



**American
Iron and Steel
Institute**

Fatigue Behavior of Advanced High Strength Steels for Automotive Applications

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- Generate fatigue data for new advanced high strength steels
- Study the effect of notch on fatigue strength





- 440W -GA - 1.40mm
- BH300 - GI - 1.43mm
- HSLA350 - GI - 1.60mm
- HSS590 - CR, bare - 1.40mm
- DP600 - GI - 1.25mm
- DP600 - HR - 2.62mm
- DP800 - GA - 1.19mm





- TRIP590 - EG - 1.45mm
- TRIP600 - CR, bare - 1.56mm
- TRIP780 - CR, bare - 1.56mm
- TRIP980 - CR, bare - 1.47mm



Table 1 Tensile Properties (As received, ASTM E8, "L" direction)

	Group 1			Group 2				
	BH300 GI	440W GA	HSLA350 GI	HSS590 CR	DP600 GI	DP600 HR	TRIP590 EG	TRIP600 CR
YS (Mpa)	309	326	356	431	412	437	428	414
UTS (Mpa)	412	462	441	608	666	616	605	679
TE (%)	35.8	29.0	28.1	24.5	23.2	28.9	32.0	27.6
UE (%)	20.4	16.3	15.8	15.1	15.3	19.6	22.6	19.6
n (6-12)	0.19	0.18	0.13	0.17	0.16	0.22	0.20	0.24



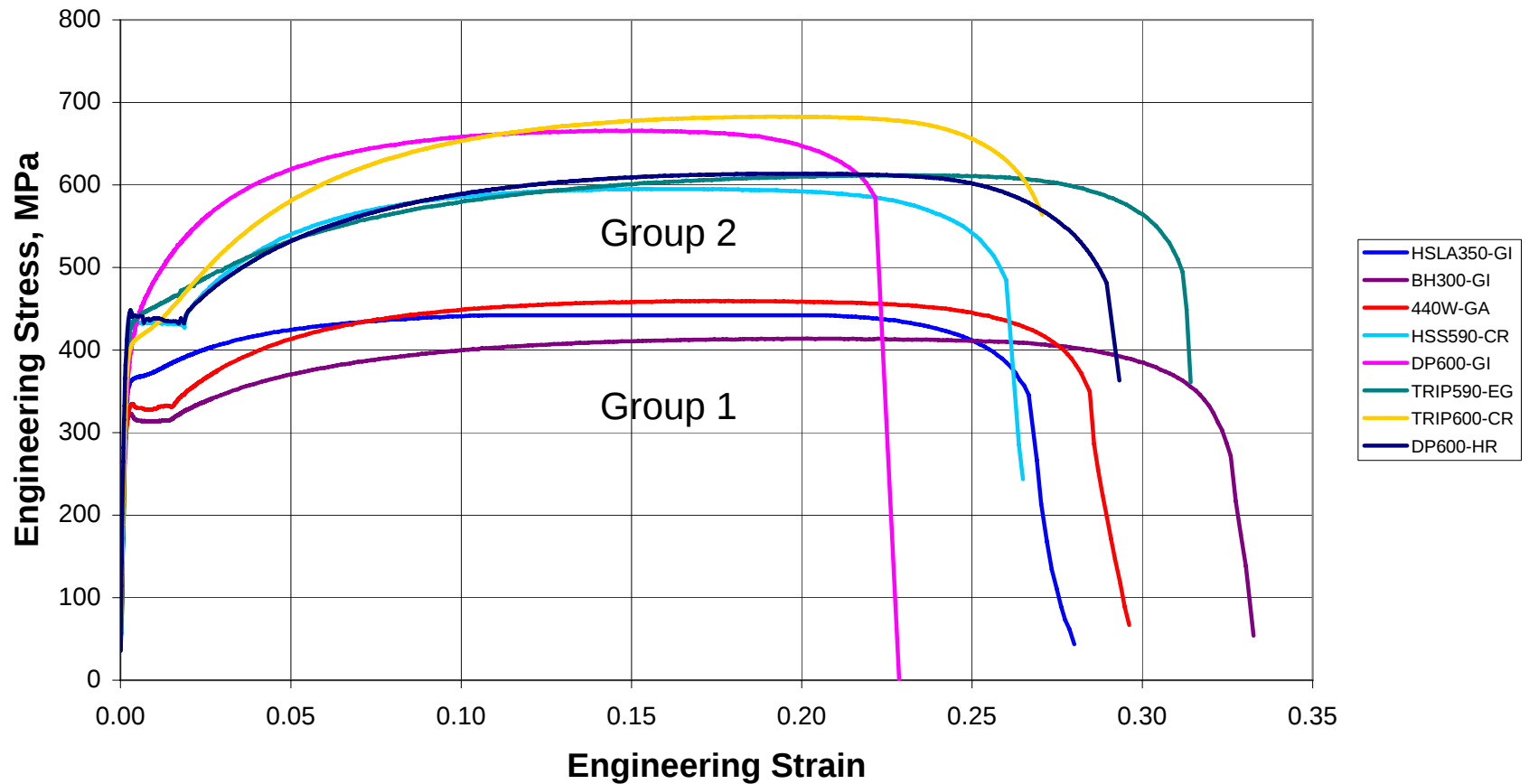
Table 1 Tensile Properties (As received, ASTM E8, "L" direction)

	Group 3		Group 4
	DP800 GA	TRIP780 CR	TRIP980 CR
YS (Mpa)	462	505	663
UTS (Mpa)	839	793	984
TE (%)	17.9	29.4	15.7
UE (%)	12.3	23.9	11.8
n (6-12)	0.13	0.26	0.13

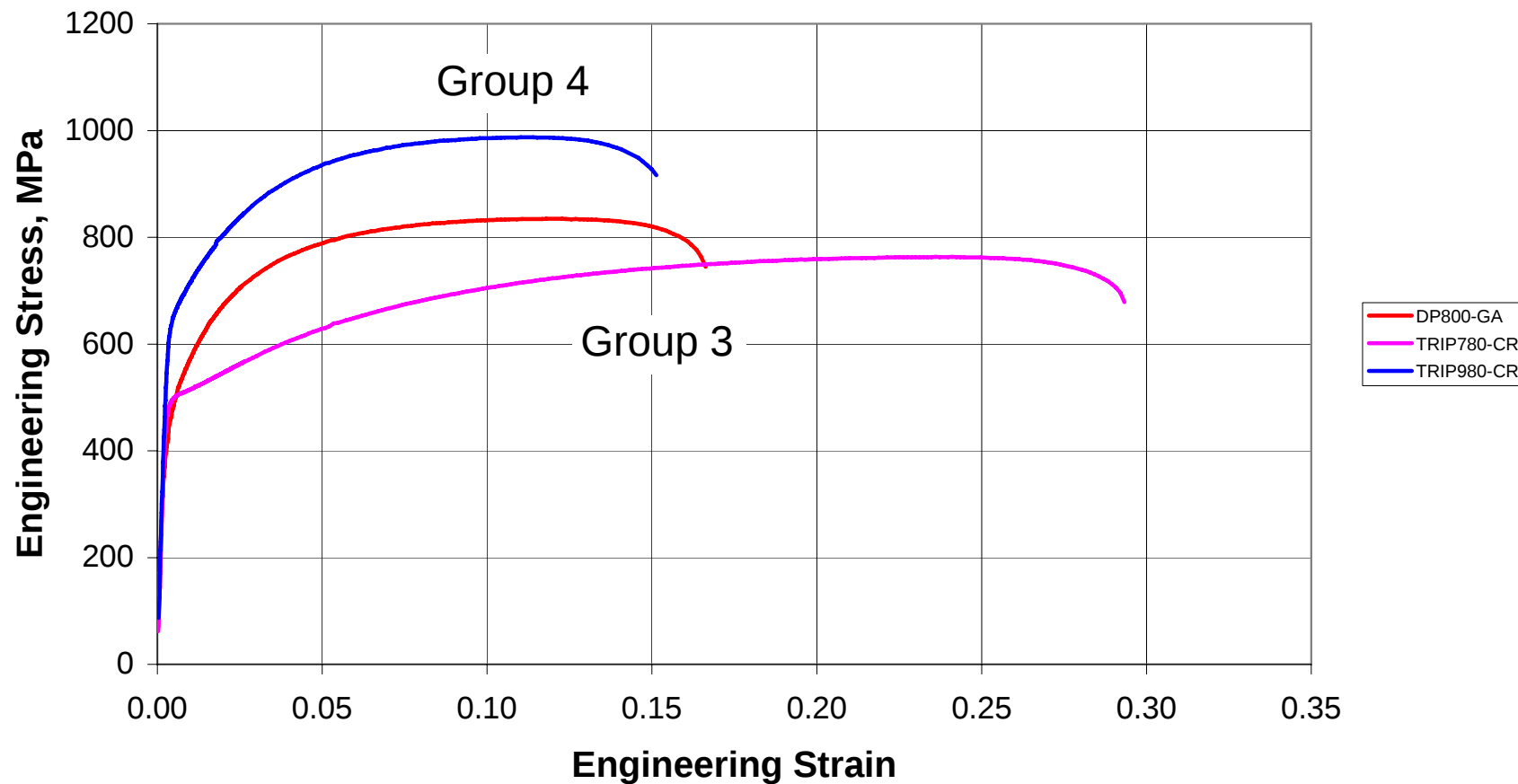




Tensile Stress-Strain Curves

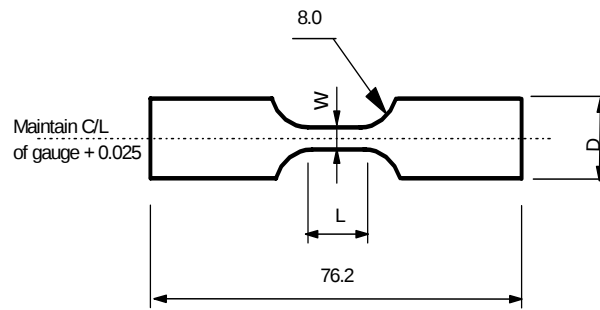


Tensile Stress-Strain Curves





Strain Controlled Fatigue



All dimensions in mm

ASTM E606
Tension-Compression

Notched Fatigue

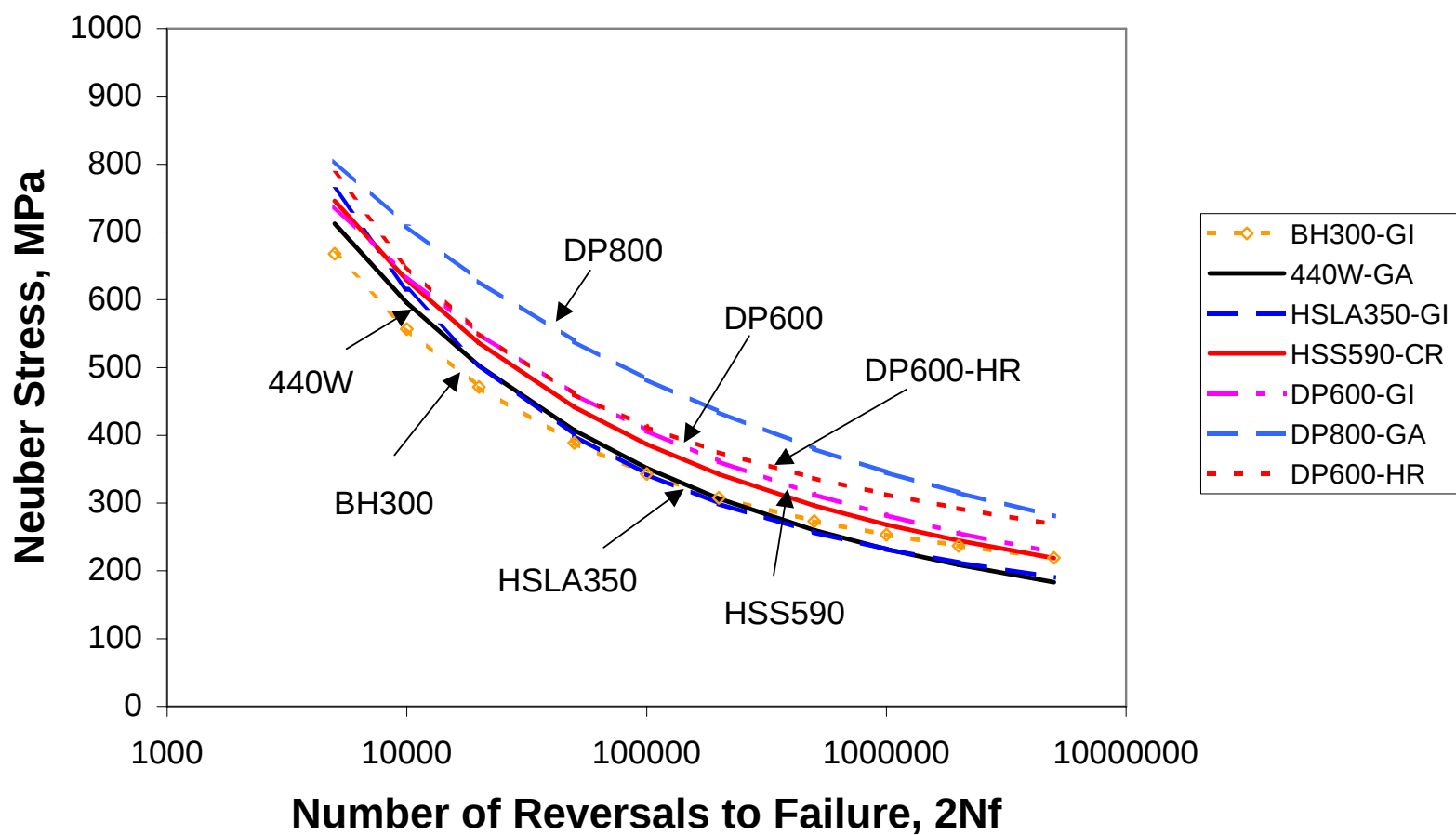


ASTM E466
Tension-Compression
 $K_t = 2.5$





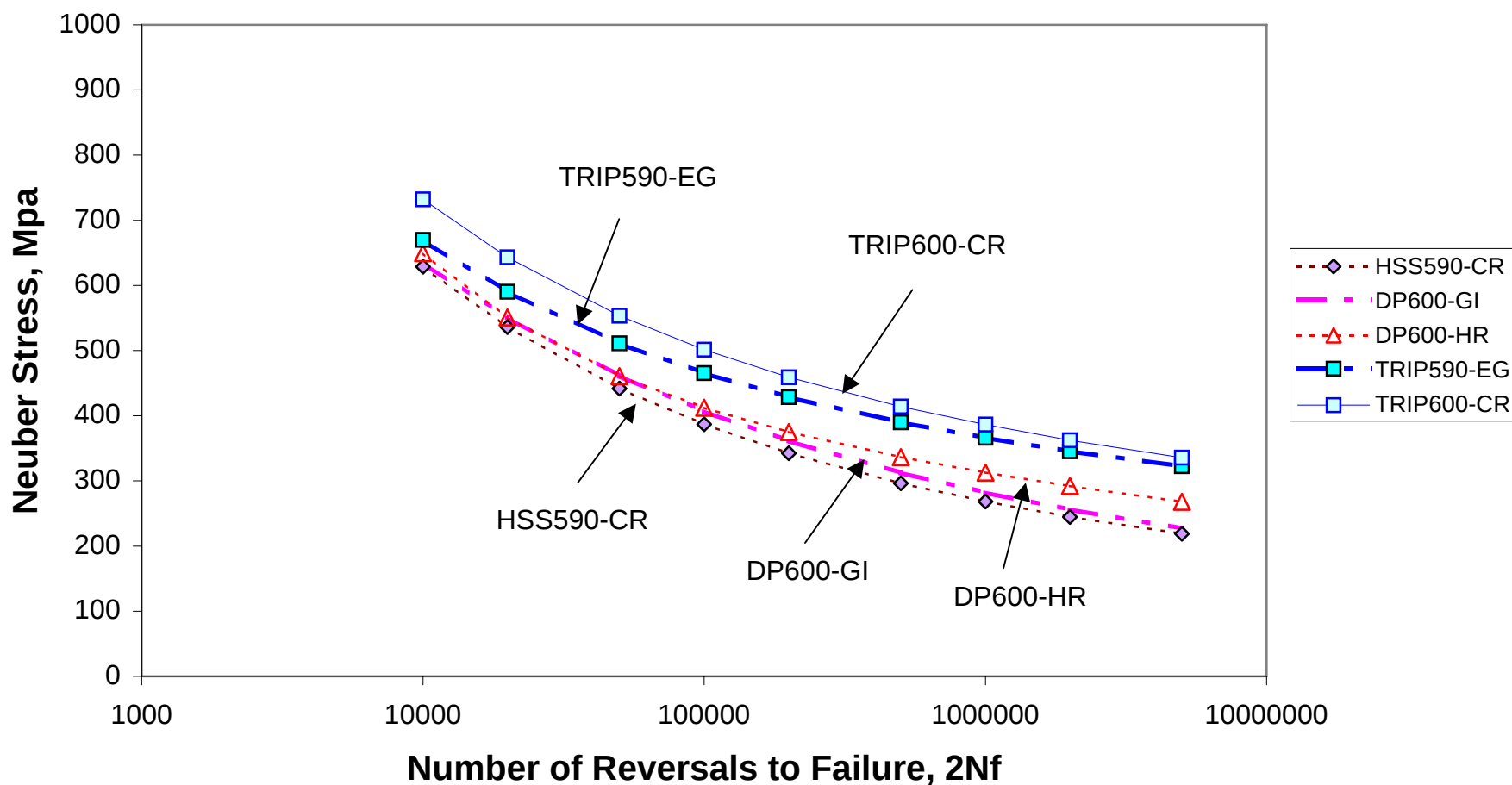
Strain Controlled Fatigue Results





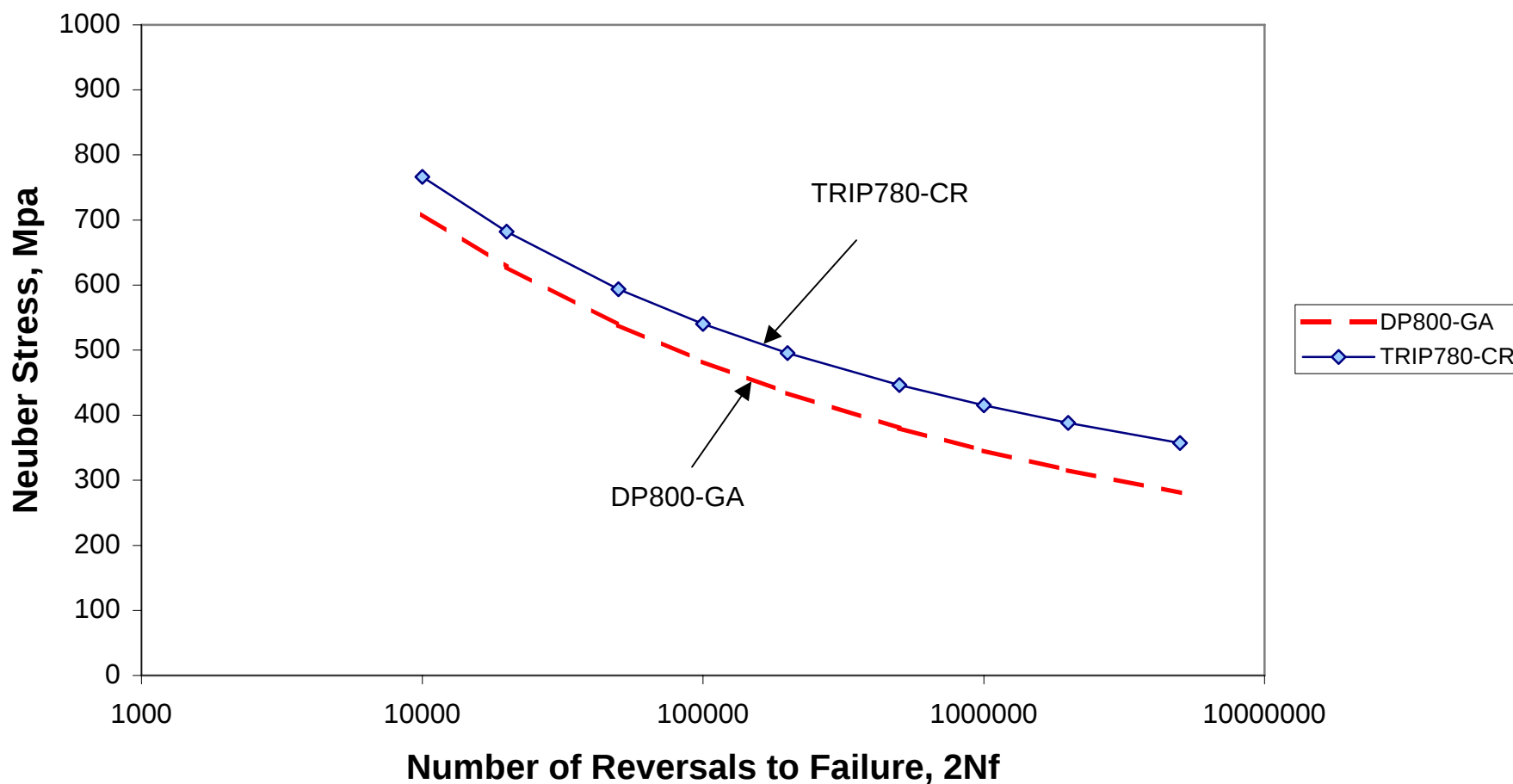
Strain Controlled Fatigue Results

Steels in Group 2



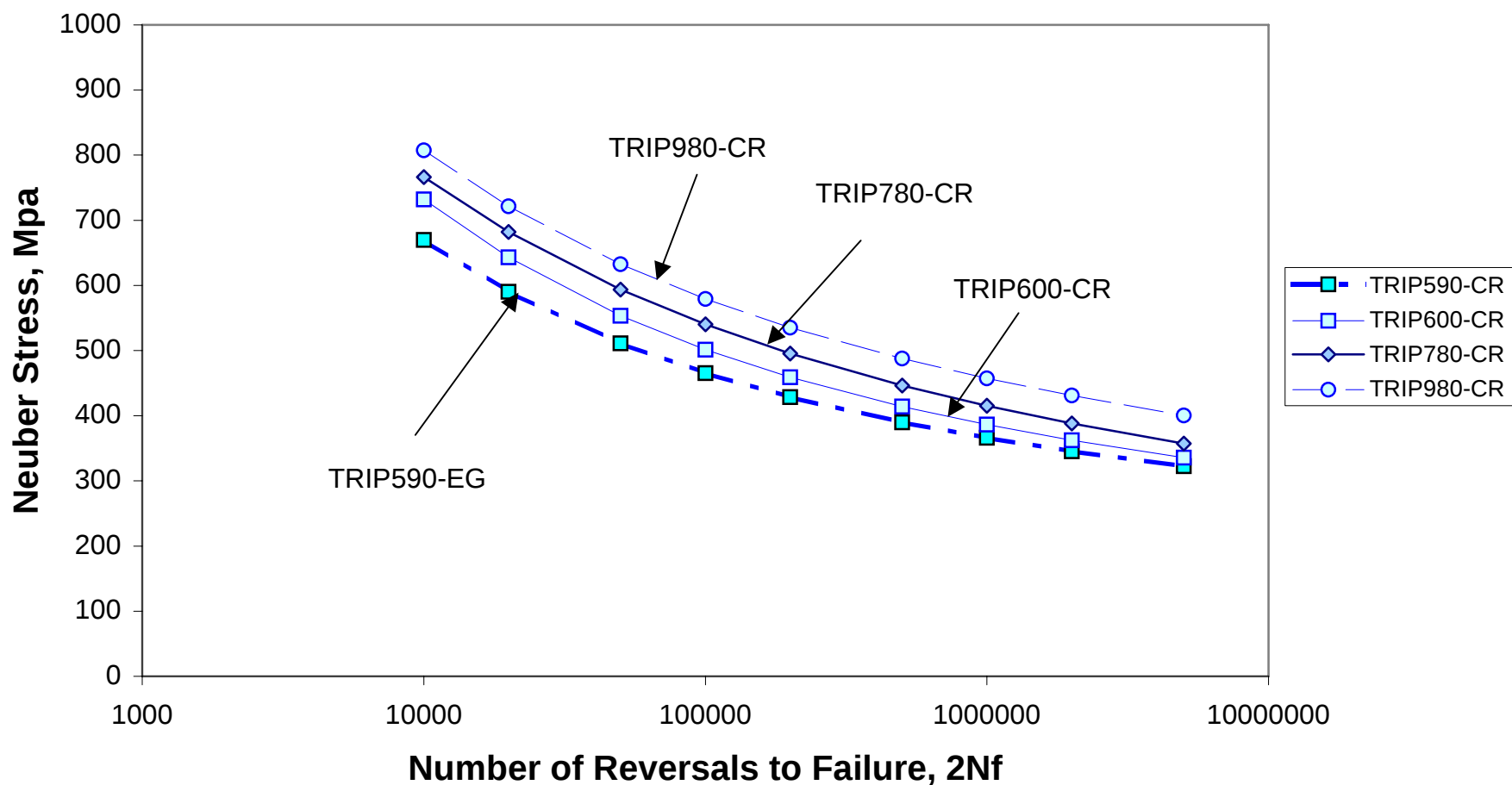
Strain Controlled Fatigue Results

Steels in Group 3



Strain Controlled Fatigue Results

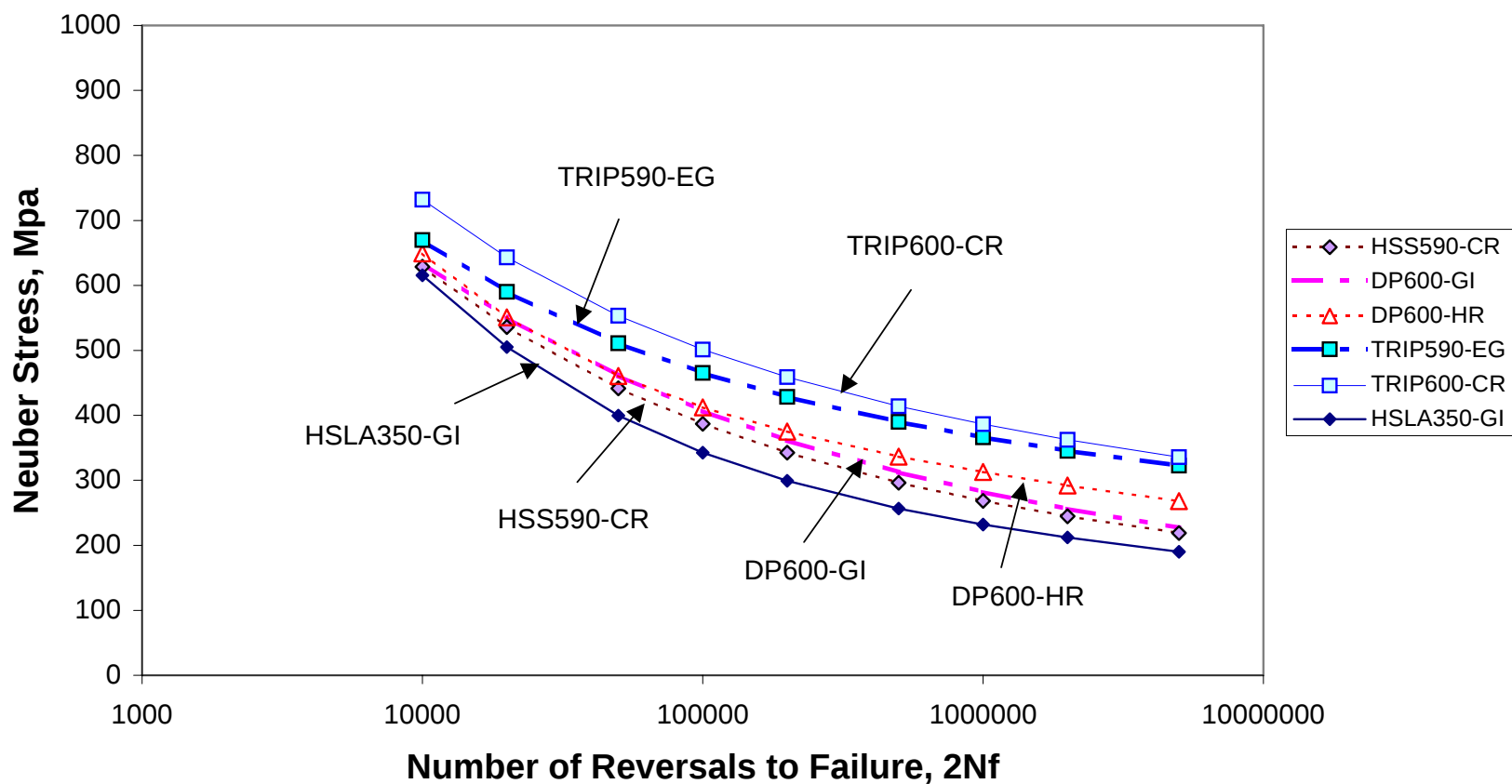
TRIP Steels





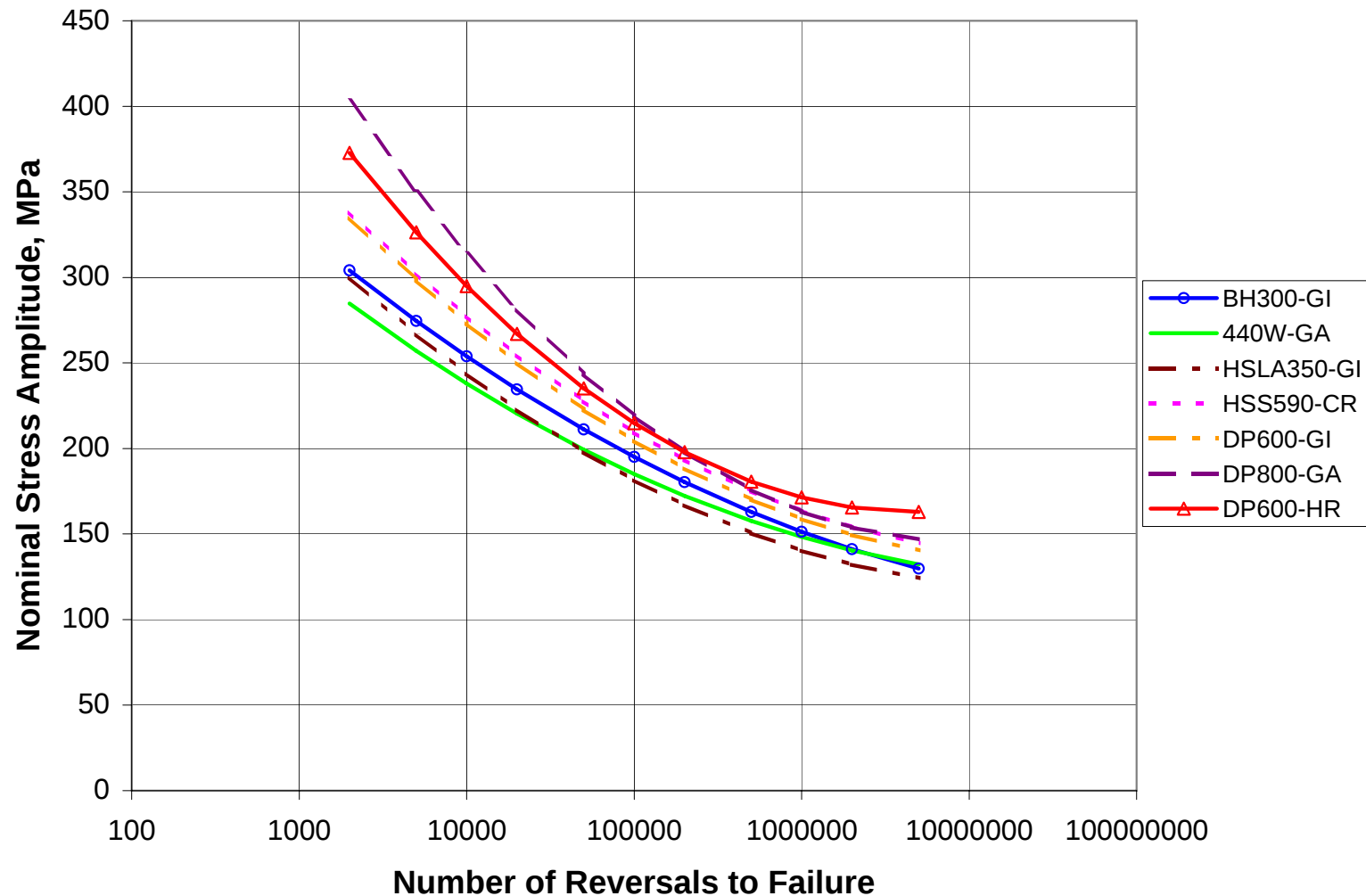
Strain Controlled Fatigue Results

HSLA350 vs. AHSS





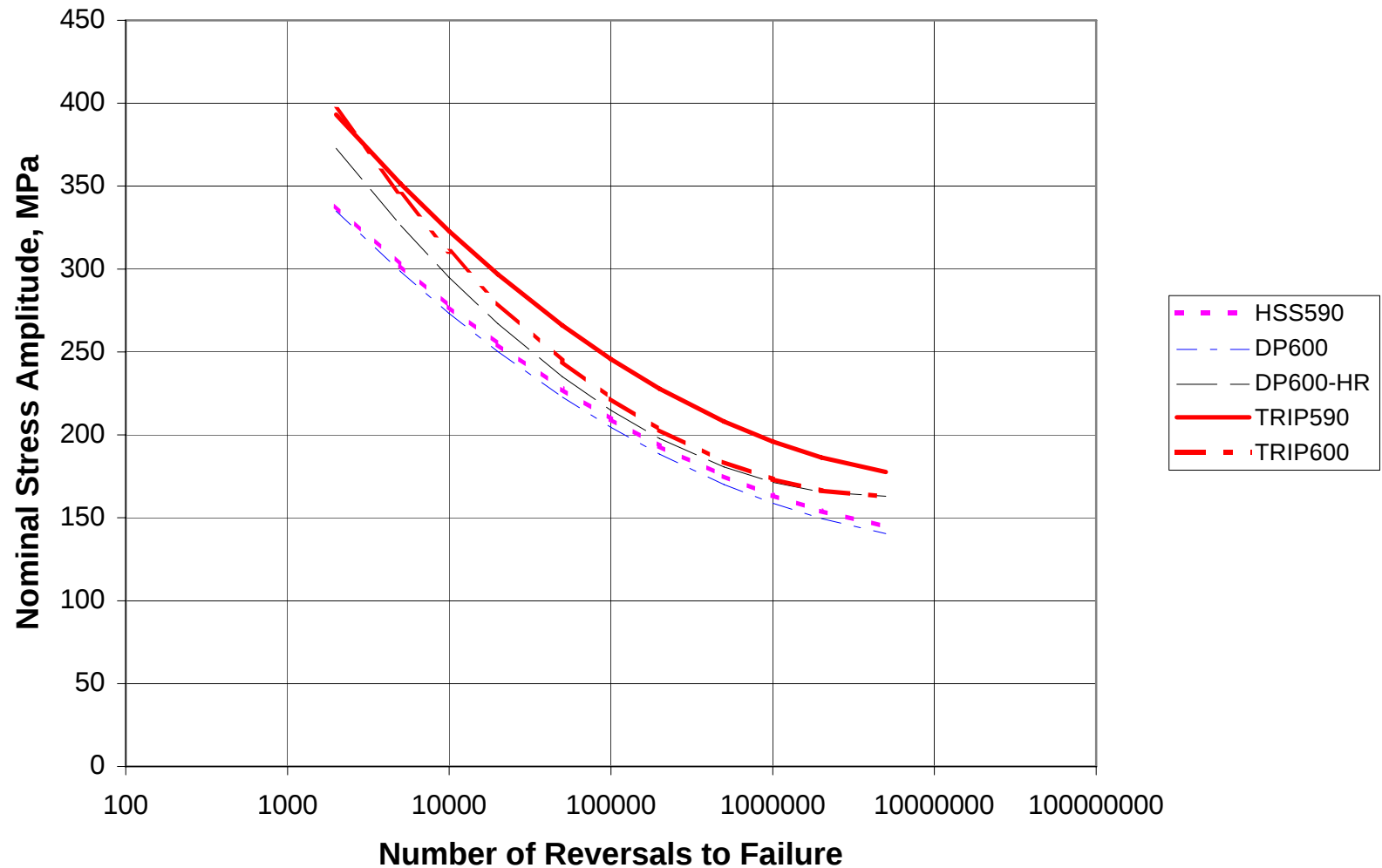
Notched Fatigue Results





Notched Fatigue Results

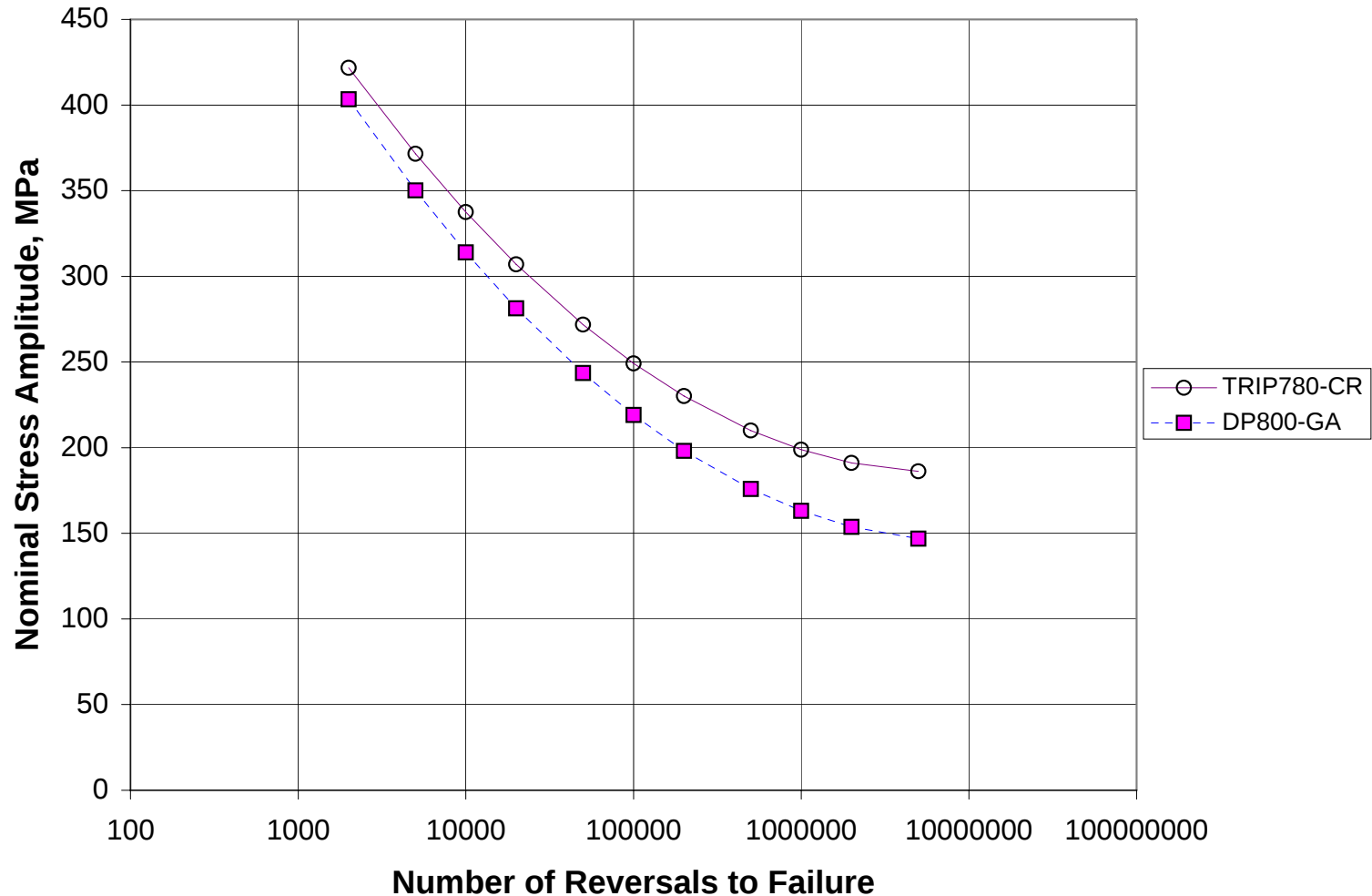
Steels in Group 2





Strain Controlled Fatigue Results

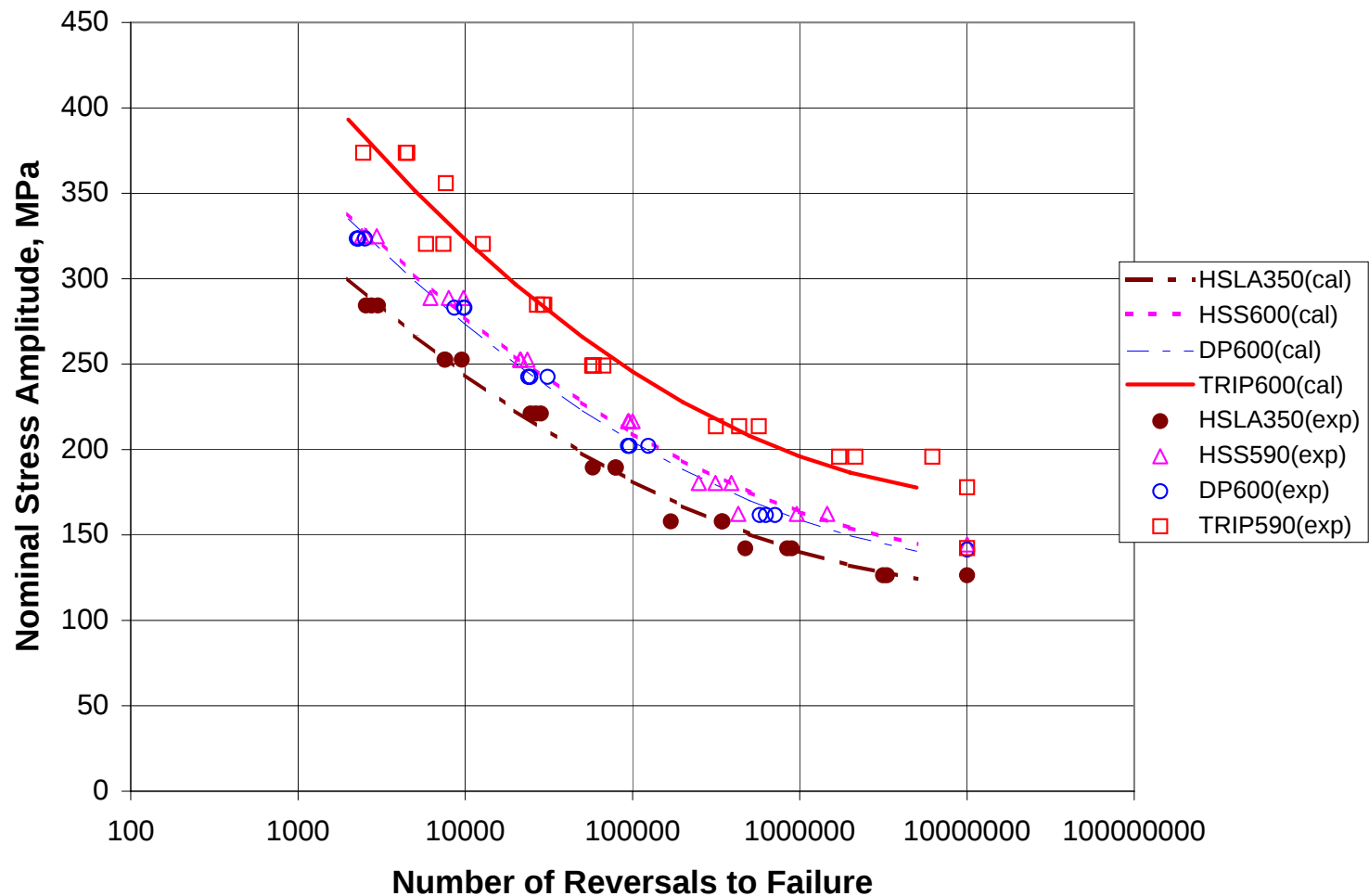
Steels in Group 3





Notched Fatigue Results

AHSS vs. HSLA350





Fatigue Properties in Summary

	<i>Steel Grade</i>	<i>UTS (MPa)</i>	<i>Endurance Limit (MPa)</i>	<i>Notch Endur. Limit (MPa)</i>	<i>K_f = EL/NNL</i>
1	BH300 <i>GI</i>	412	193	120	1.61
2	440W <i>GA</i>	462	209	130	1.61
3	HSLA350 <i>GI</i>	441	203	125	1.62
4	HSS590 <i>CR</i>	608	230	144	1.60
5	DP600 <i>GI</i>	666	228	142	1.61
6	DP600 <i>HR</i>	616	296	154	1.92
7	TRIP590 <i>EG</i>	605	336	178	1.89
8	TRIP600 <i>CR</i>	679	365	173	2.11





Fatigue Properties in Summary

	<i>Steel Grade</i>	<i>UTS (MPa)</i>	<i>Endurance Limit (MPa)</i>	<i>Notch Endur. Limit (MPa)</i>	<i>K_f = EL/NEL</i>
9	DP800 GA	839	307	147	2.09
10	TRIP780 CR	793	400	189	2.11
11	TRIP980 CR	984	427	190	2.25





- AHSS exhibited much higher fatigue strength over conventional HSS
- TRIP steel exhibited exceptionally good fatigue strength than steels of similar UTS but different microstructure
- Comparing with HSLA350, DP600 exhibits 30% higher and TRIP600 70% higher endurance limit
- With the presence of notches, AHSS still show higher notch endurance limit than HSLA350





- The project was funded and completed under the AISI/DOE Technical Road Map Program #0038
- Work was performed and results were analyzed by Ispat Inland Research Laboratories
- Support from AISI AAC member companies is greatly appreciated.

