pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF MINE SAFETY

87 (A)

August 15, 2012

Mr. Eli Schmader
Brookville Equipment Corporation
175 Evans Street
P O Box 130
Brookville, PA 15825

RE: Brookville Model 25T174D locomotive utilizing a Deutz BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM with a DST emissions control system using an DST Model M30 DPM filter (96% efficient) and a DST Model M249-210-02 diesel oxidation catalyst.

Dear Mr. Schmader:

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 July 17, 2012 Brookville Equipment Corp. submitted a request for evaluation of their Model 25T174D locomotive utilizing a Deutz BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM with a DST emissions control system using an DST Model M30 DPM filter (96% efficient) and a DST Model M249-210-02 diesel oxidation catalyst. Enclosed is the TAC's report on their findings for this piece of equipment. All of their findings must be adhered to in regards to use of this equipment.

The TAC recommends temporary approval of this equipment in their report of August 3, 2012. You requested a temporary approval to use this equipment in a letter submitted to the Bureau on August 14, 2012. Permanent approval will be recommended at the next scheduled TAC meeting on October 10, 2012.

If you have any questions on this request, please contact Joseph Sbaffoni at jsbaffoni@pa.gov or at 724-439-7469.

Sincerely,

Joseph A. Sbaffoni
Director
Bureau of Mine Safety

cc: Bowersox
Borchick

Enclosure(s)

JAS/cd

bcc: Brower
Antoon
Gaida
Timothy Young (web)
Dunn/TAC file

\\epmsuns03\bms$\AdvisoryCommittee\TAC - DIESEL LETTERS BY YEAR\2012\L_TAC_Brookville Model 25T174D Locomotive.doc

87b

Pennsylvania Technical Advisory Committee
On Diesel Powered Equipment

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

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

August 3, 2012

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

RE: Brookville Model 25T174D locomotive utilizing a Deutz BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM with a DST emissions control system using an DST Model M30 DPM filter (96% efficient) and a DST Model M249-210-02 diesel oxidation catalyst.

Dear Mr. Sbaffoni:

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 July 17, 2012 Brookville Equipment Corp. submitted a request for evaluation of their Model 25T174D locomotive utilizing a Deutz BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM with a DST emissions control system using an DST Model M30 DPM filter (96% efficient) and a DST Model M249-210-02 diesel oxidation catalyst.

On July 25, 2012 the Director of BMS requested the TAC to evaluate the Brookville Model 25T174D locomotive engine and emission package 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 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 BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM
- DST model M249 emissions control system:
  - DST Model M30 DPM filter (96% efficient)
  - DST Model M249-210-02 diesel oxidation catalyst
  - DST Model M150-301-21 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 July 13, 2012 the TAC and DEP traveled to Brookville Equipment Corp. in Brookville, 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.

Monitoring of the exhaust gas temperature produced a high exhaust gas temperature reading of 194° F, which is well below the 302° F allowed by Section 403 (b)(4) of the Act. The maximum surface temperature observed 190° F on the exhaust manifold, which is below the 302° F allowed by Section 403 (b)(3) of the Act. The maximum engine coolant temperature observed was 200° F, and the maximum engine oil temperature observed was 165° F.

The after-treatment system is fitted with a DST Model M30 DPM filter. The filter is rated by MSHA at a 96 % efficiency rating. The engine and filter extrapolations show that the diesel power package will result in an average ambient concentration of .0161 mg/m^3 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/m^3 requirement of Section 403 (a)(1) the Act. (Attachment 2)

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 July 13, 2012, as well as the data acquired and observations made during our investigation. The power package utilizing a Deutz BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM with a DST emissions control system using an DST Model M30 DPM filter (96% efficient) and a DST Model M249-210-02 diesel oxidation catalyst 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 October 10, 2012 at which time permanent approval will be recommended.

Paul Borchick

Ron Bowersox

BROOKVILLE EQUIPMENT CORP.
MODEL 25T174D
Diesel 25 Ton Locomotive
General Specifications of the Diesel-Powered Equipment Package

Engine Manufacturer			Deutz	
Engine Model			BF4M1013FC	
Horsepower			173 HP	
Rated Speed			2300 RPM	
Manufacturer's Recommended Exhaust Back-pressure (InH2O)			30 Inches Water Gauge	
Maximum Exhaust Out Temperature			950 deg F	
MSHA Engine Approval			**MSHA Part 7**	
MSHA Certification No.			07-ENA040007	
Rated Speed			2300 RPM	
Rated Horsepower			173 HP	
Exhaust GAS Flow (SCFM)			996 CFM	
ISO 8178-1 Average DPM (gr/hr)			6.2 gr/hr	
Average Ambient DPM Level (mg/m3)			0.021 mg/m3	
MSHA Ventilation Rate (CFM)			7,000 CFM (Part 7)	CFM (Part 32)
Pa. State Ventilation Rate (CFM)				
Emissions Control System			**DST Management System**	
Fuel Injection Pump	Make P/N	Bosch – Belt driven rotary fuel lift pump		
Oxidation Catalyst	Make P/N	Dry Systems Technologies M249-210-02		
Heat Exchanger	Make P/N	Dry Systems Technologies M115-301-21		
DPM Filter	Make P/N Air Rating (CFM) Surface Area (in2)	Dry Systems Technologies M30-411-01R 2100 CFM 42,231 in2	Model Filter Size Filter Length	M249 (Total System) M30 (Filter) 16 x 12 in Outer 10 x 6 in Inner 20 in
	Efficiency Recommended Exhaust Back-Pressure			98% Less than 30 inches Water Gauge

ATTACHMENT 1

CALCULATION: AMBIENT DPM EMISSION LEVEL FOR DEUTZ BF6M1013FC ENGINE

BASED ON SOUTHWEST RESEARCH INSTITUTE 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 0.12mg/m^3, when diluted by 100% of the MSHA approval plate ventilation rate for that diesel engine.

For Brookville Equipment Corporation's request for BOTE approval for our Model 25T174D Locomotive, the Deutz Diesel Engine will be used at 173 hp @ 2300 rpm.

MSHA specifications for the Deutz BF4M2012:
Approval No: 07-ENA040007-1
Ventilation Req't: 7,000 cfm

The MSHA approved ventilation rate for the Deutz BF6M1013FC is as follows:

Ventilation Rate: 7,000 cfm under MSHA approval 07-ENA040007-1

Using the equation:

$$\text{Ambient DPM Level} = DPM_{AVG} = PT/V_{vent}$$

Where:

V_{VENT} = Quantity of ventilation air req'd per MSHA 24/D88

$$= \frac{7{,}000\ ft^3}{min} \times \frac{1 m^3}{35.31\ ft^3}$$

$$= 198.24\ m^3/min$$

ATTACHMENT 2/1

Average DPM level over 8178-1 8 mode Test = 6.20 g/hr

Based on Southwest Research Institute testing filter efficiency was found to be 96.9%. Therefore the DPM would be 6.20 x .031 = 0.192 g/hr

PT = Average DPM level

$$= \frac{0.192\ gr}{1hour} \times \frac{1000mg}{1gr} \times \frac{1hour}{60min}$$

= 3.20 mg/min

SOLVE FOR AMBIENT DPM LEVEL:

$$DPM_{AMB} = \frac{(3.20\ mg/min)}{198.24\ m^3/min}$$

$$= 0.0161\ mg.m^3$$

CONCLUSION: To comply with section 203-A-a-1, the tailpipe emissions for the equipment cannot exceed 0.12mg/m^3, when diluted by 100% of the MSHA approval plate ventilation rate for that diesel engine. 0.0161 mg/m^3 < 0.12 mg/m^3, therefore, this engine package meets the requirement.

ATTACHMENT 2/2

Pennsylvania Technical Advisory Committee
On Diesel Powered Equipment

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

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

August 3, 2012

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

RE: Brookville Model 25T174D locomotive utilizing a Deutz BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM with a DST emissions control system using an DST Model M30 DPM filter (96% efficient) and a DST Model M249-210-02 diesel oxidation catalyst.

Dear Mr. Sbaffoni:

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 July 17, 2012 Brookville Equipment Corp. submitted a request for evaluation of their Model 25T174D locomotive utilizing a Deutz BF4M1013FC diesel engine (MSHA ID 07-ENA040007 - Part 7) 173HP @ 2300 RPM with a DST emissions control system using an DST Model M30 DPM filter (96% efficient) and a DST Model M249-210-02 diesel oxidation catalyst.

On July 25, 2012 the Director of BMS requested the TAC to evaluate the Brookville Model 25T174D locomotive engine and emission package 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 engine and emissions control package has not been previously approved under Section 403 of the Act.

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 October 10, 2012 at which time permanent approval will be recommended.

Paul Borchick

Ron Bowersox

CALCULATION: AMBIENT DPM EMISSION LEVEL FOR DEUTZ BF6M1013FC ENGINE

BASED ON SOUTHWEST RESEARCH INSTITUTE 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 0.12mg/m^3, when diluted by 100% of the MSHA approval plate ventilation rate for that diesel engine.

For Brookville Equipment Corporation's request for BOTE approval for our Model 25T174D Locomotive, the Deutz Diesel Engine will be used at 173 hp @ 2300 rpm.

MSHA specifications for the Deutz BF4M2012:
Approval No: 07-ENA040007-1
Ventilation Req't: 7,000 cfm

The MSHA approved ventilation rate for the Deutz BF6M1013FC is as follows:

Ventilation Rate: 7,000 cfm under MSHA approval 07-ENA040007-1

Using the equation:

$$\text{Ambient DPM Level} = DPM_{AVG} = PT/V_{vent}$$

Where:

V_{VENT} = Quantity of ventilation air req'd per MSHA 24/D88

$$= \frac{7{,}000\ ft^3}{min} \times \frac{1 m^3}{35.31\ ft^3}$$

$$= 198.24\ m^3/min$$

ATTACHMENT 2/1

BROOKVILLE

MANUFACTURERS SINCE 1918

April 27, 2012

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

Dear Mr. Sbaffoni,

This letter is in regards to an application for approval, APS # 786210, to utilize a different catalyst in the Dry Systems Technology model M249 (total system) Emissions Control System. This package is utilized in the Brookville Model 25T174D diesel 25 ton locomotive, unit approval number BOTE-D 140-06. The catalyst will be changed from a DST M113-210-02 to a DST model M249-210-02.

We are requesting a temporary approval of this system until the next Technical Adviser Committee meeting in October.

Please call or email me with any questions or concerns.

Sincerely,

Eli Schmader
Electrical Engineer
Brookville Equipment Corporation
(814) 849-6052
eschmader@brookvillecorp.com

BROOKVILLE

MANUFACTURERS SINCE 1918

July 17, 2012

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

Dear Mr. Sbaffoni,

This letter is a request for modification to the approval of a Brookville Equipment Corporation, model number 25T174D, 25 ton diesel locomotive for operation in the State of Pennsylvania. This equipment is currently approved under BOTE-D 140-06. The proposed modification is utilizing a DST Catalyst M249-210-02 in place of the DST Catalyst M113-210-02. Nothing on this unit will change except the Catalyst.

Also enclosed is the TAC committee engine package approval request.

Please review this application and if you have any questions, call me at 814-849-6052 or e-mail me at eschmader@brookvillecorp.com.

Sincerely,

Eli Schmader
Engineer
Brookville Equipment Corporation
(814) 849-6052
eschmader@brookvillecorp.com

BROOKVILLE

MANUFACTURERS SINCE 1918

July 17, 2012

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

Dear Mr. Sbaffoni,

Subject: Brookville Equipment Corporation
Request to the Technical Advisory Committee

Dear Sir:

Brookville Equipment Corporation is applying for a modification approval of the Brookville Model 25T174D Locomotive with the Pennsylvania Department of Environmental Protection, Bureau of Mine Safety and is requesting that the Technical Advisory Committee review the enclosed information and make a determination that it meets the requirements of Section 203A(1), (2), and (3).

Please review this request, and if you have any questions, please call me at 814-849-6052 or e-mail me at eschmader@brookvillecorp.com.

Best regards,

Eli Schmader
Engineer
Brookville Equipment Corporation
(814) 849-6052
eschmader@brookvillecorp.com

En: (4) General Specifications
(4) Engine Specifications
(4) Engine Performance Curves
(4) Torque Curves
(4) Eight Mode Test
(4) Calculations

APPROVAL APPLICATION FOR DIESEL-POWERED EQUIPMENT

Applicant/Manufacturer: Brookville Equipment Corporation		
Contact Person: Eli Schmader	Signature:	
Address: 175 Evans Street		
PO Box 130		
Brookville	PA	15825
City	State	Zip Code
Phone: (814) 849-2000	Fax: (814) 849-2010	E-Mail: eschmader@brookvillecorp.com
Equipment Description: 25 Ton Locomotive BOTE-D 140-06		
Model Number: 25T174D	Serial Number: 9313	
Minimum PA Air Quantity (CFM), if previously approved:	Max. Utilized Horsepower Rating at RPM: 173 HP @ 2300 RPM	
MSHA Part 7 Approval Number: 07-ENA040007	MSHA Part 7 Ventilation Rate and Particulate Index: 7000 CFM	
Drawing Number:		
Modification: No X Yes	Original PA Approval Number: BOTE-D 140-06	
Comments: Changing the DST catalyst from an M113-210-02 to a M249-210-02. Unit aproved as BOTE-D 140-06. Nothing on the unit is to changed excepted the catalyst.		
BDMS Use Only		
Submittal Date:	Comments:	
Addendums:		

BROOKVILLE EQUIPMENT CORP.
MODEL 25T174D
Diesel 25 Ton Locomotive
General Specifications of the Diesel-Powered Equipment Package

Engine Manufacturer			Deutz	
Engine Model			BF4M1013FC	
Horsepower			173 HP	
Rated Speed			2300 RPM	
Manufacturer's Recommended Exhaust Back-pressure (InH2O)			30 Inches Water Gauge	
Maximum Exhaust Out Temperature			950 deg F	
MSHA Engine Approval			**MSHA Part 7**	
MSHA Certification No.			07-ENA040007	
Rated Speed			2300 RPM	
Rated Horsepower			173 HP	
Exhaust GAS Flow (SCFM)			996 CFM	
ISO 8178-1 Average DPM (gr/hr)			6.2 gr/hr	
Average Ambient DPM Level (mg/m3)			0.021 mg/m3	
MSHA Ventilation Rate (CFM)			7,000 CFM (Part 7)	CFM (Part 32)
Pa. State Ventilation Rate (CFM)				
Emissions Control System			**DST Management System**	
Fuel Injection Pump	Make P/N	Bosch – Belt driven rotary fuel lift pump		
Oxidation Catalyst	Make P/N	Dry Systems Technologies M249-210-02		
Heat Exchanger	Make P/N	Dry Systems Technologies M115-301-21		
DPM Filter	Make P/N Air Rating (CFM) Surface Area (in2)	Dry Systems Technologies M30-411-01R 2100 CFM 42,231 in2	Model Filter Size Filter Length	M249 (Total System) M30 (Filter) 16 x 12 in Outer 10 x 6 in Inner 20 in
	Efficiency Recommended Exhaust Back-Pressure			96% Less than 30 inches Water Gauge

BF6M1013E Specification data

General

Cylinders	6	
Cylinder arrangement	In line	
Bore	108 mm	4.3 in.
Stroke	130 mm	5.1 in.
Cylinder Displacement	1.191 liter	72.7 $in.^3$
Total displacement	7.146 liter	436.0 $in.^3$
Compression ratio	17.5:1	
Combustion system	Direct injection	
Aspiration	Turbocharged	

Fuel system

Lift pump suction head, max	1.5 m	59.1 in.
Lift pump flow @max rpm	600 l/h	2.6 GPM
Max restriction in fuel supply line	200 mbar	80 in. H_2O
Max restriction in fuel return line	500 mbar	200 in. H_2O
Max restriction in fuel pre-filter	200 mbar	80 in. H_2O
Fuel filter type	Replaceable cartridge	
Fuel consumption @ max rating	39.5 l/h	10.4 GPH
Fuel consumption @ peak torque	25.6 l/h	6.8 GPH

Combustion air system

Combustion air flow @ max rating	967.0 m^3/h	569.1 CFM
Max allowable clean restriction	50 mbar	20 in. H_2O
Max allowable dirty restriction	60 mbar	24 in. H_2O

Exhaust system

Exhaust gas flow @ max rating	2069.0 m^3/h	1217.6 CFM
Exhaust temp @ max rating	530 °C	986 °F
Max allowable back pressure	75 mbar	30 in. H_2O

Cooling system

Type	External radiator	
Coolant flow rate @ max rpm	188.0 l/min	49.7 GPM
Coolant heat rejection % of gross power	57%	
Max coolant temp @ engine outlet	110 °C	230 °F
Max coolant operating pressure	1.5 bar	21.8 psi
Coolant volume in engine	7.4 liter	7.8 qt.
Coolant volume, cooler & pipes, min	0.06 l/kW, 0.05 qt/hp	
Expansion tank capacity, min	30% of circ.coolant volume	

Lubrication system

Lubrication type	Forced feed lubrication	
Oil flow at max rpm	74.5 l/min	19.7 GPM
Oil pump relief valve setting	10 bar	145 psi
Max oil temperature in oil sump	130 °C	266 °F
Filter volume	1.5 liter	1.6 qt.
Oil change interval	500 hours	

Electrical

Starter motor	12V, 3.1 kW	24V, 4.8kW
Max battery CCA	1300A	750A
Voltage drop, battery (+), max	1.0V	

Physical data

Length	1146 mm	45.1 in.	
Width	622 mm	24.5 in.	
Height	852 mm	33.5 in.	
Weight, dry	570 kg	1254 lb.	
Max bending @ housing:	800 Nm	589.6 lb-ft	
Max force @ flywheel:			
Axial:	N	0 lb.	
Radial:	N	0 lb.	

Performance data

Peak torque	702 Nm	517.4 lb-ft	
@ rpm	1400		
low idle speed	650 rpm		

Gross power

Engine RPM	1500	1800	2000	2100	2200	2300
kW, intermittent	111.0	123.0	129.0	134.0	139.0	145.0
Hp, intermittent	151.0	167.3	175.4	182.2	189.0	197.2
kW , continuous	100.0	111.0	116.0	121.0	125.0	130.0
Hp, continuous	136.0	151.0	157.8	164.6	170.0	176.8

Fuel consumption

g/kWhr	210.0	212.0	216.5	220.0	225.0	229.0
lb/hphr	0.344	0.348	0.355	0.361	0.369	0.376

Combustion air

m^3/h	460.0	575.0	652.0	690.0	729.0	967.0
CFM	270.7	338.4	383.7	406.1	429.0	569.1

Exhaust gas

m^3/h	1242.0	1552.0	1759.0	1862.0	1966.0	2069.0
CFM	730.9	913.4	1035.2	1095.8	1157.0	1217.6

Coolant

l/min	124.0	148.0	164.0	172.0	180.0	188.0
GPM	32.8	39.1	43.3	45.4	47.6	49.7

Heat rejection to coolant

kW	63.3	70.1	73.5	76.4	79.2	82.7
BTU/min	3600.5	3987.3	4180.7	4345.6	4504.9	4704.0

Noise, dB(A)

Avg. @ 1 meter	89.5	91.5	92.5			94.0

Certifications

U. S. EPA Non-road
California ARB Non-road
MSHA
European COM 1
Euro-1 on Highway

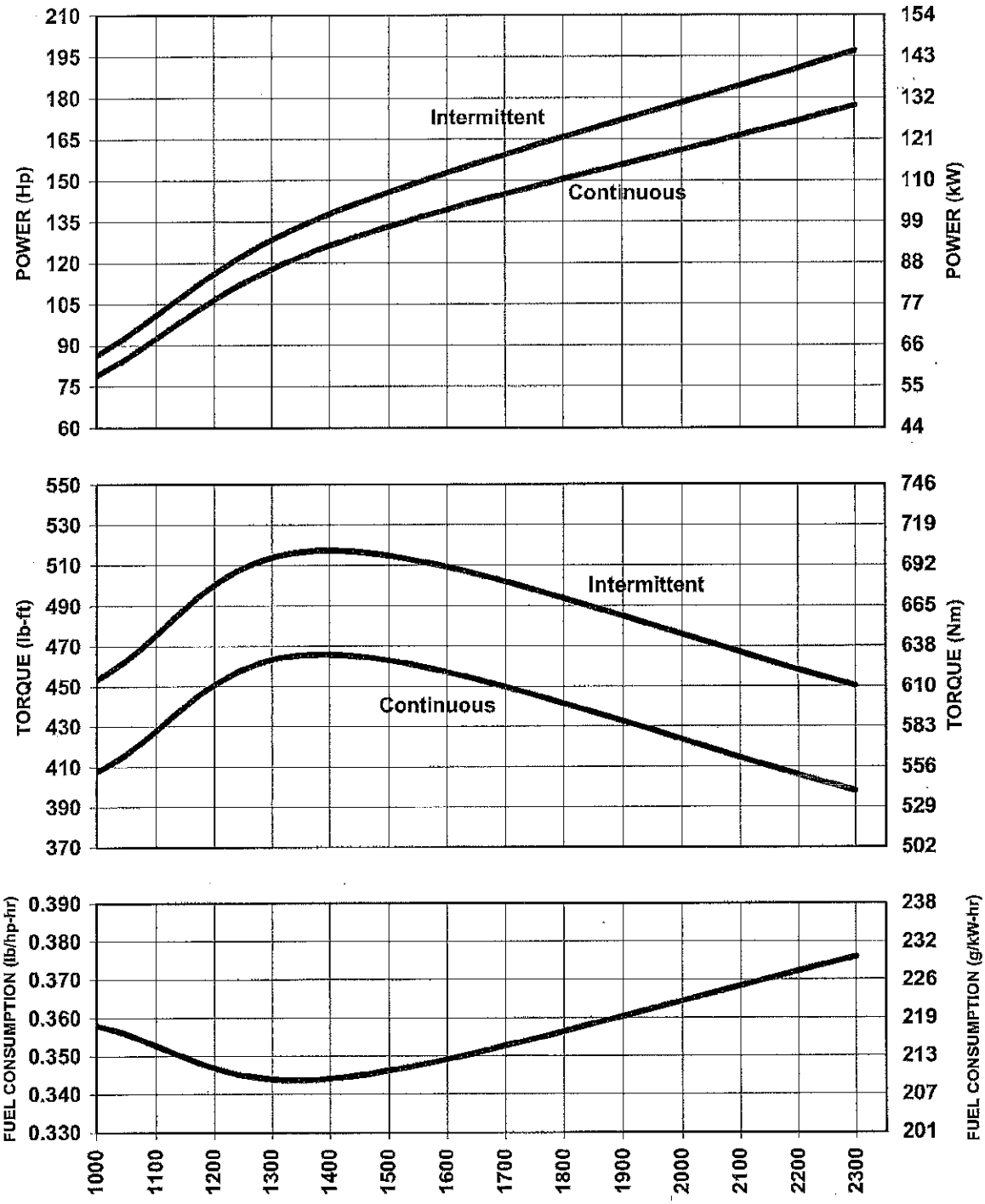
All data refer to standard conditions of 25 °C, 1000 mbar
Data are based on max intermittent output, unless noted

DEUTZ Corporation
3883 Steve Reynolds Blvd
Norcross, GA 30093 USA

Document: 9997263
Revision: 0
Date: 11 May, 2000

ENGINE PERFORMANCE CURVES

ENGINE MODEL	BF6M1013E
RATING STANDARD	ISO 3046
RATED INTERMITTENT POWER	197.2 Hp at 2300 rpm
MAX. TORQUE	517.4 lb-ft at 1400 rpm
EMISSION CERTIFICATION	EPA Tier 1/COM 1



Tolerance: +/- 5% per ISO 3046
Reference conditions: 25 °C (77 oF) 99 kPa (29.31 in. Hg)
Fuel: 40 °C (104 °F) 0.850 kg/l (7.07 lb/gal)

Document: 9997263
Date: 11 May, 2000
Name: R. H. Balkcom

Curves are based on current data and are subject to change without notice.

Printed 5/19/00,4:17 PM

C1- Test

Motorhersteller:	Deutz AG	Datum:	28.07.2004
Motortyp:	BF 4M 1013 FC	Ort:	Köln - Porz
Ausführung:	Code CE129		
Motorprüfstand:	D11		
Ingenieur:	Horstmann		
Prüfstandsfahrer:	Kossmann		
Test-Nr.:	1_0218		

Certification for MSHA, calculation of ventilation rates

Gross power

Engine type:	BF 4M 1013 FC	129,00 kW at	2300 1/min	Eng.No: 981 360	Date: 28.07.2004
Engine Code:	Code CE129				

Fuel Data:	m.% C: 86,200	m.% H: 13,300		m.% S: 0,150	m% O: 0,000
Stoich Air Demand, kg/kg fuel:	14,4862			Densitiy, kg/dm^3 at 15 °C:	0,8428

Mode			1	2	3	4	5	6	7	8
Speed	n	1/min	2300,0	2300,0	2300,0	2300,0	1400,0	1400,0	1400,0	700,0
Torque		%	100,0	75,0	50,0	10,0	100,0	75,0	50,0	0,0
Torque calculated		Nm	535,6	401,7	267,8	53,6	700,0	525,0	350,0	0,0
Torque observed		Nm	546,0	409,5	273,5	55,2	721,3	534,8	356,7	4,6
Fuel mass flow	B	kg/h	31,2279	23,13	15,93	6,04	22,31	16,35	11,03	0,87
Water content of intake air	ha	g/kg	7,43	7,24	7,39	7,45	7,48	7,58	7,83	7,66
Air mass flow, dry	GAIRD	kg/h	753,252	688,825	598,696	388,509	454,019	366,606	287,638	100,899
Air mass flow, wet	GAIRW	kg/h	758,8	693,8	603,1	391,4	457,4	369,4	289,9	101,7
Temp air intake		°C	26,7	26,9	26,9	26,6	26,9	27,2	27,2	27,2
Exhaust mass flow, wet	GEXH	kg/h	790,1	716,9	619,0	397,4	479,7	385,7	300,9	102,5
Fuel to air ratio	f/a	kg/kg	0,04146	0,03357	0,02660	0,01555	0,04915	0,04461	0,03835	0,00860
Dry to wet correction factor	J		0,9110	0,9261	0,9389	0,9594	0,8966	0,9049	0,9162	0,9721
Humidity correction factor NOx	FHUM		0,955	0,942	0,936	0,925	0,966	0,961	0,956	0,917
HC, wet	HC	ppmC1	108,2	150,9	61,4	237,5	37,9	63,9	103,0	173,4
CO, dry	CO	ppm	130,9	72,3	67,5	352,6	160,9	94,2	76,5	88,2
CO2, dry	CO2	%	8,60	6,91	5,42	2,96	10,36	9,40	7,84	1,71
NOx, dry	NOx	ppm	536,0	467,6	377,8	228,7	876,5	851,1	825,9	175,0
NO2, dry	NO2	ppm	14,3	13,4	10,5	6,5	20,0	31,7	39,6	2,9
NO, dry	NO	ppm	521,7	454,2	367,3	222,2	856,5	819,4	786,3	172,1

NO2 corrected	NO2-K	ppm	12,4	11,7	9,2	5,8	17,3	27,6	34,7	2,6
NO, corrected	NO-k	ppm	454,1	396,4	322,7	197,2	741,6	712,6	688,9	153,5
CO, corrected	CO-k	ppm	119,3	67,0	63,4	338,3	144,3	85,2	70,1	85,7
CO2, corrected	CO2-k	Vol-%	7,83	6,40	5,09	2,84	9,29	8,51	7,18	1,66
NO2 emission	mNO2	g/h	15,6	13,3	9,1	3,6	13,2	16,9	16,6	0,4
NO emission	mNO	g/h	371,7	294,5	207,0	81,2	368,6	284,8	214,8	16,3
CO emission	mCO	g/h	91,0	46,4	37,9	129,8	66,8	31,8	20,4	8,5
CO2 emission	mCO2	g/h	94027	69687	47850	17145	67685	49839	32834	2589
Ventilation rate, NO based	cfm NO	cfm	6896	5463	3840	1507	6838	5284	3985	303
Ventilation rate, NO2 based	cfm NO2	cfm	944	805	548	220	798	1021	1002	25
Ventilation rate, CO based	cfm CO	cfm	904	461	376	1290	664	316	202	84
Ventilation rate, CO2 based	cfm CO2	cfm	5946	4407	3026	1084	4280	3152	2076	164

Ventilation rate, maximum	**cfm**	**6896**
	cfm, rounded	**7000**
	cfm/HP	**40**

CO emission in C1-Test:	**0,75**	**g/kWh**	
NOx emission in C1-Test:	**5,19**	**g/kWh**	
HC emission in C1-Test:	**0,37**	**g/kWh**	
Particulate emission in C1-Test:	**0,089**	**g/kWh**	**6,197 g/h**
Particulate index:	**3647**	**cfm**	
Particulate index, rounded:	**4000**	**cfm , 23 cfm/HP**	

TORQUE CURVE TEST - ALL TESTS AT FULL THROTTLE		
MSHA # :	07-ENA040007	
Engine:	Deutz BF4M 1013FC	
Engine Rating:	173 HP @ 2300 RPM	
Engine Speed, RPM	CO, ppm	CO2, %
1000	1491	11.7
1200	238	11.26
1400	166	10.41
1600	112	9.48
1800	116	9.17
2000	123	8.88
2100	120	8.57
2300	125	8.57

CALCULATION: AMBIENT DPM EMISSION LEVEL FOR DEUTZ BF6M1013FC ENGINE

BASED ON SOUTHWEST RESEARCH INSTITUTE 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 0.12mg/m^3, when diluted by 100% of the MSHA approval plate ventilation rate for that diesel engine.

For Brookville Equipment Corporation's request for BOTE approval for our Model 25T174D Locomotive, the Deutz Diesel Engine will be used at 173 hp @ 2300 rpm.

MSHA specifications for the Deutz BF4M2012:
Approval No: 07-ENA040007-1
Ventilation Req't: 7,000 cfm

The MSHA approved ventilation rate for the Deutz BF6M1013FC is as follows:

Ventilation Rate: 7,000 cfm under MSHA approval 07-ENA040007-1

Using the equation:

$$\text{Ambient DPM Level} = DPM_{AVG} = PT/V_{vent}$$

Where:

V_{VENT} = Quantity of ventilation air req'd per MSHA 24/D88

$$= \frac{7{,}000\ ft^3}{min} \times \frac{1m^3}{35.31\ ft^3}$$

$$= 198.24\ m^3/min$$

Average DPM level over 8178-1 8 mode Test = 6.20 g/hr

Based on Southwest Research Institute testing filter efficiency was found to be 96.9%. Therefore the DPM would be 6.20 x .031 = 0.192 g/hr

PT = Average DPM level

$$= \frac{0.192\ gr}{1hour} \times \frac{1000mg}{1gr} \times \frac{1hour}{60min}$$

= 3.20 mg/min

SOLVE FOR AMBIENT DPM LEVEL:

$$DPM_{AMB} = \frac{(3.20\ mg/min)}{198.24\ m^3/min}$$

$$= 0.0161\ mg.m^3$$

CONCLUSION: To comply with section 203-A-a-1, the tailpipe emissions for the equipment cannot exceed 0.12mg/m^3, when diluted by 100% of the MSHA approval plate ventilation rate for that diesel engine. 0.0161 mg/m^3 < 0.12 mg/m^3, therefore, this engine package meets the requirement.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF MINE SAFETY

July 25, 2012

Mr. Ron Bowersox
Technical Advisory Committee Member
P.O. Box 200
Lucernemines, PA 15754

Mr. Paul Borchick
Technical Advisory Committee Member
1000 Consol Energy Drive
Canonsburg, PA 15317

Dear Mr. Bowersox and Mr. Borchick:

The Technical Advisory Committee's ("TAC") as established under Section 424 of the Pennsylvania Bituminous Coal Mine Safety Act was created to evaluate and advise the Department regarding implementation of any article on diesel-powered equipment.

Section 403 states "*An exhaust emissions control and conditioning system may be approved for multiple diesel engine applications through a single series of laboratory tests, known as the ISO 8178-1 test, only if data is provided to the advisory committee that reliably verifies that the exhaust emissions control and conditioning system will meet, for each diesel engine, the in-laboratory diesel particulate matter standard established by this subsection. Data provided to satisfy this provision shall include diesel particulate matter production rates for the specified engine as measured during the ISO 8178-1 test, if available. If ISO 8178-1 test data for diesel particulate matter production is not available for a specified engine, comparable data may be provided to the advisory committee that reliably verifies that the exhaust emissions control and conditioning system will meet, for the specified diesel engine, the in-laboratory diesel particulate matter standard established by this subsection. This standard shall only be used for in-laboratory testing for approval of diesel-powered equipment for use underground.*"

On July 23, 2012, the Bureau received a request for a modification approval of a Brookville Model 25T174D Locomotive.

Attached to this letter is the Brookville technical documentation for your review. Please advise the Department whether or not this request meets the requirements of the Act. If you have any questions on this request, please contact me at either jsbaffoni@pa.gov or at 724-439-7469. Thank you.

Sincerely,

Joseph A. Sbaffoni
Director
Bureau of Mine Safety

Enclosure(s)

cc: Eli Schmader

JAS:cd

bcc: Brower
Gaida
Antoon
Dunn/TAC file

\\epmsuns03\bms$\AdvisoryCommittee\TAC - DIESEL LETTERS BY YEAR\2012\L to TAC for Brookville Model 25T174D Locomotive.doc