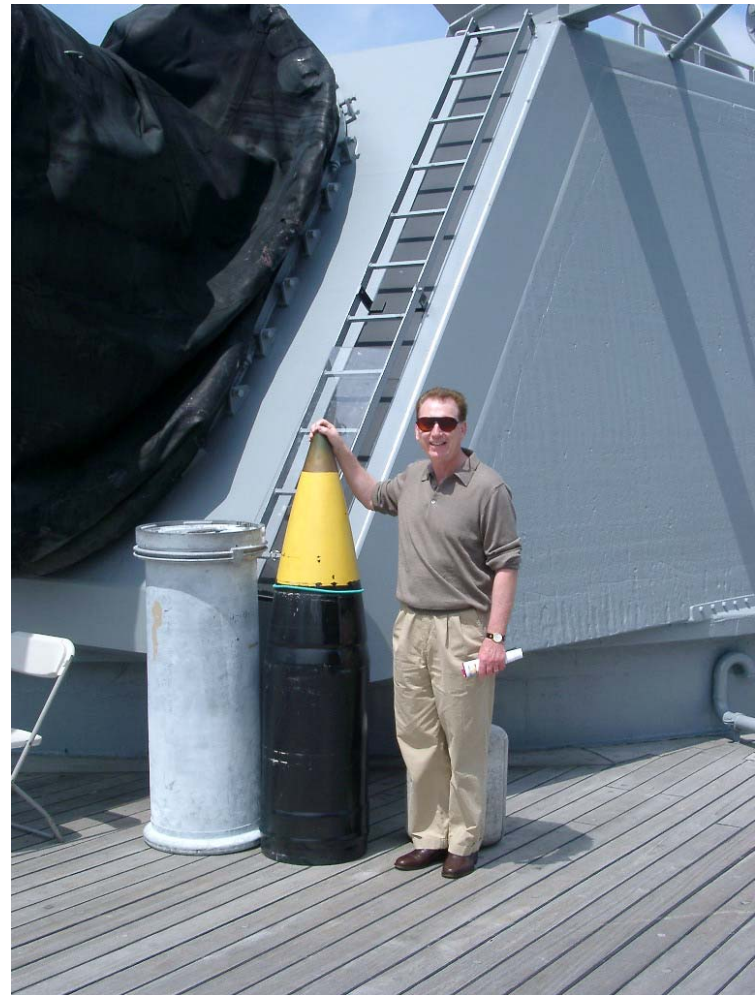


PC 10 *WILL* Be Delivered On Time



Warren Totten; David Stehouwer

December 6, 2005

History Lesson: M11 EGR and Oil E (TMC 830)

Report to HDEOCP ISM Merit System Revised Limits



**Warren Totten
David Stehouwer
December 6, 2005**

PC-9 Matrix

M11 EGR Oils – LS Means and Standard Deviations

Oil	adjXHDW	TRWL	sqrt(OFDP)	AES	ln(ASWL)	TRGI	ln(RBWL)	AWS
A	15.7	156.3	13.5673	9.0	4.8499	0.0012	3.9209	5.3
B	15.7	131.5	20.2788	8.9	4.6749	0.0014	3.9836	5.9
C	24.0	111.3	26.3477	7.2	3.5832	0.0007	3.9706	5.5
D	12.2	157.9	13.6704	7.2	5.0184	0.0000	3.6820	6.2
E	17.3	131.7	11.7164	8.5	4.7883	0.0007	3.2919	5.9
F	17.7	161.5	14.0805	7.7	4.4964	0.0009	3.2178	6.4
G	13.2	140.1	13.6620	7.5	4.5729	0.0012	3.0668	6.4
H	19.7	162.8	14.1506	8.2	4.9642	0.0006	2.9523	7.0
J	18.2	158.2	14.0751	8.1	4.6913	0.0013	3.5089	6.2
std dev	3.7	22.9	2.7	0.38	0.4100	0.00056	0.3804	0.67

Note: Oil E (TMC 830) had XHDW 17.3 mg

PC-9 Matrix

Analysis of Data – M11 EGR

- Crosshead wear is transformed and adjusted to 4.6 average soot.

$$XHDW_{adj} = 10^{\log(XHDW) - 0.2575(avSoot - 4.6)}$$

- All other parameters as reported. OFDP transformed to SQRT.

- Data Set

CMIR	oil	base	tech	lab	xhdw	trwl	ofdp	aes	aswl	trgi	rbwl	aws	
1	38932	E	2	Y	A	23.609126	172.0	127	7.4	108.4	0.0010000000	16.2	4.2
2	38967	B	2	X	A	18.860696	125.0	308	8.8	43.7	0.0010000000	30.1	3.9
3	38969	G	1	Z	A	12.024254	124.5	175	7.3	68.2	0.0010000000	18.6	4.7
4	38935	E	2	Y	A	17.497106	128.9	97	8.1	85.0	0.0001666667	22.3	4.1
5	38970	F	3	Y	A	20.770668	134.2	186	7.0	42.7	0.0010000000	17.6	4.3
6	38933	E	2	Y	A	11.403427	115.5	66	8.0	51.2	0.0011666667	7.6	5.3
7	38966	J	3	Z	A	20.313626	170.5	265	7.7	71.8	0.0010000000	23.8	4.5
8	38934	E	2	Y	A	16.018042	139.1	143	7.6	82.1	0.0000000000	17.1	4.5
9	38968	A	1	X	A	20.292868	144.5	288	8.9	56.6	0.0001666667	25.0	4.4
10	38936	E	2	Y	B	23.283084	147.2	246	8.7	116.6	0.0005000000	36.2	3.8
11	38971	D	1	Y	B	19.409366	144.7	191	6.9	196.6	0.0003333333	42.0	5.7
12	40920	J	3	Z	B	22.573732	139.7	179	7.8	120.7	0.0015000000	32.4	5.3
13	38972	B	2	X	B	19.005164	131.8	601	8.3	191.9	0.0016666667	66.2	5.3
14	38931	E	2	Y	D	15.914587	112.8	118	9.1	98.9	0.0011666667	37.2	6.4
15	38963	D	1	Y	D	9.810164	162.9	224	7.8	136.1	0.0000000000	54.8	5.7
16	38965	C	3	X	D	23.597374	107.1	606	7.7	33.5	0.0008333333	67.7	5.5
17	38964	H	2	Z	D	22.282757	164.0	184	8.6	155.8	0.0008333333	20.9	7.0
18	38927	E	2	Y	G	11.739236	104.1	178	9.0	160.5	0.0000000000	26.2	8.2
19	38962	F	3	Y	G	9.698728	196.9	171	8.2	160.9	0.0005000000	24.3	9.6
20	38930	E	2	Y	G	11.478874	148.2	190	8.4	96.6	0.0003333333	21.9	9.1
21	38960	H	2	Z	G	10.702293	167.7	175	8.6	180.4	0.0006666667	25.4	9.6
22	38959	A	1	X	G	6.245662	176.2	76	8.9	246.2	0.0020000000	69.8	7.3
23	38928	E	2	Y	G	14.913275	143.7	111	8.9	139.0	0.0003333333	28.1	9.0
24	38929	E	2	Y	G	12.098821	129.5	55	8.8	404.0	0.0013333333	62.6	8.0
25	38958	C	3	X	G	NA	NA	706	NA	NA	NA	NA	NA
26	38961	G	1	Z	G	9.496053	163.8	160	7.4	117.4	0.0011666667	17.0	9.1

PC-9 Matrix

M11 EGR Accepted Test Limits (Oct 2001)

M11 EGR Tiered Limits

	1 Test	2 Tests	3 Tests
Crosshead Weight Loss	20	21.8	22.6
Top Ring Weight Loss	175	186.0	190.9
Oil Filter Delta P	275	319.8*	340.8*
Average Sludge	7.8	7.62	7.54

* Calculated in transformed units (sqrt) and converted back to original units

These limits were calculated using ASTM D 3244

PC-9 Matrix

How did Oil E (TMC 830) perform?

- Oil E is a borderline passing oil for the M11 EGR test
- One test limits are; CWL-20mg, TRWL-175mg, OFDP-275 kPa, AES-7.8
- Four of ten (40%) of the accepted reference oil tests failed the accepted test limits

PC-9 MATRIX DATA - OIL E			
CWL	TRWL	OFDP	AES
23.6	172	127	7.4
17.49	128.9	97	8.1
11.4	115.5	66	8
16.01	139.1	143	7.6
23.28	112.8	246	8.7
15.91	104.1	118	9.1
11.23	178.2	178	9
11.47	148.2	190	8.4
14.9	143.7	111	8.9
12.09	129.5	55	8.8

Initial Exit Ballot

Proposed PC-10 Parameters

Criterion	Crosshead Weight Loss	Top Ring Weight Loss	Oil Filter Delta P	Adjusting Screw Weight Loss	Sludge
Weight	250	100	250	250	150
Maximum	6.0	90	20	40	8.9
Anchor	5.0	65	12	30	9.0
Minimum	3.5	40	5	15	9.5

Revised ISM Merit System for PC-10

Criterion	Crosshead Weight Loss	Top Ring Weight Loss	Oil Filter Delta P	Adjusting Screw Weight Loss	Sludge	Total Merits
Weight	350	0	150	350	150	1000
Maximum	7.1	100	19	45	8.7	
Anchor	5.7		13	27	9.0	
Minimum	4.3		7	16	9.3	
Average	5.3	58.9	11.3	24.6	9.0	
St Dev	1.42	15.64	5.93	11.03	0.15	

- **Anchors set above mean of 830**
- **Maximum is 1 sigma above anchor (ASWL relaxed)**
- **TRWL is 100 max**
- **Weights are revised to emphasize wear parameters and minimize Sludge and OFDP**

Merit Results for ISM Test Data

Reference Tests	Crosshead Weight Loss	Top Ring Weight Loss	Oil Filter Delta P	Adjusting Screw Weight Loss	Sludge	Calculated Merit	Final Merit
28402 1004-3	8.3	61	35	139	9.0	-2391	Fail
30048 1004-3	7.4	72	238	155	9.0	-7533	Fail
35313 1004-3	9.4	62	24	138	9.0	-2345	Fail
43672 1004-3	7.8	64	110	59	8.9	-2611	Fail
50254 1004-3	8.0	53	126	191	9.1	-5531	Fail
51225 1004-3	8.5	46	75	44	7.9	-2128	Fail
47644 830-2	5.7	57	9	20	9.2	1408	1408
50224 830-2	4.6	44	10	38	9.0	1133	1133
50226 830-2	6.4	62	6	18	8.9	1211	1211
51799 830-2	4.4	56	12	34	9.1	1272	1272
52996 830-2	2.4	68	7	24	9.0	1587	1587
52997 830-2	7.0	34	11	25	9.1	833	833
54195 830-2	4.7	40	13	27	9.1	1292	1292
54204 830-2	4.9	78	27	41	8.8	463	Fail
55570 830-2	7.1	77	8	9	9.0	1125	1125
55571 830-2	6.1	73	10	9	8.7	1175	1175
Average		5.3	58.9	11.3	24.6	9.0	1226.2
Sd Dev		1.42	15.64	5.93	11.03	0.15	208.0
50769 ISMA	5.9	76	10	137	8.6	-1300	Fail
51224 ISMA	5.9	44	3	43	9.1	856	856

Merit Results for ISM Test Data

- **830-2 has an average Merit of 1226**
 - Better than borderline pass as it was in M11 EGR
 - Not a super premium oil
- **Only 2 of the 830 matrix runs fail**
 - High CHWL and High OFDP, ASWL
 - High CHWL can be offset by good ASWL
- **All 1004 runs fail**
- **ISMA fails for high ASWL**

ISM Merit System for PC-10

- **Motion: Accept the ISM Merit System as summarized here.**

Criterion	Crosshead Weight Loss	Top Ring Weight Loss	Oil Filter Delta P	Adjusting Screw Weight Loss	Sludge	Total Merits
Weight	350	0	150	350	150	1000
Maximum	7.1	100	19	45	8.7	
Anchor	5.7		13	27	9.0	
Minimum	4.3		7	16	9.3	
Average	5.3	58.9	11.3	24.6	9.0	
St Dev	1.42	15.64	5.93	11.03	0.15	