

Windows

Window design, ratings, and applications in Parr Reactors and Pressure Vessels.

Windows can be installed in Parr reactors and pressure vessels for visual observations, light transmission and other purposes. They are usually installed in pairs so that light can be introduced through one window while the other is used for viewing. Our standard material for these windows is fused silica. Sapphire is also available for small diameter windows. Alternative window materials are available for specific transmission requirements. Windows can be mounted in several different ways.

Screw-in Windows

The simplest window is a screw-in type with a ½ inch diameter viewing area. The windows in these assemblies are sealed in a fitting which screws into the vessel using a standard 1/2 inch NPT male pipe thread. Obviously, the vessel wall must be thick enough to provide full engagement for this thread. O-ring seals restrict the maximum operating temperature to 225 °C or less, depending upon the O-ring material. Alternatively, a Grafoil gasket seal option is also available to increase temperature rating up to 350 °C. Pressure ratings range from 1900 to 5000 psi, depending upon the window material and its thickness. Although these windows are rather small for straight optical viewing, they work well for small video systems and for laser and other analytical beams. A limitation of this design is that there is a dead space approximately 1.25 inches long between the inner face of the window and the inside wall of the vessel.

Integral Windows

Parr has developed designs for installing windows in the wall of the vessel so that the inside face of the window is very close to the inside wall of the vessel. This eliminates the large dead space associated with screw-in windows. These windows are offered in the two styles described below. The maximum size of the window will depend on the size of the cylinder in which it will be installed.

Round Windows with a 1/2" diameter viewing area are the standard. Round windows are available in a variety of materials including sapphire for very high pressures (up to 5000psi). Both O-ring and Grafoil seals are available in this design. This type of window is generally used for visual, photographic or optical sensor observations.

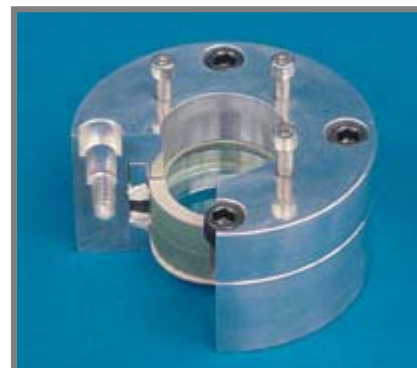
Oblong Windows with a viewing area 3.50" long and .62" wide are the standard size and can be installed on vessels of 100 mL micro or 450 mL mini and larger. Only O-ring seals are available in this design. Both Fused Silica and sapphire windows are available – maximum rating for these windows are limited to 1900psi @ 225 °C with FKM or FFKM seals. These windows are commonly used for visual observations of both the vapor and liquid phases and for observing the liquid level in the vessel. Multiple windows can be stacked or staggered on larger vessels.

The windows we have described above as standard are maintained in our inventory for readily available replacements. Custom windows in both the round and oblong styles can be furnished in larger sizes upon request. All reactors and pressure vessels equipped with windows require custom designed heaters and supports. Flexible heating mantles, integral cartridge heaters and attached circulating jackets (600 mL mini and larger) are the most commonly used heaters for window vessels.

Externally Welded Windows

Large round windows that are externally welded to the vessel can be installed. These will provide a viewing area of 1¾" to 7¼" depending on the size of the window ordered and the size of the vessel. Externally welded windows greatly reduce the maximum working pressure of the vessel as shown below:

Window Size	Max PSI	Fixture O.D.	Viewing I.D.
2 Inch	600	4¾ inch	1¾ inch
3 Inch	600	6 inch	2¾ inch
4 Inch	600	7¼ inch	3¾ inch



Design

Round window assemblies use a 1" O.D. x 0.5" thick window. This window size will be used anywhere a small window is needed in all vessel sizes. These window assemblies can be installed into a 1/2NPT opening or integrally into the cylinder. The viewing area for this window has a diameter of 0.50 inches. Large externally welded circular windows have viewing areas from 1¾" to 7-3/8" in diameter and can be supplied with a radius to match the vessel I.D.

Large oblong windows have a 3.88" x 1" window incorporated into cylinder designs ranging from 100mL to 2 gallons. The viewing area for this oblong window is 0.62" wide x 3.50 " long.

Both round window assemblies and oblong windows may be used in composite assemblies where multiple windows with a single retainer are positioned close together to provide an overall larger viewing area.

Seals

Round window designs have an o-ring seal on the side of the window. Oblong window designs have an o-ring seal on the face of the window. The o-ring is normally FKM with an option for FFKM. FEP- encapsulated silicone or NBR o-rings may be considered for use in critical CO₂ applications. Graphoil seal is offered as an option for round windows only and may be used in applications where there is chemical incompatibility with typical o-ring elastomers, higher temperatures (up to 350 °C) are needed or is desirable over O-ring seals for other reasons.

Ratings:

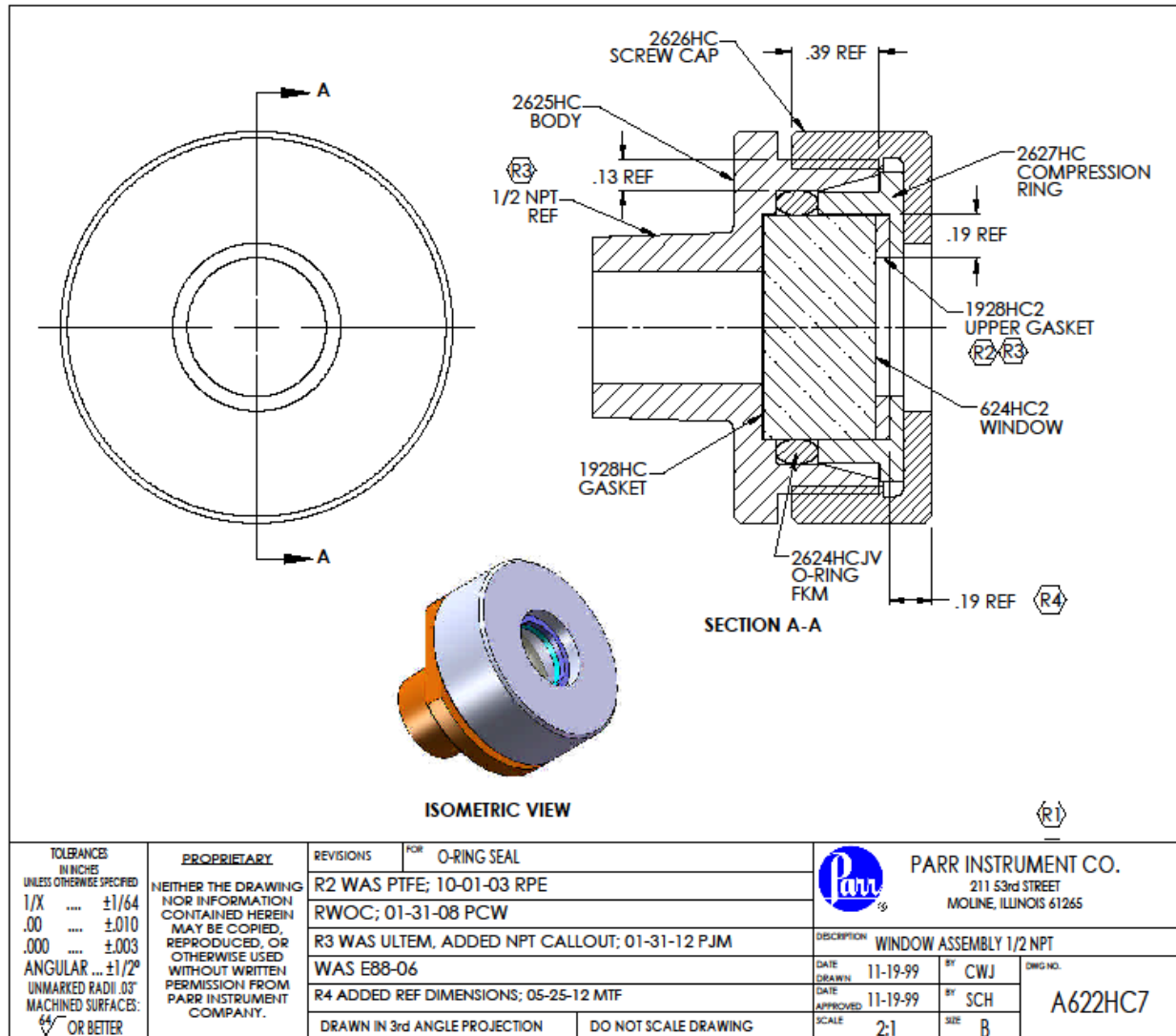
Maximum ratings for windows have been summarized in a tabular format below:

Type of Window	Max Pressure [psi]	Max Temperature [°C]		Certification Remarks <i>Note: All references to PED applications below imply PED category I and higher</i>
		FKM/FFKM (O-ring) seal	Grafoil seal	
Screw in or Integral 1" OD Fused Silica Round ⁽⁴⁾	3000	225	350 ⁽¹⁾	⁽¹⁾ Limited to 250 °C for PED applications ⁽²⁾ Limited to 175 °C for PED applications ⁽³⁾ Not available for PED applications ⁽⁴⁾ Not permissible for use with strong bases ⁽⁵⁾ Not permissible for use with strong acids ⁽⁶⁾ Limited to 3000 PSI with screw cap
Screw in or Integral 1" OD Sapphire Round ⁽⁵⁾	5000 ⁽⁶⁾	225 ⁽²⁾	350 ⁽²⁾	
Integral Fused Silica Oblong ⁽⁴⁾	1900	225	n/a	
Integral Sapphire Oblong ⁽⁵⁾	1900 ⁽³⁾	225 ⁽³⁾	n/a	

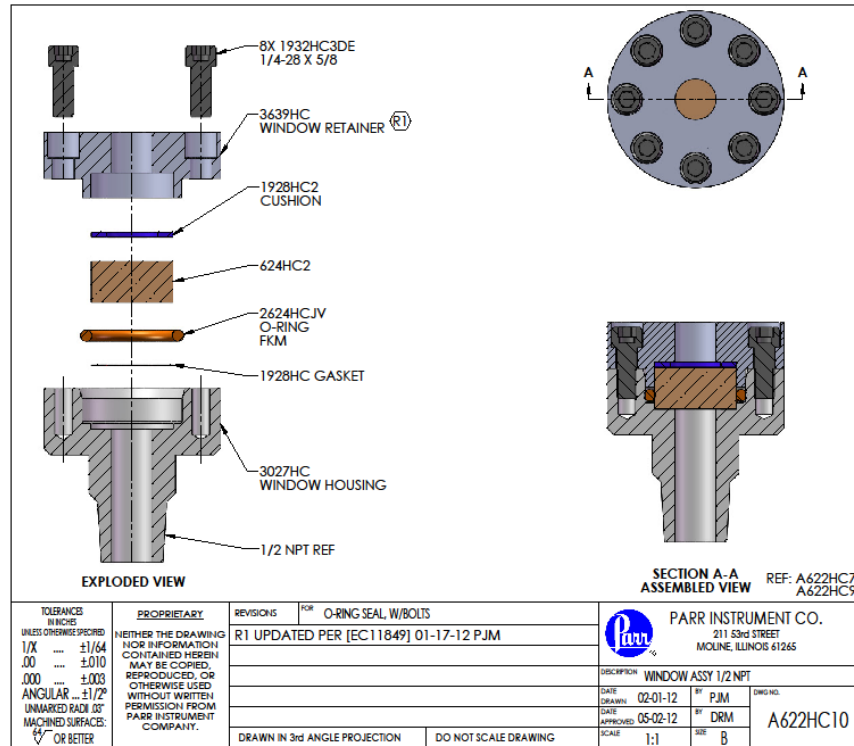
The above ratings are based solely on limitations on window and seal materials, and do not reflect potential limitations imposed by the vessel itself. All openings on pressure retaining components need to satisfy reinforcement requirements. This applies to openings on heads and cylinders needed to install all types of windows (screw in as well as integral). Reinforcement requirements vary by size and material of construction of vessels, pressure/temperature ratings and size and location of openings. In general, the above ratings can be accommodated on most T316SS vessels larger than 100 mL micro or 450 mL mini as long as the standard vessel rating is at least equal to or higher than the rating of the window itself.

Sapphire will crack when subjected to an abrupt thermal change of more than 175 °C. If a sapphire window assembly is taken above 175 °C it must be protected from being quickly cooled. In general, the above ratings can be accommodated on most T316SS vessels larger than 100 mL micro or 450 mL mini as long as the standard vessel rating is at least equal to or higher than the rating of the window itself.

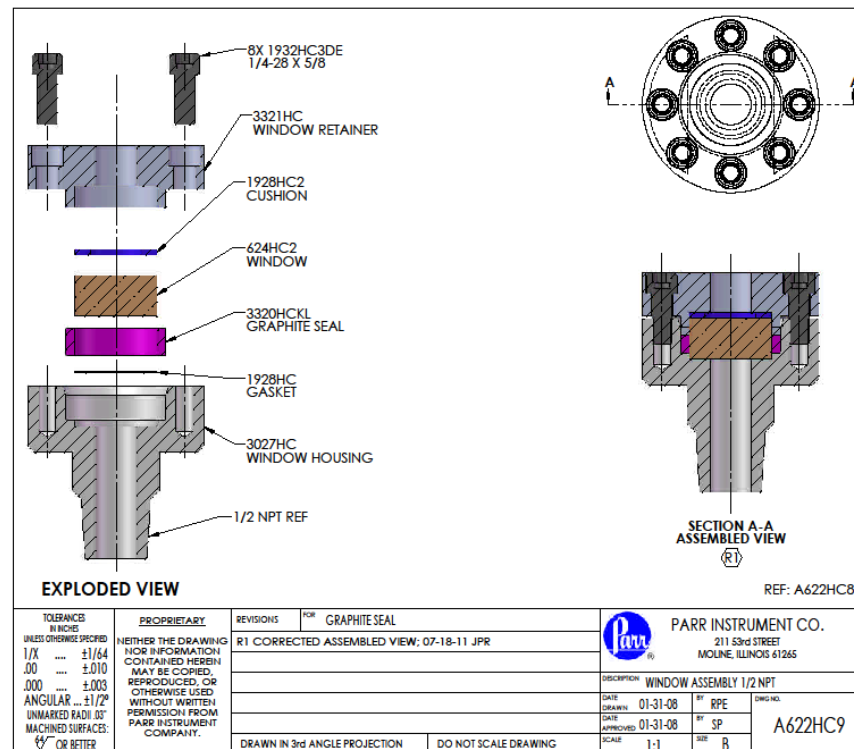
Reference Drawings



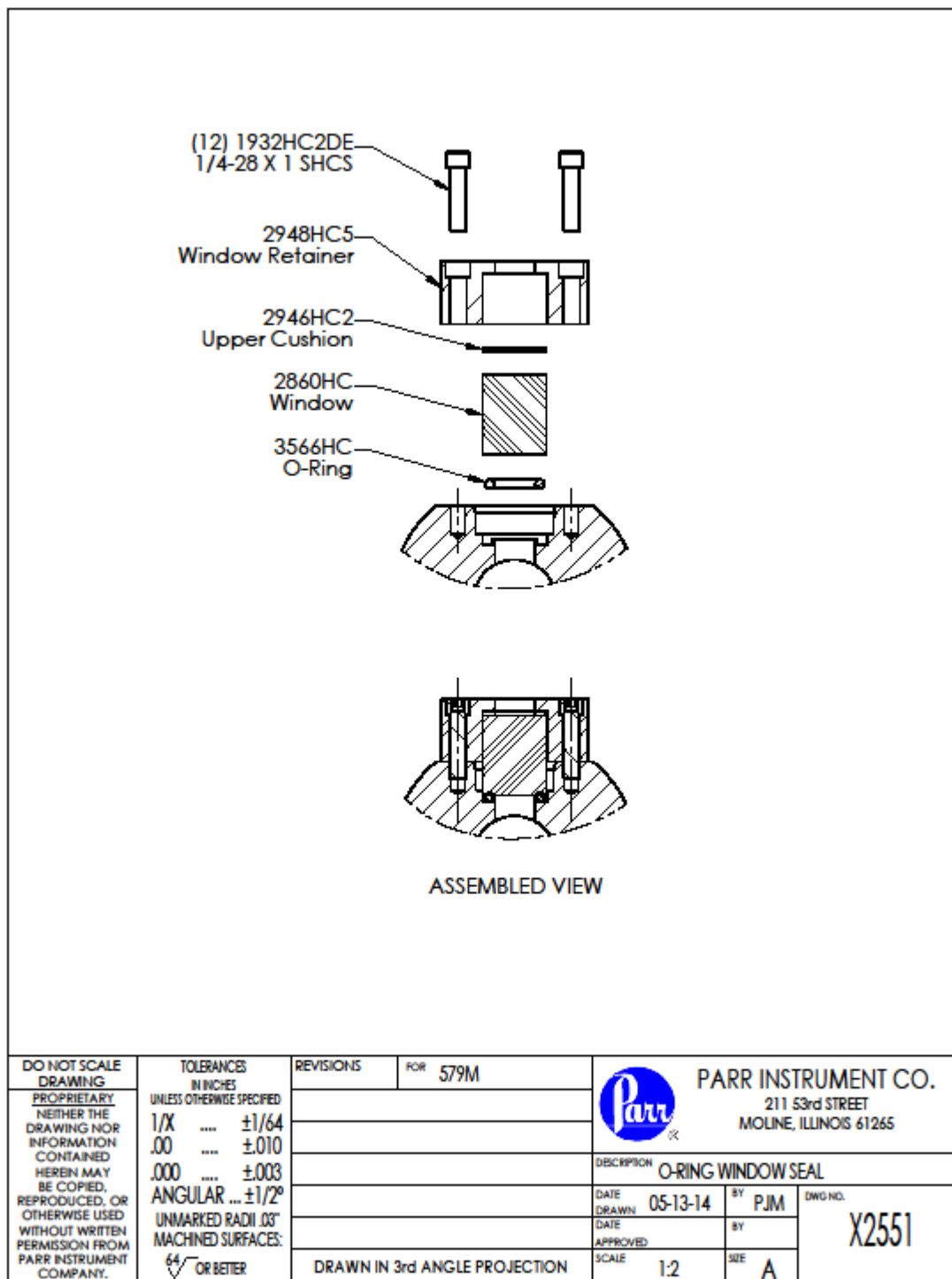
Round Window, Screw-in Style, O-Ring Seal with Cap Screw



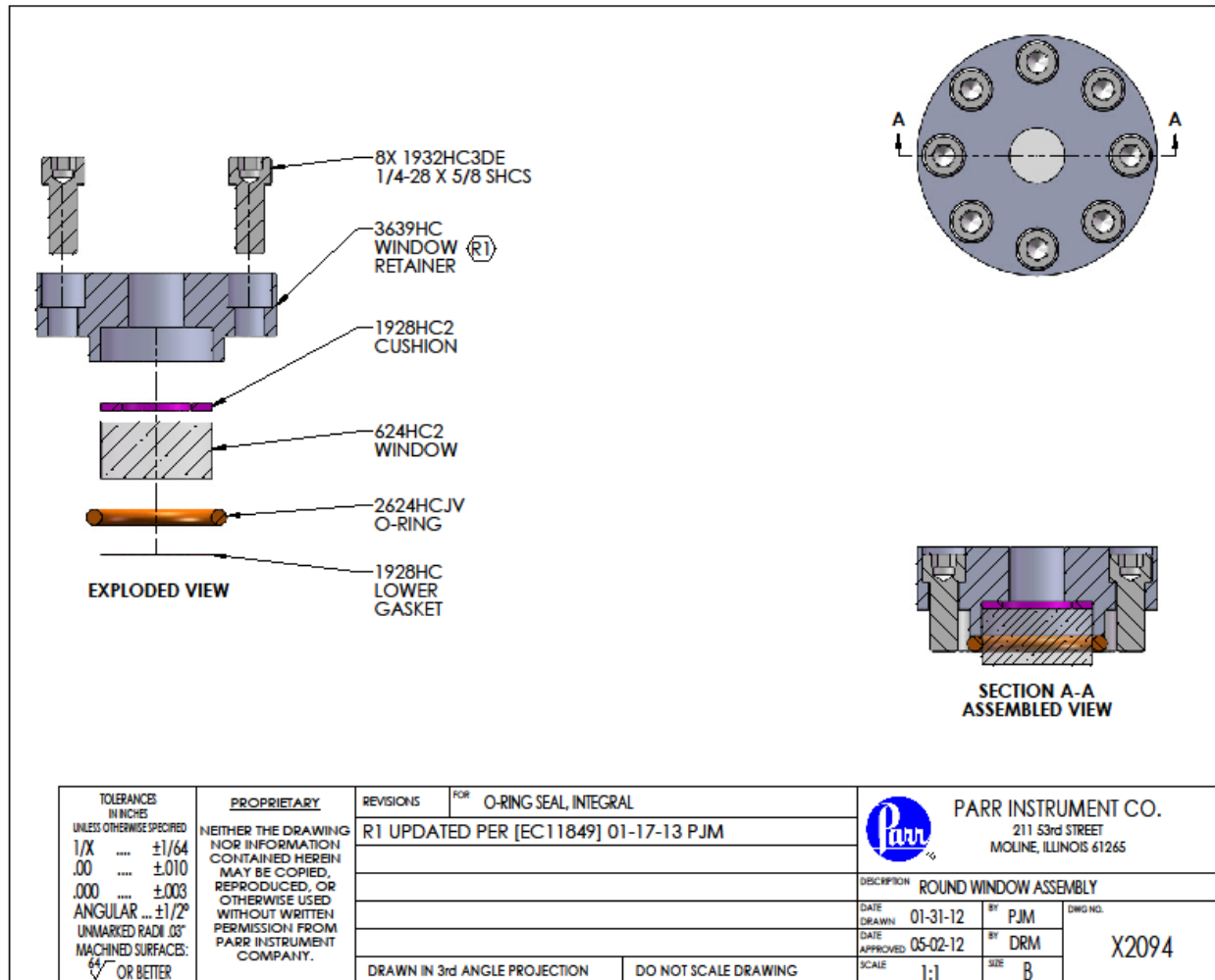
Round Window, Screw-in Style, O-ring Seal with Bolts



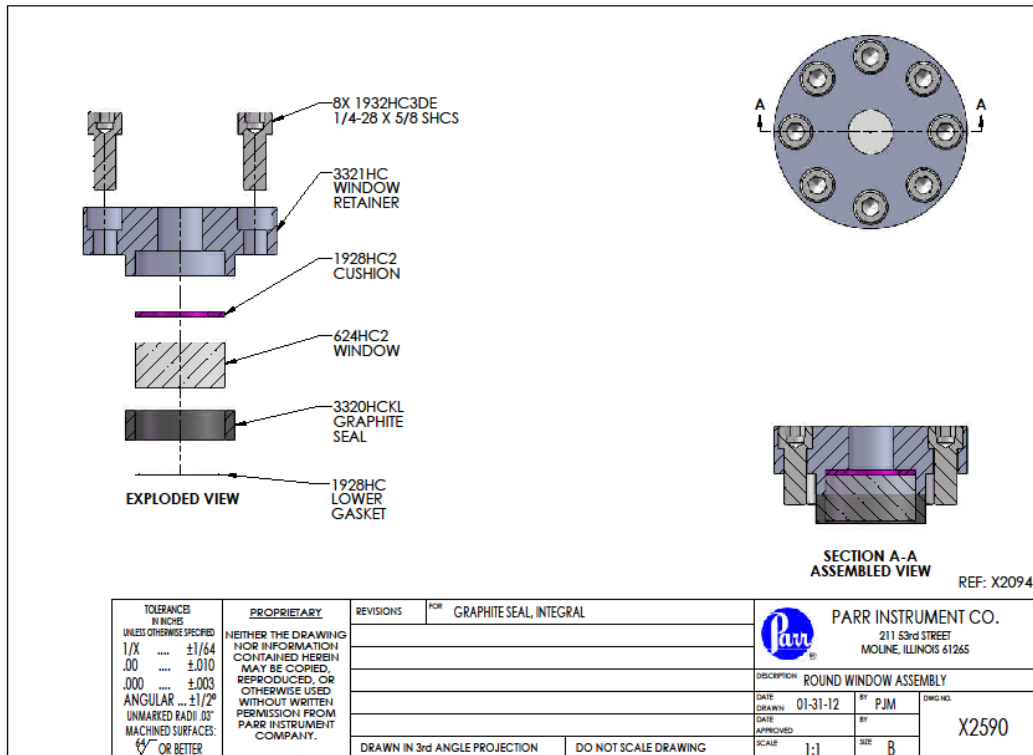
Round Window, Screw-in Style, with Grafoil Seal



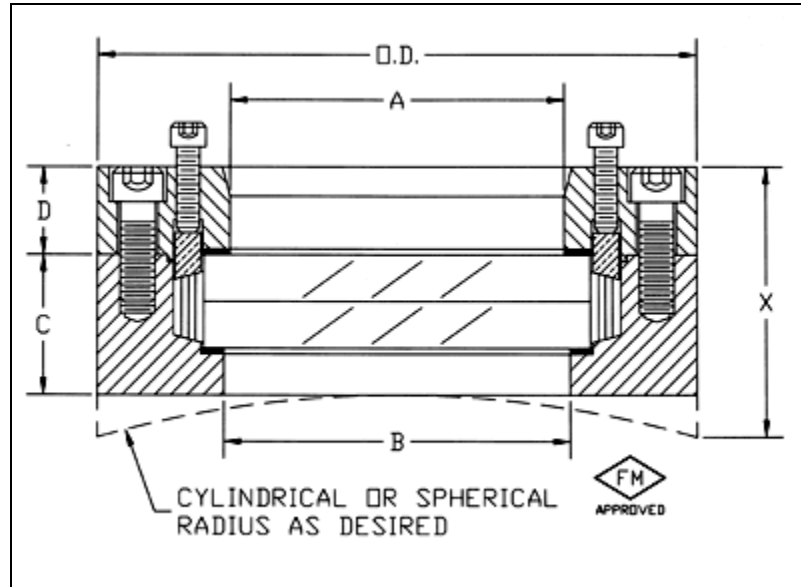
Integral Oblong Window with O-ring Face Seal



Round Window, Integral Style Style, with O-ring Seal



Round Window, Integral Style, with Grafoil Seal



Externally Welded Window

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