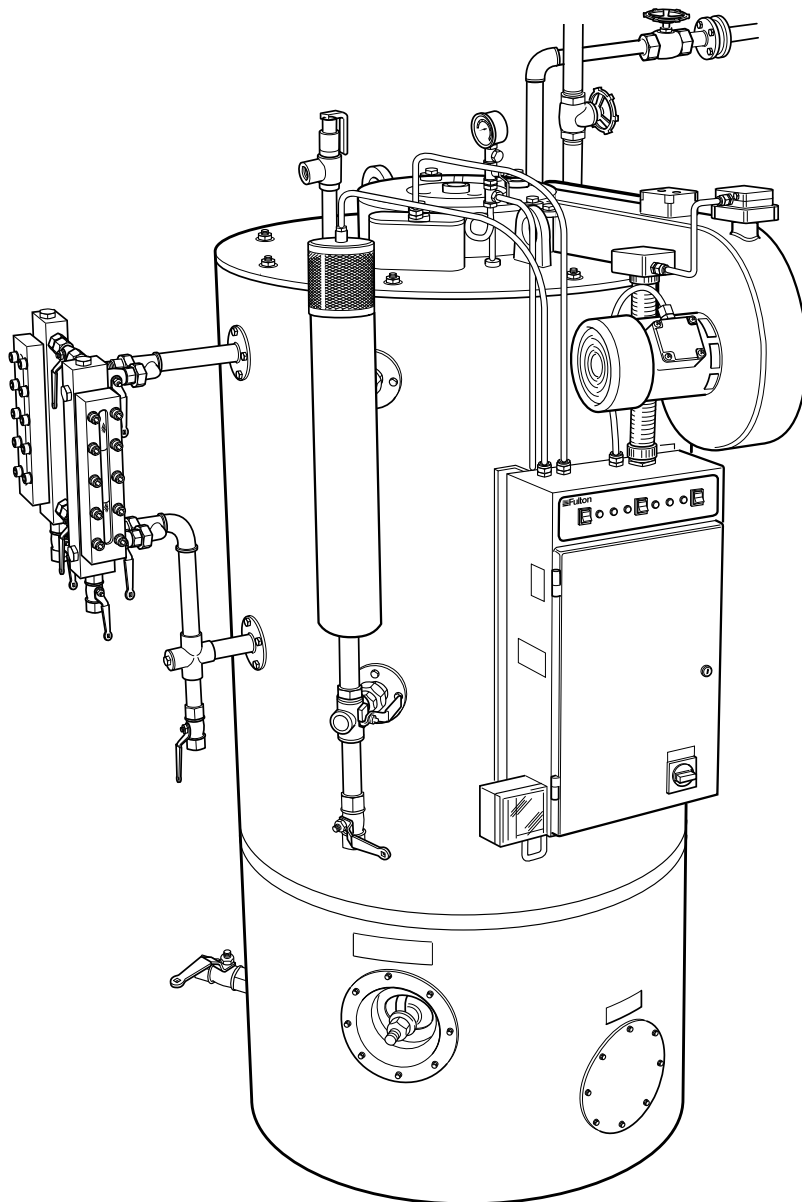


INSTALLATION, OPERATION, MAINTENANCE AND PARTS MANUAL



JFS Series - OIL FIRED STEAM BOILER

This Manual must be available to the boiler operator at all times.

IN CASE OF EMERGENCY

This boiler has been designed and constructed to meet all of the essential requirements of the applicable European Directives and subject to proper maintenance should not give occasion to any hazardous conditions. If such a condition should occur during commissioning or during subsequent operation of this product, what so ever the cause, then the fuel supply to the boiler should be isolated immediately, until such time that the fault has been investigated by a competent person and rectified.

WARNING

Steam Boilers are a potential hazard possibly fatal if not properly maintained.

Only Corgi registered personnel are allowed to work on the gas components of this boiler.

It is vitally important that the instructions given in this manual are strictly adhered to. Failure to carry out the routine maintenance checks could result in a drastic reduction in the life expectancy of the boiler.

Continual improvement in boiler design and fittings may result in some of the components used being different to those in this manual, if in any doubt about individual components or their operation, contact Fulton Service Department.

NOTE

The Pressure System Safety Regulations 2000

Fulton Boilers fall within the scope of the Pressure Systems Examination Scheme. Regular inspections are therefore required by a 'Competent Person'.

The scope of the examination and the actual intervals between examinations is at the discretion of the competent person.

It is the responsibility of the user to provide a written scheme of examination for those parts of the system in which a defect may give rise to danger.

Instructions in this manual are provided for the safe operation and maintenance of the boiler and do not cover periodic statutory inspections.

For further information contact:-

- (a) SAFed
SAFETY ASSESSMENT FEDERATION Limited.
Nutmeg House,
60 Gainsford Street,
Butlers Wharf,
London, SE1 2NY.
- (b) Health and Safety Executive local office.
- (c) Your Competent Person.

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SAFETY

The instructions provided for the operation and maintenance of the boiler MUST be observed. Failure to do so could result in damage to the boiler and serious personal injury.

WARNING

It is the responsibility of the installer to ensure all parts supplied with the boiler are fitted in a correct and safe manner.

WARNING

Do not try to do repairs or any other maintenance work you do not understand. Obtain a Service Manual from Fulton or call a Fulton Service Engineer

WARNING

Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and or damage.

WARNING

A defective boiler can injure you or others. Do not operate a boiler which is defective or has missing parts. Make sure that all maintenance procedures are completed before using the boiler.

WARNING

HYDRAULIC TEST - RISK OF BRITTLE FRACTURE
Hydraulic testing requires specialist equipment and is normally only required by engineering surveyors / inspectors. The material the boiler is manufactured from, has not been impact tested, as it is not a requirement of BS2790 (boiler construction standard). In order to ensure the material / pressure vessel does not suffer from brittle fracture, hydraulic testing should not be carried out below 5°C.

WARNING

The importance of correct boiler water and feed water cannot be over emphasised, see the relevant section in this manual.

CAUTION

LOW FEED WATER TEMPERATURE

Low feed water temperature can result in thermal shock to the boiler pressure vessel. Return the maximum amount of condensate and if necessary pre-heat the feed water. If in doubt consult FBW.

CAUTION

Obey all laws and local regulations which affect you and your boiler.

WARNING

Only qualified persons should be allowed to operate and maintain the boiler and its equipment. Boilers should always be drained through an approved Blowdown Vessel.

WARNING

Do not change the boiler fuel without consulting the boiler manufacturer.

WARNING

Non-approved modifications can cause injury and damage. Contact your Fulton dealer before modifying the boiler.

WARNING LIFTING EQUIPMENT

Make sure that lifting tackle complies with all local regulations and is suitable for the job
You can be injured if you use faulty lifting equipment. Make sure the lifting equipment is in good condition.

WARNING

Operating the boiler beyond its design limits can damage the boiler, it can also be dangerous. Do not operate the boiler outside its limits. Do not try to up grade the boiler performance by unapproved modifications.

WARNING

DANGER FROM HOT SURFACES

Steam Boilers have high temperature surfaces, that if touched may cause serious burns. Only competent and qualified personnel should work on or in the locality of a steam boiler and ancillary equipment. Always ensure the working area and floor are clear of potential hazards, work slowly and methodically.

WARNING

DANGER FROM INCOMPLETE COMBUSTION

The importance of correct burner adjustment to achieve low emissions, safe, clean and efficient combustion is paramount. Poor combustion, where unburnt oil forms carbon monoxide is both a health hazard, and the potential risk to the boiler from overheating, caused by re-burning of the unburnt gas in the secondary flue passes.

CAUTION

WATER SOFTENER and CHEMICAL TREATMENT

The chemicals required to operate the water softeners and chemical treatment plants are **NOT SUPPLIED** by Fulton. It is the responsibility of the operator to ensure adequate supplies of chemical are available at all times (including commissioning).

Costly repairs could be required should the plant operate without chemicals or the wrong dosage of chemicals.

Optional Variations (where fitted)**Appendix**

Spirax High Integrity Level Controls

C

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SPARE PARTS

Refer to Fulton for required spare parts.

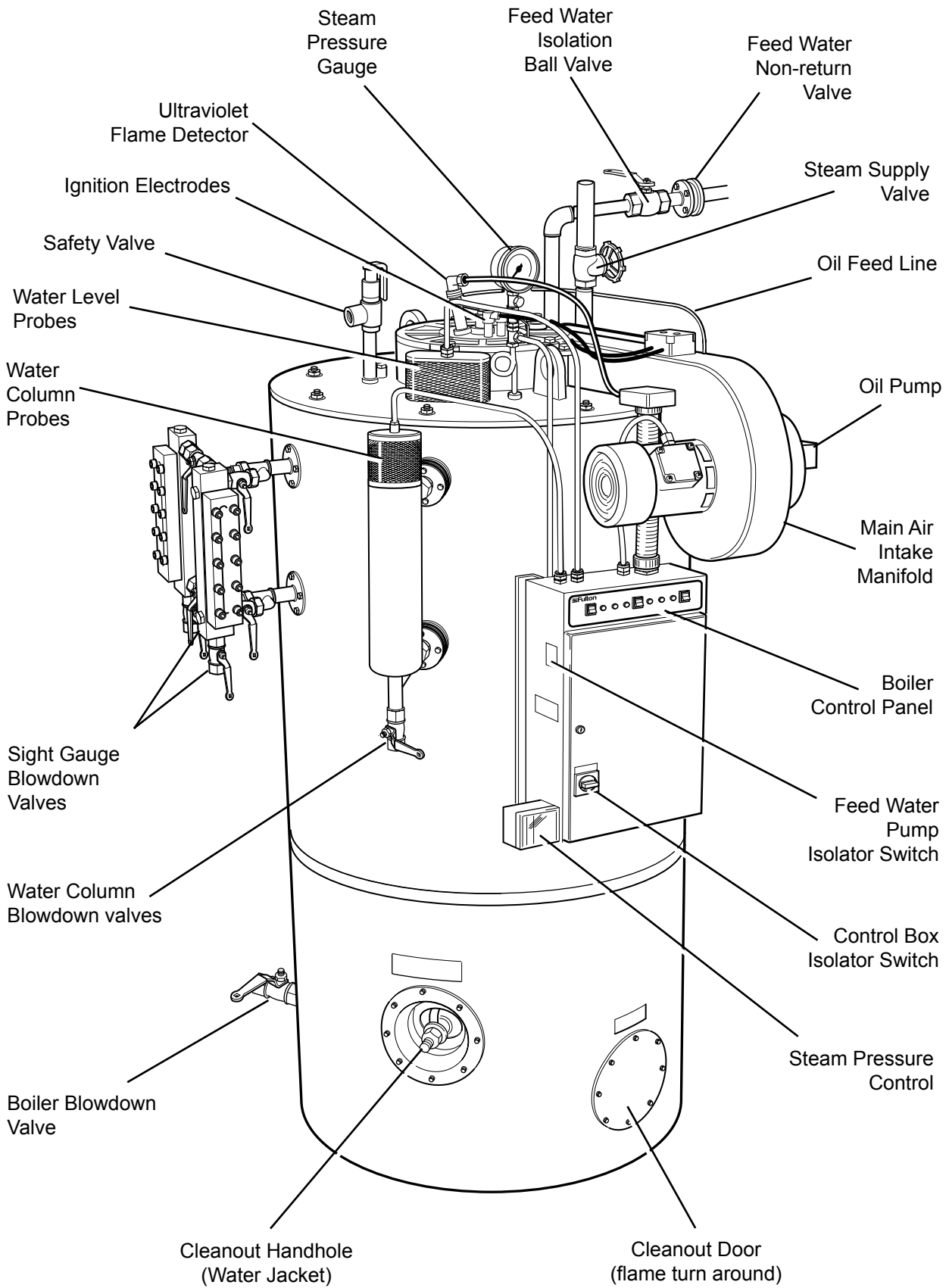


FIG.1 OIL FIRED STEAM BOILER

INTRODUCTION

SECTION 1

1.1 General

The Fulton JFS Series Oil Fired Steam Boiler is a vertical two-pass boiler of simple and efficient design and construction, incorporating a larger heat transfer surface than standard boilers it meets the peak demand for steam over a relatively short period of time, ideal for applications such as sterilisers and autoclaves.

The larger steam release surface area, results in a more stable water level under peak load conditions, producing higher quality steam.

Every care has been taken in the manufacture of the boiler to ensure that quality and reliability standards are maintained. Satisfactory performance can only be ensured if the installation recommendations, operating routines and maintenance schedules laid out in this manual are adhered to.

Particular attention should be paid to electrical installation and water treatment.

1.2 Technical Data

for a full specification refer to Section 5.

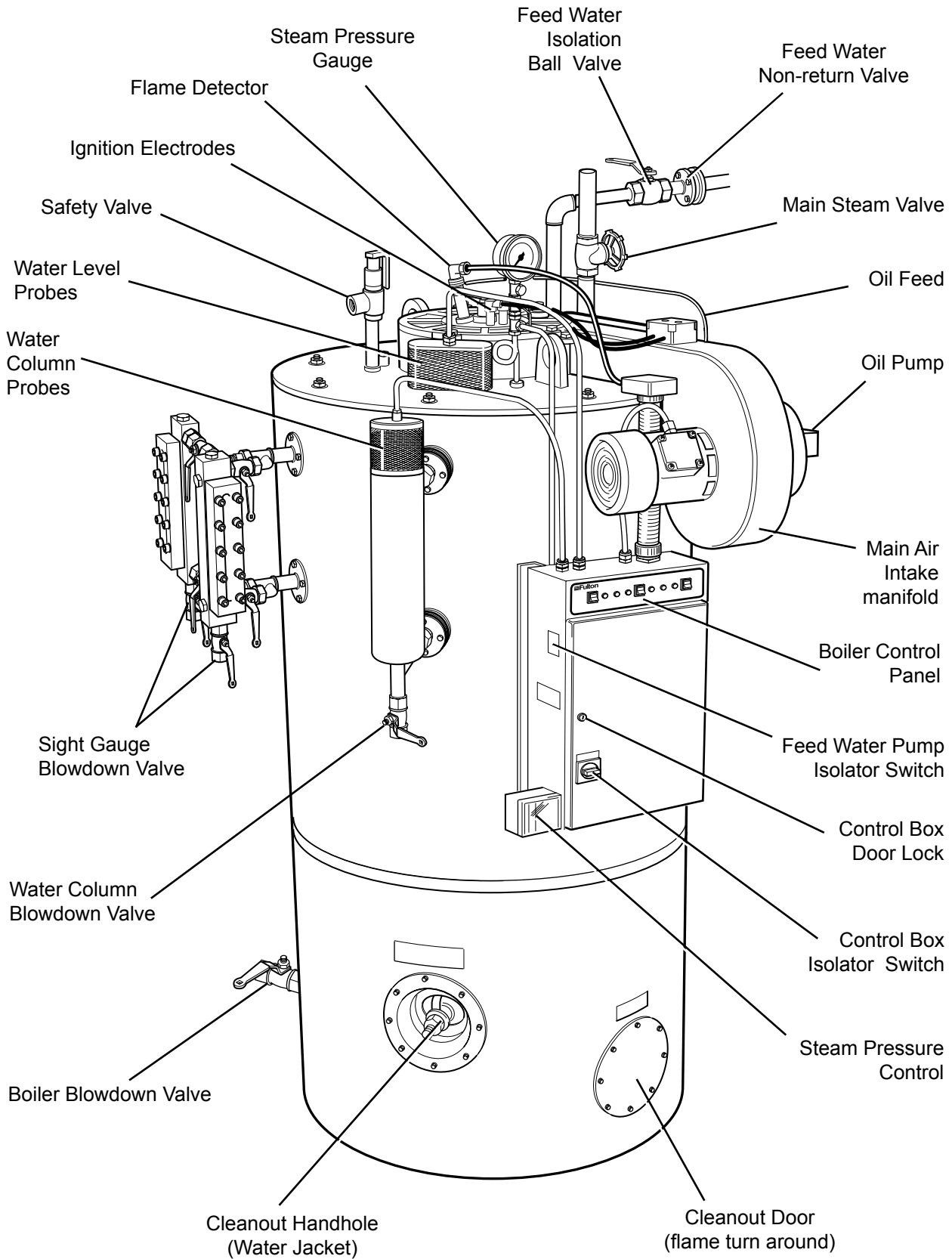


FIG. 2 GENERAL ARRANGEMENT

INSTALLATION

SECTION 2

2.1 GENERAL

The installation of a JFS Series Oil Fired Steam Boiler should be carried out by competent personnel in accordance with all relevant safety regulations. It is the responsibility of the installer to ensure that these regulations are complied with.

2.2 SITING

The boiler house should be sufficiently large to allow easy and safe access to all parts of the boiler for installation, operation and maintenance purposes. Reference should be made to **Section 5 - General Data** to ascertain the relevant dimensions and special note taken of the vertical clearance required for the removal of the burner.

The flooring must be level, laid in a non-combustible material and be of sufficient strength to support the boiler.

2.3 VENTILATION

Adequate fresh, clean air is necessary for safe and efficient combustion, and should be provided at high and low level in accordance with IGE/UP/10 Edition 2. It is essential that only fresh air is allowed to enter the combustion air system. Foreign substances, such as combustible and volatile materials in the combustion system can create hazardous conditions.

Note:

- (a) *Ensure there is adequate ventilation in the boiler room. Lack of ventilation will create a high temperature and cause control lockout.*
- (b) *Do not keep exhaust fans running with windows, doors and vents closed, this will interfere with the necessary boiler draught.*
- (c) *Do not store chemicals such as perchlorethylene in the boiler house, the fumes may damage the boiler and flue and cause the burner to lock out on flame failure.*

Ventilation requirements

Boiler Model	22	33	55
High Level (cm ²)	420	560	700
Low Level (cm ²)	835	1115	1395

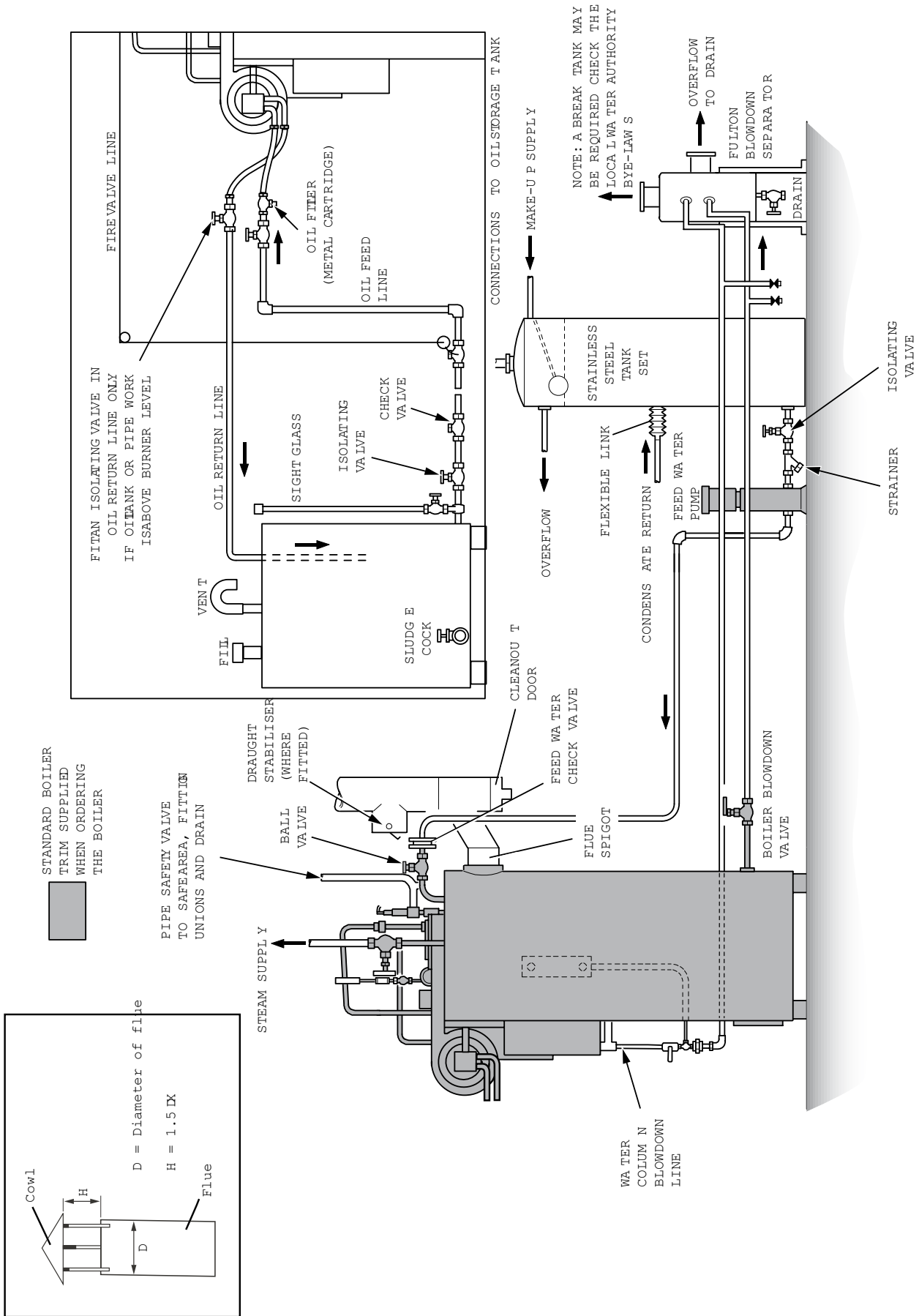


FIG. 3 TYPICAL INSTALLATION

2.4 FLUE OUTLET

The boiler is supplied with a stainless steel flue spigot that should be inserted into the flue outlet in the back of the boiler and secured with the three angle clips supplied loose in the trim box.

The height and type of flue will generally be subject to local planning regulations and approvals. The following information is intended to provide assistance where the installation of a simple flue is required. Where multi-boiler flues or difficulties are experienced, specialist advice should be obtained.

The flue diameter must be the same or larger than the flue flange provided with the boiler and the outlet should be at least 1 meter higher than the nearest ridge to avoid down draughts. Where a chimney cowl is fitted, care should be taken to ensure that the distance between the lowest point of the cowl and the top of the flue is 1.5X the diameter of the flue, and that it is of the terminal cone type.

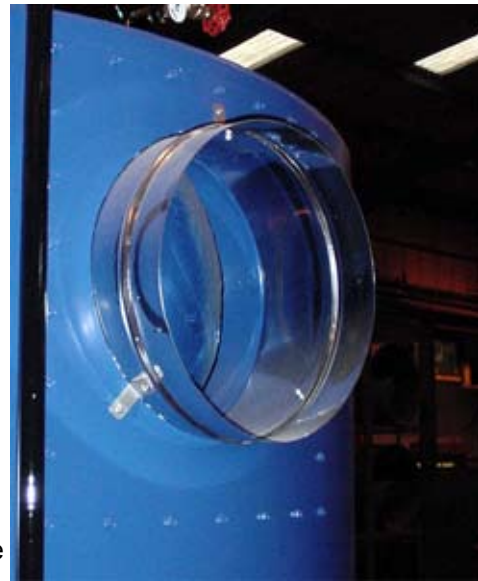


FIG. 4 BOILER FLUE CONNECTION

Note:

1. *If the flue layout is such that it may produce an excessive up-draught, a draught stabiliser may be required.*
2. *Avoid fitting 90deg. elbows whenever possible, if unavoidable compensate by increasing the flue diameter.*
3. *Ensure all flue pipes from the boiler to the main flue have a rising pitch.*

2.5 WATER SUPPLY

The quality of the water used in the boiler will affect the life and performance of the boiler. Feed water contains solids and dissolved gases, these may promote encrustations of scale; foaming, priming, surging; corrosion and pitting; or caustic embrittlement. To prevent this happening it is strongly recommended that a reputable water treatment concern is consulted prior to commissioning the boiler.

Note: see Section 5 Water Treatment.

Connect the feed water pump discharge to the check valve inlet with 25 mm. bore pipe (this may be reduced to 15 mm, where the discharge pipework is shorter than 4m in total. the pump suction pipework must remain at 25mm minimum diameter and be as short as possible), insert the stop valve supplied, between the boiler and the check valve.

It is essential to protect the feed water pump from damage by foreign matter, a strainer should therefore be fitted in the pump suction pipework Care should be taken to ensure the pipework is properly aligned and not placing any strain upon the feed water pump.

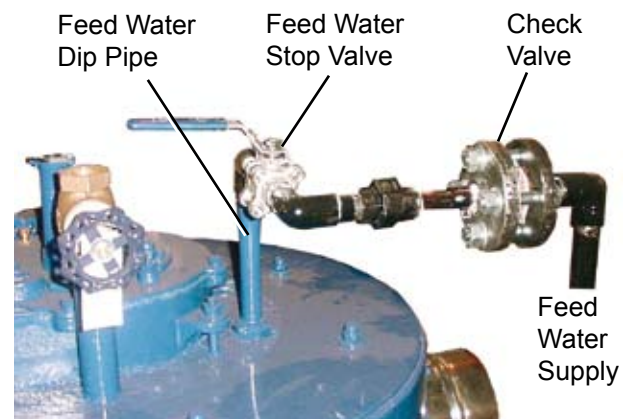


FIG. 5 BOILER FEED WATER ARRANGEMENT

Note:

1. *The boiler feed water pump may contain an inhibitor and this should be flushed from the pump prior to fitting the pump to the boiler. Failure to do so may result in water bounce or foaming due to the inhibitor forming a seal in the boiler.*
2. *If the boiler is to be operated with little or no condensate return, consideration should be given to pre-heating the feed water. If in doubt consult Fulton Boiler Works.*
3. *The feed water inlet connection on some boilers is located on the left hand side of the boiler below the sight glass assembly.*

2.6 BLOWDOWN VALVES

There are three blowdown valves on the boiler (four if two water gauge sets are fitted), the boiler blowdown valve at the rear of the boiler, the water column blowdown valve and the water gauge blowdown valve.

All of these valves must be connected to a blowdown receptacle of approved design. Regulations exist covering such items and care must be taken to ensure compliance with these regulations. If in doubt regarding blowdown arrangements, consult your Fulton agent.



FIG. 6 BOILER BLOWDOWN

2.7 MAIN STEAM VALVE

The main steam stop valve should be inserted in the steam line approximately 12in. (305 mm) from the top of the boiler.



FIG. 7 MAIN STEAM VALVE

2.8 STEAM SAFETY VALVES

Safety Valves are factory fitted and preset, they **MUST NOT** be adjusted. The discharge outlet should be piped to a safe discharge point and the piping so arranged that any condensate trapped in the pipework will drain away from the valve.

- (a) The lift pressure is indicated on the safety valve. **(Do not adjust).**
- (b) The safety valve fitted to the boiler is designed to prevent the boiler exceeding it's design pressure.
- (c) Any system connected to the boiler not capable of accepting boiler pressure must be protected by a separate safety valve set to the required pressure.
- (d) Long radius fittings to be used with a minimum of 6 diameters to the first fitting.

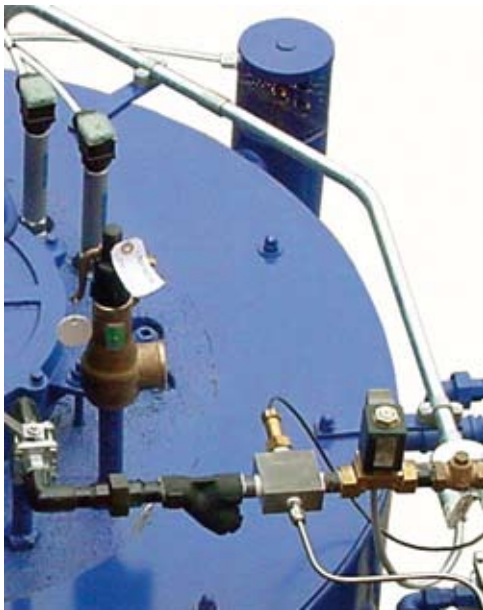


FIG. 8 SAFETY VALVE

WARNING

Factory fitted safety valves are preset to protect the boiler only and must not be used to protect any other items not capable of accepting boiler pressure.

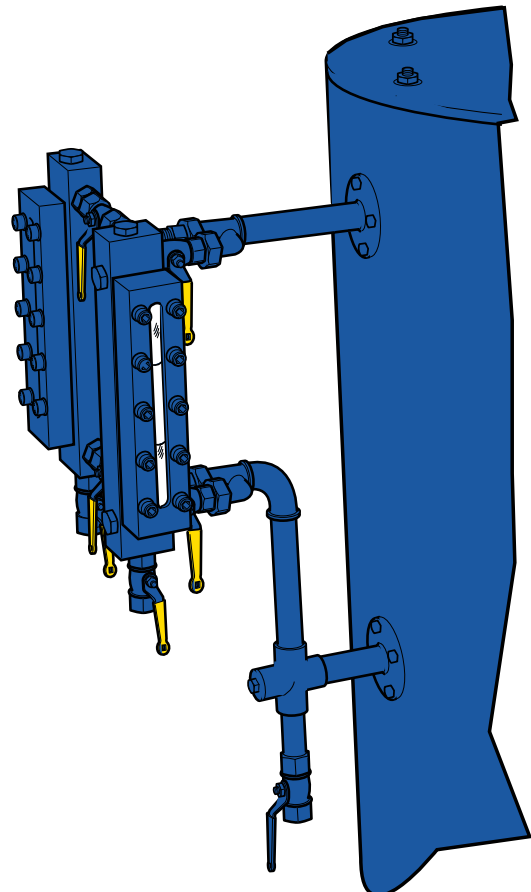


FIG. 9 WATER GAUGES

2.9 WATER GAUGE SET

(The design may vary from that illustrated)

Numbers may vary due to individual countries regulations.

Boilers are normally supplied with two complete water gauge sets. The water gauge blowdown cock should be connected to the auxiliary blowdown line from the water column blowdown valve in soft copper tubing.

The connection to the gauge cock is 6mm (0.25in.).

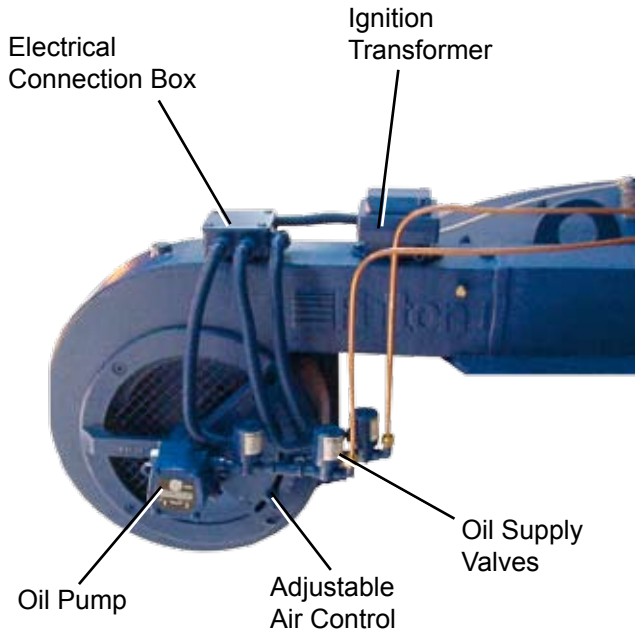


FIG.10 OIL SUPPLY

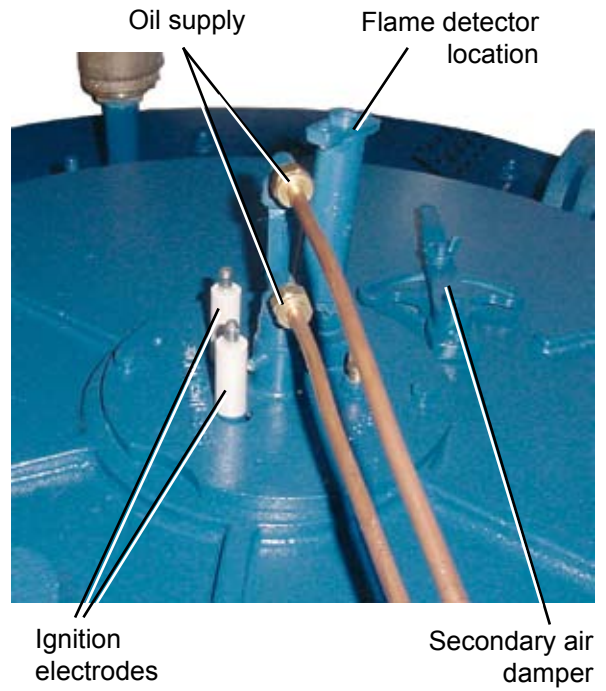


FIG.11 IGNITION ELECTRODES

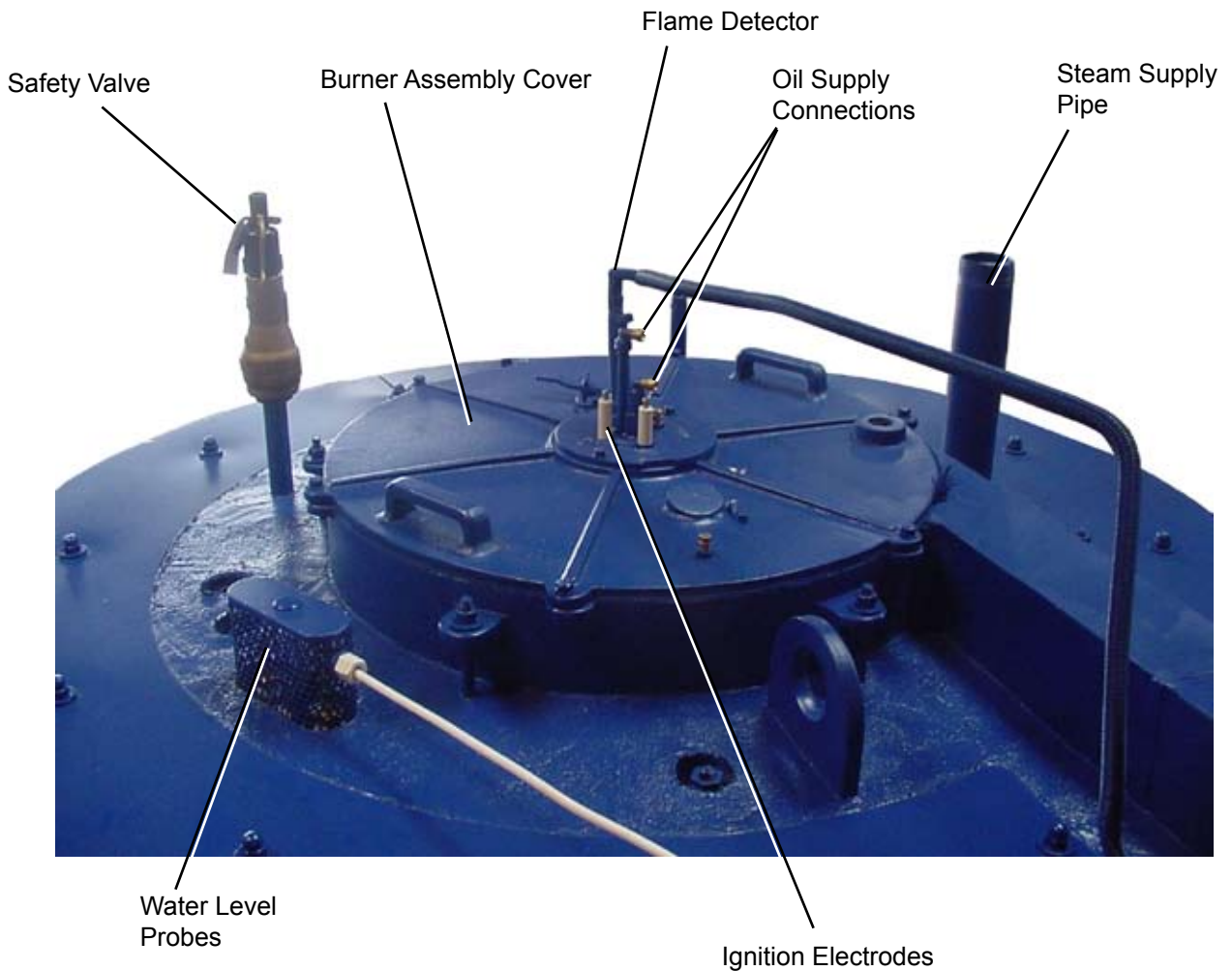


FIG. 12 BOILER TOP COMPONENTS

2.10 OIL SUPPLY

The positioning of the oil storage tank will be dependent on site conditions and local regulations. The burner fuel pump is of the bypass type requiring the installation of feed and return lines between the oil storage tank and the boiler. These lines should be in tubing of a minimum bore of 10 mm.

A fire valve, stop valve and check valves should be inserted in the oil feed line.

To avoid blockages in the fuel pump and burner nozzle, a metal cartridge oil filter should be fitted. Fibrous cartridge filters are not recommended.

The final connections between the fuel pump and the feed and return lines should be made with the flexible fuel lines supplied. If the oil storage tank is positioned higher than the boiler, a non-return valve should be fitted to the return line.

To overcome suction problems at the fuel pump, all vertical lifts in the feed pipe should be made as close to the boiler as possible. The burner fuel pump pressure is preset at the factory and should not require adjustment.

2.11 ELECTRICAL REQUIREMENTS

An individual wiring diagram for the boiler is located on the inside cover of the control box. When referring to the electrical specification of the boiler, the reference number located on the rear inside wall of the control box and the wiring diagram number should be quoted.

The audible alarms provided are mounted on the side of the control panel, if not audible they should be repositioned where they can be heard by a person competent to take the appropriate action should the alarm be activated.

Unless otherwise specified, the alarms supplied will be mains voltage models. Unless otherwise specified all models are supplied with burner motors and feed water pump motors arranged for operation on a three phase supply.

The power ratings and requirements are given in Technical Data - Section 5.

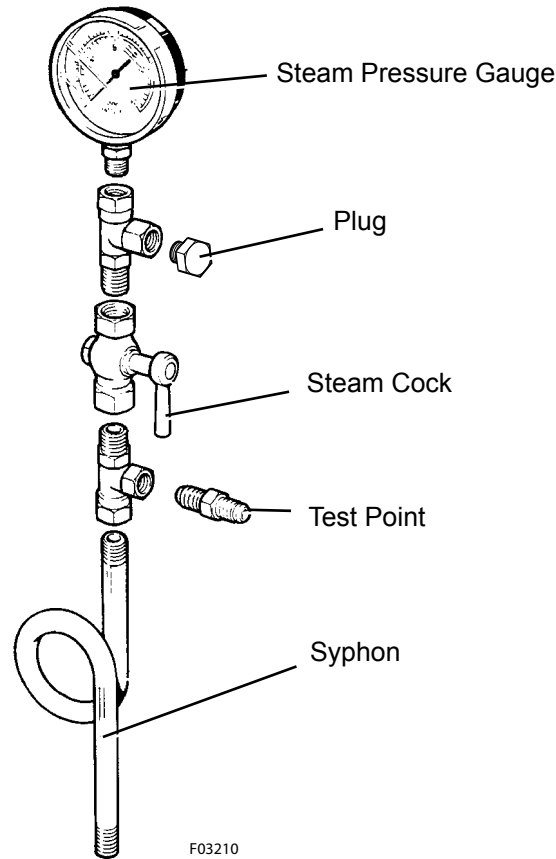


FIG. 13 STEAM PRESSURE GAUGE

2.12 STEAM PRESSURE GAUGE

The steam pressure gauge assembly should be assembled in accordance with **Fig. 9** using a suitable sealant on all joints.

The gauge should be facing towards the electrical control box and/or the operator of the boiler. Screw the assembly into the top of the boiler and connect the copper tube from the pressure controller located on the side of the control box to the nipple provided on the assembly.

2.16 COMMISSIONING THE BOILER

It is essential that the commissioning procedures listed below are carried out by a Fulton Service Engineer who will have the necessary experience and testing equipment to ensure that the installation is not only correct, but is operating safely and at optimum efficiency.

FLUE COMMISSIONING

Prior to initial firing of the boiler, the flue must be checked for leaks. This is done by BOTH of the following methods:

Visual Inspection

Check joints between all flue sections for quality of seals. Where the flue passes through the structure of the building use your judgement as to the integrity of this section of the flue.

Smoke Test

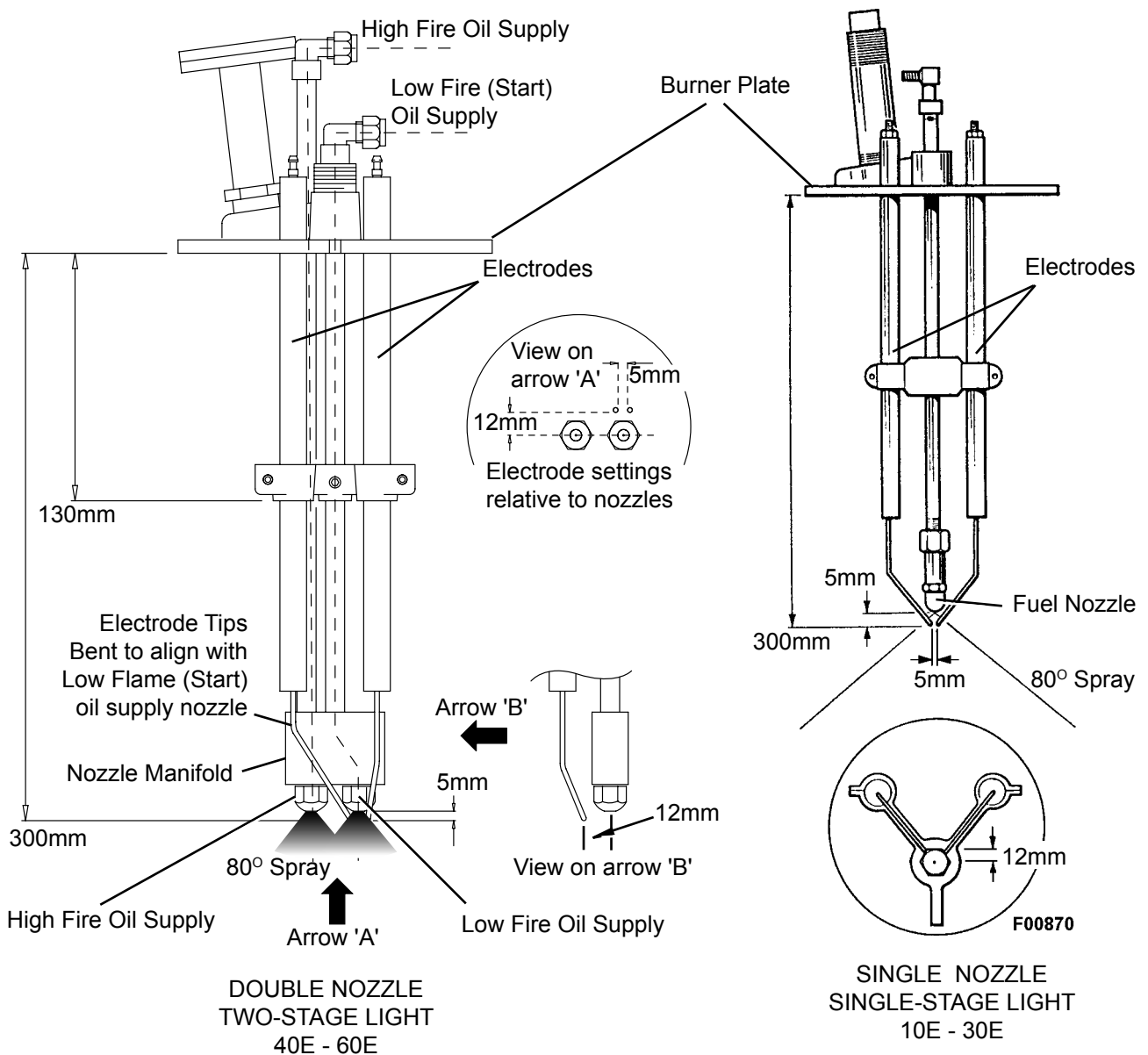
With the flue capped, the drain stabilizer pipe (if fitted) blanked and a smoke generator inserted into the flue, there should be no smoke visible from the flue.

If either of these tests fail or at any time during boiler operation, there is doubt about the integrity of the flue, shut down the boiler and contact Fulton Boiler Works Immediately.

2.16 COMMISSIONING THE BOILER - continued

INSPECTION

- (a) Ensure the boiler has been washed out after installation.
Conduct a water analysis before operating the boiler.
Examine the probes in the water column and the boiler shell.
Replace any damaged probes.
- (b) Remove the burner and check the electrodes have not been damaged and that their settings are correct. If the burner is fitted with a photocell, remove it and check for damage.
- (c) Replace the burner and reconnect the cooper oil line(s) to the oil nozzle assembly, ensuring these connections are tight. Reconnect the ignition leads and replace the sensor.
- (d) Ensure all wiring connections are correct and all terminal screws are tight.



Note: Always place the highest value nozzle (engraved on the side of the nozzle) into the low fire oil supply port in the manifold.

FIG. 14 NOZZLE AND IGNITION ASSEMBLIES

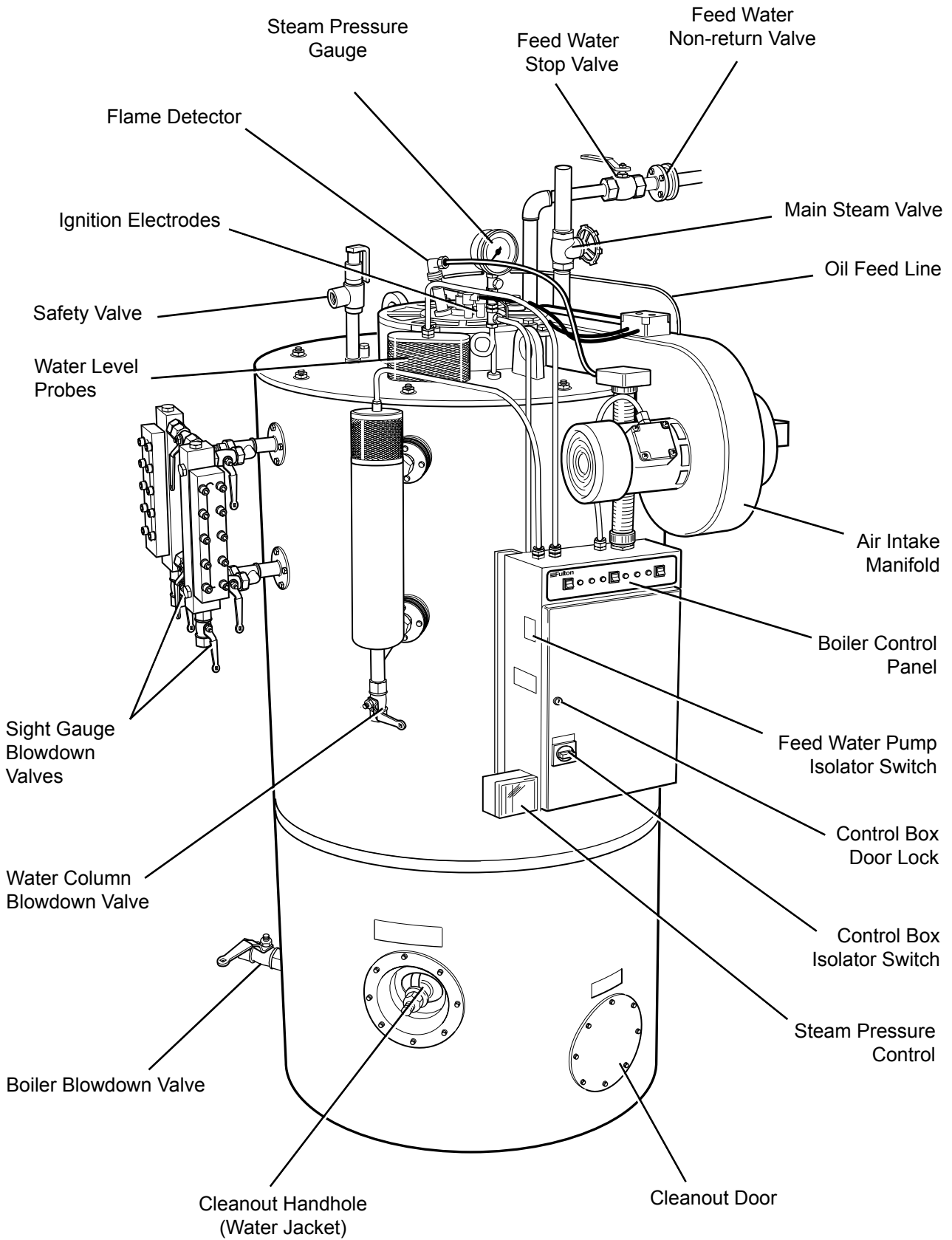


FIG. 15 COMMISSIONING THE BOILER

2.16 COMMISSIONING THE BOILER - continued

- (e) A barometric type draught stabiliser (if fitted in the flue) should be set for a draught of - 0.01in. to - 0.02in. (- 0.025mb to - 0.050 mb) of water column pressure with the burner off.
- (f) Open all the valves in the water feed line.
- (g) Open all the valves in the feed water line.

FEED PUMP

Close the isolating valve on the discharge side of the pump. Remove the priming plug from the pump head and slowly fill the pump with water. Replace the priming plug and tighten securely.

See the correct rotation of the pump on the motor fan cover. Start the pump and check the direction of rotation.

Vent the pump by means of the vent valve in the pump head. At the same time, open the discharge isolating valve a little. Continue to vent the pump. At the same time, open the discharge isolating valve a little more.

Close the vent valve when a steady stream of water runs out of it.

Completely open the discharge isolating valve.

The bypass valve located in the drain plug may be opened during the filling procedure, close the bypass when the operation is stable.

DO NOT ALLOW THE PUMP TO RUN DRY.

- (h) Open all the valves in the water feed line.
Switch on the feed water pump motor and fill the boiler.
The operation of the pump controls should be checked by using the boiler blowdown valve (located at the rear of the boiler).

When the water sight level gauge is reading two thirds full, the pump will stop.

Open the boiler blowdown valve and slowly drain the boiler. When the water level falls below the PUMP ON probe, the pump should start. If the pump does not start check the probe connections.

Close the boiler blowdown valve.

- (i) Close the boiler blowdown valve.
- (j) Start the burner as detailed in Section 3 - Operation. Allow time for the fuel pump to prime itself.
- (k) After the burner has been firing for approximately five minutes, adjust the main air control gate to obtain a clean combustion.
- (l) Observe the flame through the peephole between the electrodes and adjust the primary air control so that the flame cannot be seen 'backing up' the blast tube. Adjust the air main control to obtain a full swirling flame shape brushing the wall of the furnace by observing the flame through the eye glass in the burner plate.
- (m) Check the operation of the low water safety controls as detailed in Section 3 - Operation.

2.16 COMMISSIONING THE BOILER - continued

- (n) Adjust the steam pressure control to suit the boiler application. It should be borne in mind that boiler are designed to operate most efficiently at their maximum operating temperature. When boilers are to be operated below a pressure of 80 psi (5.5 bar) consideration should be given to the fitting of a pressure reducing set (see Section 2.8 - Steam Safety Valves).

If the pressure control is fitted with a differential scale:
(see OEM literature in section 5)

- (i) Set the main scale pressure to the pressure indicated on the boiler data plate.
- (ii) Set the differential scale to it's minimum pressure. If the pressure control has a fixed differential, e.g. no adjustable differential scale, set the main scale to the maximum pressure required.

Note: When boilers are fitted with a sequence control:

- (i) Set the main scale and differential scale as above.
- (ii) Set the set-back pressure control to the required set-back pressure.



FIG. 16 PRESSURE CONTROLLER

Note: In order to utilize the maximum flash steam capability of the boiler it is essential that the boiler is operated at the maximum working pressure (10.34 bar) and then pressure reduced down to the required system pressure.

2.17 CLEANING STEAM LINES AND PRESSURE VESSELS

During the first week of boiler operation, clean all oil and dirt from the boiler, the steam line and condensate return line.

- (a) Disconnect the condensate return pipe adjacent to the condensate return tank.
- (b) Direct the returns to a floor drain or other safe discharge point and make safe.
- (c) Leave in this position for one week to allow all impurities to flush through.
- (d) Drain the boiler completely each day.
- (e) After the week is completed, drain and flush the condensate return tank, removing all installation sediment. Reconnect the condensate return pipe to the condensate return tank.

OPERATION

SECTION 3

3.1 GENERAL

The following instructions are given for the guidance of the operator in the use of the JFS Series oil fired boiler and to provide adequate information to ensure that when the boiler is put into use it will be done safely and without risk to health.

Where original equipment Service Manuals are supplied, they must be read and understood in conjunction with this manual. All Warnings and Cautions must be observed.

DRYING OUT TIME

The refractory casing of the boiler is made from a material that uses a high proportion of water in the mixing process. Whilst some of this water is driven off by chemical reaction and the initial test firing, the refractory is still 'wet' when the boiler is delivered. For the first few days after the boiler is commissioned and in service, water will be seen running from the bottom of the casing and from around some branch pipes. **This is perfectly normal and part of the final drying process.**

3.2 BOILER CONTROLS

The following brief description of the controls used on the JFS Series oil fired boiler is intended to provide the operator with a basic understanding of the operating principles, which is essential for the continued efficient operation of the boiler.

WARNING

**The control circuit live light is derived from a single phase.
It is possible that with the control phase down or a defective
bulb the other phase could be live.
Always isolate the supply before investigating any fault.**

Note:

All the controls are of the 'fail-safe' type and are wired in series; failure of any one will automatically shut down the boiler.

Low Water Safety Relays and Feed Water Pump relays

These relays operate in conjunction with probes suspended in the boiler and water column to automatically maintain the level of water in the boiler and to cut-off the burner should the water level fall to an unsafe level.

Steam Pressure Control(s).

Located on the control panel box and connected to the steam pressure gauge assembly by copper tube the pressure regulator controls the on/off cycle of the burner, shutting the burner off when maximum pressure is reached and switching it on when the steam pressure falls.

Burner Programmer

This is the main control in the panel box. The programmer, in conjunction with a sensing device, 'supervises' the ignition sequence, proves the flame is satisfactory and finally 'monitors' the established flame. Should any fault occur, either during the ignition sequence or during normal running, the programmer will immediately go to 'lockout' and the burner will shut down.

3.2 BOILER CONTROLS continued.

Fuel Pump

Mounted on the burner scroll and driven by the burner motor, the fuel pump delivers oil to the burner nozzles at the correct pressure to allow complete atomisation and therefore combustion.

PUMP CONTROL

Pump Interrupt/Pump Run Switch.

Fitted on the left side of the control panel, used to override (switch off) the pump controls during evaporation tests.

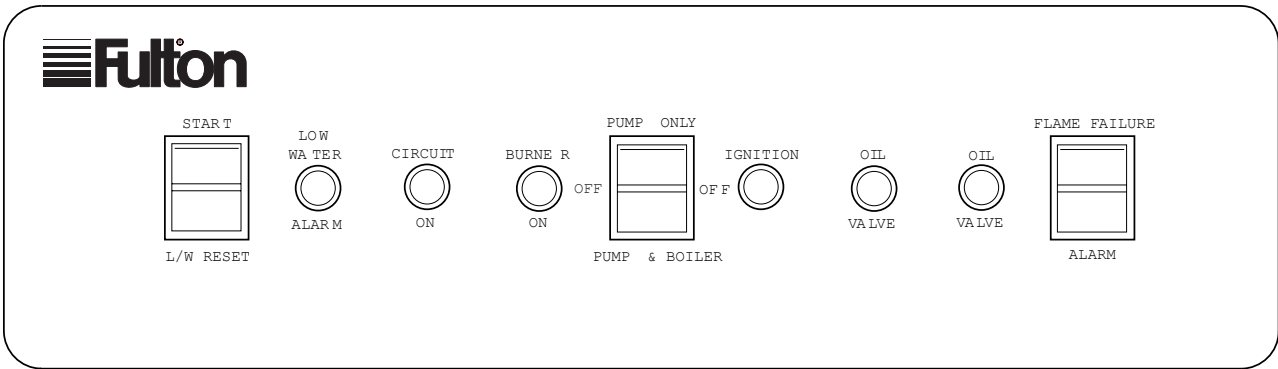


FIG. 17 JFS33 CONTROL PANEL

3.3 INDICATOR LIGHTS

Indicator lights are fitted to the control panel as an additional aid to the operator. The meaning and operating sequence of these lights is as follows:

Start / Low Water Reset

This switch is used to start the boiler and to reset the low water alarm. When the switch is pressed to initiate the start-up sequence, the low water alarm lamp also illuminates and the low water audible alarm sounds. Keeping the switch depressed for approximately 2 seconds cancels the low water alarm and initiates the burner start sequence.

Illumination of this switch and sounding of the audible alarm at any other time other than at switch on indicates that the boiler has gone to a lockout (safe condition) due to low water. Once the water in the boiler has been restored to a safe operating level, pressing the switch will reset the controls.

Circuit On

Indicates that power is being supplied to the control panel.

Low Water Alarm (1st. low water).

This light will energise, when the boiler is switched on and the water level is between 1st. low water and 2nd. low water. A light will illuminate and a pulsing alarm sound.

Low Water Reset (2nd low water).

The 1st. low water light and alarm are replaced by the 2nd. low water light and a continuous alarm, indicated by the low water reset switch.

The second alarm must be reset, the first alarm will be automatically reset by the return to normal water level.

Ignition

This lamp indicates the ignition transformer has been energised, it will remain illuminated for 5 - 10 seconds approximately during the ignition sequence.

Burner On

This lamp indicates that the burner is running and that the flame is being monitored by the burner programmer.

Flame Failure Alarm (reset)

This switch will illuminate if the burner goes to a lockout condition due to flame failure. Pressing the switch will reset the burner controller.

WARNING

No more than two attempts should be made to start the boiler by resetting the flame failure alarm (reset) Further attempts could cause the boiler and flue system to fill with vaporized oil which could cause an explosion.

Oil Valve

The two lamps provide a visual indication that the magnetic oil valves have been energised.

3.4 FILLING THE BOILER - ALL MODELS

Carry out the following procedure on the initial start up of the boiler and on every subsequent occasion when restarting the boiler after a shut down:

- (a) Ensure that the main steam stop valve is OPEN.
- (b) Ensure that the steam pressure gauge isolating valve is OPEN.
- (c) Ensure that the oil flow and return valves are OPEN, that there is an adequate oil supply in the oil tank, and that the burner oil pump has been vented.
- (d) Ensure that all the valves in the water feed line are OPEN.
- (e) Ensure that the main blowdown valve is CLOSED.
- (f) Ensure that the water level gauge isolating valve(s) is OPEN.
- (g) Ensure that the water level gauge blowdown valve(s) is CLOSED.
- (h) Ensure that the column blowdown valve is CLOSED.
- (i) Ensure that the boiler and pump switch is in the OFF position.
- (j) Ensure that all appropriate electrical isolators are switched ON.
- (k) Ensure the pump interrupt switch is in the PUMP RUN position.

 **CAUTION**

**The feed pump seals are water cooled.
The pump must never be allowed to run whilst dry, irreparable damage may result.
Ensure the pump is fully primed before energising the motor.**

- (l) Press the boiler/pump switch to the PUMP ONLY position.

Note: *If the boiler water level is below its correct level, the water pump will operate. When the water reaches the correct level (two thirds up the water level gauge sight glass), the pump will stop. If the water level is above the top of the water level gauge sight glass, drain off until the level is in the middle of the water level gauge sight glass.*

3.5 STARTING THE BURNER

- (a) CLOSE the main steam stop valve.
- (b) Press the control switch to the PUMP AND BOILER position. The low water audible alarm will sound, and the low water reset switch and low water alarm lamp will illuminate.
- (c) Press the low water reset switch for 2 seconds maximum. The audible alarm will silence and the alarm lamps will extinguish. The burner start sequence will commence.
- (d) After a maximum of one minute, the burner should be firing and the burner on lamp should illuminate.

3.5 STARTING THE BURNER - continued.

- (e) When the boiler has achieved the required (set) pressure, the main steam isolating valve should be slowly opened allowing steam to enter the system distribution pipework.



WARNING

The system should be raised to temperature slowly to allow for expansion and to avoid thermal shock and water hammer.

This can be achieved by one of two methods.

1. Crack open the main steam valve and allow the system to heat up slowly, (minimum 15 minutes) before fully opening the main steam valve.
2. Open the main steam valve when starting the boiler, allowing the boiler and system to heat up together.

Note: This can lead to water logging of the steam lines until full pressure is achieved.

3.6 DAILY OPERATING TESTS (3.6 - 3.7)

Visually inspect the steam and feed water pipework, valves and fittings for signs of leakage. If leaks are suspected shut the system down and evacuate the system to atmospheric pressure before attempting to repair the leaks. The following procedure should be carried out by a competent person to ensure the correct functioning of the water level and low water safety controls. Where possible, the boiler should not be under steam pressure during these tests, (see 3.6.5.g.2.).

Note: *Ensure that the water level is maintained during the pressure build up. If any part of the equipment is not operating correctly, the fault should be investigated before the boiler is used. Ensure that all blowdown pipework is safe and discharged to a blowdown receptacle.*

3.6.1. Pump Check

With the burner firing and the pump not running, lower the water level in the boiler by opening the main boiler blowdown valve.

As the water level falls, visible in the sight glass, and before the low water lock out position is reached the water pump should start to run. When this happens close the main boiler blowdown valve.

The water pump should continue to run and re-fill the boiler to the correct level and stop.

3.6.4 First Low Water Level (for boilers fitted with Spirax High Integrity Level Controls, see Appendix 'C')

- (a) Ensure the following:

The burner is firing.
The water level is correct in the boiler.
The water pump is not running.

- (b) Switch the pump off (Pump Interrupt) at the pump interrupt/pump run switch.

- (c) OPEN the main blowdown valve.

- (d) When the water level nears the bottom of the water level gauge sight glass, the low water alarm should sound, the low water alarm lamp should illuminate and the burner should stop firing. When this happens, CLOSE the blowdown valve IMMEDIATELY.

- (e) Switch the pump to RUN at the main pump interrupt/pump run switch. The pump should run and refill the boiler. When the water level in the boiler rises above the first low water level, the low water level lamp should extinguish, the audible alarm should silence and the burner start sequence should commence automatically.
The pump should run until the boiler water level is correct and then stop.

3.6.5 2nd. Low Water Check

(for boilers fitted with Spirax High Integrity Level Controls, see Appendix 'C')

- (a) Ensure the following:

The burner is firing.
The water level is correct in the boiler.
The water pump is not running.

- (b) Switch the pump OFF at the pump override switch.

- (c) OPEN the main blowdown valve.

- (d) When the water level nears the bottom of the water level gauge sight glass, the LOW WATER ALARM lamp should illuminate, the low water audible alarm should sound and the burner should stop firing.

- (e) Continue to blow down. As the water level falls nearer the bottom of the water level gauge sight glass, the LOW WATER RESET switch should illuminate and the second audible low water alarm should sound.

- (f) CLOSE the main blowdown valve and switch the pump ON at the pump override switch. The water pump should now start to run and refill the boiler. Once filled to the correct level the water pump should stop. The low water alarm should continue to sound, the LOW WATER RESET switch and LOW WATER ALARM lamp should remain illuminated and the burner should NOT start.

- (g) When the water level in the boiler is correct, the burner can be restarted by depressing the LOW WATER RESET switch for a maximum of 2 seconds.

1. The First and Overriding low water checks can be carried out in one operation to reduce the blowdown time and possible interruption to the steam supply.
2. Where the water level tests are to be carried out at full pressure, evaporate the water down to 1st. low level as in 3.8, blowdown the boiler from 1st. to 2nd. low water. The purpose of adopting this procedure is to prevent steam and water being expelled from the blowdown vessel vent because of prolonged blowdown.

3.7 BLOWDOWN PROCEDURES (Daily tests)

Keep the boiler, water gauge, water column and interconnecting pipework free from sludge and scale buildup by blowing down in the following manner:

Note: Where a boiler is operating continuously at steam pressure, advice should be sort from Fulton regarding the appropriate blowdown procedure.

- (a) Start the boiler and generate not more than 10psi of steam.
- (b) Shut off both the burner and the pump.

Boiler Blowdown

- (a) Fully OPEN the boiler main blowdown valve for not more than 5 seconds.
- (b) CLOSE the valve.

Note: Where high levels of suspended solids are produced, longer and/or more frequent blowdown may be required.

Water Column Blowdown

Note: The water column contains the pump ON/OFF probe, which is not safety locked.

- (a) Switch the pump off at the pump interrupt/pump run switch.
- (b) Open the water column blowdown valve for 5 seconds.
- (c) Close the water column blowdown valve.

Wait for 10 seconds for the water in the boiler to stabilise after blowdown.

- (d) Switch the pump on at the pump interrupt/pump run switch.

3.7 BLOWDOWN PROCEDURES (Daily tests) - continued.

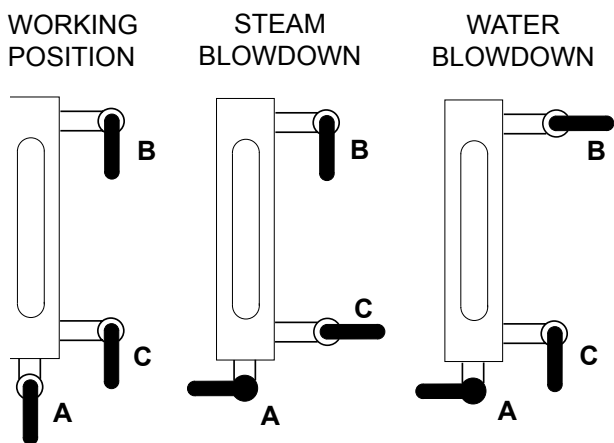
Water Gauge Blowdown

- (a) Blowdown the water gauge, set 1.
1. Open the gauge glass blowdown valve **A**
 2. Close (for approx. 3 seconds) the top gauge valve **B**
 3. Open valve **B**
 4. Close (for approx. 3 seconds) the bottom gauge valve **C**
 5. Open valve **C**
 6. Close valve **A**

Repeat for gauge set 2

On completion of the blowdown procedure ensure that all isolation valves are OPEN and all blowdown valves CLOSED.

Note: Where a Boiler is operating continuously at steam pressure, advice should be taken from a Fulton agent as to the appropriate blowdown procedure.



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Water Level Gauge operating positions.

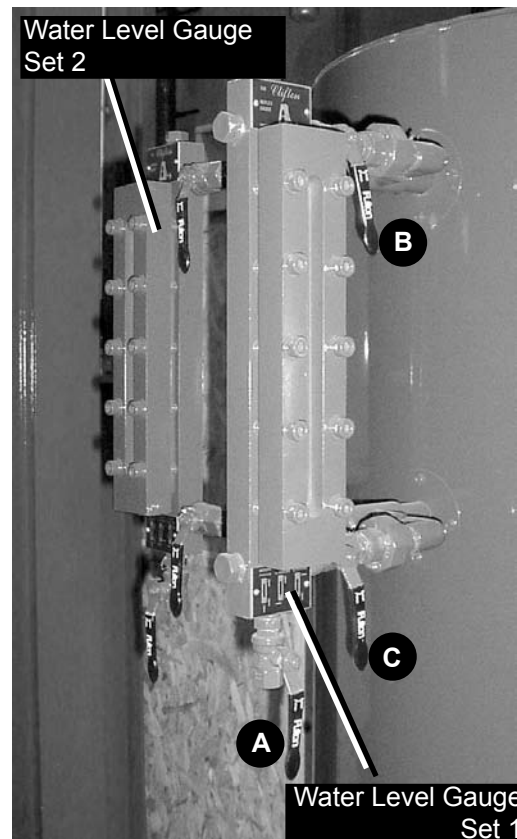


Fig. 18 WATER LEVEL SIGHT GAUGE BLOWDOWN

3.8 EVAPORATION CHECKS

With the boiler running under normal load conditions, and the pump stopped having just completed a refill cycle:

- (a) Ensure that the boiler water level is correct.
- (b) Switch the pump OFF at the pump interrupt / pump run switch.

The water level in the boiler will lower through natural evaporation. When the level nears the bottom of the water level gauge sight glass, the first low water alarm will sound, the low water alarm lamp will illuminate and the burner will shut down.

If it is required to check the second low water alarm, wait a further period for the LOW WATER RESET switch to illuminate.

When the check is complete, proceed as follows:

- (a) Switch the pump ON at the pump interrupt / pump run switch.
- (b) Press the low water reset switch. The pump will start to refill the boiler.

If the pump starts to run at any time during the test then the test must be abandoned and restarted from the beginning.

3.9 TROUBLESHOOTING

Problem	Cause	Remedy
Ignition Failure	1. Oil tank empty	Refill the oil tank. A slight delay in the re-priming of the fuel pump may cause the burner programmer to require resetting before the boiler operates satisfactorily.
	2. Power Supply	Check fuse or Circuit breaker. Reset or replace as required.
	3. Ignition Electrodes	Check electrodes for carbon build-up, clean if required. Check settings adjust if required. Check for cracks in porcelain, if found, replace.
	4. Transformer	Check voltage between transformer leads at terminal block to be sure transformer is live.
	5. UV Detector	Check for ignition interference.
	6. Loose wire connection	Check connections to all components.
	7. Burner Control	Check voltage between pilot terminal and neutral and ignition terminal and neutral. Check must be made before control locks out on safety. If no power, replace control.
	8. Oil nozzle clogging	Check oil nozzle(s), clean or replace as necessary.
	9. Faulty Oil Pump	Check to see if oil is being pumped to the boiler nozzle. Repair or replace as necessary.
Flame Failure (see note)	1. Power Supply	Check fuse or Circuit breaker. Reset or replace as required.
	2. Ignition Electrodes	Check electrodes for carbon build-up, clean if required. Check settings adjust if required. Check for cracks in porcelain, if found, replace.
	3. Main Air Adjustment	Check air adjustment. Air may be blowing flame away from the UV detector. Open primary air until fire brushes the furnace wall.
	4. UV Scanner	Check for dirt on scanner, clean as required. Check for proper location of detector.
	5. Contact open on air safety switch	Adjust to proper setting
	6. Scanner wiring reversed at panel	Change to correct terminals.
	7. Oil Supply	Check oil level in supply tank, ensure it is not below intake line. Fill tank with oil. Check for clogged nozzle. Clean or replace. Check oil filter and replace if necessary.
	8. Oil Valve	Check the voltage between oil valve neutral at terminal block to be sure oil valve is getting power.
	9. Oil Pump	Check for clogged strainer or filter. Remove and clean. Check for slipping or broken coupling. Tighten or replace.
	10. Loss of Oil Prime	Check for seized pump shaft. Replace. Check all lines for possible air leak in intake line and tighten. Check the intake line is not restricted, replace.

Note: One of the most common causes of flame failure is dirt/sediment in the oil filter, oil lines, solenoid valves or nozzle, caused by a new delivery of oil. If the oil tank level is allowed to fall near to the bottom of the tank it is highly probable that sediment on the bottom of the tank will be disturbed and mixed in with the new oil delivery, especially if the delivery rate is too fast.

3.9 TROUBLESHOOTING - continued.

Problem	Cause	Remedy
Boiler Fails to Start	1. No Power	Check fuse or circuit breaker. Reset or replace as necessary.
	2. Pressure Control	Disconnect all power to the controller. Disconnect the wires from the controller. connect an ohmmeter between the switch terminals. Lower the set point of the controller, the switch should make. raise the set point and re-check, switch should break. if the controller operates improperly, replace it.
Burner Cut-off	1. Oil tank empty	Refill the oil tank. A slight delay in the re-priming of the fuel pump may cause the burner programmer to require resetting before the boiler operates satisfactorily.
	2. Power Supply	Check fuse or Circuit breaker. Reset or replace as required.
	3. Ignition Electrodes	Check electrodes for carbon build-up, clean if required. Check settings adjust if required.
	4. UV Detector	Check for cracks in porcelain, if found, replace. Check for dirt on detector, clean as required. Check for proper location of detector.
	5. Faulty Air Switch	Check for faulty air switch by jumpering the two air switch leads at the terminal block. If the boiler starts and runs with the jumper in place, the air switch should be replaced.
	6. Faulty Level Control	Check the level control relays are securely mounted on their bases. Check the power supply to each. The relays may be checked by swapping positions and checking they are both functioning.
	7. Oil Nozzle	Check for clogged nozzle, clean or replace.
	8. Transformer	Check voltage between transformer neutral at terminal block to be sure transformer is being powered.
	9. Burner Control	Check voltage between pilot terminal and neutral and ignition terminal and neutral. Check must be made before the control locks out on safety. If no power replace control.
	10. Pressure Control	Disconnect all power to the controller. Disconnect the wires from the controller. connect an ohmmeter between the switch terminals. Lower the set point of the controller, the switch should make. raise the set point and re-check, switch should break. if the controller operates improperly, replace it.

3.9 TROUBLESHOOTING - continued.

Problem	Cause	Remedy
Poor Combustion	1. Refractory Bricks	Check the bricks are not plugged with soot or broken into pieces. Clean and replace as required.
	2. Stainless Steel Ring	Check to ensure the ring is present and fits securely against the furnace wall.
	3. Main Air Adjustment	Check air adjustment. Open main air until fire brushes the furnace wall.
	4. Secondary Air Adjustment.	Check main air adjustment to see if it has moved. Adjust as necessary and tighten in position. Check CO ₂ and O ₂ level.
	5. Draft	Check draft is neutral. Consider installing a barometric damper if the draft is too strong.
	6. Dirty Flue	Check flue for Carbon build-up or blockage. Clean flue passages with brush.
	7. Negative Room Pressure	Ensure no exhaust fans are running in the boiler room.
	8. Oil Nozzle	Check for blocked nozzle, clean or replace as necessary.
	9. Oil Pump	Check for blocked strainer or filter. Remove or clean. Check for slipping or broken coupling. Tighten or replace. Check for seized pump shaft. Replace.
Burner back fires	1. Refractory Bricks	Check the bricks are not plugged with soot or broken into pieces. Clean and replace as required.
	2. Ignition Electrodes	Check electrodes for carbon build-up, clean if required. Check settings adjust if required.
	3. UV Detector	Check for cracks in porcelain, if found, replace. Check for dirt on scanner, clean as required. Check for proper location of detector.
	4. Draft Problem	Check draft is neutral. Consider installing a barometric damper if the draft is too strong.
	5. Negative Room Pressure	Ensure no exhaust fans are running in the boiler room.
	6. Primary Air Adjustment	Check air adjustment. Air may be blowing fire away from flame detector.
	7. Oil Valve(s)	Check for leaking oil valve(s) and replace.
	8. Loss of Oil Prime	Check all lines for possible air leak in intake line and tighten. Check for possible restricted intake line. Replace.
	9. Loose Oil Fittings	Check all fittings and tighten.
	10. Blocked Oil Filter	Check and clean or replace.
	11. Blocked screen in Oil Pump	Check and clean or replace.
	12. Blocked Flue	Check flue is not blocked, clean as required. Check draft at flue.
	13. Vacuum on Pump	Check for too high a vacuum on the pump. Check oil lines and distance from tank to boiler. Repaire or replace as necessary.
	14. Hole in suction line	Check and replace as necessary.

3.9 TROUBLESHOOTING - continued.

Problem	Cause	Remedy
Boiler will not maintain pressure	1. Oil tank empty	Refill the oil tank. A slight delay in the re-priming of the fuel pump may cause the burner programmer to require resetting before the boiler operates satisfactorily.
	2. Oil Nozzle	Check for blocked nozzle. Clean or replace.
	3. Oil Valve	Check voltage between oil valve leads at terminal block to be sure oil valve is getting power.
	4. Oil Pump	Check for blocked strainer or filter. Remove and clean. Check for slipping or broken coupling, tighten or replace. Check for seized pump shaft. Replace the pump.
	5. Dirty Flue	Check flue for Carbon build-up or blockage. Clean flue passages with brush.
	6. Pressure Control	Disconnect all power to the controller. Disconnect the wires from the controller. Place an OHM meter between the switch terminals. Lower the set point of the controller, the switch should make. Raise the set point and recheck, switch should break. If the controller operates improperly, replace it.
	7. Scale buildup in boiler	Consult Fulton.
	8. Refractory Bricks	Check the bricks are not plugged with soot, cracked or broken into pieces. Clean and replace as required.
	9. Steam Traps blowing through	Check traps, clean or replace as required.
	10. Boiler size	Boiler may be undersized.

3.9 TROUBLESHOOTING - continued.

Problem	Cause	Remedy
Boiler is Surging	<ol style="list-style-type: none"> 1. Steam Traps blowing through. 2. Scale buildup or lime deposits. 3. Too much water treatment. 4. Too much of a load. 	<p>Check traps, clean or replace as required.</p> <p>Call water treatment company and consult the factory.</p> <p>Dump the return tank and flush the system. Test the water treatment.</p> <p>Check total equipment load against the boiler output. Decrease amount of equipment being used.</p>
Boiler Rumbles	<ol style="list-style-type: none"> 1. Draft Problem 2. Too much main air. 3. Air or water in the oil. 	<p>Check draft is neutral. Consider installing a barometric damper if the draft is too strong.</p> <p>Adjust main air.</p> <p>Check tank and lines for water or leaks.</p>
Boiler pushing water with steam	<ol style="list-style-type: none"> 1. Steam Traps 2. Too much water treatment. 	<p>Check traps. Clean or replace as required.</p> <p>Dump the return tank and flush the system. Test the water treatment.</p>
Pump will not cutoff	<ol style="list-style-type: none"> 1. Dirty Probes. 2. Relay failed. 3. Earth connection. 	<p>Clean or replace as required.</p> <p>Check relay is secure on its base, if so replace the relay.</p> <p>Check for tightness and clean.</p>
Pump runs but does not put water in the boiler	<ol style="list-style-type: none"> 1. Vapour locking of pump. 2. Blocked feed water line 	<p>Allow system to cool down, check steam traps and check to be sure return lines are not insulated. Check return tank temperature, if it is above 82°C vapour locking of the pump will occur. Inspect check valves. Clean and replace as needed. Replace pump with multi-stage centrifugal pump able to cope with 121°C.</p> <p>Check feed water line is not blocked, clean as required.</p>
Water pump runs intermittently	<ol style="list-style-type: none"> 1. Scale on probes. 2. Bad pump contactor. 3. Pump Motor damaged. 	<p>Check probes, clean as required.</p> <p>Check to ensure the contactor is live.</p> <p>Check to ensure the contactor coil is being pulled in. Replace as required.</p> <p>Check the pump circuit is live. If the circuit is live but the pump is not running, replace the pump.</p>
Boiler continues after shut down	<ol style="list-style-type: none"> 1. Oil Valve defective 	<p>Check the valve is opening and closing.</p> <p>Clean or replace as required.</p>
Oil fumes coming out around the oil pump housing on shut down	<ol style="list-style-type: none"> 1. Bad draft condition 2. Venting of room 	<p>Check the draft with a gauge, should read neutral. May need to install a barometric damper.</p> <p>Ensure the boiler room doors are closed and the recommended vents are clear.</p>
Boiler flooding	<ol style="list-style-type: none"> 1. Pump does not shut off. 2. Relay failed. 3. Earth connection. 4. Vacuum created with the boiler off. 	<p>Dirty probes, clean or replace as required.</p> <p>Check relay is secure on its base, if so replace the relay.</p> <p>Check for tightness and clean.</p> <p>As the boiler cools it pulls water from the system. To prevent this, add an anti-vacuum valve on the steam gauge assembly piping, this valve closes under pressure and opens under vacuum.</p>

Cause \ Fault	Ignition Failure	Flame Failure	Burner Cutoff	Poor Combustion	Burner Back Fires	Boiler will not Maintain Pressure	Boiler will not Maintain Water
Power Supply							
Oil Supply							
Refractories							
S.S. Ring							
Ignition Electrodes							
Oil Nozzle							
Main Air Adjustment							
Oil Valves							
Oil Pump							
Photoelectric Cell							
Low Water Probes							
Low Water Control							
Pressure Controller							
Burner Programmer							
Draught							
Transformer							
Sec. Air Adjustment							
Loss of Priming Oil							
Steam Overload							
Feed water Pump							
Bad Traps							
Dirty Flues							

FIG. 16 FAULT FINDING CHECK LIST

MAINTENANCE

SECTION 4

4.1 GENERAL

To ensure the efficiency of the boiler, carry out the regular maintenance instructions detailed below. If any fault is found during these operations contact your Fulton representative.

⚠ CAUTION

It is essential that regular checks are made to ensure that scale buildup is not taking place within the boiler. Such checks will ensure that water treatment being applied to the boiler feed water is effective.

The lower hand hole doors should be removed after one month of operation and the interior of the boiler thoroughly examined. If scale or sludge build up is observed, it should be removed and the water treatment supplier advised.

New gaskets must be fitted every time a handhole door is removed.

Subsequent interior examinations should be carried out on a regular basis until satisfactory conditions are observed. Thereafter, inspections should be carried out at three monthly intervals.

⚠ WARNING

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be isolated.

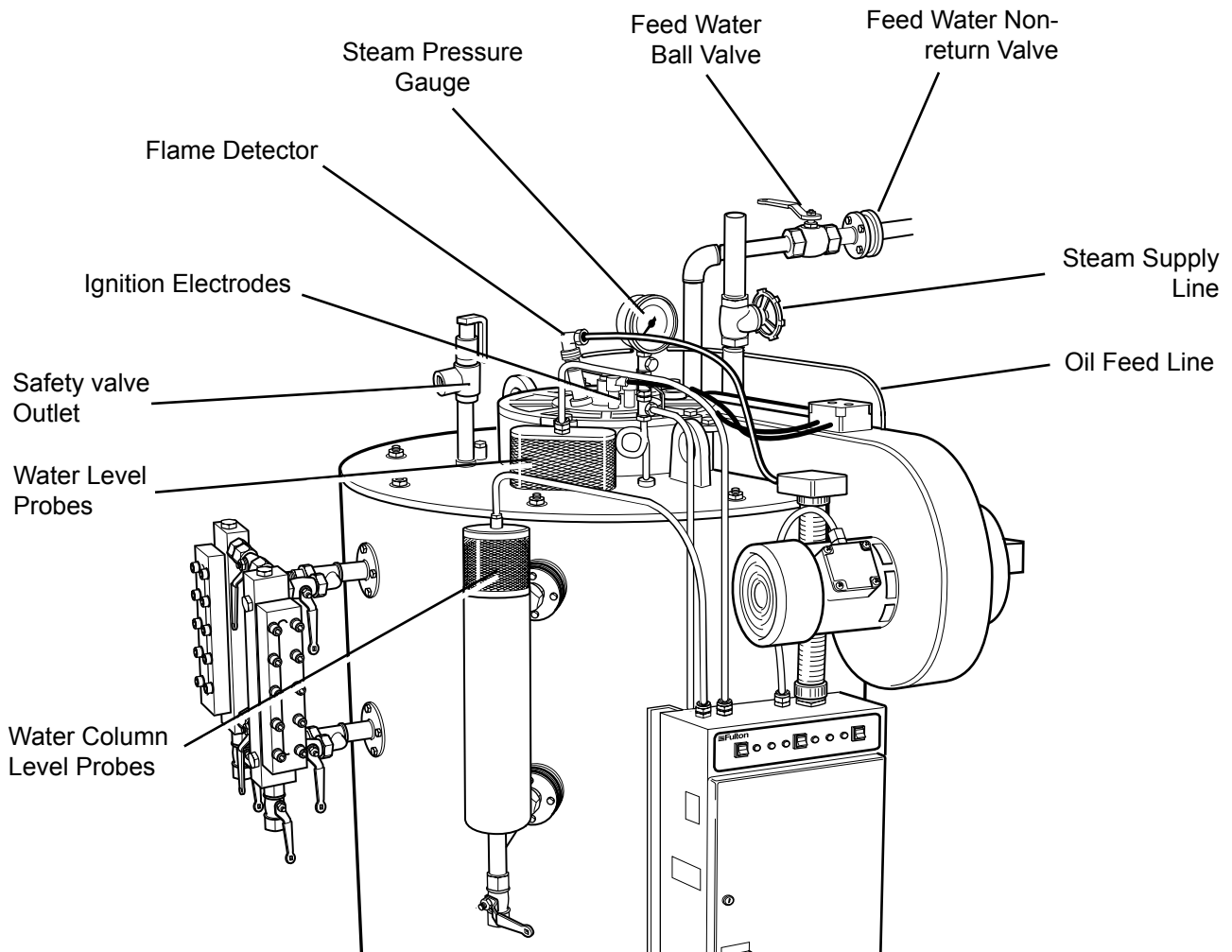


FIG. 19 BOILER MAINTENANCE

The following procedures are designed to prevent the buildup of scale, silt or sludge in the bottom of the boiler, water gauge and water column pipework. In addition to these procedures, the advice of a water treatment specialist should be sought and followed.

Note: for boilers fitted with Spirax High Integrity Level Controls see Appendix 'C'.

4.2 DAILY.

Some of the following procedures should be carried out as part of the normal operating routines of the boiler, others are required to be done as part of the boiler maintenance programme.

All boiler operating routines and tests should be recorded and kept as a boiler history.

1. **Blowdown the Boiler.**
2. **Blowdown the Water Column.**
3. **Blowdown the Water Level Gauge.**

4.3 WEEKLY (including daily)



**Ensure the fittings around the steam safety valve(s) are secure.
The safety valve will be very hot, do not operate the safety valve without protection.**

4. Ensure that the pipe from the safety valve outlet is not damaged and that it continues to a safe blowdown point.
5. The water level and safety cut-off controls must be tested under operating conditions by interrupting the water feed supply.

To carry out this test, use the feed pump interrupt switch to isolate the feedwater pump and lower the water level in the boiler by evaporation. Lower the water level passed both the 1st. and 2nd. low water levels (see section 3).

On completion, switch off (pump run) the pump interrupt switch and check that the water level is restored to normal.

4.4 MONTHLY (including weekly)



Ensure the main electrical supply is isolated before starting work.

6. Inspect the hand holes in the boiler. If any leakage is evident proceed as follows:

Note: Use only genuine Fulton replacement parts.

- a. Using the special tee handle wrench, remove the handhole assembly.
 - b. Remove the old gasket and thoroughly clean the mating faces of the plate and boiler.
 - c. Fit the handhole assembly as follows:
 1. Place the new gasket on the handhole plate and ensure that it is seating correctly. Do not use any grease, lubricant or adhesive.
 2. Position the plate in the boiler, set the crab and tighten the securing nut only sufficiently to provide a snug fit. Verify the position of the plate in the boiler to ensure that there is uniform space between the periphery of the door and the boiler inspection opening. Tighten the nut hand tight only. Using the special wrench, tighten the nut a further quarter of a turn. **DO NOT OVERTIGHTEN.**
 - d. If the gasket leaks as the pressure is building up, tighten the securing nut only sufficient to stop the leakage.
7. Inspect the flanged joint covering the rear inspection port in which the blowdown valve is fitted, if any leakage is evident replace the gasket.
8. Clean the sight glass. If any leakage is evident, renew the gasket.
9. Clean any strainers in the feed water line.
10. Check and clean the UV detector.
11. Clean any water traps and strainers fitted in the fuel line.
12. Check the operation of any steam traps fitted on the condensate return system.
13. Check boiler and feedwater quality (see water treatment in section 5).
14. Remove, clean and adjust the oil nozzle and electrode assembly.

4.5 THREE MONTHLY (including monthly)

15. Drain and isolate the boiler.
16. Remove the lower hand hole assemblies and inspect the interior of the pressure vessel for scale and sludge build up.
17. Remove the feedwater pipe from the top of the boiler. Ensure the pipe is not blocked, clean as required.

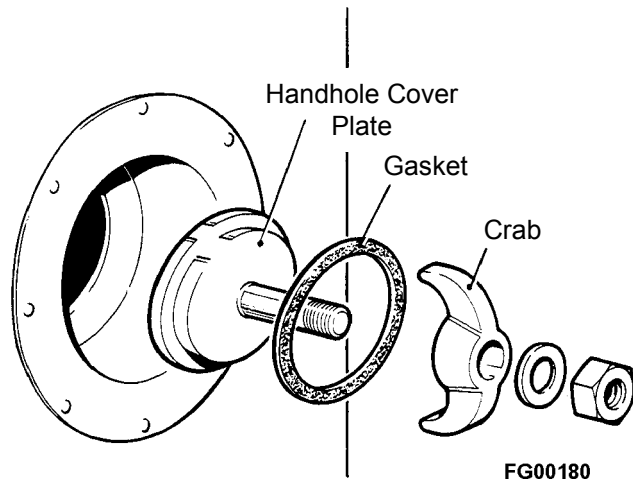


FIG. 20 HANDHOLE

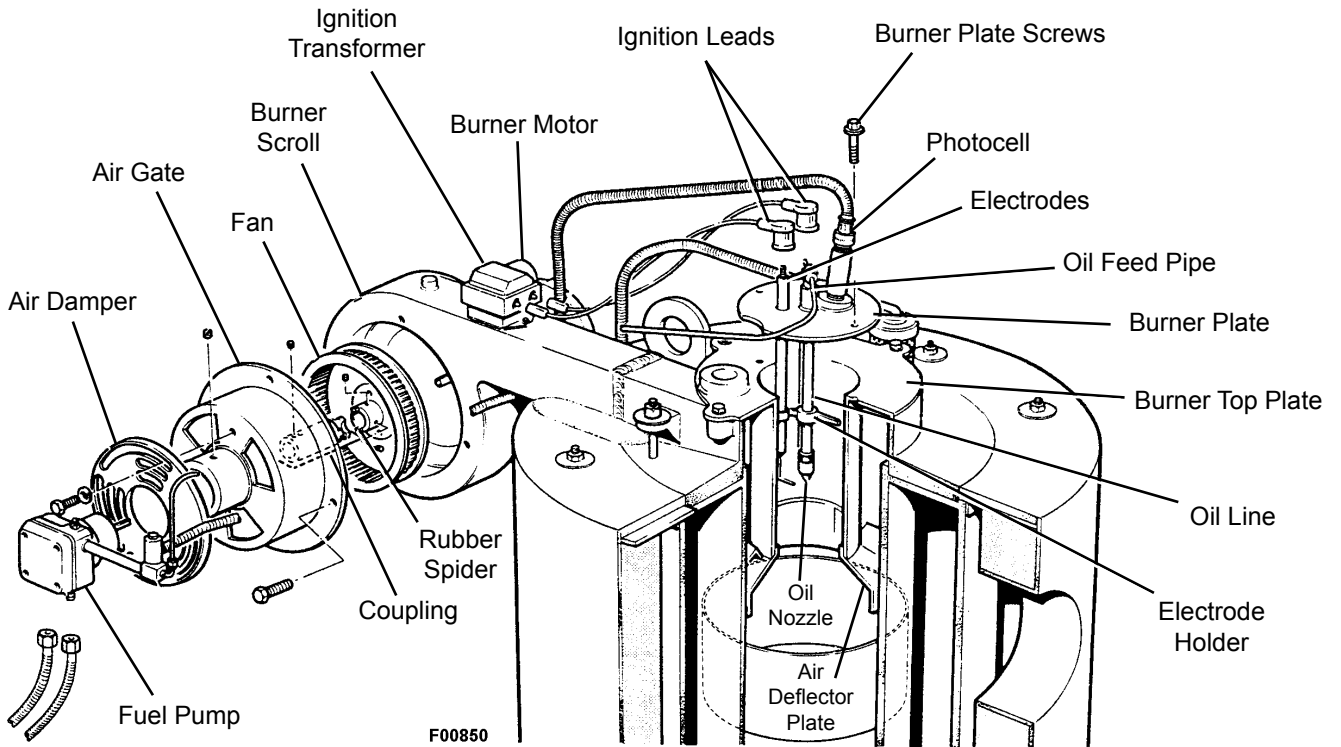


FIG 21 BURNER ASSEMBLY

4.6 SIX MONTHLY (including three monthly)

It should be noted that after a Fulton boiler has been in operation for several months, pieces of burned metal will be found in the space at the bottom of the boiler. These pieces of metal are the remains of a light gauge metal form which was used during manufacture for forming the boiler insulation. This is normal and does not affect the efficiency or the life of the boiler in any way.

18. Remove the cover plates and clean-out door. Clean out the flue passes. Check the refractories for soot or breakage, inspect the stainless steel ring. When replacing the cover plates and clean-out door, use furnace cement to ensure a tight seal, thus preventing the escape of hot gases.
19. Apply a small quantity of oil to the bearings of the burner motor and the feed water pump motor.
20. Drain and flush the feed water tank. Clean any filters in the tank, in the feed water line or in the feed water pump.
21. Remove and clean the water probes, take care not to crack the porcelain. After replacement of the probes, check the operation of the low water cutoff relay and of the feed water pump.
22. Remove the air gate and clean the fan.
23. Test the flue using the following procedure:

Visual inspection
Check joints between all flue sections for quality of seals. Where the flue passes through the structure of the building use your judgement as to the integrity of this section of the flue.

Smoke test
With the flue capped and a smoke generator inserted into the flue, there should be no smoke visible.

If either of these tests fail, shut down the boiler and contact Fulton Boiler Works immediately.
24. Remove the water gauge and water column. Rod through the top connections of both to ensure the holes in the baffle plates (approx. 6mm dia.) inside the boiler are not obstructed.
26. Check the burner combustion to ensure that excess air and carbon monoxide values are within normal limits (see combustion values in section 5).

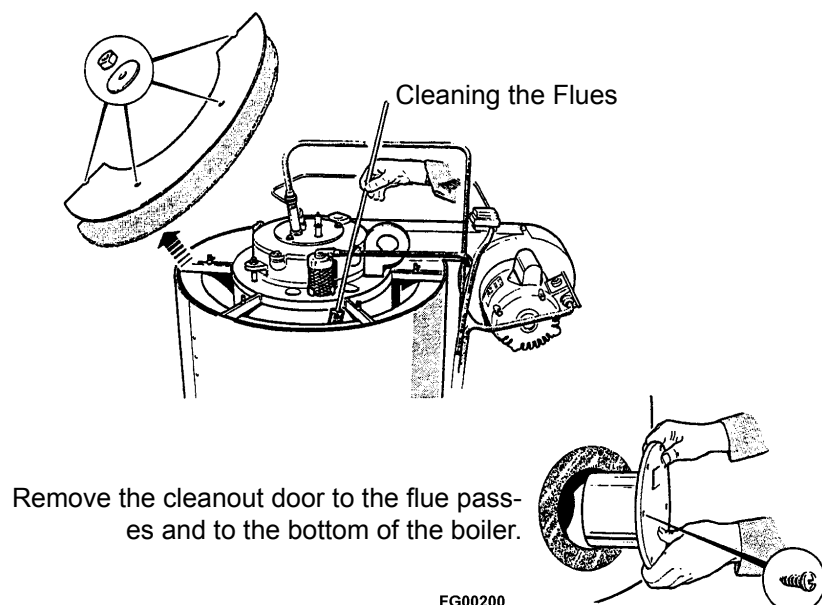


FIG. 22 FLUE CLEANING

Appendix 'C'

Spirax High Integrity Level Controls

The daily testing of boiler water level controls is a mandatory requirement as defined in the Health & Safety Executive Guidance Note PM5.

The level of supervision is dependent upon the type of level controls (limiters) fitted.

Boilers fitted with self monitoring high integrity controls (limiters) should be tested daily by a qualified boiler attendant, but may be supervised during the silent hours and weekends by a Competent Person trained to respond to an alarm.

Daily testing of the controls is required which can be by simulation, with a weekly test by interrupting the feed water pump and lowering the water by evaporation.

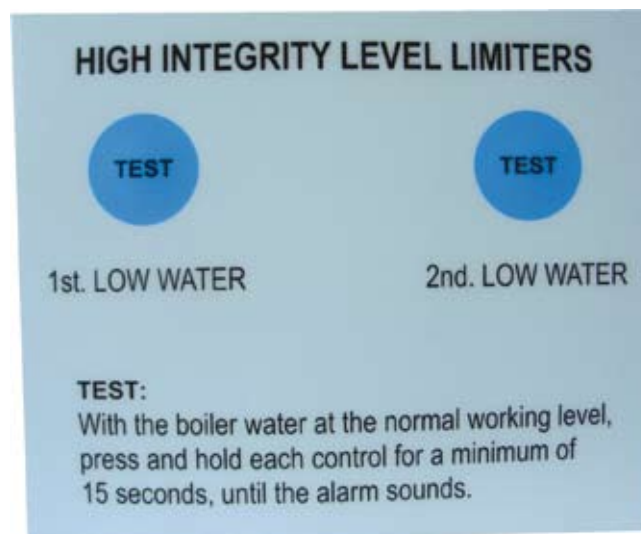
Daily Test

1st. Low water

1. With the burner firing
2. Press and hold the 1st. Low Water test button until (minimum 15 seconds) the low water alarm sounds, and the low water indicator lamp illuminates, and the burner shuts down
3. Release the test button
4. After approximately 17 seconds the low water alarm will cancel, the low water lamp will extinguish, and the burner will restart

2nd. Low Water

1. With the burner firing
2. Press and hold the 2nd. Low Water test button until (minimum 15 seconds) the low water alarm sounds, and the second low water reset switch illuminates, and the burner shuts down
3. Release the test button
4. After approximately 17 seconds the second low water relay will reset.
5. To cancel the second low water level alarm and light, depress the second low water reset switch
6. The burner will restart.



Spirax High Integrity Level Controls, continued.

Weekly Test (Daily test plus)

1st. Low Water

1. With the burner firing
2. Switch the pump interrupt switch to the pump interrupt position.
3. By evaporation lower the water level in the boiler until the first low water alarm sounds and the low water indicator lamp illuminates, and the burner shuts down
4. Switch the pump interrupt switch to the pump on position.
5. The pump will start and restore the water level to the normal position and switch off.
6. After approximately 17 seconds from restoring the first low water level the low water alarm will cancel, the low water lamp will extinguish, and the burner will restart

2nd. Low Water

1. With the burner firing
2. Switch the pump interrupt switch to the pump interrupt position
3. By evaporation lower the water level in the boiler until the low water alarm sounds, the second low water reset switch illuminates, and the burner shuts down.
4. Switch the pump interrupt switch to the pump on position.
5. The pump will start and restore the water level to the normal position and switch off.
6. After approximately 17 seconds from restoring the second low water level the second low water relay can be reset.
7. To cancel the second low water level alarm and light, depress the second low water reset switch
8. The burner will restart.

Note: These tests can be carried out consecutively, however it is possible that if the boiler is under load conditions the second low water alarm will occur immediately after the burner has shut down on first low water, without the apparent loss of any more water. The reason is the collapse of the steam bubbles at the water level surface when the heat is removed.

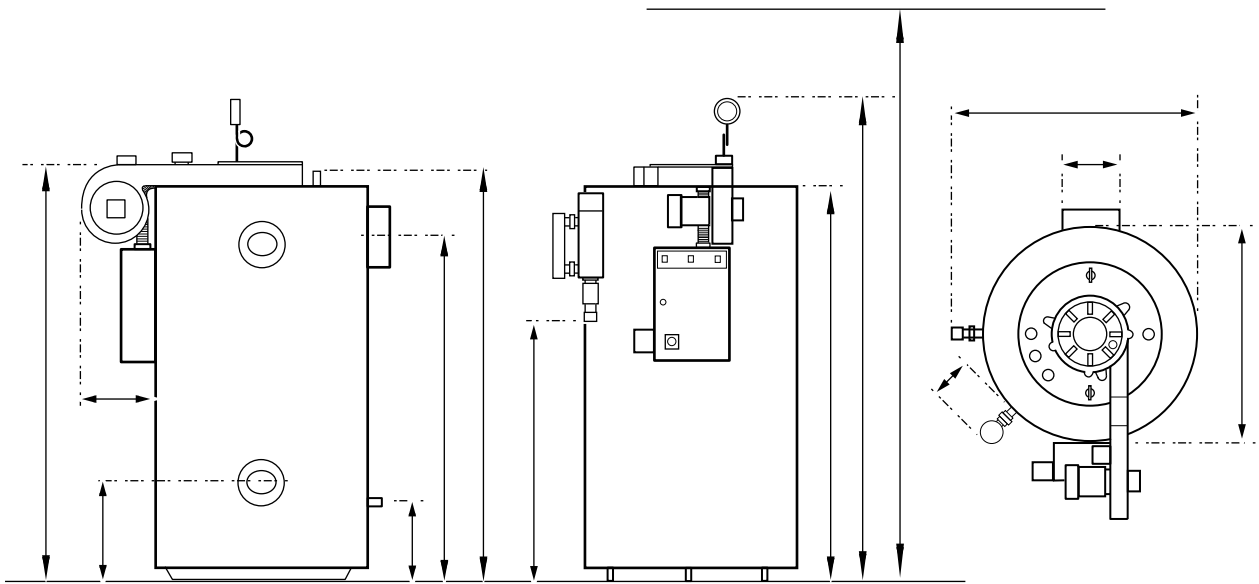
The degree of collapse could be such that the water level will disappear from the bottom of the site glass before the alarm sounds. Should this happen the second low water level alarm should be checked by lowering the water level slowly by partially opening the main

Pump Interrupt Switch



GENERAL DATA

SECTION 5



Dimensions (mm)

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
22	440	1750	1955	2295	390	2060	1880	985	310	220	152	1295	950	2800	350
33	440	2065	2395	2640	390	2455	2225	1175	425	220	203	1600	1235	3250	350
55	440	2175	2500	2795	390	2610	2380	1390	500	220	305	1890	1600	3500	350

FIG. 23 BOILER DIMENSIONS

**WARNING**

It is the responsibility of the installer to ensure all parts supplied with the boiler are fitted to the boiler in a correct and safe manner.

Connection Sizes (DN) (F=female, M=male) All connections BSP

	Model	22	33	55
Steam Outlet		32F	32F	32F
Feed Water		15M	15M	15M
Safety Valve (discharge)		32F	32F	32F
Main Boiler Blowdown		25F	25F	25F
Water Column Blowdown		20F	20F	20F
Sight Glass Blowdown		8F	8F	8F

Specification

Output (kg/h, F&A 100°C)		160	240	320
Standard Working Pressure (bar)		10.34	10.34	10.34

Firing Rates

Input (kW/h)		124	187	250
Input (BTU/h x 1000)		425	637	849
Input 35 sec. oil (US gal/h)		3.1	4.7	6.2
Input 35 sec. oil (litre/h)		11.4	17.6	23.5
Nozzle Size (US gal/h)		2.25	3.5	5.2
Nozzle Spray Angle		80°/S	80°/S	80°/S
Oil Pressure (barg)		13.1	12.1	10.6
Oil Pressure (psig)		189	176	154

Capacities and Weight

Water Content (litre)		450	740	1172
Weight Empty (kg)		1320	1900	2925
Weight Operating (kg)		370	740	1120

Electrical Requirements

FLC @ (Amp)				
400V 3ph 50Hz		4.7	4.7	4.9

Oil Boiler Combustion Values

CO₂ range	11.5 - 12.5%
CO	less than 100ppm
O₂ range	5 - 4%
Excess air	30 - 20%
Smoke	3 max.

IMPORTANT

Recommended Water Conditions

It is very important that a strict water management program is followed to ensure trouble free boiler operation.

The following are recommended for feedwater and boiler water.

FEEDWATER (water entering boiler)

pH Value	8.5 to 9.5 tested at room temperature,
Hardness	less than 2.0mg/kg in the form of CaCO ₃ ,
Suspended Solids	None
Chloride	Less than 50mg/kg
Organic Matter	Less than 5mg/kg
Oil	None

BOILER WATER (water inside boiler)

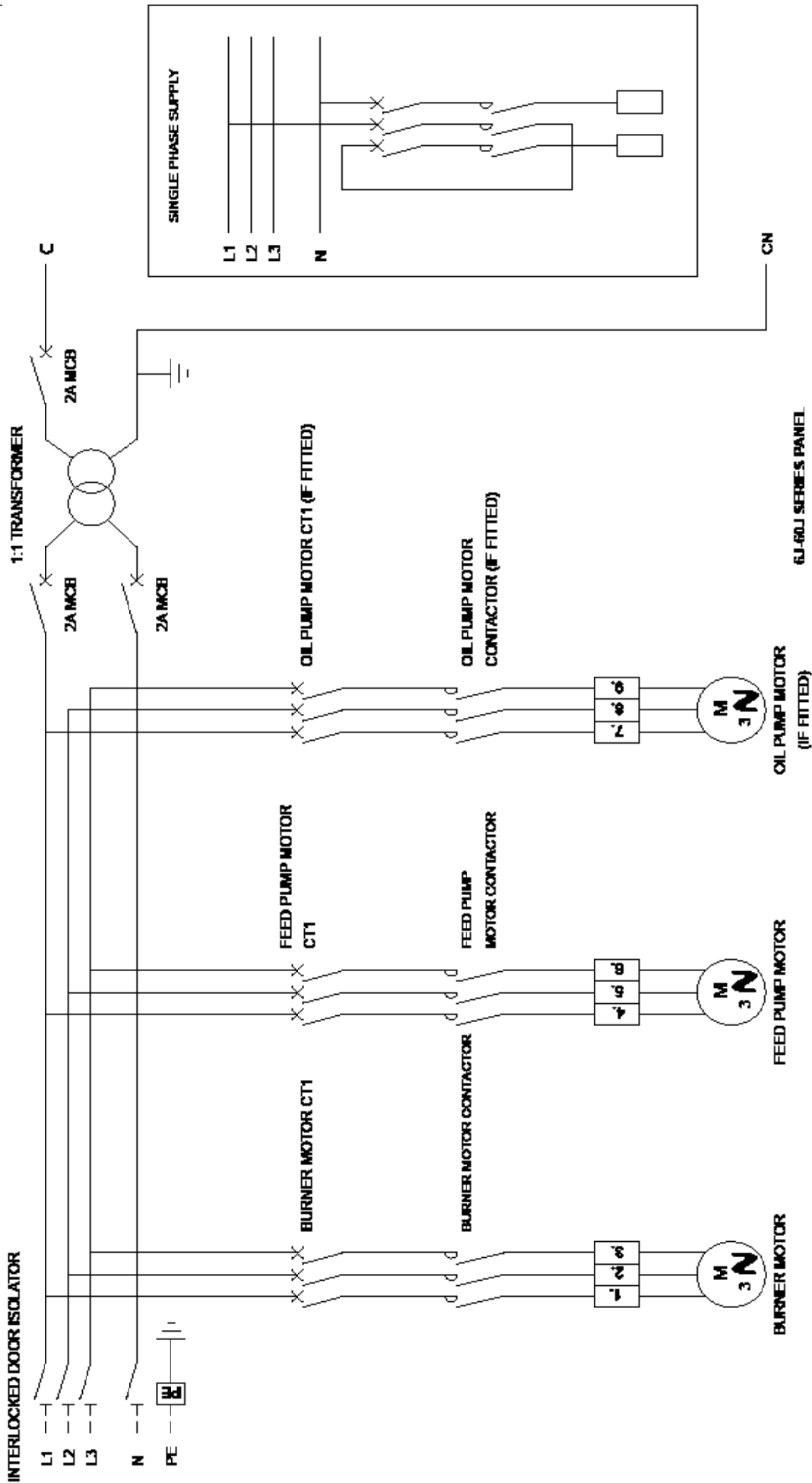
pH Value	9.5 - 11.5, tested at room temperature
Hardness	Not detectable
Suspended Solids	Less than 100mg/kg
Chloride	Less than 500mg/kg
Oxygen Scavenger, Sodium Sulphite or Tannin	20 to 50mg/kg
Phosphate	Less than 50mg/kg, in the form of PO ₄
Total Alkalinity	Less than 1000mg/kg
Caustic Alkalinity	Less than 300mg/kg as CaCO ₃
Total Dissolved Solids (TDS)	Less than 2000ppm
Iron	Less than 1mg/kg
Silica	Less than 150mg/kg, in the form of SiO ₂
Dissolved Oxygen	None

mg/kg	=	Milligrams per Kilogram
CaCO₃	=	Calcium Carbonate
PO₄	=	Phosphate
SiO₂	=	Silica
1 Grain hardness	=	17.118ppm
therefore 70ppm	=	4.10 grains hardness.
For practical purposes mg/kg	=	ppm

It is critical that the boiler water pH be alkaline (9.5 - 11.5) whenever water is in the boiler.

Daily boiler blowdown is essential to help prevent formation of deposits and reduce Total Dissolved Solids (TDS).

Consult your Water Treatment specialist to establish the frequency and duration of blowdown required to achieve the required water conditions.



SUPPLY CIRCUIT
 (FOR GAS, OIL & DUAL FUEL BOILERS)

NOTE:
 FOR CIRCUIT CONTINUATION INSTRUCTION REFER TO DRAWING E.020000.

EJ05 0001-1

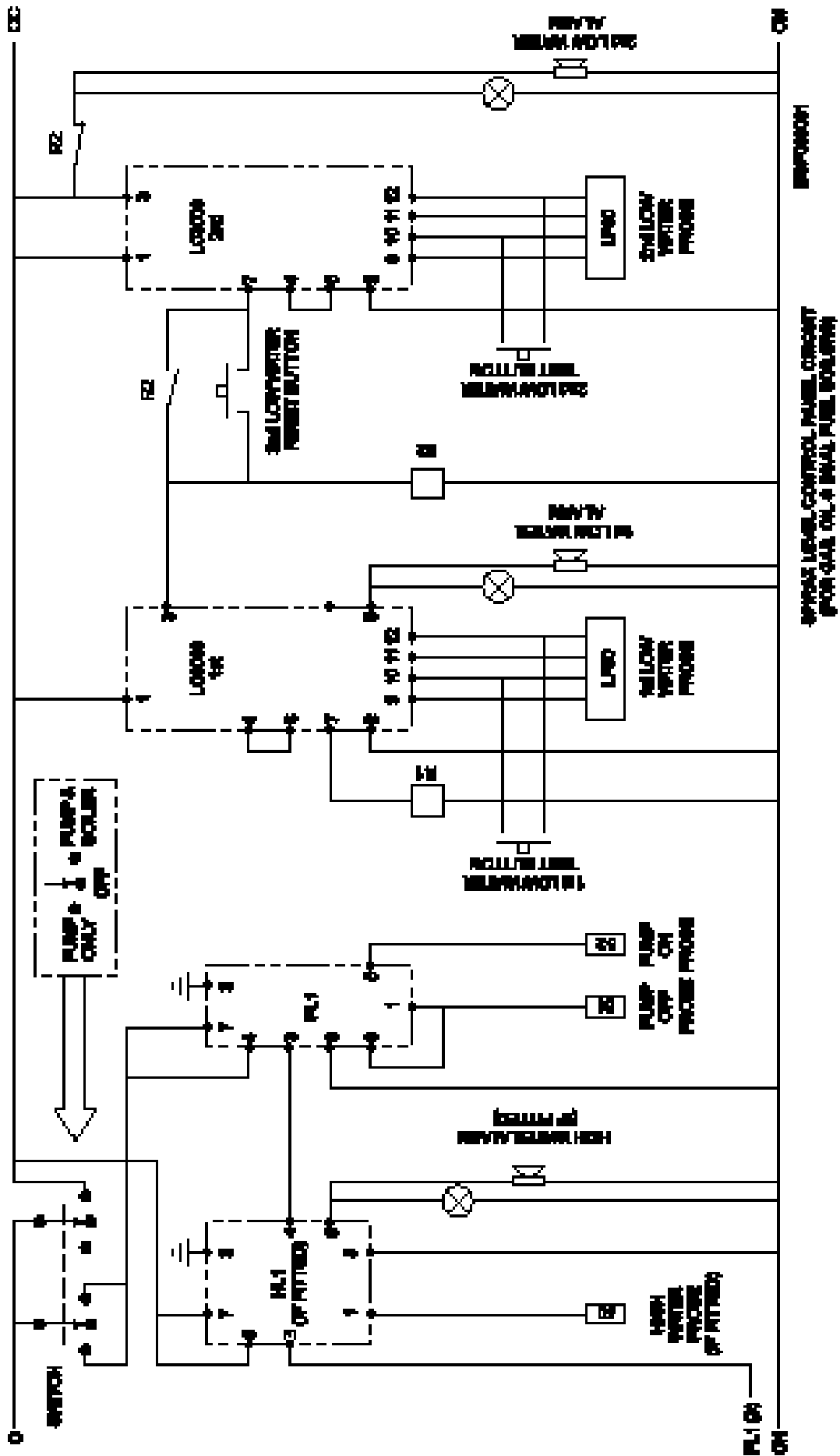


FIG. 24 SPIRAX LEVEL CONTROL CIRCUIT

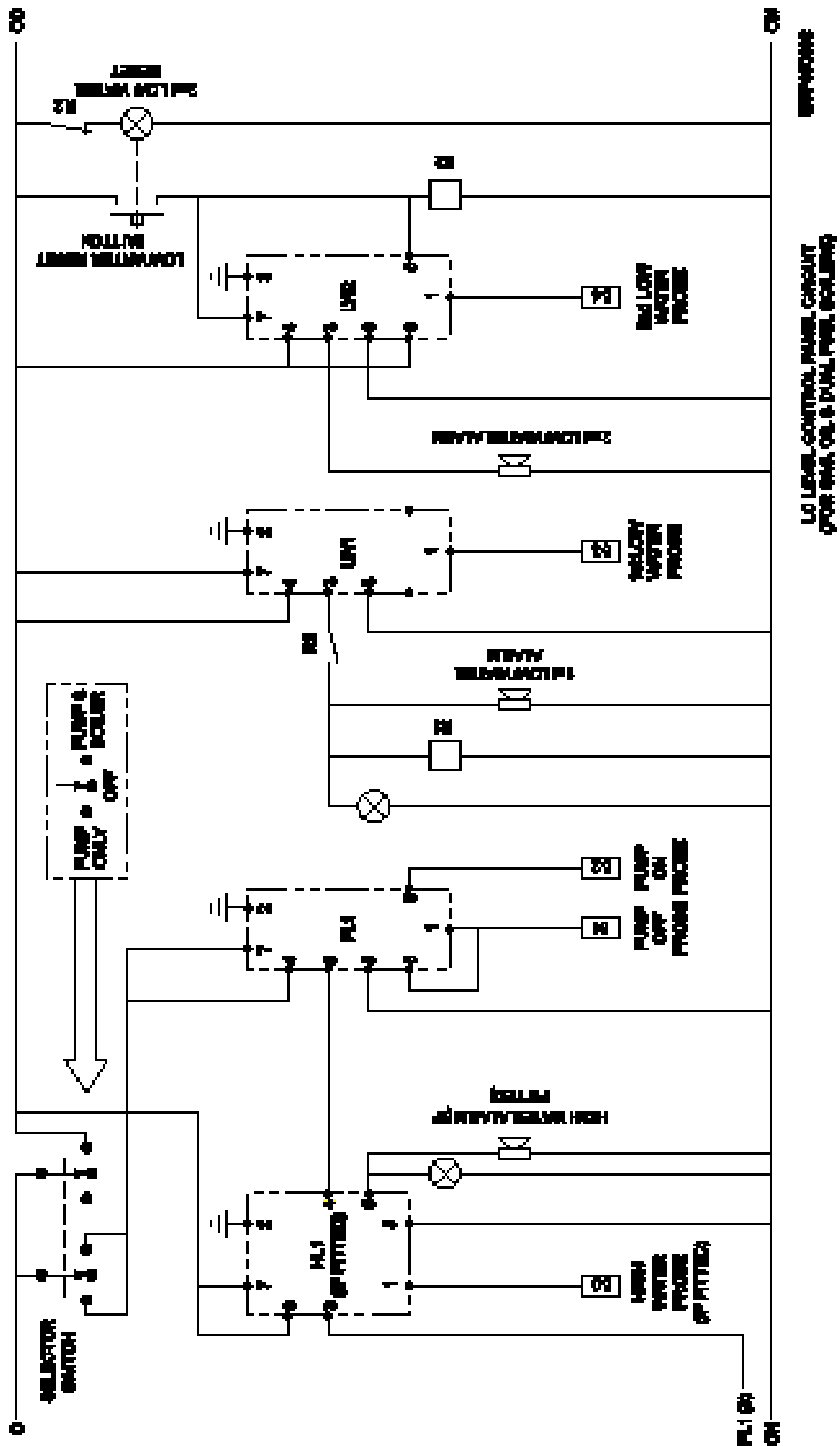


FIG. 25 LC LEVEL CONTROL CIRCUIT

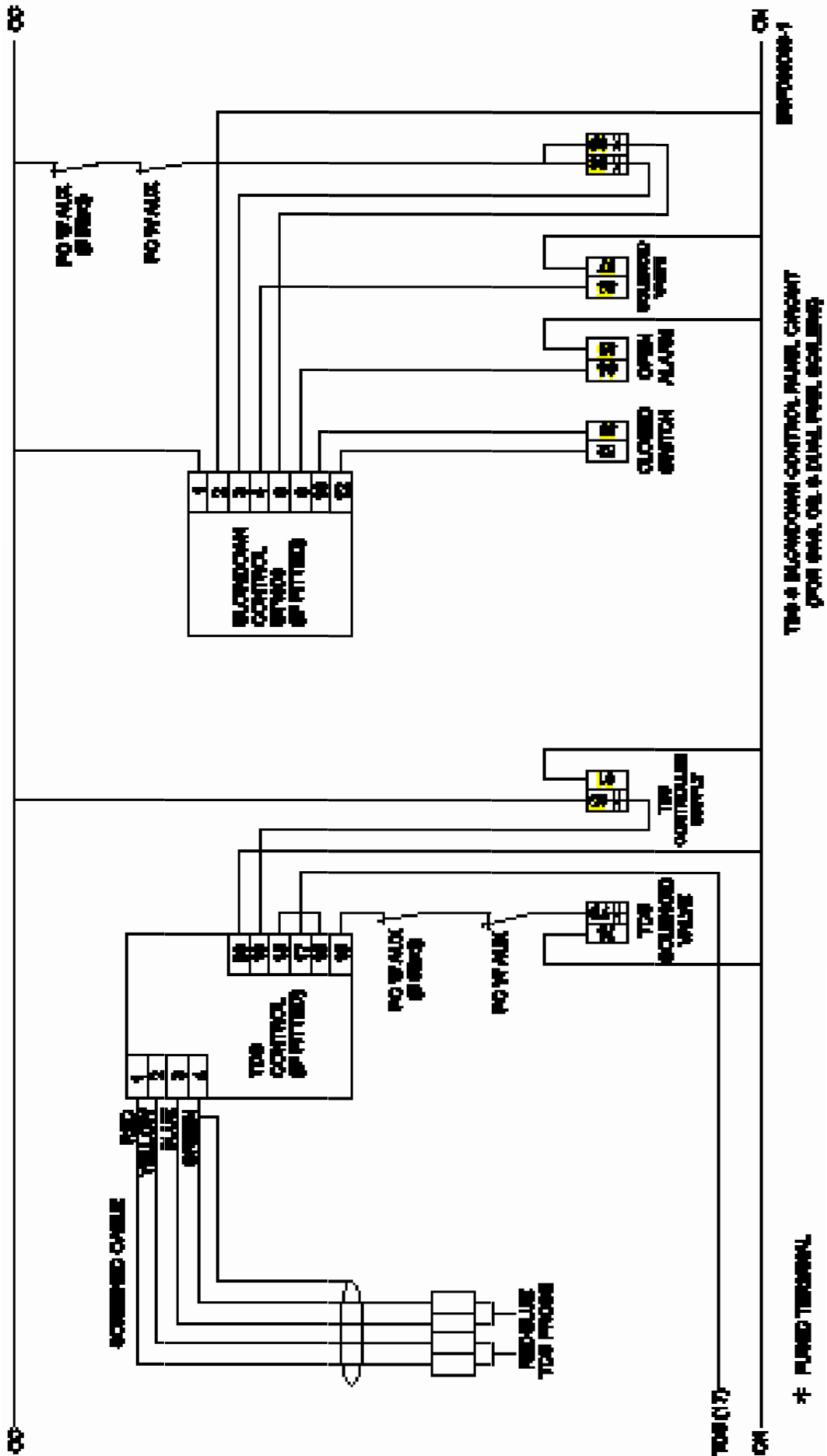


FIG. 26 TDS and BLOWDOWN CONTROL CIRCUIT



STANDARD BOILER CONTROLS TESTS - LOG

The following tests are to be performed in accordance with the maintenance schedule in the Fulton Service Manual.

Boiler No. _____

DAILY TEST						WEEKLY TEST				Date	
Date											
Water gauge blowdown test satisfactory	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No		
Water Level (by sight) 1st. gauge 2nd. gauge											
Water Level Control Feed pump, start/stop <i>Test by lowering water level</i> 1st. low water alarm Burner cut out and alarm sounded	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No		
2nd. low water alarm Burner lock out and alarm sounded	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No		
Main boiler blowdown duration/seconds											
Time test carried out											
Pressure gauge reading											
Boiler water test											
TDS											
pH											
Water treatment											
Softened water	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No		
Salt/Brine level correct	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No		
Signature of operator Log examined by _____											
											Date _____

SPARE PARTS

SECTION 6

**Consult Fulton Boiler Works for spare parts for the
JFS Range of Boilers tel: 0117 9723322**

In order to ensure spare parts are correct, please complete the details below and have them at hand when ordering parts or making enquires regarding the boiler.

- | | | |
|----|---------------------------|-------|
| 1. | Boiler number | _____ |
| 2. | Boiler type | _____ |
| 3. | Type of fuel used | _____ |
| 5. | Wiring Diagram No. | _____ |
| 6. | Commissioning Date | _____ |



The type, size and lift pressure of the safety valve fitted to a boiler is specific to that boiler. When ordering new safety valves it is important that, as well as the information requested above, the following additional information is given:

Boiler design pressure (located on the boiler data plate).

Make and type (e.g. fig no.) of safety valve fitted.

Material & Workmanship Warranty

5 Year Warranty On the Fulton Boiler Pressure Vessel

Fulton Boiler Works (Great Britain) Ltd. will repair or replace FoB factory any Fulton pressure vessel which within five (5) years of the date of delivery is found to be defective in workmanship, or material, provided this equipment is operated and maintained by the buyer for the purpose for which it was designed and in accordance with the Manufacturer's Handbook. This Warranty does not cover damage or failures that can be attributed to corrosion, scale or dirt accumulation or to low water conditions. This Warranty is good only in the United Kingdom of Great Britain and Northern Ireland. This Warranty does not include labour or delivery charges of any kind.



Fulton Boiler Works, (Great Britain) Ltd.

General Warranty

The Fulton general Guarantee is given in lieu of and in exclusion of any warranty expressed or implied, statutory or otherwise, as to the state, condition, performance, quality or fitness of the goods. Save thereunder we shall be under no obligation or liability of any kind to you in regard

to the goods. In the case of new goods manufactured and supplied by us we will make good any defect developing therein under proper use within 12 months of delivery, provided that after investigation in our sole discretion we are satisfied that the defect arose from faulty design, materials or workmanship and from no other

Defective goods or parts must be returned to us as soon as possible after discovery of the defect, Costs of carriage and of detaching and incorporating parts will be borne by you. In all cases at the termination of such 12 months all liability on our part will cease.

No liability whatsoever is to be incurred by us in respect of gauge or sight-glasses, packing glands or electric motors or any goods or accessories not of our manufacture. But so far as we are able, we shall let you have the benefit of any guarantee or warranty given to us in respect thereof.

Fulton

Fulton Boiler Works (Great Britain) Ltd.

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Telephone 0117 972 3322

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