

TECHNICAL DATA SHEET

POLYMERS

[Polyethylene \(PE\)](#)

[Polypropylene \(PP\)](#)

[Polyvinylchloride \(PVC\)](#)

[Polystyrene \(PS\)](#)

[Acrylonitrile Butadiene Styrene \(ABS\)](#)

[Polymethyl Methacrylate \(PMMA\)](#)

[Polyamide \(PA\)](#)

[Polyacetal \(POM\)](#)

[Polycarbonate \(PC\)](#)

[Styrene Ethylene Butylene Styrene \(SEBS\)](#)

[Copolyester](#)

METALS

[Aluminium](#)

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Polyethylene (PE)

LD (Low Density) - HD (High Density)

Discrete impact strength.

Can be flexible (LD) or stiff (HD) depending on the formulation.

Mechanical properties depend on the crystallinity.

Good sliding properties.

Operation temperature from -40° C. to +80° C. depending on the type.

Low moisture absorption.

Resistant to (selection):

acids, alkaline solutions, alcohol, salt solutions, water, esters, oil, some types of petrol.

Not resistant to (selection):

strong oxidative agents, swelling caused by aliphatic hydrocarbons,

brittleness due to direct solar radiations.

TECHNICAL DATA SHEET

POLYETHYLENE LOW DENSITY - PE-LD -

Properties	Testing Method	Unit	Typical Values
PHISICAL			
Specific Gravity	ISO 1183	gr/cm ³	0,92
MECHANICAL			
Yield stress	ISO 527	MPa	10
Flexural modulus	ISO 178	MPa	120
Hardness Shore D	ISO 868/A		45
THERMAL			
Softening temperature VICAT 1kg	ISO 306/A	°C	84
Embrittlement temperature	ASTM D 746	°C	< -20

NOTES:

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TECHNICAL DATA SHEET

POLYETHYLENE HIGH DENSITY - PE-HD -

Properties	Testing Method	Unit	Typical Values
PHISICAL			
Specific Gravity	ISO 1183	gr/cm ³	0,95
MECHANICAL			
Yield stress	ISO 527	MPa	27
Tensile strength at break	ISO 527	MPa	10
Elongation at break	ISO 527	%	100
Flexural modulus	ISO 178	MPa	1300
IZOD notched impact strength	ISO 180/A	J/m	40
Hardness Shore D	ISO 868/A		66
THERMAL			
Softening temperature VICAT 1kg	ISO 306/A	°C	126
Embrittlement temperature	ASTM D 746	°C	< -60
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Polypropylene (PP)

Scarce impact strength.

Discrete hardness and mechanical resistance.

Discrete sliding properties.

Operation temperature from -0° C. to +110° C. depending on the type.

Low moisture absorption.

Resistant to (selection): weak inorganic acids, alkaline solutions, alcohol, some oils, solutions of washing lyes until 100° C.

Not resistant to (selection): strong oxidative agents, petrol, benzol, halogenated hydrocarbons.

TECHNICAL DATA SHEET				
POLYPROPYLENE COPOLYMER - PP-C -				
Properties	Testing Method	Unit	Typical Values	
PHISICAL				
Specific Gravity	ASTM D792	gr/cm ³	0,90	
Water absorption (24 h – 23°C)	ASTM D570	%		
MECHANICAL				
Tensile modulus	ISO 527-2	MPa	1400	
Yield stress	ISO 527-2	MPa	28	
Elongation at yield	ISO 527-2	%	6	
Elongation at break	ISO 527-2	%	>50	
Unnotched Charpy impact strength	ISO 179/1eU	kJ/m ²	Does not break	
+23°C			120	
0°C			80	
Charpy notched impact strength	ISO 179/1eA	kJ/m ²	+23°C	
			0°C	7
			-20°C	3,5 3
THERMAL				
Heat distortion temperature HDT/B	ISO 75/2	°C	90	
Softening temperature VICAT	ISO 306	°C	151	
VST/A50			68	
VST/b50				
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TECHNICAL DATA SHEET

POLYPROPYLENE HOMOPOLYMER - PP-H -

Properties	Testing Method	Unit	Typical Values
PHISICAL			
Specific Gravity	ASTM 1505	gr/cm ³	0,9
Water absorption (24 h – 23°C)	ASTM D570	%	1,5 ÷ 2,5
MECHANICAL			
Tensile yield strength	ASTM D638	MPa	35
Elongation at maximum tensile	ASTM D638	%	14
Flexural modulus (1,3 mm/min) 1% sec	ASTM D790	MPa	1650
IZOD impact strength a 23°C	ASTM D256-A	J/m	34
ROCKWELL hardness	ASTM D785	R	111
THERMAL			
Heat distortion temperature	ASTM D648	°C	82
			54
Softening temperature VICAT	ASTM D1525-A	°C	154
			95
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Polyvinylchloride (PVC) Plasticized

Excellent impact strength, flexible.
 Scarce tear strength. Not suitable for sliding.
 Becomes fragile from -10° C. to -50° C. depending on the amount of plasticizer added.
 Maximum extended operation temperature under low stress, circa +60° C.
 Low moisture absorption.
 Resistant to (selection): partly to petrol, medium concentrated inorganic acids, alcohol, salt solutions; good fastness to light and good ageing resistance.
 Not resistant to (selection): organic solvents and aqueous solutions (brittleness), benzol,
 All the mechanical characteristics are strongly affected depending on the percentage of plasticizer added.

TECHNICAL DATA SHEET			
POLYVINYLCHLOIDE plasticized - PVC-P -			
Properties	Testing Method	Unit	Typical Values
PHISICAL			
Specific Gravity	ISO 1183	kg/dm ³	1,15 ÷ 1,2
Hardness Shore D	ISO 868		51
Tensile strength at break	ISO R527	N/mm ²	10
Elongation at break	ISO R527	%	420
Cold flex	ISO 458/2	°C	-50
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Polystyrene (PS)

- PS Shockproof
 Good impact strength. Discrete hardness and mechanical resistance.
 Scarce sliding properties. Low moisture absorption.
 Operation temperature from -40°C . to $+70^{\circ}\text{C}$. depending on the type.
 Resistant to (selection): only under certain conditions to acids and alkaline solutions.
 Not resistant to (selection): petrol, solvents, certain oils, UV radiations.

TECHNICAL DATA SHEET			
POLYSTYRENE (shockproof) - PS-I -			
Properties	Testing Method	Unit	Typical Values
PHISICAL			
Specific Gravity	ISO 1183	gr/cm ³	1,04
Water absorption (24 h – 23°C)	ISO 62	%	>0,1
MECHANICAL			
Tensile yield strength (5 mm/min)	ISO 527	MPa	18
Tensile modulus at break (5 mm/min)	ISO 527	MPa	17
Tensile elongation at break (5 mm/min)	ISO 527	%	55
Tensile modulus (1 mm/min)	ISO 527	MPa	1700
Flexural modulus (2 mm/min)	ISO 178	MPa	32
IZOD notched impact strength (+ 23°C – thickness 3,2 mm) (+ 23°C – thickness 4 mm) (- 30°C – thickness 4 mm)	ISO 180/4A	J/m	110
	ISO 180/1A	kJ/m ²	9
	ISO 180/1A	kJ/m ²	6.5
ROCKWELL hardness (scale L/M)	ISO 2039/2		L60
THERMAL			
Heat distortion temperature (1.8 Mpa – 120°C/h)	ASTM D648	°C	81
Softening temperature VICAT (10 N/50°C/h) (50 N/50°C/h)	ISO 306/A	°C	90
	ISO 306/B	°C	82
ELECTRICAL			
Dielectric strength	IEC 60243	kV/mm	65
Tracking index (CTI) sol.A	IEC 60112	-	500
OTHER			
Fire behavior (thickness 1,5 mm)	UL94	Classe	HB
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- **PS Crystal**
 Stiff, hard and fragile. Low impact strength, discrete transparency.
 Scarce sliding properties. Low moisture absorption.
 Operation temperature from -40° C. to $+70^{\circ}$ C. depending on the type.
 Resistant to (selection): only under certain conditions to acids and alkaline solutions,
 fair resistance to ageing.
 Not resistant to (selection): petrol, acetone, benzol, solvents, certain oils, UV radiations.

TECHNICAL DATA SHEET				
POLYSTYRENE (crystal) - PS -				
Properties		Testing Method	Unit	Typical Values
PHISICAL				
Specific Gravity		ISO 1183	gr/cm ³	1,05
Water absorption (24 h – 23°C)		ISO 62	%	>0,1
MECHANICAL				
Tensile yield strength (5 mm/min)		ISO 527	MPa	-
Tensile modulus at break (5 mm/min)		ISO 527	MPa	37
Elongation tensile at break (5 mm/min)		ISO 527	%	1,3
Tensile modulus (1 mm/min)		ISO 527	MPa	3200
Flexural modulus (2 mm/min)		ISO 178	MPa	60
IZOD notched impact strength (+ 23°C – thickness 3,2 mm)		ISO 180/4A	J/m	-
(+ 23°C – thickness 4 mm)		ISO 180/1A	kJ/m ²	1,7
(- 30°C – thickness 4 mm)		ISO 180/1A	kJ/m ²	1,5
ROCKWELL hardness (scale L/M)		ISO 2039/2		M80
THERMAL				
Heat distortion temperature (1.8 Mpa – 120°C/h)		ASTM D648	°C	82
Softening temperature VICAT (10 N/50°C/h)		ISO 306/A	°C	89
(50 N/50°C/h)		ISO 306/B	°C	83
ELECTRICAL				
Dielectric strength		IEC 60243	kV/mm	70
Tracking index (CTI) sol.A		IEC 60112	-	375
OTHER				
Fire behavior (thickness 1,5 mm)		UL94	Classe	HB
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Acrylonitrile Butadiene Styrene (ABS)

Stiff and strong even at low temperatures.

High hardness and good scratch resistance

Scarce sliding properties.

Operation temperature from -40° C. to +80° C. depending on the type

Low moisture absorption.

Resistant to (selection): only under certain conditions to acids and alkaline solutions,
 fair resistance to ageing.

Not resistant to (selection): petrol, acetone, benzol, solvents, certain oils, UV radiations.

TECHNICAL DATA SHEET			
ACRYLONITRILE-BUTADIENE-STYRENE - ABS -			
Properties	Testing Method	Unit	Typical Values
PHYSICAL			
Specific Gravity	ASTM D792	gr/cm ³	1,07
Water absorption (24 h – 23°C)	ASTM D570	%	0,3
MECHANICAL			
Tensile strength at break	ASTM D638	MPa	35
Tensile modulus	ASTM D638	MPa	2800
Elongation at maximum tensile	ASTM D638	%	30
Flexural modulus	ASTM D790	MPa	2700
IZOD impact c.i. 6,4 mm	ASTM D256	J/m	100
ROCKWELL hardness	ASTM D795	R	-
THERMAL			
Heat distortion temperature HDT 1,82 N/mm ²	ASTM D648	°C	86
Softening temperature VICAT 49N	ASTM D1525	°C	97
ELECTRICAL			
Dielectric strength	ASTM D149	kV/mm	-
Tracking index (CTI)	IEC 112	V	-
OTHER			
Self-extinguishing	UL94	3,2 mm	HB
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Polymethyl Methacrylate (PMMA)

Optimal transparency.

Hard, stiff, good resistance to tensile stress, optimal scratch resistance.

Scarce impact strength. Scarce sliding properties.

Good resistance at low temperatures. Low moisture absorption.

Maximum extended operation temperature +60° C.

Resistant to (selection): aliphatic hydrocarbons, acids and aqueous alkaline solutions, fats, alcohol until 30%, good fastness to light, good ageing resistance and weatherproof.

Not resistant to (selection): fluoridized hydrocarbons, alcohol higher than 30%, benzol, nitro paint, diluent, concentrated acids.

TECHNICAL DATA SHEET			
POLYMETHYL METHACRYLATE - PMMA -			
Properties	Testing Method	Unit	Typical Values
PHYSICAL			
Specific Gravity	ISO 1183	gr/cm ³	1,19
Water absorption (24 h – 23°C)	ASTM D570	%	0,20 ÷ 0,27
MECHANICAL			
Tensile strength at break	ISO 527	MPa	77
Tensile modulus	ISO 527	MPa	3300
Elongation at break	ISO 527	%	5,5
Flexural modulus	ASTM D790	MPa	
Charpy notched impact strength	ISO 180	kJ/m ²	20
ROCKWELL hardness	ASTM D795	M	90 ÷ 104
THERMAL			
Softening temperature VICAT 5 kg	ASTM D1525	°C	90 ÷ 110
ELECTRICAL			
Dielectric strength	ASTM D149	kV/mm	18
OTHERS			
Self-extinguishing	IEC 707	1,6 mm	HB
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Polyamide (types used: PA6 & PA66)

Good impact strength. Good general mechanical resistance. Good sliding properties.

Becomes fragile at -40° C. High moisture absorption.

Maximum extended operation temperature from +80° C. to +120° C. depending on the type.

Resistant to (selection): aliphatic and aromatic hydrocarbons, petrol, oils, fats, some alcohols, esters, ketones, ethers, many chlorinated hydrocarbons, weak alkaline solutions.

Sufficient ageing resistance and sufficiently weatherproof.

Not resistant to (selection): mineral acids, strong alkaline solutions, solutions of oxidative agents, formic acid, phenols, cresols, glycols, chloroforms.

The mechanical characteristics are affected depending on the type of PA, on the percentage of water absorption and on the crystallinity.

TECHNICAL DATA SHEET POLYAMIDE 6 - PA6 -			
Properties	Testing Method	Unit	Typical Values
PHYSICAL			
Specific Gravity	ASTM D792	gr/cm ³	1,14
Water absorption (24 h – 23°C)	ASTM D570	%	1,5 ÷ 2,5
MECHANICAL			
Tensile yield strength	ASTM D638	MPa	80
Tensile modulus	ASTM D638	MPa	2950
Elongation at maximum tensile	ASTM D638	%	60
Flexural modulus	ASTM D790	MPa	2800
IZOD impact strength c.i. 3,2 mm	ASTM D256	J/m	50
ROCKWELL hardness	ASTM D795	R	118
THERMAL			
Heat distortion temperature HDT 1,82 N/mm ²	ASTM D648	°C	75
Softening temperature VICAT 49N	ASTM D1525	°C	210
ELECTRICAL			
Dielectric strength	ASTM D149	kV/mm	17
Tracking index (CTI)	IEC 112	V	600
OTHER			
Self-extinguishing	UL94	3,2 mm	V2
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TECHNICAL DATA SHEET

POLYAMIDE 66 - PA66 -

Properties	Testing Method	Unit	Typical Values
PHYSICAL			
Specific Gravity	ASTM D792	gr/cm ³	1,14
Water absorption (24 h – 23°C)	ASTM D570	%	0,8 ÷ 1,0
MECHANICAL			
Tensile strength at break	ASTM D638	MPa	160
Tensile modulus	ASTM D638	MPa	3000
Elongation at maximum tensile	ASTM D638	%	50
Flexural modulus	ASTM D790	MPa	2850
IZOD impact strength c.i. 3,2 mm	ASTM D256	J/m	45
ROCKWELL hardness	ASTM D795	R	118
THERMAL			
Heat distortion temperature HDT 1,82 N/mm ²	ASTM D648	°C	95
Softening temperature VICAT 49N	ASTM D1525	°C	245
ELECTRICAL			
Dielectric strength	ASTM D149	kV/mm	17
Tracking index (CTI)	IEC 112	V	600
OTHERS			
Self-extinguishing	UL94	3,2 mm	V2
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Polyacetal (POM)

High mechanical resistance and stiffness with good strength even at low temperatures.
 Good resilience (elastic memory).
 Optimal sliding properties.
 Operation temperature from -40°C . to $+80^{\circ}\text{C}$. depending on the type.
 Does not absorb moisture.
 Resistant to (selection): alcohol, aldehyde, esters, ethers, glycols, petrol, mineral oil,
 weak alkaline solutions, weak acids. Good resistance to hydrolysis.
 Not resistant to (selection): chemical agents with oxidative effects, strong acids $\text{pH}<4$.

TECHNICAL DATA SHEET			
POLYACETAL - COPOLYMER - POM -			
Properties	Testing Method	Unit	Typical Values
PHISICAL			
Specific Gravity	ASTM D792	gr/cm ³	1,41
Water absorption (24 h – 23°C)	ASTM D570	%	0,22
MECHANICAL			
Tensile strength	ASTM D638	MPa	58
Elongation at maximum tensile	ASTM D638	%	40
Flexural strength	ASTM D638	MPa	78
Flexural modulus	ASTM D790	MPa	2256
IZOD notched impact strength	ASTM D256	J/m	49
ROCKWELL hardness scale M	ASTM D785		80
THERMAL			
Heat distortion temperature HDT/A 4,6 kg/cm ² (0,45 MPa) HDT/A 18,6 kg/cm ² (1,81 MPa)	ASTM D648	°C	160 110
Softening temperature VICAT 49N	ASTM D1525	°C	162
ELECTRICAL			
Dielectric strength	ASTM D149	kV/mm	19
OTHER			
Self-extinguishing	UL94		HB
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U.V. stabilized grade suitable for out door applications.

Properties		Test Method	Unit	Value
Physical				
Specific Gravity		ISO 1183	-	1.41
Melt Index (190°C, 2.16kg)		ISO 1133	g/10min	10.0
Shrinkage	Flow/Transverse	ISO 294	%	2.32/2.43
Water Absorption	23°C, H ₂ O, 24hr	ISO 62	%	0.93
Mechanical				
Tensile Strength	23°C	ISO 527-1/2	MPa	62
Tensile Elongation	23°C	ISO 527-1/2	%	40
Flexural Strength	23°C	ISO 178	MPa	83
Flexural Modulus	23°C	ISO 178	MPa	2,600
Notched Charpy Impact Strength	23°C	ISO 179/1eA	kJ/m ²	7.0
Rockwell Hardness		ISO 2039-2	M scale	80
Thermal				
Melting Point		ISO 11357-1	°C	166
Heat Deflection Temperature		ISO 75		
	1.8 MPa		°C	90
Flammability(0.8mm)		UL94		HB

Polycarbonate (PC)

Optimal transparency.

High mechanical resistance and hardness with good strength.

High impact strength. Scarce sliding properties.

Operation temperature from -190°C . to $+130^{\circ}\text{C}$. depending on the type. Low moisture absorption.

Resistant to (selection): thinned mineral acids, aliphatic saturated hydrocarbons, petrol, fats, oils, water (lower than 60°C .), alcohols (except methyl alcohol), weatherproof.

Stabilized types: resistant to UV radiations.

Not resistant to (selection): alkaline solutions, ammonia, ethylene chloride, aromatic hydrocarbons, benzol, amines, ozone.

TECHNICAL DATA SHEET POLYCARBONATE - PC -			
Properties	Testing Method	Unit	Typical Values
PHISICAL			
Specific Gravity	ASTM D792	gr/cm ³	1,2
Water absorption (24 h – 23°C)	ASTM D570	%	0,23
MECHANICAL			
Tensile strength at break	ASTM D638	MPa	68
Elongation at yield	ASTM D638	MPa	63
Tensile modulus	ASTM D638	MPa	2300
Elongation at break	ASTM D638	%	90
Flexural strength	ASTM D790	MPa	90
Flexural modulus	ASTM D790	MPa	2350
IZOD notched impact strength, 3,2 mm	ASTM D256	J/m	640
ROCKWELL hardness	scale M scale R	M R	75 120
THERMAL			
Heat distortion temperature HDT 1,80 MPa	ASTM D648	°C	128
ELECTRICAL			
Dielectric strength	ASTM D149	kV/mm	29
OTHER			
Self-extinguishing	UL94	1,5 mm	HB
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Styrene Ethylene Butylene Styrene (SEBS)

High toughness and optimal impact strength.

Mechanical resistance very variable depending on the type.

Scarce sliding properties. Low moisture absorption.

Operation temperature from -50° C. to $+150^{\circ}$ C. depending on the type.

Resistant to (selection): weak acids and alkaline solutions, oils, fuels, oxidation.

Not resistant to (selection): concentrated sulphuric acid, dichloromethane, chlorinated hydrocarbons, phenols.

TECHNICAL DATA SHEET

SEBS 65

Properties	Testing Method	Unit	Typical Values
Specific Gravity	ISO 1183	gr/cm ³	0,98
Tensile strength at break	ISO 37	MPa	4,0
Stress at 100% elongation	ISO 37	MPa	2,0
Stress at 300% elongation	ISO 37	MPa	3,0
Tensile elongation at break	ISO 37	%	570
Tear strength	ISO 34	kN/m	27
Tear strength with nick	ISO 34	kN/m	15
Shore hardness	ISO 868	Sh A	65

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TECHNICAL DATA SHEET

SEBS 95

Properties	Testing Method	Unit	Typical Values
Specific Gravity	ISO 1183	gr/cm ³	0,98
Tensile strength at break	ISO 37	MPa	9,5
Stress at 100% elongation	ISO 37	MPa	6,6
Stress at 300% elongation	ISO 37	MPa	7,4
Tensile elongation at break	ISO 37	%	630
Tear strength	ISO 34	kN/m	60
Tear strength with nick	ISO 34	kN/m	38
Shore hardness	ISO 868	Sh A	95

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Copolyester

Clear with a high shiny surface;
 good clarity;
 good resistance to light, heat, water;
 good impact resistance.

Property ^a	Test ^b Method	Typical Value, Units ^c
Specific Gravity	D 792	1.18
Mold Shrinkage	D 955	0.005-0.007 mm/mm (0.005-0.007 in./in.)
Tensile Stress @ Yield	D 638	43 MPa (6200 psi)
Tensile Stress @ Break	D 638	52 MPa (7500 psi)
Elongation @ Yield	D 638	7%
Elongation @ Break	D 638	210%
Tensile Modulus	D 638 <small>rigatabella</small>	1575 MPa (2.28)
Flexural Modulus	D 790	1575 MPa (2.28)
Flexural Yield Strength	D 790	64 MPa (9300 psi)
Rockwell Hardness, R Scale	D 785	111
Izod Impact Strength, Notched @ 23°C (73°F)	D 256	860 J/m (16.1 ft·lbf/in.)
Impact Strength, Unnotched @ 23°C (73°F)	D 4812	NB
Deflection Temperature @ 0.455 MPa (66 psi)	D 648	94°C (201°F)
@ 1.82 MPa (264 psi)	D 648	81°C (178°F)
Total Transmittance	D 1003	91%
Haze	D 1003	<1%
Drying Temperature		88°C (190°F)
Drying Time		4-6 hrs
Processing Melt Temperature		260-282°C (500-540°F)
Mold Temperature		38-66°C (100-150°F)

^a Unless noted otherwise, all tests are run at 23°C (73°F) and 50% relative humidity.

^b Unless noted otherwise, the test method is ASTM.

^c Units are in SI or US customary units.

Aluminium

- Used for the production of roses and selvages trimmed from sheet

Aluminium H26
EN AW 1050
¾ raw



Brass

- Used for the production of roses and selvages trimmed from sheet

Brass OT63 ½ hard
Cu 63% Zn 37%
EN 1652

- Used for the production of roses and selvages turned from brass bar

Brass OT 58
UNI-EN- 12164

- Used for the production of die-casted roses and selvages

EN 12165.98 CW 617 N



Inox

- Used for the production of roses and selvages trimmed from sheet

Stainless steel degree: AISI 304 - EN 10088

- Used for the production of springs with wire of stainless steel.

EN 10270-3-1.4310



Steel

- Used for the production of roses and selvages trimmed from sheet

Iron sheet steely,
cold-rolled, not clad, suitable to deep-drawing.
DC04 EN 10020

- Used for the production of spheres

Carbon steel degree B for industrial applications: AISI 1010 EN 52100

- Used for the production of springs with flat wire

C 82 D EN 10016-2

- Used for the production of springs with round wire for spring-loaded roses 52x10 mm.

C 72 EN 10270/1 class SM

- Used for the production of springs with round wire except for the roses 52x10 mm.

C 98 EN 10270/1 class DH



Zamak

ALLOY	European standard	Symbol Alloy	Number Alloy
ZAMAS 15	EN 1774	ZnAl4Cu1	ZL0410

