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Forgings, Titanium Alloys Heat-Treated, Finished-Part Properties: Short-Transverse Tensile, Fracture Toughness, and Longitudinal Time-Dependent-Tension 钛合金成品锻件热处理：短横向拉伸、断裂韧度和纵向时间张力（持久）			

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1. SCOPE范围

1.1 Form形式

This specification establishes requirements for titanium forgings of any shape or form from which finished parts are to be made. (See 8.2, 8.4.4, 8.6, and 8.7).

该规范规定了对于要制成成品部件的任何形状或形式的钛锻件的要求。（见8.2,8.4.4,8.6和8.7）。

1.2 Application: 应用:

These forgings are used typically in the manufacture of high-performance parts when control of short-transverse tensile, fracture toughness, tensile creep, or tensile rupture is required, but usage is not limited to such applications.

当需要控制短横向拉伸，断裂韧性，拉伸蠕变或拉伸断裂时，这些锻件通常用于制造高性能部件，但是使用不限于这些应用。

1.2.1 These forgings are to be manufactured in accordance with a documented process; product approval is based on first-article demonstrations of mechanical and microstructural properties in the heat-treat condition and section size of the finished part.

1.2.1这些锻件应根据记录的过程制造；产品批准是基于热处理条件下的机械和微结构性能以及成品零件的截面尺寸的第一篇论文。

1.2.2 Certain design and processing procedures may cause some of these products to become susceptible to stress-corrosion cracking after heat treatment; ARP982 recommends practices to minimize such conditions.

1.2.2某些设计和加工程序可能导致这些产品中的一些在热处理后容易发生应力腐蚀开裂; ARP982建议尽量减少这种情况。

1.3 Classification: 分类:

Forgings shall be of the following Grades as specified in the ordering data. (See 8.3). When no Grade is specified, Grade A shall apply.

锻件应具有订货数据中规定的以下等级。(参见8.3)。当未指定等级时,应适用A级。

1.3.1 Grade A: Acceptance tests include verification of room-temperature tensile properties and, when applicable, of room-temperature fracture toughness.

Preproduction testing includes verification of all applicable requirements.

1.3.1 A级: 验收试验包括室温拉伸性能和室温断裂韧性(如适用)的验证。生产测试包括所有适用要求的验证。

1.3.2 Grade B: Acceptance tests do not include verification of mechanical properties. Preproduction testing includes verification of all applicable requirements.

1.3.2 B级: 验收试验不包括机械性能验证。生产测试包括所有适用要求的验证。

2. APPLICABLE DOCUMENTS: 规范性引用文件:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

以下出版物以本文指定的程度形成本说明书的一部分。应适用最新版本的SAE出版物。其他出版物的适用问题应为采购订单之日生效的问题。

2.1 SAE Publications: SAE出版物:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

可从SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001获得。

AMS 2380 Approval and Control of Premium-Quality Titanium Alloys

高品质钛合金的批准和控制

AMS 2643 Structural Examination of Titanium Alloys

钛合金的结构检查

AMS 2801 Heat Treatment, Titanium Alloy Parts

热处理, 钛合金零件

AMS 2808 Identification, Forgings

鉴定, 锻件

ARP982 Minimizing Stress-Corrosion Cracking in Wrought Titanium Products

最小化加工钛产品中的应力腐蚀开裂

2.2 ASTM Publications: ASTM出版物:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

可从ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959获得。

ASTM E 8 Tension Testing of Metallic Materials

金属材料拉伸试验

ASTM E 8M Tension Testing of Metallic Materials (Metric)

金属材料拉力试验(公制)

ASTM E 21 Elevated Temperature Tension Tests of Metallic Materials

金属材料高温拉伸试验

ASTM E 139 Conducting Creep, Creep-rupture, and Stress-rupture Tests of Metallic Materials

进行金属材料的蠕变，蠕变断裂和应力断裂试验

ASTM E 292 Conducting Time-for-rupture Notch Tension Tests of Materials

材料的断裂开裂时间拉伸试验

ASTM E 399 Plane-Strain Fracture Toughness of Metallic Materials

平面应变金属材料的断裂韧性

ASTM E 1304 Plane-Strain (Chevron-Notch) Fracture Toughness of Metallic Materials

平面应变 (Chevron-Notch) 金属材料的断裂韧性

ASTM E 1447 Hydrogen Analysis

氢分析政府刊物:

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094

可从DODSSP订购服务台, 4D楼4D, Robbins Avenue, Philadelphia, PA 19111-5094

MIL-H-82100 Heat Treatment of Titanium and Titanium Alloys

MIL-H-82100钛和钛合金的热处理

MIL-STD-129 Marking for Shipment and Storage

MIL-STD-129标记装运和存储

3. TECHNICAL REQUIREMENTS: 技术要求:

3.1 Material: 材料:

Forgings shall be produced from forging stock that conforms to the material specification specified by the purchaser. (See 8.3 and Annex A).

锻件应由符合采购方规定的材料规格的锻件制成。(见8.3和附件A)。

3.2 Condition: 条件:

3.2.1 Physical: Forgings shall not be welded, shall have acceptance test tabs, and shall be supplied descaled and etched (3.5.1), with all acceptance-test tabs and test-material prolongations not consumed in predelivery testing in place. (See 8.4 and 8.5).

3.2.1物理: 锻件不应焊接, 应具有验收试验片, 并应提供除垢和腐蚀(3.5.1), 所有验收试验片和试验材料延长件在预输送试验中不消耗。(见8.4和8.5)。

3.2.2 As-Supplied Heat-Treat Condition: Forgings shall be supplied in the heat-treat condition specified by the material specification (3.1) unless otherwise specified on the drawing. (See 8.1 and 8.3).

3.2.2提供的热处理条件: 锻件应按照材料规范(3.1)规定的热处理条件供应, 除非图纸另有规定。(见8.1和8.3)。

3.3 Properties: 属性:

Test specimens, excepting those for macrostructure (3.3.2.2), shall conform to 4.3.4 and 4.3.5. 除了宏观结构(3.3.2.2)的试样外, 试样应符合4.3.4和4.3.5的规定。

3.3.1 Mechanical Properties: Mechanical properties shall conform to the requirements of the forgingstock material specification (3.1); if no such requirement exists, these properties shall be as specified by the purchaser. (See 8.1). Room-temperature tensile requirements (3.3.1.1.1) shall be applicable always; other mechanical

properties shall be applicable only when so specified by the purchaser. (See 8.1).

3.3.1 机械性能: 机械性能应符合锻造材料规范 (3.1) 的要求; 如果不存在这种要求, 则这些性能应符合买方的规定。(见8.1)。室温拉伸要求 (3.3.1.1.1) 应始终适用; 其他机械性能仅适用于购买者规定的情况。(见8.1)。

3.3.1.1 Tensile: The short-transverse test direction shall be applicable when $S_{final\ HT} > 1\ 1/2$ inches (38.1 mm); see Figure 1 for definition of $S_{final\ HT}$. The longitudinal test direction shall be applicable when $S_{final\ HT} < 1\ 1/2$ inches (38.1 mm). (See 8.4.1).

3.3.1.1 拉伸: 当 $S_{final\ HT} > 1\ 1/2$ 英寸 (38.1 mm) 时, 短横向试验方向应适用; 参见图1的 $S_{final\ HT}$ 的定义。当 $S_{final\ HT} < 1\ 1/2$ 英寸 (38.1 mm) 时, 纵向试验方向应适用。(见8.4.1)。

3.3.1.1.1 Room-Temperature: Room-temperature tensile properties shall be determined in accordance with ASTM E 8 or ASTM E 8M.

3.3.1.1.1 室温: 室温拉伸性能应根据 ASTM E 8 或 ASTM E 8M 测定。

3.3.1.1.2 Elevated-Temperature Tensile: Elevated-temperature tensile properties shall be determined in accordance with ASTM E 21.

3.3.1.1.2 高温拉伸: 高温拉伸性能应根据 ASTM E 21 测定。

3.3.1.2 Room-Temperature Fracture Toughness: Fracture toughness shall be determined either in accordance with ASTM E 399 using compact specimens or in accordance with ASTM E 1304 using short-rod or short-bar specimens provided that the required value of fracture-toughness is for the test method used. (See 8.1). Crack plane orientation, as defined in ASTM E 399, shall be “R-L” for round bars and hollow cylinders, “L-R” for upset discs, and “S-L” for all other shapes.

3.3.1.2 室温断裂韧性: 断裂韧性应根据 ASTM E 399 使用紧密试样或根据 ASTM E 1304 使用短棒或短棒试样测定, 条件是断裂韧性的要求值为 对于所使用的测试方法。(见 8.1)。如 ASTM E 399 中定义的裂纹平面取向对于圆棒和中空圆柱体应为 “R-L”, 对于锻圆盘为 “L-R”, 对于所有其它形状为 “S-L”。

3.3.1.3 Time-Dependent Tension: The testing direction shall be the longitudinal direction (See 8.4.1).

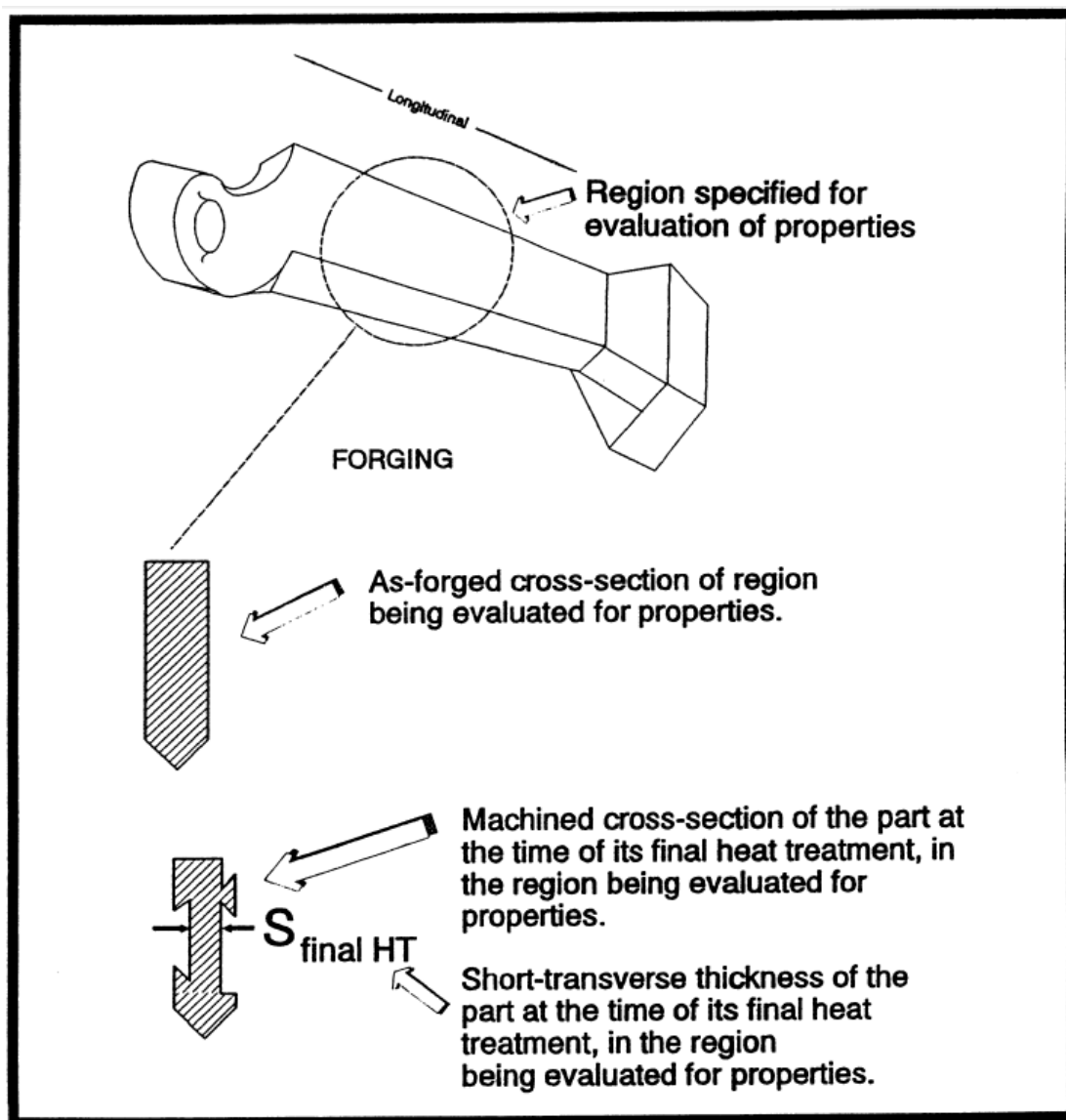
3.3.1.3 时间依赖性拉力: 试验方向应为纵向 (见8.4.1)。

3.3.1.3.1 Time-for-Rupture, Room-Temperature Tension: Time-for-rupture properties shall be determined in accordance with ASTM E 292. A standard cylindrical notched specimen shall be used.

3.3.1.3.1 断裂时间, 室温拉伸: 断裂时间应根据 ASTM E 292 确定。应使用标准的圆柱形缺口试样。

3.3.1.3.2 Creep, Creep-Rupture, and Stress-Rupture Tension Properties: Creep, creep-rupture, and stress-rupture tension properties at elevated temperatures shall be determined in accordance with ASTM E 139. For creep tests and for stress-rupture tests, either a standard cylindrical combination smooth-and-notched specimen conforming to ASTM E 292 or separate specimens, smooth and notched, machined from adjacent sections of the same specimen blank shall be used.

3.3.1.3.2 蠕变, 蠕变断裂和应力断裂拉伸性能: 高温下的蠕变, 蠕变断裂和应力断裂拉伸性能应根据 ASTM E 139 进行测定。对于蠕变试验和应力 - 断裂试验, 应使用符合 ASTM E 292 的标准圆柱组合平滑切口试样, 或使用同一试样坯料的相邻部分加工的平滑和缺口的单独试样。

FIGURE 1 - Definition of $S_{final\ HT}$ 图1 - $S_{final\ HT}$ 的定义

Longitudinal 纵

Region specified for evaluation of properties 指定用于评估属性的区域

Forging 锻造

As-forged cross-section of region being evaluated for properties

正在评估性质的区域的锻造横截面

Final HT 最终HT

Machined cross-section of the part at the time of its final heat treatment, in the region being evaluated for properties

在其最终热处理时，在被评估的性质的区域中的零件的加工横截面

Short-transverse thickness of the part at the time of its final heat treatment, in the region being evaluated for properties

在其最终热处理时，在被评估的性质的区域中的部件的短横向厚度

3.3.2 Metallurgical Structure: 显微组织:

3.3.2.1 Microstructure: Microstructure shall conform to the requirements of AMS 2380 for forgings; the product specification shall be the specification which controls the forging stock (3.1).

3.3.2.1 显微组织: 微观结构应符合AMS 2380对锻件的要求; 产品规格应为控制锻造原料(3.1)的规格。

3.3.2.2 Macrostructure: Macrostructure shall also conform to the requirements of AMS 2380 for forgings; macrostructural evaluations shall be performed on sections transverse to the grain flow at the locations of grain-flow sections (3.3.2.3).

3.3.2.2 宏观结构: 宏观结构还应符合AMS 2380对锻件的要求; 应在颗粒流段(3.3.2.3)位置横向于颗粒流动的截面上进行宏观结构评价。

3.3.2.3 Grain Flow: The internal grain-flow pattern shall conform to the requirements of the forging drawing. When not specified by the drawing, grain flow of die forgings in regions within 0.25 inch (6.4 mm) or 25 percent of the section thickness, whichever is smaller, of the forged surface shall follow the general contour of the forging; this requirement shall not apply to areas of acceptance test-tab attachment, of prolongation attachment, or of flash extrusion ("flash line" or "parting plane"). (See 8.1 and 8.4). Unless locations are specified by the purchaser, the forging manufacturer shall select suitable locations for sectioning sufficient to fully document compliance with these requirements; as a minimum, cross-sections shall be taken normal to all die-closures. (See 8.1). A different alloy with similar hot-working characteristics may be used as a test medium when the grain flow pattern of the specified titanium alloy (3.1) is too faintly revealed to record photographically. Sections shall be finished and etched in accordance with AMS 2643 to reveal the grain flow. The grain-flow pattern shall be recorded photographically for reporting purposes (4.5).

3.3.2.3 颗粒流动: 内部颗粒流动模式应符合锻造图纸的要求。当图纸没有规定时, 锻件表面的0.25英寸(6.4毫米)或25%区段(锻件表面的较小者)内的锻件的颗粒流应遵循锻件的一般轮廓; 这一要求不适用于接受件 - 接头连接, 延长连接或快速挤出(“闪蒸线”或“分离面”)的区域。(见8.1和8.4)。除非买方指定地点, 否则锻造制造商应选择合适的切割位置, 以便充分记录合规情况。有这些要求; 作为最低限度, 应使截面垂直于所有模具闭合。(见8.1)。当特定钛合金(3.1)的晶粒流动图案过暗地显示以记录照片时, 可以使用具有类似热加工特性的不同合金作为测试介质。切片应根据AMS 2643完成和蚀刻以显示颗粒流动。谷物流动模式应以照片方式记录用于报告目的(4.5)。

3.4 Surface Contamination: 表面污染:

This requirement shall apply to forgings in the as-supplied heat-treat condition (3.2.2). Surface contamination (e.g., alpha case) shall conform to the material specification which controls the forging stock (3.1).

该要求应适用于所提供的热处理条件下的锻件(3.2.2)。表面污染(例如, α 情况)应符合控制锻造原料(3.1)的材料规格。

3.5 Quality: 质量:

3.5.1 Surface Condition: Forgings shall conform to the etch inspection requirements for forgings in AMS 2380. Forging surfaces shall be cleaned so as to be free of foreign material prior to such inspection. Imperfections may be removed, in which case, surfaces shall be reinspected in accordance with this paragraph.

3.5.1表面状况：锻件应符合AMS 2380中锻件的蚀刻检验要求。锻造表面应进行清洁，以便在检查之前不含异物。缺陷可能被去除，在这种情况下，表面应按照本段重新检验。

3.5.2 Forging Control: The forging process shall be in accordance with a documented process which has met approval requirements (4.4).

3.5.2锻造控制：锻造过程应符合符合批准要求（4.4）的文件化过程。

3.5.3 Heat Treating Control: Heat treatment of forgings shall conform to the following requirements.

3.5.3热处理控制：锻件的热处理应符合下列要求。

3.5.3.1 Delivered in the As-Supplied Heat-Treat Condition (3.2.2): Forgings shall be heat treated in accordance with MIL-H-82100 or, for alloys not listed in MIL-H-82100, in accordance with instructions from the purchaser. (See 8.1).

3.5.3.1按提供的热处理条件（3.2.2）交付：锻件应按照MIL-H-82100或对于MIL-H-82100中未列出的合金进行热处理，按照 购买者。（见8.1）。

3.5.3.2 Delivered in the Finished-Part Heat-Treat Condition: Forgings shall be heat treated in accordance with AMS 2801 or, for alloys not listed in AMS 2801, in accordance with instructions from the purchaser. (See 8.1).

3.5.3.2在成品部件热处理条件下交付：锻件应根据AMS 2801进行热处理，或对于AMS 2801中未列出的合金，按照买方的指示进行热处理。（见8.1）。

3.5.4 Hydrogen Control: The maximum concentration of hydrogen in the forged material shall be as specified in the material specification which controls the forging stock (3.1); if this material specification does not specify hydrogen content, it shall not exceed 0.015 percent by weight (150 ppm). Hydrogen analysis shall be performed on acceptance-test tabs from the completely processed forgings, in accordance with ASTM E 1447.

3.5.4氢控制：锻造材料中氢的最大浓度应符合控制锻造原料（3.1）的材料规范中的规定；如果该材料规格不规定氢含量，则其不应超过0.015重量%（150ppm）。应根据ASTM E 1447，从完全处理的锻件对接受试验片进行氢分析。

3.6 Tolerances: 公差：

Flash extension, measured from the body of the forging to the trimmed edge of the flash, shall not exceed the dimensional limits in Table 1.

从锻件的主体到闪光灯的修剪边缘测量的闪光延伸不得超过表1中的尺寸限制。

TABLE 1 - Flash Extension Tolerances表1 - 闪存扩展公差

Weight of Forging after Trimming in pounds (kilograms) 修剪后的锻件重量（公斤）		Flash Extension Limits in inches (millimeters) 闪光灯延伸限制（英寸）（毫米）	
Pounds 磅	(kilograms) 公斤	Inches 英寸	(millimeters) 毫米
5 and under	(2.3 and under)	0 to 0.06	(0 to 1.5)
Over 5 to 25, incl	(Over 2.3 to 11.3, incl.)	0 to 0.09	(0 to 2.3)
Over 25 to 50, incl	(Over 11.3 to 22.7, incl.)	0 to 0.13	(0 to 3.3)
Over 50 to 100, incl	(Over 22.7 to 45, incl.)	0 to 0.19	(0 to 4.8)
Over 100 to 200, incl	(Over 45 to 91, incl.)	0 to 0.25	(0 to 6.4)
Over 500 to 1000, incl	(Over 227 to 454, incl.)	0 to 0.38	(0 to 9.6)
Over 1000	(Over 454)	0 to 0.50	(0 to 12.7)

4. QUALITY ASSURANCE PROVISIONS: 质量保证条款:**4.1 Responsibility for Inspection: 质量检测:**

The supplier shall be responsible for the performance of all tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the forgings conform to the specified requirements.

供应商应负责所有测试的性能。 买方保留采样和进行任何认为必要的确认测试的权利，以确保锻件符合规定的要求。

4.2 Classification of Tests: 测试项目:

4.2.1 Acceptance Tests: The requirements shown in Table 2 are acceptance tests and shall be performed on each lot. See 8.4.3 for the definition of a lot.

4.2.1验收试验: 表2所示的要求是验收试验，并应在每个批次上进行。 批次的定义见8.4.3。

TABLE 2 - Acceptance Tests表2-接受测试

Requirement	需求	Paragraph Reference段落参考
Material	材料	3.1
Condition	条件	3.2
Room-Temperature Tensile Properties (Grade A)	室温拉伸性能 (A级)	3.3.1.1.1
Fracture Toughness (Grade A, when specified)	断裂韧度 (A级, 指定时)	3.3.1.2
Surface Contamination	表面污染	3.4
Surface Condition	表面条件	3.5.1
Hydrogen Control	氢控制	3.5.4

4.2.2 Periodic Tests: The requirements shown in Table 3 are periodic tests and shall be performed at a frequency selected by the supplier unless frequency of testing is specified by purchaser. When Grade B is specified, the requirements for Grade B in this specification supersede those in the material specification (3.1) when a conflict exists. For Grade A, the requirements of the material specification take precedence over those in this specification when a conflict exists. (See 8.2 and 8.7).

4.2.2定期试验: 表3所示的要求是定期试验，应按供方选择的频率进行，除非买方指定试验频率。当指定B级时，当存在冲突时，本规范中B级的要求取代材料规范 (3.1) 中的要求。对于A级，当存在冲突时，材料规格的要求优先于本规范中的要求。（见8.2和8.7）。

TABLE 3 - Periodic Tests表3-周期性测试

Requirement	需求	Paragraph Reference段落参考
Room-Temperature Tensile Properties (Grade B)	室温拉伸性能 (B级)	3.3.1.1.1
Fracture Toughness (Grade B, when specified)	断裂韧度 (B级, 指定时)	3.3.1.2
Elevated-Temp., Tensile Properties (when specified)	高温, 拉伸性能 (规定时)	3.3.1.1.2
Time-for-Rupture, Room-Temp. (when specified)	断裂时间, 室温。(指定时)	3.3.1.3.1
Creep, creep-rupture, & stress-rupture (when specified)	蠕变, 蠕变断裂和应力断裂 (当指定时)	3.3.1.3.2
Metallurgical structure	冶金结构	3.3.2

4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed for first article approval and after any significant changes in the method of manufacture of the product.

4.2.3生产测试: 所有技术要求都是预生产测试，并且应在第一次批准产品时以及产品制造方法

发生任何重大变化后进行。

4.3 Sampling and Testing: 抽样和测试:

NOTE: In 4.3.1, 4.3.2, and 4.3.3 the term “forging” shall denote either the forged shape, its acceptance test tab, or an associated prolongation or separately-forged coupon, as is applicable.

注意: 在4.3.1,4.3.2和4.3.3中, 术语“锻造”应表示锻造形状, 其接受试验片, 或相关的延长或单独锻造的试样(如适用)。

4.3.1 Acceptance: The following inspections shall be performed on each lot of forgings. See 8.4.3 for the definition of a lot.

4.3.1验收: 应对每批锻件进行以下检查。批次的定义见8.4.3。

4.3.1.1 Room-Temperature Tensile: For Grade A only, one or more forgings shall be tested for roomtemperature tensile properties.

4.3.1.1室温拉伸: 对于A级, 应测试一个或多个锻件的室温拉伸性能。

4.3.1.2 Fracture Toughness: For Grade A only (when specified), one or more forgings shall be tested for room-temperature fracture toughness properties.

4.3.1.2断裂韧性: 对于A级(当规定时), 应对一个或多个锻件进行室温断裂韧性试验。

4.3.1.3 Surface Contamination: Each forging of the sample required by Table 4, and one or more forgings from each load when chemical milling is used, shall be tested for surface contamination.

4.3.1.3表面污染: 表4所要求的样品的每个锻件, 以及使用化学铣削时每个载荷的一个或多个锻件, 应测试表面污染。

TABLE 4 - Acceptance Sampling Plan for Surface Contamination

表4 - 表面污染的验收抽样计划

Lot Size批量 (Number of forgings) (锻件数)	Sample Size, Number of Forgings样品量, 锻件数量 from Lot (Minimum) 从批次(最低)
1 to 4	All
5 to 25	5
26 to 100	6
101 and over	7

4.3.1.4 Surface Condition: Each forging shall be inspected for surface condition.

4.3.1.4表面状况: 每个锻件应检查表面状况。

4.3.1.5 Hydrogen Content: One forging per lot, and one forging from each load where chemical milling is used, shall be tested for hydrogen content.

4.3.1.5氢含量: 每批一次锻造, 使用化学铣削的每个载荷锻造一次, 应测试氢含量。

4.3.2 Periodic: Forgings for periodic tests shall be selected randomly from a forging lot for which compliance with all acceptance requirements (Table 2), has been verified.

The number of forgings in the sample shall be sufficient to provide the material needed for verification of the applicable properties in Table 3 and number of determinations required.

4.3.2定期: 定期试验的锻件应从符合所有验收要求(表2)的锻造批中随机选择, 并已经过验证。样品中的锻件数量应足以提供表3中适用性能验证所需的材料和所需的测定次数。

4.3.3 Preproduction: The following inspections shall be performed. The number of forgings shall be sufficient to provide the material needed for verification of applicable properties and the number of determinations required below.

4.3.3生产：应进行以下检查。锻件的数量应足以提供验证适用性能所需的材料和下面要求的确定数量。

4.3.3.1 Mechanical Properties: There shall be three or more determinations of each applicable mechanical property.

4.3.3.1机械性能：应对每种适用的机械性能进行三次或更多次测定。

4.3.3.2 Microstructure: Microstructure shall be determined on one or more mechanical-test specimens and there shall be two or more determinations.

4.3.3.2微观结构：微观结构应在一个或多个机械试样上测定，应有两个或多个测定。

4.3.3.3 Surface Contamination: Each forging shall be tested for surface contamination.

表面污染：每个锻件应测试表面污染。

4.3.3.4 Macrostructure and Grain Flow: One or more forgings shall be sectioned for determination of grain flow and macrostructure.

4.3.3.4宏观结构和颗粒流：一个或多个锻件应分段用于确定颗粒流动和宏观结构。

4.3.3.5 Surface Condition: Each forging shall be inspected for surface condition.

4.3.3.5表面状况：每个锻件应检查表面状况。

4.3.3.6 Hydrogen Content: Each forging shall be tested for hydrogen content. There shall be three or more determinations.

4.3.3.6氢含量：每个锻件应测试氢含量。应有三个或更多的决定。

4.3.4 Sources of Test Material for Properties (3.3): The source of test material shall be either a forging, a prolongation of a forging, or a separately-forged coupon (illustrated in Figure 2). The order of preference of selection is:

4.3.4性能试验材料来源（3.3）：试验材料来源应为锻件，锻件延长件或单独锻造的试件（如图2所示）。选择的优选顺序是：

4.3.4.1 The forging in the region specified on the drawing or, when not specified, in the thickest section (See 8.1);

4.3.4.1在图纸上规定的区域，如果没有规定，在最厚部分（见8.1）中锻造；

4.3.4.2 A prolongation which has reductions in the principal directions which are approximately the same as those in the location in the forging which encompasses the region of the finished part to be evaluated (See 4.3.4.1);

4.3.4.2延长部分，其主要方向上的减小与包含待评估的成品部件区域（见4.3.4.1）的锻件位置大致相同；

4.3.4.3 A separately-forged coupon which simulates a prolongation. The purchaser-approved, documented process (to the maximum practical extent) and forging stock from the same heat (preferably from the same lot), shall be used to produce a separately-forged coupon.

4.3.4.3模拟延长的单独锻造的优惠券。采购方批准的，有文件记录的程序（最大实际程度）和来自相同热量（优选来自同一批次）的锻造原料应用于生产单独锻造的优惠券。

4.3.5 Preparation of Test Specimens for Properties (3.3):

4.3.5性能试样的制备（3.3）：

4.3.5.1 Material Size at Time of Heat Treatment:

4.3.5.1热处理时的材料尺寸：

4.3.5.1.1 Processing: 处理:

4.3.5.1.1.1 Test specimens shall be manufactured from a test-material source (4.3.4) in accordance with either option in Figure 3.

4.3.5.1.1.1 试样应由试验材料源（4.3.4）根据图3中的任一选项制造。

4.3.5.1.1.2 Material from which test specimens for mechanical and microstructural properties are to be made shall be heat treated in accordance with AMS 2801 or, for alloys not listed in AMS 2801, in accordance with instructions from the purchaser. (See 8.1).

4.3.5.1.1.2 用于制造机械和显微组织性能试样的材料应按照AMS 2801或根据买方的说明对AMS 2801中未列出的合金进行热处理。（见8.1）。

4.3.5.1.1.3 Test blocks are volumes of test material, such as are illustrated in Figure 4, within which specimen blanks are embedded to control their quench rate; the short-transverse thickness of a test block is the same as that of the part at the time of its final heat treatment (Figure 1). Specimen blanks are the aggregate of one or more single-test specimen blanks (illustrated in Figures 5 and 6). 4.3.5.1.2 covers the design of test blocks; 4.3.5.1.3 covers the design of specimen blanks. (See 8.4.2).

4.3.5.1.1.3 试块是试验材料的体积，如图4所示，试样坯料嵌入其中以控制其淬火速率；测试块的短横向厚度与其最终热处理时的部件的短横向厚度相同（图1）。样品坯料是一个或多个单试样坯料的聚集体（如图5和6所示）。4.3.5.1.2包括试块的设计；4.3.5.1.3包括试样坯料的设计。（见8.4.2）。

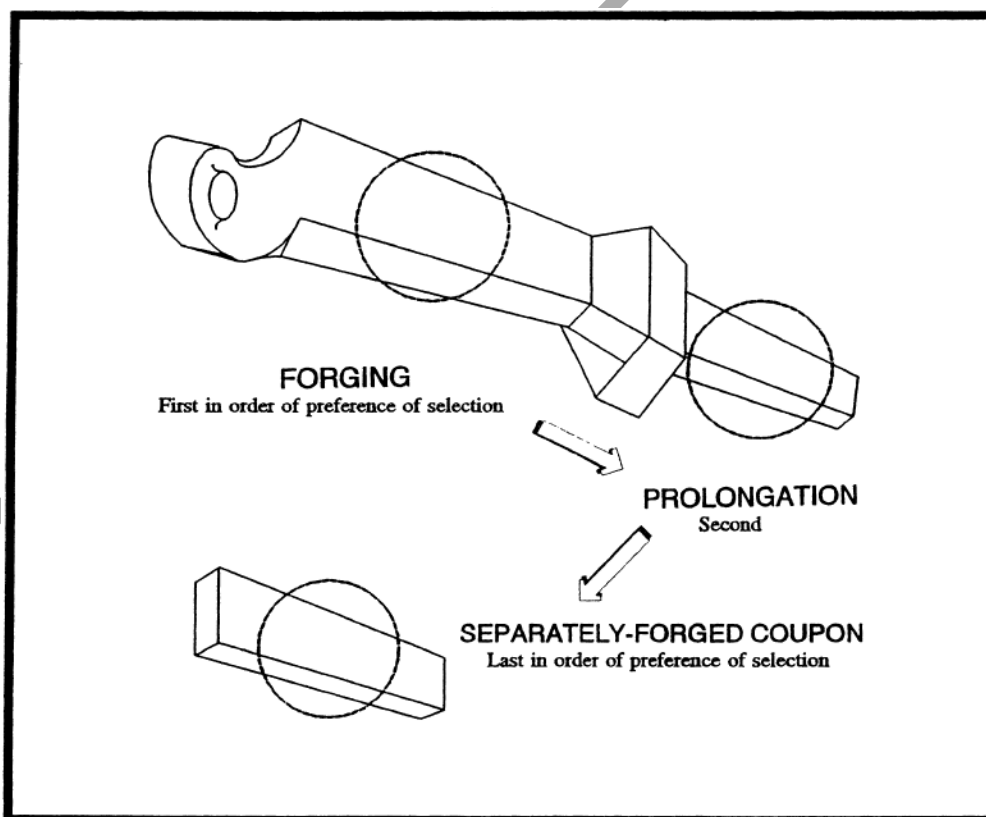


FIGURE 2 - Sources of Test Material 图2 - 测试材料的来源

Forging 锻造 First in order of preference of selection 首先按照选择的优先顺序

PROLONGATION 普通 Second 第二

SEPARATELY-FORGED COUPON 单独锻造的优惠券

Last in order of preference of selection 最后是选择的优先级

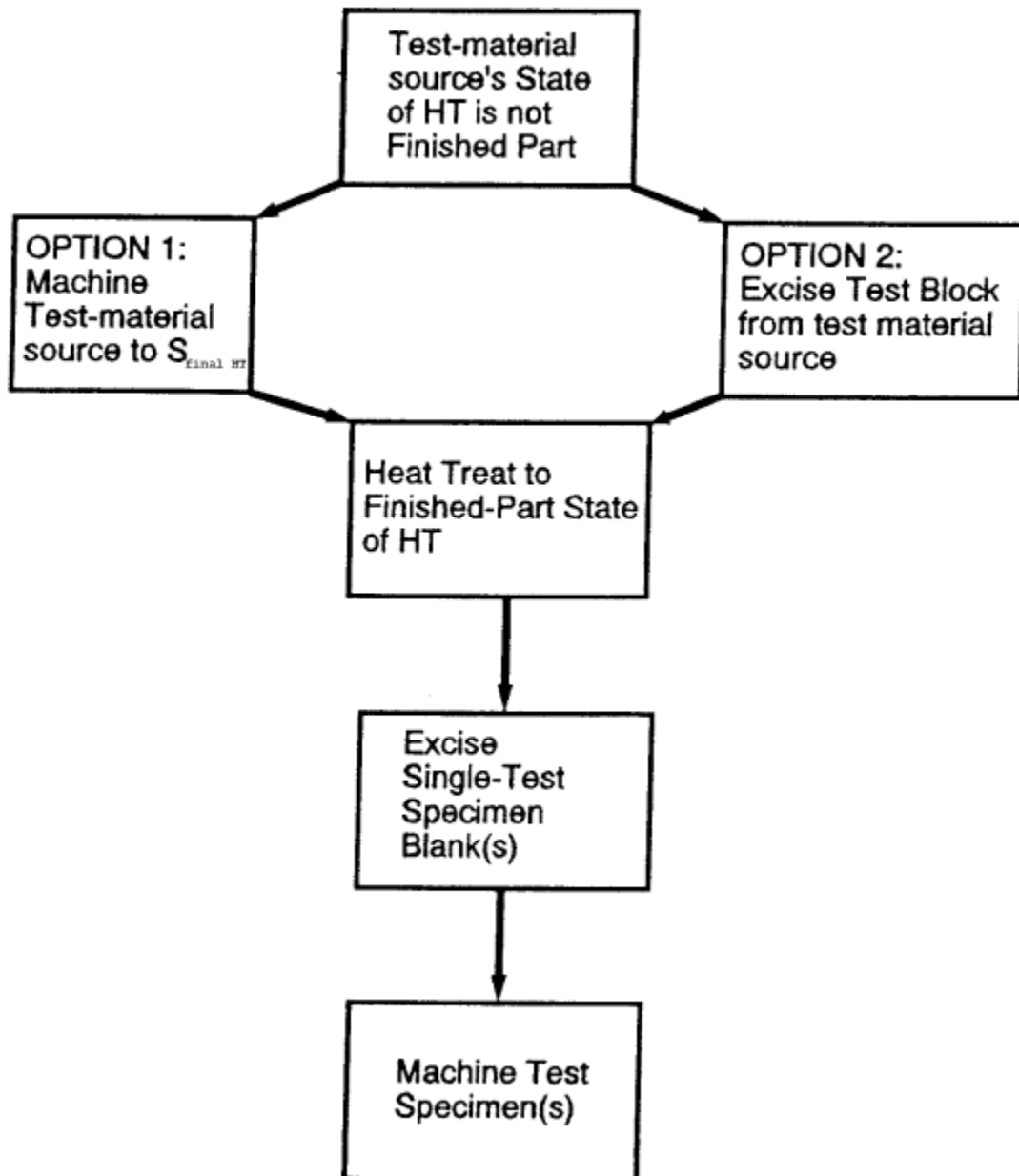


FIGURE 3 - Heat Treatment (HT) Sequence 图3-热处理 (HT) 序列

Test-material source's State of HT is not Finished Part

测试材料源的HT状态不是成品部件

OPTION 1: Machine Test-material source to $S_{final\ HT}$

选项1: 机器测试材料源 $S_{final\ HT}$

Heat Treat to Finished-Part State of HT

热处理到HT的成品状态

Excise Single-Test Specimen Blank(s)

消费单一试样空白

Machine Test Specimen(s)

机器测试样品

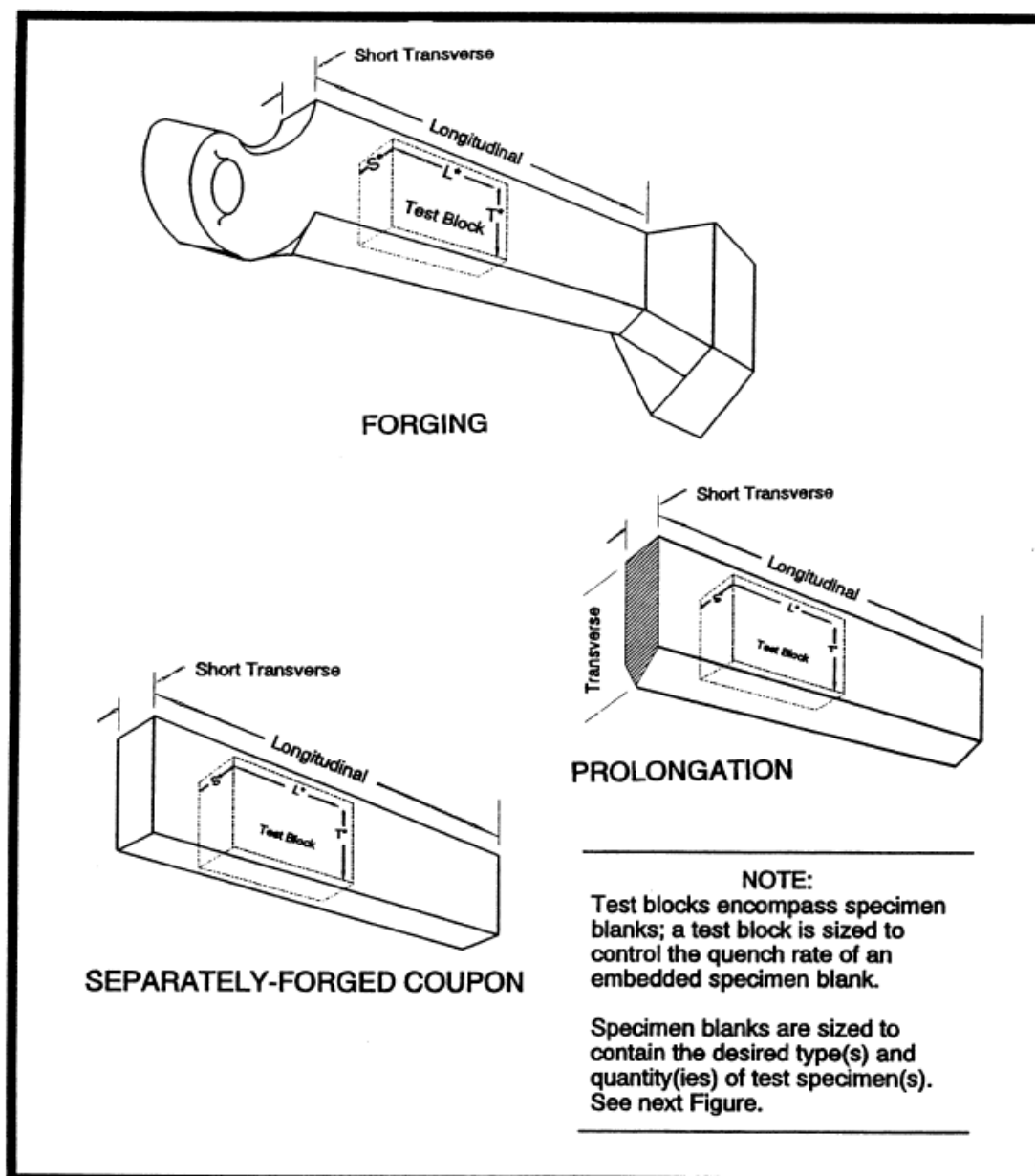


FIGURE 4 - Test Block Sources and Orientations 图4 - 测试块源和方向

Forging 锻件 Test Block 测试块 Longitudinal 纵向 Short Transverse 短横向

Prolongation 延长 Transverse 横

SEPARATELY-FORGED COUPON 单独锻造的优惠券

NOTE: Test blocks encompass specimen blank; a test block is sized to control the quench rate of an embedded specimen blank.

测试块包括样品空白; 测试块的尺寸设定成控制嵌入的样品空白的淬火速率。

Specimen blanks are sized to contain the desired type(s) and quantity(ies) of test specimen(s). See next Figure.

样品坯料的尺寸被确定为包含所需类型和数量的测试样品。 见下图。

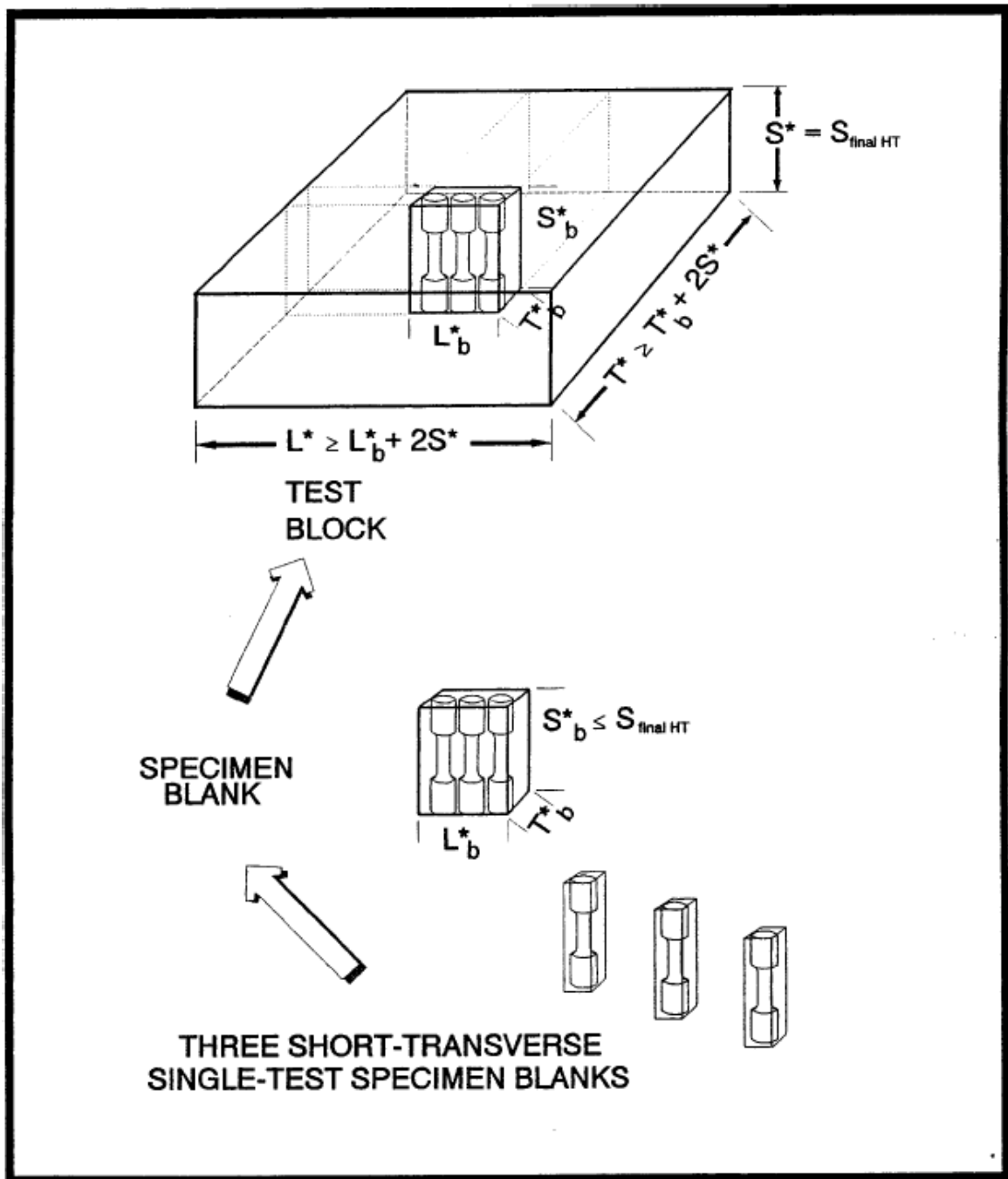


FIGURE 5 - Short-Transverse Specimen Blank Design and Test Block Design

图5 - 短横向试样空白设计和试验块设计

TEST BLOCK 测试块 $S_{final\ HT} = S_{最后HT}$

SPECIMEN BLANK 样本空白

THREE SHORT-TRANSVERSE

三短横

SINGLE-TEST SPECIMEN BLANK

单片测试样品空白

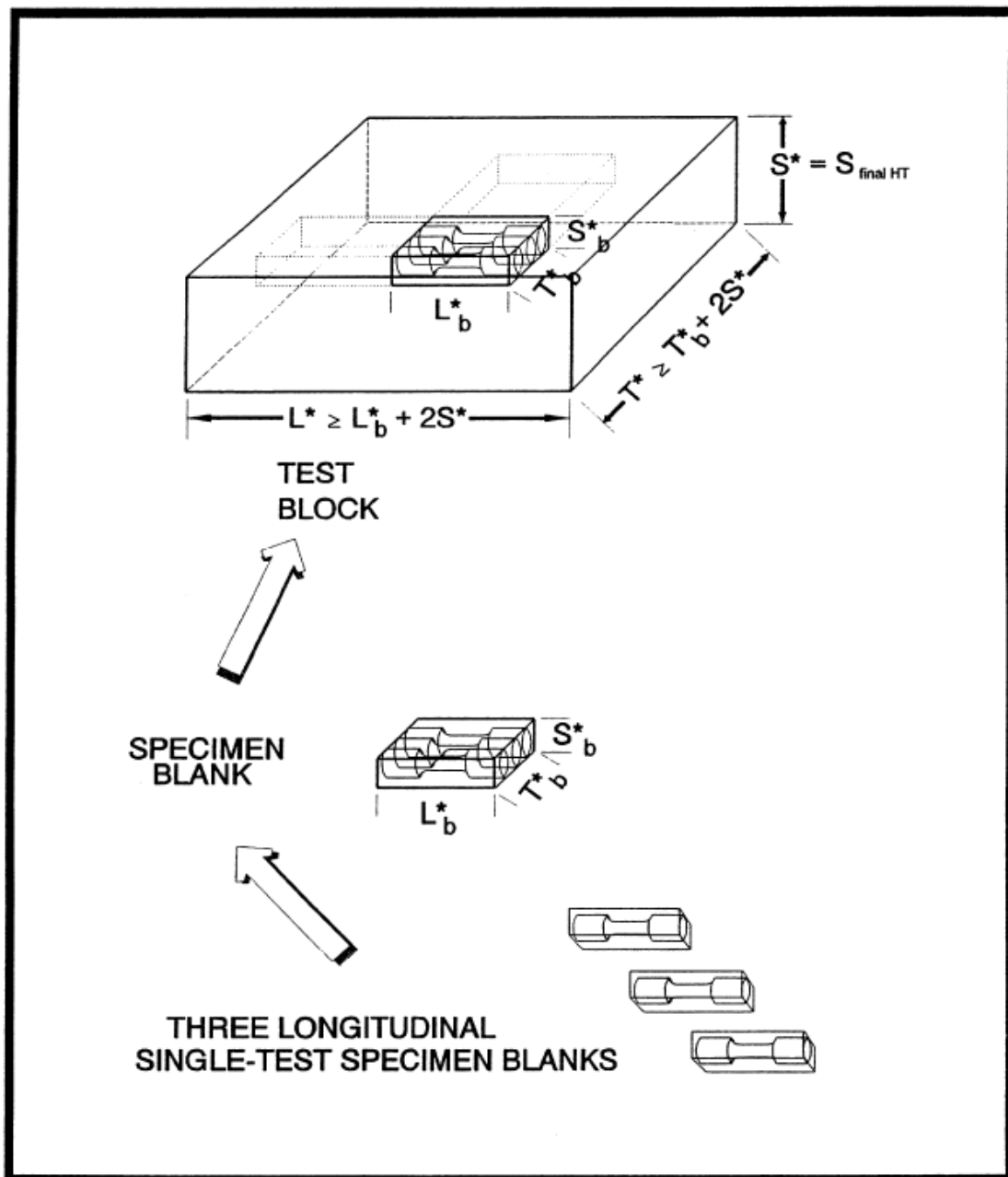


FIGURE 6 - Longitudinal Specimen Blank Design and Test Block Design

图6 - 纵向样品空白设计和测试块设计

TEST BLOCK 测试块 $S_{final\ HT} = S_{最后HT}$

SPECIMEN BLANK 样本空白

THREE SHORT-TRANSVERSE

三短横

SINGLE-TEST SPECIMEN BLANK

单片测试样品空白

4.3.5.1.2 Design of Test Blocks: 测试块设计:

4.3.5.1.2.1 Orientation: The dimensions of a test block, L^* , T^* , and S^* , shall be aligned

with respect to the metallurgical directions of the forging in accordance with Figure 4.

4.3.5.1.2.1取向: 测试块的尺寸 L^* , T^* 和 S^* 应根据图4相对于锻件的冶金方向对准。

4.3.5.1.2.2 Size: The dimensions of a test block, L^* , T^* , and S^* , shall be based on the dimensions of the encompassed specimen blank, L^*b , T^*b , and S^*b (4.3.5.1.3), in accordance with Figures 5 and 6.

4.3.5.1.2.2尺寸: 试块尺寸 L^* , T^* 和 S^* 应基于所包含的试样空白 L^*b , T^*b 和 S^*b 的尺寸 (5.1.3), 根据图5和图6。

4.3.5.1.3 Design of Specimen Blanks: Specimen-blank dimensions shall be denoted as L^*b , T^*b , and S^*b ; these dimensions shall be sufficient to encompass the desired number(s) and type(s) of single-test-specimen blanks as depicted in Figures 5 and 6. Note that while the figures illustrate a case for three smooth tensile specimens, the concept is applicable to any number of specimens and to other types of test specimens (e.g., fracture toughness or notched stressrupture).

4.3.5.1.3试样坯料的设计: 试样坯料尺寸应标记为 L^*b , T^*b 和 S^*b ; 这些尺寸应足以包含如图5和6所示的单个试验样品坯料的所需数量和类型。注意, 尽管附图示出了三个平滑拉伸试样的情况, 但是概念是 适用于任何数量的试样和其他类型的试样 (例如断裂韧性或缺口应力断裂)。

4.3.5.1.3.1 Layout and Sizing: Specimen blanks shall be sized to encompass the single-test specimen blank(s) for the desired number and type(s) of test specimen(s); Figures 5 and 6 illustrate the concept. The length of S^*b shall be in accordance with Figure 5 for short-transverse specimen blanks. The positioning of single-test-specimen blank(s) within a specimen blank shall conform to the following constraints:

4.3.5.1.3.1布局 and 尺寸: 样品坯料的尺寸应包括所需数量和类型的试样的单一试样坯料。图5和图6示出了该概念。对于短横向试样坯料, S^*b 的长度应符合图5。单个试验样本空白在样本空白内的定位应符合以下约束:

4.3.5.1.3.1.1 The preferred positioning shall be single file and lined up parallel to L^*b for the shorttransverse test direction (Figure 5), parallel to T^*b for the longitudinal test direction (Figure 6).

4.3.5.1.3.1.1优选的定位应为单个文件, 并且对于短横向测试方向 (图5) 平行于 L^*b , 并且对于纵向测试方向 (图6) 平行于 T^*b 排列。

4.3.5.1.3.1.2 Short rod/short bar-fracture-toughness-specimen (ASTM E 1304) blanks may be stacked end-to-end parallel to the test direction and treated as though they were a single, singletest specimen blank.

4.3.5.1.3.1.2短棒/短棒 - 断裂韧性 - 试样 (ASTM E 1304) 毛坯可以平行于试验方向端对端堆叠, 并作为单一的, 单一的试样毛坯进行处理。

4.3.5.2 Extraction of Specimen Blanks and Manufacture of Specimens:

4.3.5.2试样坯料的提取和试样的制造:

4.3.5.2.1 Test Material Source (Figure 2) in Finished-Part Heat-Treat Condition: A specimen blank shall be considered to be embedded in the test material source, centered in the source within $1/8S_{final HT}$, and with its edges parallel to those of the source within 10 degrees. Single-test specimen blank(s) shall be excised from the specimen blank; test specimen(s) shall be machined from the single-test specimen blank(s). The following constraints shall be conformed to:

4.3.5.2.1 成品部件热处理条件下的试验材料源（图2）：试样坯件应被认为是嵌入在试验材料源中，其中心位于1/8S_{final HT}内的源中，平行于源内的10度。单试样坯料应从试样坯料上切除；应从单试样坯件加工试样。以下约束应符合：

4.3.5.2.1.1 The short-transverse thickness of the region of the forging, prolongation, or separately-forged coupon to be evaluated for properties shall be the same as that of the part at the time of its final heat treatment, S_{final HT}; and

4.3.5.2.1.1 锻造，延长或单独锻造的试样的性能评价区域的短横向厚度应与最终热处理时的部件S_{final HT}的短 - 横向厚度相同。和

4.3.5.2.1.2 The forging, prolongation, or separately-forged coupon shall have been heat treated to the heat-treat condition of the finished part. (See 8.1)

4.3.5.2.1.2 锻造，延长或单独锻造的试样应经热处理至成品零件的热处理状态。（见8.1）

4.3.5.2.2 Test Block in Finished-Part Heat-Treat Condition: The specimen blank shall be considered as centered in the test block within 1/8S_{final HT}, with its edges parallel to those of the test block within 10 degrees. Single-test specimen blank(s) shall be excised from the specimen blank; test specimen(s) shall be machined from the single-test specimen blank(s).

4.3.5.2.2 成品部件热处理条件下的试块：试件坯料应在试件的中心位于1/8最终HT内，其边缘平行于试件的边缘10度以内。单试样坯料应从试样坯料上切除；应从单试样坯件加工试样。

4.4 Approval: 批准

Approval shall be in accordance with the requirements of AMS 2380 for forgings.

批准应符合AMS 2380对锻件的要求。

4.5 Reports: 报告

The supplier of forgings shall furnish with each production lot shipped, a report which includes AMS 4938 and the following:

锻件供应商应提供每个生产批次发货的报告，包括AMS 4938和以下：

- a. Purchase order number 订购单号码
- b. Material specification number, revision letter if any, and Grade 材料规格号，修订字母（如果有）和Grade
- c. Supplier's identification number 供应商识别号
- d. Forging stock identification and acceptance-inspection data (test results) 锻造库存鉴定和验收检验数据（试验结果）
- e. Forging lot number and, if they exist, serial number of forgings 锻造批号和，如果存在，锻件序列号
- f. Part number 零件号
- g. Quantity 数量
- h. Quantitative test results from acceptance inspection of the lot 批次验收检验的定量测试结果
- i. Statement of conformance with all specification requirements 符合所有规格要求的声明

4.6 Resampling and Retesting: 重新取样和重新测试：

If the results from a valid test fail to meet the specified requirements, acceptance of the product may be based on the results of retesting three additional specimens for each nonconforming specimen. Failure of the results of a valid retest to meet the specified

requirements shall prohibit acceptance. A test may be declared invalid only if the specimen is dimensionally discrepant, exhibits behavior which the test method deems disqualifying, or the test equipment malfunctions. The results of all tests and retests shall be reported. Specimens for retest, or for replacement of invalid tests, shall be taken from a location adjacent to the original specimen(s). If there is no adjacent material available, material shall be taken from other locations in the same lot.

如果有效测试的结果不能满足规定的要求，则产品的验收可以基于对每个不合格样品重新测试三个附加样品的结果。符合规定要求的有效重新测试结果的失效应禁止接受。只有当试样尺寸不一致，表现出试验方法认为不合格的行为或试验设备发生故障时，试验才可宣布无效。应报告所有试验和重复试验的结果。重新测试或更换无效测试的样品应取自与原始样品相邻的位置。如果没有可用的相邻材料，则应从同一批次中的其他位置取出材料。

4.7 Acceptance: 验收:

Only lots which meet all of the requirements for the inspection of interest, as specified in 4.2, shall be accepted. In acceptance tests, the failure of individual forgings to meet requirements for surface condition shall not be cause for rejection of the entire lot, but only of the individual nonconforming forgings. Rejected lots, or rejected individual forgings, shall not be resubmitted for inspection without a statement showing how the non-conformity was resolved. "Lot" is defined in 8.4.3.

只接受符合4.2中规定的所有利益检验要求的批次。在验收试验中，单个锻件满足表面条件要求的失效不应导致整个批次的废弃，而仅仅是单个不合格锻件的废弃。拒收批或拒收的个别锻件，如果没有说明不符合的解释的陈述，则不应重新提交检查。“Lot”在8.4.3中定义。

5. PREPARATION FOR DELIVERY: 交货准备:

5.1 Identification: 产品鉴定:

Forgings shall be identified in accordance with AMS 2808.

锻件应根据AMS 2808进行产品鉴定。

5.2 Preservation, Packaging, and Packing: 保存, 包装和包装:

Preservation, packaging, and packing shall conform to standard commercial practice.

保存, 包装和包装应符合标准商业惯例。

5.3 Marking of Shipping Containers: 集装箱标记:

5.3.1 Commercial Orders: Each container shall be marked as follows:

商业订单: 每个集装箱应标记如下:

Titanium Alloy _____ Forging (insert alloy designation)

AMS _____ Title _____ Grade _____ Part

Number _____

Purchase Order Number _____

Quantity Contained _____

Manufacturer's Name _____

钛合金 _____ 锻造 (镶嵌合金名称)

AMS _____ 标题 _____ 级别 _____ 部分 Number _____

订购单号码 _____

数量包含

制造商名称 _____

6. ACKNOWLEDGMENT: 确认:

A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

确认订单时, 供货方应在所有报价单上注明本标准编号以及版次。

7. REJECTIONS: 拒收:

Forgings not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

不符合本规范的锻件或购买者授权的修改将被拒绝。

8. NOTES: 注释说明:**8.1 Design Data:**

The manufacturer of the forgings needs the following design data in order to comply with the requirements of this specification.

锻件的制造商需要以下设计数据, 以符合本规范的要求。

8.1.1 Forging drawings indicating: 锻造图纸表示:**8.1.1.1 The as-forged configuration, dimensions, and tolerances.**

锻造配置, 尺寸和公差。

8.1.1.2 The locations of permissible parting lines (flash extrusion), of acceptance-test tabs, and, if

appropriate (4.3.4), of prolongations.

8.1.1.3 If appropriate (4.3.4), the location in the forging of the region to be evaluated for properties (location of test material or of test blocks).

8.1.1.3如果合适(4.3.4), 锻造中待评估区域的位置(测试材料或测试块的位置)。

8.1.1.4 The internal grain-flow pattern. (See 3.5.1). 内部粒流模式。(见3.5.1)。**8.1.2 The heat-treat condition in which the forgings are to be supplied if different from that in the material specification. (See 3.2.2.).**

8.1.2如果与材料规格不同, 供应锻件的热处理条件。(见3.2.2。)

8.1.3 If appropriate, heat-treating temperatures, times, and other controls for titanium alloys not listed in MIL-H-82100. (See 3.5.4).

8.1.3如果合适, 对MIL-H-82100中未列出的钛合金的热处理温度, 时间和其他控制。(见3.5.4)。

8.1.4 The heat-treat condition of the finished part; include temperatures, times, and other controls for titanium alloys not listed in AMS 2801. (See 3.5.4 and 8.4.4).

8.1.4成品件的热处理条件; 包括AMS 2801中未列出的钛合金的温度, 时间和其他控制(见3.5.4和8.4.4)。

8.1.5 The short-transverse thickness at the time of final heat treatment of the finished part in the region in the forging to be evaluated for properties, $S_{final\ HT}$. (See 8.4.4).

8.1.5在锻造区域的成品部件的最终热处理时的短横向厚度, 用于评价性能, $S_{final\ HT}$ 。(见8.4.4)。

8.1.6 The applicable mechanical properties other than room-temperature tensile, if any (3.3.1).

8.1.6除室温拉伸外的适用机械性能(如有)(3.3.1)。

8.1.7 Required values, in the heat-treat condition of the finished part, for the applicable mechanical properties which are not included in the material specification. (See 3.3.1 and 8.4.4).

8.1.7在成品零件的热处理条件下, 对于不包括在材料规格中的适用机械性能的要求值。(见3.3.1和8.4.4)。

8.2 Drawings, General Notes: 图纸, 一般注意:

To avoid confusion as to the extent to which the requirements of the material specification for the forging stock apply, it is recommended that the drawing for the forging has the following general notes.

为避免对锻造材料材料规格要求的适用范围造成混淆, 建议锻造图纸具有以下一般注意事项。

8.2.1 Make from forging stock in accordance with AMS (the applicable material specification for the forging stock).

8.2.1根据AMS (锻造原料的适用材料规格) 制造锻造原料。

8.2.2 Forge and accept in accordance with AMS 4938. 根据AMS 4938锻造和接受。

8.3 Ordering Data: 订购数据:

Purchase orders, in order to be complete, should specify the following:

采购订单, 为了完成, 应该指定以下内容:

a. AMS 4938

b. Material specification for the forging stock 锻造原料的材料规格

c. Purchaser-approved procurement sources for forging stock, if any
采购员批准的锻造库存采购来源 (如有)

d. Part number and Grade 零件号和等级

e. Quantity 数量

f. The necessary design data (8.1) 必要的设计数据 (8.1)

g. Frequency of periodic tests when purchaser-specified (See 4.2.2)
购买者指定的定期试验频率 (见4.2.2)

8.4 Definitions: 定义:

Terms used in AMS are clarified in ARP1917, and as follows:

AMS中使用的术语在ARP1917中阐明, 如下:

8.4.1 Test Directions: 测试方向:

8.4.1.1 Longitudinal: Direction of maximum extension of the metal during forging.

8.4.1.1纵向: 锻造期间金属的最大延伸方向。

8.4.1.2 Short Transverse: Direction of maximum contraction of the metal during forging.

8.4.1.2短横向: 锻造期间金属的最大收缩方向。

8.4.2 Test Material: 测试材料:

8.4.2.1 Acceptance-Test Tab: An extension of the forging to provide material for lot-acceptance testing (surface contamination and hydrogen control; 3.4 and 3.5.5).

The tab may be an extension of a prolongation.

8.4.2.1验收测试选项卡: 锻件的延伸部分, 用于提供批次验收测试 (表面污染和氢气控制; 3.4和3.5.5) 的材料。突片可以是延长部的延伸部。

8.4.2.2 Prolongation: An extension of the forging to provide test material, in many cases for a test block. (See 8.4.2.5).

8.4.2.2延伸: 延伸锻件以提供测试材料, 在许多情况下用于测试块。 (见8.4.2.5)。

8.4.2.3 Test Specimen: The configuration of test material in which testing to determine properties (3.3) is performed. Test specimens are extracted, in many cases, from specimen blanks. (See 8.4.2.4).

8.4.2.3试样: 进行测试以确定性能 (3.3) 的试验材料的配置。在许多情况下, 从样品坯料提取试样。 (见8.4.2.4)。

8.4.2.4 Specimen Blank: Specimen blanks are volumes of material from which test specimens are extracted. A specimen blank is generally encompassed by and heat-treated within a test block. Specimen blanks are dimensioned so as to contain adequately shaped and sized volume(s) for the desired test specimen(s). (See 8.4.2.3 and 8.4.2.5).

8.4.2.4试样坯料: 试样坯料是提取试样的材料体积。 样品坯料通常由测试块包围并在测试块内进行热处理。 样品坯料的尺寸设计为包含用于所需试样的足够形状和尺寸的体积。 (见8.4.2.3和8.4.2.5)。

8.4.2.5 Test Block: A volume of test material which encompasses a specimen blank. The size of a test block is based on the dimension of the specimen blank (as specified in Figures 5 and 6). Specimen blanks are encompassed by test blocks to control the cooling rate of the specimen blank during heat treatment of test material. (See 8.4.2.4).

8.4.2.5试块: 包括试样空白的一定体积的试验材料。 测试块的尺寸基于样品空白的尺寸(如图5和图6所示)。 样品坯料被测试块包围以控制在测试材料的热处理期间样品坯体的冷却速率。(见8.4.2.4)。

8.4.3 Lot: All forgings of the same part number or configuration, opposite hands being considered one configuration, produced in the same forging run from the same lot of forging stock, heated and forged in the same manner, and heat treated in a continuous furnace or in a series of batch-type furnace operations with no change in furnace settings or interruption of power.

8.4.3批: 具有相同部件号或构造的所有锻件,相反的手被认为是一种构造,在相同锻造工序中由相同批量的锻造坯料生产,以相同方式加热和锻造,或者在一系列分批式炉操作中,炉设置没有变化或功率中断。

8.4.4 Finished Part: The part to be manufactured from the forging.

8.4.4成品: 由锻件制造的零件。

8.5 Design of Acceptance-Test Tab: 接受设计 - 测试选项卡:

An integral, excisable acceptance-test tab needs to be appended either to each forging or, if used (4.3.4), to the test-material prolongation of each forging.

Acceptance test tabs should have dimensions greater than 3/4 inch by 3/4 inch by 1 inch (19 by 19 by 25 mm).

一个整体的,可切除的验收试验片需要附加到每个锻件或如果使用(4.3.4),每个锻件的试验材料延长件。 验收测试标签应具有尺寸大于3/4英寸×3/4英寸×1英寸(19×19×25mm)的尺寸。

8.6 Specification Objective: 规格目标:

The objective of this specification is to consolidate the requirements for military and company acquisitions into a single procurement document. It is intended for callout on an engineering drawing of a forging to supplement material, dimensional, and other drawing requirements.

本规范的目的是将军事和公司并购的要求合并到一个单一的采购文件中。它用于在锻造的工程图上标注,以补充材料,尺寸和其他绘图要求。

8.7 Frequency of Periodic Tests: 定期检查频率:

It is recommended that the frequency of periodic tests be no less than one lot per year or every 100 forgings, whichever is more frequent.

建议定期检查的频率不应少于每年一个批次或每100个锻件,以较频繁者为准。

8.8 Dimensions and properties in inch/pound units are primary; dimensions and properties in SI units are shown as the approximate equivalents of the primary units and are presented only for information.

8.8尺寸和性能以英寸/磅为单位; SI单位中的尺寸和性能显示为主要单位的近似等效值, 仅用于提供信息。

ANNEX A 附件A
RECOMMENDED CONTROLS FOR FORGING STOCK
推荐控制用于锻造

A.1 This annex imposes no requirements on forging stock. This specification assumes that certain raw material attributes will be inherited from the forging stock by the forged product and that confirmation of these attributes in production forgings is not necessary. Consequently the forging stock must be controlled to assure that those attributes desired are present at the appropriate levels. The forging stock attributes to be considered are:

A.1本附件对锻造库存没有要求。本说明书假设某些原材料属性将通过锻造产品从锻造材料继承, 并且在生产锻件中确认这些属性是不必要的。因此, 必须控制锻造原料以确保所需的那些特性以适当的水平存在。要考虑的锻造坯料属性是:

a. Chemical composition

化学成分

b. Response to heat treatment, tensile properties

响应热处理, 拉伸性能

c. Internal Integrity as indicated by ultrasonic inspection

内部完整性如超声波检查所示

d. Number of times the ingot for the forging stock was vacuum melted

锻造坯料的坯料真空熔化的次数

The following specifications are recommended for control of aircraft-quality forging stock:

以下规格建议用于飞机质量锻件的控制:

AMS 4920 - Titanium Alloy Forgings (6A1-4V)

钛合金锻件 (6A1-4V)

AMS 4921 - Titanium Bars, Forgings, and Rings (CP-70)

钛条, 锻件和环 (CP-70)

AMS 4924 - Titanium Alloy Bars, Forgings, and Rings (5A1-2.5Sn)

钛合金棒, 锻件和环 (5A1-2.5Sn)

AMS 4928 - Titanium Alloy Bars, Wire, Forgings, and Rings (6Al-4V)

钛合金棒, 线材, 锻件和环 (6Al-4V)

AMS 4930 - Titanium Alloy Bars, Wire, Forgings, and Rings (6Al-4V, ELI)

钛合金棒, 电线, 锻件和环 (6Al-4V, ELI)

AMS 4931 - Titanium Alloy Bars, Forgings, and Rings (6Al-4V, ELI)

钛合金棒, 锻件和环 (6Al-4V, ELI)

AMS 4950 - Titanium Alloy Bars, Wire, Forgings, and Rings (6Al-4V)

钛合金棒, 线材, 锻件和环 (6Al-4V)

AMS 4963 - Titanium Alloy Bars, Wire, Forgings, and Rings (6Al-4V)

钛合金棒, 线材, 锻件和环 (6Al-4V)

AMS 4966 - Titanium Alloy Forgings (5A1-2.5Sn)

钛合金锻件 (5A1-2.5Sn)

AMS 4967 - Titanium Alloy Bars, Forgings, and Rings (6Al-4V)

- 钛合金棒，锻件和环（6Al-4V）
- AMS 4970 - Titanium Alloy Bars, Wire, and Forgings (7Al-4Mo)
钛合金棒，线和锻件（7Al-4Mo）
- AMS 4971 - Titanium Alloy Bars, Forgings, and Rings (6Al-6V-2Sn)
钛合金棒，锻件和环（6Al-6V-2Sn）
- AMS 4973 - Titanium Alloy Forgings (8Al-1Mo-1V)
钛合金锻件（8Al-1Mo-1V）
- AMS 4976 - Titanium Alloy Forgings (6Al-2Sn-4Zr-2Mo)
钛合金锻件（6Al-2Sn-4Zr-2Mo）
- AMS 4978 - Titanium Alloy Bars, Wire, Forgings, and Rings (6Al-6V-2Sn)
钛合金棒，线材，锻件和环（6Al-6V-2Sn）
- AMS 4979 - Titanium Alloy Bars, Forgings, and Rings (6Al-6V-2Sn)
钛合金棒，锻件和环（6Al-6V-2Sn）
- AMS 4981 - Titanium Alloy Bars, Wire, and Forgings (6Al-2Sn-4Zr-6Mo)
钛合金棒，线和锻件（6Al-2Sn-4Zr-6Mo）
- AMS 4983 - Titanium Alloy Forgings (10V-2Fe-3Al)
钛合金锻件（10V-2Fe-3Al）
- AMS 4984 - Titanium Alloy Forgings (10V-2Fe-3Al)
钛合金锻件（10V-2Fe-3Al）
- AMS 4986 - Titanium Alloy Forgings (10V-2Fe-3Al)
钛合金锻件（10V-2Fe-3Al）
- AMS 4987 - Titanium Alloy Forgings (10V-2Fe-3Al)