LoCoLite

GA 604240

Can we replace H13 with G3500?

TBZ PARIV

Athens, Greece
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H13

Categorie Metal; Ferrous Metal; Tool Steel; Hot Work Steel

Material Notes:

High hardenability, excellent wear resistance and hot toughness. H13 has good thermal shock resistance and will tolerate some water cooling in service. Nitriding will improve hardness, but can diminish shock resistance if hardened layer is too thick. Electroslag Remelted (ESR) H13 has greater homogeneity and an exceptionally fine structure, resulting in improved machinability, polishability and high temperature tensile strength.
Applications: hot work applications: pressure die casting tools, extrusion tools, forging dies, hot shear blades, stamping dies, plastic molds. ESR H13 is great for aluminum die-casting tools and plastic mold tools requiring a very high polish.
Weldability: Pre and Post-heating recommended, can be welded with oxy-acetylene,
inert shielded gas and shielded metal arc; Filler should be similar to the base metal.

Key Words: UNS T20813, ASTM A681, FED QQ-T-570, BS 4659 BH13, BS 4659 H13, BS EN ISO 4957 :2000 X40CrMoV5-1, Werkstoff 1.2344

Physical Properties **H13 and G3500**

Physical Properties	**H13**	**G3500**
Density	7.80 g/cc	7,15 g/cc
Mechanical Properties	**Metric**	
Hardness - Rockwell	28-54 (HRD)	17,5 (C)
Tensile Strength - Ultimate	1990 MPa	> 220 MPa
Tensile Strength - Yield	1650 MPa	> 245 MPa
Modulus of Elasticity	210 GPa	124 GPa
Bulk Modulus	160 GPa	
Poissions Ratio	0,3	0,26
Thermal Properties		
Coefficient of thermal expansion	11,0 µm/m -°C	9 - 10 µm/m °C
Specific Heat Capacity	0.460 J/g-°C	0,490 J/g °C
Thermal Conductivity	**19-27 W/m-K**	**53 W/mK**

Source: http://www.matweb.com

Chemical properties:

H13 : X40CrMoV5-1 : 1.2344

ELEMENT	C	Si	Mn	Cr	Mo	V	P	S
WEIGHT-%	0,4	1,2	0,2	4,96	1,25	0,45	0,003	0,002

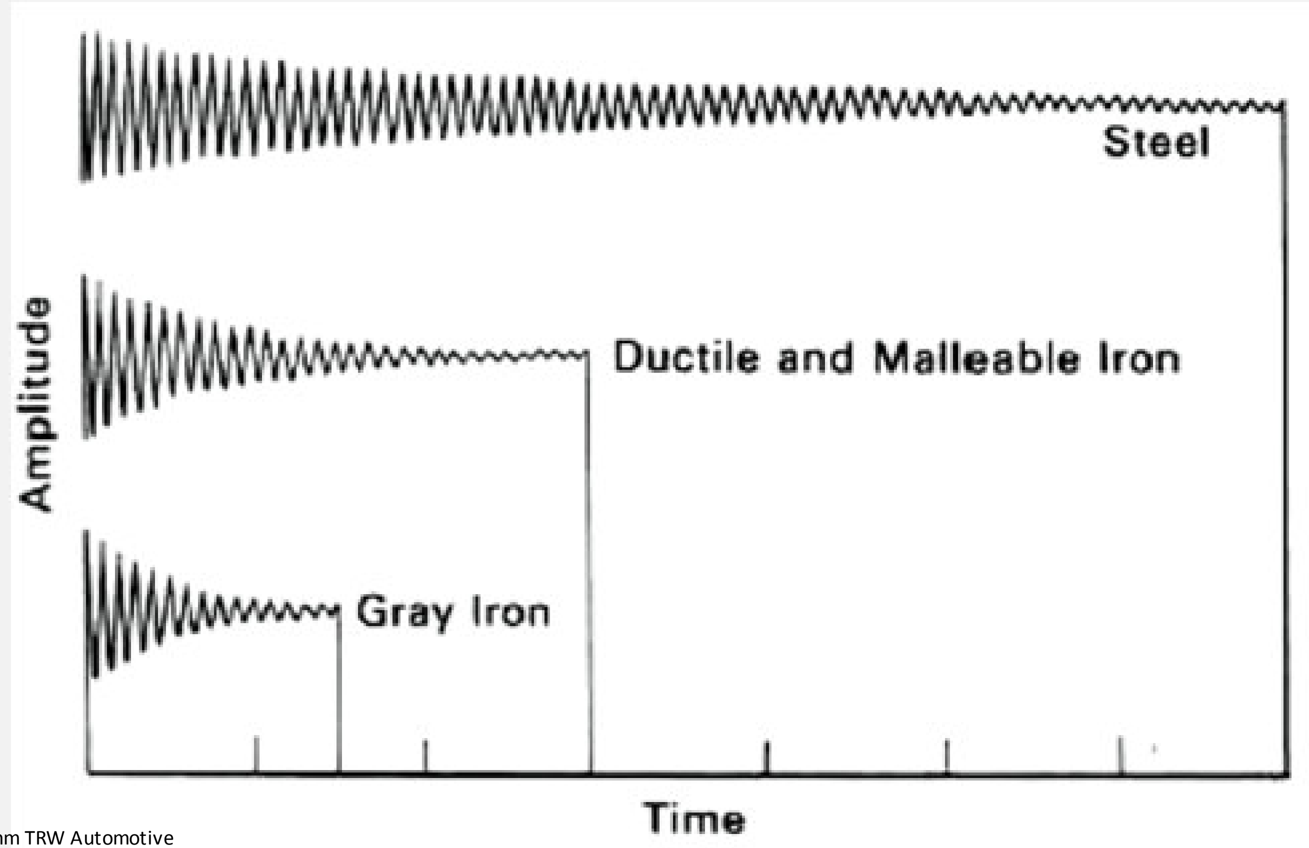
G3500

Element	Carbon - C	Silicon - Si	Manganese - Mn	Cr	Mo	V	Phosphorous - P	Sulfur - S	**Iron - Fe**
Weight %	3.0 - 3.3	1.8 - 2.2	0.6 - 0.9				0.08	0,15	**94**

Grade	Brinell hardness	Tensile Strength/Hardness	Structure
G1800	120 up to 287	135	Ferritic - pearlitic
G2500	170 up to 229	135	Pearlitic-ferritic
G3000	**187 up to 241**	**150**	**Pearlitic**
G3500	207 up to 255	165	Pearlitic
G400	217 up to 269	175	Pearlitic

Class	Tensile strength [Mpa]	Compressive strength [MPa]	Tensile modulus (E) [MPa]
20	145	228	69
30	**214**	**752**	**97**
40	393	965	124
60	431	1293	145

DAMPING



Source: Mark Ihm TRW Automotive

DAMPING

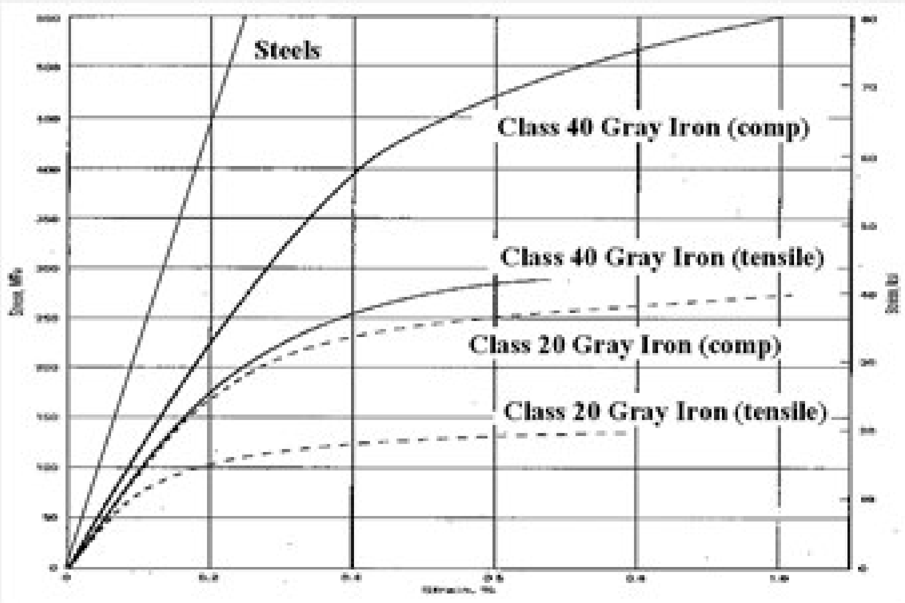
Material	Damping capacity
Gray Iron (high carbon equivalent)	100 up to 500
Gray iron (low carbon equivalent)	20 up to 100
Ductile iron	5 up to 20
Malleable iron	8 up to15
White iron	2 up to 4
Steel	app. 4
Aluminum	app. 0,47

DAMPING

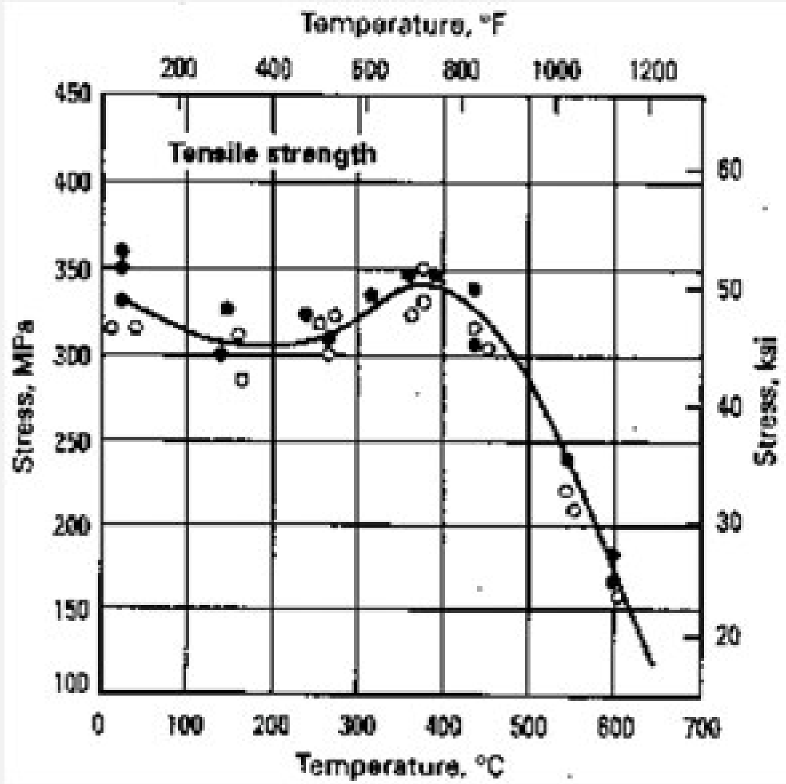
Type of Metal	Relative Decrease in Amplitude of Vibration per Cycle
Carbon Steel	1.0–2.0
Malleable Iron	3.3–6.3
Ductile Iron	3.0–9.4
50,000-psi Gray Iron	4.0–9.0
40,000-psi Gray Iron	8.5–12.0
30,000-psi Gray Iron	20–60
Hypoeutectic Gray Iron 3.2% C, 2.0% Si	40
Eutectic Gray Iron 3.9% C, 0.9% Si	105
Hypereutectic Gray Iron 3.7% C, 1.8% Si	126

Source: Mark Ihm TRW Automotive

Module of Elasticity



Tensile stress

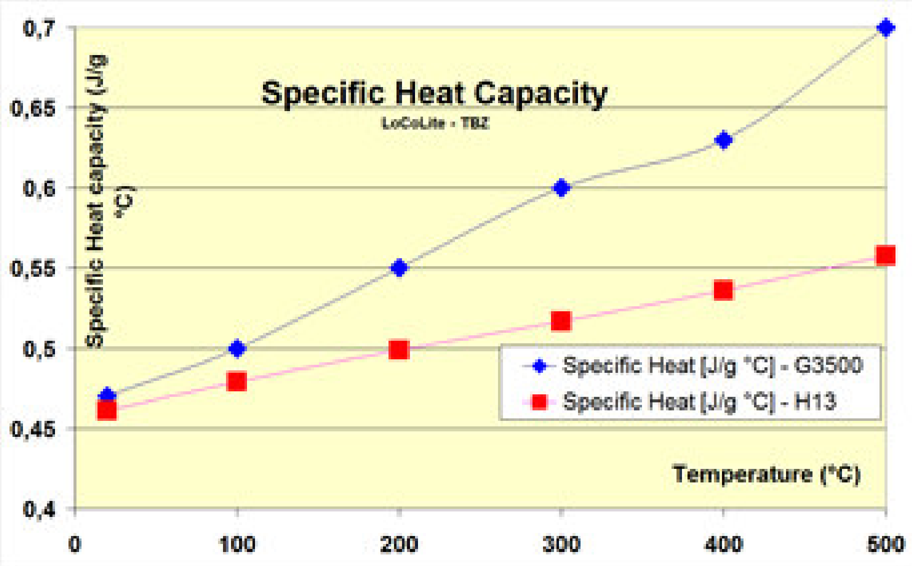


Source: Mark Ihm TRW Automotive

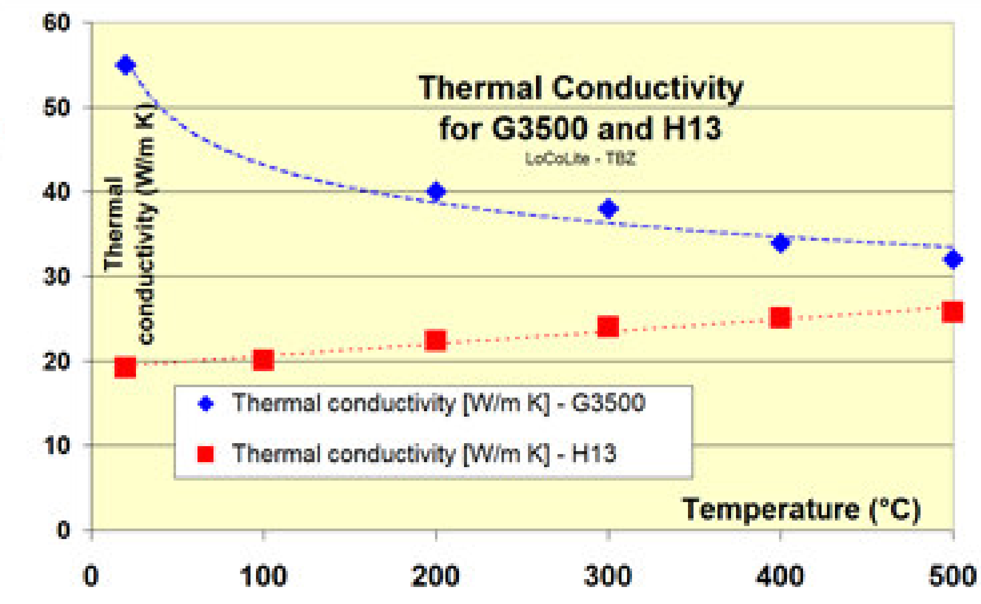
Heat Properties

Material	Density (g/cm³)	Heat Capacity (J/kg °K)	Specific Heat (J/cm³ °K)	Melt Temperature (°C)
G1800 Gray Cast Iron	7.15	545	0.076	1150
G3000 Gray Cast Iron	7.2	545	0.076	1145
G4000 Gray Cast Iron	7.25	545	0.075	1145
1008 Plain Carbon Steel	7.86	481	0.061	1620
302 Austenitic Stainless Steel	7.93	500	0.063	1400
356 Cast Aluminum Alloy	2.69	963	0.358	675
Copper	8.94	494	0.055	1083
Brass	8.75	380	0.043	990
AZ63 Cast Magnesium	1.8	1005	0.558	455

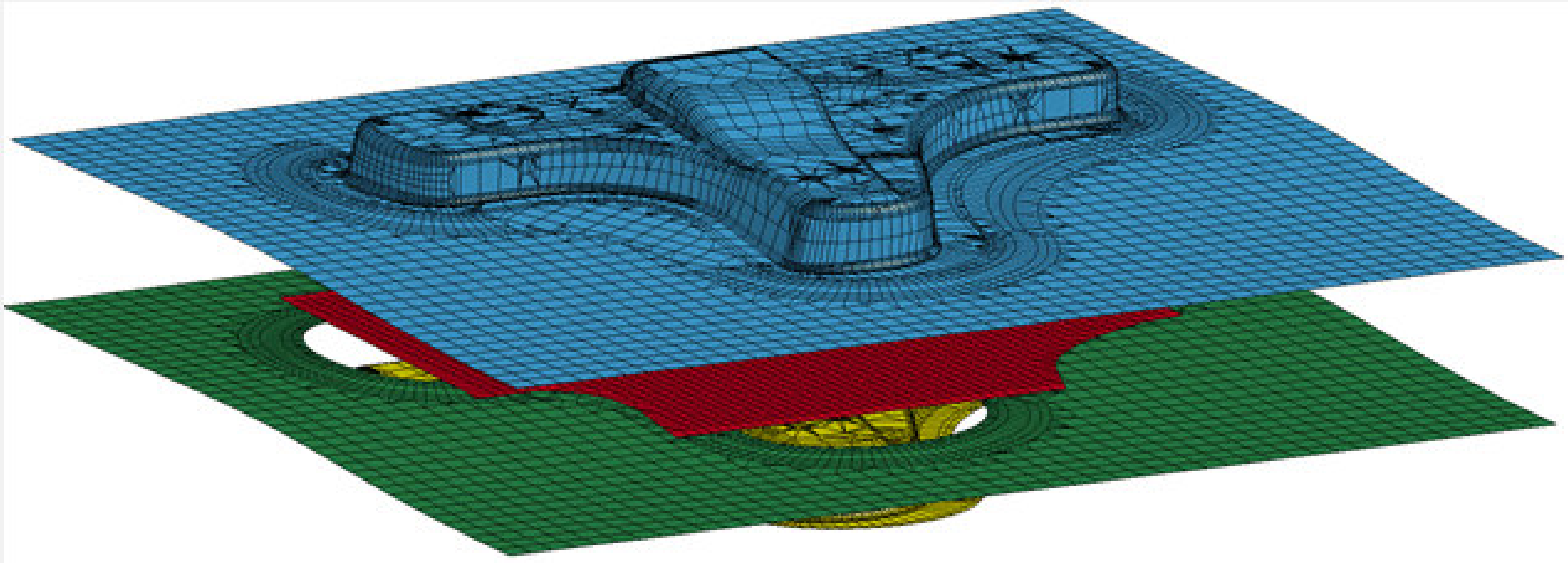
Source: Mark Ihm TRW Automotive

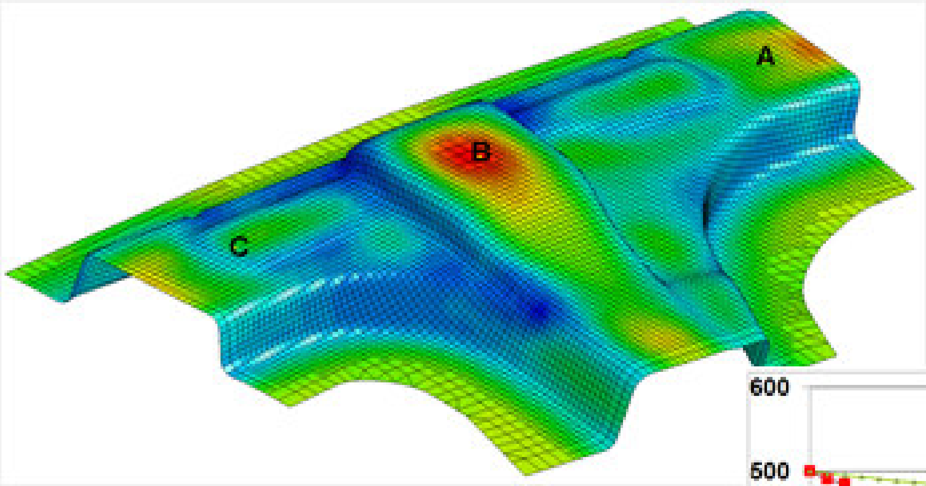


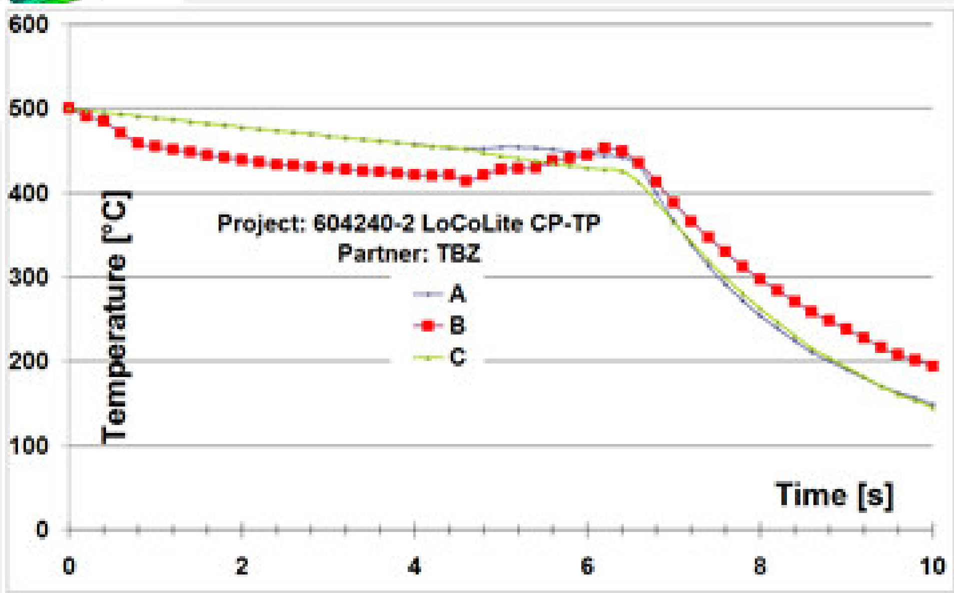
G3500 compared with H13



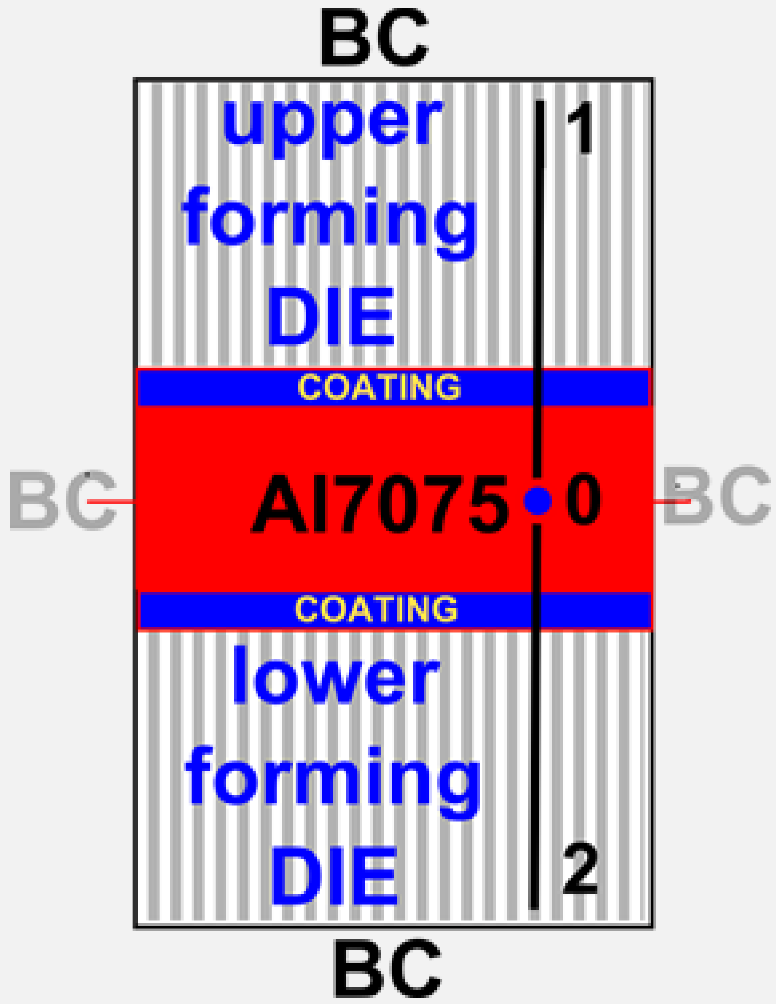
Process simulation




A
B
C


Project: 604240-2 LoCoLite CP-TP
Partner: TBZ
A
B
C
Temperature [°C]
Time [s]
0
100
200
300
400
500
600
0
2
4
6
8
10

Simplified model:
Axially symmetrical



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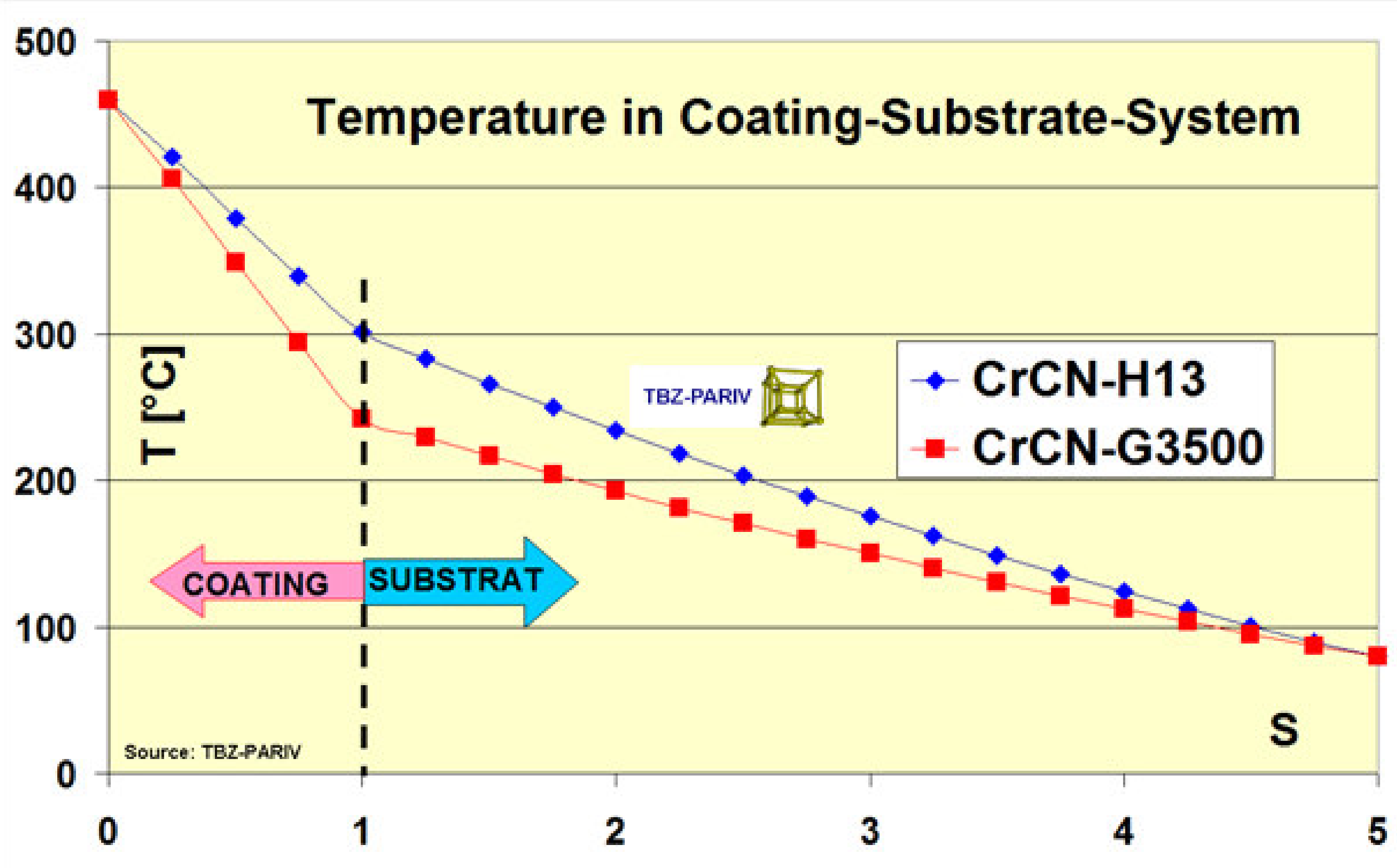
TBZ-PARIV

Used material properties

Mate-rial	Modulus of Elasticity [N/mm3]	Density [t/mm3]	CTE - linear α [1/°C]	Thermal-Con-ductivity -k- [t mm2/s3 °C]	Poissons Ratio [-]	Specific Heat Capacity [mm2/s2 °C]	Source
CrCN	3.1 105	5.9 10-9	2.3 10-6	12	0.25	6.45 108	www.matweb.com
G3500	1.50 105	7.1 10-9	10.5 10-6	46	0.26	4.6 108	www.makeitfrom.com
Al7075	7.17 104	2,81 10-9	25.2 10-6	130	0.33	9.6 108	www.matweb.com
H13	2.15 105	7.8 10-9	12.6 10-6	24,3	0.30	4,6 108	www.matweb.com


Temperature in Coating-Substrate-System
T [°C]
500
400
300
200
100
0
0
1
2
3
4
5
S
TBZ-PARIV
CrCN-H13
CrCN-G3500
COATING
SUBSTRAT
Source: TBZ-PARIV

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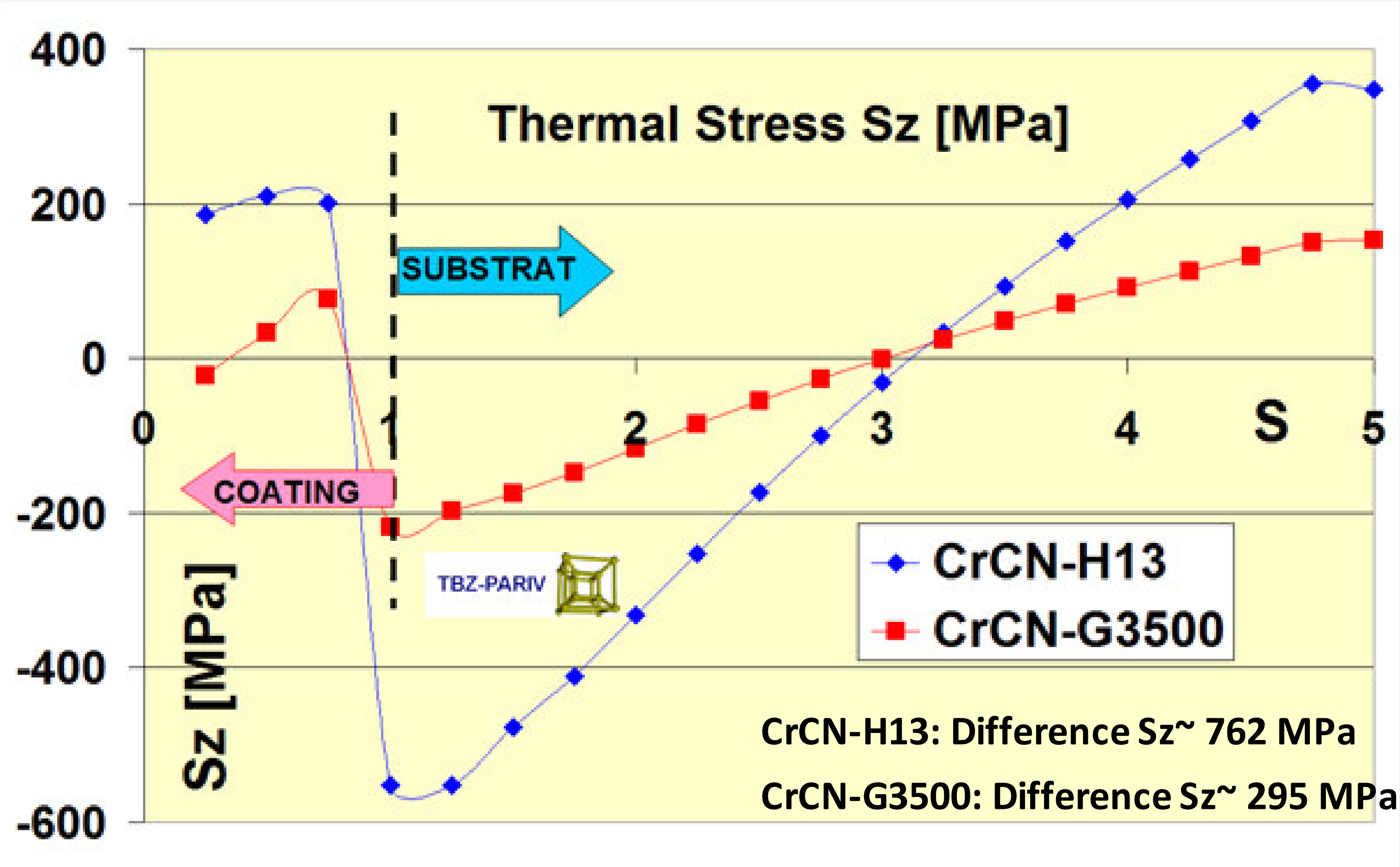

CrCN-H13: Difference Sz~ 762 MPa

CrCN-G3500: Difference Sz~ 295 MPa

SUMMARY

Based on f.e. thermal stress analysis:

The stability of coating-substrate-systems for CrCN – G3500 seemed to be better than for the commonly used system CrCN – H13. Experimental investigations shout be carried out, to verify this results.