

SPECIFICATIONS
FOR CNC VERTICAL TURN MILL
CENTER (VTMC)

Brief Scope:

The firm shall design, manufacture, supply, install, commission and prove out the CNC Vertical Turn Mill Center (VTMC), Qty: 01 No. as per the detailed and essential specifications furnished in subsequent paragraphs.

Machine Description:

The intended VTMC is of CNC version with rotary turn table of minimum Ø4500mm for machining of Aluminum alloy rings and shall have swing of minimum Ø5500mm.

The turn table of the machine shall be capable of working in "Turning" "Drilling" and "Milling" modes for the components up to Ø5500mm with separate turning and milling heads.

The machine shall essentially be of double column type with rigid, strong frame and related structures. **The table shall be essentially of casting and other structures can be either casting or welded construction.** All structures produced shall be supported with complete data of materials used, their strength details, manufacturing method, analysis report for load carrying capacity and dampening features.





The ram shall be of forged steel designed for high efficient machining with provision for live spindle attachment for drilling, milling and grinding operations. The ram shall have provision to attach milling heads which can perform machining operation in three rotary axes (Right Angle Head, Tilting Head and Straight Head). The machine shall have two programmable linear axes (X-Axis & Z-Axis) with precision hydrostatic guide ways. The machine shall also have programmable cross rail movement (W - Axis) for positioning purpose only. The C-axis drive of rotary table shall also have precision dual drive / **single direct drive** full hydrostatic guide.

Exchange of tools, tool holders and different heads should be automatic and programmable. All tools, tool holders and heads to be accommodated in the ATC magazine and magazine to be designed accordingly for auto functioning.

The machine shall have automatic work piece and tool measuring / checking facility **in both turning and milling applications** and supplied with preferably chain style tool magazine for minimum of 45 tools. **The tool magazine shall be of rugged and compact design with less space occupancy to accommodate both tools and holders. The succeeding tool or holder shall be positioned in advance in the ATC magazine for automatic pick up.**

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



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Specifications:

Sl. No	Description	Value / Parameter	Essential / Desired
1	Basic Features of the Machine		
i	Turn Table Dia	> / = 4500mm	Essential
ii	Max Swing Dia	5500mm	Essential
iii	Max Turn Dia	5500mm	Essential
iv	Max Turn Height	2000mm	Essential
v	Load Carrying Capacity	50T Minimum	Essential
vi	Working Modes	Turning, Drilling & Milling	Essential
vii	Head Type	Ram with live spindle and provision for interchangeable Turning, Drilling and Milling heads	Essential
viii	Ram Size	Minimum 350mm x 350mm of forged steel. Vendor to offer next higher size ram if the indicated size is not in the range. Graph representing ram travel v/s deflection for the entire range (W-axis at top most position and with full extension of ram) to be submitted along with offer.	Essential
ix	Feedback System	1. Linear absolute encoders (scales) with 0.001mm resolution (for X & Z) 2. Angular absolute encoders with 0.001° resolution (for Rotary axes)	Essential
2	Primary Machine Axes		
i	X-Axis with Hydrostatic Guide Ways	1. Minimum 5000mm to cover whole working table with provision for tool pick up from ATC. 2. Extra travel range in X-Axis in both the directions from the table center to accommodate the ram movement for external milling of Ø5m rings using 90° tilt milling head with minimum effective tool length of 250mm	Essential

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ii	Z-Axis with Hydrostatic Guide Ways	2000mm (See Note below)	Essential
iii	C-Axis (Table) with Full Hydrostatic Guide	360° Continuous bidirectional	Essential
iv	W-Axis (Positioning)	1000mm minimum travel in steps of 200mm programmable	Essential

Note: Total travel in Z-Axis should be achieved with combination of ram and cross rail movements. The desired Z-Axis travel is for machining 2000mm height work piece on 3 sides (OD, Top and ID) with minimum effective tool length of 200mm for machining on top face.

3 Additional Axes

i	90° Rotary Head (About Vertical Axis)	±180° continuous programmable movement with 0.001° accuracy in interpolation with C-Axis which results in simulation of Y-Axis	Essential
ii	Tilting –Head (About Vertical Plane)	±100° minimum programmable movement of milling head in interpolation with primary axes for drilling and milling of angular features. Vendor has freedom to offer tilting head having greater range of movement.	Essential

Note:

1. Alternatively, supplier can offer single universal head to replace above mentioned rotary and tilting heads. Details of universal head to be submitted along with the offer.
2. The ram shall have provision to accommodate additional heads (Facing, Tilting for offset machining, angular grinding etc) for future requirements.

4 Turn Table Description:

i	Speed (rpm)	1. 1-100 rpm. Infinitely variable speed range in turning mode 2. 1-6 rpm. Bidirectional table rotation feed in milling mode with 360000 programmable angular positions.	Essential
ii	Power (KW)	2x60 KW or more at S1-100% duty cycle. Dual (Master & Slave) main motors power output for full hydrostatic guide of the table rotation. Supplier to suggest suitable power rating to	Essential

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		achieve decent acceleration and better surface finish considering 50T load on the table. Alternatively supplier can offer Single Direct Drive system with minimum power of 120KW (@ S1) with compliance of all essential requirements of positional accuracy, full hydrostatic guide, acceleration with full load on the table and minimum backlash. The performance of similar class machine with direct drive system supplied in recent past (5 years) along with customer report shall be provided along with the offer.	
iii	Torque	a) 125000 N-m, minimum torque on the table in turning mode at 100% duty cycle b) 100000 N-m, minimum torque on the turn table in milling mode at 100% duty cycle	Essential

Note: Torque power diagram to be submitted along with the offer.

5 Live Spindle			
i	Speed	10000 rpm or more. Infinitely variable electro spindle	Essential
ii	Power	25 KW or better	Essential
iii	Torque	90 N-m or better	Essential
iv	Spindle Taper	HSK A 63	Essential
v	Spindle Cooling	a) Adequate spindle cooling to be provided. b) Necessary system (pumps, valves etc) for cooling and controlling to be specified c) Liquid cooling type is preferred.	Essential
6 Feeds			
i	Rapid Traverse (X, Z)	10000 mm/min or better	Essential

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ii	Max working feed (X, Z)	5000 mm/min or better	Essential
iii	Cross Rail	500 mm/min or better	Essential
7 Positional Accuracy (For full travel length)			
i	Reference Standard	VDI / DGQ 3441	Essential
ii	Positioning uncertainty (P), X - Axis	0.020mm or better	Essential
iii	Positioning uncertainty (P), Z - Axis	0.015mm or better	Essential
iv	Positioning uncertainty (P), C axis	5 arc seconds or better	Essential
v	Positional Error (Pa), X - Axis	0.015mm or better	Essential
vi	Positional Error (Pa), Z - Axis	0.010mm or better	Essential
vii	Positional Error (Pa), C Axis	5 arc seconds or better	Essential
vii	Reversal Error	0.005mm or better	Essential
8 Geometrical Accuracy (As per Standard ISO230)			
i	Straightness (X & Z axes)	0.01/1000mm or better (not exceeding 0.05mm on overall length)	Essential
ii	Perpendicularity between X & Z axes	0.01/1000mm or better (not exceeding 0.05mm on overall length)	Essential
iii	Perpendicularity of spindle w.r.t table	0.02/300mm or better	Essential
iv	Radial run-out of the center bore in the table working surface with surface finish Ra=1.6µm	0.02mm or better	Essential
v	Axial run-out of the working surface at table edge	0.03mm or better	Essential
vi	Repeatability of the tool holder position	0.01mm or better	Essential

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vii	Parallelism of vertical guiding surfaces on the column w.r.t to table axis	0.04/1000mm or better	Essential
viii	Parallelism and straightness of cross head motion w.r.t to table surface	0.02/1000mm or better	Essential
ix	Parallelism and straightness of ram w.r.t table axis	0.02/1000mm or better	Essential
x	Radial run-out of the taper hollow spindle axis	0.01/150mm or better	Essential
xi	Parallelism of taper hollow axis of 90° head with table	0.02/150mm or better	Essential
9 Scope			
i	Includes Design, Manufacture, Testing, Installation (Refer Section – 22 for installation conditions) and Commissioning and Prove Out (Refer Section-24 for prove out conditions)		Essential
ii	Machine make / Model No to be clearly specified in the offer		Essential
iii	Original catalogue of offered model should be enclosed		Essential
10 Technical Features			
i	The machine tool shall be CNC type Double Column, single ram Vertical Turn Mill Center. The ram shall be forged type with live and continuous spindle for attaching different type of tool holders for turning, milling and drilling operations. The machine shall have primary 4 axes (W, X, Z and C) with full hydrostatic guides on X, Z and C axes and CNC control. Additional axes (Rotary, Tilt) can be achieved with the attachment of different heads to the ram and shall have continuous programmable movement through interpolation.		Essential
ii	The guide ways on C, X and Z axes are with hydrostatic bearings and protected with suitable covers to prevent entry of foreign material. Telescopic cover is preferred at bottom and bellows at top.		Essential
iii	The ram shall be mounted with a camera at the vicinity of tool tip which will help the operator to set up and monitor the operations carried out. Alternative method if any should be suggested by the vendor.		Essential


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



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iv	Table shall be essentially of high quality casting and main structure of the machine shall be of either casting or welded construction . All structures produced shall be supported with complete data of materials used, their strength details, manufacturing method, analysis report for load carrying capacity, dampening and thermo symmetric stabilization. The machine shall be stable at highest possible speeds and feeds.	Essential
v	Table and spindle rotation should be CNC controlled and provided with built in encoders to read actual rotation speed.	Essential
vi	Each slide way should be provided with automatic centralized lubrication, wipers and adequate seals for protecting it from chips and other dust wherever required .	Essential
vii	Coolant System consists of tank, pump for recirculation and hoses shall have: a) Coolant recovery tank: 1500 liters or more b) Internal coolant supply to tool holder at 20bar or more. c) Coolant system should have paper filter 40µ or better to avoid ingress of dirt/chip into coolant tank.	Essential
viii	Machine should have chip conveyors with trolley. Chips & coolant to be separated and coolant should re-circulated into the coolant tank.	Essential
ix	Adequate illumination for full working zone.	Essential
x	UPS for CNC control system with 15 minutes (minimum) backup to be provided.	Essential
xi	The pneumatic system of the machine should be operative with air pressure of 6-7kg/cm² . The pneumatic system must have oil and moisture trap to remove oil, vapour, and moisture from the pressurized air. Separate compressor if required shall be supplied by the vendor and cost towards it to be indicated separately.	Essential
xii	The machine should be provided with necessary surge protectors. Firm to supply voltage stabilizer and isolation transformer along with the machine.	Essential
xiii	Feedback system. The machine should have direct feedback system through fully integrated linear scales and rotary encoders.	Essential
xiv	Machine should be equipped with necessary diagnostic functions to identify and rectify the problems.	Essential
xv	Machine enclosure to be provided as per standard design of manufacturer as per applicable safety norms.	Essential


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xvi	Machine shall be provided with remote diagnosis feature for easy maintenance.	Essential
xvii	Machine should be able to operate under following power supply condition: 3 phase, 415 V \pm 10%, 50 Hz \pm 5% AC supply	Essential
11 Operator Panel		
i	Manual pulse generator/ HHU with axes selector X1, X10 & X100 (detachable type).	Essential
ii	Manual ON/OFF for control system, coolant, and spindle heads.	Essential
iii	Reference point	Essential
iv	Manual tool indexing in ATC	Essential
v	Manual tool loading to spindle	Essential
vi	Emergency stop, machine lock & program lock	Essential
vii	Block search	Essential
viii	Feed rate over ride = 0-120 %	Essential
ix	Spindle over ride = 50-120 %	Essential
x	Auto/single cycle, JOG, MDA etc	Essential
xi	Test run/dry run	Essential
xii	Cycle start and stop	Essential
xiii	Part program edit selector	Essential
xiv	Cycle error indication	Essential
12 CNC Control System		
i	Siemens 840DSL control system with latest version having PC based windows software in its standard composition.	Essential
ii	CNC, NCU, PLC, PCU & operating console should be of latest version.	Essential
iii	Suitable licensed version CAM software with post processor should be offered separately. Relevant technical details (Brochure / catalogue) of CAM software and post processor offered shall be submitted along with the offer.	Essential

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iv	Electrical wired up panels to confirm to required Ingress Protection norms (IP55 or equivalent / better) and AC panel cooler to be provided.	Essential
v	The supplier should buy the Repair, Service, and Warranty contract from the Control System manufacturers for the time period offered by the supplier and transfer it to BEML.	Essential
13 Programming and Control features shall consist of the following:		
i	15" (or bigger) color TFT monitor with key board & display in English language.	Essential
ii	Entry of data for each address to be XXXXX XXXX	Essential
iii	2D & 3D graphic display & graphic simulation.	Essential
iv	Metric & inch input.	Essential
v	Spindle orientation.	Essential
vi	Linear, circular, helical interpolation.	Essential
vii	Tool Radius and length offset and tool wear compensation.	Essential
viii	Absolute & incremental Programming.	Essential
ix	ISO code program format.	Essential
x	Background editing and programming.	Essential
xi	Pitch error & backlash compensation.	Essential
xii	Alarm & error display and diagnostic features.	Essential
xiii	Software & hardware locking for machine & control.	Essential
xiv	CNC main memory hard disc 4 GB minimum & NC user's memory 10MB minimum.	Essential
xv	Program repetition, Coordinate transformation, Rotation, Mirror, Canned Cycles (Routing, Drilling, Profiling, Pocketing, tapping) and Macro programming, copying, scaling, parametric programming & program error indication.	Essential
xvi	Tool monitoring system.	Essential
xvii	DNC, External interface: Ethernet/ USB port / PCMCIA interface/ facilities.	Essential
xviii	Multi program storage with program identification.	Essential
xix	Automatic repositioning after cycle interruption.	Essential
xx	Block search & skip.	Essential
xxi	Decimal point programming.	Essential

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xxii	Program restart after interruption.	Essential
xxiii	Display of remaining cycle during execution of repetitive cycle/subroutine	Essential
xxiv	Beam sag compensation in both horizontal and vertical plane <i>if necessary</i>	Essential
14 Display Features		
i	Machine position	Essential
ii	Program under execution.	Essential
iii	Block No.	Essential
iv	Active command block.	Essential
v	Spindle speed, feed rate - actual & programmed values.	Essential
vi	Absolute position	Essential
vii	Distance to go	Essential
viii	Tool no. & offset no	Essential
ix	Error message if any	Essential
x	Mode of operation	Essential
xi	Tool under execution	Essential
xii	Relative position	Essential
xiii	In process measurement value with reference to part datum	Essential
xiv	Part program & tool file library	Essential
xv	Tool data	Essential
xvi	Work zero	Essential
xvii	Machine running time display & spindle load meter	Essential
15 Safety		
i	The machine must be provided with all safety features necessary to protect the machine, control, and the operator while in operation from possible damage/injury following CE/Equivalent norms.	Essential
ii	Automatic machine shut off with warning in the event of lubrication and coolant failure, spindle off and axis over travel.	Essential
16 Accessories		
j	Automatic tool changer (ATC) with tool magazine of minimum 45 tool pockets (For HSK milling tools and ISO/Capto turning holders)	Essential

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



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
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



ii	Automatic tool length and tool radius measurement (laser type only) system on the machine for both turning and milling tools.	Essential
iii	In process gauging with Renishaw/Blum/Marpos to be supplied. Cycles required for checking profiles, holes in continuous/discrete modes.	Essential
17 Spares		
	a) Firm shall supply recommended and essential spares kit required for trouble free operation and maintenance of the machine during warranty period.	
I	b) List of manufacturer recommended spares for operation and maintenance of the machine for a period of 3 years (on 2 shift basis) after expiry of warranty period to be furnished with price details along with the offer. The list of spares should be comprehensive consisting of electrical, mechanical and electronic items. This will not be considered for commercial evaluation of L1	Essential
18 Annual Maintenance Contract (AMC)		
i	The supplier should quote separately for AMC for a period of 3 years after expiry of warranty period along with service support for handling the AMC. This will not be considered for commercial evaluation of L1.	Essential
19 Other terms and Conditions:		
i	The machine table should have capacity to withstand load up to 50 Tons	Essential
ii	The supplier should confirm to provide after sales support (including spares supply) for a minimum period of 10 years after warranty.	Essential
20 Pre dispatch Inspection Documents		
i	Positional accuracy as per VDI/DGQ 3441 and NAS test. Inspection report to be submitted for obtaining dispatch clearance from BEML.	Essential
ii	Test charts report for the geometrical accuracies of the machine and NAS test reports are to be furnished by the supplier.	Essential
iii	All the tests required for confirming the geometrical & positional accuracies should be demonstrated to BEML engineers for acceptance.	Essential

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iv	The supplier shall prove out NAS test piece at their works and inspection reports shall be forwarded to BEML prior to dispatch of the machine.	
v	The supplier should furnish the details of NAS - test piece that should be proved at supplier's works before dispatch of the machine and same to be demonstrated after installation and commissioning at BEML.	Essential
21 Delivery		
i	a) Dispatch from manufacturer site within 18 months FOB.	Essential
ii	b) Installation and commissioning within 4-6 months after readiness of site at BEML. Firm to offer their comments in this regard.	Essential
22 Installation and commissioning		
i	Supplier is solely responsible for installation and commissioning activity at BEML site. The foundation requirements like soil strength, excavation details, foundation drawings etc shall be submitted to BEML within 45 days from the receipt of order.	Essential
ii	Foundation kit like vibro mounting pads, bolts etc. required for the foundation to be supplied.	Essential
iii	Special requirements like isolation, vibration criteria, air conditioning, dust free atmosphere and flooring type to be specified.	Essential
iv	BEML will provide free electricity, pneumatic air (at 4-6 bar pressure) and material handling equipment for supporting installation and commissioning activities. While material handling, equipment will be provided by BEML, activities including unloading of the machine after receipt at BEML, positioning of the machine at BEML site during installation etc would be carried out under direct supervision of the suppliers representatives.	Essential
23 Documentation		
i	The firm to supply 2 sets of following documents/manuals in English (Hard copy and Soft copy) a) Machine Operation b) Programming c) Maintenance: Mechanical, Hydraulic, Electronics including PLC listing	

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	<p>d) Foundation Drawings</p> <p>e) All the drawings of assemblies, sub assemblies and accessories of the machine.</p> <p>f) Machine layout drawings</p> <p>g) Circuit diagrams for Hydraulic, Pneumatic, Electrical/ Electronics etc.</p>	Essential
24	<i>Trial and Prove-Out</i>	
	<p>Trial and prove put of component shall be carried out by the firm with following scope:</p> <p>a) NAS test to be carried out at firm's works during PDI.</p> <p>b) Prove out component, Qty-02 to be proved at BEML site after installation and commissioning of machine.</p> <p>c) Firm has to buy required raw materials from the identified source. Details of raw material source will be provided by BEML</p> <p>d) Drawing of component to be proved out is enclosed at Annexure - 1.</p> <p>e) The cost details towards the above mentioned scope to be quoted separately in the offer.</p>	Essential
ii	Firm shall provide details on sequence of operations carried out for proving the components with optimum cycle time.	Essential
iii	All required NC programming, machining fixtures / clamps, cutting tools to be arranged by manufacturer for part prove out. After successful prove out, related documents including NC programming, machining fixture/clamps should be handed over to BEML.	Essential
iv	Tooling shall be from global reputed source and shall have service support in India for future procurements. Credentials of the tool suppliers and Indian service support details to be provided. Detail specifications/documents related to all tool holders and cutting tools/inserts proposed are to be provided along with the offer	Essential
25	<i>Training at BEML Site</i>	
i	<p>Supplier has to provide required training in total two batches, one in the areas of operation and second for maintenance at BEML site during commissioning and prove out of the machine. Each batch may comprise of approx 4 engineers. Training duration will be as recommended by the supplier to cover the following:</p> <p>a) Operation – Machine Operation, CNC Programming</p> <p>b) Maintenance – Mechanical, Electrical and Control System</p>	Essential

Approval Reference: ASMD / 260 / 2019 / 2610985 Date: 04.12.2019

Committee Members:

Name	Thyagaraj H.S	A.Raghunath	Shaji Mathew	M.B Arabhavi
Signature				

T.Mohan

SPECIFICATIONS
FOR CNC VERTICAL TURN MILL
CENTER (VTMC)

26	Machine Acceptance	
i	Positional accuracy as per VDI/DGQ 3441 and geometrical inspectional report as per ISO 230-1 to be repeated at BEML site and to be demonstrated.	Essential
ii	Acceptance of the machine shall be based on successful completion of installation, commissioning and part prove out at BEML site.	Essential
27	Warranty	
i	Supplier to provide Warranty for a period of 2 years for the machine and control system from the date of satisfactory completion of installation, commissioning, part prove out, training and acceptance.	Essential
28	Experience, Track Record and Qualification Criteria	
i	The supplier shall have a minimum 15 years of continuous experience (as on the date of Tender opening) and proven track record in the field of design, manufacture & supply of VTMC with more than Ø4m class. (Company profile, details of machine supplied & supporting documents shall be submitted.) Credentials for having manufactured machines of smaller diameter will not be considered for the present requirement as the technology for bigger machines in terms of structure design and infrastructure requirement are unlike.	Essential
ii	Firm shall have supplied minimum 2 nos. of similar or higher capacity machines in last 05 years to Aerospace / Defence / Energy / Power industry . Out of 2 machines, at least 1 machine should have been supplied by the manufacturer to a country other than the country of OEM. Firm shall furnish the reference orders for justification along with the relevant details, such as machine model and customer PO with date.	Essential
iii	Firm shall furnish minimum two performance reports on the supplied machines from customer end for satisfactory performance of machine for at least 1 year after installation and commissioning of the machine with contact details.	Essential
iv	The supplier shall submit a copy of accuracy & geometrical test reports / certificates of above referred machines supplied by them recently along with Purchase order/completion certificate.	Essential
v	BEML reserves the right to verify the information provided by vendor. In case the information is found to be false / incorrect, the offer shall be summarily rejected.	Essential

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Committee Members:

Name	Thyagaraj H.S	A. B. Chunnath	Shaji Mathew	M. B. Arabhavi
Signature				





T. Mohan

vi	Quotations not meeting the qualification criteria are liable for rejection and considered as "disqualified". BEML reserves the right to verify the details provided by the supplier. In case the information provided by the supplier is found to be false / incorrect, the offer will be liable for rejection.	Essential
29 General Notes		
i	The firm essentially has to meet all the mandatory conditions mentioned in the remarks column as "Essential"	Essential
ii	Comments like "Yes", "Agreed", "Will be provided at the time of supply", "Confirmed", "Will be completed" are not acceptable where numerical values are required to be quoted.	Essential
iii	Technical bids containing commercial price details will be categorically rejected.	Essential
iv	Bids with incomplete information will be categorically rejected and no additional documents will be entertained after the bid submission.	Essential
v	Commercial quote shall include the price break up as specified in the commercial bid terms & condition.	Essential
vi	Vendor other than OEM shall enclose clear valid authorization certificate.	Essential
vii	Obtaining of export license for machine supply is the responsibility of the firm and confirmation in this regard is required.	Essential
viii	Color of the machine shall be finalized while order finalization.	Essential
ix	Firm to furnish details of cost break up of all major components of the machine during order finalization.	Essential

Approved: _____
CGM (DP), Committee Chairman

Approval Reference: ASMD / 260 / 2019 / 2610985 Date: 04.12.2019

Committee Members:

Name	Thyagaraj H.S	A. Raghunath	Shaji Mathew	M.B Arabhavi
Signature				

T. Mohan