COMPLETE PACKAGE SOLUTION FOR EJECTOR DRILLING & COUNTERBORING BORING FOR DEEP BORES OF FINISH DIA 110MM

Scope: **Supply & Establishment a complete package solution for ejector drilling and counterboring operations in deep bores with a finish diameter of 110mm, achieving exceptional precision and dimensional accuracy. The scope of work includes the supply and establishment of necessary ejector and counter boring heads, consumables, and spares for rough drilling and finish counter boring operations in Valve Covers of Steam Turbines, specifically on CNC Lathes with a Swing Over Carriage (SOC) of 1100mm and a center distance of 1500mm.**

Figure 1: Ejector and Finish Counter Boring Heads

Component Details:

Component Name: Valve Cover
Drawing Number:0-11223-30001

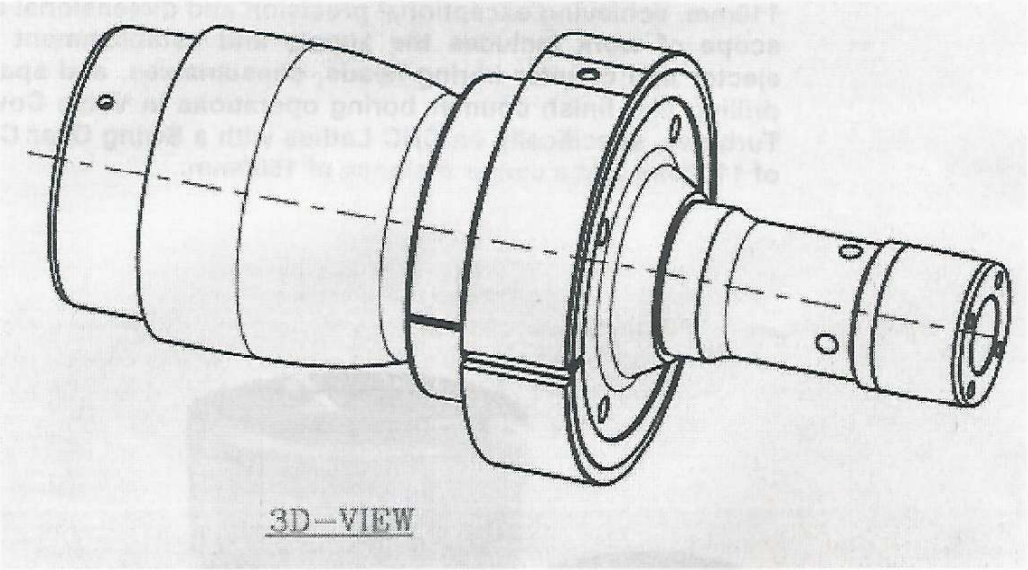

Figure 2: Valve Cover 3-D View

Blank & Material Properties of Valve Cover:

Rough machined casting of Valve Cover, including pre-requisite semi-finish/finish machining operations such as the front reference face of the bore and steady supporting diameter, will be provided. These machining operations are necessary to prepare the Valve Cover for ejector drilling and counter boring operations on the CNC Lathe.

The component in focus is the Valve Cover, identified by Drawing Number: 0-11223-30001. This rough machined casting is made of G17CrMoV5-10 material grade steel, possessing exceptional mechanical properties. The material has a 0.2% proof stress of ≥ 440 N/Sq.mm, ultimate tensile strength (UTS) of 590-780 N/Sq.mm, %El (l=5d) of ≥ 15%, %Ra of ≥ 40%, and impact strength of ≥ 27J.

The chemical composition, as per EN 10213, includes precise percentages of various elements to ensure the desired material characteristics.
C 0.15 - 0.20%, P ≤ 0.02%, Mo 0.90 - 1.10%, Sn ≤ 0.025%, Al ≤ 0.04%, Si ≤ 0.6%, S ≤ 0.015%, V ≤ 0.2-0.3%, Cu ≤ 0.3%, Mn 0.5-0.9%, Cr 1.2-1.5%, Ni ≤ 0.7, Ti ≤ 0.025%

Operations to be performed & Job Setup:

The operations to be performed exclusively entail ejector drilling and finish counterboring of the deep bore with a diameter of 110mm (with a tolerance of 0.0 to 0.036mm) in the Valve Cover. These operations encompass the complete transformation of the rough solid blank into the desired finished bore, strictly adhering to the specifications and requirements depicted in the engineering drawings. No additional turning, milling, or drilling operations are to be considered.

The Valve Cover will be clamped in the chuck with a diameter of 448mm, while steady (roller type) support will be provided at the flange diameter of 617mm. This setup allows for the machining of the through bore with a diameter of 110mm+0.035mm and a length of 910mm. The desired surface finish within the range of 0.8-1.6µ Ra, devoid of any chatter or line marks, will be achieved. Furthermore, the straightness of the bore will be maintained within 0.02mm, with an ovality and run-out not exceeding 0.02mm throughout the total length of the bore.

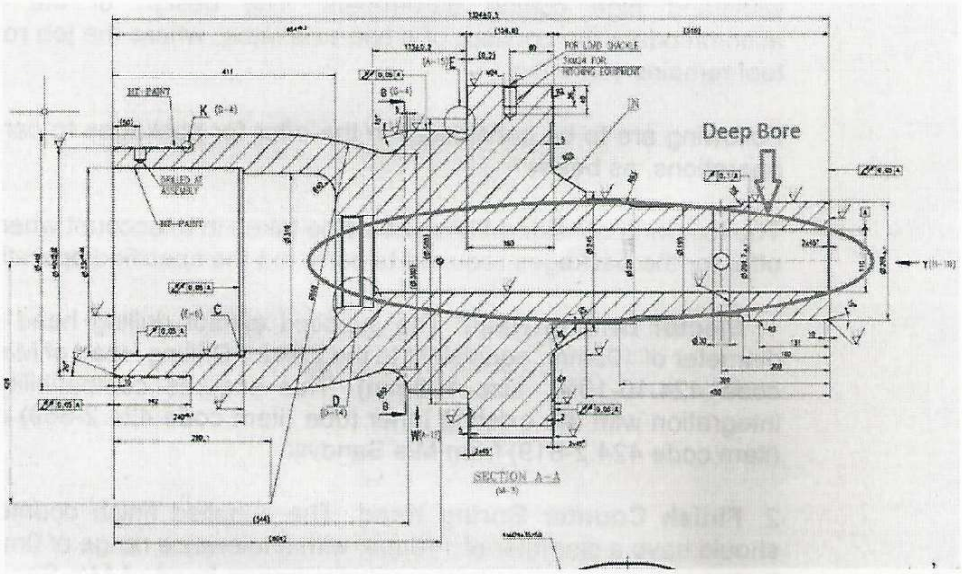

Figure 3: Valve Cover Machining Details

Machines Specifications:

The complete machining process will be performed on the CNC Lathe SOC 1100mm, manufactured by M/s Kartsu Japan, utilizing the CNC programs provided by BHEL. These programs will be developed based on the inputs provided by the vendor. The CNC Lathe possesses significant specifications, including:

- Make: M/s Kartsu Japan
- Swing Over Carriage (SOC): 1100mm
- Center Distance: 4500mm

- Max. Weight of Work-piece: 15000kg
- Chucking Diameters: 100-1000mm
- Available RPM: 320 in two steps
- Spindle Power (Main Drive): 75kw
- Coolant Type: High Pressure Oil Coolant
- Coolant Pressure: 12kg/cm2 or 11.5bar
- Coolant Flow: 200 l/min.

These specifications ensure the machine is capability to handle the complex machining operations required for the Valve Cover with precision and efficiency.

Ejector Head & Counter Boring Head:

The supplied ejector drilling head and finish counter boring head are required to seamlessly integrate with the inner tube of the existing drilling system by M/s Sandvik, which is available at BHEL. These heads should be equipped with indexable carbide inserts, featuring appropriate grade and geometry to withstand high cutting parameters. The design of the heads should accommodate the concept of a two-axis lathe, where the job rotates while the tool remains stationary.

Following are to be considered in the offer for packages to carryout specified operations, as below:

The following considerations should be taken in to account when preparing the offer for the packages required to carry out the specified operations:

1. **Ejector Drilling Head**: The supplied ejector drilling head should have a diameter of 105mm, equivalent to the Ejector Drilling Head of M/s Sandvik (item code 424.10-1050, size 105mm). This ensures compatibility or seamless integration with the existing Inner tube (item code 424.2-869) and Outer tube (item code 424.2-819) from M/s Sandvik.

2. **Finish Counter Boring Head**: The supplied finish counter boring head should have a diameter of 110mm, with a tolerance range of 0mm to 0.036mm. It should be equivalent to the counter boring head of M/s Sandvik (item code 424.31F, size 110.00mm), This ensures compatibility or seamless integration with the existing Inner tube (item code 424.2-869) and Outer tube (item code 424.2-819) from M/s Sandvik.

3. **Required Items**: Any additional items necessary to set up the supplied heads for the required operations should be included in the offer by the vendor.

4. **Coolant Provision**: The vendor should ensure provisions for the reach of flood coolant up to the cutting point and smooth exit/flow of chips during machining with the offered heads. Any materials required for this purpose should be included in the vendor's offer.

By considering these factors and incorporating them into the offer, the vendor can provide a comprehensive solution that meets the specified machining requirements for the Valve Cover.

Machining Strategy:

1. The precision engineering process begins with rough machining, focusing on creating a deep bore with a diameter of 105mm. This remarkable task necessitates the utilization of the vendor-supplied ejector drilling head. By meticulously following the cutting parameters provided by the vendor, the machining process commences, achieving a length of 900mm in a single pass.

2. Upon completing the roughing stage, the finish counter boring operation begins. The ejector drilling head is replaced with the vendor-supplied finish counter boring head, featuring a diameter of 110mm (with a tolerance range of 0mm to 0.036mm). This finishing task also involves a single pass, targeting a length of 900mm, while achieving precise dimensions and exceptional accuracy.

3. Throughout this endeavor, the expertise and support of BHEL's NC Technology department will complement the vendor's proficiency. BHEL's NC Technology team will provide comprehensive programming assistance, utilizing their profound knowledge and exceptional programming skills, to aid the vendor in optimizing the machining process.

Scope of Supply:

Sl. No.	Items (Description)	Quantity
1	Ejector Drilling Head (Dia 105mm)	2 No's
2	Finish Counter Boring Head (Dia 110mm with max tolerance 0.036mm)	2 No's
3	Inserts (All type like Center insert, Peripheral insert etc.	25 No's each type
4	Spares (Support Pads, screws, cartridges etc.)	15 No's of each type
5	Torque Wrench or Key	6 No's of each type

Sample Acceptance Criterion:

The sample acceptance criteria are outlined as follows:

a. Integration Assurance: The Drilling Head and Finish Counter Boring Head must seamlessly integrate with the inner tube (item code 424.2-869) and outer tube (item code 424.2-819) of the existing drilling system from M/s Sandvik.

b. Rough Machining - Drilling Head (Dia 105mm): The sample ejector drill head should successfully execute rough machining of minimum 1 number of deep

bores with a diameter of 105mm. This machining should occur in a single stock of length 910mm without any failures.

c. Finish Machining - Counter Boring Head (Dia 110mm): The sample finish counter boring head should successfully accomplish finish machining of minimum 1 number of deep bores with a diameter of 110mm. This machining should meet the desired accuracies and finish standards as mentioned above, all within a single stock of length 910mm without any failures.

Other Conditions:

1. Vendors are required to offer package solution, as recommended by them for complete machining of bore (one Valve Cover, as mentioned above).

2. Successful bidder shall have to supply advance sample containing 1 No's of Ejector Drilling Head (Dia 105mm), 1 No's of Finish Counter Boring Head (Dia 110mm with max tolerance 0.036mm), 5 No's of inserts of each type, 5 No's of Spares of each type and 1 No's of Torque Wrench or Key of each type on returnable bases for finishing minimum one number of deep bores of desired size with desired tolerance and drawing accuracies within 2 months after placement of PO for evaluation of their product.

3. In case, the sample do not confirm the sample acceptance criteria, BHEL at its discretion may call for fresh sample for approval or may terminate the contract after notifying the deviations to the seller. Also, in case of termination of contract, no payment shall be made for any supplied item consumed or damaged during sample acceptance trial machining.

4. In case of sample does conform the acceptance criteria & BHEL approval, the vendor shall supply PO items as pe scope on the basis of successful or established sample tool/consumables supplied by them during above successful acceptance trial.

5. The vendor is advised to keep alternate sample/ part of sample ready with them for supplying, if required, for successful establishment of tooling package as per tender scope to avoid any holdup. It may be noted that the delivery period may be extended/re-fixed for the period taken for sample approval by BHEL after submission of sample by vendor.

6. Total solution/package shall be purchased from single vendor.

7. If the vendor deems it necessary to replace or add any tools/items for the successful establishment of the required machining, they should do so without any financial implications for BHEL.

8. In case, vendor requires any clarification, they may discuss with BHEL for any clarifications prior to submission of their offer to avoid any gaps at later stage for which BHEL shall not be responsible.

9. In case of order, vendor shall be required to explain and discuss complete process of machining using offered tools to enable BHEL to prepare new / modify existing CNC programs, prior to delivery of tools, to suit the process recommended by vendor.

10. During implementation, if the process and tools recommended by the L1 vendor cannot be successfully established in one go without interruption, the vendor will be given a maximum of two additional chances to improve and achieve uninterrupted machining. If necessary, tool/insert grade replacements or additions should be made by the vendor without any financial implications for BHEL. However, failure to achieve the required results even after the third chance will result in the tender being dropped, and the failed vendor will be disqualified from participating in subsequent tenders for similar developmental work.

11. The machine's broad specifications have been mentioned above. Vendors should ensure the use of optimal cutting parameters within the specified machine parameters. The suitability of the tools for the intended application will be checked and verified during technical scrutiny and actual use.

12. Payment for the complete package solution for machining the bore in the Valve Cover will be subject to the delivery of complete scope and the successful establishment of the package solution by performing rough and finish drilling and boring operations in Valve Covers, achieving the specified requirements, accuracies, and surface finish, as detailed above, on the CNC Lathe available at BHEL, Haridwar.

13. The offer should be complete having technical specifications of each item used in package (tools, consumables, spares etc.) with their unit cost and quantity recommended by vendors for complete machining with their technical details for complete machining, detail/sequence of machining process, time-study showing tool-wise cutting parameters and machining time etc. All details should be supported by sufficient drawings/sketches/catalogue pages etc. for clear understanding of the offer by BHEL. Maximum weight, length & diameter of the offered tools should be informed.