

PC-10 Engine Test Matrix Design and Funding

**ASTM HDEOCP Meeting
March 31, 2005
Chicago, IL**

PC-10 Engine Test Matrix

Matrix Design Task Force

- The PC-10 MDTF met March 15 via teleconference to review and select “final” matrix designs
- Issues considered
 - ❖ Adding current reference oils to the ISB & T-12 Precision-only matrix designs
 - ❖ Inclusion of a known oil (Oil D from the mini-matrix) to the C13 Precision / BOI matrix
- MDTF recommendations:
 - ❖ Unanimous vote approving the addition of
 - TMC 830 to the ISB matrix
 - TMC 820 to the T-12 matrix
 - ❖ Addition of 3 Oil D runs to the C13 Matrix approved 8-1-2
 - Running the 3 Oil D tests ahead of the balance of the matrix might resolve the negative vote on this MDTF recommendation

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Detailed Designs

	A	B	C	A-1	B-1	C-1	D	D-1
Matrices	ISB/T12	ISB/T12	ISB/T12	ISB/T12	ISB/T12	ISB/T12	C-13	C-13
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2
No. of Stands	4	4	4	4	4	4	7	7
No. of Labs	2	3	4	2	3	4	5	5
No. of Oils	2	2	2	3	3	3	6	6
Total No. of Tests	14	15	16	14	15	16	26	23
								+3 on Oil D
No. of Tests/Oil	7,7	7,8	8,8	5,5,4	5,5,5	5,5,6	6,6,4,4,3,3	6,6,3,3,3,2
Detectable Difference in s of variable and using t	1.95	1.86	1.78	2.48	2.31	2.28	2.85	3.25
Detectable Difference in s of variable and MC	1.95	1.86	1.78	2.96	2.73	2.68	3.98	4.65
Comparing reference oils only				2.79	2.73	2.68	2.81	2.94
No. of Tests/Stand	4,3,4,3	4,3,4,4	4,4,4,4	4,3,4,3	4,3,4,4	4,4,4,4	4,3,4,3,4,4,4	4,3,4,3,4,4,4
Detectable Difference in s of variable and using t	2.78	2.75	2.52	2.83	2.78	2.55	2.67	2.72
Detectable Difference in s of variable taking the multiple comparison into account for several sample size combinations	3.63	3.55	3.23	3.72	3.63	3.29	3.85	4.04
	3.36	3.29		3.45	3.36		3.57	3.74
	3.88			3.98			4.12	4.32
No. of Tests/ Lab	7,7	7,4,4	4,4,4,4	7,7	7,4,4	4,4,4,4	7,7,4,4,4	7,7,4,4,4
Detectable Difference in s of variable and using t	1.95	2.26	2.52	1.98	2.28	2.55	2.19	2.23
Detectable Difference in s of variable taking the multiple comparison into account for several sample size combinations	1.95	2.66	3.23	1.95	2.71	3.29	2.93	3.05
		3.00			3.05		2.50	2.60
							3.30	3.44
Degrees of Freedom								
Oil	1	1	1	2	2	2	5	5
Stand(Lab)	2	1	0	2	1	0	2	2
Lab	1	2	3	1	2	3	4	4
Mean	1	1	1	1	1	1	1	1
Error	9	10	11	8	9	10	14	11
Total	14	15	16	14	15	16	26	23
95% CI for Sigma, Width	1.14	1.06	0.99	1.24	1.14	1.06	0.84	0.99

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- **MDTF move that the HDEOCP approve the following:**
 - ❖ **For the ISB and T-12 Precision-only Matrices**
 - Use Design A-1, B-1, or C-1 based on the number of labs & stands
 - Matrix oils: PC-10B, PC-10E, and TMC 830 for the ISB
PC-10B, PC-10E, and TMC 820 for the T-12
 - TMC to assign from the 3 oils for stand calibration outside the matrix
 - ❖ **For the C-13 Precision / BOI Matrix**
 - Use Design D-1 (or slight variant if the matrix runs in 6 labs / 27 tests)
 - Matrix Oils: PC-10A thru PC-10F (B & E featured) plus Oil D
 - Three tests on Oil D (*all 3 to be run, analyzed, and accepted by the C13 TF & HDEOCP before starting the remainder of the matrix*)
 - Protocol for stand calibration outside the matrix to be determined
- **Statisticians ready to finalize testing sequence when parameters are set**

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Funding

- **Preliminary plan established at October 20 meeting**
 - ❖ ACC & API each contribute \$1MM in cash
 - ❖ EMA to provide \$350M in cash and >\$650M in-kind
- **Initial matrices could be supported by stand calibration testing plus trade association funding (\$2.35MM)**
- **Increases in test costs from preliminary estimates cause a small shortfall in stakeholder funding**
- **PC-10 NCDT identified two stand/lab allocation options to balance lab participation and minimize shortfall**

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Lab / Stand Allocation & Funding

		NCDT Proposal				NCDT Alternate			
		Hardware Adjusted Test Costs			Hardware Adjusted Test Costs				
Lab	No.	Plan	Submitted	Prop. Adj.	No.	Plan	Submitted	Prop. Adj.	
C13	IND-1	2				4			
	IND-2	4				4			
	DEP-1	2				2			
	DEP-2	2				0			
	DEP-3	2				2			
	DEP-4	2				2			
	Sub-totals	14	1,330,000	1,369,920	1,354,941	14	1,330,000	1,391,170	1,363,761
ISB	IND-1	4				4			
	IND-2	2				2			
	DEP-4	2				2			
	Sub-totals	8	400,000	374,052	369,962	8	400,000	374,052	366,682
T-12	IND-1	2				2			
	IND-2	2				2			
	DEP-1	2				2			
	DEP-4	2				2			
	Sub-totals	8	600,000	632,008	625,097	8	600,000	632,008	619,556
Grand Total			2,330,000	2,375,980	2,350,000		2,330,000	2,397,230	2,350,000
Surplus / Shortage			20,000	-25,980	0		20,000	-47,230	0

Note: NCDT proposal includes the recommendation that test development TF/SP groups establish matrix readiness of each potential test lab by April 15

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Next Steps

- **Obtain agreement from test labs to participate based on**
 - ❖ **NCDT proposed Lab/Stand allocation**
 - ❖ **Need for price adjustment (~1 to 2% of last estimates)**
- **Finalize MOA**
 - ❖ **Review of revised document with comments incorporated**
 - ❖ **Addition of specific lab and cost information**