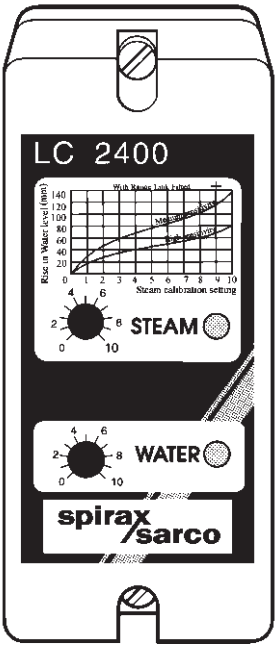
spirax sarco

LC2400 Controller
Installation and Maintenance Instructions



spirax sarco

1. Safety

Your attention is drawn to Safety Information Leaflet IM-GCM-10.

2. Application

When a large steam demand is made of a boiler, the pressure will drop, and large bubbles of steam will be formed in the water. This causes the water level to rise, and can cause the feedwater valve to close. Although the level of water has increased, the mass of water will be decreasing, a situation which actually requires the feedwater valve to be opening. A two element control system (probe/level controller and steam flowmeter), uses the output from the steam flowmeter to move the set point of the level controller.

This compensates for the tendency of the feedwater valve to close when the steam demand is high. Under certain conditions where the boiler feedwater pressure varies considerably, perhaps due to other boilers drawing water, three element control provides even closer compensation.

A three element control system uses an additional input from a water flowmeter to compensate for any variations in feedwater pressure.

3. Description

The Spirax Sarco LC2400 is used to connect a level controller to the 4 - 20 mA output signals from the steam flowmeter and (where fitted), the water flowmeter. The controller can be an LC2200 (for an electrically actuated feed valve), or an LC2300 (for a pneumatically actuated valve). The LC2400 has 'steam' and 'water' potentiometers which are used to scale the outputs of the meters. A green LED next to each potentiometer indicates that a signal is present.

4. Installation

Warning
Isolate the mains supply before unplugging LC2200 or LC2300 controllers since live terminals at mains voltage will be exposed in the controller base.
Controllers should be installed in an enclosure or control panel to provide environmental protection.

CAUTION: Allow 15 mm spacing between adjacent units for air circulation.
Spirax Sarco can provide suitable enclosures. The controller may be mounted on a 'top hat' section DIN rail using the mounting clip provided, or the clip may be removed and the controller base screwed direct to a chassis plate.

5. Wiring

Screened cable is recommended for the LC2400 wiring. The LC2400 is powered by the current loops (4 - 20 mA) and so needs no separate power supply. Figures 1 to 4, pages 4, 5, 6, and 7, show the wiring connections for various applications.

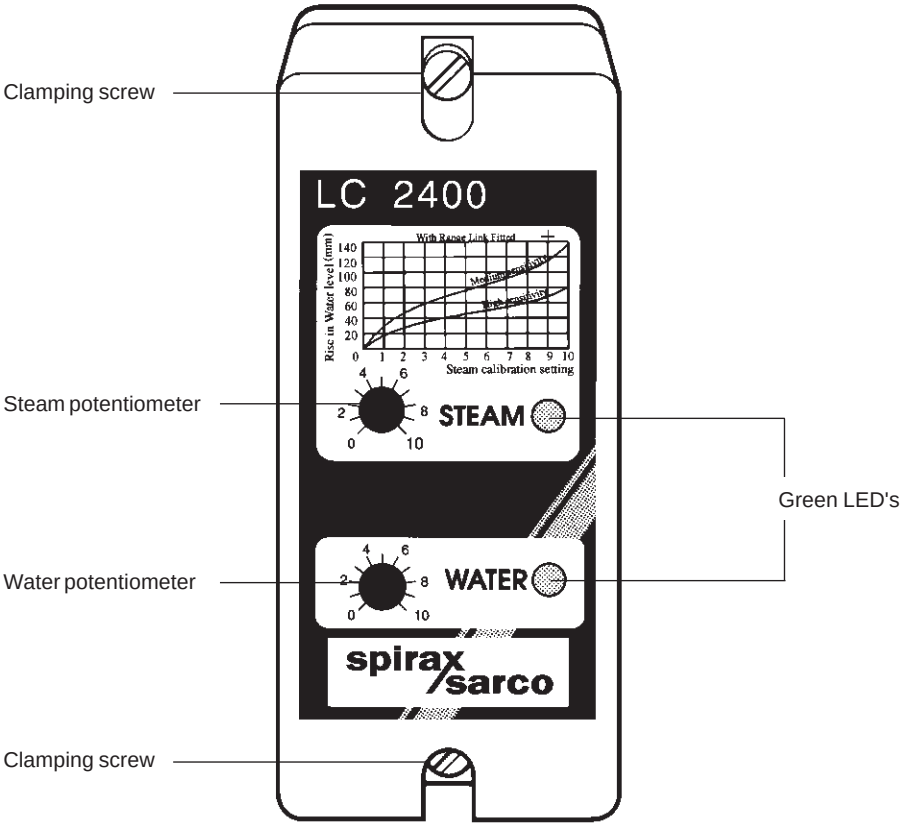
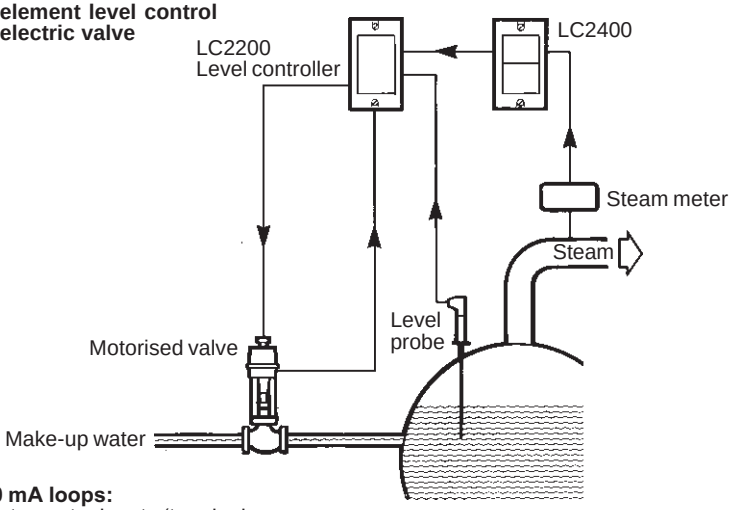


Fig. 1 Two element level control with electric valve



Note on 4-20 mA loops:
Steam and water meter inputs (terminals 3 and 10) are earthed via the level probe. Ensure any equipment connected to the loop will operate with these terminals grounded (earthed).

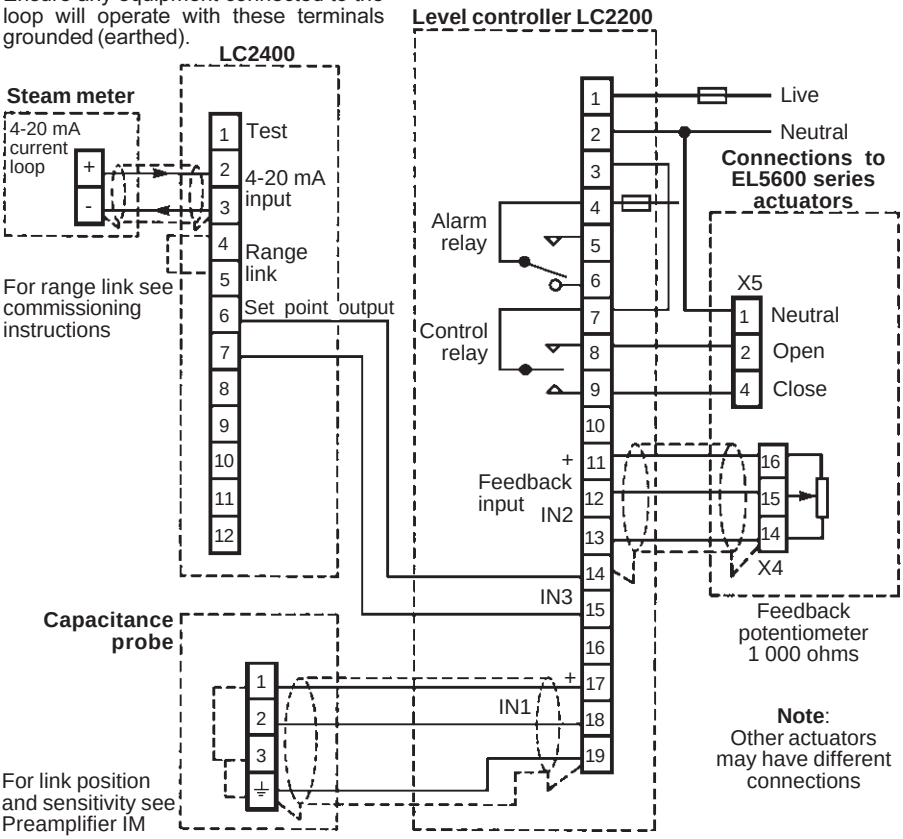
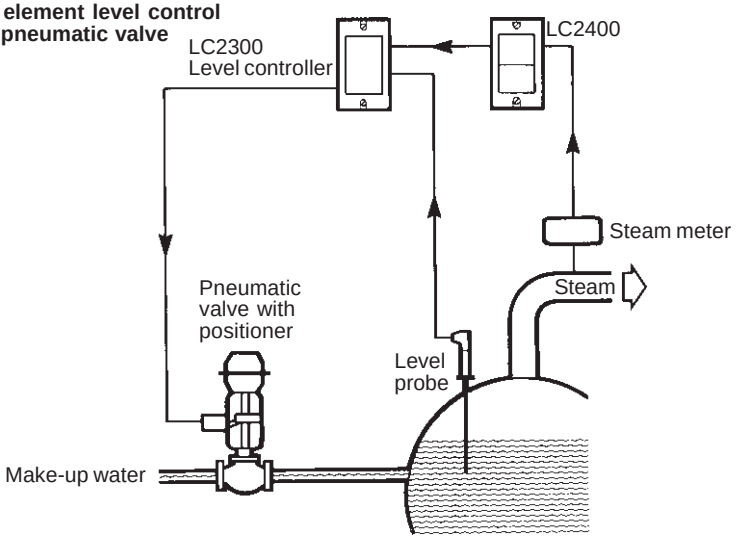


Fig. 2 Two element level control with pneumatic valve



Note on 4-20 mA loops:
Steam and water meter inputs (terminals 3 and 10) are earthed via the level probe. Ensure any equipment connected to the loop will operate with these terminals grounded (earthed).

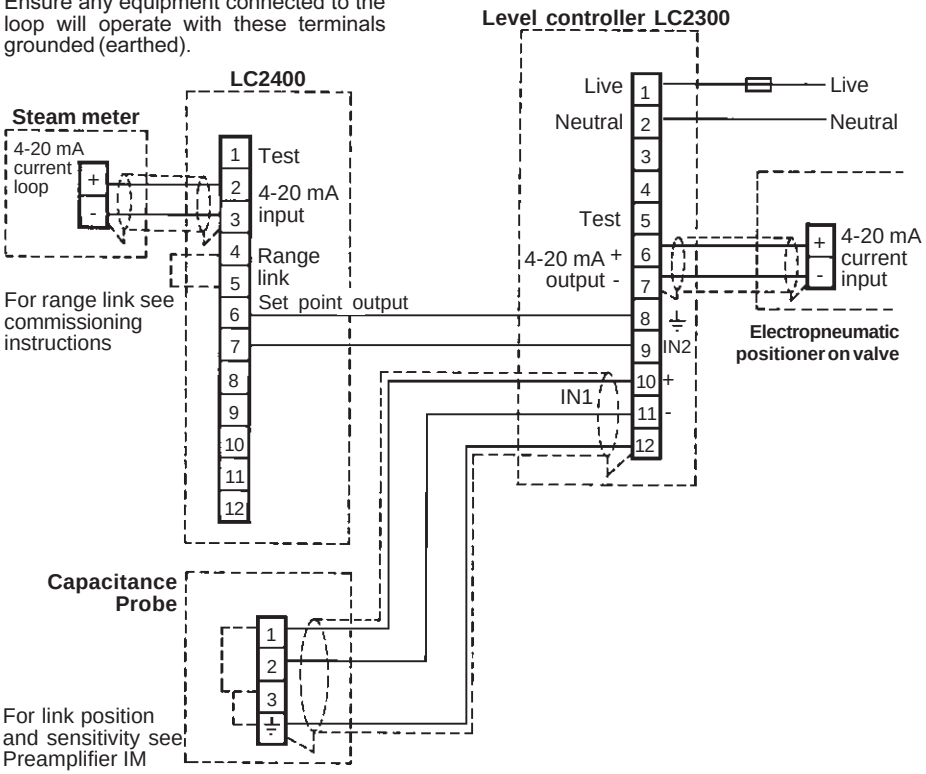
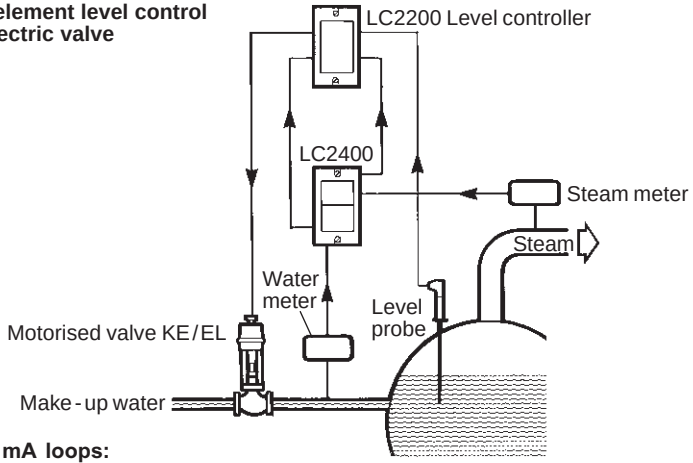


Fig. 3 Three element level control with electric valve



Note on 4-20 mA loops:
Steam and water meter inputs (terminals 3 and 10) are earthed via the level probe. Ensure any equipment connected to the loop will operate with these terminals grounded (earthed).

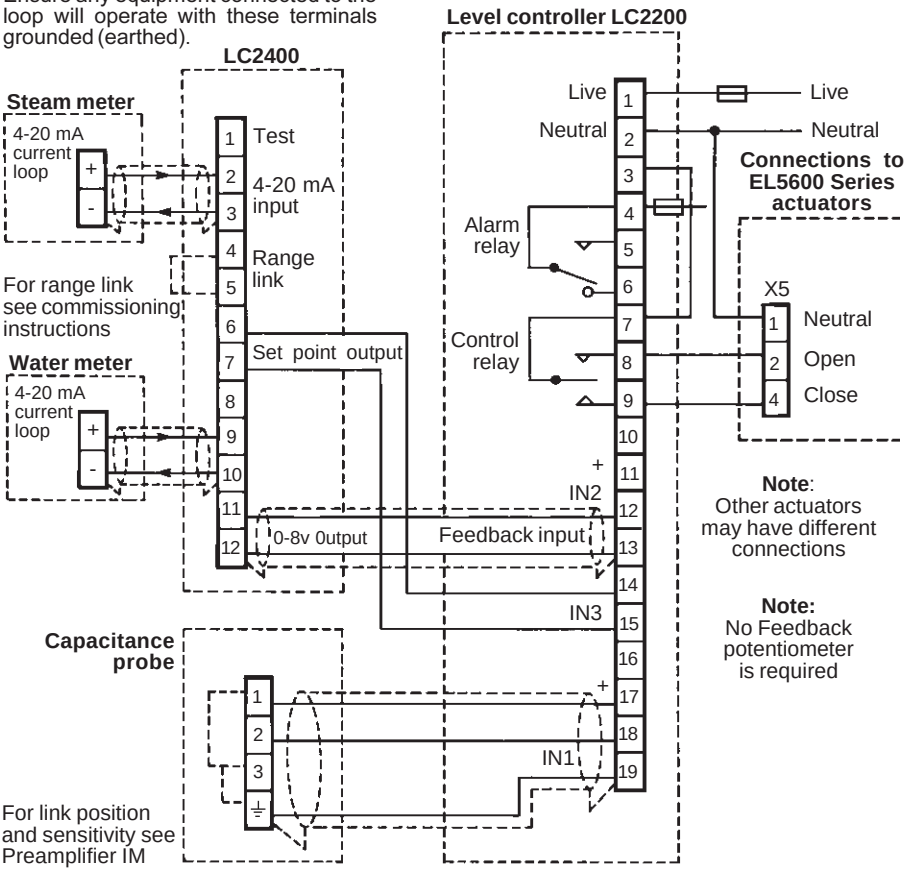
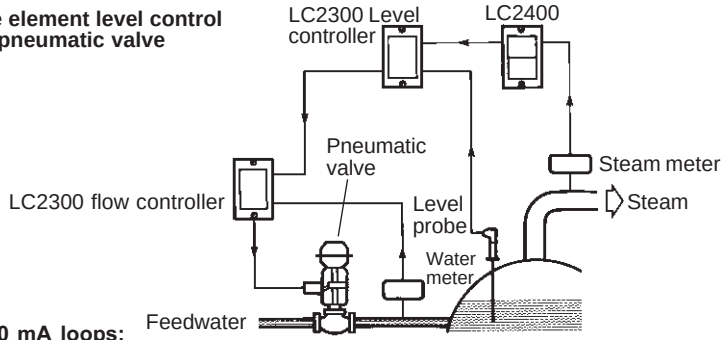
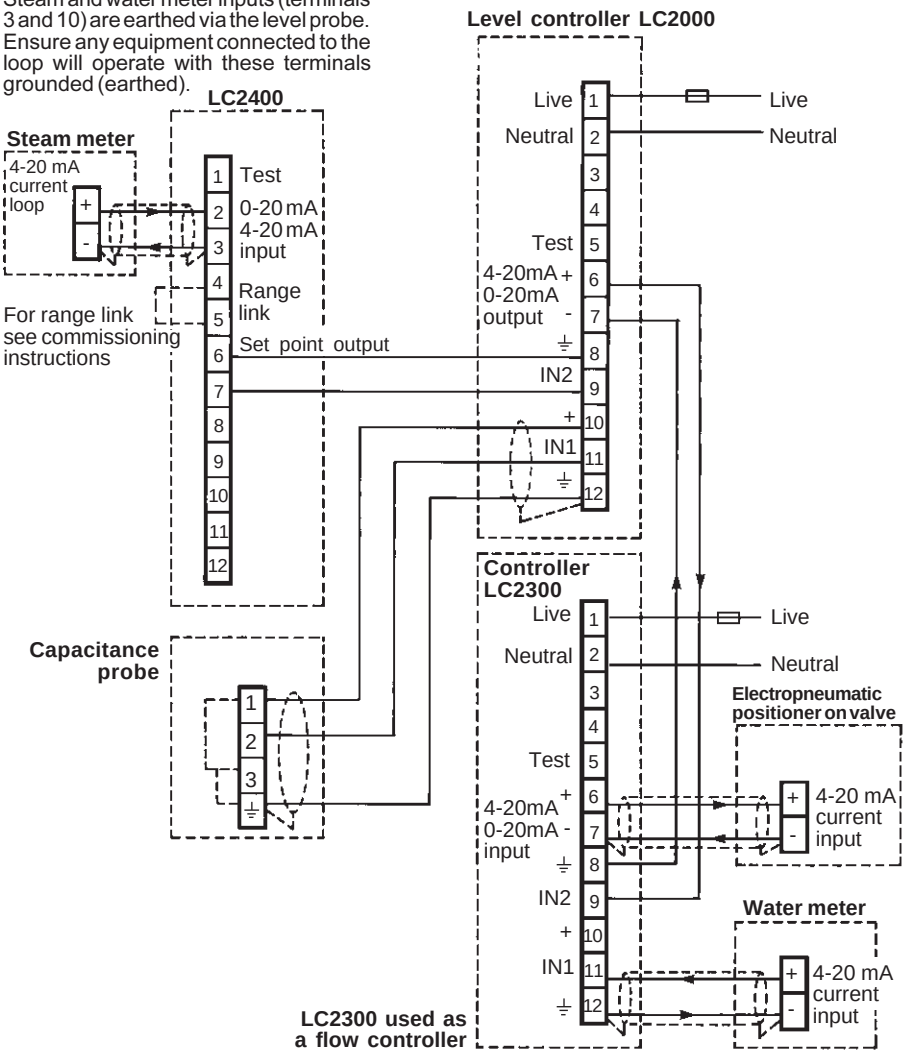


Fig. 4 Three element level control with pneumatic valve



Note on 4-20 mA loops:
Steam and water meter inputs (terminals 3 and 10) are earthed via the level probe. Ensure any equipment connected to the loop will operate with these terminals grounded (earthed).



6. Commissioning

The LC2400 has two channels; 'steam' and 'water', each channel consisting of a 4 - 20 mA input and a scaled output signal. To aid commissioning, each channel has a test input, which allows measurement of the 4 - 20 mA signal without breaking the loop. See figure 5. The 'steam' channel also has a range link, which selects one of two ranges to suit the anticipated rise in water levels. In most cases, the link is fitted. See 'Steam flowmeter input' and figures 6 and 7.
Calibration is carried out by adjusting the 'steam' potentiometer on the LC2400. This raises the control set point to match the rise in boiler water level at maximum steam demand.
For three element control using the LC2200 controller, the 'water' potentiometer is set to suit the water flowmeter range.

Preferred commissioning method Level probe input-

- Adjust the 'steam' potentiometer on the LC2400 to the zero position.
- Set the boiler water level (gauge glass) to the desired normal water level (set point).
- Adjust the LC2200 (or LC2300) set point potentiometer until the >50 % green LED just lights.
- Set the boiler water level to either the top or the bottom of the desired proportional band (valve fully closed / fully open position), whichever is most convenient.
- Adjust the LC2200 (or LC2300) proportional band potentiometer until the >100 % / <0 % amber LED just lights

The IM for the LC2300 gives further details of this procedure.

Steam flowmeter input

- Fit a wire link between terminals 4 and 5 of the LC2400.
- Alter the boiler water to the level anticipated when the steam demand is 100 %, i.e. maximum steam flow.
- Adjust / program the steam flowmeter to output a 4 - 20 mA signal representing 75 % of maximum steam flow (usually 16 mA). See note below.
- Adjust the 'steam' potentiometer on the LC2400 until the green >50% LED on the LC2200 / LC2300 just extinguishes.
- Alter the water level to the set point (at zero steam flow).
- Adjust / program the steam flowmeter to output a signal representing 0 % of steam flow (4 mA).
- Adjust the 'set point' potentiometer on the LC2200 / LC2300 until the green LED just lights.

Notes: If the green LED does not extinguish then remove the range link from terminals 4 and 5 then readjust the 'steam' potentiometer.
In use, the steam flowmeter output is 4 mA at zero steam flow, and 20 mA at maximum steam flow. However, when we adjusted the LC2200/ LC2300 set point the steam input was equivalent to zero output from the steam meter, not 4 mA. The steam flowmeter was set at 75% output to compensate for this.

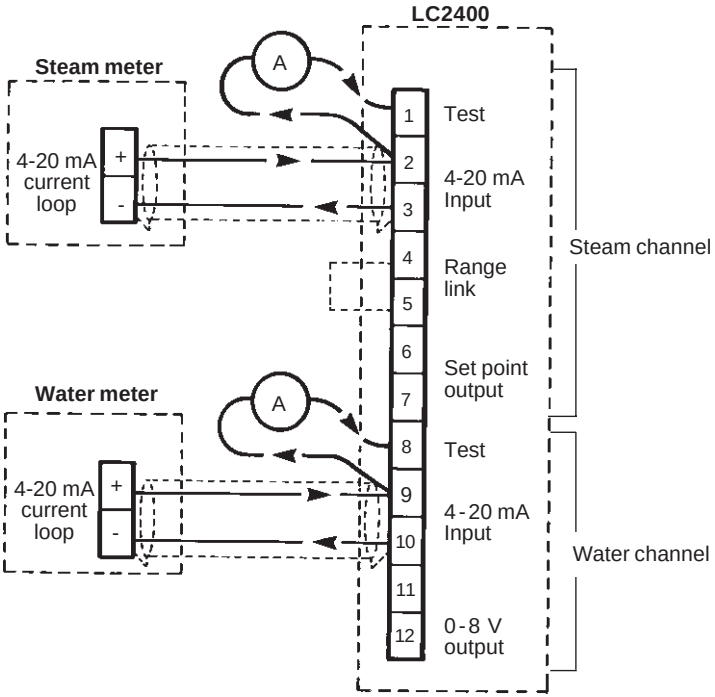


Fig. 5

Feedwater input (Three element control using LC2200)

- Calculate the output current of the water meter when the water flow is equal to the rated steam flow:-

$$\text{Output current (milli-amps)} = \frac{(\text{rated boiler output} \times 16)}{(\text{flowmeter range})} + 4$$

Note: It is essential that the units for the water flowmeter and the boiler rating are the same. i.e that both are in kg/h or lb/h

Example: A boiler has a rated output of 8 000 kg/h. The water flowmeter outputs 20 mA for a maximum flow of 12 000 kg/h:-
The output current of the meter for this size of boiler is:-

$$\text{Output current} = \frac{8\,000\ \text{kg/h} \times 16}{12\,000\ \text{g/h}} + 4 = 14.67\ \text{mA}$$

- Calculate the water calibration value with the following formula:

$$\text{Water calibration value (WCV)} = \frac{75}{\text{Output current (above mA)}}$$

i.e. For the example shown above, the output current is 14.67 mA giving a water calibration value of:

$$\text{WCV} = \frac{75}{14.67\ \text{mA}} = 5.1$$

Set the 'water' potentiometer to the water calibration value.

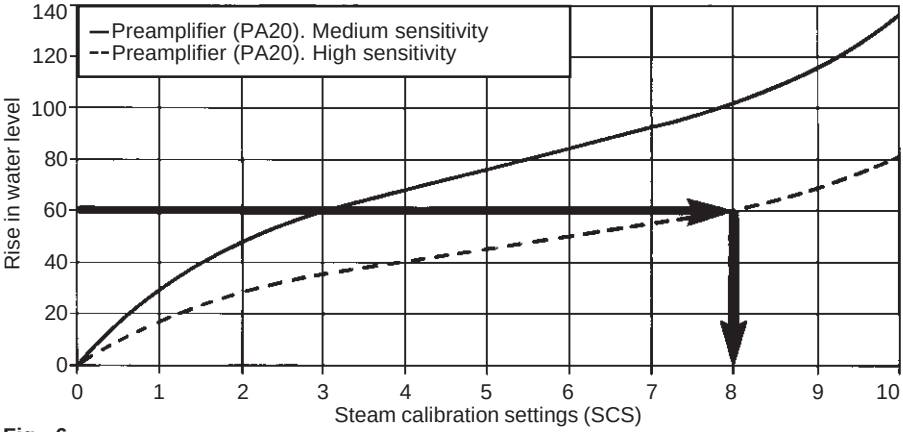


Fig. 6
Rise in water level less than 80 mm. PA20 preamplifier set to high sensitivity (range link fitted)
Rise in water level less than 140 mm. PA20 preamplifier set to medium sensitivity (range link fitted)

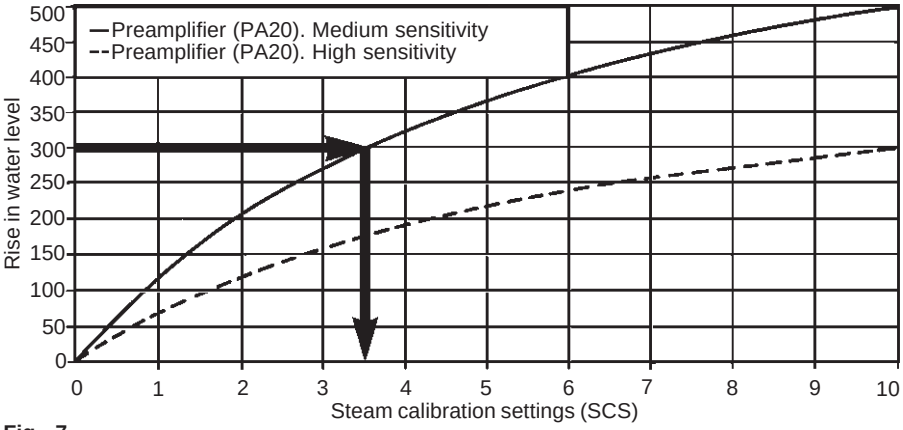


Fig. 7
Rise in water level less than 80 mm. PA20 preamplifier set to high sensitivity (range link fitted)
Rise in water level less than 140 mm. PA20 preamplifier set to medium sensitivity (range link fitted)

Alternative graphical method of commissioning the steam input. (Probe with PA20 only)
Figure 6, (also shown on the controller front panel), and figure 7 offer a convenient, though less accurate method of commissioning the steam input.

If the anticipated water level rise is:-
- less than 80 mm and the PA20 preamplifier is set to high sensitivity,

or
- less than 140 mm and the PA20 is set to medium sensitivity, then insert a range link between terminals 4 and 5 of the LC2400 and use figure 6.

If the anticipated water level rise is:-
- greater than 80 mm and the PA20 is set to high sensitivity,

or
- greater than 140 mm and the PA20 is set to medium sensitivity, do **not** insert a range link and use figure 7.

The graphs are used for a steam flowmeter with a change in output current of 16 mA (4-20 mA). If a steam flowmeter has a fixed current output, use the following formula to scale the rise in water level.

$$\text{Scaled rise in water level (mm)} = \frac{\text{Steam flow at 100\% demand (kg/h)}}{\text{Maximum steam meter rating (kg/h)}} \times \text{Actual rise in level (mm)}$$

To commission the LC2400 using the graphs:-
The two curves on each graph correspond to the sensitivity settings selected in the connector of the PA20 preamplifier.

- From the set point position on the gauge glass measure the required rise in water level caused by a steam demand.
- Note where the rise in water level meets the relevant curve on the graph.
- Read off the steam calibration setting on the bottom line of the graph.
- Set the 'steam' potentiometer to the position indicated by the graph.

The following examples demonstrate how to use the graphs:-

Example 1. If the water level is expected to rise by 60 mm when there is a 100% steam demand, and the preamplifier sensitivity is high, then the steam calibration setting is 8. (Figure 6, link fitted).

Example 2. If the water level is expected to rise by 300 mm and the pre-amplifier is set to medium sensitivity, then the steam calibration setting of 3.5 is obtained from the upper curve in figure 7. The link is not fitted in this case.

7. Calibration notes

The graphs can be used to check that the calibration is correct by projecting up from the pre-set steam calibration rise to confirm the water level rise. Both methods of calculation depend on an accurate assessment being made of the rise in water level/change in set point under full steam flow (maximum demand). This rise in water level can vary according to operating conditions, for example steady maximum steam demand or intermittent, sudden demand, and factors such as boiler pressure and water TDS level. There will also be a difference in level between the boiler and the gauge glass under different firing conditions and steam demands. Accordingly, further adjustment to the settings may well be necessary to achieve optimum performance. A change in the pattern of steam demand, for example when extra heating is needed in winter, may also require the settings to be adjusted.

8. Maintenance

No special servicing or maintenance of the LC2400 is necessary. Boiler water level controls and level alarms, however, do require regular testing and inspection. General guidance for the UK is given in Health and Safety Executive Guidance Note PM5. For specific instructions for Spirax Sarco systems please see separate literature.

9. Fault finding

Most faults which occur on commissioning are due to incorrect wiring or setting up.
If there are problems, check:-

Green LED(s) not lit - No supply from current loop present.

Loop connections reversed - polarity incorrect.

Note:
For a two element system using the input from a steam flowmeter, the 'water' LED will not light.