

The SKF logo is rendered in a bold, blue, sans-serif typeface. The letters are thick and blocky, with a distinctive design where the top and bottom horizontal strokes of the 'S', 'K', and 'F' are slightly offset from the vertical stems. A small registered trademark symbol (®) is positioned to the right of the 'F'. The logo is centered horizontally within a white rectangular area that has rounded corners and is framed by a thin red border.

Strain tempering of superbainite

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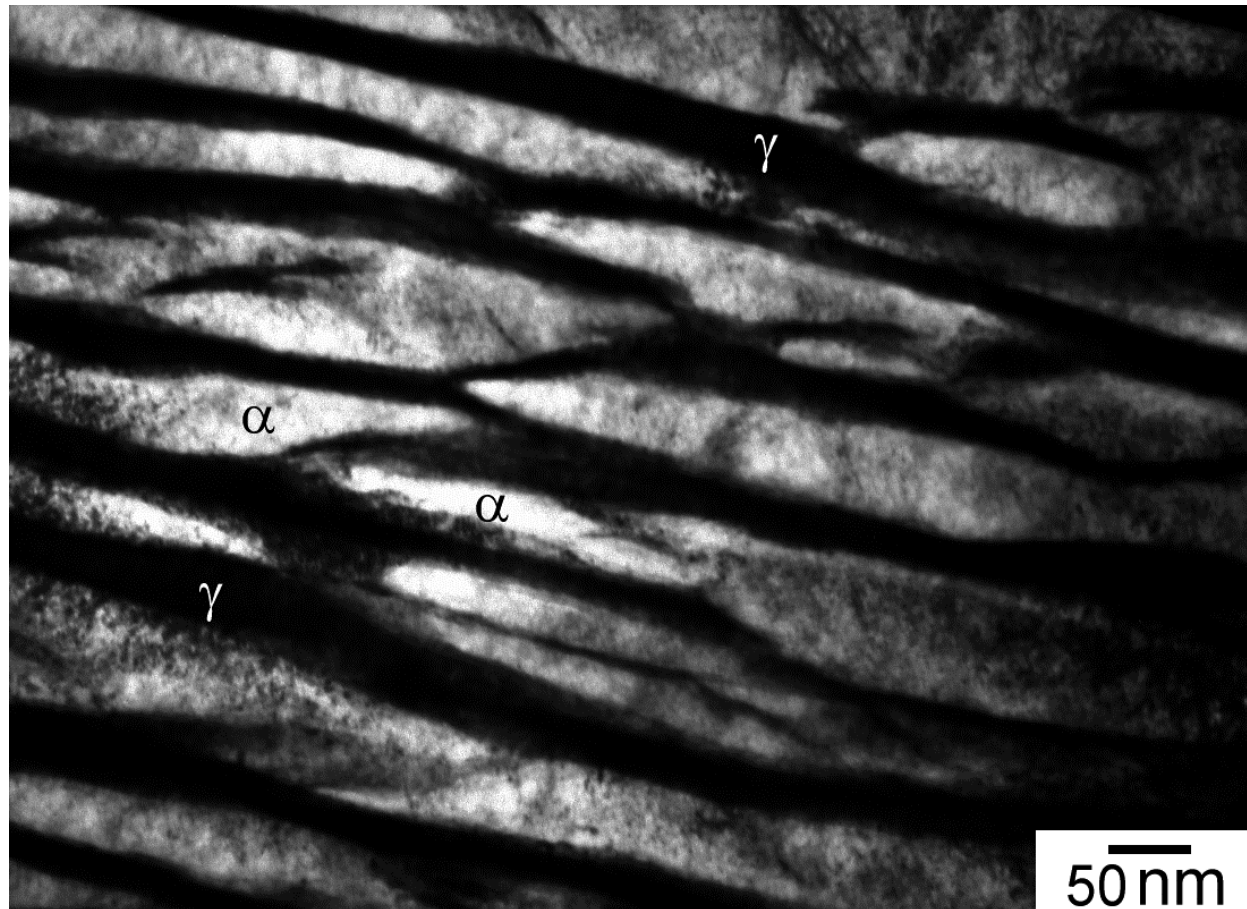
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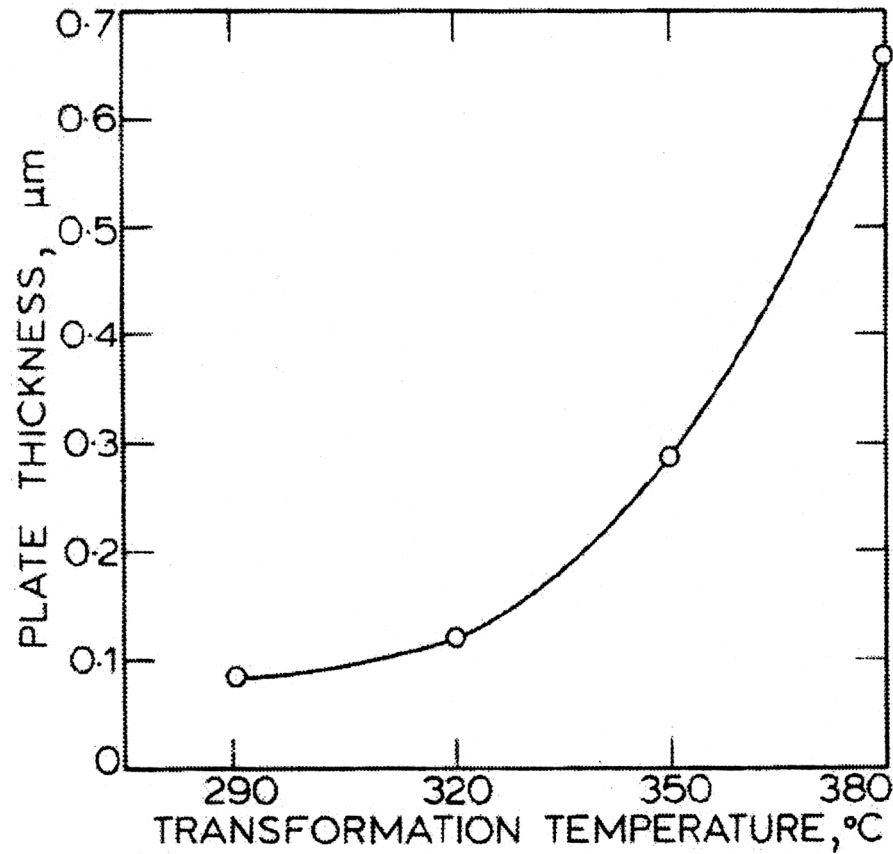
SKF[®]

Superbainite



- ❑ High-carbon high-silicon carbide-free bainite
- ❑ Carbon suppresses the bainite-start temperature leading to a finer structure

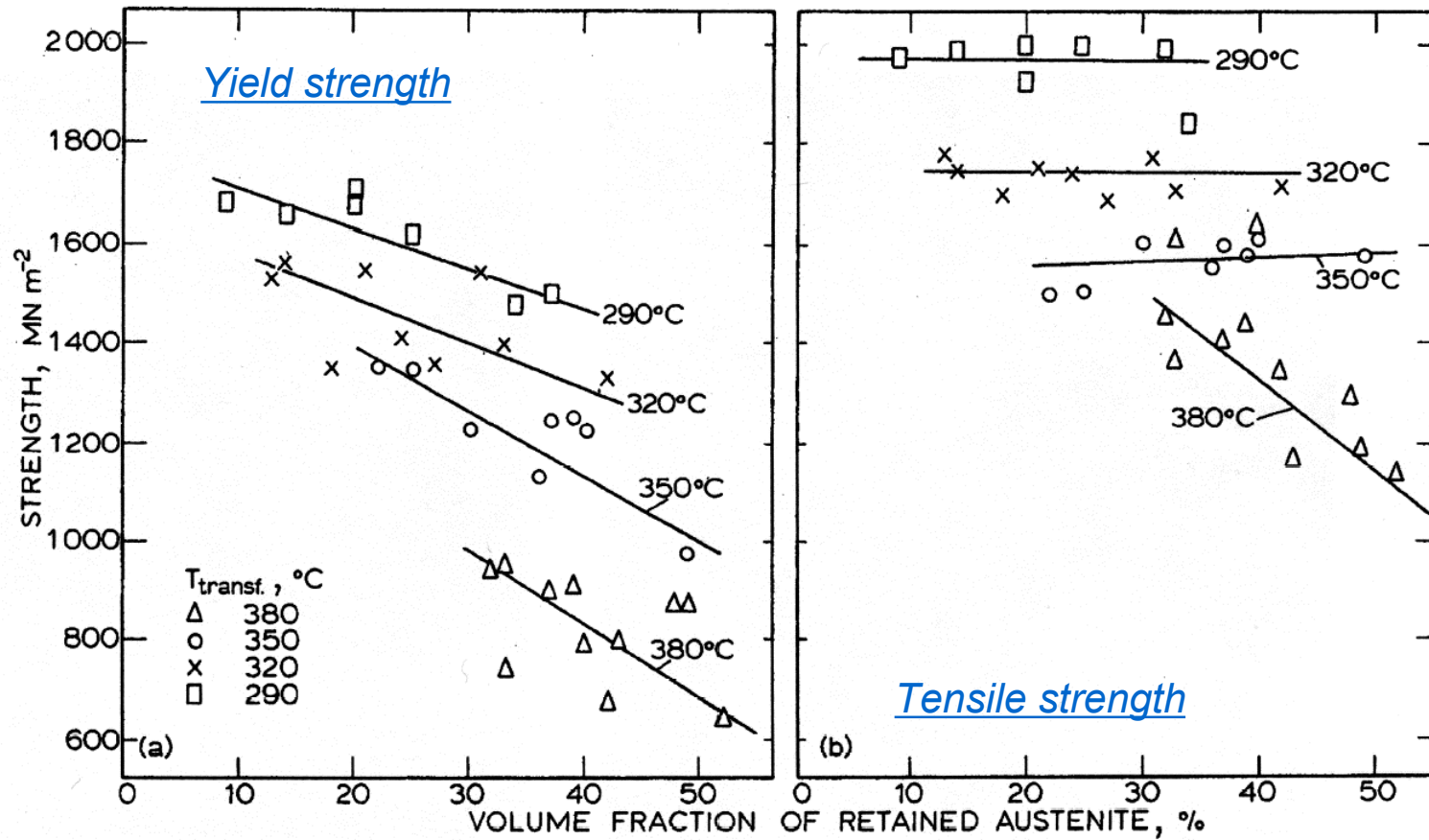
Superbainite – bainite plate width



Steels containing
0.65-0.99 C and 2-
2.78 Si (wt%),
with and without Cr

Copied from: B. P. J. Sandvik and H. P. Nevalainen. Metal. Tech., pages 213-220, June 1981

Superbainite - properties



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Superbainite – some compositions

Alloy	C	Si	Mn	Mo	Cr	Co	Al	P	S	Fe
Sp9	0.83	1.57	1.98	0.24	1.02	1.54	–	–	–	Bal.
Sp9c	0.8	1.59	2.01	0.24	1	1.51	–	0.002	0.002	Bal.
Sp10c	0.79	1.56	1.98	0.24	1.01	1.51	1.01	0.002	0.002	Bal.
Sp11c	0.78	1.6	2.02	0.24	1.01	3.87	1.37	0.002	0.002	Bal.

In wt%

Superbainite – heat treatments

- ❑ Steel ingots were provided by Corus UK, hot-rolled down to slabs of 40 mm thickness
- ❑ Samples were cut and then homogenised at 1200°C for 48 h in a vacuum furnace. Then they were left in the furnace to cool down to room temperature over a period of 24 h resulting in a fully pearlitic microstructure
- ❑ Austenitisation was carried out within the range 920°C - 1100°C depending on alloy composition
- ❑ Cooling to the isothermal holding temperature for bainite transformation to take place:
 - # at 300°C for 6 h
 - # at 250°C for 15 h
 - # at 200°C for 3 days
- ❑ Air cooling

Strain tempering

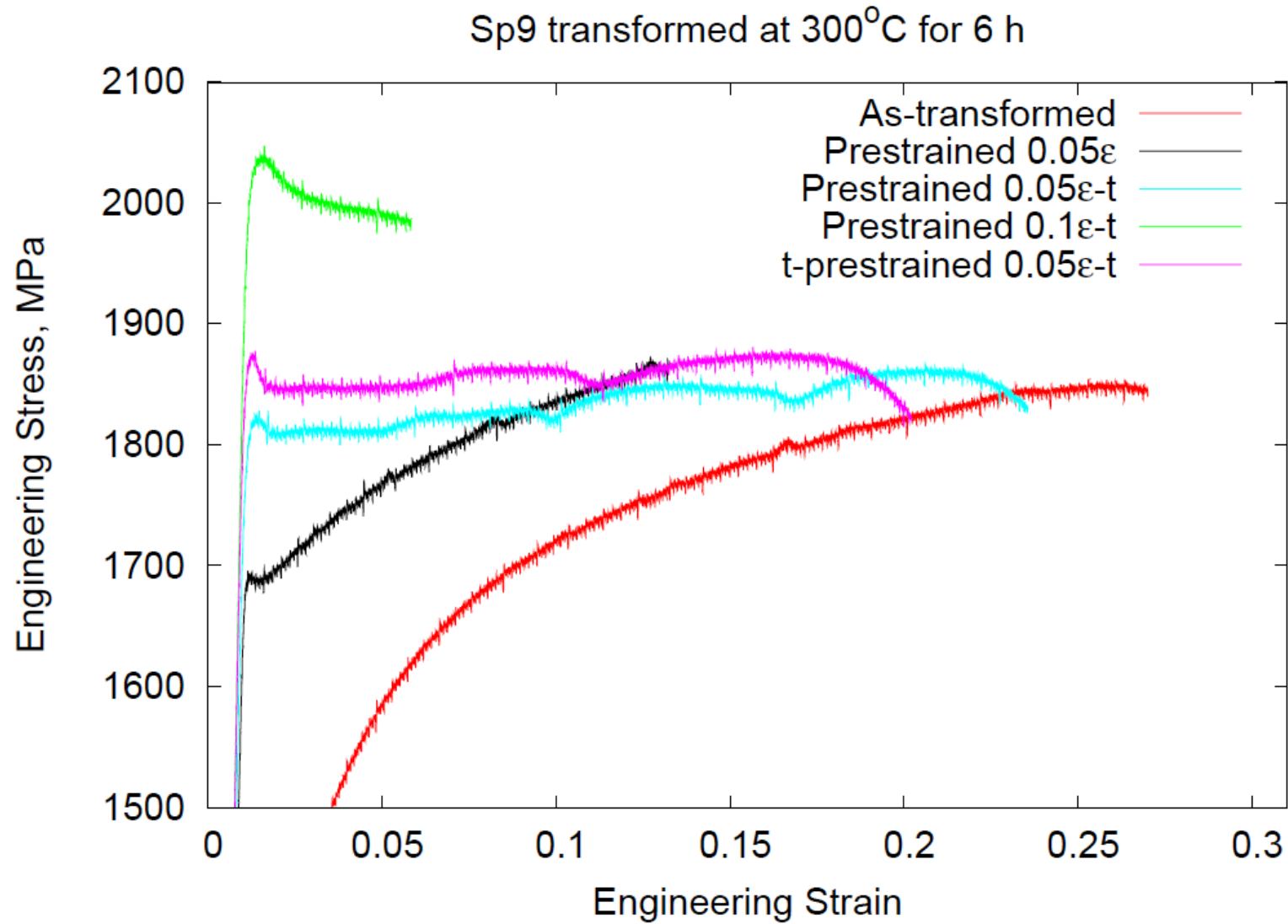
The process involves plastically deforming the as-transformed bainitic structure preceded and or followed by tempering

- Straining in uniaxial tension at room temperature to ε (engineering) ≤ 0.1 then unloading
- Tempering at 300°C for 2 h
- Testing!

References:

- 1- D. Kalish, S. A. Kulin, and M. Cohen. Bainitic structures and thermomechanical treatments applied to steel. JOM, pages 157-164, 1965
- 2- D. Kalish, M. Cohen, and S. A. Kulin. Strain tempering of bainite in 9Ni-4Co-0.45C steel. J. Mater., 5:169-183, 1970
- 3- M. K. Fondekar, A. M. Rao, and A. K. Mallik. Strain tempering of bainite. Metall. Trans., 1:885-890, 1970

Strain tempering



Strain tempering

Process	YS (before deformation) MPa	YS MPa	TS MPa	UE %	TE %
0.05 ϵ	733	1681	1872	12.7	13.2
0.05 ϵ -t	731	1789	1866	20.6	23.6
t-0.05 ϵ -t	825	1851	1881	16.4	20.2
0.1 ϵ -t	740	1999	2047	1.6	5.8

Mechanical properties of Sp9 transformed at 300°C for 6 h.
't' stands for tempering

