Caterpillar C13 Low Viscosity Study

SOUTHWEST RESEARCH INSTITUTE®

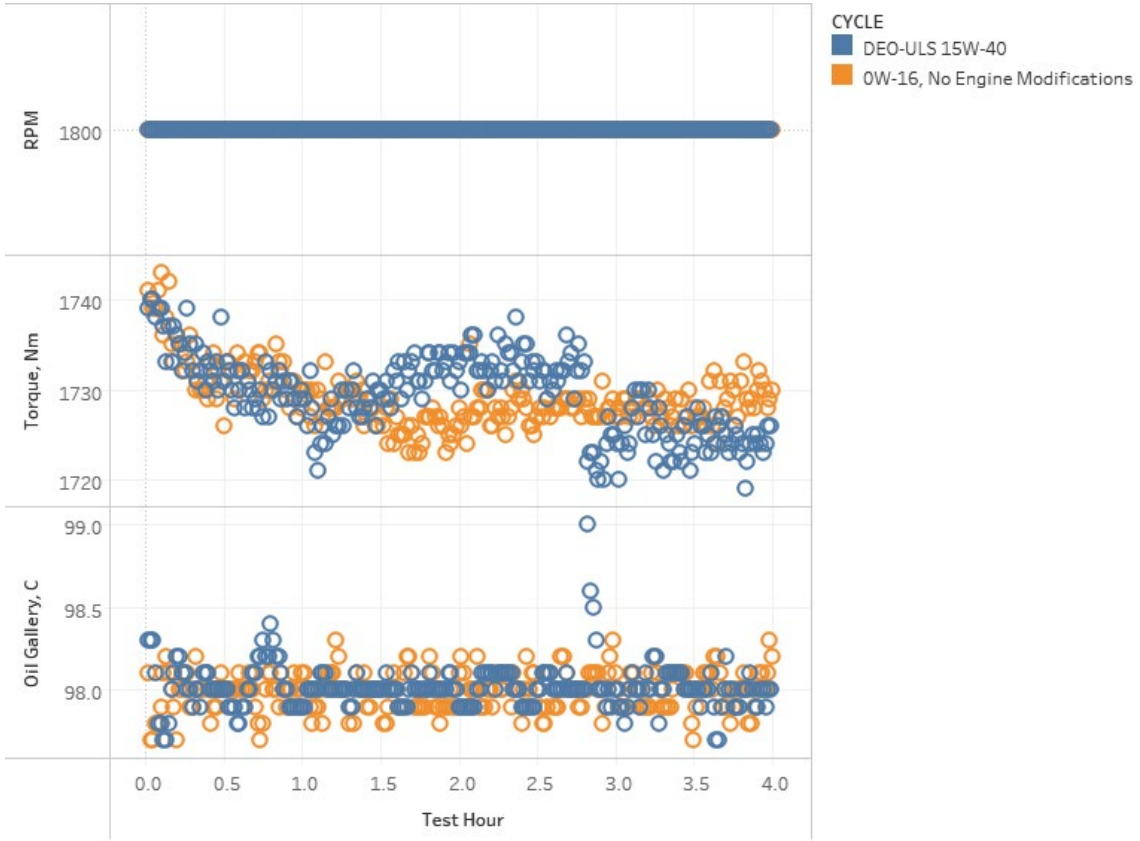
July 2024, updated September 2024

Background/Status

- 2.3 cP HTHS oil blended for evaluating the C13's ability to operate in low pressure regions
- Focus is ECM derates, not long term engine durability
- Investigation of ways to "trick" ECM derates underway
  - Unlikely to result in a modified calibration file
- Engine build broken in and run for 4 hours on Caterpillar DEO-ULS 15W-40
- Drained overnight, filter changed, charged with xW-16 oil
- Warm up and 4-hour comparison run
  - Immediately flagged "Low Oil Pressure Warning" when approaching test conditions, but no derate went active on 0W-16 oil

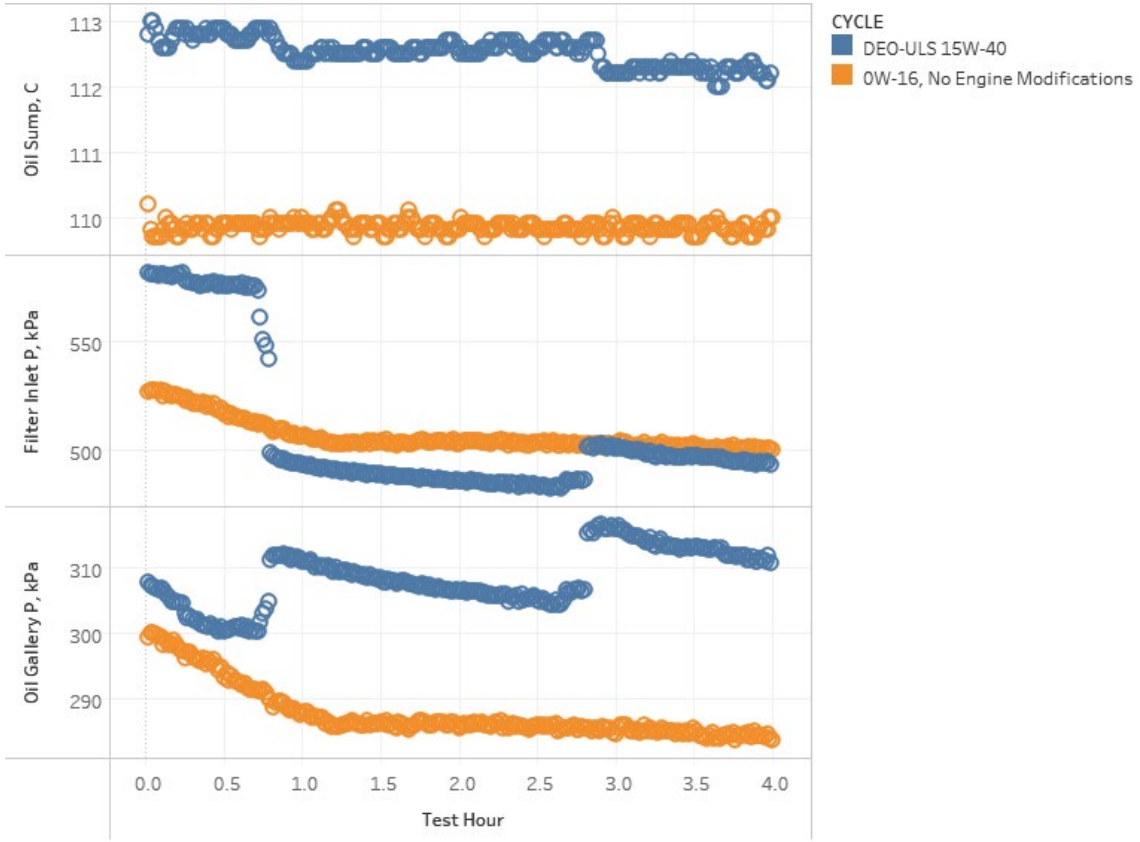
Operation

- No major operational issues
  - DEO-ULS had a shutdown at ~2:45 due to a bad dyno T/C
- No IVA faults/derates
- Stable temp control for oil system



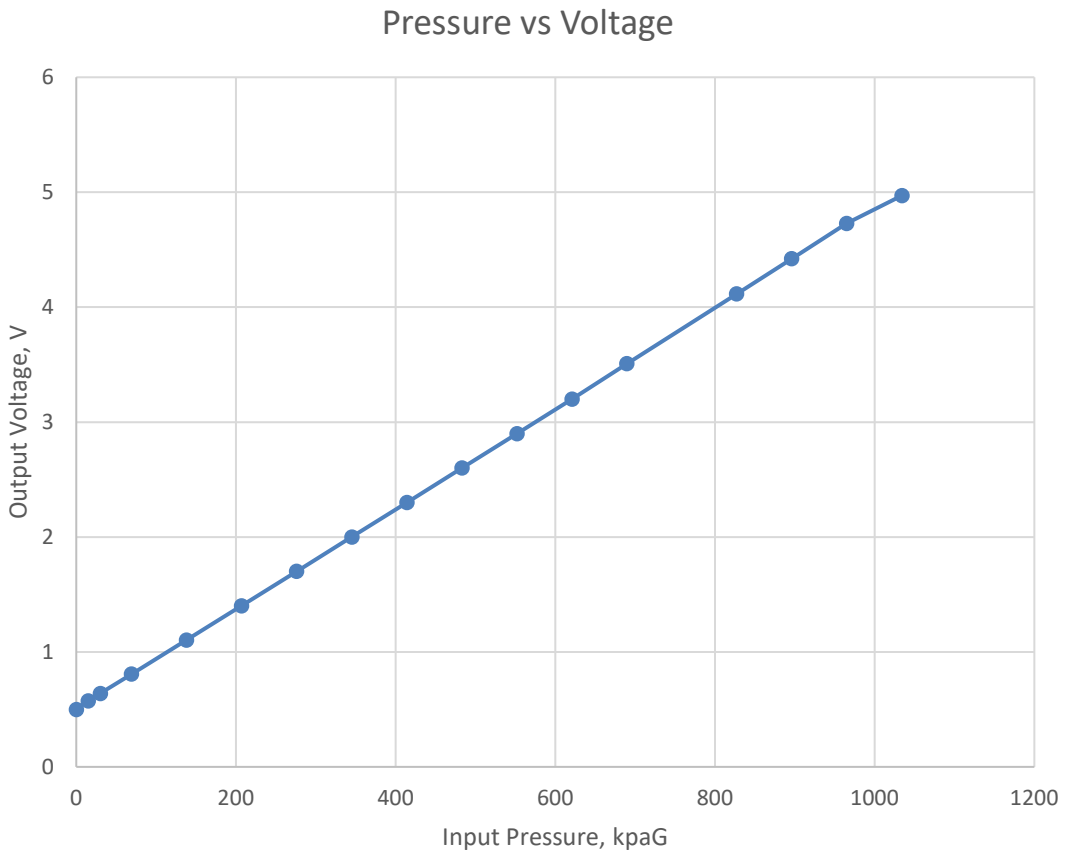
Operation 2

- ~2-3 degree delta noted in sump temp
- More pressure jumps seen with DEO-ULS, possibly more active internal control valves or things stabilizing
- 0W-16 gallery pressure stabilized near 280 kpa, DEO-ULS closer to 310 kpa



ECM Oil Pressure Sensor – 194-6725

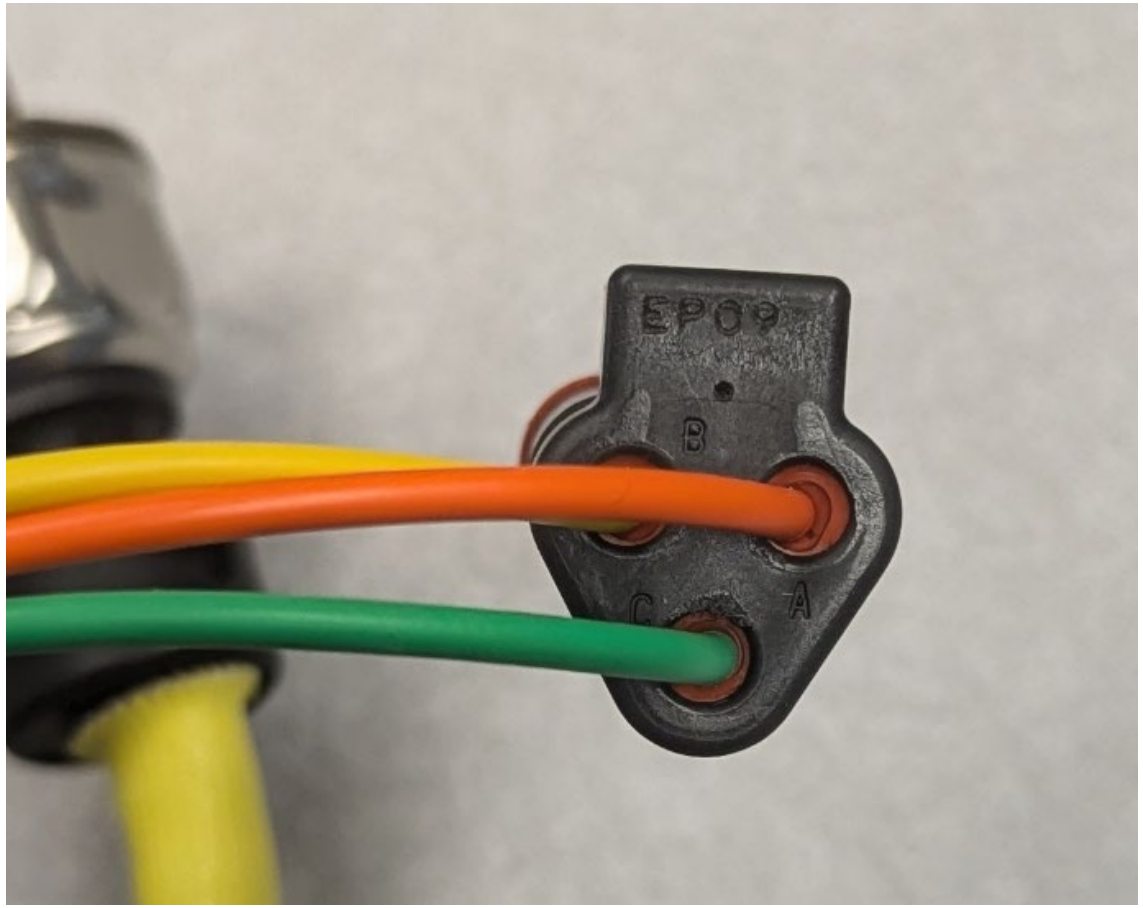
- 3-wire sensor
- 0-5V input/output



Next Steps

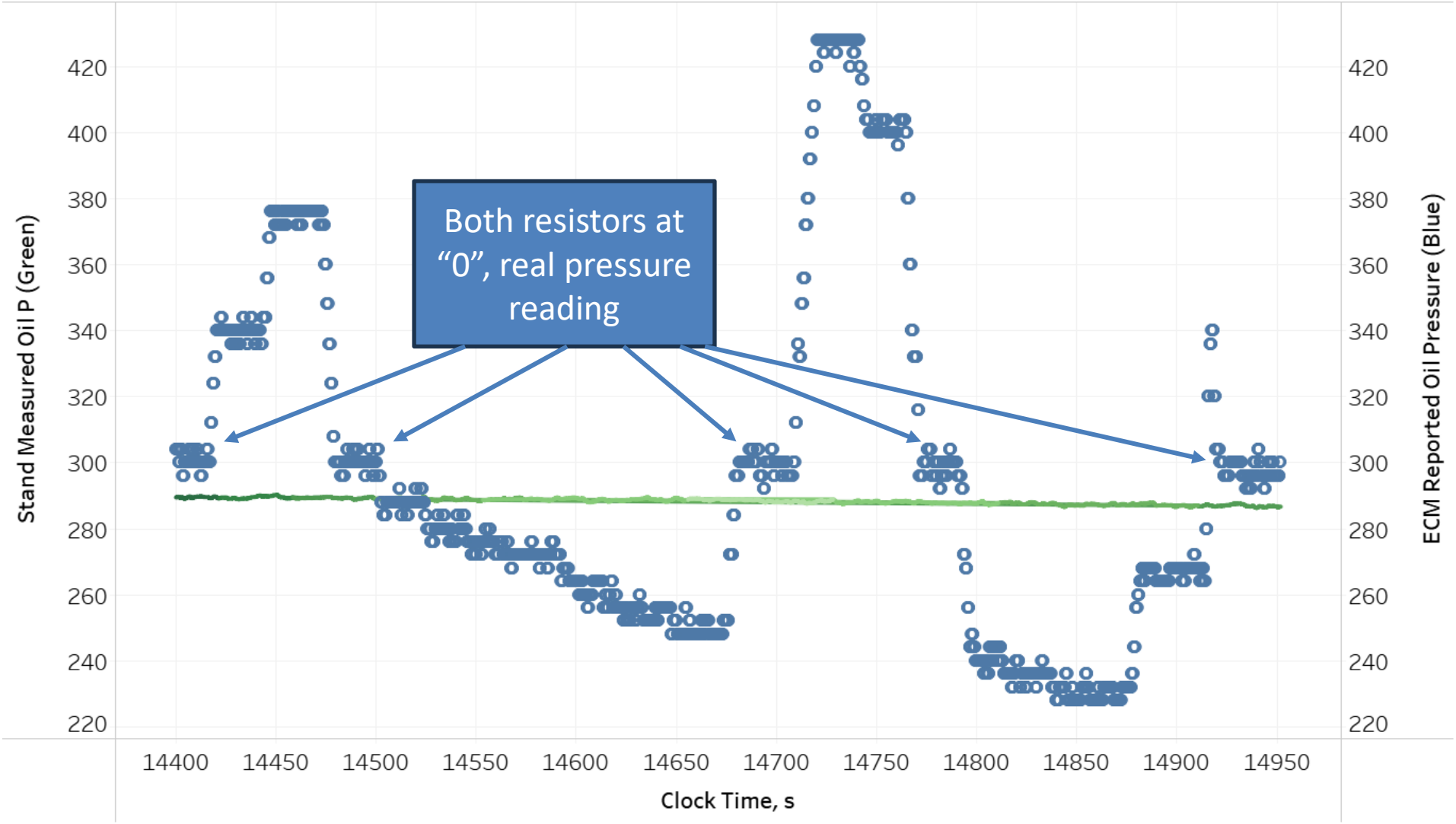
- Install jumper in between pressure sensor and ECM to add resistance and raise the "ECM Pressure" value
- May need to add something to the IVA system as well, will investigate after the main oil pressure sensor study

“Jumper” Operation



- 2 Variable Resistors
  - Between the sensor and 5V supply (A)
  - Between the sensor and Ground (B)
- Unbalances the resistance of the bridge to move the output voltage

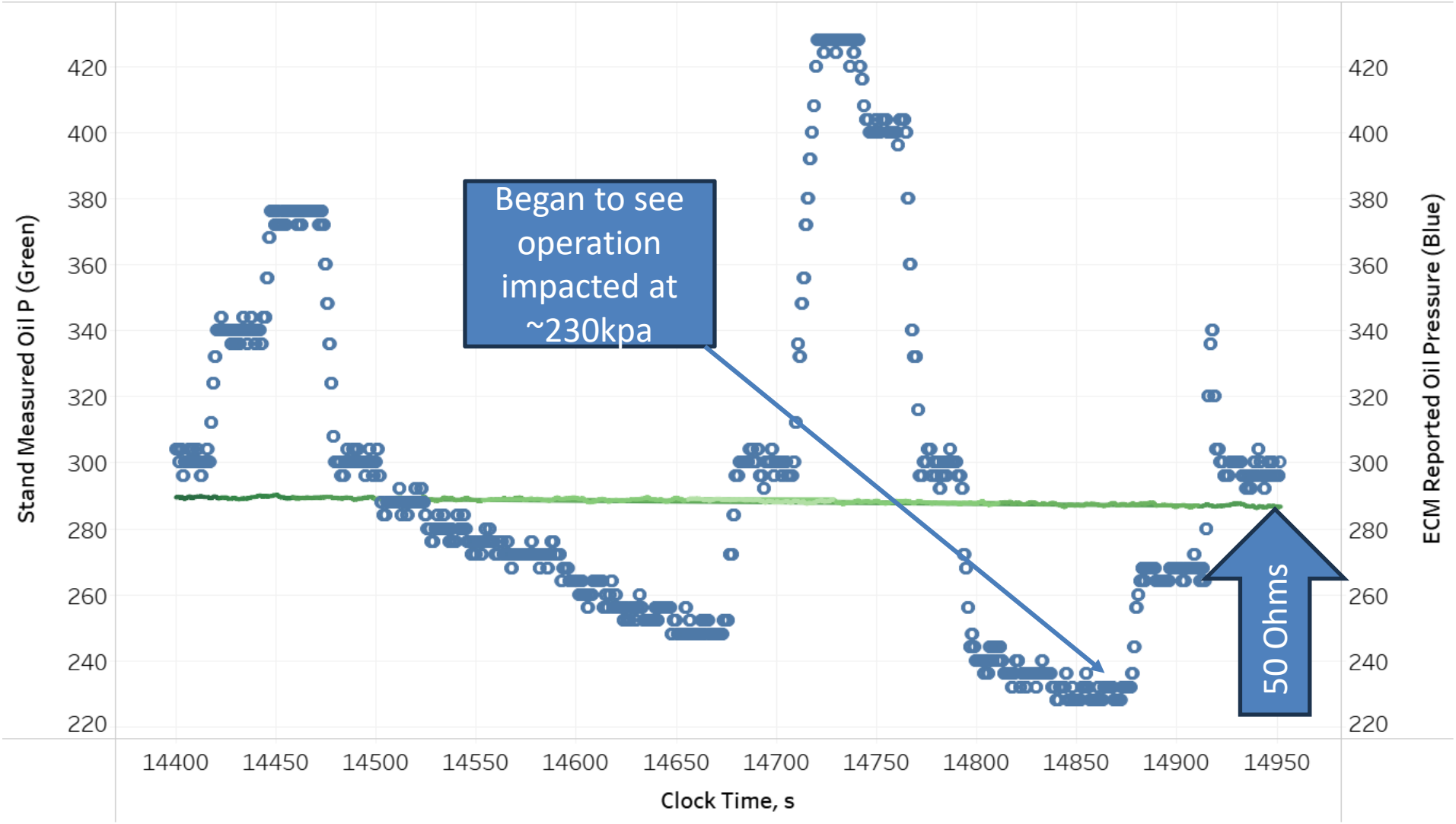
Follow On Efforts



Findings

- First "Warning" appears around 300kpa ECM measured gallery pressure
- First "Alarm" seemed to appear around 230 kpa measured gallery pressure
- Due to the nature of the sensor and resistance balancing across the bridge, response is not linear

Follow On Efforts



Conclusions

- If an oil exhibits low enough pressure at the gallery to begin triggering flags, the inclusion of a 50 Ohm resistor between the sensor Pin B and the ground should be enough to shift the ECM value into a non-flagging region
- No impact to actual oil pressure or safety of operation, that's on the stand to catch
- IVA system response not evaluated
  - No parameter reported in CAT ET/CAN data for feedback
  - More complicated system that relies on oil P as a hydraulic fluid for IVAs and has internal feedback. Adding resistance may cause more harm than benefit. Likely build related or IVA failure