

# Using the Mack T12 as an Alternative to the Mack T-10

**A Recommendation from the Mack Surveillance Panel**

**April 6, 2006**

# Developing T-12 Limits for CI-4 (Plus)

- Three different approaches have been considered :
  1. Use T-12 Merit System with lower Pass/Fail Merit
  2. Develop an Alternative T-12 Merit System to be used when a T-12 test is run for CI-4 qualification
  3. Predict T-10 performance from T-12 engine test data and use T-10 Merit System
- The Mack Surveillance Panel, after much discussion, decided to recommend the use of approach 2
  - One panel member voted negative

# 1) Use T-12 Merit System with lower Pass/Fail Merit

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- Relatively simple approach
- Involves selecting a Merit Limit (400 – 600 Range ?)
- Determine what happens when test results exceed the Merit System Max
  - Keep that parameter's contribution at zero
  - Allow the merit contribution to go negative
- Define a new set of Maxima that cannot be exceeded
- Biggest Challenge :
  - Defining the new limit and the new Maxima

## 2) Develop an Alternative T-12 Merit System

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- More complicated approach
- Requires a data set on oils run in both tests
  - Available are 7 Candidate oils and 1 Reference oil
- Compare the actual T-10 performance with the limits in the T-10 Merit System
- Create an alternative merit system that maintains the same relationship between actual T-12 performance and the new alternative T-12 Merit System
- Biggest Challenge :
  - Determining what data set to use for definition of the new Merit System

# 3) Predict T-10 performance and use T-10 Merit System

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- More complicated approach
- Requires a data set on oils run in both tests
  - Available are 7 Candidate oils and 1 Reference oil
- Establish the correlation equations for each parameter
- Use these equations to predict the T-10 performance from T-12 engine test data
- Apply the existing T-10 Merit System to obtain the test result for CI-4 (Plus) qualification purposes
- Biggest Challenge :
  - Determining the correlation equations when there is no obvious correlation for some parameters

# Defining an Alternative T-12 Merit System

Step 1 : Compare the average performance of an Industry data-set with the anchor in the T-10 Merit System

<u>Oil</u>	<u>Test (T-10 or T-12)</u>	<u>Cylinder Liner Wear</u>	<u>Top Ring Weight Loss</u>	<u>Oil Consumption</u>	<u>DELTA PB</u>	<u>PB2</u>
1	T-10	25.7	97.3	40.9	7	1
2	T-10	26.7	75	42.6	30	12
3	T-10	26.4	121.7	45.8	27	8.0
4	T-10	24.7	133	41.2	25	6
5	T-10	23.8	146	47	29	12
6	T-10	18.7	115.3	53.7	30	14.5
7	T-10	17	97	43.4	24	4
TMC 820 Avg	T-10	31.08	108.9	52.36	24.74	8.78

Average	24.3	111.8	45.9	24.6	8.3
T-10 Anchor	30	140	57	30	10
Average as % of T-10 Anchor	80	79	80	81	82

Candidate Average roughly **80 %** of Anchor for all parameters

# Defining an Alternative T-12 Merit System

## Step 2 : Calculate new anchor for the Alternative T-12 Merit System

<u>Oil</u>	<u>Test (T-10 or T-12)</u>	<u>Cylinder Liner Wear</u>	<u>Top Ring Weight Loss</u>	<u>Oil Consumption</u>	<u>DELTA PB</u>	<u>PB2</u>
1	T-12	25.7	77.1	69.0	28	9
2	T-12	17.5	60	63.9	49	16
3	T-12	18.8	29.4	78.6	42	19
4	T-12	16.4	96.4	76.2	54	18
5a	T-12	16.4	56	71.3	27	9
6	T-12	25.0	59.0	64.8	23	10
7	T-12	15.2	44	61.8	34	12
TMC 820 Avg	T-12	18.63	53.89	68.63	20.11	8.22

Average	19.2	59.5	69.3	34.6	12.7
Anchor Calculation	24.0046875	75.28322785	86.5984375	42.76388889	15.42987805
Average as % of new T-12 Anchor	80	79	80	81	82

Average as % of Anchor is maintained for all parameters

# Defining an Alternative T-12 Merit System

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## Step 3 : Define the Alternative T-12 Merit System

### Proposed T-12 Alternative Merit System

	<u>Cylinder Liner Wear</u>	<u>Top Ring Weight Loss</u>	<u>Oil Consumption</u>	<u>DELTA PB</u>	<u>PB2</u>
Weight	250	200	150	200	200
Max	26	105	95	48	20
Anchor	24	75	85	43	15
Min	12	35	50	10	0

Maxima set at equal distance from anchor as in T-10 Merit System

Anchors rounded from earlier calculated numbers

Minima set at the same values as in T-12 Merit System

Parameter weights same as in T-12 Merit System



# T-10 and T-12 Merit Systems

## T-12 Merit System

	<u>Cylinder Liner Wear</u>	<u>Top Ring Weight Loss</u>	<u>Oil Consumption</u>	<u>DELTA PB</u>	<u>PB2</u>
Weight	250	200	150	200	200
Max	24	105	85	35	14
T-12 Anchor	20	70	65	25	10
Min	12	35	50	10	0

## T-10 Merit System

	<u>Cylinder Liner Wear</u>	<u>Top Ring Weight Loss</u>	<u>Oil Consumption</u>	<u>DELTA PB</u>	<u>PB2</u>
Weight	250	150	150	225	225
Max	32	158	65	35	14
T-12 Anchor	30	140	57	30	10
Min	12	50	25	5	0

# The Impact of Various Alternative T-12 Merit Systems on Candidate Performance

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	T-10	MSP Recommendation T-12 Weights	T-10 Weights	Modified OC and Pb Limits (80 / 40 / 14) T-10 Weights	TMC 820 Included 7 times	T-12
1	1616	<b>1013</b>	1038	1002	745	533
2	1109	<b>1021</b>	967	777	559	426
3	1205	<b>1182</b>	1113	950	748	436
4	1294	<b>493</b>	459	260	37	-22
5	979	<b>1489</b>	1487	1451	1380	1125
6	989	<b>1229</b>	1233	1203	951	779
7	1505	<b>1532</b>	1505	1468	1425	1071
TMC820	1013	<b>1517</b>	1519	1490	1410	1208
Average	1214	<b>1185</b>	1165	1075	835	694

# Exit Ballot

## Proposed T-12 Alternative Merit System

	<u>Cylinder Liner Wear</u>	<u>Top Ring Weight Loss</u>	<u>Oil Consumption</u>	<u>DELTA PB</u>	<u>PB2</u>
Weight	250	200	150	200	200
Max	26	117	95	42	18
Anchor	23	82	82	35	13
Min	12	47	50	10	0