

# 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

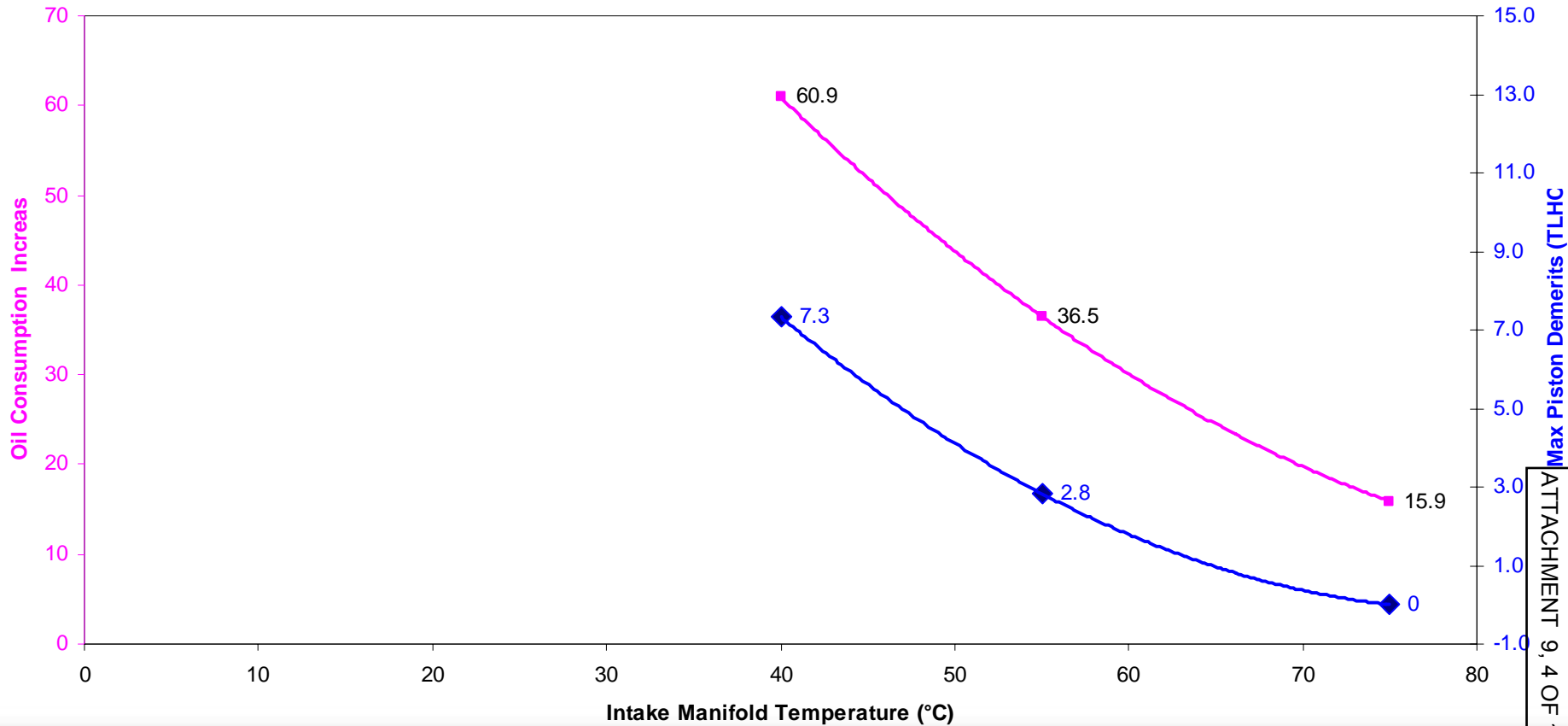
- Test started at hot temp for first 100-150 hrs, then switched to Low Temp
- Test 6 was a new engine on a new oil batch run at new test stand



# Caterpillar ECF-2 Test Results Summary

## C13 Max TLHC

### Temperature Effects on Deposits

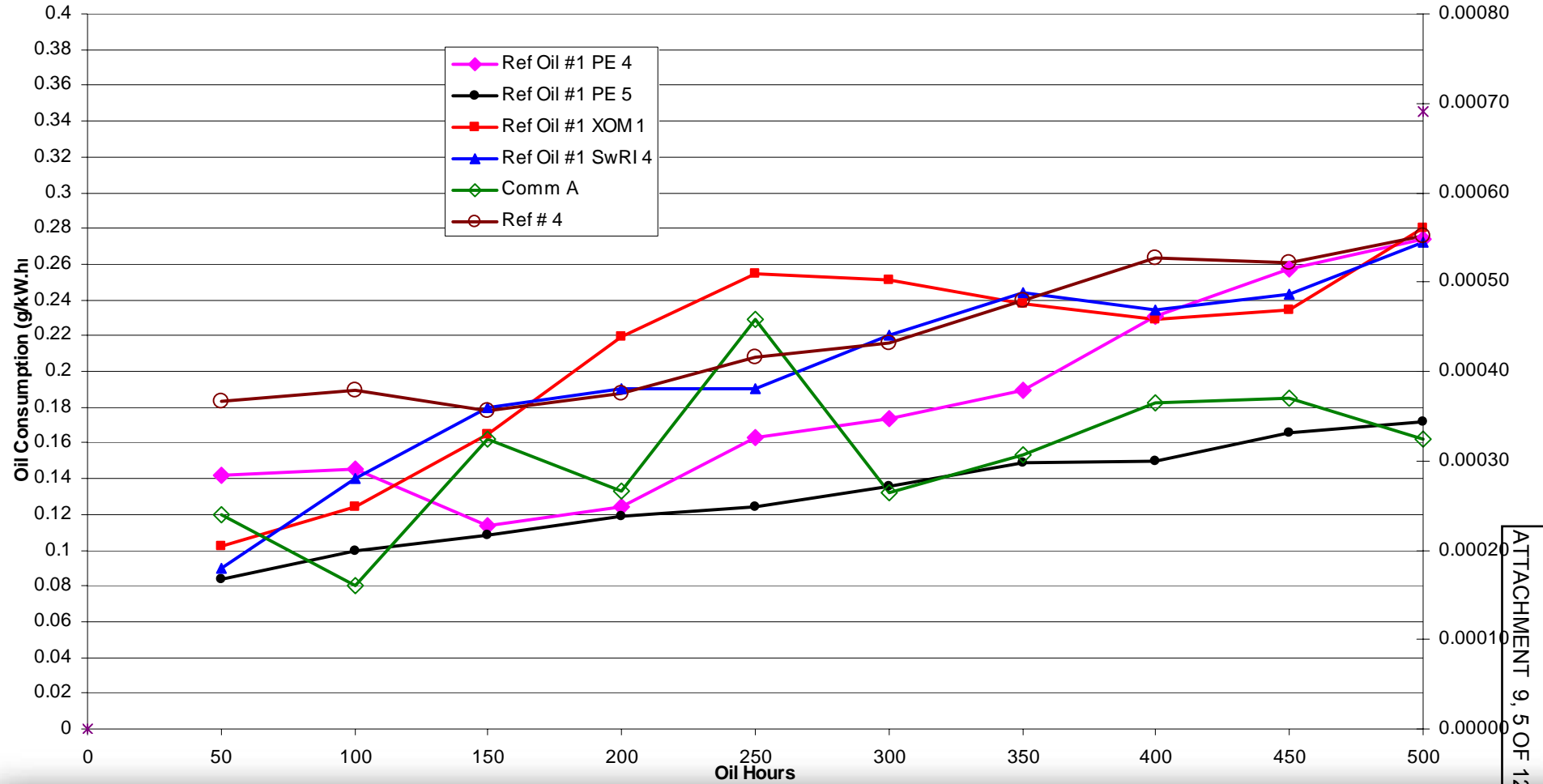


ATTACHMENT 9, 4 OF 12



# Caterpillar ECF-2 Test Results Summary

## Caterpillar C13 Oil Consumption



ATTACHMENT 9, 5 OF 12



# Caterpillar C13 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
  - 2<sup>nd</sup> ring stick with OC
4. Failing Ref #1 oil is marginal



## Caterpillar PC-10 HDEOCP UPDATE

- Low Temperature deposits issue validated
- May take opportunity 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<sub>x</sub>) 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 – 7
- 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 For 2007

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

