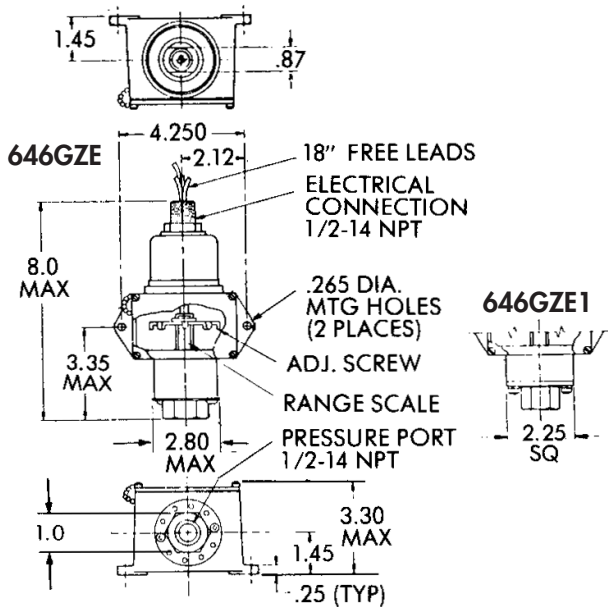


INSTALLATION DRAWING



SHIPPING WT. APPROX. 56 OZ. (1587 GRAMS)

Press. .4 to 5000 psi
Vac. 1.0 to 28.5" Hg

**SERIES:
646GZE
646GZE-7011
646VZE**

Standard Features:

- U.L. / CSA
- Explosion Proof: Div. 1, 2
- NEMA: 4, 7, 9, 13
- Fire Resistant
- Steel Body

AMBIENT TEMP. RANGE

-30° to 160° F
-34° to 71° C

Options Code:

- "E" Ethylene Propylene O-ring
- "Y" EECS Certified to EXsII T5
- "7008" Gold Contacts
- "7030" Gold Contacts w/SST Diaphragm
- "7044" Monel Port and Diaphragm
- "7045" Hastelloy Port and Diaphragm
- "7065" Teflon Wire w/SST Diaphragm

OPERATING AND ORDERING DATA:

PRESSURE SWITCHES		1/2" STAINLESS STEEL PRESSURE PORT & POLYIMIDE DIAPHRAGM			Wetted Parts	316 SST Polyimide Viton	
MODEL 646GZE		Adjustable Set-Point Range			Approx. Dead-band psi	MODEL SPDT-Std.	MODEL DPDT "M"
Max Sys. Press. psi	Proof (Test) Press. psi	On Incr. Press. psi	On Decr. Press. psi				
500	750	1.2-16	.4-15.2	.8	646GZE1	646GZEM1	
3000	5000	8-75	3-70	5	646GZE2	646GZEM2	
3000	5000	20-150	8-138	12	646GZE11	646GZEM11	
3000	5000	50-375	22-347	28	646GZE3	646GZEM3	
3000	5000	330-1000	265-935	65	646GZE5	646GZEM5	
3000	5000	950-2300	775-2125	175	646GZE7	646GZEM7	

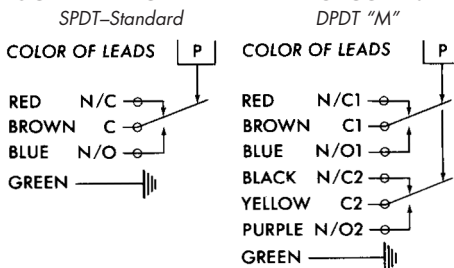
PRESSURE SWITCHES		1/2" STAINLESS STEEL PRESSURE PORT & DIAPHRAGM			Wetted Parts	316 SST Viton	
MODEL 646GZE-7011		Adjustable Set-Point Range			Approx. Dead-band psi	MODEL SPDT-Std.	MODEL DPDT "M"
Max Sys. Press. psi	Proof (Test) Press. psi	On Incr. Press. psi	On Decr. Press. psi				
500	750	1.4-16	.4-15	1	646GZE1-7011	646GZEM1-7011	
3000	5000	10-75	3-68	7	646GZE2-7011	646GZEM2-7011	
3000	5000	20-150	6-136	14	646GZE11-7011	646GZEM11-7011	
3000	5000	50-375	16-347	34	646GZE3-7011	646GZEM3-7011	
3000	5000	330-1000	250-920	80	646GZE5-7011	646GZEM5-7011	
3000	5000	950-2300	750-2100	200	646GZE7-7011	646GZEM7-7011	
5000	7500	2100-3400	1820-3120	280	646GZE9-7011	646GZEM9-7011	
5000	7500	3200-5000	2720-4520	480	646GZE10-7011	646GZEM10-7011	

VACUUM SWITCHES		1/2" STAINLESS STEEL PRESSURE PORT & POLYIMIDE DIAPHRAGM			Wetted Parts	316 SST Polyimide Viton	
MODEL 646VZE		Adjustable Set-Point Range			Approx. Dead-band In. Hg	MODEL SPDT-Std.	MODEL DPDT "M"
Max Sys. Press. psi	Proof (Test) Press. psi	On Incr. Vacuum In. Hg	On Decr. Vacuum In. Hg				
150	250	3.5-28.5	1.0-26.0	2.5	646VZE1	646VZEM1	

ELECTRICAL CHARACTERISTICS:
RATING OF SWITCH ELEMENT

VOLTS	AMPERES	
	SPDT	DPDT "M"
125 AC - 50/60 Hz	1.5	5
250 AC - 50/60 Hz	1.5	5
480 AC - 50/60 Hz	1.5	-
125 DC	.4	.5

SCHEMATIC AND WIRING CODE:



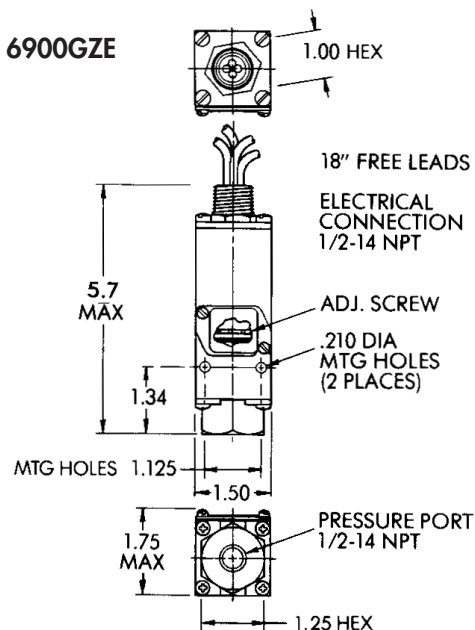
ENCLOSURE/CERTIFICATIONS:

Div. 1 explosion-proof and hermetically sealed electrical assembly Part No. 17-51 (17-73 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.

Model 646GZEM1 has an approximate dead band of .9 psi.

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



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

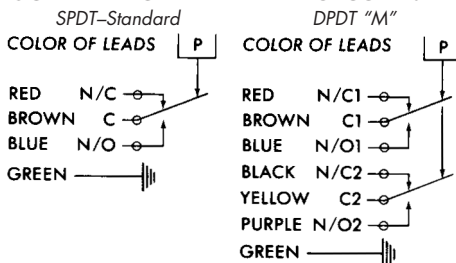
Options Code:

- "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:

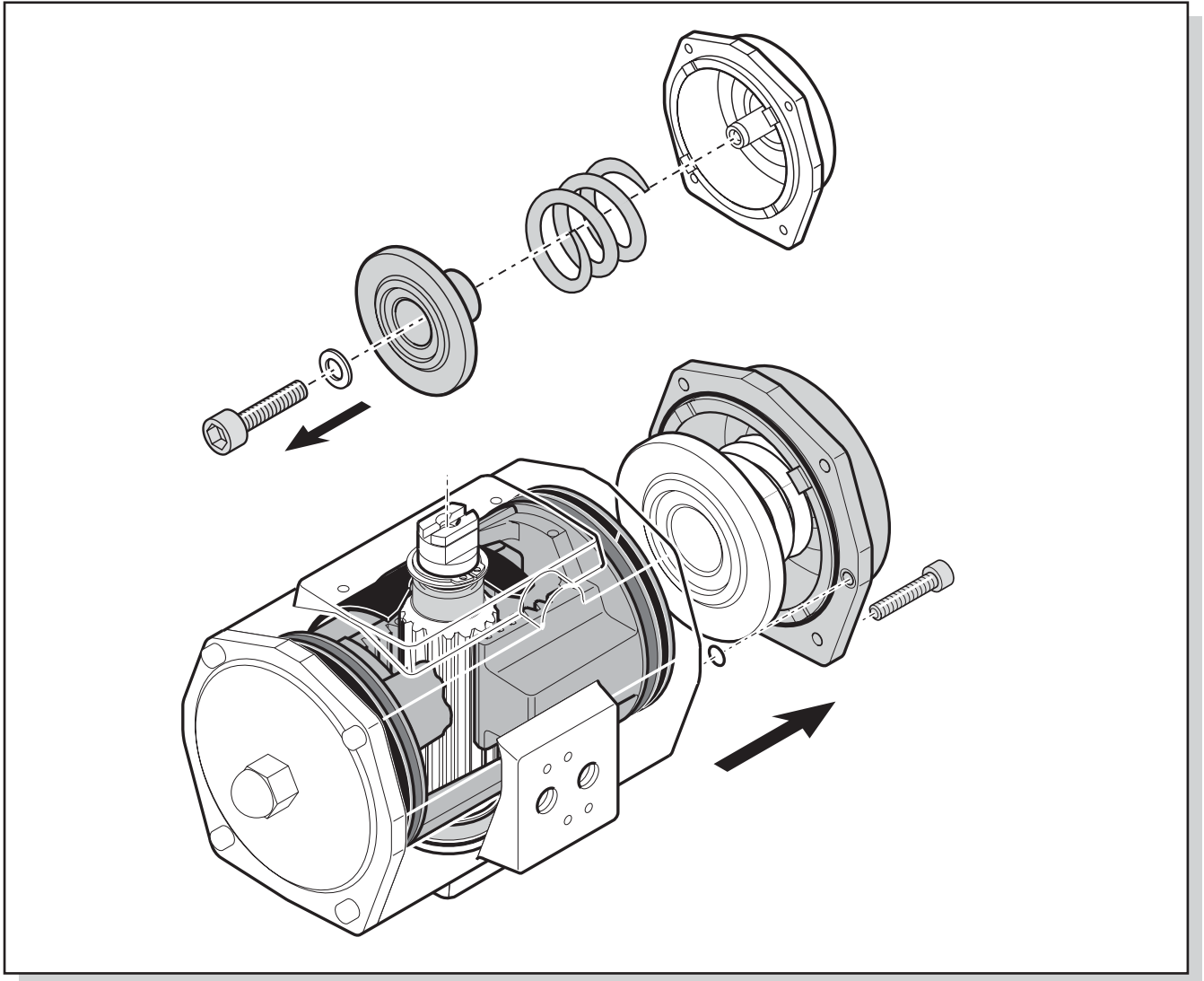
Div. 1 explosion-proof and hermetically sealed electrical assembly Part No. 46-1058 (46-1061 for "M" model option), listed by both Underwriter's Laboratories, Inc. (File No. E32961) and CSA Testing Laboratories (File No. 22921) for hazardous locations, Class 1, Groups A, B, C, and D; Class 2 Groups E, 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 Operation & Maintenance Manual

DOC.41.EDN Rev: B
March 2006

Pneumatic Actuators "E" and "P" series



EL-O-MATIC

www.El-O-Matic.com



EMERSON
Process Management

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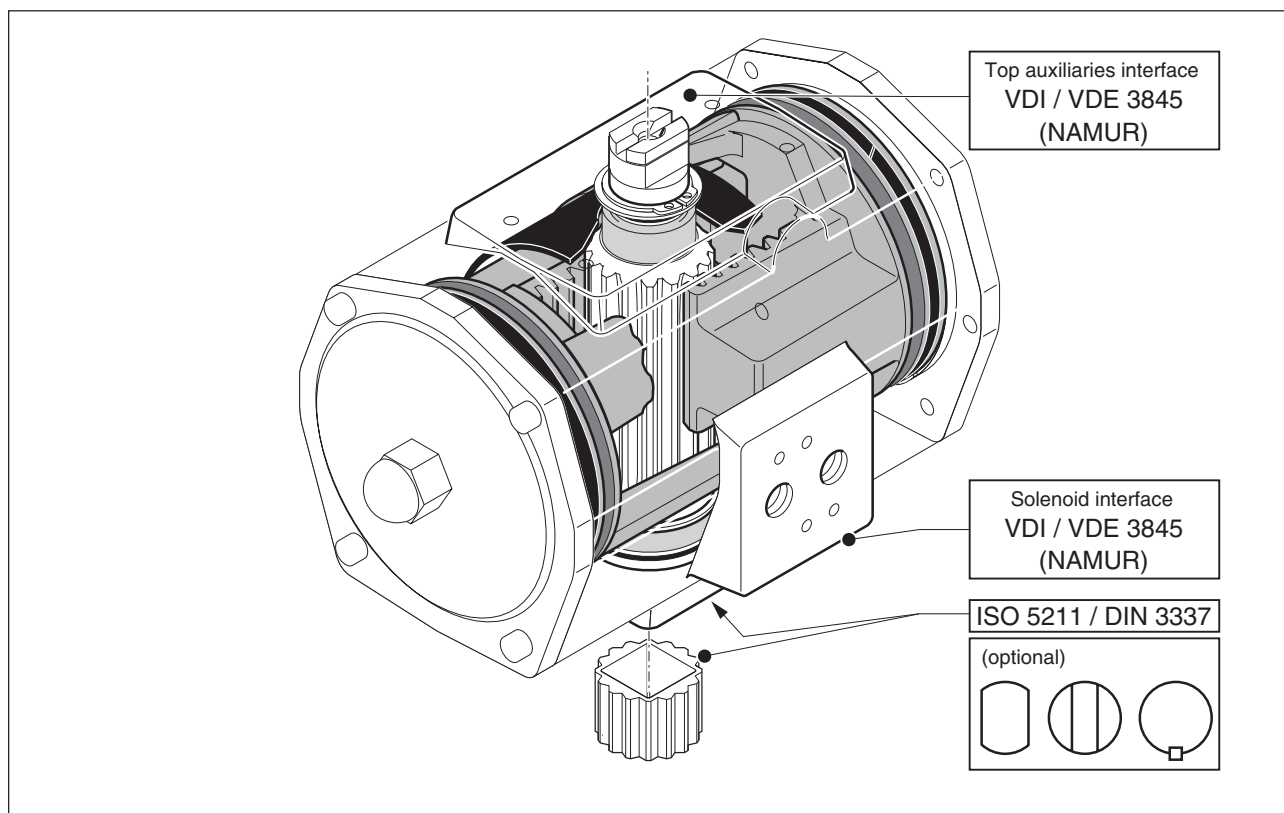
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1 INTRODUCTION / EINLEITUNG / INLEIDING

1.1 Identification / Unterscheidung / Identificatie



1.1



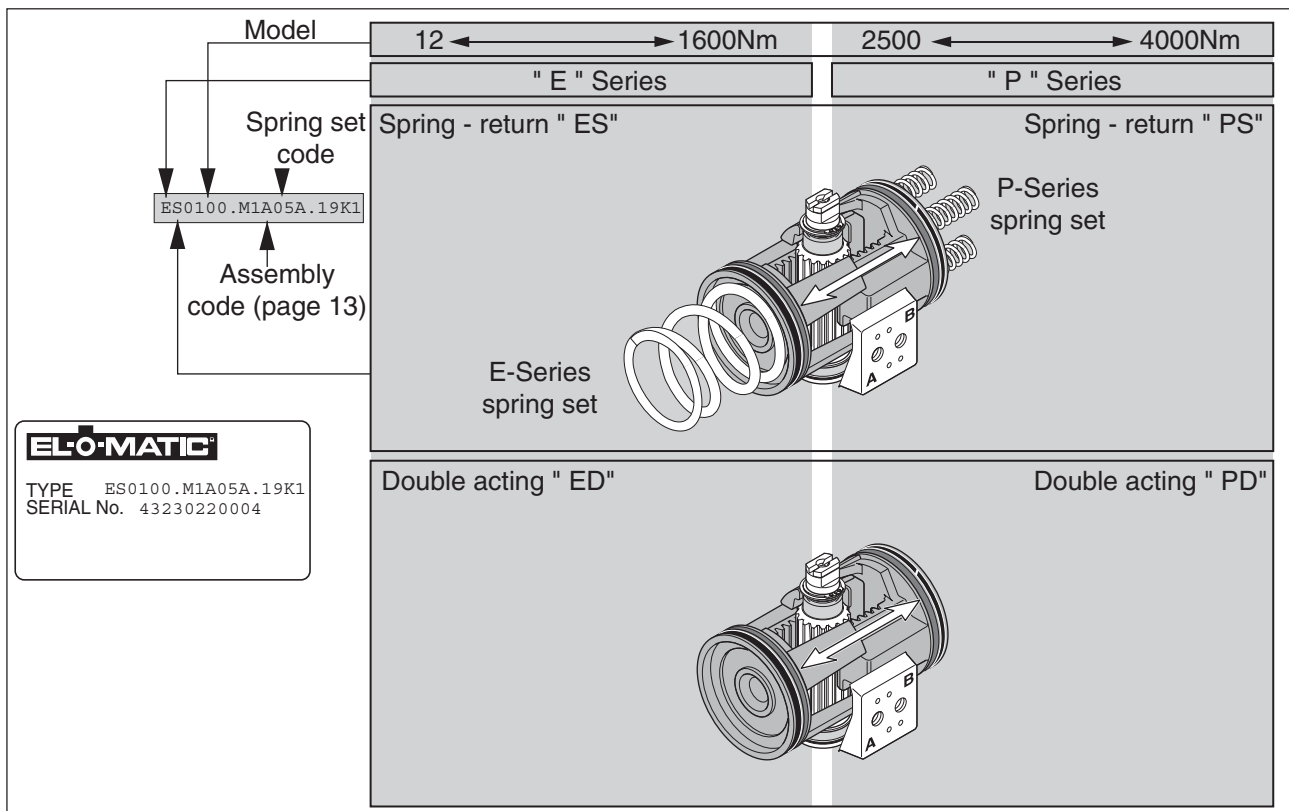
Warning! Actuator must be isolated both pneumatically and electrically before any (dis)assembly is begun. Before mounting or (dis)assembling the actuator consult the relevant sections of this manual.



Achtung! Der Antrieb muß vor jedem Ausbau sowohl pneumatisch, als auch elektrisch von allen Anschlüssen abgekoppelt werden. Lesen Sie vor dem Einbau oder Ausbau des Antriebes die entsprechenden Kapitel dieses Handbuchs aufmerksam durch!



Waarschuwing! Aandrijving moet zowel pneumatisch als elektrisch afgekoppeld worden, voordat met (de)monteren begonnen kan worden. Raadpleeg de desbetreffende paragrafen van deze handleiding alvorens te (de)monteren of toebehoren te bevestigen.



1.2

Model	-	Typ	-	model
Spring set code	-	Federsatzcodennummer	-	code verenset
Assembly code (page 13)	-	Bezeichnung der Drehrichtung (s.13)	-	montagecode (pag. 13)
"E"- Series	-	"E"-Serie	-	"E"-serie
"P"- Series	-	"P"-Serie	-	"P"-serie
Spring return	-	Federrückstellend	-	veerretour
P-Series spring set	-	Federsatz der P-Serie	-	verenset P-serie
E-Series spring set	-	Federsatz der E-Serie	-	verenset E-serie
Double acting ED	-	doppeltwirkend ED	-	dubbelwerkend ED
Double acting PD	-	doppeltwirkend PD	-	dubbelwerkend PD

1.2 Product code

Action						
ED or PD = Double acting ES or PS = Single acting (Spring return)						
Actuator type						
E-series						
0012 = E12	0025 = E25	0040 = E40	0065 = E65	0100 = E100		
0200 = E200	0350 = E 350	0600 = E600	0950 = E950	1600 = E1600		
P-series						
2500 = P2500 4000 = P4000						
Valve flange			Finish			
Metric	Metric	UNC/NPT				
ISO 5211	DIN 3337	ISO 5211				
M =	D =	U =	Standard			
N =	E =	V =	CSR coating + Aluminum pinion			
O =	F =	W =	CSR coating + Stainless Steel pinion			
Limit stops						
0 = No limit stops			Standard on P-series			
1 = L1 limit stops			Standard on E-Series			
2 = Double Stroke Adjustment			Standard on DSA-Series			
Assembly codes		Rotation	Mounting			
A = Spring to close		clock wise	in line with pipeline			
B = Spring to close		clock wise	across pipeline			
C = Spring to open		counter clock wise	across pipeline			
D = Spring to open		counter clock wise	in line with pipeline			
Spring set E-Serie			Spring set P-serie			
00 = Double acting actuator			00 = Double acting actuator			
01 = Springset 1			04 = Springset 4			
02 = Springset 2			06 = Springset 6			
03 = Springset 3			08 = Springset 8			
04 = Springset 4			10 = Springset 10			
05 = Springset 5			12 = Springset 12			
06 = Springset 6			14 = Springset 14			
Future expansion						
A = Standard						
Insert size (in mm.)⁽¹⁾	E12	E25	E40	E65	E100	E200
- ISO or UNC	00	11	14	14	19	22
- DIN	00	11	14	14	17	22
	E 350	E600	E950	E1600	P2500	P4000
- ISO or UNC	27	27	36	46	00	00
- DIN	22	27	36	46	00	00
Visual Indication Code						
D = Disk		K = Knob		N = No visual indication		
Temperature range						
0 = Standard		TS: 80°C (176°F) / -20°C (-4°F)				
1 = High temp		TS: 120°C (248°F) / -20°C (-4°F)				
2 = Low temp		TS: 80°C (176°F) / -40°C (-40°F)				

ES 0040.M 1 A 05 A.14 N 1

⁽¹⁾Actuators E12, P2500 and P4000 have no inserts. They have have a inner square directly in the pinion
180° actuators are not covered by this configuration matrix.

1.2 Produktcode

Wirkrichtung		ED or PD = Doppeltwirkend		ES or PS = Einfachwirkend (Federrückstellend)		
Antriebstyp						
E-series						
0012 = E12	0025 = E25	0040 = E40	0065 = E65	0100 = E100		
0200 = E200	0350 = E 350	0600 = E600	0950 = E950	1600 = E1600		
P-series						
2500 = P2500	4000 = P4000					
Armaturenflansch		Oberflächenbeschichtung				
Metrisch	Metrisch	UNC/NPT				
<u>ISO 5211</u>	<u>DIN 3337</u>	<u>ISO 5211</u>				
M =	D =	U =		Standard		
N =	E =	V =		CSR Beschichtung + Aluminium Welle		
O =	F =	W =		CSR Beschichtung + Edelstahl Welle		
Hubbegrenzung						
0 = Keine Hubbegrenzung	Standard bei P-series					
1 = L1 Hubbegrenzung	Standard bei E-Series					
2 = Doppelter Hubbegrenzung	Standard bei DSA-Series					
Aufbaucode	Drehrichtung	Montage				
A = Federschließend	im Uhrzeigersinn	parallel zur Leitung				
B = Federschließend	im Uhrzeigersinn	quer zur Leitung				
C = Federöffnend	gegen den Uhrzeigersinn	quer zur Leitung				
D = Federöffnend	gegen den Uhrzeigersinn	parallel zur Leitung				
Federsätze E-Serie		Federsätze P-serie				
00 = Doppeltwirkender Antrieb	00 = Doppeltwirkender Antrieb					
01 = Federsatz 1	04 = Federsatz 4					
02 = Federsatz 2	06 = Federsatz 6					
03 = Federsatz 3	08 = Federsatz 8					
04 = Federsatz 4	10 = Federsatz 10					
05 = Federsatz 5	12 = Federsatz 12					
06 = Federsatz 6	14 = Federsatz 14					
Zukünftige Erweiterung						
A = Standard						
Insertabm. (in mm.) ¹	E12	E25	E40	E65	E100	E200
- ISO oder UNC	00	11	14	14	19	22
- DIN	00	11	14	14	17	22
	E 350	E600	E950	E1600	P2500	P4000
- ISO oder UNC	27	27	36	46	00	00
- DIN	22	27	36	46	00	00
Sichtanzeige						
D = Scheibe	K = Knopf	N = Keine Sichtanzeige				
Temperaturbereich						
0 = Standard Temperatur	TS: 80°C (176°F)	/ -20°C (-4°F)				
1 = Hohe Temperatur	TS: 120°C (248°F)	/ -20°C (-4°F)				
2 = Niedrig Temperatur	TS: 80°C (176°F)	/ -40°C (-40°F)				

ES 0040.M 1 A 05 A.14 N 1

¹ Antriebe E12, P2500 und P4000 haben keine Inserts. Sie haben eine viereckige Wellenaufnahme, direkt in der Welle. 180° Antriebe werden nicht durch diese Konfigurationsmatrix abgedeckt.

1.2 Product code

Werking

ED of PD = Dubbelwerkend **ES of PS** = Enkelwerkend (Veerretour)

Aandrijvings type

E-series

0012 = E12 **0025** = E25 **0040** = E40 **0065** = E65 **0100** = E100
0200 = E200 **0350** = E 350 **0600** = E600 **0950** = E950 **1600** = E1600

P-series

2500 = P2500 **4000** = P4000

Afsluiterflens

Metrisch Metrisch UNC/NPT
 ISO 5211 DIN 3337 ISO 5211

M = **D** = **U** = Standaard
N = **E** = **V** = CSR coating + Aluminum as
O = **F** = **W** = CSR coating + RVS as

Coating

Slagbegrenzing

0 = Geen slagbegrenzing Standaard bij P-series
1 = L1 slagbegrenzing Standaard bij E-Series
2 = Dubbelzijdige slagbegrenzing Standaard bij DSA-Series

Montage codes

A = Veersluitend
B = Veersluitend
C = Veeropenend
D = Veeropenend

Verdraaiing

met de klok mee
 met de klok mee
 tegen de klok in
 tegen de klok in

Montage

in lijn met de leiding
 dwars op de leiding
 dwars op de leiding
 in lijn met de leiding

Verenset E-serie

00 = Dubbelwerkende aandrijving
01 = Verenset 1
02 = Verenset 2
03 = Verenset 3
04 = Verenset 4
05 = Verenset 5
06 = Verenset 6

Verenset P-serie

00 = Dubbelwerkende aandrijving
04 = Verenset 4
06 = Verenset 6
08 = Verenset 8
10 = Verenset 10
12 = Verenset 12
14 = Verenset 14

Toekomstige uitbreiding

A = Standaard

Insert afm. (in mm.)⁽¹⁾

	E12	E25	E40	E65	E100	E200
- ISO of UNC	00	11	14	14	19	22
- DIN	00	11	14	14	17	22
	E 350	E600	E950	E1600	P2500	P4000
- ISO of UNC	27	27	36	46	00	00
- DIN	22	27	36	46	00	00

Visuele positie aanduiding

D = Schijf **K** = Knop **N** = Geen positie aanduiding

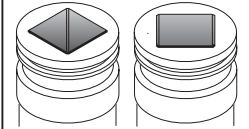
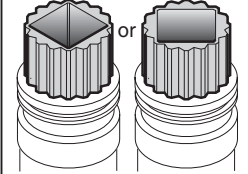
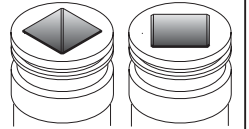
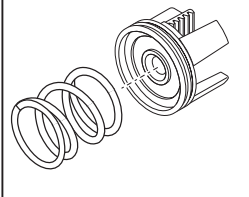
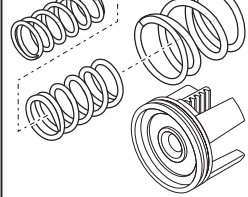
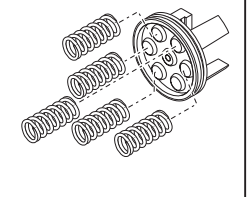
Temperatuursbereik

0 = Standaard temperatuur TS: 80°C (176°F) / -20°C (-4°F)
1 = Hoge temperatuur TS: 120°C (248°F) / -20°C (-4°F)
2 = Lage temperatuur TS: 80°C (176°F) / -40°C (-40°F)

ES 0040.M 1 A 05 A.14 N 1

⁽¹⁾ Aandrijvingen E12, P2500 en P4000 hebben geen inserts. Deze hebben een binnenvierkant direct in de as 180° aandrijvingen worden niet door deze configuratie matrix afgedekt.

**2 CONSTRUCTION DETAILS / KONSTRUKTIVE EINZELHEITEN /
CONSTRUCTIEDETAILS**

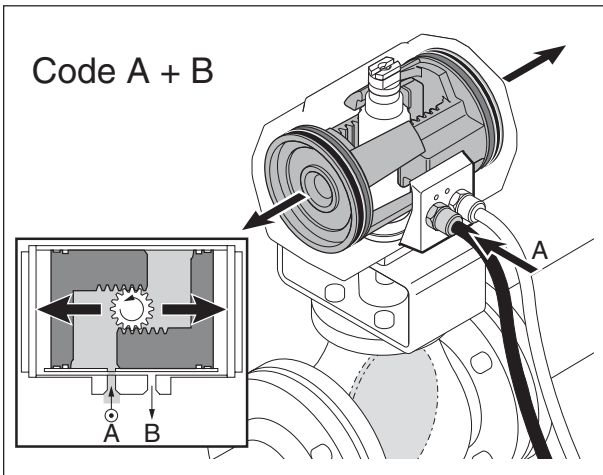
	" E " SERIES		" P " SERIES
MODEL Double acting	ED12	ED25 / ED40 / ED65 ED100 / ED200 / ED350 ED600 / ED950 / ED1600	PD2500 / PD4000
MODEL Spring return	ES12	ES25 / ES40 / ES65 ES100 / ES200 / ES350 ES600 / ES950 / ES1600	PS2500 / PS4000
Drive ISO or DIN	or 	with insert or 	or 
Spring return each piston			

2.1

"E" Series	-	"E"-SERIE	-	"E"-serie
"P" Series	-	"P"-SERIE	-	"P"-serie
MODEL double acting	-	doppeltwirkender TYP	-	MODEL dubbelwerkend
MODEL spring return	-	TYP mit Federrückstellung	-	MODEL veerretour
Drive ISO or DIN	-	Antrieb gemäß ISO oder DIN	-	Aandrijving ISO of DIN
Spring return each piston	-	beiderseits Federrückstellung	-	Veerset per zuiger
or	-	oder	-	of
with insert	-	mit Insert	-	met insert

3 PRINCIPLES OF OPERATION / FUNKTIONSPRINZIP / BEDIENING

**3.1 Air connections double acting / Luftanschlüsse, doppelwirkend /
Luchtaansluitingen, dubbelwerkend**



3.1.1

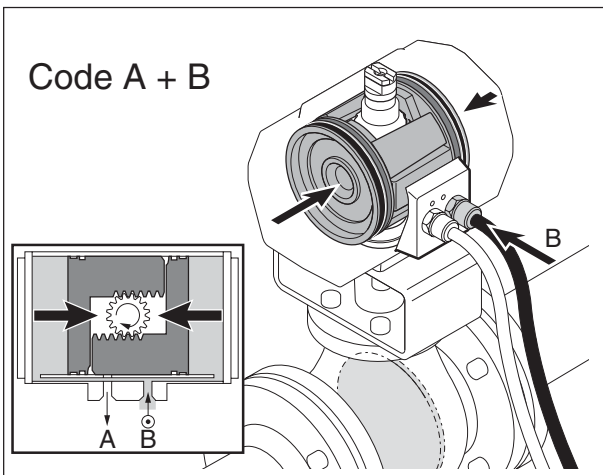
Check the assembly code before connecting air supply (see page 5). Reverse air supply in case of assembly codes C and D (see page 13).

3.1.1

Air to port A: counterclockwise / open.

3.1.2

Air to port B: clockwise / close.



3.1.2

Vor dem anschließen der Zuluft den Aufbau-code kontrollieren (siehe Seite 5). Bei Aufbau-code C und D ist die Luftzufuhr zu tauschen (siehe Seite 13).

3.1.1

Luftzufuhr an Anschluß A: gegen den Uhrzeigersinn / offen.

3.1.2

Luftzufuhr an Anschluß B: im Uhrzeigersinn / geschlossen.

Controleer de montagecode voor het aansluiten van de luchttoevoer (zie pagina 5). Verwissel de luchttoevoer in geval van montagecodes C en D (zie pagina 13).

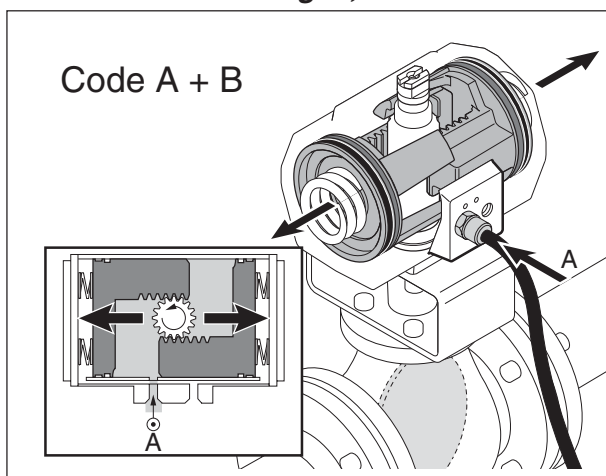
3.1.1

Lucht naar poort A: tegen de wijzers van de klok in / open

3.1.2

Lucht naar poort B: met de wijzers van de klok mee / dicht.

3.2 Air connections spring return / Luftanschlüsse mit Federrückstellung / Luchtaansluitingen, veerretour

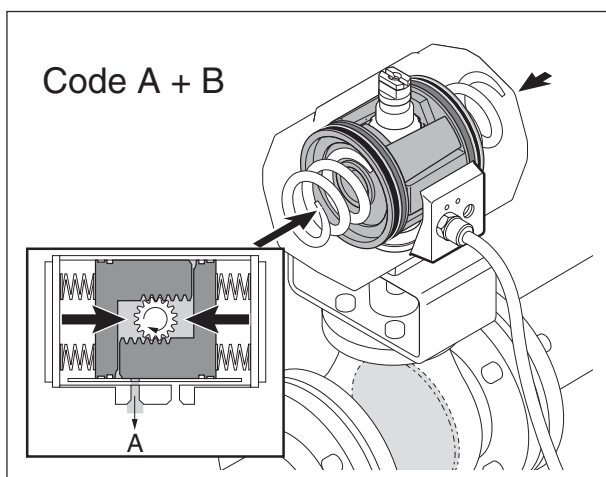


3.2.1

Check the assembly code before connecting air supply (see page 5). Reverse air supply in case of assembly codes C and D (see page 13).

3.2.1
Air to port A: counterclockwise / open.

3.2.2
Spring return: clockwise / close.



3.2.2

Vor dem anschließen des Zuluft den Aufbau-code kontrollieren (siehe Seite 5). Bei Aufbau-code C und D ist die Luftzufuhr zu tauschen (siehe Seite 13).

3.2.1
Luftzufuhr an Anschluß A: gegen den Uhrzeigersinn / offen.

3.2.2
Federrückstellung: im Uhrzeigersinn / geschlossen.

Controleer de montagecode voor het aansluiten van de luchttoevoer (zie pagina 5). Verwissel de luchttoevoer in geval van montagecodes C en D (zie pagina 13).

3.2.1
Lucht naar poort A: tegen de wijzers van de klok in / open

3.2.2
Veerretour: met de wijzers van de klok mee / dicht.

3.3 Recommended tubing sizes / Empfohlene Rohrabmessungen / Aanbevolen buisafmetingen

Actuator Model no.	Runs up to 1.2 mtr	Runs over 1.2 mtr.
Antriebstyp	Bis 1,20 m	Über 1,20 m
Aandrijving modelnr.	Tot 1,2 m	Meer dan 1,2 m
E-12, 25, 40, 65	6 mm	6 mm
E-100, 200, 350, 600, 950	6 mm	8 mm
E1600 / P-2500, 4000	6 mm	10 mm

3.4 Air consumption litre/stroke at atmospheric pressure / Luftverbrauch (Ltr./Hub) bei Atmosphärendruck / Luchtverbruik liter/slag bij atmosferische druk

Air chamber	Model						
	E12	E25	E40	E65	E100	E200	E350
A	0.05	0.1	0.16	0.22	0.35	0.8	1.2
B	0.06	0.11	0.22	0.36	0.49	1	1.8
Air chamber	E600	E950	E1600	P2500	P4000		
A	2.9	4.7	7.3	8	13.5		
B	3.1	4.9	8.0	9.3	17.5		

- Model
- Air chamber

- Modell
- Luftkammer

- Model
- Luchtkamer

4 ASSEMBLY CODES / AUFBAUCODE / MONTAGECODES

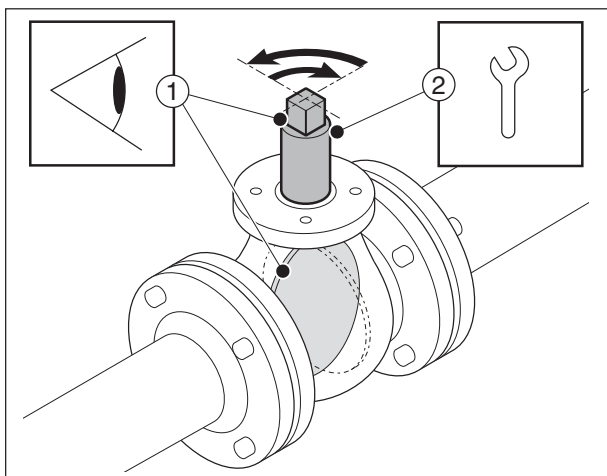
Spring to close		X=	Y=	Z=
	Code A (standard)	Shaft Welle As	Piston Kolben Zuiger	Valve Armatur Afluiser
		Standard	Standard	Closed
	Code B	+90	Standard	Closed

4.1 Spring to close (rotation CW, topview) / Schließfeder (Drehung im Uhrzeigersinn, Draufsicht) / Veersluitend (rotatie met de wijzers van de klok mee, bovenaanzicht)

Spring to open		X=	Y=	Z=
	Code C	Standard	+180	Open
	Code D	+90	+180	Open
		Shaft rotation	Wellen drehung	As verdraaing
		1 = Pressure on A-port 2 = Pressure on B-port / Springstroke	1 = A-Kammer belüftet 2 = B-Kammer belüftet / Federhub	1 = Druk op A-poort 2 = Druk op B-poort / Veerslag

4.2 Spring to open (rotation CCW) / Federkraftöffnend (Drehung gegen den Uhrzeigersinn) / Veeropenend (rotatie tegen de wijzers van de klok in)

4.1 Installation / Aufbau / Installatie

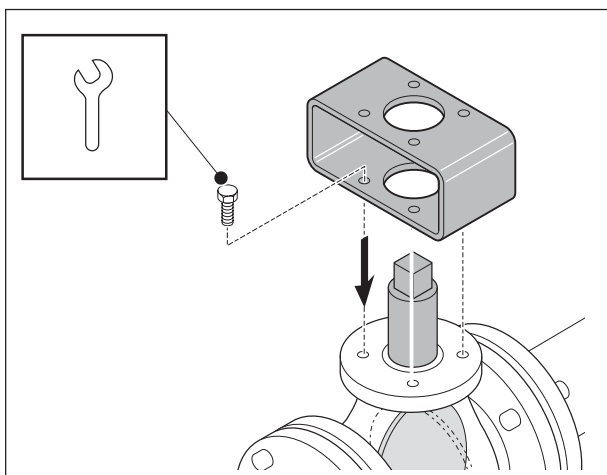


4.1.1

4.1.1
Remove handle nut, handle, lockwasher, etc. from valve if required.



Caution! When mounting do not hit with hammer on shaft top.

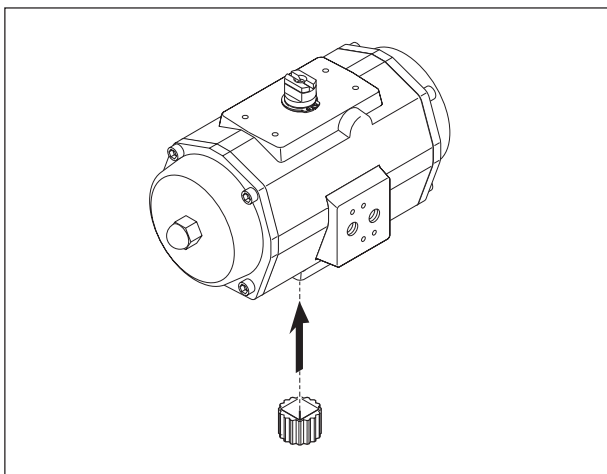


4.1.2

Mutter der Handbetätigung, Handbetätigung, Sicherungsscheibe usw., falls erforderlich, von der Armatur entfernen.



Achtung! Bei Montage nicht mit Hammer auf das Wellenende schlagen!

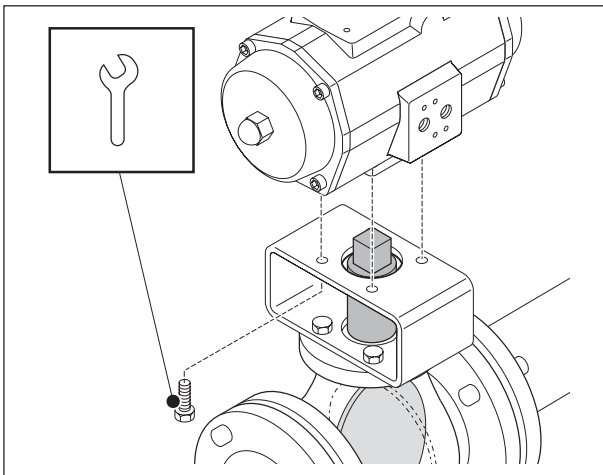


4.1.3

Verwijder indien nodig hendelmoer, hendel, veerring etc. van de afsluiter.



Voorzichtig! Bij montage niet met hammer op de astop slaan.

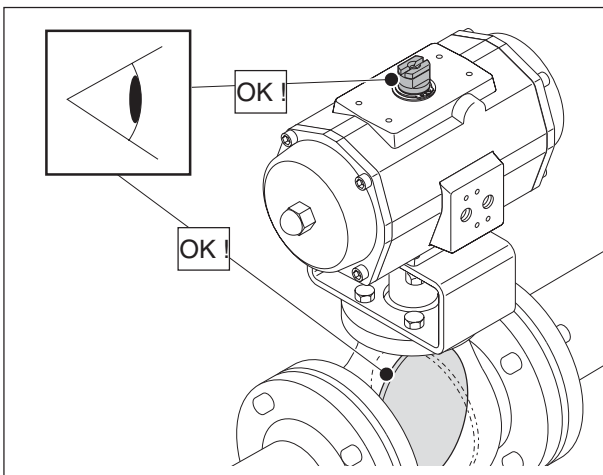


4.1.4

4.1.4 / 4.1.5.



Valves are manufactured so that they operate in only one 90 degree segment. The actuator should be mounted for counterclock-wise rotation to open and clockwise to close the valve.



4.1.5

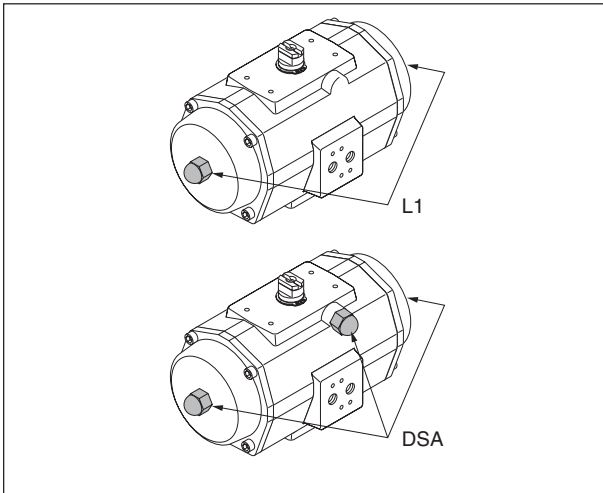


Die Armaturen sind so konstruiert, daß sie nur innerhalb eines 90°-Winkels wirksam sind. Der Antrieb sollte so montiert werden, daß eine Drehung gegen den Uhrzeigersinn die Armatur öffnet und daß eine Drehung im Uhrzeigersinn die Armatur schließt.



Afsluiters zijn zodanig geconstrueerd dat deze alleen in een segment van 90 graden werken. Bevestig de aandrijving zo dat bij rotatie tegen de wijzers van de klok in de afsluiter wordt geopend en bij rotatie met de wijzers van de klok mee de afsluiter wordt gesloten.

4.2 Stroke adjustment / Hubbegrenzung / Slagbegrenzung



4.2.1

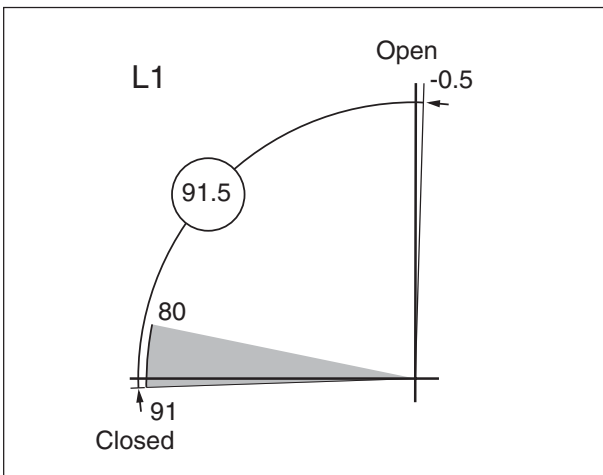
4.2.1

To achieve stroke adjustment, there are two actuator executions:

- 1- L1 One way limit stops
- 2- DSA Two way limit stops

4.2.2/4.2.3

Maximum stroke and adjustable stroke range of the L1 or DSA execution.



4.2.2

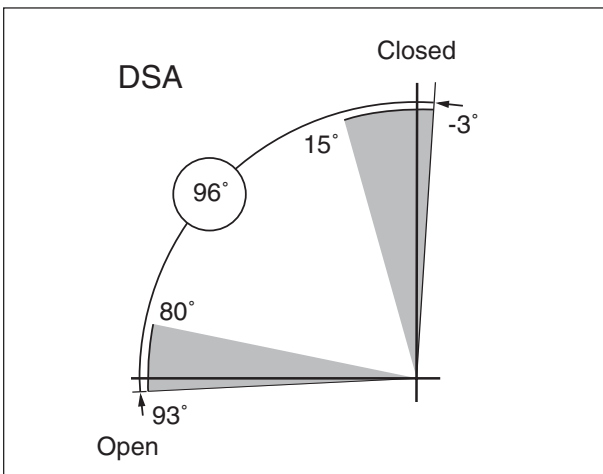
4.2.1

Für die Hubbegrenzung gibt es zwei Antriebsausführungen:

- 1- L1 einfache Hubbegrenzung
- 2- DSA doppelte Hubbegrenzung

4.2.2/4.2.3

Der Bereich des maximalen Hubs und des verstellbaren Hubs für die L1- oder DSA Ausführung.



4.2.3

4.2.1

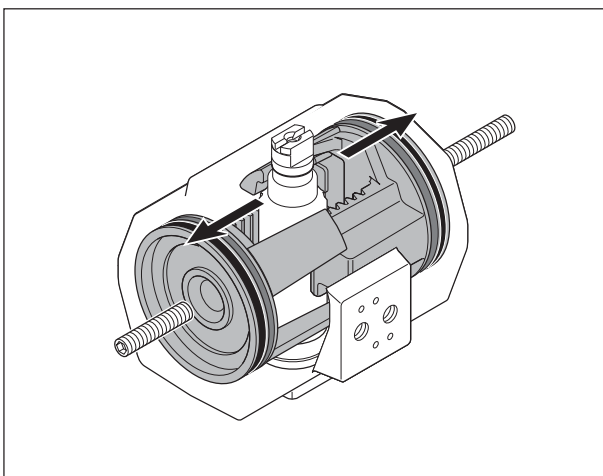
Ten behoeve van de slaginstelling bestaan er twee uitvoeringen van de aandrijvingen:

- 1- L1 enkelzijdige slagbegrenzing
- 2- DSA dubbelzijdige slagbegrenzing

4.2.2/4.2.3

Maximale slag en het bereik van de in te stellen slag van de L1- en de DSA uitvoering

4.2.1 L1 one way stroke adjustment / Einstellen der einfacher Hubbegrenzung L1 / Instellen van enkelzijdige slagbegrenzing L1

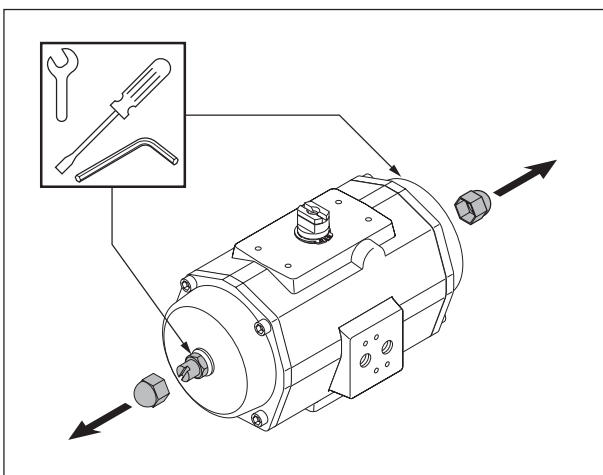


4.2.4

The L1 one way stroke adjustment limits the outward movement of the pistons (see fig. 4.2.4). The double acting and the single acting actuators both have limit stop bolts in the end caps.

Procedure:

1. Mount the actuator on the valve (see chapter 4).
2. Remove nut covers, loosen the lock nuts and turn out the limit stop bolts 4 turns (see fig. 4.2.5). Select tool from table (see page 23).



4.2.5

Die Einstellung der einfacher Hubbegrenzung L1 begrenzt die Bewegung der Kolben beim Ausfahren (siehe Abb. 4.2.4). Die Begrenzungsschrauben für den doppeltwirkenden und den einfachwirkenden Antrieb befinden sich jeweils in den Endkappen.

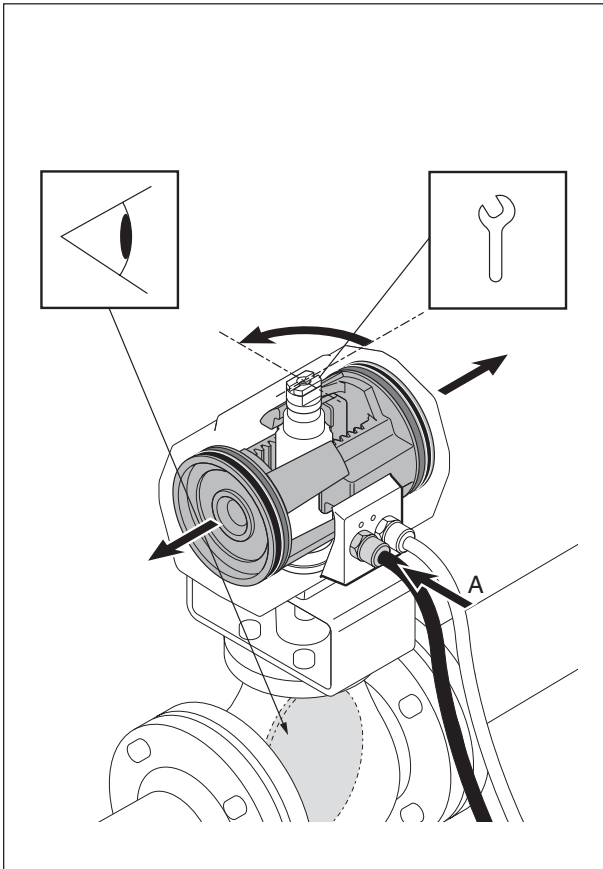
Verfahren:

1. Montieren Sie den Antrieb auf das Ventil (siehe Kapitel 4).
2. Entfernen Sie die Schutzkappen, lockern Sie die Sicherungsmuttern und drehen Sie die Begrenzungsschrauben 4 Umdrehungen heraus (siehe Abb. 4.2.5). Wählen Sie das geeignete Werkzeug aus der Tabelle (siehe Seite 23).

De L1-enkelzijdige slagbegrenzing begrenst de buitenwaartse beweging van de zuigers (zie afb. 4.2.4). De dubbel werkende en de enkel werkende aandrijvingen hebben beiden slagbegrenzingsbouten in de deksels.

Handelwijze:

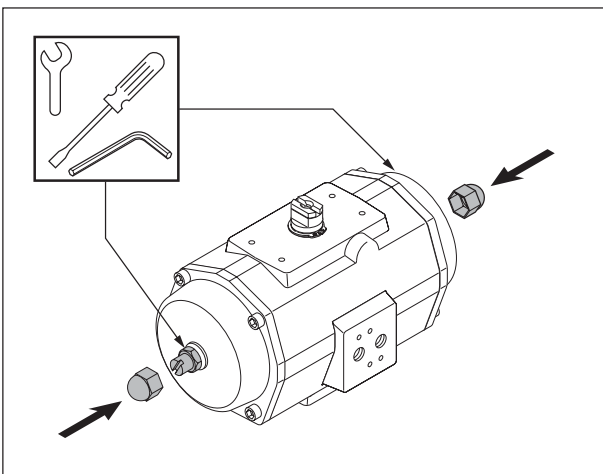
1. Bevestig de aandrijving op de afsluiter (zie hoofdstuk 4).
2. Verwijder de moerbeschermkappen, draai de borgmoeren los en draai de slagbegrenzingsbouten 4 omwentelingen naar buiten (zie afb. 4.2.5). Kies het gereedschap uit de tabel (zie pagina 23).



4.2.6

3. Turn actuator shaft until the valve is in the desired position (see fig. 4.2.6)
Use some pressure on the "A" port.
Use a wrench for accurate positioning.
4. Turn in both the limit stop bolts until an obstruction is felt (do not force) and lock the lock nut and place the nut covers (see fig. 4.2.7). Select tool from table (see page 23).

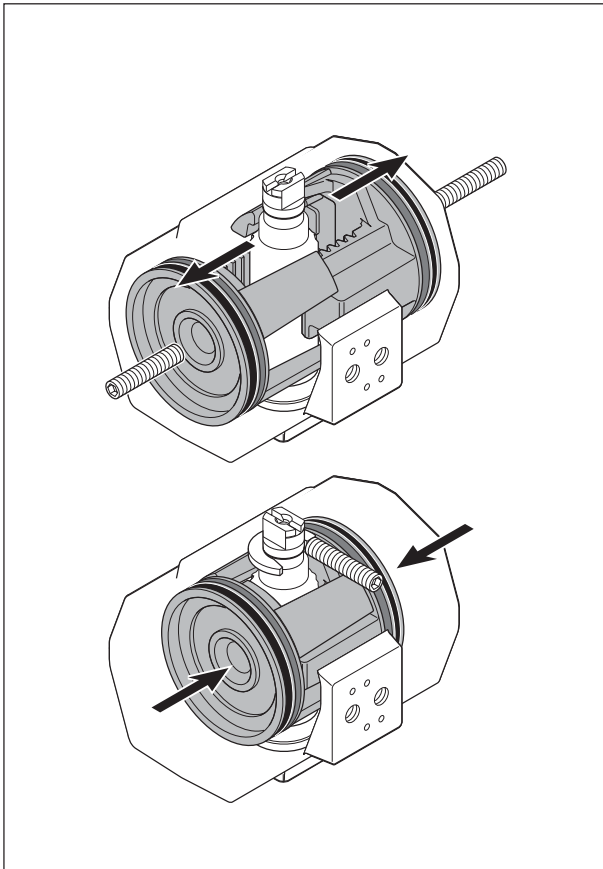
3. Drehen Sie die Antriebswelle, bis sich das Ventil in der gewünschten Position befindet (siehe Abb. 4.2.6). Geben Sie einen geringen Druck auf Anschluß "A" auf. Verwenden Sie zur genauen Positionierung einen Maulschlüssel.
4. Drehen Sie die beiden Begrenzungsschrauben hinein, bis Sie einen Widerstand verspüren (keine übermäßige Kraft aufwenden), verriegeln Sie die Sicherungsmutter und setzen Sie die Schutzkappen wieder auf (siehe Abb. 4.2.7). Wählen Sie das geeignete Werkzeug aus der Tabelle (siehe Seite 23).



4.2.7

3. Draai de aandrijvingsas, totdat de afsluiter op de gewenste positie staat (zie afb. 4.2.6). Zet een beetje druk op de "A"-poort. Gebruik een steeksleutel voor nauwkeurige positionering.
4. Draai de beide slagbegrenzingsbouten naar binnen, totdat u weerstand voelt (gebruik geen kracht), zet de borgmoer vast en plaats de moerbeschermkappen (zie afb. 4.2.7). Kies het gereedschap uit de tabel (zie pagina 23).

4.2.2 DSA two way stroke adjustment / Einstellen der doppelten Hubbegrenzung DSA / Instellen van dubbelzijdige slagbegrenzing DSA



4.2.8

The DSA two way stroke adjustment limits the outward and the inward movement of the pistons (see fig. 4.2.8). The double acting and the single acting actuators both have limit stop bolts in the end caps to limit the outward stroke. The bolt above the air connection interface limits the inward stroke.

Procedure:

1. Mount the actuator on the valve (see chapter 4).

Die Einstellung der doppelten Hubbegrenzung DSA begrenzt die Bewegung der Kolben beim Aus- und Einfahren (siehe Abb. 4.2.8). Die Begrenzungsschrauben für den doppelwirkenden und den einfachwirkenden Antrieb, die den Ausfahrhub begrenzen, befinden sich jeweils in den Endkappen. Die Schraube über dem Luftanschluß begrenzt den Einfahrhub.

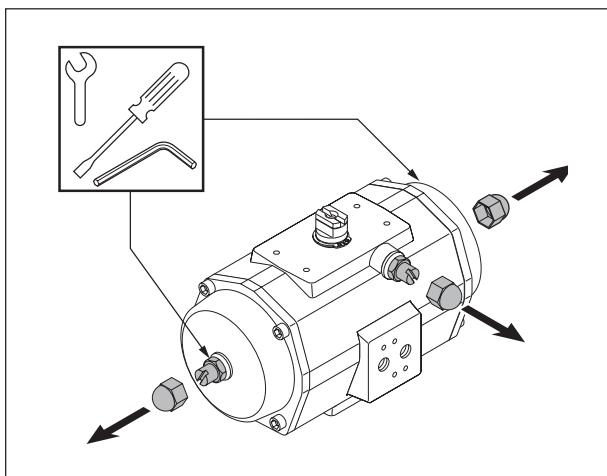
Verfahren:

1. Montieren Sie den Antrieb auf das Ventil (siehe Kapitel 4).

De DSA-dubbelzijdige slagbegrenzing begrenst de buitenwaartse en de binnenwaartse beweging van de zuigers (zie afb. 4.2.8). De dubbel werkende en de enkel werkende aandrijvingen hebben beiden slagbegrenzingsbouten in de deksels ter begrenzing van de buitenwaartse slag. De bout boven het luchtaansluitvlak begrenst de binnenwaartse slag.

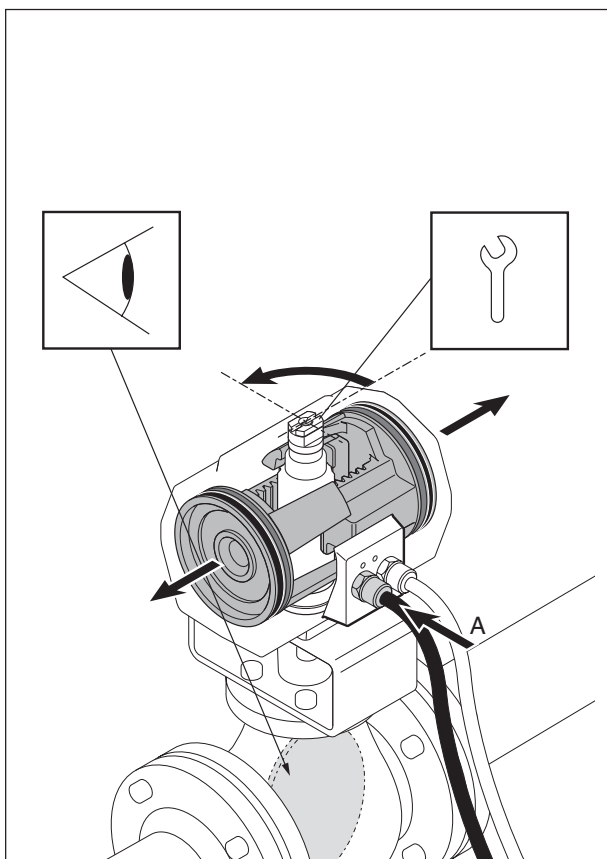
Handelwijze:

1. Bevestig de aandrijving op de afsluiter (zie hoofdstuk 4).



4.2.9

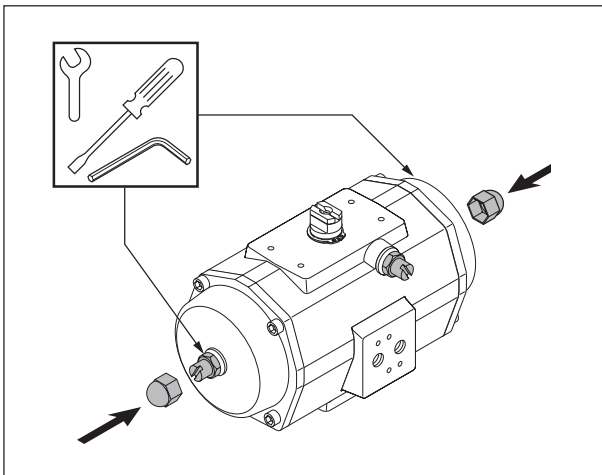
2. Remove nut covers, loosen the lock nuts and turn out the limit stop bolts 4 turns (see fig. 4.2.9).
3. Turn actuator shaft until the valve is in the desired position (see fig. 4.2.10). Use some pressure on the "A" port. Use a wrench for accurate positioning.



4.2.10

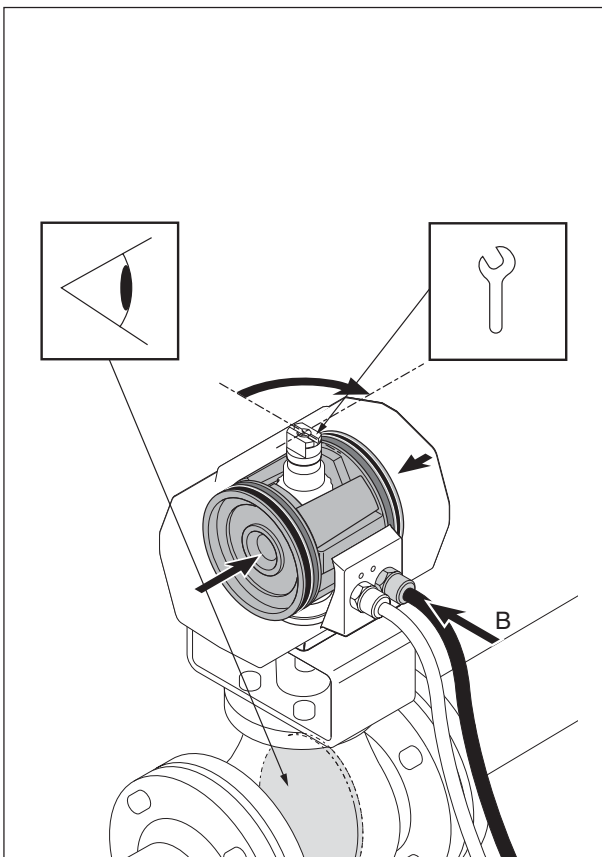
2. Entfernen Sie die Schutzkappen, lockern Sie die Sicherungsschrauben und drehen Sie die Begrenzungsschrauben 4 Umdrehungen heraus (siehe Abb. 4.2.9).
3. Drehen Sie die Antriebswelle, bis sich das Ventil in der gewünschten Position befindet (siehe Abb. 4.2.10). Geben Sie einen geringen Druck auf Anschluß "A" auf. Verwenden Sie zur genauen Positionierung einen Maulschlüssel.

2. Verwijder de moerbescermkappen, draai de borgmoeren los en draai de slagbegrenzingsbouten 4 omwentelingen naar buiten (zie afb. 4.2.9).
3. Draai de aandrijvingsas, totdat de afsluiter op de gewenste positie staat (zie afb. 4.2.10). Zet een beetje druk op de "A"-poort. Gebruik een steeksleutel voor nauwkeurige positionering.



4.2.11

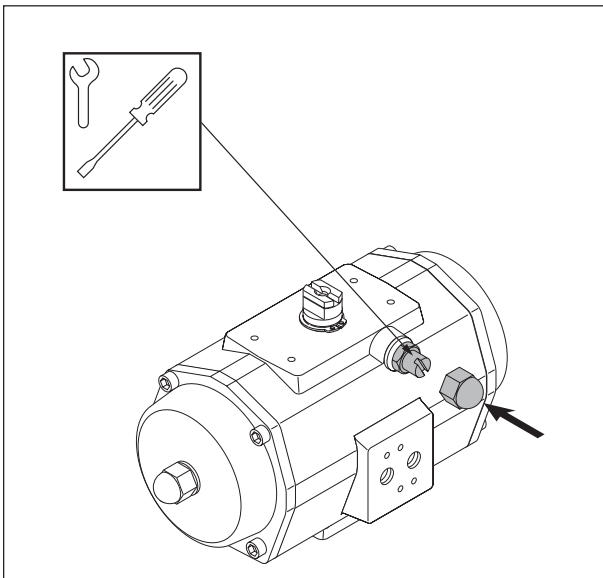
4. Turn in both the limit stop bolts until an obstruction is felt (do not force) and lock the lock nut and place the nut covers (see fig 4.2.11). The outward stroke is now set.
5. Turn actuator shaft until the valve is in the desired position (see fig. 4.2.12). Use some pressure on the "B" port. Use a wrench for accurate positioning.



4.2.12

4. Drehen Sie die beiden Begrenzungsschrauben hinein, bis Sie einen Widerstand verspüren (keine übermäßige Kraft aufwenden), verriegeln Sie die Sicherungsmutter und setzen Sie die Schutzkappen wieder auf (siehe Abb. 4.2.11). Jetzt ist der Ausfahrhub eingestellt.
5. Drehen Sie die Antriebswelle, bis sich das Ventil in der gewünschten Position befindet (siehe Abb. 4.2.12). Geben Sie einen geringen Druck auf Anschluß "B" auf. Verwenden Sie zur genauen Positionierung einen Maulschlüssel.

4. Draai de beide slagbegrenzingsbouten naar binnen, totdat u weerstand voelt (gebruik geen kracht), zet de borgmoer vast en plaats de moerbeschermkappen (zie afb. 4.2.11). De buitenwaartse slag is nu ingesteld.
5. Draai de aandrijvingsas, totdat de afsluiter op de gewenste positie staat (zie afb. 4.2.12). Zet een beetje druk op de "B"-poort. Gebruik een steeksleutel voor nauwkeurige positionering.



4.2.13

6. Turn in the limit stop bolt until an obstruction is felt (do not force), lock the lock nut and place the nut covers (see fig 4.2.13). The inward stroke is now set.
-

6. Drehen Sie die Begrenzungsschraube hinein, bis Sie einen Widerstand verspüren (keine übermäßige Kraft aufwenden), verriegeln Sie die Sicherungsmutter und setzen Sie die Schutzkappe wieder auf (siehe Abb. 4.2.13). Jetzt ist der Einfahrhub eingestellt.
-

6. *Draai de slagbegrenzingsbout naar binnen, totdat u weerstand voelt (gebruik geen kracht), zet de borgmoer vast en plaats de moerbeschermkap (zie afb. 4.2.13). De binnenwaartse slag is nu ingesteld.*

4.3 Tool table / Werkzeugtabelle / Gereedschapstabel

L1 limit stop bolts (in endcaps)					
Actuator type	Nut	Bolt	Actuator type	Nut	Bolt
ED25	W 10 mm	AK 3 mm	ED600 / 950	W 24 mm	W 11 mm
ED40 / 65	W 13 mm	AK 4 mm	ED1600	W 30 mm	W 11 mm
ED100 / 200	W 17 mm	AK 5 mm	PD2500	W 46 mm	W 17 mm
ED350	W 19 mm	AK 6 mm	PD4000	W 46 mm	W 17 mm

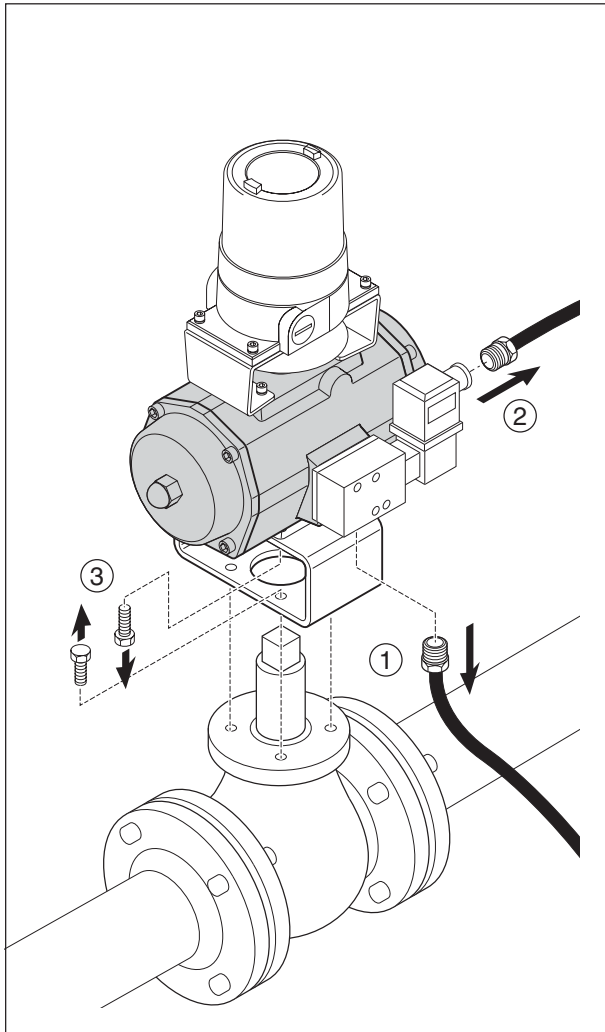
ES25 / 40	W 10 mm	SD 1.0x5.5 mm	ES600 / 950	W 24 mm	W 11 mm
ES65 / 100	W 13 mm	SD 1.0x5.5 mm	ES1600	W 30 mm	W 11 mm
ES200	W 17 mm	SD 1.2x8.0 mm	PS2500	W 46 mm	W 17 mm
ES350	W 19 mm	SD 1.2x8.0 mm	PS4000	W 46 mm	W 17 mm

DSA Limit stop bolt (above air connection interface)					
Actuator type	Nut	Bolt	Actuator type	Nut	Bolt
E25	W 10 mm	SD 1.0x5.5 mm	E200 / 350	W 19 mm	SD 1.2x8.0 mm
E40 / 65	W 13 mm	SD 1.0x5.5 mm	E600 / 950	W 24 mm	W 11 mm
E100	W 17 mm	SD 1.2x8.0 mm	E1600	W 30 mm	W 11 mm

Limit stop bolt	: Hubbegrenzungsschraube	: Slagbegrenzingbout
Endcap	: Endkappe	: Deksel
Actuator type	: Antriebstyp	: Type aandrijving
Nut	: Mutter	: Moer
Bolt	: Schraube	: Schroef
AK = Allen key	: AK = Innensechskantschraube	: AK = Imbus sleutel
SD = Screwdriver	: SD = Schraubendreher	: SD = Schroevendraaier
W = Wrench	: W = Maulschlüssel	: W = Sleutel

5 DISASSEMBLY / DEMONTAGE / DEMONTEREN

5.1 Before starting / Vor der Demontage / Alvorens te beginnen



5.1.1

5.1.1



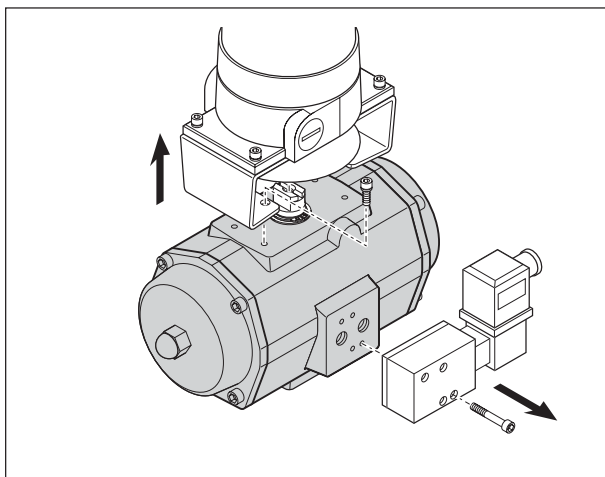
Caution! Never disassemble a valve that is under pressure!

Caution! Ball valves and plug valves can trap pressurized media in the cavity. Isolate the piping system in which the actuator valve assembly is mounted and relieve any pressure on the valve.



Achtung! Niemals eine unter Druck stehende Armatur demontieren!

Achtung! Kugel- und K ukenh ahne k onnen das Druckmedium in der Kammer einschlie en. Das Rohr system, in das das Stellglied eingebaut ist, ist drucklos zu machen, um den an der Armatur anliegenden Restdruck zu entspannen.



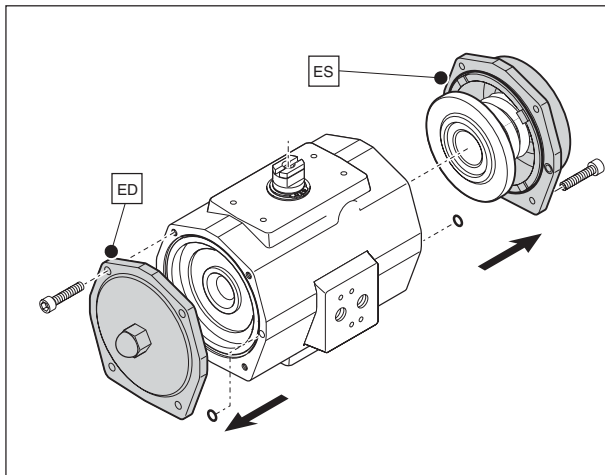
5.1.2



Voorzichtig! Demonteer nooit een afsluiter die onder druk staat!

Voorzichtig! Kogelafsluiters en plugafsluiters kunnen drukmedia in de kamer vasthouden. Isoleer het buizenstelsel, waarin de aandrijving en afsluiter zijn gemonteerd, en haal de druk van de afsluiter.

5.2 Removing endcaps type ES/ED 25 to 350 / Endkappen Typ ES/ED 25 bis 350 ausbauen / Deksels verwijderen type ES/ED 25 tot 350



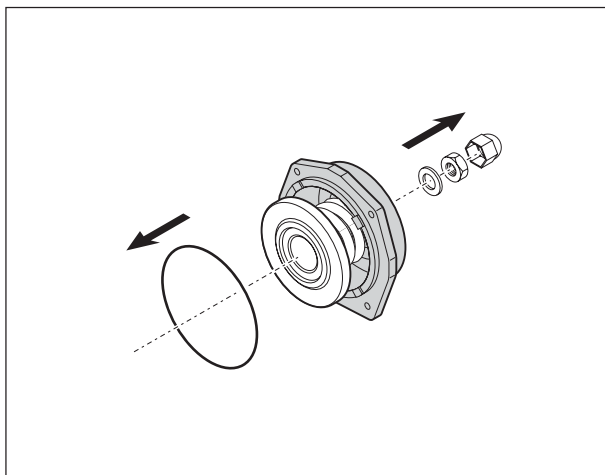
5.2.1

5.2.1 / 5.2.2 / 5.2.3

Be careful not to damage the endcap O-rings.



Caution! If the actuator is a "spring return" model, uniformly loosen all endcaps screws, two to three turns at a time, in sequence, to relieve pre-load of the springs. On all actuators with springs use caution when removing endcaps.

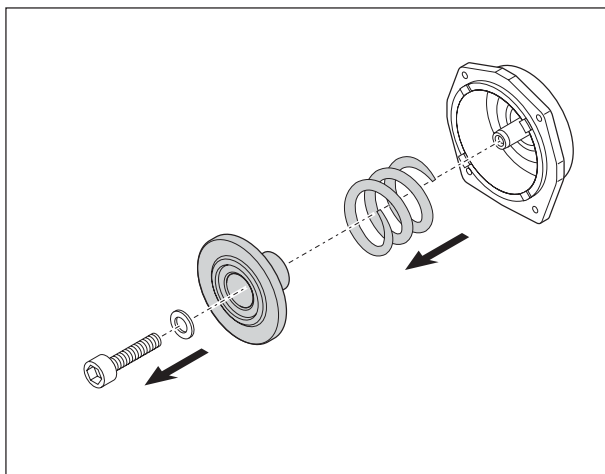


5.2.2

Beim Ausbauen darauf achten, daß die O-Ringe der Endkappen nicht beschädigt werden.



Achtung! Wenn es sich beim Antrieb um ein Typ mit Federrückstellung handelt, alle Endkappenschrauben gleichmäßig lösen. Jeweils immer nur zwei bis drei Schraubendrehungen gleichzeitig und nacheinander, um die Vorspannung der Federn zu senken. Seien Sie bei federrückstellenden Antrieben während der Demontage der Endkappen besonders vorsichtig.



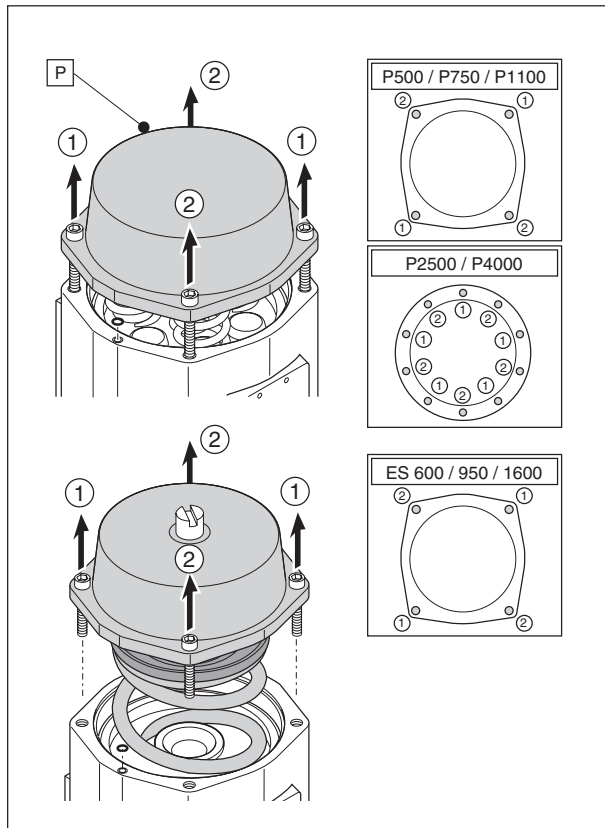
5.2.3

Let erop dat u de O-ringen van de sluitkap niet beschadigt.

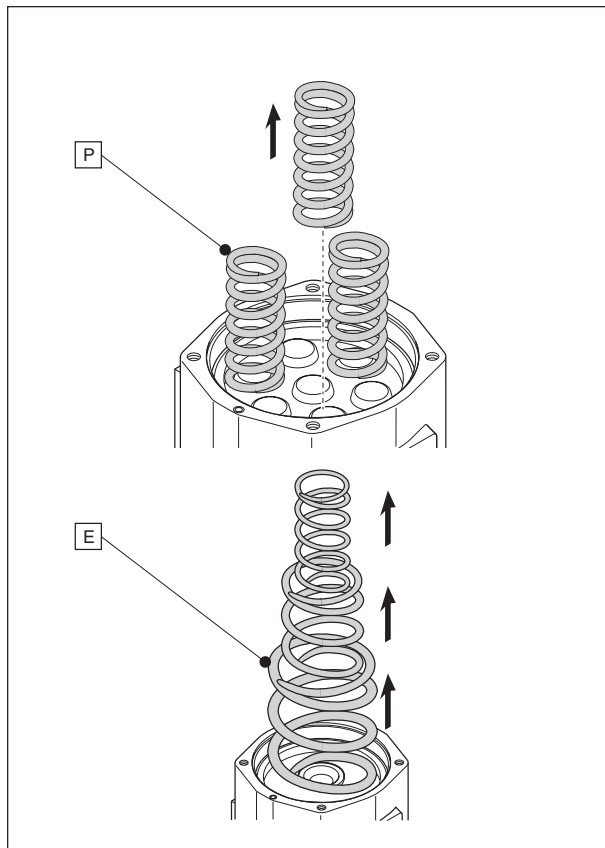


Voorzichtig! Als de aandrijving een "veerretour"-model is: draai alle schroeven van de deksels gelijkmatig los, twee tot drie slagen per keer en kruislings, om de voorspanning van de veren af te halen. Wees bij alle aandrijvingen met veren voorzichtig bij het verwijderen van deksels.

5.3 Removing endcaps type PE/PS and ES 600 to 1600 / Endkappen Typ PE/PS und ES 600 bis 1600 ausbauen / Deksels verwijderen type PE/PS en ES 600 tot 1600



5.3.1



5.3.2

5.3.1 / 5.3.2



Caution! If the actuator is a "spring return" model, first loosen screws 1, then uniformly loosen all endcap screws 2, two to three turns at a time, in sequence, to relieve pre-load of the springs.

On all actuators with springs use caution when removing endcaps.



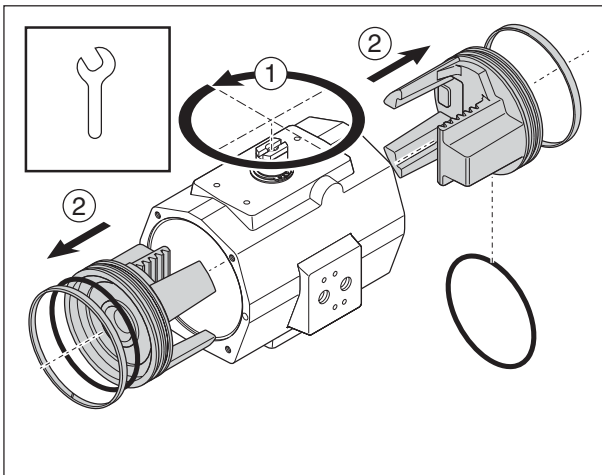
Achtung! Wenn es sich beim Antrieb um ein Typ mit Federrückstellung handelt, zuerst die Schrauben mit der Nummer 1 lösen, danach gleichmäßig alle Endkappenschrauben mit der Nummer 2 lösen. Dabei jeweils immer nur zwei bis drei Schraubendrehungen gleichzeitig und nacheinander, um die Vorspannung der Federn zu senken. Seien Sie bei federrückstellenden Antrieben während der Demontage der Endkappen besonders vorsichtig.



Voorzichtig! Als de aandrijving een "veerretour"-model is: draai eerst schroeven 1 los, draai vervolgens alle schroeven 2 van de deksels gelijkmatig los, twee tot drie slagen per keer en kruislings, om de voorspanning van de veren af te halen.

Wees bij alle aandrijvingen met veren voorzichtig bij het verwijderen van deksels.

5.4 Removing Pistons/Spindle, E- and P-series / Kolben/Wellen, E- und P-Serie, ausbauen / Zuigers/spindel verwijderen, E- en P-serie



5.4.1

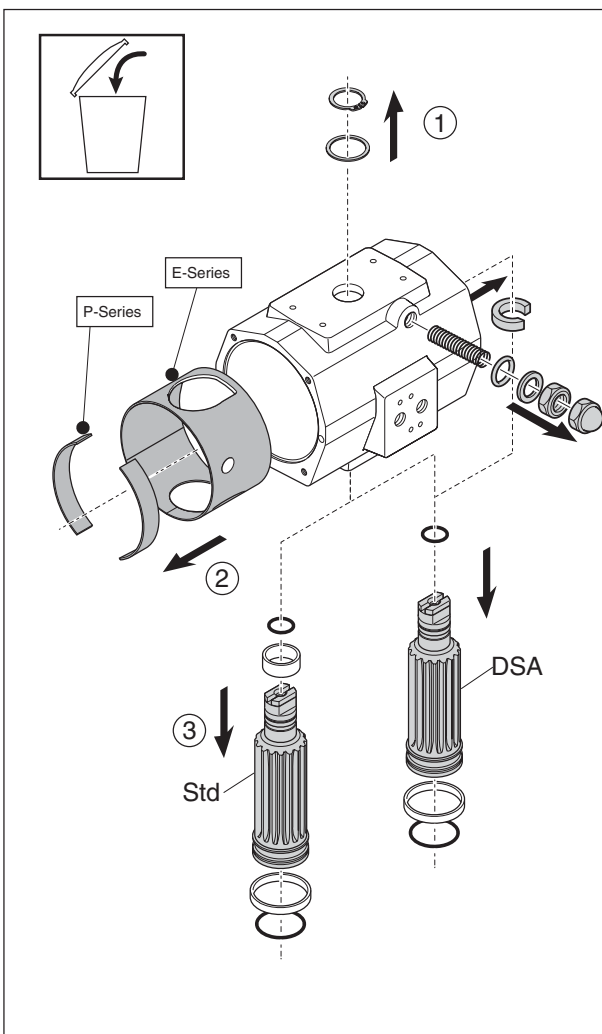
5.4.1



The two pistons can now be removed by rotating the actuator shaft.

5.4.2

In case of a DSA actuator first remove the DSA-cam through the bore of the housing. Then take out the shaft.



5.4.2

5.4.1



Die beiden Kolben werden nun durch Drehen der Antriebswelle ausgebaut.

5.4.2

Bei einem DSA Antrieb zuerst den DSA-Nocken durch die Bohrung des Gehäuses entfernen. Dann die Welle herausnehmen.

5.4.1

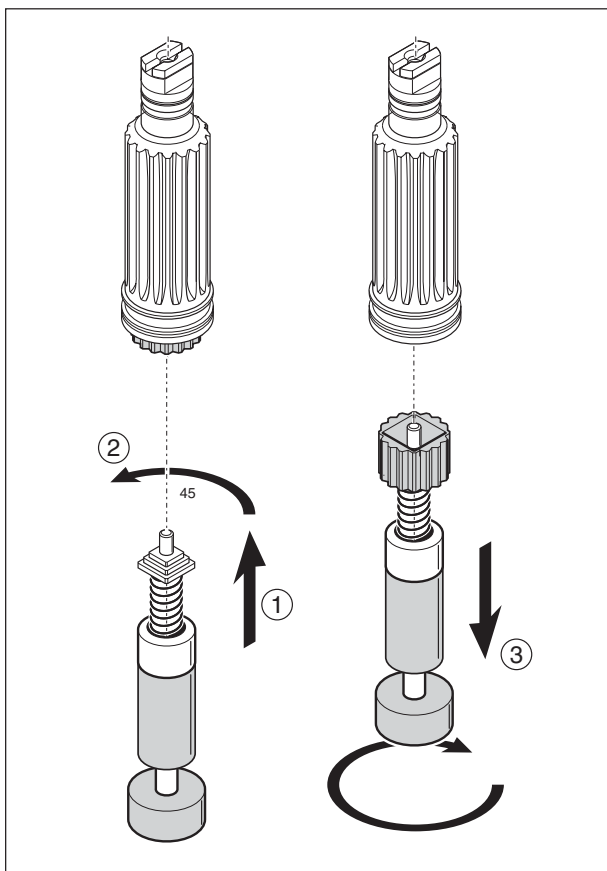


De twee zuigers kunnen nu verwijderd worden door de as van de stelaandrijving te draaien.

5.4.2

In geval van een DSA aandrijving eerst de DSA-nok verwijderen door de boring van het huis. Dan de as verwijderen.

5.5 Removing insert / *Insert ausbauen* / *Insert verwijderen*



5.5.1

5.5.1



Insert removal requires the use of the extractor part No. 590.00.001 for square sizes 11, 14 and 17. Part No 590.00.002 is used for square sizes 19, 22 and 27.



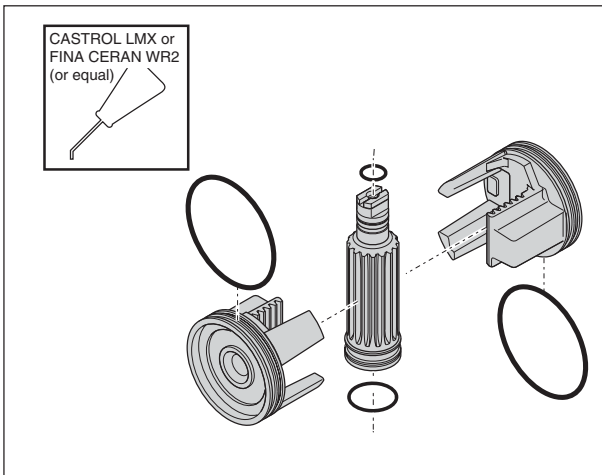
Für den Ausbau der Inserts benötigen Sie das Werkzeug Artikelnr. 590.00.001 für die Vierkantgrößen 11, 14 und 17. Werkzeug Artikelnr. 590.00.002 wird für die Vierkantgrößen 19, 22 und 27 benötigt.



Om de insert te verwijderen moet u gebruik maken van de extractor art.nr. 590.00.001 voor vierkantaftmetingen 11, 14 en 17. Art.nr. 590.00.002 wordt gebruikt voor vierkantaftmetingen 19, 22 en 27.

6 REASSEMBLY / ZUSAMMENBAU / OPNIEUW MONTEREN

6.1 Reassembly guide band and shaft / Zusammenbau von Führungsband und Antriebswelle / Opnieuw monteren van geleideband en as



6.1.1



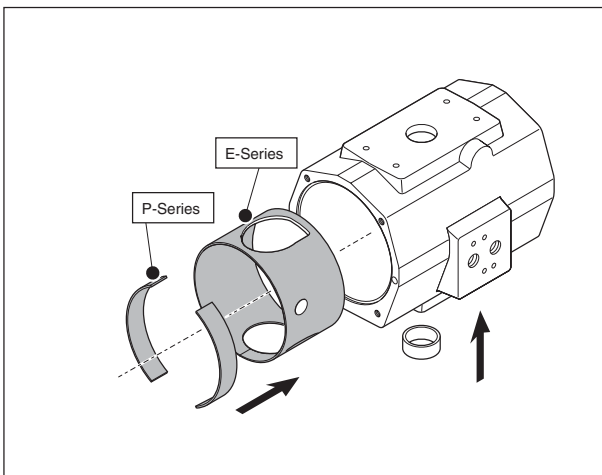
Before reassembly check the requested assembly code (see chapter 4).

6.1.1

Apply a light film of grease to all O-Rings and on the gear teeth.

6.1.3

In case of a DSA actuator mount the DSA-cam through the bore of the housing on top of the shaft.



6.1.2



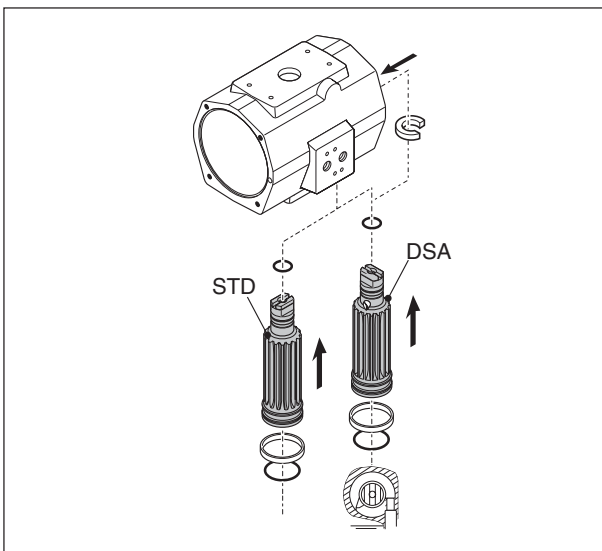
Kontrollieren Sie vor dem Zusammenbau den gewünschten Aufbaucode (siehe Kapitel 4)!

6.1.1

Alle O-Ringe und Verzahnungen einfetten.

6.1.3

Bei einem DSA Antrieb den DSA-Nocken durch die Bohrung des Gehäuses auf der Welle montieren.



6.1.3



Kontroleer voor het opnieuw monteren de gewenste montagecode (zie hoofdstuk 4).

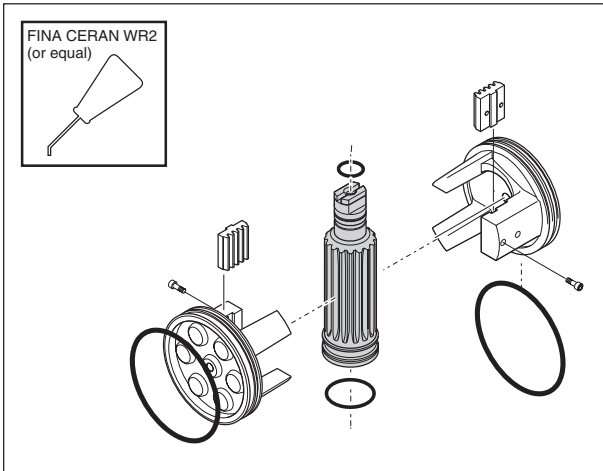
6.1.1

Breng op alle O-ringen en de tanden van de overbrenging een dunne laag smeervet aan

6.1.3

In geval van een DSA aandrijving de DSA-nok door de boring van het huis op de as monteren.

**6.2 Reassembly pistons /
Zusammenbau von Kolben /
Opnieuw monteren van zuigers**



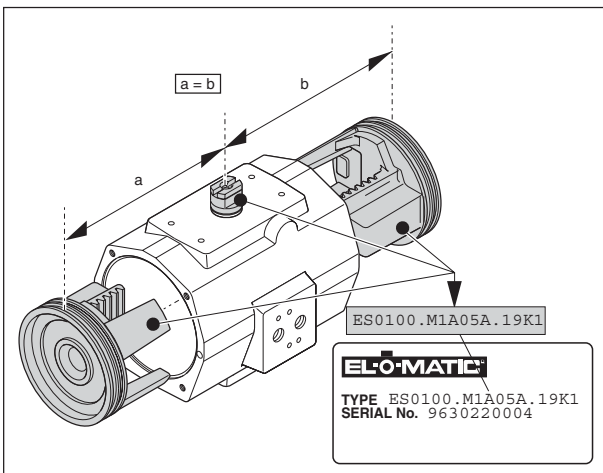
6.2.1

6.2.1

Align the pinion gear so that the teeth on the center gear will “pick-up” the pistons assembly’s rack teeth when turning the top extension of the center gear clockwise (CW) or counter clockwise (CCW) according assembly code (see page 9).

6.2.3

Ensure that smooth movement and 90 degree operation can occur without moving the pistons out of the actuator body.



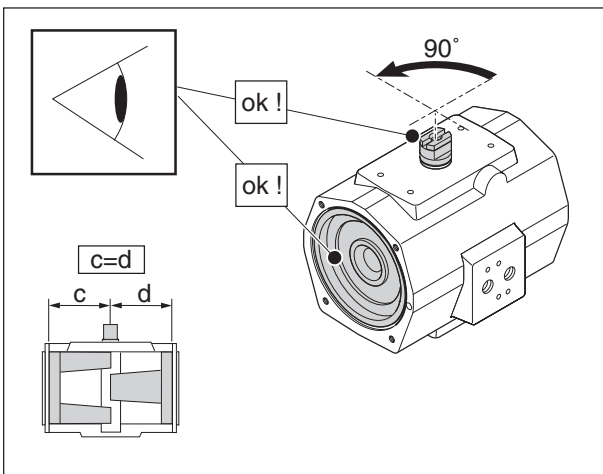
6.2.2

6.2.1

Die verzahnte Welle so ausrichten, daß die Zähne die Innenverzahnung die beiden Kolben erfaßt, wobei das obere Wellenende entweder im Uhrzeigersinn oder gegen den Uhrzeigersinn (je nach Aufbau-code, siehe Seite 9) gedreht wird. Beachten Sie bitte, daß die Schlüssel­fläche bzw. Nut am oberen Wellenende entweder parallel oder um 90° versetzt um Antrieb steht.

6.2.3

Beachten Sie, daß eine reibungslose Bewegung im 90°-Winkel möglich ist, ohne daß dabei die Kolben aus dem Antriebsgehäuse herausragen.



6.2.3

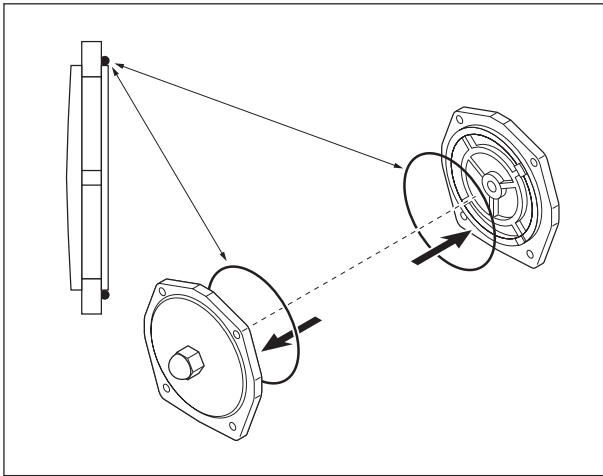
6.2.1

Richt de tandoverbrenging zodanig uit dat de tanden op de as de heugeltanden van de zuiger zullen “oppakken”, als het bovenstuk van de as met de wijzers van de klok mee of tegen de klok in wordt gedraaid naar gelang de montage code (zie pagina 9).

6.2.3

Controleer op een soepele beweging en een verdraaiing van 90 graden, zonder dat de zuigers uit de behuizing van de aandrijving naar buiten komen.

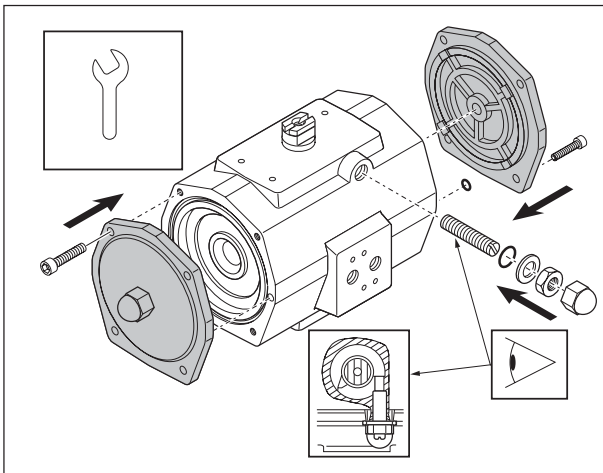
**6.3 Reassembly endcaps double acting actuators /
Zusammenbau Endkappen doppelwirkende Antriebe /
Opnieuw monteren deksels van dubbelwerkende aandrijvingen**



6.3.1

6.3.2

Ensure that endcap O-rings and airport O-rings are in place on both sides.

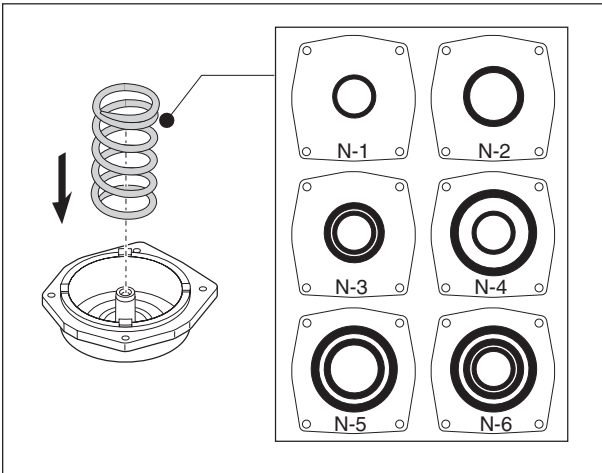


6.3.2

Beachten Sie, daß die O-Ringe der Endkappen und Luftzufuhröffnungen auf beiden Seiten eingesetzt werden.

Plaats de O-ringen van de deksels en de O-ringen van de luchtpoorten aan beide zijden.

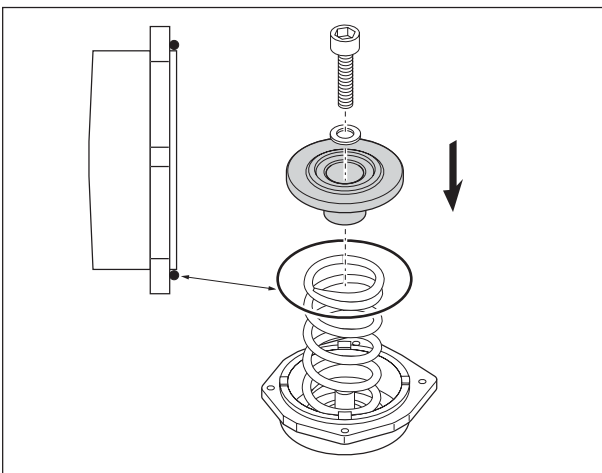
**6.4 Reassembly endcaps single acting actuators ES25 - ES350 /
Zusammenbau Endkappen einfachwirkende Antriebe ES25 - ES350 /
Opnieuw monteren deksels van enkelwerkende aandrijvingen ES25 - ES350**



6.4.1

6.4.1
When replacing springs in a spring return actuator, ensure that the springs are replaced in their identical position in the spring pack from where they were removed.

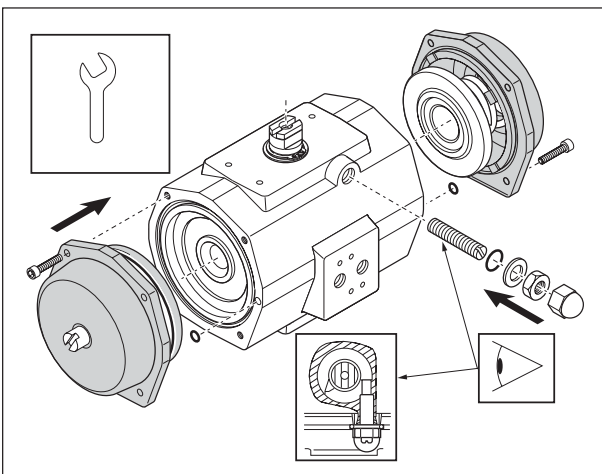
6.4.3
Ensure that endcap O-rings and airport O-rings are in place on both sides.



6.4.2

6.4.1
Beachten Sie beim Wechseln der Federn im Antrieb mit Federrückstellung, daß die Federn an ihrem ursprünglichen Platz eingebaut werden.

6.4.3
Beachten Sie, daß die O-Ringe der Endkappen und Luftzufuhröffnungen auf beiden Seiten eingesetzt werden.

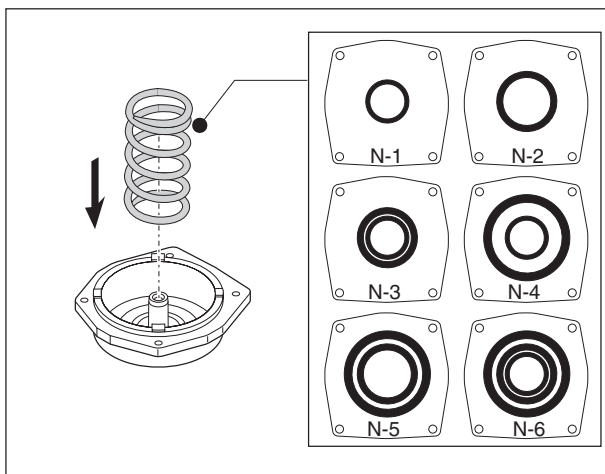


6.4.3

6.4.1
Zorg er bij het vervangen van veren in een veerretour-aandrijving voor dat de veren op exact dezelfde plaats in het verenpakket worden geplaatst, waar ze zijn verwijderd.

6.4.3
Plaats de O-ringen van de deksels en de O-ringen van de luchtpoorten aan beide zijden.

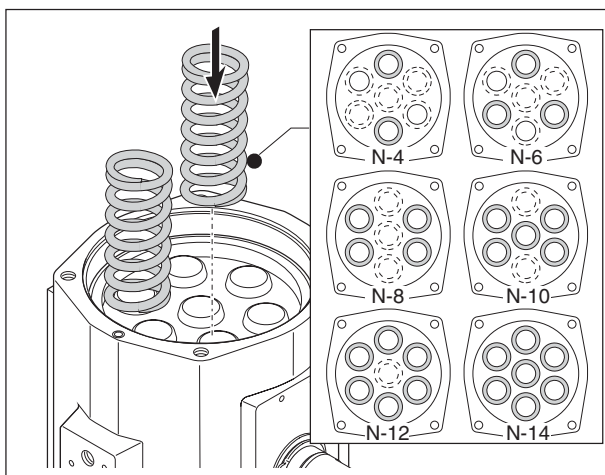
**6.5 Reassembly endcaps single acting actuators ES600 - PS4000 /
Zusammenbau Endkappen einfachwirkende Antriebe ES600 - PS4000 /
Opnieuw monteren deksels van enkelwerkende aandrijvingen ES600 - PS4000**



6.5.1

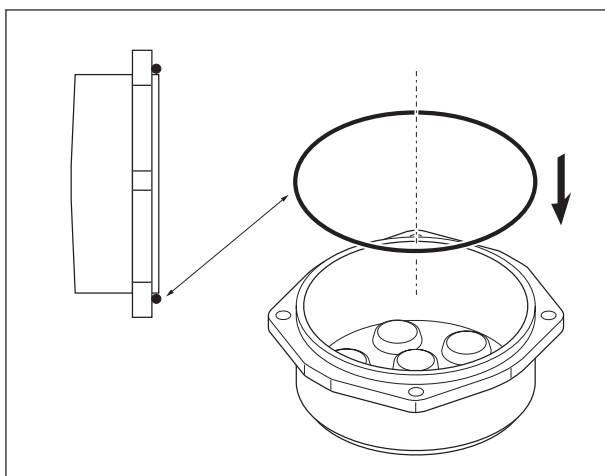
6.5.1 / 6.5.2 / 6.5.3

When replacing springs in a spring return actuator, ensure that the springs are replaced in their identical position in the endcap from where they were removed. Before assembling the springs and endcaps, make sure that the pistons are pushed inside the body.



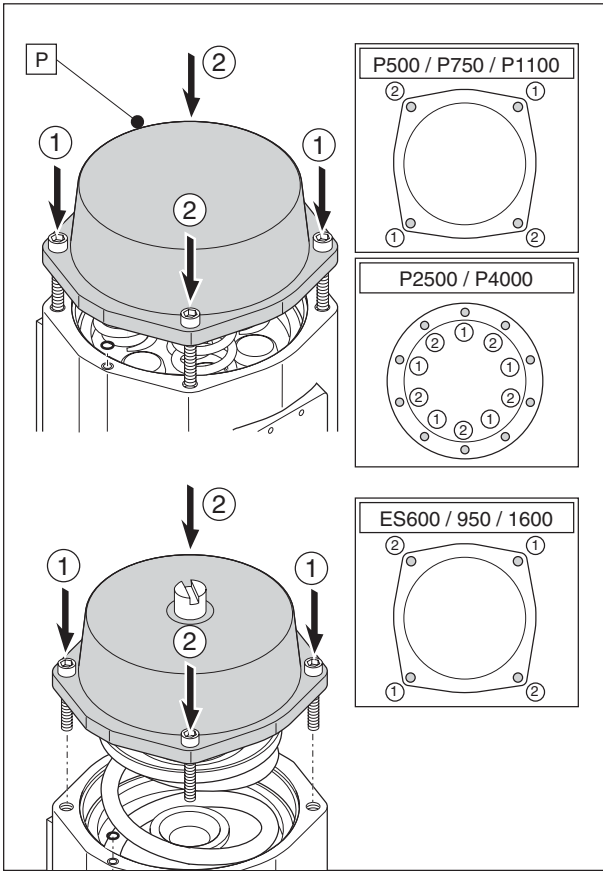
6.5.2

Beachten Sie, beim Wechsel der Federn im Antrieb mit Federrückstellung, daß die Federn an ihrem ursprünglichen Platz in der Endkappe eingebaut werden. Beachten Sie vor der Montage der Federn und Endkappen, daß die Kolben in den Antrieb hineingedrückt wurden.



6.5.3

Zorg er bij het vervangen van veren in een veerretour-aandrijving voor dat de veren op exact dezelfde plaats in de deksel worden geplaatst, waar ze zijn verwijderd. Zorg ervoor dat de zuigers naar binnen zijn, voordat u de veren en deksels monteert.



6.5.4

6.5.4

Engage the bolts with the tapped holes in the actuator body by forcing down slightly on the cap. Tighten each bolt in small and equal turns.

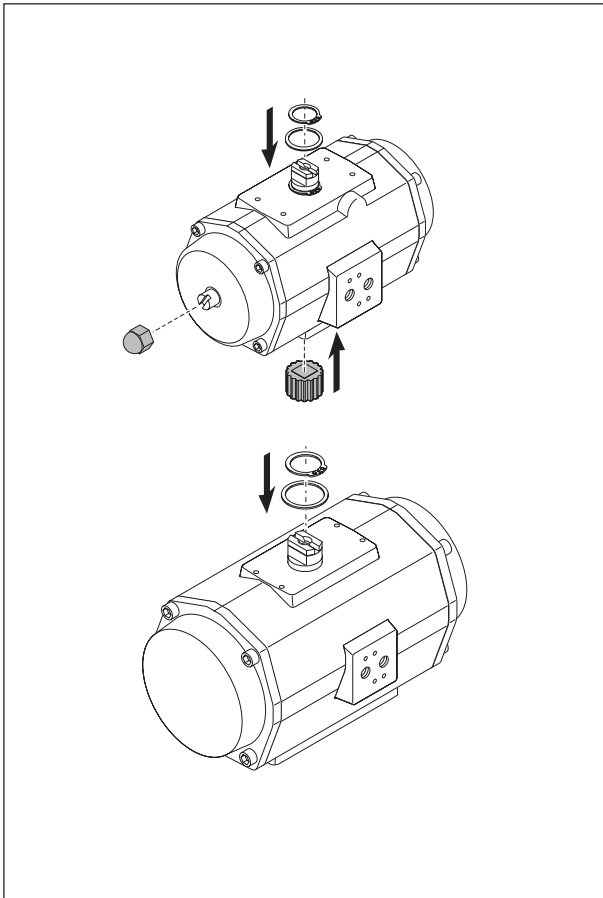


Die Schrauben mit leichtem Druck auf die Endkappe in die Gewindelöcher des Antriebsgehäuses einführen. Jede Schraube mit kurzen und gleichen Schraubendrehungen abwechselnd festschrauben.



Plaats de bouten in de schroefgaten in de behuizing van de aandrijving door de kap lichtjes naar beneden te drukken. Draai elke bout met kleine en gelijkmatige bewegingen vast.

6.6 Reassembly of springclip and insert / Zusammenbau von Seegerring und Insert / Opnieuw monteren van Seegerring en insert



6.6.1

6.6.1



Install the new shaft spring clip onto its mating groove on the top shaft extension.

Check proper functioning by applying pressure to the A-port or B-port (see chapter 3).

6.6.2

Apply pressure to the A-port and use some soapsuds around shaft top and shaft bottom to check for air leakage. Apply pressure to the B-port and use some soapsuds around the endcaps to check for air leakage.

6.6.1

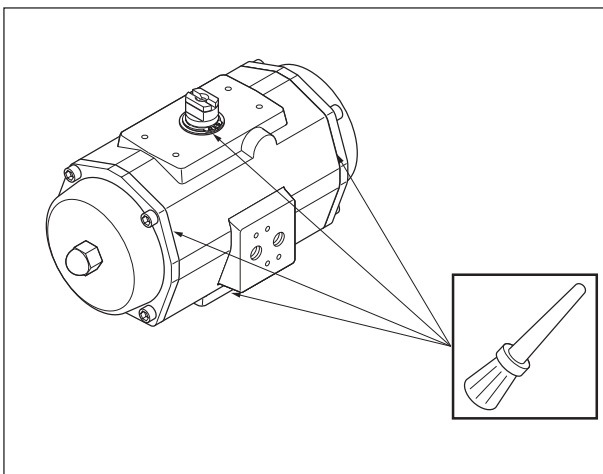


Den neuen Sicherungsring auf die dafür vorgesehene Rille am oberen Wellenende montieren.

Kontrollieren Sie die richtige Funktion des Antriebs durch anschliessen von Zuluft am Anschluß A und / oder B (siehe Kapitel 3).

6.6.2

Schließen Sie die Luftzufuhr am Anschluß A an und verwenden Sie Seifenwasser an der Wellenoberseite und Wellenunterseite zur Kontrolle der Luftdichtigkeit. Schließen Sie am Anschluß B die Zuluft an und verwenden Sie Seifenwasser an den Endkappen zur Kontrolle der Luftdichtigkeit.



6.6.2

6.6.1

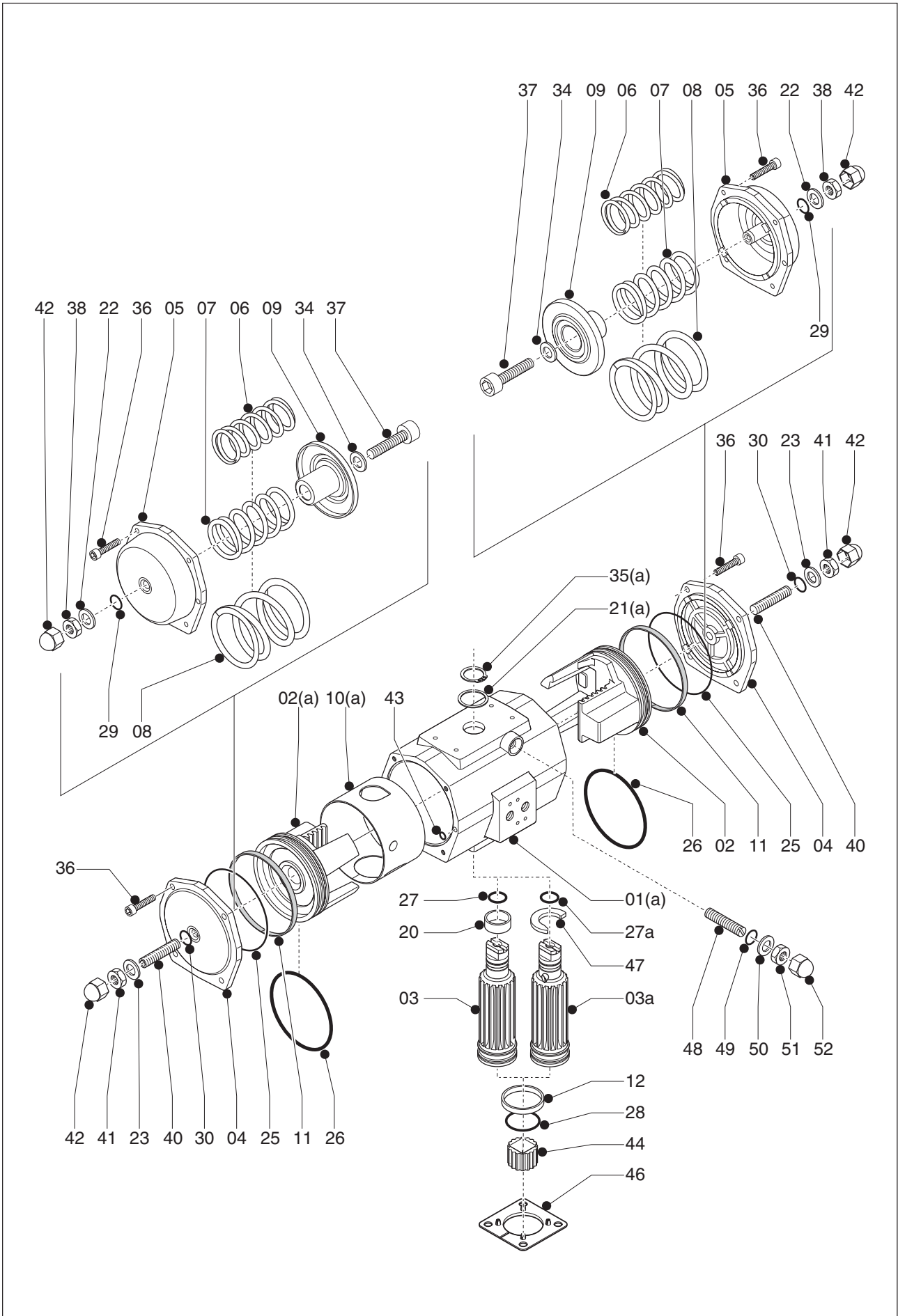


Installeer de nieuwe veerklem in de corresponderende groef op de astop.

Kontroleer het juist functioneren door luchtdruk aan te sluiten op de A-poort of de B-poort (zie hoofdstuk 3).

6.6.2

Zet luchtdruk op de A-poort en gebruik zeepsop rond as-top en as-einde voor controle van de luchtdichtheid. Zet luchtdruk op de B-poort en gebruik zeepsop rond de deksels voor controle van de luchtdichtheid.



7 PARTS LIST / STÜCKLISTE / STUKLIJSTEN

Pos.	Qty. St.Z. Aant.	Description	Bezeichnung	Benaming	Specification Spezifikation Specificatie
1	1	Body	Gehäuse	Behuizing	GAISI10Mg, DIN 1725/2
1a	1	Body DSA	Gehäuse DSA	Behuizing DSA	GAISI10Mg, DIN 1725/2
2	1	Piston	Kolben	Zuiger	GAISI7Mg, DIN 1725/2
2a	1	Piston DSA	Kolben DSA	Zuiger DSA	GAISI7Mg, DIN 1725/2
3	1	Drive Shaft	Antriebswelle	Aandrijfjas	AlZnMGCu1.5, DIN 1725/1
3a	1	Drive Shaft DSA	Antriebswelle DSA	Aandrijfjas DSA	AlZnMGCu1.5, DIN 1725/1
4	2	End Cap ED	Endkappe ED	Deksel ED	GDAISI9Cu3, DIN1725/2
5	2	End Cap ES	Endkappe ES	Deksel ES	GDAISI9Cu3, DIN 725/2
6	2	Spring-inner	Innenfeder	Veer binnen	Class C, DIN 17223
7	2	Spring-mid	Mittelfeder	Veer midden	Class C, DIN 17223
8	2	Spring-outer	Außenfeder	Veer buiten	Class C, DIN 17223
9	2	Spring Holder	Federhalter	Veerhouder	C45, DIN 17200
10*	1	Guide Band	Führungsband	Geleideband	PA66 + MoS2
10a*	1	Guide Band DSA	Führungsband DSA	Geleideband DSA	PA66 + MoS2
11*	2	Guide Band	Führungsband	Geleideband	PTFE + 2596 C
12*	1	Bearing Bush	Lagerbuchse	Lagerbus	PA66 + MoS2
20*	1	Bearing Bush	Lagerbuchse	Lagerbus	POM
21*	1	Washer	Unterlegscheibe	Afdichtring	POM
21a*	1	Washer DSA	Unterlegscheibe DSA	Afdichtring DSA	POM
22*	2	Washer ES	Unterlegscheibe ES	Sluitplaat ES	PA6
23*	2	Washer ED	Unterlegscheibe ED	Sluitplaat ED	PA6
25*	2	O-Ring	O-Ring	O-ring	Buna N
26*	2	O-Ring	O-Ring	O-ring	Buna N
27*	1	O-Ring	O-Ring	O-ring	Buna N
27a*	1	O-Ring DSA	O-Ring DSA	O-ring DSA	Buna N
28*	1	O-Ring	O-Ring	O-ring	Buna N
29*	4	O-Ring	O-Ring	O-ring	Buna N
30*	2	O-Ring	O-Ring	O-ring	Buna N
34	2	Washer ES	Unterlegscheibe ES	Afdichtring ES	C35
35*	1	Spring Clip	Seegerring	Seegerring	Ck75, DIN 17222
35a*	1	Spring Clip DSA	Seegerring DSA	Seegerring DSA	Ck75, DIN 17222
36	8	End Cap bolt ED/ES	Endkappenschraube ED/ES	Bout deksel ED/ES	AISI 304
37	2	Limit Stop Bolt ES	Begrenzungsschraube ES	Bout slagbegrenzing ES	AISI 304
38	2	Nut	Mutter	Moer	AISI 304
40	2	Limit Stop bolt ED	Begrenzungsschraube ED	Bout slagbegrenzing ED	AISI 304
41	2	Nut	Mutter	Moer	AISI 304
42	2	Nut cover	Schutzkappe	Moerbeschermkap	PE
43*	2	O-Ring	O-Ring	O-ring	Buna N
44	1	Insert	Insert	Inzetstuk	AlMgSi 1
46	1	Centre-plate (option for DIN3337 actuators)	Zentrierplatte (Option für DIN3337 Antriebe)	Centreerplaat (optie voor DIN3337)	PA6 + 25% Glass
47	1	Cam for stroke adj. DSA	Hubbegrenzungsnocken DSA	Slagbegrenzingsnok DSA	AISI 304
48	1	Limit Stop bolt DSA	Begrenzungsschraube DSA	Bout slagbegrenzing DSA	AISI 304
49*	1	O-Ring DSA	O-Ring DSA	O-ring DSA	Buna N
50*	1	Washer DSA	Unterlegscheibe DSA	Sluitplaat DSA	PA6
51	1	Nut DSA	Mutter DSA	Moer DSA	AISI 304
52	1	Nut cover DSA	Schutzkappe DSA	Moerbeschermkap DSA	PE

* Recommended Spare Parts (contained in Repair Kit or Repair Kit DSA).

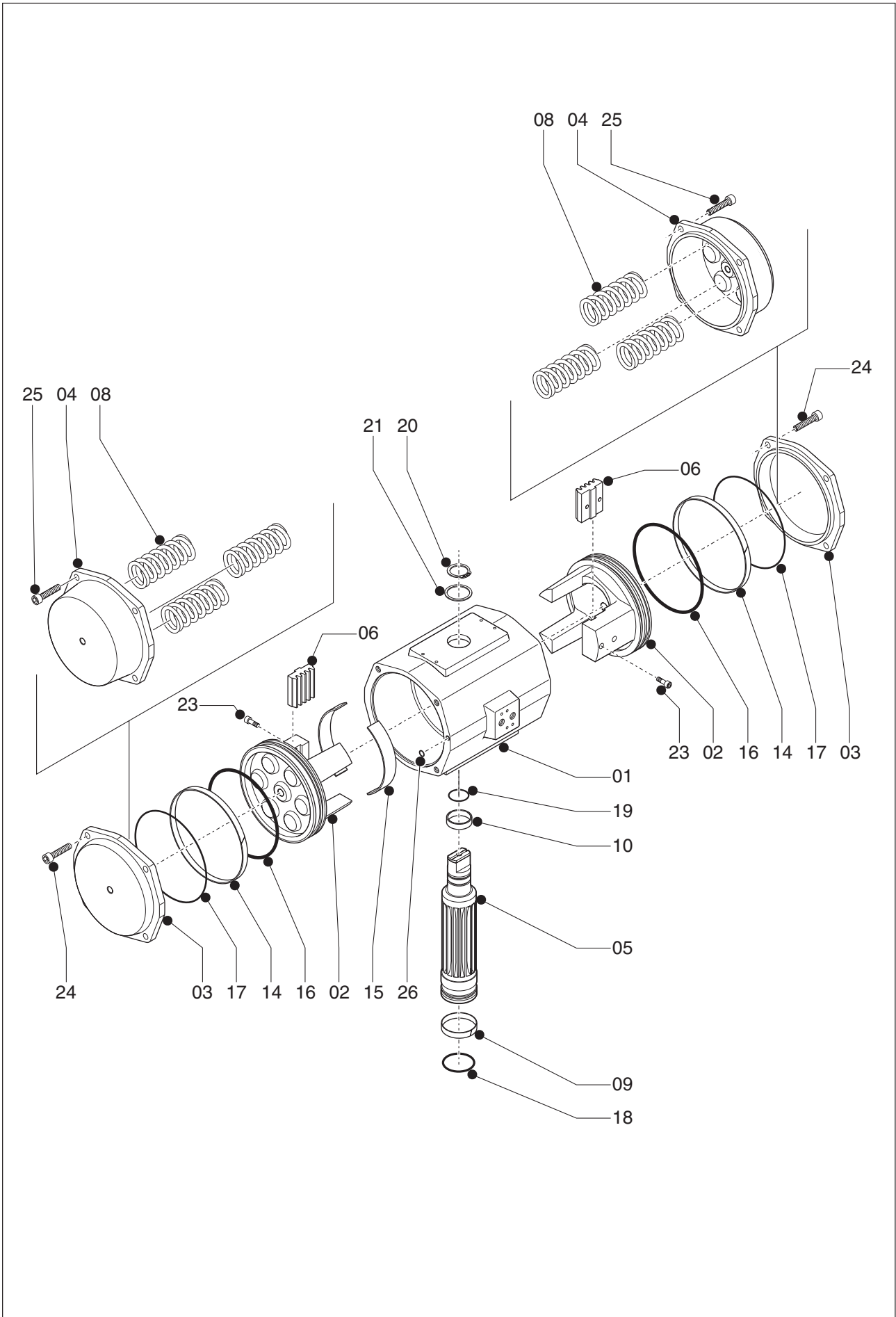
* Empfohlene Ersatzteile (Teil des Reparatursatzes oder Reparatursatz für DSA).

* Aanbevolen reserve-onderdelen (opgenomen in reparatiepakket of reparatiepakket DSA).

* The extra or specific parts of a DSA actuator are marked "DSA".

* Die zusätzlichen oder spezifischen Teile eines DSA-Antriebs sind mit der Kennzeichnung "DSA" angegeben.

* De extra of specifieke delen van een DSA aandrijving zijn gemerkt met "DSA".



Pos.	Qty. St.Z. Aant.	Description	Bezeichnung	Benaming	Specification Spezifikation Specificatie
1	1	Body	Gehäuse	Behuizing	GAISi10Mg, DIN 1725/2
2	2	Piston	Kolben	Zuiger	GAISi7Mg, DIN 1725/2
3	2	End Cap PD	Endkappe PD	Deksel PD	GAISi10Mg, DIN 1725/2
4	2	End Cap PE	Endkappe PE	Deksel PE	GAISi10Mg, DIN 1725/2
5	1	Central drive shaft	Antriebswelle	Aandrijfas	AlZnMGCu1.5, DIN 1725/1
6	2	Gear Rack	Zahnstange	Tandheugel	C45, DIN 17200
8	14	Spring	Feder	Veer	Class C, DIN 17223
9*	1	Bearing bush	Lagerbuchse	Lagerbus	PA66 + MoS2
10*	1	Bearing bush	Lagerbuchse	Lagerbus	POM
14*	2	Guide band	Führungsband	Geleideband	PTFE + 25% C
15*	2	Guide band	Führungsband	Geleideband	PTFE + 25% C
16*	2	O-ring	O-Ring	O-ring	Buna N
17*	2	O-ring	O-Ring	O-ring	Buna N
18*	1	O-ring	O-Ring	O-ring	Buna N
19*	1	O-ring	O-Ring	O-ring	Buna N
20*	1	Spring Clip	Sprengring	Seegerring	Ck75, DIN17222
21*	1	Thrust Washer	Sicherungsscheibe	Drukschijf	POM
23	2/4	Bolt	Schraube	Bout	12.9 DIN912
24	8/20	Endcap Bolt PD	Endkappenschraube PD	Bout sluitkap PD	AISI 304
25	8/20	Endcap Bolt PE	Endkappenschraube PE	<i>Bout sluitkap PE</i>	AISI 304
26*	2	O-ring	O-Ring	O-ring	Buna N

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Type i2P-100 Electro-Pneumatic Transducers

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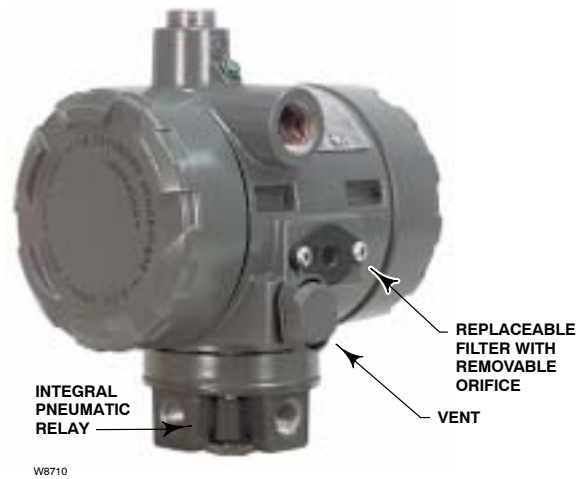


Figure 1. Type i2P-100 Electro-Pneumatic Transducer

information for the Type i2P-100 transducer (see figure 1). Refer to separate manuals for instructions covering equipment used with the transducer.

No person may install, operate or maintain a Type i2P-100 electro-pneumatic transducer without first ● being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance, and ● carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Emerson Process Management™ sales office.

Introduction

Scope of Manual

This instruction manual provides installation, operation, maintenance, and parts ordering

Description

The transducer, shown in figure 3, receives a 4 to 20 milliamper dc input signal and transmits a proportional user field-configurable pneumatic output pressure to a final control element. The pneumatic



i2P-100 Transducer

Table 1. Specifications

Input Signal⁽¹⁾

Available as standard with 4–20 mA.
User configurable by dip switch for split ranging, see table below.

Output Signal^(1,6)

Available as standard 0.2 to 1.0 bar (3 to 15 psig) or 0.4 to 2.0 bar (6 to 30 psig). User configurable by dip switch selection and zero and span potentiometer adjustment, see table below.

INPUT SIGNAL	OUTPUT PRESSURE	
	BAR	PSIG
4 to 20 mA dc	0.2 to 1.0	3 to 15
	0.4 to 2.0	6 to 30
4 to 12 mA dc	0.2 to 1.0	3 to 15
12 to 20 mA dc	0.2 to 1.0	3 to 15

Equivalent Circuit

The Type i2P–100 equivalent circuit is a series circuit consisting of a constant voltage drop (battery) of approximately 4 V dc and a total resistance of 40 ohms. Input is shunted by two 6.8 V zener diodes (see figure 9).

Supply Pressure^(1,5)

Recommended: 0.3 bar (5 psi) higher than upper range limit of output signal
Maximum: 3.4 bar (50 psig)

Medium: Air or Natural Gas⁽⁴⁾

Average Steady State Flow Rate^(1,2)

OUTPUT RANGE							
0.2 to 1.0 bar (3–15 psig)				0.4 to 2.0 bar (6–30 psig)			
SUPPLY PRESSURE							
1.5 bar (20 psig)				2.4 bar (35 psig)			
OUTPUT		FLOW RATE		OUTPUT		FLOW RATE	
Bar	Psig	Normal m ³ /h	Scfh	Bar	Psig	Normal m ³ /h	Scfh
0.2	3	0.08	3.0	0.4	6	0.09	3.6
0.6	9	0.12	4.5	1.2	18	0.19	7.0
1.0	15	0.17	6.3	2.1	30	0.27	10.2

Maximum Output Air Capacity⁽²⁾

8.0 m³/hr (5.0 scfm) at 1.4 bar (20 psig) supply pressure

Performance⁽³⁾

Reference Accuracy: ±1.0% of full scale output span; includes combined effects of hysteresis, linearity, and deadband

Independent Linearity⁽¹⁾: ±0.75% of full scale output span

Hysteresis⁽¹⁾: 0.4% of full scale output span

Frequency Response⁽¹⁾: Gain is attenuated 3 dB at 6 Hz with transducer output signal piped to a typical instrument input

Temperature Effect: ±0.14% per degrees Celsius (±0.75% per degrees Fahrenheit) of span

Supply Pressure Effect: 0.2% of full scale output span per bar supply pressure change (0.2% of full scale output span per psi supply pressure change)

Vibration Effect: Less than 1% of full scale output span when tested to ISA S75.13

Electromagnetic Interference (EMI)⁽¹⁾: Tested per IEC 61326-1 (Edition 1.1). Conforms to the European EMC Directive. Meets emission levels for Class A equipment (industrial locations) and Class B equipment (domestic locations). Meets immunity requirements for industrial locations (Table A.1 in the IEC specification document). Immunity performance shown in table 2.

Operating Ambient Temperature Limits⁽⁵⁾

–40 to 85°C (–40 to +180°F)

Electrical Classification

Hazardous Area:



Explosion proof, Dust-Ignition proof, Intrinsic Safety



Explosion proof, Non-incendive, Dust-Ignition proof, Intrinsic Safety

ATEX

Intrinsic Safety, Type n and Flameproof

IECEX

Intrinsic Safety, Type n and Flameproof

Refer to Special Instructions for Safe-Use and Installation in Hazardous Locations, tables 3 and 4, and figures 15, 16, 17, and 18 for specific approval information.

Approved for use with natural gas⁽⁴⁾

(continued)

Table 1. Specifications (continued)

<p>Electrical Housing:</p> <p>NEMA 4X, CSA enclosure 4X & IP66 when remote vented, otherwise</p> <p>NEMA 3, CSA enclosure 3 & IP64</p> <p>Connections</p> <p>Supply and Output Pressure: 1/4-inch NPT female connection</p> <p>Vent: 1/4-inch NPT female</p> <p>Electrical: Standard 1/2-inch NPT</p> <p>Wire Size: 18 to 22 AWG</p> <p>Adjustments⁽⁶⁾</p> <p>Zero and Span: Trim potentiometers (20 turn) for zero and span adjustments are located under the housing cap (see figure 10).</p> <p>Switch: Allows input signal split range and user-configurable 0.2 to 2 bar (3 to 30 psig) output.</p>	<p>Mounting Position</p> <p>■ Actuator ■ pipestand or ■ surface</p> <p>Approximate Weight (Transducer Only)</p> <p>2.5 kg (5.5 lbs)</p> <p>Actuator Stroking Time</p> <p>See figure 2</p> <p>Declaration of SEP</p> <p>Fisher Controls International LLC declares this product to be in compliance with Article 3 paragraph 3 of the Pressure Equipment Directive (PED) 97 / 23 / EC. It was designed and manufactured in accordance with Sound Engineering Practice (SEP) and cannot bear the CE marking related to PED compliance.</p> <p>However, the product <i>may</i> bear the CE marking to indicate compliance with <i>other</i> applicable EC Directives.</p>
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1. These terms are defined in ISA Standard S51.1.
 2. Normal m³/hr—Normal cubic meters per hour (0°C and 1.01325 bar, absolute). Scfh—Standard cubic feet per hour (60°F and 14.7 psia).
 3. Performance values are obtained using a transducer with a 4 to 20 mA dc input signal and a 0.2 to 1.0 bar (3 to 15 psig) output signal at an ambient temperature of 24°C (75°F).
 4. This product is approved for use with Natural Gas. Natural gas to contain no more than 20 ppm of hydrogen sulphide.
 5. The pressure and temperature limits in this document and any applicable standard or code limitation should not be exceeded.
 6. For other ranges, zero and span adjustments are needed.

Table 2. Immunity Performance

Port	Phenomenon	Basic Standard	Performance Criteria ⁽¹⁾
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	A
	Radiated EM field	IEC 61000-4-3	A
	Rated power frequency magnetic field	IEC 61000-4-8	A
I/O signal/control	Burst (fast transients)	IEC 61000-4-4	A
	Surge	IEC 61000-4-5	A
	Conducted RF	IEC 61000-4-6	A

Specification limit = ±1% of span
 1. A=No degradation during testing. B = Temporary degradation during testing, but is self-recovering.

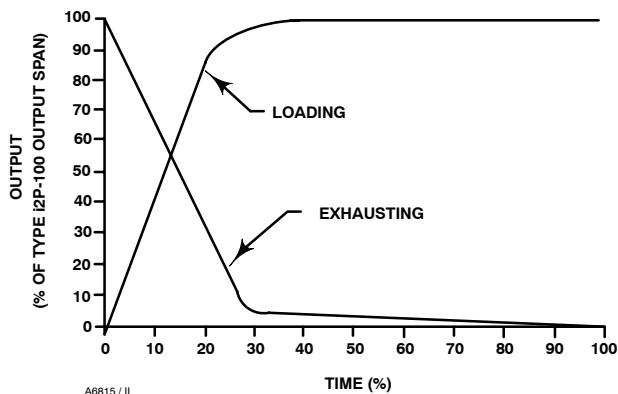


Figure 2. Output-Time Relationships for Type i2P-100 Transducer

output ranges are typically 0.2 to 1.0 bar (3 to 15 psig) and 0.4 to 2.0 bar (6 to 30 psig). A typical application is in electronic control loops where the final control element is a control valve assembly that is pneumatically operated. The input signal and output pressure range of the transducer is indicated on the nameplate, attached to the housing.

CAUTION

Dropping or rough handling of the transducer can cause damage to the converter module resulting in a shifted output or a minimum output.

i2P-100 Transducer

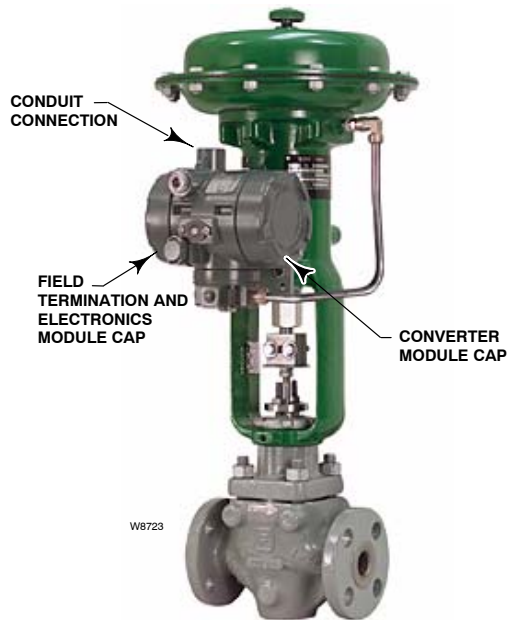


Figure 3. Type i2P-100 Electro-Pneumatic Transducer Mounted on a Size 30 667 Sliding-Stem Actuator

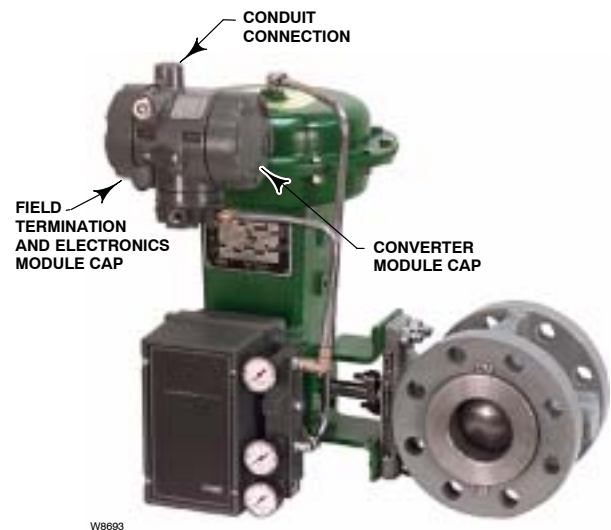


Figure 4. Type i2P-100 Electro-Pneumatic Transducer Mounted on a Size 33 1052 Rotary Actuator, 3610J Positioner and V300B Rotary Valve.

Specifications

Specifications for the Type i2P-100 transducer are listed in table 1.



WARNING

This product is intended for a specific current range, temperature range and other application specifications. Applying different current, temperature and other service conditions could result in malfunction of the product, property damage or personal injury.

Educational Services

For information on available courses for the Type i2P-100 electro-pneumatic transducer, as well as a variety of other products, contact:

Emerson Process Management
 Educational Services, Registration
 P.O. Box 190; 301 S. 1st Ave.
 Marshalltown, IA 50158-2823
 Phone: 800-338-8158 or
 Phone: 641-754-3771
 FAX: 641-754-3431
 e-mail: education@emersonprocess.com

Note

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

Installation

The i2P-100 transducer has been designed and approved for use with either air or natural gas as the supply medium. If using natural gas as the pneumatic supply medium, natural gas will be used in the pneumatic output connections of the transducer to any connected equipment. In normal operation the unit will vent the supply medium into the surrounding atmosphere unless it is remotely vented. When using natural gas as the supply medium, in a non-hazardous location in a confined area, remote venting of the unit is required. Failure to do so could result in personal injury, property damage, and area re-classification. For hazardous locations remote venting of the unit may be required,

depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations. Failure to do so when necessary could result in personal injury, property damage, and area re-classification.

Additional information for installation and safe-use in hazardous locations can be found in Special Instructions for Safe-Use and Installation in Hazardous Locations.



WARNING

To avoid personal injury or property damage from the sudden release of pressure, air, or natural gas:

- Always wear protective clothing, gloves, and eyewear when performing any installation operations.
- If installing into an existing application, also refer to the **WARNING** at the beginning of the Maintenance section of this instruction manual.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.



WARNING

This unit vents the supply medium into the surrounding atmosphere. When installing this unit in a non-hazardous (non-classified) location in a confined area, with natural gas as the supply medium, you must remotely vent this unit to a safe location. Failure to do so could result in personal injury or property damage from fire or explosion, and area re-classification.

When installing this unit in a hazardous (classified) location remote venting of the unit may be required, depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations.

Failure to do so when necessary could result in personal injury or property damage from fire or explosion, and area re-classification.

Vent line piping should comply with local and regional codes and should be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.

When received from the factory, the set screws (key 8), which provide a locking feature for the housing caps (key 2), are backed off approximately 1 turn. When using the i2P-100 transducer in explosive atmospheres these set screws must be fully engaged.



WARNING

When using this unit in explosive atmospheres, the set screws (key 8) must be fully engaged to lock/secure the housing caps. Failure to fully engage these set screws could result in unauthorized opening of the unit, which may result in personal injury or property damage caused by fire or explosion.

Special Instructions for Safe-Use and Installation in Hazardous Locations

Certain nameplates may carry more than one approval, and each approval may have unique installation requirements and/or conditions of safe-use. Special instructions are listed by agency/approval below.

After reading and understanding these special conditions of use, proceed with standard installation procedures.



WARNING

Failure to follow these conditions of safe-use could result in personal injury or property damage from fire or explosion, and area re-classification.

Table 3. Hazardous Area Classifications for North America (CSA and FM Approvals)

CERTIFICATION BODY	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
CSA	(Intrinsic Safety) Zone •Ex ia IIC T3/T4/T5 per drawing GE07471 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07471	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 5 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^\circ\text{C}$) T4 ($T_{amb} \leq 81^\circ\text{C}$) T5 ($T_{amb} \leq 46^\circ\text{C}$)	4X*
	(Explosion Proof) Zone •Ex d IIC T5/T6 Class/Division •Class I, Division 1 GP, A, B, C, D	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	(Type n) Zone •Ex nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 1, GP E, F, G Class III, Division 2 GP F, G Class III	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
FM	(Intrinsic Safety) Zone •Class I Zone 0 AEx ia IIC T3/T4/T5 per drawing GE07470 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07470	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 0 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^\circ\text{C}$) T4 ($T_{amb} \leq 81^\circ\text{C}$) T5 ($T_{amb} \leq 46^\circ\text{C}$)	4X*
	(Explosion Proof) Zone •Class I Zone 1 AEx d IIC T5/T6 Class/Division •Class I, Division 1, GP A, B, C, D	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	(Type n) Zone •Class I Zone 2 AEx nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 1, GP E, F, G Class II, Division 2, GP F, G Class III	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*

* When remotely vented.

CSA

Special Conditions of Use

None stated.

Refer to table 3 for additional information, figure 15 for the CSA loop schematic and figure 16 for the CSA and FM approvals nameplate.

FM

Special Conditions of Use

1. When product is used with natural gas as the pneumatic medium, the maximum working pressure of the natural gas supply is limited to 50 psi.
2. When product is used with natural gas as the pneumatic medium the product shall be provided

with the proper remote venting, as described on page 10 of this instruction manual.

Refer to table 3 for additional information, figure 17 for the FM loop schematic, and figure 16 for the CSA and FM approvals nameplate.

ATEX All Approvals

All ATEX approved units come with a combined nameplate which carries multiple approvals (intrinsic safety and dust, flameproof and dust, and Type n and dust), as shown in figure 18. During installation, only one type of protection method is allowed. The unit shall be marked as to which protection method it was installed as and shall not be changed or utilized in any other manner than was originally marked by the end-user.

Table 4. Hazardous Area Classifications for ATEX and IECEx Approvals

CERTIFICATE	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
ATEX	⊕ II 1 GD Gas •EEx ia IIC T3/T4/T5 —Intrinsic Safety Dust •T95°C (T _{amb} ≤ 85°C)	U _i = 30 Vdc I _i = 150 mA P _i = 1.0 W C _i = 0 nF L _i = 0 mH	T3 (T _{amb} ≤ 85°C) T4 (T _{amb} ≤ 81°C) T5 (T _{amb} ≤ 46°C)	IP66*
	⊕ II 2 GD Gas •EEx d IIC T5/T6 —Flameproof Dust •T95°C (T _{amb} ≤ 85°C)	---	T5 (T _{amb} ≤ 85°C) T6 (T _{amb} ≤ 75°C)	IP66*
	⊕ II 3 GD Gas •EEx nC II T5/T6 —Type n Dust •T95°C (T _{amb} ≤ 85°C)	---	T5 (T _{amb} ≤ 85°C) T6 (T _{amb} ≤ 75°C)	IP66*
IECEx	Gas •Ex ia IIC T3/T4/T5 —Intrinsic Safety	U _i = 30 Vdc I _i = 150 mA P _i = 1.0 W C _i = 0 nF L _i = 0 mH	T3 (T _{amb} ≤ 85°C) T4 (T _{amb} ≤ 81°C) T5 (T _{amb} ≤ 46°C)	IP66*
	Gas •Ex d IIC T5/T6 —Flameproof	---	T5 (T _{amb} ≤ 85°C) T6 (T _{amb} ≤ 75°C)	IP66*
	Gas •Ex nC IIC T5/T6 —Type n	---	T5 (T _{amb} ≤ 85°C) T6 (T _{amb} ≤ 75°C)	IP66*

* When remotely vented.



WARNING

For ATEX approvals only, end-user must select and mark only one protection method upon installation. Once marked it shall not be changed. Failure to follow these instructions will jeopardize the explosion safety of the transducer, and may result in personal injury or property damage.

ATEX Intrinsic Safety

Special Conditions for Safe-Use

1. Before putting in service, the user shall permanently cross out the areas on the nameplate with the types of protection that are not applicable (EEx ia IIC T3... T5, KEMA 05ATEX1109 X or EEx nA II T5/T6, KEMA 05ATEX1119) or mark the selected type of protection. Once determined the type of protection may not be changed.

2. Because the enclosure of the Type i2P-100 transducer is made of aluminum, if it is mounted in

an area where the use of category 1 G apparatus is required, it must be installed such, that, even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

3. Ambient temperature range:

- 40°C – + 46°C for temperature class T5
- 40°C – + 81°C for temperature class T4
- 40°C – + 85°C for temperature class T3

Electrical data:

Unit must be installed with appropriate I.S barrier with maximum entity ratings as follows:

- U_i = 30 V
- I_i = 150 mA (resistively limited)
- P_i = 1 W
- C_i = 0 nF
- L_i = 0 mH

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

i2P-100 Transducer

ATEX Flameproof

Special Conditions for Safe-Use

1. Before putting in service, the user shall permanently cross out the areas on the nameplate with the types of protection that are not applicable (EEx ia IIC T3... T5, KEMA 05ATEX1109 X or EEx nA II T5/T6, KEMA 05ATEX1119) or mark the selected type of protection. Once determined the type of protection may not be changed.

2. Electrical connections are typically made using either cable or conduit.

- If using a cable connection, the cable entry and closing devices shall be certified in type of protection flameproof enclosure “d”, suitable for the conditions of use and correctly installed. For ambient temperatures over 70°C, suitable heat resistant cables and cable glands shall be used.

- If using a rigid conduit connection, a certified sealing device in type of protection flameproof enclosure “d”, such as a conduit seal with setting compound shall be provided immediately to the entrance of the valve housing. For ambient temperature over 70°C, suitable heat resistant wiring and setting compound for the conduit seal shall be used.

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

ATEX Type n

Special Conditions for Safe-Use

1. Before putting in service, the user shall permanently cross out the areas on the nameplate with the types of protection that are not applicable (EEx ia IIC T3... T5, KEMA 05ATEX1109 X or EEx nA II T5/T6, KEMA 05ATEX1119) or mark the selected type of protection. Once determined the type of protection may not be changed.

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

IECEx Intrinsic Safety, Type n, Flameproof

Conditions of Certification

The Intrinsically Safe version has the following Entity Parameters:

$U_i = 30 \text{ V}$
 $I_i = 150 \text{ mA}$
 $P_i = 1.0 \text{ W}$
 $C_i = 0 \text{ uF}$
 $L_i = 0 \text{ uH}$

Refer to table 4 for additional information and figure 18 for the ATEX and IECEx approvals nameplate.

Mounting

When a transducer is ordered as part of a control valve assembly, the factory mounts the transducer on the actuator and connects the necessary tubing, then adjusts the transducer as specified on the order. See figures 3 and 4 for typical mounting configurations.

Transducers also can be ordered separately for mounting on a control valve assembly already in service, or for mounting on a 2-inch diameter pipestand, or a flat surface. The transducer may be ordered either with or without mounting parts.

Mounting parts include a mounting plate and bolts and, if ordered for pipestand mounting, a pipe clamp. Tubing is not included if the transducer is not factory mounted. Use 3/8-inch diameter tubing for all input and output connections. The length of tubing between the transducer output and the final control element should be as short as possible. Transducer overall dimensions are shown in figure 5. If weatherproofing is required, mount the transducer so that the vent can drain. Do not allow moisture or condensate to collect in the vent.

CAUTION

Do not mount the vent in a downward position, as the vent will not drain properly, and may become blocked with ice or debris, resulting in process instability.

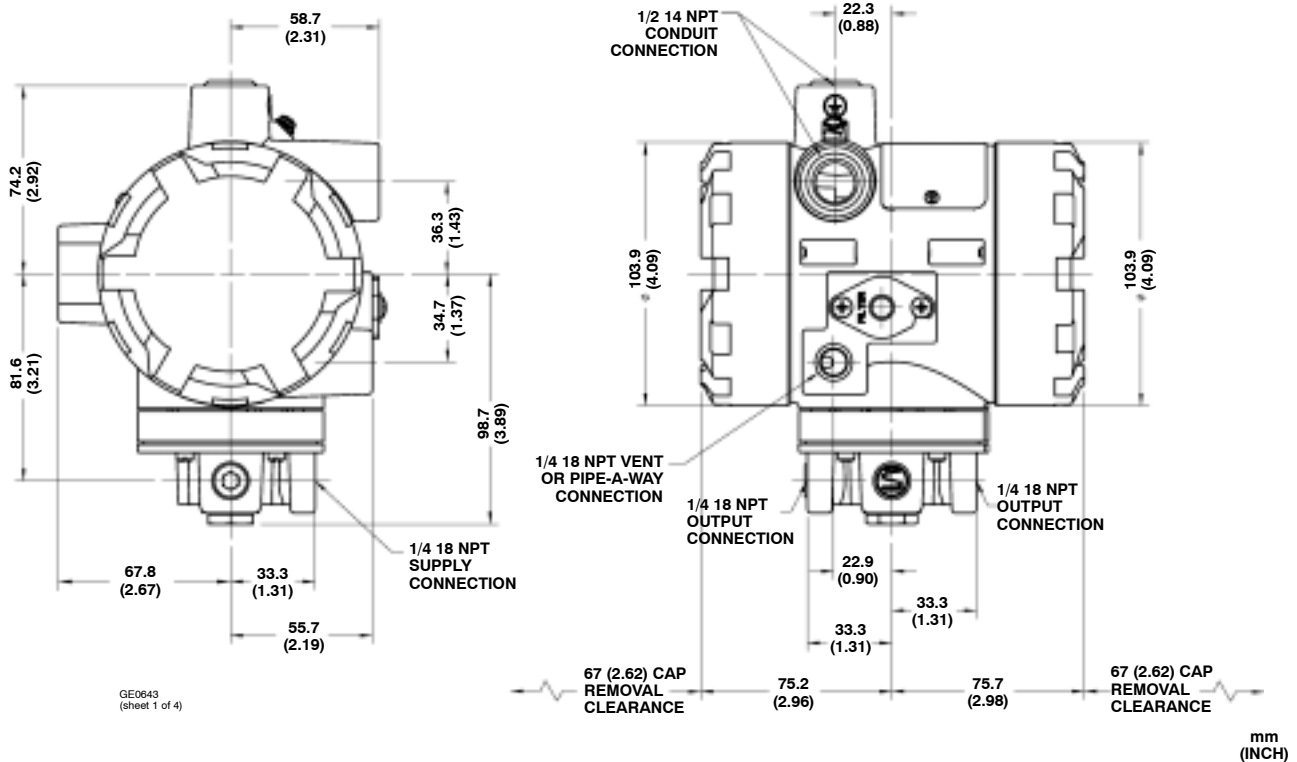


Figure 5. Dimensions and Connections

Pneumatic Connections

As shown in figure 5, all pressure connections on the transducer are 1/4-inch NPT female connections. Use 3/8-inch tubing for all pressure connections. Refer to the vent subsection below for remote vent connections.

office and Industry Instrument air quality standards for use with corrosive air or if you are unsure about the proper amount or method of air filtration or filter maintenance.

Supply Pressure Requirements



Severe personal injury or property damage could result from an unstable process if the instrument supply medium is not clean, dry, oil-free and noncorrosive. While use and regular maintenance of a filter that removes particles larger than 40 microns in diameter will suffice in most applications, check with a Fisher Field

Supply pressure must be clean, dry air or noncorrosive gas. Use a Fisher Type 67CFR Filter Regulator, or equivalent, to filter and regulate supply air. The filter regulator can be mounted on a bracket with the transducer as shown in figure 6 or mounted on the actuator mounting boss. An output pressure gauge may be installed on the regulator to indicate the supply pressure to the transducer. Also, as an aid for calibration, a second gauge may be installed on the transducer to indicate transducer output pressure.

Connect the nearest suitable supply source to the 1/4-inch NPT IN connection on the filter regulator (if furnished) or to the 1/4-inch NPT SUPPLY connection on the transducer case (if the filter regulator is not attached).

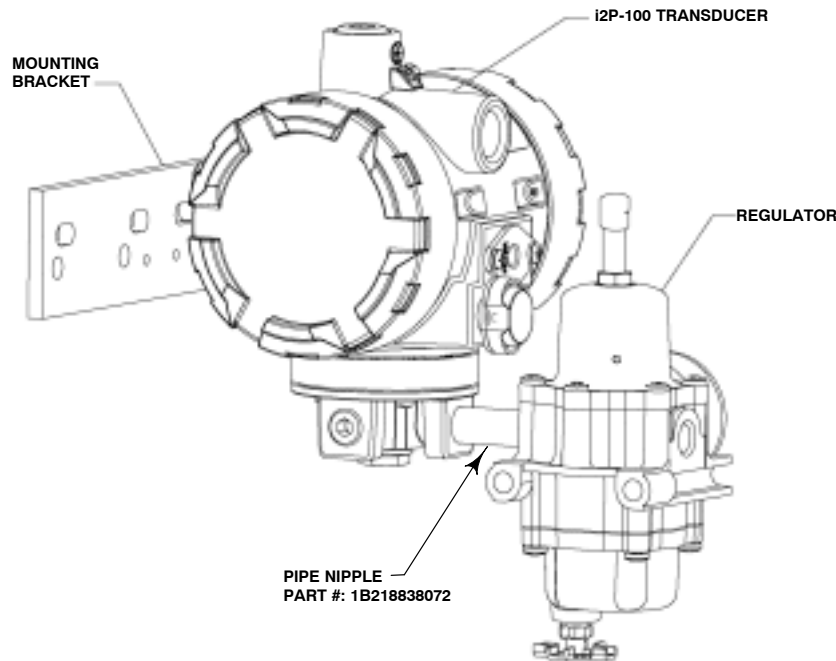


Figure 6. Typical Type i2P-100 Mounting With Type 67CFR Filter Regulator

Diagnostic Connections

To support diagnostic testing of valve/actuator/positioner packages, special connectors and hardware are available. Typical connector installations are shown in figure 7. The hardware used includes a 1/4-inch NPT pipe nipple and pipe tee with a 1/8-inch NPT pipe bushing for the connector. The connector consists of a 1/8-inch NPT body and body protector.

Note

If the Type i2P-100 transducer is used in a valve assembly with a positioner, no hook-up for diagnostic testing is required for the Type i2P-100. The hook-up for diagnostic testing should be installed at the positioner.

Install the connectors and hardware between the Type i2P-100 transducer and the actuator.

1. Before assembling the pipe nipple, pipe tee, pipe bushings, actuator piping, and connector body, apply sealant to all threads.

2. Turn the pipe tee to position the connector body and body protector for easy access when doing diagnostic testing.

Vent

When using natural gas as the supply medium ensure that the following warnings are read and understood. Contact your Emerson Process Management sales office if you have any questions regarding the information contained in this section.



This unit vents the supply medium into the surrounding atmosphere. When installing this unit in a non-hazardous (non-classified) location in a confined area, with natural gas as the supply medium, you must remotely vent this unit to a safe location. Failure to do so

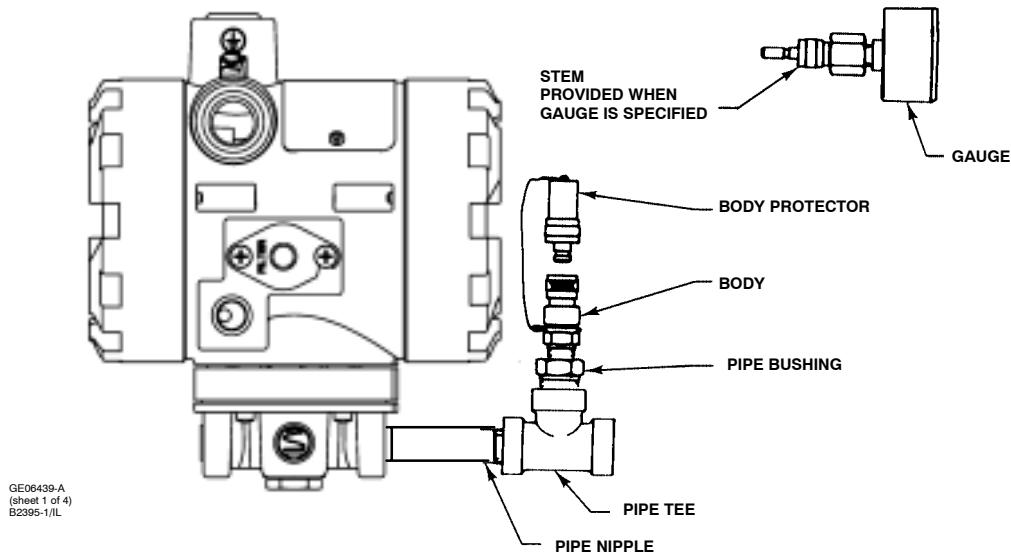


Figure 7. Diagnostics Hookup for Type i2P-100 Transducer

could result in personal injury or property damage from fire or explosion, and area re-classification.

When installing this unit in a hazardous (classified) location remote venting of the unit may be required, depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations. Failure to do so when necessary could result in personal injury or property damage from fire or explosion, and area re-classification.

Vent line piping should comply with local and regional codes and should be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.

If a remote vent is required, the vent line must be as short as possible with a minimum number of bends and elbows. To connect a remote vent, remove the plastic vent (key 71, figure 13). The vent connection is 1/4-inch NPT female. Use 3/8-inch tubing to provide a remote vent.

Electrical Connections

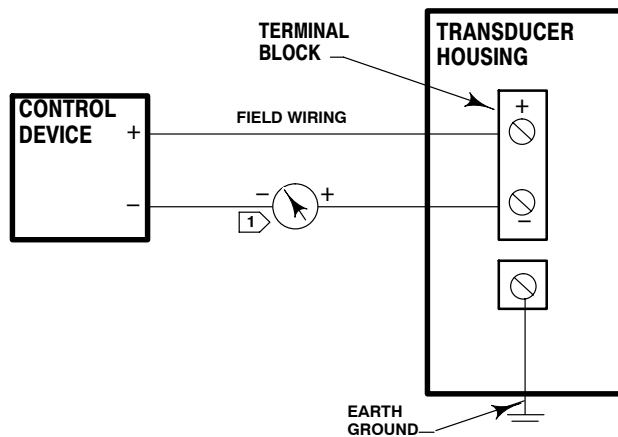
WARNING

For explosion-proof applications, or when using natural gas as the supply medium, disconnect power before removing the housing cap. Personal injury or property damage from fire or explosion may result if power is not disconnected before removing the cap.

For intrinsically safe installations, refer to the nameplate or to instructions provided by the barrier manufacturer, for proper wiring and installation.

Note

For North American explosion-proof applications in the Class/Division system, the i2P-100 has been designed such that a conduit seal is not required. For all other applications install the product as per local, regional, or national code, rules, and regulations.



NOTE:
1 FOR TROUBLESHOOTING OR MONITORING OPERATION, AN INDICATING DEVICE CAN BE A VOLTMETER ACROSS A 250 OHM RESISTOR OR A CURRENT METER.

A3875/IL

Figure 8. Typical Field Wiring Diagram

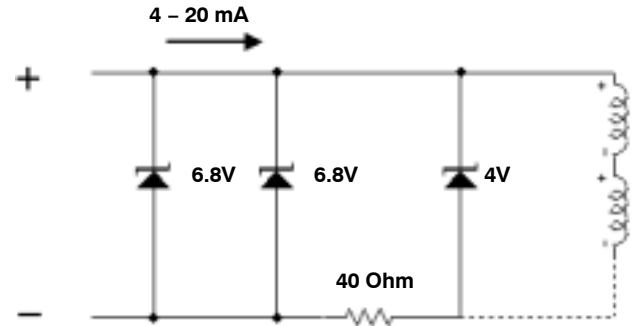


Figure 9. Equivalent Circuit

WARNING

Select wiring and/or cable glands that are rated for the environment of use (hazardous location, ingress protection, and temperature). Failure to use properly rated wiring and/or cable glands can result in personal injury or property damage from fire or explosion.

Use the 1/2-inch NPT conduit connection, shown in figure 5, for installation of field wiring.

Refer to figures 8, 9, and 10 when connecting field wiring from the control device to the transducer. Connect the positive wire from the control device to the transducer “+” terminal and, the negative wire from the control device to the transducer “-” terminal. Do not overtighten the terminal screws. Maximum torque is 0.45 N•m (4 lbf•in.). Connect the transducer grounding terminal to earth ground.

Grounding terminals are provided both inside and outside the transducer housing.

Operating Information

During normal operation, the output of the Type i2P-100 transducer is connected to the final control element.

Calibration

WARNING

On explosion-proof instruments, or when using natural gas as the supply medium, remove electrical power before removing either of the the housing caps in a hazardous area. Personal injury or property damage may result from fire or explosion if power is applied to the transducer with the cap removed in a hazardous area.

For intrinsically safe areas, current monitoring during operation must be with a meter approved for use in hazardous areas.

Equipment Required

Choose a current or voltage source that is capable, without switching ranges, of driving the transducer through its entire input range. Switching ranges on a current or voltage source will produce spikes or mid-scale reverses in the input signal presented to the transducer, causing errors. The current source should be capable of delivering 30 mA with 30 V dc maximum compliance voltage.

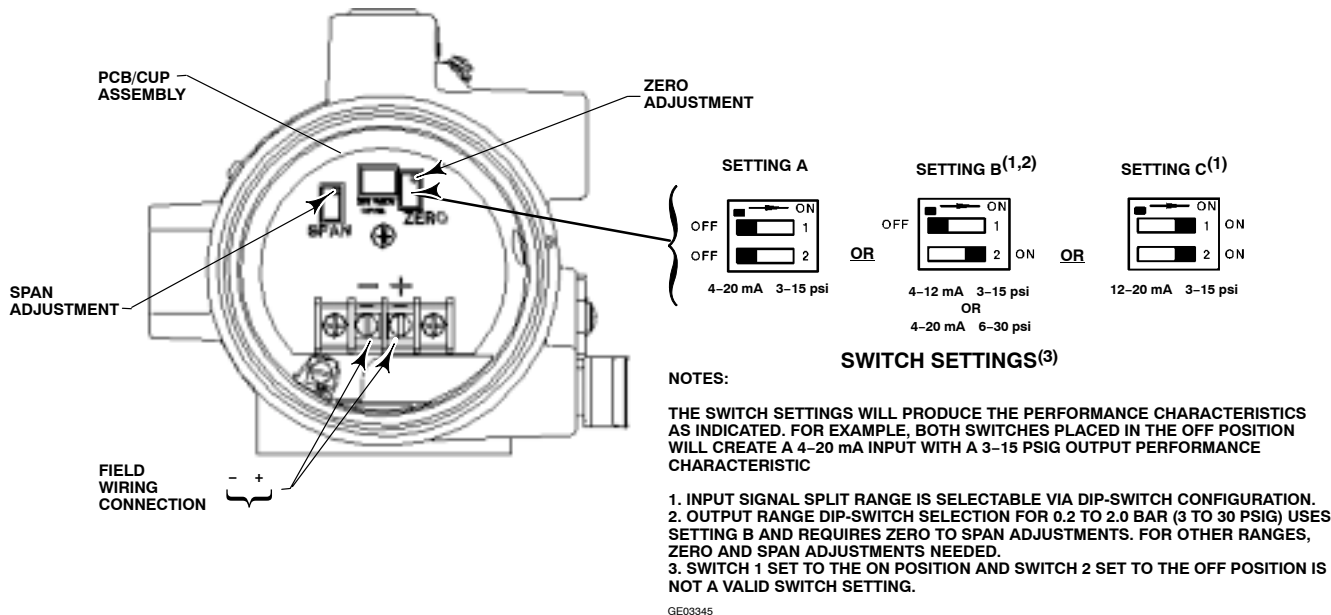


Figure 10. Zero and Span Adjustments and Switch Settings

Calibration Procedure

WARNING

To avoid personal injury or property damage due to an uncontrolled process provide some temporary means of process control before beginning the calibration procedure.

Refer to figure 10 for adjustment locations.

Note

The following steps are for a 4-20 mA, 0.2 to 1.0 bar (3 to 15 psig) configured unit. The same procedure is used for other configurations.

1. Remove electronics module cover (cover adjacent to conduit entry, see figure 3 and 4).

CAUTION

Do not attempt to remove either of the housing caps if the locking set screws (key 8) are engaged. Removing

housing caps without disengaging the set screws can cause damage to the housing caps.

2. Input and output ranges are selectable by dip switch selection. Refer to figure 10 for dip switch settings. Adjust dip switch settings and zero and span as necessary to achieve the desired input/output range.
3. If a current source other than the control device is used as the input source, disconnect the control device and connect the current source positive terminal to the transducer “+” terminal and the current source negative terminal to the transducer “-” terminal.

If an external meter is used, connect the current source positive terminal to the transducer “+” terminal. Connect the meter positive terminal to the transducer “-” terminal and the meter negative terminal to the current source negative terminal as shown in figure 8.

4. Check the supply pressure to ensure it is at the recommended pressure. Refer to table 1, the Specifications table, for supply pressure recommendations.
5. Adjust the input current to the low milliamperes dc.

i2P-100 Transducer

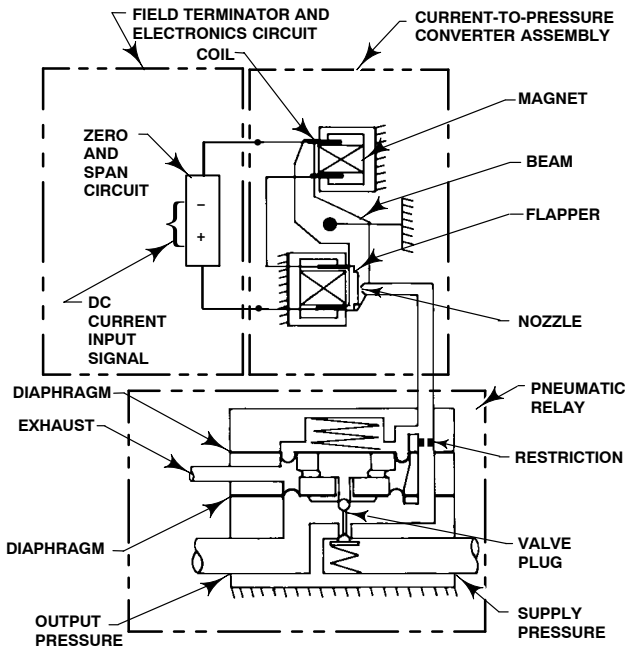


Figure 11. Type i2P-100 Transducer Schematic

6. The output pressure should be 0.2 bar (3 psig). If not, adjust the ZERO potentiometer until the output pressure is 0.2 bar (3 psig).
7. Adjust the input current to the high milliamperes dc.
8. The output pressure should be 1.0 bar (15 psig). If not, adjust the SPAN potentiometer until the output pressure is 0.8 bar (15 psig).
9. Repeat steps 5 through 8 until the output pressure is within the referenced accuracy requirements without further adjustment.
10. If a current source other than the control device was used, disconnect the current source and reconnect the control device.

Principle of Operation

The converter module receives a standard dc current input signal from a control device to operate coils in a force balanced beam system which in turn, controls bleed air through an integral nozzle/flapper arrangement. The nozzle pressure provides the input signal to operate the relay as shown in figure 11. Relay output pressure is applied, through tubing, directly to the final control element or valve/actuator assembly.

Maintenance

Due to normal wear or damage from external sources such as debris in the supply medium, periodic maintenance or repair of the transducer may be necessary. Maintenance of the transducer consists of troubleshooting, removal for inspection, and replacement of component parts, as well as removal and inspection of the external removable filter/restriction and cleaning or replacing as necessary (see figure 1).

WARNING

To avoid personal injury or property damage from the sudden release of pressure, air or natural gas:

- Always wear protective clothing, gloves, and eyewear when performing any maintenance operations.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure on both sides of the valve.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

WARNING

When using natural gas as the supply medium, or for explosion proof applications, the following warnings also apply:

- Remove electrical power before removing either housing cap. Personal injury or property damage from fire or explosion may result if power is not disconnected before removing either cap.
- Remove electrical power before disconnecting any of the pneumatic

connections or removing the external removeable filter/restriction.

When disconnecting any of the pneumatic connections or the external removeable filter/restriction, natural gas will seep from the unit and any connected equipment into the surrounding atmosphere. Personal injury or property damage may result from fire or explosion if preventative measures are not taken, such as adequate ventilation and the removal of any nearby ignition sources.

CAUTION

Do not attempt to remove either of the housing caps if the locking set screws (key 8) are engaged. Removing housing caps without disengaging the set screws can cause damage to the housing caps.

CAUTION

When replacing components, use only components specified by the factory. Always use proper component replacement techniques, as presented in this manual. Improper techniques or component selection may invalidate the approvals and the product specifications, as indicated in table 1. It may also impair operations and the intended function of the device

The converter module and the electronics module are non-repairable. If troubleshooting or alignment attempts indicate a faulty converter or electronics module, replace the module or return the transducer to your Emerson Process Management sales office for repair.

Troubleshooting

WARNING

Refer to the WARNING at the beginning of this section.

Electrical

The following procedures require taking the control valve/actuator assembly out of service. Provide some temporary means of process control before taking the control valve out of service.

1. Ensure terminal lug connections from the control device to the transducer are of the correct polarity (refer to the electrical connection procedures in the Installation section of this manual).
2. At the transducer, ensure that the milliampere dc signal is applied, and ensure that it is within the 4 to 20 milliampere range.
3. Check switches and ensure that they are properly set. Refer to figure 10.
4. If the problem has not been resolved, see Electronics Module Replacement in this manual.

Pneumatic

Provide a 4 to 30 milliampere dc current source, supply pressure, and a gauge to monitor the output pressure when checking transducer operation. Refer to figure 13 for key number locations.

1. Ensure that supply pressure to the transducer meets your requirements [0.3 bar (5 psi) higher than upper range limit of output signal, with a maximum of 3.4 bar (50 psi)].
2. Ensure that the filter (key 11) and restrictor (key 10) are open and clean. Remove the two screws (key 14), the filter cap (key 13) and the O-ring (key 12) to access the filter and restrictor.
3. If a filter/regulator is used, ensure that it is working correctly. If not, ensure the dripwell is not plugged because of excessive moisture accumulation. If necessary, drain off any moisture, and clean or replace the filter element.
4. Force the converter module to maximum output pressure with a 30 milliampere dc signal. Output pressure should build up to the approximate value of the supply pressure [maximum of 3.4 bar (50 psi)].
5. When the input current is removed, the transducer output pressure should drop to less than 0.14 bar (2 psig). If it does not, check to ensure the vent and exhaust air passageway is free from foreign material.
6. To inspect the relay assembly, refer to the Relay Maintenance procedures in this manual.
7. If the problem has not been resolved, see Converter Module Replacement in this manual.

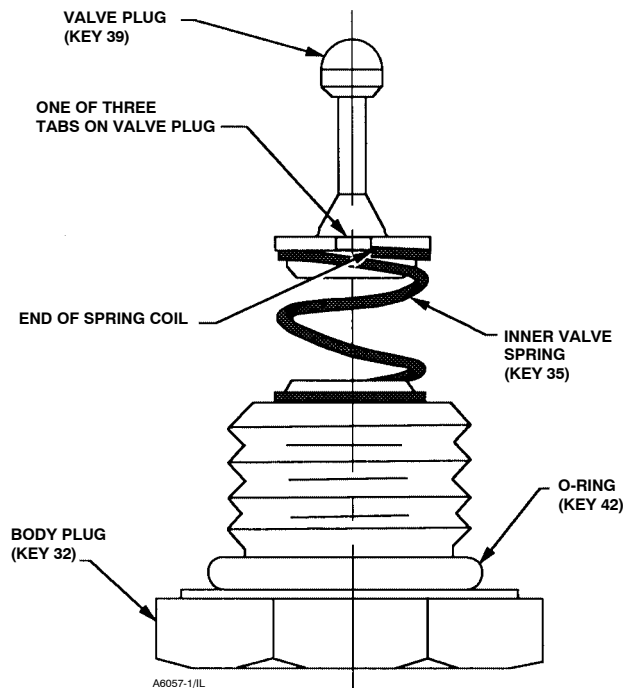


Figure 12. Valve Plug, Inner Valve Spring and Body Plug Assembly

2. Insert the converter module into position in the housing (key 1). Replace the two screws (key 52) and tighten them.
3. Replace the housing cap (key 2), making sure to re-tighten the set screw (key 8).
4. Electrically calibrate the unit using the procedure in the Calibration section of this manual.

Electronics Module Replacement



Refer to the WARNING at the beginning of this section.

Removal

Refer to figure 13 for key number locations.

1. Remove the housing cap (key 2) (the cap closest to the conduit). Note that the set screw (key 8) associated with this housing cap needs to be loosened to remove the cap.
2. Note the location of the wires, then remove the electrical wiring from the terminal block.
3. Remove the three screws (key 26) and remove the electronics module from the housing.

Replacement

1. Insert the electronics module into position in the housing (key 1). Replace the three screws (key 26) and tighten them.
2. Replace the electrical wiring removed in step 1 of the removal procedures. Do not overtighten the terminal screws. Maximum torque is 0.45 N•m (4 lbf•in).
3. Electrically calibrate the unit using the procedure in the Calibration section of this manual.
4. Replace the housing cap (key 2), making sure to re-tighten the set screw (key 8).

Converter Module Replacement



Refer to the WARNING at the beginning of this section.

Removal

Refer to figure 13 for key number locations.

1. Remove the housing cap (key 2) (the cap farthest away from the conduit). Note that the set screw associated with this housing cap (key 8) needs to be loosened to remove the cap.
2. Unscrew the two captive screws (key 52) and remove the converter module from the housing.
3. Inspect the O-ring (key 55) and replace if necessary.

Replacement

1. Lubricate the O-ring (key 55) with a silicone sealant before replacing the converter module in the housing.

Relay Maintenance



Refer to the WARNING at the beginning of this section.

Refer to figures 12 and 14 for key number locations.

Removal

1. Remove the four mounting screws (key 36, shown in figure 14) and remove the relay from the transducer. Be careful not to lose the bias spring (key 34) and input diaphragm (key 38).
2. Remove the body plug (key 32) that holds the inner valve spring (key 35) and valve plug (key 39) in place from the relay body assembly.
3. Remove the exhaust port assembly (key 33) from the relay assembly.
4. Inspect the springs, exhaust seat, valve plug, and other parts for wear or damage; replace as necessary. Note: the valve plug supply seat is an insert in the relay body (key 41). If this insert is bad, replace the relay body.
5. Make sure all parts of the relay are clean and that all passages are clear of foreign matter.

Assembly

1. Assemble the inner valve spring (key 35) onto the body plug (key 32) and fit the valve plug (key 39) onto the inner valve spring as shown in figure 12. To assure best alignment between the valve plug, inner valve spring, and body plug; fit the valve plug onto the inner valve spring so that one of the three tabs at the base of the valve plug sets at the end of the last coil of the inner valve spring.
2. Lubricate the O-ring (key 42) with a silicone sealant (key 37). Insert the assembled valve plug, inner valve spring, and body plug into the relay body (key 41). Compress the spring and thread the body plug (key 5) into place. Then, tighten the body plug.
3. Insert two of the mounting screws (key 36) into two opposite holes of the relay body (key 41). Hold the screws in place while assembling the following parts on the relay body. The screws serve as studs to align the parts as they are being assembled.
4. When replacing the exhaust port assembly (key 33), make sure all passages and screw holes are aligned and that the hole in the center of the exhaust port assembly fits over the valve plug (key 39). Place the exhaust port assembly on the relay body (key 41). Hold assembled parts in place.
5. Make sure the tabs on the body block (key 40) align with the tabs on the relay body (key 41) and that the side with 5 holes faces the relay body. Place the body block on the assembled parts. Hold assembled parts in place.
6. When replacing the input diaphragm (key 38), make sure all passages and screw holes are

aligned. Place the input diaphragm on the body block (key 40). Hold assembled parts in place.

7. Install the bias spring (key 34) into the transducer housing assembly (key 1). Make sure the tabs on the body block and relay body align with the tab on the transducer housing assembly. Place the assembled parts onto the transducer housing assembly. Thread the two mounting screws (key 36) into the transducer housing assembly. Install the remaining two mounting screws. Tighten all mounting screws to 2 N•m (20 lbf•in).
8. Perform the procedure in the Calibration section of this manual.

Parts Ordering

A serial number is assigned to each transducer and stamped on the nameplate. Always refer to this serial number when corresponding with your Emerson Process Management sales office regarding spare parts or technical information. When ordering replacement part, also specify the complete 11-character part number from the Parts list.

Note

Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Process Management should not, under any circumstances, be used in any Fisher instrument. Use of components not supplied by Emerson Process Management will void your warranty, might adversely affect the performance of the instrument, and might jeopardize worker and workplace safety.

Note

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

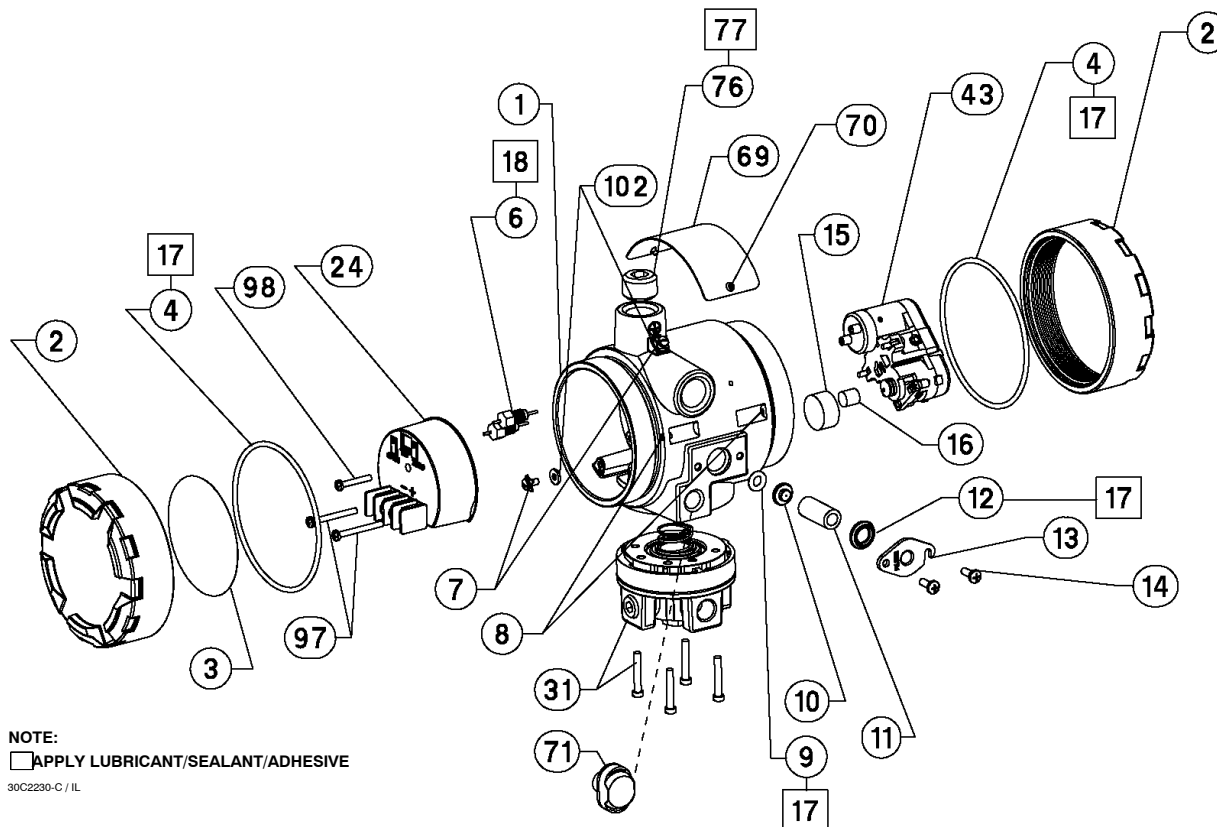


Figure 13. Type i2P-100 Transducer Assembly

Parts Kits

Description	Part Number
Repair Kit for Type i2P-100 electro-pneumatic transducer Contains O-rings (keys 4, 9, 12, and 55) and Filter (key 11)	R2P100X0012

Key	Description	Part Number
8	Set Screw (2 req'd)	1B4556X0012
9*	O-Ring ⁽¹⁾	
10	Restrictor, Primary	10C2233X012
11*	Filter ⁽¹⁾	
12*	O-Ring ⁽¹⁾	
13	Filter Cap	GB0122X0012
14	Machine Screw (2 req'd)	19B0821X012
15	Flame Arrestor	GE06959X012
16	Flame Arrestor	GE02963X012
17	Lubricant, silicone sealant (not furnished with transducer)	
18	Thread locking adhesive, high strength (not furnished with transducer)	
55	O-Ring ⁽¹⁾	
69	Nameplate, aluminum	---
70	Screw (2 req'd)	1P426928982
71	Vent Assembly	GE06162X012
76	Pipe Plug	1H5137X0012
102	Washer	1C332928982

Parts List (see figure 13)

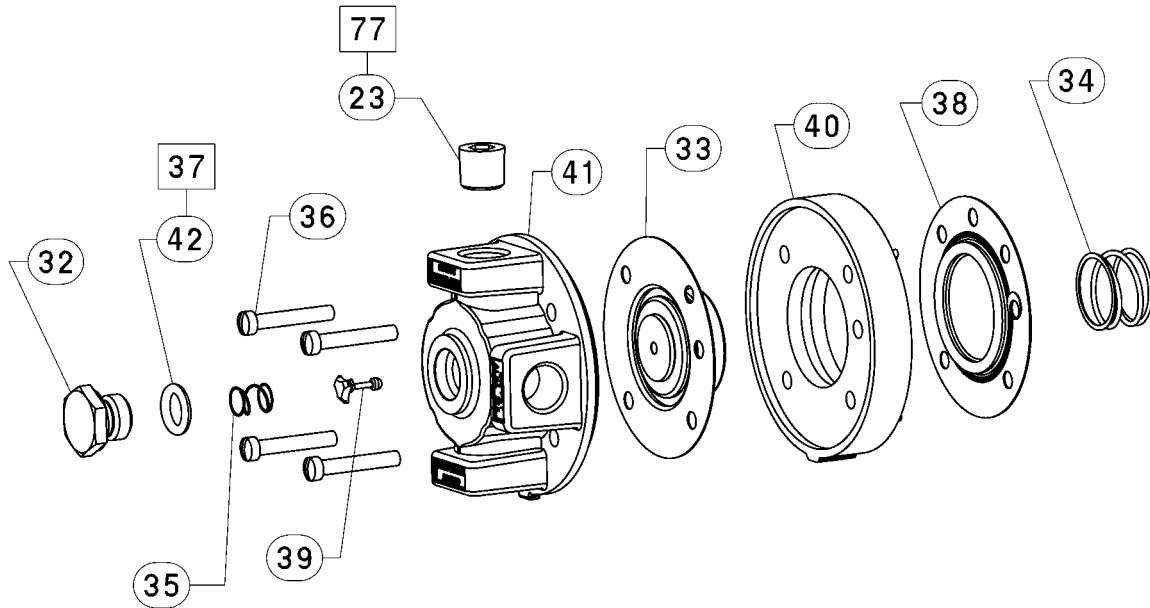
Housing

Key	Description	Part Number
1	Housing, Aluminum	
2	Cover (2 req'd)	48B6515X022
3	Configuration Label	GE03345X012
4*	O-Ring ⁽¹⁾ (2 req'd)	
6	Feed Thru (2 req'd)	
7	Wire Retainer (2 req'd)	16A2821X012

PWB/Cup Assembly

24*	PWB/Cup Assembly	GE10168X012
97	Machine Screw (2 req'd)	GE11776X012
98	Machine Screw	GE11777X012

*Recommended spare parts
1. Available in the Repair Kit



NOTE:
□ APPLY LUBRICANT/SEALANT/ADHESIVE

30C2258-B/IL

Figure 14. Type i2P-100 Relay Assembly

Key	Description	Part Number	Key	Description	Part Number
Relay Assembly (see figure 14)					
41	Relay / Body Assembly	GE03512X012			
42	O-Ring	1E5477X0062			
36	Machine Screw, fill hd (4 req'd)	1H1581X0012			
32	Body Plug	11B2363X012			
33	Exhaust Port Assembly	11B2364X012			
34	Spring	11B2369X012			
35	Spring	11B6843X012			
37	Lubricant, silicone sealant (not furnished with relay)				
38	Upper Diaphragm	21B2362X012			
39	Valve Plug	21B2370X012			
40	Body Block	31B2356X012			
77	Anti-Seize Sealant (not furnished with relay)				

I/P Converter Assembly

43*	I/P Converter Assembly	30C2218X012
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Gauge/Pipe Plug

23	Pipe plug, use when gauge is not specified (not shown)	
	Alloy steel pl	1C333528992
	Stainless steel	1C3335X0032
23	Gauge, (not shown)	
	0-30 psig/0-0.2 MPa/0-2 bar	11B8579X022
	0-60 psig/0-0.4 MPa/0-4 bar	11B8579X032

Diagnostic Connections

FlowScanner™ diagnostic system hook-up

Includes pipe tee, pipe nipple, pipe bushings, connector body, and body protector. See figure 7 for part identification. Also, part number provides correct quantities of each item.

Note

If the Type i2P-100 Transducer is used in a valve assembly with a positioner, no hook-up for diagnostic testing is required for the Type i2P-100. The hook-up for diagnostic testing should be installed at the positioner.

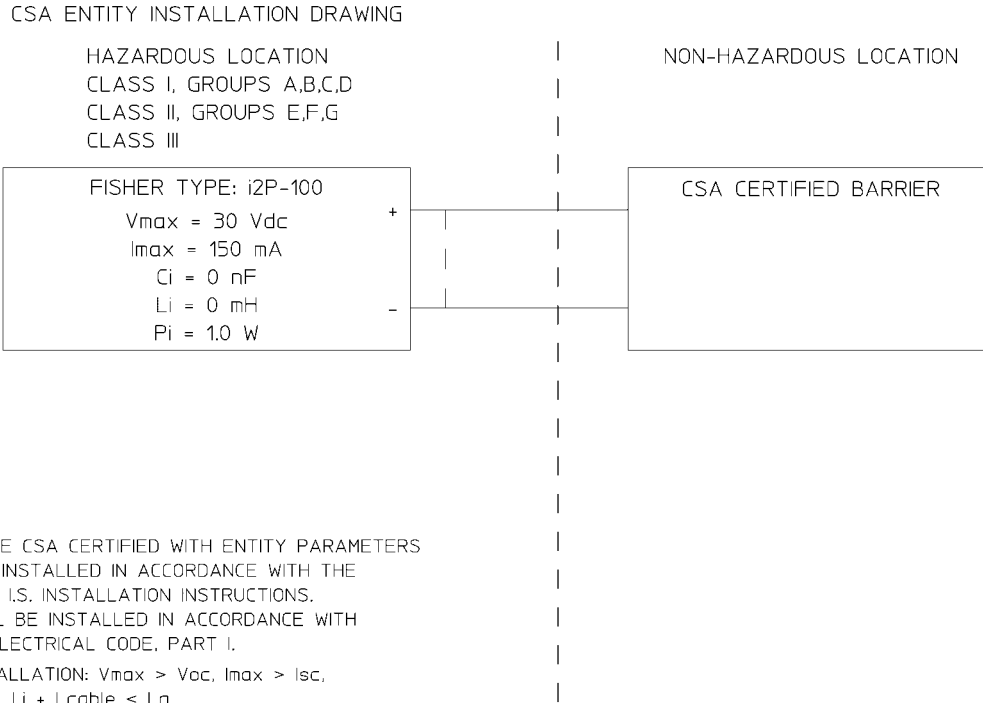
Side Output

For units with gauges		
SST fittings		12B8040X052
Brass fittings		12B8040X062
For units without gauges		
SST fittings		12B8040X072
Brass fittings		12B8040X082

*Recommended spare parts

Key	Description	Part Number	Key	Description	Part Number
Mounting Parts					
Yoke Mounting					
Type 470 size 23 through 64					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
480 Series actuator boss					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
83	Screw, steel pl (2 req'd)	1C5958X0022			
85	Mounting Bracket, Steel	3L276725092			
86	Hex Nut, steel pl (2 req'd)	1A352724122			
Type 585C size 25 and 50					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
83	Screw, steel pl (2 req'd)	1A352624052			
Type 585C (470) size 60, 68, 100, and 130 ; Type 657 and 667 size 30, 34, 40, 45, 50, 60, 70, 80 & 87; Type 1051 and 1052 size 40, 60 and 70; Type 1061 all sizes					
80	Mounting Bracket, steel	3P426825022			
81	Washer, steel pl (4 req'd)	1B865928982			
82	Cap Screw, steel pl (4 req'd)	1A381624052			
83	Screw, steel pl (2 req'd)	1C870224052			
84	Spacer	1K766824092			
Casing Mounting					
Type 657 and 667 size 30, 34, 40, 45, 50 and 60					
80	Mounting Bracket, steel		1F401225072		
81	Washer, steel pl (2 req'd)		1B865928982		
82	Cap Screw, steel pl (2 req'd)		1A381624052		
83	Screw (req'd)		1A582824052		
Type 657 and 667 size 70					
80	Mounting Bracket, steel		1F401225072		
81	Washer, steel pl (2 req'd)		1B865928982		
82	Cap Screw, steel pl (2 req'd)		1A381624052		
83	Screw (2 req'd)		1A368324052		
Type 1051 and 1052 size 20, 33, 40, 60 and 70					
80	Mounting Bracket, steel		1F401225072		
81	Washer, steel pl (2 req'd)		1B865928982		
82	Cap Screw, steel pl (2 req'd)		1A381624052		
83	Screw (req'd)		1A582824052		
Type 1250 and 1250R all sizes					
80	Mounting Bracket, steel		30B1265X022		
81	Washer, steel pl (2 req'd)		1B865928982		
82	Cap Screw, steel pl (2 req'd)		1A381624052		
87	Washer		10B6610X012		
91	U-Bolt (2 req'd)		19A7930X012		
92	Hex Nut (req'd)		19A4838X012		
Pipestand Mounting					
80	Mounting Bracket, steel		3P426825022		
81	Washer, steel pl (4 req'd)		1B865928982		
82	Cap Screw, steel pl (2 req'd)		1A381624052		
88	Pipe Clamp, steel pl		1P427028982		
Surface Mounting					
80	Mounting Bracket, Steel		GE07077X012		
82	Cap Screw		1B6098X0012		

Loop Schematics/Nameplates



NOTES:

- 1. BARRIERS MUST BE CSA CERTIFIED WITH ENTITY PARAMETERS AND ARE TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS I.S. INSTALLATION INSTRUCTIONS.
- 2. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, PART I.
- 3. FOR ENTITY INSTALLATION: $V_{max} > V_{oc}$, $I_{max} > I_{sc}$, $C_i + C_{cable} < C_a$, $L_i + L_{cable} < L_a$.

GE07471

Figure 15. CSA Loop Schematic

TYPE i2P-100 | 20 mADC == MAX, 30 VDC == MAX, 50 PSI MAX | APPROVED FOR NATURAL GAS AS SUPPLY MEDIUM. CSA ENCLOSURE 3, NEMA 3 | FISHER CONTROLS INTL LLC MARSHALLTOWN, IOWA, USA MFG LOCATION

AMB. TEMP: -40 TO 85°C

SERIAL NO. []

FACTORY CALIBRATED AS:
INPUT: 4-20 mADC OUTPUT: 3-15 PSI 6-30 PSI

FIELD CALIBRATED AS:
INPUT: _____ mA OUTPUT: _____ PSI

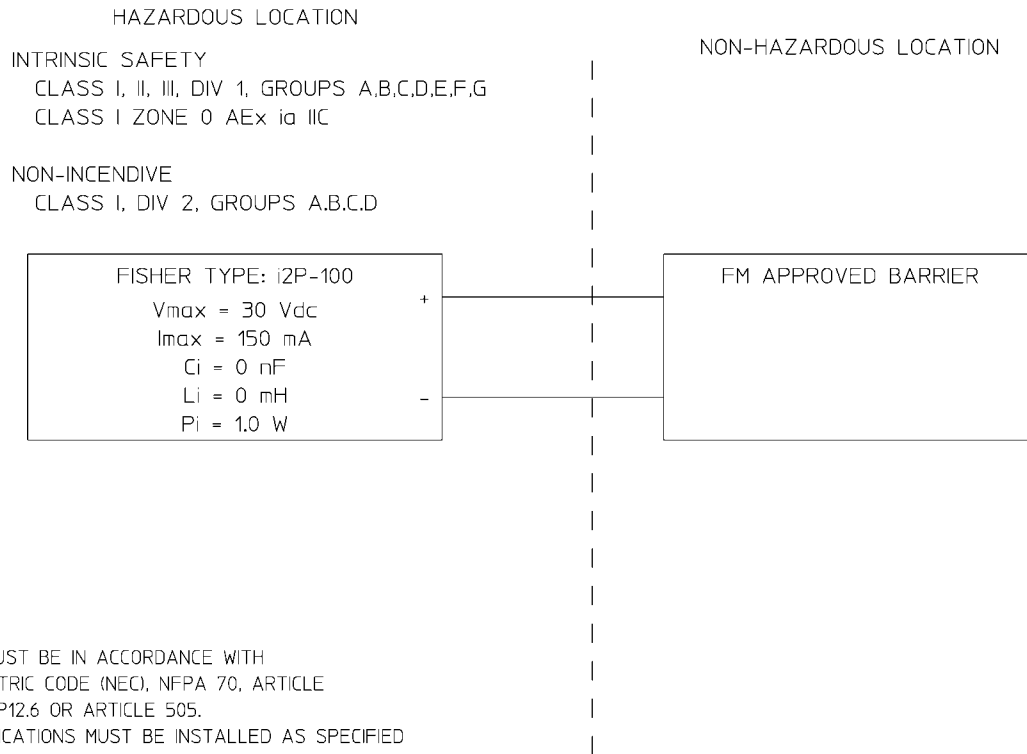
SEAL NOT REQUIRED.
CL I DIV 1 GP ABCD T5; CL I DIV 2 GP ABCD T5
CL II DIV 1 GP EFG T5; CL II DIV 2 GP FG T5
Ex ia INTRINSICALLY SAFE CL I,II,III DIV 1 GP ABCDEFG T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C)
WHEN INSTALLED PER DRAWING GE07471
Ex ia IIC T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C)
Ui,Vmax=30V Ii,Imax=150mA Pi=1.0W Ci=0nF Li=0uH
Ex d IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)
Ex nC IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)
US PATENTS - 4836011 - 4595029
OTHER PATENTS PENDING

SEAL NOT REQUIRED
IS: CL I,II,III DIV 1,2 GP ABCDEFG T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C) WHEN INSTALLED PER DWG GE07470
XP: CL I DIV 1 GP ABCD T5(Tamb≤85°C)/T6(Tamb≤75°C)
NI: CL I DIV 2 GP ABCD T5(Tamb≤85°C)/T6(Tamb≤75°C)
DIP: CL II DIV 1 GP EFG T5(Tamb≤85°C)/T6(Tamb≤75°C)
S: CL II DIV 2 GP FG T5(Tamb≤85°C)/T6(Tamb≤75°C)
CLASS I ZONE 0 AEx ia IIC T3(Tamb≤85°C)/T4(Tamb≤81°C)/T5(Tamb≤46°C)
Ui,Vmax=30V Ii,Imax=150mA Pi=1.0W Ci=0nF Li=0mH
CLASS I ZONE 1 AEx d IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)
CLASS I ZONE 2 AEx nC IIC T5(Tamb≤85°C)/T6(Tamb≤75°C)

WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. OPEN CIRCUIT BEFORE REMOVING COVER. WHEN OPERATING OVER 70°C USE SUITABLE CABLING/WIRING. GE13955

Figure 16. CSA and FM Approvals Nameplate

i2P-100 Transducer



NOTES:

1. THE INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), NFPA 70, ARTICLE 504 AND ANSI/ISA RP12.6 OR ARTICLE 505.
2. CLASS 1, DIV 2 APPLICATIONS MUST BE INSTALLED AS SPECIFIED IN NEC ARTICLE 501-4(B). EQUIPMENT AND FIELD WIRING IS NON-INCENDIVE WHEN CONNECTED TO APPROVED BARRIERS WITH ENTITY PARAMETERS.
3. LOOPS MUST BE CONNECTED ACCORDING TO THE BARRIER MANUFACTURER'S INSTRUCTIONS.
4. MAXIMUM SAFE AREA VOLTAGE SHOULD NOT EXCEED 250 V_{rms} .
5. RESISTANCE BETWEEN BARRIER GROUND AND EARTH GROUND MUST BE LESS THAN ONE OHM.
6. NORMAL OPERATING CONDITIONS 30 Vdc 20 mADC.
7. FOR ENTITY INSTALLATION (U.S. AND N.I.):
 - $V_{max} > V_{oc}$, or V_t $C_i + C_{cable} < C_a$
 - $I_{max} > I_{sc}$, or I_t $L_i + L_{cable} < L_a$
 - $P_i > P_o$, or P_t

GE07470

Figure 17. FM Loop Schematic

ATEX INTRINSIC SAFETY APPROVAL INFORMATION

ATEX FLAMEPROOF APPROVAL INFORMATION

ATEX TYPE n APPROVAL INFORMATION

TYPE i2P-100 | US PATENTS - 4836011 - 4595029 | 20 mADC == MAX, 30 VDC == MAX, 50 PSI MAX
 OTHER PATENTS PENDING | AMB TEMP: -40 TO 85°C, IP64 | APPROVED FOR NATURAL GAS AS SUPPLY MEDIUM | FISHER CONTROLS INTL LLC
 MARSHALLTOWN, IOWA, USA
 MFG LOCATION:

SERIAL NO [] FACTORY CALIBRATED AS:
 INPUT: 4-20 mADC == OUTPUT: 3-15 PSI [] 6-30 PSI []
 FIELD CALIBRATED AS: INPUT [] mADC == OUTPUT []

<p><input type="checkbox"/> KEMA 05 ATEX 1109X II 1 G D EEx ia IIC T3(Tamb≤85°C) T4(Tamb≤81°C) T5(Tamb≤46°C) Ui = 30V li = 150mA Pi = 1.0W Ci = 0F Li = 0H USE ONLY WITH A LINEAR BARRIER MAXIMUM ENCLOSURE SURFACE TEMPERATURE T95°C(Tamb≤85°C)</p>	<p><input type="checkbox"/> KEMA 05 ATEX 2099X II 2 G D EEx d IIC T5(Tamb≤85°C) T6(Tamb≤75°C)</p>	<p><input type="checkbox"/> KEMA 05 ATEX 1119 11 3 GD EEx nC II T5(Tamb≤85°C) T6(Tamb≤75°C)</p>
MAXIMUM ENCLOSURE SURFACE TEMPERATURE T95°C(Tamb≤85°C)	MAXIMUM ENCLOSURE SURFACE TEMPERATURE T95°C(Tamb≤85°C)	MAXIMUM ENCLOSURE SURFACE TEMPERATURE T95°C(Tamb≤85°C)

IECEX CSA 05.0010X
 Ex ia IIC T3(Tamb≤85°C) T4(Tamb≤81°C) T5(Tamb≤46°C)
 Ui=30V li=150mA Pi=1.0W Ci=0F Li=0H
 Ex d IIC T5(Tamb≤85°C) T6(Tamb≤75°)
 Ex nC IIC T5(Tamb≤85°C) T6(Tamb≤75°C)

CAUTION/WARNINGS:

- ELECTROSTATIC CHARGE HAZARD - DO NOT RUB OR CLEAN WITH SOLVENTS. TO DO SO COULD RESULT IN AN EXPLOSION.
- WHEN OPERATING OVER 70°C, USE SUITABLE CABLING/WIRING.
- FOR ATEX APPROVALS ONLY - USER MUST SELECT AND MARK ONLY ONE PROTECTION METHOD UPON INSTALLATION. ONCE MARKED IT SHALL NOT BE CHANGED. NOT FOLLOWING THESE INSTRUCTIONS WILL JEOPARDIZE THE EXPLOSION SAFETY.

GE06337

IECEX APPROVAL INFORMATION

Figure 18. ATEX and IECEx Approvals Nameplate

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Emerson Process Management

Fisher

Marshalltown, Iowa 50158 USA

Cernay 68700 France

Sao Paulo 05424 Brazil

Singapore 128461

www.Fisher.com



Shock/Vibration Control Switches Installation Instructions

Models: VS2, VS2C, VS2EX, VS2EXR, VS2EXRB and VS94



Please read the following instructions before installing. A visual inspection of this product for damage during shipping is recommended before mounting. It is your responsibility to have a qualified person install the unit, and make sure installation conforms with NEC and local codes.

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.



Model VS2EX

Description

The Murphy shock and vibration switches are available in a variety of models for applications on machinery or equipment where excessive vibration or shock can damage the equipment or otherwise poses a threat to safe operation. A set of contacts is held in a latched position through a mechanical latch and magnet mechanism. As the level of vibration or shock increases an inertia mass exerts force against the latch arm and forces it away from the magnetic latch causing the latch arm to operate the contacts. Sensitivity is obtained by adjusting the amount of the air gap between the magnet and the latch arm plate.

Applications include all types of rotating or reciprocating machinery such as cooling fans, engines, pumps, compressors, pump jacks, etc.

Models

VS2: Base mount; non hazardous locations.

VS2C: C-clamp mount; non hazardous locations.

VS2EX: Explosion-proof; Class I, Div. 1, Groups C and D.

VS2EXR: Explosion-proof with remote reset.

VS2EXRB: Explosion-proof; Class I, Div. 1, Group B; with remote reset.

VS94: Base mount; non hazardous locations, NEMA 4X/IP66.

Remote Reset Feature (VS2EXR, VS2EXRB and VS94 only)

Includes built-in electric solenoid which allows reset of tripped unit from a remote location. Standard on VS2EXR and VS2EXRB. Optional on VS94 (options listed below).

-R15: Remote reset for 115 VAC

-R24: Remote reset for 24 VDC

Time Delay Option (VS94 only)

Overrides trip operation on start-up. For VS94 series models, the delay time is field-adjustable from 5 seconds up to 100 seconds with a 20-turn potentiometer (5 seconds per turn approximately). Options listed below:

-T15: Time delay for 115 VAC

-T24: Time delay for 24 VDC

Space Heater Options (VS94 only)

This optional space heater board prevents moisture from condensing inside the VS94 Series case. Options listed below:

-H15: Space heater for 115 VAC

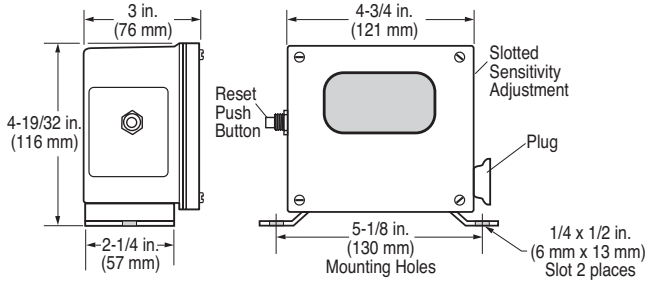
-H24: Space heater for 24 VDC

Warranty

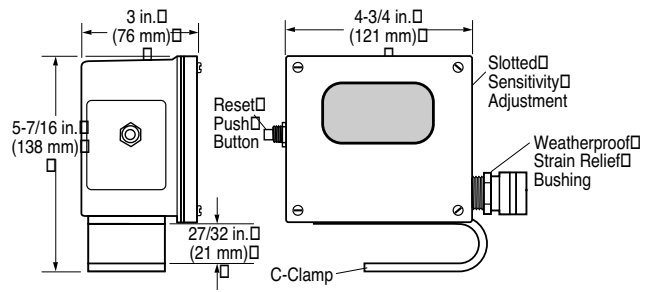
A limited warranty on materials and workmanship is given with this FW Murphy product. A copy of the warranty may be viewed or printed by going to www.fwmurphy.com/support/warranty.htm

DIMENSIONS

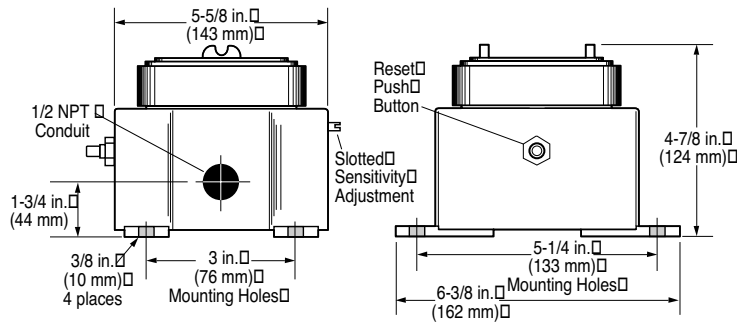
VS2



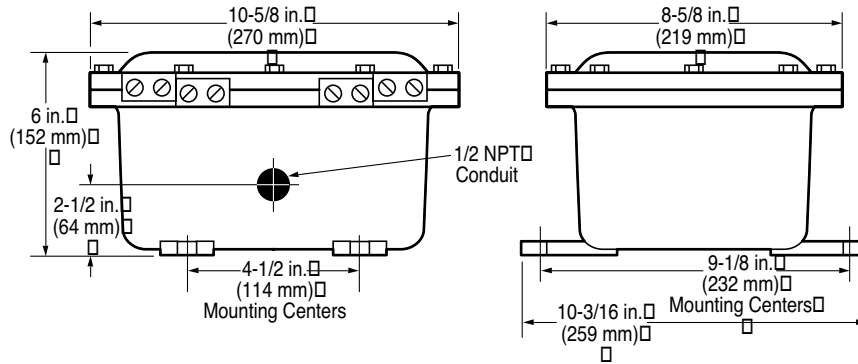
VS2C



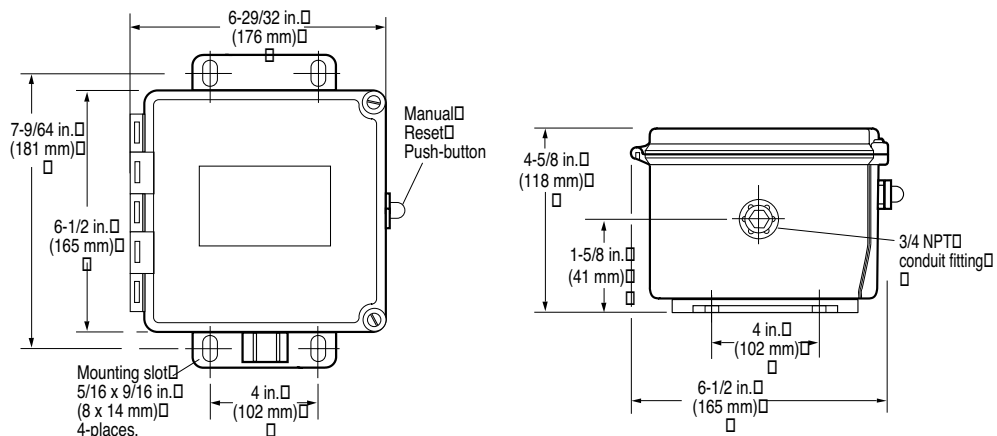
VS2EX and VS2EXR



VS2EXRB



VS94



SPECIFICATIONS

VS2 and VS2C

- **Case:** Weatherproof (equal to NEMA 3R) suitable for non-hazardous areas.
VS2: *Base mount*
VS2C: *C-clamp mount. Includes 45 feet (13.7 meters), 2-conductor 16 AWG, 30 strands/0.25 mm strand dia. (1.5 mm²) cable, and five cable hold down clamps.*
- **Contacts:** SPDT double make leaf contacts, 5A @ 480 VAC.
- **Range adjustment:** 0 - 7 G's; 0 - 100 Hz /0.100 in. displacement.

VS2EX

- **Case:** Explosion-proof and weatherproof aluminum alloy housing; meets NEMA 7/IP50 specifications; Class I, Division 1, Groups C & D; UL and CSA listed.*
VS2EX: *base mount.*
- **Snap-switches:** 2-SPDT snap-switches; 5A @ 480 VAC;* 2A resistive, 1A inductive, up to 30 VDC.
 - **Range adjustment:** 0 - 7 G's; 0 - 100 Hz /0.100 in. displacement.
- **Normal Operating Temperature:** -40 to 140°F (-40 to 60°C).

VS2EXR

- **Case:** Same as VS2EX.
- **Snap-switch:** 1-SPDT snap-switch and reset coil; 5A @ 480 VAC;* 2A resistive, 1A inductive, up to 30 VDC.
- **Remote Reset (optional):**

<i>Option</i>	<i>Operating Current</i>
-R15:	350 mA @ 115 VAC
-R24:	350 mA @ 24 VDC
- **Range adjustment:** 0 - 7 G's; 0 - 100 Hz /0.100 in. displacement.
- **Normal Operating Temperature:** -40 to 140°F (-40 to 60°C).

VS2EXRB

- **Case:** Explosion-proof aluminum alloy housing; rated Class I, Division 1, Group B hazardous areas.
- **Snap-switch:** 1-SPDT snap-switch with reset coil (option available for

additional SPDT switch); 5A @ 480 VAC; 2A resistive, 1A inductive, up to 30 VDC.

• Remote Reset:

Option Operating Current

-R15: 350 mA @ 115 VAC

-R24: 350 mA @ 24 VDC

- **Range adjustment:** 0 - 7 G's; 0 - 100 Hz /0.100 in. displacement.

VS94

- **Case:** Polyester fiberglass reinforced; NEMA type 4 and 4X; IP66; CSA types 4 and 12.
- **Conduit Fitting:** 3/4 NPT conduit fitting connection.
- **Normal Operating Ambient Temperature:** 0 to 140°F (-18 to 60°C).
- **Snap-switches:** 2-SPDT snap acting switches; 5A @ 480 VAC; 2A resistive, 1A inductive, up to 30 VDC.
- **Range adjustment:** 0 - 7 G's; 0 - 100 Hz /0.100 in. displacement.
- **Heater (optional):**

<i>Option</i>	<i>Operating Current</i>
H15	.023 A @ 115 VAC
H24	.12 A @ 24 VDC
- **Remote Reset (optional):**

<i>Option</i>	<i>Operating Current</i>
R15	.17 A @ 115 VAC
R24	.36 A @ 24 VDC
- **Time Delay (optional):**

<i>Option</i>	<i>Operating Current</i>	<i>Standby Current</i>
T15	.360 A @ 115 VAC	.01 A @ 115 VAC
T24	1.15 A @ 24 VDC	.01 A @ 24 VDC
- **Time Delay/Remote Reset:** Adjustable 20-turn potentiometer from 5 seconds to 100 seconds (5 seconds per turn approximately).

*CSA and UL listed with 480 VAC rating.

INSTALLATION



WARNING: STOP THE MACHINE AND DISCONNECT ALL ELECTRICAL POWER BEFORE BEGINNING INSTALLATION.

The VS2 and VS94 series shock switches are sensitive to shock and vibration in all three planes of motion - up/down, front/back and side/side. Front/back is the most sensitive (The reset pushbutton is located on the "front" of the unit). For maximum sensitivity mount the unit so that the front faces into the direction of rotation of the machine. (See Dimensions on page 2 for sensitivity adjustment location).

The VS2 and VS94 Series must be firmly attached/mounted to the machine so that all mounting surfaces are in rigid contact with the mounting surface of the machine. For best results, mount the instrument in-line with the direction of rotating shafts and/or near bearings. In other words, the reset push button should be mounted pointing into the direction of shaft rotation (see page 5). It may be necessary to provide a mounting plate or bracket to attach the VS2 and VS94 Series to the machine. The mounting bracket should be thick enough to prevent induced acceleration/vibration upon the VS2 or VS94 Series. Typically 1/2 in. (13mm) thick plate is sufficient. See illustrations on page 5 for typical mounting locations.



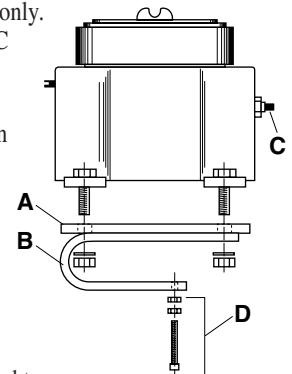
CAUTION: A dust boot is provided on the reset pushbutton for all series to prevent moisture or dust intrusion. The sensitivity adjustment for model VS2EX is not sealed; therefore, mounting

orientation should be on a horizontal plane or with the sensitivity adjustment pointing down. Sensitivity adjustment for model VS2 is covered by a plug. The plug must be in place and tight to prevent moisture or dust intrusion.

C-Clamp Installation (VS2C model only)

A C-Clamp is supplied with the VS2C model only. The C-Clamp is shipped installed on the VS2C but must be installed on the VS2EX and VS2EXR switches.

1. The C-Clamp (B) will already be installed on a 1/4 in. (6 mm) thick steel mounting plate (A). Bolt the VS2 switch to the mounting plate as illustrated — with four 5/16 in. bolts, nuts, and washers.
2. The mounting location should provide convenient access to the TATTLETALE® push button (C).
3. The hardened set screw and nuts (D) are used to tighten the switch to an I-Beam or cross member such as a Sampson post of an oilwell pumpjack.



Continued on next page.

All Models



WARNING: STOP THE MACHINE AND DISCONNECT ALL ELECTRICAL POWER BEFORE BEGINNING INSTALLATION.

1. Firmly secure the unit to the equipment using the base foot mount or C-Clamp if applicable. See *C-Clamp Installation* page 3.
For oilwell pumpjacks attach the VS2 and VS94 Series to the Sampson post or walking beam. See *Typical Mounting Locations* page 5.
2. Make the necessary electrical connections to the vibration switch. See *Internal Switches*, page 6 for electrical terminal locations and page 7 for typical wiring diagrams. **DO NOT EXCEED VOLTAGE OR CURRENT RATINGS OF THE CONTACTS.** Follow appropriate electrical codes/methods when making electrical connections. Be sure that the run of electrical cable is secured to the machine and is well insulated from electrical shorting. Use of conduit is recommended.

NOTE: If the electrical cable crosses a pivot point such as at the pivot of the walking beam, be sure to allow enough slack in the cable so that no stress is placed on the cable when the beam moves.

If conduit is not used for the entire length of wiring, conduit should be used from the electrical supply box to a height above ground level that prevents damage to the exposed cable from the elements, rodents, etc. or as otherwise required by applicable electrical codes. If conduit is not attached directly to the VS2 and VS94 Series switch, use a strain relief bushing and a weatherproof cap on the exposed end of the conduit. A “drip loop” should be provided in the cable to prevent moisture from draining down the cable into the conduit should the weathercap fail.

Sensitivity Adjustment

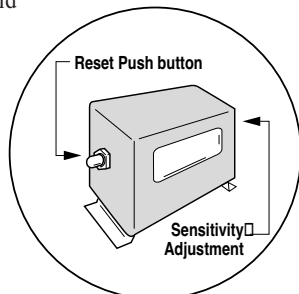


WARNING: REMOVE ALL POWER BEFORE OPENING THE ENCLOSURE. IT IS YOUR RESPONSIBILITY TO HAVE A QUALIFIED PERSON PERFORM ADJUSTMENTS, AND MAKE SURE IT CONFORMS WITH NEC AND LOCAL CODES. DO NOT ADJUST SENSITIVITY WHILE THE MACHINE IS RUNNING. STAND CLEAR OF THE MACHINE AT ALL TIMES WHEN IT IS OPERATING.

All models of the VS2 and VS94 Series cover a wide range of sensitivity. Each model is adjusted to the specific piece of machinery on which it is installed. After the switch has been installed in a satisfactory location (see page 5) the sensitivity adjustment will be increased or decreased so that the switch does not trip during start-up or under normal operating conditions. This is typically done as follows:

1. **REPLACE ALL COVERS, LIDS, AND ELECTRICAL ENCLOSURES.**
2. Press the reset push button to engage the magnetic latch. To be sure the magnetic latch has engaged, observe latch through the window on the VS2 and VS2C (see DETAIL “A”). On the VS2EX, VS94 series the reset button will remain depressed meaning the magnetic latch has engaged.
3. Start the machine.
4. If the instrument trips on start-up,

DETAIL “A”



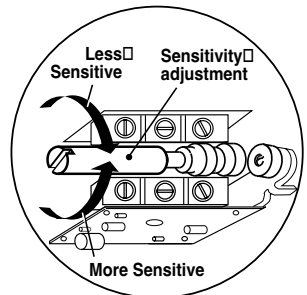
allow the machine to stop. Turn the sensitivity adjustment 1/4 turn clockwise, (adjustment for VS94 and VS2EXRB models is located within the box, see DETAIL “B”).



WARNING: MAKE THE AREA NON-HAZARDOUS BEFORE OPENING THE EXPLOSION-PROOF (-EX) ENCLOSURES.

Depress the reset button and restart the machine. Repeat this process until the unit does not trip on start-up.

DETAIL “B”



5. If the instrument does NOT trip on start-up, stop the machine. Turn the sensitivity adjustment 1/4 turn counter-clockwise. Repeat the start-up/stop process until the instrument trips on start-up. Turn the sensitivity adjustment 1/4 turn clockwise (less sensitive). Restart the machine to verify that the instrument will not trip on start-up.

6. Verify that the unit will trip when abnormal shock/vibration exists.

VS94 Time Delay Adjustment

1. Apply power to the time delay circuit. (see page 7 for time delay circuit). The time delay function will be initiated.
2. Time the length of the delay with a watch. Let time delay expire. After it expires, the override circuit will de-energize the solenoid, allowing the latch arm to trip. A clicking noise is heard.



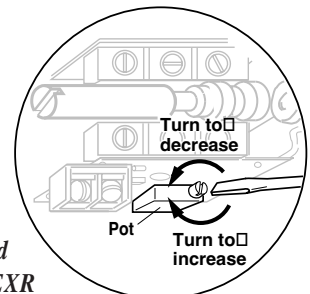
WARNING: REMOVE ALL POWER BEFORE OPENING ACCESS DOOR. IT IS YOUR RESPONSIBILITY TO HAVE A QUALIFIED PERSON ADJUST THE UNIT, AND MAKE SURE IT CONFORMS WITH NEC AND LOCAL CODES.

3. **TURN THE POWER OFF TO RESET THE TIME DELAY CIRCUIT.**

NOTE: Allow 30 seconds bleed-time between turning the power “OFF” and “ON”

4. Locate the time adjustment pot (DETAIL “C”). The time is factory-set at the lowest setting (5 seconds approximately). To increase time, rotate the 20-turn pot clockwise as needed (5 seconds per turn approximately).

DETAIL “C”



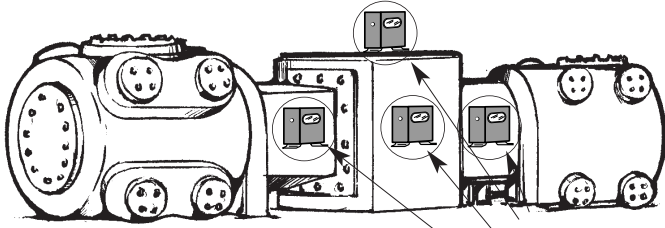
5. Repeat the above steps as necessary to obtain desired time delay.

NOTE: An external time delay can be used with the remote reset feature of the VS2EXR series to provide a remote reset and override of the trip operation on start-up. Time delay must automatically disconnect after equipment start-up.

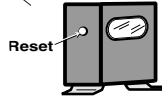
TYPICAL MOUNTING LOCATIONS

NOTE: These are typical mounting locations for best operation. Other mountings are possible. See *Installation* section on page 3.

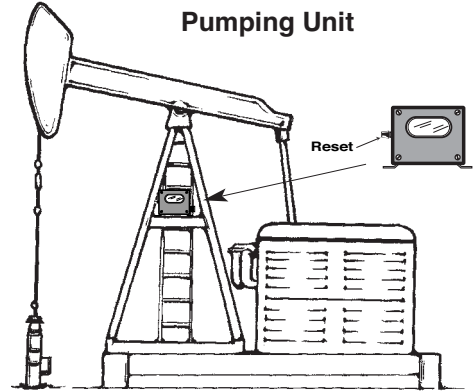
2-Throw Balance-Opposed Compressor



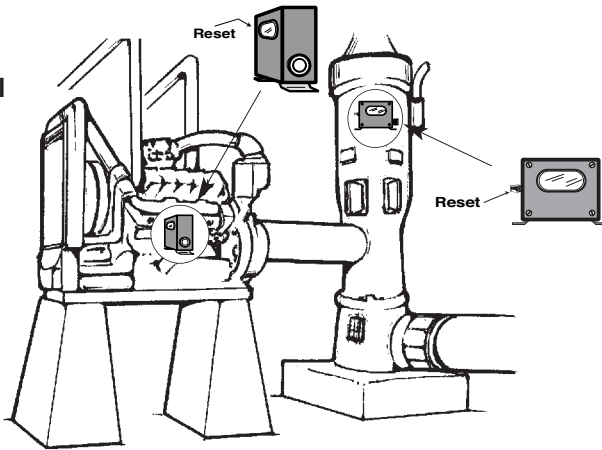
NOTE: If installing on cylinders, 2 vibration/shock switches are recommended- 1 for each cylinder.



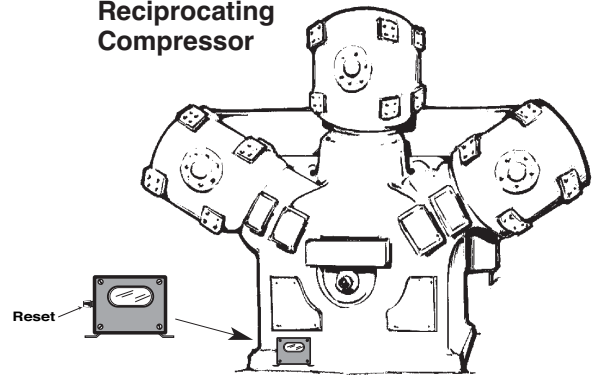
Pumping Unit



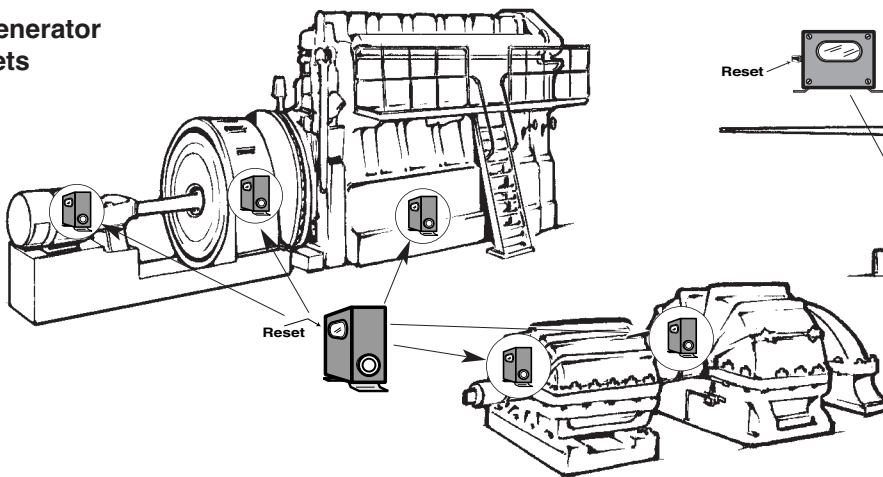
Engine and Vertical Shaft Pump



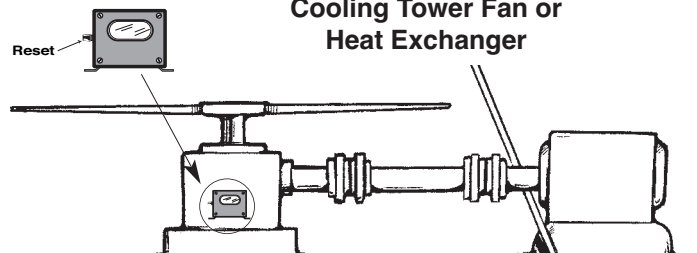
"Y" Type Reciprocating Compressor



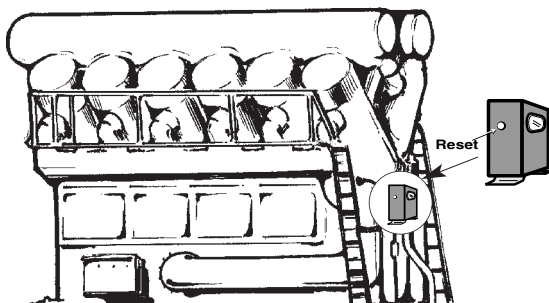
Generator Sets



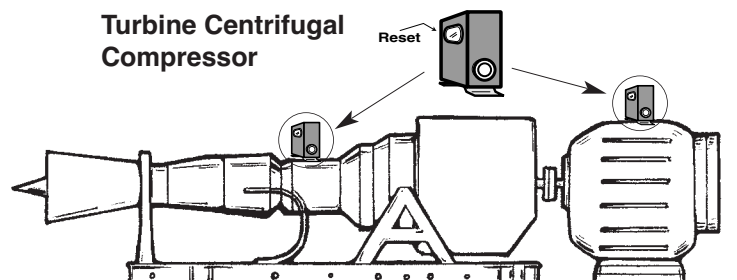
Cooling Tower Fan or Heat Exchanger



Engine Compressor

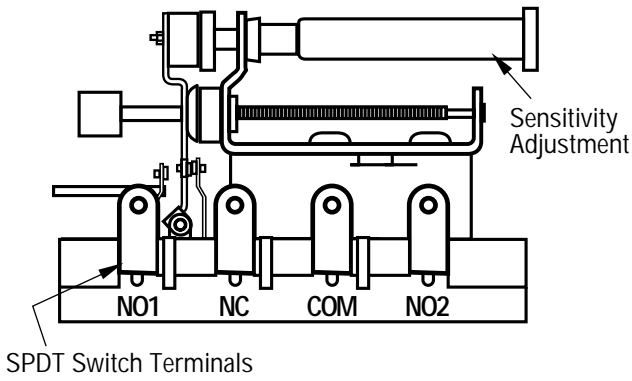


Turbine Centrifugal Compressor

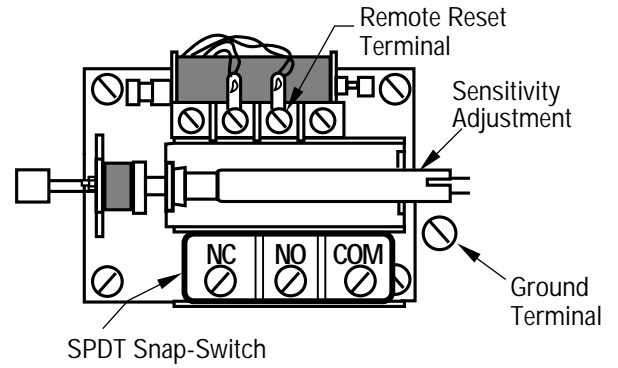


INTERNAL SWITCHES

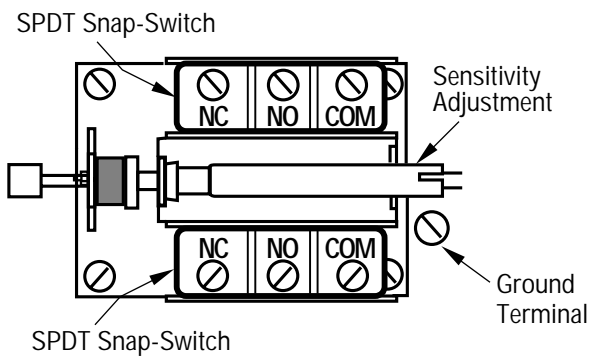
VS2 and VS2C



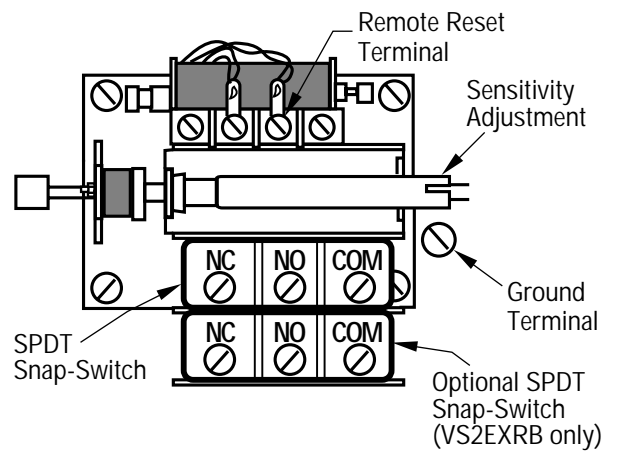
VS2EXR



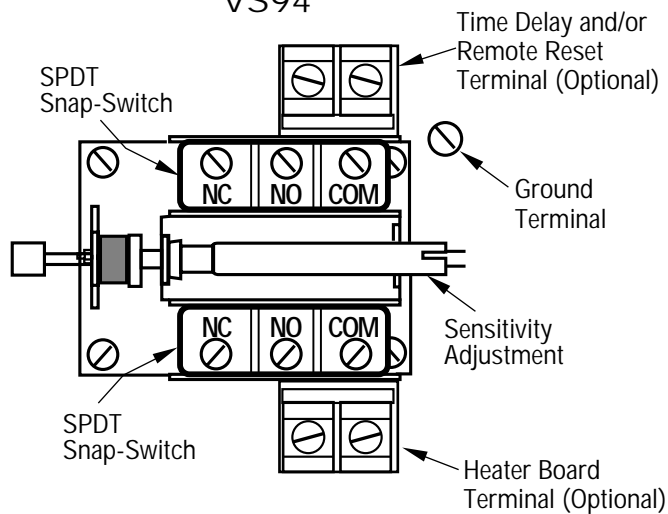
VS2EX



VS2EXB and VS2EXRB



VS94

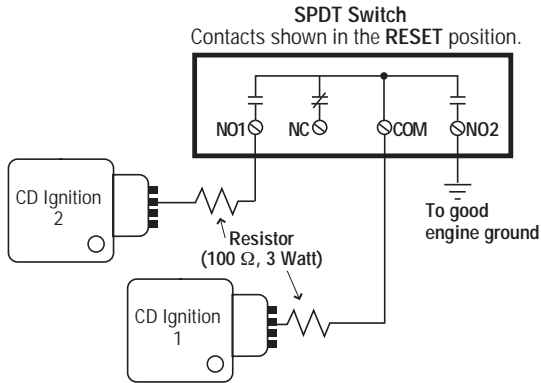


ELECTRICAL

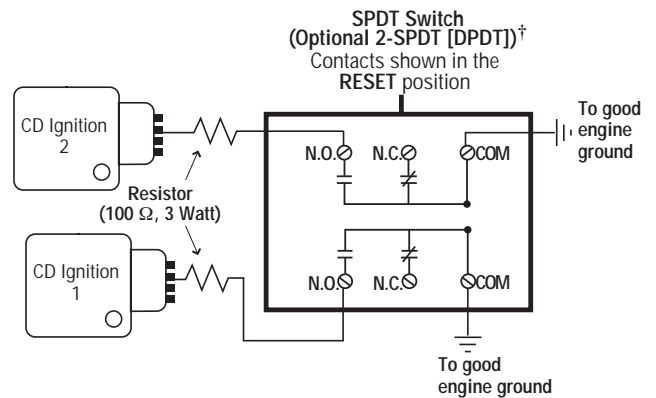


WARNING: REMOVE POWER BEFORE OPENING THE UNIT (ACCESS DOOR). STOP THE MACHINE AND DISCONNECT ALL ELECTRICAL POWER BEFORE BEGINNING THE WIRING OPERATION. IT IS YOUR RESPONSIBILITY TO HAVE A QUALIFIED PERSON INSTALL AND WIRE THE UNIT, AND MAKE SURE IT CONFORMS WITH NEC AND APPLICABLE CODES.

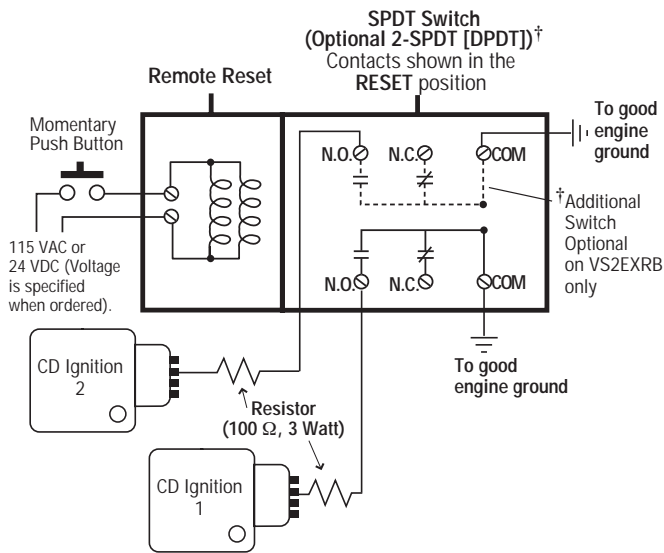
VS2 and VS2C
Typical Wiring Diagram for Single or Dual CD Ignition



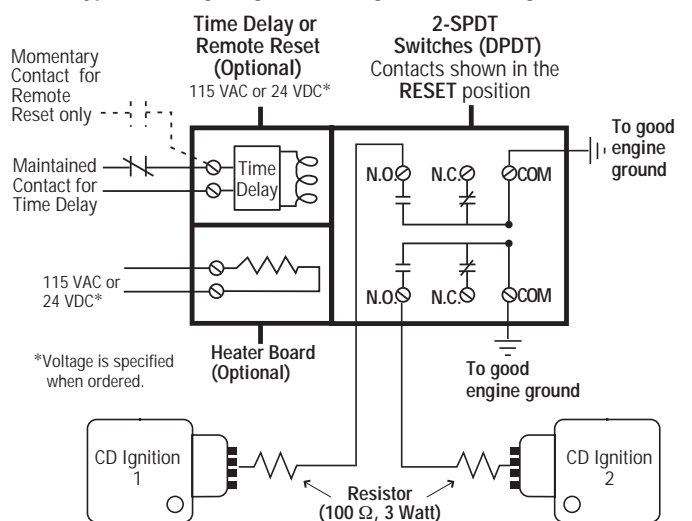
VS2EX
Typical Wiring Diagram for Single or Dual CD Ignitions



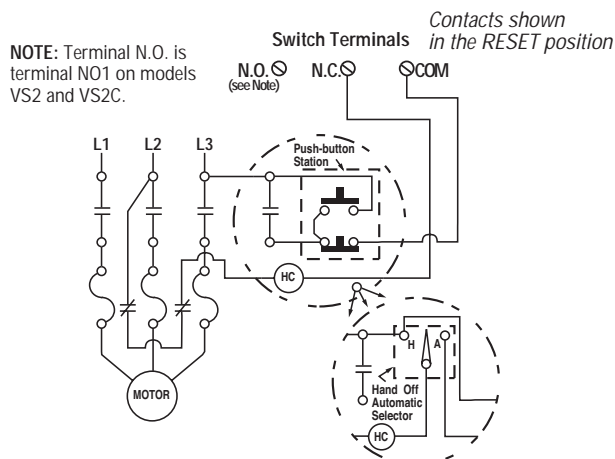
VS2EXR and VS2EXRB
Typical Wiring Diagram for Single or Dual CD Ignitions



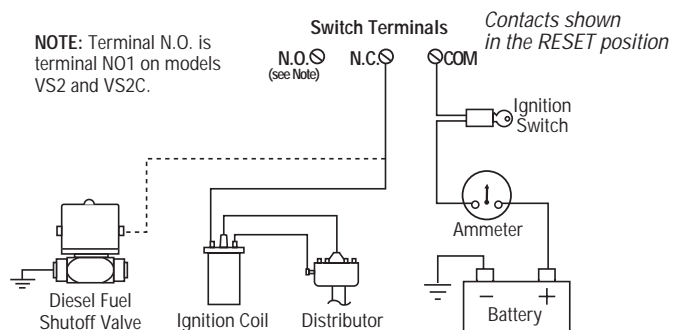
VS94
Typical Wiring Diagram for Single or Dual CD Ignitions



VS2, VS2C, VS2EX, VS2EXR, VS2EXRB and VS94
Typical Wiring Diagram for Electric Motors



VS2, VS2C, VS2EX, VS2EXR, VS2EXRB and VS94
Typical Wiring Diagram for Distributor Ignition or Diesel



SERVICE PARTS

PART NO. DESCRIPTION

VS2

20000030 Movement assembly
 20000031 Glass and gasket assembly
 20000032 Reset push button assembly

VS2C

20000030 Movement assembly
 20000031 Glass and gasket assembly
 20000032 Reset push button assembly
 20050021 Mounting clamp
 20000185 VS2C 5-clamp hardware package assembly.
 20050465 2-Conductor electrical cable, 45 feet (13.7 meters)

VS2EX

20010091 Movement assembly
 20050087 Cover
 00000309 Cover gasket
 20010090 Snap-switch and insulator kit (1 switch per kit)
prior to September 1, 1995.*
**20000288 Snap-switch and insulator kit (1 switch per kit) for models
 manufactured on September 1, 1995 or later.***
 20000289 C-clamp conversion mounting kit

VS2EXR

20000262 Movement assembly
 20050087 Cover
 00000309 Cover gasket
 20010090 Snap-switch and insulator kit (1 switch per kit)
prior to September 1, 1995.*
**20000288 Snap-switch and insulator kit (1 switch per kit) for models
 manufactured on September 1, 1995 or later.***
 20000049 Reset solenoid assembly (115 VAC)
 20000234 Reset solenoid assembly (24 VDC)
 20000289 C-clamp conversion mounting kit

PART NO. DESCRIPTION

VS2EXRB

20010090 Snap-switch and insulator kit (1 switch per kit)
prior to September 1, 1995.*
**20000288 Snap-switch and insulator kit (1 switch per kit) for models
 manufactured on September 1, 1995 or later.***
 20000057 *Inside* snap-switch and insulator kit (1 switch per kit) for
 model VS2EXRB-D **prior to September 1, 1995.***
 20000058 *Outside* snap-switch and insulator kit (1 switch per kit) for
 model VS2EXRB-D **prior to September 1, 1995.***
**20000287 Outside snap-switch and insulator kit (1 switch per kit) for model
 VS2EXRB-D manufactured on September 1, 1995 or later.***
**20000290 Inside snap-switch and insulator kit (1 switch per kit) for model
 VS2EXRB-D manufactured on September 1, 1995 or later.***
 20050077 Adjustment shaft
 20000262 Movement assembly
 20000049 Reset solenoid assembly (115 VAC)
 20000234 Reset solenoid assembly (24 VDC)

VS94 Series

25050506 Dust boot
 00000232 Conduit fitting
 20010090 Snap-switch and insulator kit (1 switch per assembly)
prior to September 1, 1995.**
**20000288 Snap-switch and insulator kit (1 switch per assembly)
 for models manufactured on September 1, 1995 or later.*****

* If no date code is found, refer to the old switch. Models with date 0895 and before use old switch.
 Dated 0995 after, use straight snap-switch arm, no rollers.

** Models dated Q1 thru Q8 (formed snap-switch arm and rollers).

***Models date coded Q9 thru Q12 and R1 thru R12 (straight snap-switch arm, no rollers).

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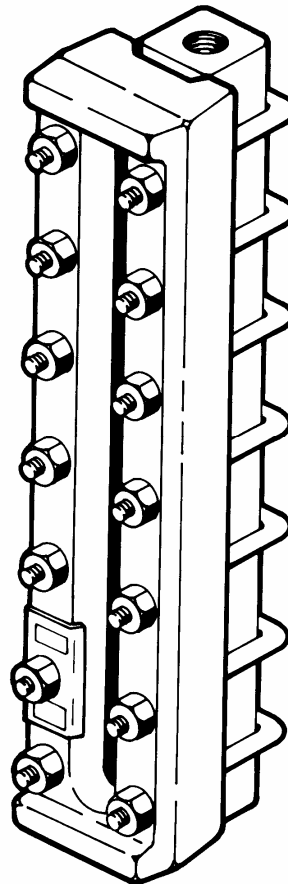
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In order to consistently bring you the highest quality, full featured products, we reserve the right to change our specifications and designs at any time.

PENBERTHY®

Flat Glass Gages

Series M



Installation, Operation and Maintenance Instructions

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PENBERTHY PRODUCT WARRANTY

Tyco Valves & Controls Prophetstown warrants its Penberthy products as designed and manufactured by TV&C Prophetstown to be free of defects in the material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. TV&C Prophetstown will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to TV&C Prophetstown and obtain written authorization to return the product. Thereafter, the product shall be returned to TV&C in Prophetstown, Illinois, with freight paid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or otherwise altered outside of TV&C Prophetstown factory, or if it has been subject to misuse, neglect or accident.

The responsibility of TV&C Prophetstown hereunder is limited to repairing or replacing the product at its expense. TV&C Prophetstown shall not be liable for loss, damage or expenses related directly or indirectly to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that TV&C Prophetstown is not responsible for damage or injury caused to other products, buildings, personnel or property, by reason of the installation or use of its products.

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INSTALLATION, OPERATION and MAINTENANCE MANUAL FOR PENBERTHY SERIES M FLAT GLASS GAGES

1.0 About the Manual

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation or maintenance.

SAFETY INSTRUCTIONS

Penberthy does not have any control over the manner in which its liquid level gage is handled, installed or used. Penberthy cannot and will not guarantee that a liquid level gage is suitable or compatible for the user's specific application.



WARNING

Contained fluids may be pressurized and can unexpectedly exit vessel connections due to apparatus or material failure. Safety glasses should be worn when installing a liquid level gage. Failure to follow instructions could result in serious physical injury.

2.0 Introduction

Penberthy liquid level gages are used to allow direct visualization of liquid level in vessels. By peering through the glass, it is possible to monitor color, clarity and level of a gas/liquid interface. Gages are available in varying lengths and configurations (end connect, side connect, multiple sections, NPT or flange connections, etc.). Visual indication can be enhanced by using reflex glass or illuminators (accessory).

2.1 System Description

Penberthy gages are comprised of six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gage. Use the exploded parts view in Section 11.0 as additional reference material.

- Chamber- provides a pressure retaining metallic channel for the liquid to enter and be viewed. Slot(s) are machined into the chamber to provide direct visualization of the process fluid.
- Gaskets- seal the gap and prevent leakage between the chamber and the glass. Gaskets are available in a variety of materials for compatibility with the media in the gage.
- Glass- allows for visual observation of the process fluid in the chamber.
- Cushion- acts as a protective buffer between the glass and the cover. For proper sealing, cushions must be as hard or harder than the gasket material.
- Cover- protects the glass assembly from external hits and provides a flat, rigid surface that is used to evenly compress the gage assembly.

Bolting- compresses the components between the covers (transparent gages) or cover and chamber (reflex gages).

Shield - (optional on transparent gages) used to prevent the process media from contacting the glass.

3.0 Available Models

Penberthy medium pressure (Series M) liquid level gages are designed for applications other than steam/water: 1) requiring pressure ratings lower than that of Penberthy Series H liquid level gages, 2) where pressure ratings are greater than those possible using low pressure (Series L) liquid level gages, or 3) for Series L pressure ranges where iron covers are not allowed.

3.1 Design Ratings at Maximum and Minimum Operating Temperatures

Gasket Material	Glass Size	Model RM & RMR Reflex	
		Wetted Parts Material Steel or Stainless Steel w/B7 Bolting	
		-20°F (-29°C) to 100°F (38°C)	600°F (316°C)
Grafoil® (standard) or Non-Asbestos	1	3000 psig (20680 kPa)	2220 psig (15310 kPa)
	2	2910 psig (20060 kPa)	2150 psig (14820 kPa)
	3	2820 psig (19440 kPa)	2080 psig (14340 kPa)
	4	2725 psig (18790 kPa)	2040 psig (14070 kPa)
	5	2630 psig (18130 kPa)	1950 psig (13440 kPa)
	6	2535 psig (17480 kPa)	1875 psig (12930 kPa)
	7	2440 psig (16820 kPa)	1805 psig (12450 kPa)
	8	2345 psig (16170 kPa)	1740 psig (12000 kPa)
	9	2250 psig (15510 kPa)	1660 psig (11450 kPa)
Top-Chem 2000®	1	3000 psig (20680 kPa)	100 psig (690 kPa) at 500°F (260°C)
	2	2910 psig (20060 kPa)	
	3	2820 psig (19440 kPa)	
	4	2725 psig (18790 kPa)	
	5	2630 psig (18130 kPa)	
	6	2535 psig (17480 kPa)	
	7	2440 psig (16820 kPa)	
	8	2345 psig (16170 kPa)	
	9	2250 psig (15510 kPa)	
25% glass filled PTFE	1 - 9	650 psig (4480 kPa) at -20°F (-29°C) to 100°F(38°C) 150 psig (1030 kPa) at 500°F (260°C)	
NBR/Buna N	1 - 9	300 psig (2070 kPa) at -20°F (-29°C) to 100°F(38°C) 225 psig (1550 kPa) at 250°F (121°C)	
FKM/Viton®	1 - 9	300 psig (2070 kPa) at -20°F (-29°C) to 100°F(38°C) 180 psig (1240 kPa) at 400°F (204°C)	
PTFE/Teflon®	1 - 9	300 psig (2070 kPa) at -20°F (-29°C) to 100°F(38°C) 150 psig (1030 kPa) at 500°F (260°C)	

Table 1

NOTE: Lower temperatures are possible with metallic material variation. (e.g., 316 Stainless construction, Grafoil® gaskets/cushions useable to -325°F [-198°C]).

Gasket Material	Glass Size	Model TM & TMR Transparent	
		Wetted Parts Material Steel or Stainless Steel w/B7 Bolting	
Grafoil® (standard) or Non-Asbestos		-20°F (-29°C) to 100°F (38°C)	600°F (316°C)
	1	2500 psig (17240 kPa)	1850 psig (12760 kPa)
	2	2315 psig (15960 kPa)	1720 psig (11860 kPa)
	3	2130 psig (14690 kPa)	1575 psig (10860 kPa)
	4	1940 psig (13380 kPa)	1435 psig (9890 kPa)
	5	1750 psig (12070 kPa)	1295 psig (8930 kPa)
	6	1565 psig (10790 kPa)	1160 psig (8000 kPa)
	7	1375 psig (9480 kPa)	1015 psig (7000 kPa)
	8	1190 psig (8200 kPa)	880 psig (6070 kPa)
	9	1000 psig (6890 kPa)	740 psig (5100 kPa)
Top-Chem 2000®	1	2500 psig (17240 kPa)	100 psig (690 kPa) at 500°F (260°C)
	2	2315 psig (15960 kPa)	
	3	2130 psig (14690 kPa)	
	4	1940 psig (13380 kPa)	
	5	1750 psig (12070 kPa)	
	6	1565 psig (10790 kPa)	
	7	1375 psig (9480 kPa)	
	8	1190 psig (8200 kPa)	
	9	1000 psig (6890 kPa)	
25% glass filled PTFE	1 - 9	650 psig (4480 kPa) at -20°F (-29°C) to 100°F(38°C) 150 psig (1030 kPa) at 500°F (260°C)	
NBR/Buna N	1 - 9	300 psig (2070 kPa) at -20°F (-29°C) to 100°F(38°C) 225 psig (1550 kPa) at 250°F (121°C)	
FKM/Viton®	1 - 9	300 psig (2070 kPa) at -20°F (-29°C) to 100°F(38°C) 180 psig (1240 kPa) at 400°F (204°C)	
PTFE/Teflon®	1 - 9	300 psig (2070 kPa) at -20°F (-29°C) to 100°F(38°C) 150 psig (1030 kPa) at 500°F (260°C)	
PCTFE/(Kel-F®) Shields 0.063" (1.6mm) thick	1 - 9	300 psig (2070 kPa) at -20°F (-29°C) to 100°F(38°C) 180 psig (1240 kPa) at 400°F (204°C)	

Table 2

NOTE: Lower temperatures are possible with metallic material variation. (e.g., 316 Stainless construction, Grafoil® gaskets/cushions useable to -325°F [-198°C]).

The pressure and temperature ratings may deviate from the previous tables if the gasketing materials of construction and/or bolting are other than those specified. Higher and/or lower temperature ratings are available with different materials of construction.

To determine the maximum allowable working pressure for a specific temperature within the design limits stated in the tables, the user should refer to Penberthy application sheets, or when provided, the specifically stated design limits on a Penberthy product proposal.

NOTE: under no circumstances should shields be used in reflex style gages. Installation of shields in reflex style gages will keep the liquid from coming in contact with the refractive prisms, thereby prohibiting visualization of the liquid level in the gage.



NEVER exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of gage components resulting in death, serious personal injury and property damage.

4.0 Inspection

Upon receipt of a liquid level gage, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

Penberthy's standard 1 section TM & TMR gage consists of: (1) chamber, (2) gaskets, (2) borosilicate flat glass, (2) rubber bands, (2) cushions, (2) covers, (1) washer, (1) nameplate and (6-14) bolting sets, depending on the size.

4.1 Glass Inspection

The self stick caution tape was applied at the factory to protect the glass during shipping, handling and installation. Do not remove the tape from the glass until all installation procedures have been completed, except during receiving inspection to momentarily inspect glass for shipping damage. Glass that is not protected will be vulnerable to dust, grit, tools and any other objects which may scratch, chip or break the glass.



DO NOT use glass that is chipped or even slightly scratched. Glass surface defects weaken the glass, which may result in glass breakage and fluid loss under pressure resulting in serious personal injury and property damage.

4.2 User Rating Inspection

The user should confirm that:

1. the Series M liquid level gage model and assembly number stamped on the nameplate conforms to the description on the user's purchase order,
2. the operating conditions described in the purchase order agree with the actual operating conditions at the installation site,
3. the actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above, and
4. the materials of construction of the liquid level gage are compatible with both the contained media and surrounding atmosphere in the specific application.



If the size, model or performance data of the liquid level gage as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for assistance. The incorrect gage can result in unacceptable performance and potential damage to the gage.

5.0 Installation

Installation should only be undertaken by qualified, experienced personnel who are familiar with equipment of this type. They should have read and understood all of the instructions in this manual. The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for the specific size and model liquid level gage.

Penberthy recommends that all liquid level gage installations be provided with gagecock sets equipped with ball check shut-off. Gagecock sets are designed to isolate the gages from the pressure vessel when it becomes necessary to drain or service the gages. The ball check shut-off is designed to retard leakage of the contained fluid in the event of gage glass breakage. Ball checks are available for both positive and negative vessel pressures.

The number of different types of gage and gagecock installations is too great to adequately detail in an installation manual. It is, therefore, the user's responsibility to assure that the knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the installation guidelines that should be employed.

5.1 Piping Strain

The gage should be mounted and connected so that it does not support any piping weight. Piping not properly supported, independent of the gage, may subject the gage to stresses that can cause leaks or glass breakage. Support brackets are available as an accessory.

5.2 Differential Thermal Expansion

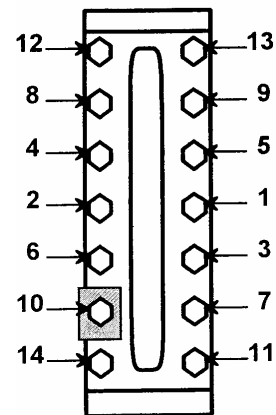
High mechanical loads may be imposed on a gage by expanding and contracting pipes due to hot or cold service. Such mechanical loads on the gage must be minimized by the use of expansion loops in the system. Failure to allow for expansion or contraction can result in leaks or glass breakage.

5.3 Mirror Viewing

For added safety, a system of indirect viewing by means of mirrors should be installed to protect personnel from the hazards of possible gage failure.

5.4 Nut Retorquing

Nut retorquing is vital to the operation of a liquid level gage because gaskets take permanent set under initial bolt loading at assembly. Tightening of nuts before installation to values specified in Table 3 is necessary to insure pressure retaining capabilities of liquid level gage to specific design ratings. The user must refer to the liquid level gage model and assembly number and to the purchase order or tag to determine materials of construction.



Nut Tightening Sequence
Figure 1

SAFETY INSTRUCTIONS

Before placing liquid level gage into initial operation, torque values must be verified. From factory testing to installation, gasketing may take “set” reducing closure force. Retorquing before operation reduces chance of leakage or gasket “blow out”.

BOLT TORQUE VALUES

GAGE MODELS & GASKET MATERIAL	ft-lb [N·m]
RM, RMR, TM, TMR w/Grafoil® (standard)	25 to 30 [34 to 41]
RM, RMR, TM, TMR w/Non-asbestos (optional)	30 to 35 [41 to 48]
Top-Chem 2000®	25 to 30 [34 to 41]
PTFE and PCTFE (Kel-F®)	20 to 25 [27 to 34]
25% glass filled PTFE	19 to 22 [26 to 30]
All models with Viton® or elastomeric (optional)	10 to 15 [14 to 20]
TM, TMR with PCTFE (Kel-F®) Shields (optional) 0.063" [1.6mm]	20 to 25 [27 to 34]

Table 3

Using a torque wrench, tighten nuts in 5 ft-lb (7 N·m) increments following the "Z" pattern sequence in Figure 1, until the torque values shown in Table 3 above for the specific liquid level gage are reached. For multiple section gages, torque the center section(s) and progressively work toward the ends of the gage.

If bolting, gasketing or glass on any repaired section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued as necessary.



WARNING

Failure to comply with the proper torquing sequence or force value can lead to leakage, gasket blow-out or glass breakage resulting in gage failure, serious personal injury or property damage.

NOTE: Depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow "Z" pattern outward to the limit of bolting on a specific gage.

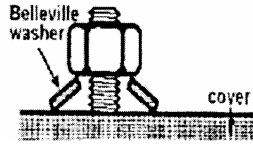
5.5 Belleville Washers

Belleville washers are used to reduce the need to retorque nuts. This is especially important for gages subject to pressure and/or thermal cycling. The conical washers allow for material expansion and contraction while maintaining axial bolt loading and, therefore, compression on the gasket.

Model RM & RMR gages require 4 washers per nut, model TM & TMR gages require 2 washers per nut (4 per bolt). Washers should be assembled with cupped side facing the gage cover. Refer to Figure 2 for proper washer assembly.

Note: the following procedure is to be done on only one side of a transparent gage.

Using a torque wrench, tighten nuts in 5 ft-lb (7 N·m) increments following the “Z” pattern sequence found in Figure 1 until the torque values shown in Table 3 are reached.



**Belleville Washer Position
Figure 2**

6.0 Operation

Before initializing liquid level gage operation, check that all installation procedures have been completed. Use only qualified experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight. Assure that nuts have been retorqued to their proper values as specified in Table 3. Remove self stick caution tape from the glass and inspect to be sure that glass is clean and free of any damage such as cracks, scratches, pits and chips.

6.1 Hydrostatic Test



Liquid level gage installations should be brought into service slowly to avoid excessive shock or stress on the glass. Rapid pressurization or sudden changes in temperature may cause glass breakage. To avoid excessive thermal shock or mechanical stress on glass, the connecting gagecocks should be opened slightly, and the gage temperature and pressure allowed to slowly equalize. If the gagecocks are equipped with ball checks, the gagecocks must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball checks in the event of failure. Failure to follow the recommended operating procedures can result in death, severe personal injury and/or property damage.

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatically pressure test all installations to at least 100 psig (690 kPa) but less than the design pressure and correct any leakage before proceeding.

7.0 Maintenance



Use only qualified experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to follow instructions can cause serious personal injury and property damage.

The rate at which components degrade is dependent upon a variety of conditions. Pressure, temperature and process media all influence the rate at which gage components deteriorate. Higher temperatures can accelerate the deterioration of gaskets, cushions, glass and metals. Acids and similar chemicals can break down the integrity of almost any material. Concentration of chemicals can accelerate the corrosion rate. Penberthy cannot create a blanket maintenance schedule for every application.

The end user is the most familiar with the process media and conditions and must be responsible for creating a maintenance schedule. The user must create maintenance schedules, safety manuals and inspection details for each liquid level gage. Realistic maintenance schedules can only be determined with full knowledge of the services and application situations involved. These will be based upon the user's own operating experience with their specific application.

If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued or repaired as necessary.

On all installations the following items should be regularly evaluated by the user for purposes of maintenance:

1. glass, for cleanliness and signs of damage or wear,
2. shields, if used, for signs of clouding, wear or deterioration,
3. gage, for signs of leakage around gaskets or at connections and
4. gage, for signs of internal or external corrosion.

7.1 Maintenance Procedures

GLASS should be given regular and careful attention. Keep glass clean using a commercial glass cleaner and a soft cloth. Inspect the surface of the glass for any clouding, etching or scratching or physical damage such as bruises, checks or corrosion. Glass that is damaged is weakened and may break under pressure. Shining a light at approximately a 45° angle will aid in detecting some of these conditions. Typical damaged areas will glisten more brightly than the surrounding glass because the light is reflected.

Detection of any damage, problem areas or surface wear is sufficient evidence to take the liquid level gage out of service. **DO NOT** proceed with operation of the liquid level gage until the glass has been replaced with a glass replacement kit following the disassembly-reassembly instructions in Section 8.0.

SHIELDS showing any signs of clouding, wear or deterioration are an indication that the gage glass has been exposed, or could soon be exposed to the contained fluid. Immediately take liquid level gage out of service. **DO NOT** proceed with operation of the liquid level gage until shields and glass have been replaced by following the disassembly-reassembly instructions in Section 8.0.

GASKET LEAKS must be repaired immediately. **DO NOT** proceed with operation of a liquid level gage until gaskets have been replaced by following Section 8.0 disassembly-reassembly instructions.

CONNECTION LEAKS at a flanged or threaded connection should be corrected by tightening the bolting at the connection or by taking the liquid level gage out of service and wrapping the connection threads with Teflon[®] tape on all male pipe threads.

CORROSION may occur if the user has selected an improper material for the liquid level gage application. It is the responsibility of the user to choose a material of construction compatible with both the contained fluid and the surrounding environment. If internal or external corrosion is present, an investigation must immediately be performed by the user. It may be necessary to contact an authorized Penberthy distributor to better determine the origin of the corrosion.

7.2 Troubleshooting

Problem: glass becomes prematurely etched or clouded in service

Cause: fluid being handled is not compatible with the glass or shields

Solution: replace the glass and install shields which will not be affected by contained fluid

Problem: glass continually breaks in service despite careful attention to maintenance procedures

Cause: thermal shock, hydraulic shock, mechanical loads, exceeding design ratings or a combination of these

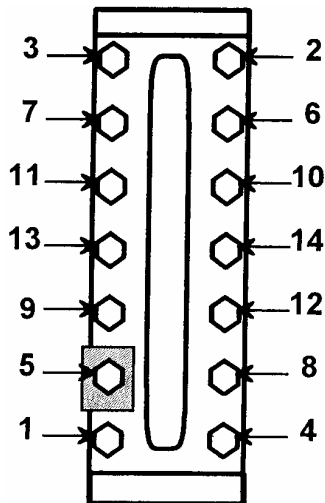
Solution: check entire system to determine possible sources of loads. Check application to determine actual operating conditions and contact an authorized Penberthy distributor on how to proceed.

8.0 Removal - Disassembly - Reassembly



Use only qualified experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. **DO NOT** proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to follow instructions can cause serious personal injury and property damage.

8.1 Disassembly



Nut Loosening Sequence
Figure 3

Secure workbench longer than the liquid level gage, and sufficiently wide to lay out parts as they are removed.

1. Lay gage on bench so nut side of fastener is up.
2. Hold gage firmly; loosen nuts starting at both ends of each section and then proceeding from both ends to the center of each section as shown in Figure 3.
3. Nut Loosening Sequence
 - remove nuts, washer, belleville washers (if any) and nameplate
 - tap covers with rubber hammer as needed to loosen and remove
 - for belleville washer assemblies: to remove covers, studs may need to be removed by laying the assembly on its side and knocking the stud/U-bolts through the cover with a hammer and punch
 - remove cushions, glass, shields (if any) and gaskets
 - tap liquid chamber or remaining covers as necessary with rubber hammer to break loose and remove remaining components
 - remove, destroy and dispose of all glass, cushions, gaskets and shields. Under no circumstances should these components be re-used or installed on a gage.

NOTE: If size of gage is smaller than shown, follow spiraling sequence from the ends until all bolting is loosened.



WARNING

Once used, cushions, gaskets and shields are permanently deformed by compression and if re-used, may cause leaks and high stress points resulting in glass breakage. Glass may contain hidden damage and internal stresses caused by previous usage. If re-used, the glass may break under pressure causing severe personal injury or property damage.

8.2 Inspection of Glass Seating Surfaces

Clean the glass seating surfaces on the liquid chamber and cover with a soft metal scraper (preferably brass) to remove all burrs, rust and remnants of the previous gaskets and cushions. Exercise extreme care to avoid gouging or scarring gasket and cushion seating surfaces.

Use a known flat piece of metal the same approximate length as the glass or a new piece of glass and a thickness gage to check flatness of each glass seating surface on liquid chamber and under cover. Surface must be flat within 0.002 inch (0.05 mm). If any one surface is found to be beyond a tolerance of 0.002 inch (0.05 mm), the entire gage must be disposed of and replaced. Gasket seating surface must have a final surface finish of 450 to 500 AARH.



WARNING

Flatness of glass seating surfaces outside 0.002 inch (0.05 mm) tolerance specified is an indication of the gage having been overstressed through repeated exposure to mechanical, thermal or hydraulic shock during its previous service. Operation of a liquid level gage which has been overstressed will result in abnormal stresses on the glass which may cause glass to break. If surface finish is not in the 450-500 AARH range, gasket may extrude under pressure with resulting sudden release of pressure, leakage of contained fluid, serious personal injury or property damage.

Glass seating surfaces should NOT be machined to achieve seating tolerance. The chamber and cover are designed for a critical thickness to achieve the pressure/temperature ratings. Machining glass seating surfaces may result in non-compliance to the necessary critical thickness due to material removal.

8.3 Reassembly

If all glass seating surfaces are found to be within the 0.002 inch (0.05 mm) tolerance described in the previous section, proceed to obtain new glass, gaskets, cushions and shields (if used) and proceed to reassemble as follows (refer to exploded parts view in Section 11.0 if needed):

1. Clean threads on bolt and nuts to remove all paint, rust and scale. Apply a light coat of oil to the threads.
2. For transparent gages, insert bolts through half the cover and lay out covers along the bench, side by side, with the liquid chamber. Use chamber to space covers and line them up with vision slots.
3. For reflex style and belleville reflex style gages, lay out covers along bench, side by side, with liquid chamber. Use chamber to space covers and line them up with vision slots.

4. For transparent belleville style gages, thread nuts on stud, place two belleville washers under nut with pointed end toward the nut (see Figure 2), insert stud through each cover and lay out covers along bench, side by side, with liquid chamber. Use chamber to space covers and line them up with vision slots.
5. Install one cushion inside each cover.



Separate installation instructions are supplied with replacement glass. All instructions supplied with the glass must be followed, as there are precautions to be taken when handling gage glass. Among the precautions is avoidance of bumping or sliding glass against any surface and inspection of individual pieces. Failure to follow any of the replacement gage glass installation instructions could result in glass breakage with resulting sudden release of pressure, severe personal injury or property damage.

6. Install rubber band around each piece of glass, then place glass centered inside each cover.
7. Install shields, if used, and gasket on glass being careful to keep components centered.
8. Place liquid chamber on the gaskets making sure all components are aligned with vision slot.
9. For reflex gage, install U-bolts in place by tapping as needed with rubber hammer, being careful not to lose alignment with vision slot.
10. For reflex gage, quickly turn over assembly onto backside of U-bolts. Assemble nameplate, washer and nuts to U-bolts. Tighten nuts with fingers. Using a torque wrench, tighten nuts in 5 ft-lb (7 N-m) increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.

NOTE: Depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow "Z" pattern outward to the limit of bolting on a specific gage.

11. For transparent gage, install gaskets and shields, if used, centered on vision slots.
12. Install rubber band around each piece of glass, then place glass centered on gasket or shields, if used.
13. Install one cushion on each piece of glass.
14. Install covers in place being careful to maintain components alignment inside.
15. Install nameplate, washer and nuts to bolts. Tighten nuts with fingers. Using a torque wrench, tighten nuts in 5 ft-lb (7 N-m) increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.
- 15A. For transparent belleville style gages: install nameplate and two belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.

NOTE: the following procedure is to be done on only one side of the gage.

- 15B. For reflex belleville style gages: install nameplate and four belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.
16. Using a torque wrench, tighten nuts in 5 ft-lb (7 N-m) increments, following the sequence in Figure 1, until the torque values shown in Table 3 are reached.

Refer to Section 5.0 for installation and Section 6.0 for operation of liquid level gage when returning to service.

9.0 Disposal at End of Useful Life

Penberthy gages are used in a variety of fluid applications. By following the appropriate federal and industry regulations, the user must determine the extent of preparation and treatment the gage must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metal, glass and polymers should be recycled whenever possible. Refer to order and TV&C - Prophetstown Material Specification sheets for materials of construction.

10.0 Telephone Assistance

If you are having difficulty with your liquid level gage, contact your local Penberthy distributor. You may also contact the factory direct at (815) 537-2311 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information available as possible when you call:

- Model #
- Name of the company from whom you purchased the liquid level gage
- Invoice # and date
- Process conditions (pressure, flow rates, tank shape, etc)
- A brief description of the problem
- Trouble shooting procedures that failed

If attempts to solve your problem fail, you may request to return your liquid level gage to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from TV&C Prophetstown before returning anything. Failure to do so will result in the unit being returned to you without being tested, freight collect. To obtain an R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- Person to contact at your company
- "Ship To" address

There is a minimum charge for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit under warranty, but is not defective, the minimum charge will apply.

Grafoil[®] is a registered trademark of Graftech
Top Chem 2000[®] is a registered trademark of Klinger
PCTFE (Formerly known as Kel-F[®], a registered trademark of 3M) is manufactured by Daikin
Viton[®] and Teflon[®] are registered trademarks of E.I. du Pont de Nemours and Company

11.0 Exploded Parts Drawing

Recommended Spare Parts		
REF #	ITEM	QTY.
100	Bolt/U-bolt	2/1 per sect.
4	Nut	2 per sect.
48	Glass	1
7	Gasket	2
8	Cushion	2
9	Shield (if used)	2

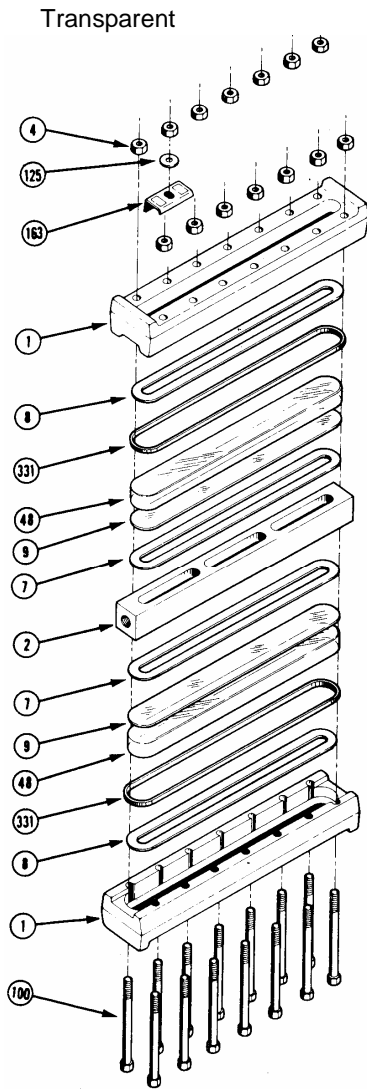


Figure 4

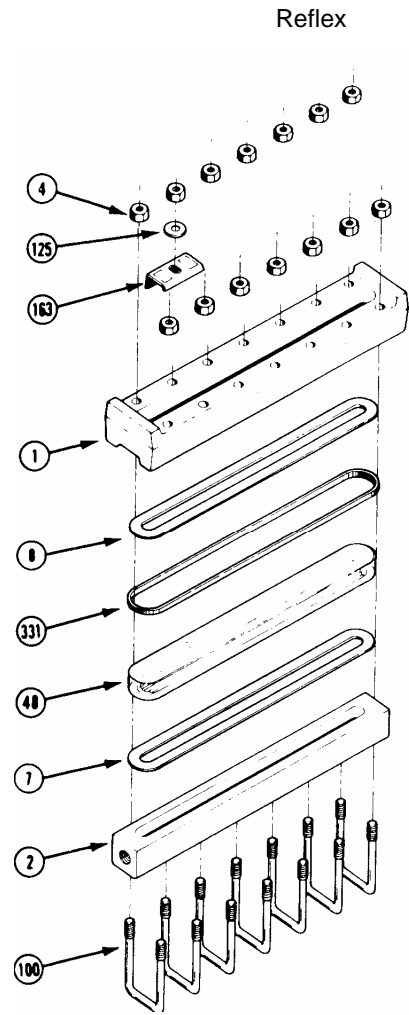


Figure 5

- 1 Cover
- 2 Chamber
- 4 Nut
- 48 Glass
- 7 Gasket
- 8 Cushion
- 9 Shield
- 100 Bolt/U-Bolt
- 125 Washer
- 163 Nameplate Band
- 331 Band

NOTE: size 9 shown - actual gage may be shorter and require fewer bolting components.

PENBERTHY

DECLARATION of CONFORMITY

In conformance with ISO/IEC Guide 22 - 96
LLG.DC r C

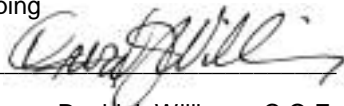
Manufacturer's Name: Tyco Valves & Controls
Manufacturer's Address: 320 Locust Street
Prophetstown, IL 61277-1147 U.S.A.

Product:
Type of Equipment: Pressure Vessel - Liquid Level Gage Glass
Equipment Class: Industrial Instrumentation - Hazardous Area
Model Designations: RL, TL, RM, RMR, TM, TMR, RH, RHR, TH, THR, RMW, TMW,
RLC, TLC

The product described above is in conformity with:

92/59/EEC	General product safety	1992
87/404/EEC	Simple pressure vessel	1987
89/392/EEC	Machinery	1989
EN 10213-1:4	Technical delivery conditions for steel castings	1996
ISO 7-1	Pipe threads where pressure-tight joints are made	1996
BS 10 1962	Flanges and bolting for pipes, gagecocks and fittings	
BS 21 BS 759 1984	Pipe threads for tubes and fittings where pressure tight Gagecocks, gages and other safety fittings for application	1985
BS 970 Part 1	Wrought steels for mechanical and allied engineering	1996
BS 970 Part 3	Wrought steel for mechanical and allied engineering	1991
BS 1501 Part 3	Steels for pressure purposes	1990
BS 1502	Steels for fired and unfired pressure vessels	1982
BS 1506	Carbon, low alloy and stainless steel bars and billets	1990
BS 1560	Circular flanges for pipes, gagecocks and fittings	1989
BS 1640 Part 1	Steel butt-welding pipe fittings	1962
BS 1640 Part 2	Steel butt-welding pipe fittings	1962
BS 1965	Butt-welding pipe fittings	1963
BS 3076	Nickel and nickel alloys: bar	1989
BS 3463	Observation and gage glasses for pressure vessels	1975
BS 3602 Part 1	Steel pipes and tubes for pressure purposes	1987
BS 3605	Austenitic stainless steel pipes and tubes	1991
BS 3643	ISO metric screw threads	1981
BS 3799	Steel pipe fittings, screwed and socket-welding	1974
BS 4504	Circular flanges for pipes, gagecocks and fittings	1989
ASME B&PV Code Section VIII	Rules for construction of pressure vessels	1995
ANSI/ASME B1.1	Unified screw inch threads un and unr thread form	1982
ANSI/ASME B1.20.1	Pipe threads, general purpose (inch)	1983
ANSI/ASME B16.5	Pipe flanges and flanged fittings	1988
ANSI/ASME B18.2.1	Square and hex nuts and screw inch series	1981
ANSI/ASME B18.2.2	Square and hex nuts	1972
ANSI/ASME B31.3	Process piping	1996

Date: 03 June 2004

Signature: 

Prophetstown, IL U.S.A.

Name: David J. Williams, C.Q.E.
Position: Quality Assurance Manager

Technical Construction File is available at stated address. Signatory is contact person.

NOTES

NOTES

tyco / *Flow Control* / **Tyco Valves
& Controls**

Penberthy

Tyco Valves & Controls, L.P. Prophetstown
320 Locust St., Prophetstown, Illinois 61277
Phone: 815-537-2311
FAX: 815-537-5764
Printed in USA
Part No. 18R66-009

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PENBERTHY

material specifications

Section 2000
 Material Specification 2606.1
 Issued 08/07
 Replaces 09/05

For: RM and TM GAGES

Ref. No.	Description	STANDARD MATERIALS					Optional Materials
		Carbon Steel to -20°F	STS Wetted to -20°F	STS Construction to -325°F	Sour Gas Service to -20°F	Low-Temp Steel to -50°F	
1	Cover	size 1 & 2	ASTM A216 Carbon steel (cast) Gr. WCB	ASTM A351 316/316L STS (cast) Gr. CF3M	ASTM A216 Carbon steel (cast) Gr. WCB	ASTM A352 Carbon Steel (cast) GR. LCB	ASTM A351 304/304L STS Gr. CF3 ASTM A182 Gr. F51 Duplex 2205 STS ASTM A494 Hastelloy B® Gr. N-12MV ASTM A352 Carbon Steel Gr. LCB ASTM A743 Alloy 20 Gr. CN7M ASTM B564 Monel® 400 N04400 ASTM A494 Hastelloy C® Gr. CW12MW ASTM A123 Galvanized Steel
		size 3 - 9	ASTM A105 (forged) Carbon Steel		ASTM A105 (forged) Carbon Steel	ASTM A350 (forged) Carbon Steel Gr. LF2 Cl. 1	
2	Chamber	ASTM A105 (forged) Carbon Steel	ASTM A276 316/316L STS	ASTM A105 (forged) Carbon Steel per NACE MR0175 &/OR MR0103	ASTM A516 Gr. 70/S5 -50°F Carbon steel	ASTM A276 304/304L STS ASTM A276 Duplex 2205 STS ASTM B164 Monel® 400 ASTM B473 Alloy 20 (CARP 20 Cb3)® ASTM B335 Hastelloy B® ASTM B575 Hastelloy C® 276 ASTM A123 Galvanized Steel	
4	Nut	ASTM A194 Carbon Steel Gr. 2 or 2H	ASTM A194 316 STS Gr. 8M	ASTM A194 Carbon Steel Gr. 2 or 2H	ASTM A194 316 STS Gr. 8M	ASTM A153 Galvanized Steel	
7	Gasket	Grafoil® Gr. GHP w/polyester (Mylar) insert					Nobestos® D7301 Garlock® 3000,3100,3200,3300,5500 PCTFE (replaces Kel-F®) Gylon® 3500, 3504, 3510 Teflon® (25% glass filled, virgin) Grafoil® Gr. GHR w/316 STS insert Buna-N Neoprene® Viton® consult factory for others
8	Cushion						
9	Shield ^A	None					ASTM D351 Mica Gr. V-4 PCTFE (replaces Kel-F®)
48	Glass	Reflex or Transparent Style Tempered Borosilicate					Aluminosilicate (Transparent only)
100	Cap Screw or U-Bolt	AISI 4140 or 4142 Alloy Steel per ASTM A193 Gr. B7	ASTM A193 316 STS Gr. B8M Cl. 2	AISI 4140 or 4142 Alloy Steel per ASTM A193 Gr. B7	ASTM A320 Alloy Steel Gr. L7	ASTM A153 Galvanized Steel	
125	Washer	ASTM B633 Zinc Plated Carbon Steel	18-8 STS (302-304 STS)	ASTM B633 Zinc Plated Carbon Steel	18-8 STS (302-304 STS)	None	
331	Band	Rubber					None

^A under no circumstances should shields be used in reflex style gages. Installation of shields in reflex style gages will keep the fluid from coming in contact with the reflective prisms, thereby prohibiting visibility of the liquid level in the gage.

PENBERTHY

material specifications

Section 2000
 Material Specification 2606.2
 Issued 08/07
 Replaces 09/05

For: RMR and TMR GAGES

Ref. No.	Description	STANDARD MATERIALS					Optional Materials
		Carbon Steel to -20°F	STS Wetted to -20°F	STS Construction to -325°F	Sour Gas Service to -20°F	Low-Temp Steel to -50°F	
1	Cover	size 1 - 3	ASTM A695 Carbon Steel Gr. 45	ASTM A240 316L STS	ASTM A695 Carbon Steel Gr. 45	ASTM A516 Carbon Steel Gr. 70/S5 -50°F	ASTM A351 304/304L STS Gr. CF3 ASTM A182 Gr. F51 Duplex 2205 STS ASTM A494 Hastelloy B® Gr. N-12MV ASTM A352 Carbon Steel Gr. LCB
		size 4 - 9	ASTM A105 (forged) Carbon Steel	ASTM A351 316/316L STS (cast) Gr. CF3M	ASTM A105 (forged) Carbon Steel	ASTM A350 (forged) Carbon Steel Gr. LF2 Cl. 1	ASTM A743 Alloy 20 Gr. CN7M ASTM B564 Monel® 400 N04400 ASTM A494 Hastelloy C® Gr. CW12MW ASTM A123 Galvanized Steel
2	Chamber	ASTM A105 (forged) Carbon Steel	ASTM A276 316/316L STS	ASTM A105 (forged) Carbon Steel per NACE MR0175 &/OR MR0103	ASTM A516 Carbon Steel Gr. 70/S5 -50°F	ASTM A276 304/304L STS ASTM A276 Duplex 2205 STS ASTM B164 Monel® 400 ASTM B473 Alloy 20 (CARP 20 Cb3)® ASTM B335 Hastelloy B® ASTM B575 Hastelloy C® 276 ASTM A123 Galvanized Steel	
4	Nut	ASTM A194 Carbon Steel Gr. 2 or 2H	ASTM A194 316 STS Gr. 8M	ASTM A194 Carbon Steel Gr. 2 or 2H	ASTM A194 316 STS Gr. 8M	ASTM A153 Galvanized Steel	
7	Gasket	Grafoil® Gr. GHP w/polyester (Mylar) insert					Nobestos® D7301 Garlock® 3000,3100,3200,3300,5500 PCTFE (replaces Kel-F®) Gylon® 3500, 3504, 3510 Teflon® (25% glass filled, virgin) Grafoil® Gr. GHR w/316 STS insert Buna-N Neoprene® Viton® consult factory for others
8	Cushion						
9	Shield ^A	None					ASTM D351 Mica Gr. V-4 PCTFE (replaces Kel-F®)
48	Glass	Reflex or Transparent Style Tempered Borosilicate					Aluminosilicate (Transparent only)
100	Cap Screw or U-Bolt	AISI 4140 or 4142 Alloy Steel per ASTM A193 Gr. B7	ASTM A193 316 STS Gr. B8M Cl. 2	AISI 4140 or 4142 Alloy Steel per ASTM A193 Gr. B7	ASTM A320 Alloy Steel Gr. L7	ASTM A153 Galvanized Steel	
125	Washer	ASTM B633 Zinc Plated Carbon Steel	18-8 STS (302-304 STS)	ASTM B633 Zinc Plated Carbon Steel	18-8 STS (302-304 STS)	None	
331	Band	Rubber					None

^A under no circumstances should shields be used in reflex style gages. Installation of shields in reflex style gages will keep the fluid from coming in contact with the reflective prisms, thereby prohibiting visibility of the liquid level in the gage.



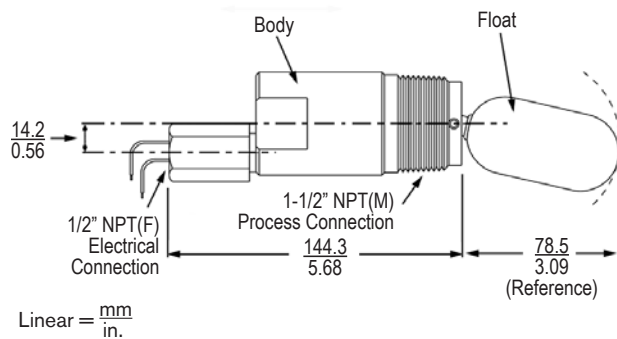
Type 1510 Electric Level Switch

Form 498

Type 1510 is a horizontally mounted, float-operated level switch suitable for plant and OEM applications where open or closed contacts are required to signal presence or absence of liquid at a discrete level. The float extension arm moves a magnet which actuates (deactuates) a hermetically sealed reed switch. Actuation (deactuation) can be reversed by rotating the unit 180 degrees.



Dimensions



Product Specifications

Mounting (Half coupling only)

Orientation	Horizontal mount only	
Connection Size	1-1/2" NPT(M) Standard	
For	<u>Change</u>	<u>To</u>
2" NPT(M)	G5A	G2A
Flanged Mounting	G5A	*

*See flange table on page 2 for option designator (316SS construction only)

Maximum Process Pressure 1500 psi (100 bar)

Electrical

Switch Type	Hermetically sealed reed switch with 18" 20 AWG wire leads
Switch Rating (resistive)	1 amp at 110 VAC 3 amps at 28 VDC

Housing Class I, Groups A, B, C & D; Divisions 1 & 2

Relay Housing Class I, Groups C & D; Divisions 1 & 2

Connection Size 1/2" NPT(F)

Contact Form SPST

(For SPDT change W9 to W1 in the model number.)

Minimum Specific Gravity 0.45

Design Code ANSI B31.3

Shipping Weight Approximately 6 lbs. (3 kg)

Agency Listing CSA Certified (optional). See Page 2.

Design and specifications are subject to change without notice. For latest revision, see www.sorinc.com.

How to Order

Select model number from table below. Accessory designator(s) may be added after ES if required. See page 2.

Body Material	Float Material	Process Rating		Model Number
303SS* Standard	316SS (Standard)	1500 psi - 40 to 400°F	100 bar	1510B - G5A - C - W9 - ES
	Monel	900 psi - 40 to 400°F	62 bar	1510B - G5A - M - W9 - ES
	Polypropylene	5000 psi - 40 to 150°F	345 bar	1510B - G5A - S - W9 - ES
316SS	316SS	1500 psi - 40 to 400°F	100 bar	1510C - G5A - C - W9 - ES
	Monel	900 psi - 40 to 400°F	62 bar	1510C - G5A - M - W9 - ES
	Polypropylene	5000 psi - 40 to 150°F	345 bar	1510C - G5A - S - W9 - ES

*Also known as ASME SA 320 Grade B8F.

Type 1510 Electronic Level Switch

Optional Flanges

Optional Flanges (316SS) construction only

Designator	Raised Face Flange		Designator	Raised Face Flange	
G7C	2-1/2"	150#	G4C	4"	150#
G7D		300#	G4D		300#
G7E		600#	G6C	6"	150#
G3C	3"	150#	G6D		300#
G3D		300#			
G3E		600#			

On flanged units, the float will be detached from the unit during shipping.

Optional Accessories Add option designator(s) to end of model number.

Description	Designator
Wetted parts are cleaned for industrial oxygen service.	BB
ATEX and IECEX approved.	CL
3/4" NPT(F) conduit connection.	CR
CSA Certified. Class I, Group A, B, C, D; Divisions 1 & 2. For relay option; Class I, Group C & D, Divisions 1 & 2.	CS*
Canadian Registration Number (CRN). Maximum allowable pressure rating is 1500 psi. Consult the factory for details.	CV
Manual check accessory (uses Viton GLT o-rings).	MC**
NACE construction - MR-01-75. Available only with 316SS materials of construction.	NC
Tag, fiber. Attached with plastic wire to housing. Stamped with customer-specified tagging information.	PP
24 VDC powered DPDT relay in explosion proof terminal box. Contact rating: 10 amps @ 115 VAC. Class I, Group C, D; Divisions 1 & 2.	RB
120 VAC powered DPDT relay in explosion proof terminal box. Contact rating: 10 amps @ 115 VAC. Class I, Group C, D; Divisions 1 & 2.	RC
Tag, stainless steel. Attached with stainless steel wire to housing. Stamped with customer-specified tagging information.	RR
Stainless steel nameplate permanently attached to housing. Stamped with customer specified tagging information.	TT
Fungicidal varnish. Covers exterior except working parts.	VV
Powder coat epoxy coating. No coating on 316SS parts or plated screws. (500 hours)	PY
Epoxy coating. Exterior only. Polyamide epoxy with 316SS pigment. (200 hours)	YY
ANSI B31.3 certificate of conformance.	CZ

*CS option is required on all flange mounted units. **Manufacturer limits on Viton GLT are -40 to 400°F.

Replacement Parts

Part Number	Description
3130-091	SPST Hermetically Sealed Reed Switch Capsule
3130-242	SPDT Hermetically Sealed Reed Switch Capsule
3130-106	SPST Hermetically Sealed Reed Switch Capsule for CSA Certified units
3130-243	SPDT Hermetically Sealed Reed Switch Capsule for CSA Certified units
3130-052	316SS Float Assembly

Limited Warranty

SOR® agrees to repair or replace any switch found to be defective in material or workmanship within five years from date of shipment. The limited warranty is valid only if the switch was installed in accordance with published factory installation instructions, operated within the design limitations stated on the nameplate, and returned to the factory for inspection, freight prepaid, within the warranty period. Contact the factory for return authorization. No claim for labor or consequential damages will be allowed.



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14685 West 105th Street, Lenexa, Kansas 66215 913-888-2630 Toll Free 800-676-6794 www.sorinc.com

Pressure Gauges

Industrial and Process



PGI Series

- 40, 50, 63, 100, 115, and 160 mm (1 1/2, 2, 2 1/2, 4, 4 1/2 and 6 in.) dial sizes
- Accuracy in accordance with ASME, EN, and JIS
- Available with a variety of end connections, including Swagelok® tube adapters
- Center-back, lower-back, and lower mount configurations
- Stainless steel and reinforced thermoplastic construction
- Available unfilled or liquid filled

Contents

Features	2	Industrial Gauge Models	
Testing and Calibration	2	<i>Stainless Steel Cases and Wetted Components</i>	
Swagelok Tube Adapters Solve Alignment Problems .	2	B Model: General-Purpose Gauge	4
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Model Selection Guide	3	M Model: Miniature Gauge	8
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		<i>Glass-Reinforced Thermoplastic Case and</i>	
		<i>Stainless Steel, Brass, or Alloy 400 Wetted Components</i>	
		P Model: Industrial Process Gauge	12
		Dial Range Designators	14
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Features

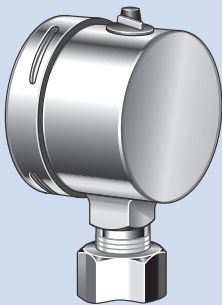
- Monitor vacuum and positive system pressures up to 15 000 psi, 1000 bar, or 100 MPa
- Manufactured in accordance with industry standards
- Available with Swagelok tube adapter end connections

Testing and Calibration

Every Swagelok industrial pressure gauge is factory calibrated and pressure tested.

Swagelok Tube Adapters Solve Alignment Problems

Swagelok tube adapters can help eliminate difficult alignment problems and can be used with any Swagelok tube fitting.



Typical Alignment Problem

When installing a gauge with a pipe fitting end connection, it is often difficult to align the dial to the desired position without damaging the gauge.

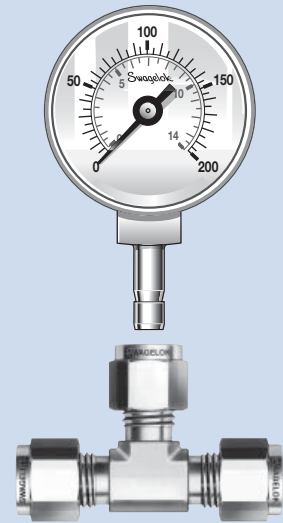
Swagelok Tube Adapters

Gauges with integral Swagelok tube adapters eliminate alignment problems.

Installation Instructions

1. Insert the gauge with integral Swagelok tube adapter into a Swagelok tube fitting.
2. Align the gauge dial to the desired position.
3. Install the fitting.

⚠ Swagelok tube adapters are to be used ONLY in Swagelok tube fittings manufactured by Swagelok Company. Use in fittings made by other manufacturers may result in leakage or slippage.



Process Connections

Connection	Maximum Pressure	Specification
Swagelok Tube Adapter		
1/4 in. and 6 mm	10 000 psi, 600 bar, 60 MPa	—
3/8 in. and 1/2 in. 10 mm and 12 mm	6000 psi, 400 bar, 40 MPa	
Male NPT		
1/8 in.	6000 psi, 400 bar, 40 MPa	ASME B1.20.1
1/4 and 1/2 in.	15 000 psi, 1000 bar, 100 MPa	
Male ISO Parallel Gauge Thread (EN)		
G1/8B (EN)	6000 psi, 400 bar, 40 MPa	EN 837-1 EN 837-3
G1/4B (EN)	15 000 psi, 1000 bar, 100 MPa	
G1/2B (EN)		
Male ISO Parallel Gauge Thread (JIS)		
G1/4B (PF) G1/2B (PF)	15 000 psi, 1000 bar, 100 MPa	JIS B7505
Male ISO Tapered Thread		
R1/8 (PT)	6000 psi, 400 bar, 40 MPa	ISO 7/1 JIS B0203
R1/4 (PT)	15 000 psi, 1000 bar, 100 MPa	
R1/2 (PT)		



G1/8B (EN), G1/4B (EN), and G1/2B (EN) are for use with Swagelok **RG** adapter fittings.
G1/8B (PF), G1/4B (PF), and G1/2B (PF) are for use with Swagelok **RJ** adapter fittings.

Model Selection Guide

Dial Range	Dial Size mm (in.)	Accuracy	Adjustable Pointer	Solid Front	Liquid Fillable	Configurations ^①			Model
						LBM	CBM	LM	
Positive pressures: 0 to 10 psi, 400 mbar, or 50 kPa	63 (2 1/2)	± 1.5 % of span ASME B40.1 Grade B, EN 837-3 Class 1.6, JIS B7505 Class 1.6	—	—	—	—	—	Yes	L
	100 (4)		—	—	—	Yes	—	Yes	
Compound pressures: Vacuum to 200 psi, 9 bar, or 1.5 MPa Positive pressures: 0 to 5000 psi, 250 bar, or 25 MPa	40 (1 1/2)	± 2.5 % of span ASME B40.1 Grade C, EN 837-1 Class 2.5, JIS B7505 Class 2.5	—	—	—	—	Yes	Yes	M
	50 (2)		—	—	—	—	—	—	
Compound pressures: Vacuum to 200 psi, 9 bar, or 1.5 MPa Positive pressures: 0 to 15 000 psi, 1000 bar, or 100 MPa	63 (2 1/2)	± 1.5 % of span ASME B40.1 Grade B, EN 837-1 Class 1.6, JIS B7505 Class 1.6	Yes ^②	Yes	Yes ^③	Yes	—	Yes	S
			Yes ^②	—	Yes	—	Yes	Yes	B
	100 (4)	± 1 % of span ASME B40.1 Grade 1A, EN 837-1 Class 1.0 JIS B7505 Class 1.0	Yes ^②	Yes	Yes ^③	Yes	—	Yes	S
			Yes ^②	—	Yes	Yes	—	Yes	B
160 (6)	—	Yes ^②	—	Yes	Yes	—	Yes	B	
Compound pressures: Vacuum to 400 psi or 2500 kPa Positive pressures: 0 to 15 000 psi or 100 000 kPa	115 (4 1/2)	± 0.5 % of span ASME B40.1 Grade 2A	Yes	Yes	Yes	Yes	—	Yes	P
	160 (6)		Yes	Yes	Yes	Yes	—	Yes	P

① Configurations: **LBM** = lower-back mount
CBM = center-back mount
LM = lower mount.

② Optional.

③ Liquid-fillable model available in lower mount configuration only.

⚠ Glycerin- and silicone-filled gauges cannot be used where strong oxidizing agents are present.

B Model: General-Purpose Stainless Steel Gauge

Features

- 63, 100, and 160 mm (2 1/2, 4, and 6 in.) dial sizes are available.
- Bayonet ring allows easy access to optional adjustable pointer.
- Lens is constructed of safety glass for additional protection.
- Design is liquid fillable.



Technical Data

Dial Ranges

Compound Gauges

- Vacuum to 0 psi through vacuum to 200 psi
- Vacuum to 0 bar through vacuum to 9 bar
- Vacuum to 0 MPa through vacuum to 1.5 MPa

Positive-Pressure Gauges

- 0 to 15 psi through 0 to 15 000 psi
- 0 to 1 bar through 0 to 1000 bar
- 0 to 0.1 MPa through 0 to 100 MPa

Accuracy

- 63 mm (2 1/2 in.): $\pm 1.5\%$ of span (ASME B40.1 Grade B, EN 837-1 Class 1.6, JIS B7505 Class 1.6)
- 100 and 160 mm (4 and 6 in.): $\pm 1.0\%$ of span (ASME B40.1 Grade 1A, EN 837-1 Class 1.0, JIS B7505 Class 1.0)

Configurations

- 63 mm (2 1/2 in.): center-back and lower mount
- 100 and 160 mm (4 and 6 in.): lower-back and lower mount

End Connections

63 mm (2 1/2 in.) Dial Size

- 1/4 and 3/8 in.; 6 and 10 mm Swagelok tube adapter
- 1/4 in. male NPT
- G1/4B (EN)
- G1/4B (PF)
- R1/4 (PT)

100 mm (4 in.) Dial Size

- 1/2 in. and 12 mm Swagelok tube adapter
- 1/4 and 1/2 in. male NPT
- G1/2B (EN)
- G1/2B (PF)
- R1/2 (PT)

160 mm (6 in.) Dial Size

- 1/2 in. male NPT
- G1/2B (EN)
- G1/2B (PF)
- R1/2 (PT)

Operating Temperature

Ambient

- Unfilled: -40 to 140°F (-40 to 60°C)
- Glycerin-filled: -4 to 140°F (-20 to 60°C)
- Low-temperature glycerin-filled: -29 to 140°F (-34 to 60°C)
- Silicone-filled: -40 to 140°F (-40 to 60°C)

Media

392°F (200°C) maximum

Temperature Error

$\pm 0.4\%$ for every 18°F (10°C) temperature change from 68°F (20°C)

Materials of Construction

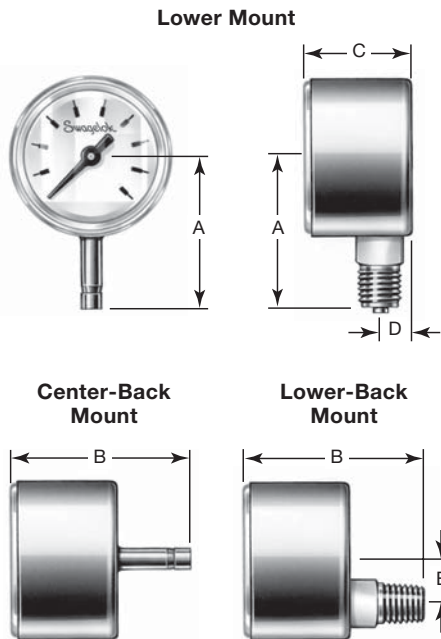
Component	Material
<i>End connection</i>	316 SS
<i>Bourdon tube</i>	
Case	304 SS
Fill fluid (if ordered)	Glycerin, low-temperature glycerin, or silicone
Movement	Stainless steel
Lens	Laminated safety glass
Lens gasket	Buna N
Dial	Aluminum
Pointer	

Wetted components listed in *italics*.

See page 16 for options and accessories for field installation.

Dimensions

Dimensions are for reference only and are subject to change.



Dial Size mm (in.)	End Connection		Dimensions, in. (mm)				
	Size	Type	A	B	C	D	E
63 (2 1/2)	1/4 in.	Swagelok tube adapter	2.26 (57.3)	2.39 (60.8)	1.30 (33.0)	0.39 (10.0)	-
		Male NPT	2.09 (53.0)	2.24 (57.0)			
		G1/4B (EN)					
		G1/4B (PF)					
	3/8 in.	R1/4 (PT)	2.31 (58.8)	2.45 (62.3)			
		Swagelok tube adapter	6 mm	2.26 (57.3)	2.39 (60.8)		
10 mm			2.31 (58.8)	2.45 (62.3)			
100 (4)	1/2 in.	Male NPT	3.15 (80.0)	3.27 (83.0)	1.97 (50.0)	0.63 (16.0)	1.18 (30.0)
		Swagelok tube adapter	3.60 (91.4)	3.44 (87.4)			
		Male NPT	3.43 (87.0)	3.27 (83.0)			
		G1/2B (EN)					
	G1/2B (PF)						
	12 mm	R1/2 (PT)	3.60 (91.4)	3.44 (87.4)			
Swagelok tube adapter		3.60 (91.4)	3.44 (87.4)				
160 (6)	1/2 in.	Male NPT	4.65 (118)	3.27 (83.0) ^①	1.97 (50.0) ^①	1.97 (50.0)	
		G1/2B (EN)					
		G1/2B (PF)					
		R1/2 (PT)					

① B is 3.90 in. (99.0 mm) and C is 2.60 in. (66.0 mm) for gauges with lower-back mount and pressure ratings of 1500 psi, 10 MPa, 100 bar or higher.

Ordering Information

Build a B model gauge ordering number by combining the designators as shown below. List option designators *alphabetically*.

PGI - 63B - PG100 - L AQ X - ABH

Product Function and Type
Pressure gauge, industrial

Dial Size and Model
63B = 63 mm (2 1/2 in.) dial
100B = 100 mm (4 in.) dial
160B = 160 mm (6 in.) dial

Dial Range
See page 14.

Process Connection Location
L = Lower mount (all dial sizes)
C = Center-back mount (63 mm [2 1/2 in.] dial size only)
B = Lower-back mount (100 and 160 mm [4 and 6 in.] dial sizes only)

Fitting Size and Type
63 mm (2 1/2 in.) Dial Size
AQ = 1/4 in. Swagelok tube adapter
BG = 3/8 in. Swagelok tube adapter
AS = 6 mm Swagelok tube adapter
BH = 10 mm Swagelok tube adapter
AO = 1/4 in. male NPT
AV = G1/4B (EN)
AX = G1/4B (PF)
BD = R1/4 (PT)
100 mm (4 in.) Dial Size
AR = 1/2 in. Swagelok tube adapter
AT = 12 mm Swagelok tube adapter
AO = 1/4 in. male NPT
AP = 1/2 in. male NPT
AW = G1/2B (EN)
AZ = G1/2B (PF)
BE = R1/2 (PT)
160 mm (6 in.) Dial Size
AP = 1/2 in. male NPT
AW = G1/2B (EN)
AZ = G1/2B (PF)
BE = R1/2 (PT)

Options (see page 16)
A = Cleaned to ASME B40.1 level IV^①
B = Certificate of calibration
E = Material certification
F = Panel-mount clamp^②
G = Front flange^②
H = Rear flange
I = Maximum indicating pointer
J = Adjustable pointer
N = Orifice (0.023 in. [0.58 mm])
^① Available for unfilled gauges only.
^② Not available in lower mount gauge configuration.

Liquid Fill Fluid
X = Unfilled
1 = Glycerin
2 = Low-temperature glycerin
3 = Silicone

S Model: Solid-Front Stainless Steel Safety Gauge

Features

- 63 and 100 mm (2 1/2 and 4 in.) dial sizes are available.
- Lower mount configuration is liquid fillable.
- Solid front and blowout back for severe service.
- Design meets safety requirements of ASME B40.1 and EN 837-1.



Technical Data

Dial Ranges

Compound Gauges

- Vacuum to 0 psi through vacuum to 200 psi
- Vacuum to 0 bar through vacuum to 9 bar
- Vacuum to 0 MPa through vacuum to 1.5 MPa

Positive-Pressure Gauges

- 0 to 15 psi through 0 to 15 000 psi
- 0 to 1 bar through 0 to 1000 bar
- 0 to 0.1 MPa through 0 to 100 MPa

Accuracy

- 63 mm (2 1/2 in.): ± 1.5 % of span (ASME B40.1 Grade B, EN 837-1 Class 1.6, JIS B7505 Class 1.6)
- 100 mm (4 in.): ± 1.0 % of span (ASME B40.1 Grade 1A, EN 837-1 Class 1.0, JIS B7505 Class 1.0)

Configurations

Lower-back and lower mount

End Connections

63 mm (2 1/2 in.) Dial Size

- 1/4 and 3/8 in.; 6 and 10 mm Swagelok tube adapter
- 1/4 in. male NPT
- G1/4B EN
- G1/4B (PF)
- R1/4 (PT)

100 mm (4 in.) Dial Size

- 1/2 in. and 12 mm Swagelok tube adapter
- 1/4 and 1/2 in. male NPT
- G1/2B EN
- G1/2B (PF)
- R1/2 (PT)

Operating Temperature

Ambient

- Unfilled: -40 to 140°F (-40 to 60°C)
- Glycerin-filled: -4 to 140°F (-20 to 60°C)
- Low-temperature glycerin-filled: -29 to 140°F (-34 to 60°C)
- Silicone-filled: -40 to 140°F (-40 to 60°C)

Media

392°F (200°C) maximum

Temperature Error

± 0.4 % for every 18°F (10°C) temperature change from 68°F (20°C)

Materials of Construction

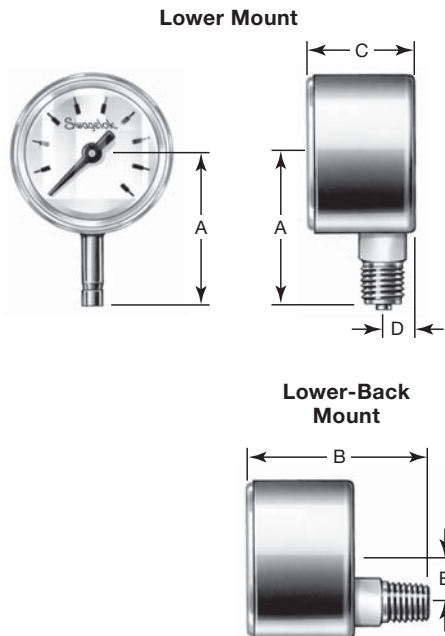
Component	Material
<i>End connection</i>	316 SS
<i>Bourdon tube</i>	
Case	304 SS
Fill fluid (if ordered)	Glycerin, low-temperature glycerin, or silicone
Movement	Stainless steel
Lens	Laminated safety glass
Lens gasket	Buna N
Dial	Aluminum
Pointer	

Wetted components listed in *italics*.

See page 16 for options and accessories for field installation.

Dimensions

Dimensions are for reference only and are subject to change.



Dial Size mm (in.)	End Connection		Dimensions, in. (mm)				
	Size	Type	A	B	C	D	E
63 (2 1/2)	1/4 in.	Swagelok tube adapter	2.26 (57.3)	2.59 (65.8)	1.65 (42.0)	0.71 (18.0)	0.71 (18.0)
		Male NPT	2.13 (54.0)	2.48 (63.0)			
		G1/4B (EN)					
		G1/4B (PF)					
	3/8 in.	R1/4 (PT)	2.31 (58.8)	2.65 (67.3)			
		Swagelok tube adapter	6 mm	2.26 (57.3)			
10 mm			2.31 (58.8)	2.65 (67.3)			
100 (4)	1/2 in.	Male NPT	3.15 (80.0)	3.66 (93.0)	2.28 (58.0)	0.94 (24.0)	1.18 (30.0)
		Swagelok tube adapter	3.44 (87.4)	3.83 (97.4)			
		Male NPT	3.43 (87.0)	3.66 (93.0)			
		G1/2B (EN)					
		G1/2B (PF)					
	12 mm	R1/2 (PT)	3.44 (87.4)	3.83 (97.4)			
Swagelok tube adapter		3.44 (87.4)	3.83 (97.4)				

Ordering Information

Build an S model gauge ordering number by combining the designators as shown below. List option designators *alphabetically*.

PGI - 63S - PG100 - L AQ X - ABG

Product Function and Type
Pressure gauge, industrial

Dial Size and Model
63S = 63 mm (2 1/2 in.) dial
100S = 100 mm (4 in.) dial

Dial Range
See page 14.

Process Connection Location
L = Lower mount
B = Lower-back mount

Fitting Size and Type

63 mm (2 1/2 in.) Dial Size

- AQ = 1/4 in. Swagelok tube adapter
- BG = 3/8 in. Swagelok tube adapter
- AS = 6 mm Swagelok tube adapter
- BH = 10 mm Swagelok tube adapter
- AO = 1/4 in. male NPT
- AV = G1/4B (EN)
- AX = G1/4B (PF)
- BD = R1/4 (PT)

100 mm (4 in.) Dial Size

- AR = 1/2 in. Swagelok tube adapter
- AT = 12 mm Swagelok tube adapter
- AO = 1/4 in. male NPT
- AP = 1/2 in. male NPT
- AW = G1/2B (EN)
- AZ = G1/2B (PF)
- BE = R1/2 (PT)

Options (see page 16)

- A = Cleaned to ASME B40.1 level IV^①
- B = Certificate of calibration
- E = Material certification
- G = Front flange^②
- I = Maximum indicating pointer
- J = Adjustable pointer
- N = Orifice (0.023 in. [0.58 mm])

^① Available for unfilled gauges only.
^② Not available in lower mount gauge configuration.

Liquid Fill Fluid
(Lower mount configuration only)

- X = Unfilled
- 1 = Glycerin
- 2 = Low-temperature glycerin
- 3 = Silicone

M Model: Stainless Steel Miniature Gauge

Features

- 40 and 50 mm (1 1/2 and 2 in.) dial sizes are available.
- Miniature size allows placement in compact spaces.
- Snap-in lens saves space when compared to twist-on lens.



Technical Data

Dial Ranges

Compound Gauges

- Vacuum to 0 psi through vacuum to 200 psi
- Vacuum to 0 bar through vacuum to 9 bar
- Vacuum to 0 MPa through vacuum to 1.5 MPa

Positive-Pressure Gauges

- 0 to 15 psi through 0 to 5000 psi
- 0 to 1 bar through 0 to 250 bar
- 0 to 0.1 MPa through 0 to 25 MPa

Accuracy

± 2.5 % of span (ASME B40.1 Grade C, EN 837-1 Class 2.5, JIS B7505 Class 2.5)

Configurations

Center-back and lower mount

End Connections

40 mm (1 1/2 in.) Dial Size

- 1/4 in. and 6 mm Swagelok tube adapter
- 1/8 in. male NPT
- G1/8B (EN)
- R1/8 (PT)

50 mm (2 in.) Dial Size

- 1/4 and 3/8 in.; 6 and 10 mm Swagelok tube adapter
- 1/4 in. male NPT
- G1/4B (EN)
- G1/4B (PF)
- R1/4 (PT)

Operating Temperature

Ambient

–40 to 140°F (–40 to 60°C)

Media

212°F (100°C) maximum

Temperature Error

± 0.4 % for every 18°F (10°C) temperature change from 68°F (20°C)

Materials of Construction

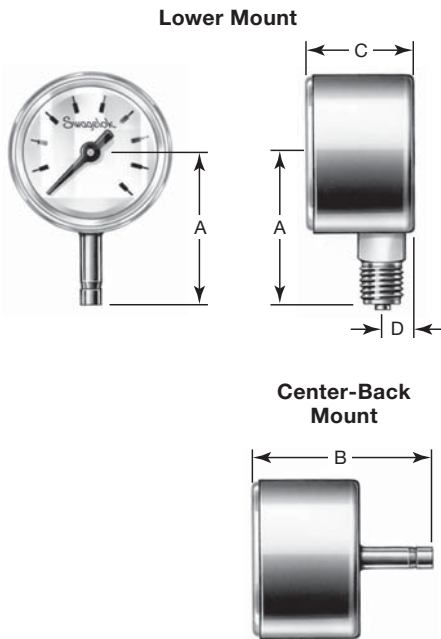
Component	Material
<i>End connection</i>	316 SS
<i>Bourdon tube</i>	
Case	304 SS
Movement	Stainless steel
Lens	Acrylic
Dial	Aluminum
Pointer	

Wetted components listed in *italics*.

See page 16 for options and accessories for field installation.

Dimensions

Dimensions are for reference only and are subject to change.



Dial Size mm (in.)	End Connection		Dimensions, in. (mm)			
	Size	Type	A	B	C	D
40 (1 1/2)	1/8 in.	Male NPT	1.54 (39.0)	2.09 (53.0)	0.98 (25.0)	0.35 (9.0)
		G1/8B (EN)				
		R1/8 (PT)				
1/4 in. 6 mm	Swagelok tube adapter	1.67 (42.3)	2.20 (55.8) ^①			
50 (2)	1/4 in.	Swagelok tube adapter	1.98 (50.3)	2.24 (56.8)	1.06 (27.0)	0.39 (10.0)
		Male NPT	1.85 (47.0)	2.13 (54.0)		
		G1/4B (EN)				
		G1/4B (PF)				
		R1/4 (PT)				
	3/8 in.		2.04 (51.8)	2.30 (58.3)		
	6 mm	Swagelok tube adapter	1.98 (50.3)	2.24 (56.8)		
10 mm		2.04 (51.8)	2.30 (58.3)			

① 2.22 in. (56.3 mm) for gauges with front flange.

Ordering Information

Build an M model gauge ordering number by combining the designators as shown below. List option designators *alphabetically*.

PGI - 50M - PG100 - L AQ X - ABE

Product Function and Type
Pressure gauge, industrial

Dial Size and Model
40M = 40 mm (1 1/2 in.) dial
50M = 50 mm (2 in.) dial

Dial Range
See page 14.

Process Connection Location
C = Center-back mount
L = Lower mount

Fitting Size and Type

40 mm (1 1/2 in.) Dial Size
AQ = 1/4 in. Swagelok tube adapter
AS = 6 mm Swagelok tube adapter
AN = 1/8 in. male NPT
AU = G1/8B (EN)
BC = R1/8 (PT)

50 mm (2 in.) Dial Size
AQ = 1/4 in. Swagelok tube adapter
BG = 3/8 in. Swagelok tube adapter
AS = 6 mm Swagelok tube adapter
BH = 10 mm Swagelok tube adapter
AO = 1/4 in. male NPT
AV = G1/4B (EN)
AX = G1/4B (PF)
BD = R1/4 (PT)

Options (see page 16)
A = Cleaned to ASME B40.1 level IV
B = Certificate of calibration
E = Material certification
F = Panel-mount clamp^①
G = Front flange^①
L = Glass lens with friction ring
N = Orifice (0.023 in. [0.58 mm])

① Not available in lower mount gauge configuration. Available factory installed only.

Liquid Fill Fluid—Not Available
Unfilled

L Model: Stainless Steel Low-Pressure Gauge

Features

- 63 and 100 mm (2 1/2 and 4 in.) dial sizes are available.
- Diaphragm capsule design offers low-pressure measurement capability.
- A zero adjustment screw is on the dial.
- Lens is constructed of safety glass for additional protection.



Technical Data

Dial Ranges

Positive-Pressure Gauges

- 0 to 15 in. H₂O through 0 to 200 in. H₂O
- 0 to 5 psi through 0 to 10 psi
- 0 to 40 mbar through 0 to 400 mbar
- 0 to 4 kPa through 0 to 50 kPa

Accuracy

± 1.5 % of span (ASME B40.1 Grade B, EN 837-3 Class 1.6, JIS B7505 Class 1.6)

Configurations

- 63 mm (2 1/2 in.): lower mount
- 100 mm (4 in.): lower-back and lower mount

End Connections

63 mm (2 1/2 in.) Dial Size

- 1/4 and 3/8 in.; 6 and 10 mm Swagelok tube adapter
- 1/4 in. male NPT
- G1/4B (EN)
- G1/4B (PF)
- R1/4 (PT)

100 mm (4 in.) Dial Size

- 1/2 in. and 12 mm Swagelok tube adapter
- 1/4 and 1/2 in. male NPT
- G1/2B (EN)
- G1/2B (PF)
- R1/2 (PT)

Operating Temperature

Ambient

–40 to 140°F (–40 to 60°C)

Media

212°F (100°C) maximum

Temperature Error

± 0.6 % for every 18°F (10°C) temperature change from 68°F (20°C)

Materials of Construction

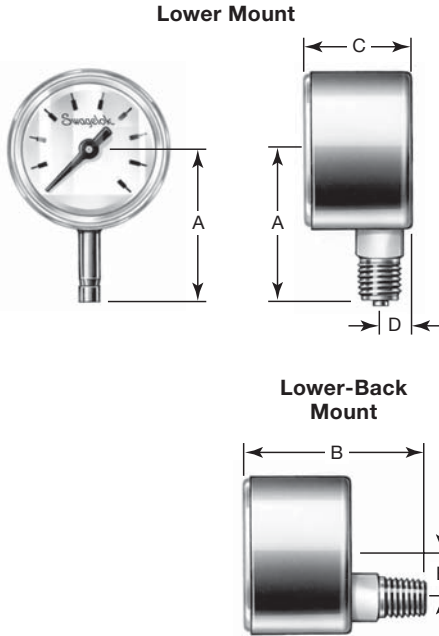
Component	Material
<i>End connection</i>	316 SS
<i>Diaphragm capsule</i>	
Case	304 SS
Movement	Stainless steel
Lens	Laminated safety glass
Dial	Aluminum
Pointer	

Wetted components listed in *italics*.

See page 16 for options and accessories for field installation.

Dimensions

Dimensions are for reference only and are subject to change.



Dial Size mm (in.)	End Connection		Dimensions, in. (mm)				
	Size	Type	A	B	C	D	E
63 (2 1/2)	1/4 in.	Swagelok tube adapter	2.26 (57.3)	—	1.65 (42.0)	0.35 (9.0)	—
		Male NPT	2.05 (52.0)				
		G1/4B (EN)					
		G1/4B (PF)					
	3/8 in.	R1/4 (PT)	2.31 (58.8)				
		Swagelok tube adapter	6 mm				
10 mm			2.31 (58.8)				
100 (4)	1/4 in.	Male NPT	3.15 (80.0)	3.27 (83.0)	2.28 (58.0)	0.63 (16.0)	1.18 (30.0)
	1/2 in.	Swagelok tube adapter	3.60 (91.4)	3.44 (87.4)			
		Male NPT	3.43 (87.0)				
		G1/2B (EN)					
		G1/2B (PF)					
	R1/2 (PT)	3.60 (91.4)	3.44 (87.4)				
12 mm	Swagelok tube adapter	3.60 (91.4)	3.44 (87.4)				

Ordering Information

Build an L model gauge ordering number by combining the designators as shown below. List option designators *alphabetically*.

PGI - 63L - IG30 - L AQ X - ABH

Product Function and Type
Pressure gauge, industrial

Dial Size and Model
63L = 63 mm (2 1/2 in.) dial
100L = 100 mm (4 in.) dial

Dial Range
See page 15.

Process Connection Location
L = Lower mount (all dial sizes)
B = Lower-back mount (100 mm [4 in.] dial size only)

Fitting Size and Type

63 mm (2 1/2 in.) Dial Size

AQ = 1/4 in. Swagelok tube adapter
BG = 3/8 in. Swagelok tube adapter
AS = 6 mm Swagelok tube adapter
BH = 10 mm Swagelok tube adapter
AO = 1/4 in. male NPT
AV = G1/4B (EN)
AX = G1/4B (PF)
BD = R1/4 (PT)

100 mm (4 in.) Dial Size

AR = 1/2 in. Swagelok tube adapter
AT = 12 mm Swagelok tube adapter
AO = 1/4 in. male NPT
AP = 1/2 in. male NPT
AW = G1/2B (EN)
AZ = G1/2B (PF)
BE = R1/2 (PT)

Options (see page 16)

A = Cleaned to ASME B40.1 level IV
B = Certificate of calibration
E = Material certification
F = Panel-mount clamp^{①②}
G = Front flange^①
H = Rear flange
I = Maximum indicating pointer
N = Orifice (0.023 in. [0.58 mm])

^① Not available in lower mount gauge configuration.
^② Available for 100 mm (4 in.) dial size only.

Liquid Fill Fluid—Not Available
Unfilled

P Model: Reinforced Thermoplastic Industrial Process Gauge

Features

- 115 and 160 mm (4 1/2 and 6 in.) dial sizes are available.
- Solid front and blowout back for severe service.
- Design meets safety requirements of ASME B40.1.
- Adjustable pointer is standard.
- Threaded cover ring allows easy access to pointer.
- Lens is constructed of clear acrylic plastic.
- Design is liquid fillable.



Technical Data

Dial Ranges

Compound Gauges

- Vacuum to 0 psi through vacuum to 400 psi
- Vacuum to 0 kPa through vacuum to 2500 kPa

Positive-Pressure Gauges

- 0 to 15 psi through 0 to 15 000 psi
- 0 to 60 kPa through 0 to 100 000 kPa

Accuracy

± 0.5 % of span (ASME B40.1 Grade 2A)

Configurations

Lower-back mount and lower mount

End Connections

115 mm (4 1/2 in.) Dial Size

- 1/2 in. Swagelok tube adapter
- 1/4 and 1/2 in. male NPT

160 mm (6 in.) Dial Size

- 1/2 in. male NPT

Weather Protection

- Weather resistant (NEMA 3/IP54)—dry case
- Weather-tight (NEMA 4X/IP56)—liquid-fillable case

Operating Temperature

Ambient

- Unfilled: -40 to 140°F (-40 to 60°C)
- Glycerin-filled: -4 to 140°F (-20 to 60°C)
- Silicone-filled: -40 to 140°F (-40 to 60°C)

Media

- 212°F (100°C) maximum
- Maximum media temperature for the brass process gauge is 140°F (60°C)

Temperature Error

± 0.4 % for every 18°F (10°C) temperature change from 68°F (20°C)

Materials of Construction

Component	Material
<i>End connection</i>	316 SS ^①
<i>Bourdon tube</i>	
Case	Black glass-reinforced thermoplastic
Fill fluid (if ordered)	Glycerin, low-temperature glycerin, or silicone
Movement	Stainless steel
Lens	Acrylic
Lens gasket	Buna N
Dial	Aluminum
Pointer	

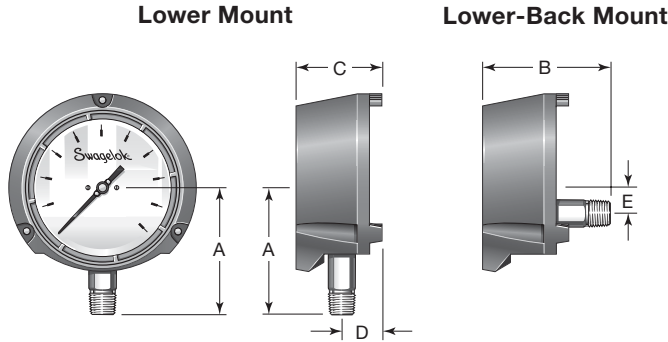
Wetted components listed in *italics*.

① Lower mount gauge configurations are also available in brass and alloy 400 materials. Performance criteria for these gauges are consistent with stainless steel except where noted.

See page 16 for options and accessories for field installation.

Dimensions

Dimensions are for reference only and are subject to change.



Dial Size mm (in.)	End Connection		Dimensions, in. (mm)				
	Size	Type	A	B	C	D	E
115 (4 1/2)	1/2 in.	Swagelok tube adapter	4.27 (108)	4.95 (126)	3.31 (84.0)	1.57 (40.0)	1.12 (28.5)
	1/4 in.	Male NPT	3.82 (97.0)	4.50 (114)			
	1/2 in.		4.06 (103)	4.74 (120)			
160 (6)	1/2 in.		4.82 (123)	4.86 (123)	3.46 (88.0)		

Ordering Information

Build a P model gauge ordering number by combining the designators as shown below. List option designators *alphabetically*.

PGI - 115P - OG160 - L AR X - BN J

Product Function and Type
Pressure gauge, industrial

Dial Size and Model
115P = 115 mm (4 1/2 in.) dial
160P = 160 mm (6 in.) dial

Dial Range
See page 14 and 15.

Process Connection Location
L = Lower mount
B = Lower-back mount

Fitting Size and Type
115 mm (4 1/2 in.) Dial Size
AR = 1/2 in. Swagelok tube adapter
AO = 1/4 in. male NPT
AP = 1/2 in. male NPT
BT = 1/2 in. long Swagelok tube adapter^①
^① For use with female Swagelok end connections.

160 mm (6 in.) Dial Size
AP = 1/2 in. male NPT

Pointer
Standard adjustable pointer

Options (see page 16)
A = Cleaned to ASME B40.1 level IV^①
B = Certificate of calibration
F = Panel-mount clamp^{②③}
I = Maximum indicating pointer^③
K = Safety glass^④
M = Liquid-fill membrane^⑤
N = Orifice (0.023 in. [0.58 mm])
Q = Brass (wetted components)^③
R = Alloy 400 (wetted components)^③
S = Mark pointer^③

^① Available for unfilled gauges only.
^② Not available in lower mount gauge configuration.
^③ Available on 115 mm (4 1/2 in.) dial size only.
^④ Not available on gauges with maximum indicating or mark pointer.
^⑤ Membrane factory installed on liquid-filled gauges.

Liquid Fill Fluid
X = Unfilled
1 = Glycerin
2 = Low-temperature glycerin
3 = Silicone

Dial Range Designators

- Maximum pressure is limited by the end connection.
- Not all dial ranges and end connections are available on all models.

S, B, and M Models

Dial Range, bar (primary scale: bar; secondary scale: psi)		
Minimum	Maximum	Designator
Vacuum -1 bar	0	BC0
	0.6	BC.6
	1.5	BC1.5
	3	BC3
	9	BC9
0	1	BG1
	1.6	BG1.6
	2.5	BG2.5
	4	BG4
	6	BG6
	10	BG10
	16	BG16
	25	BG25
	40	BG40
	60	BG60
	100	BG100
	160	BG160
	250	BG250
	400	BG400
	600	BG600
1000	BG1000	

S, B, and M Models

Dial Range, MPa (primary scale: MPa; no secondary scale)		
Minimum	Maximum	Designator
Vacuum -0.1 MPa	0	MC0
	0.06	MC.06
	0.15	MC.15
	0.30	MC.3
	0.50	MC.5
	0.90	MC.9
0	1.5	MC1.5
	0.1	MG.1
	0.16	MG.16
	0.25	MG.25
	0.40	MG.4
	0.60	MG.6
	1	MG1
	1.6	MG1.6
	2.5	MG2.5
	4	MG4
	6	MG6
	10	MG10
	16	MG16
	25	MG25
	40	MG40
60	MG60	
100	MG100	

S, B, and M Models

Dial Range, MPa (primary scale: MPa; secondary scale: kgf/cm ²)		
Minimum	Maximum	Designator
Vacuum -0.1 MPa	0	LC0
	0.06	LC.06
	0.15	LC.15
	0.30	LC.3
	0.50	LC.5
	0.90	LC.9
	1.5	LC1.5
0	0.1	LG.1
	0.16	LG.16
	0.25	LG.25
	0.40	LG.4
	0.60	LG.6
	1	LG1
	1.6	LG1.6
	2.5	LG2.5
	4	LG4
	6	LG6
	10	LG10
	16	LG16
	25	LG25
	40	LG40
	60	LG60
100	LG100	

S, B, M, and P Models

Dial Range, psi (primary scale: psi; secondary scale: bar)		
Minimum	Maximum	Designator
Vacuum -0.30 in. Hg	0	PC0
	15	PC15
	30	PC30
	60	PC60
	100	PC100
	160	PC160
	200	PC200
	0	PG15
0	30	PG30
	60	PG60
	100	PG100
	160	PG160
	200	PG200
	300	PG300
	400	PG400
	600	PG600
	800	PG800
	1 000	PG1000
	1 500	PG1500
	2 000	PG2000
	3 000	PG3000
	5 000	PG5000
	6 000	PG6000
	10 000	PG10K
	15 000	PG15K

S, B, M, and P Models

Dial Range, psi (primary scale: psi; secondary scale: kPa)		
Minimum	Maximum	Designator
Vacuum -0.30 in. Hg	0	OC0
	15	OC15
	30	OC30
	60	OC60
	100	OC100
	160	OC160
	200	OC200
	0	OG15
0	30	OG30
	60	OG60
	100	OG100
	160	OG160
	200	OG200
	300	OG300
	400	OG400
	600	OG600
	800	OG800
	1 000	OG1000
	1 500	OG1500
	2 000	OG2000
	3 000	OG3000
	5 000	OG5000
	6 000	OG6000
	10 000	OG10K
	15 000	OG15K

Dial Range Designators

- Maximum pressure may be limited by the end connection.
- Not all dial ranges and end connections are available on all models.

L Model

Dial Range, mbar (primary scale: mbar; no secondary scale)		
Minimum	Maximum	Designator
0	40	FG40
	60	FG60
	100	FG100
	160	FG160
	250	FG250
	400	FG400

L Model

Dial Range, kPa (primary scale: kPa; secondary scale mm H ₂ O)		
Minimum	Maximum	Designator
0	4	RG4
	5	RG5
	7	RG7
	10	RG10
	15	RG15
	20	RG20
	50	RG50

L Model

Dial Range, kPa (primary scale: kPa; no secondary scale)		
Minimum	Maximum	Designator
0	4	JG4
	5	JG5
	7	JG7
	10	JG10
	15	JG15
	20	JG20
	50	JG50

L Model

Dial Range, H ₂ O (primary scale: in. H ₂ O; no secondary scale)		
Minimum	Maximum	Designator
0	15	IG15
	20	IG20
	30	IG30
	60	IG60
	100	IG100
	200	IG200

L Model

Dial Range, psi (primary scale: psi; secondary scale: bar)		
Minimum	Maximum	Designator
0	5	PG5
	10	PG10

P Model

Dial Range, KPa (primary scale: KPa; no secondary scale)		
Minimum	Maximum	Designator
Vacuum -100 KPa	0	JC0
	60	JC60
	150	JC150
	300	JC300
	500	JC500
	900	JC900
	1 500	JC1500
	2 500	JC2500
0	60	JG60
	100	JG100
	160	JG160
	250	JG250
	400	JG400
	600	JG600
	1 000	JG1000
	1 600	JG1600
	2 500	JG2500
	4 000	JG4000
	6 000	JG6000
	10 000	JG10K ^①
	16 000	JG16K ^①
	25 000	JG25K ^①
	40 000	JG40K ^①
60 000	JG60K ^①	
100 000	JG100K ^①	

① Pressure range may be limited by materials of construction of the wetted components.

P Model

Dial Range, psi (primary scale: psi; no secondary scale)			
Minimum	Maximum	Designator	
Vacuum -0.30 in. Hg	0	NC0	
	15	NC15	
	30	NC30	
	60	NC60	
	100	NC100	
	160	NC160	
	200	NC200	
	300	NC300	
	400	NC400	
	0	15	NG15
		30	NG30
60		NG60	
100		NG100	
160		NG160	
200		NG200	
300		NG300	
400		NG400	
600		NG600	
800		NG800	
1 000		NG1000	
1 500		NG1500	
2 000		NG2000	
3 000		NG3000 ^①	
5 000		NG5000 ^①	
6 000	NG6000 ^①		
10 000	NG10K ^①		
15 000	NG15K ^①		

① Pressure range may be limited by materials of construction of the wetted components.

P Model

Dial Range, psi (primary scale: psi; secondary scale kgf/cm ²)			
Minimum	Maximum	Designator	
Vacuum -0.30 in. Hg	0	QC0	
	15	QC15	
	30	QC30	
	60	QC60	
	100	QC100	
	160	QC160	
	200	QC200	
	300	QC300	
	400	QC400	
	0	15	QG15
		30	QG30
60		QG60	
100		QG100	
160		QG160	
200		QG200	
300		QG300	
400		QG400	
600		QG600	
800		QG800	
1 000		QG1000	
1 500		QG1500	
2 000		QG2000	
3 000		QG3000 ^①	
5 000		QG5000 ^①	
6 000	QG6000 ^①		
10 000	QG10K ^①		
15 000	QG15K ^①		

① Pressure range may be limited by materials of construction of the wetted components.

Options and Accessories

Factory-installed options are specified in gauge ordering numbers, as shown in **Ordering Information** for each gauge model. Some items are available only as factory-installed options; others are available for field installation, as described below.

Adjustable Pointers

Gauges are available with adjustable pointers that allow resetting to zero. B, S, and P model gauges are available with adjustable pointers.

Orifices

Orifices are used to restrict flow, reducing the immediate effect of pulsations and pressure spikes. All Swagelok industrial and process gauges are available with orifices as factory-installed options.

Threaded orifices (0.023 in. [0.58 mm] inside diameter) are available for P model industrial process gauges as accessories for field installation.

P Model Threaded Orifice Kits

Orifice Material	Ordering Number
Stainless steel	PGI-P-ORIFICE
Brass	PGI-P-ORIFICE-Q
Alloy 400	PGI-P-ORIFICE-R

Special Cleaning

Special cleaning is available as an option for unfilled gauges. Internal components are cleaned in accordance with ASME B40.1, Section 5, which states that the gauge shall be free of visually detectable moisture and foreign matter (chips, slivers, weld slag or splatter, shop soil, greases, oils, or other contaminants) that could be mechanically detrimental to proper function of the gauge. The gauge is then capped and bagged to maintain cleanliness.

Certificates of Calibration

This option provides the user with a calibration sheet and a serial-numbered gauge, which has been calibrated with a gauge that is traceable to the national standard of the country of origin. Certificates of calibration are available for all Swagelok gauges.

Material Certifications

This option provides the user with a typical material certification. A typical material certification states that the gauges were manufactured from material purchased and certified as being in accordance with the specifications listed in this catalog. Material certifications are available for B, S, M, and L model gauges.

Liquid Fill

Liquid-filled gauges enhance the reliability and integrity of the measuring system for long periods under extreme operating conditions. B, S, and P model gauges are available liquid filled.

Because the type of liquid used to fill the gauge may vary with the application, Swagelok offers glycerin, low-temperature glycerin, and silicone. Glycerin fill liquid is available as an accessory for field installation.

Glycerin Ordering Numbers

Size	Ordering Number
8 oz (236 mL) squirt bottle	PGI-GLY-8
1 gal (3.8 L) bottle	PGI-GLY-128

Panel-Mount Clamps



Stainless steel panel-mount clamps are available for flush mounting Swagelok industrial gauges. The panel-mount clamp is easily installed on the gauge. This option is not available on lower mount or S model gauges. Panel-mount clamps on M model gauges must be factory installed and are available as accessories for field installation on B, L, and P model gauges.

Panel-Mount Clamp Kits

Gauge Model	Ordering Number
B model 63 mm (2 1/2 in.) size	PGI-63B-PMC
B and L models 100 mm (4 in.) size	PGI-100BCL-PMC
P model 115 mm (4 1/2 in.) size	PGI-P-115-PMC

Options and Accessories

Front Flanges



Polished stainless steel front flanges are available for flush panel mounting of Swagelok industrial gauges. This option is not available on lower mount or P model gauges and must be factory installed on M model gauges.

S, B, and L Model Front Flange Kits

Gauge Size	Ordering Number
63 mm (2 1/2 in.)	PGI-63SBL-FF
100 mm (4 in.)	PGI-100SBL-FF

Rear Flanges



Stainless steel rear flanges are available for mounting on the front of the panel. This option is not available on M, S, and P model gauges. Rear flanges are available factory installed on B and L model gauges and as accessories for field installation.

B and L Model Rear Flange Kits

Gauge Size	Ordering Number
63 mm (2 1/2 in.)	PGI-63BCL-RF
100 mm (4 in.)	PGI-100BCL-RF

Maximum Indicating Pointers

Maximum indicating pointers (MIP), available for S, B, L, and P models, identify pressure spikes in a system and are helpful during system startup and troubleshooting. The MIP adds an additional 1 % error to the gauge because of the increased load on the bourdon tube. This option is also available for field installation.



Maximum Indicating Pointer Kits

Gauge Model	Ordering Number
S, B, and L 63 mm (2 1/2 in.) size	PGI-63-MIP-SG
S, B, and L 100 mm (4 in.) size	PGI-100-MIP-SG
P 115 mm (4 1/2 in.) size	PGI-P-115-MIP-A

Coil Steam Siphons

Siphons protect pressure instruments in live steam service or other high-temperature vapor applications. The vapor condenses inside the coil of the siphon, preventing the high-temperature vapors from reaching the sensing element of the pressure instrument. Siphons are available in carbon and stainless steel.

Coil Steam Siphon Kits

Material	End Connection	Wall Schedule	Ordering Number
Steel	1/4 in. NPT	40	PGI-4-CSS-S-SC40
		80	PGI-4-CSS-S-SC80
	1/2 in. NPT	80	PGI-8-CSS-S-SC80
160		PGI-8-CSS-S-SC160	
Stainless steel		80	PGI-8-CSS-SS-SC80
	160	PGI-8-CSS-SS-SC160	

Strap Wrenches

Strap wrenches are used to remove the bayonet ring of the S, B, and L model gauges.

Strap wrench ordering number: **PGI-SB-CRR**

Options and Accessories

Additional items for P model gauges can be ordered for field installation.

Kit	Ordering Number
Safety glass, 115 mm (4 1/2 in.) size	PGI-P-115-SGLASS
Safety glass, 160 mm (6 in.) size	PGI-P-160-SGLASS
Cover ring remover, 115 mm (4 1/2 in.) size	PGI-P-115-CRR
Liquid-fill kit lower mount (includes membrane and plug)	PGI-P-FILLKIT-LM
Liquid-fill kit lower-back mount (includes membrane and plug)	PGI-P-FILLKIT-LBM
Mark pointer	PGI-P-115-MARK-A

Positionable Gauge Adapters



Features

- Positionable gauge adapter allows 360° orientation of pressure gauges.
- Inlet connection is 1/2 in. male NPT.
- Available with 1/2 in. NPT and ISO parallel gauge connections.
- All 316 stainless steel construction.
- Optional gauge siphon/snubber helps protect the instrument from steam and vapor and dampens pressure fluctuations.

Materials of Construction

Component	Material Grade/ ASTM Specification
Connector	316, 316L/A479
<i>Gauge nut, coupling</i>	316, 316L/A479
<i>Seal washer</i>	Annealed 316 SS
<i>Siphon tube, damper tube, plug</i>	316 SS

Wetted components listed in *italics*.

Ordering Information

Select a gauge adapter ordering number.

	Pressure Rating	
	6000 psig (413 bar)	10 000 psig (689 bar)
Outlet Connection	Gauge Adapter Ordering Numbers	
1/2 in. female NPT	ASN44N6	ASN44N10
1/2 in. male NPT	ASN4N46	ASN4N410
G1/2 female ISO (RG)	ASN44P6	ASN44P10

To order an optional gauge siphon/snubber, add **-SN** to the gauge adapter ordering number.

Example: ASN44N6-**SN**

Options and Accessories

Snubber Fittings—Gauge Protectors

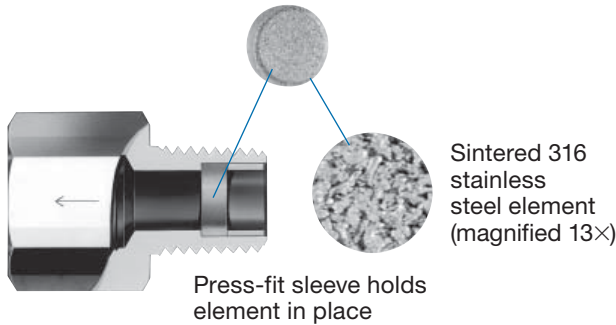
Swagelok snubber fittings protect gauges and instruments from system pressure surges and shocks. Pressure damping (snubbing) is accomplished through the use of a porous sintered 316 stainless steel element.

Installing a Swagelok snubber fitting upstream from the gauge reduces the gauge's response rate. The response rate generally varies with the initial pressure drop across the porous element of the snubber fitting and allows the gauge to reach line pressure smoothly.

Snubber fittings should be used only to protect against pressure shocks, impulses, and surges. Systems requiring control of contaminants should use filters suited to the application. See the Swagelok *Filters* catalog, MS-01-92.

Elements

With five basic elements available, snubber fittings can meet the requirements of fluid applications ranging from light gases to liquids with viscosities above 1000 SUS (Saybolt universal seconds) (220 cSt [mm²/s]). Element designators are stamped on all fittings for proper identification.



Fluid	Average Fluid Flow Estimate L/min ^①	Element Designator
Light gases from 69 to 79 SUS (13 to 16 cSt [mm ² /s])	0.05 at 25 psig (1.72 bar)	G
Air-steam from 75 to 119 SUS (15 to 25 cSt [mm ² /s])	2.4 at 25 psig (1.72 bar)	A
Water, light oils from 75 to 250 SUS (15 to 54 cSt [mm ² /s])	3.3 at 25 psig (1.72 bar)	W
Oils from 250 to 1000 SUS (54 to 220 cSt [mm ² /s])	1.3 at 10 psig (0.68 bar)	L
Oils of 1000 SUS (220 cSt [mm ² /s]) and above	0.9 at 10 psig (0.68 bar)	H ^②

① Product is tested with air at ambient temperature. Flow estimate is the average air flow multiplied by a ratio of nominal kinematic viscosities (air/fluid).

② Not available for ordering number -4-SRA-2.



Typical Installation

Effective Element Area

Fittings with 1/8 in. Male NPT Ends

0.019 in.² (12.3 mm²)

All Other Fittings

0.062 in.² (40.0 mm²)

Materials of Construction

Component	Material Grade/ASTM Specification
<i>Fitting body</i>	316 SS/A276 or brass/B453
Ferrules, nut	316 SS/A276 or brass/B453
<i>Sleeve</i>	316 SS/A276
<i>Element</i>	316 SS

Wetted components listed in *italics*.

Pressure Ratings Basis

Pressure ratings are based on ASME Code for Process Piping B31.3, at 70°F (20°C).

Maximum Differential Pressure

Stainless Steel Fittings with 1/8 in. Male NPT Ends

5000 psig (344 bar)

All Other Fittings

Stated working pressures

⚠ Pressure must be applied only in the direction of the flow arrow.

Temperature Ratings

Fitting Material	Maximum Operating Temperature °F (°C)
Brass	400 (204)
316 SS	1000 (538)

See next page for **Ordering Information** and **Dimensions**.

Snubber Fittings—Gauge Protectors

Ordering Information

Select a basic ordering number from the tables below.

Example: **-4-SA-E**

Add a body material designator.

Material	Designator
316 SS	SS
Brass	B

Example: **SS-4-SA-E**

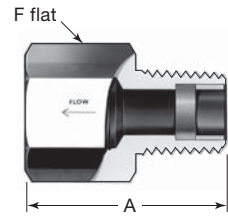
Add an element designator from the table on page 19.

Example: **SS-4-SA-EG**

Dimensions

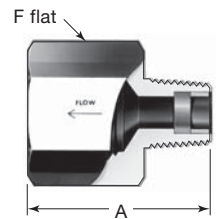
Dimensions are for reference only, and are subject to change.
Dimensions shown with Swagelok tube fitting nuts finger-tight.

Adapter



NPT Male/ Female Pipe Size in.	Basic Ordering Number	Dimensions in. (mm)		Working Pressure at 70°F (20°C) psig (bar)	
		A	F	Brass	316 SS
1/4	-4-SA-E	1.40 (35.6)	3/4	2200 (151)	4400 (303)
1/2	-8-SA-E	1.94 (49.3)	1 1/16	2400 (165)	4900 (337)

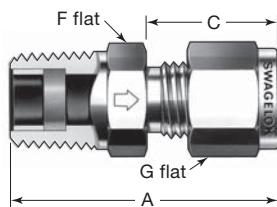
Reducing Adapter



NPT Female Pipe Size in.	NPT Male Pipe Size in.	Basic Ordering Number	Dimensions in. (mm)		Working Pressure at 70°F (20°C) psig (bar)	
			A	F	Brass	316 SS
1/4	1/8	-4-SRA-2-E	1.26 (32.0)	3/4	3300 (227)	6600 (454) ^①
1/2	1/4	-8-SRA-4-E	1.76 (44.7)	1 1/16	2200 (151)	4400 (303)
	3/8	-8-SRA-6-E	1.83 (46.5)		2400 (165)	4900 (337)

^① Maximum differential pressure: 5000 psig (344 bar).

Male NPT to Swagelok Tube Fitting



NPT Male Pipe Size in.	Tube OD in.	Basic Ordering Number	Dimensions in. (mm)				Working Pressure ^① at 70°F (20°C) psig (bar)	
			A	C	F	G	Brass	316 SS
1/4	1/4	-4-SM-A-400	1.48 (37.6)	0.70 (17.8)	9/16	9/16	2200 (151)	4400 (303)
	3/8	-4-SM-A-600	1.57 (39.9)	0.76 (19.3)	5/8	11/16		

^① For more information about pressure ratings of Swagelok tube fittings, see *Swagelok Tubing Data*, MS-01-107.

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange parts with those of other manufacturers.

Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.

WOOD'S

SURE-GRIP™

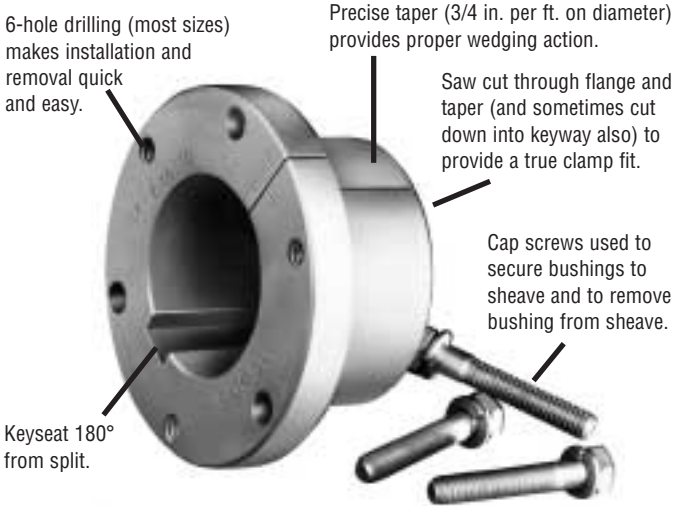
QD BUSHINGS

- **Provide a True Clamp Fit**
- **Are Easy to Install and Remove**
- **Permit Four-Way Mounting**



SURE-GRIP BUSHING FEATURES

Sure-Grip® “Quick Detachable” bushings are easy to install and remove. They are split through flange and taper to provide a true clamp on the shaft that is the equivalent of a shrink fit. All sizes except JA and QT have a setscrew over the key to help

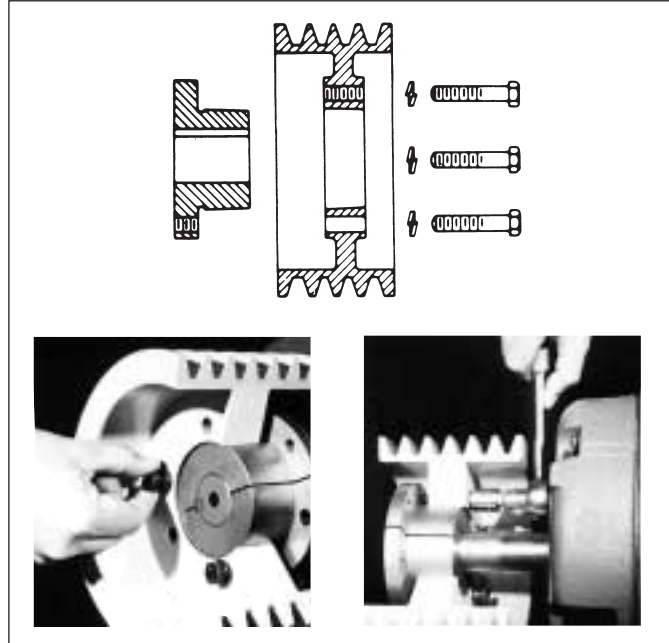


maintain the bushing's position on the shaft until the cap screws are securely tightened. Sure-Grip bushings have a very gradual taper (3/4-inch taper per ft. on the diameter) which is about half the inclined angle of many other bushings. The result is the Sure-Grip securely clamps the shaft, with twice the force of those competitive bushings, to provide extreme holding power.

Versatile Sure-Grip bushings permit the mounting of the same mating part on shafts of different diameters, and the mounting of different sheaves on the same shaft using the same bushing. Their interchangeability extends through sheaves, pulleys, timing pulleys, sprockets, flexible and rigid couplings, made-to-order items by Wood's, and to product lines of several other mechanical power transmission manufacturers.

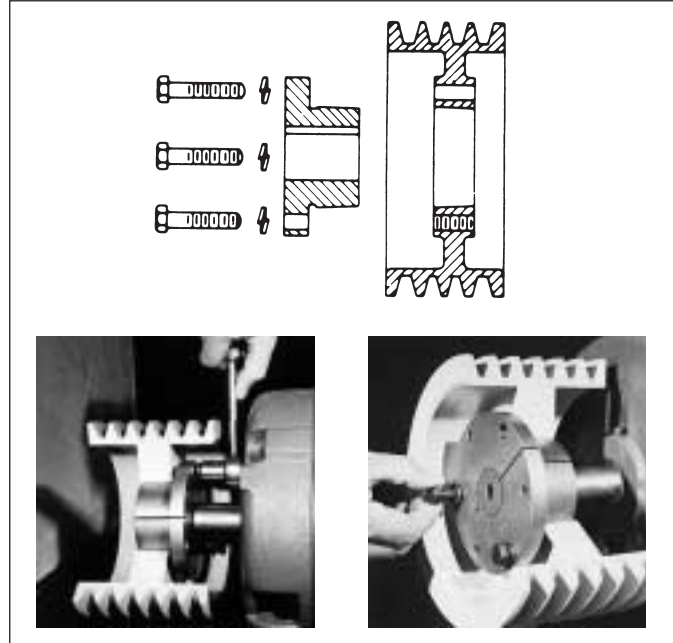
Sure-Grip bushings are manufactured with the drilled and tapped holes located at a precise distance from the keyseat; thus, a wide mating part having a bushing in each end can be mounted on a common shaft with the two keyways in line. This feature not only facilitates installation but also permits both bushings to carry an equal share of the load.

STANDARD MOUNTING



1. Cap screws from outside through drilled holes in the mating part and into threaded holes in the bushing flange located on the inside of the assembly. Or the complete assembly reversed on the shaft and;
2. Cap screws from inside through drilled holes in the mating part and into threaded holes in the bushing flange located on the outside of the assembly.

REVERSE MOUNTING

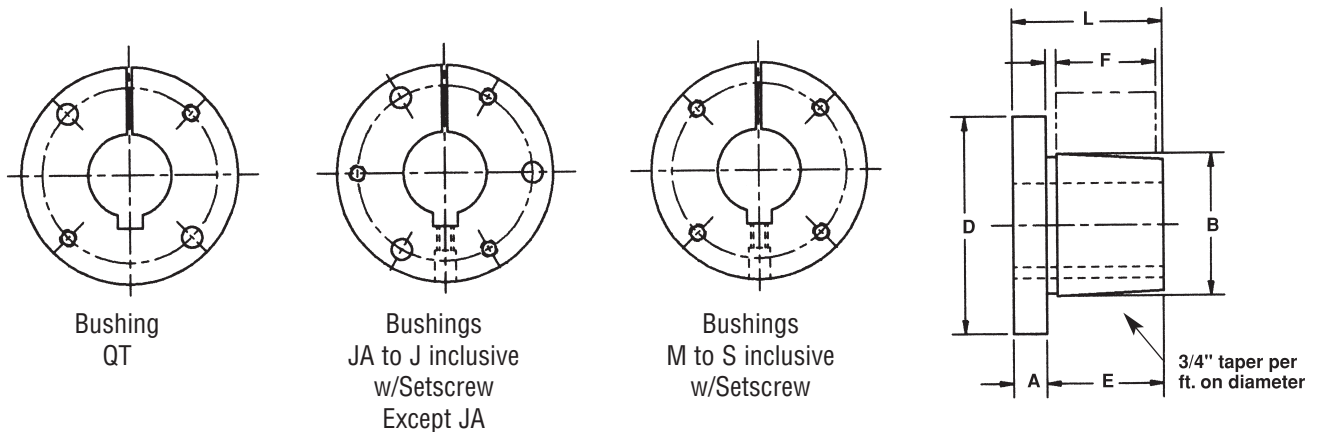


3. Cap screws from inside through drilled holes in the bushing flange located on the inside of the assembly and into threaded holes in the mating part.
4. Cap screws from outside through drilled holes in the bushing flange located on the outside of the assembly and into threaded holes in the mating part.

SURE-GRIP BUSHING DIMENSIONS



Sure-Grip bushings are designed to transmit the rated torque capacity listed in the table below when the cap screws are tightened as indicated. The bushings are stocked in all popular bore sizes, including metric bores, within the bore range for a particular bushing.



SURE-GRIP BUSHING TORQUE RATINGS AND DIMENSIONS

Bush.	Torque Capacity (In.-Lbs.)	(Note 1) Max. Bore	(Note 2) Max. Bore	DIMENSIONS IN INCHES						Bolt Circle	Cap Screws Required
				A	B	D	E	F*	L		
QT	1,750	1½	30	¼	1.625	2½	1	7/8	1¼	2	2-¼ x 1
JA	1,750	1¼	23	5/16	1.375	2	11/16	9/16	1	1 21/32	3 - #10 x 1
SH	3,500	1 5/8	36	3/8	1.871	2 11/16	7/8	13/16	1¼	2¼	3-¼ x 1 3/8
SDS	5,000	1 15/16	42	7/16	2.1875	3 3/16	7/8	¾	1 5/16	2 11/16	3-¼ x 1 3/8
SD	5,000	1 15/16	42	7/16	2.1875	3 3/16	1 3/8	1¼	1 13/16	2 11/16	3-¼ x 1 7/8
SK	7,000	2½	56	½	2.8125	3 7/8	1 3/8	1¼	1 7/8	3 5/16	3-5/16 x 2
SF	11,000	2 15/16	63	½	3.125	4 5/8	1½	1¼	2	3 7/8	3-3/8 x 2
E	20,000	3½	78	¾	3.834	6	1 7/8	1 5/8	2 5/8	5	3-½ x 2 3/4
F	40,000	3 15/16	90	13/16	4.4375	6 5/8	2 13/16	2½	3 5/8	5 5/8	3-9/16 x 3 5/8
J	55,000	4½	105	1	5.1484	7¼	3½	3 3/16	4½	6¼	3-5/8 x 4½
M	125,000	5½	130	1¼	6.500	9 1/8	5½	5 3/16	6 3/4	7 7/8	4-¾ x 6 3/4
N	150,000	6	140	1½	7.000	10	6 5/8	6¼	8 1/8	8½	4-7/8 x 8
P	250,000	7	160	1¾	8.250	11 3/4	7 5/8	7¼	9 3/8	10	4 - 1 x 9½
W	375,000	8½	200	2	10.437	15	9 3/8	9	11 3/8	12 3/4	4 - 1 1/8 x 11½
S	625,000	10	240	3¼	12.125	17 3/4	12½	12	15 3/4	15	5 - 1¼ x 15½

* Mating hub length.

1. MAX INCH BORE WITH KEYSEAT.
2. MAX MM BORE WITH STANDARD KEYSEAT.

See pages A1-4 to A1-8 for Bore and Keyseat information and weights.



SURE-GRIP BUSHINGS BORE AND KEYSEAT DIMENSIONS

(Inches)

Sure-Grip Bushings are available from stock with all the bores and keyseats listed below. In some cases, as the bore increases in diameter, a shallow keyseat is provided—due to insufficient metal thickness. When this happens, Wood's furnishes the correct rectangular key to suit at no charge. This does not affect the bushing's ability to transmit the load. The rectangular key, or flat key as some call it, fits into the standard keyway in the shaft.

Product No.	Bore	Key Seat	Wt. (*)
QT BUSHINGS			
QTMPB	7/16	No KS	.6
QT12	1/2	1/8 x 1/16	.6
QT9/16	9/16	1/8 x 1/16	.6
QT58	5/8	3/16 x 3/32	.6
QT11/16	11/16	3/16 x 3/32	.6
QT34	3/4	3/16 x 3/32	.6
QT13/16	13/16	3/16 x 3/32	.6
QT78	7/8	3/16 x 3/32	.6
QT15/16	15/16	1/4 x 1/8	.6
QT1	1	1/4 x 1/8	.6
QT1116	1-1/16	1/4 x 1/8	.6
QT118	1-1/8	1/4 x 1/8	.6
QT1316	1-3/16	1/4 x 1/8	.6
QT114	1-1/4	1/4 x 1/8	.6
QT1516	1-5/16	5/16 x 1/16	.6
QT138	1-3/8	5/16 x 1/16	.6
QT1716	1-7/16	3/8 x 1/16	.6
QT112	1-1/2	3/8 x 1/16	.6
JA BUSHINGS			
JAMPB	1/2	No KS	.8
JA12	1/2	1/8 x 1/16	.8
JA9/16	9/16	1/8 x 1/16	.8
JA58	5/8	3/16 x 3/32	.8
JA11/16	11/16	3/16 x 3/32	.8
JA34	3/4	3/16 x 3/32	.8
JA13/16	13/16	3/16 x 3/32	.8
JA78	7/8	3/16 x 3/32	.8
JA15/16	15/16	1/4 x 1/8	.8
JA1	1	1/4 x 1/8	.8
JA1116	1-1/16	1/4 x 1/16	.8
JA118	1-1/8	1/4 x 1/16	.8
JA1316	1-3/16	1/4 x 1/16	.8
JA114	1-1/4	1/4 x 1/32	.8
SH BUSHINGS			
SHMPB	7/16	No KS	1.1
SH12	1/2	1/8 x 1/16	1.1
SH9/16	9/16	1/8 x 1/16	1.1
SH58	5/8	3/16 x 3/32	1.1
SH11/16	11/16	3/16 x 3/32	1.0
SH34	3/4	3/16 x 3/32	1.0
SH13/16	13/16	3/16 x 3/32	1.0
SH78	7/8	3/16 x 3/32	1.0
SH15/16	15/16	1/4 x 1/8	1.0
SH1	1	1/4 x 1/8	.9

Product No.	Bore	Key Seat	Wt. (*)
SH BUSHINGS (continued)			
SH1116	1-1/16	1/4 x 1/8	.9
SH118	1-1/8	1/4 x 1/8	.9
SH1316	1-3/16	1/4 x 1/8	.8
SH114	1-1/4	1/4 x 1/8	.8
SH1516	1-5/16	5/16 x 5/32	.7
SH138	1-3/8	5/16 x 5/32	.7
SH1716	1-7/16	3/8 x 1/16	.7
SH112	1-1/2	3/8 x 1/16	.6
SH1916	1-9/16	3/8 x 1/16	.6
SH158	1-5/8	3/8 x 1/16	.5
SH11116	1-11/16	No KS	.5
SDS BUSHINGS			
SDSMPB	7/16	No KS	1.7
SDS12	1/2	1/8 x 1/16	1.7
SDS9/16	9/16	1/8 x 1/16	1.7
SDS58	5/8	3/16 x 3/32	1.6
SDS11/16	11/16	3/16 x 3/32	1.6
SDS34	3/4	3/16 x 3/32	1.6
SDS13/16	13/16	3/16 x 3/32	1.6
SDS78	7/8	3/16 x 3/32	1.5
SDS15/16	15/16	1/4 x 1/8	1.5
SDS1	1	1/4 x 1/8	1.5
SDS1116	1-1/16	1/4 x 1/8	1.4
SDS118	1-1/8	1/4 x 1/8	1.4
SDS1316	1-3/16	1/4 x 1/8	1.4
SDS114	1-1/4	1/4 x 1/8	1.3
SDS1516	1-5/16	5/16 x 5/32	1.3
SDS138	1-3/8	5/16 x 5/32	1.2
SDS13838KS	1-3/8	3/8 x 3/16	1.2
SDS1716	1-7/16	3/8 x 3/16	1.2
SDS112	1-1/2	3/8 x 3/16	1.1
SDS1916	1-9/16	3/8 x 3/16	1.1
SDS158	1-5/8	3/8 x 3/16	1.0
SDS11116	1-11/16	3/8 x 3/16	1.0
SDS134	1-3/4	3/8 x 1/8	1.0
SDS11316	1-13/16	1/2 x 1/8	.9
SDS178	1-7/8	1/2 x 1/16	.9
SDS11516	1-15/16	1/2 x 1/16	.8
SDS2	2	No KS	.7
SD BUSHINGS			
SDMPB	7/16	No KS	2.1
SD12	1/2	1/8 x 1/16	2.1
SD9/16	9/16	1/8 x 1/16	2.1
SD58	5/8	3/16 x 3/32	2.1
SD11/16	11/16	3/16 x 3/32	2.0

Product No.	Bore	Key Seat	Wt. (*)
SD BUSHINGS (continued)			
SD34	3/4	3/16 x 3/32	2.0
SD13/16	13/16	3/16 x 3/32	2.0
SD78	7/8	3/16 x 3/32	1.9
SD15/16	15/16	1/4 x 1/8	1.9
SD1	1	1/4 x 1/8	1.8
SD1116	1-1/16	1/4 x 1/8	1.8
SD118	1-1/8	1/4 x 1/8	1.7
SD1316	1-3/16	1/4 x 1/8	1.7
SD114	1-1/4	1/4 x 1/8	1.6
SD1516	1-5/16	5/16 x 5/32	1.6
SD138	1-3/8	5/16 x 5/32	1.5
SD13838KS	1-3/8	3/8 x 3/16	1.5
SD1716	1-7/16	3/8 x 3/16	1.4
SD112	1-1/2	3/8 x 3/16	1.4
SD1916	1-9/16	3/8 x 3/16	1.3
SD158	1-5/8	3/8 x 3/16	1.2
SD11116	1-11/16	3/8 x 3/16	1.2
SD134	1-3/4	3/8 x 1/8	1.1
SD11316	1-13/16	1/2 x 1/8	1.1
SD178	1-7/8	1/2 x 1/16	1.0
SD11516	1-15/16	1/2 x 1/16	.9
SD2	2	No KS	.8
SK BUSHINGS			
SKMPB	7/16	No KS	3.6
SK12	1/2	1/8 x 1/16	3.6
SK9/16	9/16	1/8 x 1/16	3.6
SK58	5/8	3/16 x 3/32	3.6
SK11/16	11/16	3/16 x 3/32	3.5
SK34	3/4	3/16 x 3/32	3.5
SK13/16	13/16	3/16 x 3/32	3.5
SK78	7/8	3/16 x 3/32	3.4
SK15/16	15/16	1/4 x 1/8	3.4
SK1	1	1/4 x 1/8	3.3
SK1116	1-1/16	1/4 x 1/8	3.3
SK118	1-1/8	1/4 x 1/8	3.2
SK1316	1-3/16	1/4 x 1/8	3.2
SK114	1-1/4	1/4 x 1/8	3.1
SK1516	1-5/16	5/16 x 5/32	3.1
SK151638KS	1-5/16	3/8 x 3/16	3.1
SK138	1-3/8	5/16 x 5/32	3.0
SK13838KS	1-3/8	3/8 x 3/16	3.0
SK1716	1-7/16	3/8 x 3/16	2.9
SK112	1-1/2	3/8 x 3/16	2.9
SK1916	1-9/16	3/8 x 3/16	2.8
SK158	1-5/8	3/8 x 3/16	2.7
SK11116	1-11/16	3.8 x 3/16	2.6
SK134	1-3/4	3/8 x 3/16	2.5
SK13412KS	1-3/4	1/2 x 1/4	2.5

* Approximate weight in lbs.

MPB Bushings are unsplit.

(Continued—next page)

SURE-GRIP BUSHINGS BORE AND KEYSEAT DIMENSIONS



(Inches)

Product No.	Bore	Key Seat	Wt. (*)
SK BUSHINGS (continued)			
SK11316	1-13/16	1/2 x 1/4	2.4
SK178	1-7/8	1/2 x 1/4	2.4
SK11516	1-15/16	1/2 x 1/4	2.3
SK2	2	1/2 x 1/4	2.2
SK2116	2-1/16	1/2 x 1/4	2.1
SK218	2-1/8	1/2 x 1/4	2.0
SK2316	2-3/16	1/2 x 1/8	2.0
SK214	2-1/4	1/2 x 1/8	1.9
SK21458KS	2-1/4	5/8 x 1/8	1.9
SK2516	2-5/16	5/8 x 1/16	1.8
SK238	2-3/8	5/8 x 1/16	1.7
SK2716	2-7/16	5/8 x 1/16	1.6
SK212	2-1/2	5/8 x 1/16	1.5
SK2916	2-9/16	No KS	1.3
SK258	2-5/8	No KS	1.1
SF BUSHINGS			
SFMPB	1/2	No KS	5.1
SF12	1/2	1/8 x 1/16	5.1
SF58	5/8	3/16 x 3/32	5.0
SF34	3/4	3/16 x 3/32	5.0
SF78	7/8	3/16 x 3/32	4.9
SF15/16	15/16	1/4 x 1/8	4.8
SF1	1	1/4 x 1/8	4.8
SF1116	1-1/16	1/4 x 1/8	4.7
SF118	1-1/8	1/4 x 1/8	4.7
SF1316	1-3/16	1/4 x 1/8	4.6
SF114	1-1/4	1/4 x 1/8	4.5
SF1516	1-5/16	5/16 x 5/32	4.5
SF138	1-3/8	5/16 x 5/32	4.4
SF13838KS	1-3/8	3/8 x 3/16	4.4
SF1716	1-7/16	3/8 x 3/16	4.3
SF112	1-1/2	3/8 x 3/16	4.2
SF1916	1-9/16	3/8 x 3/16	4.2
SF158	1-5/8	3/8 x 3/16	4.1
SF11116	1-11/16	3/8 x 3/16	4.0
SF134	1-3/4	3/8 x 3/16	3.9
SF11316	1-13/16	1/2 x 1/4	3.8
SF178	1-7/8	1/2 x 1/4	3.7
SF11516	1-15/16	1/2 x 1/4	3.6
SF2	2	1/2 x 1/4	3.5
SF2116	2-1/16	1/2 x 1/4	3.4
SF218	2-1/8	1/2 x 1/4	3.3
SF2316	2-3/16	1/2 x 1/4	3.2
SF214	2-1/4	1/2 x 1/4	3.1
SF21458KS	2-1/4	5/8 x 5/16	3.1
SF2516	2-5/16	5/8 x 3/16	3.1
SF238	2-3/8	5/8 x 3/16	3.0
SF2716	2-7/16	5/8 x 3/16	2.9
SF212	2-1/2	5/8 x 3/16	2.8
SF2916	2-9/16	5/8 x 1/16	2.6
SF258	2-5/8	5/8 x 1/16	2.5
SF21116	2-11/16	5/8 x 1/16	2.4
SF234	2-3/4	5/8 x 1/16	2.2
SF278	2-7/8	3/4 x 1/16	1.8
SF21516	2-15/16	3/4 x 1/32	1.7

Product No.	Bore	Key Seat	Wt. (*)
E BUSHINGS			
EMPB	7/8	No KS	10.8
E78	7/8	3/16 x 3/32	10.8
E15/16	15/16	1/4 x 1/8	10.8
E1	1	1/4 x 1/8	10.7
E118	1-1/8	1/4 x 1/8	10.6
E1316	1-3/16	1/4 x 1/8	10.5
E114	1-1/4	1/4 x 1/8	10.4
E1516	1-5/16	5/16 x 5/32	10.3
E138	1-3/8	5/16 x 5/32	10.2
E13838KS	1-3/8	3/8 x 3/16	10.2
E1716	1-7/16	3/8 x 3/16	10.1
E112	1-1/2	3/8 x 3/16	10.0
E1916	1-9/16	3/8 x 3/16	9.9
E158	1-5/8	3/8 x 3/16	9.8
E11116	1-11/16	3/8 x 3/16	9.7
E134	1-3/4	3/8 x 3/16	9.6
E11316	1-13/16	1/2 x 1/4	9.4
E178	1-7/8	1/2 x 1/4	9.3
E11516	1-15/16	1/2 x 1/4	9.2
E2	2	1/2 x 1/4	9.0
E2116	2-1/16	1/2 x 1/4	8.9
E218	2-1/8	1/2 x 1/4	8.8
E2316	2-3/16	1/2 x 1/4	8.6
E214	2-1/4	1/2 x 1/4	8.5
E21458KS	2-1/4	5/8 x 5/16	8.5
E2516	2-5/16	5/8 x 5/16	8.3
E238	2-3/8	5/8 x 5/16	8.1
E2716	2-7/16	5/8 x 5/16	8.0
E212	2-1/2	5/8 x 5/16	7.8
E2916	2-9/16	5/8 x 5/16	7.6
E258	2-5/8	5/8 x 5/16	7.5
E1116	2-11/16	5/8 x 5/16	7.3
E234	2-3/4	5/8 x 5/16	7.1
E21316	2-13/16	3/4 x 3/8	7.2
E278	2-7/8	3/4 x 3/8	7.1
E21516	2-15/16	3/4 x 1/8	6.9
E3	3	3/4 x 1/8	6.7
E318	3-1/8	3/4 x 1/8	6.3
E3316	3-3/16	3/4 x 1/8	6.0
E314	3-1/4	3/4 x 1/8	5.8
E3516	3-5/16	7/8 x 1/16	5.7
E338	3-3/8	7/8 x 1/16	5.5
E3716	3-7/16	7/8 x 1/16	5.2
E312	3-1/2	7/8 x 1/16	4.7
F BUSHINGS			
FMPB	1	No KS	17.9
F1	1	1/4 x 1/8	17.9
F118	1-1/8	1/4 x 1/8	17.7
F1316	1-3/16	1/4 x 1/8	17.6
F114	1-1/4	1/4 x 1/8	17.5
F138	1-3/8	5/16 x 5/32	17.2
F1716	1-7/16	3/8 x 3/16	17.1
F112	1-1/2	3/8 x 3/16	16.9
F1916	1-9/16	3/8 x 3/16	16.8
F158	1-5/8	3/8 x 3/16	16.7

Product No.	Bore	Key Seat	Wt. (*)
F BUSHINGS (continued)			
F134	1-3/4	3/8 x 3/16	16.3
F178	1-7/8	1/2 x 1/4	16.0
F11516	1-15/16	1/2 x 1/4	15.8
F2	2	1/2 x 1/4	15.6
F2116	2-1/16	1/2 x 1/4	15.4
F218	2-1/8	1/2 x 1/4	15.2
F2316	2-3/16	1/2 x 1/4	15.0
F214	2-1/4	1/2 x 1/4	14.8
F21458KS	2-1/4	5/8 x 5/16	14.8
F2516	2-5/16	5/8 x 5/16	14.5
F238	2-3/8	5/8 x 5/16	14.3
F2716	2-7/16	5/8 x 5/16	14.1
F212	2-1/2	5/8 x 5/16	13.9
F2916	2-9/16	5/8 x 5/16	13.7
F258	2-5/8	5/8 x 5/16	13.4
F21116	2-11/16	5/8 x 5/16	13.2
F234	2-3/4	5/8 x 5/16	12.9
F21316	2-13/16	3/4 x 3/8	12.6
F278	2-7/8	3/4 x 3/8	12.3
F21516	2-15/16	3/4 x 3/8	12.1
F3	3	3/4 x 3/8	11.8
F318	3-1/8	3/4 x 3/8	11.2
F3316	3-3/16	3/4 x 3/8	10.9
F314	3-1/4	3/4 x 3/8	10.6
F3516	3-5/16	7/8 x 3/16	11.0
F338	3-3/8	7/8 x 3/16	10.6
F3716	3-7/16	7/8 x 3/16	10.3
F312	3-1/2	7/8 x 3/16	10.0
F358	3-5/8	7/8 x 3/16	9.4
F31116	3-11/16	7/8 x 3/16	9.0
F334	3-3/4	7/8 x 3/16	8.7
F378	3-7/8	1 x 1/8	8.1
F31516	3-15/16	1 x 1/8	7.7
F4	4	No KS	6.9
J BUSHINGS			
JMPB	1-7/16	No KS	28.1
J1716	1-7/16	3/8 x 3/16	28.1
J112	1-1/2	3/8 x 3/16	28.0
J1916	1-9/16	3/8 x 3/16	27.8
J11116	1-11/16	3/8 x 3/16	27.4
J134	1-3/4	3/8 x 3/16	27.2
J178	1-7/8	1/2 x 1/4	26.7
J11516	1-15/16	1/2 x 1/4	26.5
J2	2	1/2 x 1/4	26.3
J218	2-1/8	1/2 x 1/4	25.8
J2316	2-3/16	1/2 x 1/4	25.6
J214	2-1/4	1/2 x 1/4	25.3
J2516	2-5/16	5/8 x 5/16	25.0
J238	2-3/8	5/8 x 5/16	24.7
J2716	2-7/16	5/8 x 5/16	24.5
J212	2-1/2	5/8 x 5/16	24.2
J258	2-5/8	5/8 x 5/16	23.6
J21116	2-11/16	5/8 x 5/16	23.3
J234	2-3/4	5/8 x 5/16	23.0
J278	2-7/8	3/4 x 3/8	22.2

* Approximate weight in lbs.

MPB Bushings are unsplit.

(Continued—next page)



SURE-GRIP BUSHINGS

BORE AND KEYSEAT DIMENSIONS

(Inches)

Product No.	Bore	Key Seat	Wt. (*)
J BUSHINGS (continued)			
J21516	2-15/16	3/4 x 3/8	21.9
J3	3	3/4 x 3/8	21.6
J318	3-1/8	3/4 x 3/8	20.9
J3316	3-3/16	3/4 x 3/8	20.5
J314	3-1/4	3/4 x 3/8	20.1
J3516	3-5/16	7/8 x 7/16	19.6
J338	3-3/8	7/8 x 7/16	19.3
J3716	3-7/16	7/8 x 7/16	18.9
J312	3-1/2	7/8 x 7/16	18.5
J358	3-5/8	7/8 x 7/16	17.7
J31116	3-11/16	7/8 x 7/16	17.2
J334	3-3/4	7/8 x 7/16	16.8
J31316	3-13/16	1 x 1/2	17.4
J378	3-7/8	1 x 3/8	17.0
J31516	3-15/16	1 x 3/8	16.5
J4	4	1 x 1/8	16.1
J418	4-1/8	1 x 1/8	15.2
J4316	4-3/16	1 x 1/8	14.7
J414	4-1/4	1 x 1/8	14.2
J438	4-3/8	1 x 1/8	13.2
J4716	4-7/16	1 x 1/8	12.7
J412	4-1/2	1 x 1/8	12.2
M BUSHINGS			
M11516	1-15/16	1/2 x 1/4	63.7
M2	2	1/2 x 1/4	63.3
M2316	2-3/16	1/2 x 1/4	62.3
M214	2-1/4	1/2 x 1/4	61.9
M238	2-3/8	5/8 x 5/16	61.0
M2716	2-7/16	5/8 x 5/16	60.6
M212	2-1/2	5/8 x 5/16	60.1
M258	2-5/8	5/8 x 5/16	59.3
M21116	2-11/16	5/8 x 5/16	58.8
M234	2-3/4	5/8 x 5/16	58.3
M278	2-7/8	3/4 x 3/8	57.2
M21516	2-15/16	3/4 x 3/8	56.7
M3	3	3/4 x 3/8	56.2
M318	3-1/8	3/4 x 3/8	55.2
M3316	3-3/16	3/4 x 3/8	54.6
M314	3-1/4	3/4 x 3/8	54.1
M338	3-3/8	7/8 x 7/16	52.8
M3716	3-7/16	7/8 x 7/16	52.2
M312	3-1/2	7/8 x 7/16	51.6
M358	3-5/8	7/8 x 7/16	50.4
M31116	3-11/16	7/8 x 7/16	49.7
M334	3-3/4	7/8 x 7/16	49.1
M378	3-7/8	1 x 1/2	47.6
M31516	3-15/16	1 x 1/2	46.9
M4	4	1 x 1/2	46.2
M418	4-1/8	1 x 1/2	44.8
M4316	4-3/16	1 x 1/2	44.1
M414	4-1/4	1 x 1/2	43.4
M438	4-3/8	1 x 1/2	41.9
M4716	4-7/16	1 x 1/2	41.2

Product No.	Bore	Key Seat	Wt. (*)
M BUSHINGS (continued)			
M412	4-1/2	1 x 1/2	40.4
M41116	4-11/16	1-1/4 x 5/8	37.5
M434	4-3/4	1-1/4 x 5/8	36.7
M478	4-7/8	1-1/4 x 1/4	37.8
M41516	4-15/16	1-1/4 x 1/4	37.0
M5	5	1-1/4 x 1/4	36.1
M5316	5-3/16	1-1/4 x 1/4	33.5
M514	5-1/4	1-1/4 x 1/4	32.6
M5716	5-7/16	1-1/4 x 1/4	29.9
M512	5-1/2	1-1/4 x 1/4	28.9
N BUSHINGS			
N21516	2-15/16	3/4 x 3/8	84.1
N3	3	3/4 x 3/8	83.5
N338	3-3/8	7/8 x 7/16	79.3
N3716	3-7/16	7/8 x 7/16	78.6
N312	3-1/2	7/8 x 7/16	77.9
N358	3-5/8	7/8 x 7/16	76.4
N334	3-3/4	7/8 x 7/16	74.9
N378	3-7/8	1 x 1/2	73.1
N31516	3-15/16	1 x 1/2	72.3
N4	4	1 x 1/2	71.5
N4316	4-3/16	1 x 1/2	68.9
N414	4-1/4	1 x 1/2	68.1
N438	4-3/8	1 x 1/2	66.3
N4716	4-7/16	1 x 1/2	65.4
N412	4-1/2	1 x 1/2	64.5
N458	4-5/8	1-1/4 x 5/8	62.0
N434	4-3/4	1-1/4 x 5/8	60.0
N478	4-7/8	1-1/4 x 5/8	58.1
N41516	4-15/16	1-1/4 x 5/8	57.0
N5	5	1-1/4 x 5/8	56.0
N5316	5-3/16	1-1/4 x 1/4	56.1
N5716	5-7/16	1-1/4 x 1/4	51.7
N512	5-1/2	1-1/4 x 1/4	50.6
N578	5-7/8	1-1/2 x 1/4	44.3
N51516	5-15/16	1-1/2 x 1/8	43.9
P BUSHINGS			
P21516	2-15/16	3/4 x 3/8	141.2
P314	3-1/4	3/4 x 3/8	137.6
P3716	3-7/16	7/8 x 7/16	134.9
P312	3-1/2	7/8 x 7/16	134.1
P358	3-5/8	7/8 x 7/16	132.4
P334	3-3/4	7/8 x 7/16	130.6
P378	3-7/8	1 x 1/2	128.5
P31516	3-15/16	1 x 1/2	127.6
P4	4	1 x 1/2	126.7
P414	4-1/4	1 x 1/2	122.7
P438	4-3/8	1 x 1/2	120.7
P4716	4-7/16	1 x 1/2	119.6
P412	4-1/2	1 x 1/2	118.6
P458	4-5/8	1-1/4 x 5/8	115.7
P41116	4-11/16	1-1/4 x 5/8	114.6

Product No.	Bore	Key Seat	Wt. (*)
P BUSHINGS (continued)			
P434	4-3/4	1-1/4 x 5/8	113.5
P478	4-7/8	1-1/4 x 5/8	111.2
P41516	4-15/16	1-1/4 x 5/8	110.0
P5	5	1-1/4 x 5/8	108.8
P5316	5-3/16	1-1/4 x 5/8	105.2
P514	5-1/4	1-1/4 x 5/8	103.9
P5516	5-5/16	1-1/4 x 5/8	102.7
P538	5-3/8	1-1/4 x 5/8	101.4
P5716	5-7/16	1-1/4 x 5/8	100.1
P512	5-1/2	1-1/4 x 5/8	98.8
P534	5-3/4	1-1/2 x 3/4	98.1
P578	5-7/8	1-1/2 x 3/4	95.3
P51516	5-15/16	1-1/2 x 3/4	93.9
P6	6	1-1/2 x 1/4	92.5
P6116	6-1/16	1-1/2 x 1/4	91.0
P614	6-1/4	1-1/2 x 1/4	86.6
P6716	6-7/16	1-1/2 x 1/4	83.5
P612	6-1/2	1-1/2 x 1/4	80.5
P634	6-3/4	1-3/4 x 1/8	74.7
P7	7	1-3/4 x 1/8	68.1
W BUSHINGS			
W414MPB	4-1/4	...	247.0
W478MPB	4-7/8	...	234.0
W514MPB	5-1/4	...	225.0
W578MPB	5-7/8	...	209.0
W612MPB	6-1/2	...	191.0
W714MPB	7-1/4	...	167.0
S BUSHINGS			
S6MPB	6	...	445.0
S8MPB	8	...	356.0
S9MPB	9	...	301.0

MPB bushings are unsplit.

* Approximate weight in lbs.

SURE-GRIP BUSHINGS (INCHES) WITH METRIC BORE AND KEYSEAT



BORE AND KEY INFORMATION

Product No.	Bore (mm)	Key ■	Wt. (*)
QT BUSHINGS			
QT14MM	14	5 x 5	.6
QT15MM	15	5 x 5	.6
QT16MM	16	5 x 5	.6
QT18MM	18	6 x 6	.6
QT19MM	19	6 x 6	.6
QT20MM	20	6 x 6	.6
QT22MM	22	6 x 6	.6
QT24MM	24	8 x 7	.6
QT25MM	25	8 x 7	.6
QT28MM	28	8 x 7	.6
QT30MM	30	8 x 7 †	.6
QT32MM	32	10 x 6 †	.6
QT35MM	35	10 x 6 †	.6
QT38MM	38	10 x 6	.6

Product No.	Bore (mm)	Key ■	Wt. (*)
JA BUSHINGS			
JA15MM	15	5 x 5	.8
JA16MM	16	5 x 5	.8
JA19MM	19	6 x 6	.8
JA20MM	20	6 x 6	.8
JA24MM	24	8 x 6 †	.8
JA25MM	25	8 x 6 †	.8
JA28MM	28	8 x 5 †	.8

Product No.	Bore (mm)	Key ■	Wt. (*)
SH BUSHINGS			
SH24MM	24	8 x 7	.9
SH25MM	25	8 x 7	.9
SH28MM	28	8 x 7	.9
SH30MM	30	8 x 7	.8
SH32MM	32	10 x 8	.8
SH35MM	35	10 x 8	.7

Product No.	Bore (mm)	Key ■	Wt. (*)
SDS BUSHINGS			
SDS24MM	24	8 x 7	1.5
SDS25MM	25	8 x 7	1.5
SDS28MM	28	8 x 7	1.4
SDS30MM	30	8 x 7	1.4
SDS32MM	32	10 x 8	1.3
SDS35MM	35	10 x 8	1.2
SDS38MM	38	10 x 8	1.1
SDS40MM	40	12 x 8	1.1
SDS42MM	42	12 x 8	1.0

Product No.	Bore (mm)	Key ■	Wt. (*)
SD BUSHINGS			
SD24MM	24	8 x 7	1.8
SD25MM	25	8 x 7	1.8
SD28MM	28	8 x 7	1.7
SD30MM	30	8 x 7	1.7
SD32MM	32	10 x 8	1.6
SD35MM	35	10 x 8	1.5
SD38MM	38	10 x 8	1.4
SD40MM	40	12 x 8	1.3
SD42MM	42	12 x 8	1.2

Product No.	Bore (mm)	Key ■	Wt. (*)
SK BUSHINGS			
SK24MM	24	8 x 7	3.3
SK25MM	25	8 x 7	3.3
SK28MM	28	8 x 7	3.2
SK30MM	30	8 x 7	3.2
SK32MM	32	10 x 8	3.1
SK35MM	35	10 x 8	3.0
SK38MM	38	10 x 8	2.9
SK40MM	40	12 x 8	3.6
SK42MM	42	12 x 8	2.7
SK45MM	45	14 x 9	2.6
SK48MM	48	14 x 9	2.4
SK50MM	50	14 x 9	2.3
SK55MM	55	16 x 10	2.0

Product No.	Bore (mm)	Key ■	Wt. (*)
SF BUSHINGS			
SF28MM	28	8 x 7	4.7
SF30MM	30	8 x 7	4.6
SF32MM	32	10 x 8	4.5
SF35MM	35	10 x 8	4.4
SF38MM	38	10 x 8	4.2
SF40MM	40	12 x 8	4.2
SF42MM	42	12 x 8	4.1
SF45MM	45	14 x 9	3.9
SF48MM	48	14 x 9	3.7
SF50MM	50	14 x 9	3.6
SF55MM	55	16 x 10	3.2
SF60MM	60	18 x 11	3.0
SF65MM	65	18 x 8 †	2.6

Product No.	Bore (mm)	Key ■	Wt. (*)
E BUSHINGS			
E35MM	35	10 x 8	10.2
E38MM	38	10 x 8	10.0
E40MM	40	12 x 8	9.9
E42MM	42	12 x 8	9.8
E45MM	45	14 x 9	9.6
E48MM	48	14 x 9	9.3
E50MM	50	14 x 9	9.2
E55MM	55	16 x 10	8.6
E60MM	60	18 x 11	8.1
E65MM	65	18 x 11	7.6
E70MM	70	20 x 12	7.1
E75MM	75	20 x 12	6.9
E80MM	80	22 x 11†	6.3

Product No.	Bore (mm)	Key ■	Wt. (*)
F BUSHINGS			
F45MM	45	14 x 9	16.2
F48MM	48	14 x 9	16.0
F50MM	50	14 x 9	15.8
F55MM	55	16 x 10	15.0
F60MM	60	18 x 11	14.3
F65MM	65	18 x 11	13.7
F70MM	70	20 x 12	12.9
F75MM	75	20 x 12	12.1
F80MM	80	22 x 14	11.2
F85MM	85	22 x 14	10.6
F90MM	90	25 x 14	9.7

Product No.	Bore (mm)	Key ■	Wt. (*)
J BUSHINGS			
J50MM	50	14 x 9	26.5
J55MM	55	16 x 10	25.6
J60MM	60	18 x 11	24.7
J65MM	65	18 x 11	23.9
J70MM	70	20 x 12	23.0
J75MM	75	20 x 12	21.9
J80MM	80	22 x 14	20.9
J85MM	85	22 x 14	19.3
J90MM	90	25 x 14	18.1
J95MM	95	25 x 14	16.8
J100MM	100	28 x 16	16.5

Product No.	Bore (mm)	Key ■	Wt. (*)
M BUSHINGS			
M80MM	80	22 x 14	55.0
M90MM	90	25 x 14	51.2
M100MM	100	28 x 16	46.9
M120MM	120	32 x 18	37.0

Product No.	Bore (mm)	Key ■	Wt. (*)
N BUSHINGS			
N100MM	100	28 x 16	72.3
N120MM	120	32 x 18	60.2

Product No.	Bore (mm)	Key ■	Wt. (*)
P BUSHINGS			
P150MM	150	36 x 20	95.8

• Approximate weight in lbs.

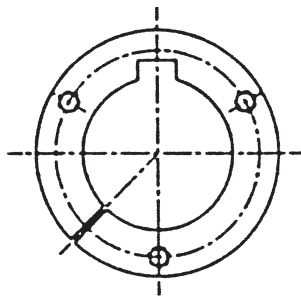
■ The metric system does not refer to keyseat or keyway dimensions as does the English system; instead, dimensions are given for the key itself, which is rectangular in shape and not square as in the English system. This meets ISO standards.

† SHALLOW KEY FURNISHED

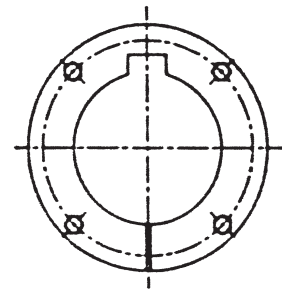
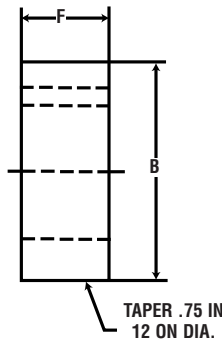
“L” SERIES FLANGELESS BUSHINGS

Bush.	Torque Capacity (In.-Lbs.)	Type Material	Max. Bore (In.)	Max. Bore† (mm)	Dimensions in Inches		Bolt Circle	Capscrews Required
					B	F		
SKL	7,000	D.I.	1-15/16	50	2.8125	1-1/8	2-3/8	3-1/4 x 1-1/2
SFL	11,000	D.I.	2-3/8	60	3.1250	1-1/8	2-3/4	4-1/4 x 1-1/2
EL	20,000	D.I.	2-7/8	73	3.8340	1-1/2	3-3/8	4-5/16 x 1-3/4
FL	45,000	D.I.	3-1/8	80	4.4375	2-3/8	3-3/4	4-3/8 x 2

† MAX BORE WITH STANDARD KEYSEAT.



**BUSHING
SKL**



**BUSHINGS
SFL TO FL**

Patent No. 5304101

To Install:

IMPORTANT: DO NOT USE LUBRICANTS IN THIS INSTALLATION

1. Inspect shafts, bushing, and mating hub. Remove all nicks, paint, dirt, grease, etc. from mating surfaces.
2. Place key in shaft's keyseat.
3. Slide bushing onto shaft and key. **Small End of Taper Must Be Outboard.**
4. Slide tapered mating hub over bushing. Align (1) the shaft key with one of the slots in the mating hub and (2) the drilled holes in mating hub with the threaded holes in the bushing.
5. Put lockwashers on cap screws and insert one cap screw thru each drilled hole in the mating hub and into the threaded hole in the bushing.
6. **Use a Torque Wrench.** Tighten all cap screws evenly and progressively in rotation. Torque around all the cap screws as often as necessary until the listed torque value remains on each cap screw.

BUSHING	TORQUE (Ft.-Lbs.)
SKL	15
SFL	15
EL	30
FL	55

CAUTION

The use of lubricants or excessive wrench torques may cause hub stresses high enough to break the mating hub!

To Remove:

1. Loosen and remove all cap screws from assembly.
2. Install one cap screw in each threaded hole in the mating hub.
3. Evenly torque each cap screw in rotation to force the mating hub off the bushing.

SURE-GRIP BUSHINGS BORE AND KEYSEAT DIMENSIONS



“L” SERIES FLANGELESS BUSHINGS

(Inches)

Product No.	Bore	Key Seat	Wt. (*)
SKL BUSHINGS			
SKLMPB	1/2	MPB*	1.7
SKL12	1/2	1/8 x 1/16	1.7
SKL58	5/8	3/16 x 3/32	1.7
SKL34	3/4	3/16 x 3/32	1.6
SKL78	7/8	3/16 x 3/32	1.6
SKL15/16	15/16	1/4 x 1/8	1.6
SKL1	1	1/4 x 1/8	1.6
SKL118	1-1/8	1/4 x 1/8	1.5
SKL1316	1-3/16	1/4 x 1/8	1.4
SKL114	1-1/4	1/4 x 1/8	1.4
SKL1516	1-5/16	5/16 x 5/32	1.3
SKL138	1-3/8	5/16 x 5/32	1.3
SKL1716	1-7/16	3/8 x 3/16	1.2
SKL112	1-1/2	3/8 x 3/16	1.2
SKL1916	1-9/16	3/8 x 3/16	1.2
SKL158	1-5/8	3/8 x 3/16	1.1
SKL11116	1-11/16	3/8 x 3/16	1.1
SKL134	1-3/4	3/8 x 3/16	1.0
SKL11316	1-13/16	1/2 x 1/4	1.0
SKL178	1-7/8	1/2 x 1/4	.9
SKL11516	1-15/16	1/2 x 1/4	.8

* Approximate weight in lbs.

MPB bushings are unsplit.

SFL BUSHINGS			
SFLMPB	1/2	MPB*	2.1
SFL12	1/2	1/8 x 1/16	2.1
SFL58	5/8	3/16 x 3/32	2.1
SFL34	3/4	3/16 x 3/32	2.0
SFL78	7/8	3/16 x 3/32	2.0
SFL15/16	15/16	1/4 x 1/8	2.0
SFL1	1	1/4 x 1/8	2.0
SFL118	1-1/8	1/4 x 1/8	1.9
SFL1316	1-3/16	1/4 x 1/8	1.8
SFL114	1-1/4	1/4 x 1/8	1.8
SFL1516	1-5/16	5/16 x 5/32	1.7
SFL138	1-3/8	5/16 x 5/32	1.7
SFL1716	1-7/16	3/8 x 3/16	1.6

Product No.	Bore	Key Seat	Wt. (*)
SFL BUSHINGS			
SFL112	1-1/2	3/8 x 3/16	1.6
SFL1916	1-9/16	3/8 x 3/16	1.5
SFL158	1-5/8	3/8 x 3/16	1.5
SFL11116	1-11/16	3/8 x 3/16	1.4
SFL134	1-3/4	3/8 x 3/16	1.4
SFL11316	1-13/16	1/2 x 1/4	1.4
SFL178	1-7/8	1/2 x 1/4	1.3
SFL11516	1-15/16	1/2 x 1/4	1.3
SFL2	2	1/2 x 1/4	1.2
SFL218	2-1/8	1/2 x 1/4	1.1
SFL21316	2-13/16	1/2 x 1/4	1.0
SFL214	2-1/4	1/2 x 1/4	1.0
SFL2516	2-5/16	5/8 x 5/16	.9
SFL238	2-3/8	5/8 x 5/16	.9

EL BUSHINGS			
ELMPB	7/8	MPB*	4.1
EL78	7/8	3/16 x 3/32	4.1
EL15/16	15/16	1/4 x 1/8	4.0
EL1	1	1/4 x 1/8	3.9
EL118	1-1/8	1/4 x 1/8	3.8
EL1316	1-3/16	1/4 x 1/8	3.8
EL114	1-1/4	1/4 x 1/8	3.7
EL1516	1-5/16	5/16 x 5/32	3.6
EL138	1-3/8	5/16 x 5/32	3.6
EL1716	1-7/16	3/8 x 3/16	3.5
EL112	1-1/2	3/8 x 3/16	3.5
EL1916	1-9/16	3/8 x 3/16	3.4
EL158	1-5/8	3/8 x 3/16	3.4
EL11116	1-11/16	3/8 x 3/16	3.3
EL134	1-3/4	3/8 x 3/16	3.2
EL11316	1-13/16	1/2 x 1/4	3.2
EL178	1-7/8	1/2 x 1/4	3.1
EL11516	1-15/16	1/2 x 1/4	3.0
EL2	2	1/2 x 1/4	3.0
EL218	2-1/8	1/2 x 1/4	2.9
EL2316	2-3/16	1/2 x 1/4	2.8
EL214	2-1/4	1/2 x 1/4	2.7
EL2516	2-5/16	5/8 x 5/16	2.6
EL238	2-3/8	5/8 x 5/16	2.5
EL2716	2-7/16	5/8 x 5/16	2.4

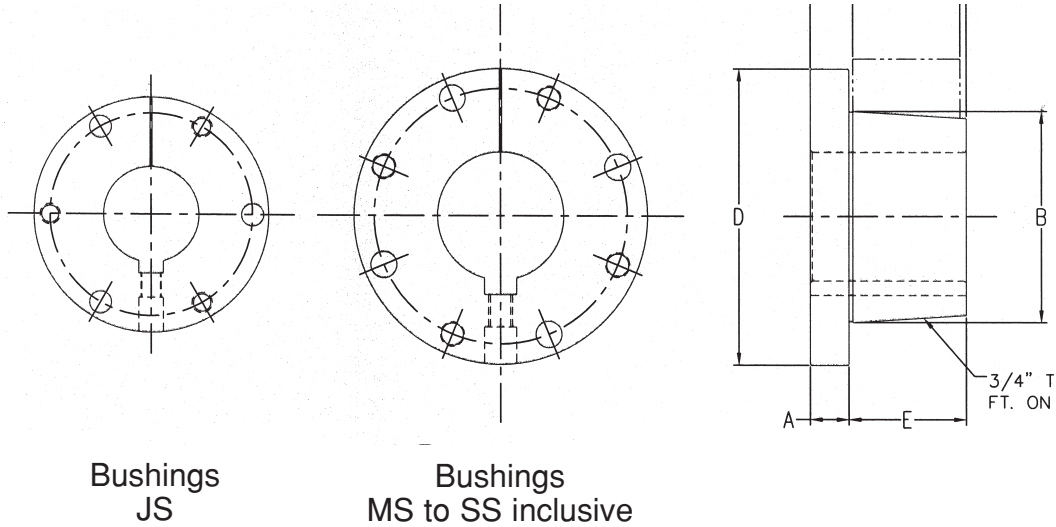
Product No.	Bore	Key Seat	Wt. (*)
EL BUSHINGS			
EL212	2-1/2	5/8 x 5/16	2.3
EL2916	2-9/16	5/8 x 5/16	2.3
EL258	2-5/8	5/8 x 5/16	2.2
EL21116	2-11/16	5/8 x 5/16	2.1
EL234	2-3/4	5/8 x 5/16	2.0
EL21316	2-13/16	3/4 x 3/8	1.9
EL278	2-7/8	3/4 x 3/8	1.8

FL BUSHINGS			
FLMPB	1	MPB*	8.5
FL1	1	1/4 x 1/8	8.5
FL118	1-1/8	1/4 x 1/8	8.3
FL1316	1-3/16	1/4 x 1/8	8.2
FL114	1-1/4	1/4 x 1/8	8.1
FL138	1-3/8	5/16 x 5/32	8.0
FL1716	1-7/16	3/8 x 3/16	7.9
FL112	1-1/2	3/8 x 3/16	7.8
FL1916	1-9/16	3/8 x 3/16	7.6
FL158	1-5/8	3/8 x 3/16	7.5
FL11116	1-11/16	3/8 x 3/16	7.4
FL134	1-3/4	3/8 x 3/16	7.3
FL178	1-7/8	1/2 x 1/4	7.1
FL11516	1-15/16	1/2 x 1/4	7.0
FL2	2	1/2 x 1/4	6.7
FL218	2-1/8	1/2 x 1/4	6.6
FL2316	2-3/16	1/2 x 1/4	6.5
FL214	2-1/4	1/2 x 1/4	6.4
FL2516	2-5/16	5/8 x 5/16	6.3
FL238	2-3/8	5/8 x 5/16	6.2
FL2716	2-7/16	5/8 x 5/16	6.1
FL212	2-1/2	5/8 x 5/16	5.9
FL2916	2-9/16	5/8 x 5/16	5.7
FL258	2-5/8	5/8 x 5/16	5.6
FL21116	2-11/16	5/8 x 5/16	5.4
FL234	2-3/4	5/8 x 5/16	5.3
FL21316	2-13/16	3/4 x 3/8	5.1
FL278	2-7/8	3/4 x 3/8	4.9
FL21516	2-15/16	3/4 x 3/8	4.8
FL3	3	3/4 x 3/8	4.6
FL318	3-1/8	3/4 x 3/8	4.5



SURE-GRIP SHORT BUSHING DIMENSIONS

Sure-Grip bushings are designed to transmit the rated torque capacity listed in the table below when the cap screws are tightened as indicated. The bushings are stocked in all popular bore sizes, including metric bores, within bore range for a particular bushing.



SURE-GRIP SHORT BUSHING TORQUE RATINGS AND DIMENSIONS

Bush.	Torque Capacity (In.-Lbs.)	Max Bore	DIMENSIONS IN INCHES					Bolt Circle	Cap Screws Required
			A	B	D	E	L		
JS	55,000	4-1/2	1	5.1484	7-1/4	2-3/8	3-3/8	6-1/4	3-5/8 x 2-1/2
MS	125,000	5-1/2	1-3/16	6.500	9-1/8	3-5/8	4-13/16	7-7/8	4-3/4 x 3
NS	150,000	6	1-1/2	7.000	10	4-1/2	6	8-1/2	4-7/8 x 3-1/2
PS	250,000	7	1-1/2	8.250	11-3/4	5	6-1/2	10	4 - 1 x 4
WS	375,000	8-1/2	1-3/4	10.437	15	5-1/2	7-1/4	12-3/4	4 - 1-1/8 x 5
SS	625,000	10	2	12.125	17-3/4	6-3/4	8-3/4	15	5 - 1-1/4 x 5

Setscrew not standard – Available as alteration.

See page A1-11 for Bore and Keyseat information and weights.

SURE-GRIP SHORT BUSHINGS BORE AND KEYSEAT DIMENSIONS



(Inches)

Product No.	Bore	Key Seat	Wt. (*)
JS BUSHINGS			
JS2716	2- 7/16	5/8 X 5/16	20.0
JS21516	2-15/16	3/4 X 3/8	18.1
JS3716	3- 7/16	7/8 X 7/16	15.9
JS31516	3-15/16	1 X 1/4	14.3
JS4716	4- 7/16	1 X 1/8	11.5

Product No.	Bore	Key Seat	Wt. (*)
MS BUSHINGS			
MS3716	3- 7/16	7/8 X 7/16	41.2
MS31516	3-15/16	1 X 1/2	37.3
MS4716	4- 7/16	1 X 1/2	33.3
MS41516	4-15/16	1-1/4 X 1/4	30.9
MS5716	5- 7/16	1-1/4 X 1/4	25.9

Product No.	Bore	Key Seat	Wt. (*)
NS BUSHINGS			
NS31516	3-15/16	1 X 1/2	66.3
NS4716	4- 7/16	1 X 1/2	52.5
NS41516	4-15/16	1-1/4 X 5/8	46.5
NS5716	5- 7/16	1-1/4 X 1/4	43.9
NS51516	5-15/16	1-1/2 X 1/8	39.0
NS6	6	1-1/2 X 1/8	38.8

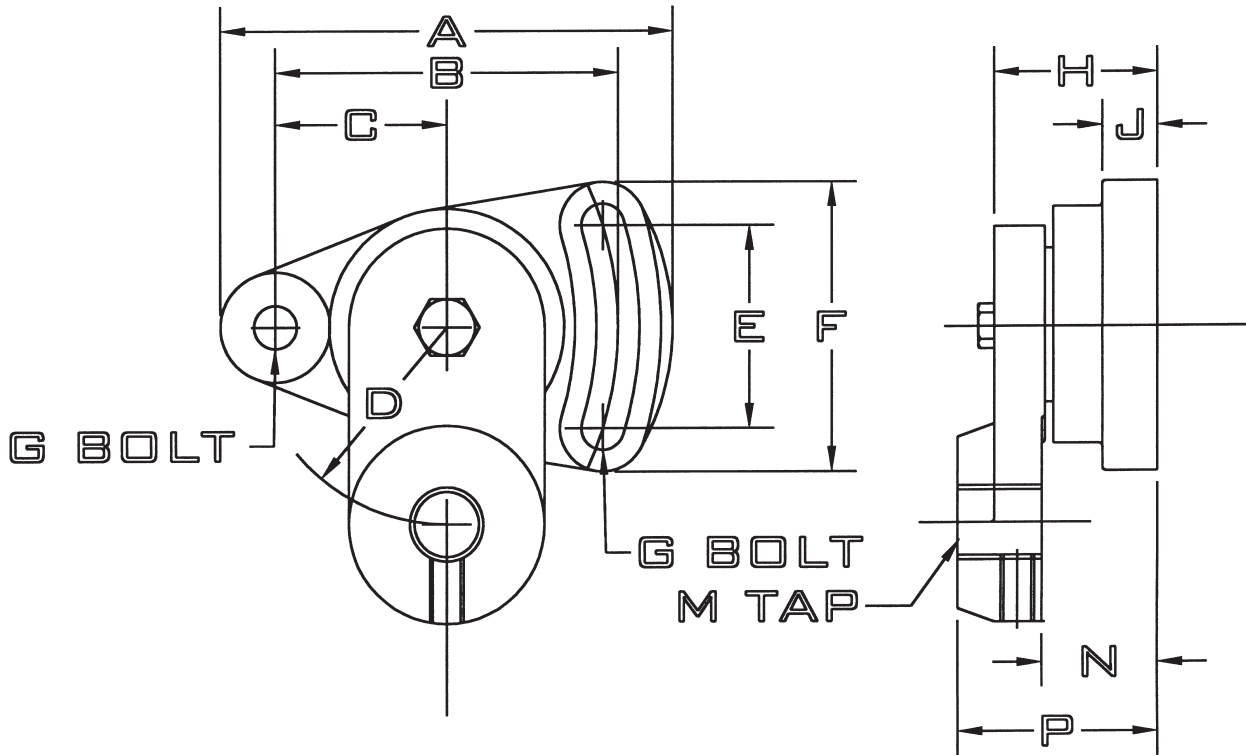
Product No.	Bore	Key Seat	Wt. (*)
PS BUSHINGS			
PS41516	4-15/16	1-1/4 X 5/8	88.3
PS5716	5- 7/16	1-1/4 X 5/8	81.3
PS51516	5-15/16	1-1/2 X 3/4	78.4
PS6	6	1-1/2 X 3/4	77.4
PS6716	6- 7/16	1-1/2 X 1/2	70.0
PS612	6- 1/2	1-1/2 X 1/2	69.0
PS61516	6-15/16	1-3/4 X 1/8	61.3
PS7	7	1-3/4 X 1/8	60.4

Product No.	Bore	Key Seat	Wt. (*)
WS BUSHINGS			
WS5716	5- 7/16	1-1/4 X 5/8	172.3
WS51516	5-15/16	1-1/2 X 3/4	161.1
WS6716	6- 7/16	1-1/2 X 3/4	155.0
WS612	6- 1/2	1-1/2 X 3/4	153.0
WS61516	6-15/16	1-3/4 X 3/4	140.0
WS7	7	1-3/4 X 3/4	139.0
WS712	7- 1/2	1-3/4 X 3/4	137.0
WS71516	7-15/16	2 X 3/4	126.9
WS8	8	2 X 3/4	124.0
WS8716	8- 7/16	2 X 1/4	107.3
WS812	8- 1/2	2 X 1/4	105.0

* Approximate weight in lbs.



DOUBLE ADJUSTMENT TENSIONER BELT DRIVE OR CHAIN TENSIONER



Product Number	DIMENSIONS IN INCHES												Weight Lbs.
	A	B	C	D	E	F	G	H	J	M	N	P	
DAM	4.62	3.50	1.75	2.00	2.06	3.06	.375	1.63	.62	3/4-10	1.16	2.01	3.0
DAL	6.94	5.25	2.63	5.00	3.00	4.56	.625	2.38	.88	1"-8	1.68	2.94	9.5

The Double Adjustment tensioner (Type DA) permits a full 360 degree rotation of the idler. A second adjustment is obtained by the long slot in the base. The arm is locked in place with an ingenious use of a tapered fit. Tensioning of a drive should follow the installation guideline for the type of drive in question.

SURE-GRIP IDLER BUSHINGS

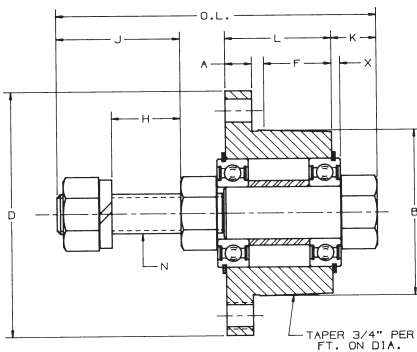


FOR USE WITH SHEAVES, PULLEYS, SPROCKETS, GEARS OR OTHER PRODUCTS DESIGNED FOR QD-TYPE BUSHINGS



Wood's Sure-Grip Idler Bushings are designed to accommodate stock V-belt sheaves, flat-belt or Timing-belt pulleys, roller or silent chain sprockets, gears or other products that use QD*-type bushings. They are equipped with two, permanently lubricated, ball-bearing units for long, smooth, trouble-free performance. Installation is made simply by slipping the threaded shaft through a hole bored in the support structure and tightening the locking nut. Sheaves, pulleys or other products can be removed without dismantling the idler bushing. These idler units are available with SH, SD, SK, SF or E Sure-Grip bushings. Wood's Sure-Grip bushings are of the most widely used, tapered, interchangeable type.

* U.S.T.M. Reg. No. 403,470 Can. T.M. Reg. No. 113,711



Product No.	DIMENSIONS										Wt. (Lbs.)	
	A	B	D	F	H	J	K	L	N	O.L.		X
SHBB	0.38	1.871	2.69	0.75	.53	0.98	0.44	1.25	1/2-13NC	3.13	.12	1.5
SDBB	0.44	2.187	3.19	1.25	.72	1.17	0.44	1.81	1/2-13NC	3.88	.12	2.5
SDBB58	0.44	2.187	3.19	1.25	.57	1.12	0.44	1.81	5/8-11NC	3.88	.12	2.7
SKBB	0.50	2.812	3.88	1.25	.85	1.42	0.62	1.88	3/4-10NC	4.50	.14	4.5
SFBB	0.50	3.125	4.63	1.38	.73	1.29	0.62	2.00	3/4-10NC	4.50	.14	8.0
SFBB1	0.50	3.125	4.63	1.38	1.08	1.91	0.62	2.00	1"-8NC	5.25	.14	8.6
EBB	0.75	3.834	6.00	1.63	1.11	2.30	0.97	2.63	1-3/8-6NC	6.88	.19	12.0

Equivalent Load Rating (lbs.)

Hours Life	Product No.	Basic Rating	RPM					
			500	1000	2000	3000	4000	5000
1000	SHBB	3320	1068	848	673	588	534	496
	SKBB	4860	1564	1241	985	861	782	726
	SFBB	4860	1564	1241	985	861	782	726
	EBB	10100	3250	2580	2048	1789	1625	1509
	SHBB	3320	848	673	534	467	424	394
2000	SDBB	3320	848	673	534	467	424	394
	SKBB	4860	1241	985	782	683	621	576
	SFBB	4860	1241	985	782	683	621	576
	EBB	10100	2580	2048	1625	1420	1290	1197
	SHBB	3320	588	467	370	324	294	273
6000	SDBB	3320	588	467	370	324	294	273
	SKBB	4860	861	683	542	474	430	400
	SFBB	4860	861	683	542	474	430	400
	EBB	10100	1789	1420	1127	984	894	830

Note: The basic rating is the maximum dynamic radial load which will allow a 90% survival rate when running at 33-1/3 RPM for 500 hours.

$$\text{Equivalent Rating} = \sqrt[3]{\frac{\text{Basic Rating}}{\text{Hours} \times 60 \times \text{RPM}/1,000,000}}$$

$$\text{Hours} = \frac{\text{Basic Rating}^3 \times 1,000,000}{\text{Load (Lbs.)}^3 \times 60 \times \text{RPM}}$$

SURE-GRIP BRUSHINGS INSTALLATION INSTRUCTIONS



The Sure-Grip tapered, QD-type interchangeable bushing offers flexible and easy installation while providing exceptional holding power. To ensure that the bushing performs as specified, it must be installed properly.

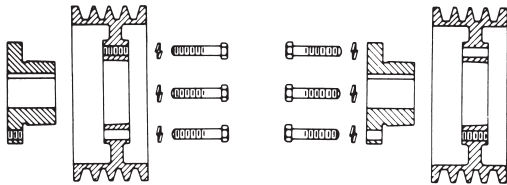
Before beginning, make sure the correct size and quantity of parts are available for the installation. The bushing has been manufactured to accept a setscrew over the key and its use is optional. It is packaged with the hardware on sizes SH to M and loosely installed in the bushing on sizes N to S.

To Install:

IMPORTANT:

DO NOT USE LUBRICANTS IN THIS INSTALLATION!

1. Inspect the tapered bore of the sheave and the tapered surface of the bushing. Any paint, dirt, oil, or grease **MUST** be removed.
2. Select the type of mounting (See Fig. 1 or 2) that best suits your application.



3. **STANDARD MOUNTING:** Install shaft key. (Note: If key was furnished with bushing, you must use that key.) Install bushing on clean shaft, flange end first. If bushing will not freely slide on the shaft, insert a screwdriver or similar object into the flange sawcut to act as a wedge to open the bushing's bore. **Caution: Excessive wedging will split the bushing.** If using the setscrew, tighten it just enough to prevent the bushing from sliding on the shaft. **Caution: Do not over-tighten setscrew!** Slide sheave into position on bushing aligning the drilled holes in the sheave with the tapped holes in the bushing flange. (Note: Install M thru S bushings so that the two tapped holes in the sheave are located as far away as possible from the bushing's sawcut.) Loosely thread the capscrews with lockwashers into the assembly. **DO NOT USE LUBRICANT ON THE CAPSCREWS!**

4. **REVERSE MOUNTING:** With large end of the taper out, slide sheave onto shaft as far as possible. Install shaft key. (See shaft key note in #3 above.) Install bushing onto shaft so tapered end will mate with sheave. (See wedging note in #3 above.) If using the setscrew, tighten it enough to prevent the bushing from sliding on the shaft. **Caution: Do not over-tighten setscrew!** Pull the sheave up on the bushing, aligning the drilled holes in the bushing flange with the tapped holes in the sheave. Loosely thread the capscrews with lockwashers into the assembly. **DO NOT USE LUBRICANT ON THE CAPSCREWS!**

5. Using a torque wrench, tighten all capscrews evenly and progressively in rotation to the torque value in Table. There must be a gap between the bushing flange and sheave hub when installation is complete. **DO NOT OVER-TORQUE! DO NOT ATTEMPT TO CLOSE GAP BETWEEN BUSHING FLANGE AND SHEAVE HUB!**

To Remove:

1. Relieve drive tension by shortening the center distance between driver and driven sheaves.
2. Lift off belts.
3. Loosen and remove cap screws. If the bushings have keyway setscrews, loosen them.
4. As shown below, insert cap screws (three in JA through J bushings, two in QT and M thru W bushings and four in S bushing) in tapped removal holes and progressively tighten each one until mating part is loose on bushing. (Exception: If mating part is installed with cap screw heads next to motor, with insufficient room to insert screws in tapped holes, loosen cap screws and use wedge between bushing flange and mating part.)
5. Remove mating part from bushing and, if necessary, bushing from shaft.



SURE-GRIP BRUSHINGS SCREW TIGHTENING INFORMATION

Tapered Bushing	Size & Thread of Cap Screw	Ft.-Lbs. To Apply With Torque Wrench
QT	1/4 x 20	9
JA	No. 10 - 24	5
SH-SDS-SD	1/4 - 20	9
SK	5/16 - 18	15
SF	3/8 - 16	30
E	1/2 - 13	60
F	9/16 - 12	110
J	5/8 - 11	135
M	3/4 - 10	225
MS	3/4 - 10	150
N	7/8 - 9	300
NS	7/8 - 9	200
P	1 - 8	450
PS	1 - 8	300
W	1-1/8 - 7	600
WS	1-1/8 - 7	400
S	1-1/4 - 7	750
SS	1-1/4 - 7	500

CAUTION: The tightening force on the screws is multiplied many times by the wedging action of the tapered surface. If extreme tightening force is applied, or if a lubricant is used, bursting pressures will be created in the hub of the mating part.



Bourdon Tube Pressure Gauges

All Stainless Steel Construction
Industrial Series Liquid Fillable • Type 23X.53

Pressure Gauges

Application

Suitable for corrosive environments compatible with 316 stainless steel wetted parts, dry and liquid fillable case, where vibration and/or pressure pulsation occur in liquid or gaseous media which will not obstruct the pressure system.

Sizes (All sizes not stocked)

2", 2½" and 4" (50, 63 and 100 mm)

Accuracy

2", 2½" ± 1.5% of span

4" ± 1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)

Vacuum / Compound to 30"HG / 0 / 200 PSI

Pressure from 15 PSI to 15,000 PSI

or other equivalent units of pressure or vacuum

Working Range

2" & 2½" Steady: 3/4 of full scale value
Fluctuating: 2/3 of full scale value
Short time: full scale value

4" Steady: Full scale value
Fluctuating: 0.9 x full scale value
Short time: 1.3 x full scale value

Operating Temperature

Ambient: -40°F to 140°F (-40°C to 60°C) ^{Note 1}

Media: max. 212°F (+100°C)

Temperature Error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection

Material: 316 stainless steel

Lower mount (LM)

Center back mount (CBM) 2½"

Lower back mount (LBM) 4"

1/4" or 1/2" NPT limited to wrench flat area

Bourdon Tube

Material: 316 stainless steel

30"Hg (Vac) to 1000 PSI C-type - 2" & 2½"

30"Hg (Vac) to 1500 PSI C-type - 4"

1500 PSI to 15,000 PSI helical type - 2" & 2½"

2000 PSI to 15,000 PSI helical type - 4"

Movement

Stainless steel

Dial

White aluminum with black lettering. 2½" with stop pin.

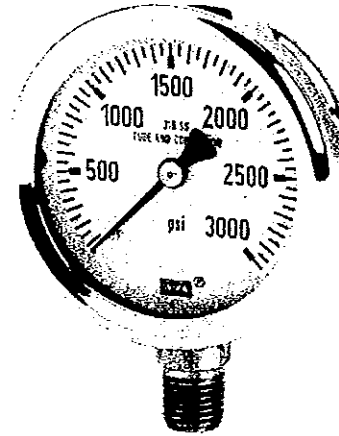
Pointer

Black aluminum, non-adjustable

Case

304 stainless steel with vent plug and SS crimping ring.

Welded case/socket connection



Weather Protection

Weather resistant (NEMA 3 / IP 54) - dry case

Weather tight (NEMA 4X / IP 65) - liquid-filled case

Standard Scale

PSI

PSI, PSI/BAR, PSI/KPA, PSI/KG/CM² (2½" CBM)

Window Gasket

Buna-N

Case Filling

232.53 - None

233.53 - Glycerine

Window

Polycarbonate

Acrylic (4")

ORDER OPTIONS (min. order may apply)

Custom dial layout

Steel zinc plated u-clamp bracket (field installable)

Stainless steel u-clamp bracket (field installable)

Pressure compensating membrane window for filled gauges

Stainless steel polished front flange (CBM or LBM only)

Stainless steel rear flange

316 SS threaded restrictor

Glycerine, silicone, or fluorolube case filling (Type 233.53) ^(Note 1)

Special connections limited to wrench flat area

Other pressure scales available:

Bar, kPa, MPa, Kg/cm² and dual scales

DIN standards

Cleaned for oxygen service

Externally adjustable red drag pointer (max. hand)

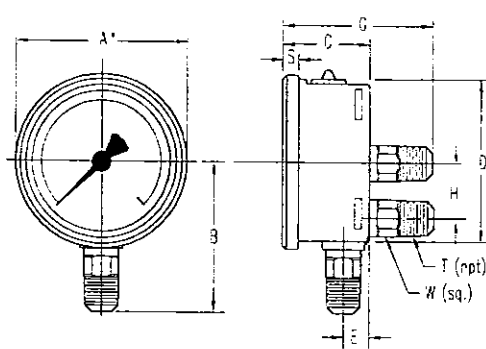
Externally adjustable red mark pointer (set pointer)

Note 1 Temperature Ranges (Liquid filled gauges)

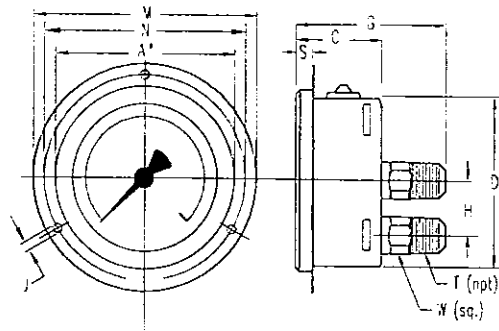
Glycerine: -4°F to 140°F (-20°C to 60°C)

Silicone: -40°F to 140°F (-40°C to 60°C)

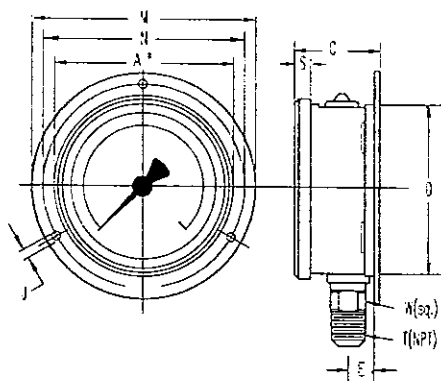
Dimensions:



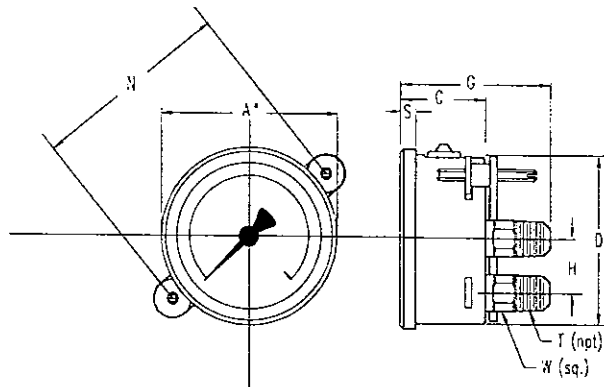
23X.53 LM/CBM/LBM



23X.53 CBM/LBM/FF



23X.53 LM/RF



23X.53 CBM/LBM/UC

A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	D	E	G	H	J	L	M	N	S	T	W
23X.53 2"	0.27 lbs. + 0.06 lbs. if filled	mm	50	48	30	50	12	53	--	3.6	6.5	71	60	5.5	--	14
		in	2	1.89	1.18	1.97	0.47	2.09		0.14	0.26	2.80	2.36	0.22	1/4"	0.55
23X.53 2.5"	0.36 lbs. + 0.08 lbs. if filled	mm	63	54	32	62	13	54	--	3.6	7.5	85	75	6.5	--	14
		in	2.5	2.13	1.26	2.44	0.51	2.13		0.14	0.30	3.35	2.95	0.26	1/4"	0.55
23X.53 4"	1.10 lbs. + 0.66 lbs. if filled	mm	100	87	48	100	15.5	79.5	30	4.8	9	132	116	8	--	22
		in	4	3.43	1.89	3.94	0.61	3.13	1.18	0.19	0.35	5.20	4.57	0.31	1/2"	0.87

NOTE: For 1/4" NPT connections on 3" and 4" gauges, reduce B* dimension by 5 mm / 0.02 in.

Panel cut-out dimensions: D + 1mm

THE MEASURE OF
Total Performance™

Ordering Information:

State computer part number (if available) / type number / size / range / connection size and location / options required.

Specifications given in this price list represent the state of engineering at the time of printing. Modifications may take place and the specified materials may change without prior notice.

05/02



WIKAI Instrument Corporation
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Lawrenceville, Georgia 30043-5868
Tel: 770-513-8200 Fax: 770-338-5118
<http://www.wika.com> e-mail: info@wika.com



Bimetal Thermometers

Stainless Steel Case and Wetted Parts

All Angle Connection

Models 32 and 52

Thermometers

Application

Industrial type design for fluid medium which does not corrode 304 stainless steel.

Size

3" (76.2 mm) Model 32

5" (127mm) Model 52

Accuracy

± 1.0% full scale value (ASME B40.3)

Ranges

-100 °F to 1000 °F (and equivalent Celsius)

Working Range

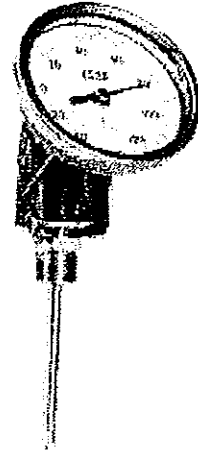
Steady: full scale value

Short time: 110% of full scale value

Over Range

Temporary over or under range of 50% up to 500 °F.

Over 500 °F max temp. 800 °F.



Standard Features

Connection

Material: 304 stainless steel

All angle, 1/2" NPT

Stem

Material: 304 stainless steel

Diameter: 1/4" (6.35 mm)

Length: 2 1/2" to 24" (63.5 mm to 609.6 mm)

Measuring Element

Bi-metal helix

Case

Material: 304 stainless steel

Hermetically sealed

External reset slotted hex head on back of case

Dial

White aluminum, dished, with black markings

Pointer

Black aluminum

Standard Scale (other scales available upon request)

Single: Fahrenheit or Celsius

Dual: Fahrenheit (outer) and Celsius (inner)

Window Gasket

Neoprene

Silicone (-100 °F and over 550 °F)

Window

Flat window glass

Weight

10 oz. (3" dial); 26 oz. (5" dial)

Add 1 oz for every 2" of stem length

STANDARD RANGES

Fahrenheit	Dual Scale F & C	Celsius
Single Scale	F Outer, C Inner	Single Scale
-100/150 F	-100/150 F & -70/70 C	-50/50 C
-40/120 F	-40/120 F & -40/50 C	-20/120 C
0/140 F	0/140 F & -20/60 C	0/50 C ¹
0/200 F	0/200 F & -15/90 C	0/100 C
0/250 F	0/250 F & -20/120 C	0/150 C
20/240 F	20/240 F & -5/115 C	0/200 C
25/125 F ¹	25/125 F & -5/50 C ¹	0/250 C
50/300 F	50/300 F & 10/150 C	0/300 C
50/400 F	50/400 F & 10/200 C	0/450 C ²
50/550 F	50/500 F & 10/260 C	100/550 C ²
150/750 F	150/750 F & 65/400 C	
200/1000 F ²	200/1000 F & 100/540 C ²	

¹ Minimum stem length 4" for Models 32 and 52

² Not recommended for continuous service over 800°F (425°C)

Order Options (min. order may apply)

Thermowells

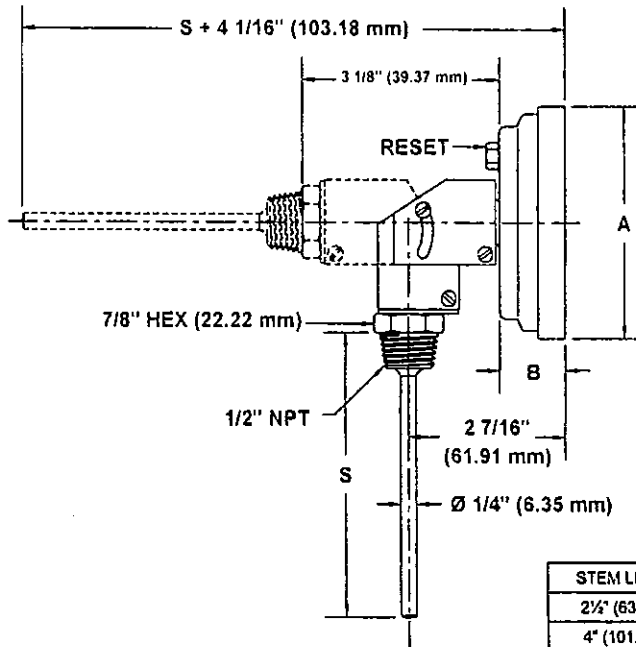
Silicone fill

Stem lengths up to 72 inches

Special scales and dial markings

Acrylic and safety glass windows

Calibration certification traceable to NIST



STEM LENGTH
2 1/2" (63.5 mm)
4" (101.6 mm)
6" (152.4 mm)
9" (228.6 mm)
12" (304.8 mm)
15" (381.0 mm)
18" (457.2 mm)
24" (609.6 mm)

WIKA MODEL	DIAL SIZE	A	B	S (Stem Length)
32	3" (76.2 mm)	3 1/4" (82.55 mm)	1 5/16" (23.81 mm)	As Specified
52	5" (127 mm)	5 1/4" (133.35 mm)	1 5/16" (23.81 mm)	As Specified

Ordering Information:

State computer part number (if available) / type number / size / range / connection size and location / options required

WIKA reserves the right to make design changes without prior notice

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