भारत सरकार – रेल मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

डब्ल्यू०डी०एम०3डी० लोकोमोटिव का रेखाचित्र पुस्तिका

DIAGRAM BOOK OF WDM3D LOCOMOTIVE

रिपोर्ट सं० एम०पी०.मिस्ले0.153, फरवरी 2008
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अनुसंधान अभिकल्प एवं मानक संगठन
मानक नगर, लखनऊ . 226 011
RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW - 226 011

WDM3D CLASS CO-CO DIESEL ELECTRIC LOCOMOTIVE

BRIEF DESCRIPTION OF THE LOCOMOTIVE

Underframe of WDM3D locomotive has a fabricated lightweight center sill (T – beams) as the main load bearing members. With this design, it is possible to manufacture underframe on fixtures procured for GM locomotives and employ dedicated GMAW welding to control the cambers as well as large scale down hand welding. In addition, the design of side sills has been simplified to reduce weight as well as better pipe clamping / layout and superior run of electrical conduits.

The cab for WDM3D locomotives has been designed on the lines of GM technology. The GM design employs wall and roof structure made of channels covered with the sheets and is, therefore structurally strong. These channels are also used for supporting perforated sheets by use of aluminum rivets, eliminating welding of studs, wooden beams, screws and fiber boards used for ALCO type cabs. PU foam is used in place of fiber glass wool for thermal and noise insulation. The GM design is simple with total elimination of wood and is aesthetically superior. Large cab sliding windows, designed for better visibility and aesthetics, have been incorporated. Cab door is of improved design, incorporating features like improved locks, firm weather strip, thicker door and front glasses.

The locomotive is equipped with high adhesion CO-CO bogies with nominal axle load of 19.5t. The high adhesion bogie provided has some modifications like stem type vertical and lateral dampers in place of eye type for better maintainability, D – shackle similar to GM locomotives, simplified side stopper, modified equaliser and compensating beam profile to avoid fouling with track blast etc., The pipe clamping has also been improved to provide improved clamp with better securing. This locomotive has two-stage suspension. Helical springs in the primary stage and rubber sandwich springs in the second stage have been provided. All traction motors are arranged unidirectional to increase adhesion.

The locomotive is powered with DLW make 251B uprated 16 cylinder fuel efficient engine for continuous operation at 3300 hp to 3600 hp gross engine power with GE7S1716 turbocharger with 22.5 sq. inch nozzle rings, 11.75 CR super bowel pistons and 251 plus cylinder heads and a large after cooler for better cooling of the engine inlet air, commensurate with the increased air flow. The first prototype is provided with one of the essentials for the power up gradation, the newly developed Stiffer unit camshaft assembly and its allied components like modified push rod & fuel cam lifters, fuel pump support etc. with start of injection at 22º BTDC.

The locomotive is equipped with AC-DC transmission consisting of a directly coupled self-ventilated BHEL make TA10102 EV model traction alternator. The existing alternator TA10102 EV has been redesigned to handle 2900 hp to 3000hp input to traction instead of 2750 hp with the rectifier mounted on the alternator itself with the view to reduce the space requirement for alternator – rectifier system, without compromising on the reliability. Axle hung nose suspended BHEL TM 5002 BY light weight traction motors for extended maintenance schedules, reduced axle loads and lower unsprung masses thus increasing the speed potential has been provided with geared for maximum speed of 120 Kmph.

The WDM3D locomotive is equipped with Microprocessor based control system. It provides fault detection of components and system, achieves higher adhesion, faster acceleration and effective wheel slip control.

The locomotive is technically suitable for multiple operations.

The prototype WDM3D Locomotive was turned out from DLW on **03.10.03 and 98 locos turned out till July 07.**

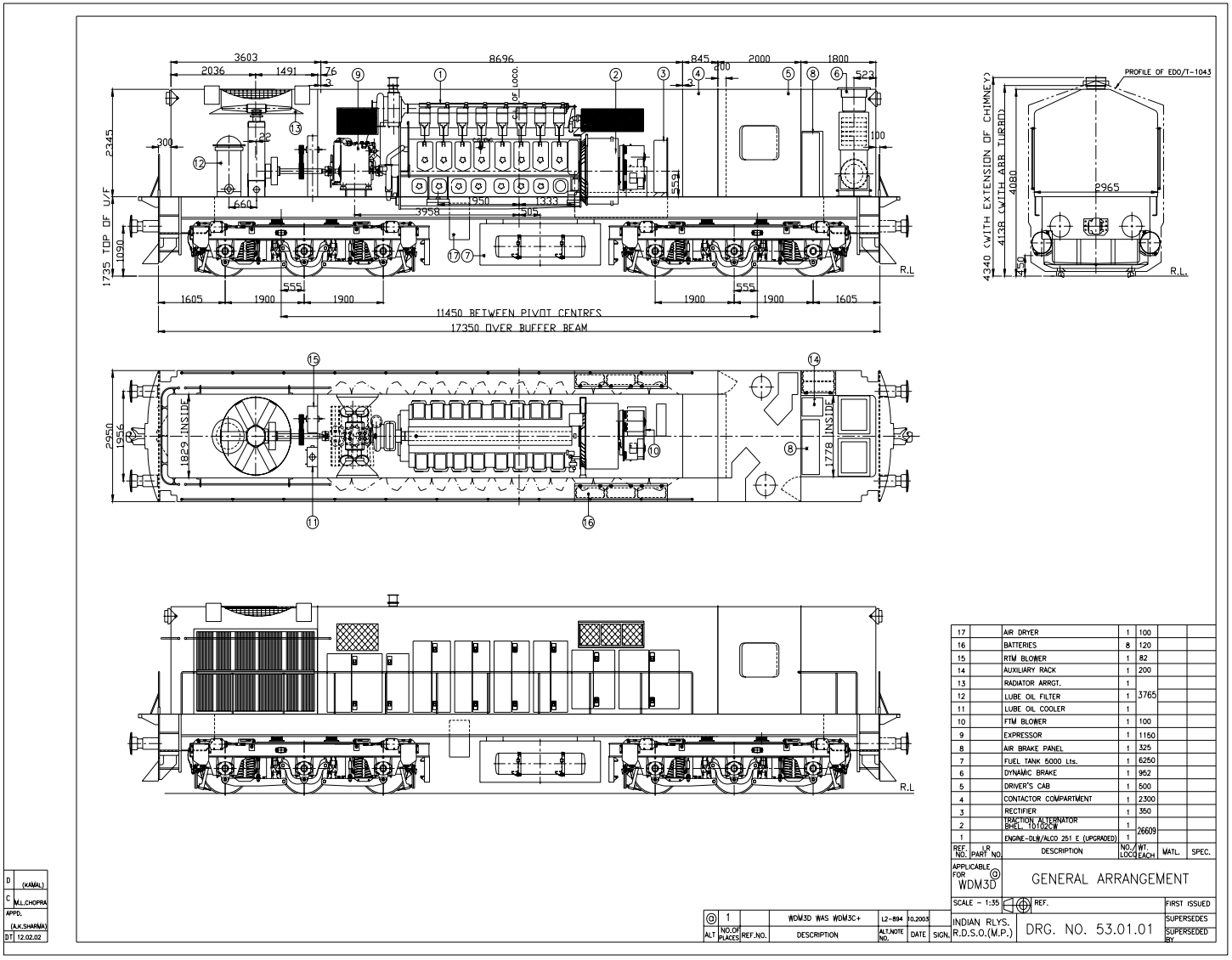
Some of the salient features of WDM3D locomotive

- Fuel tank to GM type design has been provided. This design has inherent advantages such as lesser ineffective fuel, better mounting, effective baffle & drain arrangement, modified filling hole cap assembly and superior design of fuel level indicator.
- Sand boxes as on GM locomotives pattern has been provided as this design has inherent advantages of higher capacity and extra gradient leading to better dispending and reduction in the weight of bogie.
- The main reservoirs and air dryers have been mounted on side sill to simplify the piping layout.
- Under sling battery box has been provided for easy maintenance and better aesthetics.
- Handrails have been provided on the pattern of GM locomotives.
- Compact panel-mounting brakes with three plates design, which do not have external jumper have been proved for superior maintainability and reliability. In addition, an auxiliary panel for the dual brake system has also been provided to help maintainability.
- High capacity rubber spring buffer have been provided.
- The air flow through the alternator has been improved by enlarging the ducting provided for the alternator.
- These locomotives are equipped with Microprocessor based propulsion, excitation and battery charging controls.
- Microprocessor based wheel creep control system has been provided for maximizing adhesion exploitation, employing individual wheel rpm sensing and accurate rpm and acceleration difference computation.
- A Microprocessor based (digital) engine governing system has been provided in this locomotives.
- E- beam irradiation is the modern technology used in traction cables providing better insulation & mechanical strength, higher thermal capability and hence higher current in the same cross- section of conductor leading to considerable saving in wt & oil resistance.
- Mechanically bonded radiators use seamless tube, which are mechanically bonded with header for improved reliability and longer life. Inertial type filter are used in place of mesh type oil soaked panel type car body for requires no maintenance and higher efficiency.
- These locomotives air brake system provides for modified design of the pipe unions/elbows to eliminates the problems related with poor welds and joints. The clamping has also been improved to provide special clamps location- wise.
- GM type pressurization cap which has more seating area and is of robust design has been provided in the design. Quick opening type filling cap on both tanks has also been incorporated. GM type water level gauge, which is of tubular design rather than a gasketted arrangement as in the present design , has been provided as it provides better visibility and eliminates chances of leakage. It is also proposed to provide a reliable electronic water level gauge and LWS on this locomotives.
- Robust and more powerful Sprague type pneumatic wiper motor has been provided in the design. In place of wiper arm, pantograph shall be used for complete wiping of glasses.
- With a view to improving the reliability of the Traction motor insulation scheme, a modified insulation scheme incorporating flexible wrapping tape instead of Kapton mica wrapper, ceramic packing instead of Nomex and glass mica paper instead of conventional glass mica with flakes and associated insulating materials has been provided in the light weight traction motors employed in the locomotives.
- To improve the comfort of drivers, electronically commutated cab fans located above the drivers seat have been provided. These fans should prove much more reliable than DC fans provided earlier.
- The cable conduits used on GM locomotives, both flexible and rigid, employ end fittings, which totally obviate the possibility of any oil or dirt ingress inside the conduits. The flexible conduit covering material is of an improved elastomer. These locomotives design has also provided for this type of flexible conduiting with a view to solving the problems of improperly sealed conduits and resultant cable failures.

- The head light used on GM pattern and is characterized by higher wattage, better quality of lighting due to sealed reflector, beam alignment and sturdy aluminium casting provided with silicon rubber gasketing ensuring longer life and improved reliability.
- LED type Flasher lights offer advantages of lower power consumption , longer life, continuous operation reliability, better visibility, no degradation in optical performance with time, ease in automatic operation, monochromatic nature of light and the built in redundancy for systematic errors.
- Focus lights used on GM locomotives pattern for special prismatic lens, which insures deflection of light at an angle of 20 to 30 degree, and do not cause any glare effect on the eyes of the driver. Sturdy polycarbonate body suitable for temp. upto250 deg C ensures high life for the light fitting.
- The filter housing have been designed with seamless tubes to minimize the welds and improve reliability.
- Improved fuel oil relief and regulating valves have been provided to obviate FO pressure fluctuation.
- An efficient finned type after cooler which affords smaller length and improved cooling of the brake system air has been developed for these locomotives.

Some other features to added

- Provision of rear view mirror
- Air conditioning of driver's cab
- Radiator fan with FRP fan blades
- Modified cattle guard on GM pattern



REF. NO.	A.R. PART NO.	DESCRIPTION	NO./ LOCO	WT. EACH	MATL.	SPEC.
17		AIR DRYER	1	100		
16		BATTERIES	8	120		
15		RTM BLOWER	1	82		
14		AUXILIARY RACK	1	200		
13		RADIATOR ARRGT.	1			
12		LUBE OIL FILTER	1	3765		
11		LUBE OIL COOLER	1			
10		FTM BLOWER	1	100		
9		EXPRESSOR	1	1150		
8		AIR BRAKE PANEL	1	325		
7		FUEL TANK 5000 Lts.	1	6250		
6		DYNAMIC BRAKE	1	952		
5		DRIVER'S CAB	1	500		
4		CONTACTOR COMPARTMENT	1	2300		
3		RECTIFIER	1	350		
2		TRACTION ALTERNATOR BHEL - TD102CW	1	26609		
1		ENGINE-DLW/ALCO 251 E (UPGRADED)	1			

APPLICABLE FOR WDM3D

GENERAL ARRANGEMENT

SCALE – 1:35 REF. FIRST ISSUED

INDIAN RLYS. R.D.S.O.(M.P.) DRG. NO. 53.01.01 SUPERSEDES

SUPERSEDED BY

ALT	NO.OF PLACES	REF.NO.	DESCRIPTION	ALT.NOTE NO.	DATE	SIGN.
⓪	1		WDM3D WAS WDM3C+	L2-894	10.2003	

MAIN PARTICULARS OF WDM3D LOCOMOTIVE

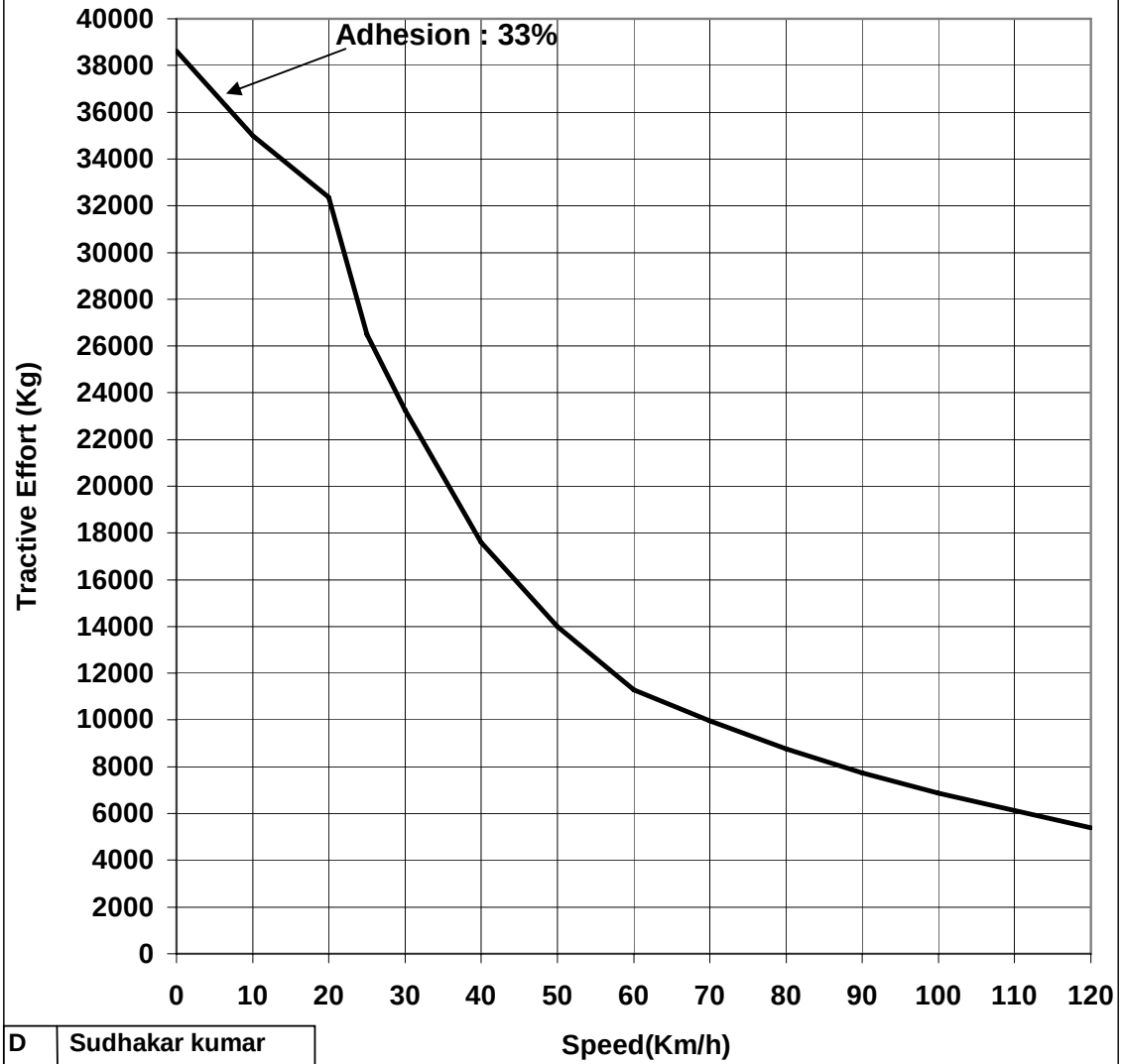
GENERAL		**Cooling system**	
Weight of loco in Working Order (T)	117.0	Water Pump type	Centrifugal
Adhesive weight in Working Order (T)	117.0	Water pump capacity	2457 l/m at 1050rpm
Maximum axle load (T)	19.5	No. of radiator fans	One
Wheel dia (new) Driving mm.	1092	Fan drive	Eddy current clutch
Tractive effort (Kg.), Maximum	38610	Fan power	90 HP at 1050 engine rpm
Continuous	25950	Water tank capacity	1210 litres
Speed (Km/h) Maximum	120	**Turbo Supercharger**	
Continuous	26.10	Make and type	GE7S1716
Transmission	Electric	Governor	Woodward / EDC
ENGINE		Weight of engine (dry) Kg	19026
Make and type	DLW 251B (Uprated)	**TRANSMISSION (ELECTRICAL)**	
No./Loco	One		
Lube oil sump capacity	1270 Litre	**Alternator**	
Horse power		Make and type	BHEL TA 10102 EV
Standard UIC condition	3300 HP	Number per locomotive	One
Site (47^oC – 600m)	3152 Hp	Maximum speed	1050 rpm
Cylinder formation	45 Degree V type	Max. Voltage Max. current	1100 v 4200 A
Number of cylinders	16	Continuous Rating : Low voltage High voltage	 3600 A, 585 V 1938 A, 1075 V
Bore and stroke in mm	228.6 X 266.7	Unit weight with accessories	6400 Kg
Compression ratio	12.5 : 1	**Traction motor**	
RPM		Make and type	BHEL TM 5002 BY
Rated	1050	Number per locomotive	Six
Idle	400	Continuous current	925 A
Mean piston speed m/sec.	9.33	Continuous voltage	380 V
B.M.E.P (Kg/cm^2)	15.041	1 Hr. rating current	950 A
Injection system		Maximum speed	2179 rpm
Type	Jerk direct	Gear ratio	18:65
Type of pump and injector	APFICO AKK	Suspension	Axle hung, nose suspension
		Unit weight(with pinion, gear & gear case)	3250 Kg

AUXILIARIES			
Auxiliary generator		**Sand**	
Make and type	BHEL AG 3101 AY-1	Number of boxes / Locomotive	4
HP absorbed	17 HP	Total capacity	0.16m^3
Rating	75V,160A at 950 rpm	**COMPRESSOR**	
Unit weight	435 Kg	Make	KPC/ELGI
Exciter		Type	KCW 623/LG3CDB
Make and type	BHEL AG 3101AY	HP absorbed	50/52/60KW at 1000 rpm
HP absorbed	30 HP	Weight	850Kg
Rating	80V,250A at 950rpm	**Compressor capacity**	
Unit weight	435Kg	**Free air delivery At 10 Kg/cm^2** At Idling (400 rpm) At 1000 rpm	 2266 l/m (KCW 623/LG3CDB) 5665 l/m (KCW623/ LG3CDB)
BATTERIES			
Make and type	EXIDE (Lead Acid 4HMFG 31KP)	**TM BLOWER (FRONT)**	
Number of cells	32	Type	Centrifugal multi-vane (DIDW)
Voltage	64	Number per locomotive	One
Capacity	450AH (10Hr)	HP absorbed	40 HP
Head light	250W, 32V	Weight	80kg (without motor)
BRAKES		**TM BLOWER (REAR)**	
Locomotive	Air, hand, BHEL make dynamic brake.	Type	Centrifugal multi-vane (SWSI)
Train	Pure air brake system.	Number per locomotive	One
System	Panel mounted IRAB-I.	HP absorbed	34 HP
CONTROL SUPPLIES		Weight	105kg (without motor)
Fuel tank (detachable)			
Number per locomotive	One		
Total capacity	6000 litres		

PERFORMANCE OF 3300 HP WDM3D
CO - CO DIESEL ELECTRIC LOCOMOTIVE

2950 HP input to traction at 1050 RPM

1 - TA 10102 EV Traction Alternator
6 - TM 5002 BY Traction Motors
Gear Ratio : 18/65, Wheel Dia.(HW) : 1055 mm
Cont. Loco. Speed : 26.10 Km/h, Cont. Loco. TE : 25950 Kg
Transition Speed : (i) 42 Km/h(Forward), 39.5 Km/h (Backward)
(ii) 52 Km/h (Forward) , 49.5 Km/h (Backward)
Starting Tractive Effort : 38610 Kg., Max. Speed : 120 Km/h
Motor Combination : 2S - 3P 100%FF, 2S - 3P 70% FF & 6P 100%FF



D	Sudhakar kumar
C	K. Bhattacharya
APPD.	DIR/EM/MP

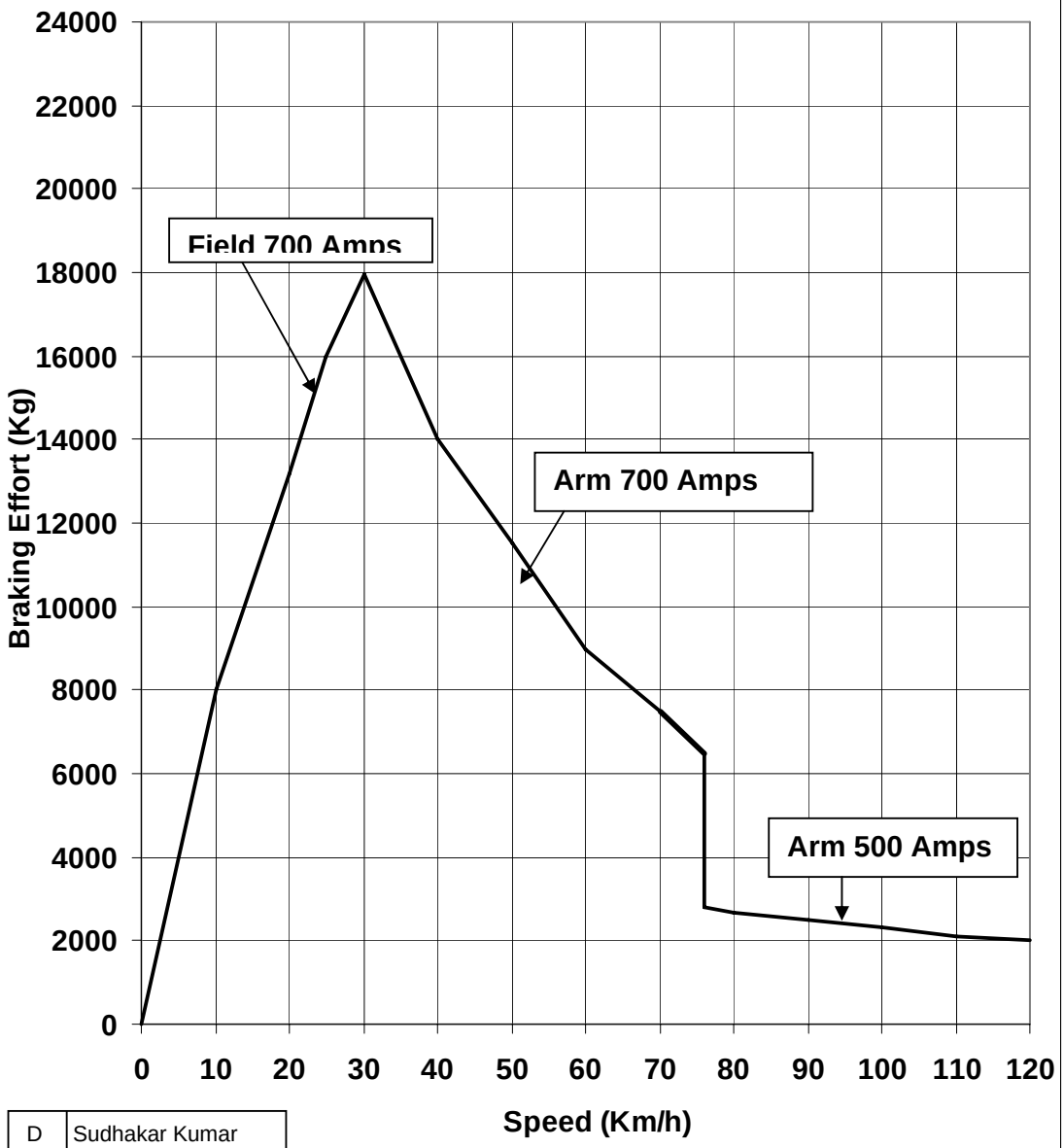
RDSO (MP)	BHEL curve no. TSG/SK/578
	GDP - 1131

DYNAMIC BRAKING CHARACTERISTIC OF 3300 HP BG WDM3D LOCOMOTIVE

TRACTION ALTERNATOR :TA 10102 EV(One)
TRACTION MOTOR : TM 5002 BY(Six)
Wheel Dia. :- 1055mm (Half Worn)
Gear Ratio :- 18:65

Resistance per motor :-
Load :- 0.500 Ohms.,
Arm + IP :-0.0216 Ohms
Total :- 0.5216 Ohms.

Motor RPM :- 18.159 x Loco.Speed in Km/h



D	Sudhakar Kumar
C	K. Bhattacharya
APPD. Vivek Khare Dir/ EM / MP	

RDSO (MP)	GDP - 1142

HAULAGE CAPACITY (PASSENGER)											
LOCO:- WDM3D				**GAUGE :- B.G.**			**WT OF LOCO : 117 t**				
Trailing load in tonnes at Km/h on tangent track, ICF stock (With 0.005m/sec² acceleration reserve)											
GRADE	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**
LEVEL	18135	11260	7460	5170	3825	2880	2240	1765	1370	1050	800
500	8205	5465	3850	2810	2175	1705	1370	1115	890	695	535
400	7210	4835	3430	2515	1960	1540	1245	1015	810	640	485
200	4465	3050	2195	1640	1295	1030	840	695	560	440	335
150	3550	2435	1765	1320	1045	835	685	565	455	355	270
100	2505	1725	1250	935	745	595	485	400	320	250	-
50	1295	885	635	470	370	285	230	-	-	-	-

NOTE:

- Values of trailing tonnages given in the chart are the maximum permissible values. The values are applicable for straight track only. On a curved section actual permissible load will be less than the values specified above. Actual permissible loads should be fixed based on load trial.
- Trailing loads fixed by load trail should be confirmed by load factor trial also and the loads recommended should be such that the load factor does not exceed 60%.

D	Sudhakar Kumar
C	K. Bhattacharya
APPD. BY	Vivek Khare Director/MP/EM

RDSO (MP)	**DE/T – 401 (A)**

HAULAGE CAPACITY (FREIGHT)												
LOCO:- WDM3D					GAUGE :- B.G.			WT OF LOCO : 117 t				
Trailing load in tonnes at Km/h on tangent track, BOXN stock												
GRADE	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**START**
LEVEL	34505	21260	13945	9545	6970	5180	3970	3090	2365	1795	1345	9560
500	10485	7120	5100	3780	2960	2345	1905	1560	1245	980	755	6335
400	8915	6095	4390	3275	2580	2055	1675	1380	1105	875	675	5840
200	5080	3515	2570	1940	1550	1250	1030	860	695	550	425	4185
150	3930	2730	2000	1515	1210	975	810	675	545	435	335	3510
100	2690	1870	1370	1035	830	665	550	460	370	290	220	2650
50	1345	925	670	500	390	310	245	200	-	-	-	1495

NOTE :

- Both starting and hauling of trailing tonnages given in the chart are the maximum permissible values. The values are applicable for straight track only. On a curved section actual permissible load will be less than the values specified above. Actual permissible loads should be fixed based on load trial**.**
- Trailing loads fixed by load trail should be confirmed by load factor trial also and the loads recommended should be such that the load factor does not exceed 60%.

D	Sudhakar Kumar
C	K. Bhattacharya
APPD. BY	Vivek Khare Director/MP/EM

RDSO (MP)	**DE/T – 401 (B)**