HPT GRADE CHAIN
CH0550, CBN060K, CH2540 & CH3515
Secomax™ HPT grade chain

Background

- PCBN machining is evolving and forcing the industry to develop new solutions
- Continued demand for productivity enhancing solutions
- Machining operations increasingly varied with both interrupted and continuous cutting
- New harder-to-machine workpiece materials being used (e.g. vacuum hardened, high chrome steels)
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Background – Workpiece materials

- Case hardened steels, SMG-H3
  - Low carbon steels for case hardening
    - 16MnCr5, 20MnCr5, 8620, etc.

- Quenched & tempered steels, SMG-H5
  - Medium carbon steels for induction hardening
    - 42CrMo4, 34CrNiMo6, etc.

- Quenched & tempered steels, bearing steels, SMG-H7
  - High carbon steels for through hardening
    - 100Cr6, etc.

- Tool steels, SMG-H8
  - Mainly for through hardening, hot work steels, cold work steels
    - X40CrMoV51, etc.
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Background – Components

Mainly components for the automotive segment (gearbox and transmission):

- Gears
- Shafts
- Rings
- Sleeves
- CV-joints
- Etc.

But also components for the bearing and mould and die segment:

- Bearing rings
- Rolls
- Punches
- Etc.
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Background – PCBN tools

1. Finer grain structures
2. Coatings
3. Changed binder type

Evolving situation
- Slower rate of performance improvement
- Lower differentiation amongst tool makers
- Finer grain sizes present new issues
  - Increased chemical reaction → crater wear
  - Lower edge strength → reduced performance in mixed operations
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The target

- To offer a complete chain of solutions for hard part turning
- Close gaps for existing grades
- Improve performance
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The target – ISO application areas

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The target – New naming structure

___ _ X X X X _ x

( _ = letter, x = digit)

- High/low cBN and generation
- Coating code
- ISO area
- Main SMG
- Insert material
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The target – New naming structure

__ X X X X __ ( _ = letter, x = digit )

- High/low cBN and generation
- Coating code
- ISO area
- Main SMG
- Insert material

Insert material
- C = PCBN
- D = PCD (Not yet decided)
- S = Sialon (Not yet decided)
- W = Whisker reinforced ceramic (Not yet decided)
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The target – New naming structure

\[ \underline{\_ \_ \ X \ X \ X \ X} \quad (\_ = \text{letter, } x = \text{digit}) \]

- High/low cBN and generation
- Coating code
- ISO area
- Main SMG
- Insert material

H, K, etc.
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The target – New naming structure

__ __ XXXX ( _ = letter, x = digit )

- High/low cBN and generation
- Coating code
- ISO area
- Main SMG
- Insert material
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The target – New naming structure

___ X X X X X ( _ = letter, x = digit )

- High/low cBN and generation
- Coating code
- ISO area
- Main SMG
- Insert material

0 = uncoated
1 = P
4 = C
5 = X, new nanolaminate
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The target – New naming structure

X X X X ( _ = letter, x = digit )

- High/low cBN and generation
- Coating code
- ISO area
- Main SMG
- Insert material

0-4 Low cBN
5-9 High cBN
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The target – Complete chain

Wear resistance, speed capability

H05  H15  H25  H35

CH0550

CH15x0

CBN060K

CH2540

CH3515
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The target

**CH0550**

- Continuous machining in hardened steels, < 65 HRc
- Solid format
- High precision finishing
- High speed capability (up to 300 m/min)
- High crater wear resistance
- > 25% improvement in tool life over competition
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The target

**CH2540**

- Interrupted machining in hardened steels, < 65 HRc
- Solid format
- Improved tool life compared to CBN160C
  - Toughness
  - Wear resistance
- Increased working window (speed & feed)
- Improved performance in mixed applications
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The target

**CH3515**

- Heavy interrupted machining in hardened steels, < 65 HRc
- Outstanding tool life compared to competition
  - Toughness
  - Wear resistance
- Cutting speeds up to 200 m/min
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The Solution – Substrate

New grades based on mix of fine and coarse cBN grains instead of uniform fine sizes...

... resulting in improvements in three areas

1. A stronger binder and reduced crater wear
2. A stronger PCBN less prone to chipping
3. Improved thermal stress management
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The Solution – Substrate

Material property: stronger CBN binder interface

- Fine grain PCBN
- Bimodal PCBN

Weaker interface makes up large share of total material content
Weaker interface makes up smaller share of total material content

Real life benefit: improved performance in continuous and light interrupted machining
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The Solution – Substrate

Material property:
Bimodal grain sizes cause cracks to deflect

Result:
Less chipping

Real life benefit: improved performance in interrupted machining
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The Solution - Coatings

- Extensive knowledge and experience regarding coatings at Seco
  - Carbide and PCBN

- Four PCBN unique PVD coatings
  - Optimized for maximum adhesion on PCBN
  - Three are patented or patent pending
  - Two based on patented nanolaminate technology
  - Use of the latest PVD coating technology available

- Extensive knowledge and experience regarding coatings at Seco
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(Ti, Al, Cr)N, nanolaminate (Patent pending)

(Ti, Al)N

(Ti, Al, Si)N, nanolaminate (Patented)

(Ti, Si)N (Patented)
Secomax™ HPT grade chain
The Solution - Coatings
Nanolaminate

- Multiple ultra thin layers stacked on top of each other
- Improves
  - Thermal stability
  - Wear resistance
  - Toughness

~7 nm layer thickness
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The Product

- Grade overview
  - Composition
  - Edge preparations
  - Available formats
The Product

Composition
- 40% cBN
- 1 + 6-7 µm grain size, average 3 µm
- Ti(C,N) binder
- (Ti,Al,Cr)N nanolaminate coating

Edge preparations
- S-01525
  - 0.15x25°, 15 µm hone
- S-01015
  - 0.10x15°, 15 µm hone

Available formats
- Solid
- Brazed tips (single & double sided)
CBN060K
The Product

Composition
- 60% cBN
- 1-2 µm grain size
- Ti(C,N) binder + super alloy
- (Ti,Al,Si)N nanolaminate coating

Edge preparations
- S-01525
  - 0.15x25°, 15 µm hone

Available formats
- Solid
- Brazed tips (single & double sided)
CH2540

The Product

Composition
- 65% cBN
- 1 + 15 µm grain size, average 6 µm
- Ti(C,N) binder
- (Ti,Si)N coating

Edge preparations
- S-01525
  - 0.15x25°, 30 µm hone

Available formats
- Solid
- Brazed tips (single & double sided)
CH3515
The Product

Composition
- 90% cBN
- Average grain size 4 µm
- AlN binder
- (Ti,Al)N coating

Edge preparations
- S-02020
  - 0.20x20°, 30 µm hone
- S-00540
  - 0.05x40°, 30 µm hone

Available formats
- Full-faced layer
- Brazed tips (single sided)
### Secomax™ HPT grade chain

Edge preparations

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Several standard options

- Possibilities to optimise, based on:
  - Operation
  - Level of interruption
  - Material
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Application strategies

Scenario: H05
Competitor H05 without wiper, applied at 200 m/min cutting speed, 0.12 mm/rev feed and 0.1 mm depth of cut. Operation is continuous cut.

Possible strategy options:
- Round inserts, CH0550
- Other solid insert with wiper, CH0550
- Same insert geometry, CH0550 with wiper
- CH0550 at 15-20% higher cutting speed
- CBN060K with reduced speed if needed, increased feed, preferable in combination with a wiper
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Application strategies

Scenario: H15
Competitor H15 without wiper, applied at 180 m/min cutting speed, 0.1 mm/rev feed and 0.15 mm depth of cut. Operation is continuous cut with some light interruptions.

Possible strategy options:

- Round inserts, CBN060K
- Other solid insert with wiper, CBN060K
- Same insert geometry, CBN060K with wiper
- CH0550 at 15-20% higher cutting speed
- CH2540 with reduced speed, if needed, increased feed, preferable in combination with a wiper
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Application strategies

Scenario: H25
Competitor H25 without wiper, applied at 160 m/min cutting speed, 0.15 mm/rev feed and 0.15 mm depth of cut. Operation is continuous cut with some medium interruptions.

Possible strategy options:
- Round inserts, CH2540
- Same insert geometry, CH2540 with wiper
- CBN060K at 15-20% higher cutting speed
- If chipping or edge breakage, use CH3515 with the same speed and, if possible, increase feed
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Application strategies

**Scenario: H35**
Competitor H35 without wiper, applied at 140 m/min cutting speed, 0.12 mm/rev feed and 0.15 mm depth of cut. Operation is continuous cut with heavy interruptions.

**Possible strategy options:**
- Apply a round insert in CH3515
- Same insert geometry in CH3515 (limited standard range)
- Similar insert geometry in CH3515 (limited standard range)
- Use CH2540 at 15-20% higher cutting speed, reduce feed 15-20% and keep depth of cut. Evaluate the wear before further actions.
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The Product Program

**CH0550**

Designation
- CCGW060208S-01525-L1-B
- CCGW09T308S-01525-L1-B
- CNGA120408S-01525-L1-B
- RNGN060300S-01525-L1-B
- VNGA160402S-01525-L1-B

**CH2540**

Designation
- CCGW060208S-01525-L1-B
- CCGW09T308S-01525-L1-B
- CNGA120408S-01525-L1-B
- RNGN060300S-01525-L1-B
- VNGA160402S-01525-L1-B

**CH3515**

Designation
- CNGA09T304S-01525-L1-B
- CNGA120412S-01525-L1-B
- CNGA120412S-01525-L1-B
- DNGA150408S-01525-L1-B
- DNGA150412S-01525-L1-B
- DNGA150604S-01525-L1-B
- DNGA150608S-01525-L1-B
- RNGN060300S-01525-L1-B
- RNGN090300S-01525-L1-B
- TNGA060402S-01525-L1-B
- TNGA060404S-01525-L1-B
- TNGA060408S-01525-L1-B
- VNGA160402S-01525-L1-B
- VNGA160404S-01525-L1-B
- VNGA160408S-01525-L1-B

New additions based on market input

Designation including grade
- CCGW060208S-L1-WZP-B, CH0550
- CCGW09T308S-L1-WZP-B, CH0550
- CNGA120412S-01525-L1-WZ-B, CH0550
- RNGN060300S-01525-L1-WF, CH0550
- TNGA160416S-00540-L1-C
- TNGA160420S-00540-L1-C

Steps:
- CH0550: 2016-Q1
- CH2540: 2016-Q1 & 2016-Q2 (Highest sales prognosis in Q1)
- CH3515: 2016-Q1

Additions: Released for sale as soon as possible
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Application examples – CH0550

Workpiece
Component: Pinion gear shaft
Material: 25MoCr4E, case hardened, SMG-H3
Hardness: 58-64 HRc
Surface: Pre-machined

Conditions
Operation: OD turning, continuous cut
Insert: DNGA150612S-01525-L1-B
Cutting length: 26 mm
Coolant: No
Cutting speed: 260 m/min
Feed rate: 0.15 mm/rev
Depth of cut: 0.20 mm

Result
CBN060K, 80 parts/edge (70 min)
CH0550, 160 parts/edge (140 min)
Secomax™ HPT grade chain
Application examples – CH0550

Workpiece
Component: Pinion gear shaft
Material: 20MnCr5S, SMG-H3
Hardness: 57-62 HRc
Surface: Pre-machined
Tool life crit.: Rz 4.0 µm

Conditions
Operation: OD turning & facing, continuous cut
Insert: CNGA120408S-01525-L1-WZ-B
Cutting length: 28 mm
Coolant: No
Cutting speed: 160 m/min
Feed rate: 0.30 mm/rev, OD
           0.25 mm/rev, facing
Depth of cut: 0.20 mm

Result
Competitor, 150 parts/edge
CH0550, 210 parts/edge
Secomax™ HPT grade chain
Application examples – CH0550

Workpiece
Component: CV-Joint
Material: SAE 1050M, SMG-H5
Hardness: 60-62 HRc

Conditions
Operation: OD facing, continuous cut, Ø68.4 mm to Ø45.1 mm
Insert: TNGA160412S30-01020
Cutting length: 11.7 mm
Coolant: No
Cutting speed: 150 m/min
Feed rate: 0.15 mm/rev
Depth of cut: 0.25 mm

Result
TNGA160412S30-01020-L1-V, CBN010C, 700 parts/edge
TNGA160412S30-01020-L1-C, CH0550, 1000 parts/edge
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Application examples – CH0550

Workpiece
Component: Output shaft
Material: SAE 1050M, SMG-H5
Hardness: 58-64 HRc
Surface: Pre-machined

Conditions
Operation: OD turning, continuous cut, Ø54 mm
Insert: DNGA150408S-01525-L1-U
Tool holder: DDJNL2525M15
Cutting length: 89 mm
Coolant: No
Cutting speed: 285 m/min
Feed rate: 0.13 mm/rev
Depth of cut: 0.38 mm

Result
CBN010, 125 parts/edge
CH0550, 195 parts/edge
Secomax™ HPT grade chain
Application examples – CH0550

Workpiece
Component: Cam
Material: 100Cr6, SMG-H7
Hardness: 60 HRc
Tool life crit. Rz 6.3 µm

Conditions
Operation: ID turning
Insert: TCGW110208S-xxxxx-L1-C
Tool holder Boring bar, Densimet, D = 20 mm; l = 90 mm
Cutting length: 7.6 mm
Coolant: Yes (for chip evacuation)
Cutting speed: 143 m/min
Feed rate: 0.15 mm/rev
Depth of cut: 0.15 mm

Result
CH0550, 2000 parts/edge (S-01015)
CBN010, 1000 parts/edge (S-01020)
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Application examples – CH0550

Workpiece
Component: Pinion gear shaft
Material: 25MoCr4E, case hardened, SMG-H3
Hardness: 58-64 HRc
Surface: Pre-machined

Conditions
Operation: OD turning, continuous cut, Ø80 mm
Insert: TNGX110308S-01525-WZ
Tool holder: CTJNR2525M11
Cutting length: 50 mm
Coolant: No
Depth of cut: 0.26 mm
Cutting speed: 180 m/min
Feed rate: 0.2 mm/rev

Result
CBN060K, 40 parts/edge, (10.8 min)
CH0550, 60 parts/edge, (16.2 min)
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Application examples – CH0550

Workpiece
Component: Gear wheel
Material: 16MnCr5, SMG-H3
Hardness: 59-62 HRc
Surface: Forging skin (blasted)
Tool life crit. Rt, max = 0.8 µm

Conditions
Operation: ID turning, interruption, keyway, Ø24 mm, length 40 mm
Insert: CCGW060208S30-L1-WZP-B
Tool holder: Capto C5 / vibration-damped by Densimet
Coolant: No
Cutting speed: 120 m/min
Feed rate: 0.065 mm/rev
Depth of cut: 0.1 mm

Result
CBN150C, 350 parts/edge, (122 min)
CH0550, 560 parts/edge, (195 min)
Secomax™ HPT grade chain

Application examples – CH0550

**Workpiece**
- **Component:** Gear wheel
- **Material:** 20MnCr5S, SMG-H3
- **Hardness:** 60-62 HRc
- **Surface:** Black
- **Tool life crit.:** Rz 3 µm

**Conditions**
- **Operation:** ID turning, continuous
- **Insert:** CCGW09T308-M2, Competitor
  - CCGW09T304S-01525-L1-B, CH0550
- **Coolant:** Yes
- **Cutting speed:** 150 m/min
- **Feed rate:** 0.075 mm/rev
- **Depth of cut:** 0.10-0.15 mm

**Result**
- Competitor 80 parts/edge
- CCGW09T308S-01525-L1-B, CH0550, 74 parts/edge
- Increase speed to 170 m/min (+13%), 85 parts/edge
- Increase feed rate to 0.1 mm/rev (+33%), use WZ, CCGW09T304S-01525-L1-WZ-B, CH0550, 120 parts/edge

+50% productivity!
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Application examples – CBN060K

Workpiece
Component: Pinion
Material: Case hardened steel, SMG-H3
Hardness: 60-62 HRc
Surface: Pre-machined
Tool life crit. Ra

Conditions
Operation: OD turning, continuous
Insert: VNGA160408S-01525-L1-U
Coolant: No
Cutting speed: 130 m/min
Feed rate: 0.10 mm/rev
Depth of cut: 0.25 mm

Result
Competitor, 200 parts/edge
CBN060K, 315 parts/edge
Secomax™ HPT grade chain

Application examples – CBN060K

Workpiece
Component: Gear wheel
Material: 25MnCr4, SMG-H3
Hardness: 58-62 HRc
Surface: Pre-machined
Tool life crit. Ra

Conditions
Operation: ID turning, continuous
Insert: TNGA160408, Competitor
Coolant: Yes
Cutting speed: 240 m/min
Feed rate: 0.10 mm/rev
Depth of cut: 0.15 mm

Result
Competitor, 400 parts/edge
CBN060K, 600 parts/edge
Secomax™ HPT grade chain
Application examples – CBN060K

Workpiece
Component: Shaft
Material: 42CrMo4, Induction hardened, SMG-H5
Hardness: 56 HRc
Surface: Pre-machined
Tool life crit. Ra

Conditions
Operation: OD turning, hard and soft with interruption in beginning and a hole in the middle, Ø 114.2 Length 472 mm
Insert: CNGM120408S-01525-L1-WZ-B CBN060K
Coolant: Yes
Cutting speed: 160 m/min 180 m/min
Feed rate: 0.22 mm/rev
Depth of cut: 0.30 mm 0.08 mm

Result
Competitor without chip breaker, 40 min/edge. No chip control
CBN060K, 45 min/edge. Good chip control.
Secomax™ HPT grade chain

Application examples – CBN060K

Workpiece
Component: Gear wheel
Material: 16MnCr5, SMG-H3
Hardness: 58-62 HRc
Surface: Black
Tool life crit. Ra

Conditions
Operation: ID turning, continuous
Insert: TNGA160408S01225ME, Competitor TNGX110308S-01525-WZ, CBN060K
Coolant: Yes
Cutting speed: 200 m/min 180 m/min
Feed rate: 0.20 mm/rev 0.38 mm/rev
Depth of cut: 0.03 mm

Result
Competitor, 1000 parts/edge
CBN060K, 1200 parts/edge, Tool life +20% and productivity +71%
Secomax™ HPT grade chain

Application examples – CBN060K

Workpiece
Component: Gear wheel
Material: Case hardened SS2158, SMG-H3
Hardness: 60-62 HRc
Surface: Pre-machined
Tool life crit. Ra

Conditions
Operation: Semi-finishing, ID turning, continuous, Ø46 mm
Length: 63 mm
Insert: RNGN0903005-01525
Coolant: No

CBN060K
Cutting speed: 180 m/min
Feed rate: 0.62 mm/rev
Depth of cut: 0.10-0.15 mm

CBN050C
Cutting speed: 200 m/min
Feed rate: 0.43 mm/rev

Result
CBN050C, 450 parts/edge
CBN060K, 500 parts/edge, +30% productivity
Workpiece
Component: Gear wheel
Material: 20MnCr5S, SMG-H3
Hardness: 63 HRc
Surface: Pre-machined

Conditions
Operations: ID Turning Ø180, length 17 mm (2 passes)
Facing Ø124 – Ø178
Insert: DNGA150408S-01525-L1-B
Coolant: No
Facing ID
Cutting speed: 180 m/min 200 m/min
Feed rate: 0.15 mm/rev 0.16 mm/rev
Depth of cut: 0.15 mm 0.05-0.15 mm

Result
CBN160C, 60 parts/edge, (57 min)
CH2540, 80 parts/edge, (76 min), no catastrophic failures anymore.
Secomax™ HPT grade chain
Application examples – CH2540

Workpiece
Component: Pinion gear
Material: 8620, SMG-H3
Hardness: 60-65 HRc (in soft, down to 40 HRc)
Surface: Pre-machined
Tool life crit.: Ra

Conditions
Operation: OD turning, Continuous hard/soft, roughing
Interrupted, finishing
Insert: DNGA150408S-01525-L1-B
Coolant: No
Roughing Finishing
Cutting speed: 120 m/min 120 m/min
Feed rate: 0.35 mm/rev 0.13 mm/rev
Depth of cut: 0.35 mm 0.10 mm

Result
CBN060K, 35 parts/edge
CH2540, 58 parts/edge
Secomax™ HPT grade chain

Application examples – CH2540

Workpiece
Component: Gear wheel
Material: 16MnCr5, case hardened, SMG-H3
Hardness: 58-60 HRc
Surface: Pre-machined

Conditions
Operation: Finishing, partly interrupted
ID turning Ø52.5 mm, 4 non chamfered holes, diam. 2 mm
Length: 24.35 mm
Insert CCGW09T308S15-L1-WZP-B (edge honed 15 µm)
Coolant: No
Cutting speed: 187 m/min
Feed rate: 0.22 mm/rev cont. cut, 0.08 mm/rev int. cut
Depth of cut: 0.10 mm

Result
CBN060K, average 210 parts/edge
CH2540, 300 parts/edge - No sudden edge breakage
Secomax™ HPT grade chain
Application examples – CH2540

Workpiece
Component: Gear wheel
Material: 16MnCr5, SMG-H3
Hardness: 58-60 HRc
Surface: Pre-machined
Tool life crit.: Ra

Conditions
Operation: Facing, interrupted + continuous
Insert: CCGW09T308S-01525-L1-B
Coolant: No
Cutting speed: 150 m/min
Feed rate: 0.12 mm/rev
Depth of cut: 0.15 mm

Result
Competitor, 270 parts/edge
CH2540, 360 parts/edge
Secomax™ HPT grade chain

Application examples – CH3515

**Workpiece**
- Component: CV-Joint
- Material: Cf53, SMG-H5
- Hardness: 60-62 HRc
- Surface: Black

**Conditions**
- Operation: ID Turning (Heavy interrupted cut), D = 74.72 mm
- Cutting length: 35 mm
- Insert: TNGA160416
- Coolant: No
- Cutting speed: 180 m/min
- Feed rate: 0.16 mm/rev
- Time in cut: 0.32 min/part
- Depth of cut: 0.20 mm

**Result**
- TNGA160416, Competitor, 550 parts/edge
- TNGA160416S30-00540-L1-C, CH3515, 1150 parts/edge
Secomax™ HPT grade chain
Application examples – CH3515

Workpiece
Component: CV-Joint
Material: SAE1050M, SMG-H5
Hardness: 60-62 HRc

Conditions
Operation: ID Turning - Heavy interrupted cut, Di = 73,74 mm
Cutting length: 29 mm
Insert: TNGA1604..
Coolant: No

Competitor
CH3515
Cutting speed: 155 mm/min 180 mm/min
Feed rate: 0.17 mm/rev 0.20 mm/rev
Depth of cut: 0.10 – 0.20 mm

Result
6NCTNGA160412T00545, Competitor, 1100 parts/edge
TNGA160420S-00540-L1-C, CH3515, 1250 parts/edge
Secomax™ HPT grade chain
Application examples – CH3515

Workpiece
Component: Gear shaft
Material: Customer specific, case hardened steel, SMG-H3
Hardness: 60-63 HRC
Surface: Pre-machined

Conditions
Operation: OD turning, Heavy interruptions + continuous with hole
Insert: CNGA120412S01030AWH, Competitor
CNGA120412S-02020-L1-B, CH3515
Cutting length: 112 mm (84 mm heavy interruptions)
Coolant: No
Cutting speed: 160 m/min
Feed rate: 0.25 mm/rev
Depth of cut: 0.25 mm
TIC: 38s

Result
Competitor, 12 parts/edge
CH3515, 45 parts/edge
Secomax™ HPT grade chain

Application examples – CH3515

Workpiece
Component: CV-Joint
Material: 8620, SMG-H3
Hardness: 58-62 HRc
Surface: Pre-machined

Conditions
Operation: ID Turning (Heavy interrupted cut), Di = 74.72 mm
Cutting length: 35 mm/part
Insert: SNGA 120412
Coolant: No
Cutting speed: 180 m/min
Feed rate: 0.16 mm/rev
Depth of cut: 0.20 mm

Result
SNGA 120412, Competitor, 1000 parts/edge
SNGA 120412S-00540-L1-D, CH3515, 1150 parts/edge
Secomax™ HPT grade chain

Application examples – CH3515

Workpiece
Component: Gear
Material: 20MnCr5, SMG-H3
Hardness: 60-62 HRc
Surface: Pre-machined

Conditions
Operation: Facing of gear teeth, heavy interruptions
Cutting length: 12 mm
Insert: CNGA120412S-02020-L1-B
Coolant: No
Cutting speed: 180 m/min
Feed rate: 0.06 mm/rev
Depth of cut: 0.10 mm
Time in cut: 20s

Result
CH3515, 100 parts/edge,
40s saved per produced part compared to grinding