Railway operation

AH2026 Railway Traffic - Market and Planning, BC

What is a Railway ?

What is a Train ?

What differs Railway from other types of transportation

- **Train driving principle:** Locomotives are separated from the carriages (wagons) and that a large number of the carriers can be part of a train, which is made possible by the low friction and the safety system.
- **Train creation principle:** Several wagons are gathered in a train, and the wagons of the various relationships use the same train, causing marshalling of wagons between the various trains.
- **Railway operation principle:** A track constraint which does nor allow meeting or overtaking on the track, and the braking distanse are often longer than the train length, This means that each train must be plannedand regulated in detail.

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What is a train ?

- A train to the public is the vehicles, a locomotive and a couple of wagons (passenger or freight) – or a motor unit (diesel or electrical)
- A train due to railway operation is a ”rail-vehicle” that has a specified timetable with a starting point and time, a final point and time and passage times along the line.

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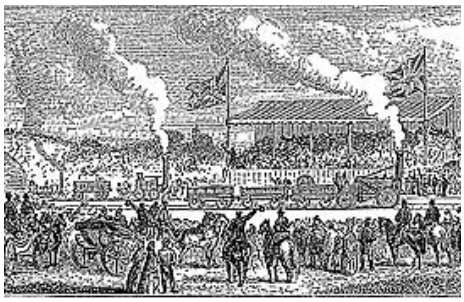
Novelty – Rocket 1829



Railway history may be said to begin after 1829 where George Stephenson and John Eriksson were part of the legendary steam locomotive competition at Rainhill for the new locomotives to the railway Liverpool-Manchester.

That line became one of the first railway lines between two cities.

A Railway Line

- A Railway Line is good for transportation with one train with one locomotive.
- But what if there are two trains ?

A Railway Line with Stations

- With stations on the railway line, the trains have the possibility to meet and pass each other
- A station is at least two tracks with connecting switches?
- The railway line is divided in Line and Stations
- The Station is controlled by a Station inspector – while the Line is ”Dark territory”

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Information to the train driver

To give information to the train driver that the switches on the station are correct positioned or that he has to break and stop outside the station area they originally used semaphores with different signal aspects.

Each station had a stations inspector responible for the station and with communication, telegraph or telephone to the connecting stations. During nighttime the used coloured carosene-lights instead

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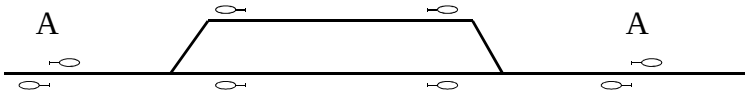
Information to the train driver

Later they introduced railway signals with red, green, white and yellow lights that in combination gave different information and instructions to the train driver – stop, proceed or proceed with restrictions. They are used both day and night.

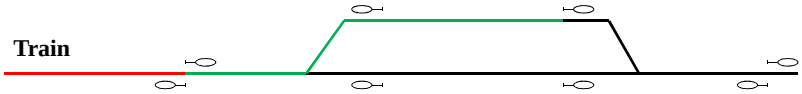
These signals gives information for both the position of the signal, but also information about the conditions of the next signal information. That gives for example a pre-warning to the driver that he should brake to be able to stop before next signal that gives the order to stop.

Signals at a station



- The signals at A is the entrance/exit signals to the station from the Line. The line to next station or signal on the line has to be free to let the train leave the station. The station has to have a free track to let a train enter the station.
- The signals inside the station is the stopping points inside the station for the trains.

Train Routes for access to next block section



Conditions for a train to be allowed entry to the next Train Route

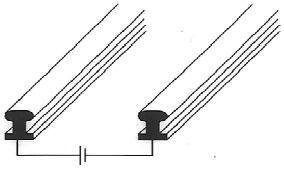
1. The train route is ready and the switches are in the correct position
2. The train route is controlled free from objects
3. The train route is locked and can not be changed
4. The train route is free from the side, flank protection
5. If everything is OK, the train route is open and the entrance signal is green

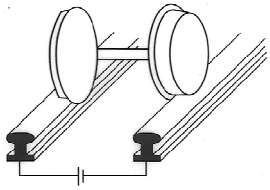
Interlocking to prevent accidents

An interlocking is an equipment that prevents the signals and the switches to be set in combi-nations that two train could enter the same track section and collide.

Here the signals and switches is controlled by wires which are handled with sticks by the station crew. In the bottom of the interlocking is a ruler that prevents combinations that gives dangerous combinations of settings.

Track Circuits





- To be able to detect trains on a track section the Track Circuit system was introduced around 1930.
- By setting an electrical potential between the two tracks, one 0 volts and the other + or – 3 volts and to measure the difference in voltage to 3 volts indicates a free track.
- If one or several wheel-axles short-cuts the two tracks (potential difference is 0 volts). That indicates that there is a train on the track section and the signals around the track section shows red signal.

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Pre signal – Main signal

- The Pre-signal is located in a distance before the main signal and shows the aspect of the coming Main signal
- Tha standard distance in Sweden is 1000 meters (othervise the distanse is marked)

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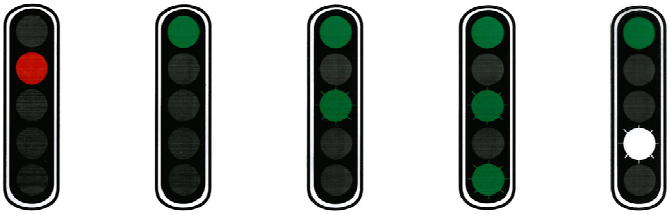
Different signal aspects



- In Sweden the two top ligths indicate the conditions at the signal position. Stop (Red) or proceed at the allowed speed (Green).
- The lower three ligths gives information about the condition at the next signal. If the top ligth is green and ...
  * the third is flashing green – the next signal shows stop.
  * the third is flashing green and the fifth is green – the next signal shows proceed at 40 km/h.
  * the fourth is flashing white – the next signal shows proceed at the allowed speed.

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Signal aspects and signal shaddow

- The first train (right) has ”drive, expect drive” in front of him and stop in the signal he just passed.
- Due to the braking distance (of the second train) the first train has a ”signal shaddow” of two block sections behind the train.
- The second train has clearance to pass the next signal in full speed and could also pass the second signal, but with restrictions. The third signal in front of him shows stop.

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Shunting signals

- Shunting signals are used inside stations for small movements in shunting
- To connect and / or deconnect train sets

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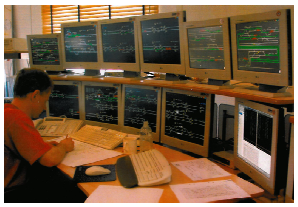
Traffic Control Centers



- Instead of station inspectors on every station, today we have Traffic Control Centers that control large areas of the railway.
- In Sweden we have eight large TCC and a few locally control centers

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Radio Block

- Radio Block: The driver receives the information and ”green signal” by radio-communication.
- No visual signals are used, only signs of block borders

Different types of traffic control

System	Operational expenditure	Investment	Capacity	Flexibility
Manual traffic control	High	Low	Low	Possible with improvisations
Remote traffic control	Relatively low	High	High	Difficult to change system
Radio-control	Low	Relatively low	Could be high	Easy to change