

Process Control Document (PCD) for Forging

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Note / Disclaimer:

- (i) This Process Control Document template is applicable for Closed die forging/open die forging/Isothermal forging/Ring rolling components.
- (ii) If any details under the above headings/contents is IPR of the company, then an Internal control document shall be prepared and authenticated for those details by the company and the Internal document reference shall be mentioned in this Process control document (PCD).
- (iii)CEMILAC/RCMA has the authority to delete or add /seek any relevant details as part of this PCD as per requirement.
- (iv)This Document contains information pertinent to <company> unauthorized copy is strictly prohibited Any error or discrepancy in the process control document shall be the responsibility of the development agency (company name)
- 1. SCOPE:

This document covers the method of manufacturing and process for forging of part

name part No.----- and Drawing No. is-----

This document issued and controlled by------

PART PHOTO & PART DETAILS:

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Part name	
Forging drg. No.	
Customer part. No.	
Forging stock specification	
Forging specification	
Overall dimension	
Supply condition	
Final heat treatment	
Project	
Manufacturing process	Open die Forging/Closed die Forging/Isothermal Forging/Ring Rolling

2. OVERVIEW OF PROCESS:

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3. PROJECT DESCRIPTION:

4. PART APPLICATION:

5. RAW MATERIAL:

Purchased to forging stock specifications as specified in Test schedule from the imported source list or Indian suppliers with LOA/ Provisional clearance / Type approval in compliance with IMTAR 21.

- Source list
- Stockist list

6. RAW MATERIAL PREPARATION:

- a. Identification of forging stock material as per material specification.
- b. Mill Test Certificate shall contain COC and TRC for imported sources. Indian source should have LOA/ otherwise follow IMTAR-21 latest version.
- c. Reference Bar Stock size dimensions as shown in below figure
 Tolerance: ± on Diameter and Length

Length (mm) =



Diameter (mm)=

Alternate Bar Stock (if used)

Any other Diameter of bar can be used with following any of the methods to reach the reference bar stock size.

a) Drawdown/ upset Operation.

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- b) Turning operation to reduce diameter.
- c) Cutting and turning operation to reduce the diameter.
- d) In the case of pre forming operation (to make a pre-form) existing before final forging, the proposed alternate bar stock can be directly forged to the desired size without affecting grain flow. The Volume requirement of the forging shall be met by the alternative bar stock.
- e) Length (mm), Diameter (mm) after the above operation------

7. UPSETTING:

Upset forging involves increasing the cross – section of a material at the expense of its corresponding length. Essentially a process for enlarging and reshaping some of the cross-sectional area of a bar, tube, or other product form of uniform section.

- a. Cut Billet is heated to ****** Electrical Resistance Furnace, Furnace calibration as per AMS 2750D furnace with *** temperature tolerance.
- b. Cooling rate
- c. Soaking time:
- d. Forging equipment details:
- e. No. of heats:
- f. Die temperature:
- g. Die material:

AFTER UPSETTING PHOTO/SKETCH

8. OPEN DIE FORGING / CLOSED DIE FORGING / ROLLING:

Die forging, is the shaping of hot metal completely within the walls or cavities of two dies that come together to enclose the work piece on all sides. The impression for the forging can be entirely in either die or can be divided between the top and bottom dies.

- a. Length of Bar stock:
- b. Diameter of the bar stock:
- c. Forging heating furnace details
- d. Capacity of the heating furnace
- e. Type of furnace
- f. Heating rate:

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- g. Heating time:
- h. Soaking time:
- i. Forging temperature:
- j. Forging equipment details
- k. Type of forging equipment /Type of press:
- I. Capacity of the forging equipment
- m. Mechanism of operation
- n. Load/Pressure/force:
- o. Die pre heat temperature:
- p. Type of die heating
- q. Die pre heat time
- r. Die material:
- s. Lubricant details:
- t. No. of heats:
- u. Strain rate:
- v. Deformation rate / Speed
- w. Forging ratio:
- x. Tooling and equipment:
- y. Forging Volume
- z. Billet volume required
- aa. Die closing tolerance

For Ring Rolling

- 1. Heat of deformation,
- 2. Roll force
- 3. Coefficient of heat transfer
- 4. Rolling speed
- 5. Roll diameter
- 6. Reduction (%)
- 7. Rolling equipment details

PHOTO/SKETCH AFTER 1ST HEAT

9. FLASH CUTTING:

Machine used for flash cutting: Band saw/ Water jet cutting/ Wire cutting/ Trimming/ Turning.

- a. Band saw Machine Process Parameters:
- b. Water jet cutting machine Process Parameters: Ex. Pressure of ------ bar.

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- c. Wire cutting machine Process Parameters: Ex. The electrode used is a piece of copper wire.
- d. Trimming machine Process Parameters:
- e. Turning machine Process Parameters:

10. HEAT TREATMENT PROCESS:

a. Heating Furnace: Electrical Resistance Furnace, Furnace calibration as per AMS 2750 and Class 4 furnace with ****C temperature tolerance.

b. Heat treatment cycle followed is as follows-

Full Batch + Cut part + Test bar

- Furnace details (type, tolerance, calibration)
- Type of heat treatment process solutionizing, ageing details
- Heating rate
- Duration/soaking time
- Temperature range
- Quenching process details (quenching medium, quench delay, cooling rate and associated details)

11. MACHINING:

- a. Plant: Lathe / CNC machine etc.
- b. Plant Specification:

12. SHOT BLASTING:

Shot blasting is a method of resurfacing process used to clean, remove irregularities, strengthen (peen) or polish metal. It is a mechanical method of propelling abrasive using a centrifugal wheel to remove surface and other impurities from the surface of forgings.

Generally, blasting prior to finishing serves three primary purposes: -

- a. It cleans and descales surfaces
- b. Adds texture to enhance paint adhesion

c. Properly reduces maintenance costs by increasing coating life

Shot size used is ------ mm, Pressure maintained is ------bar.

Add plant details:

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13. PROCESS COMPLIANCE CHECK POINTS:

PROCESS PARAMETERS	ACCEPTANCE CRITERIA
For ex: Forging temperature	400-430 deg C
Heat treatment cycle	
Soaking time	
Load/pressure	

14. FINAL INSPECTION:

15. PART IDENTIFICATION, TEMPORARY COATING & PACKING:

The part shall be identified in accordance with IMTAR 21 subpart C3.

The part shall be packed in such a way to prevent any damage or corrosion from occurring while handling, transportation, and storage. Each individual package of the part shall be provided with the outside marking ensuring traceability.

Temporary coating, has been used for corrosion inhibition against aggressive media and is very powerful in waterproofing metals.

Lanolin coating is applied to surface of finished forgings to be rust-protected by forming a thick and durable anti-corrosive layer helping with rust prevention. The forged parts are dispatched to stores.

• NOTE:

THIS DOCUMENT IS A GUIDANCE DOCUMENT. APPLICABLE SECTION/ TABLE ROWS MAY BE CONSIDERED. ANY ADDITIONAL DETAILS MAY BE ADDED. ANY NOT APPLICABLE SECTION/ TABLE ROWS MAY BE DELETED. THE TEMPLATE IS VERY GENERAL AND VARY WITH MATERIAL CLASS TO CLASS AND/OR GRADE TO GRADE, PROCESS TO PROCESS, DEVELOPMENT AGENCY PROCESS PLANT AND EQUIPMENTS. THE PROCESS CONTROL DOCUMENT MAY BE FINETUNED WITH THE TAA BEFORE LTCC BASED ON MATERIAL, APPLICATION AND EQUIPMENTS.

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