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Suomen Standardisoimisliitto

SFS-EN ISO 3785:2023:en

Metallic materials. Designation of test specimen axes in relation to product texture (ISO 3785:2023)

Tämä julkaisu on ladattu SFS Online-palvelusta (sop. nro FinElib) 21.10.2023.
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Metallic materials. Designation of test specimen axes in relation to product texture (ISO 3785:2023)

Tämä standardi sisältää eurooppalaisen standardin EN ISO 3785:2023 "Metallic materials. Designation of test specimen axes in relation to product texture (ISO 3785:2023)" englanninkielisen tekstin.

This standard consists of the English text of the European Standard EN ISO 3785:2023 "Metallic materials. Designation of test specimen axes in relation to product texture (ISO 3785:2023)".

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SFS-EN ISO 3785:2023

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NORME EUROPÉENNE
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EN ISO 3785

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English Version

Metallic materials - Designation of test specimen axes in relation to product texture (ISO 3785:2023)

Matériaux métalliques - Désignation des axes des éprouvettes en relation avec la texture du produit (ISO 3785:2023)

Metallische Werkstoffe - Kennzeichnung von Probenachsen in Bezug zur Halbzeuggefügetextur (ISO 3785:2023)

This European Standard was approved by CEN on 2 April 2023.

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Ref. No. EN ISO 3785:2023: E

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European foreword (CEN)

This document (EN ISO 3785:2023) has been prepared by Technical Committee ISO/TC 164 "Mechanical testing of metals" in collaboration with Technical Committee CEN/TC 459/SC 1 “Test methods for steel (other than chemical analysis)” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2023, and conflicting national standards shall be withdrawn at the latest by November 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 3785:2006.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO 3785:2023 has been approved by CEN as EN ISO 3785:2023 without any modification.

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Foreword (ISO)

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 4, *Fatigue, fracture and toughness testing,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 459/SC 1, *Test methods for steel (other than chemical analysis)*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 3785:2006), which has been technically revised.

The main changes are as follows:

— a reference to Annex A was added in the Introduction;

— in 6.5 a reference to ISO 15653 was added;

— a new Subclause 6.6 (Additive manufacturing) was added.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The measured mechanical properties of a metallic product, especially those characterizing ductility and toughness, such as elongation, reduction of area, fracture toughness and impact resistance, are dependent on the test specimen location within the product and orientation with respect to the product's principal directions of metal working, grain flow or otherwise-produced texture. This document specifies a method for designating specimen orientation in relation to product texture.

Additional information on the influence of mechanical working on material structure and properties is provided in Annex A.

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1 Scope

This document specifies a method for designating test specimen axes in relation to product texture by means of an X-Y-Z orthogonal coordinate system.

This document applies equally to unnotched and notched (or precracked) test specimens.

This document is intended only for metallic materials with uniform texture that can be unambiguously determined.

Test specimen orientation is decided before specimen machining, identified in accordance with the designation system specified in this document, and recorded.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Designation system

4.1 General

The method for relating specimen axes to the characteristic directions of the product makes use of an X-Y-Z orthogonal coordinate system for wrought metals:

— the letter X always denotes the direction of principal deformation (maximum grain flow in the product);

— the letter Y denotes the direction of least deformation;

— the letter Z denotes the direction normal to the X-Y plane.

4.2 Exception — not aligned

When the specimen direction does not coincide with the product's characteristic grain-flow directions, two letters are used as described for unnotched specimens in 5.2.2 and 5.2.4, and for notched specimens in 6.3.

4.3 Exception — no grain flow

When there is no grain-flow direction as in a casting, specimen location and orientation shall be specified on a part drawing and the test result shall carry no orientation designation.

5 Designation of unnotched specimens

5.1 General

The designations of unnotched specimens variously aligned with respect to the product's characteristic grain-flow directions are depicted in Figure 1. Only specimens fully aligned with, or lying midway between, the product's characteristic grain-flow directions are shown.

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5.2 Sheet, plate, bar (flat rolled products)

5.2.1 Aligned, grain flow different in all three orthogonal directions

For products of non-circular cross-section and grain flow differing in the three orthogonal directions, specimens aligned with the product's characteristic grain-flow directions are designated as either X-, Y- or Z-direction specimens as depicted in Figure 1 a).

5.2.2 Not aligned, grain flow different in all three orthogonal directions

For products of non-circular cross-section and grain flow differing in the three orthogonal directions, specimens lying midway between the product's characteristic grain-flow directions are designated as XY-, XZ- or YZ-direction specimens as depicted in Figure 1 f). When the specimen lies neither in alignment with the product's characteristic grain-flow directions nor midway between them, but rather at some other angle to them, then that angle shall be stated between the two designation letters, the first letter denoting the direction toward which the specimen axis is inclined, and the second letter the direction from which the specimen axis is inclined. This designation scheme is restricted to direction vectors that lie within any of the three planes described by the orthogonal X, Y and Z directions. When the direction vector lies outside those planes, specimen location and orientation shall be specified on a drawing of the product or part and the test result shall carry no orientation designation.

5.2.3 Aligned, equal cross-sectional grain flow

For products of non-circular cross-section with equal Y- and Z-direction grain flow, specimens oriented normal to the X-direction (principal direction of) grain flow may be designated as either Y- or Z-direction specimens, as depicted in Figure 1 a).

5.2.4 Not aligned, equal cross-sectional grain flow

For products of non-circular cross-section with equal Y- and Z-direction grain flow, specimens lying midway between the product's characteristic grain-flow directions are designated as XY-, XZ-, or YZ-direction specimens, as depicted in Figure 1 f). When the specimen lies neither in alignment with the product's characteristic grain-flow directions nor midway between them, but rather at some other angle to them, then that angle shall be stated between the two letters, the first letter denoting the direction toward which the specimen axis is inclined, and the second letter the direction from which the specimen axis is inclined. This designation scheme is restricted to direction vectors the lie within any of the three planes described by the orthogonal X, Y and Z directions. When the direction vector lies outside those planes, specimen location and orientation shall be specified on a drawing of the product or part and the test result shall carry no orientation designation.

5.3 Cylinders and thick-walled tubes

Specimen depictions in Figures 1 b) and 1 c) pertain to solid cylinders; those in Figure 1 d) apply to hollow cylinders (thick-walled tubes).

5.4 Thin-walled tubes, helical grain flow

Specimen depictions in Figure 1 e) pertain to products with helical grain flow, typically thin-walled tubing.

5.5 Castings

When there is no grain-flow direction as in a casting, specimen location and direction shall be specified on a part drawing and the test result shall carry no orientation designation.

6 Designation of notched (or precracked) specimens

6.1 General

Designating the plane and direction of crack extension for notched (or precracked) specimens, in relation to the product's characteristic grain-flow directions, is done using a hyphenated code wherein the letter(s) preceding the hyphen represent the direction normal to the crack plane and the letter(s) following the hyphen represent the anticipated direction of crack extension.

6.2 Aligned

When the specimen direction is aligned with the product's characteristic grain-flow directions, a single letter for each case is used to denote the direction perpendicular to the crack plane and the direction of intended crack extension, as depicted in Figure 2 a), 2 c) and 2 d).

6.3 Not aligned

When the specimen orientation directions lie midway between the product's characteristic grain-flow directions, two letters shall be used to denote the normal to the crack plane or the crack propagation direction, as depicted in Figure 2 b). When the specimen orientation directions lie neither in alignment with the product's characteristic grain-flow directions nor midway between them, but rather at some other angle to them, then that angle shall be stated between the two letters, the first letter denoting the direction toward which the crack plane normal or propagation direction is inclined, and the second letter the direction from which the crack plane normal or crack propagation direction is inclined. This designation scheme is restricted to direction vectors that lie within any of the three planes described by the orthogonal X, Y and Z directions. When the direction vector lies outside those planes, the specimen crack plane orientation and propagation direction shall be specified on a drawing of the product or part, and the test result shall carry no orientation designation.

6.4 No grain flow

When there is no grain-flow direction as in a casting, specimen location and crack plane orientation shall be specified on a part drawing and the test result shall carry no orientation designation.

6.5 Welds

For welds, specimen and crack plane orientation relative to the weld and parent metal, working directions are specified as prescribed in ISO 15653:2018, 6.3.

6.6 Additive manufacturing

Terms, nomenclature, and acronyms associated with coordinate systems and testing methodologies for additive manufacturing (AM) technologies are specified in ISO 17295, in an effort to standardize terminology used by AM users, producers, researchers, educators, press/media, and others, particularly when reporting results from testing of parts made on AM systems. Terms included in ISO 17295 cover definitions for machines/systems and their coordinate systems, plus the location and orientation of parts.

7 Application of designation system in material specification

7.1 General

The designation of specimen location and orientation with respect to the product characteristic directions is straightforward for regular structural configurations like plate and rod. It is more difficult for complex structural shapes, in which case knowledge of production and processing plays an essential role.

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7.2 Non-uniform grain flow

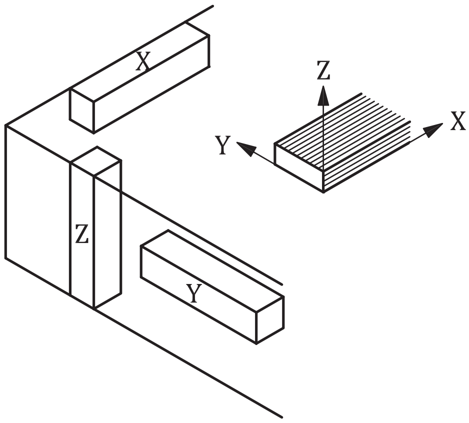
In cases where grain flow is not uniform, specimen location and orientation shall reference component geometry and be noted on component drawings along with a description of component production and processing.

7.3 Specifications

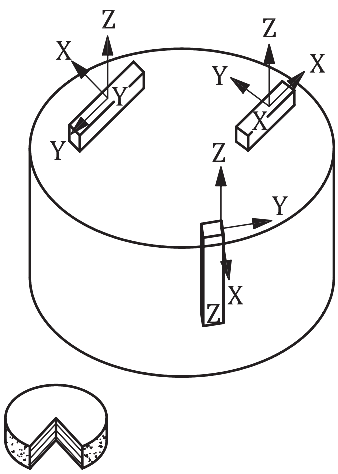
Specimen extraction shall conform to relevant specifications.

7.4 Comparisons

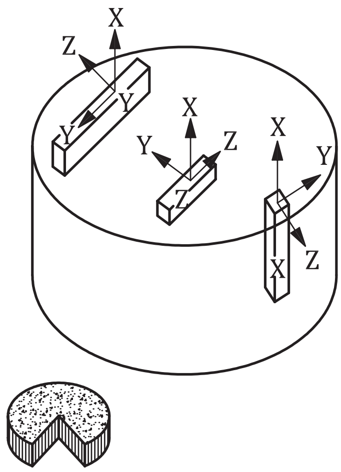
When products are to be compared on the basis of mechanical properties, it is essential that specimen location and orientation with respect to the product's grain-flow directions be comparable and that the results not be generalized beyond these limits.



a) Sheet, plate, bar



b) Cylinder — Radial grain flow, axial working direction



c) Cylinder — Axial grain flow, radial working direction

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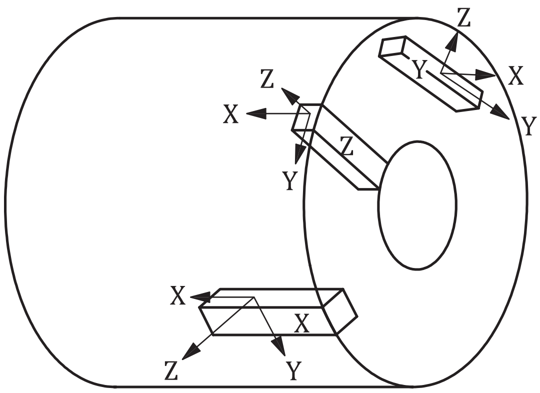
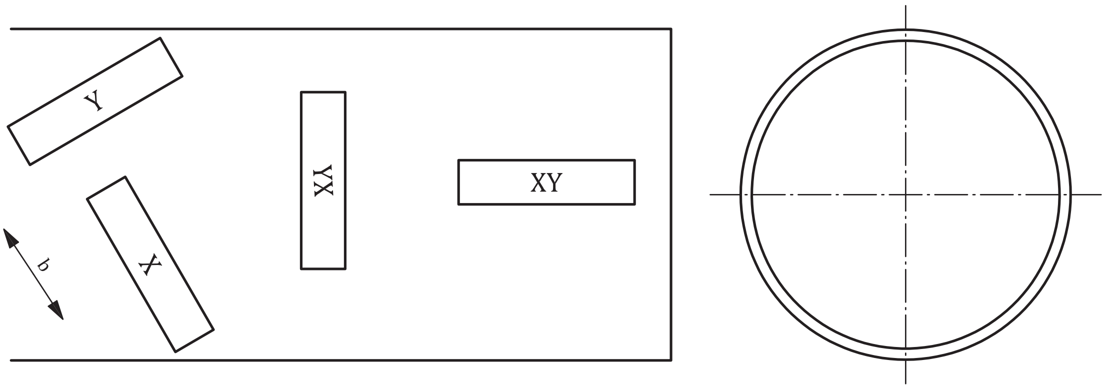
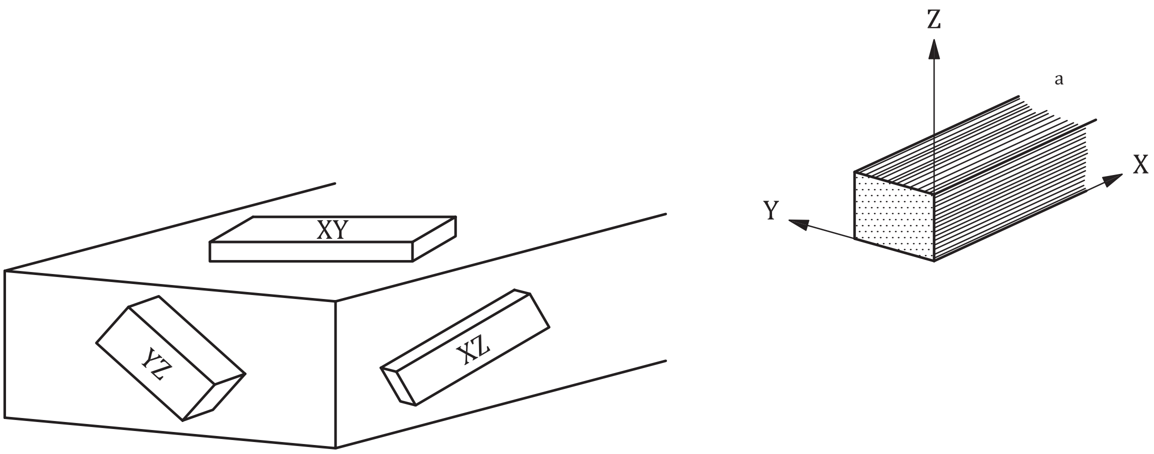


d) Tube (axial grain flow)



e) Thin-walled tube with helical grain flow



f) Not aligned — sheet, plate, bar

a Grain flow.

b Fibre.

Figure 1 Designation of unnotched test pieces

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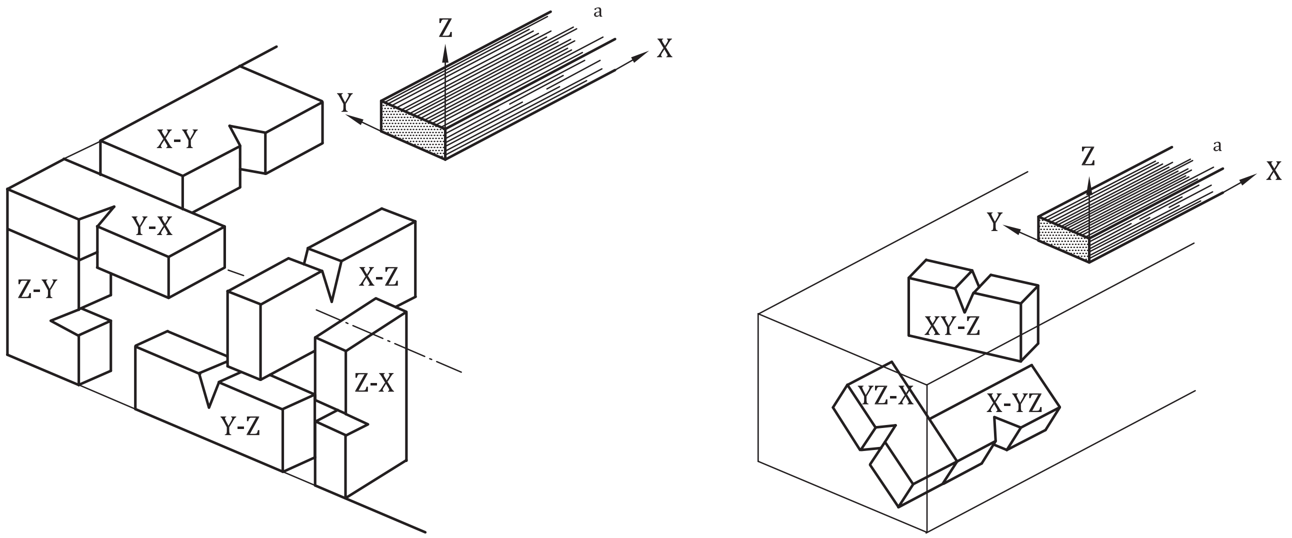
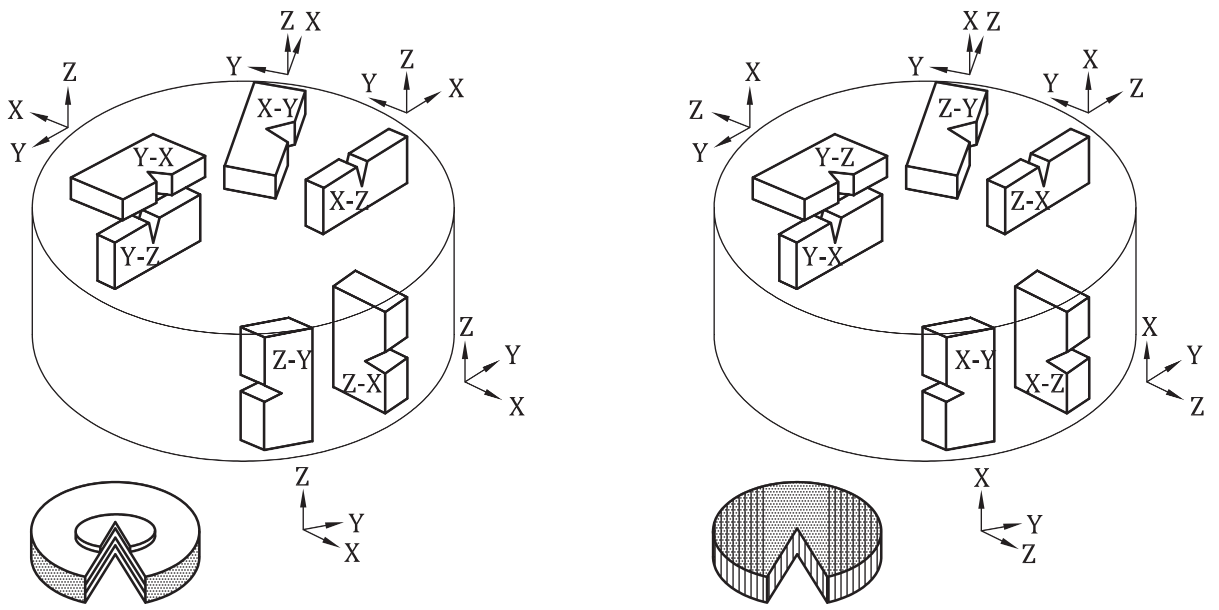


a) Aligned **b) Not aligned**



c) Radial grain flow, axial working direction **d) Axial grain flow, radial working direction**

[a] Grain flow.

Figure 2 Designation of notched (or precracked) specimens

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Annex A
(informative)
Influence of mechanical working on material structure and properties

A.1 Product production

Steep temperature gradients in the molten metal cause dendritic freezing patterns on cooling, whereas shallow gradients produce more equiaxed grains. Intermetallic compounds of all shapes and non-metallic particles of usually equiaxed shapes can be distributed throughout.

During hot working, recrystallization occurs and the intermetallic and non-metallic particles can be affected. All species within the metal are distorted, including the intermetallic and non-metallic particles if they are sufficiently malleable.

Cold working produces no recrystallization, but rather a continuous elongation of grains and possible further elongation of intermetallics and non-metallics.

The net processing effect is increased anisotropy. This should be considered in component design and fabrication, and in specimen sampling for the determination of mechanical response of the component.

A.2 Product geometry

In many instances, product geometry is tell-tale of grain flow. This is especially true of regular product forms such as plate, bar, sheet and rod. Because of the frequent coincidence of grain flow direction with product shape, specimen designation is often referred to in complimentary terms; for example, specimens taken with their long axis aligned with the long axis of the product are referred to as “longitudinal” specimens. The same is true for the transverse and short transverse directions.

Difficulty arises when the direction of principal grain flow is known to differ from the complimentary dimensions of the product; for example, short sheets cut from rolled wide coiled strip. Designations referring to the product geometry, such as tangential, radial, or axial, do not necessarily indicate the specimen orientation with respect to grain flow. In these instances, the method of production and processing is essential descriptive information. This is particularly so for forgings.

A.3 Product form, composition and processing

Besides the description of location and orientation, other factors are important in characterizing test results. Especially important are product form (bar, sheet, forging, etc.), chemical composition, and processing schedules including heat treatment and chemical or mechanical surface treatments. All this information is essential to the relevant material specification.

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Bibliography

[1] ISO 15653, *Metallic materials — Method of test for the determination of quasistatic fracture toughness of welds*

[2] ISO 17295, *Additive manufacturing — General principles — Part positioning, coordinates and orientation*

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