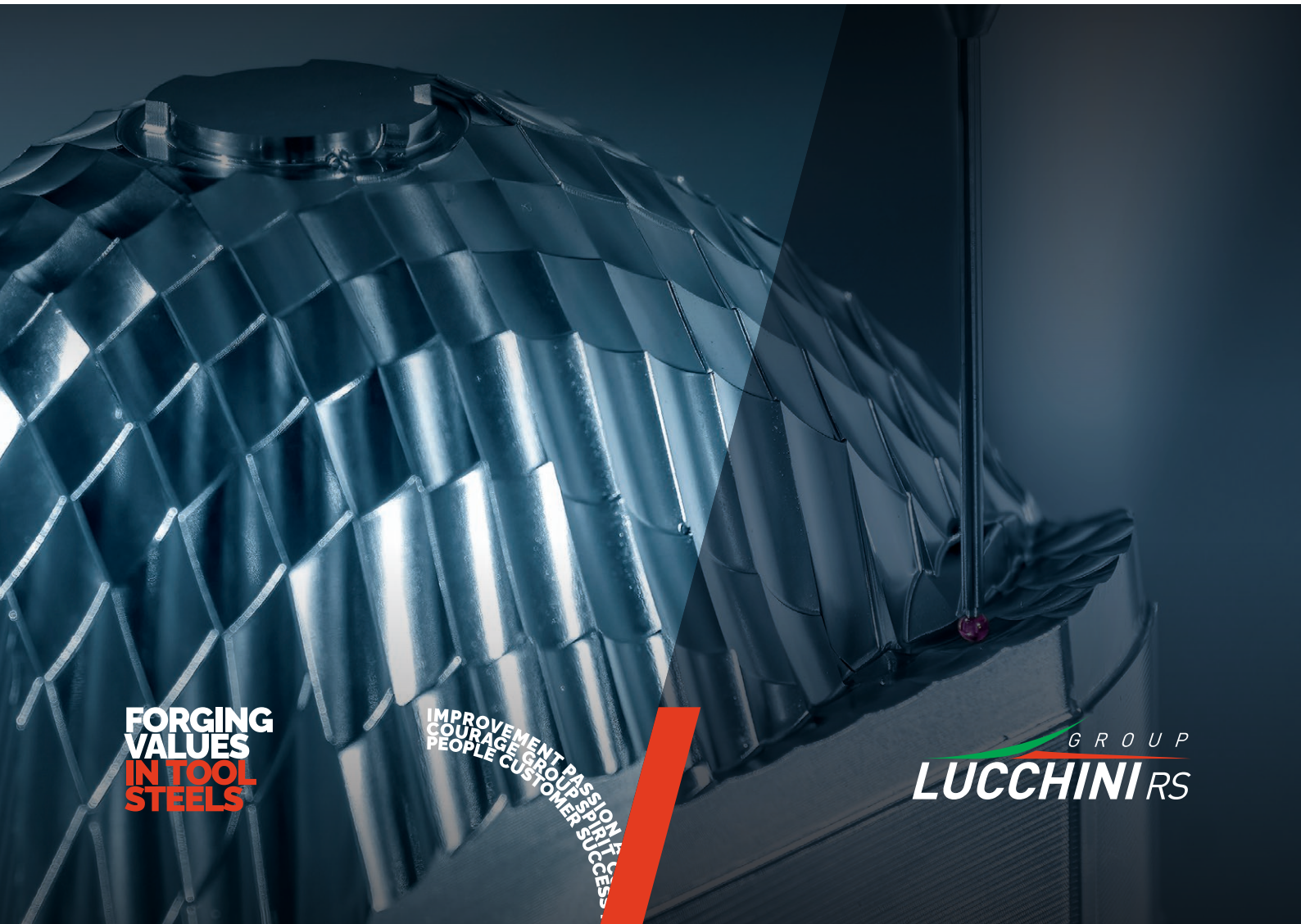
LUCCHINI 2329

SPECIAL ALLOYED STEEL DESIGNED FOR DIES, MOULDS, PUNCHES SUBJECTED TO HIGH WORKING TEMPERATURE



General characteristics

LUCCHINI 2329 is a special alloyed steel designed for the manufacture of dies, moulds, punches and other components subjected to high working temperatures. LUCCHINI 2329 is obtained through a special 'super clean' manufacturing process, which allows a high level of micro-purity to be achieved.

If subjected to suitable heat treatment, LUCCHINI 2329 can reach a hardness of 48 HRc without affecting the toughness.

In order to improve further the mechanical characteristics of the surface, LUCCHINI 2329 can be coated with PVD or PA/CVD methods.

Delivery conditions

LUCCHINI 2329 is supplied in round section in annealed condition in a wide dimensional range, from 300 mm up to 700 mm in thickness.

In the annealed condition the hardness value is lower than 220 HB, thereby guaranteeing a good machinability.

Main features

- high resistance to thermal shock and to heat cracking
- good mechanical characteristics in hot condition
- optimal mechanical characteristics in cold condition
- good toughness in hot condition.

Main application

- dies subjected to low pressure
- containers for die-casting presses
- extrusion press blocks
- sleeves for extrusion presses.

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Chemical analysis

	Range	C [%]	Si [%]	Mn [%]	Cr [%]	Mo [%]	Ni [%]	V [%]
LUCCHINI 2329 Alloying [% in weight]	min	0,44	0,60	0,70	1,70	0,25	0,50	0,15
	max	0,54	0,90	1,00	2,10	0,45	0,80	0,25

Comparison with international classifications:
W. Nr. 1.2329
DIN 46CrSiMoV7

Physical and mechanical properties

Main physical properties

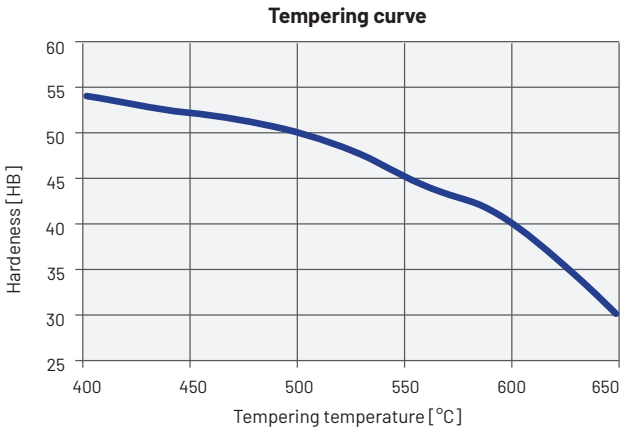
LUCCHINI 2329	20°C	400°C	600°C
Young modulus E [MPa]	210	186	179
Coefficient of linear thermal expansion α [10-6/K]	-	13,2	14,5
Thermal conductivity λ [W/mK]	27,0	29,1	32,4

Main mechanical properties

LUCCHINI 2329	400°C	500°C	600°C
Ultimate tensile strength UTS [MPa]	1.080	900	440
Yield strength YS [MPa]	850	680	270

The above mentioned are average values of a sample hardened at 870° C, quenched and tempered to achieve a hardness of 44 HRC.

Surface hardness vs tempering temperature



Remark: the above data are representative of the typical behaviour of a 350 mm thick block made in LUCCHINI 2329 and are reported for information only

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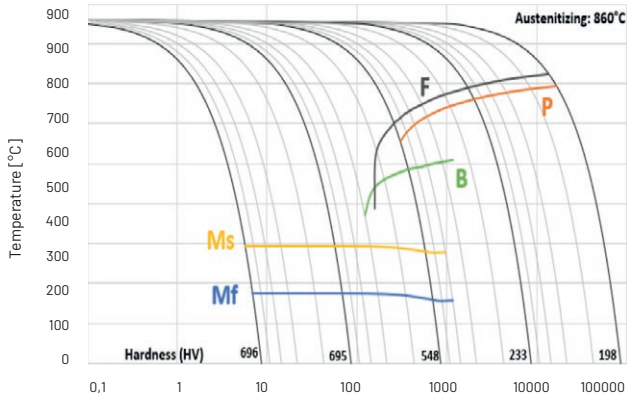
Heat treatment

LUCCHINI 2329 is supplied in the annealed condition. Heat treatment shall be carried out using the parameters recommended and given below.

Continuous cooling transformation curve (CCT)



Soft annealing

Suggested temperature	700 °C
Heating	Maximum 50°C/h
Soaking time	60 min every 25 mm thickness
Cooling	In the furnace at less than 20° C/hr

Soft annealing is recommended if optimum machinability of the material is important. After soft annealing a hardness of around 220 HB is achieved.

Stress relieving

Suggested temperature	650 °C
Heating	Maximum 100°C/h
Soaking time	60 min every 50 mm thickness
Cooling	Slow in the furnace at max 25 °C/h to 200°C, then at room temperature

If the suggested temperature is lower than the tempering temperature, the stress relieving temperature will be 50° C lower than the tempering temperature previously applied.

Stress relieving is recommended where it is necessary to eliminate residual stresses induced by mechanical working or by a preceding heat treatment.

Hardening

Hardening should be carried out after the material has been pre-heated according to the following table.

First pre-heating temperature	550°C
Soaking time	60 min every 25 mm thickness
Austenitizing temperature	870°C
Soaking time	60 min every 25 mm thickness
Cooling	Air or vacuum cooling, salt bath or polymer in H2O

Tempering

The tempering temperature to be applied to the material depends on the required mechanical properties.

A second temper at a temperature of 30-50° C below the maximum temperature previously applied will function as a stress relieving cycle.

Suggested temperature	Depending on the required mechanical properties. See tempering curve
Heating	Less than or equal 30 ° C/h
Soaking time	60 min every 25 mm thickness
Cooling	At room temperature

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Nitriding

The purpose of nitriding is to increase the resistance of the material to wear and abrasion.

This treatment is very useful for components where high performance is necessary, as it extends the life of the material.

The tempering temperature must be at least 50°C higher than the nitriding temperature.

Modern nitriding processes allow the original dimensions of the component to be maintained.

We recommend heat treating the component in the finish machined condition.

Other properties can be deeper analysed against specific Customer request: please contact our Metallurgy Department.

Polishing and photo-engraving

LUCCHINI 2329 is the suitable material when polishing and photoengraving are needed. Thanks to its integrated manufacturing process, those material manufactured by Lucchini RS are characterized by a high degree of purity.

Polishing for graining: 3 Very good
Suitability for medium gloss polishing: 3 Very good
Suitability for mirror polishing: 3 Very good
Suitability for engraving: 3 Very good

Rating scale:
4 Excellent – 3 Very good – 2 Good – 1 Normal – 0 Unsuitable

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Guidance for machining

The following parameters are approximate only and must be adjusted to the specific application and machine tool.

Turning

	Rough machining	Finish machining		
Type of insert	P20-P40 coated	HSS	P10-P20 coated	Cermet
V_c cutting speed [m/min]	150 ÷ 190	(*)	190 ÷ 230	260 ÷ 320
a_r cutting depth [mm]	5	(*)	< 1	< 0,5

Milling

	Rough machining		
Type of insert	P25-P35 not coated	P25-P35 coated	HSS
V_c cutting speed [m/min]	120 ÷ 140	160 ÷ 180	(*)
f_z feed [mm]	0,15 ÷ 0,3	0,15 ÷ 0,3	(*)
a_r cutting depth [mm]	2 ÷ 4	2 ÷ 4	(*)

	Pre-finishing		
Type of insert	P10-P20 not coated	P10-P20 coated	HSS
V_c cutting speed [m/min]	140 ÷ 160	180 ÷ 200	(*)
f_z feed [mm]	0,2 ÷ 0,3	0,2 ÷ 0,3	(*)
a_r cutting depth [mm]	< 2	< 2	(*)

	Finishing		
Type of insert	P10-P20 not coated	P10-P20 coated	Cermet P15
V_c cutting speed [m/min]	200 ÷ 240	250 ÷ 270	300 ÷ 340
f_z feed [mm]	0,05 ÷ 0,2	0,05 ÷ 0,2	0,05 ÷ 0,2
a_r cutting depth [mm]	0,5 ÷ 1	0,5 ÷ 1	0,3 ÷ 0,5

(*) not advisable

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Drilling

Type of insert	tip with interchangeable inserts	HSS	brazed tip
V_c cutting speed [m/min]	130 ÷ 160	(*)	90 ÷ 120
f_z feed per turn [mm/turn]	0,05 ÷ 0,15	(*)	0,15 ÷ 0,25

(*) not advisable

General formulae

Type of machining	**Drilling**	**Milling**
n: number of turns of mandrel	$V_c * 1000 / \pi * D_c$	$V_c * 1000 / \pi * D_c$
V_f: feed speed [m/min]	$V_f = f_z * n$	$V_f = f_z * n * z_n$
f_z feed per turn [mm/turn]	-	$f_n = V_f / n$
Note	D_c: Milling cutter or tip diameter [mm] V_c: cutting speed [m/min] f_z: feed [mm]	f_n: feed per turn [mm/turn] z_n: No. of milling cutter inserts

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Welding

Welding LUCCHINI 2329 can give good results if it is carried out using the recommended procedure.

As steel with high Carbon Equivalent content, LUCCHINI 2329 is very sensitive to cracking.

We recommend to carry out pre-heating and heat treatment after welding.

In order to obtain the best results, we recommend the following procedure:

Material condition	Annealed	
Welding technique	TIG	MMA
Pre-heating at	250 – 300°C	
Recommended Heat treatment	Heating of the material at 700 °C, cooling in the furnace to 600 °C at a rate of 20 °C/h, cooling at room temperature	

Material condition	Hardened and tempered	
Welding technique	TIG	MMA
Pre-heating at	250 – 300°C	
Recommended Heat treatment	550 °C or 50 °C lower than the tempering temperature previously applied	

Electrical Discharge Machining (EDM)

LUCCHINI 2329 can be machined by EDM to obtain complex shape. Afterwards we advise to carry out the stress relieving procedure.

Process and materials selection for product recyclability

According to the potential of steel recycling, Lucchini RS is adopting a strategy for environmental excellence in designing and manufacturing its tool steel grades, putting eco-effectiveness into practice.

The main adopted steps are:

- to carry out an environmental assessment on processes and products, with the minimum use of virgin materials and non-renewable forms of energy;
- to move toward zero-waste manufacturing processes, considering that the ultimate destination of scrapped steel moulds becomes food for the next steel making process, that is the “waste equals food” philosophy;
- to carry out a life cycle assessment for each product and process, minimizing the environmental cost of product and service over its complete life cycles, from creation to disposal, that is the “Cradle to Cradle” philosophy

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