

KRAY[®] LOS 6959

Alloyed steel for castings
with high mechanical properties

General characteristics

KrayLos® 6959 is a steel grade specifically designed for castings: bolsters and/or similar components in which elevated mechanical properties are required.

KrayLos® 6959 is an alloy steel of nickel, chrome and molybdenum with very high hardenability that permits excellent mechanical characteristics and elevated fatigue limits even where the rate of cooling is not very high.

KrayLos® 6959 is produced via a “Super Clean” technology that has the aim of improving the characteristics of micro cleanliness and homogeneity in the material.

The excellent chemical and physical properties are obtained through the liquid steel manufacturing process: from the melting of the scrap in the EAF (electric arc furnace) to the steel refining in the LF (ladle furnace) and to the subsequent degassing in the VD-VOD (vacuum oxygen degassing).

Careful procedures for melting, refining and casting constitute the “Super Clean” practice, which respects the most restrictive demands in terms of quality, such as micro purity and structural homogeneity.

The careful planning of production through Magmasoft software, moulding by hand and careful control of casting allow steel streams to be achieved with high isotropy and internal soundness.

Suitable heat treatment and careful non-destructive controls guarantee a high quality product.

In this way the piece can be delivered as is or after mechanical working; Lucchini Sidermeccanica can carry this out on request.

KrayLos® 6959 is 100% ultrasonically tested in accordance with the most demanding of quality standards.

Chemical analysis

	Range	C [%]	Si [%]	Mn [%]	Ni [%]	Cr [%]	Mo [%]	V [%]
KRAY[®] LOS 6959	min	0,30	0,15	0,40	3,00	0,80	0,35	/
Alloying [% in weight]	max	0,40	0,55	0,90	4,00	1,70	0,90	/

Table for comparison of international classification

W. Nr.	1.6959
DIN	35NiCrMo12-5

Lucchini RS’s tool steels are designed to optimize the material performances.

The mark pick out the Lucchini RS product and the number on end can refer to the Werkstoff classification or other initials, only for the characteristics of use.

Main applications

KrayLos® 6959 lends itself to the following applications:

- Bolsters

Physical and mechanical properties

Main physical properties

	20°C	400°C	600°C
Modulus of elasticity [GPa] (1GPa=1000 MPa)	210	195	176
Coefficient of thermal expansion [10 ⁻⁶ /K]	-	13,0	13,7
Thermal conductivity [W/mK]	23,8	24,3	25,0

KrayLos® 6959 can be delivered with 2 Classes of tensile strength depending on the application.

The tests, if required by the order, are carried out on suitable test pieces that are cast as part of the casting and removed after heat treatment.

Hardness

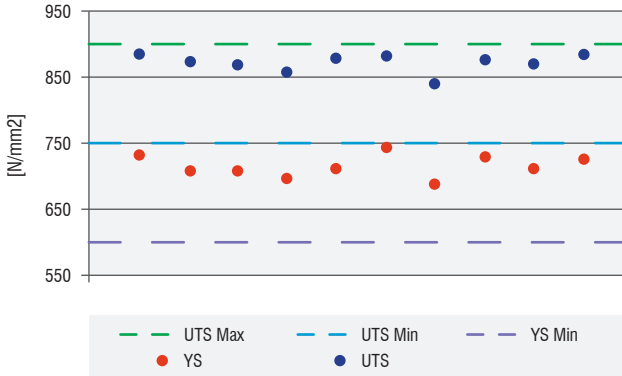
The value of Brinnell surface hardness is contained in the range 230-280 HB for Class 1 and 270-320 HB for Class 2.

Main mechanical properties

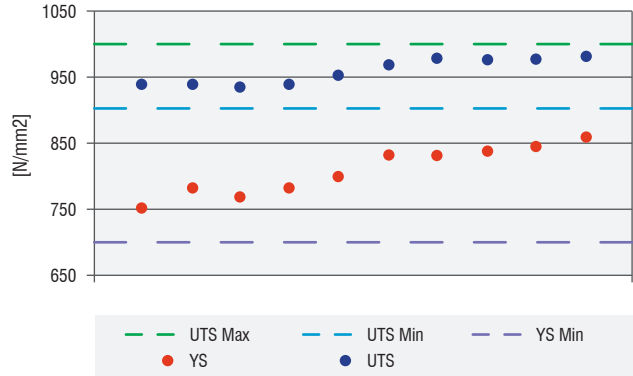
	Class 1	Class 2
Ultimate tensile strength (UTS) [N/mm ²]	750 ÷ 900	900 ÷ 1000
Yield stress (YS) [N/mm ²]	≥ 600	≥ 700
Elongation (A) [%]	≥ 16	≥ 10
Reduction of area (Z) [%]	≥ 35	≥ 30
Impact test Kv (+20°C) [J]	≥ 40	≥ 30

Statistical progression

Statistical progression YS/UTS - Class 1



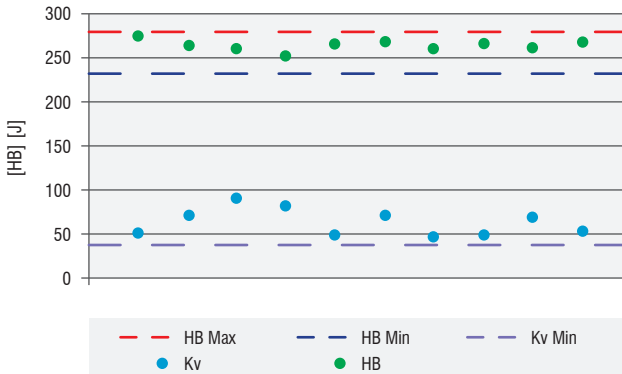
Statistical progression Rs/Rm - Class 2



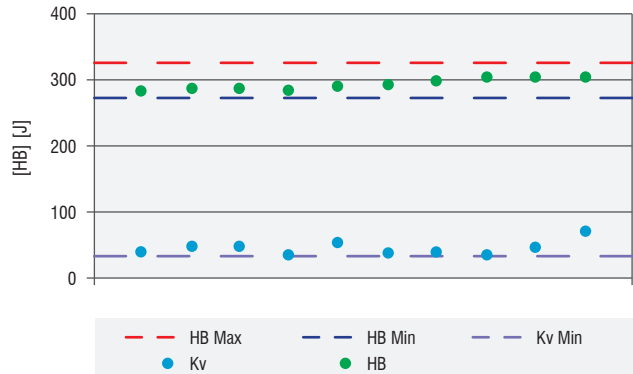
Statistical progression on the basis of Ultimate Tensile Strength (UTS) and Yield Stress (YS) data for KrayLos[®] 6959 supplied in Class 1 from standard production.

Statistical progression on the basis of Ultimate Tensile Strength (UTS) and Yield Stress (YS) data for KrayLos[®] 6959 supplied in Class 2 from standard production.

Statistical progression HB/Kv - Class 1



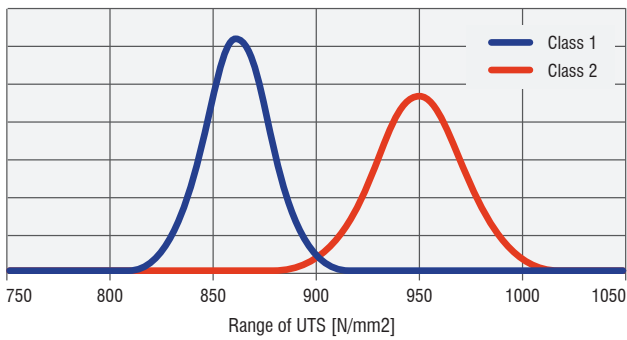
Statistical progression HB/Kv - Class 2



Statistical progression on the basis of Impact Test (Kv) and Surface Hardness (HB) for KrayLos[®] 6959 supplied in Class 1 from standard production.

Statistical progression on the basis of Impact Test (Kv) and Surface Hardness (HB) for KrayLos[®] 6959 supplied in Class 2 from standard production.

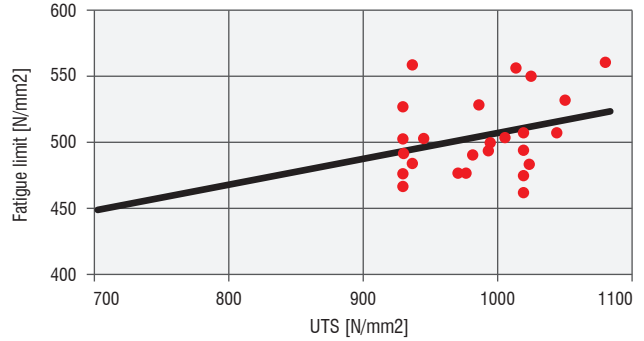
Gauss distribution of the value of UTS



Statistical distribution of the values of UTS obtained on standard production divided by Class.

Fatigue limit during rotating flexion of a smooth test piece at 50%.

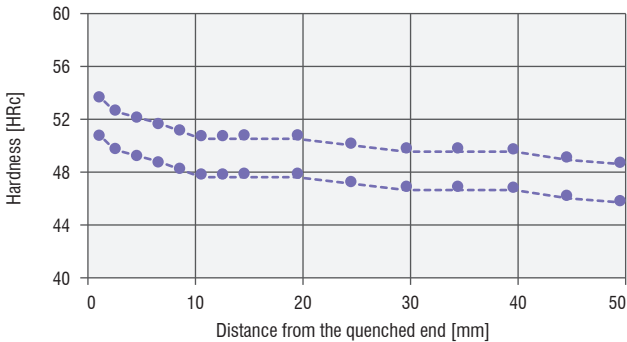
Fatigue limit as a function of UTS



KrayLos® 6959 possesses a high fatigue limit. The graph represents the line and the values of “staircase” fatigue tests during rotating flexion of a smooth test piece at 50%.

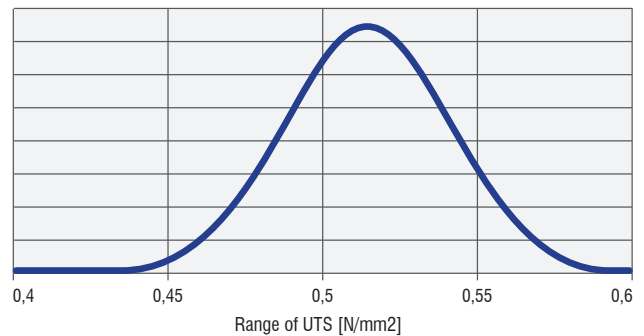
Jominy curve

Jominy hardenability band



KrayLos® 6959 possesses extremely high hardenability, which translates into excellent mechanical characteristics even in thick sections, yet without compromising the speed of cooling.

Gauss distribution fatigue limit/UTS



Curve showing relationship between fatigue limit at rotating flexion, on smooth test pieces, and the Breaking Load (UTS) for KrayLos® 6959.

In any case, other properties can be analyzed and studied deeper by Lucchini RS on specific Customer request: please consult Lucchini RS specialists of MET Department.

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 of its tool steel grades, putting eco-effectiveness into practice.

The main adopted steps are:

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