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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.

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Boiler & Engineering Skills Training Trust

Inner Firebox Repair and Renewal

Proposed Syllabus 2013

To be used in conjunction with:

Guidance Note HGR-B9021 -Is01

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

Proposed BESTT Syllabus Assessment Plan

Module: BESTT 9021

Inner Firebox Repair and Renewal
This module is to used in conjunction with:
HRA Guidance sheet B9021 – Is01

Aim

This unit will give the learners an understanding of the construction and repair of steel and copper inner fireboxes.

Introduction

This unit will give practical knowledge of:

- Inspection
- Copper Inner Fireboxes
- Welding
- Patching
- Lap joints
- Corner Radii
- Reduced plate thickness
- Quilting
- Bulged plates
- Corroded rivets
- Repair of fusible plug holes
- Oversize tube holes
- Replacing inner fireboxes

Learning Outcomes

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

LO1

1. Copper firebox repair (5)
2. Coded welding (5a)
3. Patching (5b)
4. Patching procedures (5b)
5. Overlap of patch (5b)
6. Waisted seam (5c)
7. Cracked corner radii (5d)
8. Reduced Plate thickness (5e)
9. Quilting of plates (5f)

LO2

1. Bulging of plates (copper firebox) (5g)
2. Corroded seam rivets (5h)
3. Repair of Stay holes (5i)
4. Repair of fusible plug holes (5j)
5. Copper firebox inspection (5)
6. Repair of steel fireboxes (6a)
7. Cracked Corner radii (6b)
8. Reduced plate thickness (6c)
9. Bulged plates (steel firebox)(6d)

LO3

1. Corroded rivets (6e)
2. Grooving (6f)
3. Repair of stay holes (6g)
4. Repair of fusible plug holes (6h)
5. Oversize tube holes (6i)
6. Replacement of inner fireboxes (7)
7. Converting from riveted to welded construction (7)

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.

Proposed BESTT Syllabus Assessment Plan

Ref No: HGR-B9021
Issue No: 01
Issue Date: April 2012

HERITAGE RAILWAY ASSOCIATION

GUIDANCE NOTE

INNER FIREBOX REPAIR and RENEWAL

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.

Endorsement

This document has been developed with and is fully endorsed by Her Majesty's Railway Inspectorate, a directorate of the Office of Rail Regulation (ORR).

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Supply

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Copies are available electronically via its website www.heritagerailways.com

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Table of Contents

1. Introduction

This Guidance Note is one of a series dealing with Locomotive Boilers that were produced by the “Steam Locomotive Boiler Codes of Practice” practitioners meetings.

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.

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.

Where managements decide to take actions that are not in agreement with these recommendations, following appropriate risk assessments or for other reasons, it is recommended that those decisions are reviewed by the senior management body of the organisation and a formal minute is recorded of both the reasons for and the decision reached.

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.

The term “p.s.i.” is used to indicate pressures in pounds per square inch.

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 Personal Protective Equipment 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 those undertaking the work.

4. Inspection

In the event of finding any problem with the firebox seek guidance from the boiler Competent Person before commencing any work.

5. Repair of Copper Inner Fireboxes

a) Welding of Copper Firebox Plates

Copper plate that was deoxidised during the production process can be successfully welded by the Oxy Acetylene, MIG or TIG processes. This includes the grade C107 Phosphorous Deoxidised Arsenical Copper often used for locomotive fireboxes. However it is not possible to produce welds of sufficient quality in non deoxidised or “Tough Pitch” copper, eg grade C105.

It is essential therefore that the grade of copper is ascertained by chemical analysis before any welding repairs are attempted.

Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
5	LO1 1	Copper firebox repair Selection of correct material	How to determine the correct grade of copper. Taking and analyse a sample Why is C105 not suitable for copper firebox repairs?	Classroom Workshop	
5	LO1 2	Coded welding	Understand the term coded welder and what procedural matters need completing before work commences?	Classroom	

Welding repairs must only be undertaken by suitably qualified ("coded") personnel working to specified procedures that are acceptable to the boiler competent person.

b) Patching of Copper Firebox Plates

If a welded repair is impractical then a patch repair to a copper plate may be possible subject to the approval of the boiler competent person.

The defective area of plate should be cut away and the patch ideally applied to the waterside of the hole, unless this would severely restrict the water space in which case it may be applied to the fireside. See Fig 1.

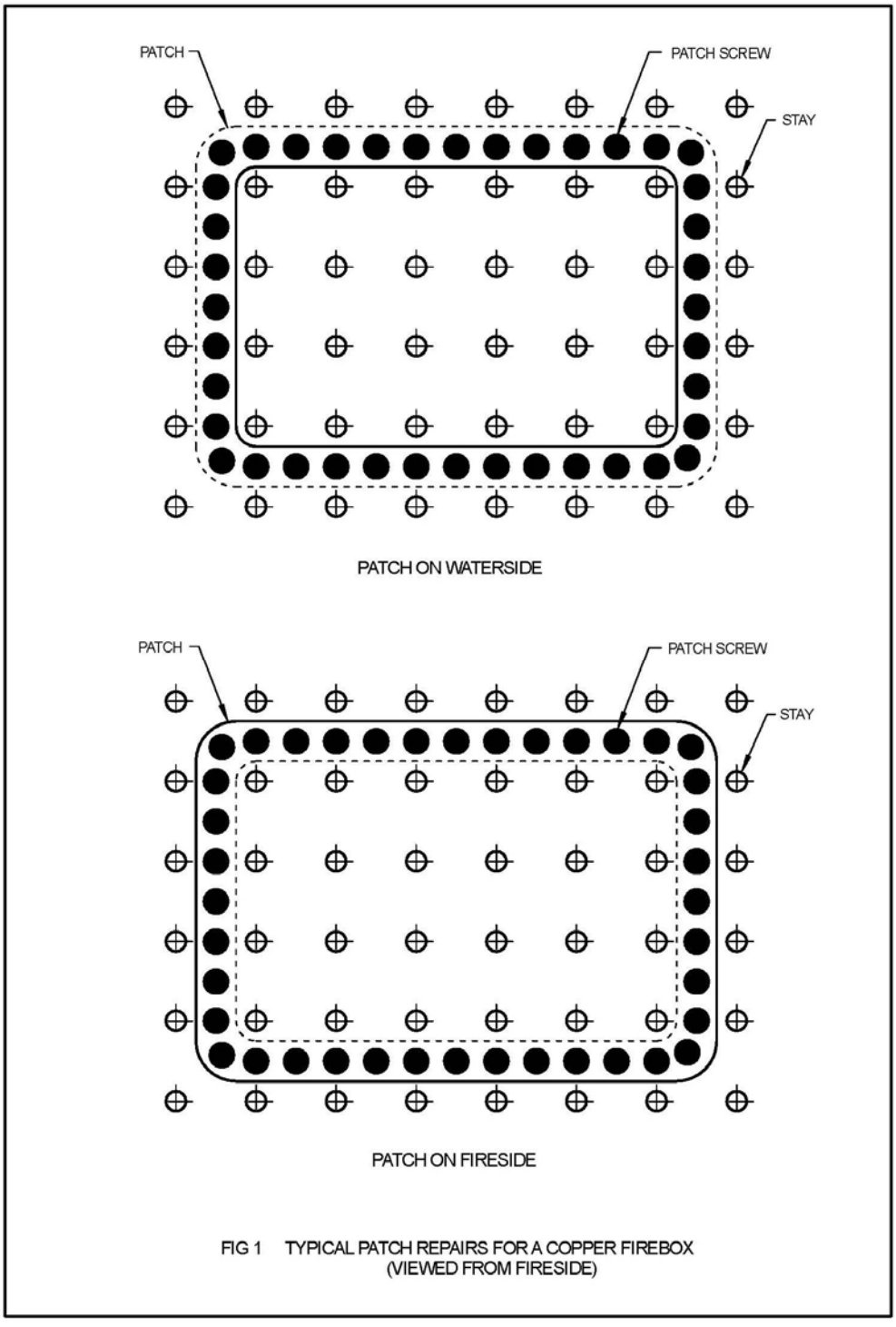


FIG 1 TYPICAL PATCH REPAIRS FOR A COPPER FIREBOX (VIEWED FROM FIRESIDE)

Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
5b	LO13	Patching of copper firebox plates	Know the limitations to patching before a complete new half side is decreed necessary	Workshop	

Alternatively the patch can extend down to the foundation ring as shown in Fig 2A.

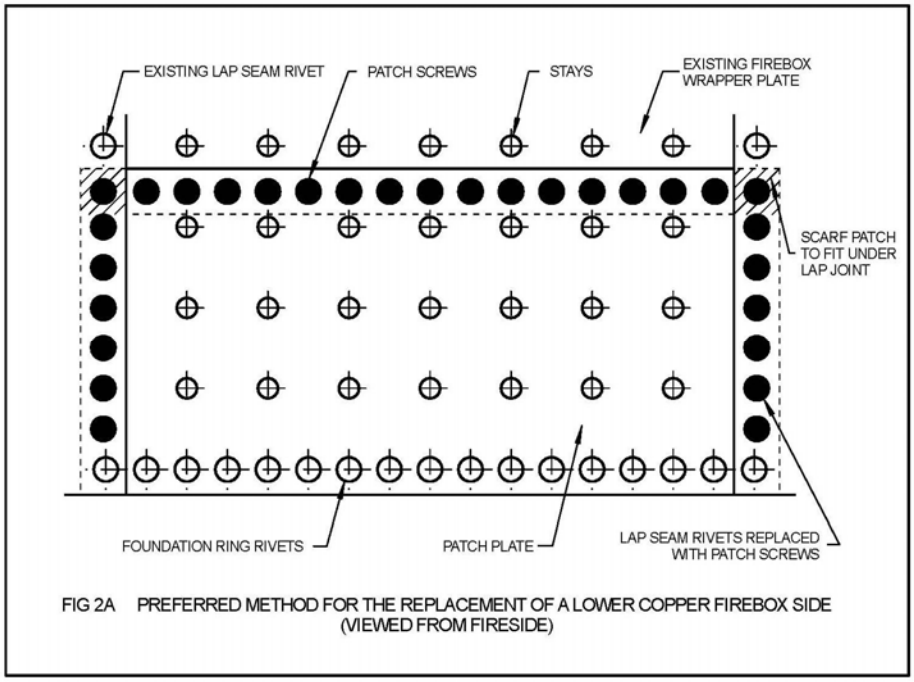


FIG 2A PREFERRED METHOD FOR THE REPLACEMENT OF A LOWER COPPER FIREBOX SIDE (VIEWED FROM FIRESIDE)

If space is restricted then lap seams may encompass both patch screws and stays as shown in Fig 2B.

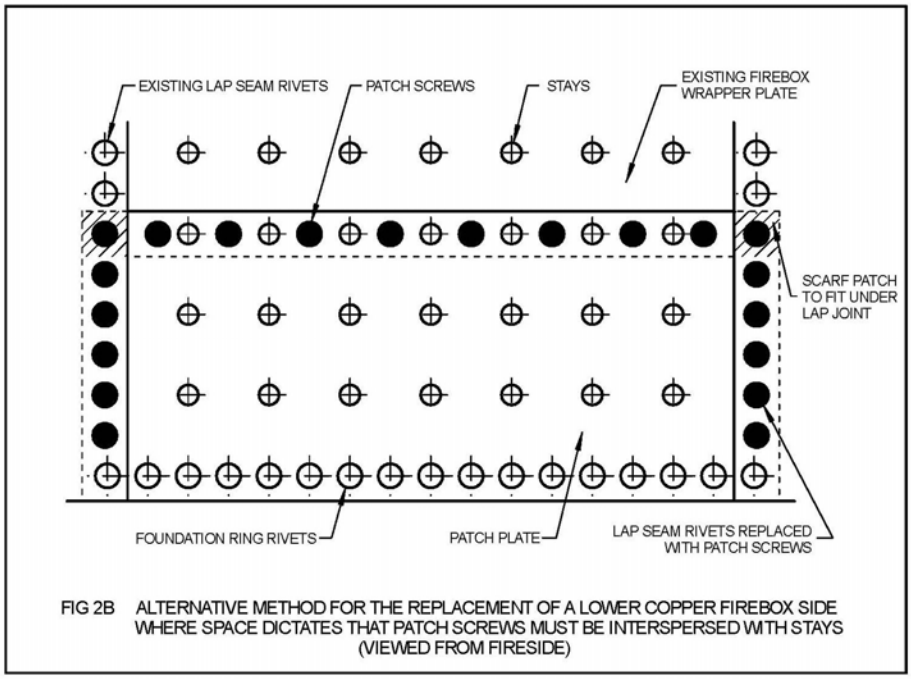


FIG 2B ALTERNATIVE METHOD FOR THE REPLACEMENT OF A LOWER COPPER FIREBOX SIDE WHERE SPACE DICTATES THAT PATCH SCREWS MUST BE INTERSPERSED WITH STAYS (VIEWED FROM FIRESIDE)

In all cases the overlap of the patch should be kept to a minimum to reduce the risk of the caulked edge becoming overheated. The patch should be carefully bedded to the firebox plate and the patch screws should normally be at between 1 7/8 and 2 1/8” pitch. (For further details of patch screws see separate Guidance Note).

Note that if a patch is inserted in the firebox crown, the low water level and/or fusible plug position may require alteration to suit the slightly different level of the patch relative to the original plate.

c) Reduced Lap Joints

The rivet centre line to lap edge distance can become reduced due to wastage or repeated caulking of the joint. In this case the lap may be built up with weld or it may be cut back and a new lap butt welded in place. Note that in both cases this is subject to the material being suitable for welding (see above) and that the firebox is at least partially dismantled in order to give complete access to the edge of the plate that is to be repaired. The area of plate around the lap seam rivet holes should be checked for cracks using a suitable NDT method, eg dye penetrant, before refitting any rivets or patch screws.

d) Cracked Corner Radii

Cracks in tubeplate, throatplate and doorplate corner radii may be welded provided that they do not completely penetrate the plate and the material is suitable for welding, (see above).

The crack should be fully removed by chipping or grinding and its removal verified by dye penetrant testing. The ground area should then be filled with weld and ground flush.

If there are multiple cracks or the crack has penetrated through to the other side of the plate then it is recommended that area be replaced with a set in patch or the entire plate replaced.

e) Reduced Plate Thickness

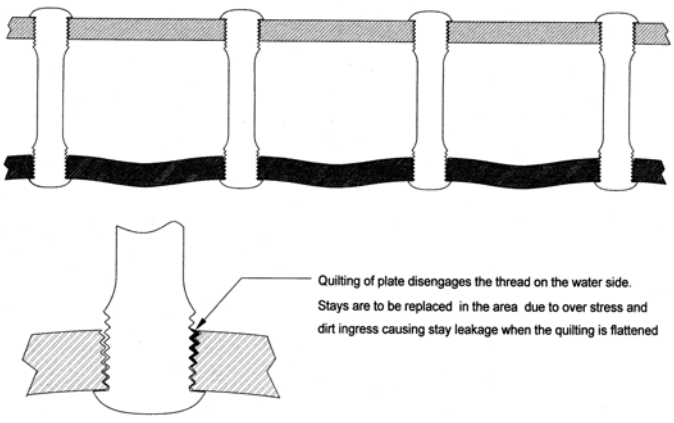
The allowable degree of wastage depends upon several factors, e.g. the pitch of the stays, the flatness of the plates, the working pressure and condition of the material in the affected area.

If it is determined that the plate has excessively thinned then, as a general guide, a plate may be built up with weld provided that the material is suitable for welding, it has not thinned to below 70% of its original thickness, and that the wasted area extends no further than that supported by any four stays.

Plates thinned to less than 3/8” should only be welded using MIG or TIG processes as Oxy Acetylene welding of thin sections can cause cracking of the plate. Plates thinned below 5/16” should not be welded by any process for the same reason.

In all other circumstances the affected area of plate should ideally be cut out and either a new piece welded in place or a patch applied. Welded in plates should have rounded corners to avoid stress concentrations and be attached using full penetration butt welds. Single sided welds are permitted where unavoidable but in all cases the weld should be verified by suitable NDT methods. Welded joints should wherever possible go midway between the stay holes and not through them.

f) Quilted Plates



If the boiler pressure has pushed the firebox plate towards the fireside in an area between some stays, the plate is normally referred to as being “quilted”.

Quilting of the plate is caused by a loss of strength due to overheating as a result of a shortage of water, or the build up of scale or oil on the waterside. It could also be due to a lamination within the plate.

In all cases the cause should first be identified and corrected. In addition the thickness of the plate should be checked by ultrasonic testing or by drilling a small hole which is subsequently plugged. This will permit the identification of thinned or laminated plates.

Fig 3 Quilting of plates

If the quilting is not severe, and the plate still has sufficient thickness, then repair may not be essential but the condition should be monitored in service. Alternatively the plate can either be pushed back with a jack, or

Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
5c	LO16	Worn and waisted lap seam	Explain why lap seams deteriorate in a copper box. Inspect a firebox with known worn laps and produce a report	Classroom	
5d	LO17	Cracked Corner Radii	With the aid of a diagram explain where you might expect to find cracks in a copper firebox inner plates and why.	Classroom	
5e	LO18	Reduced Plate thickness	Why do copper firebox plates waste away? What is the remedy for thin plates?	Classroom	

a rivet gun and a flat snap. However in more extreme cases the section of plate should be replaced. Note that any pushing back of the plate should be performed cold as localised heating can result in cracking.

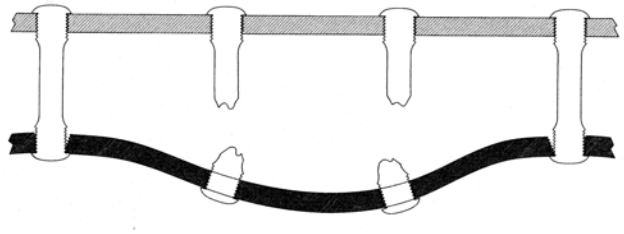
In all cases the stays in the quilted area must be renewed.

g) Bulged Plates

If the boiler pressure has pushed the firebox plate towards the fireside in an area that extends beyond some stays, the plate is normally referred to as being “bulged”.

Bulging of the plate is caused by one or more broken stays.

If the bulging is not severe, and the plate still has sufficient thickness, it can either be pushed back with a jack, or a rivet gun and a flat snap. However in more extreme cases the section of plate should be replaced. Note that any pushing back of the plate should be performed cold as localised heating can result in cracking.



Any stays in the vicinity of those that have broken will have been subjected to additional loading and may have been weakened. These stays should therefore be renewed along with the broken ones.

Fig 4: Bulged Plates

h) Corroded Lap Seam Rivets

Lap seam rivets with excessively corroded heads should be replaced with new rivets where ever possible. If the fitting of rivets is not practical then copper or steel patch screws may be used.

As the old rivets are removed they should be replaced with bolts such that there are never more than two adjacent empty rivet holes. This will help prevent the plates from springing apart. If the plates are not a close fit, for instance if a new flange has been attached, then every hole should be bolted.

To further ensure that the plates are a close fit, a flat bob tool in a small pneumatic hammer should be used to hammer the plate around the bolts. The bolts should then be re-tightened before riveting commences.

For further details of patch screws and their applications see separate Guidance Note.

i) Repair of stay holes

Stay holes with worn or damaged threads should be re threaded to take the next size of stay. If the holes are already at maximum size then it is sometimes possible to partially fill the hole with weld and re thread. Otherwise the firebox plate should be replaced, or a patch repair considered.

Damage to the plate in the vicinity of the hole as a result of excessive caulking of the stay may be built up with weld subject to the material being suitable for welding (see above).

j) Repair of Fusible Plug Holes

Fusible plug holes with worn or damaged threads should be re threaded to take the next size plug and where required spot faced square with thread. If the hole is already at maximum size then it should be plugged and a new hole cut.

The material for the new bush should be Copper Plate (BS2875 - C107) or Copper Bar (BS2874 - C107).

The location of the new hole should be as follows:

- Where one or more plugs were fitted on the centre line of the crown plate the new hole(s) should be as close as possible to the old but equidistant from four adjacent stays.
- Where two plugs were fitted at diagonal corners the new plugs should be in corresponding positions on the opposite diagonal.

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Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
5f	LO19	Quilting of plates	What causes quilting? What are the remedies and the issues?	Classroom	

Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
5g	LO2 1	Bulged Plates	Describe what causes bulging. What remedies are available and the issues with such a repair?	Classroom	
5h	LO2 2	Corroded Lap seam rivets	What causes steel rivet wastage? Describe the replacement with the firebox removed and installed.	Classroom	
5i	LO2 3	Repair of Stay holes	Identify worn stay holes and what are the repair methods?	Classroom	
5j	LO2 4	Repair of fusible plug holes	Explain the repair operations available for a worn fusible plug hole		

Care should be taken not to position a new hole directly below an obstruction such as a longitudinal or transverse stay.

If there are no alternative hole positions available then, subject to there being sufficient plate thickness, a damaged hole may be opened out and threaded to take a bush. The bush should be riveted and caulked on the fireside to prevent it coming loose. See Fig 5.

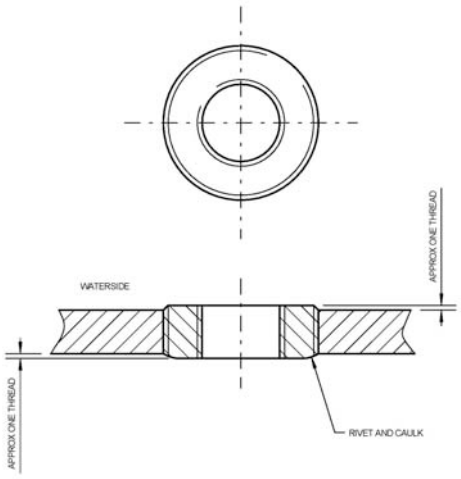

Fig 5: Typical method for fitting a Fusibile Plug bush to Copper Fireboxes

k) Oversize tube holes or cracked tubeplate ligaments.

Please refer to the relevant sections of the Guidance Notes on the fitment of boiler tubes.

6. Repair of Steel Inner Fireboxes

a) Welding of Steel Firebox Plates

Welding repairs to steel fireboxes should not cause any difficulty except that some early boilers (pre c.1890) were made of wrought iron or “Lowmoor” iron and no attempt should be made to weld these materials.

It is essential therefore that the nature of the steel is ascertained and recorded before any welding repairs are attempted.

Welding repairs must only be undertaken by suitably qualified (“coded”) personnel working to specified procedures that are acceptable to the boiler competent person.

b) Cracked Corner Radii

Cracks in tubeplate, throatplate and doorplate corner radii should be fully removed by chipping or grinding and their removal verified, ideally by magnetic particle inspection, ultrasonic or by dye penetrant testing. The ground area should then be filled with weld and ground flush.

If there are multiple cracks or the crack has penetrated through to the other side of the plate then it is recommended that area be replaced with a set in patch or the entire plate replaced.

Welded in plates should have rounded corners to avoid stress concentrations and be attached using full penetration butt welds. Single sided welds are permitted where unavoidable but in all cases the weld should be verified by suitable NDT methods eg dye penetrant or magnetic particle inspection.

c) Reduced Plate Thickness

The allowable degree of wastage depends upon several factors, e.g. the pitch of the stays, the flatness of the plates, the working pressure and condition of the material in the affected area.

If it is determined that the plate has excessively thinned then, as a general guide, a plate may be built up with weld provided that the material is suitable for welding, it has not thinned to below 70% of its original thickness and that the wasted area extends no further than that supported by any four stays.

In all other circumstances the affected area of plate should ideally be cut out and a new piece welded in place. Welded in plates should have rounded corners to avoid stress concentrations and be attached using full penetration butt welds. Single sided welds are permitted where unavoidable but in all cases the weld should be verified by suitable NDT methods. Welded joints should wherever possible go around, not through, the stay holes.

Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
5	LO2 5	Copper firebox inspection	Inspect a firebox and use a torch, camera and notebook to record your findings. Prepare a report for your supervisor.	Workshop	
6a	LO2 6	Repair of steel fireboxes	Assuming the material check allows for welding, what techniques would you use to prepare the material for a coded welder	Classroom	
6b	LO2 7	Cracked corner radii	Where are cracks likely to form?	Classroom	
6c	LO2 8	Reduced Plate thickness	What thickness increase by welding is permitted. How would you prepare the plate for a coded welder? Draw where the patch plate would fit in relation to the side stays.	Classroom	

d) Bulged Plates

If the boiler pressure has pushed firebox plate towards the fireside in an area that extends beyond some stays, the plate is normally referred to as being “bulged”.

Bulging of the plate is caused by one or more broken stays.

If the bulging is not severe, and the plate still has sufficient thickness, it may be possible to heat the plate and push it back with a jack. However in more extreme cases the section of plate should be replaced.

Any stays in the vicinity of those that have broken will have been subjected to additional loading and may have been weakened. These stays should therefore be renewed along with the broken ones.

e) Corroded Lap Seam Rivets

Lap seam rivets with excessively corroded heads should be replaced with new rivets where ever possible. If the fitting of rivets is not practical then steel patch screws may be used.

As the old rivets are removed they should be replaced with bolts such that there are never more than two adjacent empty rivet holes. This will help prevent the plates from springing apart. If the plates are not a close fit, for instance if a new flange has been attached, then every hole should be bolted.

To further ensure that the plates are a close fit, a flat bob tool in a small pneumatic hammer should be used to hammer the plate around the bolts. The bolts should then be re-tightened before riveting commences.

(For further details of patch screws and their applications see separate Guidance Note).

f) Grooving

Grooving is caused by stress corrosion as a result of the continual thermal and pressure cycling to which a locomotive boiler is subjected. It is most common adjacent to a fixed point like the foundation ring but can occur at any lap seam. In minor or isolated cases it may be possible to build the area up with weld. However the welding of an already highly stressed area is often not desirable and consequently a better solution is to replace the area of plate.

g) Repair of Stay holes

Stay holes with worn or damaged threads should be re threaded to take the next size of stay. If the holes are already at maximum size then the firebox plate should be replaced or a patch inserted. Alternatively, in isolated cases, the holes may be filled with weld and then re-drilled and threaded.

h) Repair of Fusible Plug Holes

Fusible plug holes with worn or damaged threads should be re threaded to take the next size plug. If the hole is already at maximum size then, subject to there being sufficient plate thickness, it should be fitted with a bush threaded to take the standard (smallest) size of plug.

The material for the new bush should be Boiler Plate (BS EN10028-2 P265GH) or Mild Steel Bar (BS970:070M20 or BS970:080M15).

The bush should ideally be of “top hat” section and be fitted from the waterside. Alternatively it can be of “top hat” section but with a pair of “flats” to allow it to pass through the hole from the fireside. See Fig 6.

If neither option is practical then a plain bush may be fitted. In all cases the weld should be of full penetration and from the fireside.

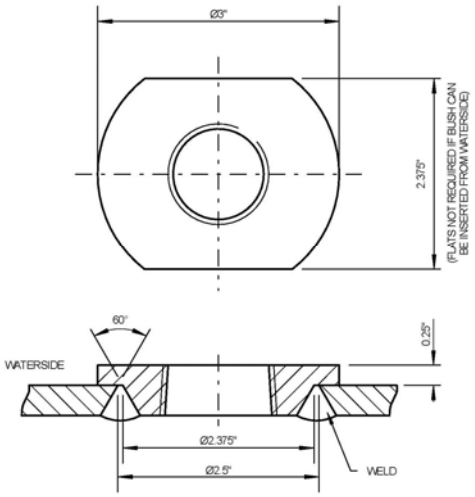

Fig 6: Typical method for fitting a Fusibile Plug bush to Steel Fireboxes

Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
6d	LO29	Bulged plates	Describe what causes bulging. What remedies are available and the issues with such a repair?	Classroom	
6e	LO31	Corroded Lap seam rivets	What causes steel rivet wastage? Describe the replacement with the firebox removed and installed.	Classroom	
6f	LO32	Grooving	How and where would you look for grooving in a steel inner firebox? When would you replace rather than build up the plate?	Classroom	
6g	LO33	Repair of stay holes	Identify worn stay holes and what are the repair methods?	Classroom	
6h	LO34	Repair of fusible plug holes	Explain the repair operations available for a worn fusible plug hole	Classroom	

i) Oversize Tube Holes or Cracked Tubeplate Ligaments.

Please refer to the relevant sections of the Guidance Notes on the fitment of boiler tubes.

7. Replacement Inner Fireboxes

a) Design

It was common within the British Isles for locomotive fireboxes to be of riveted copper construction. Such fireboxes are expensive, although relatively long lasting, compared to the welded steel fireboxes favoured elsewhere within Europe and in America.

It is permitted to change the firebox design and/or material during renewal provided this offers no increased risk to the operation of the boiler. Hence any design change should be reviewed and documented by the Competent Person before work commences.

b) Factors to be Considered when Converting Fireboxes from Copper to Steel

The properties of copper compared to steel can be summarised as:

- better conductor of heat (7 times as great)
- much greater corrosion resistance
- greater ductility

but:

- lower strength, particularly at elevated temperature
- higher coefficient of expansion (1.5 times as great)
- higher cost
- difficult to obtain in the arsenical form best suited to high temperature use

Hence if changing from copper to steel the following factors should be considered:

- Steel is stronger than copper so the plate thickness can be reduced.
- Reducing the plate thickness will help with the heat transfer but note that this is still likely to be only about 30% of that for copper. Burning of the plate due to hot spots may therefore occur.
- Steel corrodes much faster than copper so the plate thickness chosen needs to include a corrosion allowance. Even then the life of the firebox may only be one half to one third of that for copper. It is strongly recommended therefore that boiler water treatment should be used. (see Boiler Water Treatment guidance notes)
- The greater expansion of copper firebox tubeplates compared to steel boiler tubes helps to maintain a watertight seal. Steel tubeplates containing steel tubes are however more susceptible to leakage and it may be necessary to do more than just expand the tubes into the tubeplate. Seal welding is common practice but other methods include copper liners between the tube and tubeplate or internal tube ferrules. The choice of a suitable method should be discussed and agreed by the boiler competent person.
- The lower ductility of steel (together with lower corrosion resistance) can result in cracks forming in the firebox corner radii. The use of flexible stays adjacent to the firebox corners should be considered.

Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
6i	LO3 5	Oversize tube holes	See tubing of boiler guidance notes		
7	LO3 6	Replacement inner fireboxes From copper to steel	What are the factors that will need to be considered? Pros and cons. List the mechanical differences between copper and steel.		

c) Factors to be Considered when Converting Fireboxes from Riveted to Welded Construction

Riveted fireboxes have two main disadvantages when compared to those of welded construction:

- Their lap seams can in time be affected by the heat of the fire, which then results in leakage.
- They have a higher cost of construction.

Consequently, except where originality is considered essential, the substitution of welded fireboxes for riveted has become common practice.

Welded fireboxes would normally have a flanged tubeplate and doorplate butt welded to the wrapper. Fireboxes having square corners are permissible but should be restricted to smaller or narrow gauge locomotives. This is because experience has shown that the larger sizes of square cornered fireboxes can experience grooving of the plates on the fireside, adjacent to the corner welds, as a result of the corners flexing.

The firehole and foundation rings may be welded. However the depth of weld preparation required can mean that, in this instance, riveting is sometimes no more expensive. Riveting also offers the advantage that the firebox can more easily be removed for replacement in the future.

The following factors should also be considered when changing from riveted to welded design:

- The horizontal pitch of the side stays may require alteration to reduce the gap between the last vertical stay columns and the firebox corners.
- The butt welds between tubeplate or doorplate and the wrapper should not pass through any stay holes.
- Girder stays may be welded to the firebox crown but must have waterways to ensure good circulation.
- The ends of girder stays should suit the profile of the welded firebox crown.

8. Materials

Steel Boiler Plate:	BS EN10028-2 P265GH (formerly BS1501-151/161-430B)
Copper Plate:	BS2875 Grade C107 (Phosphorus Deoxidised Arsenical Copper)
Copper Bar:	BS2874 Grade C107

9. References

BS931:1951 Loco type multi-tubular boilers of riveted construction

BS2790:1969 Shell boilers of welded construction

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Proposed BESTT Syllabus Assessment Plan

Section Number	LO	Objectives	Assessment Criteria	Delivery	Date achieved and Supervisors signature
7	LO37	Converting from riveted to welded construction	Prepare a report on the pros and cons of a riveted versus welded construction	Classroom	

BESTT
Inner Firebox Repair and Renewal - Module B9021

Assessment Record for: **Training Centre:** **Year: August 14 – July 15**

LO1	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Supervisor Initials and date when completed									
LO2	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Supervisor Initials and date when completed									
LO3	**1**	**2**	**3**	**4**	**5**	**6**	**7**		
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 Assessor **Name:** TBC **Assessor Number:** 12345 **Date:** December 14