



BHARAT HEAVY ELECTRICALS LIMITED

Enquiry No. :

UNIT'S ADDRESS:

Due Date :

Supplier Qtn. No.:

UNIT'S PHONE NOS.

Date :

CONTACT PERSON'S NAME/DESIGN./PHONE NO./E-MAIL
(FROM PURCHASE DEPTT.)

Specification cum Compliance Certificate for CNC Cylindrical Teeth Grinding Machine

NOTE:-

1. Vendor must submit complete information against Qualifying Conditions (Clause no. 19.0). The offer meeting this clause would only be processed.

2. The "Offered" Column and where applicable, the "Deviations" & "Remarks" Column of this format shall be filled in by the Vendor and submitted along with the offer. Inadequate/incomplete, ambiguous, or unsustainable information against any of the clauses of the specifications/requirements shall be treated as non-compliance.

3. The offer and all documents enclosed with offer should be in English language only.

ADDRESS OF THE SUPPLIER :

ADDRESS OF THE INDIAN AGENTS :

TELEPHONE NOS.:

TELEPHONE NOS.:

FAX NOS.:

FAX NOS.:

E-MAIL ADDRESS :

E-MAIL ADDRESS :

SCOPE: Supply, Erection & Commissioning of CNC Cylindrical Teeth Grinding Machine Complying with Specification as below

SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
1	PURPOSE			
1.1	Purpose: A CNC Cylindrical Teeth Grinding M/C is required for External Teeth Grinding of various Traction Gears like Spur, Helical etc.	Vendor to confirm		
2	REQUIRED MACHINE CONFIGURATION			
2.1	CNC M/c with 1. Radial Movement (Along the job radius); 2 Axial Movement (Along the job axis); 3. Tangential Movement (Tangential to the job circumference); 4. Tilting movement for Grinding head; 5. Work table rotation (About vertical axis); 6. Tailstock column movement; 7. Dressing movements.	Vendor to confirm		
2.2	JOB REQUIREMENT			
2.2.1	WORKPIECE MATERIAL			
2.2.1.1	Work Piece Material:-Alloy steel , 55-63 RC. (Material IS standard and UTS upto 1100 N/mm ²)	Vendor to note		
2.2.2	GEAR DATA			
2.2.2.1	Max. Tip circle diameter/Outer Diameter: 804 mm	Vendor to confirm		

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2.2.2.2	Module: 1 to 12	Vendor to confirm		
2.2.2.3	Helix Angle: $\pm 45^\circ$	Vendor to confirm		
2.2.2.4	Max. Face width: 250 mm	Vendor to confirm		
2.2.2.5	Machine should be able to provide crowning facility 0 to 0.4 mm and above	Vendor to confirm		
2.2.2.6	Min. Crowning stage required: 3 stage (Lead areas to be defined)	Vendor to confirm		
2.2.2.7	Job Weight: ≥ 350 kg	Vendor to confirm		
2.2.2.8	Maximum Grindable profile depth: 35 mm	Vendor to confirm		
2.3	CAPACITY :			
2.3.1	Material Removal Capacity: The machine should be capable of removing Stock of 10mm ³ /second per flank per pass in roughing cut using grinding wheel of max. possible diameter. There should not be any cracks, chatter or burning marks on Job. The job material to be used is specified in Clause No.2.2.1.1	Vendor to confirm		
3	SPECIFICATION(Minimum Requirements):			
3.1	WHEEL HEAD			
3.1.1	Grinding wheel Inner Diameter / BORE diameter: 127mm	Vendor to confirm		
3.1.2	Grinding wheel Outer Diameter	Vendor to specify		
3.1.3	Grinding Wheel width: 15mm to 50mm	Vendor to confirm		
3.1.4	Grinding Wheel Motor Power (AC Continuous Rating - SI): ≥ 22 kW	Vendor to confirm		
3.1.5	Grinding Wheel speed range (infinitely variable)	Vendor to specify		
3.1.6	Grinding wheel should be automatically fine balanced. Integrated grinding wheel balancing unit (of MPM /MARPOSS /DITTEL/BALANCE SYSTEMS make) should be provided.	Vendor to confirm		
3.1.7	Grinding Wheel Motor Cooling System (Details to be furnished by vendor)	Vendor to specify		
3.1.8	Min. center distance between work piece and grinding wheel.	Vendor to specify		
3.1.9	Max. center distance between work piece and grinding wheel.	Vendor to specify		
3.2	RADIAL MOVEMENT (Along the job radius):			
3.2.1	Total traverse length: ≥ 500 mm	Vendor to confirm		
3.2.2	Rapid feedrate (infinitely variable): ≥ 5000 mm/min.	Vendor to confirm		
3.2.3	Resolution: 0.001mm	Vendor to confirm		
3.3	AXIAL MOVEMENT (Along the job axis):			
3.3.1	Total traverse length: ≥ 400 mm	Vendor to confirm		

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3.3.2	Rapid feedrate (infinitely variable): ≥ 5000 mm/min.	Vendor to confirm		
3.3.3	Resolution: 0.001mm	Vendor to confirm		
3.4	TANGENTIAL MOVEMENT (Tangential to the job circumference):			
3.4.1	Total traverse length: ≥ 175 mm	Vendor to confirm		
3.4.2	Rapid feedrate (infinitely variable): ≥ 5000 mm/min.	Vendor to confirm		
3.4.3	Axial Resolution: 0.001mm	Vendor to confirm		
3.5	TABLE ROTATION (About vertical axis):			
3.5.1	Table diameter: ≥ 500 mm	Vendor to confirm		
3.5.2	Table load carrying capacity: ≥ 2000 kgs	Vendor to confirm		
3.5.3	Rotation: 360°	Vendor to confirm		
3.5.4	Rapid rpm (infinitely variable):	Vendor to specify		
3.5.5	Resolution: 0.001°	Vendor to confirm		
3.5.6	Size of T-slots : To suit min. M-10mm stud / bolts.	Vendor to confirm		
3.5.7	T-slots pitch: as per DIN 508 standard	Vendor to specify		
3.5.8	Size of bore	Vendor to specify		
3.5.9	Mechanism of table drive and feedback system (Direct feedback for actual value of table should be provided.) Make of feedback system should be HEIDENHAIN / Siemens / Fagor / Rainishaw	Vendor to confirm		
3.6	TILTING MOVEMENT FOR GRINDING HEAD (Swivel of grinding wheel)			
3.6.1	Tilting range: $\pm 45^\circ$ (to the vertical axis)	Vendor to confirm		
3.6.2	Rapid rpm (infinitely variable):	Vendor to specify		
3.6.3	Resolution: 2.5"	Vendor to confirm		
3.7	TAILSTOCK COLUMN MOVEMENT:			
3.7.1	Tail stock with hydraulic/motorised adjustment for clamping of shaft type pinions between live centers. Details to be specified.	Vendor to specify		
3.8	DRESSING MOVEMENT:			
3.8.1	Grinding wheel dresser with multipoint diamond dressing roll and automatic wheel compensation should be provided for complete dressing of the grinding wheel.	Vendor to confirm		
3.8.2	Dressing axes configuration(No. of Axes) & whether the axes are Servocontrolled or not.	Vendor to specify		
3.8.3	Dressing cycles with dressing parameters for complete dressing operations.	Vendor to confirm		
3.9	DRIVE, MOTOR & FEEDBACK SYSTEM			

SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
3.9.1	Grinding and dressing wheel motor & drive: FANUC or SIEMENS AC spindle motor with matching AC spindle drive. Details like model, make, type, rating etc. should be submitted along with the offer. Note: Latest hardware & firmware at the time of delivery, should be supplied.	Vendor to confirm		
3.9.2	Feed motors & drives: FANUC or SIEMENS AC servo motors with matching AC servo drives. Details like model, make, type, rating etc. should be submitted along with the offer. Note: Latest hardware & firmware at the time of delivery, should be supplied.	Vendor to confirm		
3.9.3	Position Feedback system for all linear axes: Heidenhain sealed linear scales. Details should be submitted along with the offer.	Vendor to confirm		
3.9.4	Position Feedback system for rotary axes: Heidenhain Rotary/Angle Encoders. Details should be submitted along with the offer.	Vendor to confirm		
3.9.5	Type of power transmission & feed mechanism for all the axes	Vendor to specify		
3.9.6	Mechanism for locking of the axes: Servo Lock/Brake	Vendor to specify		
3.10	CONSTRUCTION			
3.10.1	The main bed, carriage, column and table of the machine shall be of cast iron and stress relieved with optimum stiffness, thermal stability to ensure the required accuracy.	Vendor to confirm		
3.10.2	The Guideways must be hardened & ground. Guideways must not get rusted while in contact with water-mix coolant or with humidity of atmosphere. (Details should be submitted)	Vendor to confirm		
3.10.3	All the linear axes shall slide on guideways by means of recirculating ball screw with preloaded double nut.	Vendor to confirm		
3.10.4	Metallic Telescopic Covers of rust resistant material to be provided for all the axes guide ways alongwith wipers. Joints of telescopic covers should be so sealed to avoid mixing of coolant & hydrostatic / lubricating oil is to be provided.	Vendor to confirm		
3.10.5	Vendor to furnish constructional details, including explanatory drawings of various components/assemblies like Column, guideways, wheel head, table, centers, bearing of spindle etc. of the machine. The drawings will be of general arrangement and layout types. (Detailed design drawings are not required).	Vendor to confirm		
3.10.6	Documents/Literature with photographs/illustrations, drawings and schematics, explaining the technical features of the machine and accessories should be enclosed with the offer.	Vendor to confirm		
3.11	OPERATOR'S PLATFORM:			
3.11.1	If machine can not be operated from floor level, operator's platform is to be provided, It should be comfortable for operator to carry out all the functionalities of the machine, including job loading, unloading, clamping, unclamping & setting of the jobs..	Vendor to confirm		
3.11.2	Weight carrying Capacity of the Platform: ≥ 300 Kg.	Vendor to confirm		

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3.12	SPLASH GUARDS:			
3.12.1	Splash Guard should be provided all around the machine with sufficient height to avoid spilling of coolant and scattering of grinding dust on operator's platform and shop floor. Details of the same should be submitted.	Vendor to confirm		
3.13	OPERATION AND CONTROL SYSTEM:			
3.13.1	OPERATOR'S PANEL:			
3.13.1.1	Air conditioned operator's pendant of Rittal/Schneider make with complete CNC and machine control system of required configuration shall be provided on the operator's platform. All switches with suitable interlocks should be within reach of operator of average height 170cms for easy & safe operation. All displays / indications should also be conveniently placed accordingly. Layout showing complete details should be submitted with the offer.	Vendor to confirm		
3.13.2	CNC SYSTEM & FEATURES :			
3.13.2.1	Make: FANUC / SIEMENS	Vendor to confirm		
3.13.2.2	Model :	Vendor to specify		
3.13.2.3	Latest hardware & firmware versions, as available at the time of delivery, should be supplied..	Vendor to confirm		
3.13.2.4	The system should have an Operator Panel(OP) with full alphanumeric keyboard, colour display ($\geq 10.4''$), Machine Control Panel (MCP), RS232C serial interface / USB port for data input/output, network ready and on-screen PLC Ladder display. All PLC input/output modules should be of FANUC/ SIEMENS make. Latest hardware & firmware versions, as available at the time of delivery, should be supplied. (Details to be submitted)	Vendor to confirm		
3.13.2.5	The CNC system should be OPC-UA/FOCAS compliant with necessary license	Vendor to confirm		
3.13.2.6	Provision for safe shut down of CNC Control in case of Power Failure	Vendor to confirm		
3.13.3	MANUAL OPERATION :			
3.13.3.1	Complete manual operation of machine should be possible through Machine Control Panel (MCP). The MCP should have Spindle & Feed override switches, +/- Jog keys for individual axis, Start/Stop keys for Cycle, Spindle & Feed and additional keys/switches for auxiliary functions.	Vendor to confirm		
3.13.4	HAND HELD UNIT:			
3.13.4.1	Hand Held unit, alongwith sufficient length of cable is to be offered for handwheel (MPG) operation of all individual axis in increment mode and jog mode with feed override switch.	Vendor to confirm		
3.13.5	MACHINE OPERATIONAL FEATURES:			
3.13.5.1	Provision for automatic generation of CNC programs based on input data of gear teeth, grinding wheel and associated cutting parameters as required by the user.	Vendor to confirm		
3.13.5.2	Provision for single and double flank grinding, based on profile and lead modification.	Vendor to confirm		

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3.13.5.3	Provision for grinding of tooth segments.	Vendor to confirm		
3.13.5.4	Provision for flank oriented, asymmetric & multi-stage lead crowning for grinding of single and double tooth flanks.	Vendor to confirm		
3.13.5.5	Provision for automatic division of cuts for modified cylindrical gears with modified involute profiles.	Vendor to confirm		
3.13.5.6	Provision for grinding of root fillet in a defined shape	Vendor to confirm		
3.13.5.7	Data storage up to 300 work pieces and external data storage USB/Card drive to be provided.	Vendor to confirm		
3.13.6	UPS FOR CNC SYSTEM:			
3.13.6.1	UPS with sufficient back up for safe shutdown of CNC system is to be supplied only in case of PC based CNC systems.	Vendor to confirm		
3.13.6.2	Make: Siemens Liebert, APC, Hitachi, Microtek, Sukam, Luminous or any other equivalent make of international repute.	Vendor to confirm		
3.14	MACHINE LIGHTS:			
3.14.1	Machine Lights for sufficient illumination of complete working area on both sides of machine should be provided for clear visibility.	Vendor to confirm		
3.14.2	A magnetic base portable spot light with sufficiently long cable should also be provided.	Vendor to confirm		
3.14.3	Any light required in the foundation/pit area shall also be foreseen and supplied by the vendor, if applicable.	Vendor to confirm		
3.14.4	Flashing / rotary type End of Cutting and Program Stop Light should be provided..	Vendor to confirm		
3.15	AIR CONDITIONERS:			
3.15.1	Air Conditioners are to be provided for all Electrical Panels/Cabinets including Operator's Panel, considering continuous operation at ambient condition as per clause 11.1. The blow of cool air from the air conditioners shall not fall directly on the electronic circuits/modules. ACs must be incorporated with electrical/refrigeration interlocks. Detailed specifications of the same are to be submitted. The capacity for AC of electrical cabinet should be ≥ 2 Tons and that for the operator panel/pendant ≥ 0.75 Ton. The air conditioners should be of Advance/Verner Finley/Rittal make or other reputed international makes having spares & service support in India.	Vendor to confirm		
3.16	HYDRAULIC SYSTEM: (As Applicable)			
3.16.1	The Hydraulic System should be centralised. Hydraulic Tank shall preferably be located at floor level.	Vendor to confirm		
3.16.2	Make Rexroth/Vickers/Parker/Hawe/Hydac. Details to be submitted with the offer.	Vendor to specify		

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3.16.3	Hydraulic pump capacity (flow / pressure)	Vendor to specify		
3.16.4	Each pump should have an independent motor. Tandem pumps should not be used.	Vendor to confirm		
3.16.5	Filtration System of Hoffmann should be provided (Mention Type)	Vendor to specify		
3.16.6	Oil Cooling System: Eco friendly Gas filled Refrigerated type cooling system of sufficient capacity should be provided for maintaining the oil temperature to achieve the DIN CLASS 3/4 (As mentioned in clause 13.1) when the ambient conditions as per clause 11.1. Detail specifications with schematic layout & circuit diagrams are to be submitted.	Vendor to confirm		
3.16.7	First filling of all required Oils & Grease etc. to be supplied by vendor. Indigenous (Indian) source or Indian equivalent and specifications of oils/ greases are also to be provided by the vendor.	Vendor to confirm		
3.16.8	Hydraulic circuit diagram with complete details should be provided.	Vendor to confirm		
3.17	LUBRICATION SYSTEM			
3.17.1	Suitable Lubrication System (of Vogel/SKF/Trabon make) should be provided for effective lubrication of each part of the machine. Details should be submitted along with the offer.	Vendor to confirm		
3.17.2	Failure indication like oil level and pressure are to be provided	Vendor to confirm		
3.17.3	First filling of all required Oils & Grease etc. to be supplied by vendor. Indigenous (Indian) source or Indian equivalent and specifications of oils/ greases are also to be provided by the vendor.	Vendor to confirm		
3.18	COOLANT SYSTEM :			
3.18.1	Recirculating Type Flood Coolant System with nozzles around the grinding wheel with all accessories shall be provided. Selection of coolant shall be through program as well as push buttons provided on the Operator's panel. Note: Available Coolant with BHEL is MACRON12, Shell Macron 2425 S-8 or S-14 . Vendor to specify the suitability.	Vendor to confirm		
3.18.2	Coolant collection and recirculation system should be leak-proof to avoid any spillage on shop floor, trenches & foundation pit of the machine etc.	Vendor to confirm		
3.18.3	Coolant Filtration System: Pressurized recirculating type coolant system with endless filter belt with vacuum suction .	Vendor to confirm		
3.18.4	Coolant Flow Diagram showing filters, pumps, valves, tanks etc. to be submitted with the machine.	Vendor to confirm		
3.18.5	The capacity of the system should be sufficient for the coolant to reach the grinding wheel/grinding edge at full pressure.	Vendor to confirm		
3.18.6	Coolant Tank Capacity	Vendor to specify		
3.18.7	Coolant pump & motor details for all variants of coolant system are to be submitted with the machine.	Vendor to confirm		
3.18.8	Suitable system for collection of grinding dust alongwith bin to be provided	Vendor to confirm		

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3.18.9	Layout showing location of above system should be submitted.	Vendor to specify		
3.18.10	Fume Extractor should be provided .Vendor to specify its make and type	Vendor to confirm		
3.19	ELECTRICAL :			
3.19.1	415V +/- 10%, 50HZ +/- 3 %, 3 Phase AC (3 wire system without neutral) Power Supply will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor. All types of cables, connections, circuit breakers etc. required for connecting BHEL's power supply point to different parts of the machine/control cabinets, shall be the responsibility of vendor. Requirement of grounding/earthing with required material details should be informed by vendor well in advance so that same could be incorporated during construction of foundation.	Vendor to confirm		
3.19.2	Tropicalisation: All electrical / electronic equipment shall be tropicalized	Vendor to confirm		
3.19.3	Electrical cabinets should be of Rittal/Schneider/ABB/Siemens make, properly air conditioned and sealed from ingress of liquids, dust and encroachment of vermin & rodents.	Vendor to confirm		
3.19.4	All electrical components in the cabinets should be mounted on DIN Rail.	Vendor to confirm		
3.19.5	All electrical and electronic panels including operator's panel should be provided with fluorescent lamps for sufficient illumination and power receptacles of 220Volts, 5 Amp AC.	Vendor to confirm		
3.19.6	Motors (Others than feed & spindle motors) shall conform to IEC or Indian Standards	Vendor to confirm		
3.19.7	All cables outside the electrical cabinets and operator pendant must be routed through flexible conduits capable of withstanding stress, grinding dust hazard and ingress of oil/coolant. Additionally, all cables moving with traversing axes should be of trailing type and installed in caterpillar / cable drag chain.	Vendor to confirm		
3.19.8	Vendor should ensure the proper earthing for the machine and its peripherals.	Vendor to confirm		
3.20	SAFETY ARRANGEMENTS:			
3.20.1	Following safety features in addition to other standard safety features should be provided on the machine:			
3.20.1.1	Machine should have adequate and reliable safety interlocks / devices to avoid damage to the machine, workpiece and the operator due to the malfunctioning or mistakes. Machine functions should be continuously monitored and alarm / warning indications through lights/alarm and messages (with device identification) on CNC display and panels should be available.	Vendor to confirm		
3.20.1.2	A detailed list of all alarms / indications provided on machine along with cause and remedy should be submitted by the supplier.	Vendor to confirm		
3.20.1.3	All the pipes, cables etc. on the machine should be well supported and protected. These should not create any hinderance to machine operator's movement for effective use of machine.	Vendor to confirm		

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3.20.1.4	Grinding Spindle should be statically & dynamically balanced to avoid undue vibrations.	Vendor to confirm		
3.20.1.5	Emergency Switches at suitable locations as per International Norms should be provided.	Vendor to confirm		
3.20.1.6	Oil & water pipe lines should be completely isolated from electrical systems.	Vendor to confirm		
3.21	ENVIRONMENTAL PERFORMANCE OF THE MACHINE :			
3.21.1	The Machine should conform to following factors related to environment :			
3.21.1.1	Maximum noise level shall be ≤ 85 dB(A) at normal load condition, 1 meter away from the machine with correction factor for back ground noise, if necessary. This will be measured as per international standards like DIN 45635-16. Supplier to demonstrate compliance to noise level, if asked for.	Vendor to confirm		
3.21.1.2	There shall not be any emissions from the machine except fumes of cutting fluid during machining.	Vendor to confirm		
3.21.1.3	There should not be any effluent from the machine. In case there are any effluents from the machine, requisite effluent treatment plant or pollution control device should be built into the machine by the supplier.	Vendor to confirm		
3.21.1.4	No hazardous chemicals shall be required to be used in the machine.	Vendor to confirm		
3.21.1.5	If any safety / environmental protection enclosure is required it should be built in the machine by the supplier.	Vendor to confirm		
3.21.1.6	Paint of the machine should be oil / coolant resistant and should not peel off and mix up with coolant.	Vendor to confirm		
3.22	ULTRA ISOLATION TRANSFORMER			
3.22.1	Ultra Isolation Transformer of reputed make, suitable for complete machine, its drives, controls, PLC etc. shall be supplied	Vendor to confirm		
3.22.2	Make: Neel, Aplab, Autoelectric, Servomax or any other equivalent make of international repute.	Vendor to specify		
3.22.3	Catalogue of the Ultra Isolation Transformer shall be submitted with the machine.	Vendor to specify		
3.23	PNEUMATIC SYSTEM:			
3.23.1	AIR COMPRESSOR: (As Applicable)			
3.23.1.1	Independent Air Compressor with refrigerated type Dryer & Filter and of suitable capacity for the total compressed air requirements of the machine & accessories and to suit required air quality should be supplied. The system should be so designed to have additional provision and required accessories so that BHEL compressed air supply could be used as and when required. The compressor unit should be suitable for continuous duty.	Vendor to confirm		
3.23.1.2	Make & Model of Air Compressor: Atlas Copco/Ingersoll Rand/Elgi . Details to be submitted along with the offer.	Vendor to confirm		

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3.23.1.3	Capacity (Flow, Pressure & KW)	Vendor to specify		
3.23.1.4	Catalogue of the Air Compressor shall be submitted with the machine.	Vendor to confirm		
3.23.1.5	Make & Model of Refrigerated Air Dryer	Vendor to specify		
3.23.2	COMPRESSED AIR POINTS:			
3.23.2.1	Compressed Air Point with manual ON/ OFF Valve and flexible pipe of suitable length for work piece cleaning required.	Vendor to confirm		
3.24	TOOLINGS:			
3.24.1	Complete Tooling systems as below:-			
3.24.1.1	Clamping fixtures/bushes for the jobs shown in clause 12.1 and 12.2, suitable grinding wheels, diamond dressing rolls, required screws, bolts, spanner, Allen-keys, universal keys, wheel adapter, calibration unit, test mandrel and any other item as required for the machine.	Vendor to confirm		
3.25	MEASURING SYSTEMS:			
3.25.1	On board Automatic job measuring system (includes profile, lead, pitch, runout, chord etc.), comprising of Spindle Mounted Renishaw/Mahr make system, with measuring cycles, calibration system and all types of probes/styli required for measuring all ground dimensions of the prove-out components. Vendor to furnish detailed description of the system along with machine.	Vendor to confirm		
4	LEVELING & ANCHORING SYSTEM			
4.1	Complete anchoring system including foundation bolts, anchoring materials, fixators, leveling shoes etc should be supplied	Vendor to confirm		
5	SPARES: (Optional - to be quoted seperately)			
5.1	Itemised breakup of mechanical, hydraulic, electrical and electronic spares as below are to be offered. The list to include following spares: (Unit Price of each item of spare should be offered). The spares will be ordered as per requirement. Note: The price of the spares will not be considered for the evaluation of the machine cost (L1 criteria).	Vendor to confirm		
5.2	Mechanical & Hydraulic Spares: All types of Pumps, Valves, Pressure Switches, Transducers, Flow Switches, Filters, Seals, O-rings, Hydraulic Hoses, Accumulator with charging kit etc.	Vendor to confirm		
5.3	Electrical /Electronic / CNC Spares: All types of Relays, Contactors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductor Fuses, Special Fuses, Circuit Breakers, Main Power Switch, Wheel balancing system, Encoders, Scanning Heads for Linear Scales, CNC Controller, Operator's panel with Display Unit, I/O Cards for PLC, Servo Motors for Feed Drives, Power Module & Control Cards for Main Drive as well as Feed Drives etc.	Vendor to confirm		

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5.4	All types of spares for total machine and accessories should be available for at least ten years after supply of the machine. If machine or control is likely to become obsolete in this period, the vendor should inform BHEL sufficiently in advance and provide drawings of parts / details of spares & suppliers to enable BHEL to procure these in advance, if required.	Vendor to note		
5.5	Recommended set of spares for all attachments are to be offered with details.	Vendor to confirm		
5.6	Complete list of spares for machine and accessories, along with specification / type / model and name & address of the spare supplier shall be furnished along with documentation to be supplied with the machine.	Vendor to confirm		
6	DOCUMENTATION :			
6.1	Three sets of following documents i.e from 6.1.1 to 6.1.10(Hard copies) in English language & soft copies(whenever mentioned) should be supplied along with the machine			
6.1.1	Operating manuals of Machine & CNC system	Vendor to Confirm		
6.1.2	Programming Manuals of Machine & CNC system	Vendor to Confirm		
6.1.3	Detailed Maintenance manual of machine with all drawings of machine assemblies/sub-assemblies/parts including Electrical/Pneumatic/Coolant/Hydraulic circuit diagrams shall be supplied with the machine. (Engineering/Constructional Details/Information pertaining to intellectual rights not required)	Vendor to Confirm		
6.1.4	Manufacturing drawings for all supplied tool holders, grinding attachments, coolant connections, adapters, sleeves, fixtures etc.	Vendor to Confirm		
6.1.5	Maintenance, Interface & commissioning manuals for CNC system, spindle & feed drives and position feedback system.	Vendor to Confirm		
6.1.6	Catalogues, O&M Manuals including drawings(whenever applicable.) of all bought out items and supplied Accessories	Vendor to Confirm		
6.1.7	Detailed specification of all rubber items and hydraulic/lube fittings.	Vendor to Confirm		
6.1.8	Hard copy (Print-out) as well as soft copy (in PDF format) of Electrical Schematics of the machine with comments in English	Vendor to Confirm		
6.1.9	Hard Copy of User PLC Program with symbols, comments & cross references in English language Only.	Vendor to Confirm		
6.1.10	Master List of parts used in the machine shall be submitted by the vendor.	Vendor to Confirm		
6.1.11	One additional set of all the above documentation (6.1.1 to 6.1.10) to be provided on DVD/USB Flash Drive.	Vendor to Confirm		
6.1.12	Soft Copy of User PLC Program with symbols, comments & cross reference in English language.	Vendor to Confirm		
6.1.13	Soft Copy of Machine Data & Machine parameters.	Vendor to Confirm		

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6.1.14	In case of PC based CNC system, complete GHOST back-up of CNC system hard disk (After final commissioning) on USB Flash Drive/PEN Drive is to be provided.	Vendor to Confirm		
7	TRAINING			
7.1	BHEL Persons should be trained at supplier's Works in the area of (a) CNC Part Programming for the machine & supplied equipments, - 1 person (b) Electrical, Electronic & CNC maintenance for machine & other supplied equipments - 1 person (c) Mechanical maintenance of the machine & other supplied equipments - 1 person (d) Operation of the machine with the supplied equipments/accessories - 1 person.	Vendor to Confirm		
7.2	Air-fare, boarding & lodging for the trainees shall be borne by BHEL.	Vendor to Note		
7.3	Competent, English speaking experts shall be arranged by the vendor for satisfactory & effective training of BHEL personnel.	Vendor to Confirm		
7.4	Vendor to quote for training on per man per day basis	Vendor to Confirm		
7.5	Vendor shall organize for specialised system training for one Maintenance Engineer and one Programmer at the CNC System Manufacturer's (Fanuc/Siemens) Training Centre in INDIA for minimum 1 week.	Vendor to Confirm		
8	FOUNDATION :			
8.1	Vendor shall submit the preliminary layout drawing for getting BHEL's approval within one month from the date of Letter of Intent (LOI) or P.O, whichever is earlier. Soil condition data will be furnished by BHEL along with the approval. Complete Foundation Design including details viz. static / dynamic load details etc. and Final Layout drawings shall be submitted by the supplier within three months after getting BHEL's approval. The layout should consist of all requirements pertaining to complete machine including space requirement for accessories. BHEL shall construct complete foundation for the machine under supervision of supplier and at supplier's responsibility. Vendor should arrange for the equipments for testing of foundation, if required. The vendor shall also indicate detailed specifications of grouting compound and Grouting procedure etc. for foundation bolts of the machine.	Vendor to confirm		
9	ERECTION & COMMISSIONING			

SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
9.1	Supplier to take full responsibility for carrying out erection, start up, testing of the machine and all types of supplied equipment's, machining of test pieces etc. The machine is to be erected at the site by the supplier with their own manpower, tools & tackles etc. Other erection equipment's like mobile crane, measuring instruments & devices for testing & commissioning of machines should be brought by the supplier on returnable basis. However, EOT Crane will be provided by BHEL and depends on the availability. Service requirement like air, water, electricity will be provided by BHEL at one point to be indicated by the supplier in advance. Completed commissioning & demonstration of all the features of machine/equipment's to the entire satisfaction of BHEL is the sole responsibility of vendors at BHEL Bhopal. Complete commissioning, testing including all the test is in the scope of supplier.	Vendor to confirm		
9.2	Successful proving of BHEL components and all tests, as mentioned in Clause 14 (Machine Acceptance) shall form part of the commissioning activity.	Vendor to confirm		
9.3	Instruments and necessary equipments required to carry out erection & commissioning activities should be arranged by the supplier.	Vendor to confirm		
9.4	Commissioning spares, required for commissioning of the machine within stipulated time, shall be arranged by the supplier on returnable basis.	Vendor to confirm		
9.5	Schedule of Erection and Commissioning shall be submitted with the machine.	Vendor to confirm		
10	ACCURACY TESTS:			
10.1	GEOMETRICAL ACCURACIES :			
10.1.1	GEOMETRICAL ACCURACIES: As per ISO 6545 or equivalent standard.	Vendor to confirm		
10.1.2	Geometrical Accuracy Tests shall be in accordance with relevant standard. Copy of applicable standard should be furnished. Detailed test charts for the same, clearly showing the accuracies to be achieved on the machine, shall also be submitted with the offer.	Vendor to confirm		
10.1.3	All the above accuracies are to be demonstrated to BHEL engineers during pre-acceptance tests at supplier's works and during Erection & Commissioning at BHEL Works. The equipment is to be completely tested and inspected before dispatch. Four copies of inspection certificates, accuracy and calibration charts are to be provided with machine.	Vendor to confirm		
10.2	MACHINE POSITIONAL ACCURACIES:			
10.2.1	Machine positioning accuracies & repeatability should be measured as per ISO 230-2 / ISO 6545/ Equivalent standard (latest revision) using LASER INTERFEROMETER .	Vendor to confirm		
10.2.2	Positioning Accuracy (Pa per 1000mm) for X(radial), Y (tangential)& Z axes(axial) : 0.010 mm	Vendor to confirm		

SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
10.2.3	Positioning Accuracy Pa for B(Rotary table)-axis: 6 secs	Vendor to confirm		
10.2.4	Repeatability (Ps per 1000mm) for X(radial), Y (tangetial)& Z axes(axial): 0.005 mm	Vendor to confirm		
10.2.5	Repeatability Ps for B(Rotary table)-axis: 5 secs	Vendor to confirm		
10.2.6	All the above accuracies to be demonstrated to BHEL engineers during pre-acceptance at Suppliers works and during Erection & Commissioning at BHEL Works. Note 1: LC of scale and transmission should be selected in such a way so as to achieve above accuracies	Vendor to confirm		
11	AMBIENT CONDITIONS & THERMAL STABILITY :			
11.1	Total machine including CNC system and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Power Supply: 415 V \pm 10%, 50 Hz \pm 3%, 3 ϕ , 3 WIRE WITHOUT NEUTRAL, Ambient Temperature = 25°C \pm 3°C, Relative Humidity = 60% \pm 5%. NOTE: The machine will be placed in air conditioned environment to be arranged by BHEL.	Vendor to confirm		
11.2	The machine, including attachments and accessories, should be suitable for continuous operation in its full capacity for 24 hours a day and 7 days a week throughout.	Vendor to confirm		
12	PROVEOUT OF BHEL COMPONENTS :			
12.1	Vendor shall be fully responsible for machining of components as per drawing and other requirements specified by BHEL. Clarifications, if any required by vendor, regarding accuracy requirements of the prove out components, whether specified or not, should be discussed and cleared by vendor during initial technical discussions. list of prove out components:- i) Drg .No.14391660005 (HS 65T Gearwheel), ii) Drg. No.04451664006 iii) Drg. No. 14391660004 iv) Drg. No. .04451664007 NOTE: Components having 0.4 mm grinding allowance per flank are machined using MACRON-12 or S-14 (SHELL) or equivalent coolant oil and ALUMINA Dressable Grinding wheel (Grade A 46 I 5 V).	Vendor to confirm		
12.2	Final job inspection shall be carried out on a seperate Gear Measuring Machine already available at BHEL. Vendor shall be responsible for any Deviation/rejection in prove out component due to wrong machining or malfunctioning of the machine during prove out machining and also for the delay in machining due to improper recommended tooling etc. The onus of proving the job shall be on vendor.	Vendor to confirm		
13	ACCURACIES REQUIRED IN JOB PROVE OUT			
13.1	Teeth Grinding Quality in accordance with DIN 3962 Class 3 or 4 (Latest Version)	Vendor to confirm		
13.2	Accuracies required in Job Prove out on BHEL Job			

SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
13.3	Surface Finish : Ra 0.4 micron	Vendor to confirm		
14	MACHINE ACCEPTANCE: (Tests/Activities to be Performed by Vendor)			
14.1	Tests/Activities to be carried out at supplier's works on the machine before dispatch :			
14.1.1	Geometrical accuracies as per Clause 10.1	Vendor to confirm		
14.1.2	Positioning accuracies as per Clause 10.2	Vendor to confirm		
14.1.3	The machine should be tested for continuous idle running of 8 hrs . If any break down occurs during this test, the test should be repeated for 8 hrs from that time.	Vendor to confirm		
14.1.4	Demonstration of all features of the machine, control system & accessories.	Vendor to confirm		
14.1.5	Machining of helical gear profile on a test piece with job accuracies as mentioned in Clause 13 . Vendor to arrange for the required test piece, Grinding wheel, required tool and also the instruments required for measurement of the machined test piece.	Vendor to confirm		
14.1.6	Demonstration of load capacity test as per Clause 2.3.1 . Vendor to arrange for the required test piece, Grinding wheel & required tools..	Vendor to confirm		
14.2	Tests/Activities to be carried out at BHEL works while commissioning the machine :			
14.2.1	Geometrical accuracies as per Clause 10.1	Vendor to confirm		
14.2.2	Positioning accuracies as per Clause 10.2	Vendor to confirm		
14.2.3	The machine should be tested for continuous idle running of 24 hrs . If any break down occurs during this test, the test should be repeated for 24 hrs more from that time.	Vendor to confirm		
14.2.4	Demonstration of all features of the machine, Supplied Part Programs, control system & all accessories for efficient and effective use of the machine	Vendor to confirm		
14.2.5	Machining of test piece (Gear wheel) . Vendor to arrange for the Grinding wheel & required tools. NOTE: The test piece and instruments required for measurement of the machined test piece will be provided by BHEL.	Vendor to confirm		
14.2.6	Demonstration of load capacity test as per Clause 2.3.1 . Vendor to arrange for the Grinding wheel & required tools. NOTE: The test piece will be provided by BHEL.	Vendor to confirm		
14.2.7	Job Proveout as per Clause 12.0	Vendor to confirm		
14.2.8	Two weeks supervision by the vendor for independent operation of machine by BHEL after job proveout & commissioning of machine.	Vendor to confirm		

SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
15	PACKING:			
15.1	Sea worthy & rigid packing for all items of the complete machine, CNC System, all Accessories and other supplied items, to avoid any damage/loss in transit. When machine is despatched in containers, all small loose items shall be suitably packed in boxes.	Vendor to confirm		
16	GUARANTEE :			
16.1	24 months from the date of successful commissioning & handing over of the machine to BHEL,Bhopal.	Vendor to confirm		
17	GENERAL :			
17.1	Machine Model No.	Vendor to specify		
17.2	Total connected load (KVA):	Vendor to specify		
17.3	Floor area required (Length, Width, Height) for complete machine & accessories	Vendor to specify		
17.4	Total weight of the machine	Vendor to specify		
17.5	Weight of heaviest part of machine	Vendor to specify		
17.6	Weight of the heaviest assembly / sub-assembly of the Machine	Vendor to specify		
17.7	Dimensions of largest part/ sub-assembly/ assembly of the machine	Vendor to specify		
17.8	Detailed catalogues, sketch/ photographs of the m/c and accessories/attachments should be submitted with the offer.	Vendor to confirm		
17.9	Hydraulic, Pneumatic & oil pipings should be preferably rigid, except places where flexible pipings are essential. All the pipes required for the same shall be included in the standard scope of the machine.	Vendor to confirm		
17.10	Vendor to submit, along with offer, reference list of customers where similar machines have been supplied mentioning broad specifications of the supplied machine i.e. Model, Table diameter, Load Capacity, Maximum Stroke length, Main Drive Rating, CNC System.	Vendor to specify		
18	OTHER FEATURES:			
18.1	NETWORKING:			
18.2	Machine control should have necessary hardware and software for interfacing with gigabit Ethernet Local Area Network with 100 MB/sec through UTP cables for NC program and other related data transfer. This network to be connected to wide area network/Internet. The networking should have following capabilities.	Vendor to confirm		
18.3	The machine shall appear as a node in the Entire Network. (Network Neighborhood)	Vendor to confirm		
18.4	Transfer of NC & PLC data between CNC system and network should also be possible.	Vendor to confirm		
19	QUALIFYING CONDITIONS:			

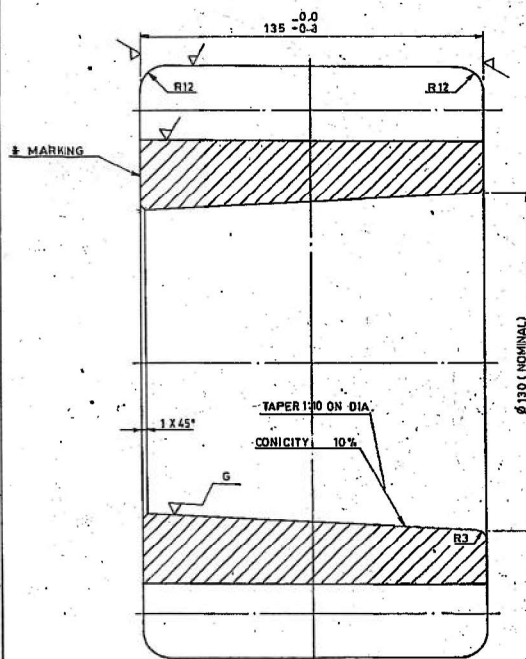
SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
19.1	The vendor must be either an Original Equipment Manufacturer (OEM) or it's authorized Dealer/Agent/Distributor for CNC Cylindrical Teeth Grinding Machines for the past 10 years (on the date of opening of tender). The authorized Dealer/Agent/Distributor have to submit along with the offer, a valid certificate of authorisation from OEM for quoting the machine, along with declaration of support from OEM for erection & commissioning, after sales service and necessary spares.	Vendor to confirm		
19.2	Only those vendors should quote who (themselves or their OEM) have supplied and commissioned at least two CNC Cylindrical Teeth Grinding Machine of same or higher sizes (Load Capacity 2000 Kg, Length of vertical stroke 500 mm, Helix Angle Accommodation $\pm 45^\circ$, Profile Grindable depth 35 mm) and Accuracies as required in Prove out component (Clause 13) in the past 10 years (on the date of opening of Tender). Vendor should submit proof of the same.	Vendor to confirm		
19.3	The machine referred to in Clause 19.2 must be presently working satisfactorily for more than one year after commissioning (on the date of opening of Tender). Vendor should submit proof of the same.	Vendor to confirm		
19.4	Out of two supplied machines as referred to in Clause 19.2 , at least one should have been supplied in the country other than country of origin or in India. Vendor should submit proof of the same.	Vendor to confirm		
19.5	<p>NOTES:</p> <p>1. Indian Machine Tool manufacturers who do not meet the qualifying criteria as mentioned in sub clauses 19.2 to 19.4, can be considered, if</p> <p>a) They have running Collaboration/ Joint Venture/ Joint Working Arrangement with a foreign partner who meets all of the qualifying criteria as mentioned in sub clauses 19.1 to 19.4.</p> <p>b) The Collaboration/ Joint Venture/ Joint Working Arrangement of the Indian Machine Tool manufacturer with its foreign partner should be of at least 2 years old (on the date of opening of tender).</p> <p>c) The Indian Machine Tool manufacturer should have supplied and commissioned at least one such machine (As specified in Clause 19.2) after Collaboration/ Joint Venture/ Joint Working Arrangement.</p> <p>d) The Indian Machine Tool manufacturer shall submit from their foreign partner a back to back guarantee for performance of the machine.</p> <p>2. BHEL reserves the right to assess the OEM with respect to their technical and financial capability. In respect of Indian Machine Tool manufacturers as noted above, BHEL reserves the right to assess the Indian Vendor & their foreign Partner with respect to their technical and financial capability.</p>	Vendor to confirm		
19.6	The following information should be submitted by the vendor about the companies where same or higher sizes machine(s) have been supplied. This is required from all the vendors for qualification of their offer.			
19.6.1	Name of the customer(s)/company(s) where referred machine is installed.	Vendor to specify		
19.6.2	Complete postal address of the customer(s).	Vendor to specify		
19.6.3	Month & Year of commissioning	Vendor to specify		

SR.NO.	DESCRIPTION FOR BHEL REQUIREMENT	Vendor to Note/Confirm/Specify	Offered	Remarks
19.6.4	Parameters of machine(s) supplied (as specified in Clause 19.2) & application for which the machine is supplied.	Vendor to specify		
19.6.5	Name and designation of the contact person of the customer/s.	Vendor to specify		
19.6.6	Phone, Mobile and email address of the contact person of the customer/s.	Vendor to specify		
19.6.7	Performance certificates from two (2) customers including one foreign customer regarding satisfactory performance of machine supplied to them (Original Certificate or through E-mail directly from the customer). Indian machine tool manufacturers having Collaboration/ Joint Venture/ Joint Working Arrangement with foreign partner who meet the qualifying requirement should submit Performance certificate of at least one machine supplied by them after Collaboration/ Joint Venture/ Joint Working Arrangement. The original certificate may be returned after verification by BHEL, if required.	Vendor to confirm		
19.6.8	BHEL reserves the right to verify the information provided by vendor at their referred customer's works including machining accuracies. It shall be the responsibility of the vendor to facilitate the visit of BHEL's team at their referred customer's works. In case the information provided by vendor is found to be false / incorrect, the offer shall be rejected.	Vendor to note		
19.7	Vendor should have average turnover of Rs.502 Lakh minimum for last 3 consecutive years ending March 2024 and it should be supported as copies of I.T.C.C annual report (Profit & Loss statement and balance sheet).	Vendor to submit		
19.8	Item being procured are highly technical and supposed to be installed in production setup which calls for high accuracy and precision. Thus, no relaxation to be given in Technical/Financial PQC to MSME/Start up vendors.	Vendor to note and confirm		
20	POINTWISE CONFIRMATION:			
20.1	Vendor should confirm/clarify pointwise (all the points) as per specification and provide original technical leaflet, technical details, photographs, scope of supply etc. at the first instance.	Vendor to confirm		
21	TERMS & CONDITIONS			
21.1	Percentage of erection & commissioning cost wrt to total supply cost: 5 %	Vendor to confirm		
21.2	Max.time of Delivery (From the date of issue of P.O/LOI): 72 Weeks or earlier	Vendor to confirm		
21.3	Max. time of Erection and Commissioning (From site readiness call received from BHEL): 6 Weeks	Vendor to confirm		
21.4	Schedule of Erection and Commissioning shall be submitted with the offer.	Vendor to confirm		

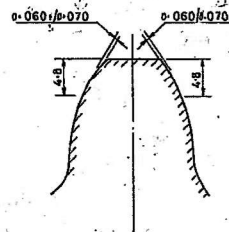
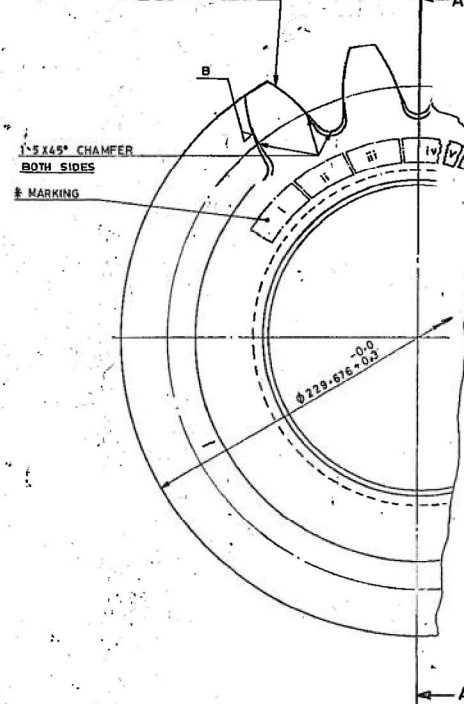
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

7000991 6E7 1 ON 'DHO



SECTION-AA

SEE DETAIL 'X' FOR TIP
RELIEF OF TOOTH

DETAIL-AT-X

TOOL LIST

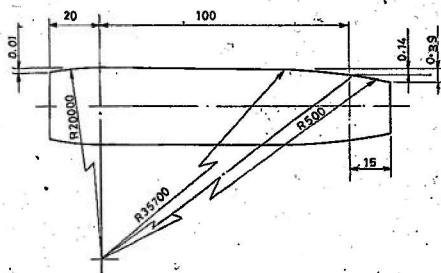
IT-NO	TOOL NO.	DESCRIPTION
001	1414.145	TAPER PLUG GAUGE
001	1414.669	SNAP GAUGE
001	1414.676	RACK CUTTER ROUGHER
001	1414.677	RACK CUTTER FINISHER
001	1414.678	BACK PLATE
001	1414.698	PIN GAUGE
001	1414.699	TEETH CUTTING BUSH FOR M/G
001	1414.700	TEETH CUTTING CLAMP & BOTTOM PLATE (MAAG)
001	1414.705	TEETH GRINDING BUSH (CRODA 80) WITH CLAMPING W.
001	1414.706	CROWNING CAM (CRODA 80)
001	1414.707	CHECKING BUSH FOR MAAG
001	1414.708	BASE CIRCLE RING
001	1414.709	PROFILE CHECKING MANDREL
001	1414.710	PINION HUB
001	1571.190	PINION BORE GRINDING FIXTURE FOR 14/1A/2052
001	1571.202	VICKERS HARDNESS TESTING PORTABLE TOOL
001	1571.215	TIP & ROOT RELIEF CAM
001	1571.403	PLUG GAUGE
001	1571.424	TEETH CUTTING BOLSTER 14/1A/2052
001	1571.431	CROWNING CAM FOR GEAR GRINDING M/C
001	1571.433	PINION GRINDING FIXTURE
001	1571.456	SNAP GAUGE 2.33.574 ± 0.3
001	1571.457	RADIUS TOOL R-12
001	1571.465	BORE GRINDING FIXTURE FOR M/G NO 14/1A/2062
001	1571.467	TEETH GRINDING MANDREL REFLECTOR MACHINE

GEAR PARTICULARS:-

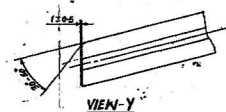
- BASIC RACK _____ BS 235-1987
- NUMBER OF TEETH _____ 16
- MODULE (m) _____ 12
- PRESSURE ANGLE _____ 20°
- ADDENDUM MODIFICATION (X.M) _____ (+7-2)
1. BASE TANGENT LENGTH OVER 3 TEETH _____ 96.619 MAX. 95.981
- NUMBER OF TEETH OF MATING GEAR _____ 85
- DRAWING NO. OF MATING GEAR _____ 1439166005
- CENTRE DISTANCE _____ 483 ± 0.1
- PITCH ORCLE DIA. (z.m.) _____ 182
- CLASS (ACCURACY GRADE) _____ 6
2. FOR OTHER TECHNICAL REQUIREMENTS WORK TO RD50 SPECIFICATION NO. MP-02800-09 (DEC.1990)
- FOR MATERIAL, MANUFACTURING TECHNIQUE AND HEAT TREATMENT REFER TO CLAUSES 2,3 & 6 RESPECTIVELY OF THE ABOVE SPECIFICATION.
- TOTAL TOOTH DEPTH SHALL CONFORM TO THE REQUIREMENTS OF PROTUBERANCE CUTTER WIDE CLAUSE 5-2 OF SPECIFICATION NO. MP-02800-09 (DEC.1990)
3. MARKING:-
- ALL PINION SHALL BEAR THE FOLLOWING MARKINGS, WHICH SHOULD BE INDELIBLE AND CLEARLY LEGIBLE.
- (i) NAME OF SUPPLIER / MANUFACTURER.
- (ii) NUMBER OF MONTH & LAST TWO DIGITS OF THE YEAR OF MANUFACTURE e.g. 4/96
- (iii) MATERIAL & SPECIFICATION OF STEEL.
- (iv) DRG. NO. OF THE PART.
- (v) MANUFACTURE / CONSECUTIVE NUMBER OF THE PART.
- (vi) NO. OF TEETH
4. ALL OVER UNLESS OTHERWISE STATED.
5. G - GROUND.
6. B - HARDENED, TEMPERED AND GROUND, EFFECTIVE CASE DEPTH AT 500 HV, AFTER GRINDING TEETH TO BE IN BETWEEN 23-27, HARDNESS ON TOOTH FACE 58-62 RC.
7. MACHININGS:-
- BORE OF THE PINION - SHALL BE FINISHED AFTER ROUGH CUTTING OF THE TEETH THE TEETH SURFACE SHALL BE FINISHED BY GRINDING AND SHALL SATISFY THE FOLLOWING MANUFACTURING TOLERANCES

INDIVIDUAL ERROR OF PITCH	0.022
CUMULATIVE ERROR ON 8 PITCHES	0.050
RADIAL RUNOUT	0.063
PROFILE ERROR	0.015
TOOTH ALIGNMENT ERROR	0.017
CONSECUTIVE ERROR OF PITCH	0.028

DETAIL OF CROWNING



006	SEE NOTE-2	001	PINION BLANK	34391660 D12	25-0
VAR	REMARKS	NO.	ITEM NO.	DESCRIPTION	DRAWING NO.
23	23-3-99	001	001	25KV AC LOCO	HS 19250 A
<p>STATUS OF DRAWING</p> <p>DISTRIBUTION OF PRINTS</p> <p>TME-1, TTX-1, TGM-2, TCX(TGM)-1, TXX-3</p> <p>DATE: 23-3-99</p> <p>REV: 01</p> <p>TOOL LIST UPDATED</p>					
<p>ADDITIONAL INFORMATION</p> <p>NAME OF CUSTOMER/PROJECT: 25KV AC LOCO</p> <p>NAME OF SUPPLIER: BHARAT HEAVY ELECTRICALS LTD. BHOPAL</p> <p>DATE: 23-3-99</p> <p>REV: 01</p> <p>TOOL LIST WAS NOT IN GEAR PARTICULAR MODIFIED (TCM-294)</p>					
<p>DATE: 23-3-99</p> <p>REV: 01</p> <p>TOOL LIST WAS NOT IN GEAR PARTICULAR MODIFIED (TCM-294)</p>					



VIEW-X

VIEW-Y

8. BACKLASH SHALL BE .25 mm OR .01 IN. 7-25-50
9. SWOT MUST MEET 700 PILLAR POINTS READING INTENSITY 5350 MAJOR SWOT TO
OBTAIN 345 MINIMUM COVERAGE IN ROOT AREA READING INTENSITY 0.00-0.01 C
11. MAGNIFIED INSPECT AS PER 15.3703.
12. THE PIVOT POINT AND THE BARS HAVE TO SHOWN SOFT AFTER HARDENING.
13. RC 34-40 AT SURFACE OF RELIEF SHOULD BE VIEWED IN VISION OF SWOT
14. FOR ALL FINGER PRESSURE PLUS GAGE BY HAND KEEPING DISTANCE OF 1ST 0.3 mm BY
THUMB SIDE
15. AS PER APTI-INDUSTRY SERVICE LIMIT OF MAXIMUM LENGTH AFTER A TEST IS 77.05.

[illegible]