



# **Installation & Operating Manual Quality Control Documents**

**Job 20960 (SO2246)**

**Gardner Denver E25  
75HP VRU Skid**

**Tamarack Valley**

**Purchase Order: TBD**

**S/N 20960**

**Brittania Industries 2009 Inc.**

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CCS Temperature Switch	
Sur-Flo Back Pressure Control Valve	
Catalytic Heater	
Thermostatic Control Valve	

## INTRODUCTION

This manual is prepared to acquaint you with the operation and maintenance of your BRITTANIA natural gas compressor package.

When it comes to service, keep in mind that Brittania Industries Inc. knows the design details of your compressor package. We invite you to contact us for all your service needs both during and after the warranty period.

Thank you for choosing a system manufactured by Brittania Industries Inc.. We assure you of our continued interest in your complete satisfaction with our products.

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## **SAFETY WARNINGS**

You will find a number of important safety and operational notices in this manual.

A box with the word CAUTION will tell you about things that could be harmful to you if ignored.

### **CAUTION**

THIS INDICATES SOMETHING THAT COULD HARM YOU OR OTHER PEOPLE!

A box with the word NOTICE will indicate items that could damage your compressor package or other equipment. Many times, this damage will not be covered by warranty and could be costly. This NOTICE will tell you how to prevent the damage.

### **NOTICE**

THIS INDICATES SOMETHING THAT COULD DAMAGE YOUR COMPRESSOR.

### **CAUTION**

BEFORE INSTALLING THIS COMPRESSOR READ AND UNDERSTAND THE SAFETY PRECAUTIONS CONTAINED WITHIN THIS MANUAL.

A CAREFUL OPERATOR IS THE BEST ASSURANCE AGAINST AN ACCIDENT!

### **NOTICE**

THIS BULLETIN IS A GUIDELINE FOR QUALIFIED PERSONNEL. THE INFORMATION CONTAINED IN THIS BULLETIN MAY NOT BE COMPLETE AND IS SUBJECT TO CHANGE WITHOUT NOTICE.



# SECTION 1

## COMPRESSOR

Repair Manual  
Parts List

# **Gardner**

---

# **Denver**

***TAMROTOR* Compressors**

## **Enduro 25** **Repair instructions**

ATTN:  
Jim

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## To the user

Enduro air end is an oil injected single stage screw, which is designed for industrial air compressors.

Each Enduro air end is designed for its own capacity range.

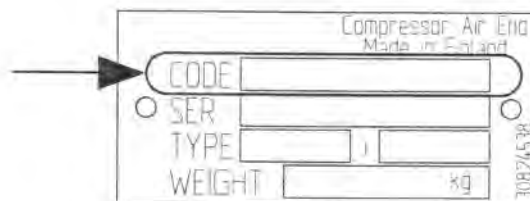
**Don't exceed the max. pressure, power and rotation speed and don't use lower than the minimum rotation speed given in the technical data.** The warranty of the air end is not valid if these values are exceeded.

Only the use of original spare parts guarantees long and reliable lifetime.

This instruction makes you acquainted with the repair of Enduro air end.

**Read these instructions carefully before starting the repair work.**

When ordering spare parts, please, give the codenumber from the plate connected to the air end.



## Safety

Read always the safety instructions of the equipment, where the air end is used!

The cleanness in all repair work is of great importance. All the foreign particles in the air end shorten the life time of the bearings and the rotors.

### Before starting the repair work

1. Disconnect the electric supply.  
(in diesel driven compressors take care that the motor cannot be started)
2. Make sure that there is no pressure in the oil receiver and close the valve between the compressor and the air line.
3. The air end and oil is hot immediately after the compressor has been stopped. Give time for cooling.

### Before starting the compressor

1. Assure that the oil used is correct (see oil recommendation), and that the oil level is correct.
2. Make sure that the rotation direction is correct by starting the compressor momentarily.  
Max starting time 2 seconds.



**Running the compressor unit in the wrong direction causes damage.**

## Technical data

Rotor size		
- male $\phi$	mm	155
- female $\phi$	mm	122,84
Lobe combination		4/5
Male rotor driven		
Displacement volume	l/rev	2,5009
Male rotor speed		
- min	rpm	1200
- max	rpm	5500
Tip speed (male)		
- min	m/s	10
- max	m/s	45
Input power		
- max	kW	75
Working pressure		
- min	bar	3
- max	bar	13
Oil injection quantity	l/min	70 - 120
Weight	kg	about 112

On the repairing of the compressor air end use always special tools.

## Disassembly

1. Clean the outside surfaces of the compressor unit from all dirt.
2. Place the compressor unit on a steady surface where the repair work can be carried out.
3. Remove the screws(19 and 30) of the outlet cover(28), and remove the cover.
4. Remove the screws(20) of the seal cover(3) , and remove the cover.
5. Mount a special tool to the drive shaft and lock it to the rotor housing.
6. Use a special tool to open the lock nuts(12 and 13) and make sure that the special tool prevents the shaft from turning.
7. Remove the screws(18) of the discharge flange(2) .
8. Remove the tool mounted to the drive shaft.
9. Remove the discharge flange using the threads in the flange.  
(In older models remove the discharge flange by lightly tapping the drive shaft with a copper drift.  
Note! Do not use a screw driver to pry off the flange.)
10. Remove the rotors from the body.  
Note! Handle the rotors with care.
11. Note the positions of the ball bearings(10 and 11).
12. Use a suitable drift to remove the outer races of the bearings.  
Note! A puller must be used for the bearing(7).
13. Use a puller to remove the inner races of the bearings.  
Note! Take care not to damage the shaft when you remove the inner sleeve(14) of the shaft seal.
14. Remove the shaft seal from its housing. Note the position of the seal(15).
15. Remove the remains of the sealings from the covers, and wash all parts clean.

16. Check the parts:

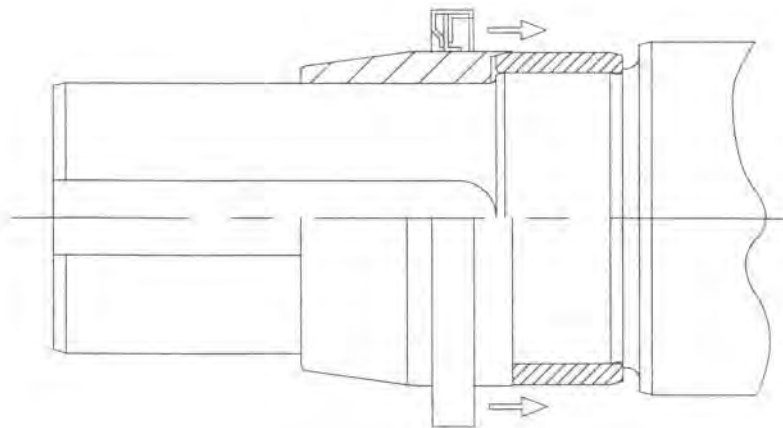
Part	Do not reuse if
Rotors	- ends have seizure marks
	- contact surface marks are uneven
	- rotors have scratches or dents
	- bearing seats are worn
	- rotors have touched body or end flanges
Body	- rotors have touched body
	- body shows signs of overheating (blue colour)
Discharge flange	- flange shows signs of overheating (blue colour)
	- rotors have touched flange
	- O-ring groove is damaged

17. Always fit new bearings and sealings.  
 Use original spare parts.

## Assembly

1. Install the bearings(7 and 9) to the body.  
 Use Loctite 601 to lock the bearings in place and use assembly tool.  
 Lubricate the bearings.
2. Using a special assembly tool, mount the inner races of the bearings(8 and 9, and 7 and 9) onto the rotors.
3. Install the rotors to the body and lock the drive shaft with a special tool.
4. Use a special tool to install the bearings(8 and 9) to the discharge flange.  
 Use Loctite 601.  
 Lubricate the bearings.
5. Using grease install the O-rings(17 and 16) into their grooves. Mount the discharge flange.
6. Use spring pins(24, 2 pcs) to install the discharge flange.
7. Tighten the screws(18) in crosswise sequence to 180 Nm.
8. Install the ball bearings(10 and 11) of the discharge flange using the special tool.  
**Note!** The thick side of the inner race outwards.
9. Install the lock nuts(12 and 13) with their own tools.  
 Apply Molykote 1000 to the threads.

10. Adjust end float:
  - Tighten the lock nuts lightly so that the clearance between the rotor ends and the discharge flange disappears. Do not overtighten.
  - Open the nuts (approx. 8-12°) so that the clearance between the rotor ends and the discharge flange is 0.03 to 0.05 mm. Move the rotors up and down to measure the clearance. Use a dial gauge. Note that the lock nuts need no separate locking.
11. Mount the outlet cover(28) with the gasket(4), and tighten the screws(19 and 30) to 25 Nm.
12. Install the protection ring(6) and the shaft seal(15) into the seal cover(3).  
Use Loctite 542 and a special tool.  
**Note!** The shaft seal lip should face inwards.
13. Install the inner sleeve of the shaft seal, using Loctite 601 and an assembly tool.
14. Install an assembly bushing for the shaft seal into the rotor shaft against the inner sleeve of the shaft seal and install the sealing housing carefully into its position (see drawing).  
Remember also to install the gasket(5).  
**Note!** The oil hole from the body to the sealing housing must be open.  
Remove the assembly bushing carefully from the shaft.
15. Tighten the screws(20) of the seal cover to 25 Nm.
16. Pour in some oil through the intake and rotate the drive shaft a few times.  
Plug and seal all openings.  
Protect the drive shaft against corrosion.





## Lubricants and tools that you need

### Lubricants

Lubricating oil	SAE 10W
Grease	Molykote 1000

### Cement

Cement	Loctite 601
Cement	Loctite 542

### Assembly tool set

<b>Assembly tool set for Enduro 25 air end</b>	<b>308 474 98</b>
assembly tools for inner race of bearing:	
inlet end, male rotor roller bearing	
inlet end, female rotor roller bearing	
discharge end, male rotor bearings	
discharge end, female rotor bearings	
assembly tools for bearing to body:	
inlet end, male rotor roller bearing	
inlet end, female rotor roller bearing	
assembly tools for bearing to discharge flange:	
male rotor roller bearing	
female rotor roller bearing	
special tool for lock of rotors	
drift for pins	
special tools for lock nut:	
male rotor	
female rotor	
assembly tool for inner sleeve of shaft seal	308 518 78
assembly bushing for shaft seal	034 236 78
assembly tool for shaft seal	308 517 48

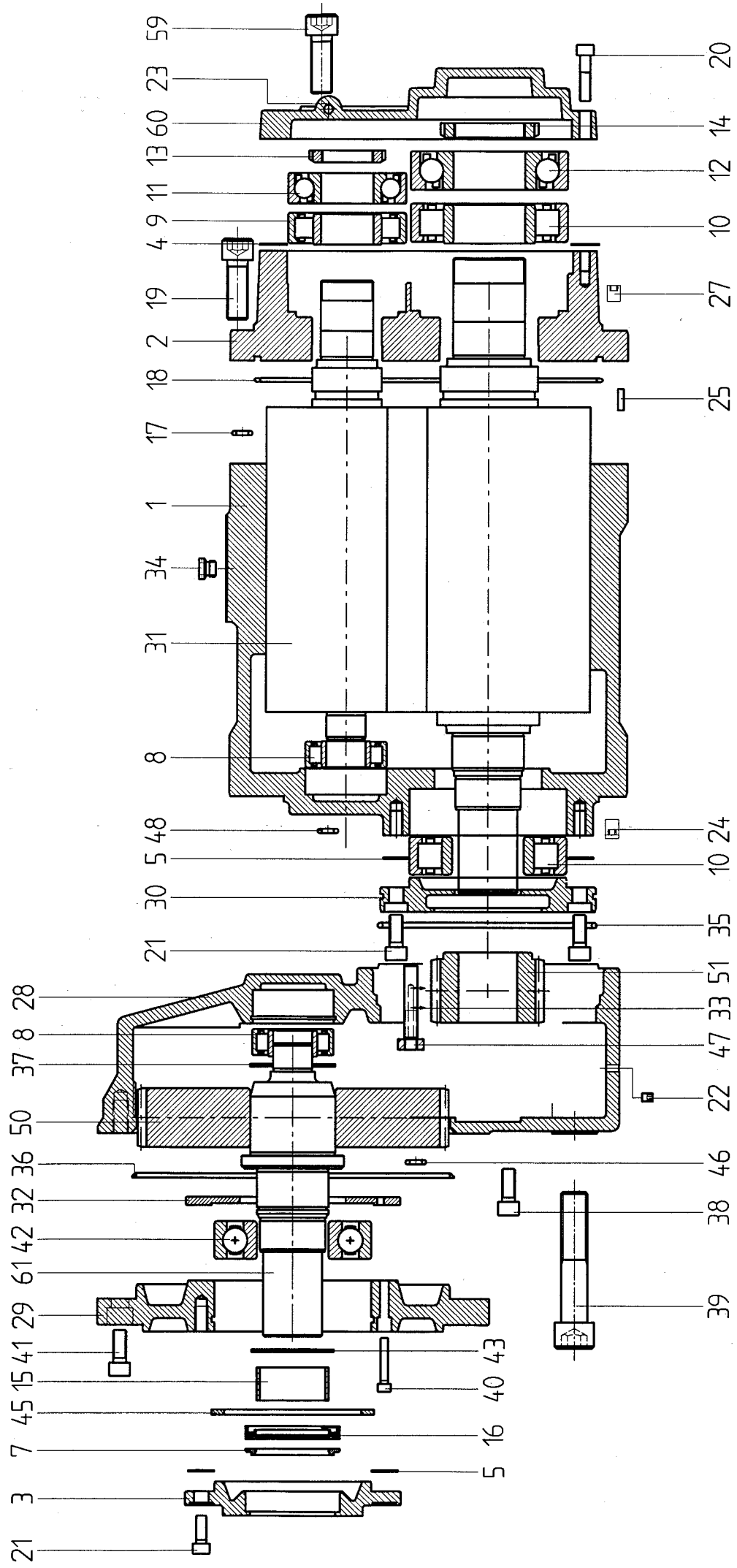
**Varaosat  
Reservdelar  
Spare parts**

**Enduro 25  
040 210**

Viite N:o Det.Nr Ref.No	Tilaus N:o Reservdel Nr Order No	Kpl Antal Qty	Nimitys	Benämning	27.11.1997 Description
			<b>KOMPRESSORI- YKSIKKÖ</b>	<b>KOMPRESSOR- ENHET</b>	<b>COMPRESSOR AIR END</b>
			<b>Yhteiset osat</b>	<b>Standard delar</b>	<b>Standard parts</b>
1	040 211 08	1	Runko	Rotorhus	Rotor housing
2	040 212 38	1	Painelaippa	Avloppsgavel	Discharge flange
3	037 913 98	1	Tiivistekansi	Tätninglock	Seal cover
4	223 242 58	1	Tiiviste	Tätning	Gasket
5	308 091 18	1	Tiiviste	Tätning	Gasket
6	308 092 48	1	Suojarengas	Ring	Protection ring
7	870 894 89	1	Rullalaakeri	Rullager	Roller bearing
8	801 076 19	1	Rullalaakeri	Rullager	Roller bearing
9	872 847 39	2	Rullalaakeri	Rullager	Roller bearing
10	874 569 49	1	Viistokuulalaakeri	Kullager	Ball bearing
11	874 571 39	1	Viistokuulalaakeri	Kullager	Ball bearing
12	869 128 99	1	Lukitusmutteri	Låsmutter	Lock nut
13	874 555 29	1	Lukitusmutteri	Låsmutter	Lock nut
15	308 341 58	1	Akselitiiviste kok.p. sisältää osan 14	Axeltätning smst. innehåller delen 14	Shaft seal assy include item 14
16	879 088 49	2	O-rengas	O-ring	O-ring
17	872 846 09	1	O-rengas	O-ring	O-ring
18	445 863 50	4	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
19	800 592 59	11	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
20	802 805 59	6	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
21	870 898 99	1	Tulpparuuvi	Plugg	Plug screw
22	872 198 19	4	Tulpparuuvi	Plugg	Plug screw
23	870 899 19	5	Tulpparuuvi	Plugg	Plug screw
24	815 318 69	2	Jousisokka	Fjäderpinne	Spring pin
25	448 595 80	1	Pidätinruuvi	Stoppskruv	Lock screw
26	807 047 79	2	Kuusiokolotulppa	Plugg	Hex.socket plug
27	308 322 68	1	Suutin	Munstycke	Nozzle
			<b>Poikkeavat osat</b>	<b>Avvikande delar</b>	<b>Differing parts</b>
			<b>040 210 81</b>		
28	039 670 08	1	Lähtökansi	Avloppskupa	Outlet cover
29	308 090 98	1	Roottoripari	Rotorpar	Rotor pair
			<b>040 210 82</b>		
28	039 671 28	1	Lähtökansi	Avloppskupa	Outlet cover
29	308 090 98	1	Roottoripari	Rotorpar	Rotor pair
30	801 471 99	2	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
			<b>040 210 83</b>		
28	039 670 08	1	Lähtökansi	Avloppskupa	Outlet cover
29	308 090 91	1	Roottoripari	Rotorpar	Rotor pair
			<b>040 210 84</b>		
28	039 671 28	1	Lähtökansi	Avloppskupa	Outlet cover
29	308 090 91	1	Roottoripari	Rotorpar	Rotor pair
30	801 471 99	2	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
*	503 402 43	1	Korjaussarja (sisältää osat / innehåller delar / include items 4, 5, 7-13, 15-17, 24	Reparationssats	Repair kit

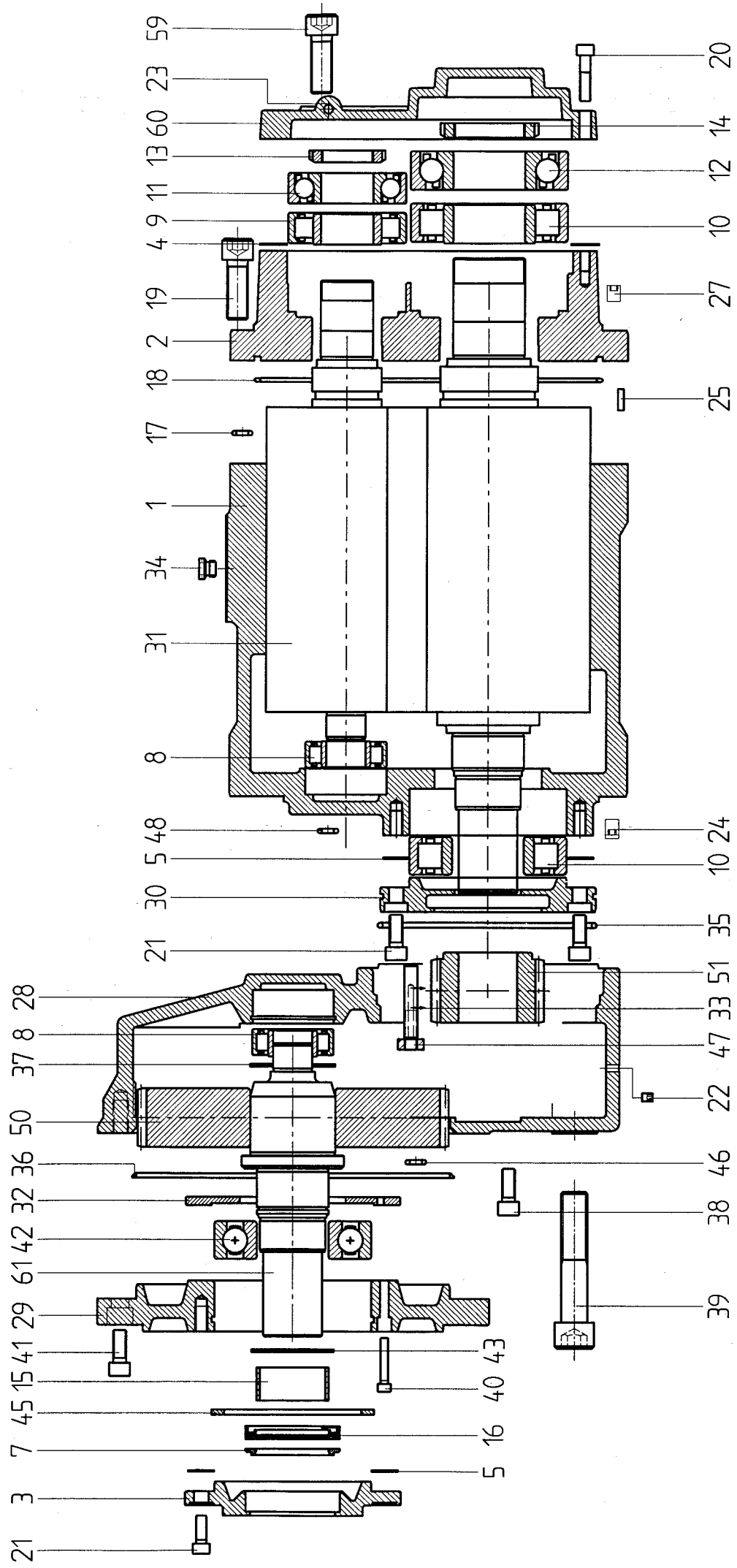
**Varaosat  
Reservdelar  
Spare parts**

**Enduro 25G  
308 346**



Viite N:o	Tilaus N:o	Kpl	Nimitys		25.05.1999
Det.Nr	Reservdel Nr	Antal		Benämning	
Ref.No	Order No	Qty			Description

			KOMPRESSORI- YKSIKKÖ	KOMPRESSOR- ENHET	COMPRESSOR AIR END
			Yhteiset osat	Standard delar	Standard parts
1	040 211 08	1	Runko	Rotorhus	Rotor housing
2	040 212 38	1	Painelaippa	Avloppsgavel	Discharge flange
3	037 913 98	1	Tiivistekansi	Tätningsslock	Seal cover
4	223 242 58	1	Tiiviste	Tätning	Gasket
5	308 091 18	2	Tiiviste	Tätning	Gasket
7	308 092 48	1	Suojarengas	Skyddsring	Protection ring
8	870 894 89	2	Rullalaakeri	Rullager	Roller bearing
9	801 076 19	1	Rullalaakeri	Rullager	Roller bearing
10	872 847 39	2	Rullalaakeri	Rullager	Roller bearing
11	874 569 49	1	Kuulalaakeri	Kullager	Ball bearing
12	874 571 39	1	Kuulalaakeri	Kullager	Ball bearing
13	869 128 99	1	Akselimutteri	Axelmutter	Lock nut
14	874 555 29	1	Akselimutteri	Axelmutter	Lock nut
16	308 341 50	1	Akselitiiviste kok.p. sisältää osan 15	Axeltätning smst. innehåller delen 15	Shaft seal assy include item 15
17	879 088 49	2	O-rengas	O-ring	O-ring
18	872 846 09	1	O-rengas	O-ring	O-ring
19	445 863 50	4	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
20	800 592 59	11	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
21	802 805 59	12	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
22	870 898 99	2	Tulpparuuvi	Plugg	Plug screw
23	872 198 19	4	Tulpparuuvi	Plugg	Plug screw
24	870 899 19	7	Tulpparuuvi	Plugg	Plug screw
25	815 318 69	2	Jousisokka	Fjäderpinne	Spring pin
27	448 595 80	1	Pidätinruuvi	Stoppskruv	Lock screw
28	040 214 98	1	Vaihdel.runko	Växellåda, hus	Gearbox casing
29	039 672 58	1	Vaihdel.laippa	Växellåda, fläns	Gearbox flange
30	037 964 68	1	Ohjausrengas	Styrningsring	Guide ring
31	308 090 98	1	Roottoripari	Rotorpar	Rotor pair
32	308 094 08	1	Välirengas	Mellanring	Spacing ring
33	308 131 98	1	Suutin	Munstrycke	Nozzle
34	308 322 68	1	Suutin	Munstrycke	Nozzle
35	866 630 99	1	O-rengas	O-ring	O-ring
36	895 984 09	1	O-rengas	O-ring	O-ring
37	422 272 90	1	Varmistinrengas	Låsring	Retaining ring
38	874 655 59	2	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
39	874 656 89	2	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
40	445 779 00	3	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
41	445 821 60	7	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
42	801 073 39	1	Urakuulalaakeri	Kullager	Ball bearing
43	422 100 40	1	Varmistinrengas	Låsring	Retaining ring
45	422 306 60	1	Varmistinrengas	Låsring	Retaining ring
46	522 049 00	1	O-rengas	O-ring	O-ring
47	800 820 19	1	Kuusiomutteri	Mutter	Nut
48	808 790 29	2	O-rengas	O-ring	O-ring
59	801 471 99	2	Kuusiokoloruuvi	Insexkantskruv	Hex.socket screw
60	039 670 08	1	Lähtökansi	Avloppskupa	Outlet cover
61	223 279 71	1	Akseli	Axel	Shaft



Viite N:o Det.Nr Ref.No	Tilaus N:o Reservdel Nr Order No	Kpl Antal Qty	Nimitys	Benämning	24.03.1997 Description
			<b>Poikkeavat osat</b>	<b>Avvikande delar</b>	<b>Differing parts</b>
			<b>308 346 91</b>		
50	223 278 42	1	Hammaspyörä	Kugghjul	Gear
51	223 278 41	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 92</b>		
50	223 277 12	1	Hammaspyörä	Kugghjul	Gear
51	223 277 11	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 93</b>		
50	223 247 92	1	Hammaspyörä	Kugghjul	Gear
51	223 247 91	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 94</b>		
50	223 359 82	1	Hammaspyörä	Kugghjul	Gear
51	223 359 81	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 95</b>		
50	223 421 62	1	Hammaspyörä	Kugghjul	Gear
51	223 421 61	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 96</b>		
50	223 431 72	1	Hammaspyörä	Kugghjul	Gear
51	223 431 71	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 97</b>		
50	223 454 72	1	Hammaspyörä	Kugghjul	Gear
51	223 454 71	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 98</b>		
50	223 455 02	1	Hammaspyörä	Kugghjul	Gear
51	223 455 01	1	Hammaspyörä	Kugghjul	Gear
			<b>308 346 99</b>		
50	223 456 22	1	Hammaspyörä	Kugghjul	Gear
51	223 456 21	1	Hammaspyörä	Kugghjul	Gear
 *	 503 402 44	 1	 Korjaussarja (sisältää osat / innehåller delar / include items 4, 5, 8-14,16-18, 25, 35-37, 42, 43, 45, 46, 48)	 Reparationssats	 Repair kit



## COMPRESSOR AIR END: ENDURO 25

TECHNICAL SPECIFICATION		
Rotor Size	Male 155 mm Female 122.84 mm	
Lobe Combination	4/5 ( Male/Female )	
Drive	Male Rotor Driven	
Displacement	2.5009 l/rev	152.60 cu.in.
Male Rotor Speed	Min. 1200 rpm Max. 5600 rpm	
Tip Speed (MRS)	Min. 9.7 m/s Max. 45.4 m/s	Min. 31.8 f/s Max. 149 f/s
Input Power	Min. 11 kW Max. 80 kW	Min. 15 HP Max. 107 HP
Working Pressure	Min. 3 bar Max. 15.2 bar	Min. 44 psig Max. 220 psig
Capacity	Min. 2.40 m <sup>3</sup> /min Max. 12.72 m <sup>3</sup> /min	Min. 85.9 cfm Max. 448.0 cfm
Weight, Direct Gear Driven	112 kg 169 kg	246 lbs 371 lbs
Dir. Of Rotation	E 25: C.W.	E 25 G: C.C.W. E 25 DG: C.W.
Belt Side Load	4300 N	

# **SECTION 2**

## **DRIVER**

Installation, Operation & Maintenance Manual



OPERATION  
&  
MAINTENANCE  
MANUAL  
FOR  
THREE PHASE  
INDUCTION  
MOTORS

5100 North IH-35  
Round Rock, Tx. 78681

**56 thru 449T  
Frame Motors**

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## 1. INTRODUCTION

This and the following instruction address the more common situations encountered in motor installation, operation and maintenance. For the TWMC motor warranty to be and to remain in effect, the motor must be installed and operated in strict accordance with the outline drawing, motor nameplates and these instructions and must not be altered or modified in any unauthorized manner.

During the installation and operation of motors in heavy industrial applications there is a danger of live electrical parts and rotating parts. Therefore, to prevent injury and/or damage, the basic planning work for installation, transportation, assembly, operation, etc. needs to be done and checked by authorized and competent personnel only.

Since these instructions cannot cover every eventuality of installation, operation and maintenance, the following points should be considered and checked.

- The technical data and information on permissible use such as assembly, connection, ambient and operating conditions given in the related catalogue, operating instructions, nameplates and other production documentation.
- The general erection and safety regulations.
- The local and plant-specific specifications and requirements.
- The proper use of transport, lifting devices and tools.
- The use of personal protective equipment.

Following indications should be observed when reading these instructions.

**Safety instructions are marked as follows:**



**Warning of electric hazards for personnel.**



**Warning of dangers for personnel.**

**ATTENTION!**

**Warning of damage for the motor or installation.**

## **2. ACCEPTING, INSPECTION, STORAGE, TRANSPORTATION**

### **Inspection upon receipt**

Check the following points upon receipt:

- Are the nameplate ratings identical with what you ordered?
- Are dimensions and color in compliance with your specifications?
- Are the nameplate ratings for space heater, thermal protector, temperature detector, etc. identical with what you ordered?
- Is there any damage?
- Are all accessories and accompanying instruction manuals in good order?
- Please ensure that the arrow head indicator really indicates direction of rotation.
- If there are any specific requirements, please ensure they are in conformity with your specifications.
- Motor stator housing may be outfitted with condensation drain holes that are either open holes, drain holes with plugs or drain holes with breather drains. For horizontally mounted motors position the drain holes at the lowest point possible to allow for the egress of condensation. For vertical shaft installations the lower end bracket must be outfitted with drains at the lowest point possible. Prior to installation remove drain plugs if fitted.

### **2.1 Storage**

When motors are not in operation, the following precautionary measures should be undertaken to assure best performance.

### **2.2 Place**

- (a) High and dry, well ventilated without direct sun, dust or corrosive gas.
- (b) Not located near to a boiler or freezer.
- (c) Entirely free from vibration and easily accessible.
- (d) Motors should be put on pallets to prevent moisture.

### **2.3 Moisture prevention**

Since moisture can be very detrimental to electrical components, the motor temperature should be maintained about 37°F (3 °C) above the dew point temperature by providing either external or internal heat. If the motor is equipped with space heaters, they should be energized at the voltage shown by the space heater nameplate attached to the motor. Incandescent light bulbs can be placed within the motor to provide heat. However, if used, they must not be allowed to come in contact with any parts of the motor because of the concentrated hot spot that could result.

## 2.4

Even during storage, the insulation resistance should be kept above the specified values.

- (a) For measurement of insulation resistance and acceptable standard values, please refer to measures stated in 4.1.2 “Measurement of insulation resistance”.
- (b) Insulation resistance test should be performed once every three months.

## 2.5

If the motor is not in operation for a long period (one week and above) after installation or has been in operation but stopped for a period of time, the following precautions must be taken.

- (a) Protect the motor in accordance with measures stated in 2.3.
- (b) Insulation resistance test should be performed as stated in 2.4.

## 2.6 Bearing protection

- (a) If the motor has been provided with a shaft shipping brace to prevent shaft movement during transit, it must be removed before operating the motor. It is very important that this brace be re-installed exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported. This prevents axial rotor movement that might damage the bearings.
- (b) Motors equipped with sleeve bearings are shipped from the factory with the bearing oil reservoirs drained. In storage, the oil reservoirs should be properly filled to the center of the oil level gauge with a good grade of rust inhibiting oil. To keep the bearing journals well oiled and to prevent rusting, the motor shaft should be rotated several revolutions about every month ensuring the shaft does not come to rest in its original position. While the shaft is rotating, it should be pushed to both extremes of the endplay.
- (c) Motors with anti-friction bearings are properly lubricated with the correct grade of grease at the factory and no further greasing is required in storage. The shaft should be rotated several revolutions about every month to maintain proper distribution of the grease within the bearings. **However, re-greasing is required if a significant period of time has elapsed between manufacture and use, or while in storage for extended time. It is a good practice to always replenish and purge with fresh grease at start up.**
- (d) Tilt-pad bearings are a type of sleeve bearing used in special design applications. Due to the nature of this bearing, a loose oil ring for delivering lubricant cannot be provided. Therefore, during the storage interval, oil must be periodically manually introduced into the pads and housing to prevent the occurrence of oxidation of the precision machined components.
  - (1) Remove the pipe plug from the bearing cap located above the tilt-bearing shell.
  - (2) Pour in approximately one cup of oil every month and rotate the shaft a few revolutions about every two (2) weeks.
  - (3) For long periods of storage, the oil that accumulates in the housing should be removed.

### **ATTENTION!**

**Care should be taken to keep parts such as fitting surfaces, key, shaft extension and axial central hole free from any foreign matter. Grease should also be generously applied to prevent rusting.**

## 2.7 Transportation

To keep the rotating parts of motors from moving, thus preventing damage and scratching during transportation, they should be held securely with a locking device. Remove all transit clamps before operating the motor. It is very important that this device be reinstalled exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported. The vertical mounting type motors should be transported in the vertical position.



**Do not use the hoisting hook/eyebolts to lift more than the motor itself. They are designed to support the motor only. Make sure the hoisting hook is correctly attached to the eyebolt(s)/lug(s) and they are fully screwed in before hoisting. Also note such parts as fan cover, ventilation box, bracket, slip-ring, etc. may have their own hoisting lugs which can only carry their own weight. Nothing extra should be attached while hoisting.**

**Do not twist the steel wires and make sure the eyebolts have been firmly screwed in and the sling angle is correct. See figure 1.**

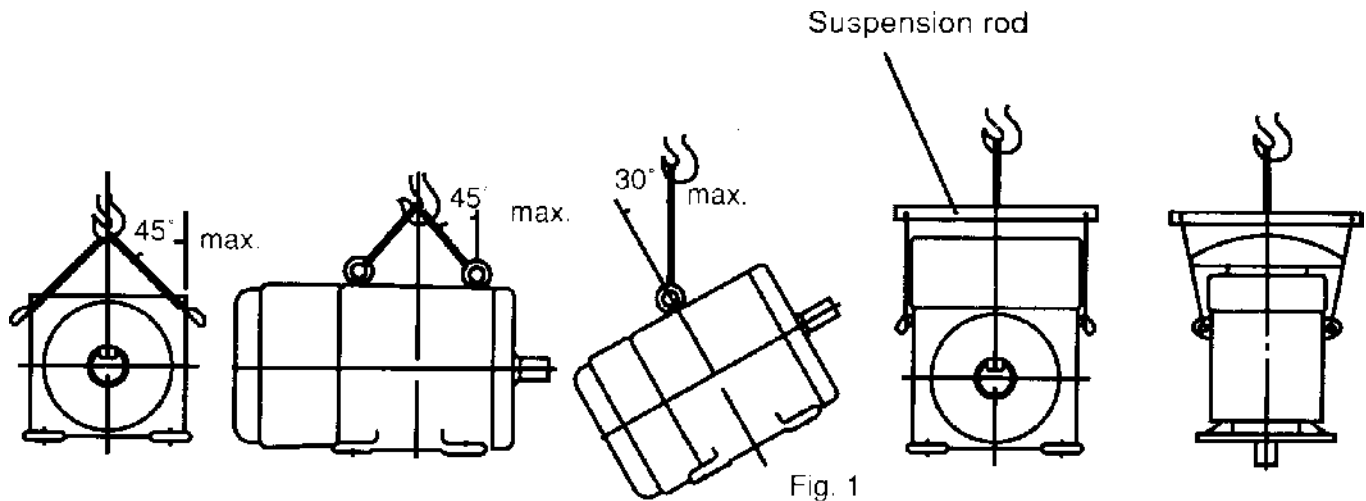


Fig. 1

## 3 INSTALLATION

### Site and environment for motor installation

#### 3.1.1

Standard environment and site conditions for the installation of motors are usually set as follows:

- (a) Ambient temperature:  $-14 \sim 104^{\circ}\text{F}$  ( $-10 \sim 40^{\circ}\text{C}$ )
- (b) Humidity: Relative humidity below 90%RH for totally enclosed types, and below 80%RH for semi-enclosed types.
- (c) Elevation: below 3,300 feet (1,000 meters).
- (d) Harmful gases, liquids, dusts, high moisture should be absent.
- (e) Foundations should be strong and free of vibration.

If there are any special environmental conditions, please inform TWMC prior to ordering.

#### 3.1.2 Ventilation and space

- (a) Installation area should be well ventilated.
- (b) The installation space should be large enough to facilitate heat dissipation and maintenance.

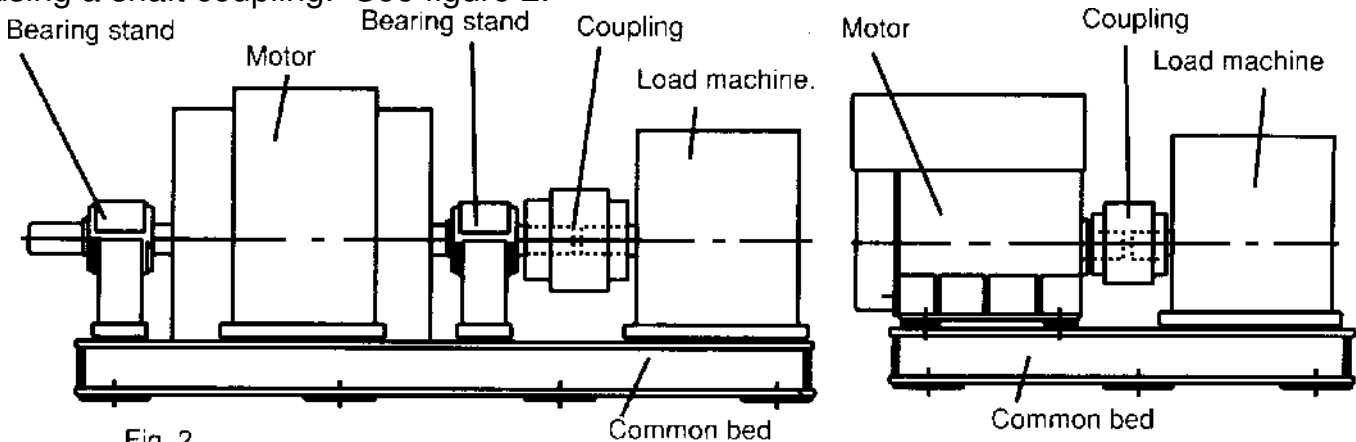


## 3.2 Foundation

### 3.2.1

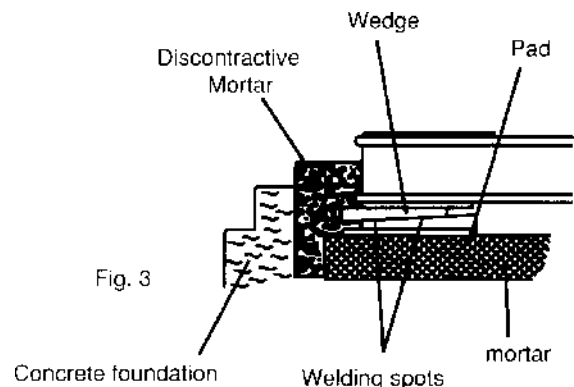
Use rigid and solid sole plate or common bed as foundation.

For best motor performance, it is advisable to use a sole plate or common bed, particularly when using a shaft coupling. See figure 2.



### 3.2.2 Installation

- Select an appropriate foundation surface for the sole plate or common bed, which will be considered the final level.
- Align the position of the common bed with reference to that level.
- Align the level accuracy at a minimum of four points such as bearing mounting, shaft extension etc. The accuracy should be within .0015 inches (0.04mm).
- Sole plate or common bed should be embedded in concrete foundation as illustrated in Fig. 3. Stiff pads should also be installed beneath the wedges, which are welded together at various spots about 15.75-19.70 inches (400-500mm) apart etc., to enable the foundation to carry evenly the weight of the whole motor.
- The base should be sturdy and rigid to keep it flat and level.
- Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
- Accurately install shaft couplings, belt sheaves etc., then weld the wedges solid to prevent untoward change in position.



### 3.2.3 The foundation of vertical induction motors: (Also the foundation of pump)

- Foundation of motor/pump must be rigid and secure to provide adequate support. There must be no vibration, twisting, misalignment etc. due to inadequate foundations.
- A massive concrete foundation is preferred in order to minimize vibration. Rigidity and

stability are enhanced by prop plate and foundation bolt. As shown in Fig. 4.

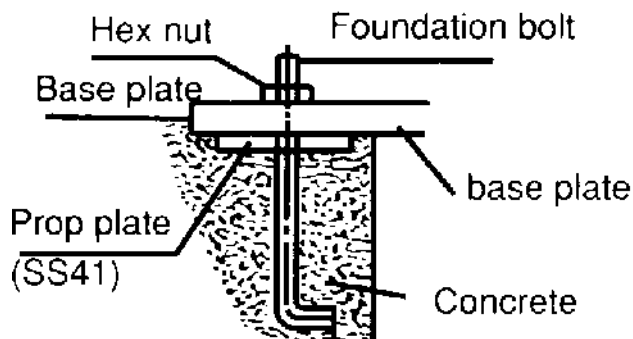


Fig. 4

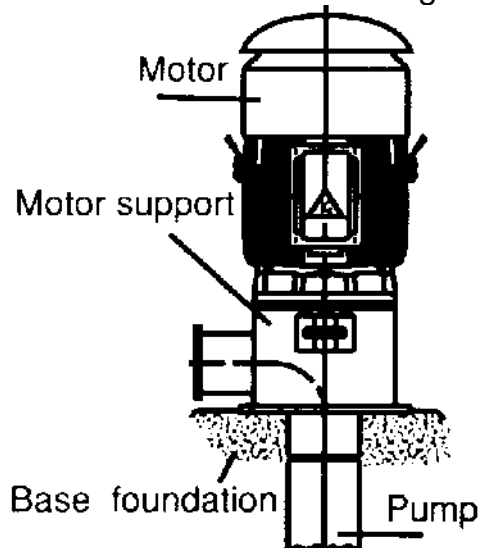


Fig. 5

### 3.2.4 Installation of vertical motors:

- All mounting surfaces must be clean and level.
- Foundation must be leveled at least at 4 points and guaranteed to be below .0015 in. (0.04mm) flat and level.
- Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
- Accurately install shaft couplings.

### 3.3 Installation of shaft coupling

#### **ATTENTION!**

**Motors must always be accurately aligned, and this applies especially where they are directly coupled.**

**Incorrect alignment can lead to bearing failure, vibration and even shaft fracture. As soon as bearing failure or vibration is detected, the alignment should be checked.**

#### 3.3.1

Field application of a coupling to the motor shaft should follow the procedures recommended by the coupling manufacturer. The motor shaft extension must not be subjected to either extreme heat or cold during coupling installation.

#### **ATTENTION!**

**Basically, the coupling should be heated and pushed onto the shaft extension with slight axial force. Do not hammer coupling to prevent bearing damage.**

#### 3.3.2

Although the sleeve bearings are equipped with thrust faces, these are intended only to provide momentary axial restraint of rotor movement either during start-up or when operating the motor disconnected from the driven equipment. They must not be operated under a constant thrust load unless they were originally designed for this condition.

Motors with either sleeve or anti-friction bearings are suitable for connection to the driven load through a flexible coupling. Coupling solidly to the load is not acceptable. With sleeve bearings, the flexible coupling should be of the limited end float type to prevent the possibility of any end thrust from the load being transmitted to the motor bearings, which could cause bearing damage. The recommended limits of end float are as follows:

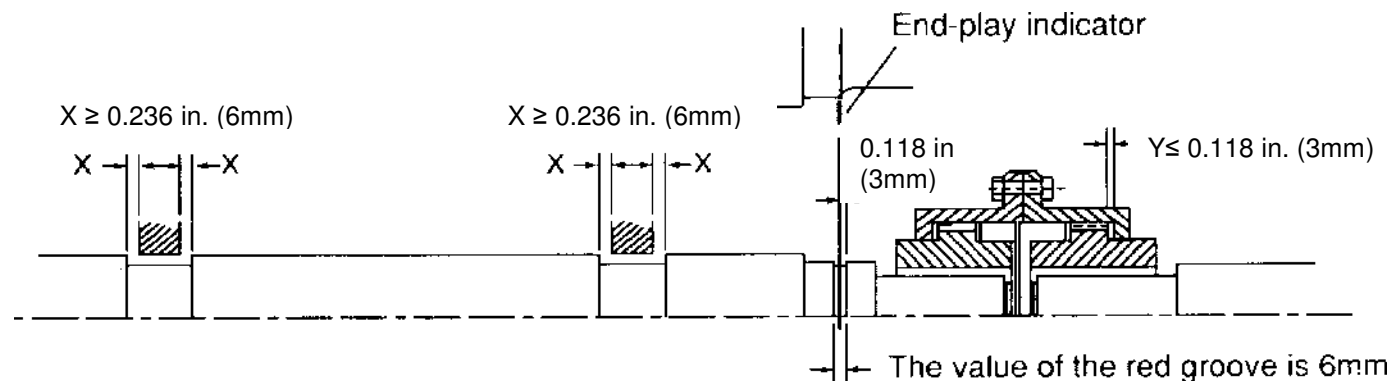


Fig. 6

- When the motor is in operation after installation, be sure that the end-play indicator is within the 0.236 in. (6mm) of the groove on the shaft or aligned to the shaft shoulder immediately outboard of the drive-end bearing to assure there is low friction between shaft and bearing.
- Unless otherwise specified, the designed end-play value  $X$  of the groove for TWMC motors in general is within 0.236 in. (6mm) as illustrated in Fig. 6. In essence, the endplay indicator is adjusted to point at the center of the groove or the drive-end shaft shoulder; thus  $X$  equals to  $\pm 0.236$  in (6mm) so, and the endplay value ( $Y$ ) of the couplings should equal or be smaller than 0.118 in. (3mm).
- If the desired value  $Y$  is greater than 0.118 in. (3mm) caused for instance by a thrust load and/or load machine with large end-play, please inform TWMC prior to entering an order.

### 3.3.3

In aligning the motor (and rotor) axially with the driven equipment, consideration should be given not only to the endplay indicator position but also to axial shaft expansion and increase in shaft centerline height due to thermal effects. In general, the axial shaft growth for motors can be disregarded since either bearing is fixed, and any shaft growth due to temperature increase will produce an elongation away from the coupling.

Shaft height growth (change in shaft centerline elevation) for TEFC machines can be calculated as follows:

$$L1 = (0.0005") \times (\text{motor foot to shaft centerline dimension})$$

For non-TEFC machines, divide the number by 2.

### 3.3.4

In normal operation, it is desirable that the motor operates on its magnetic center, so that no axial force is exerted on the coupling.

The motor shaft and the driven shaft should be aligned within the following tolerances in both angular and parallel alignment:

Unit: inches (mm)			
TIR	Range of rotating speed	Solid coupling	Flexible coupling
C	2500 rpm and above	0.0012" (0.03)	0.0012" (0.03)
	Below 2500 rpm	0.0016" (0.04)	0.0020" (0.05)
A	2500 rpm and above	0.0012" (0.03)	0.0012" (0.03)
	Below 2500 rpm	0.0012" (0.03)	0.0016" (0.04)

Angular misalignment is the amount by which the centerlines of driver and driven shafts are skewed. It can be measured using a dial indicator set up as shown in Fig. 7. The couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub face. The shafts should be forced against either the in or out extreme of their end float while being rotated.

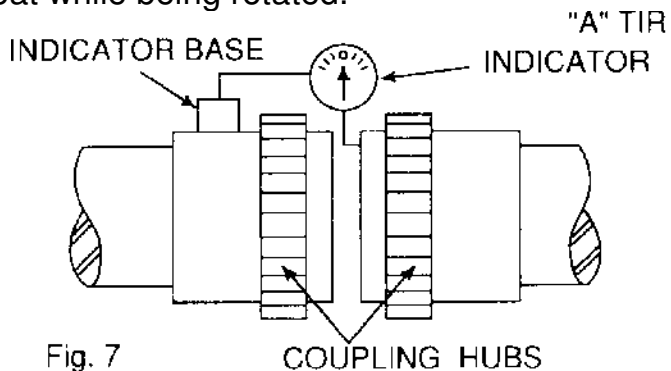


Fig. 7  
TIR=Total indicator reading (by dial indicator)

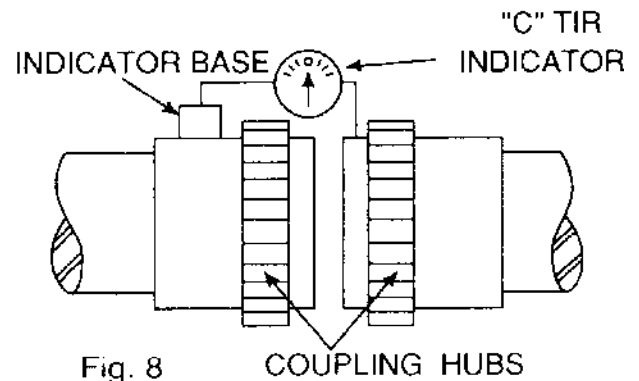


Fig. 8

Parallel misalignment is the amount by which the centerlines of the driver and driven shafts are out of parallel. It can be measured using a dial indicator set up as shown in Fig. 8. Again, the couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub outside diameter.

### 3.3.5

After the motor has been properly aligned with the driven equipment and the hold-down bolts have been installed and tightened, for motors with fabricated frames, at least two dowel pins should be installed in two diagonally opposite motor feet.

### 3.3.6 Installation of shaft coupling: (Vertical hollow shaft motor only)

- Bearings are provided to absorb some upward shaft thrust when the coupling is fitted.
- The coupling is fastened with bolts.
- This coupling type is not auto-release type.

Note: Standard high thrust motors can absorb momentary up-thrust load up to 30% of the standard down thrust load. If the up-thrust is long in duration (over 10 Seconds) and/or exceeds 30% of the standard high thrust rating, special design arrangements are required and standard motor is not suitable.

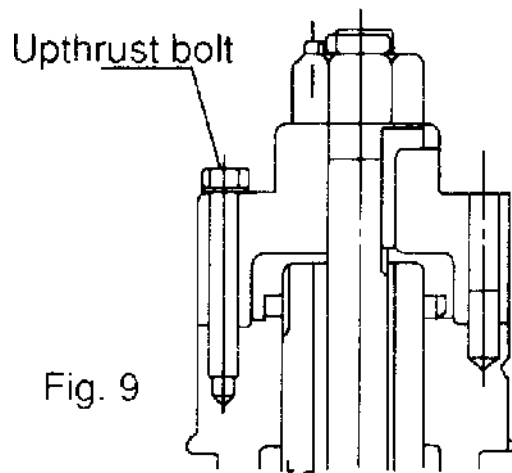


Fig. 9

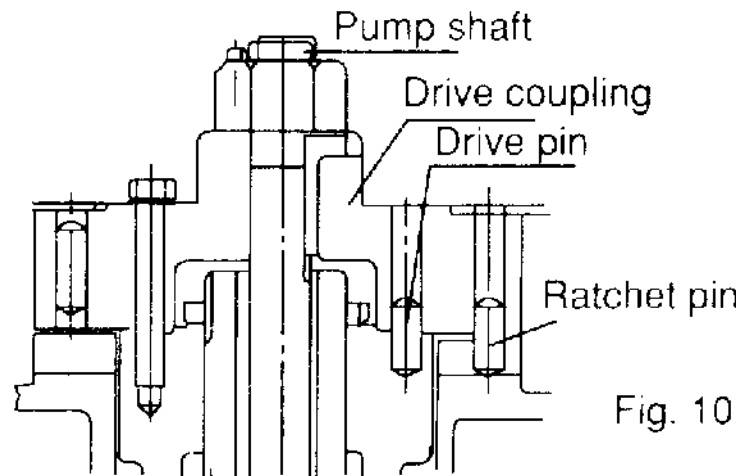


Fig. 10

### 3.3.7 Non-reverse ratchet/coupling: (If necessary)

The non-reverse coupling is also a bolted type and,

- It prevents the pump and motor from rotating in the reverse direction.
- It also prevents damage from over speeding and damage to pump shaft and bearings.
- The ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed.
- When power is removed, speed decreases, and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.
- When installing the non-reverse coupling, do not use lubricant. Lubricant will interfere with proper operation. The top half of the coupling should seat solidly on the lower half and the pins should touch the bottom of the pockets between the teeth in the plate.
- As with the bolted coupling, the up-thrust capabilities are 30% of the standard high thrust rating for down thrust.

#### **ATTENTION!**

**Do not apply non-reverse ratchets on applications in which the pump reversal time from shutdown (the instant the stop button is pressed) to zero speed is less than one second.**

### 3.4 Installation for belt drive

In general, power transmission through direct flexible coupling is appropriate for large motors. Such motors are not suitable for belt, chain or gear connection unless specially designed for such service. However, for small and medium motors of outputs within the ranges shown on table below, it is acceptable to use belt transmission as indicated. Beyond these ranges, do not apply belt sheaves unless specially designed.

#### 3.4.1

The diameter ratio between conveyance sheaves should not be greater than 5 to 1 for flat belts, and 8 to 1 for V-belts. It is also advisable to limit the belt velocity to under 115 ft/sec (35m/sec) to limit belt abrasion and vibration. The smaller the outer diameter of the V-belt sheave, the greater the shaft bending stress will be. If the bending stress is in excess of the shaft fatigue stress, the shaft may break. Therefore, please inform TWMC when you have decided the size of the sheaves and the length of the belts upon ordering.

**ATTENTION!**

Place the sheave and belt as close as possible to the motor body (it is advisable to make x as shown in Fig. 11 equal to 0) to reduce the bending moment and improve shaft life.

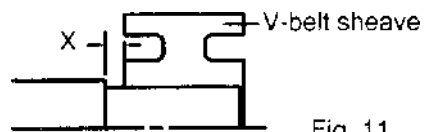


Fig. 11

**3.4.2 Table of belt-sheave application for general electric motors**

Output (KW/HP)			V-Belt Sheave							
			Conventional V-Belts				Narrow V-Belts			
4P	6P	8P	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)
11/15	-	-	B	4	160	82	3V	4	125	48
-	11/15	-	B	5	170	101	3V	5	140	59
-	-	11/15	B	5	190	101	3V	6	160	69
15/20	-	-	B	5	170	101	3V	6	125	69
-	15/20	-	B	5	224	101	3V	6	160	69
-	-	15/20	C	4	224	111	5V	3	180	60
18.5/25	-	-	B	5	200	101	3V	6	140	69
-	18.5/25	-	C	4	224	111	5V	3	180	60
-	-	18.5/25	C	5	224	136	5V	4	180	78
22/30	-	-	B	5	224	101	5V	6	160	69
-	22/30	-	C	5	224	136	3V	4	180	78
-	-	22/30	C	5	250	136	5V	4	200	78
30/40	-	-	C	5	224	136	5V	4	180	78
-	30/40	-	C	5	265	136	5V	4	224	78
-	-	30/40	C	6	265	162	5V	5	224	95
37/50	-	-	C	6	224	162	5V	4	200	78
-	37/50	-	C	6	265	162	5V	4	224	78
-	-	37/50	C	7	280	187	5V	5	250	95
45/60	-	-	C	6	265	162	5V	4	224	78
-	45/60	-	C	7	280	187	5V	5	224	95
-	-	45/60	C	7	315	187	5V	6	250	113
55/75	-	-	C	7	265	187	5V	5	224	95
-	55/75	-	C	8	300	213	5V	6	250	113
-	-	55/75	D	5	355	196	5V	6	280	113
75/100	-	-	C	8	315	213	5V	6	250	113
-	75/100	-	D	6	355	233	5V	6	315	113
-	-	75/100	D	6	400	233	5V	6	355	113
-	90/120	-	D	6	400	233	5V	6	355	113
-	-	90/120	D	6	425	233	8V	4	355	124
-	110/150	-	D	7	400	270	8V	4	355	124
-	132/175	110/150	D	7	450	270	8V	4	400	124
-	160/200	132/175	D	9	450	344	8V	4	450	124

**3.5 Conveyance with chain or gear****3.5.1**

Make sure the loading capacity of shaft and bearings is appropriate for the size and installation position (overhang) of chain and gear. If necessary, please contact us to ensure the shaft and bearings will meet your requirements.

### 3.5.2

Pay close attention to ensure the parallelism of shafts.

### 3.5.3

The teeth of couplings should be correctly and precisely matched; the force conveyance centers should lie on the same line.

### 3.5.4

There should be no skip, jumping, vibration or unusual noises.

#### **ATTENTION!**

**Do not hammer the conveyance devices such as couplings, belt sheaves, chain wheels, gears etc. onto the shaft. Those shaft fitments should be fitted and removed only by means of suitable devices. Heat shrinking may be a better alternative to avoid damaging bearings and components.**



**The exposed rotating parts should be covered to prevent accidents.**

## 3.6 Electrical connections

All interconnecting wiring for controls and grounding should be in strict accordance with local requirements such as the USA National Electrical Code and UK IEE wiring regulations. Wiring of motor and control, overload protection and grounding should follow the instructions of connection diagrams attached to the motor.

### 3.6.1 Power

The rated conditions of operation for the motor are as shown on the nameplate. Within the limits given below of voltage and frequency variation from the nameplate values, the motor will continue to operate but with performance characteristics that may differ from those at rated conditions:

±10% of rated voltage

±5% of rated frequency

±10% combined voltage and frequency variation so long as frequency variation is no more than ±5% of rated.

Operating the motor at voltages and frequencies outside of the above limits can result in both unsatisfactory motor performance and damage to, or failure of, the motor.

### 3.6.2

The main lead box furnished with the motor has been sized to provide adequate space for the make-up of the connections between the motor lead cables and the incoming power cables.



**The bolted joints between the motor lead and the power cables must be made and insulated in a workman-like manner following the best trade practices.**

### 3.6.3

Either fabricated motors or fan cooled cast frame motors are all provided with grounding pads or bolts.



**The motor must be grounded by proper connection to the electrical system ground.**

### 3.6.4

The rotation direction of the motor will be as shown by either a nameplate on the motor or the outline drawing. The required phase rotation of the incoming power for this motor rotation may also be stated. If either is unknown, the correct sequence can be determined in the following manner: While the motor is uncoupled from the load, start the motor and observe the direction of rotation. Allow the motor to achieve full speed before disconnecting it from the power source. Refer to the operation section of these instructions for information concerning initial start-up. If resulting rotation is incorrect, it can be reversed by interchanging any two (2) incoming cables.

### 3.6.5 Auxiliary devices

Auxiliary devices such as resistance temperature detectors, thermocouples, thermoguards, etc., will generally terminate on terminal blocks located in the auxiliary terminal box on the motor. Other devices may terminate in their own enclosures elsewhere on the motor. Such information can be obtained by referring to the outline drawing. Information regarding terminal designation and the connection of auxiliary devices can be obtained from auxiliary drawings or attached nameplates.

If the motor is provided with internal space heaters, the incoming voltage supplied to them must be exactly as shown by either a nameplate on the motor or the outline drawing for proper heater operation.



**Caution must be exercised anytime contact is made with the incoming space heater circuit as space heater voltage is often automatically applied when the motor is shutdown.**

## 4. OPERATION

### 4.1 Examination before start

#### 4.1.1

When motors are installed in good manner, ensure the wiring is according to the diagram. Also, the following points should be noted:

- (a) Make sure all wiring is correct.
- (b) Ensure the sizes of cable wires are appropriate and all connections are well made for the currents they will carry.
- (c) Ensure all connections are properly insulated for the voltage and temperature they will experience.
- (d) Ensure the capacity of fuses, switches, magnetic switches and thermo relays etc. are appropriate and the contactors are in good condition.
- (e) Make sure the frame and terminal box are grounded.
- (f) Make sure that the starting method is correct.
- (g) Make sure switches and starters are set at their correct positions.
- (h) Motor heaters must be switched off when the motor is running.

#### 4.1.2 Measurement of insulation resistance



**During and immediately after measuring, the terminals must not be touched as they may carry residual dangerous voltages. Furthermore, if power cables are connected, make sure that the power supplies are clearly disconnected and there are no moving parts.**



- (a) For rated voltage below 1000V, measured with a 500 VDC megger.
- (b) For rated voltage above 1000V, measured with a 1000VDC megger.
- (c) In accordance with IEEE 43, clause 9.3, the following formula should be applied:  

$$R \sim \left( \frac{\text{Rated voltage (v)}}{1000} + 1 \right) \times 10(\text{MQ})$$
- (d) On a new winding, where the contaminant causing low insulation resistance is generally moisture, drying the winding through the proper application of heat will normally increase the insulation resistance to an acceptable level. The following are several accepted methods for applying heat to the winding:
  - (1) If the motor is equipped with space heaters, they can be energized to heat the winding.
  - (2) Direct current (as from a welder) can be passed through the winding. The total current should not exceed approximately 50% of rated full load current. If the motor has only three leads, two must be connected together to form one circuit through the winding. In this case, one phase will carry the fully applied current and each of the others, one-half each. If the motor has six leads (3 mains and 3 neutrals), the three phases should be connected into one series circuit.



**Ensure there is adequate guarding so live parts cannot be touched.**

- (3) Heated air can either be blown directly into the motor or into a temporary enclosure surrounding the motor. The source of heated air should preferably be electrical as opposed to fueled (such as kerosene) where a malfunction of the fuel burner could result in carbon entering the motor.

#### **ATTENTION!**

**Caution must be exercised, when heating the motor with any source of heat other than self contained space heaters, to raise the winding temperature at a gradual rate to allow any entrapped moisture to vaporize and escape without rupturing the insulation. The entire heating cycle should extend over 15-20 hours.**

Insulation resistance measurements can be made while the winding is being heated. However, they must be corrected to 104°F (40°C) for evaluation since the actual insulation resistance will decrease with increasing temperature. As an approximation for a new winding, the insulation resistance will approximately halve for each 50°F (10°C) increase in insulation temperature above the dew point temperature.

- (e) Should the resistance fail to attain the specified value even after drying, careful examination should be undertaken to eliminate all other possible causes, if any.

#### **4.1.3 Power Source**

- (a) Ensure the capacity of the power source is sufficient.
- (b) Ensure the supply voltage and frequency ratings are identical to those on the nameplate.
- (c) Voltage variation should be confined to within ±10% of the rated value and the phase to phase voltages should be balanced.

#### **4.1.4 Bearing lubrication**

- (a) For sleeve bearing motors, the oil reservoir must be filled with oil to the correct level. On

self-lubricated bearings, the standstill oil level will be at the center of the oil gauge. The proper oil is a rust and oxidation inhibited, turbine grade oil. Refer to the lubrication nameplate for the recommended viscosity.

- (b) Motors, which are supplied with provision for flood lubrication, have an inlet orifice to meter the oil flow to the bearing. Refer to the outline drawing for these values. If the supply pressure does not match that stated on the outline, the orifice size must be adjusted to produce the specified flow rate. The drain adapter (also provided) has a weir plate fixed to the inside of the pipe to permit the establishment of the proper oil level. This weir plate must be located at the bottom of the pipe and must be parallel to the plane of the motor feet. To ensure optimum flow, the drain line should be vented to the atmosphere.

Oil inlet temperature:      Normal below 122 °F (50 °C)  
   Alarm 140 °F (60 °C)  
   Trip 149 °F (65 °C)

- (c) If the motor is in storage for over three (3) months, refilling of some new oil should be undertaken before operation to prevent bearing damage due to dry friction. The oil level should be kept at the center of the oil gauge. If necessary, drain some oil after refilling.
- (d) Motors that have been designed with anti-friction bearings for use with an oil mist lubrication system have been packed at the factory with a small amount of grease for short test runs. Continuous running should not be considered unless the oil mist system is installed and operating.
- (e) Grease lubricant type
- (1) The bearings have been well greased at the factory before delivery. However, regreasing is required if a significant period has elapsed between manufacture and use **or while in storage for extended time. It is a good practice to always replenish and purge with fresh grease at start up.**
- (2) *All motors with ZZ, or sealed bearings will have SHELL Alvania R3, or Multitemp SRL (Lithium base grease). Always check nameplate first.* All motors with open regreasable bearings will have Mobil Polyrex EM (polyurea base grease).

## **ATTENTION!**

**Do not mix different kinds of grease.**

**Mixing grease with different type of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.**

### **4.1.5 Cooling water for the cooler on water-cooled motors**

Make sure the quality, volume and inlet temperature of cooling water for the motors are normal before the machine is in operation.

Water: General tower water or industrial water.

Volume: Please see outline drawing

Inlet temperature:      Normal below 86 °F (30 °C)  
   Alarm 95 °F (35 °C)  
   Trip 104 °F (40 °C)

## **ATTENTION!**

**Make sure all locks, which fasten the movable parts of the motors during transportation, are dismantled and the shaft can rotate freely.**

**ATTENTION!**

**Ensure there is no foreign matter or tools inside the motors before starting motors**

**4.1.6**

Make sure the transmission system, including belts, screws, bolts, nuts and set pins are in good condition.



**The keys fitted to the shaft extensions are held by plastic tape only to prevent them from falling out during transportation or handling. The shaft key shall be removed to avoid flying out, when the motor is operated prior to the couplings etc. being fitted to the shaft extension.**

**4.1.7**

Make sure the items above are examined. Test the motor running with or without load. Record and check according to "Maintenance" at 15-minute intervals during the first three hours of operation. Then regular examinations should take place at longer intervals. If all goes well, the motor can be classified as "in good order".

**4.2 Starting operation****4.2.1 Starting load**

Initially run the motor unloaded prior to coupling to other machines. Unless otherwise specified, a motor usually starts with light load, which is then gradually increased, proportional to the square of the speed and at last reaches 100% load at full load speed.

**4.2.2 Starting**

Too frequent starts can be harmful to the motors. The following restrictions should be observed:

- (a) Motor can be restarted should the initial start fail. Two starts are generally permissible when the motor is cold.
- (b) Motor can be started only once when it is at normal running temperature.
- (c) Should additional starts be necessary beyond the conditions stated above, the following restrictions should be noted:
  - (1) Let the motor cool down for 60 minutes before restarting, fully loaded.
  - (2) Let the motor cool down for 30 minutes before restarting, unloaded.
  - (3) Two inching starts can be regarded as one normal start.

**ATTENTION!**

**If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately.**

**Investigate thoroughly and take corrective action before attempting a restart.**

Possible reasons for not starting are:

- (1) Too low a voltage at the motor terminals.
- (2) The load is too much for the rotor to accelerate.
- (3) The load is frozen up mechanically.
- (4) All electrical connections have not been made.

- (5) Single-phase power has been applied.
- (6) Any combination of the above.

#### 4.2.3 Rotating direction

- (a) Most TWMC motors are bi-directional. However, when some special types, such as high speed 2-Pole, certain large capacity motors, those with a non-reversing ratchet etc., should rotate in one direction, please ensure the rotation is in conformity with the directional arrow-mark shown on the attached nameplate.
- (b) To reverse a bi-directional motor, cut the power and wait until the motor stops. Then interchange any two of the three phases.

#### 4.2.4 Power Source, Voltage, Current

- (a) Ensure the voltage and frequency of the power source are identical to the ratings shown on the nameplate.
- (b) Voltage variation should be confined to within  $\pm 10\%$  of the rating and the three phase voltages should be in full balance
- (c) Ensure the motor phase currents, when without load, are within  $\pm 5\%$  of the average values.

#### 4.2.5

Frequency variation should be confined to within  $\pm 5\%$  of the rating. The aggregate variation of voltage and frequency should be confined to within  $\pm 10\%$  of the absolute value of the ratings.

#### Starting time and unusual noises

##### **ATTENTION!**

**Starting time is longer for the motors with large inertia. However, if starting time is longer than usual, or if there is difficulty in starting, or there is abnormal noise, do not run the motor and refer to TWMC Service representative.**

#### 4.2.6 Sleeve bearing oil rings (sleeve bearing types only)

As the oil ring is used to carry lubricant to sleeve bearings, frequently check to ensure the oil ring is in motion.

#### 4.2.7 Bearing temperature rise

Following the initial start-up, the bearing temperatures should be closely monitored. The rate of rise in bearing temperature is more indicative of impending trouble than is the actual temperature.

##### **ATTENTION!**

**If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.**

If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperature stabilizes.

Recommended limits on bearing temperature are as follows:

##### **Sleeve Bearings**

- By permanently installed detector

##### **Total measured temperature**

194°F (90°C)

- By temporary detector on top of the bearing sleeve near the oil ring

185 °F (85 °C)

#### **Anti-Friction Bearings**

- By permanently installed detector
- By temporary detector measuring the outside of the bearing housing

**Total measured temperature**

212 °F (100 °C)

203 °F (95 °C)

#### **ATTENTION! (For sleeve bearing)**

- (1) It must be noted that when operating flood lubricated sleeve bearings without outside lubrication supplied, the bearing temperature must not be allowed to exceed 185 °F (85 °C) total temperature
- (2) Under normal condition, for the self-lube bearing, the rate of temperature rise should be from 52 °F to 57 °F (11 °C to 14 °C) for the first ten (10) minutes after starting up and approximately 72 °F (22 °C) at thirty (30) minutes. The rate of bearing temperature rise is a function of the natural ventilation and operating conditions.
- (3) When the rate of bearing temperature rise is less than 34 °F (1 °C) per half-hour, the bearing temperature is considered to be stabilized.
- (4) If the total bearing temperature exceeds 203 °F (95 °C), the motor should be shut down immediately.

#### **Noise and Vibration**

##### **ATTENTION!**

Any abnormal noise or vibration should be immediately investigated and corrected. Increased vibration can be indicative of a change in balance due to mechanical failure of a rotor part, a stator winding problem or a change in motor alignment.

## **5. MAINTENANCE**

### **5.1 Major points in regular inspections and maintenance.**



For safety, maintenance and repairs must only be carried out by properly trained personnel.



Some testing, such as insulation resistance, usually requires the motor to be stopped and isolated from power supply.

Routine inspection and maintenance are usually performed by looking, listening, smelling and simple meters.



**High temperature may arise under operating conditions on the motor surfaces, so touching should be prevented or avoided. Keep away from moving and live parts. Unless deemed necessary, do not remove guards whilst assessing the motor.**

Timely replacement of worn parts can assure longevity and prevent breakdown.

Routine inspection and regular inspection and maintenance are important in preventing breakdown and lengthening service life.

Owing to the varied time and circumstances motors are used, it is difficult to set the items and periods for regular inspection and maintenance. However, as a guide, it is recommended to be performed periodically according to the factory maintenance program. Generally, the inspection scope is determined by the following factors:

- (a) Ambient temperature.
- (b) Starting and stopping frequency.
- (c) Troublesome parts usually affecting motor functions.
- (d) Easily abraded parts.
- (e) The important position of a motor in the operational system of a factory should be duly recognized. Therefore, its health and wellbeing should be fully protected especially when it is operating in severe conditions.

## **5.2 Motor windings:**

- (a) For measurement of insulation resistance and standards to determine quality of insulation resistance, please refer to measures stated in 4.1.2 “Measurement of insulation resistance”.
- (b) Inspection of coil-ends:
  - (1) Grease and dust accumulated on coils may cause insulation deterioration and poor cooling effect.
  - (2) Moisture must not accumulate. Keep coils warm when motor is not in use if moisture can be seen.
  - (3) Discoloring. This is mainly caused by overheating.
- (c) Ensure no movement of wedges from their original position.
- (d) Ensure the binding at the coil end is in its normal position.

## **5.3 Clean the interior of the motor:**

- (a) After a motor is in operation for some time, accumulation of dust, carbon powder and grease etc., on the inside is unavoidable, and may cause damage. Regular cleaning and examination is necessary to assure top performance.
- (b) Points to note during cleaning:
  - (1) If using compressed air or blower:
    - (a) Compressed air should be free of moisture.
    - (b) Maintain air pressure at 57psig (4 kg/cm<sup>2</sup>) since high pressure can cause damage to coils.
  - (2) Vacuum  
Vacuum cleaning can be used, both before and after other methods of cleaning, to remove loose dirt and debris. It is a very effective way to remove loose surface contamination from the winding without scattering. Vacuum cleaning tools should be non-metallic to avoid any damage to the winding insulation
  - (3) Wiping  
Surface contamination on the winding can be removed by wiping using a soft, lint-free wiping material. If the contamination is oily, the wiping material can be moistened (not dripping wet) with a safety type petroleum solvent. In hazardous locations, a solvent such as inhibited methyl chloroform may be used, but must be used sparingly and immediately removed. While this solvent is non-flammable under ordinary conditions, it is toxic and proper health and safety precautions should be followed while using it.

**ATTENTION!**

Solvents of any type should never be used on windings provided with abrasion protection. Abrasion protection is a gray, rubber-like coating applied to the winding end-turns.



Adequate ventilation must always be provided in any area where solvents are being used to avoid the danger of fire, explosion or health hazards. In confined areas (such as pits) each operator should be provided with an airline respirator, a hose mask or a self-contained breathing apparatus. Operators should wear goggles, aprons and suitable gloves. Solvents and their vapors should never be exposed to open flames or sparks and should always be stored in approved safety containers.

- (4) Keep core ducts completely clean. The difference in temperature rise could be around 50°F (10°C) before and after cleaning

**5.4 Clean the exterior of the motor:**

- (a) On open ventilated motors, screens and louvers over the inlet air openings should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air movement.

**ATTENTION!**

Screens and louvers should never be cleaned or disturbed while the motor is in operation because any dislodged dirt or debris can be drawn directly into the motor.

- (b) If the motor is equipped with air filters, they should be replaced (disposable type) or cleaned and reconditioned (permanent type) at a frequency that is dictated by conditions. It is better to replace or recondition filters too often than not often enough.
- (c) Totally enclosed air to air cooled and totally enclosed fan cooled motors require special cleaning considerations. The external fan must be cleaned thoroughly since any dirt build-up not removed can lead to unbalance and vibration. All of the tubes of the air-to-air heat exchanger should be cleaned using a suitable tube brush having synthetic fiber bristles (not wire of any type).

**5.5 Maintenance of anti-friction bearings****5.5.1 Frequency of re-lubrication:**

The life of grease varies greatly as a result of types of model, revolution speed, temperature, operational conditions etc. It is, therefore, impossible to be precise about replenishment intervals. However, for normal direct coupling transmission, the periods shown in Table 1 may be used as a guide.

**Remarks:**

- (a) The periods shown in Table 1 should be halved where bearings are used for belt drive and/or in dirty or high ambient temperature or high humidity environments.
- (b) Please refer to the lubrication nameplate, if attached to the motor.
- (c) For bearing numbers outside the range of Table 1, please contact TWMC
- (d) If the periods referred to in Table 1 for drive-end bearing and opposite drive-end are

different, for the convenience of maintenance operations, please take the shorter of the required grease replenishment periods of these bearings.

### 5.5.2 Kinds of grease:

All motors with ZZ, or sealed bearings will have SHELL Alvania R3, or Multitemp SRL (lithium base grease). All motors with open bearings will have Mobil Polyrex EM (polyurea base grease).

Certain T-frame models will utilize special grease and will be noted on the lubrication nameplate. Please use identical grease or its equivalents when maintaining lubrication schedule.

### **ATTENTION!**

**Do not mix different kinds of grease.**

**Mixing grease with different types of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.**

### 5.5.3 Grease quantity

The amount of grease per replenishment depends on the type, size and construction of the bearings. The maximum amount of one replenishment for each bearing is shown in Table 2.

This replenishment amount is also the amount used at the time the motor is initially started.

### 5.5.4 Re-greasing



**If re-lubrication is to be performed when the motor is running, stay clear of rotating parts.**

It is advisable to re-grease when the motor is running to allow the new grease to be evenly distributed inside the bearing. Before re-greasing, the inlet fitting should be thoroughly cleaned to prevent any accumulated dirt from being carried into the bearing with the new grease. The outlet for grease drainage should be opened to allow the proper venting of old grease. Use a grease gun to pump grease through the grease nipple into the bearings. After re-greasing, operate the motor for 10-30 minutes to allow any excess grease to vent out.



**TABLE 1.**

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM	3000 RPM	3600 RPM
62XX 63XX 72XX 73XX	6202									2000 Hrs	
	03										
	04										
	05										
	06										
	07										
	08										
	09										
	10										
	12										
	13	3000 Hrs								1000 Hrs	
	14										
	15								2000 Hrs	720 Hrs	
	16										
	17										
	18										
	20										
	22								1500 Hrs		
	24										
	26						2000 Hrs	1000 Hrs			
28											
30						1500 Hrs	500 Hrs				
32											
34											
36				2000 Hrs	1000 Hrs						
38											

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
NU2XX NU3XX	NU214							2000 Hrs	
	15								
	16								
	17							1500 Hrs	
	18	3000 Hrs							
	20							1000 Hrs	
	22					2000 Hrs			
	24								
	26							500 Hrs	
	28								
	30								
	32							1000 Hrs	
	34								
	36			2000 Hrs					
	38	2000 Hrs							
	40			1000 Hrs					
	44	1000 Hrs							
	48								

**TABLE 1 CONTINUED.**

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
222XX 223XX	22220							300 Hrs	
	22	1000 Hrs				500 Hrs			
	24								
	26								
	28								
	30					300 Hrs			
	32								
	34								
	36	500 Hrs							
	38								
	40								
	44								
	48	300 Hrs							

**MAINTANCE GREASING QTY.**

**d = Bore (mm)**

**D = OD (mm)**

**B = Width (mm)**

**G = Grease Qty (g)**

**TABLE 2.**

$$G = D \cdot B \cdot 0.005$$

BRG#	d	D	B	G	Full Qty	BRG#	d	D	B	G	Full Qty
	mm	mm	mm	grams	grams		mm	mm	mm	grams	grams
<b>2 SERIES</b>						<b>3 SERIES</b>					
NU202/6202	15	35	11	2	8	NU302/6302	15	42	13	3	10
NU203/6203	17	40	12	3	10	NU303/6303	17	47	14	4	13
NU204/6204	20	47	14	4	13	NU304/6304	20	52	15	4	13
NU205/6205	25	52	15	4	15	NU305/6305	25	62	17	5	17
NU206/6206	30	62	16	5	15	NU306/6306	30	72	19	7	25
NU207/6207	35	72	17	6	15	NU307/6307	35	80	21	8	25
NU208/6208	40	80	18	7	20	NU308/6308	40	90	23	10	30
NU209/6209	45	85	19	8	25	NU309/6309	45	100	25	13	35
NU210/6210	50	90	20	9	30	NU310/6310	50	110	27	15	40
NU211/6211	55	100	21	11	35	NU311/6311	55	120	29	17	50
NU212/6212	60	110	22	12	40	NU312/6312	60	130	31	20	60
NU213/6213	65	120	23	14	50	NU313/6313	65	140	33	23	80
NU214/6214	70	125	24	15	50	NU314/6314	70	150	35	26	80
NU215/6215	75	130	25	16	60	NU315/6315	75	160	37	30	100
NU216/6216	80	140	26	18	60	NU316/6316	80	170	39	33	100
NU217/6217	85	150	28	21	80	NU317/6317	85	180	41	37	120
NU218/6218	90	160	30	24	80	NU318/6318	90	190	43	41	120
NU219/6219	95	170	32	27	90	NU319/6319	95	200	45	45	140
NU220/6220	100	180	34	31	100	NU320/6320	100	215	47	51	160
NU221/6221	105	190	36	34	110	NU321/6321	105	225	49	55	190
NU222/6222	110	200	38	38	120	NU322/6322	110	240	50	60	220
NU224/6224	120	215	40	43	120	NU324/6324	120	260	55	72	270
NU226/6226	130	230	40	46	140	NU326/6326	130	280	58	81	300

\*Fill new grease until it overflows and the old grease is entirely replaced.

### 5.5.5 Oil re-lubrication (For oil lubrication types only)

Maintain proper lubrication by checking the oil level periodically and adding oil when necessary. Because of the initial clearing action of the bearing and the expansion of the oil as it comes up to operating temperature, the oil level will be higher after the motor has been in operation for a while than it is with the motor at standstill.

Overfilling should be avoided not only because of the possibility that expansion may force the oil over the oil sleeve and on to the rotor, but also because too high an operating oil level prevents the bearing from clearing itself of excess oil. The resultant churning can cause extra loss, high temperatures, and oxidized oil. If, during operation, the oil level goes above the maximum shown on the sight gauge, drain enough oil to bring the level back within the recommended operating range. **Do not permit the operating level to fall below the minimum shown on the gauge.**

#### **ATTENTION!**

**Should it ever become necessary to add excessive amounts of make-up oil, investigate immediately for oil leaks.**

Change the oil at regular intervals. The time between oil changes depends upon the severity of operating conditions and, hence, must be determined by the motor user. Two or three changes a year is typical, but special conditions, such as high ambient temperature, may require more frequent changes. Avoid operating the motor with oxidized oil.

Use only good grade, oxidation-corrosion-inhibited turbine oils produced by reputable oil companies. The viscosity of the oil to be used depends upon the type and size of the bearings, its load and speed, the ambient temperature, and the amount and temperature of the cooling water (if used). The lubrication nameplate or instructions with each motor specifies the viscosity range of oil suitable for average conditions. The usual oil viscosity recommendations are summarized in Table 3. Operation in ambient temperatures that are near or below freezing may require preheating the oil or the use of special oil. Whenever the motor is disassembled for general cleaning and reconditioning, the bearing housing may be washed out with a suitable cleaning solvent. Be sure that the oil-metering hole is clear, and then dry the housing thoroughly before re-assembly, and ensure all traces of cleaning solvent have been removed.

**TABLE 3 Oil Viscosity\*\***

Bearing function and location	Bearing Type / size	Oil Viscosity - SSU	
		@ 100°F (38°C)	@ 200°F (93°C)
Thrust Bearing	72XX, 73XX Angular contact ball And/or (62XX, 63XX)	150	45
	Spherical roller	300	53
	Plate (Kingsbury Type)	300	53

\*\*Remark: When a lubrication nameplate is attached to the motor, use the lubrication oil it stipulates.

### 5.5.6 Cleaning and installation of bearings

- (a) Apply the proper amount of grease to the disassembled parts of the bearing after they have been thoroughly cleaned with high quality cleaning oil. Then protect them from contamination before and during assembly.
- (b) Bearing installation

#### **ATTENTION!**

**Before installing the bearings, make sure that the shaft mounted parts inside the bearings are in place before installation.**

Since the bearing is a high precision component, it is important to avoid ingress of dust and foreign matter, and hammering during cleaning and installation. Use extreme care and ensure clean conditions during installation and assembly.

#### **ATTENTION!**

**The best way for bearing installation is heat shrinking. Knocking and hammering during installation should be absolutely avoided.**

The bearings should be heated in a bath of clean oil at a temperature of approximately 176°F (80°C). After warming, slide the bearings in place quickly and nimbly so they do not shrink before being fully in position.

Grease the bearing after the temperature returns to normal, and then reassemble the motor.

## 5.6 Maintenance of sleeve bearings

### 5.6.1 Daily inspections

- (a) Ensure the volume and quality of lubrication oil are in compliance with specifications. See figure 12.

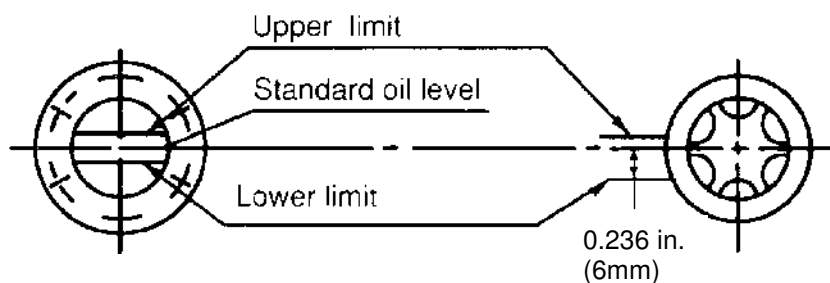
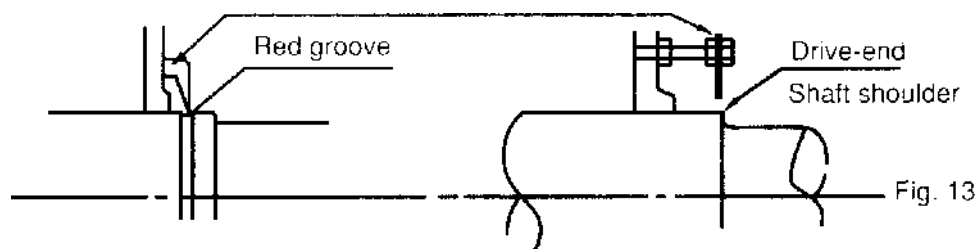


Fig. 12

- (b) Ensure there is motion of the oil ring and it is not clamped.
- (c) The indicator of the shaft endplay should be restricted within the specified range of the red groove of the shaft as shown in Figure 13. Or the  $\pm 0.118$  in. ( $\pm 3$ mm) range of the drive-end shaft shoulder, or the bearing may be damaged.



## 5.6.2 Regular examination

### (a) Periodical change of oil

The oil reservoirs of self (not flood) lubricated bearings should be drained and refilled about every six (6) months. More frequent changes may be needed on high speed (3600 rpm) motors or if severe oil discoloration or contamination occurs. In conditions where contamination does occur, it may be advisable to flush the reservoir with kerosene to remove any sediment before new oil is added. Proper care must be taken to thoroughly drain the reservoir of the flushing material before refilling with the new oil.

Refill the reservoir to the center of oil sight glass with a rust and oxidation inhibited turbine grade oil. Refer to the outline and lubrication nameplate for the correct viscosity.

### (b) Quantity of lubrication oil

Please refer to the lubrication nameplate for oil quantity.

### (c) Oil viscosity

ISO	Equivalents	Viscosity (SUS/100°F (38°C))
VG32	Esso Teresso 32	150
VG46	Esso Teresso 46	200
VG68	Esso Teresso 68	300

## 5.6.3 Disassembly



**Prior to disassembling, ensure the power supplies are disconnected and there are no moving parts.**

The bearing sleeve is of the spherically seated, self-aligning type. The opposite drive end bearing is normally insulated for larger motors (or when specified). On some motors, the insulation is bonded to the spherical seat of the bearing housing.

### **ATTENTION!**

**Extreme care must be exercised in removing the bearing sleeve from the insulated support to avoid damaging this insulation.**

The following is the recommended procedure for removing the bearing sleeve:

- (a) Remove the oil drain plug in the housing bottom and drain the oil sump.
- (b) Remove all instrumentation sensors that are in contact with the bearing sleeve. These would include resistance temperature detectors, thermocouples, thermometers, etc..
- (c) Remove the socket head bolts holding the bearing cap and the inner air seal. The end cover plate must also be removed if the non-drive end bearing is being disassembled. Remove the bearing cap and top half of the inner air seal. Place them on a clean, dry surface to avoid damage to the parting surfaces.
- (d) Remove the top half of the bearing sleeve using suitable eyebolts in the tapped holes provided. Lift the bearing top straight up and avoid any contact with the shoulders of the shaft journals that might damage the thrust faces of the bearing. Place on a clean, dry surface taking care to prevent damage to either the parting surfaces or the locating pins that are captive in the top bearing half.
- (e) Remove the screws at the partings in the oil ring and dismantle the ring by gently tapping the dowel pin ends with a soft face mallet. Remove the ring halves and immediately reassemble them to avoid any mix up with parts or damage to the surfaces at the partings.
- (f) Pull up on the garter spring surrounding the floating labyrinth seal and carefully slip out the top half. Rotate the garter spring until the lock is visible. Twist counter-clockwise to disengage the lock, remove the garter spring then rotate the lower half of the seal out of the groove in the bearing housing. Note the condition of these floating labyrinth seals. If they are cracked or chipped, they must be replaced. Do not attempt to reuse a damaged seal.
- (g) To remove the bottom bearing half, the shaft must be raised a slight amount to relieve pressure on the bearing. On the drive end, this can be done by jacking or lifting on the shaft extension. Protect the shaft. On the non-drive, jacking or lifting can be done using bolts threaded into the tapped holes provided in the shaft end.
- (h) Roll the bottom bearing half to the top of the shaft journal and then lift it using suitable eyebolts threaded into the holes provided. Again avoid any contact with the shaft shoulders that could damage the bearing thrust faces. Place the lower bearing half on a clean, dry surface to protect the parting surfaces.



**Use extreme care when rolling out the lower bearing half. Keep hands and fingers well clear of any position where they might be caught by the bearing half if it were accidentally released and rotated back to its bottom position. Serious personal injury could result.**

- (i) Protect the shaft journal by wrapping it with clean, heavy paper or cardboard.

#### 5.6.4 Re-assembly

Bearing re-assembly is basically a reverse of the disassembly procedures outlined above, with the following suggestions:

- (a) The interior of the bearing housing should be cleaned and then flushed with clean oil or kerosene.
- (b) The bearing halves and the shaft journal should be wiped clean using a lint-free cloth soaked with clean oil.
- (c) All parts should be carefully inspected for nicks, scratches, etc., in any contact surfaces. Such imperfections should be removed by an appropriate method such as stoning, scraping, filing, etc., followed by thorough cleaning.
- (d) Before installing the floating labyrinth seal halves, observe their condition. Do not attempt to use a cracked or chipped seal. The bottom half seal has a set of drilled holes in its side face. These must be placed at the bottom toward the inside of the bearing so that accumulating oil may drain back into the housing.
- (e) Put a bead of Curil-T around the seal half O.D.'s on both sides adjacent to the garter spring groove. This will prevent oil by-passing the seal around its outside.
- (f) Place the bottom seal half on top of the shaft and roll it into position. Install the top half and insert the garter spring pulling up on both ends to permit engaging the lock. Run a bead of Curil-T around the O.D's on both sides adjacent to the garter spring groove on this half also.
- (g) Carefully reassemble the two oil ring halves. Inspect the dowel pins for burrs and straightness and make any corrections required. Do not force the ring halves together. Excessive force may alter the roundness or flatness of the oil ring which can change its oil delivery performance.
- (h) Some of the pipe plugs in the housing are metric thread type and have a copper, lead, or similar material washer. If these plugs are removed, be careful not to lose the washers. Before re-assembly, inspect the washers and replace them as required.
- (i) Before installing the bearing cap, observe the position of the floating labyrinth seal. The "tab" must be on top to engage the pocket. Failure to position the seal properly will result in damage when the cap is assembled.

**ATTENTION!**

- (1) Curil-T is the only approved compound for use in the assembly of the bearings on this motor. Other products may harden and impede operation.
- (2) During the re-assembly of the bearing parts, a thin layer of Curil-T should be applied to all gaskets and machined interface surfaces. This suggestion does not apply to the machined surfaces of the bearing liner halves.
- (3) When seating the bearing shell, apply a thin layer of lube oil at the spherical surface of the liner. Slowly roll the lower bearing liner into the bearing housing making sure that the splined surface of the liner and the housing are flush. Gradually lower the shaft onto the bearing. The weight of the shaft will help rotate the bearing liner so that the babbitt surface of the liner will match the slope of the journal. Sometimes it is required to use a rubber mallet to tap lightly on the bearing housing while slowly rolling the shaft to help this seating operation.

**5.7 Maintenance of slip ring (For Wound Rotor Motors only)**

Ensure motor is disconnected from power supplies and there are no accessible moving parts before maintenance operation.

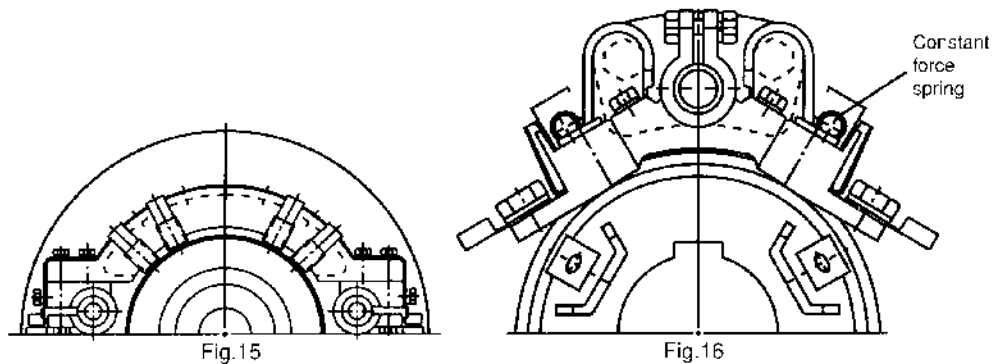
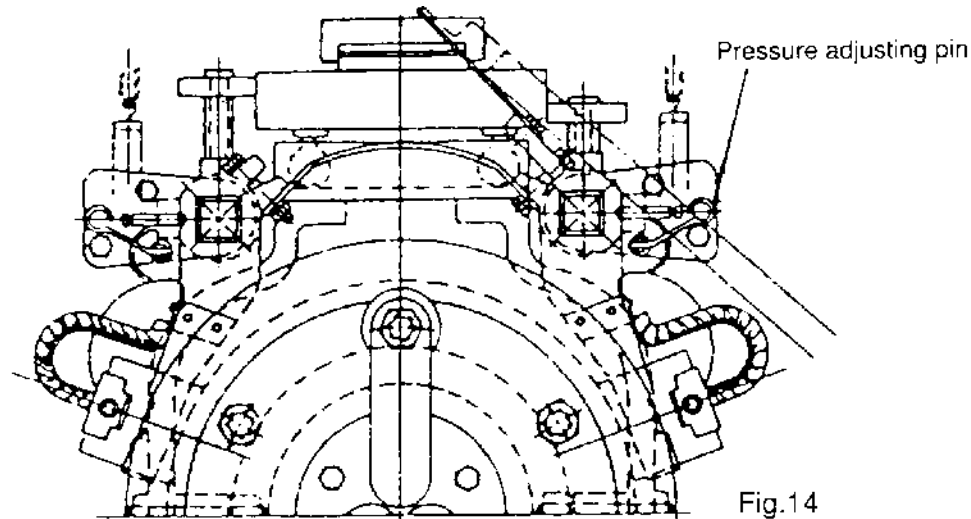
**5.7.1 Adjustment of carbon brush**

- (a) Brush pressure for normal operation:
  - Electro-graphite brush 2.8 to 3.6 psi ( $0.2 \sim 0.25 \text{ kg/cm}^2$ )  
When frequent vibrations are evident or the brush is small (area below 0.08 sq. in. ( $0.5 \text{ cm}^2$ ), the pressure should be greater than as shown.
- (b) Adjustment of brush pressure:

The brush pressure should be adjusted to keep normal operation as it wears.

  - The brush pressure may be reduced after use, so it is necessary to re-adjust. For adjustment, please turn adjusting screw, pressure adjusting pin or pressure adjusting plate as shown in Fig. 14 to obtain the correct tension ( $= 3.27 \times \text{brush cross sectional area in inches}^2$ )  $\pm 0.2 \text{ lbs}$  ( $= 0.23 \times \text{brush cross sectional area in cm}^2$ )  $\pm 10\%$  kg).
- (c) Brush pressure need not be adjusted if constant force spring is used as shown in Fig. 15 and Fig. 16.





### 5.7.2 Brush replacement

The carbon brush is a part of the equipment which is easily worn away, replace it after it is worn to  $1/2 \sim 3/4$  of original size.

#### (a) Brush material

The brush material is important to the performance of the motor. Only the most appropriate materials are chosen by TWMC, and are listed on the nameplate of the motor. It is important to know this when you replace the brush, so a recommended type is used.

#### (b) Dimensions

Brush, holder and gap between them, please refer to CNS 2322 C4051 or JIS C2802.

### **ATTENTION!**

**The gap between a brush and its holder is important for good performance and safety of the motor.**

#### (c) Adjustment of new brushes (Shown in Fig. 17)

- (1) Polish the new brush with a file until it assumes the appropriate contour of the slip ring which it touches.

- (2) Place sand-paper (JIS R6252 No. 40... 50) on the slip ring with the abrasive face of the paper against the brush to induce a closer contact by rubbing against each other.
- (3) Repeat item 2 with fine sandpaper (JIS R6252 No. 100 to 200) until the contact surface between brush and slip ring exceeds 80%.
- (4) Finally, clean the contaminated slip ring and brush with a clean cloth or compressed air.

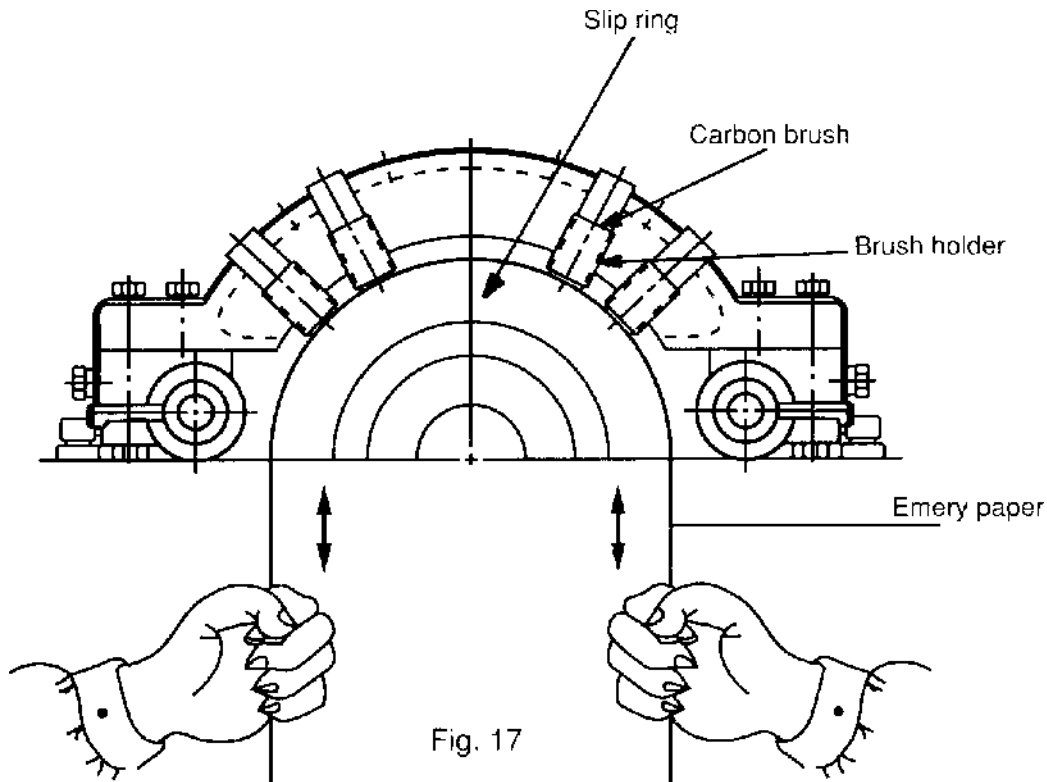


Fig. 17

## 5.8 Maintenance of non-reverse ratchet mechanism (For Vertical high Thrust Motor only)

### 5.8.1

In the pump piping system, a check valve and a stop valve should be installed in the discharge line. The check valve, placed between the pump and the stop valve, is to protect the pump from reverse flow and excessive backpressure. The stop valve is used in priming, starting and when shutting down the pump. It is advisable to close the stop valve before stopping the pump. This is especially important when the pump is operated against a high static head.

TWMC vertical high thrust motors are equipped with a non-reverse ratchet (N.R.R.) mechanism only when requested by the pump manufacturer. Typical construction of the N.R.R. mechanism is shown as Fig 18 below.

The N.R.R. mechanism keeps the pump and motor from rotating in the reverse direction. This prevents damage from over-speeding and damage to water-lubricated pump shaft bearings

when, on shutdown, the falling water column tends to drive the pump in the reverse direction. In normal operation, the ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed. When power is removed, the speed decreases and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.

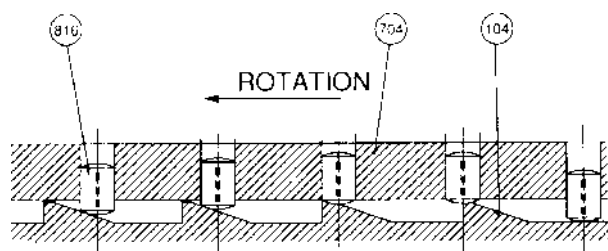
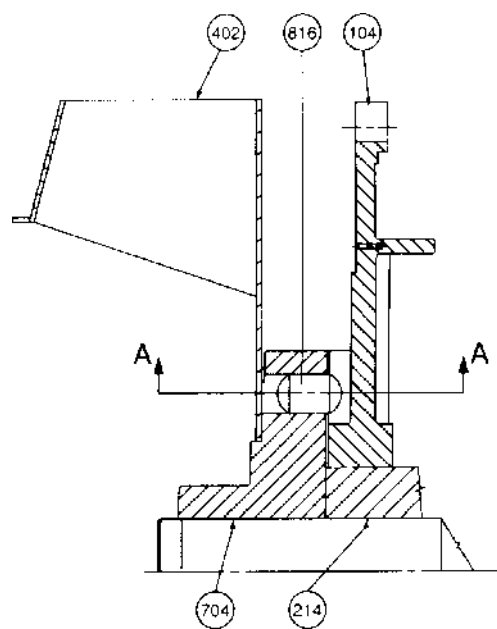
### 5.8.2

The service life of ratchet pins depends not only on the reverse shock load between the pin and ratchet tooth when the pump is stopped but also the frequency of pump starting and stopping while in service. If the pins are deformed due to this reverse shock load, then the up and down motion of the ratchet pins could be sluggish or jammed and unusual noises shall arise.

The recommended replacement period for these ratchet pins is every three (3) years. If the reverse shock load is greater than 30% of motor rated torque or the starting frequency is more than twice per day, then the replacement period should be halved.

#### ATTENTION!

The check valve and stop valve in the discharge line should be regularly inspected and maintained to assure the normal function of these valves. This is important to protect the pump and motor from damage and increase the service life of the N.R.R. mechanism.



SECTION A-A

ITEM	NAME
104	RATCHET
214	BEARING SEAT
402	EXTERNAL FAN
704	RATCHET PIN CARRIER
816	RATCHET PIN

Fig. 18

## 6. FAULT FINDING AND RECOGNITION

Kinds of Breakdown	Symptoms	Possible Causes	Remedies
Fail to start without load	Motionless and soundless	Power-off	Consult power company
		Switch-off	Switch-on
		No fuse	Install fuse
		Broken wiring	Check wiring and repair
		Broken lead	Check wiring and repair
		Broken windings	Check windings and repair
	Fuse blowing. (Automatic switch trips off, slow start with electromagnetic noise)	Short circuit of circuit switches	Check circuit switches and replace
		Incorrect wiring	Check wiring according to nameplate
		Poor contact at terminal	Lock tightly
		Windings grounded	Factory repair
		Broken windings	Factory repair
		Poor contact of circuit switches	Check and repair
		Broken wiring	Check and repair
		Poor contact of starting switches	Check and repair
		Short circuit of starting switches	Check and repair
		Incorrect connections of starting switches	Connect according to nameplate
Loading after start	Fuse blowing. Fail to restart due to trip-off of automatic switch	Insufficient capacity of fuse	Replace fuse if wiring permits
		Overload	Lighten load
		High load at low voltage	Check circuit capacity and reduce load
	Overheating motor	Overload or intermittent overload	Lighten load
		Under-voltage	Check circuit capacity and power source
		Over-voltage	Check power source
		Ventilation duct clogged	Remove the foreign matter in the duct
		Ambient temperature exceeds 104°F (40°C)	Correct insulation class to B or F, or lower ambient temperature
		Friction between rotor and stator	Factory repair
		Fuse blown (Single-phase rotating)	Install the specified fuse
		Poor contact of circuit switches	Check and repair
		Poor contact of circuit starting switches	Check and repair
		Unbalanced three-phase voltage	Check circuit or consult power company

Kinds of Breakdown	Symptoms	Possible Causes	Remedies
Loading after start	Speed falls sharply	Voltage drop	Check circuit and power source
		Sudden overload	Check machine
		Single-phase rotating	Check circuit and repair
	Switch overheat	Insufficient capacity of switch	Replace switch
		High load	Lighten load
	Bearing over-heating	High belt tension	Adjust belt tension
		Slack belt tension	Adjust belt tension
		Misalignment between motor and machine shafts	Re-align
		Over speed of bearing outer-ring	Adjust bracket
		High bearing noise	Replace the damaged bearing
Noise	Electromagnetic noise induced by electricity	Occurrence from its first operation	May be normal
		Sudden sharp noise and smoking	Short circuit of windings should be repaired at the factory
	Bearing noise	Noise of low shishi or Thru-Thru	May be normal
		Kala-Kala as a result of poor lubrication	Grease
		Kulo-Kulo as a result of poor lubrication	Clean bearing and grease
		Sa-Sa or larger noise	Replace the damaged bearing
	Mechanical noise caused by machinery	Loose belt sheave	Adjust key and lock the screw
		Loose coupling or skip	Adjust the position of couplings, lock key and screw
		Loose screw on fan cover	Lock fan cover screw tightly
		Fan rubbing	Adjust fan position
		Rubbing as a result of ingress of foreign matter	Clean motor interior and ventilation ducts
		Wind noise	Noise induced by air flowing through ventilation ducts
		Induced by conveyance machine	Repair machine
Vibration	Electromagnetic vibration	Short circuit of winding	Factory repair
		Open circuit of rotor	Factory repair
	Mechanical vibration	Unbalanced rotor	Factory repair
		Unbalanced fan	Factory repair
		Broken fan blade	Replace fan
		Unsymmetric centers between belt sheaves	Align central points
		Central points of couplings do not lie on the same level	Adjust the central points of couplings to the same level
		Improper mounting installation	Lock the mounting screws
		Motor mounting bed is not strong enough	Reinforce mounting bed

Remarks:

- (1) Circuit switches: These include knife switches, electromagnetic switches, fuses and other connection switches etc.
- (2) Starting switches: These include Delta-Star starters, compensate starters, reactance starters, resistor starters, starting controller's etc.

# **SECTION 3**

## **TECHNICAL SPECIFICATIONS**

Package Data Sheet

Performance Data

Bill of Material

P&ID

General Arrangement Drawing

Building Drawing

Skid Drawing

Fugitive Emissions Study

## **Package Data Sheet for Unit S/N 20960**

Compressor:

Make/Model: Gardner Denver Enduro E25DG Compressor  
4.4 VI, 1.38 Gear Ratio  
S/N: FE025003318

Driver:

Make/Model: Teco-Westinghouse 75HP TEFC Electric Motor, 1800  
RPM, 3PH, 60HZ, 230/460V, VFD Compatible  
S/N: YHP722B307002

Inlet Separator: 16" NPS x 56" S/S Pillar  
MAWP: 230 psig @ 300°F  
MDMT: -20°F @ 230 psig  
CA: 1/8"  
CRN: P8612.231  
S/N: 05-788-5491  
A#: 504650

Gas/Oil Separator: 20" NPS x 58" S/S Pillar  
MAWP: 300 psig @ 300°F  
MDMT: -20°F @ 300 psig  
CA: 1/8"  
CRN: R6911.231  
S/N: 05-788-5484  
A#: 524357

Cooler:

Make/Model: AKG Thermo Systems AOC-125-C-CRN  
Gas Section: MAWP 250 psig @ 250°F  
Oil Section: MAWP 250 psig @ 250°F  
S/N:  
CRN: OH0909.2136

### **NOTICE**

**Exceeding the above conditions may cause damage to the unit. The operators MUST familiarize themselves with the design limits BEFORE starting the unit.**



Date:	4/21/2023 , 10:30 AM	Quote Contact:
Customer/End-User:		Project Name:
Packager/OEM:		Site Location:

Unit Performance					
Gas Flow:	Mscfd	465.29	✖	Oil Heat Load:	BTU/min 1980.08
Shaft Power:	HP	70.36	✖	Oil Inj. Diff.:	°F 18.52
Oil Injection Temp.:	°F	161.48		Oil Flow:	gal/min 29.68
ERRORS/NOTES:					

Unit Information: E25DG233HI		
Maximum Discharge Pressure:	psiG	205.00
Maximum Discharge Temperature:	°F	239.00
Maximum Shaft Power:	HP	107.00
Minimum Oil Flow:	gal/min	16.00
Oil Orifice/Oil Pump:		0.35433in orifice
Torsional Inertia:	Lbm-ft²	N/A
Fan offered:		No

Environmental Conditions				
Suction Temperature:	°F	65.00	Shaft Speed:	RPM 1775
Suction Pressure:	psiG	2.00	@ Flange:	psiG 1.50
Discharge Pressure:	psiG	116.00	@ Flange:	psiG 121.00
Discharge Temperature:	°F	180.00		
Suction Pressure Drop:	psi	0.50		
Discharge Pressure Drop:	psi	5.00		

Site Information			
Elevation:	ft	3000.00	Base Temp. °F 65.00
Atmospheric Pressure:	psiA	13.17	Base Press. psiA 14.70

<b>Gas Analysis – Generic Gas Method (100% R.H.)</b>	
<b>Gas</b>	<b>Amount</b>
TOTALS (%):	
Specific Gravity:	0.65
K Value ( $C_p/C_v$ @ 150 °F):	1.24
Mole Weight:	N/A

Stage Data:		Stage 1	Stage 2
Internal Ratio:		4.4	
Rotor Diameter:	mm	155.000	mm
Gear Ratio:		2.333	
Versatrol Ports Available:		N/A	N/A
Versatrol Ports Open:		N/A	N/A
Turn Valve Setting:	%	N/A	N/A
Tip Speed:	m/sec	33.608	m/sec
Suction Pressure:	psiG	2.00	psiG
Discharge Pressure:	psiG	116.00	psiG
Suction Temperature:	°F	65.00	°F
Discharge Temperature:	°F	180.00	°F
Power:	HP	70.36	HP

\*All power and flow values are +/- 5%\*

\*\*\*NOTES\*\*\*

- Minimum oil viscosity is 15 centistokes at injection temperature.
- Higher viscosity oil may cause higher than predicted shaft power.
- Discharge temperatures between 230 °F and 250°F are acceptable for certain applications. Consult the factory if this condition is required.



## **20960 MASTER BILL OF MATERIAL**

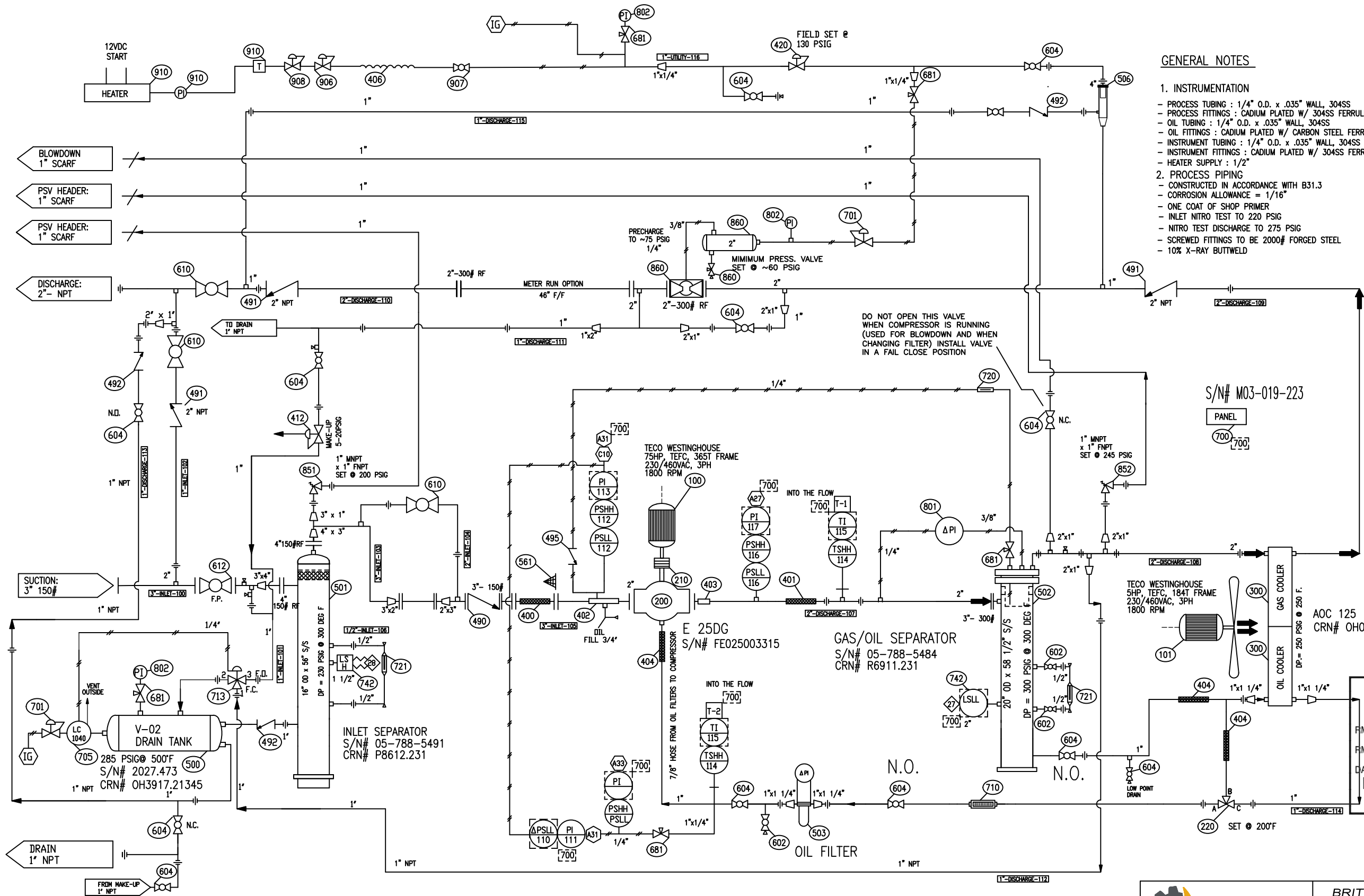
AS BUILT: May 1, 2023

<b><u>ITEM</u></b>	<b><u>SUPPLIER</u></b>	<b><u>QUANTITY</u></b>	<b><u>DESCRIPTION</u></b>
100	Teco	1	75HP Electric Motor 1800RPM TEFC, 365T OPTIM 230/460Vac 3PH, 60HZ SN: YHP722B307002
101	Teco	1	5HP Electric Motor 1800RPM TEFC, 184T OPTIM 230/460Vac 3PH, 60HZ SN: ZHV322C706012
200	A&G	1	SCREW COMPRESSOR, "TAMROTOR" MODEL ENDURO 25DG, VI =4.4 , GEAR RATIO = 2.33 2 " INLET x 2" OUTLET. SN: FE025003318
210	MOTION	1	DRIVE COUPLING, "REX-OMEGA" -1 ONLY OMEGA FLEX ELEMENT REX 9658670 E60 FLEX ELEMENT W/CS PART#5988 -2 ONLY REX 9649335 TAPERLOCK IRON HUBS - OMEGA 60 HTL CI (3020 BUSHING) PART#46893 -1 ONLY MARTIN BUSHING FOR 45MM O.D. COMPRESSOR SHAFT 3020 PART# 728959 -1 ONLY MARTIN BUSHING FOR 2.375" O.D. MOTOR SHAFT PART # 3020 2 3/8 BUSHING TB
220	A&G	1	THERMOSTATIC CONTROL VALVE, FPE, TVB1160-10861 1" NPT 200 DEGREES F ELEMENT
300	A&G	1	OIL & GAS COOLER, "AKG THERMAL SYSTEMS" MODEL AOC125-C-CRN RATED -D.P. 250 PSIG @ 250 DEGREES F BOTH SECTIONS -GAS SIDE CONN'S: 2" NPT IN / OUT -OIL SIDE CONN'S: 1 1/4" NPT IN / OUT -CRN# OH0909.2136, 250 PSI @ 250 DEGREE F. REGISTRATION FOR A.B., B.C., S.K.
400	A&G	1	FLEX CONNECTOR, "MAGIC SPAN" 304SS BRAIDED 3" - 150# RF EACH END, 12" LG, DESIGN PRESS. 230 PSIG @ 300 DEGREES F
401	A&G	1	FLEX CONNECTOR, "MAGIC SPAN" 304SS BRAIDED, 2" NPT EACH END x 10" LG, DESIGN PRESS. 300 PSIG @ 300 DEGREES F

402	A&G	1	SUCTION SPOOL, E25, "G.V./A&G" 3"-150#RF ON ONE END AND 1 1/4" PLATE FLANGE, 5 5/8 x 5 5/8 AND 2" HOLE ON THE OTHER END, CRN# OB5864.2
403	A&G	1	DISCHARGE SPOOL, E25, "G.V./A&G" 2" PIPE SCH 80 X 4" LG, TOE X POE ON ONE END AND 1 1/4" PLATE FLANGE, 4"X 2 7/16" ON THE OTHER END, CRN# OB5864.2
404	A&G	3	7/8" FLEX HOSE, USE ON OIL LINE AND RATED FOR 800PSI @ 240 F, PT# 151-16 3 - FEMALE JIC SWIVEL 3505-16-16 REUSABLE FITTING 3 - MALE NPT X MALE JIC 3516-16-16 FITTING 1 - MALE NPT X MALE JIC 1516-16-16 ADAPTER
406	A&G	1	1/2" FLEX HOSE, RATED FOR 800PSI @ 240 F
412	FISHER	1	REGULATOR, 627, 1" NPT, 1/2" ORIFICE, 5-20 PSIG
420	FISHER	1	REGULATOR, 627, 1" NPT, 1/2" ORIFICE, 70-150 PSIG
490	A&G	1	WAFFER CHECK VALVE, "VELAN PROQUIP" PT# BDB10-3B, 3" - 150#RF
491	A&G	3	SWING CHECK VALVE, "WHEATLEY" PT# 820-023216-131 2" - NPT
492	A&G	3	SWING CHECK VALVE, "WHEATLEY" PT# 820-013216-131, 1" NPT
495	A&G	1	CHECK VALVE, "PARKER" PT# 4M-C4L-1-SS, 1/4" TUBE
500	A&G	1	DRAIN TANK. "LO-TECH", 10 3/4" OD x 18" S/S D.P. = 285 PSIG @ 500 DEGREES F SWEET GAS SERVICE CRN# OH3917.21345, S/N# 2027.
501	A&G	1	INLET SEPARATOR, "QUASAR / PILLAR" 16" O.D. x 56" S/S AND DE-MISTER -D.P. = 230 PSIG @ 300 DEGREES F -CRN# P8612.213, REGISTRATION FOR PROVINCE OF AB, B.C. SASK. -,4" 150# RFWN IN / OUT CONN'S -SWEET GAS SERVICE, SN# 05-788-5491, 'A' 504650
502	A&G	1 1	GAS/OIL SEPARATOR "QUASAR / PILLAR" 20" O.D. x 58" c/w: -ONE REMOVABLE ELEMENT FLANGE O.D. 14.625", FILTER O.D. 11.75", 19" LONG, PT# S138D2191 -D.P. = 300 PSIG @ 300 DEGREES F -2" NPT INLET/OUTLET -CRN# R6911.231, REGISTRATION FOR PROVINCE OF B.C., AB., SK -SWEET GAS SERVICE, SN# 05-788-5484, 'A' 524357
503	A&G	1	OIL FILTER "DONALDSON" P/N P166663, 1 1/4" SAE O-RING IN / OUT, 50 USGPM MAX INDICATOR BLOCK P165984, INDICATOR P165965 c/w 1 OIL FILTER P165705 ELEMENT (10 MICRON) 350 PSI WORKING PRESSURE

561	A&G	1	CONE STRAINER, "MAGIC SPAN" 150% OPEN AREA, 3" - 150# SCH 80 304SS MESH MILD STEEL PERFORATED BACKING
602	A&G	9	BALL VALVE, "MERIDIAN" 1/2" NPT, FULL PORT, 2000# WOG
604	A&G	15	BALL VALVE, "MERIDIAN" 1" NPT, FULL PORT, 2000# WOG
610	A&G	3	BALL VALVE, "MERIDIAN" 2" NPT, FULL PORT, 2000# WOG
612	A&G	1	BALL VALVE, "MERIDIAN" 3" 150#RF, FULL PORT, 285# WOG PT# FB2R30R01N
681	A&G	7	NEEDLE VALVE "CENTURY ", 1/4" FNPT x 1/4" FNPT, CM2-3-F22TBV
700	A&G	1	<b>CONTROL PANEL "MURPHY" MODEL TTDJ - RETROFITTED FOR USE WITH ELECTRIC DRIVER SUITABLE FOR CLASS 1, DIV 2 AREA COMPR OIL TEMP. T.W. - PT# 34210116PIC, 5/8" x 1/2" S.S. 2.5" U DISCH TEMP. T.W. - PT# 34210116-1PIC, 5/8" FNPT x 1/2" FNPT S.S. 4" U,</b>
701	A&G	2	REGULATOR, "FISHER" 67CFR-600, 1/4" NPT, 0 TO 60 PSI SPRING RANGE, TO BE SET AT 30 PSI, C/W 0 TO 60 B/M PSIG (WINTERS) GAUGE SWEET SERVICE
705	A&G	1	LEVEL CONTROL , "MURPHY" L1200NDVO, PNEUM. LEVEL CONTR. HORIZONTAL FLOAT C/W EXT., 1500 PSI MAWP
710	A&G	1	INLINE FLOW METER "HEADLAND" MODEL H761A-040, 1" NPT, 3-40 USGPM SCALE, 3500 PSI MAWP
713	A&G	1	3-WAY GAS CONTROL VALVE, "MALLARD", 5300, 1"NPT, 3/8" ORIFICE, 0-35 PSI DIAPHRAGM GAS TO OPEN TO DISCHARGE
720	A&G	1	SIGHT FLOW INDICATOR, 3/4" NPT CROSS 2000#, C/W 2 SIGHT PLUG PT# LSP51-05 3/4" NPT
721	A&G	2	GAUGE GLASS, "QUALITY" Model Q17-R-20, Reflex level gauge, 1/2" FNPT x 10 1/4" L, CRN# 0C4222.52 / 0F4223.52 3000PSI@100F
742	A&G	2	LEVEL SWITCH / SHUTDOWN LIQUID LEVEL, "MURPHY" L1200, HORIZONTAL FLOAT, 1500 PSI MAWP
801	A&G	1	DIFFERENTIAL P.I. "MWI" 2 1/2", 0 / 30 PSID, PT# 120AA-00-OO, MAWP 6000 PSI
802	A&G	3	P.I., "WINTER'S PREMIUM GAUGE", PT# P827, 2.5" DIA. LIQUID FILLED, 1/4" NPT BTM CONN., 0 TO 300 PSI DUAL SCALE
851	Mercer	1	<b>RELIEF VALVE, "MERCER" SERIES 9100, PN: 91-17D51T07E1 D Orifice. 1" MNPT x 1" FNPT, SET @ 200 PSIG, SWEET GAS SERVICE S/N# C036947</b>
852	Mercer	1	<b>RELIEF VALVE, "MERCER" SERIES 9100, PN: 91-17D51V09E1. D Orifice. 1" MNPT x 1" FNPT, SET @ 250 PSIG, SWEET GAS SERVICE S/N# C031121</b>

860	A&G	1	DISCHARGE CONTROL VALVE, "SUR-FLO" PRESSURE DIFFERENTIAL SF10V-C-75-N6-2.6 CARBON STEEL CONES, SF75 SLEEVE REGULATOR MODEL, 2" 300/600# RF BP VALVE - C/W 12" EXPANSION BOTTLE - TO BE FIELD SET AT ~75 PSIG
906	A&G	1	PRESSURE REGULATOR "FISHER" PT# TYPE 912, 11"-250PSI SCOTT CAN
907	A&G	1	BALL VALVE "GAS FLO" 3/8" NPT PT# ACBV-3/8 600# WOG SCOTT CAN
908	A&G	1	PRESSURE REGULATOR "MAXITROL" PT# ES404, 0132 3 7.0 SCOTT CAN
910	A&G	1	THERMCAT 2000 NATURAL GAS HEATER "SCOTT CAN" 16,000 BTU, 12 V DC, 24X24, CGA, PROTECTIVE GRILLE STARTER c/w AND 25 FT TYPE 12 VOLT STARTER CABLES, JOHNSON CONTROL VALVE AND P.I. 0-15"H <sub>2</sub> O6-10-M88 1/2" NPT x 24" Heater Hose



### GENERAL NOTES

- INSTRUMENTATION
  - PROCESS TUBING : 1/4" O.D. x .035" WALL, 304SS
  - PROCESS FITTINGS : CADIUM PLATED W/ 304SS FERRULES
  - OIL TUBING : 1/4" O.D. x .035" WALL, 304SS
  - OIL FITTINGS : CADIUM PLATED W/ CARBON STEEL FERRULES
  - INSTRUMENT TUBING : 1/4" O.D. x .035" WALL, 304SS
  - INSTRUMENT FITTINGS : CADIUM PLATED W/ 304SS FERRULES
  - HEATER SUPPLY : 1/2"
- PROCESS PIPING
  - CONSTRUCTED IN ACCORDANCE WITH B31.3
  - CORROSION ALLOWANCE = 1/16"
  - ONE COAT OF SHOP PRIMER
  - INLET NITRO TEST TO 220 PSIG
  - NITRO TEST DISCHARGE TO 275 PSIG
  - SCREWED FITTINGS TO BE 2000# FORGED STEEL
  - 10% X-RAY BUTTWELD
- UTILITY PIPING
  - ALL PIPING 2" AND LESS SHALL BE Min. SCH 80
  - SCREWED FITTINGS TO BE 2000# FORGED STEEL
- PAINTING
- VESSELS
  - CRN FOR PROVINCE OF ALBERTA

SWEET GAS SERVICE



ID#58069

2023-05-15

Stamp applies to piping design to ASME B31.3 only.

S/N# M03-019-223

PANEL  
700  
700

TECO WESTINGHOUSE  
5HP, TEFC, 184T FRAME  
230/460VAC, 3PH  
1800 RPM

AOC 125  
CRN# OH0909.2136

**PERMIT TO PRACTICE**  
2045690 ALBERTA LTD.  
O/A STEP ENGINEERING

FM SIGNATURE: *Peter Poon*

FM APEGA ID #: 58069

DATE: 2023-05-15

**PERMIT NUMBER: P014014**

The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

### TUBING CONN'S

- C10 COMPRESSOR SUCTION PRESSURE
- A27 COMPRESSOR DISCHARGE PRESSURE
- A31 COMPRESSOR OIL DIFFERENTIAL PRESSURE
- A33 COMPRESSOR OIL PRESSURE

### ELECTRICAL CONN'S (INTRINSICALLY SAFE)

- 27 LOW OIL LEVEL-GAS/OIL SEPARATOR
- 28 HIGH LIQUID LEVEL-INLET SEPARATOR

### CAPILARY CONN'S

- T-1 HIGH COMPRESSOR DISCHARGE TEMPERATURE
- T-2 HIGH COMPRESSOR OIL TEMPERATURE



BRITANNIA INDUSTRIES 2009 INC.

6227-41ST STREET  
LEDUC, AB T9E 0V7  
PH. 780-986-5955  
FAX: 780-986-7113  
TOLL FREE: 866-955-7524

DATE	24/04/23
MRB	DATE
SCALE	CLIENT PO
NTS	TBD
JOB No.	20960 (S02246)

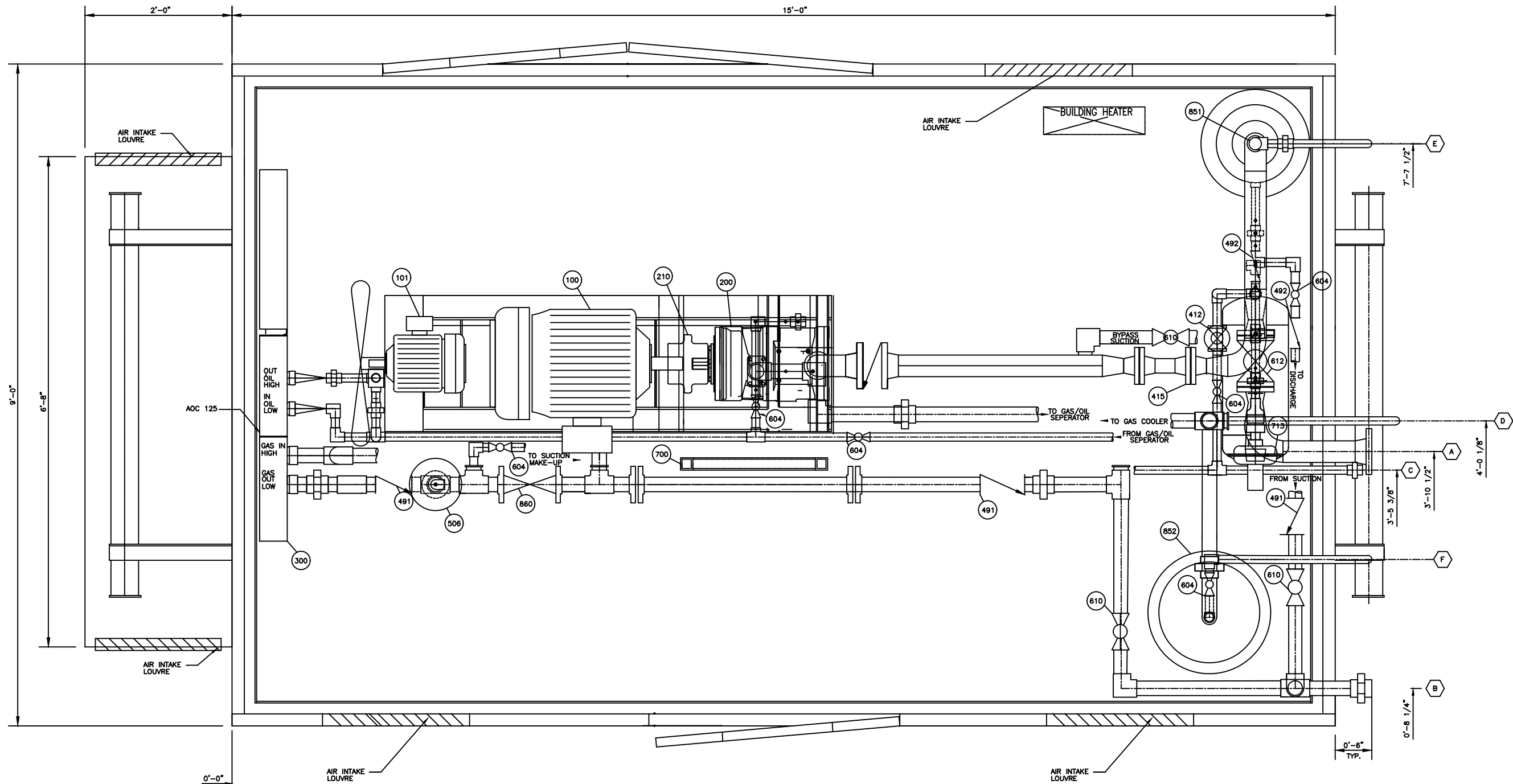
PROCESS & INSTRUMENTATION DIAGRAM  
GARDNER DENVER TAMROTOR E25DG  
75HP ELECTRIC VRU PACKAGE  
(RETROFIT TO BRAHMA UNIT S02246)

CUSTOMER TAMARACK VALLEY  
c/o FUELLED

DWG NO. 20960-100


REV. 1

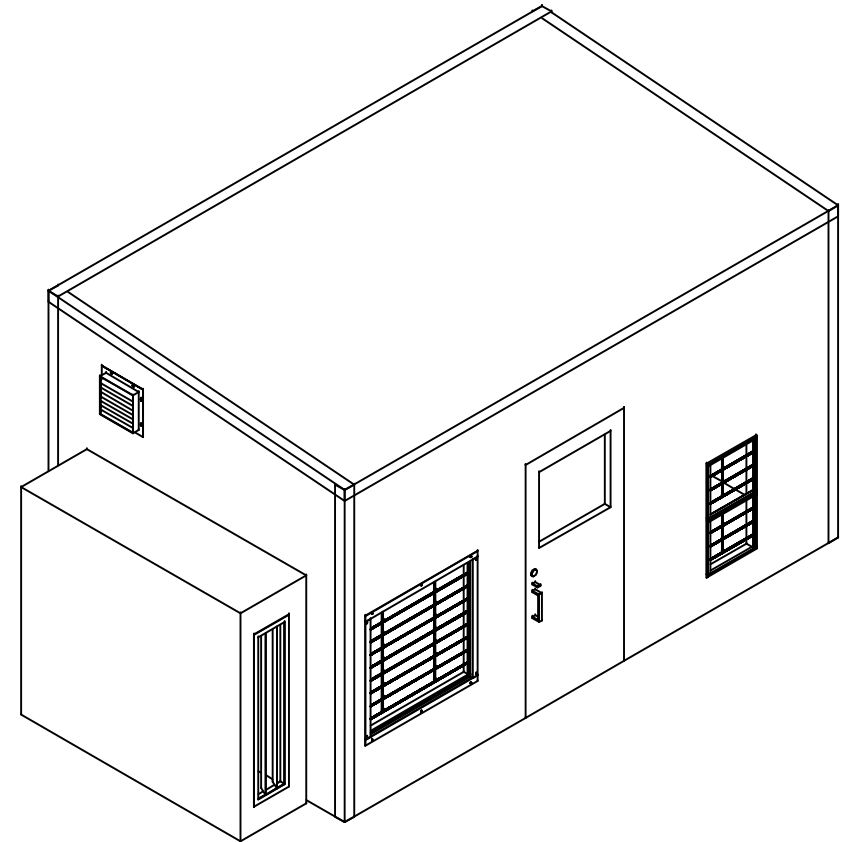
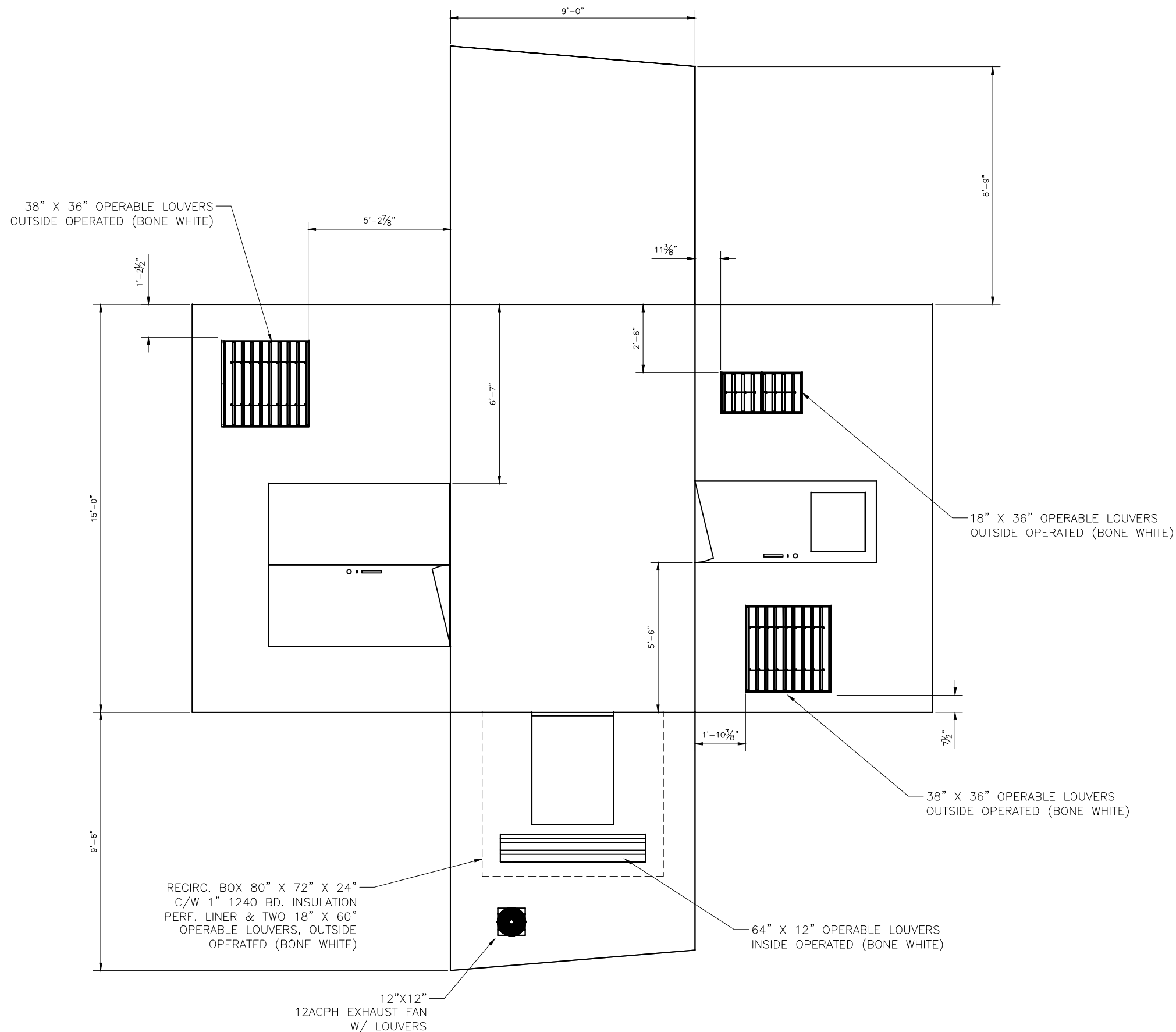
REV	DESCRIPTION	DATE	BY
1	AS BUILT	01/05/23	MRB
0	ISSUED FOR CONSTRUCTION	24/04/23	MRB
REVISION HISTORY			



PLAN VIEW

SCHEDULE OF OPENINGS			ELEV FROM TOP OF SKID TO CENTER OF PIPE
MARK	SIZE	DESCRIPTION	
A	3" 150# FLANGED	GAS SUCTION	3'-9 1/2"
B	2" NPT	GAS DISCHARGE	0'-4 7/8"
C	1" NPT	LIQUIDS DRAIN HEADER	0'-2"
D	1" PIPE	PSV #852 VENT	8'-2 1/2"
E	1" PIPE	PSV #851 VENT	8'-2 1/4"
F	1" PIPE	BLOWDOWN	6'-8 3/4"


1	AS BUILT	01/05/23	MRB
0	ISSUED FOR CONSTRUCTION	24/04/23	MRB
REV	DESCRIPTION	DATE	BY
REVISION HISTORY			
		<b>BRITTANIA INDUSTRIES 2009 INC.</b> 6227-41ST STREET LEDUC, AB T9E 0V7 PH. 780-986-5955 FAX: 780-986-7113 TOLL FREE: 866-955-7524	
DRAWN MRB	DATE 24/04/23	GENERAL ARRANGEMENT DRAWING GARDNER DENVER TAMROTOR E25DG 75HP ELECTRIC VRU PACKAGE (RETROFIT TO BRAHMA UNIT SO2246)	
APPROVED	DATE		
CLIENT P.O. NO.			
JOB No. 20960 (S02246)	CUSTOMER TAMARACK VALLEY c/o FUELLED	DWG NO. 20960-200	REV. 1

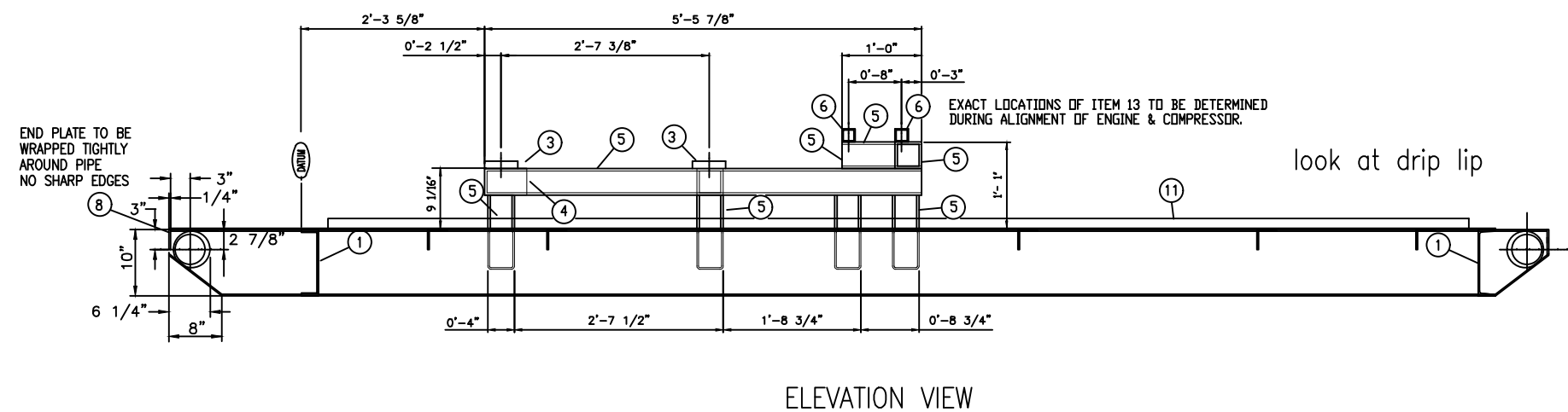
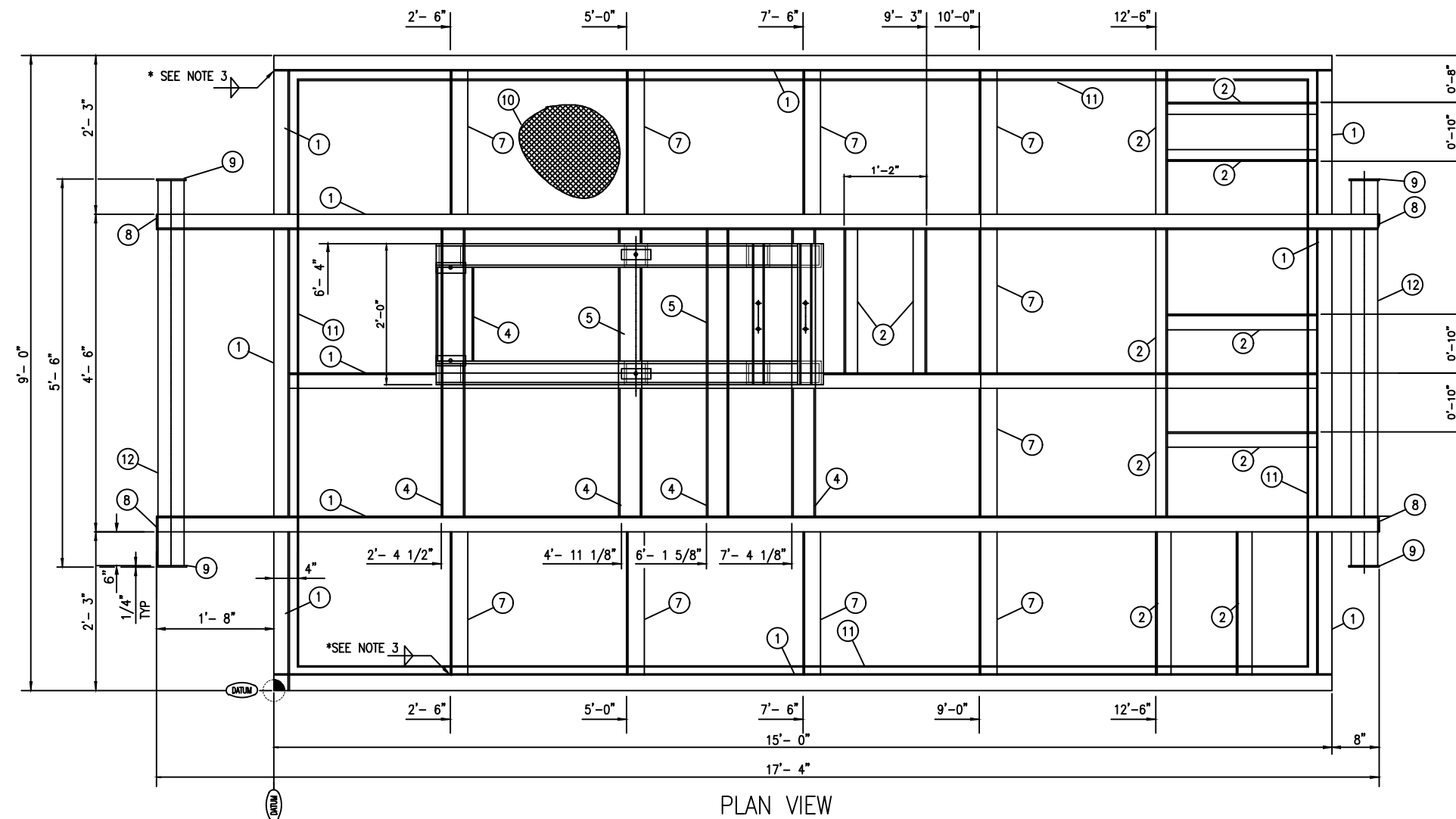


**BUILDING SPECIFICATIONS:**

EXT WALL: 22GA GALVANIZE BONE WHITE – QC 273  
EXT ROOF: 22GA GALVANIZE BONE WHITE – QC 273  
EXT TRIM: 22GA GALVANIZE BONE WHITE – QC 273  
INT LINER: 20GA ALUMINUM FLUTED – WHITE  
WALL INSUL: 3” R12 W/ 4 MILL VAPOUR BARRIER  
ROOF INSUL: 3” R12 W/ 4 MILL VAPOUR BARRIER

ONE 3’ X 7’ MAN DOOR, RH, IWG  
ONE 6’ X 7’ MAN DOOR, RH ACTIVE

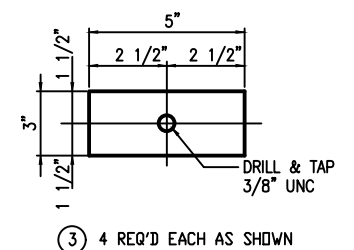
0	AS BUILT	24/04/23	MRB
REV	DESCRIPTION	DATE	BY
REVISION HISTORY			
		<b>BRITTANIA INDUSTRIES 2009 INC.</b> 6227-41ST STREET LEDUC, AB T9E 0V7 PH. 780-986-5955 FAX: 780-986-7113 TOLL FREE: 866-955-7524	
DRAWN	DATE	BUILDING DETAIL DRAWING GARDNER DENVER TAMROTOR E25DG 75HP ELECTRIC VRU PACKAGE (RETROFIT TO BRAHMA UNIT S02246)	
JB	06/10/22		
APPROVED	DATE		
.	.		
CLIENT P.O. NO.			
JOB No.	CUSTOMER	DWG NO.	REV.
20960 (S02246)	TAMARACK VALLEY c/o FUELLED	20960-201	0




BILL OF MATERIALS		
ITEM	QUANT.	DESCRIPTION
1	97'-0"	10" CHANNEL @ 15.3 #/FT.
2	16'-9 1/2"	6" CHANNEL @ 8.2 #/FT. (FLUSH ON TOP)
3	4	ENGINE SOLE PLATE, 1" THK, 5" x 3" MACHINED
4	17'-9"	HSS 6"x 4"x 1/4".
5	21'-0"	HSS 4"x 4"x 1/4".
6	4'-0"	HSS 2"x 2"x 1/4".
7	20'-6"	ANGLE, 3" x 3" x 1/4". (FLUSH ON TOP)
8	4	SKID END PLATE, 1/4" t x 2 1/4" WIDE
9	4	LOADING ROLL END PLATE, 1/4"., 4 7/8" x 5 3/8" OVAL
10	-	CHECKER PLATE, 1/4". x 9'- 0" x 16'- 0"
11	A/R	DRIP LIP, 3/16". x 1 1/2" FLAT BAR
12	2	ERW PIPE, 4" SCH 80 x 5'-6" LG
13		
14		
15		
16		

NOTES:

1. DO NOT WELD ENGINE SOLE PLATES  
TO SUB BASE BEFORE ASSEMBLY AND ALIGNMENT
2. MARK DATUM ON SKID CORNER
3. 1/4" FILLET WELD APPLIED TO ALL APPLICATIONS



6				DRWN	TRF	SKID ASSEMBLY - PLAN VIEW FOR CUMMINS G8.3 / TAMROTOR E25DG	CUSTOMER  AIR & GAS STOCK	JOB # SD-2246 REVISION: 0 10/03/05 DWG. 2246-3
5				DATE	JUNE 29, 2004			
4				SCALE	N.T.S. CD			
3				APP'D				
2								
1								
0	10-03-05	MOD	ISSUED FOR TENDER	 AIR & GAS COMPRESSION SYSTEMS LTD.				
REV	DATE	BY	DESCRIPTION					
REVISIONS								



# FUGITIVE EMISSION STUDY

FOR: BRITTANIA INDUSTRIES

75HP ELECTRIC VRU PACKAGE



REV	DESCRIPTION	DATE	BY	CHK	APP
1	IFC	2023-05-03	JF	JF	JF

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# FACILITY INFORMATION

Estimated Ambient Temperature (°F)	95
Building Length (ft)	15.0
Building Width (ft)	9.0
Eave Height (ft)	8.8
Eave to Peak (ft)	0.3
<b>Building Volume (ft³)</b>	<b>1204.88</b>

Reference Drawings and Description:

DWG NO.	REV	DESCRIPTION
20960-201	0	75HP ELECTRIC VRU PACKAGE - BUILDING DETAIL DRAWING
20960-100	1	75HP ELECTRIC VRU PACKAGE - PIPING AND INSTRUMENTATION DIAGRAM

Notes:

All calculations are based on information from client.

## EMISSION SOURCES

Emission Component	Quantities				Total Emissions Per Device
	Gas	Heavy Oil (<20 API Gravity)	Light Oil (≥20 API Gravity)	Water/Oil	leak:lbs/day
Connectors	200		0	76	2.6408
Valves	23			11	5.5772
Flanges	66			22	1.3893
Other	5			1	3.0900
Open-End	0			0	0.0000
Pump Seals	0			0	0.0000
Total Emmision Rate					12.70

The "Other" category includes: compressors, diaphragms, dump arms, hatches, instruments, meters, pressure relief valves, and polished rods.

# GAS ANALYSIS

Source Document: Maxxam Analytics  
 Report Number: B863797-TZ1953  
 Reference sample ID: 14929

	Mole Fraction	Flam. Fraction	LEL (% vol)	Molecular Weight	MW Contribution	LEL Contribution
Helium (He)	0	N/A	0.00	4.0026	0.0000	0.0000
Nitrogen (N2)	0.0018	N/A	0.00	28.0134	0.0504	0.0000
Carbon Dioxide (CO2)	0.0054	N/A	0.00	44.01	0.2377	0.0000
Hydrogen (H2)	0.0056	0.0056	4.00	2.0158	0.0113	0.0224
C1 (Methane)	0.4026	0.4056	5.00	16.04	6.4577	2.0130
C2 (Ethane)	0.1948	0.1962	3.00	30.069	5.8574	0.5844
C3 (Propane)	0.198	0.1995	2.10	44.096	8.7310	0.4158
iC4 (iso-Butane)	0.0388	0.0391	1.80	58.123	2.2552	0.0698
nC4 (Butane)	0.0819	0.0825	1.86	58.123	4.7603	0.1523
iC5 (iso-Pentane)	0.0231	0.0233	1.32	72.15	1.6667	0.0305
nC5 (Pentane)	0.0246	0.0248	1.40	72.15	1.7749	0.0344
C6 (Hexane)	0.0127	0.0128	1.10	86.18	1.0945	0.0140
C7+ (Heptane)	0.0106	0.0107	1.05	100.2	1.0621	0.0111
C8	0	0.0000	1.00	114.23	0.0000	0.0000
C9	0	0.0000	1.00	128.26	0.0000	0.0000
C10+	0	0.0000	1.00	120.1	0.0000	0.0000
H2S	0	0.0000	4.30	34.08	0.0000	0.0000
	<b>0.9999</b>				<b>33.9591</b>	<b>3.3478</b>

\* Average LEL of the mixture is calculated by Le Chatlier's method, by taking a Weighted Harmonic mean of the LEL values for the flammable components only. To accomplish this, the Mole Fraction numbers must be adjusted to remove the non-flammable components.

## LEAK RATE CALCULATIONS

**Step 1.** Determine the total hydrocarbon leak rate per hour, the total hydrocarbons per day must be divided by 24hours/day.

$$E(\text{lb/hr}) = E(\text{lb/day}) / 24(\text{hours/day})$$

$$E(\text{lb/day}) = 12.70 \text{ lb/day}$$

$$E(\text{lb/hr}) = 12.70 / 24$$

$$E(\text{lb/hr}) = \mathbf{0.53 \text{ lb/hr}}$$

**Step 2.** From the given ambient temperature(Farenheit) in the process vicinity, we can determine the volume occupied by one mole of ideal gas, at atmospheric pressure.

$$V = \frac{\text{Ideal Gas}(\text{ft/lb-mol}) \times (\text{Ambient Temp } (^{\circ}\text{F}) + 460(^{\circ}\text{R}))}{32 + 460^{\circ}\text{R}}$$

$$V = \frac{359 \times (95 + 460)}{32 + 460}$$

$$V = \mathbf{404.97 \text{ ft/lb-mol}}$$

**Step 3.** Now the Total Leak rate in cubic feet per minute.

G = Leak Rate (cfm)

E= Emission Rate (lb/ hour)

V= Volume (cubic feet/ lb-mol

mw= average mole weight

60= minutes per hour

$$G = \frac{E \times V}{60 \times mw}$$

$$G = \frac{0.53 \times 404.97}{60 \times 33.96}$$

$$G = \mathbf{0.11 \text{ cfm}}$$

As per NFPA 69, the hydrocarbon concentration may be expressed by the following equation.

**C**=Concentration of hydrocarbon in air(percentage is expressed in decimal format)

**G**=Leak Rate (cfm)

**Q**=Fresh Air introduction rate (cfm)

**n**= number of air changes

$$C = (G/Q) \times (1 - e^{-kn})$$

Q=G/C after steady state conditions, as the term  $(1 - e^{-kn})$  approaches one. For our example to keep the hydrocarbon rate below 25% LEL, the equation now becomes  $Q = G \times 4 / (0.25 \times C)$  where C will be the estimated LEL of the mixture. Equation also includes 4 for the safety factor.

$$Q = \frac{G \times 4}{0.25 \times C} \quad Q = \frac{0.11 \times 4}{0.25 \times 0.03} \quad Q = 50.25 \text{ cfm}$$

This fresh air introduction rate is the minimum ventilation rate that is required to reduce the calculated emissions below 25% of the average LEL.

To determine the amount of air changes per hour we need to achieve this ventilation rate we use the formula:

$$n = 60 \times \frac{Q}{V(\text{building})}$$

$$n = 60 \times \frac{50.254436}{1204.875}$$

$$n = 2.50 \text{ Air changes per hour (ACPH)}$$

API 505 states that as long as the release type for the building is considered secondary, and the building is adequately ventilated, the building may be classified as Zone 2. "Adequate ventilation" refers to a building that has either 6 air changes per hour (mechanical or natural) or the natural ventilation is able to reduce the emissions to less than 25% of the LEL. The emission calculation also includes a safety factor of four (4). Approved gas detection should be present to help ensure that no more than 10 hours of gas are present annually.

**"Adequate Ventilation" required by FE Calculations:**

**50.25 cfm**

or

**2.50 ACPH**



## NATURAL VENTILATION CALCULATION

Effective Leakage Area from Cracks						
Opening Type	Quantity	Height (ft)	Width (ft)	Area (ft <sup>2</sup> )	Effective Leakage Area* (in <sup>2</sup> /ft <sup>2</sup> )	Effective Leakage Area (in <sup>2</sup> )
Windows	0	3	3	0	0.026	0.00
Single Doors	1	7	3	21	0.114	2.39
Double Doors	1	7	6	42	0.114	4.79
<b>Total Effective Leakage Area from Cracks (in<sup>2</sup>)</b>						<b>7.18</b>

\* Effective Leakage Areas given in ASHRAE (1989a) "Handbook of Fundamentals" and reproduced within table 7.1 of "Heating and Cooling of Buildings, Design for Efficiency, 2nd ed.", McGraw Hill, 2002

Effective Leakage Area from Intentional Openings						
Opening Type	Quantity	Height (ft)	Width (ft)	Raw Area (ft <sup>2</sup> )	Ventilating Area** (%)	Effective Leakage Area (in <sup>2</sup> )
Louver #1	2	3.2	3	19.2	25%	691.20
Louver #2	1	1.5	3	4.5	25%	162.00
Louver #3	1	1	5.3	5.3	25%	190.80
Exhaust Fans	0	1	1	0.0	50%	0.00
Ridge Vent	0	13	0.5	0.0	50%	0.00
<b>Total Effective Leakage Area from openings (in<sup>2</sup>)</b>						<b>190.80</b>

\*\* Ventilating area is the percentage of the raw area that is completely open with no obstruction. For louvers and exhaust fans, maximum ventilating area is approximately 75% of the raw area.

<b>Total Effective Leakage Area (in<sup>2</sup>)</b>	<b>197.98</b>
<b>Total Effective Leakage Area (cm<sup>2</sup>)</b>	<b>1277.30</b>

$Q = A_{eff} * \text{SQRT} (a_s * \Delta T + a_w * v^2)$  equation 7.12 from Heating and Cooling of Buildings"

where

Q = Infiltration Rate in L/s

$a_s$  = stack coefficient in table 7.2 of "Heating and Cooling of Buildings" for one story building,  $a_s = 0.000145$

$\Delta T = T_i - T_o$ , in Kelvin - for FE studies, this is assumed to be 3° K during summer

$a_w$  = wind coefficient in table 7.3 of "Heating and Cooling of Buildings" for one story building with moderate local shielding,  $a_w = 0.000174$

v = average wind velocity in m/s - From RP505, this assumed to be approx 0.5m/s continuously

Infiltration Rate (L/s)	27.94
Infiltration Rate (ft <sup>3</sup> /s)	0.99
Infiltration Rate (ft <sup>3</sup> /m)	59.20
<b>Infiltration Rate (ACPH)</b>	<b>2.95</b>
	<b>PASS</b>

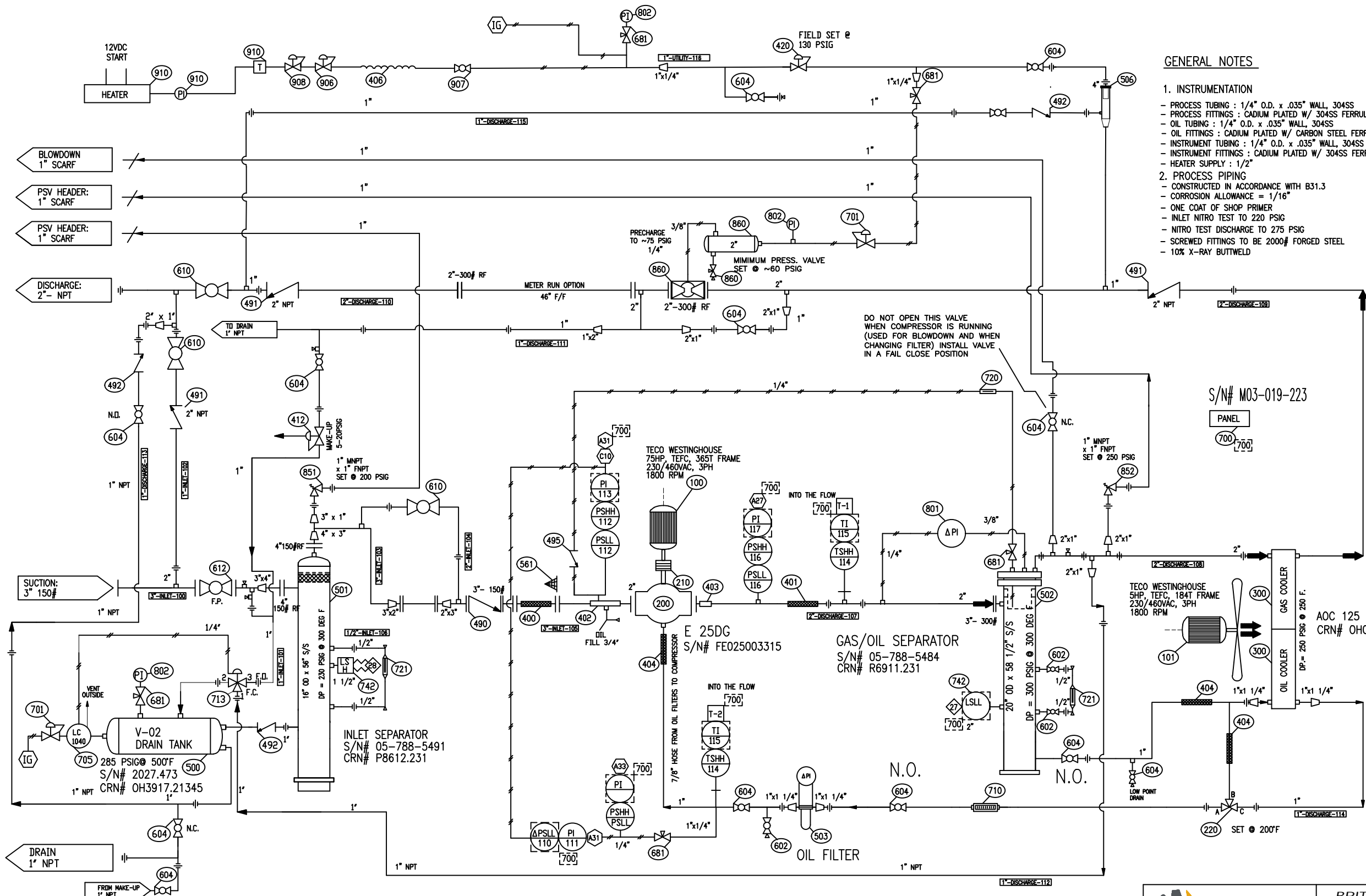
Calculated as per the formula above.

## CONCLUSION

The building can be classified as Zone 2 based on "Adequate Ventilation" as defined within API RP505. The infiltration rate, as calculated on page 9 of this report, is large enough to reduce the gas emissions to less than 25% of the LEL.

1. Louvers must be locked in the open position to maintain the Zone 2 classification. If this condition is not met, the classification of the building will revert to Zone 1.
2. The gas detection should start all exhaust fans or mechanical means in the event of the building achieving XX% LEL and a plant blowdown when XX% LEL is achieved. Set points to be determined.
3. Procedures and controls must be in place to ensure that combustible concentrations of gas do not persist for more than 10 hours per year during abnormal operating conditions or releases of gas.
4. If any of the building ventilation or process equipment is modified, including louvers, fans, pipes, valves, pumps and fitting changes, a new fugitive emission study must be completed to determine the impact on the building area classification.

APPENDIX A:  
PIPING AND INSTRUMENTATION DIAGRAM



GENERAL NOTES

- 1. INSTRUMENTATION
  - PROCESS TUBING : 1/4" O.D. x .035" WALL, 304SS
  - PROCESS FITTINGS : CADIUM PLATED W/ 304SS FERRULES
  - OIL TUBING : 1/4" O.D. x .035" WALL, 304SS
  - OIL FITTINGS : CADIUM PLATED W/ CARBON STEEL FERRULES
  - INSTRUMENT TUBING : 1/4" O.D. x .035" WALL, 304SS
  - INSTRUMENT FITTINGS : CADIUM PLATED W/ 304SS FERRULES
  - HEATER SUPPLY : 1/2"
- 2. PROCESS PIPING
  - CONSTRUCTED IN ACCORDANCE WITH B31.3
  - CORROSION ALLOWANCE = 1/16"
  - ONE COAT OF SHOP PRIMER
  - INLET NITRO TEST TO 220 PSIG
  - NITRO TEST DISCHARGE TO 275 PSIG
  - SCREWED FITTINGS TO BE 2000# FORGED STEEL
  - 10% X-RAY BUTTWELD
- 3. UTILITY PIPING
  - ALL PIPING 2" and LESS SHALL BE Min. SCH 80
  - SCREWED FITTINGS TO BE 2000# FORGED STEEL
- 4. PAINTING
- 5. VESSELS
  - CRN FOR PROVINCE OF ALBERTA

SWEET GAS SERVICE

S/N# M03-019-223

PANEL

700

TECO WESTINGHOUSE  
5HP, TEFC, 184T FRAME  
230/460VAC, 3PH  
1800 RPM

GAS COOLER  
OIL COOLER  
DP = 250 PSIG @ 250 F.  
AOC 125  
CRN# OH0909.2136

TUBING CONN'S

- 610 COMPRESSOR SUCTION PRESSURE
- 627 COMPRESSOR DISCHARGE PRESSURE
- 631 COMPRESSOR OIL DIFFERENTIAL PRESSURE
- 633 COMPRESSOR OIL PRESSURE

ELECTRICAL CONN'S (INTRINSICALLY SAFE)

- 27 LOW OIL LEVEL-GAS/OIL SEPARATOR
- 28 HIGH LIQUID LEVEL-INLET SEPARATOR

CAPILLARY CONN'S

- T-1 HIGH COMPRESSOR DISCHARGE TEMPERATURE
- T-2 HIGH COMPRESSOR OIL TEMPERATURE



BRITANNIA INDUSTRIES 2009 INC.  
6227-41ST STREET  
LEDUC, AB T9E 0V7  
PH: 780-986-5955  
FAX: 780-986-7113  
TOLL FREE: 866-955-7524

DRAWN	MRB	DATE	24/04/23
APPROVED	MRB	DATE	
SCALE	NTS	CLIENT PO	TBD

PROCESS & INSTRUMENTATION DIAGRAM  
GARDNER DENVER TAMROTOR E25DG  
75HP ELECTRIC VRU PACKAGE  
(RETROFIT TO BRAHMA UNIT S02246)

REV	DESCRIPTION	DATE	BY
1	AS BUILT	01/05/23	MRB
0	ISSUED FOR CONSTRUCTION	24/04/23	MRB

REVISION HISTORY

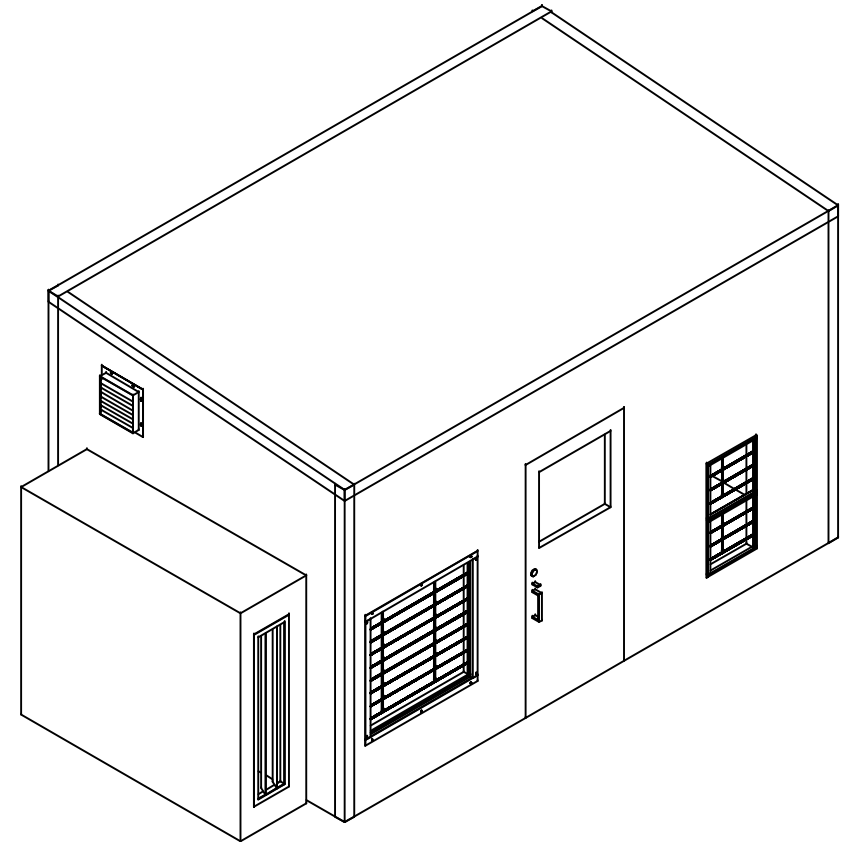
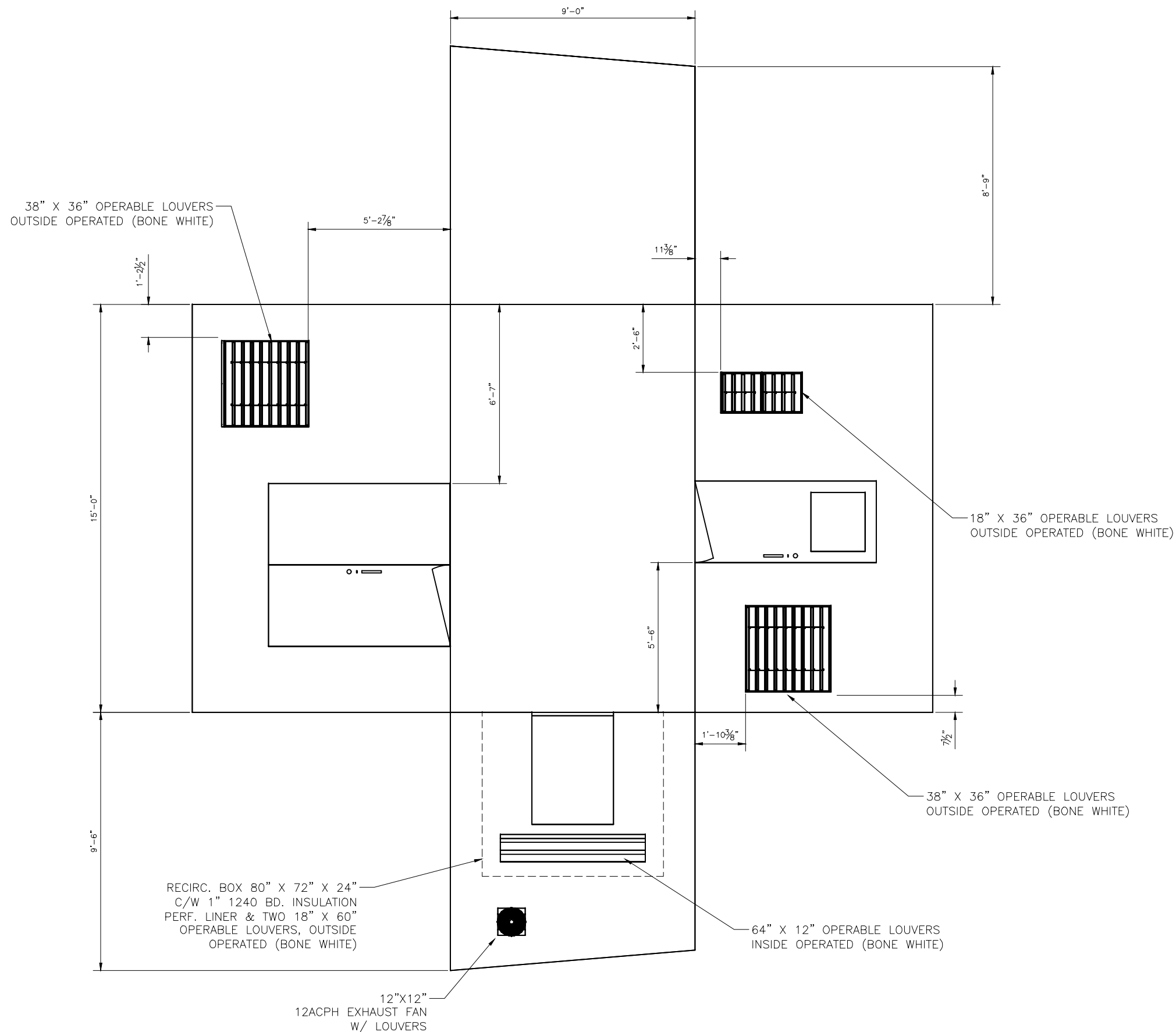
JOB No. 20960 (S02246)

CUSTOMER TAMARACK VALLEY  
c/o FUELLED

DWG No. 20960-100

REV. 1


APPENDIX B:  
BUILDING DRAWINGS



**BUILDING SPECIFICATIONS:**

EXT WALL: 22GA GALVANIZE BONE WHITE – QC 273  
EXT ROOF: 22GA GALVANIZE BONE WHITE – QC 273  
EXT TRIM: 22GA GALVANIZE BONE WHITE – QC 273  
INT LINER: 20GA ALUMINUM FLUTED – WHITE  
WALL INSUL: 3” R12 W/ 4 MILL VAPOUR BARRIER  
ROOF INSUL: 3” R12 W/ 4 MILL VAPOUR BARRIER

ONE 3’ X 7’ MAN DOOR, RH, IWG  
ONE 6’ X 7’ MAN DOOR, RH ACTIVE

0	AS BUILT	24/04/23	MRB
REV	DESCRIPTION	DATE	BY
REVISION HISTORY			
		<b>BRITTANIA INDUSTRIES 2009 INC.</b> 6227-41ST STREET LEDUC, AB T9E 0V7 PH. 780-986-5955 FAX: 780-986-7113 TOLL FREE: 866-955-7524	
DRAWN JB	DATE 06/10/22	BUILDING DETAIL DRAWING GARDNER DENVER TAMROTOR E25DG 75HP ELECTRIC VRU PACKAGE (RETROFIT TO BRAHMA UNIT S02246)	
APPROVED	DATE		
CLIENT P.O. NO.			
JOB No. 20960 (S02246)	CUSTOMER TAMARACK VALLEY c/o FUELLED	DWG NO. 20960-201	REV. 0

## APPENDIX C: GAS ANALYSIS

# **SECTION 4**

## **QUALITY CONTROL DOCUMENTS**

AB-83

Line List

PSV Test Certificates

Drain Tank Certificate of Compliance

Vessel Data Sheets

Warranty





# PRESSURE PIPING CONSTRUCTION AND TEST DATA REPORT

In accordance with the provisions of the PESR Section 31(1)

Shop Construction- ☒ Field Construction- ☐  
 Final Data Report- ☒ Partial Data Report- ☐

Complete both sides of this form

1. Constructed By: Brittania Industries (2009) Ltd. Owner's Job No: 20960

(Name of ABSA authorized primary contractor or subcontractor)  
6227-41st Street, Leduc, AB T9E 0V7

(Address)

Certificate of Authorization Permit No. AQP-2728 Expiry Date: November 30, 2025

2. Constructed For:

(Name of primary contractor if different from above)

(Address)

Certificate of Authorization Permit No. AQP- Expiry Date:

(Required when the primary contractor undertakes some/all of the quality functions, e.g., NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

3. Owner: Tamarack Valley Energy Ltd.

(Name and address)

3300, 308-4th Avenue SW, Calgary, Alberta, T2P 0H7

(Location of installation)

Certificate of Authorization Permit No. AQP- Expiry Date:

(Required when the owner undertakes some/all of the quality functions, e.g., NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

4. Piping Design Alberta Registration No.: PP-

(Required if aggregate piping volume is over 0.5m<sup>3</sup>)

5. Design Responsibility: Owner ☒; Contractor ☐

6. WP No.: WP-; Company:  Owner's WP No. (If used): WP-

(Alberta Registration No.)

(Alberta Registration No.)

Spec No(s). used: ; Owner's Spec No(s). (If used):

7. Code: Edition:

ASME B31.1 <input type="checkbox"/>	Non Boiler External Piping <input type="checkbox"/>	Boiler External Piping <input type="checkbox"/>
ASME B31.3 <input checked="" type="checkbox"/>	Service Category:	Normal <input checked="" type="checkbox"/> D <input type="checkbox"/> M <input type="checkbox"/>
	High Pressure <input type="checkbox"/>	Severe <input type="checkbox"/> High Purity <input type="checkbox"/>
ASME B31.5 <input type="checkbox"/>	ASME B31.9 <input type="checkbox"/>	CSA Z662 Steam Pipelines <input type="checkbox"/>

Drawing No Rev. No. Line No.	Fluid (Air/Stm. Etc.)	Des. Press. kPa	Des. Temp. °C (Max. & Min.)	Pressure Test kPa	Test Medium	Pipe Mat'l Spec. & Grade	C A. mm	Pipe NPS & Schedule	Flange Material & Rating	PWHT/ Preheat Temp. °C	NDE
20960-100 INLET 100 TO 106	NATURAL GAS	200 PSI	250 F	220 PSI	NITROGEN	SA106B	1/16"	4" S80 3" S80 2" S80 1" S80 1/2" S80	4" 150# 3" 150# 2" 150# SA105N	N/A	10%
20960-100 DISCHARGE 107 TO 115	NATURAL GAS	250 PSI	250 F	275 PSI	NITROGEN	SA106B	1/16"	4" S80 2" S80 1" S80 1/2" S80	4" 150# 3" 300# 2" 300#	N/A	10%
20960-100 UTILITY 116	NATURAL GAS	150 PSI	250 F	165 PSI	NITROGEN	SA106B	1/16"	4" S80 1" S80	4" 150# SA105N	N/A	10%

Constructed by: Brittania Industries (2009) Ltd.

Owner's Job # 20960

Partial Data Reports certified by sub-contractors are listed below and attached to this Data Report ☐

No.	Line No.	Spool No.	Dwg. No. (with Rev. No.)	Sub-contractor (Name)	AQP No. (if from Alberta)	Expiry (if from Alberta)

**Remarks:** For partial data report provide information about the code work that was not completed by the subcontractor (e.g., hydrostatic test, PWHT etc.). For final data report provide information about the code work that was not completed by subcontractors and subsequently completed by the primary contractor (e.g., hydrostatic test of entire assembly, PWHT etc.)

**Endorse certificate 'A' or 'B'**

**A. CERTIFICATE OF COMPLIANCE**

Signed by the subcontractor when supplying this certificate as a  
**Partial Data Report**

We certify that the statements in this Data Report are correct and that materials, construction and workmanship of the piping fabrication conform to the registered quality system and the applicable Piping code(s).

Date: \_\_\_\_\_  
Contractor

\_\_\_\_\_  
Print Authorized Representative's Name

\_\_\_\_\_  
Signature

**This certificate is not valid unless it forms part of a  
Final Data Report signed by Primary Contractor**

**B. CERTIFICATE OF COMPLIANCE**

Signed by the primary contractor when supplying this certificate as a  
**Final Data Report**

We certify that the statements in this Data Report are correct and that piping job no. 20960 described in this Data Report was constructed in accordance with the Province of Alberta Safety Codes Act and Regulations, and applicable ASME Piping Code(s).

Date: May 2, 2023 Brittania Industries

\_\_\_\_\_  
Contractor

Mark Brown

\_\_\_\_\_  
Print Authorized Representative's Name

[Signature]  
Signature

**CERTIFICATE OF INSPECTION**

I, the undersigned, employed by \_\_\_\_\_ have verified that all required examination and testing has been completed, and inspected the piping described in this construction data report to the extent necessary to be satisfied that it conforms to all applicable examination requirements of the Code and of the engineering design, and state that, to the best of my knowledge and belief, the contractor has constructed this piping in accordance with the Alberta Safety Codes Act and Regulations. By signing this certificate neither the inspector nor his or her employer makes any warranty, expressed or implied, concerning the piping described in this construction data report. Furthermore, neither the inspector nor his or her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_  
Owner's Inspector Name (please print)

\_\_\_\_\_  
ABSA Safety Codes Officer (please print)  
(BOILER EXTERNAL PIPING ONLY)

\_\_\_\_\_  
Owner's Inspector Signature:

\_\_\_\_\_  
ABSA Safety Codes Officer's Signature

LINE DESIGNATION				DESCRIPTION	DESIGN CONDITIONS			OPERATING CONDITIONS		TEST CONDITIONS				C.A. (IN.)	SCH. OR THK.	MATERIAL	RT %	PWHT	P&ID	SPOOL
SIZE (NPS)	LINE	COMM- ODITY	NO.		CODE	PRESS.	TEMP.	PRESS.	TEMP.	PRESS. (PSIG) (min.)	TEMP. (°F) (max.)	MEDIUM	DURATION (MIN.)							
						(PSIG)	(°F)		(°F)											
3"	INLET	NAT. GAS	100	PIPING SYSTEM UPSTREAM OF COMPRESSOR				PRESS. (PSIG)	TEMP. (°F)	0	220	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	10%	N	20960-100 R1
1"	INLET	NAT. GAS	101	PIPING SYSTEM UPSTREAM OF COMPRESSOR				2	65	0	220	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
1"	INLET	NAT. GAS	102	PIPING SYSTEM UPSTREAM OF COMPRESSOR				2	65	0	220	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
3"	INLET	NAT. GAS	103	PIPING SYSTEM UPSTREAM OF COMPRESSOR				2	65	0	220	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	10%	N	20960-100 R1
2"	INLET	NAT. GAS	104	PIPING SYSTEM UPSTREAM OF COMPRESSOR				2	65	0	220	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
3"	INLET	NAT. GAS	105	PIPING SYSTEM UPSTREAM OF COMPRESSOR				2	65	0	220	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	10%	N	20960-100 R1
1/2"	INLET	NAT. GAS	106	PIPING SYSTEM UPSTREAM OF COMPRESSOR				2	65	0	220	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
2"	DISCHARGE	NAT. GAS	107	PIPING SYSTEM FROM COMPRESSOR TO COOLER				116	180	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	10%	N	20960-100 R1
2"	DISCHARGE	NAT. GAS	108	PIPING SYSTEM FROM COMPRESSOR TO COOLER				116	180	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	10%	N	20960-100 R1
2"	DISCHARGE	NAT. GAS	109	PIPING SYSTEM DOWNSTREAM OF COOLER				116	120	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	10%	N	20960-100 R1
2"	DISCHARGE	NAT. GAS	110	PIPING SYSTEM DOWNSTREAM OF COOLER				116	120	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	10%	N	20960-100 R1
1"	DISCHARGE	NAT. GAS	111	PIPING SYSTEM DOWNSTREAM OF COOLER				116	120	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
1"	DISCHARGE	NAT. GAS	112	PIPING SYSTEM DOWNSTREAM OF COMPRESSOR				116	180	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
1"	DISCHARGE	NAT. GAS	113	PIPING SYSTEM DOWNSTREAM OF COOLER				116	120	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
1"	DISCHARGE	COMP. OIL	114	COMPRESSOR OIL SYSTEM				116	180	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
1"	DISCHARGE	NAT. GAS	115	PIPING SYSTEM DOWNSTREAM OF COMPRESSOR				116	120	0	270	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1
1"	UTILITY	NAT. GAS	116	UTILITY PIPING TO HEATER AND I.G.				120	100	0	165	AMBIENT	NITROGEN	10 MIN.	1/16"	80	A106-B SMLS	N/A	N	20960-100 R1

NOTES:

1. PNEUMATIC TESTING IN ACCORDANCE WITH AB-522
2. CONFIRM STORED ENERGY VALUE WILL NOT EXCEED 1677 KJ
3. THE TEST TEMPERATURE WILL BE A LEAST 17°C (30°F) ABOVE THE MDMT -29°C (-20°F).
4. BW PIPING HYDROTESTED TO 1.5X FULL DESIGN PRESSURE OF FLANGES.
5. NPT PIPING PNEUMATICALLY TESTED TO 1.1X DESIGN PRESSURE.



**PERMIT TO PRACTICE**  
2045690 ALBERTA LTD.  
O/A STEP ENGINEERING

RM SIGNATURE: *[Signature]*

RM APEGA ID #: 58069

DATE: 2023-05-15

**PERMIT NUMBER: P014014**  
The Association of Professional Engineers and  
Geoscientists of Alberta (APEGA)

ID#58069

2023-05-15

Stamp applies to piping design to ASME B31.3 only.

BRANCH: Edmonton

UVL ID#: 48764E

Work Order: W14005853

Customer PO#: 17190

Customer: BRITANNIA INDUSTRIES  
Facility: LEDUC  
A#:   
Cust. Ref.:   
Cust. WO#:

LSD:   
Vessel SN:   
Valve PO:   
Cust AFE#:

Date: 04/26/2023  
PSV Location:   
Cust Id:   
PO LINE#:   
Cost Centre#:

## VALVE DATA

Man.: MERCER Model: 91-17D51V07E1 Serial: C031121 Seat: SOFT  
Conn. Threaded Inlet: 1" MNPT Orifice: D Outlet: 1" FNPT Vacuum: N/A  
Set Press. 200 PSI Back Press.: N/A PSI CDT: N/A PSI Temp: 70 F Cap: 429 SCFM  
Lift Lever ☐ Cap Assembly: Closed Bellows: ☐ Code Symbol: UV CRN#: 0G8841.5CR1

## CUSTOMER INSTRUCTIONS

Instructions: Reset Only Pretest Required? ☒ Reset Required? ☒  
RESET INFO: New Press: 250 PSI New CDT: 0 New BP: 0 New Cap: 530 SCFM New Model: 91-17D51V09E1

## CONDITION AS RECEIVED

Visual Condition: Fair Data Plate Condition: OK Date of last service: /  
Seal Condition: Top: Intact Bottom: N/A Insignia: MVC Fittings Attached: Inlet: ☐ Outlet: ☐  
Inlet: Carbon Inlet Plugged: ☐ Outlet: Carbon Outlet Plugged: ☐ Initial Insp. Signoff: Ashley Ray

## PRETEST 1

Simmer: 193 PSI Set Press: 197 PSI Reseat: 179 PSI Leakage: 0 BPM Test Gauge: CDG03/04  
Tested By: Davin Steidel Pretest Comments:

## PRETEST 2

Simmer: Set Press: Reseat: Leakage: Test Gauge: CDG03/04  
Tested By: Pretest Comments:

## COMPONENTS INSPECTION

(0 Like New / 1 Minor / 2 Medium / 3 Major)

ITEM	CLEAN	OLY	RUSTY	CARBON	PITTED	CORRODED	SCALE	VIBRATION	GROOVED	DENTED	GALLING	GOUGED	OTHER	Machined	Lapped	Polished	Replaced	Replace Next Service	COMMENTS
DISC		1												<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
NOZZLE		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CAP-LEVER ASSY		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
COMP SCREW and LOC		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
AS FOUND: N/A AS LEFT: N/A																			
SPRING and BUTTONS		1											3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	05-009 Spring
SPINDLE / STEM														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
STEM RETAINER														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
DISC HOLDER														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
GUIDE / UPPER RING		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
LOWER RING														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
RING PIN(S)														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
BELLOWS														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
GASKET / SEALS		1											3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	WORN
CONNECTION ENDS		1	1											<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
OTHER													3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Repair Tag

DISC: Min: N/A As Rcv'd: N/A ACT - N/A NOZZLE: Min: N/A As Rcv'd: N/A ACT - N/A  
SPRING NUMBER: 05-007 Vacuum Weights: As Rcv'd: As Sent:  
Disassembly: Davin Steidel Inspection: Davin Steidel Reassembly: Davin Steidel

## FINAL TEST

Test Medium: Air Simmer: 247 PSI Set Pressure: 250 PSI  
Reseat: 230 PSI Leakage Acceptable: ☒ B.P. Test: 60 PSI Vacuum: N/A  
ADJ. RING SETTING (NOTCHES): Upper: N/A Lower: N/A Test Gauge: CDG03/04 Set Press Def: POP  
Tested by: Davin Steidel Date Final Tested: 04/28/2023

## FINAL INSPECTION:

SEAL: Top: ☒ Bottom: ☐ End Protectors Installed: ☒ Painted: ☒ Palletized: ☐ Ship Container: ☒ Flex Gaskets Supplied: ☐  
Final Inspection: Ricardo Santos Customer Inspection:  
Comments: - SERVICE RATING: ROUTINE



## PRV INSPECTION AND TEST REPORT

BRANCH: Edmonton

UVL ID#: 48765E

Work Order: W14005853

Customer PO#: 17190

20960

Customer: BRITANIA INDUSTRIES  
Facility: LEDUC  
A#:   
Cust. Ref.:   
Cust. WO#:

LSD:   
Vessel SN:   
Valve PO:   
Cust AFE#:

Date: 04/26/2023  
PSV Location:   
Cust Id:   
PO LINE#:   
Cost Centre#:

## VALVE DATA

Man.: MERCER Model: 91-17D51V0511 Serial: C036947 Seat: SOFT  
Conn. Threaded Inlet: 1" MNPT Orifice: D Outlet: 1" FNPT Vacuum: N/A  
Set Press. 50 PSI Back Press.: N/A PSI CDT: N/A PSI Temp: 70 F Cap: 128 SCFM  
Lift Lever ☐ Cap Assembly: Closed Bellows: ☐ Code Symbol: UV CRN#: 0G8841.5CR1

## CUSTOMER INSTRUCTIONS

Instructions: Reset Only Pretest Required? ☒ Reset Required? ☒  
RESET INFO: New Press: 200 PSI New CDT: 0 New BP: 0 New Cap: 429 SCFM New Model: 91-17D51T07E1

## CONDITION AS RECEIVED

Visual Condition: Fair Data Plate Condition: OK Date of last service: /  
Seal Condition: Top: Intact Bottom: N/A Insignia: MVC Fittings Attached: Inlet: ☐ Outlet: ☐  
Inlet: Carbon Inlet Plugged: ☐ Outlet: Carbon Outlet Plugged: ☐ Initial Insp. Signoff: Ashley Ray

## PRETEST 1

Simmer: 50 PSI Set Press: 51 PSI Reseat: 45 PSI Leakage: 10 BPM Test Gauge: CDG03/04  
Tested By: Davin Steidel Pretest Comments:

## PRETEST 2

Simmer: Set Press: Reseat: Leakage: Test Gauge: CDG03/04  
Tested By: Pretest Comments:

## COMPONENTS INSPECTION

(0 Like New / 1 Minor / 2 Medium / 3 Major)

ITEM	CLEAN	OLY	RUSTY	CARBON	PITTED	CORRODED	SCALE	VIBRATION	GROOVED	DENTED	GALLING	GOUGED	OTHER	Machined	Lapped	Polished	Replaced	Replace Next Service	COMMENTS
DISC		1											3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	WORN
NOZZLE		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	WORN
CAP-LEVER ASSY		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
COMP SCREW and LOC		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
AS FOUND: N/A AS LEFT: N/A																			
SPRING and BUTTONS													3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	05-007 Spring
SPINDLE / STEM														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
STEM RETAINER														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
DISC HOLDER														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
GUIDE / UPPER RING		1												<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
LOWER RING														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
RING PIN(S)														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
BELLOWS														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
GASKET / SEALS		1											3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	WORN
CONNECTION ENDS		1			1									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
OTHER													3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Repair Tag

DISC: Min: N/A As Rcv'd: N/A ACT - N/A NOZZLE: Min: N/A As Rcv'd: N/A ACT - N/A  
SPRING NUMBER: 05-005 Vacuum Weights: As Rcv'd: As Sent:   
Disassembly: Devon Harris Inspection: Davin Steidel Reassembly: Davin Steidel

## FINAL TEST

Test Medium: Air Simmer: 198 PSI Set Pressure: 200 PSI  
Reseat: 182 PSI Leakage Acceptable: ☒ B.P. Test: 60 PSI Vacuum: N/A  
ADJ. RING SETTING (NOTCHES): Upper: N/A Lower: N/A Test Gauge: CDG03/04 Set Press Def: POP  
Tested by: Davin Steidel Date Final Tested: 04/28/2023

## FINAL INSPECTION:

SEAL: Top: ☒ Bottom: ☐ End Protectors Installed: ☒ Painted: ☒ Palletized: ☐ Ship Container: ☒ Flex Gaskets Supplied: ☐  
Final Inspection: Ricardo Santos Customer Inspection:   
Comments: - SERVICE RATING: MAJOR




## Certificate Of Compliance

I Hereby Certify That The Below Registered Category "H" Pressure Fitting Has Been Designed, Manufactured, and Pressure Tested In Accordance With The Alberta Safety Codes Act, CSA B51 And ASME Section VIII, Division 1, 2004 Edition.

CRN	0H3917.2135				
S/N	2027.473				
Diameter	10.75	Inches	Overall Length	28	Inches
Year Built	2005				
MAWP	285	PSIG	@	500	°F
MDMT	-20 °F				
C.A.	0.125	Inches			
Radiography	N / A				
PWHT : Time	N/A	min.	Temp.	N/A	°F
Hydro Tested @	430	PSIG			

	Material	Thickness
Shell	SA-106 Gr. B	Sch 40 - 0.365"
Head 1	SA-234-WPB	Sch 40 - 0.365"
Head 2	SA-234-WPB	Sch 40 - 0.365"

  
Quality Control Manager  
Dennis Klokocki

March 1, 2018

A504650

**FORM U-1A MANUFACTURERS'S DATA REPORT FOR PRESSURE VESSELS**  
(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)  
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by **Pillar Resource Services Inc.: 4155 - 84th Avenue Edmonton, Alberta, Canada T6B 2Z3**  
(Name and address of manufacturer)
2. Manufactured for **Grand Valley Design Ltd.: #2 Maple Leaf Road, Box#86 Aldersyde, Alberta, Canada T0L 0A0**  
(Name and address of purchaser)
3. Location of installation **Air & Gas Compression Services Ltd.: 1310 - 43rd Avenue S.E., Calgary, Alberta, Canada T2G 2A2**  
(Name and address)
4. Type **Vert. Separator** **05-788-5491** **P8612.231** **VF-16-230S Rev.1** **N/A** **2005**  
(Honz. or vert. tank) (Mfr's serial No.) (CRN) (Drawing No.) (Matl. Bd. No.) (Year built)
5. The chemical & physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 **2004**  
Year

- to **N/A** **N/A** **N/A**  
Addenda (Date) Code Case Nos. Special Service per UG-120(d)
6. Shell: **SA106 Gr.B** **0.375"** **0.125"** **16" NPS** **57.75" Seam to Seam**  
Matl. (Spec. No., Grade) Nom. Thk. (in) Corr. Allow. (in) Diam. I.D. (ft. & in) Length (overall) (ft. & in)
7. Seams: **SMLS Pipe** **N/A** **70%** **N/R** **-** **Type 1 & Type 7 (Btm. Pl.)** **N/A** **1**  
Long. (Welded, Dbl. Singl., Lap, Butt) R.T. (Spot, Eff. (%)) Eff. (%) H.T. Temp. (F) Temp. (in) Girth (Welded, Dbl. Singl., Lap, Butt) R.T. (Spot, Eff. (%)) No. of Courses
8. Heads: (a) Matl. **SA234-WPB** (b) Matl. **SA516-70N**  
(Spec. No., Grade) (Spec. No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	Top Head	0.3282"	0.125"	-	-	2:1	-	-	-	Concave
(b)	Btm. Plate	1.25"	0.125"	-	-	-	-	-	20"	Flat

If removable, bolts used (describe other fastenings)

N/A

9. MAWP **230** **N/A** **psi at max temp.** **300** **N/A** **°F.**  
(external) (external)
- Min. design metal temp. **-20** **°F at** **230** **psi. Hydro., pneu., or comb. test pressure** **Hydro @ 299** **psi.**

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. Or Size	Type	Matl.	Nom. Thk.	Reinforcement Matl.	How Attached	Location
Inlet (N1)	1	4" CI. 150	RFWN	SA106-B	0.337"	N/A	UW16.1(c)	SHELL
Outlet/Insp. (N2)	1	4" CI. 150	RFWN	SA105N	0.337"	N/A	UW16.1(a)	TOP HEAD
HLSD (C1)	1	2" NPT	Half-Cplg	SA105N	Cl. 3000	N/A	UW16.1(a)	SHELL
LLC/Insp. (C2)	1	2" NPT	Half-Cplg	SA105N	Cl. 3000	N/A	UW16.1(a)	SHELL
Liq. Out (C3)	1	1" NPT	Half-Cplg	SA105N	Cl. 3000	N/A	UW16.1(a)	SHELL
REC. (C4)	1	1" NPT	Half-Cplg	SA105N	Cl. 3000	N/A	UW16.1(a)	SHELL
LG (C5A & C5B)	2	1/2" NPT	Half-Cplg	SA105N	Cl. 3000	N/A	UW16.1(a)	SHELL

11. Supports: Skirt **No** Lugs **No** Legs **No** Other **N/A** Other **N/A**  
(Yes or no) (No) (No) (Describe) (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report:

N/A

(Name of part, item number, Mfr's name and identifying stamp)

Impact Testing exempt as per UG-20(f) 1-5 & UCS-66(a). Approximate Volume 6.5 Ft<sup>3</sup>.

CRN registered to Grand Valley Design Ltd. Safety Valve by others (on piping) as per UG-125(g).

Vertical 2-Phase Separator (Construction Drawing No. 05-788-5491).

**CERTIFICATE OF SHOP/FIELD COMPLIANCE**

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. **33, 830**

expires **March 7, 2006**

Date **June 15, 2005**

Co. name

**Pillar Resource Services Inc.**

Signed

*[Signature]*  
(Representative)

**CERTIFICATE OF SHOP/FIELD INSPECTION**

Vessel constructed by **Pillar Resource Services Inc.** at **4155 - 84 Avenue Edmonton, Alberta, Canada T6B 2Z3**

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of

**Alberta**

and employed by

**ABSA**

have inspected the component described in this Manufacturer's Data Report on

**June 15, 2005**

, and state that,

to the best of my knowledge and belief, the manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described

in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or

property damage or a loss of any kind arising from or connected with this inspection.

Date **June 15, 2005**

Signed

*[Signature]*  
(Authorized Inspector)

Commissions

**AB #87**  
(Natl. Board (incl. endorsements), State, Prov. And No.)

**FORM U-1A MANUFACTURERS'S DATA REPORT FOR PRESSURE VESSELS**  
**(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)**  
**As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1**

① 524357

1. Manufactured and certified by Pillar Resource Services Inc.: 4155 - 84th Avenue Edmonton, Alberta, Canada T6B 2Z3  
(Name and address of manufacturer)
2. Manufactured for Grand Valley Design Ltd.: #2 Maple Leaf Road, Box#86 Aldersyde, Alberta, Canada T0L 0A0  
(Name and address of purchaser)
3. Location of installation Air & Gas Compression Services Ltd.: 1310 - 43rd Avenue S.E., Calgary, Alberta, Canada T2G 2A2  
(Name and address)
4. Type Vert. Filter 05-788-5484 R6911.231 V2S-20-300S Rev.1 N/A 2005  
(Horiz. or vert., tank) (Mfg'r's serial No.) (CRN) (Drawing No.) (Natl. Bd. No.) (Year built)
5. The chemical & physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2004  
Year
- to N/A N/A N/A  
Addenda (Date) Code Case Nos. Special Service per UG-120(d)
6. Shell: SA106 Gr.B 0.375" 0.125" 20" NPS 62" Seam to Seam  
Matl. (Spec. No., Grade) Nom. Thk. (in.) Corr. Allow. (in.) Diam. I.D. (ft. & in.) Length (overall) (ft. & in.)
7. Seams: SMLS Pipe N/A 100% N/R - Type 7 N/A 1  
Long. (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot or Full) Eff. (%) H.T. Temp. (°F) Time (hr) Girth. (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot, Eff. (%) or Full) No. of Courses
8. Heads: (a) Matl. SA516-70N (b) Matl. SA516-70N  
(Spec. No., Grade) (Spec. No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	Cover Plate	1.25"	0.125"	-	-	-	-	-	17.75"	Flat
(b)	Btm. Plate	1.75"	0.125"	-	-	-	-	-	22" Sq.	Flat

If removable, bolts used (describe other fastenings) Cover Plate bolts to Flange Ring with Eight 7/8" Dia x 4" Lg SA193-B7 Studs & SA194-2H Nuts

9. MAWP 300 N/A psi at max temp. 300 N/A °F.  
(internal) (external)
- Min. design metal temp. -20 °F at 300 psi. Hydro., pneu., or comb. test pressure Hydro @ 390 psi.  
(external)
10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. Or Size	Type	Matl.	Nom. Thk.	Reinforcement Matl.	How Attached	Location
Inlet (N1)	1	3" CI.300	RFWN	SA106-B	0.438"	N/A	UW16.1(c)	SHELL
Outlet/Insp. (C1)	1	2.375" I.D.	Half-Cplg	SA105N	CI. 3000	N/A	UW16.1(a)	COVER PLATE
LSL/LSH (C2/C3)	2	2" NPT	Half-Cplg	SA105N	CI. 3000	N/A	UW16.1(a)	SHELL
Oil Fill (C4)	1	2" NPT	Half-Cplg	SA105N	CI. 3000	N/A	UW16.1(a)	SHELL
Drain (C5)	1	1" NPT	Half-Cplg	SA105N	CI. 3000	N/A	UW16.1(a)	SHELL
LG (C6A & C6B)	2	1/2" NPT	Half-Cplg	SA105N	CI. 3000	N/A	UW16.1(a)	SHELL
DPI & Scavenger	2	1/4" NPT	NPT Tap	-	-	-	NPT Tap	COVER PLATE

11. Supports: Skirt No Lugs No Legs No Other N/A Other N/A  
(Yes or no) (No.) (No.) (Describe) (Where and how)
12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: N/A  
(Name of part, item number, Mfg'r's name and identifying stamp)

Impact Testing exempt as per UG-20(f)1-5 & UCS-66(a). Approximate Volume 10.2 Ft<sup>3</sup>.

Base Plate & Flange Ring examined by means of a Magnetic Particle Inspection as per UG-93.

CRN registered to Grand Valley Design Ltd. Safety Valve by others (on piping) as per UG-125(g).

Vertical Filter (Construction Drawing No. 05-788-5484).

**CERTIFICATE OF SHOP/FIELD COMPLIANCE**

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. 33, 830

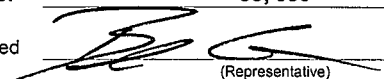
expires March 7, 2006

Date June 23, 2005

Co. name

Pillar Resource Services Inc.

Signed

  
(Representative)

**CERTIFICATE OF SHOP/FIELD INSPECTION**

Vessel constructed by Pillar Resource Services Inc. at 4155 - 84 Avenue Edmonton, Alberta, Canada T6B 2Z3

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of

Alberta

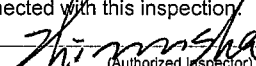
and employed by

ABSA

have inspected the component described in this Manufacturer's Data Report on June 23, 2005, and state that, to the best of my knowledge and belief, the manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date June 23, 2005

Signed

  
(Authorized Inspector)

Commissions

AB 136 A  
(Natl Board (incl. endorsements), State, Prov. And No.)



# **WARRANTY**

## **Standard Warranty Statement**

Products sold by Britannia Industries Inc. (Brittania) are warranted to be free of defects in material and workmanship for a period of twelve (12) months from the date of invoice.

Third party components such as engines, electric motors, etc. are warranted only to the extent of the original manufacturer's warranty to Britannia.

Warranty is subject to and applicable only if the following conditions have been met:

1. The product has been erected and installed by Britannia personnel.
2. The product has only been used under the normal operating conditions for which it was designed.
3. The product has received proper preventative maintenance.
4. The equipment has not been subject to misuse, neglect, or accidental damage.
5. The equipment has not been repaired or altered by any person not authorized by Britannia.
6. Britannia has received written notice of any defect no later than thirty (30) days after the Buyer learned of the defect.

In no event will Britannia be liable for consequential damages or contingent liabilities arising out of failure of this equipment.

When a component is changed or replaced during the warranty period, the new item is warranted only for the remainder of the original warranty period.

If any such defects occur within the warranty period, Britannia will undertake prompt remedial action as stated to correct the defect. Remedial action under this warranty will require Britannia, at its option, to repair or modify the product F.O.B. our Calgary service centre or to accept return of the product and to refund the purchase price, less costs of any depreciation and non-warranty damage. If warranty work is performed at the customer site, the customer is responsible for travel time and mileage, at Britannia's standard rates, to and from the site.

## **Operational Problems**

The following failures are considered to be operational problems and ARE NOT covered under warranty. Special attention should therefore be paid to prevent their occurrence.

- Damage or wear due to liquid "slugging" or condensate formation.
- Damage or wear due to dirty or incorrect lubricants.

- Damage or fouling of the separator, compressor, engine, or other components due to the ingesting of ASPHALTENES (or other long-chain hydrocarbons) or HYDRATING.
- Failure caused by lack of proper maintenance.
- Any failure resulting from owner or operator abuse or neglect including but not by way of limitation any operation, installation, application, or maintenance practice not in accordance with guidelines or specifications established by Britannia Industries Inc. or the original equipment manufacturer.
- Any failure resulting from unauthorized modifications or repairs of the Products.
- Any failure resulting from overloads, over speed, overheat, accident, or improper storage
- Failure of owner to promptly provide notice of a claimed defect.
- Repairs of a covered failure performed by non-authorized contractors or distributors.
- Failure to make damaged or faulty parts available to Britannia Industries Inc. or its authorized representative.
- Failure to supply documents such as drawings and specifications relating to the specific application of the Products.
- Failure to provide an oil sample from the damaged compressor.

## **Britannia Industries Inc. Responsibilities**

Britannia Industries Inc. will be responsible for:

1. The repair or replacement, at Britannia's election, of covered defective parts and all reasonable labour required regarding a warranted failure during the Express Warranty term.
2. Necessary labour to remove repairs and re-installs the faulty component.
3. Replacement of lubricating oil, coolant, filter elements, or other normal maintenance items that are contaminated and/or damaged as a direct result of a warranted failure.

## **Owner's Responsibilities**

Owner shall be responsible for:

1. The proper installation, operation, and maintenance of the Products with the guidelines established by Britannia Industries Inc.
2. Making the Products available to Britannia or Britannia's authorized contractors or distributors for any warranty repair during normal business hours.

3. All additional costs incurred for premium or overtime labour should owner request that repairs be made on a premium or overtime schedule.
4. Any cost of transportation.
5. Loss of revenue and loss of/or damage to real and/or personal property.
6. Prepaid return of defective parts (if requested by Britannia) and outgoing shipping costs.

### **Applicability of Vendor Warranties**

Internal combustion engines or electric motors utilised as drivers of natural gas compressors bear the warranties of their manufacturers. In some cases, these warranties may provide greater coverage or longer terms of limitation than the foregoing warranty of Britannia Industries Inc. In all cases, the internal combustion engine or electric motor manufacturer's warranty shall have precedence over Britannia's terms and conditions.

### **Warranty Procedure**

If a problem occurs during the normal warranty period, the following steps should be taken:

1. Establish exactly what the problem is.
2. Check to ensure that the proper design parameters are being observed and that the operating and hook-up instructions have been properly followed.
3. If the problem cannot be corrected, contact Britannia Industries Inc. and report the problem. Britannia will require the information from the registration tag installed on the compressor. This information should include the job number, serial number, and date of manufacture.

# **SECTION 5**

## **OPERATING MANUALS**

Murphy TTD Control Panel

Murphy Switch Gauges

Level Gauge

Murphy L1200 Level Switch

Mallard 5300 Control Valve

Fisher 627 Regulator

Fisher 67CF Regulator

Headland Flow Meter

Mercer PSVs

CCS Pressure Switches

CCS Temperature Switch

Sur-Flo Back Pressure Control Valve

Catalytic Heater

Thermostatic Control Valve

# TTDJ Series Fully Configurable Fault Annunciator Installation and Operations Manual

TTDJ-99062N  
Revised 2014-08-08  
Section 50  
(00-02-0412)



Please read the following information before installing. This installation information is intended for all TTDJ Series models. A visual inspection of this product before installation for any damage during shipping is recommended.

## GENERAL INFORMATION

### WARNING

#### BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT

- ✓ Disconnect all electrical power to the machine.
- ✓ Make sure the machine cannot operate during installation.
- ✓ Follow all safety warnings of the machine manufacturer.
- ✓ Read and follow all installation instructions.

## Description

The TTDJ is a solid-state fault annunciator and shutdown control system, with hour meter, designed to protect engines, compressors and their associated equipment. Four TTDJ modules are available:

- TTDJ-DC** : Powered by 12 or 24 VDC systems without tachometer and overspeed sensing. Includes RS485 serial port.
- TTDJ-DC-T** : Powered by 12 or 24 VDC systems with internal tachometer and overspeed sensing. Includes RS485 serial port.
- TTDJ-IGN** : Powered by negative ground CD ignition systems without tachometer and overspeed sensing. Without RS485 port.
- TTDJ-IGN-T** : Powered by negative ground CD ignition systems with internal tachometer/overspeed sensing. Without RS485 port.

All TTDJ models will accept 32 sensor inputs from normally open and/or normally closed sensors. Each of the first 16 inputs can be configured for Shutdown or Alarm Before Shutdown\*, and can be locked out by one of the Two Start-Run timers (B1:0-5 min.; B2:0-9:59 min.), or configured as Class C. The annunciator provides for both closing of a fuel valve, and grounding of an ignition after a time delay. The TTDJ has built-in Elapsed Time Meter. Run Hours and Tachometer Settings are stored in non-volatile memory, as well as the last 4 shutdowns and one alarm (alarm only stored if active at the time of shutdown). The TTDJ liquid crystal display annunciates any fault from the sensor inputs, displays engine speed and elapsed time.

Other features for all TTDJ models are: built-in Test Mode to test the sensor circuits without shutting down, on-board backup battery to retain the fault display after shutdown (IGN models only), and a history of the last 4 shutdowns with their associated Run Hours, also stored in non-volatile memory.

TTDJ-DC and TTDJ-DC-T models feature an RS485 serial communications port (MODBUS RTU slave) to interface with micro-controllers, PC'S, PLC's and controllers.

## Module/ Head

The module is the brain of the control system. It contains the microcomputer, the Liquid Crystal Display (LCD), the membrane keys for configuring the sensors inputs, the Sensor Inputs Terminal Blocks and the Power Inputs and Control Output Terminal Block. The TTDJ-DC module also includes an RS485 serial communications port (MODBUS RTU slave).

\*Alarm Before Shutdown is a function that causes annunciation and the alarm output, but will not cause a shutdown.



US Patent 6,144,116  
(model TTDJ-IGN-T only)

CSA Certified for Use in Class I, Div. 2,  
Groups C and D Hazardous Areas.

## Liquid Crystal Display

The Liquid Crystal Display sequentially provides shutdown/alarm condition, run hours, rpm, and timer information. A shutdown or alarm condition is indicated by the appropriate sensor number in the first two leftmost digits. Hours display uses all the digits. RPM display is shown in the rightmost digits with a Run Indicator in the first digit. The Timer display shows the timer number in the first digit and the time in the last three digits.

## Timers

Active Timers are indicated by the timer number in the first digit of the display, and the remaining time in the last three digits. Timer 1= Class "B1", Timer 2= Class "B2", Timer 3= Test, Timer 4= Ignition Ground Delay.

## Power and Control Inputs/Outputs

The TTDJ power and control inputs and outputs are connected to the Power Inputs terminal block on the back of the TTDJ.

In the TTDJ-IGN and TTDJ-IGN-T the FV+ output is a non-switched output that supplies stored energy from an internal capacitor. -FV and ALARM outputs are non reversible switched outputs (switched OFF for normal operation, switched ON for alarm and shutdown). When a shutdown fault is detected, the -FV and ALARM turn ON and after a time delay, the IGN input switches to ground. The alarm output does not operate for Manual Stop (code 52).

On the TTDJ-DC and TTDJ-DC-T the IGN, FV, and ALARM outputs are programmed to switch ON for normal operation.

## Sensor Inputs and Terminals

Up to 32 dry contact sensor inputs or Murphy device transistor outputs can be connected to the back of the TTDJ via a terminal block (32 pair, screw type, each with a jumper). Sensor inputs 1 to 16 are configurable as Class "A", Class "B1", Class "B2" or Class "C" functions, Shutdown or Alarm Before Shutdown\*. The Class "B" timers allow sensor inputs to be locked out at start-up. Sensor inputs configured for Alarm Only will cause the Alarm Output to turn on when tripped, and the sensor number will be annunciated while the unit continues to run. TTDJ sensor inputs 17-28 are dedicated as Class "A" Shutdown only. Sensor input 29 can be configured as a Class "A", or Class "ESD" input. Sensor input 32 is dedicated as Class "ESD". Sensor inputs 30 & 31 can have special functions or be Class "A". Any tripped sensor is detected within 1 second after faulted.

## Emergency Shutdown

Sensor input number 32 is dedicated to Emergency Shutdown. The Emergency Shutdown sensor input overrides the Test timer. Additionally, sensor input 29 can be configured as a Class "A" or Class "ESD" input.

## Remote Reset (optional, Setup 5 = 1, 3, 5 or 7)

When the Remote Reset feature is selected, point 30 with a closed contact resets the TTDJ in the same manner as when using the Reset key. The closed contacts to operate the Remote Reset feature should be kept closed only momentarily for approximately 1 second to cause a remote reset.

## Remote Lockout (optional, Setup 5 = 2, 3, 6 or 7)

The Remote Lockout inhibits the Class B1 and Class B2 Lockout timers. These Lockouts are ignored when a closed switch is seen at Input 31. An open switch at Input 31 allows the Lockouts to function normally. When the Remote Lockout is active it resets Class "C", "B1" and "B2" Lockout timers. This is intended to be used with automatic starting systems. With a contact closure on terminals 31 with the unit not running, the display will alternate between either RPM (-T models) and the Class "B1" timer, or the display will flash (non-T models). The TTDJ should be put into remote lockout immediately before stopping the engine. The contact closure should be opened once the engine is running. At that time the "B1" and "B2" timers will be allowed to count down.

## Reset Key

The Reset key resets All faults and initiates the Class "B" timers.

## Overspeed (-T models only)

These models feature an internal tachometer with Overspeed Shutdown (50). This shutdown bypasses the Ignition Ground Delay. It is not locked out by the Test Timer.

## Underspeed Annunciation (-T models only)

TTDJ-IGN-T models display (51) when an underspeed condition occurs. It is not locked out by the Test Timer.

## Loss of Ignition Annunciation (non -T models)

The TTDJ-IGN models will display (51) when ignition input is lost. It is not locked out by the Test Timer.

## Run/Stop Key (Manual Stop)

The Manual Run/Stop key is used for system shutdown from the panel. When pressed, the unit will shutdown the system without turning on the Alarm Output (on -DC models the Alarm Output is turned off on Manual Stop). Manual Stop (Shutdown 52) is not locked out by the Test Timer.

## Low Backup Battery Voltage (-IGN models)

The TTDJ-IGN models have an internal backup battery. When the "Lowbatt" display appears (this message will alternate with other displays) the battery needs to be replaced, see page 3 for details.

## Timer "O" Key

This key zeros the current displayed timer: Class "B1", "B2", Ignition Ground Timer, or Test Timer. If the TTDJ is in the Test mode, it exits Test.

## Test Key

Initiates the Test Timer with 5 minutes. Test mode is indicated by the "3" in the first digit of the display. Faulted inputs are displayed as in normal operation, but the system is not shutdown and the Alarm Output is not turned on. Press "Reset" to reset the fault and press the Timer "O" to exit. The following shutdowns override Test: Emergency Shutdown (32), Overspeed (50), Manual Stop (52), Underspeed (51), Loss of Ignition (51) and Optional Additional ESD if chosen as ESD. If Class "C" functions are used, they will need to be bypassed to test other sensors. When exiting "Test" with Class "C" functions, press "Reset" and "Timer 0" simultaneously.

## Shutdown History

The TTDJ models store the last 4 shutdown codes and any alarm present

at shutdown, as well as the elapsed time reading at which they occurred. For instance, if the unit is shutdown from sensor input 1, the display will show "01 SD1" to indicate the last shutdown. Shutdown #1 was sensor input #1. Press the "Up" key for "Shutdown 2", "3", "4", and for any present "Alarm". To view the elapsed time reading at which any of the shutdowns occurred, press "Push To Read Hours" key while viewing that shutdown.

## Class "B" Lockout Timer

Allows the system to become fully operational without shutting down by start-up related conditions. Class "B1" and Class "B2" Sensor inputs are locked out until their corresponding timer expires. Class "B1" Timer is selectable from 0:00-5:00 minutes, and Class "B2" Timer from 0:00-9:59 minutes.

## Class "C" Functions

There is a practical limit of sensor inputs defined as Class "C" Shutdown and/or Class "C" alarm of 8 points. The Class "C" function operation is that the sensor will be initially faulted on Start-up. If the sensor never clears there will not be any annunciation and alarm or shutdown. If the sensor clears for a full 2 seconds, then it is armed to alarm or shutdown. Pressing the Reset key will allow a Class "C" alarm function to go back to the Start-up state where it can remain faulted without annunciation and alarm. An example of a Class "C" function is Low Discharge pressure.

## Ignition Ground Delay

This delay is selectable from 0-20 seconds. To select the delay use SETUP.4, see User Set Up Menus and To Enter User Set Up on page 5.

## Hourmeter

The TTDJ internal hourmeter keeps track of Run Hours. To display Run Hours for 5 seconds, press the Push to Read key. Run Hours are stored in non-volatile memory, maintaining hours in the absence of power.

## RS485 Serial Port (TTDJ-DC / TTDJ-DC-T)

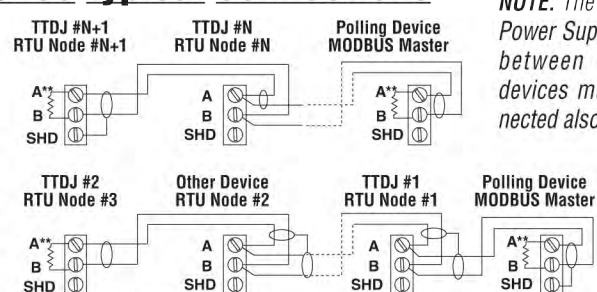
The RS485 serial port (MODBUS RTU slave) on the back of the module is provided for communicating with micro-controllers, PC's, PLC's and SCADA systems (see RS485 Typical Connections, below). It is recommended that a termination resistor\*\* (customer supplied) be used on the first and last device connected in a daisy-chain configuration.

The communication parameters are 9600 baud, no parity, 8 bits with 1 stop bit (9600,N,8,1), half-duplex. The shield terminal on the TTDJ terminal block should only be used if the drain wire on the shielded cable is not connected to ground anywhere else. Each device must have a unique RTU node number. A retry delay of 0.3 second may be helpful (set up for 3 retries).

## Modbus Integer Holding Registers

40001= RPM  
 40002= ETM (elapsed Time Meter 0-65535 Hrs.)  
 40003= Class B1 (in seconds)  
 40004= Shutdown Numbers (0=OK) (1-32, 50-52 =SD shutdown)  
 40005= Output Status (Bit 0= IGN, Bit 1= FV, Bit 2= ALR)  
 40006= Inputs 1-16 (Bit 0 = TB1..., Bit 15= TB16) (True 1= Inactive)  
 40007= Inputs 17-32 (Bit 0= TB17..., Bit 15= TB32) (True 1= Inactive)  
 If 40006 and 40007 both contain "FF" there are no active shutdowns.

## RS485 typical connections



**NOTE:** The common or Power Supply grounds between connected devices must be connected also.

\*\*Terminating resistor is 120 ohms. Install Terminating resistor at the master and the last slave. Use only Belden 9841 or 3105A cable or cabling with a characteristic impedance of 120 ohms.



## SPECIFICATIONS

### Power Input (Operating Voltages):

**TTDJ-DC; TTDJ-DC-T Models:** 10- 32VDC, 500 mW max.

**TTDJ-IGN; TTDJ-IGN-T Models:** 90-350 VDC negative ground  
CD ignition; approx. 650 $\mu$ A @ 100VDC.

**Sensor Inputs:** 32 N.O. or N.C. passive switches.

**Inputs 1-16:** Configurable as Class "A", "B1", "B2", or "C" Shutdown or Alarm Before Shutdown\*.

**Inputs 17-28:** Dedicated Class "A" shutdowns.

**Inputs 29:** Configurable as Class "A" or Class "ESD".

**Input 30:** Selectable Remote Reset or Class "A".

**Input 31:** Remote Lockout or Class "A"; inhibits the Class "B1 & B2" Lockout Timers.

**Input 32:** Class "ESD" Overrides Test Timer, typically used for emergency shutdown.

**Outputs:** 0.5 A @ 350 VDC.

**Outputs Selection:** Ground ignition immediately or trip fuel valve and ground ignition after time delay.

**Communications:** RS485 Serial Port, Modbus RTU slave (TTDJ-DC models).

**Operating Temperature:** -40 to 185°F (-40 to 85°C).

**Storage Temperature:** -40 to 185°F (-40 to 85°C).

**Sensor Scan Rate:** Within 1 second.

**B1 Start/Run Timer:** Adjustable, 0 - 5 minutes.

**B2 Start/Run Timer:** Adjustable, 0 - 9:59 minutes.

**Pulses per Revolution Range for Tach. Calibration:**  
32-360 (TTDJ-DC-T); 1 - 16 (TTDJ-IGN-T).

**Overspeed Set point:** 0 - 9999 rpm.

**Underspeed Set point:** 0 - 5000 rpm.

**Magnetic Pickup:** 5 - 120 Vrms, 0-10 kHz.

**On-Board Backup Power 00005125 (-IGN Versions only):**

6 VDC, 1300 mAh, Duracell® DL223A or Sanyo® CR-P2 Lithium battery.

**Tachometer Accuracy:**  $\pm 0.5\%$  of the display reading or  $\pm 1$  RPM  
whichever is greater.

**Hourmeter Range:** 0 to 65535 hrs.

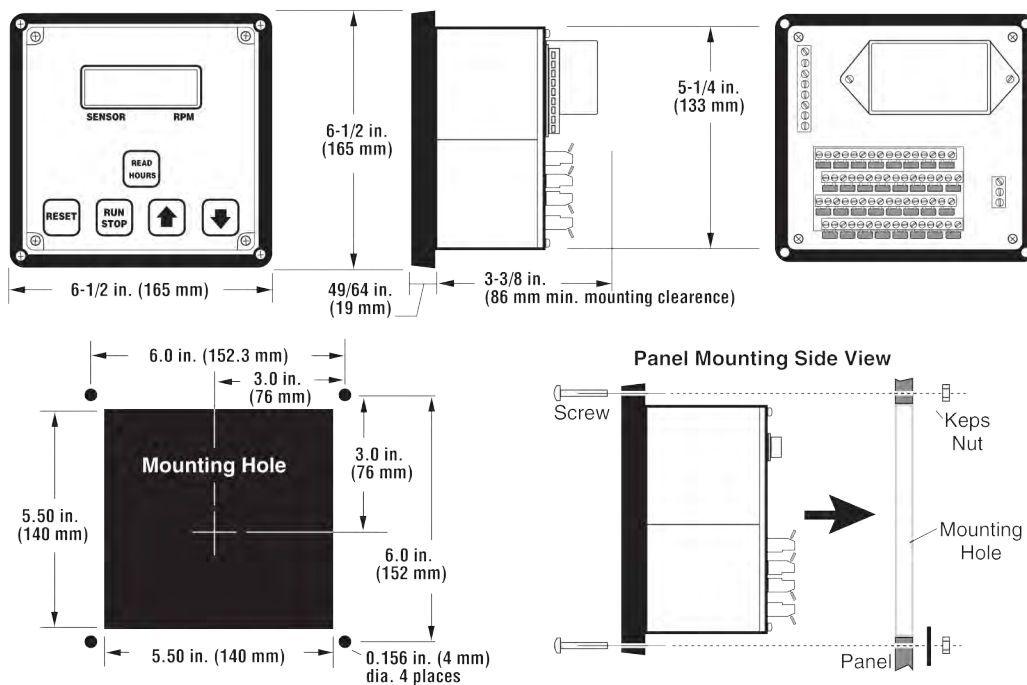
**Hourmeter Accuracy:**  $\pm 15$  minutes per year.

\*Alarm Before Shutdown is a function that causes annunciation and the alarm output, but will not cause a shutdown.

## TTDJ MOUNTING DIMENSIONS (All Models)



**WARNING: PERFORM THE MOUNTING OPERATION WITH POWER SOURCE OFF. THE TTDJ SERIES MODULE WAS DESIGNED TO BE MOUNTED WITHIN A WEATHERPROOF ENCLOSURE. IT IS INTENDED FOR MOUNTING IN A FLAT PANEL. A SQUARE MOUNTING HOLE OF 5-1/2 IN. (140 MM) AND FOUR MOUNTING SCREW HOLES ARE NEEDED. INSERT THE MODULE FROM THE FRONT SIDE OF THE PANEL AND SECURE THE FOUR MOUNTING SCREWS AND NUTS THROUGH THE BEZEL.**



## REPLACING THE BATTERY (-IGN Models only)



**WARNING: THE BACKUP POWER BATTERY IS LOCATED WITHIN THE TTDJ MODULE. THEREFORE, EXTREME CAUTION MUST BE EXERCISED WHEN REPLACING IT. FOR CLASS I, DIVISION 2, HAZARDOUS AREAS INSTALLATIONS, FIRST, SHUTDOWN THE SYSTEM AND MAKE SURE THAT THE HAZARDOUS AREA IS KNOWN TO BE NON-HAZARDOUS BEFORE OPENING THE POWER SUPPLY COVER.**

The TTDJ-IGN models include a Backup Power Battery located within the TTDJ module. To gain access to and to replace the battery do the following:

1. Make sure the area is made Non-Hazardous and shut down the System (remove power).
2. Using extreme caution remove the Power Supply Cover Screws (located on the back of the TTDJ module).
3. Gently pull the Power Supply Cover away from the back of the TTDJ to

have access to the old Backup Battery.

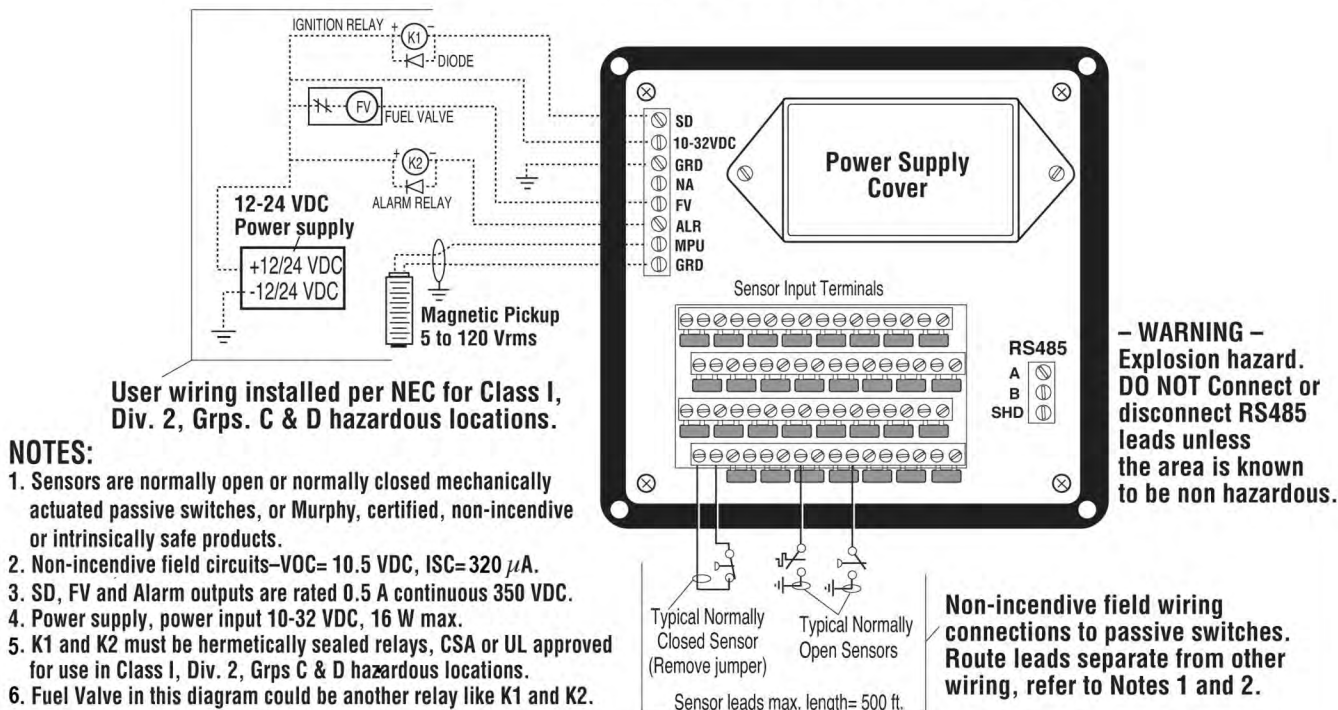
4. Locate the old Backup Battery.
5. Using extreme caution, not to damage any component, replace the battery with a 6 VDC, 1300 mAh, Duracell® DL223A or Sanyo® CR-P2 Lithium battery, available from Murphy (p/n 00005125).
6. Carefully proceed to replace the Power Supply Cover.
7. You are now ready to power up your system and resume operations.

## TYPICAL WIRING DIAGRAMS (All Models)

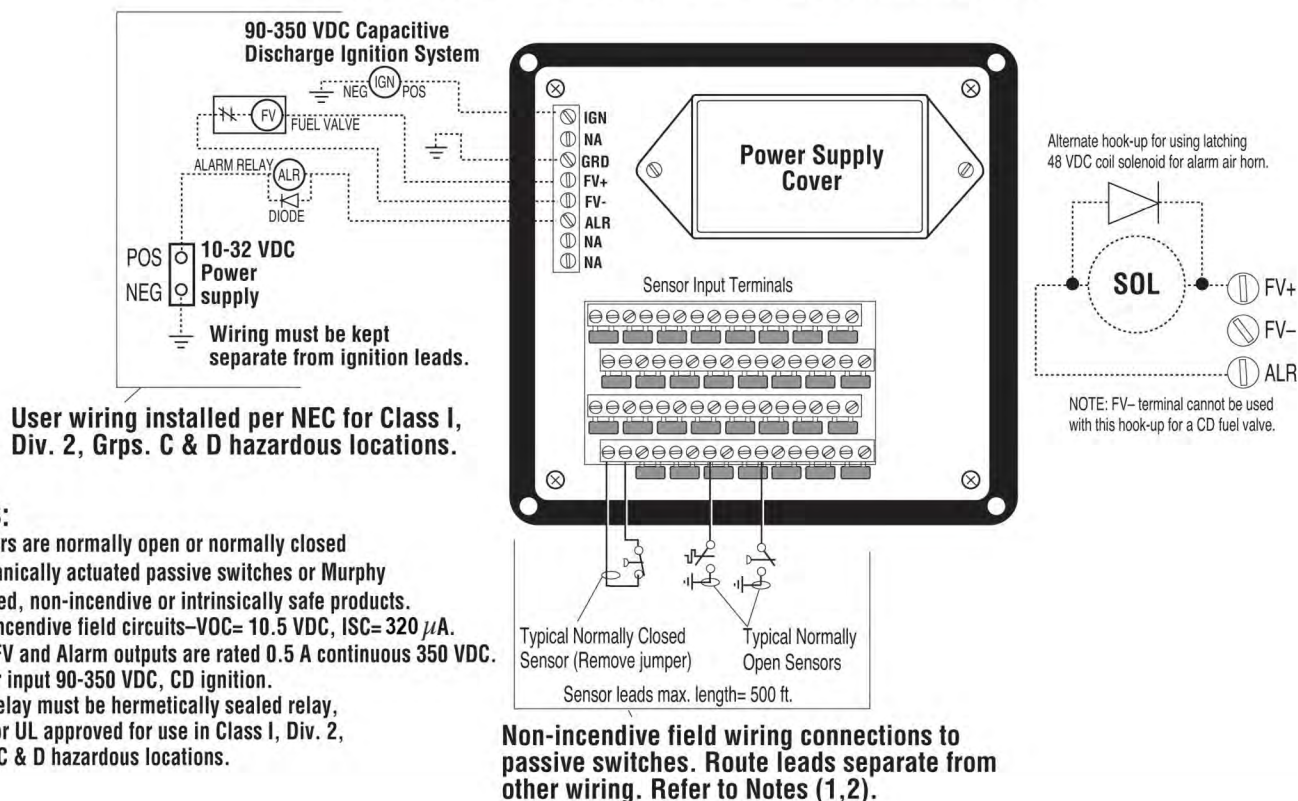


**WARNING:** FOR HAZARDOUS APPLICATION REQUIREMENTS, THE TTDJ COMPLETE SYSTEM MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC) CLASS I, DIVISION 2, GROUPS C & D (ARTICLE 504) SPECIFICATIONS AND PER MURPHY DRAWING 50-08-0039. SENSOR INPUT WIRES MUST BE SEPARATED A MINIMUM OF 2 IN. (51 MM) FROM OTHER WIRES.

### TTDJ-DC AND TTDJ-DC-T TYPICAL WIRING



### TTDJ-IGN AND TTDJ-IGN-T TYPICAL WIRING



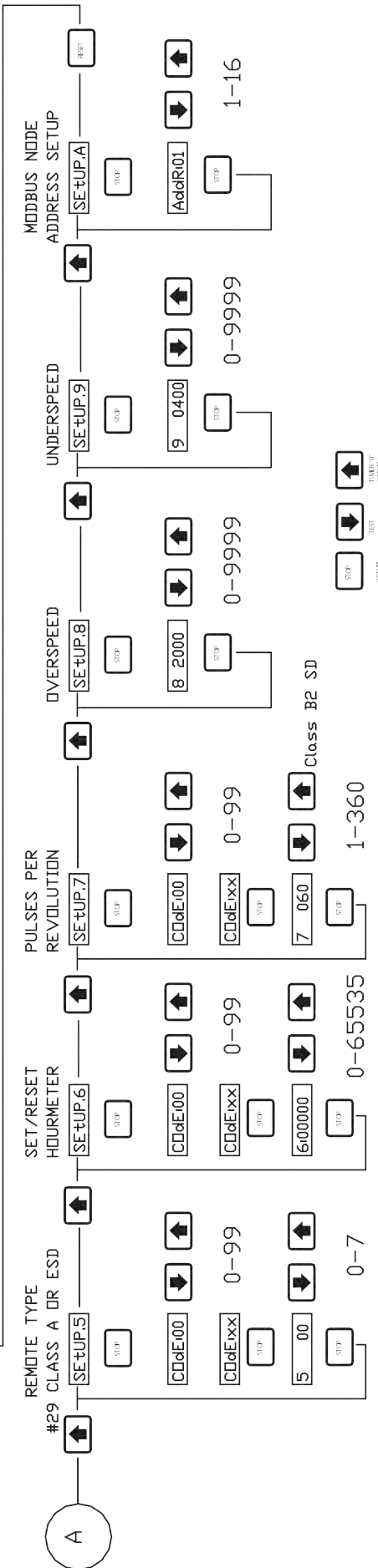
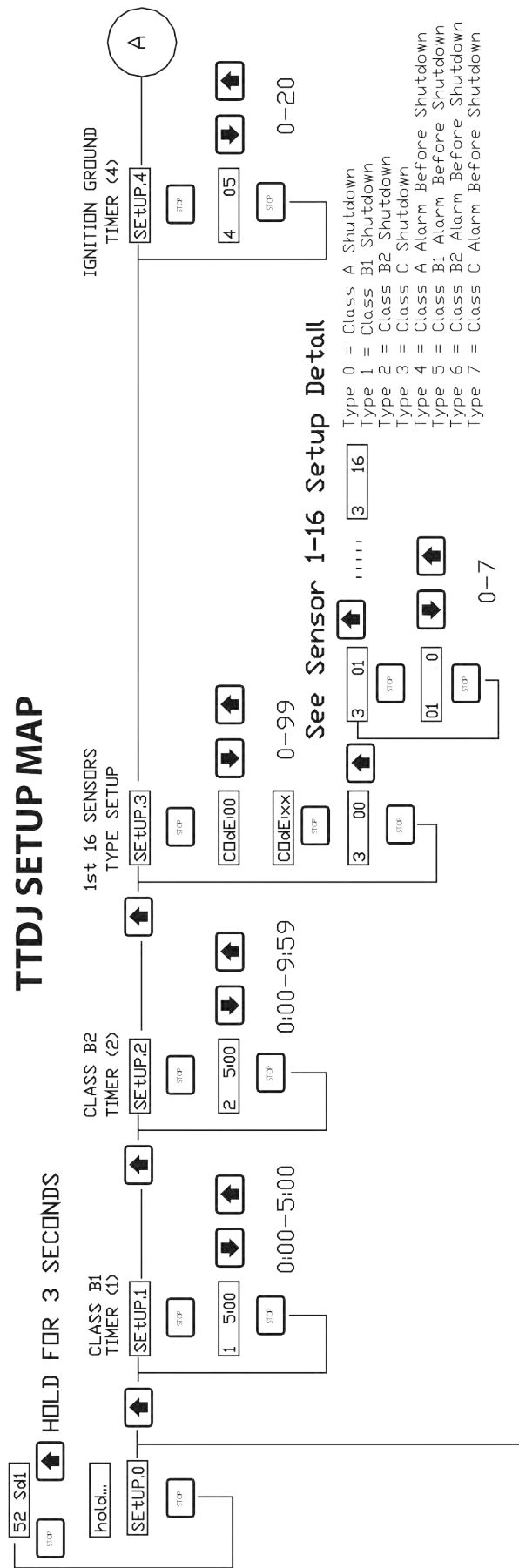


## TYPE SETUP

## Sensor 1-16 Setup Detail



# TTDJ SETUP MAP



NOTE: These keys are shown without their associated text in the diagram.  
The STOP key serves the purpose of going into a setting and saving and exiting that setting.  
The UP and DDWN keys navigate through the settings or change the value of a number.

0 = No Remote Lockout or Reset, #29 is Class A  
1 = Remote Reset, No Remote Lockout, #29 is Class A  
2 = Remote Lockout, No Remote Reset, #29 is Class A  
3 = Remote Reset and Lockout, #29 is Class A  
4 = No remote Reset or Lockout, #29 is Class ESD  
5 = Remote Reset, No Remote Lockout, #29 is Class ESD  
6 = Remote Lockout, No Remote Reset, #29 is Class ESD  
7 = Remote Reset and Lockout, #29 is Class ESD

## User Set Up Menus

The following are the User Setup Menus for All TTDJ models:

- SETUP.1 **SETUP.1** = Class B1 Timer (0 – 5:00)  
 SETUP.2 **SETUP.2** = Class B2 Timer (0 – 9:59)  
 \*SETUP.3 **SETUP.3** = Sensor 1-16 Type Setup  
 SETUP.4 **SETUP.4** = Ignition Ground Delay (0 – 20 sec.)  
 \*SETUP.5 **SETUP.5** = Remote Setup  
 0= No Remote Lockout or Reset, #29 is Class “A”  
 1= Remote Reset, No Remote Lockout, #29 is Class “A”  
 2= Remote Lockout, No Remote Reset #29 is Class “A”  
 3= Remote Reset, and Lockout, #29 is Class “A”  
 4= No Remote Reset or Lockout, #29 is Class “ESD”  
 5= Remote Reset, No Remote Lockout, #29 is Class “ESD”  
 6= Remote Lockout, No Remote Reset #29 is Class “ESD”  
 7= Remote Reset and Lockout, #29 is Class “ESD”

\*SETUP.6 **SETUP.6** = Hours Setup

The User Setup Menus shown below are also available for -T models:

- \*SETUP.7 **SETUP.7** = Pulses per revolution  
 SETUP.8 **SETUP.8** = Overspeed  
 SETUP.9 **SETUP.9** = Underspeed

The User Setup Menu shown below is for ALL -DC models:

SETUP.A **SETUP.A** = Modbus RTU node number 1-16 (-DC models)

\*These Set Up Menus are code protected (for all models).

## To Enter User Set Up Menus

**(Must be in Manual Stop #52)**

To enter the User Setup Menus the TTDJ unit Must be in the Manual Stop (#52) condition. If a shutdown is present other than Manual Stop, press the “Reset” key, then immediately Press and Hold Both the Run/Stop and Up (Timer 0) keys. Now follow these steps:

1. Press and hold both the Run/Stop and Up (Timer 0) keys until the LCD reads **hold...** (HOLD).
  2. Continue to hold both keys for 3 more seconds approximately. The display reads **SETUP.0** (SETUP.0), you are now in the User Setup Menu.
  3. Use the Up key (Timer 0) and Down (Test) keys to select the desired Setup Menu.
  4. Press the Run/Stop key to enter the desired Setup Menu.
- NOTE:** Some settings are password protected.
5. Use the Up and Down keys to preset the desired parameter. Press Reset to zero the value.
  6. When the desired value is entered, press Run/Stop.
  7. Repeat Steps 3-6 until all parameters are preset.
  8. To exit User Setup, select SETUP.0 and press Run/Stop.

## Code Protection

For Setup Menus that are code protected, the LCD will read “CODE.00” prompting the user to enter a code before allowing setup. Use the Up and Down keys to enter the code. If the code is entered incorrectly, the LCD will read “Error”. After 3 incorrect entries, the Code Setup is exited. Once the correct Code is entered, the Setup Menu is accessed.

## To Calibrate the Tachometer (TTDJ-DC-T and TTDJ-IGN-T models)

The TTDJ measures RPM based on the number of pulses per engine revolution. To calibrate the tachometer first enter the User Set Up Menus, see steps 1-3 from “To Enter User Set Up Menus” above.

Select SETUP.7. Enter the code, then enter your number of pulses per engine revolution (refer to Pulses/Revolution, above right).

## Pulses/Revolution

### TTDJ-IGN-T (Ignition Model)

For this model the number of pulses per revolution is determined by the number of cylinders and cycles of the engine, according to the following table:

Cylinders	Cycles	Pulses	Cylinders	Cycles	Pulses
1	2	1	6	2	6
2	2	2	6	4	3
2	4	1	8	2	8
3	2	3	8	4	4
4	2	4	10	4	5
4	4	2	12	4	6
5	2	5	16	4	8

**NOTE:** Divide the number of cylinders by 2 for split capacitor ignitions.  
 Multiply the number of cylinders by 2 for throw away spark ignitions.

### TTDJ-DC-T (DC Model)

For TTDJ-DC-T models the pulses per revolution can come from a magnetic pickup. The number of pulses per revolution is simply the number of teeth on the flywheel gear (32 to 360).

## Sensor Input Set Up

Sensor inputs 1-16 are configurable. The following types are available:

- Type 0** = Class A, Shutdown  
**Type 1** = Class B1, Shutdown  
**Type 2** = Class B2, Shutdown  
**Type 3** = Class C, Shutdown  
**Type 4** = Class A, Alarm Before Shutdown†  
**Type 5** = Class B1, Alarm Before Shutdown†  
**Type 6** = Class B2, Alarm Before Shutdown†  
**Type 7** = Class C, Alarm Before Shutdown†

To configure a Sensor Input:

1. Enter the SETUP.3 menu (enter the code). The Display will read: **3 00** (3 00).
2. Use the Up and Down keys to select the input to be configured. For example if you select Input #1 the display reads: **3 01** (3 01).
3. Press the Run/Stop key. Assuming you selected Input #1, and that input is currently configured as a Class A, Shutdown, the display will read **01 0** (01 0).
4. Use the Up and Down keys to select the desired Sensor Input Type.
5. Press the Run/Stop key, the display reads: **3 01** (3 01).
6. Repeat Steps 2-5 as necessary.
7. To Exit press Reset, the display shows: **3 00** (3 00). Then press the Run/Stop key.

## Elapsed Time Set / Reset

Enter the Elapsed Time Set Up, SETUP.6. First make sure the jumper for Input #30 is installed. To Set the time do the following:

1. Enter the SETUP.6 menu (enter the code). The display will read the elapsed time in hours, after the 6 (for example: **6.00001** (6.00001) if the elapsed time is 1 hour).
2. Set the desired time using the Up/Down keys. Press Reset to zero the time.
3. When the desired time is entered, press the Run/Stop key.
4. To exit User Setup, press Reset, the display will show: **SETUP.0** (SETUP 0) and press the Run/Stop key.

**NOTE:** Decimal fractional of the elapsed time is lost when the Elapsed Time Setup is entered, and it can only be set to the nearest hours.

† Alarm Before Shutdown is a function that causes annunciation and the alarm output, but will not cause a shutdown.

## SEQUENCE OF OPERATIONS

### System Start Up

Press the **RESET** key to clear any faulted sensor input and unground/enable ignition for engine operation. Apply starting power to the engine.

### Engine Speed (-T models only)

The first thing displayed on versions with Tachometer is the engine speed. While there is time remaining in either of the Class "B" timers, the display will alternate between engine speed and the Class "B" timers (4 seconds each). Once the Class "B1" timer expires, while there is time remaining in the Class "B2" timer, the display will alternate between the engine speed and the Class "B2" timer (4 seconds each). Once both Class "B" timers expire, the engine speed is displayed continuously.

### Class "B1" Timer

While there is time remaining in the Class "B1" timer, the display will alternate between engine speed and the Class "B1" time remaining for example: "1 0:30" (4 seconds each). All sensor inputs configured as Class "B1" are locked out at this point. For non -T models the "B1" display will be steady. To zero this timer, press **TIMER "0"**.

### Class "B2" Timer

Once the Class "B1" timer expires while there is time remaining in the Class "B2" timer, the display will alternate between engine speed and the Class "B2" time remaining for example: "2 0:30" (4 seconds each). All sensor inputs configured as Class "B2" are locked out at this point. For non -T models the "B2" display will be steady. To zero this timer press the **TIMER "0"** key, after the Class "B2" timer has expired.

### Elapsed Time

To display the run hours, press the **"Display Hours"** key. The current Run hours will be displayed for 5 seconds. **NOTE:** On all non tachometer models (non -T) the **RUN HOURS** are displayed after the Class "B" Timers expire, instead of **ENGINE SPEED**. The decimal point flashes to indicate the unit is running.

### Alarm Only Condition

If any one of the sensor inputs configured as an **ALARM-ONLY** is faulted, the Alarm Output will turn ON, and the sensor number will be displayed in the first two digits. Press the **RESET** key after the sensor input has cleared, to clear the display and to turn OFF the Alarm output.

### Overspeed (-T models only)

If the engine speed exceeds the Overspeed Set point the engine will shutdown, bypassing the Ignition Ground Delay. The TTDJ-T models will display "50". Overspeed overrides the Test mode.

### Underspeed (-T models only)

If after the Class "B1" Timer expires the engine speed falls below the Underspeed Setpoint, the engine will shutdown. The TTDJ will annunciate/display "51". Underspeed overrides the Test mode.

### Manual Stop

To manually shutdown the engine, press the **STOP/RUN** key. The TTDJ will shutdown the system and the display will indicate "52". Manual Stop overrides the Test mode.

### Ignition Ground Delay

Upon reaching a shutdown condition, the unit will trip the fuel valve, and, after the delay expires, ground the ignition. This delay is bypassed on **Overspeed (50)**, **Emergency Shutdown (32)**, and sensor input #29 if configured as Class "ESD".

### Loss of Ignition

TTDJ-IGN models annunciate/display "51" when ignition input is lost.

The energy stored in the FV+ circuit will trip the fuel valve.

### Resetting Shutdown Fault

After the shutdown condition is cleared on the equipment, press **RESET** key.

### Test Timer

The Test Timer is used to verify that sensors are wired properly and working correctly. To perform a sensor test while running do the following:

1. Press the **TEST** key and verify that the Test Timer is shown with 5 minutes: (3 5.00).
2. Trip the first sensor to be tested and verify that the sensor number and class type appear on the display (see displays below). The display will alternate between the Sensor Number and the Test timer.
3. Clear the sensor then press the **RESET** key. Verify that the sensor number is cleared from the display.
4. Repeat Steps 2 and 3 for each sensor.
5. To exit, press the **TIMER "0"** key or allow the Test Timer to expire.

**NOTE:** Any of the following conditions will override the Test Timer: **Emergency Shutdown (32)**, **Overspeed Shutdown (50)**, **Underspeed Shutdown -T models (51)**, **Loss of Ignition (51) non-T models**, **Manual Stop (52)**, and sensor input #29, if configured as a Class "ESD".

### Test Mode Display

In Test, when a sensor is tripped, the sensor number and the Class type are displayed, for example if sensor #1 (01) a Class "B1" shutdown is tripped in the Test the LCD reads "01 t1". The following are the Test Mode Displays:

	(t0): Class "A" Shutdown
	(t1): Class "B1" Shutdown
	(t2): Class "B2" Shutdown
	(t3): Class "C" Shutdown
	(t4): Class "A" Alarm
	(t5): Class "B1" Alarm
	(t6): Class "B2" Alarm
	(t7): Class "C" Alarm

### Warranty

A limited warranty on materials and workmanship is given with this Murphy product. A copy of the warranty may be viewed or printed by going to [www.fwmurphy.com/support/warranty.htm](http://www.fwmurphy.com/support/warranty.htm)

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# TTD™ Series Configurable Fault Annunciator

## *Installation and Operations Manual*

In order to consistently bring you the highest quality, full-featured products, we reserve the right to change our specifications and designs at any time. The latest version of this manual can be found at [www.fwmurphy.com](http://www.fwmurphy.com).

**Warranty** - A limited warranty on materials and workmanship is given with this Murphy product. A copy of the warranty may be viewed or printed by going to <http://www.fwmurphy.com/warranty>.



Enovation Controls has made efforts to ensure the reliability of the TTD System and to recommend safe usage practices in system applications. Please note that in any application, operation and controller failures can occur. These failures may result in full control outputs or other outputs, which may cause damage to or unsafe conditions in the equipment or process connected to the TTD system.

Good engineering practices, electrical codes and insurance regulations require that you use independent external protective devices to prevent potentially dangerous or unsafe conditions. Assume that the TTD system can fail with outputs full on, outputs full off or that other unexpected conditions can occur.

**Please read the following information before installing the TTD annunciator.**

This installation information is intended for all TTD Series models. A visual inspection of this product before installation for any damage during shipping is recommended.

Disconnect all power and be sure machine is inoperative before beginning installation.

Installation is to be done only by qualified technician.

Observe all Warnings and Cautions at each section in these instructions.

Device shall be wired in accordance with Class I, Division 2 wiring methods.

This equipment is suitable for use in Class I, Division 2, Groups B, C and D hazardous areas.

**WARNING** – Explosion Hazard – Substitution of components may impair suitability for Class I, Division 2.

Please contact Enovation Controls immediately if you have any questions.

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## Product Description

The TTD product is a solid-state fault annunciator and shut-down control system designed to protect engines, compressors and their associated equipment. The TTD monitors 48 normally open and/or normally closed sensors. Each of the 48 channels can be configured for Shutdown or Alarm Only. Any channel can be locked out by one of the two Start-Run timers or configured as Class C, ESD or Ignore. The annunciator provides logic for both closing of a fuel valve and grounding of an ignition after a time delay.

Incorporated in the TTD non-volatile memory:

- Run Hours/Elapsed Time Meter (hours roll over at 99,999)
- Last 10 Shutdowns with associated run hours
- Last 4 Alarms with associated run hours

### Optional Features (Model Dependent):

- Pre/Post lube timed functionality
- Tachometer w/ Overspeed and Underspeed setpoints
- Lubricator No-Flow detection for up to 4 pulsing proximity switches

## Display Head (TTD-H)

---

The Display Head shows operational and configuration data. Configuration parameters are entered via keypad or transferred using PC and Mconfig™ software. The operator interface will accept digital inputs directly on the back of the unit. Power is provided to the Display Head via a direct-mounted power supply or a cable connecting to a remote mounted power supply. The display head contains the microprocessor, the Liquid Crystal Display (LCD), the membrane keys for configuring the sensors inputs and the sensor input terminal blocks.

The TTD liquid crystal display annunciates any fault from the sensor channel, displays engine speed and run hours/elapsed time. Other features for the TTD model are: built-in Test Mode to test the sensor circuits without shutting down; Pre-lubrication and Post-lubrication timers; and onboard backup battery to retain the fault display after shutdown on ignition-powered units.

## Power Supply

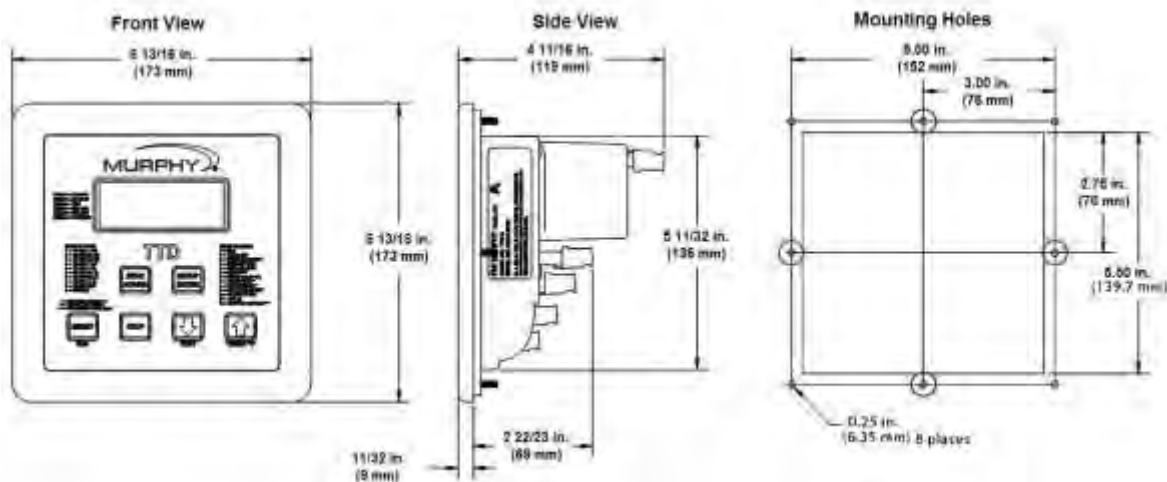
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The Power Input and Control Output Terminals are mounted on the Plug-in Power Supply (PSU-2) or on the DIN Rail Power Supply (PSU-D2). The Power Supply also includes a RS485/RS232 serial communication port (MODBUS RTU slave) to interface with micro-controllers, PCs, PLCs and/or communication and control systems. The serial communication provides read and write register capability with selectable baud rates up to 38,400 bps.

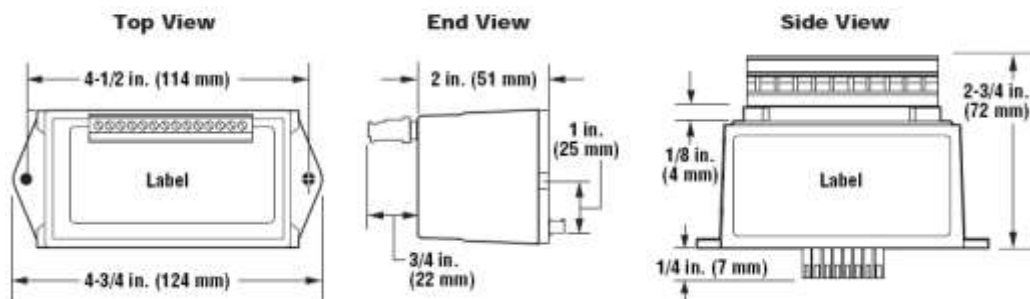
All Power Supply models are reverse polarity protected and can be powered by 10-32vdc or 90- 400vdc negative ground CD ignition. An optional Power Supply (PSU-D2) provides for 120vac power/positive ground CD ignition power. Use the PSU-1\* Power Supply for Division 1 applications. The TTD annunciator is fully operable with the internal battery. The external DC power enables communications support and turns on the display backlight.

## Dimensions

### TTD Display Head



### Power Supply



## Installation

### Mounting the Unit

The TTD head was designed to be mounted within a weatherproof enclosure. It is intended for mounting in a flat panel. A square mounting hole of 5-1/2 in. (140 mm) and 4 mounting screw holes are needed.

**WARNING!** Perform the mounting operation with power source off.

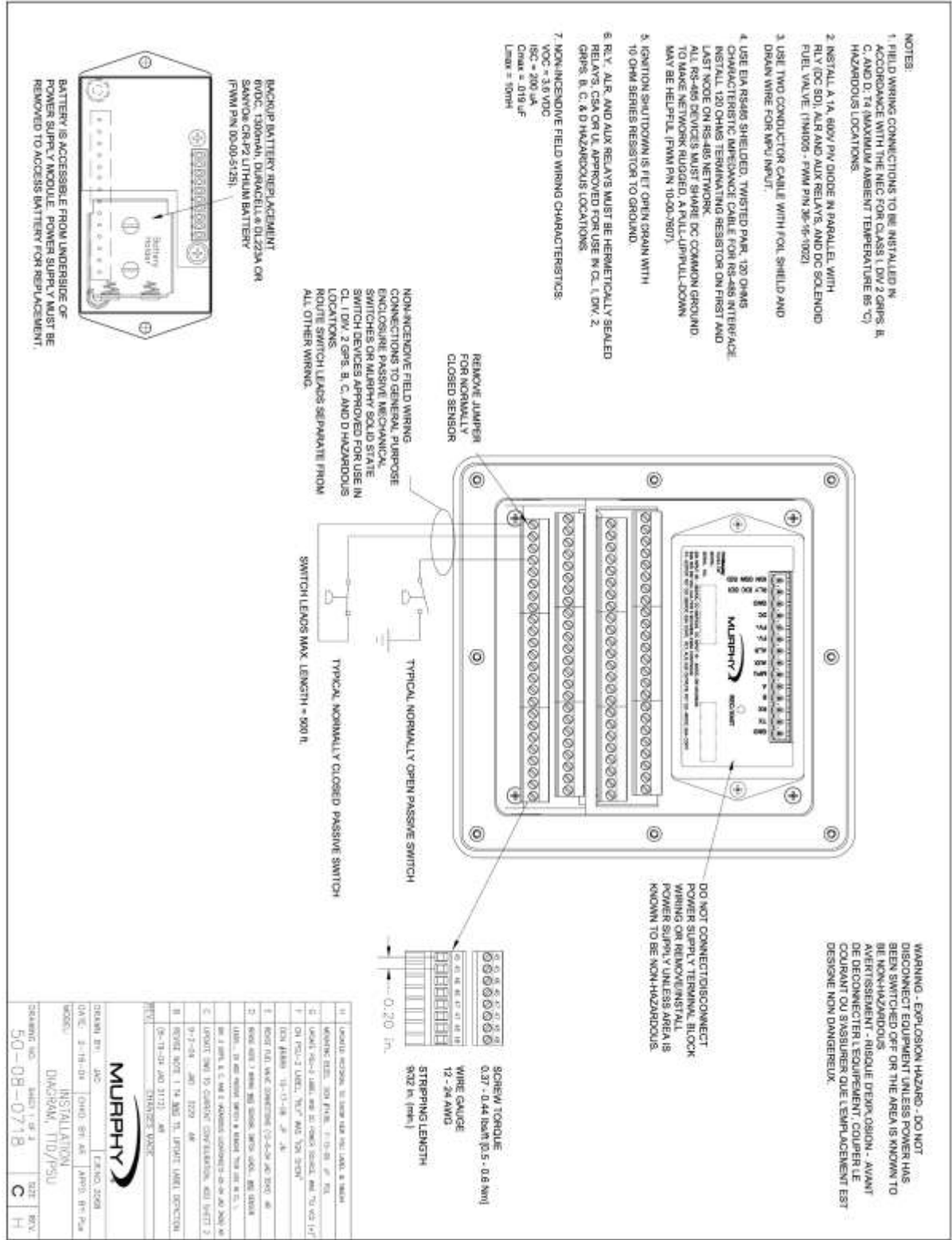
### Stud Tightening Pattern

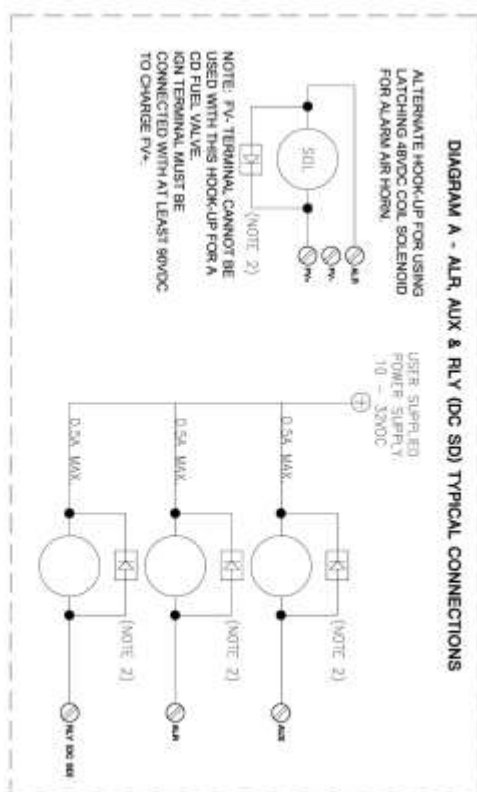
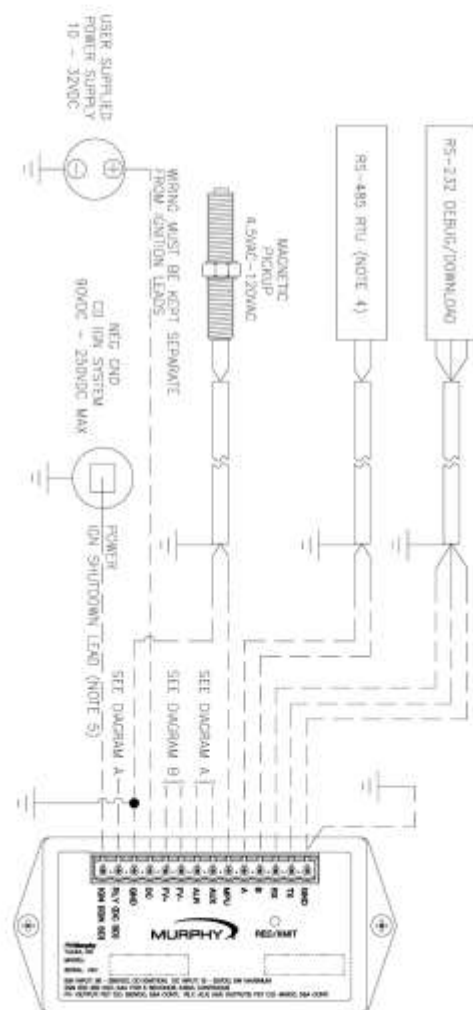
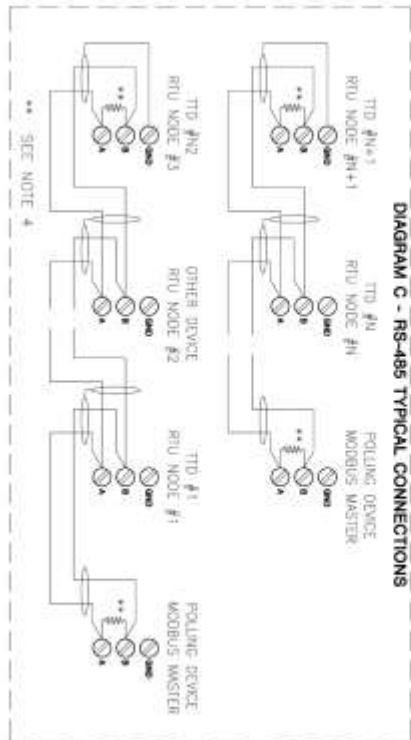
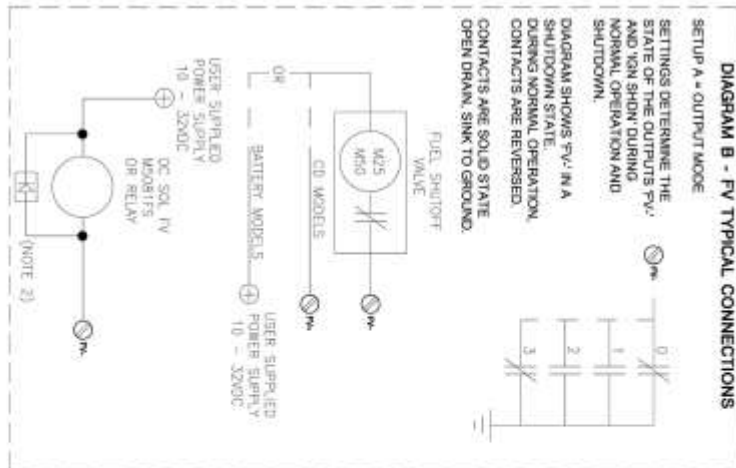
The following stud tightening instructions are required to maintain the IP66 rating when installation requires the display to be mounted in an enclosure door exposed to atmospheric conditions.



- Stud tightening pattern should be followed:
  1. Top left corner
  2. Bottom right corner
  3. Top right corner
  4. Bottom left corner
  5. Top center
  6. Bottom center
  7. Right center
  8. Left center
- Tighten holding nuts to 9 in. /lbs.

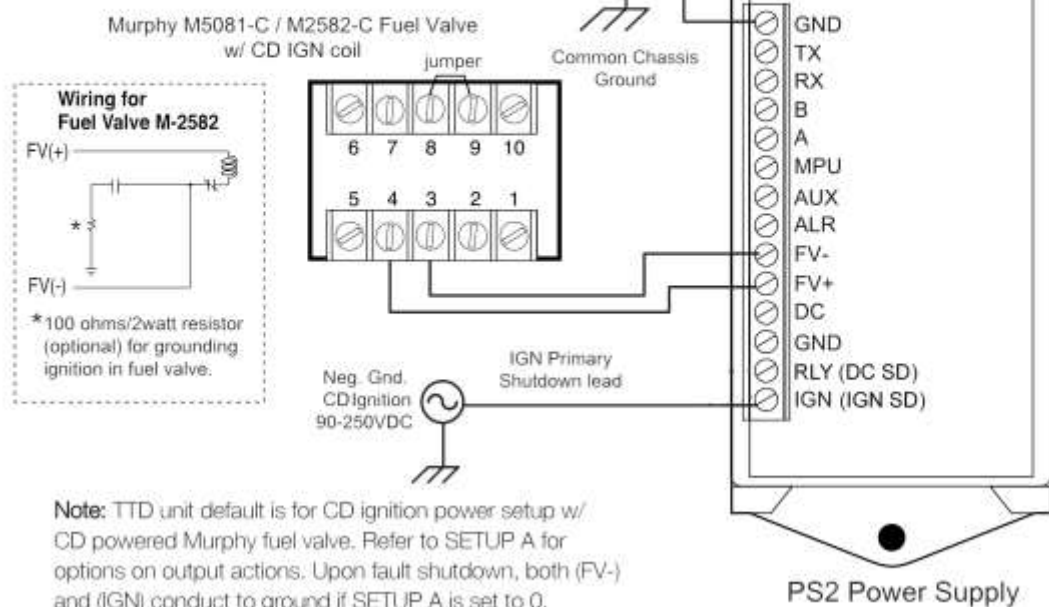
# Installation Diagram for the TTD Display



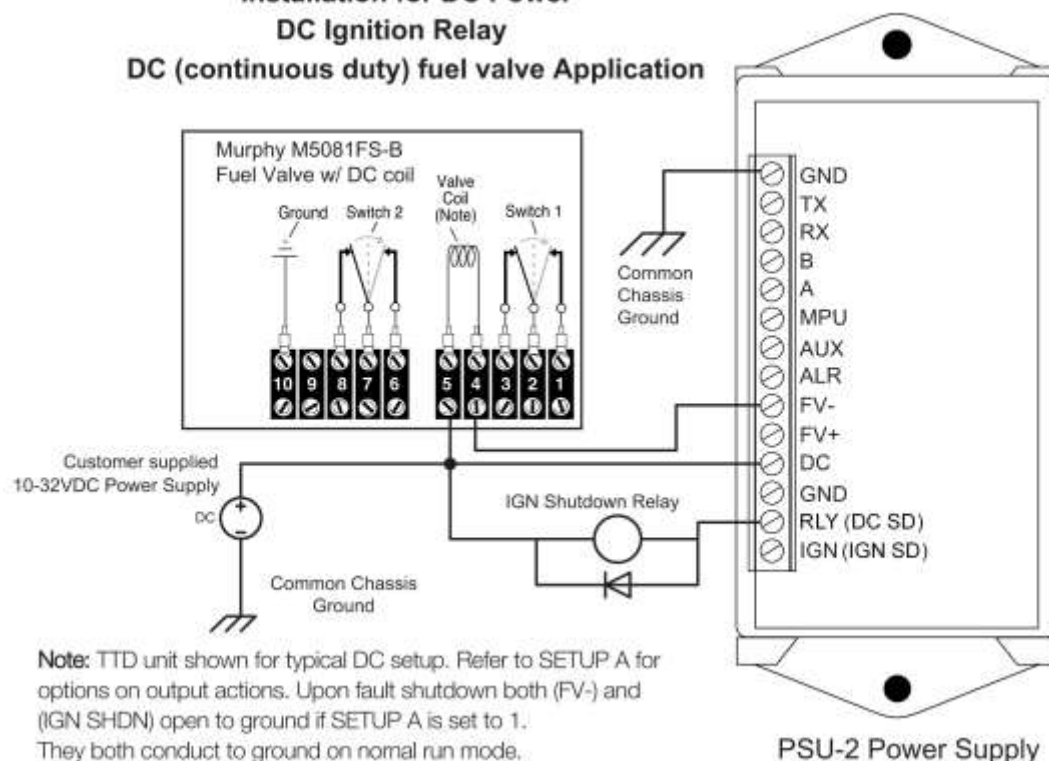


## Typical Installations for TTD Power and Control Inputs/Outputs

### Application wiring for: Negative Ground CD Ignition Power CD Fuel Valve Ground CD Ignition

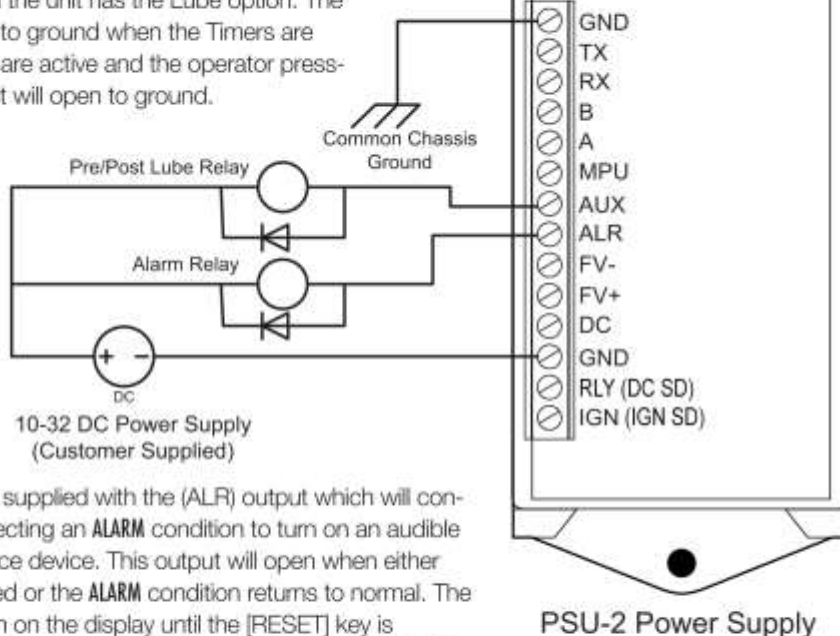


### Installation for DC Power DC Ignition Relay DC (continuous duty) fuel valve Application



## TTD Connections for Alarm, Pre/Post Lubrication Functions

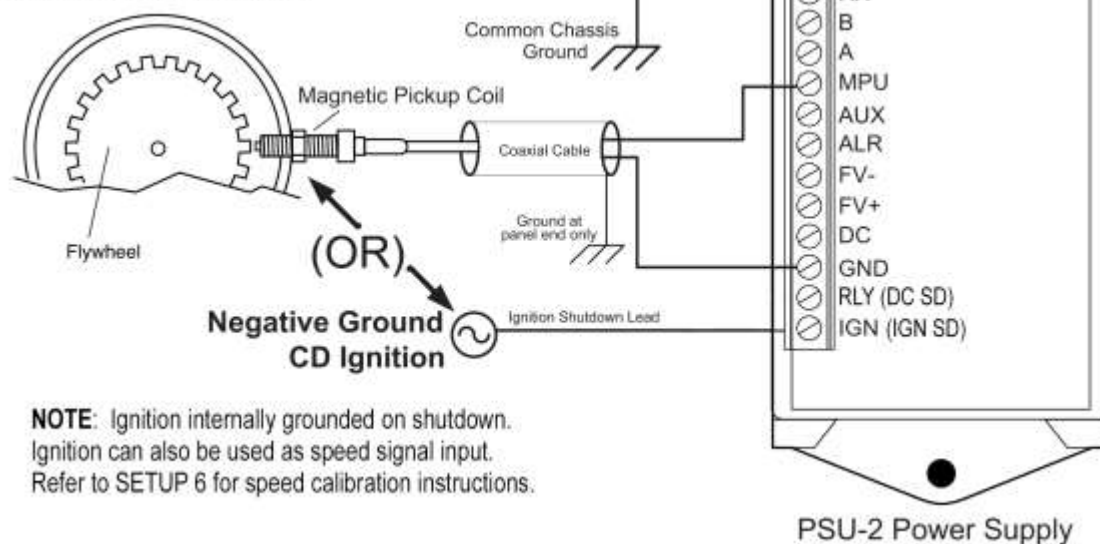
**Note:** The (AUX) output is for turning the auxiliary lubrication pump on and off based on the setting on the **TIMER 5** and **TIMER 6** in **SETUP 1** when the unit has the Lube option. The (AUX) terminal conducts to ground when the Timers are active. When the Timers are active and the operator presses [TIMER 0], the contact will open to ground.



**Note:** TTD annunciator is supplied with the (ALR) output which will conduct to ground upon detecting an **ALARM** condition to turn on an audible horn, light or other interface device. This output will open when either the [RESET] key is pressed or the **ALARM** condition returns to normal. The **ALARM** message will remain on the display until the [RESET] key is pressed acknowledging the alarm. The (ALR) output is also energized during **SHUTDOWN**. Pushing the [STOP] key will not energize the (ALR) output.

## TTD Connections for Tachometer - Hourmeter Functions

**Note:** When using a Murphy Magnetic sensor (pick up) model MP3298, MP7905 or MP7906 connect the wires to terminals (MPU) and (GND). Refer to **SETUP 6** for Speed calibration instructions.



**NOTE:** Ignition internally grounded on shutdown. Ignition can also be used as speed signal input. Refer to **SETUP 6** for speed calibration instructions.

## SETUP A = Output Mode Configuration

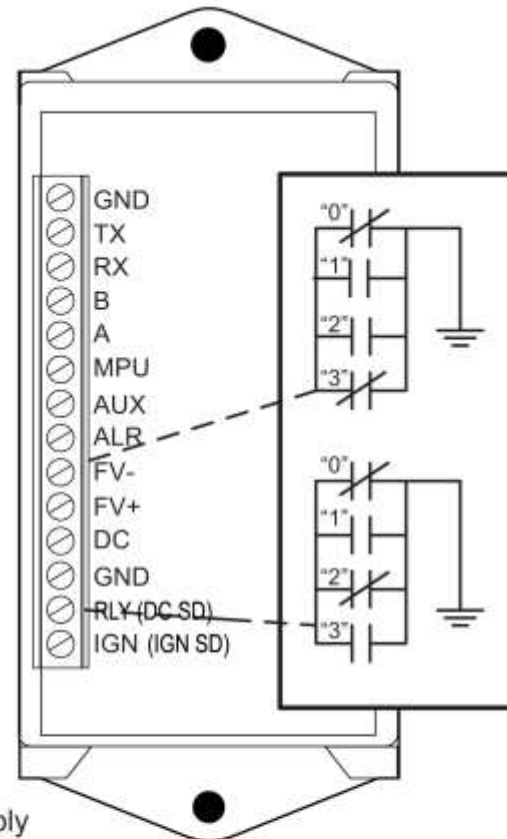
Upon shutdown the (FV-) fuel valve and (RLY) terminals will change stages and either conduct to ground or be open to ground. Their Mode of operation depends on the setting in SETUP A. This sketch represents the options on those settings 0 through 3.

Shutdown Mode					
Output Mode	IGN Kill	RELAY	FV-	ALR	AUX
0	Closed	Closed	Closed	Closed - alarm event Open - no event	Open
1	Open	Open	Open	Closed - alarm event Open - no event	Open
2	Closed	Closed	Open	Closed - alarm event Open - no event	Open
3	Open	Open	Closed	Closed - alarm event Open - no event	Open

Closed indicates closed to ground and open indicates open to ground state when unit is in Shutdown state.

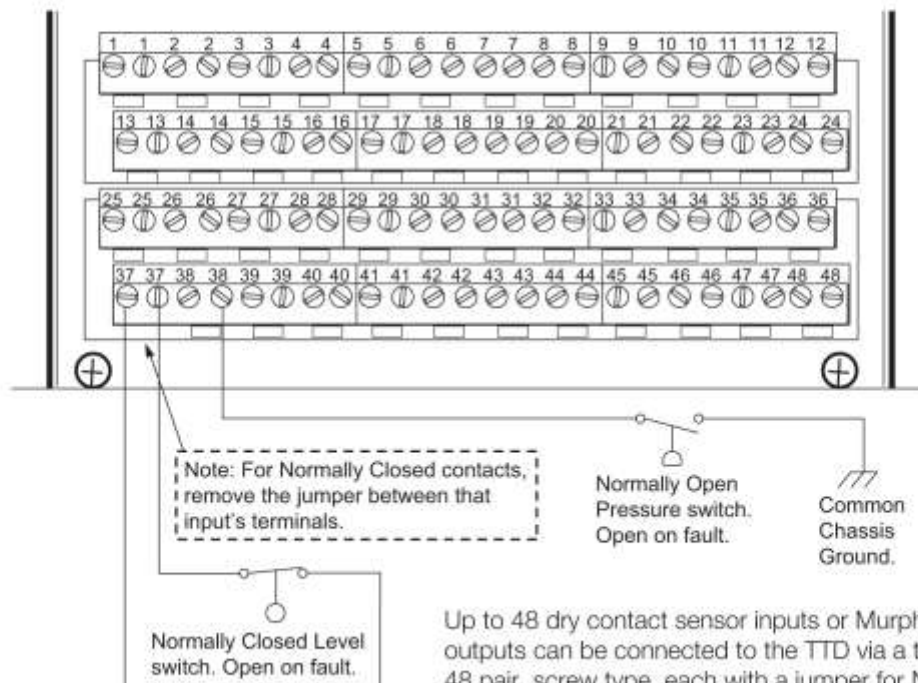
Contacts are shown in Shutdown state.

Refer to Setup A - Output Mode section of this manual for more information on the Setup A.



PSU-2 Power Supply

## TTD Input Terminal Block Connections








Up to 48 dry contact sensor inputs or Murphy device transistor outputs can be connected to the TTD via a terminal block with 48 pair, screw type, each with a jumper for N.O. (Normally Open) or N.C. (Normally Closed) configuration.



## TTD G-Lead Choke Installation Instruction

**IMPORTANT:** This installation is recommended when connecting an ignition primary lead to the TTD Annunciator to avoid potential electrical noise problems. This choke has been specifically selected for the application.

The choke (Murphy part number 50000774) is shipped with each TTD annunciator.

	<p>1. Open the choke and lay it on the table.</p>
	<p>2. Lay the wire across the inside of the choke as shown.</p>
	<p>3. Wrap the wire around the outside of the choke as shown.</p>
	<p>4. Wrap the wire back across the inside of the choke as shown. The wire should lay next to the wire from step 2.</p>
	<p>5. While holding the wires, carefully close the choke as shown. Be careful not to pinch the wire when closing the choke.</p> <p><b>NOTE:</b> Keep the wire loops on the outside of the choke as small as possible.</p>

## Backup Battery Replacement

---



**WARNING!** Before disconnecting or connecting equipment, switch the power OFF and, if possible, lock it out. Assure the area is in a non-hazardous condition before beginning the installation of any new equipment or repairing existing equipment. Bypassing these precautions may present an environment in which explosive hazards are present. If you are working in a hazardous location, take the appropriate precautions to assure the safety of all personnel and equipment.

The TTD Annunciator contains a Backup Power Battery (shipped loose with the TTD Annunciator) located in the power supply module.




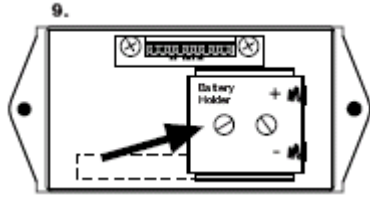
While this battery has a potential life of up to 1 year, it may require replacement. The LOW BATT icon will appear when the internal backup battery voltage is below 5.0 volts. If the battery is missing or the voltage falls below 4.6 volts, the LOW BATT icon will blink. Replace the battery when the LOW BATT icon displays in the lower left corner.



**NOTE:** Internal backup battery is not used during normal operation. Backup battery supplies power to operate TTD Annunciator when CD Ignition is the only source of power and it is not operating (Shutdown), or the user supplied +DC power source has been disconnected.

When CD Ignition or DC voltage is present, power is not consumed from the internal backup battery.

To replace the battery, follow these steps:

	<ol style="list-style-type: none"> <li><b>1. Remove the Power Supply cover screws (located on the sides of the PSU-2 Power Supply).</b></li> <li><b>2. Carefully unplug the Power Supply from the Display Module.</b></li> </ol>
	<ol style="list-style-type: none"> <li><b>3. Turn the Power Supply over to access the Backup Battery compartment.</b></li> </ol>
	<ol style="list-style-type: none"> <li>4. Use caution not to damage other components in the Power Supply compartment while removing and replacing the Backup Battery. Suggested replacements for the Backup Battery: 6 VDC, 1300 mAh, Duracell® DL223A or Sanyo® CRP2 lithium battery, available from Enovation Controls (p/n 00005125).</li> </ol>
	<ol style="list-style-type: none"> <li>5. Plug the Power Supply back onto the Display Module and secure the two mounting screws.</li> </ol>
	<ol style="list-style-type: none"> <li>6. Power up the system and resume normal operations.</li> </ol>

## Initial Power Up

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### Power On Self Test (POST)

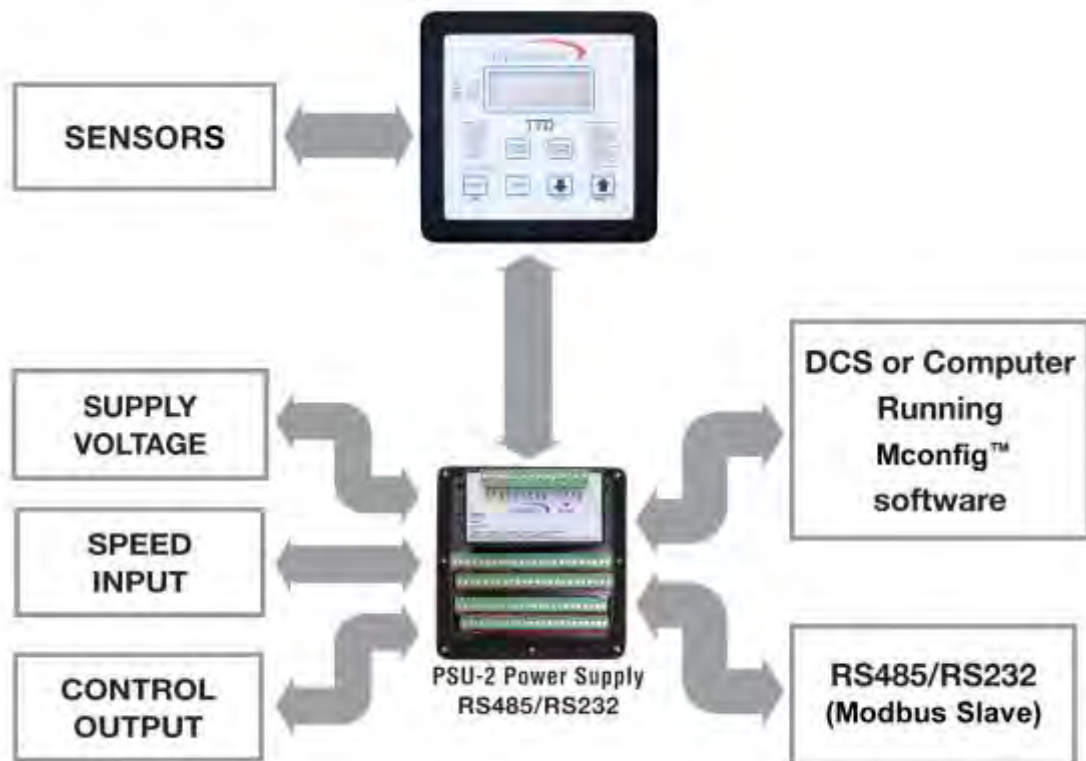
- The TTD will perform a Power On Self Test (POST) during the initial power up which will check for the following errors (in this order):
  - Low Device Voltage (code 53)
  - Crystal Failure (code 54)
  - Loss of SPI link (code 61)
- If the error is Low Device Voltage (code 53), the unit will go to the PoStErr display after testing for two seconds.
- If the error is Crystal Failure (code 54) or Loss of SPI link (code 61), the unit will reset three times to try to correct the problem. If the error is not corrected within 3 retries, the unit will go to the PoStErr display.
- The PoStErr will be displayed on the TTD as shown below :

The image shows the text "PoStErr" in a large, pixelated, monospaced font. Below it, the text "XX" is displayed in a smaller, similar font. This represents the error code displayed on the TTD.

Where XX = 53, 54 or 61

- In the event of error code 53, the supply voltage or internal battery voltage to the annunciator will need to be verified and corrected. Once complete, unit can be reset and used for normal operation.
- Fault Code 53 will deny user access to setup menus as this represents a lack of power necessary to access the EEPROM. If the Setup Menu is accessed and a Code 53 becomes active, the user will see Err 53, and the TTD will exit the Setup Menu and return to the last state (running, stopped, etc).
- Fault code 53 will not cause a shutdown during normal operation of the TTD beyond the initial POST test.
- In the event of error codes 53, 54 or 61, which do not clear, **the entire unit (TTD and PSU) needs to be returned to Enovation Controls for evaluation.**

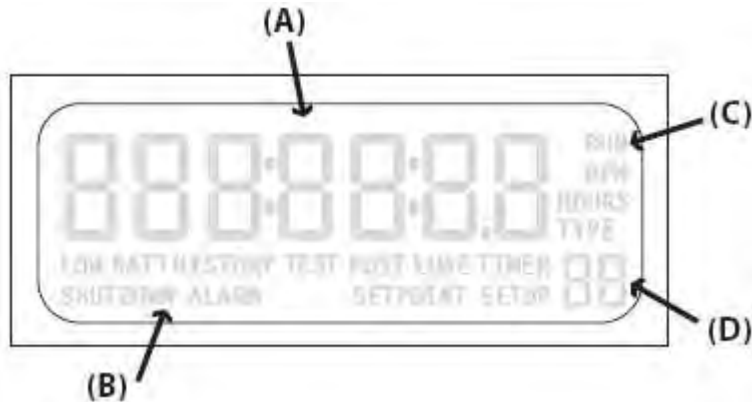
## Product Features



## The Display

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The TTD annunciator features a static LCD display (A) with backlight (external DC is required). The operating temperature is between  $-40^{\circ}$  to  $+85^{\circ}\text{C}$ . The applicable icon and number (B, C and D) will be displayed to clarify the display readings or alert the operator to an operating condition.



### Display Icons

**RUN** – run mode

**RPM** – screen value

**HOURS** – screen value

**TYPE** – channel type configuration

**LOW BATT** – low battery warning (displayed if the condition exists)

**HISTORY** – alarm or shut-down history

**TEST** – test mode

**LUBE** – pre-lubrication timer

**POSTLUBE** – post-lubrication timer

**SHUTDOWN** – stop mode

**ALARM** – alarm(s) warning (displayed if the condition exists)

**SETPOINT** – edit setpoint value

**SETUP** – setup menu(s)

## Front Panel Key Functionality

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The operator can interface with the TTD Annunciator in one of two ways. One is via the Front Panel keypad. The second way an operator can interface is with the Murphy Mconfig™ software. This provides the user with a Template displaying the TTD Annunciator setup and status by reading the Modbus registers. Set-up selections can be made and the configuration saved to file for future reference. The software is free and can be downloaded from [www.fwmurphy.com](http://www.fwmurphy.com)

## TTD Keypad Features

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**NOTE:** Because the keys have more than one function depending on the operational mode the system is in at the time, the following TTD Keypad Functionality blocks indicate the keypad action seen if that key is pressed. The **LOW BATT** icon can show in any mode if the battery charge is low.

Shutdown Mode

**SHUTDOWN** indicates the TTD identified a fault condition and alerts the operator with cause of shutdown code.

The current condition on the display indicates the **SHUTDOWN** icon is on.



	Key	Function
 (B)	Read Hours	(B) Shows the operation hours for the displayed History record*.
 (C)	Setup/Enter	Press and hold the key for 5 seconds to access the Setup Menu: The model number displays (C) and then the <b>SETUP</b> icon displays (D).
 (D)	Up Arrow	Shows the previous History record (E)*.
 (E)	Down Arrow	Shows the next History record*.
	Reset	Press [RESET] to start the Run Mode.



\*When not in the Setup Mode, History contains records for last 10 shutdowns and last 4 alarms.



## Run Mode

The condition on the display indicates the **RUN** and **RPM** icons are shown and the **ALARM** icon may be on.



	Key	Function
 (G)   (H)	<b>Read Hours</b>	(G) Shows the current operation hours. <b>RUN</b> icon indicates the hour meter is in increment mode.
	<b>Setup/Enter</b>	Press and hold the key for 5 seconds to access the Setup Menu: The model number displays and then the <b>SETUP</b> icon displays.
	<b>Timer 0 / Up Arrow</b>	Press [TIMER 0] to clear the active displayed timer. For example: B1, B2 and other timers. Also used for exiting or ending test mode operation.
	<b>Test / Down Arrow</b>	Press [TEST] to enable the Test Mode timer. Also used for extending or resetting the test timer. (H)
	<b>Reset</b>	Press [RESET] to reset the active displayed timer. <u>DO NOT</u> use to reset Test Mode Timer. This reset button will reset all class lockout timers.
	<b>Stop</b>	Press [STOP] to begin the Shut-down sequence.

## Setup Mode – Menus

The condition on the display indicates the **RUN** and **SHUTDOWN** icons may be on.



Key	Function
Setup/Enter	If the unit is in SETUP 0, pressing [ENTER] exits the unit from the Setup Mode. If the unit is in any other Setup, pressing [ENTER] accesses the submenu for that Setup.
Up Arrow	Press [UP ARROW] to navigate to the next menu.
Down Arrow	Press [DOWN ARROW] to navigate to the previous menu.
Reset/ESC	Press [ESC] to exit from the Setup Menu and return to the operational display for the current mode.
Stop	If the system is in Run Mode, pressing and holding the [STOP] key for 2 seconds will begin the Shut-down sequence.

## Setup Mode – Edit Settings

The condition on the display indicates the **SETUP** icon shows, and either the **RUN** or **SHUTDOWN** icons may show.
















Key	Function
Setup/Enter	Press [ENTER] to exit or advance a Setup menu and save changes.
Up Arrow	Press [UP ARROW] to increment the value to the maximum range. Holding the key accelerates the incrementing action.
Down Arrow	Press [DOWN ARROW] to decrement the value to the minimum range. Holding the key accelerates the decrementing action.
Reset/ESC	Press [ESC] to exit or advance the Setup Menu without saving your changes.
Stop	If the system is in Run Mode, pressing and holding the [STOP] key for 2 seconds will begin the Shut-down sequence.

**NOTE:** Editing of selected setpoints can be accomplished during run mode. Please note these changes will **NOT** take effect until unit has returned to a Shutdown state. During the Shutdown state, these settings are written to the EEPROM, which stores settings for operation. This EEPROM **CANNOT** be written to during a Run operation.

## Operational Display Messages

Several messages display during the start-up and run sequence. This tutorial shows the screens that will display as the system starts. With the unit in shut-down state and ready to start, press the [RESET] key. If Class A channels are not faulted and the unit is equipped with the Pre/Post Lube option, the unit goes into the Pre-Lube cycle. If the unit does not have the Pre-Lube option, it will go to the B1 Timer display.

<p><b>Pre-lubrication Timer Reading</b></p> 	<p>Lube Timer 5 shows the remaining time on the cycle and the LUBE icon shows on the display. The Pre-Lube cycle can be completed either by the timer reaching zero or by the operator pressing [TIMER 0]. Pressing the [TIMER 0] key will zero the time on the active visible timer only. All other active undisplayed timers will remain the same. All outputs are in a shut-down state during LUBE TIMER</p>
<p><b>B1 Timer Reading</b></p> 	<p>Once the Pre-Lube cycle completes, the outputs change state, and the B1 and B2 timers start. This display shows TIMER 1 as the remaining B1 time counts down. If this is a TTD unit with optional Tachometer, the display alternates between the active TIMER and RPM readings. If the TTD unit does not have Tachometer, the active TIMER reading alternates with the HOURS reading.</p>
<p><b>B2 Timer Reading</b></p> 	<p>Once the B1 Timer finishes, any time remaining on the B2 timer will show in the display, and the TIMER 2 icon will be visible in the lower right-hand corner of the display.</p>
<p><b>RPM Reading - Shows RPM**- Run Mode</b></p> 	<p>On TTD models supplied with tachometer, once the B1 and B2 timers have expired, the unit goes to a normal Run Mode. Both the RUN and RPM icons will be visible, and the display gives the RPM reading. TTD units without the Tachometer display the HOURS reading.</p>
	<p>Any conditions such as LOW BATT or ALARM alert the operator by having the icon show on the display. LOW BATT indicates low voltage on the Backup battery and may indicate it is time to replace the battery.</p>
<p><b>Ignition Delay Timer Reading</b></p> 	<p>At the detection of a fault, the TTD annunciator starts the shut-down sequence. The ignition delay timer shows the time remaining on the timer before the ignition is grounded or turned off. In addition, the fault channel shows on the left side of the display and flashes.</p>
<p><b>Post-lubrication Timer Reading</b></p> 	<p>If the TTD annunciator is equipped with the Pre/Post Lube option and there is time remaining in the sequence, the POSTLUBE icon, and the TIMER 6 icon displays showing the remaining time on the timer.</p>

<p><b>Shutdown Code - Shows Channel Tripped</b></p> 	<p>When the Post-Lube time counts down, the Fault Channel numeric display moves to the right. The HISTORY icon is visible, and the current shutdown is indicated in the lower right-hand corner by 01. This is the only time History records are available from the Front panel. History records can be read via the Modbus registers at any time.</p>
<p><b>Hourmeter Reading @ Shutdown Record #1</b></p> 	<p>The TTD annunciator stores the Shutdown and Alarm History. The last 10 shut-down codes and 4 alarms are stored with the hourmeter reading when they occur. For example, if the unit is shut-down from sensor input 35, the display shows 01 in the lower right-hand corner of the display to indicate the last shutdown, and the SHUTDOWN icon shows.</p> <p>Press the [UP ARROW] key to see the History of the last 10 shutdowns. For more information, see Accessing Shutdown &amp; Alarm History.</p>
<p><b>Hourmeter Reading - Running Hours</b></p> 	<p>If this is a TTD unit with Tachometer option and the unit is in the Run Mode, when the [READ HOURS] key is pressed, the display shows the running hours for 5 seconds. The display then returns to the RPM reading.</p>
<p><b>Run Mode Showing RPM Reading</b></p> 	
<p><b>Test Timer Reading</b></p> 	<p>Push the [TEST] key to start the Test Timer for up to 5 minutes. The TEST icon shows in the display. Test Mode allows the operator to simulate faults without the outputs changing state. In Test Mode, all other functions operate normally. Faulted inputs display, but the system is not shut-down, and the ALARM is not turned on. When more time is needed to simulate inputs, the operator can press [TEST] again for up to an additional 5 minutes of time. Press [RESET] to reset the fault and then press the [TIMER 0] to exit the Test Timer. These shutdowns override Test Mode:</p> <ul style="list-style-type: none"> <li>- Emergency Shutdown (47,48)</li> <li>- Overspeed (50)</li> <li>- Manual Stop (52)</li> <li>- Underspeed (51)</li> <li>- Loss of Ignition (49)</li> <li>- Optional Additional ESD, if chosen as ESD</li> </ul> <p>If Class C functions are used, they will need to be bypassed to test other sensors. When exiting Test Mode with Class C functions, press the [RESET] and [TIMER 0] keys simultaneously.</p>
<p><b>Alarm Code - Shows the Channel Tripped</b></p> 	<p>In an alarm situation, the ALARM icon is turned on, and the alarm point or channel displays. If the unit is equipped with a Tachometer option, the active point or channel alternates with the running hours at the time of the alarm.</p> <p>If a fault is detected or an alarm occurs, the appropriate fault codes display</p>

## Fault Codes

Fault Codes	Description
1-48	Indicates the channel that has faulted or alarmed
49	Loss of Ignition (When the CD ignition falls below 90 VDC $\pm$ 10%, the firmware activates the fault)
50	Overspeed
51	Underspeed
52	Manual Stop
53	Low Device Voltage (internal diagnostic)
54	Crystal Failure (internal diagnostic)
60	Watchdog Timer
61	Loss of SPI Link (internal diagnostic)
62	Low DC Voltage (Alarm)
63	Low Backup Battery (Alarm)

### Backlight used as Status Indication

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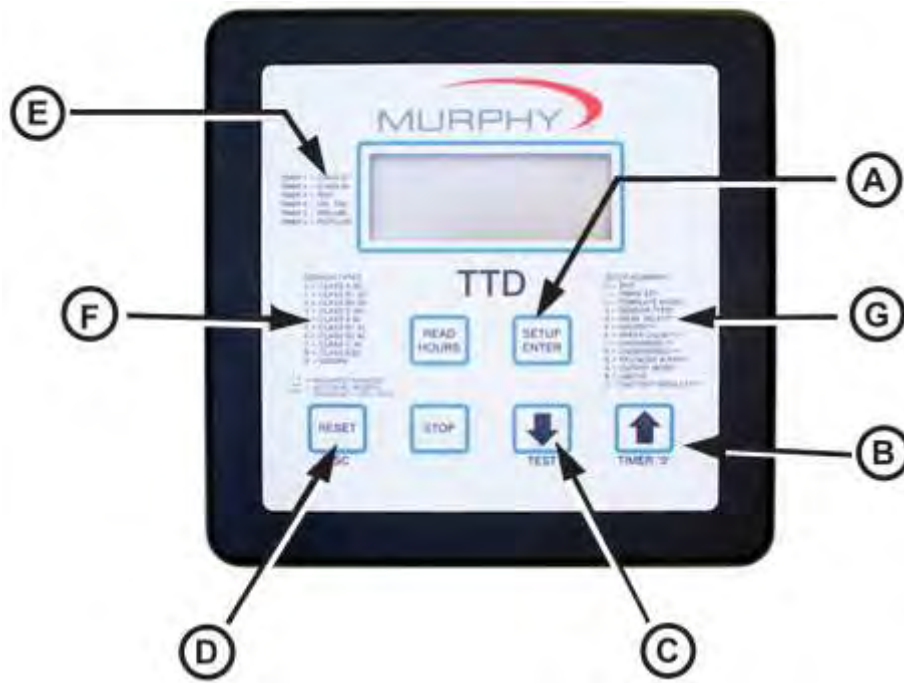
If AC or DC power is connected, the backlight functionality is implemented on Div. 2 power supplies.

**Run Mode** – The backlight will be yellow under this condition.

**Shutdown Mode** – The backlight will turn red under this condition. When a shut-down fault is detected, the backlight will blink. The backlight blinking continues for 5 minutes and can be aborted if the user presses any key. After 5 minutes, the backlight stays red. During manual shut-down sequence, the backlight will be red.

## Configuration / Setup of the TTD Annunciator






### Navigating the TTD Front Panel



The TTD Annunciator can be set up by using the Front Panel. The Setup Mode can be entered from either **RUN** or **SHUTDOWN**. However, settings can only be changed when the **SETUP** icon is blinking.

- (A) [SETUP or ENTER] key
- (B) [UP ARROW] key
- (C) [DOWN ARROW] key
- (D) [ESC] escape key
- (E) Timer information
- (F) Sensor types
- (G) Setup numbers

## Entering Setup Mode

	<p>To enter the Setup Mode, press the [SETUP/ENTER] key and hold until the display shows HOLD. Continue to press the [SETUP/ENTER] key until the model number is displayed.</p>
	<p>The HOLD display counts down for 6 seconds, shows the model number for 3 seconds and then shows SETUP 0 to indicate the unit is in Setup Mode.</p>
	<p>Press the [UP ARROW] or [DOWN ARROW] key to move through the Setup values. After selecting a different Setup to view, press the [SETUP/ENTER] key to display the current configuration of that set up value. To change a setting, press [SETUP/ENTER] again to access the menu choices. Enter changes by using the [UP ARROW] or [DOWN ARROW] key. The only time a new value can be entered is when the Setup icon is blinking.</p>
	<p>Press the [SETUP/ENTER] key again to save the new value. The display will show SAVE for a few seconds and then return to the Setup menu.</p>
	<p>To exit without saving the change, press [ESC]. Press [ESC] again to exit from the Setup Mode completely. The display will show ESC and then return to the operational screen.</p>

## Access During Run and Shutdown

Setup menus and settings can be viewed during **RUN** or **SHUTDOWN**, but most menus cannot be changed while in Run Mode. To assure changes can be made, access Setup menus while in Shutdown Mode. Press and hold the [SETUP/ENTER] key for 6 seconds to enter the Setup Mode. The display shows HOLD while the seconds count down.

When the countdown completes, the TTD annunciator is in Setup Mode. The unit model message displays for about 3 seconds before the SETUP 0 message shows. At this point, use the [UP ARROW] key to increment to another Setup Mode.



## Password Protected Settings



THIS SYMBOL INDICATES PASSWORD PROTECTED

(M)



Some settings are password protected. If a password is required to change a setting, CODE 00 displays indicating a numeric password should be entered (M). If an incorrect password is entered, ERROR (N) displays for a few seconds, and then the CODE 00 (M) notation returns to the display.

(N)



The password will only need to be entered once during any editing session. The password is reset when the editing session is exited or is timed-out due to keypad inactivity. Entering a code 0, allows read-only access to Setup menus.

Use the [UP ARROW] and/or [DOWN ARROW] keys to enter the numeric password specific to that TTD annunciator.

## Inactivity Time Out

(O)



Set up procedures need to be started and completed in a timely manner.

(P)



If the TTD annunciator is in any Setup Mode, the display function returns to the previous level of entry if there are no key presses within 30 seconds. For example, the TTD annunciator is in SETUP 3 (O), channel 25 is selected and the choice of Sensor Type is displayed (P). After 30 seconds of keypad inactivity, the TTD returns to SETUP 3 (Q).

If another 30 seconds pass with no keypad activity, escape is activated, and the unit returns to the operational screens.

(Q)





## Setup 1 – Timer Setup



THIS SYMBOL INDICATES EDITING DURING RUN MODE ALLOWED

(R)



This manual explains Setup values in order starting with SETUP 1. However, once the SETUP icon is blinking, the [UP ARROW] or [DOWN ARROW] keys can be used to increment to any Setup option. Once the option is reached, press the [SETUP/ENTER] key to access the adjustments for that Setup.

(S)



All timers are configured in SETUP 1. (R) When the SETUP icon is blinking, press the [SETUP/ENTER] key to reach the specific timer to be set. (Setup icon should blink about once a second.)

Use the [UP ARROW] or [DOWN ARROW] keys to change the configuration. Once the change is completed, press the [ENTER] key to save the changes. The unit will display SAVE (S) for few seconds, and then

move to the next timer.

If a change is made and the [ESC] key is pressed, the TTD moves to the next timer without accepting the change. If no changes were made to the setting, press the [ESC] key to return to SETUP 1, or press [ENTER] to move to the next timer.

Continue to press [ENTER] to move through all timers and review values or make changes to values as necessary.

### Timer 7 Delay Before No-Flow Shutdown

(T)



When an internal input detects a No-Flow condition, the Channel number that detected the condition is displayed along with Timer 7 and its countdown.

(T) Shows the Timer 7 display during No-flow delay before shutdown.

(U) Shows Setup 1 – Timer 7 menu.

(U)

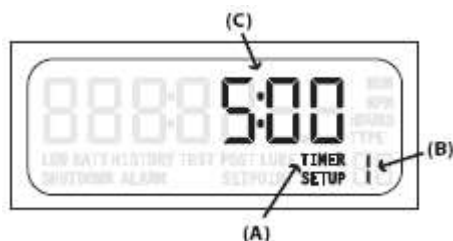


Timer 7 will not be armed until Timer 1 has expired. During Timer 1 countdown, the channels enabled as No-Flow (CH41 - CH44) will be ignored.

Setting Timer 7 to zero (Ø) will cause an immediate shutdown when Timer 1 has expired, if No-Flow is detected on any of the four enabled channels.

To enable or disable the No-Flow function use SETUP 4b thru 4E.

The active timer is indicated by the **TIMER** icon (A), timer number (B) and numeric display (C).



Timer	Timer Class	Timer Range
Timer 1	Class B1	0 to 5 minutes
Timer 2	Class B2	0 to 10 minutes
Timer 3	Test	0 to 5 minutes
Timer 4	IGN GND	0 to 20 seconds
Timer 5*	Pre-lube	0 to 5 minutes
Timer 6*	Post-lube	0 to 10 minutes
Timer 7**	Delay Before No-Flow Shd.	0 to 10 minutes

\* When timer is set to zero (0), the Timer's feature is disabled or turned off.

\*\* Delay-Only Timer: it does not enable or disable No-Flow functionality.

**NOTE:** During Run Mode if more than one Timer is active at the same time, the Timers will be displayed by the TTD in the following priority:

1. Timer 3
2. Timer 1
3. Timer 2
4. Timer 7

Timers not active during the Run Mode will not occur at the same time.

## Setup 2 – Sensor Mode



PASSWORD PROTECTED

(D)



(D) SETUP 2 is a feature that offers choices for predetermined configurations of sensor class to input channel. These choices can emulate an existing annunciator being replaced or configure a new installation by using the closest template. Units from the factory are set to an Emulation Template default of 1 with all inputs set to Class A.

(F)



Once the unit is in Shutdown Mode, enter SETUP 2 and choose from one of the eight pre-configured Emulation Template Settings or chose 0 and configure each individual sensor channel per your specifications/ requirements. Review the template settings in the first column of the Emulation Table and enter that number to

select the template. (F)

## Emulation Table

TEMPLATE SETTINGS			B1 Lockout	B2 Lockout	Class A	Class C	Over speed	Remote Reset	Remote Lockout	Local ESD	Remote ESD
0	<i>Only when SETUP 2 is set to "0" can individual channels be set in SETUP 3</i>										
1	TTD	Default	N/A	N/A	(1-46)	N/A	N/A	(45*)	(46*)	(47)**	(48**)
2	TTD	Mark II	8 (16-23)	N/A	32 (1-15, 24-40)	4 (41-44)	N/A	(45*)	(46*)	(47)**	(48**)
3	TTD	Mark III	9 (1-9)	N/A	31 (10-30, 32-40, 48)	4 (41-44)	N/A	(45*)	(46*)	(47)**	(31**)
4	TTD	Mark IV, LCDT	15 (1-15)	N/A	25 (16-40)	N/A	N/A	(45*)	(46*)	(47)**	(48**)
5	TTD	Mark IV, LCDT+	15 (1-15)	N/A	25 (16-40)	4 (41-44)	N/A	(45*)	(46*)	(47)**	(48**)
6	TTD	Generic	16 (1-16)	4 (17-20)	20 (21-40)	4 (41-44)	N/A	(45*)	(46*)	(47)**	(48**)
20	DD-20	Altronic	8 (10-17)	N/A	11 (20-27, 30-32)	N/A	N/A	(45*)	(46*)	N/A	N/A
40	DD-40	Altronic	16 (10-17, 20-27)	N/A	24 (30-37, 40-47, 1-8)	N/A	N/A	(45*)	(46*)	N/A	N/A

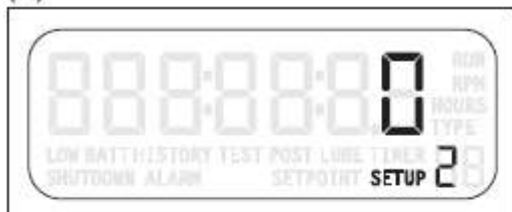
\* - If Remote Reset and Remote Lockout are selected in SETUP 4, any previous setting on channel 45 and 46 will be overridden.

\*\* - Channel 47 and 48 are defaulted to Class ESD which means they will override the Test function and shut down the unit. They can be changed if desired.

( ) - numbers in paranthesis indicate terminal/channel numbers. The number in front of the ( ) is the number of points in that template.

Note: When using the Altronic DD20 or 40 Emulation in a non-tachometer TTD, the overspeed channel must be configured.

(G)



After selecting and saving a template, any channel can be reconfigured by changing a single channel in SETUP 3. To do this, return to SETUP 2 and enter 0 as the template setting (G). The point on the template originally selected is not changed with this action. Next, go to SETUP 3 and change channels, as necessary, to the preferred configurations.

(H)



Terminals 45 & 46 are enabled in SETUP 4 for Remote Reset and Remote Lockout functionality. If they are not enabled, they can be configured the same as the other channel. If they are enabled, they will override any previous setting. Remote Reset can only be used in terminal 45, and Remote Lockout can only be used in terminal 46.

(I)



Terminals 47 and 48 are defaulted to Class ESD. This means they will override the Test function and Shutdown the unit. The functionality on these channels can be changed, if desired.

When Template 20 is selected (H), the channel assignments will duplicate the DD20. Remaining channels are configured as inactive but can be modified in SETUP 3 once SETUP 2 is set to 0. This also applies to Template 40; with the exception of channels 50 to 57 that are assigned to TTD terminals 1 to 8.

If Template 20 or Template 40 is used in a unit without the tachometer option, the overspeed channel must be configured.

## TTD Terminal Block Configuration NO/NC for DD-20

1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24
25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35	36	36
37	37	38	38	39	39	40	40	41	41	42	42	43	43	44	44	45	45	46	46	47	47	48	48
Class A				Class B				Class A															

## TTD Terminal Block Configuration NO/NC for DD-40

50	50	51	51	52	52	53	53	54	54	55	55	56	56	57	57								
1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24
25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35	36	36
37	37	38	38	39	39	40	40	41	41	42	42	43	43	44	44	45	45	46	46	47	47	48	48
Class A				Class B				Class A															

## Setup 3 – Sensor Type

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PASSWORD PROTECTED

Unit must be in Shutdown Mode to edit.

Individual sensor channel can be changed in SETUP 3 (A). As shown in the Sensor Types table, any channel can be set to one of the 11 available configurations. SETUP 2 must be set to 0 to make any changes in SETUP 3.

(A)



(B)



1. Press [SETUP/ENTER].
2. Use the [UP ARROW] key to increment and change the Channel number.
3. Press [SETUP/ENTER].
4. Use the [UP ARROW] key to select the Type (B).
5. Press [SETUP/ENTER] to SAVE the changes.

<b>Sensor Types</b>	
<b>0</b>	Class A
<b>1</b>	Class B1
<b>2</b>	Class B2
<b>3</b>	Class C
<b>4</b>	Class A Alarm
<b>5</b>	Class B1 Alarm
<b>6</b>	Class B2 Alarm
<b>7</b>	Class C Alarm
<b>8</b>	ESD
<b>9</b>	Ignore (Disabled)
<b>10</b>	Special Lockout*
<b>11</b>	Remote Reset**
<b>12</b>	Remote Lockout**
<b>13</b>	No-flow**

\* Special Lockout is a fixed 5-minute timer. This timer starts at the same time as the B1 and B2 timers. While timing, the channel assigned this type is locked out. Unlike the B1 and B2 timers, this timer cannot be reset or zeroed while the unit is running. The timer is reset only after shutdown or normal stop.

Up to 48 dry contact sensor inputs or Murphy device transistor outputs can be connected to the TTD via a terminal block with 48 pair, screw type, each with a jumper for N.O. (Normally Open) or N.C. (Normally Closed) configuration.

\*\* Settings represented as numbers for placeholders only. These values can only be set through other menu options in the TTD.

## Setup 4 – Remote Reset Remote Lockout Select and No-Flow Enable Delay



(D)



Press the [ENTER] key to read SETUP 4A. Press a second time to read SETUP 4B.

(D) Use SETUP 4A to set the Remote Reset/Remote Lockout configuration of preselected channels 45 and 46.

(E)



(E) Remote Reset and Lockout are enabled by this setup and will override any template setting. When the Remote Reset feature is enabled, a closed contact on channel 45 resets the TTD annunciator in the same manner as when using the [RESET] key.

Limit close duration to 1 second. On models with lube option, Remote Reset will start the Prelube timer.

The Remote Lockout feature resets and inhibits the Class B1, B2 and C timers and fault inputs. Any faults configured as B1, B2 or C are ignored when channel 46 is an open contact. When the contact is closed, the timers will be allowed to time and arm the faults. This feature is intended to be used with automatic start/stop signals, typically connected to a run confirmation signal to enable the faults after running. Upon an auto-stop, the Remote Lockout should be re-activated by opening the channel 46 contact, until the next start auto-start signal.

With the unit running and an open contact on channel 46, the display will flash and display the B1 timer. On units with Tachometer, the display will flash and alternate between RPM reading and B1 timer.

Configuration Settings	
0	Disabled
1	Remote Reset assigned in the CH45 (fixed)
2	Remote Lockout assigned in the CH46 (fixed)
*3	Remote Reset assigned in the CH45 (fixed) and Remote Lockout assigned in the CH46 (fixed)

*\* If Remote Reset and Lockout are used simultaneously on models with Lube option, Prelube timer is only activated if the unit is faulted or in Manual Stop and receives the Remote Reset signal. The Remote Lockout signal only inhibits the Class B1 and B2 timers. Therefore Prelube timer is skipped if the system is already reset when the Remote Lockout is released.*



## No-Flow Switch Transition Time

Use SETUP 4b through 4E to set No-Flow switch transition times.

Digital input channels 41 to 44 can be configured for detecting a transition of the switches on a divider block of a compressor system. The channels are scanned to determine if a transition has occurred in an acceptable time. The time range settings are from 0 to 59 seconds. (The default setting is zero.)

(G)



(G) SETUP 4b is the No-flow screen for CH41

(H) SETUP 4C is the No-flow screen for CH42

(I) SETUP 4d is the No-flow screen for CH43

(J) SETUP 4E is the No-flow screen for CH44

(H)



Setting the value to 0 (zero) on any channel will disable the No-flow function for that channel and allows SENSOR MODE (SETUP 2) or SENSOR TYPE (SETUP 3) to determine the Sensor channel functionality.

(I)



A non-zero value enables No-flow function for that channel and defines the timeout for the channel. Enabling No-flow function overwrites the channel SENSOR TYPE or SENSOR MODE configuration (reserves the channel only for No-flow use).

The Test Mode will be ignored if the No-flow is enabled for the channel.

(J)



Because these inputs are always in transition, the channels are always tested for open and close.

**NOTE:** Use SETUP 1 to configure (TMR7) Timer 7 delay before No-Flow shutdown.

## Setup 5 - Hourmeters

---



PASSWORD PROTECTED

(K)



(K) This setup is for reading and/or resetting the hourmeter. There are two separate hourmeters:

Hourmeter 5A can be reset.

Hourmeter 5b is the TTD internal hourmeter and keeps track of total RUN HOURS.

(L)



(L) 5A Hourmeter Setting. Range 0 to 99999 hrs. (This hourmeter can be reset.)

(M) 5b Product Life Timer. Range 0 to 99999 hrs. (11.41 years non-stop. This hourmeter cannot be reset.) The Product Life Timer reading can also be accessed through the Modbus or via the Setup menu.

(M)



**NOTE:** The hourmeter registers are in the display head not in the power supply and are not reset by changing the power supply.

## Setup 6 – Speed Calibration



PASSWORD PROTECTED

(N)



The optional Tachometer functionality is configured in SETUP 6 (N).

Pulses per Revolution is calibrated as follows:

Press [SETUP/ENTER] to reach SETUP 6A (O).

(O)



Pressing [SETUP/ENTER] a second time increments the display to 6b.

SETUP 6A is the Pulses per Revolution Setting. Speed input can be either Magnetic pickup (MPU) or CD Ignition Primary Signal (IGN). The range is .5 to 450. Use the [UP ARROW] or [DOWN ARROW] keys to reach the desired setting. Use Settings .5-16.5 with ignition input

for speed, and settings 17-450 for magnetic pickup input (10 kHz max frequency input).

In the Conversion Table, the number of cylinders and cycles of the engine determine the number of pulses per revolution for ignition input. Divide the number of cylinders by 2 for split capacitor ignitions. Multiply the number of cylinders by 2 for throwaway spark ignitions.

Conversion Table		
Cylinders	Cycles	Pulses
1	2	1
2	2	2
2	4	1
3	2	3
4	2	4
4	4	2
5	2	5
6	2	6
6	4	3
8	2	8
8	4	4
10	4	5
12	4	6
16	4	8

(Q)



SETUP 6b (Q) is the RPM Filter Enable and Loss of Ignition selection and setting. Use the [UP ARROW] or [DOWN ARROW] keys to select a value. Choose a setting from the Loss of Ignition Shutdown and RPM Filter Table to choose a monitoring combination.

Value	Loss of Ignition Shutdown	RPM Filter
0 (default)	Enabled	Disabled
1	Disabled	Disabled
2*	Enabled	Enabled
3*	Disabled	Enabled

\* If the TTD unit does not have the Tachometer option, only the 0 and 1 values are available.

Loss of Ignition Shutdown is a Class C function that can be armed only after the B1 Timer (TMR1) expires. When enabled and B1 Timer has expired, CD Ignition must be present (above 90VDC) for at least 15 seconds to arm the Loss of Ignition function. After being armed if CD Ignition falls below 90VDC for at least 15 seconds, the Shutdown sequence will begin, and code 49 will be displayed. (See *Fault Code table on page 19.*)

**NOTE:** The tolerance of the CD Ignition voltage detection is  $\pm 10\%$ . The arming and shutdown delay of 15 seconds is not adjustable.

RPM filter allows for a DEBOUNCE time before a loss of ignition, underspeed or overspeed shutdown occurs. The filter (when enabled) will take 3 more RPM readings (typically 500mS) once the threshold for shutdown has been achieved. If after these 3 attempts, the shutdown is still valid, a shutdown will occur. If the RPM reading has re-established at a valid state, the unit will remain running.

## Setup 7 – Tachometer Overspeed Option

---



EDITING DURING RUN MODE ALLOWED

(A)



Fault Code 50. (See *Fault Code table on page 19.*)

(A) Use SETUP 7 to adjust the Overspeed Setting. The range is 0 to 5000 RPM.

(B) Press [ENTER] to view the Overspeed setting.

(B)



To change the setting, use the [UP ARROW] or [DOWN ARROW] keys to reach the new Overspeed setting and press [ENTER] to save the change.

**NOTE:** Overspeed is a Class A Type Shutdown and is not locked out or testable during Test Mode.

**NOTE:** For TTD-T models used with EICS G-Lead/U-Lead for tachometer readings, disable TTD overspeed and underspeed faults, or false shutdowns may occur caused by diagnostic signals sent by EICS on the G-Lead/U-Lead.

## Setup 8 – Tachometer Underspeed Option

---



EDITING DURING RUN MODE ALLOWED

(C)



Fault Code 51. (See *Fault Code table on page 19.*)

(C) Use SETUP 8 to adjust the Underspeed Setting. The range is 0 to 5000 RPM.

(D) Press [ENTER] to view the Underspeed setting.

(D)



To change the setting, use the [UP ARROW] or [DOWN ARROW] keys to reach the new Underspeed setting and press [ENTER] to save the change.

**NOTE:** Underspeed is locked out by the B1 Timer (Timer 1). Underspeed will not cause a fault until the B1 timer expires.

**NOTE:** For TTD-T models used with EICS G-Lead/U-Lead for tachometer readings, disable TTD overspeed and underspeed faults, or false shutdowns may occur caused by diagnostic signals sent by EICS on the G-Lead/U-Lead.

## Setup 9 – Communication Settings

---



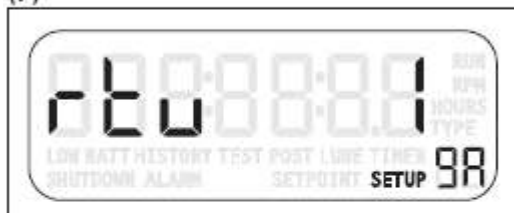
EDITING DURING RUN MODE ALLOWED

(E)



(E) Use SETUP 9 to select ports, characteristics and communication values for remote devices. Use the [UP ARROW] and/or [DOWN ARROW] to reach setting.

(F)



(F) This is the RTU (Remote Terminal Unit) setting. The range is 1 to 99 (Node number).

(G)



(G) This is the Port selection. There are two choices:

0 – RS485

1 – RS232

(H)



(H) This is the Baud rate selection. There are five choices:

0 - 9600,N,8,1

1 - 9600,N,8,2

2 - 19200,N,8,1

3 - 19200,N,8,2

4 - 38400,N,8,1 (only if the pulses/rev setting is greater than 16.5)

5 - 38400,N,8,2 (only if the pulses/rev setting is greater than 16.5)

# Setup A – Output Mode

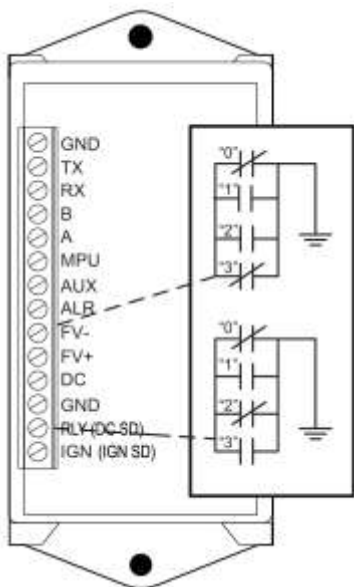


PASSWORD PROTECTED



Upon Shutdown, the FV- (Fuel Valve minus) and the RLY (Relay) terminals change state and either conduct to ground or open to ground. The change of state depends on the configuration of SETUP A.

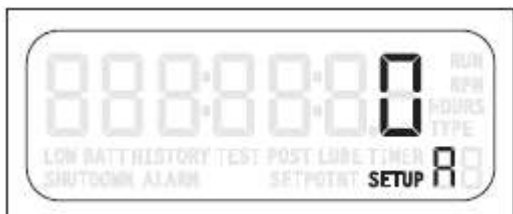
There are four choices (terminals are shown in shut-down state):



Shutdown Mode					
Output Mode	IGN Kill	RELAY	FV-	ALR	AUX
0	Closed	Closed	Closed	Closed - alarm event Open - no event	Open
1	Open*	Open	Open	Closed - alarm event Open - no event	Open
2	Closed	Closed	Open	Closed - alarm event Open - no event	Open
3	Open*	Open	Closed	Closed - alarm event Open - no event	Open

**Table Note:** Closed indicates a closed-to-ground state and open indicates an open-to-ground state when the TTD unit is in Shutdown Mode.

**Open\*** -- These outputs do not change state during a run mode — they remain open. Typically used with IGN as a speed input only and the application does not require grounding ignition on a unit fault.



Use the [UP ARROW] or [DOWN ARROW] key to select the Output Mode setting. Press [ENTER] to save the setting.



## Setup B – Unit Identification (ID)

---



EDITING DURING RUN MODE ALLOWED

(L)



(L) This function enables the operator to assign a six-digit number.

Use the [UP ARROW] arrow key to increment to the SETUP B option.

(M)



(M) Press [SETUP/ENTER] to access the Prefix screen and the [UP ARROW] or [DOWN ARROW] keys to set the Prefix ID. The Range is 0 to 99.

Press [ENTER] to save the selection and the (N) Suffix ID screen displays. Use the [UP ARROW] or [DOWN ARROW] keys to set the Suffix ID. The range is 0 to 9999.

(N)



## Setup C – Factory Default



PASSWORD PROTECTED

(A)



(A) This option returns all settings except the Product Life Time register back to the default Factory settings.

Use these instructions to return the TTD unit to the original factory defaults:

1. Enter the correct numeric password. (B)
2. Use the [UP ARROW] key to set the value to 1 (C).
3. Press the [SETUP/ENTER] key to save the change. The screen display returns to SETUP C.
4. Press the [DOWN ARROW] to reach SETUP 0.
5. Press [ENTER]

(C)



6. The EEPR screen displays to verify the factory defaults have been reinstated. (D)

**CAUTION:** Executing SETUP C resets all settings, registers and hours. Shut-down and alarm histories will also be erased.

(D)



## Voltage Readings

---

(E)



(E) The internal backup battery, external DC and ignition voltage readings are available in the VOLT menu after SETUP C. These readings are updated approximately every 4 seconds and are read-only.

Press the [ENTER] key to view each of the readings:

(F)



### - Internal Backup Battery voltage (F)

Press the [ENTER] key to set the Internal Backup Battery **Low Voltage Alarm**. Press the up/down arrow keys to enable (1), to disable return to 0. Press [ENTER].

(G)



### - External DC (G)

Press the [ENTER] key to set the External DC **Low Voltage Alarm**. Press the up/down arrow keys to the desired voltage. Press [ENTER].

(H)



### - Ignition Voltage peak (H)

If the ignition is wired to the TTD unit.

If Internal Backup Battery, External DC and CD Ignition are connected and operational, power for the TTD Annunciator has the following priority:

1. External DC is used unless voltage falls below 9VDC.
2. CD Ignition is used unless peak voltage falls below 90VDC.
3. Internal Backup Battery is used when no other voltage is present.

**NOTE:** The TTD Annunciator will operate normally under Internal Backup Battery power except communication functions and backlight will be disabled.

If Underspeed and/or Loss of Ignition are enabled, the TTD may shut down when CD Ignition is not present. The tolerance for CD Ignition detection is  $\pm 10\%$ .

# Software Version

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The Version menu (I) offers a quick and easy way to check the firmware versions in the TTD components.

To verify the current firmware, press [ENTER] to access the Version SETUP H or SETUP P. Press [ENTER] the first time to view SETUP H. Pressing [ENTER] a second time reaches SETUP P.



SETUP H indicates the software version in the Display Head. In this sample (J), the version is 8.0. (Read 8 point 0)

SETUP P indicates the software version in the Power Supply. In this sample (K), the version is 8.2. (Read 8 point 2)



## Communications

### Communications Port

---

A single bi-color (GREEN/RED) LED will be provided to give visual indication of active transmit and receive traffic.

**Interface:** Factory configured for RS485; field-selectable for RS232 or RS485

**Baud/Configuration:** 9600, 19.2K, 38.4K (\*); N,8,1;N,8,2 half-duplex communication (set-up configuration is in SETUP 9)

**Protocol:** Modbus RTU Slave (\*)

*(\*) The TTD responds to Modbus RTU Read Holding Registers request (Function Code 03). Reads can be up to 50 registers per request. An attempt to read over 50 will return an exception code. When the TTD is on the same RS485 network with other devices, a minimum 125mS poll delay must be used between each device on the network or time outs will occur from the TTD. The Modbus RTU master should be configured to use retries on the TTD, and typical timeout setting for the TTD should be 500mS or greater.*

**Connection:** There will be 2 screw terminals provided for RS485.

These will be printed or labeled as A and B. A is the non-inverting (+) signal. B is the inverting (-) signal.

There will be 3 screw terminals provided for RS232.

These will be printed or labeled as RX, TX and GND. RX is the receive signal, TX is the transmit signal and GND is the signal ground reference.

*(\*) 38.4K Baud will not be available when IGN input is selected as the source for RPM calculations. When MPU is selected, this feature is available for selection.*

## Modbus Register Address Listings

Address	Description	Type	Min Value	Max. Value	Default Value
40,001	RPM	R	-	-	-
40,002	ETM (Elapsed Time Meter 0-65535 Hrs.) (*)	R	-	-	-
40,003	Class B1 Timer (secs.)	R	-	-	-
40,004	Shutdown Code	R	-	-	-
40,005	Output Status Bit Map Bit 0 – Ignition (1 ground, 0 ungrounded) Bit 1 – Fuel Valve (1 ground, 0 ungrounded) Bit 2 – Alarm (1 ground, 0 ungrounded) Bit 3 – Pre/Post Lube (1 ground, 0 ungrounded) Bits 4, 5, 6 and 7 – N/A	R	-	-	-
40,006	Inputs 1-16 Status Bit Map	R	-	-	-
40,007	Inputs 17-32 Status Bit Map	R	-	-	-
40,008	Inputs 33-48 Status Bit Map R	R	-	-	-
40,009	Class B2 Timer (secs.)	R	-	-	-
40,010	Test Timer (secs.)	R	-	-	-
40,011	Ignition Ground Timer (secs.)	R	-	-	-
40,012	PreLube Timer (secs.)	R	-	-	-
40,013	PostLube Timer (secs.)	R	-	-	-
40,014	No-Flow Timer (secs.)	R	-	-	-
40,015	TTD-H SPI (diagnostic use only)	R	-	-	-
40,016	PS-TTDL Sync. Flag	R	-	-	-
40,017	TTD-P SPI (diagnostic use only)	R	-	-	-
40,018	Battery Voltage x10	R	-	-	-
40,019	External DC Voltage x10	R	-	-	-
40,020	Ignition Voltage x10	R	-	-	-
40,021	B1 Timer Setting (TMR1)	R/W**	0	300	300
40,022	B2 Timer Setting (TMR2)	R/W**	0	599	599
40,023	Ignition Timer Setting (TMR4)	R/W**	0	20	3
40,024	PreLube Timer Setting (TMR5)	R/W**	0	300	300
40,025	PostLube Timer Setting (TMR6)	R/W**	0	599	599
40,026	Sensor Mode Setting	R/W*	0	40	1
40,027	Input Type #01	R/W*	0	10	0
40,028	Input Type #02	R/W*	0	10	0
40,029	Input Type #03	R/W*	0	10	0
40,030	Input Type #04	R/W*	0	10	0
40,031	Input Type #05	R/W*	0	10	0
40,032	Input Type #06	R/W*	0	10	0
40,033	Input Type #07	R/W*	0	10	0
40,034	Input Type #08	R/W*	0	10	0

(\*) Hours greater than 65535 will rollover to 0. This is a 16-bit limit of the register; however, the TTD supports up to 99,999 hours.

\* Only accept Modbus write register(s) during Shutdown Mode.

\*\* Accept Modbus write register(s) during Run and Shutdown Modes.

## Modbus Register Address Listings (continued)

Address	Description	Type	Min Value	Max. Value	Default Value
40,035	Input Type #09	R/W*	0	10	0
40,036	Input Type #10	R/W*	0	10	0
40,037	Input Type #11	R/W*	0	10	0
40,038	Input Type #12	R/W*	0	10	0
40,039	Input Type #13	R/W*	0	10	0
40,040	Input Type #14	R/W*	0	10	0
40,041	Input Type #15	R/W*	0	10	0
40,042	Input Type #16	R/W*	0	10	0
40,043	Input Type #17	R/W*	0	10	0
40,044	Input Type #18	R/W*	0	10	0
40,045	Input Type #19	R/W*	0	10	0
40,046	Input Type #20	R/W*	0	10	0
40,047	Input Type #21	R/W*	0	10	0
40,048	Input Type #22	R/W*	0	10	0
40,049	Input Type #23	R/W*	0	10	0
40,050	Input Type #24	R/W*	0	10	0
40,051	Input Type #25	R/W*	0	10	0
40,052	Input Type #26	R/W*	0	10	0
40,053	Input Type #27	R/W*	0	10	0
40,054	Input Type #28	R/W*	0	10	0
40,055	Input Type #29	R/W*	0	10	0
40,056	Input Type #30	R/W*	0	10	0
40,057	Input Type #31	R/W*	0	10	0
40,058	Input Type #32	R/W*	0	10	0
40,059	Input Type #33	R/W*	0	10	0
40,060	Input Type #34	R/W*	0	10	0
40,061	Input Type #35	R/W*	0	10	0
40,062	Input Type #36	R/W*	0	10	0
40,063	Input Type #37	R/W*	0	10	0
40,064	Input Type #38	R/W*	0	10	0
40,065	Input Type #39	R/W*	0	10	0
40,066	Input Type #40	R/W*	0	10	0
40,067	Input Type #41	R/W*	0	10	0
40,068	Input Type #42	R/W*	0	10	0
40,069	Input Type #43	R/W*	0	10	0
40,070	Input Type #44	R/W*	0	10	0
40,071	Input Type #45	R/W*	0	10	0
40,072	Input Type #46	R/W*	0	10	0
40,073	Input Type #47	R/W*	0	10	0
40,074	Input Type #48	R/W*	0	10	0
40,075	Remote Reset / Remote Lockout Setting	R/W*	0	3	0
40,076	Hours Setting	R/W*	0	65535(*)	0
40,077	Pulses Per Revolution Setting x10	R/W*	5	4500	60
40,078	RPM Filter/Loss of Ignition Setting	R/W*	0	3***	0
40,079	Overspeed Setting	R/W**	0	5000	1000
40,080	Underspeed Setting	R/W**	0	5000	100
40,081	Output Mode Setting	R/W*	0	3	0
40,082	ID- Prefix	R/W**	0	99	0
40,083	ID- Suffix	R/W**	0	9999	0
40,084	Password	R/W**	0	99	-

(\*) Hours greater than 65535 will rollover to 0. This is a 16-bit limit of the register; however, the TTD supports up to 99,999 hours.

\* Only accept Modbus write register(s) during Shutdown Mode.

\*\* Accept Modbus write register(s) during Run and Shutdown Modes.

\*\*\* Range is 0 to 1 for non-Tachometer models. (See SETUP 6 - SPEED CALIBRATION section for details).

## Modbus Register Address Listings (continued)

Address	Description	Type	Min Value	Max. Value	Default Value
40,085	Test Timer Setting (TMR3)	R/W**	-0	300	300
40,086	Life Timer	R	-	-	-
40,087	TTD-H Firmware x10	R	-	-	-
40,088	PSU-X Firmware x10	R	-	-	-
40,089	PSU Type 120 - Base Model + No Flow 121 - Base Model + Tach + No Flow 122 - Base Model + Lube + No Flow 123 - Base Model + Tach + Lube + No Flow 124 - Base Model 125 - Base Model + Tach 126 - Base Model + Lube 127 - Base Model + Tach + Lube	R	-	-	-
40,090	OSC Calibration	R	-	-	-
40,091	PSU Power-up (PUR or WDT)	R	-	-	-
40,092	PSU Update History Shutdown Data	R	-	-	-
40,093	No-Flow Timer Setting (TMR7)	R/W**	0	599	0
40,094	CH41 TON/TOFF	R/W*	0	59	0
40,095	CH42 TON/TOFF	R/W*	0	59	0
40,096	CH43 TON/TOFF	R/W*	0	59	0
40,097	CH44 TON/TOFF	R/W*	0	59	0
40,098	Low DC Voltage Alarm	R/W**	0	32	0
40,099	Low Backup Battery Alarm	R/W**	0	1	0
40,100	N/A	R	-	-	-
40,101	SD History #1	R	-	-	0
40,102	ETM @ SD1	R	-	-	0
40,103	SD History #2	R	-	-	0
40,104	ETM @ SD2	R	-	-	0
40,105	SD History #3	R	-	-	0
40,106	ETM @ SD3	R	-	-	0
40,107	SD History #4	R	-	-	0
40,108	ETM @ SD4	R	-	-	0
40,109	SD History #5	R	-	-	0
40,110	ETM @ SD5	R	-	-	0
40,111	SD History #6	R	-	-	0
40,112	ETM @ SD6	R	-	-	0
40,113	SD History #7	R	-	-	0
40,114	ETM @ SD7	R	-	-	0
40,115	SD History #8	R	-	-	0
40,116	ETM @ SD8	R	-	-	0
40,117	SD History #9	R	-	-	0
40,118	ETM @ SD9	R	-	-	0
40,119	SD History #10	R	-	-	0
40,120	ETM @ SD10	R	-	-	0
40,121	Alarm History #1	R	-	-	0
40,122	ETM @ AL1	R	-	-	0
40,123	Alarm History #2	R	-	-	0
40,124	ETM @ AL2	R	-	-	0
40,125	Alarm History #3	R	-	-	0
40,126	ETM @ AL3	R	-	-	0
40,127	Alarm History #4	R	-	-	0
40,128	ETM @ AL4	R	-	-	0

\* Only accept Modbus write register(s) during Shutdown Mode.

\*\* Accept Modbus write register(s) during Run and Shutdown Modes.

\*\*\* Range is 0 to 1 for non-Tachometer models. (See SETUP 6 - SPEED CALIBRATION section for details).



## Specifications

### Power Requirements

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**PSU-2:** 10-32VDC, 10W (max); 90-400VDC CD Ignition, 750uA @ 100VDC (max)

**On-Board Backup Power:** Lithium battery, 6 VDC, 1300 mAh

**Digital Inputs:** 48 (a.k.a. Channels)

**Sensor Types:** Discrete Input, N.O. / N.C., non-incendive (with use of PSU-2)

### Magnetic Pickup Input

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**One Magnetic Pickup Sensor Input:** 3.6 - 120 VAC, 2-10 kHz

### Outputs

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**IGN:** 0.4A @ 400VDC (\*) for 5 seconds

**RLY:** 0.5A @ 48VDC cont. duty

0.15A @ 400VDC (\*) cont. duty

**FV- :** 0.5A @ 400VDC (\*) cont. duty

**ALR:** 0.5A @ 48VDC cont. duty

**AUX:** 0.5A @ 48VDC cont. duty

(\*) CSA approval for 250VDC maximum

### Operator Interface

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**Display Type:** LCD, Static, 80 segment, custom text with LED Backlight

**Display Viewable Area:** ~ 2.79 x 1 in. (71.04mm x 25.4mm)

**Display Contrast:** Automatic

**Display Backlight:** Yellow (Normal Operation), Red (Shutdown)

(Backlight will only be available when unit is powered by DC or AC.)

**Voltage Level Monitor:** Monitor and display voltage level of DC Supply, CD Ignition and internal battery

**Keypad:** 6 switches: Ridge Embossed, Metal Dome, Tactile 14 Oz. Trip Force

**Enclosure Cutout:** 5.50 x 5.50 inches (133 mm)

**Operating Temperature:** -40 to +85 degrees C

**Viewable Temperature:** -40 to +85 degrees C

**Storage Temperature:** -40 to +85 degrees C

**Tachometer Accuracy:**  $\pm 0.5\%$  of the display reading or  $\pm 1$  RPM, whichever is greater

**Resetable Hourmeter Range:** 0 to 99999 hrs.

**Non-Resetable Hourmeter Range:** 0 to 99999 hrs.

**Hourmeter Accuracy:**  $\pm 1$  hour per year

## Specifications (continued)

### Communication Port

---

A single bi-color (GREEN/RED) LED is provided to give visual indication of active transmit and receive traffic

**Interface:** Factory configured for RS485; field-selectable for RS232 or RS485

**Baud/Configuration:** 9600, 19.2K, 38.4K (\*\*); N, 8, 1; N, 8, 2 half-duplex communication

**Protocol:** Modbus RTU slave

**Connection:** There will be 2 screw terminals provided for RS485

There will be 2 screw terminals provided for RS232

There will be 1 screw terminal common for both ports labeled as GND

*(\*\*) 38.4K baud will not be available when IGN input is selected as the source for RPM calculations. When MPU is selected, this feature is available for selection*

### Third Party Approvals

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**TTD-H, PSU-2:** CSA Class I, Division 2, Groups B, C, and D

**TTD-H:** IEC 60529 – IP66 (NEMA 4 and 4X equivalent)

### Intuitive Display Icons

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Display status and assist in setup and operation resulting in greater ease of operation and interface. The appropriate icon will turn on to indicate unit status or navigation through the set-up features.

**RUN** - Run mode

**RPM** – Screen Value

**HOURS** – Screen Value

**TYPE** – Channel Type Configuration

**LOW BATT** – Low Battery Warning (displayed only when condition exists)

**HISTORY** – Shutdown History

**TEST** – Test Mode

**LUBE** – Pre-lubrication Timer

**POSTLUBE** – Post-lubrication Timer

**SHUTDOWN** – Stop Mode

**ALARM** – Alarm(s) Warning (displayed only when condition exists)

**SETPOINT** – Edit Set-point Value

**SETUP** – Setup Menu(s)

## TTD Replacement Parts and Assemblies

Part Number	Description	Notes
50700597	TTD-H Display Head	Replacement Parts and Assemblies
50700596	PSU-2 Div 2 Power Supply	
50700594	PSU-2-T Div 2 Power Supply w/ Tach	
50700944	PSU-2-L-N Div 2 Power Supply w/Pre/Post Lube and No-Flow	
50700942	PSU-2-T-L-N Div 2 Power Supply w/ Tach, Pre/Post Lube and No-Flow	
00005125	Backup Lithium Battery, 6VCD, 1200mAh	
50000774	Ignition Choke Filter	
00009741	TTD-H Plug Kit, Printed Replacement Terminal Plugs for TTD-H Sensor Inputs	
00009768	PSU-2-Plug, Printed Replacement Plug for PSU-2 Power Connector	Configuration Software
53702325	RS485 toUSB Interface Kit (53702325): To configure TTD using Mconfig™ software and PC over USB port	

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SAN ANTONIO, TX 78249

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FM 28221 (Tulsa, OK - USA)  
FM 620667 (San Antonio, TX - USA)  
FM 28221 (Rosenberg, TX - USA)  
FM 29422 (UK)



FM 523851 (China) TS 589322 (China)

# 2" and 2.5" Pressure Switchgauge® 20 and 25 Series

The 20 Series (2 inch/51 mm dial) and the 25 Series (2-1/2 inch/64 mm dial) Switchgauge models are diaphragm-actuated, pressure-indicating gages with built-in electrical switches. These switches exceed SAE standards and are used for tripping alarms and/or shutdown devices.

Ranges are available from 0-15 psi (103 kPa) [1.0 bar] through 0-400 psi (2.8 MPa) [28 bar].

The gage mechanism is enclosed in a steel case coated to resist corrosion. A polycarbonate, break-resistant lens and a polished, stainless steel bezel help protect this rugged, built-to-last instrument. Accuracy and protection from moderate overpressure is assured by a unique, unitized diaphragm chamber. A built-in pulsation dampener helps eliminate pointer flutter and is removable for cleaning. For models 20P and 25P, the gage pointer acts as a pressure indicator and as one switch pole which completes a circuit when it touches the adjustable limit contact. Contacts are grounded through the case and have self-cleaning motion to ensure electrical continuity.

Models 20PE and 25PE have internal snap-acting SPDT switches.

Gage-only models, without the switches (Murphygage®) are also available.

The Switchgauge was specifically designed to protect engines/equipment in oil field, marine, irrigation, construction and trucking applications to monitor engine lube pressure, water pump pressure, hydraulic pressure, air pressure, etc.

## Base Models

### 20P and 25P Series Switchgauge

The gage pointer makes with an adjustable contact to complete a pilot-duty circuit.

### 20PE and 25PE Switchgauge

20PE (was 20EO) and 25PE (was 25EO)

Features internal snap-acting SPDT switches, instead of the single pole/pointer contacts. When the switch closes on falling pressure, it becomes set, as pressure rises the switch resets.

### 20PABS and 25PABS Switchgauge

Same as 20P and 25P with internal SPDT snap-switch for pre-alarm.

### 20P7 and 25P7 Lockout Switchgauge

Same as 20P and 25P Series. They also include a front, semi-automatic lockout for startup override. This built-in device holds the pointer away from the contact on startup. When pressure exceeds the set point, the lockout is automatically disengaged (see following pages for details).

### 20PG and 25PG Murphygage

Gage without contact(s)



Products covered in this bulletin comply with EMC Council directive 89/336/EEC regarding electromagnetic compatibility except as noted.

## Specifications

**Dial:** White on black, dual scale; U.S.A. standard scale is psi/kPa; U.K. standard scale is psi/bar; others available (see How to Order).

**Case:** Plated steel; mounting clamp included (except for direct mount models)

**Bezel:** Polished stainless steel, standard; others are available.

**Lens:** Polycarbonate, high-impact

**Oil:** Silicon Oil

#### Temperature Range:

Ambient: -40° to 150° F (-40° to 66° C)

Process: -40° to 250° F (-40° to 121° C)

**Process Connection:** 1/8-27 NPTM brass

**Sensing Element:** Beryllium copper diaphragm

**Gage Accuracy (% of Full Scale):**

Range	Lower 1/4	Middle 1/2	Upper 1/4
≤300 psi (20 Bar)	±3%	±2%	±3%
400psi (28 Bar)	±3%	±3%	±5%

**Maximum Pressure:** See Pressure Ranges and Factory Settings table next page

**Adjustable Limit Contact (20P and 25P):** SPST contact; pilot-duty only, 2 A @ 30 VAC/DC; Normally Close (NC) when the low limit is met. Normally Open (NO) when pointer is in normal operating range. Contacts are gold flashed silver.

**Limit Contact Adjustment:** By a 1/16 in. hex wrench through 100% of the scale

**Limit Contact Wire Leads:** 18 AWG (1.0 mm2) x 12 in. (305 mm)

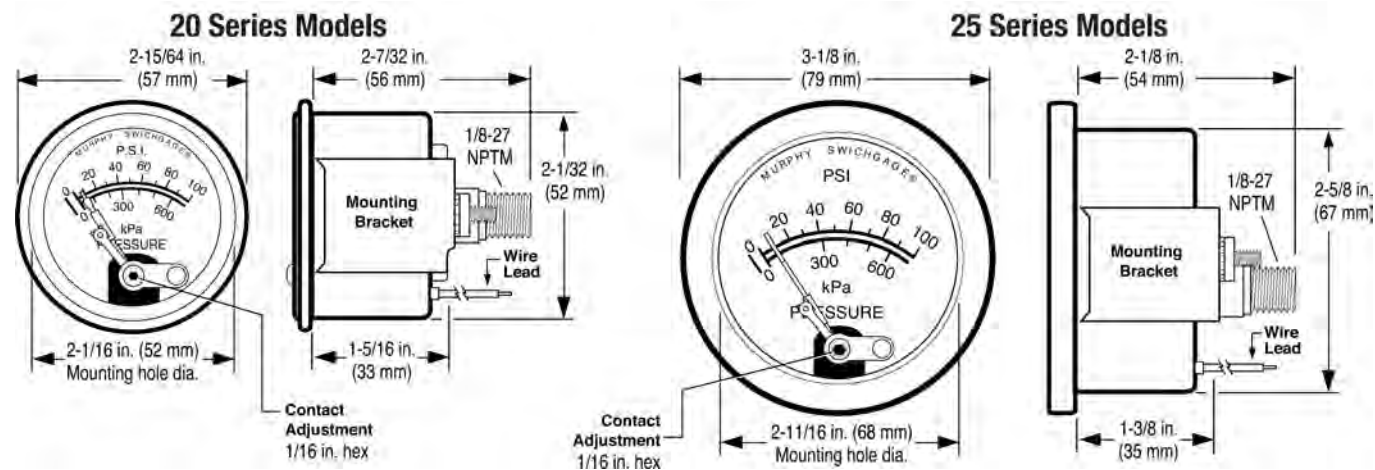
**Snap-Switch Rating (20PE and 25PE):** SPDT, 3 A @ 30 VDC inductive; 4 A @ 125 VAC inductive

**Snap-Switch Wire Leads:** 20 AWG (0.75 mm2) x 12 in. (305 mm)

**Unit Weight:** 20 Series: 8 oz. (0.23 kg); 25 Series Models: 11 oz. (0.31 kg)

**Unit Dimensions:** 20 Series: 3 x 3 x 3 in. (76 x 76 x 76 mm); 25 Series Models: 4-3/4 x 4-3/4 x 2-3/4 in. (121 x 121 x 70 mm)

## Dimensions

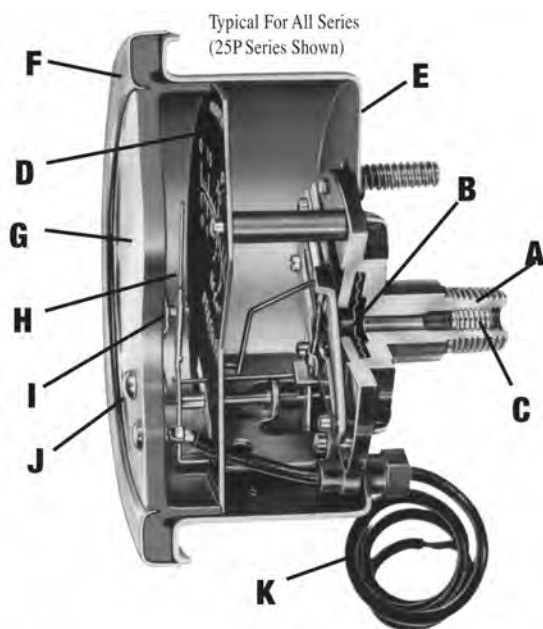


## Pressure Ranges and Factory Settings

Ranges Available psi (kPa) [bar]	Maximum Pressure	Standard Settings			High Settings			20PABS and 25PABS Settings Low			Alarm		
		psi	(kPa)	[bar]	psi	(kPa)	[bar]	psi	(kPa)	[bar]	psi	(kPa)	[bar]
0-15 (103) [1.0]	2 x scale	3	(21)	[0.2]	12	(83)	[0.8]	3	(21)	[0.2]	6	(41)	[0.3]
0-30 (103) [1.0]	2 x scale	7	(48)	[0.4]	24	(165)	[1.6]	7	(48)	[0.4]	10	(69)	[0.6]
0-50 (345) [3.5]	2 x scale	10	(69)	[0.8]	40	(276)	[2.8]	10	(69)	[0.8]	13	(90)	[1.0]
0-75 (517) [5.0]	2 x scale	15	(103)	[1.0]	60	(414)	[4.0]	15	(103)	[1.0]	18	(124)	[1.5]
0-100 (690) [7.0]	2 x scale	20	(138)	[1.5]	80	(552)	[5.5]	20	(138)	[1.0]	23	(159)	[1.5]
0-150 (1.0 MPa) [10]	2 x scale	30	(207)	[2.0]	120	(827)	[8.0]	30	(207)	[1.5]	33	(228)	[2.0]
0-200 (1.4 MPa) [14]	2 x scale	50	(345)	[3.0]	150	(1 MPa)	[10]	50	(345)	[3.0]	53	(365)	[4.0]
0-300 (2.1 MPa) [20]	1-2/3 x scale	75	(517)	[5.0]	225	(1.6 MPa)	[15]	75	(517)	[5.0]	78	(538)	[5.0]
0-400 (2.8 MPa) [28]	1-1/4 x scale	150	(1.0 MPa)	[7.0]	300	(2.1 MPa)	[20]	75	(517)	[5.0]	150	(1 MPa)	[10]

## Features

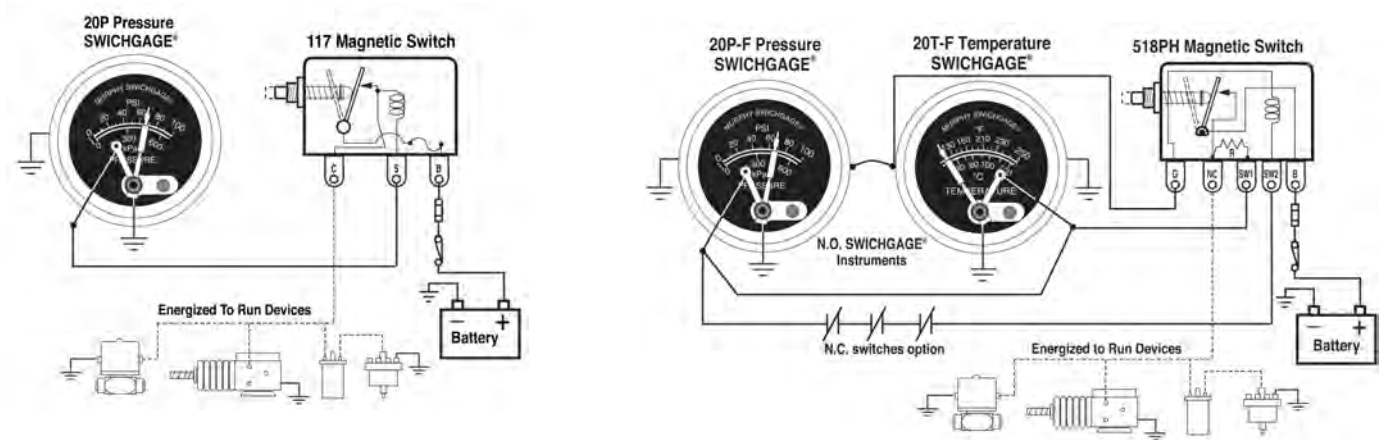
- A. Process Connection and Port:** Machined from brass bar stock; together with the diaphragm forms the diaphragm chamber.
- B. Diaphragm:** Beryllium copper; material is die formed and heat treated to very close physical and metallurgical specifications.
- C. Pulsation Dampener:** Designed to minimize undesirable pointer chatter. It is removable for cleaning.
- D. Dial:** White letters on a black background, dual scale (psi & kPa) standard; others available on request (see How to Order).
- E. Case:** Steel with zinc and iridite; mounting clamp included (except for direct mount models).
- F. Bezel:** Polished stainless steel standard, black bezel also available
- G. Lens:** Made of polycarbonate glass, high-impact treated
- H. Pointer:** Tempered nickel silver for continuity and corrosion resistance. It is mounted on a machined brass post.
- I. Limit Contact:** SPST contact; N.C. when low limit is met. N.O. when pointer operates above limit.
- J. Limit Contact Adjustment:** By 1/16 in. hex type wrench through 100% of the scale. Easy adjustment knob available.
- K. Wire Leads:** 12 in. (305 mm) long, 18 AWG (1.0 mm<sup>2</sup>) for face-adjustable contacts. 20 AWG (0.75 mm<sup>2</sup>) for snap-switches models.



**Warranty** — A limited warranty on materials and workmanship is given with this Murphy product. A copy of the warranty may be viewed or printed by going to [www.fwmurphy.com/support/warranty.htm](http://www.fwmurphy.com/support/warranty.htm)

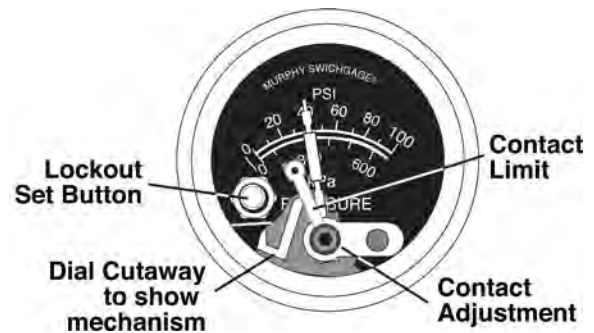
## Magnetic Switch

**INDUCTIVE AND HIGH CURRENT LOADS REQUIRE THE USE OF A MAGNETIC SWITCH.** The Switchgag contacts are for light-duty electrical switching to operate alarms or control devices. Enovation Controls manufactures the Magnetic Switch for protection of the light-duty Switchgag limit contacts. Tattletale® Magnetic Switches show the cause of shutdown for applications that include: capacitor discharge or magneto ignitions, battery systems and electric motor driven equipment. Typical wiring diagrams are shown.



## Start-Up Lockout (P7 Versions)

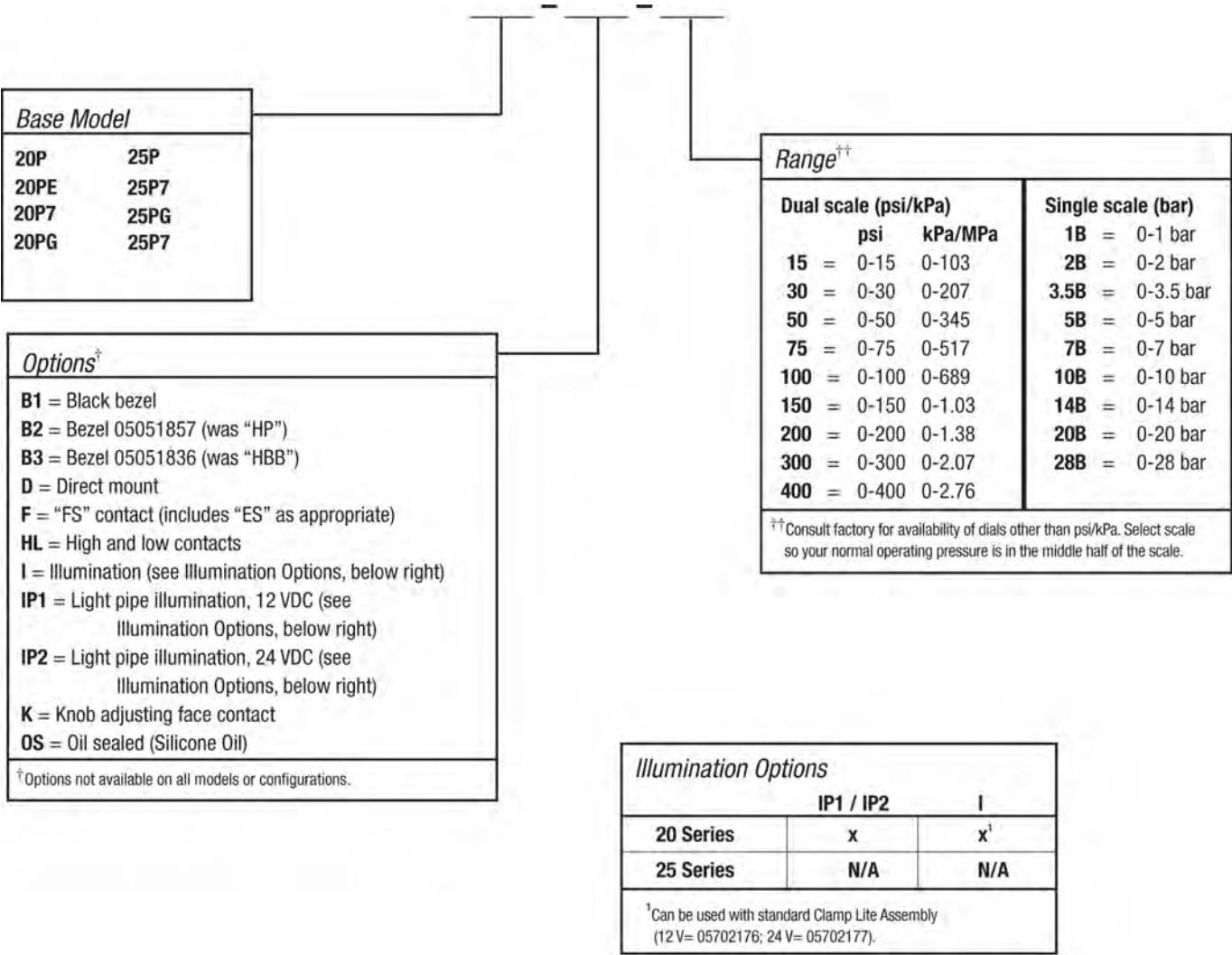
The Switchgag low limit contact can be bypassed on start-up by pushing this optional lockout button. It holds the pointer away from the shutdown contact while the engine starts. The lockout will disengage automatically on rising pressure.





# How to Order

Options listed below. All configurations may not be available. Call your sales representative or Enovation Controls for more information.





# 2" and 2.5" Differential Pressure Gage for Filter Restriction

## 20DP, 25DP, A20DP and A25DP Series

The 20DP and A20DP Series (2 inch/51 mm dial) and the 25DP and A25DP Series (2-1/2 inch/64 mm dial) Swichgage instruments are diaphragm-actuated, differential pressure-indicating gages with a built-in electrical switch. This switch is used for tripping alarms and/or shutting down equipment. These gages are intended to monitor and indicate oil, fuel or water filter restriction and can reduce the risk of dangerously high pressure which may rupture the filter, resulting in contaminants entering the system.

The 20DP and 25DP series mechanism is enclosed in a steel case coated to resist corrosion. The A20DP and A25DP series have a polycarbonate case and are sealed from the environment. All feature a polycarbonate, break-resistant lens and a polished, stainless steel bezel to help protect these rugged, built-to-last instruments.

The gage pointer acts as a pressure indicator and as one switch pole which completes a circuit when it touches the adjustable limit contact. Contacts have self-cleaning motion to ensure electrical continuity.

Additional features:

- Constant visual indication of the condition of your filter is shown on the dial.
- Two instruments in one with an accurate indicating gage and adjustable p.s.i.d. limit switch reduces inventory and installation time.
- Adjustable contact lets you set the monitoring range of the gage. The contact is tamper proof and can be set only with a 1/16 Allen-head wrench.
- All gages are made of durable materials allowing them to withstand rugged applications.
- Early filter changes cost you money and increase the risk of contaminants entering the system. A Murphy filter restriction Swichgage instrument will let you know when to change the filter and maintain peak efficiency.

### Base Models

#### 20DP, 25DP, A20DP and A25DP Swichgage instrument

The gage pointer makes with an adjustable contact to complete a pilot-duty circuit.

#### 20DPE, 25DPE, A20DPE and A25DPE Swichgage instrument

20DPE (was 20DPEO), 25DPE (was 25DPEO), A20DPE (was A20DPEO) and A25DPE (was A25DPEO).

Features an internal snap-acting SPDT switch, instead of the single pole/pointer contacts. When the switch closes on rising pressure, it becomes set, as pressure falls the switch resets. 20DPG, 25DPG, A20DPG and A25DPG Murphygage instrument gage without contact(s).



Products covered by this bulletin comply with EMC Council directive 89/336/EEC regarding electromagnetic compatibility except as noted.

### Specifications

**Dial:** White on black, dual scale; U.S.A. standard scale is psi/kPa. Other scales available

**Case:** 20DP and 25DP Series: plated steel. A20DP and A25DP Series: polycarbonate

**Bezel:** Polished stainless steel, standard; others are available.

**Lens:** Polycarbonate, high-impact

**Temperature Range:**

Ambient: -40° to 150° F (-40° to 66° C)

Process: -40° to 250° F (-40° to 121° C)

**Process Connection:** 1/8-27 NPTM brass

**Sensing Element:** Beryllium copper diaphragm

**Gage Accuracy:** ±3% maximum across scale

**Snap-Switch Rating (DPE models):** SPDT, 3 A @ 30 VDC inductive; 4 A @ 125 VAC inductive

**Adjustable Limit Contact:** SPST contact; pilot duty only, 2 A @ 30 VAC/DC; closed when the low limit is met, open when pointer is in normal operating range. Contacts are gold flashed silver.

Limit Contact Adjustment: by 1/16 in. hex wrench through 100% of scale.

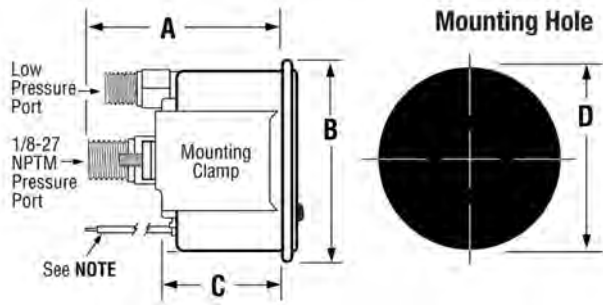
Limit Contact Wire Leads (20DP and 25DP Series): 18 AWG (1.0 mm<sup>2</sup>) x 12 in. (305 mm)

Limit Contact Terminals: A20DP Series #4 screw terminals. A25DP Series #6 screw terminals

**Unit Weight:** 20DP and A20DP Series: 9 oz. (0.25 kg); 25DP and A25DP Series: 11 oz. (0.29 kg)

**Unit Dimensions:** 20DP and A20DP Series: 3 x 2-3/4 x 2-3/4 in. (76 x 70 x 70 mm). 25DP and A25DP Series: 4-3/4 x 4-3/4 x 2-3/4 in. (121 x 121 x 70 mm)

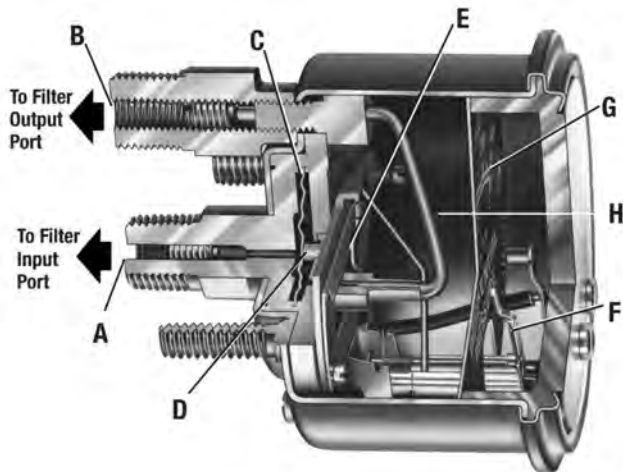
## Dimensions



	20P Series	A20DP Series	25DP Series	A25DP Series
A	2-7/32 (56)	2-9/64(54)	2-1/8 (54)	1-51/64 (46)
B	2-15/64 (57)	2-1/4 (57)	3-1/8 (79)	2-29/32 (74)
C	1-5/16 (33)	1-27/64 (36)	1-3/8 (35)	1-27/64 (36)
D	2-1/16 (53)	2-1/16 (53)	2-11/16 (68)	2-11/16 (68)

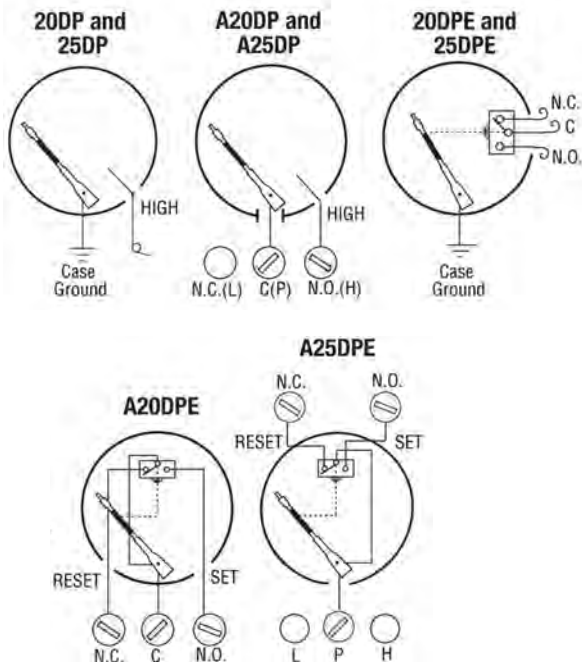
**Note:** 20 and 25 Series have 18 AWG (1.0 mm<sup>2</sup>) wire. A20 Series has #4 screw terminals, and A25 Series has #6 terminals. Dimensions are inches and (millimeters).

## Operating Characteristics



Port **A** connects to the input side of the filter. Pressure pushes diaphragm **C** forward thus pushing the button **D** which turns the crank arm **E** which in turn moves pointer **F** to register the amount of pressure on dial **G**. Port **B** connects to the outlet side of the filter. Pressure is exerted through tube **H** and pushes on the diaphragm thus applying pressure on both sides of the diaphragm. The pointer displays pressure in the amount that the input pressure is greater than the outlet pressure. As the filter is restricted by contaminants and the pressure difference reaches the critical point, the pointer touches the preset limit contact and shuts down the system or activates a visual or audible signal to alert the operator.

## Internal Wiring



## Ranges and Factory Settings

Ranges* Available	Max. Static Pressure	Max. Differential Pressure	Contact Setting
<b>0-15</b> (0-103) [0-1.0]	<b>50</b> (345) [3.4]	<b>30</b> (207) [2.0]	<b>10</b> (69) [0.8]
<b>0-30</b> (0-207) [0-2.0]	<b>150</b> (1.0) [10]	<b>60</b> (414) [4.0]	<b>20</b> (138) [1.0]
<b>0-50</b> (0-345) [0-3.5]	<b>300</b> (2.1) [20]	<b>100</b> (690) [7.0]	<b>30</b> (207) [2.0]
<b>0-75</b> (0-517) [0-5.0]	<b>300</b> (2.1) [20]	<b>150</b> (1.0) [10]	<b>50</b> (345) [3.5]
<b>0-100</b> (0-690) [0-7.0]	<b>300</b> (2.1) [20]	<b>200</b> (1.4) [14]	<b>60</b> (414) [4.0]

\* Values are shown in psi, (kPa/MPa) and [bar]. Values in kPa/MPa and bar are mathematical conversions from psi. They do not reflect actual second scale change.

## How to Order

Options listed at right. All configurations may not be available. Call your sales representative or Enovation Controls for more information.

<i>Base Model</i>		<i>Range<sup>††</sup></i>	
<b>20DP</b>	<b>25DP</b>	<b>15</b> = 0-15	
<b>A20DP</b>	<b>A25DP</b>	<b>30</b> = 0-30	
<b>20DPE</b>	<b>A25DPE</b>	<b>50</b> = 0-50	
<b>20DPG</b>	<b>25DPG</b>	<b>75</b> = 0-75	
	<b>A25DPG</b>	<b>100</b> = 0-100	
		<sup>††</sup> Select scale so your normal operating pressure is in the middle half of the scale.	

<i>Options<sup>*</sup></i>	
<b>B1</b> = Black bezel	<b>EX</b> = Explosion-proof
<b>B2</b> = Bezel 05051857 (was "HP")	<b>K</b> = Knob adjusting face contact
<b>B3</b> = Bezel 05051836 (was "HBB")	

<sup>††</sup>Options not available on all models or configurations.

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# Pressure Switchgauge® 45APE Series Instrument



## Features

- Combination Indicating Gage with Independent Low and High Snap-Acting Switches
- Field-Adjustable and Highly Visible Low and High Pressure Trip Point Indicators
- Dual-Sector Geared Movement Allows for Full-Scale Indication and Set Point Control
- Panel and Surface Mount Versions Available
- Latching Control Relay Versions Available

1 Listed for non-hazardous locations Pending for hazardous location.

The 45APE Series Switchgauge instrument is a mechanical gage for pressure indication. It includes 2 adjustable SPDT switches. These snap-acting switches can be used for start and stop, to trip alarms and to shut down equipment. Ranges are available from 30"vac (-100 kPa) [-1 bar] thru 10,000 psi (138 MPa) [1379 bar], see back page.

## Basic Operation

The 45APE Series utilizes a bourdon tube sensing unit with a stainless steel dual-sector geared movement. Each of the sectors drive separate pointers when pressure is applied to the bourdon tube. The indicating pointer (visible pointer) shows actual pressure reading, including below and beyond the low and high trip points. The low and high trip points are adjustable independently on the gage front lens. The switch operator pointer (behind the dial) is calibrated to follow the indicating pointer. The low and high trip point indicators "arrest" the switch operator pointer, and as pressure decreases or increases, through "the principal of lost motion" the respective snapswitch is tripped.

## Basic Models

**45APE Series Switchgauge instrument**  
Surface mount (square case) version.

**45APEF Series Switchgauge instrument**  
Panel mount (round case) version.

### 45APEBP Latching Control Relay Series

These models have a latching control relay for automatic ON/OFF control. They are designed to start and stop electric motor driven equipment.

### 45APEE and 45APEBPE

These models (square case) have the same features as the 45APE/45APEBP, but suitable for panel mounting.

## Applications

The 45APE Series models are widely used in applications requiring pressure indication and Form "C" low and high pressure switches.

## Specifications

**Dial:** White on black, dual scale, psi and kPa standard, 4-1/2 in. (114 mm) diameter.

**Case:** Die cast aluminum, surface or panel mount.

**Overrange:** Do not exceed 10% FS above full range.

**Process Connection:** 1/4 NPTM thru 1000 psi; 1/2 NPTM 1500 - 10,000 psi; back connection optional.

**Sensing Element:** Bronze or 316 stainless steel bourdon tube.

**Gage Accuracy:** Indicating pointer within switch points with hysteresis of <1%;  $\pm 2\%$  for first and last quarters of scale; middle half of scale is  $\pm 1\%$ .

Indicating pointer above or below trip point:

Range	Accuracy (+/-) above & below trip point only
< 100 (except 15 psi)	10
15	15
100-300	4
400-1000	2
1500-2000	12
3000-5000	8

Reading based on testing performed with switch point at mid scale which represents worst case. Switch accuracy  $\pm 1.5\%$ .

**Pressure Relief Disc:** Back of case (except EX models).

**Switch Reset Deadband:** Approximately 10% FS.

**Snap-Acting Switches:** 2-SPDT; 2 A @ 250 VAC.

**Dry Relay Contact ("BP" Models):** 10 A @ 28 VDC or 10 A @ 120 VAC.

**Wire Connections (Surface Mount):** 1/2 NPTF conduit/ terminal block.

**Wire Connections (Panel Mount):** Wire leads, 18 AWG (1.0 mm<sup>2</sup>) x 9 in. (229 mm) long.

**Wire Connections (-ES, -OS):** 1/2 NPTM conduit and wire leads, 24 AWG (0.22 mm<sup>2</sup>) x 30 in. (762 mm) long.

**Item Weight:** 5 lbs 6 oz (2.4 kg) approximately.

Explosion-proof models: 21 lb. (9.5 kg) approx.

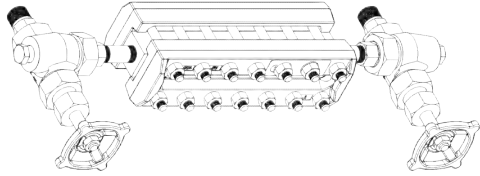
**Item Dimensions:** 10 x 9 x 6 in. (254 x 229 x 152 mm) approximately.

Explosion-proof models: 12 x 12 x 9 in (305 x 305 x 229 mm) approximately.

**CSA Certified Models:** 45APE Series models with pressure range thru 5000 psig (34.4 MPa) [344 bar] are CSA approved for Non-Hazardous locations, except options BC, ES, LC and OS. Explosion-proof "EX" models with pressure range thru 5000 psig (34.4 MPa) [344 bar] are CSA approved for Hazardous locations Class I, Groups, C & D. 45APEBP and 45APEBPE models are not CSA certified.







## JERGUSON GAGE GLASS REPAIR KITS

- JKR- \_\_\_\_\_
- S = Carllock IFG-5500 (Standard) Seal & Cushion Gaskets
  - T = Teflon Seal Gasket, IFG-5500 Cushion Gasket
  - G = Grafoil Seal Gasket, IFG-5500 Cushion Gasket
  - AG = Grafoil Seal & Cushion Gaskets
- Glass Size, 1 thru 9 (Applicable with below codes 0-4 only)  
Glass Size, 11, 12, 13, 15, 18, 20 (Applicable with codes 5 & 6 only)
- 0 = Reflex Borosilicate Glass
  - 1 = Transparent Borosilicate Glass
  - 2 = High Pressure Transparent Borosilicate Glass
  - 3 = Transparent Borosilicate Glass with Standard Mica Shields
  - 4 = High Pressure Transparent Borosilicate Glass with High Quality Mica Shields
  - 5 = Reflex Borosilicate Glass
  - 6 = Transparent Borosilicate Glass



\*Contained in Jerguson Gage Glass Repair Kits

## Rebuilding a Jerguson Level Gage

Note: A Jerguson level gage may be repaired while installed on a vessel. However, it is easier to perform the following steps in a workshop on an appropriate work table.

### Disassembly

1. Isolate gage from service, relieve internal pressure, and drain.
2. Remove the gage from the vessel (if conducting rebuild in a workshop).
3. Loosen end bolts first, then work towards center, alternating from top to bottom and following the sequence for tightening in reverse.
4. Remove glass, gaskets, cushions, and shields from assembly. Promptly dispose of all used components.
5. **NEVER REUSE GLASS, GASKETS, CUSHIONS, OR SHIELDS!**
6. Clean chamber gasket surface and cover cushion seating area. Remove all debris or residual gasket material.
7. Thoroughly inspect chamber gasket surface seating area. Remove any pitting damage, steam cuts, gouges, or scars on a milling machine. The minimum dimension shown in Figure A must be maintained.

### Reassembly

1. Place seal gasket in chamber seat and cushion gasket in cover seat. Do NOT lubricate gasket or cushion.
2. Locate the glass centrally in the chamber seat and cover to avoid glass-to-metal contact at the ends or sides. (This is best done with the gage lying flat on a bench.)  
*If the gage must be reassembled in the vertical position, use a small strip of gasket material as a spacer at each end of the glass. This will prevent any glass-to-metal contact.*
3. Inspect bolt and nut threads. If the nut cannot be **freely** spun down the length of the bolt threads, then the nut and/or bolt should be discarded. If nuts and bolts show signs of excessive corrosion, they should be discarded.
4. Apply Molykote or similar molybdenum disulfide lubricant to the bolt threads and nut seating surface.
5. If the gage includes an option for Belleville spring washers, reference Figure B for proper orientation of the washer stacks.
6. Tighten nuts finger-tight, working from the middle set, alternating outward (See Figure C). Next, tighten with a torque wrench in the same sequence in 5 ft.-lb. (6.7 N-m) increments. (See Figure D)
7. Note: New gaskets often become permanently compressed after a short time in service (especially if the gage operates hot). This causes slight leaks or apparent loosening of bolts. If the gage has not been provided with spring washers, isolate and relieve the gage and retorquing the original value after the gage has been in hot operation for 30 minutes.
8. For additional maintenance tips, refer to Jerguson bulletin J500.05.

### Notice to Plant Operators

The use of non-Original Equipment Manufacturer parts (such as glass, gaskets, etc.) will void the Agency Approval (FM, UL, CSA, CRN, ABS, etc.), pressure/temperature rating, and warranty of this equipment. Clark-Reliance requires the use of OEM parts for all repairs on this product in order to maintain plant and personnel safety, and reliable operation.

**“PARTS-PLUS”**  
Critical spare parts for  
overnight delivery, direct from  
the manufacturer.  
clark-reliance.com/parts

Figure A

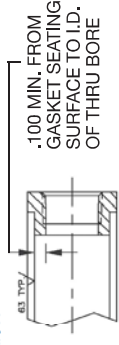
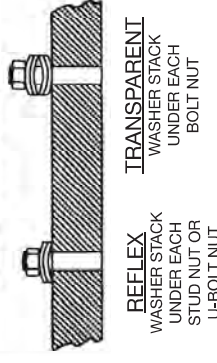


Figure B

### STACKING ORDER FOR BELLEVILLE WASHERS

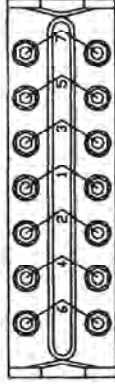


**REFLEX**  
WASHER STACK  
UNDER EACH  
STUD NUT OR  
U-BOLT NUT

**TRANSPARENT**  
WASHER STACK  
UNDER EACH  
BOLT NUT

Figure C

### SEQUENCE FOR TIGHTENING COVER BOLTS



ALWAYS START IN THE CENTER AND WORK OUT IN EACH DIRECTION. START WITH FINGER-TIGHT AND INCREASE IN 5 FT.-LB. INCREMENTS UNTIL REACHING THE FINAL TORQUE SETTING. (SEE BELOW)

Figure D

### PROCESS GAGES TORQUE DATA REFLEX AND TRANSPARENT GAGES

GAGE SERIES	FINAL TORQUE
L10	20 FT.-LBS. 27 N-m
12 (obsolete)	22 FT.-LBS. 30 N-m
300L	23 FT.-LBS. 31 N-m
18 (obsolete) & 20	32 FT.-LBS. 43 N-m
30 & 32	40 FT.-LBS. 54 N-m
40	80 FT.-LBS. 108 N-m

**TORQUE VALUES ARE THE SAME FOR ALL GASKET MATERIALS**

## JERGUSON® GAGE & VALVE

A PRODUCT OF CLARK-RELIANCE  
16633 Foltz Parkway • Strongsville, Ohio 44149, U.S.A.  
Telephone (440) 572-1500 • Fax (440) 238-8828  
[www.clark-reliance.com](http://www.clark-reliance.com)



## JERGUSON® WARRANTY

JERGUSON WILL ONLY WARRANT THE USE OF JERGUSON REPLACEMENT PARTS, WHICH CAN BE OBTAINED FROM THE REPRESENTATIVE OR MANUFACTURER, THE USE OF NONAUTHORIZED PARTS RESULTS IN A GAGE NOT TESTED OR RATED BY THE JERGUSON ENGINEERING GROUP. CATALOG RATINGS APPLY ONLY TO JERGUSON GAGES CONTAINING AUTHENTIC REPAIR PARTS.

# Installation for L1100, L1200, L1200N Series Liquid Level Switches and DVU150, DVU175, and DVU2105/2115/2120 Series Dump Valves.



Please read the following instructions before installing. A visual inspection for damage during shipping is recommended before mounting.

## GENERAL INFORMATION

### WARNING

BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT

- ✓ Disconnect all electrical power to the machine.
- ✓ Make sure the machine cannot operate during installation.
- ✓ Follow all safety warnings of the machine manufacturer.
- ✓ Read and follow all installation instructions.
- ✓ OBSERVE all pressure and electrical ratings and requirements for the devices and the operating environment.
- ✓ BE SURE all pressure HAS BEEN REMOVED from the vessel before opening any pressure connections.

### Description



**Series L1100 and L1200 Liquid Level Switches** are float activated to operate an electrical SPDT snap switch (optional DPDT on some models) for alarm or shutdown of an engine or electric motor. They screw directly into the wall of the vessel. Series L1200 can also be used with a weld collar or external float chamber.

**Series L1200N** is a float-activated, pneumatic-vent level device used to operate dump valves or similar devices. This model screws directly into the vessel or can be mounted via an external float chamber. It **cannot** be used with weld collar 15050375. Model variations include a dump valve operator with or without a filter/pressure regulator and indicating pressure gauge.

**NOTE:** All stainless steel versions of L1100, L1200, L1200N, L1200NDVO, and L1200NDVOR series carry Canadian Registration Number OF1476.2.

**Series DVU150, DVU175, DVU2105/2115/2120 Dump Valves** receive a pneumatic input signal to cause an orifice to open or close allowing liquid condensate to be drained from a pressure vessel. A pop up button indicates valve open/closed. Stainless steel versions available.

Specifications	L1100	L1111	L1200	L1200N	L1200NDVO	L1200NDVOR
<b>Body</b>						
• Standard: Electroless Nickel plated steel	X <sup>A</sup>	X <sup>A</sup>	X <sup>B</sup>	X <sup>B</sup>	X <sup>B</sup>	X <sup>B</sup>
• Optional: 316 Stainless Steel <sup>†</sup>	X <sup>A</sup>	X <sup>A</sup>	X <sup>B</sup>	X <sup>B</sup>	X <sup>B</sup>	X <sup>B</sup>
<b>Pressure Rating</b>						
• 15 psi (103 kPa) [1.03 bar] Polyethylene Float						
• 1500 psi (10.3 MPa) [103.42 bar] Stainless Float	X	X	X	X	X	X
• 2000 psi (13.8 MPa) [138 bar] BUOYGLAS <sup>™</sup> Float	X	X	X	X	X	X
<b>Temperature Rating</b>						
• Standard: -20/175°F (-29/79°C)						
• Standard: -20/300°F (-29/149°C)	X	X	X	X	X	X
• Optional: -20/400°F (-29/204°C)*	X		X	X	X	X
<b>Specific Gravity</b>						
• Standard: 0.5 with BUOYGLAS <sup>™</sup> float	X	X	X	X	X	X
• Optional: 0.65 with 304 Stainless Steel <sup>†</sup>	X		X	X	X	X
• Standard 0.73 Polyethylene Float						
<b>Electrical</b>						
• Standard SPDT: 5 A @ 125/480 VAC (see p. 3 for full ratings)	X	X	X			
• Optional DPDT: 10 A @ 250 VAC (see p. 3 for full ratings)	X	X	X			
<b>Wire:</b> 18 AWG x 36 in. (1.0 mm <sup>2</sup> x 914 mm)	X	X	X			
<b>O-Rings:</b> Viton	X	X	X	X	X	X
<b>Valve:</b> Two-way snap-action vent type						
• 1/8 in. (3 mm) orifice w/Viton "A" seat						
• 1/8 NPT inlet; 1/4 NPT vent				X	X	X
• 30-70 psi (207-483 kPa) [2.07-4.83 bar] operating pressure						
<b>Dump Valve Operator:</b> Operates Murphy DV Series dump valves or similar. 1/8 NPT inlet, outlet & vent.					X	X
<b>Pressure Regulator/Filter and Murphy 20BPG:</b> 0-75 psi (0-517 kPa) [0-5.17 bar] pressure gauge. Maximum input 300 psi (2.07 MPa) [20.68 bar]. 1/8 NPT in/out.						X
<b>Operation:</b> H=For high level, L=For low level	H	L	H	H	H	H

<sup>A</sup>=1-1/2 NPT

<sup>B</sup>=2 NPT

<sup>†</sup>Meets NACE standard MR-01-75 for direct exposure to H<sub>2</sub>S service.

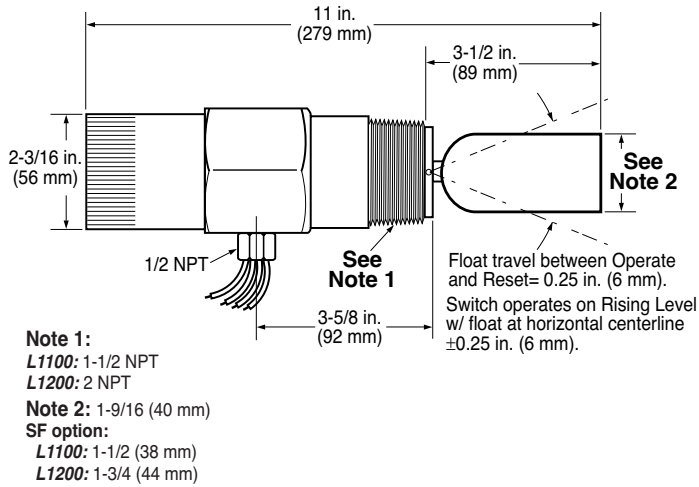
\*Not available with DPDT snap-switch.

\*\*Products covered by this literature comply with EMC Council directive 89/336/EEC regarding electromagnetic compatibility.

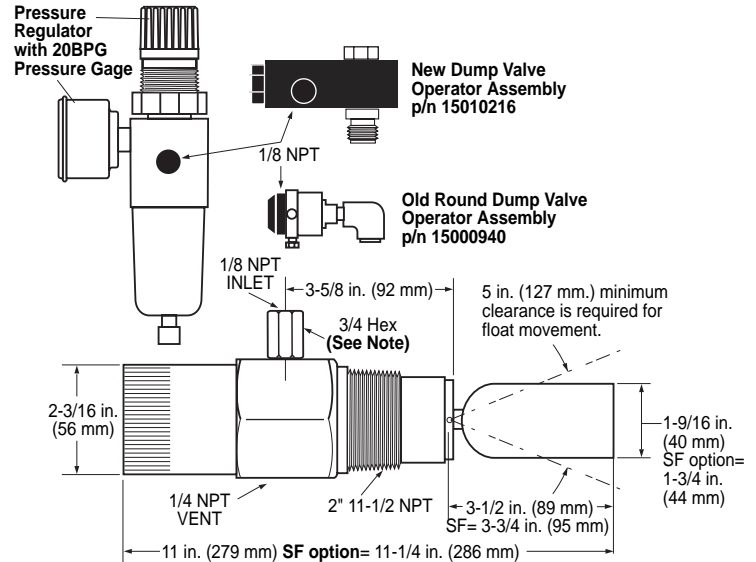


## DIMENSIONS

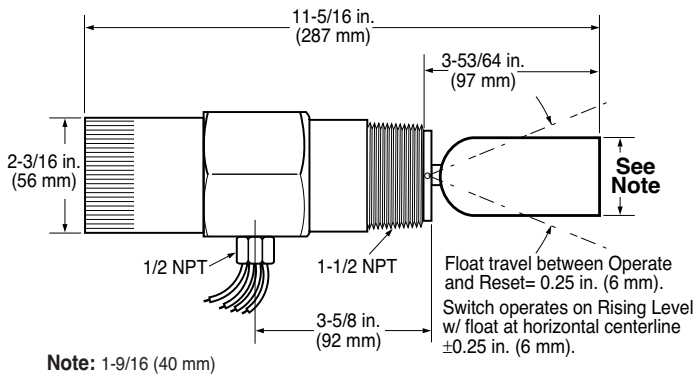
### L1100 and L1200



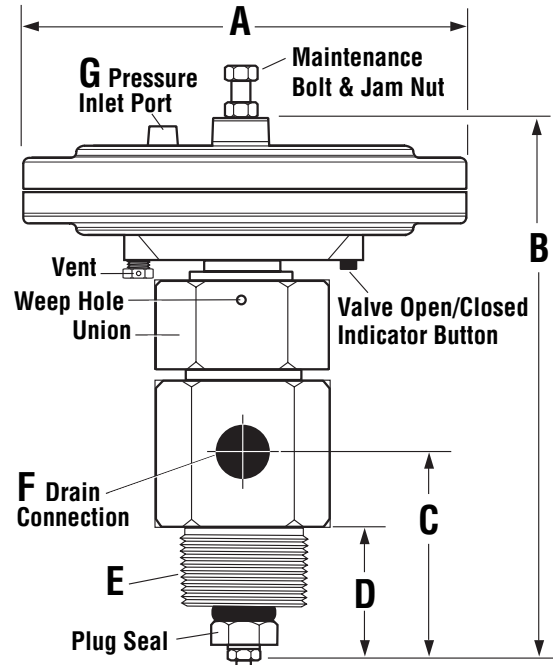
### L1200N, L1200NDVO and L1200NDVOR with Dump Valve Operator, Pressure Regulator and Gage



### L1111



### DVU150, DVU175, DVU2105/2115/2120 Series Dump Valves



	DVU150	DVU175	DVU2105	DVU2115	DVU2120
A	7.5 (191)	7.5 (191)	7.5 (191)	7.5 (191)	7.5 (191)
B	7.86 (200)	7.86 (200)	8.94 (227)	9.00 (229)	9.09 (231)
C	3.04 (77)	3.04 (77)	3.58 (91)	3.64 (92)	3.73 (95)
D	2.04 (52)	2.04 (52)	1.92 (49)	1.98 (50)	2.07 (53)
E	1-11.5 NPT	1-11.5 NPT	2-11.5 NPT	2-11.5 NPT	2-11.5 NPT
F	1/2-14 NPT	3/4-14 NPT	1-11.5 NPT	1-11.5 NPT	1-11.5 NPT
G	1/8-27 NPT	1/8-27 NPT	1/8-27 NPT	1/8-27 NPT	1/8-27 NPT

**NOTE:** Dimensions are in inches and (millimeters)

**Electrical installation to be done by qualified person according to the NEC.**

## REPLACING AND INSTALLING THE DVOA ASSEMBLY

When replacing/installing the old style DVO assembly with the new style (DVOA), tubing and fitting modifications are required. We suggest removing the L1200NDVO/DVOR from the vessel. Relieve pressure from the vessel or use block valves before removing the L1200NDVO/DVOR.

### Replacing and Installing the DVOA Assembly For Models L1200NDVO & L1200NDVOR

Tools Needed: Strap or pipe wrench; 3/4" Hex wrench; 9/16" hex wrench; needle nose pliers; tubing cutters and benders and the appropriate tools for the fittings.

1. Block off and bleed the instrument gas pressure supply to the L1200NDVO.
2. Remove the tubing between the L1200NDVO and the separator dump valve, and remove the supply gas tubing (regulator [-R] if used).
3. Remove the L1200NDVO from the vessel (optional).
4. If the L1200N was removed from the vessel, mount it in a suitable vise on a work bench (if possible).
5. Using the proper tools, disconnect the Inlet, Outlet and Exhaust fittings from the existing DVO (see fig. 1). You will re-connect these to the new DVOA in a later step.

**NOTE:** The following steps must be done with the DVO in the upright position (on top of the L1200N).

6. Remove the L1200N cover (this will aid with the alignment of the new DVOA Valve Bushing). The use of a strap wrench or a pipe wrench may be needed.
7. Insert the new Valve Bushing through the new DVOA (see fig. 2). The markings on top of the DVOA must be facing up. This will be needed in step 9.
8. With a 3/4" hex wrench loosen the existing DVO, valve stem, and static seal (see fig. 3). Once the assembly is loosened, **VERY CAREFULLY** use needle nose pliers to hold the Valve Seat Assembly in place. Remove the existing DVO making sure the Valve Seat Assembly inside the L1200NDVO is aligned and straight (see fig. 4).



**CAUTION: MAKE SURE the Valve Seat Assembly inside the L1200N remains in place after removing the DVO.**

9. Holding the Seat Assembly up with the needle nose pliers inside the L1200NDVO body, place the tip of the new DVOA valve bushing through the spring and into the hole in the center of the valve seat, and tighten the valve bushing. The Valve Seat Assembly should be able to move freely up and down after the bushing has been tighten. The DVO red button must face away from the vessel.
10. With the new DVOA aligned over the hex on the L1200NDVO body, tighten the Valve Bushing using the 9/16" hex wrench. You may need to hold the DVOA while tightening the Valve Bushing to keep it from rotating (see fig. 5).
11. If the L1200N is in the vise, operate the float and inspect for smooth and proper operation of the Valve Seat Assembly.
12. Replace the L1200NDVO cover (see fig. 6).
13. Using the appropriate tools re-install the Inlet, the Outlet and the Exhaust fittings to the new DVOA (see fig. 5).
14. If the L1200N was removed from the vessel re-install it at this time.
15. Modify existing or install new tubing to connect the Inlet, the Outlet and Exhaust fittings.

**NOTE:** Clean, dry instrument quality gas should be used. Use of filters will improve service life and reliability.

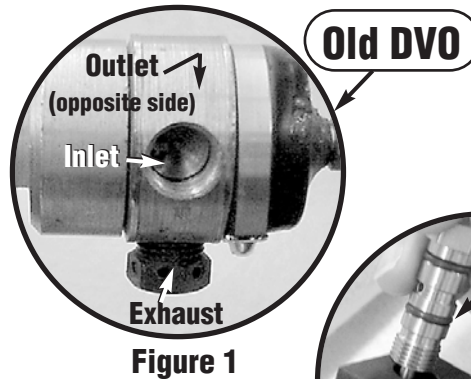


Figure 1

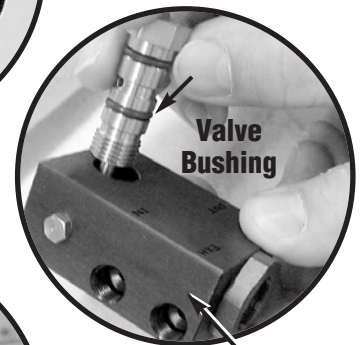


Figure 2 New DVOA



Figure 3

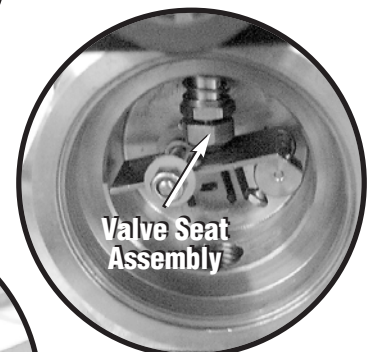


Figure 4

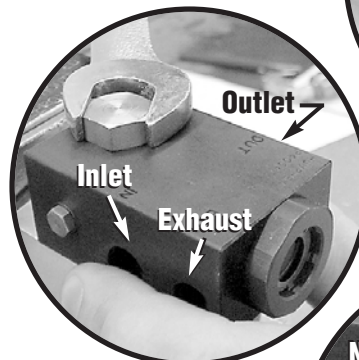


Figure 5

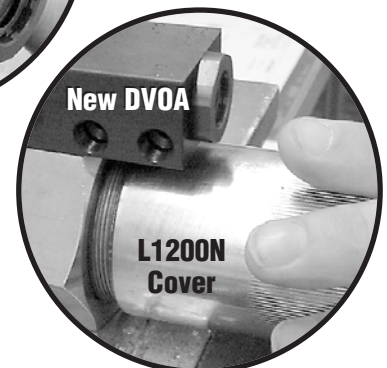
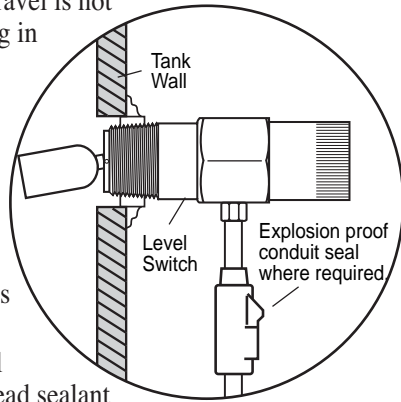


Figure 6

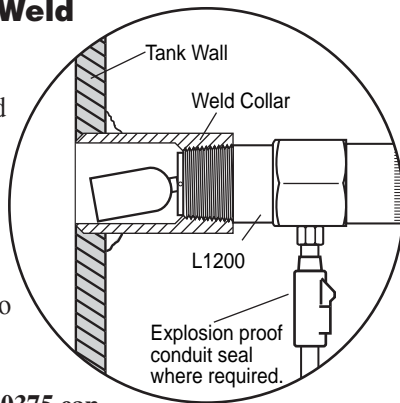
## Direct Installation into the Wall of the Pressure Vessel

1. Determine that the float travel is not obstructed by the coupling in the vessel wall, internal baffles, etc.  
Do NOT use more than one arm extension P/N 15050395.
2. BE SURE that the float and extension are tight and that the lock washer is in place.
3. Before installing the level switch a suitable pipe thread sealant is recommended. Screw the unit directly into the threaded connection in the wall of the pressure vessel.
4. Be sure that the electrical connection is positioned at the bottom. For L1200N the 1/8 NPT pneumatic connection should be on top (the 1/4 NPT vent connection should be on the bottom). See "Pneumatic models" section for further instructions for the L1200N.
5. Make the electrical wiring connections according to appropriate wiring diagrams for the alarm or shutdown system to be used. The electrical connection is 1/2-14 NPT. Electrical wiring and conduit should be installed by qualified personnel according to the NEC.
6. BE SURE all electrical connections are insulated and the cover is fully installed before reconnecting electrical power.
7. BE SURE all pressure connections are tight before pressurizing the system.



## Installation with a Weld Collar

1. The weld collar, P/N 15050375, must be welded into the wall of the pressure vessel according to code standards and good welding practices.
2. Follow above instructions for installation directly into the wall of the pressure vessel.
3. **NOTE: Weld collar 15050375 can be used ONLY with model L1200. It cannot be used with L1200N.**



## Installation Using External Float Chamber 15051098

**CAUTION: USE "NON SPARKING TOOLING".**

1. Install the float chamber 15051098 on the outside wall of the pressure vessel using 1 NPT piping. Position the 2 NPT threaded connection at the height where you want the level switch to operate. The 2 NPT threaded connection must be

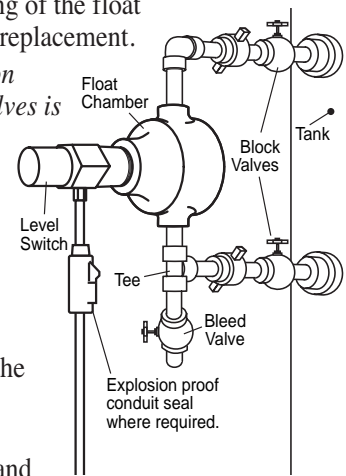
positioned away from the tank wall.

2. A tee is typically installed at the bottom of the lower 1 inch pipe riser to allow draining of the float chamber for servicing or replacement.

**NOTE:** A typical installation with Blocking and Bleed valves is shown at right.

3. Install the L1200 or L1200N in the 2 NPT connection of the float chamber. BE SURE float travel is not restricted and that the float is tight onto the float shaft.

4. To complete installation and wiring, follow the instructions for mounting directly into wall of the vessel and for wiring.



## Pneumatic Models

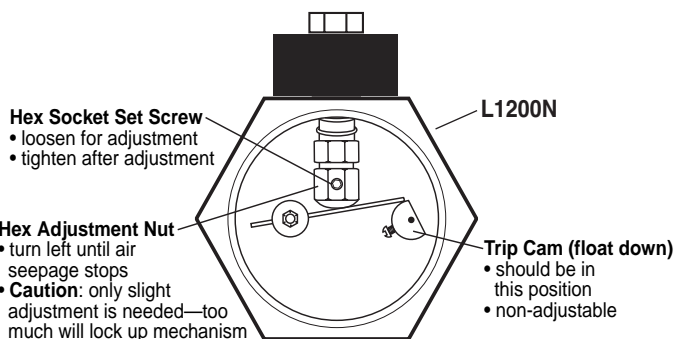
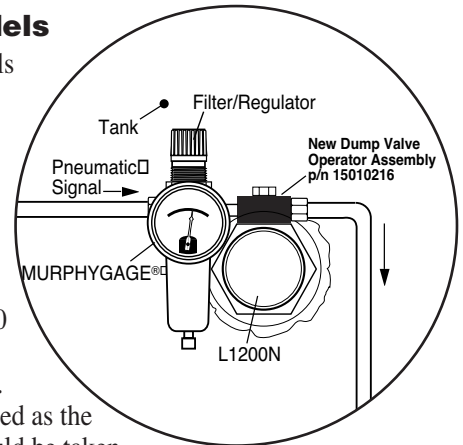
1. All pneumatic models operate on the vent principle. The pneumatic signal source **MUST BE CLEAN AND DRY**. The input pneumatic signal must be regulated between 30 and 70 psi (207-483 kPa) [2.07-4.83 bar].

If produced gas is used as the signal source, it should be taken after gas passes through the final scrubber.

A suitable filter must be positioned before the L1200NDVO to prevent liquids and/or particulates from entering the dump valve operator.

**NOTE:** Check filter periodically for wear and tear and elements that hamper the flow of the pneumatic signal.

2. All pressure connections must be tight and maintained tight so as not to leak air/gas.
3. Valve seat adjustment can be made if air/gas begins to leak. Care should be taken when adjusting as only slight movement is necessary to stop the leakage; excessive force will bind the



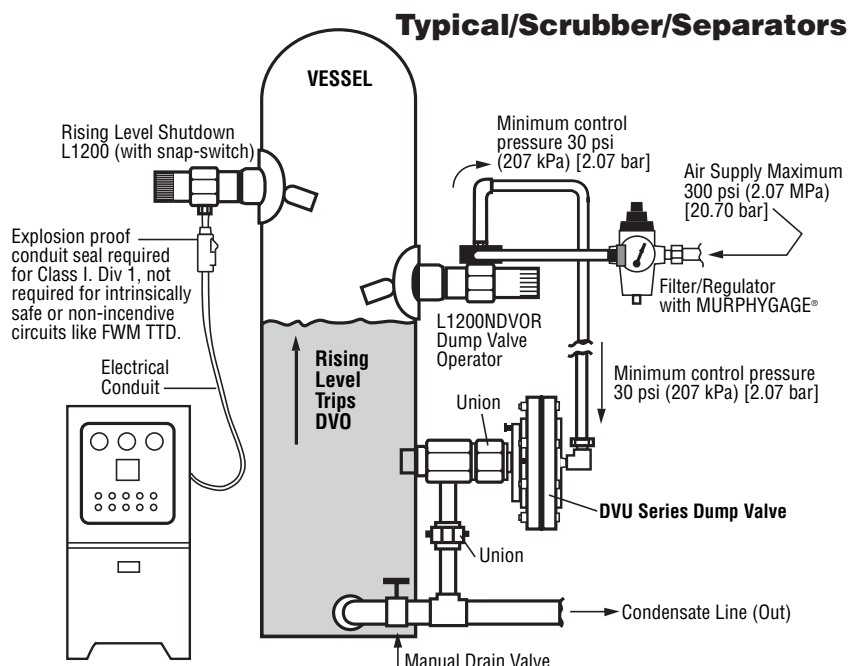
## TYPICAL INSTALLATION ON GAS COMPRESSORS

### Basic Operation

As condensate rises in the scrubber, the float on the L1200NDVOR rises and trips its pneumatic valve. The valve opens allowing pressure to enter the dump valve pilot chamber. Once the pressure enters the pilot chamber it forces the diaphragm and valve stem forward thus opening the valve seat (valve open/closed indicator button pops out) and releasing condensate through the valve stem and out the drain. As the condensate level drops, the L1200NDVOR pneumatic valve closes to shut off the pressure to the dump valve causing it to close.

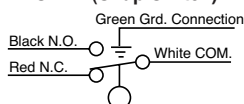
If for any reason the condensate continues to rise beyond normal dump levels, model L1200 operates the alarm and/or shuts down the equipment.

The L1200NDVOR Filter/Regulator and the MURPHYGAGE® help keep the control pressure clean and dry. They also allow the operator to adjust pressure to recommended levels.



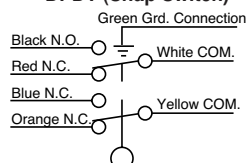
### ELECTRICAL INFORMATION

#### SPDT (Snap Switch)



**Switch Rating:** 5 A @ 125-250- 480 VAC  
1/2 A @ 125 VDC  
1/4 A @ 250 VDC  
2A @ 6-30 VDC Resistive  
1A @ 6-30 VDC Inductive

#### DPDT (Snap Switch)



**Switch Rating:** 10 A @ 125-250 VAC  
1/2 A @ 125 VDC  
1/4 A @ 250 VDC  
10 A @ 6-24 VDC  
Inductive/Resistive

### REPLACEMENT PARTS

Order by part number designation.

#### L1100/L1200\*

- 15000893: BUOYGLAS™ float
- 15000894: Stainless Steel float for L1200
- 15000937: Stainless Steel float for L1100
- 15000124: SPDT snap switch assembly
- 15010213: L1100 counter balance assembly
- 15010214: L1200 counter balance assembly

#### L1200N

- 15050420: Cam spring return
- 15050421: Cam
- 15000893: BUOYGLAS™ float
- 15000894: Stainless Steel float for L1200N
- 15050453: Valve stem
- 15010189: Counter balance assembly

#### L1200NDVO and L1200NDVOR

- 55050621: Regulator only
- 05706499: 20BPG-D-75 Pressure MURPHYGAGE®  
0-75 psi (517 kPa) [5.17 bar]
- 15010216: DVOA assembly (New rectangular style)
- 15000940: DVO assembly (Old round style)

\*To maintain hazardous location listings, all other repairs must be made by the factory.

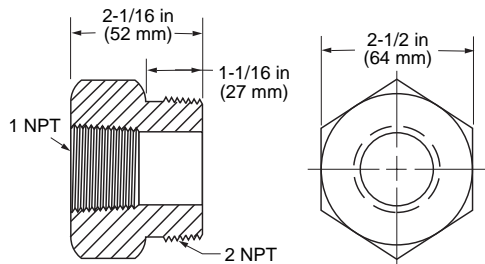


## ACCESSORIES

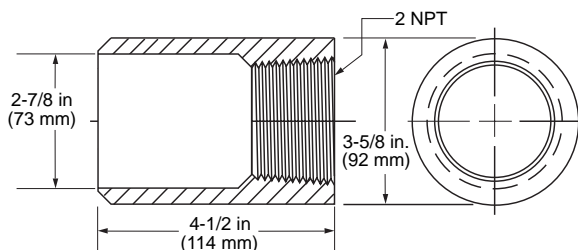
Order by part number designation.

### 55050617: DVU150/DVU175 Adapter Bushing

Material: 2-1/2 Hex bar stock C.R.S

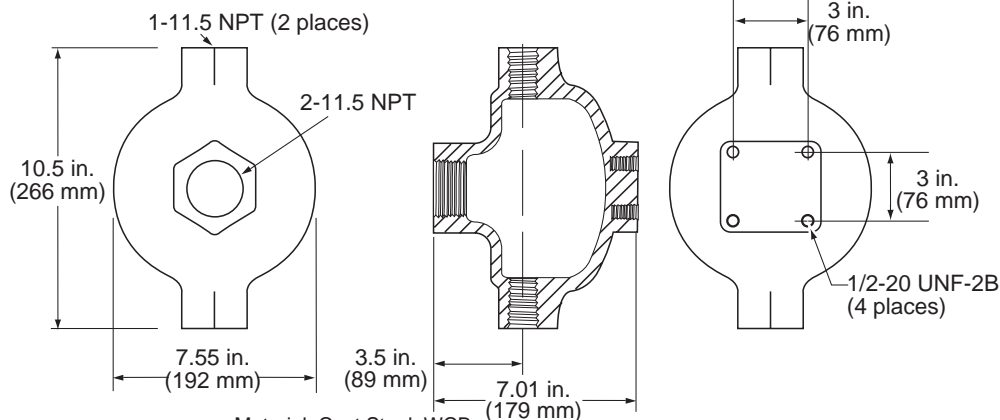


### 15050375: Weld Collar



Operating Pressure: 2000 psi (13.8 MPa) [138 bar].  
Operating Temperature: 400°F (204°C).

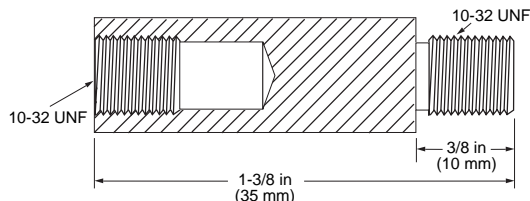
### 15051098: External Float Chamber



Material: Cast Steel. WCB

Operating Pressure: 2000 psi (13.8 MPa) [138 bar].  
Operating Temperature: 400°F (204°C).

### 15000892: Float Shaft Extension



## Warranty

A limited warranty on materials and workmanship is given with this FW Murphy product.  
A copy of the warranty may be viewed or printed by going to [www.fwmurphy.com/support/warranty.htm](http://www.fwmurphy.com/support/warranty.htm)

**MURPHY**

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# Mallard Model 5300 3-Way Control Valve

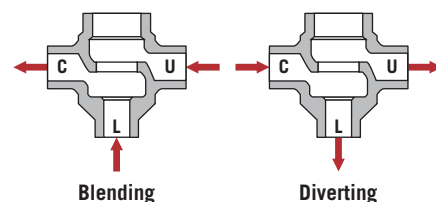
## Features

- Variety of end connections: Available with female NPT threaded connections, or flanged connections from ANSI 150 to ANSI 1500. ANSI ratings above class 600 are available in either raised face (RF) or ring joint (RTJ) style flange facing.
- Simple maintenance: Valve trim or the complete actuator assembly can be quickly changed by simply removing the hammer nut and lifting the actuator assembly off the valve body. Disassembly of the actuator or removing the valve from the line is not required. No special tools are required.
- Valve trim is available in solid 316 stainless steel or 316 stainless steel with TFE plug inserts for positive shut-off.
- Comes complete with a spring opposed diaphragm actuator which can be set up to fail to the lower or upper port.

## Specifications

Body style: 1"  
 End connections: FNPT  
 Available trim sizes  
 1" full port  
 3/4" x 3/8" blow case  
 Flow characteristic  
 Quick opening (on/off)  
 Pressure rating  
 4000 psig at 100°F (38°C)  
 Assembled valve temperature range  
 -20 to 200°F (-29 to 93°C)

The model 5300 is designed to withstand the severe service applications common to the oil and gas industry. It can be installed in converging (blender) or diverging (diverter) flow configurations. The ease of maintenance and rugged steel construction make the model 5300 a perfect choice for a wide variety of 3-way valve applications.



## Materials of Construction

Description	Material
Valve Body	Carbon Steel
Bonnet	Carbon Steel
Hammer Nut	Carbon Steel
Seat / Cage	316 Stainless Steel
Plug	Solid 316 Stainless Steel
Valve Stem	303 Stainless Steel
Packing	PTFE V-Ring
Seals	Buna-N, Viton® (Optional)
Actuator Housing	Steel
Diaphragm	Nylon-Reinforced Nitrile
Actuator Spring	Steel

## Max. Allowable Shutoff Pressure Drops

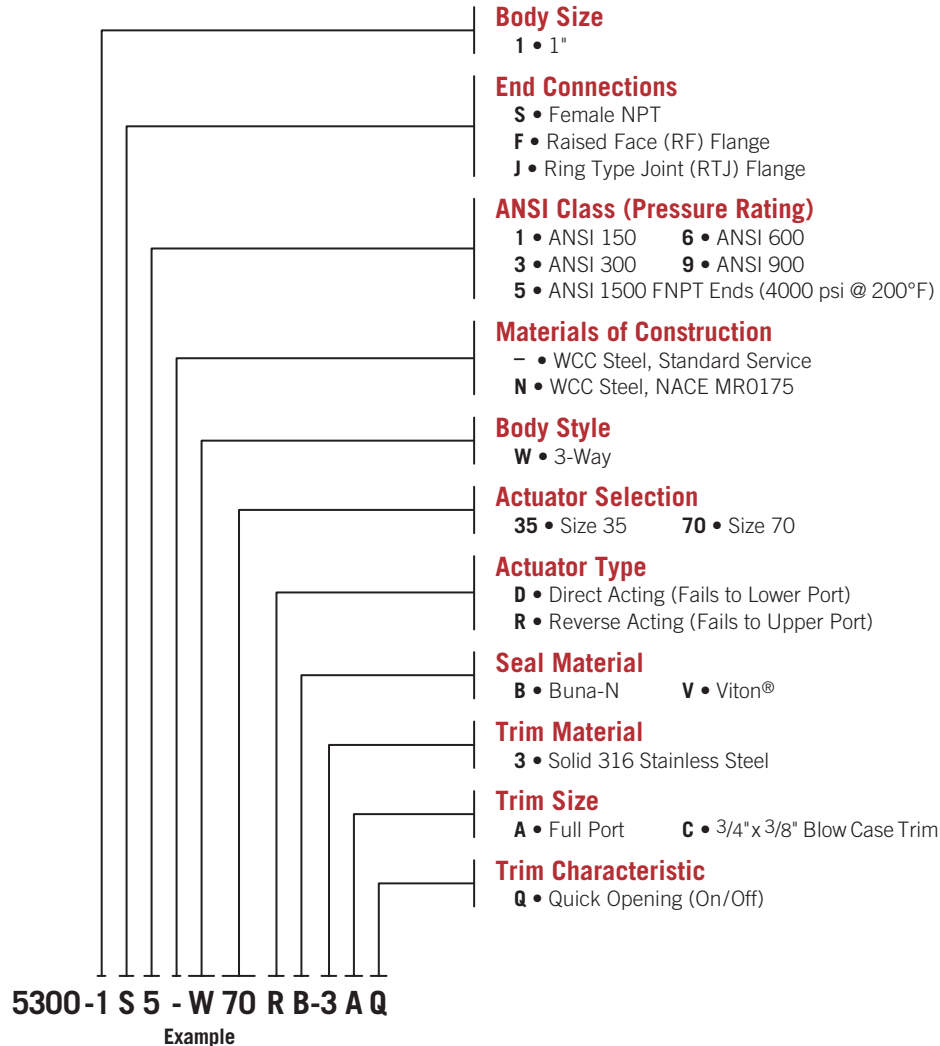
Trim Size (in.)	Actuator Size	Max. Press. Drop (psid) 1" Valve Body	
		Diverging	Blending
1	No. 35	800	400
3/4 x 3/8		1300	1300
1	No. 70	1000	800

## Flow Coefficients (C<sub>v</sub>)

Trim Size (in.)	Flow Direction	Flow Co. (C <sub>v</sub> ) 1" Valve Body
1	C-U	9.0
	C-L	12.5
3/4 x 3/8	C-U	7.7
	C-L	3.2

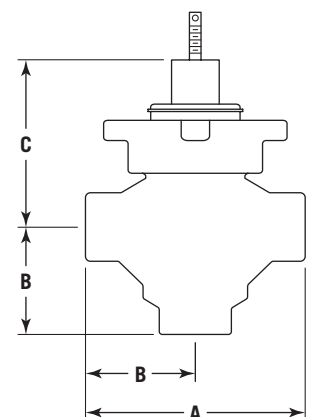
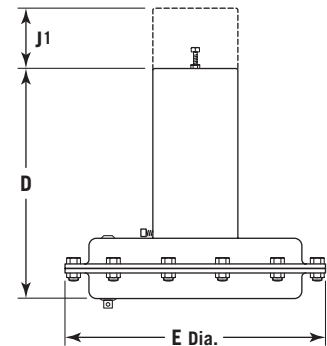
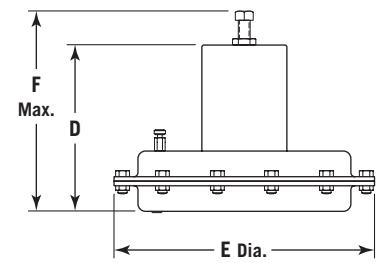
# Mallard Model 5300 3-Way Control Valve

## Part Number Codes



## Diaphragm Effective Area & Housing Max. Pressure

Actuator Size	Diaphragm Effective Area	Housing Max. Pressure
No. 35	35 in. <sup>2</sup>	50 psig
No. 70	70 in. <sup>2</sup>	35 psig



## Valve & Actuator Dimensional Data (in., mm)

End Connection	Dimension (in.) 1" Valve Body		
	A	B	C
NPT	6.25	3.12	4.62
150 RF	7.25	3.62	4.62
300 RF	7.75	3.88	4.62
600 RF/RTJ	8.25	4.12	4.62
900 RF/RTJ	9.38	4.69	4.62
1500 RF/RTJ	9.38	4.69	4.62
Dimension (mm)			
NPT	158.75	79.25	117.35
150 RF	184.15	91.95	117.35
300 RF	196.85	98.55	117.35
600 RF/RTJ	209.55	104.65	117.35
900 RF/RTJ	238.25	119.13	117.35
1500 RF/RTJ	238.25	119.13	117.35

Actuator Size	Dimension (in.) Direct Acting		
	D	E	J1
No. 35	11.25	9.50	5.50
Size 70	13.75	12.50	7.00
Reverse Acting (in.)			
No. 35	9.25	9.50	11.25
Size 70	11.50	12.50	13.50
Dimension (mm) Direct Acting			
No. 35	285.75	241.3	139.7
Size 70	349.25	317.5	177.8
Reverse Acting (mm)			
No. 35	234.95	241.3	285.8
Size 70	292.10	317.5	342.9

<sup>1</sup> Clearance required for spring removal.

May 2013

# 627 Series Pressure Reducing Regulators



## WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

Fisher® regulators must be installed, operated, and maintained in accordance with federal, state, and local codes, rules and regulations, and Emerson Process Management Regulator Technologies, Inc. (Regulator Technologies) instructions.

If the regulator vents gas or a leak develops in the system, service to the unit may be required. Failure to correct trouble could result in a hazardous condition.

Call a gas service person to service the unit. Only a qualified person must install or service the regulator.



W4793

*Figure 1. Typical 627 Direct-Operated Pressure Reducing Regulator*

## Introduction

### Scope of the Manual

This manual provides instructions for the installation, adjustment, maintenance, and parts ordering information for the 627 Series regulators. These regulators are usually shipped separate for line installation, although sometimes they are shipped installed on other equipment. Refer to the Instruction Manual of the other equipment for installation and operating instructions.

### Description

The 627 Series direct-operated pressure reducing regulators (Figure 1) are for high and low pressure systems. These regulators can be used with natural gas, air, or a variety of other gases. Performance characteristics vary according to construction.



## 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, Tables 1, 2, 3, and 4, 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



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





# 627 Series

## Specifications

The Specifications section gives some general specifications for the 627 Series regulators. The nameplates give detailed information for a particular regulator as it comes from the factory.

### Available Constructions

**Type 627:** Direct-operated pressure reducing regulator equipped with a pitot tube for greater regulated capacities (Figure 7).

**Type 627R:** Type 627 with internal relief and with an open throat (Figure 8).

**Type 627LR:** Type 627R with light rate relief spring (Figure 9).

**Type 627M:** Type 627 with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4 NPT downstream control line connection (Figure 10).

**Type 627MR:** Type 627M with internal relief (Figure 11).

**Type 627H:** Type 627 with a diaphragm limiter to deliver a higher outlet pressure (Figure 12).

**Type 627HM:** Type 627H with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4 NPT downstream control line connection (Figure 13).

### Body Sizes and End Connection Styles

Bo Dy SizE		END CoNNECTIoN STyLE	CoNSTRuCTIoN AvAILABLE
NPS	DN		
3/4	----	NPT	All
1	25	NPT, CL150 RF, CL300 RF, CL600 RF, and Long Body	
2	50	NPT, CL150 RF, CL300 RF, CL600 RF, and Long Body	

### Maximum Inlet Pressure<sup>(1)</sup> (Body Rating)

**NPT Stainless Steel:** 2000 psig / 138 bar

**Flanged Stainless Steel:** 1440 psig / 99.3 bar

**NPT Steel:** 2000 psig / 138 bar

**Flanged Steel:** 1500 psig / 103 bar

**Ductile Iron:** 1000 psig / 69.0 bar

### Maximum valve Disk Inlet Pressure Rating<sup>(1)</sup>

**Nylon (PA) Disk:** 2000 psig / 138 bar

**Nitrile (NBR) Disk:** 1000 psig / 69.0 bar

**Fluorocarbon (FKM) Disk:** 300 psig / 20.7 bar

### Maximum operating Inlet Pressure, Pressure Differential, and outlet Pressure Ranges<sup>(1)</sup>

See Table 1 for pressures by orifice size and spring range

### Maximum Spring and Diaphragm Casing Pressure<sup>(1)</sup>

See Table 2

### Maximum Body outlet Pressure<sup>(1)(2)</sup>

**(Types 627M, 627MR, and 627HM only)**

**NPT Steel:** 2000 psig / 138 bar

**Flanged Steel:** 1500 psig / 103 bar

**Ductile Iron:** 1000 psig / 69.0 bar

### Orifice Sizes

See Table 1

### Internal Relief Performance

**Type 627R:** See Table 3

**Type 627LR:** See Table 4

**Type 627MR:** Limited by field-installed control line piping

### Elastomer Temperature Capabilities<sup>(1)(3)</sup>

MATERIAL	DISK/ DIAPHRAGM	TEMPERATuRE	
		°F	°C
Nitrile (NBR)	Disk	-40 to 180	-40 to 82
	Diaphragm		
Fluorocarbon (FKM)	Disk	0 to 180	-18 to 82
	Diaphragm		
Nylon (PA)	Disk	-40 to 180	-40 to 82
Neoprene (CR) for Types 627H and 627HM only	Diaphragm	-40 to 180	-40 to 82

### Flow Coefficients

See Table 5

### IEC Sizing Coefficients

See Table 6

### Pressure Registration

**Type 627, 627H, 627R, or 627LR:** Internal

**Type 627M, 627HM, or 627MR:** External through 1/4 NPT control line connection in the diaphragm casing

### De-Icer System

See Figure 3 and Type 627M Regulator De-Icer System Application section

### Relief Indicator

For Types 627R, 627LR, and 627MR (see Figures 8, 9, and 11)

### Spring Case vent Connection

3/4 NPT with removable screened vent assembly

### Approximate Weights

**Ductile Iron, Steel, or Stainless Steel Casings:**

10 pounds / 4 kg

**Aluminum Casings:** 6.3 pounds / 3 kg

1. The pressure/temperature limits in this Instruction Manual or any applicable standard limitation should not be exceeded.

2. Types 627, 627H, 627R, and 627LR are limited by maximum diaphragm casing pressure.

3. Stainless steel body is rated to -40°F / -40°C. Steel and Ductile Iron bodies are rated to -20°F / -29°C.

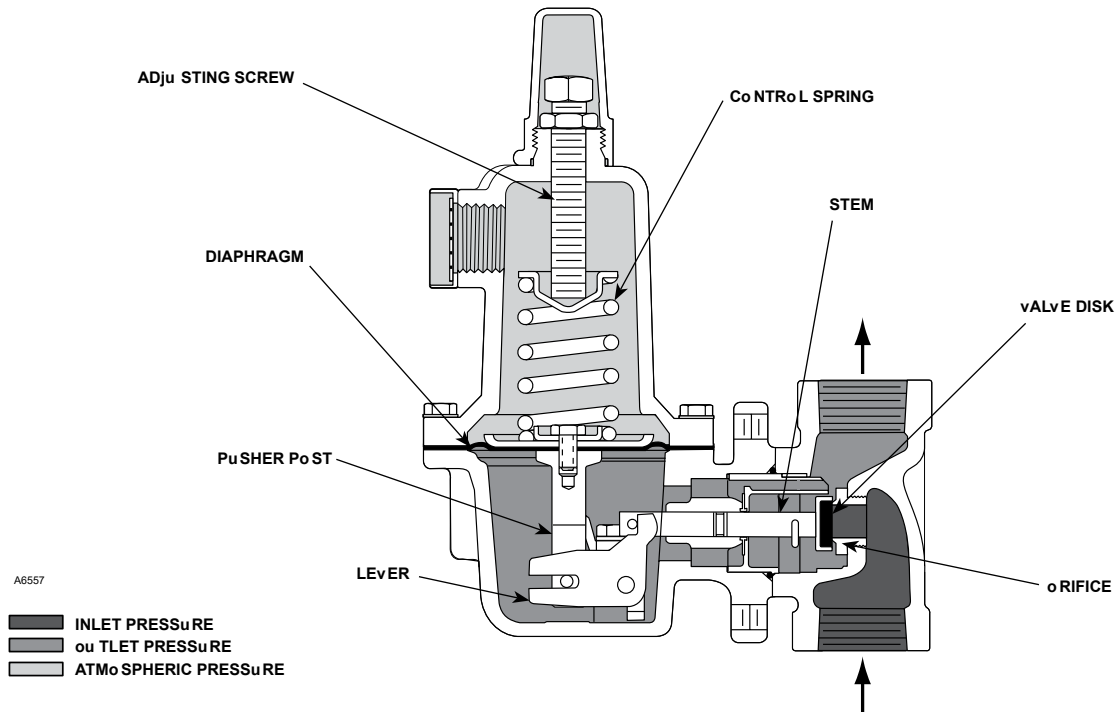


Figure 2. Type 627 Operational Schematic

those limits. The Type 627R, 627LR, or 627MR regulator with internal relief will provide downstream overpressure protection within the limits given in the Specifications section, Tables 1, 2, 3, and 4. If these limits are exceeded, additional downstream overpressure protection must be provided by the user.

Additionally, physical damage to the regulator could cause personal injury or property damage due to escaping gas. To avoid such injury or damage, install the regulator in a safe location.

## Principle of operation

Refer to Figure 2. When downstream demand decreases, the pressure under the diaphragm increases. This pressure overcomes the regulator setting (which is set by a spring). Through the action of the pusher post assembly, lever, and valve stem the valve disk moves closer to the orifice and reduces gas flow. If demand downstream increases, pressure under the diaphragm decreases. Spring force pushes the pusher post assembly downward and the valve disk moves away from the orifice.

## Product Description

**Types 627 and 627H Direct-operated Pressure Reducing Regulators**—The Types 627 and 627H regulators provide economical pressure reducing control for a variety of residential, commercial, and industrial applications. The regulator pitot tube located in a high velocity stream provides dynamic boost that compensates for outlet pressure drop.

**Type 627 Long Body**—The Type 627 Long Body regulator can be used as a drop-in replacement for existing Type 630 installations without the need to modify piping.

**Internal Relief for Type 627R, 627LR, or 627MR Regulator**—The Type 627R internal relief performance values were obtained by removing the disk assembly from the regulator. For the Type 627R, 627LR, or 627MR regulator, the internal relief across the diaphragm provides overpressure protection in many applications. As outlet pressures build up above the start-to-discharge point, the diaphragm moves off the relief valve seat allowing the excess pressure to bleed out through the screened vent.

For extra protection, should failure conditions exist which would prevent normal operation of the regulator

# 627 Series

**Table 1. Maximum Inlet Pressures and Outlet Pressure Ranges**

Type	OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND Color Code	ORIFICE SIZE		MAXIMUM INLET PRESSURE <sup>(1)</sup>					
				Nylon (PA) Disk		Nitrile (NBR) Disk		Fluorocarbon (FKM) Disk	
		Inches	mm	psig	bar	psig	bar	psig	bar
627 and 627M <sup>(3)</sup>	5 <sup>(2)</sup> to 20 psig / 0.34 to 1.4 bar 10B3076X012 Yellow	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	750	51.7	750	51.7	300	20.7
		1/4	6.4	500	34.5	500	34.5	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	250	17.2	250	17.2	250	17.2
	15 to 40 psig / 1.0 to 2.8 bar 10B3077X012 Green	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1500	103	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	500	34.5	500	34.5	300	20.7
		1/2	13	300	20.7	300	20.7	300	20.7
	35 to 80 psig / 2.4 to 5.5 bar 10B3078X012 Blue	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	2000	138	1000	69.0	300	20.7
		3/16	4.8	1750	121	1000	69.0	300	20.7
		1/4	6.4	1500	103	1000	69.0	300	20.7
		3/8	9.5	1000	69.0	1000	69.0	300	20.7
		1/2	13	750	51.7	750	51.7	300	20.7
	70 to 150 psig / 4.8 to 10.3 bar 10B3079X012 Red	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	2000	138	1000	69.0	300	20.7
		3/16	4.8	2000	138	1000	69.0	300	20.7
		1/4	6.4	1750	121	1000	69.0	300	20.7
		3/8	9.5	1250	86.2	1000	69.0	300	20.7
		1/2	13	750	51.7	750	51.7	300	20.7
627R and 627MR	5 <sup>(2)</sup> to 20 psig / 0.34 to 1.4 bar 10B3076X012 Yellow	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	750	51.7	750	51.7	300	20.7
		1/4	6.4	500	34.5	500	34.5	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	15 to 40 psig / 1.0 to 2.8 bar 10B3077X012 Green	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1500	103	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	35 to 80 psig / 2.4 to 5.5 bar 10B3078X012 Blue	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1750	121	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	70 to 150 psig / 4.8 to 10.3 bar 10B3079X012 Red	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	500	34.5	500	34.5	300	20.7
		1/4	6.4	300	20.7	300	20.7	300	20.7
		3/8	9.5	200	13.8	200	13.8	200	13.8
		1/2	13	200	13.8	200	13.8	200	13.8
627LR	15 to 40 psig / 1.0 to 2.8 bar 10B3077X012 Green	3/32	2.4			1000	69.0	300	20.7
		1/8	3.2			1000	69.0	300	20.7
		3/16	4.8			750	51.7	300	20.7
		1/4	6.4			500	34.5	300	20.7
627H and 627HM <sup>(3)</sup>	140 to 250 psig / 9.7 to 17.2 bar 10B3078X012 Blue	3/32	2.4	2000	138	1000	69.0		
		1/8	3.2	2000	138	1000	69.0		
		3/16	4.8	1750	121	1000	69.0		
		1/4	6.4	1500	103	1000	69.0		
		3/8	9.5	1000	69.0	750	51.7		
		1/2	13	750	51.7	500	34.5		
	240 to 500 psig / 16.5 to 34.5 bar 10B3079X012 Red	3/32	2.4	2000	138	1000	69.0		
		1/8	3.2	2000	138	1000	69.0		
		3/16	4.8	1750	121	1000	69.0		
		1/4	6.4	1500	103	1000	69.0		

- For inlet pressure in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.
  - For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.
  - The unbalance forces change from the wide-open monitor mode to an active regulator mode such that the Type 627M or 627HM should have a 3/8 inch / 9.5 mm or larger orifice.
- Shaded areas indicate that Fluorocarbon (FKM) and Nylon (PA) disk material are not available.

**Table 2.** Maximum Spring and Diaphragm Casing Pressure<sup>(1)</sup>

MAXIMUM PRESSURE DESCRIPTION	DIAPHRAGM CASING MATERIAL	TyPE 627		TyPES 627R AND 627LR		TyPE 627M		TyPE 627MR		TyPES 627H AND 627HM	
		psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
Maximum pressure to spring and diaphragm casings to prevent leak to atmosphere other than relief action (internal parts damage may occur)	Die cast aluminum	250	17.2	250	17.2	Not Available		Not Available		Not Available	
	Ductile iron					250	17.2				
	Steel or Stainless steel									250	17.2
Maximum pressure to spring and diaphragm casings to prevent burst of casings during abnormal operation (leak to atmosphere and internal parts damage may occur)	Die cast aluminum	375	25.9	375	25.9	Not Available		Not Available		Not Available	
	Ductile iron	465	32.1	465	32.1	465	32.1	465	32.1		
	Steel or Stainless steel	1500	103	1500	103	1500	103	1500	103		
Maximum diaphragm casing overpressure (above setpoint) to prevent damage to internal parts	All materials	60	4.1	120	8.3	60	4.1	120	8.3	120	8.3
1. If the spring case is pressurized, a metal adjusting screw cap is required. Contact your local Sales Office for details.											

1. If the spring case is pressurized, a metal adjusting screw cap is required. Contact your local Sales Office for details.

(for example, disk broken off or disk erosion), the pusher post contacts the lever retainer causing the relief valve assembly to open. Since the diaphragm continues to rise as downstream pressure builds, it opens the relief valve; thereby, opening the valve. This internal relief may be adequate for the application.

**Downstream Control Line for Type 627M, 627HM, or 627MR Regulator**—A Type 627M, 627HM, or 627MR regulator has a blocking throat stem seal with O-rings and a 1/4 NPT control line connection in the diaphragm case. A regulator with a downstream control line is used for monitoring applications or other applications where other equipment is installed between the regulator and the pressure control point. The stem seal separates the body outlet pressure from the diaphragm case.

## Installation

Regulator operation within ratings does not preclude the possibility of damage from debris in the lines or from external sources. A regulator should be inspected for damage periodically and after any overpressure condition. Key numbers referenced in this section are shown in Figures 7 through 13. Ensure that the operating temperature capabilities listed in Specifications section are not exceeded.

### Note

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

Perform steps 1 through 6 for all types of regulators:

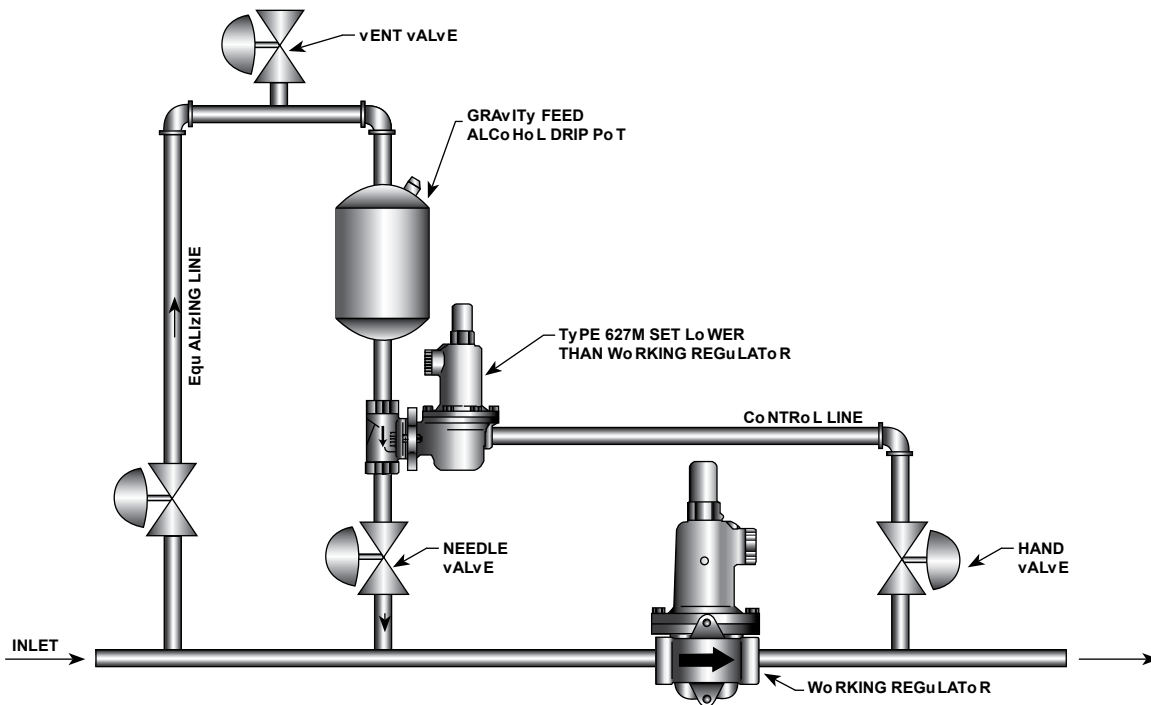
1. Only personnel qualified through training and experience should install, operate, or maintain this regulator.
2. For a regulator that is shipped separately, make sure that there is no damage to or foreign material in the regulator.
3. Ensure that all tubing and piping have been blown free of foreign debris.
4. The regulator may be installed in any position as long as the flow through the body is in the direction indicated by the arrow cast on the body.
5. If continuous operation is required during inspection or maintenance, install a three-valve bypass around the regulator.



### WARNING

**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.**

6. Position the body (key 1) and/or diaphragm spring case (key 29) so it will not collect moisture or debris into the screened vent. If the regulator requires repositioning, refer to the Body Area Maintenance Procedures and/or the Diaphragm and Spring Case Area Maintenance Procedures in the Maintenance section to reposition the screened vent for the application.



**Figure 3.** De-Icer System Operational Schematic

**Perform steps 7 through 9 for Types 627M, 627HM, and 627MR regulators only:**

7. A Type 627M, 627HM, or 627MR regulator requires a downstream control line. Install the control line before putting the regulator into operation.
8. Ensure that the downstream control line piping is at least 3/8 inch / 9.5 mm or larger outside diameter tubing and connected to a straight section of outlet piping 10 diameters downstream of the regulator.
9. A hand valve should be installed in the control line. This hand valve can be used to throttle down and dampen outlet pulsations in control pressure which may cause instability or cycling of the regulator.

## Remote vent Line Installation

All 627 Series regulators have a vent assembly installed in the 3/4 NPT spring case vent opening. The vent assembly can be removed to install a remote vent line if necessary. Remote vent lines must have the largest practical diameter. It should be as short as possible with minimum number of bends or elbows.

Protect the remote vent opening against entrance of rain, snow, or any other foreign material that may plug

the vent or vent line and prevent proper operation of the regulator. Periodically check the vent opening to be sure it is not plugged with foreign debris.

## Type 627M or 627HM Regulator De-Icer System Application

For the Type 627M or 627HM regulator de-icer system, refer to the application shown in Figure 3. With a large pressure drop across the working regulator, ice can form within this regulator. The formation of ice decreases the size of the orifice, so the regulator is unable to supply enough flow to satisfy the downstream demand. When the downstream pressure falls below the outlet pressure setting of the Type 627M or 627HM regulator, the disk assembly of the Type 627M or 627HM regulator moves off its orifice, permitting alcohol to flow into the main gas line. The alcohol carried to the main regulator by the flowstream prevents additional ice from forming on the orifice. When normal flow resumes, and as pressure in the downstream system is restored, the Type 627M or 627HM regulator shuts off.

## overpressure Protection

627 Series regulators have outlet pressure ratings that are lower than their inlet pressure ratings. A pressure-

**Table 3. Type 627R Internal Relief Performance<sup>(1)</sup>**

ouTLET PRESSuRE RANGE, SPRING PART NuMBER, AND CoLoR CoDE	ouTLET PRESSuRE SETTING		MAxIMuM ALLoWABLE DoWNSTREAM SySTEM PRESSuRE		MAxIMuM INLET PRESSuRE To KEEp MAxIMuM ALLoWABLE DoWNSTREAM SySTEM PRESSuRE FRoM BEING ExCEEDeD <sup>(2)</sup>													
					Orifice Size, Inches / mm													
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13			
	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
5 <sup>(3)</sup> to 20 psig / 0.34 to 1.4 bar  10B3076X012 Yellow	10	0.69	60	4.1	1250	86.2	740	51.0	320	22.1	190	13.1	95	6.6	75	5.2		
			100	6.9	2000	138	1500	103	620	42.7	390	26.9	180	12.4	130	9.0		
			125	8.6	2000	138	1900	131	830	57.2	480	33.1	220	15.2	160	11.0		
			175	12.1	2000	138	2000	138	1100	75.8	670	46.2	320	22.1	220	15.2		
			200	13.8	2000	138	2000	138	1300	89.6	770	53.1	360	24.8	260	17.9		
			250	17.2	2000	138	2000	138	1600	110	960	66.2	450	31.0	320	22.1		
	15	1.0	60	4.1	1000	69.0	620	42.7	260	17.9	170	11.7	90	6.2	70	4.8		
			100	6.9	2000	138	1400	96.5	610	42.1	370	25.5	170	11.7	130	9.0		
			125	8.6	2000	138	1900	131	810	55.8	480	33.1	220	15.2	160	11.0		
			175	12.1	2000	138	2000	138	1100	75.8	670	46.2	320	22.1	220	15.2		
			200	13.8	2000	138	2000	138	1300	89.6	770	53.1	360	24.8	260	17.9		
			250	17.2	2000	138	2000	138	1600	110	960	66.2	450	31.0	320	22.1		
	20	1.4	60	4.1	850	58.6	490	33.8	210	14.5	130	9.0	80	5.5	65	4.5		
			100	6.9	2000	138	1300	89.6	600	41.4	360	24.8	170	11.7	120	8.3		
			125	8.6	2000	138	1800	124	800	55.2	480	33.1	220	15.2	160	11.0		
			175	12.1	2000	138	2000	138	1100	75.8	670	46.2	320	22.1	220	15.2		
			200	13.8	2000	138	2000	138	1300	89.6	770	53.1	360	24.8	260	17.9		
			250	17.2	2000	138	2000	138	1600	110	960	66.2	450	31.0	320	22.1		
15 to 40 psig / 1.0 to 2.8 bar  10B3077X012 Green	15	1.0	60	4.1	1000	69.0	380	26.2	210	14.5	130	9.0	80	5.5	65	4.5		
			100	6.9	2000	138	1300	89.6	590	40.7	350	24.1	170	11.7	120	8.3		
			125	8.6	2000	138	1800	124	800	55.2	470	32.4	220	15.2	160	11.0		
			175	12.1	2000	138	2000	138	1100	75.8	640	44.1	320	22.1	220	15.2		
			200	13.8	2000	138	2000	138	1300	89.6	780	53.8	370	25.5	260	17.9		
			250	17.2	2000	138	2000	138	1600	66.2	960	66.2	450	31.0	320	22.1		
	20	1.4	60	4.1	630	43.4	200	13.8	150	10.3	100	6.9	70	4.8	65	4.5		
			100	6.9	2000	138	1200	82.7	550	37.9	330	22.8	160	11.0	120	8.3		
			125	8.6	2000	138	1700	117	760	52.4	450	31.1	210	14.5	160	11.0		
			175	12.1	2000	138	2000	138	1100	75.8	630	43.4	320	22.1	220	15.2		
			200	13.8	2000	138	2000	138	1300	89.6	770	53.1	360	24.8	260	17.9		
			250	17.2	2000	138	2000	138	1600	66.2	960	66.2	460	31.7	320	22.1		
	30	2.1	100	6.9	2000	138	950	65.5	450	31.1	260	17.9	140	9.7	110	7.6		
			125	8.6	2000	138	1500	103	670	46.2	400	27.6	190	13.1	150	10.3		
			175	12.1	2000	138	2000	138	1000	69.0	610	42.1	300	20.7	220	15.2		
			200	13.8	2000	138	2000	138	1200	82.7	760	52.4	360	24.8	260	17.9		
			250	17.2	2000	138	2000	138	1600	110	970	66.9	460	31.7	320	22.1		
			100	6.9	1500	103	700	48.3	330	22.8	200	13.8	120	8.3	108	7.4		
	40	2.8	125	8.6	2000	138	1300	89.6	560	38.6	340	23.4	180	12.4	140	9.7		
			175	12.1	2000	138	1800	124	1000	69.0	550	37.9	290	20.0	220	15.2		
			200	13.8	2000	138	2000	138	1200	82.7	730	50.3	350	24.1	250	17.2		
			250	17.2	2000	138	2000	138	1600	110	970	66.9	460	31.7	320	22.1		

1. The internal relief performance values are obtained by removing the disk assembly.

2. For inlet pressures in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.

3. For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.

Shaded areas indicate maximum inlet pressures allowed during system malfunction only. Table 1 gives the maximum inlet pressure for normal regulator operation.

- continued -

relieving or pressure-limiting device must be provided by the user for the Types 627, 627H, 627M, and 627HM regulators if the inlet pressure can exceed the outlet pressure rating, since these regulators do not have internal relief.

Types 627R and 627LR regulators provide internal relief which limits the total outlet pressure buildup over setpoint. Use Tables 3 and 4 to determine the total outlet pressure. This internal relief may be adequate for the application, if not, provide additional pressure relief or a pressure-limiting device downstream.

## Startup and Adjustment

### Startup



### WARNING

To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during startup, release downstream

# 627 Series

**Table 3. Type 627R Internal Relief Performance<sup>(1)</sup> (continued)**

ouTLET PRESSuRE RANGE, SPRING PART NuMBER, AND CoLoR CoDE	ouTLET PRESSuRE SETTING		MAxIMuM ALLo WABLE Do WNSTREAM SySTEM PRESSuRE		MAxIMuM INLET PRESSuRE To KEEp MAxIMuM ALLo WABLE Do WNSTREAM SySTEM PRESSuRE FRoM BEING ExCEEDeD <sup>(2)(3)</sup>											
					Orifice Size, Inches / mm											
	psig	bar	psig	bar	3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
					psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
35 to 80 psig / 2.4 to 5.5 bar  10B3078X012 Blue	40	2.8	125	8.6	2000	138	1100	75.8	500	34.5	300	20.7	170	11.7	140	9.7
			150	10.3	2000	138	1600	110	750	51.7	440	30.3	230	15.9	180	12.4
			175	12.1	2000	138	2000	138	980	67.6	580	40.0	290	20.0	220	15.2
			200	13.8	2000	138	2000	138	1200	82.7	720	49.6	340	23.4	250	17.2
			250	17.2	2000	138	2000	138	1600	110	940	64.8	450	31.0	320	22.1
	50	3.4	125	8.6	1400	96.5	820	56.5	400	27.6	230	15.9	150	10.3	140	9.7
			150	10.3	2000	138	1400	96.5	650	44.8	370	25.5	210	14.5	170	11.7
			175	12.1	2000	138	1900	131	700	48.3	530	36.5	270	18.6	210	14.5
			200	13.8	2000	138	2000	138	1100	75.8	670	46.2	330	22.8	240	16.5
			250	17.2	2000	138	2000	138	1500	103	920	63.4	430	29.6	320	22.1
	60	4.1	125	8.6	900	62.1	450	31.0	270	18.6	190	13.1	140	9.7	130	9.0
			150	10.3	1700	117	1100	75.8	540	37.2	300	20.7	190	13.1	160	11.0
			175	12.1	2000	138	1700	117	780	53.8	470	32.4	250	17.2	200	13.8
			200	13.8	2000	138	2000	138	1000	69.0	610	42.1	310	21.4	230	15.9
			250	17.2	2000	138	2000	138	1400	96.5	880	60.7	420	29.0	310	21.4
	70	4.8	150	10.3	1200	82.7	850	58.6	430	29.6	250	17.2	170	11.7	160	11.0
			175	12.1	2000	138	1400	96.5	670	46.2	400	27.6	230	15.9	190	13.1
			200	13.8	2000	138	2000	138	920	63.4	550	37.9	280	19.3	230	15.9
			250	17.2	2000	138	2000	138	1300	89.6	830	57.2	400	27.6	310	21.4
			150	10.3	800	55.2	500	34.5	300	20.7	200	13.8	160	11.0	150	10.3
	80	5.5	175	12.1	1500	103	1200	82.7	550	37.9	330	22.8	210	14.5	190	13.1
			200	13.8	2000	138	1700	117	800	55.2	480	33.1	270	18.6	220	15.2
			250	17.2	2000	138	2000	138	1200	82.7	770	53.1	390	26.9	300	20.7

- The internal relief performance values are obtained by removing the disk assembly.
  - For inlet pressures in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.
  - For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.
- - Shaded areas indicate maximum inlet pressures allowed during system malfunction only. Table 1 gives the maximum inlet pressure for normal regulator operation.

**Table 4. Type 627LR Internal Relief Performance<sup>(1)</sup>**

ouTLET PRESSuRE RANGE, SPRING PART NuMBER, AND CoLoR CoDE	ouTLET PRESSuRE SETTING		MAxIMuM ALLo WABLE Do WNSTREAM SySTEM PRESSuRE		MAxIMuM INLET PRESSuRE To KEEp MAxIMuM ALLo WABLE Do WNSTREAM SySTEM PRESSuRE FRoM BEING ExCEEDeD <sup>(2)</sup>							
					Orifice Size, Inches / mm							
	psig	bar	psig	bar	3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4	
					psig	bar	psig	bar	psig	bar	psig	bar
15 to 40 psig / 1.03 to 2.8 bar  10B3077X012 Green	30	2.1	55	3.8	500	34.5	270	18.6	110	7.6	80	5.5
			60	4.1	850	58.6	480	33.1	200	13.8	120	8.3
			66	4.5	1000	69.0	660	45.5	290	20.0	175	12.1
	40	2.8	66	4.5	380	26.2	190	13.1	85	5.9	80	5.5
			70	4.8	700	48.3	370	25.5	150	10.3	115	7.9
			75	5.2	1000	69.0	560	38.6	240	16.5	160	11.0

- The internal relief performance values are obtained by removing the disk assembly.
- For inlet pressures in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.

**Table 5. Flow Coefficients**

oRIFICE		3/4 NPT			NPS 1 / DN 25 Bo Dy			NPS 2 / DN 50 Bo Dy		
Inch	mm	Wide-o pen C <sub>g</sub> for External Relief Sizing	Wide-o pen C <sub>g</sub> for External Relief Sizing	C <sub>1</sub>	Wide-o pen C <sub>g</sub> for External Relief Sizing	Wide-o pen C <sub>g</sub> for External Relief Sizing	C <sub>1</sub>	Wide-o pen C <sub>g</sub> for External Relief Sizing	Wide-o pen C <sub>g</sub> for External Relief Sizing	C <sub>1</sub>
3/32	2.4	6.9	0.24	29.2	6.9	0.24	28.5	6.9	0.23	29.7
1/8	3.2	12.5	0.43	29.1	12.5	0.43	29.4	12.5	0.42	29.5
3/16	4.8	29	1.01	28.6	29	0.93	31.2	29	1.02	28.5
1/4	6.4	50	1.63	30.6	50	1.71	29.3	52	1.66	31.3
3/8	9.5	108	2.99	36.1	108	3.42	31.6	115	3.39	33.9
1/2	13	190	4.87	39.0	190	5.29	35.9	200	5.01	39.9

**Table 6. IEC Sizing Coefficients**

oRIFICE SizE		x <sub>T</sub>			F <sub>D</sub>	F <sub>L</sub>
Inch	mm	3/4 NPT Body	NPS 1 / DN 25 Body	NPS 2 / DN 50 Body		
3/32	2.4	0.539	0.514	0.558	0.50	0.85
1/8	3.2	0.536	0.547	0.539		0.79
3/16	4.8	0.517	0.616	0.514		0.85
1/4	6.4	0.592	0.543	0.620		0.87
3/8	9.5	0.824	0.632	0.727		0.89
1/2	13	0.962	0.815	1.01		0.86

**Table 7. Maximum Torque Values**

KEy NuMBER <sup>(1)</sup>	DESCRIPTIoN	MAxIMuM ToRquE	
		FooT-PouNDS	N•m
2	Orifice	25	34
3	Cap screw (with aluminum diaphragm casing)	16	22
	Cap screw (with ductile iron or steel/stainless steel diaphragm casing)	25	34
18	Lever cap screw	7	9.5
22	Diaphragm connector nut	17	23
26	Guide retainer (for Types 627R, 627LR, and 627MR only)	3	4.1
37	Spring case cap screw (with aluminum or ductile iron diaphragm casing)	7	9.5
	Spring case cap screw (with steel/stainless steel diaphragm casing)	35	47
46	Diaphragm cap screw (with Type 627 or 627M)	7	9.5
	Diaphragm cap screw (with Type 627H or 627HM)	14	19

1. Refer to Figures 7 through 13 for key number locations.

**pressure to prevent an overpressure condition on the diaphragm of the regulator.**

**In order to avoid an overpressure condition and possible equipment damage, pressure gauges should always be used to monitor pressures during startup.**

1. Slowly open the upstream shut-off valve.
2. Slowly open the downstream shut-off valve.
3. Check all connections for leaks.
4. Make final control spring adjustments according to the adjustment procedures.

## Adjustment

The range of allowable pressure settings is marked on the nameplate. If a pressure setting beyond this range is necessary, substitute the appropriate regulator control spring. Change the nameplate to indicate the new pressure range.

Before increasing the setting, refer to Table 1, 2, 3, or 4. Review the pressure limits for the control spring range being used and be certain that the new pressure setting will not result in an overpressure condition.

## Note

**Always use a pressure gauge to monitor pressure when making adjustments.**



# 627 Series

Refer to Figures 7 through 13 for key number locations.

1. Remove the adjusting screw cap (key 36).
2. Loosen the locknut (key 34).
3. Increase the outlet pressure setting by turning the adjusting screw (key 35) clockwise. Decrease the outlet pressure setting by turning the adjusting screw counterclockwise.
4. When the desired pressure is obtained, hold the adjusting screw (key 35) in place and tighten the locknut (key 34).

## Shutdown



### WARNING

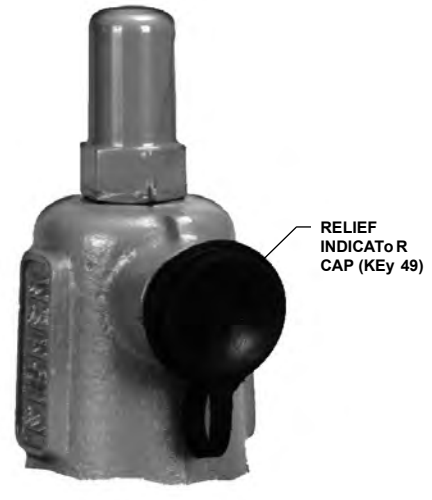
**To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during shutdown, release downstream pressure to prevent an overpressure condition on the diaphragm of the regulator.**

1. Close the nearest upstream shut-off valve.
2. Close the nearest downstream shut-off valve.
3. Open the vent valve between the regulator and the downstream shut-off valve nearest to it.
4. For a Type 627, 627H, 627R, or 627LR regulator, the regulator will open to release pressure between the upstream shut-off valve and the regulator.
5. A Type 627M, 627HM, or 627MR regulator requires venting the control line and downstream pressure from the regulator before maintenance. The pressure between these shut-off valves is released through the open regulator because the disk assembly remains open in response to the decrease in control line pressure.

## Maintenance

Unless otherwise specified, the following maintenance procedures apply to all types of regulators. For a summary of maximum torque values required for all types of regulators, refer to Table 7.

Due to normal wear, damage from external sources, or debris in the air or gas line, regulator parts such as the disk assembly, orifice, and diaphragm must



W4665

*Figure 4. Relief Indicator*

be inspected periodically and replaced as necessary to ensure correct performance. The frequency of inspection and replacement depends upon the severity of conditions and the requirements of state and federal laws. Normal wear of the orifice and disk assembly is accelerated with high pressure drops and with large amounts of impurities in the flowstream. Instructions are given below for replacing the disk assembly, orifice, diaphragm, and O-rings. These procedures may also be used for disassembly required for inspection and replacement of other parts.

### Problem Indication for Types 627R, 627LR, and 627MR Regulators

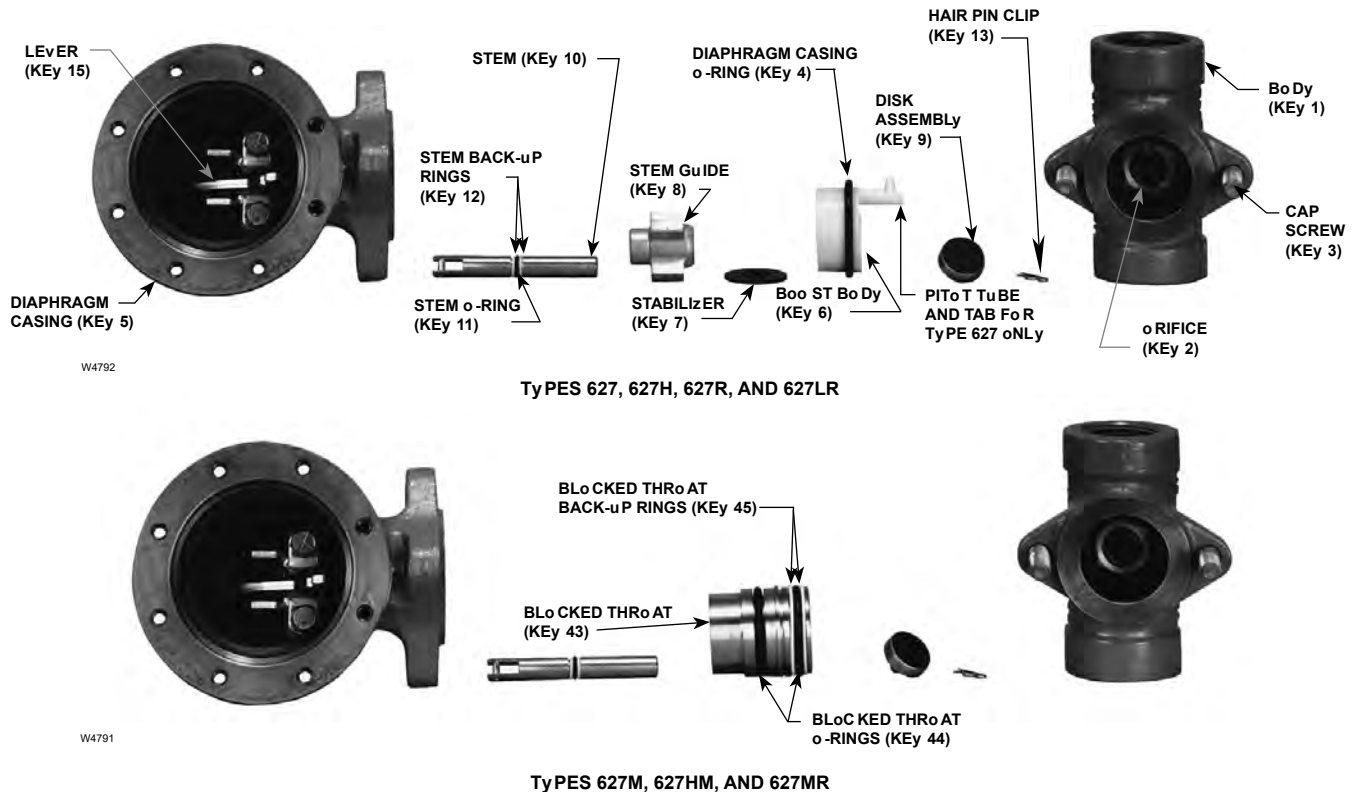


### WARNING

**Isolate the regulator from all pressure to avoid personal injury and equipment damage due to explosion or sudden release of process pressure. Cautiously release pressure from the regulator before attempting disassembly.**

The vent assembly is equipped with a relief indicator (key 49, Figure 4). The cap for the relief indicator snaps over the vent assembly opening. If the relief valve opens wide, exhaust gas pops the cap off the screen vent assembly opening indicating a problem with the regulator. If the cap pops off, refer to the shutdown and to the Body Area Maintenance Procedures to inspect the disk assembly and orifice.

If the disk assembly and orifice are not damaged, refer to the Diaphragm and Spring Case Area Maintenance Procedures in this section.



**Figure 5. Stem Assemblies**

The disk assembly and orifice can be inspected, removed, and replaced without removing the regulator body from the line connections. Refer to the Body Area Maintenance Procedures.

## Body Area Maintenance Procedures

These procedures are for gaining access to the disk assembly, orifice, diaphragm casing O-ring, and stem assembly. All pressure must be released from the diaphragm casing before performing these steps.

While using the following procedures, refer to Figures 7 through 13 for key number locations.

### Replacing the Disk Assembly or Orifice

1. To inspect and replace the disk assembly (key 9) or orifice (key 2), remove the cap screws (key 3, Figure 5), and separate the diaphragm casing (key 5) from the body (key 1).
2. Inspect and, if necessary, remove the orifice (key 2). If removed, coat the threads of the replacement orifice with lubricant and torque to 25 foot-pounds / 34 N•m.

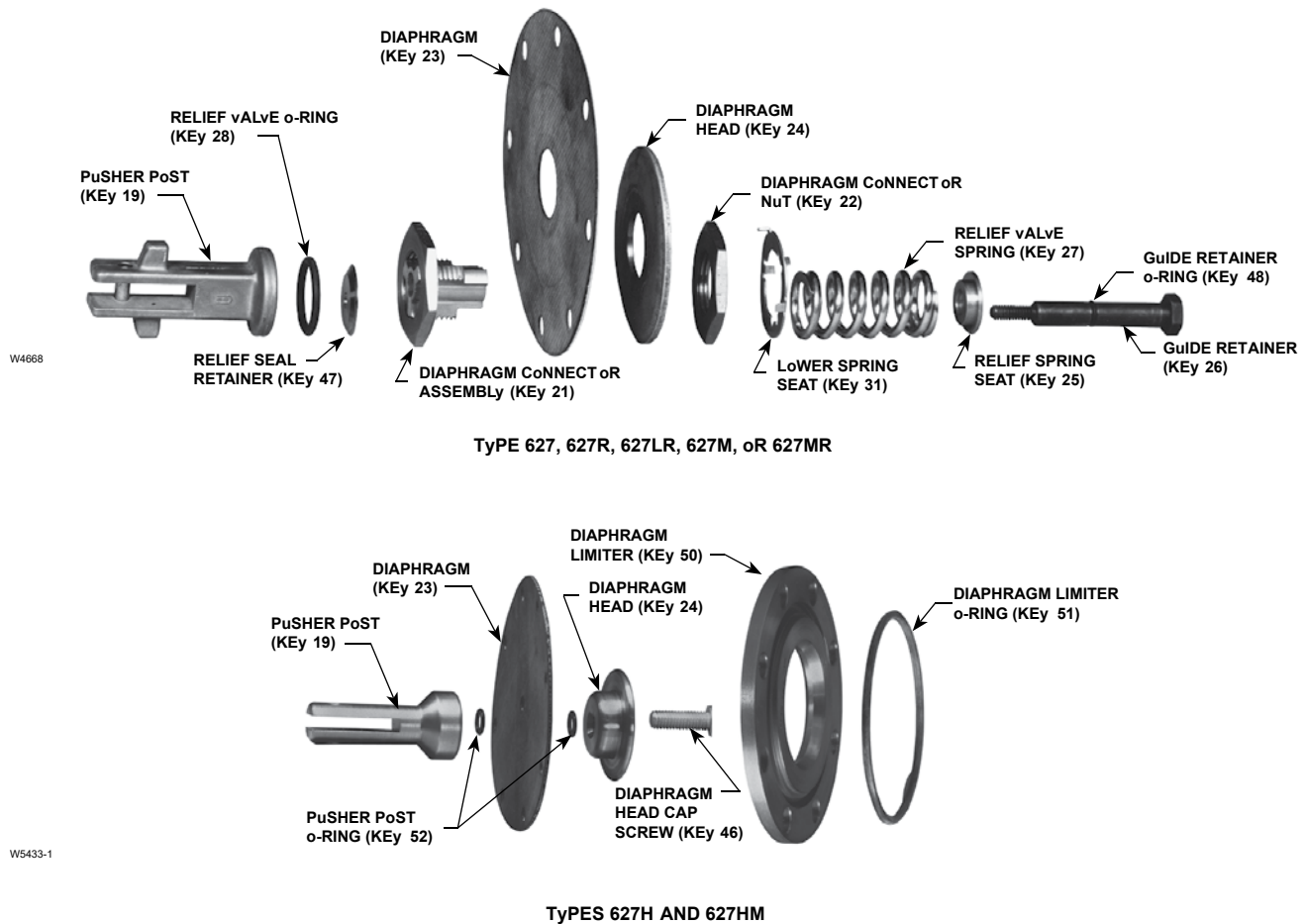
3. Inspect the disk assembly (key 9) and, if necessary, remove the hair pin clip (key 13) that holds the disk assembly (key 9) in place. If replacing the disk assembly is the only maintenance required, skip to step 16.

### Replacing the Stem Assembly

If it is necessary to perform maintenance on the stem assembly, continue with steps 4 through 8 and 15 through 19 for Types 627, 627H, 627R, and 627LR regulators, or steps 9 through 19 for Types 627M, 627HM, and 627MR regulators.

### Perform steps 4 through 8 for Types 627, 627H, 627R, and 627LR Regulators only:

4. Use steps 5 through 8 to remove and replace the stem assembly.
5. Remove the boost body (key 6), stabilizer (key 7), and stem guide (key 8) from the diaphragm casing (key 5). Unhook and remove the stem (key 10) from the diaphragm casing (key 5).
6. Remove and inspect the diaphragm casing O-ring (key 4, Figure 7, 8, 9, or 12) and replace it if necessary.



**Figure 6. Diaphragm Assemblies**

7. Apply lubricant to a replacement diaphragm casing O-ring (key 4, Figure 7, 8, 9, or 12) and install it onto the boost body (key 6). Skip to step 14.
8. For the Type 627 or 627H regulators, be sure to insert the pitot tube (tab) into the outlet side of the body (see Figure 7 or 12). Skip to step 14.
- Perform steps 9 through 19 for Types 627M, 627HM, and 627MR Regulators only:**
9. Use steps 10 through 14 to remove and replace the stem assembly.
10. To remove the blocked throat (key 43), insert a screw driver blade into the groove provided in the throat and pry it out of the diaphragm casing (key 5). Inspect and replace parts as necessary.
11. Inspect and, if necessary, replace the blocked throat O-rings (key 44, Figure 5) and back-up rings (key 45, Figure 5).
12. Apply lubricant to replacement blocked throat O-rings (key 44) and back-up rings (key 45).
13. Apply lubricant to the replacement stem O-ring (key 11) and stem back-up rings (key 12) and install them on the stem (key 10).
14. For assembly, lubricate the stem (key 10) and insert the diaphragm casing (key 5) and hook it on the lever (key 15).
15. Lubricate the contact points of the lever (key 15).
16. Insert parts into the diaphragm casing (key 5) that were removed in steps 5 and 6 or step 10 (see Figure 5).
17. Install the disk assembly (key 9), line up the hole in the disk assembly and stem (key 10) and insert the hair pin clip (key 13).
18. Position the diaphragm casing (key 5) plus attached parts in relation to the body (key 1) so that they are correct for the application.

19. Secure the diaphragm casing (key 5) to the body with the cap screws (key 3, Figure 5). For an aluminum diaphragm casing, torque the cap screws (key 3) to 16 foot-pounds / 22 N•m. For ductile iron or steel diaphragm casings, torque the cap screws (key 3) to 25 foot-pounds / 34 N•m.
20. It may be necessary to reposition the diaphragm spring case to prevent rain, ice, and foreign debris from entering the spring case. Refer to the Diaphragm and Spring Case Area Maintenance Procedures, steps 1, 2, and 21 through 25.

## Diaphragm and Spring Case Area Maintenance Procedures

These procedures are for gaining access to the control spring, diaphragm assembly, and lever assembly. All spring pressure must be released from the diaphragm casing before these steps can be performed.

While using the following procedures, refer to Figures 7 through 13 for key number locations.

1. Remove the adjusting screw cap (key 36), loosen the lock nut (key 34), and turn the adjusting screw (key 35) counterclockwise until all compression is removed from the control spring (key 32).
2. Remove the spring case cap screws (key 37), the nameplates, and lift off the spring case (key 29). If changing the control spring (key 32) or repositioning the spring case (key 29) is the only maintenance required, install the replacement control spring or rotate the spring case so it is correct for the application. Skip to step 21. For diaphragm area maintenance, continue with step 3.
3. Remove the diaphragm limiter O-ring and diaphragm limiter (keys 51 and 50, on the Type 627H or 627HM only). Remove the diaphragm assembly by tilting it so that the pusher post (key 19) slips off the lever (key 15).
4. If it is necessary to replace the lever assembly, remove the lever cap screws (key 18).
5. Install the replacement lever (key 15) into the lever retainer (key 16) by inserting the lever pin (key 17). Secure the lever assembly into the diaphragm casing with the cap screws (key 18) and torque the cap screws to 7 foot-pounds / 9.5 N•m.

If it is necessary to perform maintenance on the diaphragm assembly, continue with steps 6 through 11 and step 20 for Types 627, 627H, 627M, and 627HM regulators, or steps 12 through 19 for Types 627R, 627LR, and 627MR regulators.

### Perform steps 6 through 11 for Types 627, 627H, 627M, and 627HM Regulators only:

6. For Types 627, 627H, 627M, and 627HM regulators (Figures 5 and 6), use steps 7 through 11 to disassemble and reassemble the diaphragm assembly.
7. Remove the diaphragm head cap screw (key 46), lower spring seat (key 31, Type 627 or 627M only), and diaphragm head (key 24). On the Type 627H or 627HM, remove the pusher post O-rings (key 52). Separate the diaphragm (key 23) from the pusher post (key 19).
8. Install the diaphragm (key 23), in reverse order in step 7, on the pusher post (key 19), insert and finger tighten the diaphragm head cap screw (key 46).
9. Hook the pusher post on the lever (key 15), then turn the diaphragm (key 23) to match the holes in the diaphragm with the holes in the spring casing.
10. Unhook the pusher post from the lever (key 15) and torque the diaphragm head cap screw (key 46) to 7 foot-pounds / 9.5 N•m for the Type 627 or 627M. On the Type 627H or 627HM, torque the diaphragm head cap screw to 14 foot-pounds / 19 N•m.
11. Hook the pusher post on the lever (key 15) and check the hole alignment. If necessary, loosen the cap screw (key 46) and reposition the diaphragm (key 23) on the pusher post (key 19). Retorque the screw (see step 10). Skip to step 20.

### Perform steps 12 through 19 for Types 627R, 627LR, and 627MR Regulators only:

12. For Types 627R, 627LR, and 627MR regulators (Figure 6), use steps 13 through 19 to disassemble and reassemble the diaphragm assembly.
13. Remove the guide retainer (key 26) and separate the diaphragm parts. Refer to Figure 6 for the sequence of parts.
14. To remove the diaphragm (key 23), remove the diaphragm connector nut (key 22) and lift off the diaphragm head (key 24) and diaphragm (key 23) from the connector assembly (key 21). Do not attempt to disassemble the connector assembly (key 21).

# 627 Series

15. Position the replacement diaphragm (key 23) on the connector assembly (key 21), install the diaphragm head (key 24) and connector nut (key 22), then torque to 17 foot-pounds / 23 N•m.
16. If necessary, replace the guide retainer O-ring (key 48) and, set the guide retainer (key 26) aside, ready for assembly.
17. On the pusher post (key 19) install the relief seal O-ring (key 28) and apply lubricant. Also, install the relief seal retainer (key 47), diaphragm connector assembly (key 21, with attached parts) relief spring (key 27), upper relief spring seat (key 33), and guide retainer (key 26). Torque the guide retainer (key 26) to 3 foot-pounds / 4.1 N•m.
18. Hook the pusher post (key 19) (with attached parts) on the lever (key 15) to check the alignment of the holes in the diaphragm with the holes in the spring casing. If the holes do not line up, unhook the pusher post from the lever, hold the pusher post, and rotate the diaphragm to the correct position.
19. Install the lower spring seat (key 31) over the relief spring so it rests flat on the connector nut (key 22).
20. Insert the diaphragm assembly into the diaphragm casing (key 5) and hook the pusher post on the lever (key 15).
21. Install the control spring (key 32) and upper spring seat (key 33), and apply lubricant to the upper spring seat (key 33).
22. Install the spring case (key 29) so that the screened vent assembly (key 30) is in the correct position for the application. Place the nameplates over the screw holes, insert the spring case cap screws (key 37), and finger tighten.
23. Screw in the adjusting screw (key 35) to put slack into the diaphragm (key 23).
24. Using a crisscross pattern, finish tightening the spring case cap screws (key 37) to 7 foot-pounds / 9.5 N•m of torque.
25. If necessary, refer to the installation and/or the Startup and Adjustment procedures.
26. Install the adjusting locknut (key 34) after regulator adjustment.

## Parts ordering

When corresponding with your local Sales Office about this equipment, always reference the equipment serial number or FS number that can be found on the nameplate.

When ordering replacement parts, reference the key number of each needed part as found in the following parts list. Separate kits containing all recommended spare parts are available.

## Parts List

### Note

**In this parts list, parts marked NACE are intended for corrosion-resistant service as detailed in the NACE International Standard MR0175.**

Key	Description	Part Number
	Type 627 Parts Kit with Aluminum/Nitrile (NBR) trim (include keys 4, 9, 11, 12, and 23)	R627X000A12
	Type 627 Parts Kit with Stainless steel/ Nitrile (NBR) trim (include keys 4, 9, 11, 12, and 23)	R627X000S12
	Type 627H Parts Kit with SST/Nylon (PA) trim	R627HX00S12
	Type 627R Parts Kit with Aluminum/ Nitrile (NBR) trim (include keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00A12
	Type 627R Parts Kit with Stainless steel/ Nitrile (NBR) trim (include keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00S12
1	Body <sup>(1)</sup>	
	Ductile iron	
	1000 psig / 69.0 bar maximum inlet pressure	
	3/4 NPT	30B3046X012
	1 NPT	30B3048X012
	2 NPT	30B3096X012
	Ductile iron (Long Body)	
	1000 psig / 69.0 bar maximum inlet pressure	
	1 NPT	39B2451X012
	2 NPT	39B0414X012
	Steel	
	2000 psig / 138 bar maximum inlet pressure	
	3/4 NPT	30B3050X012
	1 NPT	30B3051X012
	2 NPT	30B7452X012
	Steel (Long Body)	
	2000 psig / 138 bar maximum inlet pressure	
	1 NPT	39B0412X012
	2 NPT	39B0415X012
	Steel, CL600 RF flanged	
	1500 psig / 103 bar maximum inlet pressure	
	NPS 1 / DN 25	40B6754X012
	NPS 2 / DN 50	40B6756X012
	Steel, CL300 RF flanged	
	750 psig / 51.7 bar maximum inlet pressure	
	NPS 1 / DN 25	41B8978X012
	NPS 2 / DN 50	41B8080X012

1. Bodies can be used for both standard and NACE constructions.

Key	Description	Part Number	Key	Description	Part Number
1	Body <sup>(1)</sup> (continued)		4*	Diaphragm Case O-ring	
	Steel, CL150 RF flanged			Nitrile (NBR)	
	290 psig / 20.0 bar maximum inlet pressure			For Type 627, 627H, or 627R only	17A2325X022
	NPS 1 / DN 25	43B8656X022		Fluorocarbon (FKM)	
	NPS 2 / DN 50	44B0666X012		For Types 627, 627R, and 627LR only	10A0037X012
	Steel, BWE		5	Diaphragm Case	
	1000 psig / 69.0 bar maximum inlet pressure			For Type 627, 627R, or 627LR	
	NPS 1 / DN 25	33B6723X012		Aluminum without 1/8-inch / 3.2 mm gauge tap	40B3084X012
	NPS 2 / DN 50	38B1688X012		Aluminum with 1/8-inch / 3.2 mm gauge tap	
	Steel, PN 16/25/40 RF			for 627 Series (except Types 627H and 627HM)	11B5380X012
	580 psig / 40.0 bar maximum inlet pressure			Ductile iron without 1/8-inch / 3.2 mm gauge tap	30B3053X012
	NPS 1 / DN 25	44B0386X012		Ductile iron with 1/8-inch / 3.2 mm gauge tap	
	NPS 2 / DN 50	44B3342X012		for 627 Series (except Types 627H and 627HM)	31B0641X012
	Stainless Steel <sup>(2)</sup> , NPT			For Type 627, 627R, or 627LR	
	2000 psig / 138 bar maximum inlet pressure			Steel	30B3104X012
	3/4 NPT	30B3050X062		Ductile iron with 1/4 NPT gauge tap for	
	1 NPT	30B3051X092		627 Series (except Types 627H and 627HM)	39A5987X012
	2 NPT	30B7452X052		Steel with 1/4 NPT gauge tap for 627 Series	
	Stainless Steel <sup>(2)</sup> , CL150 RF flanged			(except Type 627H)	30B8734X012
	275 psig / 18.9 bar maximum inlet pressure			For Type 627M or 627MR	
	NPS 1 / DN 25	43B8656X052		Ductile iron	39A5987X012
	NPS 2 / DN 50	44B0666X022		Steel	30B8734X012
	Stainless Steel <sup>(2)</sup> , CL300 RF flanged			For Type 627H, Steel	30B3104X012
	720 psig / 49.6 bar maximum inlet pressure			For Type 627, Stainless steel	30B3104X082
	NPS 1 / DN 25	41B8978X072		For Type 627HM, Steel	30B8734X012
	NPS 2 / DN 50	41B8080X072	6	Boost Body (not for Type 627M, 627HM,	
	Stainless Steel <sup>(2)</sup> , CL600 RF flanged			or 627MR), Delrin®	
	1440 psig / 99.2 bar maximum inlet pressure			For Type 627 or 627H	30B3056X012
	NPS 1 / DN 25	40B6754X102		For Type 627R or 627LR	30B3057X012
	NPS 2 / DN 50	40B6756X062	7	Stabilizer	
	Stainless Steel <sup>(2)</sup> , PN 16/25/40 RF			Nitrile (NBR)	
	580 psig / 40.0 bar maximum inlet pressure			For Types 627, 627H, 627R, and 627LR only	10B3060X012
	NPS 1 / DN 25	44B0386X032		Fluorocarbon (FKM)	
	NPS 2 / DN 50	44B3342X032		For Types 627, 627R, and 627LR only	10B3060X022
2*	Orifice		8	Stem Guide (for Types 627, 627H, 627R, and	
	Aluminum			627LR only), Powdered metal	20B3061X012
	3/32 inch / 2.4 mm	0R044109022	9*	Disk Assembly (for all Orifice Size)	
	1/8 inch / 3.2 mm	1A936709012		Aluminum holder and Nitrile (NBR) disk	1C4248X0212
	3/16 inch / 4.8 mm	00991209012		303 Stainless steel holder and Nitrile (NBR) disk	1C4248X0202
	1/4 inch / 6.4 mm	0B042009012		Aluminum holder and Nylon (PA) disk	1C4248X00A2
	3/8 inch / 9.5 mm	0B042209012		303 Stainless steel holder and Nylon (PA) disk	1C4248X0062
	1/2 inch / 13 mm	1A928809012		316 Stainless steel holder and Nylon (PA) disk	1C4248X0262
	303 Stainless steel			316 Stainless steel holder and Nitrile (NBR) disk	1C4248X0252
	3/32 inch / 2.4 mm	0R044135032		303 Stainless steel holder and	
	1/8 inch / 3.2 mm	1A936735032		Fluorocarbon (FKM) disk	1C4248X0052
	3/16 inch / 4.8 mm	00991235032		Aluminum holder and Fluorocarbon (FKM) disk	1C4248X0182
	1/4 inch / 6.4 mm	0B042035032		316 Stainless steel holder and	
	3/8 inch / 9.5 mm	0B042235032		Fluorocarbon (FKM) disk	1C4248X0192
	1/2 inch / 13 mm	1A928835032	10	Stem	
	316 Stainless steel, NACE construction only			303 Stainless steel	10B3059X012
	3/32 inch / 2.4 mm	0R0441X0012		316 Stainless steel (NACE)	10B3059X022
	1/8 inch / 3.2 mm	1A9367X0022	11*	Stem O-ring	
	3/16 inch / 4.8 mm	009912X0012		Nitrile (NBR)	
	1/4 inch / 6.4 mm	0B0420X0012		Fluorocarbon (FKM) For Types 627, 627R,	
	3/8 inch / 9.5 mm	0B0422X0012		627LR, 627M, and 627MR only	1N430406382
	1/2 inch / 13 mm	1A9288X0012	12*	Stem Back-up Ring,	
3	Cap Screw (not shown), (2 required)			Polytetrafluoroethylene (PTFE) (2 required)	1K786806992
	627 Series		13	Hair Pin Clip, Stainless steel	10B3058X012
	For Ductile iron/Steel diaphragm case	1A560724052	14	Drive Pin, Plated steel	1H3671X0012
	For Aluminum diaphragm case		15	Lever, Plated steel	20B3063X012
	(not applicable for Types 627H and 627HM)	1A352524052	16	Lever Retainer, Plated steel	30B3097X012
	Type 627 Only		17	Lever Pin	
	For Ductile iron/Steel diaphragm case	1A5607X0052		Stainless steel	10B3083X012
	For Aluminum case with Steel diaphragm case	10A3869X012		316 Stainless steel (NACE)	10B3083X022
	For SST Case and body	1A5607X0052			
	For Aluminum Case and SST body	10A3869X022			

\*Recommended spare part.

1. Bodies can be used for both standard and NACE constructions.

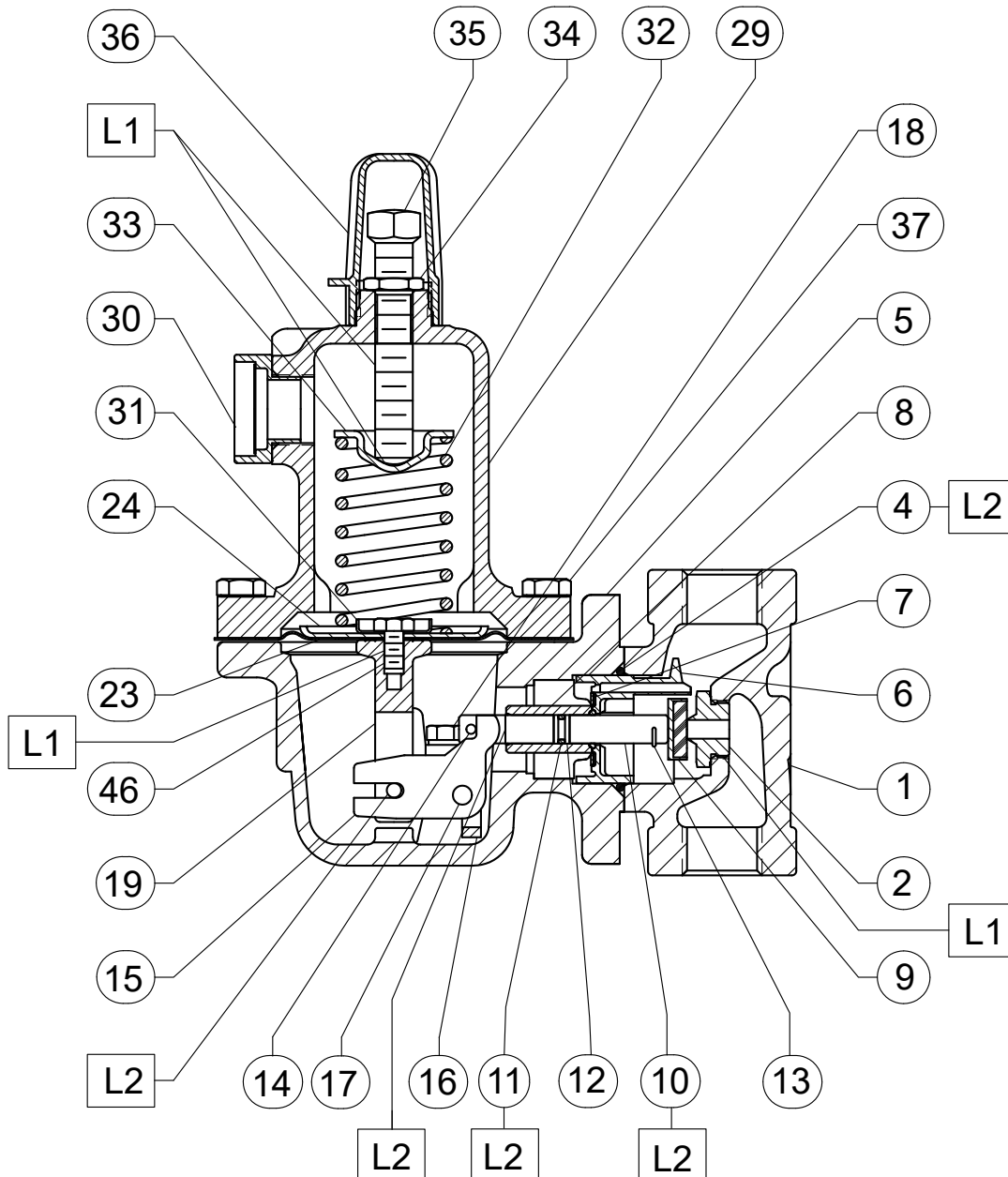
2. Stainless steel body material can be used for applications in temperature ranges down to -40°F / -40°C and are only available for Types 627, 627R, and 627H.

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# 627 Series

Key	Description	Part Number	Key	Description	Part Number
18	Lever Cap Screw (2 required) Plated steel	10B7454X012	30	Screened Vent Assembly, Plastic	10B3093X012
	316 Stainless steel (NACE)	1B2905X0012	31	Lower Spring Seat, Plated steel For Type 627 or 627M	1D666625072
19	Pusher Post, Aluminum For Type 627 or 627M	10B3098X012		For Type 627R, 627LR, or 627MR	20B3073X012
	For Type 627R, 627LR, or 627MR	10B3098X022	32	Control Spring, Plated steel 5 to 20 psig / 0.34 to 1.4 bar, Yellow	10B3076X012
	For Type 627H or 627HM, 416 Stainless steel	10B3098X032		15 to 40 psig / 1.0 to 2.8 bar, Green	10B3077X012
	Stainless steel (NACE)	10B3098X102		35 to 80 psig / 2.4 to 5.5 bar, Blue	10B3078X012
21	Diaphragm Connector (for Type 627R, 627LR, or 627MR only), Stainless steel	28B8832X012		70 to 150 psig / 4.8 to 10.3 bar, Red	10B3079X012
22	Diaphragm Connector Nut (for Type 627R, 627LR, or 627MR only), Stainless steel	10B7449X012		140 to 250 psig range / 9.7 to 17.2 bar, Blue, used for Type 627H or 627HM	10B3078X012
23*	Diaphragm Nitrile (NBR) For Type 627 or 627M with Aluminum or Ductile iron diaphragm case	10B3069X012	33	Upper Spring Seat, Plated steel	1D667125072
	For Type 627 or 627M with Steel diaphragm case	10B8735X012	34	Locknut, Plated steel	1D667728982
	For Type 627R, 627LR, or 627MR with Aluminum or Ductile iron diaphragm case	10B3068X012	35	Adjusting Screw, Plated steel For Type 627, 627M, 627H, or 627HM	10B3081X012
	For Type 627R, 627LR, or 627MR with Steel diaphragm case	10B8736X012		For Type 627R, 627LR, or 627MR	10B3080X012
	For Type 627H or 627HM with Steel diaphragm case (diaphragm is Neoprene (CR) with Nylon (PA) fabric)	12B0178X012	36	Adjusting Screw Cap, Plastic	20B3082X012
	Fluorocarbon (FKM) For Types 627R, 627LR, and 627MR with Steel case	10B8736X022	37	Spring Case Cap Screw, Plated steel (8 required) For Aluminum or ductile iron diaphragm case	1A391724052
	For Types 627 and 627M with Steel case	10B8735X042		For Steel diaphragm case	1A368324052
	For Types 627R, 627LR, and 627MR with Ductile Iron and Aluminum Casing	10B3068X022		For Stainless steel case and body	1A3683X0062
	For Types 627 and 627M with Ductile Iron and Aluminum Casing	10B3069X032		For Aluminum case and SST body	1A3917X0062
24	Diaphragm Head, Plated steel For Type 627 or 627M, Plated steel	1D666428982		For Type 627H/HM, steel diaphragm case	1A346424052
	For Type 627R, 627LR, or 627MR, Plated steel	10B3071X012		For Type 627H, Stainless steel case and body	1A3464X0022
	For Type 627H or 627HM, 416 Stainless steel	12B0175X012	43	Blocked Throat (For Type 627M, 627HM, or 627MR only), Stainless steel	10B3085X012
25	Relief Spring Seat (For Type 627R or 627MR only), Steel	10B7446X012	44*	Blocked Throat O-ring Nitrile (NBR) For Type 627M, 627HM, or 627MR only (2 required) Fluorocarbon (FKM) For Types 627M and 627MR only	1E264306992
26	Guide Retainer (For Type 627R, 627LR, or 627MR only), Stainless steel	10B7450X012			1E2643X0022
27	Relief Spring (For Type 627R or 627MR only), Plated steel	10B6757X012	45*	Blocked Throat Back-up Ring (For Type 627M, 627HM, or 627MR only), PTFE (2 required)	10B3106X012
	For Type 627LR	1B541327022	46	Diaphragm Head Cap Screw, Steel For Type 627 or 627M	1B290524052
28*	Relief Seal O-ring Nitrile (NBR) For Type 627R, 627LR, or 627MR only	1J108506992		For Type 627H or 627HM	1C379124052
	Fluorocarbon (FKM) For Types 627R, 627LR, and 627MR only	1J1085X0042	47	Relief Seal Retainer (For Type 627R, 627LR, or 627MR only), Stainless steel	10B7445X012
29	Spring Case For Type 627, 627R, or 627LR		48*	Guide Retainer O-ring Nitrile (NBR) For Type 627R, 627LR, or 627MR only	1D682506992
	Aluminum	40B3086X012		Fluorocarbon (FKM) For Types 627R, 627LR, and 627MR only	1N423906382
	Ductile iron	30B3055X012	49	Relief Indicator (For Type 627R, 627LR, or 627MR only), Rubber (not shown)	30B3100X012
	Steel	30B3102X012	50	Diaphragm Limiter (For Types 627H and 627HM only)	22B0176X012
	Stainless steel (Types 627 and 627R only)	30B3102X092	51*	Diaphragm Limiter O-ring For Types 627H and 627HM only	1K877606992
29	Spring Case (continued) For Type 627M or 627MR		52*	Pusher Post O-ring (2 required) For Types 627H and 627HM only	1C853806992
	Ductile iron	30B3055X012	58	Pipe Plug, Zinc	1D8293T0022
	Steel	30B3102X012	67	Drive Screw, 18-8 Stainless steel	1A368228982
	For Type 627H or 627HM		72	Pipe Plug, Zinc-plated steel	1A767524662
	Steel	30B3102X012			
	Stainless steel (Type 627H only)	30B3102X092			

\*Recommended spare part.



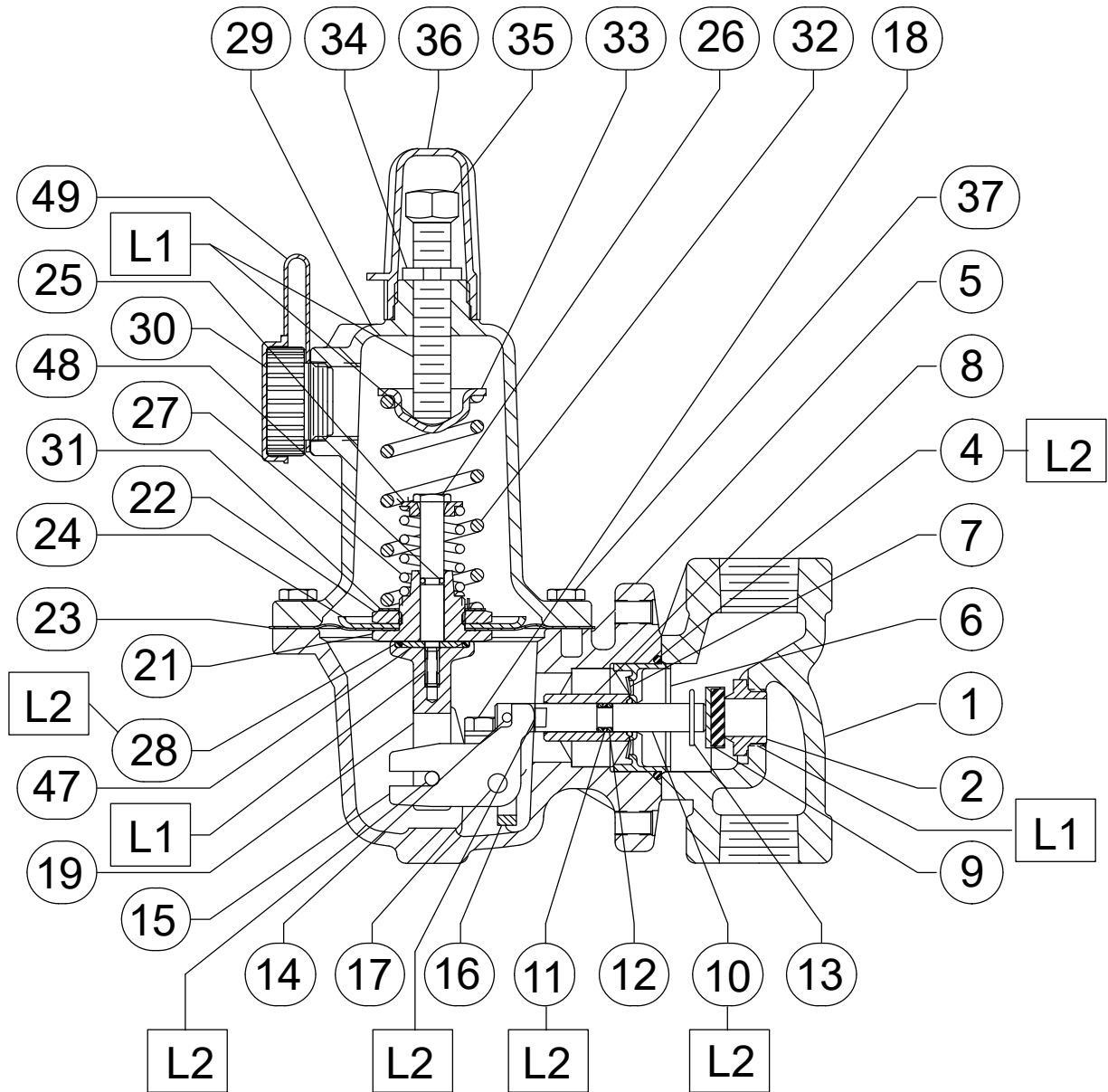
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□ **APPLY LuBRICANT<sup>(1)</sup>**  
 L1 = MuLTi-PuRPoSE LiTHIuM PoLyMER TyPE GREASE  
 L2 = ExTREME LoW-TEMPERATuRE BEARING GREASE  
 PARTS No T SHoWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

**Figure 7. Type 627 Regulator Assembly**



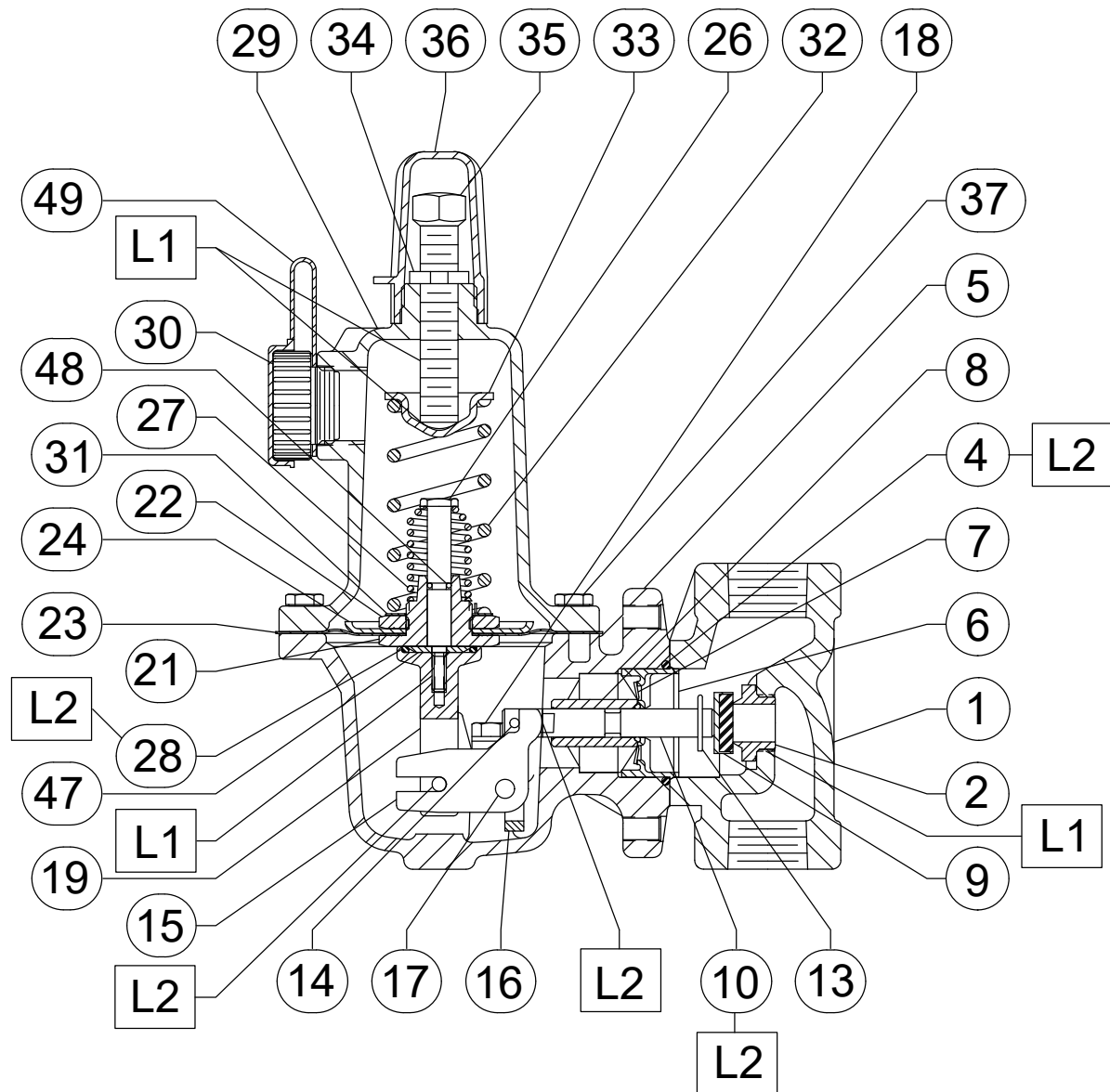


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□ APPLY LUBRICANT<sup>(1)</sup>  
 L1 = MuLTI-PuRPoSE LITHIuM PoLyMER Type GREASE  
 L2 = ExTREME LoW-TEMPERATuRE BEARING GREASE  
 PARTS NoT SHoWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

**Figure 8.** Type 627R Regulator Assembly

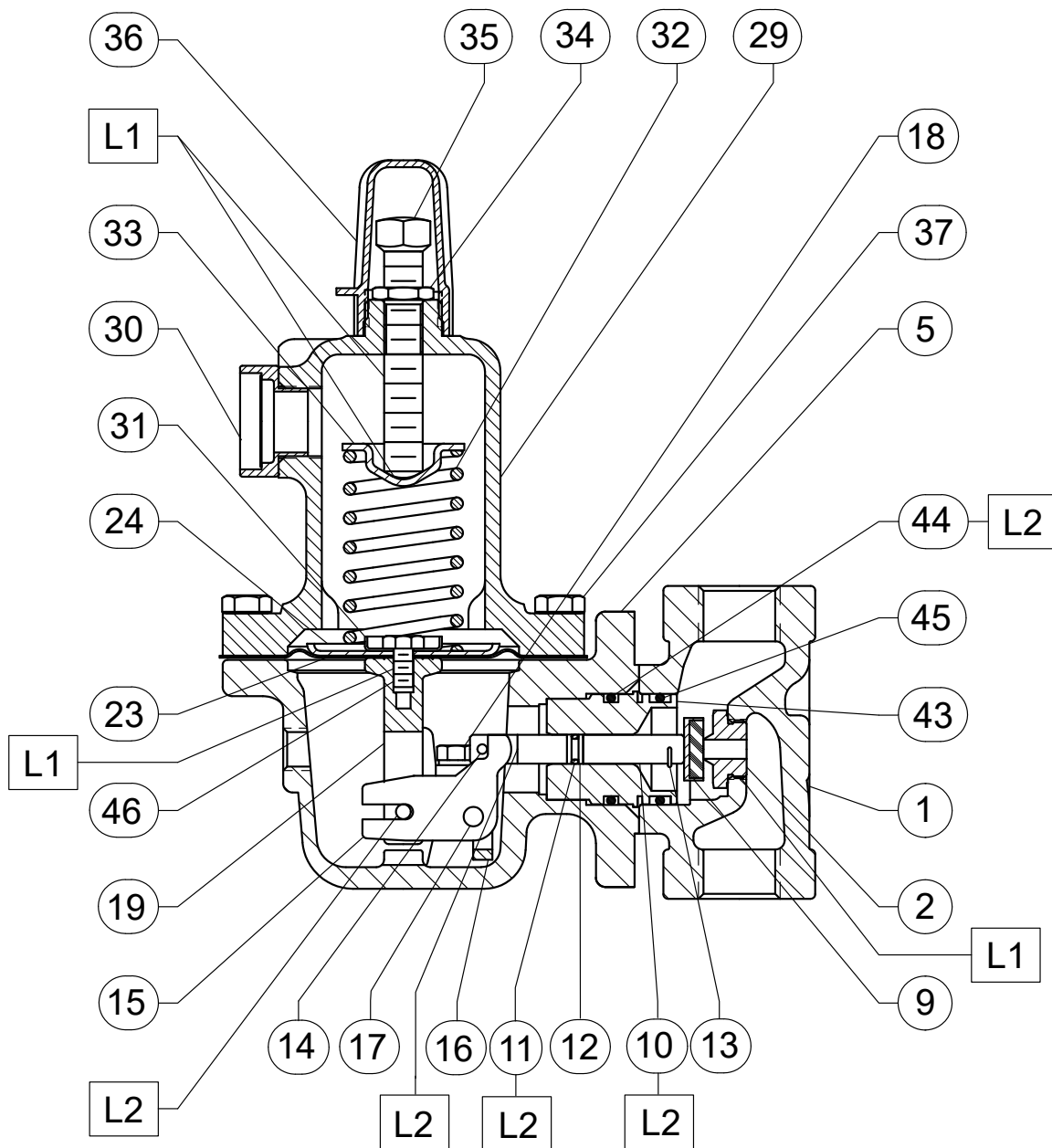


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□ **APPLY LuBRICANT<sup>(1)</sup>**  
 L1 = MuLTI-PuRPoSE LITHIuM PoLyMER TyPE GREASE  
 L2 = ExTREME Lo W-TEMPERATuRE BEARING GREASE  
 PARTS No T SHo WN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

**Figure 9.** Type 627LR Regulator Assembly

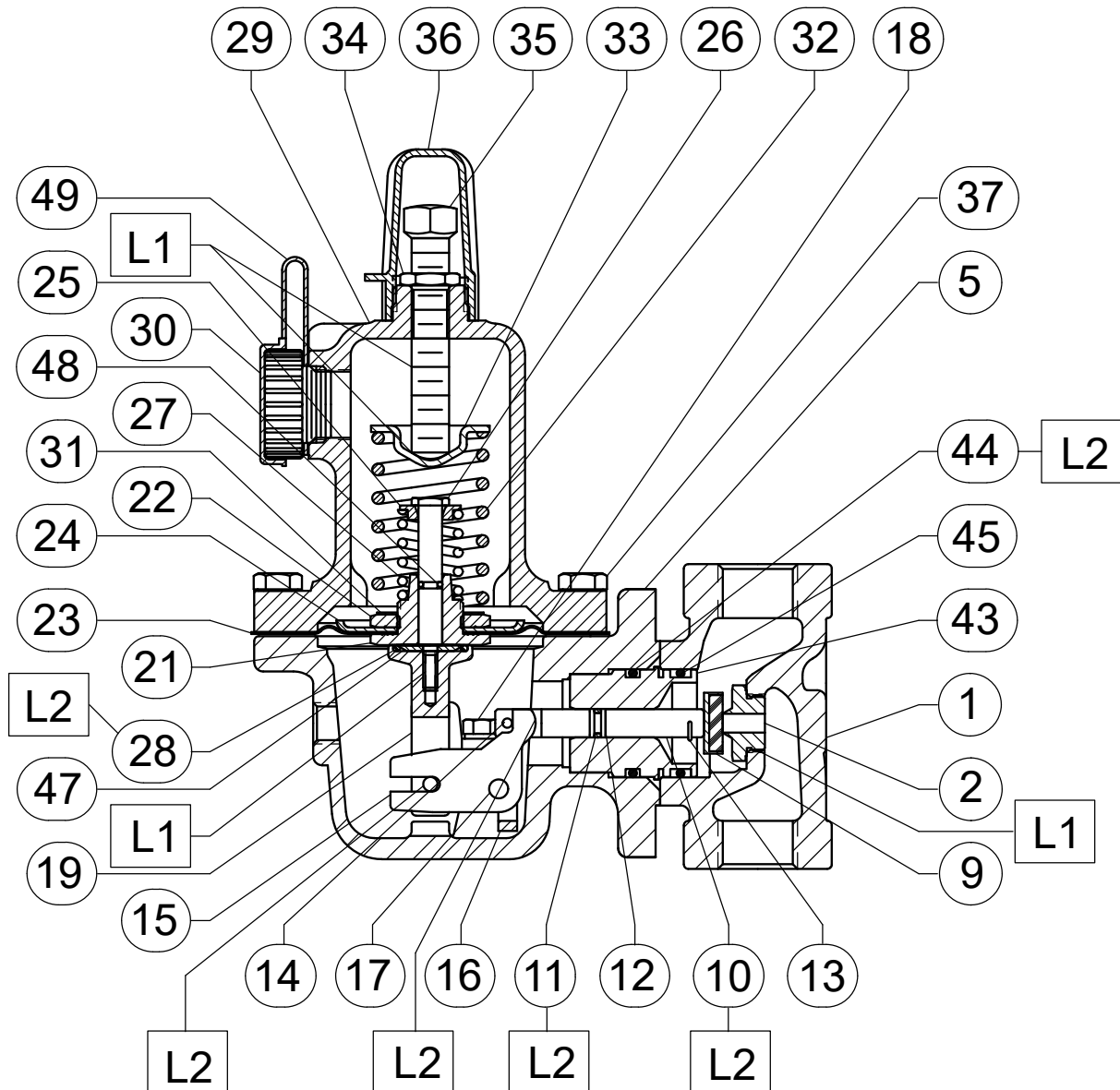


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□ **APPLY LuBRICANT<sup>(1)</sup>**  
 L1 = MuLTI-PuRPoSE LITHIuM PoLyMER TYPE GREASE  
 L2 = ExTREME LoW-TEMPERATuRE BEARING GREASE  
 PARTS NoT SHoWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

**Figure 10.** Type 627M Regulator Assembly

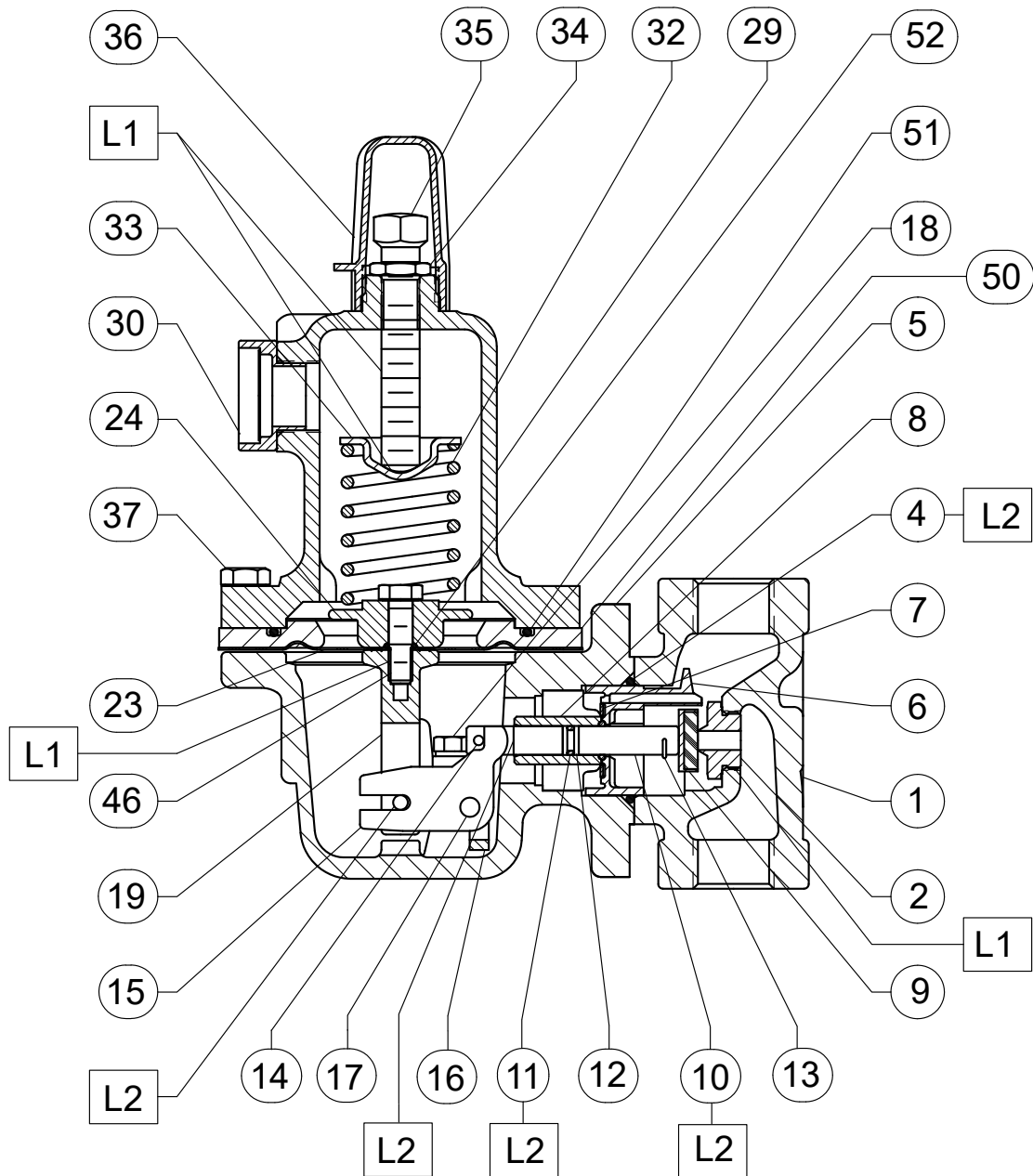


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□ **APPLY LuBRICANT<sup>(1)</sup>**  
 L1 = MuLTI-PuRPoSE LITHIuM PoLyMER TyPE GREASE  
 L2 = ExTREME LoW-TEMPERATuRE BEARING GREASE  
 PARTS No T SHoWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

**Figure 11.** Type 627MR Regulator Assembly

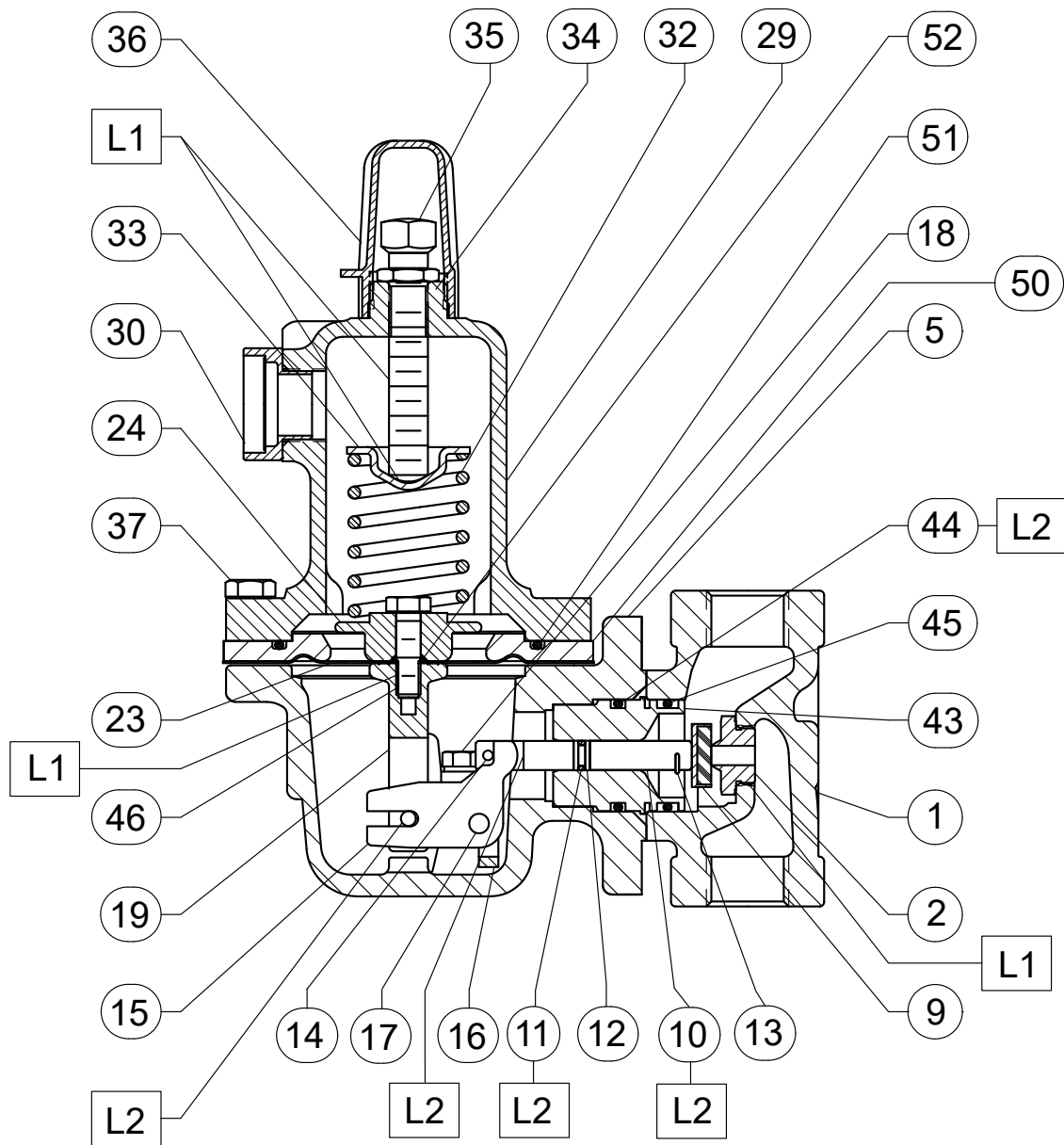


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□ **APPLY LuBRICANT<sup>(1)</sup>**  
 L1 = MuLTI-PuRPoSE LITHIuM PoLyMER TyPE GREASE  
 L2 = ExTREME LoW-TEMPERATuRE BEARING GREASE  
 PARTS NoT SHoWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

**Figure 12.** Type 627H Regulator Assembly



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□ **APPLY LUBRICANT<sup>(1)</sup>**  
 L1 = MuLTi-PuRPoSE LiTHiUm PoLyMER TyPE GREASE  
 L2 = ExTREME LoW-TEMPERATuRE BEARING GREASE  
 PARTS NoT SHoWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

**Figure 13.** Type 627HM Regulator Assembly

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# 67CF Series Installation Sheet

## Introduction

This installation sheet covers the installation and startup of the 67CF Series filter regulators. If maintenance is required, refer to the 67CF Series Instruction Manual, form 5469. Contact your Fisher Sales Representative or Sales Office to receive a copy of the instruction manual.

## Specifications

- **Maximum Inlet Pressure:**  
250 psig (17,2 bar)
- **Maximum Outlet Pressure:**  
50 psi (3,4 bar) over outlet pressure setting
- **Outlet Pressure Ranges:**  
0 to 35 psig (0 to 1,4 bar)  
0 to 60 psig (0 to 2,4 bar)  
0 to 125 psig (0 to 8,6 bar)
- **Temperature Capabilities with Nitrile (NBR):**  
-40° to 180°F (-40°C to 82°C)

## Installation



### 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, 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 in the Type 67CFR regulator does not provide full overpressure protection. The internal relief valve is designed for minor seat leakage only. If maximum inlet pressure to the Type 67CFR exceeds the maximum pressure ratings of the downstream equipment or exceeds the maximum allowable outlet pressure of the Type 67CFR, additional overpressure protection is required.

1. Regulator operation within ratings does not preclude the possibility of physical damage from external sources

or debris in the lines. Regulators should be inspected for damage periodically and after an overpressure condition.

2. Only personnel qualified through training and experience should install, operate, and maintain a regulator. Make sure there is no damage to or foreign material in the regulator and all tubing/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).



### WARNING

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.

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-inch NPT spring case vent may be remotely vented by installing tubing or piping into the vent.

6. For 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.

7. Apply a good grade of pipe compound to the male 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-inch NPT inlet connection on the body (key 1) and into the 1/4-inch NPT body outlet connection.

9. The second 1/4-inch NPT outlet can be used for a gauge or other use. If not used, it must be plugged.





# 67CF Series

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

## Startup and Adjustment

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.

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 19), if used, and turning the adjusting screw or handwheel (key 18) clockwise to increase or counter-clockwise to decrease the outlet pressure setting. Tighten the locknut to maintain the adjustment position.

## Parts List

Key	Description	Key	Description
1	Body	16 <sup>(1)</sup>	Diaphragm Assembly
2	Drain Valve	17	Spring
3	Flange Screw	18	Adjusting Screw
4 <sup>(1)</sup>	O-Ring	19	Locknut
5	Dripwell	20	Upper Spring Seat
6 <sup>(1)</sup>	Filter Element	22	Pressure Gauge
7	Spring Case	23	1/4-Inch Pipe Plug
9	Filter Retainer	24	Tire Valve
10 <sup>(1, 2)</sup>	Valve Cartridge	26 <sup>(1)</sup>	Filter Gasket
11 <sup>(1, 2)</sup>	Valve Plug	31	Panel Mounting Nut
12 <sup>(1, 2)</sup>	Valve Spring	32	Wire Seal
13 <sup>(1, 2)</sup>	Valve Retainer	33	Closing Cap
14 <sup>(1, 2)</sup>	O-Ring	34	Spacer
15 <sup>(1, 2)</sup>	Soft Seat		

1. Recommended Spare Part

2. Valve cartridge assembly includes keys 10, 11, 12, 13, 14, and 15.

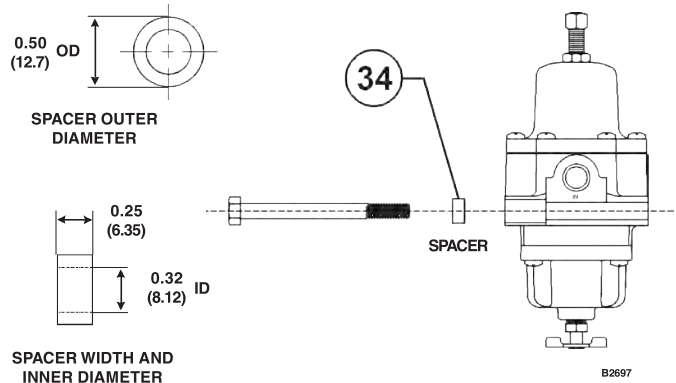


Figure 1. Spacer Diameter and Installation

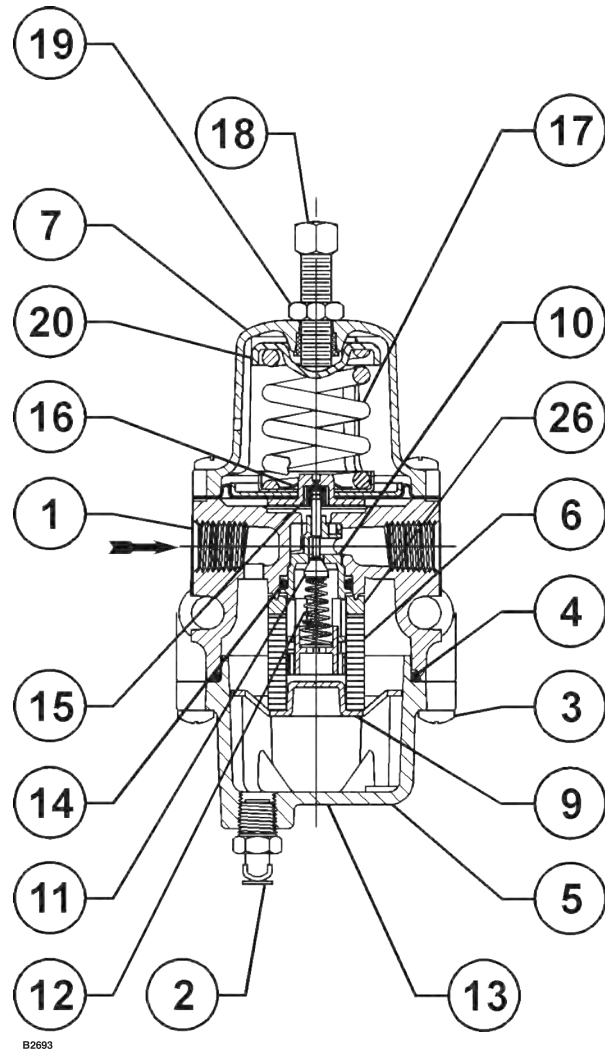


Figure 2. 67CF Series Assembly Drawings

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## Variable Area Flow Meters

### Inline Liquid Flow Meter



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## INTRODUCTION

The Inline Liquid Flow Meter is a rugged industrial class inline flow rate indicator, offered in aluminum, brass or stainless steel models to monitor a wide variety of liquids. Available in seven port sizes from 1/4... 3 inches for flow ranges from 0.02...0.20 gpm (0.1...0.75 lpm) through 20...300 gpm (100...1100 lpm), the meters are calibrated at 0.876 specific gravity for oil or other petroleum-based fluids, 1.0 for water or other water-based fluids, or 1.18 for phosphate ester liquids.

The flow meter is equipped with a 360° rotatable guard/scale which allows the meter to be installed in any orientation without regard to scale direction. Once the meter is permanently installed, the guard/scale can be rotated 360° to optimize readability.

In addition, the unique spring-loaded design of this variable area flow meter decreases viscosity sensitivity and allows it to be installed in any position, including inverted, without affecting accuracy. An optional inverted scale is available for these applications.

The standard flow meter is a unidirectional device. If required, a reverse flow bypass option is available for the oil, phosphate ester and water-based fluid models. Note that flow is measured in the forward direction only.

- **Aluminum** models are offered as a rugged, low cost flow meter for monitoring noncorrosive water-based or petroleum-based fluids under operating pressures up to 3500 psi (241 bar).
- **Brass** meters are recommended for water monitoring applications or other systems where corrosion inhibitors are not present.
- **Stainless Steel** is available for monitoring hydraulic systems operating at pressures up to 6000 psi (414 bar) or other corrosive caustic fluids, such as acetic acid. For further construction material information, see ["Materials of Construction" on page 17](#).

## PRODUCT UNPACKING AND INSPECTION

Upon receipt of the product, perform the following unpacking and inspection process:

If the product package is damaged, request the carrier to be present when unpacking the product. If the product is damaged and the carrier is not present, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

Carefully open the shipping package and follow any instructions marked on the exterior. Remove all packing material and carefully remove the product from the package.

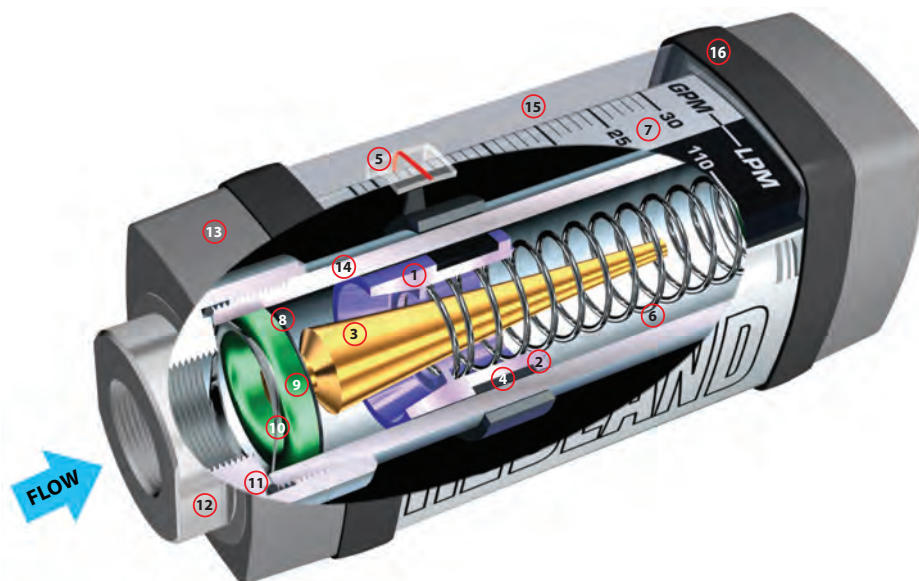
Retain an undamaged package and all packing material for possible use in reshipment or storage.

Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

## OPERATING PRINCIPLE

The flow meter is a variable area instrument. A sharp-edged orifice<sup>①</sup>, located within the piston assembly<sup>②</sup>, forms an annular opening with the contoured metering cone<sup>③</sup>. The piston assembly carries a cylindrical PPS/ceramic magnet<sup>④</sup> that is magnetically coupled to an external indicating magnet<sup>⑤</sup> which moves precisely in direct response to movement of the piston. A calibrated spring<sup>⑥</sup> opposes flow in the forward direction.

The Hedland variable area flow meters are the most readable products in their class. Brightly colored indicators move over the graduated, linear flow scale<sup>⑦</sup> which contains bold, easy to read numeral and gauge marks. The enhanced resolution virtually eliminates parallax problems associated with competitive, direct reading flow meters.



1	Orifice	9	Spider plate
2	Piston assembly	10	Retaining spring
3	Metering cone	11	Pressure seal
4	Internal magnet	12	End fitting
5	Flow indicator	13	End cap
6	Spring	14	Body
7	Flow scale	15	Guard
8	Retaining ring	16	Guard seal/bumper

Table 1: Meter components

## INSTALLATION

### ⚠ CAUTION

**THIS PRODUCT SHOULD BE INSTALLED AND SERVICED BY TECHNICALLY QUALIFIED PERSONNEL TRAINED IN MAINTAINING INDUSTRIAL CLASS FLOW INSTRUMENTATION AND PROCESSING EQUIPMENT.**

### ⚠ CAUTION

**READ INSTRUCTIONS THOROUGHLY BEFORE INSTALLING THE UNIT. IF YOU HAVE ANY QUESTIONS REGARDING PRODUCT INSTALLATION OR MAINTENANCE, CALL YOUR LOCAL SUPPLIER FOR MORE INFORMATION.**

### ⚠ CAUTION

**OIL METERS ARE NOT RECOMMENDED FOR WATER MONITORING APPLICATIONS. IF METER IS TO BE SUBJECTED TO BOTH OIL AND WATER, BRASS WATER METERS ARE SUGGESTED. CONSULT FACTORY FOR DETAILS.**

### ⚠ CAUTION

**THIS METER MAY CONTAIN RESIDUAL AMOUNTS OF TEST FLUID AT THE TIME OF SHIPMENT. THIS FLUID SHOULD BE REMOVED PRIOR TO INSTALLATION AS THE FLUID MAY BE INCOMPATIBLE OR HAZARDOUS WITH SOME LIQUIDS OR GASES. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE EQUIPMENT.**

### ⚠ CAUTION

**THIS STANDARD METER IS UNIDIRECTIONAL. ATTEMPTS TO FLOW FLUIDS IN THE OPPOSITE DIRECTION OF THE FLOW ARROW WILL RESULT IN THE METER ACTING AS A CHECK VALVE, CREATING A DEADHEADING SITUATION. IF THE DIFFERENTIAL PRESSURE MAGNITUDE IS GREAT ENOUGH, DAMAGE TO THE INTERNAL PARTS OF THE METER WILL RESULT.**

The inline flow meter is a simple device to install. However, the following measures are recommended for reliable, trouble-free operation:

- Align pipe accurately. Piping should be accurately aligned and of correct length. The high pressure body of the flow meter can withstand shock and flow/pressure pulsation. However, the piping should be firmly supported by external mounting brackets, both upstream and downstream of the meter, to avoid any pipe flexing actions that could reduce meter life.
- Use rigid mounting. If the flow meter inlet or outlet are to be rigidly mounted, and the opposing port is to be connected to flexible hose, the opposite end of the flexible hose must be rigidly mounted.
- Use Teflon® tape for sealing NPT fitting.
- Install unions. Install a union near the inlet or outlet of the meter. This will facilitate quick, easy meter removal and inspection during periodic maintenance procedures.
- Mount the meter either horizontally or vertically (flow arrow pointing to either side or straight up). If the meter must be mounted inverted, special inverted scales are available from the factory.
- Ensure the fluid is traveling in the direction of the flow arrow ([Figure 1](#)).
- Use at least a 200 mesh (74 micron) filter. The meter will allow particulate to pass that would jam most valves and flow controls. Systems that do not have filtration should be equipped with at least a 200 mesh (74 micron) filter. Most hydraulic systems already have much finer filtration.
- Dirt, ferrous metal or sealing agents, such as Teflon tape may lodge and cause malfunction. If the meter is jammed at a fixed position, follow cleaning and maintenance instructions.
- **Do not** use thread locking compounds as thread sealant.

- **Do not** install the flow meter near turbulence producing fittings such as elbows, reducers, close coupled valves, etc. The inline flow meter does not require flow straighteners or special lengths of straight inlet/outlet piping to stabilize turbulent flow patterns. However, to assure maximum operational reliability, avoid installation of elbows, valves and/or reducers immediately adjacent to the meter inlet.
- **Do not** install the meter near fast-acting valves. Fast-acting valves have the potential to create high magnitude hydraulic pressure spikes. These spikes can damage the internal components of the meter, resulting in inaccuracies or malfunction.
- **Do not** allow unidirectional meters to be operated against the direction of the flow arrow. The standard flow meter is a unidirectional flow meter. The piston acts as a check valve to block flow in the reverse direction. This causes an excessive pressure differential, which can result in damage to internal meter components. The flow meter is also available in a modified design, which offers a reverse flow bypass feature to accommodate bidirectional flow.

**NOTE:** Inline meters with a reverse flow bypass feature are available. Consult the factory for details.

## Installing the Flow Meter

1. Mount the meter so fluid is traveling in the direction of the flow arrow.

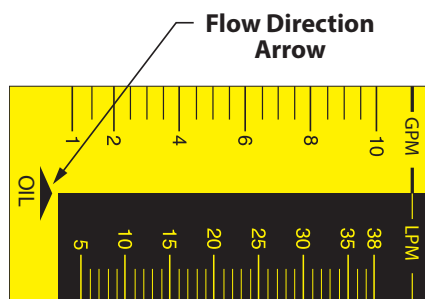
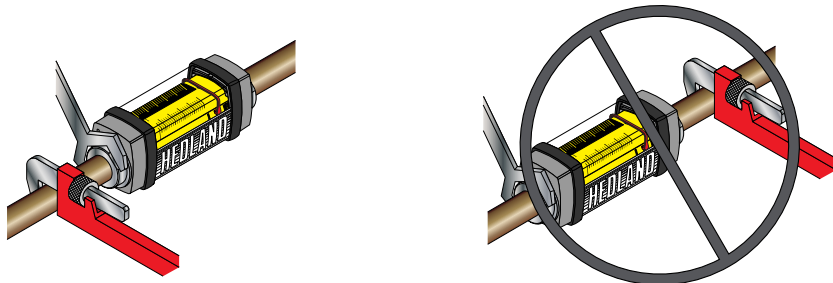


Figure 1: Flow direction arrow

2. Select a mounting location that is suitable for viewing and product service. To connect the flow meter into the piping system, place an open-ended wrench onto the flow meter wrench flats adjacent to the pipe connection being installed. **DO NOT** wrench on the opposite end of the flow meter or leakage may result.

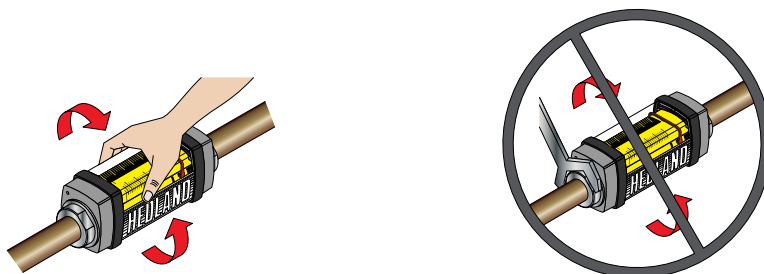


Place wrench on meter flats on the same side plumbing is being tightened.

**Never** place wrench on meter flats opposite plumbing being tightened.

Figure 2: Installing the meter

3. After installation, rotate the meter by hand to view the flow scale.



Rotate meter by hand to view flow scale

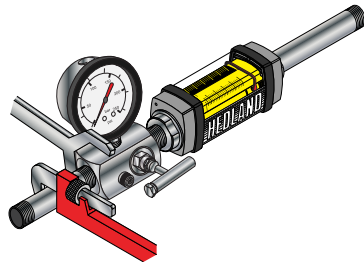
**Never** use wrench to rotate meter body when viewing flow scale

Figure 3: Rotating the meter

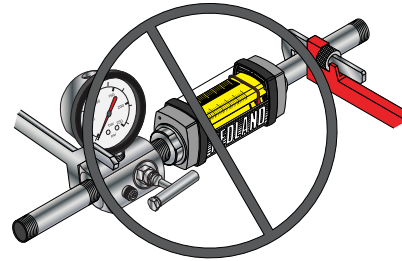


## Installing the Test Kit Flow Meter

1. Mount the VA High Pressure Test Kit Flow Meter so fluid is traveling in the direction of the flow arrow. See [Figure 1](#).
2. Install the test kit at any location in the hydraulic circuit that is suitable for viewing. To connect the test kit into the piping system, place an open-ended wrench onto the test kit valve on the inlet side or on the test kit wrench flat on the outlet side adjacent to the pipe connection being installed. **DO NOT** wrench on the opposite end of the test kit or leakage may result. See [Figure 4](#).



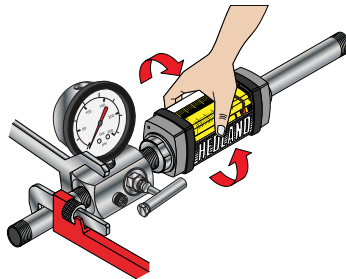
Place wrench on valve body **on the same side** plumbing is being tightened



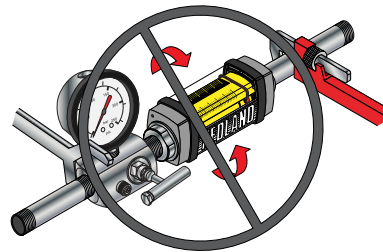
**Never** place wrench on valve body opposite plumbing being tightened

Figure 4: Installing the test kit

3. Or, use quick disconnect couplings for easy connections and to keep the test kit sealed and clean when not in use. For diagrams illustrating typical test placements for the test kits, see ["Test Procedures for Test Kit Flow Meters" on page 8](#).
4. After installation, rotate the meter by hand to view the flow scale.



Rotate meter by hand to view flow scale



**Never** use wrench to rotate meter body when viewing flow scale

Figure 5: Rotating the test kit

## OPERATION

See ["Application Information" on page 11](#).

### Test Kit Information

**ALWAYS START WITH THE LOADING VALVE OPEN.**

#### **⚠ WARNING**

**ALL TEST KITS ARE SHIPPED WITH THE LOADING VALVE IN THE CLOSED POSITION. THE LOADING VALVE MUST BE OPENED FULLY BEFORE INITIATING FLOW AND TESTING OF THE HYDRAULIC CIRCUIT. TURN THE LOADING VALVE HANDLE COUNTERCLOCKWISE TO THE FULLY OPEN POSITION. FAILURE TO OPEN THE LOADING VALVE FULLY CAN RESULT IN INJURY TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT.**



## TEST PROCEDURES FOR TEST KIT FLOW METERS

### ⚠ CAUTION

**THE INFORMATION IN THIS MANUAL IS FOR GENERAL APPLICATION ONLY. ANY INFORMATION FURNISHED BY THE MANUFACTURER OF THE MACHINE'S HYDRAULIC COMPONENTS SHOULD BE FOLLOWED. SPECIFIC SYSTEMS MAY REQUIRE SPECIFIC TEST PROCEDURES.**

### General Information

The VA High Pressure Test Kits are designed to measure flow and pressure. Power measurements are derived from the product of flow and pressure. When using a test kit, power can be calculated using the following formulas:

$HP = \frac{GPM \times PSI}{1714}$	$HP = \frac{LPM \times bar}{447.4}$	$kW = \frac{LPM \times bar}{600}$
------------------------------------	-------------------------------------	-----------------------------------

### Standard Test Conditions

1. Install the test kit as described in one of the following test procedures:
  - a. "Pump Test"
  - b. "Tee Test" on page 9
  - c. "Pump Test Using Tee Test Configuration" on page 9
  - d. "Relief Valve in Separate Housing" on page 9
  - e. "Relief Valves" on page 9
2. Open the loading valve fully by turning the handle counterclockwise.
3. Start the pump and adjust it to the rated speed.
4. Open the test kit loading valve fully and proceed with the required test procedure.
5. The test kit will indicate flow and pressure.

### Pump Test

A tee must be installed between the pump discharge port and the return line to the tank. Be sure the fluid path is only through the pump, the hydraulic test unit and back to the tank. See [Figure 6](#).

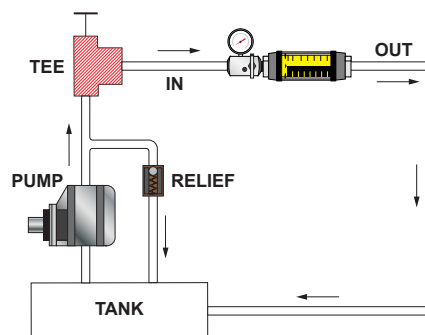


Figure 6: Pump test

1. Plug the line to the control valve.
2. Open the test it loading valve fully to read maximum pump flow at zero pressure.
3. Close the loading valve to increase pressure from zero pressure to rated or maximum pump pressure to determine pump condition.
4. The pump flow at rated pressure can now be checked against the pump manufacturer's specifications. A decrease in flow from zero pressure to maximum pressure indicates the pump condition. A pump that delivers a constant low flow at zero pressure and at maximum pressure suggests suction problems.

## Tee Test

A tee must be installed between the pump and control valve and connected to the inlet of the test kit. The outlet port of the test kit is connected to the tank. Pumps and relief valves can be isolated from the system and checked with the tee test. See [Figure 7](#).

### Pump Test Using Tee Test Configuration

1. Plug the line to the control valve.

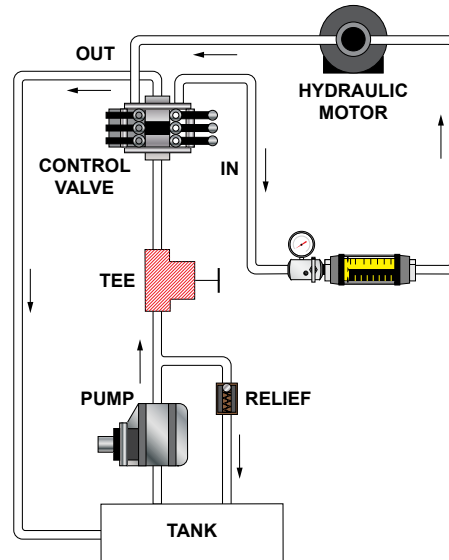


Figure 7: Tee test

2. Open the test kit loading valve fully to read maximum pump flow at zero pressure.
3. Close the loading valve to increase pressure from zero pressure to rated or maximum pump pressure to determine pump condition.
4. The pump flow at rated pressure can now be checked against the pump manufacturer's specifications. A decrease in flow from zero pressure to maximum pressure indicates the pump condition. A pump that delivers a constant low flow at zero pressure and at maximum pressure suggests suction problems.

### Relief Valve Test

1. Put a control valve into a power output mode with the output flow blocked, such as a cylinder at the end of its stroke.
2. Close the test kit loading valve while viewing the pressure. Pressure will increase until the relief valve opens. Record the pressure at this point. Repeat to check the relief valve adjustment.

### Relief Valve in Separate Housing

1. Plug any extra outlets.
2. Close the test kit loading valve and watch the pressure and flow.
3. Reconnect the control valve to the tee. Put a control valve into a power output mode with the output flow blocked, such as a cylinder at the end of its stroke.
4. Close the test kit loading valve while watching the pressure. Pressure will increase until the relief valve opens. Record the pressure at this point. Repeat to check the relief valve adjustment.

## Relief Valves

Often relief valves will start to open before they reach their full pressure flow settings. This can be noted by comparing the pressure and flow rate readings made in step 4 in "[Pump Test Using Tee Test Configuration](#)". Any great decrease in flow rate from tests made in step 4 in "[Pump Test Using Tee Test Configuration](#)" indicates a faulty relief valve.

## MAINTENANCE

### WARNING

**BEFORE ATTEMPTING TO REMOVE THE FLOW METER FROM THE LINE, CHECK THE SYSTEM TO CONFIRM THAT LINE PRESSURE HAS BEEN REDUCED TO ZERO PSI. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.**

1. Remove the flow meter from the line. Remove excess piping from meter.

**NOTE:** It is not necessary to remove the transparent dust guard from the meter to remove the meter from the line. If you choose to remove the dust guard assembly, see ["Removal of Dust Guard" on page 10](#).

2. Thoroughly wipe off the entire flow meter surface using mild detergent or isopropyl alcohol.

### CAUTION

**DO NOT USE AROMATIC HYDROCARBONS, HALOGENATED HYDROCARBONS, KETONES OR ESTER BASED FLUIDS ON POLYCARBONATE LENS. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE METER.**

3. Remove the inlet cap from the flow meter, noting the sequence of disassembly for later reference (during reassembly).
4. The internal parts are secured with a retaining ring. Remove the retaining ring and the internal wetted parts from the flow meter.

**NOTE:** If internal parts do not slide freely from flow meter, use a wooden dowel inserted into the outlet port of the meter to push the parts out.

5. Place all parts on a clean work surface. Clean and inspect all parts. Replace any that appear worn or damaged. Check inlet port O-ring for damage and replace if required.

### CAUTION

**FIELD REPLACEMENT OF THE SPRING, METERING CONE AND/OR PISTON/MAGNET ASSEMBLY MAY RESULT IN CHANGES TO THE CALIBRATION OF THE FLOW METER.**

6. Reassemble the spring, then the piston/magnet assembly and the retaining ring into flow meter.
7. Install the metering cone/spider plate assembly, retaining spring, and secure with the inlet cap.
8. Reinstall the meter to the line.

## Removal of Dust Guard

To remove the dust guard for cleaning or replacement, simply loosen the end fitting located at the bottom of the meter and slide the end cap, dust bumper, and the dust guard off the bottom of the meter, taking care to avoid damaging the O-ring seal between the end cap and the dust gland.

## Quick Re-Coupling

This piston-type variable area flow meter is inherently less sensitive to shock and vibration than other variable area designs. The unique magnetic coupling also eliminates the need for mechanical linkages that can wear or loosen over the functional life of the meter.

However, a pressure spike or extreme flow surge can cause the piston to move at such rapid speed that it disconnects the piston magnet and the external indicator ring. If this occurs, use one of these procedures to re-couple the magnet and the external indicator ring:

- If the system permits, simply change flow rate from "no flow" to "full flow" allowing the moving piston to magnetically re-couple to the indicator ring.
- For rigorous cyclical applications where de-coupling may occur frequently, consult the technical services staff for further recommendations.

## Test Kit Maintenance

### Load Valve

If the valve fails to load the system, remove the valve body and check for foreign material and worn parts or seals.

### Flow

The absence of any flow reading may indicate a seized piston assembly. Remove any material that may be preventing the piston to slide.

If the test kit still fails to indicate flow, return the test kit to the factory.

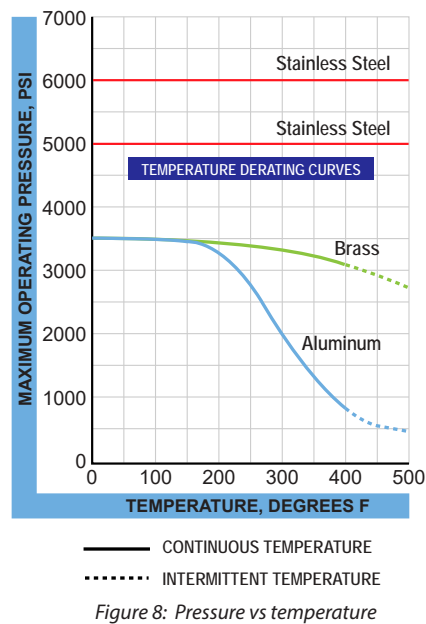
## APPLICATION INFORMATION

### Density Effect (Specific Gravity)

Any fluid density change from stated standards has a proportional effect on meter accuracy. Special scales can be supplied if actual specific gravity decreases accuracy beyond application limits. Corrections for more or less dense fluids can be made to standard scales using the following correction factors:

$$\sqrt{\frac{1.0}{\text{Specific Gravity}}} \quad \text{for water/water-based meters}$$

$$\sqrt{\frac{0.876}{\text{Specific Gravity}}} \quad \text{for petroleum-based meters}$$



## Viscosity Effect (SUS/cSt)

The design uses a precision machined, sharp-edged orifice and biasing calibration spring that assures operating stability and accuracy over the wide viscosity range common to many fluids. Generally, high flow models of each meter size provide good accuracy over a viscosity range of 40...500 SUS (4.2...109 cSt).

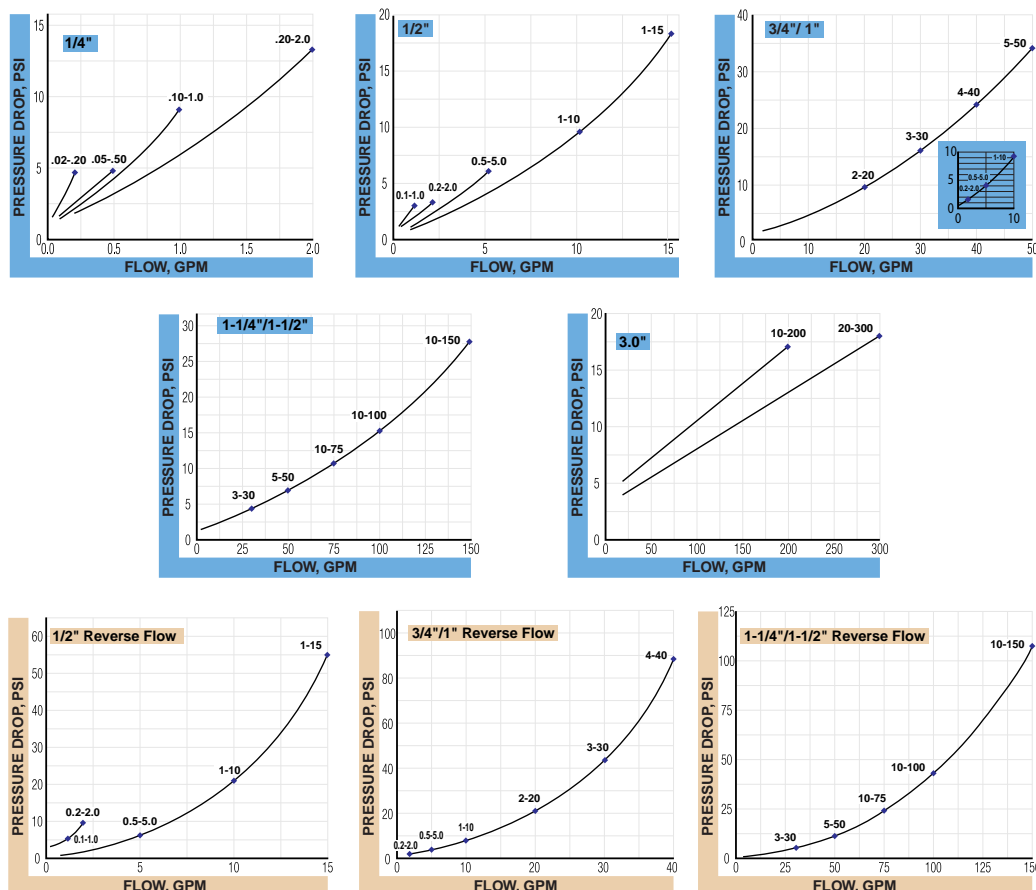
Fluid	Specific Gravity	Correction Factor		Aluminum	Brass	T16 SST	T303 SST	Viton®	EPR	Polycarbonate	Nylon	Pyrex®
		Oil	Water									
Acetic Acid (Air Free)	1.06	0.909	0.971	C	N	R	R	R	R	C	N	R
Acetone	0.79	1.053	1.125	R	R	R	R	N	R	N	R	R
Alcohol Butyl (Butanol)	0.83	1.027	1.098	C	C	R	R	C	R	R	R	R
Alcohol Ethyl (Ethanol)	0.83	1.027	1.098	C	C	R	R	C	R	R	N	R
Ammonia	0.89	0.992	1.060	R	C	R	R	N	R	N	C	R
Benzine	0.69	1.127	1.204	C	R	R	C	R	N	N	R	R
Carbon Disulphide	1.26	0.834	0.891	R	N	R	R	R	N	N	R	R
Castor Oil	0.97	0.950	1.015	C	R	R	C	R	N	C	C	R
Cotton Seed Oil	0.93	0.970	1.037	C	R	R	R	R	N	R	R	R
Ethylene Glycol 50/50	1.12	0.884	0.945	R	R	R	R	R	R	R	C	R
Freon II	1.46	0.774	0.828	R	R	R	R	R	N	R	R	R
Gasoline	0.70	1.119	1.195	R	R	R	R	R	N	C	R	R
Glycerin	1.26	0.834	0.891	R	R	R	R	R	R	R	C	R
Kerosene	0.82	1.033	1.104	R	R	R	R	R	N	R	R	R
Liquid Propane (LPG)	0.51	1.310	1.400	R	R	R	R	R	N	N	R	R
Mineral Oil	0.92	0.976	1.042	R	N	R	R	R	N	R	R	R
Naphtha	0.76	1.074	1.147	R	N	R	R	R	N	C	R	R
Perchloroethylene	1.62	0.735	0.786	C	N	R	R	R	N	N	N	R
Petroleum Oil	0.876	1.000	1.068	R	R	R	R	R	N	R	R	R
Phosphate Ester	1.18	0.862	0.921	R	R	R	R	N	R	N	R	R
Phosphate Ester Base	1.26	0.833	0.891	R	R	R	R	N	R	N	R	R
Phosphoric Acid (Air Free)	1.78	0.701	0.749	N	N	R	N	R	N	R	N	R
Sea Water	1.03	0.922	0.985	N	N	C	C	N	R	R	R	R
Synthetic Petroleum Base	1.00	0.936	1.000	R	C	R	R	R	N	R	R	R
Water	1.00	0.936	1.000	N	R	R	R	N	R	R	R	R
Water Glycol 50/50	1.07	0.905	0.967	R	R	R	R	R	N	R	R	R
Water-in-oil	0.93	0.970	1.037	R	R	R	R	N	R	R	R	R
<i>R</i> —Recommended <i>N</i> —Not Recommended <i>C</i> —Consult Factory												

Table 2: Fluid selection chart

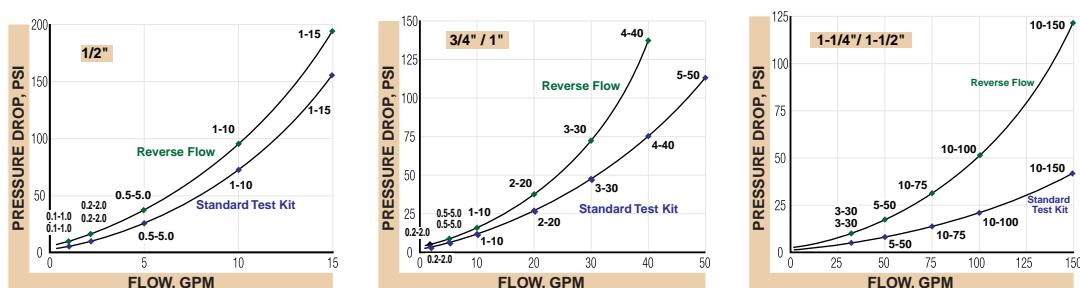
## Flow vs Pressure Drop

1. The pressure drop curves are valid for fluids with density and viscosity similar to factory test fluids. Fluids, especially with higher viscosity than these test fluids, will yield a higher pressure drop through the flow meter and piping system per a given flow volume.
2. A system must have adequate fluidic horsepower available to move the system fluid at a prescribed rate at a pressure adequate to overcome all pressure reducing devices, including the flow meter.

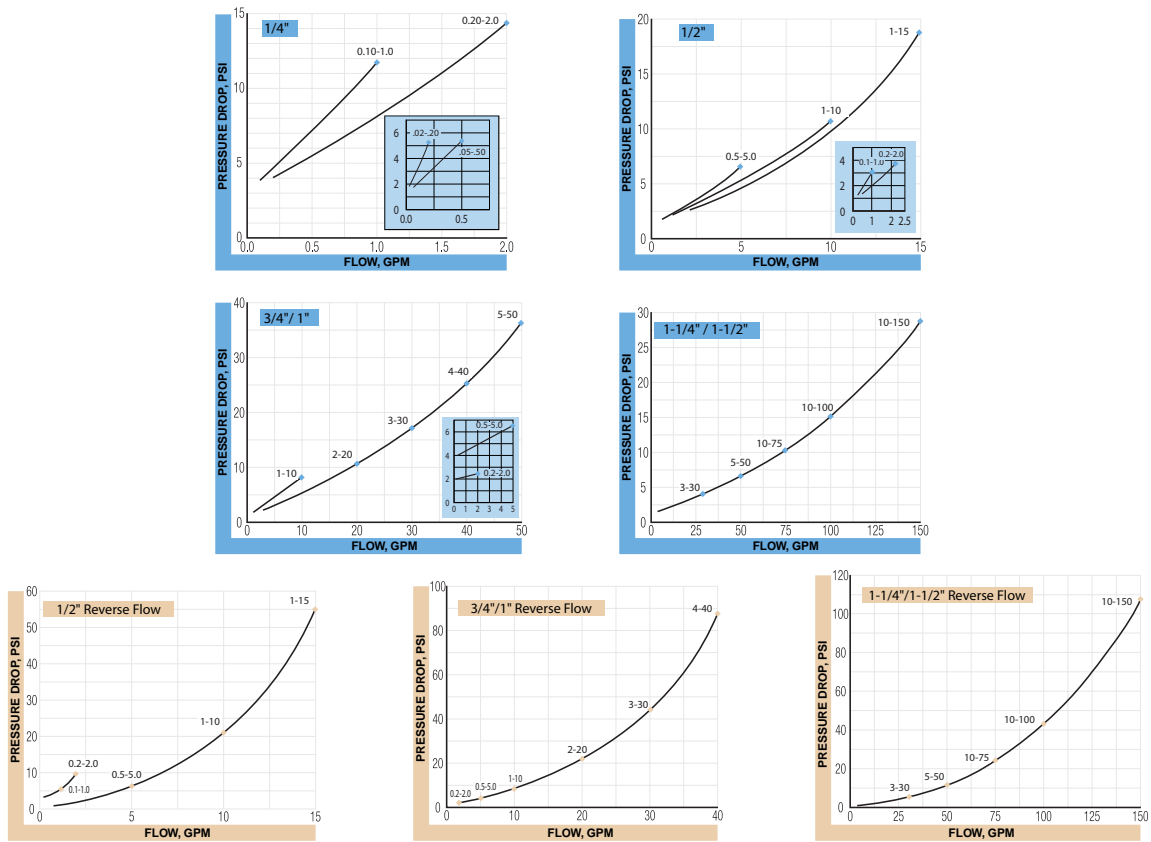
### Petroleum Fluids



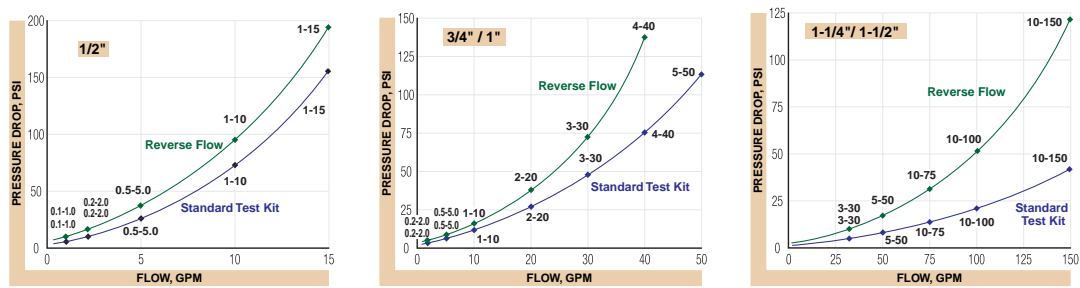
### Petroleum Test Kits



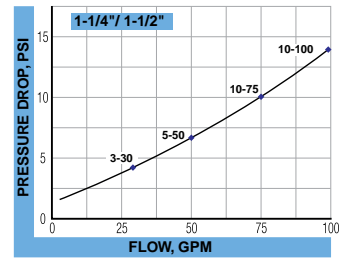
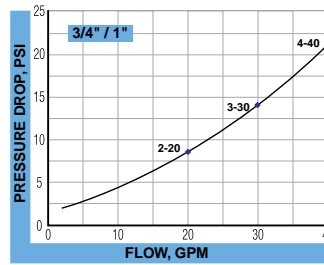
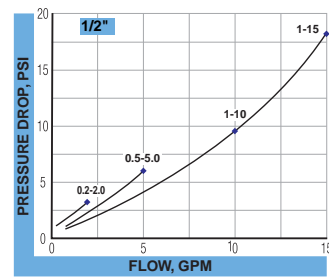
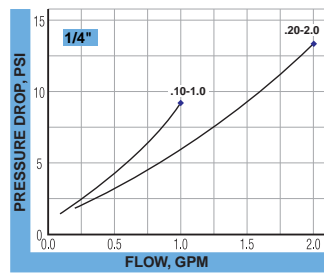
## Phosphate Ester



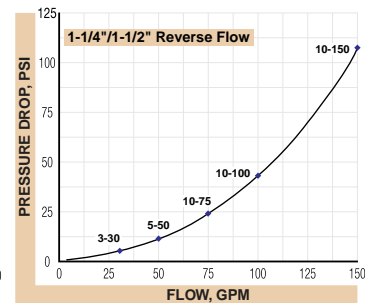
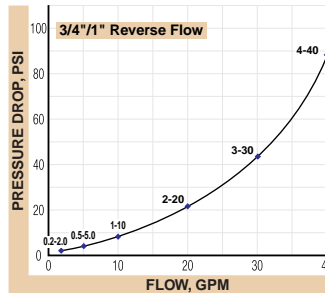
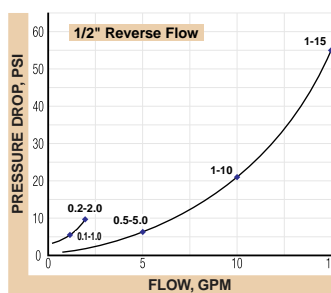
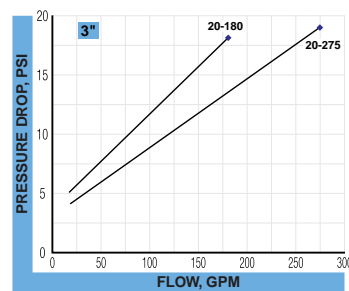
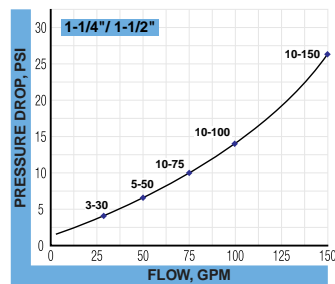
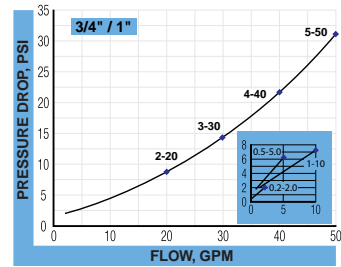
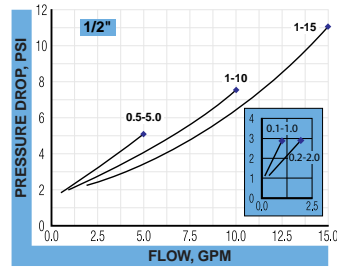
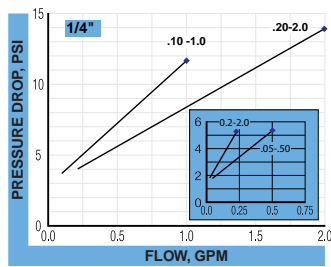
## Phosphate Ester Test Kits



## API Oil

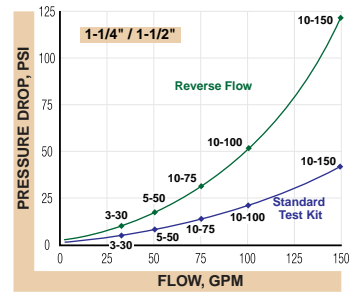
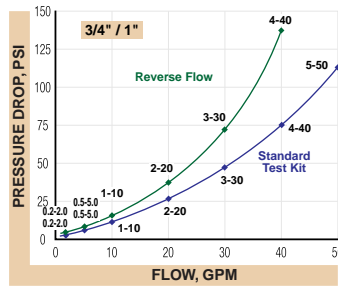
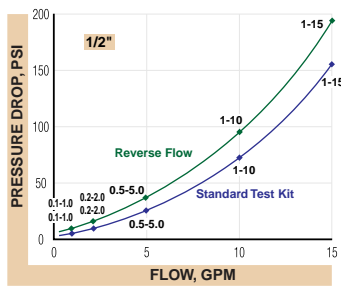


## Water-Based Fluids

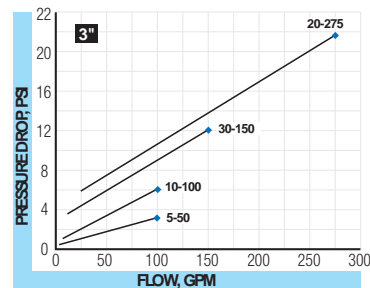
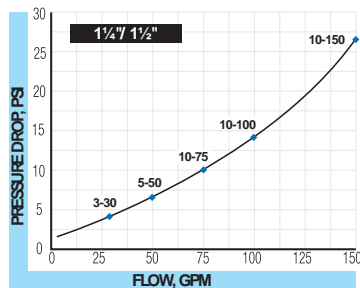
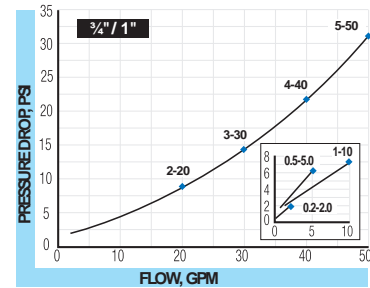
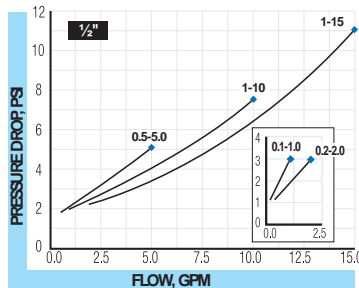
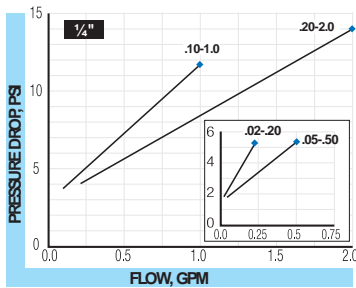




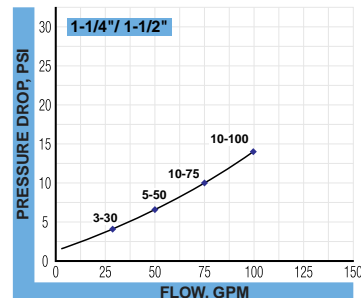
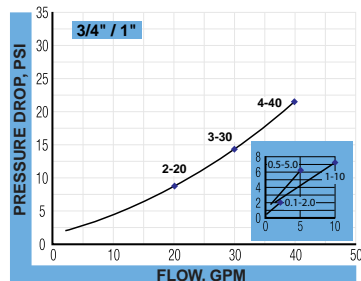
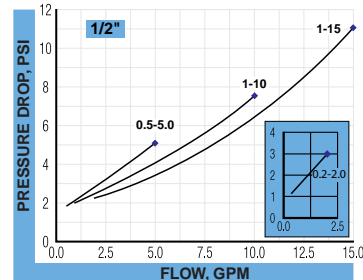
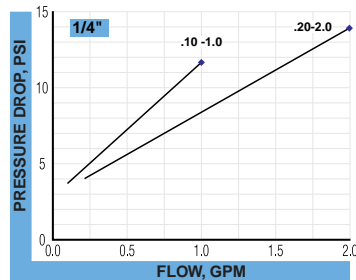
## Water-Based Test Kits



## Water



## Caustic and Corrosive Liquids



## SPECIFICATIONS

<b>Temperature Range</b>	Standard	–20...240° F (–29...116° C)
	High temperature and hostile environment	–20...400° F (–29...205° C) continuous 400...500° F (205...260° C) intermittent
<b>Pressure Rating (3:1 safety factor)</b>	Aluminum/brass models	3500 psi (241 bar) maximum
	Stainless steel models	1/4 in. and 1/2 in. sizes 6000 psi (414 bar) maximum 3/4...1-1/2 in. sizes 5000 psi (345 bar) maximum
<b>Pressure Drop</b>	See <i>“Flow vs Pressure Drop” on page 13</i> for specific meter information.	
<b>Accuracy</b>	±2% of full scale	
<b>Repeatability</b>	±1%	
<b>Threads</b>	SAE J1926/1, NPTF ANSI B2.2, BSPP ISO1179, <b>Code 61</b> and <b>Code 62</b> : SAEJ518	
<b>Test Kit Pressure Gauge, Glycerin Dampened</b>	Aluminum/brass models	0...3500 psi (0...240 bar)
	Stainless steel models	0...6000 psi (0...400 bar)
<b>Test Kit Load Valve</b>	1/2 in., 3/4 in. and 1 in. sizes	Needle valve
	1-1/4 in. and 1-1/2 in. sizes	Ball valve
	Produce $\Delta P$ up to 3500 psi (241 bar) PSID and 6000 psi (414 bar) PSID	

## Materials of Construction

### Basic Flow Meters and Test Kits

Meter Model	Body	Piston	Cone	Spider Plate	Spring	Fasteners	Pressure Seals	Guard	Retaining Ring	Retaining Spring	Indicator & Internal Magnet	Guard Seal/ Bumper	Scale Support	End Caps
Oil Basic & Test Kit	2024-T351 Anodized Aluminum			T316SS	T302SS	T303SS	Viton®	Polycarbonate	SAE 1070/1090 Carbon Steel	SAE 1070/1090 Carbon Steel	PPS/Ceramic	Buna N	6063-T6 Aluminum	Nylon ST
	C360 Brass¹													
	T303SS	2024-T351 Anodized Aluminum												
PE Basic & Test Kit	2024-T351 Anodized Aluminum			T316SS	T320SS	T303SS	EPR	Polycarbonate	SAE 1070/1090 Carbon Steel	SAE 1070/1090 Carbon Steel	PPS/Ceramic	EPR	6063-T6 Aluminum	Nylon ST
	C360 Brass													
	T303SS	2024-T351 Anodized Aluminum												
WBF Basic & Test Kit	2024-T351 Anodized Aluminum			T316SS	T302SS	T303SS	Viton®	Polycarbonate	T316SS	T316SS	PPS/Ceramic	Buna N	6063-T6 Aluminum	Nylon ST
	C360 Brass¹													
	T303SS	2024-T351 Anodized Aluminum												
Water Basic Only	C360 Brass¹			T316SS	T302SS	T303SS	Viton®	Polycarbonate	T316SS	T316SS	PPS/Ceramic	Buna N	6062-T6 Aluminum	Nylon ST
	T303SS	C360 Brass												

<sup>1</sup> 3" Models have Celcon® piston/piston ring

## API Oil/Caustic and Corrosive Liquids

Meter Model	Body	Piston	Cone	Spider Plate	Spring	Fasteners	Pressure Seals	Guard	Retaining Ring	Retaining Spring	Indicator & Internal Magnet	Guard Seal/Bumper	Scale Support	End Caps
Standard	T316SS			T316SS	T316SS	T316SS	Viton*	Polycarbonate	T316SS	T316SS	PPS/Ceramic	Buna N	6063-T6 Aluminum	Nylon ST
Hostile Environment	T316SS			T316SS	T316SS	T316SS	Viton*	Cylindrical Pyrex Glass	T316SS	T316SS	Indicator: T415S	T316SS	T316SS	T316SS
											Magnet: Teflon* Coated Alnico 8			

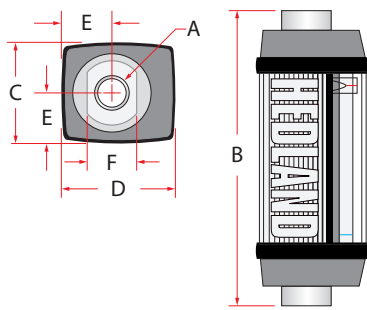
## High Temp Flow

Meter Model	Body	Piston	Cone	Spider Plate	Spring	Fasteners	Pressure Seals	Guard	Retaining Ring	Retaining Spring	Indicator & Internal Magnet	Guard Seal/Bumper	Scale Support	End Caps
Oil	2024-T351 Anodized Aluminum			T316SS	T302SS	T303SS	Viton®	Cylindrical Pyrex® Glass	SAE 1070/1090 Carbon Steel	SAE 1070/1090 Carbon Steel	Indicator: Nickel-plated Carbon Steel	Buna N	Scale: Polymide	2011-T3 Anodized Aluminum
	C360 Brass										Magnet: Teflon® Coated Alnico 8		Scale Support: T316SS	
	T303SS	2024-T351 Anodized Aluminum												
PE	2024-T351 Anodized Aluminum			T316SS	T320SS	T303SS	EPR	Cylindrical Pyrex® Glass	SAE 1070/1090 Carbon Steel	SAE 1070/1090 Carbon Steel	Indicator: Nickel-plated Carbon Steel	EPR	Scale: Polymide	2011-T3 Anodized Aluminum
	C360 Brass										Magnet: Teflon® Coated Alnico 8		Scale Support: T316SS	
	T303SS	2024-T351 Anodized Aluminum												
WBF	2024-T351 Anodized Aluminum			T316SS	T302SS	T303SS	Viton®	Cylindrical Pyrex® Glass	T316SS	T316SS	Indicator: Nickel-plated Carbon Steel	Buna N	Scale: Polymide	2011-T3 Anodized Aluminum
	C360 Brass¹										Magnet: Teflon® Coated Alnico 8		Scale Support: T316SS	
	T303SS	2024-T351 Anodized Aluminum												
Water	C360 Brass¹			T316SS	T302SS	T303SS	Viton®	Cylindrical Pyrex® Glass	T316SS	T316SS	Indicator: Nickel-plated Carbon Steel	Buna N	Scale: Polymide	2011-T3 Anodized Aluminum
											Magent: Teflon® Coated Alnico 8		Scale Support: T316SS	
	T303SS	C360 Brass												

<sup>1</sup> 3" Models have Celcon<sup>1</sup> piston/piston ring

# DIMENSIONS

## Standard Meter



A Nominal Port Size	B Length in. (mm)	C Width in. (mm)	D Depth in. (mm)	E Offset in. (mm)	F Flats in. (mm)
1/4 in. (SAE 6)	4.80 (122)	1.68 (43)	1.90 (48)	0.82 (21)	0.88 (22)
1/2 in. (SAE 10)	6.60 (168)	2.07 (53)	2.40 (61)	1.04 (26)	1.25 (32)
3/4 in. (SAE 12)	7.20 (183)	2.48 (63)	2.85 (72)	1.24 (32)	1.50 (38)
1 in. (SAE 16)	7.20 (183)	2.48 (63)	2.85 (72)	1.24 (32)	1.75 (44)
1-1/4 in. (SAE 20)	12.20 (310)	4.12 (105)	4.72 (120)	2.06 (52)	2.75 (70)
1-1/2 in. (SAE 24)	12.20 (310)	4.12 (105)	4.72 (120)	2.06 (52)	2.75 (70)

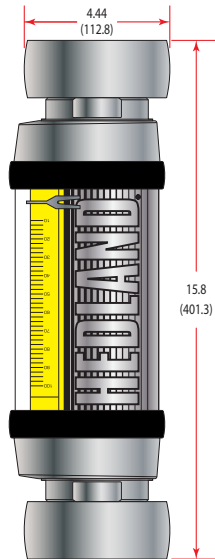
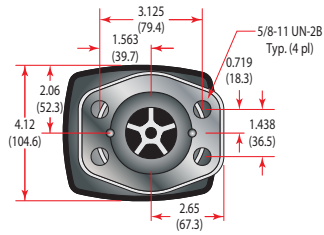


Figure 9: 1-1/2 inch; C62 Flange  
Inches (mm)

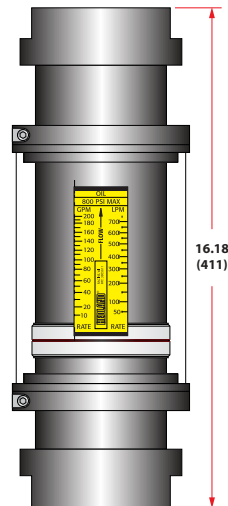
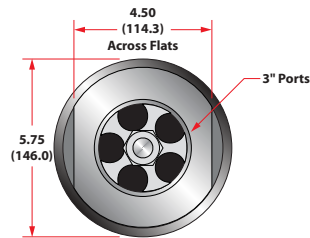


Figure 10: 3 inch; SAE, NPTF, BSPP  
Inches (mm)

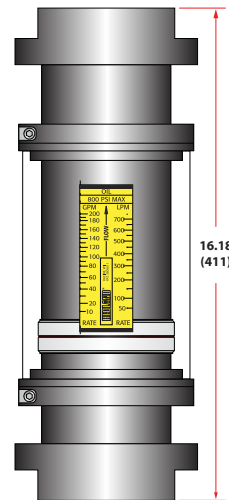
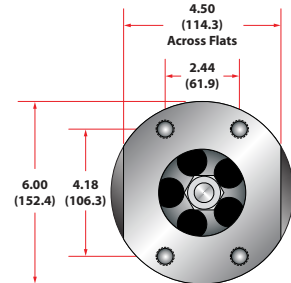
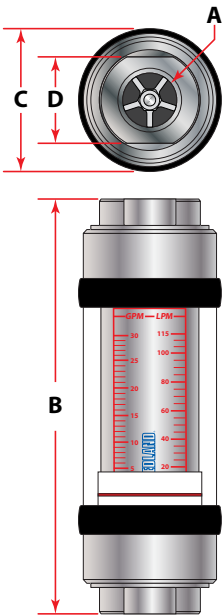


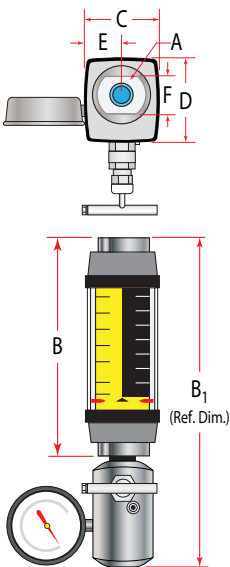
Figure 11: 3 inch; C61 Flange  
Inches (mm)

High Temp Meter



A Nominal Port Size	B Length in. (mm)	C Width in. (mm)	D Flats in. (mm)
1/4 in. (SAE 6)	6.60 (168)	2.01 (53)	1.25 (32)
1/2 in. (SAE 10)	6.60 (168)	2.01 (53)	1.25 (32)
3/4 in. (SAE 12)	7.20 (183)	2.48 (63)	1.50 (38)
1 in. (SAE 16)	7.20 (183)	2.48 (63)	1.75 (44)
1-1/4 in. (SAE 20)	12.20 (310)	4.20 (105)	2.75 (70)
1-1/2 in. (SAE 24)	12.20 (310)	4.20 (105)	2.75 (70)

Test Kit



A Nominal Port Size	B Length in. (mm)	B <sub>1</sub> Length in. (mm)	C Width in. (mm)	D Depth in. (mm)	E Offset in. (mm)	F Flats in. (mm)
1/2 in. (SAE 10)	6.60 (168)	9.60 (245)	2.07 (53)	2.40 (61)	1.04 (26)	1.25 (32)
3/4 in. (SAE 12)	7.20 (183)	10.70 (272)	2.48 (63)	2.85 (72)	1.24 (32)	1.50 (38)
1 in. (SAE 16)	7.20 (183)	10.70 (272)	2.48 (63)	2.85 (72)	1.24 (32)	1.75 (44)
1-1/4 in. (SAE 20)	12.20 (310)	20.50 (521)	4.12 (105)	4.72 (120)	2.06 (52)	2.75 (70)
1-1/2 in. (SAE 24)	12.20 (310)	20.50 (521)	4.12 (105)	4.72 (120)	2.06 (52)	2.78 (70)

Control. Manage. Optimize.



**MERCER VALVE CO., INC.**  
AUTO SEAT TECHNOLOGY®

## **9100 SERIES** **Threaded**



**THINK...MERCER FIRST™**



**MERCER VALVE**





## 9100 Series Threaded Product Overview

The Mercer Valve 9100 Series Pressure Relief Valve is "State of the Art" in soft seat, high flow rate, pressure relieving devices. The 9100 Series is a continuation of the 8100 Series, incorporating our patented **Auto Seat Technology®** into its design. Mercer Valve's **Auto Seat Technology®** has made the 9100 Series an industry leader with its reliable, repeatable set pressures. The patented soft seat design and fully guided disk allow the valve to continually outlast the competition. The soft seat 9100 Series has a field-proven lip seal design, which allows for a tighter seal up to set pressure. This tight seal reduces leaks and limits product loss.



The 9100 Series is manufactured in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 for Air/Gas and Liquid service. The 9100 Series is well suited for specialty gases, compressors, separators, transmission, gathering lines and other production processes.

### 9100 Series Threaded Features

- **Designed with Auto Seat Technology®.**
- **Consistent Set Pressures** allowing repeatable uses without repair or resetting.
- **Open, Close, Seat and Seal.**
- **Fully guided disk** keeps the disk properly aligned, opening and closing, helping to reseal the valve.
- **Mechanical Stop** prevents wear on parts and controls valve lift.
- **Low rated and fully guided spring** allows for more consistent set pressures from pop to pop.
- **Pop Action relief** allows valve to go to full lift at set pressure. Helps with DOT regulated applications.
- **Built in accordance with the requirements of ASME Boiler and Pressure Vessel Code. Sec. VIII Div 1.**
- **Non-rising stems** allowing valves to be installed in small areas.



## 9100 Series Threaded Specifications

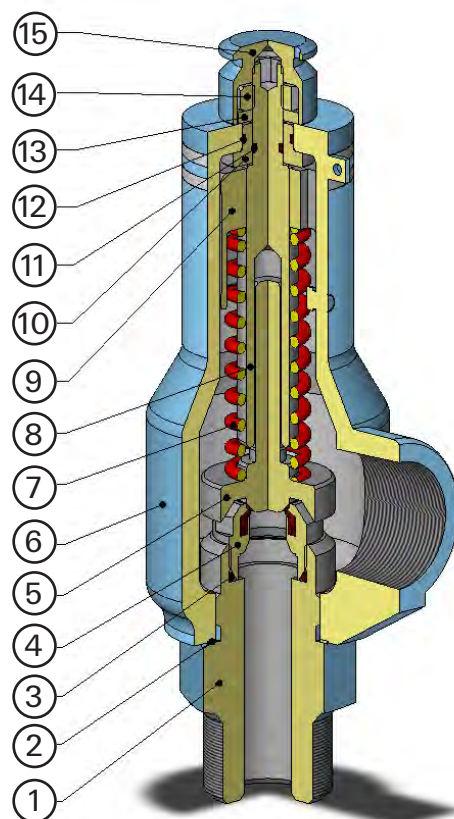
Orifice Letter	C	D	E	F	G	H	J	K
Standard Inlet Sizes	1/2", 3/4", 1"	3/4", 1"	3/4", 1"	1 1/2", 2"	1 1/2", 2"	1 1/2", 2"	2", 3"	3"
Inlet and Outlet Connection Types Available	Male NPT x Female NPT or Female NPT x Female NPT							
Actual Orifice Diameter (in)	.281	.394	.520	.655	.775	1.050	1.350	1.625
Actual Orifice Area (in <sup>2</sup> )	.062	.122	.212	.337	.472	.865	1.430	2.074
API Orifice Area (in <sup>2</sup> )	---	.110	.196	.307	.503	.785	1.287	1.838
Pressure Ranges (psi)	15 to 2999	15 to 2999	15 to 2400	15 to 2400	15 to 2000	15 to 2000	15 to 800	15 to 750
Standard Temperature Range (°F)	-20 to 400	-20 to 400	-20 to 400	-20 to 400	-20 to 400	-20 to 400	-20 to 400	-20 to 400
ASME Flow Coefficient, K <sub>d</sub> (Gas)	.818	.818	.818	.818	.818	.818	.818	.818
ASME Flow Coefficient, K <sub>d</sub> (Liquid)	.707	.707	.707	.707	.707	.707	.707	.707

**NOTE:** Mercer Valve reserves the right to change product designs and specifications without notice.





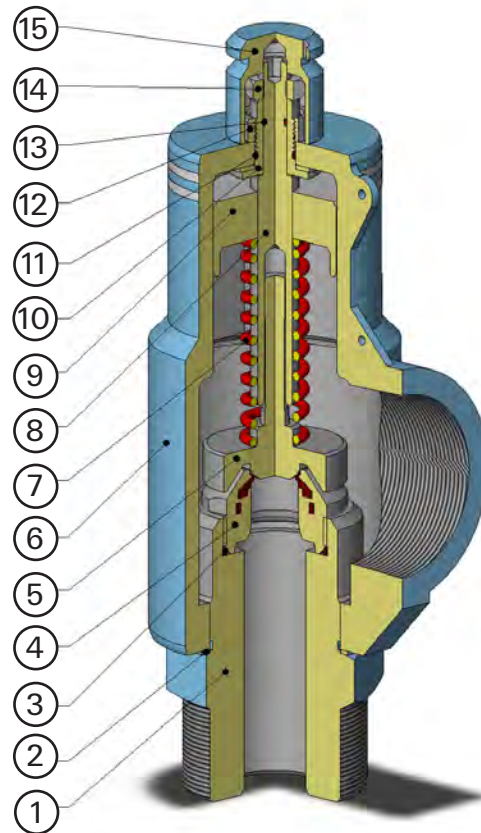
## 9100 Series Threaded Parts and Materials



### 9100 SERIES THREADED C , D , & E ORIFICES

ITEM NO	PART NAME	STANDARD MATERIALS
1	INLET BASE	CARBON STEEL
2	BASE SEAL	SOFT STEEL
3	NOZZLE O-RING	VITON
4	NOZZLE SUBASSEMBLY	STAINLESS STEEL WITH SOFT SEAT
5	DISK SUBASSEMBLY	STAINLESS STEEL
6	BODY SUBASSEMBLY	CARBON STEEL
7	SET SPRING	STAINLESS STEEL
8	ADJUSTMENT SCREW	STAINLESS STEEL
9	ADJUSTMENT BUSHING	STAINLESS STEEL
10	CENTER BUSHING	STAINLESS STEEL
11	ADJUSTMENT SCREW O-RING	BUNA N
12	CENTER BUSHING O-RING	BUNA N
13	WASHER	CARBON STEEL
14	LOCKNUT	CARBON STEEL
15	CLOSED CAP	ALUMINUM ALLOY

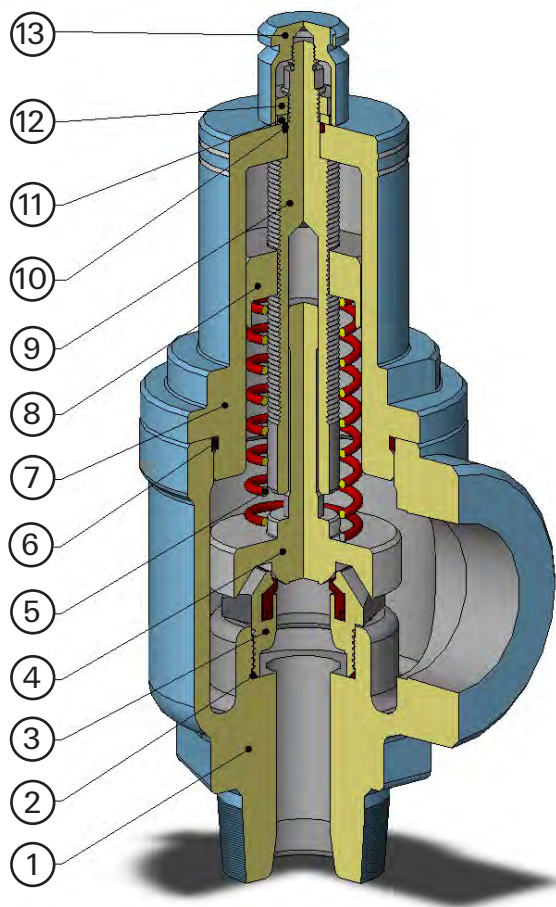
*NOTE: Mercer Valve reserves the right to change product designs and specifications without notice.*



### 9100 SERIES THREADED F & G ORIFICES

ITEM NO	PART NAME	STANDARD MATERIALS
1	INLET BASE	CARBON STEEL
2	BASE SEAL	SOFT STEEL
3	NOZZLE O-RING	VITON
4	NOZZLE SUBASSEMBLY	STAINLESS STEEL WITH SOFT SEAT
5	DISK SUBASSEMBLY	STAINLESS STEEL
6	BODY SUBASSEMBLY	CARBON STEEL
7	SET SPRING	STAINLESS STEEL
8	ADJUSTMENT SCREW	STAINLESS STEEL
9	ADJUSTMENT BUSHING	STAINLESS STEEL
10	CENTER BUSHING	STAINLESS STEEL
11	CENTER BUSHING O-RING	BUNA N
12	CENTER NUT	CARBON STEEL
13	ADJUSTMENT SCREW O-RING	BUNA N
14	LOCKNUT	CARBON STEEL
15	CLOSED CAP	ALUMINUM ALLOY

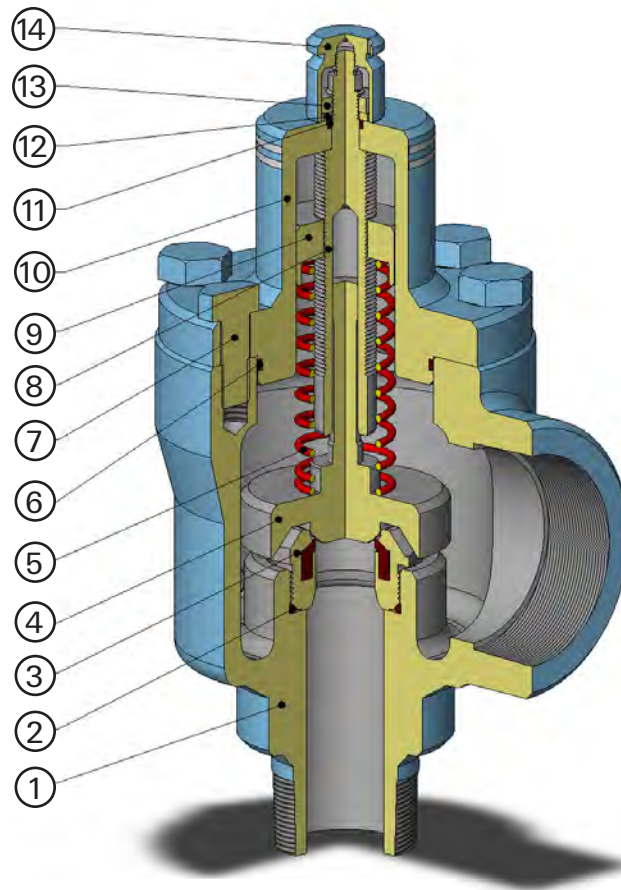
*NOTE: Mercer Valve reserves the right to change product designs and specifications without notice.*



### 9100 SERIES THREADED H ORIFICE

ITEM NO	PART NAME	STANDARD MATERIALS
1	BODY SUBASSEMBLY	CARBON STEEL
2	NOZZLE O-RING	VITON
3	NOZZLE SUBASSEMBLY	STAINLESS STEEL WITH SOFT SEAT
4	DISK SUBASSEMBLY	STAINLESS STEEL
5	SET SPRING	STAINLESS STEEL
6	BONNET O-RING	BUNA N
7	BONNET	CARBON STEEL
8	ADJUSTMENT BUSHING	STAINLESS STEEL
9	ADJUSTMENT SCREW	STAINLESS STEEL
10	ADJUSTMENT SCREW O-RING	BUNA N
11	WASHER	CARBON STEEL
12	LOCKNUT	CARBON STEEL
13	CLOSED CAP	ALUMINUM ALLOY

*NOTE: Mercer Valve reserves the right to change product designs and specifications without notice.*



### 9100 SERIES THREADED J & K ORIFICES

ITEM NO	PART NAME	STANDARD MATERIALS
1	BODY SUBASSEMBLY	CARBON STEEL
2	NOZZLE O-RING	VITON
3	NOZZLE SUBASSEMBLY	STAINLESS STEEL WITH SOFT SEAT
4	DISK SUBASSEMBLY	STAINLESS STEEL
5	SET SPRING	STAINLESS STEEL
6	BONNET O-RING	BUNA N
7	BONNET BOLTS	ALLOY STEEL
8	ADJUSTMENT SCREW	STAINLESS STEEL
9	ADJUSTMENT BUSHING	STAINLESS STEEL
10	BONNET SUBASSEMBLY	CARBON STEEL
11	ADJUSTMENT SCREW O-RING	BUNA N
12	WASHER	CARBON STEEL
13	LOCKNUT	CARBON STEEL
14	CLOSED CAP	ALUMINUM ALLOY

*NOTE: Mercer Valve reserves the right to change product designs and specifications without notice.*



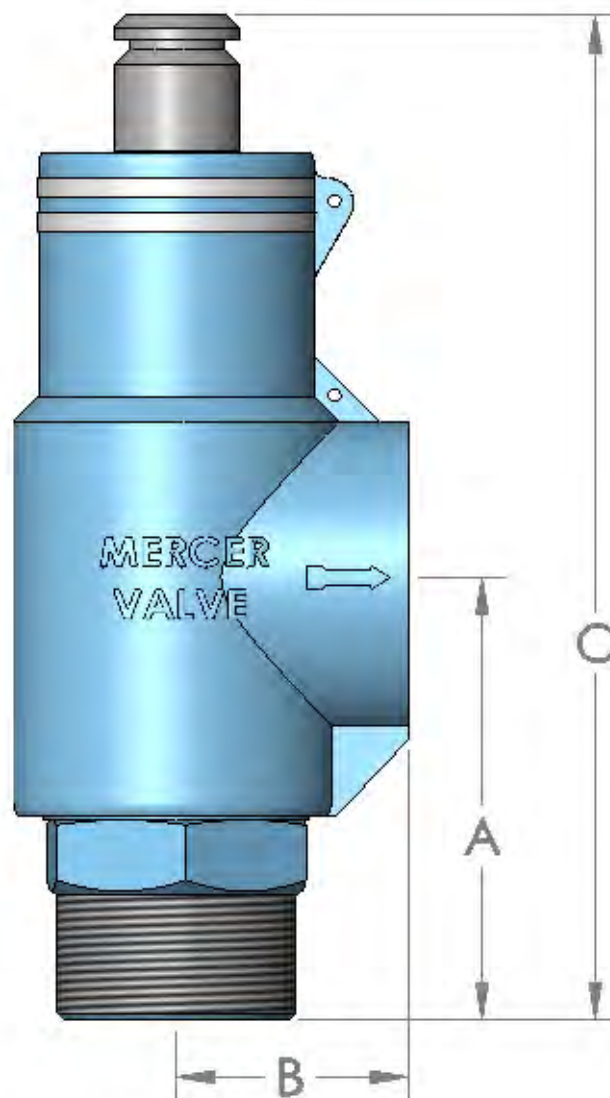
<b>INLET AND OUTLET CODE</b>	<b>INLET AND OUTLET SIZE</b>	<b>ORIFICE AVAILABLE</b>	<b>PRESSURE LIMIT (psi)</b>	<b>DIMENSIONS "A" X "B" X "C" (IN.) + 1/16</b>	<b>APPROX. WEIGHT (lbs.)</b>
05	1/2" FNPT x 1" FNPT	C	15 - 2999	2-1/4 x 1-7/8 x 7-1/16	4.5
06	1/2" MNPT x 1" FNPT	C	15 - 2999	3-1/4 x 1-7/8 x 8	4.5
11	3/4" FNPT x 1" FNPT	C , D	15 - 2999	2-1/4 x 1-7/8 x 7-1/16	4.5
11	3/4" FNPT x 1" FNPT	E	15 - 2400	2-1/4 x 1-7/8 x 7-1/16	4.5
12	3/4" MNPT x 1" FNPT	C , D	15 - 2999	3-1/4 x 1-7/8 x 8	4.5
12	3/4" MNPT x 1" FNPT	E	15 - 2400	3-1/4 x 1-7/8 x 8	4.5
16	1" FNPT x 1" FNPT	C , D	15 - 2999	3-1/4 x 1-7/8 x 8	4.5
16	1" FNPT x 1" FNPT	E	15 - 2400	3-1/4 x 1-7/8 x 8	4.5
17	1" MNPT x 1" FNPT	C , D	15 - 2999	3-1/4 x 1-7/8 x 8	4.5
17	1" MNPT x 1" FNPT	E	15 - 2400	3-1/4 x 1-7/8 x 8	4.5
22	1" FNPT x 1 1/2" FNPT	C , D	15 - 2999	3-3/8 x 2-3/8 x 9	10.5
22	1" FNPT x 1 1/2" FNPT	E	15 - 2400	3-3/8 x 2-3/8 x 9	10.5
23	1" MNPT x 1 1/2" FNPT	C , D	15 - 2999	4-1/2 x 2-3/8 x 9-5/8	11
23	1" MNPT x 1 1/2" FNPT	E	15 - 2400	4-1/2 x 2-3/8 x 9-5/8	11
27	1" FNPT x 2" FNPT	C , D	15 - 2999	3-3/8 x 2-3/8 x 9	10.5
27	1" FNPT x 2" FNPT	E	15 - 2400	3-3/8 x 2-3/8 x 9	10.5
28	1" MNPT x 2" FNPT	C , D	15 - 2999	4-1/2 x 2-3/8 x 9-5/8	11
28	1" MNPT x 2" FNPT	E	15 - 2400	4-1/2 x 2-3/8 x 9-5/8	11
33	1 1/2" FNPT x 2" FNPT	F	15 - 2400	4-5/8 x 2-3/8 x 10-5/16	11.5
33	1 1/2" FNPT x 2" FNPT	G	15 - 2000	4-5/8 x 2-3/8 x 10-5/16	11.5
34	1 1/2" MNPT x 2" FNPT	F	15 - 2400	4-7/16 x 2-3/8 x 10-1/16	11
34	1 1/2" MNPT x 2" FNPT	G	15 - 2000	4-7/16 x 2-3/8 x 10-1/16	11
33	1 1/2" FNPT x 2" FNPT	H	15 - 850	3 x 3 x 10-3/4	22
34	1 1/2" MNPT x 2" FNPT	H	15 - 850	4-1/4 x 3 x 12	22.5
42	2" FNPT x 2" FNPT	F	15 - 2400	4-5/8 x 2-3/8 x 10-5/16	12
42	2" FNPT x 2" FNPT	G	15 - 2000	4-5/8 x 2-3/8 x 10-5/16	12
43	2" MNPT x 2" FNPT	F	15 - 2400	4-7/16 x 2-3/8 x 10-1/16	12
43	2" MNPT x 2" FNPT	G	15 - 2000	4-7/16 x 2-3/8 x 10-1/16	12
42	2" FNPT x 2" FNPT	H	15 - 850	3 x 3 x 10-3/4	22
43	2" MNPT x 2" FNPT	H	15 - 850	4-1/4 x 3 x 12	23
46	2" FNPT x 2 1/2" FNPT	H	15 - 850	3 x 3 x 10-3/4	22
46	2" FNPT x 2 1/2" FNPT	H	851 - 2000	3 x 3 x 13-1/8	28
47	2" MNPT x 2 1/2" FNPT	H	15 - 850	4-1/4 x 3 x 12	23
47	2" MNPT x 2 1/2" FNPT	H	851 - 2000	4-1/4 x 3 x 14-1/2	29





INLET AND OUTLET CODE	INLET AND OUTLET SIZE	ORIFICE AVAILABLE	PRESSURE LIMIT (psi)	DIMENSIONS "A" X "B" X "C" (IN.) + 1/16	APPROX. WEIGHT (lbs.)
51	2" FNPT x 3" FNPT	J	15 – 450	3-3/4 x 4-1/4 x 11-3/4	41
51	2" FNPT x 3" FNPT	J	451 – 800	3-3/4 x 4-1/4 x 15-5/16	52
52	2" MNPT x 3" FNPT	J	15 – 450	5-1/2 x 4-1/4 x 13-3/8	42
52	2" MNPT x 3" FNPT	J	451 – 800	5-1/2 x 4-1/4 x 17-1/16	53
61	3" MNPT x 3" FNPT	J	15 – 450	5-1/2 x 4-1/4 x 13-1/2	44
61	3" MNPT x 3" FNPT	J	451 – 800	5-1/2 x 4-1/4 x 17-1/4	55
61	3" MNPT x 3" FNPT	K	15 – 285	5-1/2 x 4-1/4 x 13-1/2	46
61	3" MNPT x 3" FNPT	K	286 - 750	5-1/2 x 4-1/4 x 17-1/4	57

**NOTE:** Mercer Valve reserves the right to change product designs and specifications without notice.



**CAPACITY IN SCFM OF AIR AT 60°F AND STD ATMOSPHERIC CONDITIONS**

<b>Set Pressure (psi)</b>	<b>C 0.062</b>	<b>D 0.122</b>	<b>E 0.212</b>	<b>F 0.337</b>	<b>G 0.472</b>	<b>H 0.865</b>	<b>J 1.43</b>	<b>K 2.074</b>
<b>15</b>	30	60	104	165	231	424	701	1017
<b>20</b>	35	69	120	191	267	489	808	1172
<b>25</b>	40	78	136	216	302	554	916	1328
<b>30</b>	44	87	152	241	338	619	1023	1483
<b>50</b>	65	128	222	352	493	904	1495	2168
<b>75</b>	90	178	309	491	688	1261	2084	3023
<b>100</b>	116	228	396	630	883	1617	2674	3878
<b>125</b>	141	278	484	769	1077	1974	3264	4733
<b>150</b>	167	329	571	908	1272	2331	3853	5589
<b>200</b>	218	429	746	1186	1661	3044	5033	7299
<b>300</b>	320	631	1096	1742	2440	4471	7391	10720
<b>400</b>	423	832	1445	2298	3218	5898	9750	14141
<b>500</b>	525	1033	1795	2854	3997	7324	12109	17562
<b>600</b>	627	1234	2145	3409	4775	8751	14467	20983
<b>700</b>	730	1435	2494	3965	5554	10178	16826	24403
<b>800</b>	832	1637	2844	4521	6332	11605	19185	
<b>900</b>	934	1838	3194	5077	7111	13031		
<b>1000</b>	1036	2039	3544	5633	7889	14458		
<b>1100</b>	1139	2240	3893	6189	8668	15885		
<b>1250</b>	1292	2542	4418	7022	9836	18025		
<b>1500</b>	1548	3045	5292	8412	11782	21592		
<b>2000</b>	2059	4051	7040	11191	15675	28726		
<b>2400</b>	2468	4856	8439	13415				
<b>2600</b>	2673	5259						
<b>2800</b>	2877	5661						
<b>2999</b>	3081	6062						


**CAPACITY IN SCFM OF 0.6 SG NATURAL GAS AT 60°F AND STD ATMOSPHERIC CONDITIONS**

<b>Set Pressure (psi)</b>	<b>C 0.062</b>	<b>D 0.122</b>	<b>E 0.212</b>	<b>F 0.337</b>	<b>G 0.472</b>	<b>H 0.865</b>	<b>J 1.43</b>	<b>K 2.074</b>
<b>15</b>	38	75	130	206	289	529	875	1269
<b>20</b>	44	86	150	238	333	610	1008	1463
<b>25</b>	50	97	169	269	377	691	1142	1657
<b>30</b>	55	109	189	301	421	772	1276	1851
<b>50</b>	81	159	276	439	615	1128	1864	2704
<b>75</b>	113	222	385	613	858	1573	2600	3771
<b>100</b>	145	285	495	786	1101	2018	3336	4838
<b>125</b>	177	347	604	959	1344	2463	4071	5905
<b>150</b>	208	410	713	1133	1587	2908	4807	6972
<b>200</b>	272	536	931	1480	2072	3798	6278	9105
<b>300</b>	400	787	1367	2173	3043	5577	9220	13373
<b>400</b>	527	1038	1803	2866	4015	7357	12163	17640
<b>500</b>	655	1289	2239	3560	4986	9137	15105	21908
<b>600</b>	782	1540	2676	4253	5957	10917	18048	26175
<b>700</b>	910	1791	3112	4947	6928	12697	20990	30443
<b>800</b>	1038	2042	3548	5640	7899	14477	23932	
<b>900</b>	1165	2293	3984	6333	8871	16256		
<b>1000</b>	1293	2544	4420	7027	9842	18036		
<b>1100</b>	1420	2795	4857	7720	10813	19816		
<b>1250</b>	1612	3171	5511	8760	12270	22486		
<b>1500</b>	1931	3799	6602	10494	14698	26935		
<b>2000</b>	2568	5054	8783	13961	19554	35835		
<b>2400</b>	3079	6058	10527	16735				
<b>2600</b>	3334	6560						
<b>2800</b>	3589	7062						
<b>2999</b>	3843	7562						



**CAPACITY IN MMSCFD OF 0.6 SG NATURAL GAS AT 60°F AND STD ATMOSPHERIC CONDITIONS**

<b>Set Pressure (psi)</b>	<b>C 0.062</b>	<b>D 0.122</b>	<b>E 0.212</b>	<b>F 0.337</b>	<b>G 0.472</b>	<b>H 0.865</b>	<b>J 1.43</b>	<b>K 2.074</b>
<b>15</b>	0.05	0.11	0.19	.030	0.42	0.76	1.26	1.83
<b>20</b>	0.06	0.12	0.22	0.34	0.48	0.88	1.45	2.11
<b>25</b>	0.07	0.14	0.24	0.39	0.54	0.99	1.64	2.39
<b>30</b>	0.08	0.16	0.27	0.43	0.61	1.11	1.84	2.66
<b>50</b>	0.12	0.23	0.40	0.63	0.89	1.62	2.68	3.89
<b>75</b>	0.16	0.32	0.56	0.88	1.24	2.26	3.74	5.43
<b>100</b>	0.21	0.41	0.71	1.13	1.59	2.91	4.80	6.97
<b>125</b>	0.25	0.50	0.87	1.38	1.94	3.55	5.86	8.50
<b>150</b>	0.30	0.59	1.03	1.63	2.28	4.19	6.92	10.04
<b>200</b>	0.39	0.77	1.34	2.13	2.98	5.47	9.04	13.11
<b>300</b>	0.58	1.13	1.97	3.13	4.38	8.03	13.28	19.26
<b>400</b>	0.76	1.49	2.60	4.13	5.78	10.59	17.51	25.40
<b>500</b>	0.94	1.86	3.22	5.13	7.18	13.16	21.75	31.55
<b>600</b>	1.13	2.22	3.85	6.12	8.58	15.72	25.99	37.69
<b>700</b>	1.31	2.58	4.48	7.12	9.98	18.28	30.23	43.84
<b>800</b>	1.49	2.94	5.11	8.12	11.38	20.85	34.46	
<b>900</b>	1.68	3.30	5.74	9.12	12.77	23.41		
<b>1000</b>	1.86	3.66	6.37	10.12	14.17	25.97		
<b>1100</b>	2.05	4.02	6.99	11.12	15.57	28.54		
<b>1250</b>	2.32	4.57	7.94	12.62	17.67	32.38		
<b>1500</b>	2.78	5.47	9.51	15.11	21.17	38.79		
<b>2000</b>	3.70	7.28	12.65	20.10	28.16	51.60		
<b>2400</b>	4.43	8.72	15.16	24.10				
<b>2600</b>	4.80	9.45						
<b>2800</b>	5.17	10.17						
<b>2999</b>	5.53	10.89						



## CAPACITY IN GPM WATER AT 60°F AND STD ATMOSPHERIC CONDITIONS

Set Pressure (psi)	C 0.062	D 0.122	E 0.212	F 0.337	G 0.472	H 0.865	J 1.43	K 2.074
15	7	14	24	38	54	99	163	236
20	8	16	27	43	61	111	184	267
25	9	17	30	48	67	123	203	295
30	10	19	33	52	73	133	221	320
50	12	24	42	67	94	172	285	413
75	15	30	52	82	115	211	349	506
100	17	34	60	95	133	244	403	584
125	20	38	67	106	149	272	450	653
150	21	42	73	116	163	299	493	716
200	25	49	84	134	188	345	570	826
300	30	60	103	164	230	422	698	1012
400	35	69	119	190	266	487	806	1169
500	39	77	134	212	297	545	901	1307
600	43	84	146	233	326	597	987	1431
700	46	91	158	251	352	645	1066	1546
800	49	97	169	269	376	689	1140	
900	52	103	179	285	399	731		
1000	55	109	189	300	421	771		
1100	58	114	198	315	441	808		
1250	62	122	211	336	470	862		
1500	68	133	231	368	515	944		
2000	78	154	267	425	595	1090		
2400	86	168	293	465				
2600	89	175						
2800	92	182						
2999	96	188						



## 9100 Series Threaded Product Numbering System

**91 - 17 D 5 1**

### **VALVE SERIES**

91 – 9100 Series

### **INLET & OUTLET COMBINATION**

(See Selection Table  
on pages 8 & 9)

### **ORIFICE SIZE**

C to K

### **INLET BASE & BODY MATERIAL**

5 – CARBON STEEL/WCB  
CARBON STEEL

6 – 316 STNLS STL/WCB  
CARBON STEEL

7 – 316 STNLS STL/CF3M  
STAINLESS STEEL

### **CAP TYPE**

- 1 – CLOSED CAP
- 2 – OPEN LIFT LEVER
- 3 – CLOSED LIFT LEVER
- 4 – CLOSED CAP W/STAINLESS STEEL BONNET (H - K ORIFICE)
- 5 – OPEN LIFT LEVER W/STAINLESS STEEL BONNET (H - K ORIFICE)
- 6 – CLOSED LIFT LEVER W/STAINLESS STEEL BONNET (H - K ORIFICE)

CONSULT FACTORY FOR  
ADDITIONAL INFORMATION  
AND OPTIONS

**NOTE:** Mercer Valve reserves the right to change product designs and specifications without notice.



**2 - DIGIT "SPECIAL" CODE**

(IF APPLICABLE ASSIGNED BY MERCER)

**O-RING MATERIAL**

1 – STANDARD O-RINGS  
(VITON & BUNA-N)

**TRIM CODES**

U – 316 S.S. DISK & NOZZLE (STD GAS  
SERVICE F,G,H,J,&K ORIFICES)\*

I – 17-4 S.S. DISK & NOZZLE (STD GAS  
SERVICE D&E ORIFICES)

C – 440C S.S. DISK, 17-4 S.S. NOZZLE  
(STD GAS SERVICE C ORIFICE AND  
HIGH PRESSURE F,G,H,)\*

L – LIQUID SERVICE 316 S.S. DISK &  
NOZZLE

N – SOUR GAS SERVICE 316 S.S. DISK &  
NOZZLE

B – SOUR LIQUID SERVICE 316 S.S. DISK  
& NOZZLE

**SPRING CODE**

(ASSIGNED BY MERCER)

**SEAT MATERIAL**

V – VITON 90 DURO

T – 15% GLASS FILLED TEFLON

P – VIRGIN PEEK

\* = U TRIM CODE CHANGES TO C TRIM CODE AT  
F > 1399psi, G > 1199psi, H > 1049psi



## **9100 SERIES CATALOG**

### **CORPORATE HEADQUARTERS**

9609 NW 4th STREET  
OKLAHOMA CITY, OK 73127  
1-800-833-6402  
PHONE: (405) 495-6533, FAX: (405) 495-8728  
[SALES@MERCERVALVE.NET](mailto:SALES@MERCERVALVE.NET)

### **HOUSTON BRANCH OFFICE**

6218 LONG DRIVE  
HOUSTON, TX 77087  
1-866-833-6402  
PHONE: (713) 242-6960, FAX: (713) 242-6963  
[HOUSTON@MERCERVALVE.NET](mailto:HOUSTON@MERCERVALVE.NET)

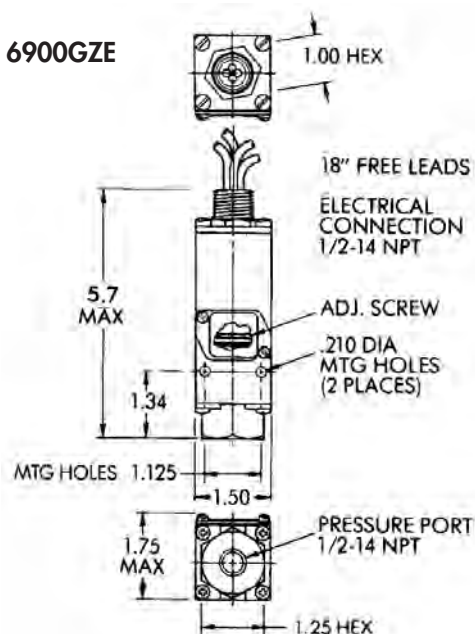
### **CALGARY BRANCH OFFICE**

#203, 2835 23rd St. NE  
CALGARY, ALBERTA T2E 7A4  
PHONE: (403) 250-5557, FAX: (403) 250-5661  
[CANADA@MERCERVALVE.NET](mailto:CANADA@MERCERVALVE.NET)

### **CHICAGO BRANCH OFFICE CUSTOMER RELATIONS DEPARTMENT**

P.O. Box 597  
Libertyville, IL 60048  
1-800-833-6402  
[CHICAGO@MERCERVALVE.NET](mailto:CHICAGO@MERCERVALVE.NET)

**[WWW.MERCERVALVE.NET](http://WWW.MERCERVALVE.NET)**

**INSTALLATION DRAWING**

6900GZE  
SHIPPING WT.  
APPROX. 19 OZ.  
(539 GRAMS)

Press. **1 to 2500** psi

## SERIES: 6900GZE

### Standard Features:

- U.L./CSA
- Explosion Proof:  
Div. 1, 2
- NEMA: 4, 7, 9, 13

### AMBIENT TEMP. RANGE

-30° to 160° F  
-34° to 71° C

**OPERATING AND ORDERING DATA:**

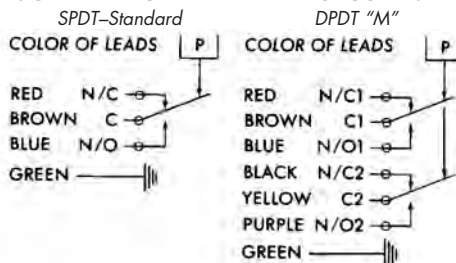
PRESSURE SWITCHES MODEL 6900GZE •		1/2" STAINLESS STEEL PRESSURE PORT AND DIAPHRAGM		Wetted Parts	316 SST Viton	
Max Sys. Press. psi	Proof (Test) Press. psi	Adjustable Set-Point Range		Approx. Dead- band psi	Model No.	
		On Incr. Press. psi	On Decr. Press. psi		MODEL SPDT-Std.	MODEL DPDT "M"
500	750	3-20	1-18	2	6900GZE12	6900GZEM12
500	750	9-75	3-69	6	6900GZE14	6900GZEM14
1500	2000	18-150	6-138	12	6900GZE16	6900GZEM16
1500	2000	45-375	15-345	30	6900GZE18	6900GZEM18
2000	3000	300-1000	225-925	75	6900GZE20	6900GZEM20
3000	4500	700-2500	520-2320	180	6900GZE22	6900GZEM22

**Options Code:**

"F" Ethylene Propylene O-ring  
 "7008" Gold Contacts  
 "7042" SST Body  
 "7043" SST Body & Gold Contacts  
 "7044" Monel Port & Diaphragm  
 "7045" Hastelloy Port & Diaphragm  
 "7052" Exp. Proof w/3' Leads  
 "7054" Exp. Proof w/6' Leads  
 "7065" Exp. Teflon Wire & SST Diaphragm

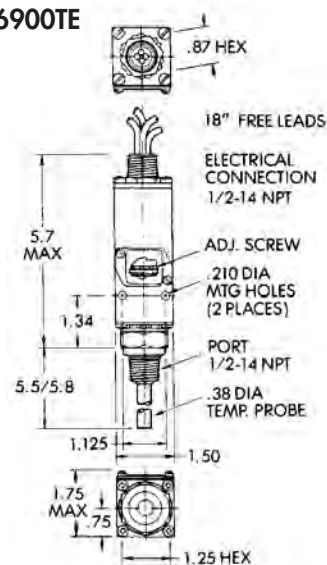
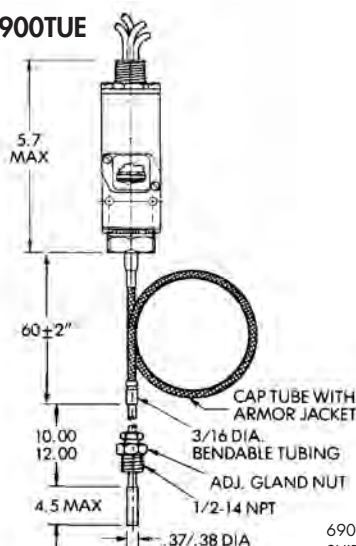
### ELECTRICAL CHARACTERISTICS: RATING OF SWITCH ELEMENT

VOLTS	AMPERES	
	SPDT Res.	DPDT "M" Res.
125 AC - 50/60 Hz	11	11
250 AC - 50/60 Hz	11	11
30 DC	5	5
125 DC	.5	.5

**SCHEMATIC AND WIRING CODE:****ENCLOSURE/CERTIFICATIONS:**

Div. 1 explosion-proof and hermetically sealed electrical assembly Part No. 46-1058 (46-1061 for "M" model option), listed by both Underwriter's Laboratories, Inc. (File No. E32961) and CSA Testing Laboratories (File No. 22921) for hazardous locations, Class 1, Groups A, B, C, and D; Class 2 Groups E, F, and G.

**HOW TO ORDER:** Specify model number, add desired "options" listing letter codes first followed by numbers:  
 Custom Control Sensors, Inc. • 21111 Plummer Street, Chatsworth, CA 91311 • Tel: (818)341-4610 • Fax: (818)709-0426  
 e-mail: switchnet@ccsdualsnap.com • http://www.ccsdualsnap.com

**INSTALLATION DRAWING****6900TE****6900TUE**

6900TE  
SHIPPING WT.  
APPROX. 21 OZ.  
(595 GRAMS)

6900TUE  
SHIPPING WT.  
APPROX. 29 OZ.  
(822 GRAMS)

Temp. **0 to 650° F****SERIES:  
6900TE  
6900TUE****6900TE Models  
with Probe****6900TUE Models  
with Capillary Tube****Standard Features:**

- U.L./CSA
- Explosion Proof: Div. 1, 2
- NEMA: 4, 7, 9, 13

**AMBIENT TEMP. RANGE**

**-30° to 160° F**  
**-34° to 71° C**

**OPERATING AND ORDERING DATA:**

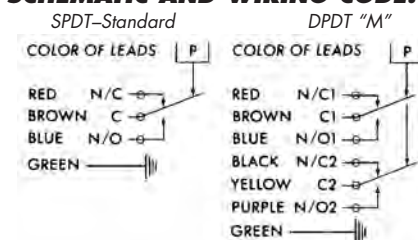
TEMPERATURE SWITCHES MODEL 6900TE			● STAINLESS STEEL TEMPERATURE PROBE		Wetted Parts		300 SST	
Maximum Probe Temperature Degrees F	Adjustable Set Point Range		Approx. Dead Band		Model Number			
	On Incr. Temperature Degrees F	On Decr. Temperature Degrees F	At Bottom of Range Degrees F	At Top of Range Degrees F	MODEL SPDT-Std.	MODEL DPDT "M"		
+200°	+20° to +120°	+0° to +113°	20°	5°	6900TE12	6900TEM12		
+300°	+80° to +205°	+60° to +198°	20°	5°	6900TE14	6900TEM14		
+400°	+185° to +315°	+165° to +308°	20°	5°	6900TE16	6900TEM16		
+500°	+280° to +405°	+260° to +398°	20°	5°	6900TE18	6900TEM18		

TEMPERATURE SWITCHES MODEL 6900TUE			● STAINLESS STEEL TEMPERATURE PROBE WITH 5' CAPILLARY TUBE		Wetted Parts		300 SST & Graphite Lubricated Glass Fiber	
+200°	+20° to +120°	+0° to +113°	20°	5°	6900TUE12	6900TUEM12		
+300°	+80° to +205°	+60° to +198°	20°	5°	6900TUE14	6900TUEM14		
+400°	+185° to +315°	+165° to +308°	20°	5°	6900TUE16	6900TUEM16		
+500°	+280° to +405°	+260° to +398°	20°	5°	6900TUE18	6900TUEM18		
+650°	+385° to +565°	+360° to +555°	25°	10°	6900TUE20	6900TUEM20		
+700°	+465° to +650°	+440° to +640°	25°	10°	6900TUE22	6900TUEM22		

**EXTERNAL PROBE PRESSURE****System Pressure: 1250 psi****Proof Pressure: 1500 psi****ELECTRICAL CHARACTERISTICS:**

RATING OF SWITCH ELEMENT

VOLTS	AMPERES	
	SPDT	DPDT "M"
	Res.	Res.
125 AC - 50/60 Hz	11	11
250 AC - 50/60 Hz	11	11
30 DC	5	5
125 DC	.5	.5

**SCHEMATIC AND WIRING CODE:****ENCLOSURE/CERTIFICATIONS:**

Div. 1 explosion-proof and hermetically sealed electrical assembly Part No. 46-1058 (46-1061 for "M" model option), listed by both Underwriter's Laboratories, Inc. (File No. E32961) and CSA Testing Laboratories (File No. 22921) for hazardous locations, Class 1, Groups A, B, C, and D; Class 2 Groups E, F, and G.

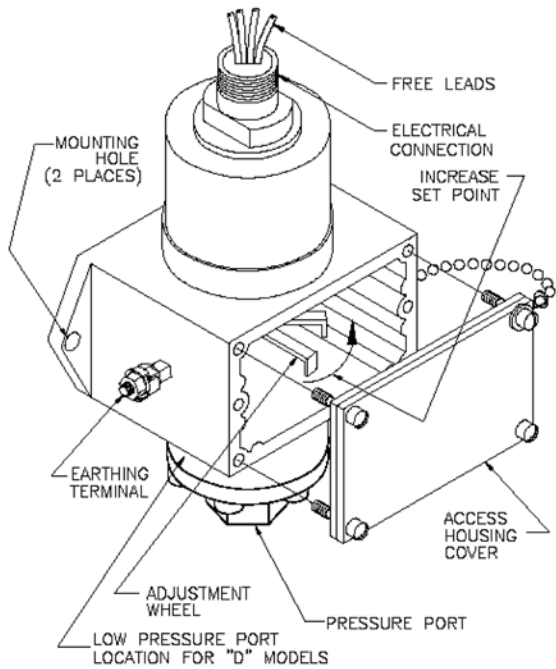
**HOW TO ORDER:** Specify model number, add desired "options" listing letter codes first followed by numbers:

See Page 23 for detail data on available Capillaries and Thermowells

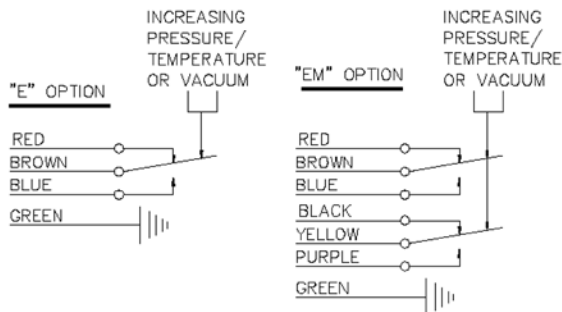
Custom Control Sensors, Inc. • 21111 Plummer Street, Chatsworth, CA 91311 • Tel: (818)341-4610 • Fax: (818)709-0426

e-mail: switchnet@ccsdualsnap.com • http://www.ccsdualsnap.com





WIRING DIAGRAM



NAMEPLATE ELECTRICAL RATINGS

BODY ASSEMBLY	VOLTAGE	MAX. CURRENT - STATIONARY (WAKE UP PRESSURE)	WATER (AMPERES)	
			10 PSI	20 PSI
"E"	125/250/450 VAC	15	30	5
	125 VDC	1.45	45	20
"EM"	125/250 VAC	5	20	20
	75 VDC	5	20	20

## FOR SERVICE OR ORDERING INFORMATION

Consult factory or authorized factory representative. Specify full catalog part number (with optional modification) and factory set-point.

## WARRANTY

All CCS products and services are sold subject to: "CCS standard terms and conditions of sale".

## Custom Control Sensors, Inc

21111 Plummer Street  
Chatsworth, CA 91311  
Tel: (818) 341-4610 • Fax: (818) 709-0426  
<http://www.ccsdualsnap.com>

CCS switches are designed to provide long life and maintain excellent set-point accuracy under adverse environmental conditions.

Check Nameplate on the switch for maximum proof (overpressure) or vacuum limits, as shown.

## I. GENERAL:

- Observe all Warnings and Cautions contained on the attached Warning Sticker, the Warning Declaration and the CCS Catalog.
- Follow all applicable Governmental or other Codes or Regulations.
- Special Conditions for Safe Use: The integral free lead wires shall or cable be mechanically protected and terminated in a suitable junction or terminal facility.

## II. MOUNTING:

- Units may be mounted in any position on a flat surface using (2) mounting holes provided and 1/4" screws at least 3/4" long.

**WARNING: RELEASE ALL PRESSURE PRIOR TO INSTALLATION OR REMOVAL OF THIS DEVICE. DO NOT EXCEED NAMEPLATE LISTED PROOF PRESSURES.**

- Units are supplied with female NPT ports as standard suitable for connection to NPT pipe nipples or NPT taper threaded pipe. CCS recommends use of either a union or bendable tubing. This will eliminate excessive strain on the housing.

- Pipe joint sealing compound is preferred over Teflon tape. However, either method of sealing is acceptable with proper care to avoid introducing sealing material into pressure switch or plumbing.

## III. ELECTRICAL CONNECTIONS:

**WARNING: DO NOT MAKE ELECTRICAL CONNECTIONS WHILE ELECTRICAL POWER IS ON. THIS PRODUCT MUST BE INSTALLED BY A QUALIFIED ELECTRICIAN TO AVOID RISK OF ELECTROCUTION.**

- Electrical conductors are provided within a male conduit connection.
- When making wire connections disconnect electrical power. Check for multiple circuits.
- Make electrical connections in accordance with the appropriate codes and regulations. Keep as much wire as possible for a service loop to facilitate service, see wiring diagrams.
- Proper grounding must be accomplished by use of the illustrated earthing terminal provided.

## IV. ADJUSTMENT:

Pressure settings are externally adjustable. (Not applicable if units are factory set)

- If the electrical circuit cannot be used for testing, disconnect electrical power and use a suitable circuit tester or light box.
- Remove access cover. Rotate adjustment wheel as illustrated with pressure port facing down; turn clockwise to increase settings or turn counterclockwise to decrease setting.
- Re-install access cover; d) Reconnect electrical circuit; e) Return power to unit.

Baseefa 03ATEX0699X



II 2 GD Ex d IIC  
T85°C Tamb -34°C/ +71°C  
T100°C Tamb -34°C/ +86°C

ELECTRICAL:

ELECTRICAL RATINGS.  
WIRING DIAGRAM OPTIONS.

SERIAL NO. YEAR

CE 1180  
IP66  
IP67

## WARNING DECLARATION

If this switch is used to protect equipment or personnel from unsafe pressure or to guard against the hazardous release of contained substances it must be installed and operated in accordance with applicable codes, regulations and standards. This switch must be used in conjunction with system design(s) or procedure(s) necessary to mitigate any hazard resulting from its failure. Conform to installation instructions accompanying this switch. Individuals who ignore this warning may suffer serious or fatal injury and do so at their own risk. Custom Control Sensors is not liable for any misuse, abuse, suitability or adequacy of user's application of the switch. Service by qualified personnel only.



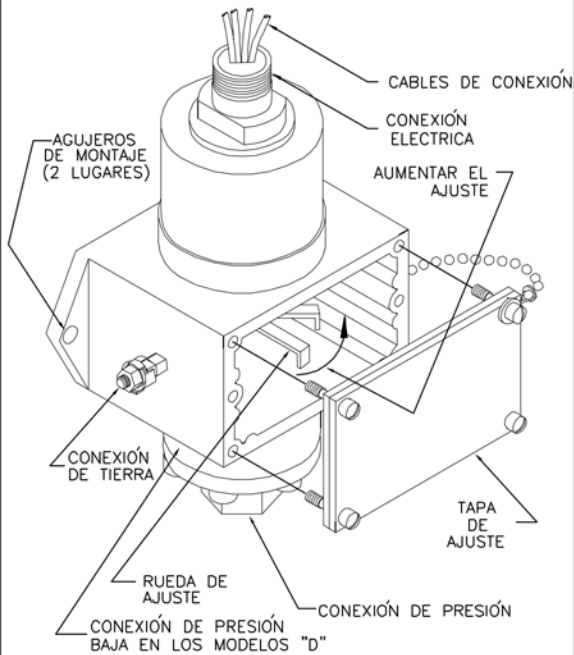
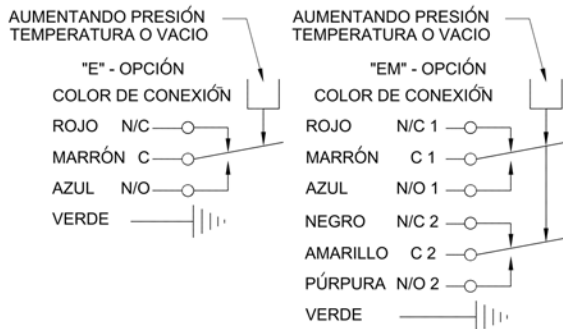


DIAGRAMA DE CONEXIONADO



CAPACIDADES DE RUPTURA

TIPO DE ENSAMBLAJE	VOLTAJE	MAXIMA CORRIENTE ELECTRICA (A)		
		ESTADO DE EQUILIBRIO	N.C.	N.O.
"E"	125/250/480 VAC	15	30	15
	125 VDC	0.40	40	20
"EM"	125/250 VAC	5	20	20
	28 VDC	5	24	24

Los presostatos y termostatos CCS han sido diseñados para una larga vida de operación y para mantener el punto de ajuste a lo largo del tiempo ante las más adversas condiciones ambientales.

Comprobar los límites de sobrepresión y vacío en la placa de identificación del aparato.

Baseefa 03ATEX0699X



II 2 GD Ex d IIC  
T85°C Tamb -34°C/ +71°C  
T100°C Tamb -34°C/ +86°C

ELECTRICAL:  
ELECTRICAL RATINGS.  
WIRING DIAGRAM OPTIONS.

CE 1180  
IP66  
IP67

SERIAL NO. YEAR

## I. GENERALIDADES:

a) Observar todas las Normas e indicaciones descritas en la etiqueta del aparato, la nota de Advertencia de estas instrucciones y cualquier otra al respecto en el catálogo de CCS-Dual-Snap.

b) Cumplir con la Formativa Legal en cada caso.

c) Especiales Condiciones de Seguridad: Los cables del aparato deberán cogerse dentro de una manguera ó conducto armado para protección mecánica y conectar los hilos en una caja antideflagrante.

## II. MONTAJE:

a) Los aparatos pueden montarse en cualquier posición sobre una superficie plana utilizando los dos (2) orificios de montaje previstos y utilizar tornillos M6x10.

**ADVERTENCIA: Liberar la presión antes de instalar ó desmontar el aparato. No superar nunca las presiones de prueba indicadas en la etiqueta del aparato.**

b) Los presostatos se suministran con conexiones a proceso hembra npt para uso con racores ó tubería roscada. CCS recomienda el uso de racorería y tubo calibrado. Esto eliminara cualquier tensión a la caja del aparato.

c) Se recomienda el uso de un sellante de roscas a la cinta de teflón aunque ambos métodos son aceptados siempre y cuando al usar cinta de teflón no introduzca trozos de ésta dentro de la conexión ó tubería que pudieran obstruir la presión.

## III. CONEXIONES ELECTRICAS:

**ADVERTENCIA: Sacar siempre la corriente para conectar y/o desconectar el aparato. La instalación deberá realizarse por un electricista cualificado.**

a) Los cables del microrruptor encapsulado salen de la caja a través de una conexión macho de 1/2" npt.

b) Desconectar la corriente. Ver el diagrama de cableado. Cablear el aparato sin corriente.

c) Proceder a la conexión eléctrica siguiendo la Normativa Vigente. No cortar demasiado los cables para una posible intervención posterior.

d) Conectar el aparato a tierra ó masa a través de la conexión de prevista en la caja.

## IV. AJUSTE:

(No se aplica si el aparato viene tarado en fábrica)

La presión de tarado se ajuste externamente.

a) Si para el ajuste ó comprobación no puede usar el propio circuito del aparato desconectar el presostato ó termostato y utilizar un circuito externo de comprobación ó tester.

b) Aflojar los cuatro (4) tornillos de la tapa frontal. Acceder a la rueda de ajuste. Aumentar el punto de disparo girando la rueda en el sentido de las agujas del reloj. En el sentido contrario disminuye el punto de disparo.

c) Volver a cerrar la tapa ó cubierta.

d) Reconectar el circuito eléctrico.

e) Devolver la alimentación al aparato.

## PARA SERVICIO O PEDIDOS

Consultar con fábrica ó un distribuidor autorizado. Especificar referencia completa del modelo y el punto de ajuste.

## GARANTIA

Todos los productos y servicios están sujetos a las Condiciones Generales y Términos de seguridad de CCS.

## Custom Control Sensors, Inc

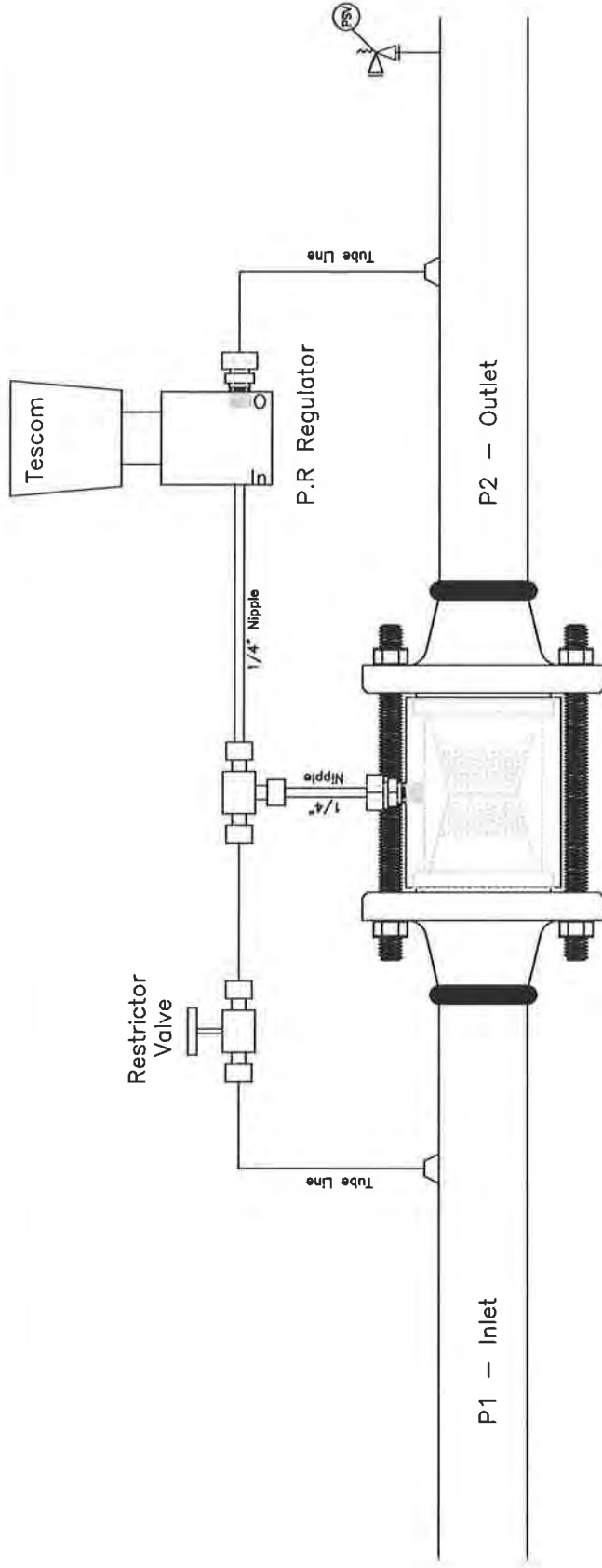
21111 Plummer Street  
Chatsworth, CA 91311

Tel: (818) 341-4610 • Fax: (818) 709-0426

<http://www.ccsdualsnap.com>

## ADVERTENCIA

Si el aparato en cuestión se usara para proteger equipos y/o personal contra sobrepresiones ó para resguardar éstos de fugas ó emisiones de sustancias peligrosas deberá instalarse y operarse correctamente de acuerdo con las Reglamentaciones y Normas vigentes. La instalación donde vayan a ser montados los interruptores deberá diseñarse de tal forma que los daños derivados por cualquier posible fallo de los aparatos queden minimizados. Ajustar la operación del aparato a las Instrucciones de Montaje e Instalación que se adjuntan. Cualquiera que pase por alto esta advertencia asume bajo su propia responsabilidad que puede sufrir serios daños ó incluso una fatal consecuencia. Custom Control Sensors no se hace responsable del mal uso ó de una instalación incorrecta del interruptor por parte del cliente. El mantenimiento del aparato solo debe ser realizado por personal calificado.



### Principle of Operation:

- \* The SF10V valve has an ease-in style housing that is placed in line between two flanges with the use of metal flexitalic gaskets, studs and nuts. The sensing lines are then attached to the P1 and P2 lines as per the above drawing (usually attaching to thread-o-lets).
- \* Setting the N.O Regulator / Pilot will determine the P2 pressure to be controlled. This is accomplished by turning the cap counter clockwise will reduce the P2 pressure clockwise. Turning the cap clockwise will increase the P2 pressure and turning the cap counter clockwise will increase the P2 pressure.
- \* The restrictor valve is used to adjust the sensitivity or response time of the SF10V valve. When commissioned, the restrictor valve must have a smaller cv (flow) than the regulator. Increasing the restrictor cv will cause the SF10V valve to lock up quickly as the P2 pressure approaches the regulators set pressure. Decreasing the restrictor cv will cause the SF10V valve to open quickly as the P2 pressure decreases (also caused by increased demand).
- \* Once the valve is up and operating the charge chamber gauge (CG), which is located on the inlet of the PR Regulator, will indicate how the valve is operating. If the CG pressure is equal to the P1 pressure, the valve is locked up and nothing is flowing thru the valve. As the CG pressure drops, this indicates that the valve is flowing (the lower the CG pressure is in relation to the P1 pressure, the more open the valve is).

### Field Commissioning:

- \* If the PR Valve is not factory set at start up, back the N.O. regulator off to restrict any flow through the SF10V valve to prevent accidentally exceeding P2 desired working pressure (counter clockwise - Caution must be taken that the charge chamber does not exceed the sleeves maximum allowable dp or damage may occur).
- \* Once P1 pressure is fully pressured up, start to open the N.O. regulator by screwing the cap down clockwise (this will start to allow flow through the valve).
- \* Continue to open the N.O. regulator until the desired P2 pressure is achieved.
- \* Before start up, have the restrictor valve 2 turn open. (Once system is up and running, the restrictor can be fine tuned to best fit your operating perimeters)

<b>SUR-FLO METERS &amp; CONTROLS LTD.</b> <b>CALGARY, ALBERTA</b>				Pressure Reducing Applications		
SCALE NTS	APPD.	TITLE:	DATE	DRN.	DWG. NO	REV.
				D.N.	SF10V PR	

# CATA-DYNE™ HEATER

## STANDARD HEATER APPLICATIONS

## INSTALLATION & OPERATION INSTRUCTIONS

**⚠ WARNING:** Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.



The Cata-Dyne™ heater can be used in all industrial indoor locations where a source of infrared radiant heat is required, providing adequate ventilation is available.

## CERTIFICATION

Model WX (Series X) Cata-Dyne™ Explosion-proof, flameless infrared catalytic gas heaters are certified by the Canadian Standards Association (CSA) for use in Class I, Divisions 1 and 2, Group D hazardous (classified) locations and Factory Mutual Global (FM), for use in Class I, Division 1, Group D hazardous (classified) locations, temperature code T2C at an ambient temperature of 40°C (104°F).

The Model BX (Series G) Cata-Dyne™ heater is certified by CSA and FM for use in general industrial non-hazardous locations. The MKII model (Series X) Explosion-proof, flameless infrared catalytic gas heater is certified by CSA for use in Class I, Divisions 1 and 2, Group D hazardous (classified) locations. Models listed are certified for industrial use only, for either natural gas or propane gas. CSA approved models are equipped for high altitudes: 0 - 4,500 ft. (0-1,370 m) above sea level.

## INSTALLATION

To ensure maximum efficiency of your Cata-Dyne™ heater, it should be installed with the heating surface positioned plus or minus 45° from the vertical plane at a height of no more than 8 ft. (2.44 m). All heaters must be installed in accordance with the latest revisions of the codes described in the table below and in accordance with any local codes and regulations. Before installing the heater, all information on the heater

### Cata-Dyne™ Heater - Models Available

WX Model (Series X)					
Approved for use in Class I, Division 1 and 2, Group D hazardous (classified) locations by both FM and CSA					
Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas		Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas	
	Max. Btu/hr	Max. kW		Max. Btu/hr	Max. kW
WX 6 x 6	1,000 Btu/hr	0.293 kW	WX 18 x 24	12,000 Btu/hr	3.514 kW
WX 6 x 12	2,000 Btu/hr	0.586 kW	WX 18 x 30	15,000 Btu/hr	4.393 kW
WX 6 x 24	4,000 Btu/hr	1.171 kW	WX 18 x 36	18,000 Btu/hr	5.272 kW
WX 6 x 60	10,000 Btu/hr	2.929 kW	WX 18 x 48	24,000 Btu/hr	7.029 kW
WX 8 x 8	1,778 Btu/hr	0.521 kW	WX 18 x 60	30,000 Btu/hr	8.786 kW
WX 10 x 12	3,333 Btu/hr	0.976 kW	WX 18 x 72	36,000 Btu/hr	10.543 kW
WX 12 x 12	4,000 Btu/hr	1.171 kW	WX 24 x 24	16,000 Btu/hr	4.686 kW
WX 12 x 24	8,000 Btu/hr	2.343 kW	WX 24 x 30	20,000 Btu/hr	5.857 kW
WX 12 x 36	12,000 Btu/hr	3.514 kW	WX 24 x 36	24,000 Btu/hr	7.029 kW
WX 12 x 48	16,000 Btu/hr	4.686 kW	WX 24 x 48	32,000 Btu/hr	9.372 kW
WX 12 x 60	20,000 Btu/hr	5.857 kW	WX 24 x 60	40,000 Btu/hr	11.715 kW
WX 12 x 72	24,000 Btu/hr	7.029 kW	WX 24 x 72	48,000 Btu/hr	14.058 kW
BX Model (Series G)					
Approved for use in general industrial non-hazardous locations by both FM and CSA					
Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas		Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas	
	Max. Btu/hr	Max. kW		Max. Btu/hr	Max. kW
BX 6 x 6	1,500 Btu/hr	0.4 kW	BX 18 x 24	18,000 Btu/hr	5.3 kW
BX 6 x 12	3,000 Btu/hr	0.9 kW	BX 18 x 30	22,500 Btu/hr	6.6 kW
BX 6 x 24	6,000 Btu/hr	1.8 kW	BX 18 x 36	27,000 Btu/hr	7.9 kW
BX 8 x 8	3,500 Btu/hr	1.0 kW	BX 18 x 48	36,000 Btu/hr	10.5 kW
BX 10 x 12	5,000 Btu/hr	1.5 kW	BX 18 x 60	45,000 Btu/hr	13.2 kW
BX 12 x 12	6,000 Btu/hr	1.8 kW	BX 18 x 72	54,000 Btu/hr	15.8 kW
BX 12 x 24	12,000 Btu/hr	3.5 kW	BX 24 x 24	24,000 Btu/hr	7.0 kW
BX 12 x 36	18,000 Btu/hr	5.3 kW	BX 24 x 30	30,000 Btu/hr	8.8 kW
BX 12 x 48	24,000 Btu/hr	7.0 kW	BX 24 x 36	36,000 Btu/hr	10.5 kW
BX 12 x 60	30,000 Btu/hr	8.8 kW	BX 24 x 48	48,000 Btu/hr	14.1 kW
BX 12 x 72	36,000 Btu/hr	10.5 kW	BX 24 x 60	60,000 Btu/hr	17.5 kW
			BX 24 x 72	72,000 Btu/hr	21.0 kW
MKII Model (Series X)					
Approved for use in Class I, Division 1 and 2, Group D hazardous (classified) locations by both FM and CSA					
Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas		Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas	
	Max. Btu/hr	Max. kW		Max. Btu/hr	Max. kW
MKII 12 x 12	4,000 Btu/hr	1.171 kW			
MKII 12 x 24	8,000 Btu/hr	2.343 kW			
MKII 18 x 24	12,000 Btu/hr	3.514 kW			
MKII 24 x 24	16,000 Btu/hr	4.686 kW			

Model WX Series Heaters are certified for use in Class I, Division 1 and 2, Group D hazardous locations by both FM and CSA/CGA

The WX Series Cata-Dyne™ features an improved efficiency catalyst pad that requires 1/3 less fuel to generate the same heat value as our BX Series Cata-Dyne™ heater.



Head Office & Factory:  
5918 Roper Road, Edmonton, Alberta, Canada T6B 3E1  
Telephone: (780) 466-3178 Fax: (780) 468-5904  
Toll Free: 1-800-661-8529

E-mail: [info@ccithermal.com](mailto:info@ccithermal.com)

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

Date of issue: July 2003

nameplate must be carefully reviewed. The nameplate lists all the fuel and electrical requirements for the heater.

All Cata-Dyne™ Heaters Installed in Canada	All Cata-Dyne™ Heaters installed in the United States
CSA/CAN – C22.1-02, Canadian Electrical Code CSA/CAN – B149.1-00, Natural Gas and Propane Installation Code	NFPA 70, National Electrical Code NFPA 54, National Fuel Gas Code

# SPECIFICATIONS

## Clearances

Appropriate clearances from the heating surface must be observed during the installation of the Cata-Dyne™ heaters (See Figure 1). Maintain nameplate clearances from combustible materials such as wood, cloth, paper, etc.

## Fuels

The Cata-Dyne™ flameless gas heater is designed to operate on clean, dry natural or propane gas as specified

on the heater nameplate.

Natural Gas – these heaters are designed to use natural gas (1000 Btu/ft<sup>3</sup>, 37 MJ/m<sup>3</sup>) at 7 in. w.c. (1.73 kPa), 4.5 in. w.c. (1.12 kPa), or 3.5 in. w.c. (0.86 kPa).

Propane – these heaters are designed to use propane gas (2500 Btu/ft<sup>3</sup>, 88 MJ/m<sup>3</sup>) at 11 in. w.c. (2.72 kPa).

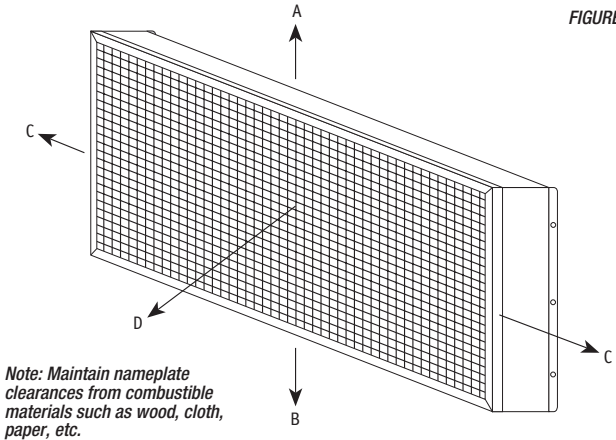


FIGURE 1

HEATER CLEARANCE										
	Radiant Surface			Sides	Top			Bottom		
Radiant Surface Position	Heaters Up To 12,000 Btu/hr	Over 12,000 Up To 48,000 Btu/hr	Over 48,000 Up To 72,000 Btu/hr	All Heaters Up To 72,000 Btu/hr	Heaters Up To 12,000 Btu/hr	Over 12,000 Up To 48,000 Btu/hr	Over 48,000 Up To 72,000 Btu/hr	Heaters Up To 12,000 Btu/hr	Over 12,000 Up To 48,000 Btu/hr	Over 48,000 Up To 72,000 Btu/hr
Vertical (0°)	28 in.	42 in.	60 in.	12 in.	18 in.	18 in.	42 in.	7 in.	12 in.	18 in.
0-45° up	28 in.	42 in.	60 in.	12 in.	18 in.	32 in.	54 in.	0 in.	12 in.	18 in.
0-45° down	28 in.	42 in.	60 in.	12 in.	18 in.	18 in.	18 in.	22 in.	24 in.	42 in.

## Piping

1. A main shut-off valve must be installed upstream of all auxiliary heater controls.
2. The 100% safety shut-off valve and appliance regulator (natural gas heaters only) must be installed in the upright position.
3. The thermostatic temperature controller should be installed with the dial shaft in the horizontal position.
4. The maximum inlet pressure to the 100% safety shut-off valve, thermostatic temperature controller and appliance regulator is 1/2 psi (3.4 kPa). If the inlet pressure is higher than this, a low-pressure service regulator must be installed upstream of these components.
5. The maximum inlet pressure to the low-pressure service regulator is 250 psi (1.7 MPa). If the inlet pressure is higher than this, a high-pressure regulator must be installed upstream.
6. All components should be installed as indicated in Figure 2 (WX and BX models only) or Figure 3 (MKII model only).

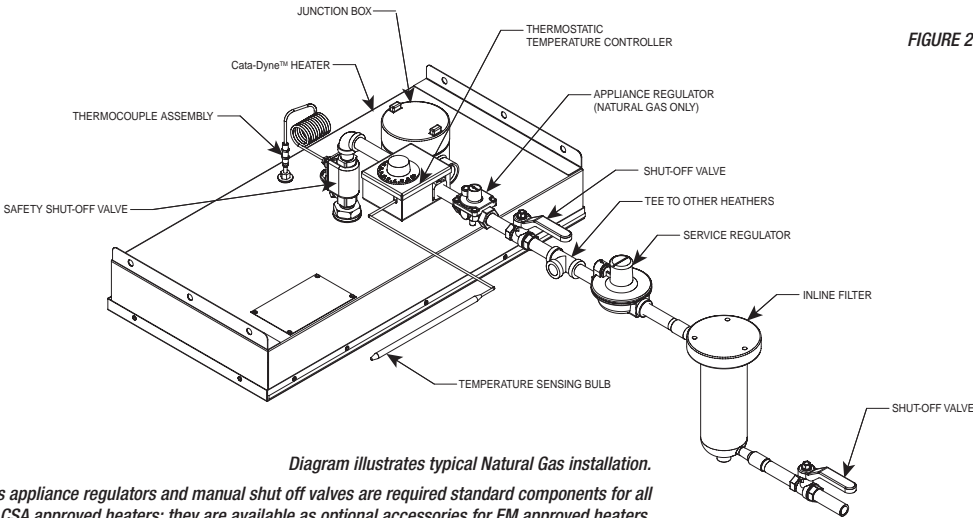


FIGURE 2

Diagram illustrates typical Natural Gas installation.  
Gas appliance regulators and manual shut off valves are required standard components for all CSA approved heaters; they are available as optional accessories for FM approved heaters.

## Electrical

1. All wiring is to be installed in accordance with the latest revisions of the Canadian Electrical Code (CEC) and/or any applicable local codes.
2. It is desirable to install an indicating light on all starting systems. This will reduce the possibility of the power being left on once the heater is started, which can severely reduce the lifespan of the heater.
3. Ground connections for 120 V and above heaters are required as indicated in Figures 4 and 5.
4. The number of terminals in the junction box can be two or four depending on the number of elements used in the fabrication of the heater. All MKII models incorporate a single element and therefore have only two terminals. The connection procedure for the different combinations is as described in Figures 4 and 5:

## Ventilation

The catalytic reaction in Cata-Dyne™ heaters occurs when natural gas or propane reacts with oxygen to produce water vapor, carbon dioxide and infrared energy. Ventilation must be provided to allow an adequate supply of oxygen for the reaction.

For every 1.0 ft<sup>2</sup> (0.093 m<sup>2</sup>) of heater surface, 40 ft<sup>3</sup>/hr (1.13 m<sup>3</sup>/hr) of air supply is required. For example, a WX 24 x 24 heater (16,000 Btu/hr / 4.686 kW ) would require 160 ft<sup>3</sup>/hr (4.53 m<sup>3</sup>) of air to ensure proper operation of the Cata-Dyne™ heater.

To reduce the carbon dioxide and water vapor concentrations in the building, a vent hood assembly can be installed to provide positive ventilation from the heater (See Figure 6).

FIGURE 4

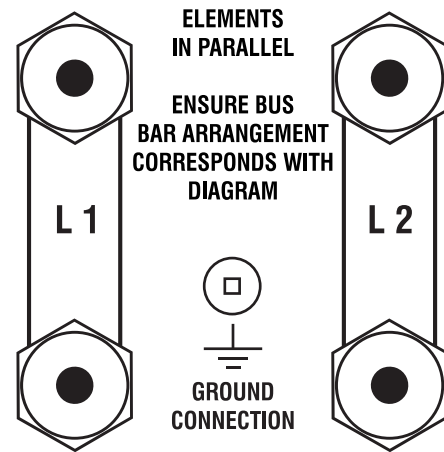


FIGURE 5

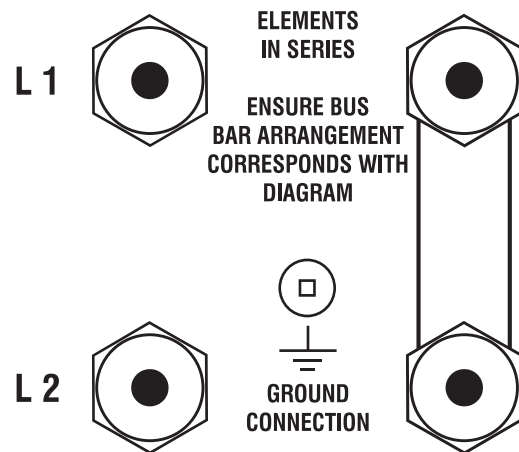


FIGURE 3

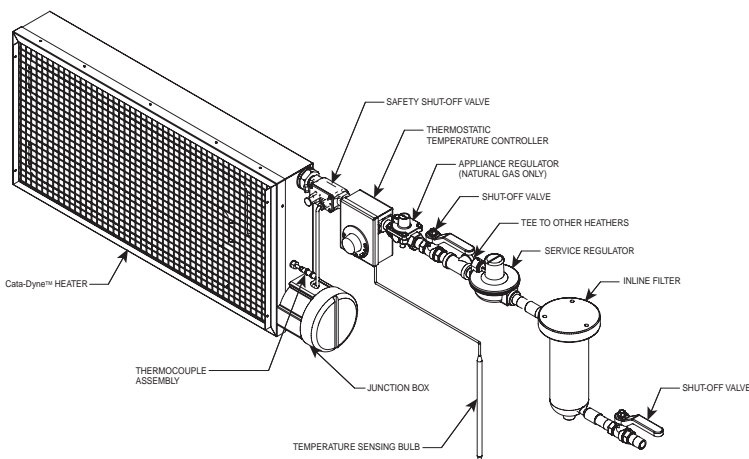
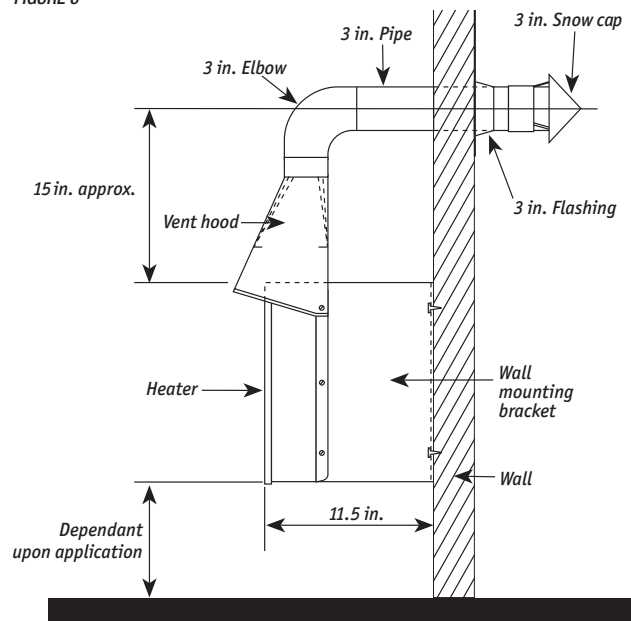


Diagram illustrates typical Natural Gas installation.

Gas appliance regulators and manual shut off valves are required standard components for all CSA approved heaters; they are available as optional accessories for FM approved heaters.

FIGURE 6





## OPERATION

All Cata-Dyne™ heaters are supplied with a Safety Shut-Off Valve (SSOV)/Thermocouple assembly to ensure the safe operation of the heater. Under no circumstances should the reset button be held or locked into the depressed position by use of a mechanical restraint. A tamper resistant model SSO V is available if desired.

### Start-up

1. Ensure the heater has been installed according to all instructions and relevant codes.
2. Turn on the main gas supply to the system.
3. If the heater is equipped with a thermostatic temperature controller, rotate the dial completely clockwise to the fully open position.
4. Turn on the power to the electrical elements.
5. After 15 minutes, depress the reset button on the top of the 100% safety shut-off valve. The button should return to the original position and internally open the valve and allow gas to flow to the heater. If the valve does not stay open when the reset button is released, it may be necessary to wait an additional few minutes and then depress the reset button again. This will allow the electrical elements additional time to warm up.
6. When the catalytic reaction is well established, turn off the electrical power to the elements.
7. If the heater is equipped with a thermostatic temperature controller, it can be set to the desired setting after the catalytic reaction has been established for at least one hour.

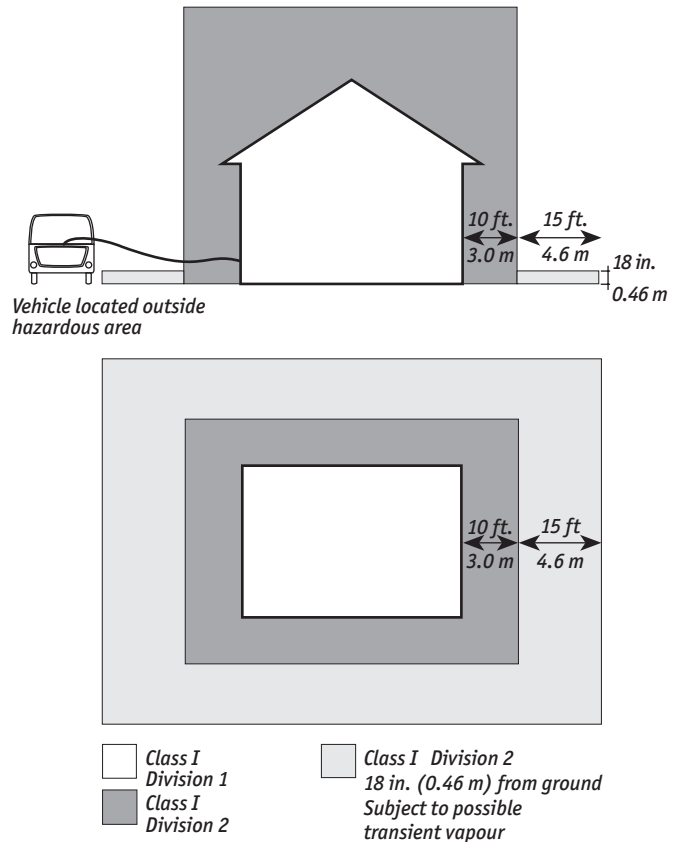
### Shut down

Turn off the gas supply to the heater.

### Multi-heater start-up

Cata-Dyne™ heaters can also be purchased/installed in multi-heater assemblies. If these assemblies are 12 V, each heater must be started individually. This ensures the correct voltage and current will be reaching the heater from the power supply.

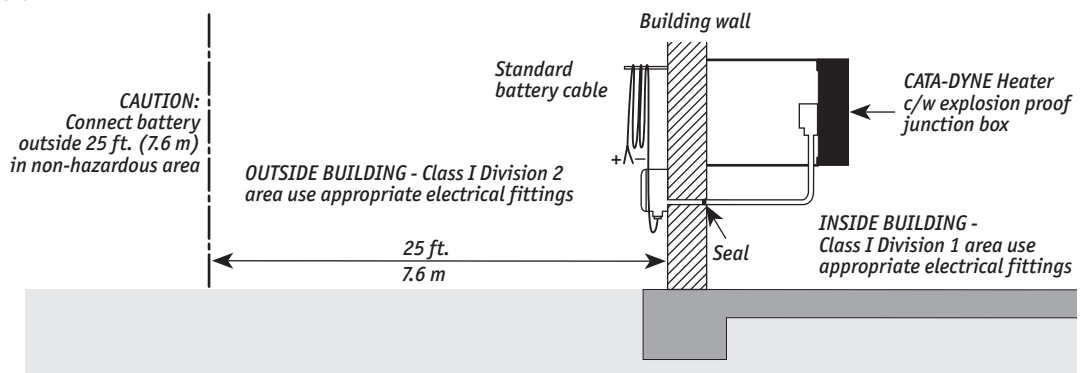
## 12 V HAZARDOUS ELECTRICAL INSTALLATIONS



Most oil and gas production buildings have an area classification as follows:

1. Class I, Division 1, within the building.
2. Class I, Division 2, outside the building for a distance of 10 ft.(3.0 m) from the building at all elevations.
3. Class I, Division 2, outside the building for a distance of 25 ft.(4.5 m) from the building at an elevation of 18 in. (0.45 m) from the ground.

All electrical apparatus and wiring within this area must conform to the appropriate codes. Connection to the power supply must be outside of the Class I, Division 2 location.



## SPOT HEATING

There are several factors to consider when Cata-Dyne™ heaters are utilized for spot heating.

Infrared energy travels in straight lines from the face of the Cata-Dyne™ heater covering approximately 160° of arc and is inversely proportional to the square of the distance. The heater should therefore be mounted as close as practical (min. of 8 in. (20 cm)) to the object requiring heat for maximum temperature rise.

Match the shape of the object requiring heat with the appropriate Cata-Dyne™ heater, e.g. WX/BX 6 x 24 for long narrow objects or WX/BX 12 x 12 for a square object.

Objects requiring heat should be painted dull, dark colors for maximum infrared absorption and objects not requiring heat should be painted light or reflective colors.

Insulate and protect plastic, rubber and similar materials from direct intense infrared heat.

## SPACE HEATING

A separate heat load calculation should be done for each building in which a Cata-Dyne™ heater will be installed for space heating purposes.

The heat load calculation determines the building heat losses through the structure and allows for air infiltration (refer to the sample Heat Load Calculation in the Cata-Dyne™ catalogue).

Cata-Dyne™ heaters produce low intensity infrared heat that is absorbed by objects within the range of the heat source. The closer the object is to the source of heat, the more heat the object will absorb. Cata-Dyne™ heaters should be placed close to the floor level within the building to heat objects close to the floor.

Ideally, Cata-Dyne™ heaters should be mounted 1-3 ft.(0.3-1 m) from the floor and equally spaced around the building perimeter for space heating applications.

If low mounting is not practical, then overhead mounting may be utilized. Overhead mounted heaters should be sloped face down to a maximum 45° angle to direct the infrared energy towards the floor. Overhead mounting should be restricted to heaters of 30,000 Btu/hr (8.8 kW) capacity and larger.

If the building requires only one heater, place the Cata-Dyne™ heater as close as possible to the center of the longest wall.

For multiple heater installations, space the Cata-Dyne™ heaters as evenly as possible around the perimeter of the building.

Make sure the piping is large enough to handle the gas load (refer to the sample Piping Calculation in the Cata-Dyne™ catalogue for sizing information).

Make sure the electrical starting system has sufficient current carrying capacity and conforms to all applicable electrical codes.

It is advisable to install an indicator light in the electrical circuit to reduce the possibility of the power being left on once the heater is started.

## PERSONAL SAFETY

The Cata-Dyne™ flameless infrared catalytic gas heater does not produce harmful carbon monoxide gas when used with natural gas or propane. Adequate ventilation must be incorporated in any building design to ensure oxygen replenishment and removal of any carbon dioxide. Protective grills should be used on any installation where personnel may come in contact with the face of the heater.

## ORDERING INFORMATION

You can order any of CCI Thermal's products by telephone, fax, mail or e-mail. To assist us in processing your order as quickly and efficiently as possible, please provide us with the following information:

- ◆ Cata-Dyne™ product name
- ◆ Cata-Dyne™ model number
- ◆ Fuel gas - natural gas or propane
- ◆ Starting voltage - 12, 24, 120, 208, 240, 480, or 600 V
- ◆ Accessories required:
  - Protection Grill
  - Wall Mount Brackets
  - Thermostat
  - Regulator
  - Start Up Leads (12 V system only)
  - Vent Hood
  - Other
- ◆ Company name and contact
- ◆ Billing address, phone number, fax or e-mail
- ◆ Shipping address and phone number
- ◆ Shipping instructions
- ◆ Special tagging instructions
- ◆ Date required
- ◆ Method of payment:
  - on account - P.O. number required
  - credit card - Visa or Mastercard number
  - cash or cheque

## GUARANTEE

CCI Thermal warrants all Cata-Dyne™ flameless infrared heaters sold to be free from defects in material or workmanship under normal use and service. The company agrees to repair or replace any Cata-Dyne™ heater which, upon its examination, reveals it to have been defective due to faulty workmanship or material, if returned to our factory, transportation PREPAID, within one (1) year from date of purchase. The company does not assume responsibility for misuse or misapplication of its heaters.

Warranty is void if Cata-Dyne™ heaters are used with sour, dirty or wet gas, or where sulphur content is greater than allowable for utility gas specifications. Warranty is void if, upon our inspection, the heater has been tampered with. Neither CCI Thermal nor the selling dealer shall be held responsible for loss of time, inconvenience, commercial loss or consequential damages relating to the use of Cata-Dyne™ heaters.

## RETURN GOODS POLICY

Prior written approval must be obtained from CCI Thermal for the return of any Cata-Dyne™ product(s). A restocking charge of 15% will apply. All returns must be shipped to our factory in Edmonton, freight prepaid. Final acceptance will be contingent on inspection at our factory.

## REPAIRS

Cata-Dyne™ heaters may require periodic maintenance or repair. Our factory is staffed with technicians who are qualified to perform any required repairs. The procedure to follow to have a heater repaired is as follows.

Send the heater to our factory in Edmonton. Include the following information with the heater:

- ◆ Company name and address
- ◆ Contact name
- ◆ Telephone number/fax number/e-mail
- ◆ P.O. number
- ◆ Advise if an estimate is required prior to starting the repair
- ◆ Details on the repair or conversion required
- ◆ Return shipping instructions

**NOTE:** Under the terms of our certification, all repairs must be performed at our factory in Edmonton.

## TROUBLE SHOOTING

1. Ensure that the fuel matches that listed on the nameplate.
2. Ensure that the voltage matches that listed on the nameplate.
3. Check for any physical damage. All signs of physical damage to the catalyst pad such as holes, tears or a general deterioration of the catalyst bed signal that it is time to have the heater repaired.
4. Check the gas supply pressure at the heater – 7 in. w.c. (1.73 kPa), 4.5 in. w.c. (1.12 kPa), or 3.5 in. w.c. (0.86 kPa) for natural gas and 11 in. w.c. (2.72 kPa) for propane.
5. Check the gas orifice for obstructions or dirt and ensure the size matches that listed on the nameplate. It may be necessary to install a filter upstream of the heater or regulator if the gas supply is dirty. If the fuel supply is constantly dirty and/or wet it would be advisable to use bottled propane fuel.
6. Check the mounting position of the heater. The face of the heater should be preferably in the vertical position and should not vary more than 45° from the vertical position for maximum efficiency.
7. Check for saturation of the catalyst face caused by condensation or rain running down the face of the heater. If the heater has been exposed to water, it is advisable to place the unit in a warm area for a period of a few hours or longer if required. Once the moisture is removed, the heater can be re-installed and re-started.
8. Check the jumper cable size to ensure that the resistance of the cable is not reducing the current to the heater. This would not allow sufficient power to the electrical element to preheat the catalyst to the activity temperature. It is recommended to run the service vehicle at fast idle while starting the heater.
9. Cata-Dyne™ heaters are designed to use clean fuel and to be used in non-contaminated atmospheres. Sulphur compounds in the fuel or atmosphere will poison the catalyst bed over a period of time and render the heater inoperative. If the heater has been exposed to sulphur compounds, it should be sent to the factory for service.
10. Avoid spraying the face of the heater with high-pressure air, steam or water because this can damage the catalyst bed. If physical damage is visible, return the heater to the factory for servicing.
11. Ensure that the temperature controller is correct for the model size, fuel, and pressure specifications for the heater it is fitted to. If the temperature controller is too low, the heater will not have sufficient fuel rating to operate and will stop.

*Separate Installation and Operation Instructions are available for oven and industrial heating applications.*



# Model 1530

## Three-Way Thermostatic Valve



1530	1 1/2" NPT
1530M	1 1/2" NPT with Manual Override
1530J16	1" SAE O-Ring
1530J20	1 1/4" SAE O-Ring
1530J24	1 1/2" SAE O-Ring
F1530	1 1/2" 125# FF Flange
SF1530	1 1/2" 150# RF Flange
SF1530X	1 1/2" 300# RF Flange

Fluid Power Energy (FPE) Thermostatic Valves utilize the principle of expanding wax, which in the semi-liquid state undergoes large expansion rates within a relatively narrow temperature range. The self-contained element activates a brass or nickel-plated sleeve, which directs flow. All FPE Thermostatic Valves are factory set at predetermined temperatures: no further adjustments are necessary. A wide range of temperatures are available for water and oil temperature control applications.

When used in a diverting application, on start-up the total fluid flow is routed back to the main system. As fluid temperature rises to the control range, some fluid is diverted to the cooling system. As fluid temperature continues to increase, more flow is diverted. When the thermostat is in a fully stroked condition, all fluid flow is directed to the cooling system. FPE Thermostatic Valves may also be used in a mixing application.

In a mixing application, hot fluid enters the "B" port and colder fluid enters the "C" port. The flows mix and the thermostat adjusts to reach the desired temperature, exiting the "A" port.

Standard FPE Thermostatic Valve Housings are made from aluminum and grey iron castings, however, ductile iron, steel and stainless steel housings are available.

Available connections: NPT, SAE O-Ring, 125# FF Flange, 150# RF Flange, 300# RF Flange, Navy and Metric Flanges.

Optional Features: Manual Override, High Over Temp elements, Plated elements. Other options available upon request.

## Features

Wide Range of Temperatures

Heavy Duty

Self-Contained

Replaceable Element

Non-Adjustable

Rugged Construction

Tamper-Proof

Operate in Any Position

Compact

Available for Refrigeration Service



**FLUID POWER ENERGY, INC.**

W229 N591 Foster Court • Waukesha, WI 53186

**262•548•6220 Fax 262•548•6239**

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



# Model 1530

MODEL NUMBER	BODY MATERIAL (*)	NOMINAL PNP SIZE	PRINCIPAL DIMENSIONS (UNITS IN & INCHES)				MAX WIDTH OF THE OTHER FLANGE	FLANGE DRILLING			NO. OF ELEMENTS	APPROX. SHIPPING WEIGHT	NOTES OR NUMBERED ENCHOTES
			"H"	"W"	"W"	"T"		NO. OF HOLES	SAE DIA. OF HOLES	BOLT CIRCLE			
*1530	A, B, D	1 1/2" NPT	5.394 (107.22)	5.176 (127.72)	5.168 (130.20)	5.174 (127.32)	5.394 (135.20)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	
*1530J	A, B, D	2" NPT	5.394 (107.22)	5.176 (127.72)	5.168 (130.20)	5.174 (127.32)	5.394 (135.20)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	
*1530J2	A, B, D	2" NPT	5.394 (107.22)	5.176 (127.72)	5.168 (130.20)	5.174 (127.32)	5.394 (135.20)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	
*1530J4	A, B, D	2" NPT	5.394 (107.22)	5.176 (127.72)	5.168 (130.20)	5.174 (127.32)	5.394 (135.20)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	
*1530M	A, B, D	1 1/2" NPT	5.394 (107.22)	5.176 (127.72)	5.168 (130.20)	5.174 (127.32)	5.394 (135.20)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	Manual Override
*1530	A, B, D	1 1/2" NPT 17" FLANGE	4 (101.60)	3.162 (80.00)	3.162 (80.00)	3.162 (80.00)	4 (101.60)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	
*1530J	A, B, D	1 1/2" NPT 10" FLANGE	4 (101.60)	3.162 (80.00)	3.162 (80.00)	3.162 (80.00)	4 (101.60)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	
*1530M	A, B, D	1 1/2" NPT 10" FLANGE	4 (101.60)	3.162 (80.00)	3.162 (80.00)	3.162 (80.00)	4 (101.60)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	Manual Override
*1530M	A, B, D	1 1/2" NPT 10" FLANGE	4 (101.60)	3.162 (80.00)	3.162 (80.00)	3.162 (80.00)	4 (101.60)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	Manual Override
*1530M	A, B, D	1 1/2" NPT 10" FLANGE	4 (101.60)	3.162 (80.00)	3.162 (80.00)	3.162 (80.00)	4 (101.60)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	Manual Override
*1530M	A, B, D	1 1/2" NPT 10" FLANGE	4 (101.60)	3.162 (80.00)	3.162 (80.00)	3.162 (80.00)	4 (101.60)	4	SAE 100	140	4	SAE D100, D=100 S & SS=10W	Manual Override

\* (Replace \* with body material type; A=Cast Iron, B=Bronze, D=Ductile Iron, S=Steel, SS=Stainless Steel)



\*1530, \*1530J



\*F1530, \*F1530X

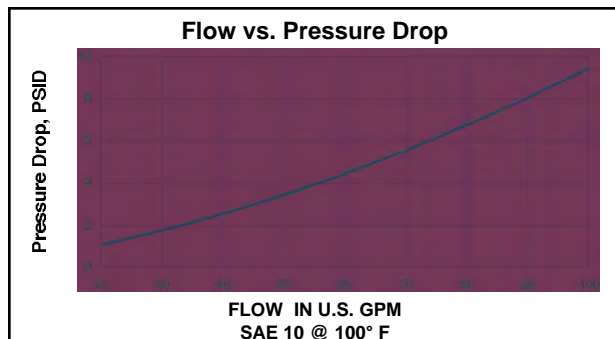


\*1530M



\*F1530M, \*F1530XM

PRESSURE RATINGS	
MATERIAL	PSI
A, B	150
D	250
S, SS	500
SF, SSF	275
SFX, SSFX	720



Recommended Pressure Drop is 2 to 7 PSI

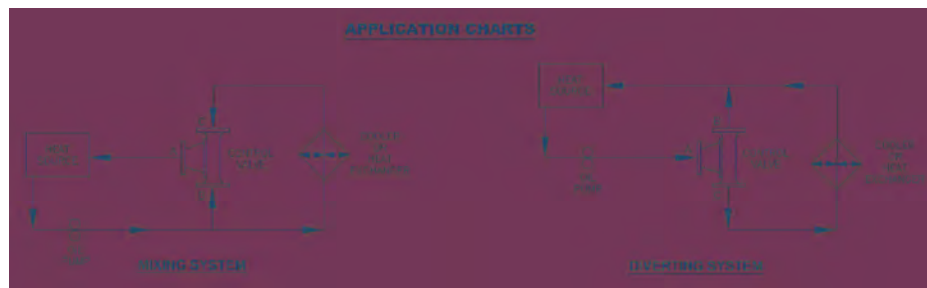
PART #	DESCRIPTION
*1530	VALVE BODY (*See table for material)
*1540	VALVE COVER (*See table for material)
1572**	O-RING (Standard material is Buna-N)
1571	LIP SEAL
1560-Temp	THERMOSTAT (Temp to follow dash)
1600	HEX BOLT
1601	LOCK WASHER
1590	NAMEPLATE

## FPE Model 1500\*\* Replacement Kit (Includes the following:)

1572**	O-RING (Standard material is Buna-N)
1571	LIP SEAL
1560-Temp	THERMOSTAT (Temp to follow dash)

(For Viton® (V) or Neoprene (E) O-Ring material, replace \*\* with V or E)

Viton® is a registered trademark of Dupont Dow Elastomers



## To Order

Specify Model Number, nominal temperature desired, and housing material. For Model coding information, visit our website or consult your factory representative.



## FLUID POWER ENERGY, INC.

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www.fpevalves.com

FPE1530-050803