



pennsylvania
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

August 15, 2017

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

Re: **ITEM:** Diesel Engine Package
MODEL: Deutz D-2011-50; **VOLTAGE:** 12 VDC; **HP:** n/a
APSID NO: 938752
APPROVAL NO. BOTE-DEES 55-17

Dear Mr. Crable:

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.

On April 20, 2017 Royal Hydraulics Service & Mfg. Inc. submitted a request to the Technical Advisory Committee ("TAC") and Bureau of Mine Safety to have this piece of equipment inspected. On June 6, 2017, The DEP Bureau Director requested the TAC to review and comment on this request.

The TAC and DEP traveled to Royal Hydraulics on June 6, 2017 to conduct their investigation and issued their report recommending temporary approval on June 8, 2017. Temporary approval was granted on June 14, 2017. Permanent approval was recommended at the TAC meeting on July 12, 2017.

Based on the recommendation of the TAC and the equipment approval staff, your request for approval is granted. Pennsylvania approval number **BOTE DEES 55-17** has been assigned to the equipment. This number must appear conspicuously on the outside of the subject equipment, and on the engine, 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 55-17.**" The plate and lettering should be resistant to removal by abrasion.

If you have any questions on this request, please contact me at either cocarson.pa.gov or at 724.404.3154.

Sincerely,

Colvin C. Carson
Director

cc: Ron Bowersox, TAC
Paul Borchick, TAC

June 14, 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 Utility Car – Model RDUC utilizing a Deutz D 2011L03i diesel engine (MSHA ID 07-ENA-040011-Part 7) 48 HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved Airflow MinNoCat Model SM10SS12SOP3P7 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP3P7 Diesel Oxidation Catalyst, a Royal Exhaust Cooler Model REC50, and an Airflow Model SFA7P400 Flame Arrestor.

Dear Mr. Caprini:

This is in response to your email dated June 14, 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 July 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, on June 6, 2017 to evaluate this equipment. Subsequently, the TAC issued a recommendation dated June 8, 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 July 12, 2017.

Sincerely,



Colvin C. Carson
Director

Enclosures

cc: Ron Bowersox, TAC
Paul Borchick, TAC

Pennsylvania Technical Advisory Committee On Diesel Powered Equipment

Paul Borchick

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Ron Bowersox

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(724) 479-8692 (Office)
Email: unwarbowersox@yahoo.com

June 8, 2017

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

RE: Royal Hydraulics Diesel Powered Utility Car - Model RDUC utilizing a Deutz D 2011L03i diesel engine (MSHA ID 07-ENA-040011- Part 7) 48HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP3P7 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP3P7 Diesel Oxidation Catalyst, a Royal Exhaust Cooler Model REC50, and an Airflow Model SFA7P400 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 April 20, 2017 Royal Hydraulics submitted a request for evaluation of their Royal Hydraulics Diesel Powered Utility Car - Model RDUC utilizing a Deutz D 2011L03i diesel engine (MSHA ID 07-ENA-040011- Part 7) 48HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP3P7 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP3P7 Diesel Oxidation Catalyst, a Royal Exhaust Cooler Model REC50, and an Airflow Model SFA7P400 Flame Arrestor.

On June 6, 2017 the TAC and DEP traveled to Royal Hydraulics in Cokeburg, PA to conduct 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 D 2011L03i diesel engine (MSHA ID 07-ENA-040011- Part 7) 48HP @ 2800 RPM
- AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP3P7 DPM Filter (95% Efficient)
- AirFlow MinNoCat Model SM10SS12SOP3P7 Diesel Oxidation Catalyst
- Royal Exhaust Cooler Model REC50
- Airflow Model SFA7P400 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 June 6, 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.

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 treated side of the emissions control system was 6 ppm when measured during the stall test. The raw CO measured was 214 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 the stall was achieved by utilizing a switch/valve that induced a hydraulic load on the engine through hydraulic displacement in the valve. The procedure for inducing a stall load is attached as Attachment 3. 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 100° F at the exit of exhaust tube, which is well below the 302° F allowed by Section 403 (b)(4) of the Act. The maximum surface temperature observed was 240° F on the coated exhaust manifold, which is below the 302° F allowed by Section 403 (b)(3) of the Act. A smoke dot test was conducted on the exhaust system at the exit of the exhaust tube and the result yielded a number around 1 on the smoke dot scale.

The after-treatment system is fitted with a MSHA Approved AirFlow MinNoCat Model SM10SS12SOP3P7 DPM Filter (95% Efficient). The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of .071 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 SM10SS12SOP3P7 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 June 6, 2017, as well as the data acquired and observations made by the TAC and DEP during our investigation. The Royal Hydraulics Diesel Powered Utility Car - Model RDUC utilizing a Deutz D 2011L03i diesel engine (MSHA ID 07-ENA-040011 - Part 7) 48HP @ 2800 RPM with an AirFlow Management System emissions control system using an MSHA Approved AirFlow MinNoCat Model SM10SS12SOP3P7 DPM Filter (95% Efficient) and AirFlow MinNoCat Model SM10SS12SOP3P7 Diesel Oxidation Catalyst, a Royal Exhaust Cooler Model REC50, and an Airflow Model SFA7P400 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. A Smoke Dot test will be conducted as part of every 100 hour maintenance inspection or more often if necessary.

If the Director should receive a request to use this equipment prior to the next scheduled TAC meeting, the TAC recommends temporary approval until the next regular scheduled TAC meeting on July 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	26" wg
Model Number	D2011 Lo3i	Gaseous Ventilation Rate (CFM)	2000 cfm
Serial Number	11835603	Raw DPM (gr/hp)	4.89 g/hr
Horse Power	48HP@2800RPM	MSHA 7E Approval Number	07-ENA-040011
Max. dirty Intake Air Restriction (H²O)	22" wg	Type of Aspiration	Natural
Max. Allowed Clean intake Restriction (H²O)	10" wg	Fuel Delivery System	Mechanical Injection
Turbocharger Boost Pressure	N/A	Low Idle (RPM)	900

ATTACHMENT 1/1

II. Filter System

Manufacturer	Airflow Catalyst Systems inc.
Manufacturer Address	2640 State Route 21 Wayland, NY. 14572
Model Number	MinNoCat SM10SS12SOP3P7
System Type	Passive, Ceramic
System Composition	Silicone Carbide (SIC)
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	SM10SS12SOP3P7

IV. Exhaust Cooler

Manufacturer	Royal Hydraulics Manufacturing and Service
Manufacturer Address	2 Washington St Cokeburg, PA. 15324
System Name	Royal Exhaust Cooler (REC)
Model No.	REC 50

DPM Calculation Sheet

Engine Model	Deutz D2011 Lo3i
MSHA Number	07-ENA0400011
Ventilation Rate	2000 cfm
Filter Type	Silicone Carbide (SIC)
Filter Efficiency	95%

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

$$(4.89\text{g/hr.}) \div (1\text{hr./}60\text{min}) \times (1000\text{mg/g}) = 81.5\text{mg/min}$$

Convert Ventilation Rate from cfm to m³/min.

$$(2000\text{ ft}^3/\text{min}) \times (.028315\text{ m}^3/\text{ft}^3) = 56.63\text{ m}^3/\text{min.}$$

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

$$(81.5\text{mg/min}) \div (56.63\text{ m}^3/\text{min.}) = 1.43\text{ mg/m}^3.$$

Solve for Ambient DPM Level AT 95% Filter Efficiency

$$1.43\text{ m}^3/\text{min} \times (100-95\% \text{ Filter Efficiency}) = .071\text{ mg/ m}^3$$

Emission Test Procedure

- Perform pre-op checklist
- Start engine as described in operations
- Allow engine to warm to operating temperature (If necessary)
- Turn on the hydraulic enable switch on main panel
- Turn on emission test switch on the left side of the main panel
- Perform necessary testing
- After testing is complete turn off test switch and the hydraulic enable
- Allow the engine to idle briefly then turn off engine