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**GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS**

**PARTICULAR SPECIFICATION  
OF**

**2300 HP CAPE GAUGE  
DIESEL-ELECTRIC LOCOMOTIVE FOR MOJAMBIQUE  
(Converted from AC-DC WDM7 Locomotives)  
( *To be manufactured at GOC Workshop* )**

**PARTICULAR SPECIFICATION  
NO. MP- 0.0800.83 (Rev.- 00)  
DECEMBER- 2008**

**RESEARCH DESIGN & STANDARDS ORGANISATION  
MANAK NAGAR, LUCKNOW-226 011.**

## SCHEDULE

2300 HP, Broad Gauge, diesel-electric locomotive having axle load of 16.5 Tonne (Max), for export, complete in all respects, shall be assembled with: -

1. One DLW 12 cylinder 251 B uprated fuel efficient diesel engine capable of producing 2300 HP under standard conditions.
2. One BHEL Make traction alternator model TA 10105 AZ with BHEL make rectifier.
3. Six China make ZD126C model traction motors.
4. One BHEL Make AG 3101AY-1 auxiliary generator or equivalent.
5. One BHEL Make AG 3101AY-1 exciter or equivalent.
6. One complete set microprocessor control equipment.
7. FTTM and RTTM blowers one each.
8. 28LAV-1-brake system with panel.
9. Two sets of CBC coupler & draft gear.
10. Two nos. three axle rigid bolster trimount fabricated bogie with single stages of suspension.
11. One expressor.
12. Weight shall be maintained 99 t with 3T ballast at location shown in GA .

## 1.1 SCOPE

This specification covers supply of Broad Gauge 2300hp diesel- electric locomotives, equipped with AC-DC transmission for Mozambique Railways.

## Locomotive Features

### GENERAL ARRANGEMENT AND EQUIPMENT LAYOUT

2.1 The general arrangement of the locomotive is as per RDSO Drawing No.SKDL - 4714.

### 2.2 Diesel Engine

The locomotive is equipped with Alco power plant of modern, strong design widely used in railroad .The fuel injection system will be controlled through a Woodward electro hydraulic governor of advance design, by the locomotive control system and having altitude compensation system

The Diesel engine shall comply with the current emission standards of UIC624 standard.

#### Diesel Engine Air filtration System

Inertial engine air filter is provided with cleaning of primary air is through cyclonic filter and of secondary air through glass fibre type bag filter Primary fuel oil filter element having RDSO Spec. No. MP.0.2600.05 & Drg. No. SK.DP-85 is provided.

Secondary fuel filter elements having RDSO Specification No. MP-0.2600-2 and Drawing No. SK.DP-2295 is provided.

#### Cooling System and Temperature Control

The Diesel engine is cooled by means of coolant which inturn is cooled with air flowing through tubular radiator, the cooling fan is driven by horizontal shaft coupled with engine shaft adequate size of radiator is provided.

#### Lubricating System

The Diesel engine shall have lubricating system with oil circulated by pump of ample capacity driven by gear train from the diesel engine crankshaft. The lubricating system is provided with primary and secondary filtration system.

#### Fuel oil system

Fuel oil system is an electrically driven fuel pump with emergency shut down mechanism, which is activated from control cab from diesel engine compartment.

Locomotive is provided detachable fuel tank with 3000 litres capacity. Fuel level indicators shall be installed at both sides of the fuel tank and consist of a combination of level indicator of red glow type to measure the fuel level. Provision to collect the drain condensate from fuel tank is provided bottom plate for this collector is made inclined towards the drainage plug.

#### Exhaust system and piping

The exhaust system for the combustion gases of Diesel engine is modular design for easy removal and maintenance. A cover is provided at exhaust out let to prevent rainwater from entering the system when engine is stopped

## **2.2 MULTIPLE UNIT OPERATION**

The locomotives shall be suitable for multiple unit operation upto a maximum of two units.

## **3.2 UNDERFRAME**

Underframe is made with box section design and is suitably modified for any equipments change required for Mozambique Railways. Design of underframe is capable to bear 400 T buff load.

## **3.3 BOGIE**

The locomotive will be equipped with two Co-Co trimount fabricated, fully equalised, and fitted with individual traction motors on all axles. In addition to the swivel bearing type loading pivot with bogie frame, about which the bogie rotates, two load bearing pads, one each side of cross member of the frame. Other features are as per RDSO Drg No SK.VL-557.

## **3.4 DRIVER'S CAB**

The locomotive is provided with full width-driving cab between the long and short hoods as shown in GA Drawing and bonnet type construction, along with two driver's control desk. Left hand drive shall be used.

### **3.4.1 Driver's control desk have following gauges**

- 1 Lube oil, Fuel oil and Booster air pressure gauge.
- 2 TM load Ammeter.
- 3 BP, MR and FP, Air Flow gauge.
- 4 Battery ammeter.

All gauges are of proven and reliable design. Graduations of all gauges are in metric units.

### **3.4.2 The following audio-visual signals are provided in cab**

1. Low lube oil pressure.
2. Hot engine.
3. Wheel slip indication.
4. Battery discharge indication.
5. Aux. Gen. failure indication.
6. Power ground.
7. GFOLR trip indication.
8. Crank case exhauster fails indication.
9. B.P. Air flow indication.
10. Rectifier airflow indication.

### **3.5 SUPERSTRUCTURE**

The locomotive is provided walk board arrangement with opening doors at suitable location for maintenance of equipments and roof is provided with hatch and gull wing door to get access from top. The sidewalls/doors are bolted to the under-frame along with detachable roof.

### **3.6 BATTERY BOX**

Side sill mounted battery box on the under-frame is provided.

### **3.7 FUEL TANK**

Integrated fuel Tank of 3000 litre capacity is provided.

### **3.8 COUPLER AND DRAFT GEAR**

The locomotive is fitted with alliance II AAR type E/F CBC assembly .

**Note:** coupler pocket shall be suitably modified to maintain height as shown in GA.

### **3.9 CATTLE GUARD**

The cattle guard is provided at each end of the locomotive.

### **3.10 BRAKES**

- The locomotive is equipped with 28LAV-1-brake system in accordance with RDSO Drg.No.SK.DP-2918.
- Rake mounted brakes to RDSO Drg No. SK.DP 3346 and schematics to RDSO Drg No.SK.DP-2918 shall be provided.
- All cut-out cocks and self-locking angle cocks are having ball type and open line parallel (OLP) except drain cocks, which are close line, parallel (CLP) type.
- The hand brake operated by lever from driving cab shall be provided.

### **3.11 EXPRESSOR**

Expressor shall be provided to RDSO specification No. MP.0.0700-11 (latest revision).

### **3.13 PIPING**

Heavy-duty seamless pipes to IS: 1239 is used for pneumatic brake system. Flexible pipes shall be provided at the following locations: -

1. Vent pipe connecting bubble collector to expansion tank.
2. Fuel oil secondary filters inlet and outlet.

### **3.14 SANDING**

Automatic sanding during wheel slip from four under-frame mounted sand boxes are provided.

### **3.15 HORNS**

Dual tone horns on each cab for both direction of motion of the locomotive is provided.

### **3.16 FIRE EXTINGUISHER**

Two Dry Chemical Powder type fire extinguishers conforming to IS: 2171 – 1985 of about 5 Kg. capacity of well-known make is provided one in each cab and Gas Cartridge conform to IS: 4947-1985.

## **4.1 DIESEL ENGINE**

4.1.1 The locomotive is powered by DLW 12 cylinder 251 B uprated fuel-efficient diesel engine.

4.1.2 Turbo supercharger having model ABB VTC 304 VG09 is used.

4.1.3 Camshafts with 140 deg. overlap are used.

## **4.3 Safety Devices**

4.3.1 Following safety devices are provided:

1. Water temperature too high (95 deg. C) - Transmission cut-off and engine returned to idle.
2. Low water in expansion tank - Engine shut down.
3. Low lube oil pressure - Engine shut down.
4. Engine speed too high (Over speed trip) - Engine shut down.
5. Adequate protection of an approved design are provided against electrical overloads and grounding.

4.3.2 The following minimum operating controls for multiple unit operation of locomotives from any one locomotive are provided: -

1. Notch control
2. Brakes
3. Forward and reverse movement control

- .4 Sanding
- .5 Wheel slip.

Safety interlock is provided to prevent locomotives in multiple unit operation from being moved when all the locomotives are not set for propulsion in the same direction.

- 4.3.3 The locomotive is provided with speed indicating and recording system to RDSO Specification No. MP.0.3700-01.

## 5.1 GENERAL

All electrical machines and control equipment generally conforms to relevant IEC Publications and tested as per RDSO approved test programme. The temperature rise limits of the IEC Publication shall be reduced by 20 deg. C for traction motor and by 30 deg. C for other machine.

## 5.2 TRACTION ALTERNATOR

### 5.2.1 Alternator Data:

Make and Type	BHEL model TA 10105 AZ
No. Per loco	One
Max voltage	750 V
Max current	4400 A
Weight	5675 Kg
Insulation	Class H
Ventilation	Self-ventilated Excitation
Excitation control	Type E

## 5.3 TRACTION MOTOR (including gear, pinion and gear case)

- 5.3.1 Six axle hung nose suspended China make ZD 126C type traction motors are provided.
- 5.3.2 The alternator end traction motors & rectifier is ventilated by a blower conforming to RDSO specification No. MP-0.2400.11.
- 5.3.3 The radiator end traction motors is ventilated by a sealed bearing type blower conforming to RDSO specification No. MP.0.2400.08.
- 5.3.4 It is preferable to use 18:93 gear ratio. Alternatively 19:92 gear ratio can be used but with some penalty on TE. (TE vs Speed curve enclosed for both gear pinion sets).

#### **5.4 AUXILIARY GENERATOR/EXCITER**

Make & Type	BHEL make 4 poles 3101AY or equivalent.
Number per loco	One Pair
Continuous rating (IEC-30°C)	75V, 160A 12 Kw (Exciter) 18.75 Kw (Aux Gen)
Insulation: (i) Armature (ii) Field	Class H Class H
Ventilation	Self-ventilated
Voltage regulator Type	VR-96
No. Per loco	One
Regulation	72 ± 1 V DC

**5.4.1 Rectifier :** Existing rectifier shall be retained

#### **5.5 LOCO PERFORMANCE AND ELECTRICAL CHARACTERISTICS**

**See Annexure II**

#### **5.6 CONTROLS**

The locomotive is provided with a proven and reliable microprocessor control system based on RDSO Specification No. MP.0.24.00.19.

#### **5.7 STORAGE BATTERY**

50 cells of model SRX2200P (10 trays of 5 cell each) 220 AH Nickel-Cadmium battery of M/s SAFT, France or equivalent.

#### **5.8 ELECTRICAL FITTINGS**

**5.8.1** The locomotive is equipped at both ends with twin beam headlights.

**5.8.2** The locomotive is provided with LED type flasher lights to RDSO Spec. No. RDSO/PE/SPEC/TL/FLT/0002-98.

**5.8.3** The locomotive is provided with LED type marker lights to RDSO spec No. ELPS/SPEC/MARKER LIGHT/01.

**5.8.4** The locomotive is provided with LED type focus lights DLW spec No. DEL/SPN/184.

**5.8.5** The cable running below the Alternator is protected by wooden cleats / conduits or by suitable means to prevent contamination with oil, water or dirt.



## **5.9 DBR AND BLOWER CUBICLE**

Existing DBR only shall be retained.

## **5.10 CABLES**

Electron-beam irradiation cross-linked type Power and Control cables of standard metric sizes shall be provided as per RDSO specification no. MP.0.5200.06.

## **6.1 PAINTING AND MARKING**

6.1.1 The locomotive will be delivered finish with pu paint to RDSO specification no M&C/PCN/100/2006. scheme for marking and painting of the locomotive is incorporated with the requirements of Mozambique Railways.

## **6.2 MAKER'S TEST CERTIFICATE**

6.2.1 Copies of test certificate guaranteeing the performance of the locomotives and its equipment will be supplied in duplicate with the delivery of each locomotive.

6.2.2 Maintenance Instructions, Equipment data, Schematics wherever necessary and Spare Parts Lists indicating catalogue numbers will be supplied to Mozambique Railways.

## **6.3 INSPECTION**

Besides internal inspection by DLW at various stages of locomotive manufacture, the final inspection will be done in accordance with the contract. The following inspection data will be furnished to Mozambique Railway as per the provisions in the contract: -

6.3.1 Certificate of fitness

6.3.2 Equipment maker's & serial Nos. - Electrical.

6.3.3 Equipment maker's & serial Nos. - Mechanical

6.3.4 Axle, wheel and gear record (Maker, Sl. Nos. etc.)

6.3.5 Engine test performance

6.3.6 Locomotive test performance- Mechanical/Electrical

6.3.7 Air brake test results

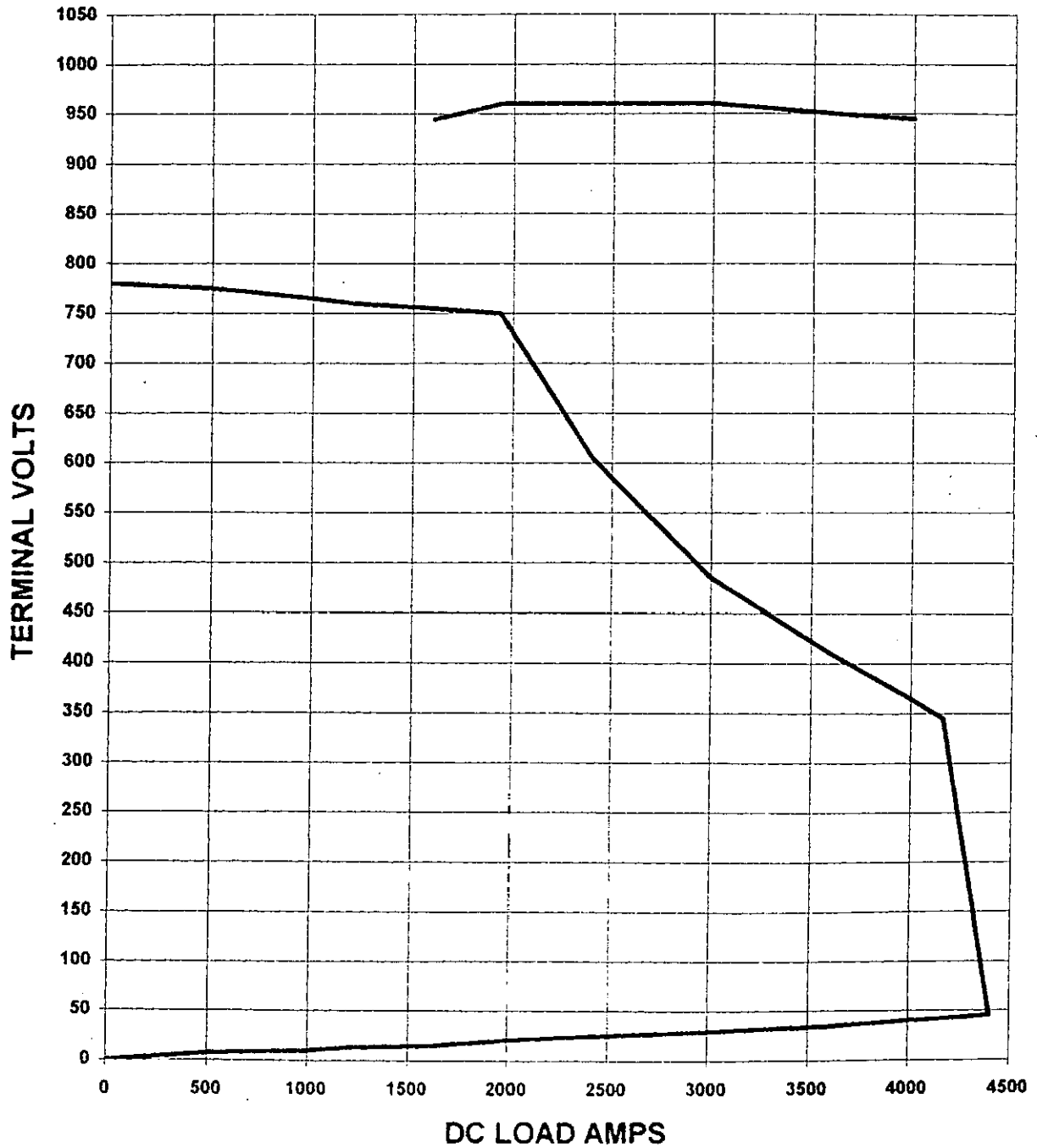
6.3.9 Axle box, bogie and undergear clearances.

**TRACTION ALTERNATOR TA10105AZ CHARACTERISTICS  
FOR 2300 HP MOZAMBIQUE RAILWAYS**

***Input to traction : 2075 HP with Microprocessor***

**HV CONT. RATING : 750 V, 1940A, 1455 KW, 1000 RPM**

**LV CONT. RATING : 335 V, 3600A, 1206 KW, 1000 RPM**



**PERFORMANCE CHARACTERISTICS OF**  
**2300 HP CG DE LOCOMOTIVE FOR MOZAMBIQUE**

**Input to Traction : 2075 HP with Microprocessor**

One Traction Alternator type TA 10105 AZ

Six Traction Motor type China TM ZD126 C

Gear ratio : 18:93, Wheel Dia. : 962 mm (HW)

Starting Tractive Effort : 28710 Kg.

Continuous Rating : 17.38 Km/h / 26167 Kg.

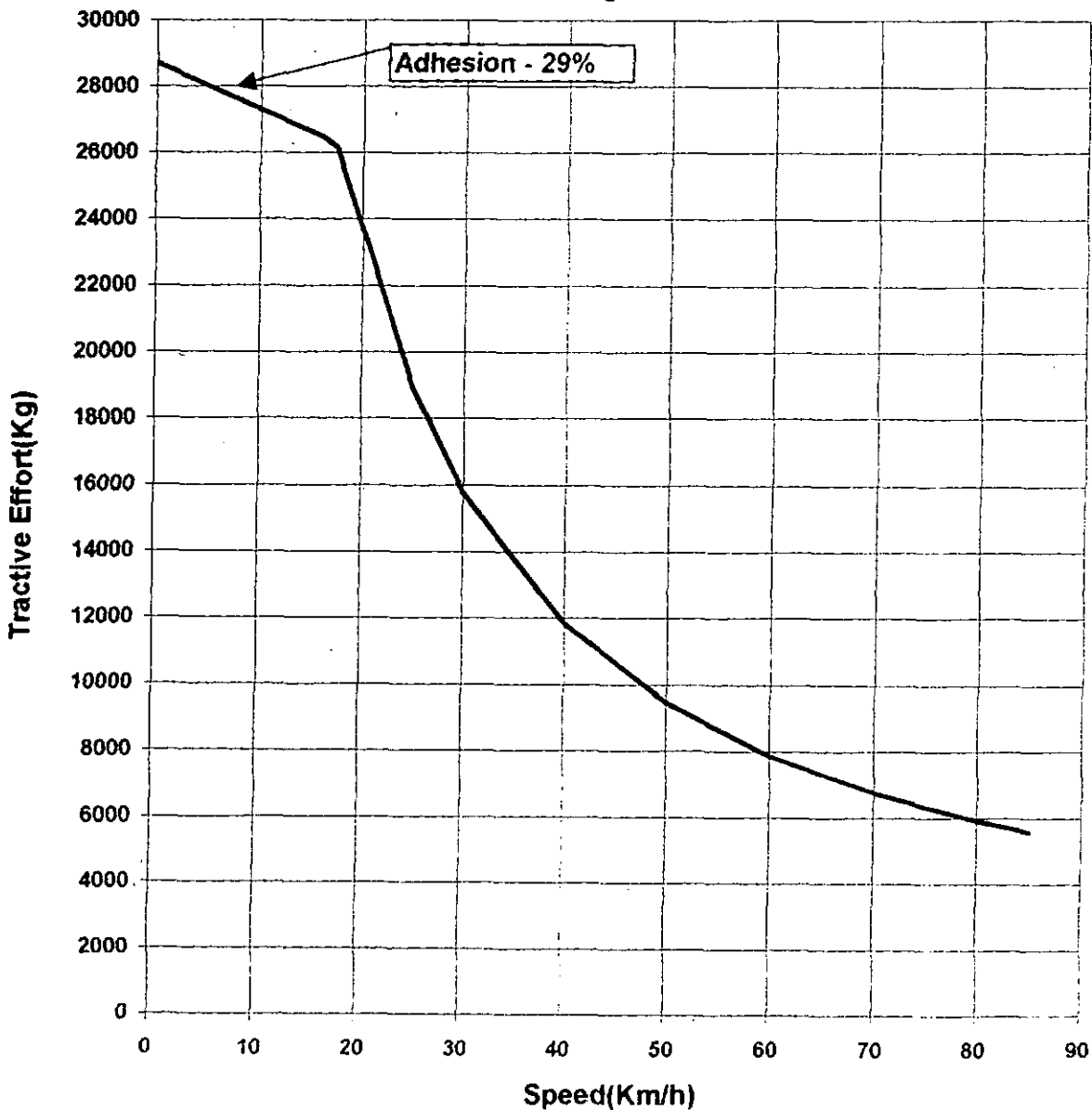
Transition Speed : i) 20 Km/h (Forward) / 17.5 Km/h (Backward)

ii) 27 Km/h (Forward) / 24.5 Km/h (Backward)

iii) 50 Km/h (Forward) / 47.5 Km/h (Backward)

Motor Combination : 2S-3P 100%FF, 2S-3P 50%FF, 6P 100% FF & 6P 50% FF

Loco adhesive weight : 99 T



# **PERFORMANCE CHARACTERISTICS OF** **2300 HP CG DE LOCOMOTIVE FOR MOZAMBIQUE**

## **Input to Traction : 2075 HP with Microprocessor**

One Traction Alternator type TA 10105 AZ

Six Traction Motor type China TM ZD126 C

Gear ratio : 19:92, Wheel Dia. : 962 mm (HW)

Starting Tractive Effort : 28710 Kg.

Continuous Rating : 18.55 Km/h / 24518 Kg.

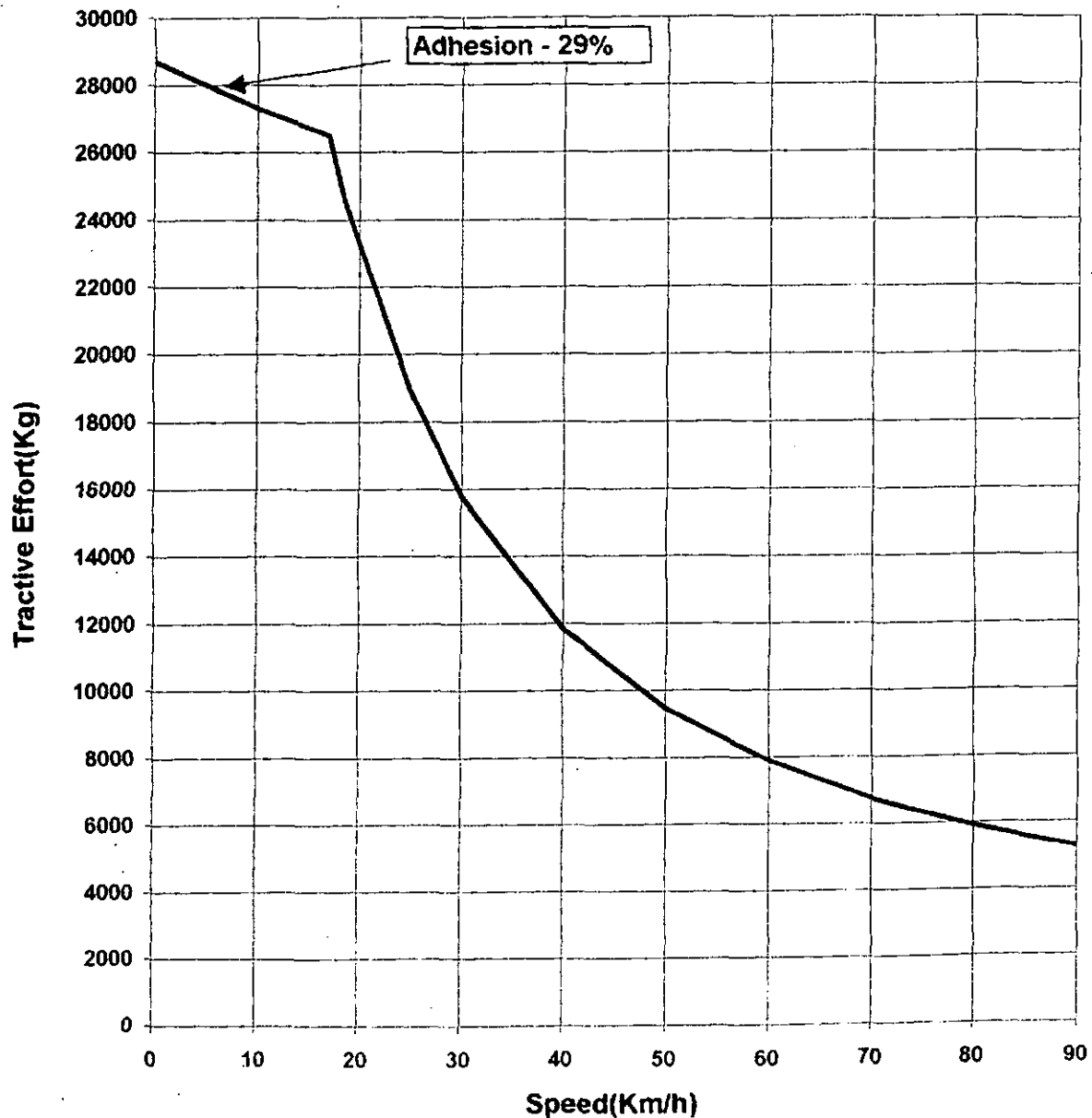
Transition Speed : i) 22 Km/h (Forward) / 19.5 Km/h (Backward)

ii) 29 Km/h (Forward) / 26.5 Km/h (Backward)

iii) 53 Km/h (Forward) / 50.5 Km/h (Backward)

Motor Combination : 2S-3P 100%FF, 2S-3P 50%FF, 6P 100% FF & 6P 50% FF

Loco adhesive weight : 99 T



### HAULAGE CAPACITY (GOODS)

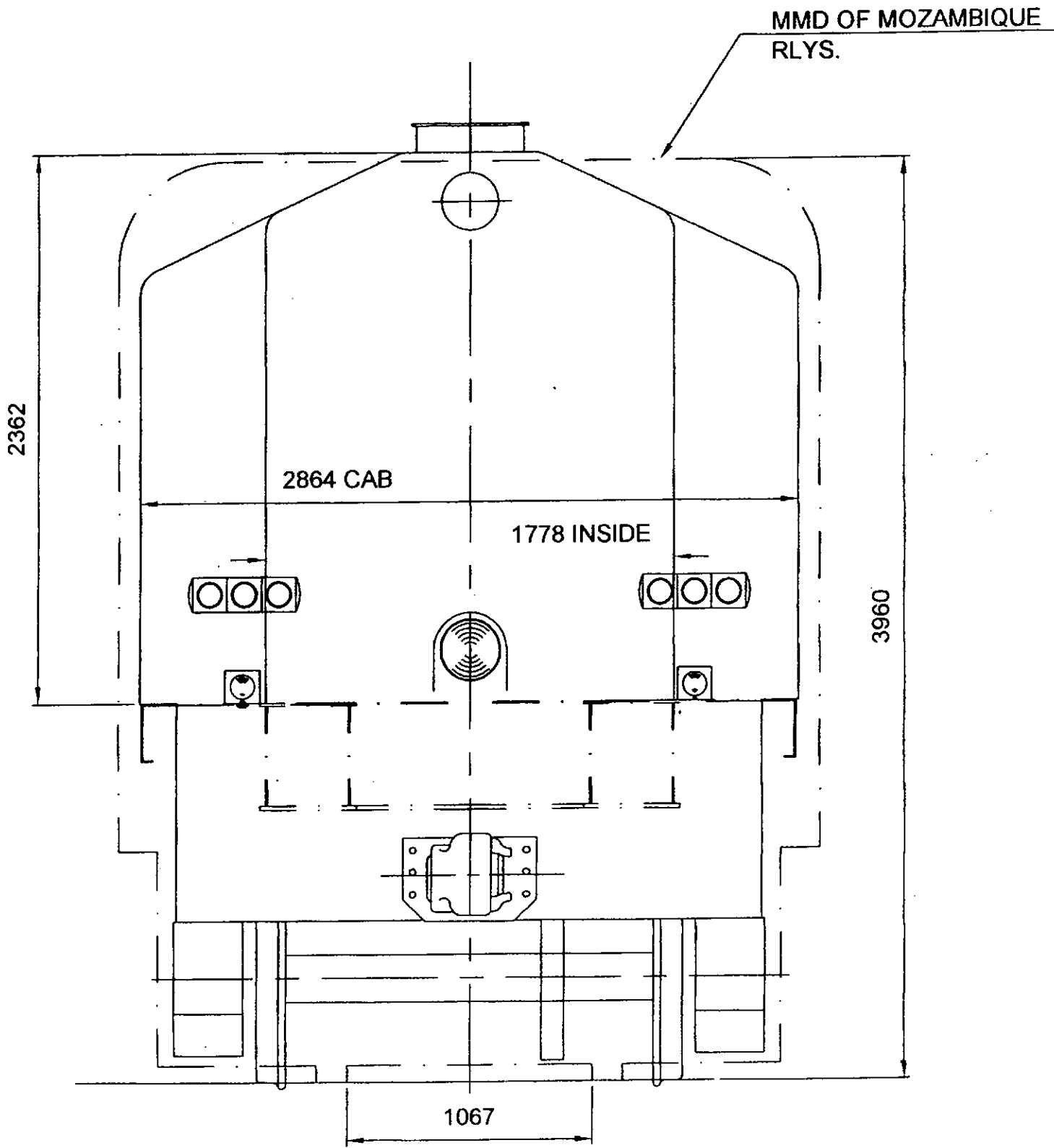
LOCO : 2300HP ( MOZAMBIQUE ) 2S-3P100%, 2S-3P 50%, 6P100%& 6P 50% GAUGE: C.G. WT OF LOCO : 99 T

Trailing load in tonnes at Km/h on tangent track, BOXN stocks.

GRADE	START	20	30	40	50	60	70	80	90
LEVEL	7015	>10000	>10000	9205	6330	4535	3340	2510	1905
500	4645	7740	4785	3355	2490	1915	1500	1190	945
400	4280	6580	4090	2885	2155	1665	1310	1045	835
200	3065	3745	2350	1680	1270	990	785	630	510
150	2570	2895	1820	1300	985	770	610	490	395
100	1935	1980	1240	885	665	520	410	325	260
50	1085	985	605	420	310	230	175	135	100
33	730	625	370	250	175	125	85	-	-

Note:

- Load chart prepared on the basis of rolling resistance values corresponding to IR MG locomotive, BG BOXN wagon stocks.
- Both starting and hauling of trailing tonnage given in the chart are the maximum permissible values. These values are applicable for straight track only. On curved section actual permissible load will be less than the value specified above
- Actual permissible loads should be fixed based on the load trial.



MOZAMBIQUE CAPE GAUGE LOCO