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BOILER CODE OF PRACTICE (BCOP)

GUIDANCE NOTE

MUDHOLE DOORS

Purpose

This document describes good practice in relation to its subject to be followed by Heritage Railways, Tramways and similar bodies to whom this document applies.

Development

This document has been developed by boiler experts in consultation with His Majesty's Railway Inspectorate (HMRI) a directorate of the Office of Rail and Road (ORR). The document HGR B9000 sets out the background to setting up the Boiler Code of Practice Committee (BCOP).

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Table of Contents

1. Introduction

Railway locomotive boilers are designed to create, store and distribute steam at high pressure. The working life of such a boiler can be considerably shortened if due care is not taken at all stages of inspection, repair, running maintenance and day-to-day running.

In the past there have been a series of accidents and explosions due to work being undertaken without having due regard to the inherent risks involved. It is with that in mind that HMRI and HRA set up the series of meetings of boiler practitioners to discuss the issues; distil good practice and codify it into this series of Guidance Notes.

This guidance is written for the assistance of people competent to perform these tasks. In places the terminology used may be specific to such practitioners.

This guidance will also be useful to those in a supervisory or more general role. However, no work should be undertaken unless the people concerned are deemed competent to do so.

2. Units

The dimensions in this document are variously described in a mixture of imperial and metric units. Where practical equivalent dimensions have been shown but in some cases the dimensions do not easily equate and so the units in force at the time the original designs were documented have been used.

3. Personal Protective Equipment

Before undertaking any work, a risk assessment must be conducted.

Protective equipment is to be supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways.

The equipment must be

- In accordance with the latest Protective Equipment at Work regulations;
- Properly assessed before use to ensure it is suitable;
- Maintained and stored properly;
- Provided with instructions on how to use it safely; and
- Used correctly by employees.

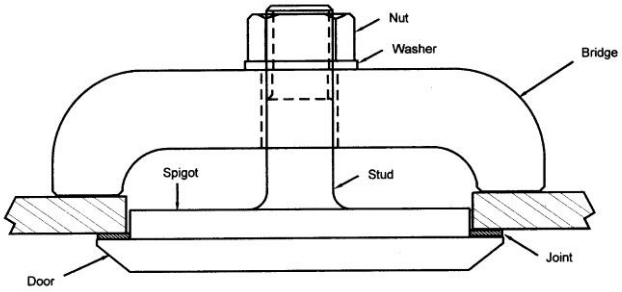
4. Inspection

In the event of finding any mudhole door to be defective or suspect, seek guidance from the boiler Competent Person before proceeding with any replacement.

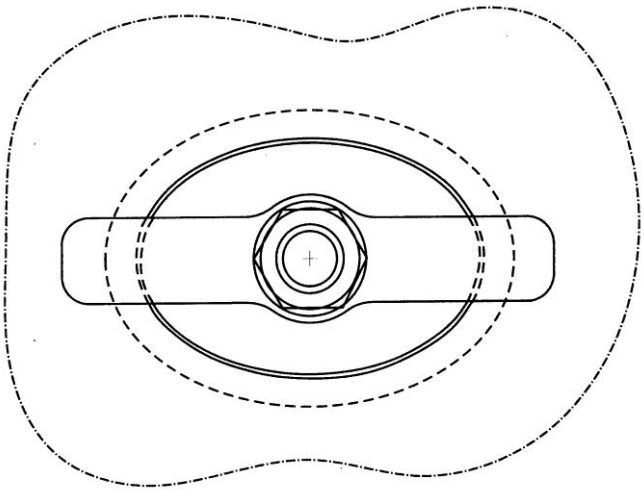
5. General

To facilitate the inspection and cleaning of boilers at regular intervals most boilers incorporate one or more mudhole doors. The number, size and location of the doors will vary with the boiler design. These doors take the form of a stepped oval of steel with a joint face forged integral with a clamping stud. The joint face abuts against the inside of the boiler plate and is sealed by an oval gasket.

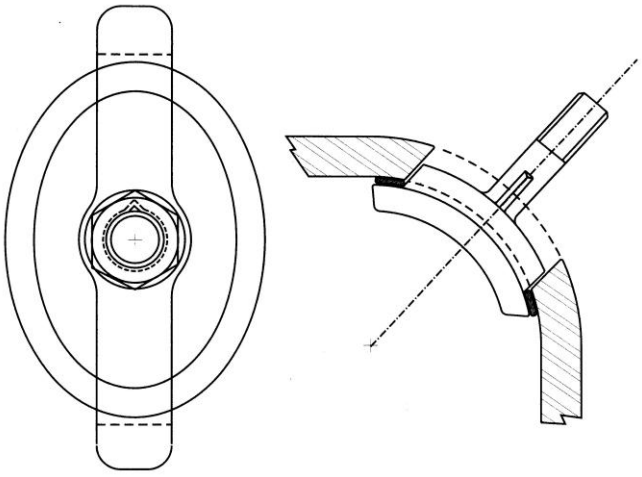
The door is retained in place by a bridge (clamp) which spans the hole in the boiler plate and a securing nut. See diagram on next page. The oval shape of the door allows it to be inserted from the outside of the boiler.



plan and sectional view of flat mudhole door assembly.



plan and sectional view of curved mudhole door assembly.

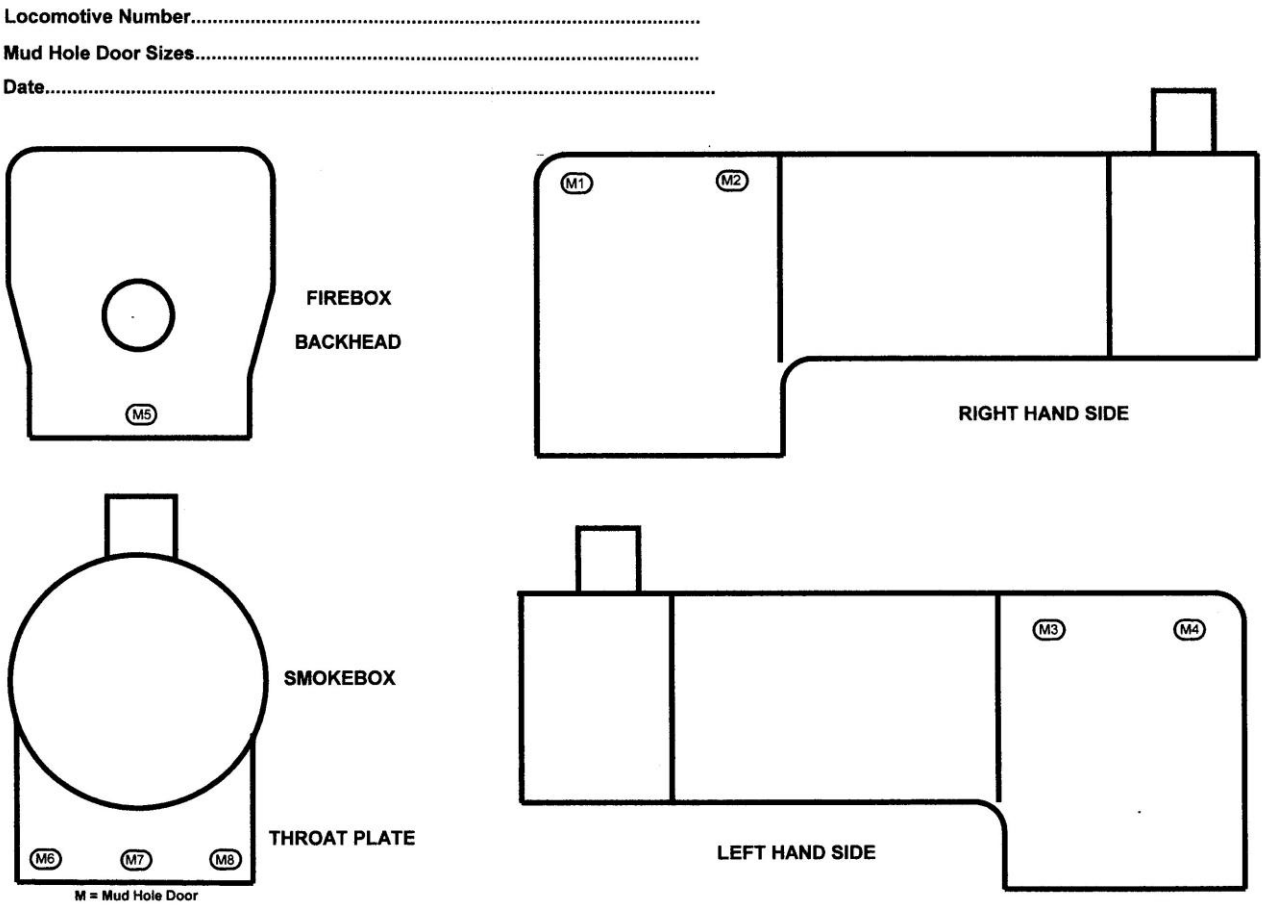


6. Competency

The inspection, fitting and repair of mudhole doors are safety critical tasks. Only those trained, deemed competent and authorised should be responsible for the inspection of mudhole doors and door holes, and the refitting of mudhole doors. Records should be kept of the action taken at each washout and by whom.

7. Maintenance plan

The boiler maintenance documentation should reference the identification and location on the boiler of each mudhole door, preferably in pictorial form on a plan, see diagram. Each door should be identified in accordance with the plan to ensure that it is always replaced in the correct position and orientation.



Typical boiler mudhole door diagram

8. Materials

Mudhole doors and bridges are manufactured from forged steel. Acceptable material grade is:-

Forged steel – BS 970 070M20

Alternatively, mudhole doors can be made up from a piece of plate with a screwed in stud. Acceptable material grades are:

Plate – BS1501/161/430 AorB, EN 10028-2P265GH, EN3B, 070M20.

Cast steel – BS3100 A1

Stud – BS 970 EN3B or 070M20

Cast Iron of any grade is **not** acceptable for manufacture of plate or stud.

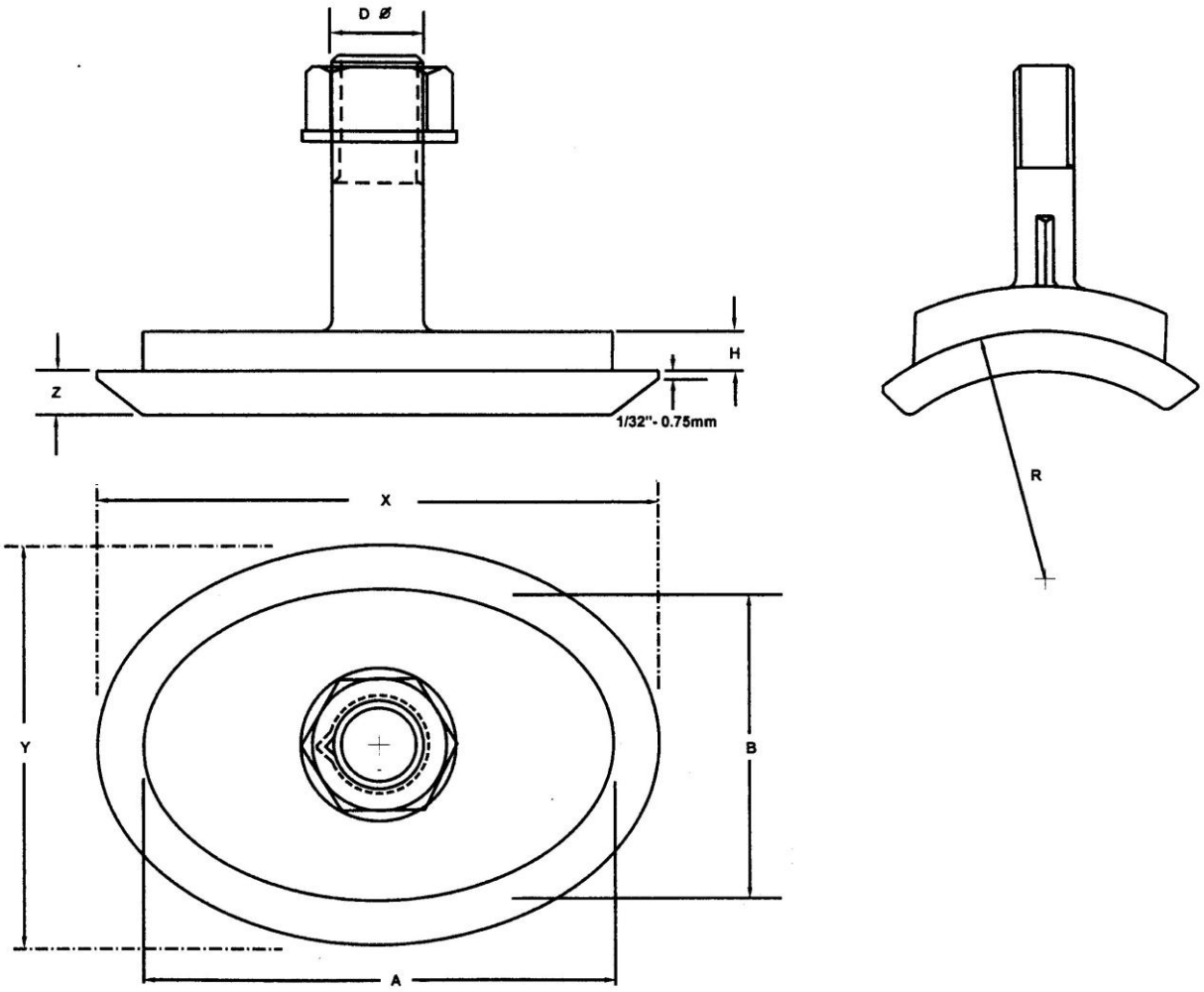
Free-cutting steel is **not** acceptable for manufacture of plate or stud.

9. Tabulation of sizes

To accommodate the requirements for access through boiler plates mudhole doors were designed in a range of shapes and sizes to suit particular boilers, the total variation of sizes are too great to list. Typical sizes for GWR and LNER with dimensions in inches were as follows:

Door Type	Door size X	Y	Door Height Z	Spigot size A	B	Spigot Height H	Stud Size D	Curve R
GWR Flat (A)	4 3/4	3 17/32	3/8	4	2 25/32	1/2	7/8 whit	-
GWR Curved top (J)	4 3/4	3 17/32	3/8	4	2 25/32	1/2	7/8 whit	7
GWR Curved Bottom (E)	4 3/4	3 17/32	3/8	4	2 25/32	1/2	7/8 whit	3 1/2
LNER	4 1/16	3 5/16	7/16	3 5/16	2 9/16	1/2	7/8 whit	-

Table 1 mudhole door dimensions



10. Jointing materials

Normal jointing materials were either Asbestos based when still permitted or cast lead. Asbestos is no longer permitted and any remaining stocks of Asbestos jointing should be disposed of as Hazardous Waste referring to your local authority or an accredited body to dispose of such waste. Lead joints remain in common use but the handling of lead creates hazards which require particular care. Acceptable jointing materials include:

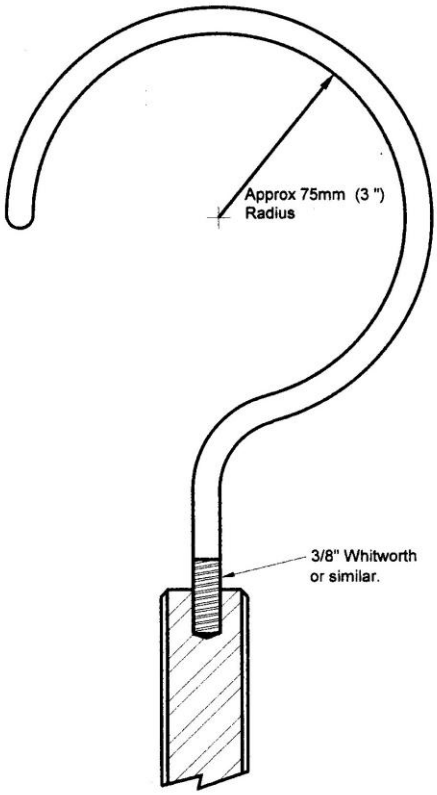
- Lead in the form of a cast ring.
- Reinforced Graphite, “Pilotgraph” or similar.
- Reinforced elasomer with non stick wrapping, “Blue Max” or similar.
- Reinforced synthetic rubber, “Topog E” or similar.
- Reinforced woven cloth, “Prekev” or similar.

All jointing materials are limited by maximum pressure and temperature restrictions so the guidance of the manufacturer should be sought to ensure the product is suitable for the service intended and fitting instructions should be closely followed.

11. Removal and cleaning

Period of removal

All mudhole doors should be removed at each and every washout. For all mudhole doors, except those at foundation ring level, care should be taken to ensure that the door does not drop inside the boiler. For such locations, a tapped hole in the stud will accommodate an attachment to prevent the door dropping inside, the bridge washer and nut being fed over the curved retaining ring, see diagram. The retaining ring does not fit through the opening in the boiler.



Door cleaning

Following removal and stripping off of old joints, mudhole doors are to be cleaned with a wire brush to remove all deposits of jointing material and scale to leave a metallic surface suitable for inspection. It is important to ensure that all boiler scale is removed from the surface of the door on the water side, joint face and spigot; any rust is to be removed. The retaining thread on the stud is to be cleaned.

Note: doors which have had lead joints fitted should be cleaned with caution to avoid the hazards created by lead, and doors in old boilers which have been out of use for some years may still have asbestos joints fitted which must be removed under controlled conditions.

Hole cleaning

Holes in the boiler plate are to be cleaned, if necessary, with fine emery paper, to remove scale for a sufficient area on the water side. Ensure that holes close to the foundation ring do not have a build up of scale at the joint between the foundation ring and the boiler plate which may prevent the door seating correctly.

Bridge cleaning

The holes in bridges should be checked for scale and cleaned.

12. Inspections and faults

Doors will suffer from the following defects over a period of time:-

- Wasting of the stud where it joins the body of the door and stretching or wastage of the thread; these require the stud to be replaced.
- Corrosion/wastage to the edge of the joint face and to the joint face itself. The joint face should be wide enough to support the joint over the full circumference of the door and to provide sufficient overlap with the boiler plate. The joint face is typically 3/8" wide and the edge is typically a minimum of 1/32" thick tapering back at 45 degrees.
- Corrosion/wastage of the spigot. The vertical face of the spigot should be parallel to the axis of the stud without any radius at the top. The height needs to be sufficient to ensure positive location in the boiler plate with a joint fitted, this height is typically ½". General corrosion/wastage in excess of 25% of the main body of the door, corrosion/wastage of the bridge locating nib on the side of the stud, and cracking at root of stud or across joint face are generally not repairable and require door replacement.

Holes

The openings in the boiler plate will suffer from general corrosion both on the water side and the outside. Corrosion on the outside will increase for doors below the waterline which have been allowed to leak over a period of time. The edges of the opening are particularly prone to corrosion, producing rounded off corners which provide less retention for the door and joint. The edges to the opening should be parallel to the axis of the door stud and not tapered. This is also the case where doors are fitted to curved boiler plate. Plates can be built up with weld and dressed back to original dimensions.

Bridges

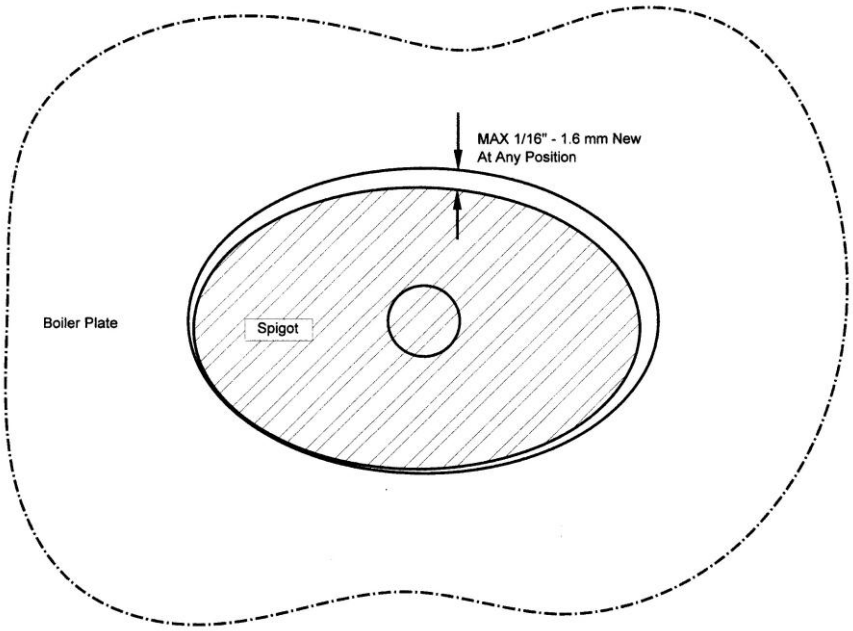
Due to their construction, bridges have a long life with little problems except for corrosion to the feet where they contact the boiler plate. Ensure that the feet are free of loose rust and are of the same length.

Nuts and Washers

Over a period of time, the threads within the securing nuts become worn and, if left unchanged, will damage the thread on the stud of the door. If the nut is loose on the stud replace the nut with new item. Stud is to have 1 ½ treads clear through the nut when assembled.

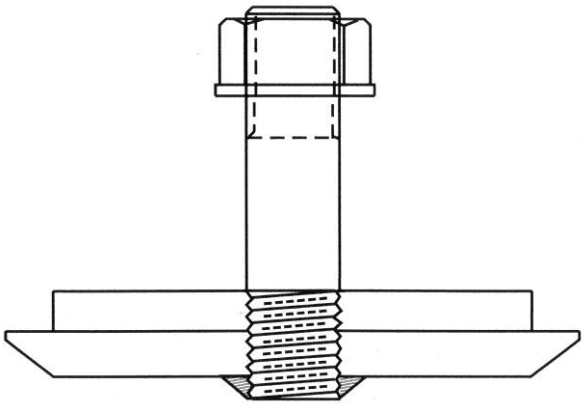
Fit of door in boiler plate opening

It is important that the door fits the opening correctly. With the door central in the opening, and no joint fitted, the maximum gap between the spigot and the boiler plate should be no more than 1/16" when new and 3/32" when 'worn' with the door at maximum offset in any direction, see diagram opposite. Errors significantly greater than this should be corrected by weld repair. The door should contact the inside of the boiler plate across the full width of the joint face all around the periphery of the door. This fit is not easy to establish, one method is to use an engineer's highlighting marker such as "blue" and file or scrape to fit.



13. Repairs

Corrosion repairs to doors can be made by welding in small areas. Welding to the spigot or joint face of the door should be undertaken by a competent coded welder using low Hydrogen steel rods and dressed back to original dimensions. If the stud requires replacement, remove the old stud by cutting flush with door. Drill and tap a hole in the door on centreline of the old stud; thread size is to be the same as on the free end of the stud. Manufacture a new stud, threaded each end and plain in the middle, material to be 070M20 or equivalent. Screw new stud into door and seal weld stud to door on the water side of the door, See diagram. Do not weld on the outside.



All welding of boiler plate work must be undertaken by a coded welder.

14. Fitting doors

The boiler records should be consulted during re-fitting to ensure that the correct door is always fitted to the correct hole, this avoids fitting the wrong door to a hole.

Stud threads should be lightly coated with Graphite grease.

Most grades of joint now available require no release agent and in such cases, it is important that the joint faces are free of oil/grease; see manufacturer's instructions applicable to the joints used.

Fit the joint to the door; if this is of the correct size, it will locate and lightly grip against the spigot all around, do not force the joint over the spigot as this will damage the joint and increase risk of failure in service, see manufacturer's instructions.

For doors that are higher than foundation ring level, attach a retaining ring to avoid dropping the door inside the boiler. Feed the door with joint attached into the opening and hold against the inside of the boiler plate. Ensure that the door is the correct way up, that it is central in the hole and that the joint is still in place. Feed the bridge, washer and nut over the retaining ring if fitted, and onto the stud. Tighten the nut finger tight and remove retaining ring. Again, inspect that the door is central in the hole and that the joint is in place. The orientation of the bridge should lie along the major axis of the door if the boiler plate is curved; if the boiler plate is flat, the bridge should be orientated to avoid any adjacent stay heads or rivets.

Tighten retaining nuts to manufacturer's instructions; generally, this is only lightly, as over tightening may cause the joint to extrude off the joint face into the water space. Some designs of joint will only soften and seal once the temperature of the boiler is raised; see manufacturer's instructions.

15. Testing in boiler

Doors are to be inspected for leakage when the boiler is first steamed following a washout. If leakage is detected, tighten the door whilst the boiler is in low steam, 20psi maximum, but this should be unnecessary as the pressure on the inner face of the door should be sufficient to seal a correctly fitting joint. Once a joint has softened and sealed, take up the slack and nip with a spanner as necessary. If leakage persists, drain the boiler of water, remove the door, inspect, clean and refit. Always fit a new joint.

16. Examination in service

Doors are to be inspected for leakage regularly when the boiler is in service. If leakage is detected tighten the door whilst the boiler is in low steam, 20psi maximum. If leakage persists drain the boiler of water, remove the door, inspect, clean and refit, always fit a new joint.

17. References

GWR 84773 Nibbed mudhole door. GWR 106494 Standard mudhole doors and lead joints.

