

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

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Antoon

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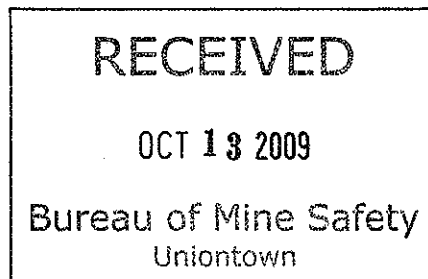
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TacFile

October 5, 2009

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



RE: Brookville Equipment Corporation Brookville Model 20T215D 20 Ton Locomotive modification to utilize the Cummins QSB6.7 – 215HP engine utilizing an Emissions Control System DST Management System using a M30 Filter.

Dear Mr. Scaffoni:

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 June 1, 2009 Brookville Equipment Corp. submitted a request to the Bureau of Mine Safety (BMS) for approval for a Brookville Model 20T215D 20 Ton Locomotive modification to utilize the Cummins QSB6.7 – 215HP engine utilizing an Emissions Control System DST Management System with a M30 Filter. The *Cummins QSB6.7 – 190HP* engine and emissions control package has been previously approved under Section 403 of the Act and assigned a BOTE-DEES NO 7-08. Only the horsepower rating will be changed in this modification request.

On June 16, 2009 the Director of BMS requested the TAC to evaluate the Brookville Equipment Corporation Brookville Model 20T215D 20 Ton Locomotive modification to utilize the Cummins QSB6.7 – 215HP engine utilizing an Emissions Control System DST Management System using a M30 Filter 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:

- Cummins QSB6.7 – 215HP @ 2500 RPM diesel engine (MSHA Certification No. 07-ENA060010)(Part 7)
- Emissions Control System DST Management System
 - Syncat Corporation M30-221-02 oxidation catalyst
 - Fleet Guard M30 DPM filter (MSHA efficiency rating 96.9 %)
 - Paas Technologies M90-301-01 heat exchanger

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 October 1, 2009 the TAC and DEP traveled to Brookville Equipment Corporation 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 181° F, which is well below the 302° F allowed by Section 403 (b)(4) of the Act. It is our belief that the heat exchanger will maintain the exhaust gas temperature well below the required 302° F. The maximum surface temperature observed was 230° F on the exhaust manifold after conducting all the CO testing. However, there was a concern on a surface temperature measurement above 302° F on the waste gate arm. Brookville agreed to cover the arm with a heat wrap designed to fit the arm without restricting its movement to address this concern.

The after-treatment system is fitted with a Fleet Guard M30 DPM filter. The filter is rated by MSHA at a 96.9 % efficiency rating. The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of .033 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 .12 mg/m³ requirement of Section 403 (a)(1) the Act. (Attachment 3)

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.

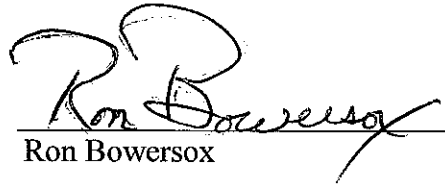
Recommendation

Our recommendation is based upon the data supplied by Brookville Equipment Corporation, the results of the tests conducted on October 1, 2009, as well as the data acquired and observations made during our investigation. The TAC has determined that the Cummins QSB6.7 – 215HP engine utilizing an Emissions Control System DST Management System with a M30 Filter 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.

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 October 14, 2009 at which time permanent approval will be recommended.



Paul Borchick



Ron Bowersox

BROOKVILLE EQUIPMENT CORP.
MODEL 20T215D
20-Ton Diesel Locomotive
General Specifications of the Diesel-Powered Equipment Package

Engine Manufacturer		CUMMINS	
Engine Model		QSB6.7	
Horsepower		215 HP	
Rated Speed		2500 RPM	
Torque Converter		Clark / Hurth	
Converter Model Number		C270	
Part Number		15-20500	
Manufacturer's Maximum Recommended Exhaust Back-pressure (Inwg)		40.7886 Inches Water Gauge	
Maximum Exhaust Out Temperature		285 deg F	
MSHA Engine Approval		MSHA Part 7	
MSHA Certification No.		07-ENA060010 (Part 7)	
Rated Speed		2500 RPM	
Rated Horsepower		215 HP	
Exhaust GAS Flow (SCFM)		1,526 CFM @ 465 deg C	
ISO 8178-1 Average DPM (gr/hr)		15.524 gr/hr	
Average Ambient DPM Level (mg/m3)		0.033 mg/m3	
MSHA Ventilation Rate (CFM)		8500 CFM (Part 7)	CFM (Part 32)
Pa. State Ventilation Rate (CFM)			
Emissions Control System		DST Management System	
Fuel Injection Pump	Make	Bosch	
	P/N	VP44	
Engine Control Module (ECM)	Make	Cummins	
	P/N	3990517 (New) 3990517RX (Reconditioned)	
ECM software	Make	Cummins (Password Protected)	
	P/N	XJ91413.99	
Joystick	Make	Brookville Equipment	
	P/N	12-1011	

Attachment 1

Oxidation Catalyst	Make	Syncat Corp.		
	P/N	M30-221-02		
Heat Exchanger	Make	Paas Tech.		
	P/N	M90-301-01		
DPM Filter	Make	Fleet Guard	Model	M 30
	P/N	M 30	Filter Size	16 x 12 in Outer
	Air Rating (CFM)	2100 CFM	Filter Length	20 in
	Surface Area (in3)	42,231 in3		
	Efficiency			
	Recommended Exhaust Back-Pressure			> 40 Inches Water Gauge

ATTACHMENT 1

Brookville 20721SD Locomotive
October 1, 2009

TimeFrom: OZ[%]	CO(ppm)	NO(ppm)	NO2(ppm)	NOx(ppm)	SO2(ppm)	CxHy[%]	CO2[%]	T Gas(f)	T Amb(f)	ETA	Lambda	Comments:
#2009-10-01 11:32:29#												
0:00:01	21	1	0	0	0	0	0	54	56.8	0	0	
0:00:11	21	1	0	0	0	0	0	57	56.8	0	0	
0:00:22	21	1	0	0	0	0	0	60	56.8	0	0	
0:00:31	21	1	0	0	0	0	0	57	56.8	0	0	
0:00:41	21	1	0	0	0	0	0	58	56.8	0	0	
0:00:52	21	1	0	0	0	0	0	58	56.8	0	0	
0:01:01	21	1	0	0	0	0	0	56	56.9	0	0	
0:01:11	21	1	0	0	0	0	0	56	57	0	0	
0:01:22	21	1	0	0	0	0	0	59	57	0	0	
0:01:31	21	1	0	0	0	0	0	60	57.1	0	0	
0:01:41	21	1	0	0	0	0	0	60	57.2	0	0	
0:01:52	21	1	0	0	0	0	0	57	57.2	0	0	
0:02:01	21	1	0	0	0	0	0	58	57.3	0	0	
0:02:11	21	1	0	0	0	0	0	58	57.3	0	0	
0:02:21	21	0	0	0	0	0	0	57	57.4	0	0	
0:02:31	21	0	0	0	0	0	0	58	57.4	0	0	
0:02:41	21	0	0	0	0	0	0	61	57.5	0	0	
0:02:51	19	1	0	0	0	0	1.5	66	57.6	0	10.5	
0:03:01	18.3	4	0	0	0	0	2	67	57.6	0	7.78	
0:03:12	18.2	5	0	0	0	0	2.1	68	57.6	0	7.5	
0:03:21	18.2	6	0	0	0	0	2.1	68	57.6	0	7.5	
0:03:31	18.2	7	0	0	0	0	2.1	68	57.6	0	7.5	
0:03:42	18.2	9	0	0	0	0	2.1	67	57.7	0	7.5	
0:03:51	18.2	11	0	0	0	0	2.1	67	57.8	0	7.5	
0:04:01	18.2	12	0	0	0	0	2.1	67	57.9	0	7.5	
0:04:11	18.2	14	0	0	0	0	2.1	68	57.8	0	7.5	
0:04:21	12.7	92	372	9	381	0	6.1	68	57.9	0	2.53	7.5 90 sec treated start
0:04:31	11.3	122	392	10	402	0	7.1	68	58	0	2.16	
0:04:41	11.2	77	414	11	425	0	7.2	68	58	0	2.14	
0:04:51	11.1	53	424	13	437	0	7.3	68	58.3	0	2.12	
0:05:02	11.1	43	425	15	440	0	7.3	68	58.4	0	2.12	
0:05:11	11	39	426	16	442	0	7.3	69	58.3	0	2.1	
0:05:21	11	37	437	18	455	0	7.3	69	58.2	0	2.1	
0:05:32	11	37	443	20	463	0	7.3	69	58.2	0	2.1	
0:05:41	11	36	443	21	464	0	7.3	69	58.3	0	2.1	
0:05:51	11	36	451	22	473	0	7.3	69	58.7	0	2.1	
0:06:02	10.9	36	457	22	479	0	7.4	69	58.6	0	2.08	
0:06:11	10.9	36	457	22	479	0	7.4	69	58.6	0	2.08	
0:06:21	15	35	457	23	480	0	7.4	69	58.6	0	2.08	
0:06:31	16.3	34	457	22	479	0	7.4	69	58.6	0	2.08	
0:06:42	16.4	32	441	10	449	0	3.4	69	59.5	0	4.47	
0:06:51	16.4	32	439	7	445	0	3.4	70	59.4	0	4.57	
0:07:01	16.4	32	437	6	445	0	3.4	70	59.3	0	4.57	
0:07:11	16.6	30	437	4	441	0	3.4	70	59.4	0	4.57	
0:07:21	18.2	25	51	3	54	0	3.2	70	59.4	0	4.77	
0:07:31	20.6	16	13	2	15	0	0.3	66	59.5	0	52.5	

ATTACHMENT 2

Brookville 201715D Locomotive
October 1, 2009

#2009-10-01 11:32:29#

Time(h:m:s)	O2(%)	CO(ppm)	NO(ppm)	NO2(ppm)	NOx(ppm)	SO2(ppm)	CxHy(%)	CO2(%)	T Gas(F)	T Amb(F)	ETA	Lambda	Comments:
0:07:52	20.8	4	6	1	7	0	0	0	61	59.5	0	0	
0:08:02	20.9	3	5	1	6	0	0	0	64	59.6	0	0	
0:08:12	20.9	2	5	1	6	0	0	0	66	59.5	0	0	
0:08:21	20.9	1	4	1	5	0	0	0	67	59.5	0	0	
0:08:31	20.9	1	3	1	4	0	0	0	70	59.4	0	0	
0:08:41	20.9	1	2	1	3	0	0	0	67	59.4	0	0	
0:08:51	20.9	1	2	1	3	0	0	0	71	59.3	0	0	
0:09:01	20.9	1	1	1	2	0	0	0	72	59.2	0	0	
0:09:11	20.9	1	1	1	2	0	0	0	70	59.2	0	0	
0:09:22	20.9	1	1	0	1	0	0	0	69	59.2	0	0	
0:09:32	20.9	1	1	0	1	0	0	0	71	59.2	0	0	
0:09:42	20.9	1	0	0	0	0	0	0	72	59.2	0	0	
0:09:52	20.9	1	0	0	0	0	0	0	71	59.1	0	0	
0:10:01	20.9	1	0	0	0	0	0	0	68	59.1	0	0	
0:10:11	20.9	1	0	0	0	0	0	0	58	59.1	0	0	
0:10:21	20.9	1	0	0	0	0	0	0	71	59.1	0	0	
0:10:31	20.5	1	39	1	40	0	0	0.4	71	59.2	0	42	
0:10:42	17.1	94	117	6	123	0	0	2.9	72	59.2	0	5.38	
0:10:51	16.9	160	126	9	135	0	0	3	73	59.5	0	5.12	
0:11:01	16.8	178	128	11	139	0	0	3.1	73	59.6	0	5	
0:11:12	16.8	185	129	12	141	0	0	3.1	73	59.7	0	5	
0:11:21	16.8	188	130	13	143	0	0	3.1	73	59.7	0	5	5 90 sec raw start
0:11:31	16.8	189	172	14	186	0	0	3.1	73	59.6	0	5	
0:11:41	12.1	357	321	24	345	0	0	6.5	73	59.7	0	2.36	
0:11:51	11.2	342	347	33	380	0	0	7.2	73	59.8	0	2.14	
0:12:01	11.1	228	385	36	421	0	0	7.3	73	59.8	0	2.12	
0:12:12	11	175	404	37	441	0	0	7.3	73	59.9	0	2.1	
0:12:21	11	155	414	37	451	0	0	7.3	73	60	0	2.1	
0:12:31	10.9	143	423	37	460	0	0	7.4	73	60.1	0	2.08	
0:12:42	10.9	138	439	37	476	0	0	7.4	73	60.2	0	2.08	
0:12:51	10.9	133	444	36	480	0	0	7.4	74	60.2	0	2.08	
0:13:01	10.9	130	445	36	481	0	0	7.4	74	60.4	0	2.08	
0:13:12	10.7	128	443	35	478	0	0	7.6	74	60.3	0	2.04	
0:13:21	10.6	129	461	34	495	0	0	7.6	75	60.2	0	2.02	
0:13:31	16.6	173	88	22	110	0	0	3.2	71	60	99	4.77 end	
0:13:41	20.5	102	25	12	37	0	0	0.4	72	60.1	0	42	
0:13:52	20.8	40	16	8	24	0	0	0	67	60.2	0	0	

ATTACHMENT 2

**CALCULATION: AMBIENT DPM EMISSION LEVEL FOR
CUMMINS QSB6.7 ENGINE
BASED ON MSHA TEST DATA**

RE: To meet the requirements of the Pennsylvania ACT 182 Diesel Powered Equipment Law, Section 203-A, a) 1), entitled Exhaust Emission Control

To comply with section 203-A-a-1, the tailpipe emissions for the equipment cannot exceed $0.12\text{mg}/\text{m}^3$, when diluted by 100% of the MSHA approval plate ventilation rate for that diesel engine.

For Brookville Mining Equipment Corporation's request for BOTE approval for our Model 20T215D locomotive, the Cummins Diesel Engine will be used at 215 hp @ 2500 rpm.

MSHA specifications for the Cummins QSB6.7:
Approval No: 07-ENA060010
Ventilation Req't: 8,500 cfm

The MSHA approved ventilation rate for the Cummins QSB6.7 is as follows:

Ventilation Rate: 8,500 cfm under MSHA approval 07-ENA060010

Using the equation:

$$\text{Ambient DPM Level} = \text{DPMAVG} = \text{PT}/\text{Vvent}$$

Where:

VVENT = Quantity of ventilation air req'd per Cummins emission certification document FR91597

$$\begin{aligned} &= \frac{8,500 \text{ ft}^3}{\text{min}} \times \frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \\ &= 240.73 \text{ m}^3/\text{min} \end{aligned}$$

DPM volume extracted from Cummins /MSHA Research Test Data:

Mode Number	DPM Corrected (g/hr)	Weighting Factor	DPM X Weighting Factor
1	32.14	.15	4.82
2	28.39	.15	4.26
3	20.09	.15	3.01
4	13.08	.10	1.31
5	6.72	.10	0.67
6	6.11	.10	0.61
7	7.63	.10	0.76
8	0.49	.15	0.07

Average DPM level over 8178-1 8 mode Test = 15.524 g/hr

Based on Southwest Research Institute testing filter efficiency was found to be 96.9%.
Therefore the DPM would be $15.524 \times 0.031 = 0.481$ g/hr

PT = Average DPM level

$$= \frac{0.481\text{gr}}{1\text{hour}} \times \frac{1000\text{mg}}{1\text{gr}} \times \frac{1\text{hour}}{60\text{min}}$$

$$= 8.02 \text{ mg/min}$$

SOLVE FOR AMBIENT DPM LEVEL:

$$\text{DPMAMB} = \frac{(8.02 \text{ mg/min})}{240.73 \text{ m}^3/\text{min}}$$

$$= 0.033 \text{ mg.m}^3$$

CONCLUSION: To comply with section 203-A-a-1, the tailpipe emissions for the equipment cannot exceed 0.12 mg/m^3 , when diluted by 100% of the MSHA approval plate ventilation rate for that diesel engine. $0.033 \text{ mg/m}^3 < 0.12 \text{ mg/m}^3$, therefore, this engine package meets the requirement.