OUTER SHEET

TECHNICAL SPECIFICATION
FOR
THREE-PHASE ASYNCHRONOUS TRACTION MOTOR
(WITH SCHEME-II TYPE ROTOR)

TYPE : 6FRA-6068 FOR WAG-9 /WAP-7 LOCOMOTIVES

Total no. of sheets – 23
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Alt No.	01	02	03	04	
Date	11/10/2023	25/05/2024	04/11/2024	As signed	
Sheet No.	10 to 13	13 & 17-23	10	10-13,16 & 17-23	

Recommended by CEE/TM	Approved by PCEE

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3-Ph Asynchronous Traction Motor (with Scheme-II type Rotor) Type 6FRA-6068 for 3 ph Electric Locomotives.	**CHITTARANJAN LOCOMOTIVE WORKS (W.B.) No. 4TMS.096.081 Rev-1 Alt-4**

Prepared & Checked by		Reviewed by	
SSE/TMDO		Dy.CEE/TMD	

Alteration Sheet:

Alt. No	Description of Alteration	Issuing Authority	Date
01	"Frequency in percentage for lot to be inspected by inspecting agency" revised in clause No. 7.5.2 vide Note No. CLW/TM/Sample QAP approved on 26/06/2023	Dy.CEE/TMD	11/10/2023
02	Para No. 7.5.2, Routine Test Schedule and Para No. 13, Bill of Material modified vide Note No. CLW/TM/17280 Vol-IV dated 10/05/2024.	Dy.CEE/TMD	25/05/2024
03	Inductance measurement between phases incorporated in para 7.5.2 Routine Test Schedule vide Note No. CLW/TM/17280 Vol-IV approved on 23/10/2024.	Dy.CEE/TMD	04/11/2024
04	Para No. 7.5.2 Routine Test Schedule, Para No. 11 Inspection Criteria, Para 13 Bill of Material modified & Para 14 Warranty added.	Dy.CEE/TMD	As signed

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Three Phase Asynchronous Traction Motor type 6FRA 6068 with Scheme-II type Rotor for 3- Ph Electric Locomotive.

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1. SUBJECT :-

Short description : Three-phase asynchronous traction motor, type: 6FRA 6068
Number : Six (06) traction motors per locomotive

2. FUNCTION/PRINCIPLE :-

2.1 Scheme :-

For general information see the following documents please:

Main current scheme	3EHP 281141
TE-speed-diagram	HBTB 490727
TE/BE-speed-diagram	HBTB 490731
Cooling system	BEHT 3056

2.2 Principle :-

Due to the converter technology it is possible to use asynchronous brushless motor, which have the advantage of being maintenance-free with smaller dimensions and a very favorable power-to-weight ratio. The freight loco for Indian Railways has two bogies, each with three axles. Three traction motors per bogie are connected in parallel to a motor converter (ASC).

The control of the motors is executed by the motor converter (ASC), which generates a voltage proportional to frequency-rate. Up to the rated point the frequency is approx. proportional to the voltage rate from the rated point to max. speed the voltage remains constant. Wheel slip and torque are accordingly defined by comparing the frequency of the rotating field and the motor speed. A positive slip generates traction forces, a negative one brake forces.

3. TECHNICAL DATA :-

3.1 Vehicle data:-

Vehicle mass	: 123 ton ± 1% (Without ballast)
Gauge	: 1676 mm
Ground clearance above rail level, wheel fully worn	: 102 mm between bottom of gear case and
Diameter of the traction wheels	
New	: 1092 mm
Half-worn	: 1054 mm
Fully-worn	: 1016 mm

3.2 Vehicle characteristics:-

All information refers to half-worn wheels.

Operational condition	: according to IEC 563-1976, clause 2.2 (a)
Initial traction force	: 460 kN

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Continuous traction force : 325 KN, range 0-50 km/h
Continuous power : 4500 kW, range 80-100 km/h
Test Speed : 110 km/h

TE-speed-diagram : HBTB 490727
TE/BE-speed-diagram : HBTB 490731

3.3 Electrical data :-

		Rated point	Maximum data
Stator frequency	:	65 Hz	132 Hz
Motor voltage (phase to phase)	:	2180 V	2180V
Stator current	:	270 A	393 A
Power factor	:	0.88	--
Torque	:	6330 Nm	9200 Nm
Power	:	850 kW	850 kW
Motor Speed at shaft	:	1283 / min	2584 / min

For additional information see:
- Data sheet traction motor : 3 EHM 426603
- Characteristics traction motor : 3 EHM 426606

3.4 Design :-

Type : 6FRA 6068
Outline Drawing : 3 EHM 211699

Weight : 2100 kg ± 5% / average
Transmission : axle suspension
Gear ratio : 21: 107 (WAG-9) & 20:72 (WAP-7)
Painting : RAL 7021 (anthrazite silky surface finish)

Remarks: In case of an earth fault, the propulsion system must stay in service. For fault-finding the vehicle should be put out of service in the evening of the day the failure happened. Drainage holes for condensing water have to be cut in.

Cooling :-

Coolant : Air
Ventilation type : by independent fan
Flow rate : 4.05 m^3/s at 1900 Pa.
Pressure drop : 1600 Pa
Air intake : The cooling air for the traction motor has to be passed through a zyclon-filter at the loco side panels.
Air escape : at the under side of the Loco's floor.

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Electrical connection:

Supply cable	:	Cables are constructed with M 12-fasteners within the terminal box.
Design	:	according to chapter 6.1 and waterproof
Insulation material	:	GRP (glass reinforced polyester) Pre-preg
Creep age distance	:	min. 45mm.

Protection system:

The traction motor meets the protection system IP 22M with the exception of the air inlet and air escape at the bearing end frame. The clamp case meets IP-55.

Fixed electrical connections: Preferably pressed-on or bolt-on.

Shocks and vibration: -
suitable for Rly. stock according to IEC-77.

Inflammability and toxicity of materials.
-Non-inflammable and non-toxic materials to be used.

3.5 Insulation system:-

Insulation class	: Class 200
Insulation system	: Veridur (R)
Diff Hot-Spot & average temp.	: ≤30º C during 1 h, short time and continuous rating.
Max. heating	: The max. heating of the winding under nominal load must never exceed temperature Index of Class 200 minus 95º C ($\Delta v \leq 253^{\circ}C - 95^{\circ} C = 158$).
Evaluation or the Insulation System	: Thermal properties, ageing according to IEEE 309 and IEC 505 - Resistance against humidity according to IEEE 429.

3.6 Auxiliary devices at the motor :-

Speed sensing System :- : Active Speed Sensor to spec No. 4TMS.096.079 (not to be supplied)

Temperature measuring :-

System	: 2 Sensors PT 100
Completely Assembled Temperature Sensor	: 4TMS.096.085 Rev-2
Rated data	: 0˚C/100 Ohm
Plugable connection	: None at the motor.
Cable length	: 2200mm.

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4.0 ADDITIONAL CLAUSE :- The successful tenderers shall submit design details and drawings to RDSO/CLW for approval before the manufacturing of prototype.

5. STANDARDS/QUALITY

5.1 Standards (Revised no from IEC handbook should be followed)

IEC 77/2	: Electrical Traction devices (components)
IEC 349/2	: Electrical Traction devices (rotating machines)
IEC 34-14	: Mechanical vibrations (rotating machines)
IEC 563	: Allowed temperatures for electrical devices
IEC 505	: Insulation system for electrical devices
IEC 505	: Draft supplement
IEEE 429	: Standard test procedure for the evaluation of sealed insulation for AC electric machinery
IEEE 304	: Test procedure for evaluation and classification of insulation systems machines.
IEC 349-2	: Electrical Traction rotation electrical machines for rail and road vehicles. Part 2 electronic converter fed ac motors.

5.2 Quality assurance

An **ISO 9001** compatible quality assurance system has to be used.

6. ENVIRONMENTAL CONDITIONS

6.1 Environmental conditions

Country		: India
Location of the traction motor		: bogie
Environmental air		: salty
Cooling air temperature		: 0 ……. + 47°C
Expose to sunshine max.		: 70°C
at shadow		: 50°C
Air humidity	nom.	: 60%
	Max.	: 100% during rainy season (monsoon)
Operational heights	nom.	: 160 m above sea level
	Range	: 0…1000/800 m above sea level.

Rainfalls : In some area heavy rainfalls have to be taken into account. Running at 10 km/h must be possible under flood condition. (102 mm above rail level).

Hot season : Extremely dusty, in some areas deserts.

Locomotive and equipment should be designed for operation in coastal region (wet and salty air) as well as in arid or semi arid areas (extremely dry and dusty air).

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6.2 Lifetime

Operational time - Daily approx. : 16 hours (approx. 330 days per year).
Environmental conditions
Rated values for environmental temperature and air humidity according to chapter 6.1.

Traction motor : 40 years from initial operation of the locomotive onwards.
Bearings : 1.6 Mio. Km (L-10 Lifetime);

6.3. Reliability

Operational condition : according to chapter 5.2
Availability rate : 98%
Life time of the locos : min. 30 years (Maintenance, spare parts lifetime)

6.3.1 Assurance of reliability

Components, modules, groups and so on, according to ABB-rules (CHVEK-IEC) & DIN-standards.

6.3.2 Failure rate

Failure classification : The following MIBF should be achieved 37-67 years.
Category 3 Failure with impact on operation (bogie-failure) MTBF: 12.5 years.
Calculation see document 3EHM 620757. "Reliability Estimation".

6.4 Security

As per client's requirements.

7.0 TEST CONDITIONS :-

7.A Type Tests :-

According to IEC 349 (latest), IEC 349-2 (latest) and test specification Indian Railways prescribes a type test for every component. Exception are only made, if the concerned component has been tested earlier, used as a strictly identical item (down to the smallest screw) and run under identical condition (e.g. leading the cooling airflow). Therefore, a type test is required. The type test planning shall be submitted to the technical project management and the Indian Railway representatives for approval.

The acceptance test place in the presence of the Inspecting Officer from Indian Railways for client's information, a definite timetable must be submitted to the project management at least 7 weeks before start of the test.

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7. B Routine tests

According to IEC 349 (latest), IEC 349-2 (latest) and test specification, they have to be submitted to the technical project management for approval.

7.1.0 SITUATION & PURPOSE

Traction motor is to be tested according to the standard IEC 349-2 (latest). Type test to be done on first 06 (Six) Nos. Traction Motors as per Type Test Schedule issued by design office. Type test on converter supply [(i) Temperature Rise test, (ii) Short time thermal test / Heat Run test & (iii) Motor Characteristics tests] to be done on one of first 06 TMs or any other subsequent TM.

7.2.0 ASSIGNMENT

Type tests on one motor with two point converter supply (except the over speed test and the cooling air measurement which can be carried out on sinusoidal voltage supply).
- Routine tests on all motors on sinusoidal voltage supply, 50 Hz.
- Evaluate or compile the type tests result in the form of a type test report, which also must contain the routine test report of the type tested motor.

7.3.0 INFORMATION AVAILABLE

-Standard instructions IEC 349 (latest), IEC 349-2 (latest)
-working instructions HTAT 620467 (test thermocouples)

7.4.0 DATA OF TEST OBJECT

Three phase asynchronous traction motor, type 6FRA6068 (Curve sheet 3EHM 426606)

			Nominal working point	**Maximum values**
Voltage (phase /phase)	U_1	V	2180(F)	2180(F)
Current(phase)	I_1	A	270(F)	393(F)
Power (shaft)	P_1	KW	850	850
Torque (shaft)	T	Nm	6330	9200
Speed	N	1/min	1283	2584
Stator frequency	f_1	Hz	65	132
Forced ventilation	1.35 m^3/s	Test Voltage		8300V
Over speed tests	3250 min^{-1}	Insulation Class		200

(F) = Fundamental value

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7.5.1 Firm must keep ready in advance before placing call for inspection and shall be made available to inspecting engineer on arrival for physical inspection.

Inspection engineer properly check acceptability of above mentioned documents before commencement of inspection.

a) Copy of PO With latest Amendments.
b) Copy of applicable latest specification, Drgs., MS/SMIs.
c) Copy of latest QAP (Quality Assurance plan/test protocol etc.
d) Sr. Nos. of equipment being offered (with Declaration about latest applicable Drg./Spec./QAP etc.)
e) Details of compliance of MS/SMIs.
f) Details of compliance of any special instruction as issued by CLW/RDSO/Consignee.
g) Details of compliance of any special condition as mentioned in PO/Amendments.
h) Details of material procurement from sub vendor (Test certificates, Invoice/material receipt details),lot wise material utilization/consumption records).
i) Internal test/measurement reports as per QAP/test protocol.
j) Stage inspection report if any earlier stage inspection done by RDSO/external inspector.)
k) Details Investigation/rectification Report if previously failed/rejected equipment is being re-offered for inspection.

The above is list of standard required documents, any other details /records like shop diary/register/or any relevant documents as required for cross verification by inspecting engineer should also be made available promptly, so that inspecting engineer may satisfy about acceptable quality standards followed by firm in manufacturing.

7.5.2 Routine Test Schedule: Routine tests (on sinusoidal supply 50Hz) (only one direction of rotation) Test to be done according to test as per IEC 349-2 (latest) & 3EHM 620794 & 3EHM 420347

SN	Nature of Tests	Specified Limit	Frequency in percentage for Lot	
			To be tested by firm	To be inspected by inspecting agency
Final Inspection:				
1	Resistance measurement on all windings.	93.28 to 103.10 mili ohm at 30°C	100%	i) 10% for lot of ≥ 20 TMs (Minimum quantity 04 numbers or next whole number whichever is higher to be taken). &
Alt-3	Inductance measurement between phases	Inductance variation should be ≤0.015 mH (15 µH)	100%	
2	No-load characteristic and winding tests:			
2.1	No-load characteristic and winding tests Measured phase current I_0	U_0 phase / phase = 2360 V, 1817 V, 545 V	100%	
	Measurement of current symmetry at $U_{0\ n}$	1817 U_0 [V] Current balance ±2%		

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SN	Nature of Tests	Specified Limit	Frequency in percentage for Lot	
			To be tested by firm	To be inspected by inspecting agency
2.2	Test of stator winding: The first two motors: The motor is to be run at U_1 (phase/phase) = 2180 V on no-load without ventilation and with the air inlet closed. The duration of the test shall be 30 minutes (stop the run by switching over the terminals U_1 and V_1) Stator winding temperature 150°C -180°C After the run, measure: --Winding temperature (resistance method) --Housing (frame) temperature -- Bearing temperature DE/nDE --Thermo-feeler readings 1 /2 --Ambient temperature The stator winding temperature (by resistance measurement) shall be 150 … 180°C. If this is not the case, than the run must be repeated with another U_1 value. Repeat the test with a second motor. Determination of the U_1-value for the following motors from the results of these two motors. The condition: After the 30min. run at this U_1-value, the winding temperature shall be at least 150°C.	U1 [V] 2180 V U1-V1 [°C] 150 - 180 °C	100%	ii) 20% for lot of < 20 TMs (Minimum quantity 02 numbers or next whole number whichever is higher to be taken). Alt-1
2.3	The following motors- The (cold) motor is to be run on no-load without ventilation and with the air inlet closed during 30 min. at the U_1-value attained from the test above (Test 2.2). Measurements after the run like test 2.2	Temperature rise of stator winding 121 - 141 °C Temperature rise of bearing DE -- 40°C max and nDE 40°C max.	100%	
2.4	Short circuit characteristic: first motor Set value :phase current I_0 Measured value ; phase to phase voltage U_0 Rotor blocked up Measurement of current symmetry at 270A, 50 Hz , blocked rotor Declared value of the short circuit current at this U_1-value is the average value from the first 4 motors.	I_1=390, 270, 80A I_1 [A] 270 A Current symmetry ± 2%	100%	i) 10% for lot of ≥ 20 TMs (Minimum quantity 04 numbers or next whole number whichever is higher to be taken). &

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SN	Nature of Tests	Specified Limit	Frequency in percentage for Lot	
			To be tested by firm	To be inspected by inspecting agency
3	Test of the isolation Winding against iron Measure isolation resistance of the winding against iron with 1000V DC.	8300 V, 1 min. I.R. > 500 MΩ	100%	ii) 20% for lot of < 20 TMs (Minimum quantity 02 numbers or next whole number whichever is higher to be taken). Alt-1
4	Check direction of rotation L_1-L_2-L_3 to U_1-V_1-W_1: Rotation clock wise as seen from DE.	Rotation clock wise as seen from DE.	100%	
5	General data			
	A. Statement of rotor diameter, stator bore diameter, air gap, type of bearings, on the test report.	As per tendered drawings & specification	100%	
Alt-4	B. Axial Play Radial Clearance DE (measured) Radial Clearance DE (effective: 0.86 x measured)	200-400 µm 130-220 µm 110-190 µm	100%	100%
6	Check of temperature sensor assly As per 4TMS.096.085 Rev-2 measure the resistance of temperature probes with multi meter & calculate the temperature which should not vary more than 2 °C	IR with 500 V megger > 50 MΩ -- Resistance of the element 107.6Ω ± 2% at temp 20 °C	100%	i) 10% for lot of ≥ 20 TMs (Minimum quantity 04 numbers or next whole number whichever is higher to be taken). & ii) 20% for lot of < 20 TMs (Minimum quantity 02 numbers or next whole number whichever is higher to be taken). Alt-1
7	Wheeling test of TM	To check temperature rise , abnormal sound, backlash range: WAG-9: 0.290 - 0.490 mm. WAP-7: 0.254 - 0.458 mm	100%	20% (Minimum quantity 02 numbers or next whole number to be taken.) & test report of remaining qty to be verified.
Alt-4	**Note**: Check sheet for assembly/overhauling of TM type 6FRA 6068 issued vide RDSO's letter number EL/3.2.182/comments/3 Ph dtd. 02/12/2024 to be filled up and jointly signed by OEM and inspection agency during routine inspection.			

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SN	Nature of Tests	Specified Limit	Frequency in percentage for Lot	
			To be tested by firm	To be inspected by inspecting agency
Stage Inspection:				
8	Verification of purchase documents	-	100%	100%
9 Alt-2	Inspection (by 3D CMM) of Associated Components of Machined Stator i.e. 11 components in kit form. Alt-4	Dimensions. (As per respective drawings with latest alt)	**To be inspected by inspecting agency** 100 % at firm premises (i.e. TM manufacturer) / sub vendors premises. Place of inspection to be decided by railway inspection agency in consultation with TM manufacturer.	
10	Inspection (by 3D CMM) of Machined Stator Assembly	Dimensions. (As per respective drawings with latest alt)	(i) 100 % CMM record verification if procured from CLW approved source **OR** (ii) 100% Internal CMM check if manufactured in-house.	20% of offered Lot at firm premises (i.e. TM manufacturer) / sub vendors premises. Place of inspection to be decided by railway inspection agency in consultation with TM manufacturer. 100 % Record Review of CMM dimensional report.
11 Alt-4	Taper draw of Rotor Shaft (finished machined)	Distance between gauge face & shaft outer face should be 1± 0.3 mm	**To be inspected by inspecting agency** 100% at firm premises (i.e. TM manufacturer) / sub vendors premises. Place of inspection to be decided by railway inspection agency in consultation with TM manufacturer.	
	UT and Dimension Measurement of Rotor Shaft (finished machined)	As per respective specification and drawing with latest alt	100 %	100 % Record Review

Note:

i. Tests Mentioned at Sr. No. 8 to 11 are independent from each other, thus tests at Sr. No. 8 to 11 can be done in single (01) stage/step or independently in 02 stages/steps may be opted by firm.

ii. If firm opts 02 stages, firm shall be independent to select any inspection from Sr. No. 8 to 11 for either stage (Stage-1 or Stage-2) or interchange, as per its convenience.

Note: This is bare minimum requirement. However, if the inspection authority desires to inspect /test more quantity or any other test not mentioned, they can do so with intimation to the manufacturer.

ROTOR :

Rotors are to be manufactured as per RDSO specification No.: RDSO/2008/EL/SPEC/0061 Rev-2 (Latest Alt. & Rev. to be followed)

7.6.1 All the supplier should have at least one set of motor suspension unit with wheel assly. with arrangement of wheeling test (e.g. podium, power supply etc)

7.6.2 Supplier should carry out fitment & wheeling test of motor with motor suspension unit with wheel assly. on 100% TM. Temperature rise, abnormal sound to be recorded .Test results/records shall be shown to the inspecting authority.

7.7 Meaning of the symbols

ΔpLe	[Pa]	=	Pressure at motor inlet
Δ Ref	[Pa]	=	Pressure at reference point (The ref. point is a fixed point at the end shield nDE. The opening below can for instance be used for it.)
cosØ (cosphi)	[1]	=	Power factor (fundamental value)
DE		=	Drive end
(F)		=	Fundamental value
F1	[Hz]	=	Stator frequency
I1	[A]	=	Stator current per phase (r.m.s value)
n	[1/min]	=	Motor speed
ns	[1/min]	=	Synchronous speed
nDE		=	Non drive end
P1	[kW]	=	Input power at the motor terminals
P2	[kW]	=	Output power at the motor shaft
Pf	[1]	=	Power factor
S	[1]	=	slip = 1-n/ns
T	[Nm]	=	Torque at the motor shaft
U1	[V]	=	Stator voltage (phase to phase) r.m.s value, at the motor terminals
V	[m³/s]	=	Cooling air flow rate (cooling air quantity)

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8. DOCUMENTATION :-

8.1 Drawings, tracings and descriptions :-

All drawings, specifications and work instructions which are necessary for design, assembly and commissioning of the traction motor, all parts list to each drawing has to be given. Within the individual lists all parts of the corresponding drawing have to be mentioned, including consumable items.

A family-tree has to be given, including all drawings, parts list and other relevant documents which are part of the documentation. Also, a complete list of all documents and all components ("Bill of Materials") has to be submitted as part of the documentation.

8.2 Manual :-

The manual includes all necessary information for correct, maintenance, fault finding and repair of the traction motor, including spare parts catalogue and instruction for assembly, dismantling and replacement of the individual components.

8.3 Structure :-

8.3.1 Drawings, tracing and descriptions

The documentation shall be structured by the following order:

1. Family tree (sorted by Ident-no.)
2. List of drawing (sorted by Ident-no.)
3. Bill of Materials (sorted by Ident-no.)
4. Drawings etc. (sorted by subassembly components, corresponding to the family tree).

All documents have to be given in proper folders; loose documents will not be accepted.

Manual :-

An overview of function and work order has to be given. The chapter of the manual must belong to the individual subassembly components. All drawings and documents, which are used as reference documents, have to be given as annexure to the manual.

8.4 No. of documents

8.4.1. Drawing, tracing and descriptions

2 sets of prints	(according to chapter 7.1.).
1 set of soft copy	(only drawings; sorted by Ident- no.)

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8.5 Type-/Routine- Test documentation/Special documents :-

Document	Made by
Technical data and information	
Design/test	
Description of function	
Program of type test/routine test	
Records of type test/routine test	

8.6 Quality proof :-

Document	Made by
Standard test plan	

9. DELIVERY REQUIREMENTS :-

(a) Developmental orders will be given after ensuring compliance with STR.
(b) Proto type traction motor should be delivered within 6 months.
(c) Proto type traction motor to be in satisfactory service on loco for at least six months after which joint clearance of RDSO & CLW shall be mandatory for supply of balance TM.
(d) Payment for proto type TM to be released only after above clearance.
(e) In case of failure, even after improvements, order to be cancelled.

10. REFERENCE DOCUMENTS :-

Sl. No	*Title*	*Ident.- No.*
1.	*TE-speed-diagram*	*HBTB 490727.*
2.	*TE/BE-speed-diagram*	*HBTB 490731.*
3.	*General scheme main power circuit*	*3EHP 281141*
4.	*Data sheet traction motor*	*3EHM 426603*
5.	*Characteristics traction motor*	*3EHM 426606*
6.	*Cooling*	*BEHT 3056*
7.	*Reliability estimation*	*3EHM 620*
8.	*Outline drawing*	*3EHM 211699*
9.	*Bogie arrangement*	*IB011-00065*

11. INSPECTION CRITERIA

a. Prototype and routine inspection will be carried out by the authorized representative of Dy.CEE/TMD & RDSO representatives or as mentioned in the P.O. at firm's premises. All the cost to be borne by the supplier.
b. Quality audit and consistency type test of TM manufacturers to be done every 05 years for ensuring reliability of Traction Motor.
c. All type tests and routine test will be carried out as per the tender specification & approved test schedule.
d. Tenderers should submit detailed drawings and technical source of sub suppliers for approval before manufacturing prototype sample.

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12.0 SOURCES OF RAW MATERIALS :-

Firms shall make bulk procurement of individual items required for sub assemblies or complete equipment from Approved sources of CLW/RDSO source only. Procurement from vendors/ suppliers whose capacity cum capability assessment & prototype testing has been successfully done and final inspection certificate is issued by CLW, can be made up to 20% of total procurable qty in a given procurement case. Firm shall keep all such procurement records and will submit the same to inspecting agency at the time of inspection to ensure that above procurement procedure is strictly adhered to.

13.0 SCOPES OF SUPPLY & BILL OF MATERIAL FOR MANUFACTURING OF 3 PH TRACTION MOTOR WITH SCHEME-II TYPE ROTOR

Alt-4 Alt-2

(Note: For all specification & drawings latest alteration /revision /modification to be verified from Dy.CEE/TMD's office after placement of valid purchase order)

Each Traction motor consists of the following items.

SN	C&D NO	DESCRIPTION OF ITEM	DRG. NO. & SPECN. NO. (latest Alt/Rev to be followed)	UNIT	QTY / TM (Indicative)
1	5712/322	Mica Glass Fabric Tape Mi/Gl-Gwb 18, size. 0.12x15 mm (in roll of 30 m)	4TMS.096.098 (or latest)	Mtr.	2840
2	5712/324	Auto Adhesive tape (KAPTON) Selbst Kl F11, size 0.07x9.5 mm (in roll of 33m)	4TMS.096.097 Alt-1 (or latest)	Mtr.	90
3	5712/325	Auto Adhesive tape (KAPTON) Selbst Kl F11, size 0.07x19.1 mm (in roll of 33m)	4TMS.096.097 Alt-1 (or latest)	Mtr.	280
4	5712/326	Auto Adhesive tape (KAPTON) Selbst Kl F11,size 0.076x50 mm (in roll of 33m)	4TMS.096.097 Alt-1 (or latest)	Mtr.	90
5	5712/327	Polyimide Foil (KAPTON) PI F01 size 0.125x510mm (in continuous roll of 50m)	4TMS.096.092 Rev-1 (or latest)	Mtr.	10
6	5716/023	Polyamide Paper (Nomex), PAP1, size 0.38x914 mm (in continuous roll of 10m)	4TMS.096.091 Rev-1 Alt-1 (or latest)	Mtr.	0.075
7	5716/015	Polyamide (NOMEX) PA Vlies 1 Size 2.5x1000 (in continuous roll of 10 m)	4TMS.096.028 Rev-1 (or latest)	Mtr.	2.75

SN	C&D NO	DESCRIPTION OF ITEM	DRG. NO. & SPECN. NO. (latest Alt/Rev to be followed)	UNIT	QTY / TM (Indicative)
8	5716/005	Glass Fibre cord-1 Ø 7	4TMS.096.100 (or latest)	Mtr.	25.25
9	5716/006	Glass Fibre card-1 Ø 11	4TMS.096.100 (or latest)	Mtr.	5
10	5716/051	Flat Hose Gl Gefl-7 Size 1.6x17 mm	4TMS.096.102 (or latest)	Mtr.	125
11	5716/024	Hose Gl Gefl 3(flat hose) Size 4x22 m	4TMS.096.101 (or latest)	Mtr.	1.8
12	5716/052	Polyester Glass Silk Tape size 0.09±0.01 x20 mm	4TMS.096.088 Rev-1 (or latest)	Mtr.	687
13	5716/010	Silicon Impregnating Resin	4TMS.096.093 Alt-1 (or latest)	Kg.	14.30
14	5716/012	Auxiliary material 38	4TMS.096.093 Alt-1 (or latest)	Kg.	0.26
15	5716/019	Basic Resin SI 32	4TMS.096.094 Alt-1 (or latest)	Kg.	0.37
16	5716/020	Accelerator 27	4TMS.096.016 Rev-1 (or latest) & 4TMS.096.094 Alt-1 (or latest)	Kg.	0.004
17	5716/045	Silicone Rubber components Elastosil RT 622 A& B and Primer G-790 of Wacker Metroark chemicals or equivalent	Primer G-790 Spec: 4TMS.096.095 Alt-1 (or latest)	Kg.	5.25
18	5760/650	Completely Assembled Temperature Sensor for 3ph Traction Motors	4TMS.096.085 Rev-2 (or latest)	No.	01
19	5780/052	Lubricating Grease	SERVOPLEX SHC-120 (IOC)	Kg.	1.5
20	5716/034	Thinner for Stator washing	4TMS.096.030 Rev-1 (or latest)	Kg.	10
21	5716/053	Non- Adhesive polyimide film tape size:- 2 mil thk. X20 mm Wide (in continuous roll of 50 m)	4TMS.096.029 Rev-1 (or latest)	Mtr.	390
22	5716/060	Polyamide (Nomex type-410) Strip Size 0.25mm thk x9 $^{+0.02/-0.4}$ mm width x 507± 0.2 mm long	4TWD.096.169 Ref-3, Alt-2 (or latest) & 4TMS.096.091 Rev-1 Alt-1 (or latest)	Pcs.	152
23	5780/073	Set of Roller Bearing each set consisting of 01 no roller bearing NU2236E/C4; 01No roller bearing NJ 320E/C4 and 01 no. Thrust coller HJ 320E	4TMS.096.065 Rev-1 Alt-3 (or latest)	Set	1
24	5716/055	Glass Tape (EGT) size 0.18x25 mm	4TMS.095.016 Rev-1 (or latest)	Mtr.	36

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Prepared & Checked by		Reviewed by	
SSE/TMDO		Dy.CEE/TMD	

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SN	C&D NO	DESCRIPTION OF ITEM	DRG. NO. & SPECN. NO. (latest Alt/Rev to be followed)	UNIT	QTY / TM (Indicative)
25	5711/301	Stator main stampings	1TWD.096.015 Alt-7 (or latest) & 4TMS.096.053 Rev-2, Alt-11 (or latest)	Nos.	940
	5711/340	Stator end plate assly	SKEL-4889 (or latest)	Nos.	02
	5721/325	Rotor main stampings	1TWD.096.010 Ref-1, Alt-10 (or latest) & 4TMS.096.053 Rev-2, Alt-11 (or latest)	Nos.	924
	5721/326	Rotor mid stampings	1TWD. 096.010 Ref-2, Alt-10 (or latest) & 4TMS.096.053 Rev-2, Alt-11 (or latest)	Nos.	16
	5721/350	Rotor end plate assly	SKEL-4890 (or latest)	Nos.	02
26	5721/321	Rotor shaft (Finished machined)	1TWD. 096.009 Alt-1 (or latest) & 4TMS.096.071 Rev-1 Alt-2 (or latest)	No.	1
27	5714/501	Neutral conductor ring Assay. (Without insulation)	4TWD.096.061 Ref-1, Alt-4 (or latest) & 4TMS.096.062 Alt-5 (or latest)	No.	1
28	5721/406	Rotor End Ring for Scheme-II Rotor	SKEL-4732 Alt-1 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	Nos.	2
29	5716/004	Stator Slot wedge	4TWD.096.050 Alt-3 (or latest) & 4TMS.096.103 (or latest)	Nos.	144
30	5715/600	Terminal Board Assiy. Complete	2TWD.096. 019 Alt-1 (or latest) & 4TMS.096.025 Rev-1 (or latest)	No.	1
31	5712/321	Winding wire, Flat Fl Cu FO 13 CR bare size: 4.00x2.00 mm & Insulated:4.23x2.23mm	4TMS.096.099 Alt-2 (or latest)	Kg.	160
32	5721/404	Rotor Bar For Scheme-II rotor	SKEL-4741, Alt-1 (or latest) & RDSO/2008/EL/SPEC/0063 Rev-4 (or latest)	Nos.	88
33	5721/405	Zr-Cu punching type Resistance Ring Mechanically interlocked to End Plate for Scheme-II Rotor	SKEL-4742 Alt-1 (or latest) & RDSO/2008/EL /SPEC/0064 Rev-3 (or latest)	Nos.	2
34	5713/400	Connections complete with clamping plate (Without insulation)	1TWD.096.014 Alt-5 (or latest) & 4TMS.096.062 Alt-5 (or latest)	Set	1
35	5780/018	Name plate for rating	4TWD.096.039 Alt-4 (or latest)	No.	1

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SN	C&D NO	DESCRIPTION OF ITEM	DRG. NO. & SPECN. NO. (latest Alt/Rev to be followed)	UNIT	QTY / TM (Indicative)
36	5780/068	Name plate	4TWD.096.090 Alt-3 (or latest)	Nos.	2
37	5711/313	Tension bar (modified)	3TWD.096.092 Alt-4 (or latest) & 4TMS.096.055 Rev-1 (or latest)	Nos.	2
38	5711/314	Tension bar (modified)	3TWD.096.093 Alt-4 (or latest) & 4TMS.096.055 Rev-1 (or latest)	Nos.	2
39	5711/315	Stator Rib (Modified)	4TWD.096.095 Alt-3 (or latest) & 4TMS.096.055 Rev-1 (or latest)	Nos.	4
40	5711/316	Cross piece (machined)	3TWD.096.094 Alt-4 (or latest) & 4TMS.096.055 Rev-1 (or latest)	Nos.	2
41	5711/317	Accessory Bar	3TWD.096.096 Alt-4 (or latest) & 4TMS.096.055 Rev-1 (or latest)	Nos.	2
42	5711/318	Accessory Bar	3TWD.096.097 Alt-4 (or latest) & 4TMS.096.055 Rev-1 (or latest)	Nos.	2
43	5721/322	Key	4TWD.096.048 Alt-2 (or latest) & 4TMS.096.055 Rev-1 (or latest)	No.	1
44	5721/324	Half ring	4TWD.096.049 Alt-3 (or latest) & 4TMS.096.055 Rev-1 (or latest)	Nos.	2
45	5720/209	Balance weight Kit for Scheme –II Rotor	4TWD.096.173 Alt-2 (or latest) 4TMS.096.083 Rev-1 (or latest)	Set	1
46	5711/308	Flange	4TWD.096.067 Alt-6 (or latest) & 4TMS.096.055 Rev-1 (or latest)	No.	1
47	5711/360	Machined Terminal Box Assay.	3TWD.096.059 Alt-4 (or latest) & 4TMS.096.055 Rev-1 (or latest)	No.	1
48	5780/013	Thrust carrying piece	3TWD.096.037 Alt-5 (or latest) & IS : 10192 (latest)	No.	1
49	5780/016	Hose clamp	4TWD.096.070 Alt-3 (or latest)	No.	1
50	5711/310	Welding plate	4TWD.096.068 Alt-4 (or latest)	No.	1

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SN	C&D NO	DESCRIPTION OF ITEM	DRG. NO. & SPECN. NO. (latest Alt/Rev to be followed)	UNIT	QTY / TM (Indicative)
51	5730/308	End Frame / DE Assly (CNC MACHD)	1TWD.096.005 Alt-11 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
52	5740/408	End frame / NDE assly (CNC MACHD)	0TWD.096.003 Alt-13 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
53	5711/319	Stator Chamber / DE (CNC MACHD)	1TWD.096.017 Alt-8 (or latest) & 4TMS.096.059 Rev-1 (or latest)	No.	1
54	5711/320	Stator chamber / NDE (CNC MACHD)	1TWD.096.016 Alt-9 (or latest) & 4TMS.096.059 Rev-1 (or latest)	No.	1
55	5780/001	Inner labyrinth / DE (CNC MACHD)	4TWD.096.028 Alt-6 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
56	5780/056	Outer bearing cap /DE (CNC MACHD)	1TWD.096.006 Alt-8 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
57	5720/202	Inner labyrinth / DE (CNC MACHD) ROTOR	4TWD.096.043 Alt-7 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
58	5780/069	Outer labyrinth / DE (CNC MACHD)	4TWD.096.029 Alt-8 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
59	5720/201	Inner labyrinth / NDE (CNC MACHD)	4TWD.096.042 Alt-7 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
60	5780/005	Inner labyrinth / NDE (CNC MACHD)	4TWD.096.031 Alt-6 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
61	5780/058	Bearing cap / NDE (CNC MACHD)	3TWD.096.032 Alt-9 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
62	5780/057	Clamp plate / NDE (CNC MACHD)	2TWD.096.033 Alt-9 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
63	5780/079	Speed probe housing	1TWD.096.077 Alt-5 (or latest) & 4TMS.096.068 Rev-2 Alt-2 (or latest)	No.	1
64	5711/309	Earthing stud	4TWD.096.066 Alt-3 (or latest)	No.	1
65	5770/700	Terminal Box cover Assay	4TWD.096.027 Alt-3 (or latest)	No.	1

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SN	C&D NO	DESCRIPTION OF ITEM	DRG. NO. & SPECN. NO. (latest Alt/Rev to be followed)	UNIT	QTY / TM (Indicative)
66	5780/094	Rubber bush	4TWD.096.171 Alt-1 (or latest)	Nos.	3
67	5780/004, 007	Sealing Rings	4TWD.096.030, Ref- 1 & 2, Alt-5 (or latest) & 4TMS.096.086 Rev-1 Alt-1 (or latest)	No.	1
68	5780/015	Corrugated Hose Coflex	3TWD.096.072 Alt-7 (or latest)	Set	1
69	5780/053	Cable binder	4TWD.096.079 Alt-5 (or latest) & 4TMS.096.067 Rev-1 (or latest)	Nos.	5
70	5780/061	Clip Assly. (without welding plate)	4TWD.096.082 Alt-2 (or latest)	Set	2
71	5720/207	Primer paint	4TMS.096.019 Rev-1 (or latest) 4TMS.096.020 Rev-1 Alt-1 (or latest)	Kg	1
	5780/065	Top coating paint		Kg	1.6
	5780/066	Hardener for top coating paint		Kg	0.14
	5780/067	Thinner for top coating paint		Kg	0.75
72	5716/041	Adhesive glass cloth tape 0.14x19 mm wide (in continuous roll of 30m)	4TMS.096.026 Rev-1 (or latest)	Mtr.	15
73	5716/042	Adhesive glass cloth tape 0.14x50 mm wide (in continuous roll of 30m)	4TMS.096.026 Rev-1 (or latest)	Mtr.	10
74	5716/044	Polyester Film(Y-P) 2 mil size 100 +2/+0 x500 +3/+0 mm	4TMS.096.104 Alt-1 (or latest)	Nos.	150
75	5780/054	Anaerobic Adhesive and sealant for threaded locking similar to three bond screw lock super 1303 of M/s Three bond Co. Ltd. /Japan	4TMS.095.018 Rev-1 (or latest)	Kg	0.11
76	5716/043	High temperature non-asbestos fabric mat. Size 0.762x914 mm wide	4TMS.096.027 Rev-2 (or latest)	Mtr.	0.35
77	5713/434	Silver Brazing alloy rod Ø 2x500 ± 6 mm long	IS:2927'75 Gr: Ba-Cu-Ag 16A (latest)	Kg	0.16
78	5713/437	Brazing flux suitable for silver Brazing alloy rod & Silver Brazing alloy foil.	4TMS.096.096 Rev-1 (or latest)	Kg	0.04
79	5780/080	Cylindrical Pin Kit	4TMS.096.072 Rev-1 (or latest)	Set	01
80	5780/090	Machined Washer Kit	4TMS.096.073 Rev-1 (or latest)	Set	01

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SN	C&D NO	DESCRIPTION OF ITEM	DRG. NO. & SPECN. NO. (latest Alt/Rev to be followed)	UNIT	QTY / TM (Indicative)
81	5780/091	Spring Washer Kit	4TMS.096.074 Rev-1 (or latest)	Set	01
82	5780/092	Standard Hardware Kit	4TMS.096.075 Rev-1 Alt-1 (or latest)	Set	01
83	5780/093	Thread Insert Kit	4TMS.096.076 Rev-1 (or latest)	Set	01
84	5780/089	Non Standard Hardware Kit	4TMS.096.077 Rev-1 Alt-1 (or latest)	Set	01
85	5721/317	Brazing Flux	EN 1045-FH 10 (latest)	Kg	0.20
86	5780/074	Liquid Gasket	4TMS.095.017 Rev-1 (or latest)	Kg	0.1
87	5721/333	Molycote (R) GN plus of Dow Corning or High Temperature EP Grease MK IMPEX Canada	-	Kg	0.025
88	5716/056	Methyl Alcohol or Industrial Solvent	IS: 517 (latest)	Kg	0.75
89	5712/331	Polyamide (Nomex Type -410) STRIP size: 0.13mm Thk x 8.4±0.05 mm width x 90mm ± 0.1 long	4TWD.096.169 Ref.1 Alt-2 (or latest) & 4TMS.096.091 Rev-1 Alt-1 (or latest)	Pcs.	1134
90	5716/054	Polyamide (Nomex Type -410) Strip 5mil thick x 25 mm x 140 mm	4TWD.096.172 Alt-1 (or latest)	Pcs.	152
91	5721/407	Silver Brazing alloy rod Ø 2x600 ± 6 mm long	DIN EN1044; AG,203 (latest)	Kg	1.03
92	5711/203	Accessories of 3-Phase Stator Chamber	3TWD.096.167, Alt-5 (or latest)	Set	1
93	T201/088	Pinion	SKDP 3847 Alt-1 (or latest), 3473 Alt-4 (or latest) RDSO.MP.0.2800.19 (Rev-0) (or latest)	Nos.	1
94	-	Irreversible Temperature Strips	4TMS.096.106 (or latest)	Nos.	2

14.0 WARRANTY

Alt-4

Warranty period for motor shall be 72 months from date of commissioning of locomotive or 78 months from date of supply whichever is earlier. The contractors shall warrant that the motors supplied under the contract shall be free from defects and faults in material, workmanship and manufacturing. In case of any failures/defects noticed within warranty period, the motors shall be repaired/ replaced by the contractor free of cost.

SHEET END

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