



# pennsylvania

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF MINE SAFETY

81A

April 5, 2012

Mr. Jim Coe  
BUCYRUS  
4041 Wurno Road  
Pulaski, Virginia 24301

RE: CAT Model 650D permissible diesel scoop utilizing a 150 HP Deutz BF4M 1013 diesel engine (MSHA Part 7 approval 07-EPA08000-01) and an emission control package utilizing a FST high temperature fiberglass DPM filter (95% efficient), an ECS Model AZ catalyst, and a Bucyrus flame arrestor and heat exchanger.

Dear Mr. Coe:

Chapter 4 of the "Bituminous Coal Mine Safety Act" (the Act) provides for the use of diesel-powered equipment in underground bituminous coal mines. Section 424 of the act created a Technical Advisory Committee ("TAC") for the purpose of advising the Department regarding implementation of Chapter 4 and evaluation of alternative technology or methods for meeting the requirements of Chapter 4.

Caterpillar (Bucyrus) submitted a request to the Bureau of Mine Safety (BMS) for approval for a Permissible Model 650D diesel scoop utilizing a 150 HP Deutz BF4M 1013 diesel engine (MSHA Part 7 approval 07-EPA08000-01) and an emission control package utilizing a FST high temperature fiberglass DPM filter (95% efficient), an ECS Model AZ catalyst, and a Bucyrus flame arrestor and heat exchanger

The Director of BMS requested the TAC to evaluate the Permissible CAT Model 650D diesel scoop and to advise the Department regarding the TAC's recommendation as to whether the referenced equipment meets requirements of Section 403 of the Act.

The diesel power package includes the following items:

- 150 HP Deutz BF4M 1013 diesel engine (MSHA Part 7 approval 07-EPA08000-01)
- FST high temperature fiberglass exhaust DPM filter (95% efficient)
- ECS Model AZ catalyst
- Bucyrus flame arrestor and heat exchanger

More detailed information on the specifications of the diesel power package is included on the General Specification Sheet which is attached as Attachment 1.

On February 1, 2012 the TAC and DEP traveled to Caterpillar (Bucyrus) in Pulaski, Virginia to inspect the equipment when it became available. The TAC evaluated the engine and exhaust emissions package, as well as procedures to check the permissible joints on the diesel engine and emission control package.

Emissions testing of the engine and after-treatment system were performed, as well as exhaust gas temperature monitoring and stall test procedure. The results of the emission tests showed the engine was performing within MSHA's approval specifications.

The maximum surface temperature observed was 183° F, the maximum exhaust gas temperature measured was 142° F, and the maximum engine coolant temperature observed was 165° F. The engine coolant shutdown was set to 201° F and the exhaust coolant shutdown was set at 197° F. These temperatures were in compliance with Section 403 of the Act.

The results of the emissions tests showed the engine was performing within MSHA's approval specifications. The after-treatment system is fitted with a FST high temperature fiberglass exhaust DPM filter (95% efficient). The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of 0.021 mg/m<sup>3</sup> of diesel particulate matter when diluted by 100% of the MSHA approval plate ventilation rate for this engine, which is well below the .12 mg/m<sup>3</sup> requirement of Section 403 (a)(1) the Act, see (Attachment 2).

The engine is equipped with a crankcase oil breather filter. The TAC had concerns regarding the maintenance of this system and the possibility of oil accumulation. The TAC recommends the filter must be an MSHA approved filter. This filter must be clearly tagged or labeled to insure that the operator can identify it as the crankcase oil breather filter during pre op checks. The TAC recommends the 100 hour maintenance check list include changing the crankcase oil breather filter during every 100 hour maintenance or more often if needed.

The TAC also evaluated the procedures to check the permissibility of the joints and gaskets on the engine and emissions control system. All joints and gaskets were not easily accessible. It was not clear if the permissible feeler gage was able to completely check all of the required locations with certainty. The TAC and DEP agreed that an alternate method was needed to ensure that no leaks were present on the connections. The TAC recommends that the feeler gage be used for permissibility on all readily accessible joints and gaskets. On the exhaust system the TAC recommends that a gas detector (sniffer) be used to check for leaks around joints or gaskets that are not readily accessible. The gas detector may detect CO, NO<sub>2</sub> or other exhaust gases. When the reading of the specific exhaust gas detected during the sniffing process is above ambient there is indication of a leak. The TAC recommends the effects of the cooling radiator fan blowing across the exhaust system must be minimized by some method to reduce the air flow during the sniffing process. All trained diesel mechanics that do the permissibility checks will be trained in the use of the specific gas detector (sniffer), the procedures to check for leaks using the detector and the training will be recorded. The gas detector will be maintained and calibrated monthly or according to the manufacturer's recommendations.

During the inspection the TAC and DEP discovered there was no gage or indicator to monitor the exhaust gas temperature and give a warning or shut down alarm. CAT agreed to install a warning and shut down indicator. There was also no oil temperature gage installed in the system. CAT explained how the oil temperature was cooled by the engine coolant system. The TAC

agreed that monitoring the engine coolant along with the engine coolant shutdown protection will not compromise the level of safety to meet the requirements of Section 403(c) of the Act.

In addition to the testing that was conducted, our investigation and our observations confirmed that the diesel power package is capable of meeting all the requirements of Section 403 of the Act.

Our recommendation is based upon the data supplied by Caterpillar, the results of the tests conducted on February 1, 2012, as well as the data acquired and observations made during our investigation. The TAC has determined that the CAT Permissible Model 650D diesel scoop utilizing a 150 HP Deutz BF4M 1013 diesel engine (MSHA Part 7 approval 07-EPA08000-01) and an emission control package utilizing a FST high temperature fiberglass DPM filter (95% efficient), an ECS Model AZ catalyst, and a Bucyrus flame arrestor and heat exchanger meets all requirements of Section 403 of Chapter 4 of the Pennsylvania Bituminous Coal Mine Safety Act. As such, we are recommending approval of the above described diesel power package with the following stipulations. This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1) be strictly adhered to.

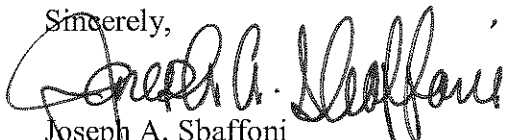
Additional TAC stipulations for approval:

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  - The TAC recommends the filter must be an MSHA approved filter.
  - The pre op check list must include a visual check of the crankcase oil breather filter for excessive oil accumulation on the filter, and instructions to change the filter before use if an oil accumulation is found.
  - This filter must be clearly tagged or labeled to insure that the operator can identify it as the crankcase oil breather filter during pre op checks.

- The TAC recommends the 100 hour maintenance check list include changing the crankcase oil breather filter during every 100 hour maintenance, or more often if needed.

If you have any questions on this request, please contact Joseph Sbaffoni at [jsbaffoni@pa.gov](mailto:jsbaffoni@pa.gov) or at 724-439-7461.

Sincerely,



Joseph A. Sbaffoni  
Director  
Bureau of Mine Safety

cc: Bowersox  
Borchick

Enclosure(s)

JAS/cd

bcc: Antoon  
Gaida  
Elias (web)  
Dunn/TAC file

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**Pennsylvania Technical Advisory Committee  
On Diesel Powered Equipment**

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February 6, 2012

Joseph Sbaffoni, Director  
Bureau of Mine Safety  
Fayette County Health Center  
100 New Salem Road, Room 167  
Uniontown, Pa. 15401



RE: CAT Model 650D permissible diesel scoop utilizing a 150 HP Deutz BF4M 1013 diesel engine (MSHA Part 7 approval 07-EPA08000-01) and an emission control package utilizing a FST high temperature fiberglass DPM filter (95% efficient), an ECS Model AZ catalyst, and a Bucyrus flame arrestor and heat exchanger.

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**Background**

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## Investigation

On February 1, 2012 the TAC and DEP traveled to Caterpillar (Bucyrus) in Pulaski, Virginia to inspect the equipment when it became available. The TAC evaluated the engine and exhaust emissions package, as well as procedures to check the permissible joints on the diesel engine and emission control package.

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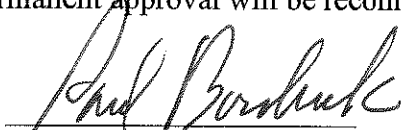
### **Recommendation**

Our recommendation is based upon the data supplied by Caterpillar, the results of the tests conducted on February 1, 2012, as well as the data acquired and observations made during our investigation. The TAC has determined that the CAT Permissible Model 650D diesel scoop utilizing a 150 HP Deutz BF4M 1013 diesel engine (MSHA Part 7 approval 07-EPA08000-01) and an emission control package utilizing a FST high temperature fiberglass DPM filter (95% efficient), an ECS Model AZ catalyst, and a Bucyrus flame arrestor and heat exchanger meets all requirements of Section 403 of Chapter 4 of the Pennsylvania Bituminous Coal Mine Safety Act. As such, we are recommending approval of the above described diesel power package with the following stipulations. This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1) be strictly adhered to.

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  - The TAC recommends the 100 hour maintenance check list include changing the crankcase oil breather filter during every 100 hour maintenance, or more often if needed.

If the Director receives a request for temporary approval for use prior to the next TAC meeting, the TAC will recommend temporary approval until the next scheduled TAC meeting on April 11, 2012 at which time permanent approval will be recommended.

  
Paul Borchick

  
Ron Bowersox



**General Specification Sheet**  
**EQUIPMENT MANUFACTURER BUCYRUS MODEL 650D DATE 9-23-11**

<b>I. Engine</b>			
Manufacturer	Bucyrus / Deutz	Particulate Index (PI)	4500 cfm
Manufacturer Address	Houston, Pa / Norcross, Georgia		
Engine Model No.	1013	Gaseous Ventilation Rate (CFM)	7500
Engine Serial No.	tbd	Raw DPM (gr/hr)	5.36
HP/RPM (rated)	150/2200	MSHA Part 7 Approval #	07-EPA080001-01
Low Idle (RPM)	1000 rpm	MSHA Part 7 Ventilation Rate (CFM)	7500
Max. Dirty Intake Air Restriction H <sup>2</sup> O	26"	Type of Aspiration	Turbo Charger / After Cooled
Max. Allowed Backpressure H <sup>2</sup> O	60"	Turbocharger Boost (psi)	20
High Idle (RPM)	2350	Fuel Delivery System	direct injection
Water-jacketed components	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Engine Cooling via	Radiator
<b>II. Particulate Filter</b>			
Manufacturer	Filter Service and Testing or Donaldson or T		
Manufacturer Address	Price, Utah ;		
Model Number	FST	System Type	High Temp Fiberglass
MSHA Efficiency Rating	95	MSHA Approved	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Treated DPM mg/m <sup>3</sup> when diluted w/100% Part 7 ventilation rate (show calc on separate sheet)	.021		
<b>III. Catalyst</b>			
Manufacturer	Engine Control Systems		
Manufacturer Address	EVARPAR - Evansville, Indiana 47725		
System Name	AZ series		
Model Number	A16-0155		
<b>IV. Flame Arrestor</b>			
Manufacturer	Bucyrus		
Manufacturer Address			
System Name	Flame Arrestor - .038		
Model Number	624254	MESG	
<b>V. Heat Exchanger</b>			
Manufacturer	Bucyrus	Model or Part #	350177
<b>VI. Fire Suppression System</b>			
Manufacturer	Ansul	Model or Part #	A101 Series



**BUCYRUS**  
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Pulaski, Virginia 24301, USA  
Tel. (+1) 540.980.4530 · Fax (+1) 540.980.6211

November 16, 2009

Bucyrus 1013 Diesel Emissions Calculations

Calculations for DPM

BF4M 1013 FC

Power Rating: 150 HP @ 2300 rpm

Approval No: 07-EPA080001

Assigned Ventilation: 7,500 cfm / 212.38 m<sup>3</sup>/min

PM rate: 5.36 g/hr = 89.33 mg/minute

Fiberglass Filter Element Efficiency 95% MSHA rating.

Adjustment based on 95% efficiency =  $(.95)(89.33 \text{ mg/minute}) = 84.86 \text{ mg/minute}$

$89.33 \text{ mg/minute} - 84.86 \text{ mg/minute} = 4.46 \text{ mg/minute emitted}$

Calculating for mg/m<sup>3</sup>, which must be less than .12 mg/m<sup>3</sup> pursuant to 196-1-5.1 of West Virginia Rules for Operating Diesel Equipment in Underground Mines in West Virginia Title 196 & Pennsylvania Diesel Regulations Article II-A Section 203-A subpart (a)

$4.46 \text{ mg/minute} / 212.38 \text{ m}^3/\text{min} = \underline{\underline{.021 \text{ mg/m}^3}}$

**Conclusion: This combination of power package and DPM control method meets the requirements for WV 196-1-5.1 and PA Article II-a Section 203 –A subpart (a).**

ATTACHMENT 2