



April 20, 2017

Mr. Mark Crable
Royal Hydraulics Service & Mfg. Inc.
2 Washington St.
Cokeburg, PA 15324

Re: **ITEM:** Diesel Engine Package
MODEL: Royal Bulk Duster 185; **VOLTAGE:** 12VDC; **HP:** 78
APSID NO: 932184
APPROVAL NO. BOTE-DEES 24-17

Dear Mr. Crable:

We have completed our evaluation of the equipment noted above, and approve its use in all bituminous underground coal mines of Pennsylvania. The equipment meets the legal requirements of the *Pennsylvania Bituminous Coal Mine Act*.

Pennsylvania approval number **BOTE-DEES 24-17** has been assigned to the equipment. This number must appear conspicuously on the outside of the subject equipment on a **2" x 4"** rust-resistant metal plate, or any other Bureau acceptable material. The approval plate should read "Commonwealth of Pennsylvania" and "Approval No. **BOTE-DEES 24-17**." The plate and lettering should be resistant to removal by abrasion.

If you want to make changes or alterations on this equipment, a written request outlining the proposed changes, together with any related prints or drawings, must be submitted to this office for approval. If you have any questions, please contact Jeff Kerch, Program Manager at 724.404.3140.

Sincerely,

A handwritten signature in black ink that reads "Colvin C. Carson". The signature is written in a cursive, flowing style.

Colvin C. Carson
Director



February 22, 2017

Mr. Mike Caprini
Diesel Maintenance Supervisor
CNX Coal Resources, LP
1000 CONSOL Energy Drive
Canonsburg, PA 15317-6506

Re: Temporary Approval – Royal Hydraulics Diesel Powered Rockduster (#001) utilizing a Deutz BF4L2011 diesel engine (MSHA ID 07-ENA-40004-1-Part 7) 78 HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved Airflow MinNoCat Model SM10SS12SOP4P4 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP4P4 Diesel Oxidation Catalyst, a Royal Hydraulic air to air Heat Exchanger and a flame arrestor.

Dear Mr. Caprini:

This is in response to your email dated February 17, 2017, requesting temporary approval for use of the equipment listed above at the Bailey Mine. The next Technical Advisory Committee on Diesel-Powered Equipment (TAC) meeting is scheduled for April 12, 2017, at which time the final approval for this equipment will be recommended by the TAC.

The TAC and the DEP traveled to the Bailey Mine in Wind Ridge, PA, to evaluate this equipment. Subsequently, the TAC issued a recommendation dated February 16, 2017, to the Bureau recommending the approval of the equipment.

Temporary approval is granted for this equipment to be used prior to the regular scheduled TAC meeting that is to be held on April 12, 2017.

Sincerely,

/s/
Colvin C. Carson
Director

Enclosures

cc: Ron Bowersox, TAC
Paul Borchick, TAC

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

Paul Borchick

(412) 736-9105 (Cell)
(724) 485-4414 (Office)
Email: paulborcluck@consolenergy.com

Ron Bowersox

(724) 726-8987 (Home)
(724) 479-8692 (Office)
Email: umwarbowersox@yahoo.com

February 16, 2017

Colvin Carson, Director
Bureau of Mine Safety
Department of Environmental Protection
131 Broadview Road
New Stanton, PA 15672

RE: Royal Hydraulics Diesel Powered Rockduster utilizing a Deutz BF4L2011 diesel engine (MSHA ID 07-ENA-40004-1 - Part 7) 78HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP4P4 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP4P4 Diesel Oxidation Catalyst, a Royal Hydraulic air to air Heat Exchanger, and a flame arrestor.

Dear Mr. Carson:

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 14, 2016 Royal Hydraulics submitted a request for evaluation of their Royal Hydraulics Diesel Powered Rockduster utilizing a Deutz BF4L2011 diesel engine (MSHA ID 07-ENA-40004-1 - Part 7) 78HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP4P4 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP4P4 Diesel Oxidation Catalyst, a Royal Hydraulic air to air Heat Exchanger and a flame arrestor. This system utilized a Ceramic (Corderite) DPM Filter.

The TAC conducted an investigation to provide a recommendation to the Director as to whether the referenced equipment meets requirements of Section 403 of the Act. The engine and emissions control package has not been previously approved under Section 403 of the Act.

The diesel power package includes the following items:

- Deutz BF4L2011 diesel engine (MSHA ID 07-ENA-40004-1 - Part 7) 78HP @ 2800 RPM
- AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP4P4 DPM Filter (95% Efficient)
- AirFlow MinNoCat Model SM10SS12SOP4P4 Diesel Oxidation Catalyst
- Royal Hydraulic air to air Heat Exchanger and a 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 February 1, 2017 the TAC and DEP traveled to Royal Hydraulics in Cokeburg, PA to inspect the equipment when it became available. The TAC evaluated the engine and exhaust emissions package. A follow-up DEP inspection was conducted on February 15, 2017.

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 CO measured on the clean side of the emissions control system was 0 ppm when measured during the stall test. The raw CO measured was 150 ppm during the stall test. The design of the equipment was such that the engine operated in a steady state operation without a varying load, so it was not possible to induce a stall test as normally done on mobile equipment. The engine was brought up to operating temperature and the CO₂ was monitored to insure the engine was loaded properly for a repeatable and comparative stall test.

Monitoring of the exhaust gas temperature produced a high exhaust gas temperature reading of 177° F at the exit of exhaust pipe, which is well below the 302° F allowed by Section 403 (b)(4) of the Act. The maximum surface temperature observed was 156° F on the exhaust manifold, which is below the 302° F allowed by Section 403 (b)(3) of the Act. The maximum engine oil temperature observed was 230° F. A smoke dot test was conducted on the exhaust system at the exit of the exhaust pipe and the result yielded a number less than 1 on the smoke dot scale.

The after-treatment system is fitted with a MSHA Approved AirFlow MinNoCat Model SM10SS12SOP4P4 DPM Filter (95% Efficient). The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of .018 mg/m³ of diesel particulate matter when diluted by 100% of the MSHA approval plate ventilation rate for this engine, which is well below the 0.12 mg/m³ requirement of Section 403 (a)(1) the Act. (Attachment 2)

Since the AirFlow MinNoCat Model SM10SS12SOP4P4 DPM Filter is a passively regenerated system, the results of the smoke dot test will determine when the components will be replaced. Any smoke dot test above a 3 will require the components to be replaced or regenerated (cleaned). Smoke dot tests will be conducted as part of every 100 hour maintenance inspection or more often if necessary.

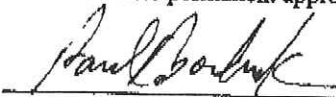
In addition to the testing that was conducted, our investigation and our observations confirmed that the diesel power package is capable of meeting all the requirements of Section 403 of the Act.

Recommendation

Our recommendation is based upon the data supplied by Royal Hydraulics, the results of the tests conducted on February 1, 2017 and February 15, 2017, as well as the data acquired and observations made by the TAC and DEP during our investigation. The Royal Hydraulics Diesel Powered Rockduster utilizing a Deutz BF4L2011 diesel engine (MSHA ID 07-ENA-40004-1 - Part 7) 78HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP4P4 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP4P4 Diesel Oxidation Catalyst, a Royal Hydraulic air to air Heat Exchanger and a flame arrestor 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.

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

If the Director should receive a request to use this equipment prior to the next scheduled TAC meeting, the TAC will recommend temporary approval until the next regular scheduled TAC meeting on April 12, 2017 at which time permanent approval will be recommended.


Paul Borchick


Ron Bowersox

General Specification Sheet

I. Engine

Manufacturer	Deutz	High Idle (RPM)	3100
Manufacturer Address	3883 Steve Reynolds Blvd. Norcross, Ga. 30093	Particulate Index (PI)	3000
		Backpressure	30" wg
Model Number	BF4L2011	Gaseous Ventilation Rate (CFM)	6000 cfm
Serial Number	TBD	Raw DPM (gr/hp)	3.7 g/hr
Horse Power	78@2800RPM	MSHA 7E Approval Number	07-ENA040004-1
Max. dirty Intake Air Restriction (H₂O)	26" wg	Type of Aspiration	Turbocharged
Max. Allowed Backpressure H₂O	20" wg	Fuel Delivery System	Mechanical Injection
Turbocharger Boost Pressure	16 PSI	Low Idle (RPM)	800

II. Filter System

Manufacturer	Airflow Catalyst Systems inc.
Manufacturer Address	2640 State Route 21 Wayland, NY, 14572
Model Number	MinNoCat SM10SS12SOP4P4
System Type	Passive
System Composition	Ceramic (Corderite)
Efficiency Rating	95%
Type of Regeneration	Passive

III. Catalyst

Manufacturer	Airflow Catalyst Systems inc.
Manufacturer Address	2640 State Route 21 Wayland, NY, 14572
System Name	MinNoCat
Model Number	SM10SS12SOP4P4

DPM Calculation Sheet

Engine Model	Deutz BF4L 2011
MSHA Number	07-ENA040004-1
Ventilation Rate	6,000 cfm
Filter Type	Ceramic (Corderite)
Filter Efficiency	95%

Convert DPM From (grams/hr) to (mg/min)

$$(3.7\text{g/hr.}) \times (1\text{hr./}60\text{min}) \times (1000\text{mg/g}) = 61.66\text{mg/min}$$

Convert Ventilation Rate from cfm to m³/min.

$$(6000\text{ ft}^3/\text{min}) \times (.028315\text{ m}^3/\text{ft}^3) = 169.89\text{ m}^3/\text{min.}$$

Divide DPM (mg/min) by Ventilation Rate (m³/min.)

$$(61.66\text{mg/min}) \div (169.89\text{ m}^3/\text{min.}) = .36\text{ mg/m}^3.$$

Solve for Ambient DPM Level AT 95% Filter Efficiency

$$.36\text{ m}^3/\text{min} \times (100-95\% \text{ Filter Efficiency}) = .018\text{ mg/ m}^3$$