

 Ranipet	Technical Delivery Condition(TDC) For AP FAN BLADE SHAFT & FAN FORGINGS of 34 Cr M04 TQ + T of EN 10083 - 1 42 Cr M04 TQ + T of EN 10083 - 1	Doc Ref:	TDC : RTF : 309
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1.0 SCOPE

- 1.1 This TDC specifies the requirements for the supply of Proof machined Forgings for use as AP fan blade shaft & Fan forgings.

2.0 MATERIAL AND PROCESS

- 2.1 The applicable specifications are:

SI.No. Specn & grade as per EN 10083-1 Equivalent as per JIS Q4105

- | | | |
|----|-----------------|---------|
| 1) | 34 Cr M04 TQ +T | SCM 435 |
| 2) | 42 Cr M04 TQ +T | SCM 440 |

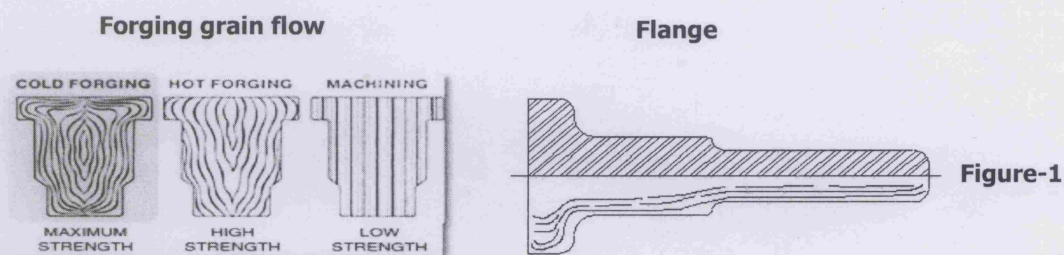
- 2.2 Applicable for new suppliers.

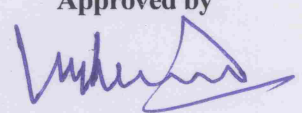
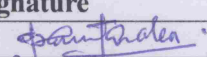
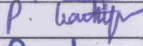
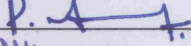
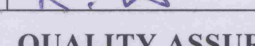
- 2.2.1 A sample shaft shall be manufactured for checking the flow lines and other Defects inline with ASTM E 381 and E 340 and for checking other requirements of this technical delivery conditions and shall be sent to BHEL for approval. The supplier shall start bulk production only after approval by BHEL.

- 2.3 Suggested Minimum forging reduction ratio of 4:1 from starting piece to finished forgings must be ensured.

- 2.3.1 The grain flow as shown in figure given below

L - Longitudinal specimen



Prepared by 	Reviewed by	signature	Approved by  (Head/QA)
	ENGG(Fans)		
	QC(Proc)		
	MPL		
	PUR		
Issued by	QA		
	QUALITY ASSURANCE		

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3.0 Chemical & Mechanical Properties:

3.1 **Material:** 34 CrMo4 TQ + T, Material No. 1.7220, EN 10083-1

As-received condition: Forged, quenched and tempered (+ QT);
Pre-machined according to the dimensions in the drawing of the purchaser, with appropriate allowance for final machining as specified below (CI No. 4.0), UT inspected and stress relieved.

3.1.1 **Chemical composition:** Chemical composition shall be checked for each melt and it shall be as per the specification.

Chemical composition as per EN:10083-3 (cast analysis)

C	Si Max.	Mn	P Max.	S Max.	Cr	Mo
0.30 to 0.37	0.4	0.60 to 0.90	0.025	0.035	0.90 to 1.20	0.15 to 0.30

3.1.2 **Mechanical properties:**

Diameter (mm)	UTS (MPa)	0.2 % Yield Strength	% Elongation	Impact (In Joules ISO-V specimen)
40-100	800-900	550	14	45
100-160	750-900	500	15	45
160-250	700-850	450	15	45

3.2 **Material:** 42 Cr Mo 4 TQ + T, Material No. 1.7225, EN 10083-1

As-received condition: Forged, quenched and tempered (+ QT);
Pre-machined according to the dimensions in the drawing of the purchaser, with appropriate allowance for final machining as specified below (CI No. 4.0), UT inspected and stress relieved.

3.2.1 **Chemical composition:** Weight in %, as per EN: 10083-3 (cast analysis)

C	Si Max.	Mn	P Max.	S Max.	Cr	Mo
0.38 to 0.45	0.4	0.60 to 0.90	0.025	0.035	0.90 to 1.20	0.15 to 0.30

3.2.2 **Mechanical properties:** To be determined on longitudinal (L) or transverse (T) specimens at room temperature except for the impact energy, which shall be determined at -20°C.

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For forgings and rolled stock	For product thickness in [mm]			
	up to 100	101 – 250	251 – 500	501 – 750
Yield point $R_{p0.2}$ min [N/mm ²]	650	500	460	390
Tensile strength R_m [N/mm ²]	900 – 1100	750 – 950	690 – 840	590 – 740
Fracture elongation A_{min} [%]	L 12	13	15	16
	T 10	10	11	12
Impact energy KV_{min} on ISO-V specimen at $-20^{\circ}C$ [J = Nm]	28	27	26	25
Brinell hardness	265 – 330	220 – 280	200 – 250	175 – 220

4.0 PRE-MACHINED CONDITION

After heat treatment, the part shall be pre-machined on all sides with the specified allowance for final machining.

The allowance shall be determined by the length as shown in the following table.

To achieve sufficient contact for the probes during the ultrasonic inspection, the surface of the forgings shall be pre-machined to a surface roughness of $R_z \leq 63$ [μm].

Length in [mm]	≤ 2000	2001 – 2500	2501 – 3000	> 3000
Cutting allowance DR in [mm]	5	6	7	8

5.0 HEAT TREATMENT

5.1 All the forgings shall be supplied in quenched and tempered condition (TQ + T condition).

6.0 TEST SAMPLE & MECHANICAL PROPERTIES

6.1 Testing of mechanical properties shall be by using specimen from finish heat treated shafts.
Specimen shall be taken at a depth of at least $1/4^{th}$ of diameter from surface.

6.2 Test specimens shall be selected melt wise and heat treatment lot wise.

6.3 The chemical and mechanical properties shall be as per tables as applicable.

7.0 NON-DESTRUCTIVE TESTING

7.1 Shafts shall be ultrasonically tested radially and axially as per ASTM A 388.

7.2 Acceptance criteria:

Forgings Length	Radial Scanning	Axial Scanning
≤ 1 meter	3 mm equivalent reflector size by DGS method	3 mm equivalent reflector size by DGS method
> 1 meter	3 mm equivalent reflector size by DGS method	One or more discontinuities resulting in complete loss of back wall reflection to 10% of the full scale height not attributing to geometric configuration when tested by back wall echo method are not acceptable.

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8.0 REPAIR

8.1 Repair involving fusion welding is prohibited.

9.0 IDENTIFICATION & PRESERVATION

9.1 All the forgings shall be packed in a box and box shall be identified with specification, melt no, suppliers emblem & P.O number. Rust preventive coat of dry resin type shall be applied on the blade shaft to avoid atmospheric corrosion.

10.0 INSPECTION & TEST CERTIFICATE

10.1 The items manufactured within India, shall be subjected to inspection by BHEL or authorised agency.

10.2 The supplier shall furnish the test certificate in English. It shall contain:-

- | | |
|-----------------------------|---|
| (a) PO and Date | (e) Heat treatment particulars |
| (b) Specification and grade | (f) Chemical composition- melt wise |
| (c) Size, No. and weight | (g) Mechanical properties- melt wise/heat treatment |
| (d) Melt no. | (h) Ultrasonic test report (CI No.7.0) |
| | (i) TDC No. |

Record of revisions

Rev No	Clause revised	Revision made	
00	--	Original issue	11.07.94
01	--	42CrMo4 TQ+T of EN 10083-4 is added Table for mechanical properties added for 34CrMo4 & 42CrMo4	30 06 96 -
02		Totally modified	02.05.02
03	3.2.2 3.1.1 & 3.2.1 7.2	1. 42CrMo4 latest Mechanical properties details added from TLT documents AM015, Drg. No. 4GK 8085d. 2. Chemical composition as per EN:10083- 3 for both materials 34 CrMo4 & 42CrMo4 added. 3. Acceptance criteria for UT updated.	06.08.14