BOILER INSPECTION GUIDELINES FOR
DRUM LEVEL INSTRUMENTATION

Per Section I of the ASME Code

Includes the 2013 Code Changes and Updates
with Recommendations from Section 7
Effective January 1, 2014
ASME SECTION I WATER GAGE REQUIREMENTS

UNDER 400 PSIG
At Least 1 Direct Reading Gage Glass
Must be "In-Service" at all times

400 PSIG and ABOVE
2 Direct Reading Gage Glasses
OR
1 Direct Reading Gage Glass and
2 Indirect (Remote) Level Indicators

Note: When the gage glass is not continuously visible to the operator, two Remote (Indirect) Reading Gages are used to meet Section I requirements, the Direct Reading Gage Glass may be valved-off (only when operating above 400 PSI), but must be maintained in serviceable condition. The two Remote Level Indicators must operate independently and be continuously displayed.
WATER COLUMNS
- 1” NPS minimum vessel connections
- ¾” NPS minimum drain connection
  - The steam connection may come out of the top of the vessel (See Connection # 4 on Figure 1)
  - The line for the steam connection from the vessel to the water column should be level or slope downward from the drum to the water column (#3)
  - The line for the water connection from the vessel to the water column should be level or upward from the vessel to the water column (#2)
- Water columns are defined as “Standard Pressure Parts” or Standard Welded Parts” in Subsection PG-11. Therefore, a Manufacturers Data report or Code Stamp is not required.
- Water columns are not permitted to be constructed from austenitic stainless steel

WATER GAGE VALVES
- ½” NPS (Min.) connection to the water column
- The Shutoff valves between the drum and the water column must be OS&Y, of through-flow design and orientation.
- Install chain operators for operating from the floor or platform for safe means of operation
- Must show position as open or closed, and have lock open capabilities
- Valves must have an unrestricted ¼” drain opening

GAGE GLASS
- Upper visibility to be no higher than lower edge of the steam connection to the drum (#6)
- Lower visibility to be no lower than the upper edge of the water connection to the drum (#5)
- The lowest visible part of the gage glass (#1) must be at least 2” above the lowest permissible water level (Level A)
- Transparent or tubular glass gage glasses that rely on observing the steam-water interface and have multiple sections, must have a minimum of 1” overlap of the visible portions.
- Internal lateral structural supports (webs) in a transparent gage glass that obstruct the viewing of the level are prohibited.
- Ported type water gage glasses must be fitted with proper illumination to provide visual discrimination between water and steam.

Gage Cocks (Try Cocks)
- Not required (Since 1991)
- If used, must be minimum ½” NPS to the water column.
**REMOTE LEVEL INDICATOR**
- ¾” NPS minimum vessel connections
- When used as a water column, the vessel connections must be 1” NPS minimum.
- ½” NPS minimum drain connection
- When used as a water column, the drain connection must be ¾” NPS minimum.
- When the two remote level indicators are used at 400 PSIG and above, the remaining gage glass may be shut off, but must be maintained in the serviceable condition.
- The display of the two indirect indicators must be continuously visible in the operators control area.
- Conductivity Probe Level Indication Systems meet Section I requirements for Indirect (Remote) Level Indicators. See Figure 2.

**MAGNETIC WATER LEVEL GAGE**
- Considered an Indirect level indicator because the actual water line can not be viewed
- Does *not* replace the Code required direct reading gage glass
- Limited use to 900 PSI
- Switches or accessories for control purposes are prohibited
- Can not be used as a water column for the attachment of water gage glasses or other Code required instruments.
- Indication scale must comply to PG-60 requirements regarding gage glass placement limitations for the viewing range
- ¾” NPS minimum vessel connections
- Can be fitted with a 4-20 mA transmitter for remote indication.
- Material of construction may include certain types of stainless steel (refer to PG-12.3)
- ½” NPS minimum drain connections

Figure 2
WATER COLUMN ISOLATION SHUTOFF VALVES

• Y-pattern globe valves are permissible, as long as the lowest edge of the seat is at least 25% of the inside diameter below the centerline of the valve. See Figure 3 below.

![Figure 3](image)

Note: Any isolation valves between the drum and a water column must be locked open on applications operating above 250 PSI

MAXIMUM PRESSURE LIMITS FOR THREADED CONNECTIONS: ¾” to 3” NPS (DN) & PSI (MPa)

<table>
<thead>
<tr>
<th>Size</th>
<th>Pressure Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3” (80)</td>
<td>400 PSI (3)</td>
</tr>
<tr>
<td>1-1/2” (40)</td>
<td>900 PSI (6)</td>
</tr>
<tr>
<td>1-1/4” (32)</td>
<td>1000 PSI (7)</td>
</tr>
<tr>
<td>2” (50)</td>
<td>600 PSI (4)</td>
</tr>
<tr>
<td>1” (25)</td>
<td>1200 PSI (8)</td>
</tr>
</tbody>
</table>

HRSG DESUPERHEATER DRAIN POTS

• Drain pots that are installed to detect and remove unvaporized water shall include automatic detection of water and automatic operation of the drain pot valves. See Figure 4 below.

![Figure 4](image)
COMMON NON-COMPLIANT DRUM LEVEL EQUIPMENT ARRANGEMENTS

☐ Magnetic Gages being used as direct reading gages. Magnetic Gages are permitted as a local indirect gage or as a remote level indicator when used with a 4-20mA transmitter to a control area indicator. A Magnetic Level Gage **cannot** replace the Code required direct reading gage glass.

☐ When the over 400 PSI Code option arrangement is used (two independent indicators for one of the gage glasses), the two indirect indicators must be continuously visible in the operators control area and the gage valves may be isolated. Viewing the boiler level on a plant operation control system computer screen does not qualify as a continuously visible indicator unless it is always on the screen. If keystrokes or mouse clicks are required to view the indirect indicator, it does not meet the Code requirements, as an indirect indicator.

☐ When the **over 400 PSI Code Option Arrangement** is used, the existing gage glasses must be able to be brought into service without further action other than opening the isolation valves, closing the drain valve, and powering on illuminators. Gage glasses that can not be turned on without repairs do not meet ASME Code requirements.

☐ Bi-color ported type water gages must be fitted with proper illumination to provide visual discrimination between water and steam. If not, the gage glass is not in Code compliance.

☐ Not having two independent indirect reading gages when the gage glass image is not directly visible in the operators control area or transmitted to the operators control area, by means of a camera, fiber optic system, or mirrors.
Proper Care Recommendations from Section 7

- Check water level in 2 or more instruments prior to start up and verify and resolve a deviation if observed
- Compare level indication accuracies regularly during operation
- Conduct blow downs of water columns & gage glasses regularly and observe promptness of restored level
- Check Water Gage Glasses to confirm there is no deviation that could be mistaken as water level
- The Water Gage Glass should be maintained perfectly at all times, even if two remote indicators are in use
- Water Gage Glasses should be properly illuminated for easy observation
- It is important to keep the water gage glass clean and easy to read. However, excessive blow down may cause premature wear of the gage internals
- Verification of high and low water alarms is critical to the prevention of water carryover or damage to drum internals
- Verify there are no leaks around the level instrumentation, piping, related isolation valves, or water column. Leaks may affect the accuracy of the indicated level and eliminating any leaks prevents a hazard
- Check external instrumentation piping for any missing insulation
- Risk of damage to equipment by steam cutting may also be prevented with routine inspections of the valves, and external piping, in addition to regular inspection of the water level
- Use Temporary Gage Glass for Boil Out (Chemical cleaning) procedures
- The function of all level instrumentation should be inspected and tested for the authorized boiler inspector during external inspections
- Two independent low water cutoffs are recommended on automatically fired boilers
- Automatic level trips should be set to trip the fuel supply, before the water level reaches the low limit of the gage glass
- Procedures should be in place to prevent false trips, when testing water columns with automatic low water trips
GOOD PRACTICE RECOMMENDATIONS

The following are not required by ASME Code, but are recommended for safe operation:

1. Chain Operators should always be installed to provide a safe means of operating gage glass isolation valves under normal conditions and in the event of glass leakage.

2. A conductivity probe system combined with a 4-20 mA level transmitter, or, two conductivity probe systems provide the best reliability due to the redundancy of probe systems. The use of two or three differential pressure transmitters (redundant devices) is not recommended due to the likelihood of simultaneous common mode failure, due to environmental variations (especially freeze-up) or loss of device sensing leg primes.

3. Trip and alarm points are within the visible range of the gage glass for visual verification.

4. Freeze protection for outdoor applications should be provided to prevent damage to the level instrumentation devices.

5. Transparent water gage glass illumination should be provided to give optimum viewing of the drum level for the operator, especially in low lit areas and when a transparent gage glass is elevated above the viewing platform.

6. Exposed piping to the gage glass or level instrument, especially the upper steam piping, should be insulated to minimize risk and level density error due to excessive cooling and condensate formation.

7. Note: Plant (owner) policies and procedures may exceed Code minimum requirements with the number of level indicating instruments to be installed, which may prevent a violation if any single instrument is out of service for maintenance.
GOOD PRACTICE RECOMMENDATIONS for Inspection, Testing, and Servicing

The following are not required by ASME Code, but are recommended for safe operation:

1. Water Gage Glasses, Water Columns, and Remote Level Indicators:
   a. Visual Inspection and Blow Down should be conducted on routine basis to verify cleanliness for easy reading of the level “ready discrimination” between steam and water. Also, to remove any sediment from collecting in the piping or valves.
   b. Visual inspection of all external instrumentation should be conducted on a monthly basis including piping, isolation valves, drain valves, and lighting accessories.
   c. Annual Servicing of Water Gage glasses is recommended. Follow the OEM instructions. Semi-annual servicing is recommended for severe service applications with poor water quality or high-pressure applications > 1500 PSIG (10 MPa)
   d. When freeze protection is not installed on level instruments, and the equipment is not in service or is isolated, it should be drained and free of water if freezing temperatures are expected in order to prevent damage.

2. Low Water Cutouts:
   a. Testing should be conducted on a daily basis. Actual plant policies may dictate more or less frequency. In any case, the maximum interval should not exceed one week.
   b. Annual servicing of low water cutouts is highly recommended. Disassemble the cutout switch assembly, examine conductivity probes or the float mechanism for contamination or wear. Replace any suspect components. Follow the OEM instructions.
For questions, consult your local Boiler Inspector, Insurance Carrier, or a Reliance Applications Engineer.

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