

The logo for ESKYLOS 2001, featuring the word "ESKY" in a stylized, outlined font, followed by "LOS" in a solid blue font, and "2001" in a solid blue font.

Age hardening ESR
steel: a new approach for
plastic moulding



General characteristics

EskyLos[®] 2001 is an alloy air hardening steel, useful for its hardening characteristics obtained by age hardening at a lower temperature than the phase transformation points.

EskyLos[®] 2001 is obtained through a special 'super clean' production process and by using the ESR (Electro-Slag-Melting) technology.

This technology offers the following advantages:

- increase of material toughness
- high micro-cleanness level
- total isotropy of the material
- very low segregation level

EskyLos[®] 2001 is supplied in the solution treated condition and is stress relieved, in order to reach hardness values of between 310 and 350 HB, comparable with a pre-hardened steel.

If high mechanical properties are required in the pattern and a homogeneous hardness throughout the whole mould is needed, EskyLos[®] 2001 can be further hardened to reach 350-450 HB, by means of an age hardening process.

Since the heat treatment occurs below the phase transformation points, this process can also be carried out on a semi-finished mould, causing minimal deformation and no cracking during the hardening phase.

The mechanical characteristics of this steel are adaptable to a wide range of applications, much more so than those obtained through other grades that are normally used in this field.

EskyLos[®] 2001 represents the ideal option for the end user who is looking for:

- high and homogeneous mechanical characteristics throughout the whole mould regardless of its complexity
- machinability
- micro-cleanness

EskyLos[®] 2001 offers the following advantages:

- excellent machinability
- excellent suitability for embossing
- excellent suitability for polishing
- excellent wear resistance related to the mechanical properties obtained on a finished mould
- exceptional dimensional stability after age hardening

- no cracking during heat treatment, regardless of shape and structure of the mould

EskyLos[®] 2001 is 100% ultrasonically inspected, according to the most demanding of standards.

Chemical analysis

ESKYLOS [®] 2001		Alloying %	
C	0,10 ÷ 0,20	Cr	0,10 ÷ 1,10
Si	0,10 ÷ 1,10	Mo	2,50 ÷ 4,50
Mn	0,10 ÷ 1,10	V	0,05 ÷ 0,25
Ni	2,50 ÷ 4,50		

EskyLos[®] 2001 is patented by Lucchini Sidermeccanica with the following patent number: MI2001A001402 from 02/07/01

Main applications

EskyLos[®] 2001 is suitable for the following applications.

Plastic moulding:

- medium and big sized moulds for the automotive industry
- moulds for food industry products
- moulds for rubber pressing
- pressure moulds (SMC, BMC)

Extrusion:

- dies and gauges for PVC extrusion
- mechanical parts for extrusion presses

Physical and mechanical properties

Main physical properties

ESKYLOS 2001	at 20°C	at 250°C	at 500°C
Modulus of elasticity [kN/mm ²]	210	197	178
Coefficient of thermal expansion from 20 °C at [10 ⁻⁶ /K]	27,5	28,3	29,0

Main mechanical properties

ESKYLOS 2001	at 20°C
Ultimate tensile strength (UTS) [N/mm ²]	1.420
Yield stress (YS) [N/mm ²]	1.080

All these values are average values obtained on a bar subjected to age hardening at 560 °C for 10 hours.

Heat Treatments

EskyLos[®] 2001 is supplied in the solution treated condition with hardness between 310 and 350 HB. We suggest applying the following parameters if a different hardness is required or if heat treatment is needed. This information is only indicative and must be adapted depending on the different heat treatment facilities employed and on the thickness of the bar.

Solubilisation

Suggested temperature	1020 °C
Soaking time	10 hours from when the core of the piece has reached the set temperature
Cooling	Room Temperature

The purpose of solution treating is to bring the material back to its original condition and eliminate the effects of previous heat treatments. We suggest carrying out a stress relieving at 400 °C after solubilization.

Stress Relieving

Suggested temperature	400 °C
Soaking time	60 min every 25 mm thickness
Cooling	slow in the furnace

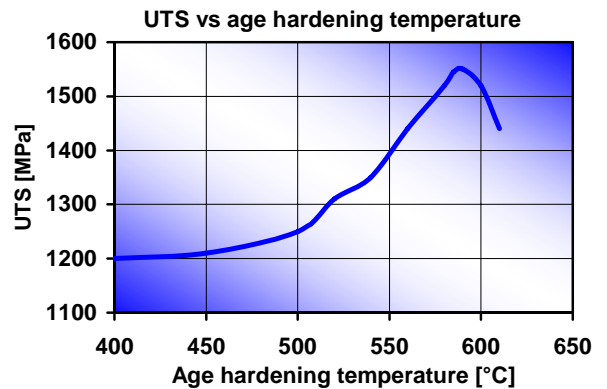
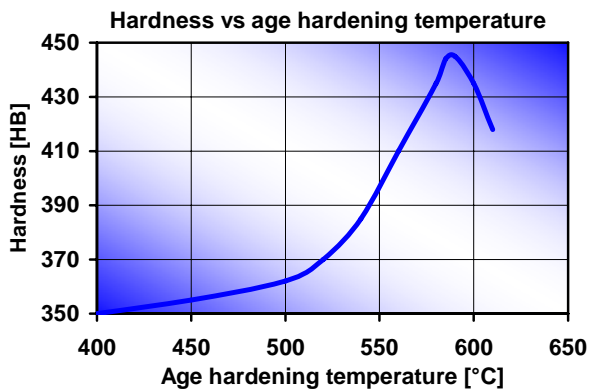
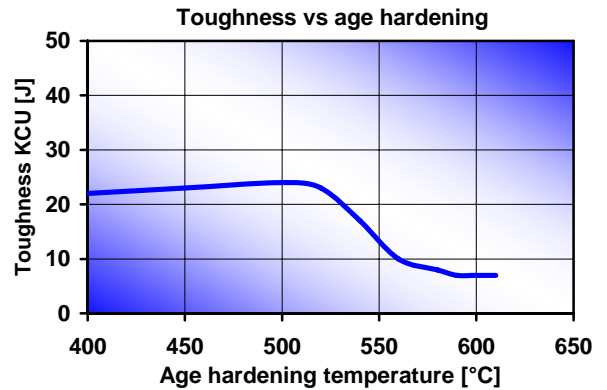
Stress relieving should be carried out to eliminate stresses caused by machining or by previous heat treatment. Solution treating is not needed before stress relieving.

Age hardening

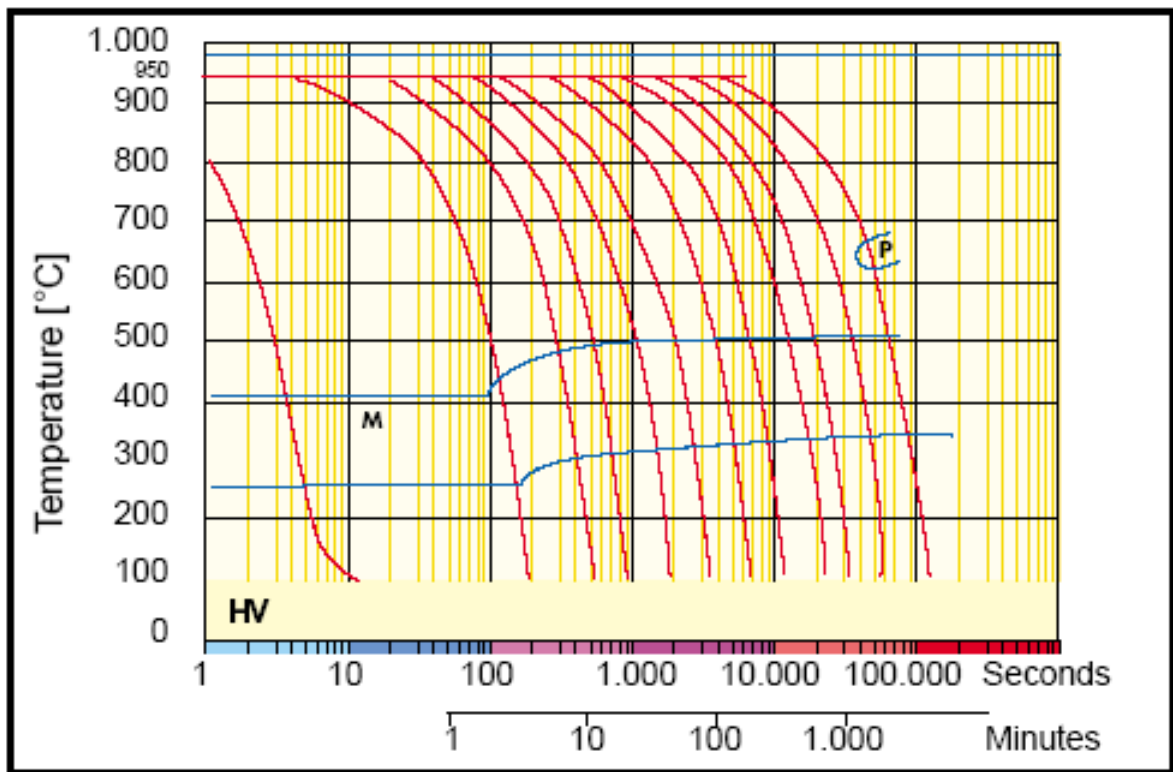
Age hardening must be carried out on a solution treated piece. We recommend carrying out this heat treatment on a semi-finished mould, in order to guarantee high hardness and homogeneous characteristics on the pattern. As the heat treatment occurs at temperatures that are lower than the phase transformation points, the risk of cracking and volume variations is very low.

We recommend age hardening for 10 hours from when the core of the piece has reached the set temperature. Once the heat treatment is completed, let the piece cool at room temperature.

This information is only indicative and must be adapted depending on the different dimensions and shape of the piece and on the heat treatment furnace.

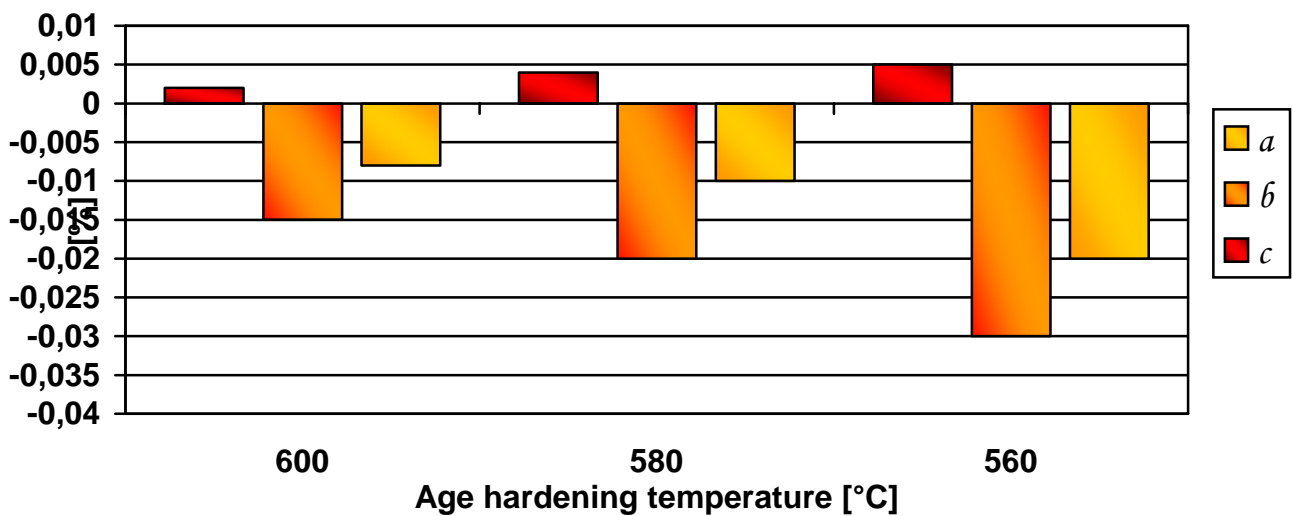
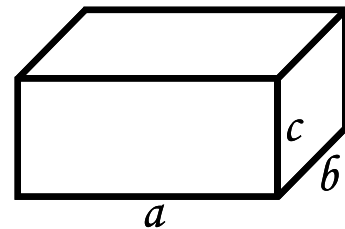


CCT Curve



Dimensional stability

Dimensional variations related to age hardening temperature on a block 100 x 100 x 50 mm of EskyLos® 2001. This information is only indicative and must be adapted depending on the different dimensions and shape of the piece and on the heat treatment.



Why choose an age hardening steel?

Pre-hardened steels are suitable for several applications in the field of moulding, as they represent a balance of:

- good machinability
- good mechanical characteristics
- simple manufacturing cycle.

However when it is necessary to obtain an elevated hardness in the piece together with homogeneity of values along the whole section, pre-treated steels display certain limits. Moulds of pre-hardened steels are obtained by 'excavating' big sized blocks that inevitably possess mechanical characteristics that reduce towards the centre and are not homogeneous.

In order to limit this problem, the following options are available:

- start the production from a harder block; however the machining will be more difficult and the toughness will decrease
- hard the mould in the semi-finished state; however this increases the risk of cracking and deformation
- apply special surface heat treatments; however the finish machining could be limited by these treatments that are often expensive.

The solution is offered by EskyLos® 2001, an age hardening steel.

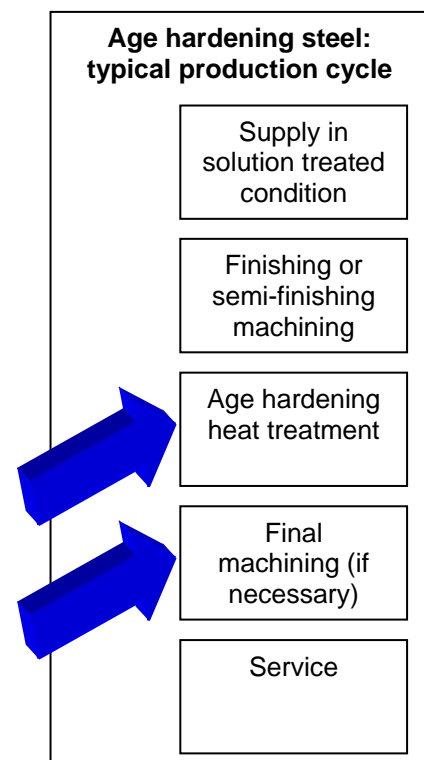
EskyLos® 2001 gives all the advantages of pre-hardened steels, without the restrictions that they present when high mechanical properties are required.

The increase in the mechanical properties is obtained through age hardening, at a temperature between 540 and 600 °C, depending on the mechanical characteristics required, without exceeding the transformation points.

Thanks to this technology, users are able to obtain the required hardness in the centre of the mould.

In addition, EskyLos® 2001 gives the following advantages:

- no cracking during heat treatment regardless of the shape or thickness of the mould
- limited deformation of the mould
- limited machining allowance, leading to an optimisation of finish machining time after age hardening
- constant fatigue limit throughout the whole mould and consequent increase of the mould life cycle



Should it be necessary to modify the shape of the mould or to further increase the mechanical properties of the mould, the original hardness and microstructure of EskyLos® 2001 can be restored through solution treating.

The advantages of the ESR technology

The ESR (Electro-Slag-Melting) manufacturing technology offers the following advantages:

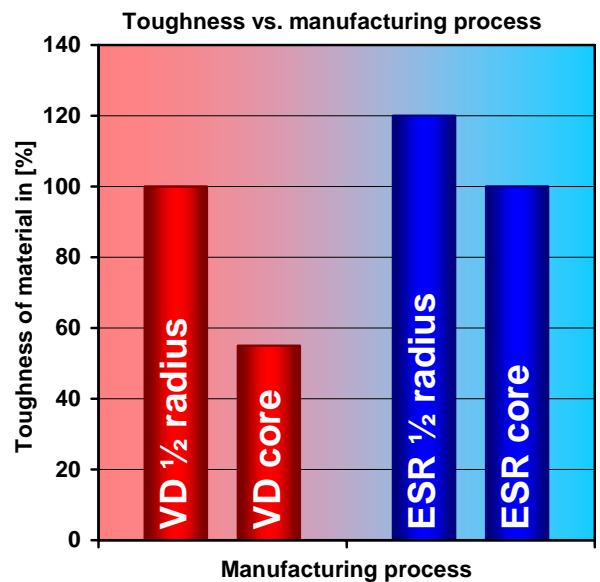
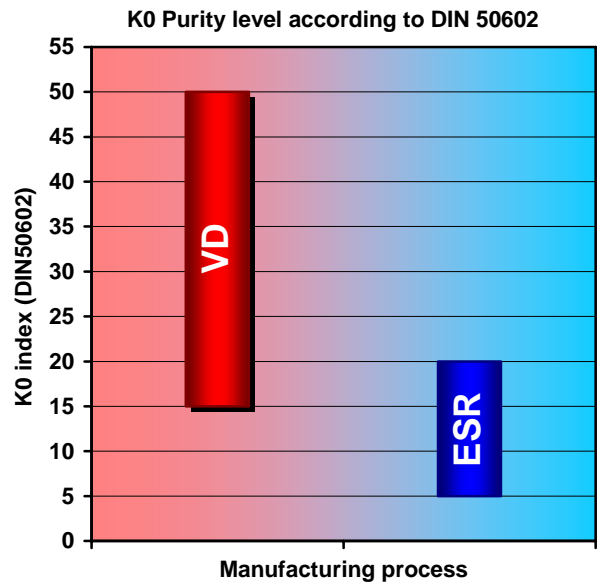
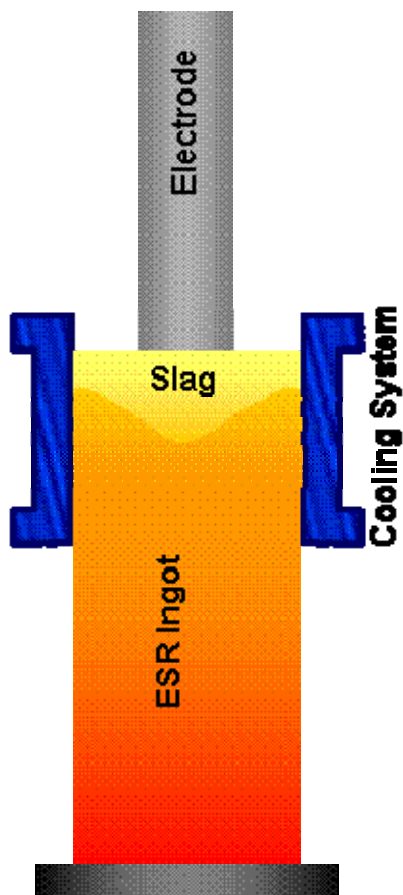
- increase of material toughness
- high micro-cleanness level
- total isotropy of the material
- very low segregation level.

The ESR process is based on ingot remelting, through a traditional VD (vacuum degassing) process, using a particular copper ingot mould that contains basic slag.

The ingot is remelted in a way that the liquid metal passes through the slag, which acts as a filter and retains the inclusions.

The process of solidification inside the ingot mould is faster than in a traditional process.

The result is homogeneous and isotropic steel



Thanks to the ESR process, EskyLos® 2001 satisfies the most difficult requirements in terms of toughness and suitability to polishing. It is suitable for the manufacture of moulds subjected to mirror polishing and to high mechanical stress.

Welding

Welding of EskyLos® 2001 can give good results if the following procedure is followed:

Condition of material	Solution treating	Age hardening
Welding technique	TIG	
Pre-heating at	200÷250 °C	
Heat treatment	(*)	(**)

(*) Please contact our technical service

(**) The need for heat treatment is established by the condition of the weldable area. Should the weldable area be substantial, solution treatment of the piece and a second age hardening treatment will be needed.

For further information, please refer to the brochure.

Photo-engraving

Thanks to modern production processes and to the low sulphur content, EskyLos® 2001 is suitable for photo-engraving to obtain various patterns. For further information, please refer to the brochure.

Polishing

Due to the ESR (Electro-Slag-Remelting) manufacturing process, EskyLos® 2001 has excellent suitability to polishing. For further information, please refer to the brochure.



Via G. Paglia, 45

24065 Lovere (BG) - ITALY

Tel. + 39 035 963492

Fax + 39 035 963551

Web <http://www.LucchiniRS.it>

E-mail toolsteels@LucchiniRS.it