

Caterpillar C13

Matrix Data Analysis

- Discussed at meeting on October 20th, 2005
- Participants: Jim Rutherford, Elisa Santos,
- Phil Scinto and John Zalar
- Participants in part: Jeff Clark and Todd Dvorak

“The industry statisticians reached consensus on analyses of the PC-10 Precision Matrices. We agreed that we have more work to do, more details to examine, more questions to address, etc. However, we don't expect the basic analyses to change substantially from what we have today and we are ready to share with the industry.”



Summary (1)

- Statistical evidence that Lab F is severe on Delta OC
- Analysis with 32 tests shows that Lab A is mild for Delta OC
- Lab B is severe for TLC and TLHC
- Additional Lab differences
 - UWD: Lab A & Lab B; Lab A & Lab G; Some indication of Lab B severity
 - TGC: Lab A & Lab G
 - TGF: Lab A & Lab F ; Lab A & Lab G



Summary (2)

- Impact of Base Oil on Delta OC seems to vary with Technology
 - Delta OC increases with Base Oil (1,2,3) for Technology B
 - And there are no significant differences among Base Oils for Technology A
- In general, Deposits for Base Oil 3 are higher compared to Base Oil 2 and Base Oil 1
- Correlation of Delta OC with Deposits is very weak: ~ 0.4 or lower, most of them not significantly different from zero
- Precision:
 - E_p is greater than 1 for TLC and TLHC
 - ~ 0.85 for TGC
 - ~ 0.65 for Delta OC and TGF



**Base Oil Effect Summary
from the BOI presentation (10/21/05)**

Parameter	Technology	Base Oil Effect Observed	Statistically Significant?
OC	A	Higher Sats/BOVI=Lower OC	No
OC	B	Higher Sats/BOVI=Higher OC	Group III
UWD	A & B	Group III=Higher UWD	Yes
TLC	A	Higher Sats/BOVI=Higher TLC	No
TLC	B	Group III=Higher TLC	Yes
TLHC	A	Higher Sats/BOVI=Higher TLHC	No
TLHC	B	Group III=Higher TLHC	Yes
TGF	A & B	NONE	NA
TGC	A & B	Group III=Higher TGC	No

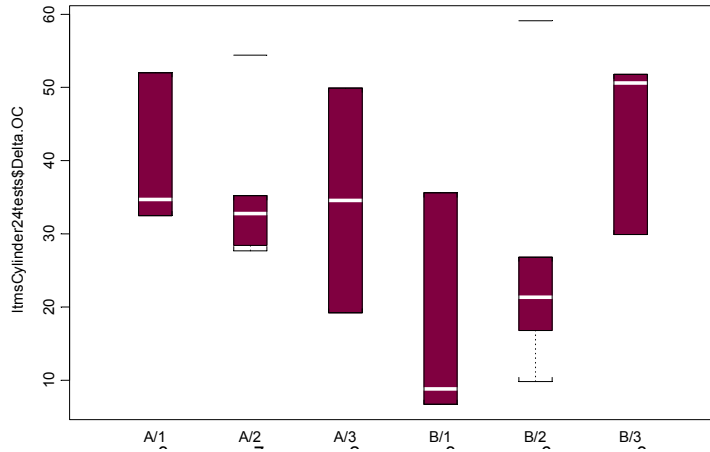


Parameter versus Tech/Base Oil Combination

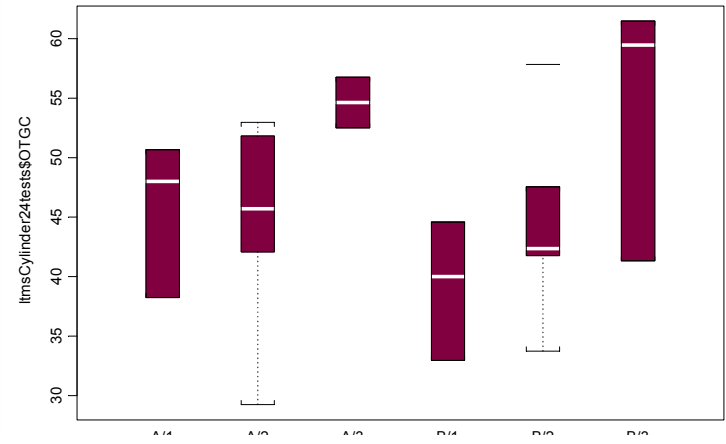
Oct 27, 2005

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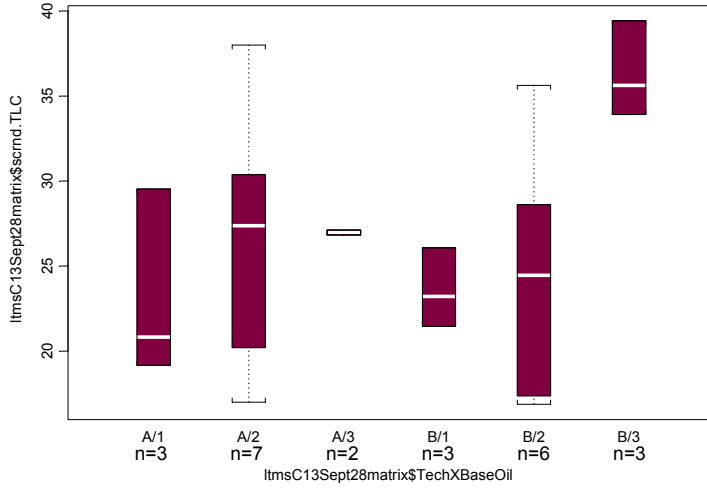
Delta OC by Tech/Base Oil



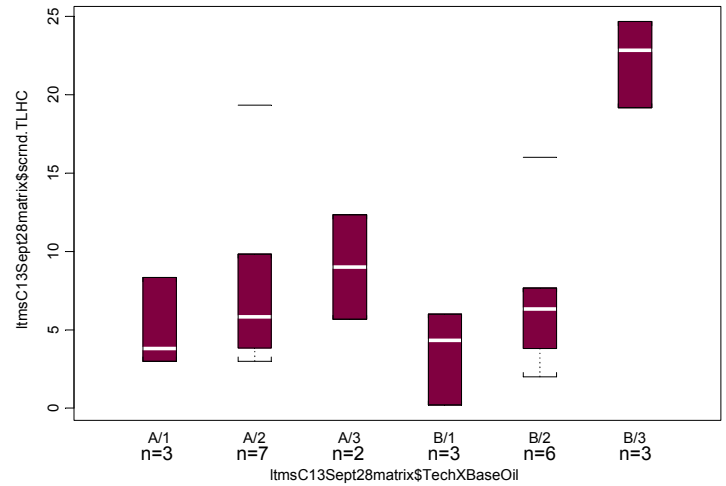
OTGC by Tech/Base Oil



OTLC by Tech/Base Oil



OTLHC by Tech/Base Oil



Precision

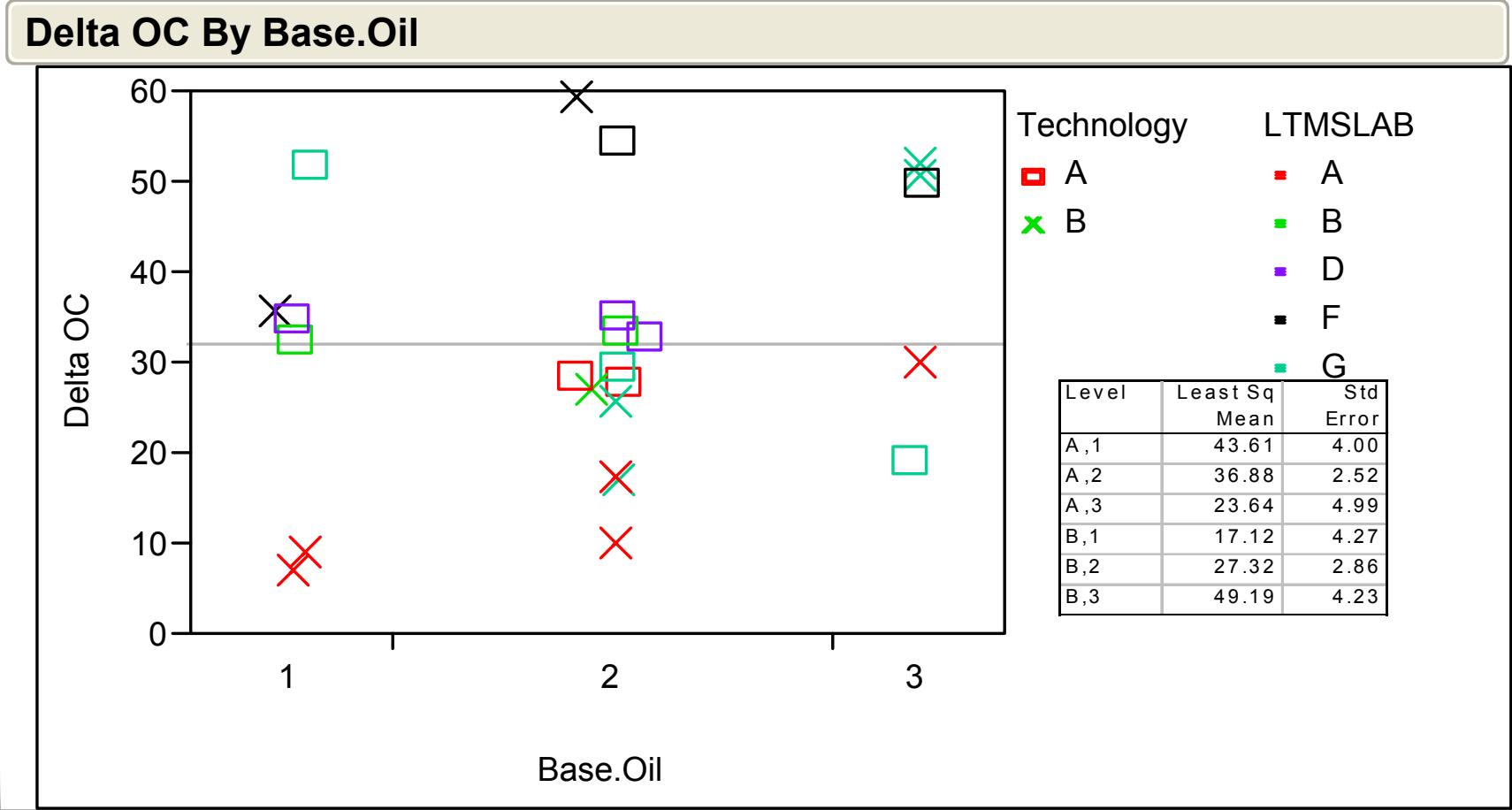
- Desirable values for E_p are greater than 1
 - E_p is greater than 1 for TLC and TLHC

Parameter	Precision based on the model		Median of MAD survey	E_{p1}	E_{p2}
	24 tests	32 tests			
Delta OC	6.5	6.82	4.5	0.6923	0.6598
OUWD	8.15	8.5			
OTGC	5.85	5.74	5	0.8547	0.8711
OTGF	7.22	6.96	4.5	0.6233	0.6466
scrnd TLC	4.02	4.25	4.5	1.1194	1.0588
scrnd TLHC	3.05	3.45	4	1.3115	1.1594

MAD survey indicates the maximum acceptable difference between two test results on the same formulation

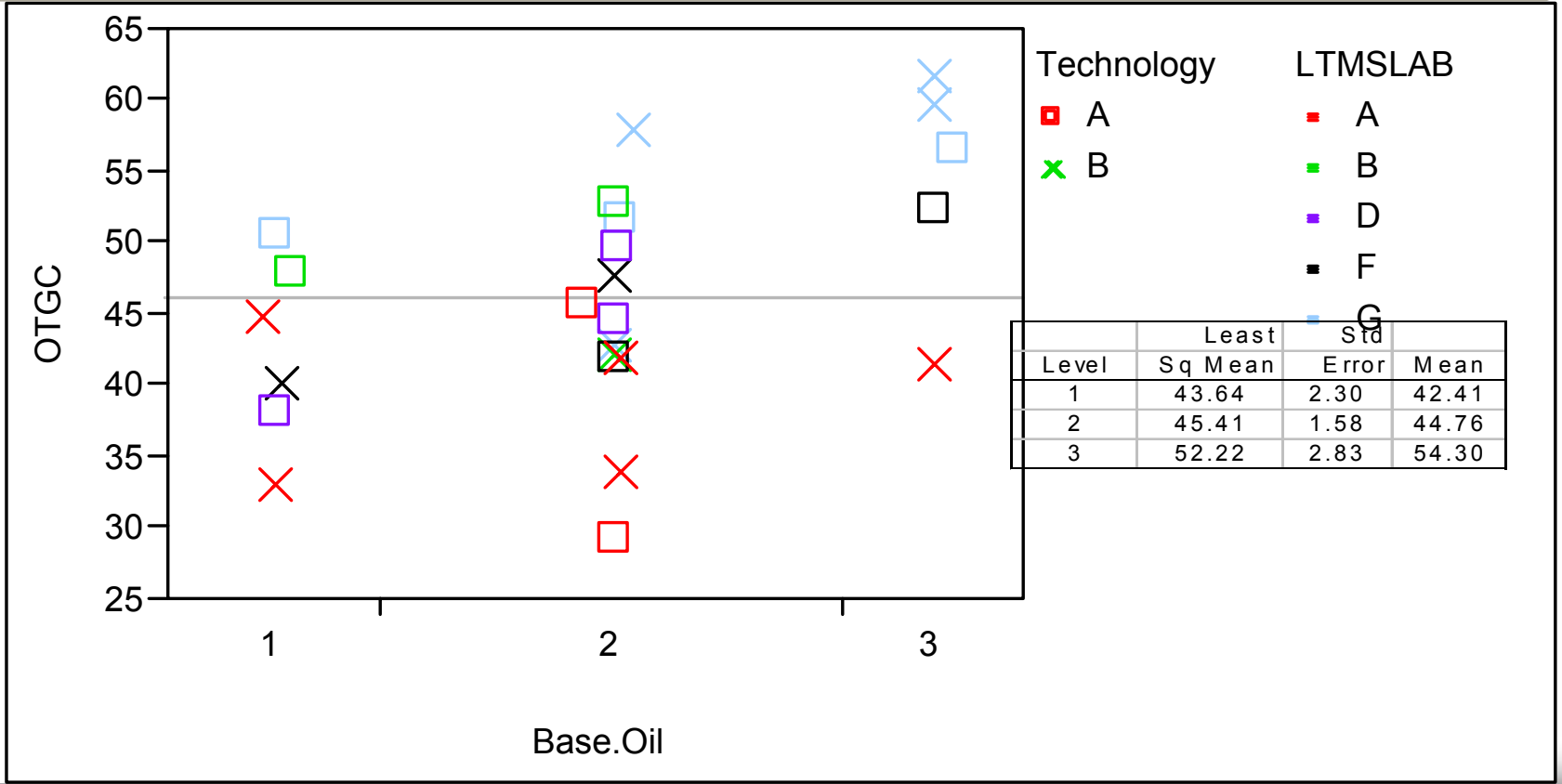


Delta OC versus Base Oil



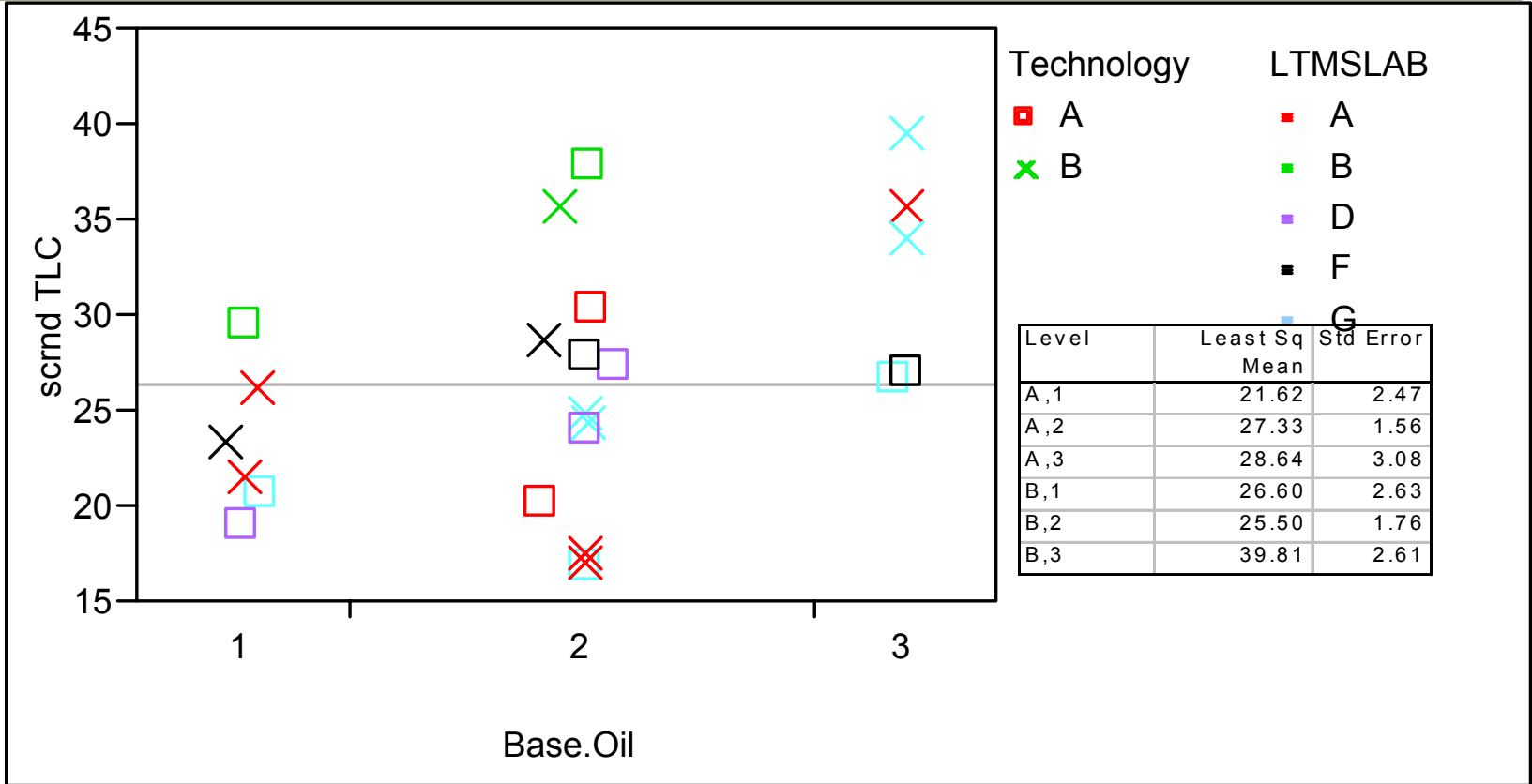
OTGC versus Base Oil

OTGC By Base.Oil



scrnd TLC versus Base Oil

scrnd TLC By Base.Oil



C13 SP Discussion of PC10

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1. C13 data analysis almost completed by statisticians who have agreed on the main findings. Further data review was requested by SP.
2. SP agreed on five Pass/Fail parameters.
3. SP waiting on choice of lower Piston Deposit parameter(s) instead of UWD. Action to complete by end next week.
4. C13 Lab Bias Task Group was established and investigations are on-going, concentrating on Torque, Oil external (Pressure, weights and cooling) system.



C13 Pass/Fail Criteria

Caterpillar Piston Deposit Test Requirements

1. No scuffed Pistons, Rings, Liners – Non-interpretatable
2. No Hot stuck Rings
3. No loss of Oil Consumption Control
4. No unacceptable Piston Deposits:
 - a) TLC
 - b) TGC
 - c) TBD (2nd ring and groove deposits)



Identify Parameters – by Nov 2

Outlier screening methods for LTMS - Nov 5

Limits proposal with determination of :

- Means methods,
- Standard deviation based on 24 BOI tests

Reference Oil selection



C13 Test Limit Status

	Min	Merit Anchor	Max	Merit Weight
Oil Consumption Delta	10	25	30.6	300
TLC	20	30	35	300
TGC	30	48	51.5	250
UWD				150

