TRAINSIMMING MODERN **ITALIAN** RAILWAYS

Part One June 2003

An E444 R with a set of Z1 coaches in the original grey/cream livery and the later two tone grey livery 1997.

E444 R Model Pek, repaint Nello

In this Part

- **Background**
- **FS Engine classification system**
- **MSTS Routes**
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- **Resources**

The 1990's continuing into this century have been ones of considerable change for the Italian state **railways FS Ferrovie dello Stato.**

Set up as a separate legal company, and divided up into passenger, regional and cargo and infrastructure activities to meet EU requirements, the FS has invested considerably into a new generation of electric locomotives, High speed lines and High speed trains, as well as Suburban EMUs.

At the same time Electric locomotives and High Speed Electrotreni and indeed some diesels designed before WWII are still in use or recently retired.

As in other Guides in the **Trainsimming** series, in **Part One** we will look at the background to Italian railways, the MSTS routes available, signalling, Engine classification system and colour schemes and the electric locomotives in use.

In **Part Two** we will look at High-speed trains, EMU's, DMUs and carriage stock.

In **Part Three** at diesel locomotives in use, shunters and cargo.

Italian locomotive classification and numbering system

The Italian system has a letter (or letters) followed by a three number class number, and then three or four numbers designating the number within the class.

Eg E 000 000 for Electric locomotives

D 000 0000 for Diesels

ALn 00 0000 Diesel Rail Cars and DMUs have four numbers Automotrice Leggera = Light railcar nafta = gasoline or diesel

ALe 000 000 for EMUs. Electric Railcar E = elettrica

ETR Fast Electric EMU EletroTRenoRapido

In this paper we will adopt the convention used in www.trenomania.it of putting the letter and first number together, although other place leave a space, or put a full stop between the two.

Electric E656 410

Six driven axels, 5th generation, Passenger

First Number	Second number	Third Number	Three or 4 Digit serial
Number of driven axels 4 Four driven axels 6 Six driven axels	A generational number showing the generation of locomotive with that axel configuration	Ties in with the number of axels. **Even** for Passenger and **odd** for Freight use. Eg **E646 for passenger and E645 for freight**	
E Electric for classes after 1982 eg E402 Number of driven axel	Number stating 01 etc with even passenger and odd freight.		

D diesel D445 1037

Mainline diesel, 4 motorised axels, and electric transmission.

1 Heavy shunter **2** Light shunter and auto tractor **3** Mainline **4** Mainline	Number of motorised axels	The generation and the transmission: **Even** Hydraulic transmission **Odd** Electric transmission	The **first** number indicates the constructor of the Automotrice: 1=FIAT; 2=Breda; 3=OM; 4=Ansaldo. The **second** figure the generation The **last two** the actual number in the series

DMU ALn 668 2419

6 Can be used in multiple, 68 seats, Made by Breda

D behind the L = Baggage car L behind the L = Postal car	If a number here it can be used in multiple units. The number is a repeat of the second number.	Number of seats. Note this may not correspond to what is actual due to modifications etc	Plus a four figure number as D

EMU Electric Railcar ALe 883.017

	The First two numbers indicate the number of seats	Generation number, beginning with 0
Ln Trailer for ALn	Same as Rail car	
Le Trailer for ALe	Same as the Railcar to which it belongs, although there are numerous variations	

ETR Fast Electric EMU ETR 460

	Thy are in Generational groups eg 200, 300, 400, with the tens designating sub groups. Eg 450, 460, 470. The ETR 500 is actually a consist with two locomotives, but names in this grouped for marketing reasons The following three numbers are in sets designating the type of carriage/motor unit.

Colour schemes

The traditional scheme introduced in 1936 for Electrical locomotives is Chestnut and brown, **Castano e Isabella**, which in recent years has been simplified to just the brown. Diesels are also brown, some with Green sides.

A number of other schemes were introduced, particular to the electric locomotives, either class specific, or for a number of similar classes, or for the type of service, for example the Short and Long distance push-pull schemes.

However from 1994 all rolling stock, including EMUs and DMUs and carriages (but not the ETRs) have been painted in variation of white, with green with blue details, know as **XMPR**, after the London design agency **XMPR International** who carried out the design.

The schemes in use at the time of the introduction of XMPR, and which can still be seen, are

Name	From	Description	Use
Castano e Isabella Chestnut and light brown	1936		From the E626 Electric locomotive, used for most Cargo locomotives
Verde e Isabella (Green and Isabella)	1968		Used for D343
Isabella	1991	A simplification with just the light brown	Used for most freight locomotives
Medium Green for Shunters (Verde dei mezzi di manovra)			For shunters
Oriental Blue and pearl grey	1967		Used with E444 and E632/633/652/656:
MDVC or Navetta – matches carriage livery	1980		Used for E426 and diesels on Local Push-pull local services
MDVE - Fire Red and Powder grey to match Passenger livery	1984		Used for E424.2 on Medium distance Push –pull services
Red and Pearl grey	1989		Used for E444R
Red	1995		Used for E402 A
XMPR (Named after the design agency XMPR International))	1996		Being applied to all Passenger locomotives, EMUs, DMUs and carriages Seriously applied from 2000 - Designed in 1994, first applied in 1996 A later variation with more light grey is known as **New Corporate Identity NCI**
E 402 B			Used for E402 B. This one has a TRENITALIA TRENO-MULTICLIENTE Logo on the side

Source is http://www.miol.it/stagniweb/xmpr-i.htm the side views are not all to the same scale.

Geography

Rail Map of Italy from the full sized map at
http://www.bueker.net/trainspotting/maps_italy.php

The electrified 3000 V DC lines are in Turquoise, and the 25 kV AC High speed lines in construction in Blue.

The only high speed line completed in Italy is the **Direttissima** 3000V DC line between Firenze (Florence) and Rome, a non-stop service using Pendolini trains taking 1hour 30 mins with an average speed of only 103mph, 165km/h. The line is however visually impressive with a large number of tunnels and viaducts.

The Border stations are from west to east there are **Ventimiglia** on the coast, **Modane** (in France) linked by the Frejus tunnel; Domodossola and the Simplon tunnel, and **Locarno** (in Switzerland) and the Gotthard north of Milan, and **Brennero** and the Brenner pass north of Balzano

The shape of Italy may be one of the most well known in the world, with the Italian Peninsula closely resembles a leg with a boot on it jutting southeast into the Mediterranean for some 800 km (500 miles) from the Alps

Italy itself is **mostly rugged and mountainous** with **some plains**, in particular **Northern Italy**, and coastal lowlands. To the North are the **Alps** and from West to East France, Switzerland, Austria and Slovenia. All down the **backbone** of the Italian peninsula is the **Apennine** range of mountains that terminates in the Calabrian massif and the mountains of **Sicily**. South of Italy, and part of the republic is the Island of Sicily, while on the East is the island of Sardinia.

Vegetation in the north is of the Mediterranean type near the coast but tends to be greener and more diverse than the south, which in the summer takes on a burnt brown aspect under the hot sun.

Italy has 57m people; Italy has a diversified industrial economy with roughly the same total and per capita output as France and the UK, although the economy is divided into a developed industrial north, and a less developed agricultural south, with 20% unemployment.

The capital **Roma** is halfway down the peninsular, on the Western side. **Milan** the largest Industrial city is in the North, while the third largest city **Naples** is further South than Rome on the West Coast. Italy is Naples. Milano - Napoli by train is 792 km by High-speed train or 6h 30'train

Population Agglomeration	m.
Roma (Rome)	3.6
Milano (Milan)	4
Napoli (Naples)	3.6
Torino (Turin)	1.6
Palermo (Sicily)	0.9
Genova	0.7
Bologna	0.5
Firenze (Florence)	0.8
Catania (Sicily)	0.8

Railways

There are almost 20,000 km of railway track in Italy, 11,000 of which is electrified. Only 1000 Km is not standard gauge.

The majority belongs to the **Ferrovie dello Stato** – The State Railways **FS** who operate about 9,500 trains on over 16,200 km of track, two-thirds of which has now been electrified, with 6,300 Km double; some 2,700 stations and stops for providing services to passengers, and 479 freight service facilities. There are 1,380 km of tunnels and 530 km of bridges and viaducts.

At the time of the Unification of Italy in 1861 there were 1732 km of lines, built by seven railway companies, and it was a priority of the new state to build railway lines. The State reduced the number of companies to 4, but in 1985 introduced a **Covenant** system where the state owned the lines, and the company owned and operated the trains.

However this did not produce the required investment in the railways so when the covenants expired in **1905** the Railways were nationalised into the state owned Corporation Ferrovie dello Stato.

Electrification began in the North of Italy in 1899 with an experimental **Three-phase alternating 3000V 15Hz current**, designed by the Hungarian Kálmán **Kandó**.
The locomotive transformed standard public utility (single-phase) current into three-phase alternating current in the locomotive.

The electrified network was increased from the 450 kilometres at the end of the First World War to 1,200 km in 1928, using the Three-phase system, with the lines in the North of Italy, in particularly from Turin, but included two routes described later on, Bolzano - Brennero, Bolzano - Merano, and Savona - Ventimiglia.

However in 1928 the Benevento – Foggia line was electrified at **3000V DC**, and the major expansion of lines in the 30's was at this voltage, and by 1939 electrification had reached 5,170 kilometres.

The electrification programme had concentrated mostly on the international links with France, Austria and Switzerland, but had ignored virtually the whole of southern Italy.

The Three-phase lines were converted to 3000V DC in the early sixties, with some minor ones converted in the 70's.

The 1930'ss were also the introduction of fast electric trains (**Electrotreni)** the ETR 200 and electric EMU's and DMUs, with the commencement of electrification of the North-South dorsal and direct lines from Bologna – Firenze (Florence), Rome – Naples.

The network and stock suffered considerably war damage (see box later the Battle for the Brenner Pass).

The Italian Railways were late-runners in High Speed railways. They saw High Speed Railways as an exclusive offer, and although the **first tilting train** went into service in 1976 between Rome and Napoli it remains a sole example until the second generation trains were built in the mid-eighties.

The first high speed line the 3000V DC **Direttissima** was completed in 1992 between Rome and Firenze, and used by High speed trains with classic stock, as well as the tilting trains.

With classic stock as well it was only in the early nineties that deliveries of the 200 km/h **Z carriage stock** was fully introduced allowing classic passenger trains at this speed.

The 90's were a period of considerable change for FS, as for other European Rail administrations.

To meet EU requirements FS was set up as a company owned by the state, and its activities split into four major operations, Passenger, Regional Transport, cargo and Infrastructure. The operating units were branded **Trenitalia**, and Infrastructure **RFI Rete Ferroviaria Italiana** although the group is still known as **Gruppo FS**.

Construction commenced on Two High speed lines at 25 kV 50Hz from Milano to Firenze and Rome to Napoli. In addition to extra tilting trains, conventional high-speed trains sets the **TER 500**, with engines at each end (like a TGV) were built, in both a 3000 V DC and a dual system version.

Purchase of Bo Bo Electric locomotives, eg the **E 402 A** and **B** and the **E 412**, using electronic traction control methods, replacing the tradional design of an articulated locomotive with three powered twin axels.

However, FS have considerable issues to face, in particularly:

Reliability is poor. Railways Today recently published their reliability targets, which are trains departing less than 30 minutes late 57%, trains arriving less than an hour late 63%, and trains actually operated, compared to schedule 80%.

Reliability with cargo is equally poor. With open access on Major European freight routes, other operators can now work into Italy. Originally SBB cargo (Swiss Railways), wanted to work with the cargo division with Trenitlalia Cargo decision taking the trains to the customer. However because of unreliability SBB have now set up their own Italian subsidiary **Swiss Cargo Italy**, and is to buy thee G2000 Vossloh diesels, and is to order 18 electric locomotives.

ETR 500 Politensione on the High Speed line (on the fictitious Valtrenomania)

MSTS Routes

The fictitious Manuzio Centrale from the cab of a D145 shunter.

The word for Landscape orientation (as in setting your printer) in some European languages is 'Italian', reflecting the rich tradition in Italian landscape paining. In the same way people in the forums are talking about the **Italian style** of routes characterised by extremely rich textures, clever use of drops and the like to produce an enriching experience.

How one like a route is personal, but to me what counts are:

- **Signature items**; both subtle and "in your face" so that you know you are in a particlular country, in particular signals, but also station signs, lights, the design of station buildings.
- **Strong Layout design** elements, ie specific points that strike a choice of recognition
- Realistic freight yards, depots and carriage sidings
- Good textures, in particular buildings and trees.

In this section we will look at four Italian Routes selected from those avalible at http://www.trenomania.it/ on the basis of recommendation on forums: All four met the above criteria.

Val Trenomia

In general I am not one for fantasy routes, as I feel the real advantage of Trainsimming compared to Railway modelling is to be able to accurately depict a route that covers a reasonable area. Val Trenomania, and the French Route Moulinsard, have to a extent changed my views slightly, in that they carry the essence of their countries Railways, have superb landscapes and buildings with good fright yards and carriage sidings that allow you to build up interesting activities, without a large length of nothing but driving in between.

Val Trenomania depicts the route between two large Terminus stations, set in the North of Italy, about 60 Km apart, with a classic route between them with other stations, sidings, goods yards etc, but also a high speed line (of about 25Km) linking the two, with the tunnels, and viaducts typical of the Italian High speed line.

The route is excellent for the Freight trips.

The drawback is it is a sealed system, with no lines leading out of it, which to me reduces its realism, and .

in addition I think the High speed line is frustrating too short, as the journey is over in twenty minutes. I hope they extend the line at some stage to allow longer activities

St.Michele - Bolzone - Brenno
By Nello

A Hilltop village going south on the Brennero line

This route is regarded as this start of the Italian style, with excellent textures, and depicts the route from the frontier station of Brennero, down thorough Bolzone and on to St Michele, on the route South to Verona, with sidings

The Brennero line is of course the major rail route from Germany, to Italy, thorough the narrow extension of Austria, and Innsbruck, between the two countries.

When the line was built between 1864 and 1867, it was all on Austrian soil, but after the First World War Sud Tyrol was separated, and became part of Italian national territory. The Italian side was electrified in 1928, one year after the Austrian, although as they use different systems, Austria and Germany using 15KV 16 2/3 Hz, trains change engines at Brennero.

The new E412 is however dual system.

Battle of Brenner Pass

The Brenner Pass is the major route from Italy, through Austria, into Germany. It was electrified before WWII. After the surrender of Italy in WWII was of strategic importance to supplying the German occupying army, and particular the Gothic Line across the North of Italy. As a consequence it was the scene of epic air war with the 57^{t} Bomb Wing of the UAAAF, assisted by other elements engaged against up to 475 Flak guns manned by the Germans or Italians. The initial target of the USAAF was to destroy the electricity supply so that more wasteful and slower steam would have to be used, and then the bridges and other infrastructure, which in the end also prevented German troops from withdrawing. 68949 sorties were made, which went on until the end of the war.

From http://members.tripod.com/jkoppie/brenner.htm

Catania- Messina Part One
By Giovanni Grasso - Rossano Privitera

The railway viaduct at Catania

This route is the eastern coast of Italy from the port of Catania, along (mostly) double track, on route to Messina, where the ferry goes to Italy. The line then goes along the Northern coat to Palermo. The route models an hour's journey North of Catania, and with stations, and siding on the way. There are no branch lines. Very good textures with a particularly good depiction of Catania.

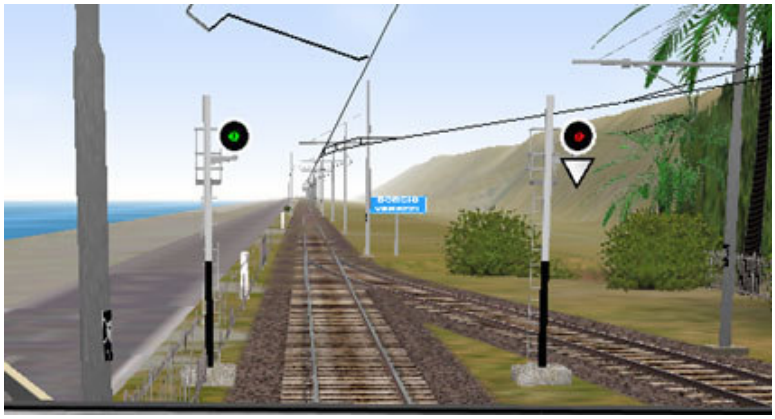
According to the La Ferrovie in Sicilia http://www.fersicilia.3000.it/ the following stock is found on the route:

E656 for all passenger work (Intercity, express and direct), and cargo trains especially push-pull.
E646 For regional trains with MDVC or MDVE stock
E636 for regional trains and diretti and cargo
D343 and **443** diesels with passenger trains, and D443 in double traction for oil refinery trains.
Ale 582 EMUs for regional trains Catania - Bicocca
Aln 668 series 1500 and 3000 DMUs for regional services from Taormina to Catania and Catania to Lentini

Vintimiglia – Savona by Loris e Michele Ornella

This line is along the Italian Rivera from Ventimiglia, the border station with the French network to Nice and Marseilles, to Savona, and eventually the line would go to Gerona. The route actually contains two lines, a single-track line along the edge of the coast, and a double track direct line.

Ventimiglia station is well depicted, and the single-track line is very well depicted. The double track is less scenic, with a continuous series of tunnels, opening out at times for stations, and back to tunnels.



Italian Signals

Italians use a main and distant signalling system.

There is an excellent description in English at

http://www.irlanda2000.info/segnalifs2002/

From the Ventimiglia - Savona line

Italian Electric locomotives

For Express trains and heavy freight there have been essentially three generations of design of Italian Electric locomotives, and all three types are in current use.

Each type was designed to maximise the adhesion on Italy's sinuous lines (the braking or tractive effort which can be transmitted wheel towards the rail in order to advance or slow down the train), taking advantage of the technology avaliabla at the time.

The first type, introduced with the **E636** in 1940, is the **articulated** locomotive, with three two-axel powered bogies – **Bo Bo Bo** arrangement. This engine type has been through 3 generations, with the last series the **E656** built between **1975–89,** as the FS decided to put its trust in tried technology, rather than in other technology becoming available**.**

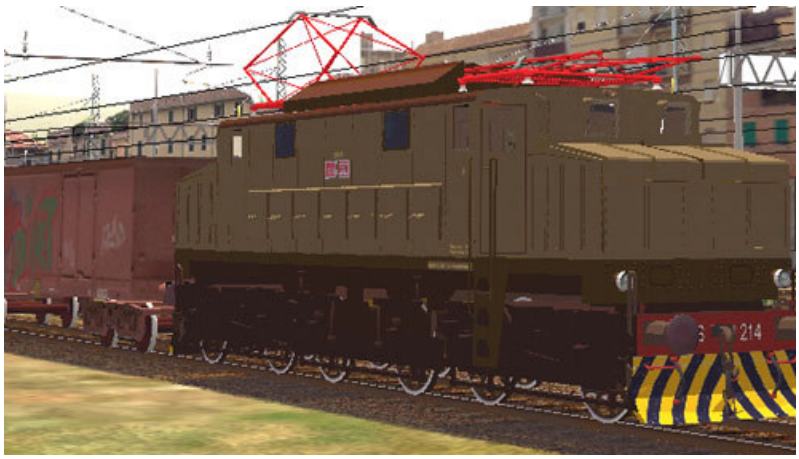
The second type is a Bo Bo Bo arrangement, but without the articulation of the engine, introduced in 1982 with the **E633 Tigri (Tigers)**, using electronic **chopper controls** to manage the adhesion. .

This was done after experiment with electronic chopper controls on converted 'Turtles', and building five prototypes. In 1989 a more powerful version the **E652** "**Tigri potenziate**" was introduced.

The third generational change was the introduction of the **Bo Bo E402 A** from 1994 **with three phase engines,** a system that has carried numerous advantages like the development of one greater specific power, an elevated force of traction to the starter and development of high power to the maximum speed (220 km/h).

Three-phase system was the system Italian railways started on, of course, but this time more advance electronic controls make it workable.

An interim step is the **Bo Bo E444 Turtles,** built between 1970 – 1974 to pull high speed expresses on Milan - Bologna; Florence - Rome; Rome - Naples, which were completely rebuilt in the 90's with new cabins and electronic controls, to form the **E444 R**, and are used for pushing fast freights



The Pre-war E626 carried on in service until the mid 90's

E 402 A Model: Pek

Class:	E402 A (and P)	E402 B	E402 C	Colour schemes:
Number Built:	**5 P + 40**	**80**	**24**	
Built:	**1994 - 1996**	**1997 -**	**2003**	402 A: Class Unique Red/white; XPMR
Voltage:	**3 kV DC**	**3kV DC/ 25kV AC**	**Triple**	
Speed:	**220 Km/hr**	**220 Km/h**	**180 Km/h**	
Max Cont Power	**5200 kW**	**5600 kW**		402B: Class unique mid grey with green top band, light grey front.
Multi:	**Yes**			
Push Pull:	**Yes**			
Number				
Passeggeri:	**40 + 2 -**	**59**	**-**	
Cargo:		**20**	**24 Ordered**	

Use: A Fast Passenger on the Main arterial lines
B Dual Voltage version of Class E402 but with different body shapes
C Triple voltage version for services to Germany and Austria

The **E402 A** is the first batch of locomotives of the Class 402. Designed for high speed using the latest three phase technology, five prototypes were built, and then forty production. The series had considerable teething problems on entering service

The **E402 B** is a dual voltage locomotive so that it can be used on new 25kV 50Hz lines, but has a **different body shape** than the E402.A, which is more aerodynamic, and which moves the air away from the pantographs. The B is designed as a Universal locomotive for pulling both passenger and high speed freight, and at Naples they do two days passenger, then four days freight

E 402 B in Mutliclient livery

Model Pek
Repaint Antimo

Class:	**E405**	**E412**
Number Built:	**42**	**20**
Built:	**2003**	**1999**
Voltage:	**3kV DC**	**3 kV DC** **15 kV AC16 2/3 Hz** **1.5 kV DC**
Speed:	**140 Km/h**	**200 Km/h**
Max cont force:		**6 kW*** at 3KV DC
Multi:		**Yes**
Number Cargo:	**42 Ordered**	**20**

The **E 412** is a dual voltage units designed for cargo use into Austria/Germany on the **Brenner**, and also on French 1.5kV DC lines (eg Modane)

The **E405** are 3000V DC only similar units originally ordered by PKP (Poland) as the Class EU11, but as they couldn't pay for them FS bought them for freight

Colour schemes: E412: XMPR

Model: Two E412 on the Brenner August 1999 Model: Richard De Stefani

Class:	**E424.2**
Number Rebuilt:	**105**
Rebuilt:	**1996-1983**
Voltage:	**3kV DC**
Speed:	**120 Km/hr**
Max Cont:	**1500 kW**
Multi:	
Push Pull:	**Yes**
Number Passenger:	**-**
Regionale:	**105**

Colour schemes: E424 Isabella; E424 N MVDE; XMPR

Use: E424 Passenger and freight, E424.2 Push-pull medium distance trains.

Use: 105 of the **158** E424 built between 1943 and 1952 were rebuilt for push–pull Regional trains, and are now known as E424 N for Navetta, numbered E424.2.

The remaining E424 were withdrawn in the late nineties.
E424.2 in MVDE livery with a regional train 2000 Model: Tardioli Alessandro, Texture: Edoardo Govoni

Class:	**E444 R**
Number Built:	**113**
Rebuilt:	**1989**
Voltage:	**3kV DC**
Speed:	**200 Km/hr**
Max Cont	**4020 kW**
Multi:	
Push Pull:	
Number Passeggeri:	**113**
Colour schemes:	Red/pearl grey; XMPR

Use: Fast Passenger

"Turtles" E444 and E447 built 1970-74 were rebuilt with new cabs with air conditioning, aerodynamic fronts and new electronic controls for better control of power. Used for pulling for pulling passenger trains at 200 km/h.

Above E444 R in XMPR livery at Ventimiglia Summer 2002. Model: Pek Repaint Gogo

An E444 Turtle in the early nineties prior to transformation in its class scheme of blue and pearl grey, with red front. So called because of the shape and the Turtle cartoon on them

The first Italian DC loco to run over 200 km/h built between 1967 and 1978 in 2 series, 006 to 057 the 1st and 057 to 117 the 2nd, plus 4 preseries loco and one (number 005) with a "full chopper" electronically starting device. Model Vittorio Dell'Aquila

Class:	**E464**
Number Built:	**50**
Built:	**1999 -**
Voltage:	**1.5/3 kV DC**
Speed:	**160 Km/hr**
Max cont power	**3000kW**
Multi:	**No**
Push Pull:	**Yes**
Number Regionale:	**ordered**
Colour:	XMPR

Use: Push-pull medium distance passenger

A single cabin locomotive used for push-pull operations of medium distance passenger wagons, including single deck UIC-X, the single deck with the low floor, and the double deck wagons seen here. The rear door is a baggage/ cycle compartment, although apparently it's a bit of a heft up.

Model: Niels Picciotto/Ernesto Imperato

Class:	**E632**	**E633**
Number Built*:	**66**	**151**
Built:	**1982-87**	**1979-88**
Voltage:		
Speed:	**160 km/hr**	**130 km/hr**
Max Cont	**4350 kW**	**4050 kW**
Multi:		**Yes**
Push Pull:		**Yes**
Number Regionale:		**55**
Cargo:	**66**	**94**

The **Tiger** were the first of a new generation of electric locomotives, and are not articulated, with the E 632 for passenger and the E633 for Cargo. The E632.1, no longer in service was a rebuilt E633 with a speed of 160 km/hr

The E633.2 were modified for multiple operations on mountain lines, although are often used for push-pull passenger trains.

The Tigers use **Chopper Control**, a development in electric traction control that eliminates the need for power resistors by causing the voltage to the traction motors to be switched on and off (chopped) very rapidly during acceleration. It is accomplished by the use of thyristors and will give up to 20% improvement in efficiency over conventional resistance controls.

Colour schemes: Blue Pearl Grey, with a Smallish Tiger cartoon, XMPR

*Iincluding Prototypes

E633 on a Genova-Ventimiglia Intercity June 1997. Model Grandi Officine Trenomania

Class:	**E636**
Number Built:	**469**
Built:	**1940 - 1962**
Voltage:	
Speed:	**110 Km/hr (14 120)**
Max cont power	**1660 kW**
Multi:	
Number Regionale:	**34**
Cargo:	**237**
Colour schemes:	Brown Isabella; simplified Isabella; Lt blue/Red front (one 636-284 “Camilla” rebuilt with a new front design after an accident); XMPR

Use: Now freight, some regional trains

An electric locomotive designed with an articulated body and Bo Bo Bo driving arrangement to maximise the adhesion on Italian system sinuous lines. This is an arrangement that FS maintained through three generations. Built until 1966 so progressive improvements and variations. Some have gearing equipped for 120km/hr.

Many are or have been mustered out, but others are showing a new colour scheme.

E633 in the (one of the) current Isabelle scheme. Model: Richard De Stefani

An E 645 of **the second series** with a freight train 2000.

Model: Alessandro Tardioli

Class:	**E645**	**E646**
Number Built:	**98**	**199**
Built:	**1959 -1965**	**1958**
Voltage:	**3kV DC**	**3kV DC**
Speed:	**110 Km/hr**	**140 Km/hr**
Max Cont power	**3480kW**	**3480 KW**
Multi:		
Push Pull:		**Yes**
Number Passenger:		**-**
Regionale		**198**
Cargo:	**96**	

Colour schemes:

At present FS paint all E645 with a complete Isabella (light brown) livery. The Milan depot has painted some working locomotives in their historical colours. See http://www.miol.it/stagniweb/smist-i.htm (Section in English).

The E646 seems to be in every scheme except Red.

Use: E645 Freight, although can be seen pulling passenger, E646 Passenger including push-pull.

Articulated Bo-Bo-Bo locomotives. The first series of 645 have cabs similar to E636, while the second series (E645.033 +) has cabs like E646 (which is the passenger version of E645).

The most important FS locos in the Sixties, when, they were pulling heavy and fast trains from the North to the South of Italy.

All of the E646 are push-pull, the later ones from new, and the others retrofitted. 78 of the E646 push pull engines will be refurbished.

E646 at Torino Sept 2000.

Model: Alessandro Tardioli

Class:	**E652**
Number Built:	**176**
Built:	**1989 - 92**
Voltage:	**3000**
Speed:	**160 Km/H**
Max cont	**4900 kW**
Multi:	**Yes**
Push Pull:	**Yes**
Number Passenger:	
Regionale:	**21**
Cargo:	**153**
Colour schemes:	Blue- grey; XMPR

Use: Intercity; Freight, (including both on the Brenner) and regional, including a short stretch at half-power in France to Mundane.

"**Tigri potenziate**" Powerful universal locomotives developed from the E632/ E633 Tiger, with three four-wheel axels.

Model: Pek

Class:	**E656**
Number Built:	**461**
Built:	**1975 -89**
Voltage:	**3 kV DC**
Speed:	**150/ Km/hr**
Max cont Power:	**4200 kW**
Multi:	**78**
Push Pull:	**78**
Number Passeggeri	**98**
Regionale:	**72 +58N 237**
Cargo:	
Colour schemes:	Blue-grey; XMPR

Use: Fast passenger; cargo; push-pull

When the time came in the mid 70's to choose a new loco the FS decided on an updated version of the E636 and E646, using the same articulated frame design and Bo Bo Bo arrangement, which are ideal for Italy's sinuous lines, rather than in untested new electronic controls.

The last 58 built between 1987-89 (656.551 +) are equipped for push pull and multi-unit.

E656 Ventimiglia Summer 2002 Model: Pek

Resources

MSTS

http://www.trenomania.it/ A Major site for routes, and stock. Has a Quality Control system

http://www.allfreenet.it/train-simulator/ All Free Net – another large selection, but duplicates some of above.

http://digilander.libero.it/pek317/ Pek's site

Railway

http://www.miaferrovia.it Excellent site for Technical details

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http://web.tiscali.it/no-redirect-tiscali/il_mondo_dei_treni/trifase.html In Italian - on the Three-phase electrification

http://interrail.publinet.it/ Historical Pages (in Italian)

The Number in Use came from the stock tables at the European Rail server http://mercurio.iet.unipi.it/list/italy.html

For details of technical terms see **The Railway Technical pages** http://www.trainweb.org/railwaytechnical/

Others in the series

Trainsimming Modern German Railways (Three Parts)
Trainsimming Modern French Railways (Three parts) (Also in French)
Trainsimming Modern Swiss Railways (SBB and BLS).

From www.trains-sim.com www.thetrain.de and www.trainsimfrance.net