Third rail

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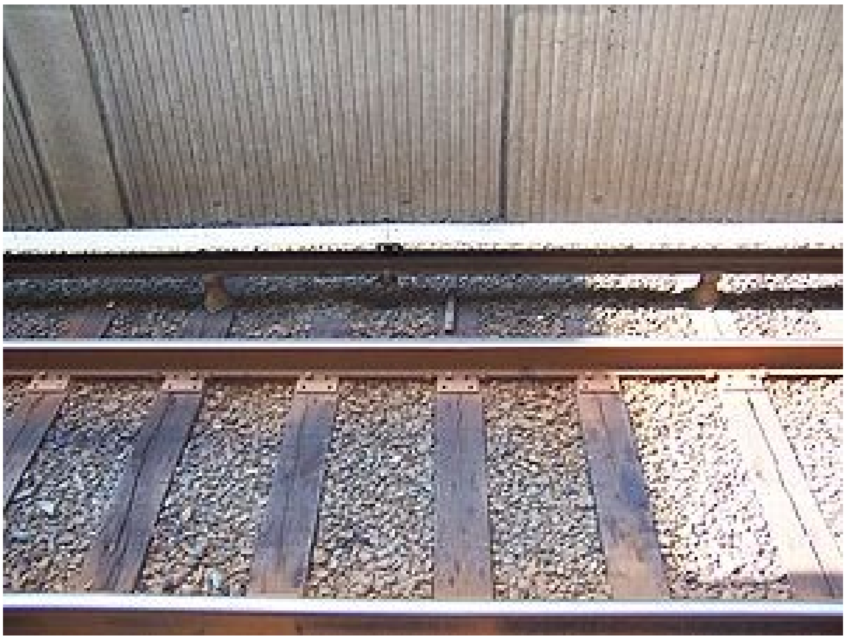
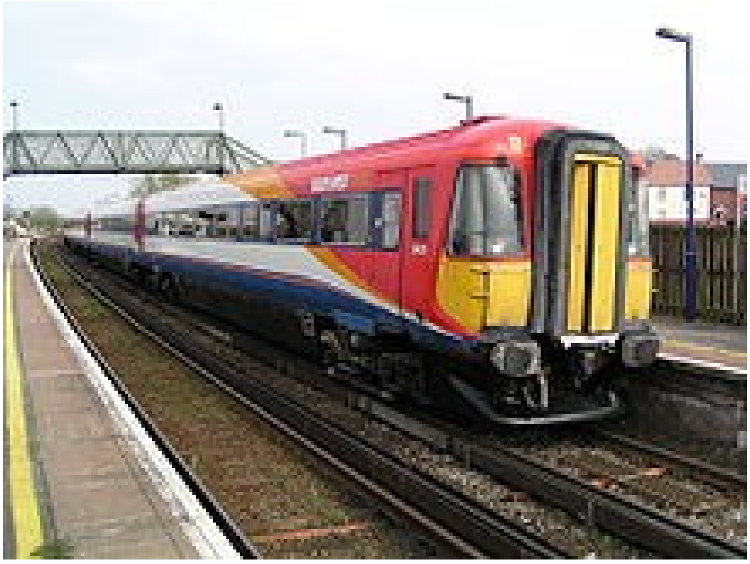
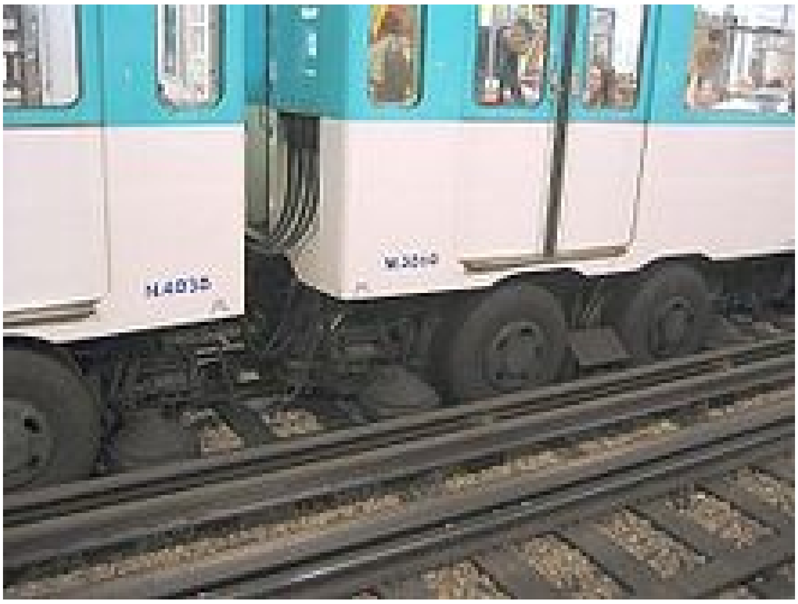
For other uses, see Third rail (disambiguation).



Third rail at the West Falls Church Metro stop near Washington, D.C., electrified at 750 volts. The third rail is at the top of the image, with a white canopy above it. The two lower rails are the ordinary running rails; current from the third rail returns to the power station through these.

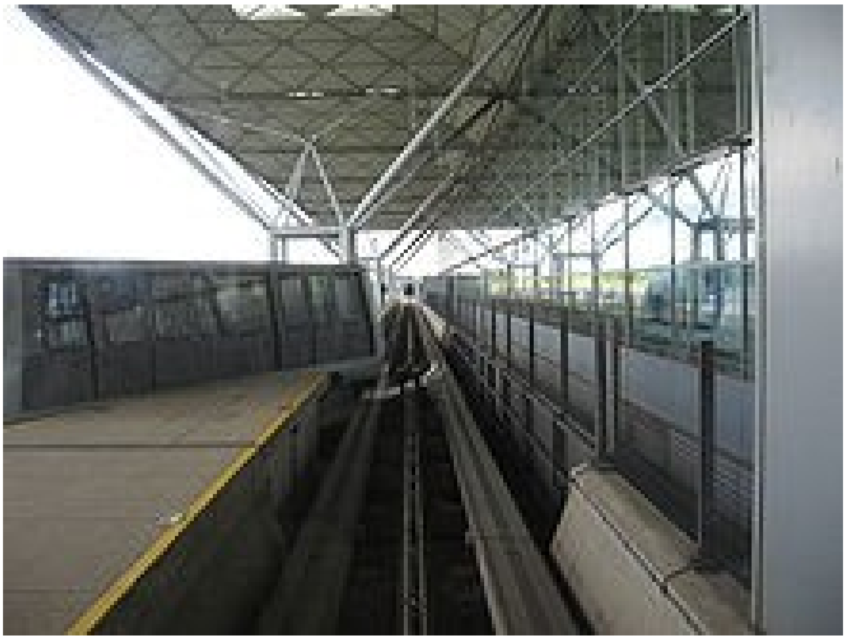


A British Class 442 third-rail electric multiple unit in Dorset. This is the fastest class of third-rail EMU in the world, reaching 108 mph 172 km/h.



Paris Metro. The guiding rails of the rubber-tyred lines are also current conductors. The current collector is between the pair of rubber wheels.

London Stansted Airport people mover central rail



London Stansted Airport people mover, showing rail switch

A **third rail** is a method of providing electric power to a railway train, through a continuous rigid conductor placed alongside or between the rails of a railway track. It is used typically in a mass transit or rapid transit system, which has alignments in its own corridors, fully or almost fully segregated from the outside environment. In most cases, third rail systems supply direct current electricity.

The third-rail system of electrification is unrelated to the third rail used in dual-gauge railways.

Contents

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Description

Third rail systems are a means of providing electric traction power to railway trains, and they use an additional rail (called a "conductor rail") for the purpose. On most systems, the conductor rail is placed on the sleeper ends outside the running rails, but in some cases a central conductor rail is used. The conductor rail is supported on ceramic insulators or insulated brackets, typically at intervals of 10 feet (3 metres) or so.

The trains have metal contact blocks called "shoes" which make contact with the conductor rail. The traction current is returned to the generating station through the running rails. The conductor rail is usually made of high conductivity steel, and the running rails have to be electrically connected using wire bonds or other devices, to minimize resistance in the electric circuit.

The conductor rails have to be interrupted at level crossings and at crossovers, and ramps are provided at the ends of the sections to give a smooth transition to the train shoes.

There is considerable diversity about the contact position between the train and the rail; some of the earliest systems used top contact, but developments used side or bottom contact, which enabled the conductor rail to be covered, protecting track workers from accidental contact and protecting the conductor rail from snow and leaf fall.

Benefits and disadvantages of third-rail systems

A contact shoe for top-contact third rail on SEPTA's Norristown High Speed Line

Electric traction systems (where electric power is generated at a remote power station and transmitted to the trains) are considerably more cost-effective than diesel or steam units, where the power unit is carried on the train. This advantage is especially marked in urban and rapid transit systems with a high traffic density.

So far as first cost is concerned, third-rail systems are relatively cheap to install, compared to overhead wire contact systems, as no structures for carrying the overhead contact wires are required, and there is no need to reconstruct overbridges to provide clearances. There is much less visual intrusion on the environment.

However as third rail systems present the hazard of electric shock, higher system voltages (above 1500 v) are not considered safe. Very high currents are therefore used, resulting in considerable power loss in the system, and requiring relatively closely spaced feed points (sub-stations).

The presence of an electrified rail also makes it extremely dangerous for a person to fall into the tracks. This, however, can be avoided using platform screen doors or the risk minimized by ensuring that the conductor rail is on the side of the track away from the platform.

Furthermore, third rail systems must either be fully grade-separated, or, if they operate at-grade, they must implement some kind of mechanism to effectively stop pedestrians from walking onto the tracks at grade crossings. A famous 1992 Supreme Court of Illinois decision affirmed a $1.5 million verdict against the Chicago Transit Authority for failing to stop an intoxicated person from walking onto the tracks at a grade crossing and attempting to urinate on the third rail.[1]

The end ramps of conductor rails (where they are interrupted, or change sides) present a practical limitation on speed due to the mechanical impact of the shoe, and 160 km/h (100 mph) is considered the upper limit of practical third-rail operation, however no testing over 100 mph has been attempted. The world speed record for a third rail train is 174 km/h (108 mph) attained on 11 April 1988 by a British Class 442 EMU.

Third rail systems using top contact are prone to accumulations of snow, and ice formed from refrozen snow, and this can interrupt operations. Some systems operate dedicated de-icing trains to deposit an oily fluid on the conductor rail to prevent the build-up.

Because of the gaps in the conductor rail (at level crossings and crossovers) it is possible for a train to stop in a position where all of its shoes are in gaps, so that no traction power is available. The train is said to be "gapped". In these circumstances a following train is brought up behind the stranded train to push it on to the conductor rail or a jumper cable is used to supply enough power to the train to get one of its contact shoes back on the third rail. On some systems this prevents the running of very short trains (which have fewer shoes).

History

Third-rail electrification systems are, apart from on-board batteries, the oldest means of supplying electric power to trains on railways using their own corridors, particularly in cities. Overhead power supply was initially almost exclusively used on tramway-like railways, though it also appeared slowly on mainline systems.

An experimental electric train using this method of power supply was developed by the German firm of Siemens & Halske and shown at the Berlin Industrial Exposition of 1879, with its third rail between the running rails. Some early electric railways used the running rails as the current conductor, as with the 1883-opened Volk's Electric Railway in Brighton. It was given an additional power rail in 1886, and is still operating. The Giant's Causeway Tramway followed, equipped with an elevated outside third rail in 1883, later converted to overhead wire. The first railway to use the central third rail was the Bessbrook and Newry Tramway in Ireland, opened in 1885 but now, like the Giant's Causeway line, closed. Also in the 1880s third-rail systems began to be used in public urban transport. Trams were first to benefit from it: they used conductors in conduit below the road surface (see Conduit current collection), usually on selected parts of the networks. This was first tried in Cleveland (1884) and in Denver (1885) and later spread to many big tram networks (e.g. Manhattan, Chicago, Washington DC, London, Paris, all closed) and Berlin (the third rail system in the city was abandoned in the first years of the 20th century after heavy snowfall.) The system was tried in the beachside resort of Blackpool, UK but was soon abandoned as sand and saltwater was found to enter the conduit and cause breakdowns, and there was a problem with voltage drop. Some sections of tramway track still have the slot rails visible.

A third rail supplied power to the world's first electric underground railway, the City & South London Railway, which opened in 1890 (now part of the Northern Line of the London Underground). In 1893, the world's second third-rail powered city railway opened in Britain, the Liverpool Overhead Railway (closed 1956 and dismantled). The first US third-rail powered city railway in revenue use was the 1895 Metropolitan West Side Elevated, which soon became part of the Chicago 'L'. In 1901, Granville Woods, a prominent African-American inventor, was granted a U.S. Patent 687,098, covering various proposed improvements to third rail systems. This has been cited to claim that he invented the third rail system of current distribution. However, by that time there had been numerous other patents for electrified third-rail systems, including Thomas Edison's U.S. Patent 263,132 of 1882, and third rails had been in successful use for over a decade, in installations including the rest of Chicago 'elevateds', as well as these in Brooklyn, New York (if not to mention the development outside the US). To what extent Woods' ideas were adopted is thus a matter of controversy.[2]

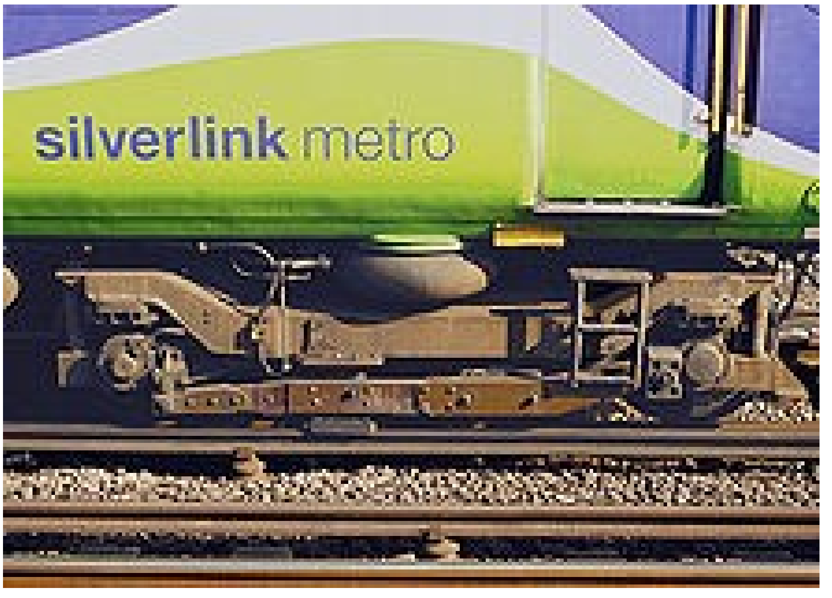
In Paris, third rail appeared in 1900 in the main-line tunnel connecting the Gare d'Orsay to the rest of the CF Paris-Orléans network. Main-line third rail electrification was later expanded to some suburban services.

Top contact third rail (see below) seems to be the oldest form of power collection. Railways pioneering in using other less hazardous types of third rail were the New York Central Railroad on the approach to its NYC's Grand Central Terminal (1907 — another case of a third-rail mainline electrification), Philadelphia's Market Street Subway-Elevated (1907), and the Hochbahn in Hamburg (1912) — all had bottom contact rail. However, the Manchester-Bury Line of the Lancashire & Yorkshire Railway tried side contact rail in 1917. These technologies appeared in wider use only at the turn of the 1920s and in the 1930s on, e.g., large-profile lines of the Berlin U-Bahn, the Berlin S-Bahn and the Moscow Metro. The Hamburg S-Bahn has used a side contact third rail at 1200 V DC since 1939.

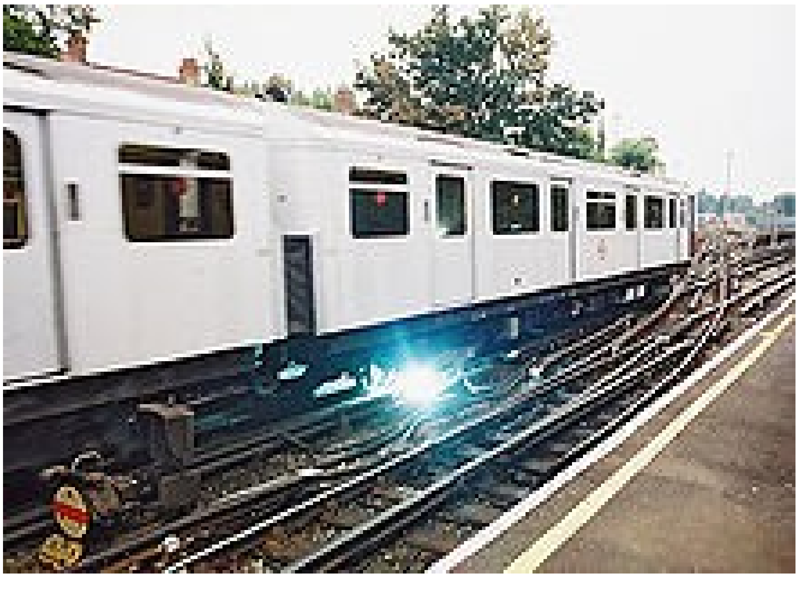
In 1956 the world's first rubber-tyred railway line, Line 11 of Paris Metro, opened. The conductor rail evolved into a pair of guiding rails required to keep the bogie in proper position on the new type of track. This solution was modified on the 1971 Namboku Line of Sapporo Subway, where a centrally placed guiding/return rail was used plus one power rail placed laterally as on conventional railways (see photo).

The third rail technology at street tram lines has recently been revived in the new system of Bordeaux (2004). This is a completely new technology (see below).

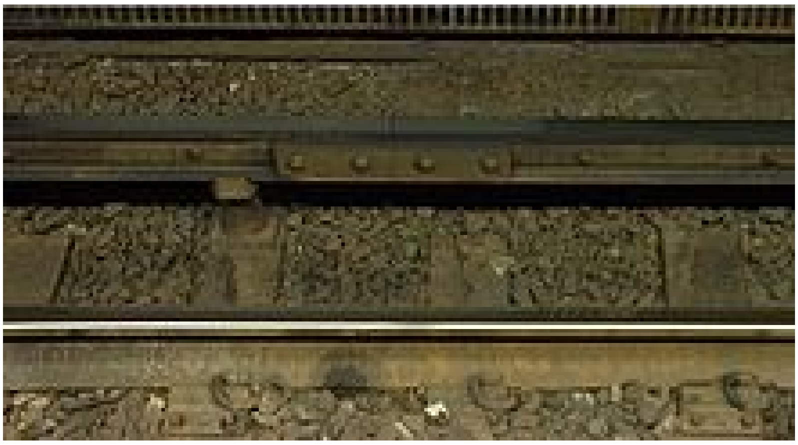
Third rail is not obsolete. There are, however, countries (particularly Japan, South Korea, India, Spain) more eager to adopt overhead wiring to their urban railways. But at the same time, there were (and still are) many new third rail systems built elsewhere, including technologically advanced countries (e.g. Copenhagen Metro, Taipei Metro, Wuhan Metro). Bottom powered railways (it may be too specific to use the term 'third rail') are also usually those having rubber-tyred trains, whether it is a heavy metro (except two other lines of Sapporo Subway) or a small capacity people mover (PM). Practically the type of railways where third rail is no longer used in new systems is regional and long distance rail, which require higher speeds and voltages.



With surface contact third and fourth rail systems a heavy "shoe" suspended from a wooden beam attached to the bogies collects power by sliding over the top surface of the electric rail. This view shows a British Rail Class 313 train.



The London Underground uses a four-rail system where both conductor rails are live relative to the running rails, and the positive rail has twice the voltage of the negative rail. Sparks like this are normal and occur when the electric power collection shoes of a train that is drawing power reach the end of a section of conductor rail.



Conductor rail on the MBTA Red Line at South Station in Boston, consisting of two strips of aluminium on a steel rail to assist with heat and electrical conduction

Running rails for power supply

The first idea for feeding electricity to a train from an external source was by using both rails on which a train runs, whereby each rail is a conductor for each pole insulated by the sleepers. This method is used by most model trains, however it does not work so well for large trains as the sleepers are not good insulators, furthermore the use of insulated wheels or insulated axles is required. As most insulation materials have worse static properties compared with metals used for this purpose, this results in a less stable train vehicle. Nevertheless, it was sometimes used at the beginning of the development of electric trains. The following systems used it:

- Gross-Lichterfelde Tramway
- Ungerer Tramway

Some trains used for rides for children at beer festivals also use this method for power supply.[citation needed]

Technical aspects

The third rail is usually located outside the two running rails, but occasionally between them. The electricity is transmitted to the train by means of a sliding shoe, which is held in contact with the rail. On many systems an insulating cover is provided above the third rail to protect employees working near the track; sometimes the shoe is designed to contact the side (called side running) or bottom (called bottom running) of the third rail, allowing the protective cover to be mounted directly to its top surface. When the shoe slides on top, it is referred to as top running. When the shoe slides on the bottom it is not affected by the build-up of snow or leaves.

As with overhead wires, the return current usually flows through one or both running rails, and leakage to ground is not considered serious. Where trains run on rubber tyres, as on parts of the Paris Métro, Mexico City metro and Santiago Metro, and on all of the Montreal Metro, live guide bars must be provided to feed the current. The return is effected through the rails of the conventional track between these guide bars (*see rubber-tyred metro*). Another design, with a third rail (current feed, outside the running rails) and fourth rail (current return, half way between the running rails), is used by a few steel-wheel systems, see fourth rail. The London Underground is the largest of these, see railway electrification in Great Britain.

On line M1 of the Milan Metro the third rail is used as the return electrical line (with potential near the ground) and the live electrical connection is made with a sliding block on the side of the car contacting an electrical bar parallel to the track approximately 1 m (3') above rail level. In this manner there are four rails. In the northern part of the line the more common overhead line system is used.

The third rail is an alternative to overhead lines that transmit power to trains by means of pantographs attached to the trains. Whereas overhead-wire systems can operate at 25 kV or more, using alternating current (AC), the smaller clearance around a live rail imposes a maximum of about 1200 V (Hamburg S-Bahn), and direct current (DC) is used. Trains on some lines or networks use both power supply modes (cf. below, "Compromise systems").

One method for reducing current losses (and thus increase the spacing of feeder/sub stations, a major cost in third rail electrification) is to use a composite conductor rail of a hybrid aluminium/steel design. The aluminium is a better conductor of electricity, and a running face of stainless steel gives better wear.

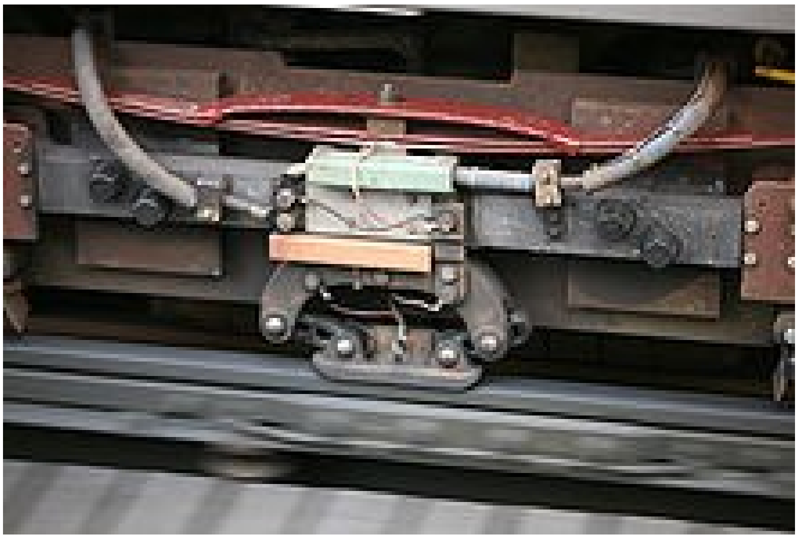
There are several ways of attaching the stainless steel to the aluminium. The oldest is a co-extruded method, where the stainless steel is extruded with the aluminium. This method has suffered, in isolated cases, from de-lamination (where the stainless steel separates from the aluminium); this is said to have been eliminated in the latest co-extruded rails. A second method is an aluminium core, upon which two stainless steel sections are fitted as a cap and linear welded along the centre line of the rail. Because aluminium has a higher coefficient of thermal expansion than steel, the aluminium and steel must be positively locked to provide a good current collection interface. A third method rivets aluminum bus strips to the web of the steel rail. The photo below-right depicts such a rail.

Compromise systems

Several systems use third rail for part of the system, and other systems such as overhead catenary or diesel power for the remainder. These may exist because of the connection of separately-owned railways using the different systems, local ordinances, or other historical reasons.

On the southern region of British Rail, freight yards were wire with overhead wiring to avoid the hazards of third rail. The locomotives were fitted with a pantograph as well as pick up shoes.

USA



Chicago Transit Authority third rail contact shoe of Chicago 'L' car.

In New York City, electric trains that must use the third rail leaving Grand Central Terminal on the former New York Central Railroad (now Metro-North Railroad) switch to overhead lines at Pelham when they need to operate out onto the former New York, New Haven and Hartford Railroad (now Metro North's New Haven Line) line to Connecticut. The switch is made "on the fly" controlled from the engineer's position.

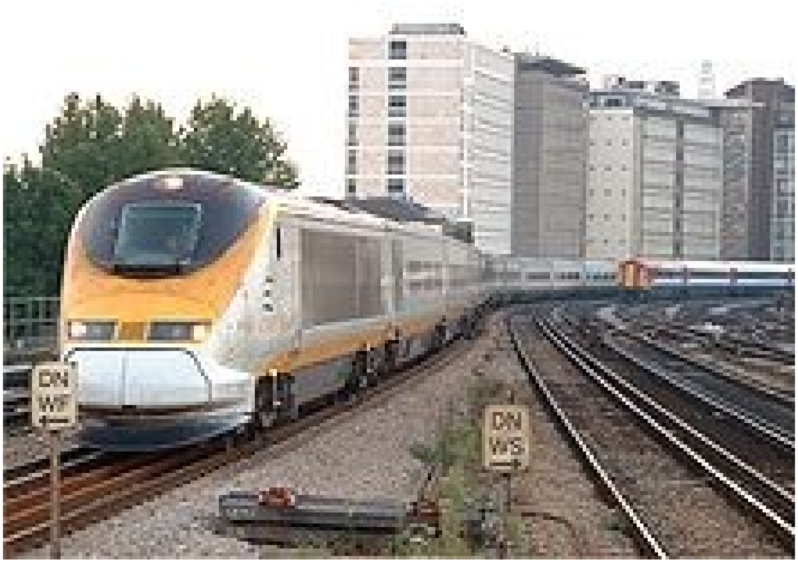
Also in New York City where diesel exhaust would pose a health hazard in underground station areas, Metro-North, Long Island Rail Road and Amtrak use diesel locomotives that can also be electrically powered by third-rail. This kind of locomotive (for example the P32AC-DM or the EMD/Siemens built DM30AC of LIRR), can transition between the two modes while underway. The third-rail auxiliary system is not as powerful as the diesel engine, so on open-air (non-tunnel) trackage the engines typically run in diesel mode, even where third rail power is available.

In Manhattan, New York City, and in Washington, D.C., local ordinances required electrified street railways to draw current from a third rail and return the current to a fourth rail, both installed in a continuous vault underneath the street and accessed by means of a collector that passed through a slot between the running rails. When streetcars on such systems entered territory where overhead lines were allowed, they stopped over a pit where a man detached the collector (*plow*) and the motorman placed a trolley pole on the overhead. Some sections of the former London tram system also used the conduit current collection system, also with some tramcars that could collect power from both overhead and under-road sources.

The Blue Line of Boston's MBTA uses third rail electrification from the start of the line downtown to Airport, where it switches to overhead catenary for the remainder of the line to Wonderland. The Orange Line's Hawker Siddeley 01200 series rapid transit cars (essentially a longer version of the Blue Line's 0600's) recently had their pantograph mounting points removed during a maintenance program; these mounts would have been used for pantographs which would have been installed had the Orange Line been extended.

Dual power supply method was also used on some US interurban railways that made use of newer third rail in suburban areas, and existing overhead streetcar (trolley) infrastructure to reach downtown, for example the Skokie Swift in Chicago.

United Kingdom



Eurostar on third rail near London

See also: Railway electrification in Great Britain

Several types of British trains have been able to operate on both overhead and third rail systems, including class British Rail Class 313, 319, 325, 365, 375/6, 377/2, 377/5, 378, 373 and 395 EMUs, plus Class 92 locomotives.

Eurostar / High Speed 1

The Class 373 used for international services operated by Eurostar via the Channel Tunnel uses overhead collection at 25 kV AC for most of its journey, with sections of 3 kV DC or 1.5 kV DC on the Continent. As originally delivered, the Class 373 units were additionally fitted with 750 V DC collection shoes, designed for the journey in London via the suburban commuter lines. A switch between third-rail and overhead collection was performed whilst running at speed, initially at Continental Junction near Folkestone, and later on at Fawkham Junction after the opening of the first section of the Channel Tunnel Rail Link. Between Kensington Olympia railway station and North Pole depot further switchovers were necessary.

The dual system caused some problems when drivers forgot to switch between modes. Failure to retract the shoes when entering France caused severe damage to trackside equipment, leading to SNCF installing a concrete block at the Calais end of the Channel Tunnel to break off the 3rd rail shoe if it had not been retracted. On the other hand, an accident occurred in the UK when a Eurostar driver failed to retract the pantograph before entering the 3rd rail system, damaging a signal gantry and the pantograph.

On 14 November 2007, Eurostar's passenger operations were transferred to St Pancras railway station and maintenance operations to Temple Mills depot deprecating the requirement for the 750DC third rail collection equipment and leading to its removal from the fleet.

In 2009, Southeastern began operating domestic services over High Speed 1 from St Pancras using its new Class 395 EMUs. These services operate on the high speed line as far as Ashford International, before transferring to the classic lines to serve north and mid Kent. As a consequence, these trains are dual voltage enabled, as the majority of the routes over which they will operate are third rail electrified.

North London Line

In London, the North London Line changes its power supply several times between Richmond and Stratford stations.{{Citation needed|date=July 2007} }The route was originally third rail throughout but a number of technical electrical earthing problems, plus part of the route also being covered already by overhead electric wires provided for electrical-hauled freight and Regional Eurostar services led to the change.[clarification needed]

Thameslink

Main article: Thameslink

The cross-city Thameslink service runs on the Southern Region third rail network from Farringdon station southwards and on overhead line northwards from Farringdon to Bedford. The changeover is made whilst stationary at Farringdon.

Northern City

Main article: Northern City Line

On the Moorgate to Hertford and Welwyn suburban service routes, the East Coast Main Line sections are 25 kV AC, with a changeover to third-rail made at Drayton Park railway station. Third-rail is still used in the tunnel-section of the route, because the size of the tunnels leading to Moorgate station were too small to allow overhead electrification.

Continental Europe

The older lines in the west of the Oslo T-bane system were built with overhead lines (some since converted to third rail) while the eastern lines were built with third rail. Trains operating on the older lines can operate both with third rail and overhead lines. To mitigate investment costs, the Rotterdam Metro, basically a third-rail powered system, has been given some outlying branches built on surface as light rail (called 'Sneltram' in Dutch), with numerous level crossings protected with barriers and traffic lights. These branches have overhead wires. Similarly, in Amsterdam one 'Sneltram' route goes on Metro tracks and passes to surface alignment in the suburbs, which it shares with standard trams. In most recent developments, the RandstadRail project also requires Rotterdam Metro trains to run under wires on their way along the former mainline railway to The Hague.

The new tramway in Bordeaux (France) uses a novel system with a third rail in the center of the track. The third rail is separated into 8 m (26 ' 3 ") long conducting and 3 m (9 ' 10 ") long isolation segments. Each conducting segment is attached to an electronic circuit which will make the segment live once it lies fully beneath the tram (activated by a coded signal sent by the train) and switch it off before it becomes exposed again. This system (called "Alimentation par Sol" (APS), meaning "current supply via ground") is used in various locations around the city but especially in the historic centre: elsewhere the trams use the conventional overhead lines, see also ground-level power supply. In summer 2006 it was announced that two new French tram systems would be using APS over part of their networks. These will be Angers and Reims, with both systems expected to open around 2009–2010.

The French Fréjus line to Modane was electrified with 1,500 V DC third rail, later converted to overhead wires at the same voltage. Stations had overhead wires from the beginning.

Conversions

Despite various technical possibilities of operating stock with dual power collecting modes, the desire to achieve full compatibility of entire networks seems to have been the decisive cause of conversions from third rail to overhead supply (or vice versa).

Suburban corridors in Paris from Gare Saint-Lazare, Gare des Invalides (both CF Ouest) and Gare d'Orsay (CF PO), were electrified from 1924, 1901, 1900 respectively. They all changed to overhead wires by stages after they became part of a wide scale electrification project of the SNCF network in the 1960s–70s.

In Manchester area, the L&YR Bury line was first electrified with overhead wires (1913), then changed to third rail (1917, cf. Railway electrification in Great Britain) and again in 1992 to overhead wires in the course of its adaptation for the Manchester Metrolink. Trams in city centre streets, carrying collector shoes projecting from their bogies, were considered too dangerous for pedestrians and motor traffic to attempt dual-mode technology (in Amsterdam and Rotterdam *Sneltram* vehicles go out to surface in suburbs, not in busy central areas). The same thing happened to the West Croydon — Wimbledon Line in Greater London (originally electrified by the Southern Railway) when Tramlink was opened in 2000.

Three lines of five making up the core of Barcelona Metro network changed to overhead power supply from third rail. This operation was also done by stages and completed in 2003.

The opposite took place in south London. The South London Line of the LBSCR network between Victoria and London Bridge was electrified with catenary in 1909. The system was later extended to Crystal Palace, Coulsdon North and Sutton. In the course of main-line third rail electrification in south-east England, the lines were converted by 1929.

The first overhead electric trains appeared on the *Hamburg-Altonaer Stadt- und Vorortbahn* in 1907. Thirty years later, the main-line railway operator, Deutsche Reichsbahn, influenced by the success of the third-rail Berlin S-Bahn, decided to switch what was now called Hamburg S-Bahn to third rail. The process began in 1940 and was not finished until 1955.

In 1976–1981, the third-rail Vienna U-Bahn U4 Line substituted the Donaukanallinie and Wientallinie of the *Stadtbahn*, built c1900 and first electrified with overhead wires in 1924. This was part of a big project of consolidated U-Bahn network construction. The other electric *Stadtbahn* line, whose conversion into heavy rail stock was rejected, still operates under wires with light rail cars (as U6), though it has been thoroughly modernised and significantly extended. As the platforms on the Gürtellinie were not suitable for raising without much intervention into historic Otto Wagner's station architecture, the line would anyway remain incompatible with the rest of the U-Bahn network. Therefore an attempt of conversion to third rail would have been pointless. In Vienna, paradoxically, the wires were retained for aesthetic (and economic) reasons.

The western portion of the Skokie Swift of the Chicago 'L' changed from catenary wire to third rail in 2004, making it fully compatible with the rest of the system.

The reasons for building the overhead powered Tyne & Wear Metro network roughly on lines of the long-gone third-rail Tyneside Electrics system in Newcastle area are likely to have roots in economy and psychology rather than in the pursuit of compatibility. At the time of the Metro opening (1980), the third rail system had already been removed from the existing lines, there were no third-rail light rail vehicles on the market and the latter technology was confined to much more costly heavy rail stock. Also the far-going change of image was desired: the memories of the last stage of operation of the Tyneside Electrics were far from being favourable. This was the construction of the system from scratch after 11 years of ineffective diesel service.

Highest voltages

- Hamburg S-Bahn: 1,200 V, since 1940
- Manchester - Bury, England: 1,200V (side Contact)
- Chambéry - Modane, France: 1,500 V, 1925–1976
- Guangzhou Metro, Line 4&Line 5: 1,500 V

In Germany during the Third Reich, a railway system with three-metre gauge width was planned. For this railway system electrification with a voltage of 100 kV taken from a third rail was considered, in order to avoid destruction of overhead wires by anti-aircraft guns. However such a power system would not have worked as it is not possible to insulate a third rail for such high voltages in the proximity of the rails and the whole project did not progress any further because of World War II.

Simultaneous use with overhead wire

A railway can be electrified with an overhead wire and a third rail at the same time. This was the case, for example, on the Hamburg S-Bahn between 1940 and 1955. A modern example is Birkenwerder Railway Station near Berlin, which has third rail on both sides and overhead wire. The whole Penn Station complex in New York City is also electrified with both systems. However, such systems have problems with the influence of the different supplies. If one supply is DC and the other AC, an undesired premagnetization of the AC transformers can occur. For this reason, double electrification is usually avoided.

The border station of Modane on the French-Italian Fréjus railway was electrified at both 1,500 V DC third rail for French trains and with overhead wires (initially three-phase, later 3,000 V DC) for Italian trains. When the French part of the line was converted to overhead wires, the voltage of the wires was dropped to 1,500 V DC. Now Italian trains run in Modane feed with 1,500 V DC instead of 3000, with half of their power.

Technical advances

The introduction of supercapacitors has the potential to lower the cost for trains running on third rail and overhead wires. Kinetic energy generated while braking is stored in supercapacitors on board the vehicle. This energy is then used when accelerating. This allows the supercapacitors to reduce current draw through the electrical pickup during acceleration, putting less stress on the electrical grid. Claimed peak energy reduction is around 30%.[citation needed]

The technology can be used equally well for diesel electric locomotives, where 25% to 40% reduction in energy consumption is claimed.[who?]

Since 2003, Mannheim Stadtbahn in Mannheim, Germany has operated a light-rail vehicle using electric double-layer supercapacitors to store braking energy.[3][4]

A number of companies are developing electric double-layer supercapacitor technology. Siemens AG is developing mobile energy storage based on double-layer supercapacitors called Sibac Energy Storage [5] Sitras SES, are developing stationary trackside version.[6] The company Cegelec is also developing an electric double-layer capacitor-based energy storage system[citation needed].

In model trains

In 1906, the Lionel electric trains became the first model trains to use a third rail to power the locomotive. Lionel track uses a third rail in the center, while the two outer rails are electrically connected together. This solved the problem two-rail model trains have when the track is arranged to loop back on itself, as ordinarily this causes a short-circuit. (Even if the loop was gapped, the locomotive would create a short and stop as it crossed the gaps.) Lionel electric trains also operate on alternating current. The use of alternating current means that a Lionel locomotive cannot be reversed by changing polarity; instead, the locomotive sequences among several states (forward, neutral, backward, for example) each time it is started. Märklin three-rail trains use a short spike of DC voltage to reverse a relay within the locomotive while it is stopped. Märklin's track does not have an actual third rail; instead, a series of short pins provide the current, taken up by a long "shoe" under the engine. This shoe is long enough to always be in contact with several pins. This is known as the stud contact system and has certain advantages when used on outdoor model railway systems. The ski collector rubs over the studs and thus inherently self cleans. When both track rails are used for the return in parallel there is much less chance of current interruption due to dirt on the line.

Modern model train sets today use only two rails. Many supply locomotives with direct current (DC) where the voltage and polarity of the current controls the speed and direction of the DC motor in the train. A growing exception is Digital Command Control (DCC), where bi-polar DC is delivered to the rails at a constant voltage, along with digital signals that are decoded within the locomotive. The bi-polar DC carries digital information to indicate the instruction and the locomotive that is being commanded when multiple locomotives are present on the same track.

Some model railroads realistically mimic the third rail configurations of their full-sized counterparts; such models may or may not actually draw power from the third rail (most do not).

The Third Rail in Politics

The "Third Rail" of politics[7][8] refer's to extremely controversial issues[9] in which it is observed that when acting unilaterally, "touch it, and you die."[10] The concept was that touching anything that powerful required the neutral application of members of competing and opposed political parties.[11]

The expression was coined[12] in 1982 by Kirk O'Donnell an aide to former House Speaker Tip O'Neill in reference to a budget issue involving the US Social Security program, an issue that at the time was itself settled by bi-partisan compromise. In Canadian usage[13] the "Third Rail" of politics may traditionally refer to health care.

See also

- Conduit current collection
- Fourth rail
- Ground level power supply
- List of rail transport systems using third rail
- List of suburban and commuter rail systems
- Railway electrification in Great Britain
- Rubber-tyred metro
- Stud contact system
- Third rail (model railroading)
- Third-rail power for trams

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External links

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- Thomas Edison's third rail patent (1882)
- Lightrail without wires - Paper on Bordeaux' new Tram with street level third rail (by the Transportation Research Board of the National Academies)
- Details of the UK 3rd/4th rail design.
- The "third rail" A short history.
- Morrison-Knudsen 1992

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