The U. S. Standard Light Mallet Type Locomotive

2-6-6-2 Wheel Arrangement with Weight on Drivers of 358,000 lb. and Tractive Effort, Compound, of 80,000 lb.

The first of the standard Mallet type locomotives designed by the United States Railroad Administration has recently been turned out by the Schenectady works of the American Locomotive Company, for delivery to the Chesapeake & Ohio. The locomotive is of the 2-6-6-2 type and is the lighter of the two standard Mallet types, of which orders for 50 were placed in 1918, 30 of these being of the lighter type and 20 of the heavier type.

The locomotive has a weight on drivers of 358,000 lb., 2,000 lb. less than the maximum permissible within the axle load limit of 60,000 lb. The cylinders are 23 in. and 35 in. in diameter by 32 in. stroke and the locomotive is designed to deliver a tractive effort of 96,000 lb. simple and 80,000 lb. compound. In the table will be found a comparison of the principal dimensions and data for a number of Mallet locomotives of the 2-6-6-2 wheel arrangement, of which the standard locomotive is the heaviest both on drivers and in total weight.

**Comparison of Recent Mallet Locomotives of the 2-6-6-2 Type**

| Name of road | U.S. Std. | B. & O. | N. & W. | C. & O. | American American American
|--------------|-----------|---------|---------|---------|-----------------------------
| Year built | 1919 | 1914 | 1912 | 1911 | 1912
| Builders | American Mallet | American Mallet | American Mallet | American Mallet | American Mallet
| Tractive effort, lb. | 80,300 | 80,000 | 72,800 | 72,800 | 72,800
| Total weight, lb. | 448,000 | 429,000 | 415,300 | 400,000 | 400,000
| Weight on drivers, lb. | 358,000 | 355,000 | 327,000 | 327,000 | 327,000
| Diameter of drivers, in. | 32 | 32 | 32 | 32 | 32
| Cylinder diameter and stroke, in. | 23 & 35 | 23 & 35 | 22 & 35 | 22 & 35 | 22 & 35
| Steam pressure, lb. per sq. in. | 225 | 220 | 220 | 200 | 200
| Heating surface, total evap., sq. ft. | 5,443 | 4,935 | 5,000 | 5,000 | 5,000
| Heating surface, equivalent* | 3,381 | 4,937 | 4,300 | 4,300 | 4,300
| Grate area, sq. ft. | 27.2 | 27.2 | 27.2 | 27.2 | 27.2
| Tractive effort x dia. drivers = equivalent heating surface* | 617.8 | 604.5 | 626.8 | 626.8 | 626.8
| Firebox heating surface = equivalent heating surface, per cent | 5.6 | 6.0 | 5.3 | 6.1

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

The boiler has an outside diameter at the first ring of 90 in., increasing to 95 9/16 in. at the fourth ring just forward into the barrel of the boiler 84 in. from the throat sheet, making the tubes 24 ft. long. It is fitted with a Security brick arch carried on five arch tubes and is fired by a Standard stoker. The fire door is of the Shoemaker power operated type and the grates are operated by Franklin power grate shakers. The boiler is fitted with the Locomotive Superheater Company's Type A superheater with 45 units.

In general the design of the frames follows that of all the other standard type locomotives which have been built. The top rails for both high and low pressure units are 6 in. wide, with a maximum thickness of 5 in. over the pedestals and a minimum thickness of 4 1/2 in. The lower rails have a maximum and minimum thickness of 3 1/2 in. and 3 in. respectively. The high pressure frames are designed with splice joints at the rear for attachment to a Commonwealth frame cradle which includes in one casting the frames, rear deck plate and trailer equalizer fulcrums. The high pressure cylinders are supported on a single front rail which is cast integral with the main frames.

The low pressure frames are designed to receive the articulation joint, which is of the Baldwin universal type, hinged for movement about a horizontal axis transverse to the center line of the locomotive and provided with a ball joint pin connection at the high pressure unit end. The low pressure cylinders are supported by double rails, both of which are bolted to the main frame. The frames of both units are spaced 41 in. from center to center, while the cylinders have a spread of 85 in. Owing to the size of the low pressure cylinders the face of the lower rail bolting flange is only 20 1/2 in. from the center line of the locomotive, thus requiring an offset in the front frame rail. This is provided by bolting the front rail to the inside face of the lower rail extension of the main frame and reducing the lateral thickness of this extended portion to 3 in. where it is joined under the cylinder to the front rail. The section of the extension under the cylinders is 11 in. deep, while that of the front rail has a vertical thickness of 7 in. The upper front rail is bolted and keyed to the top of the main frame over the front pedestal. The section of the main frame here is 13 in. deep with horizontal slots bored for the splice bolt nuts which come directly over the pedestal. The front rail has a section 6 in. wide by 5 1/2 in. in thickness.

The cylinders and valve chambers throughout are bushed with Hunt-Spiller gun iron. In the design of the high pressure cylinders is incorporated the Mellin intercepting valve which completely controls the admission of steam, either exhaust from the high pressure cylinders or steam direct from the boiler, to the low pressure receiver pipe. Piston valves are employed with both the high and low pressure cylinders.

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These valves are 12 in. in diameter and have a maximum travel of 6 in. The valves for the low pressure cylinders are double ported while those for the high pressure cylinders are the same as are used on the 0-6-0 type switchers. The front valve chamber heads on the 2-6-6-2 type locomotive interchange with those in all other standard types and the back heads are interchangeable with those in use on the 0-6-0 type switcher.

The high pressure piston specifications call for either rolled or cast steel of dished section, while for the low pressure pistons the center of which has a diameter of 30/16 in., exclusive of the bull ring, cast steel only is specified. Hunt-Spiller gun iron bull rings and packing rings are used on both high and low pressure pistons. The design of the crossheads is the same in detail as that employed on all previously built standard locomotives, and is interchangeable with that on the 0-6-0 switchers. Paxton-Mitchell packing is fitted both on the valve stems and piston rods. Steam distribution is controlled by the Baker valve gear and the Chambers back head type throttle. The locomotive is fitted with a Lewis power reverse gear.

The driving journals throughout have a diameter of 11 in. and are 6 in. long. The driving boxes are interchangeable on all journals except that the crown brass for the main journals is finished with a clearance of 1/100 in. instead of 1/32 in. The same driving box is also used on the heavy Mountain type locomotive, with the exception of the main journals, and on the main journals of the light Mikado type locomotive. The axles of the 2-6-6-2 locomotive are the same as those having the same journal sizes on the heavy Mountain type. The engine cylinder is of the constant resistance type and the tender truck is of the Cole-Scoville type.

The tender has a water capacity of 12,000 gallons and a coal capacity of 16 tons. It is furnished on a Common-wealth or cast steel frame, and is one of the three standard types which have been designed to meet the requirements of all the standard locomotives. The trucks have cast steel side frames and are of a design which is used on all the standard freight locomotives. The Unit Safety drawbar and Radial buffers are used between the engine and tender.

### Weight Distribution of the Standard 2-6-6-2 Type Locomotive

<table>
<thead>
<tr>
<th><strong>General Data</strong></th>
<th><strong>Wheel base, total</strong></th>
<th>49 ft 9 in.</th>
<th><strong>Wheel base, engine and tender</strong></th>
<th>89 ft 5 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ratio</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight on drivers + tractive effort, simple</strong></td>
<td>3.7</td>
<td><strong>Weight on drivers + tractive effort, compound</strong></td>
<td>2.7</td>
<td><strong>Total weight + equivalent heating surface</strong></td>
</tr>
<tr>
<td><strong>Tractive effort, compound x diam. drivers + equivalent heating surface</strong></td>
<td>1.676</td>
<td><strong>Equivalent heating surface of grate area</strong></td>
<td>400.3</td>
<td></td>
</tr>
<tr>
<td>Firebox heating surface + equivalent heating surface, per cent.</td>
<td>5.6</td>
<td>Weight on drivers + equivalent heating surface</td>
<td>48.5</td>
<td></td>
</tr>
</tbody>
</table>

### Clearance Diagram for the Standard Light Mallet Type Locomotive

#### General Data

- **Cylinders**
  - Kind: Compound
  - Diameter and stroke: 28 in. and 35 in.

- **Valves**
  - Kind: Piston

- **Wheels**
  - Driving diameter over tires: 40 in.
  - Driving journals, main, diameter and length: 11 in. by 13 in.
  - Engine truck wheels, diameter: 81 in.

### Other Dimensions and Data

- **Gage**: 4 ft 8½ in.
- **Service**: Freight
- **Fuel**: Bit. coal
- **Tractive effort; compound**: 90,000 lb
- **Tractive effort; simple**: 56,000 lb
- **Weight in working order**: 348,000 lb
- **Weight on drivers**: 13,500 lb
- **Weight on leading truck**: 22,500 lb
- **Weight on trailing truck**: 57,500 lb
- **Weight of engine and tender in working order**: 654,000 lb
- **Wheel base, driving**: 31 ft
- **Wheel base, rapid**: 10 ft 6 in.

#### Boiler

- **Style**: Straight top
- **Outside diameter of first ring**: 223 lb per sq. in.
- **Diameter and width**: 50 in. by 90 in.
- **Firebox plates, thickness**: Sides, back and crown, 10 in.; tube, 7 in.
- **Firebox water space**: Sides and back, 7 in.; front, 7 in.
- **Tubes, number and outside diameter**: 1,200 in.
- **Tubes and flues, length**: 24 ft
- **Heating surface, tubes**: 1,200 sq. ft.
- **Heating surface, flue**: 1,240 sq. ft.
- **Heating surface, firebox and arch tubes**: 416 sq. ft.
- **Heating surface, total**: 3,242 sq. ft.
- **Superheater heating surface**: 1,292 sq. ft.
- **Grate area**: 76.3 sq. ft.

#### Tender

- **Water bottom**: Cast steel
- **Height**: 306,580 lb
- **Wheels, diameter**: 31 in.
- **Water capacity**: 12,000 gal.
- **Coal capacity**: 16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.*