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ECE Regulation 49.02

Emission of Gaseous and Particulate Emission from Diesel Engines

Test Report and Data Sheet No 1 Report/Job No: ESF 070782

Engine Make: DongFeng Cummins Model: C220 20 Type: T.C. & C.C.

Engine No: 69109538

Operation No / *Paragraph*			Y / N / N/A
	Essential Information		
	Engine corresponding to that agreed in worst-case meeting		Yes
	Completed Annex II document available		Yes
	Information necessary for Annex 2/VIII document available		Yes
	Test Equipment Details		
A4 a1 2.3.5	Particulate sampling system full flow		
A4 4.2.6	Minimum particulate sampling time > 20 seconds		Yes
A4 a1 2.1.1	Dynamometer make and type:	AVL	
	Model:	APA404/E/2801	
	Serial Number:	127810	
	Calibration date:	25 September 2005	
A4 a1 2.1.2	Calibration details checked for measurement of:		
	Engine speed		Yes
	Temperatures		Yes
	Pressures		Yes
	Barametric pressure		Yes
A4 a2 4.1	Analyser calibration performed within the previous month		Yes
A4 a2 4.2.2	Analyser calibration gas concentration not less than 80% of the full scale value		Yes
A4 a2 4.4.9	NOx converter efficiency not less than 95%		Yes

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Test Report and Data Sheet No 2 Report/Job No: ESF 070782

Operation No / *Paragraph*					*Y / N / N/A*
		Engine Checks			
A4	4.2	Do test engine details correspond to Annex I/II document			Yes
		Fuel system and governor setting in accordance with Manufaturer´s sales and service literature			Yes
	2.8	Engine fitted with "worse-case" auxiliaries only			Yes
		Power absorbed details available for auxiliaries			Yes
A4	4.2.1	Suitable instrumentation and sample probes installed			Yes
		Atmospheric Conditions			
A4	2.	Wet Barometric pressure	102	kPa	
		Ambient temp	25.3	°C	
		Dew point temp	7	°C	
		Vapour Pressure	1.00	kPa	
		Dry Barometric pressure (ps)	101.00	kPa	
		Engine air inlet temp (T)	25.5	°C	

For naturally aspirated and mechanically supercharged engines.

F = 99/ps x (T/298)^0.7

= x =

For turbo-charged engines with or without cooling of inlet air

F = (99/ps)^0.7 x (T/298)^1.5

= 0.9861 x 1.0025 = 0.9886

Is 0.96 < F > 1.06 before the test Yes

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Test Report and Data Sheet No 3 Report/Job No: ESF 070782

Operation No / *Paragraph*					*Y / N / N/A*
		Pre-Test Checks			
A4	4.2	Have particulate sample papers conditioned for at least 2 hours prior to test?			Yes
A4	a4 2.1.2	Is particulate filter stain diameter greater than 37 mm?			Yes
		Particulate filter weighing device:			
		Make	Sartorius		
		Type	CP2P-F		
		Calibration date	9 September 2005		
A4	a4 2.2.1	Conditioning area temperature between 20 and 30 °C		°C	Yes
		Conditioning area humidity between 35 and 55%		%	Yes
A4	a2 4.1.2	Sample line disconnected, plugged and leak check performed			Yes
A4	a2 4.1	Flow rates through analysers checked			Yes
		Pre-sample span gas concentration 75 to 95% of full scale deflection			Yes
		Analyser accuracy ± 2.5% or 3 ppm for concentrations less than 100 ppm			Yes

Analysers

	Make	Type	Flow Rate	Calibration Date
CO	AVL	NDIR	To spec'	21 Nov 05
CO2	AVL	NDIR	To spec'	21 Nov 05
HC	AVL	HFID	To spec'	21 Nov 05
NOx	AVL	CLA	To spec'	21 Nov 05

A4	3	Specification of fuel used	RF-73-A-93		
A5		Sulphur contents	0.03	% mass	
		Carbon - Hydrogen ratio	6.43		

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Test Report and Data Sheet No 4 Report/Job No: ESF 070782

Operation No Paragraph					*Y / N / N/A*
		Test Details			
A4	4.2.3	Engine warmed up and all temperatures and pressures correct and stabilized			Yes
A4	4.2.4	Data derived from full load torque curve for rated and intermediate speeds			
		Rated Speed	2200.00	rpm	
		Power at Rated speed	162.00	kW	
		Peak Torque	800.00	Nm	
		Peak Torque speed	1300 - 160(	rpm Nominal peak at 1400 rpm	
	2.1.2	Intermediate speed	1400.00	rpm	
		Power at Intermediate speed	121.20	kW	
10	5.4	Rated Net Power within ± 5% of approved value			Yes

Condition	Power (kW) at various engine speed	
	Intermediate	Rated
Maximum power measured on test	121.20	162.00
Total power absorbed by engine driven equipment as per point 6.2. kW (b)	0.33	0.61
Gross engine power kW (c)	121.53	162.61
Maximum permissible power absorbed as per point 5 kW (d)	1.61	2.37
Minimum net engine power kW (e)	119.92	160.24

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Operation No
Paragraph *Y / N / N/A*

Dynamometer settings

% load	Dynamometer Setting			
	Intermediate		Rated	
	kW	Nm	kW	Nm
10	13.27	90.53	17.78	77.19
25	31.26	213.22	41.82	181.52
50	61.24	417.71	81.88	355.41
75	91.22	622.20	121.94	529.29
100	121.20	826.70	162.00	703.18

Using S = Pmin x L/100 + Paux

Where S = Dynamometer setting

Pmin = e

and Paux = (d - b)

A4	4.2	Specified speed within ± 50 rpm at test speed	Yes
		Specified torque within ± 2% of max torque value at test speed	Yes
		Fuel temperature at injection pump inlet maintained between 33 and 43 °C	Yes
A4	a1 2.1.4	Exhaust backpressure set to within ± 650 Pa of manufacturers declared value at Rated speed	Yes
A4	a1 2.1.5	Inlet depression set to within ± 300 Pa of manufacturers declared value at Rated speed	Yes
A4	a4 2.4	Exhaust backpressure at mode 8 is within ± 1.5 kPa of manufacturers declared value	Yes
A4	a1 2.3.4	Heated HC sample line maintained between 180 and 200 °C	Yes
		Heated NOx sample line maintained between 95 and 200 °C	Yes

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Test Report and Data Sheet No 6 Report/Job No: ESF 070782

Operation No *Paragraph*		*Y / N / N/A*
A4 a4 2.4	Primary tunnel temperature not exceeding 191 °C (full flow double dilution systems only)	N/A
A4 4.2.5	Dilution exhaust temperature not exceeding 52 °C (measured immediately before the primary particulate filter)	Yes
	Post-Test Checks	
A4 4.2.8 A4 a1 2.3.2	Analyser accuracy ± 2.5% or 3 ppm for concentrations less than 100 ppm	Yes
A4 5	Have particulate sample papers conditioned for at least 2 hours after test?	Yes
A4 4.2.2.1	Conditioning area temperature within ± 6 °C of pre-test value?	Yes
	Conditioning area humidity within ± 10% of pre-test value?	Yes
A4 4.2.6	Product of dilution ratio and exhaust gas flow within ± 7% of average of all modes? (partial flow systems only)	Yes
	Total mass flow rate within ± 7% of average of all modes? (full flow systems only)	N/A
A4 a3 1.2.3	Were effective weighting factors within ± 0.003 of required values?	Yes
A4 2	Was 0.96 < F > 1.06 during the test?	Yes
A4 a3 1.1.5	**Test results**	

$$NOx = \frac{\Sigma\ NOx\ mass_i * WF_i}{\Sigma\ (P_i - Paux_i) * WF_i} = 5.943\ g/kWh$$

$$CO = \frac{\Sigma\ CO\ mass_i * WF_i}{\Sigma\ (P_i - Paux_i) * WF_i} = 0.366\ g/kWh$$

$$HC = \frac{\Sigma\ HC\ mass_i * WF_i}{\Sigma\ (P_i - Paux_i) * WF_i} = 0.233\ g/kWh$$

$$PT = \frac{\Sigma\ PT\ mass_i * WF_i}{\Sigma\ (P_i - Paux_i) * WF_i} = 0.093\ g/kWh$$

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Test Report and Data Sheet No 7 Report/Job No: ESF 070782

Operation No *Paragraph*			*Y / N / N/A*
		System Verification Checks	
A4	a2 4.1.7	For partial flow systems with isokinetic probe checks the dilution ratio with the engine running using either CO2 or NOx concentrations in the raw and diluted exhaust	N/A
		For full flow systems verify the total flow by means of propane check. The gravimetric mass of propane injected into the system is subtracted from the mass measured with the full flow system and then divided by the gravimetric mass	
		(mass of Propane measured - gravimetric mass injected) / gravimetric mass	
		Any discrepancy greater than ± 3% must be corrected	Yes

The above vehicle was tested at: NAST, Xiangfan, China

on 22 November 2005

for Type Approval purposes in accordance with Directive 88/77/EEC as amended by 91/542/EEC and ECE Regulation 49R-02 and was found to comply in all respects with the level B limits.

Reported by: R.Ward Date: 22 November 2005

and

Checked by: A Grimm Date: 09-Mar-06