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TECHNICAL SPECIFICATION FOR TRACTION MOTOR TYPE TAO-659 ALONG WITH ROLLER SUSPENSION BEARING ASSEMBLY AND GEAR CASE FOR 25 KV AC BG CO-CO LOCOMOTIVE FOR INDIAN RAILWAYS

SEPTEMBER - 1997

ISSUED BY

RESEARCH DESIGNS & STANDARDS ORGANISATION.
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E-7/20

TECHNICAL SPECIFICATION FOR TRACTION MOTOR TYPE TAO-659 ALONGWITH ROLLER SUSPENSION BEARING ASSEMBLY AND GEAR CASE FOR 25 KV AC BG CO-CO LOCOMOTIVES FOR INDIAN RAILWAYS.

CHAPTER 1

1.1.0 Scope

1.1.1 The traction motor shall be supplied complete with earthing brush with holder, roller suspension bearings and suspension tube assembly & gear case (modified) alongwith any other accessories that may be required for its correct assembly and commissioning as well as reliability and maintainability on the locomotive. Pinion is not supplied with the traction motor.

1.1.2 Any deviation from this specification, incorporated by the tenderer to improve the performance, durability, reliability and maintainability of the equipment or to reduce its cost significantly, may be favourably considered provided full particulars of the anticipated benefits alongwith technical data supported by drawings calculations are furnished in the tender offer.

1.2.0 SCHEDULE OF PARTICULARS, DRAWINGS AND AS MADE TRACINGS

1.2.1 The tenderer shall furnish all relevant design data for pulsating DC and calculations, technical specifications, test results and relevant equipment drawings, and descriptive write-ups etc. necessary for correct appreciation of the offer. The technical data and particulars shall be generally in line with the proforma of Annexure C.

1.2.2 In case of deviation from this specification, the successful tenderer shall prepare and submit to the purchaser complete working drawings of components/Sub assembly in duplicate for scrutiny and approval of purchaser, before taking up manufacture of the component.

1.3.0 TESTING, COMMISSIONING AND PROTOTYPE TRIALS

1.4.1 The traction motor and its accessories covered by this specification shall be subjected to type/endurance and routine tests at the manufacturer's works before shipment/despatch, in the presence of purchaser's representative as per the test programme enclosed at Annexure B.

1.4.2 The prototype motors after tests will be first despatched to examine their correct fitment on the bogies of existing locomotives and any modifica-

tions if required will be checked up and carried out accordingly at site.

1.4.3 These prototype motors will be subjected to service trials for a period of three months or less as deemed necessary by the purchaser to prove the design, equipment performance, maintainability and reliability. All modifications found necessary based on these limited service trials to improve upon the motor design and physical construction and as mutually agreed shall be incorporated in the prototype motors and in the series supplies of the equipment at the cost of the supplier and in the manner approved by the purchaser. The service trials shall generally cover the following.

i) Observations on the mechanical and electrical conditions of the equipment including wear & tear when subjected to practical working conditions and in service.

ii) Overall reliability and maintainability aspects.

1.4.4 The detailed scheme of prototype trials to satisfy the above, shall be indicated by the supplier and mutually finalised in consultation with the purchaser. Special instrumentation, if any for correct appreciation of the various data will have to be arranged by the tenderer.

1.4.5 The above tests may, at the discretion of the purchaser, be reduced in scope in case of motors proved under local conditions of service.

CHAPTER II

OPERATION REQUIREMENTS & SERVICE CONDITIONS

2.1.0 GENERAL : The general services conditions and particulars of the system have been indicated in general governing specifications. In addition, for the traction motor in particular, the following are applicable.

2.1.1 Flood Proofing: The traction motor and gear case etc. shall be designed to permit propulsion of the locomotive at 10 Kmph through water upto a height of 200 mm above rail level. Further, the traction motor will be made completely water proof to a standing water depth of 300 mm above rail level.

2.1.2 The motor shall be designed for operation with pulsating current (rectified single phase alternating current) with a ripple factor of about 30%. The ripple factor is given by the formula:

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}} \times 100\%$$

2.1.3 The motor shall be of axle-hung nose-suspended, series - excited, forced ventilated type for use in electric locomotive.

2.1.4 The general temperature of the cooling air at the inlet of the traction motor shall be 55 degree C maximum, with relative humidity varying upto 100% saturation.

2.1.5 The diameter of the wheel when new is 1092 mm and when worn fully is 1016 mm.

2.1.6 The axle load of the locomotive is 19.8 tonnes. However, the mechanical design of the motor shall suit maximum axle loads upto 22 t.

2.1.7 The maximum service speed of the locomotives on which these motors may be used is 160 Kmph. The overspeed test of motor shall be carried out at 1.35 times of its maximum service speed.

2.1.8 The weight of motor complete with pinion, gear and gearcase shall not exceed 2800 Kg.

2.1.9 Minimum clearance from the rail level to bottom of traction motor/gear case shall be 102 mm under fully worn wheel diameter.

2.2.0 DIMENSIONS AND FITMENT OF BOGIE

2.2.1 The motor shall be designed to fit the present 3-axle trimount bogie used on locomotives. RDSO drawing No. SK.EL 3861 and 3862 gives the details of bogie and space available for mounting the traction motor. The traction motor nose is fitted with 11% to 14% manganese steel liners on both the upper and lower lugs. The detailed drawings of fitment of traction motor offered to the bogie shall be furnished. Drawing No. SK.EL.3863 shows the details of wheel and axle assembly. The two end axles of the bogie have a maximum lateral movement of 6 mm in each direction and the middle axle has a maximum lateral movement of 16 mm in each direction.

2.3.0 INTERCHANGEABILITY:

2.3.1 The motor offered shall work with the traction equipment, as available on the existing locomotive satisfactorily without any reduction in performance.

2.3.2 The motor is to be mounted on the existing bogie, the drawing of which is enclosed. The gear ratio and also the pinion and gear should be kept the same as existing, or as per requirement of Rlys. Modified axle machining drawing should be furnished by the tenderers.

2.3.3 Electrical characteristics of the new motor will match those of the existing motor (RDSO/GEL/1064).

2.3.4 The tenderer may, however, offer an alternative of a better economical design which would fit in the existing locomotive to give the required electrical characteristics and to meet the same or better operating performance. However, the design should be based on an existing working traction motor proved in service without major electrical or mechanical modification.

2.3.5 The terminal box and terminal arrangement for the traction motor shall conform to RDSO drg. No. SKEL-4413 and 4414. The sequence of terminals shall be E,F, A & Hfrom CE side.

MP connection shall be at PE side and compole connection at CE side, MP coils terminals can be connected with each other by solid copper bar and their terminal connections should be with 150 a

Fluonlex cable or equivalent 1500 V cable while coils should necessarily be connected using 150 mm^2 fluonlex cables or equivalent 1500 V cable.

2.3.6 Rocker Ring inter connections shall be done with the help of 80 mm^2, 1500 V fluonlex or equivalent 1500V cable and not by solid copper rod.

TABLE

clearance and creepage distance

Voltage of equipment (V)	Air clearance (mm)		Creepage distan (mm)	
	Clean	Dirty	Clean	Dirty
750V	13	38	19	51
1500V	19	51	38	70
25000V	140	140	203	380

3.2.3 The motor has to operate on 2S-3P, 3S-2P or 6P combination and shall be designed to withstand 1800 volts minimum.

3.2.4 Terminals shall be such that they cannot turn or be displaced when the connecting screws/bolts are tightened and are such that the conductors cannot become displaced.

3.2.5 No contact pressure shall be transmitted through insulating materials and the gripping of the conductors shall normally take place between metal surfaces.

3.3.0 GENERAL - MECHANICAL

3.3.1 Standard metric hardware shall be used.

3.3.2 All nuts and screws/bolts shall be securely locked and shall not loosen in service due to the excessive vibration to be met in service.

3.3.3 All components including bolts, nuts, washers and screws etc. shall be suitably protected against corrosion and rust.

3.3.4 At locations such as gear case suspension, suspension bearing cap fixture, end shield fixations, nose suspension sandwich block fitment etc. adequate material should be available or suitable anti-wear replaceable bushes should be used to either minimise wear or permit future building up for restoring these surfaces or replacement of the bushes etc. High tensile fasteners as per IS:1367 class 10.9 from M/s Unbrako/LPS should be used.

3.3.5 Wherever welding is done, the welded portion will be finally ground-off to give a smooth finish and to remove the notch effect at the toes of the welds. Fillet welds as far as possible should be avoided and butt welding should be preferred.

3.3.6 Adequate provision shall be included in the design to ensure that the motor does not fall on the track, in the event of failure of the sandwich mounting arrangement.

3.3.7 Armature head should be forged type.

3.3.8 Armature shaft shall be without set ring groove as per RDSO drawing No. SKEL 4415 and corresponding armature sleeve as per RDSO drawing No. SKEL 4416.

3.4.0 GENERAL - MISCELLANEOUS

3.4.1 In the design, the manufacturer shall avoid introduction of parts/components which would have only slight differences in size and capacity and shall endeavour to have minimum number of standards.

3.4.2 Corresponding components/parts of different motors supplied against this tender shall be fully interchangeable from motor to motor.

3.4.3 The number of parts requiring special attention and periodical inspection should be minimum and should be easily accessible and easy to handle.

3.4.4 In selecting the materials, the typical weather conditions prevailing in India shall be kept in view. In this regard, the manufacturer shall furnish full information regarding the suitability of selected materials under various climatic conditions given in chapter II. Necessary tests for ensuring suitability of materials shall be conducted by the manufacturer and the test results advised to the purchaser.

6358

3.4.5 It shall be ensured by suitable design that failures of the parts caused by rain, atmospheric dust and metallic dust from the brake shoes etc. are avoided.

3.4.6 Consumables: All normal wearing and consumable items such as carbon brushes, roller bearing grease, bearings, lubricating oil and gear case compound etc. etc. shall be selected to the same grades/Specifications as are already in use on the existing stocks on Indian Railways. Details of these will be furnished to the successful tenderer.

3.4.7 It must be ensured by the manufacturer that while manufacturing of traction motors all the modifications sheets and special Maintenance Instructions of RDSO issued from time to time are implemented. (See Annexure 'D').

3.5.0 **STANDARD SPECIFICATIONS, RATING, CURVES, CALCULATIONS :**

3.5.1 Read with any deviations and additions mentioned in this specification, the motor in general shall comply with IEC 349. Following is the list of standards referred to in this specification.

IEC 50	:	Definition terminology.
IEC 216	:	Guide for the determination of thermal endurance properties of electrical insulating materials. Part I, II, III & IV.
IEC 349-1991	:	Rules for rotating electrical machines for rail and road vehicles.
IEC 505 & its draft supplement	:	Guide for the evaluation and identification of insulation systems of electrical equipment.
IEC 563	:	Permissible limiting temperature in service for components of electrical equipment of traction vehicles.
IEC 165/1963	:	Rules for the testing of electric rolling stock on completion of construction and before entry in to service.
IEC 356/1971	:	Dimensions for commutators and slip rings.
IEEE-11	:	American standard for rotating Electric machinery.
IEEE-304	:	Test procedure for Evaluation and classification of insulation systems for direct current machines.

IEEE 429 : Test procedure for the evaluation of sealed insulation systems for AC Electric machinery employing form wound stator coils.

* International Electro-Technical Commission.

** The Institute of Electrical & Electronics Engineers (An American National Standard)

3.5.2 The motor design shall be suitable for existing power and control circuits of the existing locomotive.

3.5.3 ELECTRICAL CHARACTERISTIC:

.1 Line Voltage

- System : 25 KV AC
- Nominal : 22.5 KV AC
- Maximum : 27.5 KV AC

.2 Motor Voltage

- Nominal : 750 V
- Maximum : 900 V

.3 Application : Pulsating current. 30% ripple factor.

.4 Ventilation : Forced cooled air flow 80m^3/min at 20°C and static head of 150mm water gauge in commutator chamber.

.5 Class of Insulation

- Armature : H or 200-Class
- Main Pole : H or 200 - Class
- Com Pole : H or 200-Class

.6 Rating

		Voltage	Amps.	RPM	KW
a)	Continuous	750	840	1095	605
b)	One hour	750	870	1070	605
c)	Short-time rating.	: 1300A for 5 minutes and 1100 Amp. for 10 minutes.			

.7 Gear Ratio : 62/15 or 21/58 or as per requirement of Rly.

.8 Traction motor characteristics curves including efficiency without gears. : RDSO/GEL/1064

.9 Tractive effort at standard gear ratio (15/62).

- At maximum F.S. and cont. rated current. 4067 Kg.
- At minimum F.S. and Cont. rated current. 2503 Kg.
- At minimum field and max. service speed. 1095 Kg

.10 Tractive effort at gear ratio (21/58).

- At max. F.S. & continuous rated current 2718 Kg

.11 Number of poles : Six

.12 Field strength

- Maximum F.S. : 95% or suitable.
- Intermediate F.S. : 77%, 61% & 50% or suitable.
- Minimum F.S. : 42.8% or suitable.

3.5.4 SPEED:

.1 The continuous rated speed shall be calculated with half worn wheels.

.2 The maximum service speed shall correspond to a locomotive speed of 160 Kmph with gear ratio of 15/62 and 180 Kmph with gear ratio of 21/58. However the maximum operating speed of locomotive is restricted to 160 Kmph.

3.6.5 VENTILATION:

.1 It is proposed to use the existing blowers provided on the locomotive. The available quantity of cooling air is 270m^3/min at 20°C for three traction motors. However, the static head of 150 mm w.g. should be maintained in the commutator chamber of each traction motor.

.2 Air pressure switch is provided in the traction motor blower ducting to ensure that voltage can not be applied to the motors till sufficient pressure is built up. For emergency operation, short circuiting switch to by pass the switch is provided. The tenderer shall indicate the reduction of rating consequent upon failure of forced ventilation.

3.6.0 INSULATION SYSTEM:

3.6.1 The armature shall be vacuum-pressure impregnated with solventless resins suitable for class 'H' or 200 class, temp. rise limits as per clause 3.6.11 of specifications. Armature and field coils should be provided with suitable moisture impervious sealing insulation.

3.6.2 The field coils should be vacuum pressure impregnated using solventless resin of class-'H' or 200 class as in 3.6.1.

3.6.3 The maximum electric stress in the armature and field coils in service shall be well below the corona inception voltage.

3.6.4 The insulation system to be employed shall be particularly designed to withstand adverse environmental conditions. The materials comprising this system and the system itself shall have been proved to be of the highest reliability in traction application. Imperviousness to moisture will be an essential requirement.

3.6.5 The evaluation of the insulation system for thermal endurance shall be made with fabricated test models by way of accelerated ageing tests as per the test programme drawn up in accordance with the norms specified in IEC 505/1975, IEC 505 draft supplement and IEEE 304. The value of the proof voltage for dielectric test prescribed in IEEE 304 for determining the end point after each ageing cycle shall correspond to [illegible] of the dielectric test to voltage on new machine prescribed in IEC 348 ('NOT' 2E as laid down in IEEE 304).

3.6.6. Evaluation of insulation system for sealing against moisture shall be done in accordance with IEEE 429.

3.6.7 Various ageing parameters, such as heat, vibration, mechanical/compressive stresses, special environmental effects of humidity, dust, metallic dust from brake shoes etc. will be incorporated to simulate the actual working conditions as closely as possible.

3.6.8 The temperature at which an extrapolated life of 20,000 hours is obtained shall be treated as the thermal endurance limit (Temperature Index) of the insulation system.

3.6.9 The motor shall be designed such that the "hot spot" temperature under any condition of loading in any winding (armature or field) does not exceed the average temperature of that winding measurement by resistance method by more than 15°C.

3.6.10 Having regard to the system of insulation adopted and the environmental conditions, the manufacturer shall provide maximum possible margin in temperature rise, for prolonged life of the traction motors.

3.6.11 The temperature rise of traction motors during type/routine tests shall be limited to the following, it being clearly understood that no motor exceeds these limits:

i) Permissible temperature rise .. TI_a minus 90°C
- on armature windings by resistance method.

ii) Permissible temperature rise on .. TI_f minus 70°C
field windings by resistance method.

iii) Permissible temperature rise .. 85°C
on commutator.

Where TI_a is the established Temperature Index for the armature insulation system.

Where TI_f is the established Temperature Index for the field insulation system, as determined by tests prescribed above.

3.6.12 The stipulation as per IEC 349 duly modified by Clause 3.6.11 for determining the permissible temperature rise limits of series production of traction motors with reference to the first lot of prototype motor, shall also apply.

3.6.13 The temperature rise test shall be carried out on D.C. and P.C. supplies (R.F. 28-30%) as per the test programme duly approved by RDSO, Lucknow.

3.7.0 ARMATURE AND COMMUTATOR ASSEMBLY

3.7.1 Reshafting and Assembling:

.1 The armature and commutator assembly shall be so mounted on the armature shaft so as to facilitate reshafting, during maintenance, without disturbing the armature windings and commutator connections.

.2 Similarly, it would be possible to remove and replace the commutator assembly from the shaft, as a unit itself without disturbing the armature core etc.

.3 To facilitate correct placement of armature core, the bearings and other parts on the shaft, a few built-in exact matching surfaces/parts between armature core and shaft may preferably be provided.

3.7.2 The armature - commutator assembly shall be dynamically balanced such that the residual unbalance is not more than 1.5 gramme metre.

3.7.3 Maximum number of ventilating ducts possible shall be provided.

3.7.4 WINDING BEHIND COMMUTATOR RISER:

.1 The armature windings portion immediately behind the commutator riser is very vulnerable to puncture and burning due to the various operating and ambient conditions and the peculiar layout of coils in this region.

.2 Hence, special precautions shall be taken in the design of the winding, particularly for the 50 mm zone behind the commutator riser. Special insulation with high mechanical and electrical strength shall be provided particularly at the transition bend of the coils behind the riser.

.3 Further, adequate steps must be taken to make sure that the winding insulation in this zone is not affected during the process of banding.

.4 The insulation in this region of 50 mm behind the commutator riser would in any case be not less than 120% of the inter-turn puncture voltage in the slot portion.

3.7.5 Percentage equalisation shall not be less than 50%. Only rectangular Kapton covered conductor with 1/2 lap of Kapton film of 1.5 mil thick shall be used for equaliser connections.

3.7.6 Slot wedge should be of epoxy glass fibre material. Its properties in terms of shearing strength, compression strength, water absorption, resistance to flame etc. will be furnished. The breaking strength of slot wedges will not appreciably change upto a temperature of 200°C.

3.7.7 Resi-glass banding shall be provided. Resi-glass tape of RDSO approved sources only shall be used and banding procedure may be submitted for approval. Polyglass tape should also meet RDSO Specn. No. SPEC/E-7117 of Oct. 1994.

3.7.8 MATERIAL OF COMMUTATOR:

.1 The commutator bar shall be silver bearing electrolytic copper.

.2 Its silver and copper content shall be in the range of 0.06 - 0.1% and 99.9% (min) respectively.

.3 Electrical conductivity at 20°C shall be 97% minimum.

.4 The hardness value of a test piece of the commutator bar, after heating for one hour at 300 ±15 degree C and then cooling to room temperature, shall be 105 HV (20)

.5 The bar shall be finished by cold drawing or cold rolling process.

3.7.9 COMMUTATOR CONSTRUCTION:

.1 The commutator shall be of arch bound construction.

.2 Tolerances on dimensions shall be as per IEC 356/1991.

.3 The commutator shall have a safe wearing depth of 8 mm minimum, measured radially on the radius, to allow for a sufficient number of resurfacing operations.

3.7.10 COMMUTATOR MANUFACTURE:

.1 Commutator manufacturing process shall include at the stage of assembly and consolidation of copper segments and insulating separators an adequate number of static/dynamic seasoning cycles comprising cold and hot tightening of assembly fixture before machining of V-grooves.

.2 Complete details of commutator manufacture and the seasoning process shall be furnished.

.3 If the commutator is purchased from outside agencies other than CLW/BHEL, the process of manufacture, material of bars and segments and dynamic season cycle details may be submitted for approval.

3.7.11 TIG welding of the conductor to commutator riser is necessary using automatic tig welding plant. The width of risers shall be preferably 17 mm.

3.7.12 Commutation sparking index as observed by the degree of sparking at the trailing edges of the brushes will not exceed one and half.

3.7.13 Exposed portion of V-ring shall be covered with PI ring and shall be heat shrunk fitted over Vee Cone insulation.

3.7.14 The commutator riser side shall be properly sealed to prevent ingress of dust and other foreign particles.

3.8.0 FIELD SYSTEM

3.8.1 The main pole and interpole coils shall be of fully insulated type. Instead of split coils, potted single coil design of field coils should be used and moulded with the pole core without using any spring or packing between pole core and coil.

3.8.2 The pole cores along with the field coils should be firmly held in position by pole fixation bolts and their inter-connectors shall be firmly held in position by C-clamps welded at suitable location on magnet frame to sustain against excessive vibrations.

3.8.3 The field intercoils and connections will be brazed with silver brazing rod and rupatum foil.

3.8.4 The welded C-clamps of inter-connections shall be provided with 100% higher special ground insulation with very high mechanical strength than that of field coils.

3.8.5 The main pole and interpole connectors shall be firmly supported by tying with self bonding silicon rubber tape and glass tape. Epoxy/nomex spacer shall be used between welded C-clamp and inter connectors.

3.9.0 PERMANENT FIELD DIVERTING RESISTANCE & SHUNTING RESISTANCE:

3.9.1 Details of existing resistances and inductive shunt are enclosed at 'Annexure "A".

3.10.0 **BRUSH GEAR.**

3.10.1 Brush holder will be of single piece construction and its material should be Aluminium bronze to IS:305-'81 Gr.AB1 and manufactured by chill casting process. Alternatively, leaded gun metal casting to IS:1458, Class V can be used.

3.10.2 The brush box design shall be such that brushes staggered to cover the entire working length of the commutator to avoid grooving.

3.10.3 Brushes shall be of the split type with single spring as per RDSO's Drg. No. EL.BS.002 (MOD) Alt.1..

3.10.4 Brush holder spring shall be spiral type. The spring pressure shall remain fairly constant over the entire wearing length of the brushes.

3.10.5 The design of the brush holder should be such that the brush box is close to the support and the spring anchor at the far end.

3.10.6 The brush holder insulating studs shall be made of glass bonded mica and to be provided with PTFE sleeves and should withstand a tensile strength of 6500 Kgs between inserts.

3.10.7 It shall be possible to remove and examine the brushes easily during inspections. Separate spring rests will be included to hold the spring in released position for attending to the brushes.

3.10.8 Carbon brushes will be of grades. Morgan'te EG 105 (I) or EG 367 of Le carbone (imported) or equivalent as approved by RDSO, Lucknow from time to time.

3.11.0 **SPARK GAP:**

3.11.1 Adjustable spark gaps will be provided between the brush boxes and the brush holder revolving ring. These sparking studs will also be replaceable. The spark gap is to be adjusted to 1.5 mm.

3.12.0 TERMINAL BOX:

3.12.1 The terminal connections of the motor, one each for the armature & interpole and two for the main fields, shall be brought up to a terminal box located on the stator frame. The terminal box shall be water proof and also designed to keep out dust and oil etc. The arrangements shall conform to RDSO drawing No. SKEL 4369.

3.12.2 The terminal support insulators shall be made of glass-bonded mica and shall be provided with PTFE sleeves. It shall withstand a tensile strength of 6500 Kgs & a torsional load of 45 Kgf-m between inserts.

3.12.3 The design of the fastening shall be such as to permit substantial tightening torque to enable adequate contact pressure between the terminals about 3 kg/cm^2 to be maintained. Suitable spring washers or bevelled washers shall be used to prevent loosening under vibrations.

3.12.4 The sizes of the internal and external cable terminals shall be liberally rated.

3.12.5 The cable layout shall be such as to prevent fraying of the insulation during operation and maintenance. The cleats, if any provided for such a purpose at the exit of the terminal box, shall be so designed as to have a positive grip over 50 mm length of the cable with the ends suitably chamfered to avoid any damage.

3.12.6 The terminal box cover will have a neoprene sheet affixed to its inside surface to act as a gasket and as an insulation.

3.13.0 EARTH-BRUSH ASSEMBLY:

3.13.1 An earthing brush assembly may be provided on the axle cap/suspension tube of traction motor assembly.

63590

MECHANICAL DESIGN ASPECTS:

3.14.0 GENERAL CONSTRUCTIONAL FEATURES

3.14.1 The motor shall be designed and manufactured to be fitted into the existing bogies of the locomotive, the details of which are shown in the drawings No. SKEL 3861 and 3862.

3.15.0 MOTOR WEIGHT

3.15.1 The total weight of the motor including pinion, gear, gearcase, axle support bearing shells and the axle bearing cap presently is 2500 Kg.

3.16.0 NOSE SUSPENSION:

3.16.1 Existing arrangement of the nose suspension is given vide drawing No. SKEL 3861.

3.16.2 The nose suspension to be provided in the motor herein specified will be accommodated within existing lugs/brackets provided on the bogie transom without any major changes or modification being made.

3.16.3 In general the bonded sandwich mounting shall consist of end mounted metallic plates, rubber pads and intermediate metallic plates.

3.16.4 Testing physical propertes, e.g. shore hardness 'A', tensile strength, percentage elongation at break, percentage compression etc. will be furnished. The unit should have been subjected to accelerated ageing tests, low temperature test, compressive load deflection test, shear test and fatigue test etc.

3.16.5 New and condemning dimensions/condition of nose suspension components shall be specified.

3.16.6 Bonded sandwith mounting pad assembly may not be supplied along with the traction motor unless otherwise specified.

3.17.0 AXLE SUPPORT (SUSPENSION) BEARING :

3.17.1 Roller suspension bearing shall be adopted as per RDSO drawing No. SKEL-4421. Taper roller bearings shall be adopted on PE & CE side. The taper roller bearings, suspension tube and associated accessories shall be supplied along with the traction motors. The detailed drawings and design of roller suspension assembly shall be approved by RDSO, Lucknow before adoption on traction motors.

3.18.0 MODIFIED GEAR-CASE ASSEMBLY:

3.18.1 Modified gear case assembly to suit the roller suspension bearing arrangement shall be supplied along with traction motors.

3.19.0 ARMATURE BEARING:

3.19.1 The armature shall be mounted on anti-friction roller bearings of standard make and dimensions as per international standards.

3.19.2 The bearings shall have the basic life rating L-10, calculated vide ISO 281 recommendation, of at least 2 million kms (ISO - International Standards Organisation).

3.19.3 The roller bearings type NH-318 and NU-328 respectively for the commutator and pinion ends, both with C4 clearances should be adopted for the motor.

3.19.4 Maximum permissible speed of the armature shall not exceed the catalogued limiting speed of the bearing. The rolling elements and greasing arrangement will be so designed that the working tempeature of the bearings shall be well within the catalogue's limits under worst operating conditions.

3.19.5 The lubricant to be used shall be indigenously available.

3.19.6 An effective labyrinth arrangement will be provided so as to arrest any ingress of gear compound into the bearings from the pinion end side. Commutator end bearings shall be protected against ingress of dust and other foreign matter. In addition, a drain pocket will be incorporated in the housing of the pinion end suspension bearing, for collecting any traces of overflown gear compound.

3.19.7 The sealing arrangement to be provided will be on similar lines. Moreover, the sealing design shall also ensure a greasing interval of 2 years.

3.20.0 SHAFT:

3.20.1 Material used for the shaft shall be EN25 as per BS-970 or a superior quality of alloy steel.

3.20.2 The design of the shaft shall be such as to avoid sharp corners and any steep changes of cross-section.

Armature shaft without set-ring groove may be used by manufacturer as per RDSO drawing No. SKEL-4415 corresponding armature sleeve as per drawing No. SKEL-4416.

3.20.3 Design of the shaft and of the bore of armature core shall be such as to permit reshafting without damage to core or windings.

3.20.4 The shaft surface shall be closely controlled especially at the bearings and the pinion seat locations and ground all over. High surface finish of 0.8 microns or less will be provided at least on these locations.

3.20.5 All the armature shaft before assignment should be ultrasonically tested as per the code of practice, issued by Metallurgical and Chemical Dte. of RDSO, Lucknow to the CMT of all Zonal Railways/Production Units.

3.25.0 MARKING/RATING PLATE:

3.25.1 Each motor shall be provided with a suitable rating plate giving usual information including the following:

- Manufacturer's name
- Type and serial number of motor
- Rated voltage
- Rated current
- Rated speed
- Insulation class
- Date of manufacture
- Rated Kw
- Minimum and Maximum Field Strength.
- Maximum current and its duration.
- Maximum service speed.
- Maximum voltage.

3.25.2 The rating plate shall be clearly visible when the motor is installed in position.

3.25.3 Identification numbers shall also be suitably stamped on non-interchangeable matched components to facilitate assembly and to prevent mixing up. Brush holder revolving ring is non-interchangable and may be bunched with same identification mark as that of motor.

3.26.0 If any parts/components of traction motor, gear case and suspension tube etc. are procured from sub-suppliers the QAP of the vendors may be submitted along with the list of the parts which are proposed to be procured from such vendors.

ANNEXURE-A

PARTICULARS OF THE PERMANENT FIELD DIVERTER AND SHUNTING RESISTORS AND INDUCTIVE SHUNT PROVIDED FOR THE TRACTION MOTOR.

Permanent field diverter resistance	...	285 milli ohm
Shunting resistance :		
- 1st position	...	76.5 milli ohm
- 2nd position	...	46.4 milli ohm
- 3rd position	...	32.1 milli ohm
- 4th position	...	22.4 milli ohm
Inductive shunt resistance	...	.0023 ohm at 110°C
Smoothing Reactor :		
- Resistance	...	.00707 ohm at 110°C
- Inductance	...	5 mH

NOTE :

The ohmic values of permanent field diverter and shunting resistors are at the operating temperature of the resistance corresponding to continuous rating of the motor.

ANNEXURE-B

TEST PROGRANME FOR TRACTION MOTORS

S. No.	Nature of Test	IEC 349-1971 Clause	Type of Test
1.	Preliminary checks :	-	Type & Routine
	a) Verification of direction of rotation.		
	b) Verification of brush holder setting.		
	c) Measurement of cold ovality of commutator.		
	d) Measurement of resistance of individual windings.		
	e) Measurement of Impedance.		
	f) Calibration of ventilation.	With motor speed '0' & rated Draw curves.	
2.	Measurement & separation of no load losses - Determination of no load characteristic.	-	Type
3.	Temperature Rise Test :	27,35	-
	a) Continuous rating.	-	Type
	b) One hour rating	-	Type & Routine
	c) Other rating - at minimum field and low voltage rating P.C/D.C.	-	Type
4.	Over speed Test - Measurement of hot ovality.	36	Type & Routine.
5.	Starting Test	34	Type.
6.	Commutation Test P.C./D.C.	39	Type & Routine
7.	Interruption & Restoration Test	40	Type
8.	Dielectric Test	41	Type & Routine

9. Characteristic curves P.C./D.C. at rated/low voltage rating.	42 & 43	Type & Routine
10. Polarisation Index		Special
11. Tan Delta Test		Special

ANNEXURE-C

TRACTION MOTOR TA0-659

1. Continuous rating:

- Temperature rise	...	As per Specification
- Shaft output	...	585 kW
- R.P.M.	...	1060
- Volts	...	750
- Amps	...	840
- Max Voltage	...	900 Volts
- Max. service speed		2500 RPM
- Insulation	...	Class-H/Class 200
- Excitation		Series excitation.
- No. of Poles	...	Main : 6 Commutating : 6

2. Armature:

- Core	Out side/Inside diameters 500/140 mm Length : 390 mm
- Main Laminations	Grade No. B630 Or CRNGO-M5-C4 0.5 mm thick to IS-648. Alternatively, 0.5 mm thick CRNGO sheet as per DIN 46400 - 1983, Grade V600 - 50A.
- End Laminations	Gr. No.1120-1mm thick. Alternatively, 1 mm thick cold rolled carbon steel annealed sheet as per DIN 1623-1983 or IS-513-1994.
- No. and dimensions of slots	69 of 7.5 x 40.5 m
- Winding	Lap - progressive

Note: Annexure-C is for the guidance to the designer and deviations may be permitted to improve the design.

- Throw of coils — Slot 1 to 12

- Commutator pitch — Segment 1 to 2

- No. of sections per slot — 8

- No. of turns per section — 1

- Conductor dimensions — 2.8 x 8 mm (r = 0.8 mm)

- Conductor covered with — 1 layer 2/3 lapped kapton film of 1.5 mil. thick.

- Max. dimensions of covered conductor : 3.097 x 8.337mm

- Slot Insulation:

  - Two and quarter turns of Kapton mica wrapper GE 77916 of 0.15 mm thick or equivalent
    1 layer 1/8 lapped 0.05 thick x 20 PTFE tape.

- Slot liner:

  - Nomex Grade 410 sheet of 4 mil. thick.

- Overhang:

  - 2 layers 1/2 lap of GMS lap, size 0.08 mm thick x 15 mm wide.

- Final Taping over complete coil :

  - 1 layer edge to edge of fibre glass tape, size 0.08 mm thick x 10 mm wide.

- Lead Insulation:

  - 1 layer 1/2 lap of Kapton adhesive tape size 0.065 mm thick x 10 mm wide.

  - 1 layer 1/2 lap of Nomex tape grade 410 size 2 mil thick x 10 mm wide.

  - 1 layer edge to edge of fibre glass tape size 0.08 mm thick x 10 mm wide.

- Interlayer varnish - SI40C

- Impregnation :

  - VPI with solventless Varnish FT2005/500 EK or HEW 290 or GE 712 (Equivalent Rotomac RE-009).

- Test Voltages:

  As per Annexure C-1

- Armature resistance at 110°C : 0.012 Ω m

- Net weight of copper : 81 Kg

- 1 section mean length : 1.450 m

- Slot wedge : Epoxy moulded slot wedge 3.5 mm thick.

- Banding : Resiglass banding on either side of PE and CE.

3. Equilizers

- Total number : 138 i.e. 1 every 2 segments.

- Location : Commutator side.

- Pitch : Segment 1 to 93

- No. of equalizing connections per bundle : 6

- Conductor dimensions(mm) : Bare = 1.2x5.2, r = 0

- Conductor covered with one layer 2/3 lap Kapton film 1.5 mil thick, Maximum dimension of covered conductor. : 1.497 x 5.517 mm

- Net weight of copper : 4 Kg

4. Commutator

- Diameter (new) : 380 mm

- Useful length : 140 m

- Diameter (top of risers) : 498 mm

- Width of risers (new) : 17 mm

- Width of risers (machined) : 14 mm (minimum)

- Maximum permissible radial wear : 8 mm

- Number of segments : 276

- Weight of copper : 52 Kg

- Mica thickness between segments : 1.2 mm
  Vee Cones : 2.5 mm

5. Brush Holders

- Number of brush holders : 6

- Number of brushes per holder : 3

- Type of brushes : Duplex

- Dimensions of brushes(mm) : 2 x (8x43)

- Height of brushes - New : 52 mm
  - Worn limit : 27 mm

- Pressure per duplex brush - New : 2.4 kgf.
  - Worn : 2.2 kgf.

- Brush holder ring should be revolving type.

6. Field coils

Series Field & Commutating Field

Coils type	- Edgewise wound - single Section coil moulded to pole core.	
	Series	Commutating
No. of turns per coil	11	10
Conductor size	4.6 x 45 or 4.8 x 45	7.5 x 27
Impregnation	VPI with Dr. Beck's 2005/500EK or GE 712(RE-009) OR HEW 290 solventless varnish.	
Insulation between turns	2 layers of 0.15 thick semi cured ceramic paper.	
Ground Insulation	(a) 1 layer 1/2 lapped Kapton tape (.05 tk) x 25 mm.	
	(b) 1 layer 1/2 lapped sodium treated PTFE tape (.05 tk) x 13 mm.	

	(c) 3 Layer 1/2 lapped glass backed uniform mica tape. (0.13 mm thick) x 25mm.	
	(d) 1 layer 1/2 Lapped Glass tape (.13 tk) x 20 mm.	
Alternatively:	4 layer 1/2 lap of glass backed uniform mica tape size 0.13 mm thick x 20 mm wide.	
	[Alternatively -	
	(i) 2 layers 1/2 lapped glass backed flexible (processed) mica tape 0.13 mm thick (Rotomac 779 R5C)	
	(ii) 2 layers 1/2 lap 'B' staged varnished glass tape 0.13 mm thick (Rotomac 765 R0C)].	
	1 layer 1/2 lap of Tetra Fluora Ethylene tape, size 0.038 mm thick x 19 mm wide.	
	1 layer 1/2 lap of fibre glass tape size 0.13 mm thick x 20 mm wide.	
	Lead are reinforced with an extra layer, 1/2 lapped Kapton tape 0.025 x 20 mm.	
Net wt. of copper/coil (approximately)	23.68 Kg	16 Kg
Resistance at 20 degree C per coil. (±5%)	0.00114 Ohm	0.000748 Ohm
Type coil	Potted	Potted

7. Ventilation (Forced)

Air flow	80 Cubic meter per minute static head of 150 mm water gauge in commutator chamber.
Air inlet	: Section 8.3 sq. dm
Air outlet	: Section 8.1 sq.dm

Core air ducts	:	10 Nos. of 26 on 0 = 200 20 Nos. of 22 on 0 = 250 20 Nos. of 22 on 0 = 330

. Balancing:

Dynamic balancing of the completely finished armature. Residual unbalance shall be less than 1.5 gm-mtr.

. Roller bearings

(i) Armature Bearings:

- SKF/FAG roller bearings:

- Commutator side : Type: SKF NH318 ECM/C4P VA 301. or FAG NH 318 EM1 C4F1

- Pinion side : TYPE: SKF NU: 328 ECM/C4.VA301 or FAG NU 328 EM1 C4 F1.

(ii) Suspension Bearings:

- Timken/SKF/FAG make taper roller bearing

Non-gear end	Timken	Cone M349547 Cup M349510
Gear end	Timken	Cone M249747 Cup M249710

- Lubrication : Grease

- Recommended grease grade : SERVOGEM RR3 OF IOC, Multigrease LL3 of B&L.

10. Mechanical Part

- Type of suspension : Nose

- Track guage : 1676 mm

- New wheel diameter : 1092 mm

- Half worm wheel diameter : 1054 mm

- Gear ratio : 62/15 or 58/21 or suitable.

- Distance between gears centres : 476 mm

- Gear modulus : 12.36

- Maximum axle load : 22 t.

- Clearance under gear case : 140 mm
  under motor : 140/155 mm

- Nominal axle diameter : 210 mm

- Axle bearings plain sleeve type -

  Commutator side length : 200 mm

  Pinion side length : 310 mm

- Axle bearing oil :

  Servo prime 76 (IOC) or Turbinol 77 (HPC) or Turbol 78 (BPC).

- Gear Compound :

  Servo coat 170T (IOC)/Blue coat 3 (BL).

11. Main pole pieces

- Magnetic steel sheet - grade No. A 1120 - 1 mm thick

Alternatively, 1 mm thick cold rolled carbon steel annealed sheet as per DIN 1623-1983 or IS 513-1994.

- Core : Length : 420 mm
  Width : 120 mm

- Pole arc : 99°

- Radial gap length : Centre : 5.5 mm
  Tip : 10 mm

- Pole seat slim : Steel sheet 1 mm thick

Commutating pole pieces

- type : Laminated
- Fixing screws of M 16 size : non-magnetic
- Magnetic steel sheet : Grade No. 8 630 to IS-648 0.5 mm thick. Alternatively, 0.5 mm thick CRNGO sheet as per DIN46400 -1983, grade V600-50A.
- Core length : 370 mm
- Width : 32 mm
- Pole face width : 26 mm
- Radial gap length - armature side (centre) 6 mm
  - frame side .. SILIRITE SHIM 1.55 ±0.01
  STEEL SHIM 4.45 ± 0.02 mm

12. Magnetic frame:

- Type : solid
- Useful section : 2 x 290 sq.cm.

13. Weight:

- Complete armature (without pinion) : 850 Kg approx.
- Motor without gears, gearcase, axle bearings, plain, axle bearing cap. : 2250 Kg
- Complete motor : 2800 Kg approx.
- Characteristics curve : RDSO GEL-1064.

ANNEXURE C-1

TESTING VOLTAGE SCHEDULE
STAGE TESTING

TEST NO.		VOLTAGE	DURATION
	- COMMUTATOR		
1.	- Between adjacent segments after turning.	1200V	5 sec.
2.	- Between adjacent segments after mounting on mechanical parts.	1000 V	5 sec.
3.	- Between all segments connected together and ground after mounting on mechanical parts.	8200 V	1 min.
	- EQUILIZERS		
4.	- Between adjacent conductors on completely finished bundles before mounting on the armature.	800 V	5 Sec.
	- ARMATURE COILS		
5.	- Between adjacent conductors after first bounding of conductors.	800 V	5 sec.
	- ARMATURE ASSEMBLY		
6.	- Between adjacent segments after machining putty between commutator and core.	850 V	5 sec.
	- After mounting and baking equalisers:		
7.	- Between adjacent conductors	700 V	5 sec.
8.	- Between all conductors connected together and cores.	7800 V	1 min.
9.	- After mounting armature coils but before driving home (hot) between all conductors connected together and core.	7500 V	1 Min.

10.	-	After hot driving home and baking of armature coils, between all conductors connected together and core.	7000 V	1 min.
	-	After mounting slot wedge but before tin bath soldering/ TIG welding.		
11.	-	Surge voltage test between adjacent segments	250 V	1 pulse.
12.	-	D.E. test between all conductor and core.	6500 V	1 min.
	-	After banding and commutator turning to drawing dimensions plus 0.5:		
13.	-	D.E. test betwen all conductors and ground	5500 V	1 min.
14.	-	Surge voltage test between adjacent segments.	200 V	1 pulse
15.	-	Measurement of resistance between adjacent segments	-	-
	-	FIELD COILS		
16.	-	High frequency test (range of 1000 c/s) between turns after bonding.	20 V per turn	5 sec.
17.	-	High frequency test between turns after complete insulation.	20 V per turn	sec.
18.	-	D.E. test between copper and metal fixture after complete insulation	7500 V	1 min
19.	-	Between copper and frame after mounting in the motor frame.	7000 V	1 min.
20.	-	Between copper and frame after complete cabling.	6200 V	1 min.
	-	BRUSH HOLDERS		
21.	-	Acceptance test of insulating studs: Between the 2 steel fittings	15000 V	1 min

ANNDEXURE D-I

SPECIAL MAINTENANCE INSTRUCTIONS

Sl.	SMI NO.	DESCRIPTION
1.	ELRS/SMI/1	Fitting of nuts/bolts/screws.
2.	ELRS/SMI/6	Resurfacing of commutator of TM and its amendment.
3.	ELRS/SMI/13	Tightening & locking of gripping ring in TA0-659 Traction Motor.
4.	ELRS/SMI/14	Maintenance of terminal connections of TA0 659 Traction Motor, instruction for tightening of the insulators.
5.	ELRS/SMI/15	Sealing of tapped holes for terminal insulators of TA0-659 Traction Motors.
6.	ELRS/SMI/7	Providing of essential running clearance between the axle toothed ring of the oil pump drive of the suspension bearing of TA0 659 Traction Motor and recess provided in the suspension bearing cap.
7.	ELRS/SMI/25	Millivolt drop or micro-ohm resistance test on traction motor.
8.	ELRS/SMI/29	Resurfacing of commutator speed, feed, tool.
9.	ELRS/SMI/31	Undercutting and chamfering of traction motors commutator.
10.	ELRS/SMI/41	Improving the insulation of the stator internal connection of TA0 659 TM and Field Coil Ground Insulation.
11.	ELRS/SMI/39	Checking of air flow in the commutator chamber of TA0-659 Traction Motor.
12.	ELRS/SMI/42	Non-interchangeability of BHRR on TA0-659 Traction Motor.
13.	ELRS/SMI/51	Bar to bar conductor resistance and equalised resistance test on Traction Motor.

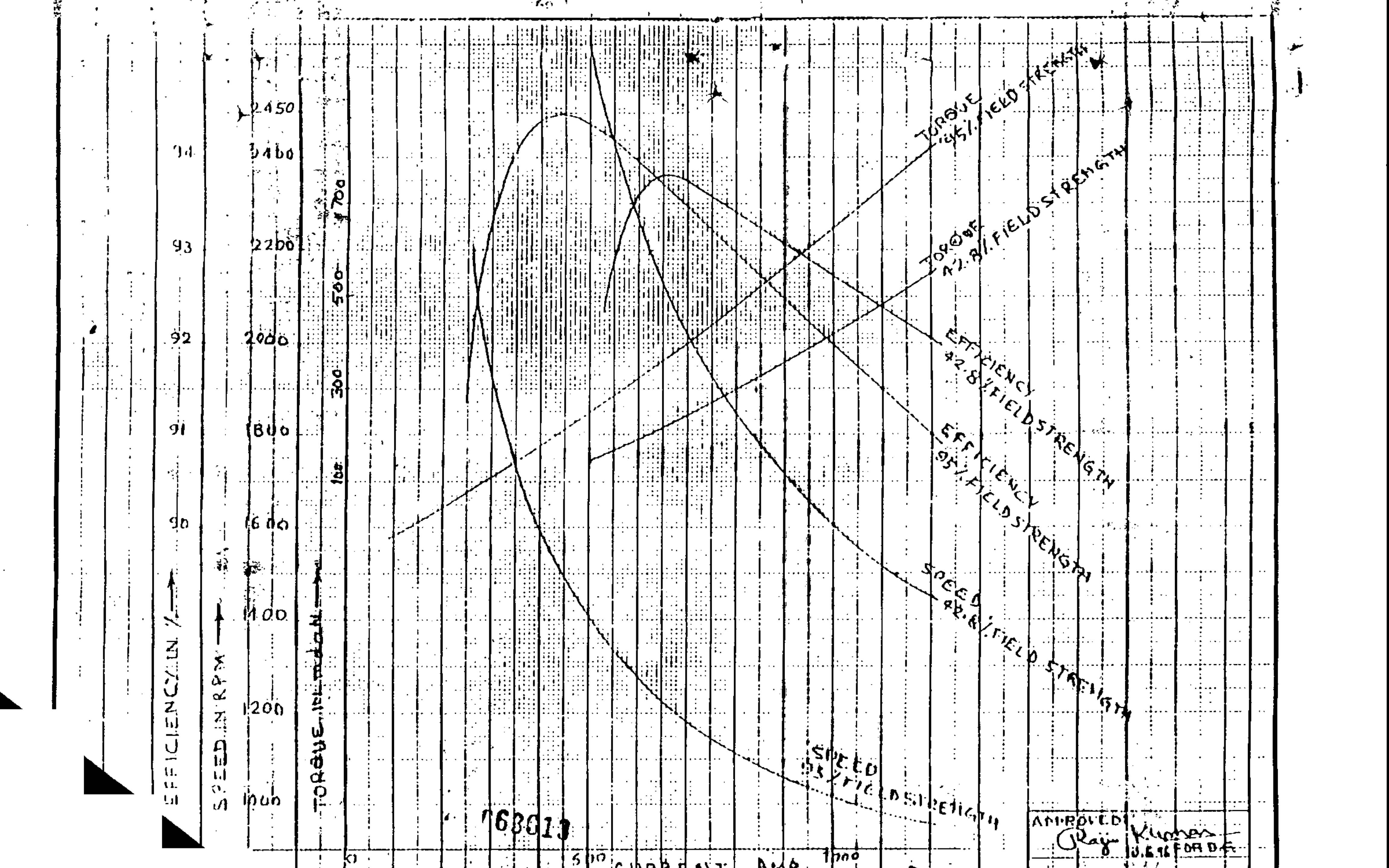
14.	ELRS/SMI/53	Insulating Scheme using Class 'H' material at the leads of armature coils in Traction Motor.
15.	ELRS/SMI/58	Special Maintenance Instructions for on condition monitoring of bearings.
16.	ELRS/SMI/60	Discontinuing high voltage DE test on overhauled traction motor.
17.	ELRS/SMI/84	Procedure for drying out of TA0-659 TM.
18.	ELRS/SMI/128	Tan Delta measurement of TM Armature.
19.	ELRS/SMI/151	Testing of brazing joint of field coils circuits of Traction Motor type TA0-659 and HS-1050 Er/HS-15250A.
20.	ELRS/SMI/160	Measurement of back lash of traction gears.
21.	ELRS/SMI/166	Ventilation of TA0-659 Traction Motor.
22.	ELRS/SMI/167	Precaution while tapping of bus bars and clamps of traction motor stators.
23.	ELRS/SMI/168	Copper bus-bar used in stator of TA0-659 Traction Motors in the Locomotive.
24.	ELRS/SMI/170	Checks on main pole and interpole coils of TA0-659 Traction Motors.
25.	ELRS/SMI/171	Fitment of "Mica-lex Insulator" on TA0-659 Traction Motors.
26.	ELRS/SMI/180	Draft rehabilitation procedure for the mechanical portion of traction motor Type TA0-659 of BG, AC Electric Locomotives.
27.	ELRS/SMI/181	Neutral setting of brush holder revolving ring of traction motor by electrical method known as "KICK METHOD".
28.	ELRS/SMI/183	Procedure for proper tightening of suspension tube fixation bolts fitted on Traction Motor type TA0-659 and HS-15250A.

ANNEXURE-D-II

MODIFICATION SHEET

Sl. No.	Modification No.	Description
1.	RDSO/WAM4/63	Taping of leads of traction motor type TA0-659 to prevent chafing in cleats.
2.	RDSO/WAM4/67	Fixing of Neoprene gasket on the terminal box cover of TA0-659 TM.
3.	RDSO/WAM4/68	Modification to Bellow of TA0-659 Traction Motors.
4.	RDSO/WAM4/90	Modification at commutator end of TA0-659 Armature Shaft and the Set Ring.
5.	RDSO/WAM4/118	Replacement of flexible contact assembly by a braided shunt in TA0-659 TM.
6.	RDSO/WAM4/158	Modification to negative connection lead of comm. pole coil (Lead No. 13) on TA0-659 TM.
7.	RDSO/WAM4/162	Modification to 'L' clamp of com. pole of TA0 659 T.M.
8.	RDSO/WAM4/164	Prevention of suspension bearing oil leakage into the stator frame.
9.	RDSO/WAM4/165	Provision of thread locking compound on bolts/screws.
10.	RDSO/WAM4/166	Modified support plate assembly for main pole and comm. pole.
11.	RDSO/WAM4/167	Modified adjustment punching for main pole core assembly to TA0-659 Traction Motor.
12.	RDSO/WAM4/168	Modified adjustment shim and silimite shim for commutating pole core of TA0 659 Traction Motor.
13.	RDSO/WAM4/169	Improved insulation scheme for interconnectors of TA0-659 TM.

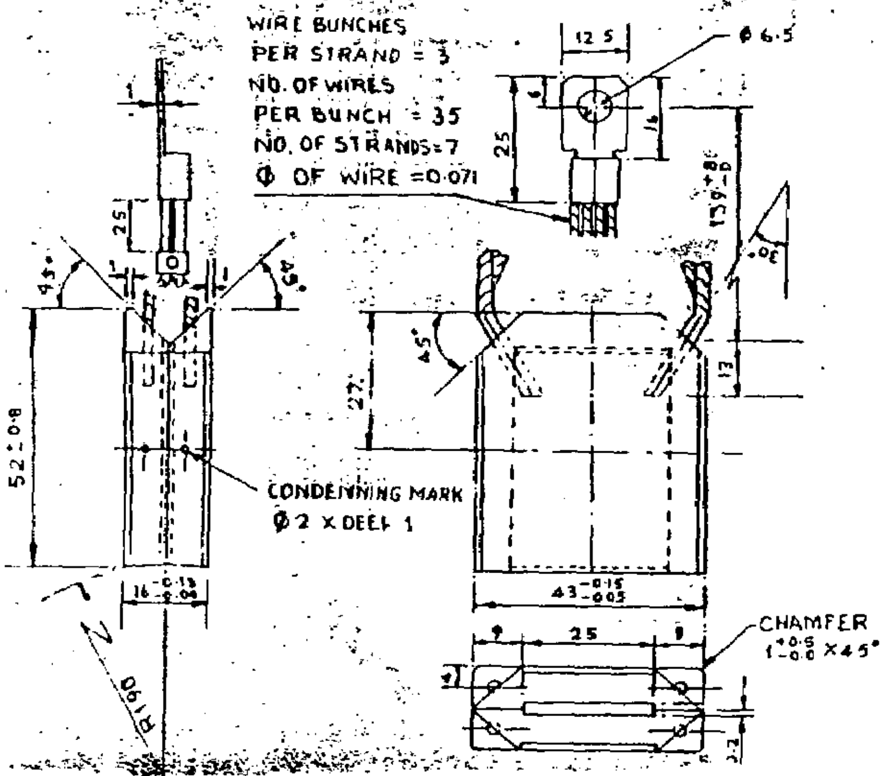
14.	RDSO/WAM4/174	Improved interconnector layout for TAO-659 Traction Motor.
15.	RDSO/WAM4/186	Modification to the protection screen of pinion end shield and air outlet of magnet frame of TAO-659 Traction Motor.
16.	RDSO/WAM4/188	Adoption of forged armature head on the armature shaft of TAO-659 T.M.
17.	RDSO/WAM4/191	Adoption of Teflon ring in lieu of Teflon band on the exposed surface of V-cone of Traction Motor.
18.	RDSO/WAM4/194	Improved interconnector layout for TAO-659 Traction Motor with potted Single Section Field Coils.
19.	RDSO/WAM4/196	Adoption of improved BHEL assembly on Traction Motor type TAO-659 with Flexible Lead wires.
20.	RDSO/WAM4/198	Improvement in the design of Armature Shaft of TAO-659 Traction Motor.



CHARACTERISTICS CURVE OF T.M. TAO 659 AT 750V. DC

63611

SUPPLIER'S NAME	GRADE			
	ORIGINAL	SUBSITUTE	APPD. BY RDSO	APPROVED WITH RESTRICTION
M/S SHREE CARBOMET	LE CARBONE EG 367			
M/S ACPL			MORGANITE EG 105(I)	MORGANITE EG 116 S(I)
M/S ELCA				SEE GRADE E 24 (I)



S.NO	DESCRIPTION	VALUE
1.	MAKE & TYPE	ALSTHOM (CLW) TAO659
2.	CONTINUOUS RATING	750V, 840A, 1058 rpm, 585 KW ALT 1
3.	ONE HOUR RATING	750V, 870A, 1010 rpm, 605 KW ALT 1
4.	MAX. SPEED	2500 rpm
5.	COMMUTATOR DIA (NEW)	380 mm
6.	COMMUTATOR DIA (OLD)	364 mm
7.	NO. OF BRUSH ARMS	6
8.	NO. OF BRUSHES PER ARM	3
9.	TOTAL NO. OF BRUSHES PER MACHINE	18
10.	CONDEMNING LIMIT	27 mm
11.	EFFORT OF SPRING ON BRUSH	2.2 TO 2.4 kg
12.	CURRENT DENSITY	136 mA/mm²

GENERAL NOTES :-

1. CARBON BRUSH SHALL GENERALLY CONFORM TO IS: 3003 PT. I TO IV UNLESS OTHERWISE STATED.
2. BRUSH GRADE AND MANUFACTURER'S NAME/TRADE MARK SHALL BE ENGRAVED ON BOTH THE WIDER FACES ABOVE THE CONDEMNING MARK.
3. CONDEMNING MARKS SHALL BE MADE ON TWO SIDE FACES.
4. RECOMENDED DIRECTION OF CUTTING OF CARBON BRUSH - GRAIN AXIAL.*
5. SPECIAL TEST: ENDURANCE TEST AS PER RDSO LETTER NO EL/2.2.70 DT. 27.9.82.
6. THIS DRG. SUPERSEDES DRG. NO. SKEL-B77 MOD 2 & EL.BS.002.
7. ALL DIMENSIONS ARE IN MM.
8. REFER TO LATEST INSTRUCTIONS ISSUED BY RDSO FOR THE VALIDITY OF APPROVAL OF BRUSH GRADES.

PART NO.	DESCRIPTION	QTY.	MATERIAL	SPECIFICATION
3.	TERMINAL	1	TINNED ELECTROLYTIC COPPER	
2.	PIG TAIL	4	ELECTROLYTIC GRADE COPPER	CLAUSE 5.2 OF IS:3003 PT. IV
1.	CARBON BRUSH	1	ELECTRO-GRAPHITE	

REF: ALSTHOM DRG. NO. 5604117 | SCALE: NTS | APPROVED:

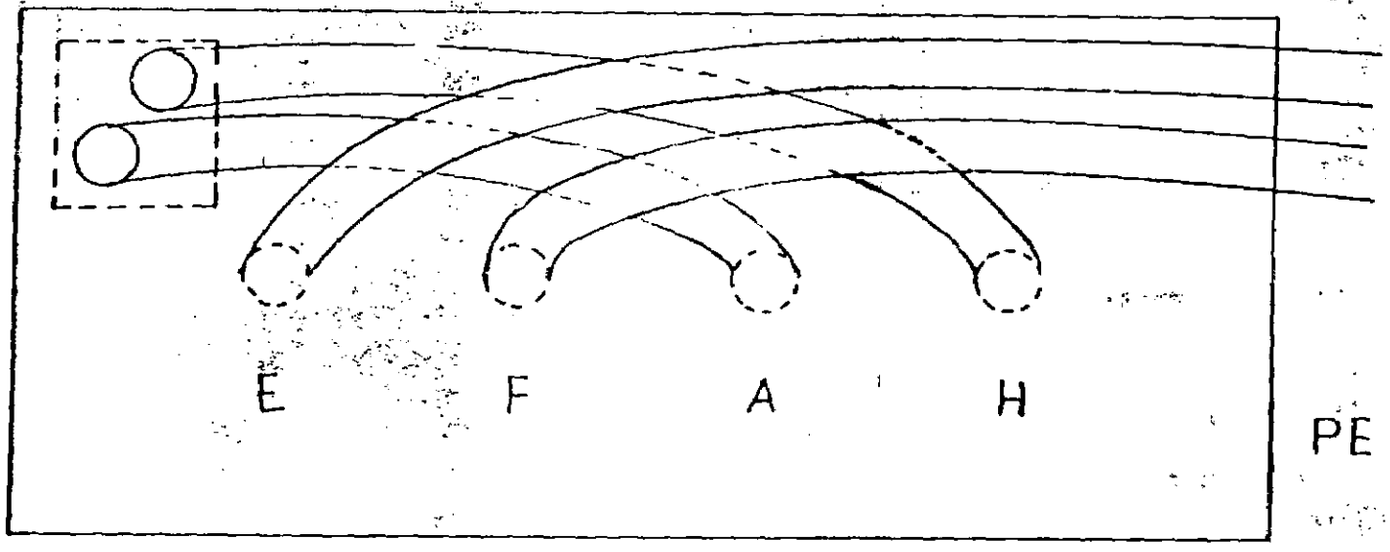
* REFER RDSO DRG. NO. SKEL 3602.

ALT	REF.	DESCRIPTION	SIGN	DATE
2		NOTE NO. 9 DELETED		
1		CONTINUOUS RATED RPM 1058 CHANGED TO 1010 RPM & ONE HOUR RATED CURRENT OF 870 A CHANGED TO 870 A	DSE	

DT. 19.12.95
D
T
C

CARBON BRUSH FOR TM TAO 659 USED ON WAM4 LOCOs

ELEC. DTE. | RDSO.EL.BS.002 (MOD)



THIS DRAWING SUPERSEDS DRG. NO. SKEL-4369.

REF:	SCALE: NTS	APPROVED Raja Kumar FOR D.G.
TERMINAL BOX CONNECTIONS OF TAO-659 TRACTION MOTOR		
R.D.S.O. ELECT. DTE		SKEL - 4413

7-7-97
CHANDRA
N.S.
HILLON

Doc. S.No 229
Amendment No1

GOVERNMENT OF INDIA MINISTRY OF RAILWAYS
RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR LUCKNOW - 226 011

No. EL/3.2.5 Dt. 17.9.98

Distribution as per list enclosed

AMENDTMENT No. 1

Sub : Amendment to Technical specification of traction motor type TAO 659 having roller suspension bearing assembly.

Ref : RDSO's Specification No. SPEC/E-7/20 of Sept'97, circulated to all Zonal Rlys & Railway Board vide this office letter of even number, Dt. 31.12.97

The few clauses of the above RDSO specification under reference have been modified as follows :

1. Clause 3.10.3 (Page No.17) - Carbon Brush Drawing

Follow RDSO's Drg. No. EL.BS.002(MOD) Alt 2 in place of Alt.1.

2. Clause 3.12.1 (Page 18) - Terminal Box

Follow RDSO's Drg. No. SKEL 4413 & 4414 in place of SKEL 4369.

3. Clause 3.15.1 (Page 18) - Motor Weight

2nd & 3rd Line Delete axle support bearing shells & axle bearing cap

Read the revised matter as follows :

"The total weight of the motor including pinion, gear, gear case /tube and suspension/ assembly is presently 2800 Kgs.

4. Clause 3.18.0 (Page 19)

Read the heading as follows :

"Modified Gearcase assembly/Gear wheel in lieu of modified gear case assembly.

conta...2/-

(22)

5. Clause 3.18.2 (Page 19)

Add this clause

"The modified gear wheel shall be procured as per RDSO Drg. No.SKDL 4455 & 4456 for 62 teeth and 58 teeth respectively.

6. ANNEXURE 'C' (Page 26)
Clause 2 - Armature (Page 26)

- Max Dimensions of covered conductor (Page 27)
- Follow 3.03 x 8.23 mm in place of 3.097 x 8.337 mm

- Interlayer Varnish (Page 27)

Read the matter as follows :

"Alsthom SI 40C or Metroare 140 C Varnish

Clause 6 - Field Coils (Page 29)

Ground Insulation (Page 29 & 30)

a) - Kapton tape

Size 0.05 mm thick x 20 mm wide in place of 0.05 mm thick x 25 mm wide.

b) - Sodium treated PTFE tape

Size 0.038 mm thick x 19 mm wide in place of 0.05 mm thick x 13 mm wide.

c) - Glass backed Uniform mica tape

Size 0.13 mm thick x 20 mm wide in place of 0.13 mm thick x 25 mm wide.

d) Fibre Glass tape

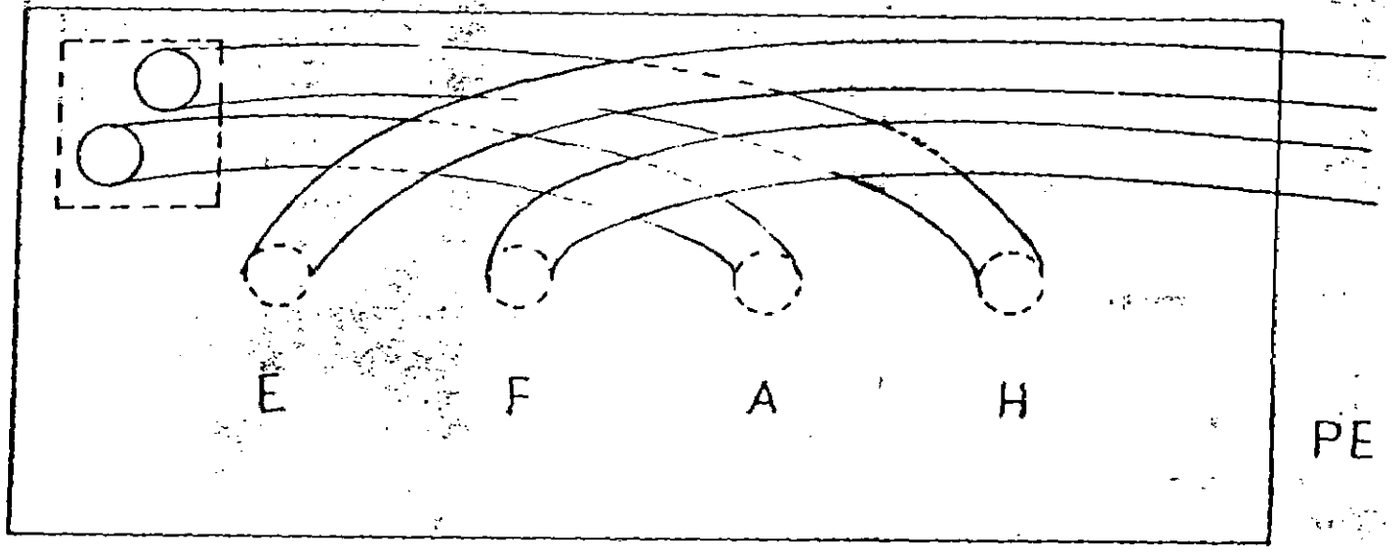
Size 0.18 mm thick x 20 mm wide in place of 0.13 mm thick x 20 mm wide.

Resistance at 20 degree C per coil (± 5%)

Resistance of comm Pole Coil

- Follow 0.00078 ohms in place of 0.000748 ohms

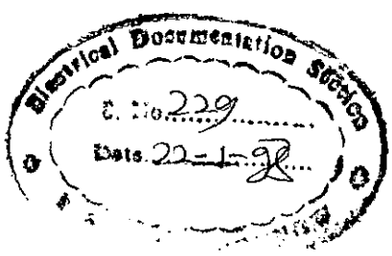
contd....3/-



THIS DRAWING SUPERSEDS DRG. NO. SKEL-4369.

REF:	SCALE: NTS	APPROVED Raja Kumar FOR D.G.
TERMINAL BOX CONNECTIONS OF TAD-659 TRACTION MOTOR		
R.D.S.O. ELECT. DTE.		SKEL - 4413

7.97
CHANDRA
N.S.
ILLON


Electrical Documentation Section
Date 22-1-92

Clause 10 Mechanical Parts (Page 32)

Delete : Details of axle bearing plain sleeve type & axle bearing oil

Clause 13 Weight (Page 33)

Delete : "Axle bearing plain sleeve axle bearing cap

Read the revised matter as follows :

" Motor without gears, gear case and suspension tube assembly.

7. Annexure D-I (Page 37 & 38)

Special Maintenance Instruction

Delete : Following SMIs are not applicable/superseded presently SMI/ 1, 41, 53 & 58

Add : SMI/186

- Bonded rubber sandwich mounting for nose suspension of traction motors.

8. Annexure D-II (Page 39 & 40)

Modification Sheets

Delete : Following Modification Sheets are not applicable/superseded presently.
MS/90, 118, 158, 169 & 174

Rajiv Kumar

(R.K.Kulshrestha)
for Director General/Elect.

63617

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RESEARCH DESIGNS & STANDARDS ORGANISATION

NO.EL/3.2.5

Manak Nagar, Lucknow-11
Dated: .10.1998

Distribution as per list enclosed.

AMENDMENT NO.2

Sub :- Amendment to Technical Specn. of Traction Motor type TA0659 having roller suspension bearing assembly.

Ref.:- RDSO's Specn. No.SPEC/E-7/20 of Sept.'97 circulated to all zonal railways and Railway Board vide this office letter of even number dated 31.12.1997.

The few clauses of the above RDSO specification under reference have been modified as follows :-

1. ANNEXURE D-I (Page 37 & 38)

Special Maintenance Instructions

Add - SMI/TM/0205-98 (Rev.-0)
Procedure for tightening of axle cap fixation bolts of traction motor type TA0659.

Raju Kumar

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for Director General(Elec)

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सत्यमेव जयते

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Research Designs & Standards Organisation
LUCKNOW-226011

No.EL/3.2.5 Dated 28.6.99

Distribution as per enclosed list

AMENDMENT No. 3

Sub: Amendment to Technical specification of traction motor type TAO-659 having roller suspension bearing arrangement.

Ref: RDSO Specification No.SPEC/E-7/20 of Sept'97 circulated to all Zonal Rlys and Rly. Board vide this office letter of even number dt.31.12.97.

...

The few clauses of the above RDSO specification under reference have been modified as follows:

1. Chapter III Detailed Engg. Specification

Clause 3.5.0 Standard specification, rating cures & Calculation

Clause 3.5.1

Read IECs & IEEEs as follows:

- IEC 216-1, 1990, 4th Edition
- IEC 349-1991, 2nd edition
- IEC 505-1975, 1st edition and its draft supplement.
- IEC 563-1976, 1st edition
- IEC 356-1971, 1st edition
- IEEE-11-1980 (R1992)
- IEEE-304-1977(R1991)
- IEEE-429-1994

Clause 3.10.0 Brush Gear

Clause 3.10.1

Read IS as follows:

"IS 305-1981, 2nd Revision, Reaffirmed 1991".

"IS 1458-1965 (Revised), Amendment 4, Reaffirmed 1991"

Clause 3.19.0 Armature bearing

Clause 3.19.2

Read the ISO as follows:

"ISO-281-1991 Revision 3, Amendment 1".

...2/-

Clause 3.20.0 Shaft

Clause 3.20.1 Shaft material

Read 'BS' as follows
"BS.970, Part3, 1991"

2. Annexure C

Traction Motor TAO 659 Data

Armature

Clause 2

Main Lamination

Read 'IS' as follow:

"IS648-1994 Fourth Revision"

End Lamination

Read 'IS' as follow:

"IS 513-1994, Fourth Revision".

3. Drawing:

i) Carbon brush (Drg No.RDSO.EL.BS.C02 (Mod) Alt.2)

Read 'IS' as follow

'IS 3003 Part 1, 1977, Amendment 1, Reaffirmed 1991
Read IS-3003 Part 2 as IS 13584-92
Read IS-3003 Parts 3 & 4 as IS-13466-92

ii) Modified arrangement of terminal box assembly (RDSO Drg.No. SKEL-4414)

Read x IS as follow:

- Follow IS 2062-1992, Fourth revision, Amendment 1 in place of IS 226-1975.
- IS 1570-1961, Amendment 5, Reaffirmed 1993
- IS 1367 Part 1-1980 2nd Revision, Reaffirmed 1991
- IS 3063 - 1994, Second Revision
- IS 1364 Part 1, 1992, Third Revision.
- IS 1079-1994, Fourth revision

Armature Sleeve (RDSO Drg. No. SKEL 4416)

Read IS as follows
IS 1030-1989, Fourth Revision, Amendment 2.

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No.EL/3.2.5 **Dated: 29.9.99**

(Distribution as per enclosed list)

Amendment No.4

Sub: Amendment to Technical specification of traction motor type TAO-659 having roller suspension bearing arrangement.

Ref: RDSO Specification No.SPEC/E-7/20 of Sept'97 circulated to all Zonal Railways & Railway Board vide this office letter of even number dt.31.12.97.

....

The few clauses of the above, RDSO specification under reference have been modified as follows:-

Chapter –III Detailed Engg.specification.

(i). Clause 3.3, General-Mechanical and clause 3.20.0,shaft .
clause 3.3.8 - (Page No.8)
and
Clause 3.20.2,Para 2 (Page No.20)

Follow RDSO Drawing No. SKEL 4415 Alt.1 in place of Drg. No. SKEL 4415 Alt.0

(ii). Clause 3.17 .0 Axle support (suspension) bearing (Page No.19)
Clause 3.17.1

General Arrangement of motor suspension unit for traction motor type TAO-659.

Follow RDSO Drawing No. SKEL4510 in place of Drg No.SKEL-4421.

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(R. K. Kulshrestha)
for Director General/Elect

Encl:Nil