

SPECIFICATION FOR DEVELOPMENT OF JOB CLAMPING CUM POSITIONING ARRANGEMENT FOR GUIDE VANES DURING HVOF COATING

SPECIFICATION NO.:- MTD-FBM-67-2010-304

1. GENERAL:-

Presently, the aerofoil section of the Hydro turbine guide vanes are required to be coated with HVOF coating to protect it from attrition due to continuous flow of water. For the same, no suitable positioning arrangement is available and the guide vanes are to be kept on V-blocks and its positioning is done, manually. As the guide vane blades are unbalanced, positioning it to any desired angle for coating, is difficult & time taking. Further, this bottleneck of guide vanes positioning to desired angle, limits the productivity of the HVOF coating Robotic facility at a very low level.

To provide mechanised positioning arrangement for guide vanes as well as providing locking of the same at any unbalanced position while retaining the guide vanes, securely, a job clamping cum positioning arrangement comprising of a Lathe based clamping / positioning arrangement is proposed to be developed. The system is proposed to be installed on a trolley cable driven trolley such that the system can be taken out of the HVOF plant for loading / unloading of the guide vanes. The proposed system once implemented would eliminate the need for manual positioning of the guide vanes and the same would be done by the flick of a push button, thus reducing operator's fatigue & waiting time.

2. CONFIGURATION (Ref. Drg. No.: 1-MTD-21-2331/2332):-

To create a new facility for guide vanes clamping & its positioning, it is proposed to provide a clamping, mechanised rotation as well as locking arrangement for the guide vanes at any unbalanced position while retaining the same securely in the chuck. The Headstock would comprise of a geared drive arrangement coupled to a spindle with a chuck at spindle end clamped on the simulated parallel T-slots of the mechanised trolley. Along the same centre line a Tailstock is clamped, using the same T-slots, for supporting the other end of the guide vanes. On the same T-slots two steadies would be provided for supporting the guide vanes on both the ends. The mechanized positioning arrangement would enable approximate angular positioning of the guide vane closed to desired angle & thereafter exact positioning angle would be attained by pinning.

The proposed system consists of developing a Lathe configuration based job clamping / positioning arrangement for facilitating quick clamping & positioning of the guide vanes for HVOF coating and holding the Guide vanes directly thru the shaft end. The proposed system is to be broadly in line with our **Drg. No.: 1-MTD-21-2331/2332**. The proposed system comprises of a clamping cum positioning arrangement with independent Headstock & Tailstock for clamping, indexing & locking of various sizes of guide vanes at any desired angular position for HVOF coating, two steadies supporting both the ends of the guide vanes. The above configuration is bolted to a pair of T-slots running across to full length of top plate of the mechanised trolley. The pitch of the T-slots is 280 mm and the size is 28 mm.

The arrangement comprises of a headstock with a 3/4 self-centring Jaw chuck of diameter around Ø 600 mm and the centreline of the same is to be at a height of around 600 mm from the trolley top. Since one end of job is having a circular keyway of dia 63 mm, a round key is to be bolted on one of the jaws. The headstock and tailstock are to be adjustable on the T-Slots on the trolley to accommodate the complete range of Guide vanes. For holding the guide vane, the tailstock is provided with a MT5 live centre. The Indexing drive arrangement is to be powered by a 3 HP, 1440 RPM motor with a gear box / geared motor. The control panel of the system is to be mounted on the headstock itself. The completely fabricated and machined guide vanes are to be placed on the steadies and held

between the two shaft ends projecting from both the ends thru centres. These are clamped by the chuck on the headstock so that the rotation can be imparted to the guide vanes. Once loaded between the headstock & tailstock, the guide vane is manipulated so that its positioning can be done & HVOF coating can be carried out. A locating pin arrangement is to be provided for locating the job at desired angle and it is to be interlocked with the indexing motor.

The trolley on which the above system is mounted broadly comprises of a suitable base trolley fabricated structure with wheels & axle, suitable bracketories for housing the complete drive system broadly in line with our Drg. No. 1-MTD-21-2332.

The drive system of the trolley includes a motor, a gearbox, chain & sprocket arrangement, spring operated cable reeling drum, control panel, control pendent etc. The power from the gearbox drive end is transmitted to the driven shaft via a chain & sprocket arrangement. The trolley is powered by a 3.0 HP rating geared motor for it's, to and fro movement. The supply voltage to the drive arrangement is to be AC 3Ø, 415 V. Since the trolley is to travel a distance of around 15 m the safety of the operators from electrical hazards has to be ensured, due to such high rating of the drive system. Hence, two transformers, of rating 3 KVA each, are to be installed into the electrical circuit. One of the transformers is to be installed at the starting point of the supply to Step Down the voltage from 415 V AC to 110 V AC. Thus, the cable meant for the power supply to the trolley would be supplying at 110 V AC, thus ensuring the safety of the operators. At the trolley's drive end, second transformer of similar rating, is to be installed to Step up the voltage to 415 V AC. The cable reeling drum is to be mounted on the trolley and its connector switch to be fixed near rails. The power from the power source is to be supplied to the Step Down transformer placed near the robot base from where the cable would be connected to the Cable reeling drum. An ICTP switch to be provided near the Step down transformer for power supply. The cable from the cable reeling drum would then be connected to the Step Up transformer mounted on the same platform of the drive unit of trolley. The cable then would be connected to the Drive input end. A separate control panel is required for the operation of the trolley is to be placed near the drive end of the trolley and control buttons to be provided on it. In addition to the control panel, 2 Nos of control pendants are to be provided to be mounted on the headstock itself, one for indexing drive arrangement and one for mechanised trolley. Two Limit switches are to be mounted on trolley on each side with dogs on the rails. A hole is to be drilled in the rail and a locating pin is to be provided on the trolley to lock the trolley. Further this locating pin to be interlocked with the trolley motor.

As the guide vanes are to be shot blasted & then HVOF coated on the same fixture, covering of all the parts viz, motors, control panel, chain sprockets, chains, etc is to be done suitably. Suitable covering is to be provided to the cable reeling drum and to the motor & gearbox of trolley.

Note: As the environment is very harsh, all the moving joints should be suitably sealed. Also all paint should be flame resistant.

3. JOB SPECIFICATION (Refer Drg. No.: 3-MTD-21-2345):-

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|---|------------------------|
| a) Max./Min. Guide Vanes length | ~ 3500 mm/1500 mm |
| b) Max. Weight of Guide vanes | ~ 2500 kgs. |
| c) Max./Min. Diameter of the Guide vanes shaft ends | ~ 270 mm/85 mm. |
| d) Material of Guide vanes | ~ MS Fabrication |
| e) HVOF Coating method | ~ Thru Robotic Welding |

4. PROPOSED SYSTEM DETAILS (Refer Drg. No.: 1-MTD-21-2331/2332):-

A) JOB CLAMPING & POSITIONING ARRANGEMENT:-

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| a) Type of construction | ~ Lathe type (with independent bolttable type Headstock & Tailstock) |
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- b) Headstock position ~ Clamped on a pair of common T-Slots on Trolley top.
- c) Tailstock position ~ Clamped on a pair of common T-Slots on Trolley top.
- d) Headstock & Tailstock adjustment ~ thru de-clamping from the T-Slot & positioning as per guide vanes batch length.
- e) Headstock Drive arrangement ~ 3 HP, 1440 RPM motor.
- f) Indexing arrangement ~ Thru a double reduction worm gearbox of gear ratio 1:1400 with pin based locking arrangement at headstock.
- g) Chuck Rotational/Indexing Speed ~ 1 RPM.
- h) Clamping arrangement ~ 3-Jaw Self-centring chuck on headstock & live centre on the tailstock. (Suitable to hold the shaft ends of guide vanes as stated above).
- i) Chuck Size ~ Ø 600 mm.
- j) Headstock Spindle Diameter ~ 150 mm.
- k) Centre Height from Trolley top ~ 600 mm
- l) Weight Capacity of arrangement ~ 4000 Kgs. (Excluding tare weight)

B) ROLLER STEADY: -

- a) No. of steadies - 02 Nos.
- b) Roller Dia. - 150 mm
- c) Roller width - 60 mm
- d) Roller sleeve - Gun metal sleeve is to be provided on the roller periphery so that the machined guide vane faces are not damaged.
- e) Centre distance between roller - 200 mm (Fixed)
- f) Max. Centre Height of rollers ~ 875 mm (From Rails top)
- g) Height adjustment of rollers - Thru a screw jack manually adjustable.
- h) Screw jack available adjustment stroke - 200 mm
- i) Rollers adjustment on the T-slots - Manually pushing the same & clamping thru T-nuts.

C) MECHANISED TROLLEY:-

- a) Load Capacity ~ 10 T (Excluding Tare Weight)
- b) Trolley Size ~ 5000 mm x 1000 mm
- c) Rail gauge - 3880 mm (Inside to inside distance)
- d) No. of axles - 01
- e) No. of wheels - 04
- f) Trolley height from the ground level ~ 300 mm
- g) Trolley travel - 15 m
- h) Speed of the trolley - 6 m/min.
- i) Geared motor - 3 Φ, 3.0 HP, Input RPM-750, Output RPM-15
- j) Suitable hooters are to be provided for the safety of the operators & trolley.
- k) A suitable Cable Reeling Drum mechanism comprising of spring loaded cable drum with winding / unwinding capacity of 15 m cable / 20 m cable is to be mounted in the trolley.
- l) 2 Limit switches to be mounted on trolley with dogs on the rails.

5. MAKE OF B.O. ITEMS:-

- a) Make of bearings – FAG/SKF only.
- b) Make of couplings – Fenner/Rollex/Equvit.
- c) Make of Chuck – GMT/Airtech/Parco/Equvit.
- d) Gearbox / Geared motor – Bonfiglioli / Elecon / Radicon only
- e) Make of motor – Bharat Bijlee / ABB / Siemens only.
- f) Electrical control elements – Siemens only

g) Make of chain / sprockets - Rollon / Rolkobo / Diamond

6. SCOPE OF SUPPLY:-

- a) Guide vanes clamping cum positioning arrangement as per our specification to meet our requirements and complete with Job clamping & indexing Lathe type arrangement with 1 No of Headstock & 1 No. of Tailstock arrangement, 1 No. of steady etc as per our Specification No.: MTD-FBM-67-2010-304. – 2 Lots
- b) Mechanised trolley with drive arrangement, cable reeling drum, step up & step down transformers, etc as per our Specification No.: MTD-FBM-67-2010-304. – 1 Lot
- c) Control Panel & Control Pendant for indexing arrangement – 2 Nos. each
- d) Control Panel & Control Pendant for trolley – 1 No. each
- e) Operation & Maintenance Manuals. – 4 Sets.
- f) Test & Guarantee Certificates. – 4 Sets.
- g) Erection, Commissioning and proving on actual jobs.

N.B.:- All the fabricated parts and brackets used in the system should be made out of structural steel. Motor control circuit elements such as contactors, relays, fuses etc to be of Siemens make. Limit switches to be from Siemens / Bhartiya Cutler Hammer. All the bearings required in the system should be of self-aligned type and to be life lubricated of SKF/FAG make only.

7. CONTROLS:-

All controls should be available on an operator's Control Pendant suitably located on the Lathe headstock & to be of a small sized box so that there is a flexibility to operate the Spindle from ergonomically convenient place. The control pendant should have the controls of Headstock CLOCKWISE/ANTI-CLOCKWISE Positioning, Emergency Stop, etc.

The Control Pendant should also have controls for trolley forward / reverse /emergency stop, MCBs/ICTP switch, etc. They should have suitable name plates so that the operator understands the functions of each switch.

8. DESIGN:-

Design of the system should be according to the latest standards keeping latest trends and developments in mind. Manufacturer may examine the existing Guide vanes HVOF coating process and should design the system after seeing the site conditions. Before taking up manufacturing, the manufacturer should get the G.A. Drawing of their proposed system duly concurred by us. However, the responsibility of proving the system on our actual jobs would lie with the manufacturer.

9. LUBRICATION:-

Suitable arrangement for lubrication is necessary. Provision is to be made for the above by providing nipples etc. at strategic places wherever required.

10. ELECTRICALS:-

All electricals should have suitable safety devices such as Thermal / Overload trip devices, Current limiting devices, Electronic shear pin, Fuses, etc. Electrical power supply available is 415 V, 3Ø, 3 wire only at 50 Hz. (No neutral is available). Hence, if there's any requirement of 220 / 110 Volts, suitable transformers may be incorporated.

All wiring to be suitably numbered / ferruled for easy maintenance. All electrical components should be of Siemens make only.

ICTP to be included in the Pendent as the supply shall be given at this point. Cable from supply point to ICTP on Pendent shall be in BHEL scope. All other cabling / wiring is to be done by the supplier.

11. SPARES:-

Necessary spares such as bearings, couplings, pinions, a set of worm & worm wheels and other items for successful running of system for at least 2 years should be quoted separately.

12. PAINTING:-

The Complete System is to be painted after Red oxide primer. The job clamping / indexing Lathe type arrangement is to be painted in opolean green colour & the trolley is to be painted in bright yellow & black strips, as per industrial norms. Paint used is to be fire resistant.

13. GUARANTEE:-

The system should be guaranteed for successful and reliable performance and for free replacement of faulty material or components / defective workmanship for a period of 12 months from the date of commissioning.

14. SAFETY:-

Structure should be stable and should not fall / collapse / bulge causing any harm to the surroundings. Wherever desirable edges should be strengthened and rounded to remove sharpness. The system should be provided with suitable safety devices to guard the system from any damage and also for the safety of the operator. Relevant safety standards are to be followed. Testing of the system under test load is to be demonstrated during inspection.

15. INSPECTION & SYSTEM CHECKS:-

Inspection of the system will be carried out at the manufacturer's works prior to dispatch of the system for satisfactory performance of the system and for the accuracies mentioned in this specification. Broadly following items shall be checked before despatch:

(a) Scope of Supply. (b) Make / Rating of all BO components such as Motor / Gearbox / Chains etc. (c) Workmanship. (d) Ergonomics. (e) Structural Stability. (f) Joint Strength. (g) Maintainability. (h) Controller Layout / Components used / Tolerance level built-in. (i) Dimensional checks. (j) Load / No-load trials as far as possible.

16. LITERATURE:-

Four copies of Operation & Maintenance manuals, Test & Guarantee Certificates, General Arrangement drawings, Electrical circuit diagrams, Lubrication charts are to be supplied with the system.

17. INSTALLATION, COMMISSIONING AND PROVING FOR PERFORMANCE:-

The installation, commissioning and proving of the system for desired performance on our actual jobs is to be done by the supplier at our works. Supplier may quote charges for the above separately.

Manufacturer should comply with the following during Erection, Commissioning and Proving:-

- (a) Experienced & qualified team headed by a team leader fully conversant with the work scope should only be deputed. Labours, if required should be brought or arranged locally.
- (b) E & C work has to be completed in one go except where it is agreed with mutual consent.
- (c) Drawings related to civil work should be sent to BHEL atleast 8 weeks in advance.
- (d) Any help required from BHEL during E & C has to be indicated in the offer itself. Except where agreed, rest has to be organised by the manufacturer should arrange required hand tools etc.
- (e) Manufacturer's team is required to comply with general discipline, industrial safety rules and workshop norms while doing the work. Any work with safety hazards etc should not be done in any case. No work should be done without proper authorization or permission.

18. DETAILS TO BE INCLUDED WITH THE OFFER:-

Following details must be supplied with the offer:-

- a) Only parties having atleast one year of experience of supplying similar indexing positioners / manipulators upto a job holding capacity of 4 tons need to quote.
- b) Full technical details / specifications, general arrangement drawing, electrical schematics, etc.
- c) Control diagrams illustrating construction of the system / equipment.
- d) Material specifications which are used in the manufacturing of the equipment.
- e) Overall dimensions and space requirements.
- f) Power and compressed requirements.
- g) List of customers to whom similar / identical system / equipment have been supplied.
- h) Point wise reply to each & every point of our specification is a must. If not complied, your offer will not be considered.

19. OTHER UTILITIES AVAILABLE WITH BHEL-BHOPAL:-

Compressed air available at 4 Kg / Sq. cm (Max.) and regular water supply.

20. AMBIENT CONDITION & TROPICALISATION:-

All electronic components should be tropicalised to withstand environmental temperature variation from 4 ° C to 50° C and Relative Humidity variation from 5% to 95 %.

21. STRESS RELIEVING OF ALL FABRICATED ITEMS:-

All fabricated basketries are to be Stress relieved.

22. MATERIAL & HEAT TREATMENT FOR MAJOR COMPONENTS:-

All wear components (in motion) needs to be properly Heat treated for maximum durability.

23. TRAINING:-

Training should be imparted to our Operators and Maintenance people for 4 - 5 days so that they should be in a position to run / maintain the system, independently.

