

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

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January 7, 2008

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

RE: Recommendation for FINAL approval of a Brookville Equipment Corporation Brookville Model 20T193D 20 Ton Locomotive with a Cummins QSB 6.7 193HP diesel engine and a M30 DST Filter (M267 Total System).

Dear Mr. Scaffoni:

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 10, 2007, Brookville Equipment Corporation (Brookville) submitted a request to the Bureau of Mine Safety for evaluation and approval pursuant to Article II-A of the act of a Cummins QSB 6.7 193HP diesel engine (MSHA Approval No. 07-ENA060010 Part 7) with a M267 DST Management System (M30 Filter) in a Brookville Model 20T193D 20 Ton Locomotive. Additionally, Brookville 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 17, 2007, the Director of the Bureau of Mine Safety 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 Brookville's request for an alternate test procedure for CO testing. The TAC began their investigation on August 30, 2007 when the equipment became available.

The diesel power package includes the following:

- Cummins QSB 6.7 193HP diesel engine (MSHA Approval No. 07-ENA060010 Part 7)
- Emissions Control System – M267 DST Management System\* which includes:
  - DST M295-225-02 Oxidation Catalyst \*
  - DST M90-301-01 heat exchanger \*
  - Fleet Guard M30 DPM filter (MSHA efficiency rating 96 %)

\* **Note:** Denotes manufacturers change in model numbers (equipment is the same).

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

In a letter to the Director of the Bureau of Mine Safety on September 6, 2007 the TAC recommended **preliminary approval** of the Brookville Model 20T193D 20 Ton Locomotive with a Cummins QSB 6.7 193HP diesel engine and a M30 DST Filter (M267 Total System). The preliminary approval recommendation contained several stipulations that were needed to comply with the 302 degree F maximum surface temperature requirement in Section 203-A-(b)(3). During this time a temporary blanket wrap was installed to cover the turbo and arm assembly to keep the surface temperature below 302 degrees F. These stipulations were brought about by the need to send a turbo away to apply a permanent insulated coating to the turbo and arm assembly which would take at least 12 weeks. The TAC and DEP would be notified when the permanent coated parts were delivered and installed to evaluate the surface temperature before recommending final approval

### **Investigation**

In an email from Eli Schmader from Brookville Equipment to the TAC on December 20, 2007 he discussed the problems that the coating application company had with applying the permanent coating to the turbo and arm assembly. These included the inability to service the turbo when needed due to the coating, the limitation of the ability of the turbo arm to operate the waste gate valve effectively, and the lack of success in applying the coating due to the configuration of the parts. Brookville requested a meeting with the TAC and DEP to discuss options and inspect the locomotive.

On January 4, 2008 the TAC and DEP traveled to the Emerald Mine shop to inspect the locomotive along with representatives from Brookville Equipment and Emerald Mine. When the blanket wrap was removed from the turbo and arm assembly there were 2 loose nuts discovered on the turbo and 1 loose bolt on the turbo arm bracket. These were not visible with the blanket wrap installed. Also there was evidence of heating under the blanket wrap. These conditions caused the TAC to decide that the full blanket wrap was not an acceptable solution to the surface temperature dilemma.

The Engine was lugged and measurements with a heat gun and 306 degree heat crayon showed that the temperature on top of the turbo arm bracket was still above 302 degrees at around 420 degrees F. This was the only significant area that had a surface temperature above 302 degrees. Brookville proposed to fabricate a "Fire Blanket" material wrap to install on the turbo arm bracket which would still allow movement of

the arm to operate the waste gate valve. A temporary wrap was constructed from the "Fire Wrap" material previously used on the blanket wrap. After it was installed on the turbo arm bracket, the engine was again started and lugged until the transmission oil temperature shut down was activated at 240 degrees. The maximum surface temperature on the turbo arm bracket as measured with the 306 degree heat stick and heat gun was found to be 130 degrees F. There was no surface temperature on any turbo significant parts above 302 degrees F. This satisfied the requirement under Section 203-A-(b)(3).

Brookville obtained measurements and agreed to manufacture a more permanent wrap made out of the same "Fire Wrap" material to replace the temporary wrap installed that day. A drawing of the permanent wrap is provided in Attachment 2.

### Recommendation

Our recommendation is based upon the data supplied by Brookville, the results of the tests conducted on August 30, 2007, September 6, 2007, and January 4, 2008 as well as the data acquired and observations made during our investigation.

The TAC has determined that the Cummins QSB 6.7 193HP diesel engine (MSHA Approval No. 07-ENA060010 Part 7) with a M267 DST Total Management System (M30 Filter) meets all requirements of Section 203-A of Article II-A of the Pennsylvania Bituminous Coal Mine Act.

As such the TAC recommends FINAL Approval to the Director with the following stipulations.

- The temporary "Fire Wrap" material wrap on the turbo arm bracket should be replaced with the permanent "Fire Wrap" part (as shown in Attachment 2) **on the first 100 hour maintenance performed after the part is delivered.** The installation of the permanent wrap shall be noted in the 100 hour maintenance record when it is installed. The BMS should be notified when this permanent part is installed.
- This recommendation is provided with the understanding that the General Specification Sheet (Attachment 1-Rev) be strictly adhered to. As stated in the September 6, 2007 recommendation to the director, we are also recommending FINAL approval of an alternate test procedure for Sections 217-A and 218-A of the act (Attachment 3).

  
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Paul Borchick

  
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Ron Bowersox

**BROOKVILLE EQUIPMENT CORP.**  
**MODEL 20T193D**  
**20-Ton Diesel Locomotive**  
General Specifications of the Diesel-Powered Equipment Package

Engine Manufacturer		CUMMINS		
Engine Model		QSB6.7		
Horsepower		193 HP		
Rated Speed		2200 rpm		
Manufacturer's Maximum Recommended Exhaust Back-pressure (InH <sub>2</sub> O)		41 Inches Water Gauge		
Maximum Exhaust Out Temperature		865 deg F		
<b>MSHA Engine Approval</b>		<b>MSHA Part 7</b>		
MSHA Certification No.		07-ENA060010 (Part 7)		
Rated Speed		2200 RPM		
Rated Horsepower		193 HP		
Exhaust GAS Flow (SCFM)		1307 CFM @ 865 deg F @ 2200 rpm		
ISO 8178-1 Average DPM (gr/hr)		16.05 gr/hr (267.5 mg/min)		
Average Ambient DPM Level (mg/m <sup>3</sup> )		0.044 mg/m <sup>3</sup>		
MSHA Ventilation Rate (CFM)		8,500 CFM (Part 7)		CFM (Part 32)
Pa. State Ventilation Rate (CFM)				
<b>Emissions Control System</b>			<b>DST Management System</b>	
Fuel Injection Pump	Make  P/N	Bosch – Belt driven rotary fuel lift pump		
Oxidation Catalyst	Make  P/N	Dry Systems Technologies M295-225-02		
Heat Exchanger	Make  P/N	Dry Systems Technologies M90-301-01		
DPM Filter	Make	Dry Systems Technologies	Model	M267 (Total System)
	P/N	M30-411-01R	Filter Size	M30 (Filter) 16 x 12 in Outer 10 x 6 in Inner
	Air Rating (CFM)	2100 CFM	Filter Length	20 in
	Surface Area (in <sup>2</sup> )	42,231 in <sup>2</sup>		
	Efficiency			96%
	Recommended Exhaust Back-Pressure			Less than 41 Inches Water Gauge

*ATTACHMENT 1-REV*



**ALTERNATIVE STALL TEST PROCEDURE FOR PA STATE ACT 182, ARTICLE II-A  
DIESEL-POWERED EQUIPMENT**

**ALTERNATE PROCEDURE, Section 217-A:** (an alternative to items 8 through 14)

1. Place the equipment into an intake entry. Make sure no personnel are in front of or behind the equipment during test.
2. Set the brakes and chock the wheels.
3. Start the diesel engine and allow it to warm up to operating temperature.
4. Install the carbon monoxide CO sampling devices into the untreated exhaust gas port provided.
5. Allow CO sampling device to stabilize.
6. Put the transmission in high gear.
7. With brake still applied, put the engine at full throttle to induce converter stall for 90 seconds. Stop test immediately if any controls or indicators are not in their operating range, or if equipment moves while at stall.
8. Record three CO readings at 60, 75, and 90-second intervals during converter stall.
9. Return engine to low idle and put transmission in neutral. Allow the torque converter temperature to stabilize.
10. Take an average of the three readings.
11. Comply with record-keeping requirements pursuant to Section 214-A.

**ALTERNATIVE PROCEDURE, Section 218-A:** (an alternative to items 10-14)

1. Place the equipment into an intake entry. Make sure no personnel are in front of or behind the equipment during test.
2. Set the brakes and chock the wheels.
3. Start the diesel engine and allow it to warm up to operating temperature.
4. Install the carbon monoxide CO sampling device into the untreated exhaust gas port provided.
5. Allow CO sampling device to stabilize.
6. Put the transmission in high gear.
7. With brakes still applied, put the engine at full throttle to induce converter stall for 90 seconds. Stop test immediately if any controls or indicators are not in their operating range, or if equipment moves while at stall.
8. Record three CO readings at 60, 75, and 90-second intervals during converter stall.
9. Return engine to low idle and put transmission in neutral. Allow the torque converter temperature to stabilize.
10. Take an average of the three CO readings.
11. Install the carbon monoxide CO sampling device into the treated exhaust gas port provided.
12. Repeat steps (5) thru (10).
13. If CO reading for untreated exhaust gas is greater than twice the baseline established under 217-A(b), or if the CO reading for treated exhaust is greater than 100 ppm, the equipment has failed and must be serviced and retested before it is returned to regular service; and
14. Comply with record-keeping requirements pursuant to Section 214-A.