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

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October 1, 2008

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

RE: Rhomac Model FWC 1430 Rail Mounted Fire / Water Car with a Deutz F21 2011 30.2 HP engine with a Rhomac ENK 25-19175-7197 disposable DPM filter (Dry System) emission control system

Dear Mr. Sbaffoni:

Article II-A of the Pennsylvania Bituminous Coal Mine Act (the act) provides for the use of diesel-powered equipment in underground bituminous coal mines. Section 224-A of the act created a Technical Advisory Committee ("TAC") for the purpose of advising the Department regarding implementation of Article II-A.

**Background**

On July 21, 2008, Rhomac, Inc. submitted a request to the Bureau of Mine Safety for evaluation and approval pursuant to Article II-A of the Act for a Deutz F21 2011 30.2 HP engine with a Rhomac ENK 25-19175-7197 disposable DPM filter (Dry System) emission control system in a Rhomac Model FWC 1430 Rail Mounted Fire / Water Car. This fire / water car includes an engine exhaust dump port to be used only during a fire fighting emergency. Additionally, Rhomac requested an alternative test procedure for the five minute carbon monoxide (CO) tests required under Sections 217-A and 218-A of the act.

On July 22, 2008, the Director of BDMS requested the TAC to evaluate the diesel power package and to advise the Department regarding the TAC's recommendation as to whether the diesel power package meets the requirements of the act, and for the TAC's recommendation on Rhomac's request for an alternate test procedure for CO testing. The

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TAC file

Director also requested the TAC make recommendations for use of the exhaust dump port.

The diesel power package includes the following items:

- Deutz F21 2011 (D2011102) 30.2HP @ 2800RPM diesel engine (MSHA Certification No. 07-ENA040010 Part 7E)
- Emissions Control System
  - ENK disposable DPM Filter (Dry System) Part No. 25-19175-7197 (95% Efficient)
  - Clean Air Systems CFD0466BCCN175 Oxidation Catalyst
  - Enardo T-803/C-IL-C4C 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**

The TAC began its investigation on September 4, 2008 when the equipment became available and traveled to Rhomac along with BMS to evaluate the equipment. Exhaust emissions tests were conducted on the fire / water car. Test results for the 5 minute test for the treated side revealed a problem existed with the catalyst. CO readings obtained during this test after five minutes were over 100 ppm CO. Rhomac reevaluated the catalyst and determined that it needed to be changed to a different model to further reduce the CO emissions. The TAC decided to return to reevaluate the engine after the new catalyst was installed.

On September 12, 2008 the TAC and DEP returned to Rhomac to evaluate the fire/ water car after the new catalyst was installed. The new catalysts, which normally are permanently coated to maintain surface temperature below 302 degrees F, reused the old catalyst coating and had to have a patch material, recommended by the manufacturer, installed until the permanently coated catalysts are received in 8-12 weeks.

Due to the nature of this piece of equipment, it was not possible to induce a normal stall on the engine by setting the brakes and running the engine in high gear. The engine on the fire / water car ran a centrifugal water pump, so another method to lug the engine was needed. After discussions with Rhomac and DEP it was agreed that the pump discharge bypass valve should be fully opened to recirculate the water back into the tanker and allow the engine to be run at the desired RPMs (2000 RPMs) and provide maximum work from the pump. This would provide similar results to standard engine stall procedures.

Emissions testing of the engine and after-treatment system were performed, as well as exhaust gas and surface temperature monitoring. The results of that testing are included in Attachment 2.

The results of the emission tests showed the engine was performing within MSHA's approval specifications, and the new catalyst performed much better than the original model. The after-treatment system is fitted with an ENK disposable DPM Filter (Dry System). The filter is rated by MSHA at a 95 % efficiency rating, which meets the

requirements of Section 203-A (b) (1) of Article II-A. The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of .064 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 203-A (a)(1) Article II-A.

Monitoring of the exhaust gas temperature produced a high exhaust gas temperature reading of 99° F, which is well below the 302° F allowed by Section 203-A (b)(4) of Article II-A. The maximum surface temperature recorded during the 5 minute tests was 260° F, which is below the 302° F allowed.

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 203-A of Article II-A of the act without reducing or compromising the level of health or safety afforded by the act.

The need for the Alternate Test procedure was also evaluated by the TAC. Both the 5 minute and 90 second tests were conducted, showing similar results. However, because of the nature of this equipment, a fire / water car with a centrifugal water pump and the ability of the engine to run the pump at maximum load for extended periods of time, the TAC believes that there is no need for the alternate test procedure. There are no components that could be damaged by the 5 minute test procedure, and no other need was shown for the 90 second test.

Because of the nature of this piece of equipment, a combination fire / water car, and the possibility of limited usage, this piece of equipment presents unusual conditions for use. The TAC had some concerns over bypassing the emissions system with the exhaust dump port during non emergency operation for use as a water car. The exhaust dump for fire fighting emergencies is done by removing a 2 inch pipe plug that dumps the exhaust to the atmosphere before it enters the ENK Filter.

The following stipulations should be included in the TAC's recommendation.

- There should be a warning label attached near the exhaust dump port stating that the plug should only be removed if exhaust back pressure shut down occurs during emergency fire fighting.
- Operators of the fire / water car should be trained in the operation and pre-op checks, as well as when the exhaust dump port could be used to bypass the engine exhaust treatment system only in a fire fighting emergency.
- Pre-op checks should include inspecting the dump port for the lead seal in tact and recording the result in the pre-op check list. This should also be part of the 100 hour inspection and recorded in the inspection record.
- Training on the procedure to lug the engine during the baseline and 100 hour tests should be provided to the diesel mechanics for this piece of equipment. This would include bringing the engine up to normal operating temperature prior to testing, fully opening the water pump discharge line bypass valve to recirculate the water back into the tank, and running the engine at the preset maximum RPM's to obtain maximum work from the engine.

- The patch material used on the catalyst permanent coating should be visually inspected during each pre-op check until the new permanent coated catalysts are installed.
- The patched coated catalysts should be replaced with the permanently coated catalysts as soon as they are received, but no later than January 1, 2009.
- The DEP should be notified when the catalysts are changed to the permanently coated catalysts.

### **Recommendation**

Our recommendation is based upon the data supplied by Rhomac, the results of the tests conducted on September 12, 2008, as well as the data acquired and observations made during our investigation. The TAC has determined that the Deutz F21 2011 30.2 HP engine (MSHA Certification No. 07-ENA040010) with a Rhomac ENK 25-19175-7197 disposable DPM filter (Dry System) emission control system meets all requirements of Section 203-A of Article II-A of the Pennsylvania Bituminous Coal Mine Act. As such, we are recommending approval of the above described diesel power package, with all the stipulations as stated above. This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1) be strictly adhered to.

The alternate test procedure is NOT recommended for this fire / water car since the need for the test was not shown.

Should the Director receive a request for temporary approval to use this equipment prior to the next regular scheduled TAC meeting on October 8, 2008, the TAC will recommend temporary approval for the fire / water car until permanent approval is recommended in the October 8, 2008 meeting.

  
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Paul Borchick

  
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Ron Bowersox

# General Specification Sheet

## I. Engine

<b>Manufacturer</b>	<b>Deutz</b>	<b>High Idle (RPM)</b>	<b>2800</b>
<b>Manufacturer Address</b>	<b>3883 Steve Reynolds Blvd. Norcross, Ga. 30093</b>	<b>Particulate Index (PI)</b>	<b>2000 cfm</b>
<b>Model Number</b>	<b>F2l 2011 (D2011102)</b>	<b>Gaseous Ventilation Rate (CFM)</b>	<b>1500 cfm</b>
<b>Serial Number</b>	<b>TBD</b>	<b>Raw DPM (gr/hp)</b>	<b>3.26 g/hr</b>
<b>Horse Power</b>	<b>30.2@ 2800 rpm</b>	<b>MSHA 7E Approval Number</b>	<b>07-ENA040010</b>
<b>Max. dirty Intake Air Restriction (H<sup>2</sup>O)</b>	<b>18" wg</b>	<b>Type of Aspiration</b>	<b>Natural</b>
<b>Max. Allowed Backpressure H<sup>2</sup>O</b>	<b>19" wg</b>	<b>Fuel Delivery System</b>	<b>Mechanical Injection</b>
<b>Turbocharger Boost Pressure</b>	<b>N/A</b>	<b>Low Idle (RPM)</b>	<b>900</b>

ATTACHMENT 1

## II. Filter System

<b>Manufacturer</b>	<b>Rohmac, Inc</b>
<b>Manufacturer Address</b>	<b>1947 Wilson Corona St. Oakland Md.</b>
<b>Filter Model Number</b>	<b>ENK Part. No. 25-19175-7197</b>
<b>System Type</b>	<b>Cooled Exhaust Dry System (Paper Filter)</b>
<b>System Composition</b>	<b>ENK Part. No. 25-19175-7197</b>
<b>Efficiency Rating</b>	<b>95%</b>
<b>Type of Regeneration</b>	<b>Disposable (Paper)</b>

## III. Catalyst

<b>Manufacturer</b>	<b>CleanAir Systems Inc</b>
<b>Manufacturer Address</b>	<b>4379 Center Place Santa Fe, NM. 87507</b>
<b>Type</b>	<b>Platinum coated DOC</b>
<b>Model Number</b>	<b>CFD0466BCCN175</b>

<b>Flame arrestor:</b>	<b>Enardo T-803/C-IL-C4C</b>
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ROHMAC 5 MINUTE TEST DATE	DIESEL RAW 9/12/2008	FIRE-WATER TEST	CAR	FWC 1430 D	ENGINE: DEUTZ	F21 2011	30 HP @ 2800 RPM	ENGINE TEMP	ENGINE OIL TEMP	TRANSMISSION OIL TEMP	EXHAUST GAS TEMP
TIME	O2 %	CO ppm	NO ppm	NO2 ppm	NOX ppm	CO2 %					
0:00:00	10.6	287	400	79	479	7.6					
0:00:10	10.6	260	410	77	487	7.7					
0:00:20	10.5	238	420	74	494	7.7	START	190	190	N/A	92
0:00:30	10.4	228	425	72	497	7.8					
0:00:40	10.4	224	428	70	499	7.8	END	195	195	N/A	90
0:00:50	10.4	222	433	68	501	7.8					
0:01:00	10.4	220	436	67	503	7.8					
0:01:10	10.4	220	436	65	501	7.8					
0:01:20	10.4	219	440	63	503	7.8					
0:01:30	10.4	218	444	62	508	7.8					
0:01:40	10.4	218	445	61	506	7.8					
0:01:50	10.4	218	445	59	504	7.8					
0:02:00	10.4	217	447	58	505	7.8					
0:02:10	10.4	216	451	56	507	7.8					
0:02:20	10.3	216	456	55	511	7.8					
0:02:30	10.3	215	458	54	512	7.8					
0:02:40	10.3	216	460	53	513	7.8					
0:02:50	10.3	215	465	52	517	7.8					
0:03:00	10.3	214	468	51	519	7.8					
0:03:10	10.3	214	469	50	519	7.8					
0:03:20	10.3	214	467	50	517	7.8					
0:03:30	10.3	213	468	49	517	7.8					
0:03:40	10.3	213	469	48	517	7.8					
0:03:50	10.3	214	471	48	519	7.8					
0:04:00	10.3	214	470	47	517	7.8					
0:04:10	10.4	214	471	47	518	7.8					
0:04:20	10.3	214	474	46	520	7.8					
0:04:30	10.3	214	474	46	520	7.8					
0:04:40	10.3	213	473	45	518	7.8					
0:04:50	10.3	213	472	45	517	7.8					
0:05:00	10.3	213	476	44	520	7.8					
0:05:10	10.3	212	478	44	522	7.8					

ROHMAC 5 MINUTE CLEAN TEST TEST DATE	DIESEL CLEAN 9/12/2008	FIRE/WAT TEST	CAR	FWC 1430	ENGINE: DEUTZ	F21 2011	4P@2800 RPM	ENGINE TEMP	ENGINE OIL TEMP	TRANSMISSION OIL TEMP	EXHAUST GAS TEMP
TIME	O2 %	CO ppm	NO ppm	NO2 ppm	NOX ppm	CO2 %					
0:00:00	10.6	8	423	101	524	7.6					
0:00:10	10.6	8	429	101	530	7.6					
0:00:20	10.6	8	428	100	528	7.8					
0:00:30	10.6	9	428	98	527	7.6	START	190	190	N/A	85.6
0:00:40	10.6	9	429	98	527	7.6					
0:00:50	10.5	9	430	97	527	7.7	END	195	195	N/A	86.7
0:01:00	10.6	9	433	96	529	7.6					
0:01:10	10.5	9	433	96	529	7.7					
0:01:20	10.5	9	435	95	530	7.7					
0:01:30	10.5	9	436	94	530	7.7					
0:01:40	10.6	9	438	94	532	7.6					
0:01:50	10.6	9	437	94	531	7.6					
0:02:00	10.6	9	437	93	530	7.6					
0:02:10	10.6	9	434	93	527	7.6					
0:02:20	10.6	10	437	92	529	7.6					
0:02:30	10.6	10	438	92	530	7.6					
0:02:40	10.6	10	438	91	527	7.6					
0:02:50	10.6	10	437	91	528	7.6					
0:03:00	10.6	10	439	90	529	7.6					
0:03:10	10.6	10	438	90	528	7.8					
0:03:20	10.6	10	438	89	527	7.6					
0:03:30	10.6	10	439	89	528	7.6					
0:03:40	10.6	10	439	89	528	7.6					
0:03:50	10.6	10	441	89	530	7.6					
0:04:00	10.6	10	442	89	531	7.6					
0:04:10	10.6	10	442	89	531	7.6					
0:04:20	10.6	10	443	89	532	7.6					
0:04:30	10.6	10	445	89	534	7.6					
0:04:40	10.6	10	442	89	531	7.6					
0:04:50	10.6	10	441	89	530	7.6					
0:05:00	10.6	10	440	89	529	7.6					
0:05:10	10.6	10	440	89	529	7.6					

ROHMAC 90 SECOND TEST DATE	DIESEL CLEAN 9/12/2008	FIRE-WAT TEST	CAR	FWC 1430	ENGINE: DEUTZ	F21 2011	P @ 2800 RPM	ENGINE TEMP	ENGINE OIL TEMP	TRANSMISSION OIL TEMP	EXHAUST GAS TEMP
TIME	O2 %	CO ppm	NO ppm	NO2 ppm	NOX ppm	CO2 %					
0:00:00	10.8	12	369	146	515	7.5					
0:00:10	10.7	12	382	147	529	7.6					
0:00:20	10.7	12	394	142	536	7.6					
0:00:30	10.7	12	402	135	537	7.6	START	195	195	N/A	85
0:00:40	10.6	12	408	127	535	7.6					
0:00:50	10.6	12	413	121	534	7.6	END	195	195	N/A	85
0:01:00	10.6	11	410	116	532	7.6					
0:01:10	10.5	11	425	113	538	7.7					
0:01:20	10.6	11	425	110	535	7.6					
0:01:30	10.6	11	425	108	533	7.6					

ROHMAC 90 SECOND TEST DATE	DIESEL RAW 9/12/2008	FIRE-WAT TEST	CAR	FWC 1430	ENGINE: DEUTZ	F21 2011	4P@2800 RPM	ENGINE TEMP	ENGINE OIL TEMP	TRANSMISSION OIL TEMP	EXHAUST GAS TEMP
TIME	O2 %	CO ppm	NO ppm	NO2 ppm	NOX ppm	CO2 %					
0:00:00	10.3	213	485	38	523	7.8					
0:00:10	10.3	213	486	38	524	7.8					
0:00:20	10.3	213	487	38	525	7.8					
0:00:30	10.3	213	487	38	525	7.8	START	195	195	N/A	91
0:00:40	10.3	213	488	37	525	7.8					
0:00:50	10.3	213	489	37	526	7.8	END	195	195	N/A	92
0:01:00	10.3	212	485	37	522	7.8					
0:01:10	10.3	212	487	36	523	7.8					
0:01:20	10.3	212	488	36	522	7.8					
0:01:30	10.3	211	487	36	523	7.8					
0:01:40	10.3	212	486	36	522	7.8					
0:01:50	10.3	213	488	36	524	7.8					

ATTACHMENT 2