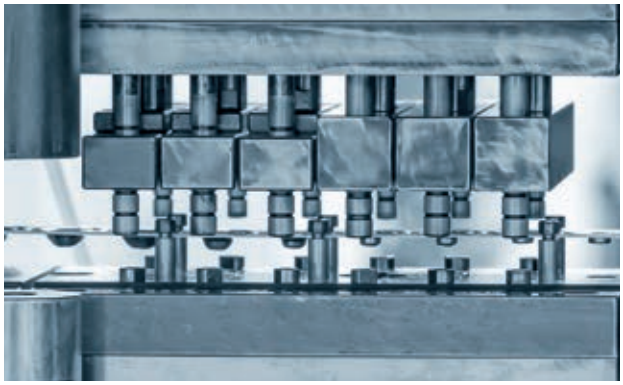
KIND&CO
EDELSTAHLWERK



The premium steel for
cold stamping and cold forming

PM823 ESR

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In tool making, alloyed cold work tool steels are used for different applications where high strength and wear resistance is required. To ensure excellent tool performance, the right choice of the tool steel is of particular importance.

The use of highly wear-resistant tool steels with excellent ductility at the same time often leads to lower tool costs and overall higher economic efficiency.

The premium steel PM823 ESR was developed for these demanding applications and offers

- excellent wear resistance due to the addition of carbide forming elements
- excellent compressive strength
- outstanding resistance to plastic deformation
- improved toughness due to smaller carbides and finer distribution carbides compared to standard cold work tool steels
- very good tempering resistance

Kind&Co

For over 130 years, we have been producing high-quality tool steel exclusively at our site in Bielstein. Kind&Co is still a family owned business today. We stand for sophisticated material solutions, highest quality, reliable service and competent advice - tailored to the respective application. We have particularly strong application expertise in the areas of die casting, extrusion and die forging.

Requirements in cold stamping and cold forming

In the stamping and forming industry, the requirements for tools are constantly increasing due to growing demands on processed material, higher precision of parts and ever-increasing cost pressure.

The reduction of emissions has been one of the main topics in the automotive industry in recent years. One option to face this issue is to reduce the vehicle weight and thus the fuel consumption. At the same time, modern vehicles must also meet higher safety standards. With the benefit of high-strength and ultra high-strength steels these two topics can be combined.

Compared to other grades of sheet metal, modern Advanced High-Strength Steel (AHSS) are designed to meet the safety and long life challenges of today‘s vehicle industry at a competitive cost. To this end, AHSS achieve increased tensile strengths of over 780 MPa and ultra high-strength steels further increased tensile strengths of > 1000 MPa. Many of the most modern parts made of multiphase steels already achieve tensile strengths of up to 1500 MPa or more with correspondingly high elongations. Beyond the automotive industry, other industries also benefit from the development of advanced high-strength steels, particularly energy, infrastructure and aerospace.

The processing of such sheets by stamping and punching, as well as forming by deep drawing, is correspondingly demanding. The tool steels used as standard up to now, such as D2 (1.2379) and A2 (1.2363), often reach their limits due to increased mechanical stresses in the forming process. Excessive wear and often chipping caused by intensive load peaks lead to low tool performance. Since tool failure often happens suddenly, production plants tend to suffer by unexpected maintenance times with high downtime costs.

Many other application in blanking, cutting, deep drawing and blending require good wear resistance and outstanding compressive strengths in combination with high toughness at the same time to ensure an efficient production process. The selection of the right tool steels with the appropriate properties is more important today than ever before in order to achieve long tool life and low tool costs at the same time.

The premium steel PM823 ESR is a cold work tool steel that can be used in many applications and combines very good wear resistance and compressive strength with very high toughness, thus supporting producers in optimising the service life of the tool.

Electro-slag remelting process (ESR)

Material properties of PM823 ESR

PM823 ESR is a premium steel for cold work applications and high performance requirements with a high contents of vanadium. PM823 ESR exceeds ledeburitic 12%-Cr and Cr8Mo2SiV steels in toughness, wear resistance, resistance to plastic deformation and compressive strength. The excellent tempering resistance, the high homogeneity and the high degree of purity support the application at complex tool loads. The steel can be easily machined in the soft annealed condition with the same parameters as conventional steels. PM823 ESR is produced via electroslag remelting (ESR).

Mat.-no.	Mass.-%					
	C	Si	Mn	Cr	Mo	V
Premium	0.84	0.85	0.40	7.70	1.50	2.45

Delivery: max. 250 HB

PM823 ESR: typical applications

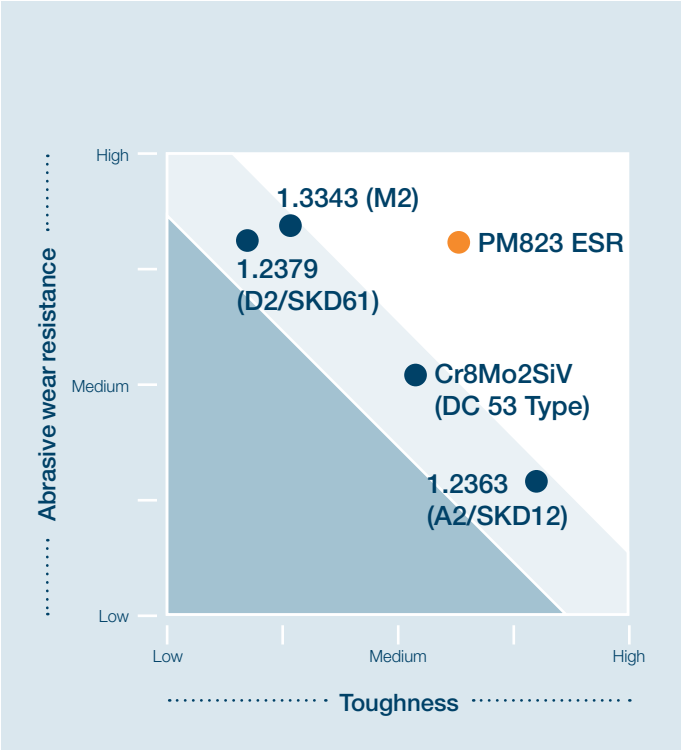
Stamping, punching and cutting tools

- Cutting tools and stamping tools in steel processing, especially for sheets with increased tensile strength (AHSS and UHSS sheets)
- Cutting and punching tools for austenitic steels
- Cutting tools for demanding materials e.g. high performance cutting tools for cutting demanding products in the electrical industry
- Cutting tools and forming tools in rubber processing and leather processing
- Shearing dies and industrial knives in the paper, cardboard and plastic industry
- Punching of holes

Tools for embossing, pressing, forming

- Forming tools in spring production
- Shearing tools in the processing of abrasive plastics
- Thread rolling tools such as jaws and rollers
- Dies and reducing dies
- Embossing tools for flat engravings
- Punches and shearing knives for sheet thicknesses up to 6 mm
- Bending tools
- Straightening and calibrating rollers for high pressures and risk of breakage
- Powder pressing tools

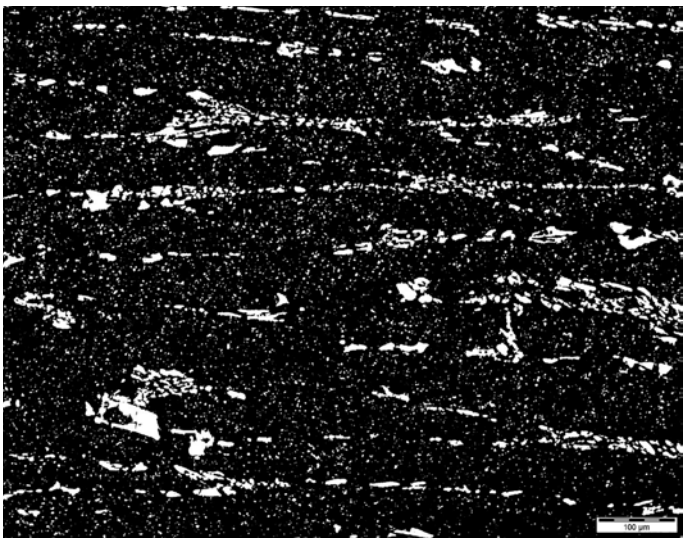
Comparision of material characteristics



- PM823 ESR combines high wear resistance and good toughness, outperforming ledeburitic 12%-Cr steels and common Cr8Mo2SiV steels.
- PM823 ESR offers an excellent tempering resistance and high homegenity and purity.

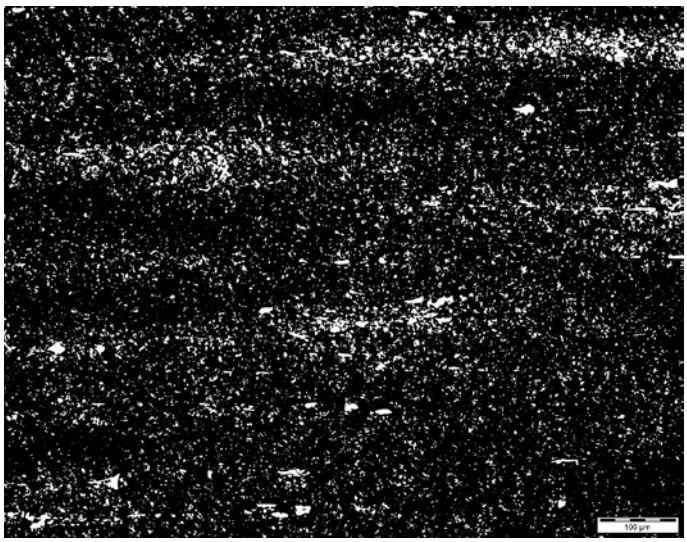
● Premium ● Standard

1.2379 (D2)



- As a result of the high chromium and carbon contents, ledeburitic primary carbides form in the steel 1.2379
- In the forged state, these primary carbides are present in a linear arrangement
- These primary carbides cause a very high wear resistance, but have a negative effect on the toughness

PM823 ESR



- Excellent resistance to abrasive wear at application hardnesses 56-62 HRC
- Very good adhesive wear resistance due to combination of high hardness and high toughness
- Excellent resistance to plastic deformation due to high yield strength
- Particularly good resistance to chipping
- Good machinability

Recommendation for heat treatment of PM823 ESR

Heat treatment in vacuum furnace

Preheating:

1. Heat up to 640 °C, equalize for minimum 30 min. Temperature difference surface-core ≤ 50 K (thermocouple in the core of a testpiece or tool)
2. Heat up to 850 °C, equalize for minimum 30 min. Temperature difference surface-core ≤ 50 K
3. Heat up to 1070 °C, equalize until piece has reached the temperature in the core area.*

(Temperature difference furnace-core ≤ 10 K)

Hardening:

The recommended austenitizing temperature is 1070 °C for a soaking time of 45 min.
Quenching with nitrogen ≥ 4,5 bar/6 bar, 1500/3000 Rpm to 100 °C / air to 80-100 °C.

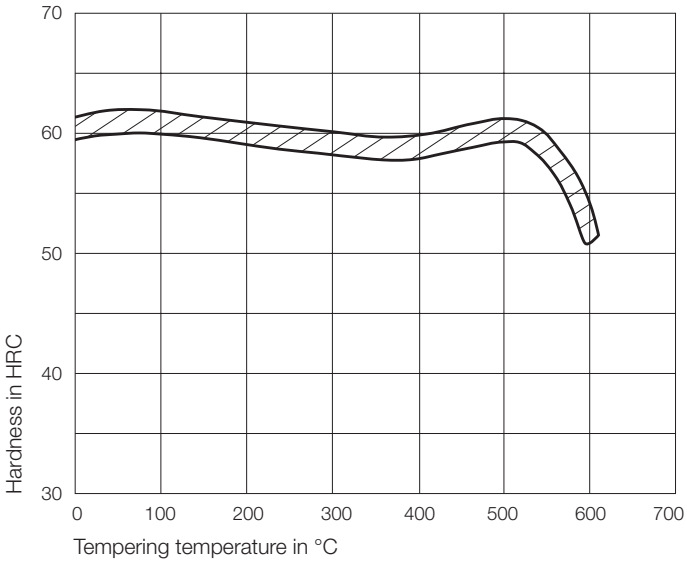
Tempering:

Equalize the pieces at 100 °C. Tempering > 530 °C according the required hardness, please see tempering diagram.

1. Tempering in protective gas, cooling down to 350 °C in furnace, then cooling down to room temperature on air.
2. Hardness testing
3. Tempering in protective gas (see tempering diagram) cooling down to 350 °C in furnace, then cooling down to room temperature on air.
4. Hardness testing
5. Tempering, if the required hardness ist not reached.

*Soaking time depends on the piece weight or reference diameter of the tool.

Tempering diagram



Physical properties				
Temperature in °C	20 - 100	20 - 200	20 - 400	20 - 600
Thermal expansion in 10^{-6}m/m x K	11,4	11,9	12,5	13,1
Temperature in °C	20	200	400	
Thermal conductivity in W/m x K	26,7	29,8	30,8	
Temperature in °C	20			
Density in g/cm³	7,60			

Examples of high performance applications

Punches in steel wheel production

Punches with a hardness of 58 - 60 HRC require a high wear resistance and a good toughness at the same time. A performance comparison with competitive steel shows better performance of PM823 ESR for a tool for punching air vent sections in the steel wheel production process. The tool made of PM823 ESR (61 HRC) finally produced 40 times more than the tool made of the competitive steel 1.2379 (62 HRC) (regular breakage of the tools).

Thread rolling

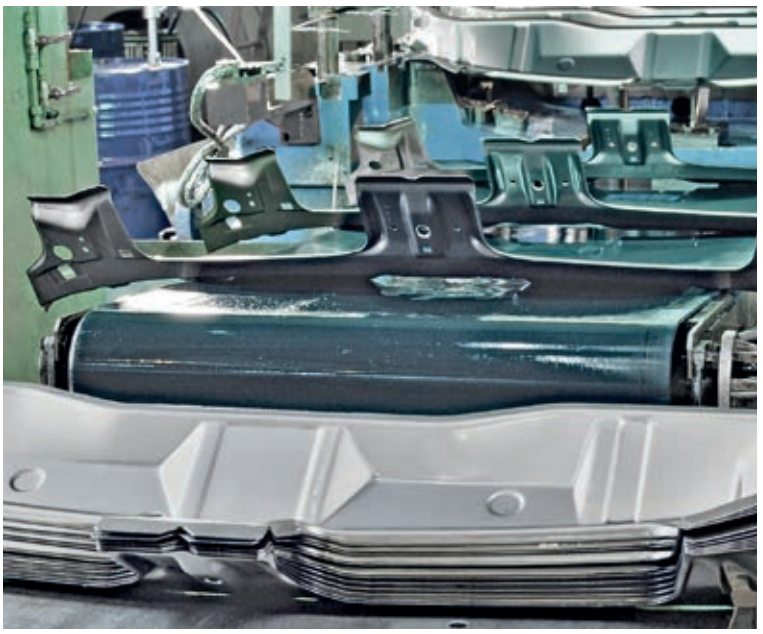
With the use of PM823 ESR (61 HRC) for a thread rolling tool, it was possible to produce 5,000 parts more than with a tool made of competitive 8% alloyed special cold work tool steels (62 HRC).

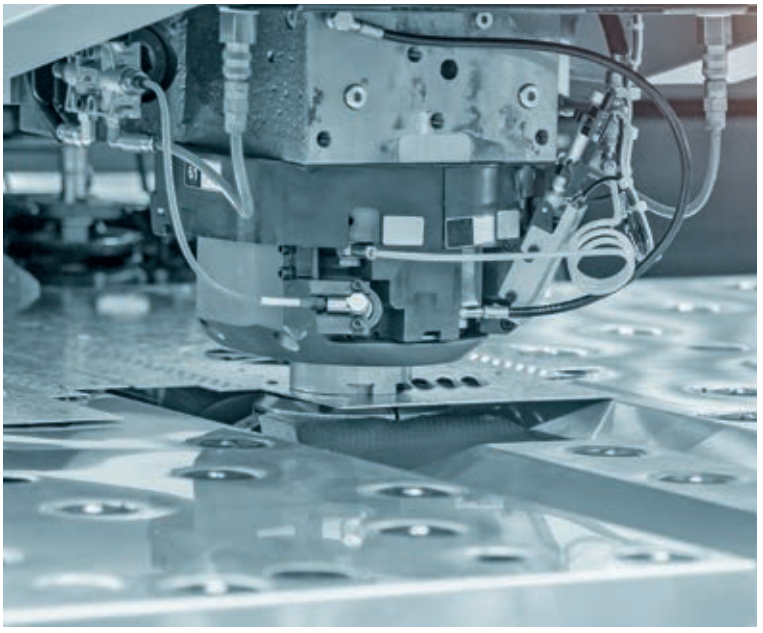
Roll mandrel in spring production / spindle for spiral springs

The usual performance with D2 steel is 3,000-5,000 parts produced. The tool made of PM823 ESR achieved 3 times the performance with more than 15,000 parts at 58 - 60 HRC.

Spacer in cold working

Previous results with a tool made of D2 are about 33,000 parts till the tool fails because of fracture. The tool made of PM823 ESR has so far achieved 5 times the performance with more than 167,000 parts and the tool is still in use.





Production processes

Melting

Forging

Heat treatment

Mechanical processing

Vacuum hardening

Surface treatment

Products

Hot-work tool steels

Cold-work tool steels

Die forging steels

Plastic mould steels

Industries

Die casting

Extrusion

Die forging

Pipe technology

Plastics technology

Hot-stamping

Special applications

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