

## How Do I Know If My Boiler Is Out Of Code?



### Your Host

Chris Modrich  
Vice President  
Lesman Instrument Co  
[chrism@lesman.com](mailto:chrism@lesman.com)



### Featured Speaker

Jim Kolbus  
Senior Product Manager  
Reliance Boiler Trim Products  
Clark-Relaince  
[jkolbus@clark-reliance.com](mailto:jkolbus@clark-reliance.com)

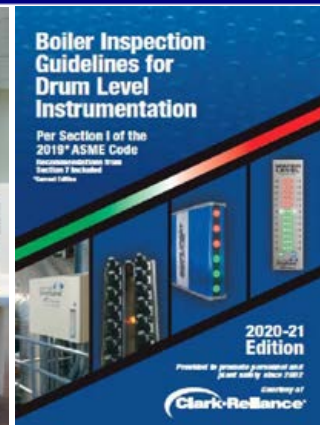


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# Boiler Drum Level Instrumentation with ASME Code Requirements and Recommendations



2021



Anderson Separators® Clark Steam Traps™ Ernst Flow Industries® Enervac™ HYCOA® Jacoby-Tarbox®

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# Topics

- **Water gage glasses & remote level indicators**
- **ASME code (Section I) requirements for water level instruments for steam power boilers operating >15 PSI**
- **Preventing code violations**
- **Isolation & drain valve concerns**
- **CSD-1 requirements for low water cutout devices**
- **Recommended blowdown procedure for level instruments**

# Direct Reading Gage Glasses



**Tubular Glass**

to 250 PSI  
(1.7MPa)



**Prismatic**

(Reflex)  
to 350 PSI  
(2.4 MPa)



**Flat Glass**

(Transparent)  
to 2000 PSI  
(14 MPa)



**Bi-Color**

(Ported)  
to 3000 PSI  
(21 MPa)

# End-to-End Reflex Gage Glasses Are Permitted

**PG-60.1 Clarifies the use of multi-section gages without overlap, due to the light refraction principle**

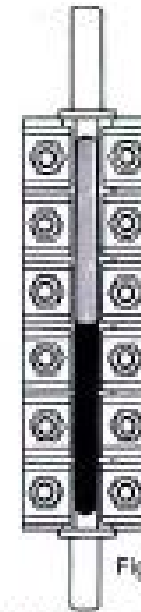
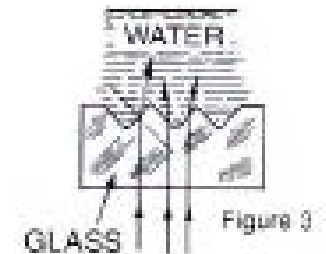
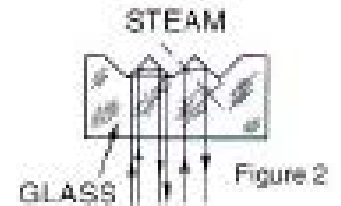


Figure 1

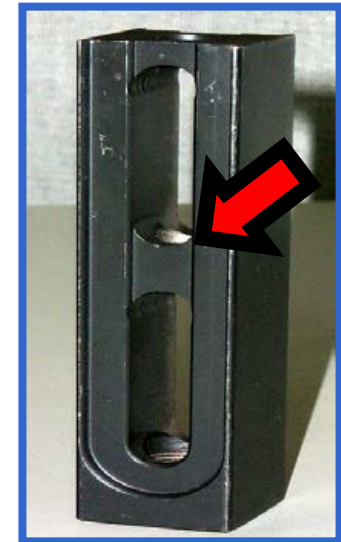
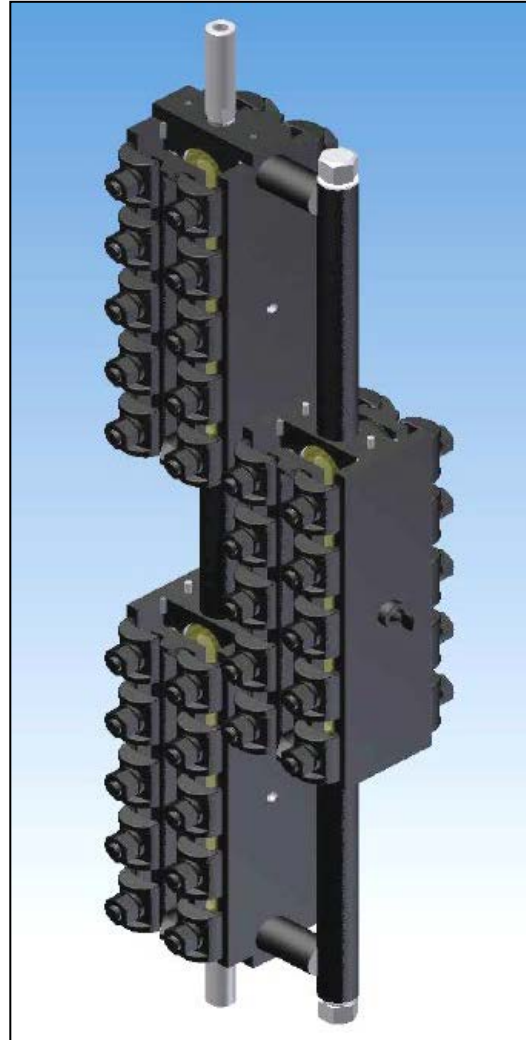
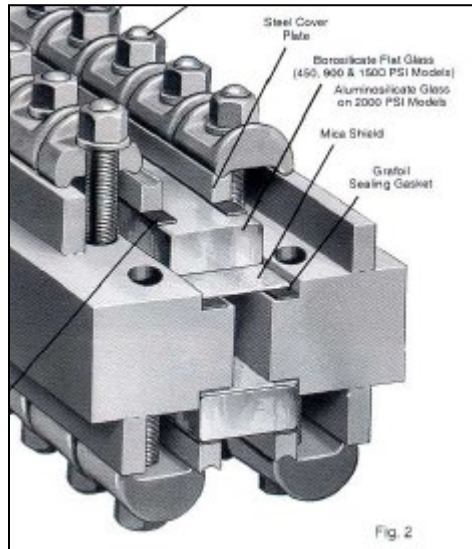
STEAM APPEARS WHITE  
WATER APPEARS BLACK





# Flat Glass Transparent Type Water Gage Glass

**PG-60.1 Transparent Type Multi-section gages require a 1" minimum overlap**

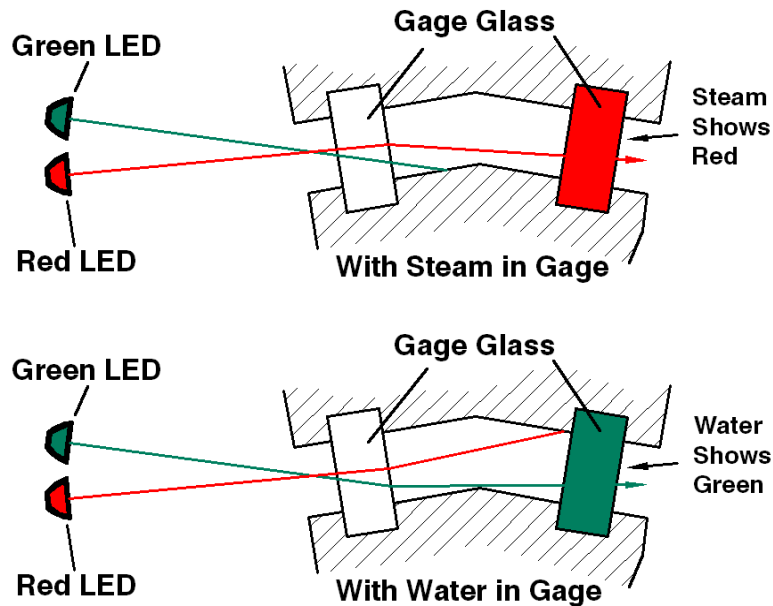


**Webs Not permitted**

# Bi-Color Ported Water Gage Principle of Operation

Water shows **GREEN** - Steam shows **RED**.

Principle of operation: Light refraction



***Bi-Color Gages must be outfitted with an illuminator to be Code Compliant***

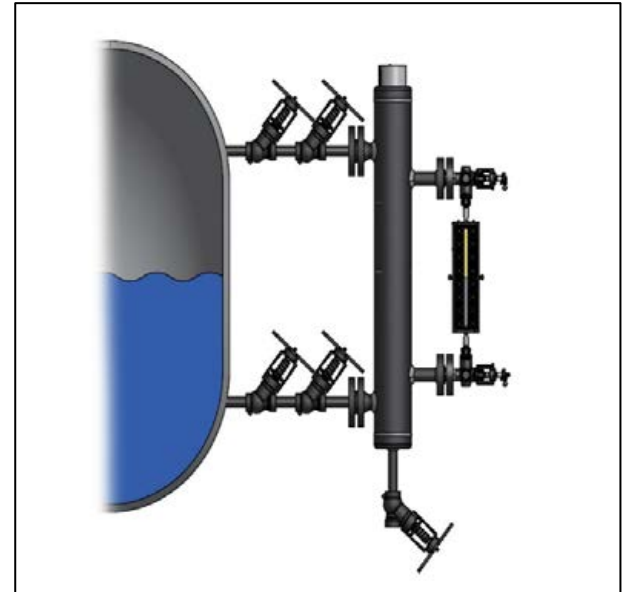
# Water Gage Requirements: (Minimum Code Requirements)

## Boilers rated up to 400 PSIG (3 Mpa) MAWP (\*)

One Direct Reading Gage Required

(Must be kept continuous service)

Note: When the level in the gage glass cannot be seen in the control area, two remote level indicators must be continuously displayed



## Boilers rated over 400 PSIG (3 Mpa) MAWP (\*)

• Two Direct Reading Gages in service in view of the operator

or

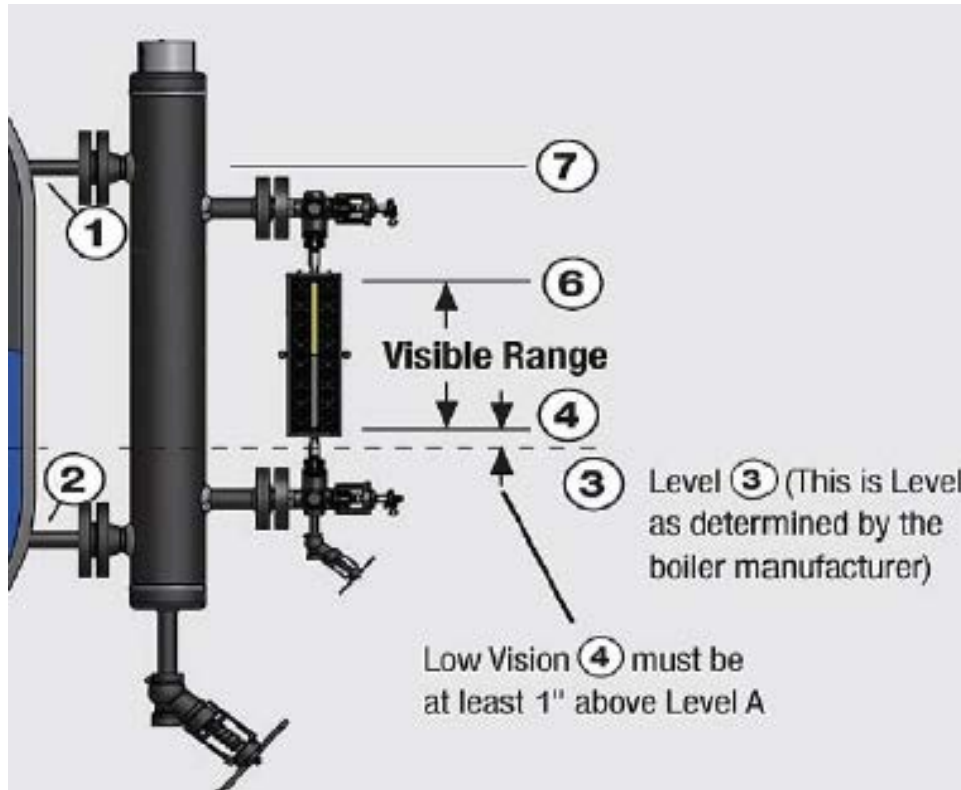
• Two independent Remote Level Indicators on continuous display  
and One Direct Reading Gage (which may be Isolated, but kept in serviceable condition)

MAWP (\*) = Maximum Allowable Working Pressure

Plant requirements may exceed code minimum



# Section I Requirements for Gage Glass Placement on Fire Tube Type Boilers



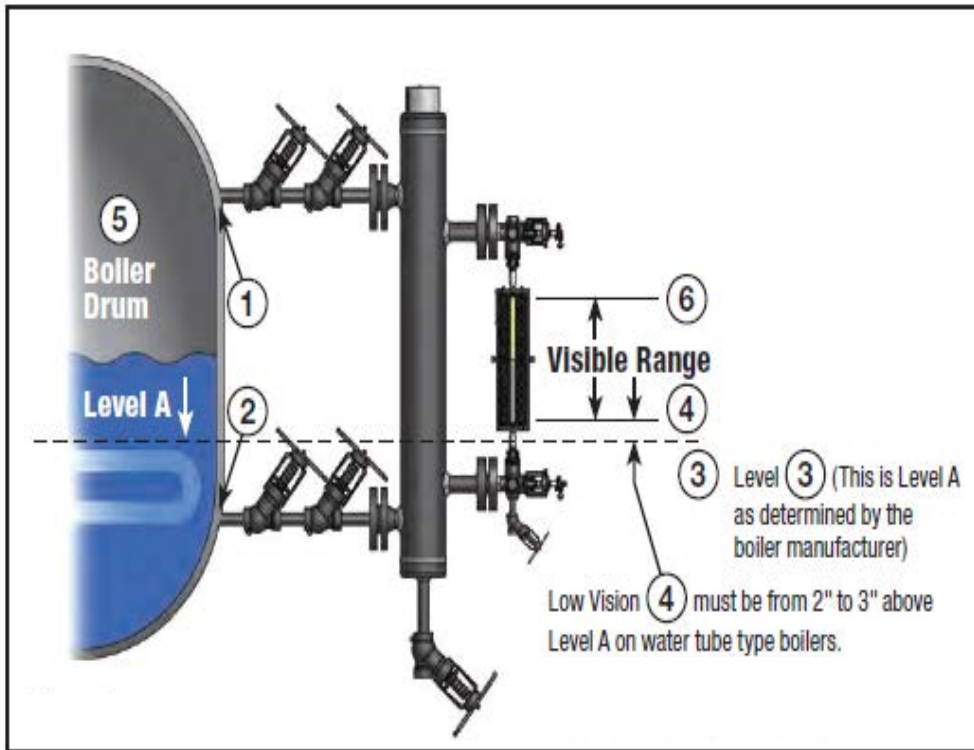
- 1- Lower side steam conn.
- 2- Upper side water conn.
- 3- Level A
- 4- Low vision
- 5- Drum
- 6- High vision
- 7- Steam conn.

**Note:** 4 and 6 must not intersect 1 and 2

**Level "A" = Lowest Permissible Water Level, at which there will be no danger of overheating the boiler**

**Lowest vision = 1 in. on boilers < 16" inside diameter  
3 in. on boilers > 16" diameter**

# Section I Requirements for Gage Glass Placement on Water Tube Type Boilers



- 1- Lower side steam conn.
- 2- Upper side water conn.
- 3- Level A
- 4- Low vision
- 5- Drum
- 6- High vision
- 7- Steam conn.

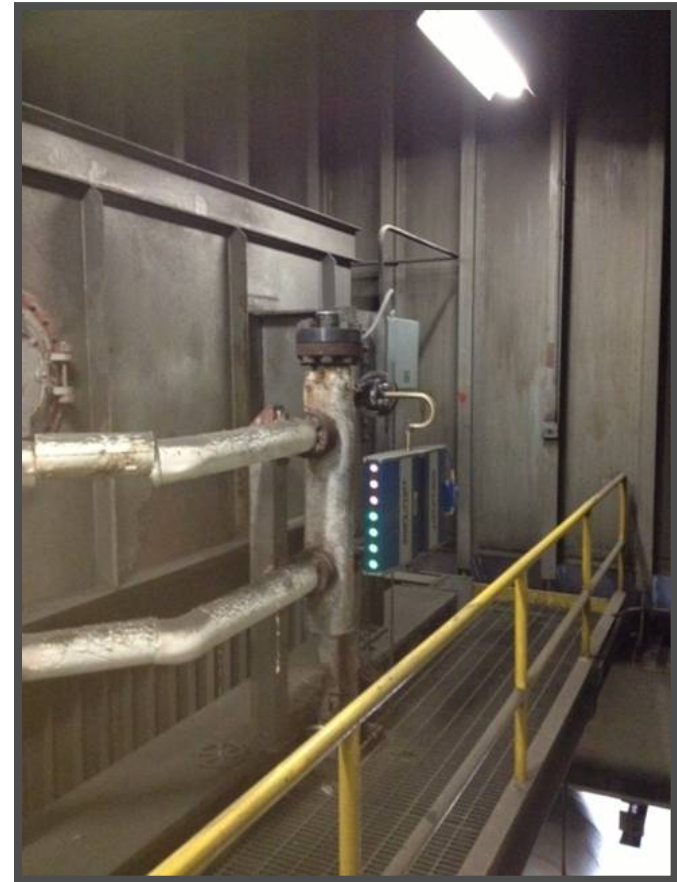
**Note:** 4 and 6 must not intersect 1 and 2

**Level "A" = Lowest Permissible Water Level, at which there will be no danger of overheating the boiler**

# Code Violation and Remedy



**Before**



**After**

# Common Remote (Indirect) Level Indicator Technologies



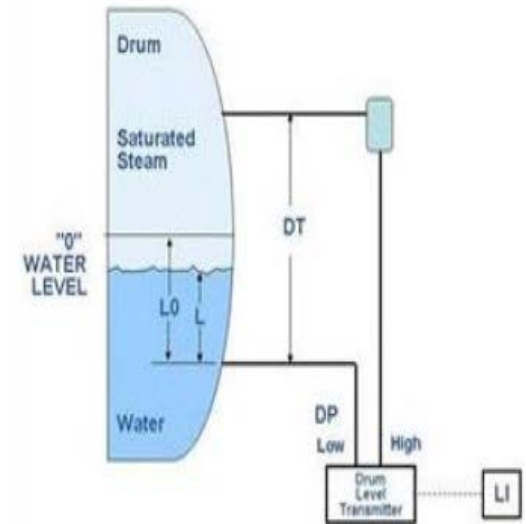
**Conductivity  
Probe**



**Magnetic**

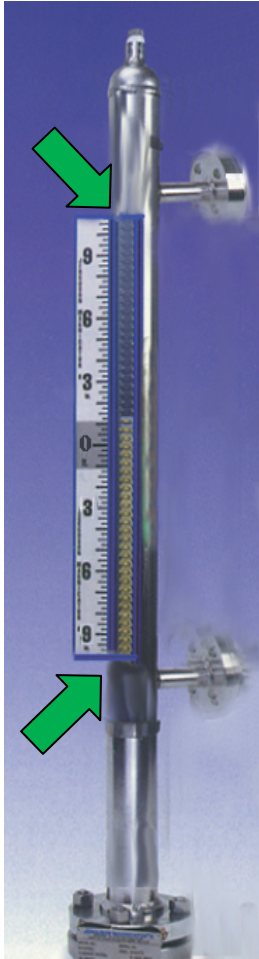


**Guided Wave**



**Differential Pressure**

# Magnetic Water Level Gages



- Code compliant as a remote reading gage for applications up to 900 PSI
- May not be used to support a water gage glass, due to stainless steel construction not permitted for water columns
- No accessories are permitted to be attached for control purposes (no switches). This device must be used for indication only
- Does **NOT** replace the Code required Direct Reading Gage Glass
- The Indication scale must follow the same rules as the gage glass ←

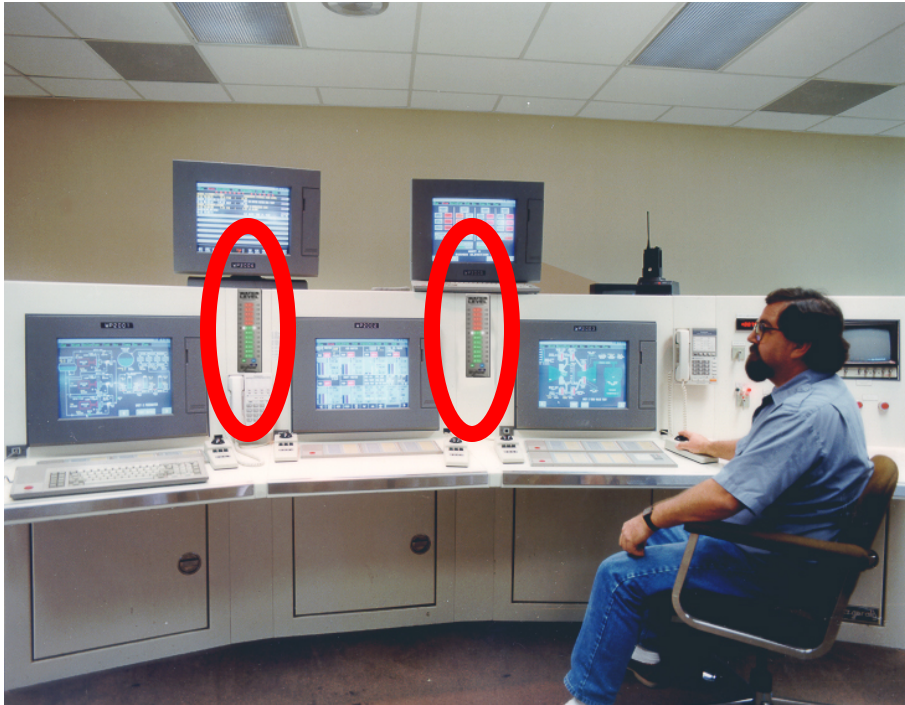


# Indicator Scale Violation and Remedy

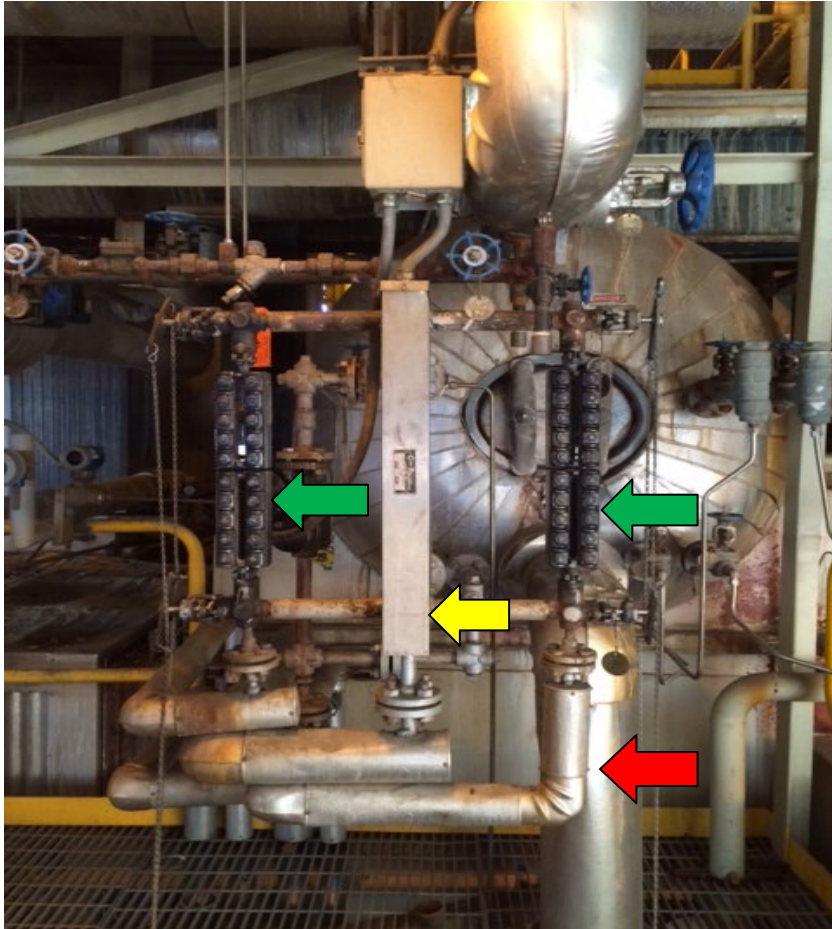








Two remote indicators are required when the gage glass is not visible in the control area



## Example of a Compliant Installation with added instrumentation for back-up



### Comments:

-  2 Gage Glasses (1 required & 2<sup>nd</sup> is a back-up)
-  1 Eye-Hye Remote Level Indicator
-  2 DP Remote Level Transmitters
-  All drain piping is routed to safe location.

Added gages & indicators provide insurance for code compliant operation in the event any single instrument is out of service for maintenance.

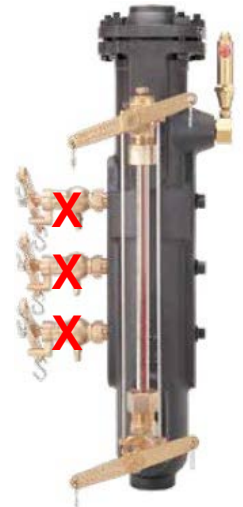
# Minimum Piping Requirements

## Drum to Water Columns & Low Water Cutouts:

- 1" Minimum pipe size on vessel connection piping
- 3/4" Minimum pipe size on water column drain piping

## Note about Gage Cocks (also known as Trycocks):

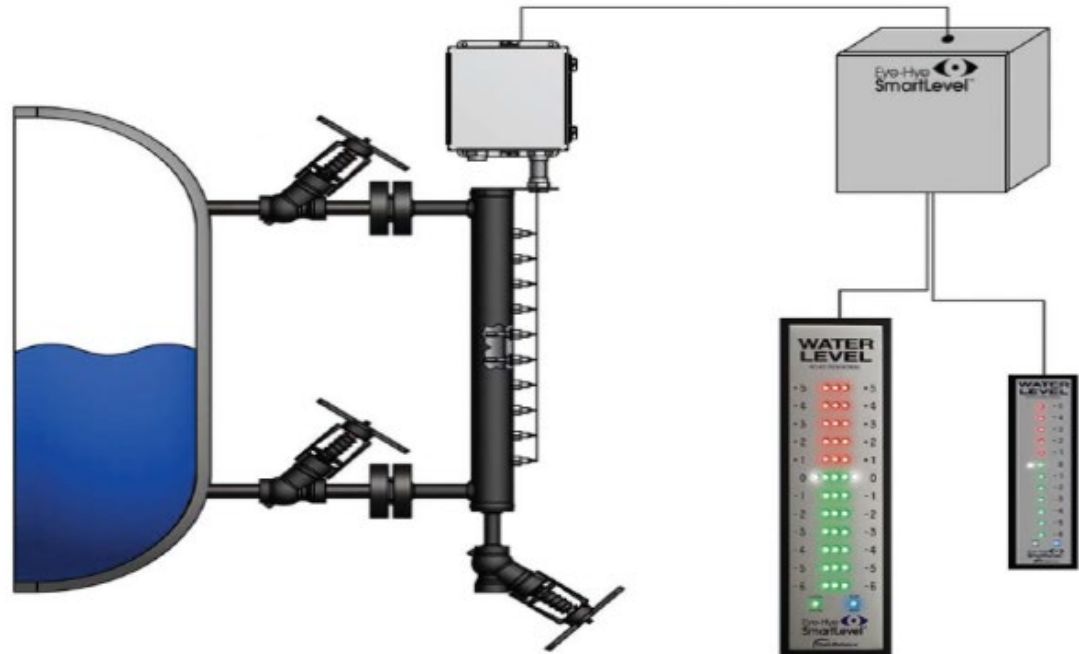
- Gage Cocks have not been required by code since 1991. (Ref: Section I, PG-60.4).
- A gage glass on all boilers operated up to 400 PSI is still required and must always be in service.



# Isolation & Drain Valve Concerns for Gage Glasses, Water Columns, Remote Level Indicators



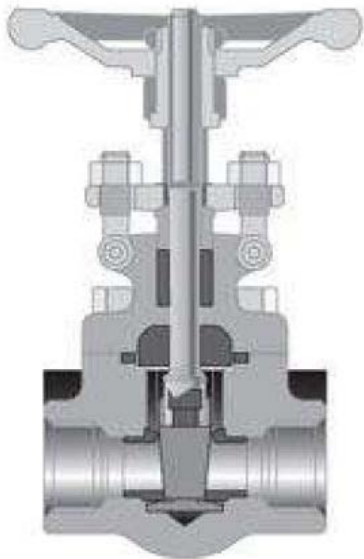
Water Column  
& Gage Glass



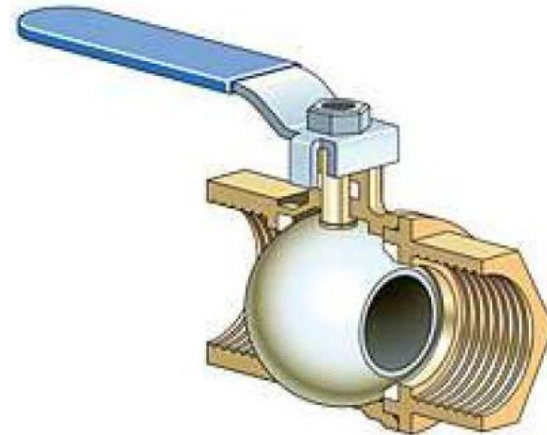
Remote Level Indicator

- Top, bottom, and drain valves must be installed.
- Drain outlet piping must be routed to a safe discharge location.

# Isolation & Drain Valves



**Typical Gate Valve**

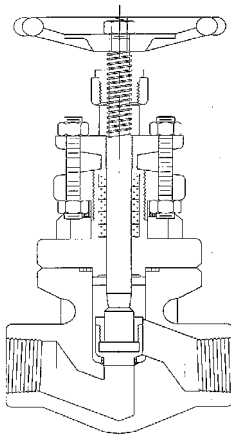


**Typical Ball Valve**

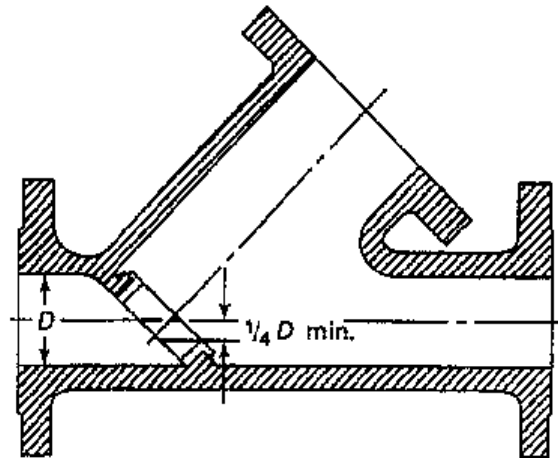


# Section I Valve Requirements

- Isolation valves installed between the drum and a water column are optional and when installed they must be locked open, to prevent unauthorized use.
- Globe valves for isolation are permitted if the opening thru the seat is in line with at least 25% of the port diameter, when the valve is open.



**Incorrect**



**Correct**



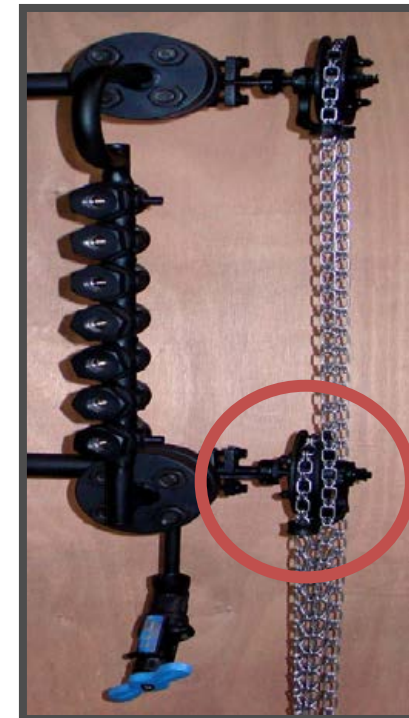
# Operating Chains on Water Gage Valves

- Valves must be operable from the operating floor or platform.
- *A chain or mechanism is required when the top or bottom valve is more than 7ft above the operating floor or platform.*

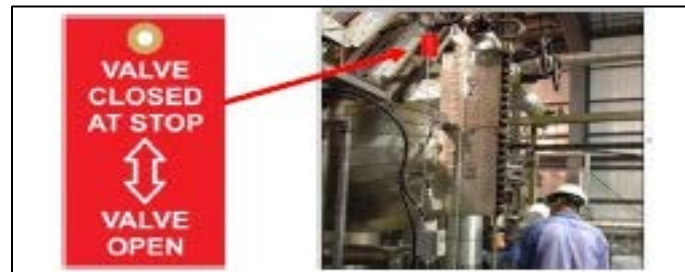


1/4 Turn Valves

Pull left handle down to open  
Pull right handle down to close



Chain Wheel

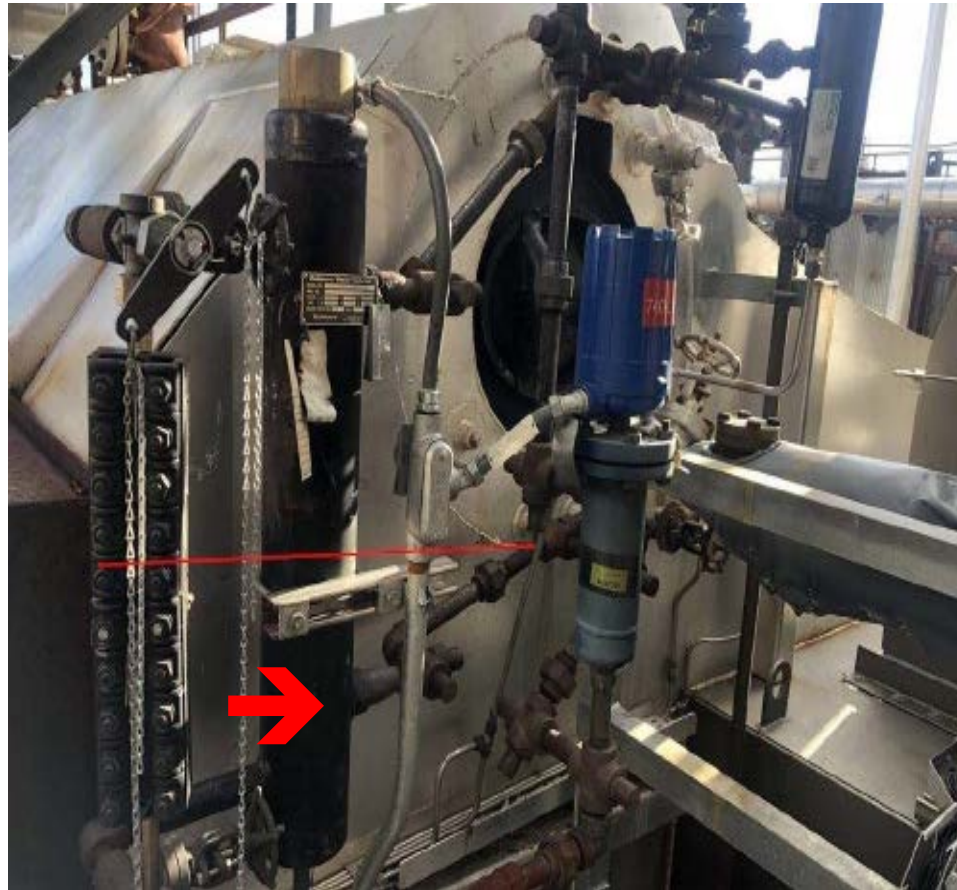


Position Indication tag for Chain Wheel Valves

# Chain Installations and Concerns



# Serious Installation Error





# Code Violations Illustrated



**A drain valve is missing on this lower water gage valve**



**Magnetic Level Gage Scale extends below lower connection, it will always indicate some level**

# Examples of Low Water Cutout Devices (also known as Low Water Fuel Cutoff)



Probe Type



Typical  
Conductivity Probe



Float Type

Probes may also be installed  
into a water column



# ASME CSD-1 (Controls and Safety Devices for Automatically Fired Boilers)

**Applications: Boilers with fuel input range up to 12,500,000 Btu/hr**

**Section CW-140 requires two separate LWCO devices**

- **The two devices must be in separate chambers and connected to separate water nozzles from the drum, but they may be connected to the same steam nozzle.**
- **Isolation valves are not permitted between the drum and the LWCO devices**
- **Minimum connection pipe size is 1" with a drain at least  $\frac{3}{4}$ " NPS**
- **One of the devices may be inserted directly into the boiler.**



## Installation Error with these 2 Low Water Cutouts



Isolation valves are not permitted between Low Water Cutouts and the boiler drum.

# Other Vital Related Applications “Off the Drum” Constructed to Section VIII



**Deaerators    Condensate Tank    Blowdown Tank    Feedwater Heater**

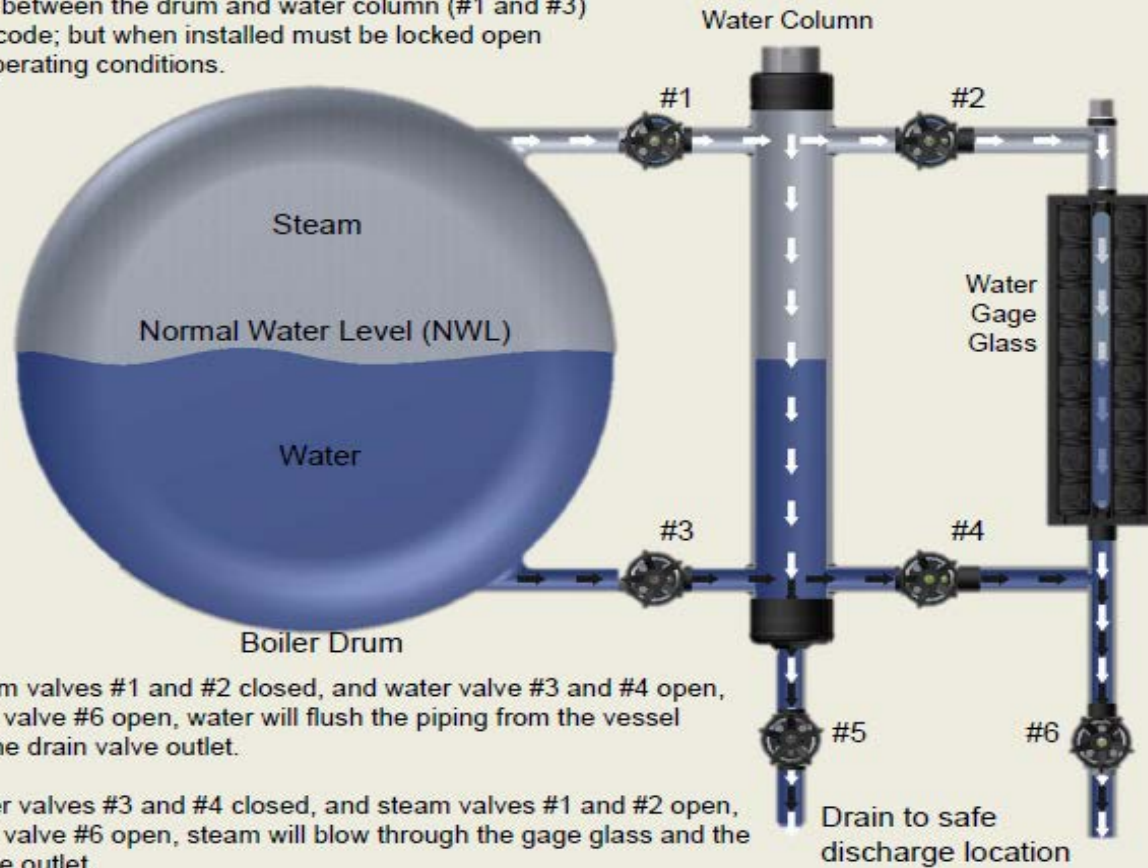
- Inspect and evaluate these applications for safe operation.
- Consider Reflex or Transparent Gage Glasses, or Magnetic Level Gages for these applications, as economic solutions to level indication issues.

# Maintenance Tips

- **Inspect gages and valves routinely for wear or leakage.**
- **Plan annual maintenance intervals**
- **Maintain insulation on mating piping for operation and personnel safety.**
- **Apply heat tracing to instrument applications that may be subjected to freezing conditions**
- **Promptly remedy any concerns**
- **Use OEM parts**
- **Conduct proper Blowdowns and not excessively. The duration should not exceed 20 seconds.**

# Recommended Blowdown Procedure

Isolation valves between the drum and water column (#1 and #3) are optional by code; but when installed must be locked open under normal operating conditions.



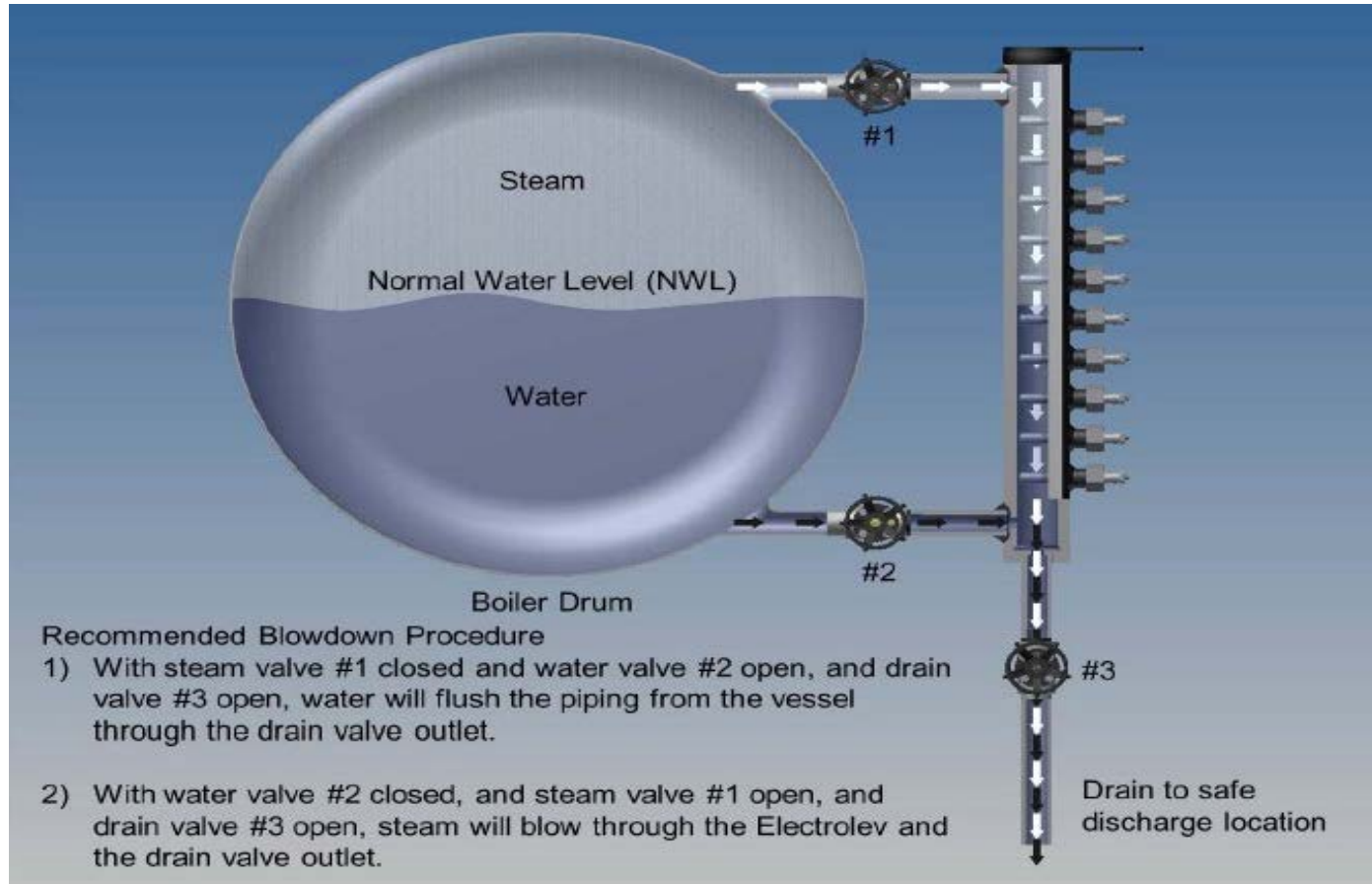
Notes:

- 1) With steam valves #1 and #2 closed, and water valve #3 and #4 open, and drain valve #6 open, water will flush the piping from the vessel through the drain valve outlet.
- 2) With water valves #3 and #4 closed, and steam valves #1 and #2 open, and drain valve #6 open, steam will blow through the gage glass and the drain valve outlet.
- 3) Valve #5 is the code required drain valve for the water column.

**Note: Bypass Low Trip during this procedure**



# Recommended Blowdown Procedure for Remote Level Indicators



**Note: Bypass Low Trip during this procedure**

# Helpful information on our website

Installation, Operation, & Maintenance Instructions  
R500.E148C  
7/10/2020

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**RFQ and Purchase Order  
Specification Work Sheets**

Section: R406.007  
Date: 4-9-2020  
Supersedes: 11-1-2011  
Page 1

**P4100 Series  
Simpliports**

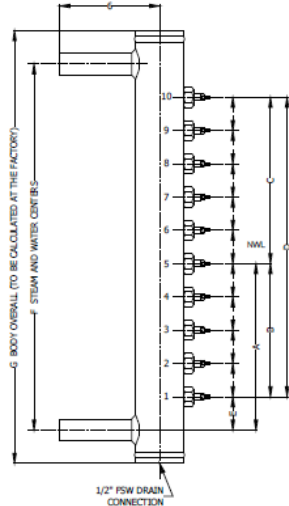


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**REQUIRED DIMENSIONAL INFORMATION**

Section: R406.017  
Date: 9/10/2010  
Supersedes: 9/10/2013  
Page 3



A	
B	
C	
D	
E	
F	
G	----

PROBE DISTANCE FROM NWL	
10	
9	
8	
7	
6	
5	
4	
3	
2	
1	

**DIMENSIONAL NOTES:**  
1) MINIMUM DISTANCE BETWEEN PROBES IS 1" (25.4mm)  
2) MINIMUM "E" DIMENSION IS 1" (25.4mm)  
3) MINIMUM DISTANCE BETWEEN TOP PROBE AND STEAM CONNECTION (UPPER CONNECTION) IS 1" (25.4mm)

Note: This illustration shows Probe #5 as NWL. However, this location could vary depending on the application. Please signify NWL as "D" in the applicable box.

Additional notes:  
\_\_\_\_\_  
\_\_\_\_\_

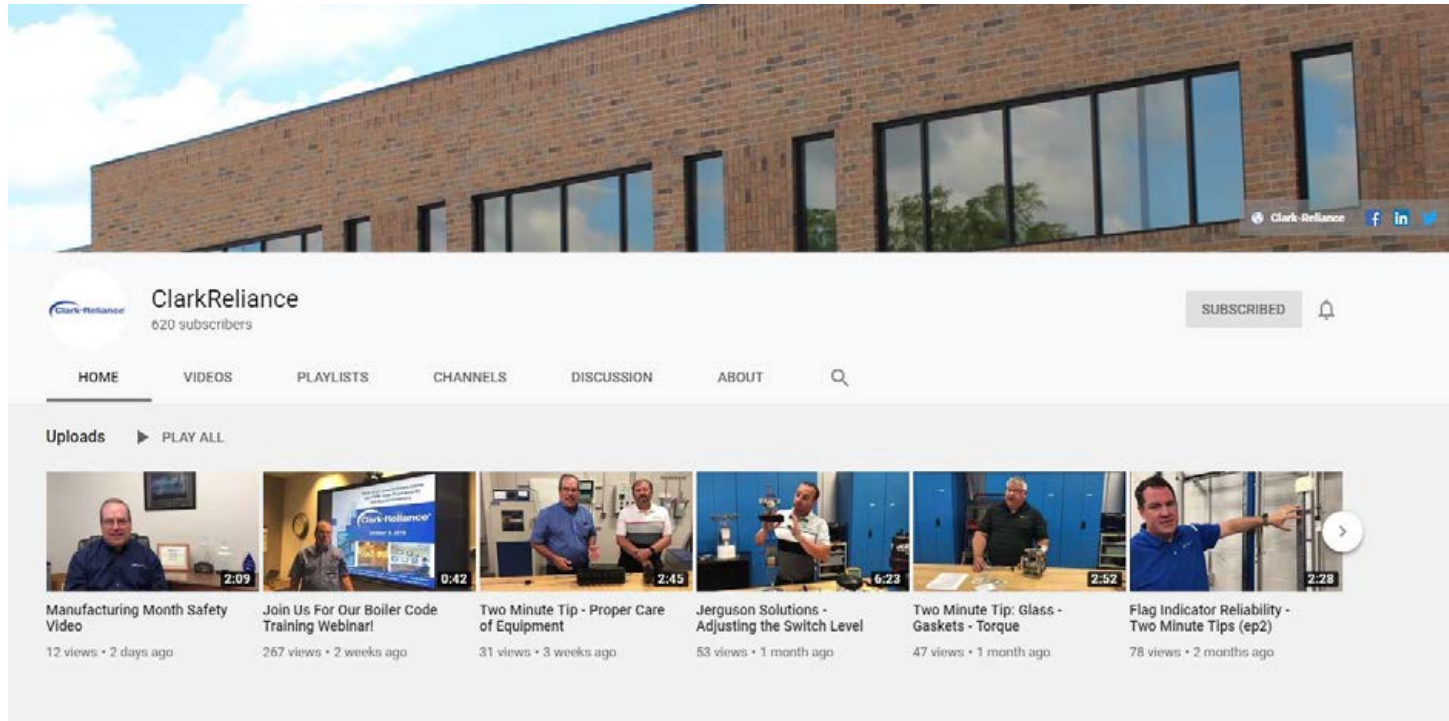
Instructions Product Selection Worksheets, and typical drawings



# Authority References

- **ASME Section I of the Boiler Code provides boiler makers and operators with minimum requirements for drum level instrumentation.**
  - **Local jurisdiction authorized Inspectors enforce & support compliance**
  - **Insurers enforce compliance**
  - **Plant Reliability Engineers are stakeholders**
  - **Clark-Reliance and our local Rep provide training & recommendations**
- **We at Clark-Reliance are a widely recognized resource**
- **We provide valuable information and recommendations to improve personnel & plant safety, and operating efficiency.**

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## Remote Level Indication Solution

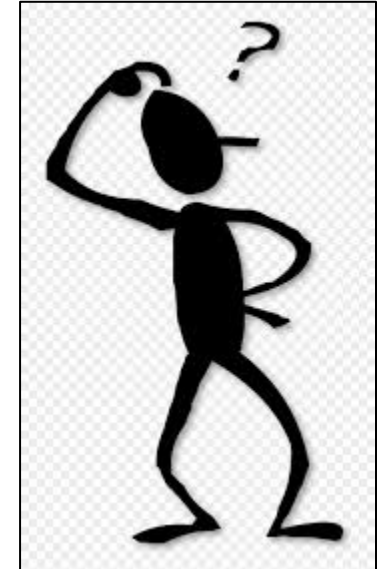


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