

New High Speed Steels

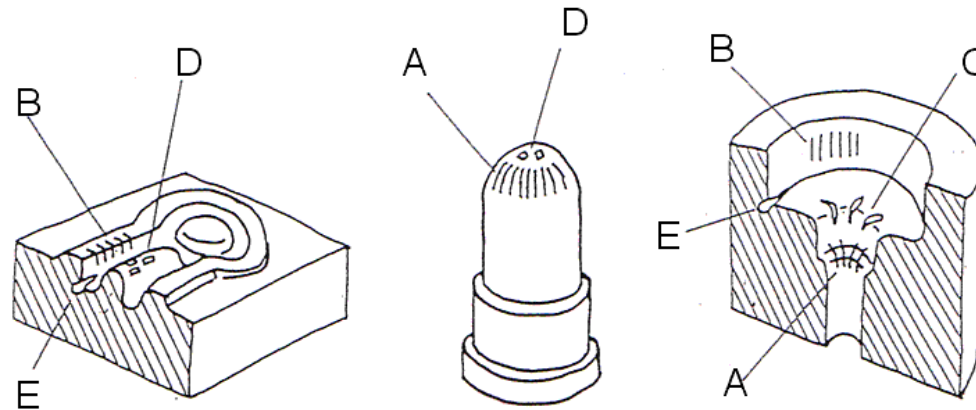
“YXR Series”

with high toughness and strength for
forming dies and tools



Required properties (1)

Hot forging die & punch

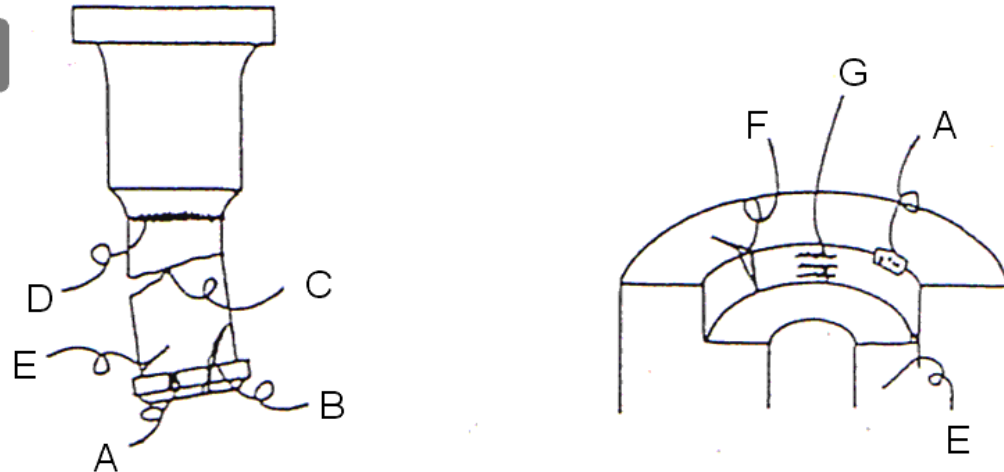


	Damage	Material	Heat treatment	Design, Utility
A	Wear (with heat influence)	Tensile strength at elevated temperature	Nitriding Austenitizing temperature	Die cooling Lubricant
B	Wear	Toughness Carbides (wear resistance)	Surface treatment Hardness	Lubricant Hard material insert
C	Heat check	Tensile strength at elevated temperature Toughness	Quenching speed Hardness Nitrided case depth	Lubricant Die cooling
D	Nitrided case exfoliation	Nitriding properties Tensile strength at elevated temperature	Nitriding condition	Lubricant Die cooling
E	Erosion			Lubricant Gas path
F	Fatal break	Toughness	Quenching speed Hardness Austenitizing temperature Nitriding condition	Pre-heating Surface finish Shrinking Die partition

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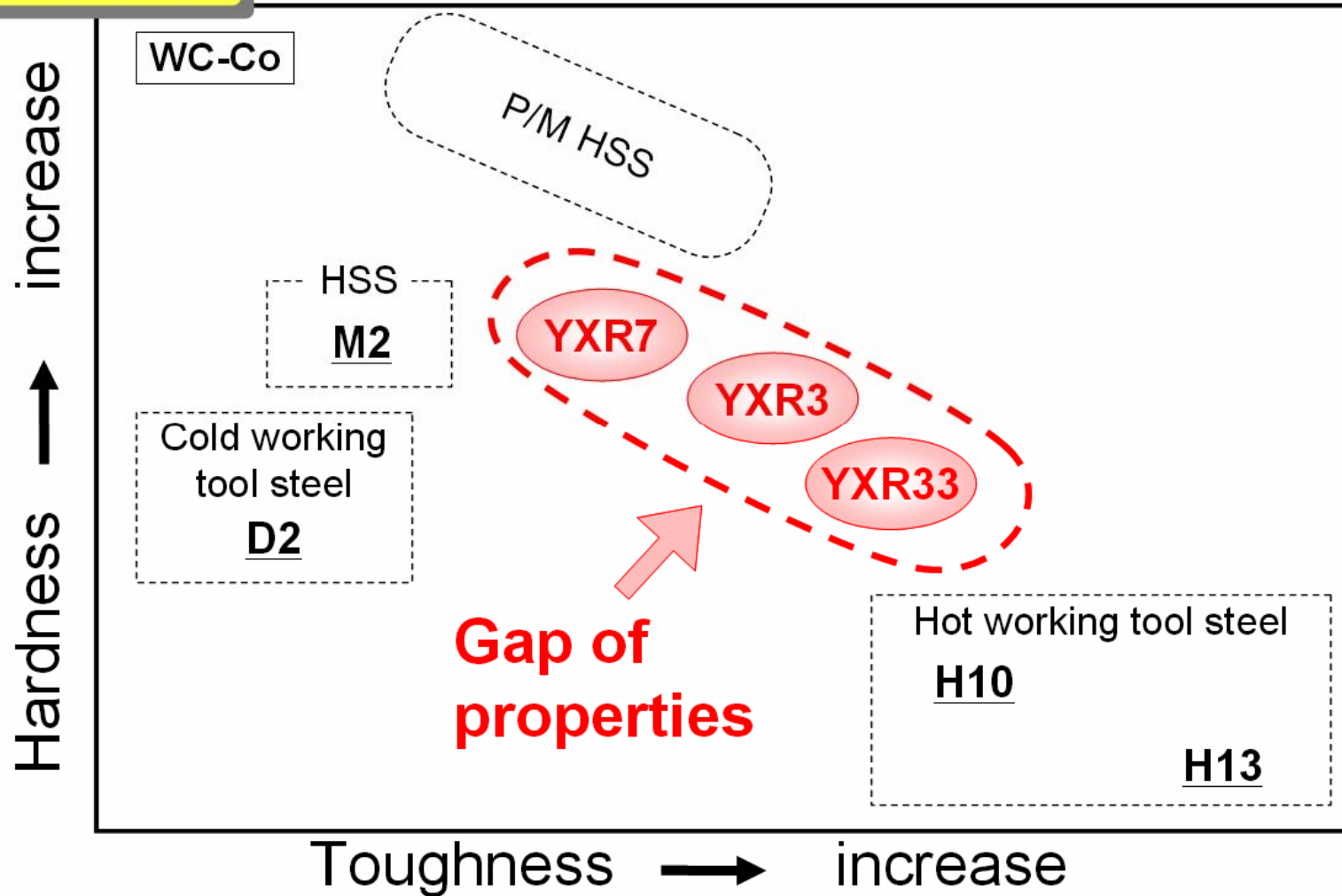
Required properties (2)

Cold forging die & punch

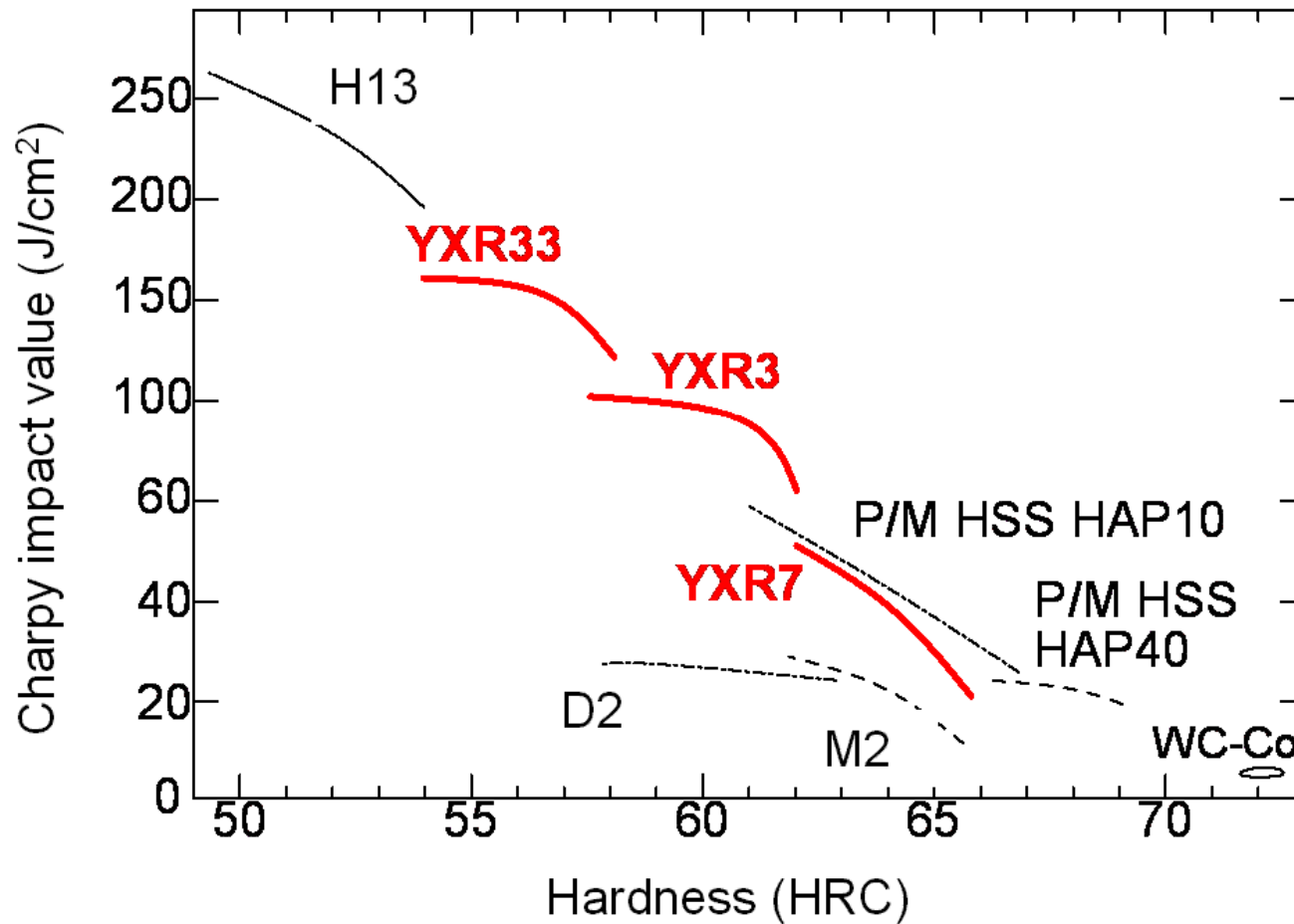


Damage	Cause	Material
A	Excessive impact (Foreign elements, miss-fitting of punch)	Toughness Compressive strength
B	Tensile stress (Friction, punch distortion)	Tensile strength Low friction Compressive strength
C	Bending stress (Center shifting, bending)	Bending strength Compressive strength
D	Cyclic stress	Fatigue strength
E	Compressive shearing stress (Forming pressure)	Compressive strength
F	Tensile stress (Forming pressure)	Tensile strength
G	Tensile stress (Friction)	Scuffing resistance Tensile strength

YXR Series

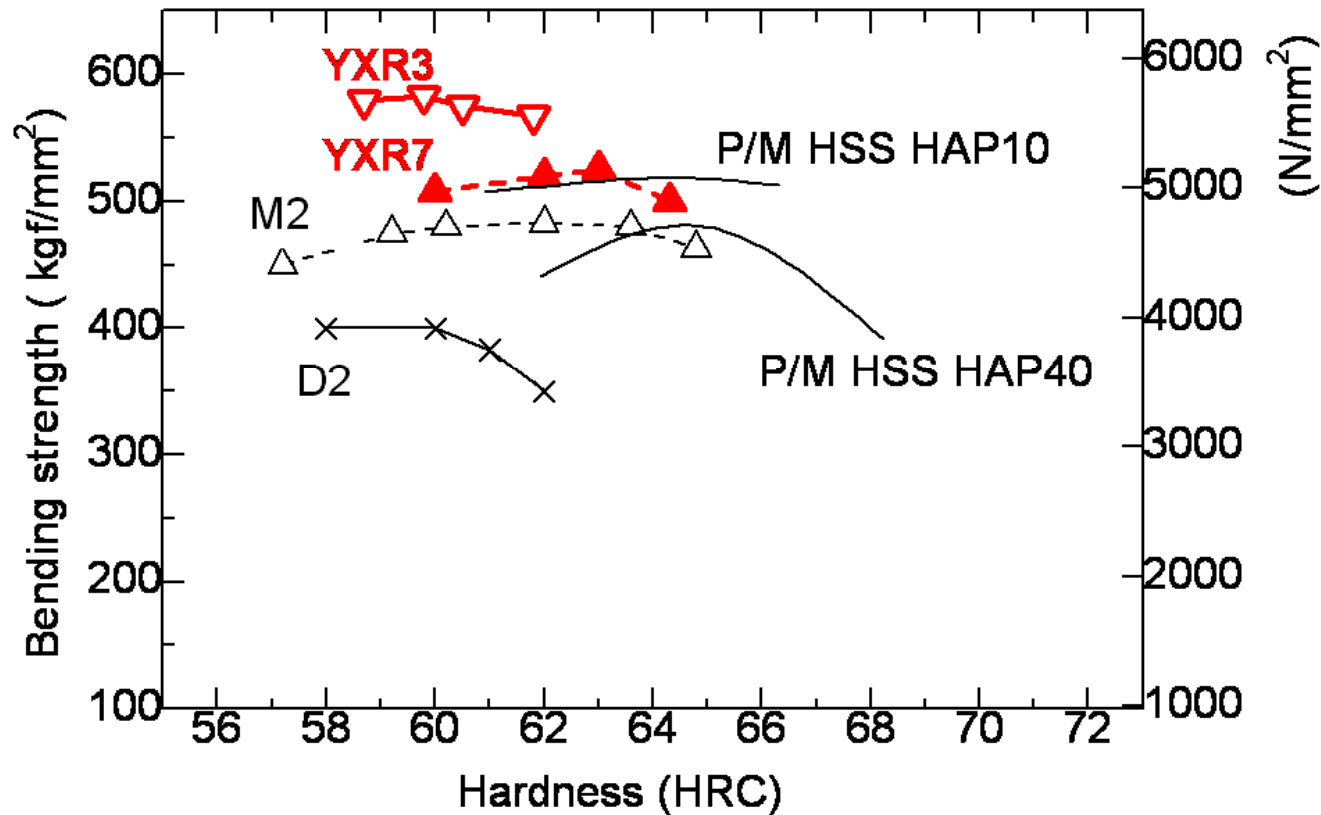


Toughness



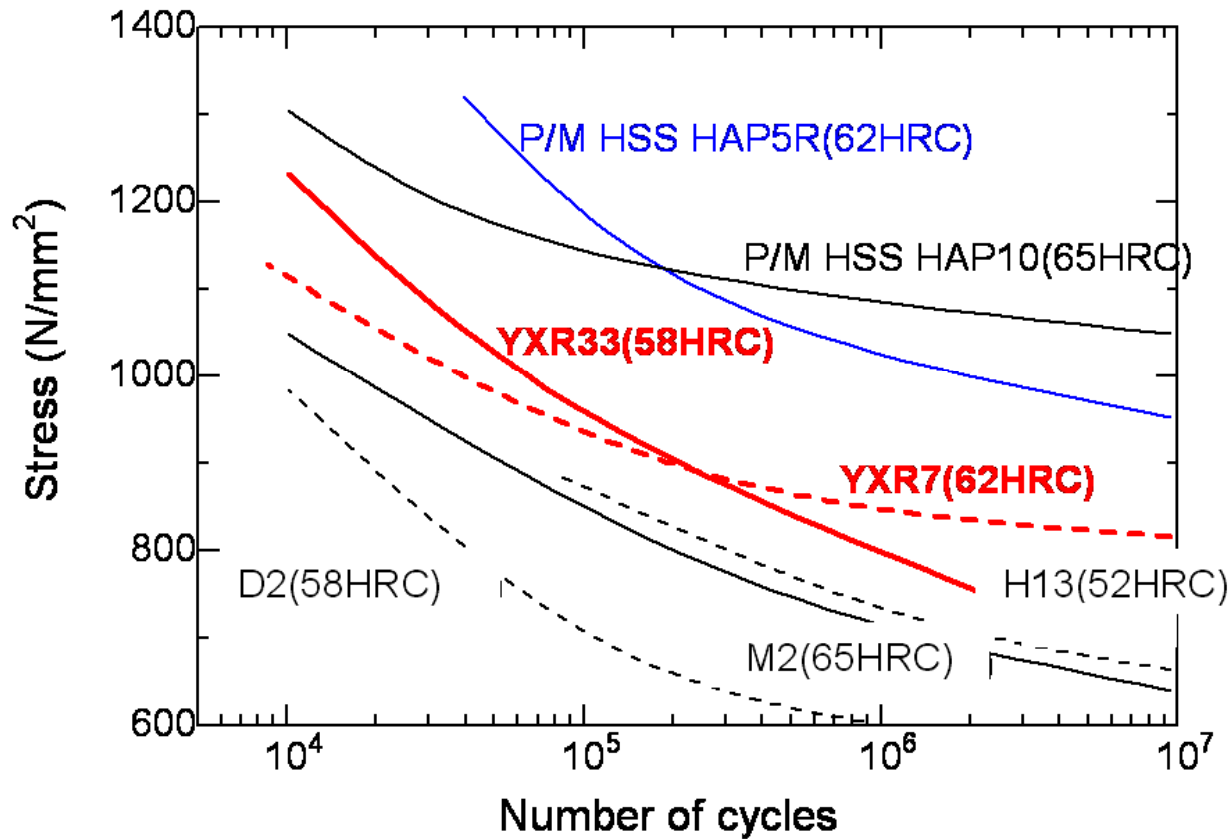
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Bending strength



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Fatigue strength



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**Heat treatment**

	Usual hardness	Quenching	Tempering
YXR7	62-65HRC	1140°C Oil	550-580°C Air
YXR3	58-61HRC	1140°C Oil	550-580°C Air
YXR33	54-58HRC	1080-1140°C Oil	550-600°C Air
M2	58-64HRC	1160-1220°C Oil	550-580°C Air
D2	57-63HRC	1000-1050°C Air	150-200°C Air 510-530°C Air
H13	46-53HRC	1000-1050°C Air	550-680°C Air



Records

Grade	Tool	Work material	Current tool material	Tool life of YXR	
YXR7	Cold forming die	S45C	M2 63HRC Cracking	63HRC Wear	Times 6
	Threading die	SCM440	D2 62HRC Cracking	65HRC Wear	5
	Warm forming punch	S53C	SKD8 58HRC Plastic flow	62HRC Plastic flow	3.5
YXR3	Knockout sleeve	Steel	M2 61HRC Breaking	61HRC Wear	5
	Cold forming punch	Steel	D2 58HRC Chipping	61HRC Wear	2.5
YXR33	Warm forging punch	SUJ2	H13 48HRC Plastic flow	58HRC Plastic flow	7
	Crusher cutter	SHP	M2 61HRC Breaking	58HRC Breaking	20

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Application (1)

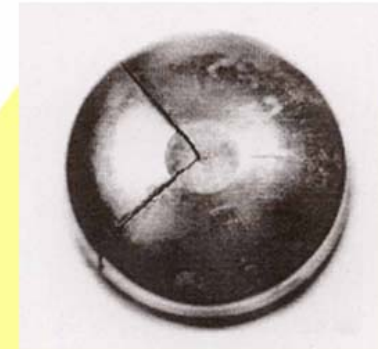


x 4



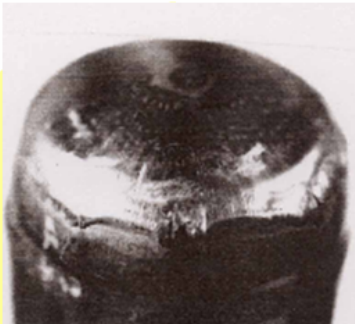
YXR33 (57HRC)

**Good wear resistance
without cracking**



M2 (60HRC)

Cracked



H13 (48HRC)

Wear

***Warm-forging punch
for CVJ parts***

Application (2)



H13 Wear

YXR33 Wear x 2



M2 Cracked

YXR33 Wear x 3



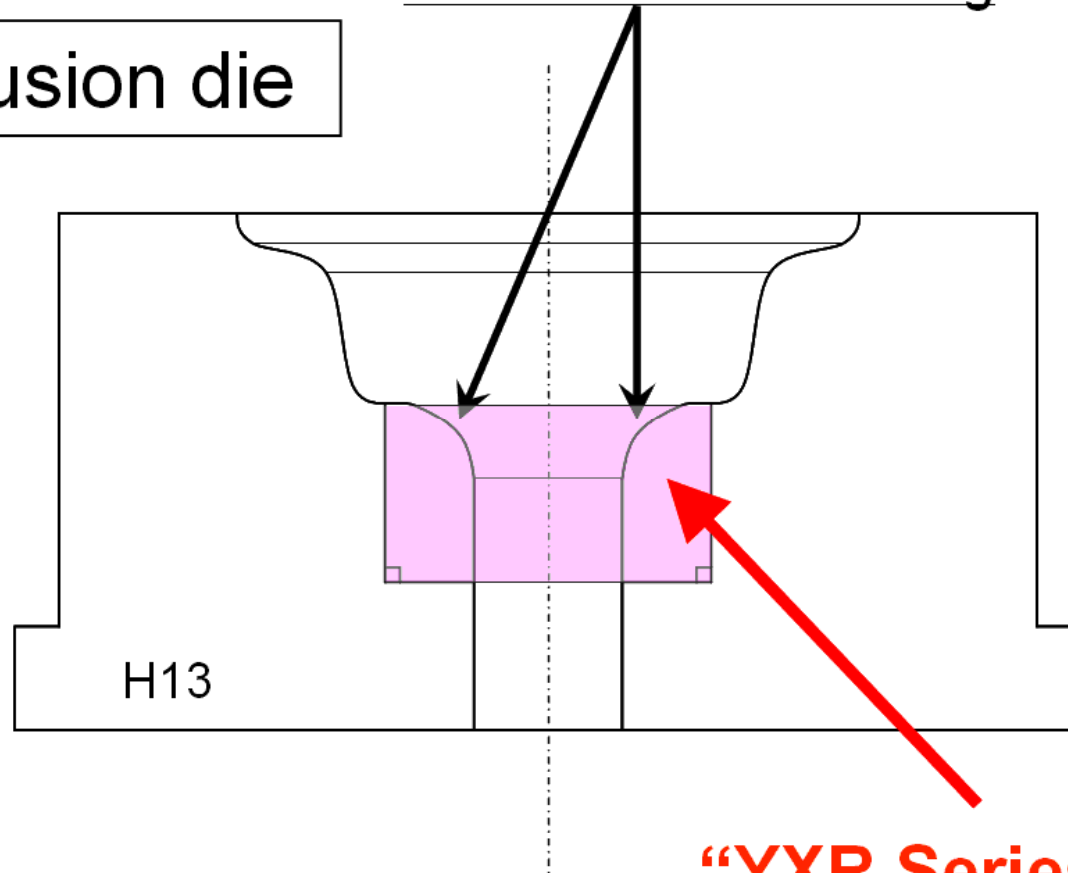
H10 Wear

YXR33 Heat checking x 2

Application (3)

Extrusion die

Wear & Heat checking



“YXR Series” Insert