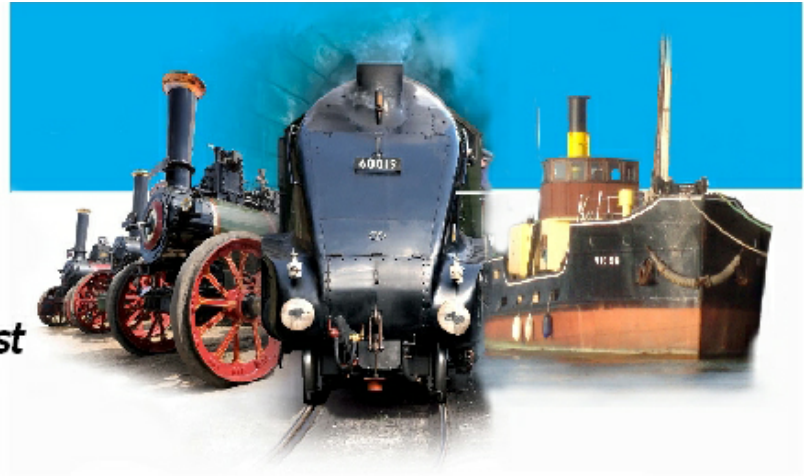


# Bestt

*Boiler & Engineering Skills Training Trust*



**Please note that this Content may change.**

These boiler training modules, incorporating sections of the HRA/ORR boiler code of practice, were prepared in 2013 as part of the HLF funded BESTT training plan project and will be progressively reviewed and updated by the BESTT Technical Committee.

# Bestt

*Boiler & Engineering Skills Training Trust*



## **Wash Out Plugs**

### **Proposed Syllabus 2013**

**To be used in conjunction with:**

**HRA Guidance Note HGR-B9009 - Is01**

**BESTT acknowledges the support of the HRA for allowing the use of the Guidance Notes**

#### **DISCLAIMER.** ISSUE 2018

The Boiler and Engineering Skills Training Trust (BESTT) has used its best endeavours to ensure that the content shown herein 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 BESTT will not be liable for its content or any subsequent use to which this document may be put.

# Proposed BESTT Syllabus Assessment Plan

## Module: BESTT

### Washout Plugs

This module is to be used in conjunction with HRA Guidance sheet BS9009 – Is01

### Aim

This unit will give the learners an understanding of the function of washout plugs used in boilers.

### Introduction

This unit will give practical knowledge of:

- Maintenance
- Materials
- Tabulation of sizes
- Thread form
- Thread Sealant
- Removing and Cleaning & Inspection
- Fitting
- Testing
- Re-working

### Learning Outcomes

The numbers in parenthesis refer to the HRA Guidance note section. Learning outcome 1 could be delivered in a classroom environment.

#### L01

1. Know thoroughly the use of correct PPE for the tasks (3)
2. How to inspect plugs (4)
3. Identify wash out plugs (5)
4. Understand Safety Critical tasks (6)
5. Be able to create a maintenance Plan (7)
6. Know the materials used (8)
  
7. Knowledge of Thread Form (10)

#### L02

1. Tabulation of standard plug sizes (9)
2. Be aware of how the threads could be cut (10)
3. Importance of using correct sealants (11)

## **Proposed BESTT Syllabus Assessment Plan**

4. Correct use of record keeping, cleaning in preparation for inspection (12)
5. Inspection of plugs and holes for damage/wear (13)

### **L03**

1. Be able to fit a washout plug (14)
2. Testing of plug in the boiler and rectification of a leak (15)
3. Re-working of plugs (16)
4. How to specify a plug tap (18)

On completion of the module the trainee should be able to use correctly and safely the following equipment:

- Taper Taps
- Taper Reamers
- Inspection equipment

### **Assessment**

Learners could demonstrate competence in this unit by:

- Documental evidence
- Photographic evidence
- Witness statements e.g. written or verbal statement from a competent person stating that they have completed tasks satisfactorily.
- Underpinning knowledge questions e.g. written questions, multi choice answer sheets, on-line tests, and assignments.
- Practical training tasks

***BESTT acknowledges the support of the Heritage Railway Association in allowing us to use their Guidance Notes in this Syllabus.***

# HERITAGE RAILWAY ASSOCIATION

## GUIDANCE NOTE

### WASHOUT PLUGS

#### **Purpose**

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

#### **Endorsement**

This document has been developed and fully endorsed by Her Majesty's Railway Inspectorate, a directorate of the Office of Rail Regulation

#### **Disclaimer**

The Heritage Railway Association 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 the Heritage Railway Association will not 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

Copies are available electronically via our website [www.heritagerailways.com](http://www.heritagerailways.com)

Users of this Guidance Note should check the HRA website to ensure that they have the latest version.

## Table of Contents

<b>SECTION</b>	<b>Page Number</b>
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

This Guidance Note is one of a series dealing with Locomotive Boilers that were produced by the 2006-8 meetings on "Steam Locomotive Boiler Codes of Practice.

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 H.M.R.I. and H.R.A. 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 works 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

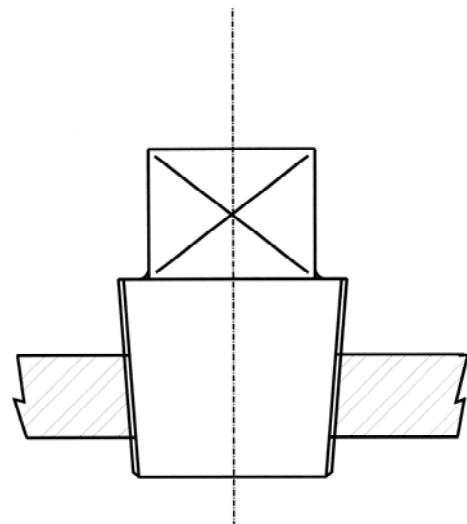
- In accordance with the latest Protective Equipment at Work regulations.
- Properly assessed before use to ensure it is suitable.
- Maintained and stored properly
- Provided with instructions on how to use it safely
- Used correctly by employees.

## 4. Inspection

In the event of finding any plugs 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:





## Proposed BESTT Syllabus Assessment Plan

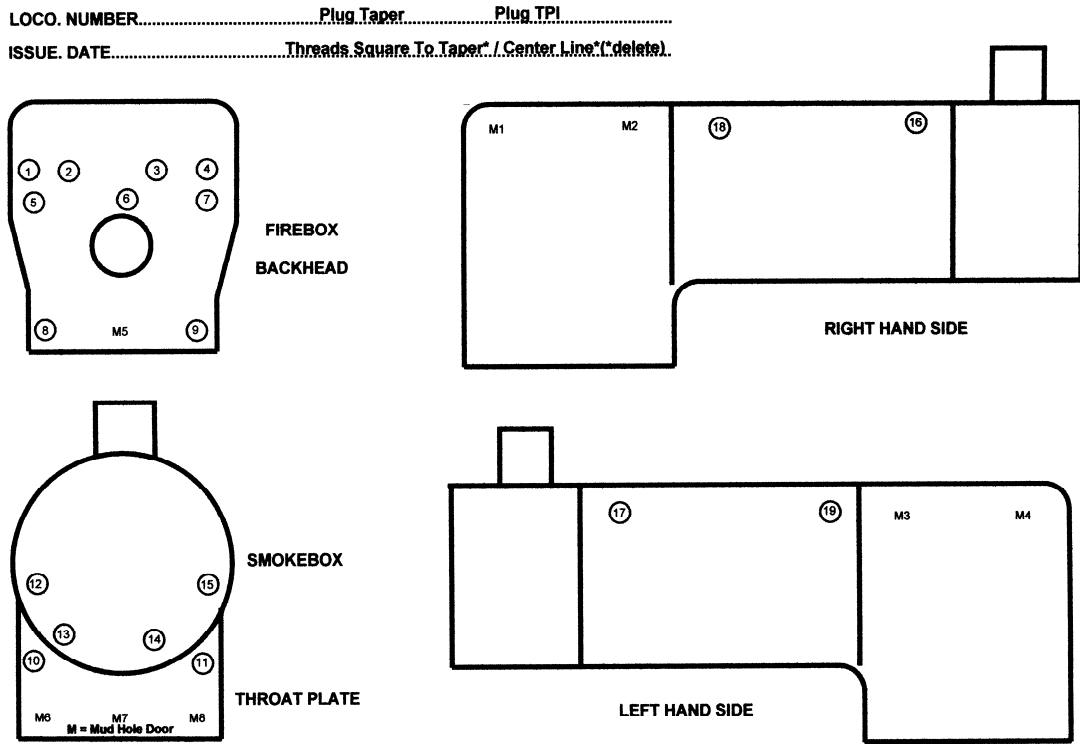
<b>Section Number</b>	<b>LO</b>	<b>Objectives</b>	<b>Assessment Criteria</b>	<b>Delivery</b>	<b>Date achieved and Supervisors signature</b>
3	LO1 1	Understand the importance of using the correct PPE	Demonstrate the correct use and care of PPE	Workshop	
4	LO1 2	Inspection of plugs – defective plug identified	Correctly identifying defective plugs and course of action to be taken	Classroom	
5	LO1 3	Identify the standard form of washout plugs	Draw the standard washout plug	Classroom	

6. Competency

The manufacture, inspection and fitting of washout plugs are safety critical tasks. Only those trained, deemed competent and authorised should be responsible for the inspection of plugs and plug holes, and refitting of washout plugs. 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 washout plug, preferably in pictorial form on a plug diagram (see below). Each plug should be stamped with it's reference number in accordance with the plan to ensure that it is always replaced in the correct location.



8. Materials

Washout plug material must be immune from the effects of corrosion caused by boiler water. Brass and it's alloys containing Zinc are not to be used. Acceptable alloys are:

BS1400 LG2; BS1400 LG4; SAE 660 (ASRM B271 1996A C93200).

## Proposed BESTT Syllabus Assessment Plan

<b>Section Number</b>	<b>LO</b>	<b>Objectives</b>	<b>Assessment Criteria</b>	<b>Delivery</b>	<b>Date achieved and Supervisors signature</b>
6	LO1 4	Understand the term Safety Critical	Description of Safety Critical tasks and the correct course of action	Classroom	
7	LO1 5	Be able to create a maintenance plan	Create a maintenance document and interpret the markings on the plug	Classroom	
8	LO1 6	Knowledge of materials used for a) the plug	Explain what materials can and cannot be used for washout plugs and why	Workshop	

**9. Tabulation of standard plug sizes**

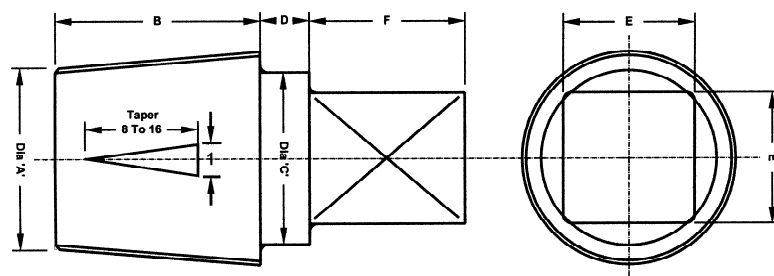
To accommodate the progressive wear of the threads in boiler plates washout plugs are manufactured in a range of sizes. The plugs usually associated with locomotive boilers are detailed in Table 1..

**TABLE 1**

Plug type	Thread				Centre section		Square			Size No
	OD small end	TPI	Taper, inc	Length	Dia	Length	AF	M/F	Length	small to large
	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 to be recommended

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



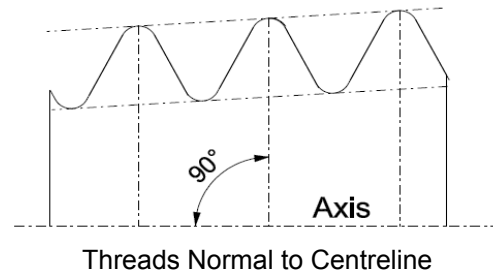
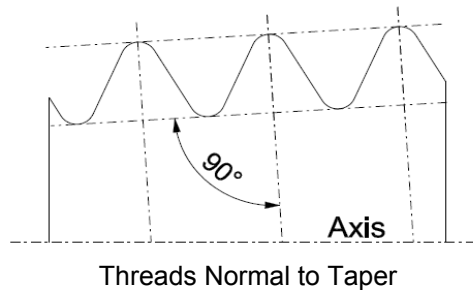
It is important that the boiler records and plug diagram (see section 7 above) detail which plug type(s) is(are) in use on the boiler.

## Proposed BESTT Syllabus Assessment Plan

<b>Section Number</b>	<b>LO</b>	<b>Objectives</b>	<b>Assessment Criteria</b>	<b>Delivery</b>	<b>Date achieved and Supervisors signature</b>
9	LO2 1	Understand the tabulation of standard plug sizes	Be able to correctly different forms of plugs, including taper, TPI, thread.	Classroom Workshop	

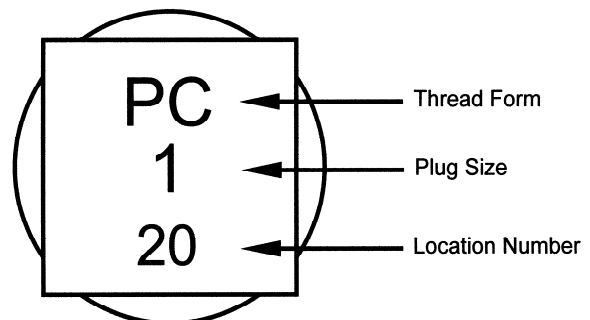
**10. Thread form**

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 especially 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.



## Proposed BESTT Syllabus Assessment Plan

<b>Section Number</b>	<b>LO</b>	<b>Objectives</b>	<b>Assessment Criteria</b>	<b>Delivery</b>	<b>Date achieved and Supervisors signature</b>
10	LO2 2	Understand the different ways that threads can be cut	Be able to identify a plug from the markings and by measurement Discuss PT and PC	Classroom and workshop	

## **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 tray to avoid plug threads becoming damaged by bruising.

## **13. Inspections and faults**

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 scrap and it must be replaced, scrap plugs should be destroyed to avoid being reused, or re-worked 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.

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 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.



## Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
11	LO2 3	Importance of using correct sealants	Be able to identify correct sealants and why PTFE based compounds should not be used	Classroom	
12	LO2 4	Correct use of records, cleaning of threads for inspection and correct storage	The creation of a maintenance record Use of correct methods for cleaning internal and external threads	Workshop	
13	LO2 5	Inspection of plugs and holes for damage/wear	Be able to correctly identify problems with plugs and holes. Know what action to take	Workshop	

## 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 250Nm (185 ft. lbs.)), do not over tighten by using an extension on the T bar handle.

## 15. Testing

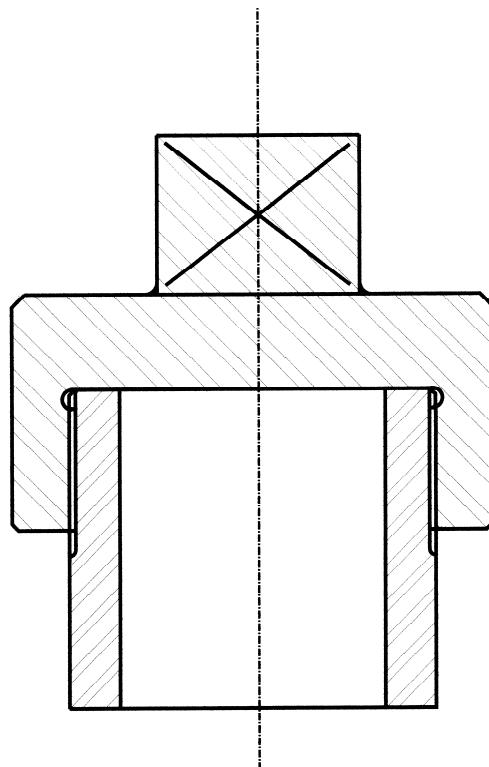
Plugs are to be inspected for leakage when the boiler is first steamed following the removal of any washout plug. If any leakage is detected no attempt is to be made to tighten the plug whilst the boiler is in steam. A further check on the tightness of the plug may be made when the boiler is cold, if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



## Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
14	LO3 1	Be able to fit a plug correctly	Know the correct projection of plugs. How to fit sequentially and tighten to correct torque. Fit 5 plugs under supervision	Workshop	
15	LO3 2	Testing of a set of plugs must be carried out	Witness a steam test and check every plug you have been involved with and write up as an addition to the plug diagram		
16	LO3 3	Reworking of plugs	Explain how a scrapped plug can be re-worked	Classroom	
18	LO3 4	How to specify a plug tap	Name the 9 identifying features you need to specify when ordering a new wash out plug tap.	Classroom	

**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)\*
- 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

---

## Proposed BESTT Syllabus Assessment Plan

### BESTT

### Wash Out Plugs - Module 9009 - Is01

Assessment Record for: Fred Bloggs

Training Centre: ABCD

Year: August 14 - July 15

L01	1	2	3	4	5	6	7		
<i>Supervisor Initials and date when completed</i>									
L02	1	2	3	4	5				
<i>Supervisor Initials and date when completed</i>									
L03	1	2	3	4					
<i>Supervisor Initials and date when completed</i>									

### Witness Statement

The trainee *Fred Bloggs* has completed the Learning outcomes to a satisfactory standard

**Signed:** Internal Supervisor

**Print Name:** Internal Supervisor **Date:** December 14

**Verified by BESST Assessor**

**Name:** TBC

**Assessor Number:** 12345 **Date:** December 14