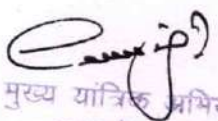


- 2.4.4 **Single Phasing Protection** - A separate current sensitive delayed action single phasing preventor shall be provided for each motor separately. Overload protection shall not be treated as single phasing preventor.
- 2.5 Control equipment shall be mounted in separate drip proof enclosures. Control enclosures and compartments are to be so designed as to give adequate protection against ingress of dust, oil, coolant or chips. All control devices like contractors etc. shall be front mounted on a rigidly fabricated metal panel for ease of operation. All other electrics shall be installed that they are readily accessible when the doors and covers are opened. Hinged covers shall be interlocked with the machine tool control to prevent operation of the machine when cover is open.
- 2.6 The motor shall be totally enclosed with or without fan cooled frame. Screen protected drip proof type motor may be provided if it is mounted inside protective enclosures.
- 2.7 The electrical equipments shall comply with the requirement of Indian Electricity Act and Rules (latest).
- 2.8 All instruments shall be of the Industrial Grade "A" (IS-1248) switch board type the range of the instrument shall be such that the maximum load expected in the circuit shall produce a deflection of 60% to 80% of the full scale.
- 2.9 The supplier shall furnish 3 sets of complete electrical and electronic wiring diagrams in full details to enable the maintenance staff to locate faults in the circuits, 3 sets of part catalogues, maintenance manuals operating instructions with details of coils and windings, used in the equipment to facilitate repairs and maintenance should also be supplied.
- 2.10 For main motor class minimum "B" Class insulation shall be provided. If any other class of insulation is proposed, detailed justification for providing different class of insulation shall be given.
- 2.11 Motors shall be designed to withstand frequent starts, stops and reversals as demanded in the operation of the machine.
- 2.12 Two earthing terminals shall be provided on all electric motors including the control gear.
- 2.13 **POWER SUPPLY**
- 2.13.1 The machine shall be suitable for operation on 415 volts 3 phase 50 cycles AC 3 wire or 4 wire system with neutral solidly earthed. The supply voltage may vary up to +10% -20%. The frequency may vary up to $\pm 3\%$. However, full rated power of the motor shall be available at the lower voltage. Firm should confirm satisfactory performance of the machine at incoming power supply in the range 415V+10%-20% and 50HZ $\pm 3\%$ frequency or should provide voltage stabilizer as specified against clause 2.13.2 below of required capacity.
- 2.13.2 The voltage stabilizer, if required, shall conform to :
- i) Input Voltage - 320 to 460 volts 3 phase 4 wire


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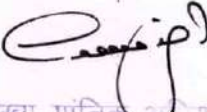
- supply.
- ii) Output Voltage - 415 volts
 - iii) Regulation - $\pm 1\%$ from No load to Full load. iv) Rate of correction - 20 volts per second per phase. v) Wave form distortion - NIL
 - vi) Efficiency - Not less than 97%.
 - vii) Winding and class of - Copper wire wound with "B" class of insulation insulation or better.
- 2.13.3 In case of machines equipped with NC, SS, CNC, Thyristor controlled devices and other sophisticated electronic gadgets including microprocessors etc. which are susceptible to power line spikes and surges, a suitable voltage stabilizer and ultra-isolation transformer to cover for the entire electrical load of the machine shall be offered as a concomitant accessory conforming to Specification for voltage stabilizer as mentioned in clause 2.13.2 above and isolation transformer to the parameters mentioned below.
- i) Transformer ratio - 1:1
 - ii) Winding - Copper wire wound with "F" class insulation or better.
 - iii) Protection - To arrest spikes and surges to the order of 3 KV for 200-400 micro seconds duration.
 - iv) Common mode rejection ratio - 120 dB
 - v) Isolation - Capacitance 0.005 Pf: resistance greater than 1000 Mega Ohms.
- 2.13.4 Voltage stabilizer shall be equipped with a protective relay to trip the AC power supply to the machine instantaneously with audio and visual indication to the operator. Settings of the protective relay for low and high voltage shall be 320 volts and 460 volts respectively.
- 2.14 ATMOSPHERIC CONDITIONS**
- 2.14.1 The ambient temperature at the site at which the machine will be installed may vary from -4°C to $+50^{\circ}\text{C}$ over the year. The relative humidity may be as high as 98%. The atmosphere is expected to be dusty. The machines offered shall be suitably tropicalised to work under these atmospheric conditions without any adverse effect on their performance.
- 2.15 The temperature rise shall not reach such a value that there is a risk of injury to any insulating material or adjacent parts.
- 2.16 The drive shall be capable of operating at any one of the speed required independent of the load in accordance with the requirements of the machine.
- 2.17 Information/data shall be furnished as per the format of submission of technical bid Annexure-A.

3. GENERAL CHARACTERISTIC

3.1 RIGIDITY AND STABILITY

- 3.1.1 The machine shall be robust, rigid and of sturdy construction. It shall be designed to meet heavy duty demands of various operations on the machine under normal

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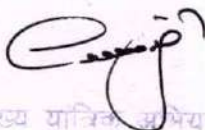

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Workshop environment for such machines. It shall be free for vibrations even when working at full capacity.

- 3.1.2 All machine castings shall be made of close grained high grade cast iron like Meehanite or equivalent materials meeting IS-210 Standards to ensure durability and rigidity. The casting shall be thermal stress relieved to ensure stability and continued accuracy.
- 3.1.3 All machine fabrications of critical load bearing assemblies like beds, columns etc. shall be adequately strengthened and stress relieved.
- 3.1.4 Change in ambient temperature shall not affect the performance of the machine.
- 3.1.5 There shall be no change in the performance of the machine either on switching on the machine or after continuous running.
- 3.1.6 There shall be no resonant vibrations throughout the working range of the machine at all load levels.

3.2 SAFETY CONTROLS

- 3.2.1 The machine shall incorporate safety devices to provide protection to the operator and machine against all possible operational and machinery failures.
- 3.2.2 Suitable interlock shall be provided to prevent machine operations in the event of:
 - 3.2.2.1 Faulty sequence of operation.
 - 3.2.2.2 Fluctuation in supply voltage.
 - 3.2.2.3 Resumption of power supply after power failure.
 - 3.2.2.4 Non-positioning of safety guards.
 - 3.2.2.5 Failure of hydraulic system (where applicable)
 - 3.2.2.6 Failure of lubricating system (In case of automatic including drop in pressure lubrication)
- 3.2.3 A fault or damage in the control circuit or interruption re-establishment after an interruption of fluctuation in whatever manner in the power supply to the machinery must not lead to dangerous situations in particular.
 - 3.2.3.1 The machinery must not start unexpectedly.
 - 3.2.3.2 The machinery must not be prevented from stopping if command has already been given.
 - 3.2.3.3 No moving part of the machinery or piece held by the machinery shall fall or be ejected.
 - 3.2.3.4 The protection devices must remain effective.
- 3.2.4 The machine shall be fitted with an emergency stop device to enable actual or impending danger to be averted. This device must be:-
 - 3.2.4.1 Conveniently located.
 - 3.2.4.2 Clearly identifiable.
 - 3.2.4.3 Stop the machine as quickly as possible without causing additional hazards.
 - 3.2.4.4 The emergency stop must remain engaged. It should be possible to disengage it only by appropriate operation. Disengaging the control must not restart the machinery but only permit restarting.



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3.2.5 Safety features shall also include.

3.2.5.1 Safety device against overload for all mechanical and electric items to the extent possible.

3.2.5.2 Safety stops against over-running of slides.

3.2.6 Guard and protection devices shall protect exposed persons against risks related to moving transmission parts (such as pulleys, belts, gears, rack and pinion, shafts etc.) and moving parts directly involved in the process to the extent possible. This shall meet the following requirements:-

3.2.6.1 Be of robust construction

3.2.6.2 Not give rise to any additional risk

3.2.6.3 Not be easy to by-pass or render non-operational

3.2.6.4 Be located at an adequate distance from danger zone

3.2.6.5 Cause minimum obstruction to the view of the production process.

3.2.6.6 Rigidly connected and not prone to rattling

3.2.6.7 Enable essential work to be carried out without the guard or protection device having to be dismantled

3.2.7 A load meter shall be provided to indicate the load on the machine. The meter shall have a suitable mark to indicate the maximum load the machine can take. Full details of the above and other safety features indicating how each one functions must be explained in the offer.

3.3 OPERATIONAL CONTROLS

3.3.1 The operation of the machine shall be by push buttons or levers. The basic rules for the direction of operation of controls and the corresponding direction of movements of the machine tools shall be as per IS:2987-1985.

3.3.2 The control devices shall be

3.3.2.1 Clearly visible and identifiable.

3.3.2.2 Ergonomically positioned for safe operation without hesitating or loss of time, and without ambiguity.

3.3.3 CNC Controls (where applicable) - The general requirements of CNC controls are given at Schedule-IV.

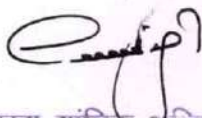
3.4 LIGHTING

3.4.1 Integral lighting suitable for the operations concerned where its lack is likely to cause a risk despite ambient lighting of normal intensity shall be provided.

3.4.2 The manufacturer must ensure that there is no area of shadow likely to cause nuisance, that there is no irritating dazzle and that there are no dangerous stroboscopic effects due to lighting provided by the manufacturer.

3.4.3 Integral parts requiring frequent inspection and adjustment and maintenance areas must be provided with appropriate lighting.

3.4.4 The machine lighting should be of low voltage so as to prevent any hazard to the operator.


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3.5 MACHINE MAINTAINABILITY

- 3.5.1 The machine shall be so designed as to require minimum possible maintenance and to give trouble free service.
- 3.5.2 All assemblies/parts of the machine shall be easily accessible for maintenance.
- 3.5.3 The machine shall not require major dis-assembly for checking and replacement of a particular part, especially for parts requiring periodical check up and replacement.
- 3.5.4 The manufacturer must provide means of access e.g. stairs, ladders, cat walks etc. to allow access safety to all areas used for production, adjustments and maintenance operations.

3.6 WEAR COMPENSATION ADJUSTMENT

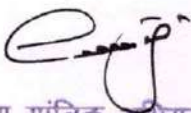
- 3.6.1 The original built in accuracy of the machine shall be capable of being maintained conveniently and economically by suitable adjustments for taking up wear on slides, bearings and load screws. The system of adjustments incorporated shall be explained in the offer.

3.7 COOLANT SYSTEM (WHERE APPLICABLE)

- 3.7.1 Suitable coolant system with pump, motor, tank, filter etc. shall be provided. The coolant pump shall be as per IS:2161-1962. The filter shall be of reusable type and indigenously available. If reusable filter cannot be offered the filter cartridge shall be readily available in India. Source of supply shall be indicated. Adequate no. of filters for 2 years working on double shift basis shall be offered as spare. Details of the coolant system shall be indicated in the offer.
- 3.7.2 The supply of coolant shall be in ample volume. Provision to re-circulate the coolant shall be available. A chip and coolant tray shall be provided. The volume of coolant flow shall be indicated. It shall be adjustable.
- 3.7.3 An enclosure shall be provided to prevent the coolant from splashing outside the machining zone. Details of enclosure shall be provided. Specific requirements of coolant system for grinding machines etc. shall be clearly indicated.

3.8 LUBRICATION SYSTEM (WHERE APPLICABLE)

- 3.8.1 The machine shall be provided with an automatic lubricating system for ensuring delivery of adequate quantity of lubricant to areas requiring continuous lubrication. Suitable arrangements must be provided for indication of failure of the lubricating system.
- 3.8.2 The system shall be provided with interlock to prevent machine operating/starting in the event of the failure lubrication system.
- 3.8.3 Reusable filters capable of filtering chips, dust particles etc. shall be provided. Indicators for showing clogged condition of filters shall be available. The filters shall be indigenously available. If reusable filter cannot be offered the filter cartridge shall be readily available in India. Source of supply shall be indicated. Adequate no. of filters for 2 years working on double shift basis shall be offered as spare.
- 3.8.4 Lubrication and filter cleaning chart shall be displayed on a metal plate at a conspicuous location on the machine indicating :-
- (a) Specific location of points on the machine to be oiled lubricated/greased.
- (b) Periodicity of lubrication of these points.


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- (c) Filter to be cleaned.
- (d) Periodicity of cleaning filters.
- (e) Periodicity of replenishing lubricating oil for the centralized system. (f) Any other similar relevant information.

3.8.5 Points where manual lubrication is needed shall be separately indicated. Frequency of lubrication shall be also clearly mentioned.

3.8.6 Lubricating oils used in the machine shall be available in India. Successful tenderer will be required to indicate brand names of approved oils manufactured by various Indian Oil Companies.

3.8.7 First fill of lubricating oils used in the machine shall be provided with the machine. Details of lubricating system provided shall be indicated.

3.9 PNEUMATIC SYSTEM (WHERE APPLICABLE)

3.9.1 The compressed air supply will be provided by the customer at the machine within pressure range of 4.5-7.5 kg/cm² and a moisture content or 1000 ppm. The pneumatic system of the machine should be designed accordingly. An alarm shall be provided for low air pressure.

3.9.2 Suitable filter/moisture trap shall be provided by the contractor in the system of pneumatic air intake. The filter shall be reusable type and indigenously available. If reusable filter cannot be offered, the filter cartridge shall be easily available in India. Source of supply shall be indicated. Adequate no. of filters for 2 years working on double shift basis shall be offered as spare.

3.9.3 Air pressure regulator, if necessary, shall be provided by the tenderer.

3.9.4 The make of pneumatic control equipment shall be of reputed make. The makes shall be indicated.

3.10. HYDRAULIC SYSTEM (WHERE APPLICABLE)

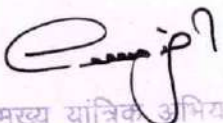
3.10.1 Hydraulic circuit must be equipped with the following safety and inspection equipments:

- (a) Pressure gauges at all places, where pressure has to be set up or inspected.
- (b) Safety valves for hydraulic circuit if relief valve does not fulfill this function.
- (c) Equipment for checking of temperature in the circuit or in the pump wherever necessary.
- (d) Arrangement to show if the filters (including those in the pump set) are choked and need cleaning. The filters shall be of reusable type and indigenously available. If reusable filter cannot be offered, the filter cartridge shall be readily available in India. Source of supply shall be indicated. Adequate no. of filters for 2 years working on double shift basis shall be offered as spare.
- (e) Alarm for low oil level.

3.10.2 The sump aggregate shall have the following:

- (a) Oil level sight gauges or any other equipment showing the minimum and maximum oil levels in sump.
- (b) A drain plug at the lowest portion of the tank.

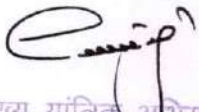
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- (c) It shall be possible to drain the oil from the tank without disconnecting any pipes or other fittings.
- 3.10.3 The temperature of oil in hydraulic circuits shall not exceed 60 degrees C in any case. Suitable arrangement shall be incorporated to ensure that the oil is not overheated under local weather conditions at continuous normal working of the machine.
- 3.10.4 Facilities for bleeding of air in case of air lock shall be provided.
- 3.10.5 The hydraulic reservoir, pump and allied equipment shall be suitably segregated from the machine in order to remove major source of heat.
- 3.10.6 Hydraulic oils used on the machine shall be available in India. Successful tenderer will be required to indicate brand names of approved oils supplied by various Indian Oil Companies.
- 3.10.7 First fill of hydraulic oils used on the machine shall be provided with the machine.

4.0 TECHNICAL LITERATURE:

- 4.1 One copy of the printed illustrative catalogue showing features of the machine and its elements must be enclosed with the bid.
- 4.2 The technical literature shall be provided for the complete machine, including imported and indigenously purchased components / sub- assemblies. The successful tenderer will have to furnish 4 (four) copies each of the following manuals directly to the consignee along with the machine. Out of these 04 sets, the bidder shall be required to submit one set of all documents in best available condition one month prior to the training for the machine. One set of technical literature should cover the following details:
- (i). Operational & Maintenance manual of the machine.
 - (ii). Operational & Maintenance manual of the servo controlled voltage stabilizer.
 - (iii). Operational & Maintenance manual of the ultra-isolation transformer.
 - (iv). Instruction & Maintenance manual for Hydraulic Oil Cooling Unit.
 - (v). User manual for Tool changer system (if provided).
 - (vi). Technical & Maintenance manual for Hydraulic System
 - (vii). Technical & Maintenance manual for Lubrication System.
 - (viii). Operator Guide for CNC Control System (if provided).
 - (ix). Programming Guide for CNC Control System (if provided).
 - (x). Diagnostic & Trouble shooting Guide for CNC Control System (if provided).
 - (xi). Start-up Guide for CNC Control System (if provided).
 - (xii). Machine Software Listing (if provided).
 - (xiii). Soft and hard copies of PLC Program in ladder form with cross reference listing and PLC project file.
 - (xiv). Drawings of tooling & fixtures, hard copies in A-2 size as well as soft copy in PDF format.
 - (xv). Wiring diagram, in which length of wires must be mentioned, hard copies in A-3 size as well as soft copy in PDF format.
 - (xvi). Mechanical drawings (spindle assembly, table assembly, column assembly), hard copies in A-1 size as well as soft copy in PDF format.


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(xvii). Spare part manual including part lists no., hard copies in A-4 size as well as in PDF format.

(xviii). Lay out drawings in A-1 size, which clearly shows the position of all type of electrical components in machine.

Note: All manual and literature should be in English/Hindi.

5.1 Spares

5.1.1 Since the machine will be under comprehensive preventive maintenance during warranty period of two (02) years and under CAMC for five (05) years after the warranty period, it is the sole responsibility of bidders to stock such spares as required for smoother execution of PMC during warranty and CAMC in order to achieve response time in compliance to machine availability as per stipulated requirements.

6.0 CONSUMABLES (If applicable)

6.1 The list of consumable spares shall be furnished and quoted along with their unit rate.

6.2 Consumables shall be supplied along with the machine or as per agreed time table, if ordered.

7.0 SPECIAL FEATURES:

7.1 Special features incorporated in the machine, if any, shall be indicated separately in the bid clearly indicating the advantages.

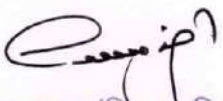
8.0 DEVIATIONS:

8.1 The tenderer shall certify that the offered machine fully meets the specification. Various design features incorporated in the machine to fulfill different technical performance requirements shall be fully explained in the offer. However, minor deviations from these specifications which do not affect or in any way interfere with the stipulated performance standards or would result in improved safety/reliability or would reduce recurring maintenance/operating cost of the machine, can be considered for acceptance. The tenderer in such eventuality shall clearly indicate the details of these deviations and their implications as per the following format:

8.2 All Deviations shall be clearly indicated in the deviation statement as per the format of submission of technical bid Annexure-A.

9.0 INSPECTION AND TESTING AT MANUFACTURER'S WORKS:

9.1 The machine shall be inspected and tested during different stages of its manufacture starting from raw material till the completion of machine, by the purchaser or his authorized representative at the supplier's or his sub-supplier's works. The Quality Assurance Programme as per Annexure- H shall be submitted along with the bid. The bidder must submit the exhaustive QAP incorporating the tests as given in Annexure-H along with other tests /stage inspection as followed by them.

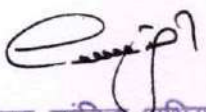

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- 9.2 A load and functional test like no load test and maximum Horse Power test must be carried out at the manufacturer's works. Rigidity of the machine shall be demonstrated to the satisfaction of appointed inspector or inspecting agency.
- 9.3 Manufacturers must have suitable facilities at their works for carrying out various performance tests on the sub-assembly/assembly/machine. The tenderer shall clearly confirm that all facilities exist and shall be made available to the inspecting authority.
- 9.4 A Sample Inspection Chart for inspecting the equipment shall be supplied along with the bid. The inspection chart should indicate all the tests that are carried out during the machine manufacture and also the tests to be offered to inspecting agency. The standard to which this inspection chart conforms should be clearly indicated. Against each test, acceptable limit/ range of values shall be indicated.
- 9.5 The complete machine shall be inspected at manufacturer's premises as per approved GA drawing. Inspecting authority shall not carry out the final inspection in case GA Drawing is not approved by the consignee.
- 9.6 The Manufacturer shall produce invoices of bought out items/sub-assemblies to ensure genuineness of such products / verification by the Inspecting agency.
- 9.7 Four Stage (Excluding Final Lot Inspection) shall be as below:

S.N	Stage	Sample size	Reference
1.	Stage 1 Inspection : RAW MATERIAL	100%	As per Quality Assurance plan of Section VI Annexure- H
2.	Stage 2 Inspection	100%	
3.	Stage 3 Inspection	100 %	
4	Stage 4 Inspection : IN PROCESS INSPECTION	100%	

10. TRAINING:

- 10.1 Free training by the firm shall be imparted in operation and maintenance of the machine. The training to be imparted shall cover operation, troubleshooting and repair of all mechanical, hydraulic, electrical & electronics equipments (CNC Control & AC Drives) and CNC/PLC part programming. This training shall be provided to 4 per consignee nominated by the consignee, for a period of 2 weeks free of cost at the manufacturer's premises. All charges pertaining to travel, boarding and lodging shall be borne by Indian Railways.


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- 10.2 Subsequently, technical experts from the manufacturer will fully and adequately provide training to operators and maintenance staff nominated by the consignee at the time of commissioning of the machine.
- 10.3 The supplier will be responsible for co-coordinating with the consignee the travel plans of trainees to ensure that the training is imparted on the machine at its assembly and testing stage. The bidder shall also submit training schedule along with the offer.

Note: All training should be imparted in English/Hindi only.

11. FOUNDATION & RELATED DRAWINGS

11.1 SUBMISSION OF GA, FOUNDATION & RELATED DRAWINGS FOR APPROVAL:

11.1.1 For each machine, the supplier shall first submit 01 copy of foundation drawings with details of construction of foundations, complete layout of machine elements like bed, hydraulic tank, coolant tank, electrical panel, Servo Controlled Voltage Stabilizer etc. and other related diagrams (Mechanical, Hydraulic, Electrical & Electronics) along with machine weight, overall dimensions, electrical load with length of 3 phase, 415 V AC electric power cable for approval as per time schedule specified in Section-IV to each consignee for approval and to enable the consignee for making necessary arrangements for Installation & Commissioning of Machine on receipt. After getting approval from consignee, the supplier shall supply directly to each consignee 6 copies of approved GA foundation drawings and related diagrams for each machine as per time schedule specified in Section-IV from the date of approval of GA drawing for information only. This information should be furnished on the pattern indicated in detail in the following IS Specifications (Latest) or relevant international standards

- i) IS: 2974 (Pt.I Para 4.1) for reciprocating type machine.
- ii) IS: 2974 (Pt.III Para 3.1) for rotary type machine (medium & high frequency.
- iii) IS: 2974 (Pt.IV para 4.1) for rotary type machines of low frequency. iv) IS: 2974 (Pt.V para 3.1) for impact type machines other than hammers

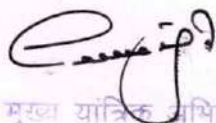
11.2 APPROVAL OF GA DRAWING

To be governed by Time Schedule in clause 7 of section-IV and following stipulations.

11.2.1 General Arrangement Drawings will be sent by the 'Contractor' to the Consignee as per Time Schedule annexed in LOA/Contract. The 'Contractor' should ensure that drawings sent to consignee are complete in all respects as specified in technical specification. The GA drawings shall be approved by the consignee and given back to the contractor, under advice to PCME/CENTRAL RAILWAY, as per the Time Schedule in the LOA/Contract.

11.2.2 Delays in submission of drawings by Contractor will be added to the delay in supply of machine in case submission of GA drawing is delayed beyond

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