# 铁道机车运用与维护专业英语

# Professional English for Railway Locomotive Operation and Maintenance

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# 前言//PREFACE

铁道机车运用与维护专业英语是本专业及其铁路相关专业的一门重要的必修课。随着铁路技术的大发展，社会经济的全球化、信息化，一带一路发展战略的提出，新车型、新技术、新工艺的不断涌现以及铁路行业的对外交流扩大化，作为铁路专业的学生，掌握专业相关英语词汇、具有一定的英文专业资料阅读能力对于从事相关工作、促进国际合作与交流，了解并学习国内外本专业的最新发展动态和技术知识是十分必要的。为满足铁道机车及相关专业专业英语的教学需求，我们编写了《铁道机车运用与维护专业英语》一书。

本教材内容主要包括铁路基本知识、机车简介、电力机车主要部件、电力机车供电系统、电力机车牵引系统、电力机车制动系统、机车行车安全装备、机车运用与维护、新型机车介绍、动车组、磁悬浮列车等。

本教材的主要特点：

（1）本书紧密结合铁道机车运用与维护及相关专业内容，内容专业、广泛、实用。

（2）在编写风格上体现一定的时代性和趣味性，加入专业前沿内容，图文并茂，用现场真实照片拉近与读者的距离。

（3）将专业词汇进行了汇总，方便教学和学习；每章附有扩展阅读材料及习题，方便使用者的进一步需求、检测学习效果，在掌握专业知识的同时提高英文阅读理解能力。

（4）附有铁道机车运用与维护专业词汇中英文对比汇总、专业英语翻译技巧，从语法语义等角度阐述了专业英语的阅读和翻译方法，同时将专业英语与公共英语契合在一起。

本书由西安铁路职业技术学院侯艳、刘芳璇担任主编；西安铁路职业技术学院王娟、谢程程担任副主编，西安铁路职业技术学院付娟、西安铁路局教育室刑永红担任主审。西安铁路职业技术学院侯艳编写了 Unit 1、Unit 2、Unit3、Unit9；西安铁路职业技术学院刘芳璇编写了 Unit 5；西安铁路职业技术学院王安明编写了 Unit 4；西安铁路职业技术学院谢程程编写了 Unit7；西安铁路职业技术学院王娟编写了 Unit8；西安铁路局机务处纪涛编写了 Unit 6。本书由西安铁路职业技术学院侯艳负责统稿，并编写了专业英语翻译技巧。

本书在编写过程中还得到了宝鸡机车检修段韩永生、雷鑫，西安铁路局闫红星、赖长贵、韩友红的大力支持，在此表示感谢！

本书虽经编者和现场技术人员多次讨论修改，但由于编者水平有限，书中难免有不妥之处，恳请批评指正。

编　者

2022 年 1 月

# PREFACE

Professional English for Railway Locomotive Operation and Maintenance is an important compulsory course for this major and its railway-related majors. With the great development of railway technology, the globalization of social economy, informatization, the development of the One Belt One Road development strategy, the continuous emergence of new models, new technologies, and new processes, and the expansion of foreign exchanges in the railway industry, as a railway professional student, Mastering professional related English vocabulary and having a certain degree of English professional reading ability is necessary for engaging in related work, promoting international cooperation and exchanges, and understanding and learning the latest developments and technical knowledge of the major at home and abroad. In order to meet the teaching needs of professional English for railway locomotives and related majors, we have compiled the book “Professional English for Railway Locomotive Operation and Maintenance”.

The content of this textbook mainly includes basic railway knowledge, introduction to locomotives, main components of electric locomotives, electric locomotive power supply systems, electric locomotive traction systems, electric locomotive braking systems, locomotive safety equipment, locomotive operation and maintenance, introduction to new locomotives, EMUs, Maglev trains, etc.

The main features of this textbook:

(1) This book closely combines the operation and maintenance of railway locomotives and related professional content, and the content is professional, extensive and practical.

(2) Reflect a certain time and interest in the writing style, add professional cutting-edge content, graphics and texts, and use real photos on the scene to narrow the distance with the readers.

(3) The professional vocabulary is summarized to facilitate teaching and learning; each chapter is accompanied by extended reading materials and exercises to facilitate users’ further needs, test learning effects, and improve English reading comprehension while mastering professional knowledge.

(4) It is accompanied by a summary of Chinese and English professional vocabulary for railway locomotive operation and maintenance, professional English translation skills, and explains the reading and translation methods of professional English from the perspective of grammar and semantics. At the same time, professional English and public English are combined.

The book is edited by Hou Yan and Liu Fangxuan of Xi'an Railway Vocational and Technical College; Wang Juan and Xie Chengcheng of Xi'an Railway Vocational and Technical College serve as deputy editors; Fu Juan and Xing Yonghong, Education Office of Xi'an Railway Vocational and Technical College serve as chief reviewers. Xi'an Railway Vocational and Technical College Hou Yan wrote Unit 1, Unit 2, Unit3, Unit9; Xi'an Railway Vocational and Technical College Liu Fangxuan wrote Unit 5; Xi'an Railway Vocational and Technical College Wang Anming wrote Unit 4; Xi'an Railway Vocational and Technical College Xie Chengcheng wrote Unit7; Xi'an Railway Vocational and Technical College Wang Juan wrote Unit 8; Xi'an Railway Bureau Locomotive Office Ji Tao wrote Unit 6. This book was edited by Hou Yan from Xi'an Railway Vocational and Technical College and compiled professional English translation skills.

In the process of writing this book, Han Yongsheng and Lei Xin from Baoji Locomotive Maintenance Section, Yan Hongxing, Lai Changgui, and Han Youhong from the Xi'an Railway Bureau also supported us. Thank you!

Although the warp editors and on-site technicians have discussed and revised this book many times, due to the limited level of the editors, there are inevitably some improprieties in the book. Please criticize and correct me.

Editor

January 2022

# 目录// CONTENTS

# Unit 1　Normal knowledge

## Text 1　Rail transport

Rail transport (Fig.1.1) is a means of conveyance of passengers and goods on wheeled vehicles running on rails, also known as tracks. It is also commonly referred to as train transport. In contrast to road transport, where vehicles run on a prepared flat surface, rail vehicles (rolling stock) are directionally guided by the tracks on which they run. Tracks usually consist of steel rails, installed on ties (sleepers) and ballast, on which the rolling stock, usually fitted with metal wheels, moves. Other variations are also possible, such as slab track, where the rails are fastened to a concrete foundation resting on a prepared subsurface.

Fig. 1.1　Rail transport

Rolling stock in a rail transport system generally encounters lower frictional resistance than road vehicles, so passenger and freight cars (carriages and wagons) can be coupled into longer trains. The operation is carried out by a railway company, providing transport between train stations or freight customer facilities. Power is provided by locomotives which either draw electric power from a railway electrification system or produce their own power, usually by diesel engines. Most tracks are accompanied by a signaling system. Railways are a safe land transport system when compared to other forms of transport. Railway transport is capable of high levels of passenger and cargo utilization and energy efficiency, but is often less flexible and more capital-intensive than road transport, when lower traffic levels are considered.

## 1. Right of way

Railway tracks (Fig.1.2) are laid upon land owned or leased by the railway company. Owing to the desirability of maintaining modest grades, rails will often be laid in circuitous routes in hilly or mountainous terrain. Route length and grade requirements can be reduced by the use of alternating cuttings, bridges and tunnels — all of which can greatly increase the capital expenditures required to develop a right of way, while significantly reducing operating costs and allowing higher speeds on longer radius curves. In densely urbanized areas, railways are sometimes laid in tunnels to minimize the effects on existing properties.

Fig. 1.2 Railway track

## 2. Motive power

Steam locomotives are locomotives with a steam engine that provides adhesion. Coal, petroleum, or wood is burned in a firebox, boiling water in the boiler to create pressurized steam. The steam travels through the smokebox before leaving via the chimney or smoke stack. In the process, it powers a piston that transmits power directly through a connecting rod and a crankpin on the driving wheel or to a crank on a driving axle. Steam locomotives have been phased out in most parts of the world for economical and safety reasons, although many are preserved in working order by heritage railways.

Electric locomotives draw power from a stationary source via an overhead wire or third rail. Some also or instead use a battery. In locomotives that are powered by high voltage alternating current, a transformer in the locomotive converts the high voltage, low current power to low voltage, high current used in the traction motors that power the wheels. Modern locomotives may use three-phase AC induction motors or direct current motors. Under certain conditions, electric locomotives are the most powerful traction. They are also the cheapest to run and provide less

noise and no local air pollution. However, they require high capital investments both for the overhead lines and the supporting infrastructure, as well as the generating station that is needed to produce electricity. Accordingly, electric traction is used on urban systems, lines with high traffic and for high-speed rail.

Diesel locomotives use a diesel engine as the prime mover. The energy transmission may be either diesel-electric, diesel-mechanical or diesel-hydraulic but diesel-electric is dominant. Electro-diesel locomotives are built to run as diesel-electric on unelectrified sections and as electric locomotives on electrified sections.

Alternative methods of motive power include magnetic levitation, horse-drawn, cable, gravity, pneumatics and gas turbine.

## New Words

| | |
|---|---|
| track | *n.* 轨道 |
| vehicle | *n.* 车辆 |
| ballast | *n.* 道砟 |
| frictional | *adj.* 摩擦的 |
| signal | *n.* 信号 |
| smokebox | *n.* 锅炉 |
| axle | *n.* 轴 |
| AC=alternating current | *n.* 交流电 |

## Technical Phrases

| | |
|---|---|
| rail transport | 铁路运输 |
| means of conveyance | 运输工具，运输资料 |
| referred to as | 被称为…… |
| In contrast to | 相比之下 |
| road transport | 汽车运输 |
| flat surface | 平面，平整表面，平直表面 |
| rolling stock | 全部车辆 |
| steel rails | 钢轨 |
| concrete foundation | 混凝土基础 |
| frictional resistance | 摩擦阻力 |
| electric power | 电力，电功率 |
| railway electrification | 铁道电气化，铁路电气化 |
| diesel engines | 柴油机(diesel engine 的名词复数) |

| | |
|---|---|
| signaling system | 信号系统 |
| energy efficiency | 能量系数，能量效率，能源效应 |
| steam engine | 蒸汽机 |
| connecting rod | [机]连杆 |
| driving wheel | 驱动轮，主动轮 |
| in working order | 能正常发挥功能，处于正常运转状态 |
| stationary source | 固定污染源 |
| overhead wire | 高架线 |

# Text 2　Train

In rail transport, a train is made up of a single or several connected rail vehicles that can be moved together along a guideway to transport freight or passengers from one place to another along a planned route. The guideway (permanent way) generally consists of conventional rail tracks, but might also be monorail or maglev. Propulsion for the train is typically provided by a separate locomotive, or from individual motors in self-propelled multiple units. Power is usually derived from diesel engines or from electricity supplied by trackside systems. Historically the steam engine was the dominant form of locomotive power, and other sources of power (such as horses, pneumatics, or gas turbines) are possible as well.

In railway terminology, consist is used to describe the group of rail vehicles which make up a train.

## 1. Types of Trains

There are various types of trains designed for particular purposes:

A train can be made up of a locomotive and attached railroad cars, or a self-propelled multiple unit. Trains can also be hauled by horses, pulled by a cable, or run downhill by gravity.

Special kinds of trains running on corresponding special “railways” are atmospheric railways, monorails, high-speed railways, Dinky Trains, maglev, rubber-tired underground, funicular and cog railways.

A passenger train may be made up of one or several locomotives, and one or more coaches. Alternatively, a train may consist entirely of passenger carrying coaches, some or all of which are powered as a “multiple unit”. In many parts of the world, especially Japan and Europe, high-speed rail is used extensively for passenger travel.

Freight trains comprise wagons or trucks instead of carriages, although some parcel and mail trains (especially Travelling Post Offices) are apparently more like passenger trains.

In the United Kingdom, a train hauled by two locomotives is said to be “double-headed”, but in Canada and the United States, it is quite usual for a long freight train to be headed by three, four, or even five locomotives.

Trains can also be mixed, hauling both passengers and freight. Such mixed trains became rare in many countries, but were ordinary on the first 19th century railroads.

Special trains are also used for track maintenance; in some places, this is called maintenance of way.

A single uncoupled rail vehicle is not technically a train, but is generally referred to as such for signaling reasons.

## 2. Passenger Trains

Passenger trains (Fig.1.3) have passenger cars. Passenger trains travel between stations; the distance between stations may vary from under 1 km to much more. Long-distance trains, sometimes crossing several countries, may have a dining or restaurant car; they may also have sleeping cars, but not in the case of high-speed rail; these arrive at their destination before the night falls and are in competition with airplanes in speed. Very-long-distance trains such as those on the Trans-Siberian railway are generally not high-speed.

Fig. 1.3 Passenger train

For trains connecting cities, we can distinguish inter-city trains, which do not halt at small stations, and trains that serve all stations, usually known as local trains or “stoppers”.

Very fast trains sometimes tilt, like the Pendolino or Talgo. Tilting is a system where the passenger cars automatically lean into curves, reducing the centrifugal forces acting on passengers and permitting higher speeds on curves in the track with greater passenger comfort.

For shorter distances many cities have networks of commuter trains, serving the city and its suburbs. Some carriages may be arranged to have more standing room than seats, or to facilitate the carrying of prams, cycles or wheelchairs. Some countries have some double-decked passenger trains for use in conurbations. Double deck high speed and becoming more common in Europe.

Passenger trains generally have emergency brake handles (or a “communication cord”) that the public can operate. Abuse is punished by a fine.

Large cities often have a metro system, also called underground, subway or tube. The trains are electrically powered, normally by third rail, and their railroads are separate from other traffic, without level crossings. Generally they run in tunnels in the city center and sometimes on elevated structures in the outer parts of the city. They can accelerate and decelerate faster than heavier, long-distance trains.

A light one- or two-car rail vehicle running through the streets is not called a train but a tram, trolley, or streetcar, but the distinction is not strict.

The term light rail is sometimes used for a modern tram, but it may also mean an intermediate form between a tram and a train, similar to metro except that it may have level crossings. These are often protected with crossing gates. They may also be called a trolley.

Maglev trains and monorails represent minor technologies in the train field.

The term rapid transit is used for public transport such as commuter trains, metro and light-rail. Nevertheless, in New York City, lines on the New York City Subway have been referred to as “trains”.

## 3. Freight trains

Freight trains (Fig.1.4) have freight cars.

Fig. 1.4 Freight train

Much of the world’s freight is transported by train. In the USA the rail system is used mostly for transporting freight (or cargo).

Under the right circumstances, transporting freight by train is highly economic, and also more energy efficient than transporting freight by road. Rail freight is most economic, and also more energy efficient than transporting freight by road. rail freight is most economic when freight is being carried in bulk and over long distances, but is less suited to short distances and small loads.

The main disadvantage of rail freight is its lack of flexibility. For this reason, rail has lost much of the freight business to road competition. Many governments are now trying to encourage more freight onto trains, on account of the environmental benefits that it would bring. There are

many different types of freight train, which are used to carry many different kinds of freight, with many different types of wagon. One of the most usual types on modern railways are container trains, by which the containers can be lifted on and off the train by cranes and loaded off or onto trucks or ships.

This type of freight train has largely superseded the traditional “box wagon” type of freight train, by which the cargo had to be loaded or unloaded manually.

There are also many other types of wagon, such as “low loader” wagons for transporting road vehicles. There are refrigerator wagons for transporting food. There are simple types of open-topped wagons for transporting minerals and bulk material such as coal and tankers (Fig.1.5) for transporting liquids and gases.


Fig. 1.5 Tanker car

Freight trains are sometimes illegally boarded by passengers who do not wish, or do not have the money, to travel by common means. this is referred to as “hopping” and is considered by some communities to be a viable from of transport. Most hoppers sneak into train yards and stow away in boxcars. More daring hoppers will catch a train “on the fly”, that is, as it is moving, leading to occasional fatalities, some of which go unrecorded.

## New Words

| | |
|---|---|
| guideway | *n*. 轨道 |
| pneumatics | *adj*. 气动的 |
| dinky | *adj*. 小巧的，精巧的 |
| funicular | *n*. 缆索 |
| uncouple | *v*. 解体 |

| | |
|---|---|
| crane | *n*. 起重机 |
| flexibility | *n*. 可伸缩的，有弹性的 |
| supersede | *v*. 替换，替代 |

## Technical Phrases

| | |
|---|---|
| diesel engine | 内燃机 |
| gas turbine | 燃气轮机 |
| tilting coach | 摆式客车 |
| centrifugal force | 离心力 |
| inter-city train | 城际列车 |
| local train/stopper | 铁路局局管内列车 |
| commuter train | 通勤车 |
| emergency brake | 紧急制动 |
| cog railway | 齿轨铁路 |
| stow away | 偷乘 |

# Text 3　History of rail transportation

Rail transport is a means of conveyance of passengers and goods by way of wheeled vehicles running on rail tracks.

The oldest, man-hauled railways date back to the 6th century B.C., with Periander, one of the Seven Sages of Greece, credited with its invention. Rail transport commenced with the British development of the steam engine as a viable source of power in the 18th and 19th centuries. Steam locomotives were first developed in the United Kingdom in the early 19th century. Built by George Stephenson and his son Robert's company Robert Stephenson and Company, the Locomotion No. 1 is the first steam locomotive to carry passengers on a public rail line, the Stockton and Darlington Railway in 1825. George also built the first public inter-city railway line in the world to use steam locomotives, the Liverpool and Manchester Railway which opened in 1830. With steam engines, one could construct mainline railways, which were a key component of the Industrial Revolution. Also, railways reduced the costs of shipping, and allowed for fewer lost goods, compared with water transport, which faced occasional sinking of ships. The change from canals to railways allowed for "national markets" in which prices varied very little from city to city. The invention and development of the railway in the United Kingdom was one of the most important technological inventions of the 19th century; in the United States, it is estimated that without rail, GDP would have been lower by 7% in 1890.

In the 1880s, electrified trains were introduced, and also the first tramways and rapid transit

systems came into being. Starting during the 1940s, the non-electrified railways in most countries had their steam locomotives replaced by diesel-electric locomotives, with the process being almost complete by 2000. During the 1960s, electrified high-speed railway systems were introduced in Japan and later in some other countries. Other forms of guided ground transport outside the traditional railway definitions, such as monorail or maglev, have been tried but have seen limited use. Following decline after World War II due to competition from cars, rail transport has had a revival in recent decades due to road congestion and rising fuel prices, as well as governments investing in rail as a means of reducing $CO_2$ emissions in the context of concerns about global warming.

## 1. Pre-steam

The earliest evidence of railway was a 6-kilometer railway, which transported boats in Greece during the 6th Century B.C., Trucks pushed by slaves ran in grooves, which provided the track element.

The line originally used wooden rails and a hemp haulage rope, and was operated by human or animal power.

The first iron plate rail way made with cast iron plates on top of wooden rails was taken into use in 1768. This allowed a variation of gauge to be used. Later, movable points were taken into use that allowed for switching.

## 2. Age of steam

The development of the stem engine spurred ideas for mobile steam locomotives that could haul trains on tracks.

In 1804, the first locomotive-hauled train using high-pressure steam was invented. Two years later, the first passenger horse-drawn railway was opened. In 1825, the first public steam railway in the world was opened.

## 3. Electrification and dieselisation

Experiments with electrical railways were started in l838. A battery-powered carriage can be capable of 6.4 km/h (4 mph). At first, all electric railways used direct current but, in 1904, a line in Austria opened with alternating current.

Steam locomotives require large pools of labour to clean. Load, maintain and run. After World War II, dramatically increased labour costs in developed countries made steam, 8n increasingly costly form of motive power. At the same time, the war had forced improvements in internal combustion engine technology that made diesel locomotives cheaper and more powerful.

## New Words

| | |
|---|---|
| conveyance | *n*. 运送；运输 |
| transport | *n*. 运输；运输工具 |

| | |
|---|---|
| | *v*. 运输 |
| groove | *n*. 凹槽，槽 |
| hemp | *n*. 大麻；麻类植物 |
| haulage | *n*. 拖曳；运费；拖运 |
| gauge | *n*. 计量器；蚤标准尺寸；容量规 |
| adopt | *v*. 收养；采取；接受 |
| maintain | *v*. 维持；维修；供养 |
| diesel | *n*. 柴油机；柴油 |
| | *adj*. 内燃机传动的；供内燃机用的 |

## Technical Phrases

| | |
|---|---|
| wheeled vehicles | 有轮列车 |
| rail tracks | 铁轨 |
| movable points | 可移动尖轨 |
| steam locomotives | 蒸汽机车 |
| intercity railway | 城际铁路 |
| direct current | 直流电 |
| alternating current | 交流电 |
| motive power | 动力 |
| internal combustion engine technology | 内燃机车技术 |
| diesel locomotive | 内燃机 |

## Exercises

Ⅰ. Answer the following questions according to the text.

1. What is the definition of a train?
2. What is the meaning of “consist”?
3. What is a trainset?
4. What are the advantages of electric locomotive?

Ⅱ. Translate the words and the phrases into Chinese.

| | |
|---|---|
| 1. guideway | 2. pneumatics |
| 3. diesel engine | 4. centrifugal force |
| 5. commuter train | 6. emergency brake |
| 7. direct current | 8. alternating current |

Ⅲ. Translate the following English paragraphs into Chinese.

1. In rail transport, a train is made up of a single or several connected rail vehicles that can be

moved together along a guideway to transport freight or passengers from one place to another along a planned route.

2. Passenger cars, or coaches, vary in their internal fittings: Seating is generally three, four, or five seats across the width of the car, with an aisle in between (resulting is 2+1, 2+2 or 3+2 seats) or at the side.

3. Rail transport is a means of conveyance of passengers and goods by way of wheeled vehicles running on rail tracks.

# Reading Material

## Classification yard

A classification yard (Fig.1.6) or marshalling yard is a railroad yard found at some freight train stations, used to separate railroad cars on to one of several tracks. First the cars are taken to a track, sometimes called a lead or a drill. From there the cars are sent through a series of switches called a ladder onto the classification tracks. Larger yards tend to put the lead on an artificially built hill called a hump to use the force of gravity to propel the cars through the ladder.

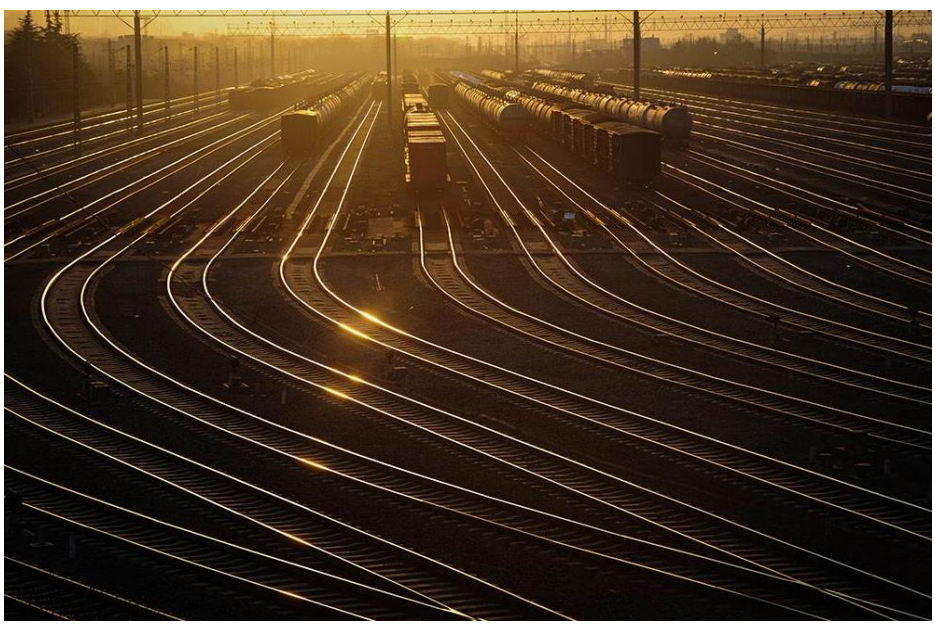

Fig. 1.6 Classification yard

Freight trains which are made up of isolated cars must be made into trains divided according to their destinations. Thus the cars must be shunted several times along their route in contrast to a unit train, which carries, for example, cars from the plant to a port, or coal from a mine to the

power plant. This shunting is done partly at the starting and final destinations and partly (for long-distance-hauling) in classification yards.

## 1. Types of classification yards

There are three types of classification yards: flat-shunted yards, hump yards and gravity yards.

## 2. Flat-shunted yards

The tracks lead into a flat shunting neck at one or both ends of the yard where the cars are pushed to sort them into the right track. There are many medium-sized flat yards in the USA and also some large ones such as (Houston-) Settegast, Decatur, East Joliet , etc.

In Europe several major classification yards in Italy have never had a hump, such as Verona Porta Nuova, Foggia or Villa San Giovanni (Fascio Bolano); other large European flat yards are for example Ohen (Switzerland) or Valea lui Traian (Constanta, Romania—this is an incompleted yard with 32 tracks which was planned to be a hump yard but has no hump). In Argentina all classification yards except Villa Maria are flat yards, although some of them have approx. 30 or more tracks.

## 3. Hump yards

These are the largest and most effective classification yards with the largest shunting capacity of several thousand cars a day. The heart of these yards is the hump: a track on a hill (hump) over which the cars are pushed by the engine after being uncoupled just before or at the top (hump crest) and then they roll, either as single cars or some coupled cars together, by gravity into their destination tracks in the classification bowl (the tracks where the cars are sorted).

The speed of the cars rolling down from the hump into the classification bowl must be regulated because of the different natural speed of wagons (full or empty, heavy or light freight, number of axles) and the different filling of tracks (whether there are presently few or already many cars on it). As concerns speed regulation there are two types of hump yards: without or with mechanisation. In the old non-retarder yards braking was generally done in Europe by railroaders who lay skates onto the tracks or in the USA by passengers on the cars. In the modern retarder yards this work is done by mechanized “rail brakes” called retarders. They are operated either pneumatically (e. g. in the USA, France, Belgium, Russia or China) or hydraulically (e. g. in Germany, Italy or the Netherlands).

Classification bowls in Europe are made up of several balloon loops, usually with eight classification tracks following a retarder in each one, often 32 tracks altogether. In the United States, many classification bowls have more than 40 tracks—up to 72—which are often divided into six to ten classification tracks in each balloon loop.

## 4. Gravity yard

Gravity yards are operated similarly to hump yards but, in contrast to the latter, the whole

yard is set up on a continuous falling gradient. When they were invented in the 19th century, saving shunting engines and instead letting the cars roll by gravity was seen as a major benefit, whereas the larger amount of manual work required to stop the rolling cars in the classification tracks was judged to be not that important. Gravity yards were a historical step in the development of classification yards and were later judged as inferior to hump yards, because it became clear that shunting engines were needed anyway (at least in inclement weather like strong winds or icy temperatures when the oil in the bearings became thick), and because manual labour was getting relatively more and more expensive. Thus, only few gravity yards were ever built, sometimes requiring massive earthwork (one example is the first German gravity yard at Dresden).

Most gravity yards were built in Germany and Great Britain, a few also in some other European countries. In the USA, there were only very few old gravity yards; one of the few gravity yards in operation today is CSX's Readville Yardsouth of Boston, Massachusetts.

Almost all gravity yards have been retrofitted with humps and are worked as hump yards.

## Railroad track

The track on a railway or railroad, also known as the permanent way, is the structure consisting of the rails, fasteners, railroad ties (sleepers, British English) and ballast (or slab track), plus the underlying subgrade. It enables trains to move by providing a dependable surface for their wheels to roll upon. For clarity it is often referred to as railway track (British English and UIC terminology) or railroad track (predominantly in the United States). Tracks where electric trains or electric trams run are equipped with an electrification system such as an overhead electrical power line or an additional electrified rail.

Rail tracks are used on railroads, which, together with railroad switches, guide trains without the need for steering. Tracks consist of two parallel steel rails, which are laid upon cross ties that are embedded in ballast to form the railroad track. The rail is fastened to the ties with rail spikes, lag screws.

Hot rolled steel in the cross section of any asymmetrical I-beam is usually used as the surface on which railway wheels run. Unlike some other uses of iron and steel, railway rails are subject to very high stresses and have to be made of very high quality steel alloy.

Rails are produced in fixed lengths and need to be joined end-to-end to make a continuous surface on which trains may run. The traditional method of joining the rails is to bolt them together using metal fishplates, producing jointed track. For more modern usage, particularly where higher speeds are required, the lengths of rail may be welded together to form continuous welded rail.

A railroad tie (also called a cross-tie in North American usage, or a railway sleeper outside North America) is a rectangular object on which the rails are supported and fixed. The tie has two

main roles: to transfer the loads from the rails to the track ballast and the ground underneath, and to hold the rails to the correct width apart. They are generally laid transverse (perpendicular) to the rails.

The track ballast is customarily crushed stone, and the purpose of this is to support the ties and allow some adjustment of their position, while allowing free drainage.

Modern track typically uses hot-rolled steel with a profile of an asymmetrical rounded I-beam. Unlike some other uses of iron and steel, railway rails are subject to very high stresses and have to be made of very high-quality steel alloy. It took many decades to improve the quality of the materials, including the change from iron to steel. The stronger the rails and the rest of the trackwork, the heavier and faster the trains the track can carry.

Other profiles of rail include: bullhead rail; grooved rail; “flat-bottomed rail” (Vignoles rail or flanged T-rail); bridge rail (inverted U-shaped used in baulk road); and Barlow rail (inverted V).

North American railroads until the mid- to late-20th century used rails 39 ft (11.89 m) long so they could be carried in gondola cars (open wagons), often 40 ft (12.2 m) long; as gondola sizes increased, so did rail lengths.

According to the Railway Gazette the 150-kilometer rail line being built for the Baffinland Iron Mine, on Baffin Island, will use older carbon steel alloys for its rails, instead of more modern, higher performance alloys, because modern alloy rails can become brittle at very low temperatures.

**Ballastless track：**

A disadvantage of traditional track structures is the heavy demand for maintenance, particularly surfacing (tamping) and lining to restore the desired track geometry and smoothness of vehicle running. Weakness of the subgrade and drainage deficiencies also lead to heavy maintenance costs. This can be overcome by using ballastless track. In its simplest form this consists of a continuous slab of concrete (like a highway structure) with the rails supported directly on its upper surface (using a resilient pad).

There are a number of proprietary systems, and variations include a continuous reinforced concrete slab, or alternatively the use of pre-cast pre-stressed concrete units laid on a base layer. Many permutations of design have been put forward.

However, ballastless track (Fig.1.7) has a high initial cost, and in the case of existing railroads the upgrade to such requires closure of the route for a long period. Its whole-life cost can be lower because of the reduction in maintenance. Ballastless track is usually considered for new very high speed or very high loading routes, in short extensions that require additional strength (e.g. rail stations), or for localised replacement where there are exceptional maintenance difficulties, for example in tunnels. Some rubber-tyred metros use ballastless tracks.

Fig. 1.7 Ballastless track

## Railway switch

A railway switch (Fig.1.8) is a mechanical installation enabling trains to be guided from one track to another.


Fig.1.8 Railway switch

The switch consists of the pair of linked tapering rails, known as points (switch rails or point blades), lying between the diverging outer rails (the stock rails). These points can be moved laterally into one of two positions to direct a train coming from the point blades towards the

straight path or the diverging path. A train moving from the narrow end toward the point blades (i.e. it will be directed to one of the two paths depending on the position of the points) is said to be executing a facing-point movement.

Unless the switch is locked, a train coming from either of the converging directs will pass through the points onto the narrow end, regardless of the position of the points, as the vehicle's wheels will force the points to move. Passage through a switch in this direction is known as a trailing-point movement.

A switch generally has a straight "through" track (such as the main-line) and a diverging route. The handedness of the installation is described by the side that the diverging track leaves. Right-hand switches have a diverging path to the right of the straight track, when coming from the point blades, and a left-handed switch has the diverging track leaving to the opposite side. In many cases, such as rail yards, many switches can be found in a short section of track, sometimes with switches going both to the right and left (although it is better to keep these separated as much as feasible). Sometimes a switch merely divides one track into two; at others, it serves as a connection between two or more parallel tracks, allowing a train to switch between them. In many cases, where a switch is supplied to leave a track, a second is supplied to allow the train to reenter the track some distance down the line; this allows the track to serve as a siding, allowing a train to get off the track to allow traffic to pass (this siding can either be a dedicated short length of track, or formed from a section of a second, continuous, parallel line), and also allows trains coming from either direction to switch between lines; otherwise, the only way for a train coming from the opposite direction to use a switch would be to stop, and reverse through the switch onto the other line, and then continue forwards (or stop, if it is being used as a siding).

A straight track is not always present; for example, both tracks may curve, one to the left and one to the right , or both tracks may curve, with differing radii, while still in the same direction.

Apart from the standard right-hand switches, switches commonly have various combinations of configurations. The most common is a single slip switches.

Components of a single slip turnout:

### 1. Points (Point Blades)

The points (switch rails or point blades) are the movable rails which guide the wheels towards either the straight or the diverging track .They are tapered on most switches.

### 2. Frog (Common Crossing)

The frog (common crossing) refers to the crossing point of two rails. This can be assembled out of several appropriately cut and bent pieces of rail or can be a single casting. A frog forms part of a railroad switch, and is also used in a level junction (flat crossing).

### 3. Guard Rail (Check Rail)

A guard rail (check rail) is a short piece of rail placed alongside the main (shock) rail opposite

the frog. These exist to ensure that the wheels follow the appropriate flange through the frog and that the train does not derail.

### 4. Switch Motor

A switch motor is an electric or pneumatic that aligns the points with one of the diverging routes.

### 5. Point Lever

A point lever and accompanying linkages are used ti align the points of a switch manually. This lever and its accompanying hardware are usually mounted to a pair of long sleepers that extend from the switch at the points.

### 6. Joints

Joints are used where the moving points meet the fixed rails of the switch. They allow the points to hinge easily between their positions.