

**Bharat Heavy Electricals Limited**  
**Ramachandrapuram : : Hyderabad – 502032**  
**M&S - DIVISION**

Tender No.: M&S/P&S/2020/67, Dt.:23.11.2020

Name of Work: Repair of Motorized Spindle of Starrag HX-253 CNC machine in New Blade Shop.

**ANNEXURE-I**

**SPINDLE DETAIL**

MACHINE MODEL: HX 253    MAKE: M/S STARRAGHECKERT, SWITZERLAND

<b>Sl. No</b>	<b>Description</b>	<b>Specification: HX– 253</b>
1	Maximum Spindle rated RPM	15,000 rpm.
2	Runs at max.	15,000 rpm.
3	Spindle Motor power	27 kW.
4	Frequency	Variable with variable drive
5	No. of poles	4
6	Tool Clamp	Draw bar mechanism with disc/helical coiled springs
7	Coolant Through Spindle.	Yes
8	Spindle is cooled by refrigerating coolant system	yes
9	Spindle Taper	HSK A63
10	Clamping force	20-22KN
11	Spindle Torque	90Nm
12	Bearing used	Ceramic Hybrid Bearing. (Angular contact ball bearing)
13	Seal reference	Not given
14	Lubrication	Life time lubrication

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Scope of work for Repairing STARRAG spindle	
1	Replacement of all bearings including ceramic hybrid/special bearings(Quantity-As fitted in spindle)
2	Replacement of draw bar assembly (including draw bar, springs and intensifier unit).
3	Replacement of hydraulic piston-cylinder for tool clamping.
4	Replacement of Collet and Gripper segments of tool clamping system as per existing part number
5	Replacement of all hydraulic, coolant, pneumatic and labyrinth seals and O-rings(Quantity-As fitted in spindle)
6	Replacement of cooling ducts of spindle and replacement of rotary union for internal coolant
7	Replacement of Encoder and Encoder wheel
8	Replacement of all Analog sensors in the spindle(Quantity-As fitted in spindle)
9	Re-winding of the motorized spindle.
10	Replacement of temperature sensor for the motor winding(Quantity-As fitted in spindle)
11	Replacement of temperature sensor for the front and rear bearings(if present)
12	Replacement of Stroke Measuring system (for monitoring tool clamp/unclamp positions)
13	Transportation of Spindle to and fro From BHEL R.C.Puram
14	Commissioning the repaired Spindle

Note: 1. All the replacements have to be one to one. Equivalent replacement will not be acceptable. All the replaced items shall be returned to BHEL, R.C.Puram along with the repaired spindles including damaged /worn parts, defective parts/bearings and copper windings (if applicable) etc.

2. Vendor to note that the Electrical connectors for Encoder and Analog sensors mounted on the motor spindle is to be supplied along with matching connector on the machine. The machine side connector should be supplied with rubber glands for protection against ingress of liquids/ mist comply.

3. Vendor shall attend the calls for repair during the warranty period and depute their servicing personnel within one week of the receipt of first intimation by BHEL.

4. Freight & transit insurance charges to and from BHEL, R.C.Puram shall be borne by the Vendor. Vendor shall collect the defective spindle from BHEL, R.C.Puram and deliver the repaired spindle to BHEL, R.C.Puram.

5. Supplier shall arrange for adequate protection and packing of the consignment so as to avoid loss and damage during transit and also take appropriate measures to prevent metal parts from rusting and Corrosion during transit. Handling instructions shall be clearly printed/painted on the packages. Each package should carry a detailed packing slip. Supplier shall be responsible for any loss/damage during transit due to defective/inadequate packing.

#### DISPATCH CRITERIA:

a) Pre dispatch inspection of the spindle after repair work will be carried out by BHEL representatives at the vendor's works to verify the proper functioning of spindles through trial run and witness the checking of run out, overheating if any, clamping force etc. (As per the test chart shown below)

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- i) Temperature within tolerance range at maximum rated speeds and load.
- ii) Run out of the spindles within the tolerance value.
- iii) Clamping force as per test chart of the spindles.
- iv) Feedback of the sensors within tolerance range for the positions of unclamp, clamp with tool and clamp without tool.
- v) Temperature sensor
- vi) Encoder signal level within the tolerance range
- b) Vendor shall invite BHEL representatives for carrying out pre dispatch inspection after the completion of the work. The vendor shall inform BHEL for pre dispatch inspection at least 7 days in advance. Deputed BHEL persons shall do pre acceptance of repaired spindle at vendor's work and give dispatch clearance.

#### ACCEPTANCE CRITERIA:

##### 1. Dispatch criteria and Commissioning

#### **1. TEMPERATURE MEASUREMENTS:**

Sl. No.	Running time (Mins)	Rotational Speed (rpm)	Temperature Pos. 1 (°C)	Temperature Pos. 2 (°C)	Temperature Pos. 3 (°C)	Room Temperature (20°C)
1	30	5000				
2	30	10000				
3	30	12000				
4	30	14000				
5	30	15000				

Maximum Acceptable Temperature-40 deg

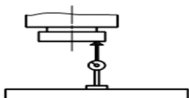
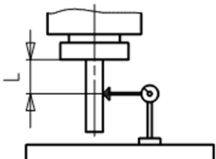
Pos1: At front bearings

Pos2: At middle of front and rear bearings

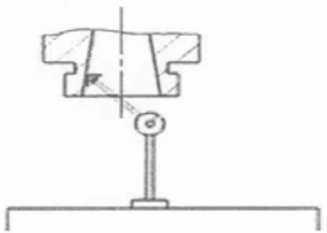
Pos3: At rear bearings

Motor winding Temperature should not exceed 55° C during above measurement.

#### **2. RUNOUT OF SPINDLES TEST CHART:**

SI No.		Description of test	Admissible deviation in microns	Measured value in microns
1		Flatness of spindlenose  Control movement by spindle rotation	2	
2		Run out of control arbor ( 300 mm) in spindle  Measurement at 200mm from gauge line	8	

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3		Runout of spindle taper Control movement by spindle rotation	6	
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**Note:** Max. permitted vibrations- 3 mm/s

### **3.CLAMPING FORCE TEST CHART**

Sl. No.	DESIRED VALUE OF CLAMPING FORCE	ACTUAL VALUE OF CLAMPING FORCE	REMARKS
1	20-22 KN(HX-253)		

### **4.TOOL CLAMP/UNCLAMP SIGNALS TEST CHART**

Sl. No.	Description	Desired Voltage	Tolerance	Achieved Voltage from sensor			Remarks
				Min.	Max.	Average	
1	Tool Unclamp	8.45 V	+0.4 V				
2	Clamped with tool	3.0 V	+/- 0.5 V				
3	Clamped without tool	1.04 V	+/- 0.1 V				

### **5.TEMPERATURE SENSOR READING**

Sl No.	Description	Desired Resistance	Actual Resistance	Remarks
1	KTY ( in encoder connector between pin no. 8 & 9)	540-610 ohm		

### **6.ENCODER SIGNALS TEST CHART**

Sl. No.	Description	Desired value	Tolerance	Actual	Remarks
1	No. of pulses between two reference marks ( both directions: Clockwise & Anticlockwise rotation of spindle)	256	NIL		
2	Peak to peak voltage	U/Ass=~1.1 V	0.95-1.2 V		
		U/Bss=~1.1 V	0.95-1.2 V		

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