

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

§ 230.24 **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.

§ 230.25 **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

§ 230.26 **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.

§ 230.27 **Maximum shearing strength of rivets.**

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

Rivets	Pounds per square inch
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

§ 230.28 **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

§ 230.29 **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 either of them, or the FRA inspector, considers it necessary due to other defects.

(b) *Repair standards.* (1) All defects disclosed by inspection shall be repaired in accordance with accepted industry standards—which may include established railroad practices, or NBIC or API established standards—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.

(2) Any welding to unstayed portions of the boiler made pursuant to §230.33 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.

§ 230.30 **Lap-joint seam boilers.**

Every boiler having lap-joint longitudinal seams without reinforcing plates

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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.

#### § 230.31 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 the FRA inspector, or the steam locomotive owner and/or operator, considers it necessary due to identifiable safety concerns.

#### § 230.32 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, 31service 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 the FRA inspector, or the steam locomotive owner and/or operator, considers it nec-

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essary due to identifiable safety concerns.

(b) *Method of inspection.*—(1) *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.

(2) *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.

(3) *Boiler exterior.* A thorough inspection shall be made of the entire exterior of the boiler while under hydrostatic pressure.

#### § 230.33 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 FRA Regional Administrator. 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 § 230.20 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 § 230.20 at this time.