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TABLE OF NATURAL AND CHEMICAL ELEMENTS - (Page 01) [Rev.01-09-'17]

SYMBOLS AND PHYSICAL PROPERTIES

Metal	Chemical Symbol	Specific weight (Kg/dm^3)	Melting point (°C)
Aluminium	Al	2,70	659,8°C
Antimony	Sb	6,62	630,5°C
Silver	Ag	10,50	960,5°C
Arsenic	As	5,72	817,0°C
Barium	Ba	3,50	714,0°C
Beryllium	Be	1,85	1'277,0°C
Bismuth	Bi	9,80	271,0°C
Boron	B	2,35	2'030,0°C
Cadmium	Cd	8,65	320,9°C
Calcium	Ca	1,55	838,0°C
Carbon	C	2,26	3'727,0°C
Caesium	Cs	1,87	28,5°C
Cobalt	Co	8,90	1'495,0°C
Chromium	Cr	7,19	1'875,0°C
Iron	Fe	7,86	1'538,0°C
Phosphorus	P	1,82	44,2°C
Magnesium	Mg	1,74	650,0°C
Manganese	Mn	7,43	1'245,0°C
Mercury	Hg	13,60	-39°C
Molybdenum	Mo	10,20	2'610,0°C
Nickel	Ni	8,96	1'453,0°C
Gold	Au	19,30	1'063,0°C
Oxygen	O	1,14	-218,8°C
Palladium	Pd	12,00	1'552,0°C
Lead	Pb	11,35	327,4°C
Platinum	Pt	21,45	1'773,0°C
Potassium	K	0,86	63,5°C
Copper	Cu	8,92	1'083,0°C
Silicon	Si	2,33	1'410,0°C
Sodium	Na	0,97	97,8°C
Tin	Sn	7,30	231,9°C
Strontium	Sr	2,60	768,0°C
Tantalum	Ta	16,60	2'996,0°C
Tellurium	Te	6,24	449,5°C
Titanium	Ti	4,51	1'668,0°C
Tungsten (Wolfram)	W	19,30	3'410,0°C
Uranium	U	19,07	1'132,0°C
Vanadium	V	6,10	1'900,0°C
Zinc	Zn	7,14	419,4°C
Zirconium	Zr	6,49	1'852,0°C
Sulphur	S	2,07	119,0°C

Alloy	Specific weight (Kg/dm^3)	Melting point (°C)
Cast Iron (average of the various alloys)	7,20	1'200,0°C
Bronze (average of the various alloys)	8,90	900,0°C
Brass (average of the various alloys)	8,30	900,0°C

SYMBOLISM AND TECHNICAL TERMINOLOGY - (page 02)

A % =	Elongation
H / M =	Magnetic permeability
H =	Henry (electrical inductance) = A / (V · s)
HB =	Brinell hardness
J =	Joule (energy, work) = N · m
K =	Kelvin thermodynamic temperature
$X \cdot 10^{-6}$ / K =	Coefficient of thermal expansion
Kg / dm^3 =	Volumetric mass
N =	Newton (force) = kg · m/sec^2
N = Kg · 9,8 =	Equivalence between Kg. and N.
Pa =	Pascal (pressure and tension) = N / m^2
Rm =	Ultimate tensile strength
Rp 0,2 =	Yield strength
W / (m·K) =	Heat conductivity
W / (m^2·K) =	Coefficient of heat transmission
Ω =	Ohm (electric resistance)
m / (Ω · mm^2 =	Electric conductivity
(Ω · m) op. (Ω · mm) =	Electric resistivity

	Round bars		Square tubes
	Square bars		Rectangular tubes
	Flat bars		"L" Profiles with equal sides
	Hexagonal bars		"L" Profiles with unequal sides
	Full radius flat bars		"U" Profiles with equal sides
	Semi-round solid bar		"U" Profiles with narrow base
	Half-round solid bar		"U" Profiles with wide base
	Round tubes		Double channel
			"T" Profiles

TECHNICAL TERMINOLOGIES - (Page 03)

From letter "**A**" to letter "**D**"

ALUMINIUM BILLET

Bar obtained by vertical casting with forced cooling in coolant. It has well-defined dimensions. It is generally used for the extrusion.

ANNEALING

Heat treatment of the metallic alloys which aims to soften, reduce the hardness and stress relief. This treatment causes a change in the structure of the original material. For example in the cast iron there are two types of soft annealing: one for the elimination of carbides (Temperature at 900 -955°C) and the other for the ferritization (Temperature at 700 -760°C. for GJL, at 900°C. for GJS).

ANODIZING

Electrolytic treatment, which forms some types of oxide layers on the metal surface, the structure and characteristics of which are different from the ones of the natural aluminium oxides. Their thickness varies from few microns to 100 microns. This treatment is typical of the aluminum and its alloys.

AUSTENITE

Primary solid solution, of interstitial type, of Carbon in Iron. γ.

BRINELL, HARDNESS

As hardness is the resistance of materials to penetration, the Brinell hardness value (H.B) is determined by the relation between an applied load (Kg), on a steel sphere of a known diameter and the diameter of the mark (mm) impressed by the sphere in the metal. For example, HB 187,5/2,5 means that the test is performed with a sphere of 2,5 mm diameter and a load of 187,5 kg. To determine the hardness of the cast iron, it is necessary to work with a sphere of 10 mm. and a load of 3'000 Kg. For non-ferrous metals, it is necessary to use the sphere of 2,5 mm. and load of 62,5 Kg.

CARBIDES

Compounds of Carbon with Iron (from Fe_4C to FeC). Normally they are components which give hardness and fragility but also wearproof to the cast iron structure. The iron carbide is the so called cementite.

CEMENTITE

Fe_3C - See "Carbides". Carbide which can rise on the external area of castings or bars, when the cooling of the liquid cast iron is performed according to the metastable curve in the iron-carbon diagram. Normally its presence as free cementite is not desirable due to its hardness and fragility. However, sometimes, it may be useful to give wearproof to the structure.

CONTINUOUS CASTING

Method for the production of bars, starting from the metal in a liquid state. The exit point of the bar is directly connected to the casting furnace and the cooling is performed in a forced and quick way. There are two types of plants: Vertical (normally used for steels, copper and precious metals) and Horizontal (normally used for cast iron and bronze).

DIE

It is the steel " mold " through which profiles of non-ferrous materials are extruded assuming the required shape. In the case of hollow profiles, it is possible to have two different dies: "bridge" and "floating needle", the latter is preferably used for profiles which require optimal resistance to pressure.

DIRECT EXTRUSION

In this process the billet moves towards the die generating frictional resistance between the billet and the container.

TECHNICAL TERMINOLOGIES - (Page 04) [Rev.01-09-'17]

From letter "**D**" to letter "**H**"

DRAWING

Procedure normally applied to rolled or extruded material consisting in the cold passage of the bar or tube through a specific die with a controlled tolerance. This procedure allows to obtain, by deformation, extremely tight dimensional tolerance (see the specific standards). There are three types of drawing process: 1 - drawing of bars with solid section; 2 - external drawing of tubes or

DUCTILITY

Property that allows the permanent deformation of materials without breaking, when subject to tensile stress. In metal materials the concept of plasticity and ductility are similar.

ELASTICITY

Property that allows the deformation of materials only during the action of tensile or compression loads. When this action ceases, the material returns to the original form prior to deformation. In metal materials it is measured with the Modulus of Elasticity and Elastic Limit.

ELASTIC LIMIT

During the elastic deformation, the maximum tensile load supported by the test-bar in the tensile testing (see "elasticity") is known as elastic limit. It is calculated by relating this load with the original section of the test-bar.

ELONGATION

Permanent deformation measured from the test-bars used for testing the tensile strength, once the test-bar reaches the maximum ultimate tensile strength. It is measured as a % on the length of the test-bar.

EQUIVALENT CARBON

Although the main element in cast iron is C, the relation between %C %Si and %P, known as "Equivalent Carbon", is an important data to define the characteristics of cast iron. The value is determined using the formula: C.E.= % C + (% Si : 3) + (% P : 3)

EXTRUSION

It is a process of hot transformation that takes advantage of the plastic condition of many materials which, pre-heated to a specific temperature, can be extruded (pushed / introduced in a forced manner) through the light of a die. There are two types of extrusion: "direct" or "inverse" depending on the techniques adopted.

FATIGUE STRENGTH

Resistance of metals to bear variable or intermittent loads with values below the Elastic Limit. Theoretically a fixed load with these values would not lead to a plastic deformation but, as the loads are variable or intermittent, the above mentioned deformation may occur. The concept of Fatigue Limit expresses the maximum load supported without deformation for a specific load variability or intermittence.

FERRITE

Solid solution of carbon in Fe α with extremely low percentages of C in primary solid solution. This structure is usually together with the pearlite in raw casting condition. It improves the workability of cast iron and has better ductility properties than the pearlite; on the contrary it gives less tensile strength to the cast iron.

HARDENING AND TEMPERING

Heat treatment which includes the sequence of two treatments: Hardening and Tempering

TECHNICAL TERMINOLOGIES - (Page 05)

From letter "**I**" to letter "**R**"

INVERSE EXTRUSION

In this process the billet remains in a fixed position while the die presses against the billet and causes the sliding of the material through its shape. This procedure requires presses with higher power than the ones for direct extrusion but it allows the extrusion of harder alloys, the use of longer billets (thus producing longer bars) and the achievement of more uniform structures on the entire section of the extruded bar.

MARTENSITE

Structure with an acicular appearance of steels and cast iron which have undergone a hardening heat treatment. It is hard (although not as much as the cementite) and not very tough. The tempering treatment together with the quenching process transforms it into tempered martensite, lowering the hardness and slightly increasing the toughness.

MODULE OF ELASTICITY

Relation between the elastic limit and the generated elastic deformation (see Elastic Limit). In particular, in the lamellar cast iron there is no pure elastic behavior, the values given are conventional and refer to the deformation expressed with a percentage and determined by the maximum breaking load (approx. 75%).

NORMALIZATION OF STEELS

Heat treatment which causes the complete solubilization of the components, with subsequent cooling in calm air. The obtained structure is characterized by an extremely fine crystal grain. This treatment is generally used for carbon steels and low alloyed steels.

PEARLITE

It consists of juxtaposed lamellas of ferrite and secondary cementite which separate during the eutectoid transformation (iron-carbon diagram). It has higher hardness and better wear resistance than the ferrite, anyhow it is perfectly workable.

PERMEABILITY

Capacity of the material to be crossed by the magnetic flow (measured in micro henry/meter =

QUENCHING

Heat treatment of ferrous alloys which consists in heating (850-900 ° C) to austenitize (to obtain an austenitic structure) (see "austenite") and cool rapidly to obtain a martensitic structure (see "martensite"). The word " surface (or induction) quenching " refers to the fact that this treatment is applied only to the superficial part of the piece.

ROCKWELL HARDNESS

As hardness is the resistance of materials to penetration, the value of the Rockwell hardness is determined by the difference between the penetration depths of 2 loads (pre-load and load, then subtracted from a fixed number). These loads act on a sphere with a specific diameter (Ø1,5875mm.) or on a diamond cone. Depending on the load values and the penetration tool, there is the scale A, B or C. This hardness test is recommended almost exclusively for steels, its application is not recommended for cast iron or non-ferrous metals.

TECHNICAL TERMINOLOGIES - (Page 06)

From letter "**R**" to letter "**W**"

ROLLING

Procedure in which the material, dragged by friction between two counter-rotating cylinders with parallel axes, copies the shape of the space (channel) existing between the cylinders. This procedure is normally used to produce sheets and plates.

ROLL STRAIGHTENING

Cold passage through steel rollers placed in series and inclined in comparison with the bar. This mechanical treatment allows, by deformation, to eliminate the roughness on the external surface of the bar, straightening the bar itself.

STABILIZATION

Heat treatment at low temperature (between 500 and 700°C.) which does not modify the metal structure. It is executed to eliminate eventual stresses inside the metals and thus stabilize the piece during the mechanical machining. It is usually performed on the raw casting or, preferably, after the first rough finishing.

TEMPERING (in the ferrous metals)

Technological process which consists in heating a steel, at a temperature below the structural transformation range, previously subject to a treatment of hardening or normalization, followed by cooling at appropriate speed in oil, water or air furnace. This process aims to reduce the stress caused by hardening, reduce the fragility of the material, increase the toughness with consequent reduction of the hardness.

TENSILE STRENGTH

It is the greatest tensile load supported by a material up to the breaking point. It is calculated by relating this maximum load with the surface of the original work section subject to the tensile testing.

TOUGHNESS

Capacity of the metal to allow plastic deformations without breaking.

VIKERS HARDNESS

As hardness is the resistance of materials to penetration, the value of the Vikers hardness is determined by measuring the relation between the applied load and the surface of the mark left on the metal by a diamond indenter shaped like a a straight pyramid with a square base and angle θ = 136 °. The units of measurement of the Vikers scale are therefore the ones of a pressure, that is to say of a load in Kgf or in Newton on a surface. The main advantage of this method for the hardness measurement is the possibility to use also small loads to check close-range hardness values; furthermore there is an high accuracy of the measurement and the scale is unique for all materials. It is however rarely used because it is expensive and the reading of the mark can be made only with a microscope.

WEARPROOF

Resistance of solid bodies to friction by rubbing the material on their surface, generally for a long duration. This normally varies according to the structure of the material.

DRAWING TOLERANCE TABLE
HARDNESS CONVERSION TABLE

ISO TOLERANCE TABLE h - j - k

Ø (in mm)	7	8	9	10	11	12	13
> 1 ÷ 3	0,009	0,014	0,025	0,040	0,060	0,090	0,140
> 3 ÷ 6	0,012	0,018	0,030	0,048	0,075	0,120	0,180
> 6 ÷ 10	0,015	0,022	0,036	0,058	0,090	0,150	0,220
> 10 ÷ 18	0,018	0,027	0,043	0,070	0,110	0,180	0,270
> 18 ÷ 30	0,021	0,033	0,052	0,084	0,130	0,210	0,330
> 30 ÷ 50	0,025	0,039	0,062	0,100	0,160	0,250	0,390
> 50 ÷ 80	0,030	0,046	0,074	0,120	0,190	0,300	0,460
> 80 ÷ 120	0,035	0,054	0,087	0,140	0,220	0,350	0,540
> 120 ÷ 180	-	-	-	0,160	0,250	0,400	0,630
> 180 ÷ 250	-	-	-	0,185	0,290	0,460	0,720
> 250 ÷ 315	-	-	-	-	0,320	0,520	0,810
> 315 ÷ 400	-	-	-	-	0,360	0,570	0,890
> 400 ÷ 500	-	-	-	-	0,400	0,630	0,970
> 500	-	-	-	-	0,440	0,700	1,100

h = all minus tolerance ex. Ø 45 h 9 = + 0 / - 0,062

j = plus and minus tolerance ex. Ø 45 j 9 = + 0,031 / - 0,031

k = all plus tolerance ex. Ø 45 k 9 = + 0,062 / - 0

Conversion Table between Vikers - Brinell and Rockwell C Hardness

Vikers - HV(1)	Brinell - HB(2)	Rockwell C - HRC(3)
350	340	34
400	378	39
450	420	44
500	465	47
520	480	48
550	510	50
600	555	53
650	595	56
700	640	58
750	683	60

(1) The measurement of the Vikers hardness for values < HV.30 is not recommended

(2) The measurement of the Brinell hardness for values > HB.595 is not recommended

(3) The measurement of the Rockwell hardness for values < HRC.39 is not recommended

INSPECTION DOCUMENTS (CERTIFICATES) - (Page 08)

INFORMATION PAGE ABOUT THE TYPES of INSPECTION DOCUMENTS

The types of Inspection Documents (Certificates) are codified by the standard **UNI EN 10204** which shall be considered as reference for any further detail on the subject. For information, we summarize hereinafter the main differences and peculiarities of the various types of certificates.

The Inspection Documents are divided into two groups and two subgroups:

Inspection Documents issued according to a non-specific control where "non-specific control" means a check effected by the manufacturer in accordance with its own procedures, in order to verify whether the products defined in the same specification and manufactured with the same manufacturing process comply with the requirements of the order or not. In this case, the products subject to control are not necessarily the products actually supplied. **(Group 2)**.

Subgroup 2.1 - Inspection Certificate "type 2.1"

Document in which the manufacturer declares that the products supplied are in compliance with the requirements of the order, without indicating any test result.

Commerciale Fond s.p.a. normally releases this inspection document, issued on its headed paper and based on the inspection effected on receipt of the goods, both on the goods themselves and the relative enclosed documents.

Subgroup 2.2 - Inspection Certificate "type 2.2"

Document in which the manufacturer declares that the products supplied are in compliance with the requirements of the order and provides the test results based on non-specific controls.

Commerciale Fond s.p.a. releases this inspection document only on specific request and according to conditions to be agreed before receiving the purchase order.

Inspection documents issued according to a specific control where "specific control" means a check effected before the delivery, in compliance with the specification of the product, on the products to be supplied or on the test units (agreed while placing the order) to which the products supplied belong, in order to verify whether they meet the requirements of the order. **(Group 3)**.

Subgroup 3.1 - Inspection Certificate "type 3.1"

Document in which the manufacturer declares that the products supplied are in compliance with the requirements of the order and in which the test results are provided. The test unit and the types of the tests to be executed are defined by the specification of the product, the official regulations and the agreements taken when placing the order, mentioned on the order itself . The document must be validated by a representative of the manufacturer authorized for the control, independent from the manufacturing department.

Commerciale Fond s.p.a. releases this inspection document only on specific request and according to conditions to be agreed before receiving the purchase order.

Subgroup 3.2 - Inspection Certificate "type 3.2"

Document prepared jointly by the representative of the manufacturer authorized for the control, independent from the manufacturing department, and the representative of the customer authorized for the control or the inspector designated by the official regulations in which they declare that the products supplied comply with the requirements of the order and in which the test results are provided.

Normally Commerciale Fond s.p.a., as trader/mediator, does not release this inspection document. In special cases and on specific agreement with the client, we may consider the possibility to execute the checks required for the placement of this certificate.

In order to avoid mistakes or possible complaints, we recommend to specify and agree the type of the certificate actually required and the relative cost when placing the order.

TABLE OF COLOURS FOR MATERIAL IDENTIFICATION - (Page 09)

CAST IRON in BARS

GJL-200C	GJL-250C	GJL-300C	G.M.I.
GJS.400-7C	GJS.400-18C	GJS.400-15C	GJS.500-14C
GJS.500-7C	GJS.600-3C	GJS.700-2C	A.D.I.

ALUMINIUM in BARS

ANTICORODAL	6082		6060		6012
11S	2011		2007		2030
ERGAL	7075		AVIONAL		2024
	CARPENTAL	7020			

ALUMINIUM in PLATES for cutting

ANTICORODAL	6082	AVIONAL	2017
ERGAL	7075	PERALUMAN	5083

BRONZE in BARS

GCuSn12	B14 UNI	GCuSn7	B14 industrial
85.5.5.5 3 alternative colours	Common Bronze	5275	Aluminium-Bronze

PLASTIC MATERIALS in BARS and PLATES

Polypropylene PP	Polyethylene PE	Polyvinyl chloride PVC
Nylon PA6	Polyethylene PET	Teflon PTFE
	Polyacetal POM C	

SERVICE OF CUTTING TO SIZE AND PRE-MACHINING - (Page 10) *(Rev.08-01-'18)*

Service of Cutting to Size executed with the following equipments:

N°12	Automatic band saws with numerical control able to cut single bars and bundles up to the maximum size of 650x650mm.
N°1	Automatic circular saw able to cut non-ferrous bars up to the maximum size of 150 x 150 mm. or rectangles with section of 200 x 100 mm., with cutting tolerance +/- 0,07mm. and roughness on the cut surface of Ra 1.2.
N°2	Automatic circular saws with numerical control able to cut plates of non-ferrous metals and plastic materials up to sizes of 4'400 x 4'400 x 120mm.
N°1	Automatic circular saw with numerical control able to cut plates in Aluminium and non-ferrous metals with sizes up to 3'200 x 3'200 x 90 mm.
N°1	Vertical band saw with numerical control able to cut plates in non-ferrous metals with maximum overall sizes of 4'100 x 1'650 x 900 mm.
N°1	Vertical band saw able to cut plates of non-ferrous metals with maximum overall sizes of 3'000 x 1'500 x 250 mm.
N°1	Vertical band saw able to cut disks from plate up to Ø 1'000 mm., thickness of 150 mm. and a maximum weight of Kg. 120 for each disk
N°1	Vertical band saw with numerical control able to cut blocks and bars in cast iron up to maximum overall sizes of 3'200 x 1'500 x 880 mm.

Summary table of the Cutting Tolerance

Type of machine:	Standard applied tolerance :	Minimum optainable tolerance, on customer's request when placing the order
Circular saw for non-ferrous bars	+ / - 0,15 mm.	+ / - 0,07mm.
Band saws for ferrous and non-ferrous bars (cuts in series)	-0 / +2 mm.	- 0,2 / +0,4 mm.
Alternative saws for bars (single cuts)	-0 / +20 mm.	-0 / +10 mm.
Band saws for plates	-1 / + 2mm.	- 0,3 / +0,4 mm.
Band saws with numerical control for ferrous plates	+ / - 3mm.	+ / - 1mm.
Circular saws for non-ferrous plates	+ /- 0,5 mm. al metro	+ / - 0,3 mm. per meter
Vertical band saw for cutting of disks	+ / - 5 mm.	-1 / +4 mm.

NB. *The cost of the cuts may vary depending on the required precision, therefore it is important to specify the really required tolerance, in order to optimize the quality / price ratio. In case of orders for cut material, the standard tolerance will be always applied, unless otherwise required from the customer, to be specified when placing the order.*

Service of Water Jet Cutting for shaped items (Service offered with the collaboration of external sub-contractors)

This type of cut, made by a jet of water and sand under high pressure, can be made on any material and allows to realize shapes according to specific drawings, both in small and large series, with dimensional tolerance of few tenths (the tolerance increases proportionally to the thickness of the plate to be cut).

Service of Rough-machining for Rectangular and Square bars in cast iron

Service of rough-machining for cast iron bars made by n°1 milling machine with automatic rotation of the bar and n°3 planer milling machines.

The main features of this service are:

- Possibility of milling bars with maximum length of 3'400 mm. and size up to 260 x 260 mm.
- Guarantee of absolute orthogonality of the plans, thanks to the automatic rotation of the bars

Dimensional tolerance on the sides Standard: +/-0,20 Fine: +/-0,10 Max: +/-0,05

Surface roughness: from Ra 3,2µm. (standard) up to Ra1,6µm. according to the requirements, to be defined before the order.

Service of Peeling for Round bars in cast iron

The service of peeling for the cast iron bars can be executed both on lamellar and spheroidal cast iron, with diameter included between Ø20 mm. and Ø67 mm. (*maximum rough diameter 70mm.*) in standard length of 3'000 - 3'100 mm.

The obtainable dimensional tolerance is h.11 (*maximum obtainable on specific request: h.9*) with roughness Rz.16.

The main advantages of the peeled cast iron are the following:

- Possibility of clamping with automatic collets and use on lathes with bar passage
- Time reduction for the final machining and longer tool life, since the outer crust is removed during the peeling.

Service of Drilling for cast iron bars in continuous casting

Service of drilling made by n°3 drilling machines, on bars with round or square sections, with the following features:

- Achievable holes diametre: from ø 25 mm to ø 100 mm every 5 mm # from ø 110 mm to ø 200 mm every 10mm.
- External bars dimension: from ø 50 mm to ø 550 mm. Maximun lenght: 3200 mm up to ø420 mm , to be defined.
- Minimum achievable thickness: ≠10 mm. # minimum perforable lenght: 500 mm.
- Dimensional tolerance on the ø of the hole: -1/-2 # concentricity tolerance between the hole and the outside of the bar: +1/-1,5 mm