Union Pacific Railroad

Mechanical Instructions

Steam Locomotives
and
Early Diesels

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UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

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"L" Group Numbers and Titles

Gen'l. Supt. MP&M
Omaha, July 1, 1947.

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-04-1

SUBJECT: CLEANING STEAM LOCOMOTIVES AND TENDERS
STANDARD PRACTICE

A. CAB:

Cab windows are to be cleaned as follows using thin paste consisting of water or denatured alcohol and whiting, or other approved window cleaner.

1. Road and helper locomotives before being dispatched from terminals.

2. Switch locomotives once each 24 hour period and subsequently to be dry wiped before each shift.

Cab deck is to be washed with water using hose and interior of cab to be wiped clean at each periodical or monthly inspection cleaning or more often as may be necessary.

B. RUNNING BOARDS, STEPS AND HANDHOLDS:

Grease and dirt are to be cleaned from top side of running boards and steps and from handholds and hand rails each trip prior to being dispatched for service.

C. TRIP AND WEEKLY CLEANING:

1. Road and Helper Locomotives and Tenders each round trip (Maintaining terminal).

Switch Locomotives and Tenders once each week.

(a) Accumulation of grease and dirt is to be removed from all parts, belly of boiler jacket, cylinder jacket and piping below running boards of locomotives and all parts and piping below underframe of tender spraying with CS-21 No. 7 Orange Label Cleaner mixed 1 part cleaner to 5 parts CS-26-C Motor Distillate, using special spray nozzles manufactured for this purpose. Where use of distillate or cresols which are flushed to sewers is prohibited by local ordinances, use CS-21 No. 9 Brown Label Cleaner mixed 1 part cleaner to 3 parts water. Allow solution to remain 15 minutes before rinsing.

(b) Remove cleaning solution by rinsing thoroughly with hot water at high pressure.

(c) To prevent rust, polished metal parts are to be given a coat of oil consisting of one part car oil to four parts petroleum distillate, using a soft brush or spray.

2. ABOVE RUNNING BOARDS AND TENDER TANK:

Passenger Locomotives and Tenders Each Round Trip (Maintaining Terminal).

Freight Locomotives and Tenders Once Each Week (Maintaining Terminal.)

Switch Locomotives and Tenders Once Each Week.

(a) Accumulation of grease and dirt is to be removed from boiler jacket, exterior of cab and tank of tender by washing with CS-21 No. 5 Green Label Cleaner at concentration of 4 oz. per gallon of water using stiff bristle brush or spray.

(b) Remove cleaning solution by rinsing thoroughly with water at line pressure. For best results allow cleaner to dry before rinsing.

D. MONTHLY AND PERIODICAL INSPECTION CLEANING:

1. BELOW RUNNING BOARDS AND BELOW TENDER FRAME:

(a) Accumulation of grease and dirt is to be removed from all parts, belly of boiler jacket, cylinder jacket and piping below running boards of locomotives and all parts and piping below underframe of tender by washing with CS-21 No. 7 Orange Label Cleaner mixed with 1 part cleaner to 5 parts CS-26-C Motor Distillate or CS-21 No. 9 Brown Label Cleaner as noted in Section C, paragraph (1-a) above.

(b) Remove cleaning solution by rinsing thoroughly with hot water at high pressure.

(c) Polished metal parts to be wiped dry to facilitate inspection and prevent rust.

(d) After inspection and work is completed, grease and dirt accumulated during inspection is to be cleaned off.

(e) Polished metal parts to be given a coat of oil consisting of one part car oil to four parts Motor Distillate to prevent rust, using a round soft brush or spray.

2. ABOVE RUNNING BOARD AND TENDER TANK:

(a) Accumulation of grease and dirt is to be removed from boiler jacket, exterior of cab and tender tank by washing with CS-21 No. 5 Green Label Cleaner at concentration of 4 oz. per gallon of water.

(b) Remove cleaning solution by rinsing thoroughly with water at line pressure.

(c) Touch up painting of exposed surfaces and lettering and numbering to be done after such surfaces are thoroughly cleaned and dry.

E. INTERIOR OF TENDER FUEL OIL TANKS:

When necessary to clean interior of tender fuel oil tank for repairs, fill tender about three quarters full of water, add one 400 lb. barrel of CS-21 No. 2 Yellow Label Lye Vat Cleaner. Connect tank heating coils and tank open heater pipe to steam lines and turn on steam to boil and agitate solution. Continue boiling as necessary (usually about 24 hours) then drain and rinse tank with hot water.

F. PRECAUTION:

Employes assigned to cleaning locomotives and tenders should wear rubber boots and rubber aprons, and exercise necessary care to protect hands and face.

By Order Of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

June 25, 1951

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-06-1

SUBJECT: METHOD OF CLEANING AIR COMPRESSORS ON STEAM LOCOMOTIVES.

INSTRUCTIONS:

When cleaning air compressors, air discharge pipe must be disconnected, strainers removed and cleaning pipes attached. Cleaning compound is to be pumped through air compressor for at least one hour (2 hours if possible) to remove gum and dirt. Hot water is then to be pumped through compressor until thoroughly cleaned.

Approved cleaner will be used at all points. When cleaners are used in laundry wagon tanks, tanks should not be filled more than one-half full, or even less, quantity used to be governed by judgment of the operator.

In making up cleaning solution the amount of water in the tank in gallons should be known and 1/2 lb. of approved cleaner added for each gallon of water. When solution weakens and amount of sludge in the tank is not too great, a small quantity of cleaner may be added to strengthen solution and its use continued, this procedure to be left to the judgment of the operator.

Shop Practice Folio sheet 78-B covers approved laundering equipment.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-07-1

SUBJECT: WELDING AND CUTTING - WATER COLUMNS, CAB TURRETS, CAB COCKS AND VALVES.

INSTRUCTIONS:

Welding or flame cutting will not be permitted on water columns, cab turrets, cab cocks and valves carrying boiler pressure.

Sand holes may be repaired by drilling, tapping and plugging, provided there is sufficient thickness of wall to hold the plug.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-08-1

SUBJECT: INSPECTION AND REPORTS
RECORD OF FIREBOX, STAYBOLTS, FLUES AND TUBES.

INSTRUCTIONS:

Form No. 7147 shall be used for reporting boiler and firebox repairs, staybolt, flue and tube replacements, whenever locomotive boilers receive running repairs, periodical inspections or classified repairs.

The Boiler Foreman shall promptly record the required information for each item of repair upon completion of work, date and sign the form. Officer in charge shall examine form as to correctness, sign, and forward to General Boiler Inspector, Omaha, Nebraska.

Form No. 7148, maintained by General Boiler Inspector, will be the master record for each locomotive boiler, compiled from information furnished on Form 7147.

By order of

General Boiler Inspector

Approved by

Gen'l Supt. MP&M

Mech. Supt. - Steam Power

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-09-1

SUBJECT: SHOP TOOLS - AIR HOSE COUPLINGS

INSTRUCTIONS:

Approved couplings, nipples and menders shown on latest issue of Drawing CD-7, "Air Hose Couplings," are to be used for shop air hose, squirt hose and air motor and air gun connections.

As an alternate for "Lowrey" gun nipples No. 21, 22 and 23-A, the following "Band-it" hose nipples have been approved:

Band-it Part No.	Size of Hose	Standard Pipe Thread Size
3814	3/8"	1/4"
1238	1/2"	3/8"
1212	1/2"	1/2"
3434	3/4"	3/4"

When "Band-it" gun nipples are used they must be properly secured by double "Band-it" bands anchored with "Band-it" buckles and applied with the regular "Band-it" tools.

Couplings, nipples and menders should be removed from unusable hose and used for mounting on other hose.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

November 14, 1949

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-09-2

SUBJECT: SHOP TOOLS - CHAIN FOR BLOCKING LOCOMOTIVES.

INSTRUCTIONS:

Locomotives in enginehouses, on circle tracks, and at other locations when required, are to have both front and back side of one driving wheel blocked with chain manufactured in accordance with latest issue of Drawing 091-CA-24247. Special link is attached to one end of chain to avoid possibility of personal injury when placing or removing chain.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-09-3

SUBJECT: SHOP TOOLS - STANDARD PRESSURES FOR MOUNTING WHEELS ON AXLES AND APPLYING CRANK PINS.

INSTRUCTIONS:

All future mounting of wheels on axles and crank pins in wheel centers must be in accordance with pressures shown on latest issue of Drawing 093-CD-18, using pressures shown in column marked "Preferred" where preferred pressures are indicated, and pressures approximately midway between "Minimum" and "Maximum" allowances for those items for which no "Preferred" pressures are shown.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-09-4

SUBJECT: SHOP TOOLS - SPRING CLAMP PLATES.

INSTRUCTIONS:

When removing or replacing elliptic bolster spring from locomotive tenders, special device incorporating use of hydraulic jack should be used at heavy repair points where such apparatus is available.

At lighter repair points, clamp plates shown on latest issue of Drawing 093-CB-23558 should be used. A sufficient number of clamp plates, Types 1 and 2, and of filler plates of varying widths to meet requirements should be manufactured by each shop requiring these tools.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-09-5

SUBJECT: INSTRUCTIONS FOR WITHDRAWAL OF STEAM LOCOMOTIVES FROM SERVICE FOR STORAGE OR AWAITING SHOP.

INSTRUCTIONS:

The following instructions will govern the selection and preparation of steam locomotives withdrawn from service for storage or awaiting shop:

1. Master Mechanics will currently confer with Division Superintendents to determine the number and classes of locomotives needed to meet transportation requirements. When the number of locomotives in service exceeds the minimum requirements, the assignmer should be immediately reduced.

2. Locomotives to be withdrawn from the assignment and removed fron service should be selected in the following preference according to classes of locomotives:

   (a) Locomotives to be placed in shop or set aside awaiting shop attention.

   (b) Locomotives in thorough condition - good for 11 or more months service.

   (c) Locomotives in good condition - good for 4 to 10 months service.

   (d) Locomotives in poor condition - good for 1 to 3 months service.

3. Repairs to locomotives withdrawn from service for shop repairs c set aside awaiting shop, should be handled consistently with service demands for various classes of power.

4. Locomotives released from shop and not required for immediate service should be thoroughly broken in and prepared for storage.

5. Locomotives withdrawn from storage for necessary service assignment should be selected in the following preference, according t classes of locomotives:

   (a) Locomotives in poor condition - good for 1 to 3 months service.

   (b) Locomotives in good condition - good for 4 to 10 months service.

   (c) Locomotives in thorough condition - good for 11 or more months service.

   (d) Locomotives which have made no mileage since released from shop.

6. Serviceable locomotives must be inspected before being placed in storage and all necessary work performed to permit locomotive being placed in service within a maximum of eight (8) hours when required for use.

7. Locomotives awaiting shop for intermediate repairs, or stored serviceable, must not be stripped of any part or parts except on written authority of Mechanical Superintendent - Steam Power who will advise this office of parts removed, and reason and necessity therefor, and arrangements made for replacement.

8. Locomotives awaiting shop for general repairs must not be stripped of any part or parts except on written authority of Master Mechanic, who will advise Mechanical Superintendent - Steam Power, copy to this office of parts removed, and reason and necessity therefor, and arrangements made for replacement.

9. Supervisors at terminals will arrange for semi-monthly inspection of locomotives in storage or awaiting shop to know that parts have not been removed except as authorized and that adequate protection is being afforded. Special Service Department must be immediately advised of any loss by theft, with copy to General Manager, Division Superintendent, Mechanical Superintendent - Steam Power and General Superintendent MP&M for their further handling.

10. Master Mechanics, Terminal Master Mechanics, Road Foremen of Engines, and other mechanical officers, when at terminals where locomotives are stored or held awaiting shop, will make periodical inspections to know that locomotives have been prepared in accordance with instructions and that locomotives stored serviceable can be made ready for immediate use.

11. All tools, supplies, fuel, and parts removed and released to Stores Department when preparing locomotives for storage, should be credited to the individual locomotive from which removed.

12. Notice in 3" letters reading:

THIS ENGINE IN STORAGE
REMOVE NO PARTS

shall be either stenciled on boarding over cab windows or on sheet metal sign manufactured from scrap or second hand material to be securely attached to boarding over cab windows, on both sides of cab of all locomotives in storage for long or short periods, or awaiting shop.

13. PREPARATION OF LOCOMOTIVES FOR TEMPORARY STORAGE:

(a) Drain boiler and remove washout plugs at mud ring corners. Apply white lead to threads on plugs and in sheets.

(b) Blow out superheater units with compressed air in boiler.

(c) Cover smoke stack or stacks with right cylinder head casing or make wood or sheet metal covers to suit.

(d) Drain air pumps, feed water pumps, injectors and feed water heater.

(e) Drain hydrostatic and mechanical lubricators, and where pipes are disconnected, ends to be turned down to provide drainage.

(f) Disconnect and drain steam and air gauges and wire gaskets to pipe to avoid loss.

(g) Remove globes from headlight, back-up light, marker lights and cab lights, and return to store stock, obtaining credit.

(h) Cover headlight, back-up light and marker lights with canvas boots.

(i) White lead polished rods, motion work, guides and exposed portion of piston rods.

(j) Generator end of turbo-generator to be covered with weather-proof canvas to avoid water getting in generator.

(k) Air, steam heat and tank hose to be disconnected, drained and tied up to provide clearance should engine be moved.

(l) Remove all tools and supplies and return to store stock, obtaining credit.

(m) Drain water from tender.
Unload all coal, clean out coal space and apply coat of no-oxide preservative or paint.
Drain oil from tenders of oil burning locomotives.

(n) Board up cab windows, cab doors and opening across back of cab.

14. PREPARATION OF LOCOMOTIVES STORED FOR LONG PERIOD:

(a) Drain boiler.

(b) Blow out superheater units with compressed air in boiler.

(c) Cover smoke stack or stacks with right cylinder head casing or make wood or sheet metal covers to suit.

(d) Drain air pumps, feed water pumps, injectors and feed water heater.

(e) Drain hydrostatic and mechanical lubricators and where pipes are disconnected, ends to be turned down to provide drainage.

(f) Disconnect and drain steam and air gauges, and wire gaskets to pipe to avoid loss.

(g) Remove globes from headlight, back-up light, marker lights and cab lights, and return to store stock, obtaining credit.

(h) Cover headlight, back-up light and marker lights, with canvas boot.

(i) White lead polished rods, motion work, guides and exposed portions of piston rods.

(j) Generator end of turbo-generator to be covered with weather-proof canvas to avoid water getting in generator.

(k) Remove air, steam heat and tank hose, and return to store stock, obtaining credit.

(l) Remove all tools and supplies and return to store stock, obtaining credit.

(m) Drain water from tender.
Unload all coal, clean out coal space and apply coat of no-oxide preservative or paint.
Drain oil from tenders of oil burning locomotives.

(n) Board up cab windows, cab doors and opening across back of cab.

(o) Remove all cab curtains, mark same to show engine number, and store in a dry place.

(p) Boilers of locomotives must be prepared against corrosion as follows:

Place 25 pounds of anti-corrosion compound broken up in small pieces in boiling water. Stir until dissolved and pour solution into empty boiler. Fill boiler entirely full with warm water through blow-off cock and allow to stand for several hours. Boiler must then be emptied and all openings closed to exclude air from circulating and drying it out. When locomotives can be placed adjacent to each other, this water can be pumped into another boiler through hydrostatic pump. When solution is used in more than two boilers, 5 pounds of anti-corrosion compound, thoroughly dissolved, should be added for each additional boiler.

By order of

Mechanical Supt. Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska
February 28, 1950

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-11-1

SUBJECT: AXLES - DRIVING - INSPECTION AND LIMIT OF SERVICE.

INSTRUCTIONS:

1. ALL LOCOMOTIVE DRIVING AXLES WITH PLAIN BEARINGS:

   (a) All driving axles are to be thoroughly cleaned and given Magnaflux test and inspection of all exposed surfaces for fractures or other defects whenever locomotives are shopped for classified repairs or wheels are sent to wheel shops.

   (b) If fractures are found, sufficient metal should be removed for further test to positively determine if defects can be eliminated and axle can be safely returned to service. If defects cannot be removed or if axle has reached condemning limits new axle must be applied.

   (c) This inspection does not require pressing wheel center off axle.

   (d) Axle journals must be rolled or ground after turning.

2. LOCOMOTIVE DRIVING AXLES WITH ROLLER BEARINGS:

   (a) After thoroughly cleaning, axles are to have Magnaflux test and inspection of all exposed surfaces whenever locomotives are shopped for classified repairs or wheels are sent to wheel shops.

   (b) At nearest shopping period representing mileage shown below driving axles must have driving wheels pressed off for a distance of 3" and axles given Magnaflux test and inspection on wheel fit portion of axles for evidence of fatigue cracks as follows:

	Axles with stress relief grooves	Axles without stress relief grooves
(1) Freight Locomotives		
Main Axles	350,000 miles	75,000 miles
Other than Main Axles	350,000 miles	200,000 miles
(2) Passenger Locomotives		
Main Axles	350,000 miles	200,000 miles
Other than Main Axles	350,000 miles	200,000 miles

   (3) When corrosion rings are in evidence at wheel fit, such corrosion rings must be carefully removed, polished and the area inspected for defects.

(4) All axles found defective are to be removed from service and reported to Office of General Superintendent MP&M.

3. AXLES UNMOUNTED:

All unmounted axles must be given Magnaflux test and inspection over entire surface and carefully examined for indications of incipient cracks before wheels are mounted.

4. MARKING:

Marking of axles which have had Magnaflux test and inspection should be handled as follows:

Axles found good for service must be marked by stamping on end of axle in 1/8" letters and figures to show date and place axle was Magnaflux tested and whether axle had wheels mounted or unmounted when test was made.

Shop symbols:

A - Albina	O - Omaha Shop
C - Cheyenne	P - Pocatello
D - Denver	PR - Provo
K - Kansas City	S - Salt Lake City
L - Los Angeles	

Indication as to whether axle had wheels mounted or unmounted:

Wheel assembly with wheels mounted on axle	Bare axle without wheels applied
Stencil - 1 after shop symbol.	Stencil - 2 after shop symbol.

Following are examples showing manner in which stenciling should be applied:

M-3-53-A-1
M-3-53-C-2

The first example would indicate that wheel assembly was Magnaflux tested in March 1953 at Albina and that wheels were mounted when tested.

The second example would indicate that bare axle was Magnaflux tested in March 1953 at Cheyenne and that wheels were not mounted when test was made.

Axles removed from service account defects are to be stenciled with white paint in 1-inch letters and figures as per following example:

Defective M-test 3-53-A

5. LIMIT OF SERVICE:

(a) Limit of service for main driving axles with roller bearings is to be as follows:

(1) Main roller bearing driving axles made of low carbon nickel steel CS-82 (stamped LC-NKL-Q on ends of axles) are to be removed after 750000 miles of service at the nearest shopping period representing this mileage.

This extension of 150000 service miles is with the understanding that at the nearest shopping period representing 600000 miles, these CS-82 roller bearing main driving axles must have driving wheels pressed off for a distance of 3" and the axles given both a Magnaflux and Reflectoscope test and inspection on wheel fit portion of axles for evidence of fatigue cracks or other defects.

(2) Main roller bearing driving axles made of steel to specification AAR M-127-47 or later issue, SAE-8630, or any other materials substituted for low carbon nickel steel CS-82, are to be removed after 600000 miles of service at the nearest shopping period representing this mileage.

(b) All driving axles with plain bearings must be removed from service when journals are 1/2 inch under original diameter.

6. UTILIZATION OF MAIN DRIVING AXLES:

(a) Main driving axles with 4" hollow bore removed from locomotives Nos. 800-844, 3700-3707, 3930-3949 and 4000-4024 are to be turned down and used for main driving axles of 5000 class locomotives or for driving axles of locomotives 3815-3839.

(b) Driving axles with 4" or 4-1/2" hollow bore released from other than main wheel positions of 4000 and 3700-3707, 3930-3949 class locomotives and all driving axles released from 3708-3717, 3950-3999 class locomotives may be reused for main drivers of 2860 and 2200 class locomotives provided that all surface defects can be removed by machining and Magnaflux test shows axle to be free from all defects.

(c) Main driving axles with 5-1/2" hollow bore released from 4000-class locomotives may be used for main drivers of 5000 class locomotives provided that all surface defects can be removed by machining and Magnaflux test shows axle to be entirely free from defects.

(d) Main driving axles removed from locomotives 3815-3839 are to be turned down and used for driving axles of locomotives 3800-3814 provided Magnaflux test shows axle to be entirely free from defects.

(e) Main driving axles when turned down for use on other power are to be given Magnaflux test and inspection to definitely establish that sufficient metal has been removed to eliminate all fatigue cracks.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l. Supt. MP&M

Omaha, Nebraska

March 5, 1953

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-11-2

SUBJECT: AXLES - ENGINE TRUCK, TRAILER TRUCK AND TENDER TRUCK OF STEAM LOCOMOTIVES - TESTING AND INSPECTING.

INSTRUCTIONS:

Each used or new axle for engine trucks, trailer trucks, or tender trucks of steam locomotives must be tested and inspected in Wheel Shops in accordance with procedure outlined below, before returning the used axle to service, also placing the new axle in service, until such time as arrangements can be made to have manufacturers make Magnaflux test of new axles.

1. Axles in Shop with Wheels Mounted for Turning of Tread, Replacing Tires or Other Work:

   (a) Sandblast or otherwise thoroughly clean surface of axle between wheel seats, except bearing surface of assemblies with inside bearings, removing all rust and scale.

   (b) Magnaflux test and inspect entire exposed surface of axle, including portion of axle between wheel seats.

   (c) When roller bearings have been removed from axle on account of having been overheated, or for other reasons, Magnaflux test must be made of axle bearing surfaces; otherwise bearings should not be disturbed.

   (d) Make thorough surface inspection of area between wheel seats for fractures, especially at nicks, dents, center punch marks or chisel marks and at any other apparent surface defects.

   (e) If no incipient fractures are found, all light nicks, dents, center punch or chisel marks, etc., must be completely removed with grinder or by filing with "smooth" mill file and followed with emery cloth.

   Removal of such surface defects must be carefully done and tapered off gradually to avoid abrupt change in section, or the formation of shoulders or offsets in the axle.

   Diameter of the axle at point where defect is removed must not be reduced more than 1/16" under the nominal diameter of new axle.

2. Axles in Shop for Dismounting Wheels:

   (a) Sandblast or otherwise thoroughly clean surface of axle between wheel seats, except bearing surfaces of assemblies with inside bearings, and dismount wheels.

(b) Make Magnaflux test and inspection of entire surface of axle.

(c) Perform all work specified in paragraphs 1(d) and 1(e) as shown above, giving special attention to wheel seats and journals.

3. Axles in Stock - Unmounted:

All secondhand axles in stock must be given Magnaflux test over entire surface and carefully examined for indentations or incipient cracks, performing all necessary work as covered by Items 1(d) and 1(e) before releasing the axle for service. Similar check must be made on new axles until such time as this work is handled by manufacturers.

4. Marking:

Marking of axles which have had Magnaflux test and inspection should be handled as follows:

Axles found good for service must be marked by stamping on end of axle opposite manufacturer's markings in 1/8" letters and figures to show date and place axle was Magnaflux tested and whether axle had wheels mounted or unmounted when test was made.

Shop symbols:

A - Albina	O - Omaha Shop
C - Cheyenne	P - Pocatello
D - Denver	PR - Provo
K - Kansas City	S - Salt Lake City
L - Los Angeles	

Indication as to whether axle had wheels mounted or unmounted:

Wheel assembly with wheels mounted on axle.	Bare axle without wheels applied.
Stencil - 1 after shop symbol.	Stencil - 2 after shop symbol.

Following are examples showing manner in which stencilling should be applied:

M-3-47-A-1
M-3-47-C-2

The first example would indicate that wheel assembly was Magnaflux tested in March 1947 at Albina and that wheels were mounted when tested.

The second example would indicate that bare axle was Magnaflux tested in March 1947 at Cheyenne and that wheels were not mounted when test was made.

Axles removed from service account defects are to be stencilled with white paint in 1 inch letters and figures as per following example:

Defective M-test 3-47-A

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-13-1

SUBJECT: BOILER - TESTING

INSTRUCTIONS:

When applying Hydrostatic Test to locomotive boilers and appurtenances the following instructions and practices must be followed:

(a) ICC Rules governing Testing of Boilers and Staybolt Testing:
17. Time of Testing
18. Removal of Dome Cap
19. Witness of Test
20. Repairs and Steam Test
21. Time of Testing Rigid Bolts
22. Method of Testing Rigid Bolts
23. 23(b), 23(c), 23(d) and 23(e). Method of Testing Flexible Staybolts and Caps.
24. Method of Testing Flexible Staybolts without caps
25. Broken Staybolts
26. Telltale Holes

(b) When applying hydrostatic test as required under Rule 17, pressure must be 25 per cent above working steam pressure.

(c) When applying hydrostatic test at monthly inspection periods and at other times, test should be applied through the boiler and hydrostatic pressure must not be less than allowed working pressure, and while under this pressure, flues, superheater units, steam pipes, nozzle joints, fire box sheets and bolts must be closely examined for defects.
Any defects noted by the above inspection must be corrected before locomotive is released for service.

(d) Safety valves must be removed and holes plugged or approved test gag used. In no case should pops be screwed down to permit increasing pressure.

(e) After fire is knocked and boiler blown down, water used for test should not be less than 150 degrees nor more than 180 degrees temperature. If boiler is cold, fill with water from source of supply and heat by steam to above temperature.

(f) When filling boilers of locomotives equipped with front end throttle, throttle valves and steam chest bleed valves should be opened and remain in open position until all air is discharged from superheater header and steam pipes.

(g) When filling boiler of any locomotives, syphon cock behind dome should be left open, also dome cover should be left loose, until water appears at both syphon cock and dome cover indicating all air has been expelled from boiler, after which syphon cock is to be closed and dome cover tightened until hydrostatic test is completed.

By order of

Actg. General Boiler Inspector

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

April 28, 1949

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-14-1

SUBJECT: BOILER DETAILS - SAFE ENDS FOR TUBES AND FLUES.

INSTRUCTIONS:

The following instructions govern the application of safe ends to boiler tubes and flues of all classes of locomotives.

Tubes and flues must be clean and free from scale.

Safe ends shall be cut and tubes and flues shall be reamed to an angle of 35 degrees as shown on drawing, when fire welded.

Safe ends only shall be cut to an angle of 35 degrees, and tubes and flues shall be reamed only enough to remove sharp corners from inner edges as shown on drawing when electric welded in machines on which pressure is used.

APPLICATION OF SAFE ENDS:

(a) Safe ends made by fire weld or electric welding machine in which pressure is used:

Not more than three safe ends on either end are to be applied to 2" and 2-1/4" diameter tubes. No weld to be more than 48" from end of tube.

Not more than two safe ends on either end are to be applied to 3-1/2", 3-3/4" and 4" diameter flues. No weld to be more than 36" from end of flue.

Not more than one safe end on either end is to be applied to 5-3/8" and 5-1/2" diameter fluos. No weld to be more than 24" from end of flue.

Old safe ends on tubes and flues are to be cut off not less than 2" back of first weld and no weld shall be within 4" of end of tube or flue.

(b) Safe ends made on flash butt welding machines used at Cheyenne and Pocatello Shops:

No restrictions as to number of safe ends to be applied to tubes and flues when applied by flash butt welding machine except no weld to be more than 60" from end of tube or flue.

For Locomotives 800-844 and 4000-4024 with 300 pound boiler pressure, no weld may be more than 24" from end of flue. Tubes and flues for 800-844 and 4000-4024 must be safe ended only on flash butt welding machines at Cheyenne and Pocatello Shops.

Sizes of tubes and flues for these classes of locomotives are as follows:

Locomotives	Sizes of Tubes and Flues
800-819	2-1/4" and 5-1/2"
820-834	2-1/4" and 3-3/4"
835-844	2-1/4" and 5-1/2"
4000-4019	2-1/4" and 4"
4020-4024	2-1/4" and 5-1/2"

RECLAIMING SHORT END OF NEW TUBES AND FLUES:

All short pieces of new flues and tubes 6" long or over are to be returned to Cheyenne and Pocatello Shops for making safe ends.

By order of

General Boiler Inspector

Approved by

Gen'l Supt. MP&M

Mech. Supt. - Steam Power

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-14-2

SUBJECT: BOILER DETAILS - CONDITION OF STAYBOLTS.

INSTRUCTIONS:

For series of locomotives shown below, the following inspection of staybolts must be made:

At each semi-annual and annual inspection period all staybolts, beginning with fourth row from center of crown sheet, each side of center line and extending to and including lower row of staybolts in short radius at sides, must be bombarded with No. 60 air hammer, using staybolt snap to fit on and over the head.

After staybolts have been bombarded boiler is to be filled with water and a pressure of not less than 100 lbs. applied. Every crown stay and staybolt in the designated areas must then be hammer tested.

All staybolts found defective must be replaced.

Locomotives of the following classes shall be included:

CLASS	U.P.	O.S.L.	O.W.	L.A.
MacA-3-10	2200-2320	2504-2564	2166-2171	2700-2735
MacA-Spec	2480-2499	2535-2554		
P-7-13	2860-2911	3114-3138	3218-3227	3176-3181
SAC-2-6	3500-3564	3565-3566	3567-3569	
2882	3570-3599			
	3670-3674			
CSA-1-2	3800-3839			
4664-3-5	3930-3999			
4884-1-2	4000-4024			
TTT-1-6	5000-5089	5300-5318	5400-5414	5525-5529
TTT-6	5306-5313			
TTT-6-7	5500-5524			
FTT-1-2				5090-5099
MT-1	7000-7039			7850-7864
MT-2	7865-7869			
UP-1-5	9000-9087	9500-9514		
FEF-1-3	800-844			

By order of

General Boiler Inspector

.. Approved by
Gen'l Supt. MP&M
Mech. Supt. - Steam Power
Omaha, Nebraska
July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-14-3

SUBJECT: BOILER DETAILS - TOP BOILER CHECKS.

INSTRUCTIONS:

The following instructions govern the servicing of top boiler checks on Locomotives series 820-844, 3800-3839, 3930-3999, 4000-4024 and such other locomotives as may hereafter be provided with this type of boiler check.

Boiler checks must be examined at each classified repairs and any found with excess scale should be removed and all scale eliminated from internal body of check and spreader by scraping followed by immersing in approved hot solution for about 30 minutes.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-1

SUBJECT: BOLTS, STUDS AND KEYS - ECCENTRIC CRANK BOLTS.

INSTRUCTIONS:

Eccentric crank bolts used for securing the eccentric crank to main crank pin must be limited in oversize to 1/4" larger than diameter specified on drawing. Main crank pins and eccentric cranks with bolt holes over the above limitation will be renewed at first classified repair shopping.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-15-2

SUBJECT: BOLTS, STUDS AND KEYS - SPRING WASHERS.

INSTRUCTIONS:

Mechanical Instructions L-15-2, dated July 1, 1947, are hereby canceled in their entirety.

Use of improved Hi-Power spring washers is to be completely discontinued on all steam locomotive parts.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l. Supt. MP&M

Omaha, Nebraska

February 6, 1952

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-15-3

SUBJECT: BOLTS, STUDS AND KEYS - MATERIAL OF.

INSTRUCTIONS:

Bolts and studs made of chrome-nickel steel Specification C.S. 87-A are to be used in the following locations, in addition to other locations already specified on drawings:

Exhaust nozzle stand bolts and studs
High pressure steam pipe flange bolts and studs
Injector check bolts or studs
Crank pin collar bolts
Main rod wedge bolts
Engine truck pedestal thimble bolts
Guide bolts
Tapered seat nuts for guide bolts
Pedestal cap bolts
Superheater header bolts
Boiler saddle bolts
Main and side rod grease cup bolts
Eccentric rod grease cup bolts
Radial buffer bolts
Injector and injector piping flange bolts
Exhaust steam injector and piping flange bolts
Exhaust pipe flange bolts on articulated locomotives
Eccentric crank bolts

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-1

SUBJECT: BOXES - DRIVING - CELLARS.

INSTRUCTIONS:

All the latest design reinforced driving boxes for MT 1-2 and TTT 1-7 class locomotives must be provided with cast steel cellars and steel end plates in accordance with drawings.

Cellars must be fitted into driving boxes and held in place by two 1" diameter bolts, made from engine bolt steel and provided with castle nuts. The cast steel cellar is to form a fixed strut across the bottom of the box and thus preserve parallel shoe and wedge faces. It is not permissible to plane off cellars for clearance. Lugs are provided in boxes for jacking cellars in and out. Cellar must be bolted in place when crown brass is pressed in and when shoe and wedge faces are machined.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-2

SUBJECT: BOXES - DRIVING - LUBRICATOR AND CELLAR.

INSTRUCTIONS:

To avoid application of improper size driving box cellars and lubricators to various classes locomotives equipped with plain bearings, check should be made of the following parts when receiving classified repairs.

DRIVING BOX CELLARS:

Inside dimensions (length and width) should not be less than shown on drawings. If any cellars are found less than specified dimensions, they should be made to conform.

PERFORATED PLATES:

Outside dimensions should not be more than specified on drawings. Templates may be used for checking if desired.

FOLLOWER PLATES:

Outside dimensions should not be more than shown on drawings.

END PLATES:

Clearance between journals and end plate on both inside and outside ends of cellar must not be less than 1/8".

It is very important that the proper clearances for driving box lubricators be maintained at all times to insure proper operation.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-3

SUBJECT: BOXES - DRIVING - LUBRICATORS.

INSTRUCTIONS:

All driving box lubricator springs must be removed and tested periodically to insure proper spring tension at all times.

Coil springs (two per box) used only with 12" x 16" driving box lubricators, have a normal free height of 5½" and must withstand a load of 40# to 45# when compressed 4½" or to within 1" of solid height.

Coil springs (single) used on driving box lubricators other than above mentioned size, have normal free height of 6½" and must withstand a load of 76# to 80# when compressed 5½" or to within 1" of solid height.

Springs failing to meet the above requirements will be scrapped. Any serviceable follower plates attached to springs should be reclaimed.

Each cellar packer's bench will be provided with two suitable standard weights, namely 42-1/2 lb. and 78 lb. for testing compression of springs.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-4

SUBJECT: BOXES - DRIVING - HUB FACE LINING.

INSTRUCTIONS:

All driving boxes with plain bearings should have hub lateral wearing faces of No. 10 B.W.G. 2-1/2" x 2-1/2" bronze netting welded to driving box hub face and approved bearing metal applied.

Bronze netting should be applied to hub face prior to application of approved bearing metal in accordance with latest drawings using the following method:

(a) Braze the edge of netting 1/4" in width and thickness around entire edge by oxy-acetylene method, using approved bronze welding rod, 1/8" or 3/16" diameter.

(b) Extreme care must be taken to prevent burning of netting.

(c) Place bronze netting flat on hub surface of box and electric weld the built-up edge of netting to box using approved electric center grip shielded phosphor bronze electrode. Positive current (Reverse Polarity).

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-5

SUBJECT: BOXES - DRIVING - LATERAL CUSHIONING DEVICE MAINTENANCE AND OPERATION.

INSTRUCTIONS:

All concerned with maintaining and servicing lateral cushioning devices should become entirely familiar with the operation, construction, application and maintenance. It is imperative that these devices be properly applied, maintained and serviced. Misapplication or faulty adjustment of parts or neglect to service may cause derailment of locomotive.

A. PURPOSE:

The purpose of a lateral cushioning device is to provide controlled lateral. When locomotive is on curved track this controlled lateral operates to relieve lateral pressure between rail and tire flange, reduce lateral stresses in both locomotive and track, prevent possible derailment of locomotive on curves or when passing through yard crossovers, and to improve riding qualities of locomotive.

Each lateral cushioning device assembly provides a certain initial resistance to lateral movement of the driving boxes. Resistance and lateral requirements vary with each individual pair of drivers and each lateral cushioning device is designed to meet these requirements.

B. OPERATION:

On straight track the springs of a lateral cushioning device exert designed pressure against spring seats. Spring seats are so arranged that no outward movement of spring seats is possible. With driving boxes in central position, a clearance of 1/32" is provided on each side which permits 1/32" lateral movement of driving box before encountering initial resistance of lateral cushioning device.

When entering a curve, the wheel flange against outer rail moves inwardly, carrying with it the axle and driving box. Greater lateral movement increases spring compression for cushioning lateral displacement end shock. Maximum lateral displacement occurs when outer flange of driving box contacts frame pedestal shoes.

On leaving curve, springs return driving box to normal position.

Lateral cushioning devices will not function as intended unless properly maintained. A lateral cushioning device not operating properly may cause driving wheel base to become rigid and thereby contribute to possible damage to rail on curves or crossovers.

C. TYPES:

Lateral cushioning devices using coil springs for the resistance elements are of two types:

(a) Direct compression type using inner coils of A.A.R. class "G" springs.

(b) Lever type using outer coils of A.A.R. class "G" springs.

The direct compression type is used on both plain and roller bearing boxes. The lever type is an earlier design and was applied to plain bearing boxes only.

D. DIRECT COMPRESSION TYPE - ROLLER BEARING LOCOMOTIVES:

(a) Construction:

Each lateral cushioning device assembly consists of two coil springs, one shaft, one shaft washer, and two spring seats. Four spring seat lugs, integral with the driving box housing, support one lateral cushioning device assembly ahead of driving box housing and one assembly behind. Both assemblies are between frames on horizontal center line of axle. Plunger ends of spring seats operate in lugs and are retained in place by keeper bolts.

With driving box housing in normal position, central between frames, a clearance of 1/32" exists between plunger ends of spring seats and hardened steel wear plates welded to frames.

Plunger ends of spring seats are drilled and tapped to provide soft grease lubrication to wearing surfaces.

(b) Application:

Lateral cushioning devices must be applied strictly in accordance with drawings.

Driving boxes must be set up so that, with boxes in central position, clearances between frame shoes and driving box lateral wear plates are in accordance with application drawings.

Spring seat plungers must be fitted to slide freely in lugs. With driving box housing in central position spring seat plungers must shoulder against lugs and clear frame wear plates 1/32" both sides.

Spring saddles must clear frames 1/4" with full amount of lateral travel.

(c) Maintenance:

Clearance between lateral cushioning device spring seats and wear plates must be checked and maintained at 1/32" on each side with boxes central between frames. All lateral cushioning devices having clearance in excess of 1/32" on each side must be restored to 1/32" clearance.

Particular attention is called to the importance of maintaining lateral motion spring seats to drawing dimensions so that plunger part of spring seat will have travel for which it was designed. If length of spring seat plunger is less than drawing dimension, and thickness of wear plate greater than standard, it will permit box to foul wear plate.

Worn spring seat ends and shoulders are to be built up by electric process using Toolweld No. 60 welding rod or equal, after which seats are to have built-up faces ground to drawing dimensions.

Spring seats must be lubricated at each maintenance terminal before locomotive is dispatched for service on all locomotives not equipped with force feed lubrication.

E. DIRECT COMPRESSION TYPE - PLAIN BEARING LOCOMOTIVES:

(a) Construction:

Lateral cushioning devices of the direct compression type applied to plain bearing driving boxes differ slightly from those used with roller bearings. Each assembly consists of two coil springs, one shaft, one shaft washer, two spring seats and two shaft pins. Elongated holes at each end of the shaft are so located that when spring seats are pinned to shaft the spring seats compress springs to the designed initial resistance. The elongated holes permit lateral movement of the spring seat against spring resistance. Four yokes welded to driving boxes support one lateral cushioning device assembly ahead of axle and one assembly behind axle. When distance between driving boxes varies from drawing dimensions, adjustment may be made by altering thickness of yoke liner.

With driving box in normal position there is a clearance of 1/32" on each side between face of frame shoe and inside flange of driving box. Clearance between spring seats and driving box is taken up by means of a yoke liner.

(b) Application:

Lateral cushioning devices must be applied strictly in accordance with drawings.

Driving boxes must be set up so that, with boxes in normal position, there is 1/32" clearance between frame shoes and inside flanges of driving boxes.

Dimensions of assembled lateral cushioning device must agree with assembly drawing. Vary thickness of yoke liner to take up any clearance between end of spring seat and driving box.

Spring saddles must clear frames 1/4" with full amount of lateral travel.

(c) Maintenance:

With this design of lateral cushioning device it is important that elongated hole at each end of shaft and pin securing spring seat to shaft be maintained to drawing dimensions in order that springs will provide resistance for which device was designed.

F. LEVER TYPE - PLAIN BEARING LOCOMOTIVES:

(a) Construction:

This type of lateral cushioning device consists of two levers, two shaft bearings, one spring housing, two springs, one spring sleeve, one spring bolt, one spring seat, two lever shafts and four rollers pin connected to lower end of levers.

Levers fulcrum on shafts supported from frames directly above driving axle.

Top ends of levers seat on spring bolt and spring housing. Levers are of forked construction and are provided with extension lugs for resting against frames or crossties. Rollers on forked ends of levers contact driving box when box is in normal position.

(b) Application:

Lateral cushioning devices must be applied strictly in accordance with drawings.

With 1/32" clearance between inside flanges of driving boxes and frame shoes, stop lugs of levers and rollers must contact main frame and driving boxes. Adjust nut on spring bolt so that distance between spring seats agrees with dimension specified on drawing.

Spring saddles must clear frames 1/4" with full amount of lateral travel.

(c) Maintenance

Stop lugs and rollers on levers must contact driving boxes and main frame and 1/32" clearance maintained between inside flanges of driving boxes and frame shoes when boxes are in normal position. Rollers worn out of round must be replaced. Stop lugs must be adjusted by using hardened steel liners of necessary thickness tack welded to frame. Bearing surface for lever rollers on inside face of driving box must be maintained to drawing dimension, building up by welding and remachining if necessary.

Adjust spring bolt nut so that distance between spring seats is in accordance with drawing dimension.

Cushioning device must be lubricated at each maintenance terminal before locomotive is dispatched for service.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-6

SUBJECT: AXLE ROLLER BEARINGS - MARKING.

INSTRUCTIONS:

Axle roller bearings are to have serial number assigned and placed on each bearing.

(a) Serial number is to be marked in 1/4" letters and figures on outer race of each bearing. Where two separate bearings are used for one journal, each bearing is to be marked with a different serial number. Serial number is to be used by all shops and terminals in reporting bearings.

(b) Bearings are to be marked with approved electric marker. Care must be exercised to make markings legible.

(c) Bearings without serial number when removed from axle or drawn from store stock are to have serial number applied.

(d) A group of serial numbers for each type of bearing has been assigned to each main terminal as indicated in Item (e). Numbers are to be used consecutively and to avoid duplication of numbers a record must be kept by each wheel shop showing numbers applied to bearings.

(e) Series of numbers preceded by letters designating type of roller bearing are assigned to each terminal as follows:

Omaha

Timken	RT1 to RT999	Timken	RT9000 to RT9999
SKF	RS1 to RS999	SKF	RS9000 to RS9999
Hyatt	RH1 to RH999	Hyatt	RH9000 to RH9999
A.S.F.	RA1 to RA999	A.S.F.	RA9000 to RA9999

Timken	RT10000 to RT10999
SKF	RS10000 to RS10999
Hyatt	RH10000 to RH10999
A.S.F.	RA10000 to RA10999
Timken	RT15000 to RT15999
SKF	RS15000 to RS16999

Denver		Albina	
Timken	RT1000 to RT1999	Timken	RT2000 to RT2999
SKF	RS1000 to RS1999	SKF	RS2000 to RS2999
Hyatt	RH1000 to RH1999	Hyatt	RH2000 to RH2999
A.S.F.	RA1000 to RA1999	A.S.F.	RA2000 to RA2999

Los Angeles

Timken - RT3000 to RT3999
SKF - RS3000 to RS3999
Hyatt - RH3000 to RH3999
A.S.F. - RA3000 to RA3999

Pocatello

Timken - RT5000 to RT5999
SKF - RS5000 to RS5999
Hyatt - RH5000 to RH5999
A.S.F. - RA5000 to RA5999

Cheyenne

Timken - RT4000 to RT4999
SKF - RS4000 to RS4999
Hyatt - RH4000 to RH4999
A.S.F. - RA4000 to RA4999

Timken - RT11000 to RT11999
SKF - RS11000 to RS11999
Hyatt - RH11000 to RH11999
A.S.F. - RA11000 to RA11999

Timken - RT12000 to RT14999
SKF - RS12000 to RS14999

Kansas Divn.

Timken - RT6000 to RT6999
SKF - RS6000 to RS6999
Hyatt - RH6000 to RH6999
A.S.F. - RA6000 to RA6999

C&NW - Chicago

Timken - RT7000 to RT7999
SKF - RS7000 to RS7999
Hyatt - RH7000 to RH7999
A.S.F. - RA7000 to RA7999

SP - San Francisco

Timken - RT8000 to RT8999
SKF - RS8000 to RS8999
Hyatt - RH8000 to RH8999
A.S.F. - RA8000 to RA8999

Example: Serial numbers applied at Omaha would be RT168 for a Timken bearing and RS168 for an SKF bearing.

Additional numbers will be furnished by Office of General Superintendent MP&M when required.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-16-7

SUBJECT: ROLLER BEARINGS - TIMKEN - LATERAL CLEARANCE DRIVING WHEEL ASSEMBLIES.

INSTRUCTIONS:

The following instructions will govern checking and maintaining lateral clearance for steam locomotive driving boxes equipped with Timken roller bearings:

All locomotives equipped with this type roller bearings on drivers must have lateral clearance of roller bearing assemblies checked at each Class 5 or heavier repairs and at any other time drivers are removed from locomotive. At each Class 5 and at any other time drivers are removed from locomotive, roller bearing assembly must be checked for lateral clearance and if found in excess of .040" must be restored to .010" - .020".

At each Class 3 or heavier repairs, lateral clearance of roller bearing assemblies must be restored to .010" - .020".

PROCEDURE FOR CHECKING AND MAINTAINING LATERAL CLEARANCE OF TIMKEN ROLLER BEARING ASSEMBLY ON LOCOMOTIVE DRIVERS

A. LOCOMOTIVES 820-829, 4000-4019, 3950-3969 AND 3975-3999 EQUIPPED WITH SINGLE ROW BEARINGS AND TWO-PIECE HOUSINGS:

1. TO CHECK LATERAL CLEARANCE:

(a) Mount dial indicator on left side of housing, placing stem of indicator in contact with a selected point on finished surface of left wheel center or crankpin.

(b) Place two slow wedges between right wheel center and housing, spacing wedges 180° apart. Take up all slack between adjusting spacer and bearing cup by applying wedges with light tapping pressure alternately on each wedge. Continue tapping until dial hand of indicator stops moving. Then set hand at Zero reading.

(c) Remove wedges on right side and use wedges similarly on left side thereby forcing housing to right side, taking care not to rotate housing from above point. Maximum lateral clearance will be indicated by dial reading.

(d) A 1-1/2 pound hammer should be used in driving wedges. Extreme care must be taken to prevent any severe wedging action with consequent damage to bearing. Procedure (b) and (c) should be repeated several times to insure that correct reading is obtained.

2. TO RESTORE LATERAL CLEARANCE TO .010" - .020":

(a) Roller bearing housings requiring lateral clearance adjustment in accordance with above must be disassembled to permit application of a new lateral adjusting spacer. Adjusting spacer must be machined to required dimensions and face ground to exact thickness to obtain a lateral clearance of .010" - .020". All grinding for adjustment must be done on inside face of adjusting spacer.

(b) After new adjusting spacer has been applied and housing bolted together with all bolts tightened ready for service, check lateral clearance following procedure outlined in 1. above.

(c) After adjustment has been completed, housing must rotate freely with no indication of binding.

B. LOCOMOTIVES 800-819, 835-844, 3930-3949 AND 4020-4024 EQUIPPED WITH SINGLE ROW BEARINGS AND ONE-PIECE HOUSINGS:

1. TO CHECK LATERAL CLEARANCE:

Follow procedure outlined in Section A, Paragraphs 1(a), 1(b), 1(c) and 1(d).

2. TO RESTORE LATERAL CLEARANCE TO .010" - .020":

(a) Adjust lateral clearance of roller bearing assembly by pressing wheels on axles as shown on latest issue of Drawing 162-CA-28395. Required lateral adjustment "A" equals actual lateral clearance as found above minus .012". Shim thickness equals "B" minus "A". Wheel will stop when shims come in contact with end of axle, thereby reducing roller bearing lateral an exact amount.

(b) Recheck lateral clearance of roller bearing assembly to verify correctness of adjustment.

(c) Make sure that housing rotates freely without binding.

C. LOCOMOTIVES 2906 AND 7002 EQUIPPED WITH DOUBLE ROW BEARINGS AND TWO-PIECE HOUSINGS:

1. TO CHECK LATERAL CLEARANCE:

Wheel assemblies must be up-ended, attaching dial indicator to suitable jigs or clamps applied to housing so that stem of indicator will contact selected point on finished surface of wheel center.

2. TO RESTORE LATERAL CLEARANCE TO .010" - .020":

Adjustment of lateral clearance on two-row bearing equipment on Locomotives 7002 and 2906 requires replacement of both inner and outer adjustment spacers. Disassemble housing and remove both inner and outer spacers on each side.

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-17-2

SUBJECT: BOXES - ENGINE TRUCKS - REMOVABLE HUB LINERS.

INSTRUCTIONS:

Removable hub liners applied to plain bearing engine trucks should be in accordance with the following:

GROUP I

All locomotives with plain bearing engine trucks, except Locomotives 5091-5099, 9000-9087 and 9500-9514, may use removable hub liners of any of the two following types:

(a) Cast brass.

(b) Steel plate with hub face lining of bronze netting filled with approved bearing metal.

GROUP II

Locomotives 5091-5099, 9000-9087 and 9500-9514 should use removable hub liners of the following type:

Steel plate with hub face lining of bronze netting filled with approved bearing metal.

METHOD OF APPLYING BRONZE NETTING TO HUB FACE PRIOR TO APPLICATION OF APPROVED BEARING METAL

(a) Braze the edge of netting 1/4" in width and thickness around entire edge by oxy-acetylene method, using approved bronze welding rod, 1/8" or 3/16" diameter.

(b) Extreme care must be taken to prevent burning of netting.

(c) Place bronze netting flat on hub surface of box and electric weld the built-up edge of netting to box using approved electric center grip shielded phosphor bronze electrode. Positive current (Reverse Polarity).

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-17-3

SUBJECT: ROLLER BEARINGS - HANDLING.

INSTRUCTIONS:

The following instructions govern care and handling of roller bearings to prevent damage from rust, corrosion, nicks, and blemishes.

1. SHIPPING ROLLER BEARINGS:

   (a) Unmounted roller bearings are to be shipped in wooden boxes properly secured with metal bands, making sure that bearings are thoroughly coated with an approved preservative lubricant on all surfaces and wrapped with one layer of light wax paper, one layer of muslin and an outside layer of crepe paper secured with masking tape and properly tagged.

   (b) Defective roller bearings before being returned to Omaha Shops for examination and reconditioning must be tagged to show the following information, also letter with same information must be furnished by Master Mechanics or Superintendents of other shops to Superintendent of Shops Omaha with copy to General Superintendent MP&M:

      (1) Type of bearing.
      (2) Manufacturer's serial number of bearing.
      (3) Manufacturer's serial number of wheels with which associated when last removed from locomotive.
      (4) Locomotive number.
      (5) Date and place removed.
      (6) Primary cause of removal.
      (7) Details regarding defective condition of bearing.
      (8) Date bearing was dismounted from axle.

2. UNMOUNTED ROLLER BEARINGS HELD AND STORED IN SHOPS:

   (a) Thoroughly clean and dry the bearing parts; bearings must be wiped only with clean rags and under no circumstances will use of waste be permitted.

   (b) Cases of deep corrosion of rollers are being found, particularly on grease lubricated bearings, and it is necessary that the following method be employed for cleaning and protection of all roller bearings against corrosion:

      (1) Remove excess grease or other lubricant adhering to boxes and bearings.

(2) Immerse boxes and bearings in tank containing boiling solution of Oakite Penetrant, strength 8 to 10 ounces per gallon of water. Time required is from 1 to 2 hours.

(3) Immediately after removing from cleaning solution, rinse with water-steam gun taking care to keep bearings hot.

(4) Immediately spray with distillate while bearings are still hot. This will prevent corrosion for a short period of time.

(5) When bearings and boxes are not to be immediately assembled and repacked, spray with light coating of preservative oil - light. This is for a short period of inside storage only.

(6) Oakite Penetrant is the most successful cleaner found to date for removal of lithium grease; however, alternate products may subsequently be found.

(c) Bearings must be stored off floor on covered racks or in cabinets in dry place not exposed to weather.

(d) Periodical inspection must be made of stored bearings and if it is found that corrosion is developing, corrective measures must be taken at once.

3. SHIPPING MOUNTED ROLLER BEARING WHEEL ASSEMBLIES:

(a) Mounted roller bearing wheel assemblies which are being shipped between terminals for store stock or to and from wheel shops for repairs and reconditioning, must be inspected for water in boxes and such bearings must have sufficient coating of oil or grease for protection against damage by corrosion and boxes must be blocked in upright position.

(b) Mounted roller bearings removed from steam locomotives which are to be forwarded to wheel shop for repairs, must be immediately inspected after removal to see that no water is present in the journal box and that bearings have sufficient coating of oil or grease for protection against corrosion.

4. MOUNTED ROLLER BEARING WHEEL ASSEMBLIES (STORAGE):

(a) Mounted roller bearings with boxes applied must be free of water and have adequate supply of oil or grease in boxes, and must be checked for moisture every 6 months.

(b) For protection in outside storage and also for inside storage for a longer period of time, coat bearings and inside of boxes with preservative oil per medium Ordnance Department Spec. AXS-674.

(c) Mounted roller bearings without boxes applied must be covered with preservative oil per medium Ordnance Department Spec. AXS-674. In addition they must be protected by muslin cloth wrapping after which another coating of AXS-674 must be added and canvas hood applied.

(d) Mounted roller bearings and boxes (except SKF crosstie, engine truck and driver boxes with housings sealed and locked to axle) must be revolved on axle several times and this procedure must be repeated not less frequently than once each week to make certain that bearing parts are covered with oil or grease at all times.

(e) Roller bearing boxes of wheel assemblies must be locked in upright position during storage.

5. GENERAL INSTRUCTIONS:

(a) Care must be exercised in handling roller bearings to avoid dents, nicks and blemishes or other mechanical damage and under no circumstances should bearings be struck with a steel hammer or sledge.

(b) It will be the responsibility of Shop Superintendents and Master Mechanics to know that only authorized cleaning solutions are used in cleaning roller bearings and that the above instructions are strictly adhered to.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l. Supt. MP&M

Omaha, Nebraska

May 13, 1953

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-17-4

SUBJECT: JOURNAL BOXES - JOURNAL BOX PACKING RETAINING SPRINGS.

INSTRUCTIONS:

Improved type journal box spring packing retainers of specially heat treated steel have been developed and these retainers will be furnished with top portion of the upright legs painted yellow, permitting easy identification of the new retainers. New type retainers should be maintained on plain bearing journal boxes of locomotive tenders as follows:

Applications should be made in complete tender sets to tenders operating behind the following locomotives, giving preference to tenders of locomotives in passenger service:

2166-2171	2700-2735	3218-3227	5000-5099	7000-7039
2200-2320	2860-2911	3500-3564	5300-5318	7850-7869
2480-2499	3114-3138	3565-3566	5400-5414	9000-9087
2504-2564	3176-3181	3567-3569	5500-5529	9500-9514
		3670-3674		

No spring packing retainer is available which can safely be used in 7" x 14" journal boxes and therefore these retainers must not be applied in 7" x 14" journal boxes of tenders of Locomotives 3570-3599.

APPLICATION OF PACKING RETAINER SPRINGS:

(For identification of parts shown in quotation marks see previously issued photo 170-SK-8965, dated 9-27-45.)

Hold the "upright legs" in the hands, with the "extension arms" pointing toward the back of the journal box and slanting downward. If the journal box lid cannot be raised high enough to be out of the way and lid interferes with this part of the application, spread the two "upright legs" far enough to clear the sides of the lid, then push the "extension arms" in through the journal box opening and toward the back of the box. With one "extension arm" on each side of the journal and just below the bearing, slide the packing retainer spring in until it clears the journal collar and then press "extension arms" down upon the packing. The "foot" or the lower member of the "extension arms" which extends downward across the front of the journal box should now be entirely below the collar of the journal and against the front of the packing.

Now take one "upright leg" at a time, using both hands and press it down until the top can be sprung into the hole in the front

of the journal bearing wedge, inserting remaining "upright leg" in similar manner. If journal bearing wedge does not have hole in front, it should be removed and replaced with a standard wedge having this hole.

After placing retainer in journal box, examine extension arms along side of the journal to ascertain that the extension arms rest on the packing for full distance along journal box side wall, adjusting retainer if necessary to obtain this position. Ample clearance must be available between the retainer and journal, including journal collar.

When tenders are in service, and inspections at layover and intermediate terminals, or other inspection points, show that retainers and packing are in proper position and in good condition, they should not be disturbed.

REMOVAL OF RETAINER:

Take hold of one of the "vertical legs" with both hands, press down until the top of the leg disengages from the hole in the wedge. Repeat this operation with the remaining vertical leg, then spread legs to clear the journal box lid, raise and pull retainer out. At no time must a pulling hook, packing iron or similar tool be used to remove the packing retainer springs.

These instructions, including prints of latest issue of Drawings 170-SK-8961 and 170-SK-8965 must be posted under glass in enginehouses and any other location where they will be available to all employes engaged in inspection, repacking and maintenance of plain bearing tender journal boxes.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-17-5

SUBJECT: JOURNAL BOXES - ROLLER BEARINGS - INSPECTION AND MAINTENANCE.

INSTRUCTIONS:

The following instructions will govern inspection and maintenance of journal box roller bearings on steam locomotives.

1. INSPECTION AT INTERMEDIATE TERMINALS:

At intermediate terminals where steam locomotive inspections are made, roller bearing boxes must be inspected for abnormal conditions and tested by feeling top of boxes or ends of axles with bare hand to determine whether any are running at excessively high temperature as compared with companion boxes. If heat indicator is blown or odor is noticeable, closer inspection must be made to develop cause.

Also, if any excessive oil is in evidence on outside of box, closer inspection will be required to see whether leakage is due to loose or faulty filler or drain plugs or journal box covers and after such leakage is corrected, height of oil in box must be rechecked and any oil left on exterior of box must be removed. All oil filling and drain plugs and fittings must be inspected to see that they are properly tightened and have wire seals inserted through holes in plugs and drain plugs, also filler plugs must be securely anchored. Any abnormal condition must be corrected.

2. TRIP INSPECTION AT ASSIGNED TERMINALS:

(a) Check oil level through filler plug hole and fill as required to maintain proper level; on inboard bearings on engine trucks oil level must be even with bottom of filler plug hole; on outboard bearings with boxes having filling plugs applied at an angle, oil level must be even with bottom inside edge of filling hole.

(b) Examine interior of boxes for free metal by inserting magnet bar through oil filler plug hole. If free metal is found or condition of lubricating oil indicates presence of excessive dirt, foreign matter or water, wheel assembly must be removed and sent to wheel shop for attention.

(c) Observe that plugs, cap screws and nuts are properly tightened, secured with lock washers and wired, using not less than 16 gauge annealed wire. Solid type filler and drain plugs must be used and it is not permissible to use hollow type plugs.

(d) Check heat indicators on boxes and when same have been blown, make careful inspection of roller bearings for cause and if necessary renew wheel assembly. Defective or blown heat indicators are to be replaced. Exposed surface of heat indicators must be kept free of paint and accumulation of dirt to avoid plugging the fusible metal.

(e) Wheel assemblies with roller bearings which have been reported or show evidence of overheating, or are otherwise defective, must be removed from trucks and sent to wheel shop for attention.

3. INSPECTION AND MAINTENANCE AT WHEEL SHOPS:

(a) Engine truck wheel assemblies equipped with Timken roller bearings with one-piece housings, when received in wheel shops for tread turning, are to be washed, oil drained and box flushed with distillate or equivalent, using at least one gallon of distillate in each end of housing. Housing must be flushed at least 3 times, revolving box during each flushing operation. After last flushing, plugs should be applied and wheel treads turned. After wheel treads have been turned, bearings should be examined by visual inspection through inspection hole and if in satisfactory condition, bearing assembly should be checked for lateral clearance, making adjustments necessary and filling box to proper level with approved roller bearing oil.

(b) Engine truck wheel assemblies equipped with SKF roller bearings:

(1) Wheel assemblies equipped with SKF roller bearings and individual boxes, also old style crosstie boxes without multiple groove spacer sleeve, received at wheel shops for wheel tread turning are to be washed and cleaned and boxes removed before being placed in wheel lathe. Also, bearings must be given preliminary cleaning and protected against steel chips and mechanical injury by application of muslin wrapping or canvas hood or both. After wheels are turned, wheels and bearings must be thoroughly cleaned and inspected for defects and bearings flushed with lubricant preservative (U.S. Army Ordnance Department Specification AXS 674 or equivalent). Housing must be thoroughly cleaned and before

housings are reassembled, space between outside and inside covers and sleeve must be filled with an approved fibrous grease to provide seal against dirt and moisture. After housings or boxes are assembled, they must be anchored to axle with clamps to prevent turning and boxes must be filled to proper level with approved roller bearing oil.

(2) Engine truck wheel assemblies equipped with SKF roller bearings having latest style crosstie housing received at wheel shops for wheel tread turning are to be handled under same procedure as Item (1) except that housings must be sealed against dirt and moisture by filling both grooves in spacer sleeve and housing with approved fibrous grease or equivalent. After housings or boxes are assembled they must be anchored to axle with clamps to prevent turning and boxes must be filled to proper level with approved roller bearing oil.

(c) All outboard types of roller bearing wheel assemblies received at wheel shop for wheel tread turning are to be washed or cleaned if necessary and boxes removed. Before being placed in wheel lathe, all roller bearings must be given preliminary cleaning and protected against steel chips and mechanical injury by application of suitable metal or canvas hoods. After wheel treads are turned, bearings and housings must be thoroughly cleaned and inspected for defects and if found satisfactory and wheels placed in storage, bearings must be slushed with an approved lubricant preservative and when boxes are reapplied, space between back cover plate and dust or water guard, or flinger, sealed with an approved fibrous grease and filled to proper level with approved roller bearing oil.

(d) Wheel assemblies removed from trucks and sent to wheel shops on account of roller bearings reported defective or showing evidence of overheating, must have roller bearings removed from axle and cleaned, using distillate, and all parts visually inspected for defects.

(e) When visual inspection of roller bearings indicates any questionable condition or when roller bearings have been involved in an accident or subjected to abuse, bearings must be removed and forwarded to Omaha Shops where further inspection must be made and if necessary these bearings should be Magnaflux or Magnaglo tested.

(f) Roller bearings not considered satisfactory for further service must be replaced.

(g) Box and roller bearing parts are to be tagged in suitable

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-17-6

SUBJECT: JOURNAL BEARINGS - HAMMER TEST.

INSTRUCTIONS:

1. GENERAL:

Whenever plain journal bearings are removed for any reason, bearings must not be reapplied until they have been hammer tested to detect loose lining. Journal bearings having loose linings must be replaced.

2. METHOD OF MAKING HAMMER TEST:

To make hammer test, use a "U" shaped holder made of No. 9 wire or similar material with ends bent to form a hook. Hold bearing within fillet end down by placing the hooks of "U" holder under lugs of bearing. Tap lightly in several places on back of bearing with ballpeen hammer. A clear ringing sound indicates tight lining but a dull ring or hollow sound indicates loose lining.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-17-7

SUBJECT: BOXES - TRAILING TRUCK REMOVABLE HUB LINERS.

INSTRUCTIONS:

Removable hub liners applied to plain bearing trailing truck boxes should be in accordance with the following:

1. LOCOMOTIVES TO WHICH THESE REMOVABLE HUB LINERS ARE APPLICABLE:

1900-1949	2000-2034	2100-2165	
2200-2259	2504-2527		2700-2708
	3100	3202-3208	2726-2732
2851-2899	3104-3133	3212-3225	3176-3181
2910-2911			
5306-5313	5300-5305		
5040-5099	5315-5318	5400-5414	
5500-5524			
7000-7039			
7865-7869			7850-7864
9000-9087	9500-9514		

Removable hub liners may be either of the two following types:

(a) Cast brass.

(b) Steel plate with hub face lining of bronze netting filled with approved bearing metal.

2. METHOD OF APPLYING BRONZE NETTING TO HUB FACE PRIOR TO APPLICATION OF APPROVED BEARING METAL:

(a) Braze edge of netting 1/4" in width and thickness around entire edge by oxy-acetylene method, using approved bronze welding rod, 1/8" or 3/16" diameter.

(b) Extreme care must be used to prevent burning of netting.

(c) Place bronze netting flat on hub surface of box and electric weld the built-up edge of netting to box using approved electric center grip shielded phosphor bronze electrode. Positive current (Reverse Polarity).

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 1, 1947

(a) Adjusting Outer Bearings:

(1) Assemble housing with trial outer adjusting spacers of equal thickness on each side. These trial spacers should be ground under nominal thickness. Use eight bolts to hold housing in place.

(2) Check lateral clearance.

(3) Machine new outer adjusting spacers and grind to proper thickness allowing .010" - .020" lateral over outer bearings. Remove trial spacers, insert new outer spacers of proper thickness and recheck adjustment.

(b) Adjusting Inner Bearings:

(1) Remove both outer adjusting spacers.

(2) Assemble housing using inner trial adjustment spacer and outer adjustment spacer of proper thickness as found in Item (a3) above, on one end only. Check adjustment following same procedure as outlined for outer bearings, allowing .002" additional adjustment over that finally obtained on the outer bearings. Machine new inner adjusting spacer and grind to proper thickness. Remove trial inner spacer, insert new inner spacer of proper thickness and recheck adjustment.

(3) Remove both inner and outer spacers.

(4) Repeat procedure in Item (2) for opposite end of housing.

(5) Assemble housing with proper inner and outer adjustment spacers in place. Bolt housing together with all bolts tightened ready for service.

(6) Make sure that housing rotates freely without binding.

(7) Repeat check on adjustment. This should agree with the adjustment of the outer bearings.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-17-1

SUBJECT: BOXES - TENDER TRUCK.

INSTRUCTIONS:

When necessary to apply one or more pair of full-size wheels in conjunction with worn wheels to 6-wheel or 4-10-0 type tender trucks, adjusting blocks may be placed over boxes with worn wheels to level up trucks as covered by latest drawings and instructions.

In no case should adjusting blocks be placed on boxes having full-size wheels. All adjusting blocks must be removed when wheels of same diameter are used.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

manner so that all parts can be replaced in the same location.

(h) Clean and handle unmounted roller bearings and mounted wheel assemblies in accordance with latest instructions.

It is extremely important that locking keys and caps at end of axle have cap screws holding same wired as shown on drawings, using not less than 16 gauge annealed wire; lock washers are not to be used under cap screws holding locking keys and caps on end of axle. Cap screws should be closely inspected for fractures before reapplied.

(i) Check heat indicators on boxes, replacing any found discharged or defective. Discharged heat indicator may have been caused by defective roller bearing.

(j) After assembly and lubrication have been completed, all plugs must be properly tightened and drain plugs and filler plugs must have wire seals inserted through holes in plugs using not less than 16 gauge annealed wire. Flat type lock washers must be applied under all cap screws and also under nuts, securing front and back covers and lids. Solid type filler and drain plugs must be used and it is not permissible to use hollow type plugs.

(k) Roller bearings which have not been inspected and maintained according to these instructions must not be permitted in service.

4. GENERAL INSTRUCTIONS:

Magnet bars must be available at all terminals where roller bearings are inspected or maintained and it will be the responsibility of Master Mechanics and Superintendents of Shops to know that magnet bars are available and that they are being used by employes responsible for checking and maintenance of roller bearings.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

November 24, 1948

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-19-1

SUBJECT: BRAKE EQUIPMENT - ANGLE COCKS STEAM LOCOMOTIVES.

INSTRUCTIONS:

A. DRILLING BLEED HOLES IN EXISTING ANGLE COCKS:

Angle cocks in brake pipe line on all steam locomotives, except those having new angle cocks with spiral side vent as per section "B" below, will be provided with 1/8" drilled bleed hole to vent air in hose when angle cocks are closed. This applies to angle cocks, both front and rear on all road and switch locomotives.

Drill 1/8" diameter hole in body of angle cock at right angle to plug and directly in center of body. Drill 1/8" diameter hole in plug of valve so that when angle cock is closed, this hole will communicate with hole in body, thereby venting air from hose.

B. REPLACEMENT WITH NEW ANGLE COCKS HAVING SPIRAL SIDE VENT.

When existing angle cocks require replacement, new style angle cocks with spiral side vent should be used which are built with vent and do not require 1/8" bleed hole.

By order of

Mech. Supt. - Steam Power

Approved by

Asst. Gen'l Supt. MP&M

Omaha, Nebraska

March 29, 1949

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-19-2

SUBJECT: BRAKE EQUIPMENT - AIR SIGNAL EQUIPMENT - REMOVAL FROM FORMER ROAD ENGINES PERMANENTLY ASSIGNED TO SWITCHING SERVICE.

INSTRUCTIONS:

In order to eliminate trip inspection and maintenance, air signal equipment on road locomotives permanently assigned to switching service should be removed when engines receive first classified repairs.

Serviceable material removed should be returned to Stores Department and used for replacements on other locomotives of the same class.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-22-1

SUBJECT: CAB - CLEARANCE BETWEEN ROOF AND TENDER.

INSTRUCTIONS:

Clearance between cab roof at center and front bulkhead of tender on all steam locomotives must not be less than 23 inches, and between cab roof side and side sheets of tender must not be less than 12 inches as shown on latest issue of Drawing 223-CA-30310.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-22-2

SUBJECT: CAB - METHOD OF FASTENING AND REINFORCING.

INSTRUCTIONS:

Cab bracing and reinforcing on all steam locomotives must conform with latest approved drawings.

Cab bracing and reinforcing not in accordance with drawings should be corrected to conform strictly with drawings not later than next classified repairs.

At each five year period or nearest Class 3 or heavier repairs when lagging and jacket are removed for boiler inspection, cabs of all classes of locomotives should be removed for inspection and repair.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-23-1

SUBJECT: CAB DETAILS - CURTAINS.

INSTRUCTIONS:

Side, hood and back cab curtains manufactured or purchased must be in accordance with drawings. Cab curtain fixtures and application of cab curtains and fixtures to locomotives are to be in accordance with drawings.

Two-piece, slide-back curtains are to be provided on all stoker fired coal burning locomotives, except locomotives equipped with cab door enclosures.

Roll-back curtain is to be provided on all hand fired coal-burning locomotives, except switch locomotives, and to all oil-burning locomotives.

One-piece slide-back curtain is to be provided on all hand fired switch locomotives.

Telescope side and hood curtain rods on road and switch locomotives subject to unusual track curvature are to be equipped with ball joint connections on cab.

Each locomotive must be equipped with suitable roll or slide-back curtain during the entire year. During period November 1 to April 1, each locomotive must be equipped with suitable side curtains. Also, each locomotive, except oil burners, must have suitable hood curtains.

During summer months, canopy cab curtains are to be removed from locomotives, and thos which can be made serviceable are to be forwarded to Omaha Shops to be reconditioned and fireproofed for the coming winter; also, any other curtains removed, which can be made serviceable, are to be reconditioned and given fireproofing treatment.

1. STANDARD FIREPROOFING TREATMENT:

(a) Any new side, hood and back curtains in store stock which are not already fireproofed are to be forwarded to points equipped for fireproofing to be fireproofed and returned to store stock. Side and hood curtains are again to be fireproofed after undergoing one winter season's service, and back curtains must again be fireproofed after the expiration of not to exceed 12 months' service.

(b) When applying fireproofed cab curtains obtained from store stock which have been properly protected from the weather,

date of fireproofing stenciled on curtains should be changed to the date of application to the locomotive and such curtains must again be fireproofed after not to exceed 12 months' service.

(c) Reclaimed and reconditioned side, hood and back curtains are to be fireproofed before being returned to service and, when reapplied, are to be dated when applied to the locomotive, and must again receive fireproofing treatment after not to exceed 12 months' service.

(d) Each cab curtain is to be stenciled showing location at which fireproofing was done and date applied. Stenciling should be applied with black paint in 1" letters and figures at top of side and back curtains, and on flap at tender end of canopy curtains.

(e) Cab curtains are to be fireproofed with approved fireproofing material by soaking in the liquid at 130° F. for twenty minutes after which they are to be removed and dried, or by such other approved method as may hereafter be specified.

(f) On the last run each day, a test piece of canvas not less than two feet square and of the same material as the cab curtains treated must be placed in the tank with the curtains fireproofed. This sample is to be properly tagged and sent to Omaha Laboratory for test before releasing the curtains fireproofed for that day. Omaha Laboratory will promptly advise whether fireproofing is satisfactory.

2. FIREPROOFING TREATMENT FOR DANDUX CANVAS:

Fireproofing of Dandux canvas purchased during the war emergency will be handled as follows:

(a) Fireproofing of Dandux side and back curtains will not be required.

(b) All Dandux hood curtains must be fireproofed by such approved fireproofing method and compound as may be specified by Omaha Laboratory.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-24-1

SUBJECT: CAB FITTINGS - STEAM HEAT VALVES.

INSTRUCTIONS:

When necessary to replace steam heat pressure reducing valves, the following shall govern:

1. LOCOMOTIVES WITH BOILER PRESSURE OF 220 LBS. PER SQUARE INCH OR LESS:

   Use present steam heat pressure reducing valves applicable to these locomotives until stock on hand is exhausted. Thereafter, when replacement is necessary, use A.A.R. 300 lb. globe valve with plug type disc and seat.

2. LOCOMOTIVES WITH BOILER PRESSURES IN EXCESS OF 220 LBS. PER SQUARE INCH:

   Replace present steam heat pressure reducing valve in kind. Locomotive classes in this group include:

3800-3839	-	No. 235 reducing valve
800-844	-	No. 239 reducing valve
3930-3999	-	- do -
4000-4024	-	- do -

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-26-1

SUBJECT: COCKS & VALVES - GLOBE AND ANGLE VALVES.

INSTRUCTIONS:

All globe and angle valves for locomotives with boiler pressures 255 pounds or less are to be A.A.R. 300 pound valves. All valves for locomotives with 300 pound boiler pressure to be 400 pound valves.

Valves used for throttling steam or hot water are to be provided with plug type seat and disc. Other valves are to have ball type seat and disc.

Throttling valves are to be used on the following steam and hot water lines:

Water Glass Drain
Water Column Drain
Squirt Hose
Blower
Stoker Jet
Stoker Cylinder
Cab Heater
Feed Water Heater Throttle
Open Fuel Oil Heater
Closed Fuel Oil Heater
Fuel Oil Atomizer

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-29-1

SUBJECT: CRANK PINS - LIMIT OF SERVICE

INSTRUCTIONS:

The limit of service of all crank pins before they must be renewed will be as indicated below.

Crank pins which have structural defects or any condition which would contribute to failure in service must be renewed regardless of accumulated mileage or extent of wear.

When limit of mileage or wear has been reached, crank pin should be renewed at nearest classified repairs representing that mileage or limit of wear. Crank pin wear must not be permitted to exceed 1/4" below the original diameter of pin.

1. MAIN CRANK PINS:

(a) Freight Locomotives:

	UP	OSL	OW	LA	
Consolidation	105 113-117 400-498	512-539			1/4" below original dia.
C-1-2	201-358	560-622	730-768	6003-6085	1/4" below original dia.
Ten Wheel	1242-1243		1730-1741		1/4" below original dia.
T-1-3		1575	1747-1751		1/4" below original dia.
MacA-1-2	1901-1949	2001-2034	2100-2165		1/4" below original dia.
MacA-3-10	2201-2320	2504-2531 2555-2564	2167-2171	2702-2734	1/4" below original dia.
MacA-Spec	2480-2499	2535-2554			1/4" below original dia.
SA-C-2-6	3500-3564	3565-3566	3567-3569		1/4" below original dia.
TTT-1-7	5000-5089 5306-5313 5500-5524	5300-5305 5315-5318	5400-5414	5525-5529	1/4" below original dia.
FTT-1-2				5090-5099	1/4" below original dia.

	UP	OSL	OW	LA	
UP-1-5	9000-9087	9500-9514			1/4" below original dia.
CSA-1-2	3800-3839				200,000 miles
4664-3-5	3930-3999				600,000 miles or 1/4" below original dia.
4884-1-2	4000-4024				600,000 miles or 1/4" below original dia.
S-1-6	4407-4480	4752	4909-4928	4244-4246	1/4" below original dia.
S-Spec	4600-4607	4753-4754			1/4" below original dia.

(b) Passenger Locmotives:

P-1-6	2851-2856		3202-3217	3160	1/4" below original dia.
P-7-13	2860-2911	3114-3138	3219-3227	3178	1/4" below original dia.
P-13	2906				100,000 miles
MT-1-2	7000-7039 7865-7869			7850-7864	200,000 miles
FEF-1-3	800-844				600,000 miles or 1/4" below original dia.

2. ALL LOCOMOTIVES, OTHER THAN MAIN CRANK PINS — 1/4" below original dia.

By order of

Mech. Supt. - Steam Power

Approved by

General Supt. MP&M

Omaha, Nebraska
May 6, 1948

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-37-1

SUBJECT: DRAW GEAR - ENGINE - DRAW BAR PIN KEY.

INSTRUCTIONS:

All draw bar pins which are retained in place by key must use solid key made of 3/8" steel properly bent around to insure against backing out of slot as shown on latest issue of Drawing 151-CA-24220.

All draw bar pin keys must be given trip inspection, and where unit safety draw bars are used, the keeper plate, or retaining bolt, must also be given trip inspection to see that bolts and cotter keys are applied and maintained.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-37-2

SUBJECT: DRAW GEAR - ENGINE
RADIAL BUFFER - WEAR AND MAINTENANCE.

INSTRUCTIONS:

Limits of wear and maintenance of Types A-1 and E-2 radial buffers between engines and tenders are to be in accordance with the following:

1. CHAFING PLATES AND CHAFING BLOCK:

Radial buffer adjustable chafing plate, stationary chafing plate and floating chafing block are to be maintained to standard dimensions and contour in accordance with drawings.

(a) Worn surfaces of adjustable chafing plate and stationary chafing plate are to be built up with steel by electric process.

All built up worn surfaces are to be finish machined true to template.

(b) Adjustable and stationary chafing plates must be inspected frequently for formation of shoulders or other defective conditions which interfere with proper operation of chafing plates. Where shoulder is forming, not to exceed 1/16", or other defective conditions are present, worn surfaces are to be built up by welding to restore standard dimensions and contour or parts are to be replaced.

(c) At Class 3 or heavier repairs, parts having curved surfaces which are not to correct contour or having other irregularities or flat spots are to be replaced or worn surfaces built up by welding to restore standard dimensions and contour.

(d) Where 1/4" is worn off face of adjustable chafing plate and stationary chafing plate, parts are to be replaced or built up by welding to restore standard dimensions.and contour.

(e) When parts are replaced, parts removed account being worn are to subsequently have worn surfaces built up by welding to restore standard dimensions and contour, and returned to store stock for reapplication as required.

(f) Where floating chafing block is worn so as to be reduced 1/4" in thickness, it should be replaced.

2. ADJUSTING WEDGES AND BEARING PLATES:

Radial buffer adjusting wedges of Type A-1 radial buffers, and adjusting wedges and wedge bearing plates of Type E-2 radial buffers are to be maintained to standard dimensions in accordance with drawings.

(a) Adjusting wedges of Type A-1 radial buffers when worn or otherwise defective, resulting in incorrect adjustment, are to be replaced or built up by welding with steel and machined to restore standard dimensions.

(b) Adjusting wedges and wedge bearing plates of Type E-2 radial buffers when friction surfaces become worn or a 1/16" shoulder is formed, or are otherwise defective, so as to interfere with proper movement, are to be replaced or built up by welding with steel to restore standard dimensions and contour. Built up worn surfaces are to be finish machined or ground smooth and true to template so that thickness and angle of parts on right and left hand sides will always be uniform.

(c) When parts are replaced, parts removed account being worn are to subsequently have worn surfaces built up by welding to restore standard dimensions and contour, and retained for reapplication as required.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-39-1

SUBJECT: ECCENTRIC - ROLLER BEARING - INSPECTION AND MAINTENANCE.

INSTRUCTIONS:

These instructions govern the inspection and maintenance of SKF roller bearing at back end of eccentric rod.

When necessary to remove eccentric cranks for removal of main rods for inspection, renewal of brasses and adjustment of lateral it is neither necessary nor desirable to detach eccentric rod from eccentric crank. The two parts should be left attached unless machine work is necessary or bearing inspection is to be made.

1. AT ENGINE HOUSES:

(a) Observe housing temperature with hand. Temperature rise of 15 to 40 degrees F. can be expected.

(b) See that grease fittings, relief fitting and cover fastenings are tight and in place.

(c) At each quarterly inspection remove front cover plate and examine roller bearing. Exercise care not to damage gasket or leave burrs on face which might prevent good sealing on reapplication.

Bearings found rusted or otherwise defective are to be removed.

The normal roller clearance for this bearing is approximately .0005" to .001".

If foreign matter is found in lubricant flush out bearing with distillate.

Reapply gasket and cover plate to same position as before removed and lubricate bearing.

2. AT SHOPS WHEN LOCOMOTIVES ARE UNDERGOING REPAIRS:

(a) At classified repairs each eccentric crank and eccentric rod are to be detached, roller bearing disassembled and thoroughly inspected.

(b) Removal of bearing:

Mark location of front cover plate and back enclosure in relation to position on eccentric rod.

Remove front cover plate

Remove lock bolt.

Apply removal nut to threaded part of adapter sleeve.

Place wrench on removal nut and drive on wrench until adapter sleeve yields and is free on pin.

Remove eccentric rod and bearing assembly from pin.

(c) Inspection and Maintenance:

Wash bearing assembly with distillate to remove grease and dirt.

Inspect felt washers and if worn or damaged they are to be renewed.

Inspect load carrying surfaces and wear surfaces of cages.

Inspect roller bearing by turning inner race and roller assembly laterally in outer race. Inner race of bearing can be inspected by removing through filler notch one roller from each row. If necessary, bearing can be completely disassembled by removing the rollers. Rollers removed should be applied to the same row from which removed.

Any defective or worn parts are to be renewed.

Remove all burrs from parts battered in handling.

Fillet end of adapter sleeve should be enlarged to provide necessary clearance and avoid fouling fillet on pin. This in particular must be done when applying a reconditioned bearing.

(d) Application of Bearing:

Lubricate rollers sparingly with grease or oil.

The felt retaining collar should have free fit on pin and the eccentric rod, roller bearing, back enclosure, collar and felts can be applied to the pin as a unit, then oil adapter sleeve and insert on pin with the split lined up with filling notch and dowel hole so that creeping of sleeve on pin can be detected. Make certain that felts properly enter grooves.

Apply lock bolt being sure dowel is tight in head, does not bottom in hole and head of bolt does not contact pin when drawn up.

With eccentric rod assembly in position on pin, draw up nut on lock bolt until adapter sleeve is reasonably tight but not gripping on pin. Screw removal nut on

threaded end of sleeve until it touches face of bearing, then draw up on lock bolt until assembly is tight on pin. Unscrew removal nut from adapter sleeve and draw up nut on lock bolt until original clearance between rollers and race is reduced by .001" to .0015" and apply cotter pin. The normal roller clearance is approximately .0005" to .001". Tapping with soft hammer on end of lock bolt will aid in obtaining bearing adjustment.

Be sure no foreign matter has entered bearing, that gasket and surfaces are in good condition to make a tight joint, that back enclosure is in same position as before removed and then apply gasket and cover plate in same position as before removed.

If roller bearing is correctly adjusted the rod will rotate freely without lost motion.

Apply grease through Alemite fitting with pressure gun until grease appears at relief fitting.

If new pin is applied to eccentric crank check dimensions against drawing. Pin diameter should be to maximum tolerance and pin as applied should project at shoulder as indicated on drawings.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

March 27, 1950

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-45-1

SUBJECT: ARCH TUBES - METHOD OF APPLICATION.

INSTRUCTIONS:

Arch tube applications to all steam locomotives requiring same must be made by first reinforcing holes in door sheet and throat sheet with electrically built up collars on fire side. Holes to be drilled 1/16" larger than outside diameter of arch tube. Tubes are to be applied without copper ferrules, then belled and rolled tight in the usual manner.

By order of

General Boiler Inspector

Approved by

Gen'l Supt. MP&M

Mech. Supt. - Steam Power

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-46-1

SUBJECT: FRAME - KEYS.

INSTRUCTIONS:

Frame keys at cylinders for all classes locomotives are to be made of tire steel forged from scrap locomotive tires.

All frame keys are to be made 12" long with taper of 1/32" in 12" on cylinder lug bearing face to insure full bearing and tight driving fit.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-46-2

SUBJECT: FRAME - PEDESTAL CAPS.

INSTRUCTIONS:

All forged steel pedestal caps purchased or manufactured for locomotives are to be mild steel Specification CS 1-A either smooth forged to size or flame cut with 3/8" finish allowance, and finished in accordance with drawings.

All pedestal caps which are flame cut must be preheated to 1000 degrees Fahrenheit before flame cutting to prevent injury to metal during flame cutting process.

Two-piece type pedestal cap spacer bars are to be fitted accurately to inside faces of pedestal toes with light drive fit. Pedestal cap is to be fitted to outside toes and frame face with spacer bar in place. Bolts holding spacer bar to pedestal cap are to be left loose until cap is fitted. Clearance must be provided for spacer bar bolts in pedestal cap as shown on drawings. Pedestal caps are to be metal to metal contact with frames on entire face with no allowance for draw.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-46-3

SUBJECT: FRAME - AUTOMATIC COMPENSATOR AND SNUBBER.

INSTRUCTIONS:

Wedge bolts must be finished and fitted to wedges as shown on drawings. Wedge bolt head must have tolerance of plus or minus 1/64" for 2-1/2" diameter hole in wedge.

Adjustments of compensators and snubbers are to be made as shown on drawings using wrench and template.

At nearest shopping period representing each 200,000 miles of service all springs in compensators and snubbers are to be removed and tested. Any springs testing below minimum requirements shown on drawings must be scrapped and new springs applied.

Only springs furnished by manufacturer of compensators are to be used in automatic compensators and snubbers.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-47-1

SUBJECT: FRAME DETAILS - CENTERING DEVICE.

INSTRUCTIONS:

To assure proper operation of boiler centering devices on articulated locomotives, centering device spring rods and spring rod pockets must be maintained to dimensions shown on drawings.

Right and left side centering device spring rods must be checked with locomotive on straight track and boiler bearing in central position, in which position spring rods should just contact bottom of spring rod pocket.

Spring rod pockets are held apart against end plates by two sets of double coil springs separated by a common spring seat. End plates are bolted to ends of saddle casting, thereby limiting outward travel of spring rod pockets and holding coil springs under initial tension.

With this arrangement, movement of front engine to the right or left is stabilized until side thrust on spring rod overcomes initial pressure on spring pocket.

Length of spring rods and depth of spring rod pockets must be maintained in accordance with drawings.

At monthly inspections centering devices on Locomotives 3500-3569, 3800-3839, 3930-3999 and 4000-4024 should be thoroughly inspected and worn pins, bushings and spring rods or other defective parts must be repaired or renewed.

Parts must be in strict accordance with dimensions shown on drawings.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-47-2

SUBJECT: FRAME DETAILS - METHOD OF FITTING WAIST SHEETS.

INSTRUCTIONS:

Locomotives provided with waist sheets which are not riveted to boiler shell must have waist sheet tee or angle irons fitted to boiler as provided in previously issued drawings.

(a) Radius of waist sheet tee or angle is dimensioned on drawings to provide 1/8" clearance between ends of tee or angle and boiler shell of cold boiler and this clearance must be maintained in accordance with drawings.

(b) Top edges of tee or angle must be machined to 1/4" radius as called for on drawings.

(c) Waist sheet must be fitted into corner of tee to reduce shear on rivets joining tee and waist sheet.

(d) Bottom of waist sheet must be machined for fit in frame crosstie.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-53-1

SUBJECT: HAND RAILS AND STEPS - CAB HAND RAIL CLEARANCE.

INSTRUCTIONS:

All locomotives in service must have clearance between the tender gangway ladder and deck and the cab hand rail checked on the sharpest curve in territory in which they operate, altering hand rail if found necessary to comply with clearances shown on latest issue of Drawing 532-CA-24049.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-54-1

SUBJECT: HEADLIGHTS, NUMBER PLATES, ETC.
HEADLIGHT TURBO GENERATORS - MAINTENANCE.

INSTRUCTIONS:

Turbo generators on locomotives are to be given periodic inspection and maintained in first-class condition.

After each 12 months or at classified repairs nearest this length of service, turbo generators are to be given a general overhauling.

A metal tag stenciled to indicate the place and date of overhauling is to be attached to each overhauled turbo generator. When an overhauled turbo generator is applied to a locomotive, date of application is also to be stenciled on the tag.

Overhauling of turbo generators between Class 3 or heavier repairs should be performed locally by maintaining terminals and handled on an exchange basis.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-56-1

SUBJECT: INJECTORS AND FEET WATER HEATERS - MAINTENANCE AND INSPECTION.

INSTRUCTIONS:

Sellers exhaust feed water heaters must be maintained in good operating condition and inspected as shown below.

DAILY INSPECTION

1. Apply kerosene to oil damper.
2. Check oil damper for oil.

MONTHLY INSPECTION

1. Examine and clean retarding valve.
2. Examine hole in check valve in retarding valve to see that it is free of carbon or scale.
3. Test retarding valve and set to release at proper pressure.
4. Examine oil damper to see that damper is clean, has oil and moves freely, using compressor oil only in damper cylinder.
5. Examine and see that valve and piston of live steam admission valve are clean and move freely. Grind seats, if necessary.
6. Renew packing on exhaust spindle.
7. Examine tubes of forcing set for scale or wear.
8. Lubricate well each operating lever.
9. Note if vacuum gauge hand is at zero; if not, reset it.
10. See that feed water strainer is clean.

QUARTERLY INSPECTION
In addition to monthly inspection

1. Remove, clean and refill with compressor oil the exhaust regulating valve.
2. Remove, examine and clean or renew all tubes and repack exhaust combining tube.
3. Repack water valve.
4. Grind in overflow valves.
5. Examine and grind in delivery line check and at same time note that pilot valve of delivery line check is free and in good condition.
6. Examine overflow disc.
7. Reduce lost motion in operating levers and rods.
8. Test bridge gauge.
9. Examine retarding valve pipe and couplings for leaks.
10. Examine by-pass valves.
11. Examine and clean tank hose strainer.

SEMI-ANNUAL INSPECTION
In addition to monthly and quarterly inspections

1. Examine for proper lift and, if necessary, grind in main steam valve and pilot valve of main steam starting valve.
2. Repack lifting stem and see that valves have full lift when connected to operating lever.
3. See that delivery branch pipe from heater to boiler is clean.
4. See that all joints in exhaust pipe are steam tight.

When engines are shopped, repairmen should follow maintenance instructions, limits of wear, tolerances, etc. as shown in the manufacturer's instruction books.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-56-2

SUBJECT: INJECTOR AND FEED WATER HEATER
INSPECTION - COFFIN FEED WATER HEATERS.

INSTRUCTIONS:

The following instructions should be enforced in regard to inspecting Coffin Feed Water Heaters:

DAILY INSPECTION

1. Drain any water from bearing casing through plug provided for this purpose.
2. Make sure bearing casing is full of oil to top of oil cup.
3. Inspect all pipes for leaks.
4. Clean suction strainer.
5. Test equipment for pump capacity with full boiler pressure using test gauge on pump delivery. With control valve wide open, if pump delivery pressure does not rise to 20 pounds above boiler pressure, the tubes in heater are leaking or pump is faulty and should be replaced.

MONTHLY INSPECTION

1. Drain oil from bearing casing, wash the casing out with clean kerosene, and refill with fresh oil.
2. Calibrate duplex gauge on dead weight tester.
3. Clean control valve pistons and cylinder with soft cloth and regrind disc with seat, if necessary.
4. Trip pump by hand.
5. Blow out cavities between pump and turbine casing and bearing bracket by air.
6. Clean screen in water leg of tender and suction strainer.
7. Remove scale from control valve and control valve leakoff line, also inspect condensate line on the interior of tender.
8. While testing pump at enginehouses, care should be taken to see whether or not the pump runs smoothly. If it is found the pump is noisy, it should be reported and replaced.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-56-3

SUBJECT: INJECTORS AND FEEDWATER HEATERS
MAINTENANCE FEEDWATER HEATERS.

INSTRUCTIONS:

The following instructions must be followed for inspection and maintenance of Worthington Feedwater Heaters.

TYPES 4-BL, 4-BL-2 HEATERS

MONTHLY INSPECTION

1. Examine and clean tank well strainer.
2. Examine suction strainer in cold water line and clean with inhibited acid to maintain full area of holes in strainer.
3. Examine, clean and grind in boiler check and maintain proper lift as follows:

   4-BL - 7/32" lift
   4-BL-2 - 7/32" lift

4. Check all drain cocks and clean if stopped up.
5. Examine vent pipes and ascertain that they are open to atmosphere, including the open drain in exhaust pipe between feather valve and heater.
6. Examine hot water pump cylinder packing.
7. Inspect hot water pump cylinder liner and piston for wear and defects. Clearance between pump piston and cylinder liner should be .025 to .035 when new. If clearance exceeds 3/32", liner should be rebored if necessary and oversize piston fitted. Limit of cylinder liner rebore is 1/8".
8. After locomotive is fired up, give pump running test and repair all leaks found.

QUARTERLY INSPECTION

In addition to monthly inspection

1. Examine return valve for proper lift which should not exceed 1/8" maximum.
2. Inspect and clean feather valve, removing carbon and making certain that strips are seating properly and that studs holding down valve body are tight and all parts properly in place.
3. Remove heater cover and examine bucket assembly, cleaning in acid vat if required; also clean passageway to drain cocks for bucket, draining and testing all parts.
4. Clean air vent chamber in heater and opening through heater into vent pipe.
5. Examine spray valve.
6. Remove and clean hot water valves assembly, facing and grinding valves and seats if required.

SEMI-ANNUAL AND ANNUAL INSPECTIONS
In addition to monthly and quarterly inspections

1. Check steam valve gear. If large end of reversing valve will take .005" thickness gauge, valve should be renewed.
2. Examine main slide valve. Anneal all gaskets before assembly.
3. Test main steam cylinder rings and if necessary, apply new cylinder packing in cold water end; also check piston fit in cylinder liner. Clearance between pump piston and cylinder liner should be .025 to .035 when new. If clearance exceeds 3/32", liner should be rebored if necessary and oversize piston fitted. Limit of cylinder liner rebore is 1/8".
4. Examine cold water valves and return valve, grinding seats if necessary.

When locomotives are shopped or feedwater heaters are inspected or repaired, maintenance instructions, limits of wear, tolerances and machining limits prescribed in instruction books issued by Worthington Pump and Machinery Corporation should be followed.

TYPES 4-S AND 5-S HEATERS

MONTHLY INSPECTION

1. Examine and clean tank well strainer.
2. Examine suction strainer in cold water pump and clean with inhibited acid to maintain full area of holes in strainer.
3. Examine, clean and grind in boiler check and maintain proper lift of 3/16".
4. Drain and renew oil in cold water pump.
5. Examine cold water pump steam governor valve and if down adjust with friction plug.
6. Examine hot water pump cylinder packing, replacing if necessary.
7. Maintenance forces should make certain that shoulders of follower plate studs are screwed in below face of piston so that follower plate will contact piston and make a tight joint. If stud shoulders are permitted to extend outward beyond face of piston the follower plate will leak and break.
8. Inspect hot water pump and cylinder liner and the fit of water piston in cylinder for wear and defects. The clearance between pump piston and cylinder liner should be .020 to .035 when new. If clearance becomes greater than 3/32", piston should be removed and oversize piston applied.

QUARTERLY INSPECTION
In addition to monthly inspection

1. Examine and clean heater including water control valve and float assembly.
2. Examine exhaust check valve plate and holding down studs and nuts and see that they are secure.
3. Examine and clean hot pump valve assembly.

SEMI-ANNUAL AND ANNUAL INSPECTIONS
In addition to monthly and quarterly inspections

1. Examine steam piston ring in drifting control valve and see that pipe from steam pipe to drifting control valve is clear with full area opening.
2. Examine guide ring and cold water pump impeller for proper clearance which should not exceed 3/64" between impeller and guide ring.

TYPES 5-SA AND 6-SA HEATERS

MONTHLY INSPECTION

1. Examine and clean tank well strainer.
2. Examine hot pump cylinder packing, replacing if necessary.
3. Maintenance forces should make certain that shoulders of follower plate studs are screwed in below face of piston so that follower plate will contact piston and make a tight joint. If stud shoulders are permitted to extend outward beyond face of piston the follower plate will leak and break. The clearance between pump piston and cylinder liner should be .025 to .035 when new. If clearance becomes greater than 3/32", oversize piston should be applied and liner rebored if necessary.
4. Examine suction strainer in cold water pump and clean with inhibited acid to maintain full area of holes in strainer.
5. Examine and clean steam line strainers at cold water pump turbine and heater header.
6. Examine and clean and grind in boiler check and maintain proper lift as follows:

   Type 5-SA with spring loaded valve - - 3/16" lift.
   Type 6-SA with cushion type
   boiler check - - - - - - - - - - - - - 7/16" lift

   With cushion type check it is necessary that the 1/8" port be clear and free from scale.

7. Drain and renew oil in cold water pump.
8. Inspect hot water pump end cylinder lining and the fit of water piston in cylinder for wear and defects.

QUARTERLY INSPECTION
In addition to monthly inspection

1. Examine and clean heater and float assembly.
2. Examine exhaust check valve plate and holding down studs and nuts and see that they are secure.
3. Examine and clean hot pump valve assembly.
4. Examine cold water pump brake shoe and ascertain that it does not drag course by contacting and wearing burrs on brake shoe. Examine wear in turbine bucket wheel and see that wear on buckets does not exceed 3/64".

SEMI-ANNUAL AND ANNUAL INSPECTIONS
In addition to monthly and quarterly inspections

1. Examine steam piston ring in drifting control valve and see that pipe from steam pipe to drifting control valve is clear with full area opening.
2. Examine guide ring and cold water pump impeller for proper clearance which should not exceed 3/64" between impeller and guide ring.

When locomotives are shopped or feedwater heaters are inspected or repaired, maintenance instructions, limits of wear, tolerances and machining limits prescribed in instruction books should be followed.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-56-4

SUBJECT: INJECTORS - REPAIRS AND MAINTENANCE.

INSTRUCTIONS:

Most of the lifting type "R" Simplex injectors on the older classes of locomotives have been in service many years, likewise the 1918 Special "A" and "B" non-lifting type injectors, and due to frequent overhauling are subject to inaccuracies with respect to position of steam nozzle, combining nozzles and delivery nozzle account refitting seats, etc. It is very important injectors be closely examined for defects during monthly inspections, also when engines are shopped for classified repairs, at which time all defects must be promptly corrected to avoid failures and insure proper functioning of injectors at all times. Interstate Commerce requirements must be maintained.

Causes of an injector not working:

1. Leaky suction pipe.
2. Loose packing of water valve stem.
3. Dirt, scale, cinders, iron or brass chips in nozzle or pipes.
4. Leaky check valve in delivery pipe or one with insufficient lift or stuck check.
5. Loose disc on water valve, not allowing close regulation.
6. Improper position of nozzles.

When replacing nozzles, carefully examine shoulders on body and nozzles, wipe same perfectly clean before replacing the parts in body. Screw parts down perfectly tight or injector will not work properly. Be careful not to damage nozzles.

When nozzle shoulders have been reseated, copper or brass liners must be inserted of thickness equal to exact amount of metal removed from seats to insure correct alignment. Spacing between nozzle seats must be in accordance with dimensions shown on drawings.

Injector bodies or other parts which cannot be properly repaired should be replaced with new parts.

These instructions should be placed in the hands of all involved in maintenance and repairs of injectors, and should also be posted under glass in all enginehouses and repair shops.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 1. 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-56-5

SUBJECT: INJECTORS - EXHAUST STEAM - MAINTENANCE AND INSPECTION.

INSTRUCTIONS:

Elesco exhaust steam injectors Types "T" and "TP" must be maintained in good operating condition and inspected as indicated below:

1. DAILY OR TRIP INSPECTION:

(a) Test injector operation with steam pressure not less than fifty (50) pounds below standard boiler pressure for the individual locomotive.

(b) Examine all pipe joints and packing nuts, observing that no leaks exist and that injector supplies water to the boiler.

2. MONTHLY INSPECTION:

(a) Starting Valve:

Grind in pilot valve and main valve.

Check operating handle rigging and observe that it is in proper condition, has no lost motion and handle latches properly.

(b) Overflow Valve:

Check by operating injector to determine valve is tight on seat and piston works free.

Lubricate piston with graphite and oil.

Grind in valve if necessary.

(c) Water Regulator:

Clean tubes with approved inhibited acid and thoroughly rinse.

Turn water regulator handle in cab observing that water regulating nozzle works freely.

Observe that water regulator index stands at zero when water regulator is closed.

(d) Change Over Valve:

Clean by pouring one pint of kerosene in a pipe or hose with a 3/4" fitting attached to relay valve vent and using air, blow kerosene through change over valve.

Check relay valve by screwing 1/4" bolt into bottom of valve seat and observe movement of valve.

Grind in valve seat.

Check change over of injector from live steam to exhaust steam and back to live steam using special test fitting.

Remove inspection plug from side of body and inspect exhaust check valve parts observing that none are loose or broken, Type "TP" injector.

(e) Cold Water Pump; Type "TP" Injector:

Check oil level and refill if necessary.

Remove governor valve cap and pour one pint of engine oil into turbine.

Test pump and adjust if necessary.

(f) Miscellaneous:

Inspect and clean exhaust pipe strainer and suction strainer.

Inspect, clean and grind in delivery check and boiler check.

Test injector gauge and clean chokes.

Check overflow indicator in cab observing that it shows "spill" when injector overflows.

Lubricate water regulator rigging and starting valve rigging parts, exhaust steam flow regulator arm and pin, and overflow valve lever pin.

3. QUARTERLY AND SEMI-ANNUAL INSPECTION:

Work to be performed as specified in Item 2 and in addition:

Inspect delivery and combining nozzles for wear or pitting and combining nozzle packing, replace if necessary.

Inspect auxiliary steam regulating valve for tightness on stem and renew packing.

Inspect high and low pressure bellows for leakage.

Clean and grind in automatic drain valve, Type "T" injector.

Check for wear and clean water valve piston, Type "T" injector.

Drain oil, clean and refill cold water pump, Type "TP" injector.

4. ANNUAL INSPECTION:

Work to be performed as specified in Items 2 and 3, and in addition:

Grind in both ends of automatic valve.

Grind in water valve, Type "T" injector.

5. GENERAL:

All defects reported or observed by inspection must be corrected before locomotive is released for service.

Injectors must be cleaned, overhauled and tested at each Class 3 or heavier repairs or more often as required by condition of injector.

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 1, 1947

By order of

Mech. Supt. - Steam Power

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-57-1

SUBJECT: LAGGING AND JACKET - JACKET IN CABS.

INSTRUCTIONS:

In order to prevent water getting under jacket and soaking lagging when back head is washed with hose, all sheets which lap at seams should be placed so edges of upper sheets lap over those lower down to provide shed for water.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-58-1

SUBJECT: LINK MOTION - ROLLER NEEDLE BEARINGS
INSPECTION, LIMIT OF SERVICE AND MAINTENANCE.

INSTRUCTIONS:

The following instructions govern the inspection, limit of service and maintenance of roller needle bearings applied to link motion of locomotives:

1. INSPECTION:

At annual inspection and other times when valve gear parts are removed from locomotives, roller needle bearings are to be checked for wear and looseness in housing and any defective condition corrected.

2. LIMIT OF SERVICE:

(a) All needle bearings used in valve gear are to be removed and carefully inspected each time locomotives are shopped for classified repairs. Bearings which inspection reveals are in good condition are to be reapplied.

(b) Link block roller needle bearings removed account mileage limit which inspection reveals are in good condition may be applied to tail end of link or to radius bar lifter.

3. MAINTENANCE AND ASSEMBLY:

(a) Valve gear parts with roller needle bearings applied should not be cleaned with any acid solution as it will cause corrosion and pitting of the polished surfaces of the bearings.

(b) Valve gear parts equipped with roller needle bearings when washed with water and steam, bearings are to be blown out with air to remove all moisture and avoid rusting.

(c) To clean roller needle bearings immerse in clear distillate and revolve the races, blow bearings out with air, apply light coat of oil to all surfaces, and store bearings in clean place under cover.

(d) Waste or dirty cloths should not be used to wipe bearings.

(e) New or reconditioned bearings drawn from store stock should be thoroughly cleaned before applying.

(f) Clean oil holes in valve gear parts before applying bearings.

(g) Bearings which are defective are to be replaced and the bearings removed should be cleaned and oiled, wrapped to avoid damage and forwarded to Omaha Shop for further inspection and disposition.

(h) It is important that proper fit be maintained between outer race of bearing and bore fit of valve gear part.

(i) When bearings show signs of looseness in bore fit of valve gear part, the bore should be reground for proper tolerance fit of 1/16" oversize bearing. Oversize bearings are carried in store stock and are identified by letter "O" after bearing number to indicate oversize.

(j) Bearings applied to valve gear parts should have a light driving or press fit, preferably applying by use of draw bolt and washers. Light tapping on head of draw bolt will facilitate application. Heavy press fit should be avoided so as not to reduce lateral clearance built into bearing.

(k) After application check bearing to see that it does not bind and rotates freely.

(l) Pin should be a light press fit in inner race of bearing, it must not be driven in.

(m) Check bearing for proper lateral.

(n) After bearings are applied to valve gear parts, assembly should be suitably wrapped to protect against dirt, grit or foreign substance until parts are to be applied to locomotive.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-58-2

SUBJECT: VALVE GEAR - INSPECTION.

INSTRUCTIONS:

Inspection of valve gear parts shall be in accordance with the following:

1. MAGNAFLUX OR WHITING INSPECTION:

Complete surface inspection of all valve gear parts shall be made by Magnaflux method if shop or enginehouse is so equipped; otherwise, use whiting method. Give particular attention on this inspection to eyes and grease passages of valve gear members.

2. INSPECTION - WHEN REQUIRED:

Magnaflux test or whiting inspection of complete surfaces of all valve gear parts shall be made at each classified repairs only for the following classes of locomotives:

800-844
3800-3839
3930-3999
4000-4024

For all other locomotives Magnaflux test or whiting inspection of complete surfaces of valve gear parts shall be made whenever such parts are removed for any purpose, and when the locomotives are shopped for classified repairs.

IMPORTANT: Magnaflux or whiting inspection shall not be construed as supplanting customary mechanical inspection of valve gear parts for wear and safe operation.

3. DEFECTIVE PARTS:

Parts with cracks, fractures, major nicks or any other defect affecting safe use shall be scrapped. All defective parts shall be promptly reported on "Defective Machinery Forms", giving full description of fracture or flaw, method by which defect was discovered, any evidence of improper tooling or surface blemishes, and listing all shop marking on part.

Defective valve gear parts removed from service shall, if their size permits, be stenciled with white paint in 1" letters and numbers to show whether defective by Magnaflux or whiting test, and date and place removed. Example:

Defective M - Test 11-46-C

showing that part found defective by Magnaflux test November, 1946 at Cheyenne. Use letter "W" for whiting test.

Defective parts too small for stenciling shall be tagged to show above information.

4. MINOR DEFECTS:

All minor defects such as nicks, blemishes, tool marks, etc., shall be removed by careful grinding, followed by polishing. Extreme care shall be taken when grinding to taper off two or three inches each side of minor defect to avoid sharp edges or abrupt change in section. Reduction in cross sectional area of part due to grinding shall not exceed 10% of the cross sectional area obtained from drawing dimension. Link motion parts with minor defects which cannot be removed within this grinding limit shall be scrapped.

5. ADJUSTMENT OF LINK MOTION PARTS:

Link motion parts shall be adjusted in accordance with standard valve setting instructions and valve gear drawings. Heating of eccentric rods to adjust length shall be closely supervised and care taken to restore original heat treatment by normalizing and tempering in accordance with the heat treatment specification. Under no circumstances shall link motion parts be heated with acetylene torch to adjust alignment.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-58-3

SUBJECT: VALVE GEAR - VALVE GEAR SETTING AND DIAGRAMS.

INSTRUCTIONS:

A. Arrange to set valve gears of steam locomotives strictly in accordance with latest issue of valve gear folio which contains index sheets, instructions, valve gear diagrams and drawings showing bushing gauges. Additional and revised sheets must be added and substituted as issued, making sure that this folio is kept up-to-date.

Setting of valves for non-common standard steam locomotives not included in valve setting folio should be handled in accordance with erecting diagrams and drawings covering valve gear details.

B. In setting valves, the following should receive careful attention:

1. Check and correct lost motion in valve gear.

2. Check spacing of valves and cages with standard gauge.

3. Check radius bar hanger or lifter to determine proper length, by swinging link, with block in mid-position and combination lever plumb.

4. Check eccentric crank throw by tramming from eccentric crank pin to points on a horizontal board suspended from link support or from fixed position on guide yoke, located in line with center of drivers, main wedges to be set up tight.

5. Direct tram to be used on all locomotives equipped with back valve head extension, tramming from back end of crosshead to outside face of guide.

6. With locomotive under maximum steam pressure, trail over in full gear and 33% running cut-off, both forward and backward motion.

7. Correct main reach rod length so link blocks will be in mid-position with reverse gear in mid-position.

8. Adjust reverse gear reach rod so that reverse lever is on center with reverse gear and link blocks in mid-position.

9. Locate stops on reverse lever quadrant to provide maximum valve travel.

10. Adjust center reach rod on articulated locomotives to equalize valve travel on both engines.

11. Maintain maximum boiler pressure when determining final adjustments to correct running cut-offs, full gear travel and application of stops on quadrants.

12. All valve stem and eccentric rod changes to be determined from measurements obtained in 33% running cut-off.

13. In checking union link for correct length on Young valve gear, place crosshead the amount of error in angularity of main rod back of mid-position, with main rods up. With crosshead in this position, move reverse lever to extreme front and back of quadrant. If union link is correct length there will be no movement of valve on opposite side.

14. Check reach rods on Young valve gear by swinging links with blocks in mid-position. Adjustment of reach rods to be determined by mid-position of reverse gear.

15. Young valve gear to be trailed over in full gear, forward and backward motion, also 33% running cut-off in forward and backward motion.

16. For locomotives with Stevenson valve gears dead centers must be taken.

C. Book record on Form 7044 must be carefully maintained. All data called for in this record must be included, kept up-to-date and held readily available for inspection.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-61-1

SUBJECT: OIL BURNING EQUIPMENT
DIAL THERMOMETERS - CALIBRATING INSTRUCTIONS.

INSTRUCTIONS:

Dial thermometers on all oil burning locomotives must be calibrated at quarterly inspection and at any time thermometer is reported inaccurate, in accordance with instructions dated March 17, 1939, copy attached.

Calibrating instructions should be posted in all roundhouses in districts maintaining oil burning locomotives so maintenance forces can familiarize themselves thoroughly with these instructions.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

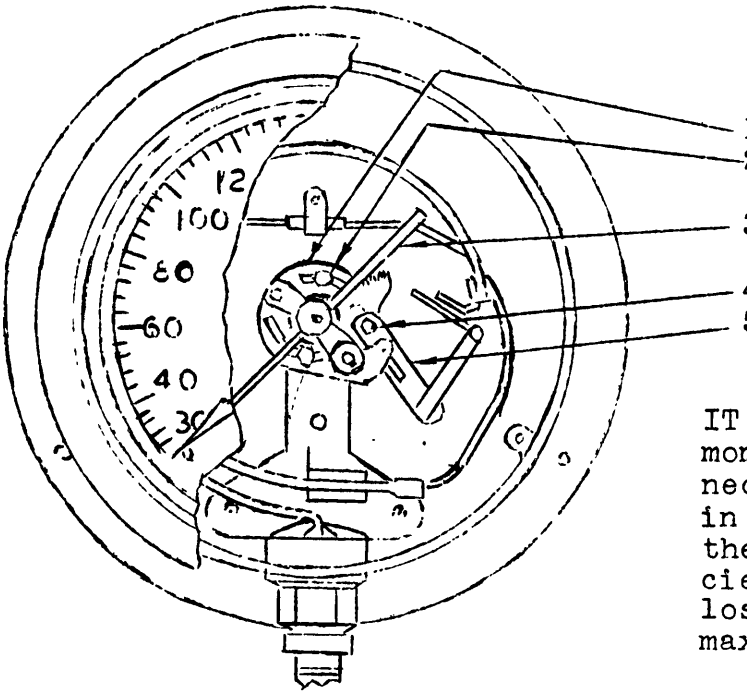
Omaha, Nebraska

July 1, 1947

OIL TANK THERMOMETERS
OIL BURNING LOCOMOTIVES Att.-L-61-1

CALIBRATING INSTRUCTIONS FOR DIAL THERMOMETERS HAVING ROTARY MOVEMENTS

Dated March 17, 1939



1. Movement
2. Movement Holding Screws
3. Pointer
4. Movement Slide Screws
5. Slide

IT IS ASSUMED that the thermometer movement and all connection bearings are free and in good condition, and that the hair spring has sufficient tension to take up all lost motion from minimum to maximum travel of the pointer.

FIRST, the thermometer should be tested at several points around the dial, by checking against an "ACCURATE" Test Thermometer in a test tank. IF THE POINTER (3) MOVES TOO FAR, the slide (5) should be lengthened or pushed out. IF THE POINTER DOES NOT TRAVEL FAR ENOUGH, the slide (5) should be shortened or pushed in. The movement slide screws (4) should be tightened after each setting or adjustment, and after calibration is correct, they should be checked to assure their being TIGHT.

After this slide (5) has been adjusted, if it is found that the thermometer is correct for the first part of the dial and moves SLOWER for the remainder, loosen the movement holding screws (2) and rotate the movement (1) a very little to the RIGHT, or clockwise. This makes the pointer move FASTER for the last part of the dial.

If the pointer is correct for the first half of the dial and then moves gradually FASTER for the remainder, the movement should be rotated a little to the LEFT, or counter-clockwise. This makes the pointer move SLOWER for the last part of the dial. The movement holding screws (2) should be tightened after each setting or adjustment, and after calibration is correct, they should be checked to insure their being TIGHT.

There is nothing difficult about the above procedure. This adjustment for accuracy and correct calibration over the entire scale is possible, only with the rotary movement.

It is recommended to check at least 3 temp. points on the dial, one near the beginning of the range, one near the center and one near the end. For example, on a range of 30/240° F., the following temps. are used conveniently: 32° F. (ice and water), 140° F. and 212° F. (boiling water) in open vessel.

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-63-1

SUBJECT: PIPE FITTINGS - BONDING PIPE SLEEVES.

INSTRUCTIONS:

All steam pipes having sleeve connections will use sleeves of new design bonded with approved alloy bonding wire and approved flux as included in drawings now in force, and are to be applied with gas burning, pipe sleeve bonding machines.

1. Prepare sleeve and pipe for bonding in accordance with latest issue of Standard Practice Folio Sheet 168. Folio sheet shows sleeve tolerances and sizes of bonding wire for various sizes of joints and materials. Attention is directed to view showing completed joint and note specifying that bonding material must show witness around entire circumference. Special care must be taken to make certain that sleeves conform to tolerances shown on various pipe sleeve drawings.

2. All steam pipes inside of locomotive cab which have outside diameter larger than 3/4" will be copper pipe with steel sleeves.

3. All steam pipes outside of locomotive cab which have outside diameter larger than 3/4" will be seamless steel tubing with steel sleeves.

4. All steam pipes 3/4" outside diameter or less used either inside or outside of cab will be copper pipe with bronze sleeves.

5. Standard sizes of steel and copper tubing for use with new design sleeves are as follows:

Cold Drawn Seamless Steel Tubing

Outside Diameter	Wall Thickness
1-1/4"	#10 BWG (.134)
1-3/4"	#10 BWG (.134)
2"	#10 BWG (.134)
2-1/4"	#10 BWG (.134)
2-1/2"	#10 BWG (.134)
2-5/8"	5/32" (.156)
2-3/4"	5/32" (.156)
3"	3/16" (.188)
3-1/4"	3/16" (.188)
3-1/2"	3/16" (.188)

Copper Tubing

Outside Diameter	Wall Thickness
5/8"	#14 BWG (.083)
1-1/4"	#10 BWG (.134)
1-1/2"	#10 BWG (.134)
3-1/2"	# 6 BWG (.203)

6. Sleeves for steam pipes which have an outside diameter larger than 3/4" will be machined from low carbon seamless steel tubing. As indicated on drawings, sleeve is bored as follows:

   (a) For steel sleeves on steel tubing bore of sleeve equals outside diameter of tubing plus .0025" to .004".

   (b) For steel sleeves on copper tubing bore of sleeve equals outside diameter of tubing plus .008" to .010".

7. Sleeves for steam pipes which have an outside diameter 3/4" or less will be machined from injector metal, Specification C.S. 12, Section 11. As indicated on drawings, sleeve is bored as follows:

   For bronze sleeves on copper tubing bore of sleeve equals outside diameter of tubing plus .002" to .004".

8. Pipe sleeves for cold drawn seamless steel tubing and copper tubing listed under Item 6 will be bored for nominal outside diameter of tubing plus bore tolerances given in Items 6(a), 6(b) and 7. Tubes which have an oversize outside diameter within the variations permitted by standard manufacturing tolerances should have the sleeve end polished with emery cloth to permit application of standard bore pipe sleeve. Listed below are standard bores for sleeves to fit tubing shown under Item 5:

Cold Drawn Seamless Steel Tubing

Sleeve Bore	Size of Cold Drawn Seamless Steel Tubing: Nominal Outside Diameter	Standard Manufacturing Tolerances - Permissible Variations Outside Diameter: Over	Under
1-1/4" plus .0025" to .004"	1-1/4"	.005"	.000"
1-3/4" - do -	1-3/4"	.010"	.000"
2" - do -	2"	.010"	.000"
2-1/4" - do -	2-1/4"	.010"	.000"
2-1/2" - do -	2-1/2"	.010"	.000"
2-5/8" - do -	2-5/8"	.010"	.000"
2-3/4" - do -	2-3/4"	.010"	.000"
3" - do -	3"	.010"	.000"
3-1/4" - do -	3-1/4"	.010"	.000"
3-1/2 - do -	3-1/2"	.015"	.000"

Copper Tubing

Sleeve Bore	Nominal Outside Diameter of Copper Tubing
5/8" plus .002" to .004"	5/8"
1-1/4" plus .005" to .006"	1-1/4"
1-1/2" - do -	1-1/2"
3-1/2" - do -	3-1/2"

Bonding of copper or steel pipe or pipe fittings with acetylene torch will not be permitted under any circumstances.

Welding of cracks, fractures or longitudinal splits on pipe will not be permitted.

All copper pipes found fractured, or walls worn more than half the original thickness, must be replaced with a new pipe or a new section of pipe.

All pipes and sleeves on locomotives must be checked and corrected in accordance with above instructions whenever pipes are removed from locomotives, work to be completed not later than at first Class 3 or heavier repairs.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-63-2

SUBJECT: EXTRA STRONG PIPE.

INSTRUCTIONS:

Extra strong pipe must be used for all steam, air and water lines on steam locomotives and tenders.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-64-1

SUBJECT: PIPING ENGINE - ASH PAN SPRINKLER.

INSTRUCTIONS:

All coal burning locomotives must be equipped with ash pan sprinklers in accordance with previously-issued drawings covering various classes of locomotives.

The ash pan sprinkler pipes on the sides of the ash pan must be located on the outside edge and clamped as shown on drawings. These pipes, in no case, should be located directly under the mud ring as this restricts the free air opening at that point.

During season ash pan sprinklers are used, they must be inspected at the end of each trip by roundhouse forces, making necessary repairs. Outgoing engineers will also test sprinkler and will not leave terminal unless it is in first-class condition. During winter months, ash pan sprinkler will be disconnected and drained to prevent freezing, except ash pan sprinklers on 3900 and 4000 class locomotives which are connected into mud ring and are equipped with automatic drain valves.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-64-2

SUBJECT: PIPING - LOCOMOTIVES - FIRE FIGHTING HOSE.

INSTRUCTIONS:

Fire fighting hose will be tested, applied and maintained as follows:

1. TEST:

(a) Fire fighting hose received from manufacturer has been subjected to a hydrostatic test of 300 pounds pressure and before applied to locomotives must be carefully inspected for possible defects.

(b) Fire fighting hose on locomotives must be given hydrostatic test once each month with a pressure equal to boiler pressure of locomotive on which hose is applied and a thorough inspection of hose made while under pressure.

(c) After hose is tested, carefully clean all dirt and cinders from outside, and in cold weather thoroughly dry to prevent cracking of rubber lining due to freezing.

2. APPLICATION:

(a) Fire fighting hose on locomotives to be 1" hose.

Road locomotive . . . . one 50 foot length
Switch locomotive . . . two 50 foot lengths

(b) When applying two lengths of 1" hose to road locomotives permanently assigned to switching service, it will be necessary to change half union and cap on end of piping to suit 1-1/2" winged union ring on end of hose.

(c) Two lengths of 1" hose to be applied to switch locomotives only when 1-1/2" hose requires renewal and after store stock of 1-1/2" hose is used up.

(d) When renewing or replacing hose on either road or switch locomotives, check is to be made to know that fitting on end of hose fits the connection on fire fighting line on locomotive.

(e) In placing hose in hose boxes, extreme care should be taken to avoid hose being kinked so as to prevent breakage at kink when pressure is applied.

3. MAINTENANCE:

Fire fighting hose is to be maintained in safe and suitable condition for service. Any defective fire fighting equipment must be repaired or replaced.

4. MARKING:

(a) When new hose is applied on locomotives, metal tag is to be attached to each length of hose showing date applied.

(b) When hose is tested, metal tag is to be attached to each length of hose showing:

Date of inspection.
Place of inspection.
Initials of inspector.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-64-3

SUBJECT: PIPING - ENGINE - PIPE COVERING.

INSTRUCTIONS:

Application of insulation to piping of steam locomotives should be made in accordance with the following instructions:

1. All exposed live steam pipes on locomotives and tenders, except injector delivery line, must be insulated.

2. Pipes carrying low pressure or exhaust steam must be insulated when specified on drawings, also when necessary to prevent injury to workmen, crews, etc.

3. 1/16" asbestos lining tape may be used only where clearances will not permit using heavier insulation.

4. Force feed lubricator oil pipes extending from lubricator to angle iron pipe supports must be covered with single or double thickness waterproofed asbestos tubing. Oil pipes placed in angle iron support are to be nested together and wrapped with 3/16" x 1-9/16" waterproofed asbestos insulating tape. Asbestos tubing is to be applied to pipes before fittings are brazed in place and securely clamped at ends with wire loop or other suitable clamps.

5. Flexible steam heat connections between engine and tender, also at rear of tender are to be lagged with waterproofed approved asbestos insulating tape and jacketed with No. 24 gauge sheet steel, soldered in place.

6. All insulation must be tightly and spirally wrapped on pipe with edges abutting and securely wired on with 16 gauge soft annealed wire loop clamps applied at ends of insulation, also with additional clamps at intervals of 24" or more closely if necessary to hold insulation securely in place.

7. Steam heat pipes on tenders must be covered with approved laced-on type asbestos pipe covering 1" thick, insulation to be laced on with double lacing using 18 gauge copper wire, adjacent sections to be laced together. Insulation must be securely clamped at ends of sections and at other locations as required, using wire loop clamps.

8. Exposed main live steam pipes to cylinders of articulated locomotives must be insulated with approved laced-on type asbestos insulation 1-1/2" or 2" thick as specified in drawings, insulation to be laced on with double lacing using 18 gauge copper wire, adjacent sections to be laced together. Metal collars must be applied at ends, and metal bands at all section joints of the insulation.

9. For locomotives 3670-3674, due to restricted clearances, main steam pipes should be insulated with approved 1" x 4" waterproof asbestos insulating tape on all portions where clearances permit and 3/8" x 2-3/8" waterproofed insulating tape on portions of piping where clearance restrictions require.

10. Materials for insulating piping of steam locomotives and tenders must be as follows:

IRON OR STEEL PIPES

1/2" Dia. and less	- 3/16" x 1" Waterproofed asbestos insulating tape
3/4" to 1-1/4" Dia.	- 3/16" x 1-9/16" Waterproofed asbestos insulating tape
1-1/2" to 2-1/2" Dia.	- 3/8" x 2-3/8" Waterproofed asbestos insulating tape
3" Dia. and over	- 1" x 4" Waterproofed asbestos insulating tape
Steam pipes on tenders	- Asbestos laced-on type insulation (1" thick)
Exposed main live steam pipes to cylinders of articulated locomotives	- Asbestos laced-on type insulation (1-1/2" or 2" thick) as specified on drawings.

COPPER PIPES

1/2" Dia. and less OD	- Single or double thickness waterproofed asbestos tubing
5/8" to 1-1/2" Dia. OD	- 3/16" x 1-9/16" Waterproofed asbestos insulating tape
2" Dia. and over OD	- 3/8" x 2-3/8" Waterproofed asbestos insulating tape

Pipe fittings and inaccessible pipes all sizes - 1/16" approved asbestos listing tape.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-64-4

SUBJECT: PIPING - ENGINE - STEAM HEAT IN CAB.

INSTRUCTIONS:

A. CAST IRON RADIATOR:

Locomotives equipped with cast iron radiators must be equipped with pressure reducing valve, steam gauge and steam traps, arranged as shown on drawings.

The working pressure on cast iron radiators must not exceed 20 lbs. per square inch. Cab heater steam gauge must have dial marked with heavy white line to indicate working pressure. Each Master Mechanic will issue bulletin to enginemen calling attention to maximum permissible working pressure of 20 lbs. per square inch cast iron cab radiators, and state that this pressure must not be exceeded. Steam traps, steam gauge and regulating valve must be inspected and tested at suitable intervals to insure proper working pressure and operation.

B. BUILT-UP TUBE TYPE OR PIPE RADIATIORS:

Locomotives equipped with built-up tube type or pipe radiators must be equipped with choke fitting in supply line and with open drain line to ash pan or as shown on drawings. Drain line must be adjacent to firebox to prevent freezing.

C. RADIATORS - TEST:

All cast iron and built-up tube type radiators must be given hydrostatic test of not less than 300 lbs. per square inch at the beginning of each heating season, and at each general shopping of locomotive. Radiators must be tagged showing date of hydrostatic test, engine number, shop and initials of employe making test.

In making this test, radiators should be removed from cabs and covered with canvas to avoid hazard of injury from flying particles in case radiators rupture under the 300 lb. water test.

To relieve exterior corrosion as much as possible, the recess in cab floor as well as radiator surfaces must be thoroughly cleaned of all dirt and moisture at each monthly inspection. Radiators must not be under pressure while being cleaned.

By order of

Mech. Supt. - Steam Power

Approved by
Gen'l Supt. MP&M
Omaha, Nebraska
July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-64-5

SUBJECT: PIPING - ENGINE - COPPER PIPES
INSPECTION AND ANNEALING.

INSTRUCTIONS:

1. Copper steam pipes on locomotives must be removed, inspected and annealed as follows:

   (a) Copper steam pipes to water columns, water glass, steam gauges, and hydrostatic lubricator, at annual inspection periods.

   (b) All copper steam pipes carrying steam under boiler pressure, when locomotives receive Class 3 or heavier repairs.

2. Sleeves should be inspected to know they are in good condition and properly bonded in conformity with latest instructions and drawings.

3. When annealing copper pipes care must be taken to avoid overheating and damage to bonded joints or fittings.

4. Defective copper pipes or sleeves must be replaced.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-64-6

SUBJECT: PIPING - ENGINE - BACK PRESSURE GAUGE.

INSTRUCTIONS:

When necessary to replace existing Duplex initial and back pressure gauge on all road locomotives, a single hand back pressure gauge with pressure snubber must be applied and piping changed in accordance with drawings.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-64-7

SUBJECT: PIPING - ENGINE - HOT BOX COOLING PIPES.

INSTRUCTIONS:

All plain bearing locomotives equipped with hot box cooling piping, must have hose connection for same between engine and tender disconnected at locomotive end, when not in use, and hose coiled around pipe from tender and securely tied with heavy hemp cord.

Hose secured in this manner is readily accessible for fastening to engine piping when required for cooling hot box on the locomotive.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-65-1

SUBJECT: PISTON HEADS AND PISTON RODS - INSPECTION.

INSTRUCTIONS:

Each time steam locomotive piston heads and piston rods are removed, for any reason, also whenever locomotives are shopped for classified repairs, careful inspection must be made of piston heads and piston rods for cracks and incipient fractures as follows:

1. Piston rods must be thoroughly cleaned.

2. Piston heads must be thoroughly cleaned and also sandblasted at all points where sandblast equipment is available.

3. At points where Magnaflux equipment is available piston heads and piston rods must be given careful Magnaflux test and inspection as covered by latest instructions.

4. At points where Magnaflux equipment is not available piston heads and piston rods must be given careful whiting test and inspection as covered by latest instructions.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-68-1

SUBJECT: REVERSE GEAR - RULES FOR REPAIRS, INSPECTION AND TESTING.

INSTRUCTIONS:

All power reverse gears must be inspected and tested before each trip and a general inspection and test is required at every thirty-day inspection period. Rules for the repairs, inspection and testing are contained in the following pages.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

INSTRUCTIONS FOR TESTING - ALCO GEARS

1. Examine all pins and bushings, arms, reverse lever and reverse gear brackets for lost motion.

   When gear will not respond to two notches movement of reverse lever on quadrant, lost motion must be corrected so gear will respond to one notch on quadrant.

2. See that air reservoirs have full pressure.

3. Test valve for leakage at exhaust port when the reverse lever has been moved to different positions of quadrant.

4. Block crosshead and front cylinder head, and move the reverse lever back. Open back drain cock and test for leaks at valve exhaust and drain cock. If air leaks then back cup leather is leaking.

5. Do the same, blocking the crosshead from the front of the guides. This tests the front cup leather.

   Inspect leather and renew in either case of leak.

6. Test piston rod packing by slowly moving the crosshead from full ahead to full back position, and holding a torch at the point where the piston rod comes through the stuffing box.

7. Test for leaks around pipe nipples and unions from valve to cylinder.

8. Test for air leaks between cylinder heads and cylinders.

9. See that small ell in crosshead wrist pin is up and oiled.

10. See that steam connection is closed and kept closed.

11. Open drain cocks regularly to prevent oil from accumulating in bottom of cylinder.

12. When making the monthly I.C.C. orifice test, the power reverse gear will be tested for leaking in the following manner:

Type of Air Compressor	Strokes per Minute Due to Orifice Only	Additional Strokes for Reverse Gear
N.Y.A.B. Co. 5-b	80	14
	90	16
	100	17
W.A.B. Co. 8½" - 150	80	9
	90	10
	100	12

Reverse gear passes air consumption test if strokes made by pump due to reverse gear only are not more than additional strokes specified in above table.

INSTRUCTIONS FOR TESTING - ALCO GEARS (Cont'd)

Engines must not be allowed to leave initial terminals with any of the following defects:

1. Piston rod packing leaking.

2. Oil cup in air supply line missing or empty.

3. Improper length hand lever reach rod which should be adjusted while engine is hot.

INSTRUCTIONS FOR OVERHAULING - ALCO GEARS

1. All reverse gear cylinders to be rebored when scored or 1/32" or more out of round at any point.

2. Rotary valves and rotary valve caps as used on ALCo gears to be ground with a very fine grinding compound. Care must be taken to remove all compound after grinding and clear all ports.

3. All reverse gear pins and bushings must show no lost motion when applied. This is important and rule must be observed as the accumulated lost motion of the several bearings is sufficient to cause creeping of the gear. All pins and bushings must be case hardened. All bushings provided with necessary oil holes

4. All reverse gear pistons - All defective or badly worn cup packing must be removed and replaced with new packing. Care should be taken when applying new packing to see that the follower bolts are properly applied and air tight, and that the edges of the leathers are not damaged in entering the cylinder.

5. All reverse gear pistons should be placed in lathe, turned and polished when rod shows any indication of wear or rough spots. Piston followers should be checked while in lathe to see that same are concentric with piston rod.

6. Lost motion between crosshead and guides should be tested and if in excess of 1/16", crosshead must be bronzed or renewed to proper fit. This is necessary in order to prevent piston rod from pounding out the packing.

7. Crosshead guides must be examined carefully and where found worn or gouged, must be corrected.

8. When lining up crosshead and guides, it is necessary that piston rod must travel on the center line of the stuffing box, and gear must be lined accordingly. This is necessary in order to preserve the gland packing.

9. All hand levers and hand lever reach rods should be inspected with reverse gears and all lost motion in pins, bushings and also loose arms must be corrected before engine is allowed in

INSTRUCTIONS FOR OVERHAULING - ALCO GEARS (Cont'd)

allowed in service. All reverse gear and hand lever supports should be inspected and bolts and studs tightened or renewed to eliminate lost motion and vibration.

10. All locomotives should be equipped with reverse gear quadrants having fine teeth.

11. Clearance between rotary valve and valve stem should not be more than .004" to .006", as this play causes movement of the crosshead without movement of the valve to compensate for it.

12. Reverse shaft counterbalance spring should be inspected and adjusted in engines so equipped. Defective and weak springs to be removed and spring case cleaned out.

13. Reach rod bracket between reverse gear and lever to be a good fit so as not to allow excessive vibration of the reach rod.

INSTRUCTIONS FOR TESTING - RAGONNET AND PRECISION REVERSE GEAR

1. Examine all pins and bushings, arms, reverse lever and reverse gear brackets for lost motion.

   When gear will not respond to two notches movement of reverse lever on quadrant, lost motion must be corrected so gear will respond to one notch on quadrant.

2. See that air reservoirs have full pressure.

3. Block between crosshead and front cylinder head, open back drain valve, move combination lever forward. This puts air pressure in the front end of cylinder. If air continues to blow from rear drain valve the front cup leather is leaking, or else blowing by valve in which case remove back head to determine condition of cup leathers and valve. This also tests the piston rod packing.

   Test for cup packing in Type "E" Ragonnet and Precision gear.

   Block engine valve motion so gear piston cannot move.

   Move gear valve so as to exhaust air from one compartment of cylinder and give full pressure in other.

   If air vents from port in forward end of piston rod it will indicate leakage by cup toward compartment that is charged.

   While front compartment is charged with air test may also be made of piston rod packing and if rear compartment of Precision gear is charged test may also be made of sleeve packing.

   Examination should also be made for leaks by cylinder head joints and cylinder drain valves.

   While testing cup packing in Type "E" gears and Precision gears, if air blows from cylinder drain in the uncharged compartment it is an indication that valve is blowing.

INSTRUCTIONS FOR TESTING - RAGONNET AND PRECISION REVERSE GEAR (Cont'd)

4. Close back drain cock, move combination lever back, releasing blocking. Move crosshead to near center position, block between crosshead and front guide stop, open front drain cock, move combination lever backward. This puts air pressure in back end of cylinder. If air continues to leak from front drain cock, the back packing cup or valve is leaking. Gear should be taken down to determine cause of leak.

5. During tests as covered in Items Nos. 3 and 4, the exhaust outlet should be carefully examined for leak in the slide valve.

6. When making the monthly I.C.C. orifice test, the power reverse gear will be tested for leaking in the following manner:

Type of Air Compressor	Strokes per Minute Due to Orifice Only	Additional Strokes for Reverse Gear
N.Y.A.B. Co. 5-b	80	14
	90	16
	100	17
W.A.B. Co. 8½" - 150	80	9
	90	10
	100	12

Reverse gear passes air consumption test if strokes made by pump due to reverse gear only are not more than additional strokes specified in above table.

Engines must not be allowed to leave initial terminals with any of the following defects:

1. Piston rod packing leaking.

2. Valve stem packing leaking.

3. Oil cup in air supply line missing or empty.

4. Improper length of hand lever reach rod - which should be adjusted while engine is hot.

INSTRUCTIONS FOR OVERHAULING - RAGONNET REVERSE GEARS

1. All reverse gear cylinders to be rebored when scored or 1/32" or more out of round at any point.

2. All reverse gear slide valves and seats, when not in perfect condition must be corrected, as follows:

When badly cut or scored, must be replaned and resurfaced.

INSTRUCTIONS FOR OVERHAULING - RAGONNET REVERSE GEARS (Cont'd)

When leaking from slight imperfection, must be scraped, using a face plate and scraper and brought to final finish with Bon Ami, rouge or other non-abrasive compounds. The use of emery or other abrasive compounds for this purpose is forbidden.

Valves and valve seats must conform to gage.

3. All reverse gear pins and bushings must be hardened and applied without lost motion.

This is important and the rule must be observed as the accumulated lost motion of the several bearings is sufficient to cause creeping of the gear.

All bushings must be provided with oil holes.

4. All reverse gear combination levers, Type "A" Ragonnet, and sliding blocks, Type "B" Ragonnet, must be inspected and all lost motion be removed, both vertically and horizontally.

5. All reverse gear pistons - All defective or badly worn cup packing must be removed and replaced with new packing. Care should be taken when applying new packing to see that the follower bolts are properly applied and air tight, and that the edges of the leathers are not damaged in entering the cylinders

6. All reverse gear piston rods should be placed in lathe, turned and polished when rod shows any indication of wear or rough spots. Piston followers should be checked while in lathe to see that same are concentric with piston rod.

7. Lost motion between crosshead and guides on Ragonnet reverse gears should be tested both vertically and horizontally, and if in excess of 1/16" crosshead or shoes must be bronzed or renewed to a proper fit. This is necessary in order to prevent piston rod from pounding out the packing.

8. Ragonnet reverse gear crosshead guides must be examined carefully, and where found worn or gouged must be corrected.

9. When lining up crosshead and guides on Ragonnet reverse gears, it is necessary that piston rod must travel on the center line of the stuffing box, and gear must be lined accordingly. This is necessary in order to preserve the gland packing.

10. When assembling valve on Ragonnet Type "A" reverse gears, see that valve is comfortable on its seat without bending or distorting valve rod or cramping valve rod in gland. If necessary, elongate valve stem hole in valve for this purpose.

Valve should have not over 1/64" horizontal play on valve stem.

On all types Ragonnet gears valves must be kept in condition so as to travel parallel with seat.

11. Valve chest rocker arm trunnion blocks on Ragonnet Type "B" and "E" gears should be examined and renewed when any lost motion

is found. The valve chest rocker arm should be checked for lost motion in valve chest gland and arm built up and valve chest gland reamed when found necessary. The use of brass bushings to reclaim valve chest glands is forbidden - gland joint ring to be refaced and reground when necessary.

12. Valve stem bushings on Ragonnet Type "A" gear should be renewed when any lost motion is found.

13. All hand levers and hand lever reach rods should be inspected with reverse gears, and all lost motion in pins, bushings, and also loose arms must be corrected before engine is allowed in service. All reverse gear and hand lever supports should be inspected and bolts and studs tightened or renewed to eliminate lost motion and vibration.

14. All locomotives having Ragonnet Types "A", "B" and "E" gears should be equipped with reverse gear quadrants having fine teeth.

15. Reverse shaft counterbalance spring should be inspected and adjusted in engines so equipped. Defective and weak springs to be removed and spring case cleaned out.

16. Steam connections to all types power reverse gears must have proper and efficient drainage at all times to prevent steam leakage into gear cylinders.

17. Reverse gear reach rod must be supported by roller or slide bearings attached to boiler or running board support. Reach rod must not cramp or bind on bearing. Use of bearing is necessary to prevent vibration of reach rod which causes creeping and wear on pins and bushings.

Omaha, Nebr.,
July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-68-2

SUBJECT: REVERSE GEAR - RULES FOR REPAIRS INSPECTION AND TESTING.

INSTRUCTIONS:

All power reverse gear cylinders, when bore is worn 1/32" out of round, should be rebored or ground to 1/16" oversize and 1/16" oversize piston and piston cups applied.

When worn 3/32", rebore or grind to 1/8" oversize and apply 1/8" oversize piston and piston cups.

Cylinders when 3/16" oversize in bore should be replaced.

When necessary to rebore cylinders, care should be taken on the last or finishing cut to loosen the clamping arrangement so as to relieve all possible distortion in cylinder due to clamping, thus insuring truly cylindrical bore. The bore should be as smooth as possible, grinding is preferred.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-68-3

SUBJECT: REVERSE GEAR PISTON ROD AND PACKING.

INSTRUCTIONS:

Reverse gear piston rod packing will be provided in three sizes, viz., standard size, and for 1/16" and 1/8" undersize piston rods for all makes and types of power reverse gears. To insure proper packing fit new piston rods will be equipped with standard or nominal size packing, and worn rods will be reground to 1/16" or 1/8" undersize and 1/16" or 1/8" undersize packing applied.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-68-4

SUBJECT: REVERSE GEAR - VALVE CHEST ROCKER ARM.

INSTRUCTIONS:

To avoid breakage of reverse gear valve chest outside rocker arms on Ragonnet Type "B" and Type "E" Reverse Gears, all arms must be removed and normalized on all locomotives passing through shops for Class 3 or heavier repairs.

Rocker arms are made from low carbon open hearth steel, SAE Specification 1020, and should be normalized at 1575 to 1650 degrees Fahrenheit and allowed to cool slowly without being exposed to moisture or drafts.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-69-1

SUBJECT: REVERSE SHAFT - INSPECTION OF REVERSE SHAFT ARM PINS - TOP RADIUS BAR HANGER PINS.

INSTRUCTIONS;

Top radius bar hanger pins for 800, 3800, 3900 and 4000 class locomotives must be removed and given careful Magnaflux test and inspection over entire surface at each semi-annual and annual inspection period.

In addition these pins must be removed and given careful and complete Magnaflux test and inspection each time these locomotives pass through shops for classified repairs.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-71-1

SUBJECT: RUNNING BOARD - ENGINE - CLEARANCE.

INSTRUCTIONS:

Running boards removed from locomotives passing through shops must be replaced in original position, viz., from center line of locomotive to outside edge of boards, so as not to reduce clear width of board.

Particular attention should be given to thickness of lagging on side of firebox so that jacket will not project and reduce required clearance.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-72-1

SUBJECT: RODS - MAIN AND SIDE - INSPECTION.

INSTRUCTIONS:

Inspection of main and side rods shall be in accordance with the following:

1. MAGNAFLUX OR WHITING INSPECTION:

Complete surface inspection of main and side rods shall be made by Magnaflux method if shop or enginehouse is so equipped; otherwise use whiting method. Give particular attention to rod eyes and grease passages, removing grease bolts and thoroughly cleaning and examining all cavities.

2. INSPECTION - WHEN REQUIRED:

Magnaflux test or whiting inspection of main and side rods of 800-844, 3800-3839, 3930-3999 and 4000-4024 class locomotives shall be made at each classified repairs only.

For all other classes of locomotives, main and side rods shall receive Magnaflux test or whiting inspection whenever rods are removed for any purpose, and at each classified repairs.

IMPORTANT: Magnaflux test or whiting inspection shall not be construed as supplanting customary mechanical inspection of main and side rods for wear and safe operation.

3. DEFECTIVE RODS:

Main and side rods with cracks, fractures, major nicks or any other defects affecting safe use shall be scrapped. All defective parts shall be promptly reported on "Defective Machinery Forms", giving full description of fracture or flaw, method by which defect was discovered, any evidence of improper tooling or surface blemishes, and listing all shop marking on rod.

Defective main and side rods removed from service shall be stenciled with white paint in 1" letters and numbers to show whether found defective by Magnaflux or whiting test, date and place removed.

Example: Defective M - Test 11-46-C,

denoting rod found defective by Magnaflux test November 1946 at Cheyenne. Use letter "W" for whiting test.

4. MINOR DEFECTS:

All minor defects such as nicks, blemishes, tool marks, etc., shall be removed by careful grinding followed by polishing. Extreme care shall be taken when grinding to taper off two or three inches each side of minor defect to avoid sharp edges or abrupt change in section.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-72-2

SUBJECT: RODS - MAIN AND SIDE - REMOVAL OF NICKS AND BLEMISHES.

INSTRUCTIONS:

To prevent progressive fractures, all nicks, abrasions, blemishes and corrosion on surfaces of main and side rods must be removed by grinding providing they are not of sufficient depth to endanger section of rod. Grinding to be tapered off two to three inches on each side of the nick or irregular surface condition to avoid an abrupt change in section.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-74-1

SUBJECT: SMOKE BOX - INSPECTION AND TEST FOR AIR LEAKS.

INSTRUCTIONS:

Locomotives after arrival at terminals where maintained or dispatched are to have smoke box thoroughly inspected for defects and all joints candled for air leaks, including front end gasket, front end door gasket and superheater header cover plate gasket.

Where there are any indications of air leaks or other defects, proper repairs must be made and defective gaskets replaced before locomotive is released for service.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-79-1

SUBJECT: STEAM GAUGES, ETC.
CYLINDER BACK PRESSURE GAUGE.

INSTRUCTIONS:

When present initial and back pressure gauges on all road locomotives become unserviceable, they are to be replaced with a single hand 5" back pressure gauge of approved type.

Cylinder back pressure in pounds is to be stenciled on inside of back pressure gauge glass in accordance with latest issue of Drawing 792-CA-26750. Size of nozzle and nozzle plate on all road locomotives must be checked at first opportunity and conform to Attachment "A", revised March 3, 1949.

ATTACHMENT REVISED AND REISSUED:

Attachment "A" shows size of nozzle, nozzle plate and operating back pressure - All classes road locomotives, revised March 3, 1949.

Attachment "A" should be posted in all Engine Dispatchers' Offices and copies should also be placed in hands of all Road Foremen of Engines, who will familiarize themselves with these instructions and see that all engineers thoroughly understand and comply with these requirements.

By order of

Mech. Supt. - Steam Power

Approved by

Asst. Gen'l Supt. MP&M

Omaha, Nebraska

March 3, 1949

UNION PACIFIC RAILROAD COMPANY
MECHANICAL INSTRUCTIONS
ATTACHMENT "A" TO MECHANICAL INSTRUCTIONS NO. L-79-1

LOCOMOTIVE CLASSES BY OWNERSHIP				COAL OR OIL BURNING	SWEENEY NOZZLES		GOODFELLOW NOZZLES		MULTIPLE JET NOZZLES			
					SIZE OF PLATE IN INCHES	BACK PRESSURE IN POUNDS	SIZE OF PLATE IN INCHES	BACK PRESSURE IN POUNDS	SIZE IN INCHES		BACK PRESSURE IN LBS.	
UP	OSL	OWR&N	LA&SL						SUMMER	WINTER	SUMMER	WINTER
800-819				OIL	–	–	–	–	3-3/4"	3-3/4"	12	12
820-834				OIL	–	–	–	–	*5-7/8"	*5-11/16"	12	13
820-844				OIL	–	–	–	–	∮5-1/16"	∮5"	12	13
835-844				OIL	–	–	–	–	3"	3"	12	12
2201-2310	2504-2529	2167-2171	2702-2734	COAL	–	–	–	–	3-3/4"	3-1/2"	8	10
2311-2320	2555-2564			OIL	–	–	–	–	3-1/2"	3-1/2"	10	10
2480-2499	2535-2554			COAL	–	–	–	–	3-1/2"	3-1/2"	8	8
2860-2911	3114-3138	3219-3227	3178	COAL	–	–	–	–	3-5/8"	3-1/2"	6	8
				OIL	–	–	6-1/2"	8	3-1/2"	3-1/2"	8	8
3500-3564	3565-3566	3567-3569		COAL-OIL	–	–	–	–	4"	4"	14	14
3800-3839				OIL	6-3/4"	15	–	–	–	–	–	–
3950-3999				COAL-OIL	–	–	–	–	x3-3/8"	x3-3/8"	12	12
3930-3999				COAL	–	–	–	–	#3-1/8"	#3-1/8"	12	12
				OIL	–	–	–	–	#3"	#3"	12	12
4000-4019				COAL	–	–	–	–	x3-1/2"	x3-3/8"	14	15
4000-4024				COAL	–	–	–	–	#3"	#3"	14	14
5001-5089	5300-5305	5400-5414	5525-5529	COAL	6-3/4"	8	–	–	4"	4"	10	10
5306-5313	5315-5318			OIL	6-1/2"	9	–	–	4"	4"	10	10
5500-5524												
			5090-5099	OIL	–	–	–	–	4"	4"	10	10
7000-7039			7850-7864	COAL	–	–	–	–	4-1/8"	4"	12	13
7865-7869				OIL	–	–	–	–	4-1/8"	4"	12	13
9000-9087	9500-9514			COAL	6"	11	–	–	–	–	–	–

* SINGLE NOZZLE, DOUBLE STACK
∮ WITH 3 STACKS
x WITH CENTRAL BLOWER IN NOZZLE TIPS
WITH BLOWER BETWEEN NOZZLE TIPS

NOTE: BACK PRESSURE IN POUNDS AS SHOWN ABOVE AND STENCILED ON INSIDE OF BACK PRESSURE GAUGE GLASS, IS TO BE FOLLOWED ONLY WHEN NECESSARY TO USE FULL THROTTLE TO PRODUCE MAXIMUM LOCOMOTIVE OUTPUT OR HORSEPOWER. WHEN LOCOMOTIVE IS NOT WORKED HARD PROPER USE OF THROTTLE AND REVERSE LEVER WILL RESULT IN LOWER BACK PRESSURE THAN SHOWN ABOVE AND, IF POSSIBLE, OPERATION AT LOWER PRESSURES THAN THOSE SHOWN IS DESIRED. HIGHER BACK PRESSURES THAN THOSE SHOWN ABOVE WILL NOT INCREASE SPEED OR POWER BUT WILL RESULT IN MORE NOISE AT THE EXHAUST AS WELL AS LOSS OF FUEL. PLEASE BE GOVERNED ACCORDINGLY AND SAVE FUEL.

OFFICE OF ASST.GEN'L SUPT. MP&M
OMAHA, NEBRASKA, MARCH 3, 1949

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-79-2

SUBJECT: STEAM GAUGES, ETC. - STOKER GAUGES.

INSTRUCTIONS:

Stoker steam gauges applied in the future must be as follows:

1. LOCOMOTIVES WITH DUPLEX STOKERS TYPES D-1, D-1B OR D-3:

   (a) One single gauge graduated 0 to 250 pounds in five-pound increments marked "Main Steam Cylinder" on face of gauge.

   (b) One duplex gauge graduated 0 to 100 pounds in one-pound increments marked "Red Hand - Left Jet, White Hand - Right Jet".

2. LOCOMOTIVES HAVING 220 TO 300 POUNDS BOILER PRESSURE WITH TYPE "BK" OR TYPE "MB" STOKERS:

   One duplex gauge graduated from 0 to 400 pounds in five-pound increments marked "Red Hand - Jet Pressure, White Hand - Engine Pressure".

3. DESCRIPTION:

Stoker gauges are to have iron case with brass ring, five (5) inch black dial with white numbers and must be equipped with safety disc assembly as shown on previously-issued drawing.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-80-1

SUBJECT: STEAM PIPES & SUPERHEATER - STEAM PIPE CASING.

INSTRUCTIONS:

Locomotives equipped with outside steam pipes should have steam pipe casing applied and maintained in accordance with the following:

1. CASING:

To be welded to smoke box with lower end neatly and tightly fitted to steam pipe. When casing is removed for any purpose, outside of steam pipe to be cleaned and polished to insure tight connection at bottom. Two-piece clamp made from 1/2" x 2" bar steel, held together by 5/8" diameter bolts to be applied at lower end of casing.

2. PACKING:

Inside of casing to be packed with alternate layers of cement and asbestos rope. Cement applied in layers about 1" thick. Packing to extend to top of casing and tamped to insure solid mass.

3. INSIDE PLATE:

1/4" plate to be applied over opening in top of casing and welded to smoke box sheet. Special care must be taken in fitting plate around steam pipe to insure a tight joint.

4. STEAM PIPE JACKET:

Section of steam pipe below casing to be covered with magnesia boiler lagging and jacketed with sheet steel.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-83-1

SUBJECT: TENDER PIPING - STEAM HEAT HOSE AND METALLIC STEAM CONNECTIONS.

INSTRUCTIONS:

1. REMOVAL OF RUBBER STEAM HEAT HOSE:

Rubber steam heat hose must be removed from rear of tenders of freight locomotives and carried in tool box during all seasons, except from such locomotives as have fire fighting attachment to steam heat line, and freight locomotives used in passenger service or held for passenger protection.

2. MAINTENANCE OF METALLIC STEAM HEAT CONNECTIONS:

Metallic steam heat connections must not be removed from tenders of locomotives so equipped, regardless of service in which the locomotives may be used. These metallic connections must be maintained in serviceable condition.

3. RUBBER STEAM HEAT HOSE AND METALLIC STEAM HEAT CONNECTIONS NOT COUPLED UP:

All rubber steam heat hose and metallic steam connections on locomotive tenders, when not actually coupled up, must have coupler head supported by chain and length of chain must be so adjusted that the lowest part of hose coupler is not less than 4" or more than 6" from top of rail. Care must be exercised in placing the chain hook around coupler head to know that hook opening is closed sufficiently to prevent accidental disengagement of hook from coupler; however, the adjustment should permit ready removal of hook from coupler head.

4. RUBBER STEAM HEAT HOSE OR METALLIC STEAM HEAT CONNECTIONS COUPLED UP:

Clearance between top of rail and bottom of lowest part of coupler head on rubber steam heat hose or metallic steam heat connections, when actually coupled together, must not be less than 2-1/2"

To insure that this minimum dimension is maintained, unless the adjustment has already been made, it will be necessary to raise the steam pipe at end sill on some of the 7000, 9000, 10000, 12000 and 18000 gallon rectangular and cylindrical tenders. The vertical distance must be measured between center line of coupler and center line of steam pipe at end sill, and if this distance is more than 2-3/4", with coupler at normal height, center line of steam pipe must be raised so that adjustment will be within the 2-3/4" limit. Care must be exercised not to provide a pocket when bending pipe.

On the 8000 and 10000 gallon USRA rectangular tenders, unless the adjustment has already been made, it will also be necessary to relocate steam pipe so as to provide a horizontal distance of 9-1/2" between center of coupler and steam pipe in addition to raising the vertical distance to 2-3/4" minimum as instructed above.

Periodic inspection must be made of each tender, adjusting if necessary the length of chain for both rubber steam heat hose and metallic steam heat connections to agree with Paragraph 3 and also checking and relocating if necessary the position of steam pipe at end sill as instructed in Paragraph 4.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-87-1

SUBJECT: TENDER HANDRAILS, ETC. - SAFETY APPLIANCES, 7000 AND 9000 GALLON CYLINDRICAL TENDERS IN SWITCHING SERVICE.

INSTRUCTIONS:

Safety appliances on all 7000 and 9000 gallon cylindrical tenders in switching service shall be applied in accordance with arrangement and clearances specified on latest issue of Drawing 872-CA-24197.

Drawing shows I.C.C. Safety Appliance requirements and clearances at handholds, handrails, steps and foot boards with opening between toe board and foot board.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-91-1

SUBJECT: THROTTLE - MULTIPLE FRONT END.

INSTRUCTIONS:

Multiple throttles on 800, 3800, 3900, 4000, 9000 and 9500 classes locomotives are to be maintained in accordance with instructions below:

1. MAGNAFLUX TEST AND INSPECTION:

Multiple throttle pilot and main valve, including cam shafts, on all the above classes of locomotives must be given Magnaflux test and inspection whenever locomotives receive Class 3 or heavier repairs, whenever cam shaft is removed to restore cam contours to gage, when erratic handling of throttle is reported by enginemen or whenever it is determined from test on inspection that excessive lost motion exists.

In addition, on Locomotives 800-834, incl., only, which have spindle type valves, multiple throttle cam shafts and pilot and main valves must be given Magnaflux test and inspection at each quarterly inspection period, due to the rapid wear on spindles, until such time as definite correction has been developed.

All new or reclaimed cam shafts and pilot and main valves must be given Magnaflux test and inspection before applied to multiple throttle.

2. LIMIT OF WEAR - VALVES:

When wear equals or exceeds 1/8" the lifting shoulders are to be built up with Stellite and ground to original dimensions. Work to be done only at main shops in accordance with drawings.

3. LIMIT OF WEAR - CAMS:

When wear on cams equals or exceeds 1/8", the shaft should be returned to manufacturer for reclamation. Cam contour on all new and reclaimed cam shafts must conform to drawings.

4. THROTTLE RIGGING ADJUSTMENT:

Throttle rigging must be applied and maintained in accordance with drawings.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 1. 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-94-1

SUBJECT: VALVE DISTRIBUTION - BUSHINGS.

INSTRUCTIONS:

Valve bushings will be used in two sizes of bore diameters, standard and 1/8" undersize. Valve bushings of standard bore diameter will be used at shops where there are no facilities for boring bushings after pressing in place.

At shops where boring bars are available, 1/8" undersize bore diameter valve bushings are to be pressed into valve chamber and then bored to standard diameter.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-94-2

SUBJECT: VALVES - DISTRIBUTION - OVERSIZE VALVE RINGS AND REBORED BUSHINGS.

INSTRUCTIONS:

To extend service life and facilitate maintenance of piston valve bushings on locomotives equipped with sectional type valve packing, all valve bushings less than 3/4 inches thick will be increased to 3/4 inches thick at next Class 3 or heavier repairs in accordance with existing instructions and drawings. These 3/4 inch thick bushings will be bored to use valve packing and bull rings of the following sizes:

Nominal
1/8" oversize
3/16" oversize (if unable to properly finish machine to 1/8" oversize)
1/4" oversize

New valve bushings applied to locomotives should be pressed into cylinder casting and bored in place to nominal diameter. Worn bushings should be rebored in place to oversize diameters in accordance with above, and should be provided with new oversize valve rings and bull rings machined to suit application to individual locomotive.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-94-3

SUBJECT: VALVE DISTRIBUTION - 4 RING
PISTON VALVES (SECTIONAL PACKING RINGS).

INSTRUCTIONS:

All piston valve sectional packing rings applied to locomotives so equipped are to be half cast iron and half bronze carried in store stock in nominal and 1/4" oversize and oversize rings machined to suit application to individual locomotive.

Tolerance for proper clearance of bull ring and packing ring when valve is assembled must be as shown on drawings.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-95-1

SUBJECT: WHEELS - DRIVING AND TRAILING TIRES

INSTRUCTIONS:

A. PURCHASE:

1. All driving tires for passenger locomotives and also for all freight locomotives in series 3930-3999 and 4000-4024 will be purchased rough turned on inside 1/4" smaller in diameter than standard shrinkage diameter.

2. (a) Driving tires for Nos. 2 and 3 pairs only of driving wheels for 9000 and 9500 class locomotives are to be purchased rough turned 1/2" smaller in diameter than standard shrinkage diameter, shops to bore to fit individual wheel centers.

(b) All other driving tires for freight and switch locomotives and trailing tires for passenger and freight locomotives will be purchased finish bored to standard shrinkage diameter with exception of driving tires for 3930 and 4000 class and Nos. 2 and 3 pairs of drivers for 9000 and 9500 class freight locomotives as covered in paragraphs 1 and 2 (a).

3. Driving and trailing tire shims will be made of hard cold rolled strip steel. This steel will be ordered in rolls 5" wide and in two thicknesses, viz., 1/32" (.03125) and 1/16" (.0625) and will be carried as regular store stock.

B. APPLICATION:

4. All new driving tires applied to passenger locomotives, all wheels of 3930 and 4000 class and Nos. 2 and 3 wheels of 9000 and 9500 class freight locomotives as covered in paragraphs 1 and 2 (a) must be bored to suit individual wheel centers and applied without shims. When tires require turning they should be turned without removing from wheel center. Shimming of driving tires on these locomotives will be permitted when tires become loose in service and require refitting or when second-hand tires are applied but such shimming must be carefully supervised.

5. All driving tires applied to freight and switch locomotives and trailing tires applied to passenger and freight locomotives may be applied by use of shims with exception of new driving tires for 3930, 4000 class and Nos. 2 and 3 wheels of 9000 and 9500 class freight locomotives as covered in paragraph 4.

6. When shims are inserted between tire and wheel center, not more than two thicknesses of shims may be used, one of which must extend entirely around the wheel. The shim extending entirely around wheel may be in three or four pieces providing pieces do not lap.

7. When Nos. 2 and 3 wheel centers of 9000 and 9500 class locomotives are .015" or more out of round or taper, these wheel centers must be trued up.

8. Heat treated driving tires where used, and all trailer tires which are heat treated, must not be heated beyond 500° to 600° F.

9. When necessary to build up rims of driving and trailing wheel centers to maintain nominal outside diameter, Shop Practice Folio Sheet 127-W must be followed.

By Order of

Mech. Supt. - Steam Power

Approved by

Gen'l. Supt. MP&M
Omaha, Nebraska
January 21, 1952

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-95-2

SUBJECT: COUNTERBALANCING - DRIVING WHEELS - STEAM LOCOMOTIVES.

COUNTERBALANCE FOLIO:

1. Locomotive counterbalance folio issued July 10, 1940 covers instructions and methods for counterbalancing driving wheels on all classes of steam locomotives.

2. Master counterbalance record for each locomotive counterbalanced will be maintained in the General Mechanical Engineer's office.

INSTRUCTIONS:

1. Period for counterbalancing:

   (a) All road locomotives shall be completely and accurately counterbalanced each time locomotive is shopped for Class 3 or heavier repairs, except as follows:

   (b) Counterbalancing of all Heavy MacArthur and Heavy Pacific type locomotives will be performed once each five years of active service.

   (c) Other lighter locomotives, including Light MacArthur, Light Pacific, Consolidation, 10-Wheel and switch locomotives will be counterbalanced once each six years of active service.

   (d) Locomotives in classes covered by items 1 (b) and 1 (c) which are overdue for counterbalancing under the prescribed service limits of five (5) and six (6) years are not to be re-counterbalanced until due for the next classified repairs or when main or other than main driving wheels are dropped for any reason. However, these locomotives must thereafter be re-counterbalanced whenever all wheels are dropped for any reason or whenever shopped for classified machinery repairs or flue replacements, provided the counterbalancing date is such that locomotives would exceed the five or six year service limit before the next normal shopping for flue or machinery work.

2. New or replacement driving wheel centers are to be accurately counterbalanced before application to locomotive.

3. Whenever driving wheel centers are transferred from one locomotive to another, counterbalance must be checked and corrected for weights required for locomotive to which wheel center assembly is applied.

4. Counterbalance must be checked whenever riding of locomotive indicates that there has been a change in conditions affecting counterbalance.

5. Counterbalance must be checked whenever main rods, side rods, crossheads, crosshead shoes, or piston heads of different designs are applied; these new parts must be matched on right and left sides of locomotive in their respective positions.

6. All counterbalancing must be done in strict accordance with methods and procedure outlined in counterbalance folio issued July 10, 1940, and no deviations shall be permitted except by supplement to mechanical instructions.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

January 3, 1951

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-95-3

SUBJECT: WHEELS - DRIVING AND TRAILING TIRES - LIMIT OF WEAR.

INSTRUCTIONS:

Tire limits shown on limit of wear drawing are based on I.C.C. requirements as representing the minimum thickness driving and trailing tires may be worn, with additional fact that these limits have been raised wherever necessary to meet operating service conditions.

1. TREAD WORN HOLLOW:

   Driving and trailing tires on all passenger locomotives, and on freight locomotives 9000-9087 and 9500-9514, must be turned when tread is worn hollow in excess of 8/32".

   On all freight locomotives, except the 9000 & 9500 class as listed above, driving and trailing tires must be turned when tread is worn hollow 5/16" in accordance with I.C.C. Rule 150, Paragraph "h".

   On locomotives used in switching service driving and trailing tires must be turned when tread worn hollow 3/8" in accordance with I.C.C. Rule 150, Paragraph "h".

2. LIMIT OF WEAR:

   Minimum thickness for driving tires must be governed by wear limits prescribed in latest issue of Drawing 952-CA-26751 which must be kept posted in all shops and enginehouses, and all concerned must be familiar with these limits of tire wear for the various classes of locomotives.

   Particular attention is called to recent change in Drawing 952-CA-26751 which provides that locomotives 800-844 must not be released from shop with driving tires less than 2-3/4" in thickness.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l. Supt. MP&M
Omaha, Nebraska
March 14, 1952

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-95-4

SUBJECT: WHEELS - WROUGHT STEEL.

INSTRUCTIONS:

A. LIMIT OF RIM THICKNESS AND USE OF SECONDHAND WHEELS:

Wrought steel wheels are to be removed from service when limit of rim thickness in respective classes of service is reached and wheels removed are to be disposed of in accordance with the following:

1. LIMIT OF RIM THICKNESS BEFORE CONDEMNATION:

(a) Steam Locomotives - Limit of rim thickness for engine truck, trailing truck and tender truck wrought steel wheels used in passenger, freight and switching service, to be as follows:

Passenger and freight service when tread is worn so that rim thickness is one (1) inch.

Switching service when tread is worn so that rim thickness for engine truck and trailing truck wheels is one (1) inch, and for tender truck wheels is three-fourths (3/4) inch.

2. LIMIT OF RIM THICKNESS AT LAST TURNING:

(a) Steam Locomotives - Limit of rim thickness at last turning for engine truck, trailing truck and tender truck wrought steel wheels used in passenger, freight and switching service to be as follows:

Passenger and freight service one and three-sixteenths (1-3/16) inches.

Switching service one (1) inch.

3. USE OF SECONDHAND WROUGHT STEEL WHEELS REMOVED FROM PREVIOUS ASSIGNMENT ON ACCOUNT OF REACHING LIMIT OF RIM THICKNESS BUT WHICH ARE SUITABLE FOR FURTHER SERVICE IN OTHER ASSIGNMENTS:

(a) 42" diameter wrought steel wheels:

Engine truck wheels removed from Locomotives 820-844 on account of reaching one (1) inch rim thickness after having hub surfaces machined as shown on latest issue of Drawing 112-ST-1802, reconditioned and remounted, are to be applied to Diesel-electric switch locomotives.

(b) 33" diameter wrought steel wheels:

Wheels removed from locomotive tenders in passenger and freight service account one (1) inch rim thickness, after being conditioned, are to be used as follows:

Wheels mounted on 6" x 11" axle are to be applied to tenders of locomotives Class S-Special, Nos. 4600-4609 and 4753-4757.

Wheels mounted on 5-1/2" x 10" A.A.R. axle are to be turned over to Stores Department for application under 100,000 lb. capacity system or foreign freight cars on which wrought steel wheels are standard.

Wheels mounted on 6" x 11" A.A.R. axle are to be turned over to Stores Department for application under 140,000 lb. capacity system or foreign freight cars on which wrought steel wheels are standard.

4. APPLICATION:

Wrought steel wheels are to be applied under steam locomotive tenders strictly in accordance with I.C.C. Laws, Rules and Instructions for Inspecting and Testing of Steam Locomotives and Tenders and Their Appurtenances.

5. DISPOSITION:

Wrought steel wheels removed from steam locomotives account reaching specified minimum rim thickness, which are not usable for other service as herein designated, shall be scrapped.

6. DISTRIBUTION:

Distribution of secondhand wrought steel wheels will be handled by Stores Department.

B. MATING, MACHINING AND MOUNTING TOLERANCES:

1. Manufacturer's marking on rim of wrought steel wheels consists of:

Date (month and year)
Brand of manufacturer
Manufacturer's serial number
Heat number
Identification mark (AAR-MW), (AAR-1W) or (AAR-2W)

and for heat treated multiple wear wheels will include the class designation as follows:

AR Class A, Rim Treated
AE Class E, Entire Wheel Treated
BR Class B, Rim Treated
BE Class B, Entire Wheel Treated
CR Class C, Rim Treated
CE Class C, Entire Wheel Treated

2. Multiple wear wrought steel wheels, when mounted on the same axle, must be mated to the same ONE-HALF OR FULL TAPE SIZE.

Heat treated multiple wear wrought steel wheels must also be mated as to CLASS DESIGNATIONS.

Multiple wear wrought steel wheels having carbon content stamped on rim of wheels, should be mated as to same carbon content for mounting on the same axle insofar as possible and if carbon content is not stamped on rim of wheels, wheels of the same heat number should also be mated for mounting on the same axle insofar as possible.

When no two wheels of the same type and one-half or full tape size are available for mounting on the same axle, the next size of the same type should be used, and wheels turned to the same one-half or full tape size.

New wheels must not be mounted with secondhand wheels.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-99-1

SUBJECT: LOCOMOTIVE CLASSIFICATION - STENCILING ON CABS.

INSTRUCTIONS:

Classification stenciling on sides of locomotive cabs on all steam locomotives must be in accordance with stenciling shown on attached list.

Copy of these instructions and list must be posted under glass in all shops and roundhouses for information and guidance of all concerned.

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M

Omaha, Nebraska

July 1, 1947

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING ON SIDES OF LOCOMOTIBE CABS

SHAY LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
59		X	DS-33 $\frac{3\text{-}13}{13}$ 147	
61		X	DT-36 $\frac{3\text{-}13\frac{1}{2}}{15}$ 200	

CONSOLIDATION TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
105,113&117	X		C-51 $\frac{20}{24}$ 140	
201-358	X	X	C-57 $\frac{22}{30}$ 191	
400-401 & 420-477	X		C-57 $\frac{21}{30}$ 163	
402-419	X		C-57 $\frac{21}{30}$ 162	
478-498	X		C-57 $\frac{21}{30}$ 172	
512-524	X	X	C-55 $\frac{21}{30}$ 167	
525-539	X	X	C-57 $\frac{21\frac{1}{2}}{30}$ 174	
560-622	X	X	C-57 $\frac{22}{30}$ 191	
715 & 718		X	C-57 $\frac{20\frac{1}{2}}{30}$ 167	
719 & 721		X	C-57 $\frac{20\frac{1}{2}}{30}$ 172	
730, 732-737, 739-745, 748-758, 760 & 762-768		X	C-57 $\frac{22}{30}$ 190	
731, 738, 747, 759, 761		X	C-57 $\frac{22}{30}$ 187	
6001-6008		X	C-57 $\frac{21}{30}$ 176	
6012-6085		X	C-57 $\frac{22}{30}$ 198	

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 1, 1947

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING ON SIDES OF LOCOMOTIVE CABS

CONSOLIDATION TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification			Remarks
105	X		C-51	20/24	140	
201-358	X	X	C-57	22/30	191	
400, 421-477	X		C-57	21/30	163	
402-419	X		C-57	21/30	162	
478-498	X		C-57	21/30	172	
512-523	X	X	C-55	21/30	167	
525-539	X	X	C-57	21½/30	174	
560-622	X	X	C-57	22/30	191	
730, 732-737, 739-745, 748-758, 760, 762-768		X	C-57	22/30	190	
761		X	C-57	22/30	187	
6007		X	C-57	21/30	176	
6018-6080		X	C-57	22/30	198	

TEN WHEEL TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification			Remarks
1242-1243	X		T-57	19/24	114	
1575		X	T-69	22/28	161	

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 24, 1950

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING
ON
SIDES OF LOCOMOTIVE CABS
MacARTHUR TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification			Remarks
1902-1949	X	X	MacA-57	23-3/4 / 30	206	Without stoker
1902-1949	X		MacA-57	23-3/4 / 30	210-D	With Duplex stoker
2001-2034	X	X	MacA-57	23-3/4 / 30	208	Without stoker
2001-2034	X		MacA-57	23-3/4 / 30	210-D	With Duplex stoker
2100-2165	X	X	MacA-57	23-3/4 / 30	208	Without stoker
2100-2165	X		MacA-57	23-3/4 / 30	210-D	With Duplex stoker
2167-2171		X	MacA-63	26 / 28	209	Oil burning
2201-2279		X	MacA-63	26 / 28	214	Oil burning
2201-2279	X		MacA-63	26 / 28	216-D	With Duplex stoker
2280-2294		X	MacA-63	26 / 28	212	Oil burning
2280-2294	X		MacA-63	26 / 28	214-D	With Duplex stoker
2295-2310	X		MacA-63	26 / 28	228-D	With Duplex stoker
2312-2320		X	MacA-63	26 / 28	212	Oil burning
2312-2320	X		MacA-63	26 / 28	214-D	With Duplex stoker
2480-2499	X		MacA-63	26 / 30	222-D	With Duplex stoker
2504-2529		X	MacA-63	26 / 28	214	Oil burning
2504-2529	X		MacA-63	26 / 28	216-D	With Duplex stoker
2535-2554	X		MacA-63	26 / 30	220-D	With Duplex stoker
2555-2564	X		MacA-63	26 / 28	228-D	With Duplex stoker
2702-2704 2726-2731		X	MacA-63	26 / 28	218	Oil burning
2709-2715 2733-2734		X	MacA-63	26 / 28	214	Oil burning

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 24, 1950

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING
ON
SIDES OF LOCOMOTIVE CABS

PACIFIC TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
2851-2856	X		P-77 $\frac{22}{28}$ 149	
2894		X	P-77 $\frac{25}{28}$ 167	Oil burning
2860-2899 2908-2911	X		P-77 $\frac{25}{28}$ 184-D	With Duplex stoker
2906	X		P-77 $\frac{25}{28}$ 193-D	Timken roller bearings and Duplex stoker
3119-3131	X		P-77 $\frac{25}{28}$ 184-D	With Duplex stoker
3114 & 3122	X		P-77 $\frac{25}{28}$ 181-BK	With BK stoker
3134-3138		X	P-69 $\frac{25}{28}$ 163	Oil burning
3160		X	P-77 $\frac{22}{28}$ 150	Oil burning
3202-3203		X	P-77 $\frac{22}{28}$ 143	Oil burning
3215-3217		X	P-77 $\frac{22}{28}$ 149	Oil burning
3206		X	P-77 $\frac{22}{28}$ 135	Oil burning
3219-3225		X	P-77 $\frac{25}{28}$ 167	Oil burning
3226-3227		X	P-77 $\frac{25}{28}$ 178	Oil burning

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 24, 1950

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING
ON
SIDES OF LOCOMOTIVE CABS

SIMPLE ARTICULATED LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
3500-3569		X	SA-C-59 $\frac{23\text{-}23}{30}$ 471	Oil burning
3500-3569	X		SA-C-59 $\frac{23\text{-}23}{30}$ 475-D	With Duplex stoker
3800-3809		X	CSA-69 $\frac{22\text{-}22}{32}$ 403	With bar frames
3810-3814		X	CSA-69 $\frac{22\text{-}22}{32}$ 400	With bar frames
3815-3839		X	CSA-69 $\frac{22\text{-}22}{32}$ 407	With bar frames
3800-3809		X	CSA-69 $\frac{22\text{-}22}{32}$ 406	With front engine locomotive bed
3810-3814		X	CSA-69 $\frac{22\text{-}22}{32}$ 401	With front engine locomotive bed
3815-3839		X	CSA-69 $\frac{22\text{-}22}{32}$ 406	With front engine locomotive bed
3930-3949	X		4664-5-69 $\frac{21\text{-}21}{32}$ 406-MB	With MB stoker
3950-3969	X		4664-3-69 $\frac{21\text{-}21}{32}$ 404-MB	With MB stoker
3975-3984		X	4664-4-69 $\frac{21\text{-}21}{32}$ 404	Oil burning
3985-3999	X		4664-4-69 $\frac{21\text{-}21}{32}$ 407-MB	With MB stoker
4000-4019	X		4884-1-68 $\frac{23\ \frac{3}{4}\text{-}23\ \frac{3}{4}}{32}$ 540-MB	With MB stoker
4020-4024	X		4884-2-68 $\frac{23\ \frac{3}{4}\text{-}23\ \frac{3}{4}}{32}$ 545-MB	With MB stoker

By order of

Mech. Supt. - Steam Power

Approved by

Genl. Supt. MP&M
Omaha, Nebraska
July 24, 1950

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING
ON
SIDES OF LOCOMOTIVE CABS

SWITCHING LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
4244-4246		X	S-51 21/26 157	
4407-4420	X	X	S-51 19/26 155	
4422-4449	X	X	S-51 21/26 156	
4451-4480	X	X	S-51 21/26 159	
4600-4607	X		S-51 21/28 165	
4752		X	S-51 21/26 156	
4753-4754		X	S-51 21/28 165	
4909-4914		X	S-51 19/26 140	
4917-4922		X	S-51 19/26 145	
4923-4926		X	S-51 19/26 155	
4928		X	S-57 20/26 146	

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 20, 1950

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING
ON
SIDES OF LOCOMOTIVE CABS

2-10-2 TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification		Remarks
5002-5006, 5009		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 291	Oil burning
5008 & 5014		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 290	Loco bed oil burning
5015-5039	X		TTT-63	$\frac{29\frac{1}{2}}{30}$ 286-D*	Coal burning
5015-5039		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 284	Oil burning
5040-5048	X		TTT-63	$\frac{29\frac{1}{2}}{30}$ 308-D*	Trailer Eq. pin in #3 hole coal burning
5049-5052, 5056, 5058-5068, 5078	X		TTT-63	$\frac{29\frac{1}{2}}{30}$ 311-D*	Trailer Eq. pin in #3 hole coal burning
5053-5055, 5057, 5069, 5071-5077, 5079-5082, 5084-5089	X		TTT-63	$\frac{29\frac{1}{2}}{30}$ 309-D*	Trailer Eq. pin in #3 hole coal burning
5083		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 298	Trailer Eq. pin in #4 hole oil burning
5300-5305	X		TTT-63	$\frac{29\frac{1}{2}}{30}$ 286-D*	
5306-5313	X		TTT-63	$\frac{29\frac{1}{2}}{30}$ 308-D*	Trailer Eq. pin in #3 hole - Coal
5315-5317		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 291	Trailer Eq. pin in #3 hole - Oil
5318	X		TTT-63	$\frac{29\frac{1}{2}}{30}$ 304-D*	Trailer Eq. pin in #3 hole - Coal
5400, 5402-5408, 5410 & 5414		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 291	Trailer Eq. pin in #3 hole - Oil
5401		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 287	Trailer Eq. pin in #3 hole - Oil
5501-5524		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 298	Trailer Eq. pin in #4 hole - Oil
5525-5529		X	TTT-63	$\frac{29\frac{1}{2}}{30}$ 290	Loco bed trailer Eq. pin in #4 hole - Oil

D* - Changes to BK on locos equipped with BK stokers

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 24, 1950

UNION PACIFIC RAILROAD COMPANY

L-99-1

CLASSIFICATION STENCILING
ON
SIDES OF LOCOMOTIVE CABS

4-8-4 TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
800-819		X	FEF-1-77 $24\frac{1}{2}$ / 32 266	Oil burning
820-834		X	FEF-2-80 25 / 32 266	Oil burning
835-844		X	FEF-3-80 25 / 32 266	Oil burning

MOUNTAIN TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
7000-7001 7003-7039	X		MT-73 29 / 28 256-D	Coal burning trailer Eq. pin in #3 hole
7000-7001 7003-7039		X	MT-73 29 / 28 256	Oil burning trailer Eq. pin in #2 hole
7002	X		MT-73 29 / 28 261-D	Timken roller bearings and Duplex stoker
7850-7869		X	MT-73 29 / 28 256	Oil burning trailer Eq. pin in #2 hole

4-10-2 TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
5090-5097		X	FTT-63 27 / 32 307	Oil burning

4-12-2 TYPE LOCOMOTIVES

Loco Nos.	Coal	Oil	Classification	Remarks
9000-9014	X		UP-67 27 / 31-32 368-BK	With BK stoker
9015-9029 9055-9062	X		UP-67 27 / 31-32 369-BK	With BK stoker
9030-9054	X		UP-67 27 / 31-32 370-BK	With BK stoker
9078-9087 9500-9514	X		UP-67 27 / 31-32 372-BK	With BK stoker

By order of

Mech. Supt. - Steam Power

Approved by

Gen'l Supt. MP&M
Omaha, Nebraska
July 24, 1950

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-99-2

SUBJECT: SPEED INDICATORS AND RECORDERS

INSTRUCTIONS FOR INSPECTION, LUBRICATION AND MAINTENANCE.

INSTRUCTIONS:

The following instructions cover the inspection, lubrication and maintenance of speed indicators and recorders on steam locomotives.

1. TRIP INSPECTION:

(a) Trip inspection is to be made of all parts of speed recorder, including instrument in cab, drive unit, drive brackets, drive conduit and brackets and any necessary repairs made.

(b) Lead pencil is to be removed and sharpened at end of each trip. After reapplying pencil, see that holder is closed and adjusted so that pencil will rest on bottom line of tape.

2. MONTHLY INSPECTION:

At each monthly inspection of steam locomotives the following work is to be performed:

(a) Place block under drive unit so that drive wheel clears driver. With both hands check the wheel shaft for lateral in bearings.

(b) If more than 1/32" lateral can be detected, loosen the two set screws on bearing adjusting plate on inside of drive and screw in adjusting plate until wheel is tight; then back off just enough so wheel will turn freely without lateral in shaft. Tighten set screws and fasten with wire locks.

3. QUARTERLY INSPECTION:

At each quarterly inspection the following work is to be performed on steam locomotives:

(a) Drain all circulating oil from hydraulic pump and reservoir and refill with special approved speed recorder circulating oil.

(b) Test speed recorder for proper speed registration.

(c) Remove flexible hose at drive and inspect steel liner for breakage or excessive wear.

(d) Remove flexible shaft from conduit, wash in kerosene and make thorough inspection. If any portion of drive cable shows appreciable wear, it should be replaced.

(e) When replacing cable in conduit, grease well with Alemite grease and fill conduit with SAE number 30 oil. The flexible cable should be of such length that with upper end connected to recor-

(e) der, not less than 3/8" nor more than 1/2" of chain should project beyond face of the lower sleeve to allow for connecting the lower terminal at drive unit.

(f) Check conduit for worn spots, breakage or holes at bends and tighten all clamps.

(g) Check drive unit brackets, springs, etc., and re-lubricate.

4. LUBRICATION:

Each instrument in cab is provided with four oil cups which must have oil replenished as follows:

(a) Oil filler opening marked "A" on instruction pamphlets lubricates worm gear box and is located in top of instrument under the cover. The oil filler hole is closed with an indicator gauge which should be removed and SAE No. 10 oil added at least each 30 days.

(b) Oil filler cup marked "B" on instruction pamphlets lubricates upper terminal gear shaft and is located on left side of instrument at bottom. This cup should be filled each trip with SAE No. 10 engine oil.

(c) The hydraulic pump and reservoir is completely filled with a special approved speed recorder circulating oil which is red in color. This reservoir should be kept full at all times. Level of oil in circulating reservoir is indicated on sight glass in body of instrument on right side. Filler plug above sight glass to be removed and special oil added as needed. Do not use any oil except approved speed recorder circulating oil.

(d) An indicating oil gauge is located at top of conduit below instrument and this gauge indicates level of oil for lubricating conduit and conduit cable. SAE No. 30 engine oil should be used to keep this gauge full to the top at all times, adding oil at Division points if necessary.

5. All speed indicators and recorders are to be maintained, lubricated, calibrated and repaired in accordance with information contained in manufacturer's bulletins.

REFERENCE:

C.P. Speed Recorder Parts List and Instruction Book No. D-135.

By order of

Mech. Supt. Steam Power

Approved by

General Supt. MP&M

Omaha, Nebraska

October 6, 1947

UNION PACIFIC RAILROAD COMPANY

MECHANICAL INSTRUCTIONS

L-99-2

SUBJECT: SPEED INDICATORS AND RECORDERS

INSTRUCTIONS FOR INSPECTION, LUBRICATION AND MAINTENANCE.

INSTRUCTIONS:

The following instructions cover the inspection, lubrication and maintenance of speed indicators and recorders on steam locomotives.

1. TRIP INSPECTION:

(a) Trip inspection is to be made of all parts of speed recorder, including instrument in cab, drive unit, drive brackets, drive conduit and brackets and any necessary repairs made.

(b) Lead pencil is to be removed and sharpened at end of each trip. After reapplying pencil, see that holder is closed and adjusted so that pencil will rest on bottom line of tape.

2. MONTHLY INSPECTION:

At each monthly inspection of steam locomotives the following work is to be performed:

(a) Place block under drive unit so that drive wheel clears driver. With both hands check the wheel shaft for lateral in bearings.

(b) If more than 1/32" lateral can be detected, loosen the four set screws on bearing adjusting plate on inside of drive and screw in adjusting plate until wheel is tight; then back off just enough so wheel will turn freely without lateral in shaft. Tighten set screws and fasten with wire locks.

3. QUARTERLY INSPECTION:

At each quarterly inspection the following work is to be performed on steam locomotives:

(a) Remove speed recorder from locomotive. Check oil seal and gaskets for leakage. Drain all circulating oil from hydraulic pump and reservoir, and refill with special approved speed recorder oil. Remove bottom plate and check reverse and idler gears with gauge provided for testing mesh of gears. Examine fit of oil seal on terminal shaft and if any appreciable looseness is indicated, oil seal and/or terminal shaft, if badly worn, must be renewed.

(b) Test speed recorder for proper speed registration and add on indicator dial the date and place recorder was tested.

(c) Remove flexible hose. Disassemble and inspect steel liner for breakage, excessive wear or other defects. Renew liner if defective. When reassembling note that steel liner is held securely in place by nipples in end of hose.

(d) Remove flexible shaft from conduit. Flush conduit with kerosene or equal solvent and blow out all loose dirt with compressed air. Clean flexible shaft and make thorough inspection. If any portion shows excessive wear or loose strands, repair or renew if required. Examine terminal links and renew or tighten loose or worn rivets.

(e) When replacing cable in conduit, grease well with Alemite grease and fill conduit with SAE number 30 oil. The flexible cable should be of such length that with upper end connected to recorder, not less than 3/8" nor more than 1/2" of chain should project beyond face of the lower sleeve to allow for connecting the lower terminal at drive unit.

(f) Check conduit for worn spots, breakage or holes at bends and tighten all clamps.

(g) Remove drive unit from locomotive and inspect all parts, renewing when necessary. Check friction driving wheel for out-of-round and flat spots, also for limit of wear. Grind wheel tread if necessary and when wheel reaches limit of wear (11 inches) wheel is to be renewed.

4. LUBRICATION:

Each instrument in cab is provided with four oil cups which must have oil replenished as follows:

(a) Oil filler opening marked "A" on instruction pamphlets lubricates worm gear box and is located in top of instrument under the cover. The oil filler hole is closed with an indicator gauge which should be removed and SAE No. 10 oil added each trip.

(b) Oil filler cup marked "B" on instruction pamphlets lubricates upper terminal gear shaft and is located on left side of instrument at bottom. This cup should be filled each trip with SAE No. 10 engine oil.

(c) The hydraulic pump and reservoir is completely filled with a special approved speed recorder circulating oil which is red in color. This reservoir should be kept full at all times. Level of oil in circulating reservoir is indicated on sight glass in body of instrument on right side. Filler plug above sight glass to be removed and special oil added as needed. While filling, operate pencil holder up and down to expel air and insure flow of oil into piston chamber. Do not use any oil except approved speed recorder circulating oil.

(d) An indicating oil gauge is located at top of conduit below instrument and this gauge indicates level of oil for lubricating conduit and conduit cable. SAE No. 30 engine oil should be used to keep this gauge full to the top at all times, adding oil at Division points if necessary.

5. CLASSIFIED REPAIRS:

(a) Speed recorder must be disassembled, all parts thoroughly cleaned, inspected for wear or other defects, and all defective parts must be renewed. After reassembling, recorder must be lubricated and calibrated for proper speed registration. Indicate on dial date and shop recorder repaired.

(b) Flexible shaft, hose and drive are to be given the same attention as for quarterly inspection.

6. All speed indicators and recorders are to be maintained, lubricated, calibrated and repaired in accordance with information contained in manufacturer's bulletins.

REFERENCE:

C.P. Speed Recorder Parts List and Instruction Book No. D-135.

By order of

Mech. Supt. Steam Power

Approved by

General Supt. MP&M

Omaha, Nebraska

July 26, 1948