
主題:變模溫系統專用模具鋼材介紹

梧濟工業股份有限公司
信昌精密模具(上海)有限公司



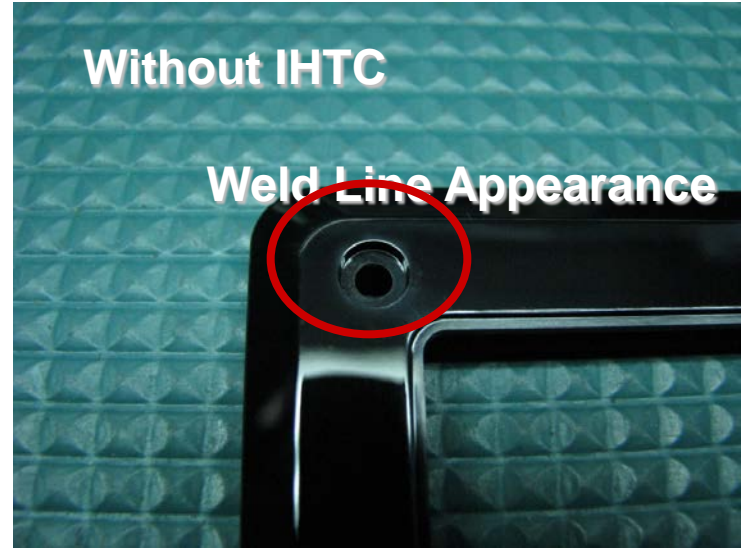
主講者：鄭富丰

With IHTC

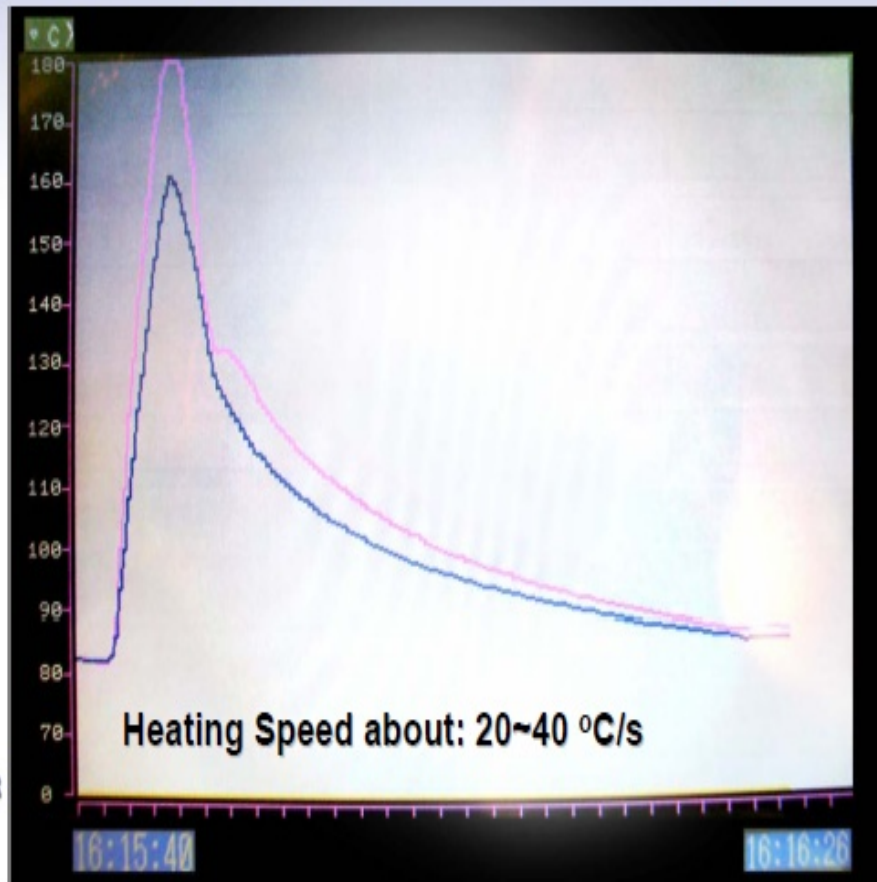


Without IHTC

Weld Line Appearance



動態溫度控制歷程 *DMTC History*



Induction Heating Temperature Control (IHTC) 設備與應用案例



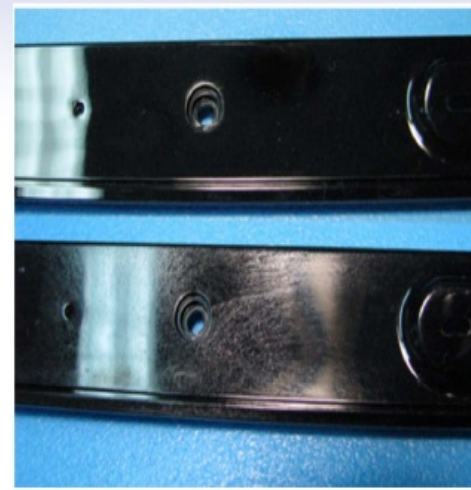
INER
Innovations

信昌精密模具

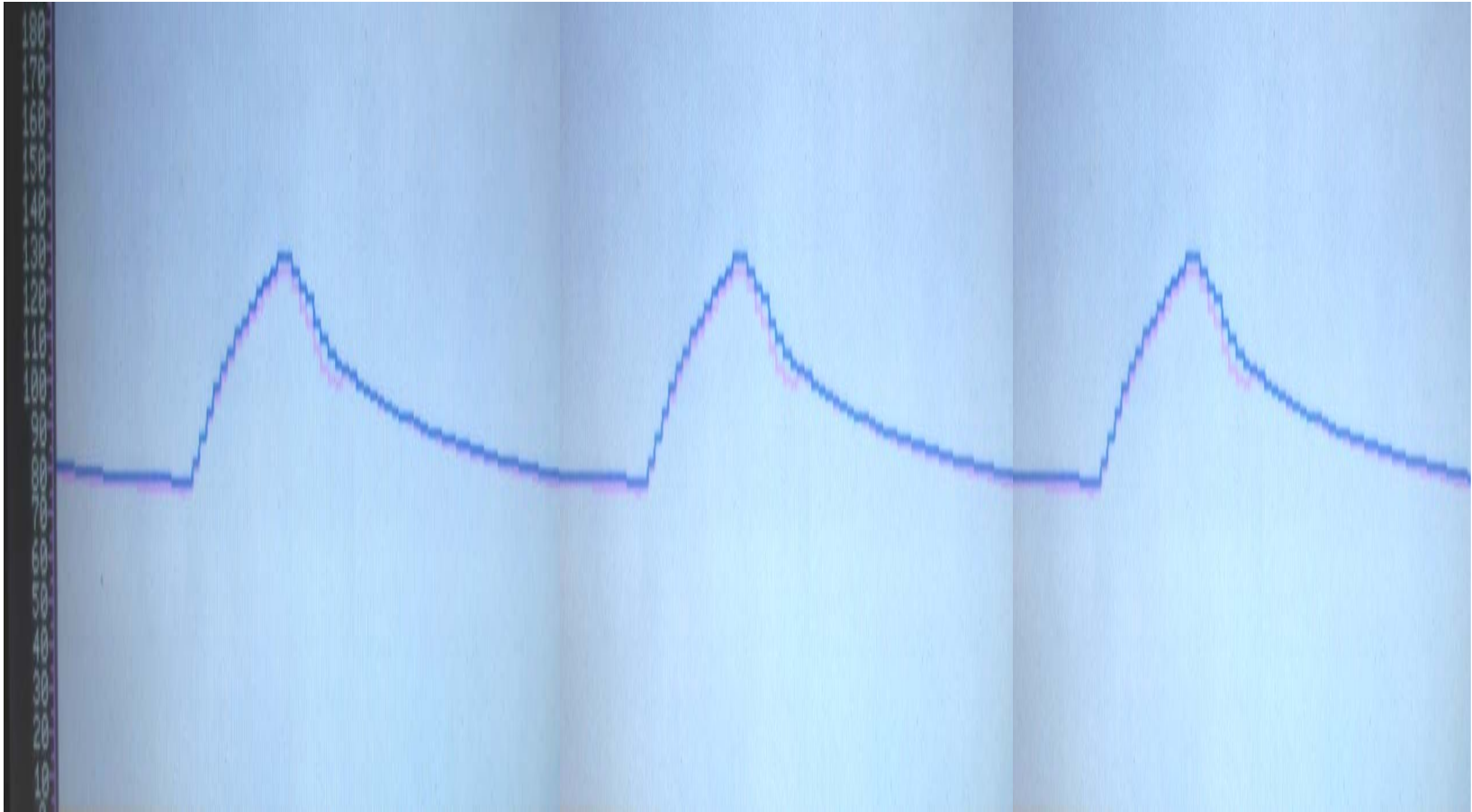
無結合線高亮面成品
High Surface Gloss Product



浮纖現象解決 *Fiber floating Elimination*



動態溫度控制歷程 DMTC History



Heating Speed about: 20~40 °C/s



M333(HRC:44-46)

W8PH(HRC:40)-RHCM

65"

Requirements:

High mirror
polishability

信昌精密模具

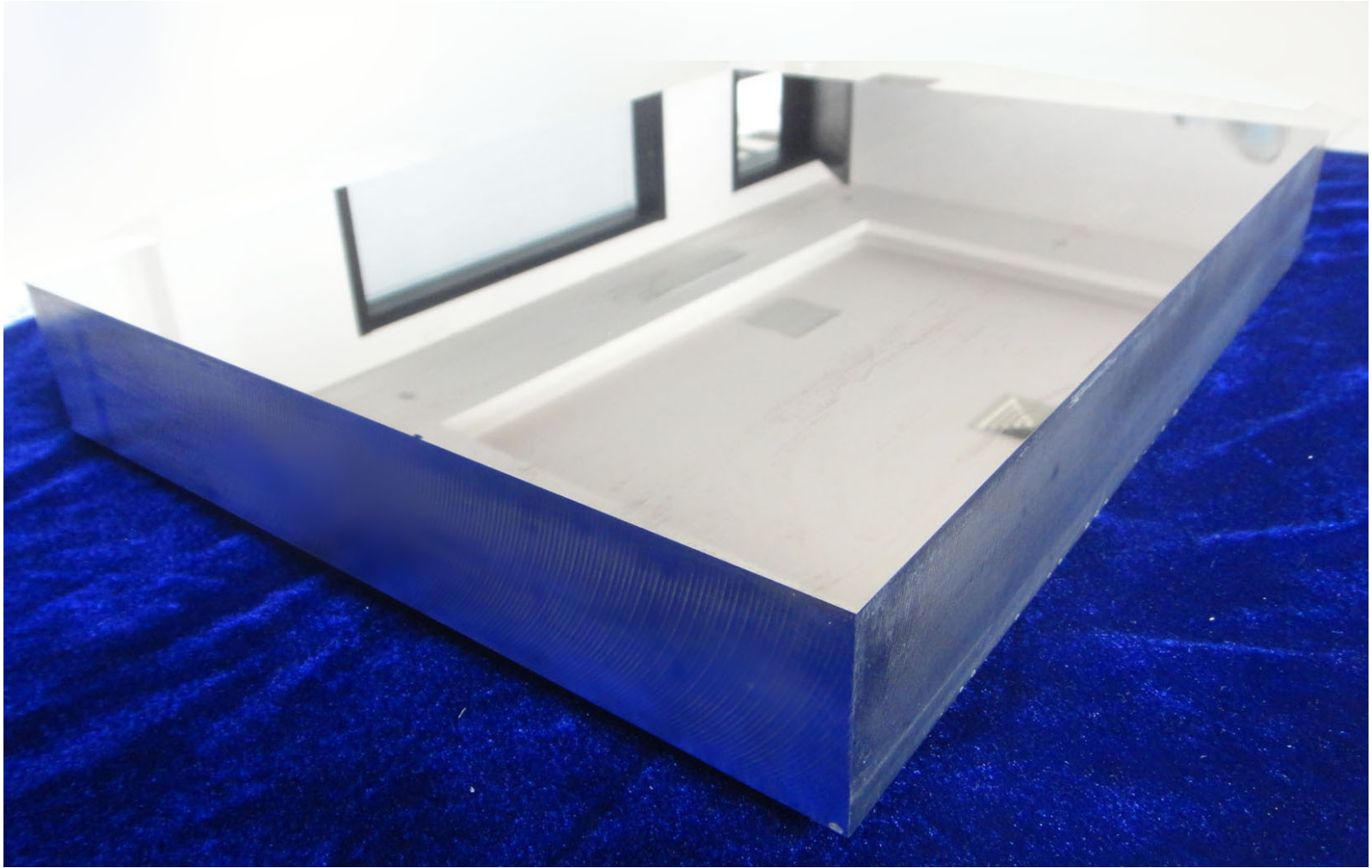
IHTC/RHCM

- 鋼材拋光性能
- 模具設計
- 鋼材韌性
- 鋼材耐蝕性
- 模具水路加工

IHTC/RHCM

- 鋼材拋光性能
- 模具設計
- 鋼材韌性
- 鋼材耐蝕性
- 模具水路加工

RHCM應用,鏡面需達到#8000。

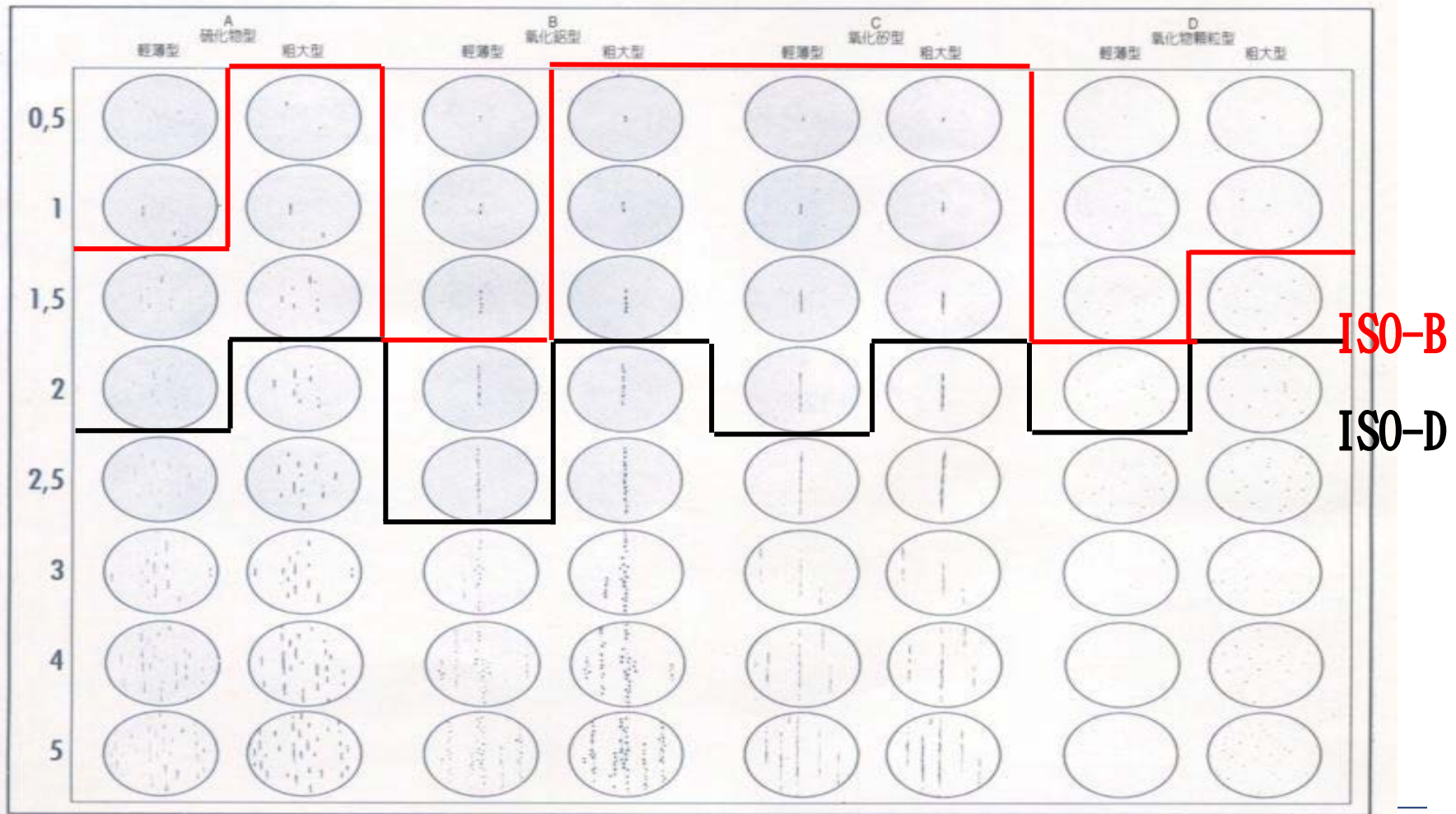


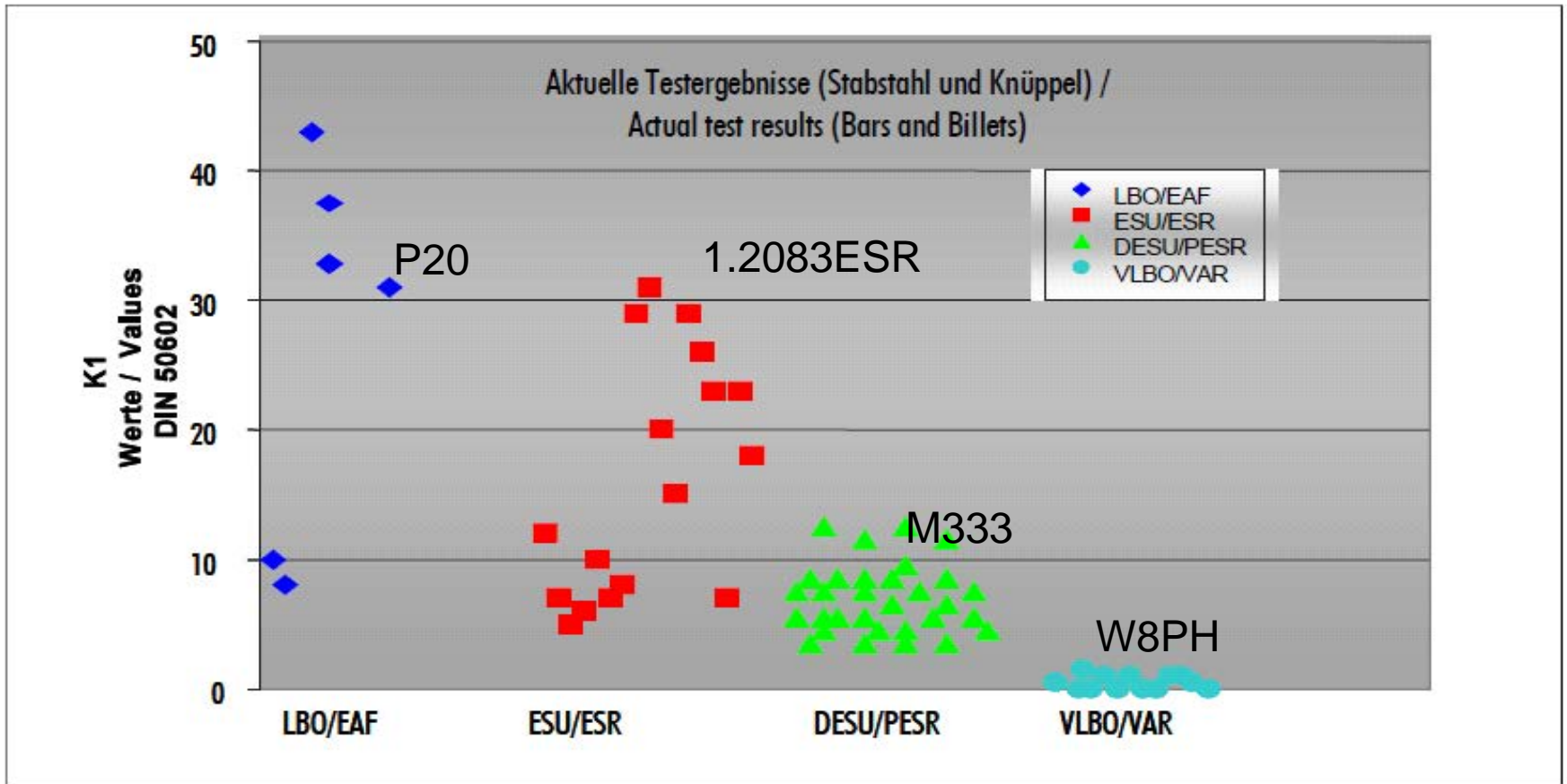
信昌精密模具

拋光性能影響

- 高清淨度----極低的雜質含量
- 基地硬度----拋光性與硬度存在絕對關係
- 合金設計----低碳、不銹鋼

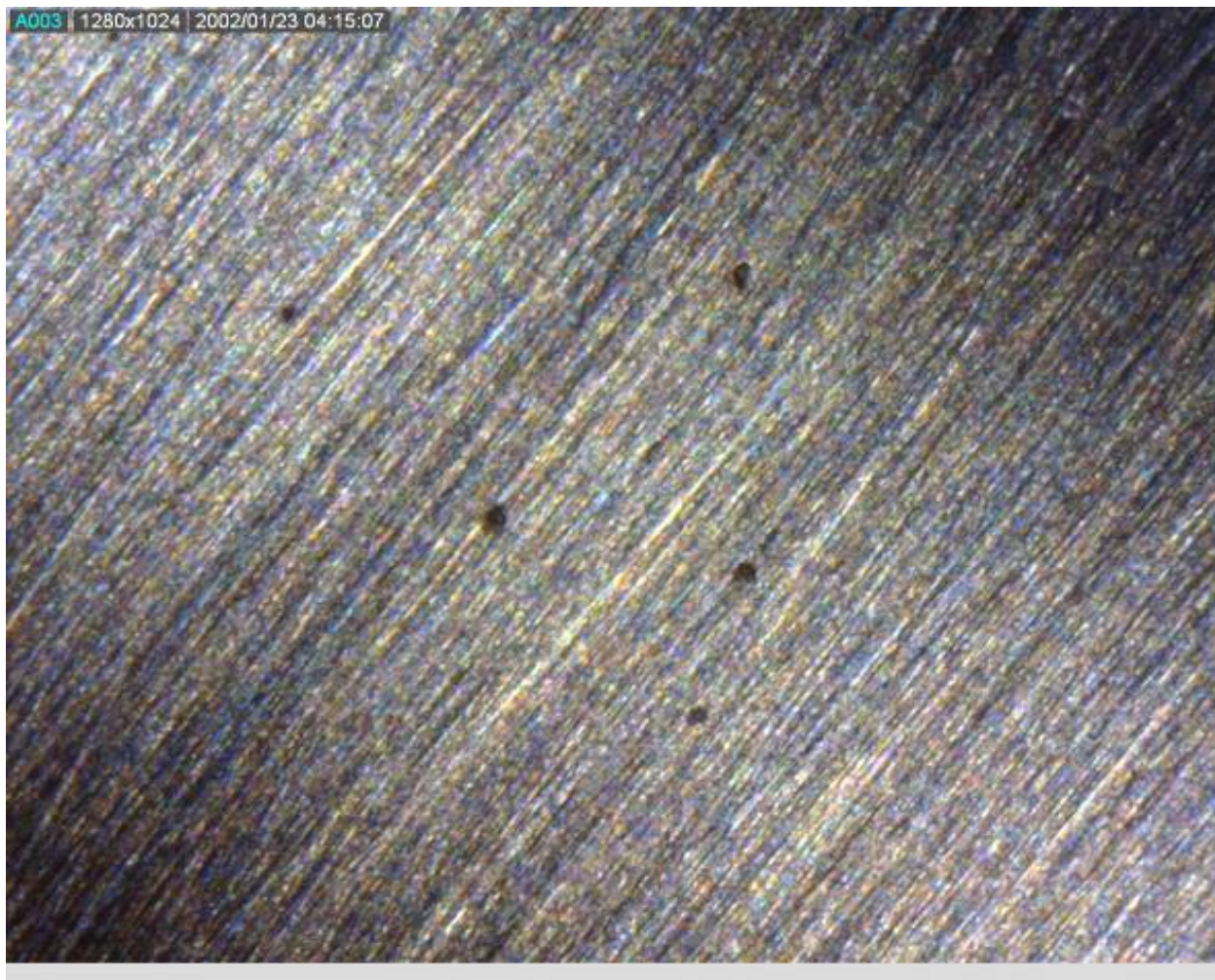
雜質含量-ASTM E45





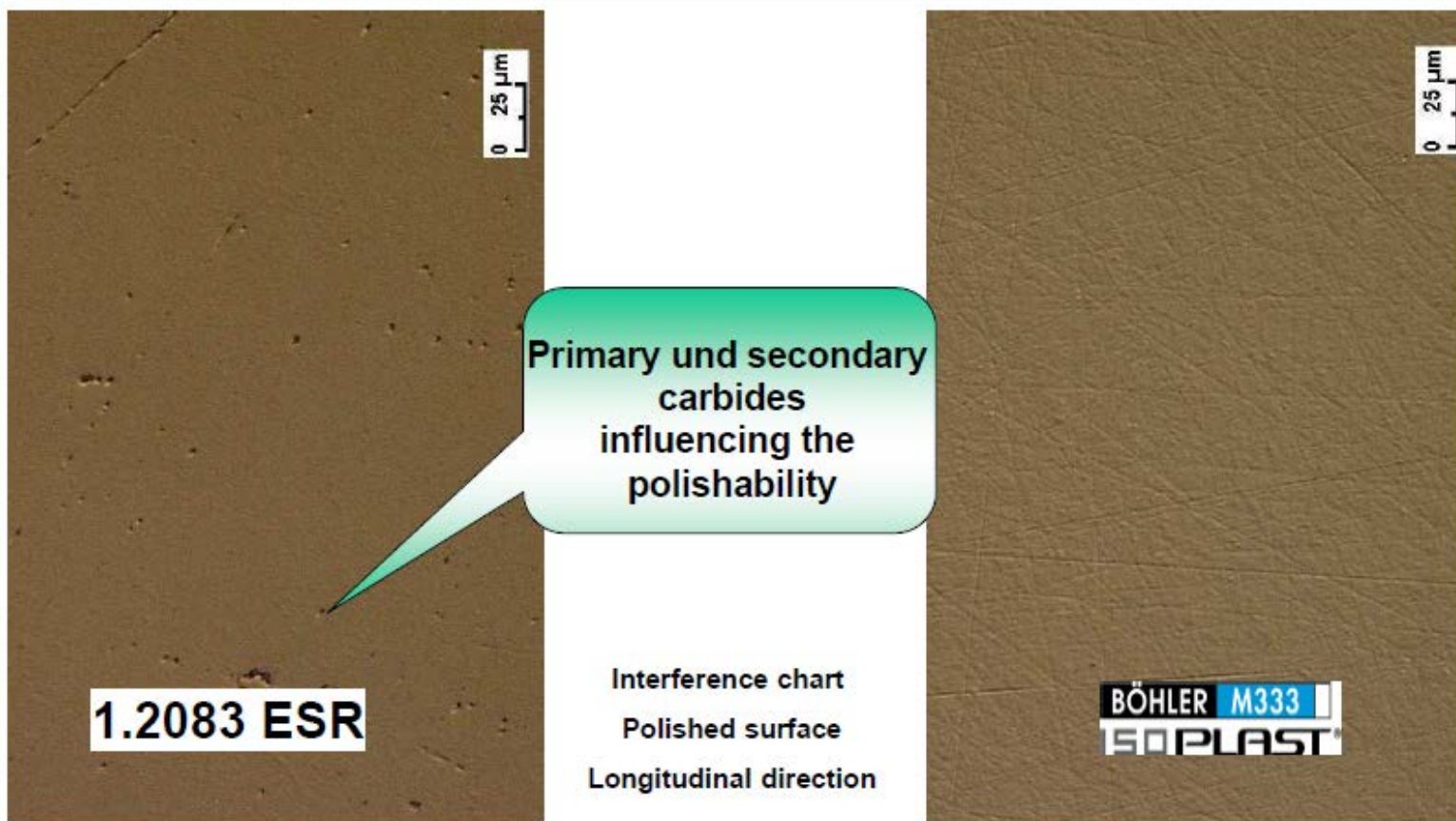
**M333, W8PH 非金屬介在物K1<10以下非常低，
抗腐蝕，拋光性達#12,000。**

夾雜物缺陷



粗大的碳化物,於拋光時剝落造成麻點

Polishability - Influence of Carbides and Carbide Banding



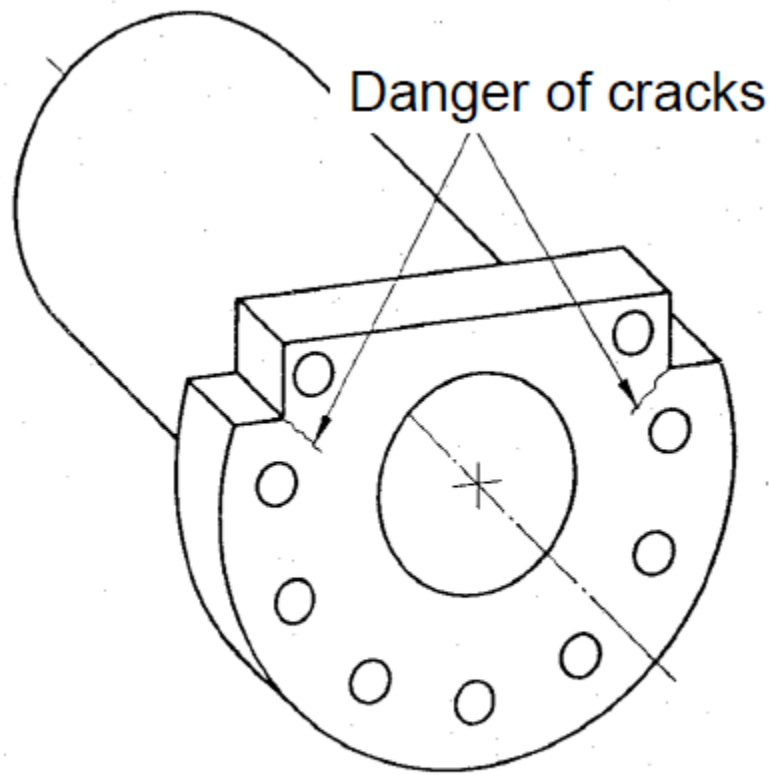
拋光性- 碳化物大小影響

信昌精密模具

IHTC/RHCM

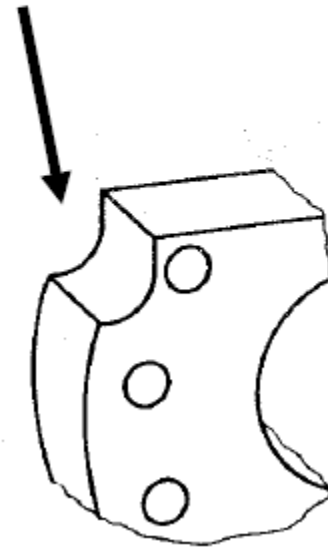
- 鋼材拋光性能
- 模具設計
- 鋼材韌性
- 鋼材耐蝕性
- 模具水路加工

■ 模具材料的選用-R角設計



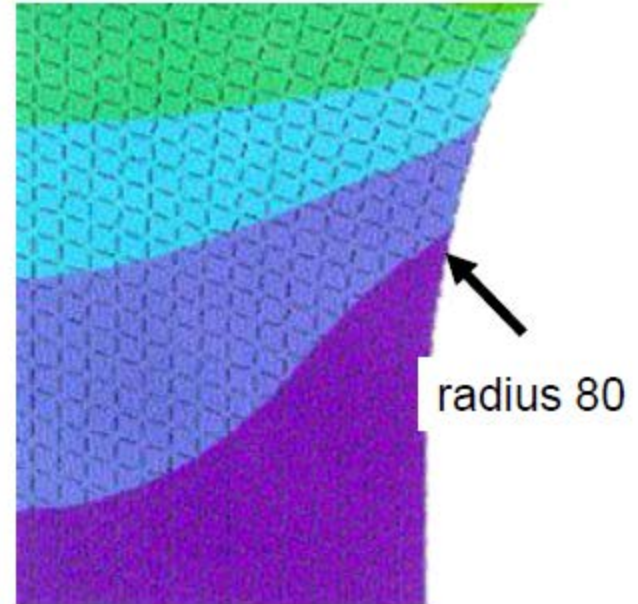
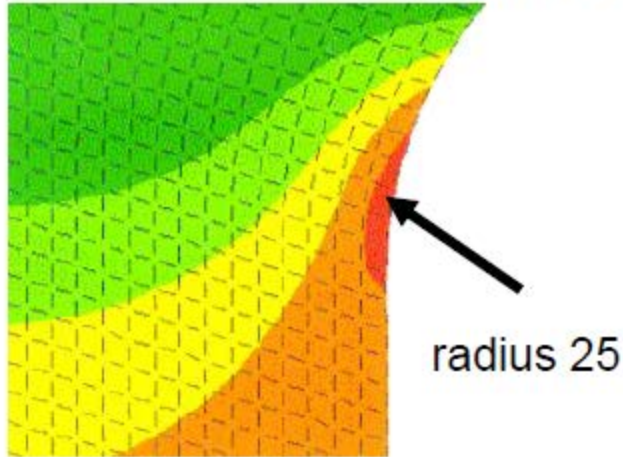
DIN 17 022

correct



■R角設計

Minimizing of tension by changing of the construction



FEM Simulation
of max. compression:



■ 銳角或直角是模具破裂主因

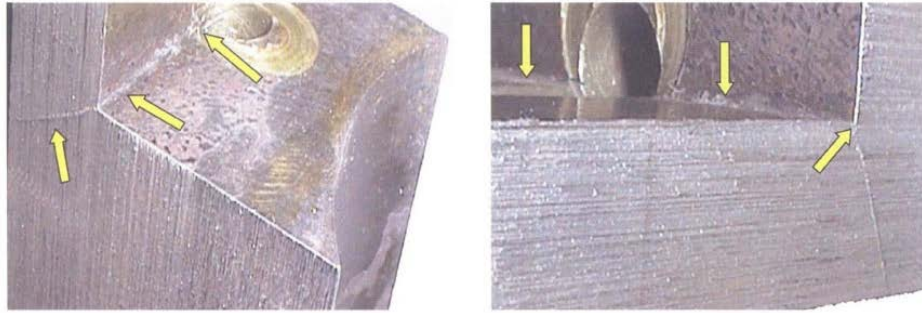
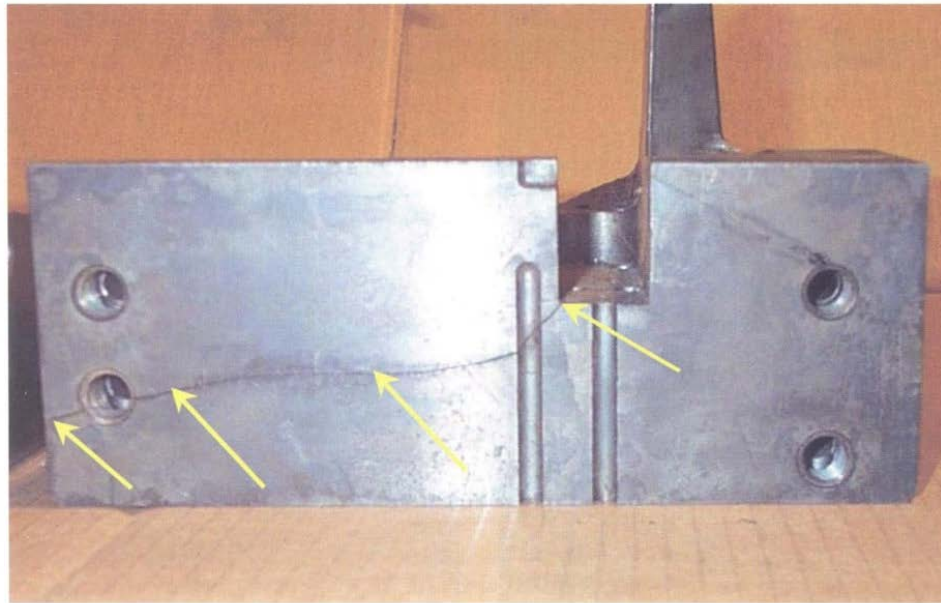


Figure 9.7: Hardness shatter at sharp-edged cross-section transitions



Source :Buderus Handbook of plastic Mould steels

IHTC/RHCM

- 鋼材拋光性能
- 模具設計
- 鋼材韌性—清靜度、合金設計、熱處理等..
- 鋼材熱傳導性
- 模具水路加工

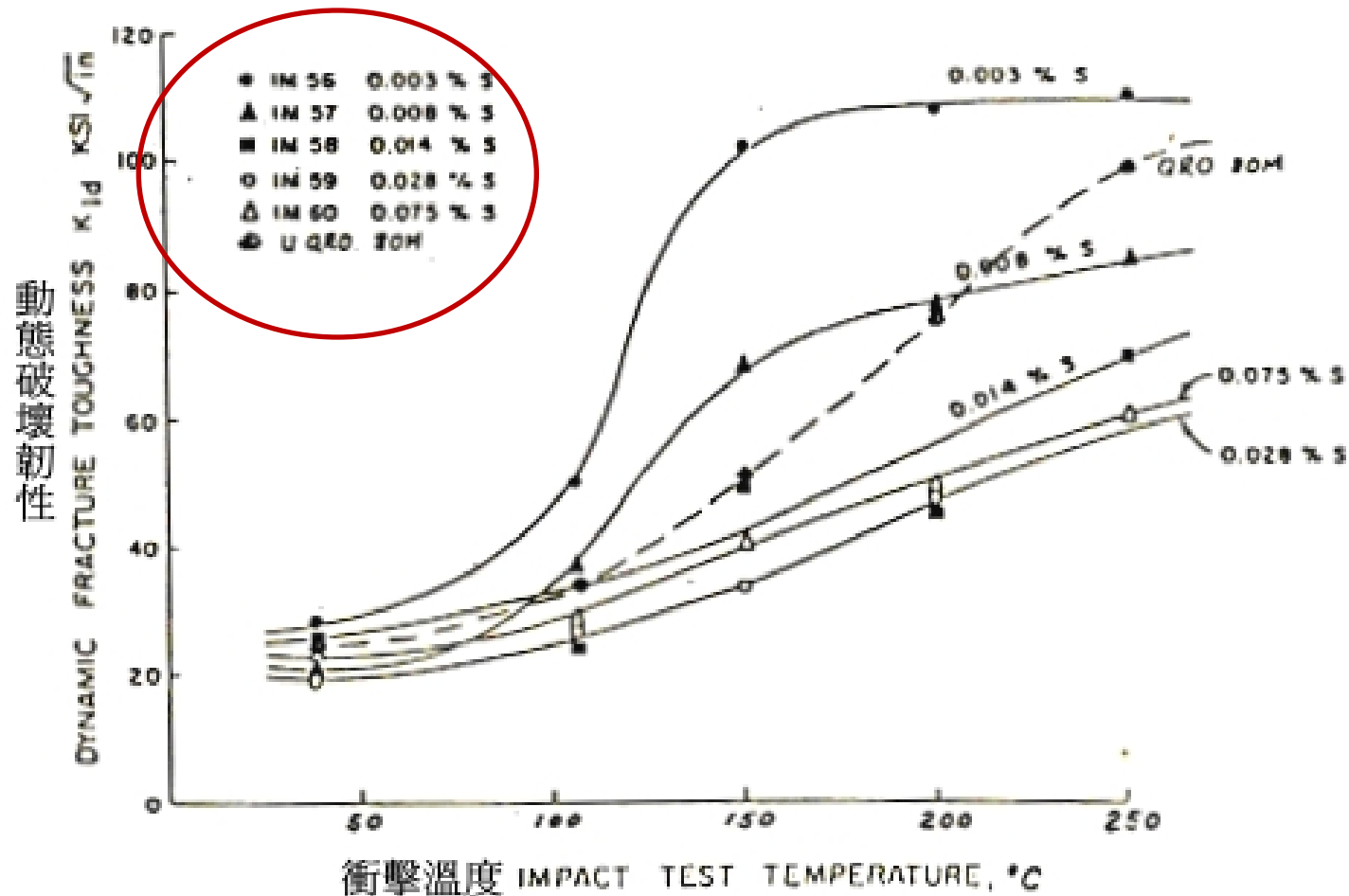
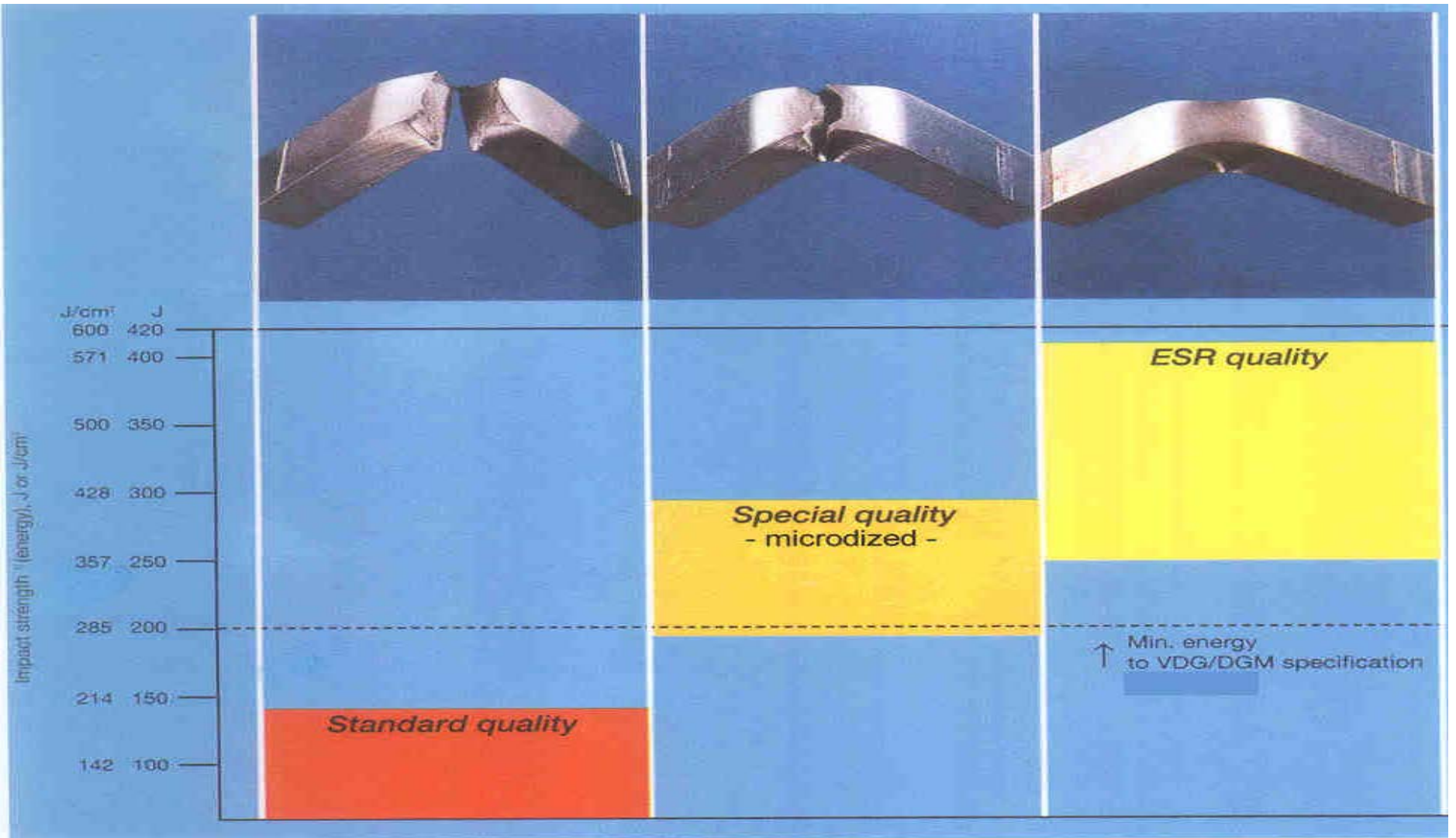


FIGURE 4: PRECRACKED CHARPY V-NOTCH TRANSITION CURVES SHOWING K_{1d} VALUES FOR H13 STEELS OF VARIOUS SULFUR CONTENTS. HARDNESS 46 ± 1 Rc, 43 ± 2 Rc FOR Q&R TOH

以 W302 (H13)材料試驗為例，硫含量愈低，破壞韌性愈佳

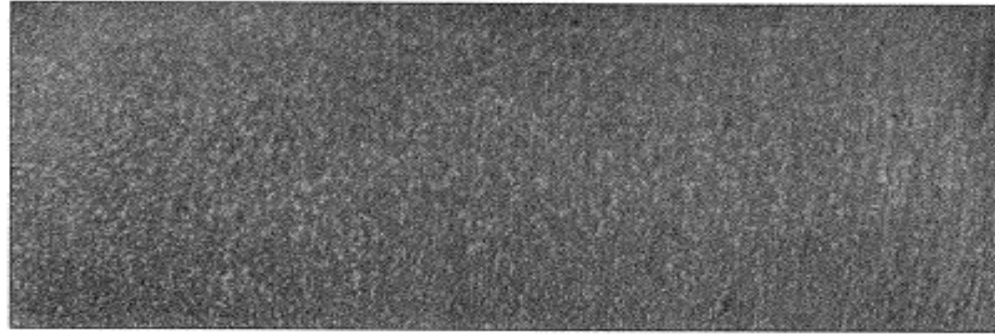


Vergleich des Makrogefüges
(Längsschliff von Scheiben)

Microstructure comparison
(longitudinal disc sections)

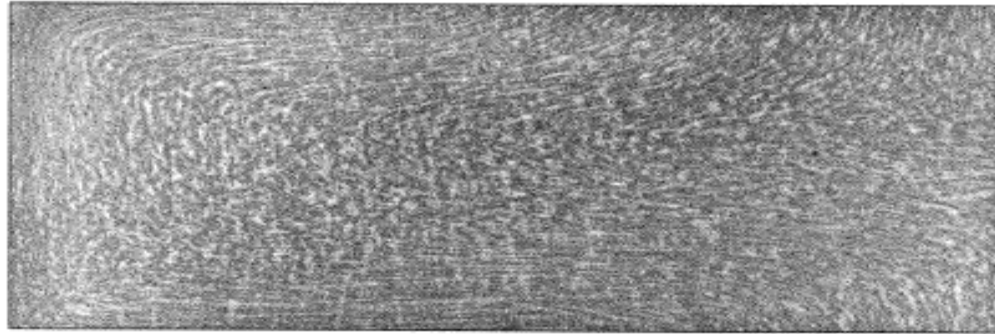
ISOBLOC / ISODISC
Stabstahl / Bar

ESR



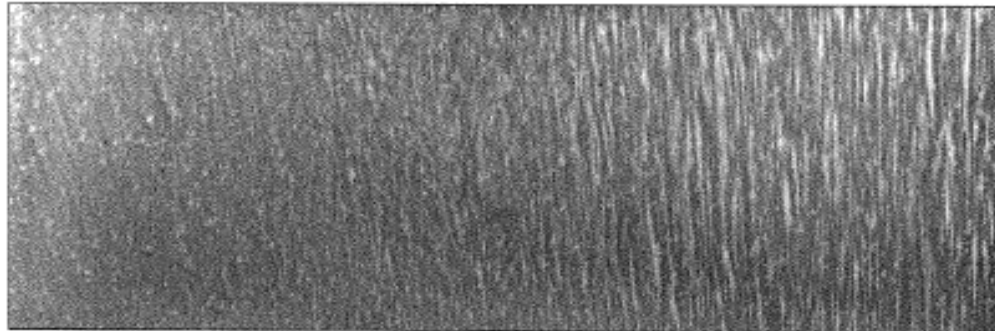
Geschmiedete Scheibe
Forged disc

鍛造

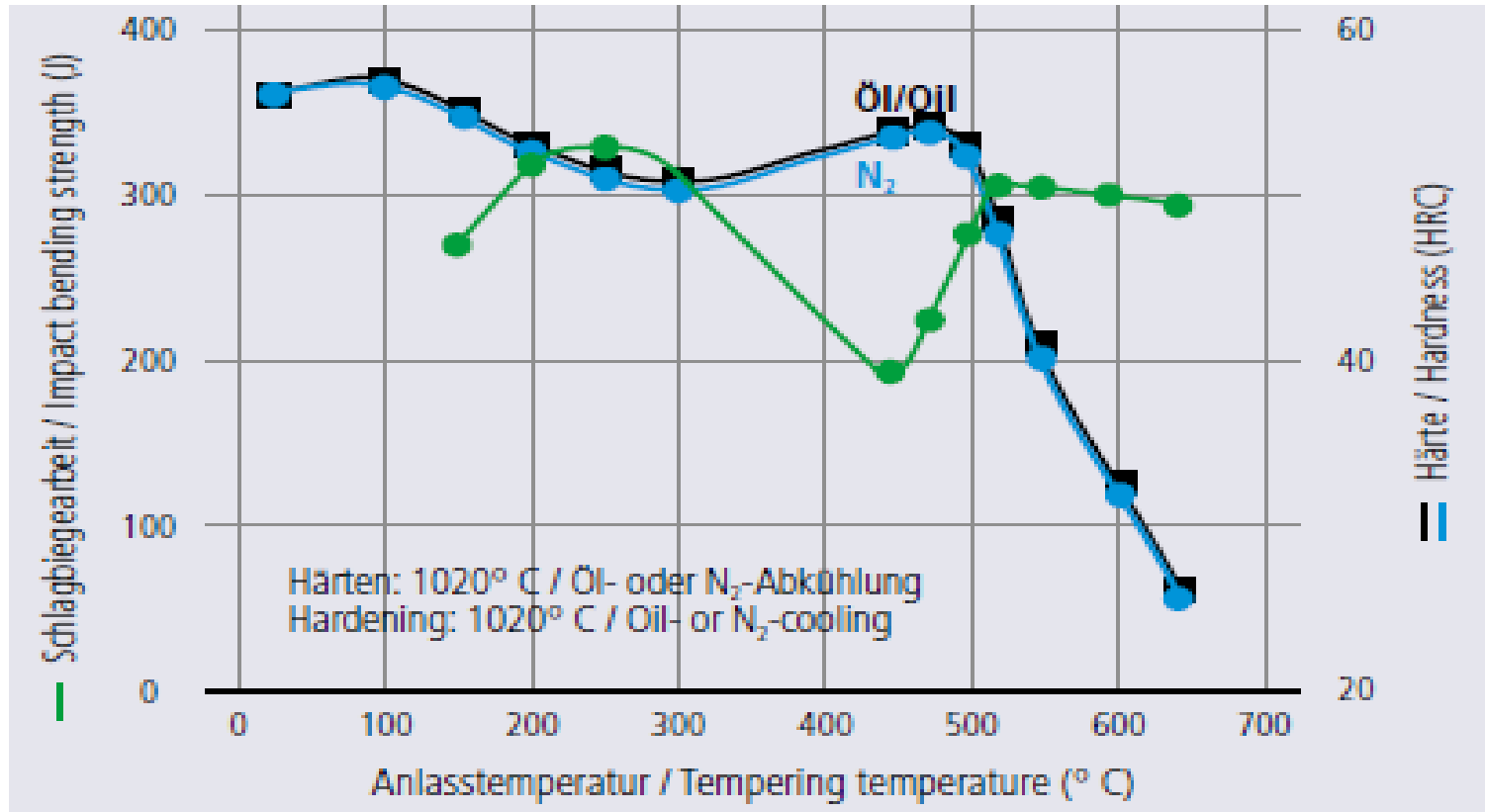


conventioneller Stabstahl
Conventional bar

傳統
煉鋼



Tempering temperature – influence on the impact toughness and hardness of BÖHLER M333 ISOPLAST®



M333 回火曲線圖

IHTC/RHCM

- 鋼材拋光性能
- 模具設計
- 鋼材韌性
- 鋼材熱傳導性
- 模具水路加工

For reasons of temperature uniformity, the temperature difference between inlet and outlet should not exceed 2 °C in injection moulding. Having determined the quantity of heat to be generally dissipated by the heat exchange medium, the essential factor is to achieve this as far as possible without major temperature differences in the cavity surface that affects part quality and cooling time. A decisive factor in this is the position and dimensioning of the water lines. The area within the mould that has the greatest effect on the cooling time is where the highest mould wall temperatures occur in the quality-critical area of the moulded part. The aim is therefore to achieve uniform temperature dissipation and distribution at the cavity surface. Temperature distribution at the cavity surface is affected by the distance between the temperature control water lines and the surface, the distance between the water lines themselves, and also by the mould material used (Figures 3.8 and 3.9).

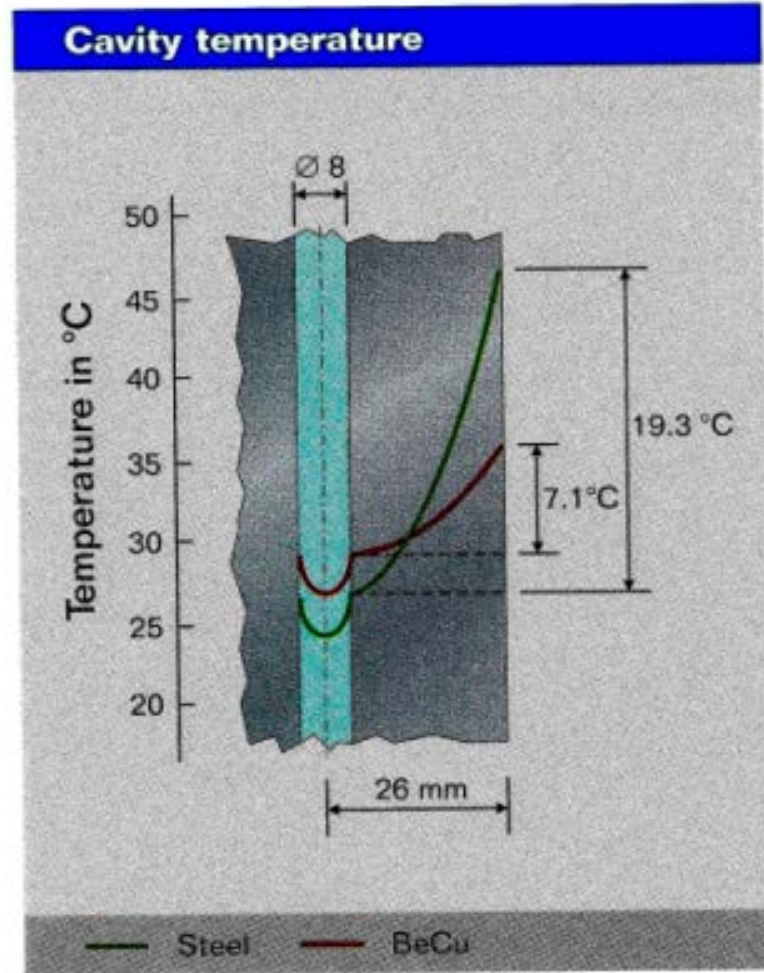
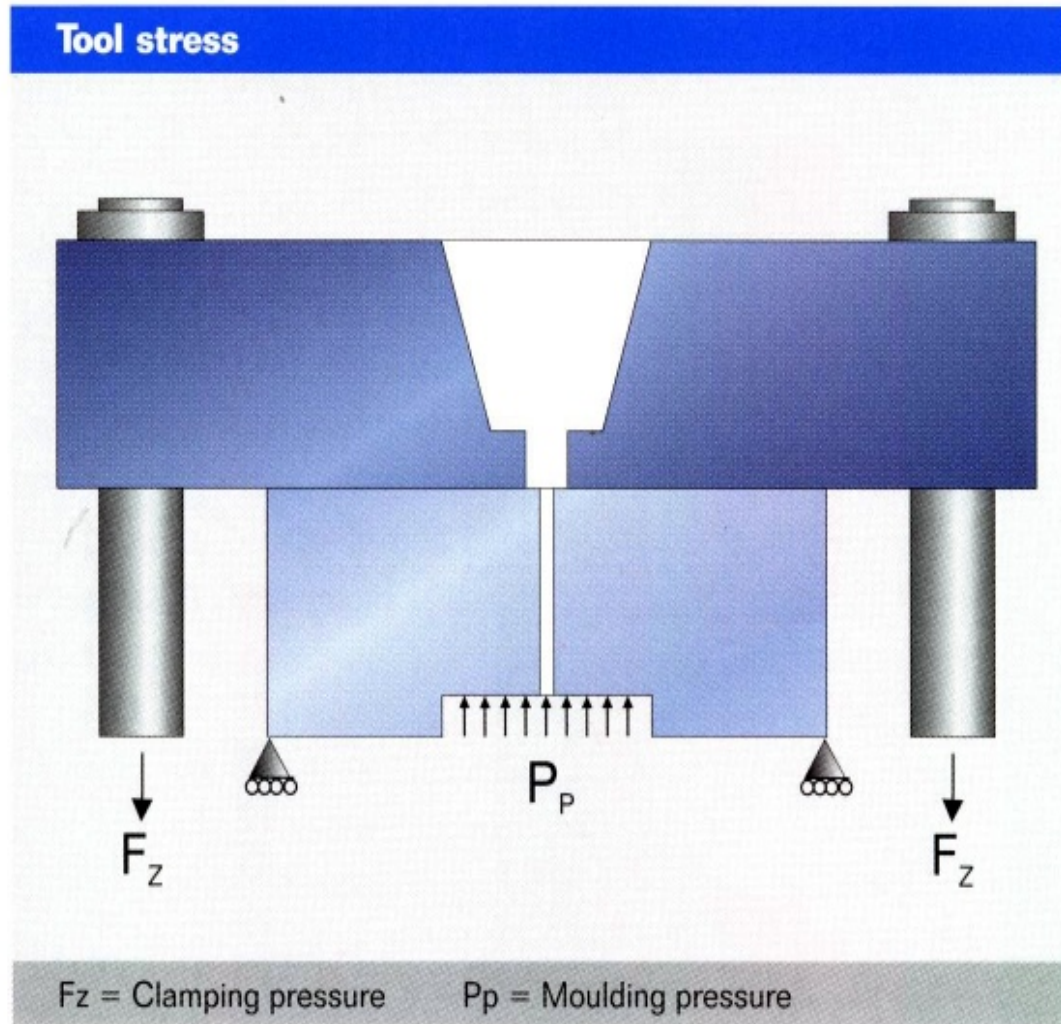


Figure 3.8: Effect of the mould material on the cavity temperature

IHTC/RHCM

- 鋼材拋光性能
- 模具設計
- 鋼材韌性
- 鋼材熱傳導性
- 模具水路加工

The mould stress assumed in the FEM simulation



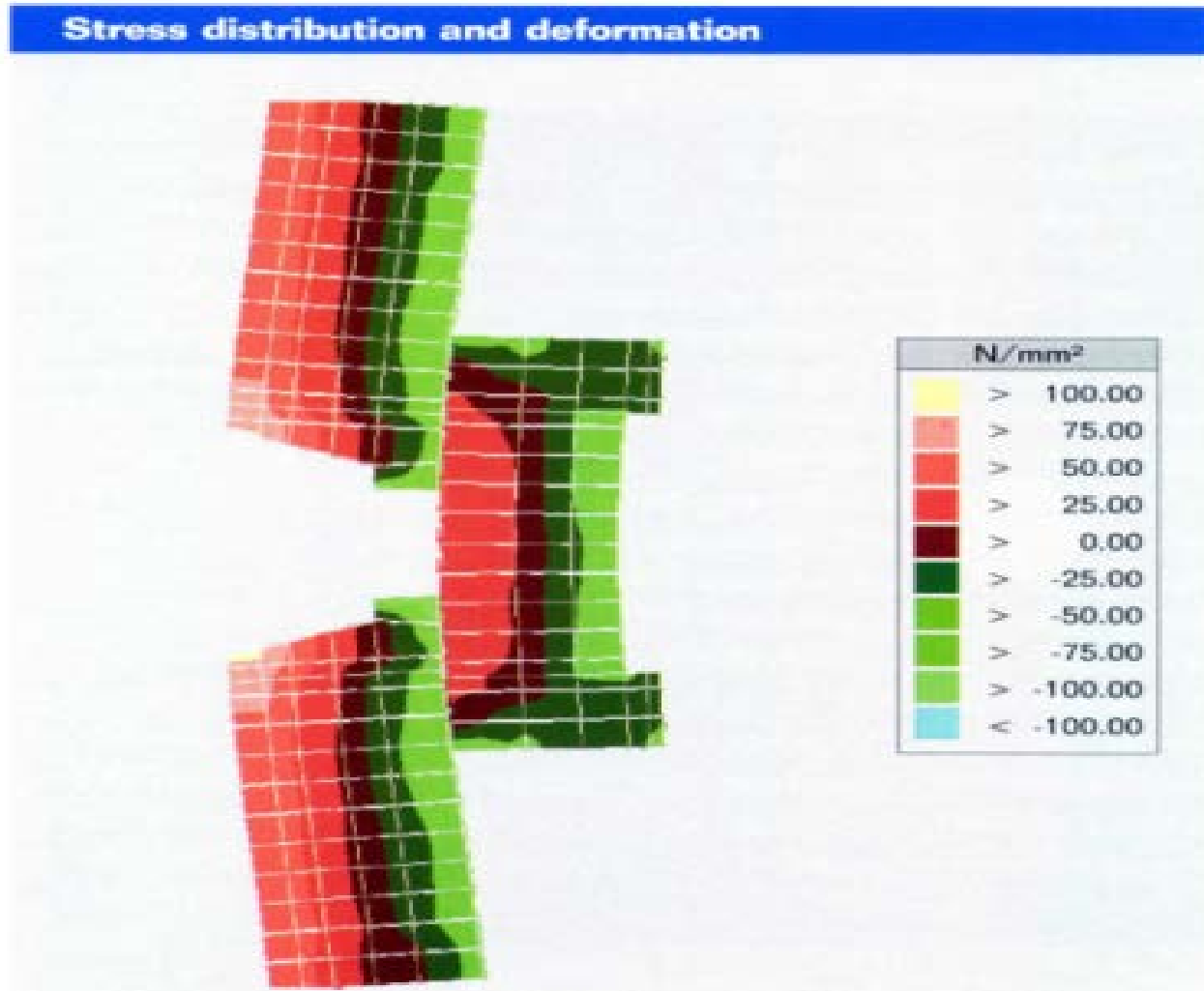
Stress distribution at the surface and in the cross section of the fixed clamping plate and the mould

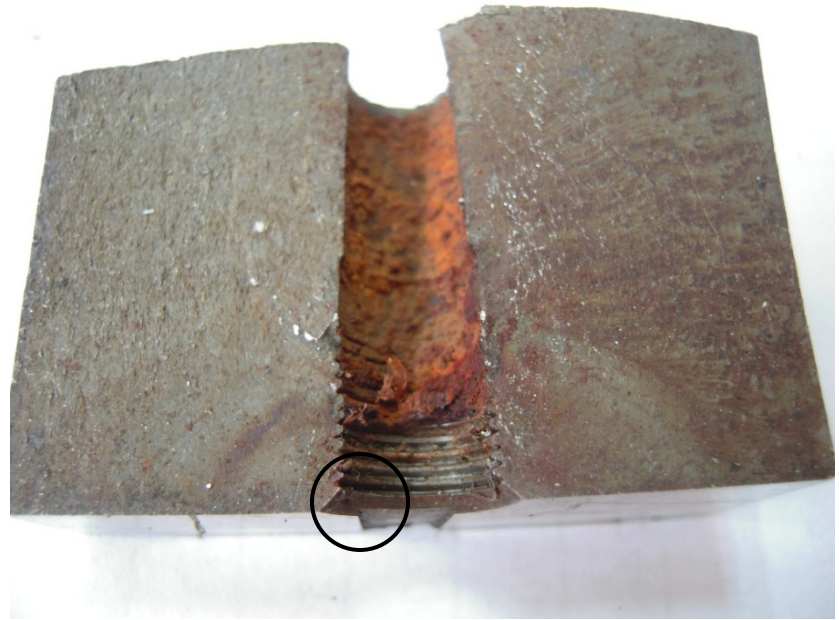
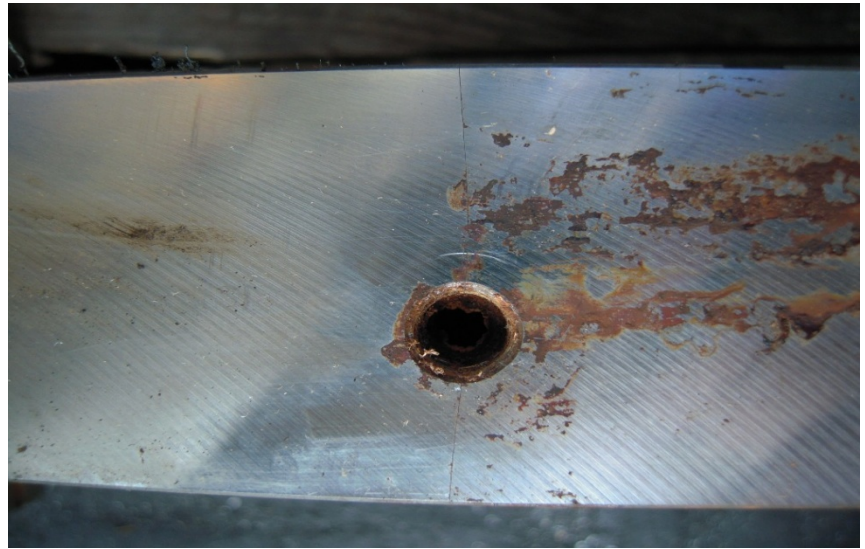
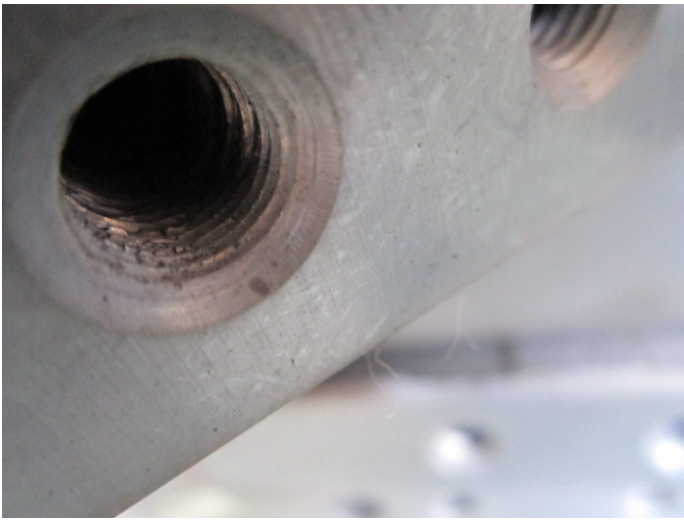
Moulds for plastics processing



Figure 3.14: Stress distribution at the surface and in the cross section of the fixed clamping plate and the mould

Deformation of injection mould and fixed clamping plate





100X

螺牙攻牙所產生的銳角斷面圖，此類銳角於模具生產過程，於水路易產生應力腐蝕。

或於熱處理過程中微裂。



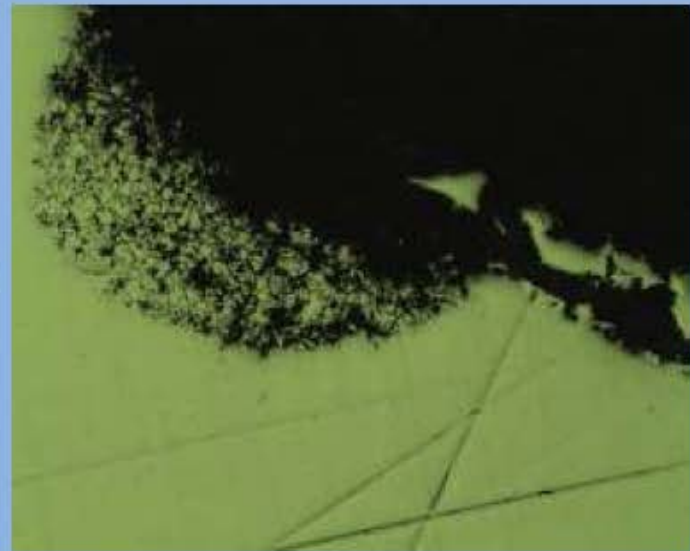
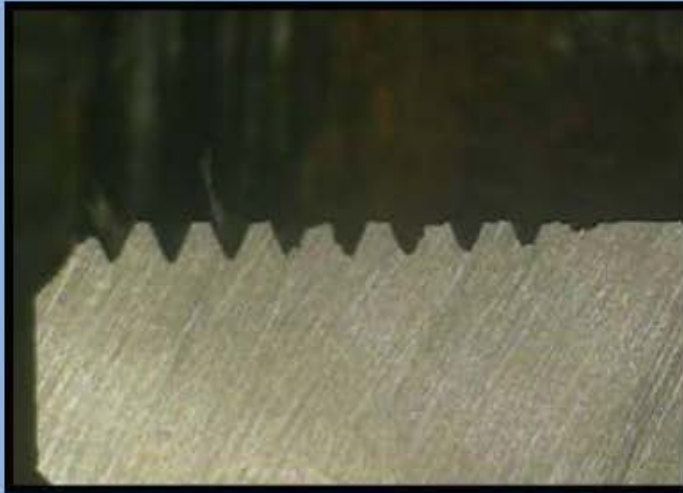
何謂應力腐蝕(Stress cross cracking)：

金屬模具因化學反應或電化學反應過程，加上模具冷熱溫差應力，引起從表至內組織結構損壞腐蝕作用而產生開裂，這就是應力腐蝕裂紋。

50X

螺牙加工中的不良處(凹陷點)，通常表面不良或粗糙，容易造成應力腐蝕的起始點。

凹陷處容易造成水路中的雜質積聚(盲孔回流)



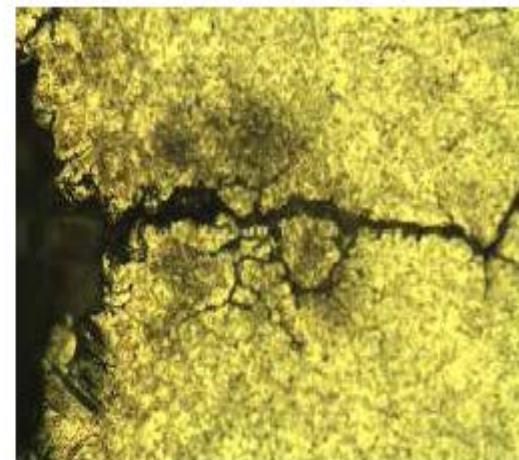
Pig 4 金相組織圖(Microstructure)50 倍(裂紋)



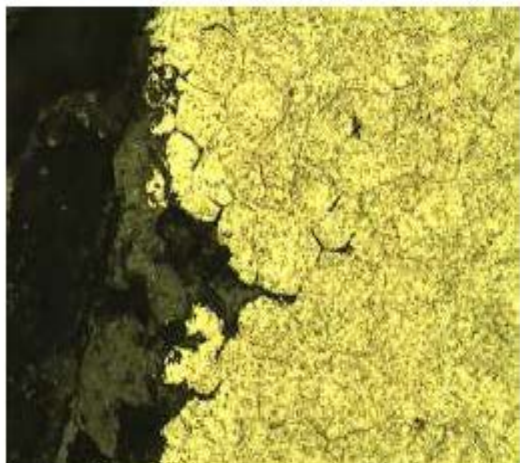
Pig 5 金相組織圖(Microstructure)50 倍(腐蝕後)



Pig 6 金相組織圖(Microstructure)200 倍(腐蝕後)



Pig 7 金相組織圖(Microstructure) 200 倍(腐蝕後)

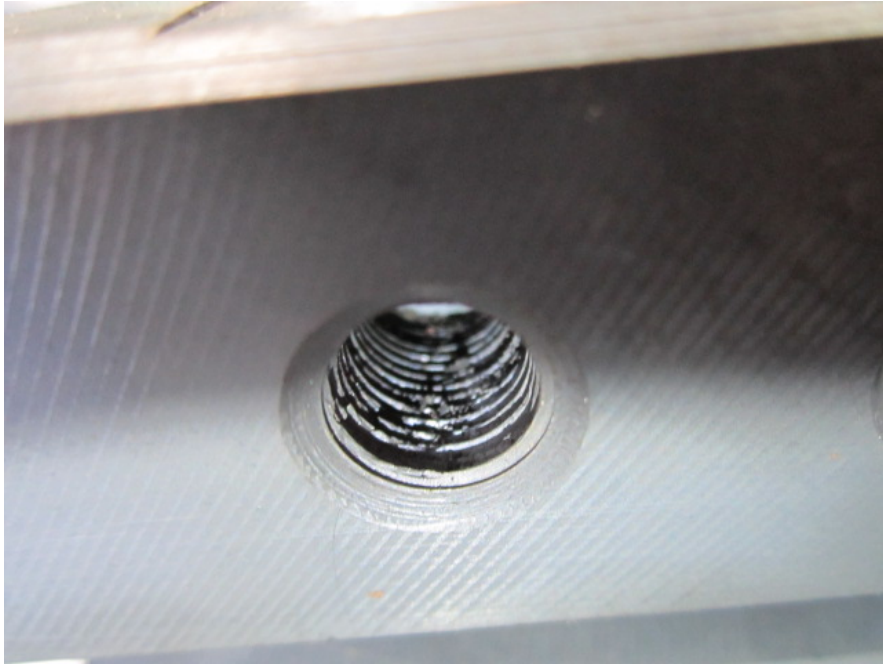


Pig 8 金相組織圖(Microstructure) 500 倍(腐蝕後)



Pig 9 金相組織圖(Microstructure)500 倍(腐蝕後)



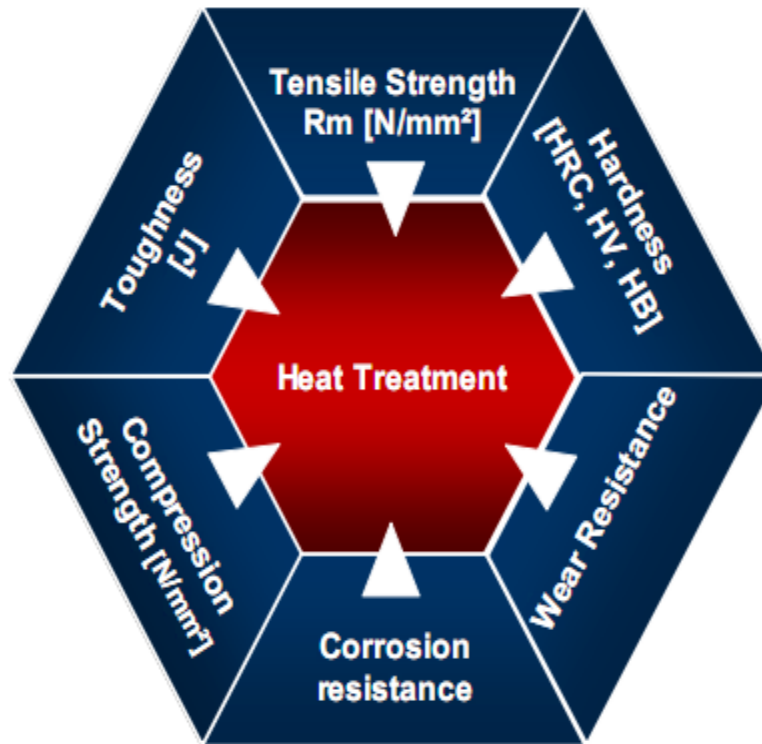


粗糙的螺牙



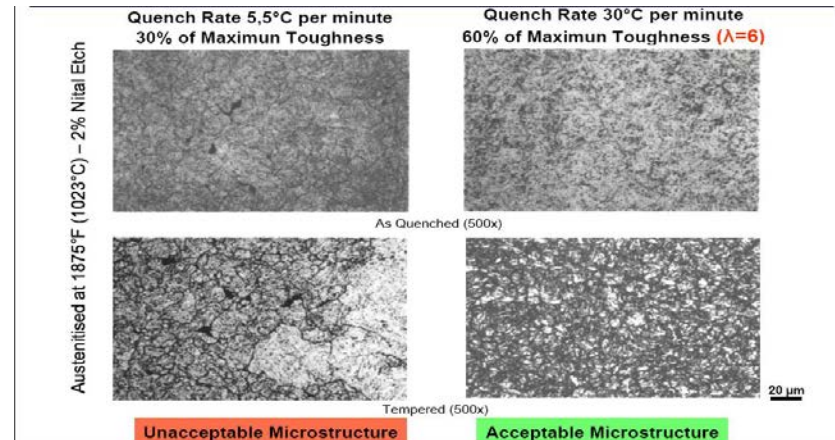
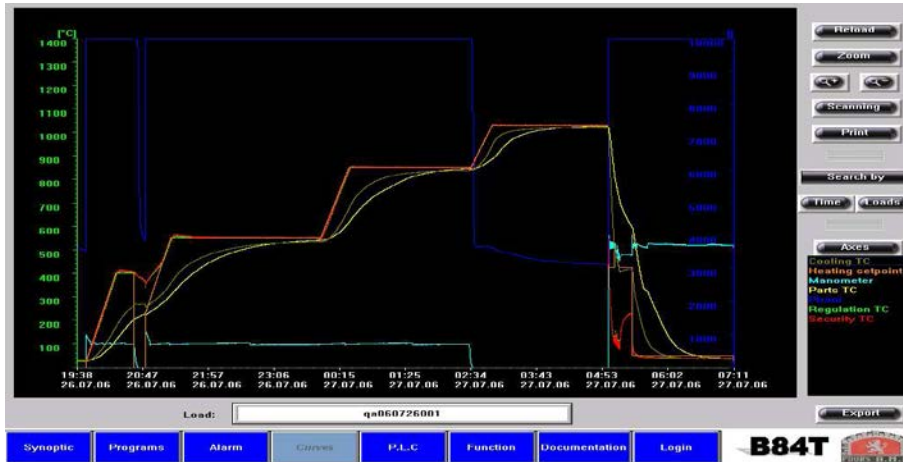
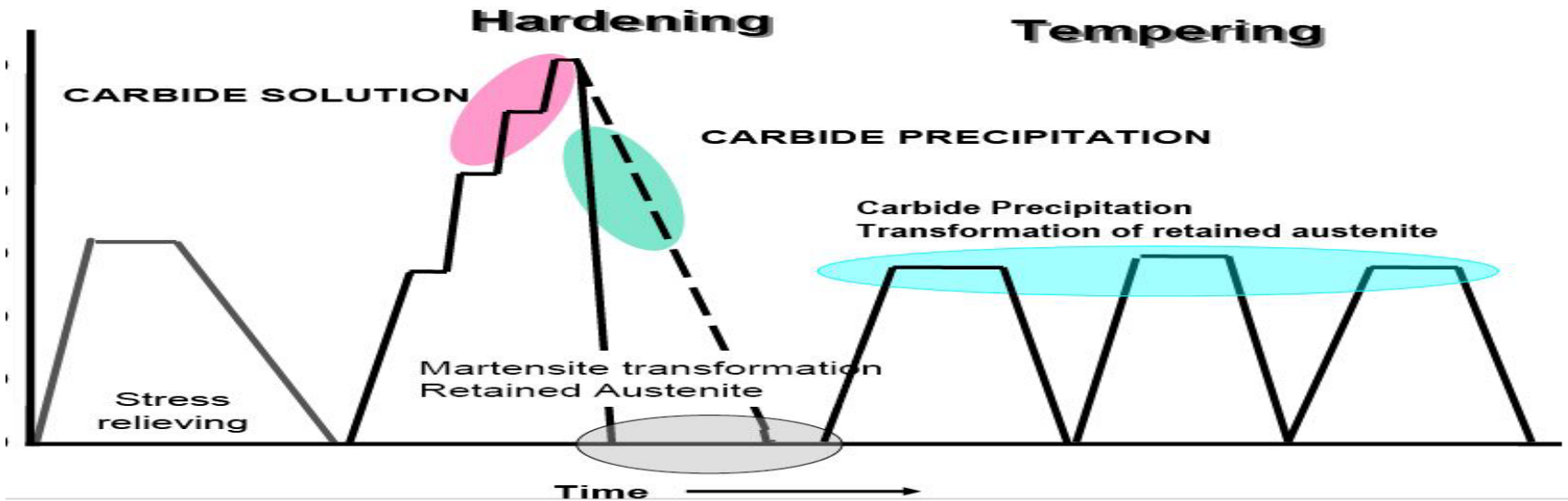
平順的螺牙

信昌牌號	硬度 HRC	合金	熱傳導係數 W/(m.k)	熱膨脹係數 $\times 10^{-6}m/(m.k)$	鏡面度	抗壓強度
M333	44-52	Cr:13%+N	25	10.5	#12000	2400 N/mm ²
W8PH	38-42	Cr,Ni	16	10.9	#10000	1400 N/mm ²
2711	38-42	Ni,Cr,Mo	35.0	12.4	#6000- 8000	1400 N/mm ²



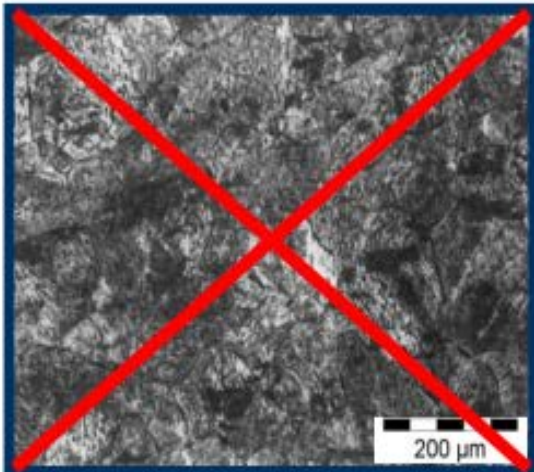
- The heat treatment gives the components the useful properties.
- The alloying elements are creating the basic.

熱處理流程意識圖

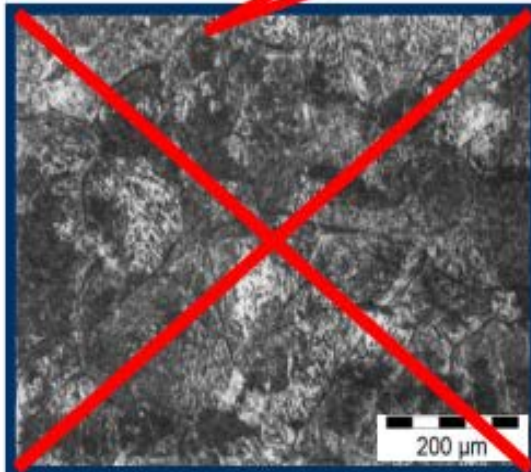


信昌精密模具

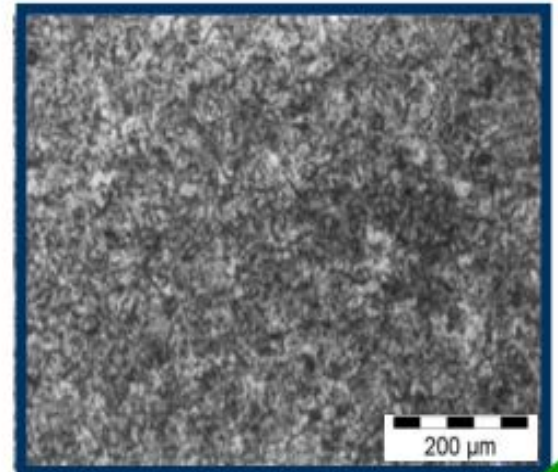
Hardening Temperature too high



980°C, 150 min
W400 VMR



1020°C, 30 min
W400 VMR

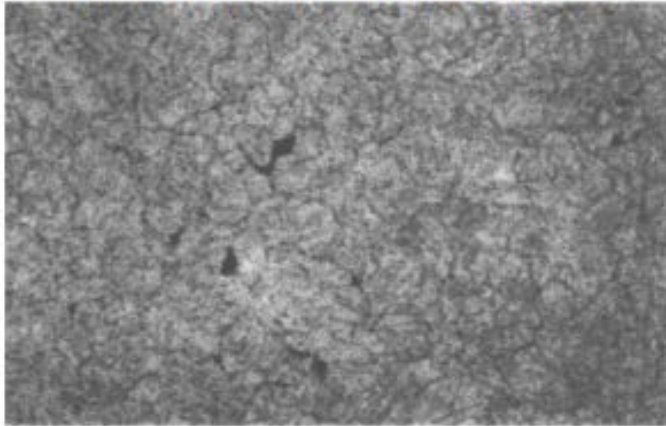


980°C, 30 min
W400 VMR

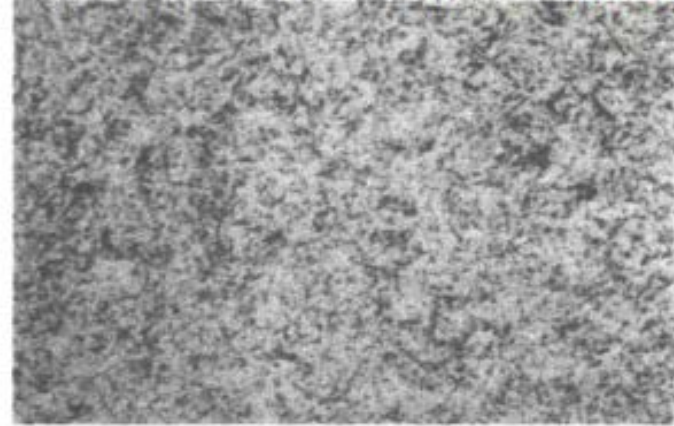
Time at temperature too long

Austenitised at 1875°F (1023°C) – 2% Nital Etch

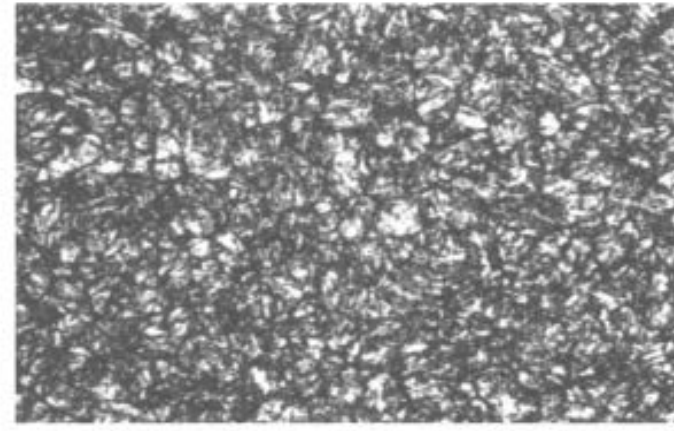
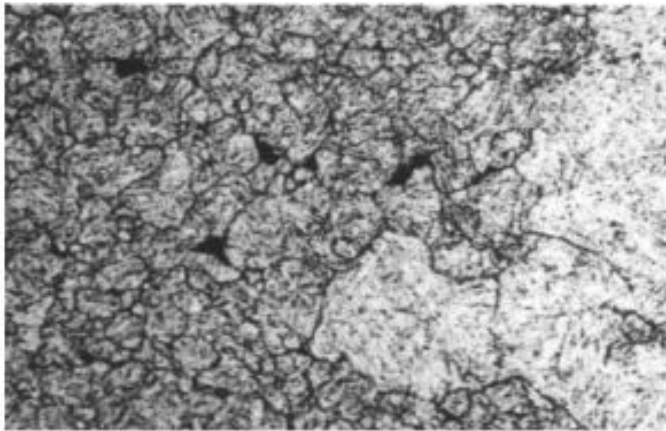
Quench Rate 5,5°C per minute
30% of Maximun Toughness



Quench Rate 30°C per minute
60% of Maximun Toughness ($\lambda=6$)



As Quenched (500x)

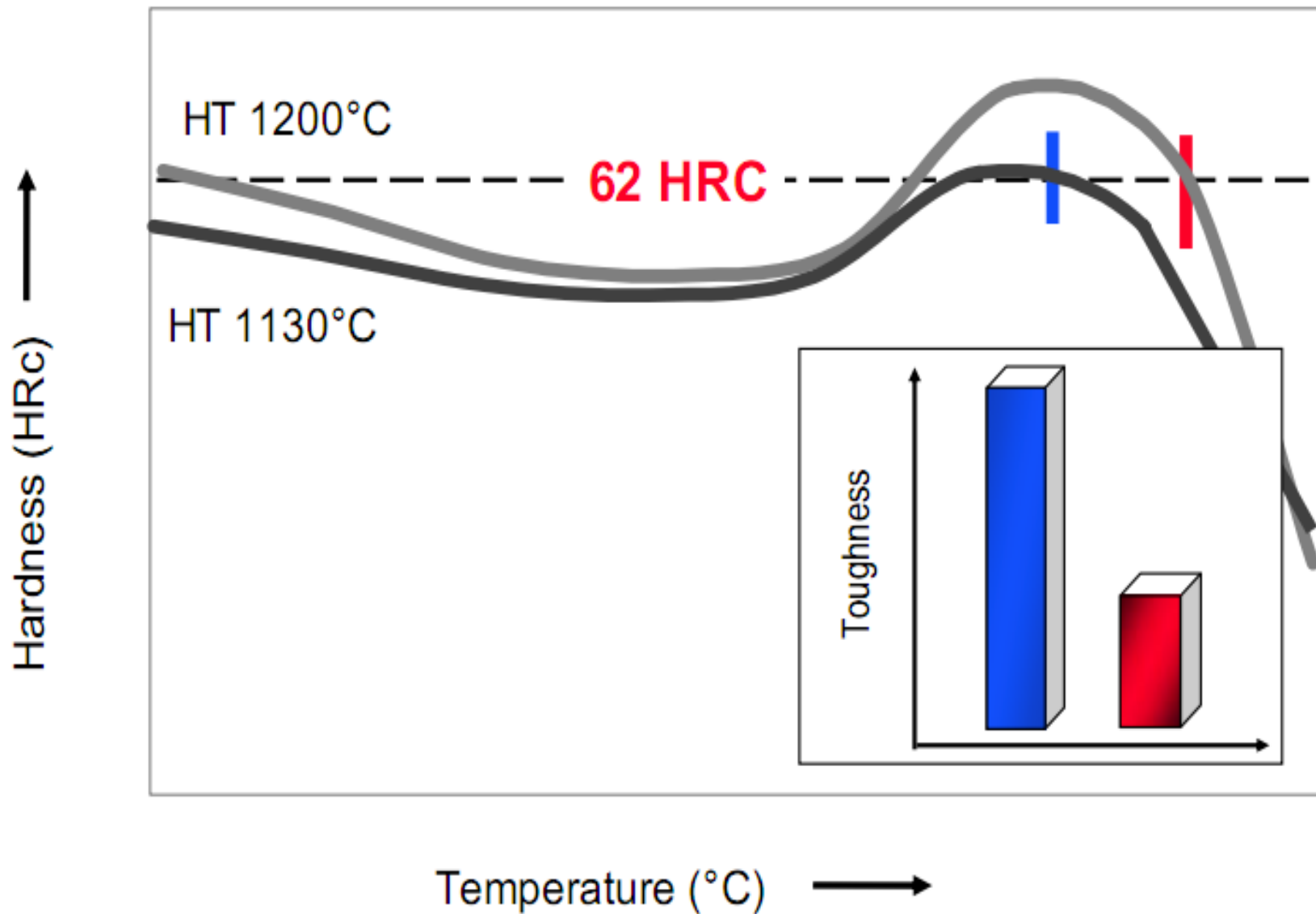


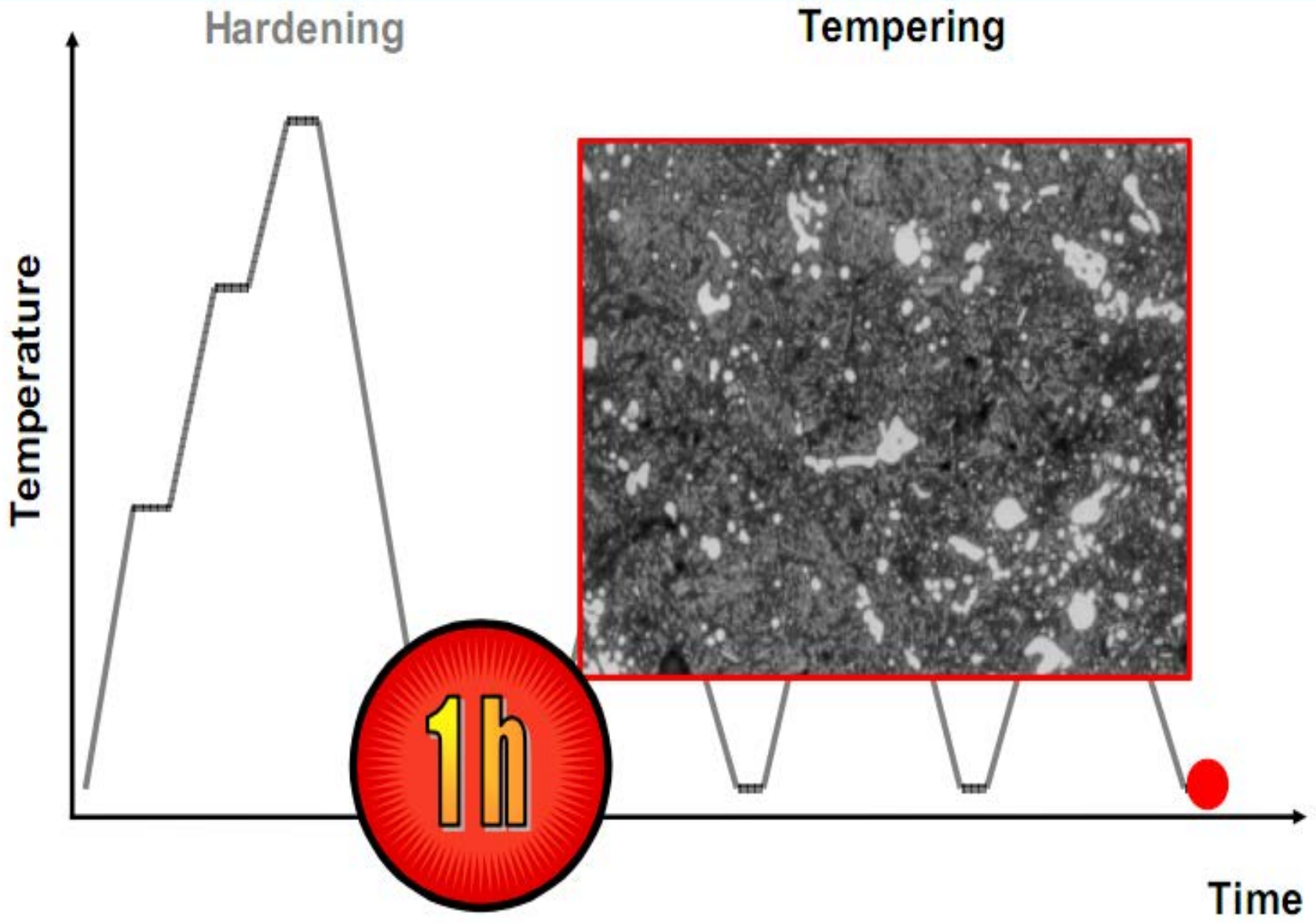
20 μ m

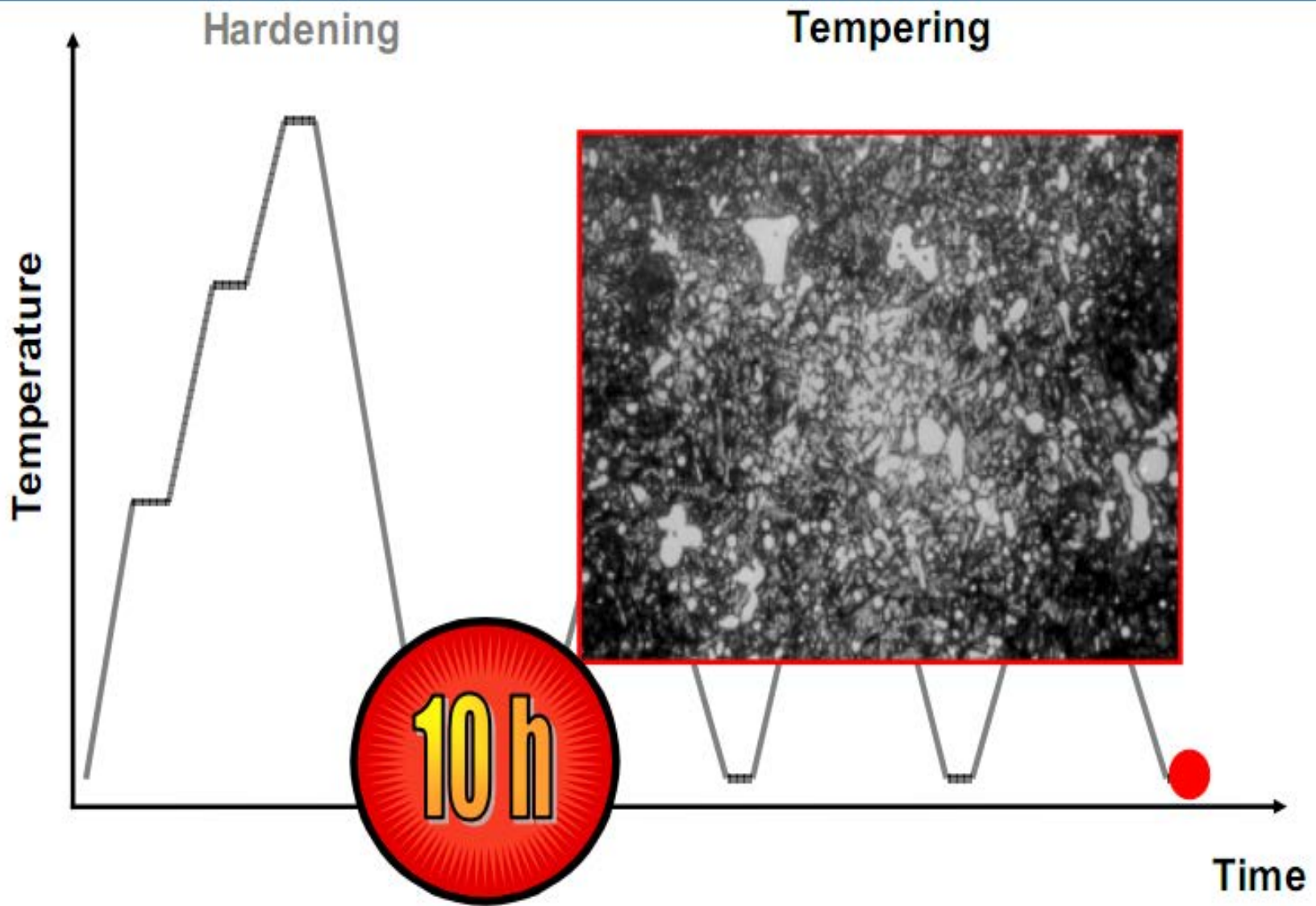
Tempered (500x)

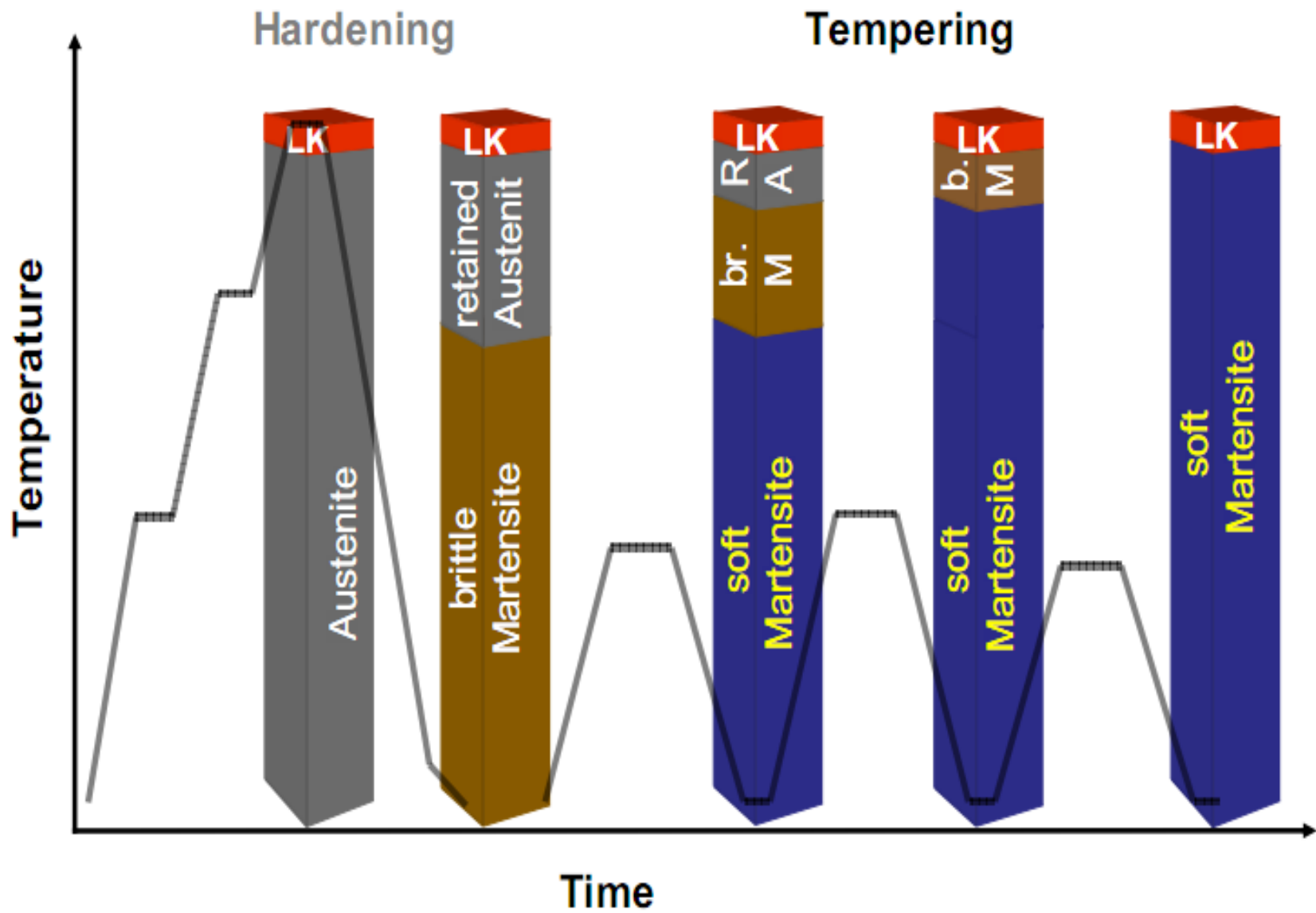
Unacceptable Microstructure

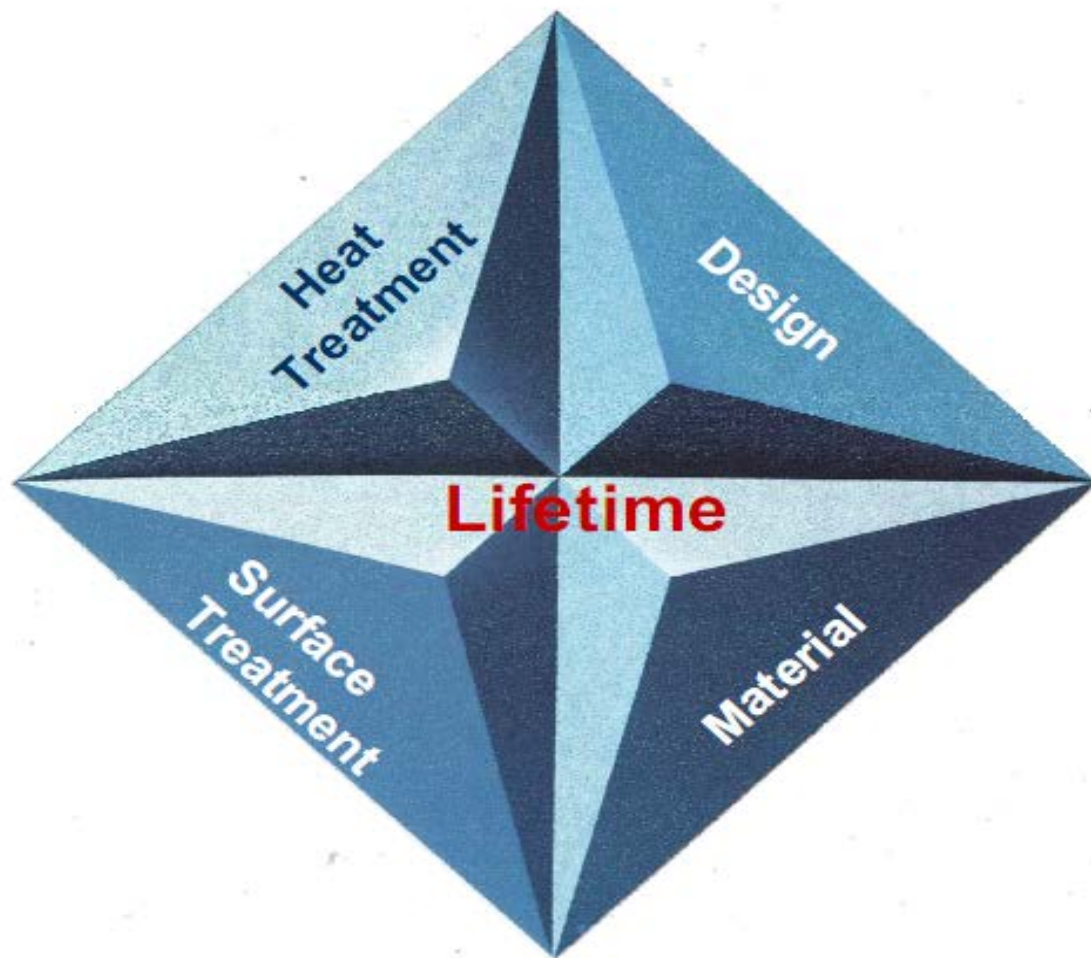
Acceptable Microstructure











Thank you for your attention