

# 4C27A Free-Cutting Datasheet

## Medical Wire



Certified according to ISO 9001

4C27A is a hardenable stainless chromium steel alloyed with molybdenum. This grade is supplied in wire form.

It is characterized by:

- Very good machinability
- High wear resistance
- Good toughness
- Good corrosion resistance due to addition of molybdenum

### Standards

ASTM: 420F Mod  
DIN: X 22 CrMoNiS 13 1

Product standard:

ASTM F899

### Applications

4C27A is a hardenable grade used for medical and dental tools as dental burrs, dental drills, bone drills, dental taps, reamers, screw drivers and drilled surgical needles.

### Chemical Composition (nominal) %

| C    | Si  | Mn  | P       | S   | Cr   | Ni  | Mo  |
|------|-----|-----|---------|-----|------|-----|-----|
| 0.22 | 0.6 | 1.3 | ≤ 0.030 | 0.2 | 13.0 | 0.8 | 1.2 |

### Mechanical Properties

| Forms of supply/ finishes | Diameter     | Tensile strength            |     | Proof strength                     |     | Elongation       |   |
|---------------------------|--------------|-----------------------------|-----|------------------------------------|-----|------------------|---|
|                           |              | R <sub>m</sub> <sup>1</sup> | MPa | R <sub>p0.2</sub> <sup>1,2,3</sup> | MPa | A <sup>1,3</sup> | % |
|                           | mm           |                             |     |                                    |     |                  |   |
| <b>Wire in coils</b>      |              |                             |     |                                    |     |                  |   |
| Annealed                  | 0.6 - 3.0    | < 800                       |     | 450                                |     | 25               |   |
| Drawn                     | 0.45 - 4.0   | 950                         |     | 770                                |     | 10               |   |
| <b>Straightened wire</b>  |              |                             |     |                                    |     |                  |   |
| Annealed                  | 0.6 - 10.0   | < 800                       |     | 450                                |     | 25               |   |
| Drawn                     | 0.6 - 3.0    | 950                         |     | 770                                |     | 10               |   |
|                           | > 3.0 - 5.0  | 950                         |     | 770                                |     | 10               |   |
|                           | > 5.0 - 10.0 | 850                         |     | 650                                |     | 11               |   |
| Drawn/ground              | 0.6 - 3.0    | 950                         |     | 770                                |     | 10               |   |
|                           | > 3.0 - 5.0  | 950                         |     | 770                                |     | 10               |   |
|                           | > 5.0 - 10.0 | 850                         |     | 650                                |     | 11               |   |
| Annealed/ground           | 0.6 - 10.0   | < 800                       |     | 450                                |     | 25               |   |

<sup>1</sup> Nominal values. Other properties on request.

<sup>2</sup> Corresponds to 0.2 % proof strength.

<sup>3</sup> Rp0.2 and elongation values are given for information only.

### Physical Properties

\_ Density (annealed): 7.8 g/cm<sup>3</sup> , 0.28 lb/in<sup>3</sup>

\_ Resistivity: cold drawn: 670 μΩm

\_ Heat treated: 740 μΩm

### Thermal expansion<sup>1</sup>

| Temperature  | 20 - 100 | 20 - 200 | 20 - 300 |
|--------------|----------|----------|----------|
| Cold drawn   | 10.5     | 11.0     | 11.5     |
| Heat treated | 11.0     | 11.5     | 11.5     |

<sup>1</sup> Mean values in temperature ranges (x10<sup>-6</sup>)

4C27A 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 <sup>1</sup> |
|----------|-------------|--------------|------------------------|
| mm       | °C          | approx. min. |                        |
| < 6      | 1030 - 1050 | 3 - 6        | in oil at 50 °C        |
| > 6      | 1030 - 1050 | 6 - 10       | in oil at 50 °C        |

<sup>1</sup> Diameter < 2 mm may also be cooled in air or, to prevent oxidation, in a protective gas.

The smaller the dimensions, the shorter the soaking time. To prevent oxidation and decarburization, hardening should be carried out in a protective gas atmosphere using nitrogen, argon or vacuum.

### Tempering

- \_ Temperature 100 – 350 °C
- \_ Temperatures below 350 °C are recommended for the retention of favorable corrosion resistance.
- \_ Tempering time 30 - 60 min.

The core of the material should have a tempering time of at least 30 min. 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.

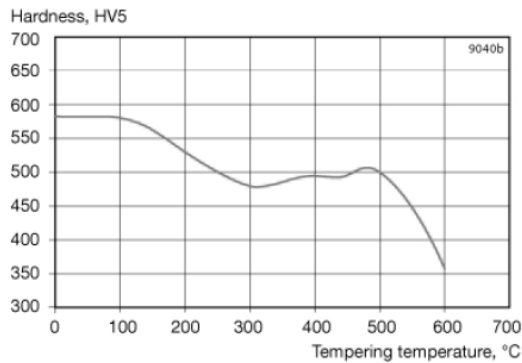


Figure 1. Hardness after recommended hardening procedures, valid for all dimensions. Soaking time 30 minutes.

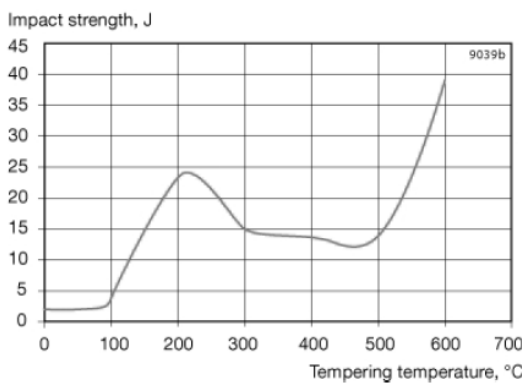


Figure 2. Hardness after recommended hardening procedures, valid for all dimensions. Soaking time 30 minutes. Standard Charpy V specimens at 20°C.

### Machining

The recommended values, based on cemented carbide cutting tools or high speed steel tools, 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 assume the use of a suitable cutting fluid. When machining without a cutting fluid, the values should be reduced by around 10 %. Detailed recommendations can be obtained from us.

### Turning

The charts below give guidance of how speed and feed affects 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. Brazed cemented carbide tools with the following data have been used: 310 L197-1212-200 grade H10F, rake angle 0°, clearance angle 6° and entering angle 90°.

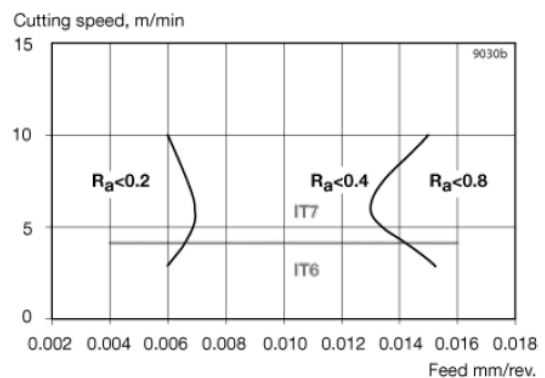


Figure 3. Wire diameter 1.00 mm, depth of cut between 0.15 - 0.25 mm. Brazed cemented carbide.

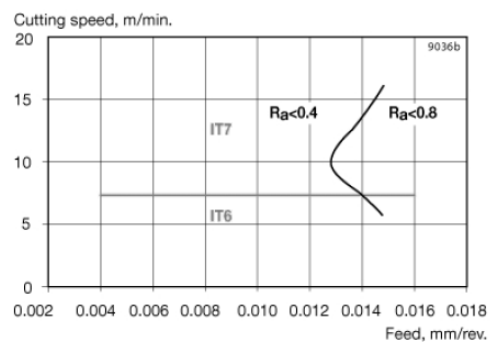


Figure 4. Wire diameter 2.00 mm, depth of cut between 0.30 - 0.50 mm. Brazed cemented carbide.

## CNC lathes and similar

Indexable insert tools. For diameters  $d < \text{approx. } 20 \text{ mm}$  lower cutting speeds should be used.

| Feed mm/rev. | Cutting speed m/min. |         |         |
|--------------|----------------------|---------|---------|
| -            | GT 4015              | CT 525  | GC 235  |
| -            | CT 5015              | GC 4015 | GC 4035 |
| 0.05         | 330                  | 250     | -       |
| 0.15         | 220                  | 210     | 200     |
| 0.5          | -                    | -       | 165     |

Longitudinal turning automatics, plunging automatics and similar machines:  
Diameter  $< \text{approx. } 10 \text{ mm}$

| Operation                      | Cutting depth<br>mm | Feed, mm/rev.               |              |                            |
|--------------------------------|---------------------|-----------------------------|--------------|----------------------------|
|                                |                     | Finish turning <sup>1</sup> | Medium       | Rough turning <sup>2</sup> |
| Single point turning           | $< 1$               | 0.005 - 0.01                | 0.01 - 0.015 | 0.025                      |
| Forming                        | 1 - 3               | 0.02                        | 0.03         | 0.05                       |
| Plunge cutting and parting off | $> 3$               | 0.01                        | 0.02         | 0.03                       |
|                                |                     | 0.005                       | 0.015        | 0.03                       |
|                                |                     | 0.01                        | 0.02         | 0.04                       |

<sup>1</sup> For parts requiring high precision.

<sup>2</sup> For parts with moderate tolerance requirements and parts that must subsequently be machined finished.

## Parting off and grooving

Parting off in CNC lathes and similar

| Tool         | Feed mm/rev. | Cutting speed m/mm. |
|--------------|--------------|---------------------|
| GC 235, 4025 | 0.05 - 0.15  | 80 - 160            |
| HSS          | 0.02 - 0.05  | 30 - 40             |

Bar automatics:

Diameter  $> \text{approx. } 2 \text{ mm}$

| Tool | Cutting speed m/min |
|------|---------------------|
| CC   | 45 - 60             |
| H2S  | 25 - 35             |

Single and multiple spindle automatic lathes:

Diameter  $> \text{approx. } 10 \text{ mm}$

| Operation                      | Feed mm/rev.   |               |
|--------------------------------|----------------|---------------|
|                                | Finish turning | Rough turning |
| 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   |

## Threading

| Tool                   | Grade  | Cutting speed m/mm. |
|------------------------|--------|---------------------|
| Threading dies         | HSS    | 1.5 - 3             |
| Self-opening die heads | HSS    | 2 - 5               |
| Thread chasers         | HSS    | 15 - 30             |
|                        | CC     | 90 - 150            |
| Thread rolling         | HSS    | 5 - 8               |
|                        | CC     | 8 - 10              |
| Thread turning         | GC1020 | 90 - 110            |

### Drilling

| Drill diameter, mm | Feed mm/rev. | Speed rpm |
|--------------------|--------------|-----------|
| 0.5                | 0.005        | 2500      |
| 1                  | 0.01         | 2200      |
| 3 <sup>1</sup>     | 0.03         | 1400      |
| 5 <sup>1</sup>     | 0.05         | 1100      |
| 8 <sup>1</sup>     | 0.07         | 800       |
| 10 <sup>1</sup>    | 0.09         | 700       |

<sup>1</sup> Cemented carbide drills of Delta type with the following data can also be used:

Grade GC1020, speed 70 - 110 m/min.

### Face milling

| Operation  | Grade      | Feed mm/tooth | Cutting speed m/min. |
|--|------------|---------------|----------------------|
| Finish milling with high cutting speed under favorable working conditions    | 530        | 0.1           | 170 - 210            |
|  | or<br>1025 | 0.2           | 150 - 190            |
| Finish and medium-rough milling under normal to difficult working conditions | 4030       | 0.1           | 150 - 180            |
|  | or<br>4040 | 0.2           | 120 - 150            |
| Medium-rough to rough milling under difficult conditions                     | SM30       | 0.1           | 110 - 130            |
|  | or<br>4040 | 0.2           | 100 - 110            |

### Endmilling

| Tool type                       | Grade CC | Cutting speed m/min. |
|---------------------------------|----------|----------------------|
| Indexable insert tools          | 530      | 240                  |
| Solid carbide end mills         | 1025     | 220                  |
| Brazed helical fluted end mills | 4040     | 160                  |
|                                 | GC1020   | 140                  |
|                                 | P40      | 55                   |

### Hobbing

| Tool | Cutting speed m/min. |
|------|----------------------|
| CC   | 25 - 50              |
| HSS  | 20 - 40              |

### Reaming:

Cutting speed for diameters > about 2 mm

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

### Feed

| Diameter mm | Feed mm/rev. | Allowance 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 are nominal. Values refer to 20°C unless otherwise stated.

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Last revision: January 2020