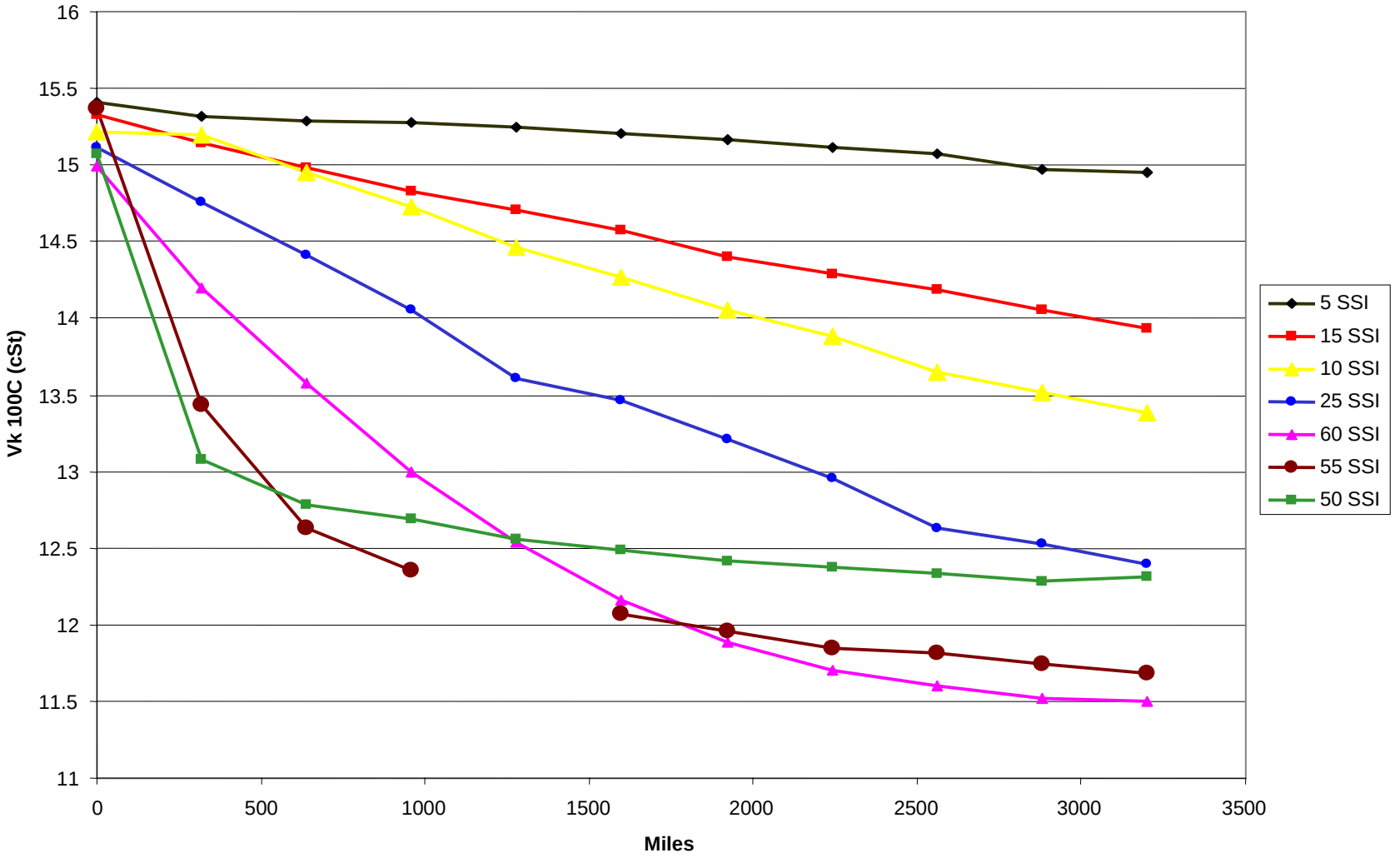
Infineum Comments on HTHS Limits for PC-9

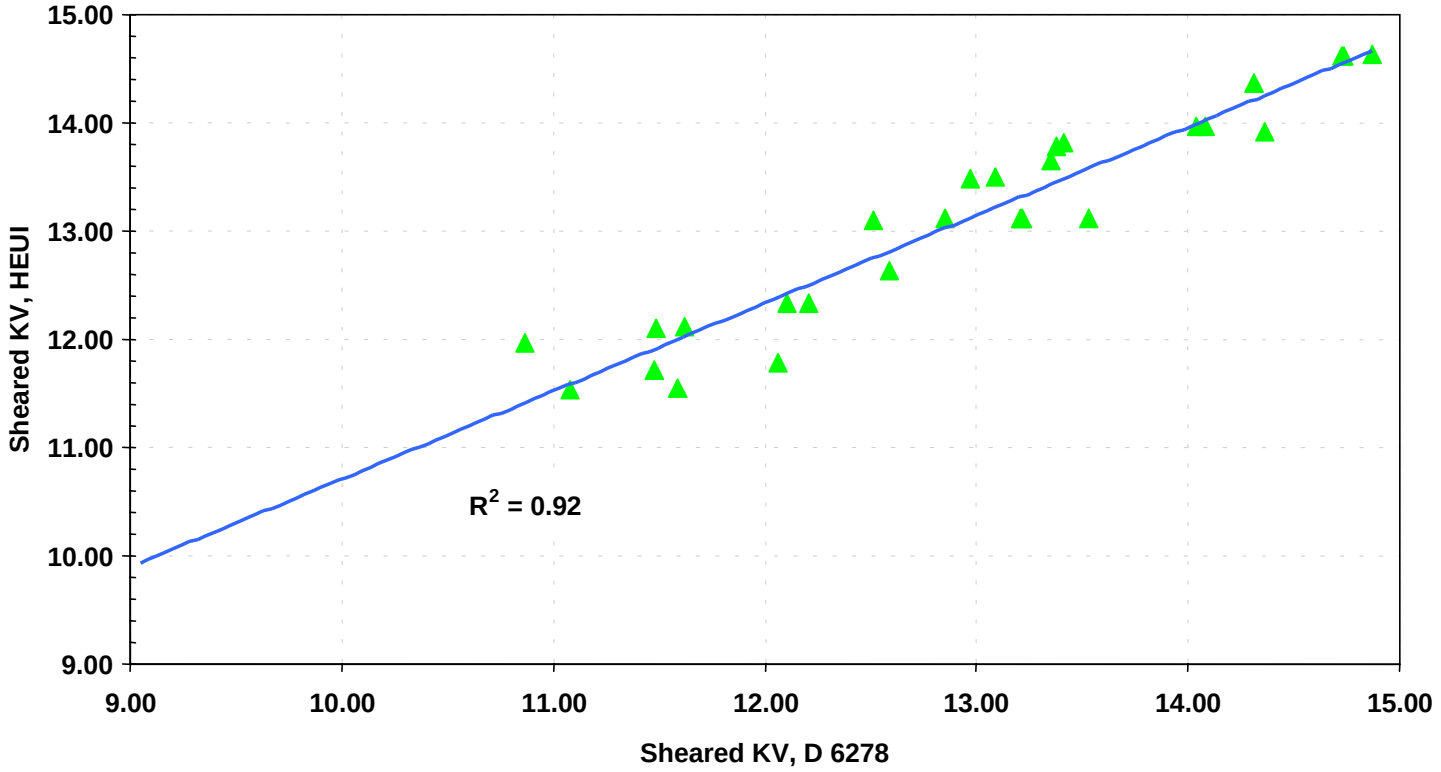
Potential HTHS Concerns

- Current SAE J300 limit of 2.9 cP for 10W-30 viscosity grade is biased toward passenger car fuel economy.
- Limits applied to fresh oil may not reflect actual performance in engine after even short periods of service.
  - A 2.9 cP oil with a 50 SSI viscosity modifier will shear to 2.5 cP.
  - Even the previously requested 10W-35 limit of 3.3 cP on a fresh oil with a 50 SSI viscosity modifier would shear to 2.9 cP.
- Idle oil pressure and minimum oil film thickness in bearings are related to lubricant viscometrics.
  - Both KV100 loss and HTHS loss after shear are related to one another as well as to the SSI of the viscosity modifier.

Viscosity Loss in the HEUI Equipped Trucks

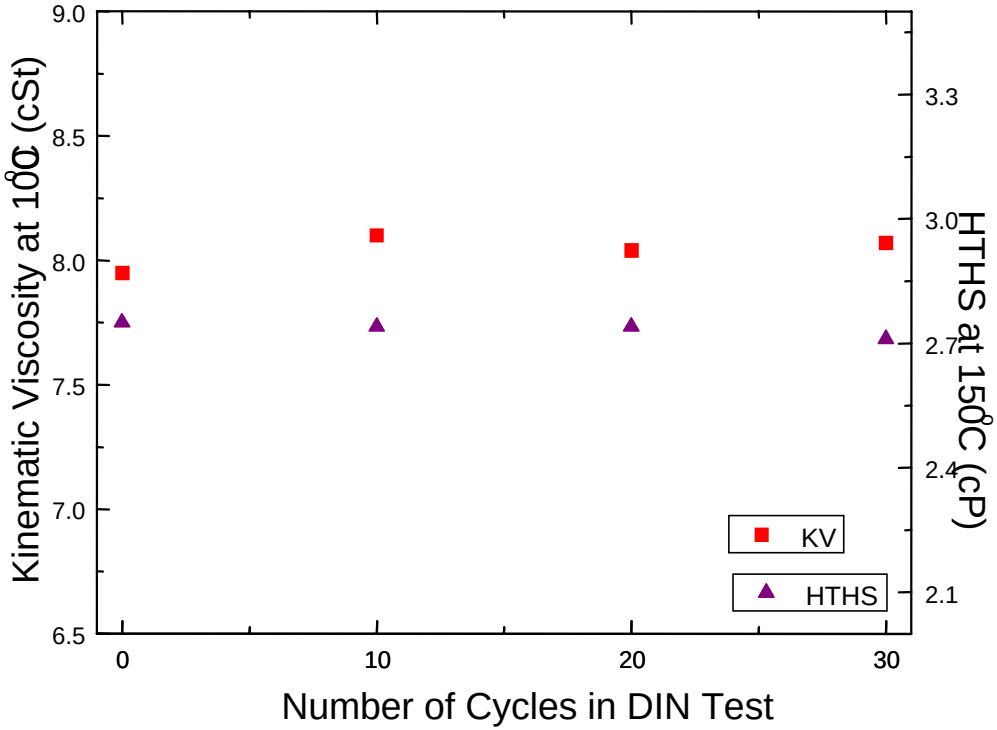


HEUI - D 6278 Correlation for 15W40 Formulations



Excellent correlation between field performance in HEUI equipped trucks and D-6278 bench shear stability test demonstrated for CH-4 development.

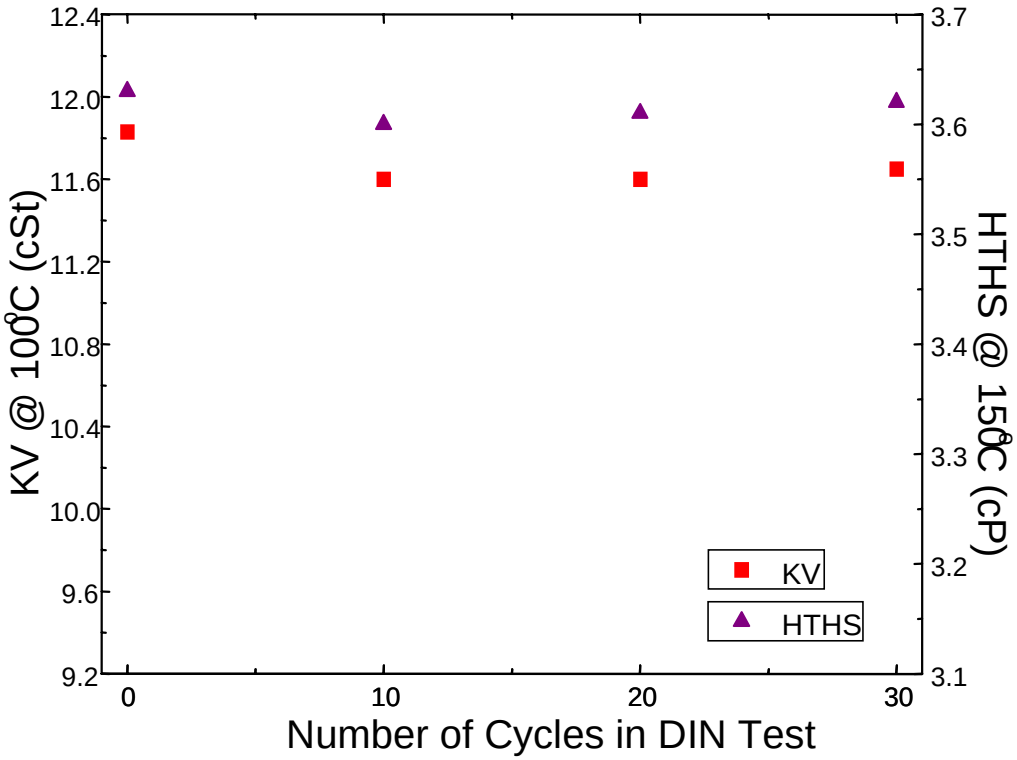
KV and HTHS Viscosity in Formulation without VM



- **Basestocks, DI and LOFI do not shear down under DIN test conditions.**
- **Changes in KV and HTHS can be attributed to the shear down of VMs only.**

KV @ 100 °C and HTHS @ 150 °C vs. Number of Cycles

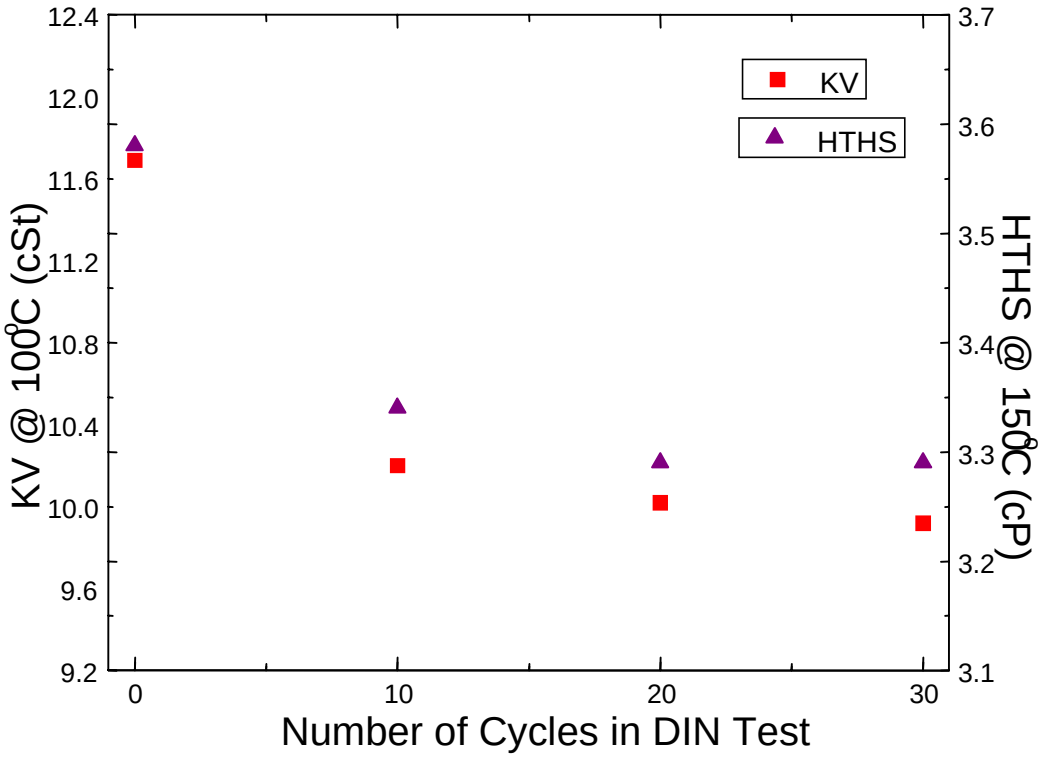
VM with SSI < 10:



- **HTHS tracks well with KV**
- **Insignificant loss of HTHS at the end of test.**

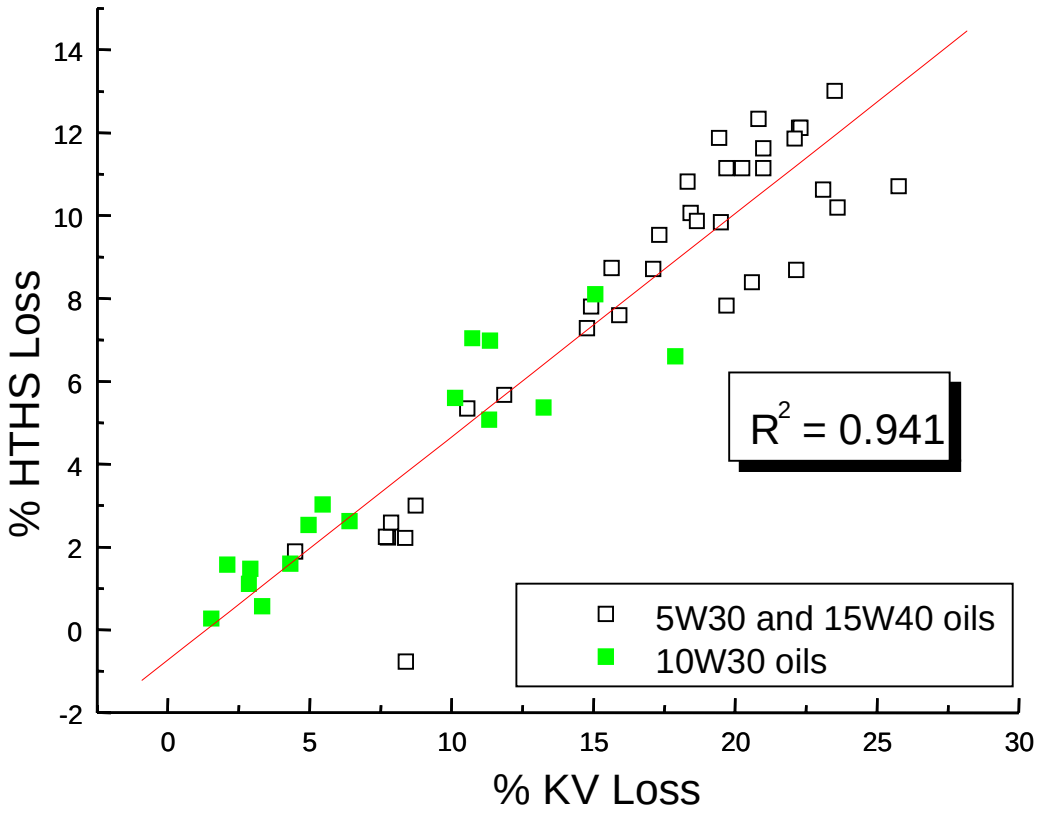
KV @ 100 °C and HTHS @ 150 °C vs. Number of Cycles

VM with SSI ~ 50:



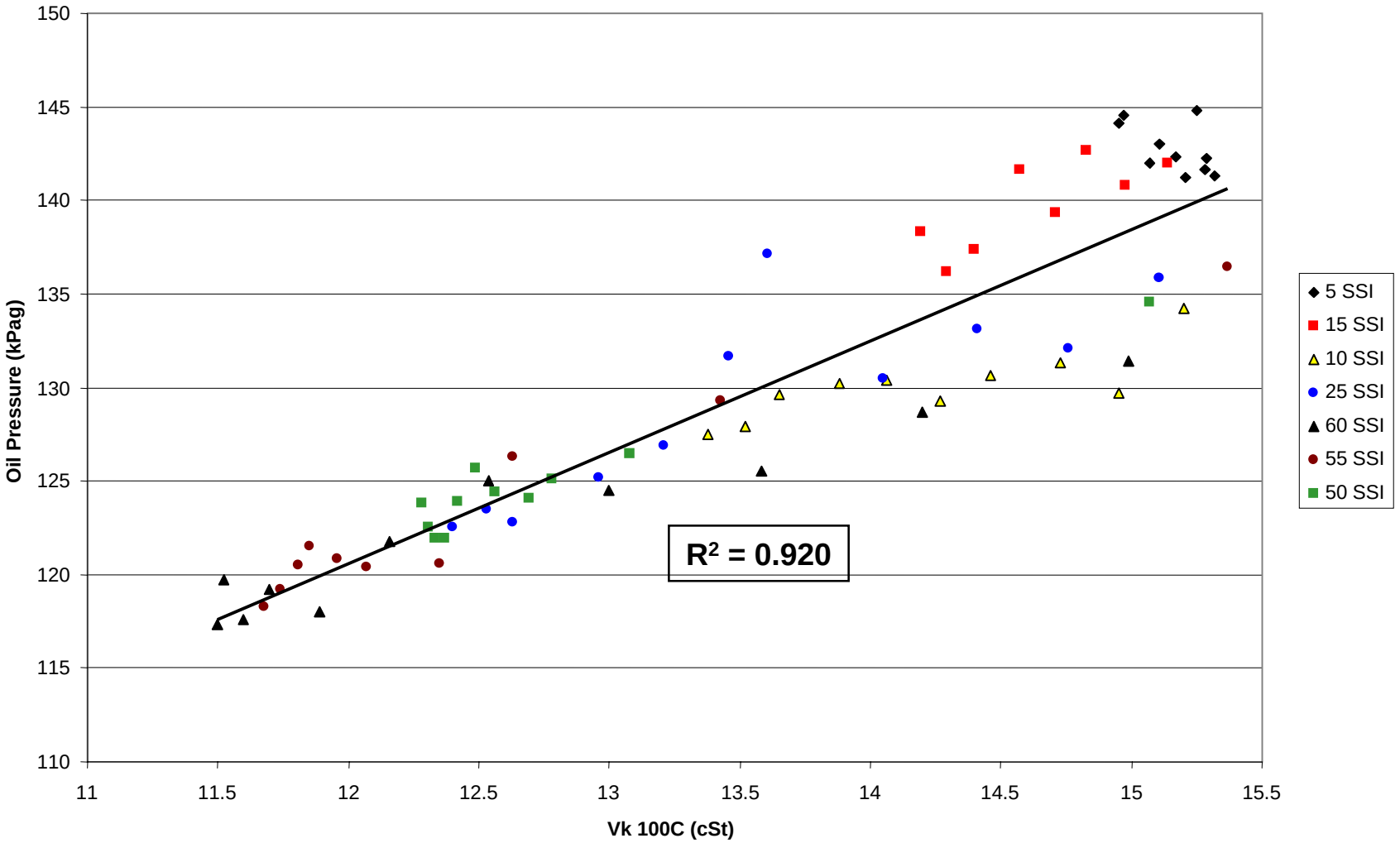
- **HTHS tracks well with KV**
- **Significant loss of HTHS at the end of test.**

% HTHS Viscosity Loss vs. % KV Loss (5W30, 10W30 and 15W40 Grades)



- **Good correlation between % HTHS loss and % KV loss for wide range of viscosity grades.**

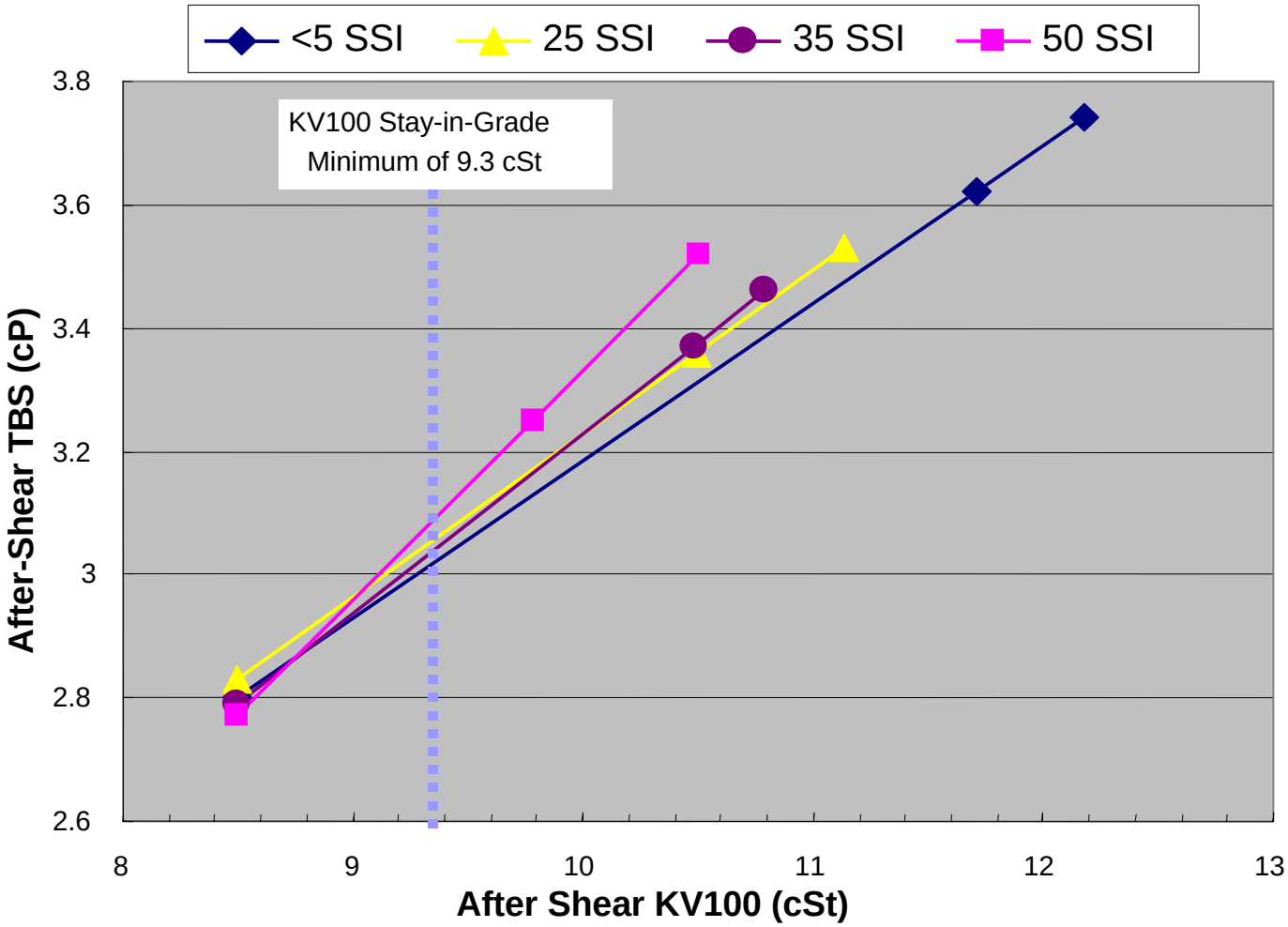
Oil Pressure as a Function of KV 100C for 15W40 Oils



Infineum Concerns

- Inherent dislike for any arbitrary chemical or physical limits on oil formulations.
- Strong preference for performance specifications.
- Any viscometric limits on fresh oils can discriminate against the use of more shear-stable polymers.
  - As noted previously, KV100 loss and HTHS loss are related.
  - The current KV100 stay in grade limits in API CH-4 apply to oils after shear, not fresh.
- No data has been shown to support the need for increased HTHS viscosity.
  - Higher HTHS viscosity will adversely impact fuel economy.

Impact of Existing KV100 Stay-in-Grade Requirement on After-Shear HTHS



Observations on 10W-30 HTHS.

- KV100 loss and HTHS loss are related to both one another and to the shear stability of the viscosity modifier.
  - The existing KV100 stay in grade requirement of 9.3 cSt after shear guarantees a minimum after shear HTHS of 3.0 cP, regardless of VM SSI.
  - This is well above the 2.5 cP after shear minimum which could happen with a 50 SSI polymer oil just meeting J300.
- The EMA accepted viscosity grade read for the new PC-9 tests looking at, among other parameters, engine wear is from 10W-30 to 15W-40.
  - 10W-30's must prove wear capability!

Summary

- The use of an after shear HTHS limit makes the parameter a performance test, not an arbitrary chemical/physical limit
- The existing KV100 limit of 9.3 cSt minimum guarantees an after shear HTHS minimum of 3.0 cP
- No data has been shown to support higher HTHS viscosity.
- Lower HTHS viscosity improves fuel economy.
- SAE 10W-30 oils will need to pass the engine wear tests to prove their performance capability.
- Infineum recommends an after shear HTHS to 3.0 cP minimum to conform to the current 9.3 cSt KV100 limit.
  - 15W-40 after shear HTHS of 3.7 cP minimum is not a problem.