L.J.STAR
INCORPORATED

Metaglas®

Technical Information

FM APPROVED

A3®

TÜV CERT

U.S. PATENT # 4,961,628

P.O. Box 1116 • Twinsburg, OH 44087 • Phone: 330/405-3040 • Fax: 330/405-3070

TABLE OF CONTENTS

METAGLAS®

THE NEW GENERATION IN SIGHT WINDOWS

1. INTRODUCTION

METAGLAS® is a registered trade name for a series of sight-window products of unmatched strength and integrity. They are made by melting circular glass inside a metal frame. This results in fusion of glass and metal. Upon cooling, the glass solidifies and the difference in the linear coefficient of thermal expansion between glass and metal then produces forces that create a uniform compressive stress throughout the glass. Because the glass prevents the metal ring from shrinking to its theoretical size, it remains in tension.

This high degree of mechanically induced compressive stress makes METAGLAS the strongest and most secure glass for sight window or visual flow indicator applications.

2. PRODUCT ASSORTMENT

Products include discs, flanges, threaded, sanitary clamp and aseptic sight windows to existing standards or to customer specifications.

3. METAGLAS DISCS

Construction: Glass fused inside a metal ring

Application: Clamping between flanges, e.g. as a replacement for conventional glass discs in sight windows and visual flow indicators.

3.1 STANDARD DISC PRODUCT RANGE

Sizes (outside diameter and thickness) and tolerances to fit between:

(1) Customer's R.F. ANSI B16.5 flange and retainer (bolt-on). See Dwg. 176. Sizes 1/2" - 10".

(2) Model DIN 28120 Sight Port (weld-type). See Dwg. 173.

(3) Visual Flow Indicators. See Dwg. 177.

(4) MetaClamp™ discs with special configurations to meet Sanitary 3-A specifications. See Dwg 180.

Materials:

Glass - Borosilicate acc. DIN 7080

Metal - Carbon Steel, Duplex SS, Hastelloy, Monel

Dimensions: See Drawings.

ANSI Rated Operating Pressure: 150 - 600 PSIG

Temperature range: See section 5.

Tolerances:

Outside diameter < 5"	: ± 0.02"
5" - 8"	: ± 0.0315"
> 8"	: ± 0.0394"
Thickness	: ± 0.0315"

3.2 ADDITIONAL DISC PRODUCTS

- Discs sized to fit between tongue and groove and RTJ flanges (Dwg. upon request)
- Discs having dimensions other than standard sizes.

Size (outside diameter) range: 20-365 mm (25/32” - 14-3/8”)

Pressure range: To several thousand PSI depending on dimensions: outside diameter, inside (view) diameter, and thickness

Materials: as above

- Flange-Type for flat face (with holes)

  Directly bolted to an ANSI flat face flange. **Note: Requires a parallel flat face mating flange with full face gasket. Factory must be consulted.**

  Size Range: 1/2” to 8”, see drawings series ANSI 13 A15-13 A60

- Flat-faced flanges, DIN PN 6-40

  Connection size according to DIN 2501 - BS 4504 - NFE 29 201.

  Caution: Requires a parallel flat face mating flange. See sec 4.1

  Materials: as above

  Dimensions: Drawings Available

4. THREADED METAGLAS WINDOWS

Construction: Glass inside a smooth-bore threaded bushing, flush on bottom side

Application: Threading into a female outlet or cover plate

- Round headed bushings with metric or BSP thread
- Hexhead Bushings with NPT-thread

  Size Range: 3/8” to 2 1/2” NPT et.al. M18x1.5 to M78x2

  Materials: as above

  Dimensions: Drawings Available

Maximum operating pressure: Function of design and size

NOTE: Threaded products, although partially defined per drawings, are not standard production items. Consult factory.

5. MATERIALS

Metals

Carbon Steel: St 52.3 1.0570,
ASTM A381-Y52
BS 1775-EXW 23

Stainless Steel: Duplex 1.4462
X2CrNiMoN 22.5
ASTM A182 F51
UNS 31803

Hastelloy C4™: 2.4610

Monel™

Temperature Range

Carbon Steel:	+14˚F to +572˚F
Duplex SS:	-22˚F to +536˚F
Hastelloy C4:	-76˚F to +572˚F
Monel:	-22˚F to +572˚F

Other Materials Available

METAL COMPOSITION

	C	Si	Mn	P	S	Cr	Mo	Ni	N	Fe	Co
	%	%	%	%	%	%	%	%	%	%	%
C.S.	≤0.20	≤0.55	≤1.60	≤0.040	≤0.040						
Duplex	≤0.03	≤1.00	≤2.00	≤0.030	≤0.020	21.0-23.0	2.50-3.50	4.50-6.50	0.08 0.20		
Hast.C4	≤0.01	≤0.08	≤1.0	≤0.025	≤0.010	14.0-18.0	14.0-17.0			≤3.0	≤2.0

Duplex Stainless Steel

The duplex stainless steels can be thought of as chromium-molybdenum ferritic stainless steels to which sufficient austenite stabilizers have been added to produce steels in which a balance of ferrite and austenite is present at room temperature. Such grades can have the high chromium and molybdenum ferritic stainless steels. In fact, the duplex grades with about equal amounts of ferrite and austenite have excellent toughness and their strength exceeds either phase present singly.

The addition of nitrogen to the newer duplex grades restores the phase balance more rapidly and minimizes chromium and molybdenum segregation without annealing. The new duplex grades combine high strength, good toughness, high corrosion resistance, good resistance to chloride SCC, and good production economy in the heavier product forms.

Compared with type 316, the annealed duplex alloys provide improved resistance to chloride stress-corrosion cracking. Another useful characteristic of the duplex grades is that they typically have yield strengths more than twice the conventional austenitic steels. In thicker sections, the duplex alloys are more impact resistance than ferritic alloys. Duplex stainless steels are alloyed with 0.15 to 0.20% Nitrogen. This minimizes alloy element segregation between the ferrite and austenite, thereby improving the as-welded corrosion resistance compared with the type 329 alloy. The nitrogen addition also increases the precipitation of austenite during casting and welding and prevents high-ferrite content in rapidly cooled welds.

Glass: Borosilicate

572°F Maximum temperature gradient through the glass

The glass must always be circular and must lie inside (and therefore may not protrude outside) the metal frame.

Chemical Resistance:

Water resistance according to DIN ISO 719: HGB 1

Acid resistance according to DIN 12 116: Acid Class 1

Caustic resistance according to DIN 52 322: Class A2

Advantages of Borosilicate over Soda Lime glass:

- Stronger
- Better pressure and temperature shock endurance
- Higher allowable temperature gradient
- Better resistance in steam and condensate environments
- Readily accepted by approval authorities

Resistance against Chemical Attack

To protect against chemical attack (sodium hydroxide, hot concentrated alkaline solutions, phosphoric acid, fluorine), METAGLAS windows can be supplied with a mica or Teflon film shield.

Repolishing

Contrary to conventional glass discs, which must be discarded, METAGLAS windows which have suffered chemical or mechanical damage (opacity, erosion, scratches) can often be repolished. Consult factory.

Stress Cracks; Air Bubbles

Metaglas discs may exhibit hairline cracks or contain bubbles. Both are inherent in the manufacturing process but due to the mechanical prestresses neither affects the utility or the security of the glass. This is in contrast to conventional glass discs, which must be discarded at the first sign of a crack.

6. TEST RESULTS

METAGLAS products have been tested and approved by safety testing departments of several major chemical and other companies under a variety of conditions, most exceeding those normally encountered in practice.

Some results:

Pressure and Temperature Cycling

- METAGLAS discs rated 375 psig were successfully cycled 2500 times between atmospheric pressure and 375 psig for 3 months at temperatures from 68°F to 428°F.
- A METAGLAS flange rated 150 psig was successfully cycled from atmospheric pressure to 150 psig every 3 seconds during six hours, then to 220 psig every 3 seconds for one hour.
- Cycling a METAGLAS flange rated at 150 psig ten times in air between room temperature and 572°F resulted in only a slight change in the vacuum tightness of the glass-to-metal bond from an initial 1×10^{-8} to 5×10^{-8}/ Sec. Torr.

Overpressurizing

- Gradual overpressurizing of a METAGLAS flange rated 100 psig resulted in slight crack formation inside the glass at 1200 psig ; however, the glass remained leaktight. At 1950 psig (20 times rated pressure) thin layers of glass began to separate, but the glass remained leaktight.
- A METAGLAS flange rated 150 psig was pressurized to 5700 psig (38 times rated pressure). Same result; surface cracks, but leaktight.

Impact testing

An impact of 36 Nm (maximum capacity of the test apparatus) on a 15mm thick METAGLAS disc using a 3-kg drop hammer resulted in local pitting of the glass which affected neither its functioning nor its tightness. By contrast, an impact of 15 Nm on a conventional glass disc resulted in complete shatter.

Bending

A 20mm thick METAGLAS disc was mounted between flanges using 2mm thick IT-300 gaskets plus one short 2mm thick gasket fragment to create unevenness. Tightening the flanges with bolts and nuts with a torque of 130 Nm resulted in cracks in the glass, but the glass remained leaktight. The same test repeated with loose glass discs resulted in complete shatter between 40 and 55 Nm.

Erosion

After being agressively eroded from a thickness of 15mm to 6mm, a Metaglas safety glass disc resisted bursting pressure of 1,230 psig before the gasket failed.

7. INSTALLATION

METAGLAS discs

Installation practice for conventional glass discs between flanges applies except:

- Use of a gasket between disc and cover flange is optional, not mandatory.
- A torque wrench is not required as over torquing will not damage disc.

Flat-faced METAGLAS flanges(with holes)

Weld pad, vessel or pipeline flange to which this type of METAGLAS disc is to be bolted must be flat-faced with full gasket or with groove and o-ring gasket. Failure to meet these conditions by bolting to a raised face flange will inevitably result in glass cracks due to excessive bending moments. Bolts and nuts should be tightened crosswise (like the wheels of an automobile); a torque wrench is not required.

8. REWORKING

Altering the shape of a METAGLAS sight window, such as drilling holes, turning, etc. can lead to excessive build up of heat or disturbance of the metal/glass equilibrium, and therefore is discouraged. If it cannot be avoided, consult factory before proceeding. Preferred practice is to fully specify a METAGLAS design, including any and all holes, with the inquiry and subsequently with the order. This is because the physical properties of these products are a function of the stresses created between the glass and the surrounding metal due to differences in their thermal coefficients of expansion. These stresses are composite and among others include radial compressive and circular tensile stresses in the metal.

The absolute strength of a METAGLAS product therefore is a function not only of glass diameter and thickness but also of the dimensions and shape of the surrounding metal.

Changing the shape or dimensions of the metal may disrupt the stress patterns. This may destroy crucial product characteristics such as pressure rating and must be avoided.

Included, for example, are drilling of holes in the finished product, altering the size or nature of existing holes (e.g., converting smooth-bore to tapped or vice versa), machining or otherwise removing some of the metal, etc.

9. ACCESSORIES

METAGLAS sight windows may be equipped with accessories such as sight lights, window wipers, etc. However, any intended accessory should be specified with the METAGLAS order to allow for pre-drilling of the METAGLAS ring (see section; REWORKING).

10. PRESSURE TESTS BY MANUFACTURER

On request, and for a fee, METAGLAS sight windows can be pressure tested at the factory at room temperature, in the presence of either a factory inspector or an inspector of an outside, authorized inspection agency. Unless specified differently, pressure tests will be performed at 4/3 x rated operating pressure and the outside inspection agency will be TÜV.

11. MATERIAL CERTIFICATES

Standard flat flanges and discs, S/S 1.4462, are normally furnished with material analysis certificate A according to DIN 50049. All others can be furnished with material certificate DIN 50049.2.2., 3.1A or 3.1B upon request with an added fee.

12. APPROVALS

To date, METAGLAS sight windows have been approved as a sight window on pressure vessels to 600 psig in accordance with TÜV and EEX in the following countries:

- Austria
- Belgium
- France
- Germany (To 900 psig for sizes per dwgs. 173 & 177)
- Netherlands
- Switzerland
- DIN Standard 7079 (for Metaglas)
- U.S.A. Factory Mutual (FM)

MetaClamp™ meets 3-A standards in the U.S. for sanitary use.

Standardized by specifications in the following European plants: Hoescht, Bayer, Merck, Degussa, Hüls, Rhone Poulenc, plus others.

13. APPLICATIONS

- Chemical process vessels and piping systems.
- Aseptic sanitary pharmaceutical & food processing vessels and process lines.
- Measurement and control systems
- Impact resistant light shields for offshore platforms
- Suitable for retrofit

Bending Moment Stresses

Metaglas® vs. Conventional Glass

The different and separate characteristics of thermally pre-stressed glass (tempered) and mechanically pre-stressed (fused glass to metal) can be explained by the created stress conditions particular to the method of manufacturing. In the case of tempered glass, the heated disc surface is chilled by air. When the hot core area cools, it contracts forcing the cooler surface area under compressive stress and the core area under tensile stress. The equilibrium is shown in the chart below, curve b.

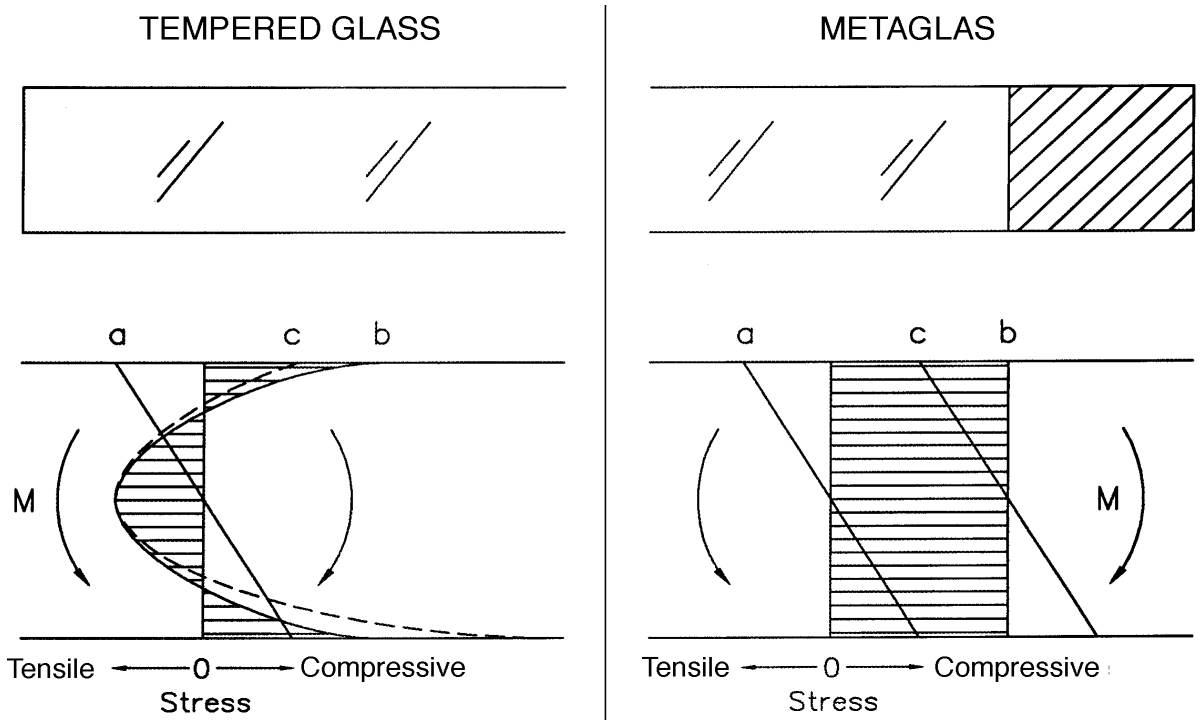
During the manufacture of the metal fused glass, the steel ring and glass are first heated to the proper fusing temperature at which the glass moves towards the steel ring. Because of differing but precise thermal expansion coefficients of steel and glass during the cooling process after fusion, a compressive stress condition is created in the glass, which is proportional in magnitude to the normal expansion at the fusion temperature. The steel ring is simultaneously placed in a tensile stress condition. In the fused glass disc, a homogeneous compressive stress condition is created through the entire cross section. This is shown below in curve b, with the shaded area indicating the area of stress.

When a bending moment, curve a, is superimposed on the existing residual stress created in the manufacturing process, the result is curve c. It can be seen that in the case of the thermally pre-stressed (tempered) glass disc, a tensile stress area is formed, which glass cannot withstand.

In the case of fused glass, the load causes the glass to be placed in the compression stress area. This results in the value of the critical stress K_C (ultimate or fracture stress) being exceeded with differing and important conditions in the two glass discs. Because the tempered disc falls within the tensile stress area, it fails completely by shattering.

Having an overstressed condition in the fused glass whereby by the value K_C is exceeded, the stress falls in the compression area and the stress value becomes smaller than K_C once again and results in stopping the crack. For every continuation of a crack, a renewed application of kinetic energy is created from residual compression (potential energy) thereby preventing a sudden bursting of the glass.

Cross section schematic of stress distribution in conventional tempered glass vs. Metaglas mechanically prestressed glass.



a. Bending stress caused by moment force M

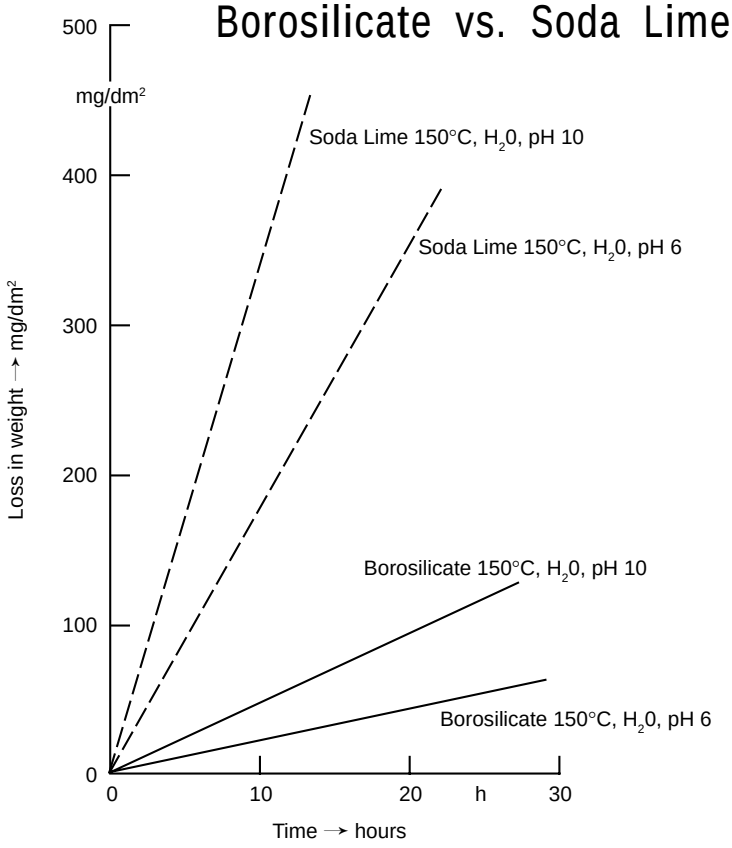
b. Stress profile of pre-stressing in manufacturing

c. Superimposed stress profile of a + b

Comparison of Degradation of Borosilicate vs. Soda Lime Glass in Water

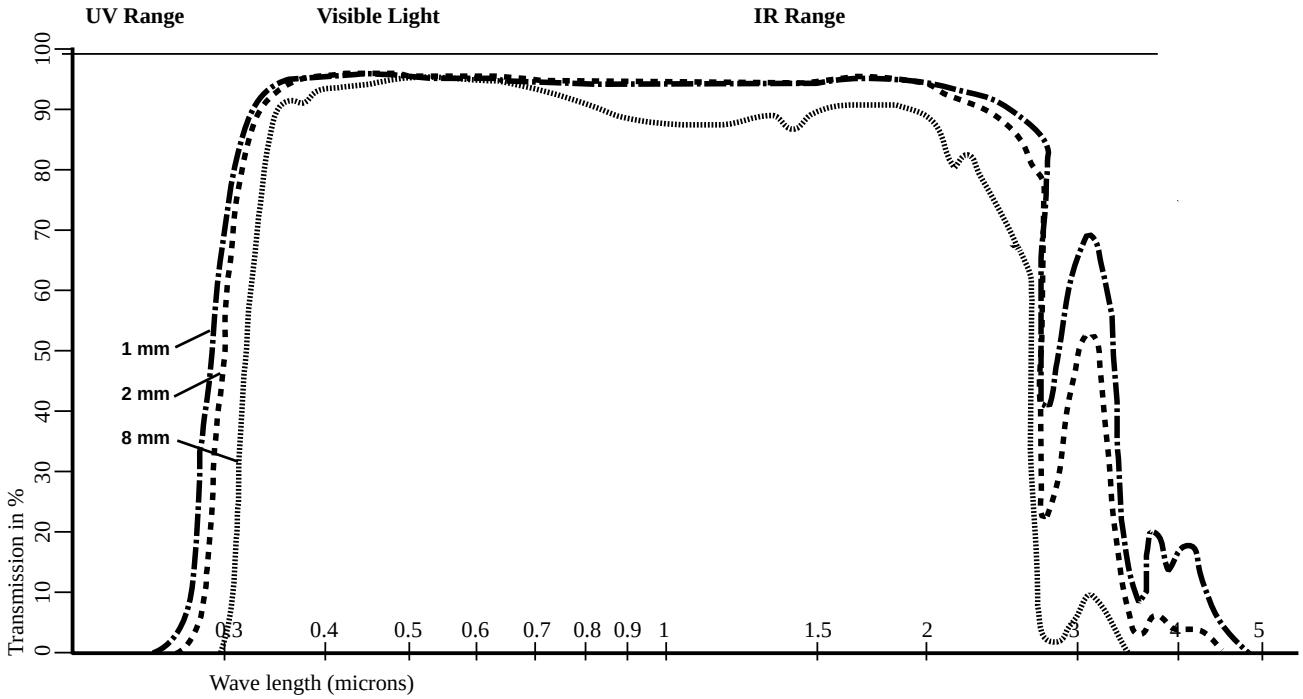
In investigating for chemically induced disintegration of Soda Lime and Borosilicate Glass, it was found that Borosilicate was much more resistant. This occurred not only at slightly acidic conditions (pH 6), but also when the pH was raised to a value of 10 (alkaline). As shown on the chart, the degradation of Soda Lime glass is 10 times greater than that of Borosilicate glass. This considerable divergence in resistance properties begins at 134°C, the initial temperature in the study.

Translated from "VGB KRAFTWERKS TECHNIK", Dr. A. Peters, Feb. 1979



Metaglas

Light Transmission Chart for Borosilicate Glass



DWG NO. 173
SHEET NO. 1

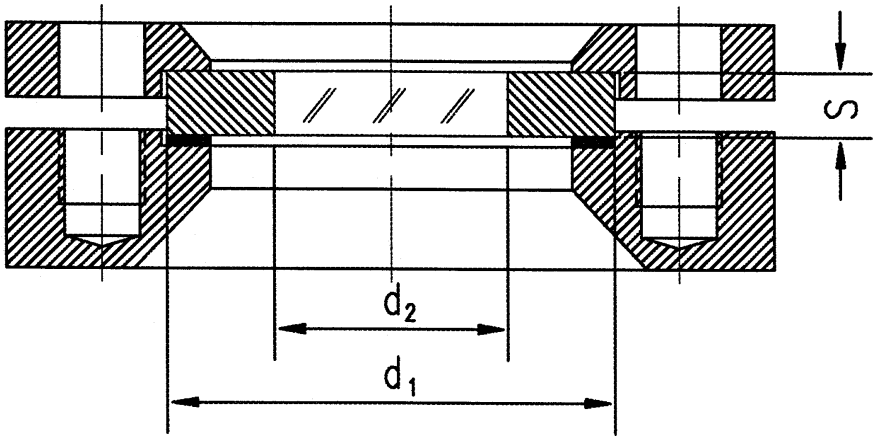
FM
APPROVED

SIGHT GLASS FUSED TO METAL CONFORMING TO DIN 7079

GLASS: BOROSILICATE (DIN 7080)

PRESSURE/TEMPERATURE CHARTS FOR EACH DISC SIZE IS AVAILABLE UPON REQUEST

NOTE: FM must authorize all changes to drawings



d_1	d_2	RECOMMENDED THICKNESS S			
		150 psi	250 psi	350 psi	600 psi
INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)
1.77 (45)	0.98 (25)	0.39 (10)	0.47 (12)		
2.36 (60)	1.38 (35)	0.39 (10)	0.47 (12)	0.59 (15)	
2.48 (63)	1.38 (35)	0.39 (10)	0.47 (12)	0.59 (15)	
3.15 (80)	1.77 (45)	0.39 (10)	0.47 (12)	0.59 (15)	0.79 (20)
3.94(100)	2.17 (55)	0.47 (12)	0.59 (15)	0.79 (20)	0.98 (25)
4.92(125)	2.56 (65)	0.59 (15)	0.79 (20)	0.98 (25)	1.06 (27)
5.91(150)	2.76 (70)	0.79 (20)	0.98 (25)	1.18 (30)	
6.89(175)	3.15 (80)	0.79 (20)	0.98 (25)	1.18 (30)	1.26 (32)
7.87(200)	3.94(100)	0.98 (25)	1.18 (30)	1.26 (32)	
9.84(250)	4.72(120)	1.18 (30)	1.26 (32)	1.50 (38)	

RING MATERIAL	MAX. WORKING TEMPERATURE
Carbon Steel (1.0570)	536°F (280°C)
Duplex Stainless Steel (1.4462)	536°F (280°C)
Hastelloy C-4 (2.4610)	536°F (280°C)

CHANGE	DESCRIPTION OF CHANGE	DATE	NAME

MANUFACTURED BY:

Herberts Industrieglas
GmbH & Co. KG
GEWERBESCHULSTRASSE 72
D-42289 WUPPERTAL GERMANY

METAGLAS®
SIGHT GLASS DISC
FOR LUMIGLAS® SERIES DIN 28120 OR SIMILAR

	DATE	NAME
DESIGNED	Feb. 1996	
CHECKED		

L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330) 405-3040 • FAX (330) 405-3070

DWG NO. 176

SHEET NO. 1

FM

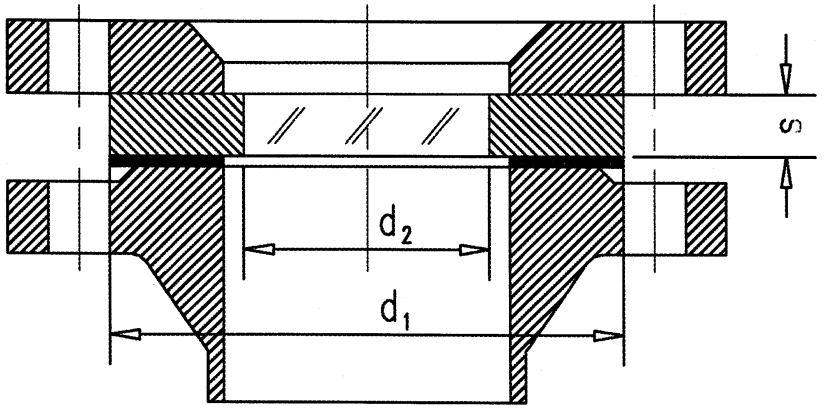
APPROVED

SIGHT GLASS FUSED TO METAL CONFORMING TO DIN 7079

GLASS: BOROSILICATE (DIN 7080)

PRESSURE/TEMPERATURE CHARTS FOR EACH DISC SIZE IS AVAILABLE UPON REQUEST

NOTE: FM must authorize all changes to drawings



ANSI NOMINAL SIZE	RECOMMENDED ANSI PRESSURE CLASS DISC SIZE								
	150 PSI			300 PSI			600 PSI		
	d_1	d_2	S	d_1	d_2	S	d_1	d_2	S
	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)
1"	2.48 (63)	1.38 (35)	0.39 (10)	2.76 (70)	1.57 (40)	0.47 (12)	2.76 (70)	1.57 (40)	0.71 (18)
1 1/2"	3.23 (82)	1.77 (45)	0.47 (12)	3.62 (92)	1.97 (50)	0.59 (15)	3.62 (92)	1.97 (50)	0.87 (22)
2"	3.94 (100)	2.17 (55)	0.59 (15)	4.21 (107)	1.97 (50)	0.79 (20)	4.21 (107)	1.97 (50)	0.79 (20)
3"	5.28 (134)	2.76 (70)	0.59 (15)	5.71 (145)	2.76 (70)	0.79 (20)	5.71 (145)	2.76 (70)	1.10 (28)
4"	6.73 (171)	3.15 (80)	0.79 (20)	6.73 (171)	3.15 (80)	0.98 (25)	7.48 (190)	3.15 (80)	1.26 (32)
5"	7.56 (192)	3.94 (100)	0.79 (20)						
6"	8.58 (218)	3.94 (100)	0.98 (25)	9.61 (244)	4.72 (120)	1.38 (35)	10.35 (263)	3.94 (100)	1.57 (40)
8"	10.75 (273)	4.72 (120)	1.18 (30)	12.01 (305)	4.92 (125)	1.38 (35)	12.40 (315)	3.94 (100)	1.57 (40)
10"	13.23 (336)	5.91 (150)	1.18 (30)	14.09 (358)	5.12 (130)	1.38 (35)			

RING MATERIAL	MAXIMUM WORKING TEMP.
Carbon Steel (1.0570)	536°F (280°C)
Duplex Stainless Steel (1.4462)	536°F (280°C)
Hastelloy C-4 (2.4610)	536°F (280°C)

CHANGE	DESCRIPTION OF CHANGE	DATE	NAME

MANUFACTURED BY:

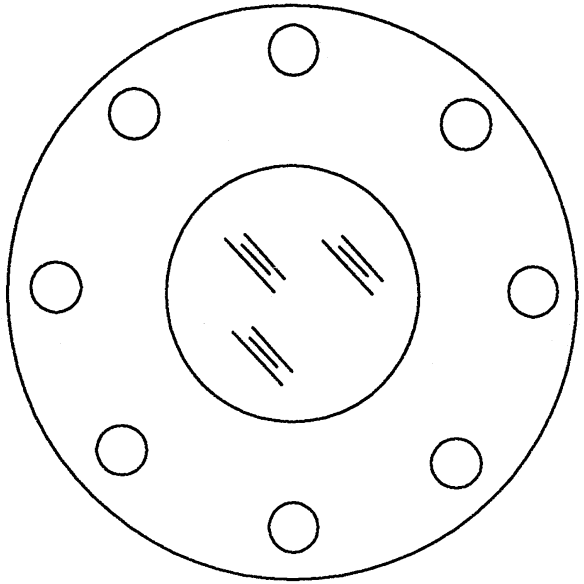
Herberts Industrieglas
GmbH & Co. KG
GEWERBESCHULSTRASSE 72
D-42289 WUPPERTAL GERMANY

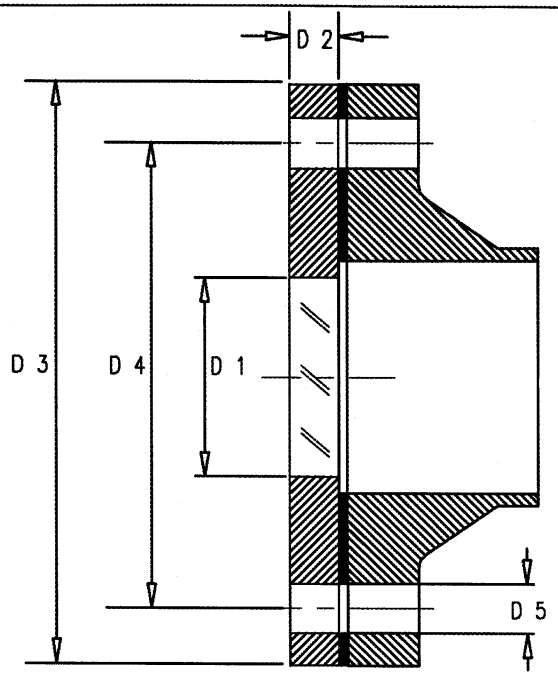
METAGLAS®
SIGHT GLASS DISC
FOR ANSI BOLT-ON
RAISED FACED FLANGES

	DATE	NAME
DESIGNED	Feb. 1996	
CHECKED		

L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330) 405-3040 • FAX (330) 405-3070

DWG. NO. 13A15





ANSI NOMINAL SIZE	RECOMMENDED ANSI PRESSURE CLASS , 150 PSI NOTE: FULL FACE GASKETS REQUIRED					BOLT HOLES
	D 1	D 2	D 3	D 4	D 5	
	INCH	INCH	INCH	INCH	INCH	QUANTITY
1 1/2"	1.57	0.63	5.0	3.88	0.52	4
2"	1.97	0.80	6.0	4.75	0.75	
2-1/2"	2.60	0.80	7.0	5.50	0.75	
3"	2.95	0.80	7.5	6.0	0.75	
4"	4.00	0.80	9.0	7.50	0.75	8
6"	5.50	1.00	11.0	9.50	0.88	
8"	6.30	1.00	13.50	11.75	0.88	

SIGHT GLASS FUSED TO METAL CONFORMING DIN 7079
GLASS: BOROSILICATE (DIN 7080)
PRESSURE/TEMPERATURE CHARTS FOR EACH DISC SIZE IS AVAILABLE UPON REQUEST

RING MATERIAL	MAXIMUM WORKING TEMP.
Carbon Steel (1.0570)	536°F (280°C)
Duplex Stainless Steel (1.4462)	536°F (280°C)
Hastelloy C-4 (2.4610)	536°F (280°C)

CHANGE	DESCRIPTION OF CHANGE	DATE	NAME

MANUFACTURED BY:

Herberts Industrieglas
GmbH & Co. KG
GEWERBESCHULSTRASSE 72
D-42289 WUPPERTAL GERMANY

METAGLAS®
SIGHT GLASS DISC
PER ANSI B16.5

	DATE	NAME
DESIGNED		
CHECKED		

L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330) 405-3040 • FAX (330) 405-3070

DWG NO. 177

SHEET NO. 1

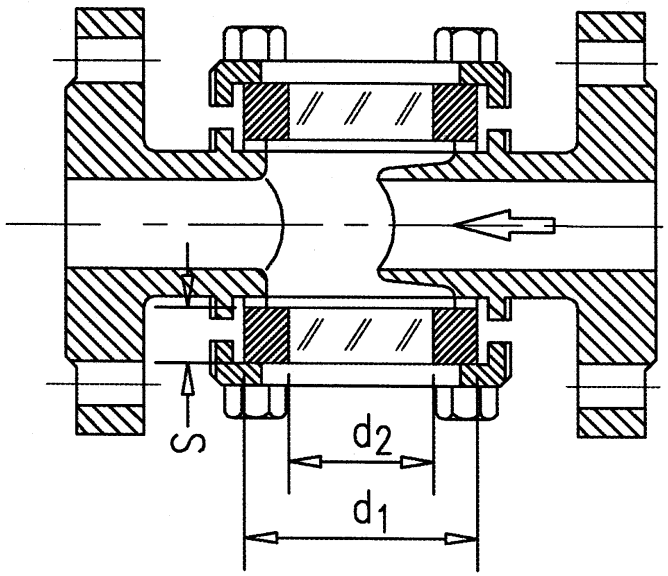
FM APPROVED

SIGHT GLASS FUSED TO METAL CONFORMING TO DIN 7079

GLASS: BOROSILICATE (DIN 7080)

PRESSURE/TEMPERATURE CHARTS FOR EACH DISC SIZE IS AVAILABLE UPON REQUEST

NOTE: FM must authorize all changes to drawings



ANSI NOMINAL SIZE	ANSI PRESSURE CLASS DISC SIZE								
	150 PSI			300 PSI			600 PSI		
	d_1	d_2	S	d_1	d_2	S	d_1	d_2	S
	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)	INCH (MM)
1/2"	1.77 (45)	0.98 (25)	0.39 (10)	1.77 (45)	0.98 (25)	0.39 (10)	1.77 (45)	0.98 (25)	0.47 (12)
3/4"	1.77 (45)	0.98 (25)	0.39 (10)	1.77 (45)	0.98 (25)	0.39 (10)	1.77 (45)	0.98 (25)	0.47 (12)
1"	1.97 (50)	0.98 (25)	0.39 (10)	1.97 (50)	0.98 (25)	0.39 (10)	1.97 (50)	0.98 (25)	0.47 (12)
1 1/2"	2.60 (66)	1.38 (35)	0.47 (12)	2.60 (66)	1.38 (35)	0.47 (12)	2.60 (66)	1.38 (35)	0.59 (15)
2"	2.99 (76)	1.57 (40)	0.47 (12)	2.99 (76)	1.57 (40)	0.47 (12)	2.99 (76)	1.57 (40)	0.67 (17)
3"	4.92 (125)	2.56 (65)	0.79 (20)	4.92 (125)	2.56 (65)	0.79 (20)	4.92 (125)	2.56 (65)	1.06 (27)
4"	5.71 (145)	2.76 (70)	0.79 (20)	5.71 (145)	2.76 (70)	0.79 (20)	5.71 (145)	2.76 (70)	1.18 (30)
6"	8.58 (218)	3.94 (100)	0.98 (25)	8.58 (218)	3.94 (100)	1.18 (30)	8.58 (218)	3.94 (100)	1.57 (40)
8"									

RING MATERIAL	MAXIMUM WORKING TEMP.
Carbon Steel (1.0570)	536°F (280°C)
Duplex Stainless Steel (1.4462)	536°F (280°C)
Hastelloy C-4 (2.4610)	536°F (280°C)

CHANGE	DESCRIPTION OF CHANGE	DATE	NAME

MANUFACTURED BY:

Herberts Industrieglas
GmbH & Co. KG
GEWERBESCHULSTRASSE 72
D-42289 WUPPERTAL GERMANY

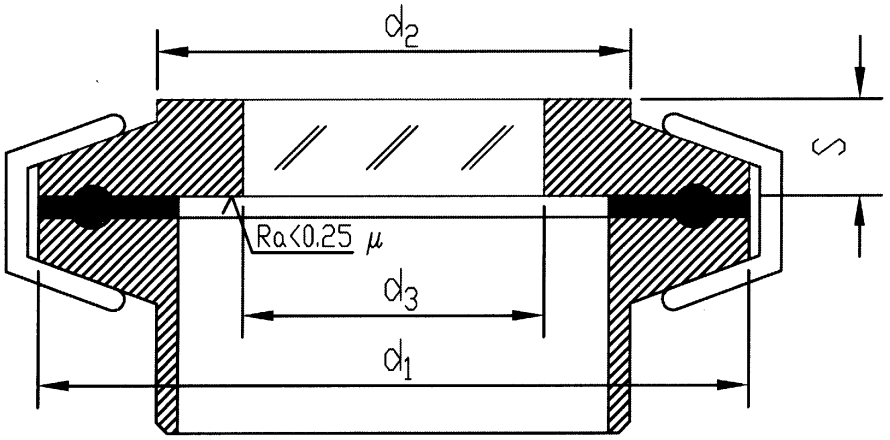
METAGLAS®
SIGHT GLASS DISC
FOR L.J. STAR VISUAL FLOW INDICATORS OR SIMILAR

	DATE	NAME
DESIGNED	Feb. 1996	
CHECKED		

L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330) 405-3040 • FAX (330) 405-3070

METACLAMP™ DISC

NO. 180



MANUFACTURED AND TESTED IN CONFORMANCE WITH A.D. STANDARDS SERIES H.P. & A.D. STANDARD WO/ TRD 100

SIGHT GLASS FUSED TO METAL CONFORMING TO DIN 7079

GLASS: BOROSILICATE (DIN 7080)

RING MATERIAL: DUPLEX STAINLESS STEEL (1.4462)
HASTELLOY C-22, C-276, C-4 (NOT 3A APPROVED)

MAXIMUM ALLOWABLE WORKING TEMPERATURE: 536°F (280°C)

STANDARD TUBE OD	d_1		d_2		d_3		S		MAXIMUM PRESSURE @ 450°F	
	INCH	(MM)	INCH	(MM)	INCH	(MM)	INCH	(MM)	PSIG	(BAR)
1", 1 1/2"	1.99	(51)	1.61	(41)	0.98	(25)	0.28	(7)	230	(16)
2"	2.52	(64)	2.05	(52)	1.18	(30)	0.28	(7)	230	(16)
2 1/2"	3.05	(78)	2.72	(69)	1.38	(35)	0.39	(10)	230	(16)
3"	3.58	(91)	2.99	(76)	1.57	(40)	0.39	(10)	150	(10)
3 1/2"	4.17	(106)	3.54	(90)	1.97	(50)	0.39	(10)	150	(10)
4"	4.69	(119)	4.02	(102)	2.17	(55)	0.47	(12)	150	(10)
6"	6.57	(167)	5.98	(152)	2.87	(73)	0.63	(16)	90	(6)
8"	8.56	(218)	7.80	(198)	3.94	(100)	0.63	(16)	90	(6)
10"	10.55	(268)	9.65	(245)	4.72	(120)	0.71	(18)	90	(6)
12"	12.56	(319)	11.81	(300)	5.51	(140)	0.79	(20)	90	(6)

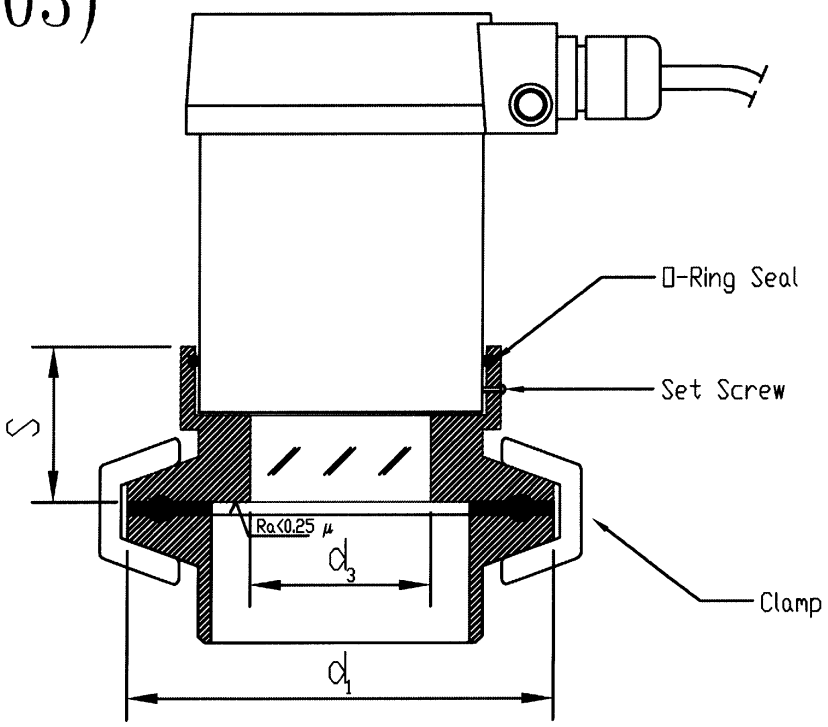
METAGLAS®
SIGHT GLASS DISC
FOR SANITARY CLAMPS
SERIES METACLAMP

		DATE	NAME
1/18/99 Revised to Include Pressure Ratings	DES.		
1/18/99 Revised to Include 10" & 12"	CHE'D.		

L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330)405-3040 * FAX (330)405-3070

NO. 180-L2

MetaClamp™ with Light (USL-03)



MANUFACTURED AND TESTED IN CONFORMANCE WITH A.D. STANDARDS SERIES H.P. & A.D. STANDARD WO/ TRD 100

SIGHT GLASS FUSED TO METAL CONFORMING TO DIN 7079

GLASS: BOROSILICATE (DIN 7080)

RING MATERIAL: DUPLEX STAINLESS STEEL (1.4462)

MAXIMUM ALLOWABLE WORKING TEMPERATURE: 280°C
MAXIMUM ALLOWABLE WORKING PRESSURE: 150 PSI

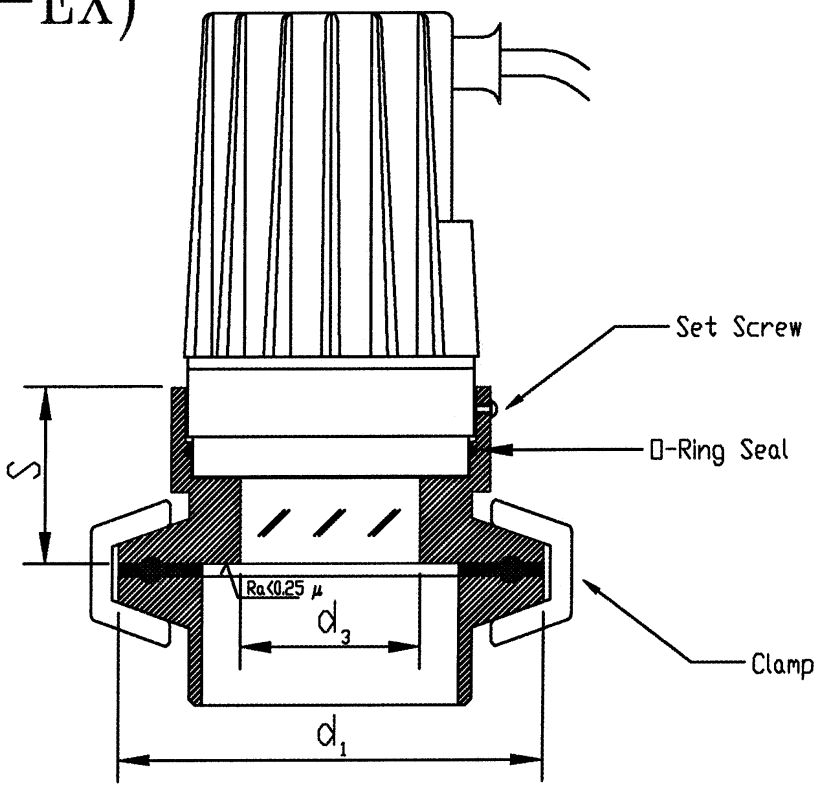
STANDARD TUBE OD	d_1		d_3		S	
	INCH	(MM)	INCH	(MM)	INCH	(MM)
1", 1 1/2"	1.99	(51)	0.98	(25)	1.18	(30)
2"	2.52	(64)	1.18	(30)	1.18	(30)
3"	3.58	(91)	1.57	(40)	1.18	(30)

	METAGLAS® SIGHT GLASS DISC FOR SANITARY CLAMPS SERIES METACLAMP WITH LIGHT		
		DATE	NAME
2/8/99 Revised to Include Set Screw	DES.		
6/24/97 Revised to O-Ring Seal	CHE'D.		

L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330)405-3040 * FAX (330) 405-3070

Metaclamp™ with EX Light (USL 05-EX)

NO. 180-LE2



MANUFACTURED AND TESTED IN CONFORMANCE WITH A.D. STANDARDS SERIES H.P. & A.D. STANDARD WO/ TRD 100

SIGHT GLASS FUSED TO METAL CONFORMING TO DIN 7079

GLASS: BOROSILICATE (DIN 7080)

RING MATERIAL: DUPLEX STAINLESS STEEL (1.4462)

MAXIMUM ALLOWABLE WORKING TEMPERATURE: 280°C
MAXIMUM ALLOWABLE WORKING PRESSURE: 150 PSI

STANDARD TUBE OD	d_1		d_3		S	
	INCH	(MM)	INCH	(MM)	INCH	(MM)
1", 1 1/2"	1.99	(51)	0.98	(25)	1.57	(40)
2"	2.52	(64)	1.18	(30)	1.57	(40)
3"	3.58	(91)	1.57	(40)	1.57	(40)

METAGLAS®
SIGHT GLASS DISC
FOR SANITARY CLAMPS
SERIES METACLAMP WITH EX LIGHT

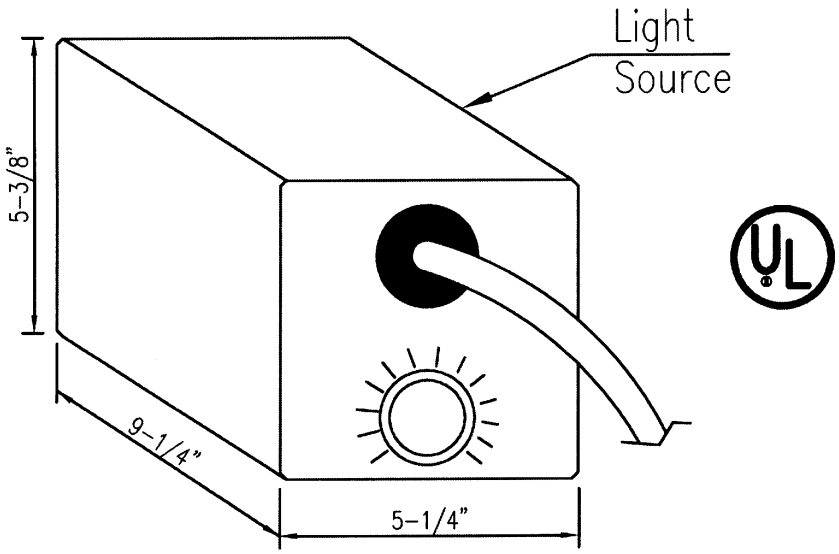
	DATE	NAME
DES.		
CHE'D.		

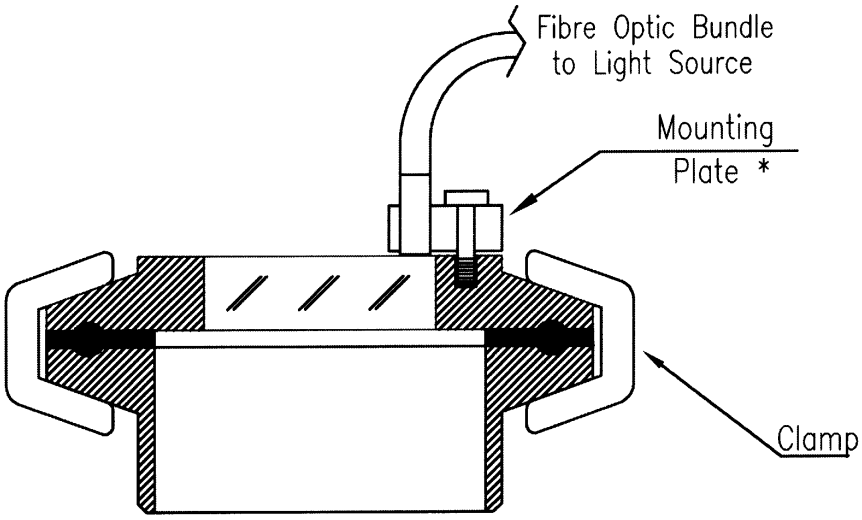
L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330) 405-3040 • FAX (330) 405-3070

NO. 180-FOB

FIBER OPTIC LIGHT

(FOR METACLAMP SIGHT WINDOW)





* Mounting plate welded to clamp for sizes 2" and smaller

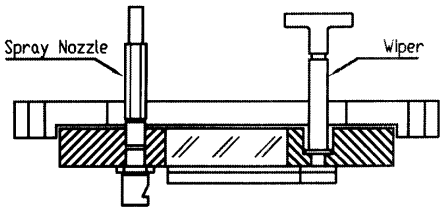
CHANGE	DESCRIPTION OF CHANGE	DATE

METAGLAS ®
SIGHT GLASS DISC
FOR SANITARY CLAMPS
SERIES METACLAMP

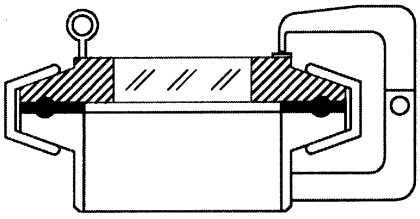
	DATE	NAME
DES.		
CHE'D.		

L. J. STAR INCORPORATED
2201 PINNACLE PARKWAY
P.O. BOX 1116
TWINSBURG, OH 44087
(330)405-3040 * FAX (330)405-3070

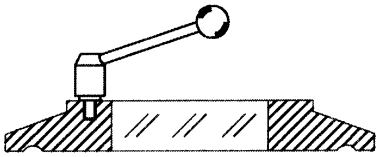
Other Metaglas Products



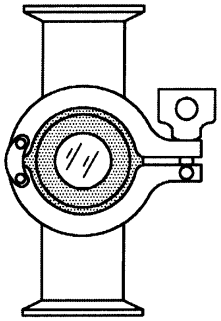
Spray Nozzle With Wiper



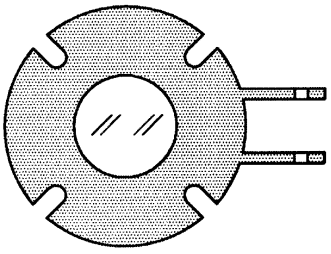
Sanitary With Hinge



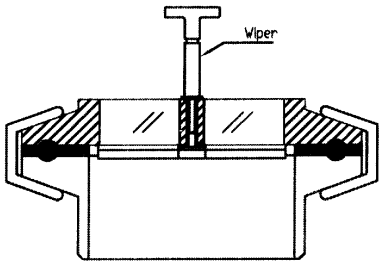
Sanitary With Handle



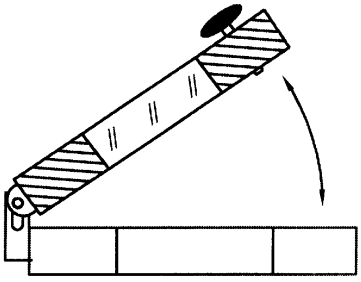
Sanitary Sight Flow



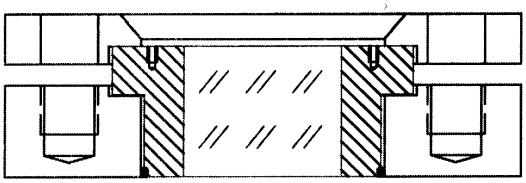
Manway Covers



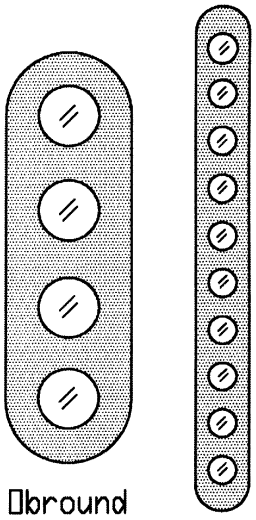
Sanitary With Wiper



Hinged Sight Glass

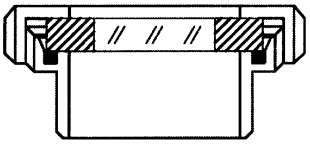


Aseptic 'Stepped' Disc

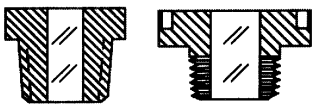


Obround

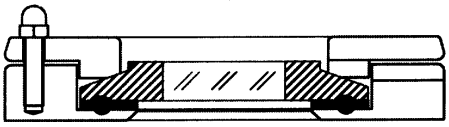
Gage Glass



Disc For MV Sight Glass



Threaded Styles



Flush Mount

MANUFACTURED AND TESTED IN CONFORMANCE WITH A.D. STANDARDS SERIES H.P. & A.D. STANDARD W0/ TRD 100

SIGHT GLASS FUSED TO METAL CONFORMING TO DIN 7079

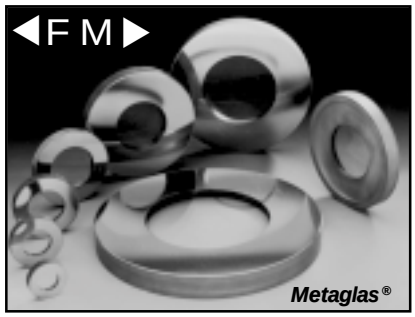
APPROVALS: FACTORY MUTUAL & 3A SANITARY STANDARD 65-00

METAGLAS®

L. J. STAR INCORPORATED
TWINSBURG, OH 44087
(330)405-3040 * FAX (330)405-3070

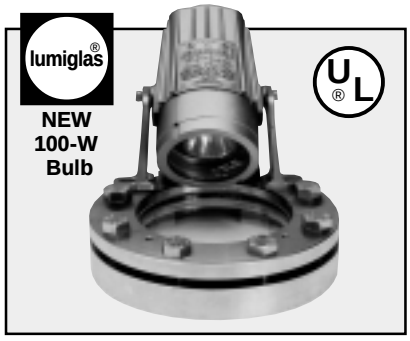
Additional L.J. Star Products

Premium Specs ★ Innovative Designs ★ Value Priced ★ Large in-Stock Inventory



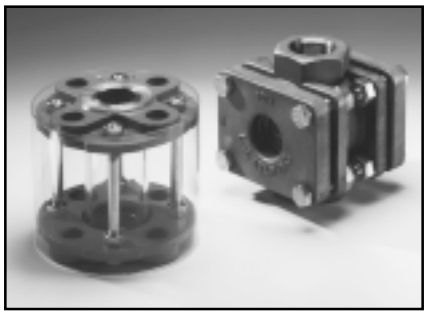
"Super" Glass Windows For Sight Flows and Viewports

A fusion of stainless steel and borosilicate glass, Metaglas® windows provide safety and long life in the most challenging applications. And they are easily removed for cleaning without danger of reinstallation stress failure.



Explosion-Proof UL 844 Luminaire For Hazardous Use

"No Quibbling" explosion-proof UL listed design provides up to 100-W of high-intensity glare-free illumination for sight flow indicators, sight ports or for specific-area lighting. Lumiglas products are manufactured to ISO9001 standards.

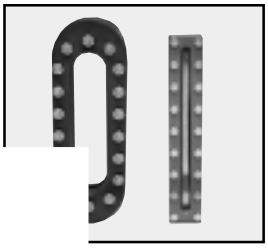


L.J. Star Visual Flow Indicators Are "Simply Better"

Choose from a full range of view-through or full, 360° view models, flanged or threaded with stainless or coated-carbon steel investment cast bodies. Options include sanitary, lined, corrosion-resistant and Factory Mutual approved designs.

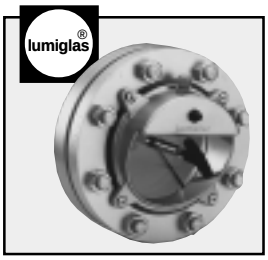
Circular Sight Glass Assembly with weld flange, ready to install. Standard rating to 235 psi at 536°F. Custom designs available.

Stainless Steel "Compact Power" Luminaire delivers powerful illumination for sight flows/ports or general areas.



Welded Rectangular & Obround Sight Glasses in standard or custom sizes and in carbon steel, stainless or special alloys.

The Classic "Lumistar" halogen Luminaire provides bright no-glare illumination with minimal sight-port obstruction.

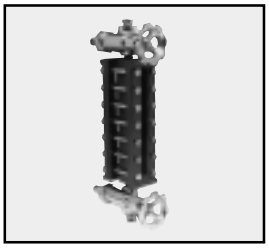


Combined Light/sight Port with central wiper and Lumistar luminaire for added visibility. Rated up to 85 psi.

MetaClamp™ 3-A sanitary-clamp windows meet sanitary standards at high pressure and extreme temperatures, safely.

Hinged, Welded Sight Glass Assembly provides quick-opening access for sampling or cleaning, rated up to 150 psi.

Circular Bolt-On Sight Glass Assembly is ready for installation on existing ANSI or DIN standard flanges, 2 to 8-in.

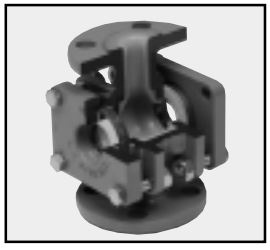


Armored External Liquid Level Gages in lengths to 10 feet give safe and easy readings at high pressures and temperatures.

Easy-Install Spray Units for installation on sight glass assemblies, suitable for use with pressure or vacuum applications.

Illuminated Screw-on "Dairy" Sight/Light Port for easy opening and cleaning plus excellent visibility.

Lined View-Thru Visual Flow Indicators handle a wide variety of corrosive chemicals; are offered in sizes from 1 to 8 inches.



Sanitary Full-View Visual Flow Indicator, equipped with 3-A approved clamp connection heads.

"Where quality in design, engineering, materials and workmanship is always a standard feature."

Custom designs are available for special applications.

L.J.STAR INCORPORATED

P.O. Box 1116
Twinsburg, OH 44087
Applications Engineering Department:
(330) 405-3040 • Fax: (330) 405-3070
E-mail: view@ljstar.com
Website: www.ljstar.com