

Section 2000
Bulletin 2100
Issued 10/05
Replaces 08/01

Direct Reading Liquid Level Gages and Gagecocks

PENBERTHY

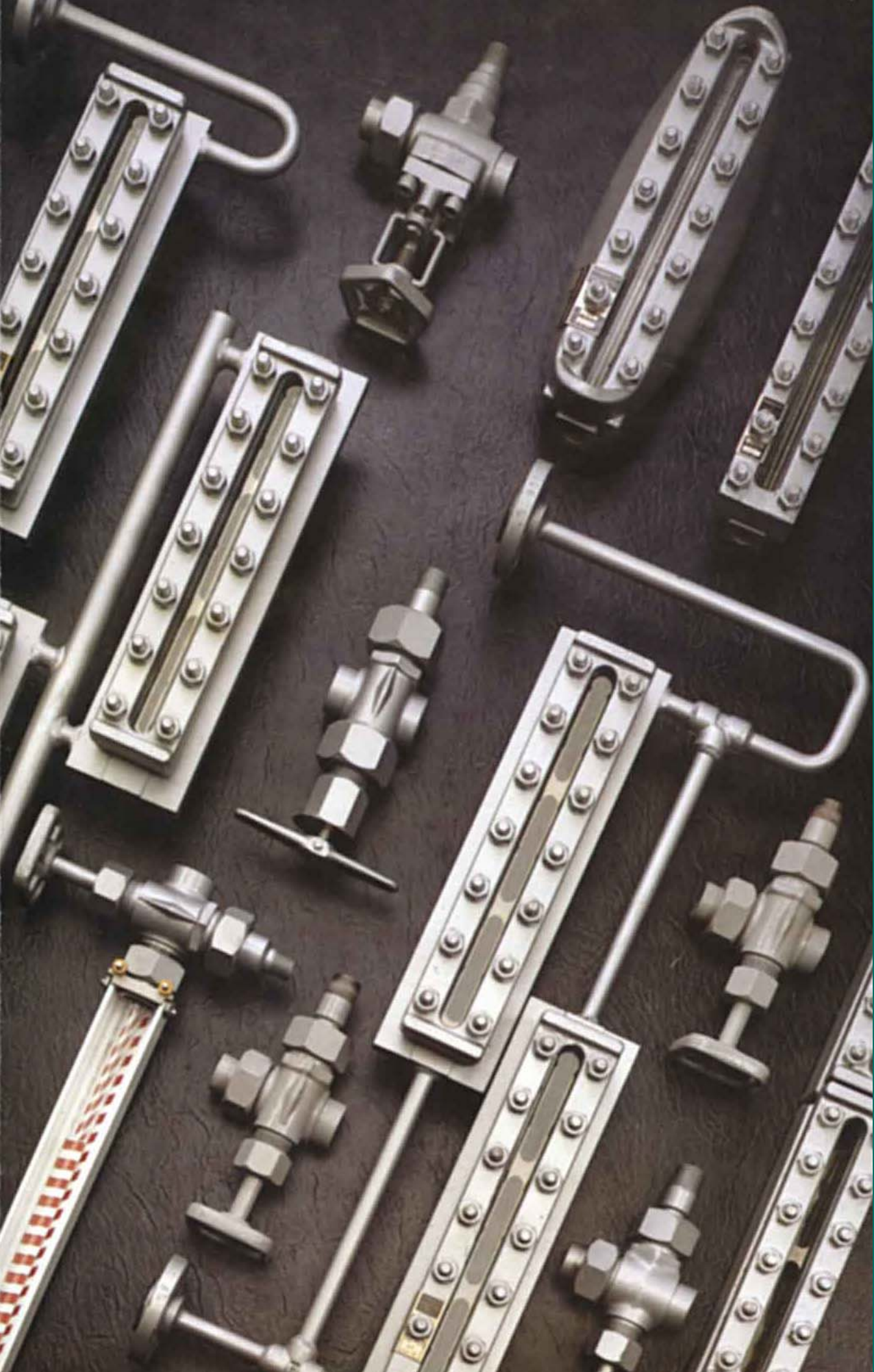


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Armored Flat Glass Gages

Flat glass gages provide direct observation of liquid level in a process vessel. The process liquid level and liquid characteristics can be observed through the glass as it rises and falls in the gage chamber.

The six basic components of flat glass gages are as follows:

Chamber

Pressure retaining element which provides rigidity to the gage assembly and a means to connect the gage to isolation gagecocks or other vessel connections.

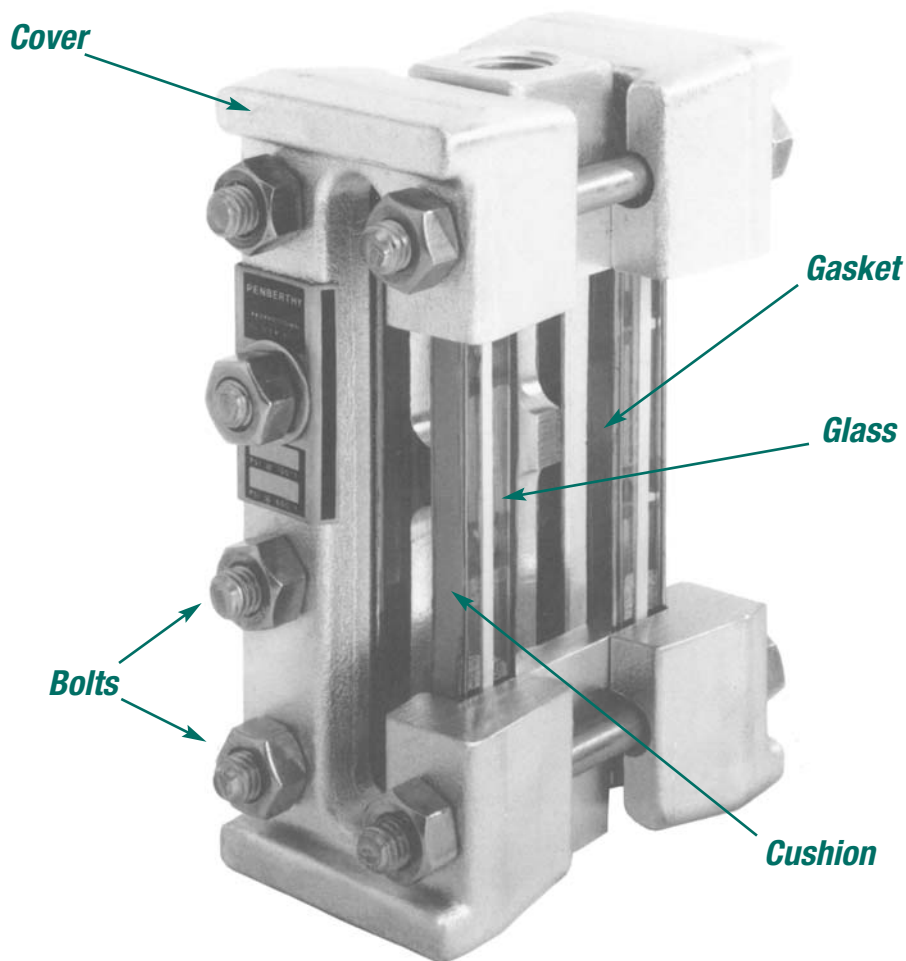
Penberthy's standard chambers have a flat gasket seat to allow for easy removal of gasket residue and fragments. Because the chamber does not have a recessed face, the gasket may be removed quickly with a flat blade.

Penberthy has an optional chamber with a recessed gasket seating surface to meet customer requirements.

Slots are machined into Penberthy's transparent gage chambers rather than continuous vision slots. These cross ties between vision slots increase the

mechanical integrity along the length of the chamber.

The cross tie provides a higher strength chamber due to the reduction of unsupported beam length. Chambers are available with PFA (Teflon®), PECTFE (Halar®), and PETFE (Tefzel®) lining.



Gasket

Seals the gap and prevents leaking between the glass and the chamber.

Glass

Contains the process liquid and provides the viewing window to the process liquid level.

Cushion

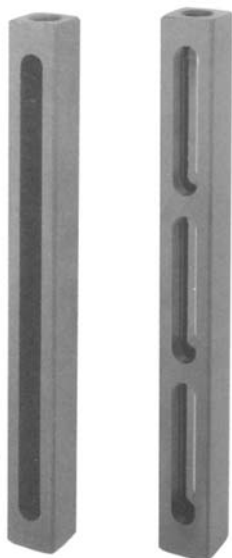
Protects the glass from mechanical stress points by acting as a buffer between the glass and cover.

Cover

Protects the glass from mechanical impact along the sides of the chamber and provides a compression surface for the bolts/studs/nuts to hold the gasket and glass tightly against the chamber.

Bolts/Studs/Nuts

Properly torqued gage bolting applies a uniform compressive load to the gage assembly for pressure retaining purposes.



Reflex

Transparent

Standard Gasket Chamber



Recessed Gasket Chamber

Multiple Section Gages

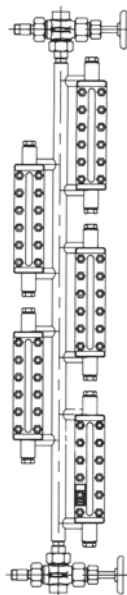
To meet visible glass lengths greater than Size 9 glass (12.625" [321 mm]), Penberthy stacks covers along the length of the single chamber. The maximum operating pressure and temperature ordinarily determine the largest glass size that can be used.

Vision slots are cut according to the size of the glass used and the number of sections necessary to meet the desired vision length or minimum center to center (vessel connections). Support brackets should be attached to larger gages to support the weight of the gage assembly.

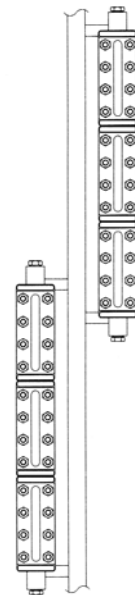
The maximum number of sections (covers) that can be used on a single gage chamber is ten. If the required liquid level vision length extends beyond 139.750" [3550 mm], multiple section gages may be bridled to a standpipe or alternately top-bottom side connected.



**3-section gage
on continuous
chamber**



**Continuous vision
single-section gages
on standpipe**



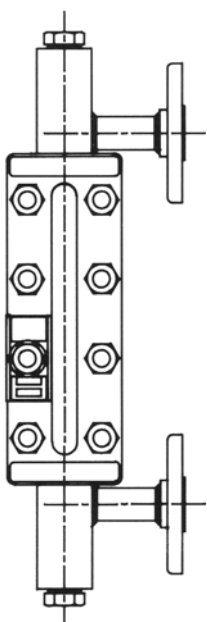
**Multiple
section gages
on standpipe**

Gage Connections

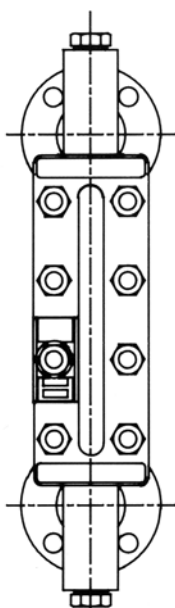
End, side and back (typically reflex only) connections can be machined into the gage chamber to provide end users with desired center to center

distance and/or the optimum vision position for liquid level viewing. Connections include NPT, BSP, ANSI flanged, DIN flanged and socketweld.

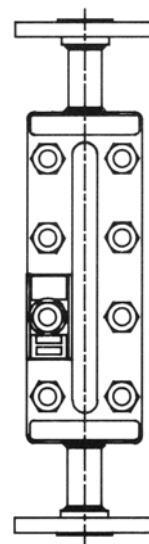
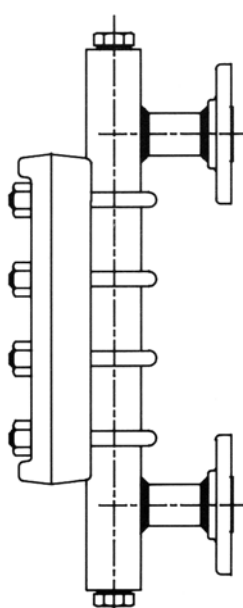
Gage Connections



**Side
Connect**



Back Connect



**End
Connect**

Reflex and Transparent Gages

Reflex gages have a single vision slot in which light can enter the gage chamber to determine liquid level. Above the liquid level, glass prisms reflect the surrounding light. Below the liquid level the liquid fills the prisms causing the glass to become relatively transparent.

Light striking the area of glass covered by transparent liquid is allowed to pass through to the interior of the gage along the entire length of the covered prism. The light is reflected from the back of the chamber to the observer. Typically the chamber appears dark. An opaque liquid such as milk would directly reflect the light at the surface of the prisms, where it appears as a solid column of white.

Light striking the area of the glass above the liquid level experiences internal reflection. Internal reflection will occur when light attempts to move from a medium having a given index of refraction to one having a lower index of refraction.

When the light attempts to move from a higher index of refraction (glass – 1.47 index of refraction) to a lower index of refraction (air – 1.00 index of refraction

through the prism angle), it reflects rather than passes through to the back of the chamber. Except for a focused line of light along the apex of the prism, the surrounding light reflects back to the observer appearing silvery.

The interface between the liquid and gas occurs where the silvery and dark/opaque area intersect.

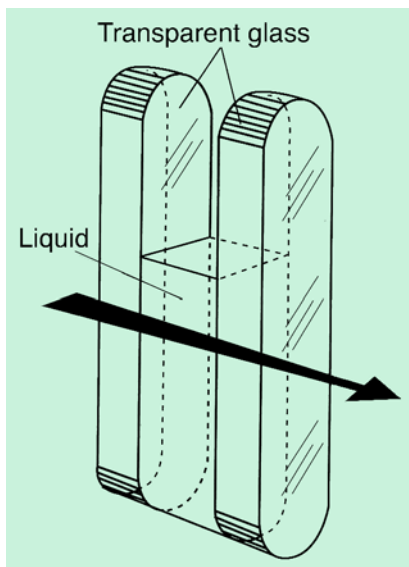
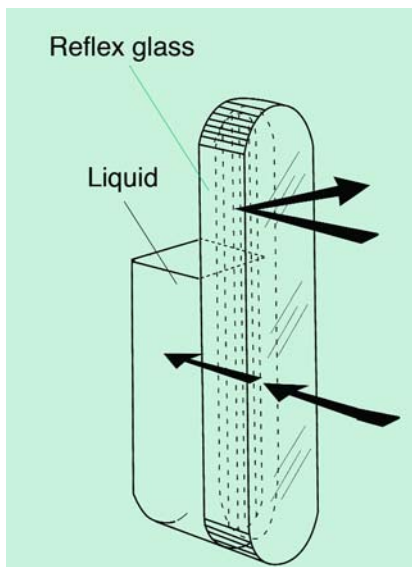
Transparent gages have a vision slot on both sides of the chamber. Light enters the gage from the side opposite the observer so that both the level of a liquid and its characteristics can be seen. For easier liquid observation in dark environments, illuminators are available for use with transparent gages.

Transparent gages may be used for interface applications.

Reflex



Transparent



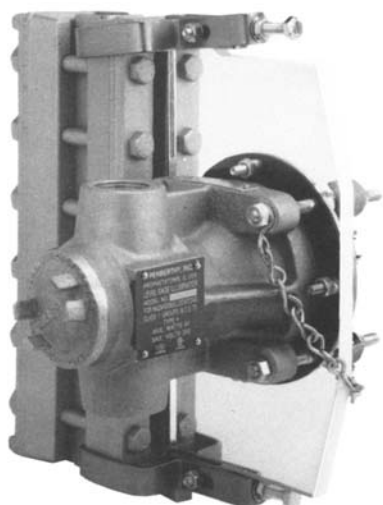
Armored Gages

Armored flat glass gages give users the ability to visually inspect liquid characteristics (color, particulate, striations, turbulence) and monitor relative fill or drain rates in a variety of applications where vibration, temperature and/or pressure extremes rule out level technologies.

End users interested in establishing a reliable, easy-to-understand level reference often use flat glass gages to verify electronic level device output at plant start-up or routine maintenance (especially pressure vessels).

Other distinct advantages:

- They require no electrical power. Level can be monitored in remote locations where no power is available. In event of a power failure, the flat glass gage is not effected.
- They are not dependent on most liquid properties. Multiple liquids can be processed through the same vessel without concerns for density, surface turbulence, di-electric, conductivity, etc.
- They're suitable for vacuum application.
- They provide a near-unlimited length of measure.
- They're non-intrusive.



Illuminator Assembly

(see p. 33 for more information)

Borosilicate Glass, Aluminosilicate Glass and Quartz

Borosilicate glass is the most common type of optic material used in Penberthy gages. Borosilicate glass offers good resistance to most chemicals at temperatures at or below 600°F [316°C].

Penberthy uses tempered borosilicate glass in its gages to improve thermal shock resistance. The tempering process involves heating the glass to a glassy transition point and rapidly cooling the glass to create compressive stress in the outer 1/6 of thickness.

Aluminosilicate glass has a higher viscosity and a lower thermal expansion coefficient compared to borosilicate glass. Aluminosilicate glass is commonly used where process temperatures are greater than 600°F [316°C] but are at or below 800°F [427°C].

Fused quartz is made from crystalline silica with few impurities (50 ppm by weight). The highest temperature rating, 1000°F [538°C], is achieved by using quartz.

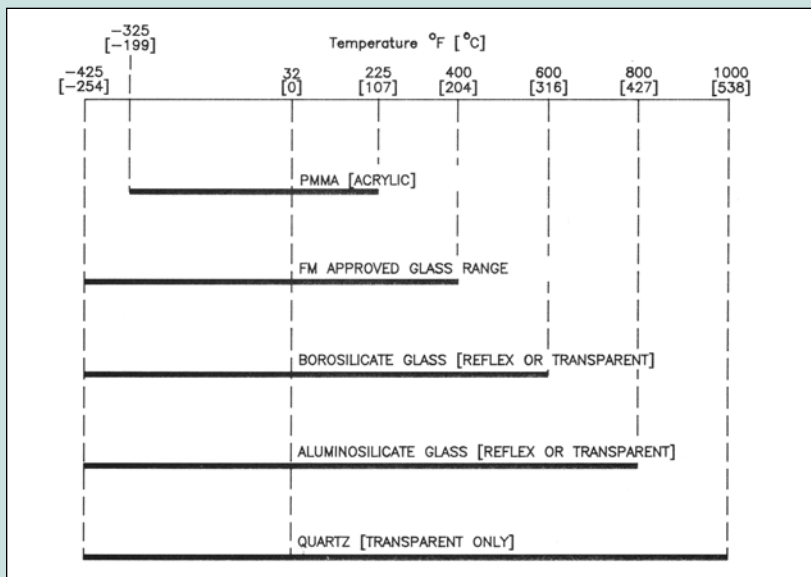
Materials other than quartz limit a gage assembly's maximum operating temperature.

Penberthy offers quartz in its model TH only. The physical properties of quartz require an extremely flat seating surface. Flatness tolerance of gasket and cushion seating surfaces on chambers and covers must be maintained to avoid torsional or point stresses on the quartz.

Shields (e.g., PCTFE, Mica) can be installed to prolong the life of transparent flat glass in corrosive or erosive environments such as hydrofluoric acid, sodium hydroxide or steam.



Temperature Ranges for Commonly Used Optical Material



Low Pressure Flat Glass Gages



for less demanding process conditions...

Penberthy's low pressure gages are designed to maximize the mechanical and economical advantages of ductile iron covers.

All materials in low pressure gages conform to ASTM specifications. RL gages can achieve pressures to 2400 psig [16550 kPa] @ 100°F [38°C] and TL gages can achieve pressures to 2000 psig [13790 kPa] @ 100°F [38°C] when manufactured with size 1 glass – see ratings table below.

Penberthy does not recommend low pressure gages for steam/water applications.

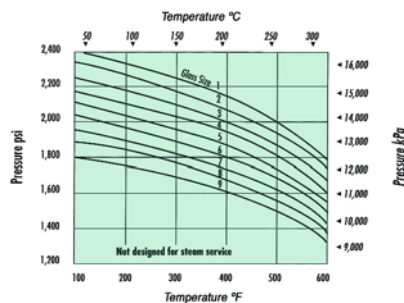
Model RL – Reflex Low Pressure



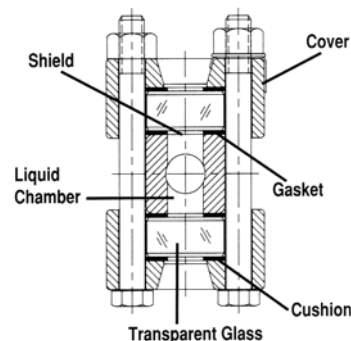
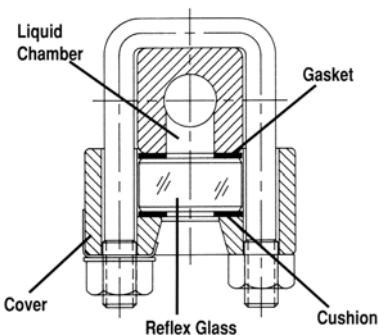
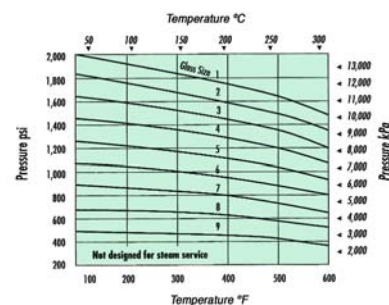
Model TL – Transparent Low Pressure



Model RL Pressure/Temperature



Model TL Pressure/Temperature



Standard/Optional Features

CONNECTION TYPE	STANDARD	OPTIONAL
End Connections		
Threaded		
1/2" NPTF	X	
3/4" NPTF		X
Socketweld		
1/2" female		X
3/4" female		X
Flanged		X
Side or Back (typically reflex only) Connections		
Threaded		
1/2" NPTF		X
3/4" NPTF		X
Socketweld		
1/2" female		X
3/4" female		X
Flanged		X

NOTE: Pressure/Temperature ratings shown for standard gasket, otherwise see chart on page 13.

Medium Pressure Flat Glass Gages



for most common process conditions...

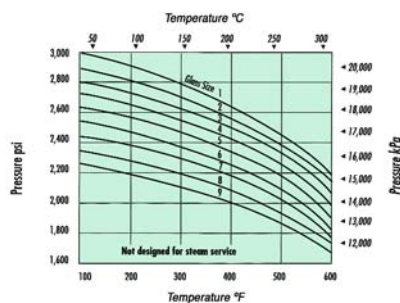
Strength and versatility make Penberthy's medium pressure gages ideal for most common process conditions. Offshore specification 2600.1 is preferred with medium pressure gages in offshore and other corrosive environments.

All materials in medium pressure gages conform to ASTM specifications.

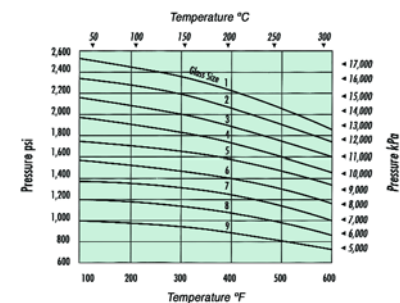
RM gages can achieve pressures to 3000 psig [20680 kPa] @ 100°F [38°C] and TM gages can achieve pressures to 2500 psig [17240 kPa] @ 100°F [38°C] when manufactured with size 1 glass – see ratings table below.

Although not designed for thermal cycling, Penberthy allows use of medium pressure gages for steam/water applications due to historical precedence - see Application Report 2781 in Penberthy Catalog.

Model RM Pressure/Temperature



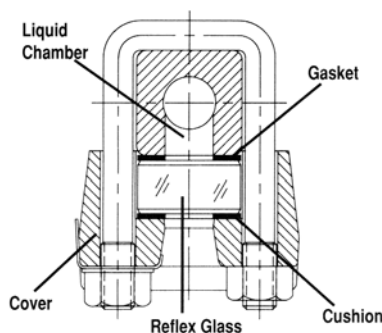
Model TM Pressure/Temperature



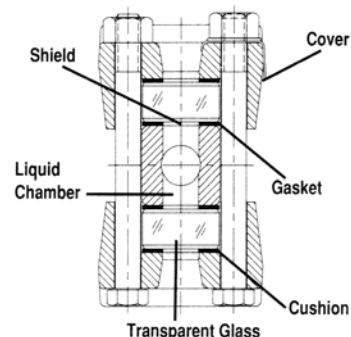
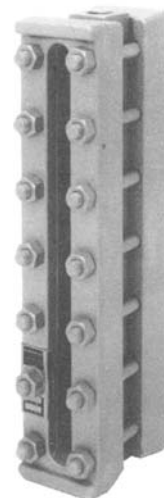
NOTE: Pressure/Temperature ratings shown for standard gasket, otherwise see chart on page 13.

For environmental Nace MR0175 &/or MR0103 gages, pressure de-rating is required

Model RM – Reflex Medium Pressure



Model TM – Transparent Medium Pressure



Standard/Optional Features

CONNECTION TYPE	STANDARD	OPTIONAL
End Connections		
<i>Threaded</i>		
1/2" NPTF	X	
3/4" NPTF		X
<i>Socketweld</i>		
1/2" female		X
3/4" female		X
<i>Flanged</i>		X
Side or Back (typically reflex only) Connections		
<i>Threaded</i>		
1/2" NPTF		X
3/4" NPTF		X
<i>Socketweld</i>		
1/2" female		X
3/4" female		X
<i>Flanged</i>		X
Chambers		
<i>Recessed Gasket</i>		X

*Gages with recessed gaskets are designed with the letter R at the end of the Model Number (i.e. RMR)

High Pressure Flat Glass Gages



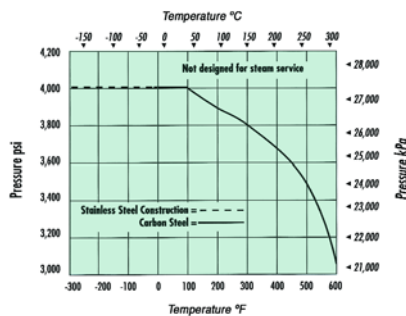
Heavy duty construction for high pressure resistance...

Penberthy engineers its high pressure cover to allow maximum rated pressure regardless of glass size. High pressure gages resist torsional stresses exceptionally well to provide a process gage for the most demanding applications.

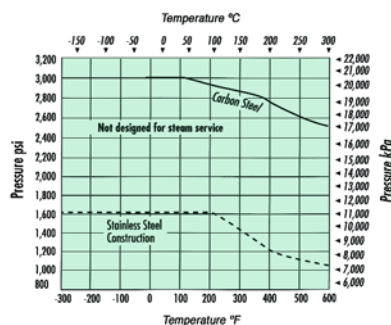
All materials in high pressure gages conform to ASTM specifications. RH gages can achieve pressures to 4000 psig [27580 kPa] @100°F [38°C] and TH gages can achieve pressures to 3000 psig [20680 kPa] @ 100°F [38°C] for all glass sizes – see ratings table below.

Penberthy does not recommend high pressure gages for steam/water applications. They are designed for high pressure, but low thermal cycle duty.

Model RH Pressure/Temperature



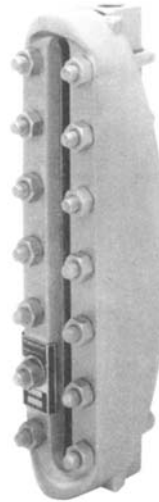
Model TH Pressure/Temperature



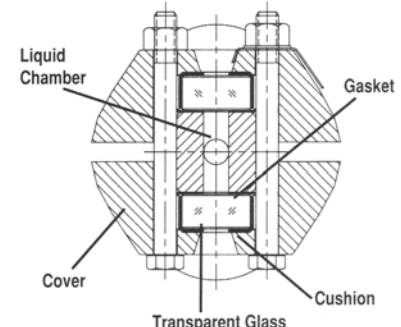
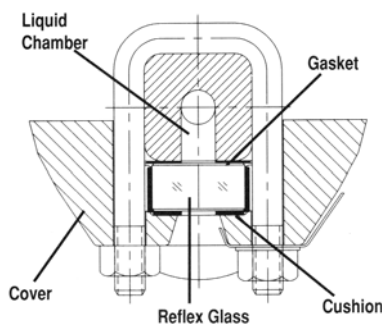
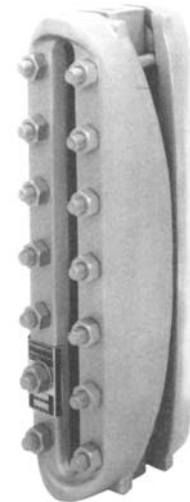
NOTE: Pressure/Temperature ratings shown for standard gasket, otherwise see chart on page 13.

For environmental Nace MR0175 &/or MR0103 gages, pressure de-rating is required

Model RH – Reflex High Pressure



Model TH – Transparent High Pressure



Standard/Optional Features

CONNECTION TYPE	STANDARD	OPTIONAL
End Connections		
Threaded		
1/2" NPTF	X	
3/4" NPTF		X
Socketweld		
1/2" female		X
3/4" female		X
Flanged		X
Side or Back (typically reflex only) Connections		
Threaded		
1/2" NPTF		X
3/4" NPTF		X
Socketweld		
1/2" female		X
3/4" female		X
Flanged		X
Chambers		
Recessed Gasket*		X

*Gages with recessed gaskets are designed with the letter R at the end of the Model Number (i.e. RHR)



Large Chamber Flat Glass Gages

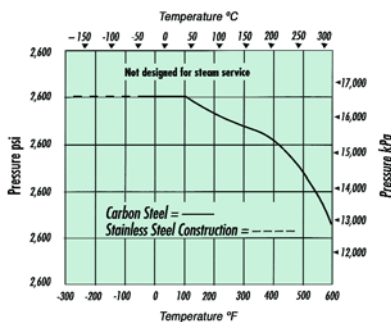
**for turbulent surface
or extremely
transparent liquids...**

Combining high pressure covers and a large cylindrical chamber, these gages can improve accuracy in determining turbulent vessel liquid levels. In addition to simulating the function of a stilling well and providing a liquid column approximately four times the diameter of standard gages, large chamber gages can provide end connections up to 2" NPTF that can accommodate various instrumentation.

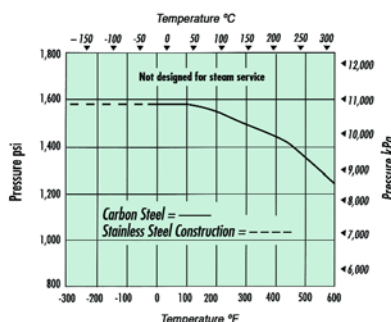
All materials in large chamber gages conform to ASTM specifications. RLC gages can achieve pressures to 2400 psig [16550 kPa] @ 100°F [38°C] and TLC gages can achieve pressures to 1580 psig [10890 kPa] @ 100° F [38°C] for all glass sizes – see ratings table below.

Penberthy does not recommend large chamber gages for steam/water applications.

Model RLC Pressure/Temperature



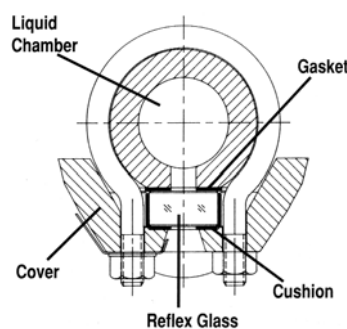
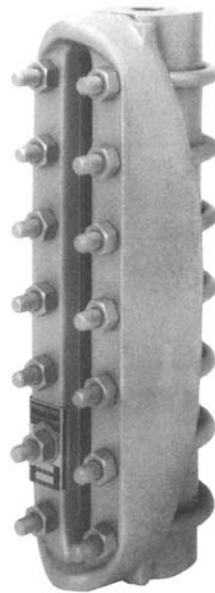
Model TLC Pressure/Temperature



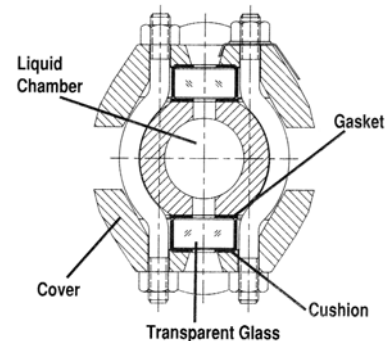
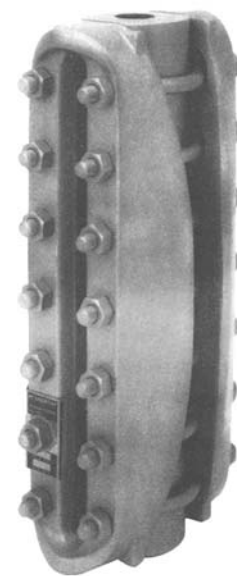
NOTE: Pressure/Temperature ratings shown for standard gasket, otherwise see chart on page 13.

For environmental Nace MR0175 &/or MR0103 gages, pressure de-rating is required

Model RLC – Reflex Large Chamber



Model TLC – Transparent Large Chamber



Standard/Optional Features

CONNECTION TYPE	STANDARD	OPTIONAL
End Connections		
Threaded		
1/2" NPTF	X	
3/4"-2" NPTF		X
Socketweld		
1/2"-2" female		X
Flanged		X
Side or Back (typically reflex only) Connections		
Threaded		
1/2" NPTF		X
3/4" NPTF		X
Socketweld		
1/2" female		X
3/4" female		X
Flanged		X

Weld Pad Flat Glass Gages



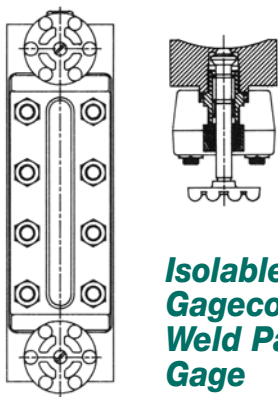
for direct mounting to vessel wall...

For application involving high vibration, highly viscous liquids or liquids with considerable amounts of solids, Penberthy offers end users a flat or radius weld pad gage. Because there are no nipples through which the process liquid enters the gage, clogging potential is eliminated.

When welding the gage to a vessel, it is extremely important to take proper precautions to prevent warpage of the chamber. Penberthy strongly recommends the use of an optional steel spacer for welding.

After welding, it is important to check the flatness of all glass seating surfaces as described in Penberthy's Installation, Operation, and Maintenance manual.

All materials in weld pad gages conform to ASTM specifications. RMW and TMW gages can achieve pressures to 2000 psig [13790 kPa] @ 100°F [38°C] –when manufactured with size 1 glass – see table below.

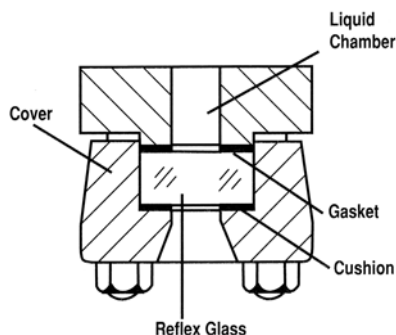
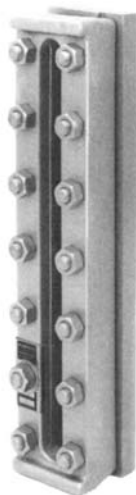


Isolable Gagecocks – Weld Pad Gage

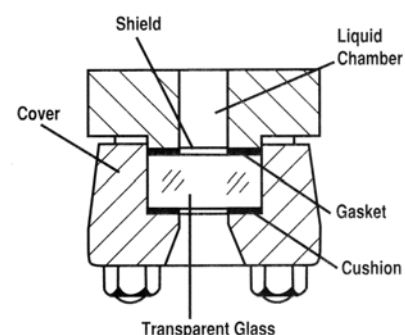
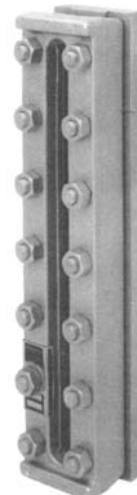
Integral gagecocks can be added to Penberthy's weld pad gages. These gagecocks allow the gage to be isolated for maintenance without lowering the liquid level below the gage.

Penberthy does not recommend weld pad gages for steam/water applications.

Model RMW – Reflex Medium Weld Pad



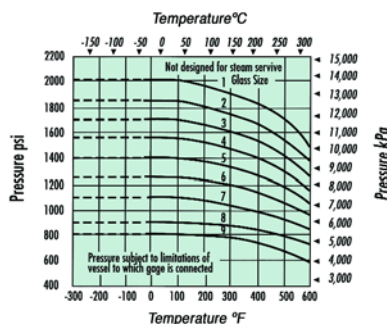
Model TMW – Transparent Medium Weld Pad



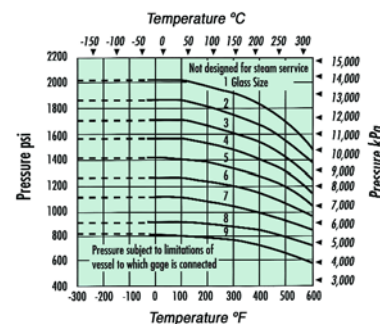
Standard/Optional Features

FEATURE	STANDARD	OPTIONAL
Flat Pad	X	
Radius Pad		
2" [51 mm] min. radius through		
12" [305 mm] max. radius		X
Isolable Gagecocks		X

Model RMW Pressure/Temperature



Model TMW Pressure/Temperature

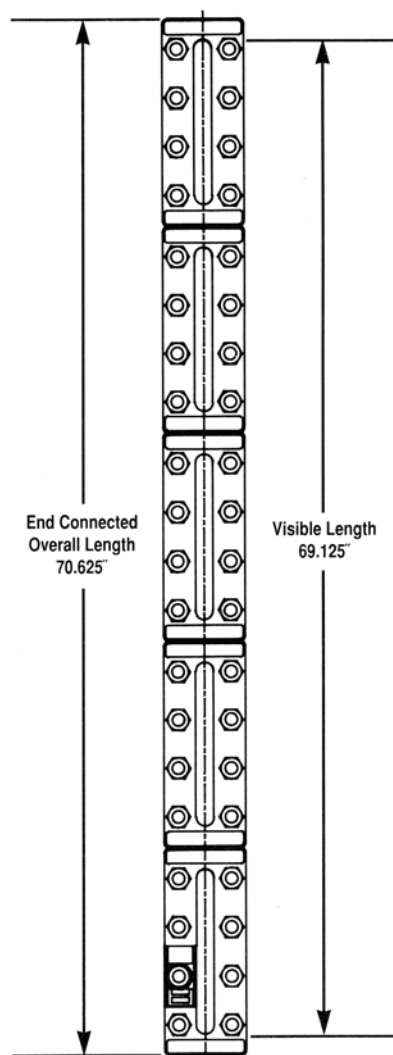


NOTE: Pressure/Temperature ratings shown for standard gasket, otherwise see chart on page 13.

For environmental Nace MR0175 &/or MR0103 gages, pressure de-rating is required

Dimensions for Process Gages

5 Section Gage Size 9 Glass



Pressure/Temperature De-Rating for Material Other Than Standard

Sections	Model	Glass Size	Visible Length		End Connected Overall Length	
			inch	mm	inch	mm
1	RL/TL	1	3.750	95	5.250	133
1	RM(R)/TM(R)	2	4.750	121	6.250	159
1	RMW/TMW	3	5.750	146	7.250	184
1		4	6.750	171	8.250	210
1		5	7.875	200	9.375	238
1		6	9.125	232	10.625	270
1		7	10.250	260	11.750	298
1		8	11.875	302	13.375	340
1		9	12.625	321	14.125	359
2		4	15.000	381	16.500	419
2		5	17.250	438	18.750	476
2		6	19.750	502	21.250	540
2	RL	7	22.000	559	23.500	597
2	TL	8	25.250	641	26.750	679
2	RM	9	26.750	679	28.250	718
3	RMR	6	30.375	772	31.875	810
3	TM	7	33.750	857	35.250	895
3	TMR	8	38.625	981	40.125	1019
3	RH	9	40.875	1038	42.375	1076
4	RHR	7	45.500	1156	47.000	1194
4	TH	8	52.000	1321	53.500	1359
4	THR	9	55.000	1397	56.500	1435
5	RLC	7	57.250	1454	58.750	1492
5	TLC	8	65.375	1661	66.875	1699
5	RMW	9	69.125	1756	70.625	1794
6	TMW	8	78.750	2000	80.250	2038
6		9	83.250	2115	84.750	2153
7		8	92.125	2340	93.625	2378
7		9	97.375	2473	98.875	2511
8		8	105.500	2680	107.000	2718
8		9	111.500	2832	113.000	2870
9		8	118.875	3019	120.375	3058
9		9	125.625	3191	127.125	3229
10		8	132.250	3359	133.750	3397
10		9	139.750	3550	141.250	3588

Gasket Material	Maximum Pressure at specified temperature psig [kPa]									
	100°F	[38°C]	250°F	[121°C]	300°F	[149°C]	400°F	[204°C]	500°F	[260°C]
Buna-N	300	[2070]	225	[1550]	—	—	—	—	—	—
EPDM	300	[2070]	225	[1550]	210	[1450]	—	—	—	—
Neoprene	300	[2070]	225	[1550]	210	[1450]	—	—	—	—
Viton® (FKM)	300	[2070]	225	[1550]	210	[1450]	180	[1240]	—	—
Daikin® (PCTFE)	300	[2070]	225	[1550]	210	[1450]	180	[1240]	—	—
Teflon® (PTFE)	300	[2070]	225	[1550]	210	[1450]	180	[1240]	150	[1030]

Ultra-High Pressure Flat Glass Gages

for extraordinary pressure and vapor requirements...

The method of clamping and sealing the glass differs from other gages in that the glass does not experience stress concentrations imposed by bolting. The glass becomes a floating member between two solidly bolted blocks of rigid plate.

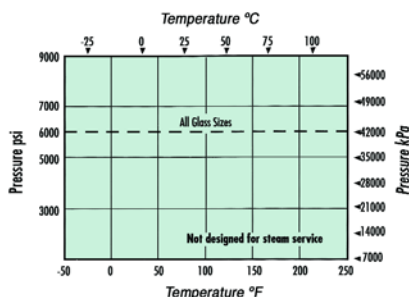
The pressure activated seal principle provides a self adjusting means of maintaining a tight joint between glass and liquid chamber. The gasket system compensates for machining variations.

Because glass can take a tremendous amount of evenly loaded compression, the gage can withstand extremely demanding pressure requirements.

All materials in TU gages conform to ASTM specifications. TU gages can achieve pressures to 6000 psig [41370 kPa] @ 250°F [121°C]. Pressure rating is not glass size dependent. A higher temperature rating 400°F [204°C] @ 6000 psig [41370 kPa] can be achieved by using Viton®. Teflon® can achieve 500°F [260°C] @ 6000 psig [41370 kPa].

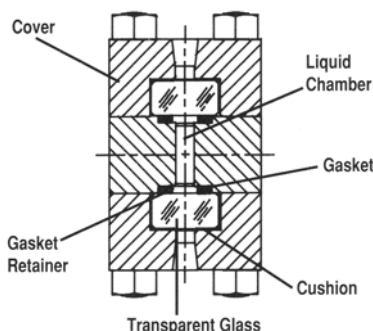
Penberthy does not recommend ultra-high pressure gages for steam/water applications.

Model TU Pressure/Temperature



NOTE: Pressure/Temperature ratings shown for standard gasket, otherwise see chart on page 13.

Model TU - Transparent Ultra High Pressure



Standard/Optional Features

CONNECTION TYPE	STANDARD	OPTIONAL
End Connections		
<i>Threaded</i>		
1/2" NPTF	X	
3/4" NPTF		X
<i>Socketweld</i>		
1/2" female		X
3/4" female		X
<i>Flanged</i>		X
Side Connections		
<i>Threaded</i>		
1/2" NPTF		X
3/4" NPTF		X
<i>Socketweld</i>		
1/2" female		X
3/4" female		X
<i>Flanged</i>		X

Dimensions

Sections	Model	Glass Size	Visible Length		End Connected Overall Length	
			inch	mm	inch	mm
1	TU	1	3.531	90	6.500	165
1	TU	3	5.531	140	8.500	216
1	TU	4	6.531	166	9.500	241
1	TU	5	7.656	194	10.625	270
1	TU	7	10.031	255	13.000	330
2	TU	1	8.875	225	11.750	298
2	TU	3	12.875	327	15.750	400
2	TU	4	14.875	378	17.750	451
2	TU	5	17.125	435	20.000	508
2	TU	7	21.875	556	24.750	629
3	TU	3	20.219	514	23.094	587
3	TU	4	23.219	590	26.094	663
3	TU	5	26.594	675	29.469	749
3	TU	7	33.719	856	36.594	929

Steam/Water Flat Glass Gages

for dynamic thermal environments...

Designed to expand and contract during dynamic thermal conditions, these steam/water gages have extra-heavy construction incorporating a wide chamber. Thermally induced gage stresses are absorbed by the linear expansion within the stuffing box or the expansion loop.

TSL stuffing box or TSL-F flanged configurations can be used for steam/water service at or below 650 psig [4480 kPa]. TSM stuffing box or TSM-F flanged configurations can be used at or below 1500 psig [10340 kPa] steam/water service.

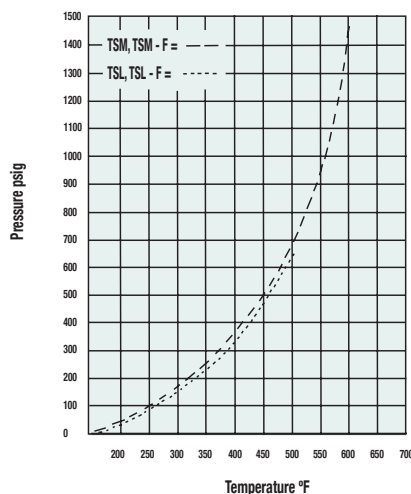
Mica shields and Belleville washers are standard to improve the long term sealing of the gage. All materials conform to ASME/ASTM specifications.

The following gagecocks are suggested for use with steam/water gages:

Model 730 OS&Y - for Model TSL and TSM gage having flanged gage connections;

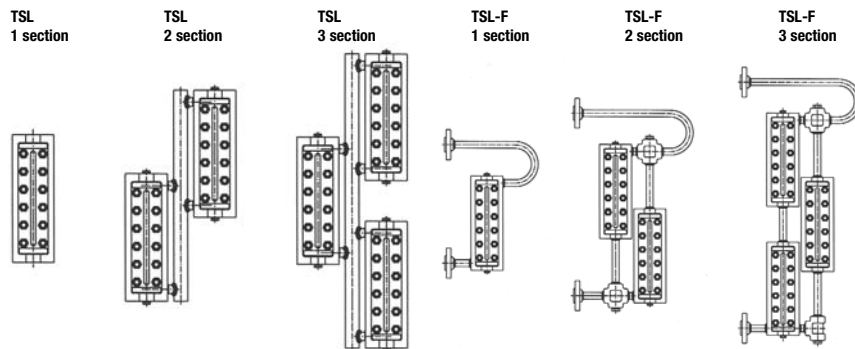
Model 780 OS&Y - for Model TSL and TSM gage having stuffing box connections.

Model TSL, TSL-F, TSM, TSM-F Pressure/Temperature

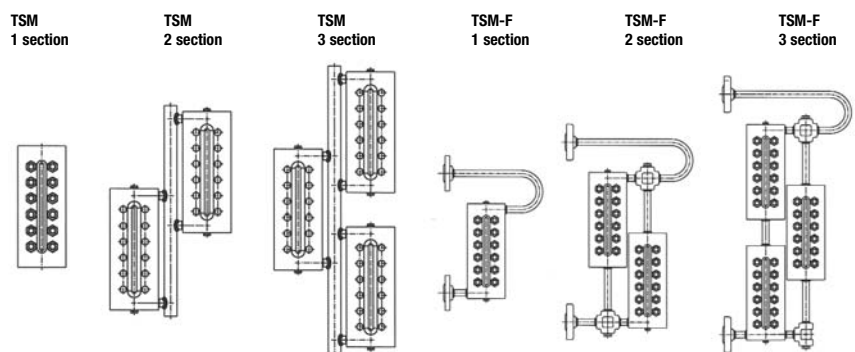


NOTE: Pressure/ Temperature ratings shown for standard gasket.

TSL Configurations



TSM Configurations



Standard/Optional Features

FEATURE	TSL		TSL-F		TSM		TSM-F	
	Std	Opt	Std	Opt	Std	Opt	Std	Opt
Connections								
Stuffing box nipple 3/4" dia.	X				X			
Flanged			X				X	
Expansion Loop			X				X	
Mica Shields	X		X		X		X	

Dimensions

Sections	Model	Glass Size	Visible Length	
			inch	mm
1	TSL	6	9.000	229
1		7	10.125	257
1		9	12.500	318
2	TSL-F	6	17.000	432
2	TSM	7	19.250	489
2	TSM-F	9	24.000	610
3	TSM-F	6	25.000	635
3		7	28.375	721
3		9	35.500	902

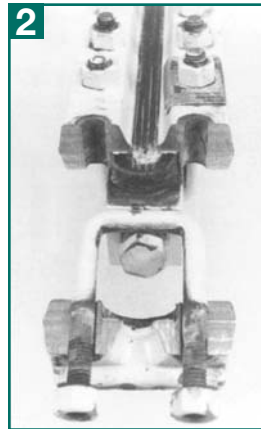


Stuffing Box Nipple

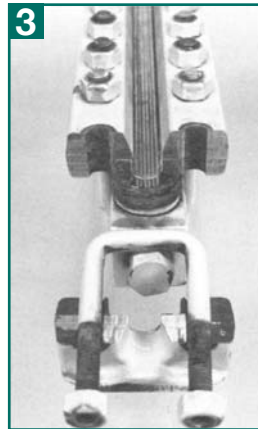
Offshore Gage Glasses



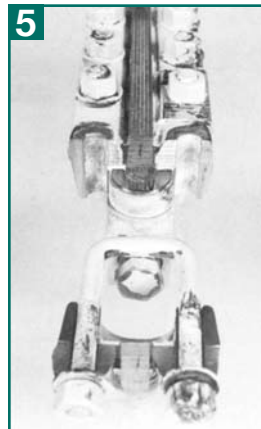
1 Two years actual offshore exposure



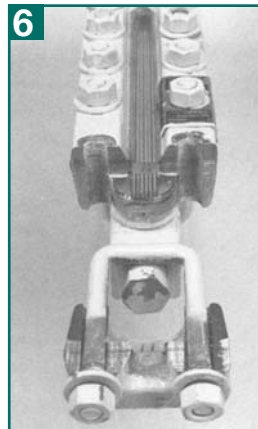
2&3 Two years offshore exposure simulated in lab



4 Flourecarbon and Moly DiSulfide coatings too easily penetrated



5 Three-part coating applied to individual parts prior to gage assembly controls corrosion-except on hardware



6 Three-part coating as applied by Penberthy provides true "offshore protection"

After experiencing a problem on one of their offshore rigs, a major oil company requested that Tyco initiate a research program to develop better corrosion protection for offshore gage glass. To assess the relative strengths and weaknesses of various coatings and materials commonly used as "offshore protection," we subjected a number of our own gages as well as competitive models to an accelerated corrosion/weathering test (ASTM B117). While the tests were performed in a controlled laboratory environment, the exposure to over 2500 hours of heat and salt spray provided a corrosive environment that was judged to be comparable to two years of actual offshore use.

Above left is a Penberthy gage (figure 1) which was used offshore for two years in the Gulf of Mexico. It was prepared according to an industry-accepted specification which the oil company had established for its offshore equipment. Badly corroded and potentially dangerous, this gage establishes a benchmark for the kind of corrosion and deterioration that typically occurs

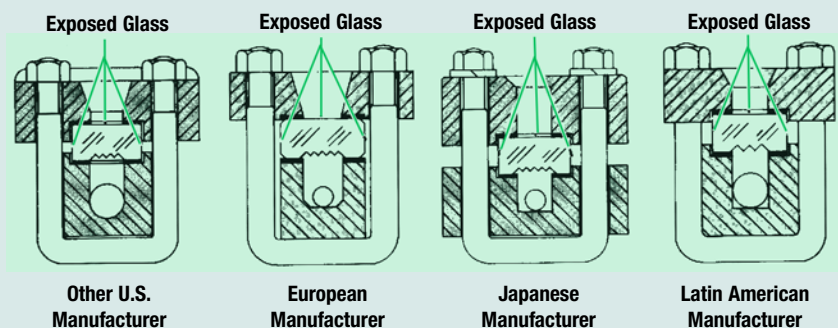
Competitive comparison shows the need for concern in selecting a gage with "offshore" design

As important as coatings are in making a gage corrosion-resistant, their value can be rendered useless if the glass is left vulnerable to other types of damage. The total protection of gage glass is critical in complementing the effectiveness of offshore coatings.

The Penberthy offshore gage design is unique in its ability to completely isolate the gage glass from abrasive forces. This complete protection is important because even seemingly

minor abrasions can cause the tempered gage glass to lose most of its pressure containing ability.

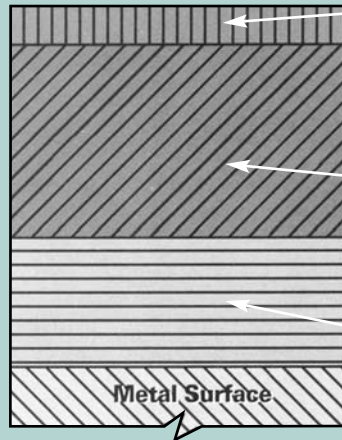
The following diagrams illustrate the relative vulnerability of the glass on competitive models.



during two years of actual offshore use. Corrosion on interior surfaces has put stress on the glass, making it vulnerable to failure. Also, the heavily corroded bolts cannot be retorqued in routine maintenance.

As a result of these tests, Tyco has developed a unique three-part coating, applied to the components before the gage is assembled, to provide unprecedented gage protection in offshore application. The Penberthy gage also includes a variety of unique design features to further extend gage life.

Durable coatings complement the effectiveness of inorganic zinc



Polyurethane Top-Coat (2 to 3 mil)

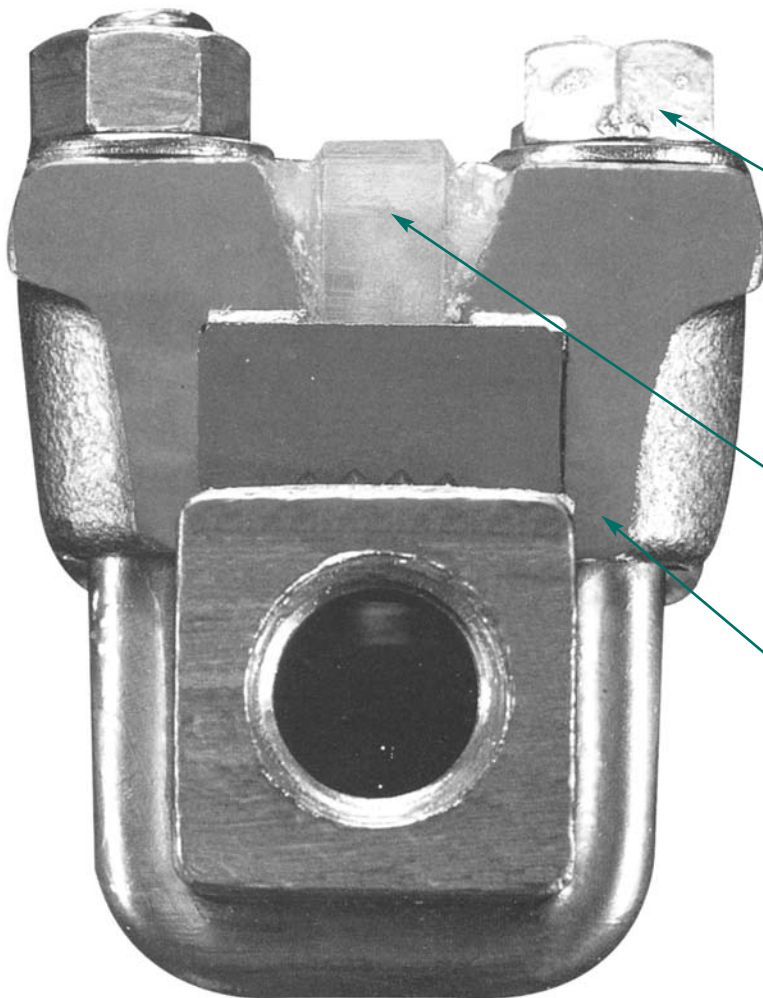
Its glossy tile-like finish dramatically upgrades the weather resistance of the layered coatings. Provides excellent added protection from chemicals and abrasion as well.

Epoxy Tie-Coat (4 to 8 mil)

Epoxy polyamide complements the zinc primer by providing added abrasion resistance and protection from weathering. Also provides an effective base for the topcoat.

Inorganic Zinc Primer (2.5 to 3 mil)

This self-curing coating produces a tight bond to prepare surfaces and protects steel galvanically. Meets performance requirements of ANSI N 101.2-1972 and N 5.12-1974.



Three Protective Coatings

First, and prior to assembly, all metal parts are coated with a layer of sacrificial inorganic zinc. Then, after assembly, they are sprayed with an epoxy tie coat and urethane finish.

Stainless Steel Hardware

Nuts, bolts and washers are stainless steel to assure that they will never rust and that nuts can be periodically retorqued, as required. Washers, in turn, prevent the protective coatings on the cover from being scraped off.

Tough PMMA Panel

Attached with a durable silicone sealant, this strong clear polymethylmethacrylate panel fully protects the glass front from flying sand and debris.

Deep Wall Cover

Gage cover extends the full depth of the glass and protects it laterally from sandblasting and other abrasives from nearby installation and maintenance operations.

Tubular Glass Gages

for cost effective level indication...

Penberthy Tubular Glass Gages are used to register liquid levels in low to medium pressure applications. They are externally mounted to the vessel and use tubular glass to provide direct visual verification of the liquid level present. The transparent glass also provides an excellent means to optically inspect fluid characteristics.

Liquid enters the gage through the lower tank connection. The meniscus present in the glass tube corresponds to the liquid level in the tank.

Available accessories allow you to customize each gage to your specific application requirements. These options can also provide enhanced level indication and protection for the tubular glass.

Protectors

Tubular glass is susceptible to accidental breakage. To counteract this condition, Penberthy offers a variety of protectors. These protectors prevent damage to the glass, but do not restrict level indication capability. In some cases the protector actually enhances it. Protectors can be adapted to fit most major manufacturers' gagecocks.

Guard Rods – Two or four metallic rods placed next to the glass tube.

Plastic or Wire Glass – A transparent box surrounding the tubular glass constructed from either clear plastic or wire glass.

Sheet Metal – Two pieces of sheet metal formed to protect both sides of the tubular glass. The front and back are left open to facilitate easy viewing.

Refractive – An extruded aluminum channel with your choice of either a polymer or glass cover. The interior is a white anodized finish with 45° angle red stripes on the back wall. As



Wire Guard Rod



Refractive Protector



Refractive Protector (Glass Union)



Sheet Metal Protector

the gage fills, liquid passes in front of the stripes. The refractive nature of the liquid changes the stripe angle showing the highly visible contrast between liquid presence and absence.

If water is the liquid used, the stripes become horizontal. Liquids with a refractive index less than water will alter the angle less, higher indexes will alter the angles more. The refractive protector is designed for use with standard tubular glass.

Internal Tubes

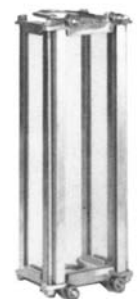
A stainless steel internal heating or cooling tube that passes through the length of the tubular glass can be used in conjunction with an offset pattern gagecock and high pressure glass.

Glass Union

Intended for use in gages over 48" in height. It allows you to join two pieces of glass within the same gage. This increases the length of the gage, yet maintains the same pressure/temperature rating as the individual pieces of glass. Glass unions should be used in conjunction with the refractive protector to provide mechanical stability.



Wire Glass Protector



Plastic Protector



Glass Union

Pressure/Temperature Ratings for Gages with a Single Piece of Tubular Glass (Both 5/8" and 3/4")

Center to Center Distance For Vessel Connections	No Corrosion up to 150°F [66°C]			Steam Boiler Service Up to 425°F [218°C]		
	High Pressure	Heavy Wall	Red Line	High Pressure	Heavy Wall	Red Line
Inches [mm]	Psig [kPa]			Psig [kPa]		
10 [254]	410 [2830]	600 [4140]	340 [2340]	310 [2140]	345 [2380]	275 [1900]
15 [381]	385 [2650]	600 [4140]	310 [2140]	280 [1930]	325 [2240]	265 [1830]
20 [508]	355 [2450]	600 [4140]	285 [1960]	265 [1830]	315 [2170]	260 [1790]
25 [635]	300 [2070]	580 [4000]	260 [1790]	250 [1720]	300 [2070]	250 [1720]
30 [762]	275 [1900]	550 [3790]	230 [1590]	NOT RECOMMENDED		
35 [889]	240 [1650]	500 [3450]	200 [1380]			
40 [1016]	210 [1450]	420 [2890]	180 [1240]			
45 [1143]	200 [1380]	360 [2480]	170 [1170]			
50 [1270]	180 [1240]	340 [2340]	160 [1100]			
55 [1397]	150 [1030]	N/A	140 [970]			
60 [1524]	140 [970]	N/A	120 [830]			
65 [1651]	125 [860]	N/A	100 [690]			
70 [1778]	100 [690]	N/A	90 [620]			

Using secured Glass Unions and multiple pieces of tubular glass will increase the pressure/temperature rating over that of an equivalent length of single glass.

Temperature Ratings for Typical Packing Material

Packing Type	Maximum Temperature Rating °F [°C]
Grafoil ® (Standard)	425 [218]
Teflon ®	425 [218]
Neoprene ®	300 [149]
Viton ®	400 [204]

Material Specifications for Glass Unions and Hydraulic Adapters

Part	Steel	Brass	316 STS
Glass Union	X	X	X
Hydraulic Adapters	X	X	X

Options Available for the Different Types of Tubular Glass

Glass Type (Both 5/8" and 3/4")	OPTIONS						
	Gagecocks	Hydraulic Adapters	Guard Rods	Plastic or Wire Glass Protector	Sheet Metal	Refractive Protector	Internal Tube
High Pressure	X	X	X	X	X	X	X
Heavy Wall	X	X	X	X	X		
Red Line	X	X	X	X	X		
Glass Union	X	X				X	X



Hydraulic Adapter

Hydraulic Adapters

Hydraulic Adapters are used in place of gagecocks for connecting the gage to your vessel. They attach directly to the ends of the tubular glass, providing a 1/2" NPT male connection. This allows you to incorporate most standard hydraulic connections currently available.

Gagecocks: Flat Glass and Tubular Glass

Offset and straight pattern designs for flat glass and tubular glass gages

Penberthy offers offset and straight pattern gagecocks that isolate the gage chamber from the liquid contents of the vessel.

Offset gagecocks have an advantage of permitting the inside of the gage glass to be cleaned easily with a minimum of disassembly. By removing the vent and drain plugs (or other connection), a straight passage through the gage chamber is opened. A brush can be inserted through the gagecock vent and drain for glass cleaning.

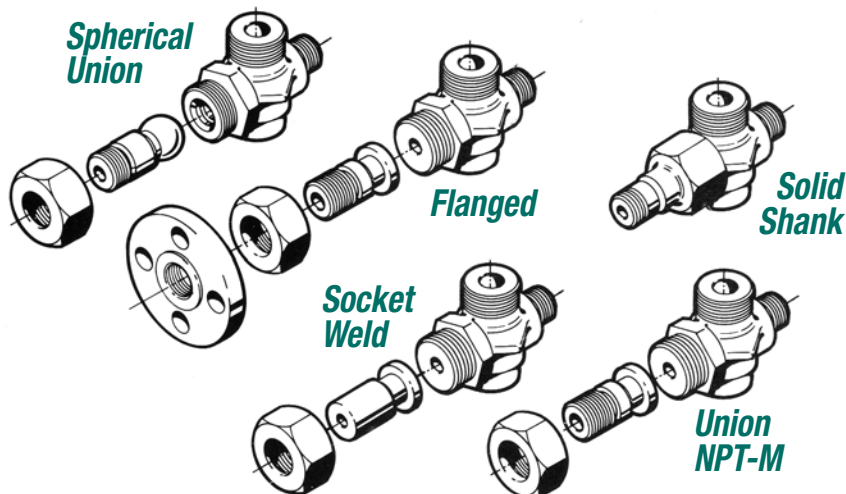
To prevent rapid loss of fluid in the event of accidental glass breakage, Penberthy supplies its gagecocks with automatic ball check shut-off. Should the glass break, the pressure drop causes the ball checks to seat to prevent loss of tank contents.

To unseat these ball checks during the liquid level readings, the tip of the gagecock stem has an extension that pushes the ball away from its seat while allowing the gage column to fill as liquid contents pass around the ball. Stainless steel retainers prevent reverse seating of balls or loss of balls during installation.

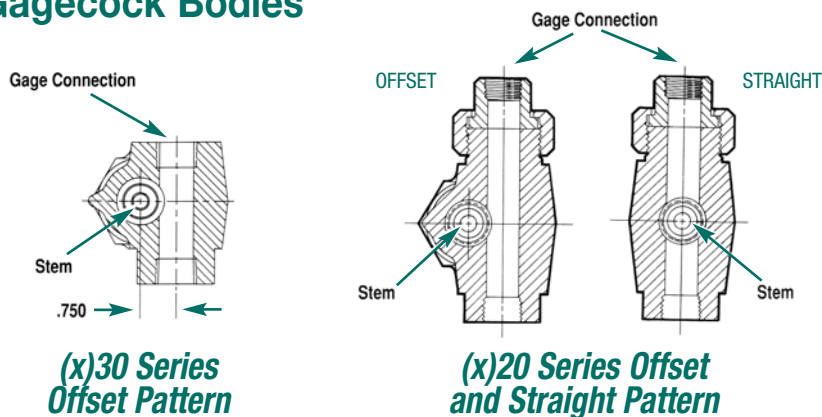
Both upper and lower gagecocks in each set are equipped with horizontal ball checks. Balls are located on the vessel side of the gagecock seats.

Gagecocks with ball checks omitted meet ASME boiler requirements. As an alternative method to ASME boiler requirements, the lower gagecock is available with an optional vertical rising ball check located in the offset portion of the gagecock body, and the upper gagecock has a leaky seat.

Gagecock Connections



Gagecock Bodies



DIMENSIONS (Flat Glass)

To obtain the maximum length permissible for given vessel center-to-center dimension using 1/2" nipples:

$$\text{Maximum Gage Length} = (\text{Gagecock Center-to-Center Dimension}) - (\text{Dimension X})$$

To determine the overall length of nipples needed to make up a gage set for fixed vessel center-to-center dimension using 1/2" nipples:

$$\text{Combined Nipple Length} = (\text{Gagecock Center-to-Center Dimension}) - (\text{Gage Length} + \text{Dimension Y})$$

Overall nipple length can be divided between nipples to suit the application. Minimum length required for each nipple is: 1-1/8" for 1/2" NPT nipple; 1-3/8" for 3/4" NPT nipple.

Penberthy Floating Shank union vessel connection permits gagecock center-to-center dimension to vary 3/8" [9.5 mm] total from actual vessel center-to-center dimension.

Series 100, 200, 300, 400 and 600 Gagecocks

These gagecocks have inside screw threads that are wetted by the liquid. They are offered with a wide range of features in both straight and offset pattern designs (600 Series - offset only).

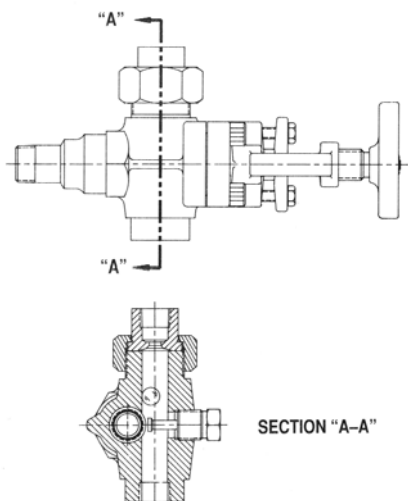
Series 500 and 700 Gagecocks - OS&Y

These are outside screw and yoke gagecocks that are used for high temperature or corrosive-liquid applications. The OS&Y design isolates the stem threads from the liquid. The stem seats in a reciprocative instead of a rotary fashion.

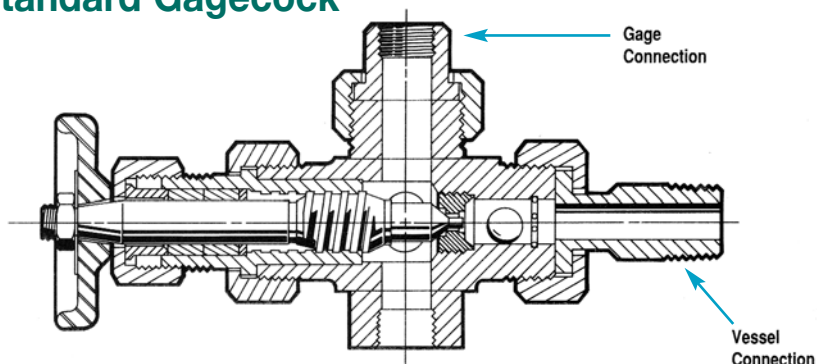
Series N2, K2, K3, N6 and N7 Gagecocks

Penberthy tubular glass gagecocks are for use in lower pressure applications. They are available with many of the same combinations of features described above for a range of uses, including union or solid shank vessel connections and a choice of stuffing box sizes for various glass diameters. All stuffing box connections are designed for positive seal with minimum radial compression. Both straight and offset pattern gagecocks are offered.

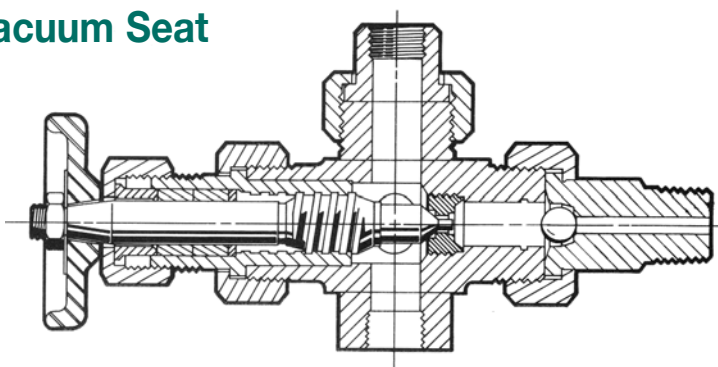
Vertically Rising Ball Check



Standard Gagecock

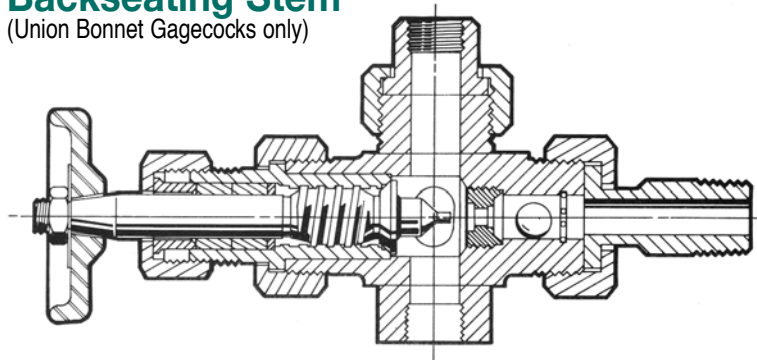


Vacuum Seat



Backseating Stem

(Union Bonnet Gagecocks only)



DIMENSIONS (Tubular Glass)

To obtain the length of glass tubing needed to make up gage set for given vessel center-to-center dimension:

$$\text{Glass Tubing Length} = (\text{Vessel Center-to-Center Dimension}) - (\text{Dimension X})$$

To obtain the length of guard rods for given gagecock center-to-center dimension:

$$\text{Guard Rod Length} = (\text{Gagecock Center-to-Center Dimension}) - (\text{Dimension Y})$$

Straight Pattern Flat Glass Gagecocks

1500 lb. ANSI rating – Pressures to
4000 psi @ +100°F [27580 kPa
@ +38°C]

Temperature Ranges from
-300°F to +750°F [-184°C to +399°C]

Design Features

The 100 and 200 series includes
models 120/220 and 130/230
with these standard features:

- Straight pattern
- Integral bonnet (100 series)
- Union bonnet (200 series)
- Union Vessel connection
- Gage connection
 - Model 120/220 - Union
 - Model 130/230 - Rigid
- Ball Check Shutoff
- Integral seat (100 series)
- Threaded renewable seat (200 series)

A variety of optional features are
available when specified.

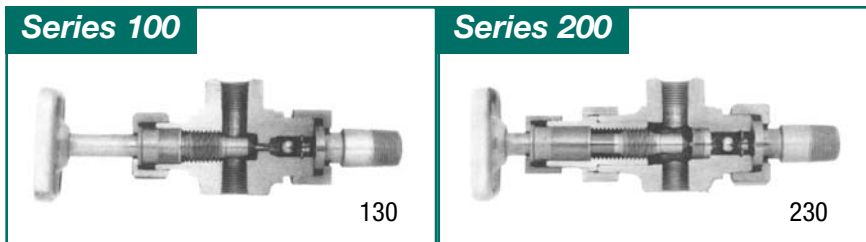
Optional materials can be specified for
the gagecock body and trim. (Trim consists
of the stem, stem packing retainer, ball
check, and seat (200 series only)). Standard
and optional materials conform to ASTM
Specifications.

ASME Boiler Code

Series 100 and 200 gagecock sets that
are acceptable for ASME Boiler Code are
supplied with ball check shut-offs
omitted.

Center-to-Center Dimensions (see p. 20)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
120/220	5-5/8 [14.9]	3-3/8 [9.2]
130/230	2-5/8 [7.3]	3/8 [1.6]



Standard/Optional Features

		120		220		130		230	
FEATURE		Std	Opt	Std	Opt	Std	Opt	Std	Opt
Pattern									
Straight		X		X		X		X	
Bonnet									
Integral		X				X			
Union				X				X	
Gage Connection									
Union	1/2" NPTF	X		X					
	1/2" NPTM		X		X				
	3/4" NPTF		X		X				
	3/4" NPTM		X		X				
Rigid	1/2" NPTF					X		X	
	3/4" NPTF						X		X
Socketweld	1/2" Female		X		X		X		X
	1/2" Male		X		X				
	3/4" Male		X		X				
	3/4" Female						X		X
Flanged			X		X		X		X
	Spherical Union		X		X				
	1/2" NPTM		X		X				
			X		X				
Vessel Connection									
Union	1/2" NPTF		X		X		X		X
	1/2" NPTM		X		X		X		X
	3/4" NPTM	X		X		X		X	
Solid Shank	1" NPTM (non floating)		X		X		X		X
	1/2" NPTM		X		X		X		X
	3/4" NPTM		X		X		X		X
Socketweld	1" NPTM		X		X		X		X
	1/2" Male		X		X		X		X
	3/4" Male		X		X		X		X
Flanged	1" Male		X		X		X		X
			X		X		X		X
	Spherical Union		X		X		X		X
	1/2" NPTF		X		X		X		X
	1/2" NPTM		X		X		X		X
	3/4" NPTM		X		X		X		X
Vent/Drain Connection									
1/2" NPTF		X		X		X		X	
3/4" NPTF			X		X		X		X
Ball Check Shut-Off									
Horizontal Lower and Upper Gagecocks		X		X		X		X	
Omitted *			X		X		X		X
Vacuum - Horizontal Upper and Lower			X		X		X		X
Seat									
Integral		X				X			
Threaded (Renewable)				X				X	
Backseating Stem					X				X
Handwheel									
w/ Standard Pitch Threads		X		X		X		X	
w/ Quick Closing Thread			X		X		X		X
Lever									
w/ Quick Closing Thread (1/4 turn)			X		X		X		X

* Acceptable for ASME Service

Pressure/Temperature

Construction	Maximum working pressure, psi [kPa] at temperatures to-									
	-300°F [-184°C] psi [kPa]	-150°F [-101°C] psi [kPa]	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	500°F [260°C] psi [kPa]	550°F [288°C] psi [kPa]	750°F [399°C] psi [kPa]
Forged Steel			4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2620 [18060]
Stainless Steel	4000 [27580]	4000 [27580]	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2755 [18990]

Offset Pattern Flat Glass Gagecocks

1500 lb. ANSI rating – Pressures to
4000 psi @ +100°F [27580 kPa
@ +38°C]

Temperature Ranges from
-300°F to +750°F [-184°C to +399°C]

Design Features

The 300 and 400 series includes
models 320/420 and 330/430
with these standard features:

- Offset pattern
- Integral bonnet (300 series)
- Union bonnet (400 series)
- Union vessel connection
- Gage connection
 - Model 320/420 - Union
 - Model 330/430 - Rigid
- Ball Check Shutoff
- Integral seat (300 series)
- Threaded renewable seat (400 series)

A Variety of optional features are
available when specified.

Optional materials can be specified for
the gagecock body and trim. (Trim consists
of the stem, stem packing retainer, ball
check, and seat (400 series only)). Standard
and optional materials conform to ASTM
Specifications.

ASME Boiler Code

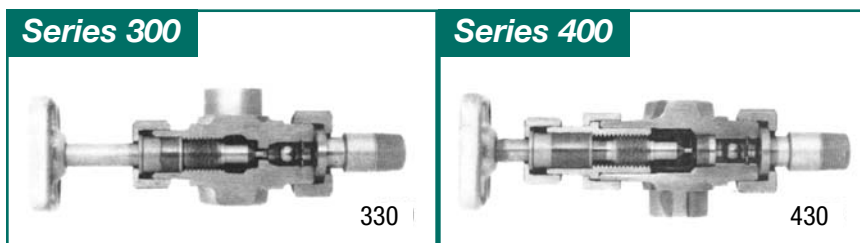
Series 300 and 400 gagecock sets that are
acceptable for ASME Boiler Code are available
as an option. Model 320/420 gagecock sets
with this option can be supplied either with
ball check shutoffs or with them omitted.
Model 330/430 gagecock sets with this option
have the ball check shutoffs omitted.

Center-to-Center Dimensions (see p. 20)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
320/420	5-5/8 [14.9]	3-3/8 [9.2]
330/430	2-5/8 [7.3]	3/8 [1.6]

Pressure/Temperature

Construction	-300°F [-184°C] psi [kPa]	-150°F [-101°C] psi [kPa]	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	500°F [260°C] psi [kPa]	550°F [288°C] psi [kPa]	750°F [399°C] psi [kPa]
Forged Steel			4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2620 [18060]
Stainless Steel	4000 [27580]	4000 [27580]	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2755 [18990]



Standard/Optional Features

		320		420		330		430	
FEATURE		Std	Opt	Std	Opt	Std	Opt	Std	Opt
Pattern									
Offset		X		X		X		X	
Bonnet									
Integral		X				X			
Union				X				X	
Gage Connection									
Union	1/2" NPTF	X		X					
	1/2" NPTM		X		X				
	3/4" NPTF		X		X				
	3/4" NPTM		X		X				
Rigid	1/2" NPTF					X		X	
	3/4" NPTF						X		X
Socketweld	1/2" Female		X		X		X		X
	1/2" Male		X		X				
	3/4" Male		X		X				
	3/4" Female						X		X
Flanged Spherical Union			X		X		X		X
	1/2" NPTF		X		X				
	1/2" NPTM		X		X				
	3/4" NPTM		X		X				
Vessel Connection									
Union	1/2" NPTF		X		X		X		X
	1/2" NPTM		X		X		X		X
	3/4" NPTM	X		X		X		X	
Solid Shank	1" NPTM (non floating)		X		X		X		X
	1/2" NPTM		X		X		X		X
	3/4" NPTM		X		X		X		X
	1" NPTM		X		X		X		X
Socketweld	1/2" Male		X		X		X		X
	3/4" Male		X		X		X		X
	1" Male		X		X		X		X
Flanged Spherical Union			X		X		X		X
	1/2" NPTF		X		X		X		X
	1/2" NPTM		X		X		X		X
	3/4" NPTM		X		X		X		X
Vent/Drain Connection									
1/2" NPTF		X		X		X		X	
3/4" NPTF			X		X		X		X
Ball Check Shut-Off									
Horizontal Lower and Upper Gagecocks		X		X		X		X	
Vertical Lower/Horizontal Upper Gagecock *			X		X				
Omitted *			X		X		X		X
Vacuum - Horizontal Upper and Upper			X		X		X		X
Seat									
Integral		X				X			
Threaded (Renewable)				X				X	
Backseating Stem					X				X
Handwheel									
w/ Standard Pitch Threads		X		X		X		X	
w/ Quick Closing Thread			X		X		X		X
Lever									
w/ Quick Closing Thread (1/4 turn)			X		X		X		X

* Acceptable for ASME Service

Straight Pattern/OS&Y Flat Glass Gagecocks

1500 lb. ANSI rating – Pressures to
4000 psi @ +100°F [27580 kPa
@ +38°C]

Temperature Ranges from
-20°F to +750°F [-29°C to +399°C]

Design Features

The 500 series includes models
520 and 530 with these
standard features:

- Straight pattern
- Outside screw and yoke
- Solid shank vessel connection
- Gage connection
Model 520 - Union
Model 530 - Rigid
- Ball Check Shutoff
- Threaded renewable seat
- Backseating stem

A variety of optional features are
available when specified.

Optional materials can be specified for
the gagecock body and trim. (Trim consists
of the stem, stem packing retainer, ball
check, and seat.) Standard and optional
materials conform to ASTM Specifications.

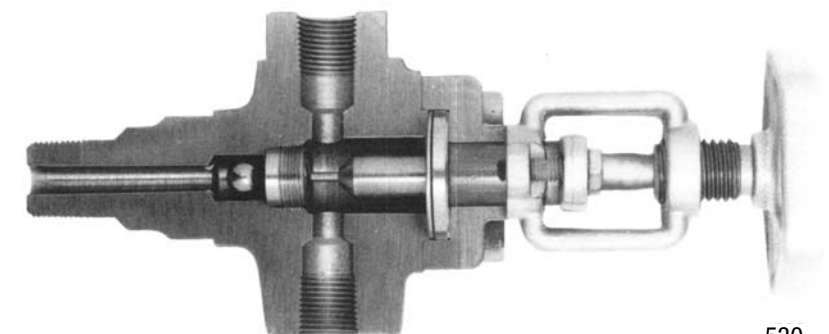
ASME Boiler Code

Series 500 gagecock sets that are
acceptable for ASME Boiler Code are
available as an option. Gagecock sets
with this option are supplied with ball
check shut-offs omitted.

Center-to-Center Dimensions (see p. 20)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
520	6-3/8 [16.8]	4-1/8 [11.1]
530	4-3/8 [11.7]	2-1/8 [6.0]

Series 500



530

Standard/Optional Features

		520		530	
FEATURE		Std	Opt	Std	Opt
Pattern					
Straight		X		X	
OS&Y					
OS&Y		X		X	
Gage Connection					
Union	1/2" NPTF	X			
	1/2" NPTM		X		
	3/4" NPTF		X		
	3/4" NPTM		X		
Rigid	1/2" NPTF			X	
	3/4" NPTF				X
Socketweld	1/2" Female		X		X
	1/2" Male		X		
	3/4" Male		X		
	3/4" Female				X
Flanged Spherical Union	1/2" NPTF		X		X
	1/2" NPTM		X		
	3/4" NPTM		X		
Vessel Connection					
Solid Shank	1/2" NPTM		X		X
	3/4" NPTM	X		X	
	1" NPTM		X		X
Socketweld	1/2" Male		X		X
	3/4" Male		X		X
	1" Male		X		X
Flanged			X		X
Vent/Drain Connection					
1/2" NPTF		X		X	
3/4" NPTF			X		X
Ball Check Shut-Off					
Horizontal Lower and Upper Gagecocks		X		X	
Omitted *			X		X
Seat					
Threaded (Renewable)		X		X	
Backseating Stem		X		X	
Handwheel					
w/ Standard Pitch Threads		X		X	
w/ Quick Closing Thread (1/4 turn)			X		X

* Acceptable for ASME Service

Pressure/Temperature

Construction	Maximum working pressure, psi [kPa] at temperatures to-							
	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	500°F [260°C] psi [kPa]	550°F [260°C] psi [kPa]	750°F [399°C] psi [kPa]
Forged Steel	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2620 [18060]
Stainless Steel	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2755 [18990]

Offset Pattern/OS&Y Flat Glass Gagecocks

1500 lb. ANSI rating - Pressures to
4000 psi @ +100°F [27580 kPa
@ +38°C]

Temperature Ranges from
-20°F to +750°F [-29°C to +399°C]

Design Features

The 700 series includes models
720, 730 and 780 with these
standard features:

- Offset pattern
- Outside screw and yoke
- Solid shank vessel connection
- Gage connection
Model 720 - Union
Model 730 - Rigid
Model 780 - Stuffing Box
- Ball Check Shutoff
- Threaded renewable seat
- Backseating Stem

A Variety of optional features are
available when specified.

Optional materials can be specified for
the gagecock body and trim. (Trim consists
of the stem, stem packing retainer, ball
check and seat.) Standard and optional
materials conform to ASTM
Specifications.

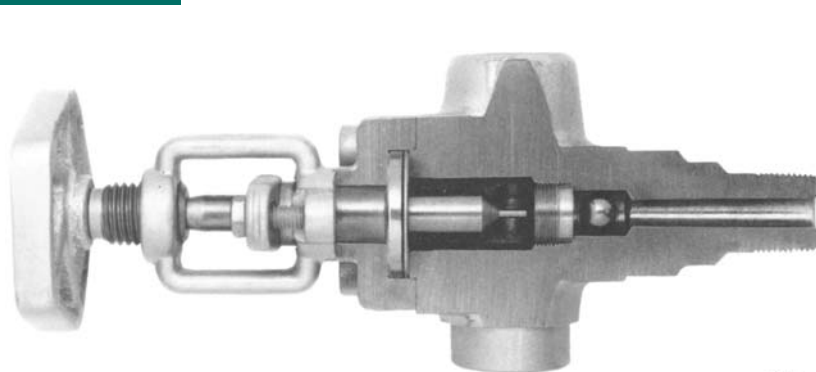
ASME Boiler Code

Series 700 gagecock sets that are
acceptable for ASME Boiler Code are
available as an option. Ball check
shut-offs can be omitted; or the Model
720 and 780 can have a vertical
rising lower ball check and horizontal,
leaky upper ball check.

Center-to-Center Dimensions (see p. 20)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
720	6-3/8 [16.8]	4-1/8 [11.1]
730	4-3/8 [11.7]	2-1/8 [6.0]

Series 700



730

Standard/Optional Features

		720		730		780	
FEATURE		Std	Opt	Std	Opt	Std	Opt
Pattern							
Offset		X		X		X	
OS&Y							
OS&Y		X		X		X	
Gage Connection							
Union	1/2" NPTF	X					
	1/2" NPTM		X				
	3/4" NPTF		X				
	3/4" NPTM		X				
Rigid	1/2" NPTF			X			
	3/4" NPTF				X		
Socketweld	1/2" Female		X		X		
	1/2" Male		X				
	3/4" Female				X		
	3/4" Male		X				
Flanged			X		X		
Spherical Union	1/2" NPTF		X				
	1/2" NPTM		X				
	3/4" NPTM		X				
Stuffing Box	3/4" Adapter Diameter					X	
Vessel Connection							
Solid Shank	1/2" NPTM		X		X		X
	3/4" NPTM	X		X		X	
	1" NPTM		X		X		X
Socketweld	1/2" Male		X		X		X
	3/4" Male		X		X		X
	1" Male		X		X		X
Flanged			X		X		X
Vent/Drain Connection							
	1/2" NPTF	X		X		X	
	3/4" NPTF		X		X		X
Ball Check Shut-Off							
Horizontal Lower and Upper Gagecocks		X		X		X	
Vertical Lower/Horizontal Upper Gagecocks*			X				X
Omitted *			X		X		X
Seat							
Threaded (Renewable)		X		X		X	
Backseating Stem		X		X		X	
Handwheel							
w/ Standard Pitch Threads		X		X		X	
w/ Quick Closing Thread (1/4 turn)			X		X		X

* Acceptable for ASME Service

Pressure/Temperature

Construction	Maximum working pressure, psi [kPa] at temperatures to-							
	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	500°F [260°C] psi [kPa]	550°F [260°C] psi [kPa]	750°F [399°C] psi [kPa]
Forged Steel	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2620 [18060]
Stainless Steel	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]	3525 [24300]	3355 [23130]	2755 [18990]

OS&Y Fugitive Emission Gagecocks

1500 lb. ANSI rating – Pressures to
4000 psi @ +100°F [27580 kPa
@ +38°C]

Temperature Ranges from
-20°F to +400°F [-29°C to +204°C]

The “Arrestor” Fugitive Emission Gagecock

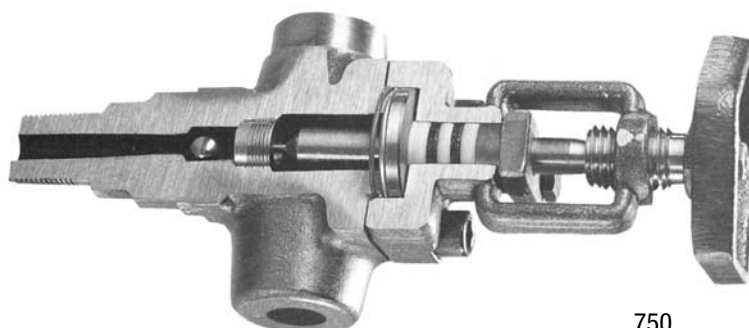
Environmental pollution is a global issue. Environmental regulations impacting plant operations include gagecocks. The “ARRESTOR” OS&Y gagecock is utilized with gage glass, mag gage or other apparatus when process fluid vapors or gases are considered to be environmentally harmful.

Penberthy’s “ARRESTOR” gagecocks are individually serialized and tested to meet EPA emission test requirements. Each (550/750 gagecock) is shipped with its individual test report that certifies less than 5 ppm methane equivalent leak rates using Kalrez® packing. Kalrez®/Zymaxx™, API 607 III Edition Fire Test qualified, is a packing material option.

Models 551/751 are available with type-accepted packing, rated to leak rates of 500 ppm methane equivalent.

Optional materials of construction can be specified for the gagecock body and trim. (Trim consists of the stem, stem packing retainer, ball and seat.) Reference Penberthy Material Specification sheets for optional materials.

Series 550/750



750

Standard/Optional Features

FEATURE	550/551		750/751	
	Std	Opt	Std	Opt
Pattern				
Straight	X			
Offset			X	
OS&Y				
OS&Y	X		X	
Gage Connection				
Socketweld	X		X	
Rigid				X
		X		X
		X		X
Flanged		X		X
Vessel Connection				
Socketweld	X	X		X
			X	
				X
Solid Shank		X		X
		X		X
		X		X
Flanged		X		X
Vent/Drain Connection				
Socketweld	X		X	
Threaded		X		X
		X		X
		X		X
Ball Check Shut-Off				
Horizontal Lower and Upper Gagecocks	X		X	
Ball Checks Omitted		X		X
Seat				
Threaded (Renewable)	X		X	
Backseating Stem	X		X	
Handwheel				
w/ Standard Pitch Threads	X		X	
w/ Quick Closing Thread (1/4 turn)		X		X

Pressure/Temperature

Construction	Maximum working pressure, psi [kPa] at temperatures to-				
	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]
Forged Steel	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]
Stainless Steel	4000 [27580]	4000 [27580]	3900 [26890]	3815 [26300]	3730 [25720]

Offset Pattern Flat Glass Gagecocks

Pressures to 6000 psi @ +250°F
[41370 kPa @ +121°C]

Temperature Ranges from
-50°F to +250°F [-46°C to +121°C]

Design Features

The 600 series includes model 630 with these standard features:

- Offset pattern
- Union bonnet
- Union vessel connection
- Rigid gage connection
- Ball Check Shutoff
- Threaded renewable seat
- Backseating Stem

A Variety of optional features are available when specified.

Optional materials can be specified for the gagecock body and trim. (Trim consists of the stem, stem packing retainer, ball check and seat.) Standard and optional materials conform to ASTM Specifications.

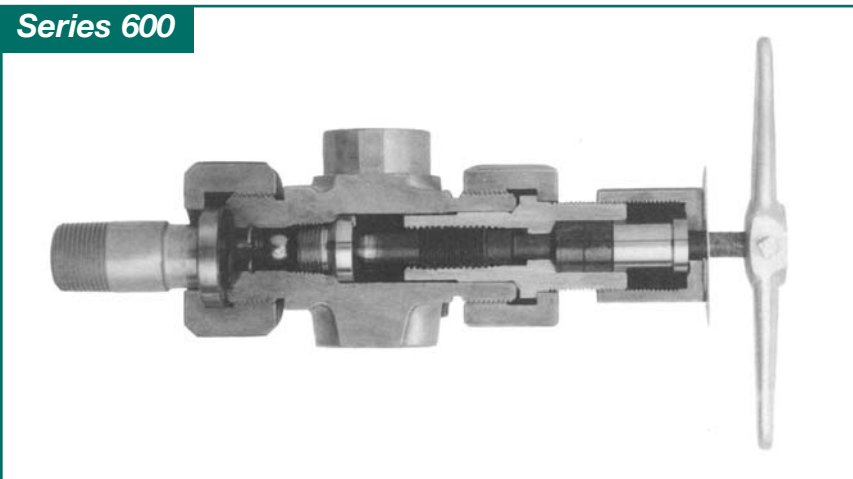
Pressure/Temperature Range

Model 630 gagecocks are rated for pressures up to 6000 psi [41370 kPa] over a temperature range of -50°F to +250°F [-46°C to +121°C]. Optional o-ring materials for vessel tailpipe can be used to increase temperature capability.

Center-to-Center Dimensions (see p. 20)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
630	3-1/8 [8.6]	7/8 [2.9]

Series 600



Standard/Optional Features

		630	
FEATURE		Std	Opt
Pattern			
Straight		X	
Bonnet			
Union		X	
Gage Connection			
Rigid	1/2" NPTF	X	
	3/4" NPTF		X
Socketweld	1/2" Female		X
	3/4" Female		X
Flanged			X
Vessel Connection			
Union	1/2" NPTM		X
	3/4" NPTM	X	
	1" NPTM		X
Solid Shank	1/2" NPTM		X
	3/4" NPTM		X
	1" NPTM		X
Socketweld	1/2" Male		X
	3/4" Male		X
	1" Male		X
Flanged			X
Vent/Drain Connection			
3/8" NPTF		X	
1/2" NPTF			X
3/4" NPTF			X
Ball Check Shut-Off			
Horizontal Lower and Upper Gagecocks		X	
Omitted *			X
Seat			
Threaded (Renewable)		X	
Backseating Stem		X	
Lever			
w/ Standard Pitch Threads		X	
w/ Quick Closing Thread (1/4 turn)			X

* Acceptable for ASME Service

Offset Pattern Tubular Glass Gagecocks

300 lb. ANSI rating - Pressures to
750 psi @ +100°F [5170 kPa
@ +38°C]

Temperature Ranges from
-300°F to +750°F [-184°C to +399°C]

Design Features

The N2 and K2 series include models
N2A/K2A, N2B/K2B and N2C/K2C with
these standard features:

- Offset Pattern
- Integral bonnet (N2 series)
Union bonnet (K2 series)
- Union vessel connection
- Stuffing Box gage connection
- Ball check shutoff
- Integral seat (N2 series)
Threaded renewable seat (K2 series)

A variety of optional features are
available when specified.

Optional materials can be specified for
the gagecock body and trim. (Trim con-
sists of the stem, stem packing retainer,
ball check, and seat (K2 series only)).
Standard and optional materials conform
to ASTM Specifications.

ASME Boiler Code

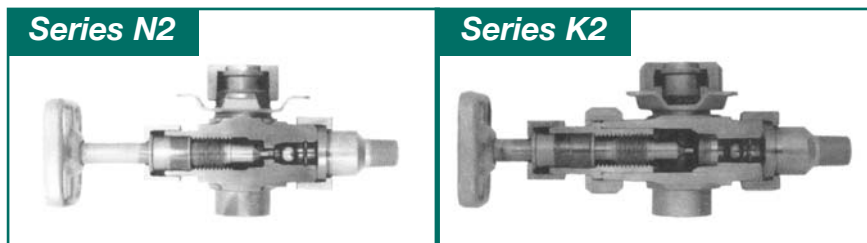
Series N2 and K2 gagecock sets that are
acceptable for ASME Boiler Code are
available as an option.

For steam/water service in excess of 350
psi [2400 kPa], transparent flat glass
gages with tubular adapters and shields
are recommended.

Center-to-Center and Guard Rod Dimensions

(see p. 21)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
All Models	1-7/8 [4.8]	2-3/8 [6.0]



Standard/Optional Features

FEATURE	N2A		K2A		N2B		K2B		N2C		K2C	
	Std	Opt	Std	Opt	Std	Opt	Std	Opt	Std	Opt	Std	Opt
Pattern												
Offset	X		X		X		X		X		X	
Bonnet												
Integral	X				X				X			
Union			X				X				X	
Gage Connection												
Stuffing Box 5/8" Glass Diameter	X		X									
3/4" Glass Diameter					X		X		X		X	
Vessel Connection												
Union 1/2" NPTM	X		X									
3/4" NPTM					X		X					
1" NPTM (non-floating)									X		X	
Solid Shank 1/2" NPTM		X		X		X		X		X		X
3/4" NPTM		X		X		X		X		X		X
1" NPTM		X		X		X		X		X		X
Socketweld 1/2" Male		X		X								
3/4" Male						X		X				
1" Male										X		X
Flanged		X		X		X		X		X		X
Spherical Union 1/2" NPTM		X		X								
3/4" NPTM						X		X				
Vent Connection												
3/4" NPTF	X		X		X		X		X		X	
Drain Connection												
1/2" NPTF	X		X		X		X		X		X	
Ball Check Shut-Off												
Horizontal Lower and Upper Gagecocks	X		X		X		X		X		X	
Vertical Lower/Horizontal Upper Gagecocks*		X		X		X		X		X		X
Omitted*		X		X		X		X		X		X
Vacuum - Horizontal Upper and Lower		X		X		X		X		X		X
Seat												
Integral	X				X				X			
Threaded (Renewable)			X				X				X	
Handwheel												
w/Standard Pitch Threads	X		X		X		X		X		X	
w/Quick Closing Threads		X		X		X		X		X		X
Lever												
w/Quick Closing Thread (1/4 turn)		X		X		X		X		X		X
Guard Rods (4 per gagecock set)												
1/4" [6.4 mm] diameter		X		X		X		X		X		X

* Acceptable for ASME Service

Pressure/Temperature

(Subject to limitations of tubular glass)

MODEL	-300°F [-184°C] psi [kPa]	-20°F [-29°C] psi [kPa]	Maximum working pressure, psi [kPa] at temperatures to: 100°F [38°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	500°F [260°C] psi [kPa]	750°F [399°C] psi [kPa]
Steel & 316 STS N2A/K2A	675 [4650]	675 [4650]	675 [4650]	610 [4210]	590 [4070]	555 [3830]	400 [2760]
Steel & 316 STS N2B/K2B, N2C/K2C	750 [5170]	750 [5170]	750 [5170]	675 [4650]	655 [4520]	610 [4210]	450 [3100]

Offset Pattern Tubular Glass Gagecocks

300 lb. ANSI rating – Pressures to
500 psi @ +100°F [3450 kPa
@ +38°C]

Temperature Range from
-20°F to +550°F [-29°C to +288°C]

Design Features

The K3 series include models K3A (150 lb. ASA) and K3B (300 lb. ASA) with these standard features:

- Offset pattern
- Union bonnet
- Rigid vessel connection
- Stuffing box gage connection
- Ball check shutoff
- Backseating stem
- Drain cock furnished

A variety of optional features are available when specified.

Optional materials can be specified for the gagecock trim. (Trim consists of the stem, stem packing retainer and ball check.) Standard and optional materials conform to ASTM Specifications.

ASME Boiler Code

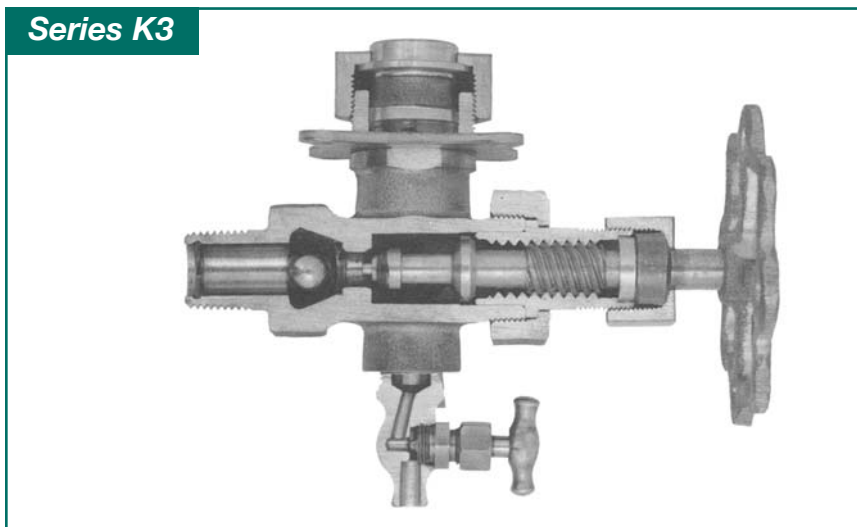
Series K3 gagecock sets that are acceptable for ASME Boiler Code are available as an option. These gagecock valve sets have a vertical rising ball check shut-off in the lower gagecock and a horizontal leaky ball seat in the upper gagecock.

Center-to-Center and Guard Rod Dimensions

(see p. 21)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
All Models	2 [5.1]	2-1/8 [5.4]

Series K3



Standard/Optional Features

FEATURE	K3A		K3B	
	Std	Opt	Std	Opt
Pattern				
Offset	X		X	
Bonnet				
Union	X		X	
Gage Connection				
Stuffing Box 5/8" Glass Dia.	X			
3/4" Glass Dia.			X	
Vessel Connection				
Solid Shank 1/2" NPTM	X			
3/4" NPTM			X	
Socketweld 1/2" Male		X		
3/4" Male				X
Flanged		X		X
Drain Connection				
3/8" NPTF	X		X	
Ball Check Shut-Off				
Horizontal Lower and Upper Gagecocks	X		X	
Vertical Lower/Horizontal Upper Gagecock*		X		X
Omitted*		X		X
Seat				
Integral	X		X	
Backseating Stem	X		X	
Handwheel				
w/Quick Closing Threads (1/4 turn)	X		X	
Lever				
Lever		X		X
Drain Cock				
Furnished	X		X	
Guard Rods (4 per gagecock set)				
1/4" [6.4 mm] diameter		X		X

* Acceptable for ASME Service

Pressure/Temperature

(Subject to limitations of tubular glass)

MODEL	Maximum working pressure, psi [kPa] at temperatures to-								Max. Steam Pressure psi [kPa]
	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	500°F [260°C] psi [kPa]	550°F [288°C] psi [kPa]		
K3A	225 [1550]	225 [1550]	215 [1480]	190 [1310]	170 [1170]	150 [1030]			175 [1210]
K3B	500 [3450]	500 [3450]	475 [3270]	425 [2930]	375 [2580]	325 [2240]	300 [2070]		360 [2480]

Straight Pattern Tubular Glass Gagecocks

125 lb. ANSI rating – Pressures to
200 psi @ +100°F [1380 kPa @
+38°C]

Temperature Range from
-20°F to +400°F [-29°C to +204°C]

Design Features

The N6 series consists of model N6A with these standard features:

- Straight pattern
- Integral bonnet
- Rigid vessel connection
- Stuffing box gage connection
- Ball check shutoff
- Drain cock furnished

A variety of optional features are available when specified.

Optional materials can be specified for the gagecock trim. (Trim consists of the stem, stem packing retainer and ball check.) Standard and optional materials conform to ASTM Specifications.

Steam Service

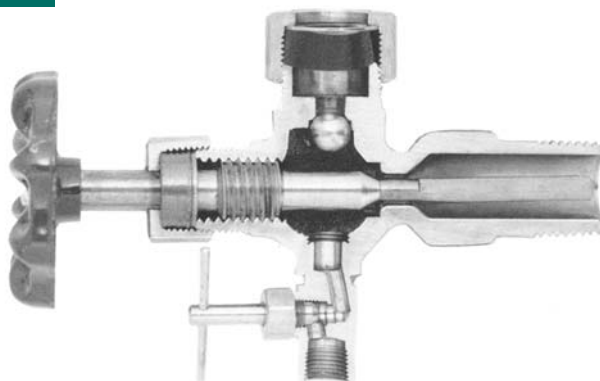
Series N6 gagecock sets for steam service are available as an option.

Center-to-Center and Guard Rod Dimensions

(see p. 21)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
N6A	1-5/8 [4.1]	+ 1/2 [1.3]

Series N6



Standard/Optional Features

FEATURE	Std	N6A	Opt
Pattern			
Straight	X		
Bonnet			
Integral	X		
Gage Connection			
Stuffing Box 5/8" Glass Dia.	X		
Vessel Connection			
Solid Shank 1/2" NPTM	X		
Socketweld 1/2" Male			X
Flanged			X
Drain Connection			
3/8" NPTF	X		
Ball Check Shut-Off			
Verticle Lower/Horizontal Upper Gagecock	X		
Vertical Lower/Horizontal Upper (Steam service Seat)*			X
Omitted*			X
Seat			
Integral	X		
Handwheel			
w/Standard Pitch thread	X		
Drain Cock			
Furnished	X		
Guard Rods (2 per gagecock set)			
3/16" [4.8mm] diameter			X

* Acceptable for ASME Service

Pressure/Temperature

(Subject to limitations of tubular glass)

MODEL	Maximum working pressure, psi [kPa] at temperatures to-					
	WITH STANDARD NEOPRENE GLASS PACKING				WITH OPTIONAL TEFLON GLASS PACKING	
	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	Max. Steam Pressure psi [kPa]
N6A	200 [1380]	200 [1380]	190 [1310]	165 [1100]	125 [860]	125 [860]

Straight Pattern Tubular Glass Gagecocks

Pressures to 500 psi @ +100°F

[3450 kPa @ +38°C]

Temperature Range from

-20°F to +500°F [-29°C to +260°C]

Design Features

The N7 series include models N7A and N7B with these design features:

- Straight pattern
- Integral bonnet
- Rigid vessel connection
- Stuffing box gage connection
- Ball check shutoff
- Integral drain cock

A variety of optional features are available when specified.

Combinations of optional features and materials are available. Each combination is designated by the model number in the Features table. Optional materials can be specified for the gagecock body and trim. (Trim consists of the stem, stem packing retainer and ball check.) Standard and optional materials are available for service as described by ASTM Specifications.

ASME Boiler Code

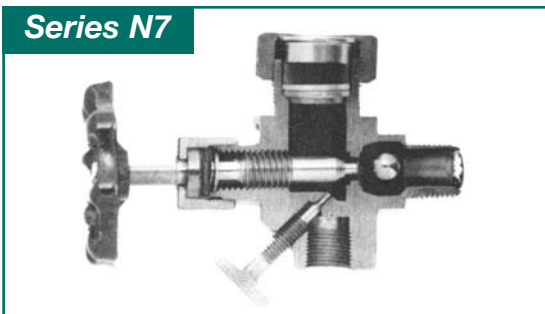
Series N7 gagecock sets that are acceptable for ASME Boiler Code are available as an option. These gagecock sets have a vertical rising ball check shut-off in the lower gagecock and a horizontal ball in the upper gagecock.

Center-to-Center and Guard Rod Dimensions

(see p. 21)

Model	Dimension X inches [cm]	Dimension Y inches [cm]
All Models	2 [5.1]	3/4 [1.9]

Series N7



Standard/Optional Features

FEATURE	N7A		N7B	
	Std	Opt	Std	Opt
Pattern				
Straight	X		X	
Bonnet				
Integral	X		X	
Gage Connection				
Stuffing Box 5/8" Glass Dia.	X			
3/4" Glass Dia.			X	
Vessel Connection				
Solid Shank 1/2" NPTM	X			
3/4" NPTM			X	
Socketweld 1/2" Male		X		
3/4" Male				X
Flanged		X		X
Drain Connection				
3/8" NPTF	X		X	
Ball Check Shut-Off				
Horizontal Lower and Upper Gagecocks (Iron, STL, STS)	X		X	
Vertical Lower/Horizontal Upper (Bronze)	X		X	
Vertical Lower/Horizontal Upper *		X		X
Omitted*		X		X
Ball Inspection Plug**				
Furnished		X		X
Omitted	X		X	
Seat				
Integral	X		X	
Handwheel				
w/Standard Pitch Thread (Iron, STL, STS)	X		X	
w/Quick Closing Threads (Bronze)	X		X	
Drain Cock				
Integral	X		X	
Polished Body				
Bronze		X		X
Guard Rods (4 per gagecock set)				
3/16" [4.8 mm] diameter		X		X

* Acceptable for ASME Service

**Required for ASME Service

Pressure/Temperature

(Subject to limitations of tubular glass)

MODEL	Maximum working pressure, psi [kPa] at temperatures to-							
	WITH STANDARD NEOPRENE GLASS PACKING				WITH OPTIONAL TEFLON GLASS PACKING			Max. Steam Pressure psi [kPa]
	-20°F [-29°C] psi [kPa]	100°F [38°C] psi [kPa]	200°F [93°C] psi [kPa]	300°F [149°C] psi [kPa]	400°F [204°C] psi [kPa]	450°F [232°C] psi [kPa]	500°F [260°C] psi [kPa]	
Bronze								
N7A	200 [1380]	200 [1380]	190 [1310]	165 [1140]	125 [860]			125 [860]
N7B	400 [2760]	400 [2760]	385 [2650]	335 [2310]	250 [1720]			250 [1720]
Ducile Iron								
N7A, N7B	500 [3450]	500 [3450]	460 [3170]	375 [2580]	290 [2000]	250 [1720]		350 [2410]
STL, STS								
N7A, N7B	500 [3450]	500 [3450]	500 [3450]	500 [3450]	500 [3450]	500 [3450]	500 [3450]	350 [2410]

Introducing the Graph-a-Bond™ gasket: superior strength and better adhesion

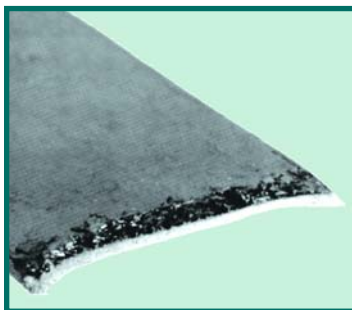
Frustrated with GRAFOIL® gasket folding, flecking, denting and slipping? Penberthy has the answer – a graphite composite gasket that provides both superior strength to resist gasket deformation and better surface adhesion than commonly used graphite gaskets. (Concept is covered by US Pat# 5,895,058, other patents and proprietary data may pertain).

Penberthy has combined the grip of fibrous gasketing with the superior sealing and physical attributes of graphite to create a Graph-a-Bond™ gasket. It provides:

- Excellent chemical resistance
- Efficient conduction of thermal energy
- Stability at high temperatures
- Extremely low microporosity (leakage)
- “Springback” resilience to conform to curved and flat surfaces
- Reduced gasket blow-out

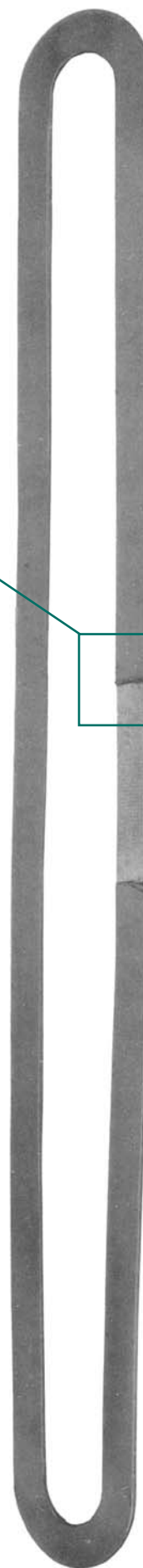
Penberthy has also attached a fibrous gasket (elastomeric binder) to the otherwise exposed graphite material to negate its natural lubricity and difficulty in handling. As a result, handling Penberthy's Graph-a-Bond gasket is much easier than conventional graphite gaskets, helping to eliminate the possibility of damage during gage assembly. The fibrous laminate also gives the graphite a higher degree of stiffness to resist deformation or bending better than graphite gaskets with polyester or metal inserts.

The Penberthy gasket is also ideal to retrofit onto aged chambers that have experienced rebuilds over the years and may leak if conventional graphite gaskets are used. Note that the Penberthy gasket fits any manufacturer's standard-size flat glass gage. Gasket material can be manufactured for use with other fittings including flanges.



Cross-section of gasket, showing fibrous laminate providing stiffness and better handling characteristics

The laminate bonding is crucial to the success of this gasket form. It is a very thin combination of acrylonitrile and phenolic polymers. The acrylonitrile, a thermoplastic, provides the initial bonding at relatively low temperatures and during the heated pressure roller initial laminating phase. As temperature is increased during application, the acrylonitrile carbonizes and the phenolic, a thermosetting polymer, becomes the bonding agent. At extreme temperatures, the entire seal (binders, adhesives, etc.) turns carbonaceous with high bonding strength to the sealed members (the so-called “frying-on”). Once carbonaceous an effective seal can be maintained until such time as excessive mechanical shifting of the elements (due to pipe stresses, thermally induced movement, etc.) occurs.



Graph-a-Bond™ Gaskets

Flat Glass Illuminators

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Other Accessories . . .

An **internal heating or cooling tube** is offered for tubular and flat glass gages. The tube passes through the inside of the gage and is in direct contact with the liquid.

Double- and single-sided external heating and cooling chambers are offered for L and M series gages. External chambers do not contact the liquid inside the gage.

Lightweight, flexible, silicon-impregnated, fiberglass insulation is available for a wide variety of gagecocks, gages and other instrumentation. Reduces heat or cold loss at temperatures from -65°F to +1000°F (-55°C to +540°C). Penberthy insulating covers can also be used with frost proof extensions and illuminators.

Frost-proof extensions are clear plastic windows that fit over the visible part of the glass in flat glass gages. In low temperature applications, they prevent build-up of frost over the visible part of the gage resisting obstruction of the view of liquid level.

Frost-Free Sizing

Lowest Temperature	Size
-30° F [-35° C]	2"
-94° F [-70° C]	4"
-148° F [-100° C]	6"
-211° F [-135° C]	8"
-274° F [-170° C]	10"
-328° F [-200° C]	12"

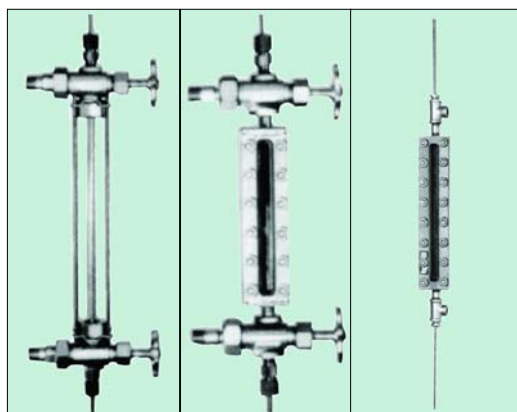
Drain valves, drain cocks and try cocks are used in the drain or vent connection of flat glass liquid level gages.

An **extended packing nut** is recommended for accommodating gagecocks with protectors and gage scales for tubular gagecocks.

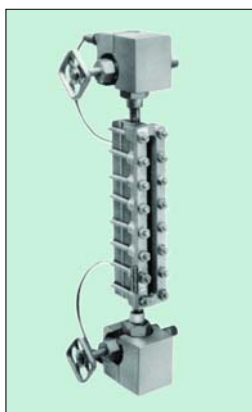
Gage scales are constructed of corrosion-resistant materials.

PENGAGE™ Selection software allows for fast, accurate and simple gage/gagecock specification.

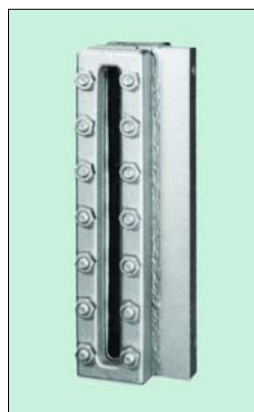
Many other accessories are available. See your representatives for details.



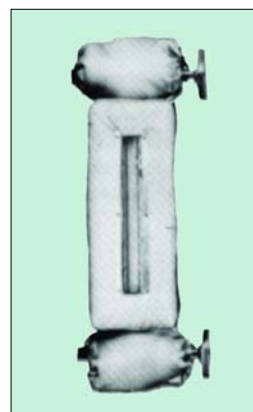
Tubular gages and end connect & side connect flat glass gages with offset pattern gagecocks, internal tube and packing adapters



Reflex gage with external chamber mounted to back and jacketed gagecocks



Transparent gage with single external chamber



Insulation Blanket



Frost-proof extensions



Drain cocks

Style	NPT		
	1/8"	1/4"	3/8"
Single male	X	X	X
Male/male	X	X	
Male/female	X	X	
Female/female	X	X	



Try cock



Extending Packing Nut



Drain valve



Gage scale

tyco

TYCO VALVES & CONTROLS, L.P.
 320 Locust St. • Prophetstown, IL 61277
 Tel. (815) 537-2311 • Fax (815) 537-5764
 Email: gagevalveteam@tycovalves.com
 Website: www.penberthy-online.com

Represented By:

