

*Southwest Research Institute*®

**Engine Lubricants Research Department**

**Update on SwRI's IR&D Program To Study  
Engine Oil Formulation Effects on Catalyst  
Poisoning in an Engine Dynamometer Test**

**Presented to the  
GF-5 Emissions System Compatibility Improvement Team  
by  
Scott Ellis**

May 4, 2006



# Progress Since Last ESCIT Meeting

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- Revised test plan based on 20-hour oil change interval
- First full-length test on Oil 33 will now have core samples at 140, 200, 260 and 320 test hours
- Conducted 10-hour degreen run on baseline catalyst with “GF-5” oil
- Started first test on Oil 33, aborted at 140 test hours
- Revised exhaust system – all stainless steel
- Revised catalyst bed thermocouple configuration
- Revised throttle control to MAP rather than TPS
- Re-started test on Oil 33, 200 hours accumulated



# Initial Run Catalyst Face at 140 hours

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May 4, 2006



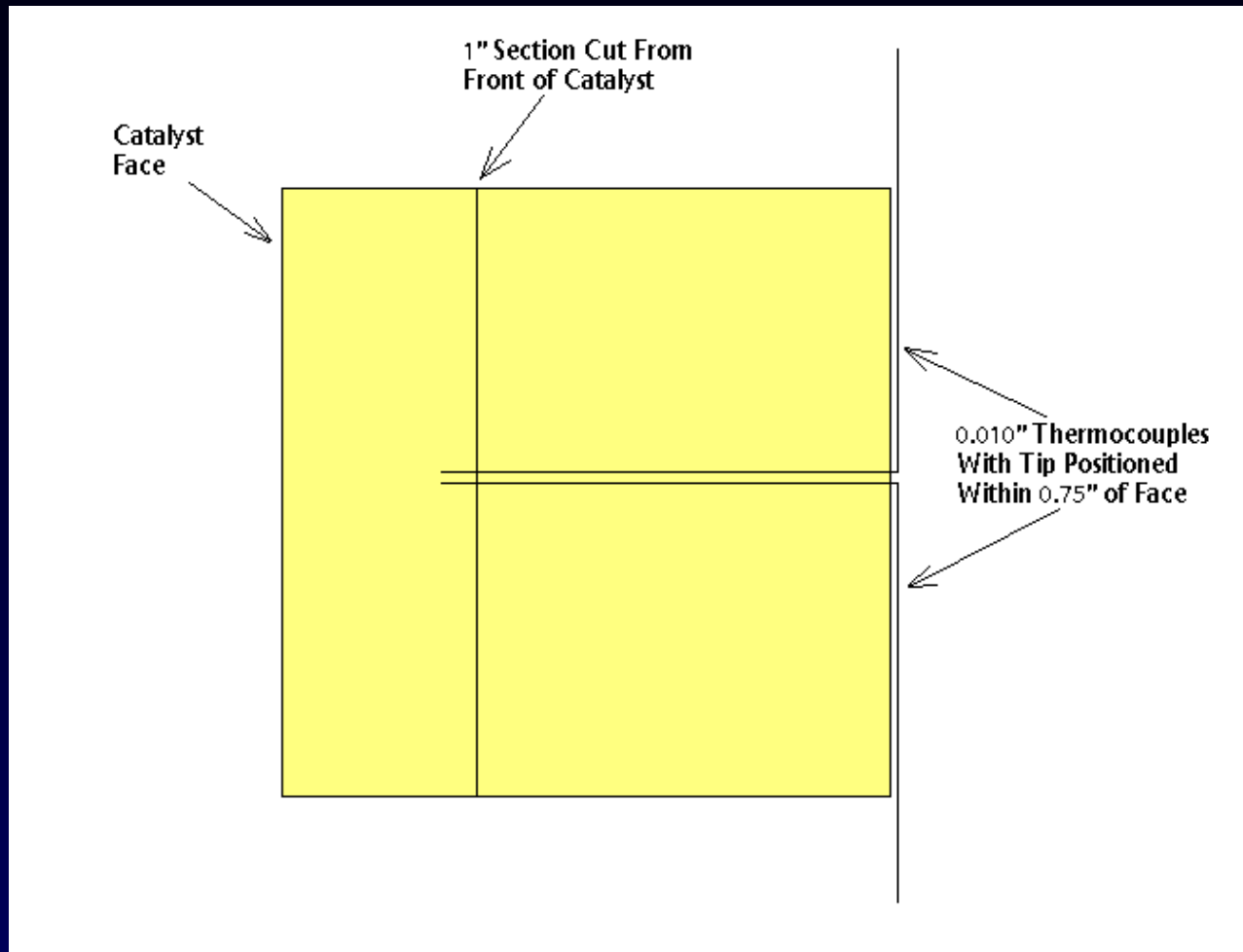
# Revised Test Cycle

Parameter	Stage 1	Stage 2	Stage 3	Stage 4	Units
Engine Speed	2,500	3,500	3,500	3,500	rpm
Manifold Absolute Pressure	81	88	Max.	88	kPa
Fuel Rate	11	18	24	18	kg/hr
Catalyst Inlet Temperature	~700	~750	~720	~700	° C
Catalyst Bed Temperature	~750	~820	~750	~820	° C
Coolant Outlet Temperature	120	120	120	120	° C
Oil Sump Temperature	150	150	150	150	° C
Duration	60	120	60	120	seconds
Engine Fueling	Stoichiometric	Slightly Rich	Full Rich	Slightly Rich	
*Air Injection	Off	Off	Off	Off	

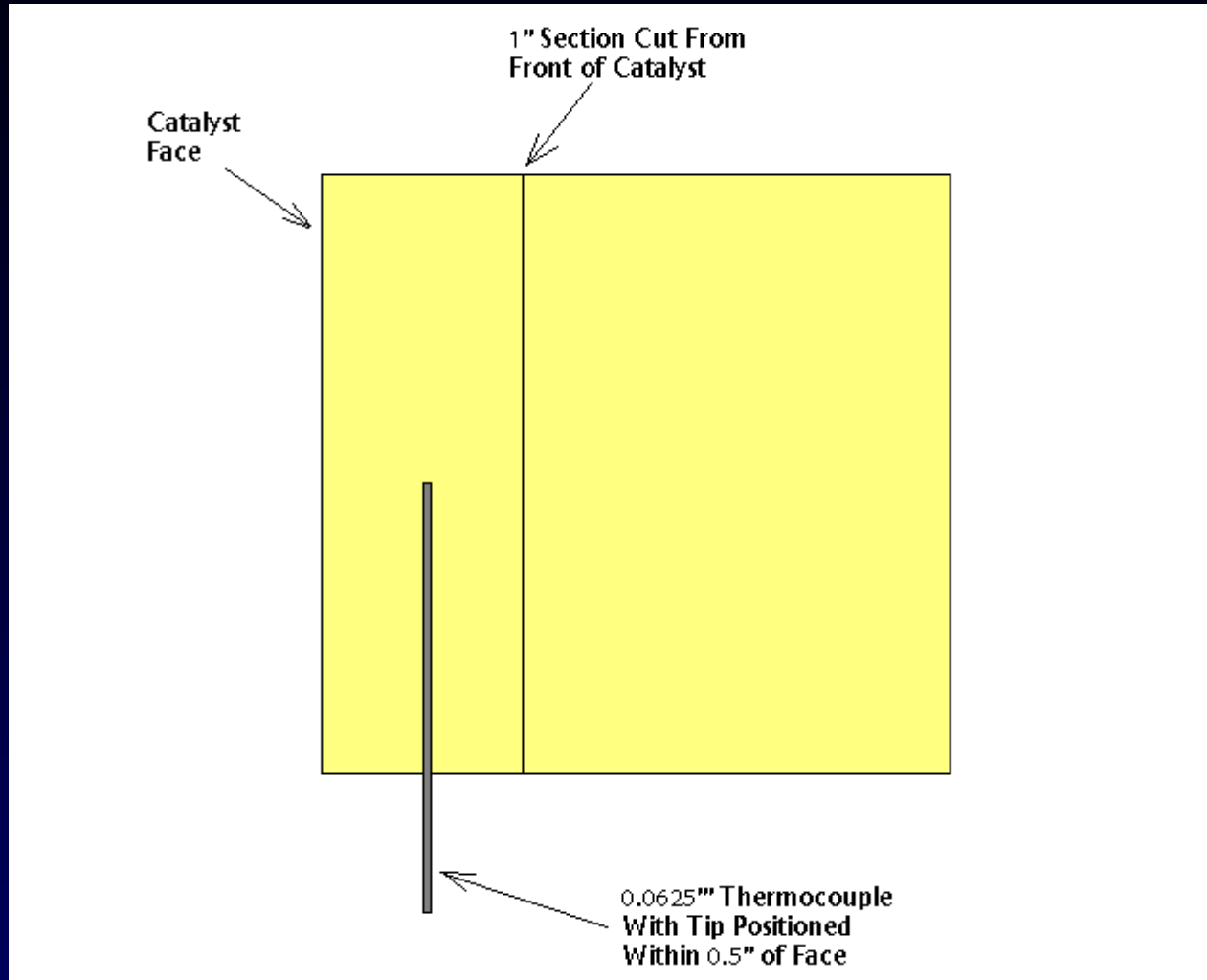
\* Air injection not used due to lack of noticeable soot accumulation



# Initial Catalyst Bed Thermocouples



# Revised Catalyst Bed Thermocouple



# Research Catalysts

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- **Six units obtained, one baseline, one abort, four tests, no spares**
- **Approximately 0.66 liter volume (40 in<sup>3</sup>)**
- **Pd-Rh wash coating**
- **900 c.p.i.**
- **Sliced 1” segment from face for core samples**
- **Reassembled in can with Interam packing**
- **Thermocouple installed approximately 0.5” from face**

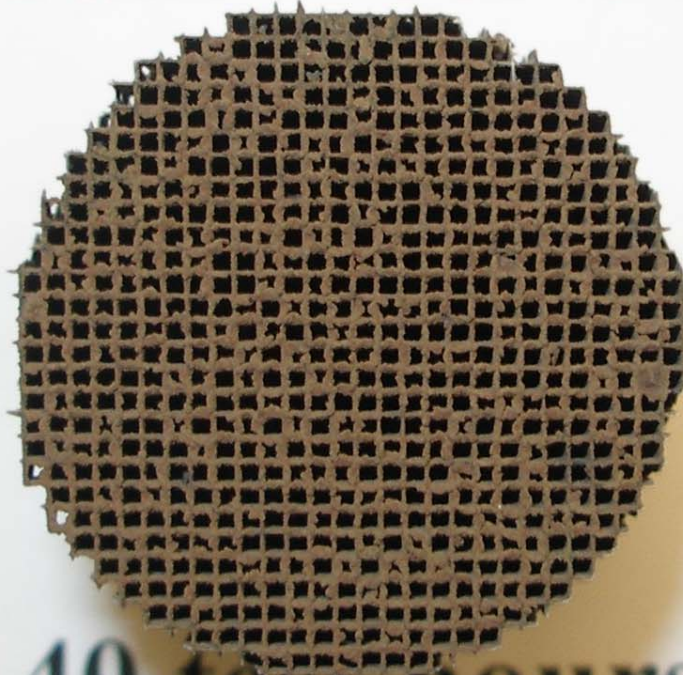


# 1" Catalyst Core Re-run at 140 hours

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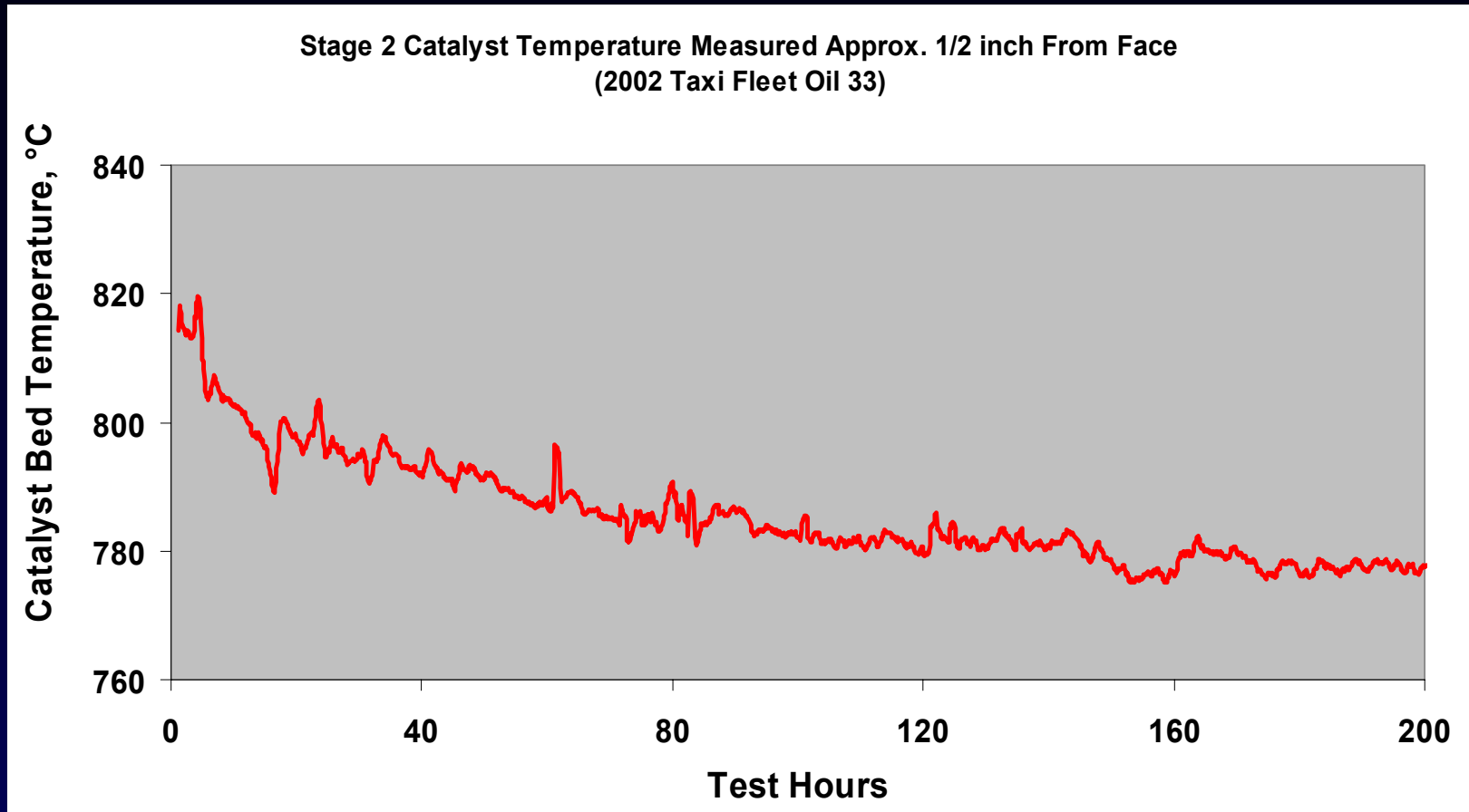
2002 Taxi Fleet Oil #33



140 test hours



# Stage 2 Catalyst Temperature Change



# Bulk Oil Consumption Rates

Test Oil	No. Oil Changes	Change Interval, hr	Avg. Cons., g/hr
90 PEI Oil Used for 24-hr Phos. Depletion Runs	2	24	26.3
“GF-5” Oil Used for 10-hr Degreeen on Baseline Cat	1	10	22.0
Oil 33 Used for Initial 320-hr Test	7	20	61.5
Oil 33 Used for Re-run 320-hr Test	10	20	67.3



# Next Steps

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- **Re-run 320-hr test on Oil 33**
  - Measure conversion efficiency on 1” core sample @ 140, 200, 260 and 320 hours compared to baseline core
  - Determine test length required for significant degradation
- **Run X-hour test on Oil 33 with PCV de-coupled**
- **Run X-hour test on Oil 35 for discrimination**
- **Run X-hour test on Oil 33 for repeatability**

