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CDTi Advanced Materials, Inc.

1st Latin America Conference on Nanoparticles and Internal Combustion Engines

CDTi Advanced Materials Inc

Manufacturer of emission control products for OEMs, integrators and retrofit markets

- 30+ Years of experience in emissions controls for On-Road Transportation, Mining, Material Handling, Refuse & Construction Equipment market.
- Supply proprietary catalyst technologies and products to major Original Equipment Manufacturers such as Honda, Toyota, GM, Epiroc, Sandvik, etc.
- US EPA, CARB & MHSA Verified DOC and DPF products.

Subjects for Discussion

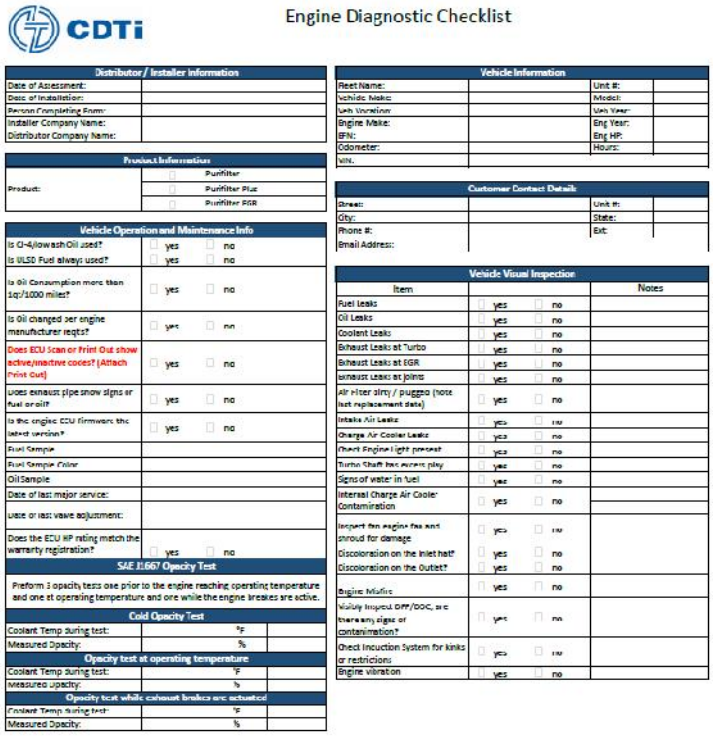
- Vehicle Pre-Assessment Prior to Installation
- Operational Concerns with Diesel Particulate Filters
- Vehicle Maintenance
- Diagnostic Tools
- Emission Reduction Device Government Verifications
- Additional Tips

VEHICLE & ENGINE PRE-ASSESSMENT

Vehicle evaluation prior to installation is one of the most important steps to ensure the DPF/DOC system performs properly and efficiently. The two main factors involved in this are temperature duty cycle and exhaust particulate output.

Engine Evaluation

- Particulate measurements via an opacity test with the engine cold and at operating temperatures. Compare the difference.
- Evaluate engine oil and coolant consumption records to confirm they are within manufacturers specifications.
- Confirm CJ-4 low ash oil is used.
- Confirm ultra-low Sulphur diesel is used.
- Check for active or inactive codes stored in the engines ECU.
- Inspect, the fuel & exhaust system for leaks, inspect the turbo, EGR system, charge air system.
- Check the air filter to ensure it is clean.



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Engine Diagnostic Checklist

Distributor / Installer Information	
Date of Assessment:	
Date of Installation:	
Person Completing Form:	
Installer Company Name:	
Distributor Company Name:	

Product Information	
Product:	☐ Purifilter
	☐ Purifilter Plus
	☐ Purifilter EGR

Vehicle Operation and Maintenance Info		
Is CJ-4/low ash Oil used?	☐ yes	☐ no
Is ULSD Fuel always used?	☐ yes	☐ no
Is Oil Consumption more than 1qt/1000 miles?	☐ yes	☐ no
Is Oil changed per engine manufacturer reqts?	☐ yes	☐ no
Does ECU Scan or Print Out show active/inactive codes? (Attach Print Out)	☐ yes	☐ no
Does exhaust pipe show signs of fuel or oil?	☐ yes	☐ no
Is the engine ECU firmware the latest version?	☐ yes	☐ no
Fuel Sample		
Fuel Sample Color		
Oil Sample		
Date of last major service:		
Date or last valve adjustment:		
Does the ECU HP rating match the warranty registration?	☐ yes	☐ no

SAE J1667 Opacity Test
Preform 3 opacity tests one prior to the engine reaching operating temperature and one at operating temperature and one while the engine brakes are active.

Cold Opacity Test		
Coolant Temp during test:	°F	
Measured Opacity:	%	
Opacity test at operating temperature		
Coolant Temp during test:	°F	
Measured opacity:	%	
Opacity test while exhaust brakes are activated		
Coolant Temp during test:	°F	
Measured Opacity:	%	

Vehicle Information			
Fleet Name:		Unit #:	
Vehicle Make:		Model:	
Veh Vocation:		Veh Year:	
Engine Make:		Eng Year:	
EFN:		Eng HP:	
Odometer:		Hours:	
VIN.			

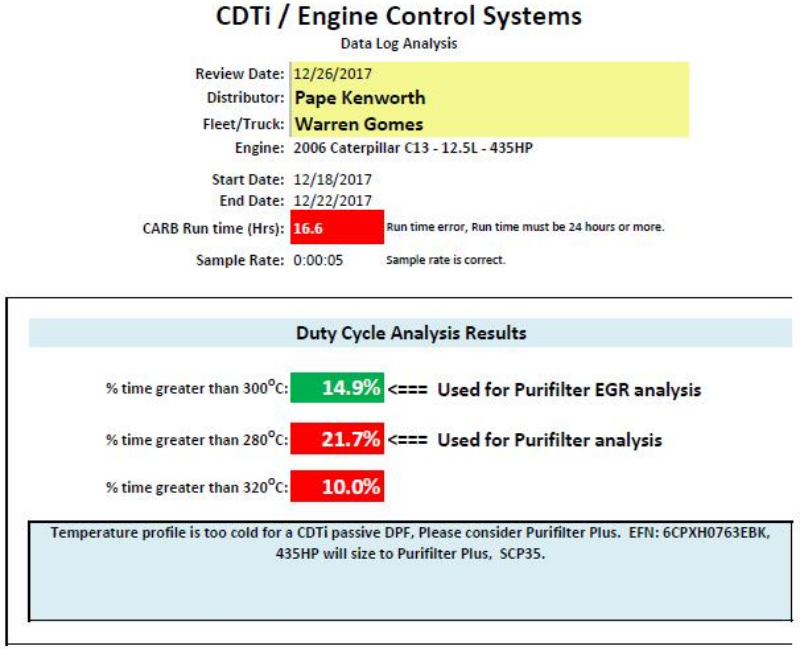
Customer Contact Detail:			
Street:		Unit #:	
City:		State:	
Phone #:		Ext:	
Email Address:			

Vehicle Visual Inspection			
Item			Notes
Fuel Leaks	☐ yes	☐ no	
Oil Leaks	☐ yes	☐ no	
Coolant Leaks	☐ yes	☐ no	
Exhaust Leaks at Turbo	☐ yes	☐ no	
Exhaust Leaks at EGR	☐ yes	☐ no	
Exhaust Leaks at joints	☐ yes	☐ no	
Air Filter dirty / plugged (note last replacement date)	☐ yes	☐ no	
Intake Air Leaks	☐ yes	☐ no	
Charge Air Cooler Leaks	☐ yes	☐ no	
Check Engine Light present	☐ yes	☐ no	
Turbo Shaft has excess play	☐ yes	☐ no	
Signs of water in fuel	☐ yes	☐ no	
Internal Charge Air Cooler Contamination	☐ yes	☐ no	
Inspect fan engine fan and shroud for damage	☐ yes	☐ no	
Discoloration on the inlet half	☐ yes	☐ no	
Discoloration on the Outlet?	☐ yes	☐ no	
Engine Misfire	☐ yes	☐ no	
Visibly Inspect DPF/DOC, are there any signs of contamination?	☐ yes	☐ no	
Check Induction System for kinks or restrictions	☐ yes	☐ no	
Engine vibration	☐ yes	☐ no	

Exhaust Duty Cycle Temperature Data Logging

A temperature probe is inserted into the exhaust pipe, in the approximate location of where the DPF assembly is planned to be installed.

- Once the thermocouple probe and logger are installed, the vehicle resumes normal daily operations. Normally this takes 2-5 days.
- At least 24 hours of engine run time is required.
- During this time the exhaust data logger is capturing exhaust temperatures at 5-10 second intervals.
- After the required run time is met, the vehicle returns to have the data logger removed.
- The data is analyzed and a DPF product is selected based on the duty cycle temperatures in relation to the passive regeneration requirements.



CDTi / Engine Control Systems

Data Log Analysis

Review Date:	12/26/2017
Distributor:	Pape Kenworth
Fleet/Truck:	Warren Gomes
Engine:	2006 Caterpillar C13 - 12.5L - 435HP
Start Date:	12/18/2017
End Date:	12/22/2017
CARB Run time (Hrs):	16.6 — Run time error, Run time must be 24 hours or more.
Sample Rate:	0:00:05 — Sample rate is correct.

Duty Cycle Analysis Results

% time greater than 300°C:	14.9%	<=== Used for Purifilter EGR analysis
% time greater than 280°C:	21.7%	<=== Used for Purifilter analysis
% time greater than 320°C:	10.0%	

Temperature profile is too cold for a CDTi passive DPF, Please consider Purifilter Plus. EFN: 6CPXH0763EBK, 435HP will size to Purifilter Plus, SCP35.

Operational Concerns with Diesel Particulate Filters

Unfortunately the two most common operational causes of DPF issues are also the most common driving conditions in CDMX. Those two operation conditions are start and stop operation, and extended idle time. During this time the engine is filling the DPF with soot, while at the same time there is not enough temperature for passive regeneration.

- Though start – stop operation cannot be changed while city driving, there is commercially available idle limiters, which automatically shut the engine down at a pre-determined amount of time, normally around 5 minutes.
- Company policy can also be implemented so that drivers will shut down their engines when it is not necessary that they are running. Though a policy such as this is commonly disobeyed and difficult to enforce.
- It is necessary to take a close look at driving patterns/ routes of each vehicle to ensure it spends sufficient time at engine conditions capable of allowing passive regeneration. For example, this may include alternating routes of all vehicles in a fleet so that they all get time on the highway at least a couple times during the week while moderately to highly loaded.

Vehicle Maintenance

Vehicle maintenance is extremely important to ensure the efficiency of the DPF system.

- An improperly maintained engine that requires repair yet is being neglected will cause the DPF to prematurely plug with particulate. This requires the DPF to be cleaned more often, thus increases the cost to the fleet.
- A properly maintained engine will reduce the maintenance costs of a DPF system. One of the most commonly neglected maintenance items is the air filter. A restricted air filter will cause a loss in engine power, fuel economy, and increase exhaust particulate.
- DPF's are rarely defective, in almost every case in which there is an issue, the culprit is an engine requiring repair, or improper applications engineering of the DPF system.
- The useful life of a properly maintained engine can match that of the vehicle itself.

DIAGNOSTIC TOOLS

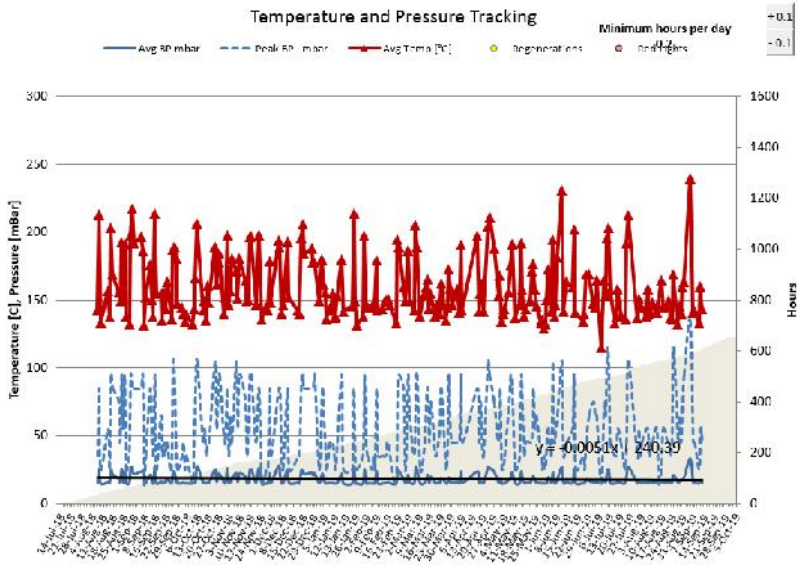
There is three key diagnostic tools for proper DPF system maintenance & repair.

Opacity Meter

The DPF system installer should have an opacity meter to read exhaust particulate output. An opacity meter uses a light beam and tests its dilution to calculate the particulate measured as a percentage.

On-Board Back Pressure and Temperature Monitoring & Logging

As part of the DPF system maintenance routine, data extracted from the back pressure and temperature logger should be analyzed to confirm the system is operating within specifications. Particularly, this is useful to look at the average duty cycle temperatures. This also will provide an average of back pressure, which can be used to determine if a problem exists so that repairs can be made.



DPF Cleaning and Flow Testing Equipment

DPF cleaning equipment integrates a flow test, which measures the restriction of a filter.

MANUFACTURER VERIFICATION & CERTIFICATION

Certifications and Verifications are critical when selecting a emissions reduction device. It is important that a DPF and or DOC is selected that holds a Verification by US CARB/ EPA or a similar entity for which heavily scrutinizes the performance, catalyst coating & materials used.

- Allowing the use of a product without any formal Verification could the negate effects of the emissions reductions device. For example, DPF's & DOC's are normally coated using precious metals. If the incorrect precious metals are used, or in incorrect quantities, it could cause secondary catalytic reactions that cause more harm than they do good.
- Part of the Certification/ Verification process ensures that there is no effect on engine performance, so that it does not damage engine components or decrease fuel economy.
- Companies that use products that are not Verified are more likely to neglect support and service after the sale. CDTi and Mannheim Motors stand by our product and will support it throughout its useful life.

THANK YOU

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