Steam Locomotive Train Driver Lesson Plan and WorkBook

(Generic Version)

Version 1

June, 2011

IMPORTANT NOTICE

This booklet is one of a series of generic training and assessment templates developed by the Association of Tourist & Heritage Rail Australia Inc (ATHRA) as guides for heritage railway operators seeking to develop or upgrade their local training and assessment resources.

This booklet and others in the series are not intended to be training resources in their own right but rather to be suitably customised, embellished and adapted by railway operators to match the specific context of their own railway, e.g. types of locomotives, rollingstock and associated equipment, the track layout and infrastructure, the local standard procedures and rules, the safety management and safeworking systems, the railway organisational structure, and the roles and functions of personnel in the railway, etc.

Railway operators seeking to use this booklet and others in the series should initially refer to the ***ATHRA Customisation Guidelines Booklet*** which provides important information on how the generic templates should be used.

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1 HOW TO USE THIS WORKBOOK

This section of the workbook provides an overview of the contents of your workbook and how you should use it for your lessons.

The workbook is intended to provide you with a systematic approach to the learning of the skills, knowledge and understanding you need to fulfil the role and responsibilities of a steam locomotive train driver on your railway. A mentor who is already a qualified and highly experienced train driver has been appointed by your railway to assist you in this learning process.

The first part of the booklet includes a simple summary of the structure and contents and the learning activities contained in the booklet for the development of what you need to know and what you need to be able to do. It describes the mutual roles of you and your mentor and summarises other publications issued by your railway that you need to use, such as safety management system, safeworking rules, rail safety requirements, operating and service manuals, checklists, standard procedures, timetables, route maps, etc.

There are five topic areas covered by the booklet. Each topic section outlines the theory and practical for a number of listed sub-topics. The outline gives a basic framework of what you need to know and be able to do in the topic area concerned. However, you will need to ***build your knowledge*** further by having discussions with your mentor and by reading the relevant sections of the publications issued by your railway to train drivers.

Each topic section also contains space for you to write your own notes on the various sub-topics based on discussions with your mentor and your own experiences during training and guided practice.

2 LIST OF REFERENCE MATERIAL

The following is a list of key reference material which will be available to you during the course of your learning activities for the lesson:

- Your railway's job description for a ***train driver on a steam locomotive***, describing a train driver's role and responsibilities
- Rail Operator's Standard Operating Procedures (SOPs) for the operation of steam locomotives
- Safety management system
- rail safety requirements and practices
- Locomotive manuals and handbooks
- Pre-operational checklists
- Rail Operator's Rule book and General Instructions, including:
  - Safeworking forms
  - Special Notices / Train Notices
  - Route maps
  - Timetables
  - Yard and shed diagrams
  - etc.

• 3 OBJECTIVES OF THE LESSON PLAN

This Lesson Plan aims to provide a program of learning that will enable the learner to develop the theory (i.e. what you need to know and understand) and the practical requirements (i.e. what you need to be able to do) in a number of topic areas ...,,

- The role and responsibilities of a train driver on a steam locomotive,
- Preparing and starting a steam locomotive,
- Moving a steam locomotive,
- Conducting train operations,
- Handling emergency and other abnormal situations. and
- Shutting down and stabling a steam locomotive

Your **mentor** will work with you in the following ways:

- Help you to develop the required understanding and skills through interactive discussions and explanations,
- Demonstrate required tasks and equipment functions,
- Assist you to obtain, read and interpret your railway's documents and manuals as well as applicable regulatory requirements,
- Observe and comment on your practice of the required skills in real and simulated situations, and
- Periodically check of what you have learnt (i.e. your knowledge and understanding and what you are able to do).

At all times, if you are in doubt or need to clarify an issue, check with your mentor or other qualified and experienced steam train drivers on your railway.

4 ROLE AND RESPONSIBILITIES OF A TRAIN DRIVER ON A STEAM LOCOMOTIVE

4.1 FUNCTIONS AND DUTIES OF A TRAIN DRIVER ON A STEAM LOCOMOTIVE

Theory

The job of a train driver on a steam locomotive may involve a variety of tasks including:

Duties prior to locomotive service

- Signing on and checking roster, notice boards, operational instructions, timetables locomotive availability and other information needed to operate a locomotive
- Confirming that the fireman has signed on
- Conducting all required pre-start checks
- Checking that the tool kit, fire extinguisher, first aid kit and other locomotive equipment is on the locomotive and is in good working order
- Carrying out a mechanical examination of the train consist (noting that the brake test is performed by a qualified person)
- Recording, rectifying, isolating and/or tagging defects and deficiencies (as applicable) or reporting to relevant personnel
- Oiling and lubricating the locomotive
- Lighting fire and raising steam in conjunction with fireman
- Maintaining steam pressure
- Correctly using the injectors
- Checking systems are operating correctly
- Starting the turbo and checking the head and marker lights
- Obtaining authority to move and position a steam locomotive
- Starting and initially moving the locomotive
- Adherence to yard instructions and safeworking rules when preparing and positioning a locomotive for service
- Operating the locomotive controls correctly as per standard operating procedures
- Moving the locomotive to required position prior to service
- Securing the locomotive in position

Duties during a journey

- Providing leadership and guidance to the fireman and working collaboratively with the fireman and other members of the train crew throughout a train journey
- Handling a train safely and effectively during a journey
- Adhering to safeworking rules, including interpreting and applying
  - *'Authority' to move a train,* and
  - a *'Cancellation of authority'*
- Following standard operating procedures:
  - when shunting rollingstock
  - when coupling and uncoupling the locomotive to rollingstock
  - when conducting a train examination
  - when handling the locomotive and train during a journey
  - when there is a train broken down in a section
  - when there are worksites on track
  - for the protection of worksites on track
  - for staff and ticket and/or other applicable safeworking system
- Taking required precautions and following standard operating procedures when approaching and traversing level crossings
- Adhering to all speed limits during a journey
- Giving and interpreting all audible, light, hand and other signals correctly
- Using radio and other communication equipment correctly
- Coupling a steam locomotive to other steam locomotives for double heading, or to a diesel locomotive (if applicable)
- Handling a train safely and effectively during a journey
- Observing all fixed signals, point stand indicators, check points, track side signs and level crossings. These are to be called by one locomotive crew member and acknowledged by the other
- Halting and securing a train in an emergency as per standard operating and emergency procedures
- Identifying faults and defects that may occur on the locomotive and its equipment (including communication equipment) and conducting associated trouble-shooting activities
- Dealing with abnormal situations that may occur during train operations, including applicable emergency communication and evacuation procedures
- Handing over a steam locomotive to a replacement crew

Duties after service

- Uncoupling a locomotive from rollingstock (during these processes the driver and fireman will follow the standard operating procedures for the type of braking system used on that railway)
- Moving a locomotive to its stabling position
- Oiling, greasing and cleaning the locomotive
- Carrying out all required post-operational checks on the locomotive
- Securing the locomotive
- Completing all required paperwork

Practical

Obtain a copy of your railway's job description or duty statement for a train driver of a steam locomotive.

Describe to your mentor the various functions and duties you must perform when working as a train driver on a steam locomotive in service.

Travel with a steam locomotive crew and observe the various functions as they are being performed by the train driver on the locomotive. Clarify with the train driver any aspects of these functions that are unclear.

4.2 STATUTORY RESPONSIBILITIES INCLUDING RAIL SAFETY AND SAFEWORKING REQUIREMENTS AND REGULATIONS RELATED TO THE DRIVING OF TRAINS

Theory

The role of a driver of a steam locomotive is to work collaboratively with the fireman to maintain the safe, effective and efficient operation of the locomotive and train before, during and after service. Train drivers must therefore be very familiar with the rail safety requirements related to the operation of steam locomotives and trains on their railway and all pertinent safeworking rules and requirements. They must also have a good working knowledge of the basic regulatory requirements for the operation of steam locomotives. . Familiarity and expertise with regulatory requirements will increase as the driver becomes more

experienced. You need to make sure you are familiar with the railway and other documents that describe your statutory responsibilities and that you understand their contents and the implications for your work as a train driver on the class(es) of steam locomotive used on your railway.

A particularly important responsibility is to be aware of the hazards involved in working as a driver on a steam locomotive and following the rail operator's strategies for minimising or eliminating the risks involved. Examples of hazards that exist on steam locomotives include:

- Falling from heights
- Working in confined spaces
- Working under wires
- Chemicals
- Fire irons
- Hot surfaces
- Scalding/burns
- Moving work platform
- Oil spills on floors
- Dehydration and fatigue
- Noise
- Flashbacks
- Working with electric lights and power

Hazard management strategies may include:

- Taking required precautions when using oil as the locomotive fuel,
- Ensuring public safety (e.g. checking when the public is in the vicinity of loco before using injectors, blowing down, cleaning fires, etc.),
- Using personal protective equipment or PPE,
- Using fire extinguishers and water hoses to control fire emergencies, including fire control strategies when working steam locomotives in bushfire conditions, and
- Following the railway's established risk management procedures.

Practical

In conjunction with your mentor, make sure you have a copy of the relevant documents and understand the requirements and responsibilities described in them. If in doubt on any aspect of your statutory responsibilities, ask your mentor to clarify them with you and, if necessary, demonstrate how these responsibilities need to be fulfilled in practice. Demonstrate to your mentor your understanding of your responsibilities and how these are applied in your role as a driver of a steam locomotive.

4.3 STANDARD PROCEDURES OF THE RAIL OPERATOR APPLICABLE TO A TRAIN DRIVER ON A STEAM LOCOMOTIVE, INCLUDING RECORD KEEPING AND THE REPORTING OF DEFECTS AND INCIDENTS

Theory

Make sure you have a copy of those standard procedures of the operator of your railway that apply to the functions and duties of a driver of a steam locomotive. You should read these procedures and make sure that you are thoroughly familiar with them and can apply them when performing the tasks of a train driver. It is important that you not only can follow these procedures but also understand their significance and the reasons why following them is so important. These procedures will include record keeping and the required action to be taken in the event of an equipment defect or a safety incident.

Practical

In conjunction with your mentor, make sure you have a copy of the relevant standard procedures and understand how they must be applied in the day to day work of a driver of a steam locomotive. If in doubt on any aspect of the procedures, ask your mentor to clarify them with you and if necessary, demonstrate to you how the various procedures should be carried out. In turn, you should gradually learn how to apply these procedures yourself progressively through your training -- gradually developing your expertise through guided practice, as instructed by your mentor.

4.4 ROLE AND RESPONSIBILITIES OF A TRAIN DRIVER ON A STEAM LOCOMOTIVE -- LEARNER'S NOTES

Insert your own notes here

5 PREPARING AND STARTING A STEAM LOCOMOTIVE

5.1 IDENTIFYING AND DESCRIBING THE COMPONENTS OF A STEAM LOCOMOTIVE AND ITS ASSOCIATED EQUIPMENT

Theory

As a driver of a steam locomotive, it is important that you know and are able to identify the components of the locomotive and its associated equipment. For the locomotive and its equipment, you must be able to describe their:

- purpose
- principal parts
- functions and operation
- potential defects and related action required to isolate, repair and/or report the defects as per standard procedures

The internal health of boilers will be a major part of Steam Heritage Rail in the future. All drivers and firemen should be competent in boiler water treatment theory, testing, and interpretation of test results. Heritage railways should refer to the *'RISSB Boiler Code of Practice, Appendix M - Boiler Water Treatment'* for details of the information on boiler water treatment to be included in their training and assessment materials for both firemen and steam locomotive drivers (suitably customised to their own local circumstances and standard procedures).

Across the heritage rail industry in Australia there are a range of different types and classes of steam locomotive in service. While there are some components and associated equipment common across the various types of steam locomotives, you need to be familiar with the features and particular components and equipment that are specific to the steam locomotive(s) used on your railway.

Typical components of a locomotive and associated boiler equipment may include those in the list below

[Note that the list may be adjusted and customised to match the locomotive and the railway concerned]:

- **ashpan** *(The ash pan is positioned below the fire grate to receive ashes and clinkers from a coal-fire boiler as they fall from the fire bed. Oil-fired boilers have a brick pan that contains the fire within the firebox. Some ash- and brick pans regulate, via the dampers, the amount of primary air entering the grate. The shape of the pan varies with the width of the grate and the position of the axles and the design of the locomotive. It may be formed in the shape of a hopper to facilitate emptying.)*
- **blower** *(A blower is fitted on all locomotives to supply artificial draft for the fire when the engine is not working. A small pipe is fitted on top of the blast pipe in the smoke box and is perforated with small holes and bent in the form of a circle. By turning on the blower steam valve in the cab, a jet of steam is directed up the chimney. This creates a vacuum in the smoke box, causing the air to be drawn through the grate and ejected out through the stack)*
- **blower valve** *(controls the flow of steam to the blower ring that creates a draft to draw the heat through the boiler tubes)*
- **blow down valve** (valve to blow out sediment contained in the boiler water and to drain the boiler empty for inspection and cleaning**)**
- **boiler (***a closed vessel or arrangement of enclosed tubes in which water is heated to supply steam to drive an engine.)*
- **boiler barrel** *(the cylindrical portion of the boiler between the firebox and the smoke-box. At each end is the tube plate to hold securely in position the tubes which connect the firebox. Placed on top is the dome where dry steam is collected. The regulator valve may be placed in it, which is secured to the internal steam pipe. Other steam pipes are placed there to supply steam for various auxiliaries.)*
- **brick arch** *(situated inside the firebox, it protects the tubes from cold air when the fire door is opened. It lengthens the path for the gases from the fire to the tubes and so ensures more complete combustion. Maintains an even temperature is maintained in the firebox.)[Further detail on the brick arch can be found in the RISSB Boiler Code of Practice]*
- **clack valve** *(a non-return valve to ensure feed water only flows in one direction – i.e. into the boiler. It also ensures that water is retained within the boiler)*
- **crosshead** *(A knuckle joint connection which joins the piston rod to the connecting rod)*
- **dampers** *(control the draft through the boiler by regulating the amount of primary air that enters the grate)* **)**
- **dome** *(placed on top of the barrel to provide a receptacle for collecting the steam well above the water level)*

- **expansion brackets.** *(moving joints fitted to the rear of a locomotive boiler to allow the expansion of the boiler. It is important that these are maintained in good working order. Seized expansion brackets could damage the boiler.)*
- **fire-hole** *(opening in the back head to allow the stoking of the boiler. It also provides secondary air to complete combustion)*
- **firebox** *(the combustion area of the boiler. It is surrounded by water on the top and all sides. At the bottom is a grate for the containing and burning and distributing primary air flow to combustible materials. An ash pan is attached below so that combusted materials may be contained)*
- **firebox wrapper plate and backplate** *(important outer components of the firebox. The boiler consists of a steel shell which includes the boiler barrel, the outer firebox wrapper plate, the back plate, throat plate, smoke box tube plate, also the inner firebox and smoke tubes)*
- **foundation ring** *(the foundation ring, also known as the mud ring, unites the lower edges of the inner and outer firebox plates (sheets). It can be forged, cast, welded or a pressed U-section. Because of the tight radius of corners in riveted foundation rings, the plates are held in place with boilermaker's (or patch) screws.)*
- **fusible plug** *(a safety device used to provide a warning of that the water level has already fallen to a dangerous level. The lead filled plugs are fitted in the top of the fire box crown. Under normal circumstances, the water covering the firebox crown prevents the lead melting. If the water level falls below the top of the firebox crown, the plug overheats and melts. The resulting blast of water and steam acts as a warning (and may perhaps subdue the fire to some extent preventing further damage)*
- **gauge glasses** – *see water gauge*
- **gudgeon pin** *(The pin that joins the crosshead to the connecting rod)*
- **injector** (*Is a device containing a series of nozzles so designed and arranged that steam entering will expand and strike a quantity of water and condense, The increased velocity, due to expansion and heat energy imparted to the water creates sufficient movement to force the water into the boiler against the pressure contained within. They are usually located one on either side of the boiler. Injectors may be classified as lifting and non-lifting. The lifting injector is placed above the high water line in the tank, requiring a vacuum created by starting the injector to fill the suction pipe with water The non lifting injector is placed below the bottom of the water tank, the suction pipe is always flooded All injectors work upon the same general principle, differing only in the details of construction.).*
- **piston rod** *(A rod that connects the piston in the cylinder to the cross-head axle)*

- **regulator or throttle** *(a valve that controls the delivery of steam to the steam chests and cylinders)*
- **safety valves** *(pressure relief valves to stop the boiler pressure exceeding the operating limit. They relieve the boiler of excess pressure above the registered pressure.)*
- **slidebars** *(also known as **Guide Bars,** They contain and allow the free movement of the crosshead **also hold** the piston rod parallel to the guides and the piston in the cylinder)*
- **steam pressure gauge** (*shows the steam pressure in the boiler above the atmospheric pressure*)
- **steam stop valve (also known as the manifold or turret)** (*isolates the boiler from the auxiliary equipment: i.e. L and R injectors, lubricators, blower, air compressor, vacuum ejector, etc.*)
- **superheater elements** *(Superheater elements are manufactured from steel tube and typically comprise multiple lengths of tubing joined by return bends. The inlet and outlet ends are joined to either the saturated steam chamber or the superheated steam chamber of the superheater header.*
- **tube plates--** front and fire-box *(the end plates that support the tubes in the boiler. The front tube plate is made of steel and attached to the boiler barrel. It has holes bored to receive tubes, the main steam pipe, inspection plugs and longitudinal stays etc. The firebox tube-plate is the plate into which the tubes are inserted, to allow the firebox gases to flow to the smoke-box)*
- **tubes** *(are surrounded by water on the outside. On the inside hot products of combustion pass. Heat from the combustion process is given up to the heating surface through the tube walls to the water and carry away the hot gases and smoke from the firebox to the smoke box.) [Further detail on tubes can be found in the RISSB Boiler Code of Practice]*
- **washout plugs** (*A small 'mudhole' used for washing out the boiler. Plugs, as compared to mudholes, are usually screwed into a taper thread)*
  [Further details on washout plugs can be found in the RISSB Boiler Code of Practice]
- **waterspace stays** *(used to tie the inner and outer plates of a firebox together to prevent them buckling and collapsing) Further detail on stays can be found in the RISSB Boiler Code of Practice]*
- **water gauge:**
  - water gauge glasses (*show by sight the quantity of water in the boiler above the vital part, .Two gauge glasses are fitted to enable one to be checked against the other)*

- steamway cock on water gauge *(an isolating cock used to shut off steam to the gauge glass as required, i.e. to isolate the steamway passage if the gauge glass were to break. Used when applying the independent test.)*
- steam way passage *(the passage which connects the boilers steam space to the gauge glass)*
- waterway cock on water gauge) *(an isolating cock to shut off steam to the gauge glass as required i.e. to isolate the waterway passage if the gauge glass were to break Used when applying the independent test.)*
- water way passage *(the passage which connects the boilers water space to the gauge glass)*
- *blow through cock (For testing and draining the gauge glass)*

- **vital part of a boiler** *(that part of the boiler which first becomes exposed during a low water condition i.e. the crown of a locomotive firebox.)*
- **whistle valve** *(controls the flow of steam to the locomotive's whistle)*

Some Key Terms

The following is a summary of some key terms related to steam locomotive boiler operation (Note that this in not an exhaustive list and you should refer to your railway's documentation and reference material, as well as having appropriate discussions with your mentor)…..

- **Saturated Steam** is steam taken directly from a boiler steam space and is characterised by having a constant temperature, volume and density for any given pressure. Because saturated steam is always generated in the presence of water it contains water droplets in suspension (This is the vapour seen issuing from cocks).

  The advantages and disadvantages of using of using saturated steam for driving reciprocating steam engines are:

  Advantages of saturated steam:

  - The wetness of saturated steam acts as a lubricant for all the components it comes in contact with, including: the governor, slide valves and the piston and its rings.
  - The gland packing relies on a small steam leak and the resultant condensate to keep it lubricated and to prevent it from drying out.
  - Assists in distributing the steam oil fed from the lubricator.
  - Most reciprocating engines are designed to operate on saturated steam.
  - For a given pressure the temperature is constant.

Disadvantages of saturated steam:

- When using saturated steam an amount of heat is given up in heating steam lines and the engine, as a result much of the steam is converted back to water.
  - This is an economic loss as no mechanical work has been performed.
  - The condensate formed can cause damage such as broken pistons or forcing the cylinder covers off the engine due to its incompressibility. .

- **Superheated Steam** (Cannot be made in the presence of water) it is steam that has passed through elements where its temperature is raised above the corresponding saturation temperature for the pressure.
- The *advantages and disadvantages of using of using superheated steam for driving reciprocating steam engines are…..*

  Advantages of superheated steam:
  - The hotter the steam is the less work it has to do.
  - Uses less coal.
  - Uses less water
  - Gives greater efficiency
  - Super heated steam has a less volume than saturated steam at the same pressure and therefore provides greater power and efficiency.
  - With sufficient super heat, expansion can take place in the engine forming less condensation, which can damage the engine.

  Disadvantages of superheated steam:
  - Lubrication must be provided, as super heated steam is an invisible odourless gas that does not have any lubricating properties.
  - Engines using high temperature super heat must be supplied with the correct grade of lubricant designed to resist vaporization and oxidization.
  - The temperature of the steam supplied to the engine can only be accurately determined with a temperature gauge.
  - **Safety Note:** Because superheated steam is invisible and odourless, it presents a danger to operational personnel. Care should be taken if a leak is suspected as this steam has the potential to cause life threatening injuries

- All steam made in the presence of water is Saturated Steam, the lower the pressure the wetter it is.
- **Simple expansion:** -- *Where the expansive energy of the steam is used in one engine only*

Steam lap: -- Is the amount the outer edge of the valve overlaps the outer edges of the steam port when placed centrally over it. The purpose of steam valve lap is to cut off the steam supply to the end of the cylinder before the piston reaches the end of its stroke allowing the steam to be used expansively..

Exhaust lap: -- Is the amount the inner edges of the valve overlaps the inner edges of the steam ports when placed centrally over it. The purpose of exhaust valve lap are twofold: It delays the release of steam acting behind the piston allowing full expansion and brings about an earlier cut-off of the exhaust steam, for compression to cushion the piston.

Lead: -- Lead is the amount of port opening for the admission of steam behind the piston for the commencement of its stroke. To ensure full steam supply to the cylinder to act on the surface of the piston at the commencement of its stroke, the valve commences to open just before the piston completes its stroke. This pre-admission also aids cushioning.

Angle of advance: The angle by which the eccentric is fixed to the axle at 90 degrees plus lap and lead angle in the direction of rotation.

Effect of "linking up": -- (Notching up) Allows the use of the steam more expansively – uses less steam, less coal and less water.

Inside Admission: -- Where steam is admitted to the cylinder via the inside edges of the valve and exhausts steam from the cylinder via the outside edges of the valve.

Outside Admission: -- Where steam is admitted to the cylinder via the outside edges of the valve and exhausts steam from the cylinder via the inside edges of the valve.

Power reverse gear is an arrangement whereby the operation of the reversing gear mechanism is operated by a power assisted device using an operating medium such as air, steam, or hydraulics.

The reasons why <u>knocks</u> can occur in the operation of a steam locomotive and the action should you take if they occur.

A knock generally occurs when the piston changes direction at each end of its stroke. Sometimes the exact location of a knock is hard to identify, it may be necessary to eliminate suspected each location by trial and error. Check your railways standard procedures for identifying and faultfinding ‘knocks’. Knocks may be caused by:

- Excessive clearance between Axle-box’s and horn guides.
- Piston Rod loose in crosshead.
- Piston striking cylinder heads
- Excessive clearance between crosshead and guide bars.
- Loose gudgeon pin in crosshead.
- Excessive clearance or looseness in Big End bearings and or fastenings
- Excessive clearance or looseness in Coupling Rod bushes or fastenings.
- Part of the locomotive being struck by reciprocating and or rotating parts.

Priming: - The following are the actions a driver should take if a locomotive is ***priming***:

- Reduce the demand for steam by easing the Regulator.
- Place locomotive in Full Gear in the direction of running.
- Open drain cocks.

Foaming: -- With foaming, the true water level in the boiler may be difficult to ascertain, this may bring uncertainty in the minds of the driver and fireman. Foaming is bought about by different conditions to priming. The actions a driver should take if a locomotive is ***foaming*** are.

- Reduce the demand for steam by easing the regulator.
- Place locomotive in full gear in the direction of running.
- Open Drain Cocks.
- If Foaming is persistent, water in the boiler may need replacing by blowing down then topping for as long as foaming persists.

Practical

1. In conjunction with your mentor and from the available railway reference documents, learn to how to locate and identify the various steam locomotive components and the associated equipment. Learn how to describe to your mentor the purpose of each component and piece of associated equipment and its function.

2. Develop a list of typical defects that could occur to the steam locomotive, its components and its associated equipment and the actions you would be required to take in conjunction with the fireman and within the limits of your responsibilities as a driver on the steam locomotive(s) concerned.

Dependent on the policies and procedures of your railway, this action may include isolation of the faulty component or piece of equipment, its repair, tagging the faulty component or piece of equipment, reporting to appropriate personnel and/or recording the defect and action taken in the appropriate log or record book.

3. Check the duties and responsibilities of a driver on a steam locomotive and the standard procedures for the servicing and checking of steam locomotives in your railway (as they relate to the duties of a driver) and confirm your understanding with your mentor.

5.2 LIGHTING FIRE AND RAISING STEAM IN CONJUNCTION WITH FIREMAN

Theory

The driver will work in conjunction with the fireman to light the fire and raise steam on the locomotive as per the standard operating procedures of the railway operator. This will include:

- ensuring adequate ventilation within a confined environment such as a locomotive shed
- conducting pre-light up procedures
- lighting the fire as per standard procedures for the locomotive concerned
- raising steam as per standard procedures for the locomotive concerned
- using a blower when raising steam including taking required precautions
- minimising smoke generation while raising steam
- testing and operation of the water gauge glass fittings
- testing the injectors as per standard operating procedures
- ensuring that the ashpan door is closed

Across the heritage rail industry in Australia there are a range of different types and classes of steam locomotive in service. Different railway operators will have their own policies and standard operating procedures for the lighting up and raising of steam for the various steam locomotives in service.

Drivers therefore need to understand and be able to implement their own railway's policies and standard operating procedures concerning the lighting up and raising steam for the various steam locomotives they will be driving.

Practical

Under the supervision of your mentor, observe and practice how to light fire and raise steam in conjunction with fireman on the steam locomotive(s) you will be driving.

Learn and demonstrate to your mentor how you can work with the fireman to light fire and raise steam on a steam locomotive in accordance with the standard operating procedures of your rail operator.

5.3 CONDUCTING PRE-START CHECKS

Theory

Prior to conducting pre-start checks on a steam locomotive, drivers will have checked the roster and interpreted the day's train activities. They will have confirmed the allocation of locomotives and located the locomotive to be checked and prepared in the yard. When preparing a steam locomotive for service, a driver will initially check the locomotive's log book to confirm that all previously identified problems have been rectified. They will then conduct a series of pre-start checks as per the railway's standard operating procedures for the steam locomotive concerned. This will usually include:

- Setting the locomotive in position for examination and lubrication as per standard operating procedures
- Conducting an examination of the **locomotive** including…
  - Checking the smokebox to ensure that the apron plate, spark arrestors and deflector plates are in position and properly secured and that the arrestors and smokebox are free from ashes
  - Examining the compressor to ensure that the glands are tight, valve covers are secure and all nuts and bolts are secure
  - Inspecting the left hand side, then underneath, then the right hand side of the locomotive using the operator's checklist for the locomotive concerned.
- Examining the **water gauge glasses** including **c**hecking that the water gauge glasses are in good condition and that spare gauge glasses are available
- Inspecting the boiler tubes from both the smokebox and firebox ends as per standard operating procedures

Railways treat boiler water with chemicals to protect the boiler metal from corrosion and to condition the water to reduce the likelihood of foaming. Water treatment also reduces the tendency for dissolved salt in the feed water to form scale on the wetted surfaces of the boiler. Water treatment processes including the choice of chemicals and the dose rates for a particular boiler and the testing of boiler water are usually conducted by *Boiler Water Treatment Specialists*.

Drivers and firemen need to be aware of their own railway's policy and procedures for boiler water treatment and who carries out the various water testing and treatment tasks. A useful reference is *the 'RISSB Boiler Code of Practice, Appendix M - Boiler Water Treatment be used'*

Practical

Under the supervision of your mentor, observe and practice how to conduct the required checks of the log book and then the pre-start examination of a steam locomotive and its associated equipment. Learn and demonstrate to your mentor how you can conduct the required inspection and checks

5.4 CHECKING BRAKE EQUIPMENT ON THE LOCOMOTIVE

Theory

A driver will follow the pre-start checklist for checking the brake equipment of the locomotive issued by the rail operator for the type and class of steam locomotive concerned. In the case of Westinghouse air brake systems, this will typically include:

- Lubricating the compressor
- Starting the compressor
- Testing air gauge
- Testing the driver's brake valves as per standard operating procedures
- Testing the brake system for leakage
- Testing the slide feed valve
- Testing non-automatic brakes where fitted
- Starting the turbo and checking the head and marker lights

In the case of a vacuum braking system, you would need to follow the standard operating procedures of your railway operator for conducting brake tests on the specific vacuum braking system in use within the railway.

Practical

Under the supervision of your mentor, observe and practice the required brake test standard operating procedures for your steam locomotive.

Learn and demonstrate to your mentor how you can complete all the required brake tests.

5.5 RECORDING, RECTIFYING, ISOLATING AND/OR TAGGING DEFECTS AND DEFICIENCIES (AS APPLICABLE) OR REPORTING TO RELEVANT PERSONNEL

Theory

Where defects and deficiencies are found in the course of the inspection and checks, they will be recorded and rectified, isolated, tagged (where applicable) or reported as per the railway's standard operating procedures and regulatory requirements.

Different railway operators will have their own policies and standard operating procedures as to what action should be taken by drivers when they discover defects and deficiencies in their locomotive and its associated components and equipment.

Drivers therefore need to understand and be able to implement their own railway's policies and standard operating procedures concerning identified defects and deficiencies.

Practical

Under the supervision of your mentor, observe and practice how to take appropriate action in the event of a number of simulated typical defects or deficiencies on your steam locomotive.

Learn and demonstrate to your mentor what action you would take if various simulated defects or deficiencies were identified on your steam locomotive.

5.6 LUBRICATING THE LOCOMOTIVE

Theory

The prime purpose of lubrication on a steam locomotive is the reduction of friction by maintaining a thin film of oil or grease between two metal surfaces in contact with one another. If the film of oil/grease is broken at any time, friction increases, causing the parts to be overheated and possibly damaged. The higher friction also means that more power is required with consequent reduction in the performance of the locomotive.

It is therefore very important, that all bearings and other moving parts on the locomotive are well and constantly lubricated.

The driver with the assistance of the fireman must follow the pre-start lubrication checklist issued by the rail operator for the type and class of steam engine concerned. All firemen and steam locomotive drivers should be able to make a replacement trimming in the case that one may need replacing. The following are examples of lubrication points on a locomotive. Dependent on the type of equipment and the procedures of the rail operator lubrication may involve oiling and/or greasing. Check with your operator the lubrication points and procedures for the type and class of steam engine concerned.:

- Ensure all trimmings are in place
- Lubricate with bearing oil (or grease where applicable) the following parts (where fitted) below the footplate…
  - All axle boxes (if oil lubricated)
  - All oil cups
  - Eccentric straps, expansion links
  - Valve spindle glands
  - Knuckle joints
  - Spring gear equipment
  - Motion gear
  - Crosshead
  - Guidebars
- Lubricate with bearing oil (or grease where applicable) the following parts (where fitted) above the footplate…
  - Precision air reversing gear lubricator and its piston rod gland
  - Spot oil reversing shaft universal coupling pins
  - Reach rod brackets
  - Tender brake gear bearings
  - Air operating cylinder
  - Mechanical lubricators
- Lubricate the following parts (where fitted) above the footplate:
  - Superheater damper door cylinder
  - Auxiliary oil cups for the piston rod and valve spindles of the locomotive
  - Mechanical Lubricators
  - Hydrostatic Lubricators
- Check the oil levels showing in the sight glasses or on the dip stick of the mechanical lubricators. The oil pipes need to be primed by rotating the ratchet handle of the lubricator as required. (where fitted and/or may be required by rail operator for the locomotive concerned)

- Where a hydrostatic lubricator is fitted), it must be filled with the necessary quantity of cylinder oil, as may be required by rail operator for the locomotive concerned.

Steam locomotive drivers and firemen need to understand their railway's policy and procedures for: (1) oiling and cleaning lubrication trimmings, (2) replacing lubrication trimmings, and (3) making a replacement trimming.

Drivers and firemen need to be aware of any responsibilities they may have for these tasks under their railway's standard operating procedures.

A useful reference on lubrication of steam locomotives including the maintenance and replacement of trimmings is *'Steam Locomotive Lubrication - Its Development and Practice' by P.W. Skellon (*ISBN No 0953041700).

[NOTE FOR RAIL OPERATORS -- As each class of locomotive has differing locomotive lubrication systems, it is important that the railway provides specific information on the procedures for their locomotives rather than have general notes]

Practical

Under the supervision of your mentor, observe and practice the required pre-start lubrication standard operating procedures for your steam locomotive.

Learn and demonstrate to your mentor how you can complete all the required lubrication tasks as a member of your locomotive crew.

5.7 MAINTAINING STEAM PRESSURE

Theory

The maintenance of the steam pressure within defined limits is critical for the safe and effective operation of a steam locomotive. The driver and the fireman work together as a team to ensure that the steam pressure is always sufficient to allow the locomotive to fulfil the tasks required. This involves monitoring the steam pressure as indicated on the steam gauge, anticipating the grade and other factors on the road ahead, planning for the level of steam required and managing the fire and steam making accordingly.

For example, when approaching a steep climbing grade the fireman must build the fire and provide the right level of draft to the fire to allow the driver to have enough steam pressure for heavy steaming. In contrast, if approaching a station or approaching a downward grade, the fire would be managed differently.

When preparing to start a steam engine therefore it is important that the steam pressure be raised to be within the required operating range before commencing locomotive operations.

Practical

Under the supervision of your mentor, observe how the driver and fireman on a steam locomotive must work together to raise the steam pressure to the required operating range and maintain it within the specified limits. Learn and demonstrate to your mentor how you can work with the fireman to raise the steam pressure to the required operating range and maintain it within the specified limits as per the standard operating procedures of your rail operator.

5.8 PREPARING THE TURBO AND TESTING THE LIGHTS

The turbo on a steam locomotive provides power for lighting the various parts of the locomotive and may also provide power for the head light on the locomotive. In preparation of the locomotive, the turbo is to be lubricated in accordance with the general instructions relating to turbo operation as published by the railway concerned. Once lubricated, all power requirements should be turned off whilst steam is admitted to the slowly to turbo and as condensate is dispersed. The turbo speed is gradually run up to operating speed. Once the turbo is at normal operating speed, the lights are tested as required as per the railway's standard operating procedures.

Practical

Under the supervision of your mentor, observe the procedures for preparing the turbo and testing the lights on a steam locomotive. Learn and demonstrate to your mentor how you can prepare the turbo and test the lights as per the standard operating procedures of your rail operator for the type and class of locomotive concerned.

5.9 STARTING AND INITIAL MOVEMENT OF THE LOCOMOTIVE

Theory

Once the driver has checked that the required steam pressure has been achieved, the locomotive will be started and initially moved as per the railway's standard operating procedures for the class of locomotive concerned. This will usually involve:

- blowing out superheater elements as per standard operating procedures
- warming the cylinders and valve chambers,
- ensuring that the cylinder cocks are initially kept open for a short distance of travel as per standard operating procedures,
- ensuring that the locomotive is in full gear prior to starting (and kept there for the first few turns of the driving wheels before notching up,
- ensuring all brakes are released prior to starting, and
- opening the regulator sufficiently to lift the locomotive, taking care to open the regulator slowly to prevent slipping (severe slipping causes excessive wear and tear to the locomotive, disturbance of the firebed and blanketing of the spark arrestor -- if slipping should occur, the regulator should be eased and, if necessary, sand applied).

Practical

Under the supervision of your mentor, observe the sequence of steps taken by a driver on a steam locomotive when starting the locomotive prior to service.

Learn and demonstrate to your mentor how you can start a steam locomotive as per the standard operating procedures of your rail operator for the type and class of locomotive concerned.

5.10 CORRECTLY USING INJECTORS

Theory

What is an injector?

An injector is a device containing a series of nozzles so designed and arranged that steam entering will expand and strike a quantity of water and condense. The increased velocity, due to expansion and heat energy imparted to the water creates sufficient movement to force the water into the boiler against the pressure contained within). They are usually located one on either side of the boiler. Injectors may be classified as lifting and non-lifting. The lifting injector is placed above the high water line in the tank requiring a vacuum created by starting the injector to flood the suction pipe with water The non-lifting injector is placed below the bottom of the water tank. The suction pipe is always flooded.

There are a great many different injectors on the market. All work upon the same general principle, differing only in the details of construction.

The injector operates by converting the thermal and kinetic energy of steam to momentum in the water. This is done via a series of converging and diverging cones in which the steam condenses into the incoming water. In the simplest injector, there is a converging steam cone, from which the steam emerges into the injector at high velocity (having both kinetic and thermal energy). Next is a combining cone, in which the steam jet and water combine. This cone is convergent. Water enters the injector between the steam, and combining, cones. The water and condensed steam emerge from this cone at high velocity (thus having a high kinetic energy but lower thermal energy), and enter a diverging cone (the delivery cone), where the velocity is reduced, However, the overall energy is maintained, and as the mass of water is unchanged, the energy is essentially unchanged in quantity and now manifests itself as pressure, which for the injector to work must be greater than the boiler pressure. The whole device is a practical example of the Law of Conservation of Energy.

When and how should injectors be tested and used?

When sufficient steam pressure is available both fed water injectors should be tested. The type of injectors and the related testing procedures tend to vary from one type of locomotive and rail operator to another. Hence the steps involved in testing and using the injectors are as specified by the rail operator for the specific locomotive concerned. After the test of the injector, the steam valve and the water valve should be shut off in sequence. A blow of steam from the overflow pipe will indicate either steam starting valve has not seated or is leaking. A combination of

boiler water and steam blowing from the overflow pipe indicates that the clack valve has not seated or is blowing through.

Practical

Under the supervision of your mentor, observe and practice how to use the injectors on the steam locomotive(s) you will be driving.

Learn and demonstrate to your mentor how you can use the injectors on the steam locomotive(s) in accordance with the standard operating procedures of your rail operator.

5.11 CHECKING SYSTEMS ARE OPERATING CORRECTLY

Theory

Once steam has been raised and the locomotive has been started the driver will carry out a check that all of the locomotive systems are operating correctly. The driver will follow the standard operating procedures of the railway for the type and class of locomotive concerned usually with the aide of a systems checklist.

Practical

Under the supervision of your mentor and using your railway's standard operating procedures and associated checklist(s), observe and practice how to check that all of the systems on a particular type and class of steam locomotive are operating correctly.

Learn and demonstrate to your mentor how you can check that all of the systems on the steam locomotive you have started are operating correctly as per the standard operating procedures of your rail operator.

5.12 PREPARING AND STARTING A STEAM LOCOMOTIVE - LEARNER'S NOTES

Insert your own notes here

6 MOVING A STEAM LOCOMOTIVE

6.1 ADHERENCE TO YARD INSTRUCTIONS AND SAFEWORKING RULES

Theory

A critical aspect of a train driver's responsibilities is to follow the safeworking rules of the railway. This includes moving a steam locomotive in the yard during its preparation for service.

You need to be thoroughly familiar with your railway's yard instructions and safeworking rules and be able to apply them when operating a steam locomotive during both its preparation for service and stabling activities.

Practical

In conjunction with your mentor, make sure you have a copy of your railway's yard instructions and safeworking rules and understand the requirements and responsibilities described in them.

If in doubt on any aspect of them, ask your mentor to clarify them with you and, if necessary, demonstrate how these responsibilities need to be fulfilled in practice.

Demonstrate to your mentor your understanding of your responsibilities and how these are applied when moving a locomotive in the yard.

6.2 OBTAINING AUTHORITY TO MOVE AND POSITION A STEAM LOCOMOTIVE

Theory

Prior to moving a locomotive when preparing it for service obtain authority to move and position the locomotive. In heritage railways, this authority is usually approval from the Station Master or Guard to move within the yard where no formal [proceed authority is required whilst within yard limits. This is critical for the safeworking of the yard and personnel within it.

Practical

Learn and demonstrate to your mentor the standard operating procedures for obtaining authority to move and position a locomotive prior to service.

6.3 OPERATING LOCOMOTIVE CONTROLS

Theory

It is important that you are thoroughly familiar with the various operating controls for the type and class of the locomotive(s) you will be driving. You must know the purpose and function of each of the controls and how and when you should use them.

Practical

Discuss with your mentor the various train controls for the type and class of the locomotive(s) you will be driving including their purposes and functions and how and when each should be used.

Your mentor will demonstrate how each control should be used.

Learn and demonstrate to your mentor how you can operate the various locomotive controls in accordance with the standard operating procedures of your rail operator.

6.4 MOVING THE LOCOMOTIVE TO REQUIRED POSITION

Theory

The driver will follow the applicable standard operating procedures and safeworking rules when moving the locomotive to the designated position in the yard ready for shunting and coupling with rollingstock in preparation for service.

Practical

Learn and demonstrate to your mentor the standard operating procedures for moving the steam locomotive to its required position prior to service.

6.5 SECURING THE LOCOMOTIVE IN POSITION

Theory

Once in position the driver will secure the locomotive in position in accordance with the rail operator's standard operating procedures of the rail operator for the type and class of steam locomotive concerned.

Practical

Under the supervision of your mentor, learn and demonstrate how to secure the steam locomotive in the designated position ready for service as per the rail operator's standard operating procedures.

6.6 MOVING A STEAM LOCOMOTIVE - LEARNER'S NOTES

Insert your own notes here

Insert your own notes here

7 CONDUCTING TRAIN OPERATIONS

7.1 FOLLOWING APPLICABLE SAFEWORKING PROCEDURES

Theory

All railways follow a system of **safeworking**, -- i.e. a system of rules and equipment used to prevent conflict between trains (and between trains and track workers).

In safeworking systems used on the tourism and heritage lines, the track is divided into sections within which only one train is normally permitted. The end points of these sections may be a place where trains may cross or pass (such as a Station or Crossing Loop), a place where trains leave the main line (a Siding) or just a specially marked location (a Block Point). Permission for a train to enter a section is referred to as an Authority. Each form of safeworking goes about the granting of these Authorities to trains in a different way.

The two most common safeworking systems used by Tourist and Heritage Railways are:

1. STAFF AND TICKET (S&T)

S&T is a token system. It comprises the issue of a Proceed Authority in the form of a staff, or where there is to be a following train in the same direction, a ticket. The system generally allows for only one train to be in the section at one time. However, on sections where following movements are authorised within the section, tickets are kept in the staff box at each end of the section. The staff box can only be unlocked by the train staff for the particular section. The safety of the system depends upon the correct handling of the staff, and where required, the tickets.

The Authority to enter the section is the staff or ticket. Each train entering the section is required to be in possession of the staff or ticket for that section and when provided, comply with signal indications. When trains are proceeding on a ticket, the train crew is required to sight the staff for the relevant section prior to departure. The setting and verification of points is undertaken by the train crews themselves or by workers at attended locations..

2. TRAIN ORDER WORKING (TOW)

TOW is a communications-based system and comprises the issue of a Proceed Authority in the form of a Train Authority, which authorises a train to move between specified points and is issued by train control to the train crew or to workers who arrange delivery to the train crew. The train crew is required to comply with the instructions in the train order together with any additional signal indications. The route over which a train is authorised to move by a Train Authority is verified as clear either through manual procedures or with computer assistance. The setting and verification of points is undertaken by the train crew themselves at unattended block locations or by workers at attended locations and are required to comply with instructions contained with the train order or by rules which include the requirements for crossing or passing of trains.

You must be thoroughly familiar with the safeworking system used on your railway and be able to apply the rules and requirements of the safeworking system correctly when fulfilling your role on the railway. ***This is critical for the safety of the railway, personnel and passengers.***

Note that you will be trained separately in safeworking systems and procedures[1].

> ***Practical***
>
> Discuss with your mentor the safeworking system used on your railway.
>
> Learn and demonstrate to your mentor how to interpret and apply the rail operator's safeworking system when driving a train on the railway'.

7.2 INTERPRETING AND APPLYING 'AUTHORITY' TO MOVE A TRAIN

Theory

Prior to moving a train you must obtain *'authority'* to move a train as per the rail operator's safeworking requirements and operational procedures. In heritage railways, this authority is usually approval from the Guard to move within a yard where no formal proceed authority is required whilst within yard limits ***This is critical for the safety of the railway, personnel and passengers.***

[1]See ***Safeworking Lesson Plan and WorkBook*** and related resources

Practical

Discuss with your mentor the standard operating procedures for obtaining 'authority' to move a train' within the safety management system of the railway. Discuss the reasons and importance for having to obtain 'authority' to move a locomotive or train.

Learn and demonstrate to your mentor how to obtain and apply authority to move a train'

7.3 INTERPRETING AND APPLYING A 'CANCELLATION OF AUTHORITY'

Theory

If for some reason the operations of a train have been cancelled and an 'Authority' has already been issued, you must obtain a 'Cancellation of authority' as per the rail operator's safeworking requirements and operational procedures. ***This is critical for the safety of the railway, personnel and passengers.***

Practical

Discuss with your mentor the standard operating procedures for obtaining a 'Cancellation of authority' and its purpose within the safety management system of the railway.

Learn and demonstrate to your mentor how to interpret and apply a 'Cancellation of authority'

7.4 FOLLOWING CORRECT PROCEDURES WHEN THERE IS A TRAIN BROKEN DOWN OR FAILED IN A SECTION

Theory

It is very important that a train driver understands the standard operating procedures that must be followed when there is a train broken down or failed in a section – as per the rail operator's safety management plan. ***This is critical for the safety of the railway, personnel and passengers.***

Practical

Learn and demonstrate to your mentor the standard operating procedures that must be followed when there is a train broken down or failed in a section.

7.5 FOLLOWING CORRECT PROCEDURES WHEN THERE ARE WORKSITES ON TRACK

Theory

A ‘‘track work authority’ allows track work on running lines between train movements. Protection Officers manage the approach of rail traffic to worksites. Movements may be controlled using hand signallers and detonator protection. Train drivers need to be aware of the standard operating procedures and safeworking rules that need to be followed by drivers when operating in the vicinity of worksites on the track. In conjunction with the fireman they must remain vigilant and respond correctly to warning devices and hand signals from protection officers. ***This is critical for the safety of the railway, personnel and passengers.***

Practical

Discuss with your supervisor the safeworking requirements for operating a train in a section where there are worksites on the track. Learn and demonstrate to your mentor the standard operating procedures and safeworking requirements for when there are worksites on track. This may involve the mentor posing a series of simulated situations or case studies.

7.6 SHUNTING

Theory

When shunting rollingstock to form a train, it is important that the driver follows the railway’s standard operating procedures and safeworking rules as they apply to shunting. The person carrying out the shunt may be the fireman, guard or other qualified worker who for the purpose becomes known as the shunter. You should be familiar with all shunting signals provided by the shunter.

Practical

In conjunction with your mentor, make sure you have a copy of your railway's standard operating procedures and safeworking rules as they apply to shunting and understand the requirements and responsibilities described in them.

If in doubt on any aspect of them, ask your mentor to demonstrate how shunting activities need to be carried out.

Demonstrate to your mentor your understanding of shunting procedures and related safety requirements and how these are applied when shunting rollingstock either in the yard, or at a station, or siding.

7.7 COUPLING LOCOMOTIVE TO ROLLINGSTOCK

Theory

When coupling a locomotive to rollingstock to form a train, the driver will initially position the locomotive a short distance from the leading vehicle of the train.

Before coupling the driver will make sure that the main air reservoir is fully charged. The shunter will should stand in a position of safety and where they can be seen by the driver and signal the driver to ease up to the leading vehicle. The driver will slowly move the locomotive and bring it to a standstill when the movement couples and then apply the locomotive's brake.

The shunter then couples the locomotive to the leading vehicle as per the railway's standard operating procedures.

For example, in an air brake system:

> *'After coupling to the train, the driver will lap the brake valve handle until the air hoses have been coupled and the brake cocks opened. The driver will then shift the brake valve handle to the full release position to charge the brake pipe. The brake valve is then returned to the running position in sufficient time to prevent an overcharge of the brake pipe.'*

It is the shunter's responsibility to make sure that the locomotive is correctly coupled to the train and that the brake pipe cocks are in the open position between the locomotive and the leading vehicle of the train.

It is critically important that the driver is able to see the shunter at all times when the locomotive or train is being moved. If the driver cannot see the shunter, he/she must immediately stop and not move the locomotive.

> ***Practical***
>
> Under the supervision of your mentor during a train journey, observe how driver works with the shunter to safely couple a steam locomotive to the leading vehicle of a train. Learn and demonstrate to your mentor how you can work with a shunter to couple a steam locomotive to the leading vehicle of a train as per your railway's standard operating procedures.

7.8 HANDLING OF TRAIN

Theory

The handling of the train requires detailed route knowledge including the location of grades, stations, sidings, crossings, fixed lineside signals, curves, speed limits, and other potential hazards such as lineside fires that may affect the running of the train. Consideration of these route features and potential hazards enables the driver to anticipate the running requirements of the train and adjust the handling of the train accordingly. This also requires collaboration with the fireman to ensure that the management of the firebed and steam pressure is appropriate for both the current track conditions and those ahead. The driver needs to regulate the operation of the locomotive to ensure its safe operation.

Lifting the train on heavy grades -- In order to achieve successful lifting of trains on steep grades when worked by superheated locomotives, it is essential that the fire be so regulated as to obtain the maximum firebox temperature with the resultant high degree of heat and requisite steam pressure. Local instructions should be followed for the railway concerned..

Light steaming – The correct adjustment of regulator and reversing screw varies according to the speed, load and the gradient traversed. Skill in making these adjustments is mainly a matter of practice and experience with the type and class of locomotive concerned. When running at relatively high speed it is a good rule to bring the gear back sufficient to prevent knocking and then place the regulator in a position which will maintain the desired running speed.

Heavy steaming– The most severe conditions are encountered when a locomotive is steaming up a moderate grade at a relatively high speed with a heavy load. Under these conditions the locomotive is required to deliver its maximum power. It is when working at maximum power output with heavy draft and relatively high speed that fires are likely to drag from under the fire door. It is important particularly under these conditions that the driver and the fireman carefully monitor the effect on the fire of heavy steaming conditions and manage the firebed and steam pressure accordingly.

Coasting **or drifting –** When coasting, locomotives must be placed in full, forward or backward gear according to the direction of running. The reversing wheel should be wound out carefully to the end of its travel to avoid jamming the nut against the end of the reversing bracket and when it reaches the end of its travel should be brought back one or two notches to leave a little clearance. Superheated engines are provided with pilot drifting valves with a drifting gauge where fitted mounted in the cab. Drivers must keep the drifting gauge at zero to prevent formation of a vacuum in the cylinders – adjusting the regulator pilot valve as the speed varies.

Picking up a train at speed – After a period of coasting, it is important that a driver is careful in the re-application of power. The application of power should be done gradually – carefully taking up the slack out of the draw gear and avoiding ‘drawgear shock’. Too rapid an application of power may cause failure of the drawgear as well as disturbing the fire bed and smokebox content resulting in the blanketing of the spark arrestors. There is also a risk of carrying over water if the regulator is opened too quickly. It is important to follow the rail operator’s standard operating procedures for picking up a train at speed after a period of coasting.

Practical

Under the supervision of your mentor during a train journey, observe how the driver handles the train and works collaboratively with the fireman to anticipate the road ahead and appropriate manage the fire bed and steam pressure, and control the speed and the power of the locomotive.

Discuss with your mentor the routes of the trains you will be driving and the ways in which the features and hazards along the road need to be considered and taken into account when handling the locomotive and managing the fire bed and steam pressure.

During a test drive of a train, learn and demonstrate to your mentor how you can handle the train and work collaboratively with the fireman to manage the fire bed and steam pressure to ensure that the train operates smoothly at the required speed and power levels to achieve timetable requirements and to comply with the rail operator's standard operating procedures.

7.9 PRECAUTIONS AND PROCEDURES WHEN APPROACHING AND TRAVERSING FIXED LINESIDE SIGNALS, POINT STAND INDICATORS, SIGNS AND LEVEL CROSSINGS

Theory

When operating a steam locomotive during a train journey, its is crucial for effective safeworking that the driver ensures that correct procedures are followed when approaching and traversing fixed signals, point stand indicators, check points, track side signs and level crossings.

The driver and the fireman work in partnership to observe the various signals, signs and indicators and to scrutinise for any abnormal situations that might occur at level crossings. The driver is assisted by the fireman who double checks the various situations at signals, signs, point stand indicators, check points, track side signs and level crossings and aids the driver in taking all required action as per safeworking rules and standard procedures. All signs and signals must be called and acknowledged. Either one of the locomotive crew must call the indication which is then repeated by the other locomotive crew member.

Practical

1. Ride in the cab of a steam locomotive for a train journey and observe the teamwork of the locomotive crew and the way that the driver and the fireman work together in the observance of fixed signals, point stand indicators and signs and the procedures for approaching and traversing level crossings.
2. Discuss with your mentor, the procedures for observance of fixed signals and level crossings and potential abnormal situations that can occur at level crossing and related action that needs to be taken should they occur.
3. Learn and demonstrate during a train journey the action you must take as a driver in the observance of signals, point stand indicators, signs and level crossings.

7.10 ADHERING TO SPEED LIMITS

Theory

The maximum speed for a railway is normally published by the Railway in its Working Timetable or similar document. This is “known as Normal Speed. Normal speed is the maximum speed permitted for that section of line or class of rollingstock: e.g. In South Australia, a 930 class loco is permitted 95 Kph max speed whilst a 500 class loco is only permitted 65 Kph etc.

Where there are curves on a railway curve speed boards indicated the maximum permissible speed around that curve.. Normal speed may be resumed when all of the train has cleared the curve. Curve speed boards are normally placed on the driver’s left had side at the point on the railway where that speed commences.

Temporary speed restrictions are applied from time to time due to the condition of the track. A” Warning Board” is placed in advance of the restricted track to indicate to the driver the speed at which the movement is enquired to proceed over the affected track. A “Start Speed Restriction Board” is placed 50 metres in advance of the point where the speed restriction is to start and drivers need to ensure their trains do not exceed that speed from the board until clear of the restricted area. A “Clearance Board” is located 50 metres beyond the point of the

speed restriction and normal speed may be resumed when the last vehicle of the movement is clear of this board. In The design and placement of boards does vary from railway to railway and you need to become familiar with the boards in use on your railway. In most railways the maximum permitted over the speed restriction is shown on the Warning Board and Restriction Board but in most cases there is no speed on the resume normal speed board.

It is critically important that a driver is aware of the location of the various speed boards (including temporary speed restrictions) along a train's route so that preparations can be made to reduce speed if the train is approaching a section with a lower speed limit.

Practical

Under the supervision of your mentor during a train journey, observe how a driver adjusts the speed of the train to comply with the speed limits indicated by the various speed boards en route, including curve speed boards where applicable.

Discuss with your mentor the location of the various speed boards on the various routes you will be driving trains. During a test drive of a train, learn and demonstrate to your mentor how you can regulate the speed of the train to comply with the required speed limits.

7.11 GIVING AND INTERPRETING HAND SIGNALS

Theory

Drivers work directly with other members of the train crew and other qualified railway personnel in the safe and effective operation of locomotives and trains. A key skill required of all the railway personnel concerned is being able to give and interpret the standard railway hand signals. In various circumstances, these hand signals may be complemented by the use of flags and lights (e.g. where night work is involved). It is important therefore that you are proficient in giving such signals as per your railway's standard procedures. You must also be able to recognise and correctly interpret signals given by others.

Note: If a hand signal is not received when one is expected, or a hand signal cannot be interpreted, the movement must be brought to an immediate and smooth halt until and correct hand signal is again received.

Practical

In conjunction with your mentor obtain and study your railway's procedures for the signals you need to be able to give and interpret when working with other railway personnel during the driving of a steam locomotive / train. In particular, identify and discuss with your mentor the various situations in which the signals are used during locomotive and train operations.

Ride in the cab of a steam locomotive for a train journey and observe the use of hand, flag and light signals by the train crew and other railway staff during the journey. Note how the crew watch for and observe the Guard's hand signal when arriving at a platform. Where the platform is on the fireman's side, the fireman will relay the hand signals to the driver.

Learn and demonstrate to your mentor the giving and interpretation of the various hand, flag and light signals used on your railway.

7.12 STOPPING AND SECURING A TRAIN IN AN EMERGENCY

Theory

When a train has been stopped such as in an emergency and has been brought to a stand and will remain stationary for a lengthy or unknown period and may be left unattended, the procedure for securing the train is as follows:

- Fully apply the brake, screw on the locomotive hand brake,
- Place the reversing gear in centre position and open the cylinder and steam chest drain valves,
- Secure the regulator by placing a locking pin in position,
- Ensure that the fireman has checked the boiler water levels and confirm that the boiler will be left with sufficient water in it,

- Close all steam valves and nigger head (manifold or steam turret) valve (where fitted), and
- Where the locomotive is to be left unattended for a period, ensure that the boiler water gauge stop valves are closed.
- Confirm that the fire is left in an appropriate state, this may involve dropping the fire (Note that by law a boiler cannot be left unattended with a fire on the grate and pressure on the gauge)
- Report to train control

> ***Practical***
>
> During a test drive of a train in conjunction with the fireman and under the supervision of your mentor, demonstrate the procedures you would follow as a driver during a simulated emergency stopping of the train. In the simulation, take all required measures to secure the train.

7.13 IDENTIFYING FAULTS AND DEFECTS AND CONDUCTING ASSOCIATED TROUBLE-SHOOTING ACTIVITIES

Theory

It is the role of the driver on a steam locomotive in conjunction with the fireman to identify any faults and defects on the locomotive and its associated components and equipment and to undertake related trouble-shooting activities.

You need therefore to be familiar with the types of faults and defects that could occur on the type of steam locomotive concerned and the trouble shooting processes typically used by drivers and firemen.

> ***Practical***
>
> During a train journey under the supervision of your mentor and with the assistance of the fireman, learn the types of faults and defects that could occur on the locomotive and the ways in which the driver can work in conjunction with the fireman to identify typical faults and defects on the locomotive and its associated components and equipment and related trouble-shooting activities.

7.14 DEALING WITH ABNORMAL SITUATIONS DURING TRAIN OPERATIONS, INCLUDING APPLICABLE EMERGENCY COMMUNICATION AND EVACUATION PROCEDURES

Theory

There are a range of abnormal and emergency situations that may occur during a train journey. You should be aware of recognising abnormal and emergency situations and your railway's procedures for train crew in the event that they occur.

The following are some examples of potential abnormal and emergency situations. The handling of many of the abnormal and emergency situations listed usually falls to the guard who would call emergency services as required and may call on the driver to 'Stop'

- failure of a fusible plug or other safety device (See below)
- a track obstruction
- trespassers crossing the track
- equipment failure
- wheel slip and uncontrolled slide
- signals in stop mode
- incorrect information or failure in communications
- a passenger emergency (e.g. illness or injury)
- an ill crew member (note that in the event of the driver becoming incapacitated, the second person may need to take over the driving of the locomotive on a temporary emergency basis)
- a passenger initiated alarm
- a false alarm
- a derailment
- a collision
- a chemical spill
- a fire and explosion on the locomotive or train
- a bomb threat
- head or marker light or whistle failure

Note that you should refer to your railway's policy and procedures for the action to be taken by train crew in the event of **a locomotive breakdown.**

Failure of a fusible plug

A fusible plug is a safety device used to provide a warning of that the water level in the boiler has already fallen to a dangerous level. The filled plugs are fitted in the top of the fire box crown. Under normal circumstances, the water covering the firebox crown prevents the lead melting. If the water level falls below the top of the firebox crown, the plug overheats and melts. The resulting blast of water and steam acts as a warning (and may perhaps subdue the fire to some extent preventing further damage)

A fireman needs to be aware of their railway's specific emergency procedures that must be followed in the event that a fusible plug melts.

An example of such procedures is:

> *Remove or extinguish the fire, but keep the blower going strongly to keep steam from entering the cab. In the case of oil, turn it off. In the case of a solid fuel, if there is a drop grate arrangement, drop the fuel into the ash pan, with the ash wetter turned on. In some arrangements, where the fire cannot be easily dropped it may be necessary to smother the fire with earth or sand. However, any practice that requires the fire door to be open has risk of burning for the crew, so this must be done with due care, and with the blower operating. Do not inject feed water, as this may flash to steam on the overheated plates of the boiler, causing greater volumes of steam and/or water to pass through the fusible plug. In all cases, steam is to be vented from the boiler by whatever auxiliary devices are available. (For example, the steam still ends up in the same place with the water turned off).*

The failure of a fusible plug indicates a very serious emergency situation and is a reportable occurrence. It is extremely important to know the emergency procedures of your railway in terms of action that must be taken in the event of the failure of a fusible plug.

Emergencies and Emergency Management Plans

Ensure you are familiar with your Railway's Emergency Management Plan and how it is applied in conjunction with the Emergency Services in your area. In the case of an emergency, confirm who is initially in charge of the site and when and how this responsibility changes to the Emergency Services and the Senior Combatant Agency at the site.

You need to be familiar with your responsibilities in the case of emergency and the requirement not to undertake any activity that is likely to destroy any evidence unless it is essential to do so in the treating of injured persons.

The incident site is controlled by the Senior Combatant Agency on site until such time as it is cleared and declared a wreck, then the Railway becomes responsibility for clearing of the track.

Prior to allowing work to commence on site, the Railway must ensure that it has undertaken an investigation to establish ensure and that all necessary evidence has been obtained.

Note: Emergency Services terminology varies from State to State, hence some terms will need to be changed to reflect the terminology of the State in which the training materials to be used. In all States, the Senior Combatant Agency is the Police except where a *Dangerous Goods Spill* occurs in which case the Emergency Services will take charge.

Notifiable Occurrences

Rail Safety Regulations require that all incidents which occur on a railway are deemed as either Category A or B. A category A incident must be reported by the railway to the Rail Safety Regulator immediately or at least within 2 hours of the incident by the person nominated by the railway concerned. A written notification is required on the appropriate form within 72 hours. Incidences deemed as Category B are to be reported within 48 hours on the appropriate form by the designated person from the railway. Each railway will have its own procedures for handling of the investigation and reporting or emergencies and all workers need to be aware of these requirements. In some instances, the Rail Safety Regulator may advise that an investigation will be conducted by that organisation and therefore nothing is permitted to be shifted until such time as the investigation has been undertaken.

If the incident occurs on a railway operated by another organisation, the railway concerned will have an operating agreement detailing the actions to be taken.

(Note: *In some States, the time frame for reporting of Category B incidences may vary and customised training materials based on the generic Lesson Plans will need to reflect the requirements of the State in which they are to be used.)*

Practical

Check your railway's documentation regarding abnormal and emergency situations and what action should be taken when they occur. In particular identify the role of the train driver in these situations.

Discuss potential abnormal and emergency situations that could occur on your railway with your mentor and the action you would need to take if they should occur. Discuss also the *Emergency Management Plan* of your railway and the policy and procedures related to *Notifiable Occurrences*,

7.15 CONDUCTING TRAIN OPERATIONS - LEARNER'S NOTES

Insert your own notes here

8 SHUTTING DOWN AND STABLING A STEAM LOCOMOTIVE

8.1 UNCOUPLING LOCOMOTIVE FROM ROLLINGSTOCK

Theory

The driver will position the train in the location where the rollingstock is to be uncoupled.

The shunter will then commence the uncoupling process as per the railway's standard procedures. For example, on a train fitted with a Westinghouse air brake system, these will typically involve….

- Closing the end cocks,
- Disconnecting the hoses
- Applying the brake on the train
- Moving out of the space between the locomotive and the rollingstock
- Then signalling the driver to ease up
- Uncouple the locomotive in accordance with standard operating procedures

On a train fitted with a **vacuum braking system**, the fireman would follow the standard operating procedures of the rail operator concerned for the uncoupling process.

Once the driver receives the fireman's signal he/she will move the locomotive slightly and hold it in position with the buffers tightly compressed using the locomotive's brake. The fireman will then remove the coupling.

It is important that the driver and fireman work closely as a team and that the driver is vigilant as to the position of the fireman at all times and acts on the fireman's hand signals. The driver must ensure there is no movement of the locomotive while the fireman is engaged in activities between the locomotive's tender and the rollingstock being uncoupled.

> ***Practical***
>
> Under the supervision of your mentor during a train journey, observe how drivers work with their firemen to uncouple a steam locomotive from rollingstock. Learn and demonstrate to your mentor how you can work with a fireman to uncouple a steam locomotive from its rollingstock.

8.2 MOVING LOCOMOTIVE TO ITS STABLING POSITION

Theory

Once a locomotive has been uncoupled from the rollingstock, it is either moved to its stabling point or initially moved to the location in the yard where all required cleaning, lubrication and post-operational checks will be conducted before eventually moving it to its stabling position. Once in its stabling position, it will be secured as per the rail operator's standard operating procedures.

The procedures involved will vary dependant upon the railway concerned.

> ***Practical***
>
> Under the supervision of your mentor, learn and demonstrate how to move the locomotive to the required position's in the yard as per the rail operator's standard procedures for the type and class of locomotive concerned.

8.3 OILING, GREASING AND CLEANING THE LOCOMOTIVE

Theory

It is very important, that all bearings and other moving parts on the locomotive are well and constantly lubricated. When stabling a locomotive therefore, a driver will work collaboratively with the fireman to complete the post-operational cleaning and lubrication procedures (typically pulling of trimmings and shutting down of lubricator) as per the checklist issued by the rail operator for the type and class of steam locomotive concerned. In the case of a steam locomotive this will include fire cleaning and the dumping of ash.

> ***Practical***
>
> Under the supervision of your mentor, learn and demonstrate how to conduct all required post operational lubrication and greasing requirements in conjunction with the fireman as per the rail operator's standard procedures for the type and class of locomotive concerned.

8.4 CARRYING OUT POST-OPERATIONAL CHECKS

Theory

After service it is important that all required post-operational checks are undertaken as per the rail operator's checklist and standard operating procedures. Any identified problems should be recorded, reported and rectified (if possible and within scope of responsibilities).

> ***Practical***
>
> Under the supervision of your mentor, learn and demonstrate how to conduct a visual inspection and other post-operational checks of the steam locomotive and its associated equipment.

8.5 SECURING LOCOMOTIVE

Theory

The locomotive should be secured as per the standard operating procedures of the rail operator for the type and class of steam locomotive concerned.

For example, these procedures may include the following:

- Bring the locomotive to a stand in the final stabling position,
- Close the regulator handle and insert the regulator locking pin
- Place the locomotive in centre gear with the drain valves open,
- Apply brakes and hand brakes and secure the handbrake,
- Chock the locomotive (if required by your railway)
- Close the manifold, turret and associated valves, and
- Ensure that when the stabling duties are completed, the boiler water level and steam pressure are left in accordance with the rail operator's standard operating procedures (note that you would not want to put water into the boiler at this time).

> ***Practical***
>
> Under the supervision of your mentor, learn and demonstrate how to secure the steam locomotive after service as per the rail operator's standard operating procedures.

8.6 COMPLETING PAPERWORK

Theory

Prior to signing off make sure that all necessary paperwork has been completed as per the rail operator's requirements. This may include:

- Time sheet,
- Log or record of locomotive operations,
- Reports of operational problems with locomotive operation and/or any defective components or equipment identified and details of any action taken or required,
- Reports of any safety incidents as per rail operator's procedures and regulatory requirements, and
- Paper work related to the return of kit to store.

Practical

Under the supervision of your mentor, learn and demonstrate how to complete all require post-operational paperwork prior to signing off as per the rail operator's requirements.

8.7 SHUTTING DOWN AND STABLNG A STEAM LOCOMOTIVE - LEARNER'S NOTES

Insert your own notes here

SEPARATE ATTACHMENT 1

STEAM LOCOMOTIVE

TRAIN DRIVER

KNOWLEDGE

CHECKLIST

SEPARATE ATTACHMENT 2

STEAM LOCOMOTIVE

TRAIN DRIVER

PERFORMANCE

CHECKLIST

SEPARATE ATTACHMENT 3

TRAIN EXAMINATION
ADDENDUM

1. LESSON PLAN AND WORKBOOK
2. KNOWLEDGE CHECKLIST
3. MENTOR'S Q&A
4. PERFORMANCE CHECKLIST