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# Pennsylvania Technical Advisory Committee
# On Diesel Powered Equipment

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

RE: Engine and emissions control package evaluation under Sections 403, 417 and 418 of the Act for a Deutz BF4L2011 (MSHA ID 07-ENA040004 Part 7) 78hp@2800rpm Engine with Rhomac DEC1202 emissions control system using an CleanAIR Permit Model FUA180W4CN - DPM filter and a CleanAIR Assure Model CWD0700BCCN oxidation catalyst in a Rhomac Diesel MineRover, Model PC740 diesel rubber tire personnel carrier.

Dear Mr. Sbaffoni:

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 March 30, 2010 Rhomac, Inc. submitted a request to the TAC and Bureau of Mine Safety (BMS) for approval for a Rhomac Model PC740 diesel rubber tire personal carrier using a Deutz BF4L2011 (MSHA ID 07-ENA040004 Part 7) 78hp@2800rpm Engine with Rhomac DEC1202 emissions control system using an CleanAIR Permit Model FUA180W4CN - DPM filter and a CleanAIR Assure Model CWD0700BCCN oxidation catalyst. The engine and emissions control package has not been previously approved under Section 403 of the Act.

On April 1, 2011 the Director of BMS requested the TAC to evaluate the Rhomac Model PC740 rubber tire personal carrier using a Deutz BF4L2011(MSHA ID 07-ENA040004 Part 7) 78hp@2800rpm Engine with Rhomac DEC1202 emissions control system using an CleanAIR

Permit Model FUA180W4CN - DPM filter and a CleanAIR Assure Model CWD0700BCCN oxidation catalyst 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:

- Deutz BF4L2011(MSHA ID 07-ENA040004 Part 7) 78hp@2800rpm Engine
- Rhomac DEC1202 emissions control system:
    - CleanAIR Permit Model FUA180W4CN - DPM filter (85% efficient)
    - CleanAIR Assure Model CWD0700BCCN oxidation catalyst
    - Protectoseal Model F674 flame arrestor

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 May 24, 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.

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. (Attachment 2)

Monitoring of the exhaust gas temperature produced a high exhaust gas temperature reading of 187° F, which is well below the 302° F allowed by Section 403 (b)(4) of the Act. The maximum surface temperature observed was 250° F on the exhaust manifold after conducting all the CO testing. A smoke dot test was conducted and the result was <1.

The after-treatment system is fitted with a CleanAIR Permit Model FUA180W4CN - DPM filter. The filter is rated by MSHA at an 85 % efficiency rating. The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of .0544 $mg/m^3$ of diesel particulate matter when diluted by 100% of the MSHA approval plate ventilation rate for this engine, which is well below the .12 $mg/m^3$ 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.

The TAC feels the need to address the unique design of the system used to cool the exhaust gas below 302 degrees F. This system utilizes an air mixing box where ambient air is drawn into the box with an electric fan to dilute and cool the exhaust gas below 302 degrees F at the outlet. Rhomac installed an additional temperature sensor in the mixing box to detect a fan malfunction if one should occur. Also the TAC feels that the intake fan may also draw dust into the mixing box, so a clean out program was agreed to by Rhomac.

**Recommendation**

Our recommendation is based upon the data supplied by Rhomac, the results of the tests conducted on May 24, 2011, as well as the data acquired and observations made during our investigation. The TAC has determined that the Deutz BF4L2011(MSHA ID 07-ENA040004 Part 7) 78hp@2800rpm Engine with Rhomac DEC1202 emissions control system using an CleanAIR Permit Model FUA180W4CN - DPM filter and a CleanAIR Assure Model CWD0700BCCN oxidation catalyst 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:

- There will be a clean out port installed in the mixing box to aid in cleanout.
- The mixing box will be cleaned out during each 100 hour maintenance or more often if necessary to avoid accumulations of dust or contaminants. This will be recorded on the 100 hour maintenance checklist.
- During pre-operational checks, prior to engine start up, the operator will make certain the inlet to the intake fan is free of obstructions, and feel for air movement at the exhaust of the mixing box while the intake fan is running to verify the fan is operating. These checks will be recorded on the pre-operational check list.

This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1) be strictly adhered to.

Should the Director receive 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 July 13, 2011 at which time permanent approval will be recommended.

Paul Borchick

Ron Bowersox

## General Specification Sheet

### I. Engine

| | | | |
|---|---|---|---|
| **Manufacturer** | **Deutz** | **High Idle (RPM)** | **3150** |
| **Manufacturer Address** | **3883 Steve Reynolds Blvd Norcross, GA 30093** | **Particulate Index (PI)** | **2500** |
| Engine Model No. | BF4L 2011 | Gaseous Ventilation Rate (CFM) | 6000 |
| Engine Serial No. | 10946179 | Raw DPM (gr/hr) | 5.7 |
| HP/RPM | 78 / 2800 | MSHA Part 7 Approval No. | 07-ENA0-0004 |
| Low Idle (RPM) | 900 | Type of Aspiration | Turbocharged |
| Max. Dirty Intake Air Restriction ($H^2O$) | 36 | Turbocharger Boost Pressure (psi) | 11.6 - 15.9 |
| Max. Allowed Backpressure $H^2O$ | 30 | Fuel Delivery System | Direct Injection |

### II. Particulate Filter

| | |
|---|---|
| **Manufacturer** | **CleanAir Systems** |
| Manufacturer Address | PO Box 23449, Santa Fe, NM 87502 |
| Model Number | FUA180W4CN |
| System Type | Ceramic non-catalyzed |
| Efficiency Rating | 85% |

### III. Catalyst

| | |
|---|---|
| Manufacturer | CleanAir Systems |
| Manufacturer Address | PO Box 23449, Santa Fe, NM 87502 |
| System Name | Assure DOC |
| Model Number | CWD0700BCCN |

### IV. Flame Arrestor

| | |
|---|---|
| Manufacturer | Protectoseal |
| Manufacturer Address | 225 Foster Ave., Bensenville, IL 60106-1690 |
| System Name | Series 670 End-of-Line Circular Plate Flame Arrestor |
| Model Number | F67-I |
| MESG | 0.025" |

ATTACHMENT 1

**Diesel Test Form**

**Equipment:** Rohmac Mine Rover PC 740

**Test Location:** Rohmac

**90 Second Test:** **Treated** ___ **Untreated** X

**Test Date:** 5-24-2011

**Recorded By:** Mike McCaffrey

| Time (sec) | O2 % | CO ppm | CO2 % | NOX ppm | NO2 ppm | SO2 ppm |
|---|---|---|---|---|---|---|
| 0 | 10 | 203 | 8.1 | 431 | 23 | ___ |
| 30 | 9.9 | 198 | 8.1 | 439 | 22 | ___ |
| 60 | 9.8 | 195 | 8.2 | 442 | 21 | ___ |
| 90 | 9.8 | 191 | 8.2 | 450 | 20 | ___ |

| | Engine Oil Temp | Engine Coolant Temp | Transmission Temp | Exhaust Gas Temp |
|---|---|---|---|---|
| Start | 200 | 200 | | 146 |
| End | 205 | 205 | | 163 |

ATTACHMENT 2-1

**Diesel Test Form**

**Equipment:** Rohmac Mine Rover PC740

**Test Location:** Rohmac

**90 Second Test:** **Treated** X **Untreated** ___

**Test Date:** 5-24-2011

**Recorded By:** Mike McCaffrey

| Time (sec) | O2 % | CO ppm | CO2 % | NOX ppm | NO2 ppm | SO2 ppm |
|---|---|---|---|---|---|---|
| 0 | 10 | 7 | 8.1 | 440 | 15 | |
| 30 | 10 | 7 | 8.1 | 441 | 16 | |
| 60 | 10 | 7 | 8.1 | 441 | 16 | |
| 90 | 10 | 7 | 8.1 | 441 | 16 | |

| | Engine Oil Temp | Engine Coolant Temp | Transmission Temp | Exhaust Gas Temp |
|---|---|---|---|---|
| Start | 200 | 200 | | 186 |
| End | 205 | 205 | | 186 |

ATTACHMENT 2-2