PULVER STAHL

SPM 23 | 30 | 60

HIGH SPEED STEELS

High speed steels

SPM 23 | 30 | 60

Chemical composition

Average %												
	SPM 23	**C** 1,28	**Cr** 4,20	**Mo** 5,00	**W** 6,40	**Co** –	**V** 3,10
	SPM 30	**C** 1,28	**Cr** 4,20	**Mo** 5,00	**W** 6,40	**Co** 8,50	**V** 3,10
	SPM 60	**C** 2,30	**Cr** 4,20	**Mo** 7,00	**W** 6,50	**Co** 10,50	**V** 6,50

Application

Properties

Advantages of the PM Technology in comparison to conventionally produced 12 % chromium and High speed steels.
+ Better toughness
+ Higher wear resistance
+ Better machinability
Please contact our team of specialists to discuss your special areas of application.

Field of applications

SPM 23	Blanking and cutting, cold forming, fine blanking, powder pressing, milling, thread cutting, broaching, grinding, countersinking, segmental circular saws
SPM 30	Blanking and cutting, cold forming, powder pressing, milling, thread cutting of difficult machinable materials, high speed broaching, grinding, etc.
SPM 60	Blanking and cutting of thin materials, cold forming, powder pressing, turned parts, cropping tools, end mills, reamers

Hardness

Hardness range HRC	
SPM 23	60-66
SPM 30	64-67
SPM 60	66-69

Temperatures

Annealing °C

870-900
The steel must be protected from decarburization and initially cooled down at 10 °C/h increments to 700 °C – followed by final cooling in a furnace.

Stress relieving °C

600-700
Stress relief annealing follows rough cutting. The steel is heated up to 600 to 700 °C. Holding time ½ h following complete heat through. Cooling in furnace to 500 °C, then freely in air.

High speed steels

Material standard SPM 23

Steel type

Material code in conformance with DIN 17350, but produced using powder metallurgy (PM) S 6-5-3 (PM)
Material number in conformance with DIN 17350, but produced using powder metallurgy (PM) 1.3344 (PM)
Grade in conformance with DIN 17350

Material analysis

The following composition must be guaranteed for this analysis batch. Composition by weight percentage of steel melt (limited).

Elements	E	C	Si	Mn	(Co)	Cr	Mo	V	W	(Cu / Ni)	P	S*	(O)	(N)
Factor	10^x	1	1	1	1	1	1	1	1	1	10^{-3}	10^{-3}	10^{-4}	1
Min.	x	1,25	0,30	0,25	—	3,80	4,70	2,80	5,90	—	—	—	—	0,03
Max.	x	1,35	0,70	0,60	0,60	4,50	5,30	3,30	6,70	0,50	30	30*	180	0,08

* To achieve an overall steel cleanliness rating "K 0" < 10, the sulphur content may not exceed 0,14 %.

- Elements for which a minimum and maximum value is not listed in the table must not be purposely added to the alloy, except for the final treatment of the melt. All necessary precautions must be taken to avoid the introduction of such elements with the scrap metals or other materials used during production.
  Contents of companion elements or impurities are permissible, however, to the extent that the workability and applicability as well as the properties prescribed for this material standard are not thereby impaired.
- When argon-atomised powder is used, the argon content must not exceed 0,05 ppm.
- The oxygen content should be measured when powder sizes of 63 to 90 µm are used.

As delivered condition

Manufacturing status annealed

Material properties

Microstructure	acc. to —	(predominant)	uniform
Carbide distribution	acc. to —	(predominant)	< 5 µm
Carbide size	acc. to —	(predominant)	without
Carbide banding	acc. to DIN 50 602	(Overall steel cleanliness rating)	K 0 < 10
Percentage purity	process "K"	(SS, OA, OS, OG)	K 4 = 0

Mechanical properties

Red hardness	acc. to DIN 50 351	≤ 280 HB

Particular suitability

This material standard is met by the following internal designations:
SPM 23, company STM Pulverstahl.

SPM 30

Material standard

Steel type

in conformance with DIN 17350, but produced using powder metallurgy (PM) S 6-5-3-8 (PM) — **Material code**
in conformance with DIN 17350, but produced using powder metallurgy (PM) — — **Material number**
in conformance with DIN 17350 — **Grade**

Material analysis

The following composition must be guaranteed for this analysis batch. Composition by weight percentage of steel melt (limited).

Elements	E	C	Si	Mn	(Co)	Cr	Mo	V	W	(Cu / Ni)	P	S*	(O)	(N)
Factor	10^x	1	1	1	1	1	1	1	1	1	10^{-3}	10^{-3}	10^{-4}	1
Min.	x	1,25	0,30	0,25	8,00	3,70	4,70	2,80	5,90	—	—	—	—	0,03
Max.	x	1,35	0,70	0,60	9,00	4,40	5,30	3,30	6,70	0,50	30	30*	150	0,08

* To achieve an overall steel cleanliness rating "K 0" < 10, the sulphur content may not exceed 0,18 %.

- Elements for which a minimum and maximum value is not listed in the table must not be purposely added to the alloy, except for the final treatment of the melt. All necessary precautions must be taken to avoid the introduction of such elements with the scrap metals or other materials used during production.
  Contents of companion elements or impurities are permissible, however, to the extent that the workability and applicability as well as the properties prescribed for this material standard are not thereby impaired.
- When argon-atomised powder is used, the argon content must not exceed 0,05 ppm.
- The oxygen content should be measured when powder sizes of 63 to 90 µm are used.

As delivered condition

annealed — **Manufacturing status**

Material properties

acc. to —	(predominant)	uniform	**Microstructure**
acc. to —	(predominant)	< 5 µm	**Carbide distribution**
acc. to —	(predominant)	without	**Carbid size**
acc. to DIN 50 602	(Overall steel cleanliness rating)	K 0 < 10	**Carbide banding**
process "K"	(SS, OA, OS, OG)	K 4 = 0	**Percentage purity**

Mechanical properties

acc. to DIN 50 351	≤ 300 HB	**Red hardness**

Particular suitability

This material standard is met by the following internal designations:
SPM 30, company STM Pulverstahl.

High speed steels

Material standard SPM 60

Steel type

Material code in conformance with DIN 17350, but produced using powder metallurgy (PM) —
Material number in conformance with DIN 17350, but produced using powder metallurgy (PM) ≈ 1.3241 (PM)
Grade in conformance with DIN 17350

Material analysis

The following composition must be guaranteed for this analysis batch. Composition by weight percentage of steel melt (limited).

Elements	E	C	Si	Mn	(Co)	Cr	Mo	V	W	(Cu / Ni)	P	S*	(O)	(N)
Factor	10^x	1	1	1	1	1	1	1	1	1	10^{-3}	10^{-3}	10^{-4}	1
Min.	x	2,27	0,40	0,30	10,10	3,90	6,70	6,20	6,10	—	—	—	—	0,03
Max.	x	2,34	0,60	0,50	10,90	4,50	7,30	6,70	6,90	0,60/0,50	50	30	100	0,06

* To achieve an overall steel cleanliness rating "K 0" < 10, the sulphur content may not exceed 0,14%.

- Elements for which a minimum and maximum value is not listed in the table must not be purposely added to the alloy, except for the final treatment of the melt. All necessary precautions must be taken to avoid the introduction of such elements with the scrap metals or other materials used during production.
  Contents of companion elements or impurities are permissible, however, to the extent that the workability and applicability as well as the properties prescribed for this material standard are not thereby impaired.
- When argon-atomised powder is used, the argon content must not exceed 0,05 ppm.
- The oxygen content should be measured when powder sizes of 63 to 90 µm are used.

As delivered condition

Manufacturing status annealed

Material properties

Microstructure	acc. to —	(predominant)	uniform
Carbide distribution	acc. to —	(predominant)	< 5 µm
Carbide size	acc. to —	(predominant)	without
Carbide banding	acc. to DIN 50 602	(Overall steel cleanliness rating)	K 0 < 10
Percentage purity	process "K"	(SS, OA, OS, OG)	K 4 = 0

Mechanical properties

Red hardness acc. to DIN 50 351 ≤ 340 HB

Particular suitability

This material standard is met by the following internal designations:
SPM 60, company STM Pulverstahl.

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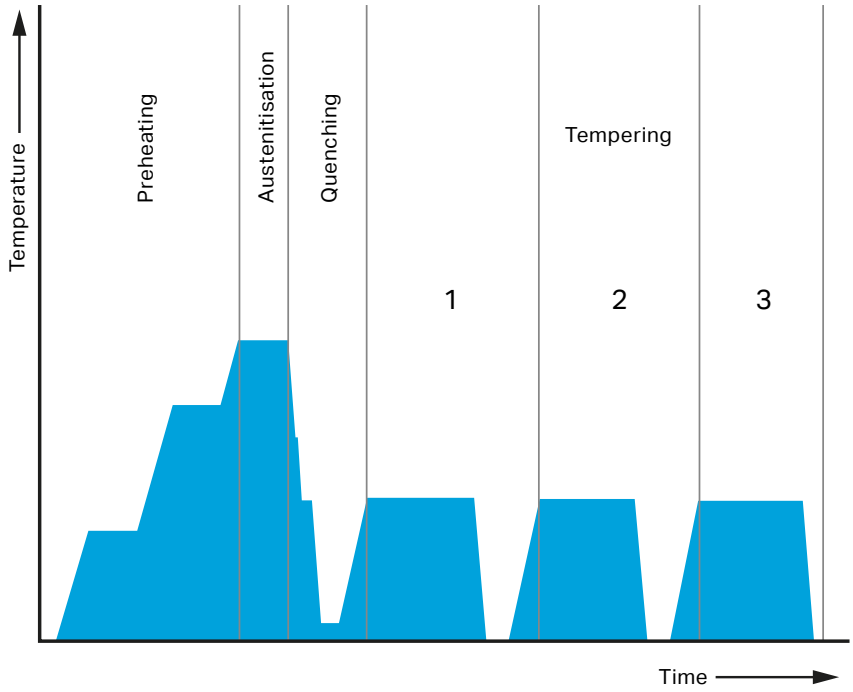
Heat treatment

Basic process

1. Preheating in two stages. Initially 450 to 500 °C, followed by salt bath 850 to 900 °C.
2. Austenitization in a salt bath.
3. Quenching preferably in salt bath to 550 °C, followed by air cooling to hand warmth.
4. Three tempering operations at 560 to 570 °C, each lasting at least one hour.

SPM steels are in principle to be subjected to three tempering operations because of their high carbon content resulting in a high percentage of retained austenite.



High speed steels

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Heat treatment instructions

Target group

Cold working
1. Preheat: 450 °C
2. Preheat: 870 °C

Hardening: as per chart
Tempering: 3 x 1 h, 560 °C

Cool down after hardening in a hot bath
approx. 550 °C

Targeted final hardness	**Austenitization temperature** °C			**Soaking time at hardening temperature ***	
± 1 HRC	SPM 23	SPM 30	SPM 60	SPM 23 / 30	SPM 60
58	1000	960	900	30	–
59	1030	980	920	25	–
60	1050	1000	940	25	–
61	1075	1020	950	20	–
62	1100	1050	960	20	–
63	1120	1075	975	20	30
64	1140	1100	1000	15	30
65	1160	1125	1030	10	25
66	1180	1150	1070	10	20
67	–	1180	1100	10	15
68	–	–	1150	–	10
69	–	–	1180	–	10

* Soaking time in seconds per mm wall thickness if preceded by preheating at 870 °C.

Dimensional accuracy during heat treatment

Dimensional accuracy

SPM steels exhibit an isotropic dimensional accuracy. The dimensional change in percent with regard to longitudinal and transverse axes is the same (approx. 0,08 to 0,12 % in relation to the normal size).

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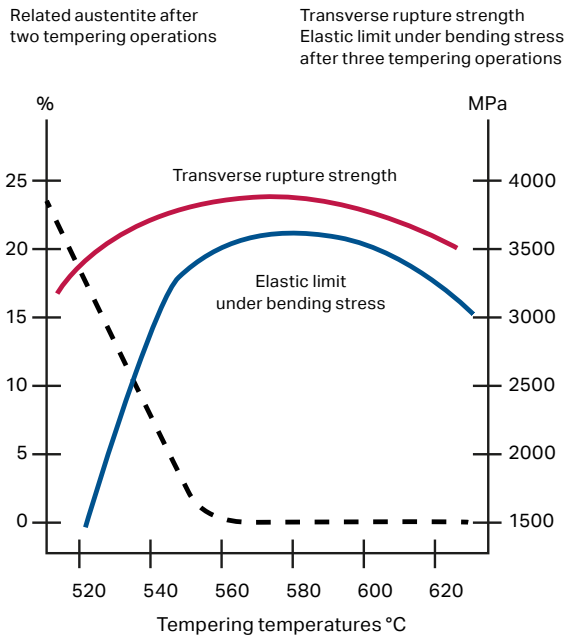
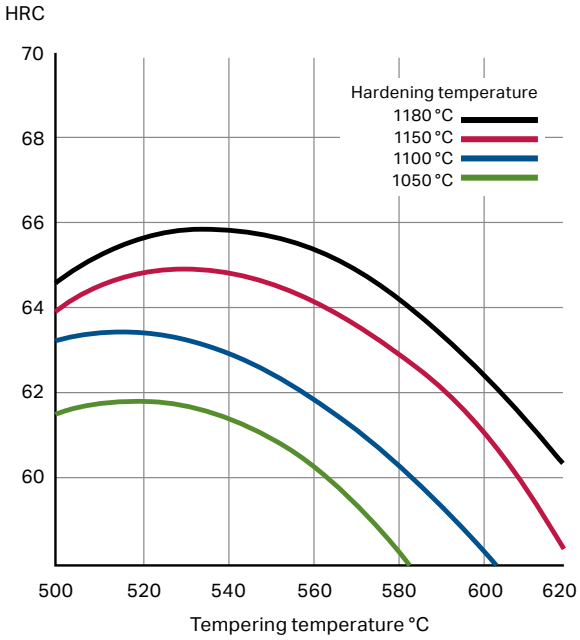
The influence of the hardening temperature on flexural strength

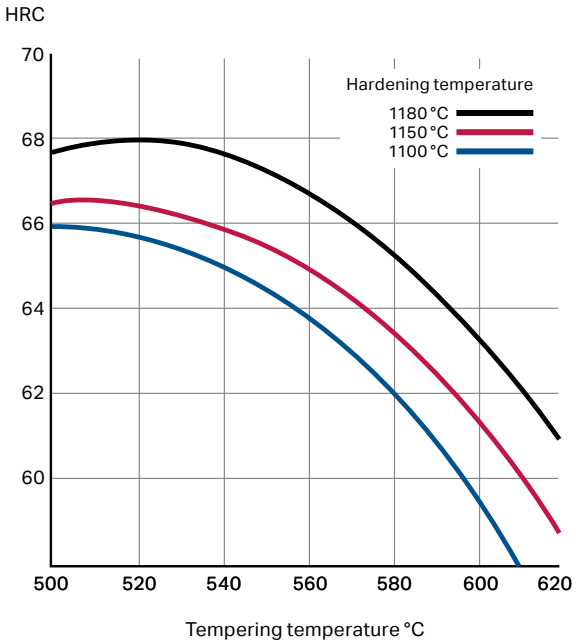
Austenitization temperature 1180 °C



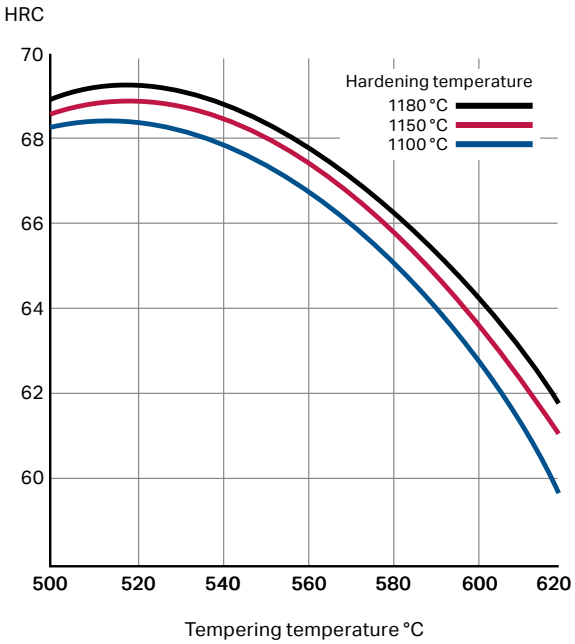
Tempering graph SPM 23



Tempering graph SPM 30



Tempering graph SPM 60



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Flexural strength

The influence of the hardening temperature on flexural strength

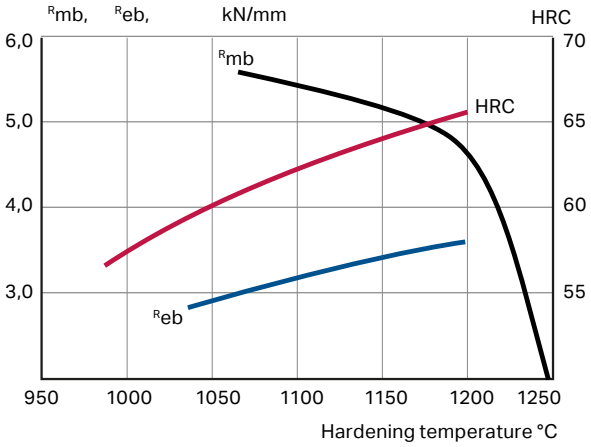
The following diagrams show the flexural strength at standard tempering temperature and increasing hardening temperature. In addition, it becomes apparent that the maximum permissible hardening temperature is limited and that toughness is significantly reduced when this temperature is surpassed.

^{R}mb = Transverse rupture strength in kN/mm, ± 10 %

^{R}eb = Flexural yield strength in kN/mm, ± 5 %

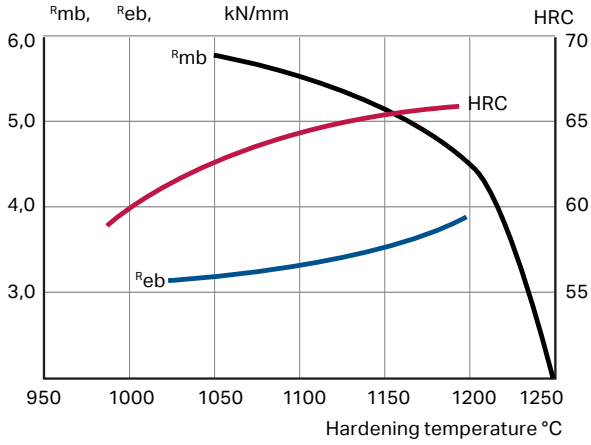
The data given are approximate values. They refer to a test piece dimension ø 10 mm.

SPM 23



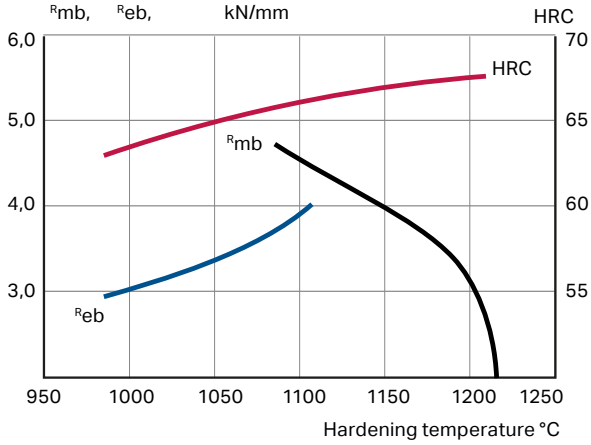
Hardened at given temperature and tempered at 560 °C, 3 x 1h

SPM 30



Hardened at given temperature and tempered at 560 °C, 3 x 1h

SPM 60



Hardened at given temperature and tempered at 560 °C, 3 x 1h

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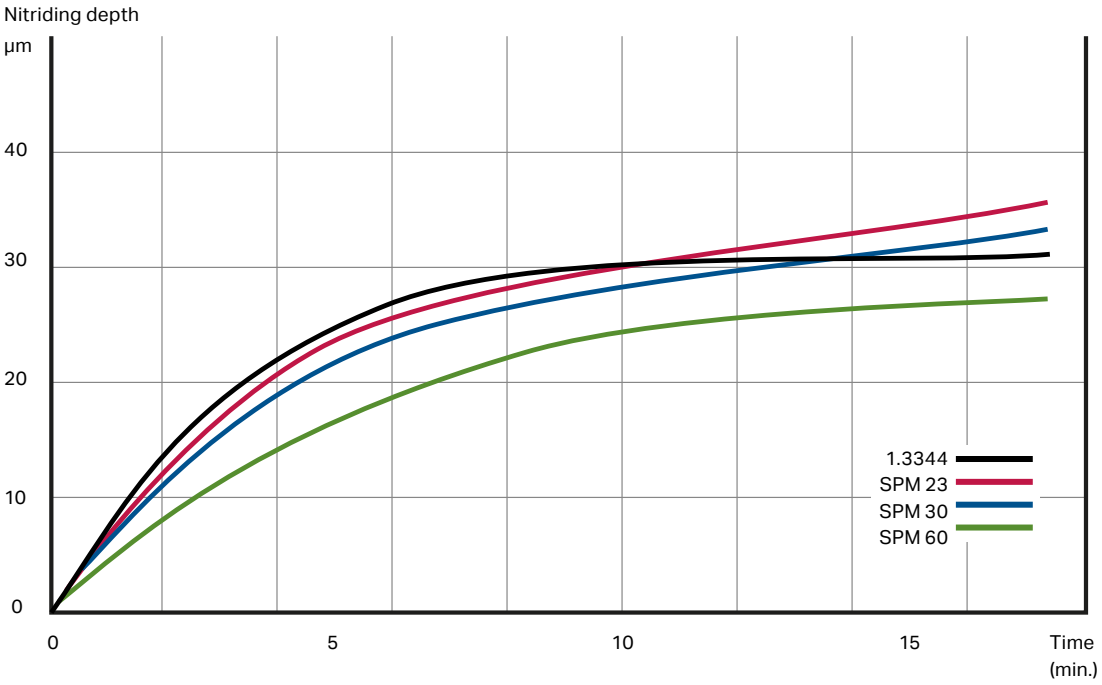
Surface treatment / Nitriding

Nitriding

SPM steels can be nitrated like conventional high speed steel. Nitriding improves wear resistance (recommended for machining soft materials). A diffusion zone of 2-20 µm is recommended, depending on the area application.

Nitriding depth



Nitriding depth after treatment in a Tenifer bath at 570 °C.
Test piece 20 ø x 10 mm.

Coating

SPM steels with their superior microstructure and a distinctive secondary hardening peak are ideal for PVD or CVD coatings. Requirements should be discussed from case to case.

High speed steels

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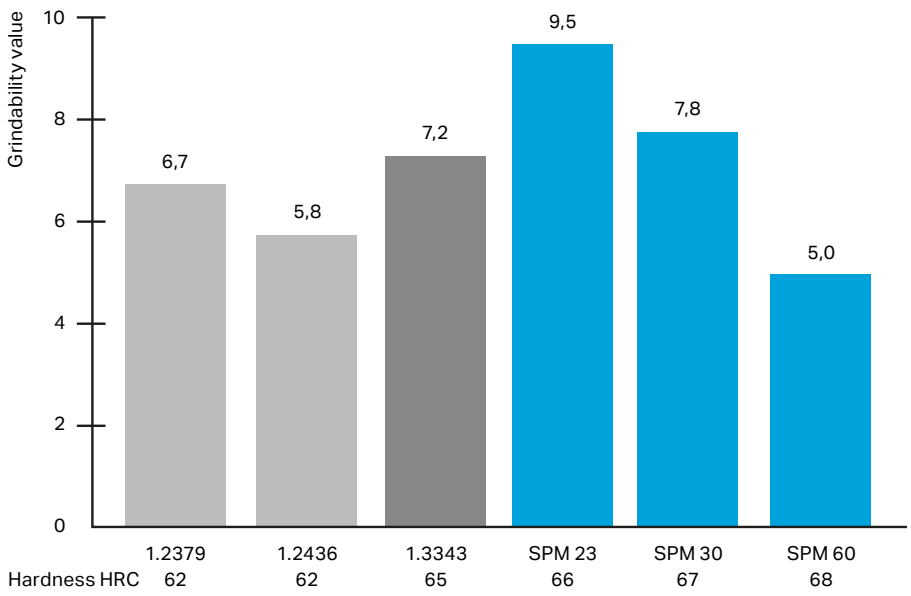
Physical properties

	20 °C			400 °C			600 °C	
	SPM 23	**SPM 30**	**SPM 60**	**SPM 23**	**SPM 30**	**SPM 60**	**SPM 23**	**SPM 30**	**SPM 60**
Density kg/dm³	8,05	8,04	7,96	7,94	7,94	7,86	7,87	7,88	7,81
Elastic modulus kN/mm²	230	240	250	205	214	222	184	192	200
Thermal expansion m/(m.K) between 20 °C and ...°C	–	–	–	11.7 x 10^{-6}	11.4 x 10^{-6}	11.9 x 10^{-6}	11.5 x 10^{-6}	10.8 x 10^{-6}	–
Thermal conductivity W/(m.K)	–	24	–	–	28	–	–	27	–
Specific heat capacity J/(kg.K)	–	420	–	–	510	–	–	600	–

Grindability

Thanks to PM production, the grindability of SPM steels is better than that of conventionally manufactured High speed steels of a similar alloy. This results in shorter grinding times and higher metal-cutting capacity per grinding wheel.
The following graph depicts the grindability.

Grindability Graph



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Machining information

Turning

		High speed steel tools		Coated carbide tools	
Steel type	**Cutting depth** mm	**Feed** mm/U	**Cutting speed** m/min.	**Feed** mm/U	**Cutting speed** m/min.
SPM 23	1	0,18	24	0,18	160
	8	0,50	15	0,50	130
SPM 30	1	0,18	23	0,18	150
	8	0,50	14	0,50	90
SPM 60	1	0,18	15	0,18	115
	8	0,50	9	0,50	60

Carbide tools e.g. SECO TP 15, Sandvik Coromant GC015 or similar coated tools of the groups C7-C6, M10-M40, P10-P40.

Milling

		High speed steel tools		Coated carbide tools	
Steel type	**Cutting depth** mm	**Feed** mm/U	**Cutting speed** m/min.	**Feed** mm/U	**Cutting speed** m/min.
SPM 23	1	0,20	27	0,18	150
	8	0,40	17	0,36	79
SPM 30	1	0,15	23	0,18	145
	8	0,36	14	0,36	73
SPM 60	1	0,15	20	0,18	135
	8	0,36	12	0,36	67

Carbide tools e.g. SECO TP 25, Sandvik Coromant GC015 or similar coated tools of the groups C5-C6, P20-P40.

Drilling

High speed steel drill	Point angle 115°-125°	8-15 m/min.	
Carbide drill	Point angle 115°-125°	30-50 m/min.	
	Emulsion cooling		

Sawing

Hack saws	High-speed steel blade	80 strokes/min.	0,15 mm/stroke
Circular saws	High-speed steel blade	8-12 m/min.	0,15 mm/stroke
	Cemented carbide	60-80 m/min.	0,08 mm/ saw tooth

High speed steels

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Delivery program

Round bars

At our products we deliver all common Round-measurements.

Flat material

We deliver all Flat-measurements at your desired size. 6-sided, blank without decarburization zone, relating to your final measurement.

As needed please order our current stock list. Not existing Round-measurements are deliverable within shortest time.

Special tubes

We are able to produce special tubes adapted to your desired sizes. For this purpose our salesmen are at your command.

Notes

PULVER STAHL

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