EXERA® 20AP FREE-CUTTING MEDICAL WIRE

WIRE

DATENBLATT

Exera® 20AP is a hardenable, free-cutting carbon steel medical wire characterized by excellent machinability. The grade has high hardness, high wear resistance and exceptional dimensional stability after hardening.

APPLICATIONS

Exera® 20AP is used for dental applications such as dental burrs and drills.

CHEMICAL COMPOSITION (NOMINAL) %

C	Si	Mn	P	S	Pb
1.0	0.2	0.4	≤0.030	0.05	0.2

FORMS OF SUPPLY

Forms of supply/ finishes	Diameter	Cu-Sn coating	Standard tolerance	Length
	mm			m
Wire in coils				
Drawn	0.80-1.60		D4	-
	1.60-2.50		D4	-
Straightened wire				
Drawn	0.80-1.15		D4	2
	1.15-2.00		D4	2
	2.00-2.50		D3	2
Drawn/ground	2.00-3.00		h7	2
	3.00-6.00		h7	3
	6.00-12.00		h7	3

Other sizes on request.
Ovality: For D1 and D2, max. 50% of the tolerance width, for D3 max. 25% of the tolerance width.

MECHANICAL PROPERTIES

Forms of supply/Finishes	Diameter	Tensile strength	Proof strength	Elongation
	mm	R_m [1)]	$R_{p0.2}$ [1) 2)]	A [1)3)]
		MPa	MPa	%
Wire in coils	0.80-1.60	770		
Drawn	1.60-2.50	720	770	4

Forms of supply/Finishes	Diameter	Tensile strength	Proof strength	Elongation
	mm	R_m [1)]	$R_{p0.2}$ [1) 2)]	A [1)3)]
		MPa	MPa	%
Straightened wire	0.80-1.15	>980	720	7
Drawn	1.15-2.00	>920	>910	3
Drawn/ground	2.00-2.50	>900	>850	5
	2.00-3.00	>920	>830	7
	3.00-6.00	810	>850	6
	6.00-12.00	750	670	10
			620	12

1) Nominal values. Other properties on request.
2) $R_{p0.2}$ and elongation values are given for information only.

Impact strength

Quenching time and temperature is dependent on material size, the specimens for impact strength are larger than standard wire.

Table of impact strength for Exera® 20AP, hardened and quenched condition (soaking temperature 800°C and soaking time 10 min, tempering time is 30 min)

Tempering temperature, °C	Impact strength, J
200	1.3
300	2.0
400	7.3
500	10.0
600	17.0

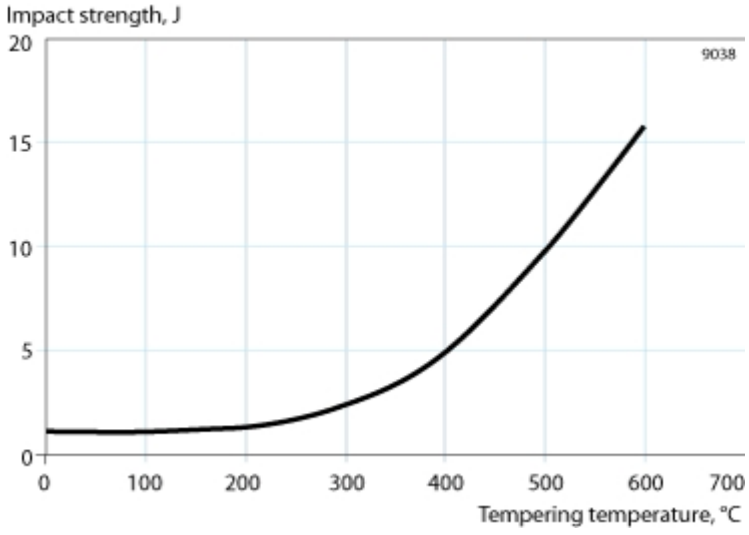

Figure 1. Impact strength after recommended hardening procedures, valid for all dimensions. Soaking time 30 minutes. Standard Charpy-V specimens at 20°C.

PHYSICAL PROPERTIES

Density annealed 7.8 g/cm³, 0.28 lb/in³

Resistivity

Cold drawn, 0.18 µΩm
Heat treated, 0.21 µΩm

Thermal expansion [1)]

Temperature, °C	20-100	20-200	20-300
Cold drawn	11.5	11.5	12.5
Heat treated	11.5	12.0	12.5

1) Mean values in temperature ranges (x10^{-6})

Exera® 20AP is a magnetic material.

HEAT TREATMENT

Soft-annealing

When required, soft-annealing should be conducted for a period of one hour at a temperature of 650 - 680°C.

Hardening

Diameter	Temperature	Soaking time	Quenching
mm	°C	approx. min.	
≤5	800 - 820	3 - 6	in oil at 50°C
> 5	790 - 810	6 - 10	in water

The smaller the diameter, the shorter the soaking time. To avoid oxidation and decarburization, hardening should be conducted in a protective gas atmosphere using nitrogen, argon or a vacuum.

Contact Sandvik for further advice.

Prolonged service at elevated temperatures causes decreased hardness when used in the hardened and tempered condition. See also "Impact strength".

Tempering

Temperature, °C	100 - 600
Tempering time, min	30 - 60

The core of the material needs a tempering time of at least 30 minutes. To reduce the risk of cracking, tempering should be conducted immediately after hardening. The heating rate should not be too high, particularly in the case of intricately shaped components.

Hardness

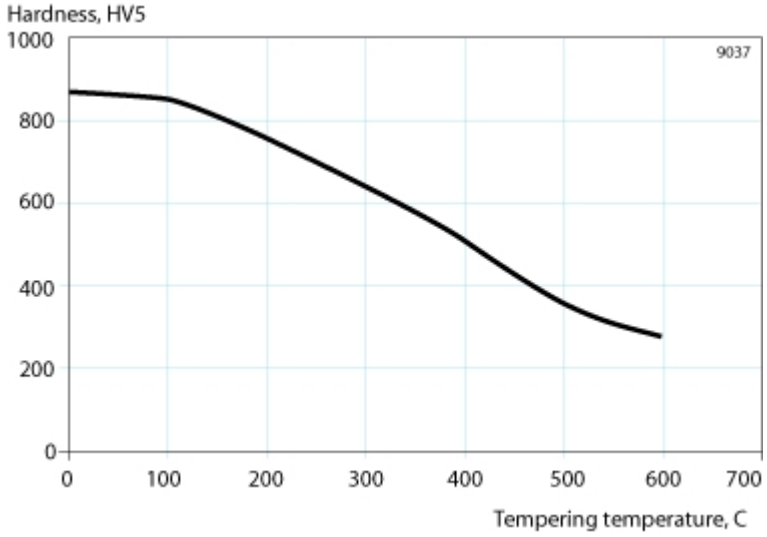

Figure 2. Hardness after recommended hardening procedures, valid for all dimensions.
Soaking time 30 minutes.

MACHINING

The recommended values, based on Sandvik Coromant cemented carbide cutting tools or high speed steel tools from Sandvik, are to be regarded as starting data. To obtain the optimal combination of finishes, tolerances and productivity the values should be adjusted for each individual operation. The data assumes the use of a suitable cutting fluid. If machining without a cutting fluid, the values should be reduced by about 10%.

Detailed recommendations can be obtained from your nearest Sandvik Coromant or Sandvik office.

In the manufacture of sophisticated precision components, the material's highly uniform and very good machinability offers reliable production with high productivity. This is of major importance since component processing costs can be several hundred times greater than the cost of the raw material.

Material in the drawn condition up to Ø 3 mm has a Cu/Sn surface layer. The layer enables components to be machined by lathes equipped with guide bushing.

Turning

The charts below give guidance of how speed and feed affect diameter tolerances and surface roughness of turned components. The charts are based on longitudinal turning. The tolerances are given by using the ISO-system, i.e. IT7 could mean h7, k7 or js7.

The tools used in Figure 3 - 6 were brazed cemented carbide tools and in Figure 7 indexable cemented carbide inserts. Brazed tools used: Sandvik Coromant tool 310 L197-1212-200 grade H10F, rake angle 0°, clearance angle 6° and entering angle 90°. Indexable tools used: Sandvik Coromant insert TCMT 110202-UF GC415 and tool holder STGCL 1212F 11.

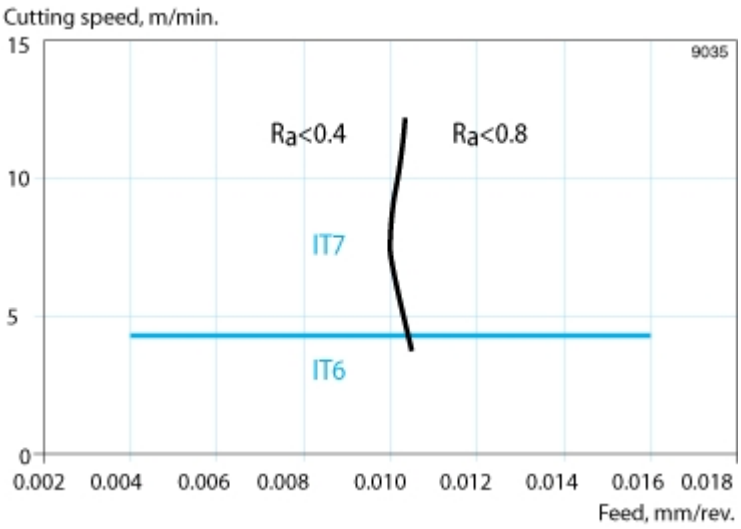

Figure 3. Wire diameter 1.20 mm, high tensile strength, drawn condition, depth of cut between 0.2-0.3 mm. Brazed cemented carbide

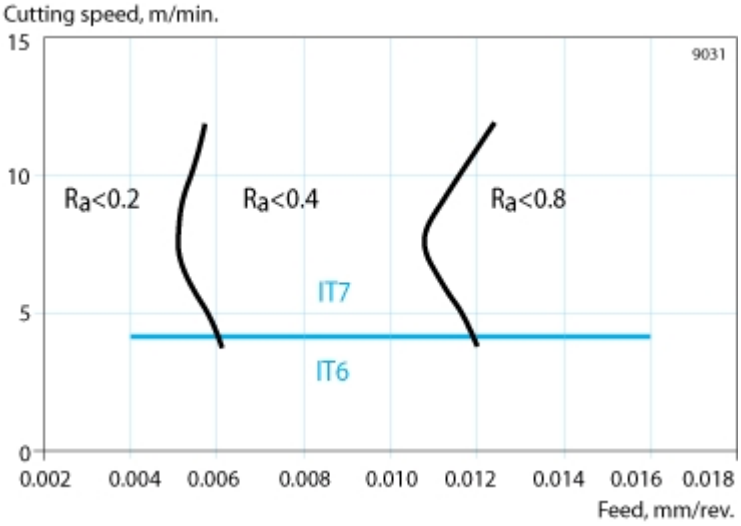

Figure 4. Wire diameter 1.20 mm, medium tensile strength, drawn condition depth of cut between 0.2-03 mm. Brazed cemented carbide.

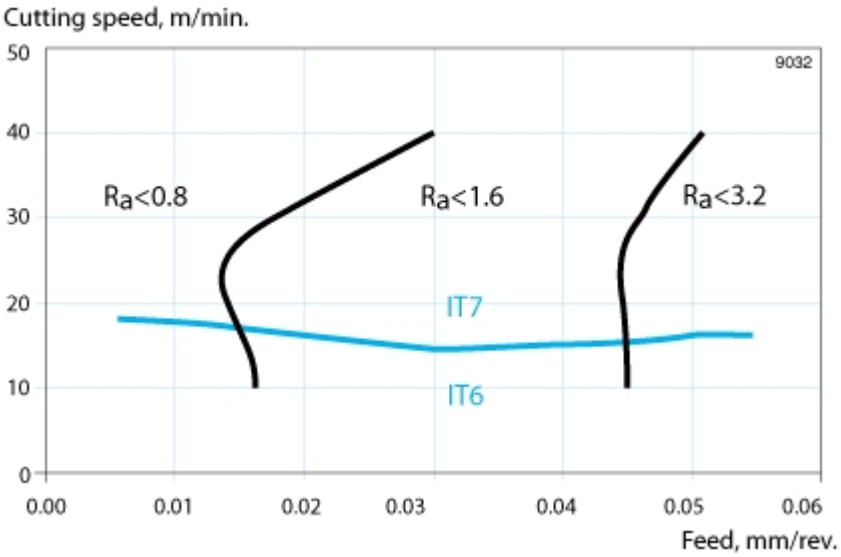

Figure 5. Wire diameter 3.00 mm, drawn condition, depth of cut between 0.4-0.6 mm. Brazed cemented carbide.

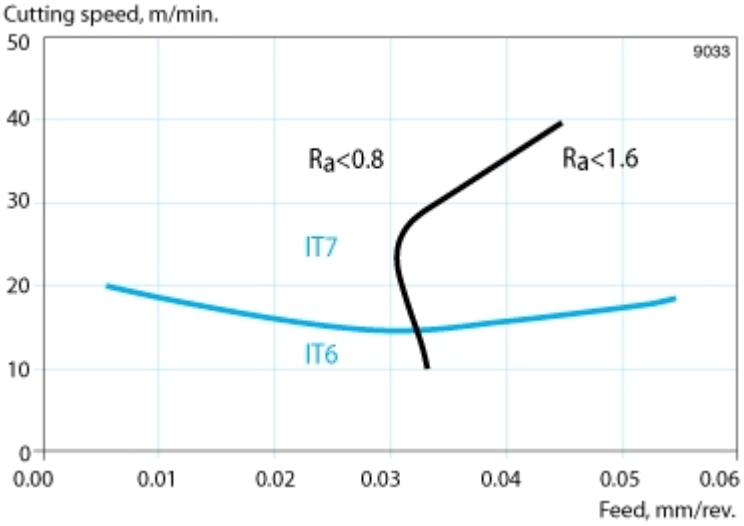

Figure 6. Wire diameter 3.50 mm, ground condition, depth of cut between 0.5-0.9 mm. Brazed cemented carbide.

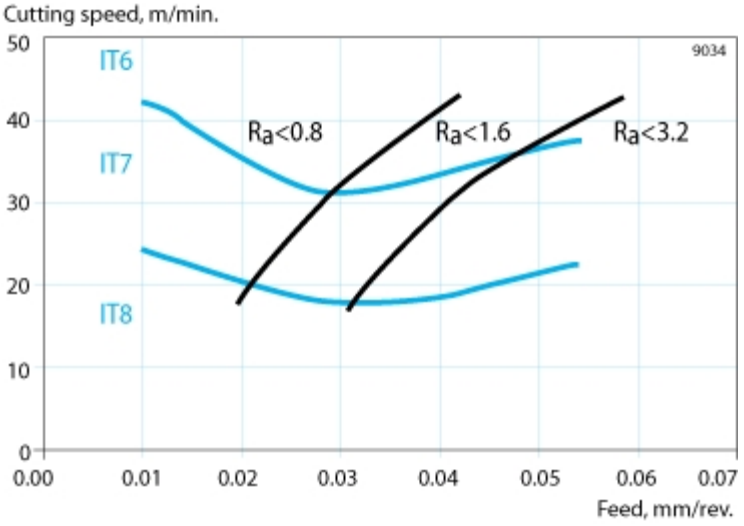

Figure 7. Wire diameter 6.0 mm, ground condition, depth of cut between 0.2-0.5 mm. Indexable cemented carbide inserts.

CNC lathes and similar

Indexable insert tools. For diameters d < approx. 20 mm lower cutting speeds should be used.

Feed	Cutting speed		
mm/rev.	m/min.		
	GC 4015	CT525	GC 235
	CT 5015	GC 4025	GC 4035
0.05	310	225	-
0.15	200	190	180
0.5	-	-	150

Bar automatics

Diameter > approx. 2 mm

Tool	Cutting speed
	m/min.
CC	45-55
HSS	25-35

Single and multiple spindle automatic lathes

Diameter > approx. 10 mm

Operation	Finish turning	Rough turning
	Feed, mm/rev.	
Single point	0.05-0.10	0.10-0.25
Forming	0.01-0.03	0.03-0.08
Plunge cutting and parting off	0.02-0.05	0.05-0.10

Longitudinal turning automatics, plunging automatics and similar machines

Diameter < approx. 10 mm	Cutting depth	Finish turning[1)]	Medium	Rough turning[2)]
Operation	mm	Feed, mm/rev.		
Single point turning	<1	0.005-0.01	0.01-0.015	0.025
Forming	1-3	0.02 0.01	0.03 0.02	0.05 0.03
Plunge cutting and parting off	>3	0.005 0.01	0.015 0.02	0.03 0.04

1) For parts requiring high precision.
2) For parts with moderate tolerance requirements and parts that subsequently must be finish machined.

Parting off and grooving

Parting off in CNC lathes and similar

Tool	Feed	Cutting speed

	mm/rev.	m/min.
GC 235, 4025	0.05-0.15	55-110
HSS	0.02-0.05	25-35

Threading

Tool	Grade	Cutting speed
		m/mm.
Threading dies	HSS	3-6
Self-opening die heads	HSS	5-10
Thread chasers	HSS CC	20-35 80-135
Thread rolling	HSS CC	10-15 15-20
Thread turning	GC1020	80-100

Drilling

Drill diameter	Feed	Speed
mm	mm/rev.	rpm
0.5	0.005	2650
1	0.01	2500
3[1)]	0.03	1500
5[1)]	0.05	1200
8[1)]	0.07	900
10[1)]	0.09	700

[1)]Cemented carbide drills of Delta type with the following data can also be used:
Grade GC1020, speed 60-100 m/min.

Milling

Operation	Grade	Feed	Cutting speed
		mm/tooth	m/mm.
Finish milling with high cutting speed under favorable working conditions	530 or 1025	0.1 0.2	140-180 110-150
Finish and medium-rough milling under normal to difficult working conditions	4030 or 4040	0.1 0.2	130-160 100-125
Medium-rough to rough milling under difficult conditions	SM30 or 4040	0.1 0.2	90-110 80-90

End milling

Tool type	Grade	Cutting speed
	CC	m/mm.
Indexable-insert tools	530	190
Solid carbide end mills	4030 4040	165 135

End milling

Tool type	Grade	Cutting speed
	CC	m/mm.
Brazed helical fluted end mills	GC1020 P40	120 40

Hobbing

Tool	Cutting speed
	m/min.
CC	30-60
HSS	25-50

Reaming

Cutting speed for diameters > about 2 mm

Reamer	Grade	Cutting speed
		m/min.
Straight/helical fluted	HSS CC	10 25
Gun drill geometry	HSS	15

Feed

Diameter	Feed	Allowance
mm	mm/rev.	mm
1-5	0.05-0.10	0.05-0.10
6-10	0.10-0.20	0.10-0.20
11-20	0.15-0.30	0.20-0.30

All data is nominal. Values refer to 20°C unless otherwise stated.

For other requirements and further information please contact Sandvik.

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