Solution technologies of die material coating and tooling high-strength steels stamping dies

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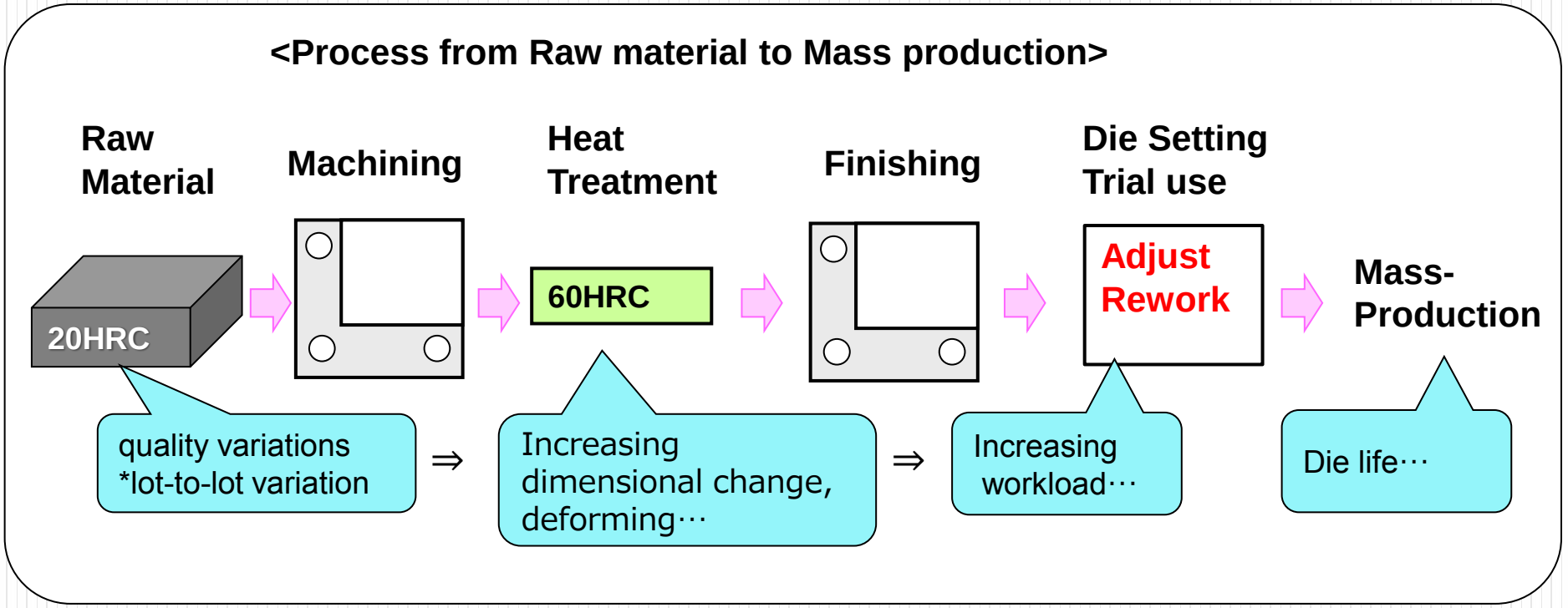
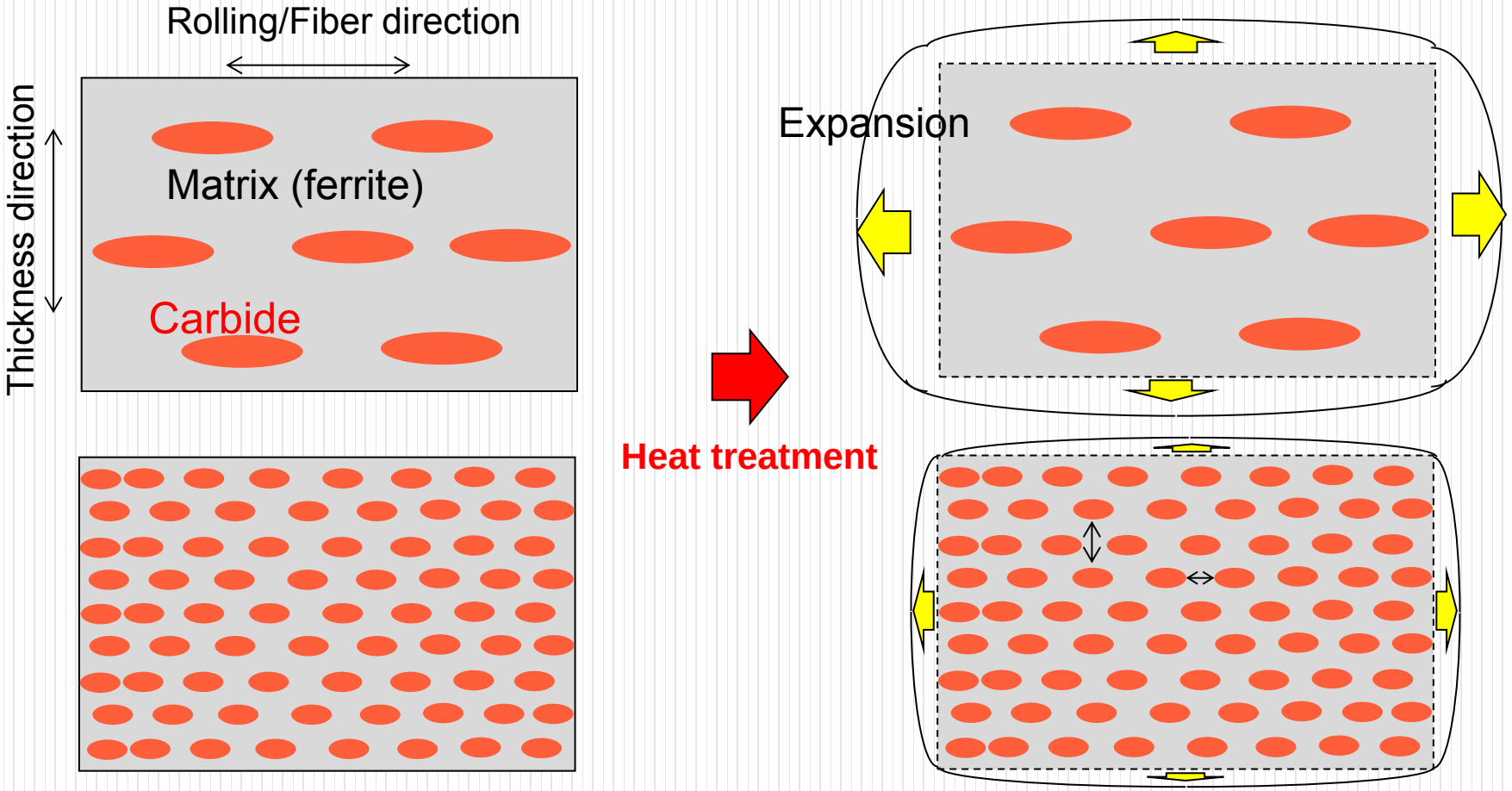
Current Problem of Standard D2/1.2379

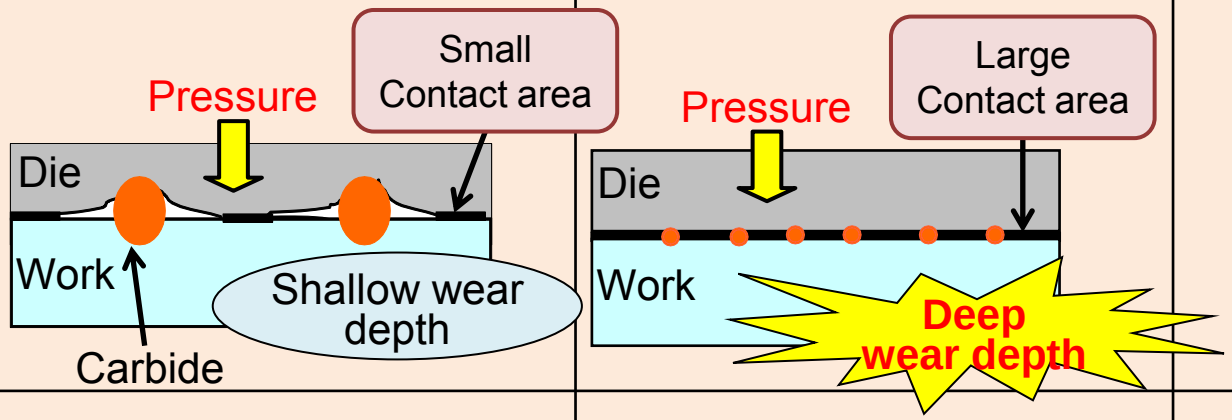
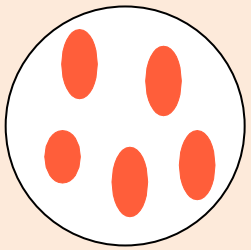
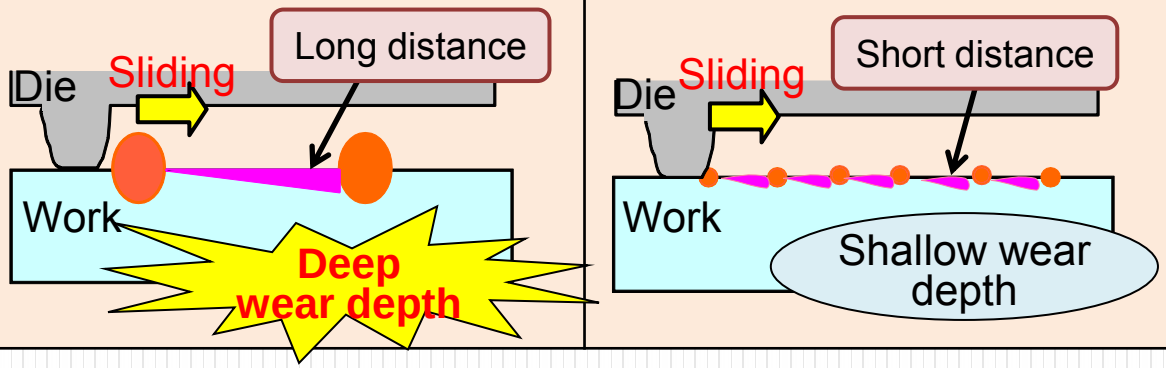
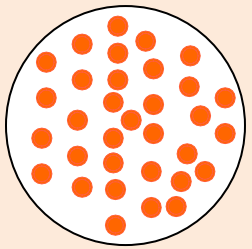


Relationship between ‘insoluble carbide’ and ‘heat treatment dimensional change’



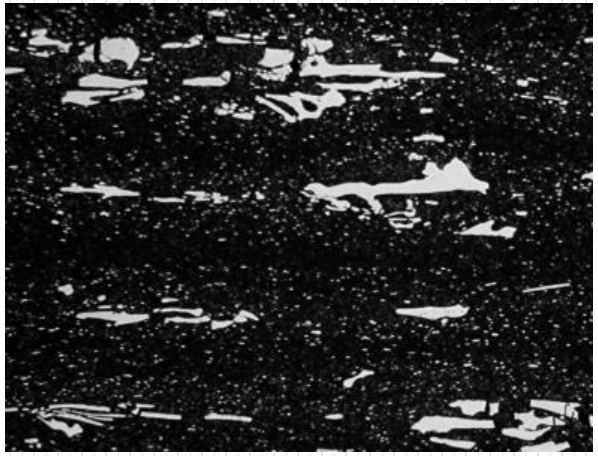
Relationship between carbide distribution and wear resistance

Impact and adhesive wear resistances are related to the carbide distribution.

Wear mode	Carbide distribution		Preferable microstructure
	Large / Sparse	Small / Dense	
High pressure area			D2/1.2379 
Sliding area			Powder metal 

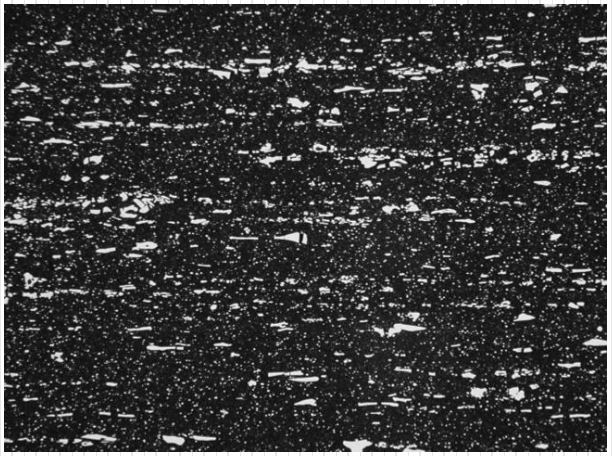
Microstructure

D2/1.2379



Coarse & directional carbide
- Large & anisotropic HT deformation
- Medium galling & wear resistance
- Characteristics will be affected by grain direction

SLD-i



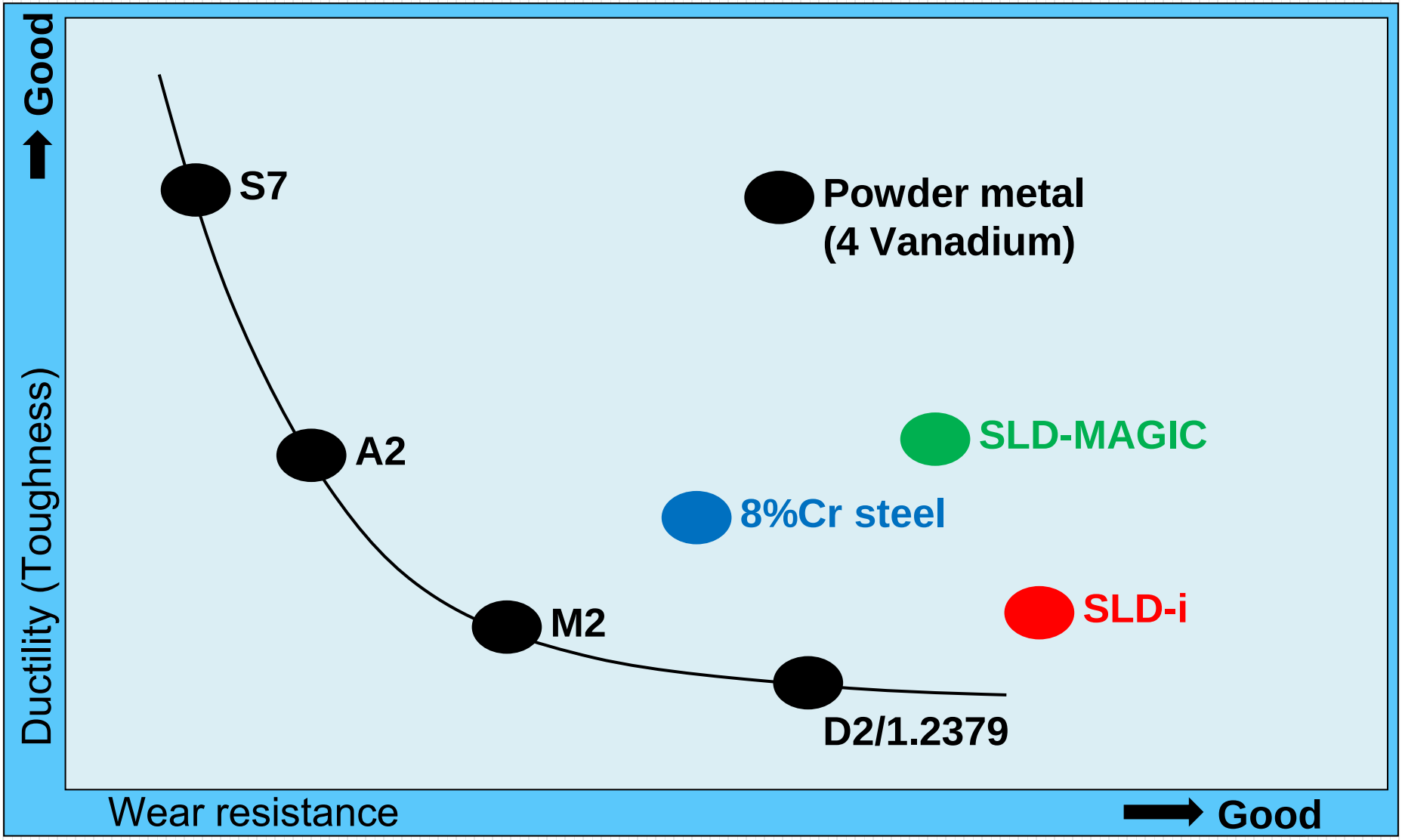
Small, dense & homogeneous carbide
- Small & isotropic HT deformation
- Good galling & wear resistance
- Achieve higher hardness than D2/1.2379

SLD-MAGIC

100µm

Large carbide + very small and dense carbide
- Small HT deformation
- Good galling & wear resistance
- Very good machinability & toughness

Alloy Design

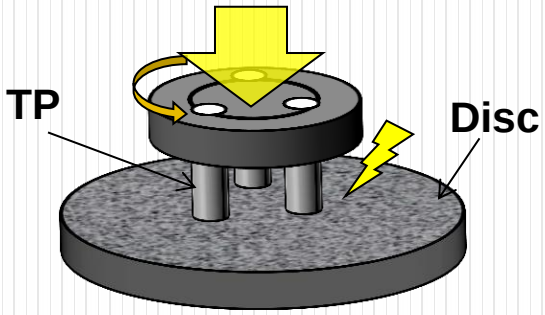


Wear resistance (Pin-on-disc test)

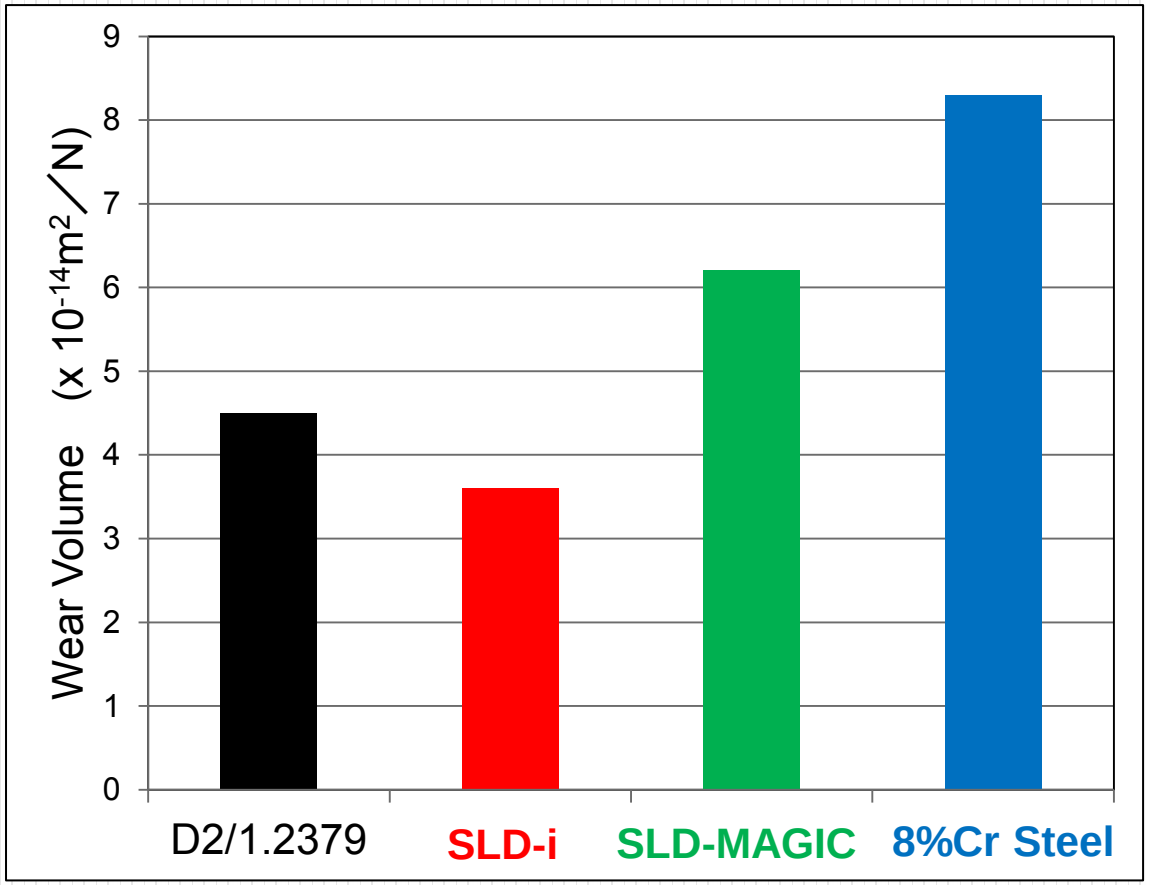
<Conditions>

Item		Condition
Test piece	Grade	D2, SLD-i, SLD-Magic and 8Cr
	Hardness	60HRC
Disc		Alumina
Surface pressure		7.8 MPa
Friction Speed		0.42 m/sec
Friction length		377 m

ASTM G99-05



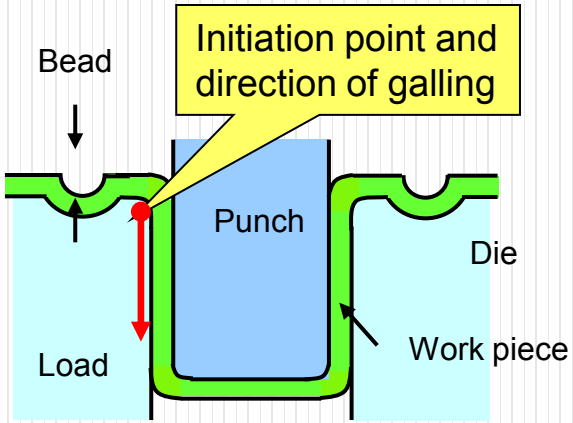
<Results>



Galling Resistance

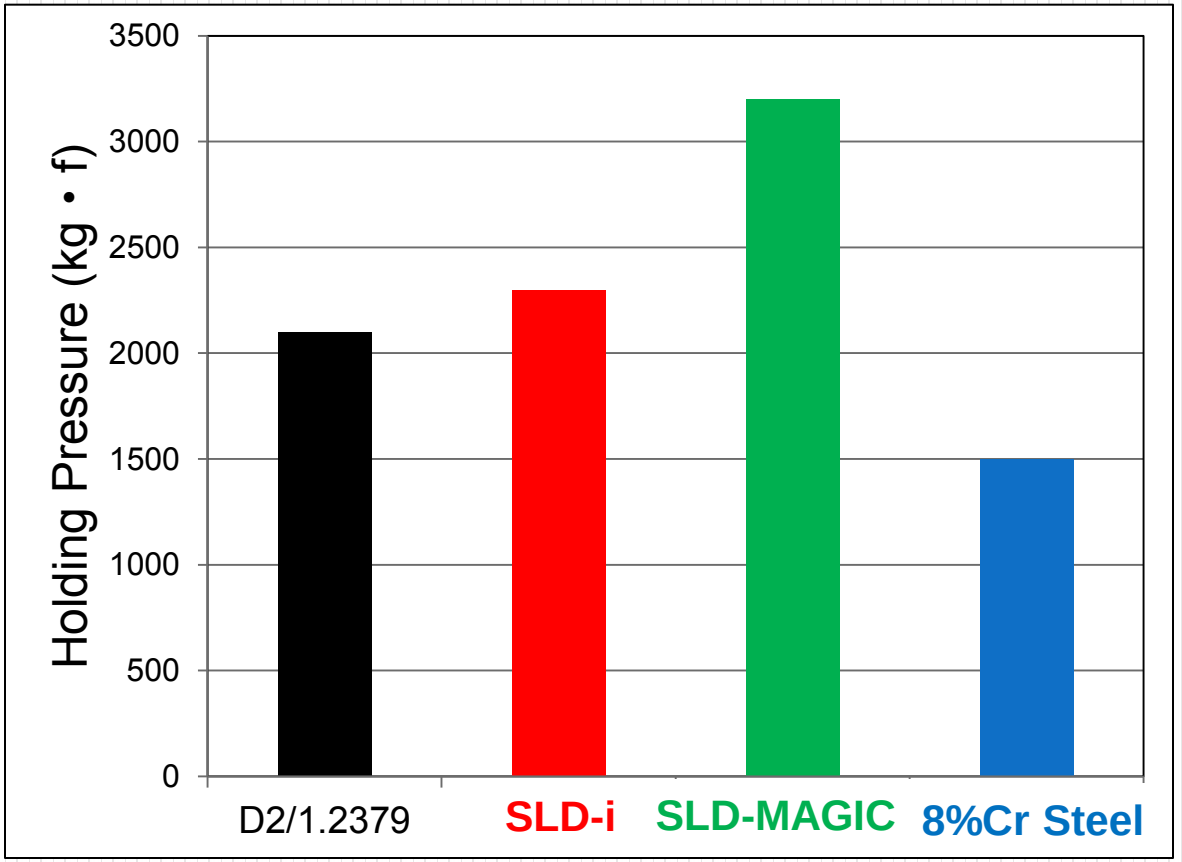
<Conditions>

Item	Condition
Length of Stroke	60mm
Pressing Velocity	60spm
Lubricant	Rust prevention oil *delivery condition
Work	980MPa HSS
Work Thickness	1.4mm (No Zn plating) Clearance:5%
Die surface condition	Polished by #8000 paper (2-4μm)



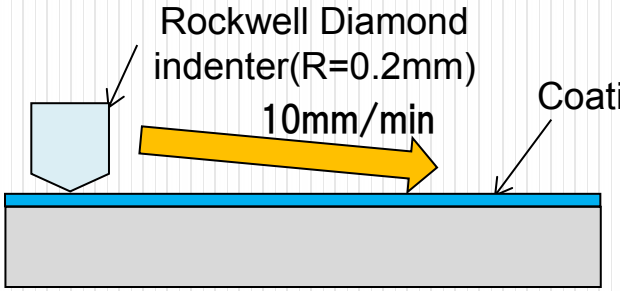
Schematic diagram of test condition

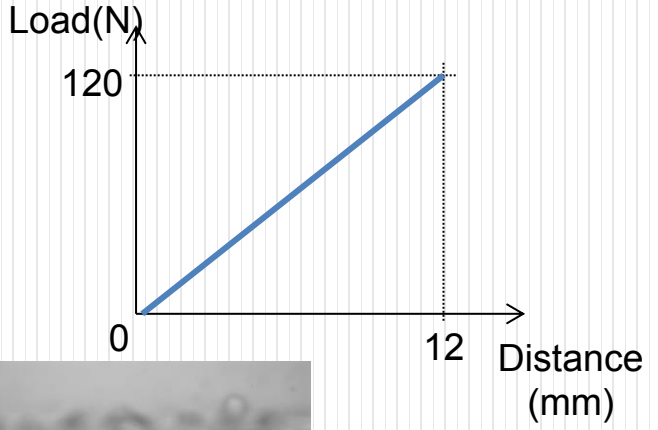
<Results>

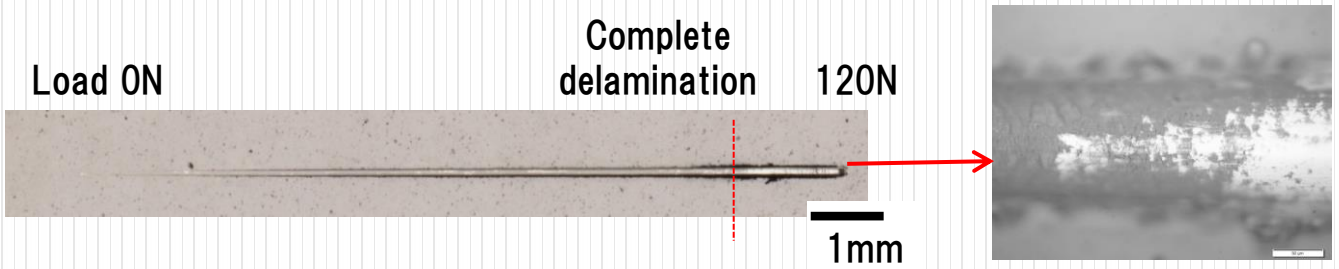


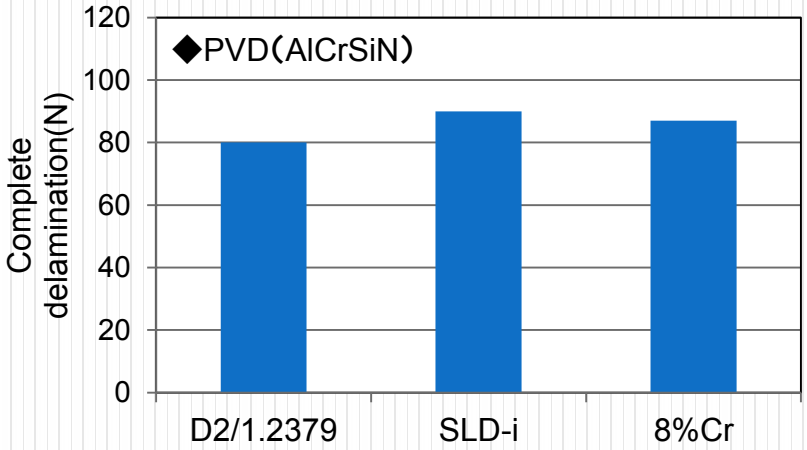
Charpy Value

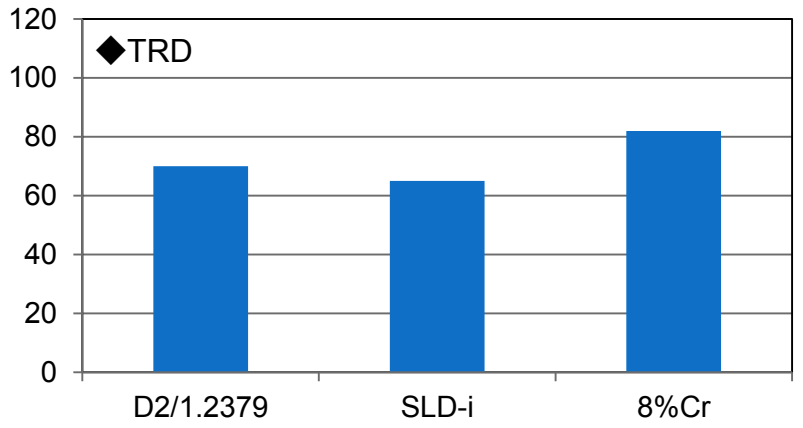
Scratch adhesion test



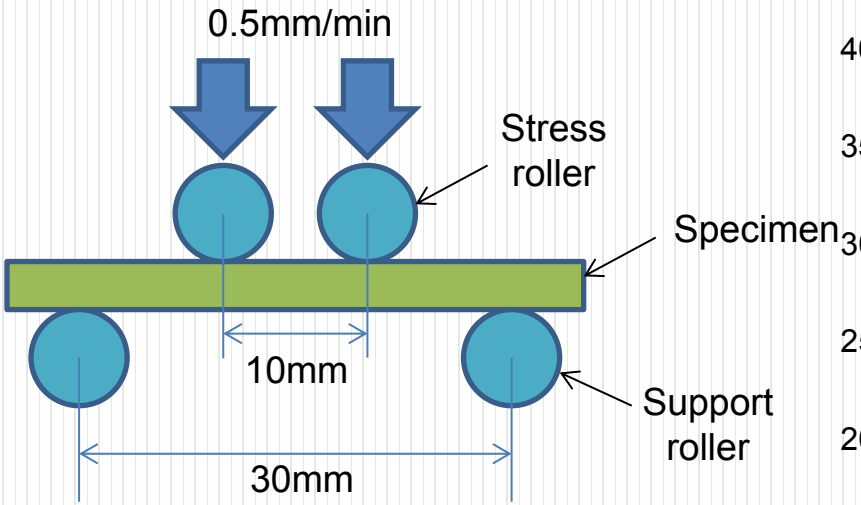




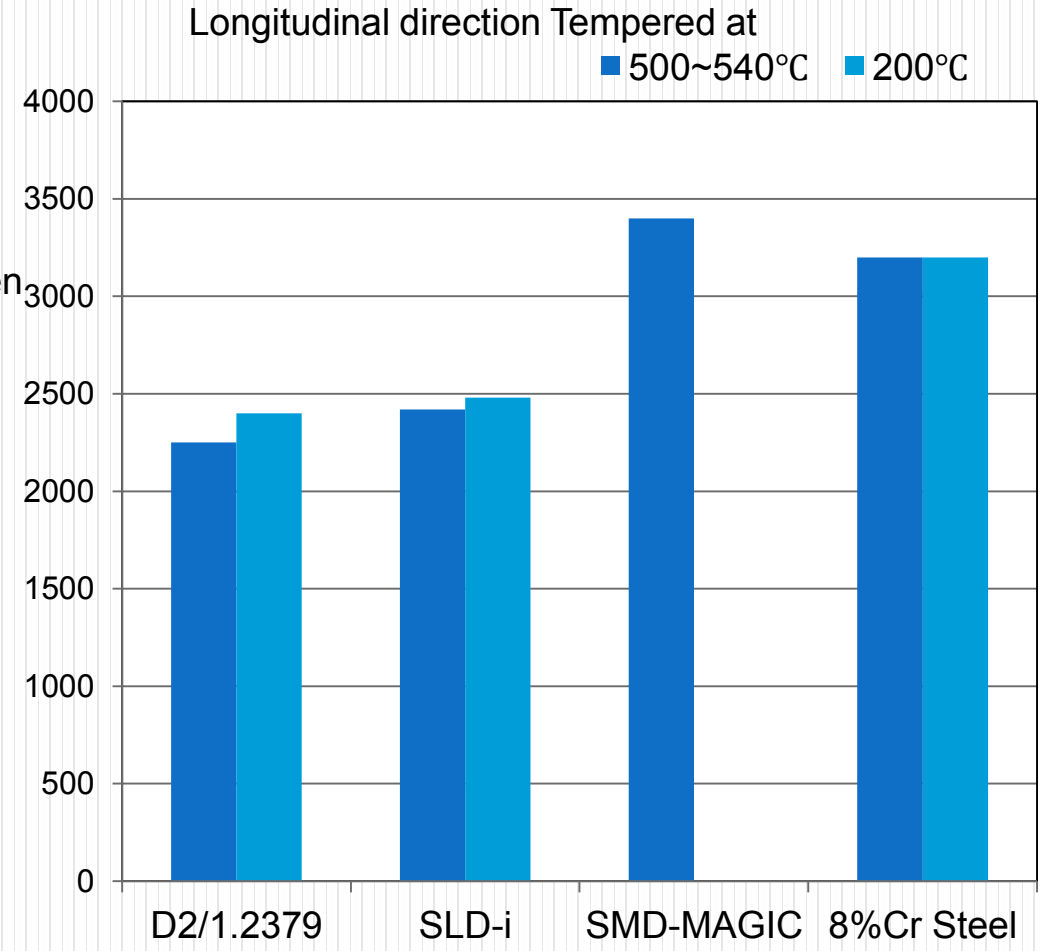




Toughness



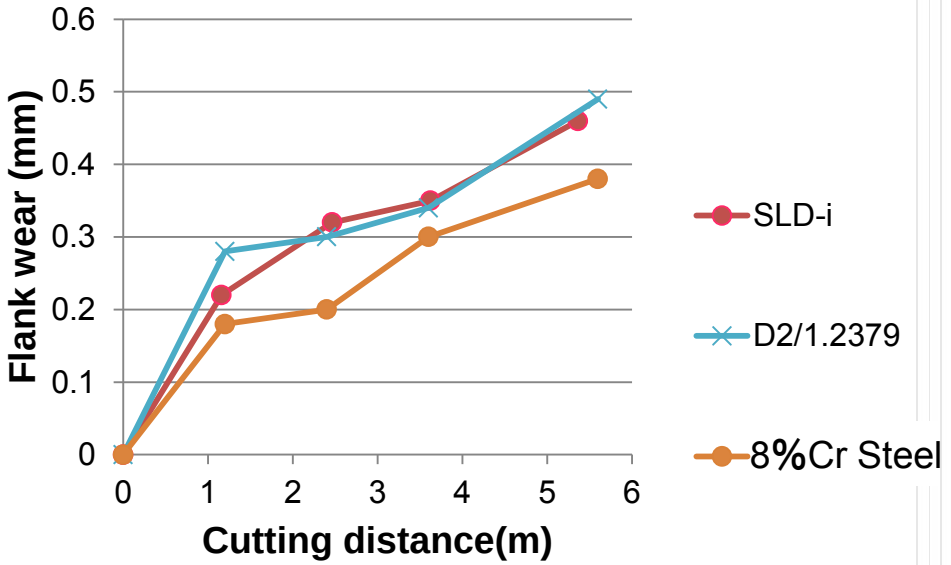
Specimen size: 4x3x36mm



Machinability

-End milling

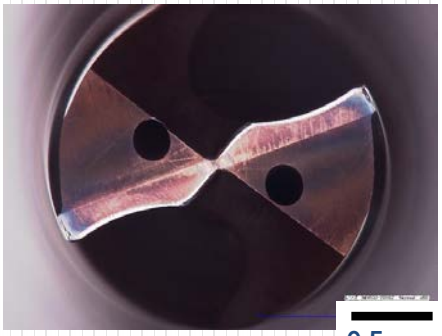
Annealed:
Vc=30m/min,
Depth of cut:0.5mm
By f8 coated HSS endmill

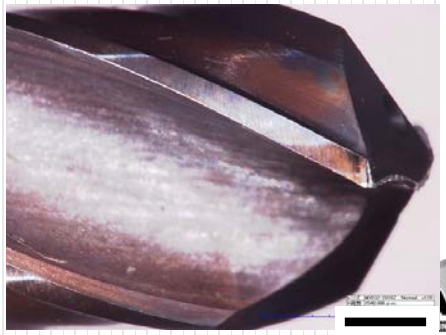


-Drilling

Annealed:
Vc=100m/min, 7958rpm
Feed: 0.12mm/rev
Hole depth: 12mm
By f4 coated carbide drill
(non-step, external rubricant)

No chipping or breaking after machining





Summary

Item	D2/1.2379	*SLD-i*	SLD-MAGIC	*8Cr*
Hardness	O	+	+	++
Dimensional change	O	++	++	− ~ −−
Galling resistance	O	+	++	O
Wear resistance	O	++	+	− ~ −−
Deflecting strength	O ~−	O	+	+
Machinability	O ~−	O	+	+
Weldability	O	O	O	O

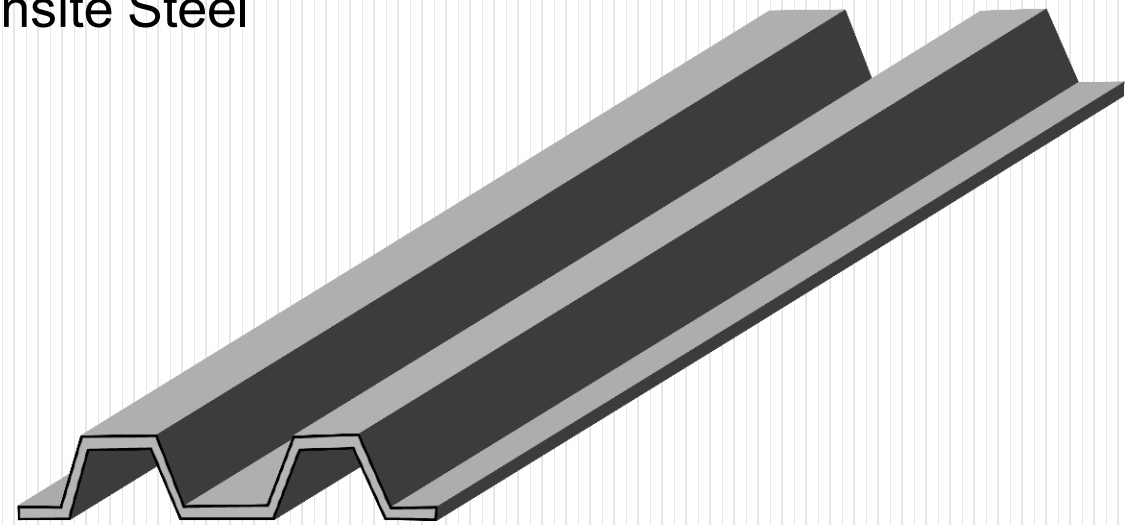
Rating ; (Poor) −− < − < O < + < ++ (Excellent)

Mill Run Test of SLD-i and D2/1.2379

-Share Tool for 1500 MPa Martensite Steel

Material information

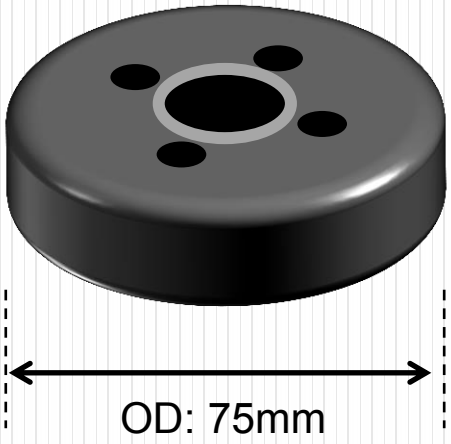
Application	Cross Member Floor Panel Part
Thickness	1.5 mm
Hardness	52 HRC
Strength	1500 MPa
Failure mode of dies	Wear/Galling



Application	Grade	Hardness	Coating	Die life before re-sharpening
Share Tool	***SLD-i***	60~62 HRC	Bare surface	35,000 cuts
	D2/ 1.2379	60~62 HRC	Bare surface	5,000 cuts

Mill Run Test of SLD-i and D2/1.2379

Punch dies for burring of hub bearing



Spec		73.86±0.01 mm
SLD-i	Sample 1	73.863 mm
	Sample 2	73.856 mm
	Sample 3	73.859 mm
	Sample 4	73.867 mm
	Sample 5	73.859 mm
	Pass rate	**100% (5/5)**
Pass rate of D2/1.2374		**10%**

Application	Grade	Coating	Die life
Punch dies for burring	***SLD-i***	TD coated	More than 500,000 hits WITHOUT repairing
	D2/ 1.2379	TD coated	10,000 – 100,000 hits with repairing

Thank You