

KEY[®] LOS 2738MSH

The plastic mould steel
for very wide application range

General characteristics

KeyLos[®] 2738MSH is the update of the long Lucchini RS tradition in the production of plastic mould steel grades, designed to offer to the end user a material with as widest as possible applications' range.

As steel of low Carbon Equivalent content generation, KeyLos[®] 2738MSH is actually able to combine the peculiarity of this family of materials with the main characteristics of KeyLos[®] 2738 standard, enhancing the toughness, the thermal conductivity, the machinability and the weldability.

KeyLos[®] 2738MSH is usually supplied in quenched and tempered condition with 280-330 HB surface hardness for maximum block's thickness 800 mm.

For the detected hardness values in standard sized products, the following correlation is usually valid and guaranteed:

$$(HB_{\text{Surface, min required}} - HB_{\text{Core}}) \leq 20HB$$

Main features

- high hardness homogeneity and toughness across the block;
- high fatigue and wear resistance;
- shorter injection cycle time thanks to high thermal conductivity;
- reduction in cutting insert cost, shorter machining time thanks to better machinability;
- good finishing properties as polishing and photo-engraving;
- reliable for nitriding and hard chromium plating;
- better weldability in comparison with KeyLos[®] 2738 standard.

Chemical analysis

	Range	C [%]	Si [%]	Mn [%]	Cr [%]	Mo [%]	Ni [%]	V [%]
KEY[®] LOS 2738MSH	min	0,22	0,15	1,20	1,20	0,30	0,25	0,04
Alloying [% in weight]	max	0,32	0,55	1,60	1,60	0,55	0,55	0,14

Table for comparison of international classification.

W. Nr. /
DIN designation: $\approx 24MnCrMoNi7$

Lucchini RS tool steels are designed in order to optimize the material's performances.

The brand name KeyLos[®] identifies Lucchini RS product, the number 2738 refers to Werkstoff classification; M stands for modified in comparison with KeyLos[®] 2738 chemical composition; SH stands for softer hardness in comparison with KeyLos[®] 2738.

Main applications

- medium sized injection and pressure moulds for plastic processing in automotive and home appliances sector;
- mould frames and High pressure die casting mould frames.

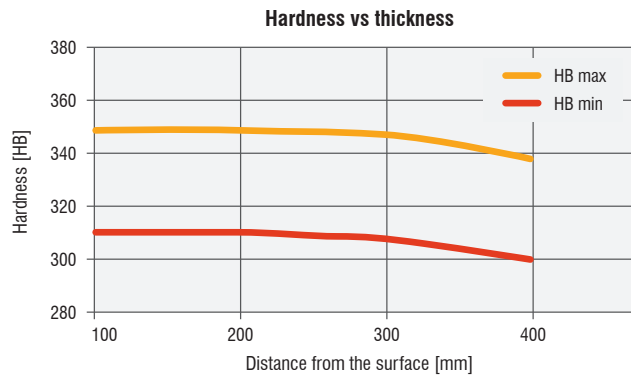
As all the other Lucchini RS tools steel grades KeyLos[®] 2738MSH is also designed with the aim to guarantee the minimum use of virgin materials, moving toward the use of scrap categories difficult to be recycled.

Physical and mechanical properties

Main physical properties

KEY[®] LOS 2738MSH	20°C	250°C	500°C
Modulus of elasticity [GPa] (1GPa=1000 MPa)	210	194	176
Coefficient of thermal expansion [10 ⁻⁶ /K]	-	12,9	14,7
Thermal conductivity [W/mK]	34,7	34,4	34

The herewith attached values are the average from half section of 600 mm thickness block, after hardening at 900 °C, quenching and tempering at 600 °C.



Main mechanical properties

KEY[®] LOS 2738MSH	20°C	200°C
Ultimate Tensile strength (UTS) [MPa]	1.030	915
Yield stress (YS) [MPa]	962	770

Heat treatments

KeyLos® 2738MSH is usually supplied in quenched and tempered condition. If different hardness/heat treatment procedure are required, we recommend the following parameters.

The herewith attached data are for information purpose only and must be adjusted to the heat treatment facility and the dimensions of the block.

Soft annealing

Suggested temperature	700 °C
Soaking time	60 min every 25 mm thickness
Cooling	slow in the furnace at max 20 °C/h to 600 °C , then at room temperature

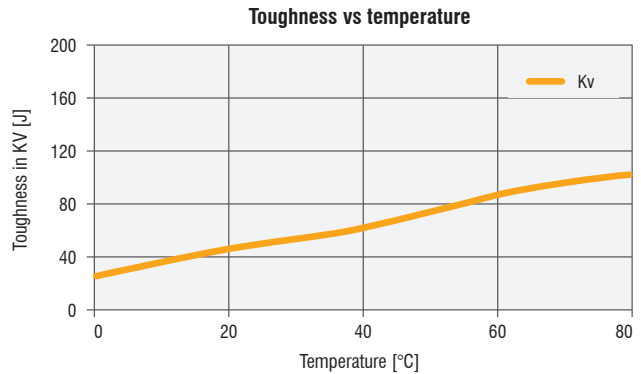
Soft annealing is useful to improve machinability. Actual hardness is ≤ 250 HB.

Stress Relieving

Suggested temperature	550 °C
Soaking time	60 min every 25 mm thickness
Cooling	slow in the furnace at max 20 °C/h to 200 °C , then at room temperature

Stress relieving is recommended to remove residual stresses produced by previous heat treatment or by machining operations.

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

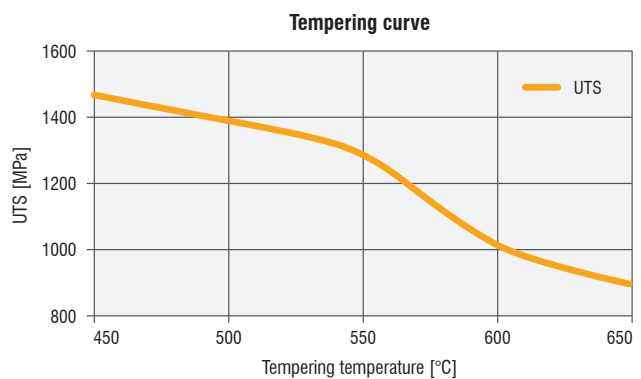


Hardening

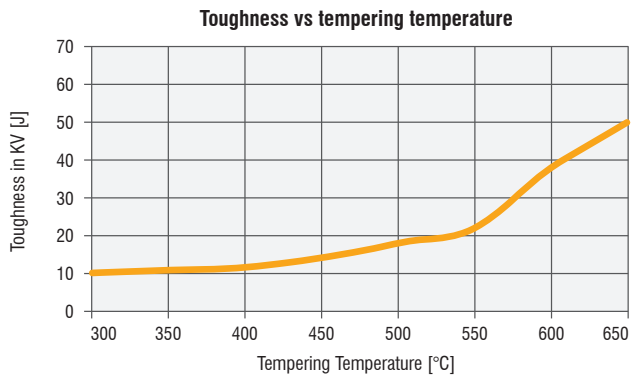
Suggested temperature	900 °C
Soaking time	60 min every 25 mm thickness
Cooling	Polymer or water quench

Tempering

Suggested temperature	The tempering temperature to be applied to the material depends on the required mechanical properties. See following graph.
Soaking time	60 min every 25 mm thickness
Cooling	Room temperature



Tempering curve of a sample which has been austenitized at 900 °C.



After tempering we suggest to carry out stress relieving at temperature 50 °C lower than the last tempering temperature.

Induction hardening

KeyLos[®] 2738MSH is suitable for induction hardening.

We recommend cooling at room temperature and tempering after induction hardening.

In any case, other properties can be deeper analysed by Lucchini RS against specific Customer request: please contact our Metallurgy Department.

Nitriding

KeyLos[®] 2738MSH is suitable for ionic and gas nitriding. This treatment is very useful for moulds subjected to extremely stressful applications.

The increase of the surface hardness, following nitriding, extends the component life cycle.

Up-to-date nitriding procedures allow to minimize the dimensional variation of the piece.

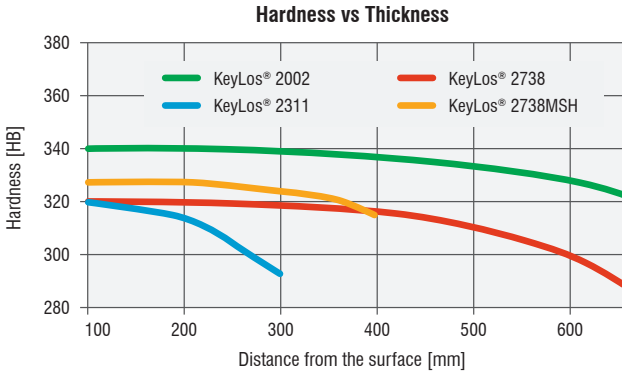
We recommend to heat treat the piece in finish machined condition.

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

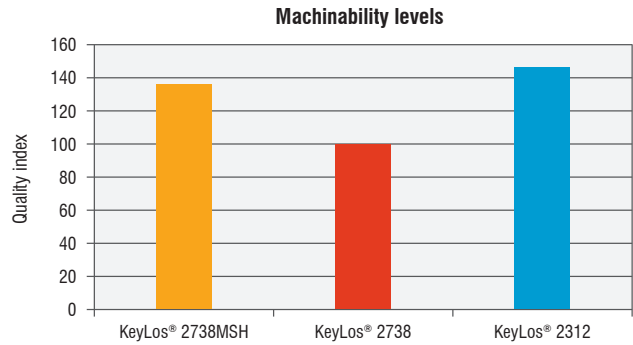
- rough machining;
- stress relieving;
- finish machining;
- nitriding.

KeyLos® 2738MSH compared to other grades

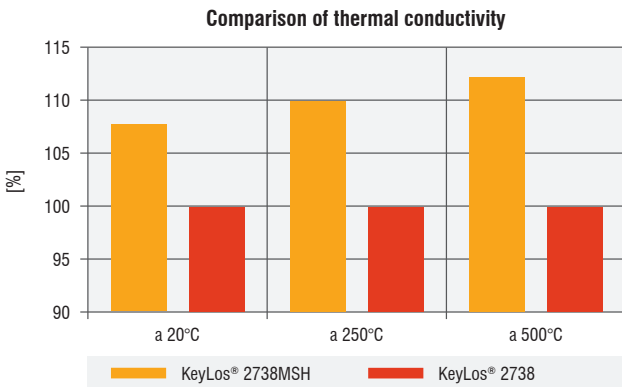
Comparison of average values of hardness variation versus thickness among KeyLos® 2738MSH, KeyLos® 2738 and KeyLos® 2311.



Comparison of machinability among KeyLos® 2738MSH, KeyLos® 2738 and KeyLos® 2312.

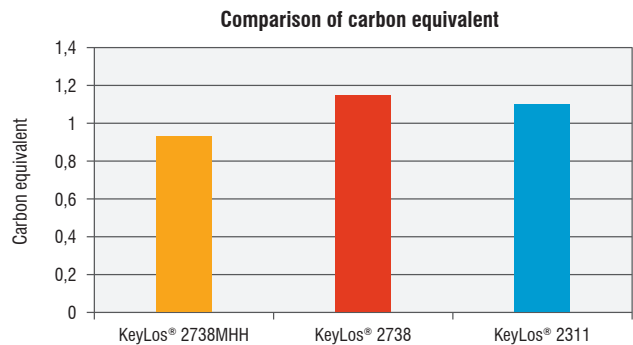


Comparison of thermal conductivity between KeyLos® 2738MSH and KeyLos® 2738.

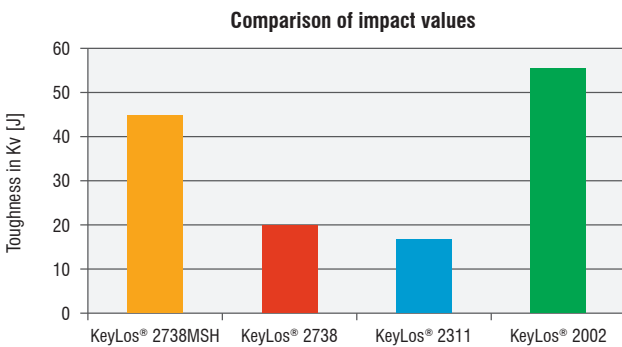


Comparison of Carbon Equivalent content among KeyLos® 2738MSH, KeyLos® 2738 and KeyLos® 2311.

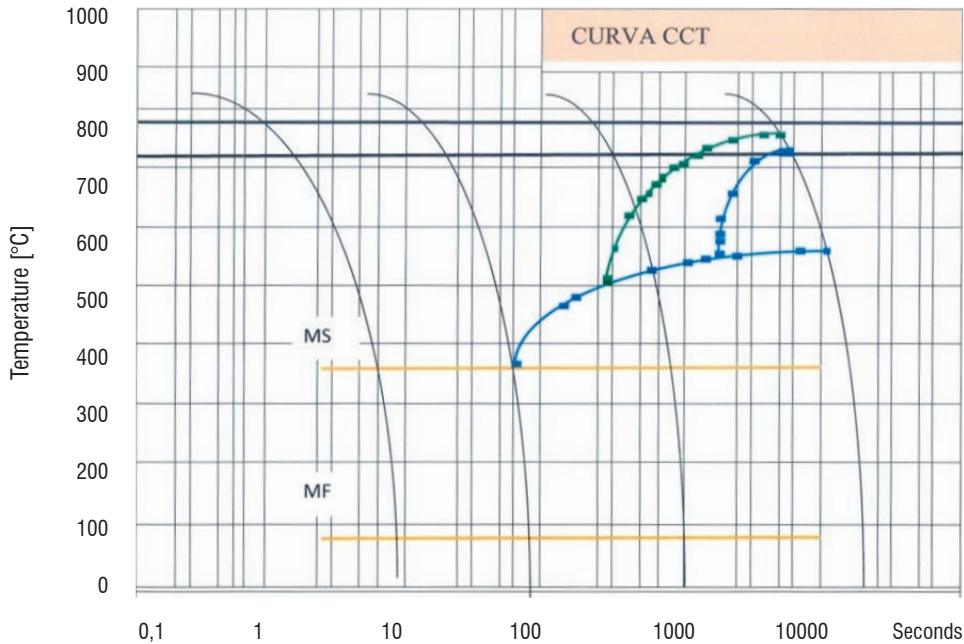
Thanks to the Carbon Equivalent content lower than the other grades traditionally normally used for plastic moulding, KeyLos® 2738MSH get better weldability and lower risk of cracking during welding repair on finish piece.



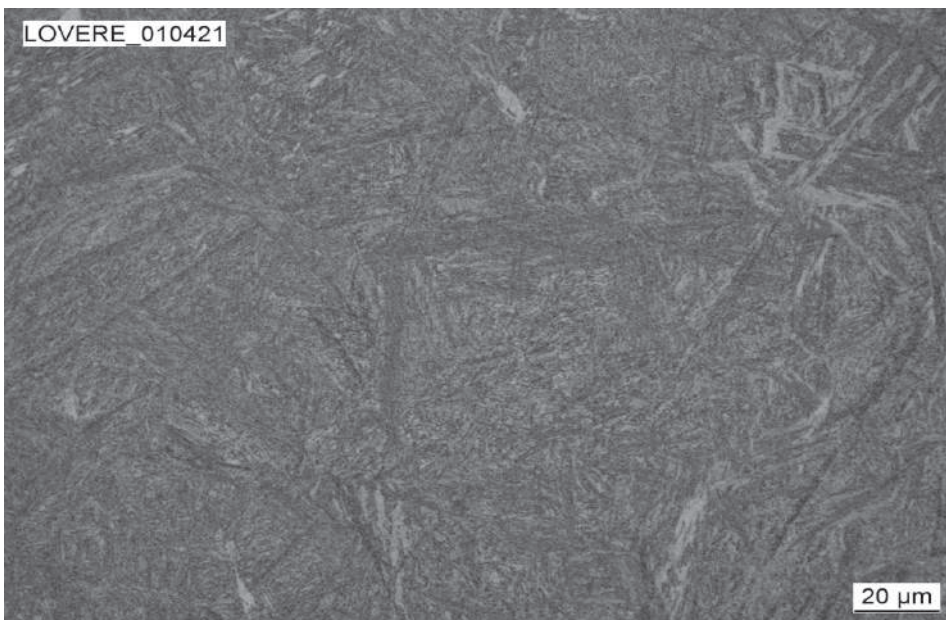
Comparison of impact values among KeyLos® 2738MSH, KeyLos® 2738 and KeyLos® 2311 with same hardness, at a temperature of 20 °C.



CCT Curve



Microstructure of KeyLos[®] 2738MSH



The microstructure of KeyLos[®] 2738MSH as delivered by Lucchini RS, detected about 20 mm under surface, consists of a fine tempered martensite.

Guidance for machining

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

Turning

Type of insert	Rough machining		Finish machining	
	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

Type of insert	Rough machining		
	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	(*)

Type of insert	Pre-finishing		
	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	(*)

Type of insert	Finishing		
	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

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

Approximate comparison between hardness and ultimate tensile strength values.

HB	530	520	512	495	480	471	458	445	430	415	405	390	375
HRc	54	53	52	51,1	50,2	49,1	48,2	47	45,9	44,5	43,6	41,8	40,5
MPa	1.900	1.850	1.800	1.750	1.700	1.650	1.600	1.550	1.500	1.450	1.400	1.350	1.300

HB	360	350	330	320	305	294	284	265	252	238	225	209	195
HRc	38,8	37,6	35,5	34,2	32,4	31	29	27	--	--	--	--	--
MPa	1.250	1.200	1.150	1.100	1.050	1.000	950	900	850	800	750	700	650

Welding

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

Welding technique	TIG	MMA
Pre-heating at	250 ÷ 300 °C	
Recommended heat treatment	Stress relieving (see heat treatment paragraph)	

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.

Electrical Discharge Machining (EDM)

KeyLos[®] 2738MSH can be machined by EDM to obtain complex shape.

Afterwards we advise to carry out the stress relieving procedure.

Chrome Plating

KeyLos[®] 2738MSH can be Chrome plated in order to enhance the mechanical characteristics on the surface.

Within 4 hours of Chrome plating, in order to prevent Hydrogen embrittlement, we advise to carry out heat treatment at 200°C for about 4 hours.

Photo-engraving

Thanks to the current production processes and to the low Sulphur content, KeyLos[®] 2738MSH is suitable for photo-engraving to obtain various patterns.

Polishing

KeyLos[®] 2738MSH is particularly suitable for polishing.