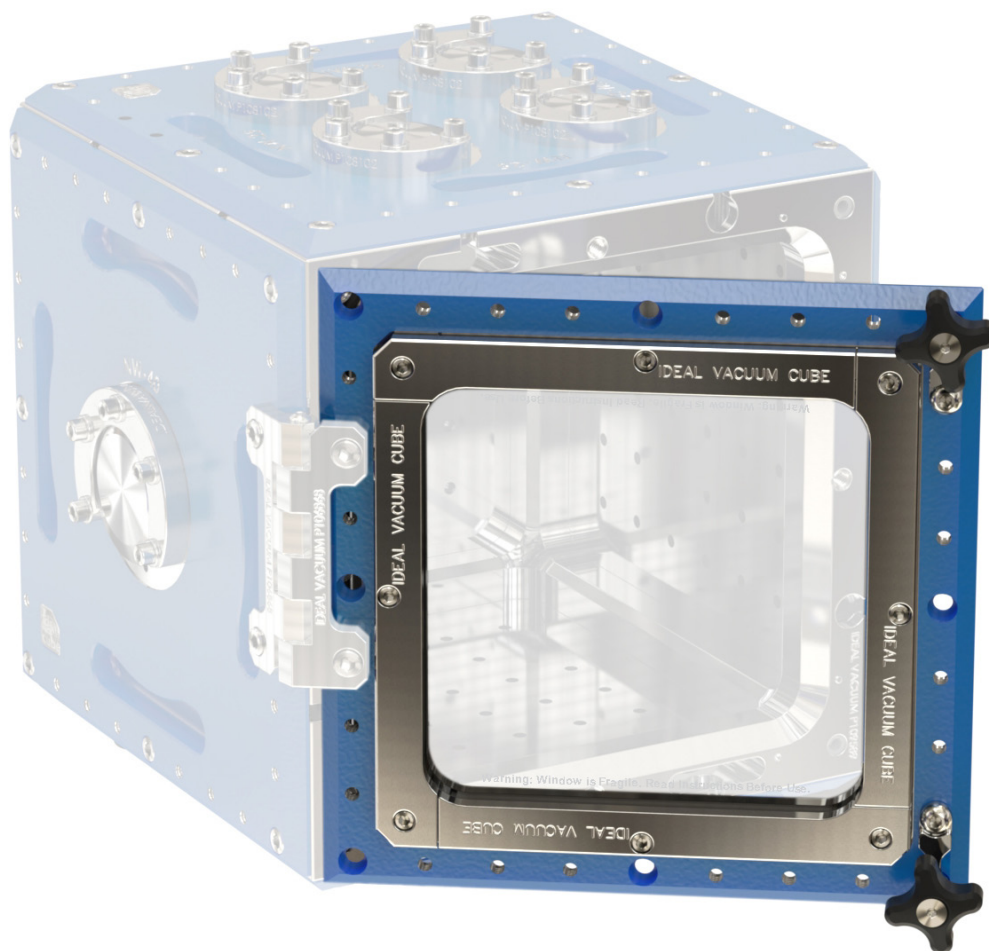




OUR PRODUCTS DEVELOP TOMORROW'S TECHNOLOGIES™

VIEWING WINDOW ASSEMBLY (VWA)

USER MANUAL



For 6x6, 6x12, 9x9 and 12x12 Inch Ideal Vacuum Cubes

WARRANTY

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If you have any questions concerning the installation or operation of this equipment, or if you need warranty or repair service, please contact us. Customer Service and Technical Support is available weekdays, from 8am-5pm, Mountain Time.

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Cover Image:

- 9x9 Modular Vacuum Cube with Glass Viewing Window (Door Option and Quick Knobs installed)

SAFETY

IMPORTANT SAFETY INFORMATION

Thank you for purchasing this equipment from Ideal Vacuum Products. We want you to operate it safely.

- **Read this manual before installing or operating this equipment. Failure to follow the warnings and instructions may result in serious injury or equipment damage.**
- **Keep this manual in a safe location for future reference.**
- **This equipment should only be installed and operated by trained, qualified personnel, wearing appropriate protective equipment.**
- **Follow all codes that regulate the installation and operation of this equipment.**

WARNING SYMBOLS AND DEFINITIONS



This is the universal safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



Indicates an imminently hazardous situation that, if not avoided, will result in death or severe injury.



Indicates an imminently hazardous situation that, if not avoided, could result in death or severe injury.



Indicates a potentially hazardous situation that, if not avoided, could result in moderate or minor injury. It may also be used to alert against unsafe practices.



Indicates an potentially hazardous situation that, if not avoided, could result in equipment or property damage.



Indicates helpful tips and recommendations, as well as information for efficient, trouble-free operation.

Internationally recognized safety symbols may be used with safety warnings to specify the type of hazard or a safety protocol to follow. For example:



Indicates an electric shock hazard



Indicates safety glasses are required

ADDITIONAL SAFETY FOR VIEWING WINDOW ASSEMBLY (VWA)



Implosion/explosion hazard. Failure to follow ALL instructions and safety precautions can result in serious injury or death.



Always wear protective equipment, including safety glasses and gloves. Exercise care when working with any vacuum component.

All viewing windows or ports are inherently fragile. Exercise great care when handling, mounting and when using a chamber with a viewing window. Below are specific warnings and special precautions needed for safely installing and using a viewing window.

VISUAL INSPECTION



Visually inspect the window upon receipt and check regularly for scratches or any irregularity. Even small scratches can cause a weak spot in the window causing failure. Keep hard objects away from the window. Use only a soft cloth or lens tissue for cleaning.

MOUNTING AND ASSEMBLY



Carefully follow all mounting and reassembly instructions in this manual if you are replacing or servicing the window pane. Strictly adhere to the bolt torque specifications and tightening order pattern. Over-tightening of bolts DOES NOT produce a more leak-proof seal. Overtightening or failure to properly reassemble a viewing window assembly could cause internal strain buildup in the window material resulting in failure.

PRESSURE



NEVER subject a viewing window equipped chamber to positive internal pressure. The viewing window is designed and rated for vacuum ONLY. Chamber pressures in excess of ambient atmosphere could cause the viewing window assembly to fail catastrophically.

TEMPERATURE CHANGES AND THERMAL GRADIENTS



The fragile nature of the window makes it susceptible to thermal shock. Rapid temperature changes under vacuum, hot or cold, can cause failure. Bakeout or cooling is permissible within the temperature rating of the Viton® O-ring seals. Keep chamber temperature changes to $<10^{\circ}\text{C/min}$ ($<18^{\circ}\text{F/min}$).

If directing a laser beam through the window, make sure the laser's wavelength can be reasonably transmitted through the window's material. Directing a laser through the window of a wavelength the window material absorbs, or focusing a laser of any wavelength within the window medium, will cause a steep thermal gradient extending outward from the point of incidence. This could result in localized weakening or fracturing of the window.

1. GENERAL INFORMATION

1.1 INTRODUCTION

The Viewing Window Assembly (VWA) is a popular option for Ideal Vacuum Cube high vacuum modular chamber systems which allows a user to inspect chamber processes and perform optical experiments. The VWA is interchangeable with other Ideal Vacuum Cube plates and can be added to an [Ideal Vacuum Cube system](#) at any time. A VWA can be implemented as a chamber side or door (with optional hardware kit). Available VWA sizes are 6x6, 6x12, 9x9 and 12x12 inches.

The VWA employs an innovative cushioned window design that holds the 3/8" thick window pane to an aluminum mounting plate. This floating window design is less prone to leakage than typical viewports in which the window material is permanently affixed to the mounting fixture. The VWA allows for service and window replacement without having to replace the entire assembly.

Two window materials are available: standard tempered glass and fused silica. See [Section 1.3](#) for complete assemblies and replacement/upgrade window pane options. See [Section 1.6](#) for an explanation of the differences between the available window material types.

The VWA, like all Ideal Vacuum Cube plates, is mounted to the exterior of the Cube frame and does not intrude into valuable chamber space. The plate is mounted to the Cube and sealed using our patented Taper-Seal™ design, which helps protect vacuum sealing surfaces and O-ring seals from damage or contamination.

All parts that make up the VWA have been carefully selected for vacuum system compatibility and longevity. All production, assembly and testing is done in our own manufacturing facility in Albuquerque, NM, U.S.A. Before it ships, every viewing window is fully assembled, visually inspected for window imperfections, helium leak tested, cleaned and sealed. This ensures that it operates correctly, safely, and is ready for immediate installation upon delivery.

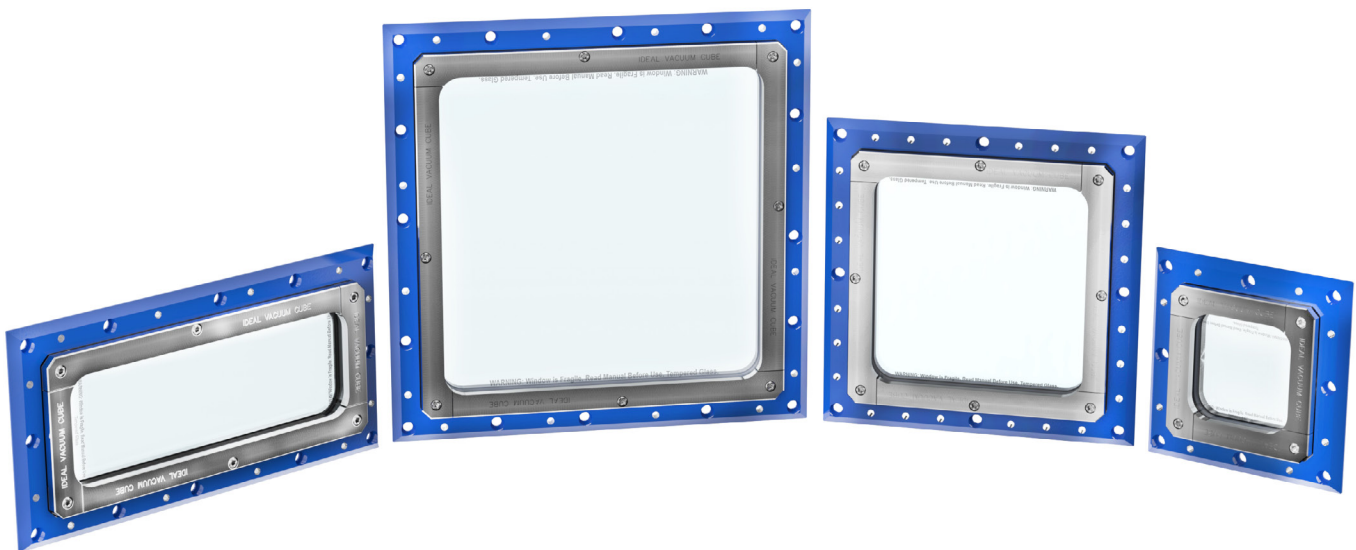


Figure 1 - Viewing window assembly sizes. From left: 6x12, 12x12, 9x9 and 6x6

1.2 SPECIFICATIONS

| PARAMETER | MEASURE/TYPE |
|--------------------------|---|
| Ultimate Vacuum Pressure | 3 x 10 ⁻⁸ Torr |
| Leak Rate | <1 x 10 ⁻⁸ std cc/sec atm Helium |
| Temperature Rating | -20° to 150° C (-4° to 302° F) |
| Thermal Gradient | 10° C/min (18° F/min) max |
| Materials | |
| Viewing Window | 3/8" thick; tempered glass or fused silica |
| Mounting Plate | 6061-T6 Aluminum |
| Hold-Downs | 6061-T6 Aluminum |
| O-Ring Seals | Viton® |
| Standoff Dowel Pins | Teflon® (PTFE) |
| Spacer Gasket | Teflon® (PTFE) |
| Frame Hold-Down Bolts | 18-8 Stainless Steel, 6-32 x 3/8" |
| Plate Size | Viewing Area |
| 6x6 in. | 8.7 in. ² |
| 6x12 in. | 26.7 in. ² |
| 9x9 in. | 35.7 in. ² |
| 12x12 in. | 80.7 in. ² |

Table 1 - Technical specifications

1.3 ASSEMBLIES AND WINDOW PANE REPLACEMENTS

| CUBE SIZE | TEMPERED GLASS | | FUSED SILICA | | WINDOW O-RING |
|-----------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | Complete Assembly | Window Only | Complete Assembly | Window Only | Viton® |
| 6x6 in. | P106869 | P1010572 | P1010571 | P1010574 | P107295 |
| 6x12 in. | P108695 | P1010577 | P1010576 | P1010581 | P108339 |
| 9x9 in. | P109976 | P1010584 | P1010583 | P1010588 | P1010490 |
| 12x12 in. | P109369 | P1010596 | P1010595 | P1010598 | P108428 |

Table 2 - Part number selector: assemblies, window and O-ring replacements

1.4 ACCESSORIES

A viewing window maintenance and service toolkit is available and includes the correct hex wrench (9/64") and an O-ring removal tool: [P1010555](#)

To convert the VWA to a door, use the Hinge Assembly and Hardware kit: [P106868](#).

For fast and easy door access, order the Quick Knob Assembly: [P107936](#).

1.5 ASSEMBLY DIAGRAM AND PARTS LIST

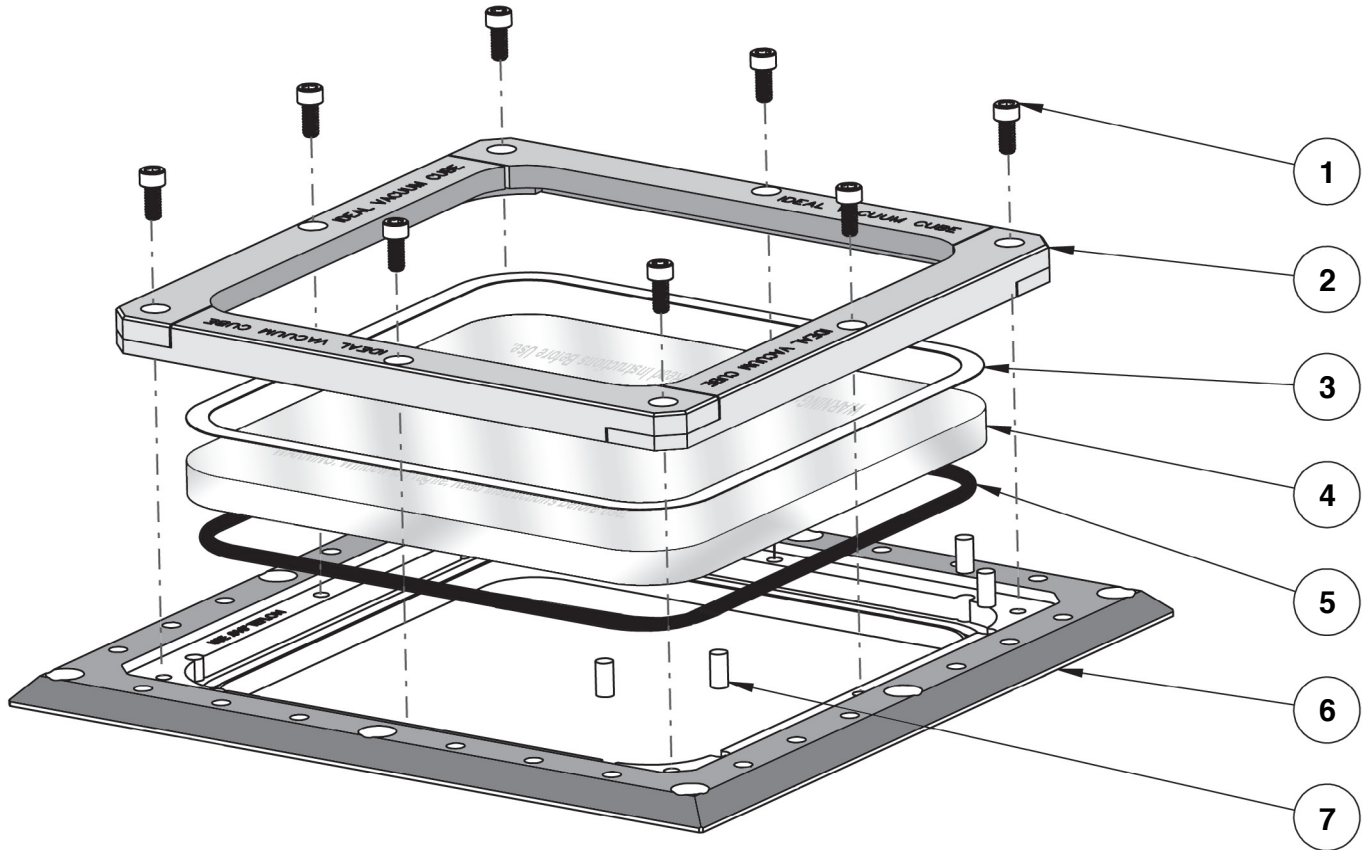


Figure 2 - Exploded view of assembly

| ITEM | DESCRIPTION | QTY. |
|------|--|------|
| 1 | Window Hold-Down Bolt, SS Socket Head, 8-32 x 3/8", Torque = 20 in-lb. Max. | 8 |
| 2 | Window Hold-Down Piece, Overlapping, Aluminum | 4 |
| 3 | Gasket/Spacer, Teflon (PTFE), .010" Thick | 1 |
| 4 | Window Pane, with Laser Etched Safety Warning Message | 1 |
| 5 | Window Pane O-Ring, Viton® | 1 |
| 6 | Cube Mounting Plate for Viewing Window, Aluminum | 1 |
| 7 | Window Standoff Dowel Pin, Teflon (PTFE), 3/16" dia. x 3/8" L | 8 |

Table 3 - Viewing window assembly parts list

1.6 WINDOW MATERIAL CHARACTERISTICS

The selection of a suitable window material depends largely on its intended purpose. We offer two window materials for the VWA: standard low-iron tempered float glass and high purity fused silica (comparable to Corning HPFS 7980). Both types are polished plate material.

Our high clarity, tempered window glass is standard low-iron float glass. It has a surface quality and flatness of Q4 per ASTM 1036-06 and 1048-04. This glass exhibits a slight blueish tint. It is the more economical window material we offer and is most commonly used for general, direct observation of roughing or high-vacuum chamber processes and can be used to facilitate optical alignments of chamber components, observe degassing of fluids, or used to help teach in-vacuo processes by direct observation. This glass is not suitable for high power laser experiments.

Our high purity fused silica windows are ground and polished to optical grade on both sides with a total thickness variation (TTV) of $<10\mu\text{m}$, a surface finish of S/D 40/20, and a surface roughness of $R_a < 1\text{ nm}$. These windows have appreciably improved transmittance, and a wider useful wavelength range than standard glass. Characteristics include extraordinarily low refractive index variations, low birefringence values, and an ultra-low thermal expansion coefficient. Fused silica is used for transmissive optics where a high laser damage threshold is required. Fused silica is used for optics operating in the deep UV, visible, and the near infrared wavelength range.

Figure 3, below, shows a comparison of the percent transmission of light including both reflection and absorption effects over the range of wavelengths that the two available viewing window pane materials can pass without unreasonable energy absorption. The graph shows that both materials have excellent transmissivity throughout the visible range. Below approximately 350 nm, standard glass begins to absorb energy significantly. Fused silica does not become overly absorptive until well into the deep UV ($<200\text{ nm}$) and maintains excellent transmissivity into the Mid IR ($\approx 2100\text{ nm}$). It does exhibit a broad OH absorption band between 2600 and 2800 nm.

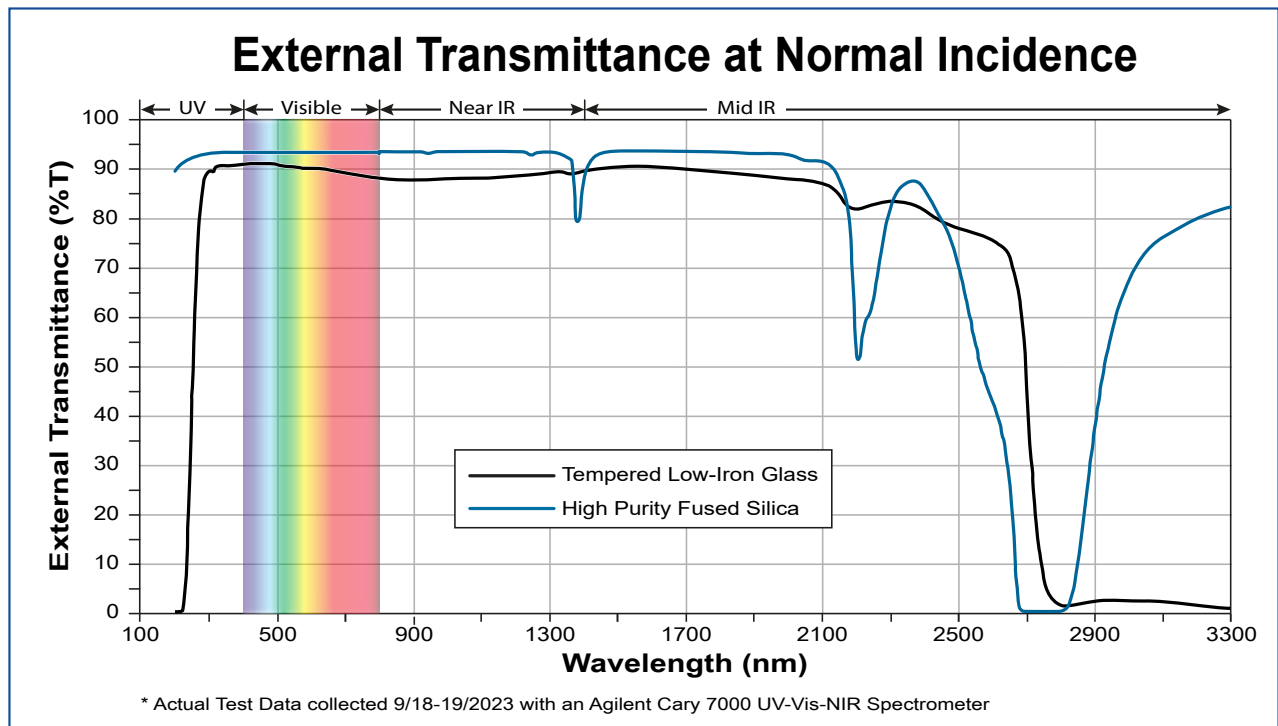


Figure 3 - External transmittance of tempered glass and fused silica at normal incidence

Both the tempered glass and fused silica are plate material. They do not have an optical grade surface finish (e.g., flatness or surface roughness that is associated with high quality optics). If a very high-quality surface finish is required, we recommend our optical vacuum Cube plates that mount standard round optics, such as those in 1, 1.5 or 2 inch outer diameters ([P108315](#), [P108316](#), [P108317](#)).

For laser application we recommend, for example, [Thorlabs WW42012](#) wedged fused silica windows. These optics have a good surface flatness of $\leq \lambda/20$ over central Ø15 mm, $\leq \lambda/10$ over clear aperture and a surface quality of 10-5 scratch-dig. Our viewing window pane materials do not have this quality of optical surface finish.

2. WINDOW PANE SERVICE, REPLACEMENT AND UPGRADES



The VWA and window pane materials are engineered with critical tolerances. Use only factory certified windows.

Occasional cleaning and servicing of the VWA is beneficial to maintain good operation. Particulates and other contaminants could begin to accumulate on the window pane, causing reduced transparency. The O-ring seal could begin to harden or deteriorate over time, resulting in poor sealing which requires O-ring replacement. Inspect the VWA regularly as part of scheduled, system preventive maintenance.

If the VWA begins to leak, it may simply require re-torquing the window hold-down bolts (see [Section 2.3](#)). **Maximum torque is 20 in-lb.** Overtightening of bolts DOES NOT produce a more leak-proof seal and could cause strain buildup in the window material resulting in failure.

Disassembly is required for any of these reasons:

1. If tightening the window hold-down bolts does not eliminate a leaky seal.
2. If the window pane becomes scratched or can not be successfully cleaned.
3. If a window replacement or upgrade is needed or desired.

The design of the VWA allows the window pane to be replaced or upgraded whenever system needs change. [Table 2](#) shows all available viewing window assemblies, replacement window panes and O-rings.

We strongly encourage a window pane replacement or upgrade be performed at our facility, as compared to in the field. This ensures the VWA is correctly serviced, properly helium leak tested and safe for continued use.

NOTE

If you have an older viewing window plate assembly (does not have a bare aluminum window frame), we will upgrade the entire viewing window assembly at no charge to the window described in this manual when you order a replacement window.

This most recent version includes the 3/8" thick glass and is more leak resistant than previous versions.

When you purchase the new replacement window, just let us know (by phone or email) that you have an older model. We will provide an RMA and return shipping label for you to send us your old viewing window plate assembly. Once we receive the old plate assembly, we will send you a complete, fully tested, updated assembly. Old plate assemblies will not be returned.

2.1 DISASSEMBLY

WARNING

Before performing any maintenance or service on the Viewing Window Assembly, the Cube chamber must be brought up to ambient atmosphere.

NOTICE

Prepare a clean, soft surface before performing any maintenance or service on a Viewing Window Assembly. The window is more fragile than many vacuum components. Be careful, use clean tools and recommended cleaning agents to perform maintenance, cleaning and service.

The Viewing Window Plate Assembly should be removed from the Cube frame prior to any maintenance or service. Go to the [IVP Cube Plate Installation manual](#) for specific instructions for removing the Viewing Window Plate Assembly from the Cube frame. We offer a Cube plate maintenance toolkit for this purpose: [P1010554](#), and a complete Cube essential service tool kit, [P1010558](#).

Once the VWA plate is unmounted from the Cube frame and placed on a clean, soft surface, the window hold-down bolts may be removed. **Use a 9/64" hex wrench.**

Start by loosening one corner bolt. Then, loosen the bolt opposite from it. Continue to loosen bolts using a “star” or “cross” pattern as shown in Figure 4 (similar to removing the lug nuts on a car). Unscrew bolts gradually (about a 1/2 turn at a time) and take several “passes” around the window until all bolts are free.

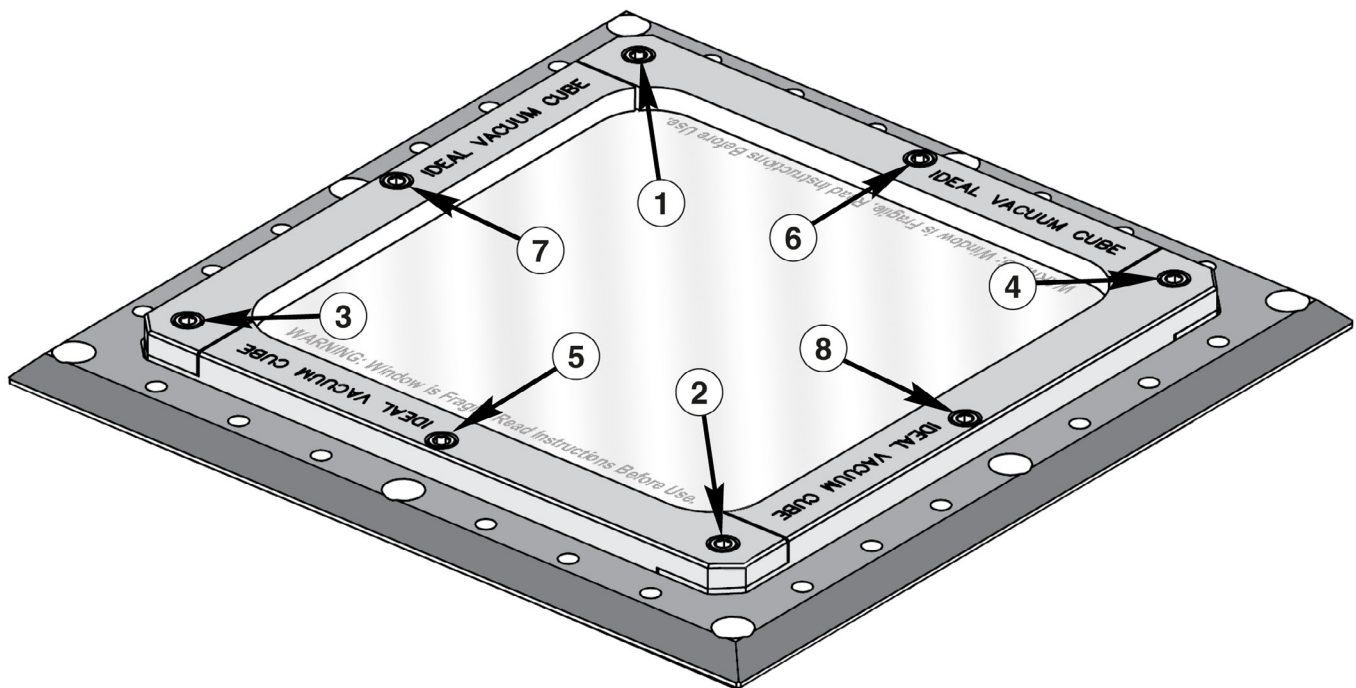


Figure 4 - Pattern for loosening window hold-down mounting bolts

1. After removing the window hold-down bolts, remove the four overlapping window hold-down pieces. Use care not to scratch the window material.

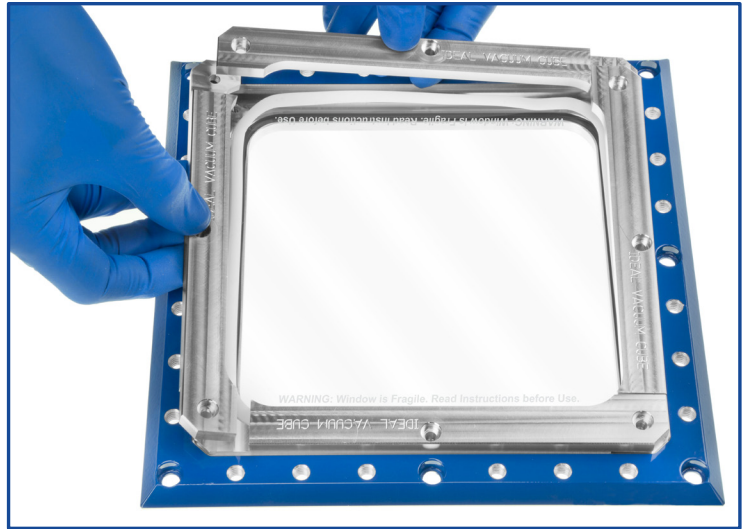


Figure 5 - Remove the (4) window hold-down pieces

2. Lift off the thin Teflon spacer gasket.

Note: Some window assemblies do not use or require a Teflon gasket. If the assembly does not have a Teflon gasket, proceed to step 3, below.

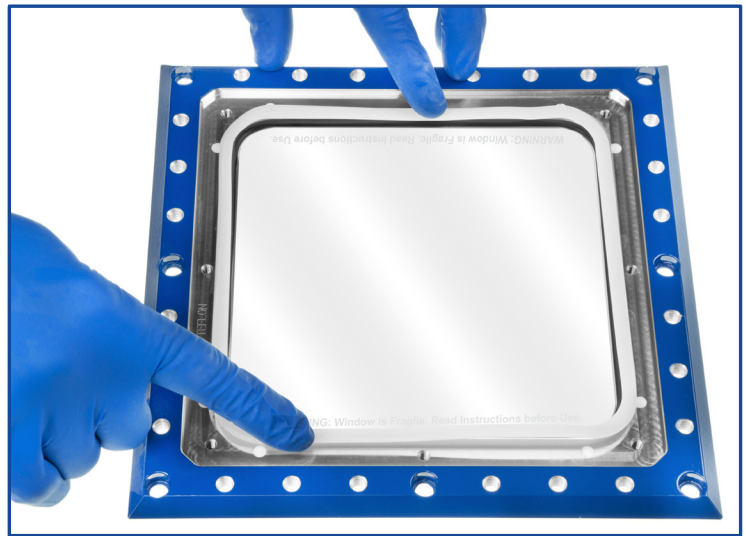


Figure 6 - Remove the Teflon gasket

3. Carefully remove the window pane from the mounting plate and place it gently on the clean, soft surface.

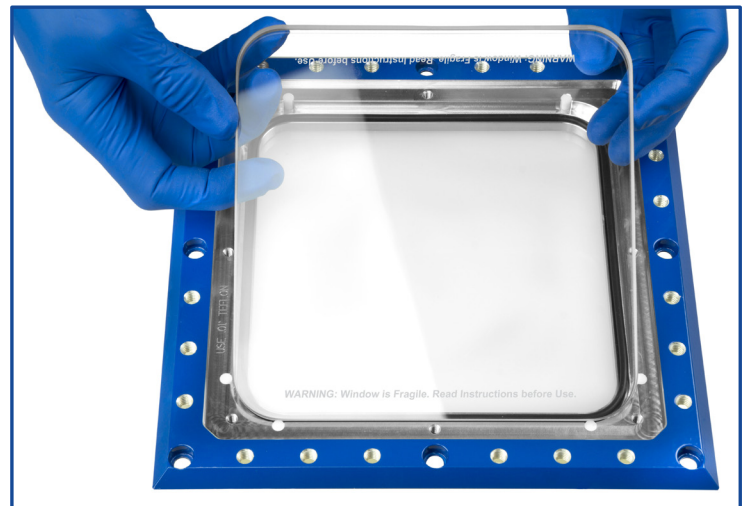


Figure 7 - Remove the window pane

2.2 MAINTENANCE AND SERVICE

Once the window pane has been removed from the assembly, all the parts can be inspected, cleaned and replaced as necessary.

Use a soft, clean, lint-free cloth and isopropyl alcohol (IPA) to clean the aluminum mounting plate and hold-down sections.

Use only IPA and lens tissue to clean the window pane.

Use a plastic O-ring removal tool, like the one shown in Figure 8 ([P1010547](#)), to carefully remove the window pane O-ring. (Figure 9). Do not use a metal tool which could damage the O-ring or the O-ring groove.



Figure 8 - O-ring removal tool

We offer a viewing window tool kit, [P1010555](#), which has the correct 9/64" hex wrench and an O-ring removal tool (shown above) needed for servicing the VWA.



Figure 9 - Remove the window O-ring

Inspect the O-ring for any damage. It can be reused as long as it remains pliable and is not permanently deformed. Replace the O-ring if needed (see [Section 1.3](#) for replacement O-rings).

Wipe the O-ring groove with IPA before installing the O-ring. Do not use vacuum grease.

2.3 REASSEMBLY

Reassemble the Viewing Window Plate Assembly in reverse order to disassembly:

1. Install the O-ring. Push it into the groove with your fingers. If the O-ring pops out of the groove, run it through your hands to create friction to warm and slightly stretch it to fit better.
2. Gently place the window pane onto the O-ring and between the Teflon dowel pins (two in each corner of the plate, illustrated by arrows in Figure 10). Align the pane so it does not touch metal when being lowered into place. Be careful not to drop the pane onto the plate. Notice that the pane fits loosely in the plate recess. This is correct.

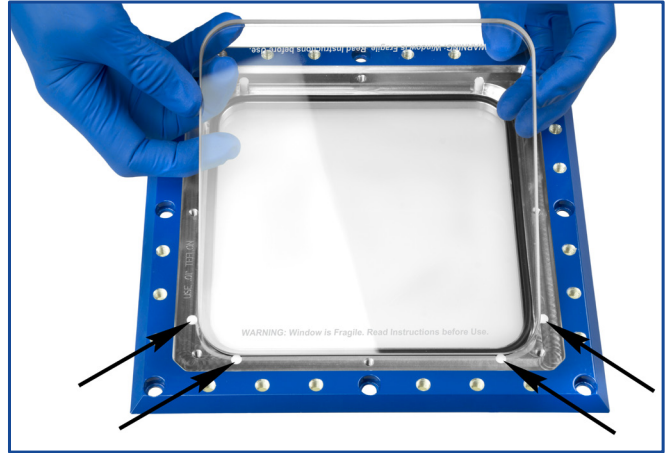


Figure 10 - Place the window pane

3. Place the Teflon spacer gasket onto the window pane. The corners should line up with the window pane corners.

Note: Some window assemblies do not use or require a Teflon gasket. If the assembly does not have a Teflon gasket, proceed to step 4 below.

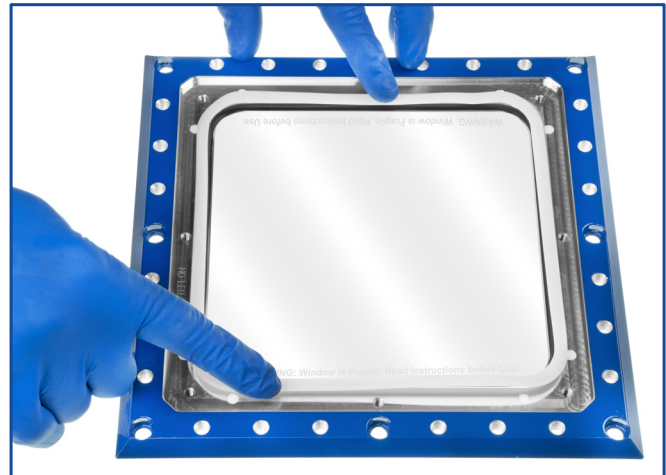


Figure 11 - Place the Teflon gasket

4. Fit the four aluminum window hold-down pieces onto the window and Teflon gasket. Notice that each hold-down piece fits under one side and overlaps the other side of the next hold-down piece.

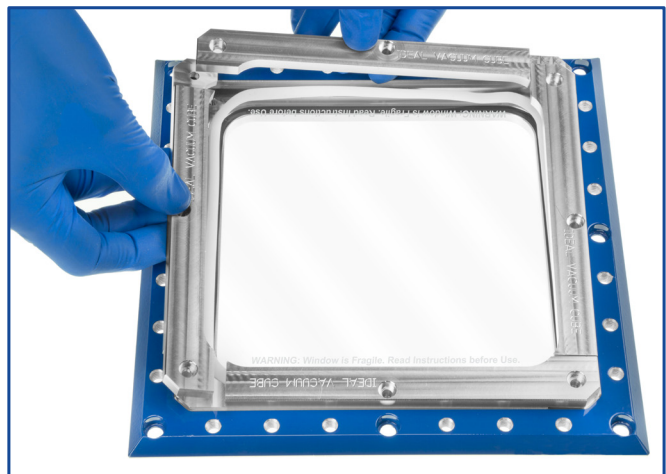


Figure 12 - Fit the (4) window hold-down pieces

2.4 SECURING THE VIEWING WINDOW

The bolt tightening procedure is similar for all sizes of the Viewing Window Assembly:

1. Replace the 8-32 x 3/8" bolts in each of the window hold-down bolt holes.
2. Begin to tighten one center bolt. Then, tighten the bolt opposite from it (similar to tightening the lug nuts on a car).
3. Use the tightening pattern shown in Figure 13, 14 or 15, corresponding to your viewing window assembly size.

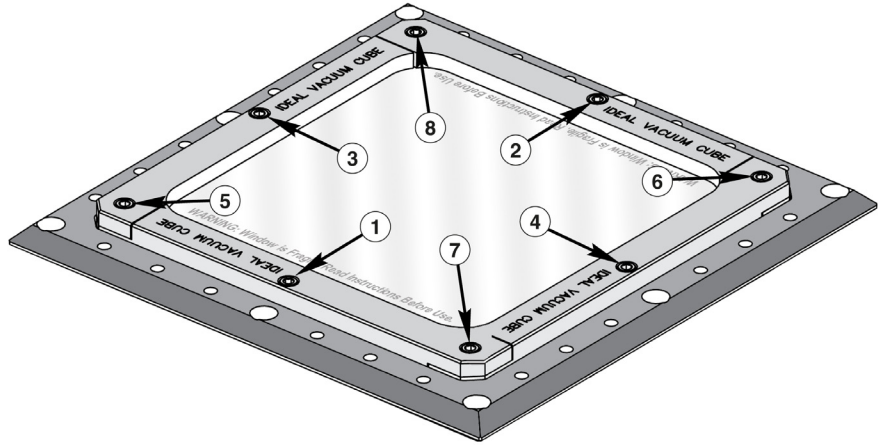


Figure 13 - 9x9 and 12x12 bolt tightening pattern

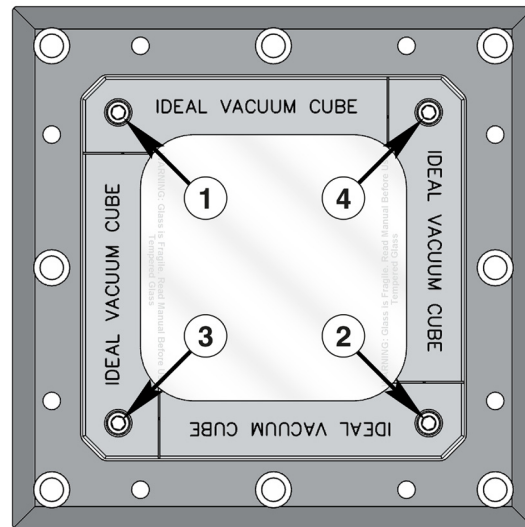


Figure 14 - 6x6 bolt tightening pattern

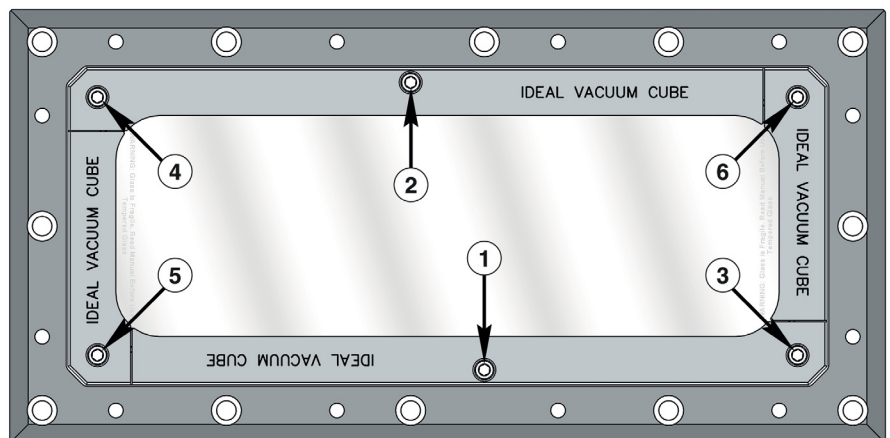


Figure 15 - 6x12 bolt tightening pattern

4. Use the 9/64" hex wrench to begin tightening the hold-down bolts (Figure 16).

5. Tighten bolts gradually (about a 1/2 turn at a time) and take several "passes" around the window until all bolts are snug .

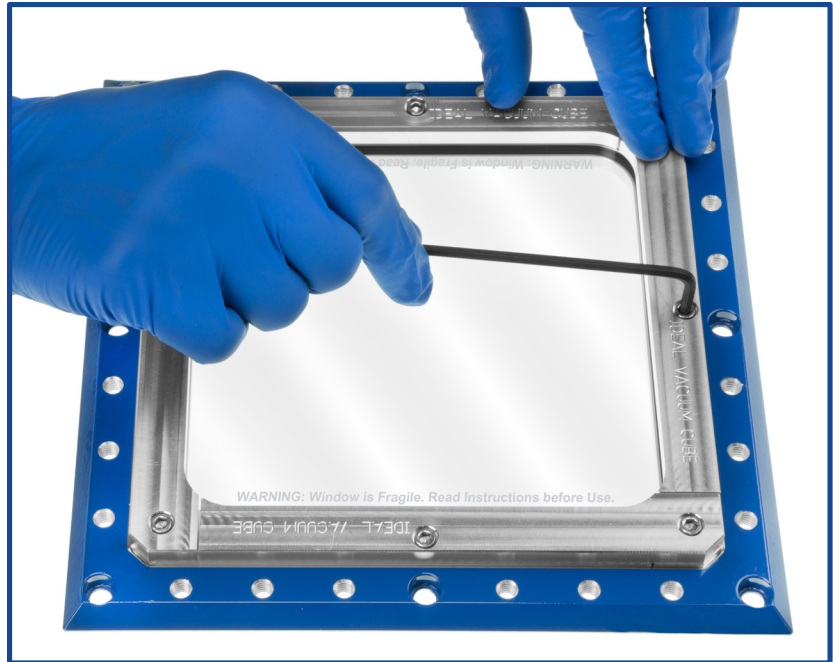


Figure 16 - Tighten bolts until snug

6. Finish tightening the bolts using a torque wrench set to **20 in-lb.** (maximum), as shown in Figure 17.

7. Continue around the pattern until all bolts have been properly torqued:

Reassembly is complete. Follow the instructions in the [IVP Cube Plate Installation Manual](#) for specific instructions and bolt torque specifications for mounting the Viewing Window Plate Assembly onto the Cube frame.

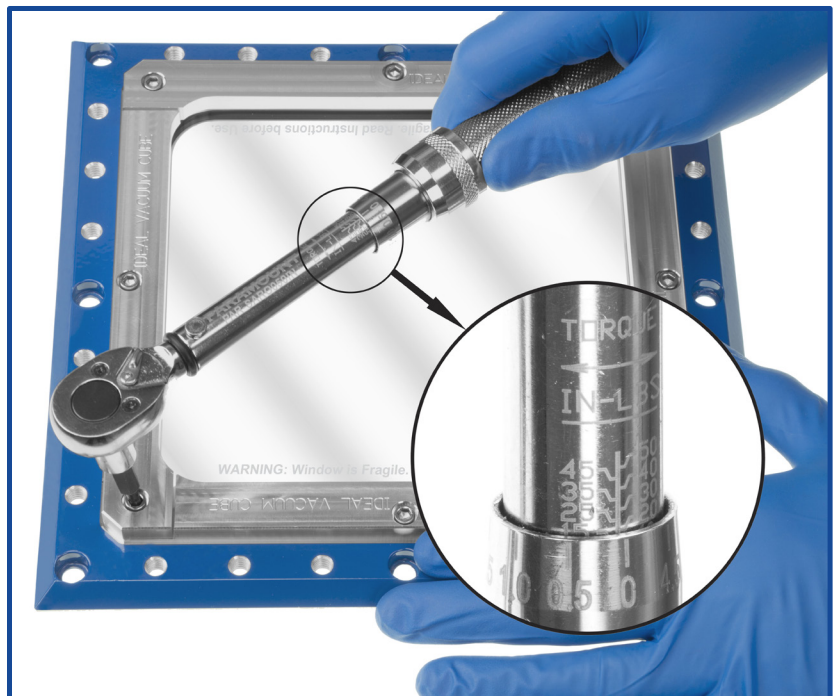


Figure 17 - Torque bolts to 20 in-lb.

2.5 FACTORY ASSISTANCE

Please contact the Ideal Customer Support Team to assist you with any issue regarding the Viewing Window Plate Assembly. We are here to help.

[Customer Service](#) and [Technical Support](#) is available weekdays, from 8am-5pm, MST.



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