

# DAIMLER

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## PC-11 Scuffing Test



Mercedes-Benz



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Chemical Technologies

## Requirements of PC-1 1 Low Viscosity Oils

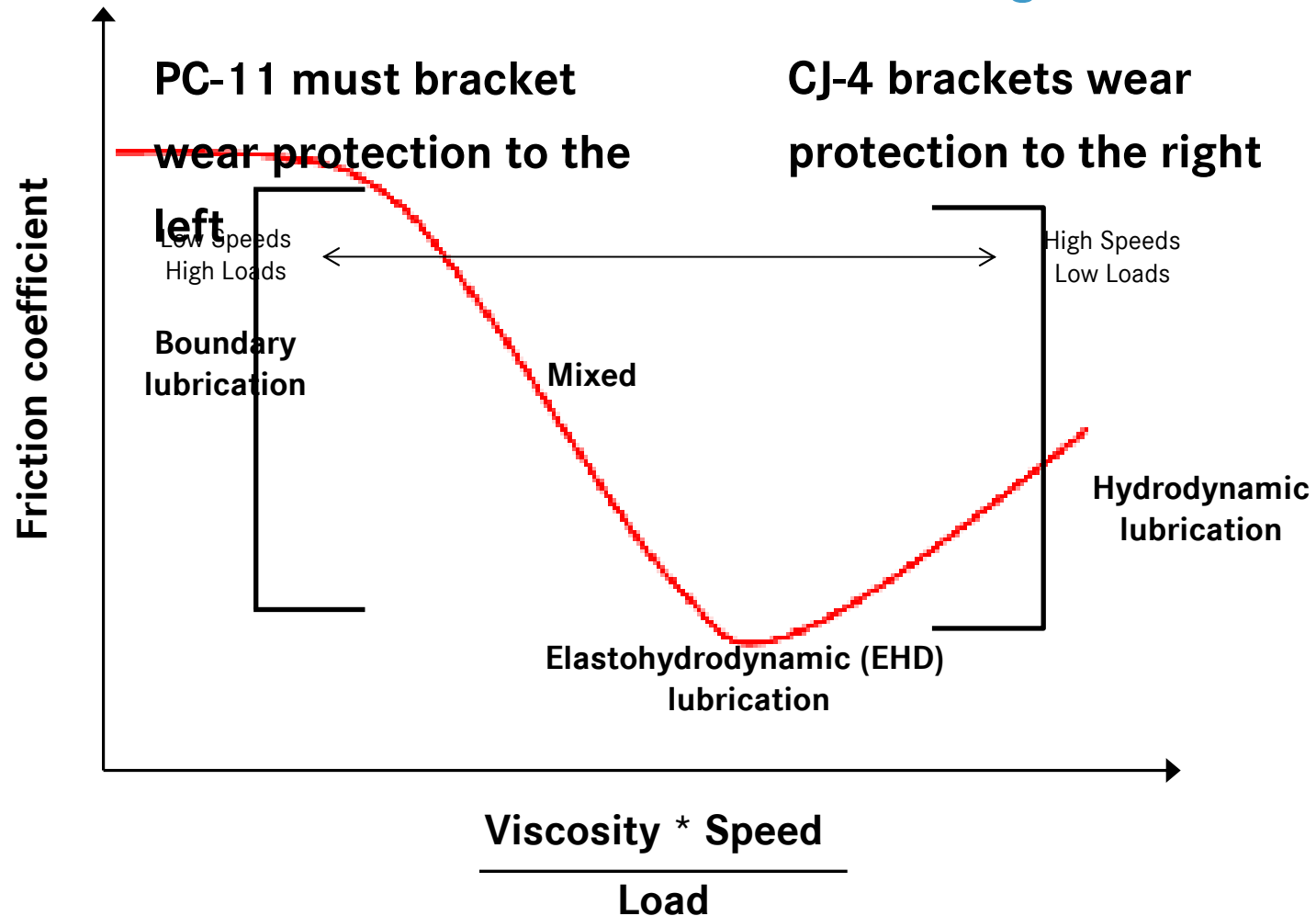
- Oxidation stability
- Aeration benefits
- Shear stability
- Compatibility with biodiesel blends
- **Scuffing/Adhesive wear**
- Fuel Economy Improvements (CO<sub>2</sub>)
- **Maintain equivalent durability to current viscosity oil**

## Scuffing / Adhesive Wear in Engines

- All engine tests within API CJ-4 address abrasive wear
  - Abrasive wear (or three-body abrasive wear) is when a third body is introduced between two lubricated surfaces causing wear, i.e. soot-induced wear
  - Engine tests run with high levels of soot
- No engine tests within API CJ-4 directly address adhesive wear
  - Adhesive wear is when the direct surface contact force is high enough to cause material transfer (cold welding and tearing)
  - Often occurs during break-in as the surface asperities wear off
  - More likely as film thickness decreases
  - Greater risk with PC-11 lower viscosity oils

# Why do we need a scuffing test

### Stribeck Curve of Lubrication Regimes



## Why are we developing the Scuffing Test

- Need for lower viscosity engine oils to improve fuel economy is apparent
- Existing wear tests within CJ-4 are insufficient
- DDC developed the 6V92TA 2-cycle liner scuffing test (albeit long ago)
- DDC is the largest on-highway EMA member that does not sponsor any API engine tests
- Lubrizol was willing to partner with DDC in a joint development effort
  - Precedence of joint engine manufacturer/additive company test development
  - Leverages engine experts and oil formulation experts during development phase
  - Shares in development costs
- Developing the test on global platform allows for adoption by API and ACEA

## How are we developing the Scuffing Test

- Goal – evaluate an oil formulation’s resistance to adhesive wear by inducing and measuring piston ring to cylinder liner scuffing
  - Correlate liner scuff resistance to adhesive wear protection throughout engine
- Engine - DD13 model (OM471LA in Europe)
  - 12.8L displacement of Daimler’s global heavy duty engine platform
- Emissions level - EPA2010 hardware and calibration
- Test cycle – details are still under development
  - Based on existing Daimler cyclical durability test designed to thermally stress the Intake Air and EGR circuits
  - Other operating parameters will be adjusted to generate repeatable liner scuffing
- **Daimler does not have a liner scuffing problem in the field**
- **Test conditions will create liner scuffing to enable a meaningful test**