Bulletin No. 227

Windows

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

Windows can be installed in Parr stirred reactors and pressure vessels for visual observations, light transmission and other purposes. They usually are 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 quartz. 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 5/8 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 and PTFE gaskets restrict the maximum operating temperature to 225 or 270 °C, depending upon the O-ring material. Pressure ratings range from 2000 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

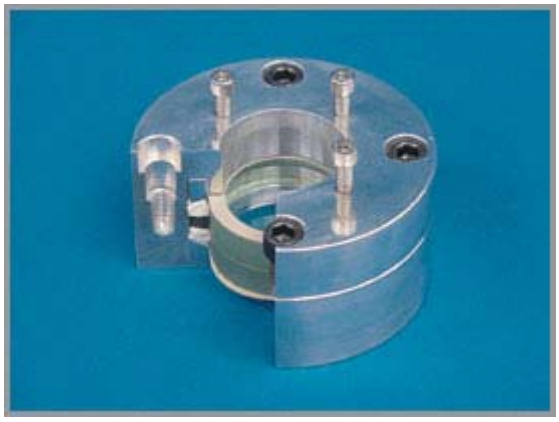
Parr has developed designs for installing windows in the wall of the vessel so that the inside face of the window is very close to the inside wall of the vessel. This eliminates the large dead space associated with screw-in windows. These windows are offered in the two styles described below. The maximum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

Circular Windows with a .62 inch diameter viewing area are the standard. Circular windows are available in a variety of materials including sapphire for very high pressures. 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 and larger. 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 on larger vessels. Windows in both the round and oblong styles can be furnished in larger sizes upon request.

The windows we have described above as standard are maintained in our inventory for readily available replacements. All reactors and pressure vessels equipped with windows require custom designed heaters and supports. Flexible heating mantles and attached circulating jackets are the most commonly used heaters for window vessels. Windows are sealed into the vessel with O-rings. For this reason, vessels equipped with windows are restricted to operating temperatures of 225 or 275 °C depending upon the O-ring material selected.

Externally Welded Windows



Large circular 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 to either 600 PSI or 300 PSI as shown below:

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

Design

Round window assemblies use 1"OD x 0.5" thick windows. This window size will be used anywhere a small window is needed in all vessel sizes. These windows can be installed into a 1/2NPT opening or integrally into the cylinder. The viewing area for this window is a diameter of 0.50 inches. Large externally welded circular windows have viewing areas from 1¾ to 7¾" and can be supplied with a radius to match the vessel size.

Oblong windows have a 3.88" x 1" window incorporated into cylinder designs ranging from 100mL to 2 gallons. The viewing area for this window is 0.62" wide x 3.5 " in length.

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

Seals

Both designs have an o-ring seal on the side of the window. The o-ring is normally FKM with an option for FFKM. PTFE encapsulated or NBR o-rings may be considered for use in critical CO_2 applications. For circular windows only, graphoil seals may be used in applications where there is chemical incompatibility with typical o-ring elastomers.

Ratings:

ASME:

For fused silica window assemblies: 3000 psi at 225°C with FKM o-rings, 270°C with FFKM, and 500°C with a graphoil seal.

For sapphire window assemblies: 5000 psi at 225°C with FKM o-rings, 270°C with FFKM, and 500°C with a graphoil seal.

For fused silica oblong window assemblies: 2000psi at 225°C C with FKM o-rings, 270°C with FFKM o-rings.

PED:

The ratings qualified by PED based on performance tests are as follows:

For fused silica window assemblies: 310 bar (4495 psi) at 150°C.

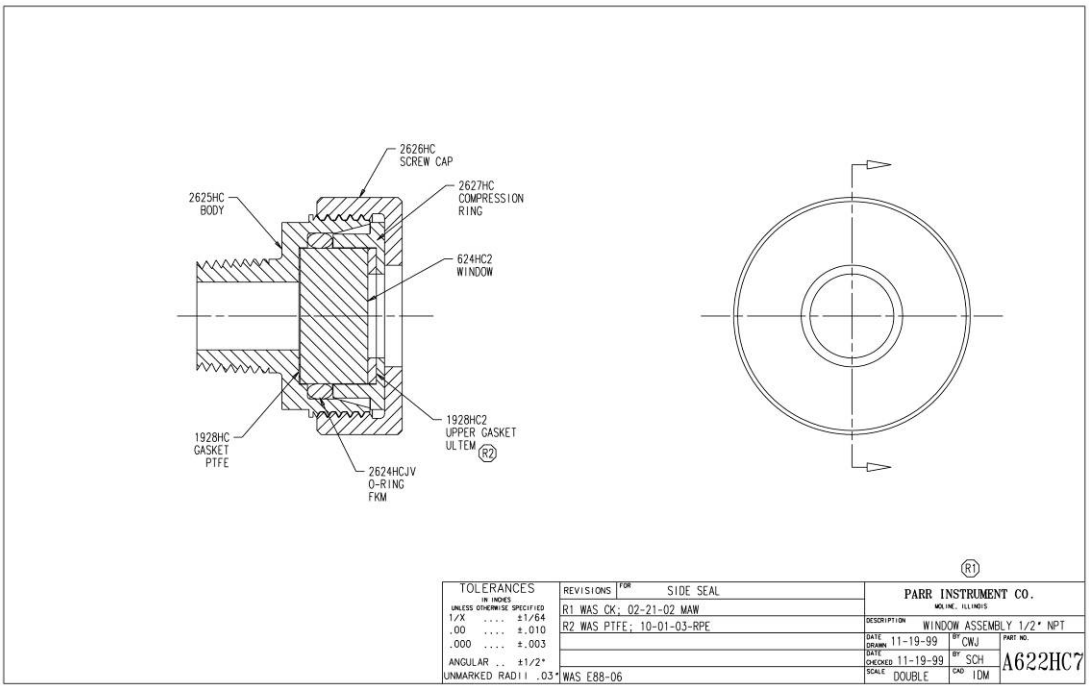
For sapphire window assemblies: 345 bar (5002 psi) at 150°C.

For fused silica oblong window assemblies: 126 bar (1833 psi) at 200°C.

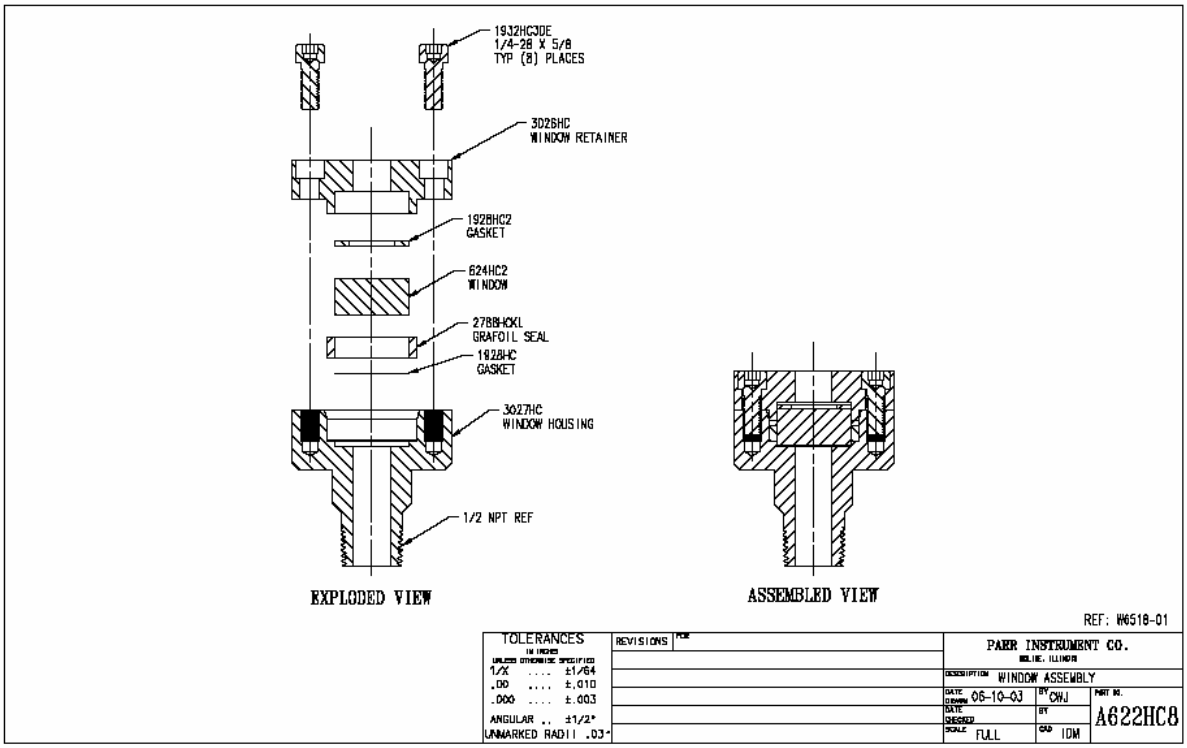
Ratings for the 1" OD windows are valid for both the 1/2NPT assembly as well as the design that is integral to the cylinder.

The PED temperature ratings were established with the entire window assembly at that particular temperature. The vessel may be rated at a higher temperature if we provide either temperature monitoring or cooling to keep the window assembly below the rated temperature.

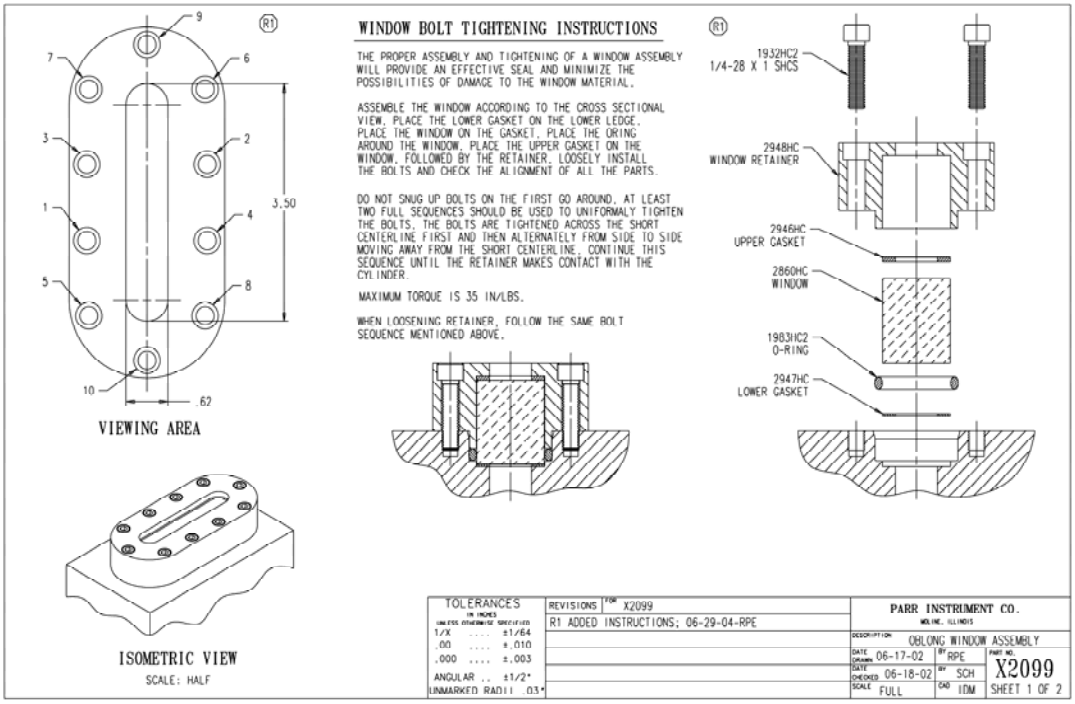
Sapphire will crack when subjected to an abrupt thermal change of more than 150°C. If a sapphire window assembly is taken above 150°C we must protect it from being quickly cooled.



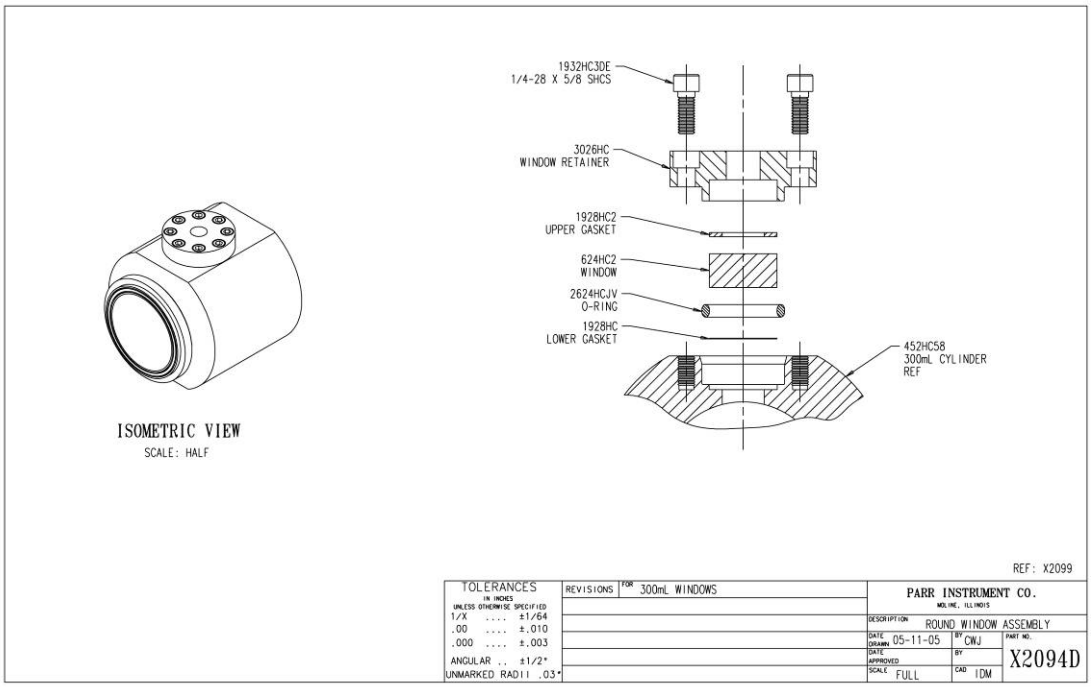
Circular Window



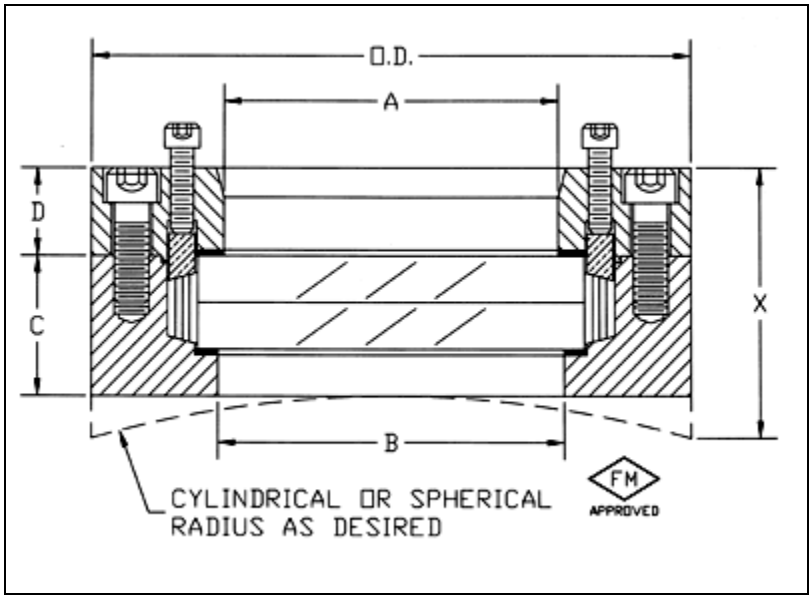
Circular Window with Graphoil Seal



Oblong Window



Integral Window



Externally Welded Window

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