

# INSTALLATION, OPERATION & MAINTENANCE MANUAL

## FLAT GLASS GAUGES

SERIES S, ST, WT



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# Warranty

Ernst Flow Industries™ a Clark-Reliance® Company warrants its manufactured goods as being free from defects in material and workmanship for one (1) year from the date of shipment. If any of the goods are found by the seller to be defective, such goods will be replaced or repaired at the seller's cost. Refer to the standard Terms and Conditions for full warranty details.

## About this Manual

The following symbols will be found throughout this manual:



**WARNING:** Potential hazard or cause for injury exists.



**CAUTION:** Potential damage to or failure of equipment exists.

This manual is designed to aid and guide in the installation, operation and maintenance of Ernst Flow Industries™ equipment. Authorized personnel must read and understand all instructions before attempting to install, operate or maintain this equipment. Only persons certified to perform work described herein should attempt any actions suggested. Safety precautions and company safety standards should be observed at all times when performing the activities described in this manual.

# Introduction

Ernst Flow Industries™ promises to continue our time honored tradition of furnishing quality products that fulfill your every requirement and do so with the highest emphasis placed on commitment to service, satisfaction and support, as we realize that you, our customer, are our greatest asset.

Ernst Flow Industries™ liquid level gauges are used to allow direct visualization of liquid level in vessels. By peering through the glass, it is possible to monitor color, clarity and level of a fluid. The gauges are available in varying lengths. Visual indication can be enhanced by using reflex glass or illuminators (accessory).

## Flat Glass Gauges (Armored Gauges)

Ernst Flow Industries™ Flat Glass Gauges are simple, rugged instruments engineered to provide accurate liquid level readings for the life of the vessel they are installed on. They are available in a complete range of models for applications ranging from pure water to highly corrosive chemicals and from cryogenic fluids to superheated steam.

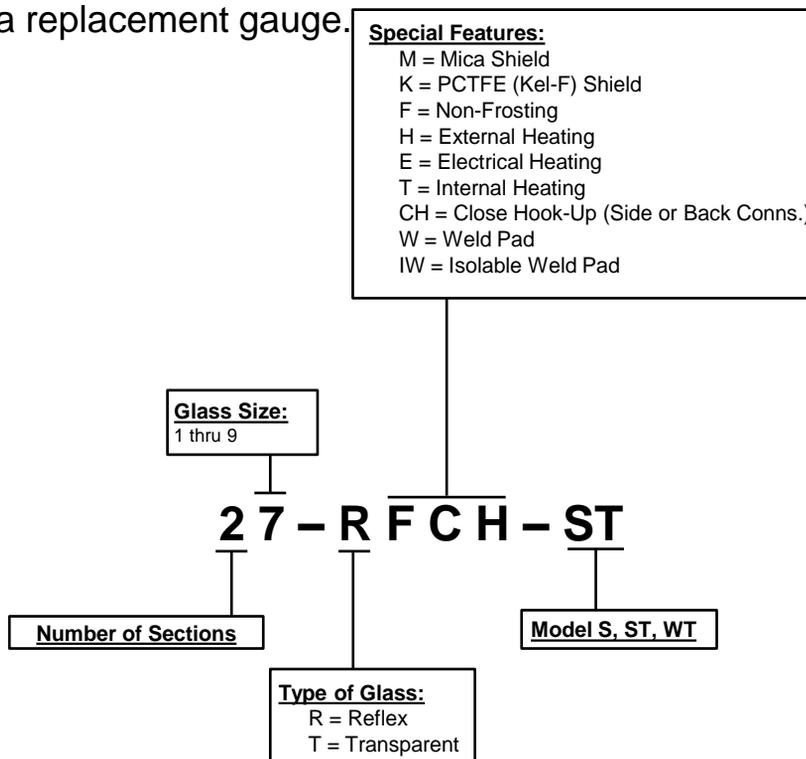
Like any instruments, Ernst Flow Industries™ Flat Glass Gauges must be installed, operated and maintained with reasonable care and due regard for the applications and environment if they are to provide accurate readings for their service lifetimes.

# Inspection and Delivery

Upon receiving an armored level gauge, check all components carefully for damage incurred during shipping. Sign for the shipment noting “damaged” and immediately notify the shipping firm of any such damage and request damage inspection.



Every Ernst Flow Industries™ Flat Glass Level Gauge includes an instrument tag. This tag contains important information used in ordering replacement parts or a replacement gauge.



Confirm that the gauge model number and pressure / temperature ratings, as indicated on the gauge rating tag, meet the application specifications. Also confirm that the gauge material is compatible with both the process fluid and the surrounding atmosphere in the application before installing.

# Installation

Before installing the gauge, consider the following:

- To avoid imposing piping strains on the gauge chamber, connect and mount the gauge so that it does not support the piping.
- Differential thermal expansion between the vessel and gauge can impose severe mechanical loads on the gauge, especially if the vessel contains hot or cryogenic liquid. To prevent these unwanted loads, install an expansion loop between the gauge and vessel or use a reasonably long run of piping.
- Support brackets should be considered for gauges over four feet in length or over 150 pounds (68kf) in weight, especially when the gauge is exposed to vibration. Support brackets will prevent overloading the connecting valves and piping and prevent damage to the gauge from excessive vibration.
- Always provide shutoff valves between the gauge and vessel. Ernst Flow Industries™ automatic safety ball check valves are recommended to help provide protection against physical injury and loss of product in the event of gasket or glass failure as well as providing a means to isolate the gauge for maintenance.
- Correct bolt torque is vital in ensuring the proper operation of the gauge. Because the gaskets relax over a period of time, bolt torque should be checked before the gauge is installed and again after the first few hours of operation. See [Bringing Gauge Into Service](#) for more details.
  - For gauges in high temperature service, see [Hot Torque of Glass Gauge](#).



**Warning:** Gauges should always be isolated from the process fluid system (by closing the upper and lower shutoff valves) and then vented and drained to relieve pressure before doing any torque or maintenance checks.

# Bringing Gauge Into Service

- ALWAYS follow the recommended bolting pattern and torque values when reassembling a gauge after repair (see [Maintenance](#) for more details)
- New gaskets often become permanently compressed after a short time, especially in hot service (see [Hot Torque of Glass Gauge](#) for more details)

## Valve Opening Procedure

1. Partially open top (gas side) valve 1/4 – 1/2 turn.
2. Slowly open bottom (liquid side) valve 1/4 – 1/2 turn.
3. The gauge level should rise to equalize with the tank level. Wait for the gauge level to stop rising before proceeding.
4. Fully open the top and bottom valves.

**Caution:** Failure to properly open ball check valves could result in the seating of the ball checks, thereby blocking the flow of fluid into the gauge and causing an incorrect gauge level reading.



**Warning:** Partially open valves may prevent the ball checks from seating during a gauge failure, potentially resulting in physical injury to personnel and loss of process fluid.

# Hot Torque of Glass Gauge

When a new glass gauge is installed in high temperature service and it is not equipped with spring washers, a hot torque procedure must be performed. This ensures that all bolting and components are properly seated for optimum performance. This procedure must also be performed after any maintenance is done to the equipment.

All work must be done by a qualified technician. All plant rules and procedures must be followed, including any lock out / tag out requirement.

The hot torque procedure shall be performed as follows:

1. The gauge shall be in service long enough for the equipment to reach operating temperature, or at least 200°F (93°C).
2. Upon reaching the desired temperature, isolate the glass gauge from service.
3. Fully open the drain valve to evacuate pressure and process fluid from the gauge.
4. Immediately re-torque the gauge nut to the values stated on page 16. There should be rotation of approximately 1/8<sup>th</sup> of a turn or more. The proper torque pattern is also diagrammed on page 16.
5. If there is no movement in the nut/bolt, the equipment was not heated properly. Repeat the procedure.
6. Once the hot torque procedure is completed, close the drain valve and return the equipment to service. Carefully check for any equipment leaks and verify proper operation of the glass gauge. Follow the procedure in [Bringing Gauge Into Service](#).

# Operation



**Warning:** Rapid opening of isolation valves can cause glass breakage and/or possible injury to personnel. Gauges should be brought into service slowly. Follow the procedure outlined in Bringing Gauge Into Service.

- Always warm up the gauge slowly when it is used with a vessel containing hot fluid (see Special Applications). Crack open the shutoff valves carefully, then wait until the gauge is fully warmed up before opening them all the way. During system shutdown, it is best to leave the shutoff valves open so the gauge can cool and depressurize along with the system (keeping the shutoff valves closed during shutdown can trap high pressure liquid in the gauge).
- For high pressure, high temperature, or hazardous fluid application, the EFI ArmourShield™ protects operators in the event of glass or gasket failure.
- Gauges should be isolated periodically and the bolt torque checked to prevent leaks. This is especially important on gauges used in intermittent operation or varying service conditions (see Special Applications).
- When putting a gauge into service, always check for leaks and be certain the shutoff valves are fully open with all vents and drains closed before leaving the site.



**Warning:** When in service, the safety ball check shutoff valves on a gauge must be fully open. A partially open valve may prevent the ball checks from seating during a gauge failure, potentially resulting in physical injury to personnel and loss of process fluid.

# Cleaning Glass in Steam Service

Proper cleaning and maintenance of flat glass gauges in steam service is vital for enhanced performance and service life. The gauge glass must be kept clean to ensure the visible water level in the chamber accurately represents the water level in the boiler. Note that the frequency and method of blow-down may affect service life and performance of glass level gauges.

A glass gauge on a boiler enables the operator to visually observe and verify the actual water level in the boiler. However, if not properly cleaned and maintained, a glass gauge can appear to show a normal water level when the boiler may actually be operating in a “low” or “low-low” water condition. A stain or coating can develop on the inside of the glass where it is in contact with boiling water. After time, this stain gives the appearance of water in the boiler, especially when the glass gauge is completely full or empty.

Also, the connection lines to the glass gauge can become clogged with sediment, causing an apparent normal water level when the boiler water may be low. After performing the blow-down procedure, if the water level does not return to the normal level promptly, the connecting piping may be partially clogged and require cleaning.

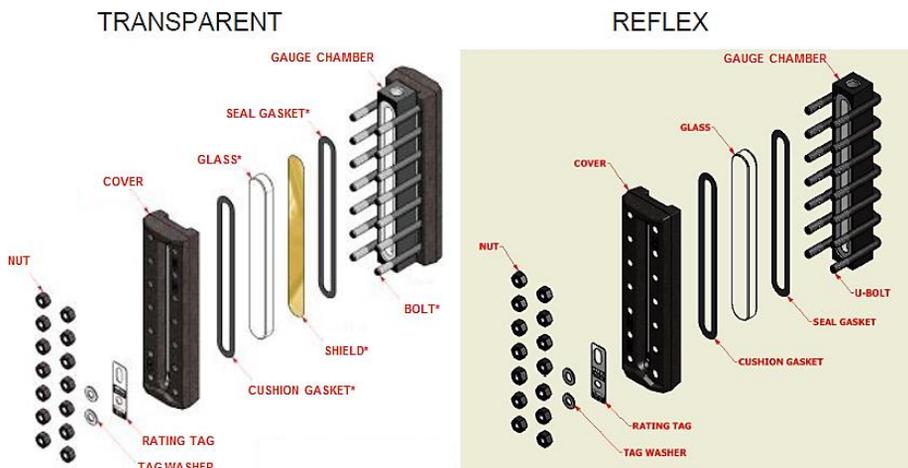
Ernst Flow Industries™ recommends the following blow-down procedure:

1. Close both the (top) steam and (bottom) water valves between the boiler drum and the gauge.
2. Open the drain valve fully on the bottom of the gauge.
3. Slightly open the water valve to clean the pipe and valve of any blockage or sediment. Once clear, close the water valve.
4. Slightly open the steam valve and allow a **gentle** rush of steam to pass through the gauge. **The steam should not pass through for longer than 20 seconds.**
5. Close the steam valve.
6. Inspect the gauge to ensure that all foreign matter is flushed from the glass or mica.
7. If the gauge is not visually clean, repeat steps 3 and 4.
8. Close the drain valve, open the steam valve 1/4 – 1/2 turn, then open the water valve 1/4 – 1/2 turn, slowly bringing the equipment back to its normal operating level. Once the level has equalized, fully open both valves. See Bringing Gauge Into Service for further instructions.
9. When bringing the gauge into service, liquid should quickly enter the glass gauge. This indicates that the lines are free of sludge, sediment or scale buildup.

Blow-down should be conducted on a routine basis, or as necessary based on water quality. Conducting blow-down more often than required to keep glass clean can lead to premature mica and glass wear, and eventually leakage or glass failure.

## Maintenance

- **Inspecting Glass:** Inspect the glass regularly for any signs of clouding or scratching. In new processes, the gauge glass should be inspected routinely until the need for replacement becomes apparent. To examine the glass from scratches, shine a very bright, concentrated light at about 45° angle. Anything that glistens brightly should be looked at closely. Any scratch that glistens and catches a fingernail and/or any star-shaped or crescent-shaped mark that glistens is reason for replacement. An inner (chemical) glass surface that appears cloudy or roughened and can't be cleaned has likely been chemically attacked and should be replaced.
- **Cleaning Glass:** Glass gauges may be taken out of service and the glass cleaned through a top-mounted offset pattern valve. Keep glasses clean using commercial glass cleaners. Where regular cleaners do not work, use dilute acids such as hydrochloric (muriatic) acid. Carefully observe safety rules when handling these chemicals. Cleaning should be done without removing the glass. This may require circulating the cleaner if the process side of the glass is not accessible. Never use harsh abrasives, wire brushes, metal scrapers, etc. that could scratch the glass. DO NOT attempt to clean any glass while the gauge is in service.
- **Receiving / Storing Glass:** Upon receiving glass, inspect the container and glass for shipping damage. When inspecting glass, unwrap and rewrap carefully. Avoid contact of the polished faces with any object (including table tops). Keep the glass in its original box until ready to use. Take care not to bend mica when handling, and avoid touching the face of the mica shield. Store it with the glass in the original box to protect against accidental breakage.
- **Disassembly:** Prior to disassembly, be sure the gauge is depressurized and at ambient temperature. Failure to do so may result in a sudden release of pressure and/or glass breakage. Loosen the end nuts/bolts first, working from opposite ends toward the center.
- **Reassembly:** The cutaways below show the construction of Reflex and Transparent glass gauges.



Ernst Flow Industries™ gauges use molded borosilicate glass, tempered to increase bending resistance. The glass has a low coefficient of expansion, is more resistant to thermal shock than other glass and is much stronger in compression than in tension. However, as with any glass, care shall still be taken to avoid imposing any bending, local stresses, or direct glass to metal contact.

The following points should be observed to maximize gauge life:

- Ensure that you have the proper gauge glass for your application. Check the data sheet for process specifications if unsure of the process temperature and pressure.  
**Note:** For applications over 600°F (315°C), aluminosilicate glass shall be used.
- The glass, gaskets and cushions shall always be replaced during maintenance, even if they appear to be in perfect condition. Gaskets and cushions relax and can harden over time while defects in glass (i.e., chips or scratches) become points of high stress concentration. Even with no visible defects, a used glass has surface stresses induced from the original assembly and pressurization of the gauge. If reassembled, the gaskets and mating surfaces will apply new stresses, which are likely to break the glass either during assembly or when the gauge is pressurized. Therefore, new glass is always required.
- The glass shall not come in contact with any metal surfaces. In service, temperature differences at points of contact will set up high stress loads and may break the glass.

# Repairing a Flat Glass Gauge

1. Set the gauge on a flat, clean surface.
2. Loosen the end bolts first, then work towards the center, alternating top to bottom and following the sequence for tightening in reverse (see Figure C on page 16 for sequence).

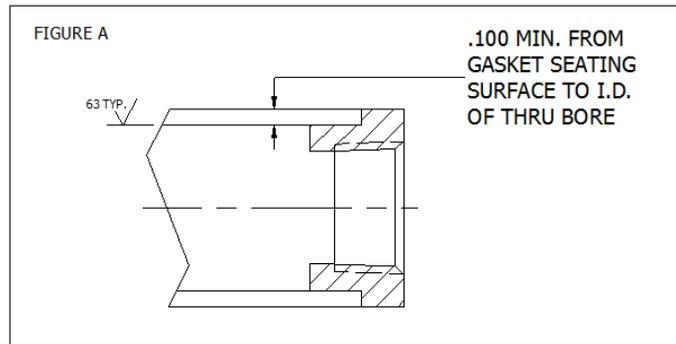


3. Remove the cover.
4. Remove the glass, gaskets, cushions, and shields (if included) from the assembly, and discard. Use a brass scraper (shown below) or other soft tool to remove any seal or cushion gasket remnants. Take care not to gouge or dent the gasket surfaces. **Promptly dispose of all used components.** (Contact Ernst Flow Industries™ to purchase brass scraper.)



5. Thoroughly inspect all chamber gasket surface seating areas. Removing any pitting damage, steam cuts, gouges or scars on a milling machine. Gasket surface flatness must be maintained within 0.002" (0.05mm). The minimum material thickness dimension shown in Figure A (page 14) shall also be maintained.

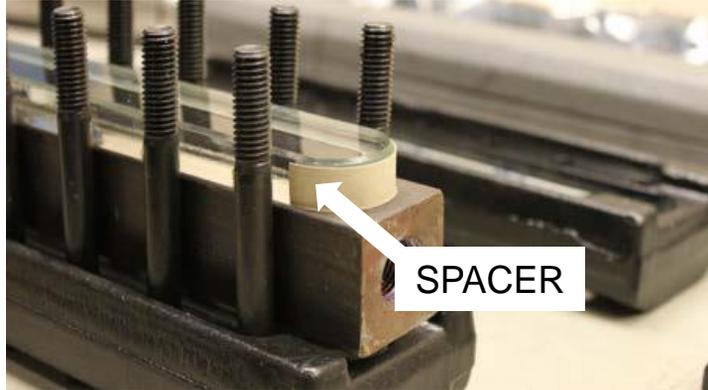
On most Ernst Flow Industries™ level gauges, one or two skim cuts can be made to clean up the chamber seating surfaces while maintaining the dimension below. Welding or sandblasting the seating surface of the chamber in order to repair damage is not recommended



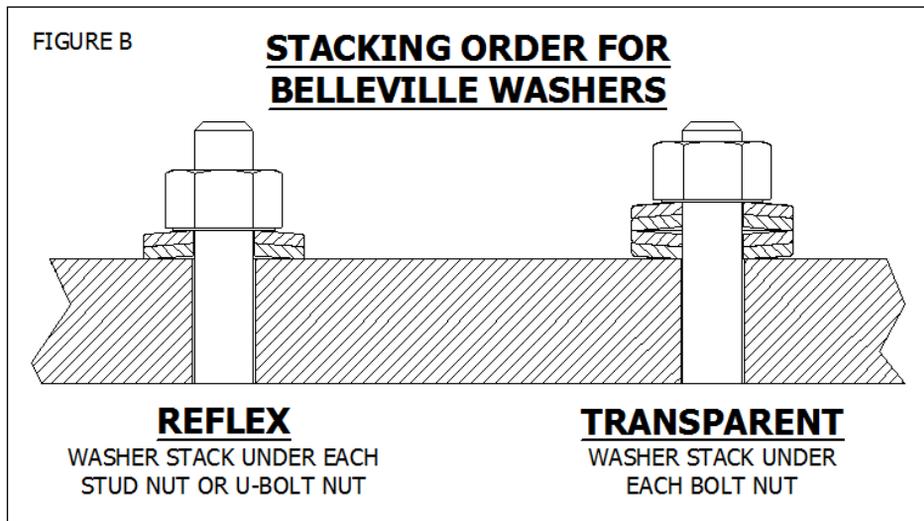
6. Repeat the process for the cover cushion gasket surface.
7. Inspect the bolt and nut threads. If the nut doesn't spin freely down the length of the bolt threads, then the nut and/or bolt should be discarded. If the nuts and bolts show signs of excessive corrosion, they should be discarded.
8. Place the seal gasket in the chamber seat and the cushion gasket in the cover seat. Do NOT lubricate the gasket or cushion (place the mica shield on the chamber gasket, if applicable). For PCTFE shields, see [Special Applications](#) on page 17.



9. Locate the glass centrally in the chamber seat and cover to avoid glass-to-metal contact at the ends or sides. Using cardboard from the glass kit box, cut strips to use as spacers to locate the new glass in place on top of the gasket and mica in the chamber. Remove the cardboard once the glass is located properly (this is best done with the gauge lying flat on a bench).



10. Apply Molykote® or a similar molybdenum disulfide lubricant to bolt threads and nut seating surface. If the gauge has spring washers, reference Figure B (below) for proper orientation of the washer stacks.



- Tighten the nuts finger-tight, working from the middle set, alternating outward (see Figure C below). Next, tighten with a torque wrench in the same sequence in 5 ft-lb. (6.7 N-m) increments until the final torque value is achieved (see Figure D below). With the torque wrench still set at the final value, make one final pass moving from left to right to confirm final torque value on all nuts. Moving from left to right will eliminate any cross talk that may have occurred between bolt sets.



**Warning:** Moving in this sequence shall only be done after achieving factory torque value in Figure D below. Failure to achieve final torque using any sequence other than as described in Figure C (below) may result in glass breakage at time of assembly or at pressurization.

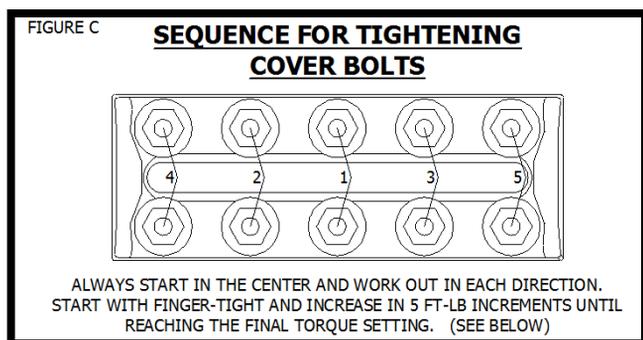


Figure D

**PROCESS GAUGES TORQUE DATA  
REFLEX AND TRANSPARENT GAUGES**

<u>GAUGE SERIES</u>	<u>FINAL TORQUE</u>
S, ST	32 FT.-LBS. 43 N-m
WT	40 FT.-LBS. 40 N-m

**TORQUE VALUES ARE THE SAME  
FOR ALL GASKET MATERIALS**

- Note: Gauges should be re-torqued prior to being put into service. Additionally, new gaskets can become permanently compressed after a short time in service (especially if the gauge operates hot). This causes slight leaks or apparent loosening of bolts. (If the gauge is installed in high temperature service and it is not equipped with spring washers, a hot torque procedure must be performed.)
- All reassembled gauges should be hydrotested for a minimum of five minutes before returning the gauge to service. Recommended hydrotest pressure is one and half (1.5x) times the gauge rating as seen on the tag.

# Special Applications

- Spring Washers for Temperature Extremes: To avoid re-torquing the cover nuts/bolts in exceptionally hot or cold applications, Belleville spring washers can be used under the nut or bolt heads to maintain gasket loading. It is best to return the gauge to a factory authorized repair center to add spring washers since they must be assembled in the proper orientation and, in most cases, longer bolting is required.
- Shields for Protection from Chemical Attack: Transparent gauge glasses used with fluids corrosive to glass require the protection of PCTFE (formerly Kel-F®) or mica shields (shields can't be used with Reflex type glass gauges). Mica shields are installed between the glass and the gasket on the process side. PCTFE shields are to be installed as follows:
  1. Install the PCTFE shield in the gauge between the chamber and glass (the PCTFE shield acts as both a gasket and a shield – no separate sealing gasket is required).
  2. Reassemble the gauge to the required torque value in the proper sequence (new glass and cushion gaskets are required – see Repairing a Flat Glass Gauge for more details).
  3. Let the gauge sit for 10-12 hours.
  4. Re-torque to the original torque value in the proper sequence.
  5. Repeat steps 3 to 4 if needed to prevent leakage.
- Vacuum Service: All glass gauges are suitable for use in vacuum service, provided the gauge assembly does not include a PCTFE shield. See valve IOM for provisions for vacuum service with valves.
- High / Low Temperature Service: To prevent thermal gradients from stress-loading the glass or possibly relaxing the gasket clamping load and causing leaks, uniformly insulate the gauge to help ensure that all components remain at the same temperature.
- Operation in Low Temperature Service: To prevent thermal shock, bring the gauge into service slowly. Crack open the shutoff valves carefully, then wait until the gauge has cooled down before opening fully. Do not isolate the gauge when cold. The fluid within will warm up, internal pressure will increase and the glass may break. Either let the gauge warm up with the system after shutdown or, if it must be isolated from the vessel, vent it to atmosphere.



- Non-Frost Extensions for Low Temperature Service: Non-frost extensions may be installed on Series S, ST, WT gauges as shown in the image at left. Install each extension by stretching the springs and attaching the hooks (4 per extension) around the bolts on the underside of the cover. In effect, the extensions raise the glass viewing surfaces far enough away from the gauge so as to prevent them from frosting over and rendering the gauge useless.

**Reflex Gauge**  
(Model EFI S with non-frost extension)

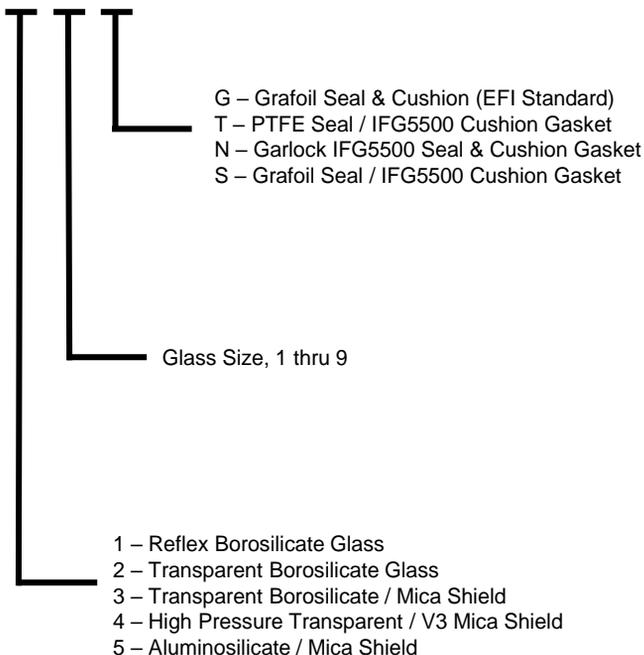
## Recommended Spare Parts

Part	Commissioning	Two Year
Glass	5%	10%
Shields (if used)	5%	10%
Gaskets	5%	10%
Cushions	5%	10%

# Replacement Glass / Gasket Kits

Use the chart below to determine the Ernst Flow Industries™ glass and gasket replacement kit that is right for your service. Contact Ernst Flow Industries™ for assistance.

**ERK -**



Example: For EFI S1105J  
Replacement: ERK-1-6-G

## Additional Information

For information about valves and accessories, contact Ernst Flow Industries™.



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