

# Diesel Locomotives of Indian Railways: A Technical History

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**Abstract** In this article, we would like to trace the history of the growth of diesel traction of Indian railways without completely sacrificing technical details. It starts from the very early times and discusses at length the coming of the ALCO locomotives on the Indian Railways (IR) and the reappearance of EMD locos on IR. We have tried to mix the historical facts with technical facts therefore calling the study presented in this paper as technical history.

## 1 The Early Diesels

Since this is a technical article on the diesel locomotives of the Indian Railways (IR), we urge the reader to first have a look at the appendix, where the locomotive codes are explained and then it would be easier to go through this article.

Diesel locomotives on IR have a long history. However the early history of diesel locomotion on IR is not very clear. It is usually assumed that the WDS1 broad-gauge diesel shunters worked in the Bandra area of Bombay (now Mumbai) in the 1930s. However Terry Martin [1] in his wonderful study on the Darjeeling Himalayan Railways, mentioned that one of the first successful dieselization in India occurred on Gaekwad's 2 ft 6 in. narrow-gauge Baroda State Railway in 1932, when Armstrong-Witworth sold four 80 hp diesel railcars. The same company supplied 90 hp diesel electric railcars to the Kalka-Shimla railway in 1933. In fact Terry Martin [1] wrote about an attempt to use diesel traction on the Darjeeling Himalayan Railways (DHR) when their directors put an order for a diesel locomotive fitted with a 165 hp General Motors (GM) diesel engine with Walford

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Transport Limited, which had its main office in Calcutta (now Kolkata). The unit cost was 23,950 rupees. However this locomotive was not successful on the DHR. Terry Martin [1] also claimed that this was one of the first diesel locomotives to be built in India. This had a mechanical drive with a five speed gear box.

Though IR now appears to be a broad gauge railway, the first mainline dieselization on IR began with the introduction of YDM1 locomotives in 1955 on the meter-gauge and they were first homed in Gandhidham on the Western Railways. There were 20 such locomotives with hydraulic transmission. One of the first beneficiaries of dieselization in India was the Northeast Frontier Railway. Its important rail junction Siliguri was the first home to YDM3 class diesel-electric locomotives built by the Electromotive Division of the GM. These locomotives were transferred later on to the Abu Road diesel shed of the Western Railways. The GM was the ruling king among diesel locomotive manufacturers. IR had however decided that though they need to move from steam to diesel, they did not want to remain captive to the big international manufacturers. They wanted to get a technology blueprint of a simpler locomotive and manufacture it in India. Though they approached GM for a technology transfer, GM was reluctant. However they did supply India with the superb 2400 hp WDM4 class, Co-Co diesel-electric locomotives, which were an export version of SD-24 class locomotives used on the railroads in the USA. These were supplied in 1962 and homed in Mughalsarai with a specific shed built for them. These locomotives were praised by most railwaymen associated with diesel traction in India. Only 72 of them were bought. Meanwhile IR experimented with hundred WDM1 class diesel-electric locomotives manufactured by American Locomotive Company (ALCO) in 1958. Dubbed as the “World Locomotive” by ALCO, these locomotives were mainly used in the Eastern and South Eastern Railways. Fitted with an ALCO class 244, V-12 diesel engine producing 1800 hp, it was used mainly for coal trains, but was also used for dieselization of some important trains like the Howrah-Madras Mail. It might be interesting to speculate why ALCO christened the WDM1 as ‘World Locomotive’. These locomotives were provided with swing bolster, double suspension “World” Co-Co bogies. The term “World” refers to the fact that WDM1, which was called DL-500-C could work across various railways of the world. This locomotive had a 16 tonne axle load thus it could work in places where high-axle loads were not possible but had demand for faster trains. Apart from the IR, DL-500-C had worked in many other railways, for example RENFE in Spain. Once inside the locomotive cab, one would be surprised that it still used a steam-era whistle chord. In fact it has one control stand and boasted a dead-man’s paddle, which the driver had to keep his foot on while driving. The drivers however were clever enough to just put a brick on the dead-man’s paddle to save them from the irritation to keeping one of their feet on the paddle throughout. The WDM1 had a good visibility and was of the carbody design where all the equipment including the cab were hosed under a single casing.

IR at that period of time operated all trains with vacuum brakes, a legacy of the British Raj though air-brakes were more efficient. If one walks down from the cab of the WDM1 through the equipment section, one would first come across the electrical compartment, which consists of the main DC generator and an auxiliary generator and then the prime-mover, the V-12 ALCO 244 four-stroke diesel engine

and then the compressor-exhauster unit. This exhauster was a special fitment for the IR, since the exhauster is used to create the vacuum in the train brake pipe. With a gear-pinion ratio of 92:19, this locomotive was capable of reaching upto 122 km/h though as per IR practice, it was restricted to 105 km/h. It had a fuel tank with a capacity of 3000 l diesel. At a speed of around 22 km/h, the maximum continuous tractive effort was achieved by the WDM1 which was about 19,280 kg. Continuous tractive effort is the tractive effort that can be maintained by the locomotive for a great length of time without damaging the traction motors. For more details on tractive effort, see the Wikipedia article ([https://en.wikipedia.org/wiki/Tractive\\_force](https://en.wikipedia.org/wiki/Tractive_force)). Note that one should not confuse it with maximum tractive effort, which is achieved at much lower speeds but cannot be maintained for a long-time. The WDM1 locomotive did not have a dynamic brake, which was indeed a disadvantage for heavy freight operation and a more powerful and well equipped diesel locomotive was sought by the IR. The first ALCO shed was built in Gaya on the then Eastern Railway to house the WDM1 class locomotives. It was later dismantled, when the route was electrified.

Since higher horsepower locomotives were required by the IR, they originally approached the GM for a technology transfer, which as we mentioned, did not work out. However ALCO agreed to transfer the technology of DL560C class 2400 hp locomotive with a V16 engine, dubbed as ALCO 251B. In fact the ALCO 251-B prime mover was delivering 2600 hp under ideal test conditions, which translated to 2400 hp braking horsepower, that too under ideal test conditions, as prescribed by the Association of American Railroads (AAR). It was rechristened as the WDM2 and was capable of operating at a maximum speed of 120 km/h on IR and it became the most reliable broad gauge (5 ft 6 in. gauge) locomotive in the history of IR (Fig. 1). Though it was bought in as an intermediate step before electric traction takes over, however to the dismay of many electrical engineers on IR, the WDM2 had a complete sway over the IR operations. It was a locomotive adapted to operate in our dusty conditions and was very versatile in operating freights and cross-country mail/express trains. The testimony of the operating capability of DL 560C was borne out by the fact that it operated with an amazing reliability on the Andes mountain route to Cuzco from Lima, which was in 1960s, the highest altitude railroad in the world. The WDM2 was a Co-Co locomotive fitted with ALCO-trimount bogies of asymmetrical design with traction motors fitted in an asymmetrical fashion too. This bogie caused track damage on IR initially but then IR tweaked the design in a way that the tracks are not harmed. In fact this Co-Co trimount bogie did a lot of track damage on the US railroads, which finally led to ALCO going out of favour with important railroad companies and then closing down altogether in 1969. In fact, ALCO had licensed the technology to companies in developed countries like England, Spain, France, Australia and Canada. India was the only developing country included in this list by ALCO.

Compared to the WDM4, the machinery of the WDM2 was very simple and thus was easy to maintain by engaging a workforce, which had just moved into diesel from steam. The only new thing was the electrical components as the WDM2 was a diesel electric locomotive, for which the staff was required to be trained. The WDM4



**Fig. 1** A WDM2 class locomotive built by DLW, homed at Pune Shed of Central Railway

needed specially trained staff. In fact ALCO completely transferred the technology of WDM2 to IR and helped it build its first indigenous diesel locomotive manufacturing facility in Varanasi, which was named as the Diesel Locomotive Works (DLW). It first began by assembling the knocked down kits sent from ALCO. This first such assembled kit was the WDM2 numbered 18233, which was dedicated to the service of the nation by the then Prime Minister Shri Lal Bahadur Shastri. ALCO meanwhile supplied around 121 fully assembled WDM2 to IR. DLW later on built WDM2's on its own and carried out several design modifications. More than 50 years of its coming to IR, the higher horsepower variants of the WDM2 family still continue to serve the IR and the nation. For more details on the WDM2, and various ALCO locomotives of IR, we would request the reader to consult the only book written about Indian ALCOs, which is titled "*The Story of Indian ALCOs: Legend of the WDM2*" by S. M. Sharma and J. Dutta [2].

It will indeed be a good idea to take a closer look at the WDM2 locomotive. The WDM2 is a road-switcher design, if we use the terminology of the US Railroads. It has a short-hood and a long-hood housing, the machinery with a cab in between the long and short-hoods with an inspection walkaway. We would take a walk from the short-hood peep into the cab and then walk along the inspection walkways and look at various machines in the WDM2. The short-hood houses the dynamic brake grids and the blower motor to cool the grids. It also houses the braking system. In fact, the

early WDM2 were equipped only with vacuum brakes and used a Westinghouse braking system called 28LV1. When DLW started making WDM2's capable of both, air-brake and vacuum-brake operation, the braking system was called 28-LAV-1. The battery knife-edge switch, which is a prime requirement before starting a dead locomotive, is also housed in the short-hood. Now once inside the cab, one would find WDM2 to be quite ergonomic by the standards of the 1960s. There are two control stands. One for the short-hood operations and the other one for the long-hood operations. In both cases, the driver sits on the right, while the assistant sits on the left. The visibility of the WDM2 in both operations was pretty good and the drivers were very happy with these sturdy machines. Originally backrests were provided in the driver's seat however they were removed later on. We say that the layout was ergonomic in the sense that the control stand was clearly divided into two parts. The pneumatic part consisted of the gauges for the braking system like brake cylinder and brake pipe pressure, auxiliary reservoir and main reservoir pressure and a vacuum level measuring gauge along with the train brake handle (A9) and independent locomotive brake handle (SA9). Among electrical parts, we have the throttle, which can be operated over a range of eight notches. It has a reverser handle and also has a dynamic braking handle, an ampere meter, an electrical speedometer (on the long-hood control stand), warning lights, head lights and classification light switches, multiple-unit shut down switch and so on. If we sit in the short-hood control stand facing the short-hood, the wall separating the cab and the long-hood houses the electrical contactor, which are used to supply the current to the DC traction motors on the axles. It also houses the engine control switch and the traction motor cut-out switch. Then as we leave the cab and move down the walk way, we first find the electrical cabinet having the main generator and the auxiliary generator. Just on the inspection door is the front-truck traction motor blower. As we open the inspection door, we see huge ALCO 251-C prime mover and its Woodward governor. Further down, we have the compressor-exhauster cabinet followed by the radiator room with a huge radiator fan and a water tank attached to the roof, from where the water is supplied across the main engine to keep it cool. Inside the radiator compartment, apart from the huge radiator fan, one can see the encasing of lube-oil filters. The WDM2 has a big fuel tank (5000 litres capacity) and two main air reservoirs hung on two different sides. The one on the right side is for braking and the other one on the left side is for other pneumatic activities such as sander, windshield wiper, etc. For more details, please refer to ref [2]. With a gear-pinion ratio of 65:18, ALCO DL 560-C gave the maximum speed of 129 km/h with 17 MT axle load. On IR, WDM2 had 18.8 MT axle load and with the same gear-pinion ratio, its maximum speed was restricted to 120 km/h.

The WDM2 locomotive came in several series of road numbers. They were in 18 series, 17 series and 16 series and built in that order. The first WDM2 i.e. the class leader was 18040, which is now on display in the National rail Museum in Delhi. However the first WDM2 to reach the Indian shores was 18046. In fact from 18,000 to 18039, IR had numbered the WDM4 s the great rivals for WDM2. The WDM2's made by ALCO achieved under test conditions a continuous tractive effort of 28580 kg at a speed of 18 km/h.



The WDM2's have a life of 36 years. In fact one of the most important features of the approach to dieselization on IR was the standardization of WDM2 as the main broad gauge locomotive. Hence all over India, it was the same locomotive and a particular locomotive could be attended to, even if it was hundreds of kilometres away from its home shed. This had not been the characteristic of development of electric traction in India, which experimented with various classes of locomotives, making the maintenance of an electric locomotive very difficult and challenging, if it was far from the home shed or home railways. This simple standardization of diesel locomotives turned the WDM2 into the most reliable locomotive in the entire history of the IR. We must also take a careful note that all future developments of diesel locomotives done by the Indian railways were based on ALCO technology on WDM2 platform.

Looking at the success of the WDM2, IR also went in for an ALCO locomotive for the meter-gauge sections. This locomotive classified DL 535 by ALCO was rechristened as YDM4 in India (Fig. 2). Several locomotives of this class were built by the Montreal Locomotive Works (MLW), Canada, which was an ALCO subsidiary. Unlike the broad-gauge designs, the YDM4 was fitted with an ALCO 6-cylinder in-line 251-D engine, which gave 1350 hp and a brake horsepower in the range of 1100–1200 hp. Without any competition from electrics, this locomotive



**Fig. 2** A DLW manufactured YDM4 meter-gauge diesel of the ALCO design

continued to hold its dominance over the vast meter-gauge network in India. These locomotives were capable of going to a maximum speed of 96–100 km/h and thus allowed introduction of many crack-trains on some important meter-gauge routes. The DLW started building this locomotive from 1968 till early 90s before the project-unigauge slowly took many YDM4's out of service. Many of them still work in Malaysia. In fact, the locomotives built in MLW were rechristened YDM4A and were used for hauling crack meter-gauge expresses like the Delhi-Jaipur Pink City Express and the Madurai-Chennai Egmore Vaigai express. These trains had very tight schedules, which would be envied even by the broad-gauge Shatabdi express trains. The YDM4 was a road-switcher like the WDM2 but had only one control stand. So if the loco ran with the short-hood face, then the driver sat on the right and while operating in the long-hood mode the driver sat on the left. In fact the Engine control switch (ECS) is in the control stand unlike the WDM2, which was in the electrical cabinet. The YDM4 had fuel tank quite similar in looks to that of WDM1 and had a capacity of 3000 l. With a gear-pinion ratio of 92:19, the locomotive ran at a maximum speed of 96 km/h, which was tweaked to 100 km/h on the YDM4A's, which led IR to introduce many meter gauge crack trains.

A very interesting experiment was carried out on the south central railways around 1970s, where they bought around eight diesel-hydraulic locomotives, which operated at a speed of 120 km/h. Two of them were fitted with Mercedes-Benz engines, while others were using a transmission designed by an Indian engineer M. M. Suri. All the eight locomotives were built by Henschel, Germany. Though they were very sophisticated locomotives (Christened as WDM3) and were efficient, their maintenance cost increased since they could not operate in dusty environment, typical to India. The only resource for WDM3 seems to be the website of the Indian Railways Fan Club (<http://www.irfca.org/faq/faq-loco2d.html>).

On the narrow gauge however, the diesel-hydraulic locomotives became the mainstay with ZDM3 and ZDM4 still operating Kalka-Shimla railway and NDM6 on the Darjeeling Himalayan Railway. These locomotives were in fact built at the Chittaranjan Locomotive Works (CLW), Kolkata, which is mainly an electric traction building unit but has developed facilities to build diesel hydraulic locomotives. They built famous shunters of WDS4 class, which were seen in major terminus stations and later replaced by DLW built WDS6 class 1350 hp diesel-electric shunters, having a YDM4 power-pack under a broad-gauge hood.

## 2 Improving WDM2

It was realized during 1980s that in order to keep up with the growing demand of railroad transportation in India, a higher-horsepower version of WDM2 locomotive was essential. The Engine Development Directorate of the Research Design and Standards Organizations (RDSO), Lucknow has been making efforts for quite some time since 1980s to improve the horsepower of ALCO 251-B prime mover. They

could successfully uprate it to produce 3100 hp over a period of time. This could be done by design and development of double helix fuel injection pump, use of steel cap pistons and optimised turbochargers, in addition to few other changes. In fact at the Charbagh diesel shed, Lucknow, a WDM2 locomotive (18589) was fitted with this higher horsepower engine, which is now called 251-C. Instead of the standard DC/DC transmission, they put in an AC/DC transmission bought from General Electric (GE), Canada. They also fitted it with a higher capacity fuel tank. Under test conditions, the locomotive produced 2800 hp, which was a significant jump over the original WDM2. Thus was born the WDM2C which was later rechristened as WDM3A (Fig. 3) (do not confuse with WDM3, which was diesel hydraulic locomotive). This locomotive thus became the benchmark for development of higher horsepower diesels in India. Further it was realised that time has come to give-up ALCO Co-Co trimount trucks and develop separate locomotives for freight and passenger services. The WDG2C, which was finally called WDG3A with the 251-C, 3100 hp prime mover and high-adhesion bogies, became an instant success in freight operations (Fig. 6). IR wanted to move forward and have higher horsepower locomotives. The latest in that line was WDM3D, which was to have a 3400 hp power-pack however in actual operating conditions, it produced only 3300 hp. The WDM-3D was a micro-processor controlled locomotive, which performed in a reliable manner. There was also a model called WDP3A, which had a potential to operate up to 160 km/h and was of a very unique car body design, in sharp contrast to the traditional hood design of IR. This locomotive worked on crack express trains in the northern part of the country well into the mid-2000s and then was shifted to



**Fig. 3** A WDM2 rebuilt as 3100 hp WDM3A by DMW patiala



ordinary passenger services. This class of locomotives still haul the Rajdhani Express from Hazrat Nizamuddin to Trivandrum Central in the Baroda-Trivandrum segment of the journey. An earlier experience in building the passenger locomotive was gained by using an upgraded version of ALCO-244 V-12 engine, which is now rated at 2300 hp. These locomotives with Bo-Bo bogies and classified as WDP1 were thought to be good for fast intercity services however they didn't perform well in practice.

The Diesel Modernization Work (DMW) at Patiala, formerly known as the Diesel Component Works (DCW) regularly carries out mid-life rehabilitation of WDM2 class locomotives and rebuilds them as WDM3A class locomotives. See [2] for more details Fig. 4.

IR had very recently (2013) developed a very unique diesel locomotive, where the diesel engine was replaced by three 800 hp diesel generator sets. This is a very energy efficient locomotive and looks almost like the ones found on US railroads. One can use all three, only two or just one generator set as per the duty assigned to the locomotive. It has been named WDM2G, and is made for light passenger trains. In fact, the current developed by the generator sets is fed to the traction motors and has a capacity of running at 120 km/h. Only two have been built until now and homed in Itarsi.

Before we end this section, it would be interesting to mention the role which IIT Kanpur has played in the development of the first Electronic Fuel Injection (EFI) system for the ALCO 251-C, 3100 hp diesel prime mover. This was achieved by a collaboration of Engine Research Laboratory (ERL, [www.iitk.ac.in/erl](http://www.iitk.ac.in/erl)), IIT Kanpur under the stewardship of Prof. Avinash Kumar Agarwal and Engine Development Directorate (EDD), RDSO under the stewardship of Dr. Anirudh Gautam.



**Fig. 4** WDM3A class locomotives with high-adhesion bogies for heavy freight operations



**Fig. 5** A long-hood view of the EFI locomotive (Photo courtesy: Prof. Avinash K. Agarwal)



**Fig. 6** A short-hood view of the EFI locomotive (Photo courtesy: Prof. Avinash K. Agarwal)

An old WDM2 (16502) was rebuilt at DMW, Patiala as a 3100 hp WDM3A (16502R) in 2011 (Figs. 5, 6), which was retrofitted with the EFI system developed at ERL, IIT Kanpur. This was the first locomotive based on the ALCO platform to have an EFI system anywhere in the world. This locomotive was unveiled in August 2011 at DMW, Patiala and then homed at the Charbagh Diesel Shed, Lucknow. This locomotive showed superior engine performance in comparison with the standard WDM3A. An electronic fuel injection system for a 4-stroke, 16 cylinders, V-configuration, medium speed, large bore locomotive diesel engine has been developed and successfully retrofitted on a rebuilt diesel locomotive. The engine employed a Pump-Line-Nozzle (PLN) system for fuel injection into the cylinder. Original fuel injection system used was a mechanical fuel injection pump connected to a mechanical fuel injector through a high pressure fuel line. The fuel injection pump metered the fuel delivery using a single helix machined on its plunger. The fuel injection timings were however optimized only for the rated speed and load resulting in non-optimised operation at other engine operating points. An electronic fuel injection pump having a solenoid valve for both fuel metering and injection timing along with ECU were developed for retrofitment on rebuilt diesel locomotives. Interfacing of the ECU to the engine test cell controller was done by developing suitable hardware and software. ECU calibration was done and various maps of the engine were developed. The engine was tested on the engine test bed at EDD, RDSO, Lucknow. High pressure injector, modified fuel headers, fuel connection systems, a new high capacity fuel pump and layout of the wire harness were installed. After thorough testing and debugging, the EFI kit was retrofitted on a rebuilt diesel locomotive at DMW Patiala and tested on load box followed by brief field trials. EFI system delivered 3.3% fuel saving in passenger duty cycle and 3.97% in freight duty cycle. In addition there was an appreciable reduction in the smoke emissions during steady-state as well as transient operations. For more details see [3].

### 3 Back to the GM-EMD

The GM diesels had been on the IR's mind and they also knew that big manufacturer will allow technology transfer, if they are on a back foot in their domestic market. Finally GM-EMD was on the back foot in the US market, while facing a stiff competition from GE. To stay on in the market, EMD introduced the first diesel locomotive with 3-phase AC asynchronous traction motors. This locomotive classified as SD70MAC showed a great potential in hauling coal trains. IR in fact used this opportunity to transfer the technology of SD70MAC to India. GM agreed this time for the technology transfer in order to increase their global footprint and to stay afloat in the locomotive market. They then built the GT46MAC and GT46PAC, which were the export versions of SD70MAC with separate passenger and freight versions. These became the now famous WDG4 and WDP4 diesel locomotives of the IR. Fitted with EMD 710 V-16 two-stroke diesel engines producing 4000 hp, these locomotives with AC traction motors were a complete

revolution in the diesel locomotive scenario in India. Having high adhesion bogies of the High Tension Steel Cast (HTSC) type, micro-processor control and an ergonomic cab, these locomotives immediately became a hallmark of advancement of diesel traction in India.

Let us now have a brief look into the way a WDP4 or a WDG4 functions. These locomotives have a diesel engine that runs a traction alternator (AC generator), which produces a single-phase AC, which gets rectified as DC, whose voltage can be varied as per the throttle position (Fig. 7). This is called the DC link voltage, which is fed into the two Traction Control Cabinets (TCC1 and TCC2), consisting of Traction Inverters and their associated computers. They convert this DC link voltage to variable frequency 3-phase AC voltage and then feed it into the traction motors. In fact the computers in TCC1 and TCC2 are linked to the main EM2000 computer in the cab, thus the power output is always known to the drivers. Further an important feature of the EMD locomotive is that when the traction motor is overloaded, the on-board computers can reduce the field excitation of the traction alternator irrespective of the throttle position. The traction inverters were originally provided by Siemens and were based on GTO technology. An Indian company 'Medha' provides the traction inverters based on IGBT technology, which allowed an increase of horsepower to 4500 hp. In fact in Siemens based TCC1 and TCC2 each controlled only one bogie however the indigenous IGBT technology allowed control of each axle individually. This is a very important improvement in the technology of EMD locos and in fact, the IGBT based locos are called GT46ACe.



**Fig. 7** HTSC bogies on the WDG4 and dynamic braking grids and fans





**Fig. 8** Radiator compartments on the WDP4 class EMD locomotives

The loco has one hood and the cab is at one end. Because of the design of the radiator, there were some visibility issues during long-hood operation thus IR indigenously developed a dual cab version called WDP4D and WDG4D (Fig. 8).

IR is keen on improvement in the horsepower output further. On a trial basis, they built a huge 20 cylinder 5500 hp locomotive called WDG5. These EMD locomotives are now changing the face of IR operations. GM however has sold EMD and EMD now calls itself Electromotive Diesels and changed several hands in short period of time.

**Important Note:** Many of the original data from ALCO was collected from the library of the National Rail Museum (NRM), Delhi, while the lead author was researching on the book [2]. There were several advertisements given by ALCO in the Indian Railways Magazine of 1963/1964 where they also provided detailed data. The lead author had collected the data from those sources. Authors would thus like to thank the National rail Museum, Delhi and the then Director of NRM, Mr. Mayank Tewari for helping and facilitating author's research. The lead author learnt about the important features of EMD locos in 2008 from DLW, Varanasi while researching on the book [2], a very little part of which has been mentioned here.

The lead author would like to note that it is very difficult to carry out academic research on the history of Indian diesel locomotives due to lack of books and academic papers. Most data are with the railways and few facts in this chapter have





**Fig. 9** Front profile of the WDG4 class 4000 hp EMD freight locomotives

been obtained by discussion with various railway employees while working on the book [2] Fig. 9.

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## Appendix: Locomotive Codes

W:	Broad Gauge
Y:	Meter Gauge
Z:	Narrow Gauge, 2 ft 6 in.
N:	Narrow Gauge, 2 ft
D:	Diesel
M:	Mixed Traffic (Both freight and passenger)

G:	Goods Locomotive
P:	Passenger
S:	Shunter
WDM2:	Broad gauge diesel mixed traffic locomotive, model number 2
WDM3A:	Broad gauge diesel of mixed traffic design. 3A represents 3100 hp similarly in WDM3D, 3D represents 3400 hp so it's a slightly strange nomenclature. Here 3 means the 3000 hp class locomotives with A, B, C, D meaning 3100 hp, 3200 hp and so on. WDG4 actually means the goods locomotive and model number 4 by linking it with WDM4, the first broad gauge model from GM but one can also interpret it as 4000 hp
Co-Co:	Two wheel-sets each of three axles, hence six axles in total. Each of the axles has one traction motor
Bo-Bo:	Two wheel set with two axles each and each axle has one traction motor
DC/DC:	DC Generator feeding DC traction motors
AC/DC:	AC Alternator feeding DC traction motors
First BG Diesel shed:	Gaya, homing WDM1
First WDM2 Shed:	Katni, developed with help from ALCO
First EMD Shed:	Hubli

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