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BEARING RELIABILITY CONFERENCE & EXPO

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The importance of raw material purity and cleanliness requirements, for precision bearing rings

Dortmund, Germany 23.03.2016

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Dr. Pietro PROSINO

Director of PROSINO S.r.l.

Our company helps (since 1946) the producers of super precision and custom made bearings by supplying them high quality rings.

We are located in Italy and we employ 92 workers

Every year we machine roughly 1.000 Tons of 100Cr6 steel

In the last 25 years we have supplied >100.000.000 rings to some of the most important EU producers such as FAG-INA, SKF, GMN, NTN-SNR.

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The purpose of my speech today is to draw your attention on the importance of the steel purity and of the correct heat treatment of the same steel

I will show some real cases that happened during my career that made me understood the importance of steel cleanliness

The cases that I will show are related to 100Cr6 steel (SAE 52100 – Din 1.3505)

Have you ever faced bearing failures caused by raw material impurity ?

Unfortunately I did……

….and it has not been very nice……

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The most common impurities are non metallic inclusions

Non-metallic inclusions are chemical compounds and nonmetals that are present in steel and alloys. They are the product of chemical reactions, physical effects, and contamination that occurs during steel manufacturing process

The goal is to use steel that have a minimum level of non metallic inclusions.

Non-metallic inclusions in steel are basically foreign substances.

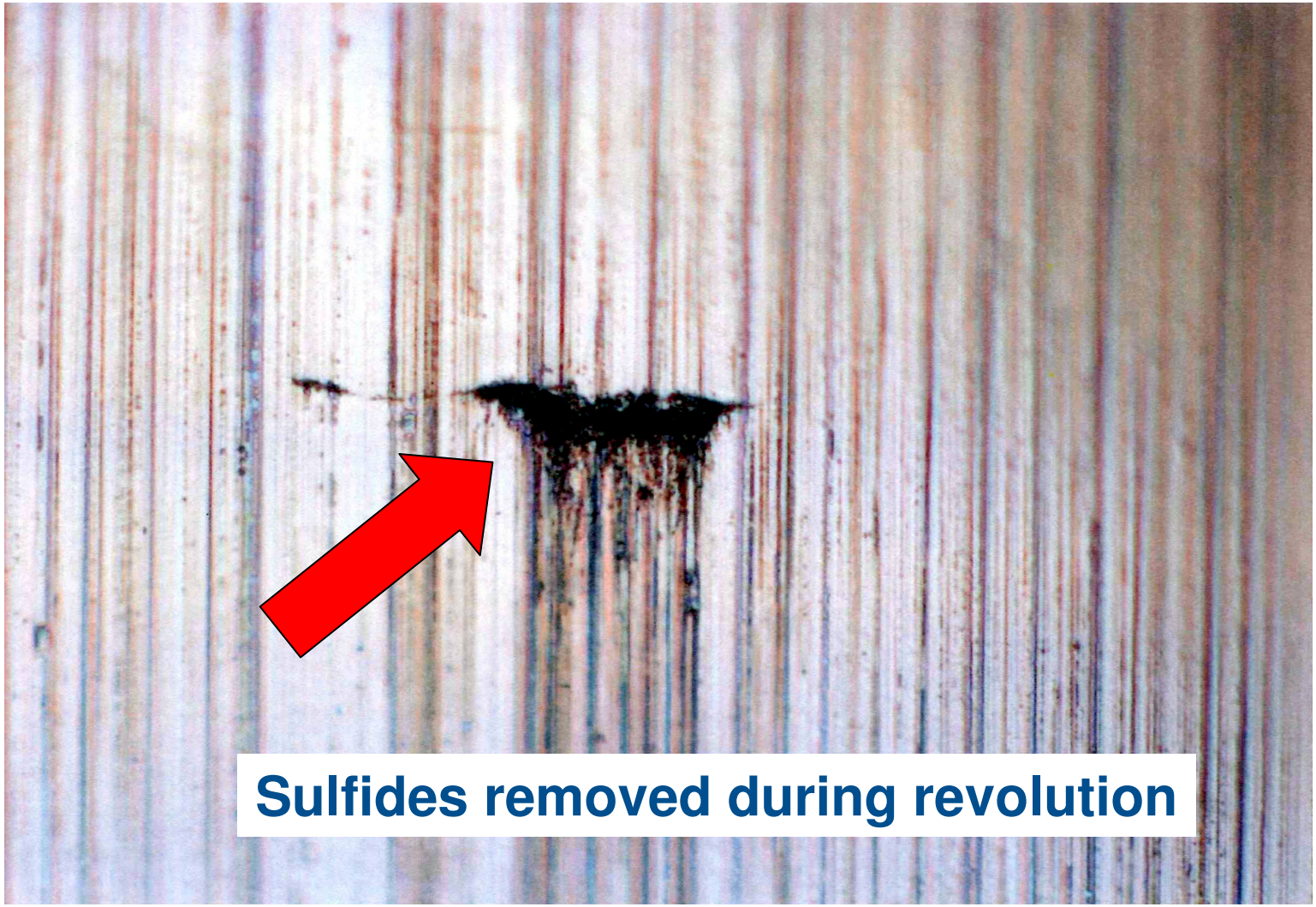
They disrupt the homogeneity of structure, so their influence on the mechanical and other properties can be considerable.

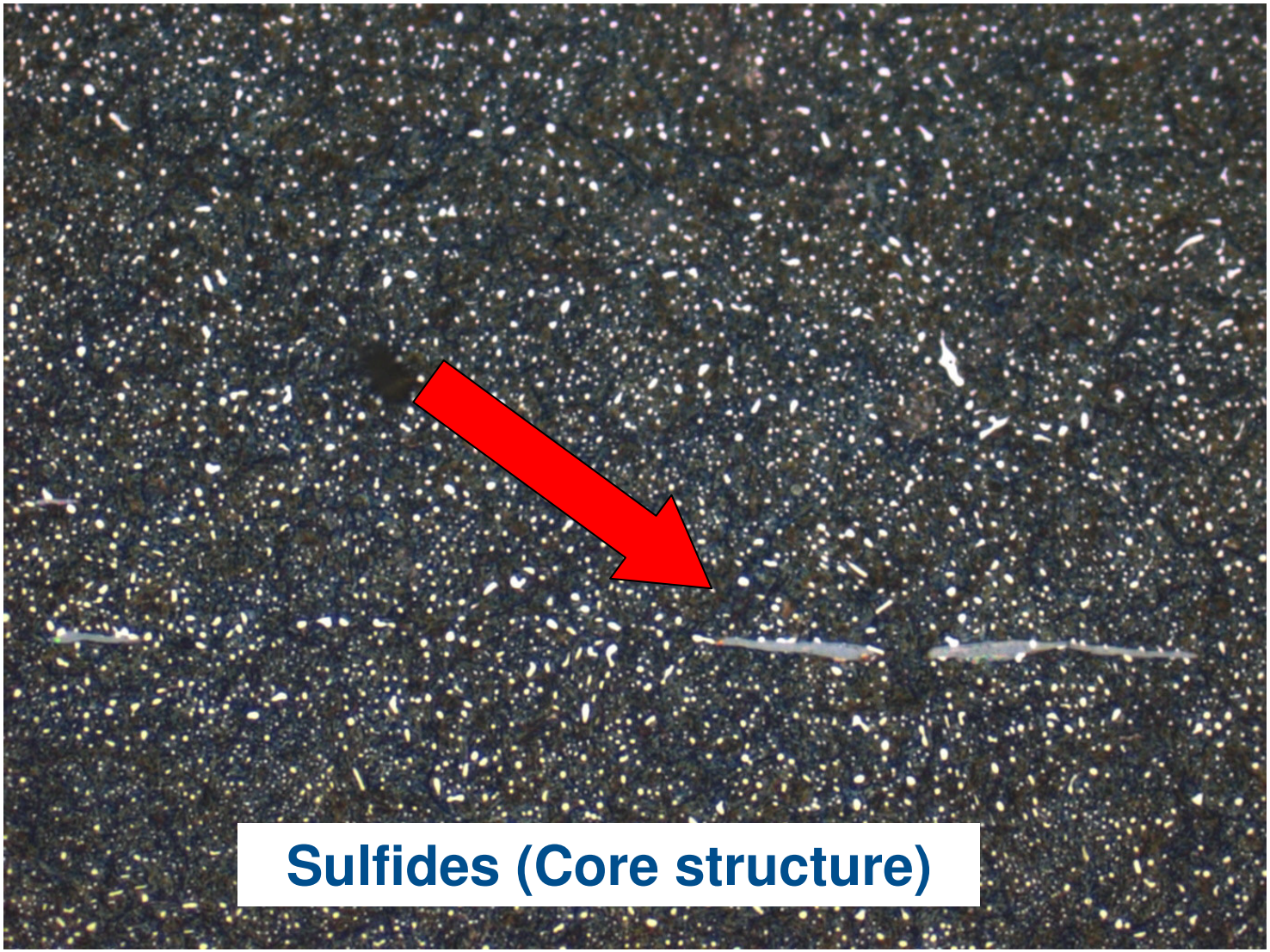
During deformation, which occurs from machining, non-metallic inclusions can cause cracks and fatigue failure in steel.

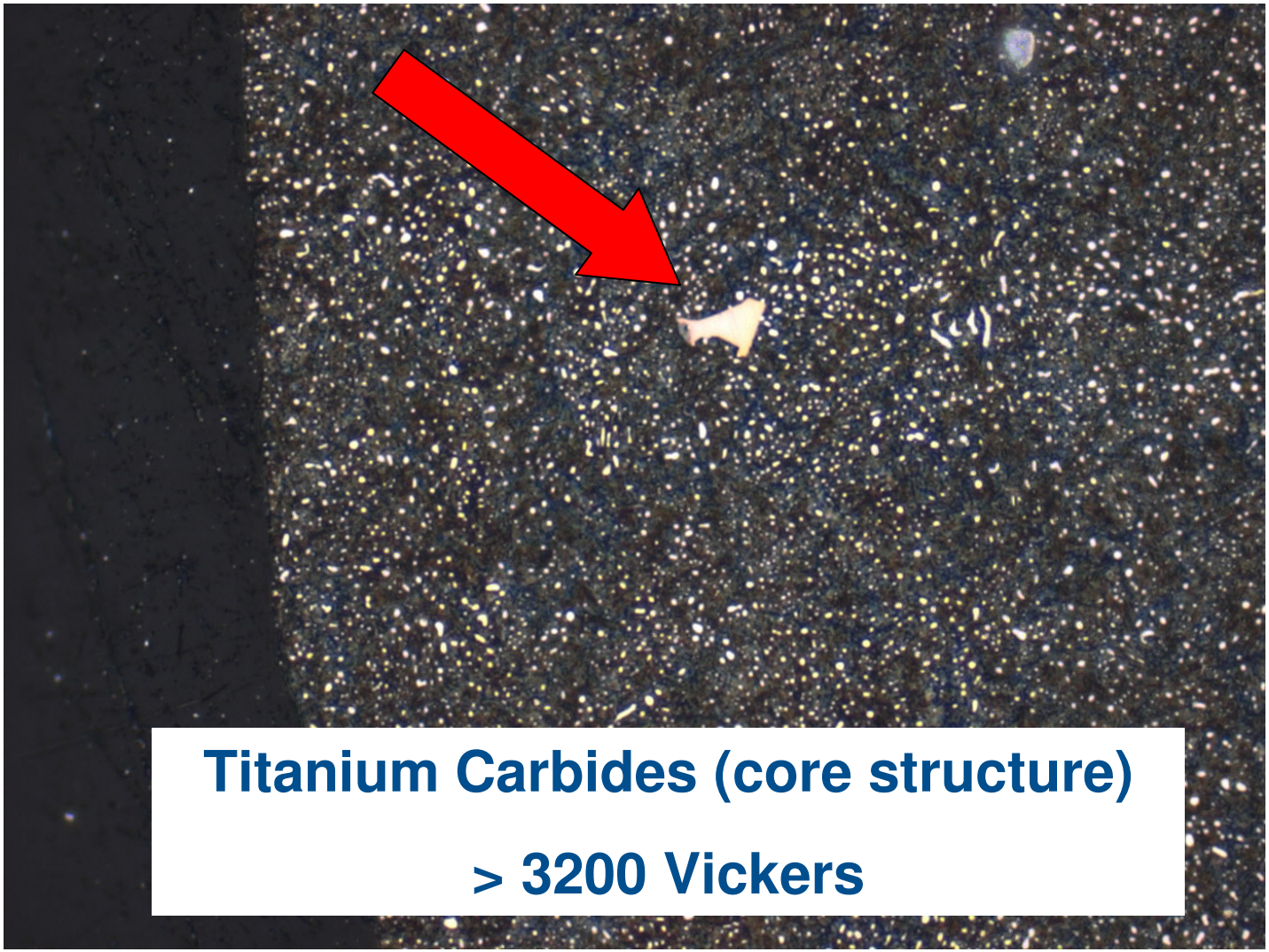
They following pictures are ball bearing tracks damaged by the presence of metal impurities

(real case reported by our customers)


Sulfides removed during revolution


Sulfides removed during revolution


Sulfides (Core structure)


Titanium Carbides (core structure)
> 3200 Vickers

The presence of these non-metallic inclusions on bearing track are extremely dangerous, since they can lead to the damages of balls, ball track geometry and consequent modification of bearing precision

Areas of attention

1) Select raw material with highest purity content (for example, low solfure bearing steel)

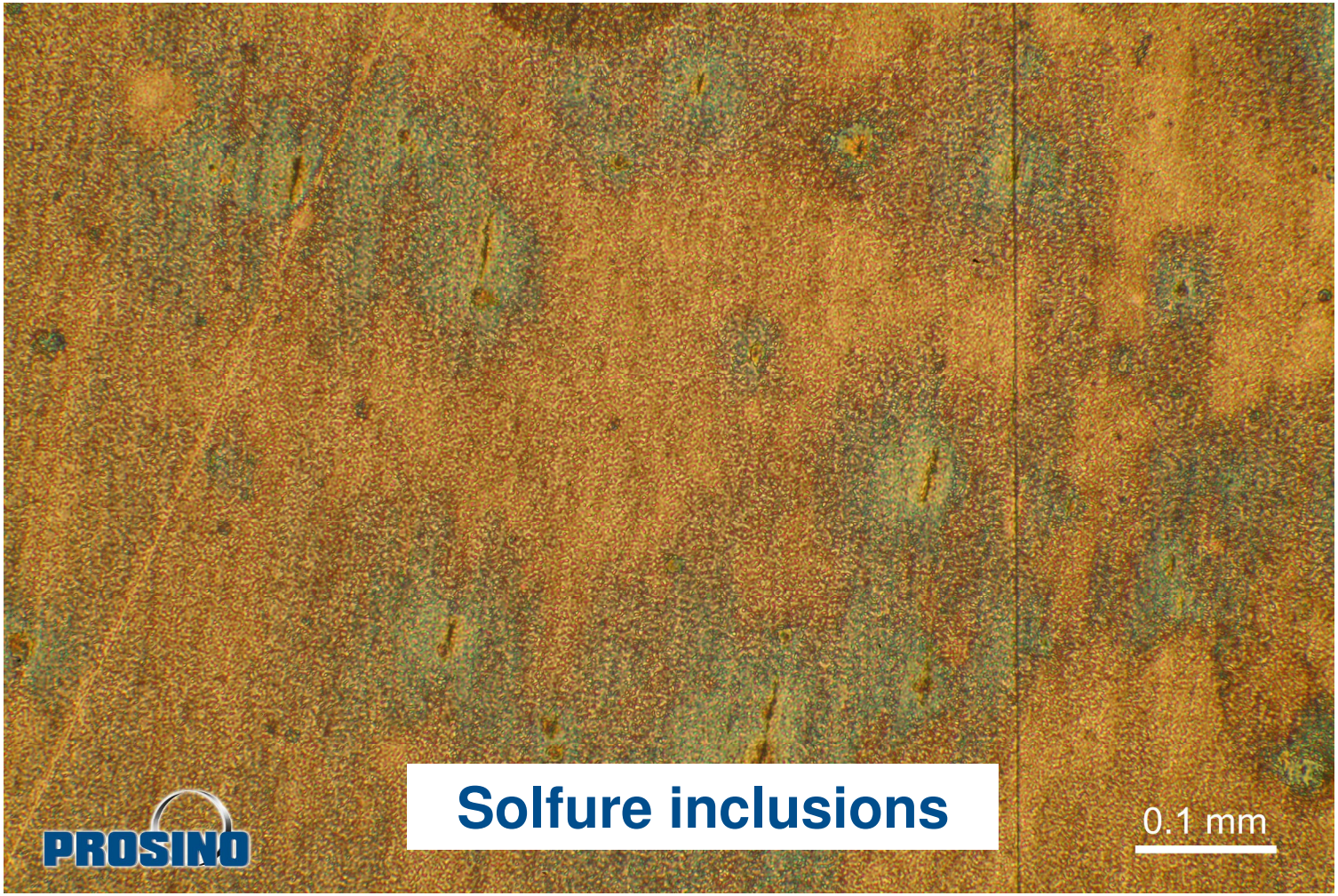
2) Perform correct heat- treating on bearing rings

Raw material purity

2 macro-areas to check

1) Non metallic inclusions (root cause: contaminations given by scrap used for the manufacturing) – see next picture

2) Tubing / Forging technology used (it has a strong influence on the carbide banding, which are highly dangerous for bearing life) – see next pictures



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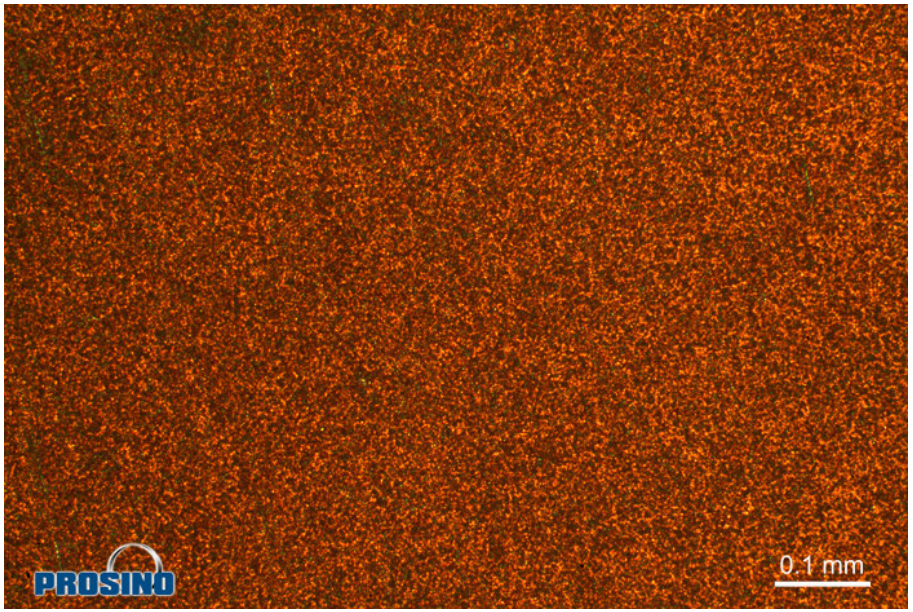
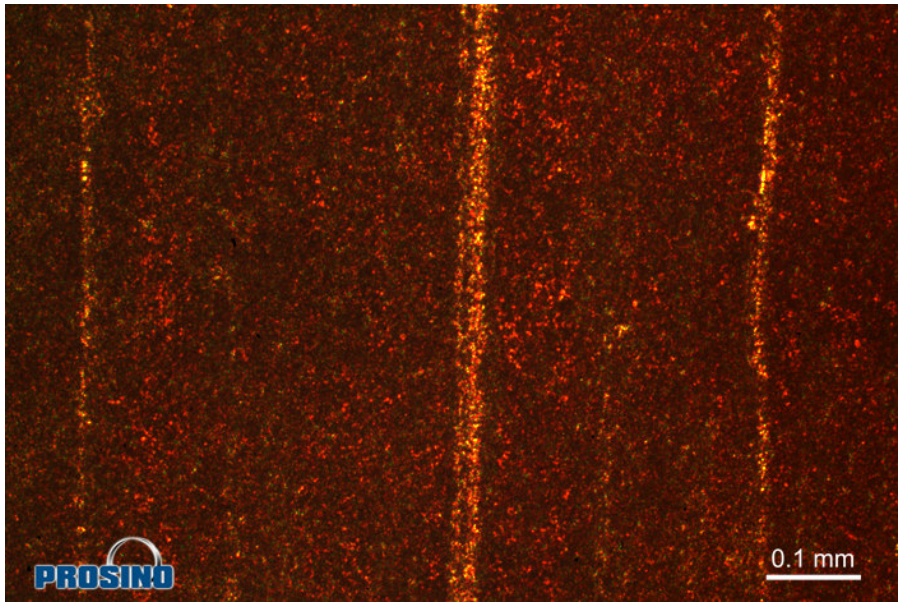
Carbide banding



Good omogenous structure



Heavy carbide banding

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Correct Heat Treatment

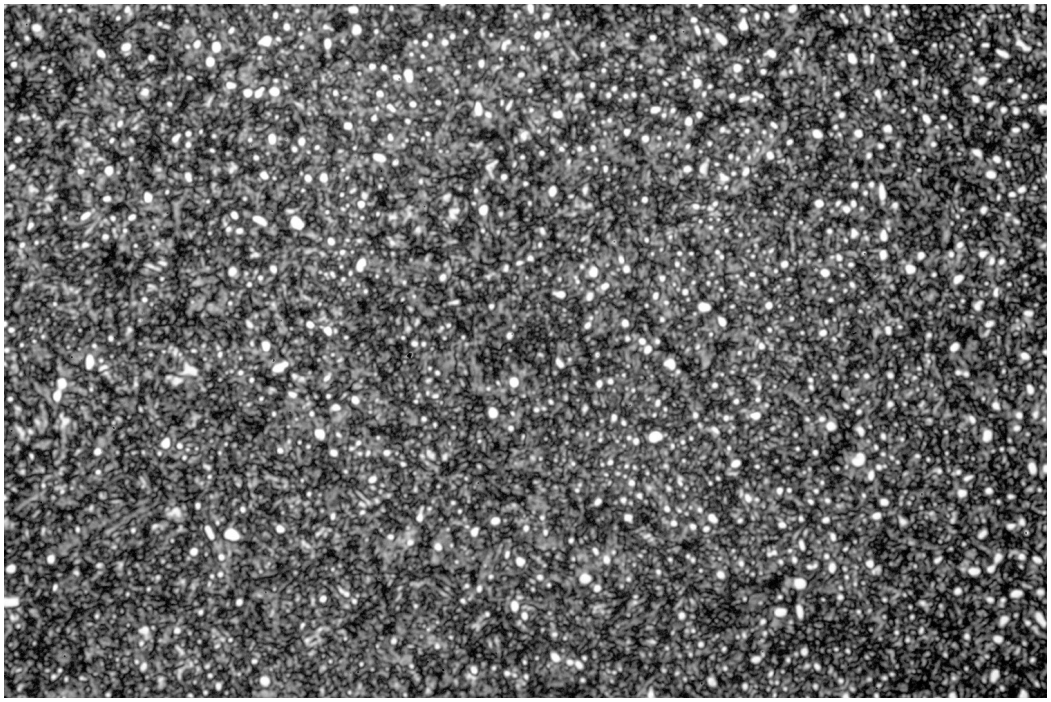
3 macro-areas to check:

1) Uniform structure (good martensite transformation) with desired core-hardness level.

2) No superficial decarburization, with desired superficial hardness level (….or hypercarburation)

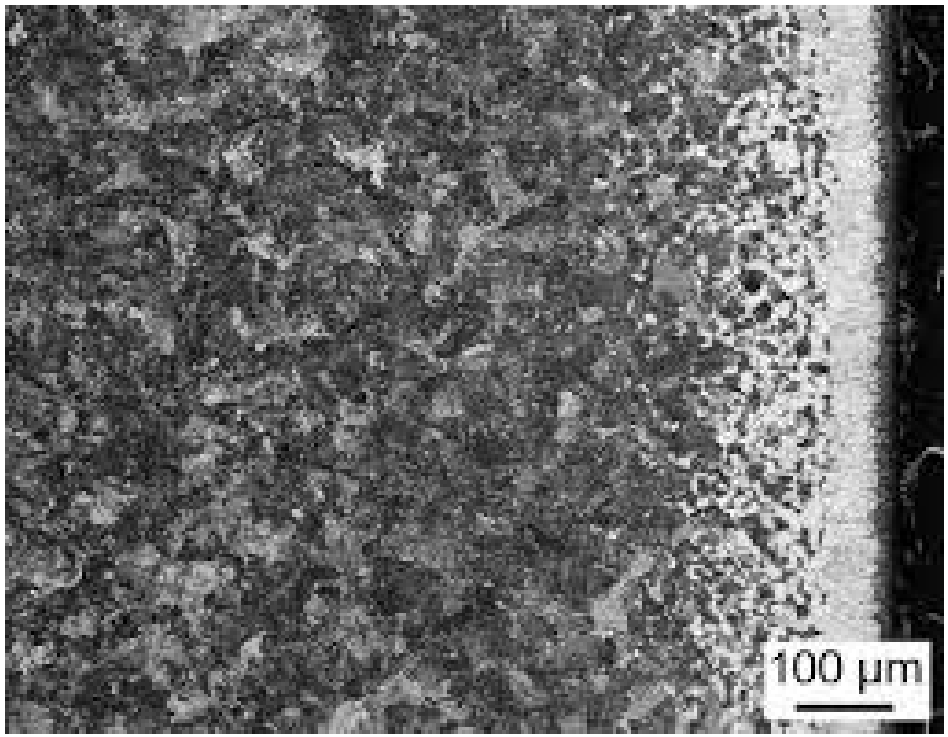
3) Lowest possible material stress

Uniform structure



Carbides are evenly distributed and have a roundish shape

Decarburization



It can be detrimental to surface properties (= Lack of carbon content)

Lowest possible level of residual stresses and dimensional stability

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Lowest possible level of residual stresses and dimensional stability can be achieved with the adoption of a special heat treatment with double annhealing and subfreezing (S0)

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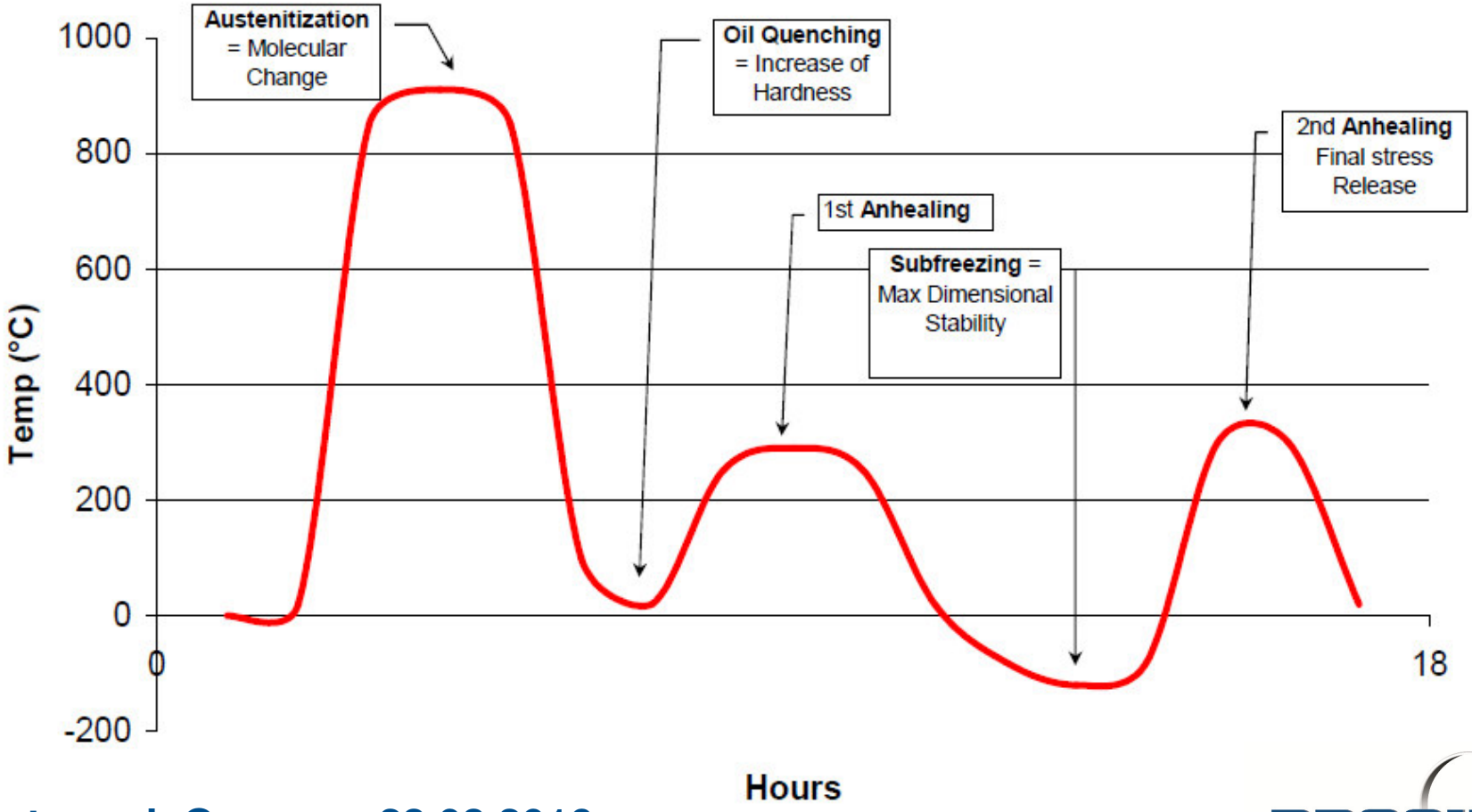
Special in house Double Anhealing and Subreezing Heat Treatment



Subreezing (with liquid Nitrogen) has the following properties:

- **Longer part life**
- **Less failure due to cracking**
- **Improved thermal properties**
- **Reduced coefficient of friction**
- **Less creep and walk**
- **Easier machining**

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Results of customer lab on the steel structure

4. Ergebnisse

	Soll S0	**Ist AR 71912 gleit-geschliffen**	**Ist AR 71912 sandgestrahlt**	**Ist AR 7008 gleit-geschliffen**	**Ist AR 7008 sandgestrahlt**	**Ist AR 71913 gleit-geschliffen**	**Ist AR 71913 sandgestrahlt**
Kernhärte	60,5 ± 2 HRC	702 –705 - 703 HV30 → **60,3 HRC**	707 – 703 – 703 HV30 → **60,4 HRC**	698 – 699 – 700 HV30 → **60,1 HRC**	699 – 702 – 698 HV30 → **60,4 HRC**	707 – 703 – 703 HV30 → **60,1 HRC**	698 – 699 – 696 HV30 → **60,0 HRC**
Restaustenit	max. 5 %	1 %	1 %	1 %	1 %	1 %	1 %
Gefüge	max. nadeliger Martensit	feinnadeliger Martensit					
Mischgefüge	Rand: ≤ 1 % bis 0,07xDW Abstand in den Funktions-flächen Kern: ≤ 5 %	nicht festgestellt					
Randanomalien (Randoxiation)	≤ 20 µm	5 µm	10 µm	5 µm	5 µm	5 µm	5 µm

CONCLUSIONS – NOW WHAT ?

1. Select serious and reliable raw material sources, sensible to material cleanliness.

2. Identify a reliable and stable heat treating process.

Thank you for your attention !

Who is interested in these topics can meet me at my booth in the hall

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