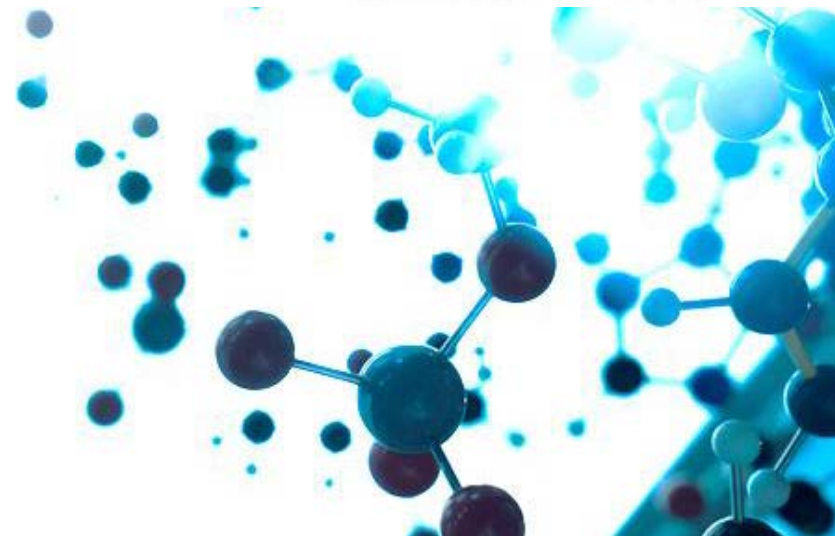


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GOODWIN
R&D

‘Material LCC-G’

A new low temperature impact property
Carbon/ Manganese Steel

...with properties far superior than conventional ASTM A352 Grade LCC
while maintaining LCC chemical and carbon equivalent requirements

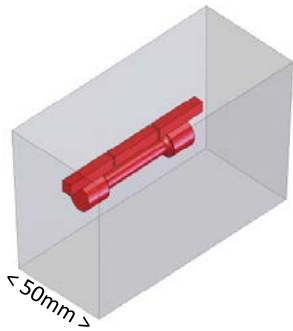


Foundrymen & Engineers for over 130 years...

www.goodwinsteelcastings.com

So what does this mean for the Design Engineer?

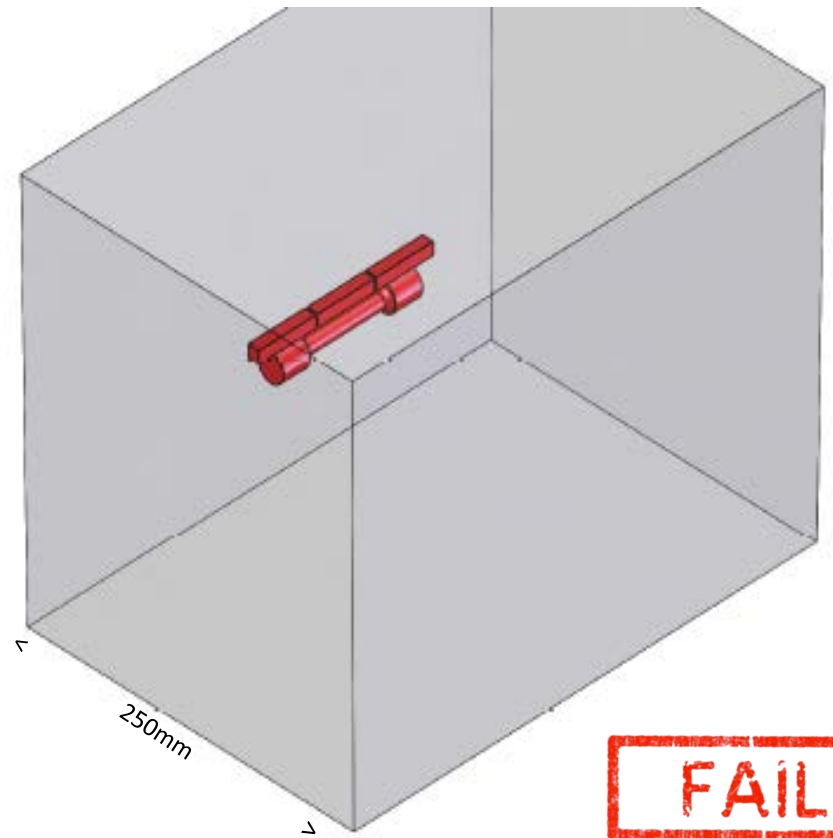
Simply put, it means don't expect the same mechanical properties in heavy sections as light sections in ferritic steel castings such as ASTM A352 Grade LCC.



Typical Properties where T=50mm tested at 1/4T

UTS	0.2% Proof	Elongation	Red of Area	Impact			Avg Impacts
(N/mm ²)	(N/mm ²)	(%)	(%)	(Joules)			(Joules)
485min	275min	22min	35min	22min			27min
520	305	25	62	44	47	52	48

“Thick sections don't have the same properties as thin sections”



Typical Properties where T=250mm tested at 1/4T

UTS	0.2% Proof	Elongation	Red of Area	Impact			Avg Impacts
(N/mm ²)	(N/mm ²)	(%)	(%)	(Joules)			(Joules)
485min	275min	22min	35min	22min			27min
497	289	20	22	8	10	11	10

“In thicker sections the mechanical properties reduce and don't meet specification!”

“Currently when specifying Ferritic Steel Castings such as LCC, mechanical properties can only be guaranteed up to approx. 100mm thickness”



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Many Ferritic Steel Castings are produced world wide with section sizes greater than 100mm, so how can the mechanical properties and design parameters be guaranteed in these components?

This is the reason for the development by Goodwin of the LCC-G Ferritic Steel grade.

“The new LCC-G grade steel was developed to capture the full potential of the cast material, utilising optimised chemistry and processing parameters which now achieves through section mechanical properties that had not been previously possible.”



“Rip up the Rules with LCC-G”

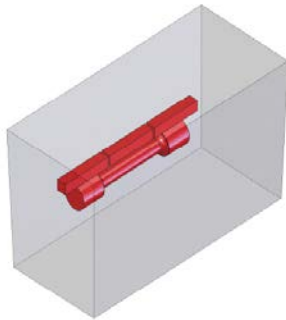
- Vastly increased impact properties in heavy sections
- Much improved heavy section material ductility
- Improvements translating to actual product
- Much greater levels of confidence and safety achieved for End Users



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With LCC-G the low temperature impact resistance and tensile ductility do not dramatically decrease with increase in section size, but instead stay far more consistent throughout

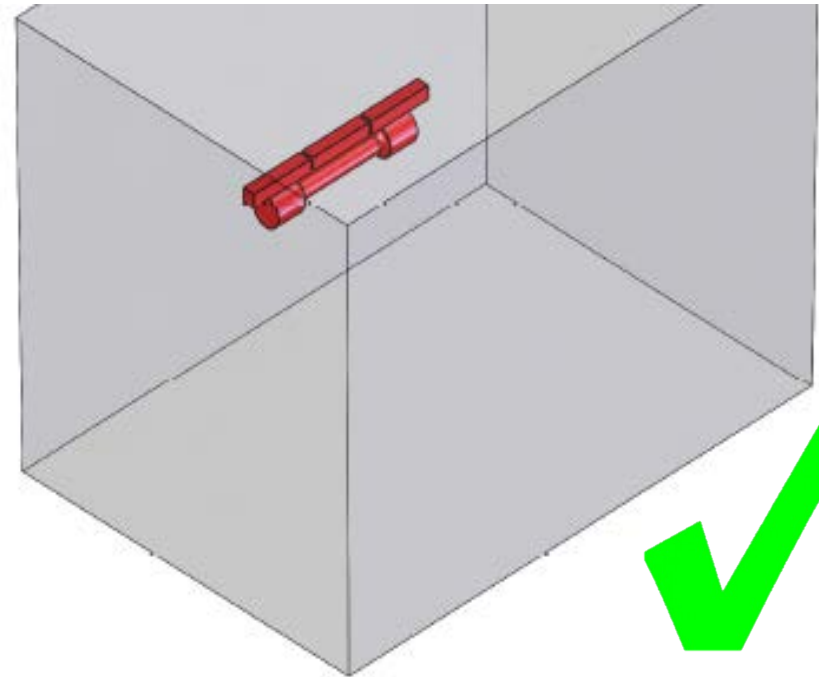


250mm Test Block

1/2T Average Impacts: 145J at -50°C

1/2T Elongation: 34%

1/2T Reduction in Area: 76%



50mm Test Block

1/2T Average Impacts: 163J at -50°C

1/2T Elongation: 38%

1/2T Reduction in Area: 78%



“User benefit from unsurpassed low temperature impact properties using LCC-G, providing a level of brittle fracture mode failure not previous achievable with the LCC Grade”



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Conventional LCC
200mm 1/4T section
12J at -46°C



Conventional
LCC

LCC-G
200mm 1/4T section
155J at -46°C



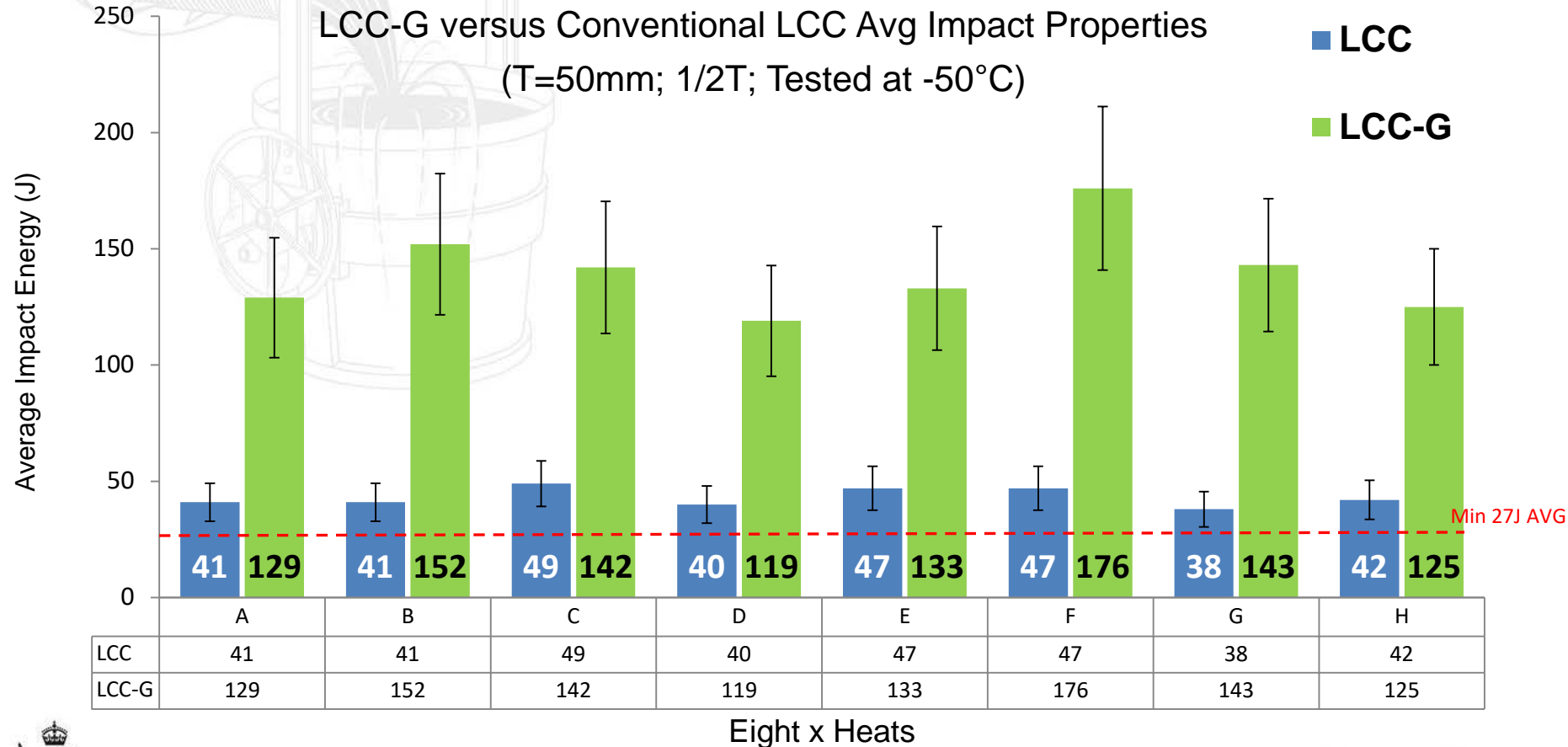
LCC-G



“End users will gain over **100% safety margin** in low temperature impact properties as a direct result of the installation of LCC-G rather than conventional LCC components”



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“Valve Manufacturers and End Users will benefit from much improved resistance to brittle fracture as a result of the specifying LCC-G over conventional LCC”



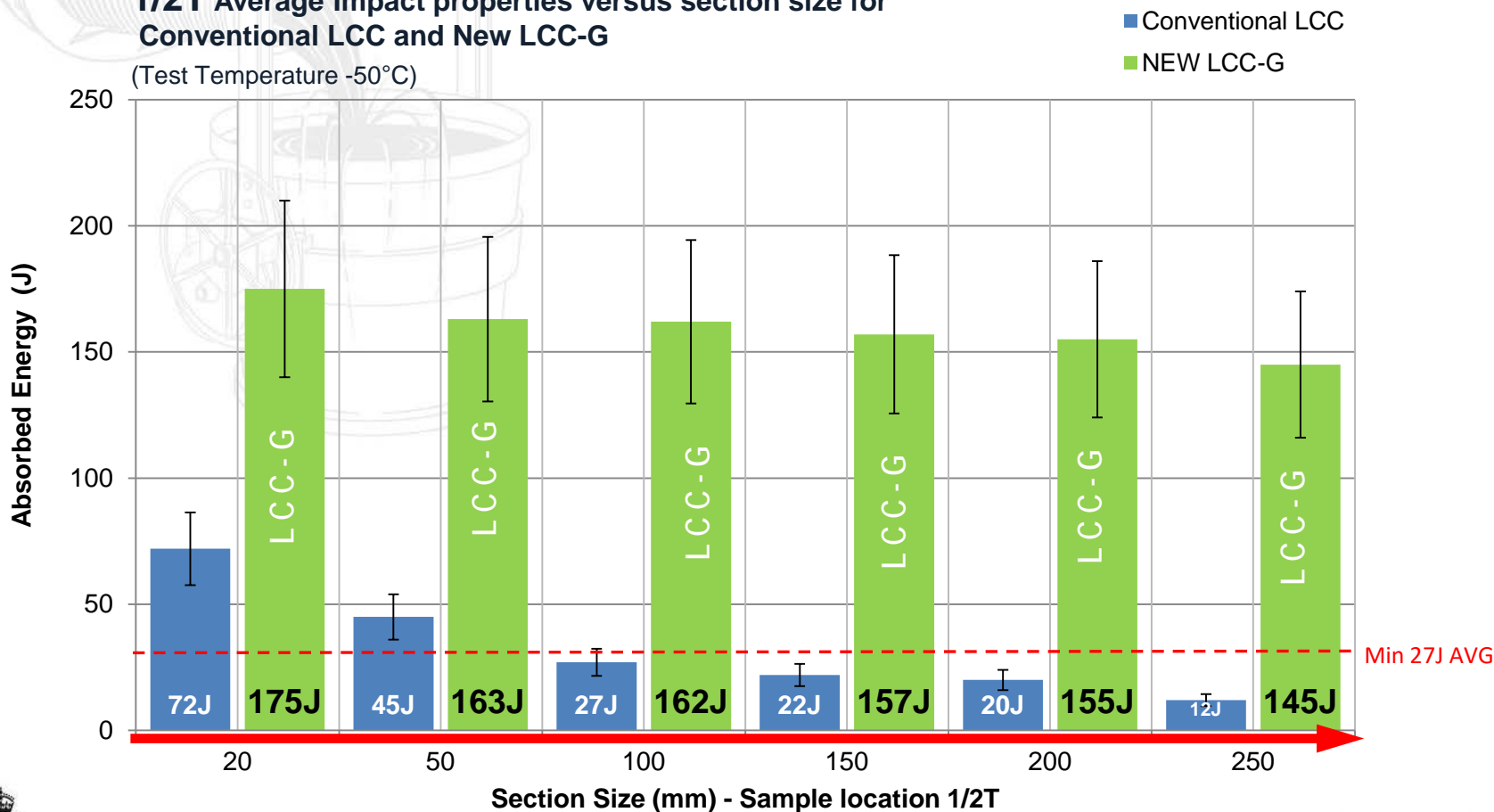
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“With Conventional LCC as section size increases Low temperature impact results fail to meet the minimum specification”

1/2T Average Impact properties versus section size for Conventional LCC and New LCC-G

(Test Temperature -50°C)

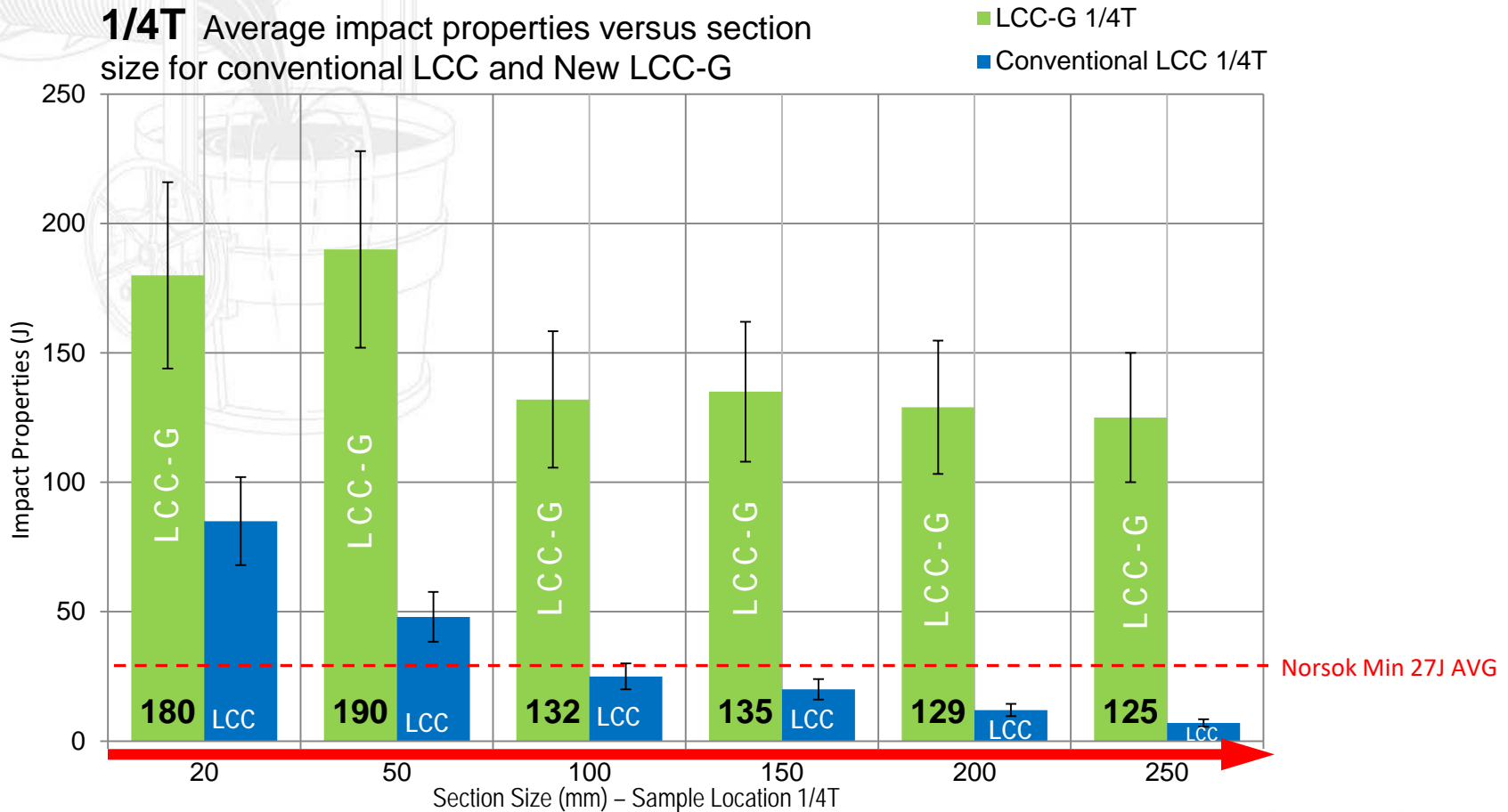


“With Conventional LCC as section size increases
Low temperature impact results fail to meet the
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1/4T Average impact properties versus section size for conventional LCC and New LCC-G

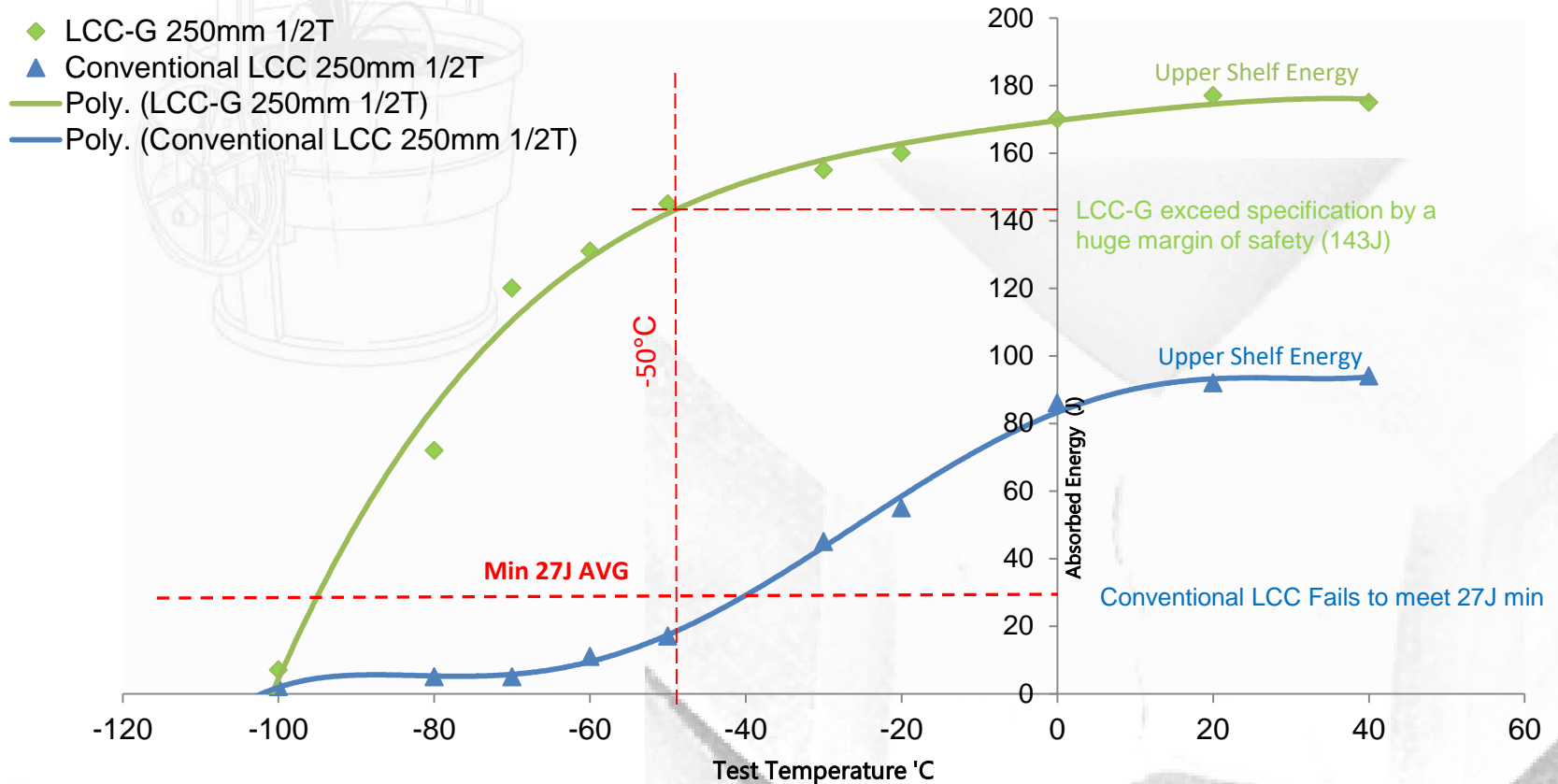


“Operators will have a much improved level of crack propagation prevention due to the superb through section low temperature impact behaviour of the new LCC-G material.”



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LCC versus LCC-G Transition Curves for a 250mm Section



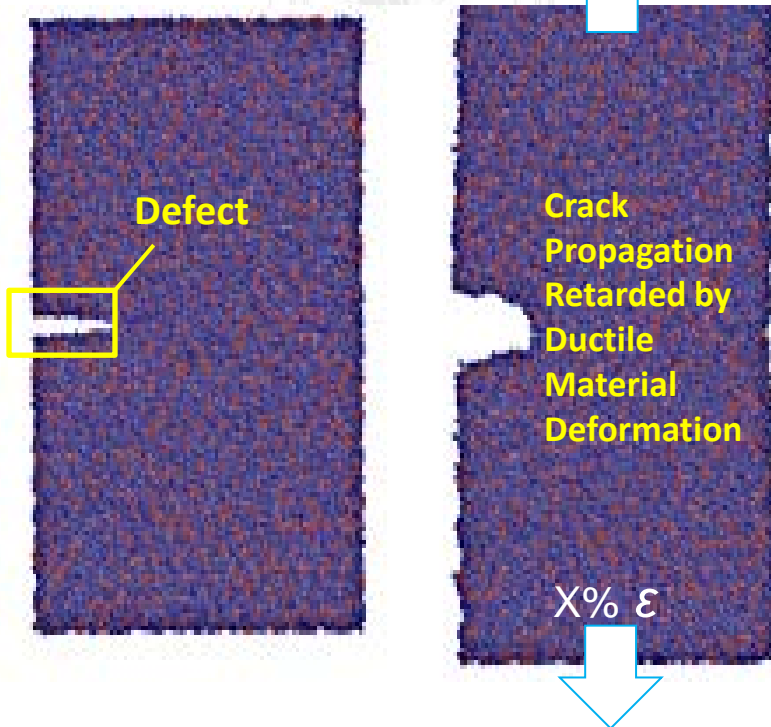
Why is Ductile Material Important for High Duty Applications?



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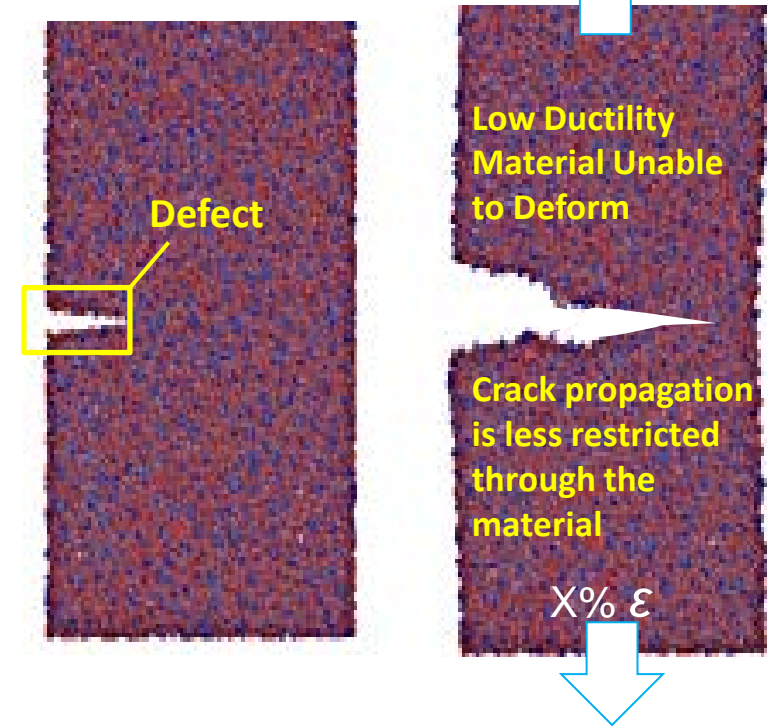
....Ductile Material Retards Crack Propagation

HIGH DUCTILITY



"LCC-G"

LOW DUCTILITY

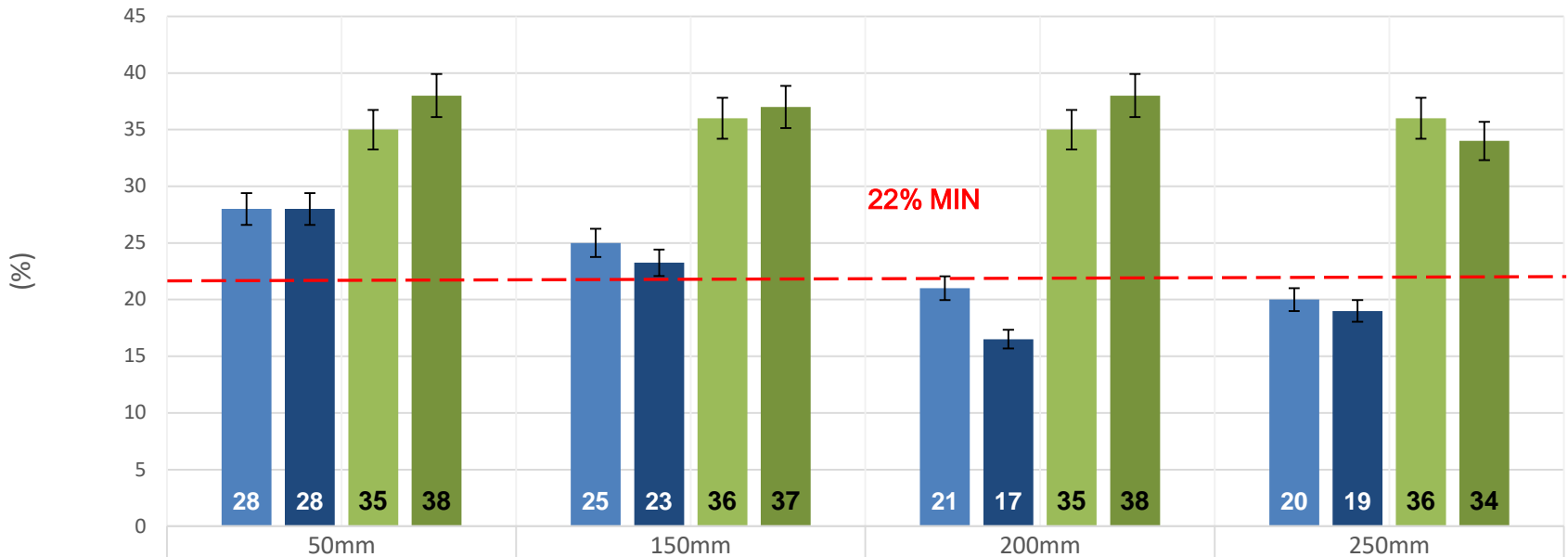


“End Users will benefit from the increased ductility of LCC-G in heavy sections by a factor greater than 1.5 times compared to conventional LCC.”



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LCC versus LCC-G 1/4T & 1/2T Tensile Average Elongation



■ 1/4T LCC	28	25	21	20
■ 1/2T LCC	28	23	16.5	19
■ 1/4T LCC-G	35	36	35	36
■ 1/2T LCC-G	38	37	38	34



“Design Engineers will enjoy levels of ductility far in excess of what had previously been achievable in cast Carbon/ Manganese steel.”

..and critically, this will extend throughout the full section of the component.”



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LCC-G versus LCC-HE 1/4T & 1/2T Average Red of Area

