TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATION FOR TITANIUM AND TITANIUM ALLOYS BILLETS OUTSOURCING

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Rev. 2	27/01/2012	*Introduction of changes in Chapters 4.4, 4.7 e 5*
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Chapter

1. Scope

The present Technical Specification defines requirements and delivery conditions required by TiFast for the outsourcing of Titanium and/or Titanium Alloy billets, provided by qualified suppliers, included in the TiFast List of Qualified Suppliers. The billets provided as per the present technical specification are intended to be rolled to bars at TiFast plant.

2. Standard References

- *Quality agreement* signed between the supplier and TiFast.
- EN 9100
- ISO 14001
- ASTM B348/348M
- AMS 4928
- AMS 4967
- AMS 6931
- ISO 5832-2
- ISO 5832-3
- EN 10204
- ETTC Pub. 2 Ed. 2
- ETTC 3
- AMS 2631
- AMS-STD-2154

Standards are intended in their latest version.

3. MATERIAL TO BE DELIVERED TO TIFAST

Is called “billet”, a round - section long product, obtained by conversion at high temperature of a feedstock of greater size, and generally devoted to be, in its turn, converted by hot rolling to bars at TiFast plant.

4. CHEMISTRY

The supplied material is included in the following Titanium grade as per international specification (see also § 2):

- Titanium Alloy 6Al – 4V (known also as Grade 5) as per ASTM B348/348M, AMS 4928, AMS 4967, AMS 6931 standards.

In case TiFast needed a special composition for alloys listed above (e.g. a special restriction on the concentration of one or more of alloying elements) or a

reference to a different standard(s), TiFast would timely communicate to the supplier the required alloy composition, referring to internal or international standards.

5. CONDITION OF DELIVERY FOR THE BILLETS

5.1 Origin of the billets and parent melt

The billet shall be originated by double melted ingot at least (e.g. double VAR remelted, EBCHR remelted + VAR remelted et cetera). The melting source and technology used to melt/remelt the parent ingot shall be previously approved by TiFast customers and specified in the Quality agreement signed with TiFast. No changes in the melting source and technology agreed upon is allowed without TiFast approval.

5.2 Surface finish

The billets are required to be delivered by the supplier with a surface machined by turning. No scale coat is allowed in any position of the billets. Roughness of the surface required is $R_a \leq 10$ microns.

Billets will be saw-cut (band saw, disc saw, etc., avoiding cutting wheel) at both extremities, and will not show any defect on the cut sections.

Longitudinal or transverse cracks are not acceptable. Local repairing of the surface, carried out by grinding, are allowed until less than 2 mm deep and accurately smoothed off. All the billets that after visual and/or dye penetrant inspection show cracks or defects, not compatible with the rolling process, will be rejected by TiFast.

5.3 Delivery dimensions

In the surface finish described above, the dimensions of the billets shall be:

- Section: circular.
- Diameter: 125 + 0 mm / - 2 mm;
- Length: 1350 mm minimum, 1550 mm maximum;

- Length's difference in the same lot: all the billets included in the same lot (i.e. from the same heat and produced in the same wroughing campaign) shall possess a length difference ≤ 80 mm (difference between the length of the longest billet and the length of the shortest billet).
- Camber (deviation from a straight line of the outer surface of the billet): maximum acceptable 2 mm on the basis of 1 m;
- Out of roundness: ≤ 2 mm.

5.4 Heat Treatment

No heat treatment is required.

5.5 Metallographic structure

The heating temperatures and the forming methods used in wroughing the billets shall be such to generate a small grained structure. In $\alpha + \beta$ Titanium alloys, the temperatures and reductions should lead to a, at least partially, globularized structure (α globules in a β matrix) or a structure with strongly deformed and distorted α laminae in a β matrix. In α Titanium alloys, the temperatures and reductions should lead to a globularized equiaxed structure (α globules).

The transformer is normally not required to analyze the structure of the billets.

The microstructure accepted by TiFast is:

- between B1 and B14 in ETTC Pub.2 Ed. 2;

The macrostructure normally accepted by TiFast is:

- between Level 10 Group B and Level 20 Group B in ETTC 3.

In case TiFast needed billets with a defined micro- and / or macrostructure, TiFast would timely communicate to the supplier the requirements and limits of acceptability on micro- and / or macrostructure, in case referring to internal or international standards.

5.6 Mechanical properties

No specific mechanical property or test is required.

5.7 Marking

The supplier shall mark the billets in a clear and univocal way with their identification codes, preferably by metal punching, and in any case with an indelible system.

The supplier shall take care to clearly identify in the packing list the same identification codes of the billets. The same codes will be referred to in the heat certificate supplied with the billets (see certification).

5.8 Non Destructive Testing (NDT)

The billets shall be checked for inner integrity via UT (Ultrasonic Testing) by the immersion or contact method as per AMS 2631 and /or AMS-STD-2154, in both cases with Acceptance Class A1 (or better). TiFast shall communicate the standard (or standards) required in the specific order.

The billets shall be checked for surface integrity via visual check and Dye penetrant test (either by fluorescent dye or by high-visibility color dye). No crack visible with the naked eye or detected by the Dye Penetrant test is allowed and in case it must be removed.

Should TiFast need the application of NDTs different by the ones quoted above, it shall timely communicate to the supplier the requirements and limits of acceptability on such NDTs, in case referring to internal or international standards.

5.9 Certification

The billets will be accompanied by a type 3.1 Certificate of Conformity (CoC), issued by the Quality Service of the supplier and compliant to EN 10204 containing the following data:

- Datum of issue;
- Name of the Supplier and its full address;
- Reference to TiFast order (order number and its datum);
- Heat number of the billets (heat number of the parent ingot) or equivalent identification code(s);
- Applied standard(s) including the revision year;

- Name(s) of the alloy as it appears on the applied standard(s) and in TiFast order;
- Chemical composition of the heat, analyzed in at least two points (e.g. TOP and BOTTOM of the ingot), with analysis of all the elements included in the applied standard(s);
- Nominal dimensions of the billets (diameter and length);
- Weight of the lot (all the billets together in the same lot);
- the name and country of the melting source;
- Any other data or reporting or certification explicitly required by TiFast (microstructure, macrostructure, NDTs, mechanical properties et cetera);
- Statement of conformity to the present Technical Specification;
- Statement that the material is radioactive – free (packaging material included).

5.10 Packaging

The billets will be delivered to TiFast duly packed in crates or fastened on wooden pallets. Other types of packaging are allowed upon agreement with TiFast.

6 ADDITIONAL NOTES

a) All the billets will be free of oil/lubricant contamination on the surfaces and accurately cleaned.

b) The billets (and packaging material) should be radioactive – free as detectable by the ordinary control systems (e.g. radio – control portal);

c) Should the supplier need any deviation or modification or addendum to the present Technical Specification, he will discuss the issue in advance with TiFast before delivering the material.

d) Should TiFast need any deviation or modification or addendum to the present Technical Specification, he will discuss the issue in advance with the supplier before the delivery of the material.

e) In case the alloy contains one or more of the “Conflict Metals” (Tantalum, Tin, Gold, Tungsten), the producer shall give TiFast the certification that such metals are from legitimate sources.