Global Advisory Group GAG - Guidance

GAG Guidance Document 001

Terms and Definitions

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Contents

Introduction

The market of many aluminium products is global and involves a global communication between the stakeholders, e.g. suppliers and purchasers. They are often of different native language, but mostly use the English language for their correspondence.

The aluminium industry uses a lot of technical terms which cannot be found in dictionaries. Some of them are collected in European or North American standards. But often they are used for different concepts, which may cause misunderstandings.

This Global Guidance Document has been prepared by the GAG/WG 01 "Terms and Definitions". It tries to improve communication in the international trade and by this intends to contribute to the elimination of trade barriers. Especially, it is intended to be a source for terms and definitions to be used in standards. By using identical terms and definitions, as far as possible, in standards of different countries or continents, a better alignment of such standards is possible.

The terms in this document are grouped in different clauses dealing with products, processing, sampling and testing, product characteristics and different types of non-conformities. It has been decided to include all these terms into one document, because it is assumed that the document will mainly be used in electronic form and search systems are used in order to find the relevant terms. In addition, an alphabetical register at the end of the document gives further guidance.

1. Scope

This Document defines general terms which are helpful for the communication within the aluminium industry and its customers relating to products of aluminium and aluminium alloys. It includes terms dealing with aluminium products, scrap and waste, processing, sampling and testing, product characteristics and different types of visual quality characteristics.

It does not include terms dealing with bauxite mining, alumina and anode production and aluminium smelting.

If other definitions of a term in this document appear in other documents, then these different definitions apply for the scope of this other document.

This Global Guidance Document tries to be as close as possible to terms and definitions as used in other standards or legal documents. If another definition of a term in this document appears in another document, then this different definition applies for the scope of this other document.

> NOTE: For materials other than aluminium different definitions can apply for terms which are defined in this document.

This Global Guidance Document tries to follow the "common language" as used in native English speaking countries, without giving preference to specific idioms of one of these counties. In cases where in different English-speaking countries different terms are used for the same concept or different concepts refer to an identical term, it gives the appropriate explanations. It does not urge specific regions to use global terms or orthographic spellings as defined in this document for local purposes. As an example, this document does not require to use the term "aluminium" instead of "aluminum" in documents where the audience is located in the USA. It is also understood that the definitions in this document may be translated into other languages, but we can provide no assurance as to the accuracy of such translations. English is the originating language for all definitions in this document.

This document is a revision of GAG Terms and Definitions 2009-01. Changes from the earlier edition are indicated as follows:

‡ - Indicates an added term.
† - Indicates a term that has been revised.

2. Aluminium products

2.1. Aluminium

2.1.1. aluminium

unalloyed aluminium or aluminium alloy

NOTE: In the USA the term "aluminum" is used.

2.1.2. unalloyed aluminium

aluminium without alloying elements where the minimum aluminium content is specified to be greater than 99,00%

NOTE: Unalloyed aluminium is often called “aluminium", i.e. the term "aluminium" then does not include aluminium alloys.

2.1.3. refined aluminium

unalloyed aluminium of high purity (aluminium content of at least: 99,950% by mass) obtained by special metallurgical treatments

2.1.4. primary aluminium

Unalloyed aluminium produced from alumina, typically by electrolysis, and with an aluminium content of 99,7%.

2.2. Alloys, alloying elements and impurities

2.2.1. alloy

substance having metallic properties and composed of two or more elements, so combined that they cannot readily be separated by physical means

2.2.2. aluminium alloy

aluminium which contains alloying elements, where aluminium predominates by mass over each of the other elements and where the aluminium content is not greater than 99,00%

2.2.3. alloying element

metallic or non-metallic element which is controlled within specific upper and lower limits for the purpose of giving the aluminium alloy certain special properties

2.2.4. impurity

metallic or non-metallic element present in a metal, the minimum content of which is not controlled

NOTE: Typically, the maximum concentration of an impurity in aluminium is controlled.

2.2.5. casting alloy

alloy primarily intended for the production of castings

2.2.6. refined aluminium alloy

casting alloy obtained after metallurgical treatment of molten metal obtained from aluminium scrap

2.2.7. wrought alloy

alloy primarily intended for the production of wrought products by hot and/or cold working

2.2.8. heat-treatable alloy

alloy which can be strengthened by suitable thermal treatment

2.2.9. non-heat-treatable alloy

alloy which is primarily strengthened only by working and not by thermal treatment

2.2.10. free machining alloy

alloy that, by virtue of its chemical composition and temper, is designed to give, on machining, small broken chips, typically by adding alloying elements with low melting point

2.2.11. hardener

alloy containing at least some aluminium and one or more additional elements intended to be added to molten aluminum to adjust the chemical composition and /or to control the as cast structure.

NOTE 1: The term “master alloy” is used for different concepts in different reasons and should be avoided. In Europe the term refers to hardeners obtained from melting and in the US the term refers to a hardener which combines several metallic elements in a fixed ratio and which is intended to be added to pure aluminum to provide a finished alloy composition.

NOTE 2: Hardeners can have various forms including waffles (obtained by casting the melt into an adequate mould), briquettes (obtained by compacting a powder), granules and wire.

2.2.12. grain refiner
hardener intended to refine the grain structure of cast aluminium

2.2.13. modifier
hardener intended to refine the microstructure of the alloy to which it is added

NOTE: An example of a modifier is 15% Sr.

2.2.14. performance hardener; performance product
hardener, not intended to adjust the chemical composition, but intended to improve alloy characteristics different from those achieved by grain refiners or modifiers

NOTE: Examples of performance hardeners include 20% Ca and 10% B.

2.3. Materials and products

2.3.1. unwrought product
product obtained by casting without further hot or cold working, e.g. ingots for rolling, ingots for extruding, ingots for forging, ingots for remelting, cast plate or castings

2.3.2. wrought product
product that has been subjected to hot working and/or cold working

2.3.3. semi-finished product †
product that has undergone some processing and is supplied for further processing before it is ready for use

NOTE: Semi-finished products include wrought products and castings. It does not include ingots and billets.

2.3.4. drawn product
product formed by pulling material through a die

2.3.5. laminated material
composite material obtained by joining layers of different materials together by means other than metallic bonding, typically by gluing them together

NOTE 1: Examples of laminated materials are paper on aluminium foil, extruded plastics films on aluminium foil, etc.

NOTE 2: Laminated material with a plastic core and aluminium skin on both sides is called "aluminium composite material (ACM)".

2.3.6. matrix
solid phase in which other constituents of the alloy are embedded as separate phases

2.3.7. slug
piece of metal of uniform thickness, of regular or irregular shape taken from a wrought product, typically for impact extrusion, with or without a centre hole

NOTE: This term is also used for cast or thyxocast pieces to be formed in semi-solid condition (thyxoforming).

2.3.8. blank
piece of metal of uniform thickness and of regular or irregular shape taken from a wrought or unwrought product

2.3.9. flake
flat or scale-like metal particles the thickness of which is small compared with the other dimensions

NOTE 1: Hardeners in the form of flakes are also called “splatters“.

NOTE 2: In product specifications or safety instructions this term is typically defined more precisely.

2.3.10. granules
metal particles of tear drop-like shape, typically of more than about 1 mm in diameter, obtained by solidification of aluminium drops

NOTE: In product specifications or safety instructions this term is typically defined more precisely.

2.3.11. aluminium powder
aggregate of discrete metal particles in specified size ranges, typically below 0,15 mm in diameter

NOTE 1: In product specifications or safety instructions this term is typically defined more precisely.

NOTE 2: Aluminium powder is typically produced by atomizing and ball-milling.

2.3.12. grit
aggregate of discrete metal particles, coarser than aluminium powder, in specified size ranges typically below 3 mm in diameter

NOTE 1: In product specifications or safety instructions this term is typically defined more precisely.

NOTE 2: Grit is typically produced by milling, grinding or crushing.

2.3.13. aluminium powder product
product obtained from fine aluminium powder by compacting and sintering, often followed by hot pressing and/or subsequent working; the product is characterized by a composition or structure which is difficult or impossible to obtain via casting

2.4. Unwrought products, excepting castings

2.4.1. ingot
cast product intended and suitable for remelting or forming by hot or cold working

2.4.2. primary aluminium ingot
ingot of unalloyed or alloyed aluminium cast from primary aluminium and possibly a small amount of run-around scrap

2.4.3. recycled aluminium ingot
aluminium ingot obtained by recycling of scrap

NOTE 1: The term "secondary aluminium" should be avoided for this concept.

NOTE 2: The terms "recycled aluminium strip", "recycled aluminium casting", "recycled aluminium profile" are defined accordingly.

2.4.4. ingot for remelting; remelt ingot
ingot intended and suitable for remelting

NOTE 1: Large ingots for remelting, typically having a mass of about 500 kg, are often called “sows“.

NOTE 2: Small ingots for remelting, typically having a mass of less than 25 kg, are often called “pigs“.

2.4.5. ingot for casting
ingot for remelting intended and suitable for the production of castings

2.4.6. extrusion ingot
ingot, intended and suitable for extruding, typically of solid circular cross-section, sometimes with a central hollow or a flattened cross-section

2.4.7. extrusion billet
extrusion ingot cut to length

2.4.8. extrusion log
extrusion ingot not cut to length

2.4.9. forging ingot
ingot intended and suitable for forging

2.4.10. rolling ingot
ingot intended or suitable for rolling

2.4.11. head (of an ingot)
end of a semi-continuously cast ingot corresponding to the end of the cast

NOTE: This term can refer to the removed head or the relevant extremity of the ingot.

2.4.12. butt (of an ingot)
end of a semi-continuously cast ingot corresponding to the start of the cast

NOTE: This term can refer to the removed butt or the relevant extremity of the ingot.

2.4.13. edge (of a rolling ingot)
one of the narrow faces (plane or of a specific geometry) of a rolling ingot parallel to the casting axis

2.4.14. rolling face (of a rolling ingot)
wide face of a rolling ingot

2.5. Castings

2.5.1. casting
product at or near finished shape, formed by solidification of the metal in a mould or a die

2.5.2. sand casting
casting produced by pouring molten metal into a sand mould and allowing it to solidify

2.5.3. permanent mould casting
casting produced by introducing molten metal by gravity or low pressure into a mould constructed of durable material, typically iron or steel, and allowing it to solidify

NOTE: permanent mould casting where the metal solidifies in a metal mould under low pressure (typically less than 1 bar above atmospheric pressure) is also referred to as "low pressure die casting".

2.5.4. semi-permanent mould casting
permanent mould casting which is made using an expendable core such as sand

2.5.5. die casting
casting produced by introducing molten metal under substantial pressure, typically above 100 bars into a metal die and characterized by a high degree of fidelity to the die cavity

NOTE: The term "pressure die casting" or "high pressure die casting" is often used for this concept.

2.5.6. precision casting
casting which fulfils special requirements concerning tolerances on form and dimensions

NOTE: Precision castings can be produced by different casting processes.

2.5.7. investment casting
precision casting formed by a three step process comprising:
a) fabrication of a ceramic mould around a wax or thermoplastic pattern with a refractory slurry that sets at room temperature;
b) removal of the pattern through the use of heat;
c) pouring of metal into this mould and allowing it to solidify

2.6. Sheet and plate

2.6.1. sheet
rolled product that is rectangular in cross section with nominal thickness less than 6 mm (in USA less than 0.250 inches [6.3 mm]) but not less than 0,20 mm (in USA greater than 0.006 inches [0.15 mm]) and with slit, sheared or sawed edges

NOTE 1: A sheet can be supplied in a corrugated, embossed, coated, edge conditioned or perforated form.

NOTE 2: Sheet between 3 mm and 6 mm is sometimes called “shate”.

NOTE 3: In Europe, the term "sheet" is only used for rolled products supplied in straight length, for coiled sheet the term "strip" is used.

NOTE 4: In the USA there is an overlap in the thickness range 0.006-0.0079 inch (0.15-0.20 mm) defined for foil and sheet. Sheet products in this gage range are supplied to sheet product specifications.

2.6.2. coiled sheet
sheet in coils with slit edges

2.6.3. plate
rolled product that is rectangular in cross section and with thickness not less than 6 mm (in USA not less than 0.250 inch) with sheared or sawn edges

2.6.4. hot rolled sheet/hot rolled plate
sheet or plate the final thickness of which is obtained by hot rolling

NOTE: A reroll plate is often called "slab".

2.6.5. cold rolled sheet/cold rolled plate
sheet or plate the final thickness of which is obtained by cold rolling

2.6.6. reroll stock
coiled sheet suitable and intended for further rolling

2.6.7. anodising sheet
sheet with metallurgical characteristics and surface quality suitable for the development of protective and decorative films by anodic oxidation processes

2.6.8. brazing sheet
sheet of a low melting point alloy or clad with a low melting point alloy, used for brazing

2.6.9. can stock
sheet or strip used for the fabrication of rigid cans including ends (lids) and tabs by drawing/ironing, pressing or forming operations. Can stock covers can body stock, end (lid) stock and tab stock

2.6.10. circle stock
sheet, strip or plate intended to be sawn, sheared or blanked into circles to be subsequently formed, drawn, etc.

2.6.11. foil stock
reroll stock suitable for further rolling to foil

2.6.12. fin stock
coiled sheet or foil suitable and intended for manufacture of fins for heat-exchanger applications

2.6.13. lithographic sheet
sheet having a superior finish on one side with respect to freedom from surface imperfections and supplied with a maximum degree of flatness for use as a plate in offset printing

2.6.14. reflector sheet
sheet with special requirements related to the surface quality intended and suitable for the manufacture of reflectors

2.6.15. roofing sheet
sheet intended and suitable for roofing application

2.6.16. tooling plate
cast or rolled product of rectangular cross-section over 6 mm (in USA 0.250 inches) in thickness, and with edges either as-cast, sheared or sawn, with internal stress levels controlled to achieve maximum stability for machining purposes in tool and jig applications

2.6.17. master coil, parent coil
coil processed to final temper as a single unit, intended to be slit and/or cut into smaller coils or into individual sheets or plates

NOTE: In North America the term "parent coil" is preferred for this concept.

2.6.18. master plate, parent plate
plate processed to final temper as a single unit, intended to be cut into smaller plates

2.6.19. top side (of a sheet)
the side of the strip with the higher surface finish requirements

NOTE 1: For coiled sheet the top side is normally the outside of the coil.

NOTE 2: For sheet supplied in stacks the top side is typically uppermost.

2.6.20. reverse side (of a sheet)
the side of the sheet which is opposite to the top side

2.6.21. painted sheet
sheet, one or both sides of which has a factory-applied paint coating of controlled thickness

2.6.22. mill finish sheet/plate
sheet/plate having a finish defined by the actual roll grinding and rolling conditions, without further specification from a customer or a standard

NOTE: The finish of mill finish sheet/plate can vary from sheet to sheet or within one sheet.

2.6.23. one side bright mill finish sheet
sheet having a moderate degree of brightness on one side and a mill finish on the other

2.6.24. satin-finish sheet
sheet with a fine-textured matte finish on one or both surfaces

2.6.25. clad sheet/clad plate
sheet or plate consisting of an aluminium core to which a thin layer of aluminium or another metal is metallurgically bonded on one side or on both sides, typically by rolling

2.6.26. Alclad sheet/Alclad plate
clad sheet/plate having on one or both surfaces a metallurgically bonded aluminium coating that is anodic to the core, thus electrolytically protecting the core against corrosion

NOTE: If one side only is clad, the product is often named "Alclad one side sheet/plate".

2.6.27. flat sheet
sheet with sheared, slit or sawed edges, which has been flattened or levelled

2.6.28. corrugated sheet, profiled sheet
roll-formed sheet of symmetric or asymmetric profile

2.6.29. patterned sheet; embossed sheet
sheet on which a raised or indented pattern has been impressed or embossed on either one or both faces

2.6.30. tread plate
sheet or plate upon which a pattern has been impressed on one side by rolling using a specially prepared roll with an appropriate pattern, to provide improved traction

2.6.31. machined plate
semi-finished product produced from a plate completely machined over one or two sides

2.6.32. blank
piece of metal of regular or irregular shape taken from a flat wrought product intended for subsequent processing such as bending, stamping or deep drawing

2.6.33. circle
circular blank fabricated from plate, sheet, or foil

2.6.34. disc
circle from which a central concentric area has been removed

2.7. Foil

2.7.1. foil
flat rolled product of rectangular cross-section with uniform thickness equal to or less than 0,20 mm (200 microns)

NOTE 1: In USA the maximum thickness of a foil is 0.0079 inch (formerly ≤ 0.006 in [0.15 mm]).

NOTE 2: In the USA there is an overlap in the thickness range 0.006-0.0079 inch [0.15-0.20 mm] defined for foil and sheet. Foil products in this gage range are supplied to foil product specifications.

2.7.2. converter foil
foil, typically soft annealed, supplied for further processing such as colouring, printing, embossing or laminating

2.7.3. container foil
single rolled foil with a gauge above approximately 35 µm, produced at soft or intermediate temper and often involving alloys of the 3xxx and 8xxx series intended for press forming into smooth or wrinkled walled containers for foodstuffs and the like

2.7.4. consumer foil; household foil
foil intended for public use, principally for use in culinary applications such as cooking and storage

2.7.5. printed foil
foil printed with a design or on all-over colour

2.7.6. embossed foil; patterned foil
foil on which a pattern has been impressed or embossed on either one or both faces

2.7.7. annealed foil
foil completely softened by thermal treatment

2.7.8. chemically cleaned foil
foil washed in a chemical solution to remove lubricants and other foreign material

2.7.9. etched foil
foil roughened chemically or electrochemically to provide an increased surface area

2.7.10. hard foil
foil fully work-hardened by rolling

2.7.11. intermediate temper foil
foil manufactured in an undetermined temper between "annealed" and "hard"

2.7.12. matte one side foil, pack rolled foil
foil with a diffuse reflecting finish on one side and a bright specular finish on the other

2.7.13. bright two-side foil
foil having a uniform bright specular finish on both sides

2.7.14. mechanically grained foil
foil mechanically roughened for such applications as lithography

2.7.15. mill finish foil
foil having a non-uniform finish which may vary from coil to coil and within a coil

2.8. Profiles and tubes

2.8.1. profile
wrought product that is long in relation to its cross-sectional dimensions which is of a form other than that of sheet, plate, rod, bar, tube, wire or foil

NOTE: For profiles sometimes the term "shape" or "section" is used.

2.8.2. extrudate
material exiting an extrusion die subject to further processing (quenching, stretching, cutting), to become an extruded profile

2.8.3. extruded profile
profile brought to final dimensions by extruding

2.8.4. cold-finished profile
profile brought to final dimensions by cold-working to obtain improved surface finish and dimensional tolerances

2.8.5. drawn profile
cold-finished profile brought to final dimensions by drawing through a die

2.8.6. solid profile
profile in which the cross-section does not include any enclosed void

2.8.7. hollow profile
profile in which the cross section completely encloses one or more voids

2.8.8. semi-hollow profile
solid profile any part of whose cross section is a partially enclosed void the area of which is substantially greater than the square of the width of the gap

NOTE: The ratio of the area of the void to the square of the gap is dependent on the class of semi-hollow profile, the alloy and the gap width.

2.8.9. seamless profile
hollow profile which does not contain any line junctures resulting from method of manufacture

2.8.10. precision profile
profile which fulfils special requirements concerning tolerances on form and dimensions

2.8.11. structural profile
profile, rolled or extruded, commonly used for structural purposes such as angles, channels, H-beams, I beams, tees, and zees

2.8.12. tube
hollow wrought product of uniform cross-section with only one enclosed void and with a uniform wall thickness, supplied in straight lengths or in coiled form; cross-sections are in the shape of circles, ovals, squares, rectangles, equilateral triangles or regular polygons and can have corners rounded, provided the inner and outer cross-sections are concentric and have the same form and orientation

NOTE: Tubes can be formed by extrusion or by forming and joining of sheet.

2.8.13. extruded tube
tube brought to final dimensions by extruding

2.8.14. drawn tube
tube brought to final dimensions by drawing through a die

2.8.15. sized tube
tube that, after extrusion, has been cold drawn a slight amount to minimize ovality

2.8.16. porthole tube/bridge tube
tube produced by extrusion of a solid billet through a porthole or bridge die

NOTE: The product is characterised by one ore more longitudinal extrusion seams

2.8.17. seamless tube
tube which does not contain any line junctures resulting from method of manufacture

2.8.18. welded tube
tube produced by longitudinal seam-welding, typically of formed sheet

NOTE: Welded tubes can be fabricated by arc-welding with or without welding wire, high frequency seam welding, or any other type of welding.

2.8.19. tube stock
semi-finished tube suitable for the production of drawn tube

NOTE: Tube stock is also referred to as tube bloom.

2.8.20. alclad tube
composite tube composed of an aluminium alloy core having on either the inside or outside surface a metallurgically bonded aluminium coating that is anodic to the core, thus electrolytically protecting the core against corrosion

2.8.21. embossed tube
tube the outside surface of which has been roll-embossed with a design in relief regularly repeated in a longitudinal direction

2.8.22. heat exchanger tube
tube used in apparatus in which fluid inside the tube will be heated or cooled by fluid outside the tube, but the term is typically not applied to coiled tube or to tube for use in refrigerators or radiators

2.8.23. structural tube
tube commonly used for structural purposes

2.8.24. pipe
tube in standardized combinations of outside diameter and wall thickness

NOTE: Pipe is commonly designated by “Nominal Pipe Sizes” and “ANSI Schedule Numbers”.

2.8.25. back-end defect ‡
cone-shaped defect resulting from surface contaminations and oxides being built up in front of the advancing extrusion pad due to container friction resulting in annular separation in the rear of the extrusion

2.9. Rod, bar and wire

2.9.1. rod
solid wrought product of circular cross section that is long in relation to its diameter, typically supplied in straight length

NOTE 1: In North America, the minimum diameter of a rod is 0.375 inches (greater than 10 mm); below this limit, the product is called "wire".

NOTE 2: In Europe, a rod is supplied in straight length; if supplied in coiled form, the product is called "wire".

NOTE 3: In Europe, a rod is often called "round bar".

2.9.2. bar
solid wrought product that is long in relation to its cross-section which is square or rectangular (excluding plate and flattened wire) with sharp or rounded corners or edges, or is a regular hexagon or octagon, typically sup-plied in straight length

NOTE 1: In North America, the minimum perpendicular distance between at least one set of parallel faces of a bar is 0.375 inches (greater than10 mm); below this limit the product is called "wire".

NOTE 2: In Europe, a bar is supplied in straight length; if supplied in coiled form, the product is called "wire".

2.9.3. extruded rod
rod brought to final dimensions by extruding

2.9.4. extruded bar
bar brought to final dimensions by extruding

2.9.5. cold-finished bar
bar brought to final dimensions by cold work to obtain improved surface finish and dimensional tolerances

NOTE: Typically cold finished bars are obtained by drawing.

2.9.6. cold-drawn rod
rod brought to final dimensions by cold-drawing through a die

2.9.7. cold-drawn bar
bar brought to final dimensions by cold-drawing through a die

2.9.8. rolled rod
rod brought to final dimensions by hot rolling

2.9.9. rolled bar
bar brought to final dimensions by hot rolling

2.9.10. brazing rod
rod of a low melting temperature alloy for use as filler metal in brazing

2.9.11. welding rod
rod for use as filler metal in joining by welding

2.9.12. square bar
bar of a square cross-section

2.9.13. rectangular bar
bar of a rectangular cross-section

NOTE: The term “rectangular rod/bar” includes “flattened circles” and “modified rectangles” of which two opposite sides are convex arcs, the other two sides being straight, of equal length and parallel.

2.9.14. hexagonal bar
bar having the cross-section of a regular hexagon

2.9.15. bus bar
rigid electric conductor in the form of a bar

NOTE: A rigid electric conductor of any cross-section is often called "bus conductor".

2.9.16. wire
solid wrought product that is long in relation to its cross-section, which is square or rectangular with sharp or rounded corners or edges, or is round, hexagonal, or octagonal

NOTE 1: In North America, the maximum diameter or perpendicular distance between parallel faces of a wire is less than 0.375 inches (up through 10.00 mm); above this limit the product is called "rod" or "bar".

NOTE 2: In Europe, a wire is supplied in coiled form; if supplied in straight length, the product is called "rod" or "bar".

2.9.17. drawn wire
wire brought to final dimension by drawing through a die

2.9.18. extruded wire
wire brought to final dimensions by extruding

2.9.19. flattened wire
wire having two parallel flat surfaces and rounded edges, typically produced by roll-flattening round wire

2.9.20. drawing stock
semi-finished solid wrought product of uniform cross section along its whole length, supplied in coils and of a quality intended and suitable for drawing into wire

2.9.21. conductor wire
wire possessing the requisite electrical and mechanical properties for use as an electrical conductor

2.9.22. brazing wire
wire of a low melting temperature alloy for use as filler metal in brazing

2.9.23. welding wire
wire for use as filler metal in joining by welding

2.9.24. alclad wire
composite wire product comprised of an aluminium alloy wire having on its surface a metallurgically bonded aluminium or aluminium alloy coating that is anodic to the alloy to which it is bonded, thus electrolytically protecting the core against corrosion

2.9.25. machining stock
bar or wire typically supplied to close tolerances and suitable for repetition machining operations

NOTE: This product is sometimes referred to as “screw machine stock” (SMS).

2.9.26. bolt stock
bar or wire suitable and intended for the manufacture of bolts

NOTE: The terms "cold heading rod" or "cold heading bar" are often used for this concept.

2.9.27. rivet stock
bar or wire suitable for the manufacture of rivets

NOTE: The terms "cold heading rod" or "cold heading bar" are often used for this concept.

2.9.28. screw stock
bar or wire suitable for the manufacture of screws

2.10. Forgings and forging stock

2.10.1. forging
wrought product formed by hammering or pressing, typically when hot, between open dies (hand forging) or closed dies (drop or die forging)

2.10.2. die forging
forging shaped by working in closed dies

2.10.3. hand forging
forging worked between flat or simply shaped dies by repeated strokes or blows and manipulation of the piece, intending to convert the metallurgical structure from cast to wrought prior to machining into a final part

2.10.4. precision forging
forging produced to tolerances closer than standard

2.10.5. drop forging
forging formed by a heavy die which drops on the metal

2.10.6. hammer forging
forging produced by repeated blows of a forging hammer

2.10.7. rolled ring forging
cylindrical product of relatively short height, circumferentially rolled from a hollow section

2.10.8. blocker-type forging
forging made in a single set of impressions to the general contour of a finished part

2.10.9. cold-coined forging
forging that has been restruck cold in order to obtain closer dimensions, to sharpen corners or outlines and in non-heat-treatable alloys, to increase hardness

2.10.10. impact
part formed in a confining die from a metal slug, typically cold, by rapid single stroke application of force through a punch, causing the metal to flow around the punch and/or through an opening in the punch or die

2.10.11. forging stock
solid product, typically ingot, rod, bar of profile, intended and suitable for forging

NOTE: Forging stock is typically a cast product or an extruded product

3. Technical and metallurgical processes, scrap and residues

3.1. Casting and allied finishing operations

3.1.1. casting process
process in which molten metal is introduced into a mould where it solidifies

3.1.2. direct chill (DC) casting
casting process in which molten metal is solidified in a water-cooled open-ended mould from the outlet of which water is directly applied to the emerging ingot

3.1.3. continuous casting
casting process in which molten metal is solidified rapidly in a cooled mould and continuously withdrawn and cut while the mould is being simultaneously replenished with liquid metal

3.1.4. rod casting
continuous casting with subsequent in-line-rolling to wire, drawing stock or coiled profile

3.1.5. strip casting
continuous casting with subsequent in-line-coiling to strip, sometimes after one or several rolling passes

3.1.6. semi-continuous casting
casting process in which liquid metal is solidified rapidly in a cooled mould and continuously withdrawn until the required length has been produced, when casting is discontinued

3.1.7. scalping
removal of the surface layer from an ingot or a semi-finished wrought product so that surface imperfections will not be worked into the finished product

3.1.8. sand casting process
casting process in which molten metal is poured into a sand mould and solidified

3.1.9. permanent mould casting process; chill casting process
casting process in which molten metal is introduced by gravity or low pressure into a mould constructed of durable material, typically iron or steel

NOTE: A permanent mould casting process where the metal solidifies in a metal mould under low pressure (typically less than 1 bar above atmospheric pressure) is also referred to as "low pressure die casting process".

3.1.10. die casting process

casting process in which molten metal is introduced under substantial pressure, typically above 100 bars into a metal die

NOTE: Also referred to as "pressure die casting (process)" or "high pressure die casting (process)".

3.1.11. investment casting process

casting process of separate steps comprising:

a) fabrication of a ceramic mould around a wax or thermoplastic pattern with a refractory slurry that sets at room temperature
b) removal of the pattern through the use of heat
c) pouring of metal into this mould and allowing it to solidify

3.2. Forming and working, general terms

3.2.1. forming

process by which a metal is transformed into a desired shape without changing its mass

3.2.2. working

forming of solid metal

3.2.3. hot working

forming of a solid metal after preheating

NOTE: Strain hardening may or may not occur during hot working.

3.2.4. cold working

forming of a solid metal without preheating

3.2.5. thermo-mechanical processing

combination of hot or cold working and heat treatment

3.2.6. drawing

pulling metal through a die in order to reduce or change the cross-section or to work harden the metal

NOTE: In forging, this term describes the process of working metal between flat dies to reduce the cross section and increase length.

3.2.7. stretching

imparting sufficient permanent set by applying a unidirectional force to cause strain hardening and reduce internal stress and distortion.

NOTE: Examples include flattening of rolled metal and straightening of extruded or extruded and drawn metal."

3.2.8. stress relieving

reduction of internal residual stresses by thermal or mechanical means

3.2.9. strain

measure of the change in size or shape of a body due to stress, relative to its original size or shape

NOTE: Tensile or compressive strain is the change, due to force, per unity of length in an original linear dimension in the direction of the force. It is typically measured in percent.

3.2.10. permanent set

strain remaining after complete release of the force producing the strain

3.2.11. strain hardening

modification of a metal structure by cold working resulting in an increase in strength and hardness, generally with loss of ductility

3.2.12. stress

force per unit of area. Stress is normally calculated on the basis of the original cross-sectional dimensions. The three kinds of stresses are tensile, compressive, and shear

3.3. Rolling and finishing of rolled products

3.3.1. rolling

forming of solid metal in a gap between two rotating cylinders

3.3.2. hot rolling

rolling after preheating

NOTE 1: The purpose of hot rolling is typically to improve the efficiency of the rolling process.

NOTE 2: Surface finish and dimensional tolerance control of hot rolled metal are generally inferior to cold rolled metal.

3.3.3. cold rolling
rolling without preheating

3.3.4. double rolling
simultaneous rolling of two foil webs in the same gap with the two webs in contact

NOTE: Sometimes the term "pack rolling" is used for this concept.

3.3.5. temper rolling
controlled reduction by rolling to develop the required mechanical properties

3.3.6. levelling
the mechanical flattening of plate, sheet or foil

NOTE: The operation is carried out by stretching, local reverse bending, and other methods.

3.3.7. roller levelling
flattening of plate or sheet by passing it between a series of staggered rolls

3.3.8. stretcher levelling
levelling carried out by uniaxial tension

3.3.9. tension levelling
flattening of a strip continuously on a series of staggered rolls with applied tension, thus stretching the strip while bending it

3.3.10. skin pass
light cold rolling of sheet or strip to improve or modify the surface finish and to minimize stretcher strain on further manipulation

NOTE: This operation can increase the yield strength and to a lesser extent the tensile strength.

3.3.11. slitting
cutting of a coiled sheet into two or more widths by the use of rotary shears

3.3.12. trimming
removal of excess metal from the edges of a coiled sheet

NOTE: This term is sometimes also used for other semi-finished product.

3.3.13. blanking (closed cut)
production of blanks by stamping on a blanking press with closed cut

3.3.14. shearing
cutting of metal by the use of a press or guillotine

3.3.15. milling (of plate)
machining process in which metal is removed by a revolving multi-edged cutter to provide flat or profile surfaces

NOTE: Removal of metal by etching is often termed "chemical milling".

3.3.16. core (of coil)
hollow cylinder on which a coiled product may be wound that forms the inside diameter of a coil

3.3.17. liner
the slab of coating metal that is placed on the core alloy and is subsequently rolled down to clad sheet as composite

3.3.18. deburring ‡
a method whereby the raw slit edge of metal is removed by rolling or filing

3.4. Extrusion, drawing and finishing of extruded/drawn products

3.4.1. extrusion (process)
process in which a billet in a container is forced under pressure through an aperture of a die

3.4.2. direct extrusion
extrusion process with relative movement between billet and container

3.4.3. indirect extrusion
extrusion process without relative movement between billet and container

3.4.4. extrusion press
machine consisting essentially of a container, a ram or other pressure-applying device, and a die, used for extrusion

3.4.5. container
hollow cylinder in an extrusion press from which the billet is extruded

3.4.6. tool
term typically referring to the dies, mandrels, etc., used in the production of extruded or drawn profiles or tube

3.4.7. extrusion die
block of steel having one or more holes of the required contour through which a billet is forced

3.4.8. porthole die
extrusion die that incorporates a mandrel as an integral part of the die assembly

NOTE 1: Bridge, spider and self-stripping dies are special forms of porthole die.

NOTE 2: Hollow profiles or tubes extruded by a porthole die are characterized by one or more longitudinal extrusion seams.

3.4.9. extrusion ratio
the ratio of the cross-sectional area of the extrusion container to that of the extruded product

3.4.10. press discard (extrusion); extrusion butt
that portion of an extrusion billet that is left unextruded

3.4.11. extrusion effect
increased tensile properties in the longitudinal direction of an extruded product caused by a characteristic non-recrystallized structure in certain alloys

3.4.12. extrusion seam
region in an extruded product where metal has been welded together in the extrusion die because of high pressure and elevated temperature

NOTE: The extrusion seam is not visible on the extruded product unless an appropriate surface treatment, e.g. etching and anodising, has been made.

3.4.13. longitudinal extrusion seam
extrusion seam in a hollow profile or a tube, parallel to the extrusion direction, which has been formed after creating two or more streams of metal and rejoining them around the mandrel of a porthole or bridge die

NOTE 1: Extrusion seams are naturally occurring in porthole/bridge dies.

NOTE 2: This concept is sometimes termed “charge weld”.

3.4.14. transverse extrusion seam
extrusion seam which is formed when two subsequent billets are welded together in the extrusion die

3.4.15. contour
that portion of the outline of a transverse cross-section of an extruded shape that is represented by a curved line or curved lines

3.4.16. straightening
correcting operation of a drawn or extruded product, to fulfil the requirements concerning tolerances on form and dimensions

3.4.17. roller straightening
straightening of an extruded or drawn product by passing it through a series of adequately arranged rolls

NOTE: For round products, this process is typically called “reeling”.

3.4.18. reeling (of wire)
winding of a wire onto a reel, bobbin or drum

3.4.19. shaving
drawing of a rod, tube or wire through a die with a cutting edge in order to remove a thin layer from its surface

3.5. Other forming operations

3.5.1. close-to-form forging; near net-shape forging
die forging of such dimensional accuracy that subsequent machining is eliminated or reduced to a minimum

3.5.2. coining (of forged material)
final cold forging operation applied to obtain close tolerances

3.5.3. controlled compression
working of forged metal at room temperature immediately after quenching and under compression through the thickness in the solution treated condition to relieve internal stresses caused by quenching, and to minimize distortion during machining

3.5.4. closed die
forging dies, typically in pairs, into which impressions have been cut to impart the required shape

3.5.5. deep drawing
forming a deeply recessed part by forcing sheet metal to undergo plastic flow between dies, typically without substantial thinning of the sheet

3.5.6. drawing and ironing
deep drawing followed by substantial thinning of the sheet in the gap between a cylinder and a ring

3.5.7. impact extrusion
process in which an unheated slug is extruded through a die by a single blow, extruded in the direction of the blow; or in the space between the punch and the closed die, extruded in the direction counter to the blow

3.5.8. superplastic forming
forming of alloy sheet, typically biaxial, which has been specially processed to have fine grain size and a low flow stress at a critical strain rate and temperature, resulting in very large plastic deformation

NOTE: Forming is typically carried out using low gas pressure to force the sheet against a single surface tool.

3.5.9. hydroforming
forming of a hollow profile or a tube in a die by use of a liquid under high pressure

3.6. Thermal treatment

3.6.1. thermal treatment
heating, holding at elevated temperature and cooling of the solid metal in such a way as to obtain desired metallurgical structure or properties

NOTE 1: Heating for the sole purpose of hot working (see 3.6.2 preheating) is excluded from the meaning of this term.

NOTE 2: The term "heat treatment" is used for the same concept as a synonym.

3.6.2. preheating
process in which the material is raised to an elevated temperature for the start of the first operation of forming solid metal

NOTE: In some cases preheating can be combined with homogenization.

3.6.3. homogenizing
process whereby metal is heated to temperatures near the solidus temperature and held at that temperature for varying lengths of time in order to reduce microsegregation and modify the form and composition of intermetallic phases, which typically results in an improved formability by hot and/or cold working

3.6.4. controlled atmosphere
atmosphere in which the partial pressures of the gases and the temperature are maintained within specified limits so as to minimize (or more rarely induce) certain reactions between the atmosphere and the product treated, e.g. oxidation

3.6.5. temper
condition of the metal produced by mechanical and/or thermal processing, typically characterized by a certain structure and specified properties

3.6.6. annealing
thermal treatment to soften metal by reduction or removal of strain hardening resulting from cold working and/or by coalescing precipitates from the solid solution

3.6.7. flash annealing
annealing carried out by heating quickly and, if necessary, holding for a short time at an appropriate temperature, typically in continuous furnaces

3.6.8. partial annealing
annealing of a cold worked metal to reduce the strength to a controlled, but not fully softened, level

3.6.9. recrystallization annealing
annealing to obtain complete recrystallization of the metal

3.6.10. super annealing
annealing of a heat treatable alloy, followed by a slow, controlled rate of cooling to produce a condition of maximum ductility with a minimum tendency to natural ageing

3.6.11. stabilizing; stabilization
thermal treatment, typically at low temperatures, used to accelerate constitutional or structural changes in a solid metal in order to promote stability in dimensions, in mechanical properties, in structure or in internal stress under service conditions

3.6.12. thermal stress relieving
reduction of internal stresses by thermal treatment

3.6.13. overheating
heating a product, beyond the intended temperature, which may result in the melting of certain constituents and a reduction in mechanical properties

NOTE: Typically, overheated metal cannot be reclaimed by thermal or mechanical treatment.

3.7. Solution heat treatment, quenching and ageing

3.7.1. solution heat treatment
heating an alloy to a suitable temperature for sufficient time to allow one or more soluble constituents to enter into solid solution, where they are retained in a supersaturated state after quenching

3.7.2. furnace solution heat treatment
heating an alloy to a suitable temperature in a furnace and holding for a sufficient time to allow one or more soluble constituents to enter into solid solution, where they are retained in a supersaturated state after quenching

3.7.3. extrusion press solution heat treatment
heating an alloy to a suitable temperature then extruding, while holding for sufficient time to allow one or more soluble constituents to enter into solid solution, where they are retained in a supersaturated state after quenching

3.7.4. forging press solution heat treatment
heating an alloy to a suitable temperature and then forging, while holding for sufficient time to allow one or more soluble constituents to enter into solid solution, where they are retained in a supersaturated state after quenching

3.7.5. rolling mill solution heat treatment
heating an alloy to a suitable temperature, rolling the material to final thickness, while holding for sufficient time to allow one or more soluble constituents to enter into solid solution where they are retained in a supersaturated state after quenching

3.7.6. quenching
cooling a metal from an elevated temperature by contact with a solid, a liquid or a gas, at a rate rapid enough to retain most or all of the soluble constituents in solid solution

3.7.7. air quenching
quenching of a product by forced air, e.g. ventilators

3.7.8. hot line quenching
quenching of a rolled product on its exit from hot mill

3.7.9. press quenching
quenching of an extruded product on its exit from the extrusion press

3.7.10. as-quenched condition
condition of an alloy during the time immediately following quenching and before the mechanical properties have been significantly altered by precipitation hardening

3.7.11. quenching stress
non-uniform stress retained within the metal after quenching

3.7.12. critical quenching rate
minimum mean cooling rate from solution treatment temperature necessary to enable an alloy to possess certain mechanical properties in the precipitation hardened condition

3.7.13. incubation period (quenching)
the interval between the quenching operation and the start of a significant change in properties produced by precipitation hardening

3.7.14. transfer period (quenching)
the time between removing the metal from the solution treatment furnace and contact with the quenching medium

3.7.15. ageing
treatment of a metal aiming at a change in its properties by precipitation of intermetallic phases from supersaturated solid solution

NOTE 1: Ageing can be a treatment at room temperature (natural ageing) or a thermal treatment (artificial ageing).

NOTE 2: In North America the term "aging" is used.

3.7.16. precipitation hardening
increase in strength and hardness caused by precipitation of intermetallic phases from supersaturated solid solution

3.7.17. age softening
decrease in strength and hardness at room temperature in certain strain hardened alloys containing magnesium

3.7.18. delayed ageing
process where an alloy is kept below room temperature in order to prevent or delay precipitation from supersaturated solid solution

NOTE: After returning to room temperature precipitation process will continue normally.

3.7.19. peak ageing
artificial ageing under temperature and time conditions that result in maximum tensile strength

3.7.20. under-ageing
artificial ageing below peak ageing temperature and time conditions resulting in slightly reduced tensile strength and improved ductility, compared with peak aged metal

3.7.21. over-ageing
artificial ageing beyond peak ageing temperature and time conditions, in order to improve selected metallurgical characteristics of the metal, e.g. resistance to stress corrosion or intergranular corrosion

NOTE: Over-ageing results in reduced tensile properties compared with peak aged metal.

3.7.22. step ageing
artificial ageing typically carried out in two successive stages at different specified temperatures

3.7.23. ramp ageing
step ageing involving a time-controlled increase or decrease in temperature between the specified temperatures, either in steps or continuously

3.7.24. pre-ageing
short thermal treatment applied after quenching, but before significant precipitation hardening occurs

3.8. Electrochemical and chemical treatment

3.8.1. electrochemical brightening
electrochemical treatment to improve the reflectivity of a surface

3.8.2. electropolishing
polishing of a metal surface by making it anodic in an appropriate electrolyte

3.8.3. anodised metal
metal with an anodic layer, produced by an electrolytic oxidation process in which a metal surface layer is converted to an oxide layer having protective, decorative or functional properties

3.8.4. clear anodised metal
metal with a substantially colourless, translucent anodic oxidation finish

3.8.5. colour anodised metal
anodised metal coloured either during anodising or by subsequent colouring processes

3.8.6. integral colour anodised metal
metal that has been anodised using an appropriate (typically organic acid based) electrolyte which produces a coloured finish during the anodising process itself

3.8.7. electrolytically colour anodised metal
metal with an anodic oxidation layer that has been coloured by the electrolytic deposition of a metal or metal oxide into the pore structure

3.8.8. dyed anodised metal
metal with an anodic oxidation layer coloured by absorption of dye-stuff or pigments into the pore structure

3.8.9. combination colour anodised metal
metal with an anodic oxidation layer that is coloured by electrolytic colouring or produced by integral colour anodising followed by absorption dyeing

3.8.10. interference colour anodised metal
metal with an anodic oxidation layer coloured by means of optical interference effects, as intended

3.8.11. bright anodised metal
anodised metal with a high specular reflectance as the primary characteristic

3.8.12. protective anodising
anodising where protection against corrosion or wear is the primary characteristic and appearance is secondary or of no importance

3.8.13. decorative anodising
anodising where a decorative finish with a uniform or aesthetically pleasing appearance is the primary characteristic

3.8.14. architectural anodising
anodising to produce an architectural finish to be used in permanent, exterior and static situations where both appearance and long life are important

3.8.15. hard anodised metal
anodised metal on which the anodic oxidation finish has been produced with wear and/or abrasion resistance as the primary characteristic

3.8.16. sealing
treatment of anodised metal by hydrothermal processes carried out after anodising to close the pores of the anodic layer and to reduce the absorption capacity of the coating

3.8.17. cold impregnation; cold sealing
sealing at temperatures significantly below 100℃, but higher than room temperature

3.8.18. significant surface
the part of the product covered or to be covered by the anodised layer and for which this layer is essential for serviceability and/or appearance

3.8.19. chemical brightening
chemical treatment to improve the reflectivity of a surface

3.8.20. chemical polishing
polishing of a metal surface by immersion in a solution of chemical reagents

3.8.21. degreasing
removal of substances from the surface of a product which may negatively affect the subsequent surface treatment, e.g. oil or grease, typically by a suitable organic solvent or an aqueous detergent

3.8.22. etching
selective dissolution of the surface of a metal in a liquid, typically caustic soda, with the intention to improve the surface aspect or to prepare the surface for further treatment or for inspection

NOTE 1: Etching can also be performed by an electrochemical process.

NOTE 2: Caustic etching is important to produce the required product appearance in architectural and decorative anodising.

NOTE 3: The term "pickling" for this concept is not a preferred term within the aluminium industry.

3.9. Coating

3.9.1. coating (organic)
process in which a coating material is applied on a metallic substrate, including cleaning and chemical pretreatment

NOTE 1: This term covers a one-side or two-side, single or multiple application of liquid or powder coating materials which are subsequently cured.

NOTE 2: This term also covers laminating with plastic films.

3.9.2. coil coating
continuous coating of a coiled metal sheet

3.9.3. backing coat
single coating of any type with no particular requirements for appearance, malleability, corrosion protection, etc., typically on the reverse side of the coated product

3.9.4. conversion coating
inorganic pretreatment applied to a metal surface by dipping or spraying or the use of a roll-coater to build up a stable oxide film to enhance coating adhesion and to retard corrosion

NOTE 1: Liquids containing chromates or phosphates are often used for conversion coating.

NOTE 2: For many applications, chromate pretreatments have been replaced by non-chromate pretreatments.

3.9.5. priming
application of a coating material, often combined with a corrosion inhibitor, after suitable pretreatment, over which a subsequent coating layer will be applied

3.9.6. pretreatment priming
application of a solution containing a resin, a corrosion inhibitor and an acid, which is allowed to dry on and provide the key for subsequent painting

3.9.7. single coat system
single coating either with requirements on appearance, malleability, corrosion protection, subsequent painting, etc., or as a primer with special properties regarding adhesion and corrosion protection for post-painting applications

3.9.8. multiple coat system
system comprising a primer or a base coat, possibly intermediate coat(s), and a top coat with particular requirements on appearance, malleability, corrosion protection, etc.

3.9.9. organic coating
paint or lacquer film on a coated product produced from wet paint or from powder coating, or the laminated organic film

3.9.10. film coating
organic film applied to a substrate to which an adhesive and, as appropriate, a primer has been applied beforehand

3.9.11. lacquering
coating with a formulation based on a dissolved material which forms a transparent layer primarily after drying by evaporation of the solvent

3.10. Mechanical surface treatment and surface finish

3.10.1. mechanical polishing
polishing with a flexible rotating mop carrying an abrasive compound

3.10.2. grinding
removal of material by means of abrasives contained in, or bonded to, a rigid or flexible holder

3.10.3. linishing
grinding with a coarse abrasive to remove superficial defects, either to produce a decorative finish or preparatory to further processing

3.10.4. buffing
mechanical finishing operation in which fine abrasives are applied to a metal surface by rotating fabric wheels for the purpose of developing a lustrous finish

3.10.5. shot blasting
projection of abrasive grit, e.g. sand, small particles of steel, glass, plastic beads or other materials, or a mixture of abrasive grit, water and air on a product in order to in order to obtain a roughened surface topography

NOTE 1: Depending upon the particle size used for this process, a matte or satin finish is produced.

NOTE 2: Surface contamination from the blast media can require additional cleaning.

NOTE 3: The term "blast cleaning" is also used for this concept.

3.10.6. brushing
mechanical roughening of a surface, typically with rotating brushes

3.10.7. tumbling; barrelling
treatment of products in a rotating container in the presence of abrasives and water for deburring or to produce a variety of surface textures

3.10.8. finish
the characteristics of the surface of a product

3.10.9. matte finish
diffuse finish typically produced by rolling, etching, brushing or blast cleaning

3.10.10. mirror finish
finish after rolling or polishing with high specular reflectivity

3.10.11. satin finish
fine-textured matte finish, mainly by special roll grinding

3.10.12. scratch-brushed finish
matte or satin finish produced by abrasion with rotating wire brushes

3.10.13. embossed finish
pattern mechanically impressed on a surface by rolling or pressure

3.10.14. mill finish
finish, naturally occurring after rolling

3.10.15. natural oxide film
oxide film that forms naturally on the metal and is relatively impervious to atmospheric attack

3.10.16. visible surface
surface of the semi-finished product which is intended to be visible in final use

3.11. Marking, packaging and delivery

3.11.1. packaging
operation comprising the choice and preparation of an adequate package for specified products and the action of packing

3.11.2. packing
operation by which the product is enveloped in wrapping and/or enclosed in containers or otherwise secured

3.11.3. marking
application of numbers, letters, labels, tags, symbols or colours, for identification and handling instruction during shipping, handling and storage

3.11.4. all-over marking
method of identifying products by printing at close intervals over the surface the name or symbol of the manufacturer, the relevant specification number and, in some cases, the temper and thickness of the material

3.11.5. cast number
number by which the cast is identified

NOTE: The cast number typically includes the number of the melt from which the cast has been made,

3.11.6. pallet
load board designed to be moved by materials handling equipment e.g. fork-lift trucks

3.11.7. manufacturer
company in which a specifically identified production process, related to a product, is performed

3.11.8. supplier
person, company, or other organization being the contractual partner of the purchaser of a specified product

NOTE: A supplier can be a manufacturer or a distributor.

3.11.9. purchaser
person, company, or other organization that purchases a specified product

NOTE: The purchaser is the contractual partner of the supplier

3.11.10. order document
document or set of documents to which supplier and purchaser agreed at the time of ordering

NOTE: An ordering document can be an order of the purchaser confirmed by the supplier or a quotation of the supplier confirmed by the purchaser

3.12. Aluminium scrap and recycling operations

3.12.1. (aluminium) scrap
raw material, destined for trade and industry, mainly consisting of aluminium resulting from the collection and/or recovery of

- metal that arises as by-product at various production stages; or
- products after use

to be used for the production of wrought and cast alloys and for other production processes

3.12.2. new scrap
scrap arising from the various production stages of aluminium products, before the aluminium product is sold to the final user

3.12.3. internal scrap
new scrap that is melted in the same company where this scrap has been generated

NOTE: Internal scrap is not traded on the market and typically does not appear in trade statistics

NOTE: Internal scrap which is transferred between sites of the same company still is termed "internal scrap"

NOTE: Also known as turn-around scrap, in-house scrap, run-around scrap or home scrap

3.12.4. old scrap
scrap arising from products after use

3.12.5. traded scrap
scrap that is traded on the market

NOTE: Traded scrap typically meets requirements on characteristics agreed upon between supplier and purchaser.

3.12.6. skimmings
material composed of intimately mixed aluminium, aluminium oxides and gas, which has been removed from the surface of the molten metal or from the bottom and walls of liquid metal containers, e.g. furnaces or transport ladles or transfer channels

NOTE: This concept is also termed "dross".

3.12.7. black dross
skimmings from scrap remelting, characterised by a dark colour, typically resulting from oxides of alloying elements or attached soot particles

NOTE: This term should not be used for salt slag, see 3.13.1.

3.12.8. metallics
fraction of skimmings with high concentration of metallic aluminium, produced by crushing or grinding of skimmings by means of ball mills, hammer mills, impactors, etc., followed by screening

3.12.9. spills
scrap with high recoverable aluminium content consisting of metal which spilled over the rim or penetrated through leakages of liquid metal containers, e.g. furnaces, crucibles, troughs or dies

3.12.10. cuttings
scrap mainly of sheet arising from cutting, blanking, shearing or similar operations

3.12.11. turnings
new scrap consisting of grains, chips, curls, flakes etc. resulting from machining or other operations

3.12.12. used beverage cans (UBC)
scrap consisting of used aluminium beverage cans

3.12.13. used aluminium packaging
scrap consisting of used packaging which contain aluminium in recoverable portions

3.12.14. incinerator scrap
aluminium scrap that has been separated from the combustion residues of an incinerator

3.12.15. processed scrap
scrap that has undergone one or more processing operation(s)

3.12.16. loose scrap
scrap that has not undergone any operation of compacting and from which pieces can be individually picked up

3.12.17. shredded scrap
scrap that has been reduced into smaller parts by a shredder operation

3.12.18. granulated scrap
scrap consisting of pieces in a size range between a few millimetres and a few centimetres, generated by processing larger pieces through machines such as crushers, knife mills, hammer mills or choppers

3.12.19. compacted scrap
scrap in the form of compacted briquettes or bales

NOTE: Typically, briquettes are much smaller and have a higher density than bales.

3.12.20. clean scrap
scrap that does not contain foreign material

3.12.21. coated scrap
scrap consisting of pieces with any kind of coating, e.g. paint, varnish, printing ink, plastics, paper, metal

NOTE: Anodised scrap is not included.

3.12.22. anodised scrap
scrap consisting of pieces of anodised aluminium, including colour anodised aluminium

3.12.23. wrought scrap
scrap consisting of pieces of wrought aluminium

3.12.24. scrap for direct melting
scrap considered by the purchaser suitable for direct charging into his melting furnaces

3.12.25. foreign material
any material other than aluminium or aluminium alloys being physically identifiable as part of scrap consignment

NOTE 1: Foreign material can be attached to pieces of scrap or separate.

NOTE 2: Examples of foreign material are powder, water, oil or other fluids, grease, wood, plastic, glass, stones, paper, sand, non-aluminium metals, dry paints, inks, lacquers, rubber, dirt.

NOTE 3: The term "foreign substance" is also used.

3.12.26. free iron
any ferrous metal, either magnetic or non-magnetic, being a foreign material

3.12.27. steriles / inerts
inorganic components of scrap which are separate from the pieces of scrap and do not significantly modify the chemical composition of the metal after melting, e.g. stones, soil, glass, dust

3.12.28. contaminant
physical or chemical component of the scrap which, if not properly monitored and managed, negatively affects the quality of the scrap as a raw material for certain applications or shows hazardous properties during certain operations

3.12.29. volatile substance
foreign material that is removed from the scrap by appropriate thermal processes, e.g. drying or decoating, before the scrap melts

NOTE 1: Examples of volatile substances are water, rolling oils, emulsions, paints, plastics or paper.

NOTE 2: Volatile substances can be removed in separate operations or directly in specially designed melting furnaces.

3.12.30. moisture
liquid that adheres to the scrap and can be identified in the delivered lot

NOTE: Moisture can be due to fabrication, usage, pick up during storage or transport.

3.12.31. baling/briquetting
production of bales/briquettes from loose scrap

3.12.32. delacquering/decoating
removal of any solid organic surface layer, e.g. lacquer, paint, wax or adhering solid organic material, e. g. plastic or rubber, by thermal or mechanical treatment

NOTE: Delacquering of used beverage cans or similar packaging scrap can include the removal of entrapped moisture.

3.12.33. shredding
reduction of the size of pieces of scrap, end-of-life products or compacted scrap into small pieces, by operations such as crushing or tearing

3.12.34. shearing
reduction of the size of pieces of bulky scrap by cutting operations

3.12.35. sorting
separation of different fractions of loose scrap, manually or by other methods

3.12.36. sink and float
processes where materials with different densities are separated through air flotation or heavy media systems

3.12.37. drying
thermal treatment of scrap which intends to remove liquid foreign materials, typically water, oil or emulsions

3.12.38. scrap consignment
ordered quantity of scrap of the same requirements, sent in one or more scrap shipments

3.12.39. scrap shipment
scrap quantity sent with one separate shipping document, e.g. a truck load

3.12.40. classification
set of procedures adopted by the purchaser which intends to verify the compliance the received scrap with the contractual purchasing terms

3.12.41. declared mass
mass of a scrap consignment as declared on a shipment document

3.12.42. gross mass
mass of a scrap consignment which includes all foreign materials, but does not include packaging material and dunnage

3.12.43. net mass
mass of aluminium scrap in a scrap consignment after deduction of foreign materials

NOTE: Foreign material can be deduced by calculation, based on product information and test results.

3.12.44. metal content
aluminium portion of a scrap inspection lot which is obtained after deduction of foreign material

3.12.45. metal yield
portion of a scrap consignment that, after proper melting, can become useable metal

NOTE 1: The metal yield is typically expressed as percentage (mass fraction).

NOTE 2: This term is often defined in a different way in contracts.

3.12.46. net metal yield
portion of the net mass of scrap that, after proper melting, can become useable metal

NOTE: The net metal yield is typically expressed as percentage (mass fraction).

3.13. Residues of the aluminium industry

3.13.1. salt cake; salt slag
residue after remelting of aluminium scrap in a rotary furnace, consisting of fluxing salt in which metallic and non-metallic particles are entrapped in amounts that exhaust its fluxing properties

NOTE: Fluxing salt is used for refining in rotating furnaces in order to

1. cover the molten metal to prevent oxidation,
2. increase the net metal yield,
3. clean the metal from non-metallic inclusions and dissolved metallic impurities (e.g. calcium and magnesium), and
4. enhance thermal efficiency in the furnace.

3.13.2. salt slag residue
insoluble residue of the salt slag recycling process, i.e. after removal of the coarse metallic particles, namely aluminium, and of the water soluble components

NOTE: Salt slag residue consists of metal oxides, mainly aluminium oxide, with a small portion of silicates and very fine metallic aluminium particles.

3.13.3. sludge from flue gas treatment
sludgy residue occurring after the treatment of emissions with water and a possible subsequent filtration in order to remove undesired components

3.13.4. furnace linings
refractory residues consisting of linings that have been removed from furnaces, crucibles and launders after use

NOTE: According to the way of furnace operation furnace linings can be contaminated by contact with salt, alloying elements or impurities of the melt.

3.13.5. spent liquid metal filter material
refractory residues consisting of spent rigid media filter or bed filter material used in cast-houses in order to clean and distribute aluminium melts

NOTE: This residue often contains significant amounts of aluminium.

3.13.6. spent graphite parts (from melt treatment devices)
residues consisting of components of graphite and other carbon materials which typically have been used at high temperatures in contact with liquid aluminium, e.g. as tubes for flushing gas treatment

3.13.7. spent blasting grit
abrasive grit which has been used for blast cleaning of castings, typically mixed with fine particles removed from the surface of the casting which has been treated

3.13.8. filter dust from cast-houses
dust residue obtained from the dust filtration, typically from the melting operation in aluminium cast-houses, which can contain calcium compounds, salt flux compounds, aluminium oxide, and graphite

3.13.9. fines
fine-grained portion obtained from the milling of skimmings holding a low metal content, but a high content of aluminium oxides and other oxides

3.13.10. waste water treatment residues
oily sludge, which is obtained from an internal waste water purification of a plant

3.13.11. oil filter residues (from rolling mills)
residues, typically consisting of fine-grained, claylike filter media, e.g. diatomite, obtained from the filtration of cold rolling oils, which contain rolling oil and a small amount of rolling fines

3.13.12. spent hot rolling emulsion
hot rolling emulsion which can no longer be used or recovered for its purpose

3.13.13. spent roll grinding emulsion
water-base emulsion from roll grinding, from which the grinding residue has been removed by filtration, but which is no longer capable of fulfilling its original function and must be discarded

3.13.14. roll grinding sludge
sludge from roll grinding, typically consisting of aluminium particles, iron particles and emulsion residue, from which the roll grinding emulsion has been removed by filtration

3.13.15. mixed spent oils
mixture of different oil residues from metal working machines, typically together with major portions of water and other impurities

NOTE: Mixed spent oils of a high viscosity are often called oil sludge.

3.13.16. spent machine oil
oil residues, mainly from lubrication and hydraulic oil, typically resulting from the maintenance of machines, mixed with small portions of water and other impurities

3.13.17. lacquer sludge
fluid lacquers originally intended to be used for lacquering of aluminium that are no longer usable for their purpose, e.g. lacquers which can be pumped from containers

3.13.18. waste coating materials
dried or hardened lacquers which are no longer fluid and no longer usable for their purpose, e.g. residues in paint containers

3.13.19. sludge from anodising/etching
sludgy residues resulting from the partial removal of the liquid phase from spent bath after anodising or etching

3.13.20. sludge from surface treatment, free from chromium
sludge obtained from neutralisation and dewatering of spent chromium-free liquids used for chemical or electrochemical surface treatment of aluminium

3.13.21. sludge from surface treatment, contaminated with chromium
sludge obtained from neutralisation and dewatering of spent liquids which contain chromium and are used for chemical or electrochemical surface treatment of aluminium

3.13.22. spent caustic etching liquid
etching liquid which is no more capable of fulfilling its original function and therefore is discarded

3.13.23. aluminium brushing dust
dust, typically consisting of pyrophorous metallic aluminium and aluminium oxides generated by mechanical brushing of aluminium surfaces

3.13.24. spent hardening salts
bath or hardening salts for the hardening of machine parts, mainly extrusion dies, which are no longer usable, both containing cyanides, or a mixture of both components

3.13.25. spent mixed solvents
organic solvents which are no longer capable of fulfilling their original function and must be discarded, typically mixed or contaminated with impurities

4. Sampling, testing and product characteristics

4.1. Sampling and preparation of test-pieces

4.1.1. consignment
quantity of product of the same specification, sent in a single shipment

NOTE: The term "consignment" has in North America a different connotation, meaning shipped to an intermediate point and not invoiced until consumed.

4.1.2. inspection lot
consignment or part thereof submitted for inspection or sampling, characterised by a set of identical criteria, e.g. grade or alloy, temper, size, shape, thickness or cross-section or fabrication batch

4.1.3. melt
quantity of molten metal that has simultaneously undergone the same preparatory treatment in the furnace before the casting operation

4.1.4. cast
quantity of products cast simultaneously from the same melt

NOTE 1: The different ingots of a cast can have different dimensions.

NOTE 2: This term is not used for castings.

NOTE 3: In North America, multiple “drops” are made with one cast number.

4.1.5. heat treatment lot
quantity of products of the same grade or alloy, form, thickness or cross-section and produced in the same way, heat treated in one furnace load, or such products solution treated and subsequently precipitation treated in one furnace load

NOTE 1: More than one solution-treatment batch can be included in one ageing furnace load.

NOTE 2: For heat treatment in a continuous furnace (vertical or horizontal), the products continuously heat-treated during a specified time (e.g. 8 h) can be considered as one heat treatment lot.

4.1.6. sample
representative part, portion or piece of an inspection lot selected for inspection or testing

4.1.7. specimen
that portion of a sample taken for evaluation of some specific characteristics or properties or for the purpose of producing test pieces

NOTE: In North America the terms "coupon" is often used instead.

4.1.8. test piece
piece taken from a sample or a specimen which is suitably prepared for test

NOTE: In North America the terms "coupon" and "specimen" are often used instead.

4.1.9. limiting sample
sample or specimen showing to which extent quality characteristics of a product are acceptable

NOTE: Limiting samples typically demonstrate "just acceptable" and "just unacceptable" forms of a quality characteristic.

4.1.10. layout sample
prototype of a product, typically a casting or a forging, that has been subjected to detailed measurement to demonstrate conformance to an engineering drawing which sets forth the required characteristics

NOTE: A layout sample can be the "first article" of a production or a sample taken out of the running production.

4.1.11. longitudinal direction †
the direction of the major metal flow in a working operation; also referred to as rolling direction or extrusion direction depending upon working method

4.1.12. transverse direction
any direction perpendicular to the longitudinal direction

4.1.13. long transverse direction
transverse direction parallel to the major sectional dimension of the product

4.1.14. short transverse direction
transverse direction parallel to the minor sectional dimension of the product

NOTE 1: For hand forgings, this direction is typically the direction of forging.

NOTE 2: For rolled or extruded products the (wall) thickness is measured in the short transverse direction.

4.1.15. cross direction ‡
the direction at right angles to the direction of rolling, extruding or drawing

4.2. Tests

4.2.1. test
operation to which the test piece is subjected in order to measure or classify a property

4.2.2. inspection
activities necessary to compare characteristics of a product with specified requirements

4.2.3. macro-etching test
test for which the metal is etched in order to reveal its macrostructure

4.2.4. dye penetrant test; liquid penetrant inspection
non-destructive test characterised by the following steps:

- immersing the clean and degreased test piece in a dye penetrant or covering it with a layer of dye penetrant;
- removing the residual superfluous dye penetrant from the surface of the test piece after a specified period;
- visual control of the surface of the test piece, possibly after a developer has been applied, if the dye seeps out from any flaws and cracks

NOTE: The dye can be a fluorescent dye which can be detected by means of an U.V. lamp.

4.2.5. ultrasonic test
non-destructive test employing high-frequency sound waves for the location and assessment of size of internal defects

4.2.6. eddy current test
non-destructive test in which eddy-current flow is induced in the test piece, mainly for the assessment of different properties, e.g. the soundness of tubes, presence of specific surface or sub-surface defects, microstructure or thickness of surface layers

4.2.7. tensile test
test in which the test piece is stressed in tension, normally until fracture, to determine one or more of its tensile properties

4.2.8. pressure test
hydraulic or pneumatic test applied to a tube or a hollow profile to ensure that the metal will withstand a specified pressure for a specified time without unacceptable leakage or distortion

4.2.9. fracture test
test in which a piece of metal is notched and broken and the fractured surface examined in order to assess grain structure and freedom from defects

4.2.10. torsion test
test in which a test piece is twisted axially for a given number of revolutions

4.2.11. bend test
test intending to assess bending characteristics and ductility of a product by bending a test piece under defined conditions, typically with a predetermined radius and angle

NOTE: The predetermined radius is called bend radius.

4.2.12. hardness test
test for the determination of hardness properties and the estimation of strength properties, typically by relating the load applied to an indenter of prescribed form to the depth or surface area of the impression produced

4.2.13. bore test (of tube)
test on tube to verify freedom from constriction by passing a metallic bob or wire of specified dimensions through the tube

4.2.14. drift expanding test (of tube)
diametrical expansion of the end of a tube sample to a predetermined amount by the insertion of a cone, to assess the quality of the tube

NOTE: In North America, the term “flare test" is used for this concept.

4.2.15. cut-up test (of forgings)
destructive test carried out on forgings to verify details of the grain flow and mechanical properties in various positions in the forgings

4.2.16. flattening test (of tube)
test in which a tube test piece is flattened in a direction perpendicular to the longitudinal axis until the diameter or major axis is reduced to a predetermined value

4.2.17. flanging test
test in which a disc-shaped rim of predetermined size is formed at the end of a tube or hollow profile test piece to assess its suitability for specific application, e.g. the manufacture of tubular rivets or flanged products

NOTE: The flanging test typically assesses the soundness of extrusion seams.

4.2.18. wrapping test
test consisting of winding the wire a specified number of turns around a mandrel of diameter stated in the material specification

NOTE: The test can also include a specified programme of unwinding or of unwinding and rewinding.

4.2.19. earing test
test consisting of deep-drawing of a blank into a cup in order to assess the earing properties of the metal

4.2.20. Erichsen test
cupping test in which a piece of sheet metal, restrained only at the periphery, is deformed by a cone-shaped spherically ended plunger until fracture occurs; the height of the cup in millimetres at fracture initiation is a measure of the ductility

4.2.21. Mullen test
measurement of bursting strength of foil by applying increasing pressure to a defined area of the test piece until it ruptures

4.3. Mechanical properties

4.3.1. mechanical properties
properties of a material that are associated with elastic and inelastic reaction when force is applied, or that involve the relationship between stress and strain; for example, modulus of elasticity, tensile strength, endurance limit

NOTE 1: These properties are often incorrectly referred to as physical properties.

NOTE 2: The mechanical properties obtained by a tensile test, e.g. modulus of elasticity in tension, tensile strength and elongation are often termed "tensile properties".

4.3.2. modulus of elasticity; Young's modulus
ratio of stress applied to a material to corresponding strain throughout the range where they are proportional

NOTE: As there are three kinds of stresses, so there are three kinds of moduli of elasticity for any material — modulus of elasticity in tension, modulus of elasticity in compression, and modulus of elasticity in shear (shear modulus).

4.3.3. tensile strength

ratio of maximum load before rupture in a tensile test to original cross-sectional area

NOTE: Also called “ultimate tensile strength”.

4.3.4. proof strength; yield strength

stress necessary to produce a defined small plastic deformation in a material under uniaxial tensile or compressive load

NOTE 1: If the plastic deformation under tensile load is defined as 0,2%, then the term “proof strength $R_{p0,2}$“ or "yield strength 0,2%" is used.

NOTE 2: The term “proof strength” is used in European and ISO standards, whereas the term “yield strength” is used in North American documents.

4.3.5. elongation (to fracture)

the percentage increase in distance between two marks on a test piece, termed "gauge marks", that results from straining the test piece in tension to fracture between these gauge marks

NOTE 1: The elongation depends on the distance between the gauge marks.

NOTE 2: The elongation depends on the cross-sectional dimensions of the test piece. For example, the values obtained from sheet specimens will be lower for thin sheet than for thicker sheet. The same is true for extrusions.

NOTE 3: Elongation is the simplest and most common representation of the ductility of the material.

4.3.6. gauge length

distance between two gauge marks on a test piece between which the test piece ruptures during a tensile test

NOTE 1: The gauge length before applying the load is termed “original gauge length”.

NOTE 2: Sometimes the spelling "gage" is used.

4.3.7. elongation A

percentage elongation after fracture related to a gauge length of $5,65 * \sqrt{S_0}$, where S_0 is the initial cross-sectional area of the test-piece

NOTE 1: The earlier designation A_5 should be avoided.

NOTE 2: For round cross-sections the gauge length is calculated as 5*d, where d is the diameter of the test-piece between the gauge marks.

N0TE 3: In some US documents the gauge length is also specified as 4*d.

4.3.8 elongation A_{50mm}

percentage elongation after fracture related to an original gauge length of 50 mm and a constant original width of the test piece between the gauge marks

NOTE 1: Existing standards specify the original width of the test piece between the gauge marks as 12,5 mm.

NOTE 2: In the US, the gauge length is often 2 inches, i.e. 50,8 mm.

4.3.9 shear strength

maximum gross stress, i.e. maximum force divided by original cross section, which a material withstands before fracture when submitted to a shear test

NOTE 1: Shear strength is an important quality characteristic of rivets.

NOTE 2: The shear strength is normally about 60% of the tensile strength.

4.3.10. creep rupture strength

maximum gross stress which the material withstands when submitted to sustained loading at a defined temperature, typically above 100℃

4.3.11. Poisson's ratio

ratio between longitudinal elongation and transverse contraction in uniaxial testing

NOTE: The Poisson's ratio is typically at 0,33 for all alloys and tempers.

4.3.12. hardness

resistance of a metal to plastic deformation, typically measured by indentation

4.3.13. Brinell Hardness, HB

resistance to penetration of a spherical indentor under standardized conditions

NOTE 1: HB is approximately equal to $0,3 * R_m$ when R_m is the tensile strength, expressed in MPa.

NOTE 2: If tungsten carbide as indentor material is specified, e.g. ISO 6506-1, then the designation HBW is used.

4.3.14. Vickers Hardness, HV
resistance to penetration of a square-based pyramidal diamond indentor under standardized conditions
NOTE: HV is approximately equal to 1,10 * HB.

4.3.15. ductility
ability of a material to deform plastically before fracturing

4.3.16. workability; malleability; formability
relative ease with which a metal can be formed by rolling, extruding, drawing, deep drawing, forging, etc.

4.3.17. deep drawability
suitability of a flat product for forming of deeply recessed parts by means of deep drawing, often assessed by the maximum drawing ratio, i.e. the ratio of the maximum drawable blank diameter to a given stamp diameter

4.3.18. toughness
ability of a metal to absorb energy and deform plastically before fracturing, typically measured by the energy absorbed in a notch impact test or the area under the stress-strain curve in tensile testing

4.3.19. fracture toughness
parameter indicating the resistance of a material to crack extension

4.3.20. impact resistance; shock resistance
ability to resist impact

4.3.21. internal stress
stress set up within a metal as a result of previous operations, e.g. casting, thermal treatment or working

4.3.22. residual stress
internal stress left in the finished product after all fabricating operations, including stress relieving where applicable, have been carried out

4.3.23. fatigue
tendency for a metal to break under conditions of repeated cyclic stressing considerably below the tensile strength
NOTE: Fatigue fractures begin as minute cracks that grow under the action of the fluctuating stress.

4.3.24. fatigue strength
maximum stress amplitude that can be sustained by a product for a specified number of cycles generally expressed as the stress amplitude giving a 50% probability of fracture after a given number of load cycles

4.3.25. endurance limit
limiting stress below which a material will withstand a specified large number of cycles of stress

4.3.26. earing
wavy projections spaced symmetrically around the rim of a deep drawn product due to non-uniform directional properties in the aluminum and/or by improperly adjusted tooling

4.3.27. pressure tightness
absence of leakage at a specified pressure

4.3.28. spring back effect
elastic partial recovery of a metal after cold forming operations such as bending

4.3.29. brittleness ‡
tendency of a metal or material to fracture without undergoing appreciable plastic deformation

4.4.30. minimum bend radii ‡
minimum recommended radii expressed in terms of thickness for bending sheets and plates without fracturing in a standard press brake with air bend dies; values are normally given in standards where required

4.4. Product characteristics on form and dimensions

4.4.1. straightness
the extent to which the axis or the edge of a product approaches a straight line

4.4.2. lateral curvature; lateral bow †
deviation of a longitudinal edge from a straight line
Note: Also called “camber”.

4.4.3. flatness
the extent to which the surface of a product approaches a plane

4.4.4. longitudinal bow; longitudinal arch; longitudinal curvature
deviation from straightness in the plane of a flat product along the main axis**,** as measured by use of a baseplate on which the product is positioned so that its own weight minimizes the curvature

4.4.5. transverse bow; transverse arch
curvature in the plane of a flat product perpendicular to the main axis

4.4.6. concavity
inward curvature across the width of a flat product

4.4.7. convexity
outward curvature across the width of a flat product

4.4.8. crown
difference in thickness between one of the edges and the centre of a rolled product

4.4.9. twist
The extent to which a product is twisted around its longitudinal axis

4.4.10. concentricity
the extent to which the inner and outer walls of round tube have a common centre of curvature

4.4.11. eccentricity
deviation between the centres of curvature of the inner and outer walls of round tube

NOTE 1: Eccentricity is typically determined as the difference between the mean wall thickness and minimum or maximum wall thickness at any one cross-section.

NOTE 2: The permissible degree of eccentricity can be expressed by a plus and minus wall-thickness tolerance.

4.4.12. ovality
departure of the cross-section of a round tube, rod or bar or wire from a true circle

4.4.13. squareness
characteristic of having adjacent sides, planes or axes meeting at 90°

4.4.14. corner
convex junction between two surfaces

4.4.15. fillet
concave junction between two surfaces

4.4.16. angularity
conformity to or deviation from, specified angular dimensions in the cross section of a shape or bar

4.4.17. forging plane
reference plane or planes normal to the direction of applied force from which all draft angles are measured

4.4.18. baseplate
thick, stable plate having a horizontal surface of a very high, controlled flatness, mainly used for controlling the straightness, flatness, twist etc. of rolled and extruded products

4.4.19. circumscribing circle
circle that will just contain the cross-section of a profile, typically designated by its diameter

4.4.20. mean diameter (of round rod/bar or tube)
average of any two diameters measured at right angles in the same cross-sectional area

4.4.21. mean wall thickness (of tube)
average of the largest and the smallest wall thickness of tube measured in the same plane perpendicular to the axis of the tube

4.4.22. tolerance
maximum allowable deviation from a specified characteristic

4.4.23. tolerance range
difference between the maximum limit of a parameter and the minimum limit of a parameter of a specified characteristic

NOTE: The tolerance range is an absolute value without sign.

4.4.24. gauge (thickness is the preferred term) ‡
commonly used to describe the thickness of aluminium sheet or coil in inches / millimeters.

NOTE: This is not to be confused with comparative gauges such as Brown & Sharpe, US Standard, and Manufacturers sheet steel, which use a number to designate a non-corresponding thickness, i.e. “2O

Gauge" is .037 in. on the Brown & Sharpe scale

4.5. Physical and metallurgical product characteristics

4.5.1. physical properties

the properties, other than mechanical properties, that pertain to the physics of a material; for example, density, electrical conductivity, heat conductivity, thermal expansion

4.5.2. electrical resistivity

electrical resistance of a given material related to unit length and unit cross- section area

4.5.3. electrical conductivity

the reciprocal of electrical resistivity

4.5.4. coefficient of thermal expansion

expansion per unit length when the material temperature is raised one degree

NOTE: The coefficient of thermal expansion varies slightly with the temperature and is typically measured at 20℃.

4.5.5. liquidus temperature

temperature at which total melting of the solid is achieved upon heating from the solid state, or at which solid first appears upon cooling from the liquid state

4.5.6. solidus temperature

temperature at which liquid first appears upon heating from the solid state

NOTE 1: For some alloys prior homogenizing may significantly raise the solidus temperature (AA7075 for example).

NOTE 2: Exceeding the solidus temperature during heat-treating has extremely deleterious effect on material properties.

4.5.7. density

mass per unit volume

4.5.8. specific heat capacity

amount of heat necessary to raise the temperature of 1 kg of material by 1℃, under constant pressure

4.5.9. wettability

degree to which a metal surface can be wet by water

NOTE: Wettability allows the assessment of the amount of residual lubricants on the surface.

4.5.10. microstructure

structure of a metal as revealed by microscopic examination of a surface, typically after mechanical and/or chemical preparation, e.g. polishing and micro-etching

4.5.11. macrostructure

structure of a metal as revealed by visual examination of a surface without any enhanced magnification, typically after mechanical and/or chemical preparation, e.g. machining and macro-etching

4.5.12. cast structure; as-cast structure

structure of an ingot or casting characterized by shape and orientation of grains, segregation of alloying elements and impurities and distribution of intermetallic phases

4.5.13. metal grain

crystal of uniform grid orientation within a metal

4.5.14. equiaxed grains

grains or crystals that have approximately the same dimensions in three axial directions

4.5.15. grain size

mean size of metal grains expressed in terms of the number of grains per unit area or unit volume, as the mean grain diameter or an appropriate index

4.5.16. cell size (of a cast metal)

mean size of subdivisions of metal grains in ingots or castings, caused by microsegregation and/or by precipitation of intermetallic phases during solidification

4.5.17. dendrite

crystal that has a treelike branching pattern, being most evident in cast metals slowly cooled through the solidification range

4.5.18. dendrite arm spacing
mean distance of adjacent secondary arms of a dendrite

NOTE: The dendrite spacing can only be determined if a dendritic cast structure with primary and secondary dendrite arms can be clearly detected.

4.5.19. grain flow
change of the shape of metal grains under the influence of hot or cold working

4.5.20. grain growth
growth of larger metal grains at the expense of smaller ones

4.5.21. recrystallization
nucleation and growth of new undeformed metal grains in a deformed metal

NOTE: Deformed metal grains are characterised by a tight network of dislocations

4.5.22. critical strain (recrystallization)
the minimum amount of cold work or cold deformation necessary to initiate recrystallization during subsequent annealing or solution heat treatment

NOTE: One can distinguish between the lower critical strain corresponding to the onset of the recrystallization, which typically causes coarse grain, and the somewhat higher upper critical strain that produces a fine recrystallized grain.

4.5.23. fluidity
ability of a liquid metal to flow (into a mould)

4.5.24. anodising quality ‡
an indication that special attention has been paid to the metallurgical characteristics and surface quality of the aluminium sheet or extrusion to assure that a uniform and blemish-free decorative anodic film will form during anodising

NOTE 1: Normally a special order between customer and supplier.
NOTE 2: See ISO 7599 Annex A for guide to grades of aluminium for anodizing.

4.5.25. fibrous structure ‡
the characteristic of wrought metal that indicates directional properties - it is revealed by etching a longitudinal section or manifested by the fibrous appearance of a fracture

5. Visual quality characteristics

5.1. General terms

5.1.1. quality characteristic
inherent characteristic of a product, process or system related to a requirement

NOTE 1: Inherent means existing in something, especially as a permanent characteristic.

NOTE 2: A characteristic assigned to a product, process or system (e.g. the price of a product, the owner of a product) is not a quality characteristic of that product, process or system.

NOTE 3: For aluminium products a quality characteristic can be a dimension, a mechanical property, a physical property, a functional characteristic, or the appearance.

5.1.2. visual quality characteristic
quality characteristic which can be detected by visual inspection of the material, sometimes after preparation of a sample and/or by use of a microscope

NOTE 1: The existence of a visual quality characteristic does not necessarily imply a nonconformity, nor does it have necessarily any implication as to the usability of a product.

NOTE 2: A visual quality characteristics can be rated on a scale of severity, in accordance with appropriate specifications, e.g. to establish whether or not the product is of acceptable quality.

5.2. Typical terms for ingots and castings

5.2.1. cold shut (cast product)
linear discontinuity in a cast surface caused by freezing of the melt meniscus in contact with the mould and the liquid metal flowing over the solidified metal

5.2.2. segregation
non-uniform distribution or concentration of impurities or alloying elements that arises during the solidification of an ingot

5.2.3. macrosegregation
segregation over macroscopic distances

5.2.4. microsegregation
segregation over microscopic distances, typically associated with cellular or dendritic solidification

5.2.5. gravity segregation
macrosegregation caused by the settling out of heavy constituents, or rising of light constituents in a solidifying melt

5.2.6. inverse segregation
macrosegregation caused by interdendritic liquid metal in a solidifying ingot or casting which is sucked towards its surface, due to volume shrinkage caused by solidification

5.2.7. surface segregation (unwrought product)
thin surface layer of a cast metal characterized by concentrations of the alloying elements significantly different from the concentration in the melt; the layer is generated by interdendritic liquid metal which has been pushed through the surface of the cast metal during solidification by gravity

NOTE: Surface segregation layers of non-uniform thickness which give a cast surface a characteristic appearance are also called “liquations”.

5.2.8. hot crack
crack formed in a cast metal or in a welding because of internal stress developed on cooling at the solidus temperature or slightly above

NOTE: For castings the term “hot tear” is also used.

5.2.9. cold crack
crack in cast metal initiated by mechanical stresses at temperatures significantly below the solidus temperature

5.2.10. shrinkage cavity
void left in cast metals as a result of solidification shrinkage

5.2.11. porosity
fine holes or pores within a cast metal

5.2.12. gas porosity
porosity caused by entrapped gas or by evolution of dissolved hydrogen during solidification

5.2.13. twin columnar grains (TCG)
macrostructure of rapidly solidified cast metal characterized by a twin plane in the centre of each dendrite stem parallel to the direction of crystal growth

NOTE: Twin columnar grains are often termed "feather crystals".

5.2.14. butt curl
deformation of the bottom butt of a rolling ingot caused by a sudden increase of heat transfer by water impingement at the start of the DC casting process

5.2.15. butt swell
convexity of the rolling faces of a rolling ingot in the area of the bottom butt caused by non-stationary cooling conditions during the start of semi-continuous casting

5.2.16. misrun
open hole in the wall of a casting where the part did not fill completely before solidification.

5.3. Visual quality characteristics related to form and dimension

5.3.1. off gauge
deviation of a dimension of a product, e.g. width or wall thickness, from the specified tolerances

5.3.2. kink
abrupt deviation from straightness

NOTE 1: The term "hook" is sometimes used for this concept.

NOTE 2: For rolled products, this term is also used for an abrupt bend or deviation from flatness, which is caused by localized bending during handling.

5.3.3. buckle
departure from flatness represented by alternate bulges and hollows or waves along the length of a product

5.3.4. centre buckle
departure from flatness represented by alternate bulges and hollows along the length and in the centre across the width of a product, the edges of which remain comparatively straight

NOTE: Centre buckles are also termed "centre waves" or "pockets".

5.3.5. quarter buckle
departure from flatness represented by alternate bulges and hollows along the length and is approximately at both quarter points across the width of a product, the edges of which remain comparatively straight

5.3.6. edge buckle †
departure from flatness represented by a corrugated or wave-like formation of the edges of a product in which the centre area remains comparatively flat

NOTE: Edge buckles are also termed "edge waves" or "wavy edges" or “edge ripples”.

5.3.7. dent
sharply delimitated surface impression on the metal, often caused by a blow from another object

5.3.8. expansion dent
localized surface deviation from flat generated by expansion of vapor during thermal treatment of cold rolled coiled sheet

5.3.9. repeating dent
dent appearing periodically, often caused by a particle adhering to a rotating roll over which the metal has passed

5.3.10. corner turn-up
deviation of the corner(s) of a sheet from a perfectly flat plane on which it rests, often caused by distortion, buckle or twist condition

5.3.11. belled edge ‡
excessive build-up of material on edge(s) of a coil during a rewinding operation; typical causes include excessive edge burr, turned edge, and “dog bone” shaped cross sectional profiles

5.3.12. coil orientation ‡
with the coil core vertical (“eye-to-sky”) and viewed from above, a trace of the metal edge from the ID to the OD involves clockwise movement

5.3.13. clockwise coil ‡
with the coil core vertical (“eye-to-sky”) and viewed from above, a trace of the metal edge from the ID to the OD involves clockwise movement

5.3.14. counter-clockwise (anti-clockwise) coil ‡
with the coil core vertical (“eye to the sky”) and viewed from above, a trace of the metal edge from the ID to the 00 involves a counter-clockwise (anti-clockwise) movement

5.3.15. coil set; coil curvature ‡
a lengthwise curve or set found in coiled strip metals following its coil pattern; a departure from longitudinal flatness; can be removed by roller or stretcher levelling from metals in the softer temper ranges

5.3.16. coil set, reversed ‡
longitudinal bow in an unwound coil in the direction opposite to the curvature of the wound coil

5.3.17. telescoping; coned-out coil ‡
transverse slipping, primarily in one direction of successive wraps or layers of a coil so that the edge of the coil is conical rather than flat - this can occur during the coiling operation or during subsequent handling

5.3.18. eye-to-sky ‡
coil packed on a skid so the coils are laying flat and ID is vertical (common packing orientation)

5.3.19. eye-to-wall; eye-to-side ‡
coil packed on a skid so that the coils are standing on edge and the ID is horizontal (less common packing orientation)

5.3.20. dish ‡
a concave surface departing from a straight line edge to edge - indicates transverse or across the width

5.3.21. canning ‡
dished distortion in a flat or nearly flat surface, sometimes referred to as oil canning

5.3.22. oscillation ‡
uneven wrap in coiling and lateral travel during winding; improper alignment of rolls over which the metal passes before rewinding and insufficient rewind tension are typical causes

5.3.23. loose coil end ‡
a condition in a coil due to insufficient tension which creates a small void between adjacent wraps
NOTE: This condition is also called “loose wrap”

5.4. Visible surface quality characteristics on wrought products, mainly mechanical

5.4.1. mark
damage in the surface of the product, e.g. indentation or raised surface

NOTE: If the source of the mark is known, a more precise composite term is used, e.g. "chatter marks".

5.4.2. chatter marks
regularly spaced superficial marks, transverse to the rolling or extrusion direction, produced by vibration between the metal and the working surface during fabrication

5.4.3. ripple marks
optical surface effect in the form of a very slight repeated transverse wave or shadow mark, sometimes encountered with rolled or drawn products

5.4.4. rub mark
mark consisting of a large number of very fine scratches or abrasions

NOTE 1: A rub mark can occur by metal-to-metal contact, movement in handling and movement in transit.

NOTE 2: Rub marks are often termed "friction scratches". More severe forms of rub marks, caused by handling are often termed "handling scratches" or "handling marks".

5.4.5. stop mark
transverse peripheral ridge on a product arising from a stoppage during rolling, extrusion or drawing

5.4.6. stretcher grip mark
transverse indentation at the ends of a product impressed by the grips of a stretching machine

5.4.7. arbor mark
surface damage in the vicinity of a coil ID caused by contact with a roughened, damaged or non-circular arbor

5.4.8. bite mark
periodical imperfection on the surface of a rolled product, generally perpendicular to the rolling direction, because of a mark on a roll coating caused by the initial feeding of the ingot

5.4.9. roll mark
periodic raised or depressed area on a rolled product formed during rolling by the imprint of a damage on the roll

NOTE 1: The repeat distance is a function of the offending roll diameter.

NOTE 2: A greatly enlarged roll mark whose height or depth is very shallow is often called a "roll bruise mark".

5.4.10. knife mark
continuous scratch (which may also be creased) near a slit edge of a rolled product, caused by sheet contacting the slitter knife

5.4.11. whip mark
surface abrasion on a rolled product, generally diagonal to the rolling direction, caused by a fluttering action of the metal as it enters the rolling mill

5.4.12. stretcher jaw mark
cross-hatched appearance left by jaws at the end(s) of metal that has been stretched, if insufficient metal has been removed after the stretching operation

5.4.13. herringbone marks
superficial markings taking the form of alternate light and dark bands forming a V or W pattern across the width of rolled metal

5.4.14. pinch marks
pressed-in folds in rolled products, generally running parallel to the direction of rolling

5.4.15. indentation
small hollow mark on the surface of a the metal

NOTE: An indentation is also termed "pit".

5.4.16. scratch †
sharp linear indentation in the surface of the metal

NOTE 1: This is sometimes referred to as a “nick”.
NOTE 2: A gross / deep scratch is often called a “gouge”.

5.4.17. rolled-in scratch
scratch that occurs during the fabricating process and is subsequently rolled over

NOTE: A rolled in scratch often appear as a greyish white ladder showing distinct transverse lines within the longitudinal indentation.

5.4.18. drawn-in scratch
scratch occurring during the fabricating process and subsequently drawn over, making it relatively smooth to the touch

5.4.19. machine scratch
straight indentation in the rolling direction of a rolled product, caused by contact with a sharp projection on the equipment

5.4.20. tension scratches
short longitudinal indentations parallel to the rolling direction of rolled products, resulting from relative movement between adjacent wraps of the coil during unwinding or rewinding

NOTE: Tension scratches are sometimes termed "block marks".

5.4.21. burnish streak
bright region on the sheet caused by excessive roll surface wear

5.4.22. coating streak
banded surface appearance on a rolled product caused by non-uniform adherence of roll coating to a work roll during hot and/or cold rolling

NOTE: If generated in the hot rolling process, it is also called “hot mill pickup”.

5.4.23. grinding streak
streak with a helical pattern appearance transferred to a rolled product from a work roll

5.4.24. herringbone streak
elongated alternately bright and dull chevron markings

5.4.25. pickup
irregular surface appearance caused by intermittent adhesion between the forming tools and the metal

NOTE: The condition of excessive friction between the forming tool and the metal is often termed "galling".

5.4.26. sliver
thin elongated piece of the parent metal on the surface of a product, completely or partially detached

NOTE: Slivers are often rolled-over surface damages.

5.4.27. broken surface
surface having multiple minute cracks running transverse to the direction of working

5.4.28. lamination
internal crack or separation aligned parallel to the principal surfaces of a rolled product

5.4.29. broken edge
edge of a rolled product containing cracks, splits, or tears, caused by inability to be formed without fracturing

5.4.30. alligatoring; crocodiling
longitudinal doubling and/or splitting at both ends of a slab in a plane parallel to the rolled surface occurring during the first passes of the reversing hot mill

5.4.31. roll grind
the uniform ground finish on the work rolls which is imparted to the sheet or plate during rolling

5.4.32. burr
thin ridge of roughness on an edge left by a cutting operation such as slitting, trimming, shearing, blanking, sawing, etc.

5.4.33. crazing ‡
a macroscopic effect of numerous surface tears, transverse to the rolling direction, which can occur when the entry angle into the cold mill work rolls is large; can also occur when forming or heat-treating an anodized product (see also cross-hatched surface)

5.4.34. cross-hatched surface ‡
a surface having innumerable minute cracks running normal to the direction of working

5.4.35. hair, slitter ‡
minute hair-like sliver along edge(s) due to shearing or slitting operation

5.4.36. mill edge ‡
the edge of strip, sheet or plate in the as rolled state i.e. unsheared

5.5. Visible quality characteristics of wrought products, mainly metallurgical

5.5.1. structural quality characteristics
quality characteristics caused by an inadequate microstructure or macrostructure

5.5.2. flow lines
the line pattern which shows the direction of flow on the surface

5.5.3. streak
superficial band or line which produces a non-uniform surface appearance

NOTE 1: Wide streaks are often termed "stripes".

NOTE 2: According to the source or appearance of the streak, a more precise composite term is used, e.g. "dirt streak".

5.5.4. bearing streak
longitudinal discoloration, typically lighter than the surrounding metal, which can occur as a result of uneven cooling, where there are large changes in wall thickness

5.5.5. structural streak
streak on etched or anodised surfaces resulting from a non-homogeneous distribution of intermetallic phases in the metal, resulting from the solidification conditions of the ingot

5.5.6. fir-tree structure
macrostructure of an etched and/or anodised metal, characterized by areas of different gloss, with sharp boundaries between these areas, caused by different types of intermetallic phases

NOTE: Fir-tree structure originates in the macrostructure of the ingot. It can be found in sections of the ingot, after appropriate mechanical pretreatment and subsequent etching or anodising.

5.5.7. inclusion
extraneous material accidentally entrapped into the liquid metal during melting or melt treatment or entrapped in the metal surface during hot or cold working

5.5.8. razor streak
thin streak on the surface of a wrought product, only visible after chemical or electrochemical surface treatment, caused by an inclusion or a cluster of inclusions in the metal which has been elongated during hot and/or cold working

NOTE: Razor streaks are often termed "stringer inclusions".

5.5.9. inclusion mark
mark in a metal surface resulting from an inclusion

NOTE: The term includes marks with still visible inclusions or voids from which the inclusions have left.

5.5.10. blister
raised spot, inside hollow, on the surface of products caused by the penetration of a gas into a subsurface zone typically during thermal treatment

NOTE: A void resulting from blister that has ruptured is often termed "blow hole".

5.5.11. core blister
blister resulting from a gas-filled hole in the core of the metal

NOTE: In thin-walled products, core blisters are visible on both opposite surfaces.

5.5.12. orange peel
surface pattern on formed products which occurs when a coarse grain structure is present in the formed surface of the metal

5.5.13. coarse grain ‡
excessively large grains typically produced by a heat treatment

5.6. Discolorations, oil/dirt, stains and corrosion

5.6.1. water stain
superficial surface oxidation due to the reaction of water films held between closely adjacent metal surfaces such as between wraps of a coil or sheets in a stack

NOTE 1: The appearance of a water stain varies from iridescent in mild cases to white, gray, or black in more severe instances.

NOTE 2: Sometimes the term "water stain corrosion" is used for this concept.

5.6.2. oil stain
surface discoloration which may vary from dark brown to white, produced during thermal treatment by incomplete decomposition of residual lubricants on the surface

5.6.3. heat treat stain
discoloration due to non-uniform oxidation of the metal surface during heat treatment

5.6.4. surface bloom
surface discoloration that can develop on metal during exposure to moist atmospheres or during thermal treatment

5.6.5. heat treat contact mark
brownish, iridescent, irregularly shaped stain with a slight abrasion located somewhere within the boundary of the stain, resulting from metal-to-metal contact during the quenching of solution heat-treated flat sheet or plate

5.6.6. smudge; smut
dark film of debris, sometimes covering large areas, deposited on the sheet during rolling or left on the surface of a metal after electroplating or etching

5.6.7. rolled-in metal
particle of metal, other than the parent metal, rolled into the surface of the product

NOTE: Rolled-in particles of the parent metal are called slivers, see 5.4.26.

5.6.8. rolled-in dirt
imperfection or defect in the surface of a rolled product caused by particles as dust or dirt entrapped between the rolling cylinder and the rolled product

5.6.9. dirt streak
surface discoloration which may vary from gray to black, is parallel to the direction of rolling, and contains rolled in foreign debris

NOTE: Dirt streaks typically result from extraneous material that drops from an overhead location onto the rolling surface and are shallow enough to be removed by etching or buffing.

5.6.10. grease streak
narrow discontinuous streak caused by excessive lubricant dripping on the surface of the rolled product during rolling

5.6.11. high lube
nonconformity, when lubricant limit exceeds the maximum agreed upon limit measured in weight per unit area

5.6.12. low lube
nonconformity, when the lubricant does not meet the minimum agreed upon limit measured in weight per unit area

5.6.13. buff streak
dull continuous streak caused by smudge build-up on a buff used at shearing or other operations

5.6.14. corrosion
deterioration of a metal by chemical or electrochemical reaction with its environment

5.6.15. exfoliation corrosion
corrosion that progresses approximately parallel to the metal surface, causing layers of the metal to be elevated by the formation of corrosion product

5.6.16. stress corrosion cracking
cracking resulting from selective directional attack caused by the simultaneous interaction of sustained tensile stress at an exposed surface with the chemical or electro-chemical effects of the surface environment

5.6.17. intercrystalline corrosion; intergranular corrosion
corrosion occurring preferentially at the grain boundaries of a metal

5.6.18. pitting corrosion
localized corrosion resulting in small pits or craters in a metal surface

5.6.19. filiform corrosion
corrosion in the form of irregularly distributed thread-like filaments that can occur under certain conditions under coatings

5.6.20. oxidation ‡
chemical combination with oxygen to form an oxide; exposure to atmosphere sometimes results in localized, excessive oxidation of the exposed surface, hence a staining or discoloration; this effect is increased with temperature increase (see water stain)

5.6.21. fretting corrosion ‡
action that results in surface damage, especially in a corrosive environment, when there is relative motion between solid surfaces in contact under pressure

NOTE: This is commonly called “traffic marking”.

5.7. Visible quality characteristics of coated and clad products

5.7.1. flaking
condition in coated sheet where portions of the coating become loosened due to inadequate adhesion

5.7.2. flow lines
lines on the surface of painted sheet, brought about by incomplete levelling of the paint

NOTE: This term is sometimes used for the line pattern revealed by etching, which shows the direction of plastic flow on the surface or within a wrought structure.

5.7.3. pick-off
the transfer of portions of the coating from one surface of the sheet to an adjacent surface due to poor adhesion of the coating

5.7.4. holiday
uncoated area of a coated product due to non-wetting of the metal surface by the coating

5.7.5. solvent pop
blister and/or void in the coating resulting from trapped solvents released during curing process

5.7.6. oven scratch
scratch which is caused by moving contact of coating against a non-moving object in an oven

5.7.7. striation
longitudinal non-uniform coating thickness caused by uneven application of the liquid coating

5.7.8. coating build-up
coating thickness greater than nominal in localized area of sheet, typically along edges, due to uneven application techniques

5.7.9. lube spot
non-uniform, extraneous deposit of lube on the coated sheet

5.7.10. bond blister
raised spot on only one surface of the metal whose origin is a blister between the cladding and core in a clad product

5.7.11. coating blister
blister in the coating of an alclad or a clad product

5.7.12. diffusion staining
patchy discoloration, which may vary from gray to brown, that can arise from diffusion in clad metal

NOTE: When diffusion staining has the form of a streak, then the term "diffusion streak" is used.

5.7.13. pressure mottling
non-uniform surface appearance of a laminated product resulting from uneven pressure distribution between adjacent layers of the product

5.8. Typical terms for extruded products and forgings

5.8.1. pickups
torn, comma-like spots on the surface of extruded products caused by a local material deposition on the surface of the die

5.8.2. die line
continuous longitudinal line formed on an extruded or drawn product caused by minor irregularities and/or the build-up of aluminium or non-metallic inclusions, on the bearing surfaces of the die

5.8.3. broken die
deviation from the desired cross-section due to the absence of a certain portion of the die used to extrude the profile

5.8.4. carbon mark
gray or black surface marking caused by contact with carbon run-out blocks

5.8.5. snap mark
band-like pattern around the full perimeter of an extruded section and perpendicular to its length, caused by an abrupt change of an extrusion parameter during the process

NOTE: If the extrusion process is abruptly suspended, then the term "stop mark" is used.

5.8.6. saw lubricant stain
yellow to brown area of surface discoloration at the ends of the extruded length, caused by certain types of saw lubricants if they are not removed from the metal prior to the thermal treatment

5.8.7. torn surface
deep longitudinal rub mark resulting from abrasion by extrusion or drawing tools

5.8.8. multi-hole die effect
non-concentric configuration of grain structure resulting from the use of multi-hole dies

5.8.9. reeling marks
superficial spiral markings present on round extruded or drawn products that have been straightened by reeling

5.8.10. stretcher strain markings
permanent surface distortion in the form of either flamboyant patterns or Lueders lines that can appear under certain conditions on stretched extruded products

NOTE: The onset of these markings varies according to the type of metal and the degree of stretching.

5.8.11. hot spot
dark, grey or black surface patch on anodised extruded products caused by non-uniform cooling after extrusion

NOTE: Hot spots are typically associated with lower hardness and coarse magnesium silicide precipitates.

5.8.12. traffic marks
abrasions, typically dark in colour, resulting from relative movement between metal surfaces during handling and transit, e.g. during the cooling of profiles on the run-out table

NOTE: A mirror image of a traffic mark is observed on the adjacent contacting surface.

5.8.13. speed cracks, speed tear
transverse surface cracks, preferentially in corner radii or extremities of a profile, caused by localized high temperature

5.8.14. peripheral coarse grain
area of recrystallized grains at the periphery of an extruded product (or forged product if made from extruded stock), which has sometimes lower properties than the non-recrystallized core

5.8.15. non-fill
deviation of a die forging from the specified form caused by failure of metal to fill a forging die impression

5.8.16. mismatch
deviation of a die forging from the specified form caused by opposing die halves not being in perfect alignment

5.8.17. flash
thin protrusion at the parting line of a die forging which forms when metal, in excess of that required to fill the impressions, is forced between the die interfaces

5.8.18. cold shut (forging); lap
discontinuity in a forging caused by metal flowing into a section from two directions

5.8.19. fin
thin projection on a forging resulting from trimming or from the metal under pressure being forced into hairline cracks in the die or around die inserts

5.8.20. back-end defect ‡
Cone-shaped defect resulting from surface contaminations and oxides being built up in front of the advancing extrusion pad due to container friction resulting in annular separation in the rear of the extrusion

5.8.21. front-end defect ‡
parabolically shaped defect caused by oxides and lubricants from the billet end surface being trapped when two billets are welded during billet to billet extrusion resulting in poor welds; (also known as transverse-weld defect)

5.9. Typical terms for foil and formed products

5.9.1. roll holes (foil)
holes in foil with a maximum diameter > 0,2 mm which occur at regular intervals throughout the rolled coil length

5.9.2. perforations (foil)
holes in foil with a maximum diameter > 0,2 mm which occur randomly throughout the rolled coil length

5.9.3. pinholes (foil)
voids in foil of gauge below 20 µm of normally round or oval shape with a maximum diameter < 0,2 mm, randomly distributed

5.9.4. broken matte finish
non-uniform surface on the matte side of packed rolled foil, caused by bright spots

5.9.5. sticking (of foil)
adherence of contacting foil surfaces in a coil sufficient to interfere with the normal ease of unwinding

5.9.6. strain mark
Surface patterns on formed products of some alloys after straining

NOTE 1: Stochastical flamboyant strain marks which can appear at low strain levels are often termed “strain marks type A.

NOTE 2: Strain marks which appear between 45° and 5 5° to the straining direction are often termed “str ain marks type B” or “Lueders lines”.

5.9.7. looper lines
closely spaced symmetrical lines on the surface of a formed product, typically occurring after a deep drawing operation

6. Glossary

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