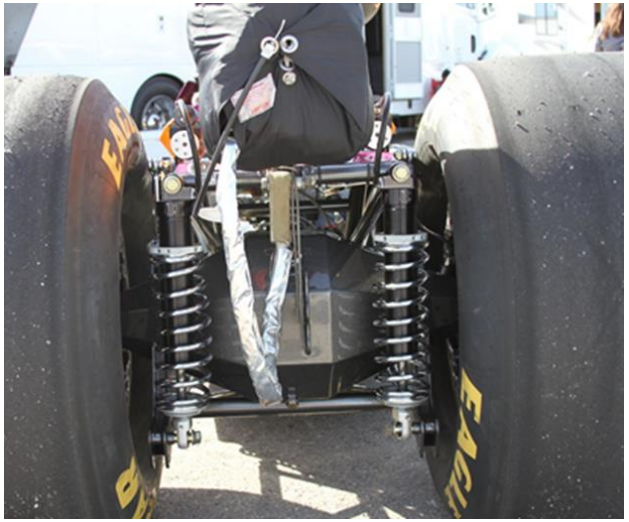
Shock Absorber

- High VI (200 – 300)
  - Low viscosity, ISO <32
  - Heating
    - Friction
    - Pressurization



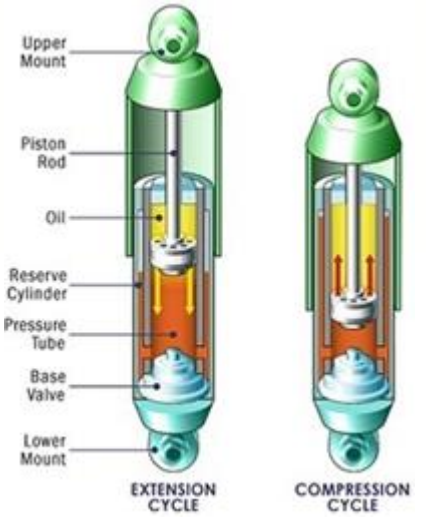


Photo: Dragzine.com, Mack Springs

Shock Challenges

- Low viscosity (< ISO 32), high VI (200+)
  - Little room for adding VI improver before out of grade
    - PMA for fastest VI per cSt

- Sliding friction on metals, dynamic seals
  - Need package with great stick-slip results plus AO/AW/CI/etc.

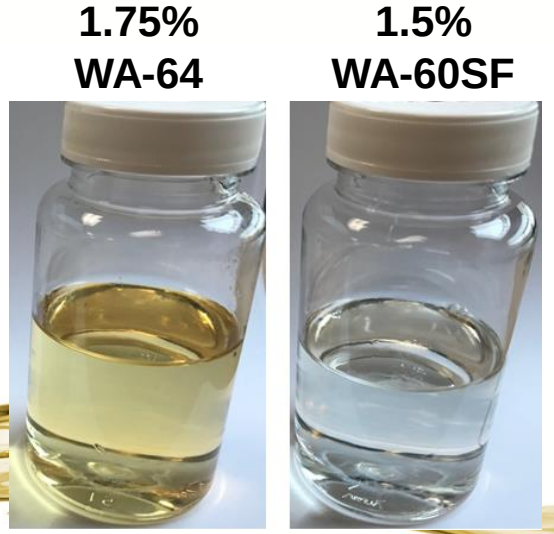
Formulation Approach

- Way oil packages – ad pak
- Low viscosity oils – base oil
  - Specific oils for very high VI
- Functional M Series PMA – thickener
  - MH-2000 / MH-4000 / MH-7000
  - With the right oil, VI 200/300/400 is possible with PMA

Way Oil Pack for Shock?

- Functional Products WA products
  - No stick-slip (“stiction”) in precision industrial machinery
  - Contains everything else - AO/AW/EP/CI/demuls.

- Merits
  - P-47 and GM LS-2 specifications
  - AW D4172: <0.4mm wear at 1200 rpm, 65˚C
  - EP D2596: >200 kgf weld
  - 1a copper corrosion on “SF” packages



Very High VI Shock

- Do you need Asteric or Comb technologies for very high VI?
  - No.

- The potential for high VI is due in part to the base fluids
  - Certain base fluids have high ‘VI potential’
    - Which?

Very High VI Base Oil Selection

- Compare final VI of 15% MH-2000 in various base fluids:

Base Fluid	VI w/ 15% MH-2000
D-Limonene	572
Cross C-35	357
Methyl Ester	335
Isopropyl Oleate	313
Synfluid PAO2	284
Lexoluble 2I-214	271
65 SUS White Oil	254
Ultra S3	238
Yubase 4	230
Phillips 70N	227
Cross L-60	204
Phillips 110N	190
Yubase 8	173
Phillips 600N	133
Ergon 150BS	116

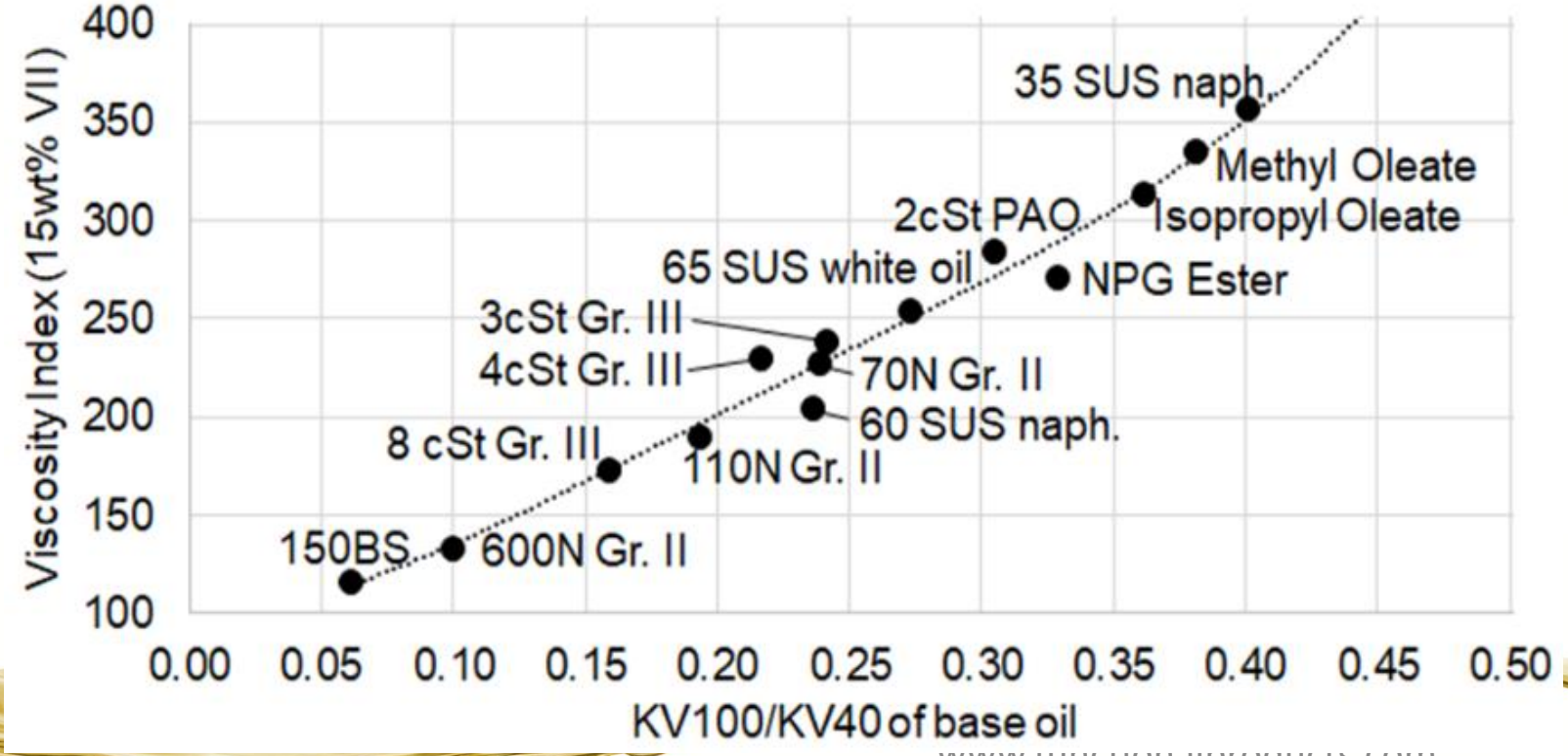
How do these final VI's correlate to the base fluid?

Initial VI?

Low KV?

Base Fluids with High VI Potential

- *KV100/KV40 ratio predicts potential for high VI*



Summary of Approach

- WA package for excellent stick-slip and performance
- The right base fluid for very high VI at low viscosity
  - Low viscosity, high KV100/KV40
- Functional PMA as the thickener of choice

- These three key points were used to implement a new tool

Shock Absorber Calculator

- Live demo w/ Gavin
  - Pick your base oil
  - Pick your VM
  - Pick a way oil package
- Base oils for high VI
  - Functional can toll