

used, along with the manufacturer's name, brand model etc. The successful bidder may be required to produce invoices to ensure genuineness of such products by the Inspecting agency.

15.2 The preferred makes of components/ bought out items used in the machine shall be as below.

S.N.	Sub Assembly	Make
1	Spindle and axis drive motors (AC servo motors)	Siemens/Fanuc/Allen Bradely/Indramat
2	Hydraulic system & elements	Rexroth/Vickers/ATOS/Parker/Yuken/ Bosch
3	CNC Control system	Siemens/ Fanuc/ Heidenhain
4	Ball screws	Hiwin/ Rexroth Star/ THK/ Tsubaki/ INA/ Gamfior/ Mannesmann
5	Control cabinet	RITTAL/Siemens/ETA
6	Bearings	FAG/RHP/NTN/KOYO/SKF/ Timken/ SNFA/NSK/INA
7	Toolings/Inserts	Sandvik/ Kennametal-Widia / Addison/Isca/ Taegutec / Walter/ Tungaloy
8	LM Guide ways and roller packs	Rexroth Star/ Hiwin / INA / Schenberger /THK/Tsubaki
9	Lubrication system	Cenlub /Rexroth/Vogel
10	Tool monitoring system	Montronix/Opti Mill/ Artis/ Blum
11	Tool pre-setter	Zoller/ PWS/ Kyoritsu/ Speroni
12	Component probing system	Renishaw/ M&H/ Blum
13	Telescopic covers	Sur Hennig/ Raksha/ Tecnimetal
14	Rack & pinion arrangement	Mannesmann/own make of reputed machine tool manufacturer
15	Hydraulic oil cooling system	Warner Finlay/ Plannerberg/ Warkin/ Kelvin/ Mayfran/ Axa
16	Chip conveyor	Miven Mayfran/ Universal/ Tecnimetal/ Amber Anthony
17	Control gears	Siemens/Fanuc/Telemecanique
18	Voltage stabilizer	Delta/ Aplat/ Servomax/ Neel/Clean Power
19	Ultra-isolation transformer	Delta/ Aplat/ Servomax/ Neel/ Clean Power
20	Encoders	Heidenhain/ Balluff/ Sony/AMO
21	Linear Scales	Heidenhain
22	Gear box	ZF/ RS/ Alfa
23	Electric cables	Lapp/ Indramat/ Siemens

16 SERVICE FACILITY IN INDIA AND TECHNICAL SUPPORT:

- 16.1 The bidder shall indicate in their offers as to what type of after sales service facilities for the machine will be made available in India. The complete details such as organization for after sales service, its location (s), and number of technically competent and trained engineers shall be clearly indicated. Bidder not offering complete Servicing/repair facilities in India to ensure quick response to maintenance / servicing calls is not likely to be considered.
- 16.2 Firm should clearly indicate that in case of components / sub-assemblies taken from reputed bidders such as Vickers, Rexroth, RITTAL, THK, Siemens, Fanuc etc., the parent company has already entered into a contract with their Indian units / affiliates for undertaking repairs / after sales service during warranty and post warranty.
- 16.3 The supplier or his authorized agent should attend for breakdown promptly within 48-72 hours of call during warranty period.

- 16.4 Firm shall provide free telephonic, fax and e-mail support for 5 (five) years even after completion of CAMC in case of queries on operational and maintenance problems of the machine.
- 17. WARRANTY OBLIGATION:**
- 17.1 Contractor shall provide complete warranty against any design, manufacturing defects, and such other defects for a period of 24 months from the date of final commissioning / proving out of the machine at the ultimate destination. Any approval of acceptance by purchaser of the Stores or of the material incorporated herein shall not in any way limit the contractor's liability. To this effect, the contractor shall provide a Warranty Bond from a Nationalized Indian bank or Scheduled Bank established in India and acceptable to ER for an amount equivalent to 10% of the contract value.
- 17.2 The machine shall be designed for a life of 15 years with regular maintenance and all the structural members of the machine and the foundation shall be guaranteed for 15 years against cracks breakages and etc. during the course of normal operations. Suitable undertaking in this regard is to be submitted by the bidder.
- 17.3 The warranty period would also cover comprehensive preventive maintenance, which is inclusive of all spares, material and labour cost. All maintenance consumables like lubricants and grease except hydraulic oil / machine coolants shall form part of the scope of the preventive maintenance during the warranty.
- 17.4 All the defects during the warranty period shall be removed by the Contractor at his own cost within reasonable period of time.
- 17.5 Regarding all replacement and repairs, the Purchaser shall call upon the Contractor to deliver or perform under this warranty. This shall be delivered and performed by the Contractor within 03 days, promptly and satisfactorily. The warranty period shall be extended by the number of days the machine remains under breakdown during the warranty period.
- 17.6 The machine shall at all times give contractual out-put and accuracy. Any deficiency or break down for a total of 02 hr. or more for a day would be treated as failure for the day, for the purpose of extending warranty period. The warranty period will be extended by the number of days the machine remains under breakdown during the warranty period and the warranty Bank Guarantee would be returned at the end of such extended warranty period for the full machine.
- 17.7 The details of preventive maintenance to be provided during warranty period shall be indicated by the tenderer giving details of type of preventive schedule, periodicity on items to be checked, items to be replaced and expected plant down time. Preventive maintenance schedules shall be conducted on weekends as far as possible or any other day through mutual agreement with consignees. Released parts against replacement may be handed over to contractor.
- 17.8 In case the total breakdown period in any one of years during warranty period, exceeds 500 hrs. the consignee shall inform the same to headquarter. To ensure this a record of breakdown (duly signed by shop in-charge) in hours on quarterly basis should be maintained by the consignee and joint report with the contractor shall be made for each breakdown attention. At the end of first and second year of warranty, these details of breakdown hours during warranty period should be advised as per performance appraisal report given in Annexure-E of section-V and warranty period will be extended by the no of days the machine was in break-down condition. The firm will then request for release of Warranty Bank Guarantee [WBG] annexing the performance appraisal report as per Annexure-E of Section-V and the breakdown details mentioned above. CAMC BG is required to be submitted before release of WBG.

The warranty herein contained shall not apply to any material which shall have been repaired or altered by the Purchaser or on his behalf in any way without the consent of the Contractor so as to affect the strength, performance or reliability or to any defects to any part due to misuse, negligence or accident. The decision of the Purchaser in regard to Contractor's liability and the amount, if any, payable under this warranty shall be conclusive and final.

18. **Comprehensive Annual Maintenance Contract (CAMC):** Bidders are required to compulsorily provide comprehensive Annual Maintenance Contract as per Annexure IV for 5 years (post warranty period) of the machine. The CAMC contract is inclusive of all spares, material and labour costs. All consumables except Diesel fuel, lubricating oils or coolant shall form a part of the scope of comprehensive AMC.

The yearly cost of the CAMC will be as under:

- (i) 1st year basic cost of CAMC : 4 (four)% of the basic cost of the machine excluding taxes.
- (ii) 2nd year basic cost of CAMC : 4 (four)% of the basic cost of the machine excluding taxes.
- (iii) 3rd year basic cost of CAMC : 5 (five)% of the basic cost of the machine excluding taxes.
- (iv) 4th year basic cost of CAMC : 6 (six)% of the basic cost of the machine excluding taxes.
- (v) 5th year basic cost of CAMC : 6 (six)% of the basic cost of the machine excluding taxes.

Note: Yearly escalation of cost of CAMC will be applicable based on the all-India general combined Consumer Price Indices [CPI] inflation rate. CAMC cost for a year will be fixed after considering escalation based on comparison with date of commissioning. This revised cost will be fixed individually before start of each year of CAMC. GST & other tax (if applicable) will be extra as applicable.

Preventive Maintenance Schedules shall be carried out as per Standard Maintenance Practices for the machine and shall be indicated by bidders.

SPECIFICATION FOR 5-AXIS CNC MACHINING CENTRE

TECHNICAL PARAMETERS

S. N.	Parameters	Specified values	Actual offered values
1	MAJOR PARAMETERS		
1.1	Longitudinal travel (X-axis)	10000 mm (minimum)/ (to accommodate two frames)	
1.2	Transverse travel (Y-axis)	3500 mm (minimum)	
1.3	Vertical travel (Z-axis) of the RAM	1200 mm (minimum)	
1.4	Job passage height clearance	1200 mm (minimum)	
2	OTHER PARAMETERS		
2.1	Size of worktable	10500 mm X 4000 mm	
2.2	Rapid power traversing of linear axes (X, Y & Z)	16000 mm/min (minimum)	
2.3	Main spindle size	To suit the job requirements	
2.4	Taper spindle	ISO 50	
2.5	Speed range (Preferably should be in 3 speed ranges)	10 - 4500 RPM (infinitely variable)	
2.6	Spindle Power	AC 36 KW (S6-60%) minimum	
2.7	Feed rate of linear axes (X, Y, Z)	5 - 10000 mm/min (minimum)	
2.8	W axis Feed rate	5 - 10000 mm/min (minimum)	
2.9	Admissible bench load	1000 kg/sqm.	
2.10	ATC		
2.10.1	No. of Tools holders	Minimum 60	
2.10.2	Tool taper	ISO 50	
2.10.3	Tool to Tool change time	20 sec. Maximum	
2.11	Head		
2.11.1	Universal Head		
a)	Motor Power	25 KW (Continuous rating) (minimum)	
b)	Tool taper	ISO 50	
c)	C-axis rotation	±180 degree	
d)	A-axis swivel	± 135 degree	
2.11.2	Vertical/ Horizontal Head		
a)	Motor Power	25 KW (Continuous rating) (minimum)	
b)	Tool taper	ISO 50	
c)	C-axis rotation	±180 degree	
2.12	Positioning accuracy as per VDI/DGC 3441		
a)	X-axis	0.050 mm for total travel of 10000 mm	
b)	Y-axis	0.025 mm for total travel of 3500 mm	
c)	Z-axis	0.020 mm for a travel of 1200 mm	
d)	Angular accuracy of A and C axes	± 2 seconds.	

No deviation will be accepted in Major Parameters. Minor deviations may be accepted in Other Parameters.

SPECIFICATION FOR 5-AXIS CNC MACHINING CENTRE
OPERATIONS AND PROCESS SHEET FOR FIAT BOGIE FRAME

FIAT Bogie frame to Drawing No. LW03007 (Sheet 1 of 2) is required to be machined as per machining process / operations shown below and also duly indicated on the relevant drawings.

- a) Milling operation of Control Arm Brackets at four locations having two control arm brackets per locations i.e. Total 08 control arm brackets per bogie frame. Also finish machining of holes of each of control arm bracket.
- b) Milling operation on mounting brackets for fitment of disk brakes for four locations involving Horizontal and vertical milling operations. Also finish machining of holes in vertical and horizontal direction.
- c) Finish Machining of 02 holes of each bracket and surface machining of Anchor link brackets at two locations in bogie frame located diagonally opposite to each other.
- d) Finish machining of holes and surface machining of each of cross section brackets on cross tube assembly at four locations.
- e) Finish machining of four holes of each of Anti Roll Bar Brackets at two locations (LH & RH).
- f) Machining of Spring guide tube at bottom on four locations of primary suspensions.

Note: The machining of holes and faces is at 6° to vertical and horizontal axes, therefore the Z axis should be freely indexable to approach the job at required angles for machining Operations.

Drawings are enclosed for reference. These drawings being confidential documents shall not be disclosed or published to third party in India or abroad without prior written permission of Rail Coach Factory (Indian Railways) and shall not be used for any other purpose except for study of the job requirements vis-a-vis machine specification / proposal being considered by the machine bidder/ supplier.

BIDDERES ARE REQUESTED TO VISIT BMF, BUDGE BUDGE, WEST BENGAL FOR BETTER UNDERSTANDING OF THE OPERATIONS AND ESTIMATION OF CYCLE TIME, TOOL LAYOUT AND REQUIREMENT OF ADDITIONAL HEADS AND CUTTERS.

SPECIFICATION FOR 5-AXIS CNC MACHINING CENTRE

FORMAT FOR TIME SCHEDULE CHART

(Refer Clause no 11 of Technical Specification)

S.N.	Activity	Activity code	Time Schedule		Remarks, if any
			By Purchaser	Offered by Bidder	
1	Issue of LOA	D1	...		
2	Submission of PBG by Successful Bidder	D2	D1 + 21 days		
3	Issue of PO by ER after verification of PBG	D3	D2 + 21 days		
4	Submission of GA drawings to consignee by Successful Bidder/Supplier	D4	D3 + 45 days		
5	Approval of GA drawings from date of receipt from supplier	D5	D4 + 45 days		
6	Handing over of clear site by Consignee	D6	By D5 or latest by [D8 - 90 days]		
7	Completion of Foundation	D7	D6 + 60 days		
8	Supply of machine at site	D8	D5 + 270 days		
9	Installation of Machine	D9	D8 + 60 days		
10	Prove Out and commissioning of machine	D10	D9 + 30 days		
11	Issue of commissioning certificate	D11	D10 + 30 days		
12	Warranty	D12	D11 + 2 years		
13	CAMC	D13	D12 + 5 years		

COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT

(Sec clause 18 of Technical Specification)

1. Tenderers are required to **compulsorily provide** a comprehensive Annual Maintenance Contract for the machine supplied against this specification, which will be including of all spares, material and labour costs. The duties and taxes as applicable should be indicated separately. All Consumables spares and materials shall form a part of the scope of comprehensive AMC except Diesel/ fuel, lubricating oils or coolant.
2. After completion of warranty period, CAMC shall be operated, managed and paid by the consignee. The detailed terms and conditions of CAMC shall be as given in following clauses:
3. The duration of CAMC shall be 5 (five) years from the date of expiry of warranty.

The yearly cost of the CAMC will be as under:

- (i) 1st year basic cost of CAMC : 4 (four)% of the basic cost of the machine excluding taxes.
- (ii) 2nd year basic cost of CAMC : 4 (four)% of the basic cost of the machine excluding taxes.
- (iii) 3rd year basic cost of CAMC : 5 (five)% of the basic cost of the machine excluding taxes.
- (iv) 4th year basic cost of CAMC : 6 (six)% of the basic cost of the machine excluding taxes.
- (v) 5th year basic cost of CAMC : 6 (six)% of the basic cost of the machine excluding taxes.

Note: Yearly escalation of cost of CAMC will be applicable based on the all-India general combined Consumer Price Indices [CPI] inflation rate. CAMC cost for a year will be fixed after considering escalation based on comparison with date of commissioning. This revised cost will be fixed individually before start of each year of CAMC. GST & other tax (if applicable) will be extra as applicable.

4. Tenderer have to provide CAMC services at consignee's location without any preconditions. The CAMC should include complete responsibility for the bought out sub-assemblies and components like CNC system, diesel engine, AC unit etc.
5. The details of preventive maintenance services to be provided under CAMC shall be provided by the bidder in the following format

S.N.	Type of preventive schedule	Periodicity	Items to be checked	Items of replacement	Expected plant down time

Preventive maintenance shall be conducted on weekends through mutual agreement with the consignee. Each preventive maintenance schedule normally shall not exceed one day. The total shutdown time for preventive maintenance should be kept as low as possible. The preventive maintenance regime offered must be aimed at achieving minimum 90% uptime of the plant excluding the plant downtime for preventive maintenance schedules.

6. The bidder shall ensure that in case a failure is reported by a consignee's qualified service engineer, he must visit the site within 3 days from the date of complaint on calendar days' basis. This period of 3 days after the failure report shall be treated as grace period, which will not count towards plant down time for upto one failure per quarter and a maximum of 4 failures per annum. In case the number of failures exceed one during any quarter or four during any year of CAMC, grace period of only 2 days will be permissible for such additional failures. Complaints shall be lodged by consignee through fax, e-mail or per bearer at address given by the bidder. The responsibility to keep the failure reporting address details current will rest on the bidder solely.
7. In case preventive maintenance is carried out along with breakdown maintenance schedule, preventive maintenance time will be deducted from breakdown time of the plant.
8. **Penalty Clause:** Penalty shall be levied on the bidder for maintaining plant up time below the limit of 90% calculated on working days basis, after discounting for grace period and preventive maintenance

period. Penalty shall be calculated as percentage of quarterly payment and will be deducted from the respective quarterly payments. Penalty calculation will be done over quarterly payment period.

S. N.	Non-availability Slab	Applicable Penalty
1.	90% to 80%	0.5% for every 1% (or part thereof) reduction in availability
2.	Below 80%	1% for every 1%(or part thereof) reduction in plant below 80%

9. A Bank Guarantee equal to 3 (three) percent of the original cost of the machine will be submitted by the bidder at the commencement of CAMC, which will be returned on successful completion of CAMC period. CAMC Bank Guarantee will be submitted by the tenderer to the consignee 90 days before expiry of warranty. CAMC BG will have the validity of at-least 5 (five) years and 6 (six) months from the commencement of CAMC. The bidder can submit multiple BG for lesser duration to cover the entire period of 5 (five) years and 6 (six) months from the commencement of CAMC. However, these BGs must be submitted at least 60 days in advance of expiry of previous BG. In-case the bidder fails to provide CAMC services successfully, the CAMC BG will be forfeited. This BG forfeiture will be in addition to penalty as per clause 8 above.
Warranty BG will not be released until CAMC BG is submitted by firm.
10. Plant up time of less than 60% for two consecutive quarters will constitute complete failure of bidder to provide the CAMC services successfully and the CAMC BG will be forfeited. This will be in addition to penalty clause 8 above for the period of actual performance.
11. (a) It is the sole responsibility of the bidder to stock all spares and materials as required for smooth execution of CAMC in order to achieve response time in compliance to machine availability as per stipulated requirements.
(b) In all cases of plant failure except as mentioned in clause 12(c), any other spare part or material necessary to restore the plant to proper working order will be arranged by the bidder as a part of CAMC.
(c) In case of damage to the machine on account of any external factor, viz., floods, earthquake, fire, arson or sabotage, entire cost of spare parts and material necessary for repair of the plant shall be borne by the railways. However, the bidder shall provide services of their engineers free of cost as a part of CAMC to restore the plant to working order.
(d) In case of damage to the plant as mentioned in para 12(c), any spare part and material necessary to restore the plant to proper working order shall be arranged by the bidder and charged on actual basis duly certified by authorized railway official in the next quarterly bills. The rates charged for such spare parts shall be based on the current OEM's published spare part rate list or current DGS&D rate list for spare parts of the OEM or spare part rates agreed upon by Purchaser in their latest AT for a similar machine. The bidder shall furnish one of these documents to support the rates charged for spares used for repair under para 12(b).
12. Normally quarterly payment under CAMC will be made to the bidder within 30 days from the end of that quarter subject to submission of the following documents by the bidder to the paying authority assigned by the consignee:
 - a. Consignee's certificate for work done as per proforma 'A' with calculation of down time and penalty applicable.
 - b. A certificate by consignee that no spare part is due with the bidder as per clause 11 above.
 - c. Bills submitted by the bidder & accepted by consignee.
 - d. Attested photocopy of the CAMC BG.
13. Other general conditions shall be governed by Bid Document as applicable to respective ER Purchase Order.

Proforma-AConsignee's Certificate for Quarterly Work Done Under CAMC

1. Name of Plant:
2. Consignee:
3. ER Purchase Order No:
4. Name of /Contractor:
5. Quarterly charges for CAMC(Standard): Rs _____
ER PO No. _____ dt _____
6. Quarter for which bills are preferred: _____
From: _____ To _____
7. No. of Breakdown during the quarter:
8. Calculation of Penalty and Net CAMC charges payable to Contractor for the quarter:

(i)	Total Plant Down Time (in days)	
(ii)	Standard down days for preventive maintenance (in days/quarter)	
(iii)	Total grace period for breakdown	
(iv)	Net down time for the plant = [(i) - ((ii) + (iii))]	
(v)	100% Availability for the quarter (in days)	
(vi)	Actual availability = [(v) - (iv)]	
(vii)	Actual availability in %age = [{ (vi) / (v) } X 100]	
(viii)	Calculation of penalty	
	(a) %age availability between 80% & 90%	
	(b) %age availability below 80%	
	(c) Penalty = [{ (vii a) X (5) X 0.005 } + { (vii b) X (5) X 0.01 }]	
(viii)	Net amount payable as CAMC charges to = [(5) - (viic)]	

It is certified that all spares borrowed by the contractor for the previous quarter have been returned in good condition.

Signature of authorised representative of consignee

GENERAL CHARACTERISTICS**1. RIGIDITY AND STABILITY:**

- 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 Workshop environment for such machines. It shall be free for vibrations even when working at full capacity.
- 1.2 All machine castings shall be made of close-grained high-grade cast iron like Meehanite or equivalent materials meeting IS: 210-2009 (latest) Standards to ensure durability and rigidity. The casting shall be thermal stress relieved to ensure stability and continued accuracy.
- 1.3 All machine fabrications of critical load bearing assemblies like beds, columns etc. shall be adequately strengthened and stress relieved.
- 1.4 Change in ambient temperature shall not affect the performance of the machine.
- 1.5 There shall be no change in the performance of the machine either on switching on the machine or after continuous running.
- 1.6 There shall be no resonant vibrations throughout the working range of the machine at all load Levels.

2. SAFETY CONTROLS:

- 2.1 The machine shall incorporate safety devices to provide protection to the operator and machine against all possible operational and machinery failures.
- 2.2 Suitable interlock shall be provided to prevent machine operations in the following events of:
 - Faulty sequence of operation.
 - Fluctuation in supply voltage.
 - Resumption of power supply after power failure.
 - Non-positioning of safety guards.
 - Failure of hydraulic system (wherever applicable)
 - Failure of lubricating system (in case of automatic operations including drop in pressure in lubrication)
- 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
 - The machinery must not start unexpectedly.
 - The machinery must not be prevented from stopping if command has already been given.
 - No moving part of the machinery or piece held by the machinery shall fall or be ejected.
 - The protection devices must remain effective.
- 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
 - Conveniently located.
 - Clearly identifiable.
 - Able to stop the machine as quickly as possible without causing additional hazards.

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 will only permit restarting.

2.5 Safety features shall also include

- Safety device against overload for all mechanical and electric items to the extent possible.
- Safety stops against over-running of slides.

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 :-

- Be of robust construction
- Not give rise to any additional risk
- Not be easy to bypass or render non-operational
- Be located at an adequate distance from danger zone
- Cause minimum obstruction to the view of the production process
- Rigidly connected and not prone to rattling
- Enable essential work to be carried out without the guard or protection device having to be dismantled

2.7 A load display on the control screen 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. OPERATIONAL CONTROLS:

3.1 The operation of the machine shall be by push buttons or lever. 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: 2987-1992 (latest).

3.2 The control devices shall be

- Clearly visible and identifiable.
- Ergonomically positioned for safe operation without hesitating or loss of time, and without ambiguity.

4. LIGHTINGS:

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.

4.2 The bidder must ensure that there is no area of shadow likely to cause nuisance, that there is no irritating dazzle and that there is no dangerous stroboscopic effect due to lighting provided by the bidder / manufacturer.

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

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

5. MACHINE MAINTAINABILITY:

5.1 The machine shall be so designed as to require minimum possible maintenance and to give trouble-free service.

5.2 All assemblies/parts of the machine shall be easily accessible for maintenance.

5.3 The machine shall not require major disassembly for checking and replacement of a particular part, especially for parts requiring periodical check-up and replacement.

5.4 The bidder must provide means of access e.g. stairs, ladders, cat walks etc. to allow safe access to all areas used for production, adjustments and maintenance operations.

6. WEAR COMPENSATION ADJUSTMENT:

- 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.
- 6.2 The system of adjustments incorporated shall be explained in the offer.

7. COOLANT SYSTEM (WHEREVER APPLICABLE):

- 7.1 Suitable coolant system with pump, motor, tank, filter etc. shall be provided. The coolant pump shall be as per IS: 2161-1996 (latest). 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 three shift basis shall be offered as spare. Details of the coolant system shall be indicated in the offer.
- 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.
- 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.

8. LUBRICATION SYSTEM (WHEREVER APPLICABLE):

- 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.
- 8.2 The system shall be provided with interlock to prevent machine operating/starting in the event of the failure lubrication system.
- 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 three shift basis shall be offered as spare.
- 8.4 Lubrication and filter cleaning chart shall be displayed on a metal plate at a conspicuous location on the machine indicating
- Specific location of points on the machine to be oiled lubricated/greased.
 - Periodicity of lubrication of these points.
 - Filter to be cleaned.
 - Periodicity of cleaning filters.
 - Periodicity of replenishing lubricating oil for the centralized system.
 - Any other similar relevant information.
- 8.5 Points where manual lubrication is needed shall be separately indicated. Frequency of lubrication shall be also clearly mentioned.
- 8.6 Lubricating oils used in the machine shall be available in India. Successful bidding win must be required to indicate brand names of approved oils manufactured by various Indian Oil Companies.
- 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.

9. PNEUMATIC SYSTEM (WHEREVER APPLICABLE):

- 9.1 The compressed air supply required (if specified in Technical Specification) at the customer at the machine within pressure range of 4.5-7.5 kg/cm² and a moisture content up to 1000 ppm maximum. The pneumatic system of the machine should be designed accordingly. An alarm shall be provided for low air pressure.

- 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 three shift basis shall be offered as spare.
- 9.3 Air pressure regulator, if necessary, shall be provided by the bidder.
- 9.4 The make of pneumatic control equipment shall be of reputed make. The makes shall be indicated.

10. HYDRAULIC SYSTEM (WHEREVER APPLICABLE):

- 10.1 Hydraulic circuit must be equipped with the following safety and inspection equipment.
- Pressure gauges at all places, where pressure has to be set up or inspected.
 - Safety valves for hydraulic circuit if relief valve does not fulfil this function.
 - Equipment for checking of temperature in the circuit or in the pump wherever necessary.
 - 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 three shift basis shall be offered as spare.
 - Alarm for low oil level.
- 10.2 The sump aggregate shall have the following:
- Oil level sight gauges or any other equipment showing minimum and maximum oil levels in sump.
 - A drain plug at the lowest portion of tank.
 - It shall be possible to drain the oil from the tank without disconnecting any pipe or other fitter.
- 10.3 The temperature of oil in hydraulic circuits shall not exceed 60° 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.
- 10.4 Facilities for bleeding of air in case of air lock shall be provided.
- 10.5 The hydraulic reservoir, pump and allied equipment shall be suitably segregated from the machine in order to remove major source of heat.
- 10.6 Hydraulic oils used on the machine shall be available in India. Successful bidder will be required to indicate brand names of approved oils supplied by various Indian Oil Companies.
- 10.7 First fill of hydraulic oils used on the machine shall be provided with the machine.

SPECIFICATION FOR 5-AXIS CNC MACHINING CENTRE

GENERAL SPECIFICATION (ELECTRICAL)

- 1.0 The provision of this general specification electrical shall apply for the equipment.
- 2.0 All the equipment and material shall comply with appropriate Indian Standards (latest) or National Standards of the country of origin provided the latter are equivalent to or better than the former. For items for which Indian Standards are not published, National Standards shall be acceptable. The bidder shall indicate the standards applicable. The following standards are applicable in particular.
(Corresponding International Standards like ASA/NEMA/BSS/DIN etc. may also be quoted)

IS: 325-1979 (latest) / IS 12615:2018	Three phase induction motors (Corresponding to IEC Pub- 34-1) (Latest)
IS:375-1963 (latest) / IS 5578, IS 11353	Marking and arrangement of switch gear, bus bars, main connection and auxiliary wiring.
IS:996-1979 (latest) / IS:996-2009	Single phase small AC and universal electrical motors.
IS:1231-1974 (latest)/ IS 1231:2019	Dimensions of three phase induction motors (corresponding to IEC Pub-72-1-Latest)
IS: 1248 (latest)	Direct acting indicating analogue electrical Measuring instruments and their accessories (corresponding to IEC Pub- 51-Latest)
IS:1271-1985 (latest)/ IS:1271-2012	Classification of insulation material for electrical machinery & apparatus in relation to their thermal stability in service. (corresponding to IEC-Pub-85 Latest)
IS:1356 (latest)	Electrical equipment of machine tools
IS: 2516 (latest)/ IS: 13947 & IS 13118	Circuit breakers (corresponding to IEC- Pub-56-Latest)
IS:6875- (latest)/ IS 13947	Push Buttons and related control switch gear, bus bars, main connection & auxiliary wiring.

- 3.0 Unless otherwise specified in the main specification, the AC motors and starters shall be of the following type. Bidder can however, give alternative proposal with justification, if in his view alternative proposal is warranted by site conditions.

Sl. No	Type of Motor	Type of Starter
3.1	Any type of A.C. Motor Starting current of which does not exceed 75 Amp.	Direct on line.
3.2	A.C. Squirrel cage induction motors, starting current of which is above 75 Amp.	Star delta or auto transformer type.
3.3	A.C. slip-ring type motor	Resistance type air/fan cooled.
3.4	A.C. Synchronous or synchronous induction motor	Suitable maker Standard.
3.5	D.C. Motor	Resistance / Thyristor type.

- 4.0 The control gear of AC/DC motors shall incorporate the following protection devices as standard/concomitant accessories.
- 4.1 **No voltage protection:** No voltage protection shall be provided so that machine will not start up again by itself when following an interruption the supply is restored.
- 4.2 **Short Circuit Protection:** To protect against short circuits due to insulation failure of faulty connections, HRC fuses shall be provided for each motor. The rating of the fuse shall be such as to take care of the over current due to motor starting.
- 4.3 **Overload Protection:** To prevent motors from overloading, overload protection shall be provided separately for each motor. Three phase motors shall be protected by overload tripping devices on each phase.

- 4.4 **Single Phasing Protection:** A separate current sensitive delayed action single phasing preventer shall be provided for each motor separately. Overload protection shall not be treated as single phasing preventer.
- 5.0 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 contactors etc. shall be front mounted on a rigidly fabricated metal panel for ease of operation. All other electrics shall be so 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.
- 6.0 The motor shall be totally enclosed with or without fan cooled frame. Screen protected drip proof (SPDP) type motor may be provided if it is mounted inside protective enclosures.
- 7.0 The electrical equipments shall comply with the Indian Electricity Act and Rules.
- 8.0 All instruments shall be of 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.
- 9.0 The supplier shall furnish 4 (four) sets of complete electrical and electronic wiring diagrams in full details to enable maintenance staff to locate faults in the circuits, 4 (four) 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 to the consignee.
- 10.0 For main motor class "B" insulation shall be provided. If any other class of insulation is proposed, detailed justification for providing different class of insulation shall be given.
- 11.0 Motors shall be designed to withstand frequent starts, stops and reversals as demanded in the operation of the machine.
- 12.0 Two earthing terminals shall be provided on electric motors including control gear.
- 13.0 POWER SUPPLY:**
- 13.1 The machine shall be suitable for operation on 415 Volts 3 phase 50 cycles AC 3 or 4 wire system with neutral solidly earthed. The supply voltage may vary upto $\pm 10\%$. The frequency may vary upto $\pm 3\%$. However, full rated power of the motor shall be available at the lower voltage. Voltage stabilizer as specified below shall not be required for machine having electrical motor power requirement upto 30KW.
- 13.2 In case of machine not equipped with NC/CNC/Thyristor controlled devices, a suitable servo-controlled voltage stabilizer of adequate capacity to cater to entire electrical load of the machine having electrical load requirement exceeding 30 KW shall be offered along with machine as a concomitant accessory. Voltage stabilizer from reputed makes/sources is acceptable. The voltage stabiliser shall conform to:

1	Input voltage	320 to 460 volts 3 phase 4 wire unbalanced supply
2	Output voltage	415 volts
3	Regulation	+ 1% from No load to Full load
4	Rate of correction	20 volts per second per phase.
5	Wave form distortion	NI
6	Efficiency	Not less than 97%
7	Winding and class of insulation or better.	Copper wire wound with "B" class insulation

- 13.3 In case of machines equipped with NC/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 & ultra-isolation transformer of adequate capacity to cover up the entire electrical load of the machine shall be offered as a concomitant accessory conforming to Specification for voltage stabilizer as mentioned in clause 13.2 above and isolation transformer to the parameters mentioned below:

a	Transformer ratio	1:1
b	Winding	Copper wire wound with "B" class insulation or Better
c	Protection	To arrest spikes and surges to the order of 3 KV for 200-400 micro seconds duration
d	Common mode noise rejection	120dB
e	Isolation	Capacitance 005 Pf (Pico farad) for resistance greater than 1000 Mega Ohms.

- 13.4 Voltage stabilizer shall be equipped with a proactive 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. Protective relay shall be provided as concomitant accessory on the machines having electrical load below 30 KW.

14.0 ATMOSPHERIC CONDITION:

- 14.1 The ambient temperature at the site at which the machine will be installed may vary from +5°C to +50°C over the year. The relative humidity may be as high as 99.8%. 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.
- 15.0 The temperature rise shall not reach such a value that there is a risk of injury to any insulating material or adjacent parts.
- 16.0 The drive shall be capable of operating at any one of the speeds required independent of the load in accordance with the requirements of the machine.

SPECIFICATION FOR 5-AXIS CNC MACHINING CENTRE

SPECIFICATION FOR CNC SYSTEM (See clause 2.1 of Technical Specification)

1. The machine shall be provided with the latest model of microprocessor based CNC control of Fanuc / Siemens / Heidenhain make and shall have five axes control with hard disk. Programming language shall be according to DIN 66025.
2. Controls for all machine functions should be from the operator control station. Some exceptions depending upon design of the machine can be accepted but these must be clearly indicated in the offer.
3. The programme / software entry & display shall be either in plain language dialogue or by ISO standard Programming language to enable a full machining cycle to be built up prior to its execution.
4. A full set of alphanumeric keys for functional values and operating command shall be provided.
5. A 10.4 inch colour graphics flat screen or better shall be provided.
6. Controls shall be through push button for manual positioning of machine, manual control of spindle rotation and machine ancillaries.
7. The CNC system shall be capable of programmed control machine functions like axis movement and velocity control at pre-selected speeds, clamping of slides on reaching the programmed position, start and stop rotation and reversal of spindle, selection of spindle speeds, feed rates, start and stop of cutting fluid, tool positioning selection.
8. Programming software shall be facilitated with an overall sensor for the reduced speed and feed rates against previous higher selected speeds and feed rates during machining operations.
9. The standard features of the CNC system shall be described in detail in the offer. These should include but not be limited to the following features:
 - 9.1. 3-axes linear as well as circular interpolation.
 - 9.2. Helical and full circle programming in all principal planes.
 - 9.3. Standard programming with 0.0001" or 0.001 mm resolution with automatic recognition and acceptance of inch/mm.
 - 9.4. Absolute and incremental programming.
 - 9.5. Decimal point programming.
 - 9.6. Dwell cycle programmes.
 - 9.7. Facility of automatic tool off setting.
 - 9.8. Facility of tool nose radius compensation.
 - 9.9. Data protection key shall be provided. It shall prevent the program offset, parameters data etc. from being registered, set, modified or deleted erroneously.
 - 9.10. Mirror image programming on x-y, y-z and z-x planes.
 - 9.11. Scanned cycle programming for repetitive machining particular to the type of machine offered in boring and drilling cycles.
 - 9.12. Facility to have sub programme storage space of at least 1GB or more compact on disc drive. The memory shall be adequate for loading the complete programme of the Job. Facility of accepting input either through machine keyboard, punch tape reader/compact disc drive/CD/DVD/USB or from a remote device through RS 232 port/USB should exist. The latter should be usable to download the machine programme into any storage or copying device facility of programme search using programme name or programme number shall be available. It shall be possible to select the sequence number required to be searched.
 - 9.13. The programming codes would be ISO standard and shall be automatically recognized.