2-wire, 3-wire, or 4-wire configurations. In addition, the Series 78 sensor is available with dual elements (dual 3-wire configuration). See Figure 1-1.

Figure 1-1. Series 68, 78, and 58C Lead Wire Configurations.



*NOTE: For 3-wire systems use one White and two Red leads. Do not common the White leads. Insulate or terminate the unused White lead in a manner that prevents shorting to the ground. For 2-wire systems, common both sets of leads.*

# Series 58C, 68, 68Q, and 78 RTD

## Series 58C Sheath Cutting Procedure

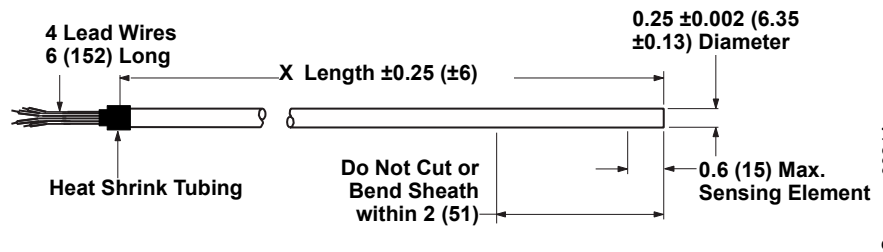
1. Determine the length to which the sheath will be cut. The finished length needs to include an additional 1.5 inches for compression fittings, or 2.5 inches for spring-loaded fittings (see Figure 1-2).
2. Remove and save the heat shrink tubing from the rear of the sensor.
3. Place the sensor in a vise, taking care not to overtighten, and position the tubing cutter on the sheath.
4. Score the sheath to a depth of approximately  $\frac{1}{64}$  inch. **To prevent damage to the lead wire insulation, do not cut completely through the sheath.**
5. Firmly grasp the end of the sheath with your hand or a pair of pliers. Using a sharp snapping motion, break off and remove the excess sheath material. Take care not to strip or damage the lead wire insulation while removing the excess sheath material.

### NOTE

If you are unable to easily break off the excess sheath material, deepen the score and repeat Step 5.

6. Replace the heat shrink tubing.

Figure 1-2. Series 58C Sensor Dimensional Drawings



**Series 183  
 Thermocouples**

Rosemount Series 183 Thermocouples are manufactured using ISA Type J, K, E, or T wire with “Special Limits of Error” accuracy, the characteristics of which are outlined in Table 1-1. They can be installed using different junction and lead wire configurations (see Figures 1-3 and 1-4).

Table 1-1. Characteristics of Series 183 Thermocouple Types.

ISA Thermocouple Types	Thermocouple Wire Alloys	Temperature Range		Limits of Error (Interchangeability)
		°C	°F	
J	Iron/Constantan	0 to 760	(32 to 1400)	±1.1 °C or ±0.4% of measured temperature, whichever is greater
K	Chromel/Alumel	0 to 1150	(32 to 2102)	±1.1 °C or ±0.4% of measured temperature, whichever is greater
E	Chromel/Constantan	0 to 900	(32 to 1652)	±1.0 °C or ±0.4% of measured temperature, whichever is greater
T	Copper/Constantan	-180 to 0	(-292 to 32)	±1.0 °C or ±1.5% of measured temperature, whichever is greater
		0 to 371	(32 to 700)	±0.5 °C or ±0.4% of measured temperature, whichever is greater

Figure 1-3. Series 183 Junction Configurations

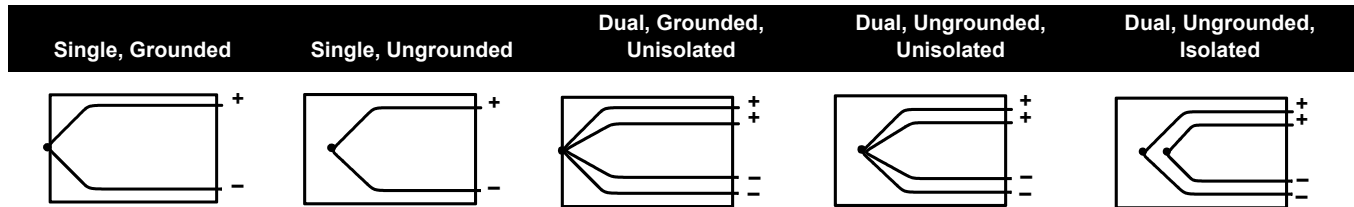
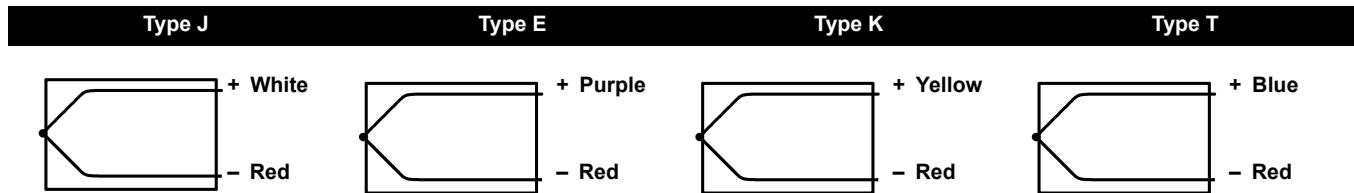


Figure 1-4. Series 183 Lead Wire Configurations



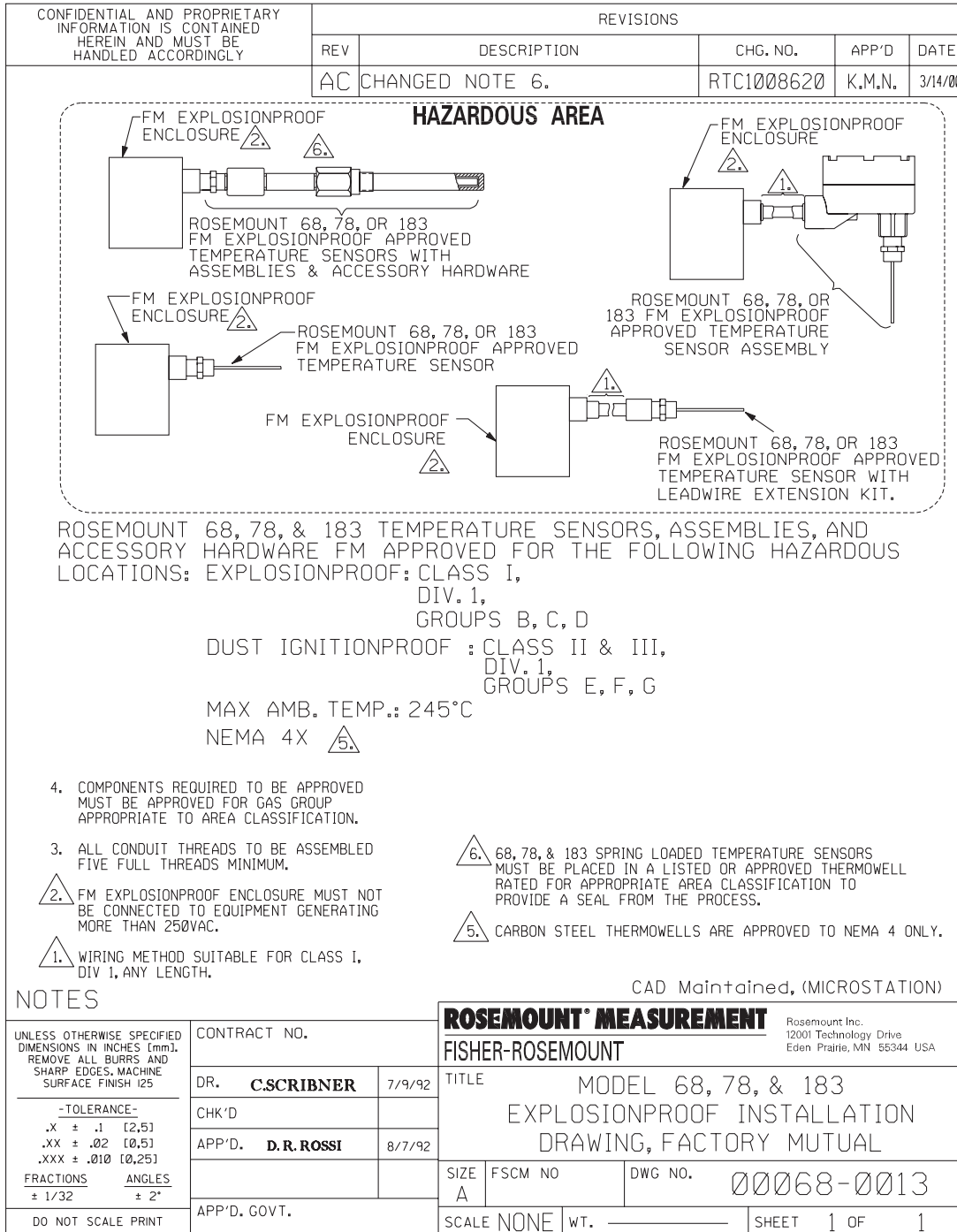
**APPROVAL DRAWINGS  
 FOR HAZARDOUS  
 LOCATION  
 INSTALLATION**

Rosemount Series 68, 78, and 183 Temperature Sensors can be ordered with Factory Mutual (FM) and Canadian Standards Association (CSA) Explosion-proof approvals. Install in accordance with applicable approval drawings to maintain certified ratings.

# Series 58C, 68, 68Q, and 78 RTD

## Factory Mutual (FM) Explosion-Proof

Figure 1-5. Installation Drawing 00068-0013, Rev. AC



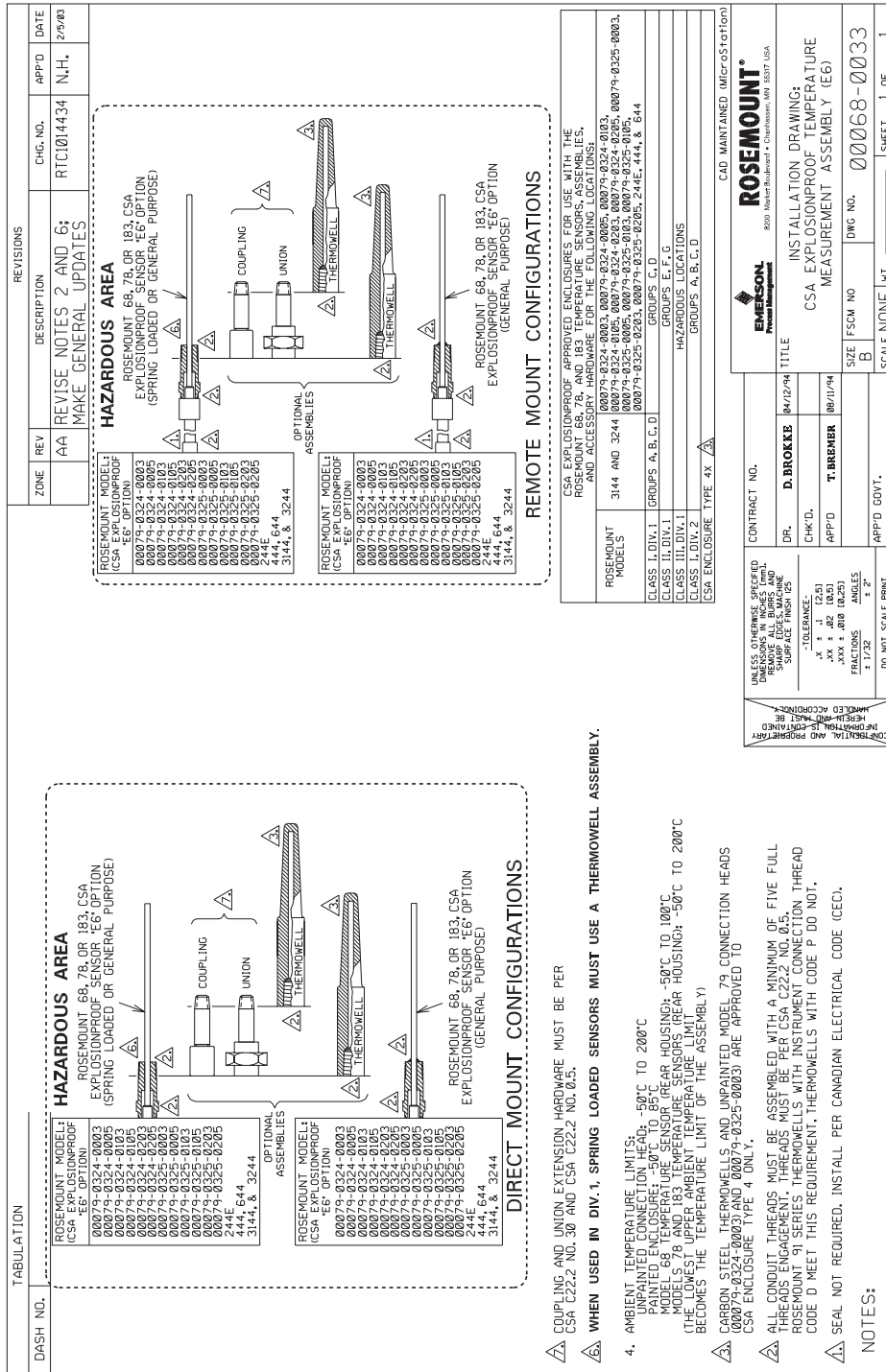
**NOTE**

For Hand-Tight Assembly Option XA: End-User (installer) must unscrew threaded joints, then reassemble and tighten all joints per installation drawing 00068-0013.



**Canadian Standards Association (CSA) Explosion-Proof**

Figure 1-6. Installation Drawing 00068-0033, Rev. AA



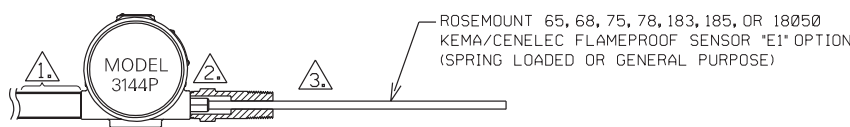
## CENELEC Flameproof

Figure 1-7. Installation Drawing 03144-0324, Rev. AB

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY	REVISIONS				
	REV	DESCRIPTION	CHG. NO.	APP'D	DATE
	AA	NEW RELEASE	RTC1011243	D.B.	7/17/01
AB	CHANGE ISSEP REFERENCES TO KEMA	RTC1011874	D.B.	11/26/01	

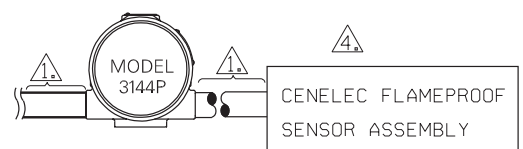
  

**HAZARDOUS AREA**



**DIRECT MOUNT SENSOR CONFIGURATIONS**

**HAZARDOUS AREA**




**REMOTE MOUNT SENSOR CONFIGURATIONS**

7. WAIT 10 SECONDS AFTER DISCONNECTING POWER BEFORE REMOVING COVER.
6. A CONDUIT PLUG MUST BE INSTALLED INTO ANY UNUSED CONDUIT ENTRIES.
5. ROSEMOUNT MODELS 3144P KEMA/CENELEC FLAMEPROOF APPROVAL Ex II 2 G  
DESCRIPTION: EE x d IIC T6 (T<sub>amb</sub>= -40°C TO +70°C) T5 (-40°C TO +80°C), IP66

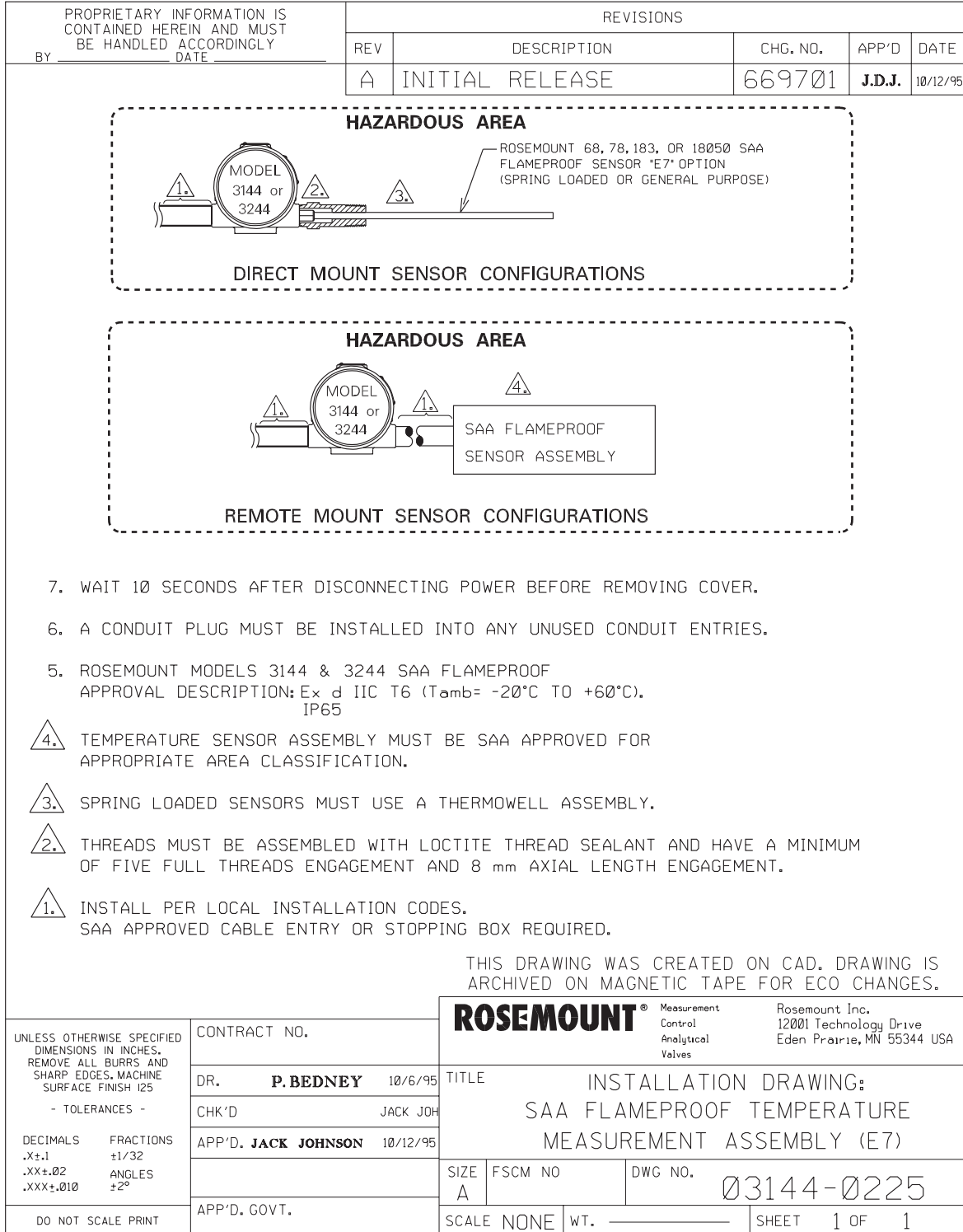
- 4. TEMPERATURE SENSOR ASSEMBLY MUST BE CENELEC APPROVED FOR APPROPRIATE AREA CLASSIFICATION.
- 3. SPRING LOADED SENSORS MUST USE A THERMOWELL ASSEMBLY.
- 2. THREADS MUST BE ASSEMBLED WITH LOCTITE THREAD SEALANT AND HAVE A MINIMUM OF FIVE FULL THREADS ENGAGEMENT AND 8 mm AXIAL LENGTH ENGAGEMENT.
- 1. INSTALL PER LOCAL INSTALLATION CODES.  
CENELEC APPROVED CABLE ENTRY OR STOPPING BOX REQUIRED.

CAD MAINTAINED (MicroStation)

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125  -TOLERANCE- .X ± .1 [2,5] .XX ± .02 [0,5] .XXX ± .010 [0,25]  FRACTIONS      ANGLES ± 1/32            ± 2°  DO NOT SCALE PRINT	CONTRACT NO.		 <b>ROSEMOUNT®</b> 8200 Market Boulevard • Chanhassen, MN 55317 USA	
	DR. <b>NGA DOAN</b>	6/29/01	TITLE	
	CHK'D		INSTALLATION DRAWING:	
	APP'D. <b>DIRK BAUSCHKE</b>	7/17/01	KEMA/CENELEC FLAMEPROOF TEMPERATURE MEASUREMENT ASSEMBLY (EI)	
	APP'D. GOVT.		SIZE A	FSCM NO.
		SCALE NONE	WT. _____	SHEET 1 OF 1

**Standard Association of Australia (SAA) Flameproof**

Figure 1-8. Drawing 03144-0225, Rev. A



# Series 58C, 68, 68Q, and 78 RTD

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## **Emerson Process Management**

### **Rosemount Inc.**

8200 Market Boulevard  
Chanhassen, MN 55317 USA  
T (U.S.) 1-800-999-9307  
T (International) (952) 906-8888  
F (952) 949-7001

[www.rosemount.com](http://www.rosemount.com)



### **Emerson Process Management Temperature GmbH**

Frankenstrasse 21  
63791 Karlstein  
Germany  
T 49 (6188) 992 0  
F 49 (6188) 992 112

### **Emerson Process Management Asia Pacific Private Limited**

1 Pandan Crescent  
Singapore 128461  
T (65) 6777 8211  
F (65) 6777 0947  
[AP.RMT-Specialist@emersonprocess.com](mailto:AP.RMT-Specialist@emersonprocess.com)



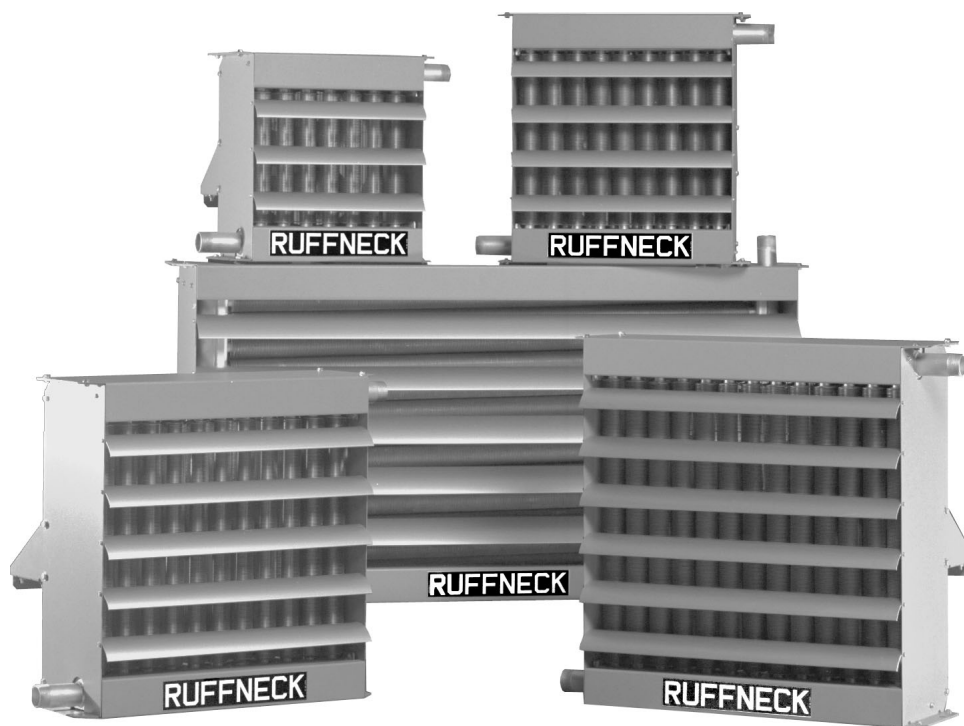
**EMERSON**  
Process Management

# RUFFNECK®

Owner's Manual

## Advanced Horizontal Series

Heat-Exchanger Unit Heaters



ISO 9001:2000  
Registered QMS  
OCB# 02-1977

This manual covers installations, maintenance, repair and replacement parts.

### **WARNING!**

**READ ALL IMPORTANT NOTICES ON PAGE 3.**

**PLEASE ADHERE TO INSTRUCTIONS PUBLISHED IN THIS MANUAL.**

**Failure to do so may be dangerous and may void certain provisions of your warranty.**

RUFFNECK® is a key brand of CCI Thermal Technologies Inc.  
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# HEATER MAINTENANCE CHECKLIST

For Heat-Exchanger Unit Heaters

Heater Model: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
Date of Maintenance: \_\_\_\_\_ Maintenance Done By: \_\_\_\_\_  
Comments: \_\_\_\_\_

## WARNING

Heater should only be serviced by qualified personnel with heating equipment experience. Disconnect heater from power supply before servicing heater. Lock the switch in the "OFF" (open) position and/or tag the switch to prevent unexpected power application.

### PERIODIC (before and as required during heating season)

- |  |  |
|--|--|
| <p>1. <b>CLEAN</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Finned Tubes</li> <li><input type="checkbox"/> Fan</li> <li><input type="checkbox"/> Fan Guard</li> <li><input type="checkbox"/> Motor</li> <li><input type="checkbox"/> Louvers</li> </ul> | <p>2. <b>CHECK</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Motor for smooth, quiet operation</li> <li><input type="checkbox"/> Louvers for proper angle and tightness</li> <li><input type="checkbox"/> Electrical junction box cover for tightness</li> </ul> |
|--|--|

Remove dust using compressed air. Do not spray with water or solvents.

### ANNUAL (before heating season)

1. **ELECTRICAL**
  - Check all terminal connections and conductors.** Tighten loose connections. Conductors with damaged insulation must be replaced.
  
2. **MECHANICAL**
  - Check for fluid leakage.** If any fluid leakage occurs from the heater, remove it from service and have the heat exchanger replaced. A factory supplied heat exchanger can be shipped in less than a week from stock. Refer to the "Repair and Replacement" section for details.
  - Electrical junction box.** Inside of enclosure must be clean, dry, and free of foreign materials. Cover must be completely on and tight.
  - Check motor shaft bearing play.** Replace motor if play is excessive or if motor does not run quietly and smoothly. Motor bearings are permanently lubricated.
  - Check fan.** Replace immediately if cracked or damaged.
  - Check louvers.** Louver screws should be tight. Louvers are not to be closed more than 75° from horizontal.
  - Check the tightness of all hardware.** All nuts and bolts, including mounting hardware, must be tight.
  - TURN HEATER MOTOR ON FOR A MINIMUM OF 15 MINUTES.** Check for air exiting heater through louvers and smooth running of fan motor.



For assistance, please call  
Toll Free: 1-800-661-8529 (24 hrs)  
U.S. & Canada

# IMPORTANT NOTICES

## **WARNING:**

**Read and adhere to the following. Failure to do so may result in severe or fatal injury.**

1. Read and follow the instructions in this manual.
2. Heaters are to be installed and serviced only by qualified personnel experienced in electrical and piping work.
3. Installation, piping, and wiring of the heater must adhere to all applicable codes.
4. It is essential that any unit heater that will be used in a hazardous (classified) location is equipped with a electric motor approved for such service, and the temperature of the heat transfer medium is below the ignition temperature of the atmosphere.
5. Do not operate heater in atmospheres which are corrosive to steel or aluminum, unless it has been coated with a factory approved protective coating.
6. For steam service use only single-pass models. Refer to model coding (page 7) for number of passes in heat exchanger.
7. Refer to heat exchanger data plate for pressure and temperature limits.
8. Heater must be kept clean. When operating in a dirty environment, regularly clean the finned tubes, fan and fan guard. Follow the recommended maintenance procedures. Refer to the "Heater Maintenance Checklist" section for details.
9. Use factory approved replacement parts only.
10. If there are any questions or concerns regarding the heater, contact the factory. Refer to the last page of this manual for details.

**WARRANTY WILL BE VOID  
IF INSTRUCTIONS ARE NOT FOLLOWED**

## INSTALLATION

The installation instructions provide a general guideline for the installation and wiring of the heater. All applicable codes must be adhered to.

### **MECHANICAL**

#### LOCATION

1. For optimum heating, the heaters should be installed as follows:
  - a. There are no obstructions that may impede the heater's air inlet or discharge.
  - b. The air discharge is directed into open areas and not at occupants.
  - c. The air discharge is not directed at a thermostat.
  - d. The air discharge is directed across areas of heat loss, such as doors and windows (see Figure 1).
  - e. The air discharge is directed along, and at a slight angle towards, exterior walls (see Figure 1).
  - f. If equipment freeze protection is important, direct air discharge at equipment.
  - g. Air discharge streams support each other and create a circular air flow. It is not required that the heater's air throw reaches the next heater.
  - h. For warehouses or large workshops it may be acceptable to use fewer, larger heaters.

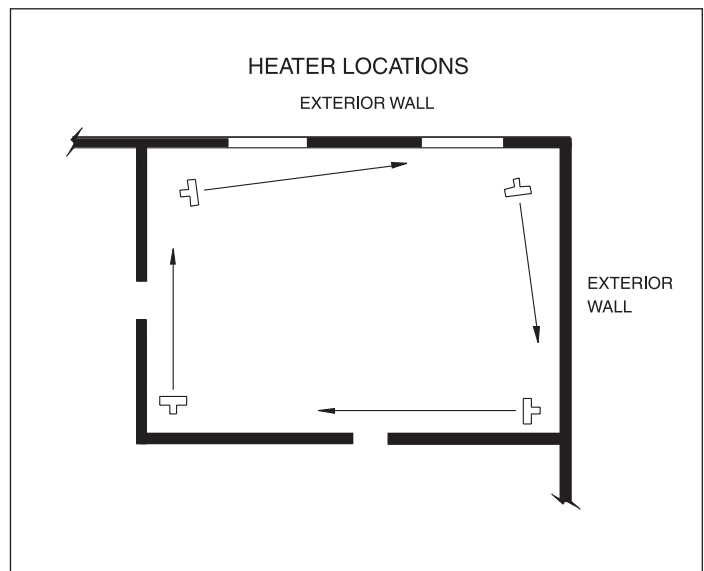


FIGURE 1

## MOUNTING

- The unit heater is designed to be installed in an upright and level position. However, it may be installed in any position provided that for steam service the inlet is above the outlet and the bottom of the heat exchanger drains towards the outlet.
- Heater cabinets are designed to be mounted from the top or bottom using 1/2" (14 mm) bolts. For heater dimensions, see Figure 2 for single fan or Figure 3 for 24" tandem.

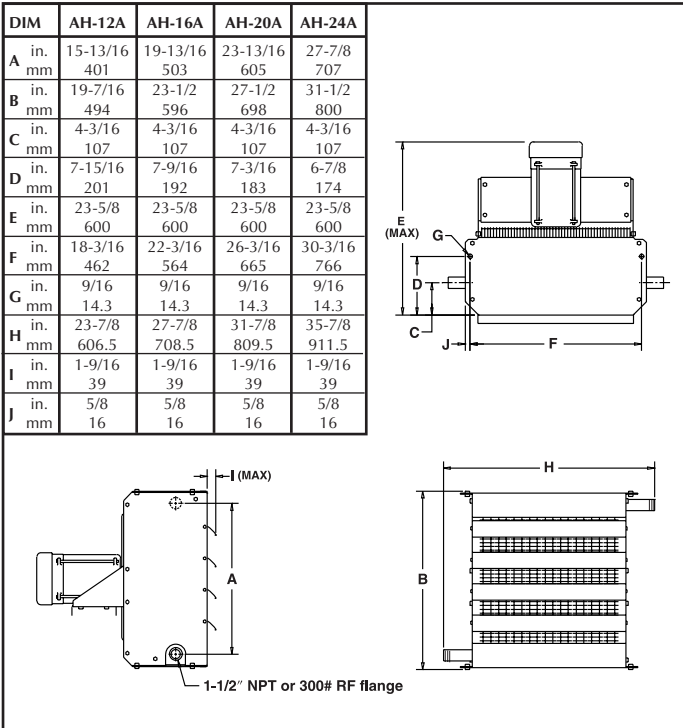


FIGURE 2

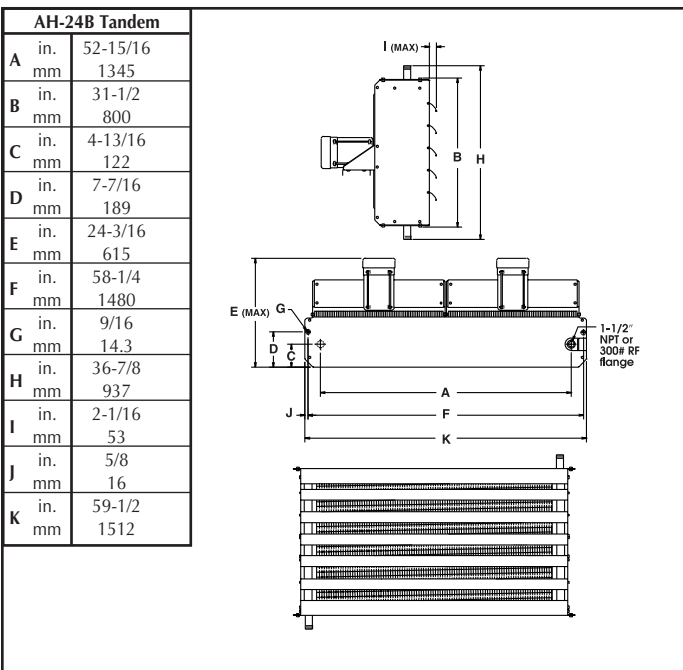


FIGURE 3

- The mounting structure must be strong enough to:
  - support the heater's weight (refer to the specification section),
  - provide sufficient stiffness to prevent excessive vibration, and
  - withstand abusive situations such as transportable installations.
- For ease of installation, a variety of mounting kits are available from the factory.

## MOUNTING HEIGHTS

- In order to ensure that warm air reaches the floor, heaters are typically mounted 7-1/2' (2.3 m) to 12' (3.7 m) above the floor.
- Heaters may be mounted at higher elevations and still provide warm air at the floor level. The maximum elevation at which warm air will still reach the floor depends on site and operation conditions.
- Louvers can be adjusted to provide greater downward deflection of the discharge air. It is recommended that louvers not be closed more than 75° from full open.

## MOUNTING CLEARANCES

- Leave at least 20" (500 mm) clearance between the rear of the motor and the nearest obstruction.
- Clearance equal to the height of the heater cabinet above, or beneath, the cabinet is required for easy fan or motor replacement.

## TEMPERATURE CONTROL

- If required, the unit heater's output may be thermostatically controlled by the following:
  - Airflow through the heat exchanger can be turned on and off by thermostatically controlling the fan motor. Usually the flow of the heat transfer medium is allowed to pass through the heat exchanger without interruption. This is the most economical method of controlling the heater.
  - Heat transfer medium flow may be controlled by a thermostatic valve, while allowing the fan motor to run continuously to circulate room air.
  - Absolute control of the heater output from the heat exchanger will require that the fan and heat transfer medium be shut off. Such control of the heater output is possible by a thermostatic valve control in combination with the thermostatic fan control.

## FINAL INSPECTION

- Before application of electrical power:
  - Check that all connections are secured and comply with the applicable wiring diagram (see Figure 7) and code requirements.
  - Confirm the power supply is compatible with the data plate rating on motor.
  - Remove any foreign objects from heater.
  - Ensure all electrical covers are well secured.
  - Ensure the fan rotates freely, ensure air exits through louvers and the fan rotates counterclockwise when viewed from the rear of the heater.



## PIPING APPLICATIONS

1. For steam service use only single-pass heaters. Refer to Model Coding Section for tube-side pass designation.
2. Refer to figures 4-6 for typical piping applications.
3. To prevent condensate from entering the heater, slope steam supply lines toward the steam main. In long supply lines, drip traps may be needed.
4. For steam systems, use properly sized continuously draining steam traps, such as float or thermostatic types. Traps must be sized to handle start up and operational flows.
5. If the condensate return main is above the heater outlet or is pressurized, install a check valve after the steam trap and a drain valve at the strainer to drain the system during the off season.
6. Allow for efficient condensate drainage and sub-cooling by maintaining the outlet pipe size between the heater and steam trap. Provide at least a 10 inch (254 mm) drop leg at condensate outlet.
7. In horizontal steam and condensate lines use eccentric reducers only.
8. Allow for pipe expansion.
9. Eliminate pipe stress by adequately supporting all piping. Do not rely on heater to support piping.
10. All piping must be properly sized for expected flow rates.
11. For more piping information, consult industrial piping handbooks.
12. Comply with all applicable piping codes.

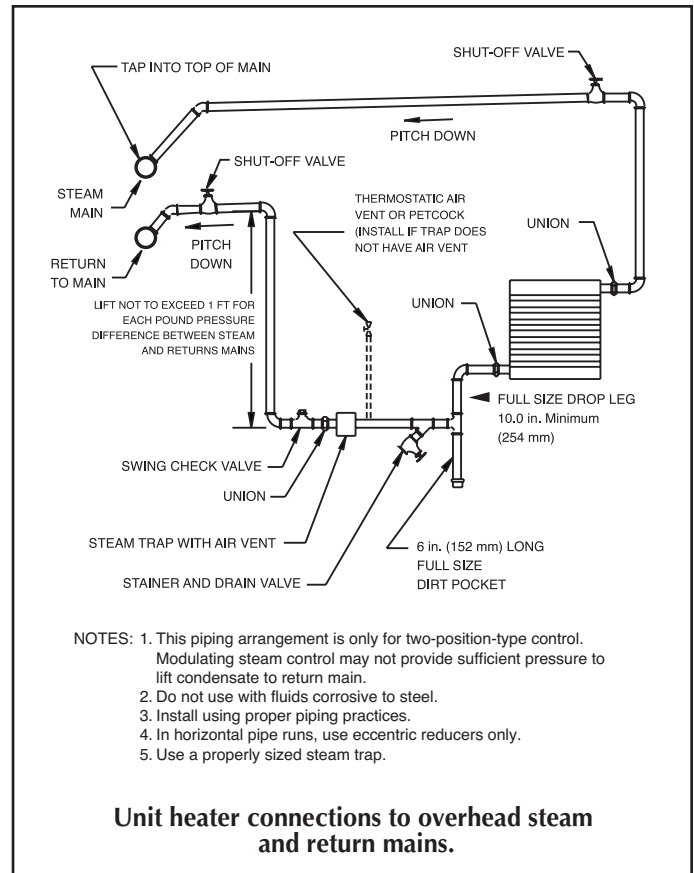


FIGURE 4

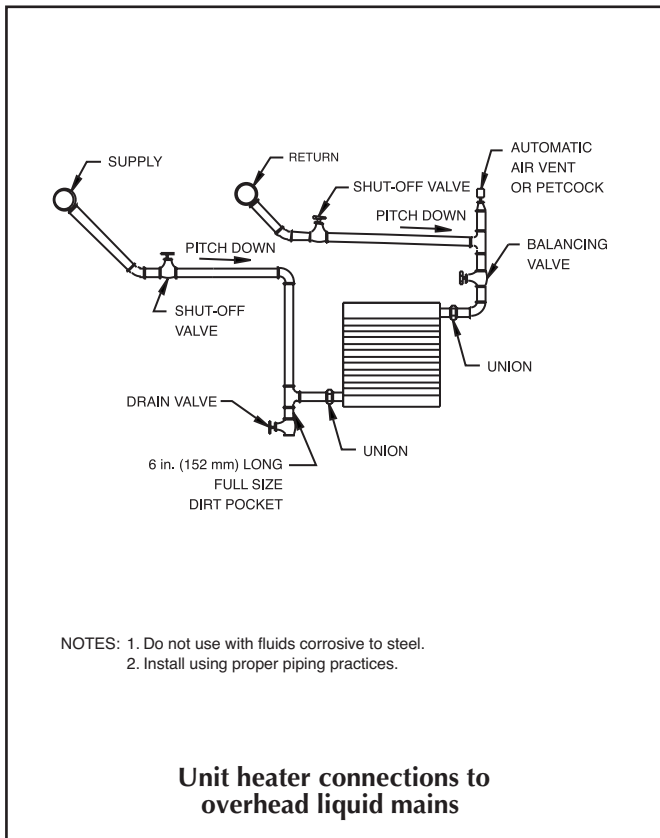


FIGURE 5

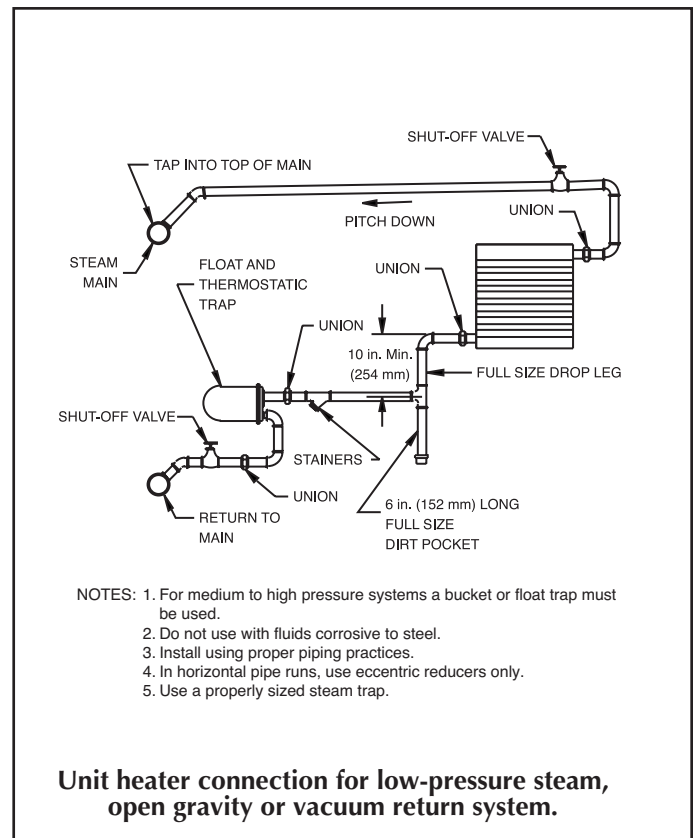
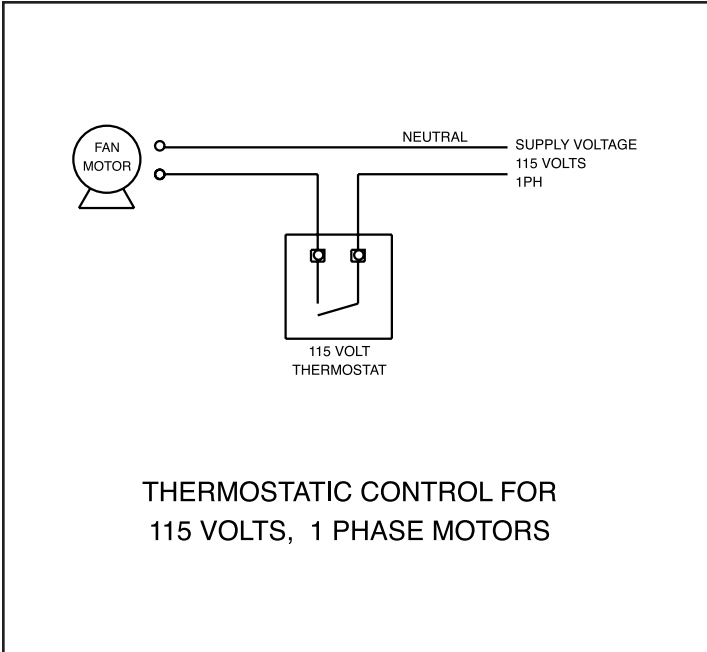


FIGURE 6

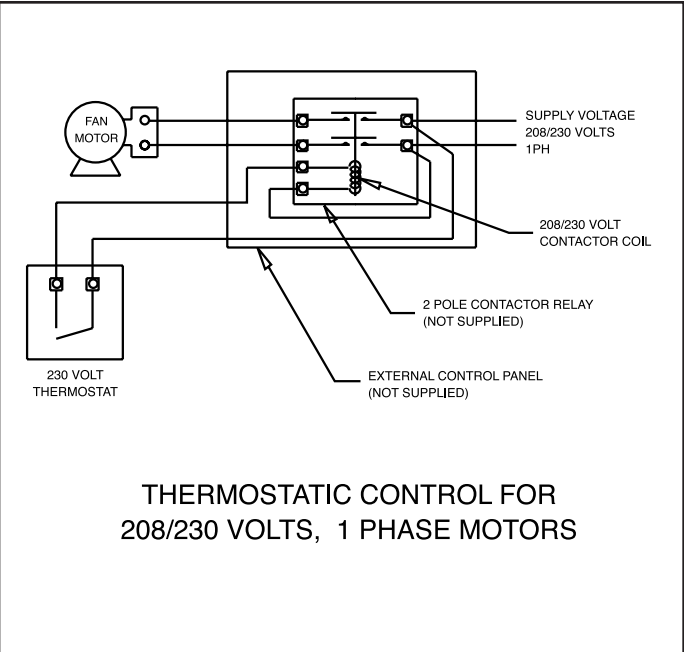
# MOTOR WIRING DIAGRAMS

## CAUTION

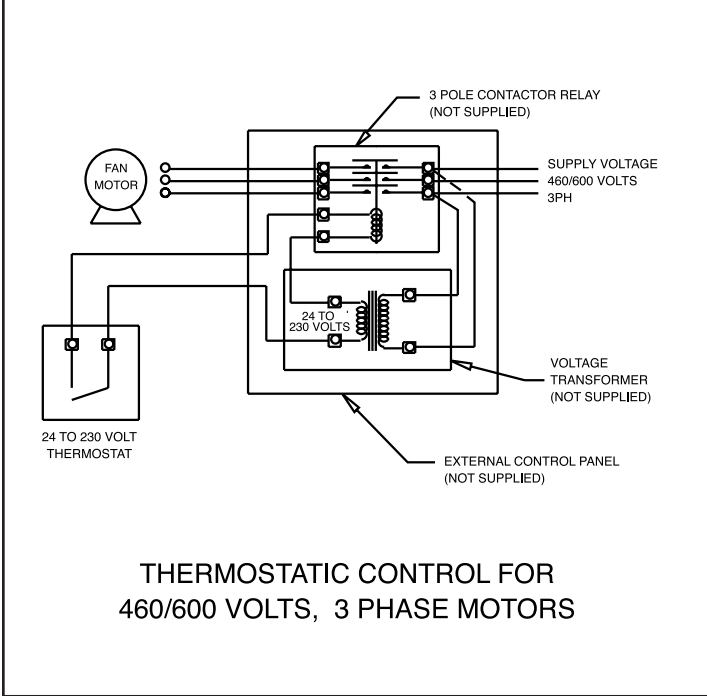
Installation must be done by qualified personnel, and comply with local electrical codes. For internal wiring of control devices and starters, consult device manufacturer. The thermostat must have an electrical rating equal to or exceeding the rating of the control device. For wiring of the fan motor, refer to diagram on the motor. These wires must be connected in series with the motor control circuit.



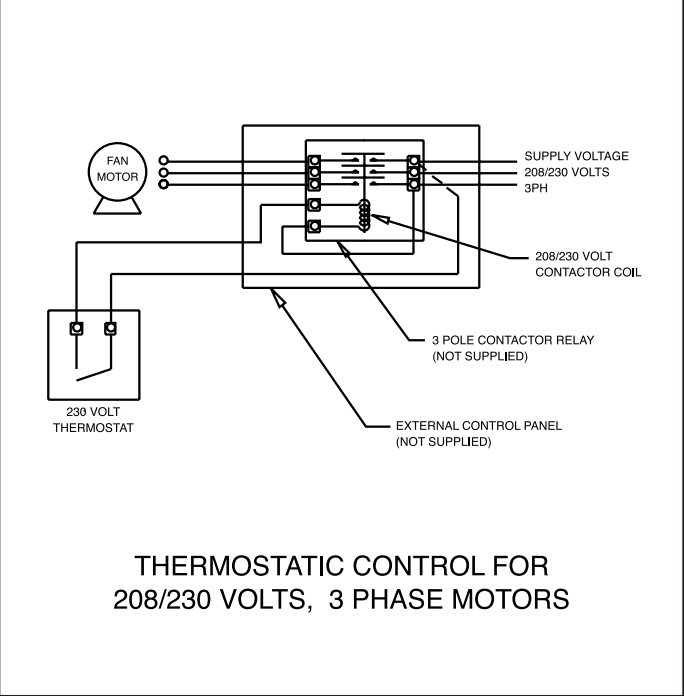
THERMOSTATIC CONTROL FOR 115 VOLTS, 1 PHASE MOTORS



THERMOSTATIC CONTROL FOR 208/230 VOLTS, 1 PHASE MOTORS



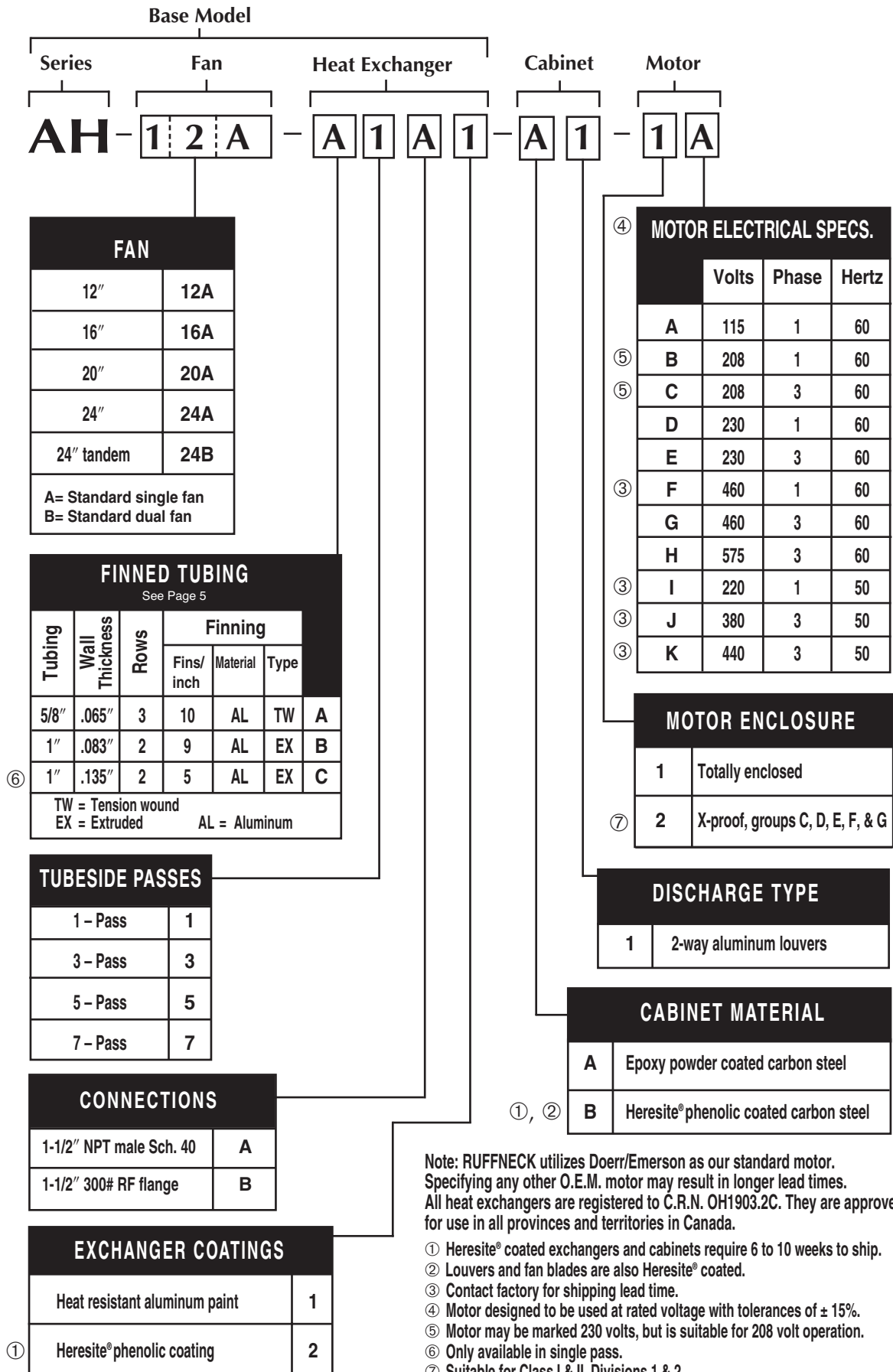
THERMOSTATIC CONTROL FOR 460/600 VOLTS, 3 PHASE MOTORS



THERMOSTATIC CONTROL FOR 208/230 VOLTS, 3 PHASE MOTORS

FIGURE 7

# MODEL CODING



Note: RUFFNECK utilizes Doerr/Emerson as our standard motor. Specifying any other O.E.M. motor may result in longer lead times. All heat exchangers are registered to C.R.N. OH1903.2C. They are approved for use in all provinces and territories in Canada.

- ① Heresite® coated exchangers and cabinets require 6 to 10 weeks to ship.
- ② Louvers and fan blades are also Heresite® coated.
- ③ Contact factory for shipping lead time.
- ④ Motor designed to be used at rated voltage with tolerances of ± 15%.
- ⑤ Motor may be marked 230 volts, but is suitable for 208 volt operation.
- ⑥ Only available in single pass.
- ⑦ Suitable for Class I & II, Divisions 1 & 2.

# REPAIR & REPLACEMENT

## WARNING

Heater should only be serviced by qualified personnel with heating equipment experience. Disconnect heater from power supply before repairing heater. Lock the switch in the off (open) position and/or tag the switch to prevent unexpected power application. Heater surfaces may be hot.

1. After repairing any component:
  - a. Check that electrical connections are correct and secure.
  - b. Remove any foreign material from enclosures,
  - c. Install and secure all covers.
  - d. Ensure that all fasteners are tight.
  - e. Remove all foreign objects from heater.
  - f. Ensure air exits through louvers and fan rotates counterclockwise when viewed from rear of heater (see Figure 9).

## MOTOR, FAN, AND FAN GUARD

1. Remove bolts holding motor to the motor mount.
2. Remove the two piece fan guard assembly (see Figure 10).
3. Lift the motor assembly off the motor mount.
4. Before removing the fan, measure and record the location of the fan hub on the motor shaft (see Figure 11). If fan is difficult to remove, use a gear puller on the fan hub.
5. To reassemble, position fan on motor shaft and tighten set screws.
6. Place motor assembly onto motor mount and fasten the fan guard to cabinet.
7. Center fan in shroud opening. Leave approximately 1/16" to 3/16" (1.6 to 4.8 mm) gap between the motor and fan guard. (see Figure 8).
8. Bolt motor to motor mount. Manually spin the fan blade to ensure it rotates freely before applying power.
9. Air must exit through louvers and fan must rotate counterclockwise when viewing from the rear of the heater (see Figure 9).

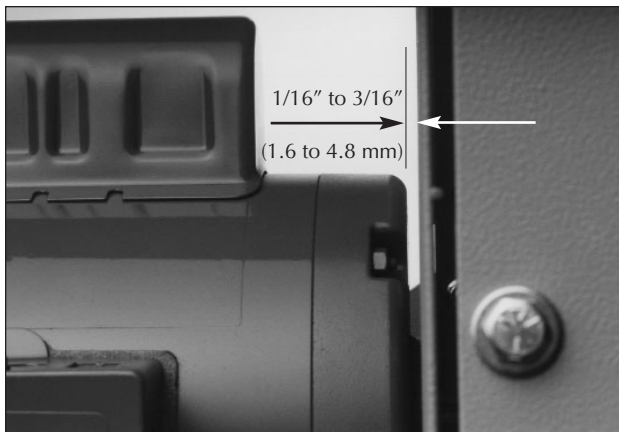


FIGURE 8

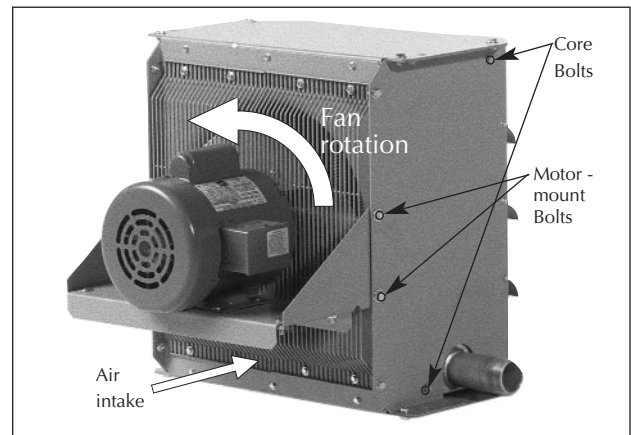


FIGURE 9

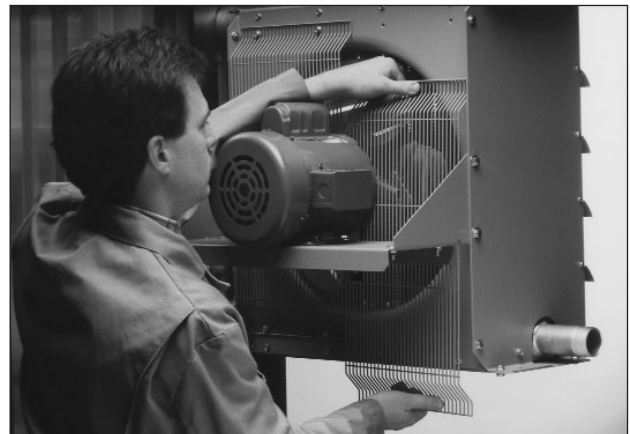


FIGURE 10



FIGURE 11

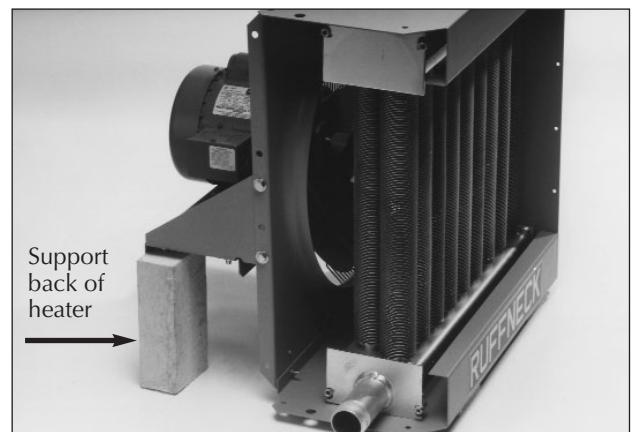


FIGURE 12

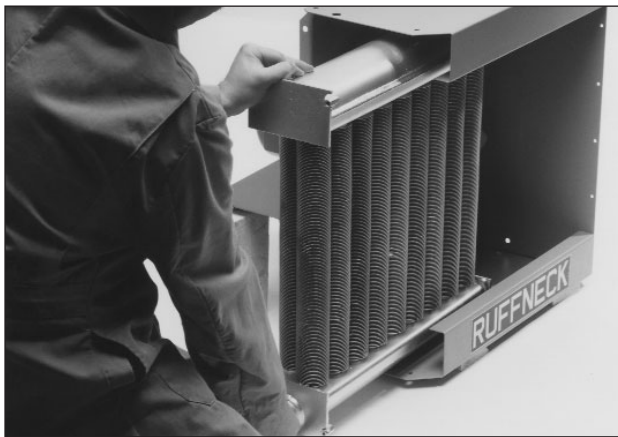


FIGURE 13

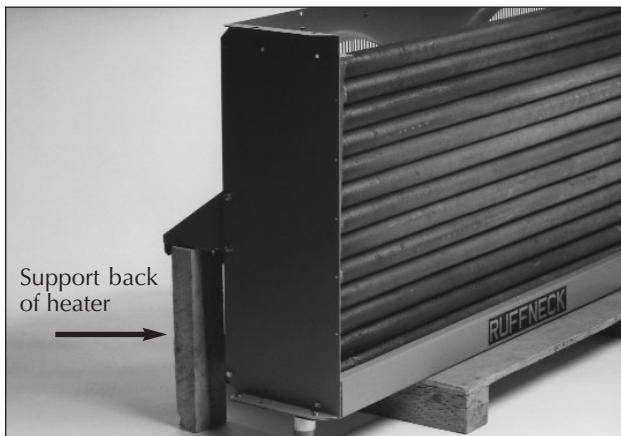


FIGURE 14



FIGURE 15



FIGURE 16

## HEAT EXCHANGER REMOVAL OF SINGLE- MOTOR UNIT HEATER

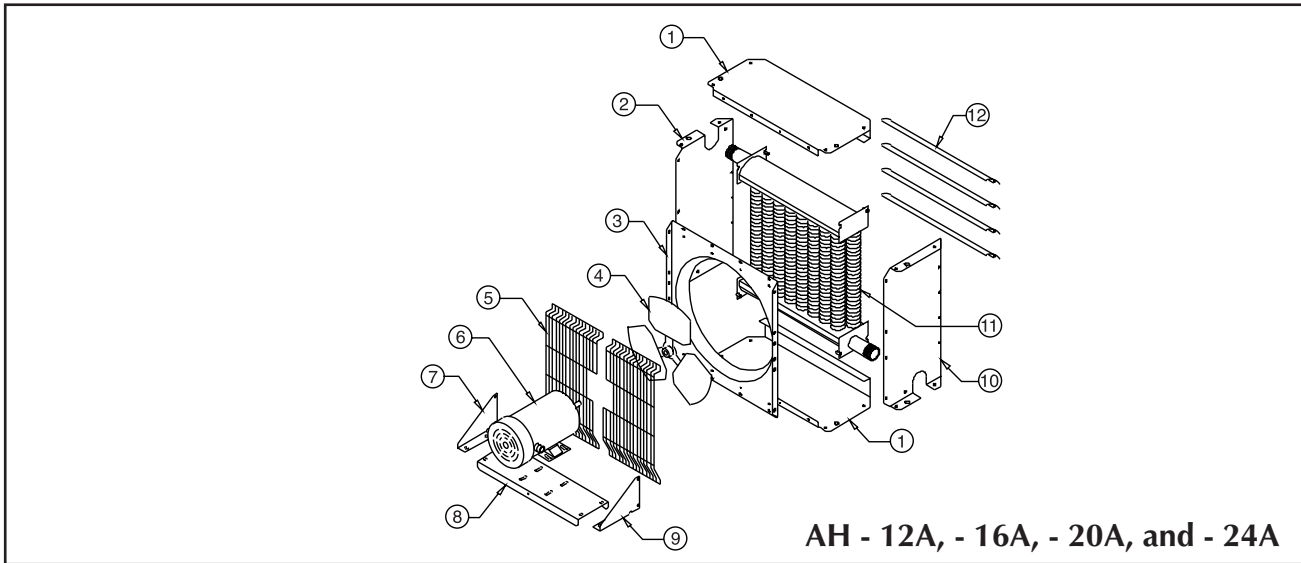
1. Remove unit heater from its mounted location and lower to a stable working surface.
2. Remove all louver blades from the front of the cabinet.
3. Remove the left fan guard and left cabinet side panel as described below. If the heat exchanger has flanged connections, also remove the top cabinet panel.
4. Support the weight of the heat exchanger by the piping connection while removing the four core bolts that fasten the heat exchanger to the cabinet. (See figure 9). Allow heat exchanger to rest on the bottom of the cabinet.
5. Remove the two bolts holding the motor mount to the left side of the cabinet. Support motor mount while removing these two bolts. Once cabinet side has been removed, reinsert the bolts in the motor mount. Place a support under the motor mount to prevent the cabinet from rolling over during heat exchanger removal (see Figure 12).
6. With the cabinet side removed and motor mount supported, slide heat exchanger out of the cabinet. (see Figure 13). On larger units, assistance may be necessary due to the weight of the heat exchanger.
7. To install heat exchanger into cabinet, reverse order of heat exchanger removal procedure.

## HEAT EXCHANGER REMOVAL OF DOUBLE-MOTOR UNIT HEATER

(Due to the weight of the heat exchanger, an assistant is recommended to help with the following procedure.)

1. Remove unit heater from its mounted location and lower to a stable work surface. To prevent damage to the bottom piping connection, do not rest heater on connection while servicing.
2. Remove all louvers from the front of the cabinet.
3. Remove the top cabinet panel by removing the four bolts in the corners of the top panel and the fasteners along the top of the shrouds (see Figure 14).
4. Have an assistant support the weight of the heat exchanger while removing the eight bolts that fasten the heat exchanger to the cabinet (see Figure 15). Once the bolts on one side are removed, lower that side of the heat exchanger to rest on the bottom of the cabinet. Place a support under the motor mount of the cabinet to prevent the cabinet from rolling over during heat exchanger removal (see Figure 14).
5. Loosen cabinet side panel fasteners but do not remove. If the heat exchanger has flanged connections also remove the left side panel.
6. Lift the heat exchanger up and out through the front of the cabinet (see Figure 16).
7. To install heat exchanger procedure, reverse the order of heat exchanger removal procedure.

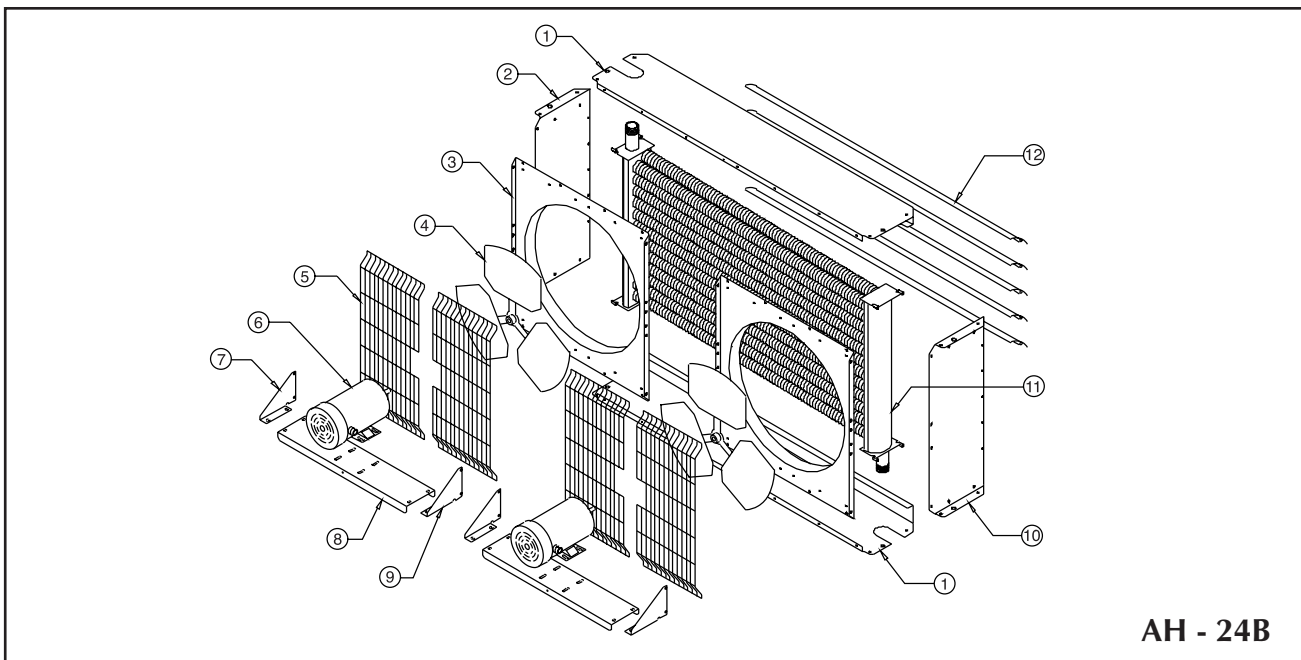
## PARTS LIST



**AH - 12A, - 16A, - 20A, and - 24A**

ITEM	AH-12A	AH-16A	AH - 20A	AH-24A	AH-24B	DESCRIPTION
1	5378	5382	5386	5390	5394	Panel,AH Top/Bottom
2	5376	5380	5384	5388	5392	Panel, AH Right Side
3	5379	5383	5387	5391	5391	Panel, AH Shroud
4	5448	5449	5450	5451	5451	Fan
5	4087	4088	4089	5396	5396	Fan Guard (half)
6	***	***	***	***	***	Motor
7	3789	3789	3789	3789	3789	Bracket, Motor Mount Right
8	3785	3786	3787	5433	5433	Channel, Motor Mount
9	3788	3788	3788	3788	3788	Bracket, Motor Mount Left
10	5377	5381	5385	5389	5393	Panel, AH Left Side
11	**	**	**	**	**	Heat Exchanger
12	4075	4076	4077	5741	5742	Kit, Louver (c/w screws)

\*\* Provide complete model and serial number of heater when ordering replacement heat exchanger.  
 \*\*\* Provide motor voltage, phase, horsepower and service classification when ordering replacement motor.  
 Note: For items not shown, contact factory



**AH - 24B**

## GENERAL SPECIFICATIONS

Approvals	CRN (Canada) - Steam and HVAC liquids only.
Fan	Three blade aluminum, steel spider and hub with 5/8" bore.
Fan Guard	Two piece design with close wire spacing. 3/8" diameter probe will not enter. Epoxy coated to match cabinet color.
Mounting Holes	9/16" diameter holes, two at top and two at bottom of heater.
Cabinet Material	14 gauge (0.075") steel. Epoxy coated with five-stage pretreatment, including iron phosphate.
Motors	CSA and/or UL listed 1725 RPM permanently lubricated ball bearing type with rigid base. Explosion-proof or totally enclosed construction. All 50 and 60 hertz, standard voltages available.
Louver Blades	Anodized extruded aluminum.
Header Material	3/16" (0.187") carbon steel.
Fluid Connections	1-1/2" NPT male Sch. 40 or 1-1/2" 300# RF flanges.
Max. Operating Press.	450 psi.
Max. Operating Temp.	650°F.
Finned Tubes	<ul style="list-style-type: none"> <li>• 5/8" outside diameter (16 gauge, 0.065" wall thickness) carbon steel tubes. Tension wound aluminum fins @ 10 fins per inch, or</li> <li>• 1" outside diameter (14 gauge, 0.083" wall thickness) carbon steel tubes. Extruded aluminum fins @ 9 fins per inch, or</li> <li>• 1" outside diameter (10 gauge, 0.135" wall thickness) carbon steel tubes. Extruded aluminum fins @ 5 fins per inch.</li> </ul>

## **MODEL SPECIFICATIONS**

Base Model*	Air delivery**	Air throw at 15 psi steam	Motor *** requirements	Tube passes	Net weight Δ	Shipping weight Δ
AH-12A-A__	1150 CFM	28' (8.5m)	1/4 HP	1 or 3	102 lbs.	142 lbs.
AH-12A-B__	1160 CFM	28' (8.5m)	1/4 HP	1 or 3	107 lbs.	147 lbs.
AH-12A-C1	1030 CFM	28' (8.5m)	1/4 HP	1	118 lbs.	158 lbs.
AH-16A-A__	1840 CFM	40' (12.2m)	1/4 HP	1, 3 or 5	127 lbs.	167 lbs.
AH-16A-B__	1780 CFM	40' (12.2m)	1/4 HP	1, 3 or 5	138 lbs.	178 lbs.
AH-16A-C1	1840 CFM	40' (12.2m)	1/4 HP	1	153 lbs.	193 lbs.
AH-20A-A__	2930 CFM	40' (12.2m)	1/2 HP	1, 3 or 5	155 lbs.	205 lbs.
AH-20A-B__	2700 CFM	40' (12.2m)	1/2 HP	1, 3 or 5	170 lbs.	220 lbs.
AH-20A-C1	3000 CFM	40' (12.2m)	1/2 HP	1	195 lbs.	245 lbs.
AH-24A-A__	3890 CFM	40' (12.2m)	1/2 HP	1, 3, 5 or 7	189 lbs.	249 lbs.
AH-24A-B__	3640 CFM	40' (12.2m)	1/2 HP	1, 3, 5 or 7	212 lbs.	272 lbs.
AH-24A-C1	3490 CFM	40' (12.2m)	1/2 HP	1	258 lbs.	318 lbs.
AH-24B-A__	7650 CFM	65' (19.8m)	(2) 1/2 HP	1, 3, 5 or 7	313 lbs.	413 lbs.
AH-24B-B__	7420 CFM	65' (19.8m)	(2) 1/2 HP	1, 3, 5 or 7	376 lbs.	476 lbs.
AH-24B-C1	6690 CFM	65' (19.8m)	(2) 1/2 HP	1	440 lbs.	540 lbs.

\* See page 7 for model coding.

\*\* At 70°F and sea level.

\*\*\* Ruffneck reserves the right to substitute motors of higher horsepower.

Δ Add 12 lbs to flanged units.

## LIMITED 1-YEAR WARRANTY

CCI Thermal Technologies Inc. warrants all RUFFNECK® Advanced Horizontal Series Unit Heaters against defects in materials and workmanship for a period of one (1) year from date of purchase on the following terms:

1. We will provide replacement parts free of charge as necessary to restore any unit to normal operating condition, provided that the inoperative parts be returned to us freight prepaid and that the replacement parts be accepted freight collect.
2. The complete heater may be returned to our plant for repair or replacement (at our discretion), provided that all related freight costs be borne by the customer.
3. Corrosion and contamination by dirt, dust, etc. will not be considered as defects and, therefore, are not warrantable.
4. The heater must not be modified in any way.
5. The heater must be installed, used and stored only in accordance with the owner's manual and placarded information.

This warranty shall be limited to the actual equipment involved and, under no circumstances, shall include or extend to installation or removal costs, or to consequential losses or damages.

## CLASSIFICATION

All RUFFNECK® AH heaters may be supplied with CSA or UL approved explosion-proof motor for use in hazardous locations. Divisions 1 & 2 Class I Groups C & D and Class II, Groups E, F, and G or TEFC (Totally Enclosed Fan Cooled) motors. Ensure the motor meets the classification requirements.

**PLEASE ADHERE TO INSTRUCTIONS PUBLISHED IN THIS MANUAL.**

**Failure to do so may be dangerous and may void certain provisions of your warranty.**

**For further assistance, please call:**

**24-Hour Hotline: 1-800-661-8529**

(U.S. and Canada)

Please have model and serial numbers available before calling.

**RUFFNECK®** 

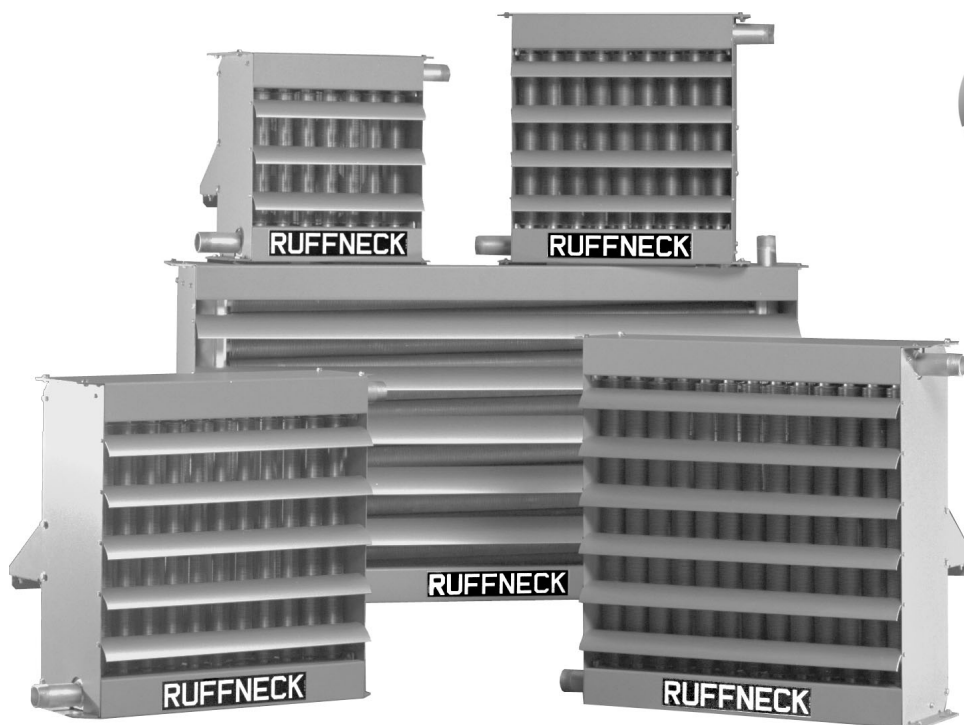
 **CCI Thermal**  
Technologies INC

5918 Roper Road  
Edmonton, Alberta T6B 3E1 Canada  
Phone: (780) 466-3178  
Fax: (780) 468-5904  
[www.ccithermal.com](http://www.ccithermal.com)



# RUFFNECK®

## Guide d'utilisation Aérothermes à échangeur de chaleur **Série AH** **Advanced Horizontal**



ISO 9001:2000  
Registered QMS  
QCB# 02-1977

Ce guide traite de l'installation, de la maintenance, de la réparation et des pièces.

### **AVERTISSEMENT**

**LIRE TOUS LES AVIS IMPORTANTS À LA PAGE 3.  
RESPECTER LES DIRECTIVES DU PRÉSENT GUIDE  
pour éviter tout danger ainsi que l'annulation de certaines dispositions de la garantie.**

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# LISTE DE CONTRÔLE DE MAINTENANCE DE L'AÉROTHERME

Pour aérothermes à échangeur de chaleur

Modèle d'aérotherme : \_\_\_\_\_ N° de série : \_\_\_\_\_

Date de maintenance : \_\_\_\_\_ Maintenance faite par : \_\_\_\_\_

Commentaires : \_\_\_\_\_

## AVERTISSEMENT

Seul un personnel qualifié et expérimenté avec les appareils de chauffage peut effectuer la maintenance de cet aérotherme. Couper l'alimentation électrique de l'aérotherme avant d'effectuer la maintenance de l'aérotherme. Régler l'interrupteur à la position OFF (arrêt) ou l'étiqueter pour empêcher tout branchement accidentel.

### PÉRIODIQUE (avant ou, au besoin, pendant la période de chauffe)

- |                    |   |                    |   |
|--------------------|---|--------------------|---|
| <b>1. NETTOYER</b> | <input type="checkbox"/> Tuyaux à ailettes    | <b>2. VÉRIFIER</b> | <input type="checkbox"/> Fonctionnement silencieux du moteur                          |
|                    | <input type="checkbox"/> Ventilateur          |                    | <input type="checkbox"/> L'angle et le serrage des lames déфлекtrices                 |
|                    | <input type="checkbox"/> Grille de protection |                    | <input type="checkbox"/> L'étanchéité du couvercle de la boîte de jonction électrique |
|                    | <input type="checkbox"/> Moteur               |                    |   |
|                    | <input type="checkbox"/> Lames déфлекtrices   |                    |   |

**Enlever la poussière au jet d'air comprimé. Ne pas vaporiser d'eau ni de solvants.**

### ANNUELLE (avant la période de chauffe)

- ENTRETIEN ÉLECTRIQUE**
  - Vérifier tous les conducteurs et les bornes de connexion.** Serrer les connexions lâches. Remplacer les conducteurs dont l'isolation est endommagée.
- ENTRETIEN MÉCANIQUE**
  - Vérifier s'il y a des fuites de fluide.** S'il y a des fuites de fluide de l'aérotherme, le retirer du système et remplacer l'échangeur de chaleur. Les échangeurs de chaleur tenus en inventaire peuvent être expédiés en moins d'une semaine. Pour plus de détails, consulter la section « Réparation et remplacement ».
  - Boîte de jonction électrique.** L'intérieur de la boîte de jonction doit être propre, sec et exempt de corps étrangers. Le couvercle doit être complètement fermé et étanche.
  - Vérifier les roulements de l'arbre du moteur.** Remplacer le moteur s'il y a jeu excessif des roulements d'arbre du moteur ou si le moteur ne tourne pas silencieusement. Les roulements du moteur sont lubrifiés en permanence.
  - Vérifier le ventilateur.** Si le ventilateur est fissuré ou endommagé, le remplacer immédiatement.
  - Vérifier les lames déфлекtrices.** Les vis des lames déфлекtrices doivent être serrées. L'angle de fermeture des lames déфлекtrices ne doit pas dépasser 75° à partir de l'horizontale.
  - Vérifier le serrage de toutes les attaches.** Tous les boulons, écrous, vis et pièces d'assemblage, doivent être bien serrés.
  - FAIRE FONCTIONNER LE MOTEUR DE L'AÉROTHERME PENDANT AU MOINS 15 MINUTES.** S'assurer que l'air sort par les lames déфлекtrices et que le moteur tourne silencieusement.

**RUFFNECK®** 

Pour de l'assistance, composer le  
numéro sans frais 1-800-661-8529 (24 heures sur 24)  
(Canada et É.-U.)

# AVIS IMPORTANTS

## AVERTISSEMENT :

**Lire et respecter les directives suivantes afin d'éviter tout risque de blessure grave ou mortelle.**

1. Lire et suivre les directives du présent guide.
2. L'installation et la maintenance de cet aérotherme ne doivent être effectuées que par les personnes qualifiées dans les travaux électriques et de tuyauterie.
3. L'installation de l'aérotherme, de la tuyauterie et du câblage doivent être conformes aux codes en vigueur.
4. Il est essentiel que tout aérotherme devant être utilisé dans un emplacement (classé) dangereux soit équipé d'un moteur électrique certifié pour utilisation dans les emplacements dangereux, et que la température du fluide caloporteur soit inférieure à la température d'inflammation de l'atmosphère.
5. Ne pas faire fonctionner l'aérotherme dans des environnements corrosifs pour l'acier ou l'aluminium, sauf si l'aérotherme est enduit d'un revêtement protecteur certifié par le fabricant.
6. Pour utilisation avec la vapeur, n'utiliser que les modèles à une seule passe. Vérifier le codage de modèle pour connaître le nombre de passes de l'échangeur de chaleur.
7. Vérifier les limites de pression et de température indiquées sur la plaque signalétique de l'échangeur de chaleur.
8. L'aérotherme doit être maintenu propre. S'il est utilisé dans un environnement propice à la saleté, nettoyer périodiquement les tuyaux à ailettes, le ventilateur et la grille de protection. Suivre les procédures de maintenance recommandées. Pour plus de détails, consulter la section « Liste de contrôle de maintenance de l'aérotherme. »
9. N'utiliser que les pièces de rechange originales du fabricant.
10. Pour toute question concernant l'aérotherme, communiquer avec le fabricant (voir la dernière page de ce guide).

**LA GARANTIE SERA ANNULÉE  
SI CES DIRECTIVES NE SONT PAS SUIVIES**

## INSTALLATION

Les directives d'installation donnent une idée générale de l'installation et du câblage de l'aérotherme. Se conformer à tous les codes en vigueur.

### INSTALLATION MÉCANIQUE

#### POSITIONNEMENT

1. Pour un chauffage optimal, installer l'aérotherme comme suit :
  - a. S'assurer qu'il n'y a aucune obstruction nuisant à l'arrivée d'air ou à la sortie d'air de l'aérotherme.
  - b. Diriger la sortie d'air vers les espaces ouverts et non vers les personnes.
  - c. Ne pas diriger la sortie d'air vers un thermostat.
  - d. Diriger la sortie d'air vers les zones de déperdition thermique, comme les portes ou les fenêtres (voir la figure 1).
  - e. Diriger la sortie d'air sur un petit angle le long des murs extérieurs (voir la figure 1).
  - f. Pour protéger un équipement contre le gel, la sortie d'air doit être dirigée vers cet équipement.
  - g. Les sorties d'air doivent être complémentaires et créer un courant circulaire. Il n'est pas nécessaire que le jet d'air d'un aérotherme atteigne le prochain aérotherme.
  - h. Pour les entrepôts ou ateliers à grande surface, on peut utiliser des aérothermes plus gros et moins nombreux.

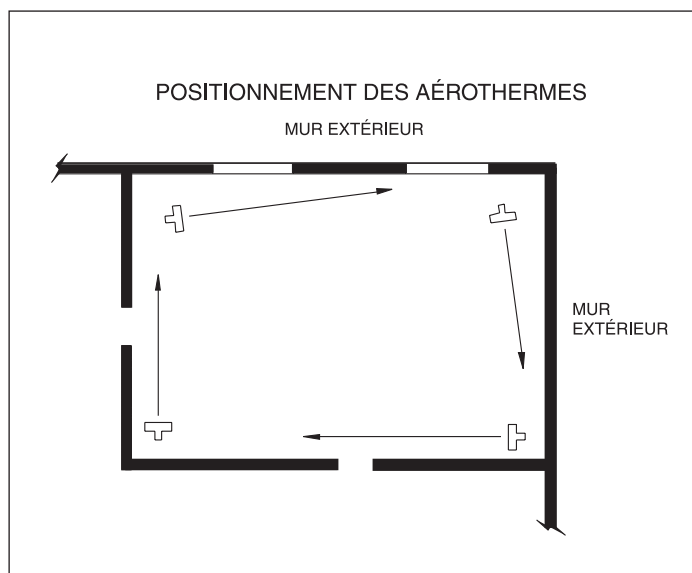


FIGURE 1

## INSTALLATION

- Cet aérotherme est conçu pour être installé en position verticale et de niveau. Cependant, il peut être installé dans n'importe quelle position, pourvu qu'en utilisant la vapeur, l'entrée soit située au-dessus de la sortie, et que le bas de l'échangeur de chaleur puisse drainer vers la sortie.
- Le boîtier d'aérotherme doit être vissé par le haut ou par le bas, en utilisant des boulons de 1/2 po (14 mm). Pour les dimensions d'aérotherme, voir la figure 2 (unités à un seul ventilateur) ou la figure 3 (unités de 24 po en tandem).
- La structure de la surface d'installation doit être suffisamment solide pour :
  - supporter le poids de l'aérotherme (voir la section « Spécifications »);

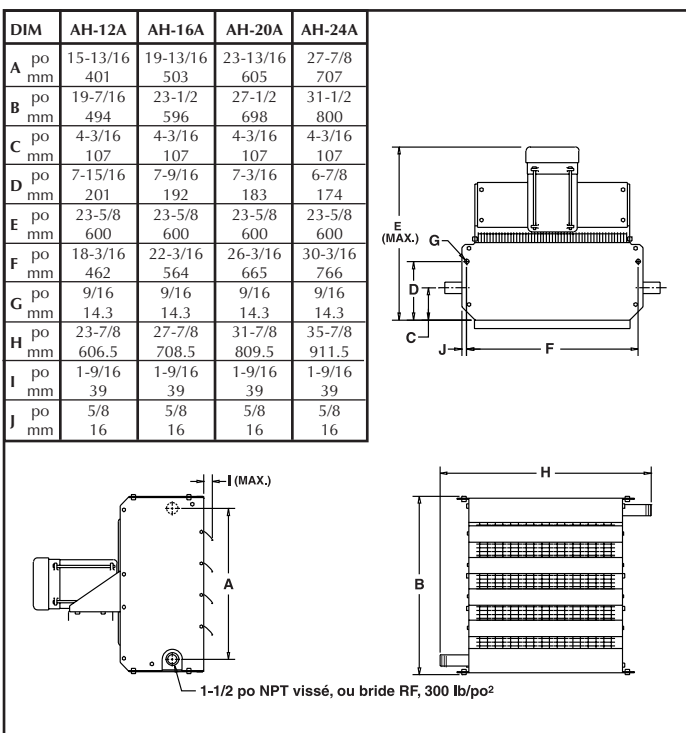


FIGURE 2

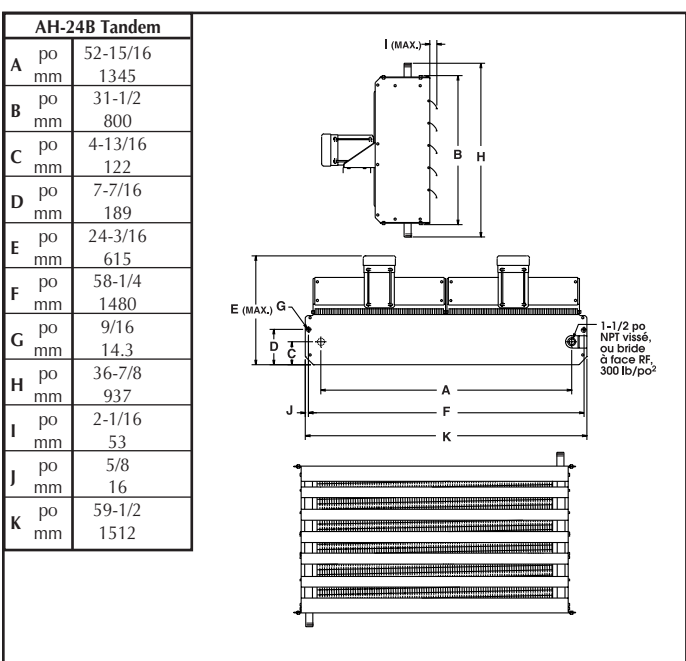


FIGURE 3

- offrir suffisamment de rigidité pour éviter les vibrations excessives; et
  - résister aux chocs comme ceux subis dans les installations mobiles des réchauffeurs.
- Afin de faciliter l'installation, plusieurs types de trusses de montage sont disponibles auprès du fabricant.

## HAUTEUR D'INSTALLATION

- Pour s'assurer que l'air chaud atteint le plancher, les aérothermes sont généralement installés à une hauteur comprise entre 7 1/2 pi (2,3 m) et 12 pi (3,7 m) au-dessus du plancher.
- Les aérothermes peuvent être installés plus haut et fournir quand même un apport d'air chaud au niveau du plancher. La hauteur maximale à laquelle l'air chaud peut atteindre le plancher dépend du lieu et des conditions de fonctionnement.
- Les lames déflectrices peuvent être ajustées pour projeter l'air davantage vers le plancher. L'angle de fermeture des lames déflectrices ne doit pas dépasser 75° à partir de l'horizontale.

## DÉGAGEMENT AUTOUR DE L'AÉROTHERME

- Laisser un dégagement minimal de 20 po (500 mm) entre l'arrière du moteur et l'obstacle le plus proche.
- Un dégagement équivalent à la hauteur totale de l'aérotherme est requis, en haut ou en bas de l'aérotherme, pour permettre un remplacement facile du ventilateur ou du moteur.

## RÉGULATION DE TEMPÉRATURE

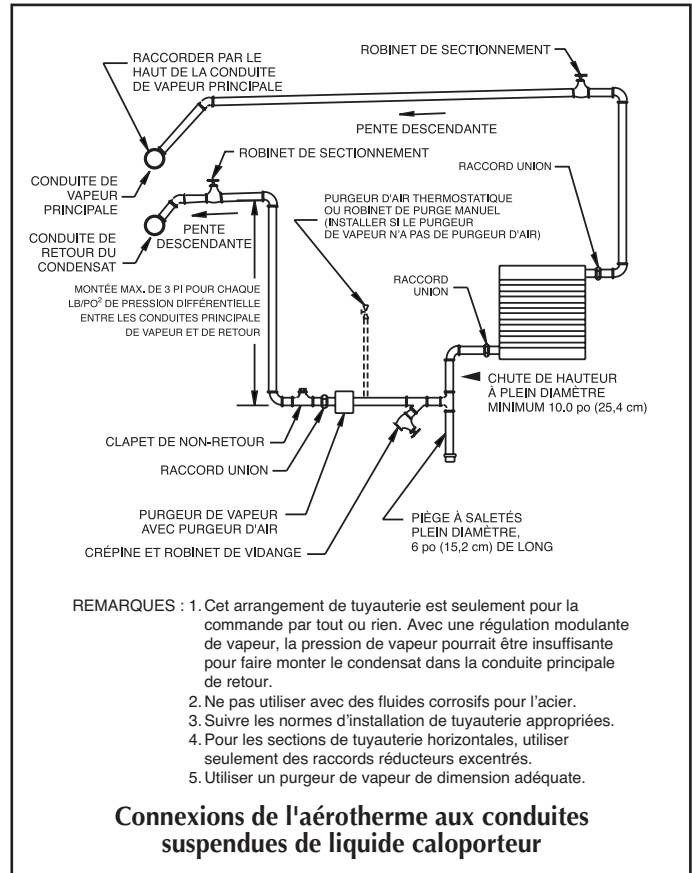
- Au besoin, la régulation de température de l'aérotherme peut être faite par thermostat, comme suit :
  - Le débit d'air à travers l'échangeur de chaleur peut être coupé ou rétabli par commande thermostatique du moteur de ventilateur. Habituellement, on laisse circuler le fluide caloporteur dans l'échangeur de chaleur sans interruption. C'est la méthode de régulation d'aérotherme la plus économique.
  - Le débit de fluide caloporteur peut être commandé par soupape thermostatique, permettant un fonctionnement continu du moteur de ventilateur pour maintenir la circulation d'air dans le local.
  - Pour une régulation absolue de température de sortie de l'aérotherme à partir de l'échangeur de chaleur, on doit pouvoir arrêter le ventilateur et couper le débit de fluide caloporteur. Pour ce faire, on utilise une commande à soupape thermostatique combinée à la régulation thermostatique du ventilateur.

## INSPECTION FINALE

- Avant de mettre sous tension :
  - S'assurer que toutes les connexions sont serrées et que l'installation est conforme au schéma de câblage pertinent (voir la figure 7) et aux exigences des codes.
  - S'assurer que l'alimentation électrique est compatible avec la puissance nominale de l'aérotherme, indiquée sur la plaque signalétique du moteur.
  - Retirer tout corps étranger de l'intérieur de l'aérotherme.
  - S'assurer que tous les couvercles des boîtiers électriques sont bien fermés.
  - S'assurer que le ventilateur tourne librement, que l'air sort par les lames déflectrices et que le ventilateur tourne en sens inverse des aiguilles d'une montre, vu de l'arrière de l'aérotherme.

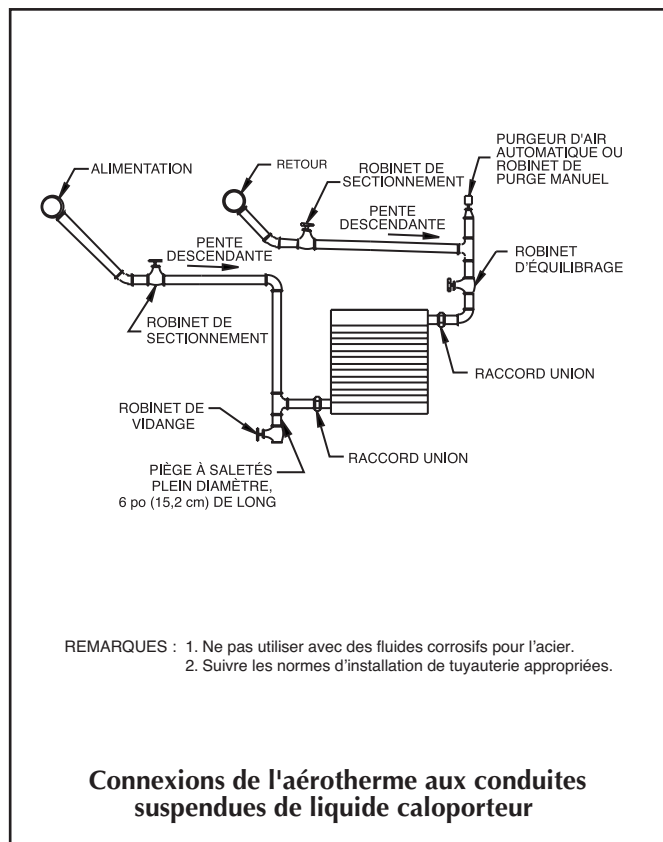
## INSTALLATION DE TUYAUTERIE

1. Pour utilisation sur système de vapeur, n'utiliser que des aérothermes à une seule passe. Se référer à la section « Codage de modèle » pour connaître le nombre de passes-tube.
2. Les installations typiques de tuyauterie sont illustrées aux figures 4 à 6.
3. Pour empêcher que le condensat n'entre dans l'aérotherme, diriger la pente descendante du tuyau d'alimentation de vapeur vers la conduite de vapeur principale. Pour les longs tuyaux d'alimentation, des clapets d'évacuation peuvent être requis.
4. Pour les systèmes de vapeur, utiliser des purgeurs de vapeur à drainage continu (ex. à flotteur ou thermostatiques), dimensionnés selon les débits de vapeur en service et au démarrage.
5. Si la conduite principale de retour du condensat est pressurisée ou située plus haut que la sortie de l'aérotherme, installer un clapet de non-retour après le purgeur de vapeur, et un robinet de vidange à la crépine pour drainer le système en période d'inutilisation.
6. Assurer un sous-refroidissement et drainage du condensat efficaces en conservant le plein diamètre du tuyau de sortie entre l'aérotherme et le purgeur de vapeur. Prévoir une chute de hauteur minimale de 10 po (25,4 cm) à la sortie du condensat de l'aérotherme.
7. Pour les conduites horizontales de vapeur et de condensat, utiliser seulement des raccords réducteurs excentrés.
8. Prévoir de l'espace en raison de l'élargissement de la tuyauterie.
9. Prévoir des supports adéquats pour réduire les contraintes dans la tuyauterie. L'aérotherme ne doit pas servir de support.
10. Toute la tuyauterie doit être dimensionnée adéquatement en fonction des débits prévus.
11. Pour plus de renseignements sur la tuyauterie, consulter les manuels techniques de tuyauterie industrielle.
12. Respecter tous les codes de tuyauterie en vigueur.



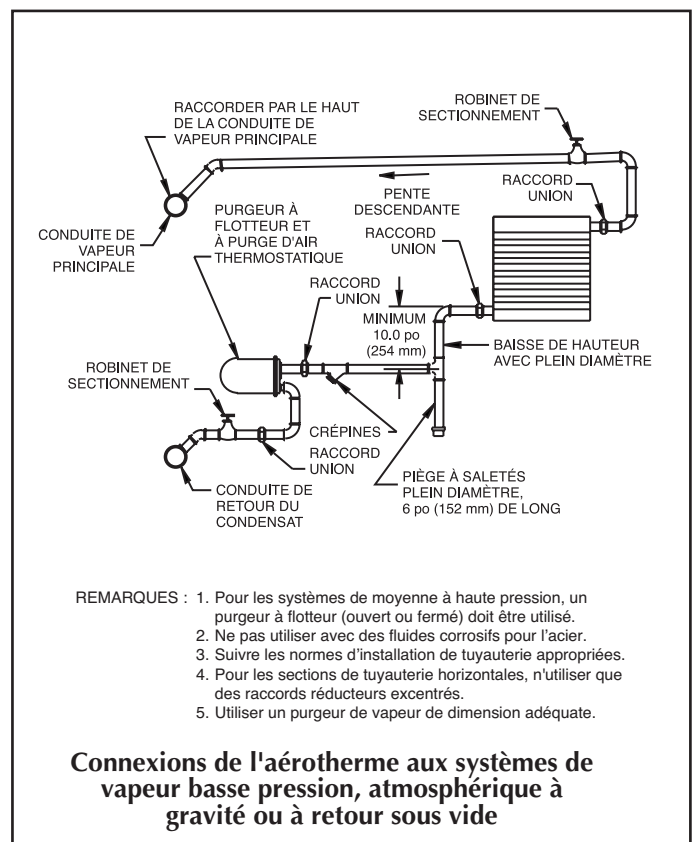
**Connexions de l'aérotherme aux conduites suspendues de liquide caloporteur**

FIGURE 4



**Connexions de l'aérotherme aux conduites suspendues de liquide caloporteur**

FIGURE 5



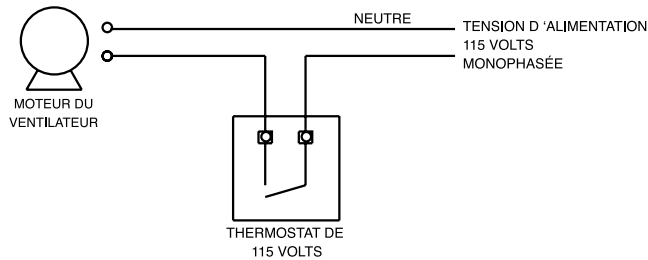
**Connexions de l'aérotherme aux systèmes de vapeur basse pression, atmosphérique à gravité ou à retour sous vide**

FIGURE 6

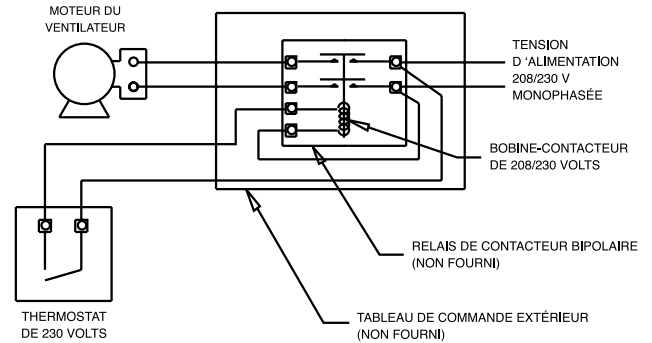
# SCHÉMAS DE CÂBLAGE DU MOTEUR

## AVERTISSEMENT

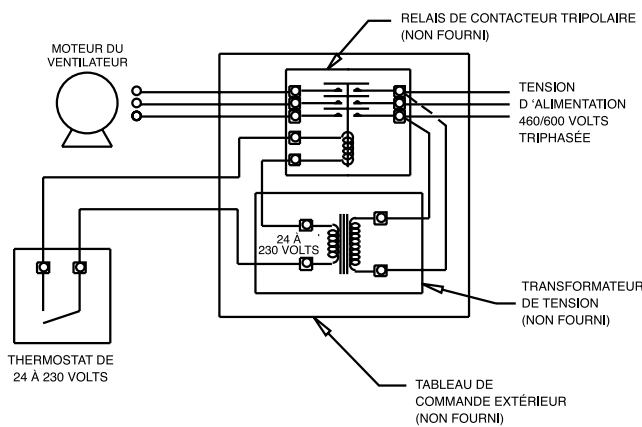
L'installation de l'aérotherme doit être effectuée par un personnel qualifié et doit être conforme à tous les codes électriques locaux. Pour le filage et câblage interne des appareils de régulation et démarreurs, consulter les fabricants de ces appareils. Le thermostat doit avoir des caractéristiques électriques équivalentes ou supérieures à celles des appareils de régulation. Pour le câblage du moteur de ventilateur, se référer à la plaque signalétique du moteur. Ces câbles et fils doivent être connectés en série avec l'unité de commande du moteur.



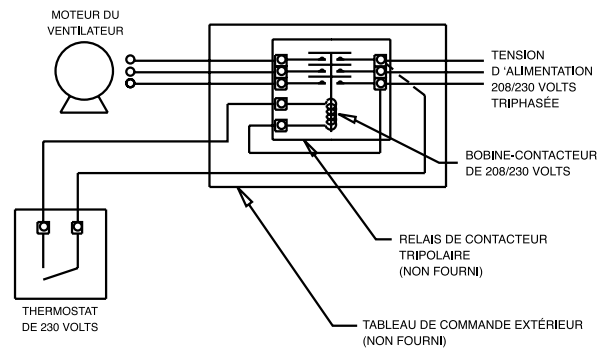
RÉGULATION THERMOSTATIQUE POUR MOTEURS MONOPHASÉS DE 115 VOLTS



RÉGULATION THERMOSTATIQUE POUR MOTEURS MONOPHASÉS DE 208/230 VOLTS



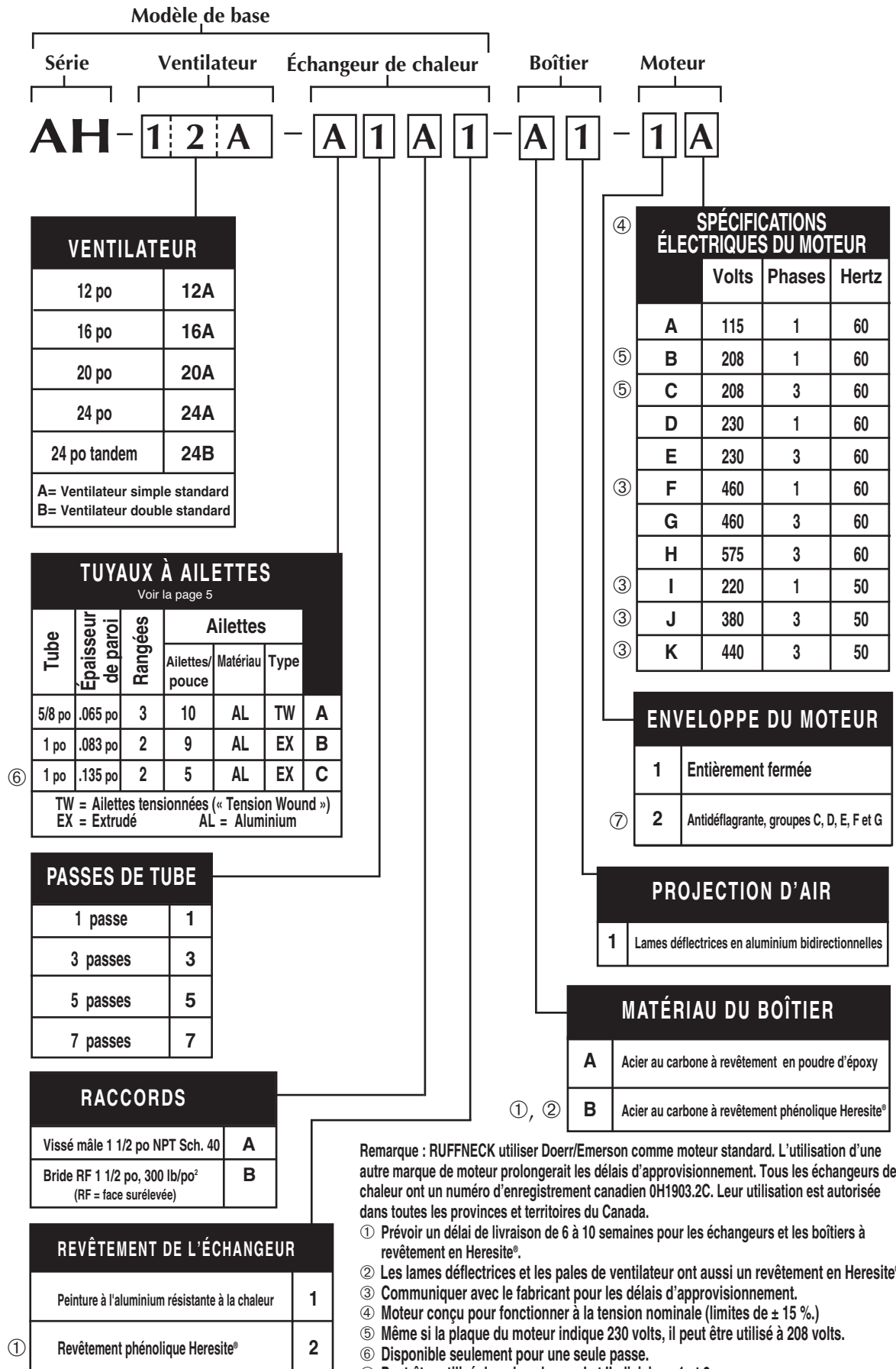
RÉGULATION THERMOSTATIQUE POUR MOTEURS TRIPHASÉS DE 460/600 VOLTS



RÉGULATION THERMOSTATIQUE POUR MOTEURS TRIPHASÉS DE 208/230 VOLTS

FIGURE 7

# CODAGE DE MODÈLE



# RÉPARATION ET REMPLACEMENT

## AVERTISSEMENT

Seul un personnel qualifié et expérimenté avec les appareils de chauffage peut effectuer la maintenance de cet aérotherme. Couper l'alimentation électrique de l'aérotherme avant d'effectuer la maintenance de l'aérotherme. Régler l'interrupteur à la position OFF (arrêt) ou l'étiqueter pour empêcher tout branchement accidentel. Les surfaces de l'aérotherme peuvent être chaudes.

1. Après avoir réparé un composant
  - a. Vérifier la qualité et le serrage des connexions électriques.
  - b. Retirer tout corps étranger de l'intérieur des boîtiers.
  - c. Installer et bien fixer tous les couvercles.
  - d. S'assurer que toutes les attaches soient bien serrées.
  - e. Retirer tout corps étranger de l'intérieur de l'aérotherme.
  - f. S'assurer que l'air sort par les lames déflectrices et que les pales du ventilateur tournent dans le sens inverse des aiguilles d'une montre lorsqu'on regarde de l'arrière de l'aérotherme (voir la figure 9).

## MOTEUR, VENTILATEUR ET GRILLE DE PROTECTION

1. Retirer les boulons retenant le moteur au support du moteur.
2. Retirer la grille de protection en deux parties (voir la figure 10).
3. Soulever et retirer le moteur du support de moteur.
4. Avant de retirer le ventilateur, mesurer et noter la position du moyeu du ventilateur sur l'arbre du moteur (voir la figure 11). Si le ventilateur est difficile à enlever, utiliser un extracteur d'engrenage sur le moyeu de l'hélice.
5. Pour réinstaller, placer le ventilateur sur l'arbre du moteur et serrer les vis de retenue.
6. Placer le moteur sur son support et fixer la grille de protection au boîtier.
7. Centrer le ventilateur dans l'ouverture de l'enveloppe. Laisser un écart d'environ 1/16 po à 3/16 po (1,6 mm à 4,8 mm) entre le moteur et la grille de protection (voir la figure 8).
8. Boulonner le moteur à son support. Avant de rétablir l'alimentation électrique, faire tourner à la main les pales du ventilateur pour s'assurer qu'elles tournent librement.
9. L'air doit sortir par les lames déflectrices et le ventilateur doit tourner dans le sens inverse des aiguilles d'une montre lorsqu'on regarde de l'arrière de l'aérotherme (voir la figure 9).

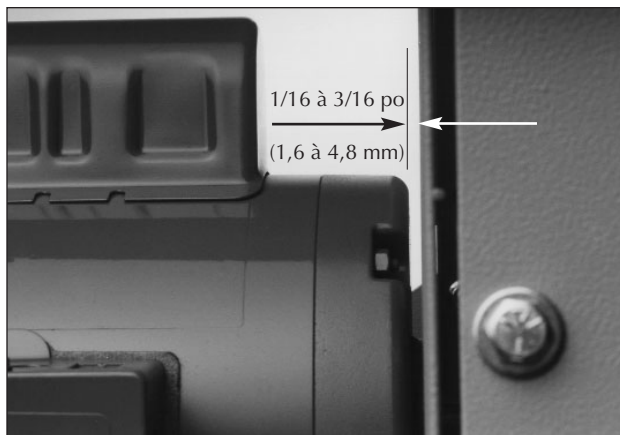


FIGURE 8

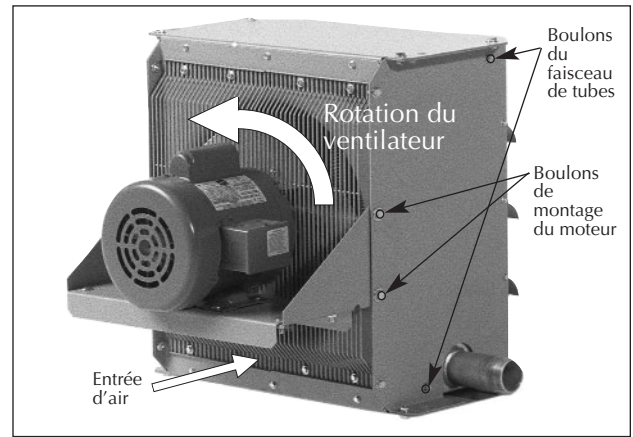


FIGURE 9



FIGURE 10



FIGURE 11

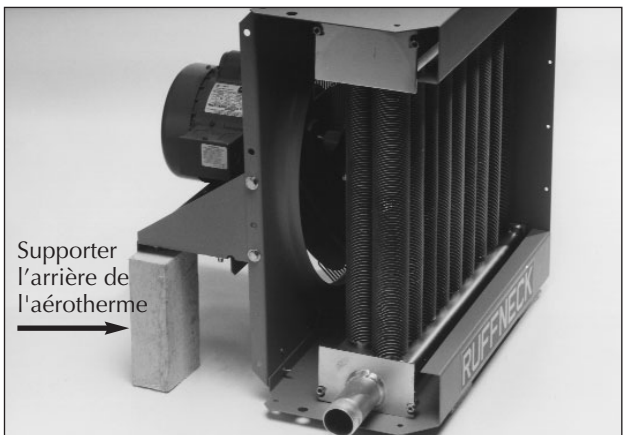


FIGURE 12



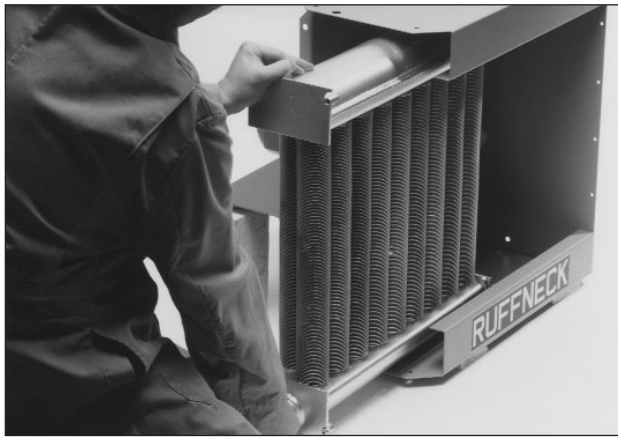


FIGURE 13



FIGURE 14



FIGURE 15



FIGURE 16

## DÉMONTAGE DE L'ÉCHANGEUR - AÉROTHERMES À 1 MOTEUR

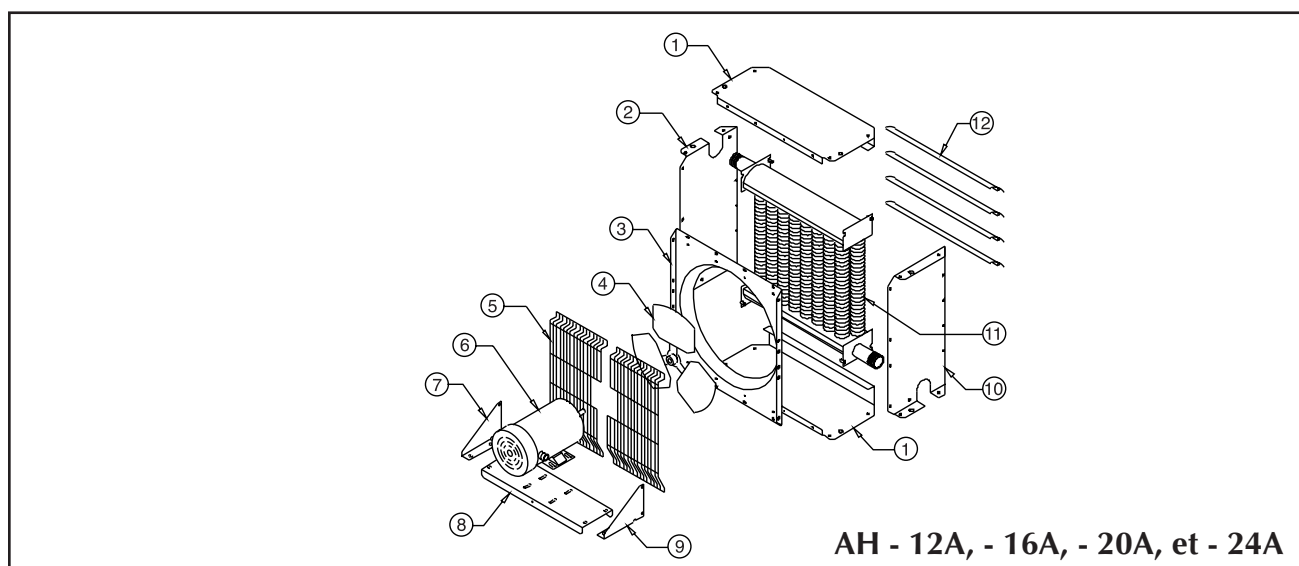
1. Enlever l'aérotherme de sa position d'utilisation et le poser sur une surface de travail stable.
2. Retirer toutes les lames déflectrices à l'avant du boîtier.
3. Retirer la grille de protection gauche du ventilateur et le panneau latéral gauche du boîtier tel que décrit ci-après. Si l'échangeur de chaleur a des raccords à brides, retirer aussi le panneau supérieur du boîtier.
4. Tout en supportant le poids de l'échangeur de chaleur par le raccord de tuyauterie, retirer les 4 boulons du faisceau retenant l'échangeur au boîtier (voir la figure 9). Déposer l'échangeur de chaleur sur le fond du boîtier.
5. Tout en supportant la base du moteur, retirer les deux boulons retenant la base du moteur au panneau latéral gauche du boîtier. Après avoir retiré ce panneau, réinsérer les boulons dans la base du moteur. Placer un support sous la base du moteur pour empêcher le boîtier de basculer lors du démontage de l'échangeur de chaleur (voir la figure 12).
6. Quand le panneau latéral du boîtier est enlevé, supporter la base du moteur pour sortir l'échangeur de chaleur du boîtier en le glissant (voir la figure 13). Pour les gros aérothermes, l'aide d'une autre personne peut être nécessaire à cause du poids de l'échangeur.
7. Pour réinstaller l'échangeur de chaleur dans le boîtier, inverser l'ordre de la procédure de démontage.

## DÉMONTAGE DE L'ÉCHANGEUR - AÉROTHERMES À 2 MOTEURS

(En raison du poids de l'échangeur de chaleur, il est recommandé d'avoir un assistant pour effectuer la procédure suivante.)

1. Enlever l'aérotherme de sa position d'utilisation et le poser sur une surface de travail stable. Pour éviter d'endommager les raccords de tuyauterie du bas, ne pas déposer l'échangeur de chaleur sur ces raccords.
2. Retirer toutes les lames déflectrices à l'avant de l'aérotherme.
3. Enlever le panneau supérieur du boîtier en retirant les boulons aux quatre coins ainsi que les attaches au haut de l'enveloppe (voir la figure 14).
4. Demander à un assistant de supporter le poids de l'échangeur de chaleur au moment de retirer les 8 boulons retenant l'échangeur au boîtier (voir la figure 15). Après avoir retiré les boulons d'un côté, déposer ce côté de l'échangeur sur le fond du boîtier. Placer un support sous la base du moteur pour empêcher le boîtier de basculer lors du démontage de l'échangeur (voir la figure 14).
5. Desserrer les attaches du panneau latéral du boîtier, mais sans les retirer. Si l'échangeur de chaleur a des raccords à brides, retirer aussi le panneau latéral gauche.
6. Soulever l'échangeur de chaleur pour le sortir par l'avant du boîtier (voir la figure 16).
7. Pour réinstaller l'échangeur de chaleur dans le boîtier, inverser l'ordre de la procédure de démontage.

## LISTE DES PIÈCES

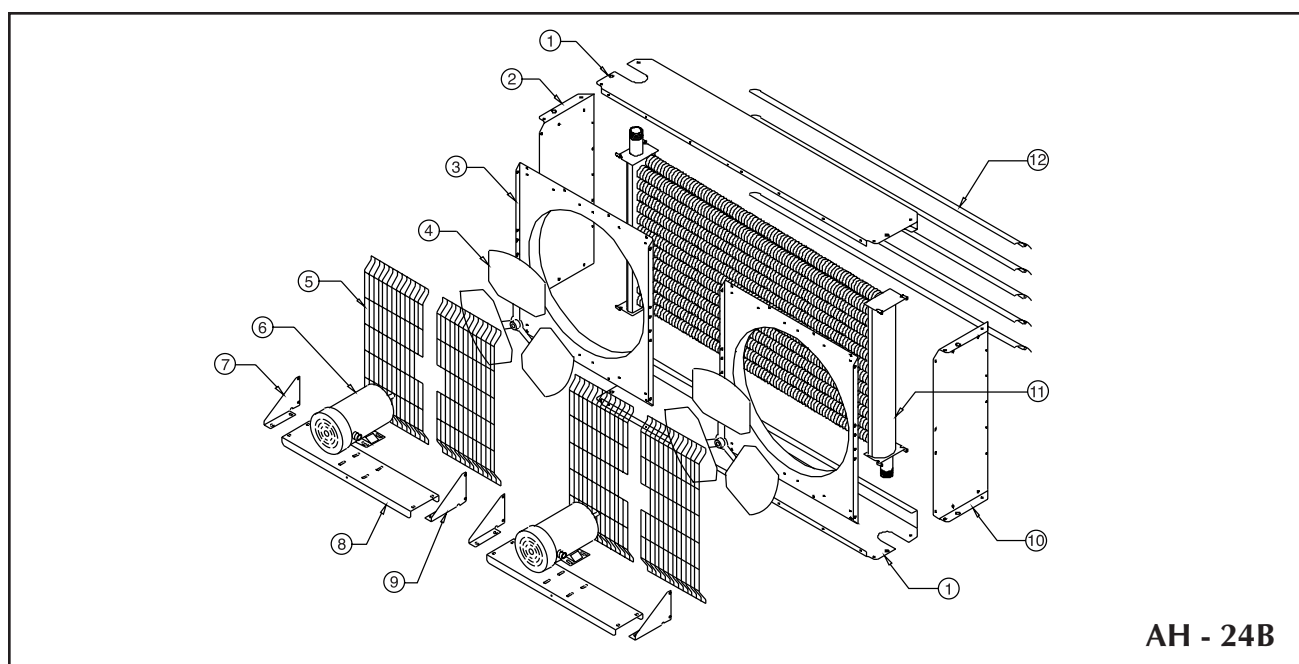


ARTICLE	AH-12A	AH-16A	AH - 20A	AH-24A	AH-24B	DESCRIPTION
1	5378	5382	5386	5390	5394	Panneau AH, supérieur/inférieur
2	5376	5380	5384	5388	5392	Panneau AH, côté droit
3	5379	5383	5387	5391	5391	Panneau AH, enveloppe
4	5448	5449	5450	5451	5451	Ventilateur
5	4087	4088	4089	5396	5396	Grille de protection (moitié)
6	***	***	***	***	***	Moteur
7	3789	3789	3789	3789	3789	Cornière, base du moteur, droite
8	3785	3786	3787	5433	5433	Profilé en U, base du moteur
9	3788	3788	3788	3788	3788	Cornière, base du moteur, gauche
10	5377	5381	5385	5389	5393	Panneau AH, côté gauche
11	**	**	**	**	**	Échangeur de chaleur
12	4075	4076	4077	5741	5742	Lames défléctrices et vis

\*\* Pour commander un échangeur de chaleur de rechange, spécifier les numéros de modèle et de série de l'aérotherme.

\*\*\* Pour commander un moteur de rechange, spécifier la tension, le nombre de phases, la puissance (HP) et la classe d'utilisation.

Remarque : Pour les articles non montrés, communiquer avec le fabricant.



# SPÉCIFICATIONS GÉNÉRALES

Certification	CRN (Canada) – Vapeur et liquides pour climatiseurs seulement.
Ventilateur	Trois pales en aluminium. Porte-pales en acier et moyeu à alésage de 5/8 pouce.
Grille de protection	Modèle deux pièces à mailles rapprochées. Retient tout objet de 3/8 po de diamètre. Revêtement époxyde aux couleurs du boîtier.
Trous de montage	Trous de 9/16 po de diamètre, deux trous au haut et deux trous au bas de l'aérotherme.
Matériau du boîtier	Acier de calibre 14 (0.075 po). Revêtement époxyde avec prétraitement en cinq étapes, dont au phosphate de fer.
Moteur(s)	Homologué ACNOR et/ou UL, 1725 tr/min, roulements à billes à lubrification permanente avec base rigide. Antidéflagrant ou de construction totalement fermée. Toutes tensions standard disponibles pour 50 et 60 Hertz.
Lames déflectrices	Aluminium anodisé extrudé.
Matériau du collecteur	Acier au carbone de 3/16 po (0.187 po).
Raccords de tuyauterie	Filetage mâle NPT 1 1/2 po, Sch. 40 ou brides RF à face surélevée 1 1/2 po, 300 lb/po <sup>2</sup>
Pression utilisation max.	450 lb/po <sup>2</sup>
Temp. utilisation max.	650 °F
Tuyaux à ailettes	<ul style="list-style-type: none"> <li>• Tubes en acier carb., diam. ext. 5/8 po (calibre 16, épaisseur 0.065 po). Ailettes en aluminium tensionnées (« Tension Wound ») à 10 ailettes par pouce, ou</li> <li>• Tubes en acier carb., diam. ext. 1 po (calibre 14, épaisseur 0.083 po). Ailettes en aluminium extrudé à 9 ailettes par pouce; ou</li> <li>• Tubes en acier carb., diam. ext. 1 po (calibre 10, épaisseur 0.135 po). Ailettes en aluminium extrudé à 5 ailettes par pouce.</li> </ul>

## Spécifications de modèle

Modèle de base*	Débit d'air**	Portée du jet d'air à vapeur 15 lb/po <sup>2</sup>	Puissance de moteur requise***	Passes de tube	Poids net Δ	Poids à l'expédition Δ
AH-12A-A__	1 150 pi <sup>3</sup> /min	28 pi (8,5 m)	1/4 HP	1 ou 3	102 lb	142 lb
AH-12A-B__	1 160 pi <sup>3</sup> /min	28 pi (8,5 m)	1/4 HP	1 ou 3	107 lb	147 lb
AH-12A-C1	1 030 pi <sup>3</sup> /min	28 pi (8,5 m)	1/4 HP	1	118 lb	158 lb
AH-16A-A__	1 840 pi <sup>3</sup> /min	40 pi (12,2 m)	1/4 HP	1, 3 ou 5	127 lb	167 lb
AH-16A-B__	1 780 pi <sup>3</sup> /min	40 pi (12,2 m)	1/4 HP	1, 3 ou 5	138 lb	178 lb
AH-16A-C1	1 840 pi <sup>3</sup> /min	40 pi (12,2 m)	1/4 HP	1	153 lb	193 lb
AH-20A-A__	2 930 pi <sup>3</sup> /min	40 pi (12,2 m)	1/2 HP	1, 3 ou 5	155 lb	205 lb
AH-20A-B__	2 700 pi <sup>3</sup> /min	40 pi (12,2 m)	1/2 HP	1, 3 ou 5	170 lb	220 lb
AH-20A-C1	3 000 pi <sup>3</sup> /min	40 pi (12,2 m)	1/2 HP	1	195 lb	245 lb
AH-24A-A__	3 890 pi <sup>3</sup> /min	40 pi (12,2 m)	1/2 HP	1, 3, 5 ou 7	189 lb	249 lb
AH-24A-B__	3 640 pi <sup>3</sup> /min	40 pi (12,2 m)	1/2 HP	1, 3, 5 ou 7	212 lb	272 lb
AH-24A-C1	3 490 pi <sup>3</sup> /min	40 pi (12,2 m)	1/2 HP	1	258 lb	318 lb
AH-24B-A__	7 650 pi <sup>3</sup> /min	65 pi (19,8 m)	(2) 1/2 HP	1, 3, 5 ou 7	313 lb	413 lb
AH-24B-B__	7 420 pi <sup>3</sup> /min	65 pi (19,8 m)	(2) 1/2 HP	1, 3, 5 ou 7	376 lb	476 lb
AH-24B-C1	6 690 pi <sup>3</sup> /min	65 pi (19,8 m)	(2) 1/2 HP	1	440 lb	540 lb

\* Voir page 7 pour le codage de modèle.

\*\* À 70 °F et au niveau de la mer.

\*\*\* Ruffneck se réserve le droit d'installer des moteurs de plus grande puissance (HP).

Δ Ajouter 12 lb pour les aérothermes avec raccords à brides.

## GARANTIE LIMITÉE DE 1 AN

Les aérothermes à échangeur de chaleur de série AH (Advanced Horizontal) sont garantis contre tout défaut de fabrication et de main-d'œuvre pour une période d'un (1) an à partir de la date d'achat, selon les modalités suivantes :

1. Nous fournissons, à nos frais, les pièces de rechange requises pour remettre tout aérotherme en état de fonctionnement, à condition que les pièces défectueuses nous soient retournées fret payé d'avance et que les pièces de rechange soient acceptées avec port dû.
2. L'aérotherme complet peut être retourné à notre usine pour être réparé ou remplacé (selon notre décision), à condition que tous les frais d'expédition impliqués soient assumés par le client.
3. La corrosion et la contamination dues à la saleté, à la poussière ou autres, ne sont pas considérées comme des défauts et ne sont donc pas couvertes par la garantie.
4. L'aérotherme ne doit être modifié d'aucune façon.
5. L'aérotherme doit être installé, utilisé et entreposé conformément aux directives du guide d'utilisation et aux directives des étiquettes et plaquettes signalétiques.

La présente garantie se limite à cet équipement et, en aucun cas, ne couvre les coûts d'installation ou de démontage, ou tout dommage ou perte encourus.

## CLASSIFICATION

Les aérothermes AH RUFFNECK® peuvent tous être livrés avec un moteur antidéflagrant homologué ACNOR ou UL pour utilisation dans des endroits dangereux. Moteurs de divisions 1 et 2, classe I, groupes C et D et classe II, groupes E, F et G ou TEFC (moteur blindé avec ventilateur extérieur). S'assurer que le moteur est conforme aux exigences de classification.

**RESPECTER LES DIRECTIVES DU PRÉSENT GUIDE  
pour éviter tout danger et l'annulation de certaines dispositions de la garantie.  
Pour toute assistance supplémentaire, composer ce numéro :**

**Ligne sans frais (24 h) : 1-800-661-8529**

(Canada et É.-U.)

Avant d'appeler, vérifier les numéros de modèle et de série.

**RUFFNECK®** 

 **CCI Thermal**  
Technologies INC.

5918 Roper Road  
Edmonton, Alberta T6B 3E1  
Canada  
Téléphone : (780) 466-3178  
Télécopieur : (780) 468-5904  
[www.ccithermal.com](http://www.ccithermal.com)

# Bourdon Tube Pressure Gauges Industrial Stainless Steel Gauge Type 232.54 - Dry Case Type 233.54 - Liquid-filled Case

WIKAI Datasheet 23X.54

## Applications

- Intended for adverse service conditions where pulsating or vibration exists
- Process industry: chemical/petrochemical, power stations, mining, on and offshore, environmental technology, mechanical engineering and plant construction
- Suitable for gaseous or liquid media that will not obstruct the pressure system

## Special features

- Vibration and shock resistant (with liquid filling)
- All stainless steel construction
- Pressure ranges up to 15,000 psi

## Standard Features

### Design

ASME B40.100 & EN 837-1

### Sizes

2½" & 4" (63 & 100 mm)

### Accuracy class

2½": ± 2/12% of span (ASME B40.100 Grade A)

4": ± 1% of span (ASME B40.100 Grade 1A)

### Ranges

Vacuum / Compound to 200 psi

Pressure from 15 psi to 15,000 psi

or other equivalent units of pressure or vacuum

### Working pressure

2½":      Steady:      3/4 scale value  
             Fluctuating: 2/3 full scale value  
             Short time: full scale value

4":        Steady:      full scale value  
             Fluctuating: 0.9 x full scale value  
             Short time: 1.3 x full scale value

### Operating temperature

Ambient: -40°F to +140°F (-40°C to +60°C) - dry  
             -4°F to +140°F (-20°C to +60°C) - glycerine filled  
             -40°F to +140°F (-40°C to +60°C) - silicone filled

Medium: +212°F (+100°C) maximum



Bourdon Tube Pressure Gauge Model 232.54

### Temperature error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

### Weather protection

Weather tight (NEMA 4X / IP 65)

### Pressure connection

Material: 316L stainless steel

Lower mount (LM) or center back mount (CBM) - 2½"

Lower mount (LM) or lower back mount (LBM) - 4"

1/4" NPT or 1/2" NPT limited to wrench flat area

### Bourdon tube

Material: 316L stainless steel

2" & 2½": ≤ 1,000 PSI: C-type,  
                 ≥ 1,500 PSI: helical type

4":        ≤ 1,500 PSI: C-type,  
                 ≥ 2,000 PSI: helical type

### Movement

300-series stainless steel

### Dial

White aluminum with black lettering; 2½" size with stop pin

**Pointer**

Black aluminum, friction adjustable

**Case**

304 stainless steel with vent plug and polished stainless steel bayonet ring. Suitable for liquid filling. Welded case/socket connection

**Window**

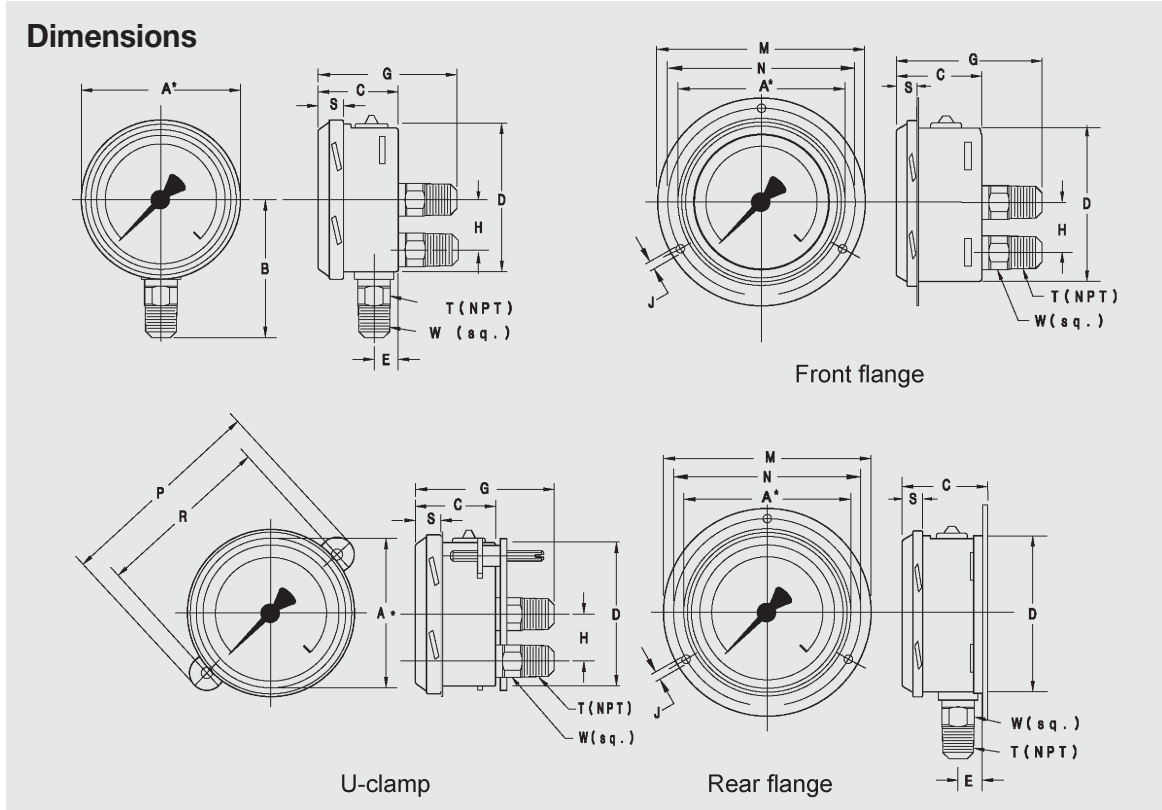
Laminated safety glass with Buna-N gasket

**Case fill**

Glycerine 99.7% - Type 233.54

**Optional extras**

- 316SS restrictor
- Accuracy  $\pm 1.0\%$  of full scale (2 1/2" size)
- Stainless steel front or rear flange
- Zinc-plated steel or SS u-clamp bracket (field installable)
- Red drag pointer or mark pointer
- Silicone or fluorolube case filling
- Special connections limited to wrench flat area
- Custom dial layout
- Other pressure scales available  
bar, kPa, MPa, kg/cm<sup>2</sup> and dual scales



Size		A	B	C	D	E	G	H	J	M	N	P	R	S	T	W	Weight
2.5"	mm	70	54	33.5	62	13	55.5	-	3.6	85	75	87	72	12		14	0.36 lb. dry
	in	2.75	2.13	1.32	2.44	0.51	2.19	-	0.14	3.35	2.95	3.43	2.83	0.47	1/4"	0.55	0.44 lb. filled
4"	mm	110	87	49.5	100	15.5	81	30	4.8	132	116	125	110	15		22	1.10 lb. dry
	in	4.30	3.43	1.95	3.94	0.61	3.19	1.18	0.19	5.20	4.57	4.92	4.33	0.59	1/2"	0.87	1.76 lb. filled

Recommended panel cutout is dimension D + 1 mm

**Ordering information**

Pressure gauge model / Nominal size / Scale range / Size of connection / Optional extras required  
 Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing.  
 Modifications may take place and materials specified may be replaced by others without prior notice.



**WIKI Instrument Corporation**  
 1000 Wiegand Boulevard  
 Lawrenceville, GA 30045  
 Tel (770) 513-8200 Toll-free 1-888-WIKA-USA  
 Fax (770) 338-5118  
 E-Mail info@wika.com  
 www.wika.com

# Bimetal Thermometer Model TI.52, Stainless Steel Case & Wetted Parts

Datasheet TI.52

## Applications

- Suitable for fluid medium which does not corrode 304 stainless steel

## Special features

- Industrial design
- Adjustable angle connection with external reset
- Stainless steel case and wetted parts

## Standard version

### Size

5" (127mm) Type TI.52

### Accuracy

+ 1.0% full scale value (ASME B40.3)

### Ranges

-100°F to 1000°F (and equivalent Celsius)

### Working Range

Steady: full scale value

Short time: 110% of full scale value

### Over Range

Temporary over or under range tolerance of 50% of scale up to 500°F. (260°C). For ranges above 500°F, maximum over range is 800°F; continuous. 1000°F intermittent.

### Connection

Material: 304 stainless steel

Adjustable angle, 1/2" NPT

### Stem

Material: 304 stainless steel

Diameter: 1/4" (6.35 mm)

Length: 2½" to 72" (63.5 mm to 1,828.8 mm)

### Measuring Element

Bi-metal helix

### Dial

White aluminum, dished, with black markings



### Thermometer TI.52 Case

Material: 304 stainless steel

Hermetically sealed per ASME B40.3 standard

Ingress protection IP 65

External reset slotted hex head on back of case

### Pointer

Black aluminum

### Standard Scales

Single: Fahrenheit or Celsius

Dual: Fahrenheit (outer) and Celsius (inner)

### Window Gasket

Neoprene

Silicone (-100°F and over 550°F)

### Window

Flat instrument glass

### Weight

26 oz. (5" dia)

Add 1 oz for every 2" of stem length

### Dampening

Inert gel to minimize pointer oscillation

### Movement

Viscous inert gel to enhance pointer operation

### Warranty

7- Year Warranty

## Optional Extras

- Thermowells
- Silicone fill
- Dampened Movement
- Special scales and dial markings
- Acrylic and safety glass windows
- Calibration certification traceable to NIST
- Min/max pointer
- DIN standards

## STANDARD RANGES

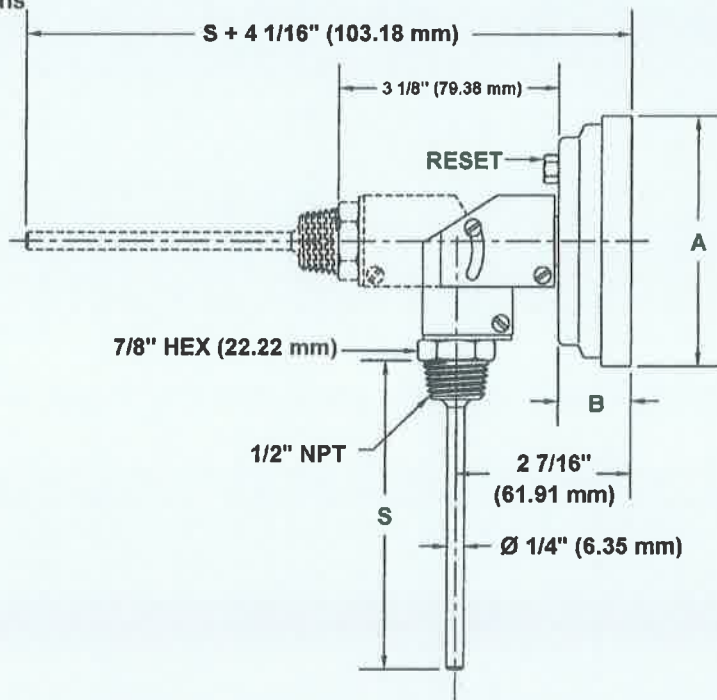
Fahrenheit	Dual Scale F & C	Celsius
Single Scale	F Outer, C Inner	Single Scale
-100/150 F	-100/150 F & -70/70 C	-50/50 C
-40/120 F	40/120 F & -40/50 C	-20/120 C
0/140 F	0/140 F & -20/60 C	0/50 C <sup>1</sup>
0/200 F	0/200 F & -15/90 C	0/100 C
0/250 F	0/250 F & -20/120 C	0/150 C
20/240 F	20/240 F & -5/115 C	0/200 C
25/125 F <sup>1</sup>	25/125 F & -5/50 C <sup>1</sup>	0/250 C
50/300 F	50/300 F & 10/150 C	0/300 C
50/400 F	50/400 F & 10/200 C	0/450 C <sup>2</sup>
50/550 F	50/500 F & 10/260 C	100/550 C <sup>2</sup>
150/750 F	150/750 F & 65/400 C	
200/1000 F <sup>2</sup>	200/1000 F & 100/540 C <sup>2</sup>	

<sup>1</sup>Minimum stem length 4" for Type 52

<sup>2</sup>Not recommended for continuous service over 800°F (425 C)

## Dimensions

### Standard versions



Stem Length
2 1/2" (63.5 mm)
4" (101.6 mm)
6" (152.4 mm)
9" (228.6 mm)
12" (304.8 mm)
15" (381.0 mm)
18" (457.2 mm)
24" (609.6 mm)

WIKA Type	DIAL SIZE	A	B	S (Stem Length)
52	5" (127 mm)	5-1/4" (133.35 mm)	15/16" (23.8 mm)	As Specified

Note: Thermowells for temperature instruments are recommended for all process systems where pressure, velocity, or viscous, abrasive and corrosive materials are present individually or in combination. A properly selected thermowell protects the temperature instrument from possible damage resulting from these process variables. Furthermore, a thermowell permits removal of the temperature instrument for replacement, repair or testing without effecting the process media or the system.

#### Ordering information

State computer part number (if available) /type number/size/range/connection size and locations/options required. WIKA reserves the right to make changes without prior notice.



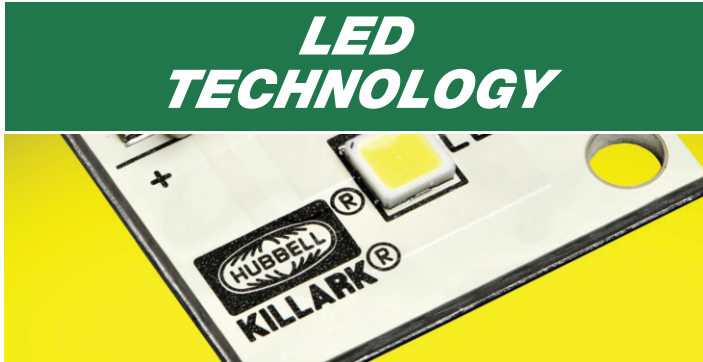
**WIKAI Instrument Corporation**  
 1000 Wiegand Boulevard  
 Lawrenceville, GA 30043  
 1-888-WIKA-USA /770-513-8200 (in GA)  
 Fax 770-338-5118  
 info@wika.com www.wika.com







Hubbell is committed to be a recognized leader in conserving natural resources to sustain our environment.



**INDEX**

**VM4LB/VM4LC Series - High Wattage 55-130W Luminaires**

Introduction ..... 1  
 Catalog Logic ..... 2  
 Ordering Information ..... 3 - 9  
 Components/Electrical Ratings/Temperature Data ..... 10 - 11  
 Dimensions ..... 12  
 Photometrics ..... 13  
 Dual-Lite Inverter Systems ..... 13  
 LED Lighting Range ..... Back Cover

KILLARK® is pleased to announce NEW HIGHER WATTAGE LED sources in its time-tested industrial grade luminaires for harsh and hazardous locations. Market demand for this labor and energy saving clean white light is growing exponentially. KILLARK is there with high wattage fixtures for harsh (wet, corrosive and NEMA 4X locations) plus hazardous duty including Class I Division 2; Class II Divisions 1 & 2. With the new offering, users can replace mid to high wattage HID's at greater mounting heights.

**What Makes this Product GREEN?**

- Saves Significant Maintenance Labor Time and \$ (fewer trips for relamping)
 

	Hours Life <sup>①</sup>	No. Trips
Killark LED	55,000	1.0
150HPS	24,000	2.3
175MH	10,000	5.5
150/175MHP	15,000	3.7
84CFL (2 x 42W)	10,000	5.5
300 Incan.	1,000	55.0
- Lower facility carbon footprint (emissions) by reducing electrician maintenance trips to fixture
- Service Trucks: direct diesel or gas emissions
- Forklifts, Scissor-lifts, or Cherry Pickers: use utility electricity to charge batteries, or gas
- High Color Rendering (5000°Kelvin range - CCT; 70 CRI) for better visibility can reduce the number of fixtures needed.
- The US DOE recognizes “Spectrally Enhanced Lighting”, particularly at low light levels, as a method to maintain visual effectiveness using fewer watts, e.g. vs HPS (2100°Kelvin - CCT; 21CRI) <sup>②</sup>.
- Killark LED luminaires use RoHS compliant materials to minimize environmental contamination

① At 40 C Ambient Minimum LED Life to 70% of initial lumen output; HID, CFL, Incandescent from mfg. catalog data

② For more information go to [http://www1.eere.energy.gov/femp/news/news/\\_detail.html?news\\_id=10382](http://www1.eere.energy.gov/femp/news/news/_detail.html?news_id=10382)

**Key Features and Benefits**

- L70 55,000 hours life at 40° C (5+ years to 70% of initial output) equals Minimal Maintenance.
- LM79-08 Certified Photometrics Tested (NIST Recognized Lab)
- LM80-08 Lumen Maintenance Measurement (including TM-21)
- Solder-LESS LED Board Connections - Vibration Resistant
- Dual Drivers - Redundant Systems - Half of fixture can be turned off for greater energy savings for most models
- Less than 135 Watts of Power
- Instant on - including after power interruption
- “World Voltage” 120-277VAC 50/60Hz, 347-480V, 120-250VDC
- Crisp white light - 5000°K range (CCT); 70 CRI
- Wide variety of optics, including Globes, all glass Refractors, Reflectors, Enclosed Reflectors, Flat Lens plus Polycarbonate Spin-Top
- Optional Mounting arrangements, including Pendant, Wall, Ceiling, Stanchion, Cone, and exclusive “EZ” mount
- Copper-Free Aluminum construction with electrostatically applied epoxy/polyester powder paint, plus Stainless Steel External Hardware for Corrosion Resistance
- Traditional Industrial Appearance and Optical Performance using globes, reflectors or refractors, VM4LC models can also use the new patent pending Flat-Lens for a reduced profile
- **No external heat sink which reduces dirt/dust collection**
- Up to 115 lumens per watt (VM4LB13030 w/VMG25 globe)
- Patented Swing-Barrel Nut labor saving mounting system
- Polycarbonate 12” spintop and Flat-Lens suitable for CLASS II Group “G” Food Areas





VM4LB with Globe/Guard



VM4LC with Flat Lens



**Class I, Div. 2, Groups A,B,C,D**  
**Class I, Zone 2, Groups IIC, IIB, IIA**  
**Class II, Div. 1 & 2, Groups E,F,G**  
**Class III**  
**Suitable for wet locations**  
**NEMA 3, 4X**  
**IP66**  
**Marine**

Certified - File LR11713

Contact Factory for other certification details

**FEATURES-SPECIFICATIONS**

**CERTILITE<sup>®</sup> V LED**

**Applications**

CERTILITE<sup>®</sup> V VM4L LED fixtures are designed for installations where moisture, dirt, dust, corrosion and vibration may be present, or NEMA 3 and 4X areas where wind, water, snow or high ambients can be expected. They can be used in locations made hazardous by the presence of flammable vapors or gases or combustible dusts as defined by the NEC/CEC.

Typical applications include manufacturing plants, food processing, and certain chemical and petrochemical processing facilities, sewage treatment plants, off-shore and dockside installations, garages and storage facilities.

**Compliances**

- UL-8750 for LED lighting
- UL-844 Standard for lighting fixtures for hazardous locations, Class I, Division 2; Class II, Divisions 1 and 2; Class III
- CSA C22.2 no. 137-M1981 electric luminaires for use in hazardous locations
- Enclosed and gasketed
- NEMA 3, 4X
- IP66 & Marine

**Materials**

- Ballast tank, splice box and cast guards corrosion resistant copper-free aluminum alloy
- Baked powder epoxy/polyester finish, electrostatically applied for complete, uniform corrosion protection
- All external hardware - stainless steel
- Reflectors - Polyester reinforced fiber glass or aluminum

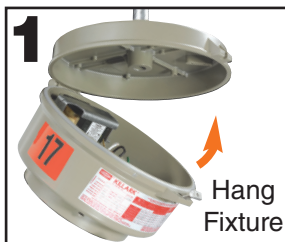
**LED Luminaire Features and Standards**

- Traditional Industrial Appearance, Suitability, and Photometric Performance
- Wide variety of optics including globes, globes with reflectors, all-glass refractors, spin-top refractors and flat lens

- Swing-Barrel Nut patented tank mounting system
- Optional Mounting arrangements including Pendant, Wall, Ceiling, Stanchion and others
- VM4L LED Housings can be retrofitted to existing VM splice boxes; upgrade from HID sources
- Crisp White Light for Excellent Color Rendering - Chromaticity 5000 K (CTT range); approx. 70 CRI
- Energy Savings - less than 130 Watts of Power
- Long Life - 50,000 - 55,000 maintenance free hours to 70% initial lumens
- Ambient suitability -40°C to 55°C
- Instant On - Including after power interruption
- World Voltage 120 - 277VAC 50/60Hz
- Solder-LESS LED Board Connections - Vibration Resistant
- Dual Drivers - Redundant Systems (built-in backup) for most models, or for additional energy savings half of fixture can be turned off
- LM80-08\* Measurement of lumen maintenance for LED light sources (including TM-21)
- LM79-08\* Certified "Absolute" Photometry, including Chromaticity Color for Solid State Lighting
- L70 Values - Industry Nomenclature for Hours of use to 70% of Initial Lumens
- Two LED internal heat sink styles
  - Bulb (VM4LB)
  - Concave (VM4LC)

\* LM-xx + TM-21 are Illumination Engineering Society standards designed to promote uniformity in testing procedures among test labs and manufacturers. For more information go to [www.ies.org](http://www.ies.org)

**Swing-Barrel Nut (Patented)**



**NEW! LED INTERNAL Heat Sinks**

**Bulb style (VM4LB)** offers traditional appearance - important in facility upgrades. Maximum lumen output, but has more glare at line-of-sight mounting heights.

**Concave style (VM4LC)** models can use all optics plus new patent pending VZRxF12 flat Spin-Top for a compact profile. Recessed concave LED array produces less glare.



**Non-Glass Polycarbonate 12" Flat Lens**



Patent Pending

# CERTILITE<sup>V</sup>

*The Logical Choice*

## CertiLite<sup>®</sup>V LED Catalog Number Logic



Recommended energy saving replacement for VM4L12030 is VM4LC07030 (lumen equivalent)



Higher efficiency LED's require NO external heat sink

VM4L B 130 30 0 0 00

**Housing Series** — 7-3/4" thread w/driver and LED's

**B**—Bulb heat sink  
**C**—Concave heat sink

**Lamp Wattage**  
Approx. VA (wattage) of driver & LED's

- 055W LED
- 065W LED
- 070W LED
- 080W LED
- 090W LED
- 100W LED
- 105W LED
- 130W LED

**Voltage**

- 30—120-277VAC 50/60 Hz<sup>Ⓛ</sup>
- 33—347-480VAC 50/60Hz<sup>Ⓛ</sup>
- 34—120-250VDC (to 105W)<sup>Ⓛ</sup>

**Mounting Type**

- A**—Pendant
- X**—Ceiling
- B**—Wall Bracket
- C**—Cone Top
- E**—EZ Mount Adapter<sup>Ⓛ</sup>
- D**—Stanchion 25°
- S**—Stanchion Straight 90°
- N**—None (mount ordered separately)<sup>Ⓛ</sup>

**Entry (Mounts available)**

- 2—3/4" NPT (A,B,C,X)
- 3—1" NPT (A,B,C,X)
- 4—1 1/4" NPT (D,S)
- 5—1 1/2" NPT (D,S)
- 6—3/4" NPT 5-Hub (X)
- 7—1" NPT 5-Hub (X)
- 8—M20 4-Hub (X)
- 9—M25 5-Hub (X)
- Z**—EZ Mount Adapter<sup>Ⓛ</sup>
- N**—None (mount ordered separately)<sup>Ⓛ</sup>

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**Guard**

- G**—Guard (Globes & Glass refractors)
- N**—No Guard

**Optic**

- GL**—Globe
- R1**—Type I Refractor (all glass)
- R3**—Type III Refractor (all glass)
- R5**—Type V Refractor (all glass)
- ER**—Enclosed Refractor
- EP**—Polycarbonate Shielded Enclosed Reflector\*
- P5**—5" Polycarbonate Spin-Top\*
- S2**—Type II 12" Spin-Top Refractor
- S5**—Type V 12" Spin-Top Refractor
- FG**—Silicone Coated Globe
- TG**—Teflon<sup>®</sup> Coated Globe
- T1**—Teflon<sup>®</sup> Coated Type I Refractor (all glass)
- T3**—Teflon<sup>®</sup> Coated Type III Refractor (all glass)
- T5**—Teflon<sup>®</sup> Coated Type V Refractor (all glass)
- T2**—Teflon<sup>®</sup> Coated Type II 12" Spin-Top Refractor
- TV**—Teflon<sup>®</sup> Coated Type V 12" Spin-Top Refractor

**PF**—Spin-Top with flat poly lens (VM4LC only)

**GF**—Spin-Top with flat glass lens (VM4LC only)

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**Options/Accessories**

- F**—Single Fuse<sup>Ⓛ</sup>
- FF**—Double Fuse<sup>Ⓛ</sup>
- TBx**—Terminal Blocks  
x= Variations (May be alphanumeric to indicate terminals)
- P1**—Photocell 120V<sup>Ⓛ</sup>  
Factory Installed
- P2**—Photocell 208-277V<sup>Ⓛ</sup>  
Factory Installed
- P3**—Photocell 347V<sup>Ⓛ</sup>  
Factory Installed
- QD**—QD Wired at Ballast<sup>Ⓛ</sup>
- CP**—Component Pack (Tank w/mount, optic, guard - LED's included in tank)
- AN**—Assembled (Tank w/mount, optic, guard - LED's included in tank)

**Accessories**—See <sup>Ⓛ</sup> below

- <sup>Ⓛ</sup> 55W, 65W, 70W single driver
- <sup>Ⓛ</sup> 105W max.
- <sup>Ⓛ</sup> Completes as "EZ", conduit mounting boxes ordered separately - See catalog grids.
- <sup>Ⓛ</sup> Completes as NN-Mount ordered separately.
- <sup>Ⓛ</sup> Teflon<sup>®</sup> is a registered trademark of DuPont, Inc.
- <sup>Ⓛ</sup> Fusing not for Marine or Canadian installations.
- <sup>Ⓛ</sup> Photo cells for Class I, Div. 2 only.
- <sup>Ⓛ</sup> QD = Quick Disconnect. Allows easy tank removal for maintenance. Electrician simply unplugs tank from mount for fixture relocation or repair due to impact damage.
- <sup>Ⓛ</sup> Accessories - Shown for ordering convenience (shipped separately)
 

S	VMPSD40	Fiberglass White Reflector
A	VMPA40	Fiberglass ANGLE White Reflector
D	HRD400	Deep White Reflector
Z	HRD400ALZ	Deep Alzak Reflector

**\*Non-glass Grp G Food Processing Suitability**





**Globe & Guard or  
Glass Refractor & Guard**



**Spin-Top Poly or Glass  
Flat Lens VM4LC only**



**Spin-Top Poly or  
Glass Refractor**



**Enclosed Reflector**



**Poly Food Optic**

VM4LB SERIES PENDANT WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	ENCLOSED REFLECTOR	POLYCARBONATE FOOD OPTIC
55	3/4"	120-277VAC	VM4LB05530A2GLG	VM4LB05530A2R5G	VM4LB05530A2S5G	VM4LB05530A2P5G	VM4LB05530A2ERN	VM4LB05530A2EPN
65	3/4"	120-277VAC	VM4LB06530A2GLG	VM4LB06530A2R5G	VM4LB06530A2S5G	VM4LB06530A2P5G	VM4LB06530A2ERN	VM4LB06530A2EPN
70	3/4"	120-277VAC	VM4LB07030A2GLG	VM4LB07030A2R5G	VM4LB07030A2S5G	VM4LB07030A2P5G	VM4LB07030A2ERN	VM4LB07030A2EPN
80	3/4"	120-277VAC	VM4LB08030A2GLG	VM4LB08030A2R5G	VM4LB08030A2S5G	VM4LB08030A2P5G	VM4LB08030A2ERN	VM4LB08030A2EPN
90	3/4"	120-277VAC	VM4LB09030A2GLG	VM4LB09030A2R5G	VM4LB09030A2S5G	VM4LB09030A2P5G	VM4LB09030A2ERN	VM4LB09030A2EPN
100	3/4"	120-277VAC	VM4LB10030A2GLG	VM4LB10030A2R5G	VM4LB10030A2S5G	VM4LB10030A2P5G	VM4LB10030A2ERN	VM4LB10030A2EPN
105	3/4"	120-277VAC	VM4LB10530A2GLG	VM4LB10530A2R5G	VM4LB10530A2S5G	VM4LB10530A2P5G	VM4LB10530A2ERN	VM4LB10530A2EPN
130	3/4"	120-277VAC	VM4LB13030A2GLG	VM4LB13030A2R5G	VM4LB13030A2S5G	VM4LB13030A2P5G	VM4LB13030A2ERN	VM4LB13030A2EPN

VM4LC SERIES PENDANT WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	12" SPIN-TOP POLYCARBONATE FLAT LENS* ④	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	POLYCARBONATE FOOD OPTIC
55	3/4"	120-277VAC	VM4LC05530A2GLG	VM4LC05530A2PFN	VM4LC05530A2R5G	VM4LC05530A2S5G	VM4LC05530A2P5G	VM4LC05530A2EPN
65	3/4"	120-277VAC	VM4LC06530A2GLG	VM4LC06530A2PFN	VM4LC06530A2R5G	VM4LC06530A2S5G	VM4LC06530A2P5G	VM4LC06530A2EPN
70	3/4"	120-277VAC	VM4LC07030A2GLG	VM4LC07030A2PFN	VM4LC07030A2R5G	VM4LC07030A2S5G	VM4LC07030A2P5G	VM4LC07030A2EPN
80	3/4"	120-277VAC	VM4LC08030A2GLG	VM4LC08030A2PFN	VM4LC08030A2R5G	VM4LC08030A2S5G	VM4LC08030A2P5G	VM4LC08030A2EPN
90	3/4"	120-277VAC	VM4LC09030A2GLG	VM4LC09030A2PFN	VM4LC09030A2R5G	VM4LC09030A2S5G	VM4LC09030A2P5G	VM4LC09030A2EPN
100	3/4"	120-277VAC	VM4LC10030A2GLG	VM4LC10030A2PFN	VM4LC10030A2R5G	VM4LC10030A2S5G	VM4LC10030A2P5G	VM4LC10030A2EPN
105	3/4"	120-277VAC	VM4LC10530A2GLG	VM4LC10530A2PFN	VM4LC10530A2R5G	VM4LC10530A2S5G	VM4LC10530A2P5G	VM4LC10530A2EPN
130	3/4"	120-277VAC	VM4LC13030A2GLG	VM4LC13030A2PFN	VM4LC13030A2R5G	VM4LC13030A2S5G	VM4LC13030A2P5G	VM4LC13030A2EPN

① Catalog numbers shown are with Guard (except ER/EP/PF); to omit guard change ending G to N; e.g. VM4LB05530A2GLN.

② Catalog numbers shown are with 3/4" conduit openings; change "2" to "3" for 1"; e.g. VM4LB05530A3GLG.

③ 120VAC through 277VAC 50/60Hz. See logic for other voltages.

\* For Glass 12" Spin-Top Flat Lens change PFN to GFN at end of catalog number.



**Globe & Guard or  
Glass Refractor & Guard**



**Spin-Top Poly or Glass  
Flat Lens**



**Spin-Top Poly or  
Glass Refractor**



**Enclosed Reflector**



**Poly Food Optic**

VM4LB SERIES CEILING WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	ENCLOSED REFLECTOR	POLYCARBONATE FOOD OPTIC
55	3/4"	120-277VAC	VM4LB05530X2GLG	VM4LB05530X2R5G	VM4LB05530X2S5G	VM4LB05530X2P5G	VM4LB05530X2ERN	VM4LB05530X2EPN
65	3/4"	120-277VAC	VM4LB06530X2GLG	VM4LB06530X2R5G	VM4LB06530X2S5G	VM4LB06530X2P5G	VM4LB06530X2ERN	VM4LB06530X2EPN
70	3/4"	120-277VAC	VM4LB07030X2GLG	VM4LB07030X2R5G	VM4LB07030X2S5G	VM4LB07030X2P5G	VM4LB07030X2ERN	VM4LB07030X2EPN
80	3/4"	120-277VAC	VM4LB08030X2GLG	VM4LB08030X2R5G	VM4LB08030X2S5G	VM4LB08030X2P5G	VM4LB08030X2ERN	VM4LB08030X2EPN
90	3/4"	120-277VAC	VM4LB09030X2GLG	VM4LB09030X2R5G	VM4LB09030X2S5G	VM4LB09030X2P5G	VM4LB09030X2ERN	VM4LB09030X2EPN
100	3/4"	120-277VAC	VM4LB10030X2GLG	VM4LB10030X2R5G	VM4LB10030X2S5G	VM4LB10030X2P5G	VM4LB10030X2ERN	VM4LB10030X2EPN
105	3/4"	120-277VAC	VM4LB10530X2GLG	VM4LB10530X2R5G	VM4LB10530X2S5G	VM4LB10530X2P5G	VM4LB10530X2ERN	VM4LB10530X2EPN
130	3/4"	120-277VAC	VM4LB13030X2GLG	VM4LB13030X2R5G	VM4LB13030X2S5G	VM4LB13030X2P5G	VM4LB13030X2ERN	VM4LB13030X2EPN

VM4LC SERIES CEILING WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	12" SPIN-TOP POLYCARBONATE FLAT LENS*	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	POLYCARBONATE FOOD OPTIC
55	3/4"	120-277VAC	VM4LC05530X2GLG	VM4LC05530X2PFN	VM4LC05530X2R5G	VM4LC05530X2S5G	VM4LC05530X2P5G	VM4LC05530X2EPN
65	3/4"	120-277VAC	VM4LC06530X2GLG	VM4LC06530X2PFN	VM4LC06530X2R5G	VM4LC06530X2S5G	VM4LC06530X2P5G	VM4LC06530X2EPN
70	3/4"	120-277VAC	VM4LC07030X2GLG	VM4LC07030X2PFN	VM4LC07030X2R5G	VM4LC07030X2S5G	VM4LC07030X2P5G	VM4LC07030X2EPN
80	3/4"	120-277VAC	VM4LC08030X2GLG	VM4LC08030X2PFN	VM4LC08030X2R5G	VM4LC08030X2S5G	VM4LC08030X2P5G	VM4LC08030X2EPN
90	3/4"	120-277VAC	VM4LC09030X2GLG	VM4LC09030X2PFN	VM4LC09030X2R5G	VM4LC09030X2S5G	VM4LC09030X2P5G	VM4LC09030X2EPN
100	3/4"	120-277VAC	VM4LC10030X2GLG	VM4LC10030X2PFN	VM4LC10030X2R5G	VM4LC10030X2S5G	VM4LC10030X2P5G	VM4LC10030X2EPN
105	3/4"	120-277VAC	VM4LC10530X2GLG	VM4LC10530X2PFN	VM4LC10530X2R5G	VM4LC10530X2S5G	VM4LC10530X2P5G	VM4LC10530X2EPN
130	3/4"	120-277VAC	VM4LC13030X2GLG	VM4LC13030X2PFN	VM4LC13030X2R5G	VM4LC13030X2S5G	VM4LC13030X2P5G	VM4LC13030X2EPN

① Catalog numbers shown are with Guard (except ER/EP/PF); to omit guard change ending G to N; e.g. VM4LB05530X2GLN.

② Catalog numbers shown are with 3/4" conduit openings; change "2" to "3" for 1"; e.g. VM4LB05530X3GLG.

③ 120VAC through 277VAC 50/60Hz. See logic for other voltages.

\* For Glass 12" Spin-Top Flat Lens change PFN to GFN at end of catalog number.





**Globe & Guard or  
Glass Refractor & Guard**



**Spin-Top Poly or Glass  
Flat Lens VM4LC only**



**Spin-Top Poly or  
Glass Refractor**



**Enclosed Reflector**



**Globe, Guard and Angle Reflector**

VM4LB SERIES WALL WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	ENCLOSED REFLECTOR	GLOBE, GUARD & ANGLE REFLECTOR ④
55	3/4"	120-277VAC	VM4LB05530B2GLG	VM4LB05530B2R5G	VM4LB05530B2S5G	VM4LB05530B2P5G	VM4LB05530B2ERN	VM4LB05530B2GLG-A
65	3/4"	120-277VAC	VM4LB06530B2GLG	VM4LB06530B2R5G	VM4LB06530B2S5G	VM4LB06530B2P5G	VM4LB06530B2ERN	VM4LB06530B2GLG-A
70	3/4"	120-277VAC	VM4LB07030B2GLG	VM4LB07030B2R5G	VM4LB07030B2S5G	VM4LB07030B2P5G	VM4LB07030B2ERN	VM4LB07030B2GLG-A
80	3/4"	120-277VAC	VM4LB08030B2GLG	VM4LB08030B2R5G	VM4LB08030B2S5G	VM4LB08030B2P5G	VM4LB08030B2ERN	VM4LB08030B2GLG-A
90	3/4"	120-277VAC	VM4LB09030B2GLG	VM4LB09030B2R5G	VM4LB09030B2S5G	VM4LB09030B2P5G	VM4LB09030B2ERN	VM4LB09030B2GLG-A
100	3/4"	120-277VAC	VM4LB10030B2GLG	VM4LB10030B2R5G	VM4LB10030B2S5G	VM4LB10030B2P5G	VM4LB10030B2ERN	VM4LB10030B2GLG-A
105	3/4"	120-277VAC	VM4LB10530B2GLG	VM4LB10530B2R5G	VM4LB10530B2S5G	VM4LB10530B2P5G	VM4LB10530B2ERN	VM4LB10530B2GLG-A
130	3/4"	120-277VAC	VM4LB13030B2GLG	VM4LB13030B2R5G	VM4LB13030B2S5G	VM4LB13030B2P5G	VM4LB13030B2ERN	VM4LB13030B2GLG-A

VM4LC SERIES WALL WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	12" SPIN-TOP POLYCARBONATE FLAT LENS*	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	GLOBE, GUARD & ANGLE REFLECTOR ④
55	3/4"	120-277VAC	VM4LC05530B2GLG	VM4LC05530B2PFN	VM4LC05530B2R5G	VM4LC05530B2S5G	VM4LC05530B2P5G	VM4LC05530B2GLG-A
65	3/4"	120-277VAC	VM4LC06530B2GLG	VM4LC06530B2PFN	VM4LC06530B2R5G	VM4LC06530B2S5G	VM4LC06530B2P5G	VM4LC06530B2GLG-A
70	3/4"	120-277VAC	VM4LC07030B2GLG	VM4LC07030B2PFN	VM4LC07030B2R5G	VM4LC07030B2S5G	VM4LC07030B2P5G	VM4LC07030B2GLG-A
80	3/4"	120-277VAC	VM4LC08030B2GLG	VM4LC08030B2PFN	VM4LC08030B2R5G	VM4LC08030B2S5G	VM4LC08030B2P5G	VM4LC08030B2GLG-A
90	3/4"	120-277VAC	VM4LC09030B2GLG	VM4LC09030B2PFN	VM4LC09030B2R5G	VM4LC09030B2S5G	VM4LC09030B2P5G	VM4LC09030B2GLG-A
100	3/4"	120-277VAC	VM4LC10030B2GLG	VM4LC10030B2PFN	VM4LC10030B2R5G	VM4LC10030B2S5G	VM4LC10030B2P5G	VM4LC10030B2GLG-A
105	3/4"	120-277VAC	VM4LC10530B2GLG	VM4LC10530B2PFN	VM4LC10530B2R5G	VM4LC10530B2S5G	VM4LC10530B2P5G	VM4LC10530B2GLG-A
130	3/4"	120-277VAC	VM4LC13030B2GLG	VM4LC13030B2PFN	VM4LC13030B2R5G	VM4LC13030B2S5G	VM4LC13030B2P5G	VM4LC13030B2GLG-A

① Catalog numbers shown are with Guard (except ER/EP/PF); to omit guard change ending G to N; e.g. VM4LB05530B2GLN.

② Catalog numbers shown are with 3/4" conduit openings; change "2" to "3" for 1"; e.g. VM4LB05530B3GLG.

③ 120VAC through 277VAC 50/60Hz. See logic for other voltages.

④ See logic for reflector ordering options or order angle reflector VM4PA40 separately.

\* For Glass 12" Spin-Top Flat Lens change PFN to GFN at end of catalog number.



**Globe & Guard or  
Glass Refractor & Guard**



**Spin-Top Poly or  
Glass Flat Lens**



**Spin-Top Poly or  
Glass Refractor**



**Enclosed  
Reflector**



**Poly Food Optic**

VM4LB SERIES CONE WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	ENCLOSED REFLECTOR	POLYCARBONATE FOOD OPTIC
55	3/4"	120-277VAC	VM4LB05530C2GLG	VM4LB05530C2R5G	VM4LB05530C2S5G	VM4LB05530C2P5G	VM4LB05530C2ERN	VM4LB05530C2EPN
65	3/4"	120-277VAC	VM4LB06530C2GLG	VM4LB06530C2R5G	VM4LB06530C2S5G	VM4LB06530C2P5G	VM4LB06530C2ERN	VM4LB06530C2EPN
70	3/4"	120-277VAC	VM4LB07030C2GLG	VM4LB07030C2R5G	VM4LB07030C2S5G	VM4LB07030C2P5G	VM4LB07030C2ERN	VM4LB07030C2EPN
80	3/4"	120-277VAC	VM4LB08030C2GLG	VM4LB08030C2R5G	VM4LB08030C2S5G	VM4LB08030C2P5G	VM4LB08030C2ERN	VM4LB08030C2EPN
90	3/4"	120-277VAC	VM4LB09030C2GLG	VM4LB09030C2R5G	VM4LB09030C2S5G	VM4LB09030C2P5G	VM4LB09030C2ERN	VM4LB09030C2EPN
100	3/4"	120-277VAC	VM4LB10030C2GLG	VM4LB10030C2R5G	VM4LB10030C2S5G	VM4LB10030C2P5G	VM4LB10030C2ERN	VM4LB10030C2EPN
105	3/4"	120-277VAC	VM4LB10530C2GLG	VM4LB10530C2R5G	VM4LB10530C2S5G	VM4LB10530C2P5G	VM4LB10530C2ERN	VM4LB10530C2EPN
130	3/4"	120-277VAC	VM4LB13030C2GLG	VM4LB13030C2R5G	VM4LB13030C2S5G	VM4LB13030C2P5G	VM4LB13030C2ERN	VM4LB13030C2EPN

VM4LC SERIES CONE WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	12" SPIN-TOP POLYCARBONATE FLAT LENS* ④	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	POLYCARBONATE FOOD OPTIC
55	3/4"	120-277VAC	VM4LC05530C2GLG	VM4LC05530C2PFN	VM4LC05530C2R5G	VM4LC05530C2S5G	VM4LC05530C2P5G	VM4LC05530C2EPN
65	3/4"	120-277VAC	VM4LC06530C2GLG	VM4LC06530C2PFN	VM4LC06530C2R5G	VM4LC06530C2S5G	VM4LC06530C2P5G	VM4LC06530C2EPN
70	3/4"	120-277VAC	VM4LC07030C2GLG	VM4LC07030C2PFN	VM4LC07030C2R5G	VM4LC07030C2S5G	VM4LC07030C2P5G	VM4LC07030C2EPN
80	3/4"	120-277VAC	VM4LC08030C2GLG	VM4LC08030C2PFN	VM4LC08030C2R5G	VM4LC08030C2S5G	VM4LC08030C2P5G	VM4LC08030C2EPN
90	3/4"	120-277VAC	VM4LC09030C2GLG	VM4LC09030C2PFN	VM4LC09030C2R5G	VM4LC09030C2S5G	VM4LC09030C2P5G	VM4LC09030C2EPN
100	3/4"	120-277VAC	VM4LC10030C2GLG	VM4LC10030C2PFN	VM4LC10030C2R5G	VM4LC10030C2S5G	VM4LC10030C2P5G	VM4LC10030C2EPN
105	3/4"	120-277VAC	VM4LC10530C2GLG	VM4LC10530C2PFN	VM4LC10530C2R5G	VM4LC10530C2S5G	VM4LC10530C2P5G	VM4LC10530C2EPN
130	3/4"	120-277VAC	VM4LC13030C2GLG	VM4LC13030C2PFN	VM4LC13030C2R5G	VM4LC13030C2S5G	VM4LC13030C2P5G	VM4LC13030C2EPN

① Catalog numbers shown are with Guard (except ER/EP/PF); to omit guard change ending G to N; e.g. VM4LB05530C2GLN.

② Catalog numbers shown are with 3/4" conduit openings; change "2" to "3" for 1"; e.g. VM4LB05530C3GLG.

③ 120VAC through 277VAC 50/60Hz. See logic for other voltages.

\* For Glass 12" Spin-Top Flat Lens change PFN to GFN at end of catalog number.







**Globe & Guard or  
Glass Refractor & Guard**



**Spin-Top Poly or  
Glass Refractor**



**Globe Guard &  
Angle Reflector**



**Spin-Top Poly or  
Glass Flat Lens**



**Enclosed  
Reflector**

VM4LB SERIES 25° STANCHION WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	ENCLOSED REFLECTOR	GLOBE GUARD & ANGLE REFLECTOR ④
55	1-1/2"	120-277VAC	VM4LB05530D5GLG	VM4LB05530D5R5G	VM4LB05530D5S5G	VM4LB05530D5P5G	VM4LB05530D5ERN	VM4LB055D5GLG-A
65	1-1/2"	120-277VAC	VM4LB06530D5GLG	VM4LB06530D5R5G	VM4LB06530D5S5G	VM4LB06530D5P5G	VM4LB06530D5ERN	VM4LB065D5GLG-A
70	1-1/2"	120-277VAC	VM4LB07030D5GLG	VM4LB07030D5R5G	VM4LB07030D5S5G	VM4LB07030D5P5G	VM4LB07030D5ERN	VM4LB070D5GLG-A
80	1-1/2"	120-277VAC	VM4LB08030D5GLG	VM4LB08030D5R5G	VM4LB08030D5S5G	VM4LB08030D5P5G	VM4LB08030D5ERN	VM4LB080D5GLG-A
90	1-1/2"	120-277VAC	VM4LB09030D5GLG	VM4LB09030D5R5G	VM4LB09030D5S5G	VM4LB09030D5P5G	VM4LB09030D5ERN	VM4LB090D5GLG-A
100	1-1/2"	120-277VAC	VM4LB10030D5GLG	VM4LB10030D5R5G	VM4LB10030D5S5G	VM4LB10030D5P5G	VM4LB10030D5ERN	VM4LB100D5GLG-A
105	1-1/2"	120-277VAC	VM4LB10530D5GLG	VM4LB10530D5R5G	VM4LB10530D5S5G	VM4LB10530D5P5G	VM4LB10530D5ERN	VM4LB105D5GLG-A
130	1-1/2"	120-277VAC	VM4LB13030D5GLG	VM4LB13030D5R5G	VM4LB13030D5S5G	VM4LB13030D5P5G	VM4LB13030D5ERN	VM4LB130D5GLG-A

VM4LC SERIES 25° STANCHION WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	12" SPIN-TOP POLYCARBONATE FLAT LENS* ④	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	GLOBE GUARD & ANGLE REFLECTOR ④
55	1-1/2"	120-277VAC	VM4LC05530D5GLG	VM4LC05530D5PFN	VM4LC05530D5R5G	VM4LC05530D5S5G	VM4LC05530D5P5G	VM4LC05530D5GLG-A
65	1-1/2"	120-277VAC	VM4LC06530D5GLG	VM4LC06530D5PFN	VM4LC06530D5R5G	VM4LC06530D5S5G	VM4LC06530D5P5G	VM4LC06530D5GLG-A
70	1-1/2"	120-277VAC	VM4LC07030D5GLG	VM4LC07030D5PFN	VM4LC07030D5R5G	VM4LC07030D5S5G	VM4LC07030D5P5G	VM4LC07030D5GLG-A
80	1-1/2"	120-277VAC	VM4LC08030D5GLG	VM4LC08030D5PFN	VM4LC08030D5R5G	VM4LC08030D5S5G	VM4LC08030D5P5G	VM4LC08030D5GLG-A
90	1-1/2"	120-277VAC	VM4LC09030D5GLG	VM4LC09030D5PFN	VM4LC09030D5R5G	VM4LC09030D5S5G	VM4LC09030D5P5G	VM4LC09030D5GLG-A
100	1-1/2"	120-277VAC	VM4LC10030D5GLG	VM4LC10030D5PFN	VM4LC10030D5R5G	VM4LC10030D5S5G	VM4LC10030D5P5G	VM4LC10030D5GLG-A
105	1-1/2"	120-277VAC	VM4LC10530D5GLG	VM4LC10530D5PFN	VM4LC10530D5R5G	VM4LC10530D5S5G	VM4LC10530D5P5G	VM4LC10530D5GLG-A
130	1-1/2"	120-277VAC	VM4LC13030D5GLG	VM4LC13030D5PFN	VM4LC13030D5R5G	VM4LC13030D5S5G	VM4LC13030D5P5G	VM4LC13030D5GLG-A

① Catalog numbers shown are with Guard (except ER/EP/PF); to omit guard change ending G to N; e.g. VM4LB05530D5GLN.

② Catalog numbers shown are with 1-1/2" conduit openings; change "5" to "4" for 1-1/4"; e.g. VM4LB05530D4GLG.

③ 120VAC through 277VAC 50/60Hz. See logic for other voltages.

④ See logic for reflector ordering options or order angle reflector VMPA40 separately.

\* For Glass 12" Spin-Top Flat Lens change PFN to GFN at end of catalog number.



**Globe & Guard or Glass Refractor & Guard**



**Spin-Top Poly or Glass Flat Lens**



**Spin-Top Poly or Glass Refractor**



**Enclosed Reflector**



**Globe, Guard and Dome Reflector**

VM4LB SERIES STRAIGHT STANCHION WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE②	VOLTAGE③	GLOBE & GUARD	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	ENCLOSED REFLECTOR	GLOBE GUARD AND DOME REFLECTOR④
55	1-1/2"	120-277VAC	VM4LB0553S5GLG	VM4LB0553S5R5G	VM4LB0553S5S5G	VM4LB0553S5P5G	VM4LB0553S5ERN	VM4LB0553S5GLG-S
65	1-1/2"	120-277VAC	VM4LB0653S5GLG	VM4LB0653S5R5G	VM4LB0653S5S5G	VM4LB0653S5P5G	VM4LB0653S5ERN	VM4LB0653S5GLG-S
70	1-1/2"	120-277VAC	VM4LB0703S5GLG	VM4LB0703S5R5G	VM4LB0703S5S5G	VM4LB0703S5P5G	VM4LB0703S5ERN	VM4LB0703S5GLG-S
80	1-1/2"	120-277VAC	VM4LB0803S5GLG	VM4LB0803S5R5G	VM4LB0803S5S5G	VM4LB0803S5P5G	VM4LB0803S5ERN	VM4LB0803S5GLG-S
90	1-1/2"	120-277VAC	VM4LB0903S5GLG	VM4LB0903S5R5G	VM4LB0903S5S5G	VM4LB0903S5P5G	VM4LB0903S5ERN	VM4LB0903S5GLG-S
100	1-1/2"	120-277VAC	VM4LB1003S5GLG	VM4LB1003S5R5G	VM4LB1003S5S5G	VM4LB1003S5P5G	VM4LB1003S5ERN	VM4LB1003S5GLG-S
105	1-1/2"	120-277VAC	VM4LB1053S5GLG	VM4LB1053S5R5G	VM4LB1053S5S5G	VM4LB1053S5P5G	VM4LB1053S5ERN	VM4LB1053S5GLG-S
130	1-1/2"	120-277VAC	VM4LB1303S5GLG	VM4LB1303S5R5G	VM4LB1303S5S5G	VM4LB1303S5P5G	VM4LB1303S5ERN	VM4LB1303S5GLG-S

VM4LC SERIES STRAIGHT STANCHION WITH OPTIC AND GUARD ①								
WATTS	HUB SIZE②	VOLTAGE③	GLOBE & GUARD	12" SPIN-TOP POLYCARBONATE FLAT LENS*	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	GLOBE GUARD AND DOME REFLECTOR④
55	1-1/2"	120-277VAC	VM4LC0553S5GLG	VM4LC0553S5PFN	VM4LC0553S5R5G	VM4LC0553S5S5G	VM4LC0553S5P5G	VM4LC0553S5GLG-S
65	1-1/2"	120-277VAC	VM4LC0653S5GLG	VM4LC0653S5PFN	VM4LC0653S5R5G	VM4LC0653S5S5G	VM4LC0653S5P5G	VM4LC0653S5GLG-S
70	1-1/2"	120-277VAC	VM4LC0703S5GLG	VM4LC0703S5PFN	VM4LC0703S5R5G	VM4LC0703S5S5G	VM4LC0703S5P5G	VM4LC0703S5GLG-S
80	1-1/2"	120-277VAC	VM4LC0803S5GLG	VM4LC0803S5PFN	VM4LC0803S5R5G	VM4LC0803S5S5G	VM4LC0803S5P5G	VM4LC0803S5GLG-S
90	1-1/2"	120-277VAC	VM4LC0903S5GLG	VM4LC0903S5PFN	VM4LC0903S5R5G	VM4LC0903S5S5G	VM4LC0903S5P5G	VM4LC0903S5GLG-S
100	1-1/2"	120-277VAC	VM4LC1003S5GLG	VM4LC1003S5PFN	VM4LC1003S5R5G	VM4LC1003S5S5G	VM4LC1003S5P5G	VM4LC1003S5GLG-S
105	1-1/2"	120-277VAC	VM4LC1053S5GLG	VM4LC1053S5PFN	VM4LC1053S5R5G	VM4LC1053S5S5G	VM4LC1053S5P5G	VM4LC1053S5GLG-S
130	1-1/2"	120-277VAC	VM4LC1303S5GLG	VM4LC1303S5PFN	VM4LC1303S5R5G	VM4LC1303S5S5G	VM4LC1303S5P5G	VM4LC1303S5GLG-S

① Catalog numbers shown are with Guard (except ER/EP/PF); to omit guard change ending G to N; e.g. VM4LB0553S5GLN.

② Catalog numbers shown are with 1-1/2" conduit openings; change "5" to "4" for 1-1/4"; e.g. VM4LB0553S54GLG.

③ 120VAC through 277VAC 50/60Hz. See logic for other voltages.

④ See logic for reflector ordering options or order dome reflector VMPSD40 separately.

\* For Glass 12" Spin-Top Flat Lens change PFN to GFN at end of catalog number.





**Globe & Guard or  
Glass Refractor & Guard**



**Spin-Top Poly or  
Glass Flat Lens**



**Spin-Top Poly or  
Glass Refractor**



**Enclosed Reflector**



**Poly Food Optic**

**VM4LB SERIES EZ ADAPTER WITH OPTIC AND GUARD ①②**

WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	ENCLOSED REFLECTOR	POLYCARBONATE FOOD OPTIC
55	②	120-277VAC	VM4LB05530EZGLG	VM4LB05530EZR5G	VM4LB05530EZS5G	VM4LB05530EZP5G	VM4LB05530EZERN	VM4LB05530EZEPN
65	②	120-277VAC	VM4LB06530EZGLG	VM4LB06530EZR5G	VM4LB06530EZS5G	VM4LB06530EZP5G	VM4LB06530EZERN	VM4LB06530EZEPN
70	②	120-277VAC	VM4LB07030EZGLG	VM4LB07030EZR5G	VM4LB07030EZS5G	VM4LB07030EZP5G	VM4LB07030EZERN	VM4LB07030EZEPN
80	②	120-277VAC	VM4LB08030EZGLG	VM4LB08030EZR5G	VM4LB08030EZS5G	VM4LB08030EZP5G	VM4LB08030EZERN	VM4LB08030EZEPN
90	②	120-277VAC	VM4LB09030EZGLG	VM4LB09030EZR5G	VM4LB09030EZS5G	VM4LB09030EZP5G	VM4LB09030EZERN	VM4LB09030EZEPN
100	②	120-277VAC	VM4LB10030EZGLG	VM4LB10030EZR5G	VM4LB10030EZS5G	VM4LB10030EZP5G	VM4LB10030EZERN	VM4LB10030EZEPN
105	②	120-277VAC	VM4LB10530EZGLG	VM4LB10530EZR5G	VM4LB10530EZS5G	VM4LB10530EZP5G	VM4LB10530EZERN	VM4LB10530EZEPN
130	②	120-277VAC	VM4LB13030EZGLG	VM4LB13030EZR5G	VM4LB13030EZS5G	VM4LB13030EZP5G	VM4LB13030EZERN	VM4LB13030EZEPN

**VM4LC SERIES EZ ADAPTER WITH OPTIC AND GUARD ①②**

WATTS	HUB SIZE ②	VOLTAGE ③	GLOBE & GUARD	12" SPIN-TOP POLYCARBONATE FLAT LENS*	TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V GLASS REFRACTOR & GUARD	12" SPIN-TOP TYPE V POLYCARBONATE REFRACTOR & GUARD	POLYCARBONATE FOOD OPTIC
55	②	120-277VAC	VM4LC05530EZGLG	VM4LC05530EZPFN	VM4LC05530EZR5G	VM4LC05530EZS5G	VM4LC05530EZP5G	VM4LC05530EZEPN
65	②	120-277VAC	VM4LC06530EZGLG	VM4LC06530EZPFN	VM4LC06530EZR5G	VM4LC06530EZS5G	VM4LC06530EZP5G	VM4LC06530EZEPN
70	②	120-277VAC	VM4LC07030EZGLG	VM4LC07030EZPFN	VM4LC07030EZR5G	VM4LC07030EZS5G	VM4LC07030EZP5G	VM4LC07030EZEPN
80	②	120-277VAC	VM4LC08030EZGLG	VM4LC08030EZPFN	VM4LC08030EZR5G	VM4LC08030EZS5G	VM4LC08030EZP5G	VM4LC08030EZEPN
90	②	120-277VAC	VM4LC09030EZGLG	VM4LC09030EZPFN	VM4LC09030EZR5G	VM4LC09030EZS5G	VM4LC09030EZP5G	VM4LC09030EZEPN
100	②	120-277VAC	VM4LC10030EZGLG	VM4LC10030EZPFN	VM4LC10030EZR5G	VM4LC10030EZS5G	VM4LC10030EZP5G	VM4LC10030EZEPN
105	②	120-277VAC	VM4LC10530EZGLG	VM4LC10530EZPFN	VM4LC10530EZR5G	VM4LC10530EZS5G	VM4LC10530EZP5G	VM4LC10530EZEPN
130	②	120-277VAC	VM4LC13030EZGLG	VM4LC13030EZPFN	VM4LC13030EZR5G	VM4LC13030EZS5G	VM4LC13030EZP5G	VM4LC13030EZEPN

① Catalog numbers shown are with Guard (except ER/EP/PF); to omit guard change ending G to N; e.g. VM4LB05530EZGLN.

② VMEZA tank adapters UL "classified" as an assembly for use between VM tanks and EZ mounts. Order EZ mounts separately - see page 11 on components page.

③ 120VAC through 277VAC 50/60Hz. See logic for other voltages.

\* For Glass 12" Spin-Top Flat Lens change PFN to GFN at end of catalog number.



Pendant



Ceiling



Wall



Cone Top



25° Stanchion



Straight Stanchion



EZ Adapter\*  
VMEZA



Tank Adapter  
See next page to order

CERTILITE® VM MOUNTING SPLICE BOXES							
CATALOG NUMBER							
HUB SIZE	PENDANT	CEILING 4 HUB	CEILING 5 HUB	WALL	CONE TOP	25 DEGREE STANCHION	90 DEGREE STANCHION
3/4"	VMA2B	VMX2B	VMX6B	VMB2B	VMC2B	—	—
1"	VMA3B	VMX3B	VMX7B	VMB3B	VMC3B	—	—
1-1/4"	—	—	—	—	—	VMD4B	VMS4B
1-1/2"	—	—	—	—	—	VMD5B	VMS5B
M-20	—	VMX8B**	VMX9B	—	—	—	—

\*VMEZA is used between a ballast tank and an EZ mount - ordered separately. See catalog grids.

\*\*VMX8B furnished with 3 non-metallic plugs.

VM4L LED OPTICS AND ACCESSORIES		
DESCRIPTION	OPTIC LOGIC	GUARD ⑤
Flat Lens (glass spin top) "C" tank only	VZRGF12 (GF)	VZRF12GRD
Flat Lens (polycarbonate spin top) "C" tank only	VZRPF12 (PF)	VZRF12GRD
Globe (glass)	VMG25 (GL)	VMAG25S
Reflector (all glass) Type I	VMR251 (R1)	VMAG25S
Reflector (all glass) Type III	VMR253 (R3)	VMAG25S
Reflector (all glass) Type V	VMR255 (R5)	VMAG25S
Enclosed Reflector	VMER40 (ER)	VMERG
Enclosed Reflector with Polycarbonate Lens*	VMEP40 (EP)④	—
Reflector (Polycarbonate spin top) 12" Type V*	VZRP175B (P5)	VMRWGS
Reflector (glass spin top) 12" Type V	VZRG4050 (S5)	VMRWGS
Reflector (glass spin top) 12" Type II	VZRG4020 (S2)	VMRWGS
Globe (Silicone coated)	VMG25F (FG)	VMAG25S
Globe Teflon® coated①	VMG25T (TG)	VMAG25S
Reflector Teflon® coated (all glass) Type I	VMR251T (T1)	VMAG25S
Reflector Teflon® coated (all glass) Type III	VMR253T (T3)	VMAG25S
Reflector Teflon® coated (all glass) Type V	VMR255T (T5)	VMAG25S
Reflector Teflon® coated (spin top) 12" Type V	VZRG4050T (TV)	VMRWGS
Reflector Teflon® coated (spin top) 12" Type II	VZRG4020T (T2)	VMRWGS

\*Non-glass over Food/Grain Class II Div 1 Group G Certified; VMER40, VZRP175B, and VZRPF12

① Teflon is a registered trademark of DuPont, Inc.

VM4L LED REFLECTORS AND ACCESSORIES	
DOME REFLECTOR (Polyester reinforced fiberglass)	VMPSD40
ANGLE REFLECTOR (Polyester reinforced fiberglass)	VMPA40
DEEP DOME REFLECTOR (White Painted Aluminum)	HRD400
DEEP DOME REFLECTOR (Anodized Aluminum)	HRD400ALZ
120VAC Photocell with FS Style Cover②	VMFSPC1
208-277VAC Photocell with FS Style Cover②	VMFSPC2
Bottom Closure for VMAG25S⑤	VMAGBC
4-sided EXIT Accessory (use without guard)③	VEXA400

② Order single-gang FS box separately. For photocell factory installed in tank, see logic.

③ For use with Generator or UPS powered fixtures

④ For wall applications mount must be spaced out for bottom hub

⑤ Guards are 316 Stainless. Bottom closure for VMAG25S pt. no. VMAGBC



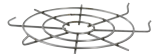
VMG25



VMR255  
VMR253  
VMR251



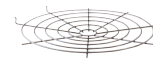
VMAG25S



VMAGBC



VMER40



VMERG



VMEP40



VZRG4050  
VZRG4020



VMRWGS



VZRPF/VZRGF



VMPSD40

Standard Dome, Fiberglass  
White Reflector, Dia: 16"



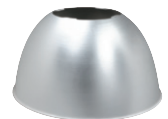
VMPA40

30° Angle, Fiberglass  
White Reflector, Dia: 16"



HRD400

Deep Aluminum, White  
Reflector, Dia: 21"



HRD400ALZ

Deep Aluminum, Anodized  
Reflector, Dia: 21"



VMFSPC



VEXA400  
Fixture not included





### “EZ” Mount Adapter

For easy fixture relocation or to repair fixture on ‘bench top’.

VMEZA adapter is used between a ballast tank and EZ mount ordered separately. →



Pendant



Ceiling



Wall Bracket



25° Stanchion

MOUNTING BOXES				
CATALOG NUMBER				HUB SIZE
PENDANT	CEILING	BRACKET	STANCHION	
EZA2	EZX2	EZB2	—	3/4"
EZA3	EZX3	EZB3	—	1"
—	—	—	EZD4*	1-1/4"/1-1/2**

\*1-1/2" furnished with 1-1/2"-1-1/4" reducer and extension.



### Competitive Adapters

Designed to ease upgrading of other manufacturer's fixtures to KILLARK LEDs where removal of existing mounting screws and conduit would be difficult and time consuming.

Tank adapter to Crouse-Hinds®<sup>①</sup> VM Series mounts  
 Tank adapter to CH (70's era wall mount with deep box)  
 Tank adapter to Appleton®<sup>②</sup> MERCMASTER II mounts  
 Tank adapter to Appleton® MERCMASTER III mounts  
 Tank adapter to Hazlux®<sup>③</sup> mounts

VMCHVM  
 VMCHVM-DEEP  
 VMM2LP  
 VMM3KP  
 VMHLDS

① Crouse-Hinds is a registered trademark of EATON® corporation.

② Appleton and MERCMASTER are registered trademarks of Emerson® Industrial Automation.

③ Hazlux is a registered trademark of Thomas & Betts.

VM4L LED HOUSINGS & GLOBE, DRIVERS AND LEDS - ELECTRICAL RATINGS <sup>①</sup>					
CAT. NO.	VOLTAGE 50/60HZ	WATTAGE	AMPS 120/277	CIL <sup>②</sup>	WEIGHT <sup>③</sup>
VM4LB05530	120-277VAC	55	0.48/0.21	6960	18.9
VM4LB06530	120-277VAC	65	0.56/0.24	8960	18.9
VM4LB07030	120-277VAC	70	0.60/0.30	8700	18.9
VM4LB08030	120-277VAC	80	0.68/0.30	10440	18.9
VM4LB09030	120-277VAC	90	0.77/0.33	11200	18.9
VM4LB10030	120-277VAC	100	0.85/0.37	13440	18.9
VM4LB10530	120-277VAC	105	0.89/0.39	13920	18.9
VM4LB13030	120-277VAC	130	1.10/0.48	17920	18.9
VM4LC05530	120-277VAC	55	0.48/0.21	6960	17.4
VM4LC06530	120-277VAC	65	0.56/0.24	8960	17.4
VM4LC07030	120-277VAC	70	0.60/0.30	8700	17.4
VM4LC08030	120-277VAC	80	0.68/0.30	10440	17.4
VM4LC09030	120-277VAC	90	0.77/0.33	11200	17.4
VM4LC10030	120-277VAC	100	0.85/0.37	13440	17.4
VM4LC10530	120-277VAC	105	0.89/0.39	13920	17.4
VM4LC13030	120-277VAC	130	1.10/0.48	17920	17.4

① Driver THD < 20%, Powerfactor 99% @ 120V; Line Regulation 2%; Load regulation 5%; Protected against Over-voltage and Over-current.

② CIL = Calculated Initial Lumens of LED component based on mfg. data and driver current INSIDE the optic. This value is provided as a reference only for comparison to traditional light sources such as incandescent, HID, or fluorescent which use initial values in "relative" photometry. KILLARK LED luminaires are tested using the Absolute photometry method (LM79-08), which calculates delivered lumens only. KILLARK's LED luminaires provide very bright white 5000 K (CCT) color and can appear brighter than traditional light sources with higher lumen values under both photopic and scotopic conditions.

③ With ceiling mount.

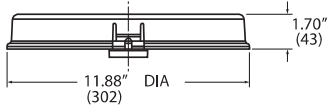
④ TM-21 based values require very long duration testing. The TM-21/L70 "official reported" value is based on 7,800 to 10,000 hours testing (at time of printing) at 1000mA to 1500mA drive current, depending on LED chip utilized.

"Reported L70" is a factor of test duration. KILLARK's VM4LC/B series utilizes lower 700mA maximum drive current - "calculated" values by the major chip vendors utilized predict L70 life up to 150,000+ hours even at 1000mA.

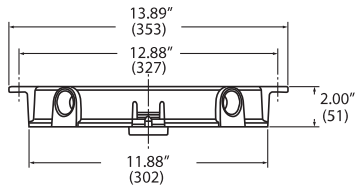
THERMAL PERFORMANCE DATA						
CAT. NO.	AMBIENT	C1D2	C2D1	L70		SUPPLY WIRE
				TM-21 <sup>④</sup>	CALCULATED	
VM4LB05530	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LB06530	40°C	T4A	EFG	72600	109000	75°C
	55°C	T4	EFG	72600	109000	90°C
VM4LB07030	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LB08030	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LB09030	40°C	T4A	EFG	72600	109000	75°C
	55°C	T4	EFG	72600	109000	90°C
VM4LB10030	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LB10530	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LB13030	40°C	T4A	EFG	72600	109000	75°C
	50°C	T4	EFG	72600	109000	90°C
VM4LC05530	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LC06530	40°C	T4A	EFG	72600	109000	75°C
	55°C	T4	EFG	72600	109000	90°C
VM4LC07030	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LC08030	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LC09030	40°C	T4A	EFG	72600	109000	75°C
	55°C	T4	EFG	72600	109000	90°C
VM4LC10030	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LC10530	40°C	T4A	EFG	60100	137000	75°C
	55°C	T4	EFG	60100	137000	90°C
VM4LC13030	40°C	T4A	EFG	72600	109000	75°C
	50°C	T4	EFG	72600	109000	90°C

TOTAL LUMEN OUTPUT W/VMG25 GLOBE		
Wattage	Bulb (VM4LB)	Concave (VM4LC)
55	5842	5275
65 <sup>④</sup>	8577	8229
70	7111	6524
80	8525	7559
90 <sup>④</sup>	10520	10210
100 <sup>④</sup>	12220	11910
105	10780	9600
130 <sup>④</sup>	15630	15370

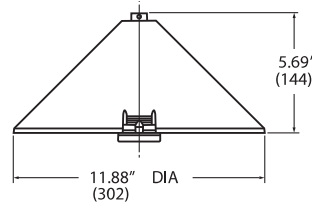
④ Extra high lumen per watt LED's



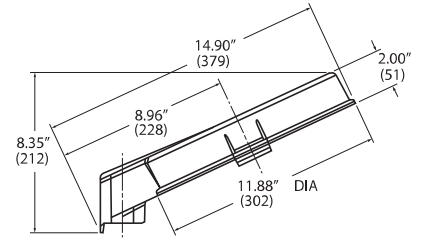
Pendant Mount



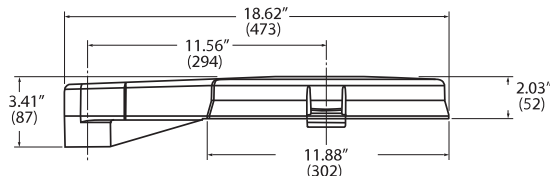
Ceiling Mount



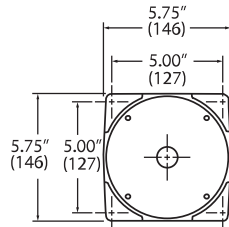
Cone Mount



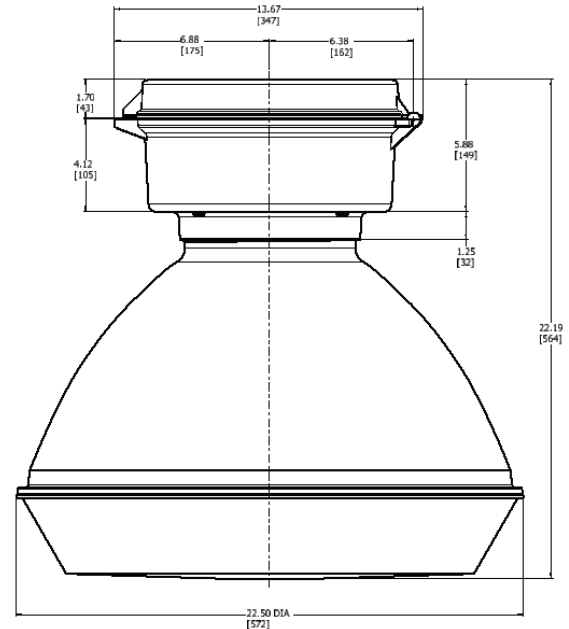
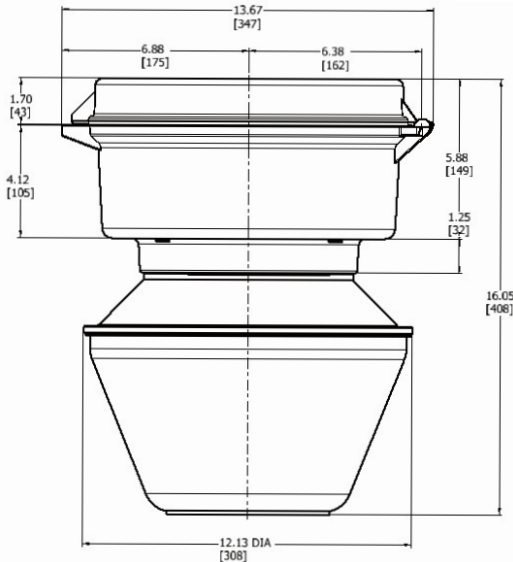
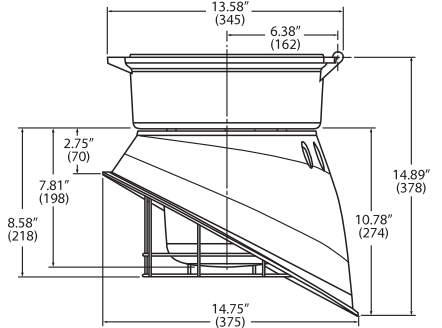
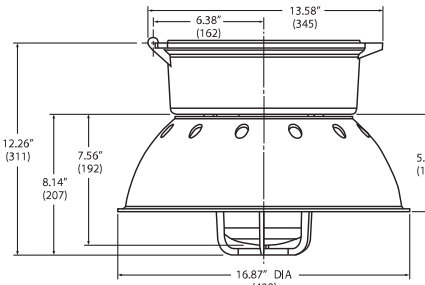
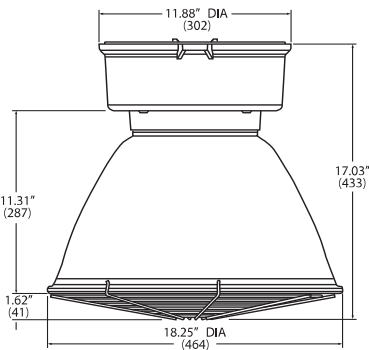
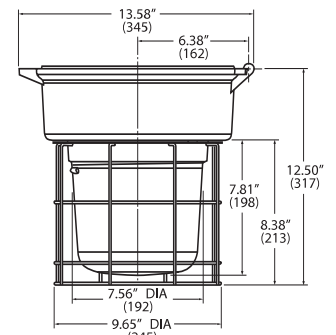
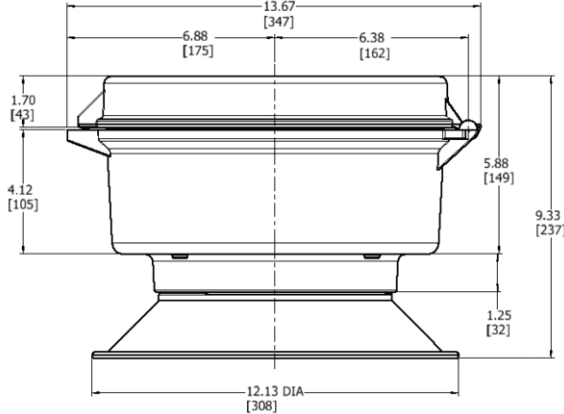
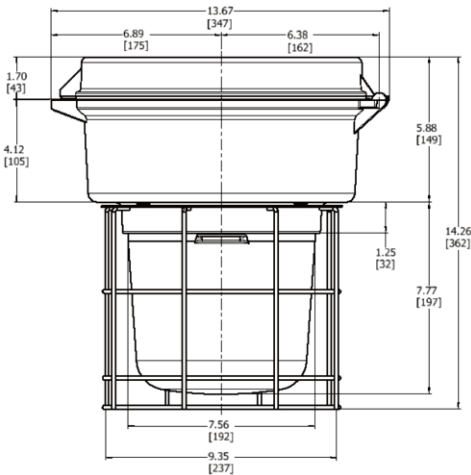
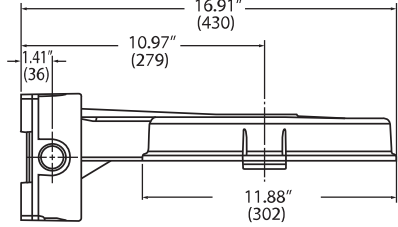
Stanchion(25°) Mount



Stanchion(0°) Mount



Wall Bracket Mount



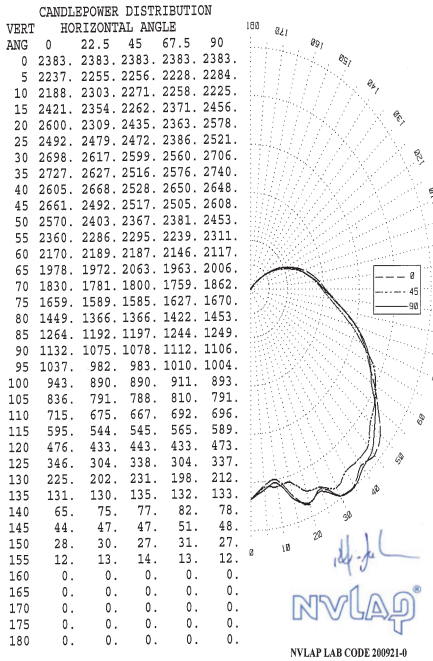
**LED 130 Watt "B"  
Globe Only**



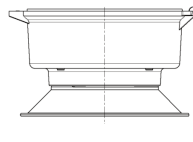
Zonal Lumen Summary

Zone	Lumens	%Lamp	%Fixt
0-30	2022 N.A.		12.9%
0-40	3663 N.A.		23.4%
0-60	7682 N.A.		49.1%
0-90	12708 N.A.		81.3%
90-120	2495 N.A.		16.0%
90-130	2784 N.A.		17.8%
90-150	2916 N.A.		18.7%
90-180	2922 N.A.		18.7%
0-180	<b>15630</b> N.A.		100.0%

Absolute Photometry  
Total Luminaire Efficiency = N.A.%  
Spacing to Mounting Height Ratio 1.7



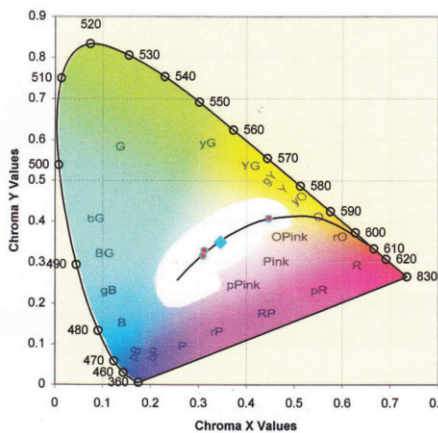
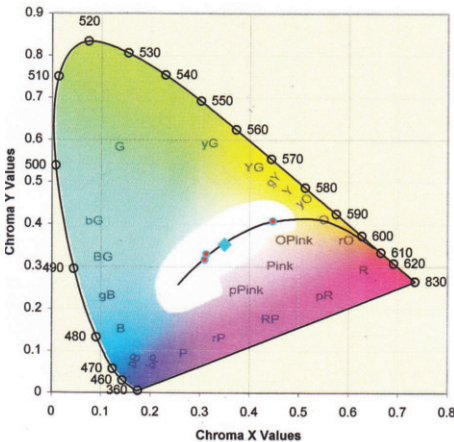
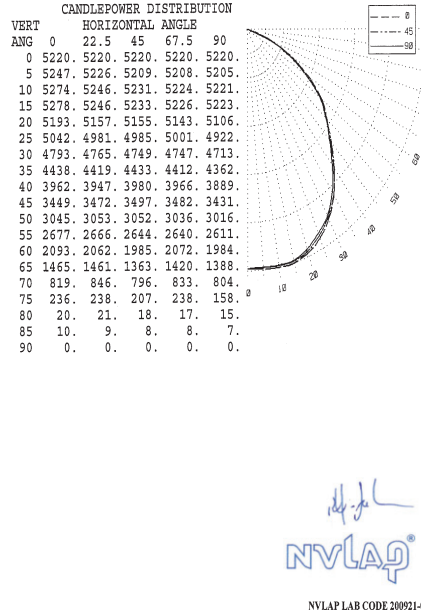
**LED 130 Watt "C"  
Flat Lens Spin Top**



Zonal Lumen Summary

Zone	Lumens	%Lamp	%Fixt
0-30	4291 N.A.		31.1%
0-40	7066 N.A.		51.3%
0-60	12131 N.A.		88.0%
0-90	13780 N.A.		100.0%
90-120	0 N.A.		0.0%
90-130	0 N.A.		0.0%
90-150	0 N.A.		0.0%
90-180	0 N.A.		0.0%
0-180	<b>13780</b> N.A.		100.0%

Absolute Photometry  
Total Luminaire Efficiency = N.A.%  
Spacing to Mounting Height Ratio 1.3



**LiteGear®**  
**Single Phase Compact Inverter**  
Provides Emergency power for LED & other luminaires\*



**LG1-up to 100W**



**LG2-up to 250W**

Applications (Non-Hazardous) For areas where the inverter can be mounted in a non-hazardous ambient of 20°C to 30°C, up to 1,000 feet between inverter and load.

**Features**

- Interruptible emergency AC power system
- 90 minute emergency operation Input/Output VAC: 120/120 or 277/277
- For normally-on, normally off and switched loads
- LED status indicators; Push Button test switch
- Overload and short-circuit protection
- Maintenance-free lead-calcium batteries
- Self testing/diagnostics optional for LG2
- \*Not for use with HID Lamps

**Compliance**

UL Listed to Standard 924 (Emergency Lighting)  
NFPA 101 (Life Safety Code)

Call Dual-Lite (866) 313-3909\* for more information or go to [www.dual-lite.com](http://www.dual-lite.com)

\*Dual Lite Tech Support










See [www.hubbell-killark.com](http://www.hubbell-killark.com)  
**LIGHTING SOFTWARE**  
for additional High Wattage LED photometrics



Hubbell Lighting, Inc.



# LED LIGHTING RANGE FROM KILLARK®

	<b>CERTILITE<sup>V</sup></b> VML1	<ul style="list-style-type: none"> <li>• LED 40, 45, 50W</li> <li>• Reduced profile</li> <li>• Swing-barrel nut &amp; EZ Mount Adapter for easy installation</li> </ul>	Class I, Div. 2, Groups A,B,C,D Class I, Zone 2, Groups IIC, IIB, IIA Class II, Div. 1&2, Groups E,F,G Class III Suitable for wet locations Marine NEMA 3, 4X
	<b>CERTILITE<sup>V</sup></b> VM4LB VM4LC	<ul style="list-style-type: none"> <li>• LED 55 - 130W</li> <li>• Up to 115 Lumens/watt</li> <li>• Patented Swing-barrel nut &amp; "EZ" adapter</li> <li>• 2 styles of internal LED heat sinks</li> </ul>	Class I, Div. 2, Groups A,B,C,D Class I, Zone 2, Groups IIC, IIB, IIA Class II, Div. 1&2, Groups E,F,G Class III Suitable for wet locations NEMA 3, 4X IP66 Marine
	<b>CERTILITE</b> MBL	<ul style="list-style-type: none"> <li>• LED 14 - 50W</li> <li>• Compact Design</li> <li>• 60,000 maintenance free hours with crisp white light</li> <li>• Globe or Flat Lens models</li> </ul>	Class I, Div. 2, Groups A,B,C,D Class I, Zone 2, Groups IIC, IIB, IIA Class II, Div. 1&2, Groups E,F,G Class III Suitable for wet locations NEMA 3, 4X Marine
	<b>SERIES</b>	<b>HIGHLIGHTS</b>	<b>SUITABILITY</b>
	<b>VSL</b>	<ul style="list-style-type: none"> <li>• LED 13 &amp; 16W</li> <li>• Utility retrofits for energy savings</li> <li>• Compact size, traditional look</li> </ul>	Class I, Div. 2, Groups A,B,C,D Class I, Zone 2, Groups IIC, IIB, IIA Class II, Div. 2, Groups F,G Class III Suitable for wet locations <hr/> Class II, Div. I, Groups E,F,G Class I, Div. II, Groups A,B,C,D
	<b>DVL</b>		
	<b>HOSTILE<sup>LITE</sup></b> EML	<ul style="list-style-type: none"> <li>• LED 40, 45, 50W</li> <li>• Compact Explosion-proof with traditional industrial appearance</li> <li>• Factory Sealed</li> </ul>	Class I, Div. 1&2, Groups C,D Class I, Zones 1&2, Groups IIB, IIA Class II, Div. 1&2, Groups E,F,G Class III, Div. 1&2 Suitable for wet locations Marine NEMA 3, 4, 4X Factory Sealed
	<b>PETRO<sup>BRIGHT</sup></b> KFL KFLC	<b>KFL</b> <ul style="list-style-type: none"> <li>• LED 60-125W</li> <li>• Up to 115 Lumens/Watt</li> <li>• 5000K White Light</li> <li>• L70 50,000+ Hours</li> </ul> <b>KFLC</b> <ul style="list-style-type: none"> <li>• Compact Size</li> <li>• 30 - 45W</li> </ul>	Class I, Div. 2, Groups A,B,C,D Class II, Div. 1&2, Groups E,F,G Class III Suitable for wet locations Marine NEMA 3, 4X, IP66
	<b>HOSTILE<sup>LITE</sup></b> EBS	<ul style="list-style-type: none"> <li>• LED 10W 5000K Color</li> <li>• Up to 5X's Brighter than comparable units</li> <li>• Exit Sign</li> <li>• Remote Mount Options</li> </ul>	Class I, Div. 1&2, Groups B,C,D Class I, Zones 1&2, Groups IIB+H2, IIA Class II, Div. 1&2, Groups E,F,G Class III Enclosure Type 4 (NEMA 4) NEMA 7BCD, 9EFG

\*See catalog data for complete ratings, certifications and series features



**KILLARK®**

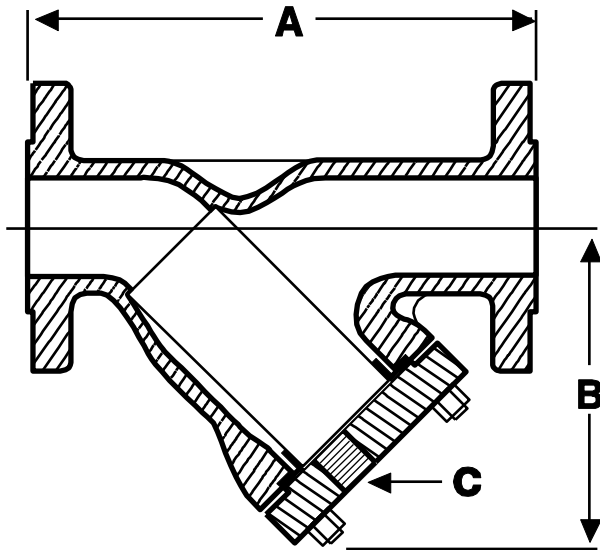
3940 M.L. King Dr. St. Louis, MO 63113  
 TEL: (314) 531-0460 FAX: (314) 531-7164  
 www.hubbell-killark.com

RACO® BELL® KILLARK® HAWKE® CHALMIT® WIEGMANN®

SBVM4LB-VM4LC 04-13  
 ©2013 Hubbell Incorporated (Delaware)



<h1>ALTA</h1>	<b>MODEL NYF 150</b> <b>150# ANSI CARBON STEEL</b> <b>RAISED FACE FLANGED</b> <b>"Y" STRAINER</b>	<b>DRAWING A 120</b>  <b>REV 1</b>
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DESCRIPTION	MATERIAL
BODY	ASTM A216 GR. WCB
COVER	ASTM A216 GR. WCB
STUD	ASTM A193 GR. B7
NUT	ASTM A194 GR. 2H
GASKET	NON ASBESTOS
SCREEN 1" TO 1 1/2"	304 SS 1/32 PERF
SCREEN 2" TO 12"	304 SS 1/8 PERF

TEMPERATURE		WORKING PRESSURE	
C	F	kPa	P.S.I.
-29 to 38	-20 to 100	1965	285
95	200	1790	260
150	300	1585	230
200	400	1380	200
260	500	1170	170

**FLANGES ARE IN ACCORDANCE WITH ANSI B16.5**  
**ALL STRAINERS ARE INDIVIDUALLY HYDROSTATICALLY TESTED TO ANSI B16.5**

SIZE		DIMENSIONS						SCREEN REMOVAL		NET WEIGHT	
		A		B		C					
mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	Kg.	Lbs.
25	1	162	6 3/8	127	5	15	1/2	152	6	5	11
40	1 1/2	197	7 3/4	133	5 1/4	15	1/2	165	6 1/2	7.7	17
50	2	200	7 7/8	152	6	20	3/4	165	6 1/2	10.4	23
80	3	254	10	177	7 1/2	25	1	228	9	19	42
100	4	308	12 1/8	279	11	40	1 1/2	406	16	33	73
150	6	470	18 1/2	368	14 1/2	50	2	508	20	64	140
200	8	549	21 5/8	525	20 5/8	50	2	812	32	116	255
250	10	660	26	584	23	50	2	889	38	161	355
300	12	762	30	660	26	50	2	1090	43	209	490

**FEATURES** BODY HAS A MACHINED SEAT TO HOLD SCREEN SECURELY.

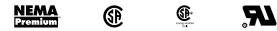
COVER HAS A MACHINED SCREEN HOLDER TO ALIGN SCREEN DURING INSTALLATION AND TO RETAIN SEDIMENT WHEN COVER IS REMOVED.

BODY IS MACHINED TO HOLD COVER GASKET IN A BLOW-OUT PROOF DESIGN.

FLANGES ARE BACK FACED OR SPOT FACED.



**MODEL:** ADVANTAGE PLUS IEEE READY  
**TYPE:** AEHH8R



Effective 09-22-14  
Supercedes All Previous

### APPLICATIONS

- Fans & Blowers
- Compressors
- Any Severe Duty / Petro-Chemical / Pulp & Paper Applications
- Pumps
- Mixers
- Crushers
- Conveyors

### PRODUCT OVERVIEW

- 1-500HP
- 3600, 1800, 1200 & 900RPM
- Horizontal F1 Mount
- 60Hz, 460V or 575V
- Totally Enclosed IP54 Design
- \*NEMA Premium Efficiency

### DESIGN FEATURES

- 1.15 S.F. Sine Wave Power; 1.0 S.F. VFD Power
- Class B Temperature Rise
- Max Elevation 3300ft
- Continuous Duty
- 40°C Ambient
- Class F Insulation
- Sound Pressure Level Complies with IEEE 841
- NEMA Design B or C
- Bearing Temperature Rise Below 45°C for 4P and 6P ratings; 50°C for 2P Motors

### MECHANICAL FEATURES

- Oversized Open C3 Clearance Bearings with Regreaseable Provisions
- Polyrex EM Grease
- Dynamically Balanced Die-Cast Aluminum Rotor up to 449T Frames; Copper/Copper Alloy 5000 and Larger
- Cast-Iron Frame and End Brackets with Grease Provisions and Bearing Caps
- Frame Provided with Two Threaded Drain Holes and Stainless Steel Breather Drains
- Cast-Iron Conduit Box up to 445T Frames; Fabricated Steel Conduit Box 447T Frames and Larger, Gasketed, F1 Mounting
- Non-Sparking Plastic Fan up to 449T 4,6 & 8 Pole Motors; Bronze Fan 440TS 2 Pole Motors and 5000 Frames and Larger
- Number of Leads 460V/575V: 3 Leads; Solderless Lug Terminals on All Leads
- Grounding Terminal Inside Main Terminal Box and Provisions for Grounding Terminal on Motor Frame
- Interchangeable F1 and F2 mounting up to 449T
- Dual Drilled Feet for Longer Frames (i.e. 145T also Drilled for 143T) 449T and Below
- Paint System: Zinc Chromate Epoxy Primer, Phenolic Rust Proof Base with Lacquer Top Coat; All Internal Surfaces are Coated with Moisture Resistant Varnish
- Stainless Steel Nameplate and Hardware
- Rubber Flinger on DE up to 280T; Copper Flinger on Both Ends 280TS and Larger
- \*\*HPE™ High Pulse Endurance Spike Resistant Wire
- 2 Dips Phenolic Alkyd Resin Varnish with Red Varnish Spray on Both Ends
- Winding RTD's, Space Heaters and Provisions for Bearing RTD's Standard 5000 Frames and Larger

### OTHER FEATURES

- \*CSA Certified for Class I, Division II, Groups B, C and D and Class I, Zone 2, Groups IIB+H2, IIB and IIA
- \*\*Inverter Duty Speed Range 10:1 CT and 20:1 VT up to 300HP; 3:1 CT and 20:1 VT 301-500HP
- \*\*\*Meets NEMA MG1 Part 31.4.4.2

\* Applies to 1-500HP; 2, 4 & 6 Pole Only

\*\* Precautions should be taken to eliminate or reduce voltage spikes and shaft currents that may be imposed on the motor by the VFD as stated per NEMA MG1, Part 31.4.4.

# ENER-TECH

ENER-TECH INDUSTRIES ALBERTA LTD.

EDMONTON.

## MODEL ET PROPELLER FANS

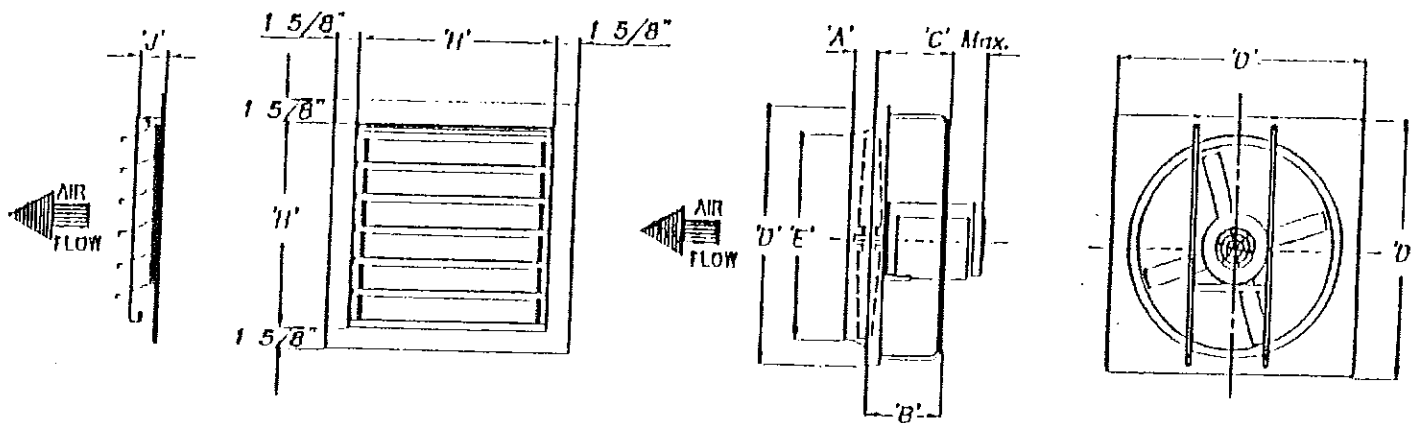
Standard Airflow

### DIMENSIONS

Model	A	B	C	D	E	H	J
ET-12	2 1/2"	8 1/2"	4"	18"	12 3/4"	12"	3"
ET-16	2 1/2"	8 1/2"	4"	20"	16 3/4"	16"	3"
ET-20	2 1/2"	8 1/2"	4"	24"	20 3/4"	20"	3"
ET-24	2 1/2"	8 1/2"	4"	28"	24 3/4"	24"	3"

Dimensions given on this sheet are correct within limits suitable for normal installation requirements.

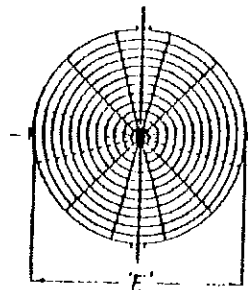
Project
Location
Architect
Engineer
Contractor
Submitted by
Date



### FEATURES

**ET FANS,** designed for heavy-duty ventilation applications. Fans with explosion proof motors designed to exhaust atmospheres containing flammable, explosive vapors or gases. Explosion proof motors are CSA approved for Class I, Group D and Class II, Groups E, F and G hazardous locations. Air delivers based on AMCA test code for exhaust systems. Heavy-duty venturi panel, fixed position motor base with rigid tubular supports. Fan blade is non-sparking, cast or fabricated aluminum. Back guard is heavy gauge steel wire.

**STANDARD SHUTTERS,** for normal applications. Mill finish aluminum vanes with steel pivot pins. 19 ga. welded steel frame. Gray enamel finish. Vanes counter-balanced for easy operation, steel reinforced, felted for quiet, weathertight closure. Tie rod attached to vanes on fan side. 9/32" diameter mounting holes.



REAR & FRONT FAN GUARD

Blade Dia.	CFM AIR DELIVERY					Motor Required		No. Blade Wings
	Free Air	1/8" BP	1/4" BP	3/8" BP	1/2" BP	HP	RPM	
ET12-1	800	600	500	350	200	1/4	1725	3
ET12-2	1200	1050	900	750	600	1/4	1725	4
ET12-3	1400	1350	1000	900	800	1/4	1725	4
ET12-4	1700	1400	1200	1000	950	1/4	1725	4
ET16-1	2720	2275	1820	1390	1075	1/4	1725	4
ET20-1	3020	2620	2100	1640	1290	1/4	1725	4
ET20-2	3620	3110	2630	2155	1720	1/3	1725	4
ET20-3	4700	4055	3430	2900	2350	1/2	1725	4
ET24-2	5480	4965	4450	3895	3135	1/2	1725	4
ET24-3	6860	6155	5450	4750	4045	3/4	1725	4

**CERTIFICATION DATA SHEET**

**Model#:** 56C17E5314 G  
**CONN. DIAGRAM:** 102005-84  
**OUTLINE:** B-104196-631

**WINDING#:** ZC496 R2 3  
**ASSEMBLY:** F1 ONLY

**TYPICAL MOTOR PERFORMANCE DATA**

HP	KW	SYNC. RPM	F.L. RPM	FRAME	ENCLOSURE	KVA CODE	DESIGN
1/4	.187	1800	1725	56	EPNV	P	NO DESIGN CODE

PH	Hz	VOLTS	FL AMPS	START TYPE	DUTY	INSL	S.F	AMB	ELEVATION
1	60	115/208-230	4.8/2.3-2.4	ACROSS THE LINE	CONTINUOUS	B3	1.0	40	3300

FULL LOAD EFF: 59.5	3/4 LOAD EFF: -	1/2 LOAD EFF: -	GTD. EFF	ELEC. TYPE	NO LOAD AMPS
FULL LOAD PF: 57.5	3/4 LOAD PF: -	1/2 LOAD PF: -	0	CAP START IND RUN	2.9 / 1.5

F.L. TORQUE	LOCKED ROTOR AMPS	L.R. TORQUE	B.D. TORQUE	F.L. RISE
12 LB-FT	24.8 / 12.4	47.8 LB-FT 398	33.3 LB-FT 278	50

SOUND PRESSURE @ 3 FT.	SOUND POWER	ROTOR WK^2	MAX. WK^2	SAFE STALL TIME	STARTS / HOUR	APPROX. MOTOR WGT
0 dBA	10 dBA	0 LB-FT^2	0 LB-FT^2	0 SEC.	0	0 LBS.

**\*\*\* SUPPLEMENTAL INFORMATION \*\*\***

DE BRACKET TYPE	ODE BRACKET TYPE	MOUNT TYPE	ORIENTATION	SEVERE DUTY	HAZARDOUS LOCATION	DRIP COVER	SCREENS	PAINT
STANDARD	STANDARD	RIGID	HORIZONTAL	FALSE	EXP PROOF CL I GR C&D CL II GR F&G T3B	FALSE	NONE	STANDARD

BEARINGS		GREASE	SHAFT TYPE	SPECIAL DE	SPECIAL ODE	SHAFT MATERIAL	FRAME MATERIAL
DE	OPE						
BALL	BALL	STANDARD	T	NONE	NONE	STANDARD	ROLLED STEEL
-	-						

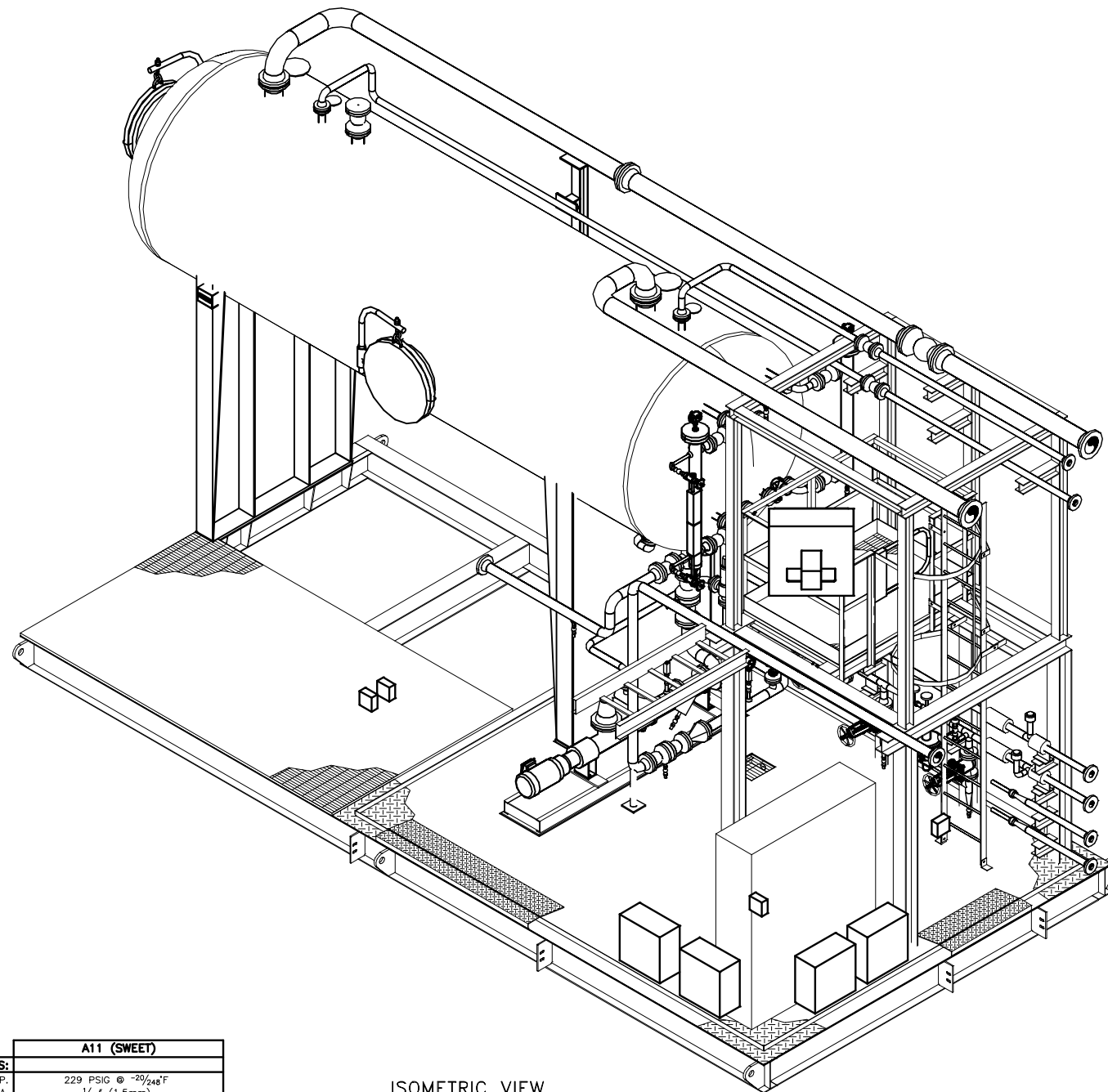
THERMO-PROTECTORS				THERMISTORS	CONTROL	SPACE /n HEATERS
THERMOSTATS	PROTECTORS	WDG RTDs	BRG RTDs			
NONE	AUTOMATIC	NONE	NONE	NONE	FALSE	NONE VOLTS

\*  
N  
O  
T  
E  
S  
\*

INVERTER TORQUE: NONE
INV. HP SPEED RANGE: NONE
ENCODER: NONE
NONE NONE
NONE NONE PPR
BRAKE: NONE -
NONE P/N NONE
NONE NONE
- FT-LB NONE V NONE Hz

## **SECTION B**

### **BILL OF MATERIAL AND DRAWINGS**



**TIE-IN SCHEDULE:**

- 1 NPS 6(150)-CL150 ASME RF HC DRAIN INLET, B.O.P. @ ELEV. 15'-11<sup>5</sup>/<sub>16</sub>" (4859)
- 2 NPS 2(50)-CL150 ASME RF VENT GAS CONN., B.O.P. @ ELEV. 15'-11<sup>5</sup>/<sub>16</sub>" (4859)
- 3 NPS 3(80)-CL150 ASME RF RECOVERED HC DRAIN, B.O.P. @ ELEV. 8'-0" (2438)
- 4 NPS 3(80)-CL150 ASME RF TRUCK OUT CONNECTION, ⌀ @ ELEV. 5'-3" (1600)
- 5 NPS 2(50)-CL300 ASME RF HEAT MEDIUM SUPPLY, ⌀ @ ELEV. 4'-4" (1321)
- 6 NPS 2(50)-CL300 ASME RF HEAT MEDIUM RETURN, ⌀ @ ELEV. 3'-3" (991)
- 7 NPS 2(50)-CL150 ASME RF FUEL GAS INLET, B.O.P. @ ELEV. 14'-4<sup>7</sup>/<sub>16</sub>" (4380)
- 8 NPS 2(50)-CL150 ASME RF UTILITY AIR SUPPLY, ⌀ @ ELEV. 1'-0" (305)
- 9 NPS 2(50)-CL150 ASME RF INSTRUMENT AIR SUPPLY, ⌀ @ ELEV. 2'-0" (610)
- 10 NPS 2(50)-CL150 ASME RF FLOOR DRAIN, ⌀ @ ELEV. 0'-4" (102) BELOW TOP OF MAIN SKID
- 11 NPS 6(150)-CL150 ASME RF HP FLARE GAS, B.O.P. @ ELEV. 15'-11<sup>5</sup>/<sub>16</sub>" (4859)
- 12 24" CABLE TRAY ENTRY FOR 575V CUT OUT SIZE 35" WIDE x 14" HIGH @ ELEV. 8'-11" (2715mm)

**HEAT TRACING NOTES:**

- 2"-8" PIPE USE 1/2" 316 SS (0.035") TUBING;
- 10" PIPE USE 3/4" 316 SS (0.049") TUBING;
- SS BANDING TO SECURE TRACING;
- SHOP TO SEE PROJECT MANAGER FOR INSTALLATION DETAILS.

**GENERAL NOTES:**

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE MECHANICAL FLOWSHEET.
2. PROCESS PIPING TO BE DESIGNED TO ASME B31.3 2012 EDITION AND REGISTERED IN ALBERTA.
3. PRESSURE VESSELS ARE TO BE REGISTERED IN ALBERTA.
4. VESSELS AND PIPING TO BE INSULATED AS PER FLOWSHEET AND/OR FABRICATION DRAWINGS.
5. PAINTING AS PER GS-6100:
  - INDOOR UNINSULATED VESSEL & PIPING (SYSTEM P1):  
SURFACE PREPARATION: SSPC-SP6  
PRIMER: 4-6 mils CLOVAGUARD 8315 EPOXY  
FINISH: 2-3 mils CLOVATHANE 834 POLYURETHANE  
(VESSEL & PIPING 16376 LIGHT GRAY, STRUCTURAL 15090 BLUE, LADDERS AND HANDRAILS FS13591 SAFETY YELLOW)
  - INSULATED VESSEL & PIPING (SYSTEM P4):  
SURFACE PREPARATION: SSPC-SP10  
PRIMER: 5-8 mils CLOVALINE 8329 HEAVY DUTY EPOXY NOVOLAC LINING (GREY)  
FINISH: NONE
  - INTERNAL COATING VESSEL:  
SURFACE PREPARATION: SSPC-SP5  
PRIMER: 5-8 mils DFT HIGHLAND 74  
TOP COAT: 5-8 mils DFT HIGHLAND 74
  - OUTDOOR STRUCTURAL (SYSTEM NP):  
STRUCTURAL: UN-PAINTED  
GRATING: GALVANIZED
6. ALL ELEVATIONS SHOWN ARE FROM TOP OF MAIN SKID MEMBERS. DEPTH OF SKID IS 1'-0<sup>1</sup>/<sub>2</sub>".
7. ALL SKID EDGE CONNECTIONS TO BE HELD AT DIMENSIONS AND ELEVATIONS SHOWN FOR CUSTOMER TIE-INS.
8. SKID IS DESIGNED FOR AN EIGHT (8) POINT LIFT.
9. I/A SERVICE VENTING: BLEED TYPE INSTRUMENTS, REGULATOR BONNETS, INSTRUMENT CASES AND CONTROL VALVE ACTUATORS ARE NOT VENTED.
10. 1" INSTRUMENT AIR HEADER AS SHOWN ON FLOWSHEET (SHOP TO RUN AS REQ'D) WITH 1/4" TAKE-OFFS c/w ISOLATION NEEDLE VALVE, REGULATOR, AND TUBING TO COMPLETE.
11. REMOVE ALL FLOATS/DISPLACERS FROM ALL LEVEL CONTROLLERS AND SWITCHES. TAG AND CRATE FOR SHIPPING.
12. ALL INSTRUMENTS SHALL BE TAGGED AS FOLLOWS: 001-XX-10-XXXX, SO PG-1012 WOULD BE TAGGED 001-PG-10-1012
13. PROTECT ALL OPENINGS FOR SHIPPING.
14. ESTIMATED SHIPPING WEIGHT UNIT: 51,000 lbs.
15. ALL PIPING HYDRO TESTS TO BE CHART RECORDERS

A11 (SWEET)	
<b>DESIGN CONDITIONS:</b>	229 PSIG @ -20 <sup>24</sup> / <sub>16</sub> F D.P. & TEMP. BW C.A. 1/16" (1.5mm) NPT/SW C.A. 1/16" (1.5mm) RADIOGRAPHY 10% P.W.H.T. NONE HYDROTEST 426 PSIG
<b>PIPING:</b>	BW PIPING 3" - 20" SCH. STD. SA-106-B 2" SCH. 80, SA-106-B SW PIPING ≤ 1 1/2" SCH. 80 SA-106-B NPT PIPING ≤ 1 1/2" SCH. 80 SA-106-B INSTRUMENT TUBING 3/8" O.D. 316 STAINLESS STEEL (0.035") PROCESS TUBING 1/2" O.D. 316 STAINLESS STEEL (0.049")
<b>FITTINGS:</b>	BW FITTINGS 3" - 20" SCH. STD. SA-234-WPB 2" SCH. 80, SA-234-WPB SW FITTINGS ≤ 1 1/2" CL3000 SA-105N NPT FITTINGS ≤ 1 1/2" CL3000 SA-105N * FLANGES RFWN BORE TO PIPE, SA-105N GASKETS 316 SS 'CG' FLEXICARB BOLTING SA-193-B7/SA-194-2H PUMP/L.G. NIPPLES SCH. 160, SA-106-B INSTR. TUBING FITTINGS 316 SS SWAGelok (DOUBLE FERRULE) PROCESS TUBING FITTINGS 316 SS SWAGelok (DOUBLE FERRULE)

- \* INSTRUMENT NOZZLES AND PIPING CONTAINING GLYCOL SHALL BE CL300
- \*\* 5% RT FIT-UP
- \*\*\* 10% MPI ON ANY PIPING FILLET WELDS (SW).
- \*\*\*\* PIPE SCHEDULE IS SELECTED BASED ON PRESSURE AND CORROSION LIMITS.
- \*\*\*\*\* SEE SOCKETWELD PROCEDURES FOR GAP.

**ISOMETRIC VIEW**

SCALE: 1/2"=1'-0"  
BUILDING NOT SHOWN

ONE (1) UNIT REQ'D

DWG.	DESCRIPTION	REV.	DATE	BY	CHK'D	DATE	DESCRIPTION
D-2013-8440-50F-001	MECHANICAL FLOWSHEET	A	2013-07-21	ZR			ISSUED FOR CUSTOMER APPROVAL
		B	2013-07-24	VIK			ISSUED FOR CUSTOMER APPROVAL
		C	2013-08-29	ZR			ISSUED FOR CUSTOMER APPROVAL
		D	2013-10-08	DD			RE-ISSUED FOR CUSTOMER APPROVAL
		E	2013-08-29	VIK			RE-ISSUED FOR CUSTOMER APPROVAL
		O	2013-11-15	HZ			ISSUED FOR CONSTRUCTION
		I	2014-02-14	JY			CHG. TUBING SIZE

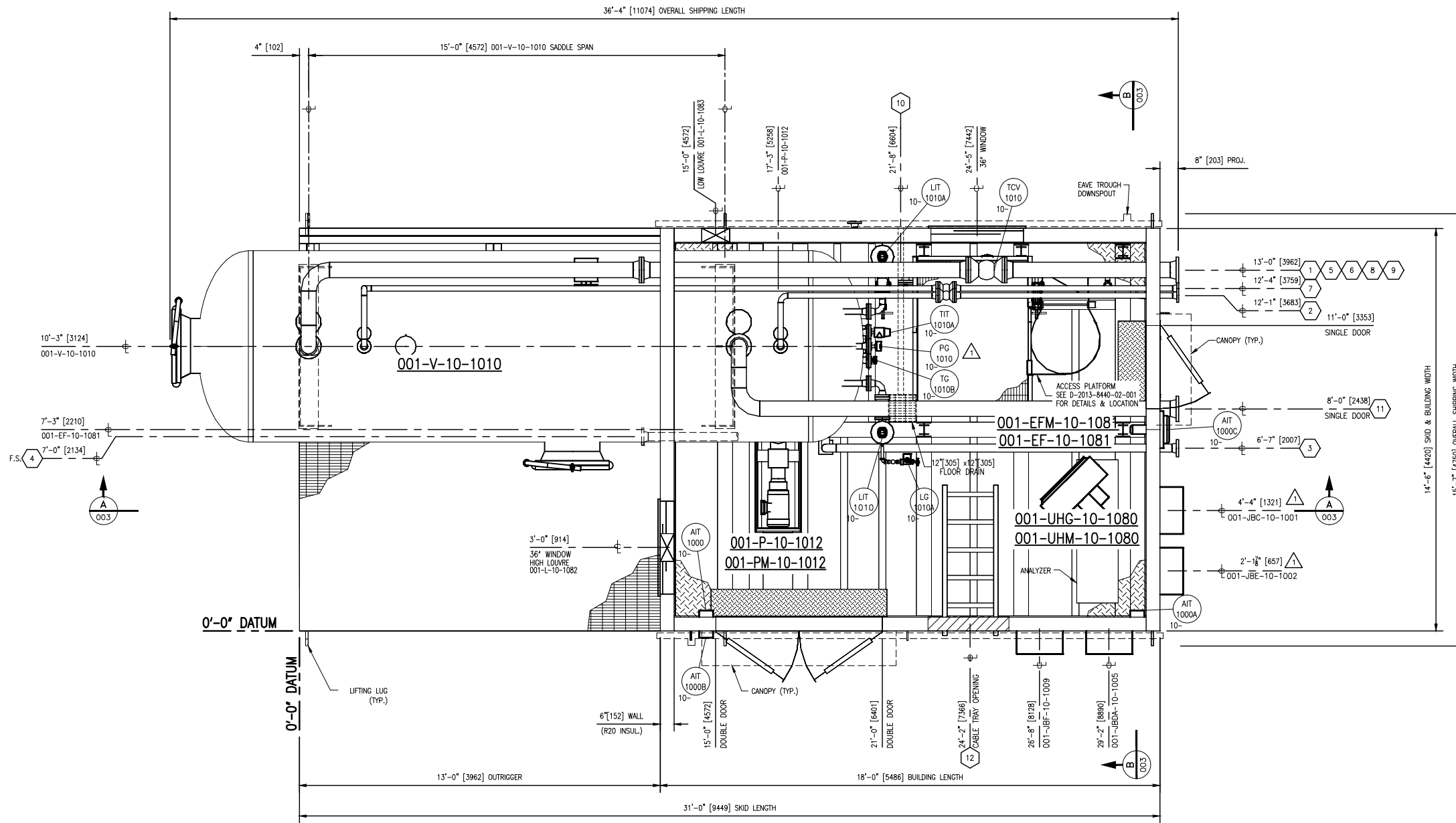
  

DRAWN	ZR	DATE	2013-06-17
SCALE	NTS	CHK'D	

ALCO GAS & OIL PRODUCTION EQUIPMENT LTD.	LOCATION: FERRIER CPF PROJECT, AB	L.S.D.: 11-02-039-08 WSM
ISOMETRIC VIEW & NOTES	CUSTOMER: DEVON CANADA CORPORATION	
COB CLOSED HYDROCARBON DRAIN PACKAGE	DWG/SHOP ORDER: D-2013-8440-50A-001/003	REV. 1
TAG: 001-PK-10-1000		

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PLAN VIEW  
SCALE: 1/2"=1'-0"

**GENERAL NOTES:**

1. SEE DRAW D-2013-8440-50A-001 FOR GENERAL NOTES.

**PIPING SPEC. SCHEDULE:**

1. SEE DRAW D-2013-8440-50A-001 FOR PIPING SPEC. SCHEDULE.

**TIE-IN SCHEDULE:**

1. SEE DRAW D-2013-8440-50A-001 FOR TIE-IN SCHEDULE.

ONE (1) UNIT REQ'D

DWG.	DESCRIPTION	REV.	DATE	BY	DESCRIPTION
		2	2014/05/08	RF	AS BUILTS
		1	2013/11-26	RK/L	REVISE DIMENSIONS
		0	2013/11-14	HZ	ISSUED FOR CONSTRUCTION
		E	2013/10-08	VJK	RE-ISSUED FOR CUSTOMER APPROVAL
		D	2013/09-10	DD	RE-ISSUED FOR CUSTOMER APPROVAL
		C	2013/08-23	ZR	ISSUED FOR CUSTOMER APPROVAL
		B	2013/07-24	VJK	ISSUED FOR CUSTOMER APPROVAL
D-2013-8440-50F-001	MECHANICAL FLOWSHEET	A	2013/07-18	DD	ISSUED FOR CUSTOMER APPROVAL

DRAWN	DATE	SCALE	CHK'D
ZR	2013-06-17	NTS	

**ALCO GAS & OIL**  
PRODUCTION EQUIPMENT LTD.

**PLAN VIEW**  
**COB CLOSED HYDROCARBON DRAIN PACKAGE**  
TAG: 001-PK-10-1000

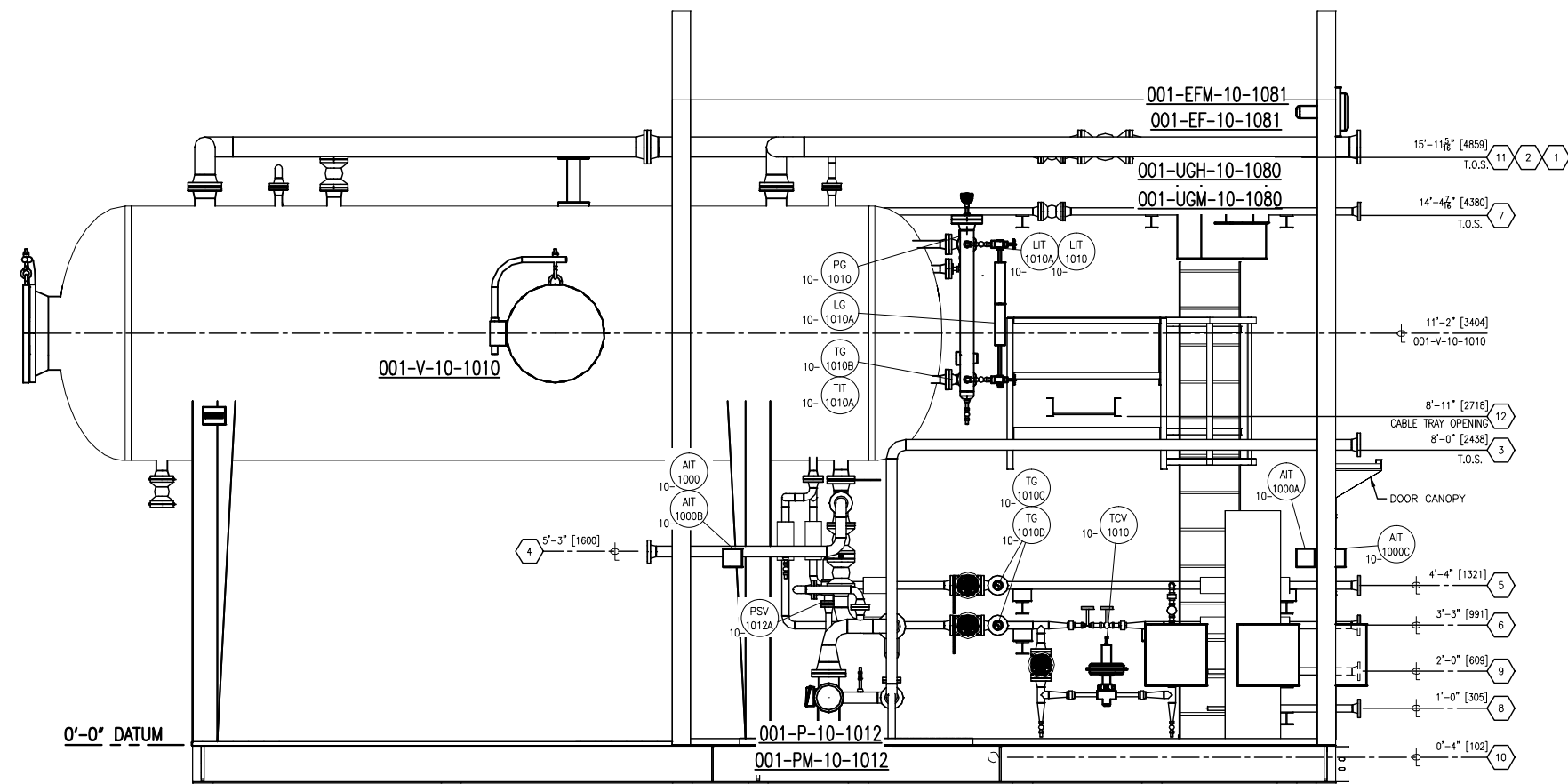
LOCATION: FERRIER CPF PROJECT, AB  
CUSTOMER: DEVON CANADA CORPORATION

L.S.D.: 11-02-039-08 WSM

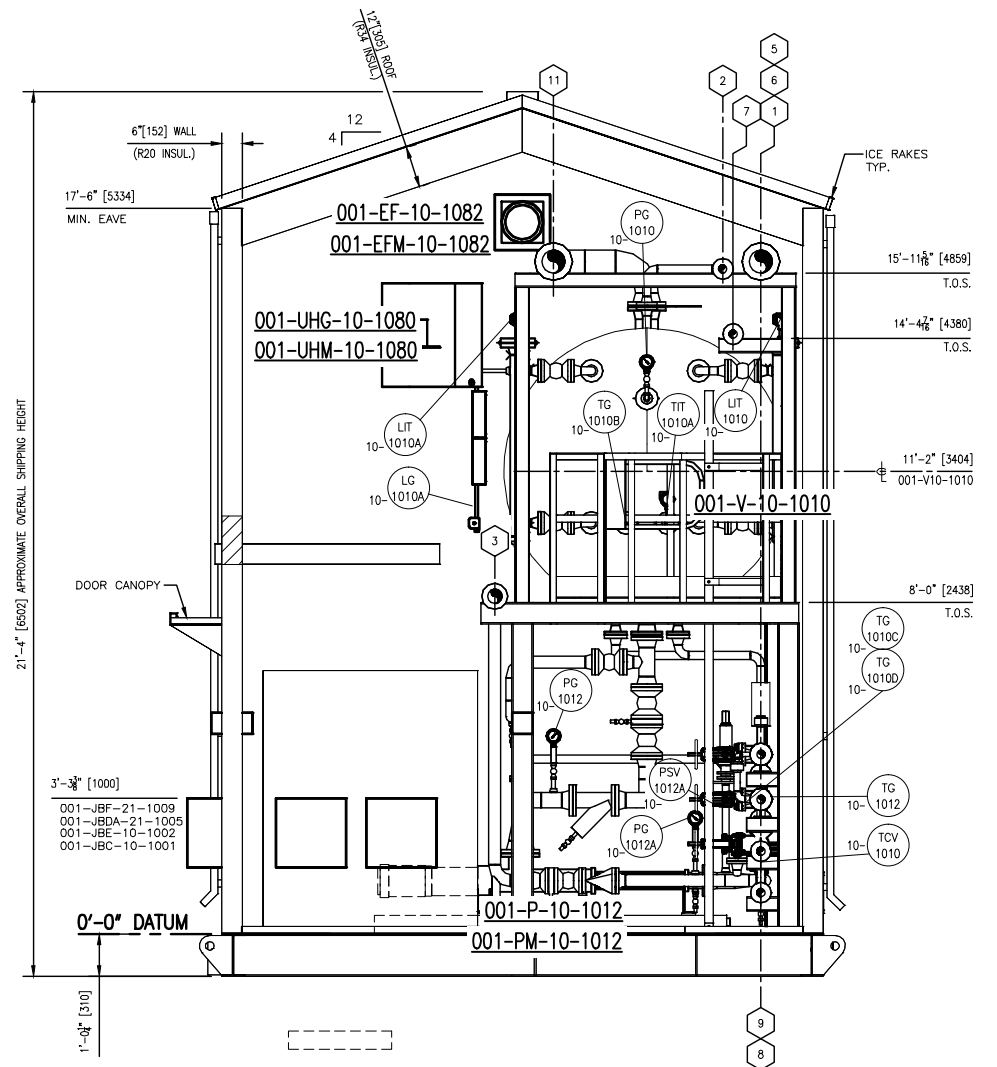
DWG./SHOP ORDER: D-2013-8440-50A-002/003

REV. 2

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SECTION A-A  
SCALE: 1/2"=1'-0"



VIEW B-B  
SCALE: 1/2"=1'-0"

**GENERAL NOTES:**

1. SEE DRAW D-2013-8440-50A-001 FOR GENERAL NOTES.

**PIPING SPEC. SCHEDULE:**

1. SEE DRAW D-2013-8440-50A-001 FOR PIPING SPEC. SCHEDULE.

**TIE-IN SCHEDULE:**

1. SEE DRAW D-2013-8440-50A-001 FOR TIE-IN SCHEDULE.

ONE (1) UNIT REQ'D

DWG.	DESCRIPTION	REV.	DATE	BY	DESCRIPTION
D-2013-8440-50F-001	MECHANICAL FLOWSHEET	A	2013-07-24	DO/AM	ISSUED FOR CONSTRUCTION
		B	2013-07-24	VIK	ISSUED FOR CUSTOMER APPROVAL
		C	2013-08-23	ZR	ISSUED FOR CUSTOMER APPROVAL
		D	2013-10-08	DD	RE-ISSUED FOR CUSTOMER APPROVAL
		E	2013-10-08	VIK	RE-ISSUED FOR CUSTOMER APPROVAL
		O	2013-11-14	HZ	ISSUED FOR CONSTRUCTION

DRAWN	ZR		<small>The information contained herein is the confidential property of Alco Gas and Oil Production Equipment Ltd., and is not for publication. The information is based on the understanding that no part thereof shall be copied or communicated to a third party without authorization in writing from Alco Gas and Oil Production Equipment Ltd.</small>
DATE	2013-06-17		
SCALE	NTS	<b>SECTION VIEWS</b> <b>COB CLOSED HYDROCARBON DRAIN PACKAGE</b> <b>TAG: 001-PK-10-1000</b> LOCATION: FERRIER CPF PROJECT, AB L.S.D.: 11-02-039-08 WSM CUSTOMER: DEVON CANADA CORPORATION	
CHK'D			
DWG./SHOP ORDER: D-2013-8440-50A-003/003		REV. 0	



001-EF-10-1081

BUILDING EXHAUST FAN

ENERTECH ET12-1  
16 ACPH

001-EFM-10-1081

BUILDING EXHAUST FAN MOTOR

1/4 HP 575V/3PH/60Hz, XP MOTOR

001-UHG-10-1080

BUILDING HEATER

GLYCOL HEATER  
MODEL AH-24A-A1A1-A1-2H

001-UHM-10-1080

BUILDING HEATER MOTOR

1/2 HP, 575V/3PH/60Hz, XP MOTOR

001-V-10-1010

COB CLOSED HYDROCARBON DRAIN VESSEL

78" (1981mm) I.D. x 20'-0" (6096mm) 5/8"  
FULL VACUUM/50 PSIG D.P. @ -49/300°F + 1/16" C.A.  
FULL VACUUM/345 kPag @ -49/160°C + 1.5mm C.A.

001-P-10-1012

COB CLOSED HYDROCARBON PUMP

NM0638YQ2514K 4x6  
PROGRESSIVE CAVITY  
RATED CAPACITY = 77 USGPM (17.6 m<sup>3</sup>/h)  
DIFF. PRESSURE = 49 PSIG (340 kPa)

001-PM-10-1012

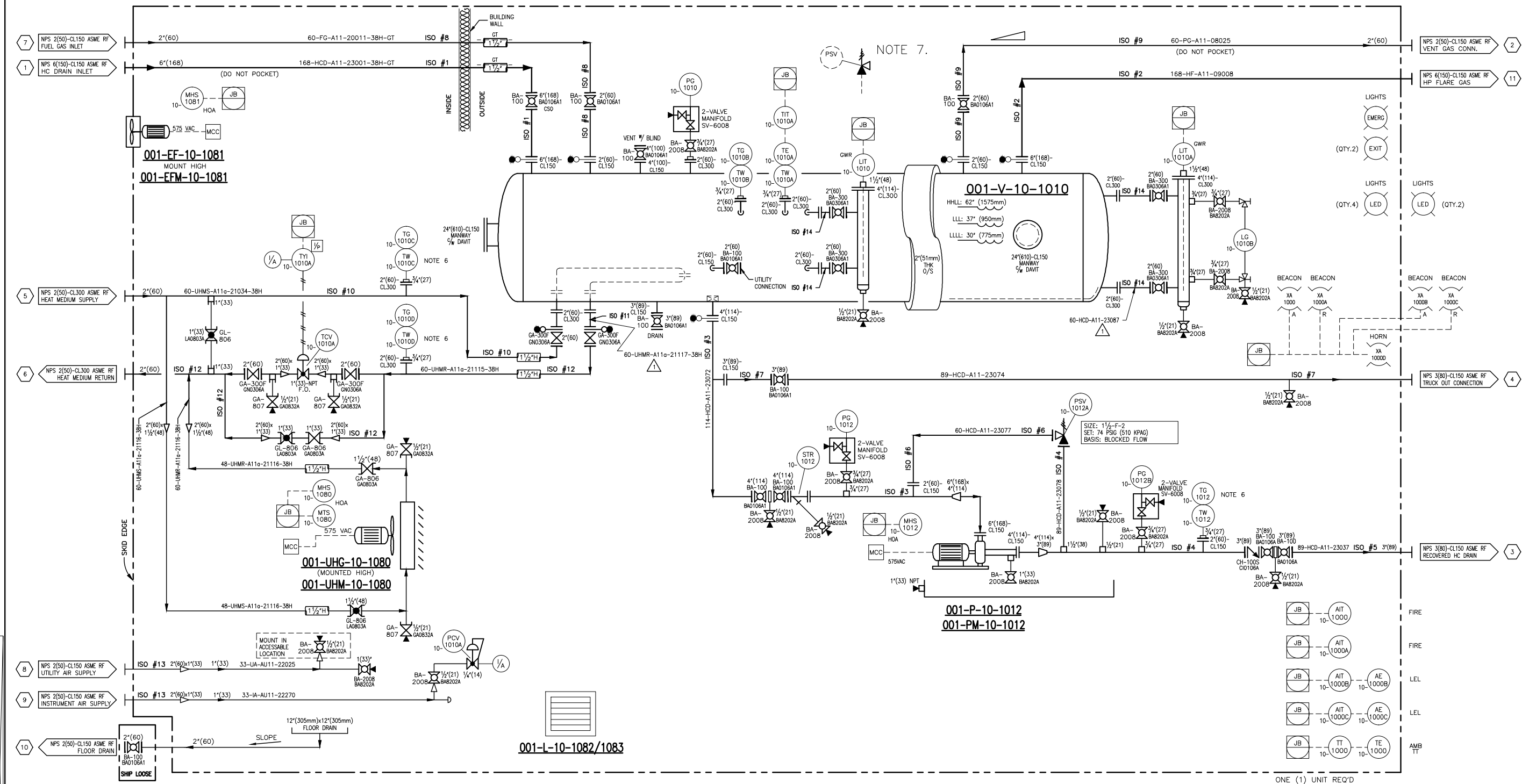
COB CLOSED HYDROCARBON PUMP MOTOR

TECO TEFC  
7.5HP @ 1800 RPM  
575V/3PH/60Hz CLASS 1 ZONE 2 GR IIc  
IEEC 841

001-L-10-1082/83

MANUAL LOUVERS

MANUALLY ADJUSTABLE  
12"x12" (305mm x 305mm)  
QTY. OF (2)



**VALVE TAGGING**

GA-818

VALVE TYPE: L, S, T, B, C, G, H, N, P, SV

TRIM: 0 = STANDARD, 1 = SOUR, 2 = SOUR LOW TEMPERATURE, 3 = LOW TEMPERATURE, 4 = HIGH TEMPERATURE, 5 = STAINLESS STEEL

END CONN.: 0 = RF, 1 = RTU, 2 = SW, 3 = NPT x SW, 4 = MNPT x FNPT, 5 = FULL PORT, 6 = SWING CHECK, 7 = PISTON CHECK, 8 = PORTED RELIEF

WOG PRESSURE RATINGS ONLY APPLY TO THREADED AND SOCKET-WELDED BALL VALVES.

**NOTES:**

- ITEMS SUPPLIED BY EQUIPMENT VENDOR.
- ITEMS SUPPLIED BY CUSTOMER & INSTALLED BY ALCO.
- ITEMS DENOTES TURBINE METERS REQUIRING A MIN. STRAIGHT PIPE LENGTH OF 100" UPSTREAM & 50" DOWNSTREAM.
- REFER DEVON P&ID FER-001 1102039085-A-PID-1001-01 FOR CONTROLS
- ALL INSTRUMENTS SHALL BE TAGGED AS FOLLOWS: 001-XX-10-XXXX, SO PG-1012 WOULD BE TAGGED 001-PG-10-1012
- DO NOT COMPLY WITH GS-4500 SEC 11.1.1
- PSV FOR VESSEL 001-V-10-1010 TO BE INSTALLED BY OWNER, ON PIPING, PER PLANT P & ID.

**GENERAL LEGEND:**

- DENOTES PNEUMATIC TIE-IN.
- DENOTES PNEUMATIC COMPRESSOR PANEL TIE-IN.
- DENOTES CAPILLARY TIE-IN.
- DENOTES ELECTRICAL TIE-IN (BY OTHERS).
- DENOTES ELECTRICAL JUNCTION BOX TIE-IN.
- DENOTES LOCAL PLC TIE-IN (BY OTHERS).
- DENOTES LOCAL ELECTRICAL PANEL TIE-IN.
- DENOTES FIELD MOUNTED INSTRUMENT.
- DENOTES LOCAL PANEL INSTRUMENT.
- DENOTES LOCAL PANEL INSTRUMENT (MOUNTED INSIDE PANEL)

DWG.	DESCRIPTION	REV.	DATE	BY	DESCRIPTION
D-2013-8440-50A-001	LAYOUT/ASSEMBLY	A	2013-06-01	ZR	ISSUED FOR CUSTOMER APPROVAL
		B	2013-08-29	VJK	ISSUED FOR CUSTOMER APPROVAL
		C	2013-08-29	ZR	ISSUED FOR CUSTOMER APPROVAL
		D	2013-09-19	DD	RE-ISSUED FOR CUSTOMER APPROVAL
		E	2013-11-15	HZ	ISSUED FOR CONSTRUCTION
		O	2014-02-26	HZ	ADDED LINE NUMBER

ALCO GAS & OIL PRODUCTION EQUIPMENT LTD.

**MECHANICAL FLOWSHEET**  
COB CLOSED HYDROCARBON DRAIN PACKAGE  
TAG: 001-PK-10-1000

LOCATION: FERRIER CPF PROJECT, AB L.S.D.: 11-02-039-08 WSM  
CUSTOMER: DEVON CANADA CORPORATION  
DWG/SHOP ORDER: D-2013-8440-50F-001/001 REV. 1


REV. NO.	ITEM	QTY	DESCRIPTION	MATERIAL	NOTE	UNIT WEIGHT	TOTAL WEIGHT	WHSE	SUPPLIER	DEL'Y DATE	P.O. NUMBER	P.O. DATE	UNIT PRICE	TOTAL PRICE	REMARKS
	V-1010	1	CLOSED HYDROCARBON DRAIN VESSEL: 78" ID x 20'-0" s/s; FV/50 PSIG @ -49/302 °F 1/16" CA; 2 PHASE; SWEET; FULL INTERNAL COATING			15,750	15,750								D-2013-8440-01-001
	6	1	ADDITIONAL B-OF-M FOR V-1010 HOOK-UP			60	60								B-2013-8440-01H-001
	10	1	14'-6" x 31'-0" x W12 @ 26# STRUCTURAL STEEL SKID: (6) POINT LIFT, 1/4" THK. CHK. PLATE FLOORING, 2" HIGH PERIMETER AND PUMP DRIP LIP c/w DOOR RAMPS & FLOOR DRAIN; 3" THK SPRAY-ON CLASS I URETHANE INSULATION ON UNDERSIDE BUILDING			14,500	14,500								D-2013-8440-02-001
	17	1	NPS 4 CL300 VERTICAL LEVEL CONTROL CAGE: FOR FISHER 5300 GWR FV/50 PSIG @ -49/302°F + 1/16" CA; (V-1010); SWEET			131	131								C-2013-8440-03-001
	19	1	NPS 4 CL300 VERTICAL LEVEL CONTROL CAGE: FOR FISHER 5300 GWR FV/50 PSIG @ -49/302°F + 1/16" CA; (V-1010); SWEET			131	131								C-2013-8440-04-001
	22	1	14'-6" x 17'-0" x 17'-6" MIN. EAVE GABLE TYPE PRE-PAINTED BUILDING: (1) 3'-0"x7'-0" DOOR; (1) 6'-0"x7'-0" DOOR; (2) 36" SLIDING WINDOW; R20 WALLS, R34 ROOF			13,000	13,000								B-2013-8440-50-001
	EF-1081		ET-12 EXHAUST FAN; SIZED FOR 16 ACPH												
	EFM-1081		1/4 HP 575/3/60 XP MOTOR												
	L-1082		12" x 12" MANUAL LOUVER												
	L-1083		12" x 12" MANUAL LOUVER												
	P-1012	1	NETZSCH PC PUMP MODEL NM063BY02S14K; 77 USGPM @ 49 PSIG DP			800	800								MR8440-50-001 R1
	PM-1012		TECO 7.5 HP @ 1800 RPM 575V C1Z2 GR IIa IEEEE841												
	UHG-1080	1	RUFFNECK AH-24A-A1A1-A1-2H GLYCOL BUILDING HEATER: c/w RUFFNECK XT-311 X.P. THERMOSTAT			100	100								
	MTS-1080														
	UHM-1080		1/2 HP 575V/3PH/60Hz X.P. ELECTRIC MOTOR												
				TOTAL EQUIPMENT WEIGHT:	50,960 Lbs.		44,472								

REVISIONS		
REV.	DATE	REV. BY
A	Oct. 15, 2013	RE
0	Nov. 6, 2013	RE

**NOTES:** \*\*\* SEE NOTE COLUMN FOR APPLICATION NUMBERS \*\*\*  
1. ALL INSTRUMENTS TO BE TAGGED 001-XX-10-XXXX SO TG-1010B  
WOULD BE TAGGED 001-TG-10-1010B

BOM\_Hookup.xlt (rev.1g), Printed: 08/21/2014

**NOTE: ONE (1) UNIT REQUIRED.**

BY:	RE		<b>GAS &amp; OIL</b> PRODUCTION EQUIPMENT LTD. <small>*GP of the ALCO GAS &amp; OIL PRODUCTION EQUIPMENT LIMITED PARTNERSHIP.</small>	The information contained herein is the confidential property of ALCO Gas & Oil Production Equipment Ltd., and is not for publication. The information is issued on the understanding that no part thereof shall be copied or communicated to a third party without authorization in writing from ALCO Gas & Oil Production Equipment Ltd.
DATE:	Oct. 15, 2013			
CHK'D:		<b>BILL OF MATERIALS</b> COB CLOSED HYDROCARBON DRAIN PACKAGE 001-PK-10-1000		
APP'D:				
CUSTOMER:	DEVON CANADA CORPORATION	LOCATION:	FERRIER CPF	
L.S.D.:	11-02-039-08 W5M	DWG/SHOP ORDER:	<b>B-2013-8440-50B-001/007</b>	REV. 0

REV. NO.	ITEM	QTY	DESCRIPTION	MATERIAL	NOTE	UNIT WEIGHT	TOTAL WEIGHT	WHSE	SUPPLIER	DEL'Y DATE	P.O. NUMBER	P.O. DATE	UNIT PRICE	TOTAL PRICE	REMARKS
	LG-1010B	1	PENBERTHY 3RL7 REFLEX LEVEL GAUGE; 33-3/4" VISIBLE LENGTH 1950 PSIG @ -20/100°F			30	30								
	53	1	SET OF NPS 3/4 NPT PENBERTHY 330J GAUGE COCKS: 4000 PSIG @-20/100°F			5	5								
	LIT-1010	2	ROSEMOUNT 5302HAS1S1E3BE00410RAE6M1S4B2 GUIDED WAVE RADAR 1 1/2" NPT; 4-20 mA HART; ETHYLENE PROPYLENE O-RING 4'-10" COAXIAL 316L SST PROBE; REMOTE MOUNTING FV/580 PSIG; -40/266 °F ; CSA XP			10	20								
1	PG-1010 PG-1012	2	WIKA 233.30 233.34 PRESSURE GAUGE: 4 1/2" DIAL, 1/2" NPT LOWER MOUNT, LIQUID FILLED, 0-60 PSIG PRESSURE RANGE -40/140 °F AMB; 212 °F MEDIUM			2	4								
1	PG-1012B	1	WIKA 233.30 233.34 PRESSURE GAUGE: 4 1/2" DIAL, 1/2" NPT LOWER MOUNT, LIQUID FILLED, 0-100 PSIG PRESSURE RANGE -40/140 °F AMB; 212 °F MEDIUM			2	2								
1	PSV-1012A	1	FARRIS 26FA10L-120; "F" ORIFICE 0.307 IN2; 1 1/2" CL150RF x 2" CL150RF -20/800 °F <b>CONSOLIDATED 1905-00FC-1-CC-MS-31-RF-LA, 1 1/2" CL150 x 2"CL150; "F" ORIFICE; LIQUID SERVICE; SET @74 PSIG</b>			44	44								
	STR-1012	1	NPS 4 CL150 RF Y-STRAINER: 285 PSIG AT 100°F; 1/8" PERFORATED SCREEN; STANDARD MATL'S			29	29								
TOTAL PAGE WEIGHT (Lbs.):							134								

REVISIONS		
REV.	DATE	REV. BY
A	Oct. 15, 2013	RE
0	Nov. 6, 2013	RE
1	Nov.21,2013	PD

**NOTES:** \*\*\* SEE NOTE COLUMN FOR APPLICATION NUMBERS \*\*\*

BOM\_Hookup.xlt (rev.1g), Printed: 08/21/2014

**NOTE: ONE (1) UNIT REQUIRED.**

BY: RE  
DATE: Oct. 15, 2013  
CHK'D  
CHK'D  
APP'D:

	<b>GAS &amp; OIL</b> PRODUCTION EQUIPMENT LTD. <small>*GP of the ALCO GAS &amp; OIL PRODUCTION EQUIPMENT LIMITED PARTNERSHIP.</small>	<small>The information contained herein is the confidential property of ALCO Gas &amp; Oil Production Equipment Ltd., and is not for publication. The information is issued on the understanding that no part thereof shall be copied or communicated to a third party without authorization in writing from ALCO Gas &amp; Oil Production Equipment Ltd.</small>
	<b>BILL OF MATERIALS</b> COB CLOSED HYDROCARBON DRAIN PACKAGE 001-PK-10-1000	
CUSTOMER: DEVON CANADA CORPORATION		LOCATION: FERRIER CPF
L.S.D.: 11-02-039-08 W5M		DWG/SHOP ORDER: <b>B-2013-8440-50B-002</b>
		REV. 1


REV. NO.	ITEM	QTY	DESCRIPTION	MATERIAL	NOTE	UNIT WEIGHT	TOTAL WEIGHT	WHSE	SUPPLIER	DEL'Y DATE	P.O. NUMBER	P.O. DATE	UNIT PRICE	TOTAL PRICE	REMARKS
	TCV-1010A	1	NPS 1-NPT FISHER D4 CONTROL VALVE AND ACTUATOR, 1/4" DIA. PORT,			35	35								
	TYI-1010A		FAIL OPEN, BENCHSET AT 6-30, PSIG, 4250 PSIG SHUT-OFF												
	PCV-1010A		CV -50/300°F; ACTUATOR 50PSIG @ -40/200°F												
			w/ FISHER I2P-100; DIRECT ACTING; 4-20 mA INPUT; 6-30 PSIG OUTPUT												
			-40/185°F; CSA XP												
			w/ NPS 1/4-NPT FISHER 67 CFR REGULATOR: 0-35 PSIG SPRING RANGE, NITRILE												
			250 PSIG; -40/180 °F												
	TG-1010B	1	WIKA TI.50 BIMETAL THERMOMETER; 5" DIAL; BACK MOUNT;			5	5								
	TW-1010B		0 TO 250 °F RANGE; DUAL SCALE; 18" STEM (16.5" INSERT); 304SS												
			GAUGE DAMAGE @ 50% OVER TEMPERATURE RANGE												
			c/w WIKA TW15 THERMOWELL; 3/4" NPT PROCESS; 1/2" NPTF INSTRUMENT												
			TAPERED; 16.5" INSERT LENGTH; 304/304L SS												
	TG-1010C	3	WIKA TI.51 BIMETAL THERMOMETER; 5" DIAL; BOTTOM MOUNT;			10	30								
	TG-1010D		0 TO 250 °F RANGE; DUAL SCALE; 6" STEM (4.5" INSERT); 304SS												
	TG-1012		GAUGE DAMAGE @ 50% OVER TEMPERATURE RANGE												
	TW-1010C	3	c/w WIKA TW15 THERMOWELL; 3/4" NPT PROCESS; 1/2" NPTF INSTRUMENT												
	TW-1010D		TAPERED; 4.5" INSERT LENGTH; 304/304L SS												
	TW-1012														
	TIT-1010A	1	ROSEMOUNT 644HAK6J6M5 TEMPERATURE TRANSMITTER			10	10								
	TE-1010A		4-20 MA; CSA XP; -40/185 °F												
	TW-1010A		c/w ROSEMOUNT 0068N21C3B165T26E6												
			SENSOR ONLY; PLATINUM; 304L SST; 16.5" INSERT; 3/4" NPT PROCESS												
			-58/752 °F; CSA XP												
			***MOUNT: FROM TRANSMITTER END, LCD SCREEN @ 9:00												
							TOTAL PAGE WEIGHT (Lbs.):	80							

REVISIONS		
REV.	DATE	REV. BY
A	Oct. 15, 2013	RE
0	Nov. 6, 2013	RE

**NOTES:** \*\*\* SEE NOTE COLUMN FOR APPLICATION NUMBERS \*\*\*

BOM\_Hookup.xlt (rev.1g), Printed: 08/21/2014

**NOTE: ONE (1) UNIT REQUIRED.**

BY: RE		<b>GAS &amp; OIL</b> PRODUCTION EQUIPMENT LTD. <small>*GP of the ALCO GAS &amp; OIL PRODUCTION EQUIPMENT LIMITED PARTNERSHIP.</small>	The information contained herein is the confidential property of ALCO Gas & Oil Production Equipment Ltd., and is not for publication. The information is issued on the understanding that no part thereof shall be copied or communicated to a third party without authorization in writing from ALCO Gas & Oil Production Equipment Ltd.
DATE: Oct. 15, 2013			
CHK'D			
CHK'D	<b>BILL OF MATERIALS</b>		
APP'D:	COB CLOSED HYDROCARBON DRAIN PACKAGE 001-PK-10-1000		
CUSTOMER: DEVON CANADA CORPORATION	LOCATION: FERRIER CPF		
L.S.D.: 11-02-039-08 W5M	DWG/SHOP ORDER: B-2013-8440-50B-003	REV. 1	

REV. NO.	ITEM	QTY	DESCRIPTION	MATERIAL	NOTE	UNIT WEIGHT	TOTAL WEIGHT	WHSE	SUPPLIER	DEL'Y DATE	P.O. NUMBER	P.O. DATE	UNIT PRICE	TOTAL PRICE	REMARKS
			<b>BUILDING DEVICES</b>												
	AIT-1000	2	DET-TRONICS X3301A4N13W1; MULTISPECTRUM IR FLAME DETECTOR			5	10								
	AIT-100A		ALUMINUM; 4-20 mA; FM/CSA/ULC/ATEX/CE/IECEX; -40/167°F												
	AIT-1000B	2	GENERAL MONITORS S4000CH-1-0-01-1; GAS DETECTOR			5	10								
	AIT-1000C		ALUMINUM; 4-20 mA; FM/CSA/ULC/ATEX/CE/IECEX; -40/167°F												
	TIT-1000	1	ROSEMOUNT 644HAK6J6M5 TEMPERATURE TRANSMITTER			5	5								
	TE-1000		4-20 MA; CSA XP; -40/185 °F c/w ROSEMOUNT 0068N21N00N060E6 SENSOR ONLY; PLATINUM; 304L SST; 6" INSERT; NO THERMOWELL												
	XA-1000	2	FEDERAL SIGNAL 191XL-S120240A; SURFACE MOUNT			5	10								
	XA-1000B		AMBER STROBE; 120VAC; C-UL; CL1D2 ABCD T6 @ 40°C c/w LHWB HAZARDOUS LOCATION MOUNTING BRACKET												
	XA-1000A	2	FEDERAL SIGNAL 191XL-S120240R; SURFACE MOUNT			5	10								
	XA-1000C		RED STROBE; 120VAC; C-UL; CL1D2 ABCD T6 @ 40°C c/w LHWB HAZARDOUS LOCATION MOUNTING BRACKET												
	XA-1000D	1	FEDERAL SIGNAL 300GCX-120 HORN UTM (UNIVERSAL TONE MODULE); 120VAC; -67/150 °F			5	5								
	BA-100	1	NPS 6-CL150 RF BALL VALVE; 740 PSIG @ 100°F;		1	32	32								
	BA0106A1		REGULAR PORT; FLOATING; LONG PATTERN; A216-WCB BODY; 316 SS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON BODY SEALS; ASME B16.34, API 598; API 607												
	BA-2008	2	NPS 1-NPT BALL VALVE: 2000 PSIG @ 100°F,		1	2.4	5								
	BA8202A		REGULAR PORT; FLOATING; CHROME PLATED CS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON SEALS; ASME B16.34, API 598; FIRE API 607												
			TOTAL PAGE WEIGHT (Lbs.):				87								


REVISIONS		
REV.	DATE	REV. BY
A	Oct. 15, 2013	RE
0	Nov. 6, 2013	RE

**NOTES:** \*\*\* SEE NOTE COLUMN FOR APPLICATION NUMBERS \*\*\*

1. \*\*\*SEE DEVON SPECIFICATION GS-5300 APPENDIX A FOR ACCEPTED MANUFACTURERS\*\*\*

**NOTE: ONE (1) UNIT REQUIRED.**

BOM\_Hookup.xlt (rev.1g), Printed: 08/21/2014

BY:	RE		<b>GAS &amp; OIL</b> PRODUCTION EQUIPMENT LTD. <small>*GP of the ALCO GAS &amp; OIL PRODUCTION EQUIPMENT LIMITED PARTNERSHIP.</small>	<small>The information contained herein is the confidential property of ALCO Gas &amp; Oil Production Equipment Ltd., and is not for publication. The information is issued on the understanding that no part thereof shall be copied or communicated to a third party without authorization in writing from ALCO Gas &amp; Oil Production Equipment Ltd.</small>
DATE:	Oct. 15, 2013			
CHK'D		<b>BILL OF MATERIALS</b>		
APP'D:		COB CLOSED HYDROCARBON DRAIN PACKAGE 001-PK-10-1000		
CUSTOMER:	DEVON CANADA CORPORATION	LOCATION:	FERRIER CPF	
L.S.D.:	11-02-039-08 W5M	DWG/SHOP ORDER:	<b>B-2013-8440-50B-004</b>	REV. 1

REV. NO.	ITEM	QTY	DESCRIPTION	MATERIAL	NOTE	UNIT WEIGHT	TOTAL WEIGHT	WHSE	SUPPLIER	DEL'Y DATE	P.O. NUMBER	P.O. DATE	UNIT PRICE	TOTAL PRICE	REMARKS
	BA-300 BA0306A1	4	NPS 2-CL300 RF BALL VALVE; 740 PSIG @ 100°F; REGULAR PORT; FLOATING; LONG PATTERN; A216-WCB BODY; 316 SS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON BODY SEALS; ASME B16.34, API 598; API 607		1	32	128								
	BA-100 BA0106A1	3	NPS 4-CL150 RF BALL VALVE; 285 PSIG @ 100°F; REGULAR PORT; FLOATING; LONG PATTERN; A216-WCB BODY; 316 SS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON BODY SEALS; ASME B16.34, API 598; API 607		1	76	228								
	BA-100 BA0106A1	4	NPS 3-CL150 RF BALL VALVE; 285 PSIG @ 100°F; REGULAR PORT; FLOATING; LONG PATTERN; A216-WCB BODY; 316 SS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON BODY SEALS; ASME B16.34, API 598; API 607		1	31	124								
	BA-100 BA0106A1	4	NPS 2-CL150 RF BALL VALVE; 285 PSIG @ 100°F; REGULAR PORT; FLOATING; LONG PATTERN; A216-WCB BODY; 316 SS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON SEALS; ASME B16.34, API 598; FIRE API 607 ***** QTY 1 SHIP LOOSE*****		1	27	108								QTY 1 SHIP LOOSE
	BA-2008 BA8202A	5	NPS 3/4-NPT BALL VALVE: 2000 PSIG @ 100°F, REGULAR PORT; FLOATING; CHROME PLATED CS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON SEALS; ASME B16.34, API 598; FIRE API 607		1	2.4	12								
	BA-2008 BA8202A	10	NPS 1/2-NPT BALL VALVE: 2000 PSIG @ 100°F, REGULAR PORT; FLOATING; CHROME PLATED CS BALL AND STEM; A-193-B7/A-1942-H NYLON SEATS; TFE OR VITON SEALS; ASME B16.34, API 598; FIRE API 607		1	2.2	22								
	CH-100S CI0106A	1	NPS 3-CL150 RF SWING CHECK VALVE; 285 PSIG @ 100°F; REGULAR PORT; BOLTED CLOSURE w/ SPIRAL WOUND GASKET (GRAPHITE/SS); API TRIM 8 A-193-B7/A-1942-H		1	72	72								
	GA-300F GN0306A	4	NPS 2-CL300 RF GATE VALVE; 740 PSIG @ 100°F; FULL PORT; OS&Y; A216-WCB BODY; BOLTED BONNET; SPIRAL WOUND GASKET (GRAPHITE/SS) FLEXIBLE WEDGE; API TRIM 8; DIE-FORMED FLEXIBLE GRAPHITE PACKING w/ ANTI-EXTRUSION RINGS AND CORROSION INHIBITOR; HANDWHEEL; A-193-B7/A-1942-H; API-600		1	66	264								
							TOTAL PAGE WEIGHT (Lbs.):	958							


REVISIONS		
REV.	DATE	REV. BY
A	Oct. 15, 2013	RE
0	Nov. 6, 2013	RE

**NOTES:** \*\*\* SEE NOTE COLUMN FOR APPLICATION NUMBERS \*\*\*

1. \*\*\*SEE DEVON SPECIFICATION GS-5300 APPENDIX A FOR ACCEPTED MANUFACTURERS\*\*\*

BOM\_Hookup.xlt (rev.1g), Printed: 08/21/2014

**NOTE: ONE (1) UNIT REQUIRED.**

BY:	RE		<b>GAS &amp; OIL</b> PRODUCTION EQUIPMENT LTD. <small>*GP of the ALCO GAS &amp; OIL PRODUCTION EQUIPMENT LIMITED PARTNERSHIP.</small>	<small>The information contained herein is the confidential property of ALCO Gas &amp; Oil Production Equipment Ltd., and is not for publication. The information is issued on the understanding that no part thereof shall be copied or communicated to a third party without authorization in writing from ALCO Gas &amp; Oil Production Equipment Ltd.</small>
DATE:	Oct. 15, 2013			
CHK'D:		<b>BILL OF MATERIALS</b>		
CHK'D:				
APP'D:		COB CLOSED HYDROCARBON DRAIN PACKAGE 001-PK-10-1000		
CUSTOMER: DEVON CANADA CORPORATION		LOCATION: FERRIER CPF		
L.S.D.: 11-02-039-08 W5M		DWG/SHOP ORDER: <b>B-2013-8440-50B-005</b>		REV. 1

REV. NO.	ITEM	QTY	DESCRIPTION	MATERIAL	NOTE	UNIT WEIGHT	TOTAL WEIGHT	WHSE	SUPPLIER	DEL'Y DATE	P.O. NUMBER	P.O. DATE	UNIT PRICE	TOTAL PRICE	REMARKS
	GA-806	1	NPS 1 1/2-SW GATE VALVE: CLASS 800; 1975 PSIG @ 100°F		1	15.2	15								
	GA0803A		REGULAR PORT; OS&Y; A105N BODY; BOLTED BONNET; SPIRAL WOUND GASKET (GRAPHITE/SS) SOLID WEDGE; API TRIM 8; DIE-FORMED FLEXIBLE GRAPHITE PACKING w/ ANTI-EXTRUSION RINGS AND CORROSION INHIBITOR; HANDWHEEL; A-193-B7/A-1942-H; API-602												
	GA-806	1	NPS 1-SW GATE VALVE: CLASS 800; 1975 PSIG @ 100°F		1	4	4								
	GA0803A		REGULAR PORT; OS&Y; A105N BODY; BOLTED BONNET; SPIRAL WOUND GASKET (GRAPHITE/SS) SOLID WEDGE; API TRIM 8; DIE-FORMED FLEXIBLE GRAPHITE PACKING w/ ANTI-EXTRUSION RINGS AND CORROSION INHIBITOR; HANDWHEEL; A-193-B7/A-1942-H; API-602												
	GA-807	4	NPS 1/2-NPT x SW GATE VALVE: CLASS 800; 1975 PSIG @ 100°F		1	83	332								
	GA0832A		REGULAR PORT; OS&Y; A105N BODY; BOLTED BONNET; SPIRAL WOUND GASKET (GRAPHITE/SS) SOLID WEDGE; API TRIM 8; DIE-FORMED FLEXIBLE GRAPHITE PACKING w/ ANTI-EXTRUSION RINGS AND CORROSION INHIBITOR; HANDWHEEL; A-193-B7/A-1942-H; API-602												
	GL-806	1	NPS 1 1/2-SW GLOBE VALVE: CLASS 800; 1975 PSIG @ 100°F		1	16.5	17								
	LA0803A		REGULAR PORT; OS&Y; A105N BODY; BOLTED BONNET; SPIRAL WOUND GASKET (GRAPHITE/SS) PLUG TYPE SWIVEL DISC; API TRIM 8; DIE-FORMED FLEXIBLE GRAPHITE w/ ANTI-EXTRUSION RINGS AND CORROSION INHIBITOR; HANDWHEEL; A-193-B7/A-1942-H; API 602												
	GL-806	2	NPS 1-SW GLOBE VALVE: CLASS 800; 1975 PSIG @ 100°F		1	8.6	17								
	LA0803A		REGULAR PORT; OS&Y; A105N BODY; BOLTED BONNET; SPIRAL WOUND GASKET (GRAPHITE/SS) PLUG TYPE SWIVEL DISC; API TRIM 8; DIE-FORMED FLEXIBLE GRAPHITE w/ ANTI-EXTRUSION RINGS AND CORROSION INHIBITOR; HANDWHEEL; A-193-B7/A-1942-H; API 602												
	SV-6008	3	ANDERSON GREENWOOD PTMVDC4 TWO VALVE MANIFOLD TEFLON PACKING; DELRIN SEAT; A108 BODY; 1/2" FNPT		1	5	15								
							TOTAL PAGE WEIGHT (Lbs.):	400							


REVISIONS		
REV.	DATE	REV. BY
A	Oct. 15, 2013	RE
0	Nov. 6, 2013	RE

**NOTES:** \*\*\* SEE NOTE COLUMN FOR APPLICATION NUMBERS \*\*\*


1. \*\*\*SEE DEVON SPECIFICATION GS-5300 APPENDIX A FOR ACCEPTED MANUFACTURERS\*\*\*

BOM\_Hookup.xlt (rev.1g), Printed: 08/21/2014

**NOTE: ONE (1) UNIT REQUIRED.**

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DATE:	Oct. 15, 2013			
CHK'D		<b>BILL OF MATERIALS</b>		
CHK'D				
APP'D:		COB CLOSED HYDROCARBON DRAIN PACKAGE 001-PK-10-1000		
CUSTOMER: DEVON CANADA CORPORATION		LOCATION: FERRIER CPF		
L.S.D.: 11-02-039-08 W5M		DWG/SHOP ORDER: <b>B-2013-8440-50B-006</b>		REV. 1

REV. NO.	ITEM	QTY	DESCRIPTION	MATERIAL	NOTE	UNIT WEIGHT	TOTAL WEIGHT	WHSE	SUPPLIER	DEL'Y DATE	P.O. NUMBER	P.O. DATE	UNIT PRICE	TOTAL PRICE	REMARKS
<b>*** ADDITIONAL ITEMS TO COMPLETE ASSEMBLY ***</b>															
	290	1 LOT	1 1/2" & UNDER SCH. 80 SML'S PIPE TO COMPLETE ASSEMBLY	SA-106-B		100	100								
	291	1 LOT	1 1/2" & UNDER NPT/SW CL3000 FITTINGS TO COMPLETE ASSEMBLY	SA-105N		50	50								
	292	1 LOT	INSTRUMENT TUBING TO BE 1/4" DIA. (0.035")	316 SS		25	25								
	293	1 LOT	GLYCOL HT TUBING TO BE 1/2" DIA. (0.035")	316 SS		25	25								
	294	1 LOT	INSTRUMENT TUBING TO BE 3/8" DIA. (0.035")	316 SS		25	25								
	295	1 LOT	PROCESS TUBING TO BE 1/2" DIA. (0.049")	316 SS		25	25								
	296	1 LOT	GLYCOL HT TUBING TO BE 3/4" DIA. (0.049")	316 SS		25	25								
	297	1 LOT	SWAGELOK TUBE FITTINGS TO COMPLETE ASSEMBLY; DOUBLE FERRULE	316 SS		25	25								
<b>*** PIPING ISOMETRICS TO COMPLETE ASSEMBLY ***</b>															
	ISO#1	1	HC DRAIN INLET			810	810								
	ISO#2	1	HP FLARE GAS OUTLET			420	420								
	ISO#3	1	CONDENSATE OUTLET			250	250								
	ISO#4	1	CONDENSATE OUTLET			135	135								
	ISO#5	1	CONDENSATE OUTLET			190	190								
	ISO#6	1	PSV-1012A GAS RELIEF			60	60								
	ISO#7	1	TRUCK OUT CONNECTION			90	90								
	ISO#8	1	FUEL GAS INLET			200	200								
	ISO#9	1	VENT GAS CONNECTION			120	120								
	ISO#10	1	HEAT MEDIUM SUPPLY			230	230								
	ISO#11	1	HEAT MEDIUM RETURN			120	120								
	ISO#12	1	HEAT MEDIUM RETURN			200	200								
	ISO#13	1	UTILITY/INSTRUMENT AIR SUPPLY			50	50								
	ISO#14	1	SPOOLS FOR LIT-1010 & LIT-1010A			150	150								
<b>*** ELECTRICAL WORK ***</b>															
	314	1 LOT	JB DEVICE WIRING; SAFTEY INSTRUMENT WIRING; CALBE TRAY/CONDUIT			500	500								MR8440-50-002
	MHS-1012	3	HAND OFF AUTO SWITCH; CROUSE HINDS EDS21273												MR8440-50-002
	MHS-1080														
	MHS-1081														
						TOTAL PAGE WEIGHT (Lbs.):									
						3,825									

<b>REVISIONS</b>			<b>NOTES:</b> *** SEE NOTE COLUMN FOR APPLICATION NUMBERS ***										BY: RE	 <b>GAS &amp; OIL</b> PRODUCTION EQUIPMENT LTD. <small>*GP of the ALCO GAS &amp; OIL PRODUCTION EQUIPMENT LIMITED PARTNERSHIP.</small>	<small>The information contained herein is the confidential property of ALCO Gas &amp; Oil Production Equipment Ltd., and is not for publication. The information is issued on the understanding that no part thereof shall be copied or communicated to a third party without authorization in writing from ALCO Gas &amp; Oil Production Equipment Ltd.</small>		
REV.	DATE	REV. BY	CHK'D	DATE: Oct. 15, 2013													
A	Oct. 15, 2013	RE	CHK'D														
0	Nov. 6, 2013	RE	APP'D:														
			BILL OF MATERIALS										COB CLOSED HYDROCARBON DRAIN PACKAGE 001-PK-10-1000				
			CUSTOMER: DEVON CANADA CORPORATION					LOCATION: FERRIER CPF									
			L.S.D.: 11-02-039-08 W5M					DWG/SHOP ORDER:					B-2013-8440-50B-007				
													REV. 1				



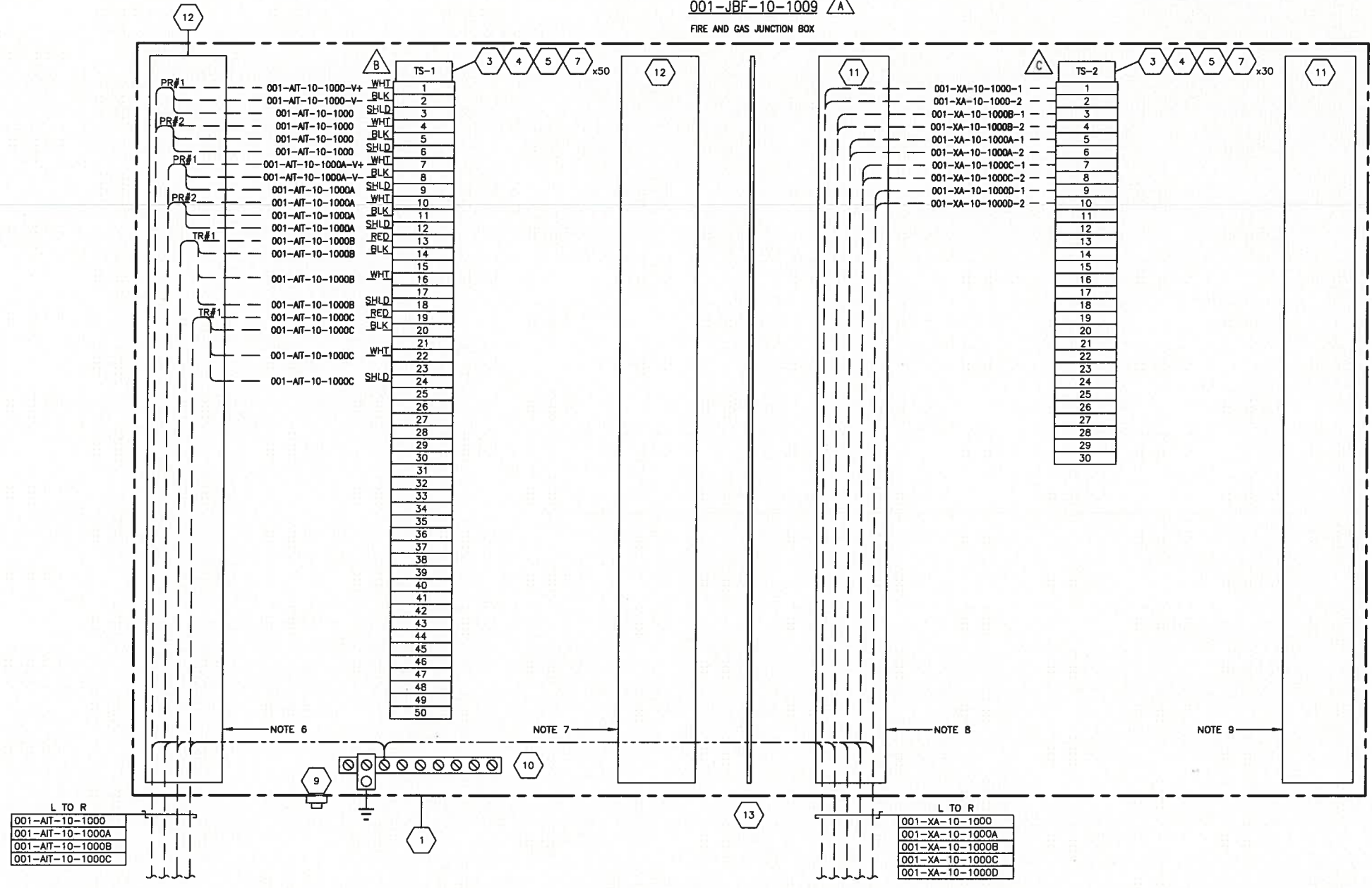


**NOTES:**

- INDIVIDUAL PAIR/TRIAD SHOULD BE LABELED AS A WHOLE WITH A DEVICE TAG.
- LAMACOIDS TO BE BLACK ON WHITE BACKGROUND UNLESS SPECIFIED.
- INSTRUMENT CABLES ARE TO BE TERMINATED ON THE LEFT HAND SIDE OF THE TERMINAL STRIP. HOMERUN CABLES ARE TERMINATED ON THE RIGHT HAND SIDE.
- LAMACOIDS TO BE WHITE ON RED BACKGROUND. SEE DETAIL 1.
- WIREWAY TO BE MINIMUM 2" FROM TERMINALS.
- 24VDC FIELD WIRING.
- 24VDC HOMERUN WIRING.
- 120VAC FIELD WIRING.
- 120VAC HOME RUN WIRING.

LAMACOIDS LIST						MATERIAL LIST					
ITEM	QTY.	DESCRIPTION	SIZE (mm)	SUPPLIER	ITEM	QTY.	DESCRIPTION	MANUFACTURER	CATALOG NO.	SIZE	SUPPLIER
A	1	001-JBF-10-1009	20mm TEXT	50x300	VENDOR	1	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20H200BGQRLP	-	VENDOR
B	1	TS-1	5mm TEXT	10x20	VENDOR	2	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20P20	-	VENDOR
C	1	TS-2	5mm TEXT	10x20	VENDOR	3	DIN RAIN TERMINAL STRIP	WEIDMULLER	TS 32	-	VENDOR
D	1	(SEE DETAIL 1)	5mm TEXT	100x150	VENDOR	4	AS REQ'D TERMINAL STRIP END BRACKET	WEIDMULLER	K-1	-	VENDOR
E	-	-	-	-	VENDOR	5	AS REQ'D TERMINAL MARKER	WEIDMULLER	SCHT 5	-	VENDOR
F	-	-	-	-	VENDOR	6	-	WEIDMULLER	SAK 2.5	-	VENDOR
G	-	-	-	-	VENDOR	7	80 SAK 4 FEED THROUGH TERMINAL	WEIDMULLER	SAK 4	-	VENDOR
H	-	-	-	-	VENDOR	8	-	WEIDMULLER	SAK 6	-	VENDOR
I	-	-	-	-	VENDOR	9	1 COVER/GASKET AND BREATHER DRAIN	CROUSE-HINDS	ECD385	-	VENDOR
J	-	-	-	-	VENDOR	10	1 200mm GROUND BUS C/W KA2U LUG	OPEN	-	-	VENDOR
K	-	-	-	-	VENDOR	11	AS REQ'D GREY WIREWAY c/w COVER	PANDUIT	-	1" x 3"	VENDOR
L	-	-	-	-	VENDOR	12	AS REQ'D WHITE WIREWAY c/w COVER	PANDUIT	-	1" x 3"	VENDOR
M	-	-	-	-	VENDOR	13	AS REQ'D METAL SEPARATOR BARRIER	OPEN	-	-	VENDOR
N	-	-	-	-	VENDOR	14	1 END PLATE	WEIDMULLER	AP SAK4-10	-	VENDOR
						15	1 CORROSION INHIBITOR	CROUSE-HINDS	CID-101	-	VENDOR

001-JBF-10-1009  
FIRE AND GAS JUNCTION BOX



DETAIL 1  
NOTE 4

**CAUTION!**  
THIS JUNCTION BOX IS SUPPLIED FROM MORE THAN ONE SOURCE OF VOLTAGE  
120VAC UPS POWER  
24VDC UPS POWER

GENERAL NOTES		REVISIONS					<b>PERMIT TO PRACTICE</b> ACERO ENGINEERING INC. Signature: _____ Date: _____ PERMIT NUMBER: P09337 The Association of Professional Engineers, Geologists and Geophysicists of Alberta.	<b>Acero Engineering Inc.</b> 	<b>devon</b> COB CLOSED HYDROCARBON DRAIN PACKAGE TAG: 001-PK-10-1000 FIRE AND GAS JUNCTION BOX DETAILS	CLIENT DRAWING NUMBER 1928NE-ELC-5562	SCALE N.T.S.	ACERO DRAWING No. 91-02-06-5500	REV. 0
DRAWING NUMBER	REFERENCE DRAWINGS	REV.	DATE	DESCRIPTION	DWN.								

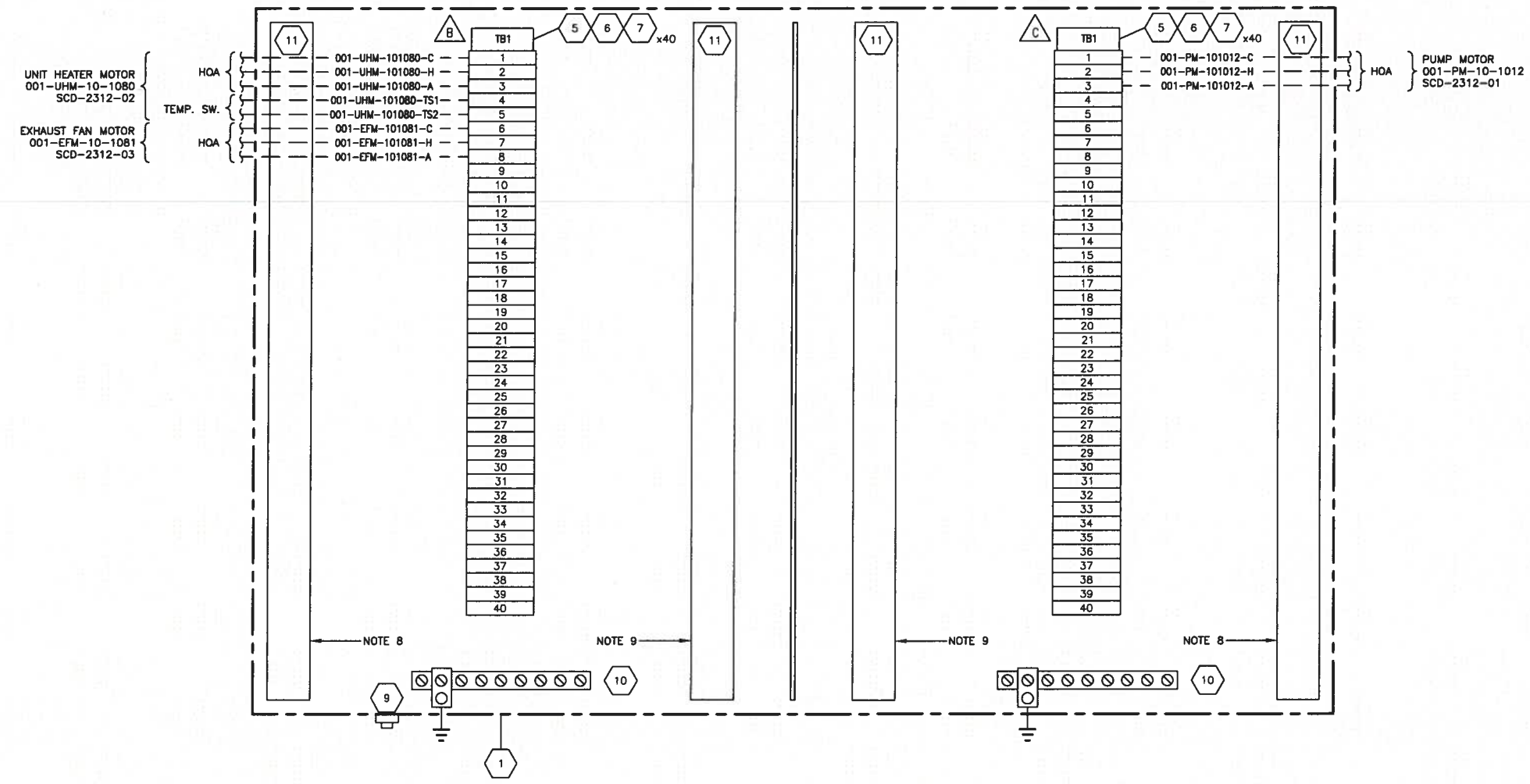
**NOTES:**

1. WIRE TAGGING SHALL BE PROVIDED AT BOTH ENDS TO EACH INDIVIDUAL CONDUCTOR AS PART OF THE E&I CONTRACTOR SCOPE.
2. THE JUNCTION BOX SHOWN ON THIS DRAWING WILL BE SUPPLIED & INSTALLED BY THE VENDOR PACKAGE SKID.
3. GROUNDING WIRE SHALL BE CONNECTED TO THE GROUND BAR AND TO THE NEAREST GROUND PORT CONNECTION AS PART OF THE E&I CONTRACTOR SCOPE.
4. REFER TO INDIVIDUAL SCHEMATIC DIAGRAM FOR TERMINATION TO THE MCC AND VFD CABINETS.
5. THE VENDOR SHALL BE REQUIRED TO FOLLOW THE WIRE TERMINATIONS OF THE END DEVICES AS SHOWN IN THE DRAWING. ANY DIFFERENCES IN THE INTERFACE TERMINATIONS SHALL BE RESOLVED BY THE NOMINATED DEVON PROJECT ENGINEER AFTER CONSULTING WORLEYPARSONS AND THE SKID VENDOR.
6. LAMACOIDS TO BE WHITE ON RED BACKGROUND UNLESS SPECIFIED.
7. WIREWAY TO BE MINIMUM 2" FROM TERMINALS.
8. FIELD WIRING.
9. HOME RUN WIRING.

LAMACOIDS LIST						MATERIAL LIST						
ITEM	QTY.	DESCRIPTION	SIZE (mm)	SUPPLIER	ITEM	QTY.	DESCRIPTION	MANUFACTURER	CATALOG NO.	SIZE	SUPPLIER	
A	1	001-JBC-10-1001	20mm TEXT	50x300	VENDOR	1	1	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20H200BGRLP	-	VENDOR
B	1	TB1	5mm TEXT	10x20	VENDOR	2	-	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20P20	-	VENDOR
C	1	TB2	5mm TEXT	10x20	VENDOR	3	AS REQ'D	DIN RAIN TERMINAL STRIP	WEIDMULLER	TS 32	-	VENDOR
D	1	SEE DETAIL 1	12mm TEXT	75x150	VENDOR	4	AS REQ'D	TERMINAL STRIP END BRACKET	WEIDMULLER	K-1	-	VENDOR
E	-	-	-	-	VENDOR	5	AS REQ'D	TERMINAL MARKER	WEIDMULLER	SCHT 5	-	VENDOR
F	-	-	-	-	VENDOR	6	-	SAK 2.5 FEED THROUGH TERMINAL	WEIDMULLER	SAK 2.5	-	VENDOR
G	-	-	-	-	VENDOR	7	80	SAK 4 FEED THROUGH TERMINAL	WEIDMULLER	SAK 4	-	VENDOR
H	-	-	-	-	VENDOR	8	-	SAK 6 FEED THROUGH TERMINAL	WEIDMULLER	SAK 6	-	VENDOR
I	-	-	-	-	VENDOR	9	1	COVER/GASKET AND BREATHER DRAIN	CROUSE-HINDS	ECD385	-	VENDOR
J	-	-	-	-	VENDOR	10	2	200mm GROUND BUS C/W KA2U LUG	OPEN	-	-	VENDOR
K	-	-	-	-	VENDOR	11	AS REQ'D	GREY WIREWAY c/w COVER	PANDUIT	-	1" x 3"	VENDOR
L	-	-	-	-	VENDOR	12	1	END PLATE	WEIDMULLER	AP SAK4-10	-	VENDOR
						13		CORROSION INHIBITOR	CROUSE-HINDS	CID-101	-	VENDOR
						14	AS REQ'D	METAL SEPARATOR/BARRIER	OPEN	-	-	VENDOR

001-JBC-10-1001 A

CONTROL JUNCTION BOX



DETAIL 1 D

NOTE 8

WARNING

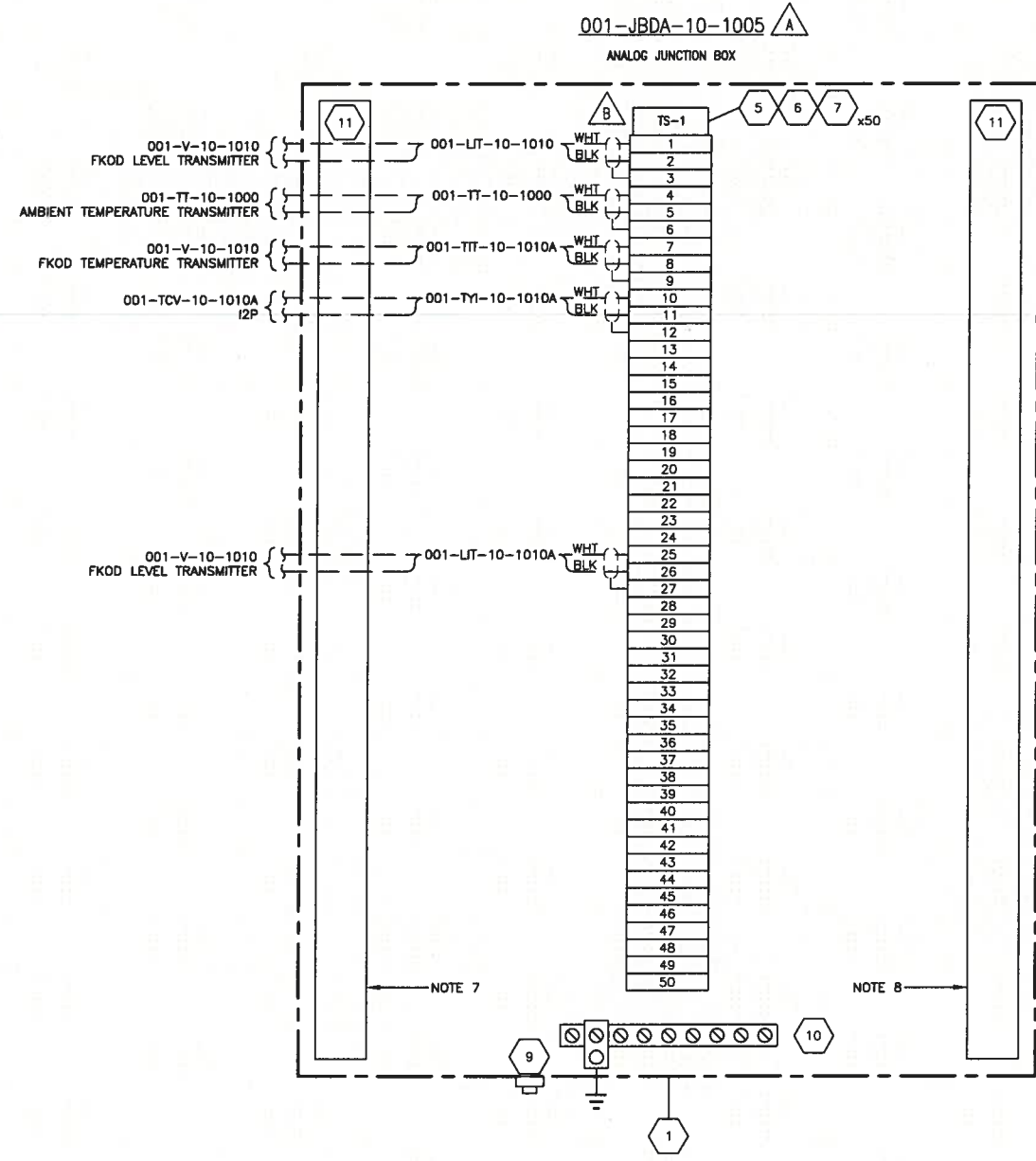
MORE THAN ONE VOLTAGE SOURCE

GENERAL NOTES:		REVISIONS					<b>PERMIT TO PRACTICE</b> ACERO ENGINEERING INC. Signature: _____ Date: _____ PERMIT NUMBER: P09337 The Association of Professional Engineers, Geologists and Geophysicists of Alberta.	<b>Acero Engineering Inc.</b> APP. SK DATE 14 09 12 CKD. TF DATE 14 09 12 DES. - DATE - DWN. FX DATE 14 09 12		<b>devon</b> COB CLOSED HYDROCARBON ORAIN PACKAGE TAG: 001-PK-10-1000 CONTROL JUNCTION BOX DETAILS	
DRAWING NUMBER	REFERENCE DRAWINGS	REV.	DATE	DESCRIPTION	DWN.			CKD.	DES.	APP.	CLIENT DRAWING NUMBER
		0	14 09 15	ISSUED FOR CONSTRUCTION (ACERO PROJ. #1491002)					1928NE-ELC-5563	N.T.S.	91-02-06-5501

**NOTES:**

1. WIRE TAGGING SHALL BE PROVIDED AT BOTH ENDS TO EACH INDIVIDUAL CONDUCTOR AS PART OF THE E&I CONTRACTOR SCOPE.
2. THE JUNCTION BOX SHOWN ON THIS DRAWING WILL BE SUPPLIED & INSTALLED BY THE VENDOR PACKAGE SKID.
3. GROUNDING WIRE SHALL BE CONNECTED TO THE GROUND BAR AND TO THE NEAREST GROUND PORT CONNECTION AS PART OF THE E&I CONTRACTOR SCOPE.
4. THE VENDOR SHALL BE REQUIRED TO FOLLOW THE WIRE TERMINATIONS OF THE END DEVICES AS SHOWN IN THE DRAWING. ANY DIFFERENCES IN THE INTERFACE TERMINATIONS SHALL BE RESOLVED BY THE NOMINATED DEVON PROJECT ENGINEER AFTER CONSULTING WORLEYPARSONS AND THE SKID VENDOR.
5. LAMACOIDS TO BE BLACK ON WHITE BACKGROUND UNLESS SPECIFIED.
6. WIREWAY TO BE MINIMUM 2" FROM TERMINALS.
7. FIELD WIRING.
8. HOME RUN WIRING.

LAMACOID LIST						MATERIAL LIST						
ITEM	QTY.	DESCRIPTION	SIZE	SUPPLIER	ITEM	QTY.	DESCRIPTION	MANUFACTURER	CATALOG NO.	SIZE	SUPPLIER	
A	1	001-JBDA-10-1005	20mm TEXT	50x300	VENDOR	1	1	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20H2008GQRLP	-	VENDOR
B	1	TS-1	5mm TEXT	10x20	VENDOR	2	-	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20P20	-	VENDOR
C	-	-	-	-	VENDOR	3	AS REQ'D	DIN RAIN TERMINAL STRIP	WEIDMULLER	TS 32	-	VENDOR
D	-	-	-	-	VENDOR	4	AS REQ'D	TERMINAL STRIP END BRACKET	WEIDMULLER	K-1	-	VENDOR
E	-	-	-	-	VENDOR	5	AS REQ'D	TERMINAL MARKER	WEIDMULLER	SCHT 5	-	VENDOR
F	-	-	-	-	VENDOR	6	-	SAK 2.5 FEED THROUGH TERMINAL	WEIDMULLER	SAK 2.5	-	VENDOR
G	-	-	-	-	VENDOR	7	50	SAK 4 FEED THROUGH TERMINAL	WEIDMULLER	SAK 4	-	VENDOR
H	-	-	-	-	VENDOR	8	-	SAK 6 FEED THROUGH TERMINAL	WEIDMULLER	SAK 6	-	VENDOR
I	-	-	-	-	VENDOR	9	1	COVER/GASKET AND BREATHER DRAIN	CROUSE-HINDS	ECD385	-	VENDOR
J	-	-	-	-	VENDOR	10	1	200mm GROUND BUS C/W KA2U LUG	OPEN	-	-	VENDOR
K	-	-	-	-	VENDOR	11	AS REQ'D	WHITE WIREWAY c/w COVER	PANDUIT	-	1" x 3"	VENDOR
L	-	-	-	-	VENDOR	12	1	END PLATE	WEIDMULLER	AP SAK4-10	-	VENDOR
						13	1	CORROSION INHIBITOR	CROUSE-HINDS	CID-101	-	VENDOR



<p>GENERAL NOTES</p>	<p>REVISIONS</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>REV.</th> <th>DATE</th> <th>DESCRIPTION</th> <th>DWN.</th> <th>CKD.</th> <th>DES.</th> <th>APP.</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>14 09 15</td> <td>ISSUED FOR CONSTRUCTION (ACERO PROJ. #1491002)</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	REV.	DATE	DESCRIPTION	DWN.	CKD.	DES.	APP.	0	14 09 15	ISSUED FOR CONSTRUCTION (ACERO PROJ. #1491002)						<p>PERMIT TO PRACTICE ACERO ENGINEERING INC.</p> <p>Signature: _____</p> <p>Date: _____</p> <p>PERMIT NUMBER: P09337</p> <p>The Association of Professional Engineers, Geologists and Geophysicists of Alberta.</p>	<p><b>Acero Engineering Inc.</b></p> <p><b>devon</b></p> <p>COB CLOSED HYDROCARBON DRAIN PACKAGE TAG: 001-PK-10-1000 ANALOG JUNCTION BOX DETAILS</p>													
REV.	DATE	DESCRIPTION	DWN.	CKD.	DES.	APP.																									
0	14 09 15	ISSUED FOR CONSTRUCTION (ACERO PROJ. #1491002)																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>DRAWING NUMBER</th> <th>REFERENCE DRAWINGS</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> </tr> </tbody> </table>	DRAWING NUMBER	REFERENCE DRAWINGS			<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>APP.</th> <th>SK</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td>14 09 12</td> </tr> <tr> <th>CKD.</th> <th>TF</th> <th>DATE</th> </tr> <tr> <td> </td> <td> </td> <td>14 09 12</td> </tr> <tr> <th>DES.</th> <th>DATE</th> <th> </th> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <th>DWN.</th> <th>FX</th> <th>DATE</th> </tr> <tr> <td> </td> <td> </td> <td>14 09 12</td> </tr> </tbody> </table>	APP.	SK	DATE			14 09 12	CKD.	TF	DATE			14 09 12	DES.	DATE					DWN.	FX	DATE			14 09 12	<p>CLIENT DRAWING NUMBER: 1928NE-ELC-5564</p> <p>SCALE: N.T.S.</p> <p>ACERO DRAWING No. 91-02-06-5502</p>	<p>REV. 0</p>
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		14 09 12																													
CKD.	TF	DATE																													
		14 09 12																													
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		14 09 12																													

**NOTES:**

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4. THE VENDOR SHALL BE REQUIRED TO FOLLOW THE WIRE TERMINATIONS OF THE END DEVICES AS SHOWN IN THE DRAWING. ANY DIFFERENCES IN THE INTERFACE TERMINATIONS SHALL BE RESOLVED BY THE NOMINATED DEVON PROJECT ENGINEER AFTER CONSULTING WORLEYPARSONS AND THE SKID VENDOR.
5. LAMACOIDS TO BE BLACK ON WHITE BACKGROUND UNLESS SPECIFIED.
6. LAMACOIDS TO BE WHITE ON RED BACKGROUND. SEE DETAIL 1.
7. FIELD WIRING.
8. HOME RUN WIRING.
9. WIREWAYS TO BE MINIMUM 2" FROM TERMINALS

**LAMACOIDS LIST**

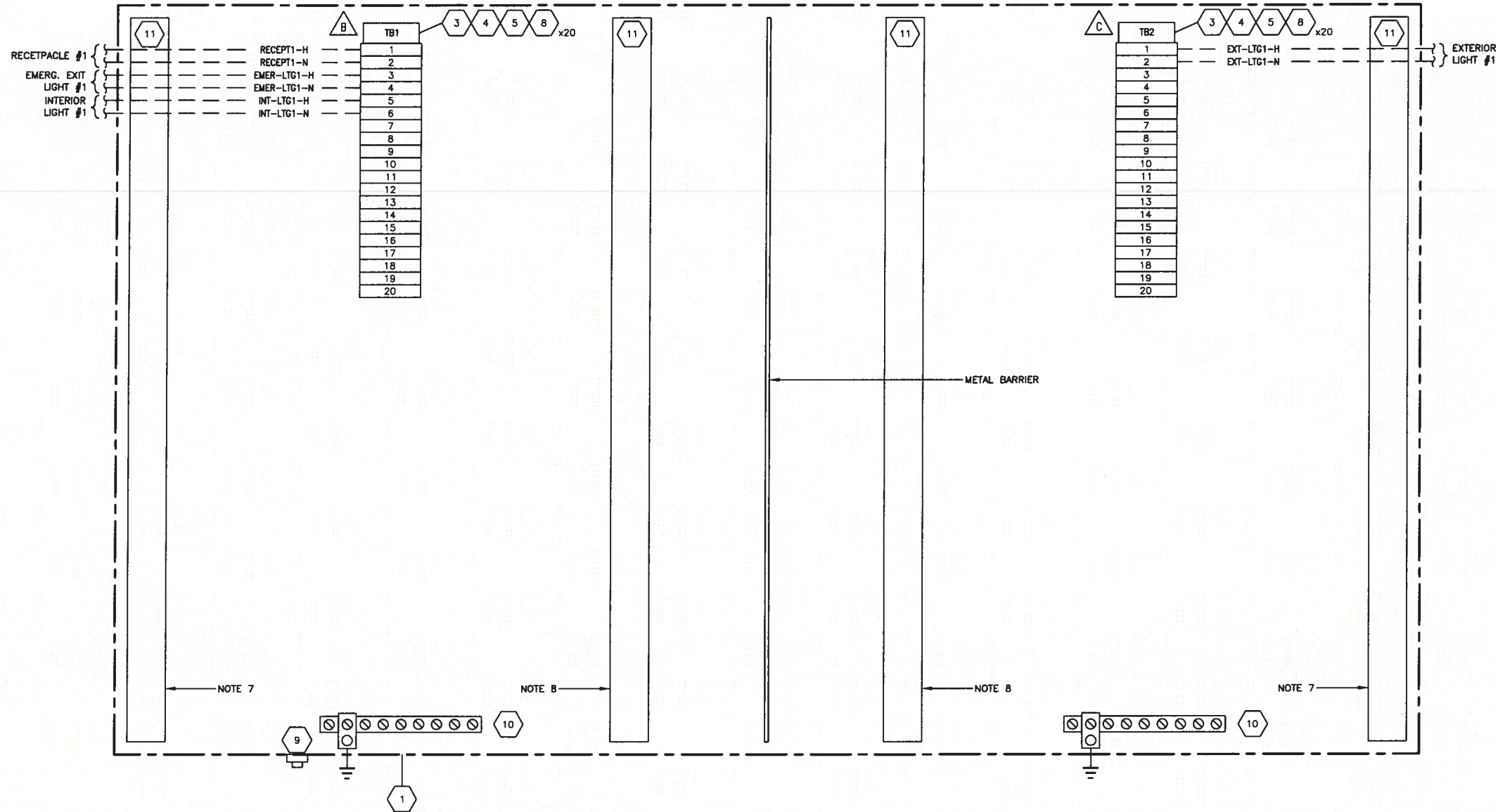
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A	1	001-JBE-10-1002	20mm TEXT	50x300	VENDOR
B	1	TB1	5mm TEXT	10x20	VENDOR
C	1	TB2	5mm TEXT	10x20	VENDOR
D	1	(SEE DETAIL 1)	12mm TEXT	75x150	VENDOR
E	-	-	-	-	VENDOR
F	-	-	-	-	VENDOR
G	-	-	-	-	VENDOR
H	-	-	-	-	VENDOR
I	-	-	-	-	VENDOR
J	-	-	-	-	VENDOR
K	-	-	-	-	VENDOR
L	-	-	-	-	VENDOR

**MATERIAL LIST**

ITEM	QTY.	DESCRIPTION	MANUFACTURER	CATALOG NO.	SIZE	SUPPLIER
1	1	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20H200BQRLP	-	VENDOR
2	-	JUNCTION BOX NEMA 4X c/w BACKPAN	HOFFMAN	A20P20	-	VENDOR
3	AS REQ'D	DIN RAIN TERMINAL STRIP	WEIDMULLER	TS 32	-	VENDOR
4	AS REQ'D	TERMINAL STRIP END BRACKET	WEIDMULLER	K-1	-	VENDOR
5	AS REQ'D	TERMINAL MARKER	WEIDMULLER	SCHT 5	-	VENDOR
6	-	SAK 2.5 FEED THROUGH TERMINAL	WEIDMULLER	SAK 2.5	-	VENDOR
7	-	SAK 4 FEED THROUGH TERMINAL	WEIDMULLER	SAK 4	-	VENDOR
8	40	SAK 6 FEED THROUGH TERMINAL	WEIDMULLER	SAK 6N	-	VENDOR
9	1	COVER/GASKET AND BREATHER DRAIN	CROUSE-HINDS	ECD385	-	VENDOR
10	2	200mm GROUND BUS C/W KA2U LUG	OPEN	-	-	VENDOR
11	AS REQ'D	GREY WIREWAY c/w COVER	PANDUIT	-	1" x 3"	VENDOR
12	1	END PLATE	WEIDMULLER	AP SAK4-10	-	VENDOR
13	-	CORROSION INHIBITOR	CROUSE-HINDS	CID-101	-	VENDOR
14	AS REQ'D	METAL SEPARATOR BARRIER	OPEN	-	-	VENDOR

001-JBE-10-1002 **A**  
POWER JUNCTION BOX

**DETAIL 1** **D**  
NOTE 6



**WARNING**  
MORE THAN ONE  
VOLTAGE SOURCE

**GENERAL NOTES:**

**REVISIONS**



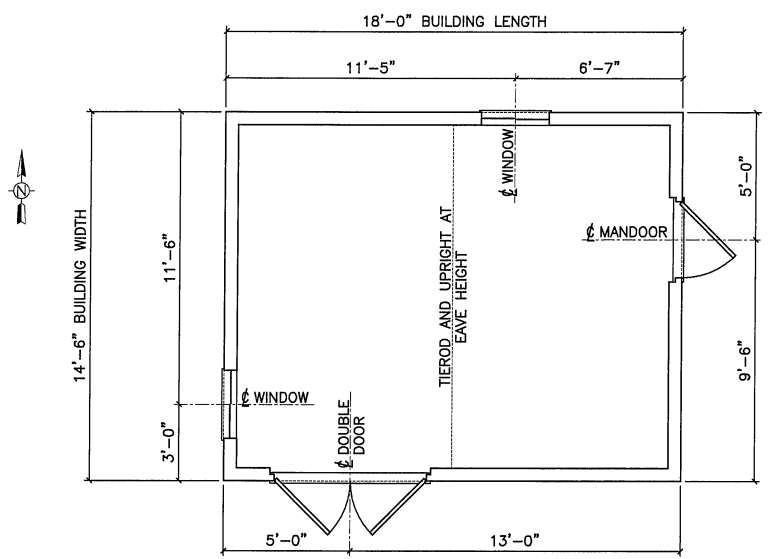
**PERMIT TO PRACTICE**  
ACERO ENGINEERING INC.  
Signature: \_\_\_\_\_  
Date: \_\_\_\_\_  
PERMIT NUMBER: P09337  
The Association of Professional Engineers, Geologists and Geophysicists of Alberta.

**Acero Engineering Inc.**

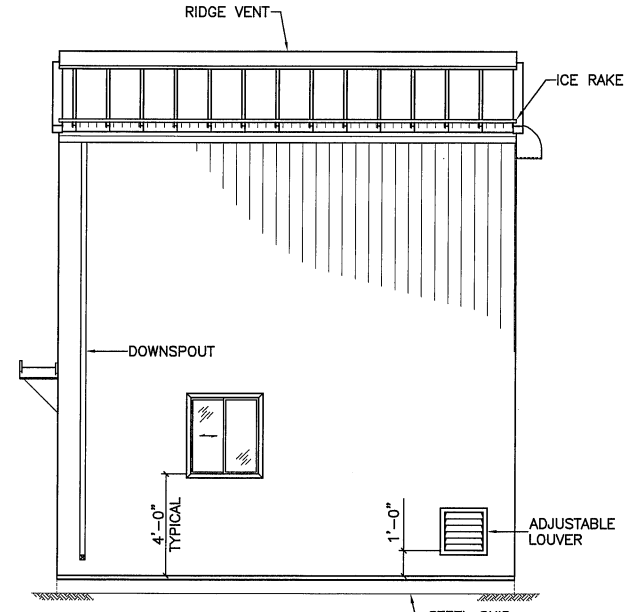
P. ENG.	SK	DATE
APP.	SK	14 09 12
DKD.	TF	14 09 12
DES.	DATE	-
DWN.	FX	14 09 12

**devon**  
COB CLOSED HYDROCARBON DRAIN PACKAGE  
TAG: 001-PK-10-1000  
ELECTRICAL  
JUNCTION BOX DETAILS

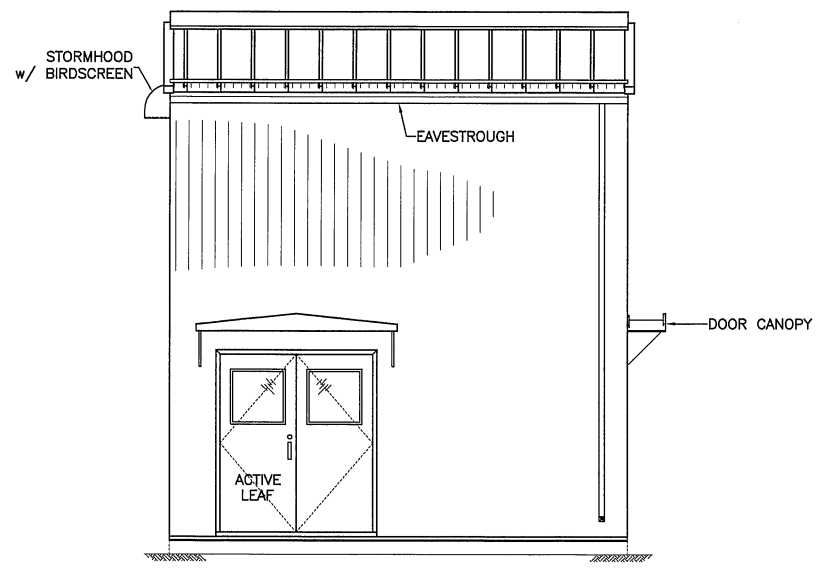
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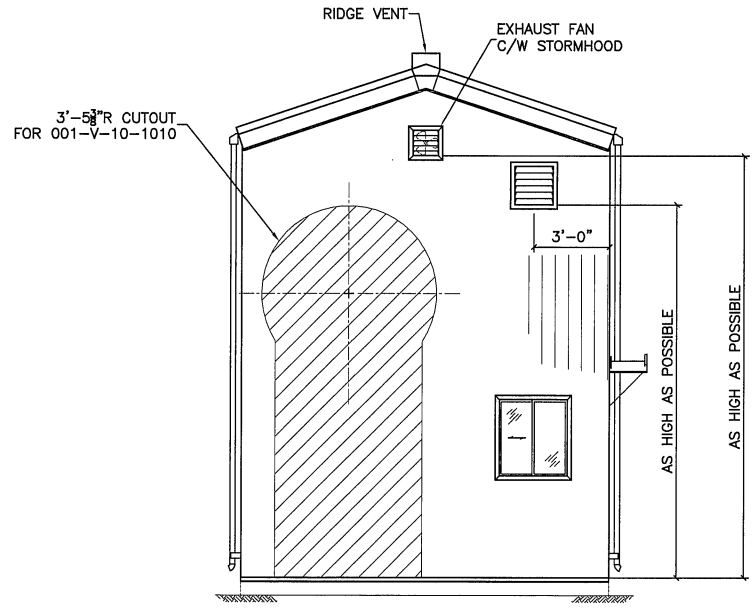
FLOOR PLAN VIEW



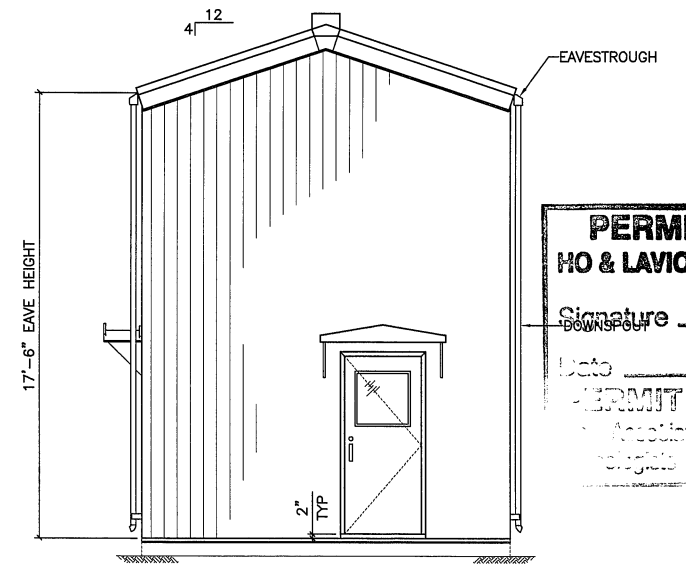
NORTH ELEVATION



SOUTH ELEVATION



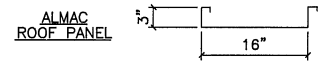
WEST ELEVATION



EAST ELEVATION

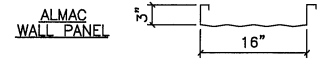
ROOF CONSTRUCTION:

- 22ga. PREPAINTED STEEL INTERLOCKING STRUCTURAL RIB ROOF PANELS, C/W 8000 SERIES PAINT SYSTEM, TO COLOR: STONE GREY (QC-8305)
- 26ga. STEEL INSULATION RIBS AT ROOF PANEL JOINTS.
- R35 (10") FIBREGLASS BATT INSULATION.
- 6 MIL POLY VAPOUR BARRIER.
- 24ga. PREPAINTED ALUMINUM FLUTED PROFILE LINER PANELS, TO COLOUR: WHITE



WALL CONSTRUCTION:

- 22ga. PREPAINTED STEEL INTERLOCKING STRUCTURAL RIB WALL PANELS, C/W 8000 SERIES PAINT SYSTEM, TO COLOR: STONE GREY (QC-8305)
- 6" DEEP VERTICAL ZEE-BAR STRAPPING/RIB STIFFENER AT EACH WALL RIB.
- R20 (6") FIBREGLASS BATT INSULATION.
- 6 MIL POLY VAPOUR BARRIER.
- 24ga. PREPAINTED ALUMINUM FLUTED PROFILE LINER PANELS, TO COLOUR: WHITE



TRIM COLOURS:

- GABLE FLASHING AND ALL NOTED FLASHINGS ARE TO BE FORMED FROM 8000 SERIES PREPAINTED STEEL MATERIAL TO COLOUR: SLATE BLUE (QC-8260)

ACCESSORIES:

- (A) ONE ONLY 3'-0" x 7'-0" STEEL INSULATED EXTERIOR WALK-IN DOOR C/W HARDWARE AS FOLLOWS:
  - \*DOOR LEAF-20ga. STEEL 45mm THK POLY-URETHANE (R12)
  - \*DOOR FRAME-18ga. PRESSED STEEL (KNOCKDOWN)
  - \*BUTT HINGES (3)-"STANLEY" #BB1409 x 114x102 x 26D
  - \*PANIC HARDWARE-"YON DUPRIN" #44TP
  - \*LOCK CYLINDER-"DOREX" #501 KA x C26D
  - \*GLASS-24" x 24", SINGLE GLAZED I.W.G.
  - \*HYDRAULIC CLOSURE-"SHANAHANS" #SH-1003-BCX x 689
  - \*CHECKCHAIN-"CANAROPA" #3548
  - \*THRESHOLD-"PEMKO" #1700A (ALUMINUM)
  - \*WEATHERSTRIP-"PEMKO" #306AV (ALUM./VINYL)
  - \*SWEEP-"PEMKO" #315CN (ALUM./NEOPRENE)
  - \*22ga. SHEETMETAL CANOPY, TO COLOR: SLATE BLUE (QC-8260)
- DOOR LEAF FINISH: SLATE BLUE (QC-8260)
- DOOR FRAME FINISH: SLATE BLUE (QC-8260)
- (B) ONE ONLY 6'-0" x 7'-0" STEEL INSULATED EXTERIOR DOUBLE DOOR C/W HARDWARE AS FOLLOWS:
  - \*DOOR LEAF-20ga. STEEL 45mm THK POLY-URETHANE CORE (R12)
  - \*DOOR FRAME-18ga. PRESSED STEEL (KNOCKDOWN)
  - \*BUTT HINGES (6)-"STANLEY" #BB1409 x 114x102 x 26D
  - \*PANIC HARDWARE-"YON DUPRIN" #44TP (ACTIVE LEAF ONLY)
  - \*LOCK CYLINDER-"DOREX" #501 KA x C26D
  - \*STRIKER PLATE FOR PANIC HARDWARE
  - \*HYDRAULIC CLOSURE-"SHANAHANS" #SH-1003-BCX x 689 (ACTIVE LEAF ONLY)
  - \*GLASS (2)-24" x 24", SINGLE GLAZED I.W.G.
  - \*CHECKCHAIN (2)-"CANAROPA" #3548
  - \*THRESHOLD-"PEMKO" #1700A (ALUMINUM)
  - \*WEATHERSTRIP-"PEMKO" #306AV (ALUM./VINYL)
  - \*SWEEP (2)-"PEMKO" #315CN (ALUM./NEOPRENE)
  - \*HEADBOLT/FOOTBOLT (INACTIVE LEAF ONLY)
  - \*22ga. SHEETMETAL CANOPY, TO COLOR: SLATE BLUE (QC-8260)
- DOOR LEAF FINISH: SLATE BLUE (QC-8260)
- DOOR FRAME FINISH: SLATE BLUE (QC-8260)
- (C) TWO ONLY 2'-8" WIDE x 3'-0" HIGH (NOM. SIZE), DOUBLE GLAZED ALUMINUM SLIDING WINDOW C/W LOCK AND FIBERGLASS CLOTH HALF SCREEN AND I.W.G. GLASS. FRAME FINISH: SLATE BLUE (QC-8260)
- (D) TWO ONLY 18'-0" LONG, CONTINUOUS EAVESTROUGH ASSEMBLY C/W ONE DOWNSPOUT ASSEMBLY PER SIDE. EAVESTROUGH FINISH: SLATE BLUE (QC-8260) DOWNSPOUT FINISH: SLATE BLUE (QC-8260)
- (E) TWO ONLY 18'-0" LONG, CONTINUOUS ROOF MOUNTED ICE RAKE. FINISH: TO MATCH ROOF PANELS

HVAC EQUIPMENT:

- (F) TWO ONLY 1'-6" WIDE x 1'-6" HIGH, ADJUSTABLE WALL LOUVERS C/W EXTRUDED ALUMINUM BLADES, BIRDSCREEN AND MANUAL CONTROLS. FINISH: MILL FINISH ALUMINUM
- (G) ONE ONLY WALL MOUNTED EXPLOSION PROOF EXHAUST FAN, "ENERTECH" MODEL NO. ET-12-4 C/W 575V/60hz/3ph, 1/4hp MOTOR, BACKDRAFT DAMPER, GUARD AND STORMHOOD W/ BIRDSCREEN. (EACH FAN IS CAPABLE OF 1200cfm @ 1/4 S.P.) HOOD FINISH: STONE GREY (QC-8305)
- (H) ONE ONLY 16'-0" LONG, CONTINUOUS RIDGE VENT ASSEMBLY, C/W 9" WIDE THROAT, BIRDSCREEN AND MANUALLY OPERATED DAMPERS. HOOD FINISH: STONE GREY (QC-8305)

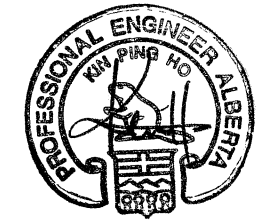
CONSTRUCTION NOTES:

- ALL EXTERIOR SCREWS ARE TO BE CADMIUM PLATED. "UN-PAINTED" SIZES AND LOCATION AS SHOWN ON BUILDING DETAIL DRAWING.
- INTERIOR LINER SCREWS ARE TO BE PAINTED TO MATCH LINER MATERIAL, TO COLOUR: WHITE
- BUILDING PACKAGE IS TO INCLUDE BASE FLASHING AND Z-TYPE INTERIOR FLASHING OVER 2" CONTAINMENT DRIP LIP.

BUILDING MATERIAL SPECIFICATIONS

PREPAINTED STEEL c/w GALVANIZED SUBSTRATE - A653, G90, Gr 37  
 c/w GALVALUME SUBSTRATE - A792, AZ150, Gr 37  
 PLAIN GALVANIZED STEEL - A653, G90, Gr 37  
 PLAIN GALVALUME STEEL - A792, AZ165, Gr 37

BUILDING DESIGN LOADS (kPa) - ROCKY MOUNTAIN HOUSE, AB LOADS (ABC 2006)  
 GROUND SNOW LOAD - S<sub>s</sub> = 1.90, S<sub>r</sub> = 0.10  
 WIND LOAD q<sub>1/10</sub> = 0.33, q<sub>1/50</sub> = 0.43  
 SEISMIC ZONE - S<sub>a</sub>(0.2) = 0.150, S<sub>a</sub>(0.5) = 0.080, S<sub>a</sub>(1.0) = 0.040  
 S<sub>a</sub>(2.0) = 0.020, PGA = 0.080  
 IMPORTANCE FACTOR = 1.00 U.N.O.

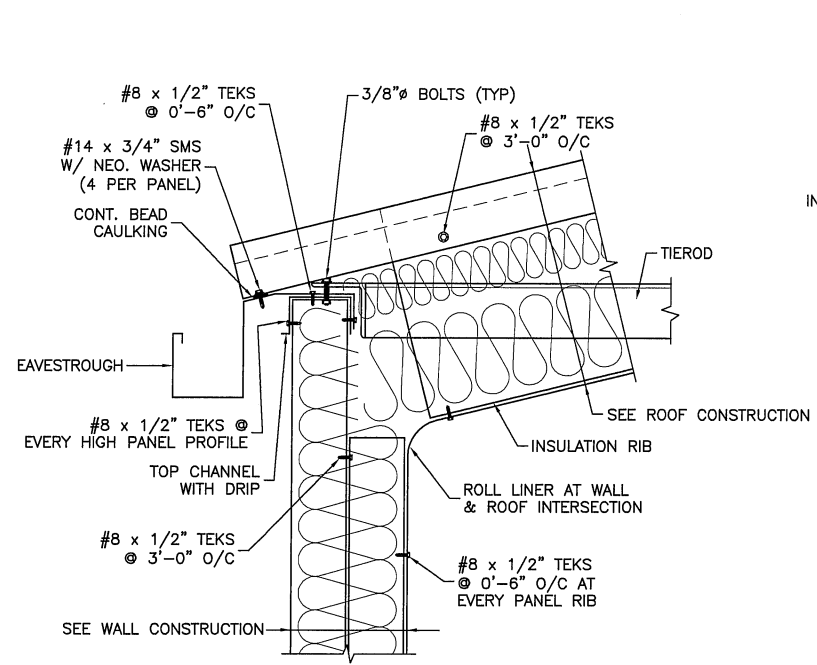


**PERMIT TO PRACTICE**  
**HO & LAVIOLETTE ENGINEERING LTD.**  
 Signature: *Kim Ping Ho*  
 Date: APR 10/14  
 PERMIT NUMBER: P 03171  
 Association of Professional Engineers, Geologists and Geophysicists of Alberta

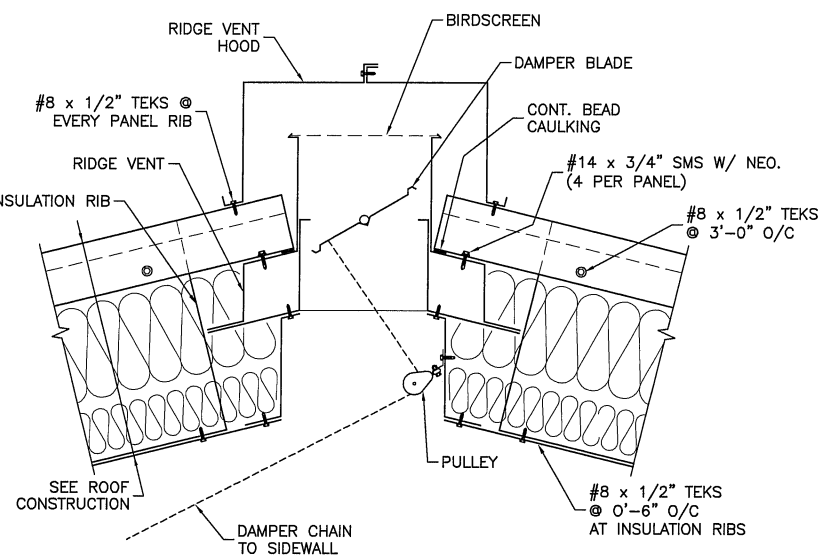
REV.	DESCRIPTION	BY	DATE
1	ISSUED AS-BUILT	KM	2014/03/26

**METAL BUILDINGS ALMAC METAL BUILDINGS**  
**Almac Metal Industries Ltd.**  
 6140-76th AVENUE EDMONTON, ALBERTA T6B 0A6  
 PHONE: (780) 465-0861 FAX: (780) 465-4198

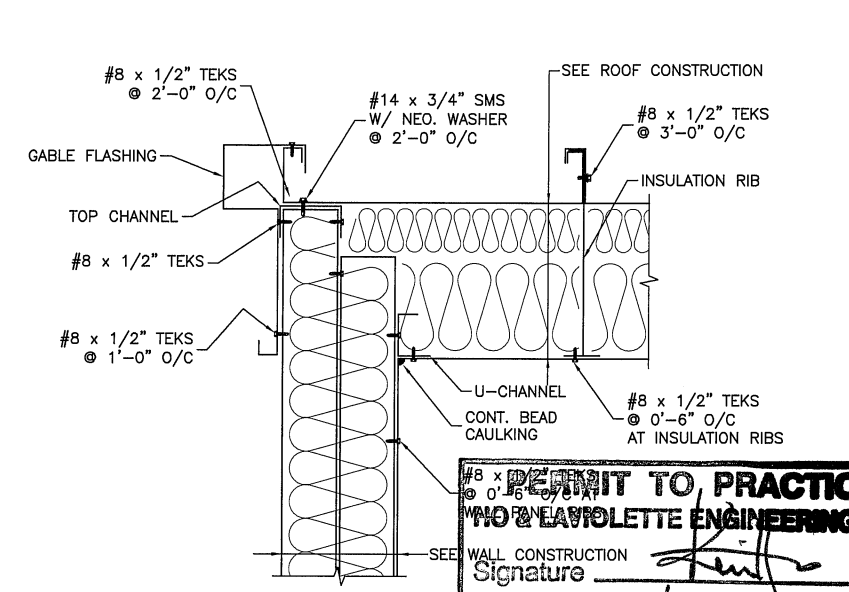
CLIENT: ALCO GAS & OIL	DRAWN BY: KM	CHECKED BY:
TITLE: DEVON CANADA 001-BU-10-1000	SCALE: 1/8" = 1'-0"	DATE: 2014/03/26
LOCATION: LSD: 11-02-039-08 W5M	JOB NUMBER: 14499	SHEET: B1
SHEET DESCRIPTION: PLAN AND ELEVATION VIEWS	REV. 0	



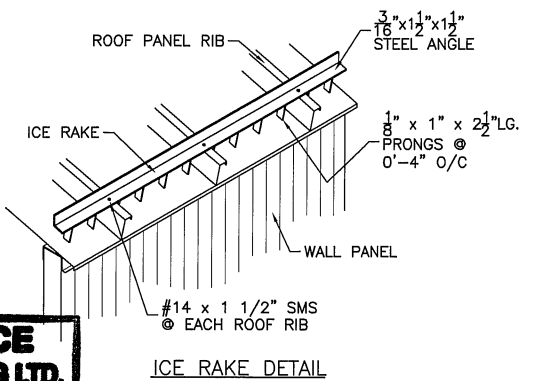
EAVE DETAIL



RIDGE DETAIL

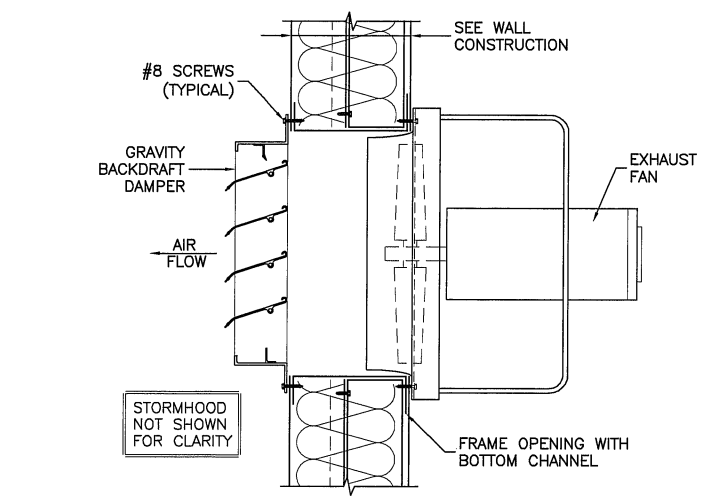
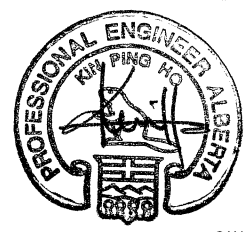


GABLE DETAIL

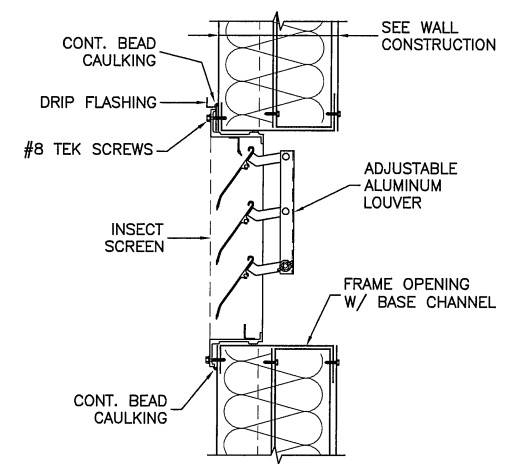


ICE RAKE DETAIL

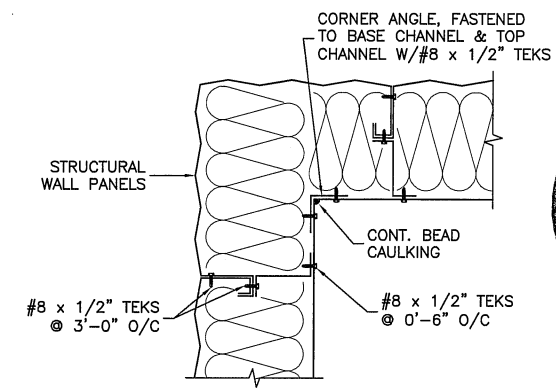
**PERMIT TO PRACTICE**  
**W/O LAVIOLLETTE ENGINEERING LTD.**  
 Signature \_\_\_\_\_  
 APR 10/14  
**PERMIT NUMBER: P 03171**  
 The Association of Professional Engineers,  
 Geologists and Geophysicists of Alberta



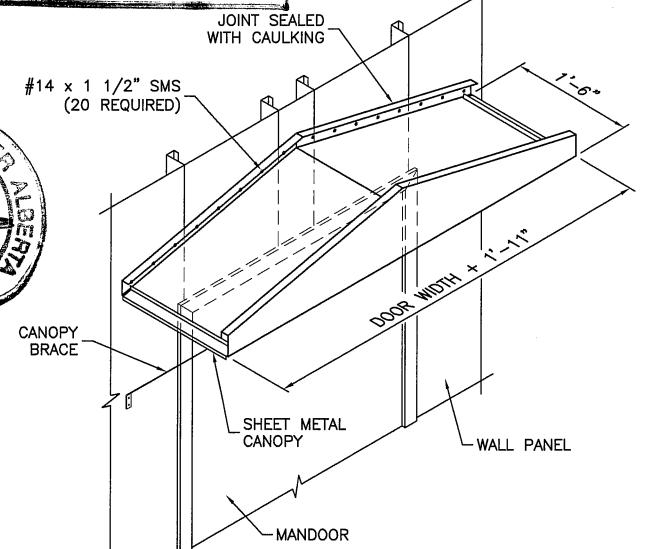
EXHAUST FAN DETAIL



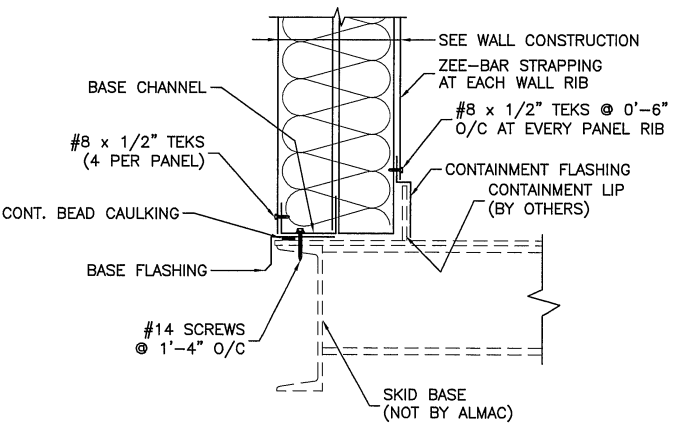
ADJUSTABLE LOUVER DETAIL



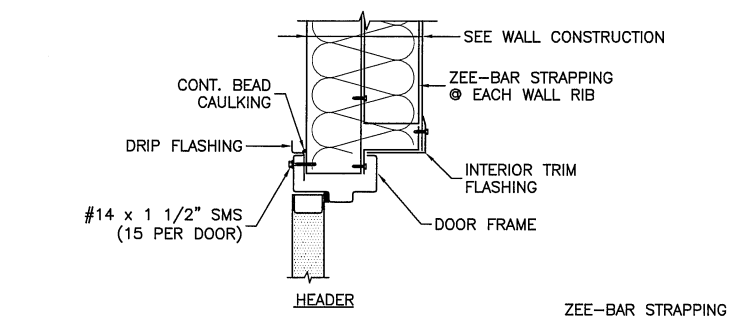
BUILDING CORNER DETAIL



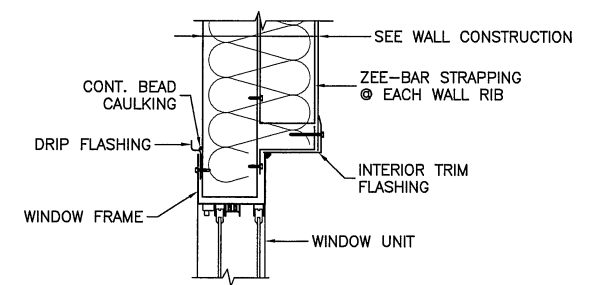
SHEET METAL CANOPY DETAIL



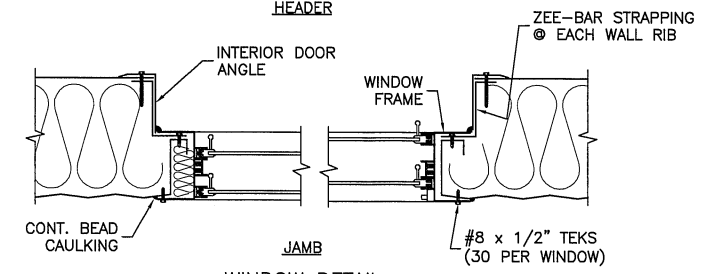
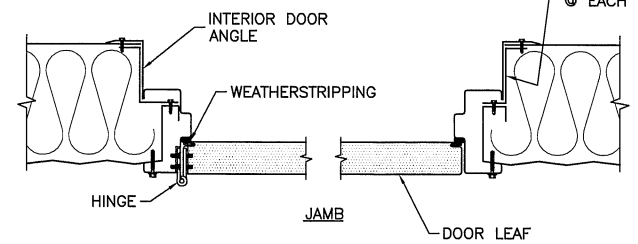
BASE DETAIL



MANDOOR DETAIL



WINDOW DETAIL



ISSUED AS-BUILT	KM	2014/03/26
REV.	DESCRIPTION	BY DATE

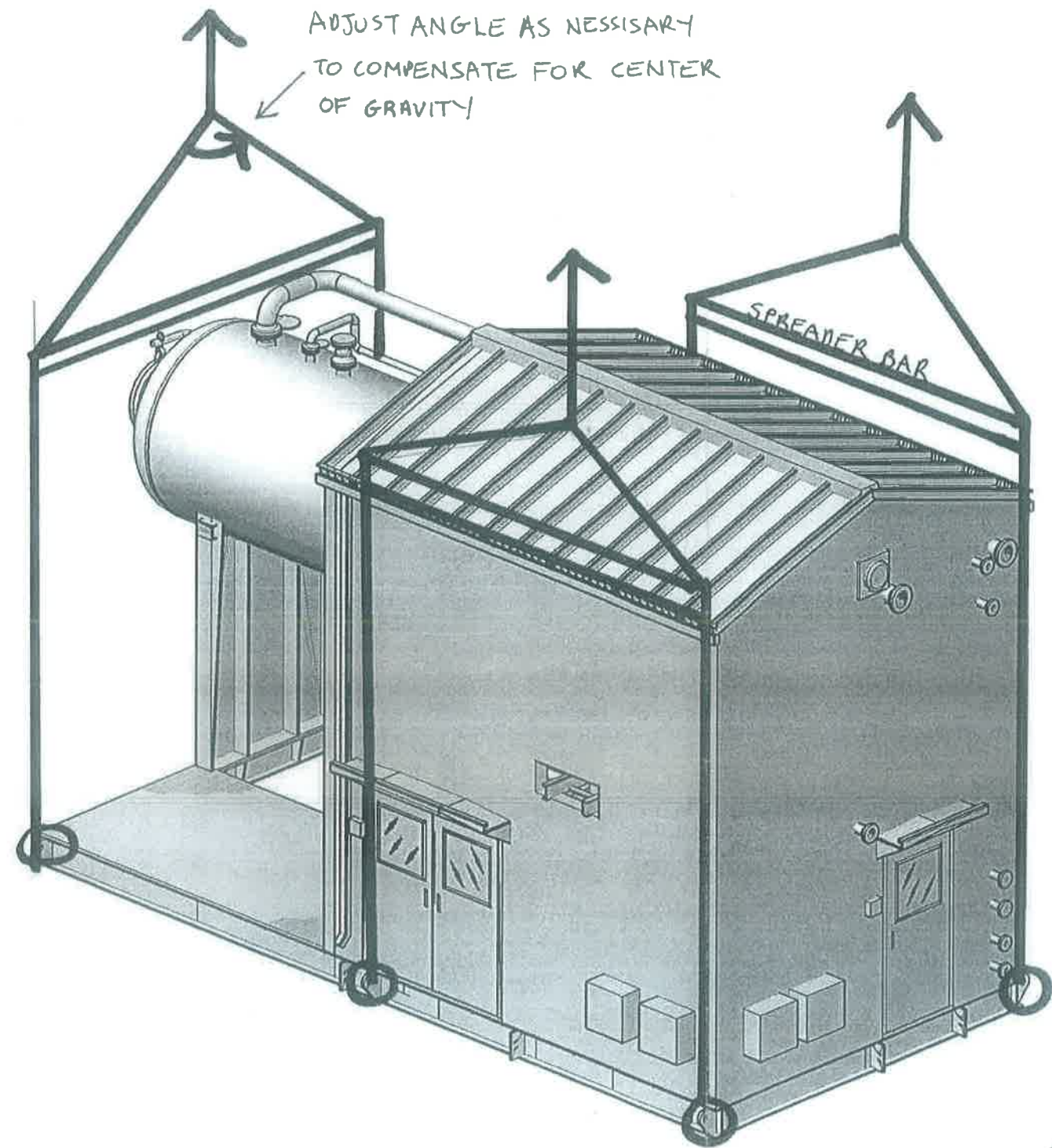


**Almac Metal Industries Ltd.**

6140-76th AVENUE  
 EDMONTON, ALBERTA  
 T6B 0A6  
 PHONE: (780) 465-0861  
 FAX: (780) 465-4198

CLIENT:	ALCO GAS & OIL	DRAWN BY:	KM	CHECKED BY:	
TITLE:	DEVON CANADA 001-BU-10-1010	SCALE:	NTS	DATE:	2014/03/26
LOCATION:	LSD: 11-02-039-08 W5M	JOB NUMBER	14499	SHEET	B2
SHEET DESCRIPTION:	TYPICAL BUILDING DETAILS			REV.	0

REF# 8440-50



PROFESSIONAL ENGINEER OF ALBERTA  
 MAGDI I. GHOBRIAL  
*08/08/2014*

DRAWN		<small>The information contained herein is the confidential property of Alco Gas and Oil Production Equipment Ltd., and is not to be published. The information is based on the understanding that the user thereof shall be held responsible for any errors or omissions in a third party's use of this information in selling their own gas and oil production equipment.</small>
DATE		
SCALE		
CHK'D		
<b>LIFTING DIAGRAM</b> <b>COB - CLOSED HYDROCARBON DRAIN PACKAGE</b> TAG: 001-PK-10-1000		
LOCATION: FERRIER CPF PROJECT, AB		L.S.D.: 11-02-039-08 WSM
CUSTOMER: DEVON CANADA CORPORATION		
DWG/SHOP ORDER:	D-2013-8440- 50	REV 0



**TIE-IN SCHEDULE:**

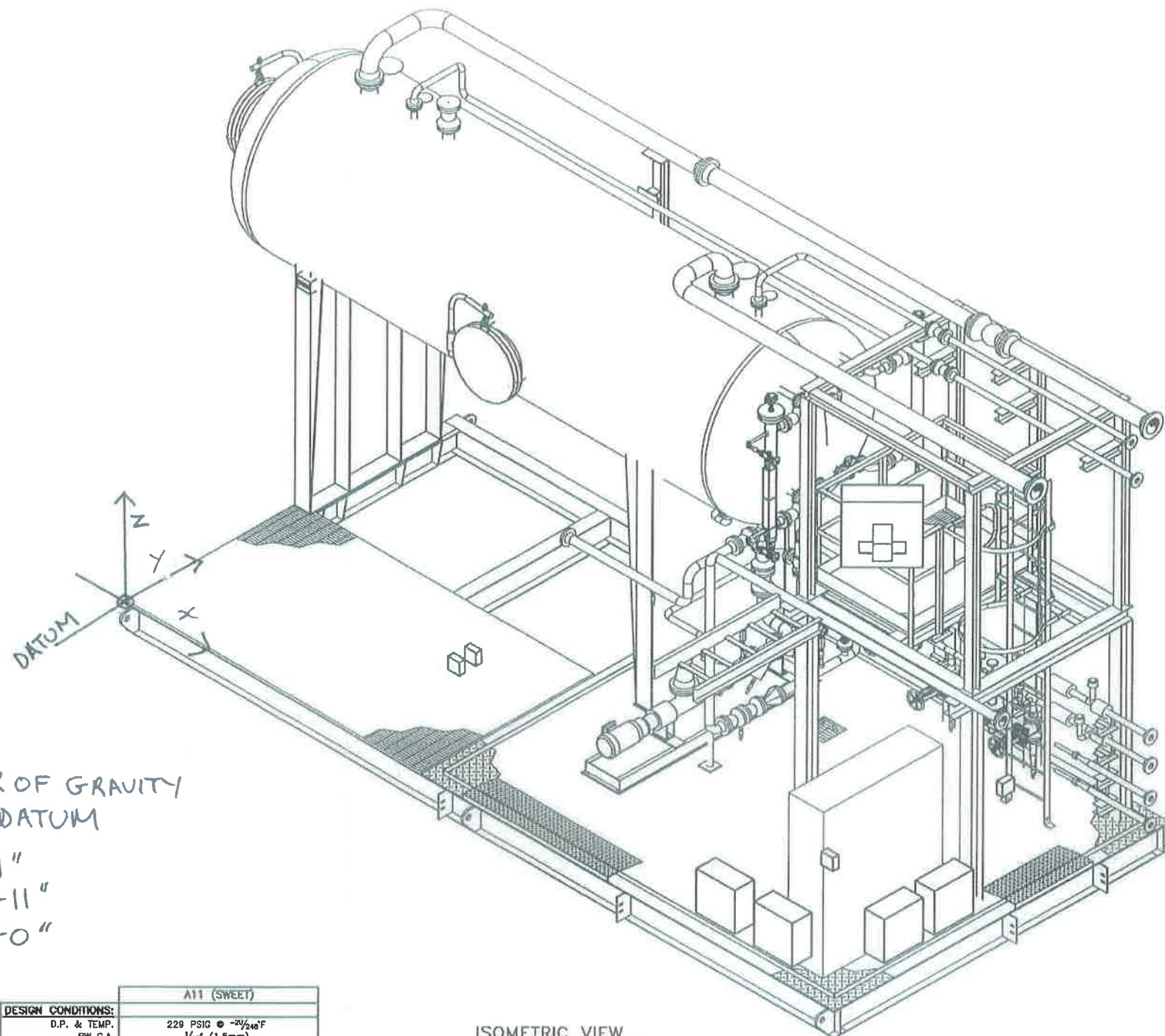
- 1 NPS 6(150)-CL150 ASME RF HC DRAIN INLET, B.O.P. @ ELEV. 15'-11 1/16" (4859)
- 2 NPS 2(50)-CL150 ASME RF VENT GAS CONN., B.O.P. @ ELEV. 15'-11 1/16" (4859)
- 3 NPS 3(80)-CL150 ASME RF RECOVERED HC DRAIN, B.O.P. @ ELEV. 8'-0" (2438)
- 4 NPS 3(80)-CL150 ASME RF TRUCK OUT CONNECTION, @ ELEV. 5'-3" (1800)
- 5 NPS 2(50)-CL300 ASME RF HEAT MEDIUM SUPPLY, @ ELEV. 4'-4" (1321)
- 6 NPS 2(50)-CL300 ASME RF HEAT MEDIUM RETURN, @ ELEV. 3'-3" (991)
- 7 NPS 2(50)-CL150 ASME RF FUEL GAS INLET, B.O.P. @ ELEV. 14'-4 1/16" (4380)
- 8 NPS 2(50)-CL150 ASME RF UTILITY AIR SUPPLY, @ ELEV. 1'-0" (305)
- 9 NPS 2(50)-CL150 ASME RF INSTRUMENT AIR SUPPLY, @ ELEV. 2'-0" (610)
- 10 NPS 2(50)-CL150 ASME RF FLOOR DRAIN, @ ELEV. 0'-4" (102) BELOW TOP OF MAIN SKID
- 11 NPS 6(150)-CL150 ASME RF HP FLARE GAS, B.O.P. @ ELEV. 15'-11 1/16" (4859)
- 12 24" CABLE TRAY ENTRY FOR 575V CUT OUT SIZE 35" WIDE x 14" HIGH @ ELEV. 8'-11" (2715mm)

**HEAT TRACING NOTES:**

- 2'-8" PIPE USE 1/2" 316 SS (0.035") TUBING;
- 10" PIPE USE 3/4" 316 SS (0.049") TUBING;
- SS BANDING TO SECURE TRACING;
- SHOP TO SEE PROJECT MANAGER FOR INSTALLATION DETAILS.

**GENERAL NOTES:**

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE MECHANICAL FLOWSHEET.
2. PROCESS PIPING TO BE DESIGNED TO ASME B31.3 2012 EDITION AND REGISTERED IN ALBERTA.
3. PRESSURE VESSELS ARE TO BE REGISTERED IN ALBERTA.
4. VESSELS AND PIPING TO BE INSULATED AS PER FLOWSHEET AND/OR FABRICATION DRAWINGS.
5. PAINTING AS PER GS-6100:
  - INDOOR UNINSULATED VESSEL & PIPING, STRUCTURAL (SYSTEM P1):  
SURFACE PREPARATION: SSPC-SP6  
PRIMER: 4-6 mils CLOVAGUARD 8315 EPOXY  
FINISH: 2-3 mils CLOVATHANE 834 POLYURETHANE  
(VESSEL & PIPING 16376 LIGHT GRAY, STRUCTURAL 15090 BLUE, LADDERS AND HANDRAILS FS13591 SAFETY YELLOW)
  - INSULATED VESSEL & PIPING (SYSTEM P4):  
SURFACE PREPARATION: SSPC-SP10  
PRIMER: 5-8 mils CLOVALINE 8329 HEAVY DUTY EPOXY NOVOLAC LINING (GREY)  
FINISH: NONE
  - INTERNAL COATING VESSEL:  
SURFACE PREPARATION: SSPC-SP5  
PRIMER: 5-8 mils DFT HIGHLAND 74  
TOP COAT: 5-8 mils DFT HIGHLAND 74
  - OUTDOOR STRUCTURAL (SYSTEM NP):  
STRUCTURAL: UN-PAINTED  
GRATING: GALVANIZED
6. ALL ELEVATIONS SHOWN ARE FROM TOP OF MAIN SKID MEMBERS, DEPTH OF SKID IS 1'-0".
7. ALL SKID EDGE CONNECTIONS TO BE HELD AT DIMENSIONS AND ELEVATIONS SHOWN FOR CUSTOMER TIE-INS.
8. SKID IS DESIGNED FOR AN EIGHT (8) POINT LIFT.
9. I/A SERVICE VENTING: BLEED TYPE INSTRUMENTS, REGULATOR BONNETS, INSTRUMENT CASES AND CONTROL VALVE ACTUATORS ARE NOT VENTED.
10. 1" INSTRUMENT AIR HEADER AS SHOWN ON FLOWSHEET (SHOP TO RUN AS REQ'D) WITH 1/4" TAKE-OFFS c/w ISOLATION NEEDLE VALVE, REGULATOR, AND TUBING TO COMPLETE.
11. REMOVE ALL FLOATS/DISPLACERS FROM ALL LEVEL CONTROLLERS AND SWITCHES. TAG AND CRATE FOR SHIPPING.
12. ALL INSTRUMENTS SHALL BE TAGGED AS FOLLOWS: 001-XX-10-XXXX, SO PG-1012 WOULD BE TAGGED 001-PG-10-1012
13. PROTECT ALL OPENINGS FOR SHIPPING.
14. ESTIMATED SHIPPING WEIGHT UNIT: 51,000 lbs.
15. ALL PIPING HYDRO TESTS TO BE CHART RECORDERS



CENTER OF GRAVITY FROM DATUM  
X 13'-1"  
Y 7'-11"  
Z 6'-0"

A11 (SWEET)	
<b>DESIGN CONDITIONS:</b>	
D.P. & TEMP.	229 PSIG @ -20°F
BW C.A.	1/16" (1.5mm)
NPT/SW C.A.	1/16" (1.5mm)
RADIOGRAPHY	10%
P.W.H.T.	NONE
HYDROTEST	426 PSIG
<b>PIPING:</b>	
BW PIPING	3' - 20" SCH. STD. SA-106-B 2' SCH. 80, SA-106-B
SW PIPING	≤ 1 1/2" SCH. 80 SA-106-B
NPT PIPING	≤ 1 1/2" SCH. 80 SA-106-B
INSTRUMENT TUBING	1/2" O.D. 316 STAINLESS STEEL (0.035")
PROCESS TUBING	1/2" O.D. 316 STAINLESS STEEL (0.049")
<b>FITTINGS:</b>	
BW FITTINGS	3' - 20" SCH. STD. SA-234-WPB 2" SCH. 80, SA-234-WPB
SW FITTINGS	≤ 1 1/2" CL3000 SA-105N
NPT FITTINGS	≤ 1 1/2" CL3000 SA-105N
FLANGES	RFWN BORE TO PIPE, SA-105N
GASKETS	316 SS 'GG' FLEXICARB
BOLTING	SA-193-B7/SA-194-2H SCH. 160, SA-106-B
PUMP/L.G. NIPPLES	316 SS SWAGelok (DOUBLE FERRULE)
INSTR. TUBING FITTINGS	316 SS SWAGelok (DOUBLE FERRULE)
PROCESS TUBING FITTINGS	316 SS SWAGelok (DOUBLE FERRULE)



ISOMETRIC VIEW  
SCALE: 1/2"=1'-0"  
BUILDING NOT SHOWN

REV.	DATE	BY	DESCRIPTION
1	2014-06-11	JY	CHG. TUBING SIZE
2	2014-06-11	HZ	ISSUED FOR CONSTRUCTION
3	2014-06-11	VJK	RE-ISSUED FOR CUSTOMER APPROVAL
4	2014-06-11	DD	RE-ISSUED FOR CUSTOMER APPROVAL
5	2014-06-11	ZR	ISSUED FOR CUSTOMER APPROVAL
6	2014-06-11	VJK	ISSUED FOR CUSTOMER APPROVAL
7	2014-06-11	ZR	ISSUED FOR CUSTOMER APPROVAL

ONE (1) UNIT REQ'D

DRAWN: ZR  
DATE: 2013-06-17  
SCALE: NTS  
CHK'D:

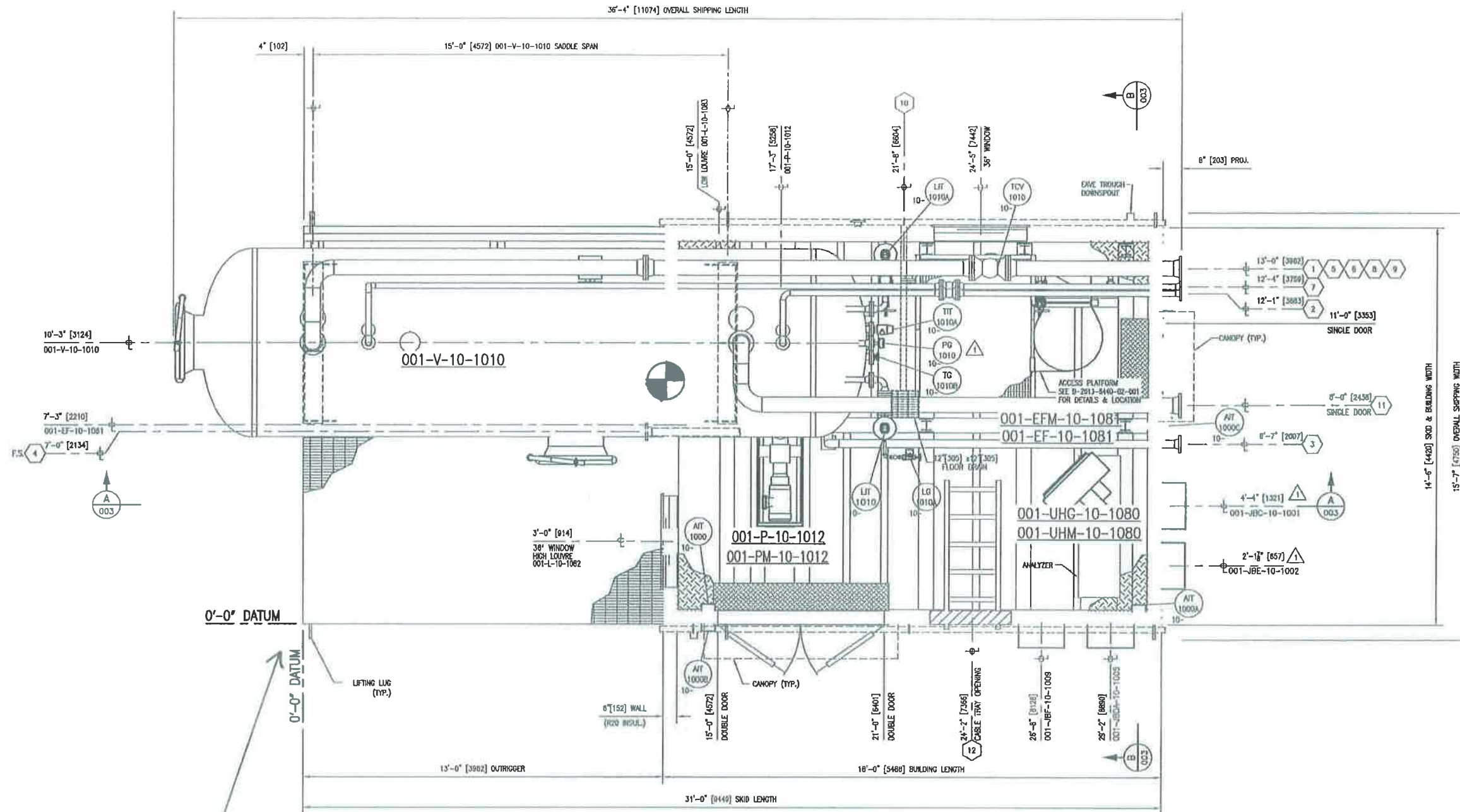
**ALCO GAS & OIL**  
PRODUCTION EQUIPMENT LTD.

ISOMETRIC VIEW & NOTES  
COB CLOSED HYDROCARBON DRAIN PACKAGE  
TAG: 001-PK-10-1000

LOCATION: FERRIER CPF PROJECT, AB  
CUSTOMER: DEVON CANADA CORPORATION  
L.S.D.: 11-02-039-08 W5M

DWG./SHOP ORDER: D-2013-8440-50A-001/003  
REV. 1

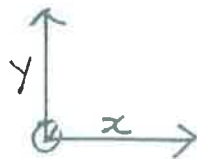
- \* INSTRUMENT NOZZLES AND PIPING CONTAINING GLYCOL SHALL BE CL300
- \*\* 5% RT FIT-UP
- \*\*\* 10% MPI ON ANY PIPING FILLET WELDS (SW).
- \*\*\*\* PIPE SCHEDULE IS SELECTED BASED ON PRESSURE AND CORROSION LIMITS.
- \*\*\*\*\* SEE SOCKETWELD PROCEDURES FOR GAP.



PLAN VIEW  
SCALE: 1/2"=1'-0"

CENTER OF GRAVITY FROM DATUM

X 13'-1"  
Y 7'-11"  
Z 6'-0"



**GENERAL NOTES:**

- SEE DRAW D-2013-8440-50A-001 FOR GENERAL NOTES.
- PIPING SPEC. SCHEDULE:**
- SEE DRAW D-2013-8440-50A-001 FOR PIPING SPEC. SCHEDULE.
- TIE-IN SCHEDULE:**
- SEE DRAW D-2013-8440-50A-001 FOR TIE-IN SCHEDULE.



REV.	DATE	BY	DESCRIPTION	REVISIONS
2	2013/06/05	RF	AS BUILTS	
1	2013/11/28	RKL	REVISE DIMENSIONS	
0	2013/11/14	HZ	ISSUED FOR CONSTRUCTION	
E	2013/10/08	VJK	RE-ISSUED FOR CUSTOMER APPROVAL	
D	2013/09/10	DD	RE-ISSUED FOR CUSTOMER APPROVAL	
C	2013/07/24	ZR	ISSUED FOR CUSTOMER APPROVAL	
B	2013/07/24	VJK	ISSUED FOR CUSTOMER APPROVAL	
A	2013/07/18	DD	ISSUED FOR CUSTOMER APPROVAL	

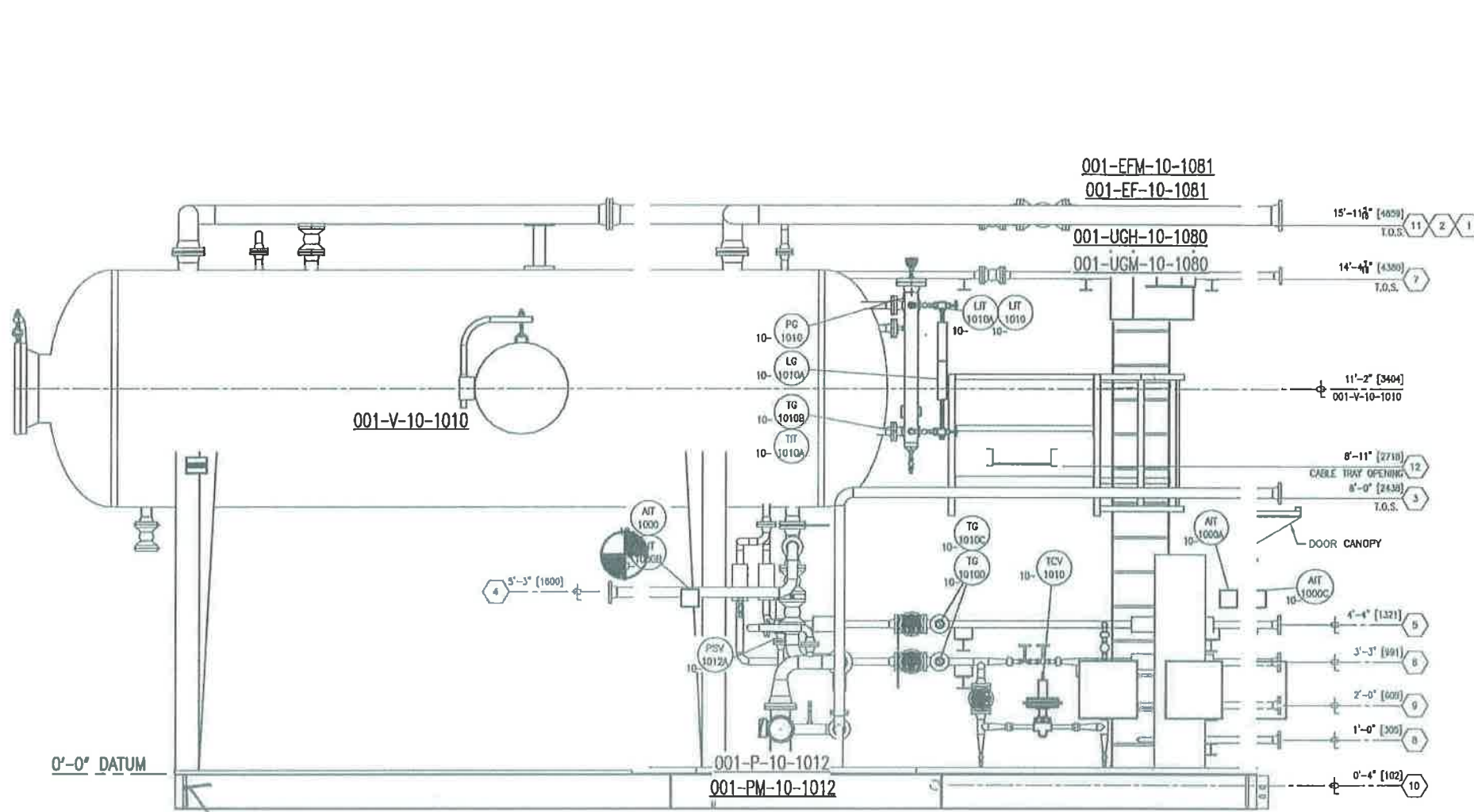
DWG.	DESCRIPTION	REV. DATE	REV. BY	DESCRIPTION
D-2013-8440-50F-001	MECHANICAL FLOWSHEET			

AS BUILTS	DRAWN	ZR
REVISE DIMENSIONS	DATE	2013-06-17
ISSUED FOR CONSTRUCTION	SCALE	NTS
RE-ISSUED FOR CUSTOMER APPROVAL	CHK'D	
RE-ISSUED FOR CUSTOMER APPROVAL		
ISSUED FOR CUSTOMER APPROVAL		
ISSUED FOR CUSTOMER APPROVAL		
ISSUED FOR CUSTOMER APPROVAL		

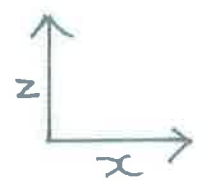
  

ONE (1) UNIT REQ'D	
<b>ALCO GAS &amp; OIL</b>	PRODUCTION EQUIPMENT LTD.
PLAN VIEW	
COB CLOSED HYDROCARBON DRAIN PACKAGE	
TAG: 001-PK-10-1000	
LOCATION: FERRIER CPF PROJECT, AB	L.S.D.: 11-02-039-08 W5M
CUSTOMER: DEVON CANADA CORPORATION	
DWG/SHOP ORDER: D-2013-8440-50A-002/003	REV. 2

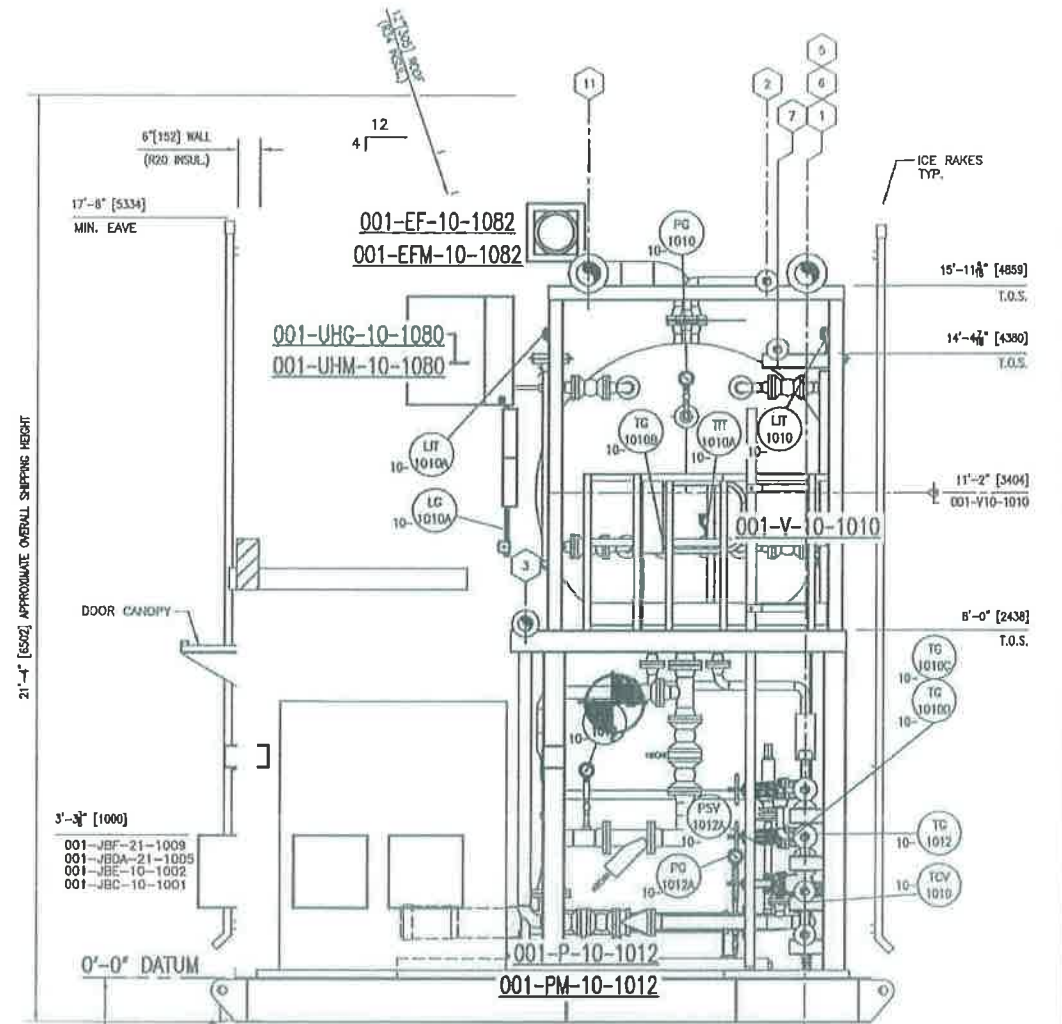


CENTER OF GRAVITY FROM DATUM

X 13'-1"  
Y 7'-11"  
Z 6'-0"

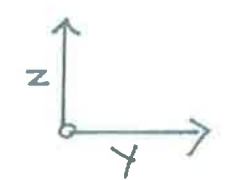


SECTION A-A  
SCALE: 1/2"=1'-0"



CENTER OF GRAVITY FROM DATUM

X 13'-1"  
Y 7'-11"  
Z 6'-0"



VIEW B-B  
SCALE: 1/2"=1'-0"

- GENERAL NOTES:**
- SEE DRAW D-2013-8440-50A-001 FOR GENERAL NOTES.
- PIPING SPEC. SCHEDULE:**
- SEE DRAW D-2013-8440-50A-001 FOR PIPING SPEC. SCHEDULE.
- TIE-IN SCHEDULE:**
- SEE DRAW D-2013-8440-50A-001 FOR TIE-IN SCHEDULE.



REV	DATE	DESCRIPTION
O	2013-08-17	ISSUED FOR CONSTRUCTION
E	2013-10-01	RE-ISSUED FOR CUSTOMER APPROVAL
D	2013-09-10	RE-ISSUED FOR CUSTOMER APPROVAL
C	2013-08-23	ISSUED FOR CUSTOMER APPROVAL
B	2013-07-24	ISSUED FOR CUSTOMER APPROVAL
A	2013-07-18	ISSUED FOR CUSTOMER APPROVAL

ONE (1) UNIT REQ'D

ALCO GAS & OIL PRODUCTION EQUIPMENT LTD.

**SECTION VIEWS**  
COB CLOSED HYDROCARBON DRAIN PACKAGE  
TAG: 001-PK-10-1000

LOCATION: FERRIER CPF PROJECT, AB L.S.D.: 11-02-039-08 WSM  
CUSTOMER: DEVON CANADA CORPORATION  
DWG/SHOP ORDER: D-2013-8440-50A-003/003 REV. 0

## **SECTION C**

### **INSTRUMENT DATASHEETS**

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000	
	2	Service			001-PK-10-1000 FIRE DET	
	3	Application				
	4	Line Number	Equipment Number	---	001-PK-10-1000	
	5	Area Classification	Location	CLASS 1 ZONE 2 IIA T3	FIELD	
	6	Ambient Temperature Range			-40 TO 35 °C	
	7					
	8					
	9					
PROCESS CONDITIONS	10	Gas Components				
	11	Mole Weight or Specific Gravity				
	12	Distance From Source				
	13	Humidity				
	14	Vibration				
	15	Location				
	16					
DETECTOR	17					
	18	Model				
	19	Enclosure				
	20	Mounting				
	21	Sensor Type		(3) IR SENSORS		
	22	Detection Range		30.5 M; 16.8M; 4.6M (METHANE)		
	23	Field of Vision		±45° HORIZONTAL +45°/-30° VERTICAL (METHANE)		
24	Sensitivity		VERY HIGH; MEDIUM; LOW			
25	UV Pass Band					
26	IR Center Wavelength					
MONITOR/ TRANSMITTER	27	Model		X3301A4N13W1		
	28	Enclosure		NEMA 4X		
	29	Mounting		STANDARD		
	30	Type		IR FIRE DETECTION		
	31	Typical Response Time		<10 SECONDS		
	32	Minimum Response Time		0.5 SECONDS		
	33	Calibration		FACTORY CALIBRATED		
	34	Analog Output		0-20 mA		
	35	Power Supply		24 VDC		
	36	Local Indication		BLINKING LED LIGHTS		
	37	Alarm Relay		5 amp @ 30 VDC, NORMALLY DE-ENERGIZED		
	38	Calibrated Range		TO NOT REQUIRED		
	39					
OPTIONS	40	Calibration/Test Kit		NOT INCLUDED		
	41	Optical Air Guard				
	42	Swivel Elbow				
	43	Mounting Bracket				
	44					
	45					
	46					
PURCHASE	47	Manufacturer		Det-tronics		
	48	Model		X3301A4N13W1		
	49	Purchase Order Number				
	50	Price				
	51	Serial Number				

Notes: See Notes Page

				INSTRUMENT SPECIFICATION Fire Detector Code: 621			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000-01			Sheet <input type="text"/> of <input type="text"/>
							Rev.: <input type="text"/>

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000
	2	Service		001-PK-10-1000 FIRE DET	

Notes:

				INSTRUMENT SPECIFICATION			
				Fire Detector			
				Code: 621			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000A	
	2	Service			001-PK-10-1000 FIRE DET	
	3	Application				
	4	Line Number	Equipment Number	---	001-PK-10-1000	
	5	Area Classification	Location	CLASS 1 ZONE 2 IIA T3	FIELD	
	6	Ambient Temperature Range			-40 TO 35 °C	
	7					
	8					
	9					
PROCESS CONDITIONS	10	Gas Components				
	11	Mole Weight or Specific Gravity				
	12	Distance From Source				
	13	Humidity				
	14	Vibration				
	15	Location				
	16					
DETECTOR	17					
	18	Model				
	19	Enclosure				
	20	Mounting				
	21	Sensor Type		(3) IR SENSORS		
	22	Detection Range		30.5 M; 16.8M; 4.6M (METHANE)		
	23	Field of Vision		±45° HORIZONTAL +45°/-30° VERTICAL (METHANE)		
24	Sensitivity		VERY HIGH; MEDIUM; LOW			
25	UV Pass Band					
26	IR Center Wavelength					
MONITOR/ TRANSMITTER	27	Model		X3301A4N13W1		
	28	Enclosure		NEMA 4X		
	29	Mounting		STANDARD		
	30	Type		IR FIRE DETECTION		
	31	Typical Response Time		<10 SECONDS		
	32	Minimum Response Time		0.5 SECONDS		
	33	Calibration		FACTORY CALIBRATED		
	34	Analog Output		0-20 mA		
	35	Power Supply		24 VDC		
	36	Local Indication		LED LIGHTS		
	37	Alarm Relay		5 amp @ 30 VDC, NORMALLY DE-ENERGIZED		
	38	Calibrated Range		TO NOT REQUIRED		
	39					NOT AVAILABLE
OPTIONS	40	Calibration/Test Kit		NOT INCLUDED		
	41	Optical Air Guard				
	42	Swivel Elbow				
	43	Mounting Bracket				
	44					
	45					
	46					
PURCHASE	47	Manufacturer		Det-tronics		
	48	Model		X3301A4N13W1		
	49	Purchase Order Number				
	50	Price				
	51	Serial Number				

Notes: See Notes Page

				INSTRUMENT SPECIFICATION Fire Detector Code: 621			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000A-01			Sheet <input type="text"/> of <input type="text"/>
							Rev.: <input type="text"/>

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000A
	2	Service		001-PK-10-1000 FIRE DET	

Notes:

				INSTRUMENT SPECIFICATION			
				Fire Detector			
				Code: 621			
				Instr. Chk	Process Chk	Appr.	
							Sheet <input type="text"/> of <input type="text"/>
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000A-01			Rev.:

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY



GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000B
	2	Service		001-PK-10-1000 LEL GAS DET	
	3	Application			
	4	Line Number	Equipment Number	---	001-PK-10-1000
	5	Area Classification	Location	CLASS 1 ZONE 2 IIA T3	FIELD
	6	Ambient Temperature Range		-40 TO 35 °C	
	7				
	8				
	9				
PROCESS CONDITIONS	10	Gas Components			
	11	Mole Weight or Specific Gravity			
	12	Distance From Source			
	13	Humidity			
	14	Vibration			
	15	Location			
	16				
SENSOR	18	Model			
	19	Enclosure			
	20	Mounting			
	21	Sensor Type		CONTINUOUS DIFFUSION LOW TEMPERATURE CATALYTIC BEAD	
	22	Detection Range		0 TO 100% LEL	
	23	Calibration Gas		CALIBRATE WITH 50% LEL OF PREDICTED GAS	
	24	Accuracy		±3% < 50% LEL; ±5% ≥ 50% LEL	
25	Tag No.		001-AE-01-1000B		
MONITOR/ TRANSMITTER	26	Model		S400CH-1-0-01-1	
	27	Enclosure		NEMA 4X	
	28	Mounting		STANDARD	
	29	Type		LEL GAS DETECTOR	
	30	Transmittance Integral With Sensor			
	31	Response Time		<10 SECONDS	
	32	Calibration		1 HR POST START UP THEN EVERY 90 DAYS THEREAFTER	
	33	Analog Output		0-20 mA	
	34	Power supply		24 VDC	
	35	Local Indication		(3) DIGIT LED	
	36	Zero Drift		<5% OF SCALE PER YEAR	
	37	Alarm Relay		8A @ 30 VDC	
	38	Calibrated Range		0	TO
OPTIONS	40	Calibration Kit		NOT INCLUDED	
	41	Calibration Magnet			
	42	Dust Guard			
	43	Splash Guard			
	44	Separation Kit			
	45	Junction Box			
	46				
PURCHASE	47	Manufacturer		General Monitors	
	48	Model		S400CH-1-0-01-1	
	49	Purchase Order Number			
	50	Price			
	51	Serial Number			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION				
				Gas Detector				
				Code:622				
				Instr. Chk	Process Chk	Appr.		
							Sheet	of
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000B-01			Rev.:	

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000B
	2	Service		001-PK-10-1000 LEL GAS DET	

Notes:

				INSTRUMENT SPECIFICATION Gas Detector Code:622					
				Instr. Chk	Process Chk	Appr.	Sheet	of	PLATE
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000B-01			Rev.:		

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000C
	2	Service		001-PK-10-1000 LEL GAS DET	
	3	Application			
	4	Line Number	Equipment Number	---	001-PK-10-1000
	5	Area Classification	Location	CLASS 1 ZONE 2 IIA T3	FIELD
	6	Ambient Temperature Range		-40 TO 35 °C	
	7				
	8				
	9				
PROCESS CONDITIONS	10	Gas Components			
	11	Mole Weight or Specific Gravity			
	12	Distance From Source			
	13	Humidity			
	14	Vibration			
	15	Location			
	16				
SENSOR	17				
	18	Model			
	19	Enclosure			
	20	Mounting			
	21	Sensor Type		CONTINUOUS DIFFUSION LOW TEMPERATURE CATALYTIC BEAD	
	22	Detection Range		0 TO 100% LEL	
	23	Calibration Gas		CALIBRATE WITH 50% LEL OF PREDICTED GAS	
24	Accuracy		±3% < 50% LEL; ±5% ≥ 50% LEL		
25	Tag No.		001-AE-01-1000C		
MONITOR/ TRANSMITTER	26	Model		S400CH-1-0-01-1	
	27	Enclosure		NEMA 4X	
	28	Mounting		STANDARD	
	29	Type		LEL GAS DETECTOR	
	30	Transmittance Integral With Sensor			
	31	Response Time		<10 SECONDS	
	32	Calibration		1 HR POST START UP THEN EVERY 90 DAYS THEREAFTER	
	33	Analog Output		0-20 mA	
	34	Power supply		24 VDC	
	35	Local Indication		(3) DIGIT LED	
	36	Zero Drift		<5% OF SCALE PER YEAR	
	37	Alarm Relay		8A @ 30 VDC	
	38	Calibrated Range		0	TO
OPTIONS	39				
	40	Calibration Kit		NOT INCLUDED	
	41	Calibration Magnet			
	42	Dust Guard			
	43	Splash Guard			
	44	Separation Kit			
PURCHASE	45	Junction Box			
	46				
	47	Manufacturer		General Monitors	
	48	Model		S400CH-1-0-01-1	
	49	Purchase Order Number			
	50	Price			
	51	Serial Number			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION			
				Gas Detector			
				Code: 622			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000C-01			Sheet of
							Rev.:

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-AIT -10-1000C
	2	Service		001-PK-10-1000 LEL GAS DET	

Notes:

				INSTRUMENT SPECIFICATION Gas Detector Code: 622			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-AIT-10-1000C-01			Sheet <small>1</small> of <small>1</small>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-LG -10-1010B	
	2	Service		001-V-10-1010 CLSD HC DRN VESL			
	3	Line Number	Equipment Number	TANK/VESSEL NOZZLE		001-V-10-1010	
	4	Area Classification	Location	CLASS 1 ZONE 2 IIA T3		FIELD	
	5						
PROCESS CONDITIONS	6	Fluid	State				
	7	Pressure	Min.	Oper.	Max.	kPa-g	5 kPa-g
	8	Temperature	Min.	Oper.	Max.	°C	40 °C
	9	Design Pressure	Design Temperature		345	kPa-g	150 °C
	10	Oper. Specific Gravity					
	11						
	12						
GAUGE	13	Type		REFLEX			
	14	<del>Center To Center Distance</del> <b>VISIBLE LENGTH</b>		33.75	in		
	15	Sections Required		3			
	16	Connection Size	Rating		3/4" NPTF	1800 psig @ 100 °F	
	17	Connection Arrangement		TOP BOTTOM			
	18	<del>Body Material</del> <b>GLASS MATERIAL</b>		BOROSILICATE GLASS			
	19	Cover Material					
	20	Gasket Material					
	21	Float Material					
	22	Shield		No			
	23	Illuminator	Power Supply		NONE		
	24	Jacket or Internal Tracer		NONE			
	25	Frost Extension	Length		NONE		
	26	Calibrated Scale					
	27						
	28						
	29						
VALVES	30	Type		PENBERTHY 330J GAUGE COCKS			
	31	Number Required		2			
	32	Body Material					
	33	Trim Material					
	34	Packing Material					
	35	Ball Check					
	36	Vessel	Size	Rating			
	37	Connection	Union				
	38	Gauge	Size	Rating			
	39	Connection	Union				
	40	Drain	Size	Rating			
	41	Connection					
	42	Vent	Size	Rating			
	43	Connection					
OPTIONS	44						
	45						
	46						
	47						
	48						
PURCHASE	49						
	50	Manufacturer		Penberthy			
	51	Model		3RL7			
	52	Purchase Order Number					
53	Price						
54	CRN Number						

Notes: See Notes Page

				INSTRUMENT SPECIFICATION				
				Level Gauge				
				Code: 820				
				Instr. Chk	Process Chk	Appr.		
							Sheet	of
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-LG-10-1010-01			Rev.:	

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-LG -10-1010B
	2	Service		001-V-10-1010 CLSD HC DRN VESL	

Notes:

				INSTRUMENT SPECIFICATION Level Gauge Code: 820			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-LG-10-1010-01			Rev.:

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-LIT -10-1010	
	2	Service		001-V-10-1010 CLSD HC DRN VESL			
	3	Line Number	Equipment Number	TANK/VESSEL NOZZLE		001-V-10-1010	
	4	Area Classification	Location	Class 1, Zone 2, Group IIA, T3		FIELD	
	5	Ambient Temperature Range		Outside, -40°C to +35°C			
	6	Function	Mounting	Tank Level		Remote Mount	
	7						
	8						
PROCESS CONDITIONS	9	Fluid	State	Hydrocarbon Drain		Liquid	
	10	Pressure	Min.	Oper.	Max.	kPa-g	kPa-g
	11	Temperature	Min.	Oper.	Max.	°C	°C
	12	Design Pressure	Design Temperature	345 kPa-g		150 °C	
	13	Lower Oper. S.G.	Lower Oper. Visc.				
	14	Vacuum	Over Pressure	FULL VACUUM			
TRANSMITTER	15	Application		Level measurement			
	16	Type		GUIDED WAVE RADAR			
	17	Instrument Differential Pressure Range Limits		TO		kPa	
	18	Calibrated Differential Pressure Range		TO		kPa	
	19	Calibrated Level Range		0 TO 1800mm		CALIBRATE IN FIELD	
	20	Elevation	Suppression				
	21	Element Type		COAXIAL PROBE			
	22	Element Material	Body Material	316 SST		POLYURETHANE COVERED AL	
	23	Max. Static Pressure	Body Rating				
	24	Process Flanges Material					
	25	Wetted O - Ring Material		ETHYLENE PROPYLENE			
	26	Fill Fluid and Rated Temperature Range					
	27	Bolts	Enclosure			NEMA 4X	
	28	Process Connection	Electrical Connection	3/4" NPT		1/2"NPT	
29	Accuracy	Response Time	> OF 3mm OR 0.03% DISTANCE				
30	Allow. Oper. Pressure	Allow. Oper. Temp.	4000 kPag		266 °C		
DIAPHRAGM SEAL	31	Process Connection & Rating		NO DIAPHRAGM SEAL			
	32	Diaphragm Material	Seal Construction				
	33	Housing Material: Upper / Lower					
	34	Fill Fluid and Rated Temperature Range					
	35	Capillary Armour Material					
	36	Capillary Type	Capillary Length				
	37	Flush Ring Material	No. of Flush Rings				
	38	Flushing Conn. Size	No. of Connections				
	39	Gasket					
	40						
OPTIONS	41	Integral Meter	Scale	Yes			
	42	Mounting Brackets		6.5' REMOTE MOUNT CABLE AND BRACKET			
	43						
	44						
	45						
COMMUNICATION	46	Communication Type / Output		4 - 20 mA			
	47	Power Supply		24 VDC			
	48						
	49						
PURCHASE	50	Manufacturer		Rosemount			
	51	Model		5302HAS1S1E3BE00410RAE6M1S4B2			
	52	Purchase Order Number					
	53	Price					
	54	CRN Number		0F09004.2			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION DP Level Transmitter Code: 353				
				Instr. Chk	Process Chk	Appr.		
A	JN	11/26/2012	Issued for Process Data				Sheet	of
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-LIT -10-1010 -DSH			Rev.: A	

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-LIT -10-1010
	2	Service		001-V-10-1010 CLSD HC DRN VESL	

Notes: 1. Instrument selection and material testing requirement shall be in accordance with "GS-4410 Measurement Equipment - Installation Criteria", "GS-4500 - Instrument Design and Installation Specification" and "GS-5210 - Piping Class Specification", latest revisions.  
 2. Vendor to provide stainless steel tag c/w Owner tag number properly attached to the instrument.

				INSTRUMENT SPECIFICATION DP Level Transmitter Code: 353			
				Instr. Chk	Process Chk	Appr.	
A	JN	11/26/2012	Issued for Process Data				Sheet <input type="text"/> of <input type="text"/>
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-LIT -10-1010 -DSH			Rev.: A

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY



GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-LIT -10-1010A	
	2	Service		001-V-10-1010 CLSD HC DRN VESL			
	3	Line Number	Equipment Number	TANK/VESSEL NOZZLE		001-V-10-1010	
	4	Area Classification	Location	Class 1, Zone 2, Group IIA, T3		FIELD	
	5	Ambient Temperature Range		Outside, -40°C to +35°C			
	6	Function	Mounting	Tank Level		Remote Mount	
	7						
	8						
PROCESS CONDITIONS	9	Fluid	State	Hydrocarbon Drain		Liquid	
	10	Pressure	Min.	Oper.	Max.	kPa-g	kPa-g
	11	Temperature	Min.	Oper.	Max.	°C	°C
	12	Design Pressure	Design Temperature		kPa-g		°C
	13	Lower Oper. S.G.	Lower Oper. Visc.				cP
	14	Vacuum	Over Pressure		FULL VACUUM		
TRANSMITTER	15	Application		Level measurement			
	16	Type		GUIDED WAVE RADAR			
	17	Instrument Differential Pressure Range Limits		TO		kPa	
	18	Calibrated Differential Pressure Range		TO		kPa	
	19	Calibrated Level Range		0	TO	1800mm	CALIBRATE IN FIELD
	20	Elevation	Suppression				
	21	Element Type		COAXIAL PROBE			
	22	Element Material	Body Material		316 SST		POLYURETHANE COVERED AL
	23	Max. Static Pressure	Body Rating		4000 kPag		
	24	Process Flanges Material					
	25	Wetted O - Ring Material					
	26	Fill Fluid and Rated Temperature Range					
	27	Bolts	Enclosure				NEMA 4X
	28	Process Connection	Electrical Connection		3/4" NPT		1/2"NPT
29	Accuracy	Response Time		> OF 3mm OR 0.03% DISTANCE			
30	Allow. Oper. Pressure	Allow. Oper. Temp.		4000 kPag		266 °C	
DIAPHRAGM SEAL	31	Process Connection & Rating		NO DIAPHRAGM SEAL			
	32	Diaphragm Material	Seal Construction				
	33	Housing Material: Upper / Lower					
	34	Fill Fluid and Rated Temperature Range					
	35	Capillary Armour Material					
	36	Capillary Type	Capillary Length				
	37	Flush Ring Material	No. of Flush Rings				
	38	Flushing Conn. Size	No. of Connections				
	39	Gasket					
	40						
OPTIONS	41	Integral Meter	Scale		Yes	%	
	42	Mounting Brackets		6.5' REMOTE MOUNT CABLE AND BRACKET			
	43						
	44						
	45						
COMMUNICATION	46	Communication Type / Output		4 - 20 mA			
	47	Power Supply		24 VDC			
	48						
	49						
PURCHASE	50	Manufacturer		Rosemount			
	51	Model		5302HAS1S1E3BE00410RAE6M1S4B2			
	52	Purchase Order Number					
	53	Price					
	54	CRN Number		0F09004.2			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION DP Level Transmitter Code: 353				
				Instr. Chk	Process Chk	Appr.		
A	JN	11/26/2012	Issued for Process Data				Sheet	of
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-LIT -10-1010A -DSH				Rev.: A

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-LIT -10-1010A
	2	Service		001-V-10-1010 CLSD HC DRN VESL	

Notes: 1. Instrument selection and material testing requirement shall be in accordance with "GS-4410 Measurement Equipment - Installation Criteria", "GS-4500 - Instrument Design and Installation Specification" and "GS-5210 - Piping Class Specification", latest revisions.  
2. Vendor to provide stainless steel tag c/w Owner tag number properly attached to the instrument.

				INSTRUMENT SPECIFICATION DP Level Transmitter Code: 353			
				Instr. Chk	Process Chk	Appr.	
A	JN	11/26/2012	Issued for Process Data				Sheet <input type="text"/> of <input type="text"/>
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-LIT -10-1010A -DSH			Rev.: A

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-PCV -10-1010A		
	2	Service		I/A SPLY				
	3	Line Number	Location	33-IA-AU11-22270		FIELD (OUTSIDE)		
	4	Line Size and Schedule	Inlet	Outlet	1 in STD	1	80	
	5	Ambient Temp. Range	Flange Face to Face	-40 TO 35 °C				
PROCESS CONDITIONS	6	Process Fluid	Upstream Condition	INSTRUMENT AIR		Gas/Vapor		
	7	Max Differential Pressure At Shut Off		150 lbf/in <sup>2</sup>				
	8	Critical Pressure	Critical Temperature	kPa-a		°C		
	9	Design Pressure	Design Temperature	150 lbf/in <sup>2</sup> -g		100 °F		
	10			Units	@ Max Flow	@ Norm Flow	@ Min Flow	
	11	Flow Rate		kg/h				
	12	Inlet Pressure		kPa-g				
	13	Pressure Drop		lbf/in <sup>2</sup>				
	14	Inlet Temperature		°C				
	15	Inlet Density / Spec. Gravity / Molecular Mass		kg/m <sup>3</sup>				
	16	Inlet Compressibility Factor		—				
	17	Inlet Viscosity		cP				
	18	Inlet Specific Heat Ratio		—				
	19	Inlet Vapour Pressure						
	CALCULATED RESULTS	20	Flow Coefficient Cv		—			
		21	Wide Open Flow - Calculated					
		22	Sound Pressure Level		dBA			
	BODY	23	Size	Trim Size	Cv	1/4 in		0.36
		24	Form or Type					
25		End Connections & Rating		1/4" NPT 250 psig				
26		Material: Body / Flange		ALUMINUM				
27		Max. Pressure / Max. Temp.		250 psig / 180 °F				
28		Stem Material	Packing Material		SS			
29								
TRIM	30	Lubricator	Iso. Valve					
	31	Guiding	No. Ports					
	32	Trim Form						
	33	Trim Material	Seat Material					
	34	Gasket Material	Bushing Material					
	35	Required Seat Tightness						
ACTUATOR / PILOT	36	Type						
	37	Pilot						
	38	Supply to Pilot						
	39	Self Connection	External Connection					
	40	Diaphragm Material						
	41	Spring Range						
	42	Set Point						
	43	Max Allowable Inlet Pressure						
ACCESSORIES	44							
	45	Filter Regulator	Supply Gauge					
	46	Line Strainer						
	47	Housing Vent						
	48	Internal Relief		YES				
49	Owner Tag Plate							
PURCHASE	50	Manufacturer		Fisher				
	51	Model		67CFR				
	52	Purchase Order Number						
	53	Price		---				
54	CRN Number		0C8768.52ADD1					

Notes: See Notes Page

				INSTRUMENT SPECIFICATION Pressure Regulator Code: 141			
				Instr. Chk	Process Chk	Appr.	
							Sheet <input type="text"/> of <input type="text"/>
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-PCV-10-1010A-01			Rev.:



GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-PCV -10-1010A
	2	Service		I/A SPLY	

Notes:

				INSTRUMENT SPECIFICATION Pressure Regulator Code: 141			
				Instr. Chk	Process Chk	Appr.	
							Sheet <input type="text"/> of <input type="text"/>
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-PCV-10-1010A-01			Rev.:

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001			001-PG -10-1010		
	2	Service		001-V-10-1010 CLSD HC DRN VESL					
	3	Line Number	Equipment Number	TANK/VESSEL NOZZLE			001-V-10-1010		
	4	Ambient Temp. Range	Location	Outside, -40°C to +35°C			FIELD		
	5	Site Barometric Pressure		kPa-a					
PROCESS CONDITIONS	6	Fluid	State				Gas/Vapor		
	7	Pressure	Min.	Norm.	Max.	kPa-g	5	kPa-g	kPa-g
	8	Temperature	Min.	Norm.	Max.	°C	40	°C	°C
	9	Design Pressure	Design Temperature	345 kPa-g			150 °C		
	10	Pulsation	Vibration						
GAUGE	11	Certification		ASME B40.100					
	12	Type		Direct Mount					
	13	Range		0 TO 60			psig		
	14	Figure Interval		Mfr. Standard					
	15	Minor Graduation		Mfr. Standard					
	16	Mounting		Vertical					
	17	Dial Size	Dial Color	4 1/2 in			White w/ black lettering		
	18	Pointer Zero Adjustment							
	19	Case Material		304 SS					
	20	Ring Construction	Ring Material	Mfr. Standard			SS		
	21	Blow-Out Protection							
	22	Lens Material		Safety Glass					
	23	Pressure Element Type and Material		Bourdon Tube, 316 Stainless Steel					
	24	Liquid Fill and Rated Temperature Range		GLYCERINE 212 °F					
	25	Socket Material		316 Stainless Steel					
	26	Connection Size		1/2 in					
	27	Connection Location		Bottom					
	28	Movement Material		316 Stainless Steel					
	29	Nominal Accuracy		±1% of Span					
	30	Rated Temperature Range		-40°C to +100°C					
	31	Over Pressure Rating		1.3 times the scale range.					
DIAPHRAGM SEAL	32	Type		NO DIAPHRAGM SEAL					
	33	Process Connection Size and Rating							
	34	Diaphragm Material							
	35	Bottom Housing Material							
	36	Top Housing Material							
	37	Capillary Length							
	38	Capillary Material							
	39	Flushing Connection							
	40	Flushing Ring: # of Connections and Material							
	41	Fill Fluid and Rated Temperature Range							
	42	Connection to Instrument							
	43	Rated Pressure Range							
	OPTIONS	44	Syphon: Type	Material					
45		Snubber: Type	Material						
46		Cooling Fins							
47									
48									
PURCHASE	49								
	50	Manufacturer		Wika					
	51	Model		233.34					
	52	Purchase Order Number		---					
	53	Price							
	54	CRN Number		0F02026.2					

Notes: See Notes Page

				INSTRUMENT SPECIFICATION				
				Pressure Gauge				
				Code: 831				
				Instr. Chk	Process Chk	Appr.		
A	JN	11/26/2012	Issued for Process Data				Sheet	of
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-PG -10-1010 -DSH				Rev.: A

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-PG -10-1010
	2	Service		001-V-10-1010 CLSD HC DRN VESL	

Notes:

				INSTRUMENT SPECIFICATION			
				Pressure Gauge			
				Code: 831			
				Instr. Chk	Process Chk	Appr.	
A	JN	11/26/2012	Issued for Process Data				Sheet <input type="text"/> of <input type="text"/>
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-PG -10-1010 -DSH			Rev.: A

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001			001-PG -10-1012		
	2	Service		001-P-10-1012 CLSD HC DRN PMP IN					
	3	Line Number	Equipment Number	114-HCD-A11-23072			001-P-10-1012		
	4	Ambient Temp. Range	Location	Outside, -40°C to +35°C			FIELD		
	5								
PROCESS CONDITIONS	6	Fluid	State				Liquid		
	7	Pressure	Min.	Norm.	Max.	kPa-g	5	kPa-g	kPa-g
	8	Temperature	Min.	Norm.	Max.	°C	40	°C	°C
	9	Design Pressure	Design Temperature	345 kPa-g			150 °C		
	10	Pulsation	Vibration						
GAUGE	11	Certification		ASME B40.100					
	12	Type		Direct Mount					
	13	Range		0 TO 60 psig					
	14	Figure Interval		Mfr. Standard					
	15	Minor Graduation		Mfr. Standard					
	16	Mounting		Vertical					
	17	Dial Size	Dial Color	4 1/2 in			White w/ black lettering		
	18	Pointer Zero Adjustment							
	19	Case Material		304 SS					
	20	Ring Construction	Ring Material	Mfr. Standard			SS		
	21	Blow-Out Protection							
	22	Lens Material		Safety Glass					
	23	Pressure Element Type and Material		Bourdon Tube, 316L Stainless Steel					
	24	Liquid Fill and Rated Temperature Range		GLYCERINE 212 °F					
	25	Socket Material		316 Stainless Steel					
	26	Connection Size		1/2 in					
	27	Connection Location		Bottom					
	28	Movement Material		316 Stainless Steel					
29	Nominal Accuracy		±1% of Span						
30	Rated Temperature Range		-40°C to +100°C						
31	Over Pressure Rating		1.3 times the scale range.						
DIAPHRAGM SEAL	32	Type		NO DIAPHRAGM SEAL					
	33	Process Connection Size and Rating							
	34	Diaphragm Material							
	35	Bottom Housing Material							
	36	Top Housing Material							
	37	Capillary Length							
	38	Capillary Material							
	39	Flushing Connection							
	40	Flushing Ring: # of Connections and Material							
	41	Fill Fluid and Rated Temperature Range							
	42	Connection to Instrument							
	43	Rated Pressure Range							
	OPTIONS	44	Syphon: Type	Material					
45		Snubber: Type	Material						
46		Cooling Fins							
47									
48									
PURCHASE	49								
	50	Manufacturer		Wika					
	51	Model		233.34					
	52	Purchase Order Number		---					
	53	Price							
	54	CRN Number		0F02026.2					

Notes: See Notes Page

				INSTRUMENT SPECIFICATION			
				Pressure Gauge			
				Code: 831			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-PG -10-1011A -DSH			Sheet <input type="text"/> of <input type="text"/>
							Rev.: <input type="text"/>



GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-PG -10-1012
	2	Service		001-P-10-1012 CLSD HC DRN PMP IN	

Notes:

				INSTRUMENT SPECIFICATION			
				Pressure Gauge			
				Code: 831			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-PG -10-1011A -DSH			Sheet <input type="text"/> of <input type="text"/>
							Rev.: <input type="text"/>

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001			001-PG -10-1012B		
	2	Service		001-P-10-1012 CLSD HC DRN VESL DISCH					
	3	Line Number	Equipment Number	89-HCD-A11-23037			001-P-10-1012		
	4	Ambient Temp. Range	Location	Outside, -40°C to +35°C			FIELD		
	5								
PROCESS CONDITIONS	6	Fluid	State				Liquid		
	7	Pressure	Min.	Norm.	Max.	kPa-g	5	kPa-g	kPa-g
	8	Temperature	Min.	Norm.	Max.	°C	40	°C	°C
	9	Design Pressure	Design Temperature	345 kPa-g			150 °C		
	10	Pulsation	Vibration						
GAUGE	11	Certification		ASME B40.100					
	12	Type		Direct Mount					
	13	Range		0 TO 100			psig		
	14	Figure Interval		Mfr. Standard					
	15	Minor Graduation		Mfr. Standard					
	16	Mounting		Vertical					
	17	Dial Size	Dial Color	4 1/2 in			White w/ black lettering		
	18	Pointer Zero Adjustment							
	19	Case Material		304 SS					
	20	Ring Construction	Ring Material	Mfr. Standard			SS		
	21	Blow-Out Protection							
	22	Lens Material		Safety Glass					
	23	Pressure Element Type and Material		Bourdon Tube, 316L Stainless Steel					
	24	Liquid Fill and Rated Temperature Range		GLYCERINE 212 °F					
	25	Socket Material		316 Stainless Steel					
	26	Connection Size		1/2 in					
	27	Connection Location		Bottom					
	28	Movement Material		316 Stainless Steel					
29	Nominal Accuracy		±1% of Span						
30	Rated Temperature Range		-40°C to +100°C						
31	Over Pressure Rating		1.3 times the scale range.						
DIAPHRAGM SEAL	32	Type		NO DIAPHRAGM SEAL					
	33	Process Connection Size and Rating							
	34	Diaphragm Material							
	35	Bottom Housing Material							
	36	Top Housing Material							
	37	Capillary Length							
	38	Capillary Material							
	39	Flushing Connection							
	40	Flushing Ring: # of Connections and Material							
	41	Fill Fluid and Rated Temperature Range							
	42	Connection to Instrument							
	43	Rated Pressure Range							
	OPTIONS	44	Syphon: Type	Material					
45		Snubber: Type	Material						
46		Cooling Fins							
47									
48									
PURCHASE	49								
	50	Manufacturer		Wika					
	51	Model		233.34					
	52	Purchase Order Number		---					
	53	Price							
	54	CRN Number		0F02026.2					

Notes: See Notes Page

				INSTRUMENT SPECIFICATION			
				Pressure Gauge			
				Code: 831			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-PG -10-1011 -DSH			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-PG -10-1012B
	2	Service		001-P-10-1012 CLSD HC DRN VESL DISCH	

Notes:

				INSTRUMENT SPECIFICATION			
				Pressure Gauge			
				Code: 831			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-PG -10-1011 -DSH			Sheet <input type="text"/> of <input type="text"/>
							Rev.: <input type="text"/>

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-PSV -10-1012A	
	2	Service		001-P-10-1012 CLSD HC DRN PMP SUCT			
	3	Line Number	Equipment Number	89-HCD-A11-23038		001-P-10-1012	
	4	Nozzle (Full, Semi)		Full			
	5	Design	Safety, Relief, Safety-Relief		Safety-Relief		
	6	Type	Conventional, Bellow, Pilot Operated		Conventional		
	7	Bonnet Type		Enclosed			
	8	Ambient Temp. Range	Location		-40°C to +35°C		FIELD
PROCESS CONDITIONS	9	Fluid	State		Condensate		Liquid
	10	Required Capacity		17.489 Am <sup>3</sup> /h			
	11	Molecular Mass					
	12	Oper. Pressure	Set Pressure		340 kPa-g		510 kPa-g
	13	Oper. Temperature	Relieving Temperature		40 °C		40 °C
	14	Back Pressure	Constant		5 kPa-g		
	15		Variable		0 kPa-g		
	16		Total		5 kPa-g		
	17	% Allowable Overpressure		10			
	18	Overpressure Factor		1.10			
	19	Compressibility Factor		1			
	20	Latent Heat of Vaporization					
	21	Specific Heat Ratio					
	22	Relief Density		kg/m <sup>3</sup>			
	23	Relief Viscosity		0.81 cP			
	24	Barometric Pressure					
	25	Rupture Disk at Inlet	Coefficient		No		
26	Design Pressure	Design Temperature		1965 kPa-g		427 °C	
BASIS AND SELECTION	27	Design Code		ASME VIII			
	28	Sizing Basis		Non-Fire Case			
	29	Design per		API 520			
	30	Calculated Area		0.30035 in <sup>2</sup>			
	31	Selected Area		0.307 in <sup>2</sup>			
	32	Orifice Designation	Calculated Capacity		F		18.624 Am <sup>3</sup> /h
	33	Selected Valve Capacity					
CONNECTIONS	34						
	35	Size: Inlet	Outlet		1 1/2 in		2 in
MATERIALS	36	Rating / Facing	Rating / Facing		ANSI 150# RF flange, per A11		ANSI 150# RF flange, per A11
	37	Body and Bonnet		SA-216 WCB			
	38	Nozzle and Disc		316 SS			
	39	Resilient Seat Seal					
	40	Guide and Rings		316 SS			
	41	Spring		Alloy Steel			
	42	Bellows					
	43						
OPTIONS	44	Sour Service / NACE					
	45	Cap: Screwed or Bolted		Screwed			
	46	Lever: Plain or Packed		None			
	47	Test Gag		No			
	48	Owner Instrument Tag					
PURCHASE	49	Certificate					
	50	Manufacturer		Consolidated			
	51	Model		1905-00FC-1-CC-MS-31-RF-LA			
	52	Purchase Order Number					
	53	Price					
54	CRN Number						

Notes: See Notes Page

				INSTRUMENT SPECIFICATION Pressure Safety Valve Code: 121			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-PSV-10-1012B-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYSTEM / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-PSV -10-1012A
	2	Service		001-P-10-1012 CLSD HC DRN PMP SUCT	

- Notes:
1. The pressure relief valve conforms to ASME Section VIII, B31.3 and API 520, latest revisions.
  2. Instrument selection and material testing requirement is in accordance with 'GS-4500 - Instrument Design and Installation Specification', and 'GS-5210 - Piping Class Specification A11', latest revisions.
  3. Instrument material, bolting, PWHT& NDE requirements per pipe spec A11. ITP, datasheet, sizing calculation, dimension drawing... per this Requisition Section III, Supplier Data Requirements (SDR).
  4. Item #3 Line Number, additional information: Inlet as 168-HF-A11-09070-38H, Outlet as 273-HF-A11-09060-38H.
  5. Vendor to provide a SS tag, with Owner full tag number, permanently attached to the instrument.

				INSTRUMENT SPECIFICATION Pressure Safety Valve Code: 121			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-PSV-10-1012B-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001			001-TCV -10-1010A				
	2	Service		001-V-10-1010 CLSD HC DRN VESL							
	3	Line Number		60-UHMR-A11a-21115-38H							
	4	Area Classification	Location	Class 1, Zone 2, Group IIA, T3			FIELD				
	5	Ambient Temperature Range		Outside, -40°C to +35°C							
	6	Allowable Sound Pressure Level dBA		<=85 dBA within 1 meter, at any flow condition							
	7	Available Air Supply Pressure:	Min.	Max.	550 kPa-g		910 kPa-g				
	8	Signal Failure Position		Open							
	9	Valve Fail Position	Certificate	Open			CSA, CRN				
PIPE LINE	10	Line Size and Schedule	Inlet	Outlet	2 in 80		2 in 80				
	11	Pipe Material	Pipe Insulation		SA106 GR.B		38H				
PROCESS CONDITIONS	12	Process Fluid	Upstream Condition		UHM		Liquid				
	13	Max Differential Pressure At Shut Off		1693 kPa							
	14	Critical Pressure	Critical Temperature		15790 kPa-a		391 °C				
	15	Design Pressure	Design Temperature		1693 kPa-g		120 °C				
	16		Units	@ Max Flow	@ Norm Flow	@ Min Flow					
	17	Flow Rate	kg/h	104	42	8.4					
	18	Inlet Pressure	kPa-g	459	535	550					
	19	Pressure Drop	kPa	79	155	170					
	20	Inlet Temperature	°C	65	65	65					
	21	Inlet Density / Specific Gravity / Molecular Mass		kg/m³	1037.5	1037.5	1037.5				
	22	Inlet Compressibility Factor		—							
	23	Inlet Viscosity	cP	1.285	1.285	1.285					
	24	Inlet Specific Heat Ratio		—							
	25	Inlet Vapour Pressure		kPa-a	18.98	18.98	18.98				
	CALCULATED RESULTS	26	Flow Coefficient Cv		—	0.133	0.038	0.0073			
27		Travel		%	22	10	7				
28		Sound Pressure Level		dBA	85	85	85				
BODY AND TRIM	29	Manufacturer	Fisher								
	30	Model	D4								
	31	Body Type	Single Seat Globe								
	32	Body Size	Trim Size	1 in	3/8 in						
	33	Rated Cv	Characteris.	3.53	Equal %						
	34	End Connec. & Rating		1" NPT 4250 psig							
	35	Body Material		SA 352 LCC							
	36	Bonnet Type	Material	Bolted	Same as Body						
	37	Flow Direc.	Action To	Up	N/A						
	38	Lubricator	Isolat. Valve	No	No						
	39	Guiding	No. of Ports	****	1						
	40	Trim Type	Rated Travel	Metal	3/4 in						
	41	Plug/ Ball/ Disk Material		S41600							
	42	Balanced / Unbalanced		Unbalanced							
	43	Seat Material		S17400							
	44	Cage	Stem Material	N/A	****						
45	Packing Material		PTFE								
46	Packing Type		V-ring								
ACTUATOR	47	Manufacturer									
	48	Model		INTEGRAL TO D4							
	49	Type		Diaphragm Spring Return							
	50	Size	Area								
	51	Sizing									
	52	Handwheel Location									
	53	Bench Range / MAWP		N/A / 4250 psig							
	54	Action		Fail Open							
Notes: See Notes Page				PURCHASE	55	Manufacturer					
					56	Model					
					57	Signal:Inlet	Outlet				
					58	Increase Signal, Valve:					
					59	Cam Char.	Integral I/P				
				60	Bypass	Gauges	No				
				61	Tag Number						
				62	Manufacturer						
				63	Model						
				64	Type						
				65	When De-Energ.Valve:						
				66	Solenoid Tag						
				67	Manufacturer						
				68	Model						
				69	Type	Quantity					
				70	Contacts / Rating						
				71	Switching Position						
				72	Switch Tags						
				73	Manufacturer	Fisher					
				74	Model	67 CFR					
				75	Set Press	Filter	Gauge	275 kPa-g	Yes	Yes	
				76	Hydro. Pressure						
				77	Allowable Leakage		ANSI IV (standard)				
				78	Valve Testing		Yes as per Fisher FMP-2C6				
				79	Manufacturer		Fisher				
				80	Model		D4				
				81	PO Number						
				82	Price						
				83	Valve CRN Number		0C3862.2C				
				84	Soft Tag						
				INSTRUMENT SPECIFICATION							
				Control Valve							
				Code: 111							
C	DL	5/10/2013	Issued for Quotation		Instr. Chk	Process Chk	Appr.				
B	DL	4/17/2013	Issued for Squad Check								
A	JN	1/14/2013	Issued for Process Data						Sheet	of	
No.	By	Date	Revision		Dwg. No.: FER-001.1102039085-J-DSH-TCV-10-1010-01				Rev.: C		

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TCV -10-1010A
	2	Service		001-V-10-1010 CLSD HC DRN VESL	

- Notes:
1. REQ number is 407014-00120-00-IC-REQ-0003 (WP) / FE-CPF-J003 (Devon).
  2. Valve selection and material testing requirement shall be in accordance with "GS-4500 - Instrument Design and Installation Specification", "GS-5300 - Valves and Valve Classes", "GS-5210 - Piping Class Specification", and "GS-5310 - Valve Technical Descriptions.
  3. See Requisition Section III - Supplier Data Requirements for valve NDE and documentation requirements.
  4. As a minimum valve wetted materials must comply to API Trim 8.
  5. Globe valve body shall meet the minimum material requirements as per valve specification GS-5310, section LA0306A1 - Globe Valve; OS&Y; ASME Class 300; RF flanged; A216-WCB body; bolted bonnet w/ spiral wound gasket (graphite/SS); plug type swivel disc; API Trim 8; die-formed flexible graphite packing w/ anti-extrusion rings and corrosion inhibitor; A193-B7 / A194-2H body bolting; MDMT -29°C, Max. = 400°C; per ASME B16.34 and API 598 (API 600 as applicable).
  6. Actuator shall be sized to provide, under minimum air supply conditions (550 kPa-g), the torque or thrust requirements to position and fully stroke the valve against maximum differential pressure stated on line 13.
  7. All test documentation shall reference the full instrument tag number.
  8. Hydrostatic testing to be performed as per ANSI / ISA 75.19.01 latest revision.
  9. All valve & accessories shall be supplied with a permanent SS label stating the full tag number & all other pertinent information.
  10. Valve actuator, positioner & accessories shall be certified for use in -40°C ambient temperature conditions.
  11. Line 28 Sound Pressure Level will be <85 dBA for all process sizing conditions.

				INSTRUMENT SPECIFICATION					
				Control Valve					
				Code: 111					
C	DL	5/10/2013	Issued for Quotation	Instr. Chk	Process Chk	Appr.	Sheet	of	
B	DL	4/17/2013	Issued for Squad Check						
A	JN	1/14/2013	Issued for Process Data						
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TCV-10-1010-01				Rev.: C	

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-TG -10-1010B		
	2	Service		001-V-10-1010 CLSD HC DRN VESL				
	3	Line Number	Equipment Number	60-UHMS-A11a-21034-38H		001-V-10-1010		
	4	Area Classification	Location	Class 1, Zone 2, Group IIA, T3		FIELD		
	5	Ambient Temperature Range		-40 TO 35°C				
	6							
PROCESS CONDITIONS	7	Fluid	State	CONDENSATE		Liquid		
	8	Temperature	Min.	Oper.	Max.	°C	°C	
	9	Oper. Pressure	Max. Pressure		5	kPa-g	kPa-g	
	10	Oper. Flow	Max. Flow					
	11	Oper. Velocity	Max. Velocity			m/s	m/s	
	12	Design Pressure	Design Temperature		345	kPa-g	150 °C	
	13	Oper. Density / SG / Molecular Mass						
	14	Viscosity	Compressibility			cP		
	15	Vibrations	Erosion	Oxidizing Atm.				
	16							
THERMOMETER	17	Type		Bimetallic Thermometer				
	18	Range		0	TO	250	°F	
	19	Dial Size	Dial Color		5	in	White w/ black lettering	
	20	Case Material	Hermetically Sealed		304 SS		YES PER ASME B40.3	
	21	Stem Type	Stem Material		304SS			
	22	Stem/Union Thread	Stem Position					
	23	Stem Length	Stem Diameter		18	in		
	24	Sheath Material	Coating					
	25	External Calibrator						
	26							
	27	FILLED SYSTEM	Type		NO FILL			
	28		Compensation					
	29		Capillary Length					
	30		Capillary Material					
31	Armor Material							
32	Bulb Diameter		Bulb Length					
33	Bulb Type							
34	Bulb Connection							
THERMOWELL	Line 42	Thermowell Tag Number		001-TW-01-1010B				
	U	Process Connection		3/4" NPT				
		Construction Type		TAPPED				
		Well Material		304SS				
		Flange Material	Flange Welding					
	40	Internal Connection	Bore Diameter		0.385"			
	41	Insertion Length (U)	Flange Standoff (FS)		16.5"			
	42	Length - Bottom of Thread/SW/Flange to Top		2"				
	43	Overall Length (line 42 + U)		18.5"				
	Line 42	Tip Diameter	Tip Thickness					
45	Root Diameter							
FS U	Vibration Calculation Results							
	Treatments	Finish						
	Stamping	Plug & Chain						
	Thermowell Model Number							
	Manufacturer		Wika					
PURCHASE	Model		TI.50					
	Purchase Order Number		---					
	Price							
	CRN Number		0H07851.52					

Notes: See Notes Page

				INSTRUMENT SPECIFICATION Thermometer Code: 841				
				Instr. Chk	Process Chk	Appr.		
				Sheet		of		
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TG-10-1010B-01			Rev.:	



GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TG -10-1010B
	2	Service		001-V-10-1010 CLSD HC DRN VESL	

Notes:

				INSTRUMENT SPECIFICATION			
				Thermometer			
				Code: 841			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TG-10-1010B-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TG -10-1010C	
	2	Service		UHM SPLY TO 001-V-10-1010		
	3	Line Number	Equipment Number	60-UHMR-A11a-21115-38H	001-V-10-1010	
	4	Area Classification	Location	Class 1, Zone 2, Group IIA, T3	FIELD	
	5	Ambient Temperature Range		-40 TO 35°C		
	6					
PROCESS CONDITIONS	7	Fluid	State	GLYCOL	Liquid	
	8	Temperature	Min. Oper. Max.	°C 90 °C	°C	
	9	Oper. Pressure	Max. Pressure	550 kPa-a	kPa-a	
	10	Oper. Flow	Max. Flow			
	11	Oper. Velocity	Max. Velocity	m/s	m/s	
	12	Design Pressure	Design Temperature	1693	150 °C	
	13	Oper. Density / SG / Molecular Mass				
	14	Viscosity	Compressibility	cP		
	15	Vibrations	Erosion	Oxidizing Atm.		
	16					
THERMOMETER	17	Type			Bimetallic Thermometer	
	18	Range			0 TO 250 °F	
	19	Dial Size	Dial Color	5 in	White w/ black lettering	
	20	Case Material	Hermetically Sealed	304 SS	YES PER ASME B40.3	
	21	Stem Type	Stem Material		304SS	
	22	Stem/Union Thread	Stem Position			
	23	Stem Length	Stem Diameter	6 in		
	24	Sheath Material	Coating			
	25	External Calibrator				
	26					
	27	FILLED SYSTEM	Type			NO FILL
	28		Compensation			
	29		Capillary Length			
	30		Capillary Material			
31	Armor Material					
32	Bulb Diameter		Bulb Length			
33	Bulb Type					
34	Bulb Connection					
THERMOWELL	Line 42	35 Thermowell Tag Number			001-TW-10-1010C	
	U	36 Process Connection			3/4" NPT	
		37 Construction Type			TAPPERED	
		38 Well Material			304SS	
		39	Flange Material	Flange Welding		
	40	Internal Connection	Bore Diameter	0.385"		
	41	Insertion Length (U)	Flange Standoff (FS)	4.5"		
	42	Length - Bottom of Thread/SW/Flange to Top			2"	
	43	Overall Length (line 42 + U)			6.5 in	
	Line 42	44	Tip Diameter	Tip Thickness		
FS U	45	Root Diameter				
	46 Vibration Calculation Results					
	47	Treatments	Finish			
	48	Stamping	Plug & Chain			
	49 Thermowell Model Number					
	PURCHASE	50	Manufacturer			Wika
51		Model			TI.51	
52		Purchase Order Number			---	
53		Price				
54		CRN Number			0H07851.52	

Notes: See Notes Page

				INSTRUMENT SPECIFICATION Thermometer Code: 841				
				Instr. Chk	Process Chk	Appr.		
								Sheet <input type="text"/> of <input type="text"/>
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TG-10-1010C-01				Rev.:

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TG -10-1010C
	2	Service		UHM SPLY TO 001-V-10-1010	

Notes:

				INSTRUMENT SPECIFICATION			
				Thermometer			
				Code: 841			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TG-10-1010C-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TG -10-1010D	
	2	Service		UHM RTN FROM 001-V-10-1010		
	3	Line Number	Equipment Number	60-UHMR-A11a-21115-38H	001-V-10-1010	
	4	Area Classification	Location	Class 1, Zone 2, Group IIA, T3	FIELD	
	5	Ambient Temperature Range		-40 TO 35°C		
	6					
PROCESS CONDITIONS	7	Fluid	State	GLYCOL	Liquid	
	8	Temperature	Min. Oper. Max.	°C 65 °C	°C	
	9	Oper. Pressure	Max. Pressure	380 kPa-a	kPa-a	
	10	Oper. Flow	Max. Flow			
	11	Oper. Velocity	Max. Velocity	m/s	m/s	
	12	Design Pressure	Design Temperature	1693	150 °C	
	13	Oper. Density / SG / Molecular Mass				
	14	Viscosity	Compressibility	cP		
	15	Vibrations	Erosion	Oxidizing Atm.		
	16					
THERMOMETER	17	Type	Bimetallic Thermometer			
	18	Range	0 TO 250	°F		
	19	Dial Size	Dial Color	5 in	White w/ black lettering	
	20	Case Material	Hermetically Sealed	304 SS	YES PER ASME B40.3	
	21	Stem Type	Stem Material		304SS	
	22	Stem/Union Thread	Stem Position			
	23	Stem Length	Stem Diameter	6 in		
	24	Sheath Material	Coating			
	25	External Calibrator				
	26					
	27	FILLED SYSTEM	Type	NO FILL		
	28		Compensation			
	29		Capillary Length			
	30		Capillary Material			
	31		Armor Material			
	32		Bulb Diameter	Bulb Length		
	33		Bulb Type			
	34		Bulb Connection			
THERMOWELL	Line 42	35	Thermowell Tag Number	001-TW-01-1010D		
	U	36	Process Connection	3/4" NPT		
		37	Construction Type	TAPPED		
		38	Well Material	304SS		
		39	Flange Material	Flange Welding		
	40	Internal Connection	Bore Diameter	0.385"		
	41	Insertion Length (U)	Flange Standoff (FS)	4.5"		
	42	Length - Bottom of Thread/SW/Flange to Top		2"		
	43	Overall Length (line 42 + U)		6.5 in		
	Line 42	44	Tip Diameter	Tip Thickness		
FS U	45	Root Diameter				
	46	Vibration Calculation Results				
	47	Treatments	Finish			
	48	Stamping	Plug & Chain			
	49	Thermowell Model Number				
	PURCHASE	50	Manufacturer		Wika	
51		Model		TI.51		
52		Purchase Order Number		---		
53		Price				
54	CRN Number		0H07851.52			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION			
				Thermometer			
				Code: 841			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TG-10-1010D-01			Sheet <input type="text"/> of <input type="text"/>
							Rev.:

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TG -10-1010D
	2	Service		UHM RTN FROM 001-V-10-1010	

Notes:

				INSTRUMENT SPECIFICATION			
				Thermometer			
				Code: 841			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TG-10-1010D-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-TG -10-1012		
	2	Service		001-P-10-1012 CLSD HC DRN PMP DISCH				
	3	Line Number	Equipment Number	89-HCD-A11-23037		001-P-10-1012		
	4	Area Classification	Location	Class 1, Zone 2, Group IIA, T3		FIELD		
	5	Ambient Temperature Range		-40 TO 35 °C				
	6							
PROCESS CONDITIONS	7	Fluid	State	CONDENSATE		Liquid		
	8	Temperature	Min.	Oper.	Max.	°C	°C	
	9	Oper. Pressure	Max. Pressure		kPa-a	187	kPa-a	
	10	Oper. Flow	Max. Flow		16	Am <sup>3</sup> /h	17.6	
	11	Oper. Velocity	Max. Velocity				m/s	
	12	Design Pressure	Design Temperature				°C	
	13	Oper. Density / SG / Molecular Mass						
	14	Viscosity	Compressibility		cP			
	15	Vibrations	Erosion	Oxidizing Atm.				
	16							
THERMOMETER	17	Type		Bimetallic Thermometer				
	18	Range		0	TO	250	°F	
	19	Dial Size	Dial Color	5	in	White w/ black lettering		
	20	Case Material	Hermetically Sealed	304 SS		YES PER ASME B40.3		
	21	Stem Type	Stem Material		304SS			
	22	Stem/Union Thread	Stem Position					
	23	Stem Length	Stem Diameter		6	in		
	24	Sheath Material	Coating					
	25	External Calibrator						
	26							
	27	FILLED SYSTEM	Type		NO FILL			
	28		Compensation					
	29		Capillary Length					
	30		Capillary Material					
31	Armor Material							
32	Bulb Diameter		Bulb Length					
33	Bulb Type							
34	Bulb Connection							
THERMOWELL	Line 42	Thermowell Tag Number		001-TW-01-1012				
		Process Connection		3/4" NPT				
		Construction Type		TAPPED				
		Well Material		304SS				
	U	39	Flange Material	Flange Welding				
		40	Internal Connection	Bore Diameter		0.385"		
	Line 42	41	Insertion Length (U)	Flange Standoff (FS)		4.5"		
		Length - Bottom of Thread/SW/Flange to Top		2"				
		Overall Length (line 42 + U)		6.5 in				
		44	Tip Diameter	Tip Thickness				
FS U	45	Root Diameter						
	Vibration Calculation Results							
	47	Treatments	Finish					
	48	Stamping	Plug & Chain					
	Thermowell Model Number							
PURCHASE	50	Manufacturer		Wika				
	51	Model		TI.51				
	52	Purchase Order Number		---				
	53	Price						
54	CRN Number		0H07851.52					

Notes: See Notes Page

				INSTRUMENT SPECIFICATION Thermometer Code: 841				
				Instr. Chk	Process Chk	Appr.		
							Sheet	of
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-TG -10-1011 -DSH				Rev.:

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TG -10-1012
	2	Service		001-P-10-1012 CLSD HC DRN PMP DISCH	

Notes:

				INSTRUMENT SPECIFICATION			
				Thermometer			
				Code: 841			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: 11-02-J-001-TG -10-1011 -DSH			Sheet <input type="text"/> of <input type="text"/>
							Rev.: <input type="text"/>

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001		001-TIT -10-1010A						
	2	Service		001-V-10-1010 CLSD HC DRN VESL								
	3	Line Number	Equipment Number	TANK/VESSEL NOZZLE		001-V-10-1010						
	4	Line Size	Line Schedule	N/A								
	5	Area Classification	Location	Class 1, Zone 2, Group IIA, T3		FIELD						
	6	Ambient Temperature Range		-40 TO 35 °C								
	7											
PROCESS CONDITIONS	8	Fluid	State	Hydrocarbon Drain		Liquid						
	9	Temperature	Min.	Oper.	Max.	°C	°C					
	10	Oper. Pressure	Max. Pressure		5	kPa-g	kPa-g					
	11	Oper. Flow	Max. Flow			kg/h	kg/h					
	12	Oper. Velocity	Max. Velocity			m/s	m/s					
	13	Design Pressure	Design Temperature		345	kPa-g	150 °C					
	14	Oper. Density	Molecular Mass			kg/m <sup>3</sup>						
	15	Oper. Viscosity		cP								
16	Vibrations	Erosive	Oxidizing									
17												
ELEMENT	18	Element Tag No.	001-TE-10-1010A					55	Head Type	DIN A SINGLE SENSOR INPUT		
	19	Element Type	RTD					56	Material	ALUMINUM		
	20	T/C	ISA Type					57	Enclosure	NEMA 4X		
	21		Epoxy					58	Terminal Block			
	22		Ground	Unground			59	Conduit Connection	1/2" NPT			
	23								60	Ext.Type and Material		
	24	RTD	Material		PLATINUM			61	Nipple Size			
	25		Resistance		100 omhs			62	Union			
	26		Wire Matl/Gauge		22 GAUGE			63	Nipple Union Length			
	27									64	Spring Loaded	
	28	Single/Double/Other	SINGLE					65				
	29	Diameter								66	Transmitter Type	RTD
	30	Sheath Material	NO SHEATH					67	TE Types Supported	RTD OR THERMOCOUPLE		
	31	Coating	NO COATING					68	Cold Junction Comp.			
	32								69	Enclosure	NEMA 4X	
	33	Element Model No.	0068N21C3B165T26E6					70	Housing Material	ALUMINUM		
	34	Thermowell Tag No.	001-TW-10-1010A					71	Power Supply	24 VDC		
35	Process Connection	3/4"					72	Electrical Connection				
36	Construction Type	TAPERED					73	Accuracy	± 0.15 °C			
37	Well Material	304 SS					74	Response Time	<0.5 s			
38	Flange Material	NO FLANGE					75	Linearization of Output				
39	Flange Welding	Full Penetration					76	Range Limits	-200 TO 850 °C			
40	Internal Connection	1/2"					77	Calibrated Range	-50 TO 150 °C			
41	Bore Diameter								78	Communication Type	4-20 mA HART	
42	Insertion Length (U)	16.5"					79	Configuration From				
43	Flange Standoff (FS)								80	Internal Diagnostics	YES	
44	Thread/Flange to Top								81	Integral Indicator	LCD DISPLAY	
45	Overall Length (44+U)								82	Indicator Scale		
46	Tip Diameter								83	Custom Configuration		
47	Tip Thickness								84	Mounting Bracket		
48	Root Diameter								85			
49	Vibration Calc. Result								86			
50	Plug & Chain						87	Manufacturer	Rosemount			
51	Treatments						88	Model	644HAK6J6M5			
52	Finish	Stamping						89	Purchase Order No.	---		
53								90	Price			
54	Thermowell Model No.	REFER TO TE MODEL #					91	CRN Number	0F00956.92			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION				
				Temp Transmitter/Element/Well				
				Code: 344				
				Instr. Chk	Process Chk	Approved		
							Sheet	of
No.	By	Date	Revision	Dwg No: FER-001.1102039085-J-DSH-TIT-10-1010A-01				Rev.:



GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TIT -10-1010A
	2	Service		001-V-10-1010 CLSD HC DRN VESL	

Notes: 1. Instrument selection and material testing requirement shall be in accordance with "GS-4410 Measurement Equipment - Installation Criteria", "GS-4500 - Instrument Design and Installation Specification" and "GS-5210 - Piping Class Specification", latest revisions.  
 2. Vendor to provide stainless steel tag c/w Owner tag number properly attached to the instrument.

				INSTRUMENT SPECIFICATION Temp Transmitter/Element/Well Code: 344			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TIT-10-1010A-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TT -10-1000	
	2	Service	001-PK-10-1000 AMB TEMP			
	3	Line Number	Equipment Number	---	001-PK-10-1000	
	4	Line Size	Line Schedule			
	5	Area Classification	Location	Class 1, Zone 2, Group IIA, T3	FIELD	
	6	Ambient Temperature Range	-40 to 35 °C			
	7					
PROCESS CONDITIONS	8	Fluid	State		Gas/Vapor	
	9	Temperature	Min.	Oper.	Max.	
	10	Oper. Pressure	Max. Pressure			
	11	Oper. Flow	Max. Flow			
	12	Oper. Velocity	Max. Velocity			
	13	Design Pressure	Design Temperature			
	14	Oper. Density	Molecular Mass			
	15	Oper. Viscosity	cP			
ELEMENT	16	Vibrations	Erosive	Oxidizing		
	17					
	18	Element Tag No.	001-TE-10-1010			55
	19	Element Type	RTD			56
	20	T/C	ISA Type			57
	21		Epoxy			58
	22		Ground	Unground		
	23					60
	24	RTD	Material	PLATINUM		61
	25		Resistance	100 omhs		62
	26		Wire Mat/Gauge	22 GAUGE		63
	27					64
	28	Single/Double/Other	SINGLE			65
	29	Diameter				66
	30	Sheath Material	NO SHEATH			67
	31	Coating	NO COATING			68
	32					69
33	Element Model No.	0068N21N00N060E6			70	
34	Thermowell Tag No.	NO THERMOWELL			71	
35	Process Connection				72	
36	Construction Type				73	
37	Well Material				74	
38	Flange Material				75	
39	Flange Welding	Full Penetration			76	
40	Internal Connection				77	
41	Bore Diameter				78	
42	Insertion Length (U)				79	
43	Flange Standoff (FS)				80	
44	Thread/Flange to Top				81	
45	Overall Length (44+U)				82	
46	Tip Diameter				83	
47	Tip Thickness				84	
48	Root Diameter				85	
49	Vibration Calc. Result				86	
50	Plug & Chain				87	
51	Treatments				88	
52	Finish	Stamping			89	
53					90	
54	Thermowell Model No.				91	

Notes: See Notes Page

				INSTRUMENT SPECIFICATION				
				Temp Transmitter/Element/Well				
				Code: 344				
				Instr. Chk	Process Chk	Approved		
							Sheet	of
No.	By	Date	Revision	Dwg No: FER-001.1102039085-J-DSH-TT-10-1000-01				Rev.:

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-TT -10-1000
	2	Service		001-PK-10-1000 AMB TEMP	

Notes:

				INSTRUMENT SPECIFICATION Temp Transmitter/Element/Well Code: 344			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-TT-10-1000-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000
	2	Service		001-BU-10-1000 ESD ALM STRB(INT.)	
	3	Line Number	Equipment Number	---	001-PK-10-1000
	4	Location		FIELD	
	5				
	6				
	7				
	8				
	9				
	10				
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	48				
	49				
	PURCHASE	50	Manufacturer		Federal Signal Corp.
51		Model		191XL-S120240A	
52		Purchase Order Number			
53		Price			
	54	CRN Number			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION				
				Custom Datasheet				
				Code: 999				
				Instr. Chk	Process Chk	Appr.		
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000-01			Sheet	of

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000
	2	Service		001-BU-10-1000 ESD ALM STRB(INT.)	

Notes:

				INSTRUMENT SPECIFICATION Custom Datasheet Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000A
	2	Service		001-BU-10-1000 ESD ALM STRB(EXT.)	
	3	Line Number	Equipment Number	---	001-BU-10-1000
	4	Location		FIELD	
	5				
	6				
	7				
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	49				
PURCHASE	50	Manufacturer		Federal Signal Corp.	
	51	Model		191XL-S120240R	
	52	Purchase Order Number			
	53	Price			
	54	CRN Number			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION			
				Custom Datasheet			
				Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000A-01			Rev.:

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000A
	2	Service		001-BU-10-1000 ESD ALM STRB(EXT.)	

Notes:

				INSTRUMENT SPECIFICATION Custom Datasheet Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000A-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000B
	2	Service		001-BU-10-1000 PRO/GAS ALM STRB(INT.)	
	3	Line Number	Equipment Number	---	001-BU-10-1000
	4	Location		FIELD	
	5				
	6				
	7				
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PURCHASE	50	Manufacturer		Federal Signal Corp.	
	51	Model		191XL-S120240A	
	52	Purchase Order Number			
	53	Price			
	54	CRN Number			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION			
				Custom Datasheet			
				Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000B-01			Rev.:



GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000B
	2	Service		001-BU-10-1000 PRO/GAS ALM STRB(INT.)	

Notes:

				INSTRUMENT SPECIFICATION Custom Datasheet Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000B-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000C	
	2	Service				001-BU-10-1000 PRO/GAS ALM STRB(INT.)
	3	Line Number	Equipment Number	---	001-BU-10-1000	
	4	Location			FIELD	
	5					
	6					
	7					
	8					
	9					
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	PURCHASE	50	Manufacturer		Federal Signal Corp.	
51		Model		191XL-S120240R		
52		Purchase Order Number				
53		Price				
54		CRN Number				

Notes: See Notes Page

				INSTRUMENT SPECIFICATION					
				Custom Datasheet					
				Code: 999					
				Instr. Chk	Process Chk	Appr.			
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000C-01				Sheet	of

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000C
	2	Service		001-BU-10-1000 PRO/GAS ALM STRB(INT.)	

Notes:

				INSTRUMENT SPECIFICATION Custom Datasheet Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000C-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000D
	2	Service		001-BU-10-1000 ALM HORN	
	3	Line Number	Equipment Number	---	001-PK-10-1000
	4	Location		FIELD	
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	6				
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PURCHASE	50	Manufacturer		Federal Signal Corp.	
	51	Model		300GCX-120 c/w UTM	
	52	Purchase Order Number			
	53	Price			
	54	CRN Number			

Notes: See Notes Page

				INSTRUMENT SPECIFICATION			
				Custom Datasheet			
				Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000D-01			Rev.:

GENERAL	1	P&ID Number	Tag Number	D-2013-8440-50F-001/001	001-XA -10-1000D
	2	Service		001-BU-10-1000 ALM HORN	

Notes:

				INSTRUMENT SPECIFICATION Custom Datasheet Code: 999			
				Instr. Chk	Process Chk	Appr.	
No.	By	Date	Revision	Dwg. No.: FER-001.1102039085-J-DSH-XA-10-1000D-01			Sheet <input type="text"/> of <input type="text"/>
				Rev.:			

Project: CONVENTIONAL RED DEER / FERRIER - 11-02 GATHERING SYST / 001 - OIL BATTERY

## **SECTION D**

### **EQUIPMENT DATASHEETS**



VESSEL DATA SHEET

SHT 1 OF 1

1 CLIENT Devon Canada

2 PROJECT Ferrier Central Processing Facility ITEM NO. 001-V-10-1010

3 FABR. SPEC GS-3310 SERVICE COB CLOSED HYDROCARBON DRAIN VESSEL

4 MANUFACTURER Alco Gas & Oil REGISTRATION NO. W3166.2

DESIGN DATA			
REGISTERED	<u>Yes</u>	PROVINCE OF	<u>A.B.</u>
OPERATE (internal)	<u>5</u>	kPa(g) @	<u>40</u> °C
OPERATE (external)	<u>Atm</u>	kPa(g) @	<u>35 / -40</u> °C
DESIGN (internal)	<u>345</u>	kPa(g) @	<u>150</u> °C
DESIGN (external)	<u>Full Vacuum</u>	kPa(g) @	<u>150</u> °C
MINIMUM DESIGN METAL TEMPERATURE (°C)	<u>-45</u>		
STRESS RELIEF	<u>NO</u>	WHY	<u>NOT REQUIRED</u>
RADIOGRAPHY	<u>R2</u>	JOINT EFF	SHELL (%) _____ HEAD (%) _____
WIND VELOCITY (kmph)	<u>100</u>	EARTHQUAKE ZONE	_____
<input checked="" type="checkbox"/> ASME VIII DIV I		<input type="checkbox"/> ASME VIII DIV II	
<input checked="" type="checkbox"/> SWEET SERVICE		<input type="checkbox"/> SOUR SERVICE	
<input checked="" type="checkbox"/> HORIZONTAL		<input type="checkbox"/> VERTICAL	

WEIGHTS			
LESS INTERNALS (kg)	<u>7144</u>	INTERNALS WT (kg)	<u>100</u>
OPERATING WT (kg)	<u>25,600</u>	HYDROTEST WT (kg)	<u>32,000</u>

	SHELL		HEADS	
	TOP	BOTTOM	TOP	BOTTOM
TYPE	<u>Rolled Plate</u>		<u>SE 2:1</u>	
ASME MATERIAL	<u>SA 516-70N</u>		<u>SA 516-70N</u>	
DESIGN THICKNESS (mm)	<u>9.5 NOMINAL</u>		<u>9.5 NOMINAL</u>	
CORROSION ALLOW (mm)	<u>1.6</u>		<u>1.6</u>	
TOTAL MIN THICK (mm)	<u>7.9</u>			

FABRICATOR TO PROVIDE			
<input type="checkbox"/>	SKIRT & BASE RING	<input type="checkbox"/>	SUPPORT GRID
<input type="checkbox"/>	LEGS	<input checked="" type="checkbox"/>	PIPE COIL
<input checked="" type="checkbox"/>	SADDLES	<input checked="" type="checkbox"/>	LIFTING LUGS
<input type="checkbox"/>	PLATFORM CLIPS	<input type="checkbox"/>	TAILING LUG
<input type="checkbox"/>	PLATFORMS	<input checked="" type="checkbox"/>	SAND BLASTING
<input type="checkbox"/>	LADDER CLIPS	<input checked="" type="checkbox"/>	EXTERNAL PAINTING / COATING
<input type="checkbox"/>	LADDERS	<input checked="" type="checkbox"/>	INTERNAL COATING
<input type="checkbox"/>	INSULATION RINGS	<input checked="" type="checkbox"/>	GROUND LUG
<input type="checkbox"/>	PIPE SUPPORT CLIPS	<input checked="" type="checkbox"/>	INLET NOZZLE DISTRIB <u>N1</u>
<input checked="" type="checkbox"/>	PIPE SUPPORTS	<input type="checkbox"/>	SPECIAL NOZZLE BKR _____
<input type="checkbox"/>	TOP DAVIT	<input checked="" type="checkbox"/>	VORTEX BREAKER <u>N3, N4</u>
<input checked="" type="checkbox"/>	MANWAY DAVIT	<input type="checkbox"/>	SYPHON DRAIN _____
<input checked="" type="checkbox"/>	MANWAY HINGE	<input checked="" type="checkbox"/>	STUDS & NUTS <u>193 B7 / 194 2H</u>
<input type="checkbox"/>	PAINTERS TROLLEY	<input checked="" type="checkbox"/>	GASKETS <u>316 SS</u>
<input type="checkbox"/>	TRAY SUPPORT RINGS	<input checked="" type="checkbox"/>	BLIND FLANGES <u>M1, M2</u>
<input type="checkbox"/>	SEAL PAN SUPPORT	<input type="checkbox"/>	FIREPROOFING CLIPS _____
<input type="checkbox"/>	MIST ELIMINATOR	<input type="checkbox"/>	_____
<input type="checkbox"/>	MIST ELIMINATOR SUPPORT	<input type="checkbox"/>	_____
<input type="checkbox"/>	DOWNCOMER SUPPORTS	<input type="checkbox"/>	_____
<input type="checkbox"/>	ANCHOR BOLT CHAIRS	<input type="checkbox"/>	_____

1981mm ID x 6096mm S/S

CONNECTION SCHEDULE											
MARK	SIZE	QTY	SERVICE	RATING	TYPE	MARK	SIZE	QTY	SERVICE	RATING	TYPE
<u>N1</u>	<u>6"</u>	<u>1</u>	<u>HC Drain Inlet</u>	<u>150#</u>	<u>RF</u>	<u>N11A/B</u>	<u>2"</u>	<u>2</u>	<u>Level Bridle A</u>	<u>300#</u>	<u>RF</u>
<u>N2</u>	<u>6"</u>	<u>1</u>	<u>HP Flare Gas Outlet</u>	<u>150#</u>	<u>RF</u>	<u>N12A/B</u>	<u>2"</u>	<u>2</u>	<u>Level Bridle B</u>	<u>300#</u>	<u>RF</u>
<u>N3</u>	<u>4"</u>	<u>1</u>	<u>Condensate Outlet</u>	<u>150#</u>	<u>RF</u>	<u>N13</u>	<u>2"</u>	<u>1</u>	<u>TIT</u>	<u>300#</u>	<u>RF</u>
<u>N4</u>	<u>3"</u>	<u>1</u>	<u>Drain</u>	<u>150#</u>	<u>RF</u>	<u>N14</u>	<u>2"</u>	<u>1</u>	<u>TG</u>	<u>300#</u>	<u>RF</u>
<u>N5</u>	<u>2"</u>	<u>1</u>	<u>Vent Gas Outlet</u>	<u>150#</u>	<u>RF</u>						
<u>N6</u>	<u>2"</u>	<u>1</u>	<u>Fuel Gas Inlet</u>	<u>150#</u>	<u>RF</u>						
<u>N7</u>	<u>4"</u>	<u>1</u>	<u>Vent</u>	<u>150#</u>	<u>RF</u>						
<u>N8</u>	<u>2"</u>	<u>1</u>	<u>Utility</u>	<u>150#</u>	<u>RF</u>						
<u>N9</u>	<u>2"</u>	<u>1</u>	<u>Pressure Indicator</u>	<u>300#</u>	<u>RF</u>	<u>M1</u>	<u>24"</u>	<u>1</u>	<u>Manway w/ blind</u>	<u>150#</u>	<u>RF</u>
<u>N10A/B</u>	<u>2"</u>	<u>2</u>	<u>Heat Medium Coil</u>	<u>300#</u>	<u>RF</u>	<u>M2</u>	<u>24"</u>	<u>1</u>	<u>Manway w/ blind</u>	<u>150#</u>	<u>RF</u>

REMARKS: BALANCE OF INFORMATION TO BE PROVIDED BY VENDOR

1. Vessel to be insulated with 2" thickness mineral wool and aluminum cladded.

2. Lifting Lugs and Saddles design to -45°C.

3. Vessel to have an internal heating coil to maintain the liquid temperature at 10°C by using utility heating Glycol. Vendor to size coil, heating Glycol conditions are: Supply Temperature: 90°C, Pressure 550 kPag; Return Temperature: 65°C, Pressure: 380 kPag. Glycol system design pressure: 1693 kPag, design temperature: 120°C.

4. Vessel saddle height will be provided with adequate height to provide required suction head for the pump.

5. Vessel internal coating: Highland 74 per GS-6200



JOB NO. 407014-00120

WorleyParsons DATA SHT NO. 407014-00120-00-ME-DAS-0701

DEVON DATA SHEET NO. FER-001.1102039085-M-DSH-V-10-1010

REV	DATE	MECH	PROC	CHKD	APPR
<u>0</u>	<u>28-May-14</u>				<u>RE</u>

**POSITIVE DISPLACEMENT PUMP DATA SHEET**

SHT 1 OF 2

1 CLIENT Devon Canada

2 PROJECT Ferrier Central Processing Facility ITEM NO. 001-P-10-1012

3 FABR. SPEC. API 676 with exception SERVICE COB Closed Hydrocarbon Drain pump

4 PUMP TYPE  PISTON  PLUNGER  METERING  DIAPHRAGM  DIRECT ACTING STEAM / GAS

5  ROTARY  GEAR  SCREW  OTHER

6 DRIVERS NO. MOTORS 1 ITEM NO. 001-PM-10-1012 NO. TURBINES \_\_\_\_\_ ITEM NO. \_\_\_\_\_

7 OTHERS \_\_\_\_\_ NO. \_\_\_\_\_ ITEM NO. \_\_\_\_\_

8 PUMP MANUFACTURER NETZSCH MODEL / SIZE NM063BY02S14K NO. REQ'D 1

9  **SITE CONDITIONS**

10 ALT (m) 1020 ATM PRESS (kPa(a)) \_\_\_\_\_

11 RELATIVE HUMIDITY MIN (%) \_\_\_\_\_ MAX (%) \_\_\_\_\_

12 OUTDOOR TEMPERATURE MIN (°C) -40 MAX (°C) 35

13 INDOOR TEMPERATURE MIN (°C) \_\_\_\_\_ MAX (°C) \_\_\_\_\_

14 AREA CLASSIFICATION

15  UNCLASSIFIED

16  CLASS 1 ZONE 2 GROUP IIA TC: T3

17 LOCATION

18  INDOOR  OUTDOOR

19  HEATED  UNHEATED

20  COVERED  TROPICAL

21  DUST \_\_\_\_\_

22  CORROSIVE GASES \_\_\_\_\_

23  OTHER \_\_\_\_\_

9  **MANUFACTURERS DATA**

10 RATED BHP (kW) \_\_\_\_\_ rpm \_\_\_\_\_

11 HHP (kW) \_\_\_\_\_ rpm \_\_\_\_\_

12 EFFICIENCY (%) MECH \_\_\_\_\_ VOLUMETRIC \_\_\_\_\_

13 ACCELERATION HEAD (kPa) \_\_\_\_\_

14 NPSH REQUIRED (at grade) 1.3m

	LIQUID	STEAM
DESIGN PRESS	kPa(g)	
DESIGN TEMP	°C	
HYDRO TEST	kPa(g)	
CYLINDER TYPE		

24 MAX FRAME BHP (kW) \_\_\_\_\_ @ \_\_\_\_\_ rpm

25 STEAM / GAS CONSUMPTION (kg / hr) \_\_\_\_\_

26 COOLING WATER (m<sup>3</sup> / hr) \_\_\_\_\_

27 JACKET STEAM (kg / hr) \_\_\_\_\_

28 RELIEF VALVE SETTING (kPa(g)) \_\_\_\_\_

29 SUCTION LINE SIZE

30 DIAMETER (mm) \_\_\_\_\_ LENGTH (m) \_\_\_\_\_

31 API MATERIAL CLASS \_\_\_\_\_

25  **OPERATING CONDITIONS**

26 LIQUID Hydrocarbon Drain  FLAMMABLE

27 CORR / EROSION BY \_\_\_\_\_  TOXIC

28 PUMPING TEMP (C) RATED 50 MIN \_\_\_\_\_ MAX \_\_\_\_\_

29 VISCOSITY (cP) RATED 0.81 @ 50 °C

30 MAX \_\_\_\_\_ @ \_\_\_\_\_ °C

31 SPECIFIC GRAVITY

32 RATED 0.75 MAX \_\_\_\_\_ @ 50 °C

33 VAPOR PRESS (kPa(a))

34 RATED 90 MAX \_\_\_\_\_ @ 50 °C

35 NPSH AVAILABLE(at grade) 0.7 (Note 1.2) m (exclude acc hd)

**ACCESSORIES**

36  BASE PLATE (pump & driver)

37  SOLE PLATE

38  INLET PULSATION DAMPERS \_\_\_\_\_ % MAX AMPL

39  OUTLET PULSATION DAMPERS \_\_\_\_\_ % MAX AMPL

40  JACKET FOR

41  HEATING  COOLING

42  GEAR UNIT

43 RATING (kW) \_\_\_\_\_ SF \_\_\_\_\_

44 MFG \_\_\_\_\_ MODEL \_\_\_\_\_

45  INTEGRAL  SEPARATE  V-BELT

46  VARIABLE SPEED DRIVE UNIT

47 MFG \_\_\_\_\_ MODEL \_\_\_\_\_

48 SPEED RANGE (rpm) \_\_\_\_\_ TO (rpm) \_\_\_\_\_

49 RATED POWER (kW) \_\_\_\_\_

50  RELIEF VALVE

51  INTEGRAL  SEPARATE

52 SIZE (mm) 38 x 60 SET POINT (kPa(g)) 510

53  COUPLING

54 TYPE \_\_\_\_\_

55 MFR \_\_\_\_\_ MODEL \_\_\_\_\_

56  STEAM CYLINDER LAGGING

57 WEIGHT (kg)

58 PUMP \_\_\_\_\_ DRIVER \_\_\_\_\_

59 BASE PLATE \_\_\_\_\_ TOTAL \_\_\_\_\_

60 DIMENSIONS L x W x H (m) \_\_\_\_\_

	MIN	NORM	RATED
FLOW	m <sup>3</sup> / hr		<u>16</u>
SUCT PRESS	kPa(g)	<u>flooded</u>	
DISCH PRESS	kPa(g)	<u>340</u>	
DIFF PRESS	kPa		
LIQUID COMPRESSIBILITY			

NOZZLES	SIZE	RATING	FACING	POSITION
SUCTION	<u>6"</u>	<u>CL150</u>	<u>RF</u>	<u>VERTICAL UP</u>
DISCHARGE	<u>4"</u>	<u>CL150</u>	<u>RF</u>	<u>HORIZONTAL</u>
STEAM IN				
STEAM OUT				

50  **TESTS AND INSPECTION**

	REQ'D	WITNESS
51 HYDROSTATIC	<input checked="" type="radio"/>	<input type="radio"/>
52 RUNNING	<input type="radio"/>	<input type="radio"/>
53 PERFORMANCE	<input type="radio"/>	<input type="radio"/>
54 NPSH	<input type="radio"/>	<input type="radio"/>
55 LINEARITY ACCURACY	<input type="radio"/>	<input type="radio"/>
56 REPEATABILITY	<input type="radio"/>	<input type="radio"/>
57 SHOP INSPECTION	<input type="radio"/>	<input type="radio"/>
58 DISMANTLE & INSPECT	<input type="radio"/>	<input type="radio"/>

**APPLICABLE SPECIFICATIONS**

API 674  API 675  API 676



**WorleyParsons**  
resources & energy

JOB NO. 407014-00120  
DATA SHEET NO. 407014-00120-00-ME-DAS-0702

REV	DATE	MECH	PROC	ELEC	APPR	CHKD

**POSITIVE DISPLACEMENT PUMP DATA SHEET**

SHT 2 OF 2

1 CLIENT Devon Canada



2 PROJECT Ferrier Central Processing Facility ITEM NO. 001-P-10-1012  
 3 FABR. SPEC. API 676 with exception SERVICE COB Closed Hydrocarbon Drain pump

CONSTRUCTION														
RECIPROCATING	ROTARY	CONTROLLED VOLUME												
BORE (mm) _____ STROKE (mm) _____	PUMP TYPE <input type="checkbox"/> GEAR <input type="checkbox"/> SPUR <input type="checkbox"/> HELICAL <input type="checkbox"/> SCREW <input type="checkbox"/> LOBE <input type="checkbox"/> VANE <input checked="" type="checkbox"/> PROGRESSIVE CAVITY _____ <input type="checkbox"/> _____	BORE (mm) _____ STROKE (mm) _____ NO. FEEDS _____ DIAPHRAGM DIA _____ NO. _____ VALVE, TYPE _____ NO. _____ <input type="checkbox"/> NO. VALVES PER FEED _____ <input type="checkbox"/> BACK PRESS VALVE BY _____												
ROD LOAD ACTUAL (kg) _____ ALLOWED (kg) _____ STALL (kPa) _____ RAM (kPa) _____ <input type="checkbox"/> SIMPLEX <input type="checkbox"/> DUPLEX <input type="checkbox"/> MULTIPLEX <input type="checkbox"/> CLOSE CLEARANCE <input type="checkbox"/> SINGLE <input type="checkbox"/> DOUBLE ACTING <input type="checkbox"/> NO. _____ TYPE _____ <input type="checkbox"/> REMOVABLE LINER	ROTOR MOUNT <input type="checkbox"/> OVERHUNG <input type="checkbox"/> BTWN BEARINGS TIMING GEARS <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> INT <input type="checkbox"/> EXT DISPLACEMENT (mm <sup>3</sup> / rev) _____ _____ _____ _____ _____ _____ _____ _____	<b>CAPACITY CONTROL</b> <input type="checkbox"/> MANUAL <input type="checkbox"/> REMOTE <input type="checkbox"/> EXTERNAL BYPASS <input type="checkbox"/> SPEED VARIATION <input type="checkbox"/> STROKE ADJUSTMENT <input type="checkbox"/> PNEUMATIC <input type="checkbox"/> ELECTRONIC CONTROL SIGNAL RANGE: _____ TO _____ kPa(g) _____ TO _____ MA												
VALVE TYPE <input type="checkbox"/> DISC <input type="checkbox"/> WING <input type="checkbox"/> DOUBLE PORTED <input type="checkbox"/> BALL														
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">SUCTION</th> <th style="text-align: center;">DISCHARGE</th> </tr> </thead> <tbody> <tr> <td>VELOCITY m / s</td> <td></td> <td></td> </tr> <tr> <td>NUMBER</td> <td></td> <td></td> </tr> <tr> <td>AREA mm<sup>2</sup></td> <td></td> <td></td> </tr> </tbody> </table> <input type="checkbox"/> SCREWED <input type="checkbox"/> PRESSURE FIT <input type="checkbox"/> HORIZONTAL <input type="checkbox"/> VERTICAL <input type="checkbox"/> TAILRODS		SUCTION	DISCHARGE	VELOCITY m / s			NUMBER			AREA mm <sup>2</sup>				
	SUCTION	DISCHARGE												
VELOCITY m / s														
NUMBER														
AREA mm <sup>2</sup>														

MATERIALS					
	LIQUID	STEAM	CASING BODY	CARBON STEEL	CASING BODY
CYLINDER			LINER		COUNTOUR PLATE
LINER			STATOR	<b>NEMOLAST S65L BUNA-N</b>	HYDRAULIC DIAPH
HEAD			ROTOR	<b>CHROME PLATED STEEL</b>	PROCESS DIAPH
PISTON/PLGR			END PLATE		PLUNGER
PISTON RINGS			VANES		VALVES
PISTON ROD			TIMING GEARS		VALVE SEATS
VALVES			BEARING HOUSING		VALVE GUIDE
SEATS			SHAFT		VALVE BODY
SPRINGS			SHAFT SLEEVE		VALVE GASKET
SHAFT			GLAND		FRAME
CRANKSHAFT			BASE PLATE	<b>STRUCTURAL STEEL</b>	HEAD
GLAND					LANTERN RING
LANTERN RING					
BASE PLATE					

PACKING AND MECHANICAL SEAL			
PACKING MAT'L _____	NO. OF RINGS _____	SIZE OF RINGS _____	(LIQ / STM)
SEAL MANUF <b>JOHN CRANE</b>	MODEL <b>SINGLE API 682 1CW-FL</b>		
SEAL CODE _____	<input type="checkbox"/> FLUSH PLAN _____	<input type="checkbox"/> QUENCH GLAND _____	
<input type="checkbox"/> SELF FLUSHED	<input type="checkbox"/> EXTERNAL FLUSHED _____	<input type="checkbox"/> FLUSH FLUID _____	
<input type="checkbox"/> MECH LUBRICATOR	DRIVEN BY _____		
<input type="checkbox"/> FLUID END	<input type="checkbox"/> MOTOR	<input type="checkbox"/> GAS END	<input type="checkbox"/> SHAFT

BEARINGS	DRIVER
RADIAL BEARING TYPE _____ MAT'L _____ NO. _____ INT / EXT _____	TYPE <b>IEEE841</b> MAKE <b>TECO</b> MODEL _____ ENCLOSURE <b>TEFC</b> POWER (kW) <b>5.6</b> VOLT / PH / HZ <b>575/3/60</b> SPEED (rpm) <b>1800</b> SPACE HEATER <b>NO</b>
THRUST BEARING TYPE _____ MAT'L _____	

REMARKS: INFORMATION TO BE COMPLETED BY:  WP     VENDOR

1.1 - Pump will handle HC liquids + water - for a conservative estimate higher density (water) and lighter vapour pressure (HC) are used

1.2 - NPSH shown does not include 0.9 m available process margin

<p><b>WorleyParsons</b> resources &amp; energy</p>	JOB NO. <u>407014-00120</u>	REV	DATE	MECH	PROC	ELEC	APPR	CHKD
	DATA SHEET NO. _____							
	<b>407014-00120-00-ME-DAS-0702</b>							

**PACKAGE DATA SHEET - BUILDING**

SHT 1 OF 1

PROJECT <b>Ferrier Central Processing Facility</b> FABR. SPEC <b>GS-2510</b>	CLIENT <b>DEVON CANADA</b> ITEM NO. <b>001-BU-10-1000</b> SERVICE <b>COB Closed Hydrocarbon drain package Building</b>																																																																																										
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SPAN (m) <b>4.420</b> LENGTH (m) <b>5.486</b> EAVE HEIGHT (m) <b>5.334</b> ROOF SLOPE <b>4:12</b> OTHER <b>Must be within shipping envelope</b>	SNOW LOAD (1/50) Ss/Sr (kPa) <b>1.9 / 0.1</b> DESIGN WIND PRESSURE (1/50) (kPa) <b>0.43</b> DESIGN RAIN - 60 MIN / One Day (mm) <b>26.7 / 72.3</b> SEISMIC <b>Sa(0.2)=0.15, Sa(0.5)=0.08, Sa(1.0)=0.04, Sa(2.0)=0.02, PGA=XXX</b> AREA CLASSIFICATION <b>Class 1 Zone 2, Grp. IIA, T3</b>																																																																																										
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## **SECTION E**

### **STORAGE & PRESERVATION PROCEDURES**

## **Long Term Storage Outside in Alberta**

**Submitted By:** Jerry Roberts  
**Submittal Date:** Feb 2008  
**Valid Until:** 2010  
**Source of Info:** John Mangan Fisher Marshalltown

Below is Fisher's opinion on storage. It does not line up with common practice in the field but it is starting point.

### **Long Term Storage of Fisher Control Valves**

If valve body, actuator and positioner are to be placed outdoors for extended periods of time in northern climates we would recommend covering the valve body ends with either plywood or masonite (and taping them shut), spraying with a choice of rust inhibitors, or crating up the entire assembly ( with a protective wrap). Ideally these valves should be stored in a warehouse until they are ready for a final location. If left outside in temperatures near -50 Deg F and exposed to the elements for months on end, the end user can expect that all Soft goods such as seals, o-rings, packing rings, etc need to be changed out before Operation.

- Any supply pressure and other pneumatic tubing ports are either plugged with threaded plugs or otherwise sealed to prevent rain and other elements from entering.
- Anything that can be done to prevent water or moisture from accumulating and sitting on any surface (internal or external) of each component should be pursued. A covered environment that is kept at a temperature above 20 Deg F such building or warehouse is recommended.



Emerson Process Management  
**Rosemount Inc.**  
8200 Market Boulevard  
Chanhassen, MN 55317 USA

Date: [REDACTED]

Subject: Product Storage Guidelines

The general storage guideline for industrial instrumentation is to store devices in a location that prevents physical damage. The area shall be situated and constructed so that the instruments will not be subject to flooding conditions. The area shall be provided with a uniform temperature controlled environment to prevent condensation and corrosion.

Storage temperature with an integral meter option shall be -40 to 185 degF (-40 to 85 degC)  
Storage temperature without an integral meter shall be —50 to 230 degF (-46 to 110 degC) For more details on temperature storage limits please refer to individual Product Data Sheets supplied by Rosemount.



### 3 Packaging, Transportation, Storage

#### 3.1 Packaging and Transportation

NEMO® pumps are shipped in railroad containers or crates unless the customer specifies otherwise. The packings are labelled and symbols give the handling instructions in accordance with DIN 55402. On receipt check for any transport damages. Transport damages should be reported to the transporter immediately. The pumps should be transported as closely as possible to the location of installation and only there should they be uncrated.

Uncrated horizontal pumps should be lifted by using a shackle which can be attached to the baseplate. The bolt holes of the frame or the lifting lugs attached to the baseplate could be used as shown on the installation drawing.

Vertical pumps should be lifted by using the bolt down holes, lifting lugs or shackles attached to the baseplate. This is shown on the installation drawing. For most applications, the drive is mounted on top of the pump.



Be careful when lifting top heavy pumps. The centre of gravity may be above the points where the lifting gear is attached to. If the case, secure additionally against tipping over!

Vertical pumps should not be deposited unless they are secured vertically. **Hazards of tipping!** Deposit only in horizontal position!




It is essential to avoid that the total pump unit be suspended with eye bolts of the motor or gear box. These eye bolts should be used for lifting the motor and/or the gear box **only**.

**The Accident Prevention Rules, Section 18.4 relating to lifting accessories for the lifting of loads (VBG 9a) must be strictly adhered to.**

Because of the variety of possible pump designs and applications, only general instructions can be given here. These should be good enough for experienced assemblymen or transportation experts. When in doubt, please ask for detailed information on the pump unit concerned.

Continued Page 3.0R

	Date	Name	Signed	Revision: 4
issued	23.06.98	Mangel		Substitute for issue of 07.12.94
approved	24.06.98	Denk		
released	25.06.98	Denk		text no. <b>30100</b> 
copy to: 95				

When moving the pump or unit on **wheels** strictly attend to the following:

- Pad lock the motor drive and secure against unintended starting up.
- Move the pump unit carefully and slowly, especially where the ground is uneven. **Hazards of tipping!**
- Ensure a stable position of the pump or unit at the operating/storage place and secure it by actuating **all** clamping devices on **all** the wheels or rollers against voluntary moving away.
- Where fitted loosely, carefully watch the pipe bends when pumping.  
**Power of repulsion!**
- Where necessary, secure the pump unit additionally with support blocks.

### 3.2 Storage

The pumps are preserved for transport unless specified otherwise. In cases of longer storage the pumps should be handled as follows until installation:

- **Stator:**

If the pump is not to be used immediately, then the elastomer along the contact line between rotor and stator may become permanently distorted (compression-set). This will increase the break away torque. Therefore, the stator should be removed and kept separately in a clean, cool and dry environment.

**Standard DIN 7716** summarizes detailed information on the storage of rubber products, some of which is gathered here, and the following notice applies to a storage for a period of up to six months.

*General*

*Most of the rubber products may change their physical properties under unfavourable conditions or if treated improperly, which will result in a shorter lifetime.*


*Or they may become useless through excessive hardening, aging, regenerating or permanent deformation, also because of blistering, cracking or other damages appearing on the surfaces.*

*The changes may occur under the influence of oxygen, ozone, heat, light, humidity, solvents or because of storing the products under tension.*

*If stored and treated properly, the rubber products will keep their properties, even over a long period of time (some years), almost unchanged.*

*This does, however, not apply to uncured rubber compounds.*

Continued Page 3.1

Revision: 4		Date	Name	Signed
Substitute for issue of 07.12.94	issued	23.06.98	Mangel	
	approved	24.06.98	Denk	
 text no. 30100	released	25.06.98	Denk	
	copy to: 95			



#### *Store room*

*The environment in which rubber products are being kept must be cool, dry, free of dust and rather airy, and they must not be stored in the open, not even in a weather sheltered space.*

*Rubber products should be kept in surroundings not having less than minus 10 °C and not more than plus 15 °C.*

*Store rooms should not be damp, and it must be ensured that there will be no condensation.*

*Most favourable is an environment offering a relative humidity under 65 %.*

*Rubber products must be protected against light, particularly direct sunlight or artificial light when having a high UV portion.*

*They should furthermore be kept away from ventilation, especially draught, by wrapping them up.*

*As ozone is very aggressive and harmful there should be no store room used which houses equipment likely to produce ozone, e.g. electric motors or other equipment which might bring about sparks or other electrical discharges.*

*There must be no solvents, oil, grease, lubricants or any chemicals kept in a store room.*

#### ■ **Rotor**

Please support with wooden blocks and cover up against harm from mechanical impact.

For rotors of RCC (material number 1.2436):

coat the surfaces with protective grease to avoid rusting.

#### ■ **Shaft Sealing by packing gland**

Remove the gland and coat the exposed shaft surface with grease.

#### ■ **Pump parts in stainless steel**


No grease coating necessary.

#### ■ **Other, non-coated pump parts**

Protect with grease.

#### ■ **Drives**

Please observe the drive supplier's instructions.

	Date	Name	Signed	Revision:
issued	23.06.98	Mangel		Substitute for issue
approved	24.06.98	Denk		of
released	25.06.98	Denk		
copy to: 95				text no. <b>30100</b> 



## **SECTION F**

### **CALCULATIONS**

**Project**

Details  
 line 2  
 line 3  
 line 4

**KILLARK ELECTRIC**

3940 M. L. King Dr.  
 St. Louis, MO 63113  
 (314) 531-0460



**KILLARK**

Date:6/25/2014

Page 1 of 3

## Luminaire Schedule

Symbol	Qty	Label	Description	Arrangement	Lumens/Lamp	LLF	Lum. Lumens	Lum. Watts
⊙	4	VM4LB07030xxGL-S	VM4LB07030xxGL-S	SINGLE	N.A.	0.900	6441	66

## Luminaire Location Summary

LumNo	Label	X	Y	Z	Orient	Tilt	Switched	Dimming
1	VM4LB07030xxGL-S	4	4	16	0	0	On	1.00
2	VM4LB07030xxGL-S	14	4	16	0	0	On	1.00
3	VM4LB07030xxGL-S	14	10.5	16	0	0	On	1.00
4	VM4LB07030xxGL-S	9	4	16	0	0	On	1.00

**Project**  
 Details  
 line 2  
 line 3  
 line 4

**KILLARK ELECTRIC**

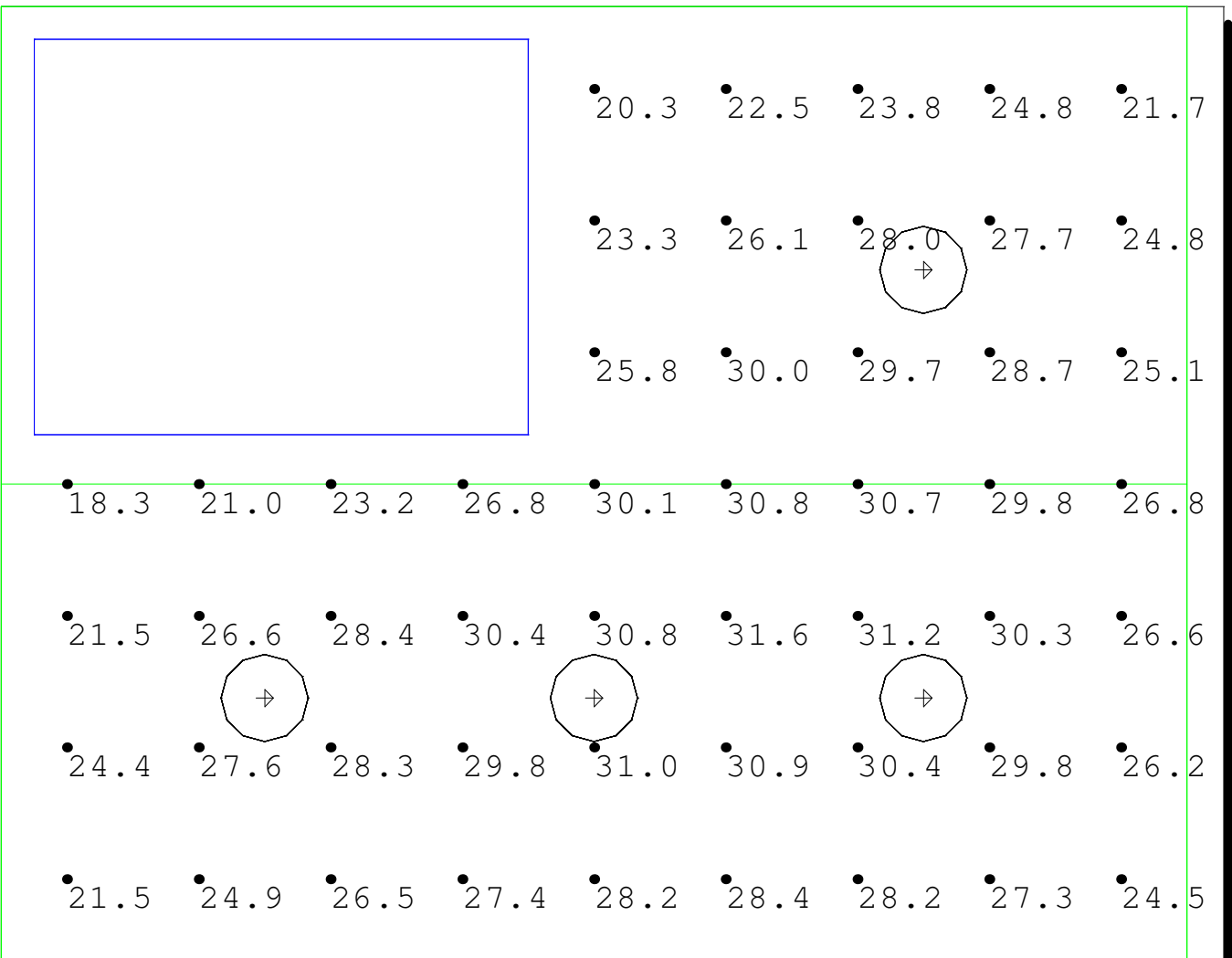
3940 M. L. King Dr.  
 St. Louis, MO 63113  
 (314) 531-0460



Date:6/25/2014

Page 2 of 3

Numeric Summary								
Label	CalcType	Grid Plane	Units	Avg	Max	Min	Avg/Min	Max/Min
Room_Floor	Illuminance	0	Fc	26.91	31.6	18.3	1.47	1.73



Not to Scale

**Project**

Details  
line 2  
line 3  
line 4

**KILLARK ELECTRIC**

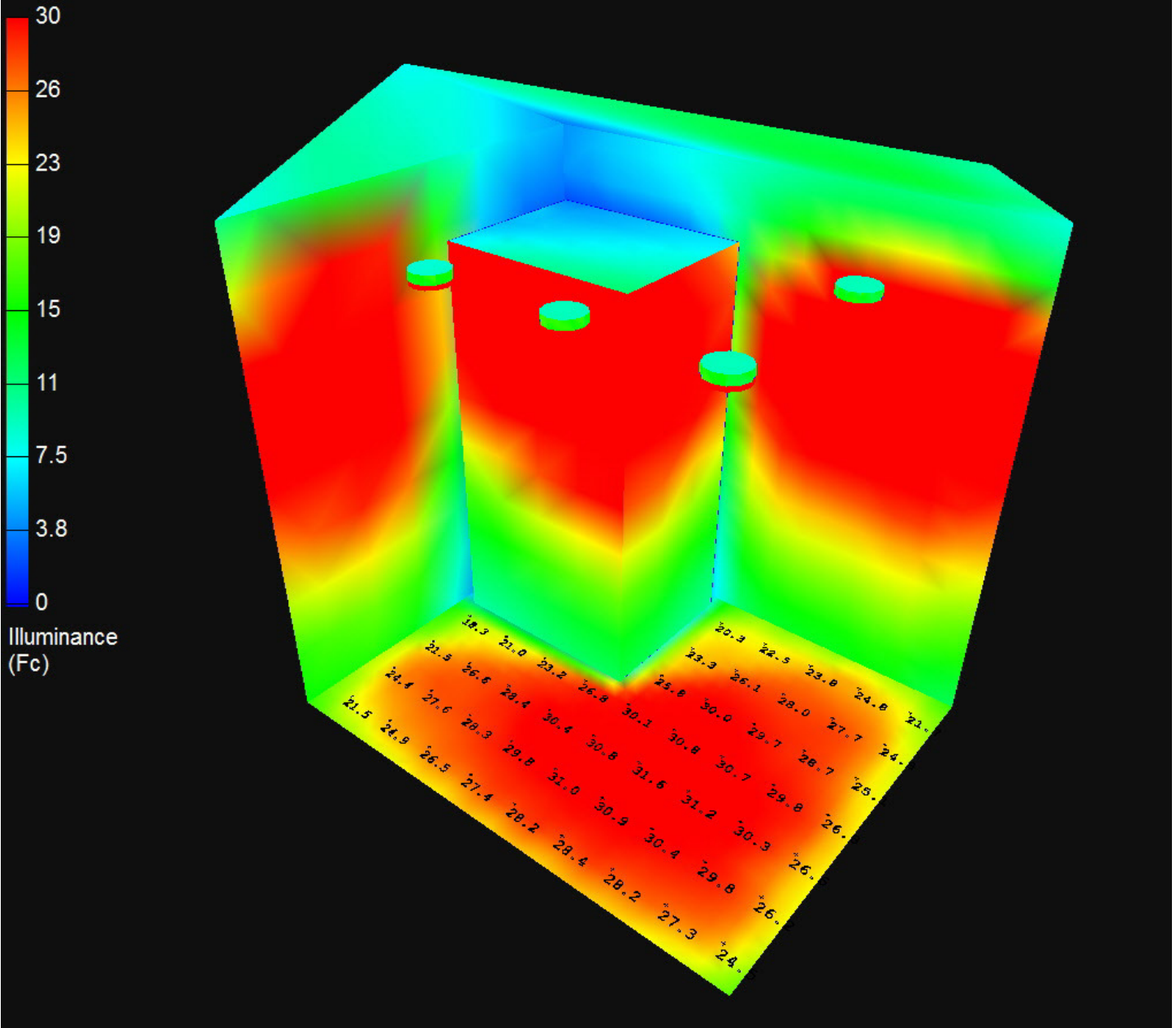
3940 M. L. King Dr.  
St. Louis, MO 63113  
(314) 531-0460



**KILLARK**

Date:6/25/2014

Page 3 of 3



July 12, 2014

Maximo Arpia

ALCO Gas & Oil Production Equipment Ltd.

5203-75 Street, Edmonton, AB T6E 5S5

**Fugitive Emissions Study for:**

**Ferrier Central Processing Facility located at 11-02-039-08 W5M**

**001-PK-10-1000 COB Closed Hydrocarbon Drain Building**

Dear Mr. Arpia,

A fugitive emission study was done in accordance with API 505 for the Devon Canada 001-PK-10-1000 COB Closed Hydrocarbon Drain Building located at the Ferrier Central Processing Facility. The process valve and fitting count was tabulated by ALCO from the P&ID drawing D-2013-8440-50F-001/001 Rev 1 of the building and supplied to DJA for the study.

ALCO also provided the hydrocarbon gas analysis used for this study which is attached.

The study showed a ventilation rate of 1.1 air changes per hour is required to consider the building as adequately ventilated. The required ventilation rate is within the natural ventilation rate expected for this type of building equipped with ventilation openings and therefore this building is recommended to be considered a **Class I Zone 2 Group IIA hazardous area**.

The following provisions are required for Class 1 Zone 2 hazardous building areas:

- 1) A continuously monitored gas detection system shall be provided in the building with alarming functions available to facility operations personnel to ensure that a gas leak does not persist in the building for an extended period of time.
- 2) The gas process shall be shut down and de-pressured upon detection of gas concentrations at or exceeding 40% of the gas lower explosion limit.
- 3) An artificial ventilation system shall be installed consisting of building exhaust fans and louvers. The artificial ventilation system shall become operational upon detection of gas concentrations at or exceeding 20% of the gas lower explosion limit.
  - a. Ventilation air shall be drawn from a non-hazardous area.
  - b. All vent openings shall remain unobstructed at all times.
- 4) The artificial ventilation system shall be:
  - a. designed to provide a minimum of six (6) air changes per hour and;
  - b. tested regularly to assure good working order
- 5) The building cold weather heating system shall be designed so as to maintain the design internal ambient temperature with the artificial ventilation system operational.
- 6) All electrical equipment and materials in the building shall be specified and installed in accordance with the Canadian Electrical Code Section 18.

The primary component in the fluid analysis provided is hexane which has an auto-ignition temperature of

# DJA ENGINEERING SERVICES INC.

1400 – 340 12<sup>th</sup> Ave SW  
Calgary, AB T2R 1L5  
T: (403) 444-0038

www.djaes.com  
info@djaes.com  
F: (403) 537-0158

225 °C (i.e. vapours can ignite on a hot surface with temperature greater than or equal to the auto-ignition temperature). Other significant gas components have auto-ignition temperatures lower than hexane, for example nonane has an auto-ignition temperature of 205 °C.

A T3 equipment temperature code allows a maximum surface temperature of 200 °C and has been selected as the appropriate temperature code for this building.

It is recommended that a note appear on the overall area classification drawing for the facility indicating that a fugitive emission study has been performed for this building and the area is classified as recommended in this study.

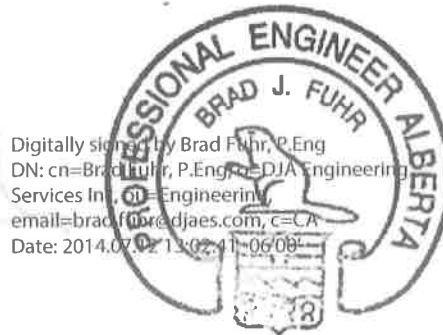
The study results are based solely on the information included herein. Should changes occur in the building or process design parameters, this study will become invalid.

Sincerely,



**Brad Fuhr, P.Eng.**

DJA Engineering Services Inc.



(enclosures: study calculation summary, valve and fittings tally, building dimensions and process piping and instrumentation diagrams, hydrocarbon gas & liquid analysis)

# DJA ENGINEERING SERVICES INC.

## 4335 CALCULATION TITLE PAGE

Project Number: 33229-02

Document Number: 4335-FES CALC

Date issued:	Rev:	By	Chk'd by:	Issued For:
12-Jul-2014	0	Dave Pichach	Brad Fuhr	Final Use

### DESCRIPTION:

Fugitive emissions estimation and natural ventilation calculations used to determine whether an enclosure can be considered adequately ventilated

### PROJECT INFORMATION:

001-PK-10-1000 COB Closed Hydrocarbon Drain Building located at Devon Canada Ferrier Central Processing Facility 11-02-039-08 W5M

### REFERENCED CODES AND STANDARDS:

CSA C22.1-12 Canadian Electrical Code  
API 505 - Recommended Practice for Classification of Locations for Electrical Installations  
API-4638 - Calculation Workbook for Oil and Gas Production Equipment Fugitive Emissions

### ASSUMPTIONS:

Maximum building internal ambient temperature is 40 deg C  
Assume natural ventilation of the building is 2 air changes per hour.

### CONCLUSIONS:

The liquid composition contains high concentrations of hexane which has an autoignition temperature of 225 deg C. Therefore a **T3** temperature code has been selected.  
A hazardous area classification of **Class I Zone 2 Group IIA** is recommended.

# DJA ENGINEERING SERVICES INC.

## 4335 HAZARDOUS GAS ANALYSIS SUMMARY

Project Number: 33229-02

Document Number: 4335-FES CALC

COMPONENT	MOLE FRACTION	MOLECULAR WEIGHT (g/mol)	COMPONENT WEIGHT	CASRN	RELATIVE VAPOUR DENSITY	FLASH POINT (°C)	LFL/LEL (% by volume of air)	UFL/UEL (% by volume of air)	AUTOIGNITION TEMPERATURE (°C)	GAS GROUP	
										North America	IEC
H2	0.0000	2.0159	0.00	1333-74-0	0.070	-	4.0	75.0	560	B	IIC
He	0.0001	4.0020	0.00	7440-59-7	0.138	-	-	-	-	-	-
N2	0.0050	28.0135	0.14	7727-37-9	0.972	-	-	-	-	-	-
CO2	0.0142	44.0095	0.62	124-38-9	1.530	-	-	-	-	-	-
H2S	0.0000	34.0760	0.00	7783-06-04	1.190	-82	4.3	46.0	260	C	IIB
H2O	0.0000	18.0153	0.00	7732-18-5	-	-	-	-	-	-	-
C1	0.9481	16.0330	15.20	74-82-8	0.550	-221	5.0	15.0	537	D	IIA
C2	0.0320	30.0700	0.96	74-84-0	1.040	-130	2.9	12.5	510	D	IIA
C3	0.0007	44.1000	0.03	74-98-6	1.550	-104	2.4	9.5	468	D	IIA
iC4	0.0000	58.1230	0.00	75-28-5	2.110	-60	1.4	8.3	460	D	IIA
nC4	0.0000	58.1230	0.00	106-97-8	2.050	-60	1.8	8.4	287	D	IIA
iC5	0.0000	72.1510	0.00	78-78-4	2.480	-51	1.4	8.3	420	D	IIA
nC5	0.0000	72.1510	0.00	109-66-0	2.480	-40	1.4	8.3	243	D	IIA
C6	0.0000	86.1780	0.00	110-54-3	2.970	-22	1.2	7.7	225	D	IIA
C7	0.0000	100.2050	0.00	142-82-5	3.460	-7	1.1	7.0	204	D	IIA
C8	0.0000	114.2320	0.00	111-65-9	3.930	13	1.0	6.5	206	D	IIA
C9+	0.0000	128.2590	0.00	111-84-2	4.410	31	0.9	2.9	205	D	IIA
MeOH	0.0000	32.0400	0.00	67-56-1	1.110	9	6.0	36.0	440	D	IIA
C2H6O	0.0000	46.0684	0.00	64-17-5	1.590	13	3.3	24.5	363	D	IIA
Other	0.0000	0.0000	0.00								
Other	0.0000	0.0000	0.00								
<b>TOTAL</b>	<b>1.0000</b>		<b>16.96</b>								

**NOTES:**

1) Gas Analysis mole fraction summary provided in Appendix A



# DJA ENGINEERING SERVICES INC.

## 4335 HAZARDOUS LIQUIDS ANALYSIS SUMMARY

Project Number: 33229-02

Document Number: 4335-FES CALC

COMPONENT	MOLE FRACTION	MOLECULAR WEIGHT (g/mol)	COMPONENT WEIGHT	CASRN	RELATIVE VAPOUR DENSITY	FLASH POINT (°C)	LFL/LEL (% by volume of air)	UFL/UEL (% by volume of air)	AUTOIGNITION TEMPERATURE (°C)	GAS GROUP	
										North America	IEC
H2	0.0000	2.0159	0.00	1333-74-0	0.070	-	4.0	75.0	560	B	IIC
He	0.0000	4.0020	0.00	7440-59-7	0.138	-	-	-	-	-	-
N2	0.0000	28.0135	0.00	7727-37-9	0.972	-	-	-	-	-	-
CO2	0.0002	44.0095	0.01	124-38-9	1.530	-	-	-	-	-	-
H2S	0.0000	34.0760	0.00	7783-06-04	1.190	-82	4.3	46.0	260	C	IIB
H2O	0.0000	18.0153	0.00	7732-18-5	-	-	-	-	-	-	-
C1	0.0016	16.0330	0.03	74-82-8	0.550	-221	5.0	15.0	537	D	IIA
C2	0.0094	30.0700	0.28	74-84-0	1.040	-130	2.9	12.5	510	D	IIA
C3	0.0506	44.1000	2.23	74-98-6	1.550	-104	2.4	9.5	468	D	IIA
iC4	0.0256	58.1230	1.49	75-28-5	2.110	-60	1.4	8.3	460	D	IIA
nC4	0.0922	58.1230	5.36	106-97-8	2.050	-60	1.8	8.4	287	D	IIA
iC5	0.0705	72.1510	5.09	78-78-4	2.480	-51	1.4	8.3	420	D	IIA
nC5	0.0933	72.1510	6.73	109-66-0	2.480	-40	1.4	8.3	243	D	IIA
C6	0.2148	86.1780	18.51	110-54-3	2.970	-22	1.2	7.7	225	D	IIA
C7	0.0451	100.2050	4.52	142-82-5	3.460	-7	1.1	7.0	204	D	IIA
C8	0.0000	114.2320	0.00	111-65-9	3.930	13	1.0	6.5	206	D	IIA
C9+	0.0143	128.2590	1.83	111-84-2	4.410	31	0.9	2.9	205	D	IIA
Methylcyclopentane	0.0461	32.0400	1.48	287-92-3	2.400	-37	1.5	8.7	361	D	IIA
Benzene	0.0274	46.0684	1.26	71-43-2	2.700	-11	1.3	8.0	498	D	IIA
Cyclohexane	0.0606	0.0000	0.00	110-82-7	-	-20	1.3	8.4	260	D	IIA
Methylcyclohexane	0.1033	0.0000	0.00	110-82-7	-	-20	1.3	8.4	260	D	IIA
Toluene	0.0817	0.0000	0.00	108-88-3	3.200	4	1.0	7.0	530	D	IIA
E-Benzene	0.0107	0.0000	0.00	71-43-2	2.700	-11	1.3	8.0	498	D	IIA
M-Xylene	0.0523	0.0000	0.00	106-42-3	3.660	25	1.1	7.0	535	D	IIA
<b>TOTAL</b>	<b>1.0000</b>		<b>48.83</b>								

**NOTES:**

1) Liquids Analysis mole fraction summary provided in Appendix B

# DJA ENGINEERING SERVICES INC.

## 4335 TOTAL PREDICTED EMISSIONS SUMMARY

Project Number: 33229-02

Document Number: 4335-FES CALC

### TOTAL HYDROCARBON EMISSIONS CALCULATION DATA FROM OIL AND GAS PRODUCTION OPERATIONS (lb/component-day)

COMPONENT	GAS			HEAVY OIL (<20 API GRAVITY)		
	QTY	EPA AVERAGE EMISSION FACTORS	TOTAL EMISSIONS	QTY	EPA AVERAGE EMISSION FACTORS	TOTAL EMISSIONS
VALVE	8	2.4E-01	1.9200		4.4E-04	0.0000
CONNECTOR	16	1.1E-02	0.1760		4.0E-04	0.0000
FLANGE	17	2.1E-02	0.3570		2.1E-05	0.0000
OPEN-ENDED		1.1E-01	0.0000		7.4E-03	0.0000
PUMP SEAL		1.3E-01	0.0000		N/A	N/A
OTHER**		4.7E-01	0.0000		1.7E-03	0.0000
	<b>GAS TOTALS (lb/day)</b>		<b>2.4530</b>	<b>HEAVY OIL TOTALS (lb/day)</b>		<b>0.0000</b>
COMPONENT	LIGHT OIL (≥20 API GRAVITY)			WATER/OIL ***		
	QTY	EPA AVERAGE EMISSION FACTORS	TOTAL EMISSIONS	QTY	EPA AVERAGE EMISSION FACTORS	TOTAL EMISSIONS
VALVE	24	1.3E-01	3.1200		5.2E-03	0.0000
CONNECTOR	46	1.1E-02	0.5060		5.8E-03	0.0000
FLANGE	33	5.8E-03	0.1914		1.5E-04	0.0000
OPEN-ENDED		7.4E-02	0.0000		1.3E-02	0.0000
PUMP SEAL		6.9E-01	0.0000		1.3E-03	0.0000
OTHER**	2	4.0E-01	0.8000		7.4E-01	0.0000
	<b>LIGHT OIL TOTALS (lb/day)</b>		<b>4.6174</b>	<b>WATER/OIL TOTALS (lb/day)</b>		<b>0.0000</b>
<b>TOTAL PREDICTED EMISSIONS (lb/day)</b>					<b>7.0704</b>	

### AVERAGE MOLE WEIGHT OF HYDROCARBON EMISSIONS

TYPE	MOLE WEIGHT	DEFAULT MOLE WEIGHT		PERCENT OF EMISSIONS	AVERAGE MOLE WEIGHT
GAS	16.96	16.03		34.69%	5.88
HEAVY OIL		67.53	X	0.00%	0.00
LIGHT OIL	48.83	46.33		65.31%	31.89
Oil/WATER		56.31	X	0.00%	0.00
<b>TOTAL AVERAGE MOLE WEIGHT</b>					<b>37.77</b>

**NOTES:**

\*\* The "OTHER" category includes: compressors, diaphragms, drains, dump arms, hatches, instruments, meters, pressure relief valves, polished rods, and vents

\*\*\*Water/Oil emission factors apply to water streams in oil services with a water content greater than 50% from the point of origin to the point where the water content reaches 99%. For water streams with a water content greater than 99%, the emission rate is considered negligible.

# DJA ENGINEERING SERVICES INC.

## 4335 REQUIRED VENTILATION RATE CALCULATION SUMMARY

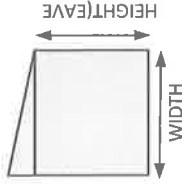
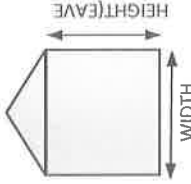
Project Number: 33229-02 Document Number: 4335-FES CALC

### BUILDING VOLUME (ft<sup>3</sup>) [V] CALCULATION

	VOLUME
LENGTH (ft)	18.00
WIDTH (ft)	14.50
HEIGHT TO EAVE (ft)	17.50
ROOF PITCH (X:12)	4
<b>TOTAL BUILDING VOLUME (ft<sup>3</sup>)</b>	<b>4882.9</b>

### BUILDING TYPE

GABLE STYLE     SHED STYLE



### REQUIRED VENTILATION RATE (ACPH) [Q] CALCULATION

PREDICTED HC EMISSIONS (lb/hr)	0.3
TOTAL AVERAGE MOLE WEIGHT (mw)	37.8
MAXIMUM ENCLOSURE AMBIENT TEMPERATURE (°F)	104
LOWER EXPLOSION LIMIT (%)	1%
APPLIED SAFETY FACTOR	4

CORRECTED GAS VOLUME AT AMBIENT TEMPERATURE (ft <sup>3</sup> ) [V]	412
PREDICTED HYDROCARBON LEAK RATE (cfm) [G]	0.053
FRESH AIR INTRODUCTION RATE @ 25% LEL (cfm) [Q]	21.4
MINIMUM REQUIRED VENTILATION RATE (cfm) [Q']	85.6

**ENCLOSED AREA MINIMUM REQUIRED AIR CHANGES PER HOUR    1.1**

EQUIPMENT AND FITTINGS WORKSHEET FOR  
 PREDICTED HC EMISSIONS PER COMPONENT  
 FOR GAS PLANT OPERATIONS (SHEET 1 OF 2)

PROJECT: COB CLOSED HC DRAIN PKGE  
 DATE: 6/13/2014

BUILDING: 2014-8440-50 (14499)  
 BY: MA

COMPONENT		GROUP 1	GROUP 2	GROUP 3
TYPE	STYLE	No. OF COMPONENTS	No. OF COMPONENTS	No. OF COMPONENTS
VL	GATE			
	MULT			
	BALL	6		
	PLUG			
	GLBE			
	NDLE	2		
	CHCK			
	BTFY			
	RELF			
	SUBTOTAL			
CN	FLFF	17		
	FLRI			
	THRD	16		
	GASK			
	UNIN			
	TUBE			
	ORIN			
	FLGA			
	SUBTOTAL			
HA	FLFF			
	THIF			
	SUBTOTAL			
SP	RERO			
	ROSH			
	MESL			
	SUBTOTAL			
DI	VLOP			
	DPRS			
	SUBTOTAL			
SM	GATE			
	BALL			
	PLUG			
	GLBE			
	NDLE			
	RELF			
	SUBTOTAL			

EQUIPMENT AND FITTINGS WORKSHEET FOR  
 PREDICTED HC EMISSIONS PER COMPONENT  
 FOR GAS PLANT OPERATIONS (SHEET 2 OF 2)

PROJECT: COB CLOSED HC DRAIN PKGE	BUILDING: 2014-8440-50 (14499)
DATE: 6/13/2014	BY: MA

COMPONENT		GROUP 4	GROUP 5	GROUP 6
TYPE	STYLE	No. OF COMPONENTS	No. OF COMPONENTS	No. OF COMPONENTS
VL	GATE			
	MULT			
	BALL	20		
	PLUG			
	GLBE			
	NDLE	4		
	CHCK	1		
	BTFY			
	RELF	1		
	SUBTOTAL			
CN	FLFF	33		
	FLRI			
	THRD	45		
	GASK			
	UNIN			
	TUBE			
	ORIN			
	FLGA			
	SUBTOTAL			
SG	GLSS	1		
	SUBTOTAL			
SP	RERO			
	ROSH			
	MESL			
	SUBTOTAL			
SM	GATE			
	BALL			
	PLUG			
	GLBE			
	NDLE			
	RELF			
	SUBTOTAL			
PP	OPTX			
	SUBTOTAL			



**SITE DATA SHEET**

SHT 1 OF 1



CLIENT DEVON CANADA  
PROJECT FERRIER CENTRAL PROCESSING FACILITY

**PHYSICAL DATA**

LOCATION (CPF) Rocky Mountain House, Alberta  
11-02-039-08 W5M

ELEVATION 1020-1030 m  
ATM. PRESSURE 89.55 kPa(a)

**CLIMATIC TEMPERATURES**

	AVERAGE	MAXIMUM	MINIMUM
WINTER °C			-40
SUMMER °C		40	
YEARLY °C			

**DESIGN TEMPERATURES**

WINTER -40 °C  
SUMMER 28 °C  
AIR COOLER DESIGN TEMPERATURE 35 °C

**WIND**

	WINTER	SUMMER
PREVAILING DIRECTION	NW	NW
PRESSURE COEFFICIENT Cp	1	1
REFERENCE WIND PRESSURE kPag	0.5	0.5
IMPORTANCE FACTOR Iw	1	1
EXPOSURE	A	A
DESIGN WIND SPEED / GUST	<u>100 / 160</u> km/h	

**RAINFALL**

AVERAGE 425 mm/yr  
MAXIMUM 86.0 mm/d

**DESIGN MAXIMUM**

RAINFALL (mm)	TIME PERIOD (hr)
<u>72.3</u>	<u>24 (1:10 yr)</u>
<u>26.7</u>	<u>1 (1:10 yr)</u>

DESIGN LOAD (summer) 10.0 kg/m<sup>2</sup>

RELATIVE HUMIDITY: 57-80 %

**SNOW**

GROUND SNOW LOAD, S<sub>g</sub> 1.9 kPa  
ASSOCIATED RAIN LOAD, S<sub>r</sub> 0.1 kPa

**DESIGN FROST GROUND PENETRATION**

3.0 m

**SEISMIC**

DESIGN BASIS NBC 2010 Site Class C

S<sub>a</sub>(0.2) 0.15  
S<sub>a</sub>(0.5) 0.08  
S<sub>a</sub>(1.0) 0.04  
S<sub>a</sub>(2.0) 0.02  
IMPORTANCE FACTOR 1

**ELECTRIC POWER**

4160V / 3PH / 60 HZ Areas 001/002/003  
600V / 3PH / 60HZ Areas 001/002/003 Office/Warehouse  
120V/208V / 1PH / 60HZ Areas 001/002/003 Office/Warehouse  
208V / 3PH / 60HZ Office/Warehouse

**FUEL GAS (main and pilot fuel)**

		Phase 1B	Deep Cut
H2O	mole %	0.00003	0.00000
He	mole %	0.00008	0.00009
N2	mole %	0.00429	0.00497
CO2	mole %	0.01544	0.01418
H2S	mole %	0.00000	0.00000
C1	mole %	0.81925	0.94810
C2	mole %	0.10557	0.03198
C3	mole %	0.04348	0.00066
IC4	mole %	0.00399	0.00001
nC4	mole %	0.00828	0.00001
iC5	mole %	0.00082	0.00000
nC5	mole %	0.00061	0.00000
C6	mole %	0.00011	0.00000
C7+	mole %	0.00005	0.00000
MEG	mole %	0.00000	0.00000
DEWPOINT	°C		
MIN / MAX TEMPERATURE	°C		
NORMAL SUPPLY PRESSURE	kPa		
MIN / MAX PRESSURE	kPa		- / 6500

**UPS**

120 / 1PH / 60HZ Yes  
24 VDC Not Used

**INSTRUMENTATION & CONTROL**

110 / 1PH / 60HZ not used  
24 VDC Yes

**HEAT MEDIUM**

WARM Remark 1 °C  
UTILITY Remark 1 °C

**INSTRUMENT AIR**

PRESSURE (NORMAL/MIN/MAX - at header) 830/550/910 kPa  
TEMPERATURE (NORMAL / MIN / MAX) 25/20/45 °C  
DEW POINT -60 °C

**UTILITY AIR**

PRESSURE (NORMAL/MIN/MAX - at header) 830/620/910 kPa  
TEMPERATURE (NORMAL / MIN / MAX) 25/20/45 °C  
DEW POINT -60 °C

**PROCESS WATER**

PRESSURE (NORMAL / DESIGN) Remark 1 kPa  
TEMPERATURE (NORMAL / DESIGN) Remark 1 °C

**POTABLE/UTILITY WATER**

PRESSURE (NORMAL / DESIGN) Remark 1 kPa  
TEMPERATURE (NORMAL / DESIGN) Remark 1 °C

**COOLING MEDIUM**

TYPE Remark 1  
SUPPLY PRESSURE (NORMAL/MIN/MAX) Remark 1 kPag  
SUPPLY TEMPERATURE Remark 1 °C  
MAX. DIFF. PRESS. ALLOWABLE Remark 1 kPa  
RETURN TEMP. MAX. ALLOW. Remark 1 °C  
RETURN TEMP. MIN. ALLOW. Remark 1 °C  
DESIGN PRESSURE Remark 1 kPag

**REMARKS:**

1.0 Refer to document no. 407014-00120-00-PR-TAB-0001 Utilities Table for information.



JOB NUMBER 407014-00120  
DATA SHEET NO. 407014-00120-00-ME-DAS-0085

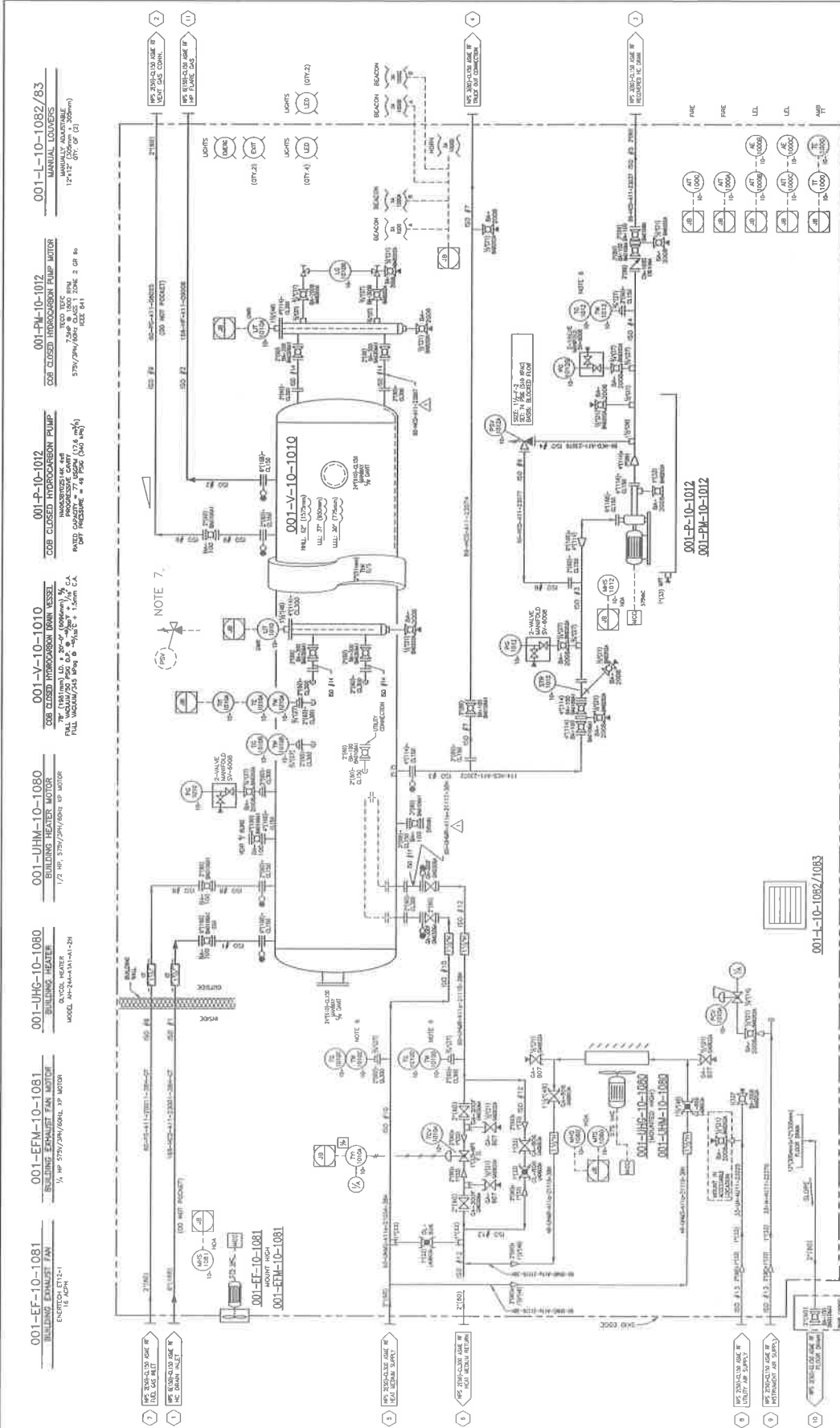
REV	DATE	MECH	PROC	ELEC	CHKD	APPR
C	2012.08.28	JNG			TA	
D	2012.10.10	JNG			TA	
E	2012.11.08	JNG			LK	

**2013-8440-50/51 Liquid Composition**

**Liquids Composition at CHD Vessels**

	COB		LEP		
	LP Sep	FWKO Liquids	HP Sep	LP Sep	Stabilizer
N2	0.00005%	0.000%	0.00%	0.01%	0.00%
CO2	0.01718%	0.017%	0.06%	0.28%	0.33%
C1	0.16472%	0.182%	0.24%	3.44%	2.14%
C2	0.94414%	0.728%	0.97%	2.42%	3.61%
C3	5.05900%	2.898%	4.29%	3.65%	6.40%
iC4	2.56287%	1.012%	2.81%	1.49%	2.47%
nC4	9.22085%	3.194%	6.84%	3.30%	5.29%
iC5	7.05389%	4.698%	4.78%	2.33%	3.22%
nC5	9.32850%	2.030%	5.85%	2.99%	3.94%
C6	21.48283%	19.457%	7.28%	5.29%	5.62%
C7	4.51453%	5.357%	1.75%	1.75%	1.63%
C8	0.00000%	11.560%	10.55%	12.32%	10.86%
C9+	1.42757%	35.407%	34.060%	43.067%	37.124%
Mcyclopentane	4.61109%	0.191%	2.98%	2.11%	2.28%
Benzene	2.74130%	0.106%	1.82%	1.27%	1.38%
Cyclohexane	6.06391%	0.197%	4.09%	3.08%	3.23%
Mcyclohexane	10.32864%	0.157%	6.04%	5.73%	5.47%
Toluene	8.17209%	0.084%	3.10%	3.06%	2.86%
E-Benzene	1.07373%	0.003%	0.28%	0.32%	0.28%
M-Xylene	5.23311%	0.013%	1.77%	2.09%	1.84%
H2O	0.00000%	12.707%	0.43%	0.03%	0.02%





001-L-10-1082/83  
MANUAL COVER  
12" X 12" (305 x 305 mm)  
REV. 01

001-PM-10-1012  
COB CLOSED HYDROCARBON PUMP MOTOR  
375W/230V/60Hz/3-Phase/1800 RPM  
NEMA 31  
REV. 01

001-P-10-1012  
COB CLOSED HYDROCARBON PUMP  
375W/230V/60Hz/3-Phase/1800 RPM  
NEMA 31  
REV. 01

001-V-10-1010  
COB CLOSED HYDROCARBON DRAIN TANK  
1000 GAL (3785 L)  
NOMINAL VOLUME  
REV. 01

001-JHM-10-1080  
JUNCTION BOX  
1/2" HP, 375W/230V/60Hz/3-Phase/1800 RPM  
REV. 01

001-JHC-10-1080  
JUNCTION BOX  
1/2" HP, 375W/230V/60Hz/3-Phase/1800 RPM  
REV. 01

001-FFM-10-1081  
FLARE GAS FURNACE MOTOR  
1/2" HP, 375W/230V/60Hz/3-Phase/1800 RPM  
REV. 01

001-FF-10-1081  
FLARE GAS FURNACE  
1/2" HP, 375W/230V/60Hz/3-Phase/1800 RPM  
REV. 01

REVISIONS		DATE		BY		CHECKED		APPROVED	
1	ISSUE	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
2	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
3	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
4	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
5	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
6	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
7	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
8	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
9	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM
10	REVISED FOR CONSTRUCTION	01/10/2010	JHM	JHM	JHM	JHM	JHM	JHM	JHM

GENERAL LEGEND	
1	FLARE GAS BURNER
2	FLARE GAS STACK
3	FLARE GAS FURNACE
4	FLARE GAS MOTOR
5	FLARE GAS MOTOR
6	FLARE GAS MOTOR
7	FLARE GAS MOTOR
8	FLARE GAS MOTOR
9	FLARE GAS MOTOR
10	FLARE GAS MOTOR

NOTES	
1	THIS DRAWING IS THE PROPERTY OF ALCO GAS & OIL. IT IS TO BE KEPT IN CONFIDENCE AND NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF ALCO GAS & OIL.
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VALVE TAGGING	
1	COB CLOSED HYDROCARBON PUMP MOTOR
2	COB CLOSED HYDROCARBON PUMP
3	COB CLOSED HYDROCARBON DRAIN TANK
4	COB CLOSED HYDROCARBON DRAIN TANK
5	COB CLOSED HYDROCARBON DRAIN TANK
6	COB CLOSED HYDROCARBON DRAIN TANK
7	COB CLOSED HYDROCARBON DRAIN TANK
8	COB CLOSED HYDROCARBON DRAIN TANK
9	COB CLOSED HYDROCARBON DRAIN TANK
10	COB CLOSED HYDROCARBON DRAIN TANK

REFERENCE DRAWINGS	
001-L-10-1082/83	MANUAL COVER
001-PM-10-1012	COB CLOSED HYDROCARBON PUMP MOTOR
001-P-10-1012	COB CLOSED HYDROCARBON PUMP
001-V-10-1010	COB CLOSED HYDROCARBON DRAIN TANK
001-JHM-10-1080	JUNCTION BOX
001-JHC-10-1080	JUNCTION BOX
001-FFM-10-1081	FLARE GAS FURNACE MOTOR
001-FF-10-1081	FLARE GAS FURNACE

MECHANICAL FLOW SHEET	
001-L-10-1082/83	MANUAL COVER
001-PM-10-1012	COB CLOSED HYDROCARBON PUMP MOTOR
001-P-10-1012	COB CLOSED HYDROCARBON PUMP
001-V-10-1010	COB CLOSED HYDROCARBON DRAIN TANK
001-JHM-10-1080	JUNCTION BOX
001-JHC-10-1080	JUNCTION BOX
001-FFM-10-1081	FLARE GAS FURNACE MOTOR
001-FF-10-1081	FLARE GAS FURNACE

ALCO GAS & OIL	
1	ALCO GAS & OIL
2	ALCO GAS & OIL
3	ALCO GAS & OIL
4	ALCO GAS & OIL
5	ALCO GAS & OIL
6	ALCO GAS & OIL
7	ALCO GAS & OIL
8	ALCO GAS & OIL
9	ALCO GAS & OIL
10	ALCO GAS & OIL

## **SECTION G**

### **SHIPPING**



INSPECTION GROUP INC.



2836 Ellwood Dr., Edmonton, AB, Canada, T6X 0A9, Phone: (780) 450-8883 Fax: (780) 450-8884, [projects@mtlinspection.com](mailto:projects@mtlinspection.com)

### INSPECTION RELEASE REPORT

<b>MTL Job No.</b>	3048-1	<b>Release No.</b>	001
<b>Devon PO#</b>	4100001343 / FE-CPF-M023	<b>WBS No.</b>	01-00348.01.01.03
<b>Project</b>	Ferrier – Central Processing Facility	<b>Location / LSD</b>	Ferrier – CPF LSD: 11-02-39-08 W5M
<b>Client Project Engineer</b>	Susan Chin – Engineer Shane Usipuik – QA Lead Amrik Dhaliwal - Expeditor	<b>Phone</b>	403-776-6403 <a href="mailto:Susan.chin@dvn.com">Susan.chin@dvn.com</a> 403-232-7497 <a href="mailto:Shane.usipuik@dvn.com">Shane.usipuik@dvn.com</a> 403-776-6435 <a href="mailto:Amrik.dhaliwal@dvn.com">Amrik.dhaliwal@dvn.com</a>
<b>Vendor</b>	Alco Gas & Oil Production – Edmonton, AB	<b>Vendor Job No.</b>	8440-50
<b>Vendor Primary Contact</b>	Michael Wagner – Calgary, AB	<b>Phone</b>	403-243-5055
<b>Equipment</b>	(1) Closed Hydrocarbon Drain Package	<b>Tag No.</b>	001-PK-10-1000
<b>Carrier</b>	Trans Tech	<b>Trailer No.</b>	
<b>Packing Slip No.</b>		<b>Waybill No.</b>	

Rev #	Inspection	Shipping	Details	Date	Inspector	Vendor
0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Final inspection to building package.	August 13, 2014		X
1	<input type="checkbox"/>	<input type="checkbox"/>				
2	<input type="checkbox"/>	<input type="checkbox"/>				
3	<input type="checkbox"/>	<input type="checkbox"/>				

#### Description of Material or Equipment

- Closed Hydrocarbon Drain Package c/w ship loose items.

		Yes	No	N/A
<b>Shop Release</b>	The Vendor Quality Control shall ensure that all Non-Conformance Reports are signed off if applicable.	X		
<b>Shop Release</b>	The Vendor Quality Control shall ensure that all the documentation is forwarded to the site with the completed equipment.	X		
<b>Shop Release</b>	The Client Representative shall witness equipment loading and tie down and will verify that any loose material to be installed at site is secured for transport.	X		
<b>Shop Release</b>	The Vendor shall ensure all packaging, markings and shipping preparations are in compliance with Devon specifications, purchase order, notes and attachments.	X		

#### Deficiency Items if Applicable

Attached  N/A Comments: *see attached AIL*

Dan de Groot		August 13, 2014	780-218-1298	<a href="mailto:djdegroot@telus.net">djdegroot@telus.net</a>
Inspector	Signature	Date	Phone	E-Mail

Any omission or failure on part of the inspector to disapprove or reject any work or materials shall not be construed as acceptance of any defective work or materials.  
DOCUMENT T45 (Rev 1)



INSPECTION GROUP INC.

devon

2836 Ellwood Dr., Edmonton, AB, Canada, T6X 0A9, Phone: (780) 450-8883 Fax: (780) 450-8884, projects@mtinspection.com

*David Glasgow	*David Glasgow	*Aug 13/14	*780-465-9061	*dave.glasgow@alcojasoil.com
Vendor Quality Representative	Signature	Date	Phone	E-Mail
ADDITIONAL NOTES				



RYAN

**STANDARD UNIFORM STRAIGHT BILL OF LADING - NOT NEGOTIABLE**

RECEIVED, Subject to the classification and tariffs in effect on the date of the receipt by the carrier of the property described in this Original Bill of Lading.

CARRIER TRANS TECH (SHIPPER) DATE AUG 13, 2014  
 TRUCK DEPOT

CONSIGNEE DEVON CANADA  
 ADDRESS LSO: 11-02-039-08 WSM (STREET & NUMBER)  
 DESTINATION FERRIER CPF PROJECT (CITY) ALTA (P.O. BOX)  
 ROUTING

NO. OF PACKAGES	DESCRIPTION OF ARTICLES, MARKS, EXCEPTIONS AND APPROXIMATE SIZE	APPROX. WEIGHTS	RATES
1	HYDROCARBON DRUM PACKING		
	TAC 001-PK-10-1000		

9440-50

**C.O.D.**  
 CASH ON DELIVERY

Amount \$ \_\_\_\_\_  
 Fee \$ \_\_\_\_\_  
 Total \$ \_\_\_\_\_

SHIPPER TO CIRCLE IF PREPAID OR COLLECT →  
 If Not Indicated the Shipment will Automatically Move Collect

PREPAID  E. & O.E. COLLECT

DECLARED VALUATION MAXIMUM LIABILITY OF CARRIER IS \$2.00 PER LB. UNLESS DECLARED VALUATION STATES OTHERWISE.

Shipper ALCO GAS & OIL PRODUCTION EQUIPMENT LTD. Carrier TRANS TECH  
 Per [Signature] Per [Signature] Date AUG 13, 2014

Received at the point shown on the date specified and from the shipper mentioned herein, the property herein described in apparent good order, except as noted (contents and conditions of contents of packages unknown) marked, consigned and destined as indicated below, which said carrier agrees to carry and deliver to the said consignee at the said destination if on its own route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of the said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the conditions not prohibited by law, whether printed or written, including conditions on back hereof, which are here agreed to by the shipper and accepted for himself and his assigns.

**ALCO**

**GAS & OIL**  
**PRODUCTION EQUIPMENT LTD.**  
 7415 53rd AVE.  
 P.O. BOX 5853 STN. "L"  
 EDMONTON ALBERTA T6C 4G3

BILL OF LADING

PS 02734

JOB NUMBER  
8440-50DATE July 29<sup>th</sup>  
2014PHONE: (403) 465-9061  
TELEX: 037-43276

PACKING SLIP

COB Closed Hydrocarbon  
DRAIN PACKAGEDEVON CANADA CORPORATIONS  
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OS  
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OFERRIER CPF

QTY. ORDERED	BACK ORDER	DESCRIPTION	QTY. SHIPPED
2	0	Door Canopies	2
5	0	box of electricals	5
1	0	Pump manual	1
2	0	WIKA Pressure gauges 0-60 PSIG 4 1/2" DIAL TAG - PG-1010, PG-1012	2
1	0	WIKA Pressure gauge 0-100 PSIG 4 1/2" DIAL 0-100 TAG - PG-1012B	1
1	0	WIKA Thermometer 5" DIAL 0-250°F Range 18" long MOR TAG - TG-1010B	1
3	0	WIKA Thermometer 5" DIAL 0-250°F Range 6" stem TAG - TG-1010C, TG-1010D, TG-1012	3
1	0	2" -150- RF Ball Valve with Handle	1

CLAIMS MUST BE MADE WITHIN 5 DAYS OF RECEIPT OF GOODS.

WAREHOUSE COPY

**ALCO**



**GAS & OIL**  
PRODUCTION EQUIPMENT LTD.  
7415 53rd AVE.  
P.O. BOX 5853 STN. "L"  
EDMONTON ALBERTA T6C 4G3

BILL OF LADING

PS 02742

JOB NUMBER  
8440-50

DATE Aug 15-2016

PHONE: (403) 465-9061  
TELEX: 037-43276

PACKING SLIP

Devon Canada Corporation

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QTY. ORDERED	BACK ORDER	DESCRIPTION	QTY. SHIPPED
1	Q	QC Manual.	1

CLAIMS MUST BE MADE WITHIN 5 DAYS OF RECEIPT OF GOODS.

WAREHOUSE COPY



# Westpower Equipment Ltd.

4451 - 54 Avenue S.E.  
 Calgary AB T2C 2A2  
 Phone: (403) 720-3300 Ext. Fax: (403) 236-9812

# Quote

DATE February 10, 2015  
 NUMBER Q000011946  
 CUSTOMER NO. ALC001

**BILL TO:**

ALCO Gas & Oil  
 E-mail: Alco\_ap@AlcoGasOil.com  
 5203 - 75 Street  
 Edmonton AB T6E 5S5

**SHIP TO:**

ALCO Gas & Oil  
 E-mail: Alco\_ap@AlcoGasOil.com  
 5203 - 75 Street  
 Edmonton AB T6E 5S5

(780) 465-9061 Ext.

(780) 465-9061 Ext.

P.O. NUMBER	SALESPERSON	QUOTE DATE	REQ. DATE	ORDER NUMBER
RFQ Ryan	0000000003	09-Feb-15		Q000011946
F.O.B.	SHIP VIA		TERMS	
Westpower			Net 30 days	

PART NUMBER DESCRIPTION	UOM	QUANTITY REQ.	UNIT PRICE	EXTENDED PRICE
956486 Connecting Rod NM063 02S ( 4-6 weeks delivery )	EA	1		
NDB4963493 Rotor NM063 02S (4-6 weeks delivery )	EA	1		
NDB4955237 Stator NM036 02S ( currently stock Netzsch ON )	EA	1		
TBA Gear Joint Kit NM063 02S ( 4-6 weeks delivery )	EA	1		
P505687 Mechanical Seal, John Crane ( 5-6 weeks )	EA	1		

**CANADIAN DOLLARS  
 NET AMOUNT**

**FREIGHT  
 G.S.T.**

**TOTAL DUE**

Business Number 139422976RT0001