Die Wear and Galling in Stamping DP980 Steels

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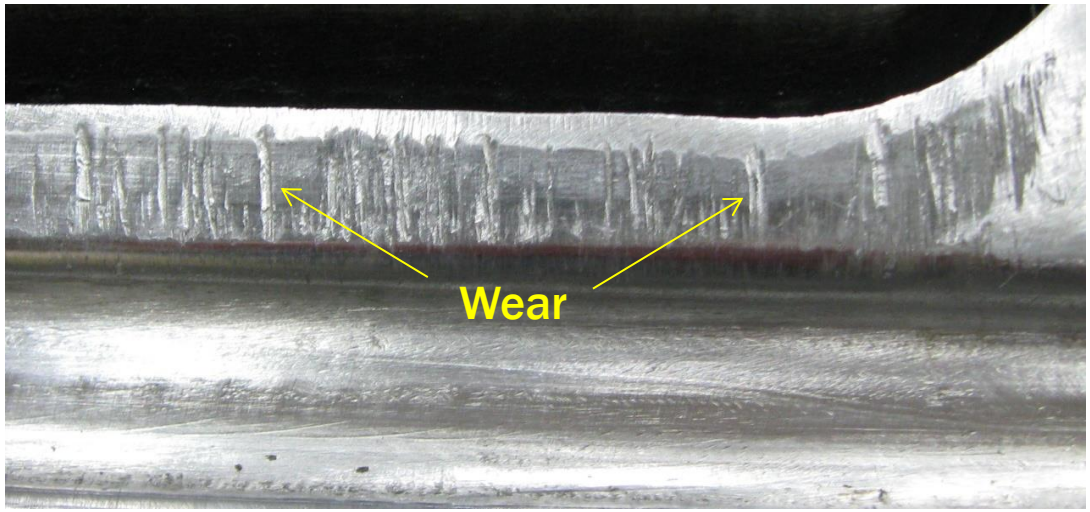
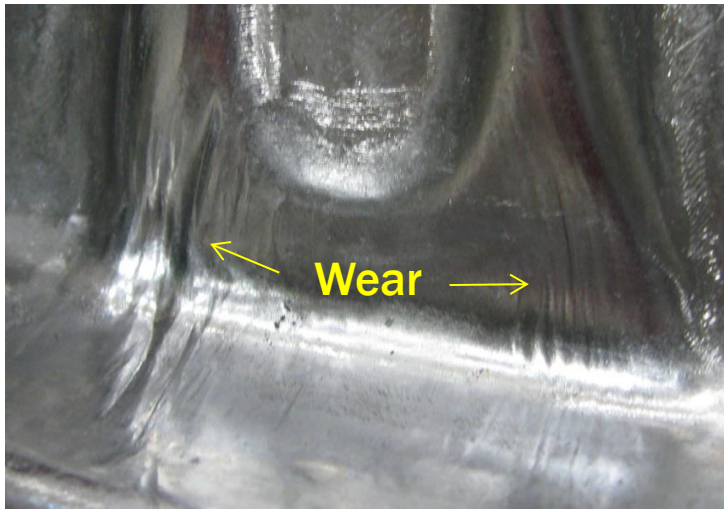
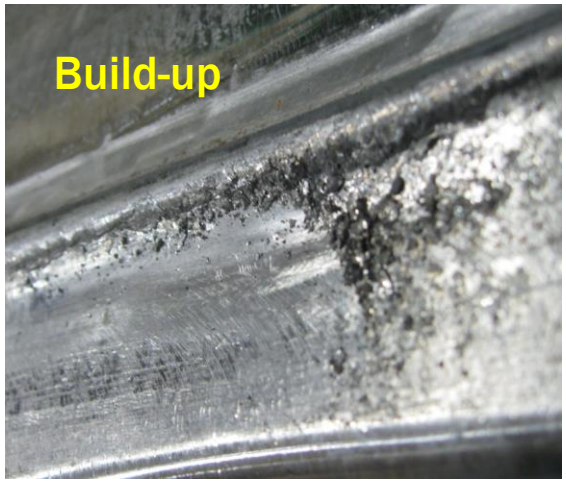
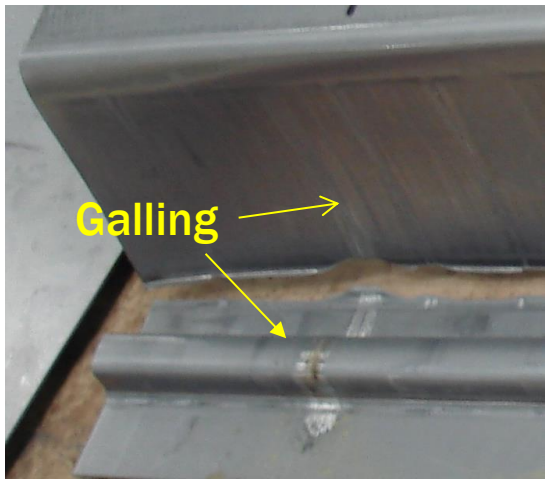
Die Wear of Non-Coated Die





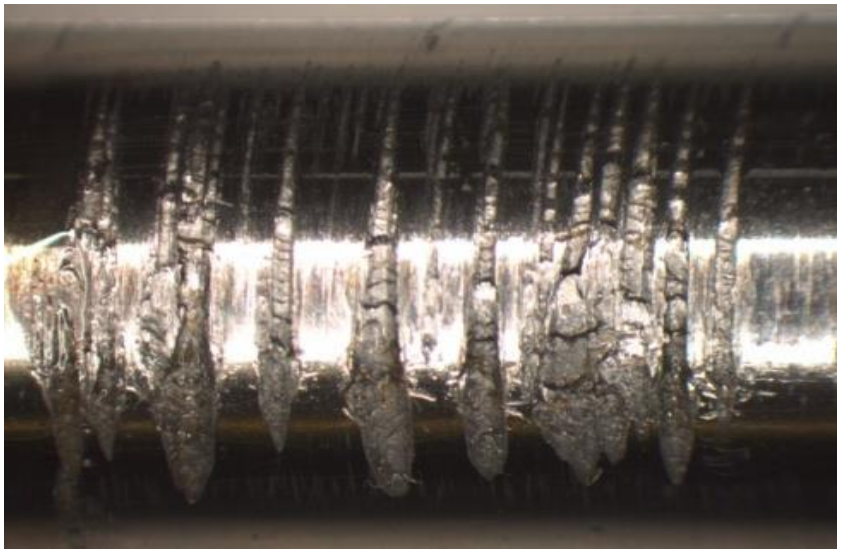




Improper Die Heat Treatment

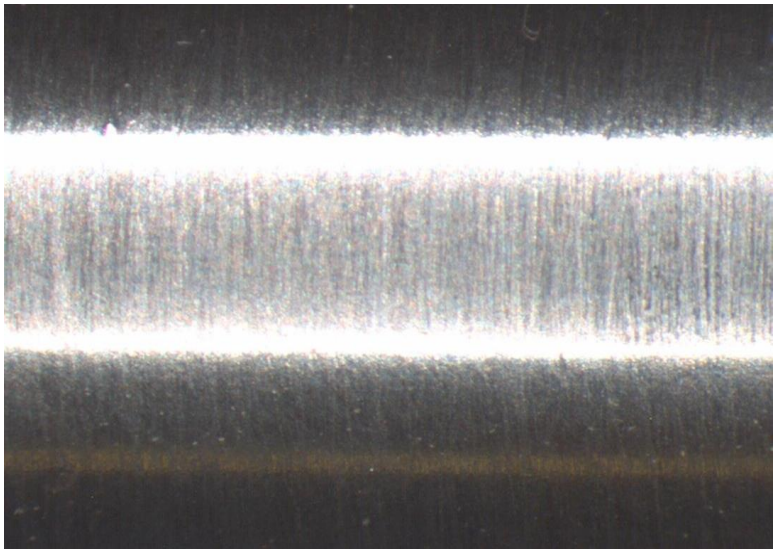
Good Heat Treatment of the Die is Required : 58~60 RC

Wear/Damage



No heat-treat die in stamping DP980

No Wear/Damage



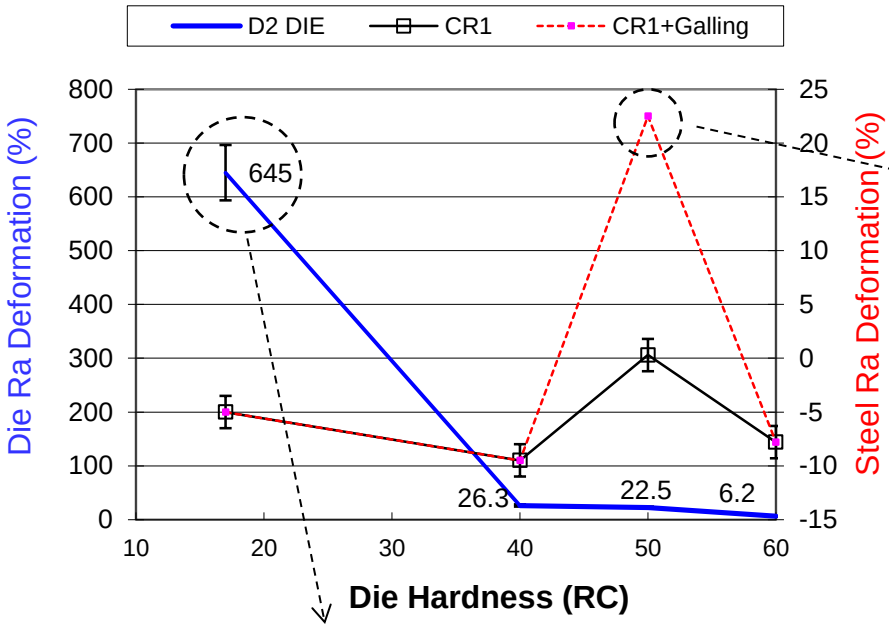
Proper heat-treat die in stamping DP980

Sheet Steel and Die Material Properties

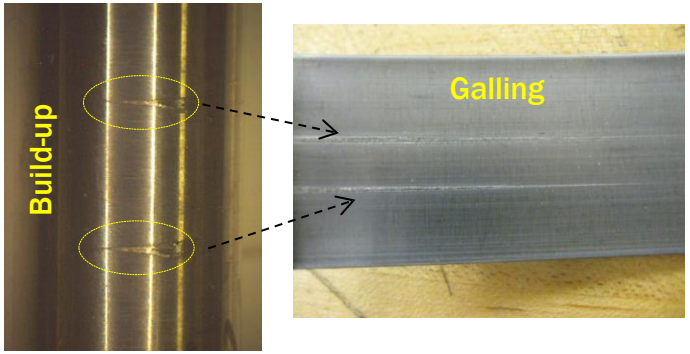
	T (mm)	Yield (MPa)	Tensile (MPa)	T.E %	N	R	Ra (μm)
CR1	1.4	826	1005	15.3	0.088	0.76	0.60
CR2	1.4	592	1049	13.1	0.116	0.82	2.10
GI	1.0	733	1040	13.2	0.118	0.97	0.58
GI-Prephos	1.0	710	1026	13.5	0.110	0.78	0.57

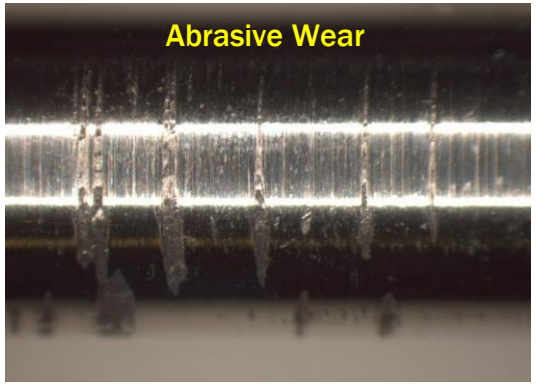
Die Material	Ra (μm)	Rockwell Hardness	Scale
D2-as received	0.08	17 (96 Rb)	Rc
D2-40RC	0.13	42	Rc
D2-50RC	0.29	47	Rc
D2-60RC	1.07	60	Rc
Ion Nitride (IN)	0.48	60	Rc
Chrome Nitride (PVD)	0.09	58	Rc

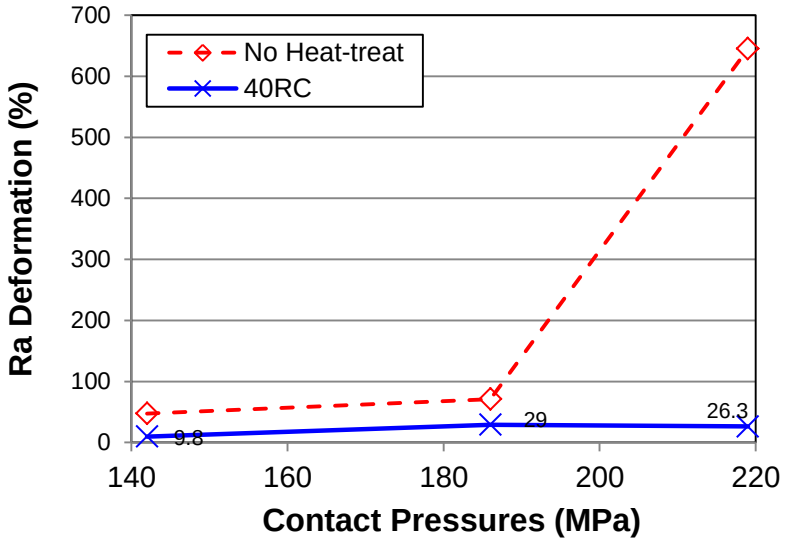
Effects of Die Hardness



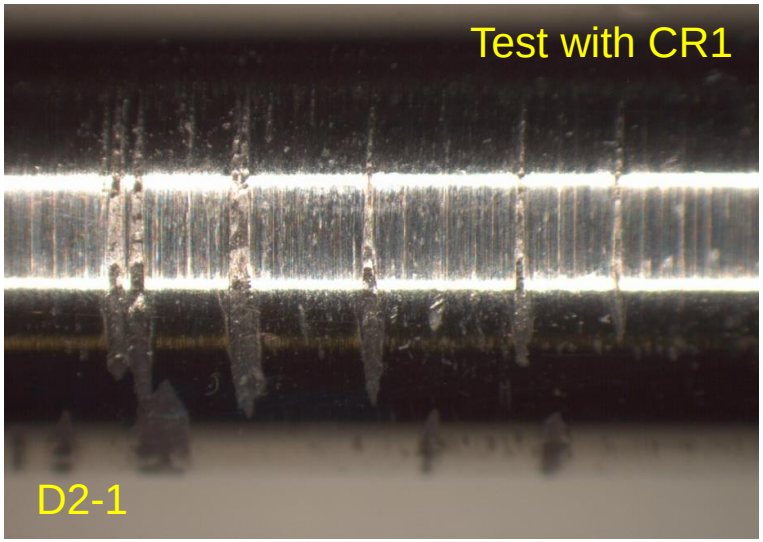
Wear ↗ Pressure ↘ Die Hardness

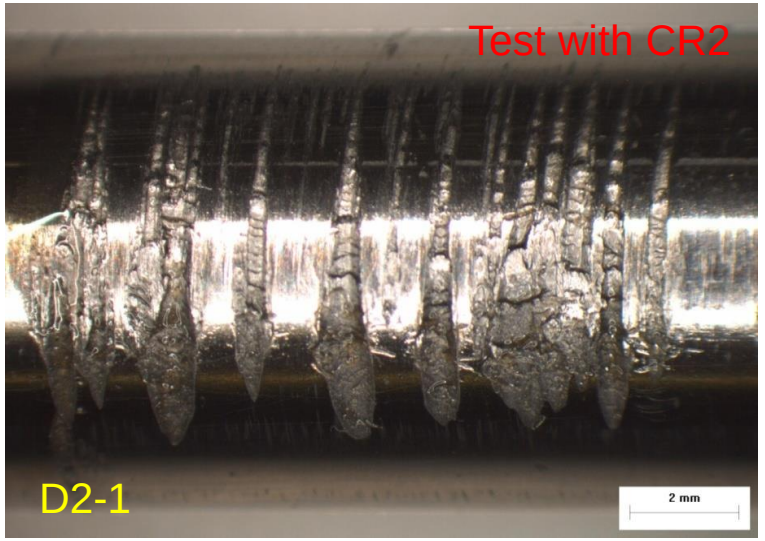


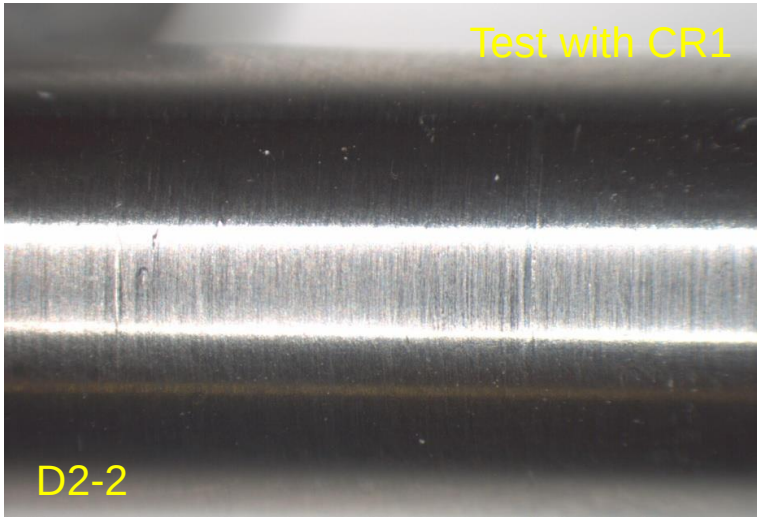


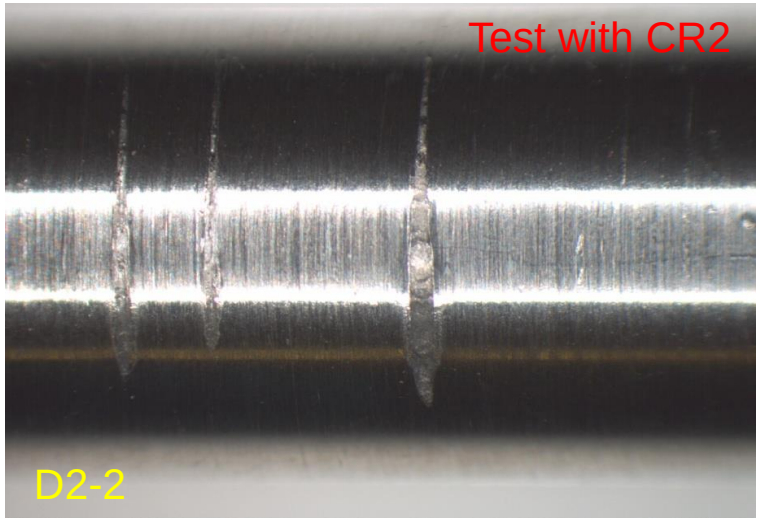


Variation of Die Materials



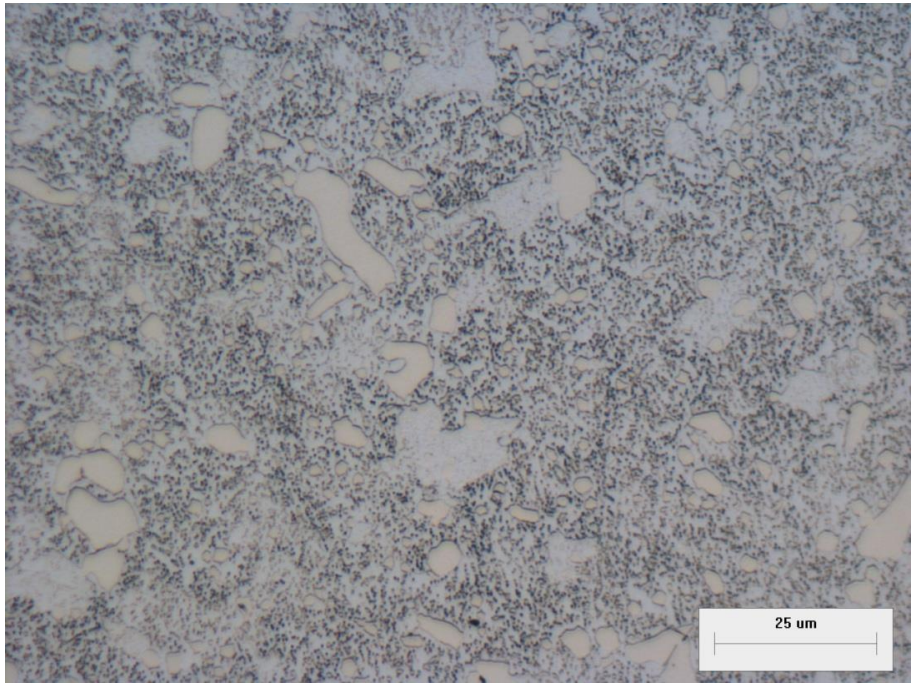




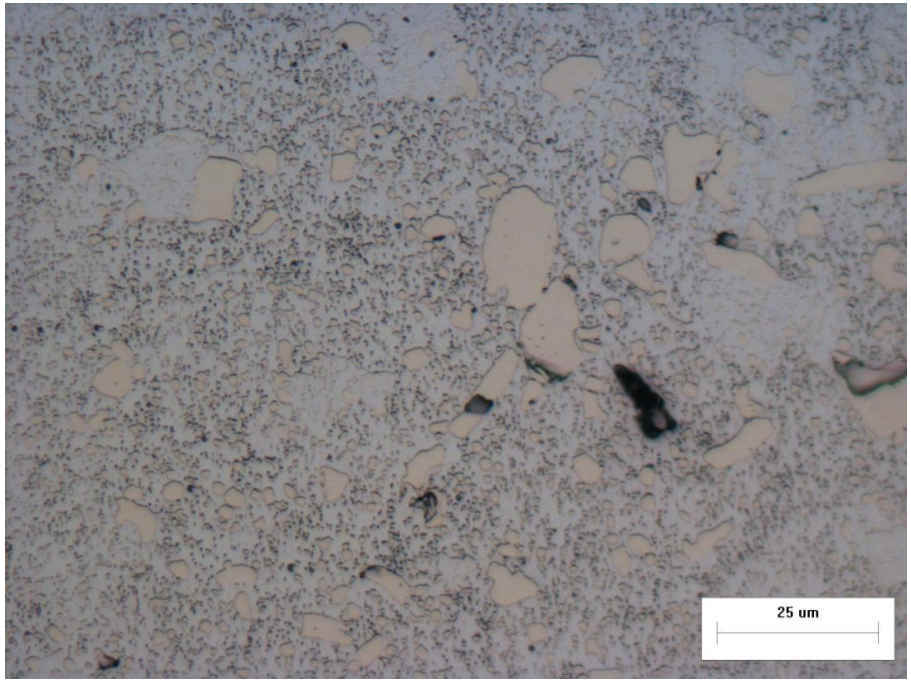


Variation of Die Materials

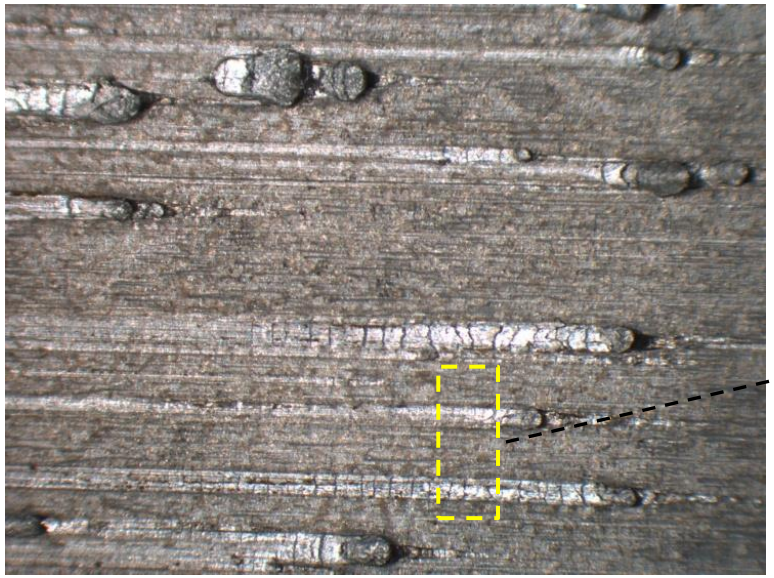
D2-1: 96RB (~ 17RC)

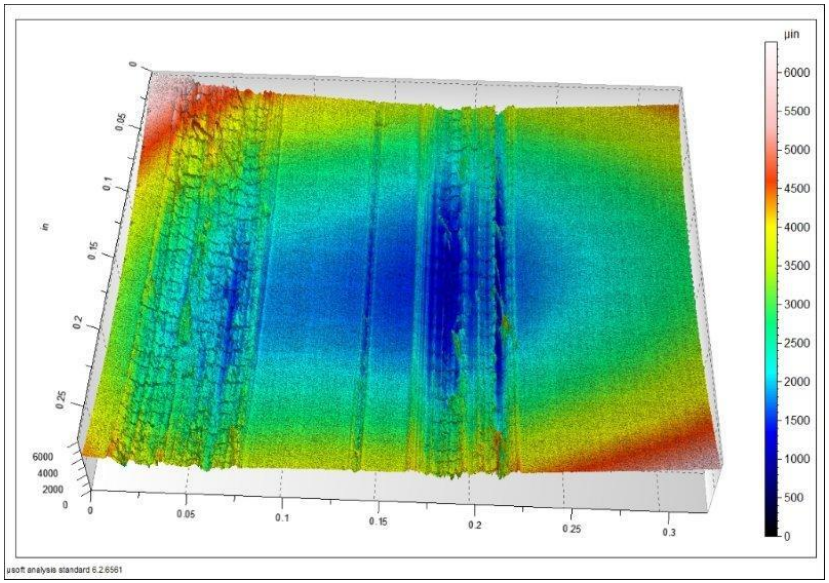


D2-2: 98RB (~ 17RC)



Short Term, Anti-Galling Strategy-Dry Lubricant

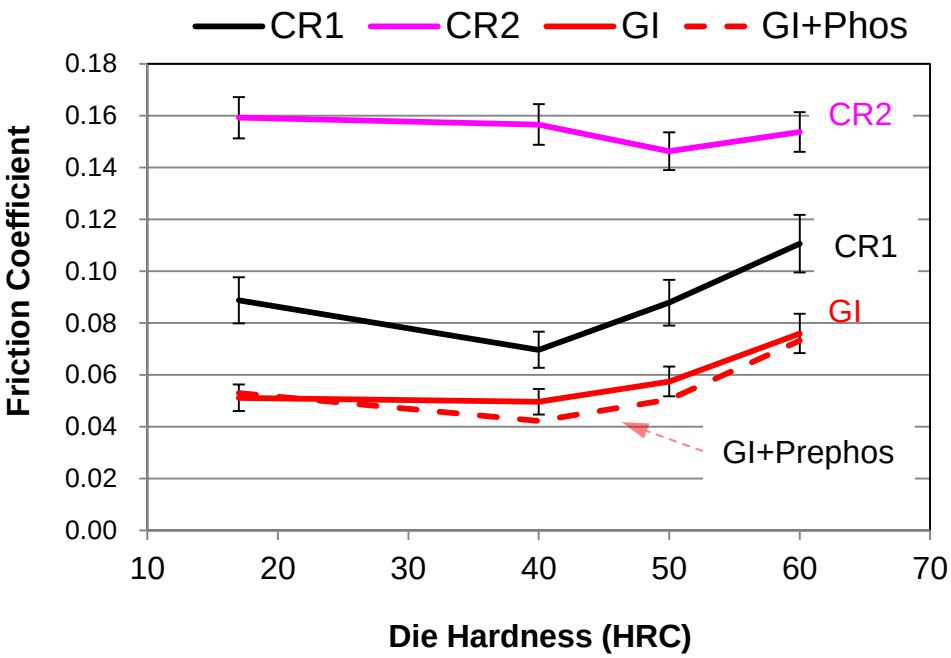




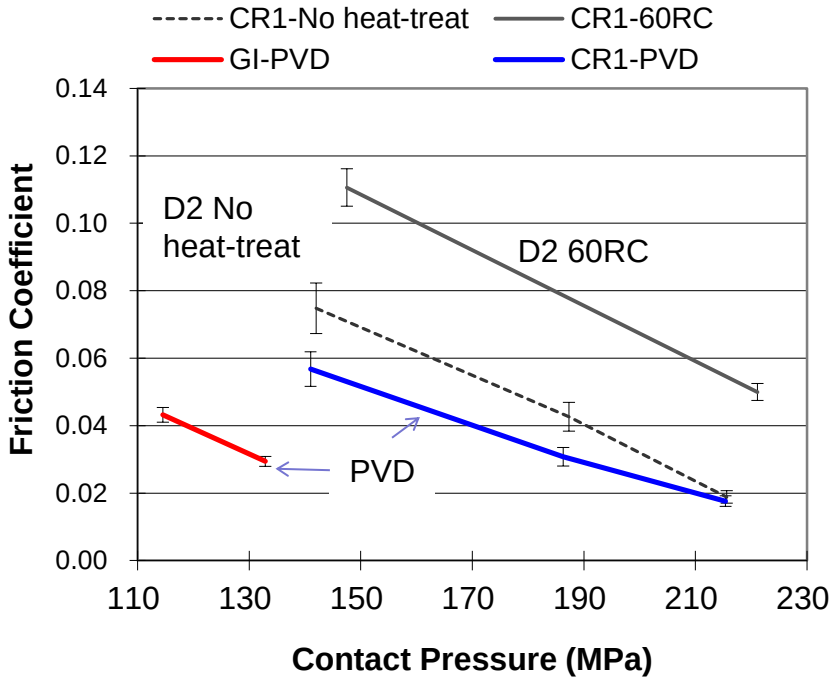
No Die Wear
No Die Build-up
No Steel galling

Friction Behavior

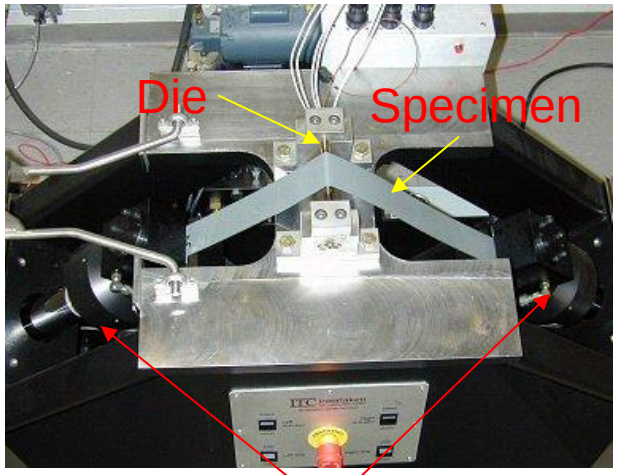
Tryout Condition

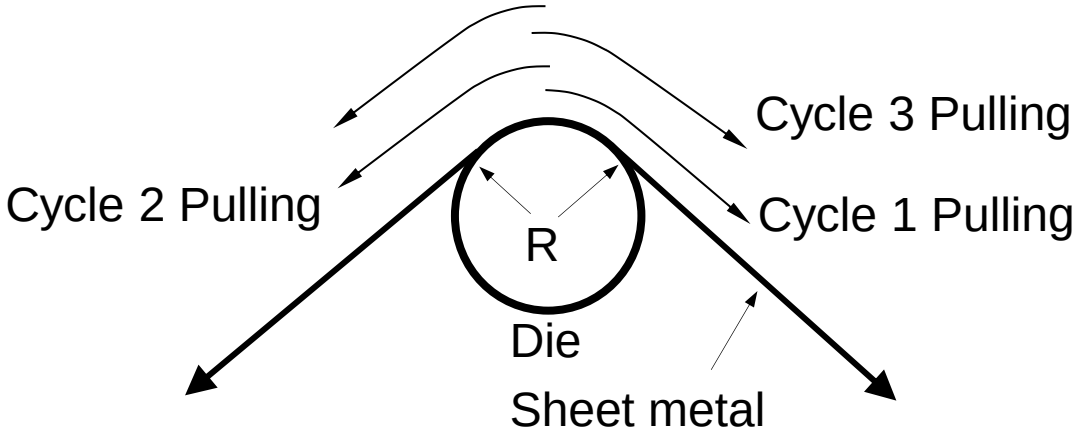


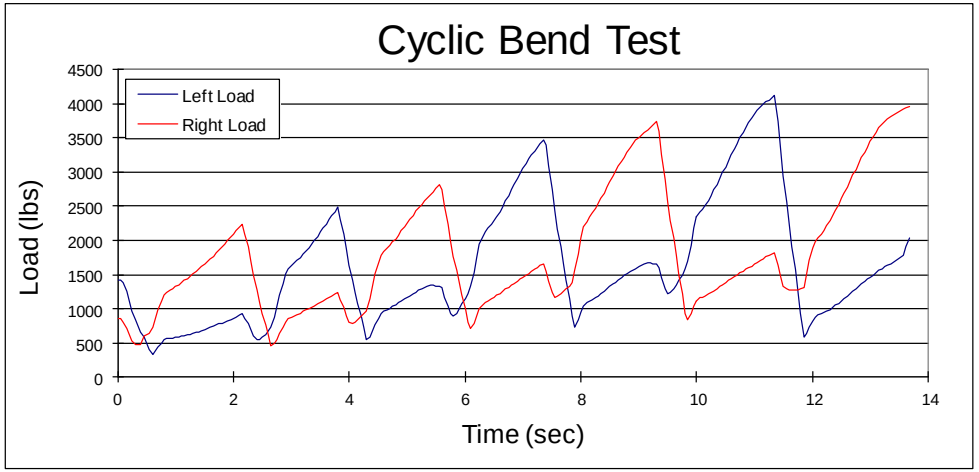
Production Condition



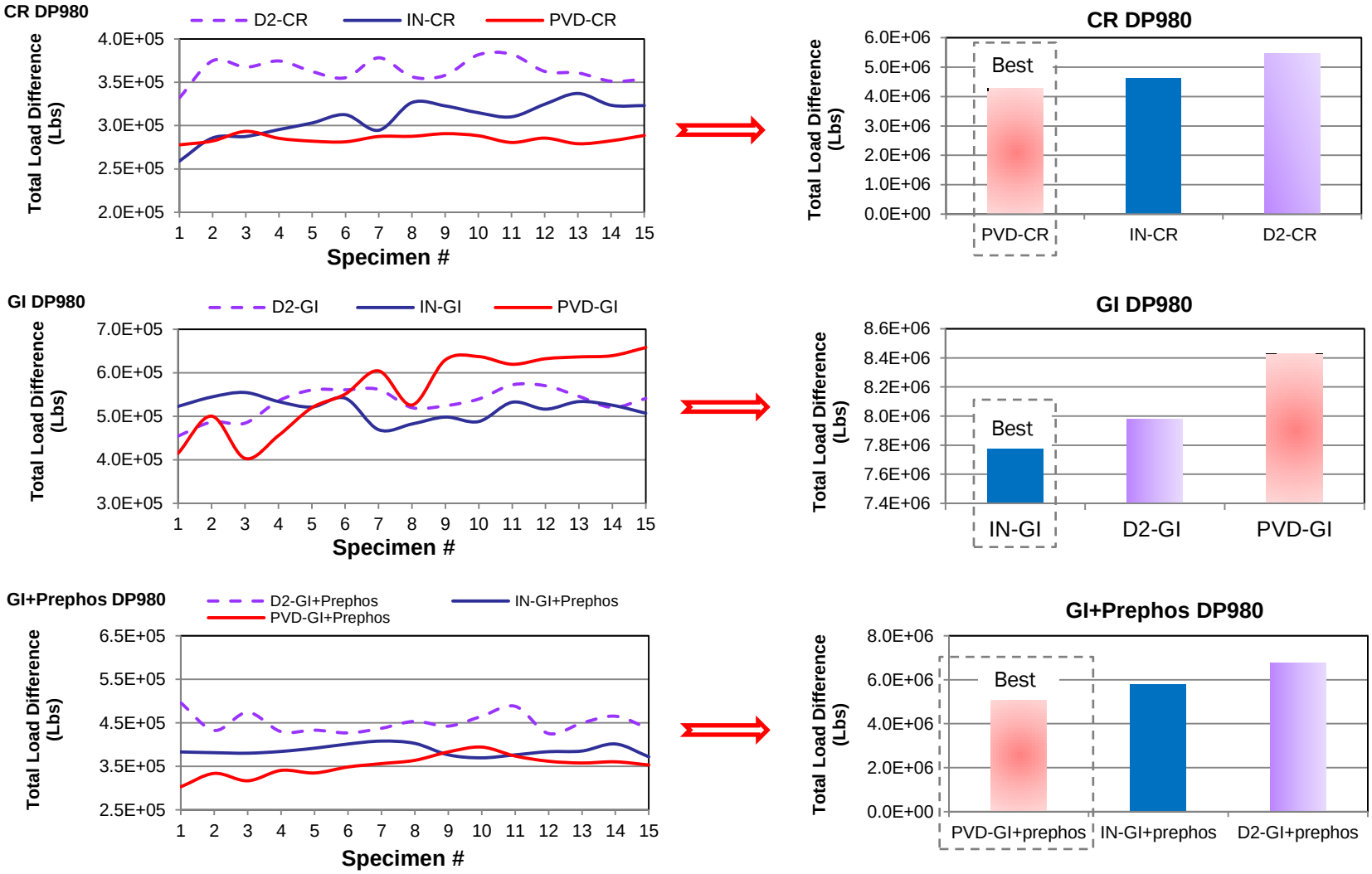
USS Cyclic Bend Die Wear Test



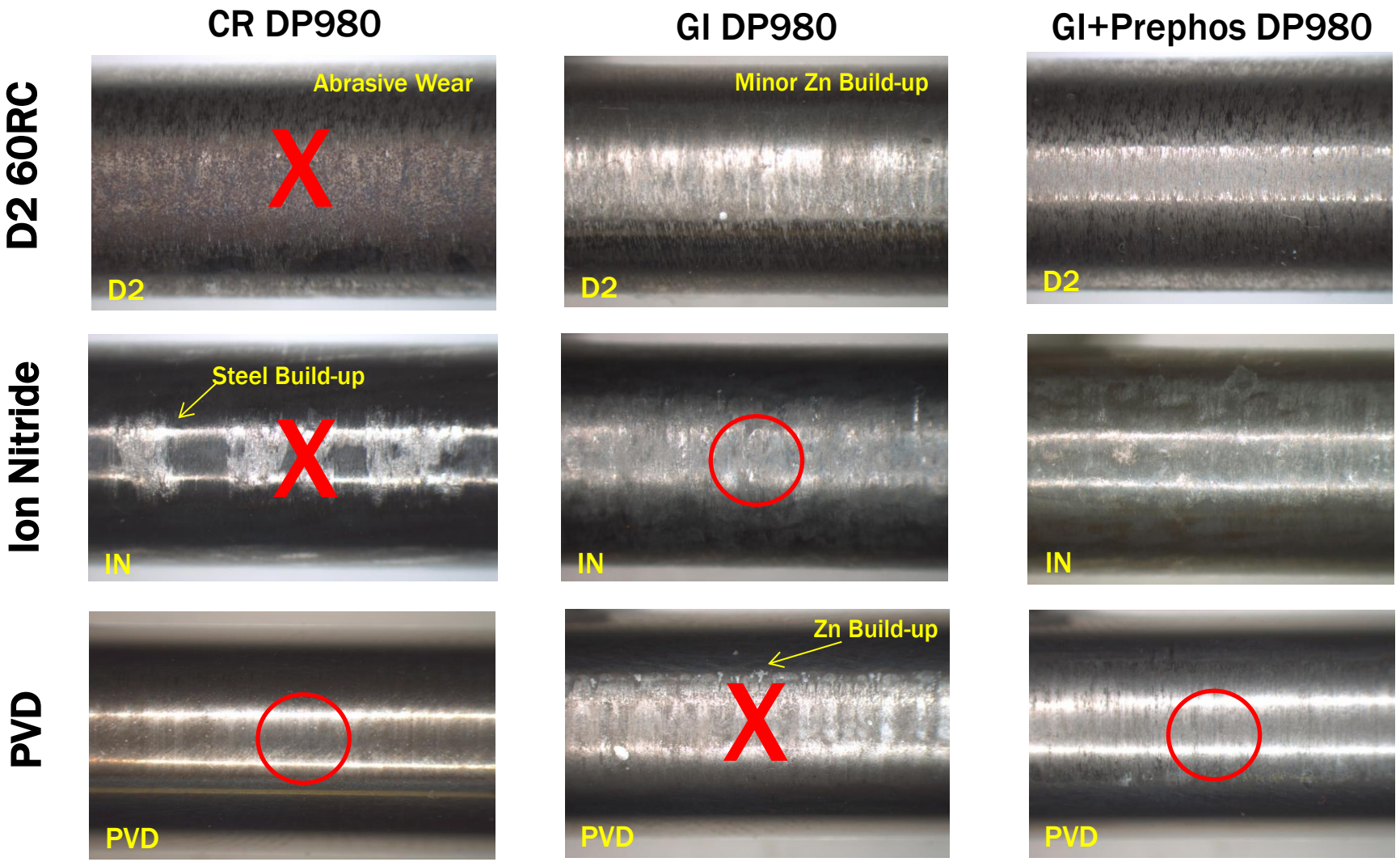




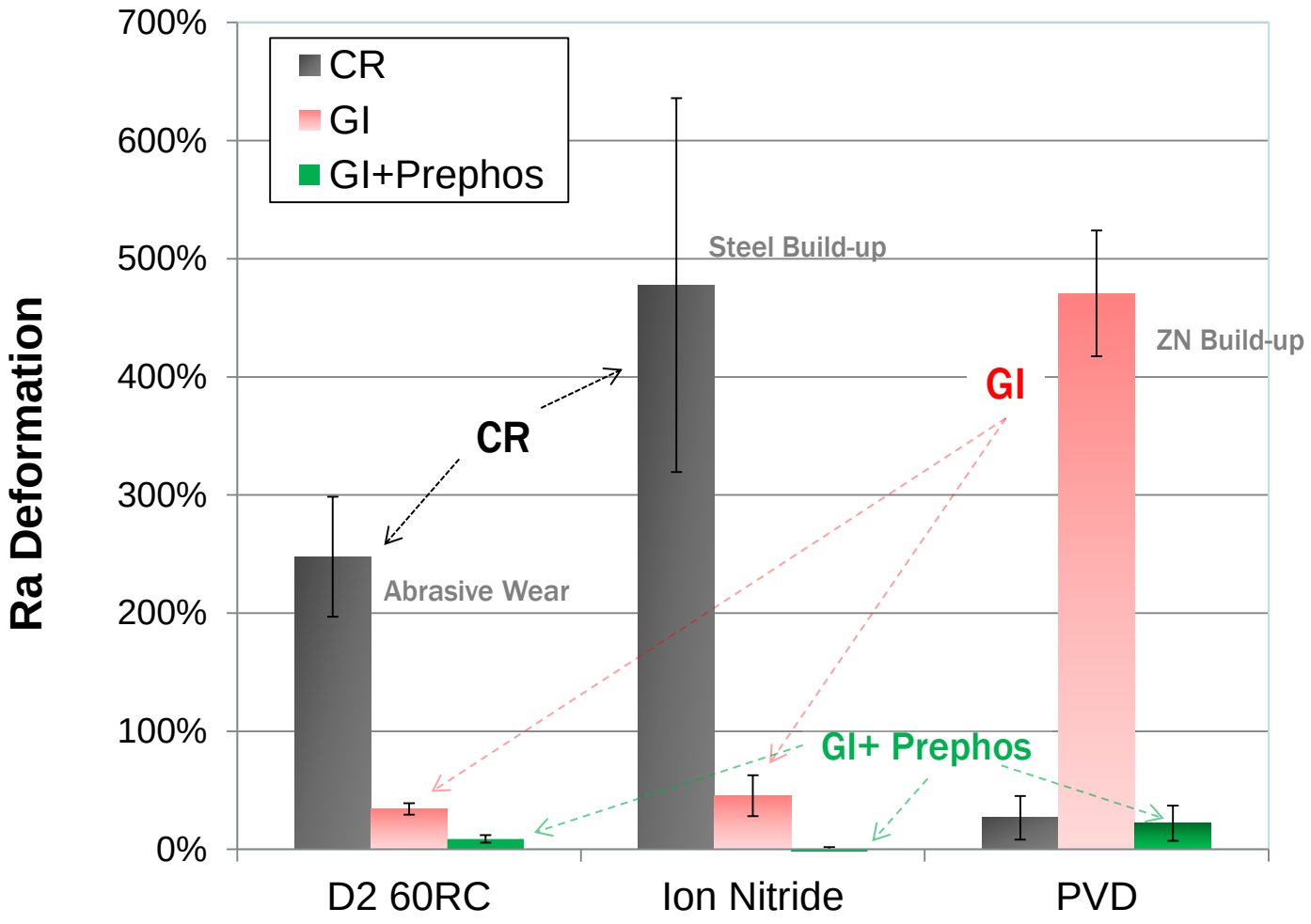
Die Wear in Production Condition



Die Wear in Production Condition



Die Wear in Production Condition



Summary

- Insufficient die surface hardness was found to be the root cause of die wear and galling in stamping DP980 steels, and a tool steel with 60RC hardness is recommended for non-coated die tryouts.
- Newly developed dry lubricants can be used to prevent die wear and galling in non-coated die tryouts with DP980.
- Cold-roll DP980 is found to have higher friction, galling and die wear characteristics than coated DP980 in both the non-coated die tryout and production conditions.
- PVD die is recommended for stamping cold-roll DP980, while Ion Nitride die is for GI-coated DP980.
- Pre-phosphate coating is observed to reduce friction and prevent die wear and galling in stamping DP980 steels.