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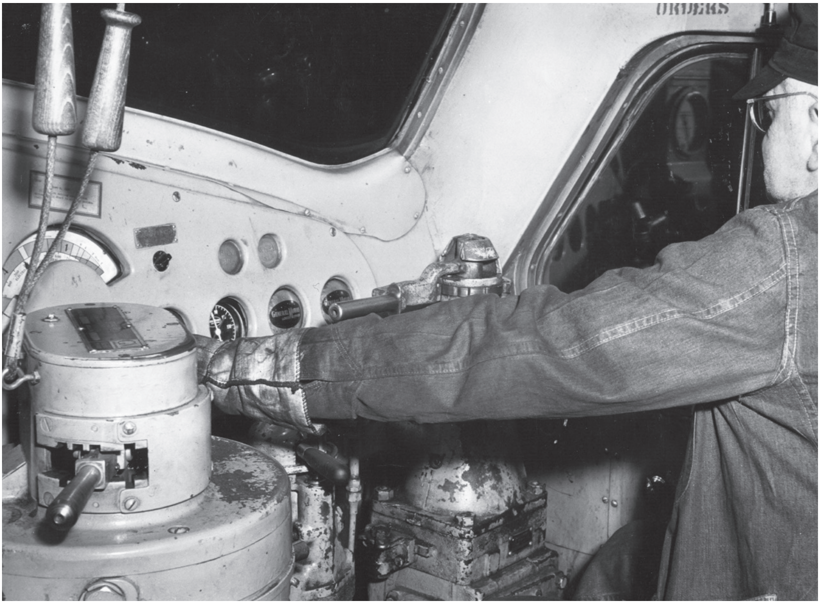


An engineer is at the controls of an EMD E unit in 1950. The locomotives and trains have changed, but the engineer's job is largely the same. William A. Akin

Conductor. The conductor is in charge of the train, directing movements as needed. On passenger trains, the conductor is responsible for passenger ticketing as well. On freight trains the conductor rode in the caboose, which served as his office. With the elimination of the caboose, the conductor became one of two positions in the cab, together with the engineer.

Brakeman (trainman). In the 1800s, a brakeman had a hazardous job, walking the tops of cars to set and release brakes by hand, as well as coupling cars with link-and-pin couplers. By the early 1900s the main duty was to throw turnouts and couple and uncouple cars. Through the 1960s, most freight trains had head- and rear-end brakemen; the position was largely eliminated by the 2000s, with duties added to the conductor position.

Passenger conductors are responsible for the train itself, as well as passenger seating and ticketing (and tracking money from ticket sales). Trains magazine collection

A Pennsylvania freight conductor uses a fusee to give a highball to the head end in 1960. Cabooses are now gone and radio has changed how crews do their jobs. Don Wood

Station agent. The station agent was responsible for working with shippers and local passengers, ordering freight cars for loading, and dealing with passenger ticketing. At small stations, the position was sometimes combined with the operator.

Operator. In the days of timetable and train-order operations, the operator at each station was responsible for passing train orders from the dispatcher to the crews on passing trains. This was typically done by telegraph through the 1940s (later in many locations). At small stations, this position was sometimes combined with the station agent.

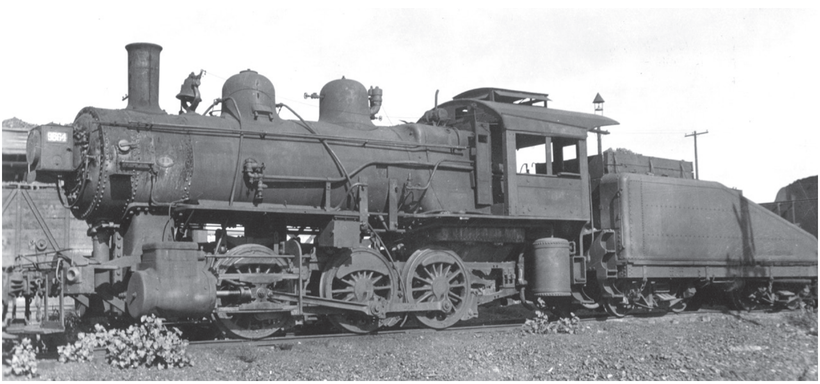
A brakeman is ready at a switch stand in 1943. Jack Delano, Library of Congress

Wheel arrangements (Whyte classifications)

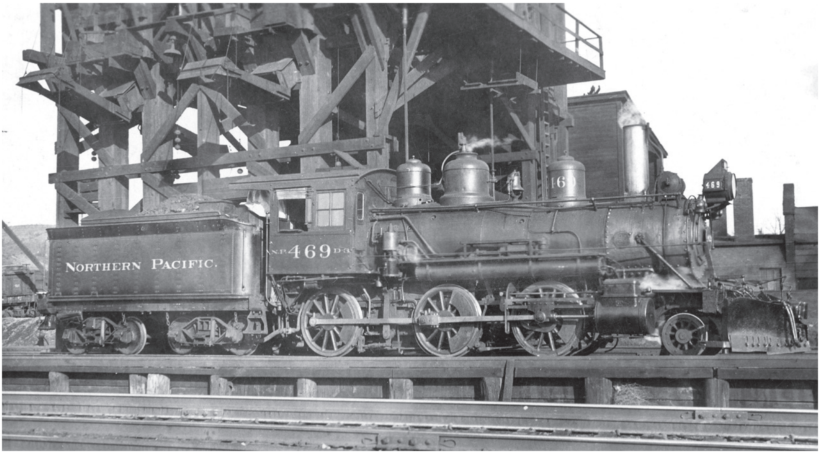
Steam locomotives are classified by their number of leading (pilot) wheels, drivers, and trailing wheels using the Whyte system (named for Frederick M. Whyte, a New York Central mechanical engineer who came up with the system). It's easy to understand: if a locomotive has a two-wheel lead truck, eight driving wheels (four axles), and a two-wheel trailing truck, the locomotive is classified a 2-8-2. Articulated and duplex locomotives have an extra number for the additional set of drivers (a Union Pacific Big Boy, for example, is a 4-8-8-4). Most locomotives could be classified either as switchers (no pilot or trailing wheels), freight, or passenger locomotives, with some locomotive types used in both passenger and freight service. Characteristics of any given type—and their size—varied widely among railroads. Here's a summary of the most common wheel arrangements, their nicknames, and their typical uses, starting with locomotives lacking pilot trucks, then with two- and four-wheel lead trucks:

0-4-0, 0-6-0, 0-8-0: Switching. Switching locomotives had to operate well in either direction while pushing or pulling heavy cuts of cars, often through tight curves and complex trackwork. Switchers operated at slow speeds, negating the need for lead or trailing trucks for stability. This also maximized pulling power, as all of a switching locomotive's weight was on its driving wheels. Slow speeds allowed the use of small-diameter drivers (51" was typical; many later switchers had 57"), which increased tractive effort.

Switchers typically had small tenders, as fuel and water consumption were lower than road locomotives—they were constantly starting and stopping,



Switching locomotives lack pilot and trailing trucks. This is a Pennsylvania 0-6-0 with a slope-back tender. TRAINS magazine collection



This Northern Pacific 2-6-0 Mogul was built in the 1890s. Note the lightweight rods and small tender. Brian Solomon collection

not operating for long periods at high speed—and fuel and water sources were nearby in the yards in which they worked. Tenders for switchers were lower in profile or slope-backed to allow rearward visibility, critical for bidirectional operation. Switching locomotives also typically had smaller boilers and fireboxes compared to road locomotives. Other common switcher details included headlights and footboards on the rear of tenders, footboards instead of a pilot at the locomotive front, and often an additional sandbox, needed for bi-directional operation. Few 0-4-0s were built after 1900; by then railroads were opting for heavier 0-6-0s and then 0-8-0s to handle the increasing car and train sizes of the time.

0-8-8-0: Pusher/helper. The 0-8-8-0, first developed in 1907, could pull more than the couplers and freight car frames of its era could stand. Because the cars could withstand compression better than tension, additional power to get heavy trains up a grade was applied at the rear (usually ahead of the caboose). Later 0-8-8-0s were built as extra-heavy switchers for hump-yard duty. They were almost exclusively used in the East in mountainous territory.

2-4-2: Columbia. Passenger. In 1893 Baldwin Locomotive Works introduced the 2-4-2, the Columbia type. It had high drivers and a wide firebox supported by a rigid trailing axle; it was intended for fast passenger service despite its two-wheel lead truck, but was quickly superceded by the 4-4-2. The wheel arrangement became common for tank locomotives (as the 2-4-2T).

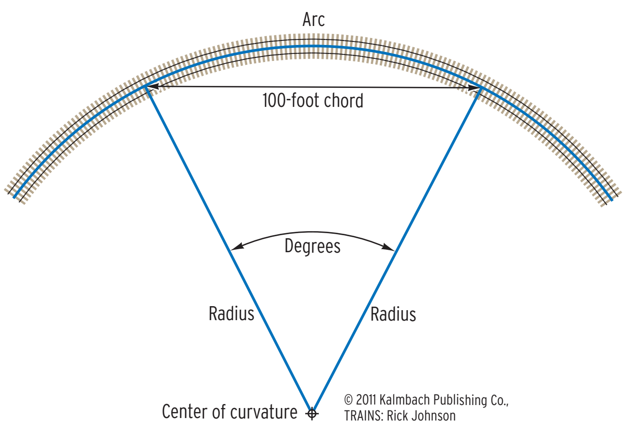
Even in mountainous territory, railroads try to keep grades at 2 percent or under. It's not just long, sustained mountain grades that present problems, however. An otherwise level rail line that follows the undulations of rolling farmland, for example, might have a series of up and down grades each a couple of thousand feet long and no more than a half a percent, but with long trains this will cause slack to continually run in and out as part of the train is going down while another is going up. This can damage couplers and loads, and makes it a challenge to maintain consistent speeds.

Profiles like this are most often found on branch lines and secondary lines, where short trains and slow speeds mitigate their effects. On high-traffic routes, most railroads invested in the cost of smoothing profiles, in some cases re-routing original lines to cut down on grades and/or curves.

A route's "ruling grade" is the limiting grade found on a particular line (usually a subdivision or other operating district), and is used to determine the maximum load that can be pulled (usually listed by specific locomotive type in steam days and in tons per horsepower in the diesel era). The ruling grade is not necessarily the steepest: a shorter, steeper grade may be more easily surmounted than a longer, not-as-steep grade.

Track types

Railroads must specify each line they operate as "main track" or "other than main track," but tracks and routes fall into several general classifica-



Railroads measure the sharpness of curves in degrees, based on the angle formed by a 100-foot chord and the center point of the curve radius. Kalmbach Media

Most mainline curves are superelevated, with the outer rail a few inches higher than the inside rail. Railroads use complex formulae to determine the ideal superelevation. Jeff Wilson

tions. Main lines are the main through routes of a railroad. They are maintained to the highest standards, and are often signaled. Secondary lines are main tracks that might not see as much traffic as a primary line; they may have lower speed limits or more operating restrictions compared to a railroad's primary lines, or be unsignaled. Branch lines are non-through routes that diverge off of a main line. They can be short (a few miles to a neighboring town) or be hundreds of miles long; they can be low traffic or host several trains per day. Along any of these routes you'll find passing sidings, which are double-ended tracks that allow trains to meet or locomotives to go around their train for switching; spurs, which are single-ended sidings commonly used to serve industries; and yard tracks, which are groups of tracks used to sort or store cars (see "yard operations" in Chapter 1).

Track quality and classifications

All track is not maintained to the same standards. Track ranges from smooth, well-profiled main lines to weedy, undulating branch lines and just about anything in between. The differences among types of track are defined by the Federal Railroad Administration (FRA), which publishes classifications for prototype track ranging from Class 1 to Class 9 (plus an additional "excepted" category). Each classification has a maximum allowed speed, along with minimum maintenance standards that must be followed. Each railroad determines the class of its track. Here's a summary of the classifications: