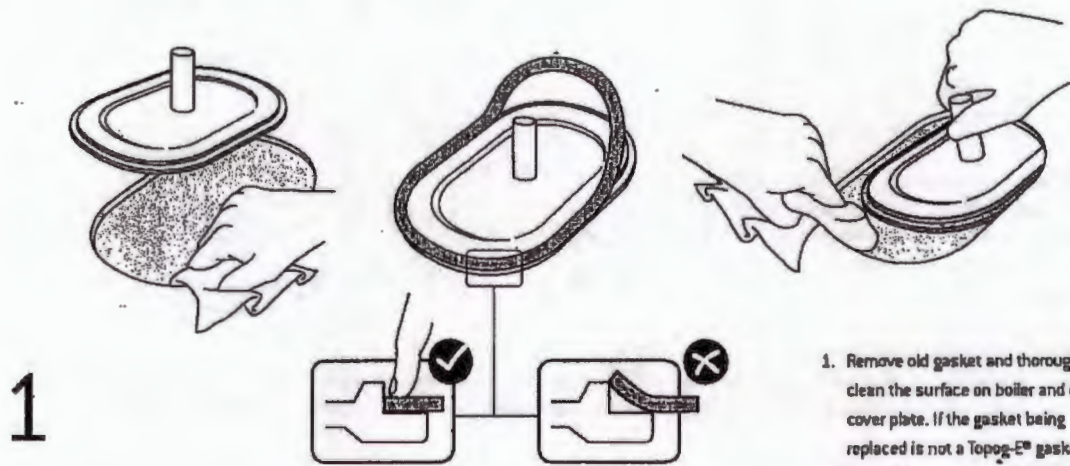


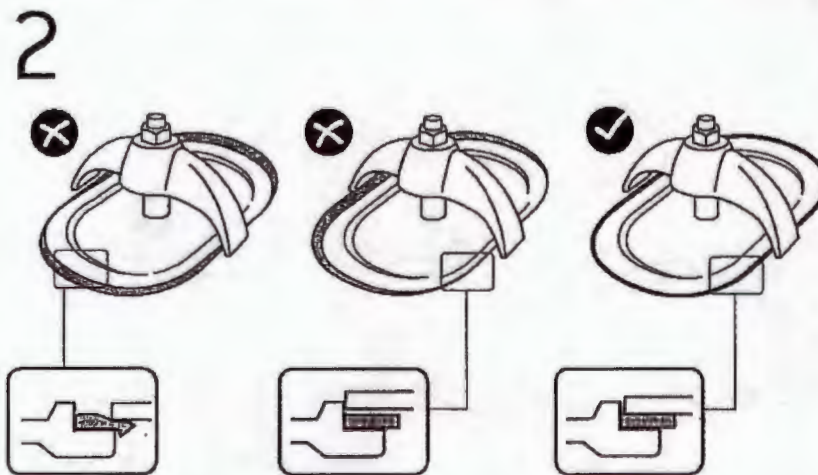
The Topog-E Gasket Company

Installation of Topog-E® gaskets in steam boilers.



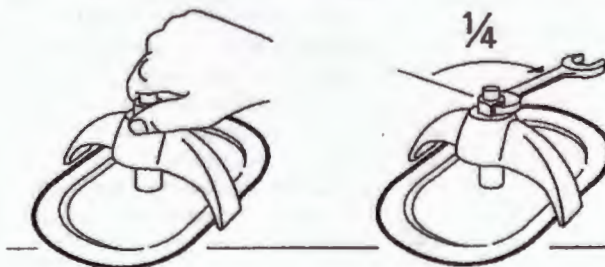
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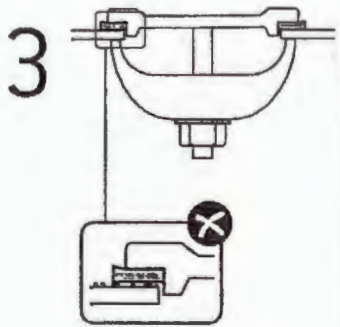
1. Remove old gasket and thoroughly clean the surface on boiler and on cover plate. If the gasket being replaced is not a Topog-E® gasket it may be necessary to buff each surface. Place new Topog-E® gasket on inspection cover plate, and make sure that the gasket is pushed down tight on the plate. Do not use any grease, lubricant or adhesive. When the cover plate is in the boiler and the gasket is in place, make one last cleaning swipe using a rag wrapped around your finger to ensure the mating surface in the boiler is clean.



2

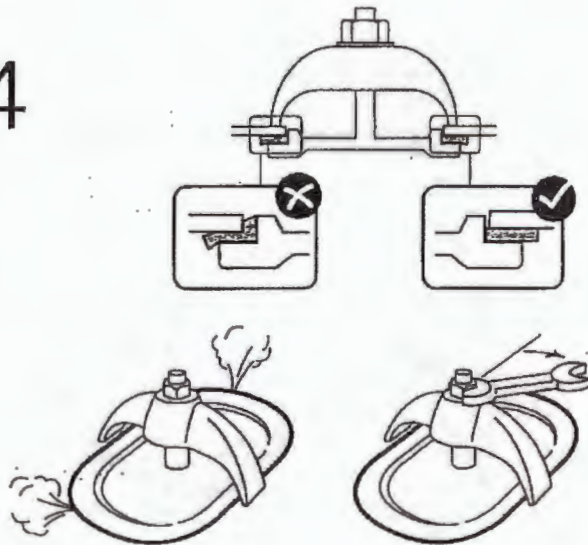
2. Set crab, then center plate in opening and tighten nut enough to give a snug fit. Make it hand tight then increase pressure on the gasket with a quarter turn of wrench.





3. Gaskets on the bottom of a boiler shell are typically more difficult to install without leaking because small particles tend to become lodged between the mating surfaces after they have been cleaned. This can lead to over-tightening of the gasket to stop leakage. It is recommended to drain the boiler and start over or the gasket's service life may be shortened.

4



4. Do not over-tighten as it will over-compress the gasket and shorten its service life.

If gasket leaks while pressure is being built up, tighten only enough to stop leakage.

5. As pressure builds up to operating level in the boiler, the nut and crab will loosen as it typically takes several days for the gasket to reach its ultimate compression. It is important to keep the nut at least finger tight until it no longer loosens.

5



6. Never re-use a Topog-E® gasket!

7. Topog-E® bolt gaskets (when required) should be used with Topog-E® handhoie gaskets.

Topog-E® gaskets are sold for use in steam, water, air, and other selected applications only. Recommendations for their use are based on tests believed to be reliable and on actual customer experience. Since their installation and use are beyond our control we cannot guarantee the results, whether or not such use is in accordance with instructions. We disclaim any responsibility.

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TOPOG-E GASKET

As a rough generalization it may be stated that the speed of a reaction doubles for each 10°C (18°F) rise in temperature. The pressure-temperature gradation is non-linear and this tubular presentation of steam (PSI) vs. temperature (°F) picks off four levels that are separated successively by 18°F increments, and relates these levels with survival terms for the gasket.

180 psi	380°F	1 year
225 psi	398°F	6 months
280 psi	416°F	3 months
335 PSI	432°F	1½ months

The Topog-E gasket material has specific and aggressive resistance to the hostile environment of live steam. If very low oxygen content is present in the steam, trouble rarely arises with a properly mounted Topog-E gasket inside the boiler.

From the exterior, however, the true difficulty arises. Here, we see an annulus of rubber beyond the cover plate. This rubber is exposed to the highly corrosive attack of an atmosphere that is 18% oxygen. The gas adjacent to the gasket is almost the temperature of the metal that is almost the temperature of the steam.

The situation is further complexed by the fact that rubber under stress degrades more rapidly than rubber not under stress. This may be verified by a rubber band in your desk drawer. Unperturbed, survival is measured in years. Stretched over a sheaf of papers - in months.

When stress is accompanied by extreme heat in the presence of oxygen, deterioration of the rubber begins. These three agents, stress, heat, and oxygen prevent extended survival of a Topog-E gasket.

Any action that reduces the magnitude of one or more of these agents extends the service life of the gasket. Now, the heat varies with steam pressure, so it is immune to an action. Limiting the amount of oxygen that reaches the rubber is a possibility and work is being done now on impermeable barrier substrates.

The remaining element stress exists, and fortunately a good degree of adjustment is possible and available in proper mounting. The target is to never let the gasket witness a greater pressure than the steam pressure that it is to seal.

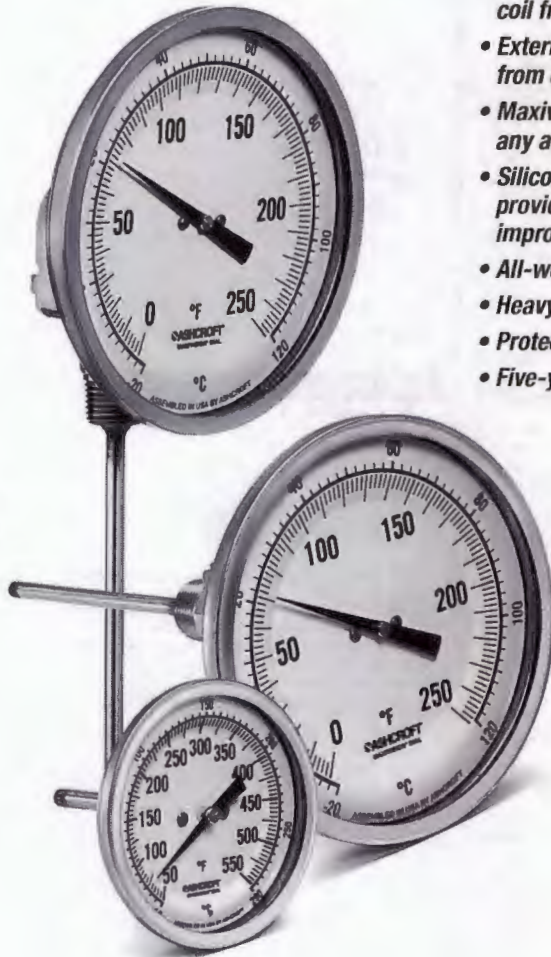
The gasket should be well centered on the opening and snubbed up with only enough pressure to hold it in place. Fire up the boiler. During the interval preceding steam pressure, the rubber is acting as a heat sink. As in all elastomeric vulcanizates it is undergoing stress-relaxation. There is a reduction in modulus and a measurable change in resistance to compression deflection. Since the system is well within its elastic memory the system is unharmed. As heat mounts leakage will occur and further snubbing is necessary, but only to the extent of preventing serious leakage. The advent of steam will itself form the seal. The crab should be firmed and maintained firm since deactivating the boiler for night or weekend will create a negative pressure and interrupt the seal from within. Once the seal is broken it is difficult to reestablish.

Using this technique it is possible to exceed the charted terms by several magnitudes.

EI Series Bimetal Thermometers

FEATURES

- 1% full span accuracy ASME B40.200 (ASME B40.3 Grade A)
- Maximum ambient temp. is 200°F (94°C)
- Hermetically sealed case to prevent entry of moisture, interior corrosion and coil freeze-up.
- External adjustment permits zero reset from outside the case.
- Maxivision® dial allows readability from any angle without parallax error.
- Silicone coil dampening (up to 400°F) provides vibration dampening and improves response time.
- All-welded SS construction
- Heavy-Duty glass lens
- Protection NEMA 4X/IP66
- Five-year limited warranty



SPECIFICATIONS

Ashcroft®	
Series:	EI
Dial Sizes:	2", 3", 5"
Stem Length:	2 1/2"-60" (1)
Case & Stem:	304 SS, hermetically sealed
Stem Dia:	.250"
Window:	Heavy-duty glass, plastic or shatterproof glass optional
Dial:	Maxivision®, black figures on white background
Pointer:	Black
Connection:	Plain, pointed plain, 1/4 NPT, 1/2 NPT, 1/2 NPT union and 1/2 NPT adjustable union
Connection Location:	Everyangle™, Lower, Rear
Ranges:	-80/120°F-200/1000°F -50/50°C-100/500°C
Options:	Code Description
	C4 Individual calibration cert.
	XCS Dual scale (2)
	XDM Dial marking
	XNH SS tag
	XNN Paper tag
	XPD Plastic window
	XSG Shatter proof glass
	X3B 3/8" stem dia. with 1/2 NPT
	X02 1/4 NPT when 1/2 NPT is standard (3)
	XS1 Silicone free
	XYW 316 SS Housing (4) and stem

- (1) 25"-60" lengths available, consult factory
- (2) Dual scale available with 3" and 5" case only
- (3) Only available on rear connection
- (4) Only available on 5" Everyangle™

Thermowells must be used on all pressure or velocity applications, to protect the stem of thermometer from corrosion and physical damage, and to facilitate removal of the thermometer without disturbing the process. Maximum ambient temperature is 200°F (95°C).

HOW TO ORDER

Dial Size: 3" Code 30 _____

Case Style: EI _____

Stem Connection: 1/2 NPT Code 60 _____

Stem Location: Rear Code R _____

Stem Length: 4" Code 040 _____

Range: Code 0/250°F _____

Options: Stainless steel tag _____

All specifications are subject to change without notice.
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EI Series Bimetal Thermometers

EI Series selection table

Case	Size	Dial	Code	Style Code	Stem			Stem Lengths Available		Temperature Range						
					Conn.	Code	Location	Code	"S" Length (inches)	Code	°F Fahrenheit	°/Div.	Fig. Inter.	°C Celsius	°/Div.	Fig. Inter.
2"	20				Plain	40	Rear	R	2 1/2	025	-80/120	2	20	-50/50	1	10
					Pointed	50					-20/120††			-10/110	2	10
					1/2 NPT	60					-40/120	1	10	-20/120	2	20
3"	30				1/2 NPT Union	42	Everyangle	E	4	040	30/130††		20	0/50††	1	5
					1/2 NPT	60					0/200		2	0/100	1	10
					1/2 NPT	60					20/120		50	10/150	2	20
					1/2 NPT	60	Rear	R	6	060	0/250		50	0/200	2	20
					1/2 NPT	60	Lower	L	9	090	50/300		50	0/300††	5	50
					1/2 NPT Union	42	Everyangle	E	12	120	0/250		50	0/400†	5	50
1/2 NPT	60	50/550		50	50/450**†	5					50					
1/2 NPT	60	200/700†		50	100/500**†	5					50					
5"	50				1/2 NPT Adjust. Union	70	Everyangle	E	15	150	100/800†	10	100			
					1/2 NPT	60					200/1000**†					
					1/2 NPT	60	Rear	R	18	180						
					1/2 NPT	60	Lower	L	24	240						

CONTACT FACTORY FOR ADDITIONAL STEM LENGTHS AND RANGES NOT LISTED

EI Series dual scale ranges

Dual scales are available in 3" and 5" dial sizes in the following ranges:

Inner		Outer	
-80/120°F	and	-60/50°C	
-40/120°F	and	-40/50°C	
-40/160°F	and	-40/70°C	
-20/120°F	and	-30/50°C††	
0/200°F	and	-20/90°C	
0/250°F	and	-20/120°C	
30/130°F	and	0/55°C††	
50/300°F	and	10/150°C	
50/400°F	and	10/200°C	
50/550°F	and	10/290°C	
100/800°F	and	50/400°C†	
200/700°F	and	100/370°C†	
200/1000°F	and	100/550°C**†	

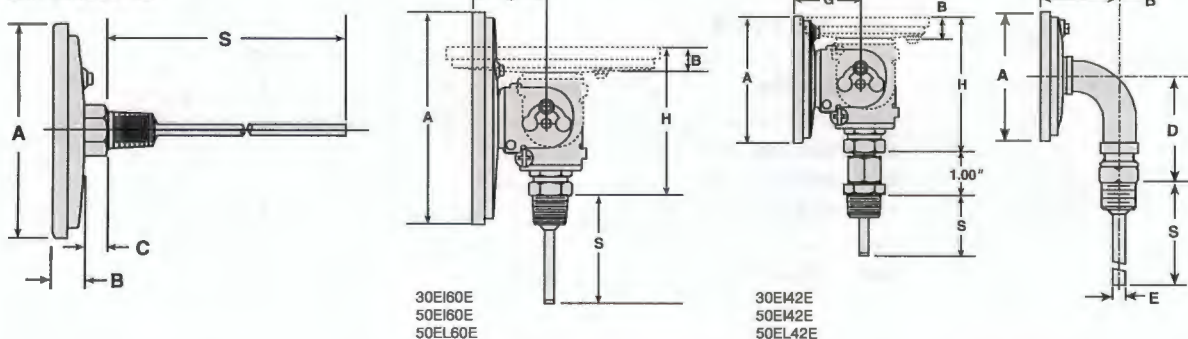
EI Dimensions

Case Series	Dial	Connection Location	A	B	C	D	E	G	H	S	NPT	Hex	Weight in ounces ^(a)
													S - 2 1/2"
EI	2"	Rear (Plain)	2 3/32 (53)	3/8 (10)	3/8 (8)	-	-	-	-	-	-	1 1/16	4 1/2
EI	2"	Rear (Plain, pointed stem)	2 3/32 (53)	3/8 (10)	3/8 (8)	-	-	-	-	-	-	1 1/16	4 1/2
EI	2"	Rear (Threaded)	2 3/32 (53)	3/8 (10)	3/8 (8)	-	-	1/4	-	-	4 1/2	1 1/16	4 1/2
EI	3"	Rear	3 3/32 (80)	1 9/32 (15)	3/8 (8)	-	-	1/2	-	-	1/4	7/8	7
EI	3"	Lower	3 3/32 (80)	1 27/32 (47)	-	2 5/8 (67)	1/4 (6)	-	1/2	-	1/2	7/8	11
EI	3"	Everyangle	3 3/32 (80)	1 9/32 (15)	-	-	-	1 21/32 (42)	3 1/32 (89)	-	1/2	7/8	10
EI	5"	Rear	5 1/32 (128)	2 3/32 (18)	3/8 (8)	-	-	-	-	-	1/2	7/8	16
EI	5"	Lower	5 1/32 (128)	1 15/16 (49)	-	3 3/8 (92)	1/4 (6)	-	-	-	1/2	7/8	26
EI	5"	Everyangle	5 1/32 (128)	2 3/32 (18)	-	-	-	1 7/8 (48)	3 21/32 (93)	-	1/2	7/8	25

NOTES:

- Figures in parenthesis () are in millimeters. All other dimensions are in inches.
- Standard "S" dimensions are 2 1/2, 4, 6, 9, 12, 15, 18 and 24 inches. Standard stem diameter is 1/4 inch.
- Add 1 oz. for every 2 inches of stem length.

DIMENSIONS



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INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR ASHCROFT® BIMETAL DIAL THERMOMETERS



GENERAL

In removing the thermometer out of the packing box, handle it by the case or case outlet. Avoid handling it by the stem.

INSTALLATION OF THERMOMETERS

The thermometer should be mounted at any convenient location where it will be subjected to the average temperature variations to be indicated.

For an everyangle connection please refer to the reverse side of this document before beginning the installation.

Avoid bending the stem as this will cause misalignment of the internal parts, resulting in undue frictional errors.

To tighten the thermometer to the apparatus, use a wrench applied to the hexagon head of the threaded connection located just outside of the case.

INSTALLATION

Locate the stem so that at least two inches will be subjected to the average temperature to be measured.

Exposing the stem to a temperature in excess of the highest dial reading should be avoided.

The thermometer is normally provided with a threaded connection. To tighten the thermometer to the apparatus or into the well, use an open-end wrench applied to the hexagon head of the threaded connection. Turn until reasonably tight, then tighten still further in the same manner as a pipe elbow or similar pipe fitting until the scale is in the desired position for reading. **DO NOT TIGHTEN BY TURNING THE THERMOMETER CASE.**
Install the dry type thermometer so that the maximum case temperature is kept below 200°F at all times.
Install the liquid filled type thermometer so that the maximum case temperature is kept below 150°F at all times.

When a thermometer is equipped with a well, the well should be installed onto the apparatus first. The stem of the thermometer should then be coated with a heat conducting medium (a mixture of glycerin and graphite or vaseline or any other heavy lubricant may be used), after which the thermometer stem is inserted, and tightened into the well.

CAUTION:

Thermowells should be used on all pressurized applications, to protect the thermometer from corrosion or physical damage, and to facilitate removal of the thermometer without disturbing the process.

TESTING

Ashcroft Bimetal Dial Thermometers are carefully calibrated at the factory and under most operating conditions will retain their accuracy indefinitely. However, as in the case of all instruments, it is well to make periodic checks for accuracy against known standards.

ADJUSTMENT

If it is necessary to make an adjustment to the thermometer proceed as follows:

On thermometers fitted with an "External Adjustment" – Use a small wrench, small screwdriver or a coin to turn the slotted hexagon head in the back of the case until the pointer indicates the proper temperature on the dial.

MAINTENANCE OF DIAL THERMOMETERS

Aside from occasional testing, little or no maintenance is required.

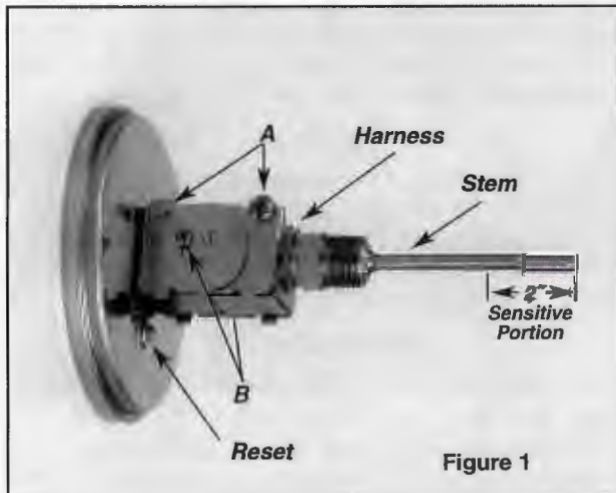
Be sure that the gasketed glass cover is on the case at all times, as moisture and dirt inside the case will eventually cause the thermometer to lose its accuracy. (See caution note below.)

If the thermometer is used for measuring the temperature of a material that may harden and build up an insulating layer on the stem, the thermometer should be removed from the apparatus occasionally, and the stem cleaned. Observe this precaution to ensure the sensitivity of the instrument.

CAUTION:

Bimetal Thermometers operating below freezing must have a perfectly tight case to prevent entrance of moisture which eventually will condense and freeze inside the stem. This condition shows up as a failure of the thermometer to read accurately below 32°F or 0°C. For this reason it is important to avoid damage to the glass front while the stem temperature is at freezing or below. All thermometers are hermetically sealed in a dry atmosphere at the factory and require no further maintenance.

This thermometer was designed to be positioned to face the direction of easiest reading.



CAUTION: To assure longest life, the "EVERY-ANGLE" joint should be operated only when necessary during installation or removal of the thermometer.

POSITIONING THE STEM

Before installation, the stem should be set to the desired angle as follows:

Figure 1: Loosen the four screws labeled "A" and "B" in Figure 1, until the harness revolves freely without twisting the flexible housing.

Figure 2: While holding the case, revolve the harness clockwise or counterclockwise, as indicated by arrows in Figure 2, to place the harness in a position that will permit flexing the stem in the desired direction with respect to the case. Then lock the two screws labeled "A."

Figure 3: Flex the stem to the desired angle with respect to the face of the thermometer, as shown in Figure 3, then lock the two screws labeled "B."

INSTALLATION

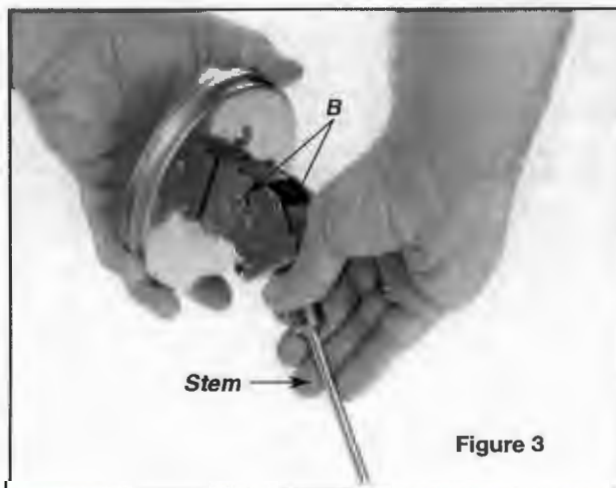
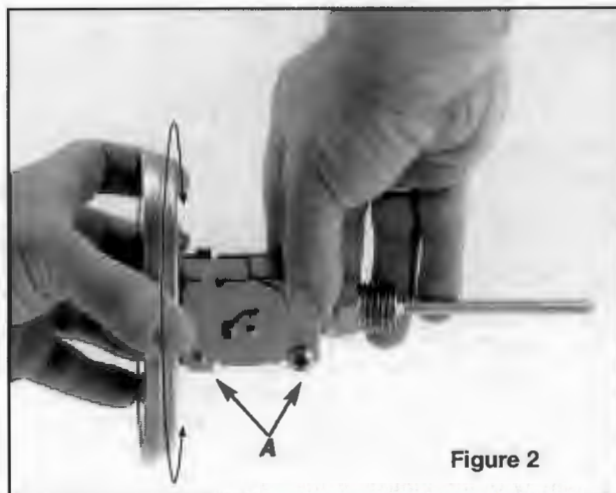
The lower 2" of the stem is the sensitive portion. Be sure this part of the stem is exposed to the temperature to be measured.

Tighten the thermometer to the apparatus or into the thermometer well, using an open-end wrench applied to the hexagon head of the connection bushing. Turn until reasonably tight, then tighten further (in the same manner as a pipe fitting) until the scale is in the desired position for reading.

DO NOT TIGHTEN BY TURNING THE THERMOMETER CASE OR THE HARNESS. INSTALL THE DRY TYPE EVERYANGLE THERMOMETER SO THAT THE MAXIMUM CASE TEMPERATURE IS KEPT BELOW 200°F. INSTALL THE LIQUID-FILLED TYPE EVERYANGLE THERMOMETER, SO THAT THE MAXIMUM CASE TEMPERATURE IS KEPT BELOW 150°F.

THERMOMETER WELLS

When the thermometer is equipped with a well, the well should first be removed from the thermometer and screwed into the apparatus.



Type 1379 Duragauge® Pressure Gauge Available With **PLUS!**™ Performance Option



- 4½" full-size Bourdon tube
- Patented Duratube™ with as welded tube construction controls stress for longer life
- "Round Cap Tip" construction lowers stresses for longer life
- Micrometer adjustable pointer.
- Exclusive Teflon coated 400 series stainless steel rotary movement for longer life
- **PLUS!**™ Performance Option:
 - Liquid-filled performance in a dry gauge
 - Fights vibration and pulsations without liquid-filled headaches
 - Order as option XLL
- Epoxy-coated system for superior corrosion resistance

Type 1379 Duragauge® pressure gauge is offered in 4½", 6" and 8½" dial sizes. This rugged, solid-front aluminum case gauge is tops in its field. It is available as a weatherproof hermetically sealed or liquid-filled version in 4½" and 6" sizes in pressures to 30,000 psi. Like the 1279, it can be easily field converted from the weatherproof version to either the sealed or liquid-filled version using an optional kit. Ranges 50,000, 80,000 and 100,000 psi are available in 6" hermetically sealed and liquid-filled cases. All cases are coated with black epoxy which will withstand most environmental conditions.

PRODUCT SPECIFICATIONS

Model Number:	1379
Accuracy:	½% full scale (Grade 2A, ASME B40.100)
Ranges:	Vacuum – 100,000 psi*
Dial Size:	4½", 6", 8½" diameter
Case Material:	Black, aluminum, solid front
Ring:	
4½" & 6" Dial:	Threaded reinforced black polypropylene
8½" Dial:	Hinged, aluminum, black epoxy coated
Back Cover:	Polycarbonate
Weather Protection:	Dry Case: IP54 Liquid filled or hermetically sealed case: IP65
Window:	Glass
Dial:	Aluminum, white background, black pressure scale
Bourdon Tube (A)⁽¹⁾ and Socket:	C510 Phos. bronze/brass
Pointer:	Micrometer adjustable
Movement:	Rotary, 400 SS, Teflon® coated pinion gear and segment
Conn. Size:	¼", ½" NPT, ¼" high pressure for gauges 20,000 psi and above
Conn. Location:	Lower or back

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PRODUCT OPTIONS

Fill: L-Glycerin-Standard
XGV-Silicone-Optional
XGX-Halocarbon-Optional

PLUS!

Performance: XLL
Hermetically Sealed, IP65: H
Flush Mounting Ring: X56
Receiver Gauge: XPR
Shatter Proof Glass Window: XSG
Acrylic Window: XPD
Red Set Hand: XSH
Max. Pointer: XEP

⁽¹⁾ Joints silver brazed, ⁽²⁾ Joints welded, ⁽³⁾ See Bulletin DU-5 1379 HP

TEMPERATURE LIMITS

	Ambient	Process	Storage
Dry	-20/200°F ⁽¹⁾ (-29/93°C)	-20/250°F ⁽¹⁾ (-29/121°C)	-40/250°F (-40/121°C)
PLUS!	-40/150°F (-40/66°C)	-40/200°F (-40/93°C)	-40/150°F (-40/66°C)
LF (glycerin)	20/150°F (7/66°C)	20/150°F (7/93°C)	0/150°F (-18/66°C)
(silicone)	-40/150°F (-40/66°C)	-40/200°F (-40/93°C)	-40/150°F (-40/66°C)
(halocarbon)	-40/150°F (-40/66°C)	-40/200°F (-40/93°C)	-40/150°F (-40/66°C)

(1) Available for temperatures below -20°F, see Product Information page ASH/PI-21B for details.

Note: Other than discoloration of the dial and hardening of the gasketing that may occur as ambient or process temperatures exceeds 150°F, non-liquid-filled gauges with standard glass windows, can withstand continuous operating temperatures up to 250°F (121°C). Liquid-filled gauges can withstand 200°F (93°C) but glycerin fill and acrylic window will tend to yellow. Accuracy at temperatures above or below the reference ambient temperature of 68°F (20°C) will be affected by approximately .4% per 25°F. Gauges with welded joints will withstand 750°F (450°F (232°C) with silver brazed joints) for short times without rupture, although other parts of the gauge will be destroyed and calibration will be lost. For continuous use and for process or ambient temperatures above 250°F (121°C), a diaphragm seal or capillary or siphon is recommended.

STANDARD RANGE TABLE**

Pressure: ~ psi	Figure Interval	Max Graduation
0/15	1	0.1
0/30	5	0.2
0/60	5	0.5
0/100	10	1
0/160	20	2
0/200	20	2
0/300	50	2
0/400	50	5
0/600	50	5
0/800	100	10
0/1000	100	10
0/1500	200	20
0/2000	200	20
0/3000	500	20
0/5000	500	50
0/6000	500	50
0/10,000	1000	100
0/20,000	2000	200
0/30,000	5000	200
0/50,000***	5000	500
0/80,000	10,000	1000
0/100,000	10,000	1000

*50,000, 80,000, & 100,000 psi ranges available with 6" dial size only

**Full standard and metric equivalent range table available on our web site.

***See Bulletin DU-5 1379 HP

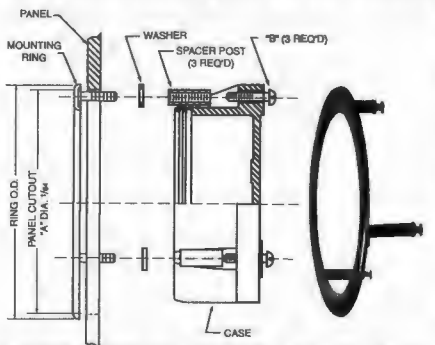
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Type 1379 Duragauge® Pressure Gauge Available With PLUS!™ Performance Option

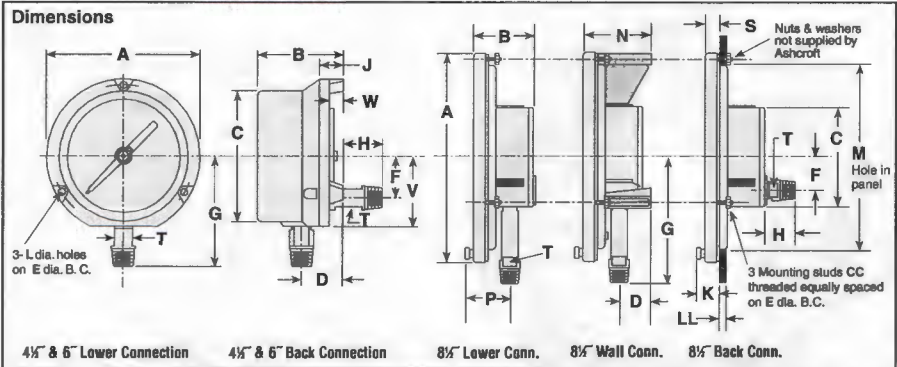
Compound				
Range	Figure Interval		Minor Grads	
	in Hg	psi	in Hg	psi
30" Hg/15 psi	5	3	0.5	0.2
30" Hg/30 psi	10	5	1	0.5
30" Hg/60 psi	10	10	1	1
30" Hg/100 psi	10	10	2	1
30" Hg/150 psi	10	20	5	2
30" Hg/200 psi	30	20	5	2
30" Hg/300 psi	30	50	5	2

Vacuum		
Range	Figure Interval	Minor Grads
30/0 in. Hg	5 in	0.2 in
34/0 ft H ₂ O	5 ft	0.5 ft

TYPE 1278M SERIES FLUSH MOUNTING RING
Used to flush mount gauge case. Standard finish is black; optional polished stainless steel finish is available.



Gauge Size	Ring O.D.	"A" DIA.	"B" Size of 3 Screws	"C" Size of Washers	Spacer
4½	6 (152)	5½ (148)	#10-24 x 1½	7/16 x 1½ x 5/16	1
6	7¾ (197)	7¾ (185)	#¾-20 x 1	1½/16 x 1½ x 1/16	1½/16



Dial Size Inches	A	B	C	D	E	F	G	H	J	K	L	M	P	S	T	V	CC	LL	Wgt (lbs)
4½	5¼ (148)	3¾ (96)	4¾ (124)	1¾ (41)	5¾ (137)	1½ (42)	3¼ (100)	¾ (20)	1½ (27)	—	.218 (6)	—	2¼ (54)	—	¾ (16)	2¾ (67)	—	—	25 (Dry) 3.5 (LF)
6	7¾ (192)	3½ (89)	6¾ (162)	1¾ (41)	7 (178)	1½ (42)	4¼ (114)	¾ (20)	1½ (27)	—	.218 (6)	—	2¼ (54)	—	¾ (16)	2¾ (67)	—	¼-½ (3/13)	3.0 (Dry) 4.0 (LF)
8½	10¼ (256)	2½ (73)	4¾ (121)	1½ (27)	9¾ (244)	1¾ (41)	6 (152)	1¾ (35)	—	1½ (27)	—	9 (228)	—	1½ (17)	—	—	#10-24	—	4.5 (Dry) 5.5 (LF)

Order Coding Example

45	1379	S	S	04	L	XEPNH	100	#
----	------	---	---	----	---	-------	-----	---

SIZE	TYPE	SYSTEM (TUBE & SOCKET)	CASE DESIGN SOLID FRONT	PROCESS CONNECTION SIZE	CONNECTION LOCATION	OPTIONS (X VARIATIONS) ⁽¹⁾	RANGE	ENGINEERING UNITS ⁽¹⁾
(45) 4½	1379	(A) Bronze tube, Brass socket ⁽¹⁾ (P) K-Monel tube, Monel 400 socket ⁽²⁾ (R) 316L SS tube, steel socket (S) 316L ⁽²⁾	(S) Dry (IP54) (SH) Dry, Hermetically Sealed, Field Fillable (IP65) (SL) Liquid filled (glycerin standard) (IP65)	(02) 14 NPT male ⁽¹⁾ (04) 1/2 NPT male ⁽¹⁾ (09) 9/16-18 UNF-2B Aminco (standard for high pressure >20,000psi) ⁽¹⁾ Max pressure 20,000psi	(B) Back (D) Side (3:00) (E) Side (9:00) (L) Lower (T) Top (12:00)	(GV) Silicone case fill (GX) Halocarbon case fill (NH) St. St. Wired Tag (TS) Throttle screw ⁽²⁾ (6B) Oxygen service (PD) Acrylic window (SG) Safety glass (EP) Maximum pointer, adjustable (SH) Red set hand, stationary (LL) PLUS! Performance (56) Flush mounting ring (C4) Individual calibration chart ⁽¹⁾ Others on request ⁽²⁾ Standard with hermetically sealed or liquid filled gauge	See website for most common ranges offered	(#) PSI (BR) Bar (KG) Kilograms/CM2 (KP) Kilopascal (IN) Inches of Mercury Vacuum ⁽¹⁾ See website for more units of measure
(60) 6								
(85) 8½								

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All sales subject to standard terms and conditions.
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PRESSURE GAUGE INSTALLATION, OPERATION AND MAINTENANCE



THEORY

1. The first part of the theory is the definition of the system. This is done by specifying the input and output variables and the relationships between them. The second part is the derivation of the transfer function, which is a mathematical representation of the system's behavior. The third part is the analysis of the system's stability and performance. This is done by using various techniques such as the root locus method, the Nyquist criterion, and the Bode plot.



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1.0 SELECTION & APPLICATION

Users should become familiar with ASME B40.100 (Gauges – Pressure Indicating Dial Type – Elastic Element) before specifying pressure measuring gauges. That document – containing valuable information regarding gauge construction, accuracy, safety, selection and testing – may be ordered from:

ASME International
Three Park Avenue
New York, N.Y. 10016-5990
800-843-2763 (US/Canada)
001-800-843-2763 (Mexico)
973-882-1170 outside North America
email: infocentral@asme.org
www.asme.org

WARNING: To prevent misapplication, pressure gauges should be selected considering media and ambient operating conditions. Improper application can be detrimental to the gauge, causing failure and possible personal injury, property damage or death. The information contained in this manual is offered as a guide in making the proper selection of a pressure gauge. Additional information is available from Ashcroft Inc.

The following is a highlight of some of the more important considerations:

1.1 Range – The range of the instrument should be approximately twice the maximum operating pressure. Too low a range may result in (a) low fatigue life of the elastic element due to high operating stress and (b) susceptibility to overpressure set due to pressure transients that exceed the normal operating pressure. Too high a range may yield insufficient resolution for the application.

1.2 Temperature – Refer to Section 2 of this manual for important information concerning temperature related limitations of pressure gauges, both dry and liquid filled.

1.3 Media – The material of the process sensing element must be compatible with the process media. Use of a diaphragm seal with the gauge is recommended for process media that (a) is corrosive to the process sensing element; (b) contain heavy particulates (slurries) or (c) are very viscous including those that harden at room temperature.

1.4 Oxidizing media – Gauges for direct use on oxidizing media should be specially cleaned. Gauges for oxygen service should be ordered to variation X6B and will carry the ASME required dial marking “USE NO OIL” in red letters. Gauges for direct use on other oxidizing media may be ordered to variation X6W. They will be cleaned but carry no dial marking. *PLUS!* Performance gauges or Halocarbon filled gauge or diaphragm fill is required for use with oxidizing media; order variation XCF.

1.5 Pulsation/Vibration – Pressure pulsation can be dampened by several mechanisms; the patented *PLUS!* Performance gauge will handle the vast majority of applications. One exception to this is high frequency pulsation which is difficult to detect. The only indication may be an upscale zero shift due to movement wear. These applications should be addressed with a liquid filled gauge, or in extreme cases, a remotely mounted liquid filled gauge connected with a length of capillary line. The small diameter of the capillary provides excellent dampening, but can be plugged. The Ashcroft 1106 pulsation dampener and 1112 snubber are auxiliary devices which dampen pulsation with less tendency to plug.

1.6 Gauge fills. – Once it has been determined that a liquid filled gauge is in order, the next step is selecting the type of fill.

Glycerin satisfies most applications. While being the least expensive fill, its usable temperature range is 20/180°F. **Silicone** filled gauges have a broader service range: –40/250°F. Oxidizing media require the use of **Halocarbon**, with a service range of –40/250°F. Pointer motion will be slowed at the low end of the low end of these temperature ranges.

1.7 Mounting – Users should predetermine how the gauge will be mounted in service: stem (pipe), wall (surface) or panel (flush). Ashcroft wall or panel mounting kits should be ordered with the gauge. See Section 3.

2.0 TEMPERATURE

2.1 Ambient Temperature – To ensure long life and accuracy, pressure gauges should preferably be used at an ambient temperature between –20 and +150°F (–30 to +65°C). At very low temperatures, standard gauges may exhibit slow pointer response. Above 150°F, the accuracy will be affected by approximately 1.5% per 100°F. Other than discoloration of the dial and hardening of the gasketing and degradation of accuracy, non-liquid filled Type 1279 (phenolic case) and 1379 (aluminum case) Duragauge® gauge, with standard glass windows, can withstand continuous operating temperatures up to 250°F. Unigauge models 2½” and 3½” 1009 and 1008S liquid filled gauges can withstand 200°F but glycerin fill and the acrylic window of Duragauge® gauges will tend to yellow. Silicone fill will have much less tendency to yellow. Low pressure, liquid filled Types 1008 and 1009 gauges may have some downscale errors caused by liquid fill expansion. This can be alleviated by venting the gauge at the top plug (pullout the blue plug insert). To do this the gauge must be installed in the vertical position.

Although the gauge may be destroyed and calibration lost, gauges can withstand short times at the following temperatures: gauges with all welded pressure boundary joints, 750°F (400°C); gauges with silver brazed joints, 450°F (232°C) and gauges with soft soldered joints, 250°F (121°C). For expected long term service below –20°F (–30°C) Duragauge® and 4½” 1009 gauges should be hermetically sealed and specially lubricated; add “H” to the product code for hermetic sealing. Add variation X_{VY} for special lubricant. Standard Duralife® gauges may be used to –50°F (–45°C) without modification.

2.2 Accuracy – Heat and cold affect accuracy of indication. A general rule of thumb for **dry gauges** is 0.5% of full scale change for every 40°F change from 75°F. Double that allowance for gauges with hermetically sealed or liquid filled cases, except for Duragauge® gauges where no extra allowance is required due to the elastomeric, compensating back. Above 250°F there may exist very significant errors in indication.

2.3 Steam service – In order to prevent live steam from entering the Bourdon tube, a siphon filled with water should be installed between the gauge and the process line. Siphons can be supplied with ratings up to 4,000 psi. If freezing of the condensate in the loop of the siphon is a possibility, a diaphragm seal should be used to isolate the gauge from the process steam. Siphons should also be used whenever condensing, hot vapors (not just steam) are present. Super heated steam should have enough piping or capillary line ahead of the siphon to maintain liquid water in the siphon loop.

2.4 Hot or very cold media – A five foot capillary line assembly will bring most hot or cold process media within the recommended gauge ambient temperature range. For media above

750°F (400°C) the customers should use their own small diameter piping to avoid possible corrosion of the stainless steel. The five foot capillary will protect the gauges used on the common cryogenic (less than -300°F (200°C) gases, liquid argon, nitrogen, and oxygen.) The capillary and gauge must be cleaned for oxygen service. The media must not be corrosive to stainless steel, and must not plug the small bore of the capillary.

2.5 Diaphragm seals – A diaphragm seal should be used to protect gauges from corrosive media, or media that will plug the instrument. Diaphragm seals are offered in a wide variety of designs and corrosion resistant materials to accommodate almost any application and most connections. Visit www.ashcroft.com for details.

2.6 Autoclaving – Sanitary gauges with clamp type connections are frequently steam sterilized in an autoclave. Gauges equipped with polysulfone windows will withstand more autoclave cycles than those equipped with polycarbonate windows. Gauges equipped with plain glass or laminated safety glass **should not be autoclaved**. Gauge cases should be vented to atmosphere (removing the rubber fill/safety plug if necessary) **before** autoclaving to prevent the plastic window from cracking or excessively distorting. If the gauge is liquid filled, the fill should be drained from the case and the front ring loosened before autoclaving.

3.0 INSTALLATION

3.1 Location – Whenever possible, gauges should be located to minimize the effects of vibration, extreme ambient temperatures and moisture. Dry locations away from very high thermal sources (ovens, boilers etc.) are preferred. If the mechanical vibration level is extreme, the gauge should be remotely located (usually on a wall) and connected to the pressure source via flexible tubing.

3.2 Gauge reuse – ASME B40.100 recommends that gauges not be moved indiscriminately from one application to another. The cumulative number of pressure cycles on an in-service or previously used gauge is generally unknown, so it is generally safer to install a new gauge whenever and wherever possible. This will also minimize the possibility of a reaction with previous media.

3.3 Tightening of gauge – Torque should never be applied to the gauge case. Instead, an open end or adjustable wrench should always be used on the wrench flats of the gauge socket to tighten the gauge into the fitting or pipe. NPT threads require the use of a suitable thread sealant, such as pipe dope or teflon tape, and must be tightened very securely to ensure a leak tight seal.

CAUTION: Torque applied to a diaphragm seal or its attached gauge, that tends to loosen one relative to the other, can cause loss of fill and subsequent inaccurate readings. Always apply torque **only** to the wrench flats on the lower seal housing when installing filled, diaphragm seal assemblies or removing same from process lines.

3.4 Process isolation – A shut-off valve should be installed between the gauge and the process in order to be able to isolate the gauge for inspection or replacement without shutting down the process.

3.5 Surface mounting – Also known as wall mounting. Gauges should be kept free of piping strains. The gauge case mounting feet, if applicable, will ensure clearance between the pressure relieving back and the mounting surface.

3.6 Flush mounting – Also known as panel mounting. The applicable panel mounting cutout dimensions can be found at www.ashcroft.com

4.0 OPERATION

4.1 Frequency of inspection – This is quite subjective and depends upon the severity of the service and how critical the accuracy of the indicated pressure is. For example, a monthly inspection frequency may be in order for critical, severe service applications. Annual inspections, or even less frequent schedules, are often employed in non-critical applications.

4.2 In-service inspection – If the accuracy of the gauge cannot be checked in place, the user can at least look for (a) erratic or random pointer motion; (b) readings that are suspect – especially indications of pressure when the user believes the true pressure is 0 psig. Any gauge which is obviously not working or indicating erroneously, should be immediately valved-off or removed from service to avoid a possible pressure boundary failure.

4.3 When to check accuracy – Any suspicious behavior of the gauge pointer warrants that a full accuracy check be performed. Even if the gauge is not showing any symptoms of abnormal performance, the user may want to establish a frequency of bench type inspection.

4.4 When to recalibrate – This depends on the criticality of the application. If the accuracy of a 3-2-3% commercial type gauge is only 0.5% beyond specification, the user must decide whether it's worth the time and expense to bring the gauge back into specification. Conversely if the accuracy of a 0.25% test gauge is found to be 0.1% out of specification then the gauge should be recalibrated.

4.5 Other considerations – These include (a) bent or unattached pointers due to extreme pressure pulsation; (b) broken windows which should be replaced to keep dirt out of the internals; (c) leakage of gauge fill; (d) case damage – dents and/or cracks; (e) any signs of service media leakage through the gauge including its connection; (f) discoloration of gauge fill that impedes readability.

4.6 Spare parts – As a general rule it is recommended that the user maintain in inventory one complete Ashcroft® instrument for every ten (or fraction thereof) of that instrument type in service.

5.0 GAUGE REPLACEMENT

It is recommended that the user stock one complete Ashcroft® instrument for every ten (or fraction thereof) of that instrument type in service. With regard to gauges having a service history, consideration should be given to discarding rather than repairing them. Gauges in this category include the following:

- a. Gauges that exhibit a span shift greater than 10%. It is possible the Bourdon tube has suffered thinning of its walls by corrosion.
- b. Gauges that exhibit a zero shift greater than 25%. It is likely the Bourdon tube has seen significant overpressure leaving residual stresses that may be detrimental to the application.
- c. Gauges which have accumulated over 1,000,000 pressure cycles with significant pointer excursion.
- d. Gauges showing any signs of corrosion and/or leakage of the pressure system.
- e. Gauges which have been exposed to high temperature or exhibit signs of having been exposed to high temperature – specifically 250°F or greater for soft soldered systems; 450°F or greater for brazed systems; and 750°F or greater for welded systems.

- f. Gauges showing significant friction error and/or wear of the movement and linkage.
- g. Gauges having damaged sockets, especially damaged threads.
- h. Liquid filled gauges showing loss of case fill.

NOTE: ASME B40.100 does not recommend moving gauges from one application to another. This policy is prudent in that it encourages the user to procure a new gauge, properly tailored by specification, to each application that arises.

6.0 ACCURACY: PROCEDURES/DEFINITIONS

Accuracy inspection – Readings at approximately five points equally spaced over the dial should be taken, both upscale and downscale, before and after lightly rapping the gauge to remove friction. **A pressure standard with accuracy at least four times greater than the accuracy of the gauge being tested is recommended.**

Equipment – A finely regulated pressure supply will be required. It is critical that the piping system associated with the test setup be leaktight. The gauge under test should be positioned as it will be in service to eliminate positional errors due to gravity.

Method – ASME B40.100 recommends that **known** pressure (based on the reading from the pressure standard used) be applied to the gauge under test. Readings including any error from the nominal input pressure, are then taken from the gauge under test. The practice of aligning the pointer of the gauge under test with a dial graduation and then reading the error from the master gauge (“reverse reading”) can result in inconsistent and misleading data and should NOT be used.

Calibration chart – After recording all of the readings it is necessary to calculate the errors associated with each test point using the following formula: $ERROR \text{ in percent} = 100 \text{ times } (TRUE \text{ VALUE minus } READING) \div RANGE$. Plotting the individual errors (Figure 1) makes it possible to visualize the total gauge characteristic. The plot should contain all four curves: upscale – before rap; upscale – after rap; downscale – before rap; downscale – after rap. “Rap” means lightly tapping the gauge **before** reading to remove friction as described in ASME B40.100.

Referring to Figure 1, several classes of error may be seen:

Zero – An error which is approximately equal over the entire scale. This error can be manifested when either the gauge is

FIG. 1

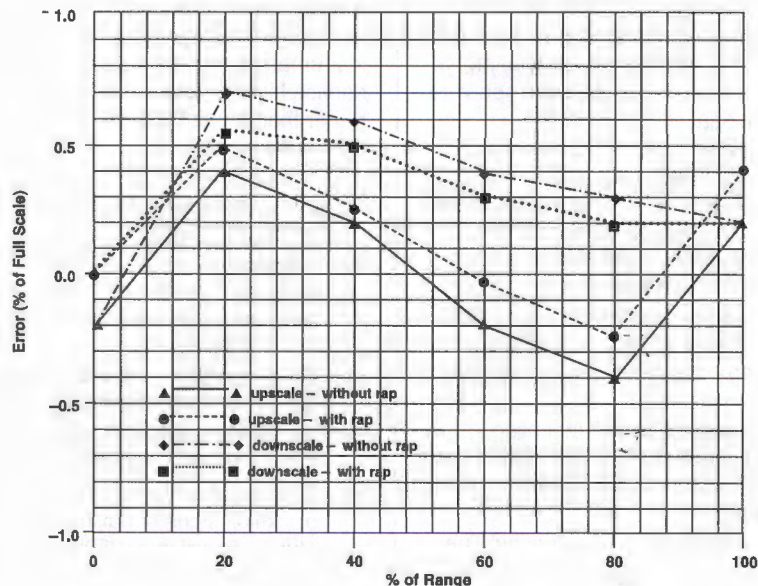
TYPICAL CALIBRATION CHART

INDICATED VALUE (PSI)

True Value – PSI	Increasing – Without RAP	Increasing – With RAP	Decreasing – Without RAP	Decreasing – With RAP
0	-.4	0	-.4	0
40	+.8	+1.0	+1.4	+1.1
80	+.4	+.5	+1.2	+1.0
120	-.4	-1.0	+.8	+.6
160	-.8	-.5	+.6	+.4
200	+.4	+.8	+.4	+.4

ERROR (% OF FULL SCALE)

True Value – % of Range	Increasing – Without RAP	Increasing – With RAP	Decreasing – Without RAP	Decreasing – With RAP
0	-.20	0	-.20	0
20	+.40	+.50	+.70	+.55
40	+.20	+.25	+.60	+.50
60	-.20	-.05	+.40	+.30
80	-.40	-.25	+.30	+.20
100	+.20	+.40	+.20	+.20



dropped or overpressured and the Bourdon tube takes a permanent set. This error may often be corrected by simply repositioning the pointer. Except for test gauges, it is recommended that the pointer be set at midscale pressure to "split" the errors.

Span – A span error exists when the error at full scale pressure is different from the error at zero pressure. This error is often proportional to the applied pressure. Most Ashcroft gauges are equipped with an internal, adjusting mechanism with which the user can correct any span errors which have developed in service.

Linearity – A gauge that has been properly spanned can still be out of specification at intermediate points if the response of the gauge as seen in Figure 1 (Typical Calibration Chart) is not linear. The Ashcroft Duragauge® pressure gauge is equipped with a rotary movement feature which permits the user to minimize this class of error. Other Ashcroft gauge designs (e.g., 1009 Duralife®) require that the dial be moved left or right prior to tightening the dial screws.

Hysteresis – Some Bourdon tubes have a material property known as hysteresis. This material characteristic results in differences between the upscale and downscale curves. This class of error can **not** be eliminated by adjusting the gauge movement or dial position.

Friction – This error is defined as the difference in readings before and after lightly tapping the gauge case at a check point. Possible causes of friction are burrs or foreign material in the movement gearing, "bound" linkages between the movement and the bourdon tube, or an improperly tensioned hairspring. If correcting these potential causes of friction does not eliminate excessive friction error, the movement should be replaced.

6.1 Calibration – Rotary Movement Gauges and Type 1259 Gauges – Inspect gauge for accuracy. Many times gauges are simply "off zero" and a simple pointer adjustment using the micrometer pointer is adequate. If inspection shows the gauge warrants recalibration to correct span and/or linearity errors, proceed as follows:

- Remove ring, window and, if solid front case, the rear closure assembly.
- Pressurize the gauge **once** to full scale and back to zero.
- Refer to Figure 2 (Ashcroft System Assembly w/Rotary Gear Movement) for a view of a typical Ashcroft rotary system assembly with component parts identified. Refer to

FIG. 2 ASHCROFT SYSTEM ASSEMBLY W/ROTARY GEAR MOVEMENT

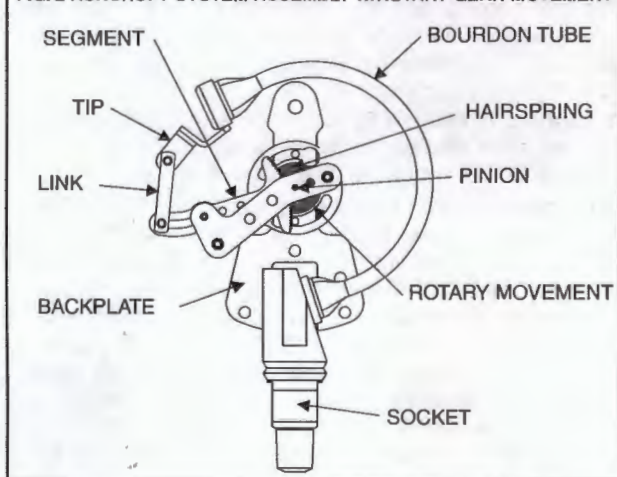


FIG. 2A ASHCROFT TYPE 1259 SYSTEM ASSEMBLY

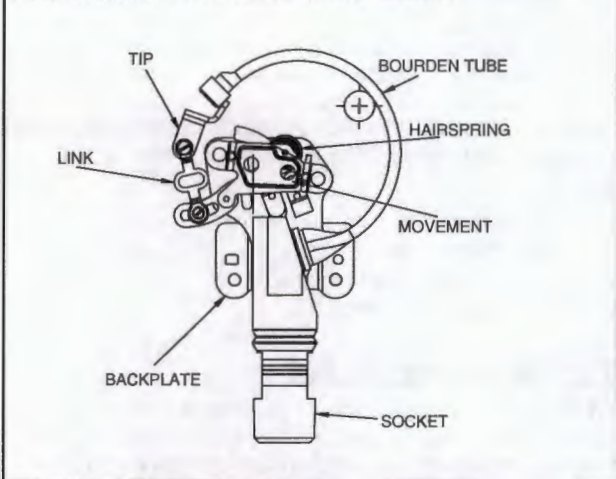
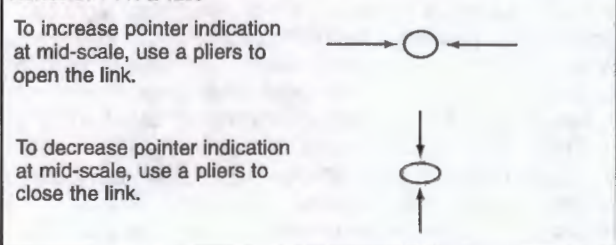


Figure 2A for link configuration of Type 1259 gauge.

- Adjust the micrometer pointer so that it rests at the true zero position. For open front gauges the pointer and dial must also be disassembled and the pointer should then be lightly pressed onto the pinion at the 9:00 o'clock position.
- Apply full scale pressure and note the magnitude of the span error. With open front gauges, ideal span (270 degrees) will exist when at full scale pressure the pointer rests exactly at the 6:00 o'clock position.
- If the span has shifted significantly (span error greater than 10%), the gauge should be replaced because there may be some partial corrosion inside the Bourdon tube which could lead to ultimate failure. If the span error exceeds 0.25%, loosen the lower link screw and move the lower end of the link toward the movement to increase span or away to decrease span. An adjustment of 0.004 inch will change the span by approximately 1%. This is a repetitive procedure which often requires more than one adjustment of the link position and the subsequent rechecking of the errors at zero and full scale pressure.
- Apply midscale pressure and note error in reading. Even though the gauge is accurate at zero and full scale, it may be inaccurate at the midpoint. This is called linearity error. For corrections to linearity with the Type 1259

FIG. 2B LINEARITY ADJUSTMENT & LINK CONFIGURATION FOR ASHCROFT TYPE 1259



gauges refer to Figure 2B. For rotary movement gauges, note the following: if the error is positive, the movement should be rotated counter clockwise. Rotating the movement one degree will change this error by approximately 0.25%. Rotating the movement often affects span and it should be subsequently rechecked and readjusted if necessary according to step 6.1e and 6.1f.

- While recalibrating the gauge, the friction error – difference in readings taken with and without rap – should be

noted. This error should not exceed the basic accuracy of the gauge. If the friction error is excessive, the movement should be replaced. One possible cause of excessive friction is improper adjustment of the hairspring. The hairspring torque, or tension, must be adequate without being excessive. The hairspring should also be level, unwind evenly (no turns rubbing) and it should never tangle.

NOTES:

- 1 For operation of test gauge external zero reset, refer to page 17.
- 2 For test gauge calibration procedure, refer to Figure 2 on page 18.

7.0 DIAPHRAGM SEALS

7.1 General – A diaphragm seal (isolator) is a device which is attached to the inlet connection of a pressure instrument to isolate its measuring element from the process media. The space between the diaphragm and the instrument's pressure sensing element is solidly filled with a suitable liquid.

Displacement of the liquid fill in the pressure element, through movement of the diaphragm, transmits process pressure changes directly to a gauge, switch or any other pressure instrument. When diaphragm seals are used with pressure gauges, an additional 0.5% tolerance must be added to the gauge accuracy because of the diaphragm spring rate.

Used in a variety of process applications where corrosives, slurries or viscous fluids may be encountered, the diaphragm seal affords protection to the instrument where:

- The process fluid being measured would normally clog the pressure element.
- Pressure element materials capable of withstanding corrosive effects of certain fluids are not available.
- The process fluid might freeze due to changes in ambient temperature and damage the element.

7.2 Installation – Refer to bulletin OH-1 for information regarding (a) seal configurations; (b) filling fluids; (c) temperature range of filling fluids; (d) diaphragm material pressure and temperature limits; (e) bottom housing material pressure and temperature limits; (f) pressure rating of seal assembly; (g) accuracy/temperature errors of seal assembly; (h) diaphragm seal displacement. The volumetric displacement of the diaphragm must at least equal the volumetric displacement of the measuring element in the pressure instrument to which the seal is to be attached.

It is imperative that the pressure instrument/diaphragm seal assembly be **properly** filled prior to being placed in service. Ashcroft diaphragm seal assemblies should only be filled by a seal assembler certified by Ashcroft Inc. Refer to section 3.3 for a cautionary note about not applying torque on either the instrument or seal relative to the other.

7.3 Operation – All Ashcroft® diaphragm seals, with the exception of Type 310 mini-seals, are continuous duty. Should the pressure instrument fail, or be removed accidentally or deliberately, the diaphragm will seat against a matching surface preventing damage to the diaphragm or leakage of the process fluid.

7.4 Maintenance – Clamp type diaphragm seals – Types 100, 200 and 300 – allow for replacement of the diaphragm or diaphragm capsule, if that ever becomes necessary. The Type 200 top housing must also be replaced with the diaphragm. With all three types the clamping arrangement allows field disassembly to permit cleaning of the seal interior.

7.5 Failures – Diaphragm failures are generally caused by either corrosion, high temperatures or fill leakage. Process media build-up on the process side of the diaphragm can also require seal cleaning or replacement. Consult Customer Service, Stratford CT for advice on seal failures and/or replacement.

WARNING: All seal components should be selected considering process and ambient operating conditions to prevent misapplication. Improper application could result in failure, possible personal injury, property damage or death.

8.0 DAMPENING DEVICES

8.1 General – Some type of dampening device should be used whenever the pressure gauge may be exposed to repetitive pressure fluctuations that are fairly rapid, high in magnitude and especially when transitory pressure spikes exceeding the gauge range are present (as with starting and stopping action of valves and pumps). A restricted orifice of some kind is employed through which pressure fluctuations must pass before they reach the Bourdon tube. The dampener reduces the magnitude of the pressure pulse thus extending the life of the Bourdon tube and movement. This reduction of the pressure pulsation as "seen" by the pressure gauge is generally evidenced by a reduction in the pointer travel. If the orifice is very small the pointer may indicate the average service pressure, with little or no indication of the time varying component of the process pressure.

Commonly encountered media (e.g. – water and hydraulic oil) often carry impurities which can plug the orifice over time thus rendering the gauge inoperative until the dampener is cleaned or replaced.

Highly viscous media and media that tend to periodically harden (e.g., asphalt) require a diaphragm seal be fitted to the gauge. The seal contains an internal orifice which dampens the pressure fluctuation within the fill fluid.

8.2 Throttle Screws & Plugs – These accessories provide dampening for the least cost. They have the advantage of fitting completely within the gauge socket and come in three types: (a) a screwed-in type which permits easy removal for cleaning or replacement; (b) a pressed in, non-threaded design and (c) a pressed in, threaded design which provides a highly restrictive, helical flow path. Not all styles are available on all gauge types.

8.3 Ashcroft Pulsation Dampener – Type 1106 Ashcroft pulsation dampener is a moving pin type in which the restricted orifice is the clearance between the pin and any one of five preselected hole diameters. Unlike a simple throttle screw/plug, this device has a self-cleaning action in that the pin moves up and down under the influence of pressure fluctuations.

8.4 Ashcroft Pressure Snubber – The heart of the Type 1112 pressure snubber is a thick porous metal filter disc. The disc is available in four standard porosity grades.

8.5 Ashcroft Needle Valves – Type 7001 thru 7004 steel needle valves provide varying degrees of dampening. These devices, in the event of plugging, can easily be opened to allow the pressure fluid to clear away the obstruction.

8.6 Chemiquip® Pressure Limiting Valves – Model PLV-255, PLV-2550, PLV-5460, PLV-5500 and PLV-6430, available with and without built-in snubbers, automatically "shut off" at adjustable preset values of pressure to protect the gauge from damage to overpressure. They are especially useful on hydraulic systems wherein hydraulic transients

(spikes) are common.

9.0 TEST EQUIPMENT & TOOL KITS

See our website www.ashcroft.com for more details

9.1 Pressure Instrument Testing Equipment

Type 1305D Deadweight Tester

Type 1327D Pressure Gauge Comparator

Type 1327CM "Precision" Gauge Comparator

9.2 Tools & Tool Kits For Recalibration of 4½" and Larger Gauges

Type 2505 universal carrying case for 1082 test gauge

Type 266A132-01 span wrench for 1082 test gauge

Type 1281 socket O-Ring kit for 1279/1379 lower connect

Type 1285 4½" ring wrench for 1279/1379 lower & back connect

Type 1286 6" ring wrench for 1379 lower & back connect

Type 3220 pointer puller (all gauges except 1009 Duralife®)

Type 3530 pinion back-up tool for 1009 Duralife®

Type 3220 Handjack set

Type 1105 Tool Kit

9.3 Kits to Convert a Dry Gauge to a Liquid Filled or Weather Proof Case Gauge

Type 1280 conversion kit for 4½" lower connect
1279/1379

Type 1283 conversion kit for 4½" back connect
1279/1379

Type 1284 conversion kit for 6" lower & back connect



TYPE 1105
TOOL KIT

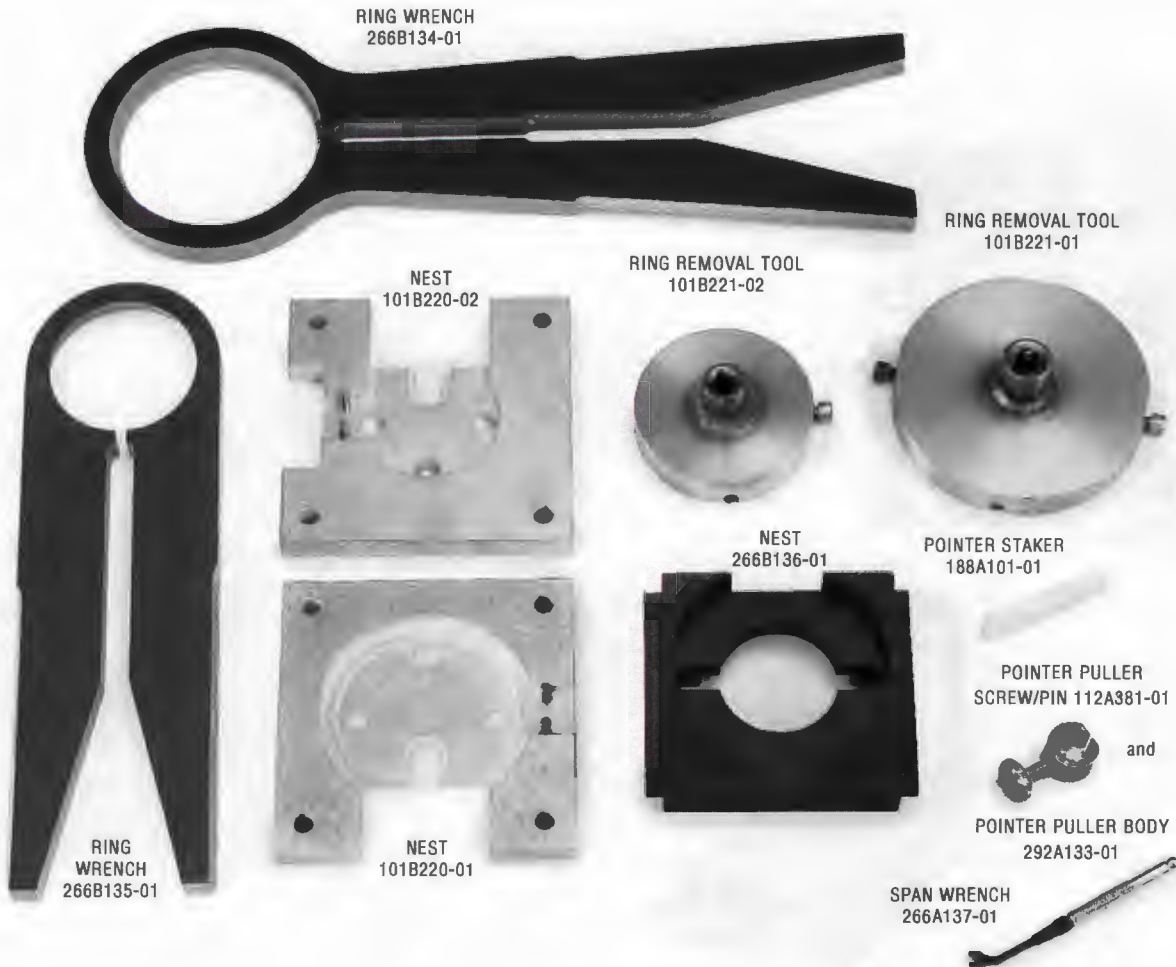
TYPE 3220
HAND JACK SET

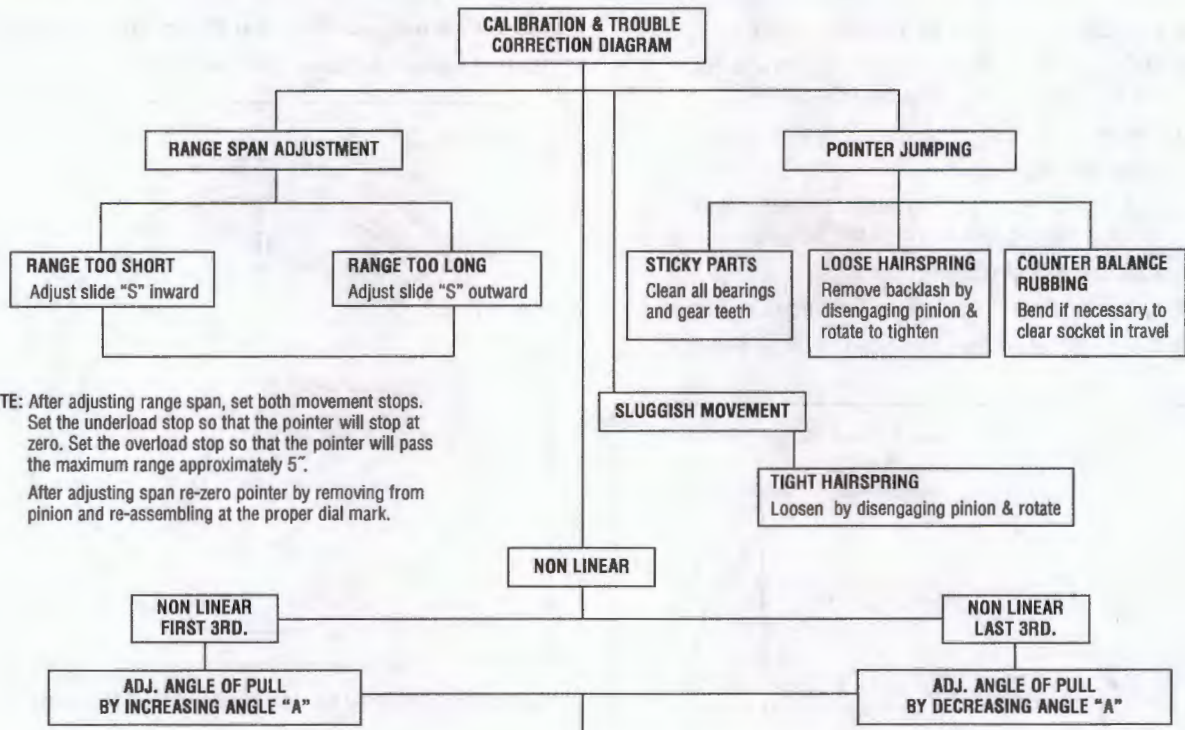


9.4 2½ & 3½ 1009 Duralife® Gauge Tools

Description	Part No.
Pointer Puller Screw/Pin ⁽²⁾⁽³⁾⁽⁴⁾	112A381-01
Pointer Puller Body ⁽²⁾⁽³⁾⁽⁴⁾	292A133-01
Pointer Staker ⁽²⁾⁽⁴⁾	188A101-01
Span Wrench ⁽²⁾⁽⁵⁾ (to adjust span)	266A137-01
Ring Wrench 3½" ⁽¹⁾⁽⁵⁾ (for ring removal) (35 1009)	266B134-01
Ring Wrench 2½" ⁽¹⁾⁽⁵⁾ (for ring removal) (25 1009)	266B135-01
Nest 2½" & 3½" ⁽¹⁾⁽⁵⁾ (to hold gauge for ring removal) (25/35 1009)	266B136-01
Ring Removal Tool ⁽⁶⁾ (25 1009)	101B221-02
Ring Removal Tool ⁽⁶⁾ (35 1009)	101B221-01
Nest 2½" ⁽⁶⁾ (to hold gauge for ring removal) (25 1009)	101B220-02
Nest 3½" ⁽⁶⁾ (to hold gauge for ring removal) (35 1009)	101B220-01
Type 1230 throttle plug insertion (¼ NPT) for 1009 Duralife [®]	1230
Type 1231 throttle plug insertion (¼ NPT) for 1009 Duralife [®] (body only)	1231
Tool to open orifice on push-in throttle plug	101A206-01

- (1) Formerly 1206T Tool Kit.
- (2) Formerly some parts in 1205T Tool Kit.
- (3) Both parts must be purchased together.
- (4) Previous and current design.
- (5) Previous design only.
- (6) Current design only.





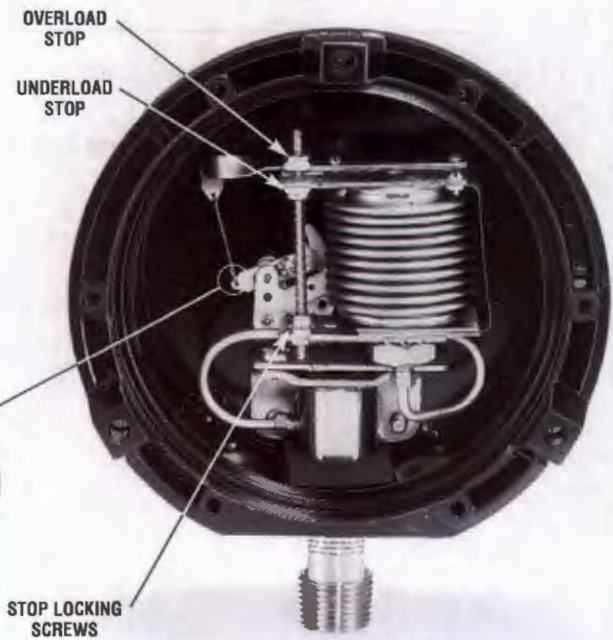
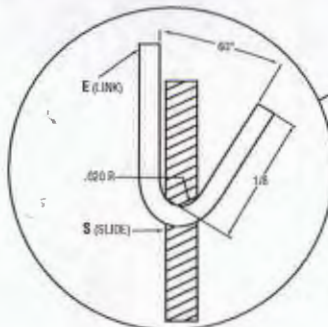
NOTE: After adjusting range span, set both movement stops. Set the underload stop so that the pointer will stop at zero. Set the overload stop so that the pointer will pass the maximum range approximately 5". After adjusting span re-zero pointer by removing from pinion and re-assembling at the proper dial mark.

NOTE: To increase or decrease angle "A," bend tip inward or outward as required. Doing this may run the movement segment off the pinion. This can be corrected by cutting off one end off the link "E" decreasing its length, or makin a new length from .032 dia. phos. bronze wire.
Caution: When reproducing link end, follow figure 44 very closely. this will prevent too much play, or, binding in operation.

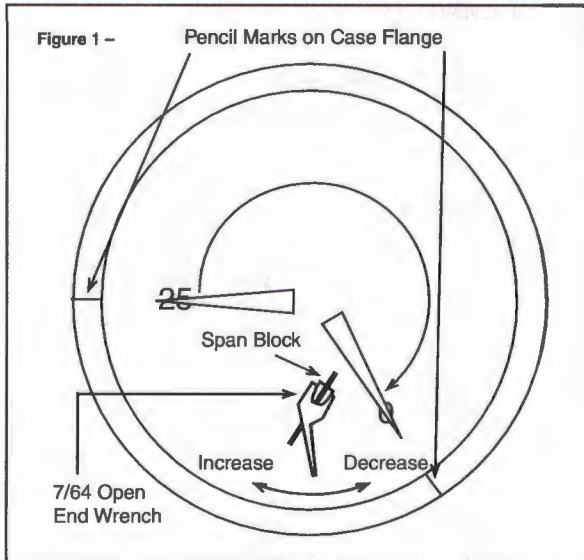
REF: Replacing System Bellows

After assembling bellows to the gauge socket securely, subject system to 30 psi for five minutes, allowing bellows to travel approximately 1/8" against the overload stop. After this, heat treat system for 15 hours at 250°F, this procedure is necessary to prevent gauge drift.

SLIDE AND LINK (angle "A")
Enlarged view of slide and link



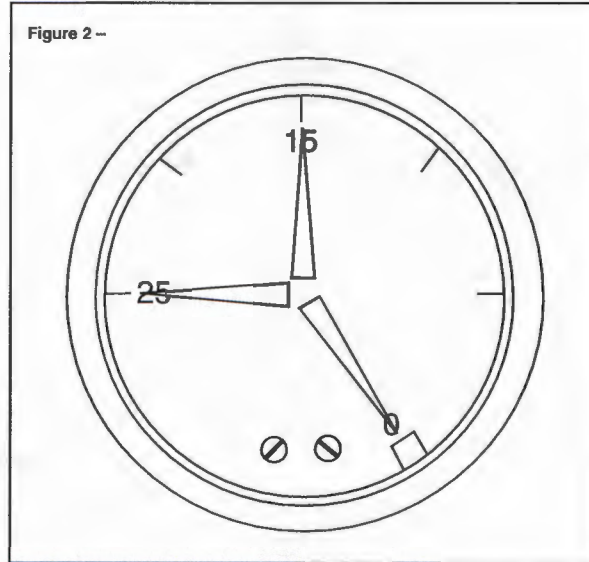
1. Remove ring, window and gasket pointer.
2. Using a pencil, refer to dial and mark the 0 and 25" Hg positions on the case flange.
3. Remove dial.
4. Apply 25" Hg vac.
5. Lightly press pointer onto pinion carefully aligning it with the 25" Hg vac. mark on the flange.
6. Release vacuum fully.
7. Note agreement of pointer to zero mark on flange.
8. If span is high or low, turn span block as shown in Figure 1.



9. Repeat steps 4 through 8 until span is correct.
10. Remove pointer.
11. With 25" Hg vac applied, reassemble dial, dial screws (finger tight) and point.
12. Apply 15" Hg vac. and note accuracy of indication. If required, slide dial left or right to reduce error to 1% maximum.
13. Firmly tighten dial screws.
14. Firmly tap pointer onto pinion.

15. recheck accuracy at 15 and 25" Hg vac. (Figure 2).
16. Reassemble window, gasket and ring.

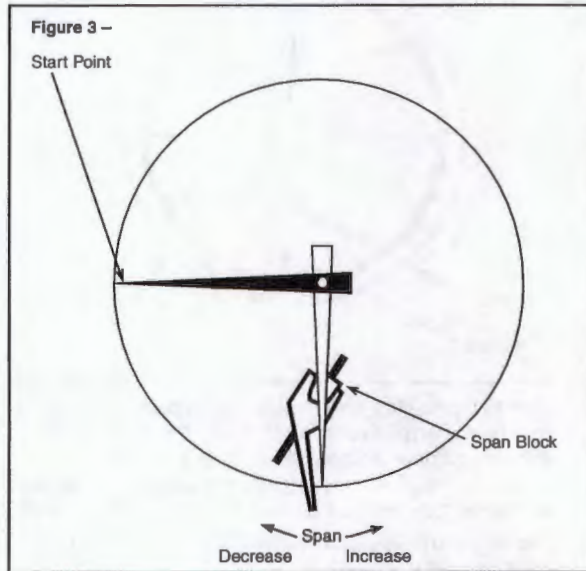
Figure 2 --



Notes: See page 10 for any tools required to calibrate.

**For models produced prior to
September 2008 for 2½" version and
December 2008 for 3½" version.
Back of gauge will have a date code sticker.**

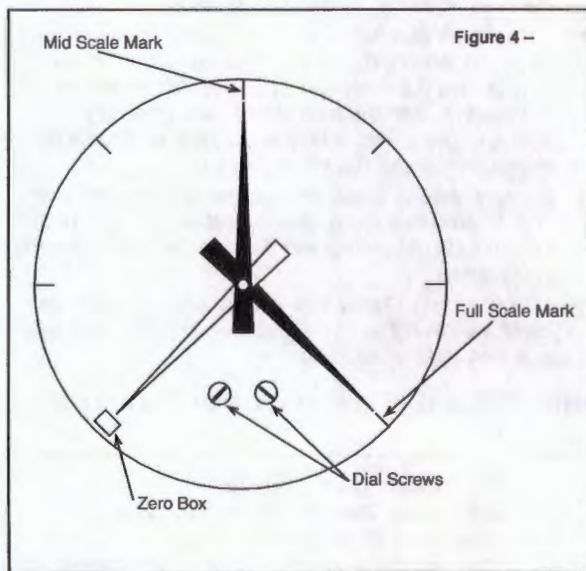
Step 1. With the dial off, install pointer at 9 o'clock "lightly,"
Figure 3.



Step 2. Go to full scale pressure...rotate span block with tool until pointer rests at 6 o'clock.

Step 3. Go to zero pressure (9 o'clock)...if pointer has not moved away from start point, go to Step 4. If pointer has moved, repeat Step 1 until span is correct.

Step 4. Install dial with screws snug.



Step 5. Install pointer centered in zero box, Figure 4.

Step 6. Go to full scale pressure...check that pointer is within 1% of full scale mark. If not, remove pointer and dial and return to step 1, Figure 4.

Step 7. Go to mid-scale pressure...rotate dial until mid-scale mark is aligned with pointer, Figure 4.

Step 8. Tighten dial screws and stake on pointer.

Step 9. Check zero and full scale. Reassemble window, gasket and ring.

Notes: See page 10 for any tools required to calibrate.

For models produced prior to September 2008 for 2½" version and December 2008 for 3½" version.
Back of gauge will have a date code sticker.

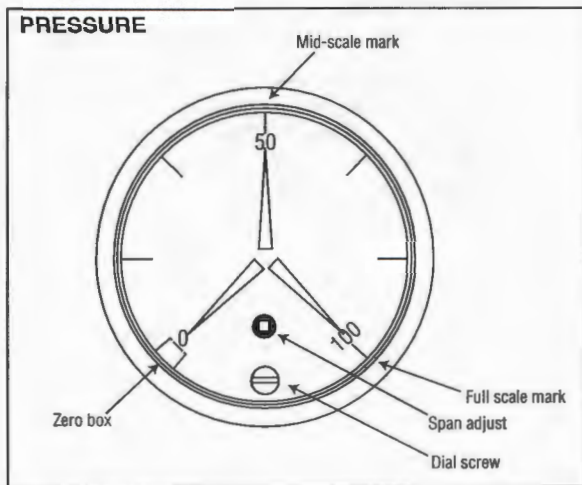
ASHCROFT® Current Type 1009 Duralife® Calibration Procedure – Pressure and Vacuum Range



Calibration – 1009 Duralife® Gauge –

Inspect gauge for accuracy. At times gauges are simply “off zero” and opening the ventable plug at the top of the gauge will relieve internal gauge pressure and correct the offset. If this is not adequate and inspection shows that the gauge warrants recalibration to correct zero, span and/or linearity errors, proceed as follows:

Remove ring, window, and gasket using Ashcroft Ring Removal Tools P/N 101B220-02 and 101B221-02 for 2½” gauges and 101B220-01 and 101B221-01 for 3½” gauges.

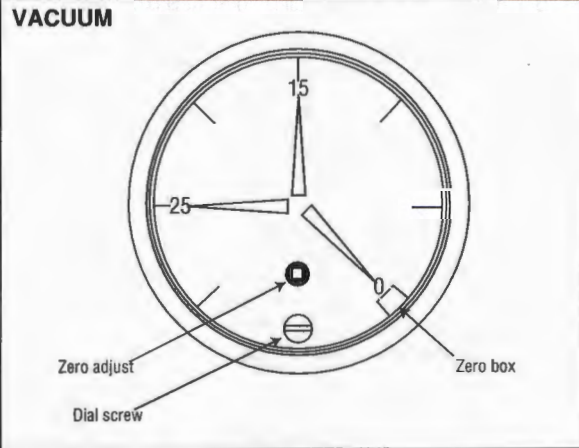


Positive Pressure Ranges –

1. Adjust pointer with a slotted screwdriver until it is in the center of the zero box. This is often all that is required to correct calibration issues.
2. Apply full scale pressure. If error exceeds 1% rotate the black span adjustment device with a #0 square drive bit. Clockwise increases span, counterclockwise decrease span.
3. Fully exhaust pressure and check that pointer still is still in the zero box. If not, repeat step 1 and 2
4. Once 0 and full scale are within tolerance, pressurize gauge to mid-scale.
5. If gauge is within 1%, calibration is complete. If not loosen the dial screw and rotate dial left or right to adjust midpoint. Retighten dial screw.
6. If an adjustment was made in step 5, recheck the gauge at zero and full scale, adjust accordingly until zero, mid and full scale points are in tolerance.

Vacuum Range –

1. Adjust pointer with a slotted screwdriver until it is in the center of the zero box. This is often all that is required to correct calibration issues.
2. Apply 25 inches Hg vacuum. If the error exceeds 1% adjust pointer with a slotted screwdriver until gauge is within tolerance.



3. Vent to 0 pressure and check pointer position in the zero box. If error exceeds 1% rotate the black span adjustment device with a #0 square drive bit. Clockwise rotation moves pointer clockwise, counterclockwise rotation moves the pointer counterclockwise.
4. Repeat step 1 and 2 until 0 and 25 inches of Hg are within gauge tolerance.
5. Apply 15 inches Hg vacuum. If gauge is within 1%, calibration is complete. If not loosen the dial screw and rotate dial left or right to adjust midpoint. Retighten dial screw.
6. If an adjustment was made in step 4, recheck the gauge at zero and 25 inches of Hg vacuum, adjust accordingly until zero, 15 and 25 inches Hg are in tolerance.
7. Continue below.
Re-assemble window and ring to gauge:
 - a. If plastic window is used, push window back into front of gauge, ensure the o-ring does not roll out of window groove (lubricate if necessary). Align the tabs of the window with the tabs of the case front. Once window is in place, install ring and tighten with tools referenced above and shown on page 10.
 - b. If safety glass is used, reinstall window, gasket, and ring. Ensure that the gasket is seated properly under all four tabs of the ring and does not wrinkle when ring is tightened.

Note: Tighten ring: Apply 120-200inlb of torque. Rotate ring clockwise to tighten. Warning: over tightening of safety glass may induce cracking.

Notes: See page 10 for any tools required to calibrate.

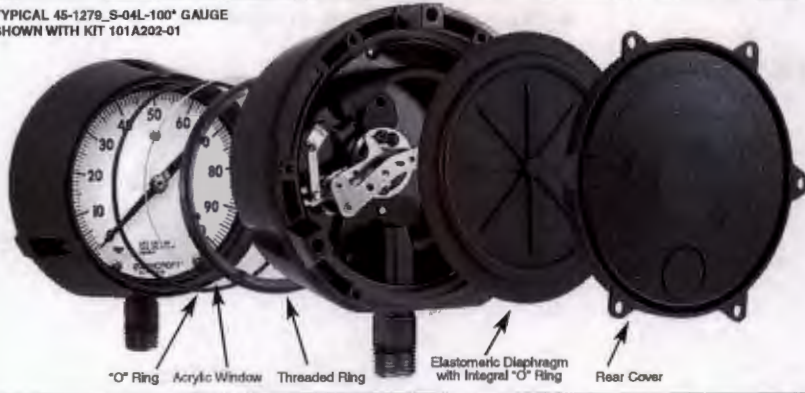
For models produced after September 2008 for 2½” version and December 2008 for 3½” version. Back of gauge will have a date code sticker.

**TYPE 1279 & 1379 SOLID FRONT DURAGAUGE®
PRESSURE GAUGE CONVERSION INSTRUCTIONS TO:**

- Convert A Standard Dry Gauge To A Liquid Filled Gauge
- Convert A Standard Dry Gauge To A Dry, Weatherproof IP66 Gauge

ASHCROFT®

TYPICAL 45-1279_S-04L-100° GAUGE
SHOWN WITH KIT 101A202-01



	1279		1379		
	4½" LOWER	4½" BACK	4½" LOWER	4½" BACK	6" LOWER & BACK
KIT PART NO.	101A202-01	101A203-01	1280	1283	1284
	QUANTITY INCLUDED				
ACRYLIC WINDOW	1	1	1	1	1
FRONT O-RING	1	1	1	1	1
DIAPHRAGM ⁽¹⁾	1	1	1	1	2(1-LC:1-BC)
REAR COVER	1	1	1	1	2(1-LC:1-BC)
COVER SCREWS	4	4	-	-	-
THROTTLE SCREWS	2	2	2	2	2
GARTER SPRING	-	1	1	1	1
FILL IDENTIFICATION	1	1	1	1	1
THREADED RING	-	-	1	1	1
TOP FILL PLUG	-	-	1	1	-

1. When Halocarbon fill is a requirement, rear case diaphragm bladder material is Viton instead of the standard Buna diaphragm bladder. Consult factory for part number.

	TEMPERATURE LIMITS ¹			60 psi and Under Down Scale Zero Shift Required
	Ambient	Process	Storage	
Dry (IP66)	-20/200°F (-29/93°C)	-20/250°F ⁽¹⁾ (-29/121°C)	-40/250°F (-40/121°C)	NONE
LF (glycerin)	20/150°F (7/66°C)	20/200°F (7/93°C)	0/150°F (-18/66°C)	NONE
(silicone)	-40/150°F (-40/66°C)	-40/200°F (-40/93°C)	-40/150°F (-40/66°C)	.12 psi
(halocarbon)	-40/150°F (-40/66°C)	-40/200°F (-40/93°C)	-40/150°F (-40/66°C)	.12 psi

Note: Other than discoloration of the dial and hardening of the gasketing that may occur as ambient or process temperatures exceeds 150°F, non-liquid-filled gauges with standard glass windows, can withstand continuous operating temperatures up to 250°F (121°C). Liquid-filled gauges can withstand 200°F (93°C) but glycerin fill and acrylic window will tend to yellow. Accuracy at temperatures above or below the reference ambient temperature of 68°F will be affected by approximately .4% per 25°F. Gauges with welded joints will withstand 750°F (450°F (232°C) with silver brazed joints) for short times without rupture, although other parts of the gauge will be destroyed and calibration will be lost. For continuous use and for process or ambient temperatures above 250°F (121°C), a diaphragm seal or capillary or siphon is recommended.

(1) Available for temperature below -20°F, see Production Information page ASH-PI-21B for details

1. Unscrew front threaded ring (turn CCW). Remove and discard glass window. For range spans 60 psi and under, shift pointer down scale by the amount shown in the table. With either the glass or plastic window, replace the O-ring with one furnished in the kit.
2. Remove protective paper from acrylic plastic window taking care not to scratch window. Assemble window in gauge.
3. Moisten face of threaded ring with silicone oil or silicone grease where ring bears up against window. Replace front threaded ring and tighten firmly hand tight. See instructions on reverse side for applying proper torque to ring to establish desired squeeze on O-ring seal. (Fig. 4).

It is important to hold gauge rigidly, otherwise ring lugs may be damaged during removal or assembly process.

4. From rear of gauge, remove and discard these parts: rear cover and cover gaskets from case. **Note:** Disregard Step Nos. 5a and 5b if converting to hermetically sealed version. When converting a 45-1379 with the top fill hole configuration, p/n 256A176-01 fill plug is required and must be ordered separately.
5. **Filling Procedures:**
 - a. **Manual Filling Procedure:** Place gauge face down on bench and tip gauge by blocking up front with a ¾ inch block at the 12 o'clock dial position. Tipping of the gauge is necessary so fluid will flow into

front cavity of the case. Pour in fill liquid to within about ¼ inch of rear seal lip. When bubbles stop rising, front cavity is filled. Remove ¾ inch block and pour in liquid until level is about ¼ inch below rear sealing lip.

Note: An alternative method of filling is to fill the front dial cavity, adding the front window, etc., as in Step No. 3. Then fill the rear of the gauge. This method eliminates the need to tip the gauge.

- b. **Vacuum Pump Fill Procedure:** (This procedure is recommended when filling a large number of gauges.) Place gauge face down and insert a ¼ inch diameter tube, connected to a vacuum pump, through the 12 o'clock position hole in the rear, solid front portion of the case (see Fig. 5). Evacuate the air from the front dial cavity while pouring in the fill fluid through the case back. The vacuum will displace the air with fluid. When the dial cavity is solidly filled, remove the tubing and continue to pour the fill fluid to within ¼ inch BELOW the O-ring channel lip.

Pre-measuring fill amount is not necessary with above methods. For reference, amount of fill is approximately 400 ml. or 14 fluid oz. (4½" GA.) and 455 ml. or 16 fluid oz. (6" GA.).

- c. **Note:** The liquid fill level should be ¾" (±½") as measured from the inside of the ring at the 12:00 o'clock position.

6. On lower connection gauges, assemble rear seal diaphragm to case.

For back connection gauges see instructions on reverse side. (Fig. 2/4).

7. **For 1279:**

Assemble rear cover and six self tapping screws in a criss-cross pattern and torque to 12 in lbs. (±2 in lbs.)

For 1379:

- Thread rear ring and torque to 200 in lbs
- Install stainless steel back cover using two screws. Torque screws to 14 in lbs. (±2 in lbs.)

8. Assemble throttle screw to threaded hole in socket.

Note: If system is monel (socket wrench flat stamped "PHS" or "PH") use monel throttle screw.

9. Check appropriate box on fill identification label, and peel off label back, and attach fill label to gauge case.

10. If gauge is to be repackaged:

- a. Include enclosed instruction sheet inside carton.

- b. Change type number on carton label to:
 - (1) Hermetically Sealed - 1279(*)SH.
 - (2) Liquid Filled - 1279(*)SL.

* Bourdon Tube System Code

Glycerin or silicone should not be used in applications involving Oxygen, Chlorine, Nitric Acid, Hydrogen Peroxide or other strong oxidizing agents, because of danger of spontaneous chemical reaction, ignition or explosion. Halocarbon should be specified. Products with this fill can be ordered from factory.

The use of fluids other than those listed in the table above (for example, Hydrocarbon-based oils) may result in leakage caused by a reaction between the fluid and the elastomeric seals. Consult the factory before filling with any other fluid.

**TYPE 1279 & 1379 SOLID FRONT DURAGAUGE®
PRESSURE GAUGE CONVERSION INSTRUCTIONS TO:**

- Convert A Standard Dry Gauge To A Liquid Filled Gauge
- Convert A Standard Dry Gauge To A Dry, Weatherproof IP66 Gauge



INSTRUCTIONS FOR USING CONE TOOL AND RING WRENCH

Garter Spring & Diaphragm Assembly (Back Connection Gauge Only)

- Place cone tool over socket shank as shown.
- Moisten lip of socket and outer O-ring surface with silicone oil or grease.
- Place diaphragm with rib side facing upward over cone into case groove. Diaphragm O-ring must be completely in socket-shank groove.
- Place garter spring over cone as shown and slide onto diaphragm in socket groove.
- Assemble rear cover with screws per step 7.

Front Ring Assembly (All Gauges)

- Assemble ring to case by hand to start.
- Place ring on wrench as shown.
- Use 1/2" drive extension and torque ring to 200 in. lb.

Alternate Method

- Tighten ring snugly by hand.
- Mark case and ring.
- Turn ring another 100 to 120 degrees (slightly less than 1/4 turn) using the ring wrench and 1/2" drive socket wrench or place the blunt end of a wooden or plastic dowel against a ring lug and tap with a hammer.

BACK CONNECTION ASSEMBLED GAUGE

Fig. 2

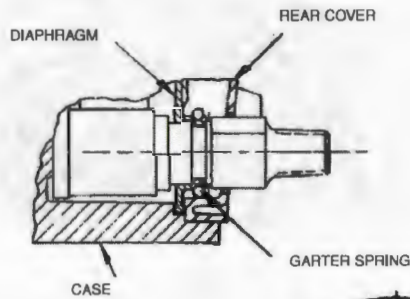


Fig. 3

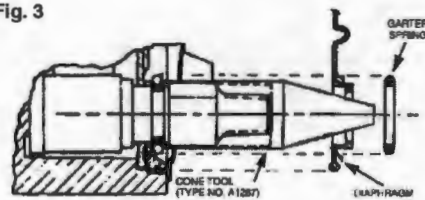
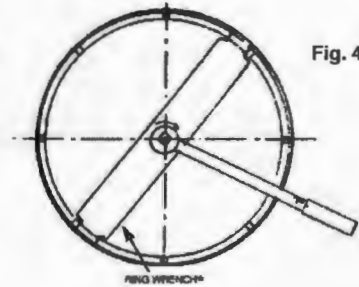


Fig. 4

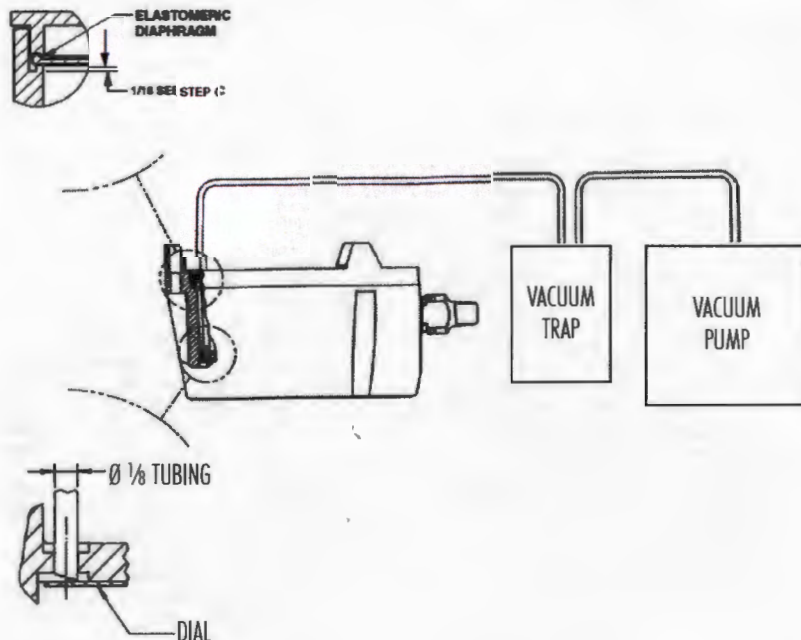


INSTRUCTIONS FOR LIQUID FILLING ASHCROFT® TYPE 1279 AND 1379 SOLID FRONT DURAGAUGE® PRESSURE GAUGES USING A VACUUM PUMP

- Insert a length of 1/8" diameter tubing through the 12 o'clock position hole in the rear, solid front portion of the case, as shown.
- Evacuate the air from the front dial cavity while pouring in the fill fluid through the case back. The vacuum will displace the air with fluid.*
- When the dial cavity is solidly filled, remove the tubing and continue to pour the fill fluid to within 1/8" below the o-ring channel lip, as shown.
- When converting a 45-1379 with the top fill hole configuration, p/n 256A176-01 fill plug is required and must be ordered separately.

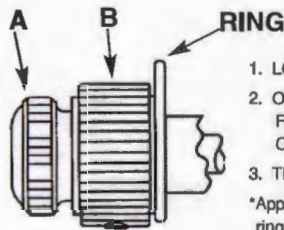
*To prevent breakage, reduce vacuum to 15 in. Hg for plain glass and safety glass.

Fig. 5



**INSTRUCTIONS FOR USE OF EXTERNAL
EASY ZERO™ ADJUST FEATURE***

Fig. 1



1. LOOSEN RING-LOCKING SCREW A.
2. OBTAIN REQUIRED ADJUSTMENT BY ROTATING KNOB B CLOCKWISE OR COUNTER-CLOCKWISE.
3. TIGHTEN SCREW A DOWN ON KNOB B.

*Applicable only for test gauge with hinged ring design.

**ADDITIONAL
CALIBRATION INSTRUCTIONS**

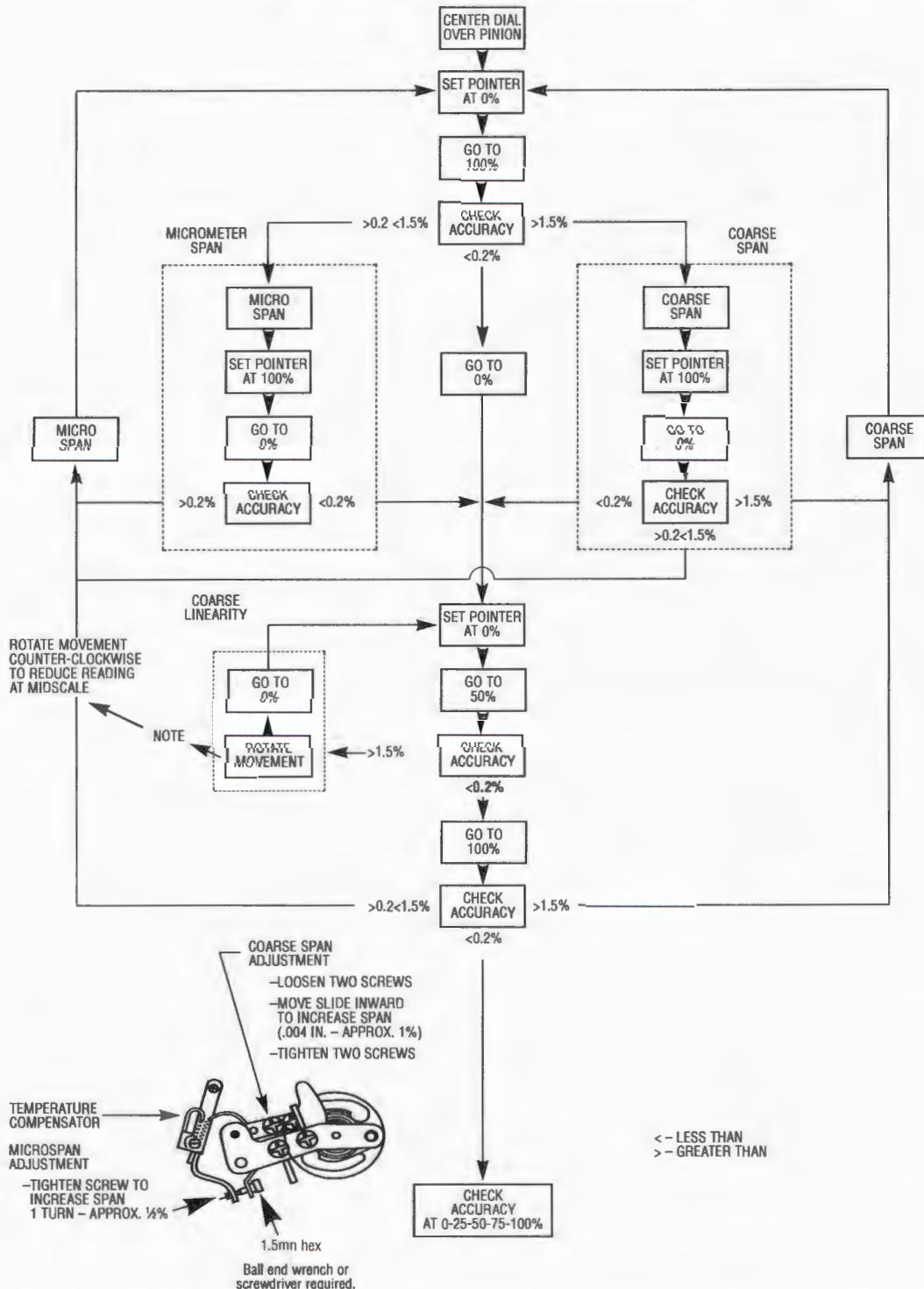
- 1) "Standards shall have nominal errors no greater than $\frac{1}{4}$ of these permitted for the gauge being tested."
(Ref: ASME B40-100-1998)
- 2) The instrument used as the calibration standard should have a maximum range no greater than 2x that of the gauge being tested. (i.e. Do not use a 400psi standard to test a 15psi gauge.)
- 3) "Known pressure shall be applied at each test point on increasing pressure (or vacuum) from one end to the other end of the scale. At each test point the gauge shall be . . .
lightly tapped, and then read . . ."
(Ref: ASME B40.1 ¶ 6.2.4.1)
- 4) To read gauge indication, move eye over red pointer tip at OD of printed dial until red reflection in mirror band is no longer visible, and then read the pointer position in reference to the dial.

**Installation and Maintenance Instructions for
ASHCROFT® Type 1082 Test Gauge
Calibration Procedure – Pressure Range**



Fig. 2

THIS TEST GAUGE IS PROVIDED WITH A MICROSPAN™ ADJUSTMENT TO SIMPLIFY CALIBRATION. THE FLOW CHART BELOW OUTLINES THE RECOMMENDED CALIBRATION PROCEDURE





McDonnell & Miller
a xylem brand

INSTRUCTION MANUAL

MM-217N



Series 150S and 157S

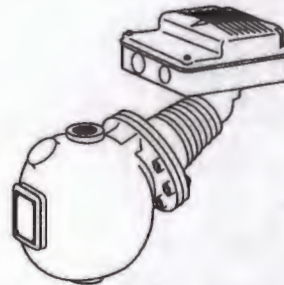
(Snap Switch, All Models except 157S-RB-P)

Low Water Cut-Off/Pump Controllers

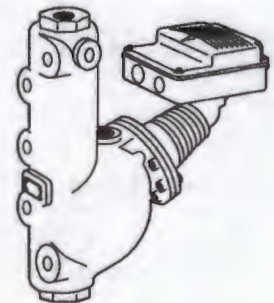
For Steam Boilers and Other Level Control Applications

Typical Applications:

- Primary or secondary pump controller/
low water fuel cut-off
for steam boilers
- Motorized valve controller
- Low water cut-off
- High water cut-off
- Alarm actuator



Series 150S



Series 157S



WARNING



- Before using this product read and understand instructions.
- Save these instructions for future reference.



- All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.

- To prevent serious burns, the boiler must be cooled to 80°F (27°C) and the pressure must be 0 psi (0 bar) before servicing.



- To prevent electrical shock, turn off the electrical power before making electrical connections.
- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.



- We recommend that secondary (redundant) Low Water Cut-Off controls be installed on all steam boilers with heat input greater than 400,000 BTU/hour or operating above 15 psf of steam pressure. At least two controls should be connected in series with the burner control circuit to provide safety redundancy protection should the boiler experience a low water condition. Moreover, at each annual outage, the low water cut-offs should be dismantled, inspected, cleaned, and checked for proper calibration and performance.

- To prevent serious personal injury from steam blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.



- To prevent a fire, do not use this low water cut-off to switch currents over 7.4A, 1/3 Hp at 120 VAC or 3.7A, 1/3 Hp at 240 VAC, unless a starter or relay is used in conjunction with it.
- California Proposition 65 warning! This product contains chemicals known to the state of California to cause cancer and birth defects or other reproductive harm.
- Previous controls should never be installed on a new system. Always install new controls on a new boiler or system.

Failure to follow this warning could cause property damage, personal injury or death.

CAUTION:

- A more frequent replacement interval may be necessary based on the condition of the unit at time of inspection. McDonnell & Miller's warranty is one (1) year from date of installation or two (2) years from the date of manufacture.

OPERATION

Maximum Pressure: 150 psi (10.5 kg/cm²)

Electrical Ratings

Voltage	Pump/Circuit Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	7.4	44.4	345 VA at
240 VAC	3.7	22.2	120 or 240 VAC

Alarm Circuit Rating	
Voltage	Amps
120 VAC	1
240 VAC	1/2

Motor Horsepower	
Voltage	Hp
120 VAC	1/3
240 VAC	1/3

Enclosure rating: NEMA 1 General Purpose

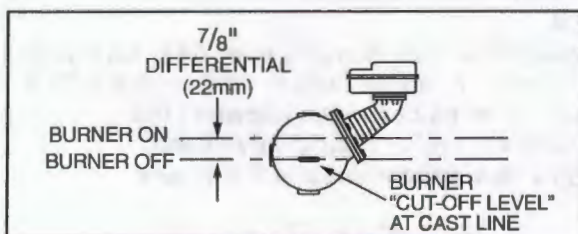
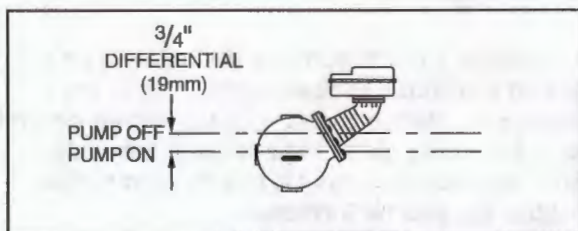
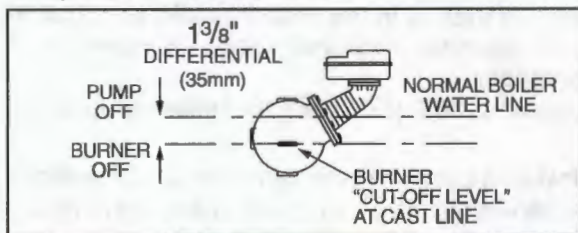
Settings and Differential Pressures

Values are ± 1/8" (3.2mm).

Series 150S, 157S

Pressure	Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
0 psi (0 kg/cm ²)	Pump Off	15/16 (24)	5/16 (8)
	Pump On	5/8 (16)	
	Burner On	5/8 (16)	3/8 (16)
	Burner Off	1/4 (6.4)	
150 psi (10.5 kg/cm ²)	Pump Off	13/8 (41)	3/4 (19)
	Pump On	5/8 (16)	
	Burner On	7/8 (22)	7/8 (22)
	Burner Off	0 (0)	

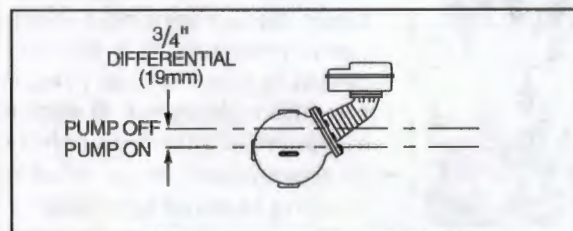
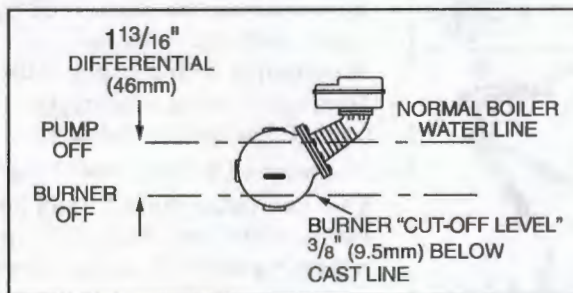
150 psi (10.5 kg/cm²) Levels



Model 150S-MD, and 157S-MD

Pressure	Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
0 psi (0 kg/cm ²)	Pump Off	15/16 (24)	3/8 (16)
	Pump On	9/16 (14)	
	Burner Off	0 (0)	N/A
150 psi (10.5 kg/cm ²)	Pump Off	17/16 (37)	3/4 (19)
	Pump On	11/16 (17)	
	Burner Off	- 3/8 (-16)	N/A

150 psi (10.5 kg/cm²) Levels



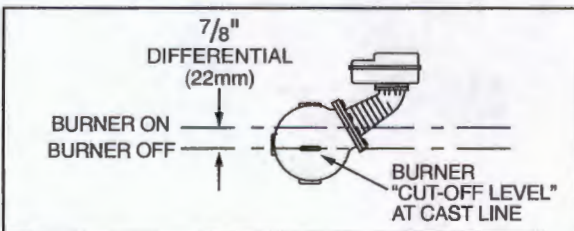
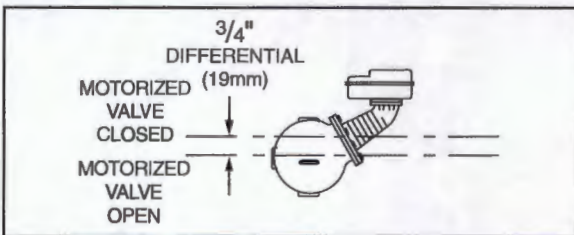
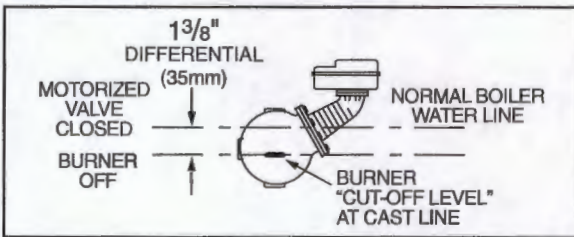
Settings and Differential Pressures (continued)

Values are $\pm 1/8"$ (3.2mm).

Model 158S

Pressure	Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
0 psi (0 kg/cm ²)	Motorized Valve Closed	15/16 (24)	5/16 (8)
	Motorized Valve Open	5/8 (16)	
	Burner On	5/8 (16)	3/8 (16)
	Burner Off	1/4 (6.4)	
150 psi (10.5 kg/cm ²)	Motorized Valve Closed	13/8 (41)	3/4 (19)
	Motorized Valve Open	5/8 (16)	
	Burner On	7/8 (22)	7/8 (22)
	Burner Off	0 (0)	

150 psi (10.5 kg/cm²) Levels

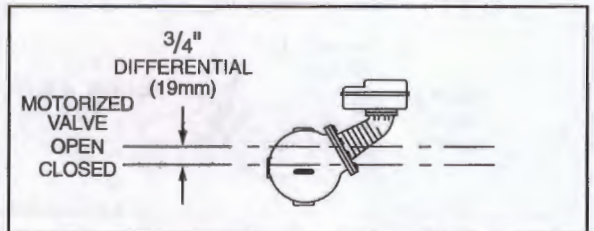
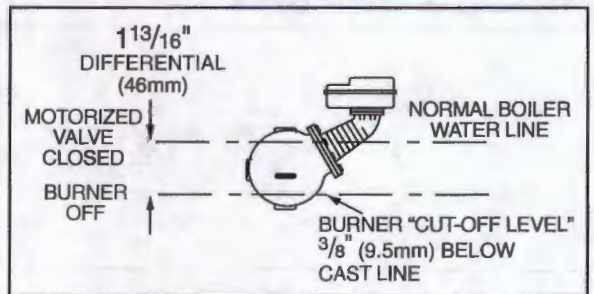


NOTE: Due to the slower operation of some motorized valves, complete valve opening or closing will occur at slightly different levels than indicated above.

Model 158S-MD

Pressure	Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
0 psi (0 kg/cm ²)	Pump Off	15/16 (24)	3/8 (16)
	Pump On	9/16 (14)	
	Burner Off	0 (0)	N/A
150 psi (10.5 kg/cm ²)	Pump Off	17/16 (37)	3/4 (19)
	Pump On	11/16 (17)	
	Burner Off	- 3/8 (-16)	N/A

150 psi (10.5 kg/cm²) Levels



NOTE: Due to the slower operation of some motorized valves, complete valve opening or closing will occur at slightly different levels than indicated above.

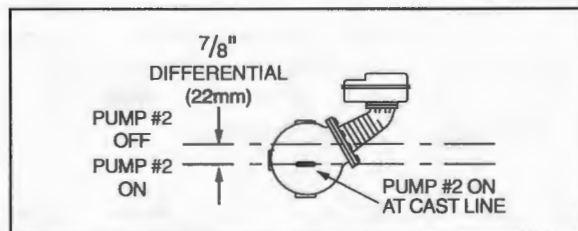
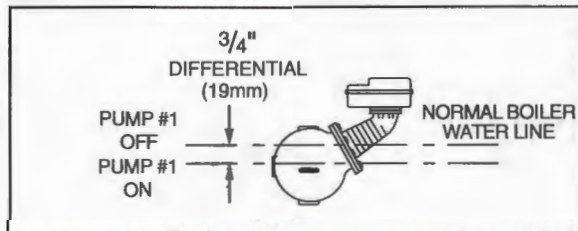
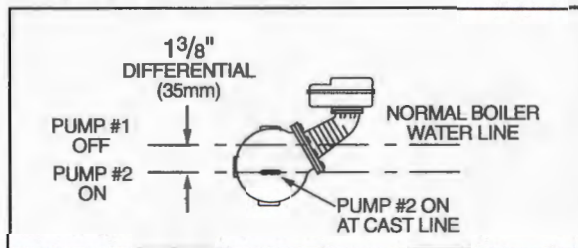
Settings and Differential Pressures (continued)

Values are $\pm 1/8"$ (3.2mm).

Model 159S

Pressure	Setting	Approximate Distance Above Cast Line In. (mm)	Differential In. (mm)
0 psi (0 kg/cm ²)	Pump #1 Off	15/16 (24)	5/16 (8)
	Pump #1 On	5/8 (16)	
	Pump #2 Off	5/8 (16)	3/8 (16)
	Pump #2 On	1/4 (6.4)	
150 psi (10.5 kg/cm ²)	Pump #1 Off	13/8 (41)	3/4 (19)
	Pump #1 On	5/8 (16)	
	Pump #2 Off	7/8 (22)	7/8 (22)
	Pump #2 On	0 (0)	

150 psi (10.5 kg/cm²) Levels



INSTALLATION

TOOLS NEEDED:

Two (2) pipe wrenches, one (1) flathead screw driver, and pipe sealing compound.

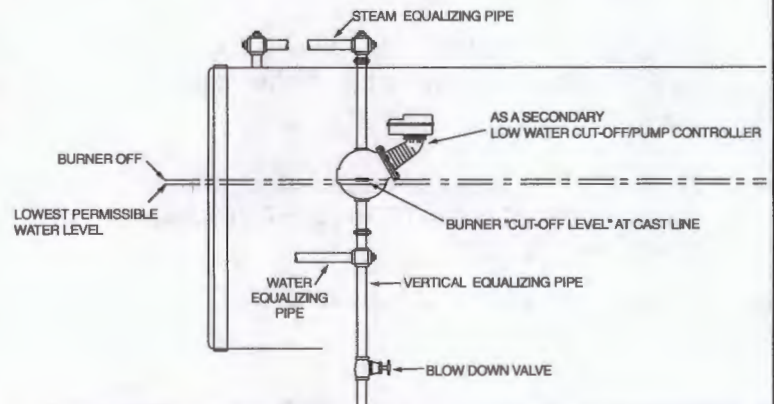
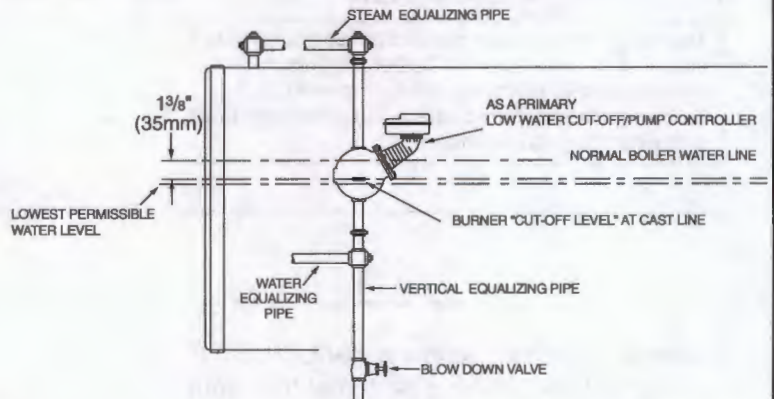
IMPORTANT: Follow the boiler manufacturer's instructions along with all applicable codes and ordinances for piping, blow down valve and water gauge glass requirements.

STEP 1 - Determine the Elevation at Which the Low Water Cut-Off/Pump Controller Must be Installed

If the control will be the **primary low water fuel cut-off**, size the steam (top) and water (bottom) equalizing pipe lengths so that the horizontal cast line on the body is **1 3/8" (35mm) below the boiler's normal water level, but not lower than the lowest, safe permissible water level, as determined by the boiler manufacturer.**

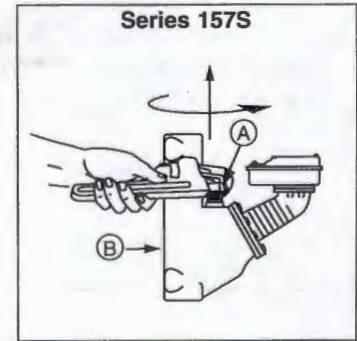
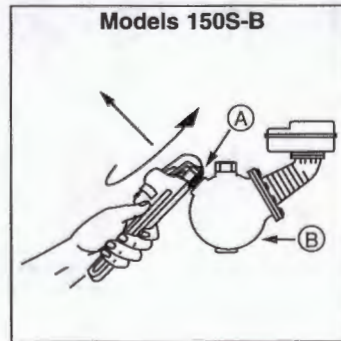
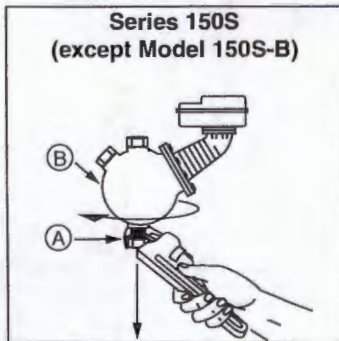
OR

If the control will be the **secondary low water fuel cut-off**, size the steam (top) and water (bottom) equalizing pipe lengths so that the horizontal cast line on the body is **at or above, the lowest, safe permissible water level, as determined by the boiler manufacturer.**



STEP 2 - Installing the Low Water Cut-Off

- Using a pipe wrench, unscrew the plastic float blocking plug (A) from the low water cut-off body (B).

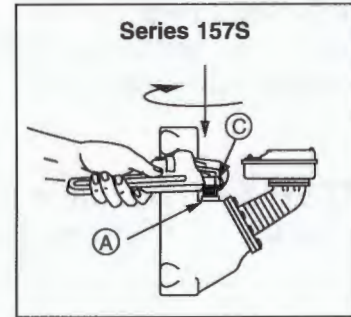
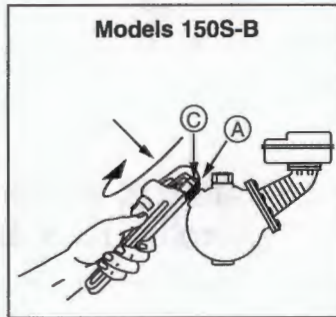


- b. For Model 150S-B and Series 157S**
(For all other models, proceed to Step 3).

Screw the 3/4" NPT steel plug (C) (provided) in tapping (A).

CAUTION

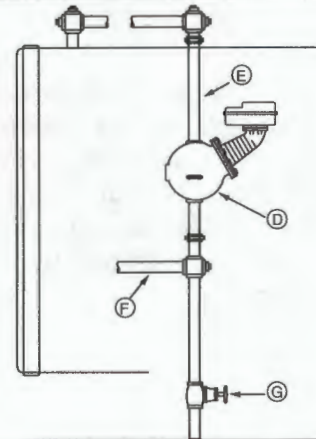
The plug must be reinstalled before control is shipped installed on the boiler, and removed when boiler is installed after shipment. Failure to follow this caution may damage float and operating mechanism.



- c. Mount and pipe the low water cut-off (D) on a vertical equalizing pipe (E) at the required elevation level, as determined in Step 1.**

Install a full ported blow down valve (G) directly below the lower cross of the water equalizing pipe (F).

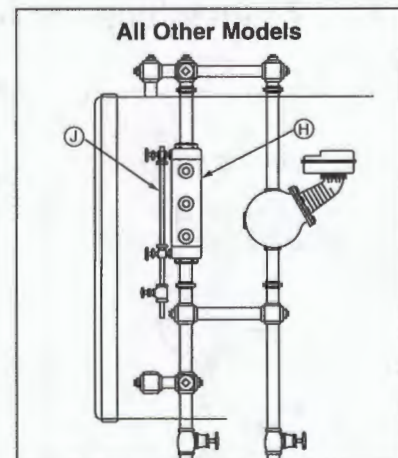
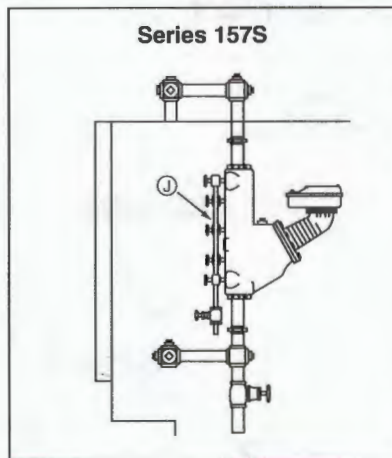
Note: 1" NPT tappings are provided, with the exception of some 157 and 157S models which are 1 1/4" NPT.



STEP 3 - Installing a Water Gauge Glass (Required on all steam boilers)

- a. Install a water column (H) (not included with product) for all models except Series 157S (with integral water column).**

- b. Install a water gauge glass (J).**
Note: Gauge glass and tri-cocks not included with product.



STEP 4 - Electrical Wiring

WARNING



- To prevent a fire, do not use this product to switch currents over 7.4A, 1/3 Hp at 120 VAC or 3.7A, 1/3 Hp at 240 VAC, unless a starter or relay is used in conjunction with it.
- To prevent electrical shock, turn off the electrical power before making electrical connections.
- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.

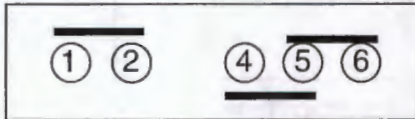


- Modification of the switch assembly before or after installation could cause damage to the boiler and/or boiler system.
- Failure to follow this warning could cause electrical shock, an explosion and/or a fire, which could result in property damage, personal injury or death.

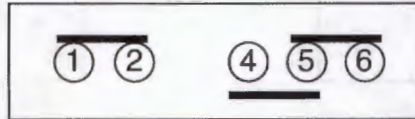
Switch Operation

For all Models except 158S and 159S

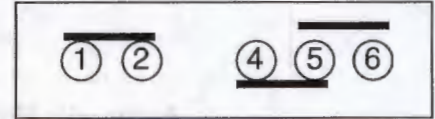
Boiler feed pump off,
burner on, alarm off.



Boiler feed pump on,
burner on, alarm off.

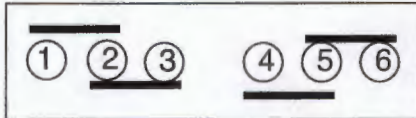


Boiler feed pump on,
burner off, alarm on.

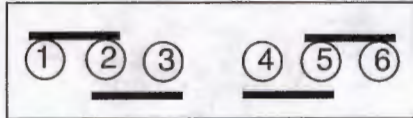


For Model 158S

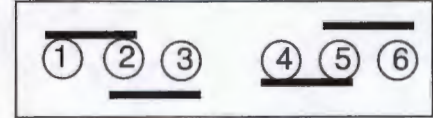
Motorized valve closed,
burner on, alarm off.



Motorized valve open,
burner on, alarm off.

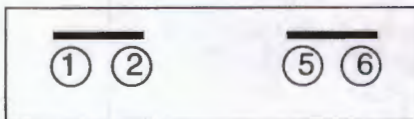


Motorized valve open,
burner off, alarm on.

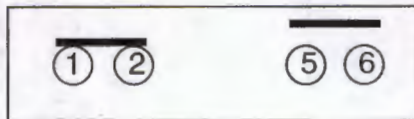


For Model 159S

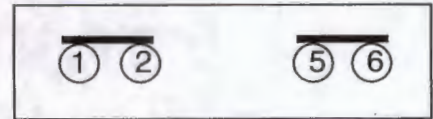
Pump #1 off,
pump #2 off.



Pump #1 on,
pump #2 off.



Pump #1 on,
pump #2 on.



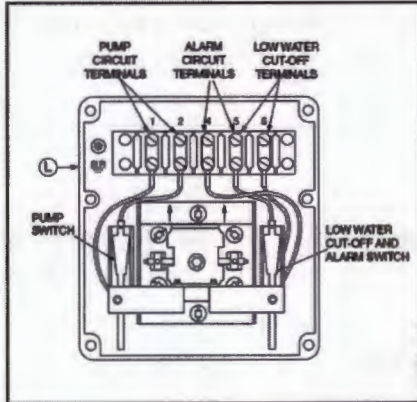
- Using a flathead screwdriver, remove the junction box cover (K).



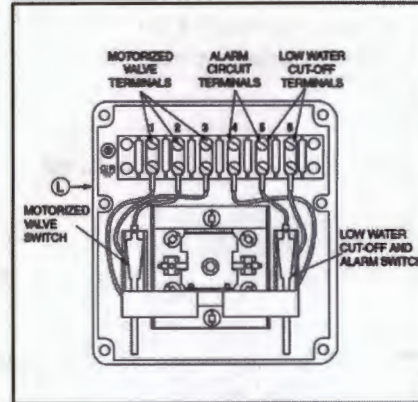
b. Following the appropriate wiring diagram, (refer to page 9) based on your application requirements, and using BX armored cable or Thinwall electrical metal tubing connector fittings, make electrical connections to the junction box (L).

IMPORTANT: There must be a minimum space of 1/2" (13mm) between connector fittings and electrical live metal parts.

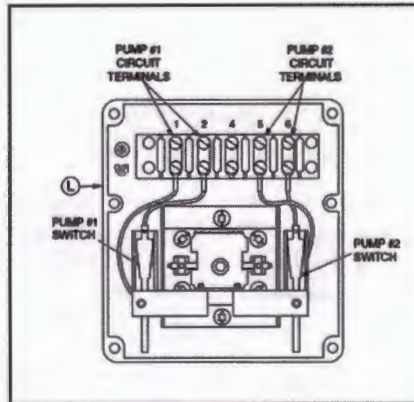
Snap Switches (Series 150S and 157S)



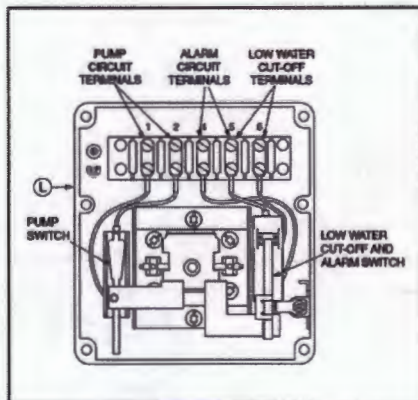
**Automatic Reset
(All models except 158S and 159S)**



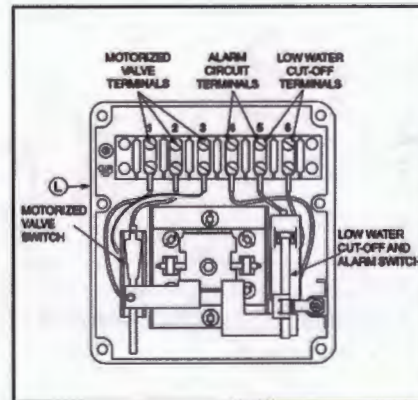
**Automatic Reset
Model 158S**



**Automatic Reset
Model 159S**



**Manual Reset
(All models except 158S)**



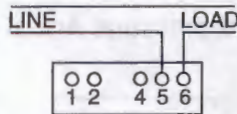
**Manual Reset
Model 158S-M**

WIRING DIAGRAMS

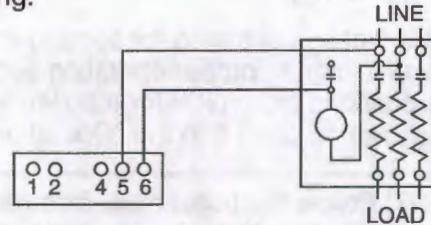
For Motorized Valves, refer to the valve manufacturer's wiring instructions.

Low Water Cut-Off Only

1. Main Line Switch - For burner circuits within the switch's electrical rating.
2. Pilot Switch - To holding coil of a starter when the burner circuit exceeds the switch's electrical rating.



OR

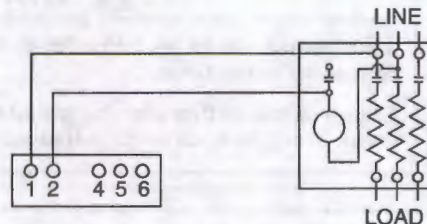


Pump Control Only

1. Install a starter or relay in pump control circuit, as shown, to prevent damage to snap switch and help insure proper switch/control operation. Failure to do so may shorten the life of the switch when actual amperage exceeds switch rating.

NOTE: For Model 159S, use terminals 5 and 6 from starter or relay for pump # 2.

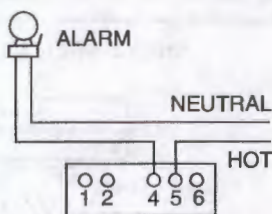
2. Connect wires from holding coil of pump starter or relay to terminals 1 and 2 as shown.



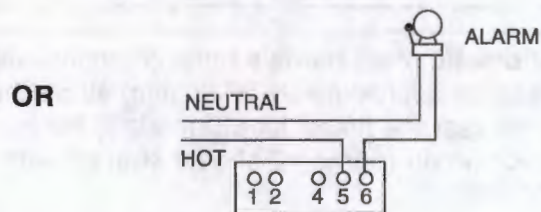
NOTE: To help insure most effective operation, balance boiler feed pump(s) to deliver required water feeder rate to match boiler steaming requirements.

Alarm Circuit Only

1. Low Water Alarm

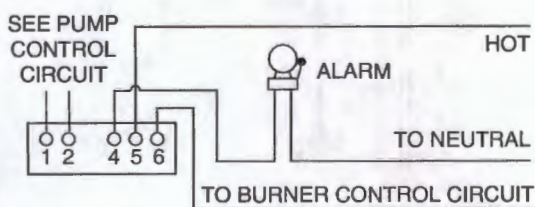


2. High Water Alarm

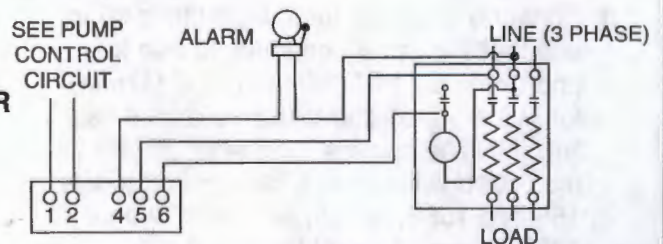


Combination Pump Control, Low Water Cut-Off and Alarm

1. Main Line Switch - For burner circuits within the switch's electrical rating.
2. Pilot Switch - To holding coil of a starter when the burner circuit exceeds the switch's electrical rating.



OR



6. Re-attach the junction box cover (K).

Note:
Cover must be installed correctly as shown



STEP 5 - Testing

This control is factory calibrated for specific applications. The following testing procedure is only meant to serve as a verification of proper operating sequence. Dimensions provided are typical for a boiler not being fired and and/or not at pressure. Actual operating ranges are shown on page 2 in the "Operation" section.

IMPORTANT: Follow the boiler manufacturer's start-up and operating instructions along with all applicable codes and ordinances. **Note:** Water levels stated below are only for 150 psi (10.5 kg/cm²) operation.

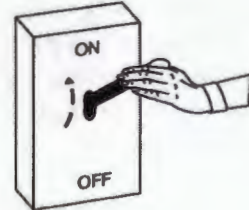
- a. Turn on the electric power to the boiler. With the boiler empty the pump should go on and the burner must remain off.

WARNING



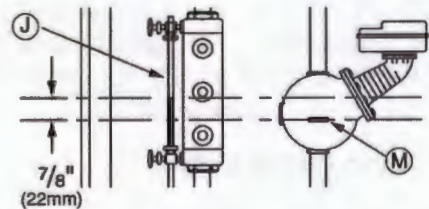
If the burner comes on, immediately turn the boiler off and make the necessary corrections.

Failure to follow this warning could cause an explosion or fire and result in property damage, personal injury or death.



- b. The boiler should begin to fill with water. Watch the gauge glass (J) until the water level reaches approximately $\frac{7}{8}$ " (22mm) above the horizontal cast line (M) on the low water cut-off.

IMPORTANT: If water does not start filling the boiler, immediately turn off the the boiler and make the necessary corrections.

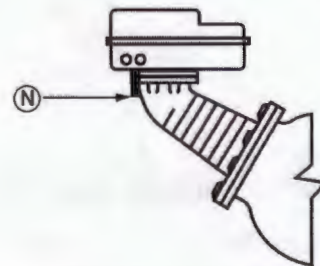


- c. **For automatic reset models only.** When the water level reaches approximately $\frac{7}{8}$ " (22mm) above the horizontal cast line (lower for MD models) the burner should come on (pump #2 should shut off with Model 159S).

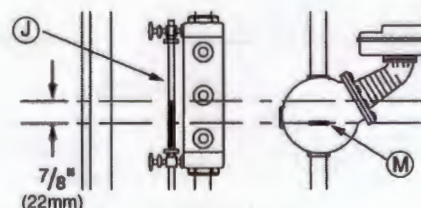
OR

For manual reset models only. When the water level reaches approximately $\frac{7}{8}$ " (22mm) above the horizontal cast line press the reset button (N). The burner should then come on.

Snap Switch Models



- d. Continue watching the gauge glass (J) to see that the water continues to rise to approximately $1\frac{3}{8}$ " (35mm) ($1\frac{7}{16}$ " (37mm) for MD models) above the horizontal cast line (M). The pump should shut off (the motorized valve should close with Models 158 and 158S, or with Models 159 and 159S, pump #1 should shut off).



CAUTION



To prevent serious personal injury from steam pipe blow down, connect a pipe to avoid exposure to steam discharge.

Failure to follow this caution could cause personal injury.

- e. Blow down the control when the water in the boiler is at its normal level and the burner is on. Follow Blow Down Procedure found in Maintenance Section on the last page of these instructions.

INSTALLATION COMPLETE

MAINTENANCE

SCHEDULE:

Blow down control as follows when boiler is in operation.

- Daily if operating pressure is above 15 psi.
- Weekly if operating pressure is below 15 psi.

NOTE

More frequent blow-down may be necessary due to dirty boiler water and/or local codes.

- Remove head assembly and inspect water side components annually. Replace head assembly if any of the internal components are worn, corroded or damaged or if control no longer operates properly.
- Inspect the float chamber and equalizing piping annually. Remove all sediment and debris.

NOTE

The control may need to be inspected and cleaned more frequently on systems where there is the potential of excessive scale or sludge build-up. This includes systems:

- With high raw water make-up
- With no condensate return
- With untreated boiler water
- Where significant changes have been made to the boiler-water chemical treatment process
- With oil in the boiler water

Replace head mechanism every 5 years.

More frequent replacement may be required when severe conditions exist.

Replacement parts are available from your local authorized McDonnell & Miller Distributor.

The use of parts or components other than those manufactured by McDonnell & Miller will void all warranties and may affect the units compliance with listings or regulating agencies.

BLOW DOWN PROCEDURE:

⚠ CAUTION	
	To prevent serious personal injury from steam pipe blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.
	Failure to follow this caution could cause personal injury.

When blowing down a control at pressure, the blow down valves should be opened slowly. The piping needs to be warmed up and stagnant water in the drain piping needs to be pushed out. Suddenly opening a blow down valve causes steam to condense, which can create water hammer. Damage to components can occur when water hammer occurs due to improper blow down piping. For these reasons, McDonnell & Miller recommends a dual valve blow-down system for each control.

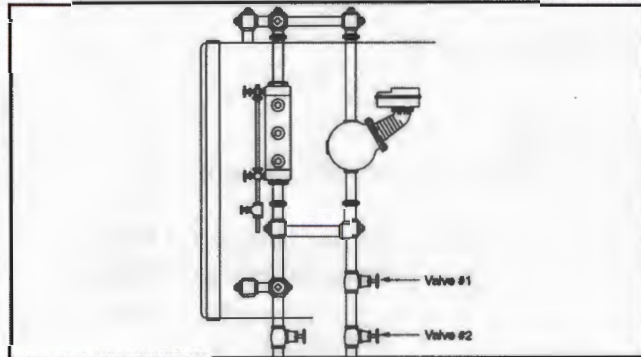
Blow down the control when the water in the boiler is at its normal level and the burner is on.

NOTE: Refer to page 2 for switch operating points.

- Open upper valve (#1)
- Slowly open the lower valve (#2)
- Water in the sight glass should lower.
- As the water in the sight glass lowers, the pump should turn on.

- As the water continues to lower in the sight glass, the burner should turn off.
 - Slowly close the lower valve (#2).
 - Close the upper valve (#1)
 - The water level in the sight glass should rise, first turning on the burner and then turning off the pump.
- NOTE:** On manual reset models, the reset button will need to be pressed after the water level has been restored before the burner will operate.

NOTE
If this sequence of operation does not occur as described, immediately close all the valves, turn off the boiler and correct the problem. Inspection/cleaning of the float mechanism may be required to determine why the control was not working properly. Retest the control after the problem has been identified and corrected.



COMMERCIAL WARRANTY

Warranty. For goods sold to commercial buyers, Seller warrants the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of one (1) year from the date of installation or two (2) years from the date of manufacture, whichever shall occur first, unless a longer period is specified in the product documentation (the "Warranty").

Except as otherwise required by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty provided Buyer gives written notice to Seller of any defects in material or workmanship within ten (10) days of the date when any defects or non-conformance are first manifest. Under either repair or replacement option, Seller shall not be obligated to remove or pay for the removal of the defective product or install or pay for the installation of the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have sole discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall terminate Seller's obligations under this Warranty and render this Warranty void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that have been: (a) repaired by third parties other than Seller or without Seller's written approval; (b) subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) damaged from ordinary wear and tear, corrosion, or chemical attack; (e) damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) damaged due to a defective power supply or improper electrical protection; or (g) damaged resulting from the use of accessory equipment not sold or approved by Seller. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO THE GOODS PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. EXCEPT AS OTHERWISE REQUIRED BY LAW, BUYER'S EXCLUSIVE REMEDY AND SELLER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER FOR THE DEFECTIVE PRODUCT. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

LIMITED CONSUMER WARRANTY

Warranty. For goods sold for personal, family or household purposes, Seller warrants the goods purchased hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be free from defects in material and workmanship for a period of one (1) year from the date of installation or two (2) years from the product date code, whichever shall occur first, unless a longer period is provided by law or is specified in the product documentation (the "Warranty").

Except as otherwise required by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty provided Buyer gives written notice to Seller of any defects in material or workmanship within ten (10) days of the date when any defects or non-conformance are first manifest. Under either repair or replacement option, Seller shall not be obligated to remove or pay for the removal of the defective product or install or pay for the installation of the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have sole discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall terminate Seller's obligations under this Warranty and render this Warranty void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. The Warranty is conditioned on Buyer giving written notice to Seller of any defects in material or workmanship of warranted goods within ten (10) days of the date when any defects are first manifest.

Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that have been: (a) repaired by third parties other than Seller or without Seller's written approval; (b) subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) damaged from ordinary wear and tear, corrosion, or chemical attack; (e) damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) damaged due to a defective power supply or improper electrical protection; or (g) damaged resulting from the use of accessory equipment not sold or approved by Seller. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

THE FOREGOING WARRANTY IS PROVIDED IN PLACE OF ALL OTHER EXPRESS WARRANTIES. ALL IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO ONE (1) YEAR FROM THE DATE OF INSTALLATION OR TWO (2) YEARS FROM THE PRODUCT DATE CODE, WHICHEVER SHALL OCCUR FIRST. EXCEPT AS OTHERWISE REQUIRED BY LAW, BUYER'S EXCLUSIVE REMEDY AND SELLER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER FOR THE DEFECTIVE PRODUCT. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

To make a warranty claim, check first with the dealer from whom you purchased the product or call +1-847-966-3700 for the name and location of the nearest dealer providing warranty service.

xylem
Let's Solve Water

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ITT

McDonnell & Miller

Installation & Maintenance
Instructions
MM-206(D)

Series 63



Low Water Cut-Off

Typical Applications:

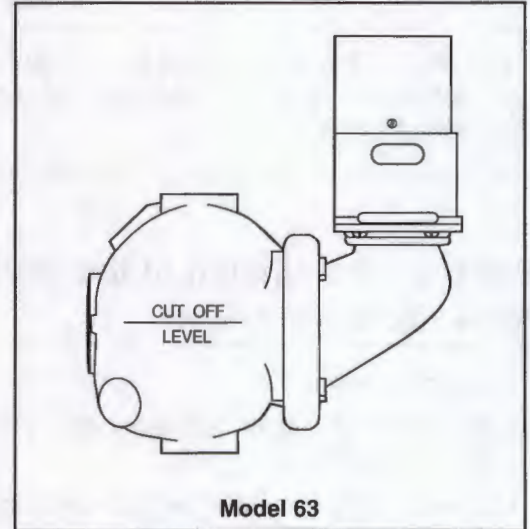
- Primary or secondary low water cut-off for hot water and steam boilers.
- Low water cut-off
- High water cut-off
- Alarm actuator

OPERATION

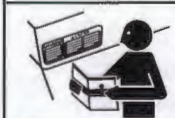
Maximum Boiler Pressure: 50 psi (3.5 kg/cm²)

Electrical Ratings

Voltage	Motor Switch Rating (Amperes)		Pilot Duty
	Full Load	Locked Rotor	
120 VAC	10.2	61.2	125 VA at
240 VAC	5.1	30.6	120 or 240 VAC



⚠ WARNING



- Before using this product read and understand instructions.



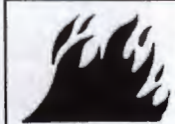
- Save these instructions for future reference.



- All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.



- To prevent serious burns, the boiler must be cooled to 80°F (27°C) and the pressure must be 0 psi (0 bar) before servicing.



- To prevent electrical shock, turn off the electrical power before making electrical connections.

- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.

- We recommend that secondary (redundant) Low Water Cut-Off controls be installed on all steam boilers with heat input greater than 400,000 BTU/hour or operating above 15 psi of steam pressure. At least two controls should be connected in series with the burner control circuit to provide safety redundancy protection should the boiler experience a low water condition. Moreover, at each annual outage, the low water cut-offs should be dismantled, inspected, cleaned, and checked for proper calibration and performance.

- To prevent serious personal injury from steam blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.

- To prevent a fire, do not use this low water cut-off to switch currents over 10.2A, 1/2 Hp at 120 VAC or 5.1A, 1/2 Hp at 240 VAC, unless a starter or relay is used in conjunction with it.

Failure to follow this warning could cause property damage, personal injury or death.

INSTALLATION –

Model 63 – For Steam Boilers with 1" (25mm) Equalizing Lines

TOOLS NEEDED:

One (1) flathead screwdriver and two (2) pipe wrenches.

STEP 1 - Determine the Location of the Low Water Cut-Off

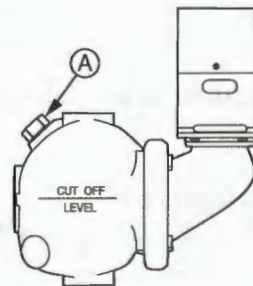
- a. Whether the gauge glass is mounted directly into the boiler or on an independent water column, the cut-off line on the 63 body casting should be mounted 1/2" (15mm) above the lowest visible point of the gauge glass.

STEP 2 - Installation of the Model 63

For 63 models with float block

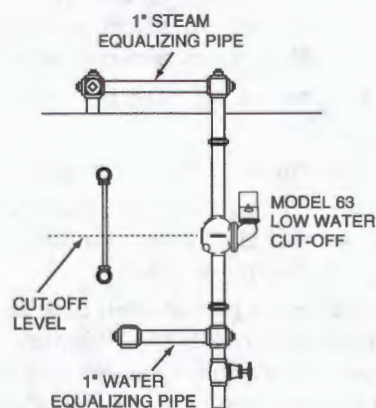
Using pipe wrench

- Remove float blocking plug (A) from low water cut-off body tapping.
- Screw 3/4" NPT steel plug (provided) in tapping.

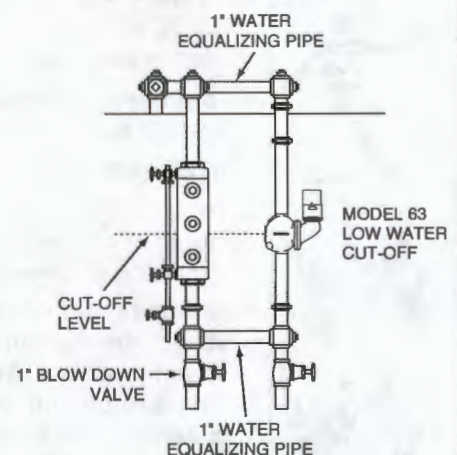


- a. Locate the gauge glass and determine the level that the 63 has to be mounted at in order to achieve the criteria in Step 1.
- b. Pipe the 63 following the diagrams shown to the right. Follow the diagram that represents your boiler.
- c. Crosses should be used at each right angle connection for inspection and cleaning.
- d. Make sure the blow-down valves are full port.
- e. While the burner is operating, open the blow-down valve, causing the water level to drop in the float chamber while burner is operating. As the float drops the alarm circuit (if used) closes first; then on further drop the cut-off circuit will open, shutting the burner off.
- f. Test the Model 63 before leaving the site.

Gauge Glass Mounted Directly into Boiler



For Boilers with Independent Water Columns



INSTALLATION –

Model 63 – For Hot Water Boilers with 1" (25mm) Equalizing Lines

TOOLS NEEDED: One (1) flathead screwdriver and two (2) pipe wrenches.

STEP 1 - Determine the Location of the Low Water Cut-Off

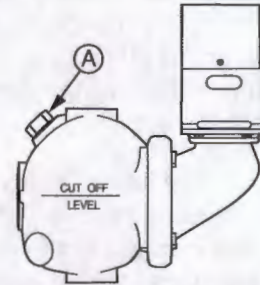
- a. The line on the casting of the model 63 must be installed above the lowest permissible water level determined by the boiler manufacturer.

STEP 2 - Installation of the Model 63

For 63 models with float block

Using pipe wrench

- Remove float blocking plug (A) from low water cut-off body tapping.
- Screw 3/4" NPT steel plug (provided) in tapping (A).



For float type controls it is recommended that Test-N-Check® (TC-4) valves be used in the upper and lower equalizing lines. They offer a functional means for testing the 63 control, and conform to the ASME CSD-1 code.

- a. Study the figures to the right and determine which figure shows how the 63 control will be attached to the boiler.

Figure 1. Connect the upper equalizing pipe to the riser going to the radiation or to the compression tank. Connect the lower equalizing pipe to any available opening in the side of the boiler. **NOTE:** If no opening is available in the side of the boiler, connect the lower equalizing pipe into the drain connection.

Figure 2. If there is a tapping available on the top of the boiler, connect the upper equalizing pipe to it. **NOTE:** During initial filling or after blow-down the upper equalizing pipe and possibly the 63 control will have an air pocket. Connect a vent or bleed valve on the top of the vertical equalizing pipe. If the Test-N-Check (TC-4) valve is used the vacuum breaker can be used to bleed the air pocket.

CAUTION: When bleeding an air pocket manually, protect yourself from being burned with hot water.

Figure 3. If there is no tapping available on the boiler, connect both the upper and lower equalizing pipe into the vertical riser going to the radiation or to the compression tank. **IMPORTANT:** The horizontal equalizing pipe should be below the horizontal run going to the radiation. If it is not, an air pocket will be created and a vent or bleed will have to be installed.

- b. While the burner is operating open the blow-down valve, causing the water level to drop in the float chamber. As the float drops the alarm circuit (if used) closes first; then on further drop the cut-off circuit will open, shutting the burner off.
- c. Test the Model 63 before leaving the site.

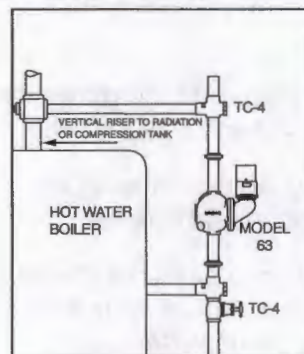


Figure 1

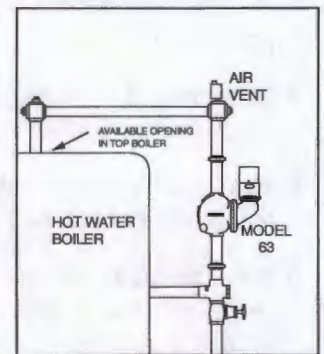


Figure 2

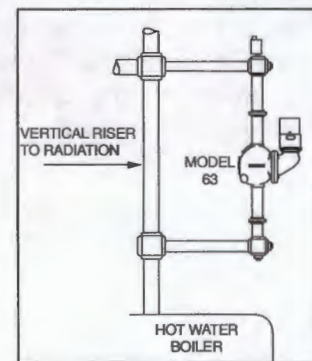


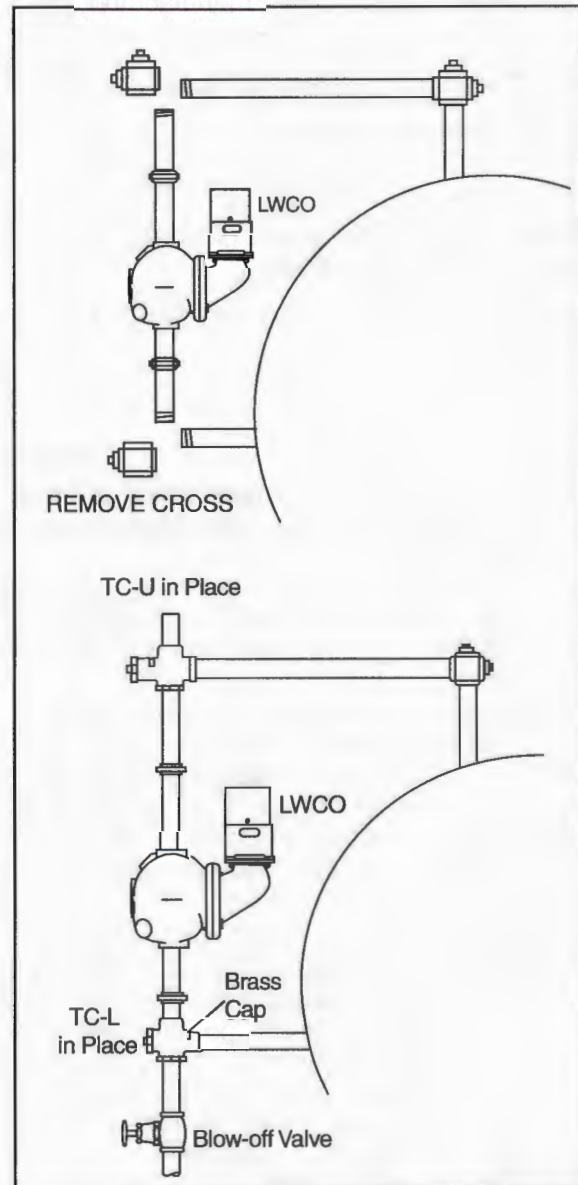
Figure 3

TEST-N-CHECK® VALVES

Simplify Testing of Low Water Cut-offs on Hot Water Boilers

Installation of the TC-4 Test-N-Check valves with a New Low Water Cut-off

1. Assemble the TC-U (the upper Test-N-Check valves, with the vacuum breaker) into the upper equalizing line in place of the cross described in the low water cut-off installation instructions. **NOTE:** The vacuum breaker must be on the top and the long leg must face the boiler. **NOTE:** Make sure low water cut-off position is located in accordance with the boiler manufacturer's recommended cut-off level.
2. Assemble the TC-L (the lower Test-N-Check valve, without the vacuum breaker) into the lower equalizing line in place of the cross described in the low water cut-off installation instructions. **NOTE:** The brass cap must be located above the center of the lower equalizing line, and the long leg must face the boiler.
3. Assemble the blow-off valve into the bottom port of the TC-L.
4. Assemble 1" NPT pipe plugs into the remaining open port in both the TC-U and TC-L.
5. Complete the installation as described in the low water cut-off installation instructions.
6. After all piping assembly has been completed, refill the system with water, turn on all electrical supply and bring system to operating conditions. After system reaches operating pressure, inspect to make sure no leaks exist at the threaded connections. Test valves by opening blow-off valve while burner is on, to make sure valves operate correctly and low water cut-off shuts burner off.



IMPORTANT:

- Installation should be performed by qualified personnel only, in accordance with all applicable codes.
- If vacuum breaker stem is accidentally depressed, hot water could be discharged causing burns.
- Blow-off valve drain piping should be piped to a suitable drain to handle hot water and steam discharge, and should be the same size as the equalizing pipe.

ELECTRICAL WIRING

TOOLS NEEDED:

One (1) flathead screwdriver.

WARNING



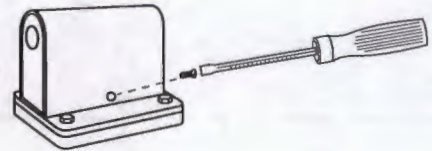
- To prevent electrical shock, turn off the electrical power before making electrical connections.
- This low water cut-off must be installed in series with all other limit and operating controls installed on the boiler. After installation, check for proper operation of all of the limit and operating controls, before leaving the site.



Failure to follow this warning could cause electrical shock, an explosion and/or a fire, which could result in property damage, personal injury or death.

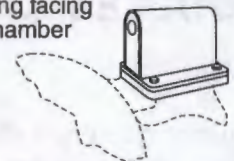
Cover Removal and Installation Procedure

- Using a flathead screwdriver, remove the one (1) screw that secures the switch cover.
- Place the cover on the switch housing and, using a flathead screwdriver, tighten the one (1) screw to approximately 2 ft•lb (2.6 N•m).

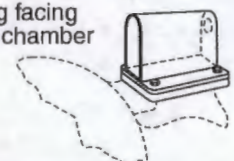


- The No. 2 switch can be positioned with the conduit opening facing toward or away from the float chamber. These are the only positions in which the switch will function properly. See drawing at right.
- On initial fill-up, push the 2M manual reset button after the proper water level is reached to energize the burner. If a low water condition occurs and the water level has been restored, push the reset button to energize the burner.
- Follow the wiring diagrams below to wire the No. 2 Switch. Terminals C and NC are the low water cut-off switch. Terminals C and NO are alarm switch. If the electrical load exceeds the rating of the switch, use an auxiliary relay or motor starter.

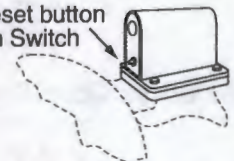
Conduit opening facing toward float chamber



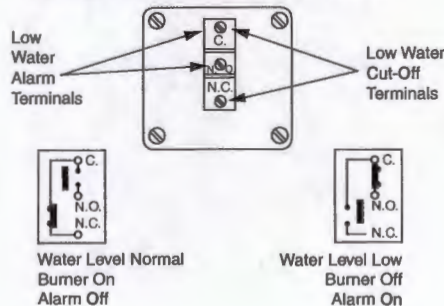
Conduit opening facing away from float chamber



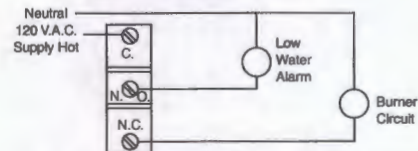
Manual reset button on No. 2m Switch



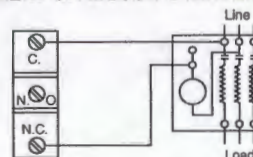
SCHEMATIC OF SWITCH OPERATION



USED AS A MAIN LINE SWITCH AND/OR LOW WATER ALARM



USED AS A PILOT SWITCH TO COIL OF RELAY OR MOTOR STARTER



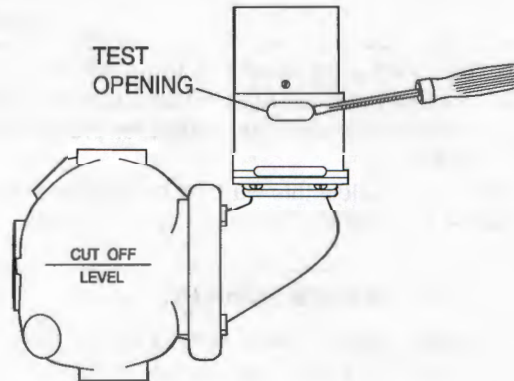
WARNING

Do not use automatic water feeders with manual reset LWCO's.

Failure to follow this warning could cause flooding, property damage, personal injury or death.

TESTING

- Control can be tested on a hot water boiler by gently inserting a screwdriver in the test opening below the switch (see drawing) and lifting linkage to cause float to drop, thereby simulating a low water condition.



TROUBLESHOOTING

Problem:

1. Burner does not shut off on low water.

- a. **Cause:** Float chamber is loaded with mud or sediment.
- Test:** With water level below the control check if terminals C and N.C. are open. If not, remove switch and manually test if terminals C and N.C. can be opened.

Solution: Open float chamber and clean. At this time, check for a build-up of scale or sediment between corrugations of the bellows.

- b. **Cause:** Contacts are fused together.

Test: Remove switch and operate manually to verify proper switch operation.

Solution: Replace switch. Check electrical load and make sure it is within the ratings of the switch.

MAINTENANCE

SCHEDULE:

- Blow down control as follows when boiler is in operation:

Steam:

- Daily if operating pressure is above 15 psi.
- Weekly if operating pressure is below 15 psi.

Hot Water:



- Quarterly

NOTE

More frequent blow-down may be necessary due to dirty water and/or local codes.

- **Disassemble and inspect annually. Replace the low water cut-off if it is worn, corroded, or if components no longer operate properly.**
- **Inspect the float chamber and equalizing piping annually. Remove all sediment and debris.**
- **Replace head mechanism every 5 years.**
More frequent replacement may be required when severe conditions exist such as rapid switch cycling, surging water levels, and use of water treatment chemicals.
- **We recommend head mechanism replacement when the switch(es) no longer operate properly.**
If you choose to replace the switch(es), order the proper McDonnell & Miller replacement switch or switch assembly and follow the Repair Procedure provided.

PROCEDURE:

 CAUTION	
	To prevent serious personal injury from steam pipe blow down, connect a drain pipe to the control opening to avoid exposure to steam discharge.
	Failure to follow this caution could cause personal injury.

1. Blow down the low water cut-off when the water level is at its normal level and the burner is on. **Slowly** open the blow down valve until it is fully open and observe the water level fall in the gauge glass. Close the valve after verifying that the pump contacts have closed and the burner shuts off. If this does not happen, immediately shut off the boiler and correct the problem.

Warrick[®] Series 26NM Control Installation and Operation Bulletin

This bulletin should be used by experienced personnel as a guide to the installation of the Series 26NM Control. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors or a representative if further information is required.

Specifications

Control Design: Solid-state components enclosed in a clear Lexan plug-in style housing. Not NEMA Rated.

Contact Design: 1 SPDT (1 form A), N.O. Non powered contacts.

Contact Ratings: 10A @120/240-VAC resistive (120°F), 1A @120/240VAC resistive (150°F), 1/3 Hp @ 120/240-VAC (120°F).

Contact Life: Mechanical -5 million operations Electrical - 100,000 operations minimum at rated load

Supply Voltage: Factory Configured: 24V, 120V, 220V, or 240V AC +10%/-15% of nominal, 50/60 Hz. Factory Configured: 208V/240V Model: 187V Min to 242V Max, VAC 50/60 Hz

Power Consumption: 24/120/220/240-VAC with relay energized - 4.4 VA.

Secondary Circuit: 2.3 VAC RMS voltage on probes, < 1 milliampere source capability.

Sensitivity: Factory programmed to 4.7K, 10K, 26K, 50K, or 100K Ohms

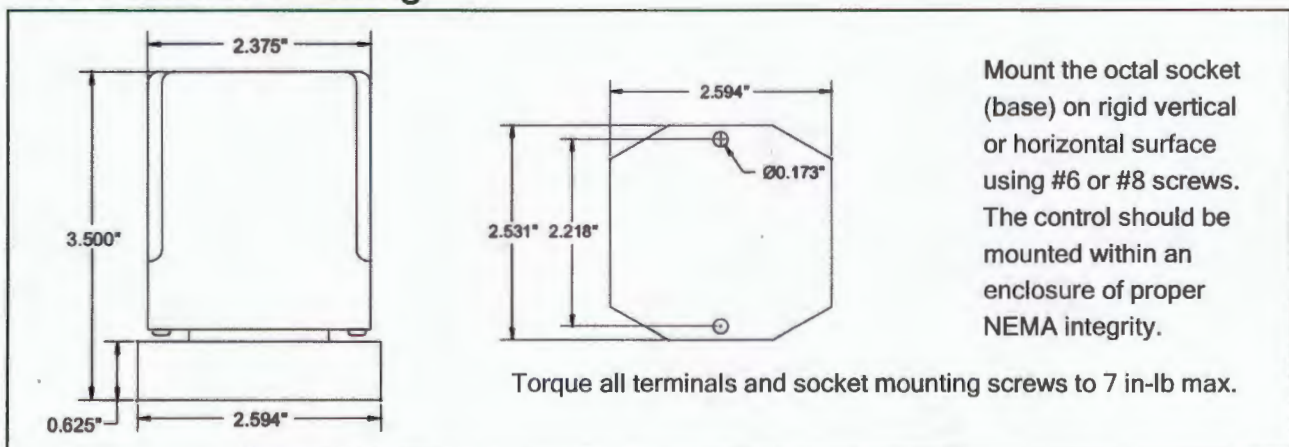
Operating Ambient Temperature Range: -40°F to +150°F (-40°C to +65°C)

Terminals: All connections made with screw-clamp terminals.

Time Delays: Standard LLCO, 0.5 sec. on rising level, 3 sec. on falling level. Optional 0-90 sec. time delays in 1-sec. increments for rising and falling.

Listings: Control carries U.L. Limit Control Listing (UL-353) for 24VAC and 120VAC Line Powered units only (220VAC, 240VAC, 208/240VAC units not rated).

Dimensional Drawing



Installation

1. Install octal socket in appropriate enclosure using two #6 or #8 screws.
2. Install rail mount socket on appropriate rail (DIN mount) in appropriate enclosure if applicable.
3. Wire control per wiring diagram following N.E.C and local codes.
4. Install control module in socket

Sensitivity vs. Maximum Probe Wire Distance*

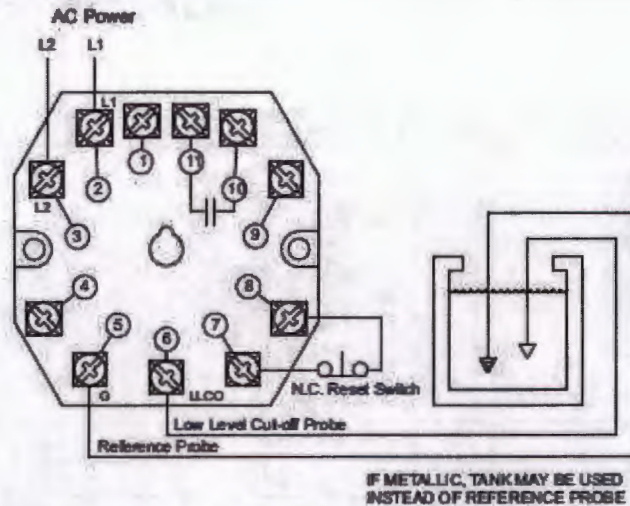
SENSITIVITY CHARACTER	SENSITIVITY (K-OHMS)	Distance (FT)
A	4.7	900
B	10	600
C	26	250
D	50	100
E	100	50

* Based on type MTW or THHN wire, #14 or #16 AWG

Mount the octal socket (base) on rigid vertical or horizontal surface using #6 or #8 screws. The control should be mounted within an enclosure of proper NEMA integrity.

Torque all terminals and socket mounting screws to 7 in-lb max.

Wiring Diagram



Operation

AUTOMATIC RESET (Reset Switch terminals not wired)
When the liquid rises to the electrode on terminal LLCO, the control energizes, changing state of the load contacts. (LED will be lit) The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will not be lit) returning load contacts to original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for a full three seconds before control de-energizes.

MANUAL RESET (Normally closed pushbutton installed across reset terminals) When the liquid rises to the electrode on terminal LLCO, the control will remain de-energized until the pushbutton is depressed. Upon Reset Switch activation, the control will energize, (LED will be lit) changing the state of the contacts. The control remains energized until the liquid level recedes below electrode on terminal LLCO. The control then de-energizes, (LED will not be lit) returning load contacts to their original state. Unless otherwise specified, there is a three second time delay on decreasing level. Liquid must be below probe on terminal LLCO for full three seconds before control de-energizes. Operator to wait 5 full seconds after power is applied before pressing reset switch (if manual reset is used).

MANUAL RESET OPTIONAL POWER OUTAGE FEATURE (Normally closed pushbutton across reset terminals) Control will auto-recover from a power loss. With liquid present on LLCO electrode at a power outage event, the control will de-energize and will automatically re-energize upon return of power with liquid present on the probe at power-up. However, if loss of liquid is sensed on power-up, the control will remain de-energized until liquid again rises to electrode and pushbutton is depressed. The control will not attempt to auto-recover from a power outage if no liquid was present on the probe at power loss.

TEST FEATURE

Allows LLCO circuit to be tested without the need to drop the water level in the boiler to create a dry probe condition. Holding down the reset button for 3 seconds will allow the LLCO circuit to trip, simulating a dry probe. The controller will return to normal operation once the reset button is pressed a second time.




LED STATUS INDICATOR In normal operation, the LED on the control will either be on or off depending on the controller state. On-board microprocessors continuously monitor for fault conditions. In the event a fault is detected, the LED will blink a pattern indicating the fault type. If you experience an inoperable control and the LED is blinking, attempt to leave the control in the blinking state and contact the factory for assistance.

26NMXXXXX-XX-XX

- Time Delay Increasing Level: 0-90 seconds, Blank = 0 seconds.
- Time Delay Decreasing Level: 0-90 seconds, Blank = 3 seconds.
- Optional Character: see Chart
- Enclosure: 0-None, 1-NEMA 1, 2-NEMA 4
- Socket Style: A-11 Pin Octal, B-Din Mount, M-NONE, Module Only
- Supply Voltage: 1-120VAC (+10%/-15%), 2-240VAC (+10%/-15%), 3-24VAC (+10%/-15%), 5-220VAC (+10%/-15%), 8-208/240VAC (187 to 242 VAC absolute Range)
- Mode/Sensitivity: A-4.7K, B-10K, C-26K, D-50K, E-100K

	N.C. Pushbutton	Power Outage	Test Feature
A	X	X	X
B			X
C	X		
E		X	
F	X	X	
Y	X		X
Z		X	X
0	No Option		

FITTINGS AND PROBES

3E	3N	3B																												
																														
1" to 3" NPT	#10 Machine Screws from Underside	3/8" - 18NPT, 5/8" - 18UNF, 5/8" - 24UNEF																												
1 thru 7	1 thru 3	1																												
Series 3E fittings are cast metal, pressure-tight assemblies capable of handling 1-7 probes. Attachment to vessels is accomplished with external pipe threading. 3E Fittings require the use of 3R rigid or 3W wire suspended electrodes.	Series 3N fittings accommodate 1-3 probes operating at atmospheric pressure. The assembly mounts on a flat surface atop open tanks or closed vessels. 3N Fittings require the use of 3R rigid or 3W wire suspended electrodes.	Series 3B fittings are compact pressure tight assemblies that hold a single electrode probe for use in water and chemicals. These fittings incorporate a 1/4-20 female thread that must be combined with a Series 3R (rigid rod electrode) or Series 3W/3Y (wire suspended electrode) to make a complete assembly.																												
Die-cast aluminum, epoxy coated	Die-cast aluminum, epoxy coated	—																												
Cast iron, red brass, 316 stainless steel	PVC, red brass, 316 stainless steel	316 stainless steel																												
Teflon®	Teflon®	Teflon®																												
125 psig @ 353°F (cast iron) 250 psig @ 406°F (brass, 316 S.S.)	0 psig @ 150°F (PVC) 0 psig @ 500°F (brass, 316 S.S.)	250 psig @ 406°F 500 psig @ 75°F																												
U.L. File #MP2489, Vol. 1 Sec. 1; CSA; FM	CSA File #LR11644	U.L. File #MP2489, Vol. 1 Sec. 1; CSA; FM																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>No. of Probes</th> <th>Attachment to Vessel</th> <th>Conduit Boss Thread Size</th> <th>Terminal Housing Size (W" x D" x H")</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1" NPT</td> <td style="text-align: center;">1/2" NPT</td> <td style="text-align: center;">2-1/4 x 2-1/4 x 2-1/4</td> </tr> <tr> <td style="text-align: center;">2-3</td> <td style="text-align: center;">2" NPT</td> <td style="text-align: center;">1/2" NPT</td> <td style="text-align: center;">3-1/4 x 3-1/4 x 2-3/8</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">2-1/2" NPT</td> <td style="text-align: center;">1/2" NPT</td> <td style="text-align: center;">3-1/4 x 3-1/4 x 2-3/8</td> </tr> <tr> <td style="text-align: center;">5-7</td> <td style="text-align: center;">3" NPT</td> <td style="text-align: center;">3/4" NPT</td> <td style="text-align: center;">4 x 4 x 2-1/2</td> </tr> </tbody> </table>	No. of Probes	Attachment to Vessel	Conduit Boss Thread Size	Terminal Housing Size (W" x D" x H")	1	1" NPT	1/2" NPT	2-1/4 x 2-1/4 x 2-1/4	2-3	2" NPT	1/2" NPT	3-1/4 x 3-1/4 x 2-3/8	4	2-1/2" NPT	1/2" NPT	3-1/4 x 3-1/4 x 2-3/8	5-7	3" NPT	3/4" NPT	4 x 4 x 2-1/2	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>No. of Probes</th> <th>Attachment to Vessel</th> <th>Conduit Boss Thread Size</th> <th>Terminal Housing Size (W" x D" x H")</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1-3</td> <td style="text-align: center;">2-1/4" square flat pad, 1-1/2" dia. hole in top of vessel secured with #10 machine screws at the corners of a 1-1/2" square</td> <td style="text-align: center;">1/2" NPT</td> <td style="text-align: center;">2-1/4 x 2-1/4 x 2-1/4</td> </tr> </tbody> </table>	No. of Probes	Attachment to Vessel	Conduit Boss Thread Size	Terminal Housing Size (W" x D" x H")	1-3	2-1/4" square flat pad, 1-1/2" dia. hole in top of vessel secured with #10 machine screws at the corners of a 1-1/2" square	1/2" NPT	2-1/4 x 2-1/4 x 2-1/4	
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<p>Series 3E X X</p> <p>Number of Probes 1 thru 7</p> <p>Body Material A - Cast Iron B - Red Brass C - 316 Stainless Steel</p>	<p>Series 3N X X</p> <p>Number of Probes 1 thru 3</p> <p>Body Material A - PVC B - Red Brass C - 316 Stainless Steel</p>	<p>Series 3B X B</p> <p>Thread 1 - 3/8" - 18 NPT 2 - 5/8" - 18 UNF 3 - 5/8" - 24 UNEF</p> <p>Metal Parts B - 316 Stainless Steel</p>																												
3R, 3W ¹	3R, 3W ¹	3R solid rod (up to 4') 3W ¹ or 3Y ² (greater than 4')																												

Custom options available. Consult factory.

WARRICK CONDUCTIVE SENSORS