

Caterpillar ECF-2 Test Criteria

500 hour – Steady State Test Cycle

Test Pass/Fail Criteria:

1. No Loss of Oil Consumption Control
2. No stuck rings/Loss of ring side clearance
3. No Liner Scuffing or Bore Polish
4. No Loss of Blowby Control
5. Measured Piston Deposits
6. EOT Oil Quality to be monitored



Caterpillar ECF-2 Test Matrix

Test Conditions	IMT	Coolant	Oil	Fuel Rate
	°C	Oil #1	Oil #2	Oil #3
High Temperature	75	OK	OK	OK
Intermediate Temp	55	Sluggish	Stuck	OK
Low Temperature	40	Stuck	Stuck	Stuck

Low Temperature Issue



Caterpillar ECF-2 Test Matrix

	#	Ref 1	Ref X
Intermediate Temps	1	36% Inc OC, Stuck Ring	41 % Inc OC, Sluggish Rings
Hot Temps	2	16 % Inc OC, Rings Free	49% Inc OC, Rings Free (Ref #2)
Low Temps	3	105 % Inc OC, Stuck Rings*	31% Inc OC, Stuck Rings* (Ref #2)
	4	62 % Inc OC, Stuck Ring	43% Inc OC, Rings Free
	5	61 % Inc OC, Stuck Ring	Comm B
	6	78 % Inc OC, Rings Free	46% Inc OC, Rings Free Comm A

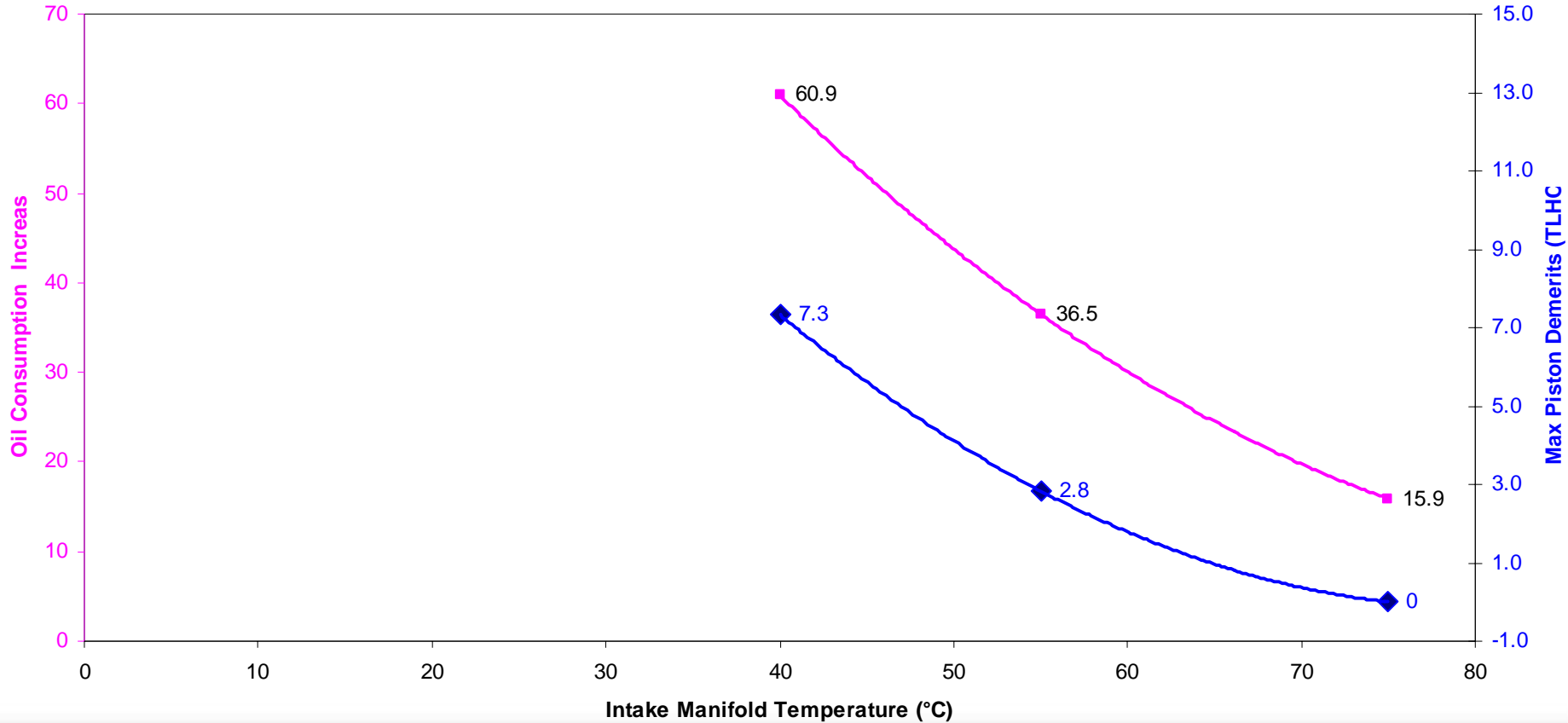
- Test started at hot temp for first 100-150 hrs, then switched to Low Temp
- Test 6 was a new engine on a new oil batch run at new test stand



Caterpillar ECF-2 Test Results Summary

C13 Max TLHC

Temperature Effects on Deposits



Caterpillar PC-10 HDEOCP UPDATE

- Low Temperature deposits issue validated
- May take opportunity to move to update and specify closer tolerances of Production hardware for Oil Test engine
- Low Reference Oil (Ref 1) selected
- High reference being sought



Caterpillar PC-10 Test Proposals

Forward and Backward Compatibility

- High Temp deposits tests in past
- New lower Temp combustion with lower Piston Temps

This will drive two piston deposit tests for PC-10:

- 1) 1P for High Temperature Backward Compatibility
- 2) C13 for lower temperature (low NO_x) engines



Caterpillar PC-10 Test Proposals

Fuel Sulfur for PC-10 Tests:

- 1) 1P 500 ppm for Backward Compatibility
- 2) C13 <15 ppm for Forward Compatibility

- 3) CCV test



Caterpillar PC-10 Test Proposals

Phase II Test Development:

- 1) Test Cycle Completed
- 2) C13 Test engines installed – 6
- 3) C13 Test engines provided to date - 13
- 4) Installing 2 C13s at CAT



Caterpillar PC-10 Test Proposals

Phase II Test Development:

- 1) Likely upgrade Piston and rings
- 2) Looking at acceptable Ref Oil
- 3) Complete test by Dec 04



Caterpillar ECF-2 Test Summary

1. Oil Consumption Control – unacceptable/variable
2. Get New PRL – Repeat temperature study
 - Extend operating range sensitivity
3. No Correlation – Oil consumption with deposits
 - 2nd ring stick with OC
4. Failing Ref #1 oil is marginal



Caterpillar ECF-2 Test For 2007

1. Time to explore other deposit effects
 - CCV
 - ULSDF
 - Aftertreatment
 - Engine Durability of low Ash oils

