



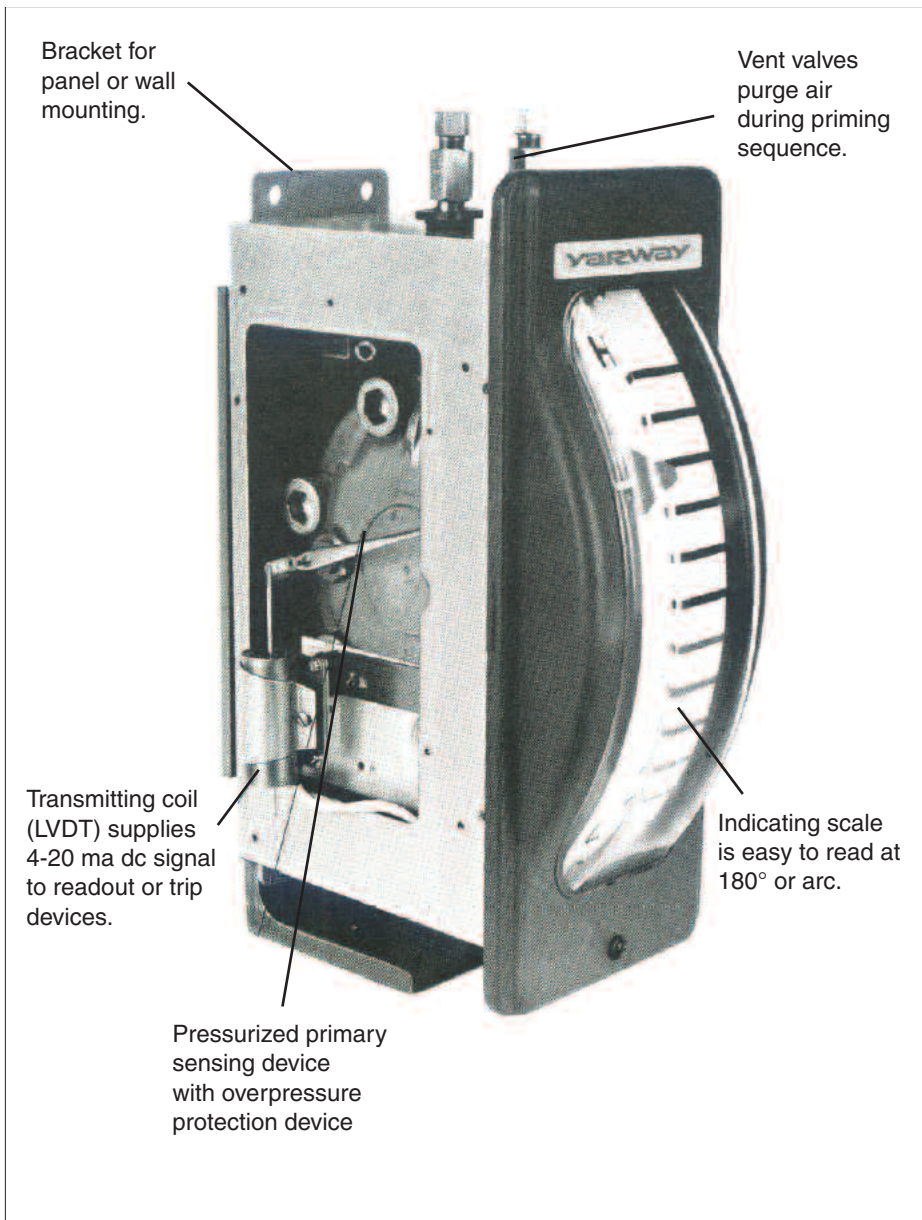
Remote Liquid Level Indicator

Features and benefits

- Remote reading
Transfers hard-to-see liquid level readings from inaccessible points down to eye level.
- Continuous indication
The primary sensing device is operated by the liquid in the boiler itself.
- Foolproof
The actuating diaphragm can withstand high unbalanced pressure.
- Complete
It can be linked with a control module that actuates sound and light alarm accessories to provide a complete indicating and controlling system.
- Density compensation
For changes in density at various operation pressures - 0 to 3000 psi [0 to 207 bar].
- No mechanical linkages
Located outside the pressure zone, the indicating system receives its signal through a magnetic coupling.



Remote Liquid Level Indicator



The liquid level indicator system is the product of specialists in boiler trim design. The indicator, a differential pressure device, is operated by the water vessel itself, using the weight difference between a constant head and variable head of water. Its accessories include a transmitting coil and signal conditioner to provide a dc milliampere signal to one or more secondary (repeater) indicators; a control module with magnetically or cam actuated switches to perform alarm, trip and shut-off functions.

Major Components of the System

Primary Indicator - The primary (transmitting) indicator couples a reliable magnetically actuated indicating mechanism with a transmitting coil (LVDT) and armature assembly which is actuated by the indicator pointer. A signal conditioner energizes the transmitting coil receiving an output signal which is conditioned to dc milliampere output proportional of the primary pointer reading. Enclosures meet the condition of NEMA 1, 2 & 5 (see page 9).

Excerpts from Section I of the 1996 ASME1 Boiler and Pressure Vessel Code 60.1 Water Level Indicators

Two independent remote level indicators may be used instead of one of the two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 400 psi [2800 kPa]. When both remote level indicators are in reliable operation, the gage glass may be shut off but shall be maintained in servicable condition.

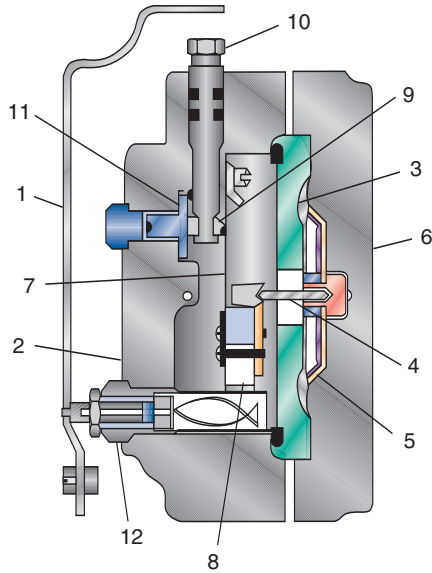
When the direct reading of gage glass water level is not readily visible to the operator in his working area, two dependable indirect indications shall be provided, either by transmission of the gage glass image or by remote level indicators.

The lowest visible part of the water gage glass shall be at least 2 inches [51 mm] above the lowest possible permissible water level, at which level there will be no danger of overheating any part of the boiler when in operation at that level. When remote level indication is provided for the operator in lieu of the gage glass, the same minimum level reference shall be clearly marked.

Connections from the boiler to the remote level indicator shall be at least $\frac{3}{4}$ " pipe size to and including the isolation valve and from there to the remote level indicator at least $\frac{1}{2}$ " [13 mm] O.D. tubing. These connections shall be completely independent of other connections for any function other than water level indication.

Note

1. The American Society of Mechanical Engineers, Boiler and Pressure Vessel Committee, establishes rules of safety governing the design, fabrication and inspection of boilers and unfired pressure vessels.



Standard Parts

Item No.	Part	Material
1	Pointer	Aluminum
2	Front housing	Aluminum bronze
3	Backing plate	Stainless steel
4	Pin	17-4 PH stainless steel
5	Diaphragm	Dacron EPT coated
6	Rear housing	Aluminum bronze
7	Deflection plate	Beryllium copper or stainless steel
8	Magnet	Alnico 5
9	Fulcrum bar	Brass
10	Range adjustment screw	Stainless steel
11	Zero adjustment screw	Brass
12	Spiral well assembly	Stainless steel

Indicator Operation - The indicator combines two separate elements; (1) a sensing element which responds to differential pressure and (2) an indicating system which presents response as a true reading of level.

The sensing element measures and compares the variable head of the liquid in vessel to a constant head. Contained within a pressurized housing, the sensor is self-powered by the hydraulic forces imposed upon it.

The indicating system is located outside the pressure zone and receives the actuating force through a permanent magnet coupling, thereby eliminating direct mechanical linkages and stuffing boxes.

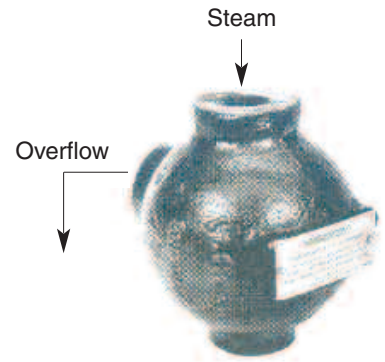
The high pressure, right-hand side of the indicator is connected to the constant head chamber which is installed above high water level.

The low pressure, left-hand side is connected to the lower drum connection. The indicator diaphragm (5) responds to signals from both these sources. The pipe connected to the head chamber delivers a constant head pressure force from the chamber to the high pressure side of the diaphragm. The other pipe, which is connected to the lower fitting of the drum, produces a variable head pressure on the low pressure side of the diaphragm as the liquid level changes. Any change in the differential head pressure produces a force variation on the diaphragm. This variation results in motion of the pin (4) and the deflection plate (7). This plate, anchored at one end, is fitted at the free

end with a permanent horseshoe magnet (8). Poles of the magnet straddle a spiral armature inside a pressure isolating well (12) threaded into the housing (2). A counter balanced pointer (1) is fastened to the outer end of the armature. When motion of the deflection plate changes the position of the horseshoe magnet, its movement along the well causes rotation of the spiral armature, which in turn actuates the pointer to respond to every change in liquid level. The pointer moves over a standard ten-division vertical scale (dial).

Head chamber - In most installations the water level gage glass reading is the accepted standard of reference. To assure indicating accuracy, the indicator system is provided with suitable compensation to match the pressure demands of the particular system. Three types of compensation are available: natural, temperature, and pressure compensation.

Natural compensation - pressures 0 to 750 psi [0 to 52 bar]. The constant head chamber (necessary with most liquid level indicators) assures natural compensation by reducing the density of the water in the indicator. In operation, steam from the boiler fills the constant head chamber, heating the water in this chamber and in the upper portion of the constant head pipe running to the indicator. The side overflow is connected to the lower fitting on the pressure vessel. In addition to this natural compensation, the indicator is calibrated to the average gage glass water density.



**Natural Compensation
Low Pressure Head Chamber**



**Temperature Compensation
Head Chamber Assembly**

Temperature compensation -

pressures 751 to 3000 psi [52 to 207 bar]. On pressures above 750 psi [52 bar], density changes due to increasing temperatures become sufficiently pronounced to require the addition of a temperature compensating jacket fastened around the variable and constant head pipes of the constant head chamber. This permits reheating of the constant head pipe by the steam within the variable head pipe, adjusting the density of the water so that mid-scale accuracy is guaranteed for all pressures. In addition, this compensation provides full scale accuracy at the specified operating pressure (see chart 1). Note: Indicators are normally calibrated to density of water in the gage glass. Drum density reference (true drum level) calibration is also optionally available.

Pressure Compensation -

recommended for operating pressure 1500 to 3000 psi [103 to 207 bar]. When total, full-scale accuracy is necessary for all pressures, as during activation or deactivation of a high pressure boiler, pressure compensation (used in conjunction with temperature compensation) can be added to the indicator, thereby providing additional pointer movement to compensate for density of the water in the gage glass or to actual water in the drum, as specified.

Vent Valves

The indicator is equipped with vent valves that purge air from both sides of the diaphragm and the piping system to maintain system accuracy.

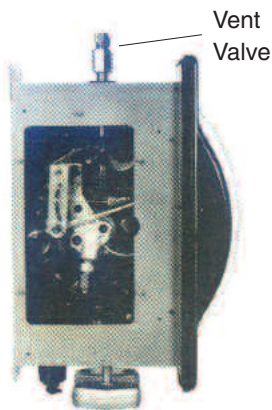


Figure 4400P Indicator with Pressure Compensator

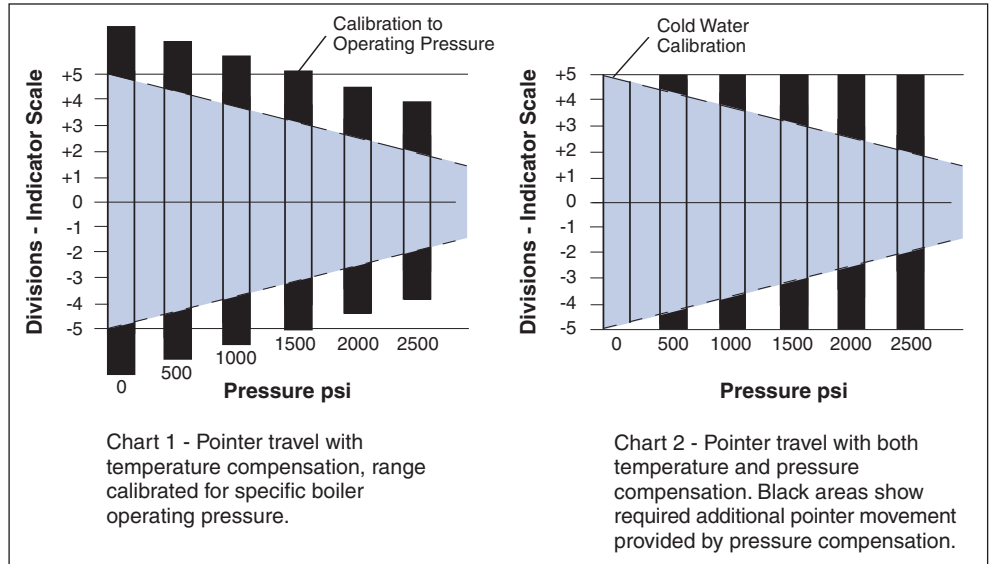


Chart 1 - Pointer travel with temperature compensation, range calibrated for specific boiler operating pressure.

Chart 2 - Pointer travel with both temperature and pressure compensation. Black areas show required additional pointer movement provided by pressure compensation.



Instrument Valve Manifold

Instrument Shut-Off Valves

For pressure to 750 psi [52 bar], the indicator is equipped with two isolation valves as standard equipment.

Instrument Valve Manifold

An IVM consisting of a middle equalizing valve and two shut-off valves is supplied on indicators operating under high pressure conditions. The equalizing valve permits balancing of the pressure on opposite sides of the diaphragm during startup and priming operations. The IVM is optional for low pressure and standard for systems 751 to 3000 psi [52 to 207 bar].



Figure 4459 dc Secondary Indicator

Secondary Indicator - Fig 4459

In combination with the signal conditioner, the primary indicator can electrically operate one or more secondary instruments which can be panel mounted remote from the primary. The loop impedance can be up to 550 ohms. The secondaries are independent of any pressure connections, operating instead on a dc output signal from the primary indicator/signal conditioner. Enclosures meet the condition for NEMA 1 and 5 (see page 9).

The use of secondary instruments is ideal for:

1. Central control panels where instruments could be damaged by a leaky high pressure liquid line.
2. Remote locations where the distance from the primary instrument is too great for the use of pressure piping.
3. Installations where freezing condition might rupture liquid level tubing connections.
4. Systems where the indicator must be elevated far above the liquid level.

Secondary indicator Figure 4456 is available in the same case size as the primary indicator.

The electrical requirements for the secondary indicator are; input 4-20 ma dc (2 wire transmission cable, 14-16 gage). Impedance at connector is 79 ohms.



Figure 4456
dc Secondary Indicator

Signal Conditioner (ac/dc converter) Figure 4487

This device is required with the primary indicator to deliver an output signal which varies with the level measured by the primary instrument. The signal conditioner transmits an electronic signal from the primary indicator to secondary indicator(s) as well as computers and other system accessories. The electrical requirements of the signal conditioner are:

- power supply, 115v ac or 230v ac
- 50 or 60 Hz output signal
- 4-20 ma dc into maximum load of 550 ohms.

Optionally available in 10-50 ma dc into load of 200 ohms for computer analog systems. The enclosures meet NEMA 4 (see page 9).

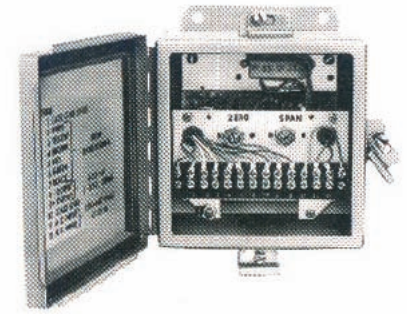
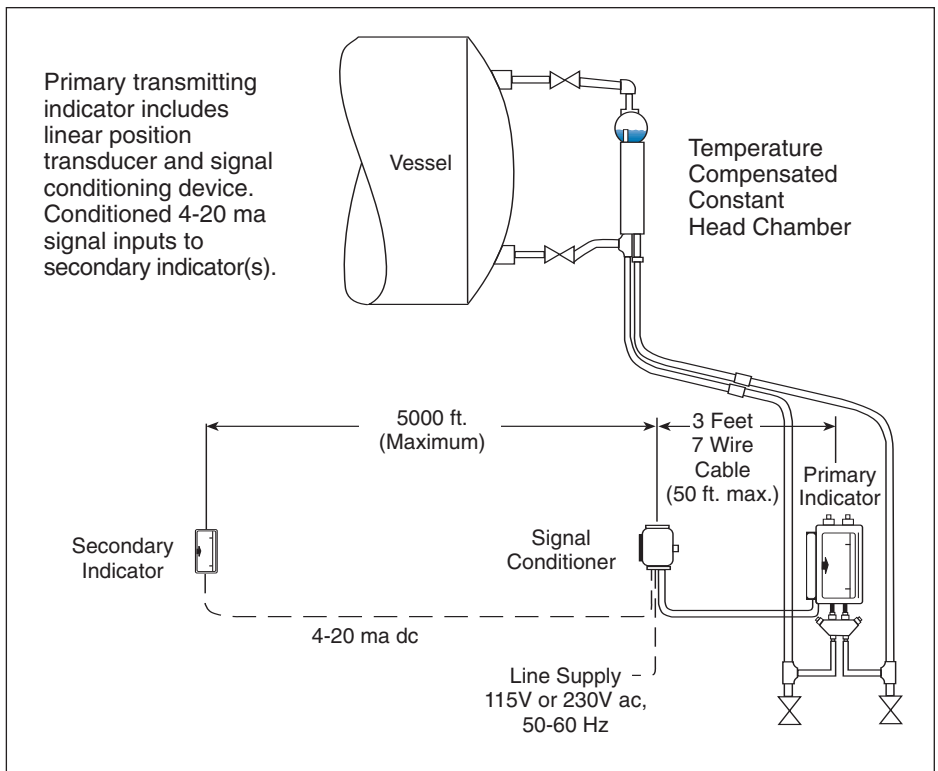


Figure 4487
Signal Conditioner
(ac/dc converter)



Auxiliary Components of the System

Control Module

This control module is attached to the indicator and is used to actuate lights and/or audible alarms, pump cut-in and cut-out, fuel cut-out, control systems. The control module consists of a two pole magnet fastened to the shaft of the indicator pointer, two or more magnetic mercury switches attached to adjustable arms and two relays. Relays are available for 115v ac or dc and contracts rated at 15 amps, 115v ac. Two, three, or four switches can be supplied for any indicator, except the pressure compensated version which is limited to two switches. The control module is factor installed on the indicator but can be added to existing installations. Enclosures meet NEMA 1, 2, and 5 (see page 9).

Up to four mechanical snap action cam actuated switches are available, in place of mercury switches, on all except pressure compensated units.

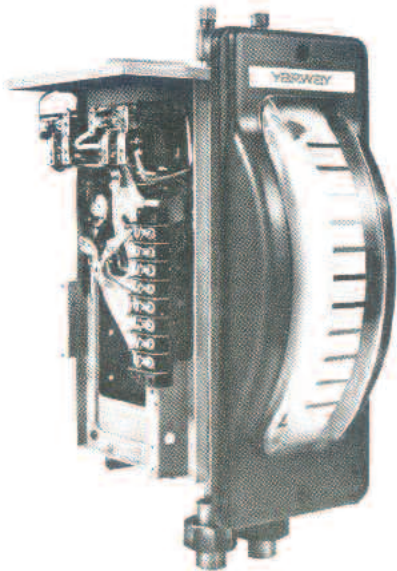


Figure 4400C
Indicator with Control Module

Dual Current Alarms

Control modules for pressure compensated indicators have two switches. For more than 2-switch actuation, the pressure compensated primary indicator can be supplied with a 2-switch control module and supplemented by a dual current alarm for two additional high and low switch set points. The dual current alarm system is an auxiliary switch device with electronic solid state switches. The input impedance is 250 ohms for each unit and operation is from a 4-20 ma dc output of the Figure 4487 signal conditioner. The output relay contacts are rated at 5 amps, 115v ac, 24v dc or 3 amps, 230v ac. A maximum of two dual current alarms can be used with each signal conditioner. Enclosure meets NEMA 1 (see page 9).

Special Indicator Dial

The indicators are supplied with a ten division dial. Other dials are available to meet specific applications.

Remote Hi-Lo Signal Lights Figure 4424

Lights can be added to the indicator control system to provide further visual indication of the liquid level. The lights provide high and low level warnings and normal level. One lens is always lit to indicate the circuit is functioning. This unit is designed for simple panel mounting. Lights are 115v ac or dc; 230v ac or dc optional.



Figure 4424
Remote Signal Lights

Accessory Elements of the System

Special Outdoor Enclosures (NEMA 3)

Enclosures for Indicators

Heated Enclosure - Where ambient temperature in the area is below 70°F.

Unheated Enclosure - Protection against driving rain.

Weatherproof Shields for Temperature Compensated Head Chambers

751 to 3000 psi [52 to 207 bar]

Heated Shield - Where ambient temperature in the area is below 100°F.

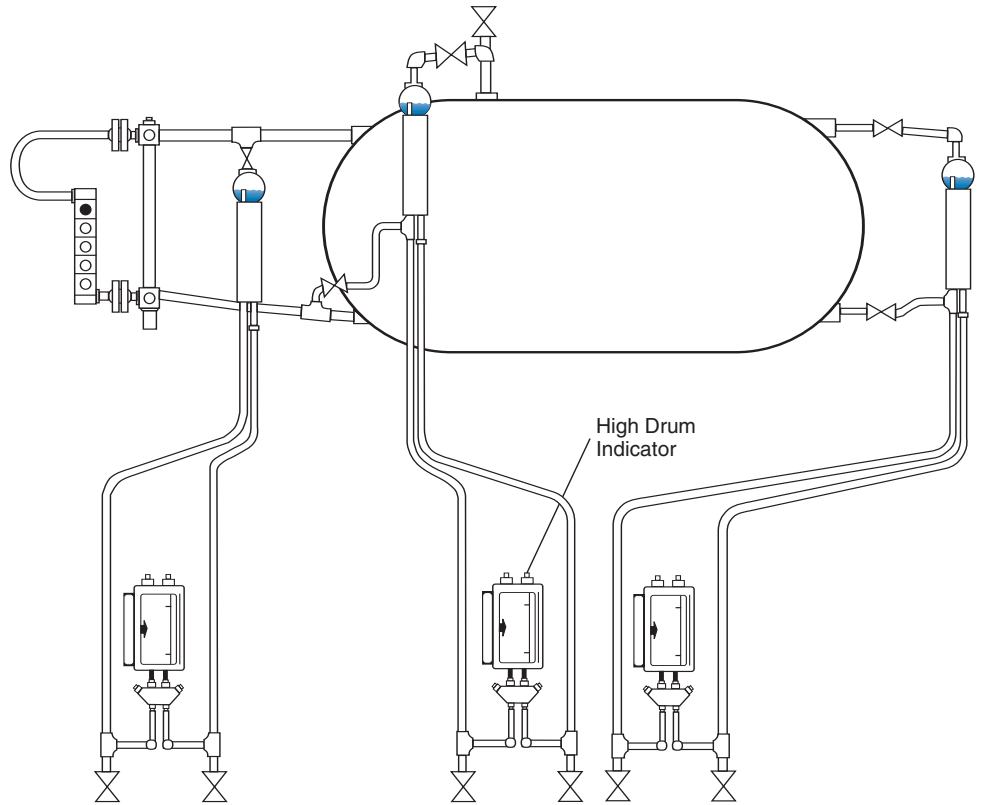
Unheated Shield - For protection against high winds and driving rain.

Applications

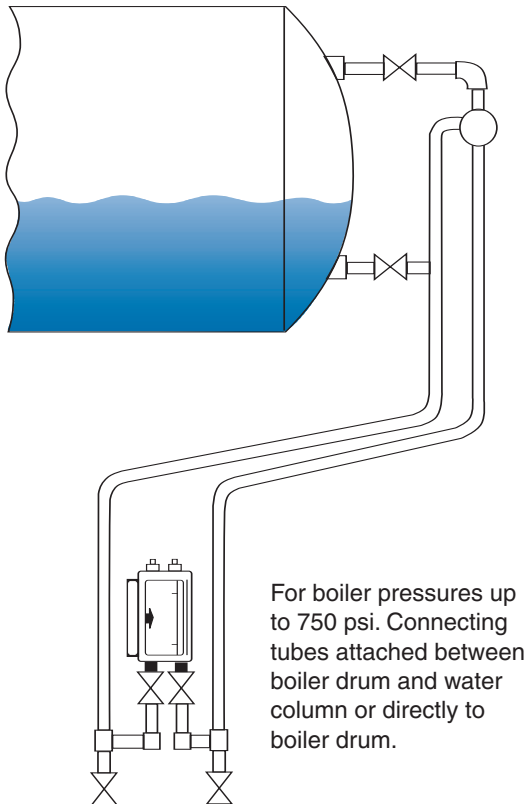
Utility Station Boiler System

The ASME Power Boiler Code specifies that in power boilers with all drum safety valves set at or above 900 psi [62 bar], two remote level indicators may be used instead of one of the two required gage glasses for boiler liquid level indication per Paragraph 60.1.1, Section 1. During boiler operation, it is permissible to deactivate the water gage, thus entirely transferring the indicating function to the indicating system.

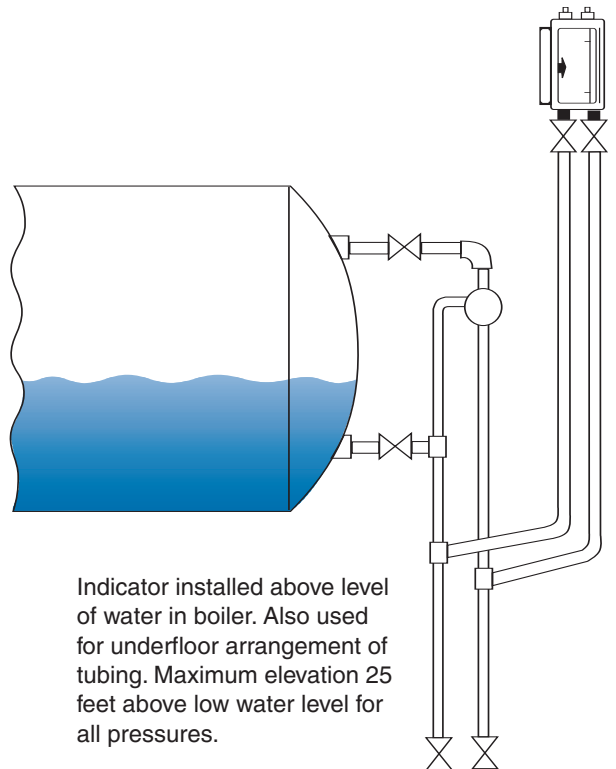
A high drum indicator is shown which provides readings during drum flooding subsequent to boiler shut-down.



High pressure installation meeting ASME code requirements.



For boiler pressures up to 750 psi. Connecting tubes attached between boiler drum and water column or directly to boiler drum.

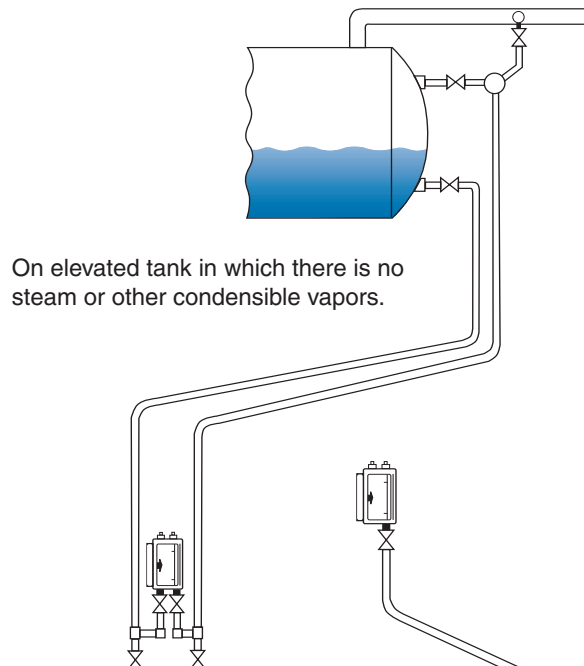
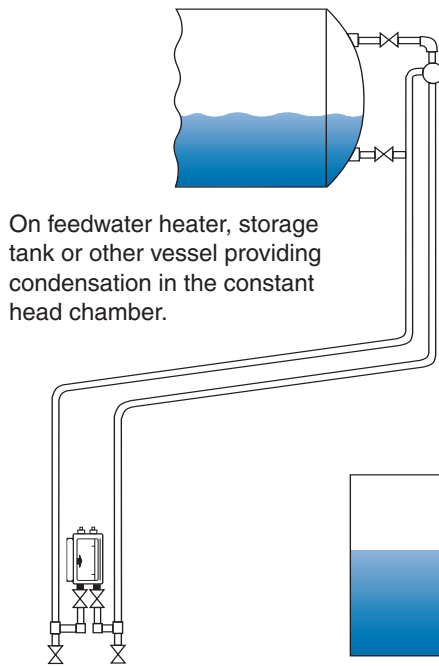
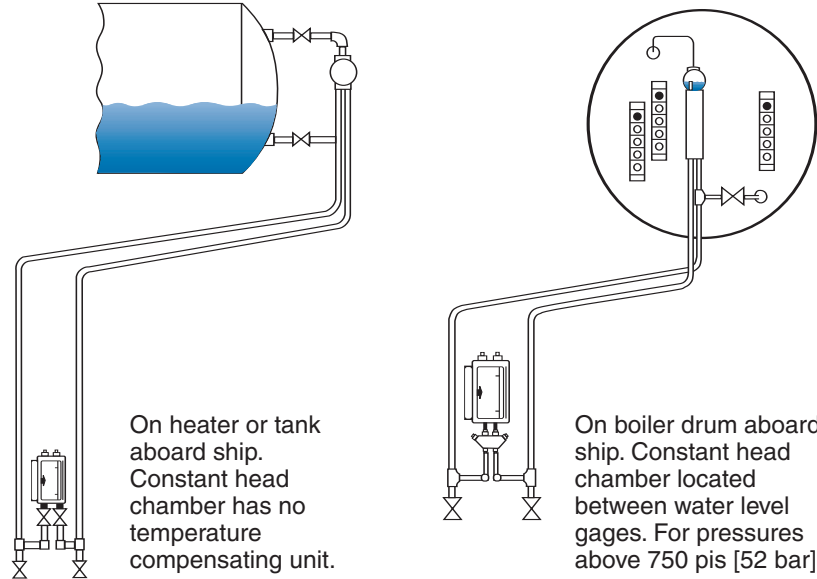


Indicator installed above level of water in boiler. Also used for underfloor arrangement of tubing. Maximum elevation 25 feet above low water level for all pressures.

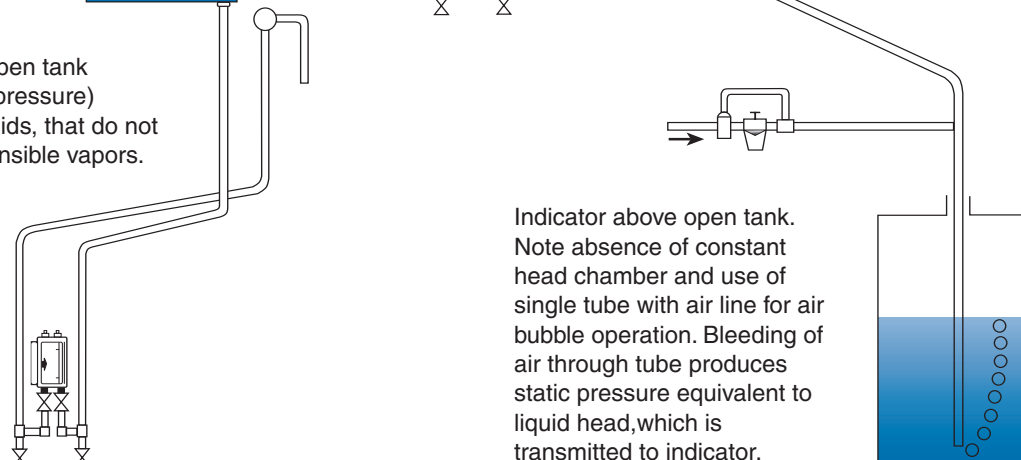
Shipboard - The indicator provides accurate readings for boiler drum level, deaerating and surge tanks. With air bubbler system operation, it can also be used to show level in miscellaneous ship storage and cargo tanks.

The indicating system can be used on a boiler drum aboard ship with the constant head chamber located between water level gages.

Storage Tanks - The indicator system can be used with a variety of tanks. It is frequently used on high and low pressure feed water heaters, storage tanks, or other vessels providing condensation in the constant head chamber. Other uses include elevated open tanks containing liquids with no condensable vapors where the level in the constant head chamber is maintained by occasionally opening a filler valve.



On elevated open tank (atmospheric pressure) containing liquids, that do not provide condensable vapors.



How to Specify

Liquid Level Indicator The Indicator is to be of self-powered, differential pressure, manometric-type, and operated by the measured fluid itself. It should require no external source of energy or secondary elements of level reproduction mechanism. The sensory and indicating elements shall be connected through magnetic coupling. Internally illuminated, the indicator shall provide clear readings in a 180° viewing arc. For a primary indicator (with transmitting coil) a signal conditioner is required to provide the milliamp dc output.

Fig. 4487 Signal Conditioner 4-20 ma dc output signal shall provide the milliamp dc output for use in a system for remote readout devices of milliamp dc characteristics such as secondary indicators, dual current alarms, computers and trip units.

Fig. 4459 Secondary Indicator if specified shall be provided for interconnection with the primary indicator. Independent of any pressure connections, secondary indicator operates on dc signal from signal conditioner. Input 4-20 ma dc. Also available in full size case (Fig. 4456).

Fig. 4426 Control Module if specified, shall be provided with the liquid level indicator for actuation of lights, audible alarms, fuel cut-out, and annunciator through positive relay action.

Fig. 4424 Hi-Lo Signal Lights if specified, shall be provided with indicator-control system to contribute **visual** high and low level warnings.

Fig. 4425 Hi-Lo Signal Alarms if specified, shall operate from control module, horns blast **audible** warnings of high or low liquid levels.

How to Order

For selection of indicator, use the following as guidelines:

1. Select proper design pressure.

Pressure psi [bar]	Range Span	
	5 - 40" [127 - 1016 mm]	41 - 500" [1041 - 12700 mm]
750 [52]	Fig. 4412	Fig. 4414
1550 [107]	Fig. 4416	Fig. 4418
2500 [172]	Fig. 4420	Fig. 4422
3000 [207]	Fig. 4460	Fig. 4462

2. Provide actual range (in inches or mm) required and determine Figure number of Indicator. When ordering, exact range must be specified.

3. Select the features required to be added to the Basic Indicator from the following suffix list. When ordering, add the appropriate suffix letters to the Figure number

- R – Primary Indicator with 4487 Signal Conditioner (ac/dc converter, 4-20 ma dc output).
- C – Indicator with standard 2-switch Control Module. (Extra switches optional).
- RC – Primary Indicator with Fig. 4487 Signal Conditioners (ac/dc converter, 4-20 ma dc output) and 2-switch Control Module.
- P – Indicator with pressure compensation.
- PR – Primary Indicator with pressure compensation and Fig. 4487 Signal Conditioner (ac/dc converter, 4-20 ma dc output).
- PC – Indicator with pressure compensation and 2-switch Control Module.
- PRC – Primary Indicator with pressure compensation, Fig. 4487 Signal Conditioner (ac/dc converter, 4-20 ma dc output) and 2-switch Control Module.
- B – Indicator with bubbler system (Fig. 4412-4414). No constant head chamber or instrument shut-off valves but with a differential purge regulator. (Available with features "R" and "C").

4. If Secondary Indicators are required, please specify.

Enclosure Types

NEMA Type 1. General Purpose enclosures are for indoor use wherever oil, dust or water is not a problem.

NEMA Type 2. Driptight enclosures are used indoors to exclude falling moisture and dirt.

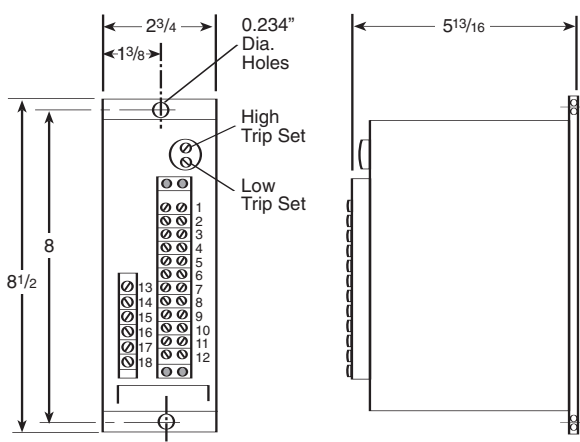
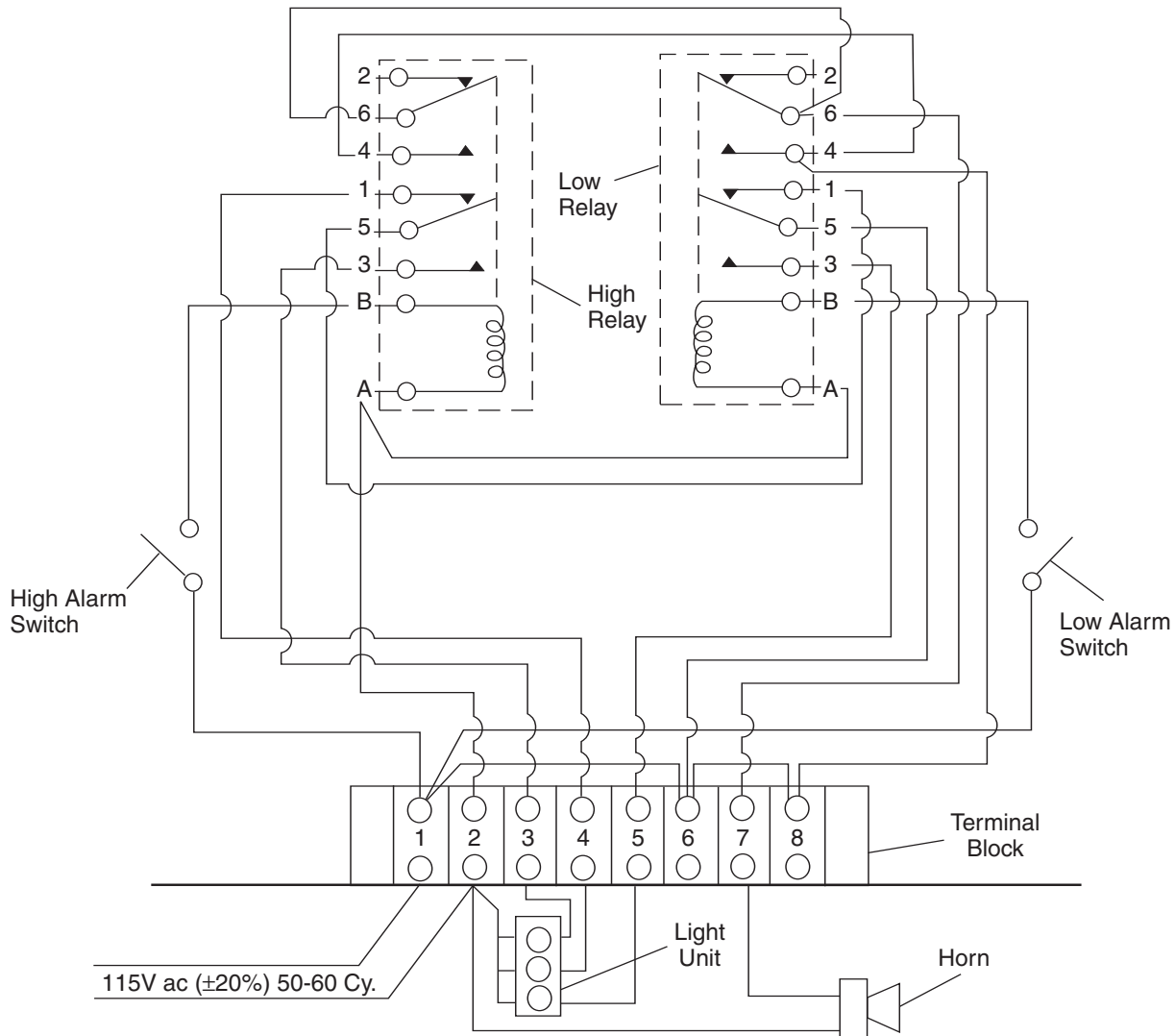
NEMA Type 3. Weather resistant (weatherproof) enclosures provide protection against rain, sleet and snow.

NEMA Type 4. Protects against windblown dust, rain, splashing water and hose directed water.

NEMA Type 5. Dust Tight (Non-hazardous) enclosures exclude dust.

NEMA Type 6. Industrial use enclosures exclude oil, coolant, flyings, dust, lint, etc.

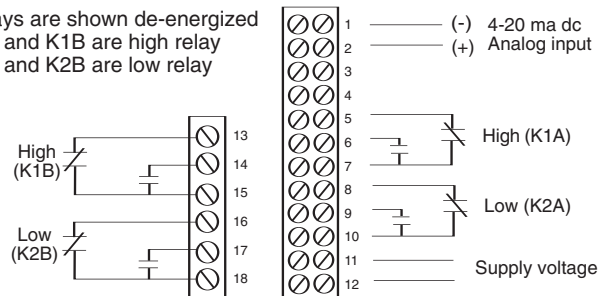
Standard Control Module Wiring



Dimensions - Dual Current Alarm

All dimensions shown are approximate for installation purposes only.

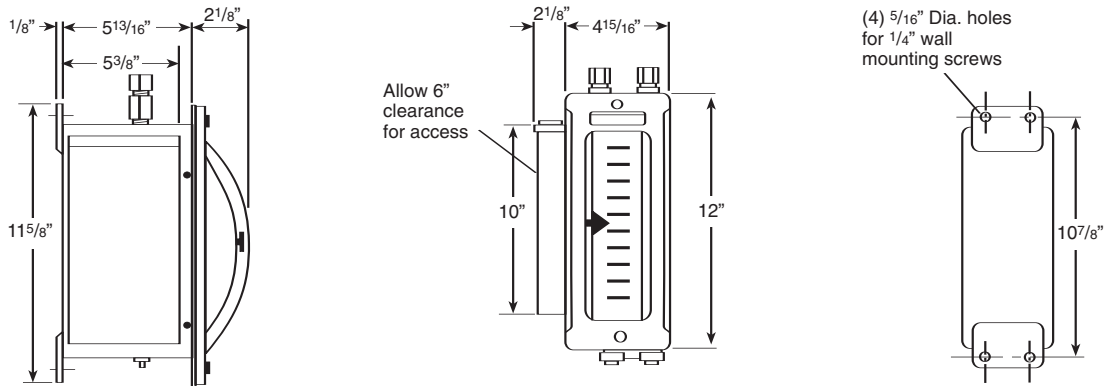
Relays are shown de-energized
K1A and K1B are high relay
K2A and K2B are low relay



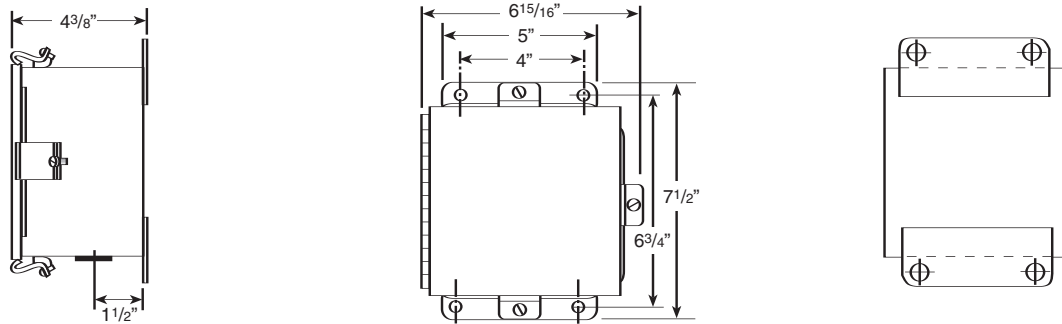
Wiring Schematic - Dual Current Alarm

Outline and Mounting Dimensions

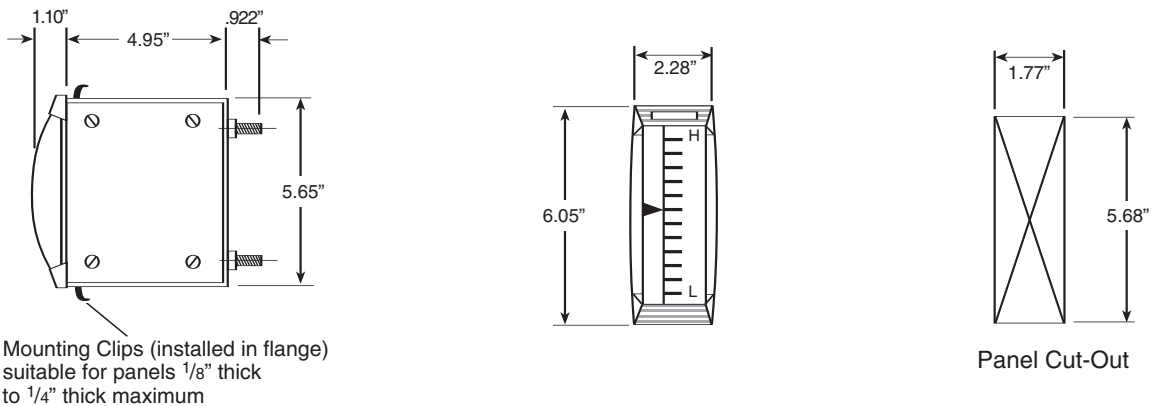
Primary Transmitting Indicator



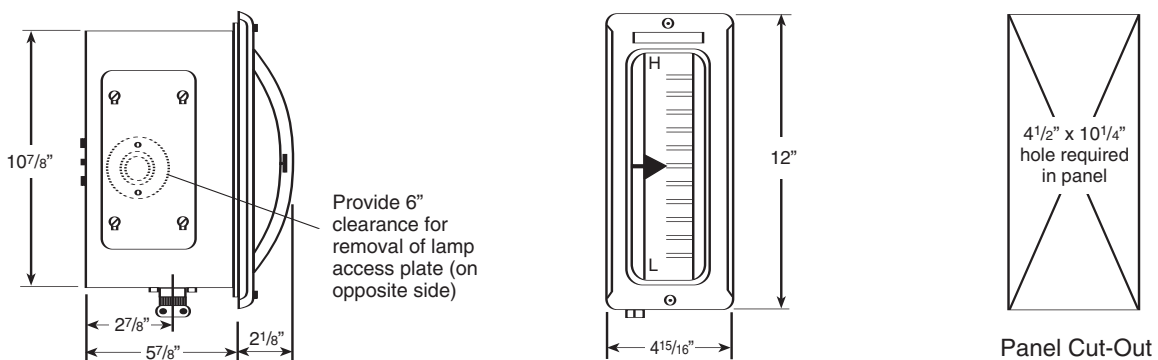
Signal Conditioner (Figure 4487)



Secondary Indicator (Figure 4459)



Full-Size Secondary Indicator (Figure 4456)



Available Options to Monitor Boiler Water Levels

Color-Port Gage Glass Systems

Contrasting red (steam) and green (water) readings show water level by means of illuminator spotlights through the ports. Mirror systems and FiberPort fiberoptic systems for remote transmission of light readings.



FiberPort Fiberoptic Transmission System

Transmits, via fiber optic cable, the red (steam) and green (water) indications of water level provided by the Color-Port Gage Glass. Cable lengths to 1,000 ft. Wide angle read-out for line-of-sight viewing.



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