

Emission Based Maintenance Program

By

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Emission Based Maintenance Program “EMBP”

- 1. What is EMBP?
- 2. Why do an EBMP?
- 3. How do I do an EBMP?
- 3. What can you expect out of an EBMP?

What is EBMP?

- 1. What is Maintenance
- Webster defines maintenance as keeping equipment in existing state, to preserve from decline or failure
- If this interpretation is correct mines can not use maintenance to improve existing conditions!!!
- 2. Maintenance + EBMP
- Maintenance + EBMP will meet the definition of maintenance and also let us improve on what we have.

What is EBMP?

- 1. Using engine emissions to determine what maintenance is needed on each vehicle.
- A. Establish a baseline
- B. Compare the baseline to the approval data.
- C. Meet or exceed the approval data.

Baseline. Where did they start?

Date	Unit #	Oxygen %	CO	CO2 %	NOX
1/8/04	HTT101	10.40%	173	7.70%	1667
1/12/04	HTT102	11.60%	515	6.80%	819
1/8/04	HTT103	11.70%	119	6.80%	1235
1/12/04	HTT104	12.50%	540	6.20%	1109
1/12/04	HTT105	11.30%	288	7.10%	711
1/12/04	HTT106	11.70%	441	6.80%	706
1/8/04	HTT107	11.60%	405	6.90%	798
1/13/04	HTT109	7.50%	143	9.90%	1469
1/20/03	HTT110	17.30%	248	2.70%	1587
1/8/04	HTT113	12.10%	473	6.50%	1281
1/8/04	HTT114	9.90%	353	8.10%	953
1/29/04	HTT115	12.20%	36	6.50%	795
1/12/04	HTT116	11.60%	247	6.80%	762
1/20/04	HTT117	7.90%	147	9.60%	1035
1/20/04	HTT118	8.30%	129	9.30%	832
	AVG.		284		1050

Baseline. Where should we be?

			RPM	CO-ppm
B-087	DETROIT	SERIES 60 6063 HK32	2100	38
			2000	37
			1900	35
			1800	34
			1700	28
			1600	31
			1500	29
			1400	34
			1300	52

Baseline. Where are they now?

Date	Unit #	Oxygen %	CO	CO2 %	NOX
8/2/05	HTT101	12.00%	94.00	6.60%	397
8/11/05	HTT102	12.10%	87.00	6.50%	542
8/16/05	HTT103	11.80%	158.00	6.70%	423
8/11/05	HTT104	11.30%	180.00	7.10%	496
8/2/05	HTT105	11.10%	163.00	7.20%	501
8/11/05	HTT106	11.50%	91.00	7.00%	648
8/11/05	HTT107	10.30%	107.00	7.90%	469
8/11/05	HTT109	10.50%	91.00	7.70%	700
8/29/05	HTT110	9.80%	79.00	8.20%	534
8/15/05	HTT113	11.10%	86.00	7.30%	393
8/11/05	HTT114	8.90%	42.00	8.90%	778
8/11/05	HTT115	10.00%	122.00	8.00%	1191
8/11/05	HTT116	11.80%	119.00	6.70%	490
8/23/05	HTT117	9.00%	114.00	8.80%	418
8/17/05	HTT118	11.70%	50.00	6.80%	631
AVG.			106		574

Results. M/NM Mine.

- 1. 62% reduction in CO.
- 2. 45% reduction in NOX.
- 3. We are still 40% higher than approval data in CO.
- 4. The data is now in a tight group.
- 5. Make changes to reduce CO even further.

Results.

Coal Mine 8,710' elevation.

- 1. 1997 With all engines and drive trains at OEM settings. Fleet Average was;
 - CO 1597ppm
 - NOX 997ppm
- 2. 2005 With no engines and drive trains at OEM settings. Fleet Average is;
 - CO 159 ppm
 - NOX 496 ppm

Why do an EBMP?

- 1. Benefits for our employees. Cleaner environment.
 - A. If our people are truly our biggest asset why not make the workplace as clean and safe as possible.
- 2. Equipment is more useable.
 - A. Equipment that is running correctly is always more efficient and useable.
- 3. Cost savings.
 - A. With fuel and engine replacement costs where they are today efficient engines are a must for a good bottom line.
- 4. Equipment is more reliable.
 - A. When vehicles are running correctly overheating, and general downtime is reduced.

How I do an EBMP?

- 1. You need to understand what it is you are looking for.
 - A. Carbon Monoxide, Oxides of Nitrogen, Oxygen, Carbon Dioxide.
 - B. RPM. Stall RPM, High Idle no load, and Transition.
 - C. Rated Engine Power vs. Actual power.
 - D. The engine produces emissions, but the drive train and other parasitic loads puts a total load on the engine. For example; 1. running in a Lug condition vs. running in the power band, 2. Transmission over full, 3. Hydraulic unloader valve set to high.

Gaseous Emissions.

- 1. Carbon Monoxide. Tasteless, odorless, colorless and lighter than air.
- 2. Product of incomplete combustions.
- 3. TLV 50 ppm-MSHA, ACGIH 25 ppm
- 4. Symptoms. Headaches, dizziness, can cause death in high concentrations.
- 5. Caused by too high fuel to air ratio. Plugged air filters, restricted intake system, Turbo problems, misadjusted timing and fueling system set too high. Elevation.

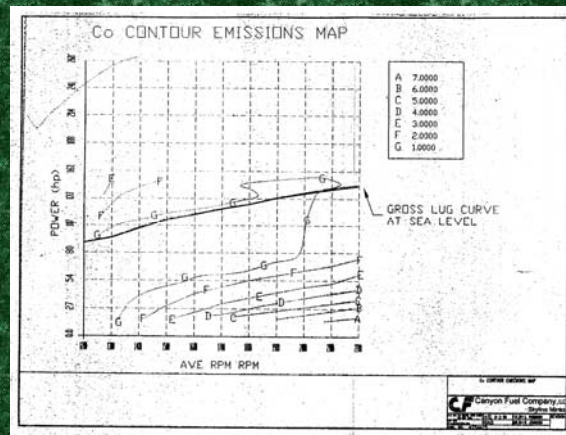
Gaseous Emissions.

- 1. Oxides of Nitrogen. $\text{NOX}=\text{NO}+\text{NO}_2$
- 2. TLV= MSHA-NO 25ppm and NO_2 5ppm
- A. TLV=ACGIH-NO 25ppm and NO_2 3ppm
- 3. Symptoms. Sore throat, burning eyes.
- 4. Caused by combustion. $\text{O}_2+\text{N}_2+\text{HEAT}=\text{NOX}$
- 5. Higher than normal NOX can be caused by incorrect timing, bad fuel or ineffective after cooling.

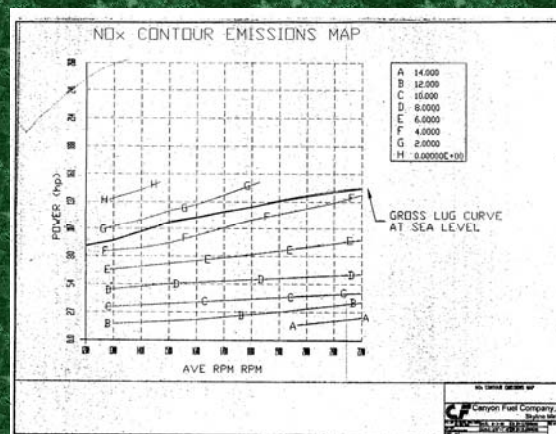
Gaseous Emissions.

- 1. Oxygen vs. CO_2 .
- A. If an engine is at low load the O_2 will be high (13%-17%) and the CO_2 will be low (2%-8%)
- B. If an engine is at high load the O_2 will be low (6%-10%) and the CO_2 will be high (6%-11%).
- 2. Why is this important?

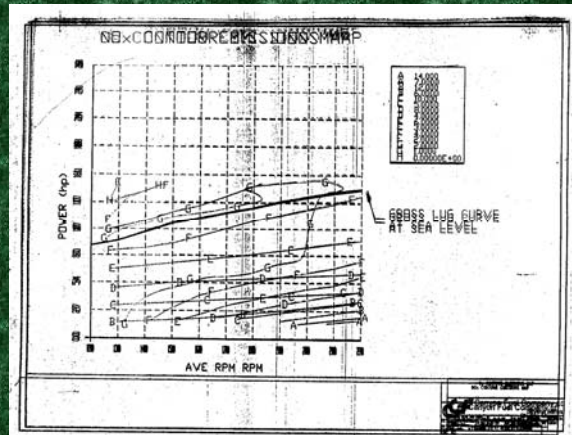
Gaseous Emissions. CO



Gaseous Emissions. NOx.

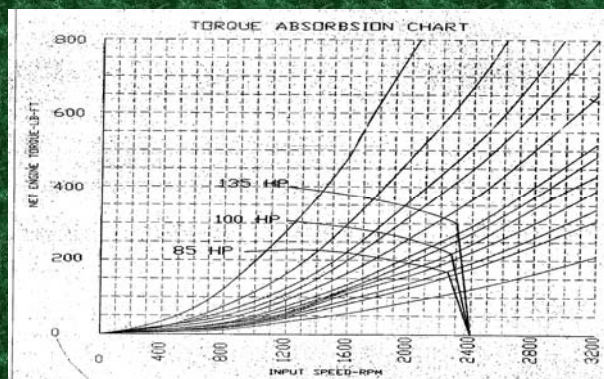


Gaseous Emissions. CO & NOX



RPM.

- 1. Horse Power = Torque X RPM / 5252.
- 2. Rated Power vs. Actual Power.



What Can you expect out of an EBMP?

- 1. Lower emissions. = A cleaner environment for our people.
- 2. Less fuel consumption.
- 3. Long engine life.
- 4. Higher up time, lower down time.
- 5. Less regulatory problems. Citations.
- It does take some work but it is worth it.

Questions?