

# LIMA LOCOMOTIVE WORKS, INCORPORATED

Lima, Ohio, October 9, 1942

## ENGINE SPECIFICATION

- 1 Order No. 1173 For UNITED STATES WAR DEPARTMENT  
 War Dep't. Spec. T-1569, dated Aug. 15, 1942.
- 2 Based on C.O. 1171 (Handicate) General Design Shown by C. O. 1171
- 3 No. of Engines 90 Type 2-8-0 Service \_\_\_\_\_
- 4 Shop Numbers 8158-8247 Road Numbers 2152-2241 R. R. Co's Class \_\_\_\_\_
- 5 Made by A.M.S. \*Contract W 2789 to 637  
 Purchase Order #59684 Checked by P. E. P.

6	Cylinders	<u>19"</u>	dia.,	<u>26"</u>	stroke		
7	Driving wheels	<u>57"</u>	dia.				
8	Boiler type	<u>straight top, radial stayed,</u>		Working pressure	<u>225 lbs. per sq. inch.</u>		
9	Tubes, number	<u>150</u>	dia.,	<u>2"</u>	length	<u>13'-6"</u>	
10	Flues, number	<u>30</u>	dia.,	<u>5-3/8"</u>	length	<u>13'-6"</u>	
11	Firebox inside	<u>84-1/8"x70-1/4"</u>		Grate area	<u>41.0</u>	sq. ft. Fuel	<u>Soft coal</u>
12	Heating sur.	Tubes	Flues	Arch Tubes & Syphons	Firebox Comb. Grate	Total	Superhtr. Pipes
13	(in sq. ft.)	<u>1055</u>	<u>563</u>	<u>15</u>	<u>*128</u> <u>136</u>	<u>1765</u> <u>1773</u>	<u>471</u> <u>480-</u>
14							
15	Weight, loaded	Eng. Truck	Any pair Drivers	Total Drivers	Trailing Truck	Total Eng.	
16	Specified	<u>20,800</u>	<del><u>150,500</u></del>	<u>139,500</u>	- -	<u>160,300</u>	
17	Actual	<u>*21,000</u>		<u>140,000</u>		<u>161,000</u>	
18	Limitations	<u>36,000 lbs. on any one axle,</u>		<u>and wt. on drivers <sup>LT, WT ENG-143,100</sup> 141,000 lbs.</u>			
19	Wheel base, Driving	<u>15'-6"</u>	, Engine	<u>23'-3"</u>	, Total E. & T.	<u>51'-7-3/4"</u>	
20	Tractive power without Booster	<u>31,500</u>	lbs.	Factor of adhesion	<u><del>4.43</del> 4.45</u>		
21	Booster tractive power	- - -	lbs.	Total tractive power	- - - - lbs.		
22	Gauge of track	<u>4'-8-1/2"</u>	curvature (max.)	<u>25 deg.</u>	grade-(max.)	<u>2%</u>	
23	Tender, water capacity	<u>6500</u>	U.S. gals.	Fuel capacity	<u>10 tons</u>		
24	Limitations, height	<u>12'-11"</u>	width	<u>9'-0 3/4"</u>	length over all	<u>61'-0-1/4"</u>	
25	Clearance diagram	<u>A. L. Co. dwg. 993-S-965380, rev. Y</u>					
26	Brake rigging or other parts of running gear must not be closer than 7" to rail for a distance laterally of 3'-8-1/2" either side of center.						
27							

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1	Material Specifications and Inspection	
2	<u>SPECIFICATION</u>	<u>MATERIAL</u>
3	A.A.R. E-M-101 E-M-102	Tender Axles, Grade "A". Carbon Steel Forgings, Grade 3, annealed; Guides, Cross-head pins, Side Rod Knuckle Pins.
4		
5	Main Driving Axles of medium carbon steel, quenched and tempered, and in accordance with the following:	
6		Minimum Yield Point = 55,000 lbs. per sq. inch. Minimum Tensile Strength = 90,000 lbs. per sq. inch.
7		Minimum Elongation in 2" = 20%; aim at 24%. Reduction in Area = 45%.
8	Axles to be hollow, bored before heat treatment.	
9	E-M-104	Normalized and tempered carbon steel forgings, Class "A" Driving axles (except Main) Eng. Truck Axles, Main and Side Rods, Crank Pins, Piston Rods.
10	E-M-106	Driving Tires, Class "B"; tensile test required.
11	E-M-107 M-108	Multiple wear Rolled Steel Wheels, untreated. Boiler Tubes, Flues, Arch Tubes, Dry Pipe.
12	M-110 M-111	Rivet Steel and Rivets. Pipe, Steel.
13	M-112 M-113	Steel Bars, Carbon, for Springs. Elliptic Springs, Plain carbon steel, Release Method, Spring bands of "Dead-soft" O.H. Steel.
14	M-114	Helical Springs, plain carbon steel; "load-carrying".
15	M-115 M-116	Boiler and Firebox Steel, "Basic". Firebox steel, Gr. "A" Structural Steel, Angles, Tees, Channels, and U.M. Plate, use Structural Grade.
16		Tank quality plates, 3/16" and over, use Grades "B" & "C" Plates and Sheets, under 3/16", use Commercial Grade.
17	M-117 E-M-201	Steel Castings, Grade "B", annealed.
18	M-302 M-305	Refined Wrought Iron Bars, Grade "B". Staybolt Iron.
19	M-306 M-401	Pipe, Welded wrought iron. Brake Shoes (if used).
20	M-403 M-404	Tender Truck Wheels, east iron. Pipe Fittings and Unions; for 300 lbs. pressure.
21	E-M-501 E-M-503	Tender Truck Journal Bearings and Lining. Hard Bronze, bearings for Eng. Truck and Driving Boxes, Main and Side Rods, Ecc. Rods, Valve Gear.
22	E-M-601	Air Brake Hose.
23	M-602 E-M-606	Air Brake Hose Gaskets. Tender Tank Hose.
24	M-607 M-909	Rubber Goods. Water Gauge Glasses, Class "A".
25	A.S.T.M. A-45-14 A-48-41 B-23-26	Cylinders and Cylinder Parts. Misc. Gray Iron Castings, Class 30. Babbitt, Grade 7.
26		
27	<u>BOLTS &amp; STUDS:</u> The finished engine bolts and studs, except those of .30 to .40 carbon steel, will be made of mild steel to S.A.E. Spec. #1020. Bolts and studs requiring .30 to .40 carb. steel will be made of material to S.A.E. Spec. #1035.	
28		
29	<u>WHITE METAL:</u> This metal will be to the following formula:	
30		Antimony ..... 4.00%. Tin ..... 3.00%. Lead ..... 93.00%.

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1	10	Ash or Oil Pan of tank steel, 3/16" thick.
2		Air or hand operated from ground
3		Hoppers, number and material two, of steel plate
4		Slide of . . . . . guide of . . . . .
5		Drop plate of cast iron frame of bar steel, welded construction
6		
7		
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9		
10	11	Driving Axles of medium carbon steel, normalized and tempered, except main, which will be quenched and tempered, see page 2
11		Main journals 8" dia., 11" long, wheel fit 8" dia., hollow bored 2" dia.
12		Axles smooth turned between journals, Journals roller burnished. Other Journals 8" dia., 11" long, wheel fit 8" dia., hollow bored No dia.
13		Ends of hollow bored in main axle not to be plugged. Axles from open market
14		Axle marking as required
15		
16		Engine Truck Axle of medium carbon steel, normalized and tempered
17		Axle smooth turned between wheel seats; Journals roller burnished . Journals 6" dia., 10" long, wheel fit 6" dia., hollow bored No dia.
18		Axles from Open market
19		Axle marking as required
20		Trail. Truck Axle, front of None rear of none
21		Journals, front, . . . . dia., . . . . long, wheel fit . . . . dia., hollow bored . . . . dia.
22		Journals, rear, . . . . dia., . . . . long, wheel fit . . . . dia., hollow bored . . . . dia.
23		Axle from, front . . . . . rear . . . . .
24		Axle marking . . . . .
25		
26	12	Bell None
27		
28		Bell ringer None
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113-14	Boiler	Boiler to be built to <del>F. C. C.</del> or A. S. M. E. <del>rules</del> Boiler Code, Sect. #3, except to have factor of safety of 4.
2	Boiler designed for	225 lbs. pressure; factor of safety Boiler well designed,
3	Hydrostatic test	281 lbs. Steam test 245 lbs.
4	Working pressure	225 lbs. (slightly countersunk under heads of rivets.)
5	Boiler	68-3/4" O. D. at front, 70" O. D. at throat
6	Shell of	basic flange quality boiler steel.
7	Seams horizontal	, multiple riveted butt joint with inside and outside welt strips.
8		
9	Seams circumferential	double riveted lap.
10		
11	Rivets	of steel, and shall be power driven wherever possible, and all rivet holes shall be reamed.
12	Pressure plate	of cast iron, steam and water test and working press. cast on; Shop No., Govt. Identification Number and Safety Valve Setting stamped on.
13	Thickness of sheets, smoke box	1/2" and liner 1/2"
14	front tube	9/16" , 1st course 5/8" , 2nd 5/8" , 3rd - - -
15	Throat	11/16" , roof and , sides 1/2" , backhead 1/2"
16	Back sloping	Yes ; throat sloping Yes ; roof and sides in one piece.
17	Seal weld shall be applied at each outside corner firebox seam, extending 10" up from bottom.	
18	Tube sheet ring	to be cut out of plate.
19	Bracing of wrought iron or steel, "Blunt" type bracing, patent #1738982, to be used, but brace rods will have Lima standard jaws.	
20		
21		
22	Dome	32" I. D., 4-1/4" high. Material basic firebox quality plate, in one piece and double riveted to boiler.
23	Shut-off valve	None
24	Dome cap flange quality plate and	provided with copper gasket Inspection dome None
25	Dome casing	of pressed steel; integral with sand box.
26	Engine shop number to be stamped on dome.	
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ORDER 1173

1	Firebox of basic firebox quality steel plate, welded construction throughout.
2	Door sheet and tube sheet seams located between first and second row of staybolts Combustion chamber None { front and back.
3	All firebox sheets welded to mud ring. Thickness of crown and sides $3/8"$ comb. chbr. ---
4	tube $1/2"$ , throat ---, door $3/8"$
5	Crown and sides and comb. chamber in one piece, Yes
6	Thermic syphon None Plate --- thick.
7	
8	Firebox ring cast steel, with integral lugs for application of expansion plates.
9	Width at front $4"$ , sides $3-1/2"$ , back $3-1/2"$ and $3"$ thick
10	Sheets to be single riveted to ring. Finish ring inside and out.
11	Studs in mud ring arranged to take either oil pan or ashpan.
12	
13	Fire hole elliptic, $13" \times 18"$ , seam butt welded
14	
15	Staybolts $15/16"$ dia., spaced not over $4"$ centers
16	Body of bolt turned No. Test hole drilled in outer end $7/32"$ dia.
17	
18	Hollow staybolts applied as required for oil fuel.
19	Thermic syphon staybolts None
20	
21	Flexible and other bolts, <del>except</del> and hollow of staybolt iron
22	
23	Flexible bolts None/ type --- bolts --- dia. with --- sleeves <del>except</del> expansion stays, see page 6.
24	Installation of flexibles ---, approx. --- in number
25	
26	Radial stays $1"$ dia. in crown, $13/16"$ dia. body, $1"$ dia. in roof, four rows each side of six center rows.
27	
28	Crown stays, see page 6
29	
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ORDER 1173

1	Crown stays, <del>button or</del> taper head type	Six rows wide
2	1-1/32" dia. at point, taper 1-1/2" in 12" in crown;	13/16" dia. body 1" dia. in roof
3		
4	Expansion stays	two front rows 14 wide, the six center rows to be same as
5		on item 2, with A. L. Co. "WRA" sleeve and cap and "Y" nut. Four rows each side
6		six center rows to be A. L. Co. type "YC" bolts, 15/16" dia., 1" end, with
6		"WRA" sleeve and cap.
6		Threading on staybolts, 12 per inch, Whitworth Standard.
7	All taps in boiler for studs	American Nat. form, 12 thd., taper 3/4" in 12".
8		
9	Tubes of hot drawn seamless steel	
10	Tubes from open market	
11	Number 150	dia., 2" thick #13 BWG. / length 13'-6" spaced 11/16" min. or #12 BWG. min.
12		Tubes swaged to 1-7/8" at back end and expanded to 2-1/16" at front end.
12		All tubes set at back with copper ferrules swaged and beaded, and electric welded.
13	All tubes in flue zone and 10	per cent <sup>min.</sup> of remainder beaded at front
14		
15	Flues of hot drawn seamless steel	
16	Flues from Open market	
17	Number 30	dia., 5-3/8" thick #9 min. / length 13'-6" #10 BWG.
18		All flues set at back with copper ferrules, swaged at back and beaded at both ends, and electric
19		welded at back end. Flues swaged to 4-1/2" O. D. at back end and expanded to
19		5-7/16" O. D. at front
20		
21	Fire brick tubes of hot drawn seamless steel	
22	Number three	dia., 3" thick #7 B.W.G. Min.
23		
24	Smoke consumer tubes	None
25		
26		
27	Stoker tubes	None
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1	84	Tender Brakes	Westinghouse air brake; Steam and vacuum brake from New York
2		Air Brake Co. *Hand brake to be applied.	Schedule
3		Braking power shall be 100% of the light weight of tender based on cylinder pressure equal to 75% of boiler pressure.	
4		Train Signal	None
5		Vent valve	with
6		Brake cylinder	6" dia. 8-1/2" stroke. Type steam
7		Packing	
8		Slack adjuster	None
9			
10		Brake arrangement on frame	
11			
12			
13		Hand brake shaft	<del>None</del> *Hand brake shaft to be located on front of right water/leg.
14			
15		Brake arrangement on truck	
16			
17			
18		Brake beams, type	" Buffalo", to their dwg. B-1883
19		Maker	
20		Third point support	
21		Hangers to be loop type	
22		Brake shoes	of cast iron, A. B.S. & F. Co., dwg. 15107-C
23			
24		Brake heads	of cast steel.
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1	Superheater inspection holes None
2	
3	Waist sheet angles or tees
4	
5	Fusible plug ( two ) in crown sheet, 1-1/4" dia., 12 A.N.F. thd., taper 3/4" in 12" see Dwg. 661-S-1474, locate on centerline of crown, one near each end.
6	Arch tube plugs Prime, with malleable iron core to their Cd. 418. Plugs 3-9/64" at point, taper 3/4" in 12", and 12 A. N. F. threads per inch. ( 6 per set)
7	
8	Washout plugs Prime, with malleable iron core, to their Cd. 418. Plugs 2" at point, taper 3/4" in 12", and threaded 12 A. N.F. threads per inch (16 per set)
9	Plugs shall be applied in corners of firebox, above firedoor, crown sheet and tubes and in boiler waist.
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20	<b>BOILER TEST</b>
21	Each boiler must be tested in conformance with the A. S. M. E. locomotive boiler code. Any leaks developing may be caulked, but the test shall be
22	repeated until all leaks are stopped. After A. S.M. E. test, the boiler shall be fired and the pressure raised to 245 lbs. per square inch, and shall
23	be steam tight at this pressure. After the steam test, the boiler shall be blown down and allowed to stand until it is cool. It shall be then refilled
24	with water, about 150 deg. Fah. and the pressure raised to 245 lbs. by firing. The boiler shall remain steam tight until thoroughly cooled down .
25	
26	Note: Boiler, except smokebox, shall be painted on outside, one coat of red lead
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ORDER 1173

## 1 18 Brackets, Stands, Etc.

2 Miscellaneous small brackets on backhead, such as gauge stand supports, etc., to be secured to boiler by studs screwed into nuts welded to boiler sheet. Miscel-

3 laneous large brackets, such as water gauge and water column supports, valve han-

4 dle support, etc., will be secured to boiler with studs threaded into 2" dia. blocks welded to boiler sheet.

## 5 19 Brake Equipment, Operating, Air brake, Westinghouse, for train only; steam

6 brake on engine and tender; vacuum brake for train only. Steam and vacuum brake

7 Schedule details from N.Y.A.B.Co., except ejector, Gresham and Craven graduable

8 steam brake valve, ball check valve and pet. cock for timing reservoir, see pg.9-A.

9 Air Pump, one, 9-1/2" , strainer

10 Material from British War Com. will be shipped to B.L.W., we to obtain material (from them.)

11 Air pump packing

12 Pump location, smokebox front, left side.

13 Pump drip pan drain pipe carried below deck and locate so that drain will drip Exhaust piped to main cylinder exhaust passage. (on ground.)

14 Air pump steam valve

15 Train signal

16 Main reservoir capacity (total) not less than cubic inches

17 Main reservoir, right side 20-1/2" x 72".

18 Main reservoir, left side 20-1/2" x 72".

19 Reservoir hydro. test pressure W.A.B. Std. lbs. sq. in. certificate / Drain cock required.

20 Reservoir location right and left under running boards, ahead of throat.

21 Train line carried to front of engine and rear of tender for both air brake and vacuum brake. It will be necessary to furnish and apply only one air hose at each end with provisions for changing to opposite side of engine or tender as desired.

22 Piping L.L.W. Standard.

23 Vacuum brake ejector exhaust piped to smokebox, end of pipe bent to discharge up stack. Muffler not required. Exhaust pipe of iron or steel; steam pipe, 2-1/4" C.D. copper. \*2" iron or steel pipe.

24 Apply drain pipe from drain connection on pump governor and extend down below running board.

25 Vacuum brake equipment shall maintain a 20" vacuum in the train line against a 5/16" dia. orifice with large ejector and against a 1/8" dia. orifice with small ejector, with relief valve set to maintain a 21" max. vacuum, and with 100 lbs. steam pressure at ejector.

26 Air brake equipment shall maintain 70 lbs. pressure in the train line with air pump operating at 120 strokes per minute against a 11/64" dia. orifice.

27 Leakage in complete air system shall not exceed 3 lbs. per minute from operating pressure.

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1	All engines will be arranged for application of ejectors, graduable steam brake valves, ball checks, and pet cocks. These parts will be applied for testing, and then removed and retained at Lima for further disposition. The ejectors, graduable steam brake valves, etc., with which locomotives will operate, will be furnished and applied at destination.
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# ENGINE SPECIFICATION

ORDER 1173

1	20	Brake Equipment, Foundation American Brake Company
2		Drivers, <del>trailers and engine trucks</del> Schedule N-140-81
3		shoes on of wheels
4		Brake cylinders, front , two 8" dia. 8-1/2" stroke; back - - dia. - - stroke
5		Braking power shall be 60% of weight on drivers, in working order. Cylinder pressure based on 75% of boiler pressure.
6		Brake hanger pins are to be tapered 3/4" in 12" in frame and hanger brackets.
7		
8		
9	21	Bumper (front) of flat steel plate, securely fastened to main frames, and to be 94" wide
10		Knee of forged steel
11		Step on back of bumper, each end, and must not extend beyond end of bumper.
12		Push pole pocket None
13		Deck plate of Diamond pattern plate. Design of deck to permit easy removal of steam chest valve, and location of running board step tread to be midway between deck and runboard.
14		
15		
16	22	Cab of steel plate, #12 U. S. Gauge lined with wood at roof only.
17		Roof covered with - - - cab long wide
18		Cab to be open back type without drop windows in back wall.
19		Back extension of cab roof to be detachable for shipping purposes. *yellow pine
20		Cab floor and engine deck to be of steel plate covered with hard wood flooring, except raised portions, which will not be covered.
21		
22		Door and windows glazed with laminated plate glass, 3/16" thick.
23	23	Cab Details and Fittings
24		Door of steel, L.S. only Windows , sash from O. M. Edwards Co. only
25		Storm Window Prime panel, R. S./ Apron of Diamond pattern steel plate
26		Windshield wings will not be required Saddle angle iron Bracket steel plate
27		Ventilator in roof to be adjustable
28		Arm rest suitable
29		Door fixtures with, L.S.
30		Ventilator fixtures with

ORDER 1173

1 89 Tender Truck, type four wheel; cast steel side frame, and without spring  
plank.

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Bolster of cast steel

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7

Center plate of cast steel

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Side bearings plain

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Side bearing spacing and clearance, see group 85

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12

Truck safety chains None

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Water Scoop None

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Wheels of cast iron, chilled tread, nominal dia. 33", AAR std.  
650# wheel, with tread contour and flange thickness as shown on A. C.F.  
Maker Open Market. dwg. 31-2580

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Marking as required.

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1	28	Cock Riggings
2		Cylinder hand operated
3		Port <del>Grader, type "OK" #86</del> *None
4		Blow off hand operated from cab.
5		
6	29	Crank Pins, Main of medium carbon steel, normalized and tempered and hollow
7		bored 2" diameter
8		Pins, other than main of medium carbon steel, normalized and tempered.
9		Main pin located in third driving wheel
10		Pins from - shop made
11		Crank pin nuts and collars of medium carbon steel, annealed. Front crank pin collar, recessed type, secured with through bolt and nut on outside.
12		Marking as required
13		
14	30	Crosshead of cast steel type "Laird", for two bar guides,
15		shoes of cast iron with babbitted wear surfaces.*Side liners of cold rolled bronze.
16		Wrist pin of medium carbon steel, annealed journal 4" dia. 3-1/2" long
17		Pin applied from outside and secured by locking plate
18		*Wear plates for front end of main rod of hard bronze.
19		Arm none, Union link driven from extension on crosshead pin.
20		Crosshead key of high carbon steel, L.L.W. Std.
21		Apply "Gits" oil cup #1007 on crosshead for lubricating front end of main rod.
22	31	Cylinders of cast iron 19" dia. 26" stroke, cast
23		with half saddle attached, securely bolted together and to frames.
24		Bushings of None, see below
25		Test pressure: 225#, see below
26		Provide bosses for indicator connections* and drain cocks, also for peep hole plugs, cylinder cocks, bushing plugs and connections for force feed lubricator pipes at top of cylinder. All bosses to be tapped and unused holes, plugged, except bosses for indicator* and cylinder bushing plugs to be left blank.
27		Application of cylinder bushings to correct defective cylinders will be permitted at the discretion of the R. R. inspector. No bushing less than 1/2" in wall thickness will be permitted. Cylinders having wall thickness of less than 3/4" after re boring will be rejected. Hydrostatic test shall be applied after application of bushings. Cored opening in bottom of cylinder to be covered by a plate larger than opening.
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ORDER 1173

1	32	Cylinder Details
2		Head, front of cast iron back of cast iron
3		Front cylinder head studs to be grooved.
4		Cylinder head casings of pressed steel 1/8" steel plate, disc type, stud nuts to be exposed.
5		Cylinder casing of #18 U. S. Gauge sheet steel, to be given coat of red lead primer on inside.
6		Suitable covered openings shall be provided in cylinder jacket at plugs.
7		Steam chest bushings of high grade cast iron, bored / after insertion with starting ports
8		Head, front of cast iron back of cast steel, both arranged to support mechanical lubricator
9		Head casings of pressed steel None steel plate, disc type, at front only.
10		Valve rod crosshead guide of cast iron
11		
12		
13	33	Cylinder Compound Attachments None
14		
15		
16	34	Cylinder, By-Pass and Relief Valve
17		Relief valve (in cyl. heads) None
18		Vacuum valve (in steam chest) None
19		Drifting valve None
20		
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24	36	Dome (see group 14)
25		
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ORDER 1173

1	40	Engine Truck, type two-wheel, inside bearing with cast steel swing frame and bolster and cast steel heart-shaped hangers. Pedestals of forged steel. Rail guards, see page 23, item 1.
2		
3		Bolts securing radius bar brace to radius bar to have double nuts.
4		
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10	41	Trailing Truck, type None
11		Truck designed for booster - - -
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19	44	Exhaust Pipe of cast iron.
20		Nozzle of cast iron, bored 5-1/4" dia., and fitted with cross bridge.
21		Blower ring to be provided, A.A.R. circular perforated pipe design, mounted around nozzle, approximately flush with top of same.
22		
23		
24	45	Firedoor, Firebrick, Etc.
25		Firedoor of cast iron, hand operated and with renewable cast iron liner.
26		
27		Firebrick arch to be applied, supported on three arch tubes.
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ORDER 1173

1	50	Guides and Attachments, type "two-bar" for "Laird" crosshead and arranged for force feed lubrication, <del>two</del> <sup>one</sup> outlet to each top guide.
2		Guides of medium carbon steel, annealed.
3		Guides to be finished all over and ground smooth, with wearing edges rounded. Provision to be made on wearing surfaces for over-travel at ends of stroke.
4		Yoke of Universal mill plate.
5		Yoke sheet tank steel.
6		Yoke knee of cast steel.
7		Yoke ends None
8		Guides secured at both ends with straight turned bolts fitted with castle nut and split cotter pin. Sheet steel liners shall be provided at both ends of guides for adjustments.
9		Striking points between piston and cylinder heads shall be plainly marked on guides at front and rear ends of crosshead shoe travel.
10		
11		
12		
13	51	Grate Arrangement
14		Operated by hand in two sections
15		
16	52	Grate Details
17		Grate bars of <del>cast</del> "Tuyere" type, Hulson light-weight.
18		Dump grate of cast - - - at front or back of firebox - - -
19		Dump operated from ground or firing deck - - -
20		Side frames of cast iron in sections
21		Side frames supported by cast steel brackets.
22		Center frame of cast iron.
23		Center frame supports of cast steel.
24		
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1	MECHANICAL LUBRICATORS, Continued:
2	Lubricator on right steam chest head to be provided with plate marked "VALVE OIL"
3	and arranged to lubricate the following:
4	1 - feed to R.H. steam chest.
	1 - feed to L.H. steam chest.
5	1 - feed to R.H. Cylinder barrel at top.
	1 - feed to L.H. Cylinder barrel at top.
6	1 - feed to R.H. Main guide, <del>two outlets.</del>
	1 - feed to L.H. Main guide, <del>two outlets.</del>
7	1 - feed to R.H. Engine Truck Box.
	1 - feed to L.H. Engine Truck Box.
8	
9	
10	Lubricator on left steam chest head to be provided with plate marked "ENGINE OIL",
11	and arranged to lubricate the following:
12	2 - feeds to rear driving boxes.
	2 - feeds to main driving boxes.
13	2 - feeds to inter. driving boxes.
	2 - feeds to front driving boxes.
14	
15	
16	Lubricators provided with three-point combination winter, summer and blank position
	locked control stainless steel hardened heater choke.
17	Heater lines of pickled extra heavy wrought iron pipe.
18	Oil lines of $\frac{3}{8}$ " Bundy tubing, covered with extra heavy waterproof asbestos loom
	or tubing. <sup>see below.</sup> Each end of covering to be properly clamped to prevent unraveling.
19	All pipe connections to be brazed type.
	Flexible connections shall be of hose suitable for 5,000 lbs. per square inch in-
20	ternal pressure.
	* Oil lines running in angle iron trough, will not be covered with loom, but will
21	be wrapped together with trough.
22	
23	
24	*NOTE: To avoid congealing tendencies, on locomotives shipped during cold weather,
25	the valve oil lubricator is to be filled with engine oil or S.A.E.-30, and feeds to
	cylinders and steam chests <sup>* set two turns open.</sup> turned off. At destination, messenger will drain the
26	lubricator, put feed lines back in operation and fill with valve oil. See page
	32-A, item 5.
27	
28	
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ORDER 1173

1	61	Painting, Lettering, Numbering and Photographs
2		<b>PAINING:</b> Locomotives shall be finished in accordance with L.L.W. Dwg. 992-A-418.
3		All painted surfaces shall be suitably primed.
4		Interior of cab shall receive two coats and exterior surfaces shall receive three coats of paint as follows:
5		Black,- All exterior surfaces, except finished parts, last coat to be lusterless black enamel.
6		Black,- Heat resistant and one coat of lusterless black enamel to be applied to smokebox and stack.
7		Green,- Applied to inside of cab and fittings.
8		
9		The letters U.S.A. will be stencilled with lusterless gray paint in Gothic caps., 9" high, each side of tender.
10		Road numbers to be applied on sides of cab and rear of tender with lusterless gray paint in Gothic figures, 7" high.
11		Lusterless gray paint to Q.M.C. Tentative Spec. H.D.Q.-ES-680, Class 9, to match Color Plate 44-A-5, page 111 in dictionary of color by Maerz & Paul (McGraw-Hill).
12		Inside of water tank, outside of boiler, except smokebox, and inside of boiler and cylinder jacket to be given one coat of red lead primer.
13		
14		
15		<b>PHOTOGRAPHS:</b> Locomotives to be photographed in accordance with Lima standard (practice.
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1	65	Piston of cast iron.
2		
3		
4		Packing rings of high grade cast iron, plain style.
5		Rod of medium carbon steel, annealed 3-3/4" dia.
6		Rods from Shop made.
7		Rod packing Paxton-Mitchell, suitable for superheated steam.
8		Piston rod ground between fits. Rod fit in piston to be taper and shoulder, pressed in, secured by nut with end of rod riveted over nut. Fit in crosshead to be taper and shoulder. Rods shall be of sufficient length to permit replacement of piston packing without disconnecting piston rod from crosshead.
9		
10		
11		
12		
13	66	Plugs, hand hole and washout are found in the particular groups.
14		
15	68	Reverse Lever of mild steel, and to be applied on right hand side.
16		Reverse lever end of - - -
17		Fulcrum of steel plate
18		Quadrant of mild steel
19		Latch of Mild steel
20		
21		
22		Power reverse gear None.
23		Cylinder - - - packing - - -
24		Cylinder bracket - - -
25		
26		
27		Screw reverse gear None
28		
29		
30		

## ENGINE SPECIFICATION

ORDER 1173

1	72	Rods (Main) of medium carbon steel, normalized and tempered, "I" section
2		Bearings of hard bronze.
3		Front end bearing, <del>one piece type</del> , pressed in.
4		Back end solid type, with fixed bronze bushing, pressed in.
5		Fillets in rod to be 1/2" minimum, and 1/8" corner radii.
6		Oil <del>or grease</del> cups same as on C.O. 1171, with wick feed. Apply 7/16" dia. hole through wick nipple. Oil cup at front end to be open type to catch drip from cup on crosshead; cup filled with curled hair.
7		
8		<del>Rods to be drop tested, yes or no</del>
9		
10		
11		
12		
13		Rods (side) of medium carbon steel, normalized and tempered, rectangular section
14		Rods shall be smoothly finished, with 1/8" corner radii.
15		Bearings of hard bronze, all to be fixed bushing type.
16		
17		
18		Knuckle pin of medium carbon steel, annealed.
19		Knuckle pin bushings of hard bronze.
20		Location of knuckle pin front of intermediate and back of main pins.
21		Knuckle pin nut and washer of medium carbon steel, annealed.
22		Rod oil <del>or grease</del> cups bosses applied top and bottom so that rods will be interchangeable R. or L. Oil cups, see item 6.
23		<del>Rods to be drop tested, yes or no</del>
24		
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1	77	Spring Rigging
2		Driving box saddle of cast steel.
3		Equalizers between drivers <del>of</del> and hangers of mild steel.
4		Equalizer, front of mild steel
5		Equalizer, transverse of mild steel
6		Trailing truck equalizer None
7		The engine truck, front, and intermediate drivers shall be equalized together. Rear and main drivers shall be equalized on each side.
8		
9		Keys for equalizer beam pins to be omitted.
10		Equalizer fulcrum, front of cast steel
11		Equalizer fulcrum, back of - - -
12		
13		
14		
15		
16	78	Steam Gauge, Safety Valves, Etc.
17		Steam gauge, number One, Maker Ashcroft, type 1146, double spring, black enameled non-glare dial. Cock and fittings furnished by L.L.W.
18		Dial 6-3/4" dia., graduated to *500 <del>400</del> lbs. Case of cast iron. Gauge conveniently located in plain view of engineer and fireman.
19		
20		Air gauges with brake M.O.
21		
22		
23		
24		Cab turret one of cast steel / for saturated steam. Turret valve handles in cab readily accessible. Turret casing not required.
25		Dry pipe of extra heavy wrought iron, extending into dome.
26		Cab turret None of for superheated steam and arranged to
27		supply the following accessories - - -
28		
29		Dry pipe of - - - and fitted with - - - shut-off
30		

# ENGINE SPECIFICATION

ORDER 1173

1	94	Valves, Distribution, Piston	type, 10" dia.	inside	admission
2		Packing rings cast iron, high grade, and to be "L" shape.			
3		Bull rings of cast iron, high grade.			
4		ends of forged steel, Valve body of seamless steel tubing, / , followers of cast steel.			
5		Valve travel	6-1/2"	Maximum cut-off	82.2% Steam lap 1-1/4"
6		Exhaust lap or clearance	line and line	Lead	1/4"
7		Valve stem of med. carb. steel, annealed dia. 1-5/8"			
8		Steam packing Paxton-Mitchell, suitable for superheated steam.			
9		Valve rod crosshead of mild steel.			
10					
11					
12					
13					
14	95	Driving Wheels, of cast steel	others of		
15		Dia. of wheel	57"	; dia. of center	51"
16		Hub liner of steel plate, rolled in. Provide 1/8" radius in bottom corners of counterbore for liner.			
17					
18		Tires of O.H. Steel.			
19		Tire section as shown on Dwg. 952-A-275.			
20		All	pairs flanged	5-1/4" wide	3" thick
21			pair plain	- - - wide	- - - thick
22		Between tires, front 53-3/8", 2nd 53-1/2", 3rd 53-1/2", 4th 53-3/8", 5th - - -			
23		Retaining rings None, held by shrinkage and lip.			
24		Counterbalance Cross counterbalancing will not be required, and balance blocks cast solid, but with adjusting pockets.			
25					
26					
27					
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1	96	Whistle and Rigging
2		Whistle, Nathan, 5" plain type, of cast iron, mounted on side of dome. *Apply shield back of whistle.
3		Rigging arranged for hand operation by both engineer and fireman. Whistle cord shall be 3/8" dia. sash cord, from whistle into cab, through a thimble on left side, across cab and shall terminate in a pear-shaped drop.
4		
5		
6	99	Miscellaneous
7		Engine to be weighed
8		* for L.L.W. file only.
9		REPORTS: One copy each of I.C.C. forms #3 and #4 to be placed in cab and two copies of each to be given to the Govt. Inspector, who will transmit them to the office of Lt. Col. J. S. Seybold.
10		
11		
12		Speed recorder None
13		PATTERN NUMBERS: Pattern numbers to be assigned to all castings, similar to the system used on C.O. 1171.
14		
15		Booster None
16		
17		
18		Safety appliances - - -
19		
20		
21		
22		DRAWINGS, CATALOGS, ETC.: Lima to furnish set of specialty catalogs, obtained from manufacturers, with each locomotive. Each specialty and appliance shall carry the manufacturer's serial number and such other pertinent information usually furnished by the manufacturer for identification.
23		
24		
25		GENERAL: Locomotives shall be suitable for satisfactory road operation at any speed up to 40 miles per hour, and on any grade up to 2% and on 25 degrees curve. The load on driving axles shall be distributed so as not to exceed the weights shown on page 1, item 18.
26		
27		The general design shall be such as to produce a workmanlike, practical, and satisfactory locomotive without novel or untried devices, and with a minimum of critical raw material. Continued on page 35-A.
28		
29		
30		

# LIMA LOCOMOTIVE WORKS, INCORPORATED

## LOCOMOTIVE RATIOS

### UNITED STATES WAR DEPARTMENT

### R. R.

Made by HBS  
Ckd. by AVF  
Date February 7, 1918

1	Type	<b>2-8-0</b>	
2	<del>Inquiry</del> —Order No.	<b>C.O. 1181</b>	
3	Specification No.	-----	
4	Drawing No.	-----	
5	Fuel	<b>Soft Coal</b>	<b>Oil</b>
6	Boiler Type and Diameter <b>St. Top</b>	<b>68-3/4" O.D.</b>	
7	Weight on Drivers, lbs.	<b>140,000</b>	<b>139,350</b>
8	Weight on Truck, lbs.	<b>21,000</b>	<b>20,400</b>
9	Weight on Trailer, Front Wheels, lbs.	-----	-----
10	Weight on Trailer, Back Wheels, lbs.	-----	-----
11	Weight Total Engine, lbs.	<b>161,000</b>	<b>159,750</b>
12	Cylinders, Dia. x Stroke, ins.	<b>19 x 26</b>	
13	Driving Wheel— <del>Booster Wheel</del> , Diameter, ins.	<b>57</b>	
14	Boiler Pressure and Percent Maximum Cut-off	<b>225/; 82%</b>	
15	Tractive Power, Main Cylinders, lbs.	<b>31,800</b>	
16	Tractive Power, With Booster, lbs.	-----	
17	Factor of Adhesion	<b>4.45</b>	<b>4.42</b>
18	Cylinder Horse Power	<b>1462</b>	
19	Steam Rate per H. P., lbs.	<b>20.8</b>	
20	<b>STEAM TOTAL PER HOUR MAX. H. P., lbs.</b>	<b>30410</b>	<b>Oil Burner</b>
21	Coal Rate per H. P., lbs.	<b>3.25</b>	<b>Figured for</b>
22	<b>COAL TOTAL PER HOUR MAX. H. P., lbs.</b>	<b>4750</b>	<b>Coal</b>
23	Grate Area Required, sq. ft. @ 120 lbs. per sq. ft.	<b>39.6</b>	
24	Grate Area Actual, sq. ft.	<b>41.0</b>	
25	Coal per Sq. Ft. Actual Grate for Cyl. H. P., lbs.	<b>115.7</b>	
26	Grate Length x Width, ins.	<b>84-1/8 x 70-1/4</b>	
27	Superheater, Type and Heating Surface, sq. ft.	<b>"A" - 471</b>	
28	No. and Size of Superheater Units	<b>30; 1-1/2"</b>	
29	Feed Water Heater	-----	
30	Tubes—No., Diameter and Gage	<b>150; 2"; 13M</b>	
31	Flues—No., Diameter and Gage	<b>30; 5-3/8"; 10M</b>	
32	Tube Length and Spacing	<b>13'-6"; 3/4"</b>	
33	Flue Spacing	<b>7/8"</b>	
34	Tubes and Flues Internal Area, Swaged End, sq. in.	<b>725</b>	
35	Tubes and Flues Internal Area, Nom. Diam. sq. in.	<b>770</b>	
36	Area Thru Superheater Pipes and Dry Pipe, sq. in.	<b>34.2 &amp; 44.2</b>	
37	Heating Surface—Tubes, sq. ft.	<b>1055</b>	
38	Heating Surface—Flues, sq. ft.	<b>567</b>	
39	Heating Surface—Arch Tubes, <del>Circs.</del> <del>Suph.</del> sq. ft.	<b>15</b>	
40	Heating Surface—Firebox <del>and Combust. Churn</del> , sq. ft.	<b>123</b>	
41	Heating Surface—Total, sq. ft.	<b>1765</b>	
42	Evaporation by Tubes, per sq. ft., lbs.	<b>10.56</b>	
43	Evaporation by Flues, per sq. ft., lbs.	<b>12.37</b>	
44	Evaporation by Tubes—Total, lbs.	<b>11141</b>	
45	Evaporation by Flues—Total, lbs.	<b>7014</b>	
46	Evaporation by Firebox at 55 lbs. per sq. ft., lbs.	<b>7865</b>	
47	<b>EVAPORATION—TOTAL, lbs.</b>	<b>26020</b>	
48	Boiler Horse Power	<b>1231</b>	
49	Boiler H. P. % of Cylinder H. P.	<b>85.6</b>	
50	Weight per Cylinder Horse Power, lbs.	<b>110.1</b>	<b>109.3</b>
51	Weight per Boiler Horse Power, lbs.	<b>128.7</b>	<b>127.8</b>
52	Steam Space Factor	<b>703</b>	
53	Firebox Volume, cu. ft., Gross	<b>178</b>	
54	Main Axle, Diameter and Stress	<b>8" - 31900</b>	
55	Driving Axle Journal and Bearing Pressure, lbs.	<b>8"x11" - 173</b>	<b>8"x11" - 174</b>
56	Engine Truck Axle Jour. and Bearing Pressure, lbs.	<b>6"x10" - 159</b>	<b>6"x10" - 154</b>
57	Trailing Axle Jour. and Bearing Pressure Front, lbs.	-----	-----
58	Trailing Axle Jour. and Bearing Pressure Back, lbs.	-----	-----
59	Tender Truck Axle Jour. and Bearing Pressure, lbs.	<b>5"x9" - 315</b>	<b>5"x9" - 315</b>
60	Tank Capacity—Fuel	<b>10 Tons</b>	<b>1800 Gals.</b>
61	Tank Capacity—Water	<b>6500 Gals.</b>	<b>6500 Gals.</b>
62	Weight of Tender—Full Load, lbs.	<b>115,500</b>	<b>114,050</b>