

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

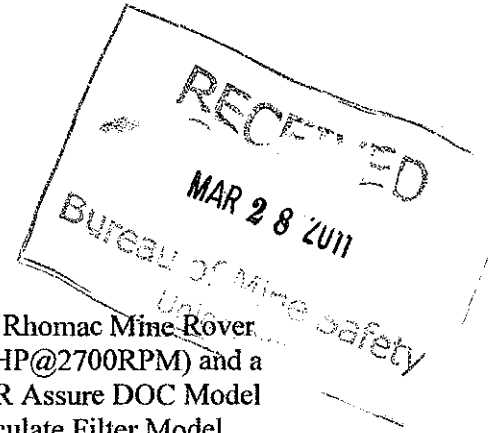
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March 24, 2011

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



RE: Rhomac, Inc. request for an alternate diesel power package for the Rhomac Mine Rover PC732 (BOTE-D 136-09) to utilize a KUBOTA V2403-M engine (49HP@2700RPM) and a Rhomac Inc Exhaust Conditioning System Model DEC 1202, CleanAIR Assure DOC Model CWD0700BCCN30 Oxidation Catalyst, CleanAIR Permit Diesel Particulate Filter Model FPA108W4CN30.

Dear Mr. Scaffoni:

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.

**Background**

On December 20, 2010 Rhomac, Inc. submitted a request to the TAC and Bureau of Mine Safety (BMS) for an alternate diesel power package for the Rhomac Mine Rover PC732 (BOTE-D 136-09) to utilize a KUBOTA V2403-M engine (49HP@2700RPM) and a Rhomac Inc Exhaust Conditioning System Model DEC 1202, CleanAIR Assure DOC Model CWD0700BCCN30 Oxidation Catalyst, CleanAIR Permit Diesel Particulate Filter Model FPA108W4CN30.

The engine and emissions control package has not been previously approved under Section 403 of the Act.

The Director of BMS requested the TAC to evaluate the Rhomac Mine Rover Model PC732 rubber tire personal carrier using a KUBOTA V2403-M engine (49HP@2700RPM) and a Rhomac Inc Exhaust Conditioning System Model DEC 1202, CleanAIR Assure DOC Model CWD0700BCCN30 Oxidation Catalyst, CleanAIR Permit Diesel Particulate Filter Model FPA108W4CN30 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:

- KUBOTA V2403-M diesel engine (49HP@2700RPM) with MSHA ID 07-ENA080011 (Part 7)
- Rhomac Inc Exhaust Conditioning System Model DEC 1202
- CleanAIR Assure DOC Model CWD0700BCCN30 Oxidation Catalyst (25% DPM reduction)
- CleanAIR Permit Diesel Particulate Filter Model FPA108W4CN30 (89% efficient)

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

### **Investigation**

On March 14, 2011 the TAC and DEP traveled to Rhomac, Inc. in Mount Storm, WV to inspect the equipment when it became available. The TAC evaluated the engine and exhaust emissions package, as well as engine exhaust gas temperature and surface temperature to see if they meet the requirements under Section 403 of the Act.

Emissions testing of the engine and after-treatment system were performed, as well as exhaust gas temperature monitoring and stall test procedure. At the end of the 90 second CO tests the Raw CO was measured at 240ppm, and the Treated CO was measured at 11ppm (Attachment 2). The results of the emission tests showed the engine was performing within MSHA's approval specifications.

Monitoring of the exhaust gas temperature produced a high exhaust gas temperature reading above 302° F, which exceeded the maximum temperature allowed by Section 403 (b)(4) of the Act. It was determined that modifications needed to be made to the exhaust cooling system. This system utilizes a fan that blows air into the cooling chamber to provide a venturi effect to cool the exhaust gas. There were areas where the exhaust gas temperature was below 302° F, however this was not the case across the entire exhaust gas exit. It was also determined that the exhaust gas temperature probe needed relocated to measure the exhaust gas temperature at its highest range.

On March 22, 2011 the TAC and DEP revisited Rhomac to reevaluate the exhaust gas temperature after the modifications were made. The temperature probe was relocated to an area that represented the maximum exhaust gas temperature as requested by the TAC. The engine was operated in the lug condition for over 5 minutes. The maximum exhaust gas temperature measured was 280° F, which is within the requirements of Section 403. A test was also conducted to see if the engine would shut down by the exhaust gas temperature probe if the fan on the cooling chamber was off. The engine shut down after 80 seconds. The TAC considered the system to provide adequate protection as required under Section 403.

The maximum surface temperature observed was below 302° F after conducting all the CO testing.

The after-treatment system is fitted with a CleanAIR Permit Diesel Particulate Filter Model FPA108W4CN30 (89% efficient) and the CleanAIR Assure DOC Model CWD0700BCCN30 Oxidation Catalyst (25% DPM reduction). The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of .106 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 below the .12 mg/m<sup>3</sup> requirement of Section 403 (a)(1) 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. However due to the unique design of the exhaust gas cooling system, the TAC recommends that a test period be established during the first 100 hours of operation to record any exhaust system component failures and part replacements. This shall include the fan on the exhaust cooling chamber. The TAC and DEP shall be notified at the end of the 100 hours of any such failures and corrective actions taken.


### **Recommendation**

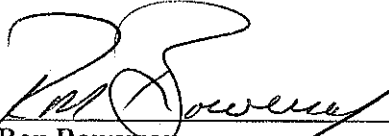
Our recommendation is based upon the data supplied by Rhomac, the results of the tests conducted on March 14 and March 22, 2011, as well as the data acquired and observations made during our investigation. The TAC has determined that the KUBOTA V2403-M engine (49HP@2700RPM) and a Rhomac Inc Exhaust Conditioning System Model DEC 1202, CleanAIR Assure DOC Model CWD0700BCCN30 Oxidation Catalyst, CleanAIR Permit Diesel Particulate Filter Model FPA108W4CN30 meets all requirements of Section 403 of Chapter 4 of the Pennsylvania Bituminous Coal Mine Safety Act. As such, we are recommending temporary approval of the above described diesel power package and the 100 hour test period. This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1) be strictly adhered to.

Due to the unique design of the exhaust gas cooling chamber, the TAC recommendation includes these additional stipulations:

- During operator pre-op checks(include in the pre-op check list):
  - Check to be sure the intake for the exhaust cooling chamber fan is not obstructed. Obstructions shall be cleared before operation.
  - Turn the key to the run position to start the exhaust cooling chamber fan (not engine) and feel for airflow at the exhaust discharge to determine the fan is operating properly.
- During each 100 hour maintenance (include on 100 hour maintenance checklist):
  - Clean out the exhaust gas cooling chamber
  - Conduct a smoke dot test in the port provided on the exhaust system. If the result is over 3 repairs must be made to the exhaust emission control system before operation.

On March 23, 2011 the TAC received a request from Gene Davis, Rosebud Mining, for temporary approval for use prior to the next TAC meeting. The TAC recommends temporary approval, including all stipulations above, until the next scheduled TAC meeting on April 13, 2011 at which time permanent approval will be recommended, pending completion of the 100 hour test period.

  
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Paul Borchick

  
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Ron Bowersox

**General Specification Sheet**

**I. Engine**

Manufacturer	Kubota	High Idle (RPM)	2700
Manufacturer Address	505 Schelter Road Lincolnshire, IL 60069	Particulate Index (PI)	4000
Engine Model No.	V2403-M-DI-E3	Gaseous Ventilation Rate (CFM)	3000
Engine Serial No.	AJ0660	Raw DPM (gr/hr)	6.54
HP/RPM	49 / 2700	MSHA Part 7 Approval No.	07-ENA080011
Low Idle (RPM)	950	Type of Aspiration	Natural
Max. Dirty Intake Air Restriction (H <sup>2</sup> O)	20	Turbocharger Boost Pressure (psi)	N/A
Max. Allowed Backpressure H <sup>2</sup> O	42	Fuel Delivery System	Direct Injection

**II. Particulate Filter**

Manufacturer	CleanAir Systems
Manufacturer Address	PO Box 23449, Santa Fe, NM 87502

Model Number	FPA108W4CN30
System Type	Ceramic
Efficiency Rating	89%

**III. Catalyst**

Manufacturer	CleanAir Systems
Manufacturer Address	PO Box 23449, Santa Fe, NM 87502
System Name	Assure DOC
Model Number	CWD0700BCCN30    ** 25% DPM reduction**

**IV. Flame Arrestor**

Manufacturer	Protectoseal
Manufacturer Address	225 W. Foster Avenue, Bensenville, IL 60106
System Name	End-of-Line Circular Plate Flame Arrestor
Model Number	674
MESG	0.025"

ATTACHMENT 1

**Diesel Test Form**

Equipment: Personnel Carrier Model PC732

Test Location: Rohmac

90 Second Test: Treated  Untreated  Test # 1

Test Date: 3-14-2011

Recorded By: \_\_\_\_\_

Time (sec)	O2 %	CO ppm	CO2 %	NOX ppm	NO2 ppm	NO ppm
0	<u>9.4</u>	<u>351</u>	<u>8.5%</u>	<u>509</u>	<u>39</u>	<u>470</u>
30	<u>7.8</u>	<u>265</u>	<u>9.7</u>	<u>520</u>	<u>32</u>	<u>488</u>
60	<u>7.7</u>	<u>249</u>	<u>9.8</u>	<u>522</u>	<u>27</u>	<u>495</u>
90	<u>7.7</u>	<u>240</u>	<u>9.8</u>	<u>523</u>	<u>25</u>	<u>498</u>
	<u>7.7</u>	<u>237</u>	<u>9.8</u>	<u>522</u>	<u>23</u>	<u>499</u>

	Engine Oil Temp	Engine Coolant Temp	Transmission Temp	Exhaust Gas Temp
<u>Start</u>	_____	_____	_____	_____
<u>End</u>	_____	_____	_____	_____

