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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.



Boiler Washout and Examination

Proposed Syllabus 2013

To be used in conjunction with:

Guidance Note RHG1

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Module: RHG 1

Boiler washout and examination This document has not been endorsed by HRA and is provided 'as is' until the final version evolves from HRA.

Aim

This unit will give the learners an understanding of how to wash out a boiler and its examination during washout.

Introduction

This unit will give practical knowledge of:

- 1. PPE
- 2. The Washout
- 3. Examination of water spaces
- 4. Examination of Firebox
- 5. Examination of Smokebox
- 6. Examination of outer casing
- 7. 'Boxing up'

Learning Outcomes

The numbers in parenthesis refers 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. Knowledge of materials (5)
- 3. Understanding how a fusible plug functions (5)
- 4. Types of fusible plugs (5)
- 5. Maintenance plan (7)
- 6. Tabulation of fusible plug sizes (9)
- 7. Use of PTFE based compounds (14)

L02

- 1. Know the materials used (8)
- 2. Know the two types of plug used (9)
- 3. Be aware of how the threads could be cut (10)
- 4. Understand length of plugs (11)
- 5. Out sourcing of plugs (12)
- 6. Manufacture of plugs (13)

LO3

- 1. Identification of serviceable & unserviceable fusible plugs (16)
- 2. Tapping of new fusible plug holes in crown (16)
- 3. Be able to fit a fusible plug (17)
- 4. Testing of plug in the boiler and rectification of a leak (18)
- 5. Leading of new plugs and re-leading of used plugs (20)

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

- Safety wellingtons
- Waterproof clothing
- Pressure washing equipment
- Helmet and visor
- Paraffin flare or other illumination device e.g. low voltage lamps

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.

GUIDANCE NOTE

BOILER WASHOUT AND SUBSEQUENT EXAMINATION

Purpose

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

Endorsement

This document has not been endorsed by HRA or ORR but has been provided as a stopgap until the HRA authorised document evolves from draft.

Disclaimer

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Supply

This document has been prepared with help from Gordon Reed NRM Volunteer Boilersmith and member of the HRA/ORR Boiler Guidance Working Group. It draws freely also on Gordon Reed's Shed Boilersmith Guide.

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1. Introduction

A steam boiler produces steam from clean raw water. The steam boils off as pure wet steam and unless the boiler water was put in originally as distilled water, any impurities in the water will be left behind in the boiler as the steam is drawn off.

The boiler of a large locomotive will consume over 100 gallons of water every mile, and each gallon might contain 15 grams of impurities, which may or may not be dissolved in the feedwater. Over a long period this impurity precipitates out and being heavier than water sinks to the lower horizontal surfaces. This might be tubes or firebox crown, stays or usually the foundation ring. In addition the oxygen contained in the cold feed water causes corrosion of the inner steel surfaces of the boiler which forms rust and deposits itself as iron oxide on the inner surfaces

This layer of deposit impairs the heating effectiveness of the boiler as it increases the thermal barrier between the fire and the water In the worse cases it can create such a thermal barrier that the temperatures on the fireside of the heating surfaces overheat and distort causing damage.

It is essential that these inner surfaces are kept free of deposits by regularly opening up of the insides of the boiler and using a pressure washer to purge the water spaces of deposit and leaving them clean.

This washing out will typically be carried out after ten to twenty days of steaming and provides those responsible for the boiler with a ready made opportunity to make a safety inspection of the inside surfaces of the boiler to monitor corrosion, metal fatigue, and wear. The Boilersmith responsible for the inspection will make sure that the boiler is safe to "box-up" and continue in service until the next washout, recording the findings in the maintenance record. If something untoward is found then the Responsible Person must be consulted and appropriate action taken.

This guide details how this procedure should be carried out, and what should be looked for and checked during inspection.

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
1	LO1 1	Understand why boilers need washing out	Explain the process which causes the deposits to occur within the boiler	Classroom	
1	LO1 2	Washout frequency	Explain the effect deposits have on the performance of the boiler	Classroom	

2. Personal Protective Equipment

The following equipment is essential for washing out boilers:

- Steel toecap wellingtons
- Waterproof trousers and Jacket
- Waterproof long cuff gloves
- Helmet with visor
- Waterproof torch
- Paraffin flare and lighter

3. The Washout

Before the washout starts, get the agreement of the Responsible person which mud doors and washout plugs are to be removed to wash out and examine. Check that all the mud hole doors and the washout plugs are removed from their places after being marked indelibly as to their position and orientation. The surrounds of these openings of course must be similarly marked. Type correction fluid bottles such as TIPPEX make ideal clear markers that will survive the washout process, and ensure that all the plugs and doors go back in their original places. Record the numbering and lettering system that has been used in the Boiler Maintenance Record, with a diagram similar to that shown in the Washout Plug Guidance Note HGR B 9009. Remember to mark mud door bridges so they go back in the same place and configuration.

Open the regulator or injector valves to allow air into the top of the boiler to ease draining. Dislodge the lower mud doors, which will aid the removal of sludge from the boiler with the rush of water that is in the boiler. Remove the remaining washout plugs and doors.

You must use a pressure washer, which has sufficient volume and pressure to be deemed suitable for boiler washouts (A portable Fire Pump feeding from a temporary supply such as a plastic dustbin with a mains water feed is ideal)

Systematically wash all surfaces of the boiler especially the horizontal surfaces such as firebox crown, stays, and tubes, bottom of the barrel and foundation ring. Special attention must be paid to the difficult to get at areas such as under the tube nest at the front of the boiler and around the palm stays and throatplate.

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
2	LO1 3	PPE requirements for washout	Be able to select and wear the correct PPE for a boiler washout	Classroom Workshop	
3	LO1 4	Understand which plugs and doors need to be removed prior to washout	Present a plan for washout and mud door removal to the responsible person. Justify the choice.	Workshop	
3	LO1 5	Importance of replacing plugs and doors back in their original location	Agree a scheme with competent person for mark up and storage of components	Workshop	
3	LO1 6	Recording of identification marks before removal	Complete a boiler maintenance record	Workshop	
3	LO1 7	Removing the doors and plugs	Carry out the plan agreed in LO1 4 -6	Workshop	
3	3 LO1 8 Washout process and debris removal		Carry out a washout using correct PPE under supervision. Dislodge debris	Workshop	

4. Examination Of Water Spaces Following Washout

Once you are satisfied that the interior is clean then using a strong small torch (attached to a string!) or a paraffin flare on a twisted steel wire stem like a flue brush. Start the inspection:

- Special attention should be paid to the following areas.
- Junction of roof stays to firebox crown
- Side stays
- Throatplate stays
- Palm stays
- The tops of the tubes and flues look for scabbing and deposits.

You are looking for cracked or broken stays (often where the stay joins the steel outer plate and therefore the most difficult to spot).

Look at roof stays where the stay penetrates the roof of the firebox often resulting in wasting of the stay diameter. Also look for any unrecorded grooving of plates around the foundation ring, and any unusual situations or abnormalities, which you should report to the Competent Person. You might also locate areas where the washout has been inadequate and needs further dislodging to get rid of all the sediment.

- Record all your findings in the Washout inspection record in the Boiler Maintenance Document.
- Prepare the washout plugs and mud doors for reassembly as detailed in HGR 9009 and HGR 9014.

5. Examination Of The Firebox Following Washout

Most routine boiler problems manifest themselves in the firebox so the washout presents an excellent opportunity to examine the internal surfaces.

You are looking to see that all tubes are leak tight. That all stays are leak tight and that the lap seams and rivets are not showing the tell-tale white staining that indicates water leakage under pressure.

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
4	LO2 1	Inspection of water spaces	The correct use of a paraffin flare and a torch on a string	Workshop	
4	LO2 2	Identification of spaces which are critical on washout	Inspect and comment on all the critical spaces.	Workshop	
4	LO2 3	Stay fracture & examination	Draw a diagram where stays fracture and why	Workshop	
4	LO2 4	Roof stay inspection	Inspect roof stays and describe the findings to the supervisor	Workshop	
4	LO2 5	Preparation of doors and plugs for reassembly as HGR 9009 and HGR 9014	Explain how to prepare washout plugs and mud doors as HGR 9009 & HGR 9014	Workshop & Masterclass	
5	LO2 6	Know that most faults occur in the firebox area	Inspect firebox with a competent person and explain your findings	Workshop	
5	LO2 Understand 7 'Quiting'		Explain how quilting occurs and how it might be remedied	Workshop & Masterclass	

Check that there is no "quilting" of the firebox sided between the supporting stays. Check the lap seams for leaks at rivets or seams and check the integrity of the fusible plug(s) by observation and poking into the hole with a welding electrode. Any sign of the lead plug looking distressed must be reported to the competent person. Check that the Brick Arch is stable and not excessively cracked.

6. Examination Of Smokebox Following Washout

Check for evidence of tube or stay leakage or any signs on the main steam pipes of leakage. Again leakage will show as a white stain and the matt uniform coating of soot will not be present in the areas of the leak. Check where the front tubeplate joins the barrel that there are no leaking rivets or seams. Check for any untoward signs of trouble on the petticoat, smokebox door and blower assembly. Examine bottom flange of tubeplate for wastage. (Wastage caused by soot and ash deposits forming Sulphur Dioxide).

7. Examination Of Outer Casing After Washout

Where the outer casing is visible check all seams rivets and fittings for steam tightness and report any abnormalities. With wide firebox locomotives it is possible to examine the whole boiler but where the firebox is between the frames it is often not possible to examine this gap

8. Replacing Washout Plugs

Apply a small amount of graphite grease to the portions of the thread of the plugs that are going to mate with the boiler platework.

The washout plug when tightened should protrude through into the water space by plate thickness plus three threads.

Take extra care when inserting washout plugs that are sited on corners where the thread in the platework can be discontinuous because of the bent plate. This is a highly safety critical operation where the plug can so easily be cross threaded and appears to be tightening. (In the past this has had disastrous consequences). It is a wise precaution to ask a second safety critical approved person to come and check that the right plug is entered into the threaded platework correctly before tightening the plug beyond hand tight.

Section Number	LO) Objectives Assessment Criteria		Delivery	Date achieved and Supervisors signature
6	LO3 1	Purpose of smokebox	Examine smokebox and report the findings to a competent person	Masterclass & Workshop	
7	LO3 2	Understand outercasing issues including wide firebox locos. Be able to identify any untoward signs	Conduct a survey of the outer surfaces of a boiler after washout with a competent person and explain the findings	Masterclass & Workshop	
8	LO3 3	Understanding of the correct fitting of washout plugs	Prepare & fit under supervision a set of washout plugs	Masterclass & Workshop	
8	LO2 4	Special precautions needed for curved plate washout plates	Correctly fit under supervision a washout plug in a curved plate. Demonstrate why 2 persons might be needed	Masterclass & Workshop	

9. Tightening W/O Plugs

Use a correctly fitting spanner for the head of the washout plug and the spanner length should not exceed 18 inches in length for tightening.

Do not enter all the plugs with the intention of coming back and tightening later. Therein lies trouble! Enter each plug in sequence and tighten fully before moving on to the next in sequence until the entire plug fitting is complete.

10. Refitting Mud Doors

Prepare the openings and doors as described in HGR9009 making sure that the door bridges go back in the same configuration.

11. Steam Test

Once the boiler is "boxed up" and filled with water to half a gauge glass, assuming that no leaks are seen on any of the openings then the fire can be lit and steam raised slowly. The boiler should be monitored regularly during the steam pressure raising process.

Although it is unlikely that washout plugs will need to be tightened to stop leaks, any tightening must be done without pressure in the boiler. Mud doors may require additional seating as the pressure builds up at the back of the door and presses the joint more tightly. It might be necessary to follow up the nuts on the bridges slightly but not to tighten with a large spanner to achieve a seal.

Be aware that lead joints do need a slight "nipping up" every time the boiler is steamed and cooled. This is normal behaviour.

Check all the joints that have been made and inside the smokebox looking at the smokebox tubeplate and plugs for leaks which will need a strong torch to check through the smoke to the disturbed washout plugs at the base of the tubeplate.

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
9	LO3 5	Understand how to correctly tighten a washout plug wash out plug		Masterclass & Workshop	
10	LO3 6	The correct fitting of Mud doors	Fit a full set of mud doors under supervision	Masterclass & Workshop	
11	LO3 7	Steam Test	Fill boiler with water to correct level, check for initial leaks. Light fire and check for leaks under light steam with a supervisor.	Workshop	
12	LO3 8	Completion	Complete a boiler maintenance record, compare to previous record	Workshop	

12. Completion

Record the washout in the Boiler Maintenance Record and report any abnormalities to the Responsible Person.

Richard Gibbon C Eng F I MechE 4th November 2013

BESTT Boiler Washout and Examination - Module RHG1

Assessment Record for:

Training Centre:

Year: August 14 – July 15

L01	1	2	3	4	5	6	7	8	
Supervisor									
Initials and									
date when									
completed									
LO2	1	2	3	4	5	6	7		
Supervisor									
Initials and									
date when									
completed									
LO3	1	2	3	4	5	6	7	8	
Supervisor									
Initials and									
date when									
completed									

Witness Statement

The trainee has completed the Learning outcomes to a satisfactory standard

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

Verified by BESST AssessorName:TBCAssessor Number: 12345Date: December 14