

# BÖHLER Tool Steels for thin sheet forming

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JYVÄSKYLÄ, Finland 26.Jan 2023

- Successful Application – K390 PM in comparison with D2/ 1.2379
- Successful Application – K340 ID in comparison with D2/ 1.2379
- Wear and Defects on cold work application
- Technical Data

- Successful Application – K390 PM in comparison with D2/1.2379

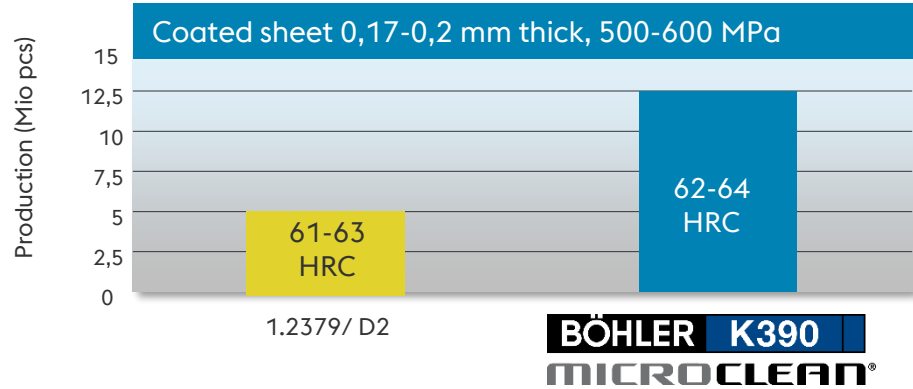
# K390 MICROCLEAN®



## Successful Application – Deep Drawing of clamping rings for paint cans



Failure Mode: Wear, Chipping



**SAVE 13.000 Euro  
using**



# K390 MICROCLEAN®



## Successful Application – Deep Drawing of clamping rings for paint cans

Tooling cost 1.2379/ D2 6270 Euro\*  
Tool life PM 2053 5.000 KPcs  
Number of Pcs. Produced 20.000KPcs  
Cost :  
 $6270/5.000.000*20.000.000= 25080\text{Euro}$

Tooling cost K390PM 7320 Euro\*  
Tool life K390PM 12.500KPcs  
Number of Pcs. Produced 20.000KPcs  
Cost :  
 $7320/12.500.000*20.000.000= 11712\text{Euro}$

**SAVE 13368 Euro!!**  
**Client loose 334 Euro per week not using**



\* Set of tool

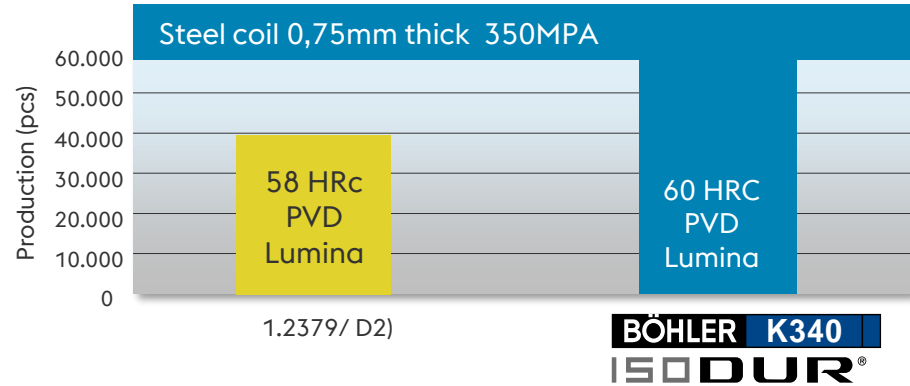
- Successful Application – K340 in comparison with 1.2379/ D2

# K340 ISODUR

## Successful Application – Deep Drawing Automotive Part



Failure Mode: Fatigue, Chipping



**SAVE 23.00 Euro**  
using

**BÖHLER K340**  
**ISODUR®**

# K340 ISODUR®



## Successful Application – Deep Drawing Automotive Part

Tooling cost 1.2379/ D2 1990 Euro

Tool life 40.000 Pcs

Number of Pcs. Produced 500KPcs

Cost :

$1990/40.000*500.000= 24875$  Euro

Tooling cost K340 2700 Euro

Tool life K340 60.000 Pcs

Number of Pcs. Produced 500KPcs

Cost :

$2700/60.000*500.000= 22500$  Euro

**SAVE 2375 Euro!!**

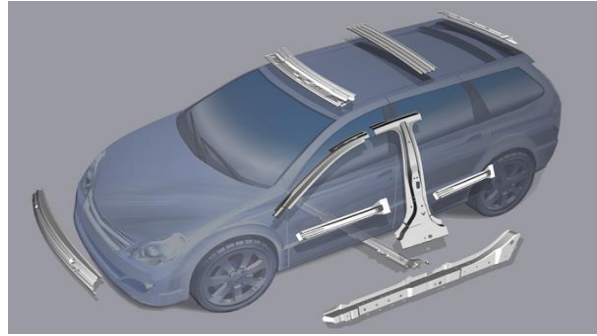
**BÖHLER K340**  
**ISODUR®**



- Successful Application – K340 ID

# Bohler K340 ISODUR®

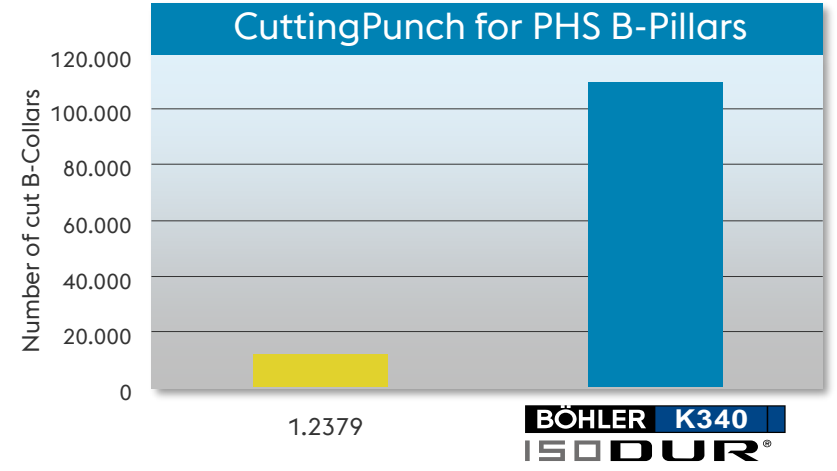
## Cutting Punch for PHS B-Pillars



**Material processed:**  
PHS -Steel 22MnB5,  
Rm ~ 1500 Mpa

Thickness: 1,25mm

**Failure Mode:**  
Overload and Chipping at Cutting  
Edge

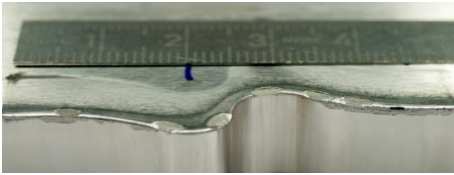


**SAVE 14.000 Euro**  
using



# Bohler K340 ISODUR®

## Cutting Punch for PHS B-Pillars



1.2379 defects

Tooling cost 1.2379      400 Euro  
Tool life 1.2379      12.000 Pcs  
Number of Pcs. Produced 500K Pcs  
Cost :  
 $400/12.000 * 500.000 = 16.667$  Euro

Tooling cost K340      510 Euro  
Tool life K340      110.000 Pcs  
Number of Pcs. Produced 500K Pcs  
Cost :  
 $510/110.000 * 500.000 = 2318$  Euro

**SAVE 14.349 Euro!!**  
**Client loose 502 Euro per week not using**



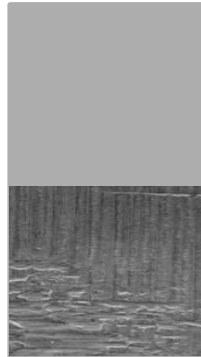
- Wear and Defects on cold work application

# Wear and defects in Cold work application

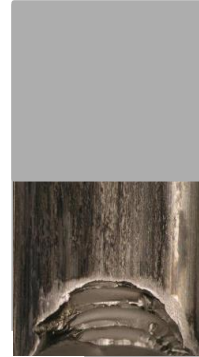
Abrasive wear



Adhesive wear



Fatigue



Surface defect

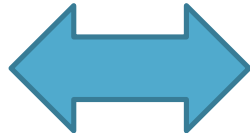


# "FROM HARM COMES WISDOM"

**Failure-  
mechanism**



**optimal tool steel**



### Abrasive wear

Cutting edge:  
Erosion of the  
Matrix

### Adhesive wear

Material transfer-  
Cold welding

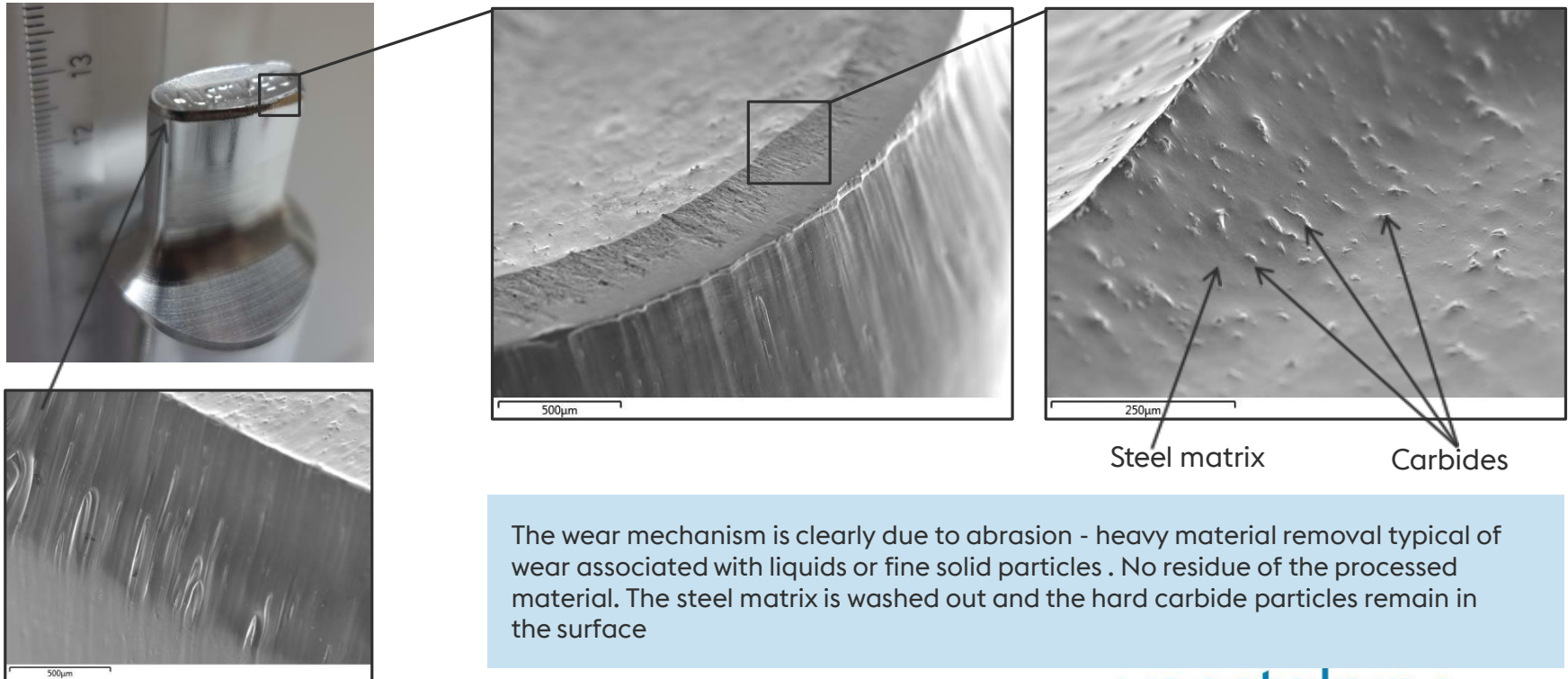
### Fatigue

Cracking and propagation due to  
cyclic loading

### Fractures & cracks

(EDM layers, deformation of hard  
machining, notches, .....)

# ABRASIVE WEAR



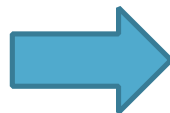
The wear mechanism is clearly due to abrasion - heavy material removal typical of wear associated with liquids or fine solid particles . No residue of the processed material. The steel matrix is washed out and the hard carbide particles remain in the surface

## Abrasive wear

Erosion of the matrix

## Adhesive wear

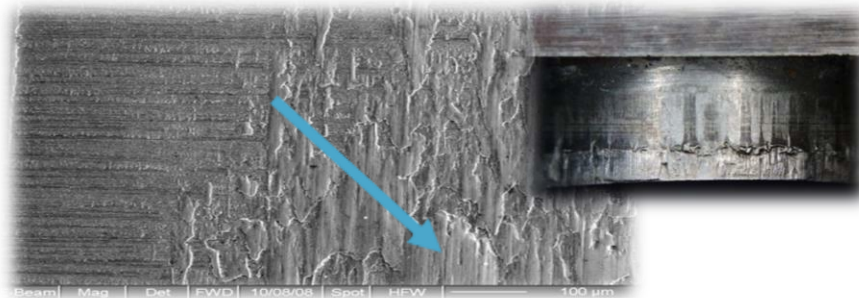
Local cold welding,  
Material transfer  
Tribooxidation  
(insufficient coating)



## Fatigue

Surface disruption,  
Plastic deformation  
Fatigue crack initiation and  
crack growth

- » Coating (DLC, TiCN, TiAlCN)
- » High strength matrix
- » High hard phase content  
(minimum spacing, fine particles,  
uniform distribution) PM steels!
- » Al additive  
(Böhler K340, ISODUR)

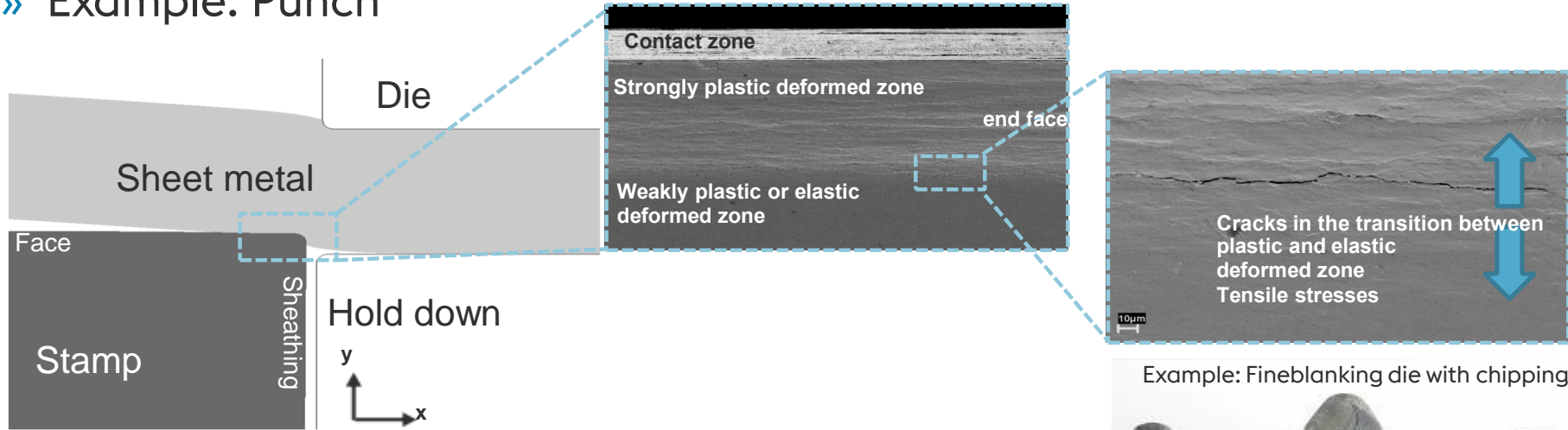


Transferred material



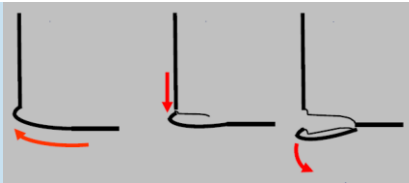
# MATERIAL FATIGUE

## » Example: Punch



### Fatigue

Surface disruption and plastic deformation  
Fatigue crack initiation and crack growth  
spalling



Example: Fineblanking die with chipping



voestalpine

ONE STEP AHEAD.

# Fatigue Resistance

## Effects of Surface Quality

Affecting of the surface by EDM - Processes

“Roughing and fine cuts”

Source: AGIE

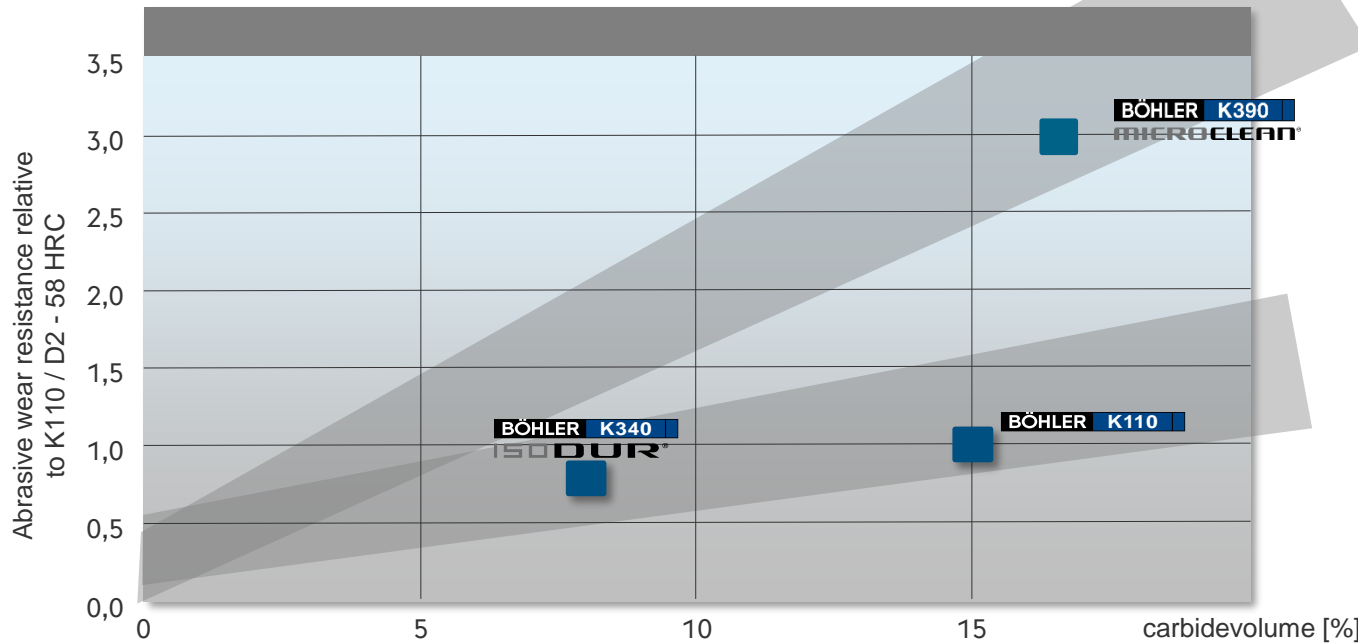


- Technical Data

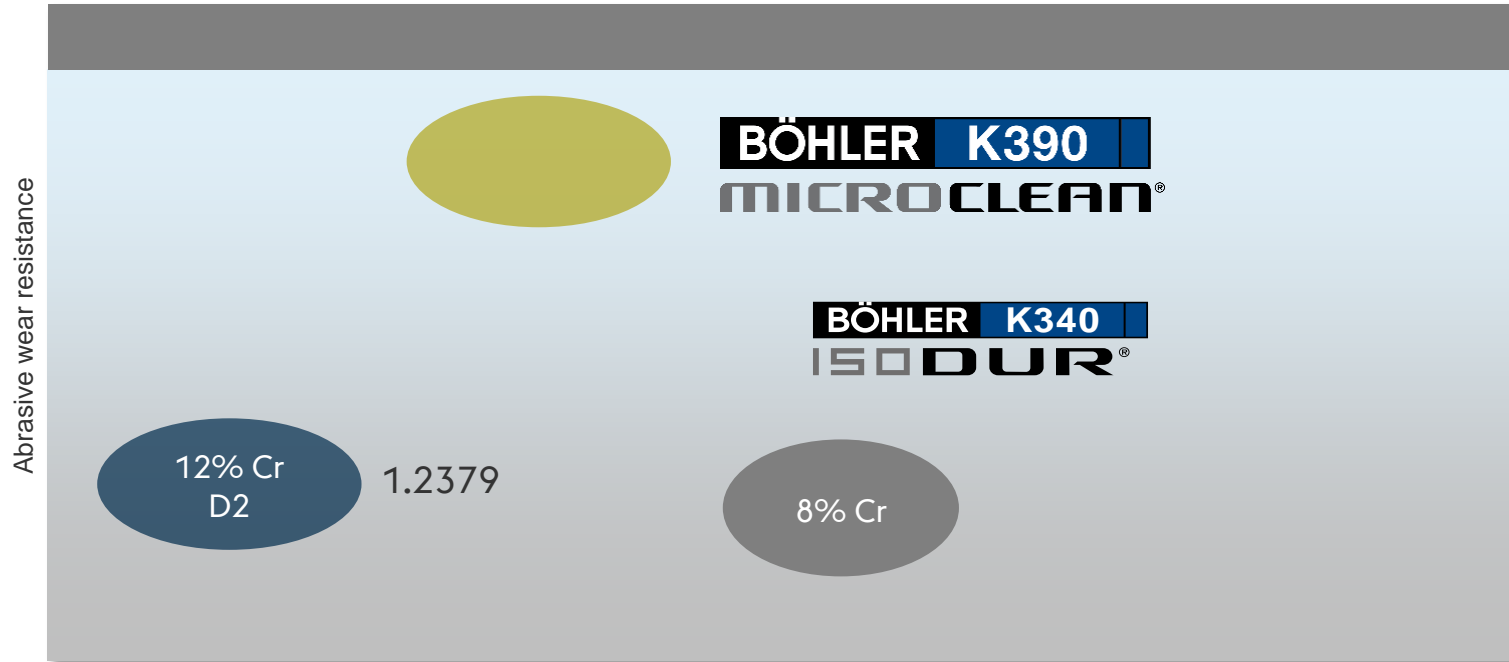
# WEAR RESISTANCE



## ASTM G65 rubber wheel-dry sand test

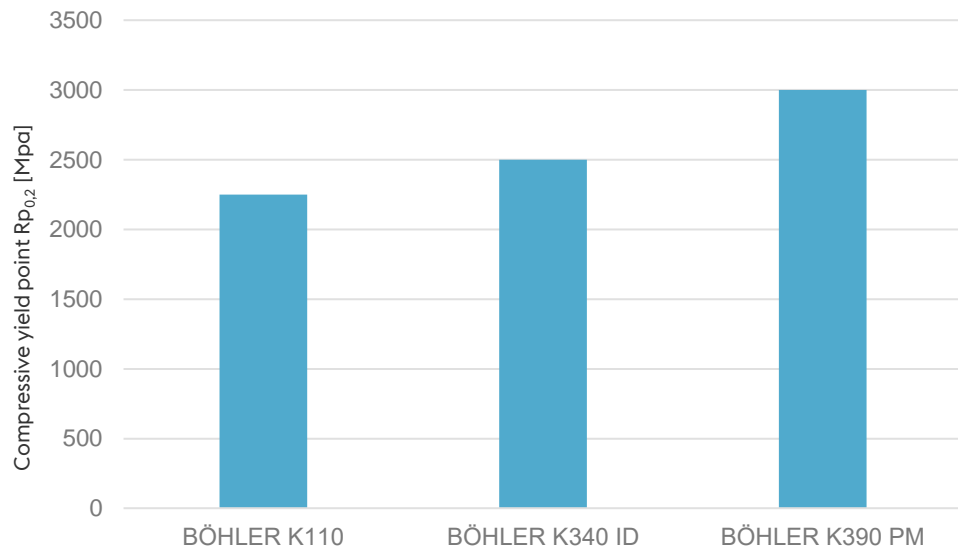


# Wear Resistance/ Toughness



# Fatigue Strength

Directe correlation between Compressive Strength and Fatigue Strength



Compressive Strength of Tool steels acc. to DIN 50106

Cylindrical specimen with Height/Diameter Ratio of 1,5

- Decision Tree

# » Coldwork Applications for thin sheet forming

## Punching, fine blanking, punching, cutting, .....



High performance  
PM tool steels

**BÖHLER K390**  
**MICROCLEAN®**

Highest wear  
resistance &  
compressive strength

Standard - PM tool steels

**BÖHLER K490**  
**MICROCLEAN®**

Best combination of wear resistance  
toughness and flexibility in WZ  
construction (e.g. WBH)

ESR grades

**BÖHLER K340**  
**ISODUR®**

Higher toughness with similar wear  
resistance (D2)

Standard  
Cold Work Steel

**BÖHLER K110**  
1.2379 / D2 / X153CrMoV12

voestalpine BÖHLER Edelstahl GmbH & Co KG

voestalpine



# Thank you / Kiitos / Danke

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**voestalpine High Performance Metals International**  
<http://www.bohler.at/export/en/>

**voestalpine**  
ONE STEP AHEAD.

**BÖHLER** **K110**

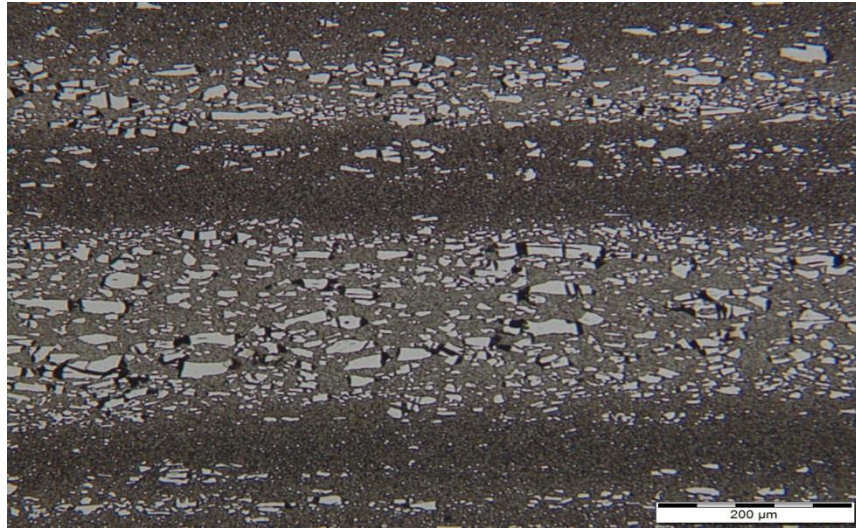
# Tool steel for „Nothing“ - but your risks for free!

Praxis Example: Punch made from Standard 1.2379 versus Böhler K110

Start material: rund 33 mm



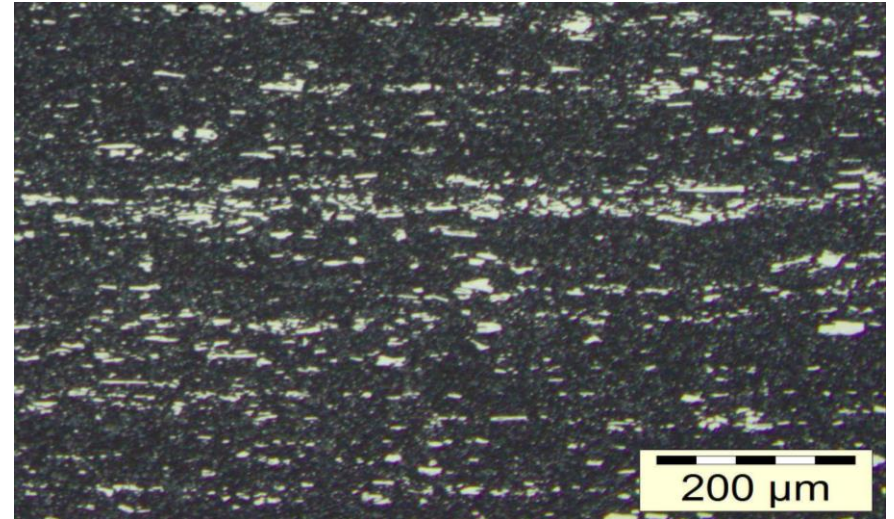
## Standard Grade 1.2379



Direction: Longitudinal

Magnification: x 100

BÖHLER K110



Direction: Longitudinal

Magnification: x 100

# Standard Grade 1.2379

# BÖHLER K110

<b>C 1,48 %</b>	→	<b>C 1,55 %</b>
Si ~ 0,3 %		Si ~ 0,3 %
Mn ~ 0,2 %		Mn ~ 0,5 %
P ~ 0,02 %		P ~ 0,02 %
<b>S 0,0029 %</b>	→	<b>S 0,0005 %</b>
Cr ~ 11,0 %		Cr ~ 11,3 %
<b>Mo ~ 0,6 %</b>	→	<b>Mo ~ 0,7 %</b>
<b>Ni ~ 0,2 %</b>	→	<b>Ni ~ 0,3 %</b>
V ~ 0,7 %		V ~ 0,7 %
W ~ < 0,1 %		W ~ 0,2 %
Cu ~ < 0,1 %		Cu ~ 0,1 %
Co ~ < 0,1 %		Co ~ < 0,1 %
Ti ~ < 0,1 %		Ti ~ < 0,1 %
Al ~ < 0,1 %		Al ~ < 0,1 %
Nb ~ < 0,1 %		Nb ~ < 0,1 %
B ~ < 0,001 %		B ~ < 0,001 %



## Standard Grade 1.2379

## BÖHLER K110

Origin	???
Mill standards	???
Certificate	???
Volatile quality	???
Machining behavior	???
Cleanliness	???
Carbide grain size	???
Carbide distribution	???
Behavior in heat treatment	???
Behavior surface treatment	???
Local service package	???
Technical support	???
After – sales service	???
Claim handling	???
Price competitive	YES
<b>Risk for the tool maker/user</b>	<b>YES</b>

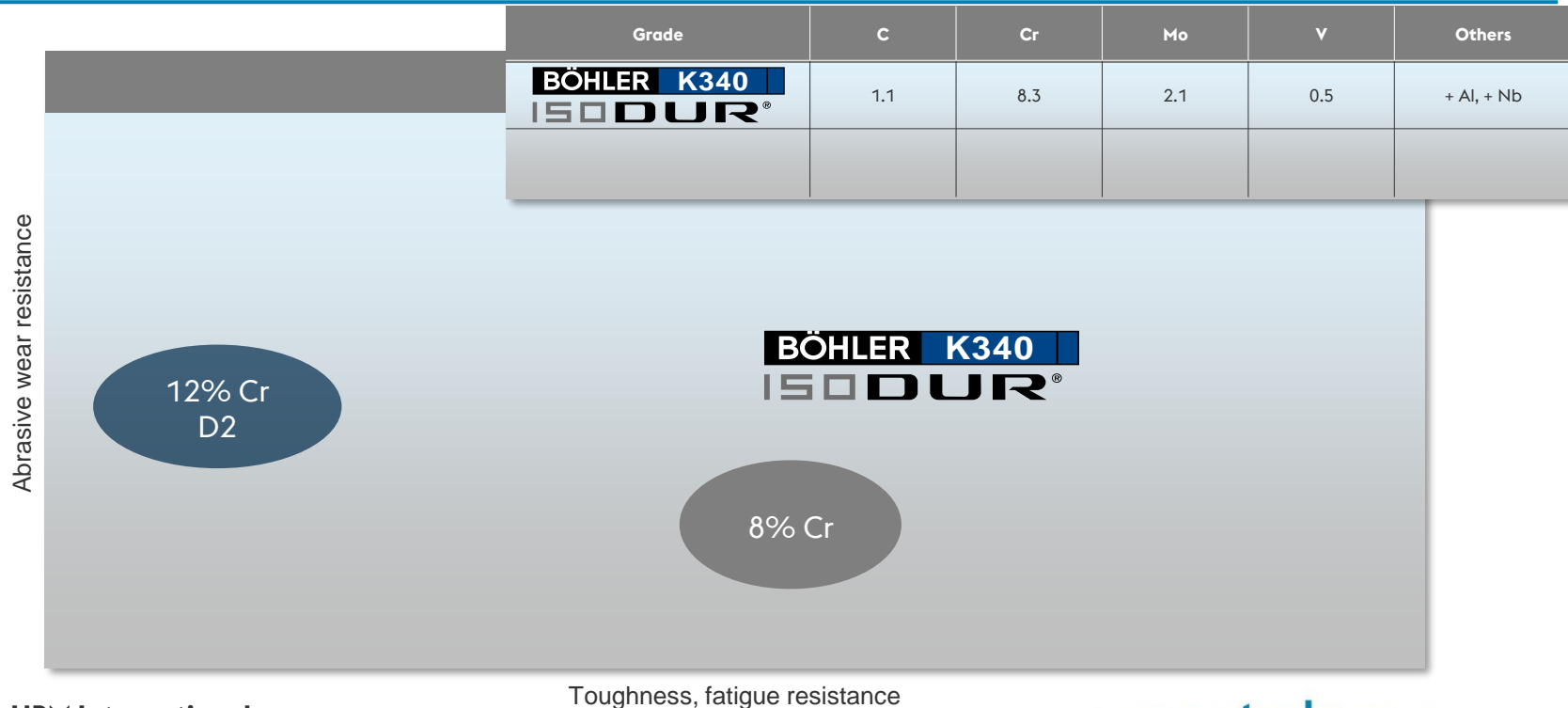
Austrian origin	YES
Certified mill (ISO standards)	YES
Mill certificate	YES
Constant quality	YES
Constant machining behavior	YES
Cleanliness	YES
Grain size	YES
Carbide distribution	YES
Behavior in heat treatment	YES
Further surface treatment	YES
Local Service package	YES
Technical support	YES
After – sales service	YES
Price competitive	YES
<b>Risk for the tool maker/user</b>	<b>NO</b>

The choice is yours

**BÖHLER K340**

**ISODUR<sup>®</sup>**

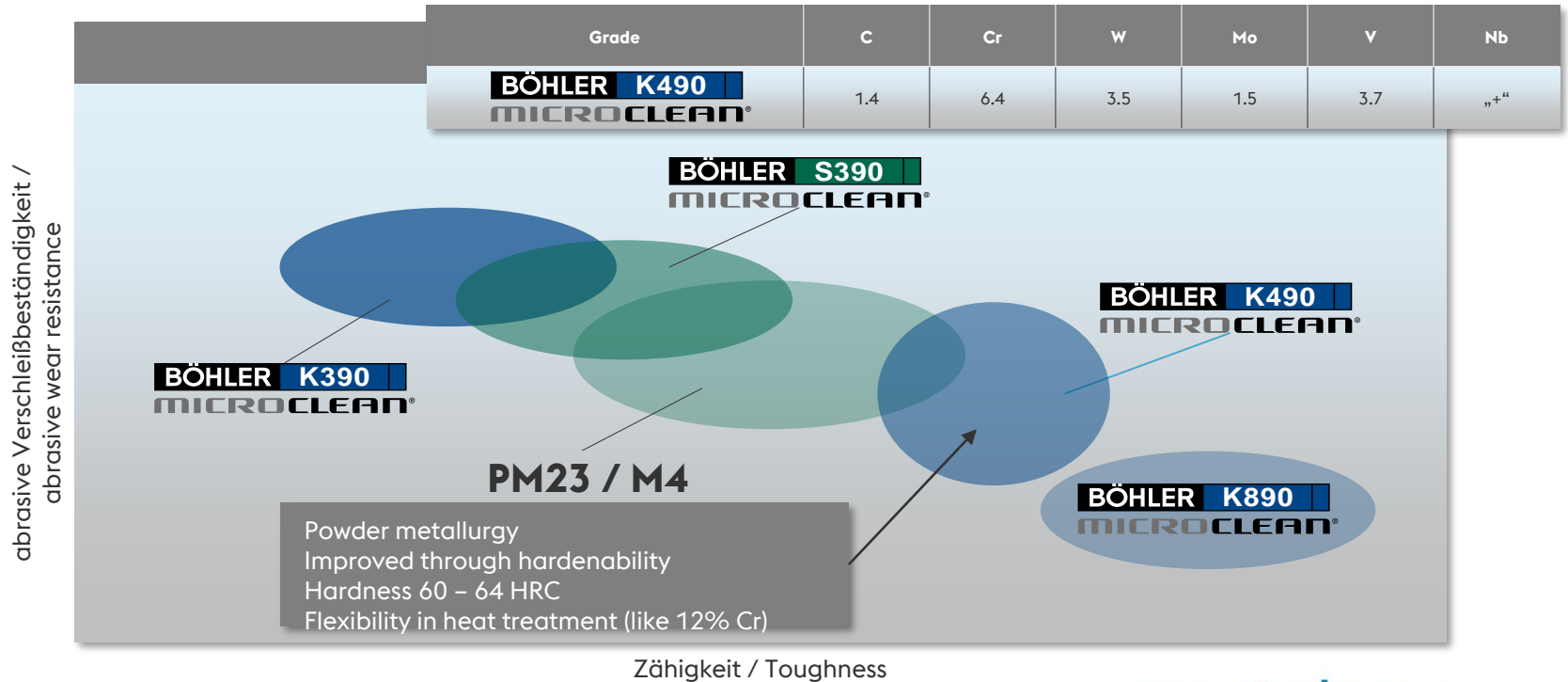
# 8% CR – ESR – COLD WORK TOOL STEELS





**BÖHLER** **K490**  
**MICROCLEAN**®

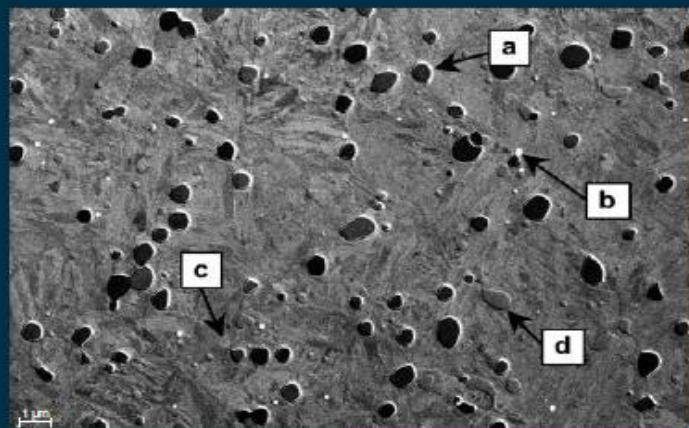
# UNIVERSAL PM – COLD WORK TOOL STEEL



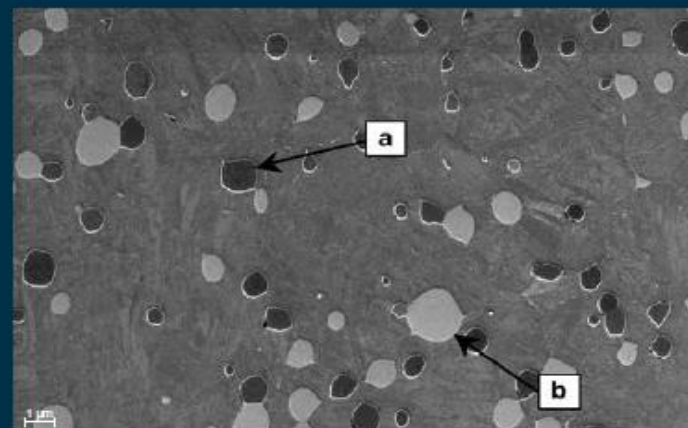
# Universal PM – Cold work tool steel

## Fine und complex micro structure

Cold work tool steel with medium alloying-content and medium carbide content (approx. 10 %)  
Complex composition consisting of 4 different carbide-types  
Fine microstructure, short distances of carbides → Machinability ↑  
Adhesive wear-resistance ↑



BÖHLER K490 MICROCLEAN



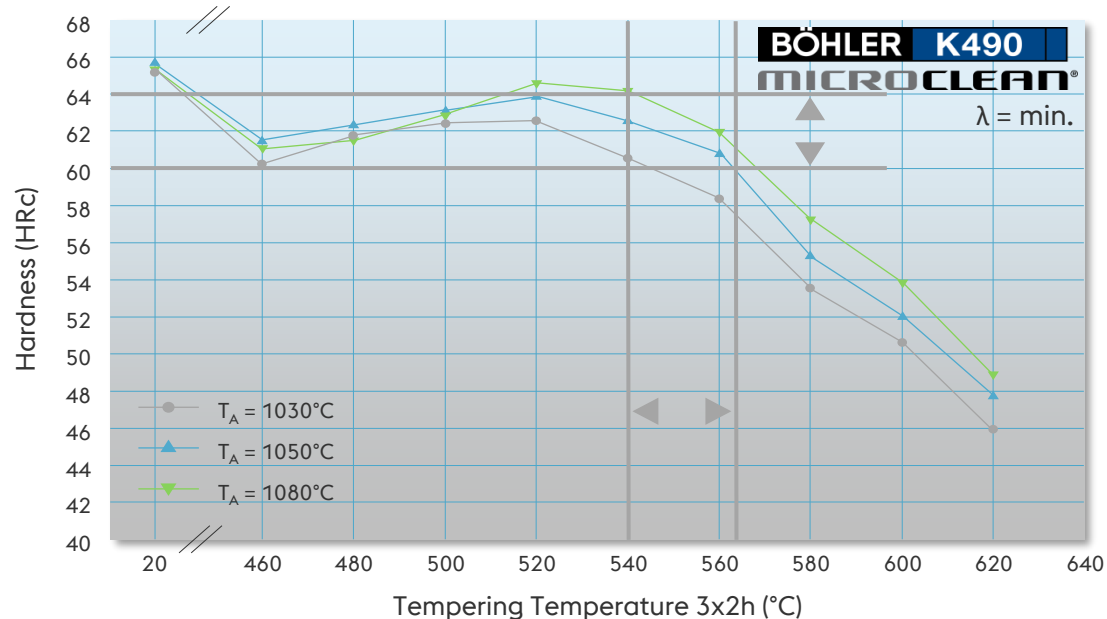
PM23 Type

a = MC-type    b =  $M_6C$ -type    c =  $M_7C_3$ -type    d =  $M_{23}C_6$ -type

# Universal PM – Cold work tool steel



## Tempering chart



Ideal properties at hardening - temperatures between  $1030^\circ\text{C}$  and  $1080^\circ\text{C}$

→ Heattreatable in the same lot as typical cold work tool steels (e.g D2)

→ More flexible and more economical h.t. compared to PM23 and M4 HSS-types

# Universal PM - Cold work tool steel



## Impact energy and abrasive wear resistance

