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THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

E11

COMMUNICATION CONCERNING APPROVAL GRANTED OF AN ENGINE TYPE WITH REGARD TO EMISSIONS OR MEASUREMENT OF POWER OF THE ENGINE ONLY, PURSUANT TO REGULATION NO 24.03

Approval No: 24R-031851

1. Trade name or mark of vehicle: Not applicable

2. Trade name or mark of engine: Dongfeng Cummins Engine Company Limited

3. Vehicle type: Not applicable

4. Engine type: C220 20 Engine Approval No:

5. Manufacturer's name and address:

   Dongfeng Cummins Engine Company Limited
   Automobile Industry Development Zone
   Xiangfan
   Hubei Province
   P.R. China 441004

6. If applicable, name and address of manufacturer's representative not applicable

7. Engine submitted for Type Approval on: 23 November 2005

8. Technical service conducting Approval tests: Vehicle Certification Agency

9. Date of report issued by that service: 23 November 2005

10. Number of report issued by that service: CSF 070782

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11. Test results:

11.1 Emissions

11.1.1 Tests at steady speeds:

Measurement points	Engine Speed n (rpm)	Power P (kW)	Nominal flow G (litres/sec)	Measured absorption values (m^{-1})
1	2200	161.1	151.6	0.08
2	1960	156.0	135.0	0.06
3	1720	145.5	118.5	0.06
4	1480	127.9	102.0	0.04
5	1240	107.7	85.4	0.25
6	1000	81.8	68.9	1.29

For engine type approval, power absorbed by the fan during the tests: Not applicable

11.1.2 Free acceleration tests

11.1.2.1 Engine test in accordance with Annex 5 (1) Not Applicable

Percentage of maximum rpm (2)	Percentage of maximum torque at rpm stated (2)	Measured absorption value m^{-1}	Corrected absorption value m^{-1}
100	100		
90	100		
100	90		
90	90		
100	80		
90	80		

(2) The lower limit may be that stated by the manufacturer in accordance with this Regulation, part I, paragraph 6.3.4

11.1.2.2 Engine test according to this Regulation, part I, or vehicle test according to part III (1):
Corrected absorption value (m-1) 0.71

Rpm at start: 750

11.2 Stated net maximum power (1): 160 kW at 2200 rpm

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12. Make and type of opacimeter: AVL 4390 G004

13. Principal characteristics of engine type:

Engine working principle: compression ignition

Number and layout of cylinders: 6 in line

Cylinder capacity: 8268 cm^3

Fuel feed: Indirect injection

Supercharging equipment: Turbocharger

14. Approval GRANTED

15. Reason(s) for extension of approval: not applicable

16. Place: BRISTOL

17. Date: 21 MARCH 2006

18. Signature:

A. W. STENNING
Head of Product Certification

19. A list of the documents contained in the approval file transmitted to the administrative service which has granted approval is annexed to this communication.

CSF070782

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a) ESSENTIAL CHARACTERISTICS OF THE ENGINE AND INFORMATION CONCERNING THE CONDUCT OF TEST

1. DESCRIPTION OF ENGINE

1.1	Manufacturer	: Dongfeng Cummins Engine Co.,Ltd
1.2	Manufacturer's Engine Code	: C220 20
1.3	Cycle	: Four stroke
1.4	Bore (mm)	: 114
1.5	Stroke (mm)	: 135
1.6	Number and layout of cylinders	: 6 in-line, 1-5-3-6-2-4
1.7	Engine capacity (cm^3)	: 8268
1.8	Volumetric compression ratio	: 18:1
1.9	Minimum cross-sectional area of inlet and outlet ports (mm^2)	: 1615/1035
1.10	Cooling system	
1.11.1	Liquid	
1.11.1.1	Nature of liquid	: Antifreeze and anticorrosive liquid
1.11.1.2	Circulating pump (s)	: Yes
1.11.1.3	Characteristics or make (s) and type (s)	: Centrifugal
1.11.1.4	Drive ratio (s)	: 2:1
1.11.2	Air	
1.11.2.1	Blower	: No

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1.11.2.2	Characteristic or make (s) and type (s)	
1.11.2.3	Drive ratio (s)	: N/A
1.12	Temperature permitted by the manufacturer	
1.12.1	Liquid cooling	
	Maximum temperature	
	At outlet (k)	: 373
1.12.2	Air cooling	
	Reference point	
	Maximum temperature at Reference point (k)	:326K (Maximum temperature of the air at the outlet of the intake intercooler)
1.12.3	Maximum charge air outlet temperature of the inlet intercooler (k)	: 372
1.12.4	Maximum exhaust temperature at the point in the exhaust pipe (s) adjacent to the outer flange (s) of the exhaust manifold (s) (k)	: 923
1.12.5	Fuel temperature min. (k)	: 313

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	max. (k)	: 317
1.12.6	Lubricant temperature	
	min. (k)	: 353
	max. (k)	: 393
1.13	Pressure charger	
1.13.1	Make	: Holset
1.13.2	Type	: HX40
1.13.3	Intercooler	
1.13.4	Intake system maximum allowable intake depression at rated engine speed and at 100% load (kPa)	: -3.7±1.0
1.15	Exhaust system Maximum allowable exhaust back pressure at rated engine speed and at 100% load (kPa)	: 8.136 ± 0.339
2.	additional anti-smoke devices (if any, and if not covered by another heading)Description or diagram	: N/A
3.	Fuel feed	

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3.1	Feed pump	
	Pressure (KPa)	
	Or Characteristic diagram	: 42
3.2	Injection system	
3.2.1	Pump	
3.2.1.1	Make (s)	: BOSCH
3.2.1.2	Type (s)	: PES6P120ARS7390
3.2.1.3	Delivery (mm3) per stroke or cycle	
	at engine speed (rpm) at full	:112±7mm^3/cycle at 2200rpm at full
	injection or characteristic diagram	
	Mention the method used	: 1.85(On pump bench)
3.2.1.4	Injection timing	
3.2.1.5	Static timing (with tolerance)	: 15.5° ±1CA
3.2.2	Injection piping	
3.2.2.1	Length (mm)	: 808
3.2.2.2	Internal diameter (mm)	: 1.8
3.2.3	Injector (s)	
3.2.3.1	Make (s)	: BOSCH
3.2.3.2	Type (s)	: KBAL105P29
3.2.3.3	Opening pressure (KPa)	
	or characteristic diagram	: 29000-31000
3.2.4	Governor	

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3.2.4.1	Make (s)	: BOSCH
3.2.4.2	Type (s)	: RQV350
3.2.4.3	Speed at which cut-off starts under full load (rpm)	: 2275
3.2.4.4	Maximum no-load speed 9rpm)	: 2500
3.2.4.5	Idling speed (rpm)	: 750±100
3.3	Cold start system	
3.3.1	Make (s)	: Not applicable
3.3.2	Type (s)	: Not applicable

4. Valve timing

4.1 Maximum lift of valves and angles of opening and closing in relation to dead centers of equivalent data

Maximum lift of valves (mm)

Intake	: 12.751
Exhaust	: 12.598

Angles of opening and closing

Intake Valve

Opening (BTDC)	: 10.0
Closing (ATDC)	: 34.0

Exhaust Valve

Opening (BBDC)	: 45.0
Closing (ATDC)	: 10.0

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4.2 Reference and /or setting range (mm)

Intake (cold) : N/A

Exhaust (cold) : N/A

5. Engine-driven equipment

Maximum permissible power absorbed by the engine-driven equipment as specified in and under the operating conditions of Directive ECE R49/02, Annex I, section 5.1.1. at each engine speed as defined in section 4.1 of Annex III to this Directive.

Idle (kW) : 0.3

Intermediate (kW) : 1.65

Rated (kW) : 2.61

6. Additional information on test conditions

6.1 Lubricant used

6.1.1 Make (s) : Classic Blue

6.1.2 Type (s) : 15W40 CF4

(State percentage of oil in mixture

if lubricant and fuel are mixed)

6.2 Engine-driven equipment

6.2.1 Enumeration and identifying details : Air filter, muffler, fan

6.2.2 Power absorbed (kW) at various : N/A

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Indicated engine speeds

Equipment	Idle	Intermediate	Rated
Alternator		0.33	0.61
Total		0.33	0.61

6.3 Dynamometer setting (kW)

Per cent load	Idle	Intermediate	Rated
10	—	13.27	17.78
25	—	31.26	41.82
50	—	61.24	81.88
75	—	91.22	121.94
100	—	121.20	162.00

7. Engine performances

7.1 Engine speeds

Idle (rpm) :600~800

Intermediate (rpm) :1400

Rated (rpm) :2200

7.2 Engine power (kW)

(Measured in accordance

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With the provisions of

Directive ECE R49/02)

c= a+b : e= c-d

	Idle	Intermediate	Rated
Maximum power measured on test (kW(a))	42	121.2	162.0
Total power absorbed by engine-driven equipment as per section 6.2.2. (kW(b))	—	0.33	0.61
Gross engine power (kW(c))	—	121.53	162.61
Maximum permissible power absorbed as per section (kW(d))	—	1.61	2.37
Maximum net engine power (kW(e))	—	119.92	160.24

a) CHARACTISTICS OF THE ENGINE-RELATED VEHICLE PARTS

1. Intake system depression : -3.17±1.0

at rated engine rpm and

at 100% load (KPa)

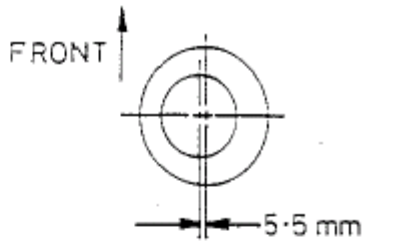
2. Exhaust system back : 8.136 ± 0.339

Pressure at rated engine

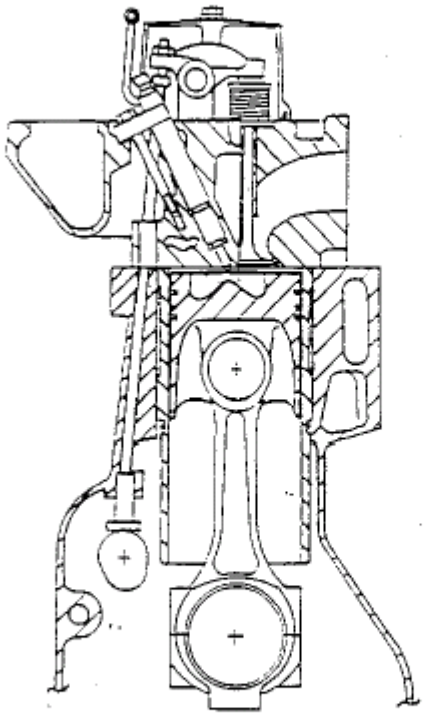
Rpm and at 100% load (kPa)

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PLAN VIEW OF PISTON

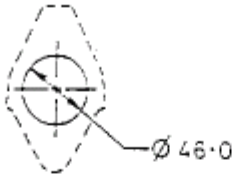


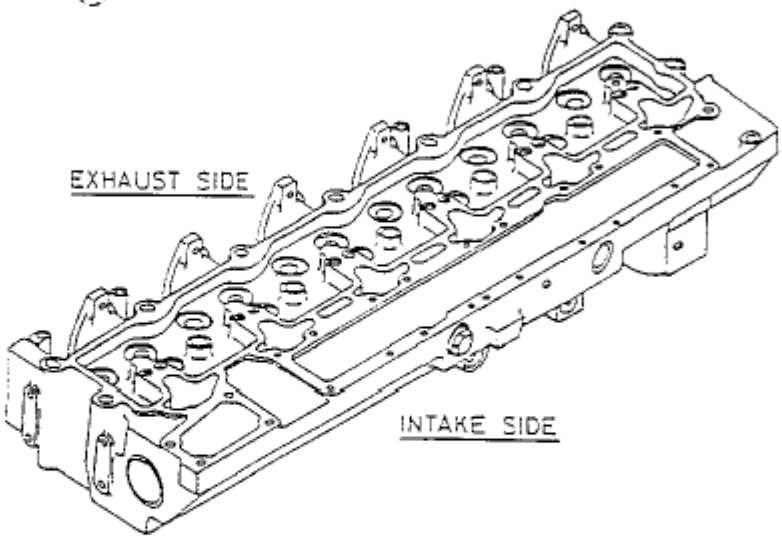
CROSS SECTIONAL VIEW
OF CUMMINS "C","CT" AND
"CTA" SERIES ENGINES.

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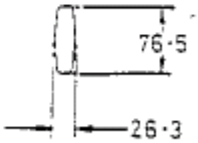
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EXHAUST OUTLET PORT
AREA = 1662 mm²

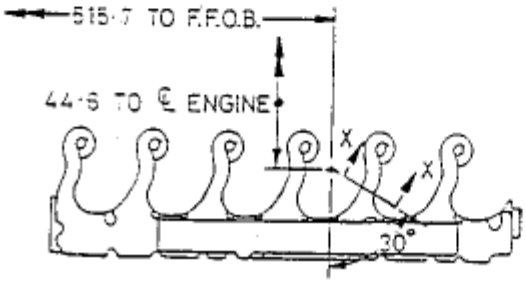




AIR INTAKE PORT
AREA = 1860 mm²



SECTION X X



AIR INTAKE PORT SCROLLS

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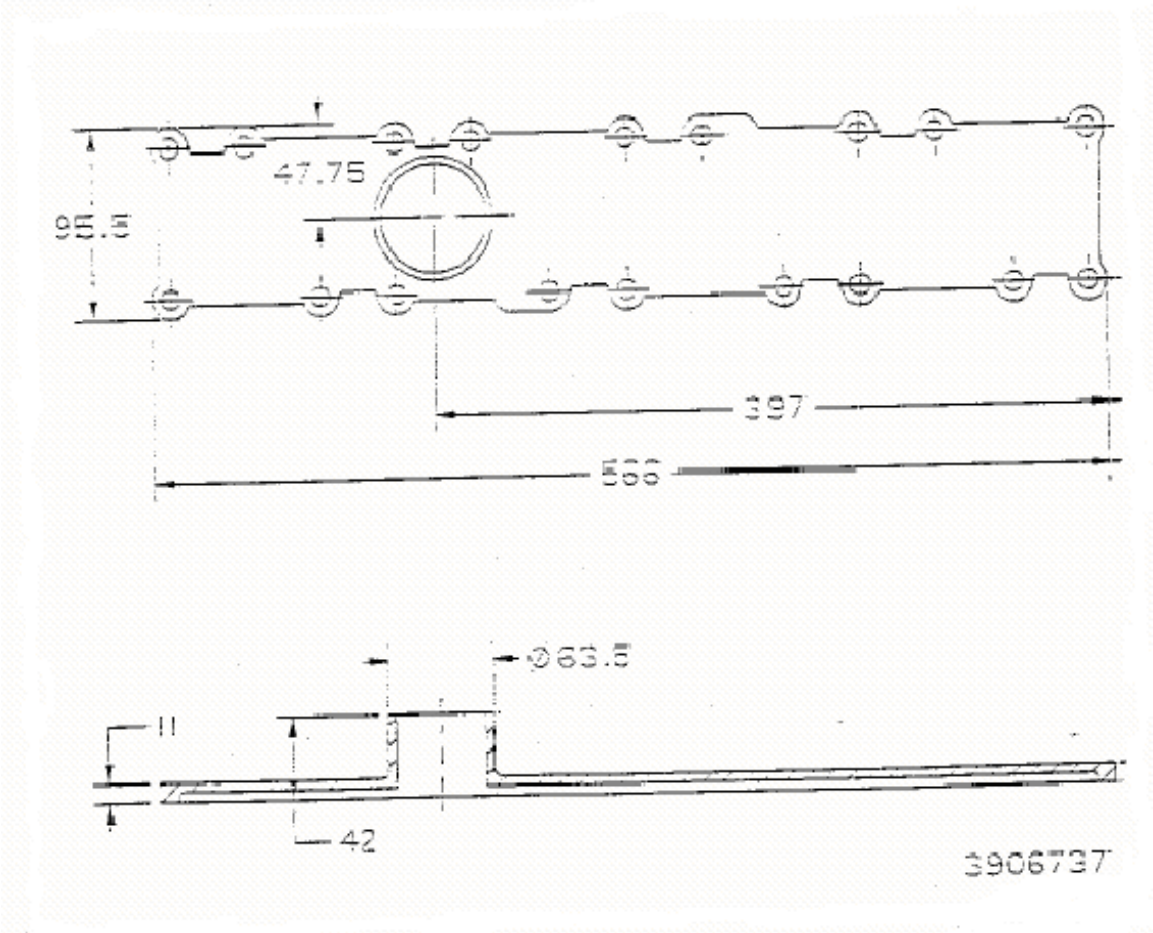
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FAN POWER ABSORPTION

Power absorbed by viscous fan hub
in maximum slip condition is 1.0 kW
over the speed range of the test.

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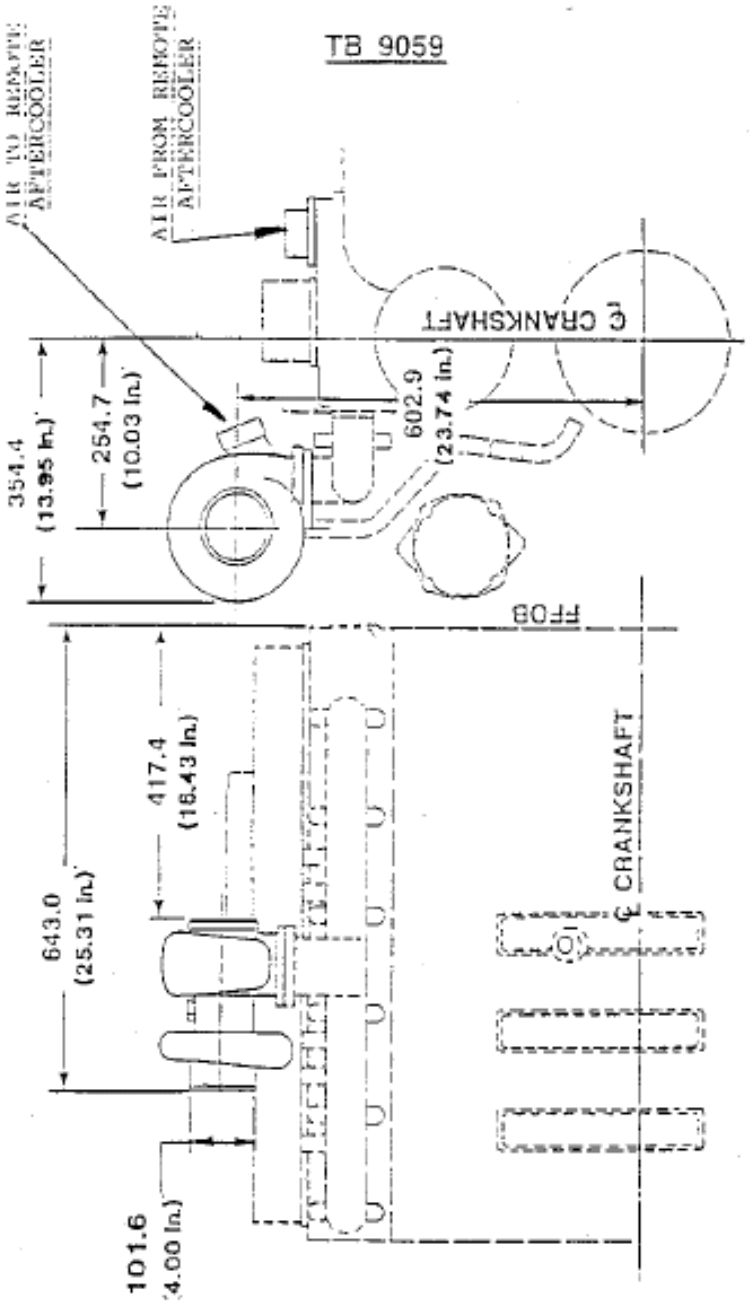
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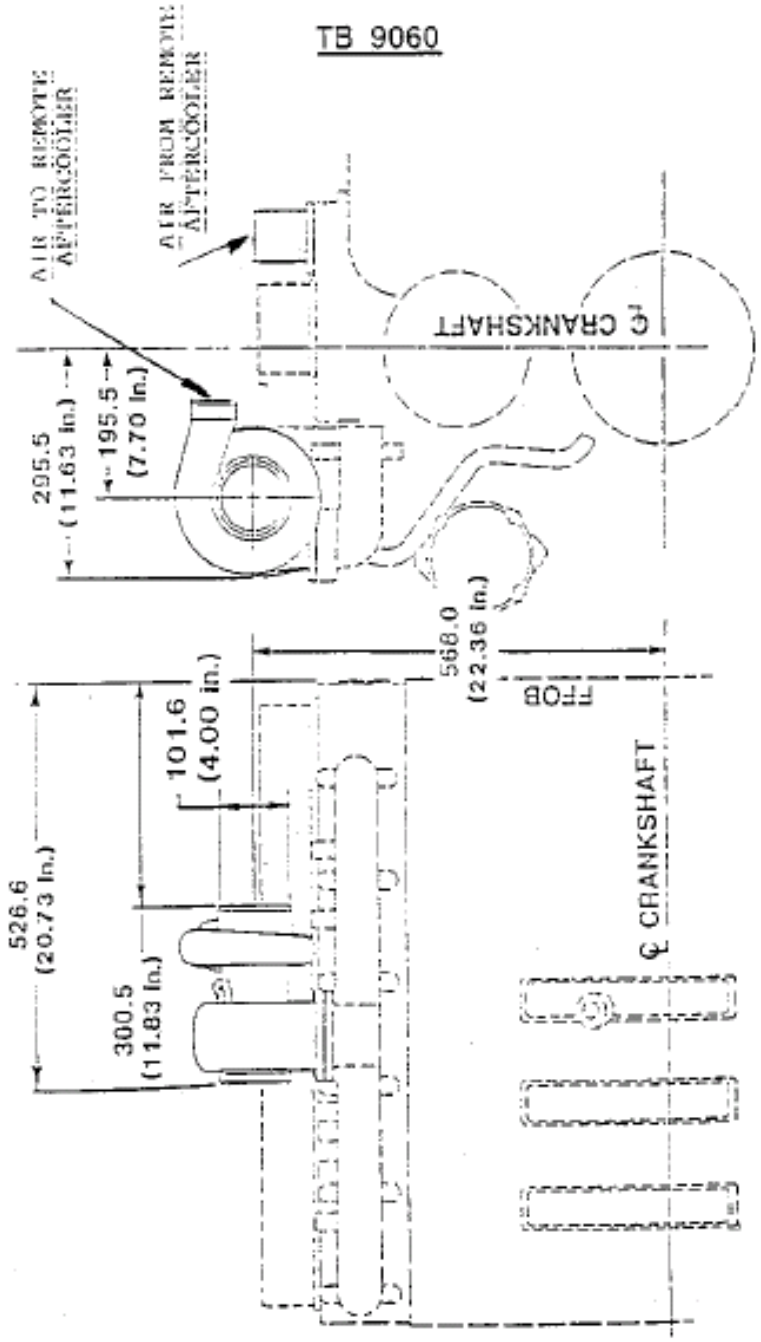
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TURBOCHARGER LOCATION



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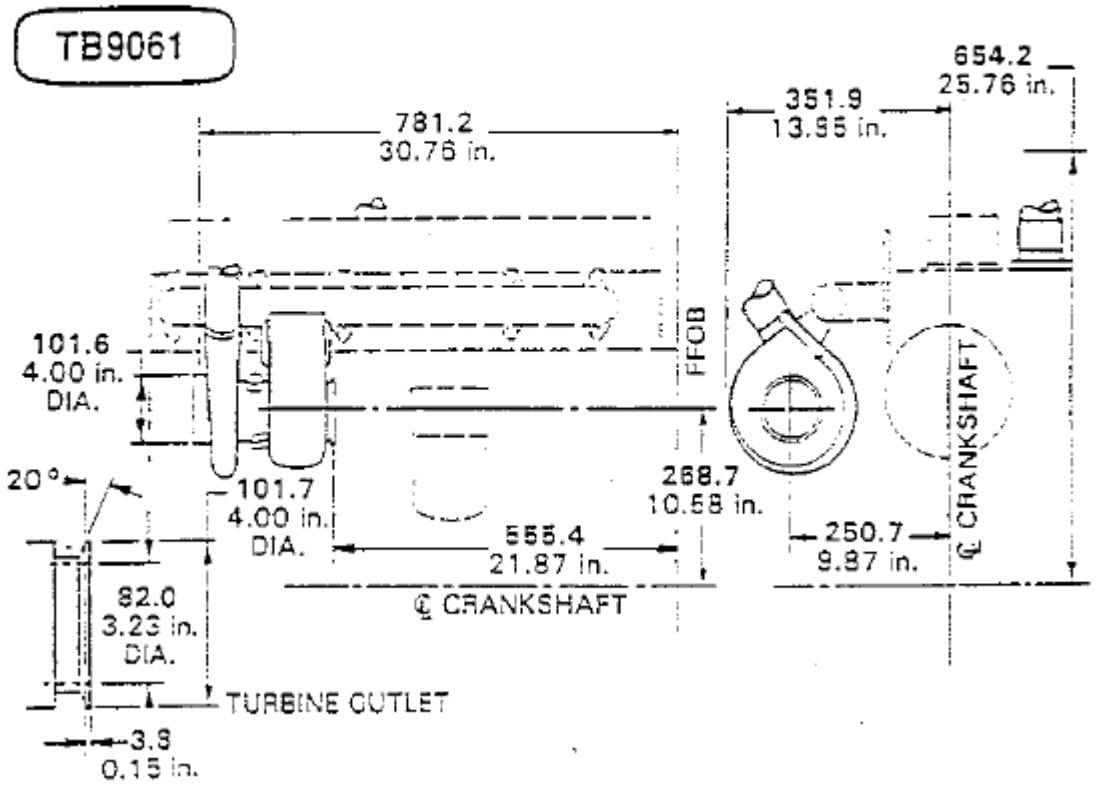
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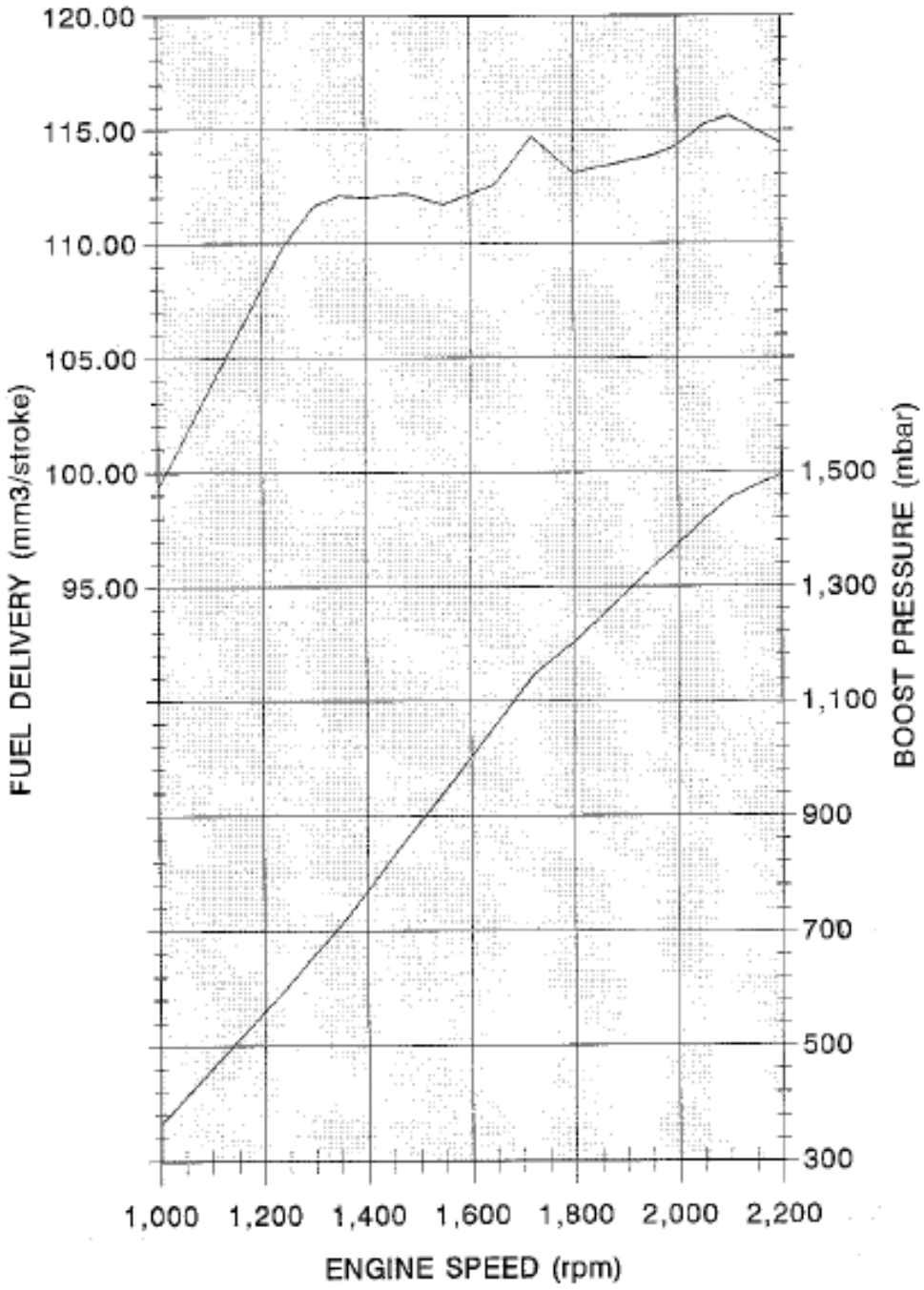
TURBOCHARGER LOCATION



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Boost control & fuel delivery characteristics
Full engine load



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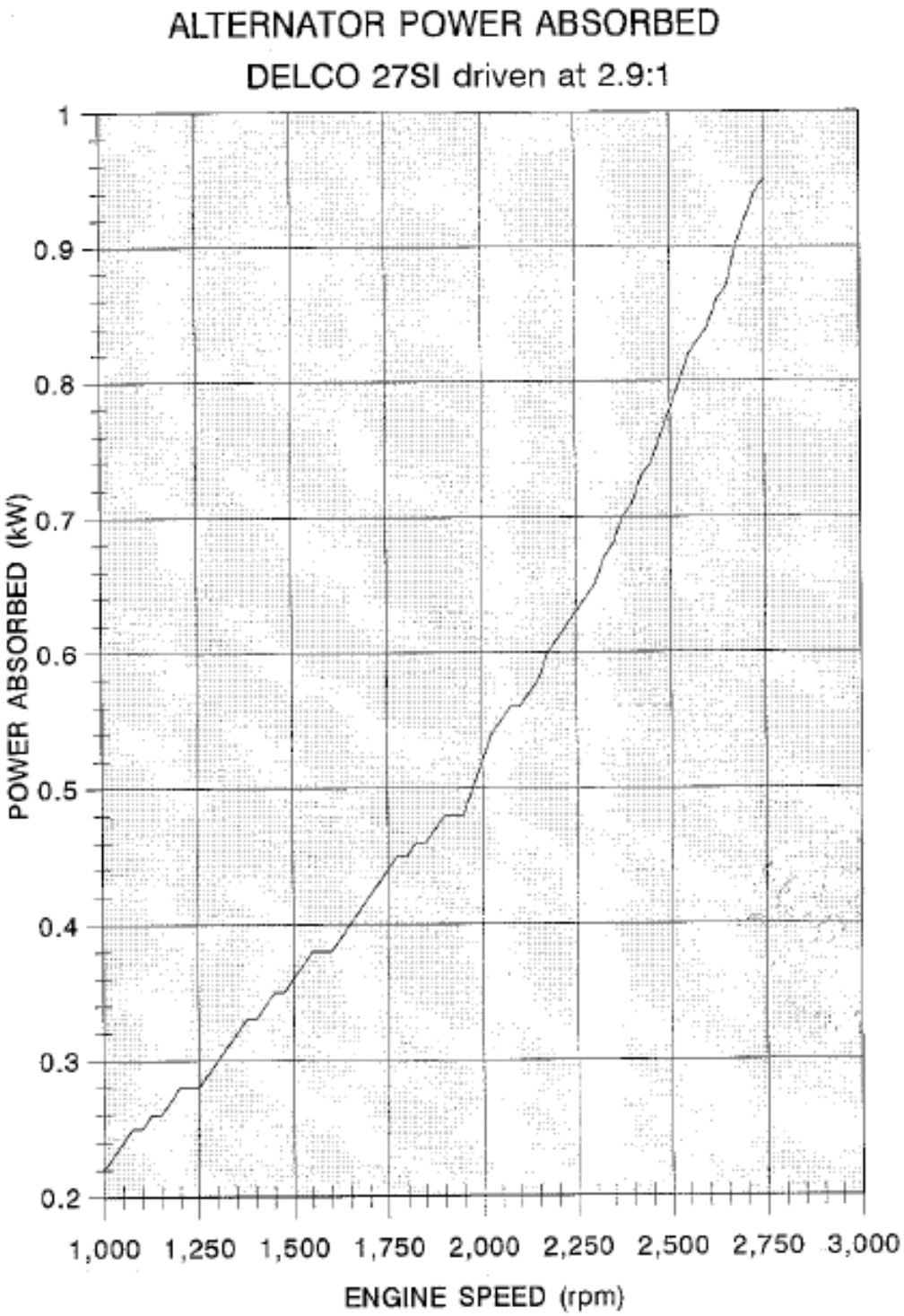
ADDITIONAL ANTI-SMOKE DEVICE

BOOST CONTROL

The Bosch P7100 fuel pump is fitted with a boost control device (Boost Capsule), designed to regulate the fuel delivery output to correspond with the inlet manifold pressure on turbocharged engines during acceleration and lugging. When a turbocharged engine is accelerated, there is sometimes a delay between the throttle lever arriving at full fuel position, and the turbocharger providing it's boost pressure to the combustion chamber. Consequently there is not sufficient air to completely burn the fuel, resulting in excessive smoke during this acceleration. The Boost Control device will sense the air pressure in the manifold during this period and adjust the fuel pressure to limit the amount of fuel injected, thus reducing the smoke produced.

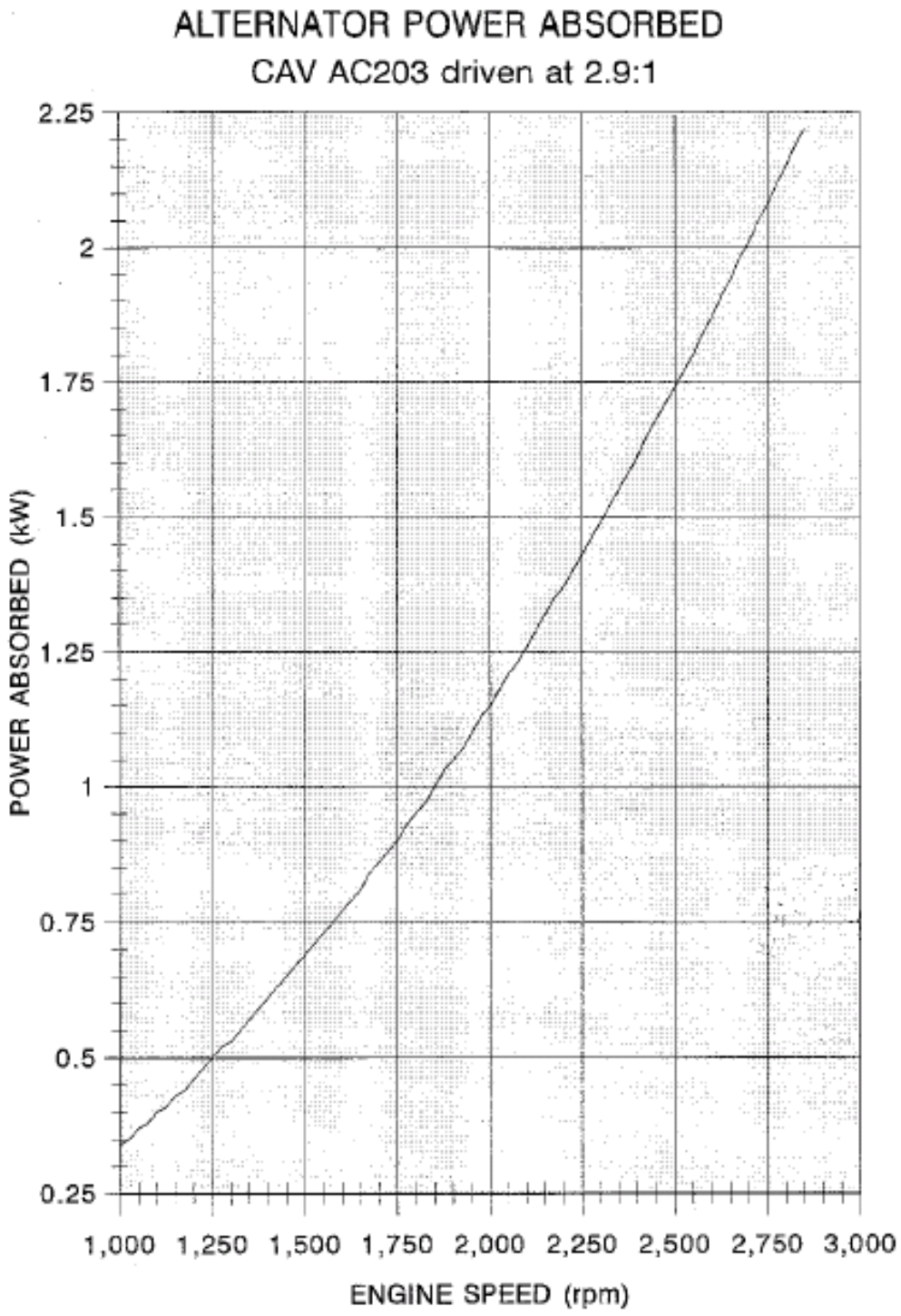
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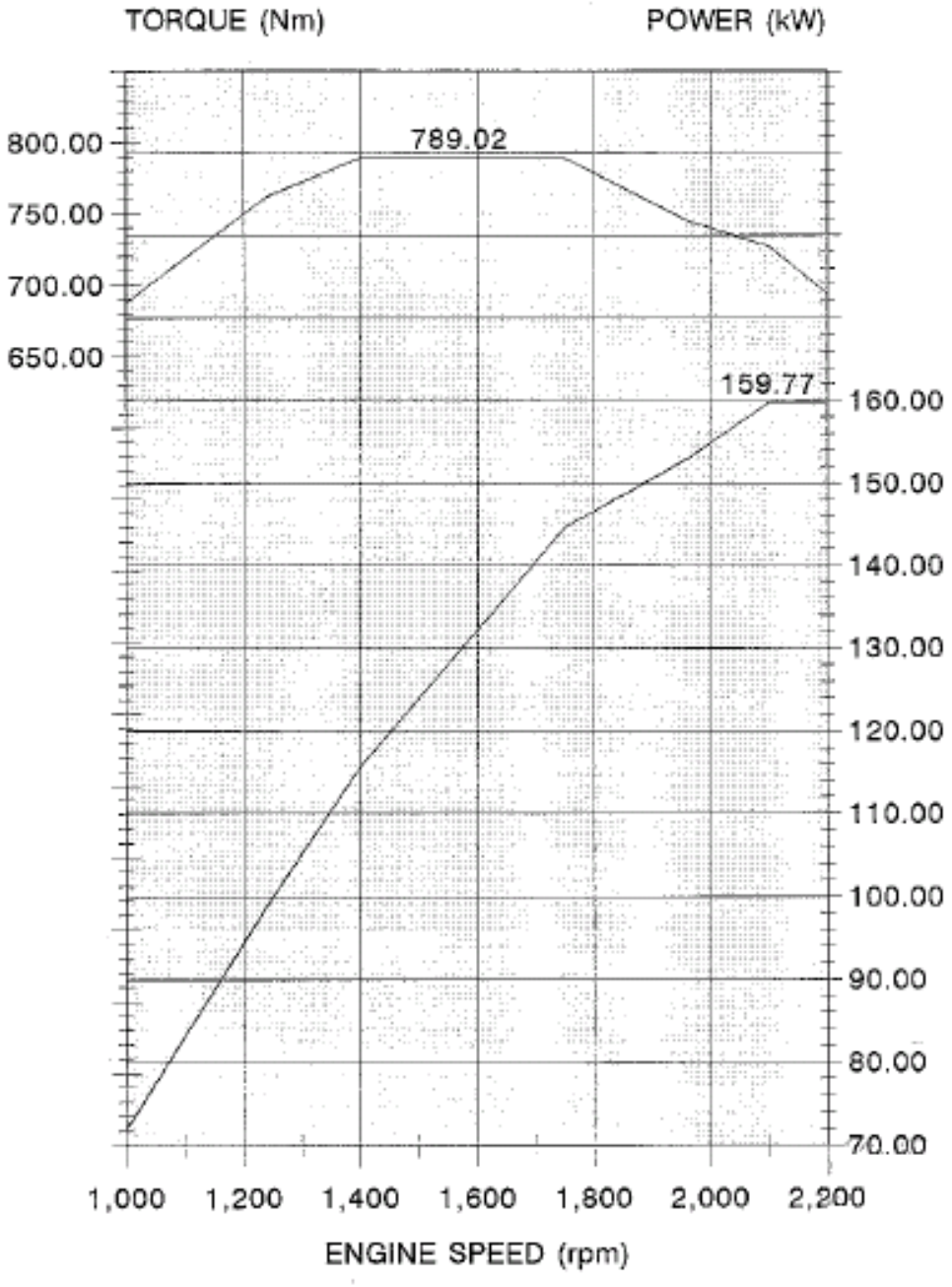
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DECLARED NET ENGINE PERFORMANCE DATA



WORST CASE:
FAN: KYSOR 1.0kW ALT: CAV AC203

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Engine Model: C220 20
Job Number: P94-95/2572
Attachment No: 9b

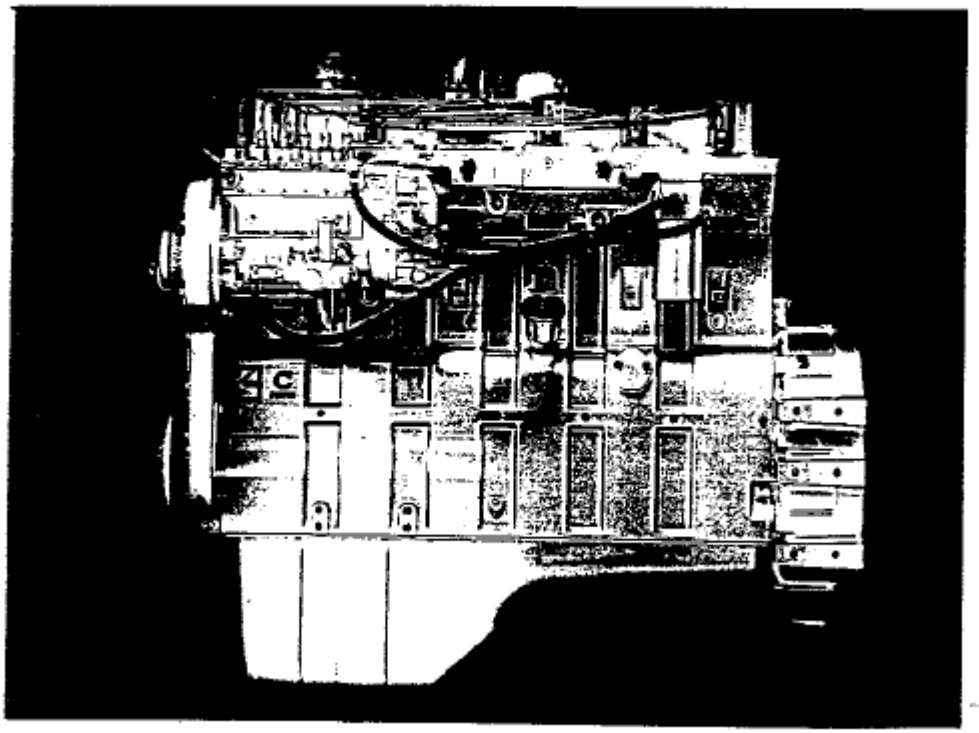
G TRQ (Nm)	697.86	770.80	797.75	798.44	797.07	796.99	752.64	734.25	701.14
G PWR (kW)	73.08	100.09	116.96	123.75	143.57	146.06	154.48	161.47	161.53
DRIVEN (kW)	0.22	0.28	0.33	0.35	0.43	0.44	0.48	0.56	0.61
T GRS (kW)	73.30	100.37	117.29	124.10	144.00	146.50	154.96	162.03	162.14
WORST FAN (kW)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
WORST ALT (kW)	0.34	0.49	0.61	0.81	0.88	0.90	1.10	1.26	1.37
ABSORB (kW)	1.34	1.49	1.61	1.81	1.88	1.90	2.10	2.26	2.37
NET (kW)	71.96	98.88	115.68	122.28	142.11	144.59	152.86	159.77	159.77
NET (Nm)	687.20	761.53	789.02	789.02	789.02	789.02	744.77	726.52	693.51
ENGINE (rpm)	1,000.00	1,240.00	1,400.00	1,480.00	1,720.00	1,750.00	1,960.00	2,100.00	2,200.00

WORST CASE:
FAN: KYSOR 1.0kW ALT: CAV AC203

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PHOTOGRAPH OF ENGINE



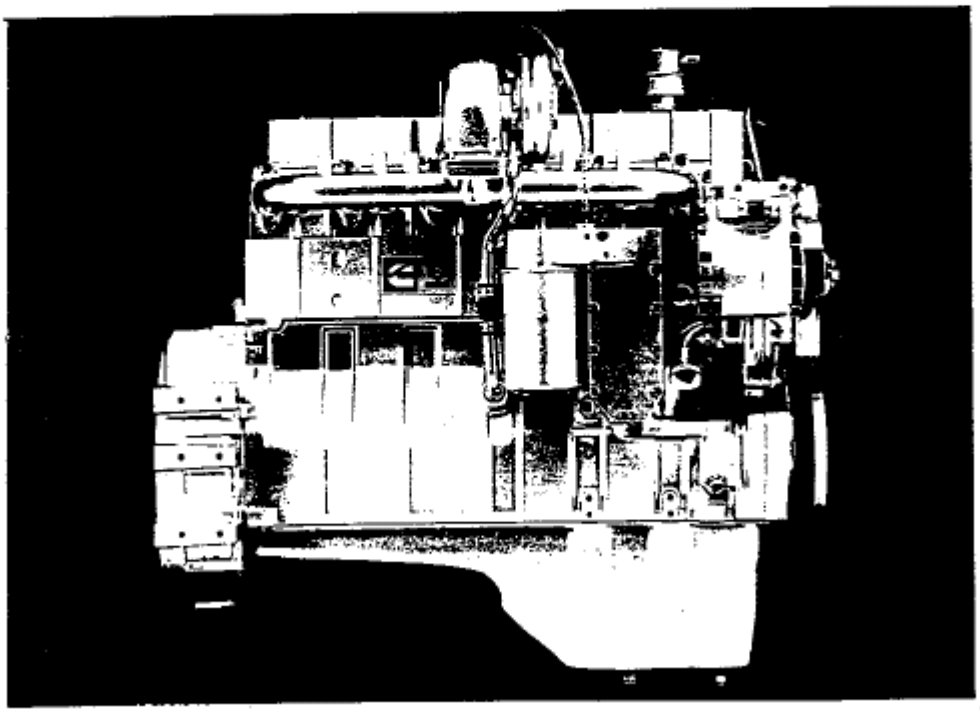
FUEL PUMP SIDE

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东风康明斯发动机有限公司
Dongfeng Cummins Engine Company, Ltd.

PHOTOGRAPH OF ENGINE



Cummins C Series

EXHAUST SIDE

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