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## **CIRCULAR NO. M-3**

### **Steam Locomotive Inspection, Maintenance, and Operating Standards**

Effective: June 28, 2001



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## SUBPART A GENERAL

### 1. Short Title

For ease of reference, these standards may be referred to as the “Steam Locomotive Standards”.

### 2. Scope

These standards describe the minimum safety requirements for steam propelled locomotives operating on federally certified railways in Canada.

### 3. Implementation.

Except as provided for in this Section, the locomotive owner and/or operator shall perform a 1472 service day inspection that meets the requirements of Section 17 when the locomotive's flues are next removed, but no later than 2 years after these standards are made effective.

At the time the locomotive owner and/or operator completes this inspection, it must begin to comply with the rest of the provisions of this part.

Within one year of the effective date of these standards the following sections of this standard must be complied with: Sections. 7, 51, 57, 68, 70, 85, 87, 115, and 116.

If the locomotive owner or operator makes available all required documentation that indicates that the locomotive has had an equivalent inspection, this 1472 service day inspection may be deferred for up to 4 calendar years from the date of that previous inspection.

A 1472 service day inspection as required by FRA regulation Part 230 is considered an equivalent inspection for this purpose.



4. Person qualified to inspect

a) Annual, 5 year or 1472 day inspection

A person who is qualified to perform any annual, 5 year or 1472 day service day inspection as required by this standard must be certified according to NBIC, ASME, or to an equivalent standard acceptable to the government agency having jurisdiction. .

b) Daily, 31 or 92 service day inspection

A person who is qualified to perform to perform any daily, 31 or 92 service day inspection shall:

- i. have been trained to inspect all of the items listed under those sections in Appendix A, and
- ii. have demonstrated knowledge by means of a written or oral examination, and
- iii. have received no less than 6 months of practical experience through on the job training under the guidance and direction of another qualified inspector.

Documentation providing evidence for persons qualified under this section shall be recorded and maintained by the locomotive owner and/or operator.

5. Person qualified to operate

A person who is qualified to operate a steam locomotive shall:

- a) be qualified according to the Canadian Railway Operating Rules (CROR), and
- b) be qualified to inspect steam locomotives as required in Section 4 (b) and
- c) have received classroom training on how to operate steam locomotives, and
- d) have demonstrated knowledge by means of a written or oral examination, and
- e) have received no less than 6 months practical experience through on the job training under the guidance and direction of another qualified operator, or other equivalent practical experience as required by the Railway.

Documentation providing evidence for persons qualified under this section shall be recorded and maintained by the locomotive owner and/or operator.

6. Preemptive effect

Except as provided herein, this standard preempts any local or provincial rule, regulation, standard or order covering the same subject matter regarding the inspection, maintenance or operation of steam locomotives and boilers while on railway tracks subject to federal jurisdiction.





## 7. Exemptions

Any exemptions to any part of these standards must be submitted at least 90 days in advance to each affected railway company(s) for approval. Such an exemption, if approved, will be valid only for operation on that railway companies tracks. Separate exemptions are required in order to operate on another railway.

## 8. Responsibility for compliance.

The railway company is directly responsible to Transport Canada for compliance to all parts of this standard and to any other rule, regulation or order imposed under the Railway Safety Act.

Prior to the operation of any steam locomotive on a federal railway, the railway company shall provide Transport Canada with a current copy of Form No. 4 as described herein, and a current copy of the NBIC inspection report required by Part V of the Canadian Occupational Safety and Health Regulations.

The locomotive owner and/or operator, if other than a railway company, is directly responsible to the railway company for ensuring that all requirements of this standard are satisfied, and is the entity primarily responsible for compliance with this standard. Although the duties imposed by this standard are generally stated in terms of the duties of a railway or a steam locomotive owner and/or operator, any person, including a contractor for a railway, who performs any function covered by this standard must perform that function in accordance with this standard.

## 9. Definitions

As used in this standard, terms listed in this section have the following definitions:

<b>"Alteration"</b>	Any change to the boiler which affects its pressure retention capability. Rating changes are considered alterations
<b>"ANSI"</b>	American National Standards Institute
<b>"API"</b>	American Petroleum Institute
<b>"ASME"</b>	American Society of Mechanical Engineers
<b>"Boiler surfaces"</b>	The boiler interior is all the space inside a boiler occupied by water or steam under pressure, and all associated surfaces inside that space exposed to that water and steam. The boiler exterior is the opposite surface of all components directly exposed to the boiler interior. This includes the fire side of the firebox sheets
<b>"Break"</b>	A fracture resulting in complete separation into parts



<b>"Code of original construction"</b>	The manufacturer's or industry code in effect when the boiler was constructed. If the exact code is not known, the closest contemporary code may be used provided it does not pre-date the construction date of the boiler
<b>"Crack"</b>	A fracture without complete separation into parts, except that castings with shrinkage cracks or hot tears that do not significantly diminish the strength of the member are not considered to be cracked
<b>"Dead locomotive"</b>	A locomotive unable to produce tractive effort
<b>"Fire"</b>	Anything that produces products of combustion that heat transferring components of the locomotive are exposed to
<b>"Government agency"</b>	Any government agency, or representative or inspector of such agency, who has jurisdiction over railway locomotives and/or steam pressure vessels in a location where any work or operation referred to in this standard may take place.
<b>"Locomotive operator"</b>	Person or entity which operates, but which does not necessarily own, one or more steam locomotives. This term means, for purposes of inspection and maintenance responsibility, the entity responsible for the day-to-day operation of the steam locomotive, or the delegate thereof. This entity may be a railway or a person or persons who operate a steam locomotive under contract for a railway.
<b>"Locomotive owner"</b>	Person or entity which owns, but which does not necessarily operate, one or more steam locomotives that is operated on a railway to which this standard applies. For purposes of inspection and maintenance responsibility, this term includes that entity's delegate as well.
<b>"MAWP"</b>	Maximum allowable working pressure as specified by the steam locomotive specification Form No. 4. (See appendix C)



<b>"NBIC"</b>	National Board Inspection Code published by the National Board of Boiler and Pressure Vessel Inspectors.
<b>"NDE"</b>	Non-destructive Examination.
<b>"NPS"</b>	Nominal Pipe Size.
<b>"Person"</b>	An entity of any type, including but not limited to the following: a railway; a manager, supervisor, official, or other employee or agent of a railway; any owner, manufacturer, lessor, or lessee of railway equipment, track, or facilities; any independent contractor providing goods or services to a railway; and any employee of such owner, manufacturer, lessor, lessee, or independent contractor.
<b>"Railway"</b>	Any railway company certified by the Canadian Transportation Agency and subject to the Railway Safety Act.
<b>"Renewal"</b>	Replacement in kind with a newly manufactured or remanufactured (restored to original tolerances) component. Materials shall be suitable for the service intended.
<b>"Repair"</b>	Any work which results in a restoration in kind.
<b>"Serious injury"</b>	Any injury that is reportable to Labour Canada or to the Transportation Safety Board
<b>"Service day"</b>	Any calendar day that the boiler has steam pressure above atmospheric pressure with fire in the firebox. In the case of a fireless steam locomotive, any calendar day that the boiler has steam pressure above atmospheric pressure.
<b>"Stayed portion of the boiler"</b>	That portion of the boiler designed to require support to retain internal pressure by the addition of strength members, such as staybolts, braces, pressure by the addition of strength members, such as staybolts, braces, diagonal stays, tubes, etc.
<b>"Steam locomotive"</b>	A self-propelled unit of equipment powered by steam that is either designed or used for moving other equipment. This includes a self-propelled unit designed or used to carry freight and/or passenger traffic.



**"Transport  
Canada"**

The Canadian Department of Transport, Rail Safety Branch.

**"Unstayed Portion  
of the Boiler"**

That portion of the boiler designed to be self-supported in retaining internal pressure without additional strength members such as staybolts, braces, pressure without additional strength members such as staybolts, braces, diagonal stays, tubes, etc.

**"Wastage"**

A reduction in the thickness of a mechanical component, such as a pipe or sheet

10. Information collection

All documents required by this standard, including but not limited to inspections, repairs, and qualifications, shall be collected and maintained by the locomotive owner and/or operator, and shall be made available to any affected railway company and to any government agency.

GENERAL INSPECTION REQUIREMENTS

11. Repair of non-complying conditions

The steam locomotive owner and/or operator shall repair any steam locomotive that fails to comply with the conditions of this standard, and shall approve any such repairs made, before placing the locomotive back into service.



## 12. Movement of non-complying steam locomotives

### a) General limitations on movement

A steam locomotive with one or more non-complying conditions may be moved only as a "lite" steam locomotive or a steam locomotive in tow, except as provided in paragraph (b) of this Section. Cars essential to the movement of the steam locomotive and tender(s), including tool cars and a bunk car, may accompany "lite" movements.

### b) Conditions for movement

Prior to movement, the steam locomotive owner and/or operator shall determine that it is safe to move the locomotive, determine the maximum speed and other restrictions necessary for safely conducting the movement, and notify in writing the engineer in charge of the defective steam locomotive and, if towed, the engineer in charge of the towing locomotive consist, as well as all other crew members in the cabs, of the presence of the non-complying steam locomotive and the maximum speed and other movement restrictions. In addition, a tag bearing the words "non-complying locomotive" shall be securely attached to each defective steam locomotive and shall contain the following information:

- i. The steam locomotive number;
- ii. The name of the inspecting entity;
- iii. The inspection location and date;
- iv. The nature of the defect;
- v. Movement restrictions, if any;
- vi. The destination; and
- vii. The signature of the person making the determinations required by this paragraph

### c) Yard movements.

A non-complying steam locomotive may be moved "lite" or dead within a yard at speeds not in excess of 10 miles per hour without meeting the requirements of paragraph (b) of this Section if the movement is solely for the purpose of repair. The locomotive owner and/or operator is responsible for ensuring that the movement may be safely made.

### d) Non-complying conditions developed en route.

The locomotive owner and/or operator may continue in use a steam locomotive that develops a non-complying condition en route until the next daily inspection or the nearest forward point where the repairs necessary to bring it into compliance can be made, whichever is earlier. Before continuing en route, the steam locomotive owner and/or operator shall determine that it is safe to move the steam locomotive, determine the maximum speed and other restrictions necessary for safely conducting the movement, and notify in writing the engineer in charge of the defective steam locomotive and, if towed, the engineer in charge of the towing steam locomotive consist, as well as all other crew members in the cabs, of the presence of the non-



complying steam locomotive and the maximum speed and other movement restrictions.

e) Special notice for repair.

Nothing in this section authorizes the movement of a steam locomotive subject to a Transport Canada Notice and Order unless the movement is made in accordance with the restrictions contained in that Notice and Order.

13. Daily inspection

a) General

A person qualified according to Section 4 (b) shall inspect each steam locomotive and its tender each day that they are offered for use to determine that they are safe and suitable for service. The daily inspection shall be conducted to comply with all Sections of this standard, and a daily inspection report shall be kept by the steam locomotive owner and/or operator in the place where the steam locomotive is normally maintained and shall be made available upon reasonable request. (See appendices A and B)

b) Pre-departure

At the beginning of each day the steam locomotive is used, an individual competent to do so shall, together with the daily inspection required in paragraph (a) of this Section, inspect the steam locomotive and its tender and appurtenances to ensure that they are safe and suitable for service, paying special attention to the following items:

- i. Water glasses and gauge cocks;
- ii. Boiler feedwater delivery systems, such as injectors and feedwater pumps; and
- iii. Air compressors and governors, and the air brake system.
- iv.

c) Inspection reports

The results of the daily inspection shall be entered on Form No. 2 (See appendix C) which shall contain, at a minimum, the name of the railway, the initials and number of the steam locomotive, the place, date and time of the inspection, the signature of the employee making the inspection, a description of the non-complying conditions disclosed by the inspection, conditions found in non-compliance during the day and repaired and the signature of the person who repaired the non-conforming conditions. This report shall be retained even if no non-complying conditions are detected. A competent individual shall sign the report, certifying that all non-complying conditions were repaired before the steam locomotive is operated. This report shall be retained on file for at least 92 days at the location designated by the steam locomotive owner and/or operator.



#### 14. Thirty-one (31) service day inspection

a) General

A person qualified according to Section 4 (b) shall perform the 31 service day inspection after the steam locomotive has accrued 31 service days. This inspection shall consist of all 31 service day inspection items and all daily inspection items (See appendix A). Days in service shall be counted, recorded and readily available for inspection upon reasonable request.

b) Notification

Any affected railway company or government agency having jurisdiction may require a steam locomotive owner and/or operator to provide them with timely notification before performing a 31 service day inspection, including the scheduled date and location for inspection, so that they may be present for such inspection.

c) Documentation

A report of inspection (Form No. 1) shall be kept by the steam locomotive owner and/or operator in the place where the steam locomotive is normally maintained and shall be made available upon reasonable request.

#### 15. Ninety-two (92) service day inspection

a) General

A person qualified according to section 4 (b) shall perform the 92 service day inspection after the steam locomotive has accrued 92 "service-days." This inspection shall include all daily, all 31 service day, and all 92 service day inspection items (See appendix A). Days in service shall be counted, recorded, and readily available for inspection upon reasonable request.

b) Documentation

A report of inspection (Form No. 1) shall be kept by the steam locomotive owner and/or operator in the place where the steam locomotive is normally maintained and shall be made available upon reasonable request.



16. Annual inspections

a) General

- i. A person qualified according to section 4.(a) shall perform the annual inspection after 368 calendar days have elapsed from the time of the previous annual inspection. This inspection shall include all daily, all 31 service day, all 92 service day, and all annual inspection items. (See appendix B)
- ii. A person qualified according to section 4 (a) shall perform a flexible staybolt and cap inspection in accordance with Section 41 at each fifth annual inspection.

b) Notification.

Any affected railway company or government agency having jurisdiction may require a steam locomotive owner and/or operator to provide them with timely notification before performing an annual inspection, including the scheduled date and location for inspection, so that they may be present for such inspection.

c) Documentation.

A report of inspection (Form No. 3) shall be kept by the steam locomotive owner and/or operator in the place where the steam locomotive is normally maintained and shall be made available upon reasonable request.

17. One thousand four hundred seventy-two (1472) service day inspection

a) General.

Before any steam locomotive is initially put in service or brought out of retirement, and after every 1472 service days or 15 years, whichever is earlier, a person qualified according to section 4(a) shall inspect the entire boiler. In the case of a new locomotive or a locomotive being brought out of retirement, the initial 15 year period shall begin on the day that the locomotive is placed in service or 365 calendar days after the first flue tube is installed in the locomotive, whichever comes first. This 1472 service day inspection shall include all annual, and 5th annual, inspection requirements, as well as any items required by the steam locomotive owner and/or operator or a government agency having jurisdiction. At this time, the locomotive owner and/or operator shall complete, update and verify the locomotive specification card (Form No. 4), to reflect the condition of the boiler at the time of this inspection. (See appendices A and B)

b) Notification.

Any affected railway company or government agency may require a steam locomotive owner and/or operator to provide them with timely notification before performing a 1472 service day inspection, including the scheduled date and location for inspection, so that they may be present for such inspection.





c) Documentation

A report of inspection (Form No. 4) shall be kept by the steam locomotive owner and/or operator in the place where the steam locomotive is normally maintained and shall be made available upon reasonable request.

## RECORDKEEPING REQUIREMENTS

18. Service day record

For every steam locomotive currently in service, the steam locomotive owner and/or operator shall have available, and be able to show the affected railway company and/or government agency upon request, a current copy of the service day record that contains the number of service days the steam locomotive has accrued since the last 31, 92, Annual and 1472 service day inspections.

19. Posting of Form No. 1 and Form No. 3.

a) Form No. 1.

The steam locomotive owner and/or operator shall place a copy of the 31 and 92 service day inspection report (Form No. 1), properly filled out, under transparent cover in a conspicuous place in the cab of the steam locomotive before the inspected boiler is put into service. This Form No. 1 will not be required for the first 31 service days following an annual inspection and the posting of an Form No. 3. (See appendix B)

b) Form No. 3

In addition to the Form No. 1, the steam locomotive owner and/or operator shall also maintain in the cab a current copy of Form No. 3 in the manner described in paragraph (a) of this section. (See appendix C)



20. Alteration and repair report for steam locomotive boilers

a) Alterations.

When an alteration is made to a steam locomotive boiler, the steam locomotive owner and/or operator shall complete an alteration report (Form No. 19), detailing the changes to the locomotive and the work was completed. This form shall be attached to, and maintained with Form 4. Alteration reports shall be filed and maintained for the life of the boiler. (See appendix B)

b) Welded and riveted repairs to unstayed portions of the boiler.

Whenever welded or riveted repairs are performed on unstayed portions of a steam locomotive boiler, the steam locomotive owner and/or operator shall complete Form No. 19, that details the work done to the steam locomotive. Repair reports shall be filed and maintained for the life of the boiler. (See appendix B)

c) Welded and riveted repairs to stayed portions of the boiler

Whenever welded or riveted repairs are performed on stayed portions of a steam locomotive boiler, the steam locomotive owner and/or operator shall complete a repair report (Form No. 19), detailing the work done. Repair reports shall be maintained for the life of the boiler. (See appendix C)

21. Steam locomotive number change

When a steam locomotive number is changed, the steam locomotive owner and/or operator must reflect the change in the upper right-hand corner of all documentation related to the steam locomotive by showing the old and new numbers: Old No. 000 New No. XXX.

22. Accident reports

In the case of an accident due to failure, from any cause, of a steam locomotive boiler or any part or appurtenance thereof, resulting in serious injury or death to one or more persons, the locomotive owner and/or operator shall immediately report the accident to the railway company on whose line the accident occurred and shall cooperate completely with any subsequent reporting requirements and/or investigations requested by the railway company or any government agency.



## SUBPART B BOILERS AND APPURTENANCES

### 23. Responsibility for general construction and safe working pressure

The steam locomotive owner and operator are responsible for the general design and construction of the steam locomotive boilers under their control. The steam locomotive owner shall establish the safe working pressure for each steam locomotive boiler, after giving full consideration to the general design, workmanship, age, and overall condition of the complete boiler unit. The condition of the boiler unit shall be determined by, among other factors, the minimum thickness of the shell plates, the lowest tensile strength of the plates, the efficiency of the longitudinal joint, the inside diameter of the course, and the maximum allowable stress value allowed. The steam locomotive operator shall not place the steam locomotive in service before ensuring that the steam locomotive's safe working pressure has been established.

### ALLOWABLE STRESS

#### 24. Maximum allowable stress

##### a) Maximum allowable stress value

The maximum allowable stress value on any component of a steam locomotive boiler shall not exceed 1/4 of the ultimate tensile strength of its material.

##### b) Safety factor

When it is necessary to use the code of original construction in boiler calculations, the safety factor value shall not be less than 4.

#### 25. Maximum allowable stress on stays and braces.

The maximum allowable stress per square inch of net cross sectional area on fire box and combustion chamber stays shall be 7,500 psi. The maximum allowable stress per square inch of net cross sectional area on round, rectangular, or gusset braces shall be 9,000 psi.

### STRENGTH OF MATERIALS

#### 26. Tensile strength of shell plates

When the tensile strength of steel or wrought-iron shell plates is not known, it shall be taken at 50,000 psi for steel and 45,000 psi for wrought iron.



27. Maximum shearing strength of rivets

The maximum shearing strength of rivets per square inch of cross sectional area shall be taken as follows:

<u>Rivets</u>	<u>Pounds per square inch</u>
Iron Rivets in Single Shear	38,000
Iron Rivets in Double Shear	76,000
Steel Rivets in Single Shear	44,000
Steel Rivets in Double Shear	88,000

28. Higher shearing strength of rivets.

A higher shearing strength may be used for rivets when it can be shown through testing that the rivet material used is of such quality as to justify a higher allowable shearing strength.

## INSPECTION AND REPAIR

29. Inspection and repair

a) Responsibility.

The steam locomotive owner and/or operator shall inspect and repair all steam locomotive boilers and appurtenances under their control. They shall immediately remove from service any boiler that has developed cracks in the barrel. The steam locomotive owner and/or operator shall also remove the boiler from service whenever the affected railway company or a government agency considers it necessary due to other defects.

b) Repair standards.

All defects disclosed by inspection shall be repaired in accordance with accepted industry standards which may include established railway practices, NBIC, ASME, API, CSA or other appropriate and established standard before the steam locomotive is returned to service. The steam locomotive owner and/or operator shall not return the steam locomotive boiler or appurtenances to service unless they are in good condition and safe and suitable for service.

Any welding to unstayed portions of the boiler made pursuant to Section 33 shall be made in accordance with an accepted national standard for boiler repairs. The steam locomotive owner and/or operator shall not return the steam locomotive boiler or appurtenances to service unless they are in good condition and safe and suitable for service.



30. Lap-joint seam boilers

Every boiler having lap-joint longitudinal seams without reinforcing plates shall have sufficient lagging, jacketing, flues, and tubes removed at every annual inspection so that an inspection of the entire joint, inside and out, can be made, taking special care to detect grooving or cracks at the edges of the seams.

31. Flues to be removed

a) Inspection of the boiler interior

During the 1472 service day inspection, the steam locomotive owner and/or operator shall remove all flues of steam locomotive boilers in service, except as provided in paragraph (b) of this Section, for the purpose of inspecting the entire interior of the boiler and its bracing. After removing the flues, the steam locomotive owner and/or operator shall enter the boiler to remove scale from the interior and thoroughly clean and inspect it.

b) NDE testing.

If the boiler can be thoroughly cleaned and inspected without removing the superheater flues, and it can be shown through appropriate NDE testing methods that they are safe and suitable for service, their removal may not be required at this time. Their removal may be required, however, if a government inspector or the steam locomotive owner and/or operator, considers it necessary due to identifiable safety concerns.



32. Time and method of inspection.

a) Time of inspection

The entire boiler shall completely be inspected at the 1472 service day inspection. The jacket, lagging and any other components interfering with the provision of inspection access shall be removed at this time. Those portions of the boiler that are exposed and able to be inspected as required by the daily, 31 service day, annual and fifth annual inspections shall be inspected at those times. The interior of the boiler also shall be inspected at each annual inspection, after the completion of any hydrostatic test above MAWP, and whenever a sufficient number of flues are removed to allow examination. The jacket, lagging and any other components shall also be removed to provide inspection access whenever requested by a government agency or when the steam locomotive owner and/or operator considers it necessary due to identifiable safety concerns.

b) Method of inspection

- i. Entire boiler. During the 1472 service day inspection, the entire boiler shall be examined for cracks, pitting, grooving, or indications of overheating and for damage where mud has collected, or heavy scale formed. The edges of plates, all laps, seams, and points where cracks and defects are likely to develop, shall be thoroughly inspected. Rivets shall be inspected for corrosion and looseness.
- ii. Boiler interior. When inspecting the boiler interior, it must be seen that braces and stays are taut, that pins are properly secured in place, and that each is in condition to support its proportion of the load. Washout plugs shall be removed for access and visual inspection of the water side of the firebox sheets. Washout plug threads, sleeves and threaded openings shall be examined at this time.
- iii. Boiler exterior. A thorough inspection shall be made of the entire exterior of the boiler while under hydrostatic pressure.



33. Welded repairs and alterations

- a) Unstayed portions of the boiler containing alloy steel or carbon steel with a carbon content over 0.25 percent  
Prior to welding on unstayed portions of the boiler, the steam locomotive owner and/or operator shall submit a written request for approval to the government agency having jurisdiction in the location where the work is to be done. If the approval is granted, the steam locomotive owner and/or operator shall perform any welding to unstayed portions of the boiler in accordance with an accepted national standard for boiler repairs. The steam locomotive owner and/or operator shall satisfy reporting requirements in Section 20 at this time.
- b) Unstayed portions of the boiler containing carbon steel not exceeding 0.25 percent carbon  
The steam locomotive owner and/or operator shall perform any welding to unstayed portions of the boiler in accordance with an accepted national standard for boiler repairs. The steam locomotive owner and/or operator shall satisfy reporting requirements in Section 20 at this time.
- c) Wastage  
The steam locomotive owner and/or operator shall submit a written request for approval to the government agency having jurisdiction in the location where the work is to be done before performing weld build up on wasted areas of unstayed surfaces of the boiler that exceed a total of 100 square inches or the smaller of 25 percent of minimum required wall thickness or 1/2 inch. Wasted sheets shall not be repaired by weld build up if the wasted sheet has been reduced to less than 60 percent of the minimum required thickness as required by this standard.
- d) Flush patches  
The steam locomotive owner and/or operator shall submit a written request for approval to the government agency having jurisdiction in the location where the work is to be done for the installation of flush patches of any size on unstayed portions of the boiler.
- e) Stayed portions of the boiler  
The steam locomotive owner and/or operator shall perform welded repairs or alterations on stayed portions of the boiler in accordance with established railway practices, or an accepted national standard for boiler repairs. The steam locomotive owner and/or operator shall satisfy the reporting requirements in Section 20 at this time.



34. Riveted repairs and alterations

a) Alterations to unstayed portions of the boiler

Prior to making riveted alterations on unstayed portions of the boiler, the steam locomotive owner and/or operator shall submit a written request for approval to the government agency having jurisdiction in the location where the work is to be done. If approval is granted, the steam locomotive owner and/or operator shall perform any riveting to unstayed portions of the boiler in accordance with established railway practices or an accepted national standard for boiler repairs. The steam locomotive owner and/or operator shall satisfy reporting requirements in Section 20 at this time.

b) Repairs to unstayed portions of the boiler

The steam locomotive owner and/or operator shall perform any riveted repairs to unstayed portions of the boiler in accordance with established railway practices, or an accepted national standard for boiler repairs. The steam locomotive owner and/or operator shall satisfy reporting requirements in Section 20 at this time.

c) Repairs to stayed portions of the boiler

The steam locomotive owner and/or operator shall perform riveted repairs or alterations on stayed portions of the boiler in accordance with established railway practices or an accepted national standard for boiler repairs. The steam locomotive owner and/or operator shall satisfy reporting requirements in Section 20 at this time.

PRESSURE TESTING OF BOILERS

35. Pressure testing

The temperature of the steam locomotive boiler shall be raised to at least 70 deg. F any time hydrostatic pressure is applied to the boiler.





36. Hydrostatic testing of boilers

a) Time of test.

The locomotive owner and/or operator shall hydrostatically test every boiler at the following times:

- i. During the 1472 service day inspection, and at every annual inspection thereafter;
- ii. After making any alteration to the boiler;
- iii. After installing a flush patch on an unstayed portion of the boiler; and
- iv. After any riveting on an unstayed portion of the boiler.

b) Methods of testing

The metal temperature of the boiler shall be between 70 degrees Fahrenheit and 120 degrees Fahrenheit each time it is subjected to any hydrostatic pressure. Hydrostatic testing required by these rules shall be conducted at least 25 percent above the MAWP.

c) Internal inspection.

An internal inspection of the boiler shall be conducted following any hydrostatic test where the pressure exceeds MAWP.

37. Steam test following repairs or alterations

Upon completion of any repair or alteration, the locomotive owner and/or operator shall conduct a steam test of the boiler with steam pressure raised to between 95 percent and 100 percent of the MAWP. At this time, the boiler shall be inspected to ensure that it is in a safe and suitable condition for service.

## STAYBOLTS

38. Telltale holes

a) Staybolts less than 8 inches long

All staybolts shorter than 8 inches, except flexible bolts, shall have telltale holes 3/16 inch to 7/32 inch diameter and at least 1 1/4 inches deep in the outer end.

b) Reduced body staybolts

On reduced body staybolts, the telltale hole shall extend beyond the fillet and into the reduced section of the staybolt. Staybolts may have through telltale holes.

c) Telltale holes kept open

All telltale holes, except as provided for in Section 41, must be kept open at all times.



39. Broken staybolts

a) Maximum allowable number of broken staybolts

No boiler shall be allowed to remain in service with two broken staybolts located within 24 inches of each other, as measured inside the firebox or combustion chamber on a straight line. No boiler shall be allowed to remain in service with more than 4 broken staybolts inside the entire firebox and combustion chamber, combined

b) Staybolt replacement

Broken staybolts must be replaced during the 31 service day inspection, if detected at that time. Broken staybolts detected in between 31 service day inspections must be replaced no later than 30 calendar days from the time of detection. When staybolts 8 inches or less in length are replaced, they shall be replaced with bolts that have telltale holes 3/16 inch to 7/32 inch in diameter and at least 1 1/4 inches deep at each end, or that have telltale holes 3/16 inch to 7/32 inch in diameter their entire length. At the time of replacement of broken staybolts, adjacent staybolts shall be inspected.

c) Assessment of broken staybolts

Telltale holes leaking, plugged, or missing shall be counted as broken staybolts.

d) Prohibited methods of closing telltale holes.

Welding, forging, or riveting broken staybolt ends is prohibited as a method of closing telltale holes.

40. Time and method of staybolt testing

a) Time of hammer testing

i. General.

All staybolts shall be hammer tested at every 31 service day inspection, except as provided in paragraph (a)(ii) of this Section. All staybolts also shall be hammer tested under hydrostatic pressure any time hydrostatic pressure above the MAWP specified on the boiler specification Form No. 4 is applied to the boiler. (See appendix B.)

ii. Exception for inaccessible staybolts.

The removal of brickwork or grate bearers for the purpose of hammer testing staybolts during each 31 service day inspection will not be required if the staybolts behind these structural impediments have a telltale hole 3/16 inch to 7/32 inch in diameter their entire length. Whenever the brickwork or grate bearers are removed for any other reason, however, the bolts shall be inspected at that time.



b) Method of hammer testing.

If staybolts are tested while the boiler contains water, the hydrostatic pressure must be not less than 95 percent of the MAWP. The steam locomotive owner and/or operator shall tap each bolt with a hammer and determine broken bolts from the sound or the vibration of the sheet. Whenever staybolts are tested while the boiler is not under pressure, such as during the 31 service day inspection, the staybolt test must be made with all the water drained from the boiler.

41. Flexible staybolts with caps

a) General

Flexible staybolts with caps shall have their caps removed during every 5th annual inspection for the purpose of inspecting the bolts for breakage, except as provided in paragraph (b) of this Section.

b) Drilled flexible staybolts

For flexible staybolts that have telltale holes between 3/16 inch and 7/32 inch in diameter, and which extend the entire length of the bolt and into the head not less than one third of the diameter of the head, the steam locomotive owner and/or operator need not remove the staybolt caps if it can be established, by an electrical or other suitable method, that the telltale holes are open their entire length. Any leakage from these telltale holes during the hydrostatic test indicates that the bolt is broken and must be replaced. Before the steam locomotive is placed in service, the inner ends of all telltale holes shall be closed with a fireproof porous material that will keep the telltale holes free of foreign matter and permit steam or water to exit the telltale hole when the bolt is broken or fractured.

c) Recordkeeping

The removal of flexible staybolt caps and other tests shall be reported on Form No. 3. (See appendix B)

d) Testing on request

Staybolt caps also shall be removed, or any of the tests in this Section made, whenever a government agency or the steam locomotive owner and/or operator considers it necessary due to identifiable safety concerns about the condition of staybolts, staybolt caps or staybolt sleeves.

## STEAM GAUGES

42. Location of gauges

Every boiler shall have at least one steam gauge which will correctly indicate the working pressure. The gauge shall be positioned so that it will be kept reasonably cool and can conveniently be read by the engine crew.



43. Gauge siphon

The steam gauge supply pipe shall have a siphon on it of ample capacity to prevent steam from entering the gauge. The supply pipe shall directly enter the boiler and be maintained steam tight. The supply pipe and its connections shall be cleaned each time the gauge is tested.

44. Time of testing

Steam gauges shall be tested prior to being installed or being reapplied, during the 92 service day inspection, and whenever any irregularity is reported.

45. Method of testing

Steam gauges shall be compared with an accurate test gauge or dead weight tester. While under test load at the MAWP of the boiler to which the gauge will be applied, the gauge shall be set to read that pressure as accurately as the physical limitations of the gauge will allow. Under test the gauge shall read within the manufacturer's tolerance at all points on the gauge up to 25 percent above the allowed pressure. If the manufacturer's tolerance is not known, the gauge must read within 2 percent full scale accuracy at all points on the gauge up to 25 percent above allowed pressure.

46. Badge plates

A metal badge plate showing the allowed steam pressure shall be attached to the boiler backhead in the cab. If boiler backhead is lagged, the lagging and jacket shall be cut away so that the plate can be seen.



47. Boiler number

a) General

The builder's number of the boiler, if known, shall be stamped on the steam dome or manhole flange. If the builder's number cannot be obtained, an assigned number, which shall be used in making out specification cards, shall be stamped on the steam dome or manhole flange.

b) Numbers after January 10, 1912

Numbers which are stamped after January 10, 1912 shall be located on the front side of the steam dome or manhole flange at the upper edge of the vertical surface, oriented in a horizontal manner, and have figures at least 3/8 inch high.

c) Name of manufacturer or owner.

The number shall be preceded by the name of the manufacturer if the original number is known or the name of the steam locomotive owner if a new number is assigned.

SAFETY RELIEF VALVES

48. Number and capacity of safety relief valves

a) Number and capacity

Every government agency may require verification of sufficient safety valve relieving capacity. A boiler shall be equipped with at least two safety relief valves, suitable for the service intended, that are capable of preventing an accumulation of pressure greater than 6 percent above the MAWP under any conditions of service.

b) Determination of capacity

Safety relief valve capacity may be determined by making an accumulation test with the fire in good, bright condition and all steam outlets closed. Additional safety relief valve capacity shall be provided if the safety relief valves allow an excess pressure of more than 6 percent above the MAWP during this test.

49. Setting of safety relief valves

a) Qualifications of individual who adjusts

Safety relief valves shall be set and adjusted by a competent person who is thoroughly familiar with the construction and operation of the valve being set.

b) Opening pressures

At least one safety relief valve shall be set to open at a pressure not exceeding the MAWP. Safety relief valves shall be set to open at pressures not exceeding 6 psi above the MAWP.



c) Setting procedures

When setting safety relief valves, two steam gauges shall be used, one of which must be so located that it will be in full view of the persons engaged in setting such valves; and if the pressure indicated by the gauges varies more than 3 psi they shall be removed from the boiler, tested, and corrected before the safety relief valves are set. Gauges shall in all cases be tested immediately before the safety relief valves are set or any change made in the setting. When setting safety relief valves, the water level shall not be higher than 3/4 of the length of the visible water glass, as measured from the bottom of the glass.

d) Labeling of lowest set pressure

The set pressure of the lowest safety relief valve shall be indicated on a tag or label attached to the steam gauge so that it may be clearly read while observing the steam gauge.

50. Time of testing

All safety relief valves shall be tested, and adjusted if necessary, under steam at every 92 service day inspection, and also whenever any irregularity is reported.

## WATER GLASSES AND GAUGE COCKS

51. Number and location of water glasses & gauge cocks.

a) General

- i. Every boiler shall be equipped with at least one water glass which shall be visible from both the engineer and fireman's positions in the cab.
- ii. If not visible from both positions, the boiler must have 2 water glasses, one visible from each position.
- iii. The lowest reading of the water glass(s) shall not be less than 3 inches above the highest part of the crown sheet.
- iv. If the boiler has only one water glass, then it must also be equipped with three gauge cocks.
- v. The reading of the lowest gauge cock shall not be less than 3 inches above the highest part of the crown sheet.
- vi. Gauge cocks shall be positioned to correspond with the bottom, the middle, and the top of the water glass.
- vii. The water glass tube(s) shall have an internal diameter not less than 3/8".

b) Tubular type glasses and shields

Water glass tube(s) shall have an internal diameter of not less than 3/8 inch.

c) High pressure prismatic type glasses

High pressure prismatic type glasses should have the lenses removed only in the event of leakage, if the lens becomes cloudy or etched, or the lens loses reflectivity. No shields are required for high pressure prismatic type glasses.



52. Water glass valves

All water glasses shall be equipped with no more than two valves capable of isolating the water glass from the boiler. They shall also be equipped with a drain valve capable of evacuating the glass when it is so isolated.

53. Time of cleaning

The spindles of all water glass valves and of all gauge cocks shall be removed and valves and cocks thoroughly cleaned of scale and sediment at every 31 service day inspection, and when testing indicates that the apparatus may be malfunctioning. In addition, the top and bottom passages of the water column shall be cleaned and inspected at each annual inspection.

54. Testing and maintenance

a) Testing

All water glasses must be blown out, all gauge cocks must be tested, and all passages verified to be open at the beginning of each day the locomotive is used, and as often as necessary to ensure proper functioning.

b) Maintenance

Gauge cocks, water column drain valves, and water glass valves must be maintained in such condition that they can easily be opened and closed by hand, without the aid of a wrench or other tool.

55. Tubular type water and lubricator glasses and shields

a) Water glasses

Tubular type water glasses shall be renewed at each 92 service day inspection.

b) Shields

All tubular water glasses and lubricator glasses must be equipped with a safe and suitable shield which will prevent the glass from flying in case of breakage. This shield shall be properly maintained.

c) Location and maintenance

Water glasses and water glass shields shall be so located, constructed, and maintained that the engine crew can at all times have an unobstructed view of the water in the glass from their proper positions in the cab.

56. Water glass lamps.

All water glasses must be supplied with a suitable lamp properly located to enable the engine crew to easily see the water in the glass.



## INJECTORS, FEEDWATER PUMPS AND FLUE PLUGS

### 57. Injectors and feedwater pumps.

#### a) Water delivery systems required

Each steam locomotive must be equipped with at least two means of delivering water to the boiler, at least one of which is a live steam injector.

#### b) Maintenance and testing

Injectors and feedwater pumps must be kept in good condition, free from scale, and must be tested at the beginning of each day the locomotive is used, and as often as conditions require, to ensure that they are delivering water to the boiler. Boiler checks, delivery pipes, feed water pipes, tank hose and tank valves must be kept in good condition, free from leaks and from foreign substances that would obstruct the flow of water.

#### c) Bracing

Injectors, feedwater pumps, and all associated piping shall be securely braced so as to minimize vibration.

### 58. Flue plugs.

#### a) When plugging is permitted

Flues greater than 2 1/4 inches in outside diameter (OD) shall not be plugged. Flues 2 1/4 inches in outside diameter (OD) or smaller may be plugged following failure, provided only one flue is plugged at any one time. Plugs must be removed and proper repairs made no later than 30 days from the time the plug is applied.

#### b) Method of plugging

When used, flue plugs must be made of steel. The flue must be plugged at both ends. Plugs must be tied together by means of a steel rod not less than 5/8 inch in diameter.

### 59. Fusible plugs

If boilers are equipped with fusible plugs, the plugs shall be removed and cleaned of scale each time the boiler is washed but not less frequently than during every 31 service day inspection. Their removal shall be noted on the Form No. 1 or Form No. 3. (See appendix B)





## WASHING BOILERS

### 60. Time of washing

#### a) Frequency of washing

All boilers shall thoroughly be washed as often as the water conditions require, but not less frequently than at each 31 service day inspection. The date of the boiler wash shall be noted on the Form No. 1 or Form No. 3. (See appendix B)

#### b) Plug removal

All washout plugs, arch tube plugs, thermic siphon plugs, circulator plugs and water bar plugs must be removed whenever locomotive boilers are washed.

#### c) Plug maintenance

All washout plugs, washout plug sleeves and threaded openings shall be maintained in a safe and suitable condition for service and shall be examined for defects each time the plugs are removed.

#### d) Fusible plugs cleaned

Fusible plugs shall be cleaned in accordance with Section 59.

### 61. Arch tubes, water bar tubes, circulators and thermic siphons

#### a) Frequency of cleaning

Each time the boiler is washed, arch tubes and water bar tubes shall thoroughly be cleaned mechanically, washed, and inspected. Circulators and thermic siphons shall thoroughly be cleaned, washed and inspected.

#### b) Defects

Arch tubes and water bar tubes found blistered, bulged, or otherwise defective shall be renewed. Circulators and thermic siphons found blistered, bulged or otherwise defective shall be either repaired or renewed.

#### c) Method of examination

Arch tubes, water bar tubes and circulators shall be examined using an appropriate NDE method that accurately measures wall thickness at each annual inspection. All arch brick shall be removed for this inspection. If any are found with wall thickness reduced below that required to render them safe and suitable for the service intended at the MAWP specified on the boiler specification they must be replaced or repaired. (See appendix B)



## STEAM PIPES

### 62. Dry pipe

Dry pipes subject to pressure shall be examined at each annual inspection to measure wall thickness. Dry pipes with wall thickness reduced below that required to render the pipe suitable for the service intended at the MAWP must be replaced or repaired.

### 63. Smoke box, steam pipes and pressure parts

The smoke box, steam pipes and pressure parts shall be inspected at each annual inspection, or any other time that conditions warrant. The individual conducting the inspection must enter the smoke box to conduct the inspection, looking for signs of leaks from any of the pressure parts therein and examining all draft appliances.

## STEAM LEAKS

### 64. Leaks under lagging

The steam locomotive owner and/or operator shall take out of service at once any boiler that has developed a leak under the lagging due to a crack in the shell, or to any other condition which may reduce safety. Pursuant to Section 29, the boiler must be repaired before being returned to service.

### 65. Steam blocking view of engine crew.

The steam locomotive owner and/or operator shall keep the boiler, and its piping and appurtenances, in such repair that they do not emit steam in a manner that obscures the engine crew's vision.



## SUBPART C STEAM LOCOMOTIVES AND TENDERS

### 66. Design, construction, and maintenance

The steam locomotive owner and operator are responsible for the general design, construction and maintenance of the steam locomotives and tenders under their control.

### 67. Responsibility for inspection and repairs

The steam locomotive owner and/or operator shall inspect and repair all steam locomotives and tenders under their control. All defects disclosed by any inspection shall be repaired in accordance with accepted industry standards, which may include established railway practices, before the steam locomotive or tender is returned to service. The steam locomotive owner and/or operator shall not return the steam locomotive or tender to service unless they are in good condition and safe and suitable for service.

### 68. Speed indicators and event recorders

Steam locomotives that operate at speeds in excess of 25 mph (40 km/h) shall be equipped with speed indicators. Where equipped, speed indicators shall be maintained to ensure accurate functioning.

Steam locomotives that operate at speed in excess of 20 miles per hour shall be equipped with event recorders designed and installed to function in a manner similar to those used in traditional locomotives.

A record of the design of the event recorder and functions recorded will maintained on file and made available to railway companies and government agencies upon reasonable request.

### 69. Ash pans

Ash pans shall be securely supported from mud-rings or frames with no part less than 2 1/2 inches above the rail. Their operating mechanism shall be so arranged that they may be safely operated and securely closed.



## BRAKE & SIGNAL EQUIPMENT

### 70. Safe condition

#### a) Pre-departure inspection

At the beginning of each day the locomotive is used, the steam locomotive operator shall ensure that:

- i. The brakes on the steam locomotive and tender are in safe and suitable condition for service;
- ii. The air compressor or compressors are in condition to provide an ample supply of air for the locomotive service intended;
- iii. The devices for regulating all pressures are properly performing their functions;
- iv. The brake valves work properly in all positions; and
- v. The water has been drained from the air-brake system.

#### b) Brake pipe valve required

Each steam locomotive shall have a brake pipe valve attached to the front of the tender, the rear of the back cab wall, or adjacent to the exit of a vestibuled cab. The words "Emergency Brake Valve" shall be clearly displayed near the valve.

### 71. Orifice testing of compressors

#### a) Frequency of testing.

The compressor or compressors shall be tested for capacity by orifice test as often as conditions may require, but not less frequently than once every 92 service days.

#### b) Orifice testing criteria.

- i. Compressors in common use, as listed in the following table, shall have orifice test criteria as follows:

<u>Make</u>	<u>Compressor Size</u>	<u>Strokes per minute</u>	<u>Diameter of orifice (in inches)</u>	<u>Air Pressure maintained (in pounds)</u>
Westinghouse	9 1/2	120	11 / 64	60
Westinghouse	11	100	3 / 16	60
Westinghouse	150 CFM 8 1/2 CC	100	9 / 32	60
Westinghouse	120 CFM 8 1/2	100	15 / 64	60
New York	2A	120	5 / 32	60
New York	6A	100	13 / 64	60
New York	5A	100	13 / 64	60



Note: This table shall be used for altitudes to and including 1,000 feet. For altitudes over 1,000 feet the speed of compressor may be increased 5 single strokes per minute for each 1,000 feet increase in altitude.

- ii. For compressors not listed in the table in paragraph (b)(1) of this Section, the air pressure to be maintained shall be no less than 80 percent of the manufacturer's rated capacity for the compressor.



## 72. Testing main reservoirs

### a) Hammer and hydrostatic testing

Except as described in paragraphs (b) through (d) of this Section, every main reservoir, except those cast integrally with the frame, shall be hammer and hydrostatically tested during each annual inspection. The reservoir shall be hammer tested while empty and with no pressure applied. If no defective areas are detected, a hydrostatic test of MAWP shall be applied.

### b) Drilling of main reservoirs.

- i. Only welded main reservoir originally constructed to withstand at least five times the MAWP may be drilled over its entire surface with telltale holes that are 3/16 of an inch in diameter. The holes shall be spaced not more than 12 inches apart, measured both longitudinally and circumferentially, and drilled from the outer surface to an extreme depth determined by the following formula:

$D = (.6PR / (S - .6P))$  Where:

D = Extreme depth of telltale holes in inches but in no case less than one-sixteenth inch;

P = certified working pressure in psi;

S = 1/5 of the minimum specified tensile strength of the material in psi; and

R = inside radius of the reservoir in inches

- ii. One row of holes shall be drilled lengthwise of the reservoir on a line intersecting the drain opening. When main reservoirs are drilled as described in paragraph (b)(1) of this Section, the hydrostatic and hammer tests described in paragraph (a) of this Section are not required during the annual inspection. Whenever any telltale hole shall have penetrated the interior of any reservoir, the reservoir shall be permanently withdrawn from service.



c) Welded main reservoirs without longitudinal lap seams

For welded main reservoirs that do not have longitudinal lap seams, an appropriate NDE method that can measure the wall thickness of the reservoir may be used instead of the hammer test and hydrostatic test required in paragraph (a) of this Section. The spacing of the sampling points for wall thickness shall not be greater than 12 inches longitudinally and circumferentially. The reservoir shall permanently be withdrawn from service where the NDE testing reveals wall thickness less than the value determined by the following formula:

$$t = (PR / (S - 0.6P))$$

Where:

t = Minimum value for wall thickness;

P = Certified working pressure in psi;

S = 1/5 of the minimum specified tensile strength of the material in psi, or 10,000 psi if the

tensile strength is unknown; and

R = Inside radius of the reservoir in inches

d) Welded or riveted longitudinal lap seam main reservoirs.

- i. For welded or riveted longitudinal lap seam main reservoirs, an appropriate NDE method that can measure wall thickness of the reservoir shall be used instead of, or in addition to, the hammer test and hydrostatic test. The spacing of the sampling points for wall thickness shall not be greater than 12 inches longitudinally and circumferentially. Particular care shall be taken to measure along the longitudinal seam on both plates at an interval of no more than 6 inches longitudinally. The reservoir shall be withdrawn permanently from service where NDE testing reveals wall thickness less than the value determined by the following formula:

$$t = (PR / (0.5S - 0.6P))$$

Where:

t = Minimum value for wall thickness;

P = Certified working pressure in psi;

S = 1/5 of the minimum specified tensile strength of the material in psi, or 10,000 psi if

the tensile strength of steel is unknown; and

R = Inside radius of the reservoir in inches.

- ii. Repairs of reservoirs with reduced wall thickness are prohibited.



73. Air gauges

a) Location

Air gauges shall be so located that they may be conveniently read by the engineer from his or her usual position in the cab. No air gauge may be more than 3 psi in error.

b) Frequency of testing

Air gauges shall be tested prior to reapplication following removal, as well as during the 92 service day inspection and whenever any irregularity is reported.

c) Method of testing

Air gauges shall be tested using an accurate test gauge or dead weight tester designed for this purpose.

74. Time of cleaning

All valves in the air brake system, including related dirt collectors and filters, shall be cleaned and tested in accordance with accepted brake equipment manufacturer's specifications, or as often as conditions require to maintain them in a safe and suitable condition for service, but not less frequently than after 368 service days or during the second annual inspection, whichever occurs first.

75. Stenciling dates of tests and cleaning

The date of testing and cleaning and the initials of the shop or station at which the work is done, shall legibly be stenciled in a conspicuous place on the tested parts or placed on a card displayed under a transparent cover in the cab of the steam locomotive.

76. Piston travel

a) Minimum piston travel.

The minimum piston travel shall be sufficient to provide proper brake shoe clearance when the brakes are released.

b) Maximum piston travel.

The maximum piston travel when steam locomotive is standing shall be as follows:

<b><u>Type of wheel brake</u></b>	<b><u>Maximum piston travel (in inches)</u></b>
Cam Type Driving Wheel Brake	3 1/2
Other forms of Driving Wheel Brake	6
Engine Truck Brake	8
*Tender Brake	9





77. Foundation brake gear

a) Maintenance

Foundation brake gear shall be maintained in a safe and suitable condition for service. Levers, rods, brake beams, hangers, and pins shall be of ample strength, and shall not be fouled in any way which will affect the proper operation of the brake. All pins shall be properly secured in place with cotter pins, split keys, or nuts. Brake shoes must be properly applied and kept approximately in line with the tread of the wheel.

b) Distance above the rails

No part of the foundation brake gear of the steam locomotive or tender shall be less than 2 1/2 inches above the rails.

78. Leakage

a) Main reservoirs and related piping

Leakage from main reservoir and related piping shall be tested at every 92 service day inspection and shall not exceed an average of 3 psi per minute in a test of 3 minutes duration that is made after the pressure has been reduced to 60 percent of the maximum operating pressure.

b) Brake cylinders

Leakage from brake cylinders shall be tested at every 92 service day inspection. With a full service application from maximum brake pipe pressure, and with communication to the brake cylinders closed, the brakes on the steam locomotive and tender must remain applied for a minimum of 5 minutes.

c) Brake pipes

Steam locomotive brake pipe leakage shall be tested at the beginning of each day the locomotive is used, and shall not exceed 5 psi per minute.

79. Train signal system

Where utilized, the train signal system, or any other form of on-board communication, shall be tested and known to be in safe and suitable condition for service at the beginning of each day the locomotive is used.



## CABS, WARNING SIGNALS, SANDERS & LIGHTS

### 80. Cabs and cab amenities

#### a) General provisions.

Cabs shall be securely attached or braced and maintained in a safe and suitable condition for service. Cab windows of steam locomotives shall provide an undistorted view of the track and signals for the crew from their normal position in the cab. Cab floors shall be kept free of tripping or slipping hazards. The cab climate shall be maintained to provide an environment that does not unreasonably interfere with the engine crew's performance of their duties under ordinary conditions of service.

#### b) Steam pipes

Steam pipes shall not be fastened to the cab. New construction or renewals made of iron or steel pipe greater than 1/8 inch NPS that are subject to boiler pressure in cabs shall have a minimum wall thickness equivalent to schedule 80 pipe, with properly rated valves and fittings. Live steam heating radiators must not be fastened to the cab. Exhaust steam radiators may be fastened to the cab.

#### c) Oil-burning steam locomotives

If the cab is enclosed, oil burning steam locomotives that take air for combustion through the fire-door opening shall have a suitable conduit extending from the fire-door to the outside of the cab.

#### d) Cab amenities

To extent practicable, steam locomotive cabs will be equipped with all of the crew safety and health amenities required by OSH On Board Regulations (Part II), including cab seats, toilet facilities, refrigerator, safety tools, and first aid kit. Where an application is not practicable, that amenity will be provided at the nearest reasonable location on the tender or within the train. The operating crews will be advised of those locations.

#### e) Fire extinguishers.

Each steam locomotive / tender combination will be equipped with at least 2 fire extinguishers of the design and specification required by the OSH On Board Regulations (Part II).



81. Cab aprons

a) General provisions.

Cab aprons shall be of proper length and width to ensure safety. Cab aprons shall be securely hinged, maintained in a safe and suitable condition for service, and roughened, or other provision made, to afford secure footing.

b) Width of apron.

The cab apron shall be of a sufficient width to prevent, when the drawbar is disconnected and the safety chains or the safety bars are taut, the apron from dropping between the steam locomotive and tender.

82. Fire doors

a) General provisions

Each steam locomotive shall have a fire door which shall latch securely when closed and which shall be maintained in a safe and suitable condition for service. Fire doors on all oil-burning locomotives shall be latched securely with a pin or key.

b) Mechanically operated fire doors

Mechanically operated fire doors shall be so constructed and maintained that they may be operated by pressure of the foot on a pedal, or other suitable appliance, located on the floor of the cab or tender at a suitable distance from the fire door, so that they may be conveniently operated by the person firing the steam locomotive.

c) Hand-operated doors

Hand operated fire doors shall be so constructed and maintained that they may be conveniently operated by the person firing the steam locomotive.

83. Cylinder cocks

Each steam locomotive shall be equipped with cylinder cocks which can be operated from the cab of the steam locomotive. All cylinder cocks shall be maintained in a safe and suitable condition for service.



84. Reset safety controls

Each steam locomotive will be equipped with a reset safety control system of a design that is similar to that used on traditional locomotives.

Records shall be maintained on the design and installation of such a system and will be made available to affected railway companies and government agencies upon reasonable request.

Operation of the reset safety control system will be made part of the training for qualified operators.

85. Audible warning device

a) General provisions

Each steam locomotive shall be equipped with an audible warning device that produces a minimum sound level of 96db(A) at 100 feet in front of the steam locomotive in its direction of travel. The device shall be arranged so that it may conveniently be operated by the engineer from his or her normal position in the cab.

b) Method of measurement

Measurement of the sound level shall be made using a sound level meter conforming, at a minimum, to the requirements of ANSI S1.4-1971, Type 2, and set to an A-weighted slow response. While the steam locomotive is on level, tangent track, the microphone shall be positioned 4 feet above the ground at the center line of the track and shall be oriented with respect to the sound source in accordance with the microphone manufacturer's recommendations.

86. Required illumination

a) General provisions

Each steam locomotive used between sunset and sunrise shall be equipped with an operable headlight that provides illumination sufficient for a steam locomotive engineer in the cab to see, in a clear atmosphere, a dark object as large as a man of average size standing at least 800 feet ahead and in front of such headlight. If a steam locomotive is regularly required to run backward for any portion of its trip other than to pick up a detached portion of its train or to make terminal movements, it shall also be equipped on its rear end with an operable headlight that is capable of providing the illumination described in this paragraph (a).

b) Dimming device

Such headlights shall be provided with a device whereby the light from same may be diminished in yards and at stations or when meeting trains.



c) Ditch lights.

Each steam locomotive used in a lead position and operated at more than 25 mph over public grade crossings will be equipped with 2 ditch lights of similar intensity and mounted so as to be facing in the normal direction of travel and at locations similar to those used on traditional locomotives.

i. Where multiple locomotives utilized.

When two or more locomotives are used in the same train, the leading locomotive only will be required to display a headlight and ditch lights.

87. Cab lights

Each steam locomotive shall have cab lights that sufficiently illuminate the control instruments, meters and gauges to allow the engine crew to make accurate readings from their usual and proper positions in the cab. These lights shall be so located and constructed that the light will shine only on those parts requiring illumination and does not interfere with the engine crew's vision of the track and signals. Each steam locomotive shall also have a conveniently located additional lamp that can be readily turned on and off by the persons operating the steam locomotive and that provides sufficient illumination to read train orders and timetables.

## THROTTLES & REVERSING GEAR

88. Throttles

Throttles shall be maintained in safe and suitable condition for service, and efficient means shall be provided to hold the throttle lever in any desired position.

89. Reverse gear

a) General provisions

Reverse gear, reverse levers, and quadrants shall be maintained in a safe and suitable condition for service. Reverse lever latch shall be so arranged that it can be easily disengaged, and provided with a spring which will keep it firmly seated in quadrant. Proper counterbalance shall be provided for the valve gear.

b) Air-operated power reverse gear

Steam locomotives that are equipped with air operated power reverse gear shall be equipped with a connection whereby such gear may be operated by steam or by an auxiliary supply of air in case of failure of the main reservoir air pressure. The operating valve handle for such connection shall be conveniently located in the cab of the locomotive and shall be plainly marked. If an independent air reservoir is used as the source of the auxiliary supply for the reverse gear, it shall be provided with means to automatically prevent loss of pressure in event of failure of the main reservoir air pressure.



- c) Power reverse gear reservoirs  
Power reverse gear reservoirs, if provided, must be equipped with the means to automatically prevent the loss of pressure in the event of a failure of main air pressure and have storage capacity for not less than one complete operating cycle of control equipment.

## DRAW GEAR AND DRAFT SYSTEMS

### 90. Draw gear between steam locomotive and tender

- a) Maintenance and testing.  
The draw gear between the steam locomotive and tender, together with the pins and fastenings, shall be maintained in safe and suitable condition for service. The pins and drawbar shall be removed and tested for defects using an appropriate NDE method at every annual inspection. Where visual inspection does not disclose any defects, an additional NDE testing method shall be employed. Suitable means for securing the drawbar pins in place shall be provided. Inverted drawbar pins shall be held in place by plate or stirrup.
- b) Safety bars and chains generally  
One or more safety bar(s) or two or more safety chains shall be provided between the steam locomotive and tender. The combined strength of the safety chains or safety bar(s) and their fastenings shall be not less than 50 percent of the strength of the drawbar and its connections. These shall be maintained in safe and suitable condition for service, and inspected at the same time draw gear is inspected.
- c) Minimum length of safety chains or bars  
Safety chains or safety bar(s) shall be of the minimum length consistent with the curvature of the railway on which the steam locomotive is operated.
- d) Lost motion  
Lost motion between steam locomotives and tenders not equipped with spring buffers shall be kept to a minimum and shall not exceed 1/2 inch.
- e) Spring buffers  
When spring buffers are used between steam locomotives and tenders the spring shall be applied with not less than 3/4 inch compression, and shall at all times be under sufficient compression to keep the chafing faces in contact.

### 91. Chafing irons

Chafing irons that permit proper curving shall be securely attached to the steam locomotive and tender, and shall be maintained to permit lateral and vertical movement.



92. Draw gear and draft systems

Couplers, draft gear and attachments on steam locomotives and tenders shall be securely fastened, and maintained in safe and suitable condition for service.

DRIVING GEAR

93. Pistons and piston rods

a) Maintenance and testing

Pistons and piston rods shall be maintained in safe and suitable condition for service. Piston rods shall be inspected for cracks each time they are removed, and shall be renewed if found defective.

b) Fasteners

Fasteners (keys, nuts, etc.) shall be kept tight and shall have some means to prevent them from loosening or falling out of place.

94. Crossheads.

Crossheads shall be maintained in a safe and suitable condition for service, with not more than 1/4 inch vertical or 5/16 inch lateral clearance between crossheads and guides.

95. Guides

Guides shall be securely fastened and maintained in a safe and suitable condition for service.

96. Main, side, and valve motion rods

a) General

Main, side or valve motion rods developing cracks or becoming otherwise defective shall be removed from service immediately and repaired or renewed.

b) Repairs

Repairs, and welding of main, side or valve motion rods shall be made in accordance with an accepted national standard. The steam locomotive owner and/or operator shall maintain detailed repair records available for railway company or government agency inspection for all welding of defective main rods, side rods, and valve gear components.



- c) Bearings and bushings  
Bearings and bushings shall so fit the rods as to be in a safe and suitable condition for service, and means shall be provided to prevent bushings from turning in the rod. Straps shall fit and be securely bolted to rods. Floating bushings need not be provided with means to prevent bushings from turning.
  - d) Side motion of rods  
The total amount of side motion of each rod on its crank pin shall not exceed 1/4 inch.
  - e) Oil and grease cups  
Oil and grease cups shall be securely attached to rods, and grease cup plugs shall be equipped with a suitable fastening that will prevent them from being ejected.
  - f) Main rod bearings  
The bore of main rod bearings shall not exceed pin diameters more than 3/32 inch at front or back end. The total lost motion at both ends shall not exceed 5/32 inch.
  - g) Side rod bearings  
The bore of side rod bearings shall not exceed pin diameters more than 5/32 inch on main pin nor more than 3/16 inch on other pins.
97. Crank pins
- a) General provisions  
Crank pins shall be securely applied. Securing the fit of a loose crank pin by shimming, prick punching, or welding is not permitted.
  - b) Maintenance  
Crank pin collars and collar fasteners shall be maintained in a safe and suitable condition for service.





## RUNNING GEAR

### 98. Driving, trailing, and engine truck axles

#### a) Condemning defects

Driving, trailing, and engine truck axles with any of the following defects shall be removed from service immediately and repaired (see appendix A for inspection requirements):

- i. Bent axle;
- ii. Cut journals that cannot be made to run cool without turning;
- iii. Transverse seams in iron or steel axles;
- iv. Seams in axles causing journals to run hot;
- v. Axles that are unsafe on account of usage, accident or derailment;
- vi. Any axle worn 1/2 inch or more in diameter below the original/new journal diameter, except as provided in paragraph (a)(7) of this Section;
- vii. Any driving axles other than main driving axles with an original or new diameter greater than 6 inches that are worn 3/4 inch or more in diameter below the original/new diameter.

#### b) Journal diameter stamped

For steam locomotives with plain bearings, the original/new journal diameter shall be stamped on one end of the axle no later than January 18, 2005.

### 99. Tender truck axles.

The minimum diameters of axles for various axle loads shall be as follows:

<u>Axle load</u> <u>(in pounds)</u>	<u>Minimum diameter</u> <u>of journal</u> <u>(in inches)</u>	<u>Minimum</u> <u>diameter of wheel</u> <u>seat</u> <u>(in inches)</u>	<u>Minimum diameter</u> <u>of center</u> <u>(in inches)</u>
50 000	5 1/2	7 3/8	6 4/9
38 000	5	6 3/4	5 7/8
31 000	4 1/2	6 1/4	5 1/3
22 000	3 3/4	5	4 3/8
15 000	3 1/4	4 5/8	3 7/8



100. Defects in tender truck axles and journals

a) Tender truck axle condemning defects

Tender truck axles with any of the following defects shall be removed from service immediately and repaired:

- i. Axles that are bent;
- ii. Collars that are broken, cracked, or worn to 1/4 inch or less in thickness;
- iii. Truck axles that are unsafe on account of usage, accident, or derailment;
- iv. A fillet in the back shoulder that is worn out; or
- v. A gouge between the wheel seats that is more than 1/8 of an inch in depth.

b) Tender truck journal condemning defects

Tender truck journals with any of the following defects shall be removed from service immediately and repaired:

- i. Cut journals that cannot be made to run cool without turning;
- ii. Seams in axles causing journals to run hot;
- iii. Overheating, as evidenced by pronounced blue black discoloration;
- iv. Transverse seams in journals of iron or steel axles; or
- v. Journal surfaces having any of the following:
  - vi. A circumferential score;
  - vii. Corrugation;
  - viii. Pitting;
  - ix. Rust;
  - x. Etching.

101. Steam locomotive driving journal boxes.

a) Driving journal boxes

Driving journal boxes shall be maintained in a safe and suitable condition for service. Not more than one shim may be used between the box and bearing.

b) Broken bearings

Broken bearings shall be renewed.

c) Loose bearings

Loose bearings shall be repaired or renewed.



102. Tender plain bearing journal boxes

Plain bearing journal boxes with the following defects shall be removed from service immediately and repaired:

- a) A box that does not contain visible free oil;
- b) A box lid that is missing, broken, or open except to receive servicing;
- c) A box containing foreign matter, such as dirt, sand, or coal dust that can reasonably be expected to damage the bearing; or have a detrimental effect on the lubrication of the journal and bearing;
- d) A lubricating pad that:
  - i. Is missing;
  - ii. Is not in contact with the journal;
  - iii. Has a tear extending half the length or width of the pad, or more, except by design;
  - iv. Shows evidence of having been scorched, burned, or glazed;
  - v. Contains decaying or deteriorated fabric that impairs proper lubrication of the pad;
  - vi. Has an exposed center core (except by design); or
  - vii. Has metal parts contacting the journal;
- e) A plain bearing that:
  - i. Is missing, cracked, broken;
  - ii. Has a bearing liner loose;
  - iii. Has a broken out piece; or
  - iv. Has indications of having been overheated, as evidenced by:
    - v. Melted babbitt;
    - vi. Smoke from hot oil; or
    - vii. Journal surface damage; or
- f) A plain bearing wedge that:
  - i. Is missing, cracked or broken; or
  - ii. Is not located in its design position.

103. Tender roller bearing journal boxes.

Tender roller bearing journal boxes shall be maintained in a safe and suitable condition.

104. Driving box shoes and wedges

Driving box shoes and wedges shall be maintained in a safe and suitable condition for service.



105. Lateral motion

a) Condemning limits

The total lateral motion or play between the hubs of the wheels and the boxes on any pair of wheels shall not exceed the following limits:

	<u>Inches</u>
Engine truck wheels (with swing centers)	1
Engine truck wheels (with rigid centers)	1 1/2
Trailing truck wheels	1
Driving wheels	3/4

b) Limits increased

These limits may be increased on steam locomotives operating on track where the curvature exceeds 20 degrees when it can be shown that conditions require additional lateral motion.

c) Non-interference with other parts

The lateral motion shall in all cases be kept within such limits that the driving wheels, rods, or crank pins will not interfere with other parts of the steam locomotive.

TRUCKS, FRAMES AND EQUALIZING SYSTEMS

106. Steam locomotive frame

a) Maintenance and inspection

Frames, decks, plates, tailpieces, pedestals, and braces shall be maintained in a safe and suitable condition for service, and shall be cleaned and thoroughly inspected as often as necessary to maintain in a safe and suitable condition for service with cleaning intervals, in any case, not to exceed every 1472 service days.

b) Broken frames

Broken frames properly patched or secured by clamps or other suitable means which restores the rigidity of the frame are permitted.

107. Tender frame and body

a) Maintenance

Tender frames shall be maintained in a safe and suitable condition for service.

b) Height difference

The difference in height between the deck on the tender and the cab floor or deck on the steam locomotive shall not exceed 1 1/2 inches.



- c) Gangway minimum width  
The minimum width of the gangway between steam locomotive and tender, while standing on tangent track, shall be 16 inches.
  - d) Tender frame condemning defects  
A tender frame with any of the following defects shall be removed from service immediately and repaired:
    - i. Portions of the tender frame or body (except wheels) that have less than a 2 1/2 inches clearance from the top of rail;
    - ii. Tender center sill that is broken, cracked more than 6 inches, or permanently bent or buckled more than 1/2 inches in any six foot length;
    - iii. Tender coupler carrier that is broken or missing;
    - iv. Tender center plate, any portion of which is missing or broken or that is not properly secured; or
    - v. Tender that has a broken side sill, crossbearer, or body bolster.
108. Steam locomotive leading and trailing trucks
- a) Maintenance  
Trucks shall be maintained in safe and suitable condition for service. Center plates shall fit properly, and the male center plate shall extend into the female center plate not less than 3/4 inch. All centering devices shall be properly maintained and shall not permit lost motion in excess of 1/2 inch.
  - b) Safety chain required  
A suitable safety chain shall be provided at each front corner of all four wheel engine trucks.
  - c) Clearance required  
All parts of trucks shall have sufficient clearance to prevent them from interfering with any other part of the steam locomotive.
109. Tender trucks.
- a) Tender truck frames  
A tender truck frame shall not be broken, or have a crack in a stress area that affects its structural integrity. Tender truck center plates shall be securely fastened, maintained in a safe and suitable condition for service, and provided with a center pin properly secured. The male center plate must extend into the female center plate at least 3/4 inch. Shims may be used between truck center plates.
  - b) Tender truck bolsters  
Truck bolsters shall be maintained approximately level.



- c) Condemning defects for springs or spring rigging  
Springs or spring rigging with any of the following defects shall be taken out of service immediately and renewed or properly repaired:
    - i. An elliptical spring with its top (long) leaf or any other five leaves in the entire spring pack broken;
    - ii. A broken coil spring or saddle;
    - iii. A coil spring that is fully compressed;
    - iv. A broken or cracked equalizer, hanger, bolt, gib or pin;
    - v. A broken coil spring saddle; and
    - vi. A semi-elliptical spring with a top (long) leaf broken or two leaves in the top half broken, or any three leaves in the entire spring broken.
  - d) Tender securing arrangement  
Where equipped, tender devices and/or securing arrangements intended to prevent the truck and tender body from separating in case of derailment shall be maintained in a safe and suitable condition for service.
  - e) Side bearings and truck centering devices.  
Where equipped, side bearings and truck centering devices shall be maintained in a safe and suitable condition for service.
  - f) Friction side bearings  
Friction side bearings shall not be run in contact, and shall not be considered to be in contact if there is clearance between them on either side when measured on tangent level track.
  - g) Side bearings  
All rear trucks shall be equipped with side bearings. When the spread of side bearings is 50 inches, their maximum clearance shall be 3/8 inch on each side for rear trucks and 3/4 inch on each side for front trucks, where used. When the spread of the side bearings is increased, the maximum clearance shall be increased proportionately.
110. Pilots
- a) General provisions. Pilots shall be securely attached, properly braced, and maintained in a safe and suitable condition for service.
  - b) Minimum and maximum clearance. The minimum clearance of pilot above the rail shall be 3 inches and the maximum clearance shall be 6 inches measured on tangent level track.



## 111. Spring rigging

### a) Arrangement of springs and equalizers

Springs and equalizers shall be arranged to ensure the proper distribution of weight to the various wheels of the steam locomotive, maintained approximately level and in a safe and suitable condition for service. Adjusting weights by shifting weights from one pair of wheels to another is permissible.

### b) Spring or spring rigging condemning defects

Springs or spring rigging with any of the following defects shall be removed from service immediately and renewed or properly repaired:

- i. Top leaf broken or two leaves in top half or any three leaves in spring broken. (The long side of a spring to be considered the top.) Broken springs not exceeding these requirements may be repaired by
- ii. applying clips providing the clips can be made to remain in place;
- iii. Any spring with leaves excessively shifting in the band;
- iv. Broken coil springs; or
- v. Broken driving box saddle, equalizer, hanger, bolt, or pin.

## WHEELS AND TIRES

## 112. Wheels and tires

### a) Mounting

Wheels shall be securely mounted on axles. Prick punching or shimming the wheel fit will not be permitted. The diameter of wheels on the same axle shall not vary more than 3/32 inch.

### b) Gage

Wheels used on standard gage track will be out of gage if the inside gage of flanges, measured on base line is less than 53 inches or more than 53 3/8 inches. Wheels used on less than standard gage track will be out of gage if the inside gage of flanges, measured on base line, is less than the relevant track gage less 3 1/2 inches or more than the relevant track gage less 3 1/8 inches.

### c) Flange distance variance

The distance back to back of flanges of wheels mounted on the same axle shall not vary more than 1/4 inch.



d) Tire thickness

Wheels may not have tires with a minimum thickness less than that indicated in the table in this paragraph (d). When retaining rings are used, measurements of tires to be taken from the outside circumference of the ring, and the minimum thickness of tires may be as much below the limits specified earlier in this paragraph (d) as the tires extend between the retaining rings, provided it does not reduce the thickness of the tire to less than 1 1/8 inches from the throat of flange to the Counterbore for the retaining rings. The required minimum thickness for tires, by wheel center diameter and weight per axle, is as follows:

<b><u>Weight per axle (weight on drivers divided by number of pairs of driving wheels)</u></b>	<b><u>Diameter of wheel center (inches)</u></b>	<b><u>Minimum thickness (inches)</u></b>
30,000 pounds and under	44 and under	1 1/4
	Over 44 to 50	1 1/3
	Over 50 to 56	1 3/8
	Over 56 to 62	1 4/9
	Over 62 to 68	1 1/2
	Over 68 to 74	1 4/7
	Over 74	1 5/8
Over 30,000 to 35,000 pounds	44 and under	1 1/3
	Over 44 to 50	1 3/8
	Over 50 to 56	1 4/9
	Over 56 to 62	1 1/2
	Over 62 to 68	1 4/7
	Over 68 to 74	1 5/8
	Over 74	1 2/3
Over 35,000 to 40,000 pounds	44 and under	1 3/8
	Over 44 to 50	1 4/9
	Over 50 to 56	1 1/2
	Over 56 to 62	1 4/7
	Over 62 to 68	1 5/8
	Over 68 to 74	1 2/3
	Over 74	1 3/4
Over 40,000 to 45,000 pounds	44 and under	1 4/9
	Over 44 to 50	1 1/2
	Over 50 to 56	1 4/7
	Over 56 to 62	1 5/8
	Over 62 to 68	1 2/3
	Over 68 to 74	1 3/4





	Over 74	1 13 / 16
Over 45,000 to 50,000 pounds	44 and under	1 1/2
	Over 44 to 50	1 4/7
	Over 50 to 56	1 5/8
	Over 56 to 62	1 2/3
	Over 62 to 68	1 3/4
	Over 68 to 74	1 13 / 16
	Over 74	1 7/8
Over 50,000 to 55,000 pounds	44 and under	1 4/7
	Over 44 to 50	1 5/8
	Over 50 to 56	1 2/3
	Over 56 to 62	1 3/4
	Over 62 to 68	1 13 / 16
	Over 68 to 74	1 7/8
	Over 74	2
Over 55,000 pounds	44 and under	1 5/8
	Over 44 to 50	1 2/3
	Over 50 to 56	1 3/4
	Over 56 to 62	1 13 / 16
	Over 62 to 68	1 7/8
	Over 68 to 74	2
	Over 74	2

e) Tire width.

Flanged tires shall be no less than 5 1/2 inches wide for standard gage and no less than 5 inches wide for narrow gage. Plain tires shall be no less than 6 inches wide for standard gage and no less than 5 1/2 inches wide for narrow gage.

113. Wheels and tire defects.

Steam locomotive and tender wheels or tires developing any of the defects listed in this Section shall be removed from service immediately and repaired. Except as provided in Section 114, welding on wheels and tires is prohibited. A wheel that has been welded is a welded wheel for the life of the wheel.

a) Cracks or breaks

Wheels and tires may not have a crack or break in the flange, tread, rim, plate, hub or brackets.



- b) Flat spots  
Wheels and tires may not have a single flat spot that is 2 1/2 inches or more in length, or two adjoining spots that are each two or more inches in length.
- c) Chipped flange  
Wheels and tires may not have a gouge or chip in the flange that is more than 1 1/2 inches in length and 1/2 inch in width.
- d) Broken rims  
Wheels and tires may not have a circumferentially broken rim if the tread, measured from the flange at a point 5/8 inch above the tread, is less than 3 3/4 inches in width.
- e) Shelled-out spots  
Wheels and tires may not have a shelled-out spot 2 1/2 inches or more in length, or two adjoining spots that are each two or more inches in length, or so numerous as to endanger the safety of the wheel.
- f) Seams  
Wheels and tires may not have a seam running lengthwise that is within 3 3/4 inches of the flange.
- g) Worn flanges  
Wheels and tires may not have a flange worn to a 15/16 inch thickness or less, as measured at a point 3/8 inch above the tread.
- h) Worn treads  
Wheels and tires may not have a tread worn hollow 5/16 inch or more.
- i) Flange height  
Wheels and tires may not have a flange height of less than 1 inch nor more than 1 1/2 inches, as measured from the tread to the top of the flange.
- j) Rim thickness  
Wheels may not have rims less than 1 inch thick.
- k) Wheel diameter  
Wheels may not have wheel diameter variance, for wheels on the same axle or in the same driving wheel base, greater than 3/32 inch, when all tires are turned or new tires applied to driving and trailing wheels. When a single tire is applied, the diameter must not vary more than 3/32 inch from that of the opposite wheel on the same axle. When a single pair of tires is applied the diameter must be within 3/32 inch of the average diameter of the wheels in the driving wheel base to which they are applied.



114. Wheel centers.

a) Filling blocks and shims

Driving and trailing wheel centers with divided rims shall be properly fitted with iron or steel filling blocks before the tires are applied, and such filling blocks shall be properly maintained. When shims are inserted between the tire and the wheel center, not more than two thicknesses of shims may be used, one of which must extend entirely around the wheel. The shim which extends entirely around the wheel may be in three or four pieces, providing they do not lap.

b) Wheel center condemning defects

Wheel centers with any of the following defects shall be removed from service immediately and repaired:

- i. Wheels centers loose on axle;
- ii. Broken or defective tire fastenings;
- iii. Broken or cracked hubs, plates, bolts or spokes, except as provided in paragraph (b)(4) of this Section; or
- iv. Driving or trailing wheel center with three adjacent spokes or 25 percent or more of the spokes in the wheel broken.

c) Wheel center repairs

Wheel centers may be repaired by welding or brazing provided that the defect can properly be so repaired and, following the repair, the crankpin and axle shall remain tight in the wheel. Banding of the hub is permitted.

d) Counterbalance maintenance

Wheel counterbalances shall be maintained in a safe and suitable condition for service.



## STEAM LOCOMOTIVE TANKS

### 115. Feed water tanks.

#### a) General provisions

Tanks shall be maintained free from leaks, and in safe and suitable condition for service. Suitable screens must be provided for tank wells or tank hose and shall be maintained in a manner that allows the unobstructed flow of water. Feed water tanks shall be equipped with a device that permits the measurement of the quantity of water in the tender feed water tank from the cab or tender deck of the steam locomotive. Such device shall be properly maintained.

#### b) Inspection frequency

As often as conditions warrant but not less frequently than every 92 service days, the interior of the tank shall be inspected, and cleaned if necessary.

#### c) Top of tender

Top of tender behind fuel space shall be kept clean, and means provided to carry off excess water. Suitable covers shall be provided for filling holes.

### 116. Oil tanks

The oil tanks on oil burning steam locomotives shall be maintained free from leaks. The oil supply pipe shall be equipped with a safety cut-off device that:

- a. Is located adjacent to the fuel supply tank or in another safe location;
- b. Closes automatically when tripped and that can be reset without hazard; and
- c. Can be hand operated from clearly marked locations, one inside the cab and one accessible from the ground on each exterior side of the steam locomotive.



## APPENDIX A - EXCLUSIONS & EXCEPTIONS

These Standards do not apply to locomotives used exclusively in tourist excursion train service that travels no further than a round trip of 150 miles (240 km) at a speed not exceeding a maximum of 25 mph (40 km/h) if:

- a) the locomotive owner uses these standards as a guide and consults with the locomotive operator and/or railway to establish appropriate inspection, safety criteria and speed restrictions to be applied exclusively in tourist trains; and
- b) the locomotive operator files railway schedules with Transport Canada that specify the locations of the service, the round trip distance, the type of equipment operated, along with the applicable inspection, safety criteria, and any other restrictions imposed on the operation of such equipment, 90 days prior to operation.
- c) the locomotive owner/operator complies with Part V of the Canadian Occupational Safety and Health Regulations and provides Transport Canada upon request with a current copy of the NBIC inspection report required by that Part V of the Canadian Occupational Safety and Health Regulations.



## APPENDIX B - INSPECTION REQUIREMENTS

The lists in this appendix are intended as guidance only. Adherence to this list does not relieve the steam locomotive owner and/or operator of responsibility for either:

- a) Completing the inspection and maintenance requirements described in this standard; or
- b) ensuring that the steam locomotive, tender and its parts and appurtenances are safe and suitable for service.
- c)

### Daily Inspection Requirements; Section 13

1. Observance of lifting pressure of the lowest safety valve.
2. Testing of water glasses and gauge cocks.\*
3. Inspection of tubular water glass shields.
4. Inspection of all cab lamps.\*
5. Inspection of boiler feedwater delivery systems.\*
6. Inspection of lagging for indication of leaks.
7. Inspection for leaks obstructing vision of engine crew.
8. Observance of compressor(s) and governor to ascertain proper operation.\*
9. Inspection of brake and signal equipment.\*
10. Inspection of brake cylinders for piston travel.
11. Inspection of foundation brake gear.
12. Inspection of sanders.\*
13. Inspection of draw gear and chafing irons.
14. Inspection of draft gear.
15. Inspection of crossheads and guides.
16. Inspection of piston rods and fasteners.
17. Inspection of main, side, and valve motion rods.
18. Inspection of headlights and classification lamps.\*
19. Inspection of running gear.
20. Inspection of tender frames and tanks.
21. Inspection of tender trucks for amount of side bearing clearance.

Note: All items marked (\*) should be checked at the beginning of each day the locomotive is used.

### 31 Service Day Inspection Requirements; Section 14

1. Washing of boiler.
2. Cleaning and inspection of water glass valves and gauge cocks.
3. Cleaning, washing and inspection of arch tubes, water bar tubes, circulators and siphons.
4. Removal and inspection of all washout and water tube plugs.
5. Testing of all staybolts.
6. Removal, cleaning and inspection of fusible plugs (if any).



#### 92 Service Day Inspection Requirements; Section 15

1. Removal and testing of all air and steam gauges.
2. Cleaning of steam gauge siphon pipe.
3. Renewal of tubular water glasses.
4. Testing and adjusting of safety relief valves.
5. Testing of main reservoir and brake cylinder leakage.
6. Entering and inspection of tender tank interior.

#### Annual Inspection Requirements; Section 16

##### Testing of thickness of arch and water bar tubes (arch brick to be removed)

2. Hydrostatic testing of boiler.
3. Testing of all staybolts.
4. Interior inspection of boiler.
5. Thickness verification of dry pipes.
6. Smoke box inspection.
7. Main reservoir hammer or UT testing and hydrostatic testing (for non-welded and drilled main reservoirs)
8. Removal and inspection of steam locomotive drawbar(s) and pins (NDE testing other than merely visual)
9. Inspection of longitudinal lap joint boiler seams.

#### 5 Year Inspection Requirements; Section 16

1. Inspection of flexible staybolt caps and sleeves.

#### 1472 Service Day Inspection Requirements; Section 17

1. Removal of boiler flues (as necessary) and cleaning of boiler interior.
2. Removal of jacket and lagging and inspection of boiler interior and exterior.
3. Hydrostatic testing of boiler.
4. Thickness verification (boiler survey) and recomputation and update of steam locomotive specification card, (Form No. 4).

## Appendix C - Inspection Forms

### Form No. 1

### 31 and 92 Service Day Inspection Report

Date of \_\_\_\_\_ Owner \_\_\_\_\_ Locomotive Initials \_\_\_\_\_  
Inspection \_\_\_\_\_ Operator \_\_\_\_\_ Locomotive No. \_\_\_\_\_

#### 31 and 92 Service Day Requirements

Instructions: Non-complying conditions shall be repaired and this report approved before the locomotive is returned to service. Where condition is called for, enter either: (1) Good - No defects which could be discovered by a reasonable inspection; (2) Fair - Functioning less than optimally but safe and suitable and not in violation of the regulations; or (3) Poor - Not in compliance with the regulations. In any case N/A means - not applicable.

Was boiler washed? \_\_\_\_\_ Were steam leaks repaired? \_\_\_\_\_  
Were water gauge and valve passages cleaned? \_\_\_\_\_ Condition of draft system and draw gear. \_\_\_\_\_  
Were gauge cock passages cleaned? \_\_\_\_\_ Condition of running gear. \_\_\_\_\_  
Were all washout plugs removed and inspected? \_\_\_\_\_ Condition of driving gear. \_\_\_\_\_  
Were arch tubes, circulators, siphons and water bar tubes Condition of spring/equalizing system. \_\_\_\_\_  
cleaned and inspected? \_\_\_\_\_ Condition of tender running gear. \_\_\_\_\_  
Were fusible plugs removed, cleaned & inspected? \_\_\_\_\_ Condition of brake equipment. \_\_\_\_\_  
Were staybolts hammer tested? \_\_\_\_\_ Were injectors tested and in good condition? \_\_\_\_\_  
Were all broken staybolts replaced? \_\_\_\_\_ Was feedwater pump tested and in good condition? \_\_\_\_\_

#### 92 Service Day Requirements

Date of previous 92 Service Day Inspection \_\_\_\_\_ Were tubular water glasses renewed? \_\_\_\_\_  
Safety relief valves pop at \_\_\_\_\_ psi \_\_\_\_\_ psi \_\_\_\_\_ psi Were air compressor(s) orifice tested? \_\_\_\_\_  
Were all steam gauges tested? \_\_\_\_\_ Was main reservoir tested for leakage? \_\_\_\_\_  
Were all air brake gauges tested? \_\_\_\_\_ Were brake cylinders tested for leakage? \_\_\_\_\_  
Were steam gauge siphon pipe(s) cleaned? \_\_\_\_\_ Was tender tank entered and inspected? \_\_\_\_\_  
If no 92 Service Day Inspection is done, enter number of service days used since last 92 Service Day Insp. \_\_\_\_\_

\_\_\_\_\_  
INSPECTOR The above work has been performed and the report is  
approved. \_\_\_\_\_  
\_\_\_\_\_  
INSPECTOR OFFICER IN CHARGE



Form No. 2

### Daily Locomotive Inspection Report

Date of \_\_\_\_\_ Owner \_\_\_\_\_ Locomotive Initials \_\_\_\_\_  
Inspection \_\_\_\_\_ Operator \_\_\_\_\_ Locomotive No. \_\_\_\_\_

Instructions: Non-complying conditions shall be repaired and this report approved before locomotive is returned to service. This report shall be filed even if no non-complying conditions are reported, however it does not have to be approved before the locomotive is returned to service if no non-complying conditions are reported. Locomotive, including its tender and appurtenances, shall be inspected each day it is offered for use.

Repairs needed:

Repairs done by:


CONDITION OF WATER GLASSES: _____	CONDITION OF AIR COMPRESSOR: _____
CONDITION OF GAUGE COCKS: _____	MAIN RESERVOIR PRESS.: HP _____ psi,
LF _____ psi	
CONDITION OF INJECTORS / PUMPS: _____	BRAKE PIPE PRESSURE: _____ psi
BOILER SAFETY VALVE LIFTS AT: _____ psi	LOCOMOTIVE BRAKE PIPE LEAKAGE: _____ lbs. per minute
SEATS AT: _____ psi	CONDITION OF BRAKES: _____
CONDITION OF PISTON ROD AND VALVE STEM PACKING _____	CONDITION OF SANDERS: _____

Where condition is called for enter:

Good - No defects which could be discovered by a reasonable inspection.

Fair - Functioning less than optimally but is in safe and suitable condition, and not in violation of the rules.

Poor - Not in compliance.

N/A - Not applicable.

Inspector's signature: \_\_\_\_\_ Occupation: \_\_\_\_\_

The above work has been performed, except as noted, and the report is approved  
by: \_\_\_\_\_

Approved

Note: Additional items may be added to this form if desired.

\_\_\_\_\_  
Occupation  
Date

## Annual Inspection Report

Date of \_\_\_\_\_ Owner \_\_\_\_\_ Locomotive Initials \_\_\_\_\_  
Inspection \_\_\_\_\_ Operator \_\_\_\_\_ Locomotive No. \_\_\_\_\_

Instructions: Non-complying conditions shall be repaired and this report approved before the locomotive is returned to service. Where condition is called for, enter either (1) Good - No defects which could be discovered by a reasonable inspection; (2) Fair - Functioning less than optimally but safe and available and not in violation of the regulations; or (3) Poor - Not in compliance with the regulations. If any case N/A means - not applicable.

Boiler hydrostatically tested to \_\_\_\_\_ psi, at a water temperature of \_\_\_\_\_ degrees F.

Was boiler washed? \_\_\_\_\_

Were water gauge and valve passages cleaned? \_\_\_\_\_

Were gauge cock passages cleaned? \_\_\_\_\_

Were all washout plugs removed and inspected? \_\_\_\_\_

Were arch tubes, circulators, siphons and water bar tubes

cleaned and inspected? \_\_\_\_\_

Thickness of arch tubes \_\_\_\_\_; Water bar tubes \_\_\_\_\_

Dry pipe thickness \_\_\_\_\_; Circulator thickness \_\_\_\_\_

Were water column passages cleaned and inspected? \_\_\_\_\_

Was boiler entered and inspected? \_\_\_\_\_

Were drilled flexible staybolt telltale holes tested? \_\_\_\_\_

Were staybolts hammer tested? \_\_\_\_\_

Were all broken staybolts replaced? \_\_\_\_\_

Were longitudinal lap seams inspected? \_\_\_\_\_

Was smoke box entered and inspected? \_\_\_\_\_

Safety relief valves pop at \_\_\_\_\_psi \_\_\_\_\_psi \_\_\_\_\_psi

Were injectors tested and in good condition? \_\_\_\_\_

Was feedwater pump tested and in good condition? \_\_\_\_\_

Were all steam gauges tested? \_\_\_\_\_

Were steam gauge siphon pipe(s) cleaned? \_\_\_\_\_

Were steam leaks repaired? \_\_\_\_\_

Were tubular water glasses renewed? \_\_\_\_\_

Were fusible plugs removed, cleaned & inspected? \_\_\_\_\_

Flexi caps removed on (date) \_\_\_\_\_

Were all air brake gauges tested? \_\_\_\_\_

Main reservoir hydro \_\_\_\_\_ psi, hammer \_\_\_\_\_

NDE\_\_\_\_\_, Drilled\_\_\_\_\_

Were brake cylinders tested for leakage. \_\_\_\_\_

Was main reservoir tested for leakage.

Were air compressor(s) orifice tested? \_\_\_\_\_

Condition of driving gear. \_\_\_\_\_

Condition of running gear. \_\_\_\_\_

Condition of draft system and draw gear. \_\_\_\_\_

Condition of spring/equalizing system. \_\_\_\_\_

Condition of brake equipment. \_\_\_\_\_

Condition of tender running gear. \_\_\_\_\_

Was tender tank entered and inspected? \_\_\_\_\_

1. *Journal of Management Studies*, 1996, 33, 1, 1-14.

The above work has been performed and the report is approved.

OFFICER IN CHARGE

### Locomotive Air Brake Cleaning, Testing and Inspection Record

[illegible]

FORM 4

**BOILER SPECIFICATION CARD**

Locomotive No. \_\_\_\_\_; Boiler No. \_\_\_\_\_; Date built \_\_\_\_\_  
 Boiler built by: \_\_\_\_\_  
 Owned by: \_\_\_\_\_  
 Operated by: \_\_\_\_\_  
 Type of boiler: \_\_\_\_\_; Dome, where located: \_\_\_\_\_

**BOILER SURVEY DATA**

Where condition is called for, use: **New** - New material at the time of the boiler survey; **Good** - Little or no wear and/or corrosion; **Fair** - Obvious wear and/or corrosion.

**Boiler Shell Sheets**

Material:	Type of Material (wrought iron, carbon steel, or alloy steel)	Carbon Content	Condition
1st course (front)	_____	_____	_____
2nd course	_____	_____	_____
3rd course	_____	_____	_____
Rivets	_____	n/a	n/a

Documentation of how material was determined shall be attached to this form.

Measurements:		At Seam	Thinnest		
Front flue sheet,	thickness	n/a	_____	ID _____	ID _____
1st course,	thickness	_____	_____	ID _____	ID _____
2nd course,	thickness	_____	_____	ID _____	ID _____
3rd course,	thickness	_____	_____	ID _____	ID _____

When courses are not cylindrical give ID at each end

Is boiler shell circular at all points? \_\_\_\_\_  
 If shell is flattened, state location and amount \_\_\_\_\_  
 Are all flattened areas of shell stayed adequately for the pressure allowed by this form? \_\_\_\_\_

Water Space at Mud Ring: Sides \_\_\_\_\_, Front \_\_\_\_\_, Back \_\_\_\_\_  
 Width of water space at sides of fire box measured at center line of boiler: Front \_\_\_\_\_, Back \_\_\_\_\_

**Firebox and Wrapper Sheets**

Firebox sheets:	Thickness	Material	Condition
Rear flue sheet	_____	_____	_____
Crown	_____	_____	_____
Sides	_____	_____	_____
Door	_____	_____	_____
Combustion chamber	_____	_____	_____
Inside throat	_____	_____	_____
Wrapper sheets:			
Throat	_____	_____	_____
Back head	_____	_____	_____
Roof	_____	_____	_____
Sides	_____	_____	_____

#### Steam Dome

Dome is made of \_\_\_\_\_ pieces (not including seam welts, if any), Top opening diameter \_\_\_\_\_  
Middle cylindrical portion - ID \_\_\_\_\_, Opening in boiler shell, longitudinally - \_\_\_\_\_

Dome sheets:	Thickness	Material	Condition
Base	_____	_____	_____
Middle cylindrical portion	_____	_____	_____
Top	_____	_____	_____
Lid	_____	_____	_____
Boiler shell liner for steam dome opening:	_____	_____	_____
Is liner part of longitudinal seam?	_____		

#### Arch Tubes, Flues, Circulators, Thermic Siphons, Water Bar Tubes, Superheaters, and Dry Pipe

Arch tubes: OD \_\_\_\_\_, wall thickness \_\_\_\_\_; number \_\_\_\_\_; condition \_\_\_\_\_

##### Flues:

OD \_\_\_\_\_, wall thickness \_\_\_\_\_, length \_\_\_\_\_; number \_\_\_\_\_; condition \_\_\_\_\_  
OD \_\_\_\_\_, wall thickness \_\_\_\_\_, length \_\_\_\_\_; number \_\_\_\_\_; condition \_\_\_\_\_  
OD \_\_\_\_\_, wall thickness \_\_\_\_\_, length \_\_\_\_\_; number \_\_\_\_\_; condition \_\_\_\_\_

Circulators: OD \_\_\_\_\_, wall thickness \_\_\_\_\_; number \_\_\_\_\_; condition \_\_\_\_\_

Thermic siphons: number \_\_\_\_\_; plate thickness \_\_\_\_\_; condition \_\_\_\_\_  
neck OD \_\_\_\_\_, neck thickness \_\_\_\_\_; condition \_\_\_\_\_

Water bar tubes: OD \_\_\_\_\_, wall thickness \_\_\_\_\_

##### Superheater units directly connected to boiler with no intervening valve:

Type \_\_\_\_\_, Tube OD \_\_\_\_\_, wall thickness \_\_\_\_\_; number \_\_\_\_\_; condition \_\_\_\_\_

##### Dry pipe subject to pressure:

OD \_\_\_\_\_, wall thickness \_\_\_\_\_, material \_\_\_\_\_; condition \_\_\_\_\_

#### Stay Bolts, Crown Bar Rivets, and Braces

##### Stay bolts:

Smallest crown stay diameter \_\_\_\_\_, avg. spacing \_\_\_\_\_ X \_\_\_\_\_; condition \_\_\_\_\_  
Smallest stay bolt diameter \_\_\_\_\_, avg. spacing \_\_\_\_\_ X \_\_\_\_\_; condition \_\_\_\_\_  
Smallest combustion chamber stay bolt dia. \_\_\_\_\_,  
avg. spacing \_\_\_\_\_ X \_\_\_\_\_; condition \_\_\_\_\_

##### Measurement at smallest diameter

##### Crown bar bolts & rivets:

Roof sheet rivets, smallest dia. \_\_\_\_\_, ave. spacing \_\_\_\_\_ X \_\_\_\_\_; condition \_\_\_\_\_  
Roof sheet bolts, smallest dia. \_\_\_\_\_, ave. spacing \_\_\_\_\_ X \_\_\_\_\_; condition \_\_\_\_\_  
Crown sheet rivets, smallest dia. \_\_\_\_\_, ave. spacing \_\_\_\_\_ X \_\_\_\_\_; condition \_\_\_\_\_  
Crown sheet bolts, smallest dia. \_\_\_\_\_, ave. spacing \_\_\_\_\_ X \_\_\_\_\_; condition \_\_\_\_\_

**Braces:**

	Number	Total Area Stayed	Total Cross Sectional Area of Braces	
			Actual	Equivalent Direct Stay
Backhead	_____	_____	_____	_____
Throat sheet	_____	_____	_____	_____
Front tube sheet	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

**Safety Valves, Heating Surface, and Grate Area**

<b>Safety valves:</b>	Total number of safety valves on locomotive _____	
Valve Size	Manufacturer	No. valves of this size and manufacture
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**Heating Surface:**

Heating surface, as part of a circulating system in contact on one side with water or wet steam being heated and on the other side with gas or refractory being cooled, shall be measured on the side receiving heat.

Firebox and Combustion Chamber	_____	square feet
Flue Sheets (less flue ID areas)	_____	square feet
Flues	_____	square feet
Circulators	_____	square feet
Arch Tubes	_____	square feet
Thermic Siphons	_____	square feet
Water Bar Tubes	_____	square feet
Superheaters (front end throttle only)	_____	square feet
Other	_____	square feet
<b>Total Heating Surface</b>	_____	square feet

**Grate area:** \_\_\_\_\_ square feet

**Water Level Indicators, Fusible Plugs, and Low Water Alarms**

Height of lowest reading of gauge glasses above crown sheet: \_\_\_\_\_

Height of lowest reading of gauge cocks above crown sheet: \_\_\_\_\_

Is boiler equipped with fusible plug(s)? \_\_\_\_\_, number \_\_\_\_\_

Is boiler equipped with low water alarm(s)? \_\_\_\_\_, number \_\_\_\_\_

### Calculations

**Staybolt stresses:**

Stay bolt under greatest load, maximum stress \_\_\_\_\_ psi  
 Location \_\_\_\_\_  
 Crown stay under greatest load, maximum stress \_\_\_\_\_ psi  
 Location \_\_\_\_\_  
 Combustion chamber stay bolt under greatest load, maximum stress \_\_\_\_\_ psi  
 Location \_\_\_\_\_

**Braces:**

Round or rectangular brace under greatest load, maximum stress \_\_\_\_\_ psi  
 Location \_\_\_\_\_  
 Gusset brace under greatest load, maximum stress \_\_\_\_\_ psi  
 Location \_\_\_\_\_

**Boiler shell plate tension:**

Greatest tension on net section of plate in longitudinal seam \_\_\_\_\_ r  
 Location (course #) \_\_\_\_\_ ; Seam Efficiency \_\_\_\_\_

**Boiler plate and components, minimum thickness required @ tensile strength:**

Front tube sheet	@ _____	Rear flue sheet	@ _____
1st course at seam	@ _____	1st course not at seam	@ _____
2nd course at seam	@ _____	2nd course not at seam	@ _____
3rd course at seam	@ _____	3rd course not at seam	@ _____
Roof sheet	@ _____	Crown sheet	@ _____
Side wrapper sheets	@ _____	Firebox side sheets	@ _____
Back head	@ _____	Door sheet	@ _____
Throat sheet	@ _____	Inside throat sheet	@ _____
Combustion chamber	@ _____	Dome, top	@ _____
Dome, middle	@ _____	Dome, base	@ _____
Arch tubes	@ _____	Dome, lid	@ _____
Water bar tubes	@ _____	Thermic siphons	@ _____
Dry pipe	@ _____	Circulators	@ _____

If tensile strength used is greater than 50,000 psi for steel or greater than 45,000 psi for wrought iron, supporting documentation must be furnished.

**Boiler Steam Generating Capacity:** \_\_\_\_\_ pounds per hour

The following may be used as a guide for estimating steaming capacity:

Pounds of Steam Per Hour Per Square Foot of Heating Surface:

Hand fired	8 lbs. per hr.
Stoker fired	10 lbs. per hr.
Oil, gas or pulverized fuel fired	14 lbs. per hr.

## Description of Alteration

[illegible]

### Record of Waivers

[illegible]

Calculations done by: \_\_\_\_\_; Verified by: \_\_\_\_\_

Data used to verify the foregoing specifications is current and accurate. Based upon the information contained in this document and all necessary calculations, this boiler of Locomotive (Initial & number) \_\_\_\_\_ is safe for a working pressure of \_\_\_\_\_ psi.

\_\_\_\_\_ Date \_\_\_\_\_; \_\_\_\_\_ Date \_\_\_\_\_

**Locomotive Owner**

### Locomotive Operator

Make working sketch here or attach drawing of longitudinal and circumferential seams used in shell of boiler, indicating on which courses used and give calculated efficiency of weakest longitudinal seam.



## Form No. 5

## Locomotive Service Day Record

Locomotive Initial and No. \_\_\_\_\_ owned by \_\_\_\_\_ and operated by \_\_\_\_\_ was placed in service following a 1472 Service Day Inspection on (start date) \_\_\_\_\_. This locomotive shall not be operated after (date) \_\_\_\_\_, or it shall not be operated after it has accumulated 1472 service days from the above start date, whichever comes first, at which time it shall be due for a 1472 Service Day Inspection.

	Year											
Serv. days since last insp.												
Annual Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
92 Service Day Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
92 Service Day Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
92 Service Day Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
31 Service Day Date												
Serv. days since last insp.												
Annual Date												
TOTAL												

A copy of this record shall be filed with the Regional Administrator after 31 December and prior to 31 January of each year.

Signed \_\_\_\_\_

Officer in Charge

**Report of**  
**ALTERATION** ☐  
**or**  
**Welded or Riveted REPAIR** ☐

Locomotive Initials \_\_\_\_\_ Locomotive No. \_\_\_\_\_; Boiler No. \_\_\_\_\_;

Owned by \_\_\_\_\_

Operated by \_\_\_\_\_

Date work completed \_\_\_\_\_

Description of work: \_\_\_\_\_

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Stress Calculations:

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Remarks: \_\_\_\_\_

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Attach drawings used in the repair or alteration or make drawings on back of this form.

Work done by: \_\_\_\_\_;

Certified by: \_\_\_\_\_