

BOILER CODE OF
PRACTICE (BCOP)



GUIDANCE NOTE

WASHOUT PLUGS

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).

Disclaimer

The Heritage Railway Association and BCOP has used its best endeavours to ensure that the content of this document is accurate, complete and suitable for its stated purpose. However, it makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems of work or operation. Accordingly, neither the Heritage Railway Association nor BCOP will be liable for its content or any subsequent use to which this document may be put.

Supply

This document is published by the Heritage Railway Association (HRA).

Copies are available electronically via its website www.hra.uk.com

Users of this Guidance Note should check the HRA website, www.hra.uk.com , to ensure that they have the latest version.

Table of Contents

<u>SECTION</u>	<u>Page Number</u>
1. Introduction	3
2. Units.....	3
3. Personal Protective Equipment	3
4. Inspection	3
5. General	3
6. Competency.....	4
7. Maintenance plan	4
8. Materials	4
9. Tabulation of standard plug sizes.....	5
10. Thread form	6
11. Thread sealant.....	7
12. Removal and cleaning	7
13. Inspections and faults.....	7
14. Fitting	8
15. Testing	8
16. Re-working plugs.....	8
17. Cap type washout plugs	8
18. Plug hole taps	9
19. References	9

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; an explanation of terms used is available in document HGR-B9000.

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:

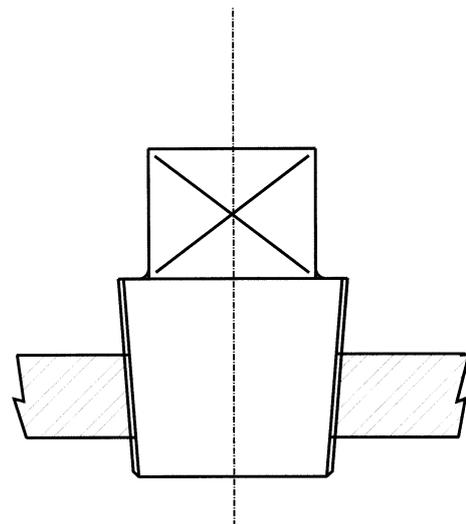
- In accordance with the latest Protective Equipment at Work regulations;
- Properly assessed before use to ensure it is suitable;
- Maintained and stored properly;
- Provided with instructions on how to use it safely; and
- Used correctly by employees.

4. Inspection

In the event of finding any plugs that are 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 designs of boiler incorporate several washout plugs; the number and location of the plugs will vary with the boiler design. These plugs take the form of a solid billet of alloy, usually bronze, one end having a tapered thread to engage in a matching thread in the boiler shell and at the other end a raised head, usually square, for driving the plug, see diagram:



9. Tabulation of standard plug sizes

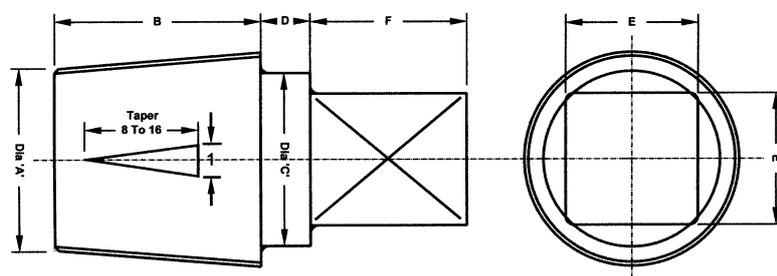
To accommodate the progressive wear of the threads in boiler plates, washout plugs are manufactured in a range of sizes. The plugs usually associated with locomotive boilers are detailed in Table 1.

TABLE 1

Plug type	Thread				Centre section		Square			Size No small to large
	OD small end	TPI	Taper, inc	Length	Dia	Length	AF	M/F	Length	
	A			B	C	D	E		F	
BR STD	1 3/8" to 2" by 1/16"	12	1:08	1 5/8"	-	-	1 1/4"	M	1"	1 to 11
GWR	1 5/16" to 1 9/16" by 1/16"	12	1:08	1 1/2"	-	-	1"	M	1"	1 to 5
LMS	1 7/16" to 2" by 1/16"	12	1:12	1 1/2"	-	-	1 1/4"	M	1"	A to K
LNER extra long	1 3/8" to 1 3/4" by 1/8"	11	1:09	2 3/4"	1 5/8"	1 1/2"	1 1/4"	M	1 1/2"	1 to 4
LNER long	1 3/8" to 1 3/4" by 1/8"	11	1:09	2"	1 5/8"	7/8"	1 1/4"	M	1 1/2"	1 to 4
LNER ordinary	1 3/8" to 2" by 1/8"	11	1:09	2"	-	-	1 1/4"	M	1 1/2"	1 to 6
SR long	1 3/8" to 2 1/4" by 1/16"	12	1:08	1 5/8"	Tapered	1 5/8"	1 1/4"	M	1"	-
SR short	1 3/8" to 2 1/4" by 1/16"	12	1:08	1 5/8"	-	-	1 1/4"	M	1"	-
SR sunk	1 3/8" to 2 1/4" by 1/16"	12	1:08	1 7/8"	-	-	11/16"	F	1"	-
Austerity	1 7/16" to 1 3/4" by 1/16"	12	1:12	1 1/2"	-	-	1 3/16"	M	1"	A – F
BSPT	1", 1 1/8", 1 1/4", 1 1/2", 1 3/4" nominal	11	1:16	1 5/8"	-	-	1 1/4"	M	1"	-

Other ranges of sizes have been adopted by manufacturers in the past; however, those tabulated represent the majority remaining in use and are recommended.

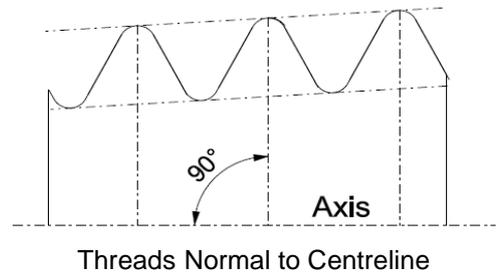
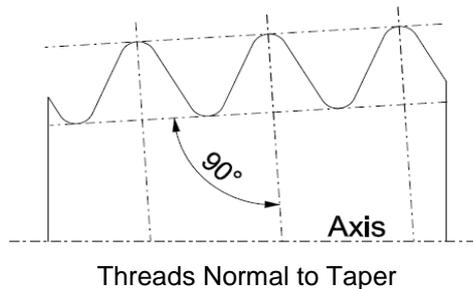
The dimensions are as detailed in the figure to the right:



It is important that the boiler records and plug diagram (see section 7 above) detail which plug type(s) is(are) in use on the boiler.

10. Thread form

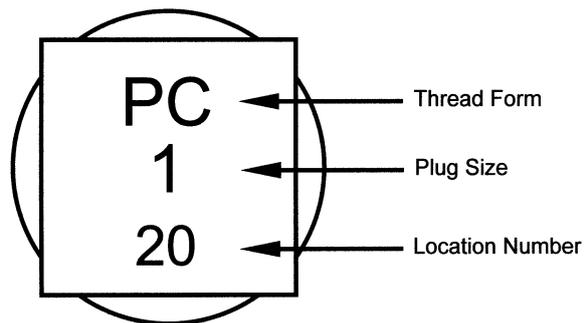
Threads sizes will vary according to design but, usually, the threads are of Whitworth form. The TPI of the thread is always measured along the centre line of the plug. There are two methods of cutting the threads on the tapered portion of the plug, either a) square to the taper of the thread - this allows modern full form threading tips to be used, or b) square to the centre line of the plug - this requires specially ground full form chasers to cut the correct profile thread (see figure below).



Both methods are acceptable, however it is important that the two thread forms are not mixed up and that both boiler thread and plug are to the same standard; only one type should be used on any single boiler. Washout plug taps are available to either form.

It is important that the boiler records and plug diagram (see item 7 above) detail which form is in use on a boiler and that the plugs and any spares are appropriately marked. The marking on the head of the plug shown in the figure to the right will assist identification.

- PC – Thread cut perpendicular to the centre line.
- PT – Thread cut perpendicular to the taper.



11. Thread sealant

Plug threads should be sealed with a lubricating sealant such as graphite grease. No hard setting sealant or jointing compound is to be used as this builds up over time in the thread forms and is difficult to remove from plug and hole. Suitable graphite grease compounds are petroleum jelly based; compounds with linseed oil are hard setting and not suitable.

The use of PTFE and PTFE tapes can cause toxic fumes at elevated boiler temperatures (300+ °C) and their use should be avoided in locations where elevated temperatures may be encountered

12. Removal and cleaning

Period of removal: A list of plugs to be removed at each and every washout should form part of the boiler records and plug diagram, and a list of the plugs to be removed at annual exam should also form part of the boiler records and plug diagram; all plugs are to be removed at overhaul.

Plug cleaning: Plugs are to be cleaned with a fine hand wire brush to remove all deposits of graphite grease and scale to leave a bright surface suitable for inspection.

Hole cleaning: Holes are to be cleaned with small wire brush, or tap, if necessary; paraffin or similar solvent used with a tooth brush will leave a surface suitable for inspection.

Storage of plugs: Use a partitioned aluminium, plastic or wooden tray to avoid plug threads becoming damaged by bruising.

13. Inspections and faults

Plugs. Worn threads gradually result from the constant removal, cleaning and refitting of washout plugs. Plugs will suffer from pulled threads, ripped or lost threads, wasting in the centre section and twisted squares. Any such defect will render the plug unserviceable and it must be replaced; unserviceable plugs should be destroyed to avoid being reused, or re-worked to a smaller thread size, if salvageable. The limit of wasting in the centre can be gauged by using a straight edge from end to end of the thread; the maximum permitted clearance is 0.010". Pulled threads will require a suitable gauge for threads cut square to axis, this must be especially manufactured to suit the purpose; for threads cut square to face a normal gauge will suffice but should only be 3 threads long.

Plate work. Holes will suffer from ripped or lost threads, corroded threads, cracking in plate and cross threaded holes. 4 complete consecutive turns of full form thread in the boiler plate without any damage is the absolute minimum acceptable. Note that a tapered thread, cut by a tap, will always leave a line where the tap stopped cutting; this may on occasions be mistaken for a crack. If necessary, use the tap to advance the point of cut by a small amount and re-inspect. Any holes with signs of damage or being tapped cross threaded should be re-tapped on the correct alignment to the next size up, removing all trace of the damage or cross-threading. When tapping threads, use a sharp tap in conjunction with a cutting compound, ensure the tap is perpendicular to the plate and advance the tap by up to ½ turn per cut and back off as required to free swarf. Avoid the end of the tap causing damage to internal components within the boiler, such as pipes and stays. For threads in new plate, an appropriate taper reamer should be used to prepare the hole to the correct taper, prior to tapping to avoid excess use of the tap. When inspecting holes, sufficient light must be available to illuminate all of the surfaces and, if necessary, a mirror to inspect parts of the thread not visible directly.

Fit of plug-in hole. The plug must always enter into the water space by at least 2 full threads to avoid the build up of scale against which a plug may bottom, particularly where a doubling plate may be fitted to the boiler. If necessary, relieve the threads in the doubling plate to avoid the plug bottoming. When fitted, the plug should have at least 2 full threads clear on the outside of the boiler. The plug should not protrude so far into the boiler that there is a risk of it fouling any internal components.

14. Fitting

The boiler records and plug diagram should be consulted during re-fitting to ensure that the correct plug number is always refitted into the correct hole number; this avoids fitting the wrong plug to a hole. Plug threads should be coated with Graphite grease - see thread sealant above; no hard setting lubricant or jointing compound is permitted.

Firstly, insert the plug into the hole and tighten by hand. If cross threading is suspected, rock the plug by hand when it is about 4 turns from tight; if satisfactory, it should have the same amount of play in every direction; continue to tighten by hand as far as possible. To fully tighten, use a purpose made square socket which is a good fit on the square of the plug; push the socket hard up against the end of the square to avoid damaging the plug or twisting the square. When fitting plugs, it is important that it is done as a single operation on each and every individual plug without distraction; the plug is either 'out in the tray' or 'fitted tight'. Do not put all the plugs in hand tight and follow around with the socket. For most standard sized plugs an 18" T bar on the square socket will give an appropriate torque when operated by hand (approximately 100Nm (75 ft. lbs.)). Do not over tighten by using an extension on the T bar handle.

15. Testing

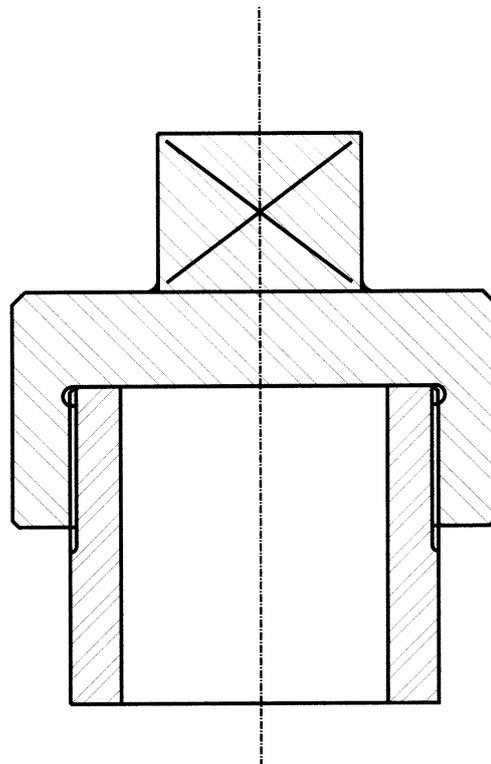
Plugs are to be inspected for leakage when the boiler is first steamed, following the removal of any washout plug. If any leakage is detected, no attempt is to be made to tighten the plug whilst the boiler is in steam. A further check on the tightness of the plug may be made when the boiler is cold, if necessary, drain the boiler of water, remove the plug, inspect, clean and refit.

16. Re-working plugs

If a plug thread becomes damaged then no repair is possible except to remove material by re-cutting the thread and reducing it by one or more sizes.

17. Cap type washout plugs

Some boilers use a cap type washout plug (see below), where the boiler thread is male and the cap thread is female and blind. Most of the above guidance applies to these; however, in addition, it is important to ensure that the male thread seals in the bottom of the cap.



18. Plug hole taps

Taps for cutting plug hole threads are available from various manufacturers. When specifying the tap required the following details are to be provided to the supplier:

- Small end diameter (usually 1/8" less than the plug small end)*;
- TPI along the centreline (usually 12 see Table 1)*;
- Inclusive angle of thread (usually 1:8 see Table 1)*;
- Length of cut (usually 3");
- Number of flutes (usually 5);
- Pitch tolerance (usually plus or minus 0.001" over one inch);
- Material to be cut;
- Thread form (usually Whitworth)*; and
- Thread, square to centreline (PC) or square to taper (PT)*.

The tap is to be clearly identified with the details marked*.

19. References

SL/SW/20 BR Standard washout plugs.

GWR 101077 Standard plugs and stays for locomotive boilers.

GWR 134284 Chart of regional washout plugs BR(W) 1954.

LMS "Red book" section B12.

end of document