

राष्ट्रीय वांतरिक्ष प्रयोगशालाए  
National Aerospace Laboratories

(विज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)

पीवी सं / PB No. 1779, एचएएल एयरपोर्ट रोड / HAL Airport Road, बेंगलूर / Bangalore- 560 017, भारत / INDIA

फोन / Phone: (Off) +91-80- 25273351 - 54, 2508 6000 - 6599, फेक्स / Fax: +91-80-2526 0862, 2527 0670

वेबसाइट / Website : <http://www.nal.res.in>

NAL 1959-2009  
ISO 9001-2000  
ORGANISATION

*Golden Jubilee Year*  
(June 2008 - May 2009)

Our Fax No.:080- 25269611

**PURCHASE ORDER No.: 61F/ENK/10/257F/08**

NAL/PUR/ENK/10/257F/08

August 24, 2009

M/s. Takumi Machinery Company Ltd.,  
#50, 35<sup>th</sup> Road, Taichung Industrial Park,  
Taiwan

**Sub :** Supply of Takumi H-13 Machining Centre

**Ref :** Your Quotation No. Dmm/Takumi/346/08-09 dtd: 12.02.2009 &  
Your Letter No. DMM/NAL/006/09-10 dtd. July 27, 2009.

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Dear Sirs,

We, with pleasure place firm orders on you for supply of the items mentioned below under the terms & conditions overleaf.

Sl.No	Description of Items	Quantity	Rate / Unit US\$	TOTAL US\$
01.	Takumi VMC 3 Axis Model No. H-13 as per the specifications enclosed at Annexure A&B.	01 Set	173500.00	173500.00
			Less Discount @5%	(-) 8675.00
			<b>CIF CHENNAI</b>	<b>164825.00</b>

**NOTE:**

- Please mail your order acceptance to enable us to process for L/C.
- Consignment may please be handed over to: (By Ocean freight). This freight forwarder is nominated by us for the sake of convenience and ease of customs clearance in India

M/s. TOP Express Inc.  
2F-8, No.32, SEC-1,  
Chengkung Road,  
Nanggang Chiu, Taipei,  
Taiwan 115 R.O.C  
TEL: 00 886 2 66158666  
FAX: 00 886 2 6615511

- Delivery: within 8 – 10 weeks after receipt of order or LC whichever is later, subject to export clearance.



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4. Shipment: By Ocean freight.
5. No Agency Commission is payable to M/s. Drass Mechatronics & Machinery Pvt. Ltd., Bangalore - 22.
6. Other terms & conditions enclosed as per annexure 'C'.

Yours faithfully,

(R.K. RAO)

Controller of Stores & Purchase

Copy to : M/s. Balmer & Lawrie & Co.Ltd.,  
BANGALORE - 17.

CC: M/s. Drass Mechatronics & Machinery Pvt. Ltd.  
#782/20-1, 1<sup>st</sup> Floor, 6<sup>th</sup> Cross,  
L.N. Colony, Yeshwanthpur, B'lore - 22.

Fax: 41275172



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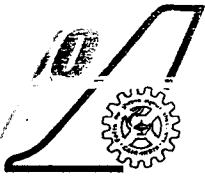
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August 24, 2009

## Annexure 'C' Terms and Conditions

1. Price: CIF Chennai Port.
2. Payment: 100% Non confirmed and irrevocable, Letter of Credit shall be established against which 90% payment would be released on despatch of documents and balance 10% after installation & commissioning subject to submission of 10% Performance Bank Guarantee valid for 2 months, beyond the warranty period of 24 months, for main machine. Prior to discharge of the 10% PBG after the expiry of warranty period, your agent should submit a fresh PBG for US\$500/- valid for 2 months beyond the warranty period (i.e. 14 months) from the date of expiry of the warranty of the main machine towards the performance obligations of the spindle.
3. Pre-Despatch Inspection & Final Acceptance Tests: The machine shall be inspected at manufacturer's works as per VDI/DGQ 3441 or JIS standards and one copy of the inspection report shall be sent to NAL for records. The tests shall be repeated at NAL premises as part of acceptance test procedure. Inspection and acceptance shall be done using ball bar and laser inspection methods. Other issues related to this clause shall be as per the provisions of the bidding documents.
4. Vendor should conduct inspection of the site and inform us its suitability and the installation pre-requisites.
5. Installation & Commissioning: The scope of supply shall include machine handling at the buyers premises to the place of installation, unpacking, installation & commissioning, and trial runs with testing should be done by M/s. Drass Mechatronics and Machinery Pvt. Ltd., Bangalore. No assistance will be provided by NAL during the course of installation and commissioning. However the machine will be cleared with INDIAN CUSTOMS & moved up to the premises by NAL.
6. Training: Training in operation, programming, post processing and maintenance for a period of 1 week for 3 engineers at machine tool builders place shall be provided free of cost. However, NAL will bear the expenses towards Air travel, Visa and Insurance charges. The necessary local hospitality, local travel and boarding should be provided by M/s. Takumi Machinery Company Ltd., Taiwan.



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7. Vendor should assist for transportation of the machine from Chennai to Bangalore, positioning and installing the same at site. However, the cost towards the above shall be borne by NAL.
8. Warranty: The machine along with all standard and optional accessories including CNC controller, transform, Flash card reader and servo stabilizer shall be warranted for defective materials, manufacturing defects and malfunctioning for a period of 24 months from the date commissioning. All spares during the warranty period should be supplied on CIF basis. However, for the spindle assembly warranty shall be for 36 months from the date of acceptance, which includes replacing or repairing the spindle assembly free of cost during this 36 months warranty. The warranty includes dismantling, exporting, assembly, alignment, testing and final assembly at NAL on CIF basis.
9. Liquidated Damages: As time is the essence of this order, the date of delivery should be strictly adhered to, otherwise the Director reserves to deduct, a sum equivalent to 0.5 percent of the contract value for each week or part thereof of delay until actual delivery or performance, up to a maximum deduction of 10 Percent of the Contract value, the LD will be applicable from the date of the original L/C, reaching beneficiary bank and issue of order acknowledgement. However, there shall be no LD in the following conditions.
  - a) If there is any delay by NAL for "PRE DISPATCH INSPECTION"
  - b) If there are any changes desired on the machine during PDI & acceptance.
10. After Sales Support & Maintenance: Reliable after sales support in service and application is a must. The manufacture should ensure availability of trained service engineers in India who can be deputed to attend any service problem within 48 hours on reporting of the same. Four Preventive maintenance in a calendar year and any number of breakdown maintenance during AMC, after warranty period, must be provided, after the end of warranty period, at a cost of Rs.1,20,000/- by your agent - M/s. Drass Mechatronics and Machinery Pvt. Ltd., Bangalore; provided NAL choose to enter into an separate AMC (The supplier should enter into a separate service contract for maintenance after expiry of warranty period).
11. All other terms & conditions to extent not superceeded in this purchase order, shall be governed by the provisions of the bidding documents.

*R.K.RAO*

(R.KRAO)

Controller of Stores & Purchase

ANNEXURE - "A"

SPECIFICATIONS FOR A 3 AXES SIMULTANEOUSLY CONTROLLED  
CNC VERTICAL MACHINING CENTRE

APPLICATION :

The CNC Machining Centre with simultaneous 3 axes Control (X, Y, Z,) should be of proven design and of latest technology.

The machine shall be compact, rigid and equipped with wide range of accessories to machine all types of materials viz, Aluminium alloys, steel, Titanium etc., typically encountered in aerospace applications.

SCOPE OF SUPPLY:

The scope of supply shall include one basic machine with standard and necessary accessories, CNC control system, erection, commissioning and proving of components, one set of standard tools, pre-dispatch inspection, testing and calibration using laser and ball bar test .

SALIENT FEATURES OF THE MACHINE:

STRUCTURE:

- The machine should be of Bed type design with complete splashguard.
- The machine structure shall be of close grained MEHANITE LINCESED cast iron in double column design and normalized so as to have high damping characteristics.
- The machine should facilitate easy access, easy loading and unloading of work piece and provide excellent visibility of working area.
- The machine shall be provided with chip tray with filtering and cutting fluid recycle and oil skimmer

SPINDLE:

- Spindle shall be of heavy-duty high frequency type spindle and thermally stabilized by circulation of chilled oil & air suspension around the spindle.
- Tool clamping will be by disc springs and declamping by hydro pneumatic cylinder.
- Spindle is to be provided with power fail monitoring circuit & also provided with the over rated Z axis motor 5.5 KW with brake to ensure that there will not be any drop in case of power failure. Further to this it should be provided additional PLC which can be enabled wherein the PFM sense the power failure and automatically the Z axis will go up by 0.2mm.

GUIDE WAYS:

- All linear movements shall be OIL LUBRICATED ROLLER TYPE linear motion guide ways
- All guide ways shall be properly protected from ingress of swarf by suitable smooth moving telescopic covers and wipers.

DRIVES:

- Each axis should have independent infinitely variable brushless AC Servo drives.
- Axis drive motors should be of adequate rating and torque so as to quickly respond to the commands during high speed machining operations.0.5G acceleration with 3500 Kg load on the table.
- X, Y, Z axes ball screws shall be directly coupled to servomotors and supported at both ends with dowels on the bearing seat along with ANGULAR CONTACT BEARING.

**TABLE:**

- The worktable shall be made of fine grained cast iron with HARDENED 'T' slots
- The machine shall be anchored firmly to the foundation.

**COOLANT SYSTEM:**

- Ring coolant system and coolant gun to be provided.

**FEED BACK DEVICES:**

- High precision linear glass scales shall be provided as standard for linear axes X, Y and Z axes.
- EDGE Finder.
- The feed back devices shall be properly housed to protect them from dust, chips, cutting oil etc.,

**LUBRICATION SYSTEM:**

- The machine shall be provided with automatic centralized lubrication system.

**AUTOMATIC TOOL CHANGER:**

- ATC shall be of proven type and should have been tested for reliability.
- ATC shall be well protected from cutting oil and swarf.
- ATC shall have a capacity for mounting minimum 30 tools
- When the tool is changed using ATC, reference location should be maintained

**CNC CONTROLLER:**

- The controller should support 3 axes simultaneously
- Should be capable of executing the programme in active mode from the HDD for large part programmes of length up to a maximum 100 MB
- The CNC system should be operator friendly, easily programmable and with PC architecture and Windows operating system. It should be capable of working continuously without interruption at ambient temperatures of up to 45 deg Celsius.
- The CNC should be of FANUC 18i MB with HP NANO control .The CNC controller shall support high precision machining of complex and intricate parts.
- The machine should be capable of error correction by using Renishaw M 10 Gold laser interferometer.
- It should be equipped with pre-settable intelligent functions for optimizing both profiling precision and trajectory speed.
- Electronic hand wheel, RS - 232 C input/output interfaces RJ-45 shall be provided as standard.
- ETHERNET and DATA Server with LARGE PROGRAM DUMPING facility should be provided as standard apart from the internal memory of the CNC.

**ACCURACY:**

- The machine shall have intrinsically high mechanical accuracy and should guarantee the accuracy and roundness specified while machining at high speeds of complex parts.
- Positioning and repeatability checks as per VDI/DGQ - 3441 standards shall be conducted and test report should be submitted along with the machine using ball bar and laser interferometer.

**POWER SUPPLY:**

3

- The machine should be suitable for connection to 415 V, 3 Phase, 50Hz AC supply as noted in technical specification.
- Servo voltage stabilizer and isolation transformer of 50KVA rating shall be supplied along with the machine.

**DOCUMENTS:**

Two sets of following documents in English both hard copy and soft copy shall be supplied along with the machine.

- Machine tests charts
- Machine layout and foundation plan
- Installation manual
- Operation and maintenance manual
- Electrical /Electronic circuit diagrams and manuals

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**SPECIFICATIONS OF TAKUMI 3 AXES SIMULTANEOUSLY CONTROLLED HIGH  
SPEED HIGH PRECISION VERTICAL MACHINING CENTRE**

**MODEL: H-13 "DOUBLE COLUMN BRIDGE TYPE"**

SL NO	DESCRIPTION	SPECIFICATION
I	<b>TABLE :</b>	
1.1	Table size	900 mm x1400 mm
1.2	T slots/tapped hole size	To suit M 16 T nuts/22mm width
1.3	Table loading capacity	3500 kg or better
2	<b>TRAVERSES:</b>	
2.1	X-axis	900 mm
2.2	Y-axis	1300 mm
2.3	Z-axis	700 mm
2.4	Overload protection for all axes	Should be available by way of software and hardware
3	<b>NUMBER OF AXES</b>	3 (simultaneous interpolation axes)
3.1	Linear axes	3 (X, Y & Z)
4	<b>SPINDLE :</b>	
4.1	Spindle motor	25HP AC SERVO FANUC
4.2	Spindle speed	Direct drive 15000 rpm
4.3	Spindle taper	HSK-63A
4.4	Spindle cooling	Continuous cooling by way of heavy capacity chiller
4.5	Spindle cleaning	By air
4.6	Spindle bearing type and arrangement	Hybrid ceramic bearing or better
4.7	Spindle run out	0.005 mm or less @ spindle nose
4.8	Coolant through spindle	20 bar with filtering system and separate coolant tank
4.9	Spindle maximum torque	95.5Nm
4.91	Spindle type	Integral with motor (direct driven),
5	<b>FEED DRIVE:</b>	Digital
5.1	Feed motor torque (Newton meter) X, Y & Z axes	Approximate 64 Nm for all axes
5.2	Maximum thrust capacity (kgs) X, Y & Z axes	1390 Kgs
5.3	Arrangement of connecting ball screw to feed motor	Directly coupled with rigid below coupling
5.4	Manual jog feed rate	2 m /min
5.5	Servo motors	High torque brush less AC digital drive type
6	<b>PROGRAMMABLE FEED RATES:</b>	
6.1	X Axis	0-20m/min
6.2	Y Axis	0-20 m/min
6.3	Z Axis	0-20 m/min
7	<b>RAPID TRAVERSE:</b>	
7.1	X, Y axes	30 m/min
7.2	Z axis	30 m/min
8	<b>AUTOMATIC TOOL CHANGER:</b>	
8.1	Tool capacity	Minimum 30tools
8.2	Maximum tool dia with adjacent pocket empty	Dia 150
8.3	Maximum tool dia with adjacent pocket occupied	Dia 100 or more
8.4	Maximum tool weight	7 kg

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8.5	Maximum tool length	300 mm
8.6	Tool selection method	Random, shortest path
8.7	Tool change time (chip to chip)	Less than 4 sec.
8.8	Tool breakage detection	To be provided
9	<b>ACCURACY (as per VDI -DGQ 3441):</b>	
9.1	LINEAR AXES (X, Y & Z) Positional accuracy	0.006 mm/mtr.
9.2	Repeatability	0.003mm
10	<b>RESOLUTION:</b>	
10.1	Linear axes (X, Y & Z)	0.001mm
11	<b>POSITION MEASURING SYSTEM</b>	High accuracy HEIDENHAIN optical
12	<b>SERVICE SUPPORT IN BANGALORE</b>	Must be available for at least 5 years M/s.Drass Mechatronics & Machinery Pvt Ltd.
13	<b>LUBRICATION SYSTEM</b>	Automatic centralized lubrication system, specify
14	<b>CHIP DISPOSAL SYSTEM</b>	Scrape type chip conveyor with chip bucket
15	<b>INTEGRATED COOLANT SYSTEM:</b>	
15.1	Programmable coolant system	To be supplied
15.2	Coolant tank capacity	400 ltrs
15.3	Coolant pump capacity	9 HP
15.4	Coolant pump pressure	Specify
15.5	Flushing system	Flush coolant for chip cleaning & splash gun for job cleaning
15.6	Filtration of coolant	50 microns paper filter
16	<b>CONTROL SYSTEM:</b>	
16.1	Micro processor based CNC continuous path control compatible of interfacing with the host computer	Fanuc 18i MB with 10.4 inch TFT display
16.2	Number of simultaneous interpolated axes	3 linear axes
16.3	Integrated programmable controller	To be provided
16.4	Floating zero	To be provided
16.5	Display of all machine and control functions on CRT screen in English	To be provided
16.6	Display of all messages and solutions on CRT screen in English	To be provided
16.7	Graphic simulation of programme on CRT	To be provided
16.8	Storage of all data in non-volatile memory	To be provided
16.9	Compensation for tool length and diameter	To be provided
17	<b>Contour compensation (3D comp)</b>	To be provided
17.1	Back lash compensation	To be provided
17.2	Pitch error compensation	To be provided
17.3	Number of tool offsets	100
17.4	Feed override	0-120%
17.5	Spindle speed override	0-120%
17.6	Rapid rate override	0-120%
17.7	Continuous and incremental jog with pulse generator	To be provided
17.8	Axis calibration	Multi point to be provided
17.9	Dry-run	To be provided
18	Spindle power monitoring	To be provided
18.1	Panel cooler	To be provided

18.2	Key board	To be provided
18.3	CRT size & colour	10.4 inch color TFT LCD Display.
18.4	Hour run meter	To be provided
18.5	Load meter	To be provided
18.6	Electronic hand wheels for axes	To be provided
18.7	Mode selector (manual/single/auto)	To be provided
18.8	Mid program restart	To be provided
18.9	Programming help system	By manuals
19	Program storage capacity	2.0 GB
19.1	Part Program storage	2.0 GB
19.2	RS-232-C port with full input/output capabilities for 1) Measuring probe 2) DNC link	To be provided
19.3	Drip feed	To be provided
20	<b>OPERATING INTERACTIVE MACHINE PROGRAMMING (OPERATOR'S GUIDANCE) Graphics:</b>	To be provided
20.1	Programming with graphic support	To be provided
20.2	Graphic simulation of tool path	To be provided
20.3	Work piece representation in solid model 3-D view	To be provided
20.4	Work piece representation in a plan view with different shades of depth & in three planes (as in the work piece drawing)	To be provided
20.5	Real time graphics of work piece machining	To be provided
20.6	Panel lock	To be provided
20.7	Emergency stop	To be provided
21	<b>OTHER REQUIREMENTS:</b>	
21.1	Protection to the system & logic circuits against all interference (electronic, magnetic etc.,)	To be provided
21.2	Save routines after tool breakage or power failure	To be provided
21.3	Operating noise level	Less than 60dB
21.4	Machine lamp	To be provided(3 Lamps)
21.6	Weight of the machine	18000 kg
21.7	Machine height	3700 mm
21.8	Floor space required	3500 X3500
21.9	Total connected power	50KVA
21.10	Rigid Tapping facility	To be provided
22	<b>POWER SUPPLY CONDITIONS:</b>	415V, 3 phase, 50 Hz, 4 wire supply
22.1	1) Variations in voltage 2) Frequent fluctuation The system must be able to function under the above fluctuations of voltage and frequency	-10% to +10% (Note: Servo stabilizer and isolation transformer of 50 KVA capacity to be supplied)
23	<b>WARRANTY:</b>	24 months from the date of acceptance of the machine at NAL for the entire machine. However the warranty for spindle is 36 months from the date of acceptance of the machine at NAL.
24	<b>TOUCH PROBE</b>	
24.1	Touch probe	BLUM PROBE
24.2	Job measurement system using touch probe	To be provided

24.3	Work offset probing	BLUM to be provided
24.4	Interface hardware & software for touch probe	Blum TC 50 probe with blum ready cycles to be provided
24.5	Tool offset measuring	Blum laser with EX 50 laser unit
24.6	Work offset probing	To be provided
25	SPARES :	FOR 2 YEARS OF RUNNING To be supplied as per annexure "B" to be provided
26	LUBRICANTS AND OTHER CONSUMABLES	To be supplied (One set)
27	LIST OF ESSENTIAL DOCUMENTS ALL IN ENGLISH (HARD & SOFT COPY)	3 sets ( Refer Annexure B)
28	COMMISSIONING OF MACHINE & TRAINING OF OPERATORS	To be done at NAL free of cost
29	TRAINING FOR OPERATION, MAINTENANCE, POST PROCESSING AND PROGRAMMING AT MANUFACTURES SITE FREE OF COST	1 Weeks for 3 engineers at machine tool builder's place free of cost excluding Air ticket

7

### LIST OF MANUALS

31	<b>MACHINE TOOL OPERATION MANUAL:</b>	
31.1	Torque-speed characteristics of spindle Motor and feed servomotor	To be provided
31.2	Test chart with measured values	To be provided
31.3	Foundation plan and details (To be supplied in advance before despatch)	To be provided
31.4	Circuit diagrams of electrical and hydraulic systems	To be provided
31.5	Service & maintenance manuals	To be provided
31.6	Pneumatic connection details& conditions of air supply	To be provided
31.7	Vibration isolation details	To be provided
31.8	Any other special requirements to be specified	To be provided
32	<b>CONTROL SYSTEM:</b>	
32.1	Operating manuals	To be provided
32.2	Programming manuals	To be provided
32.3	Description of the control interface, circuit diagram of CNC, PLC drive control etc.	To be provided
32.4	Manuals of bought out items incorporated in the system	To be provided
32.5	Spare parts list with source supply and prices	To be provided
32.6	Installation & commissioning manual	To be provided
32.7	PLC Application Programme listing	To be provided
33	<b>DRIVES:</b>	
33.1	Drive Installation Manual	To be provided
33.2	Drive Maintenance Manual	To be provided

Annexure -B

LIST OF SPARES

Sl. No.	DESCRIPTION	QUANTITY
1.	Bearings used for mounting of ball screw rods for X ,Y, Z axes	1 set
2.	Coolant Pump	1 No.
3.	Auxiliary/machine function Push button used in controller	1. set
4.	Emergency Stop Button used in controller	1 no.
5.	Fuses used in controller	2 sets
6.	Oil seals	1 set
7.	O-rings	1set

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