



Technical specifications EST gaseous fuel engine.

1. Manufacturer's directive

Manufacturer's declaration in accordance with Art.4, Clause 2 in combination with Appendix 2, Section B of Directive 89/392/EEC in the version 93/44EEC. The engine which is described is intended for installation in a machine in the spirit of the EC Machine directive. Engine commissioning is prohibited until it has been determined that the machine into this engine is to be installed meets the stipulations of the EC Machine directive (89/392/EEC, last amended via 93/44/EEC)

2. Engine description

The EST gaseous fuel engine is based on an automotive engine manufactured by VOLKSWAGEN under the engine code BEF.

The engine is a liquid cooled four cylinder in line engine with a specific gaseous fuel intake system with an integral electric throttle system.

Due to the diverse purposes for which this engine can be used, the notes on the following pages must be adhered to under all circumstances on development of new devices in order to ensure the flawless function and long service life of the entire device under operating conditions.

Direct valve actuation via an overhead camshaft driven by a toothed belt.

Maintenance free valve gear using hydraulic tappets. Electric throttle system operated by an engine fitted Engine Control Unit.

Pressure circulation with a gear wheel driven oil pump with an oil filter positioned in the main flow. Oil cooling is carried out via an oil-coolant heat exchanger.

Displacement	cm ³	1984
Bore / stroke	mm	82,5 / 92,8
Compression	[-]	10,5
Firing order	[-]	1-3-4-2
Moments of inertia		
Crankshaft in total	kgm ²	0,033
Flywheel (single mass)	kgm ²	0,101
Weight [approx]	kg	140

3. Engine technical data (see diagrams)

Rated power (propane)*	38-42 kW@2800	[56,5 kW@4000]
Max torque (propane)*	140-143 Nm@2100-2400	[146 Nm@2400]

*) Depending on Air Fuel Ratio strategy

Min idling speed	rpm	800
Max idling speed	rpm	4000
Oil consumption	l/hr	0,05-0,10

4. Engine management system

The ECU is fitted direct on the engine and connected to the specific engine sensors and actuators.

A wiring loom with a central 4 pole connector is fitted to the engine, from this connector the user interface is realized, see electric wiring diagram.

Application specific control and calibration parameters are programmed.

EST will provide a user ftp site for customer specific software to enable customers to re calibrate the engine to another fuel or other application needs.

Through the main connector a flexible user interface is already provided, traditional or via a CAN [SAE J 1939].

Customer specific access is available through display software, the level of access can be controlled by a customer specific pass word strategy.



5. Notes on engine installation

- The engine position is 15 degrees clockwise, seen from the flywheel side.
The specified oil dipstick marks apply to this engine installation position.
In case of a deviating engine installation position, the oil dipstick marks must be modified accordingly.
Other engine positions possible but this has to be cleared with EST.
- Belt drive load take-off Nm 50 (radially or axially via crankshaft)
- Engine electrical equipment
Starter 12 V kW 1,8
Three phase alternator 12V A 70 (90-120 A optional)
- Flywheel adapter, KTR see separate sheet. **[VW Flywheel 026 105 269 L]**

6. Fuel

Octane rating RON 95
Fuels LPG, EN 589 , Natural gas

7. Cooling circuit (see diagram)

Close-loop cooling system (pressure system with separate expansion tank and pressure relief valve.

Coolant capacity	Ltr	5-6	depending on cooling system
Pressure relief valve opening	bar	1,2-1,5	
Thermostat, at engine inlet			
Start opening	°C	87	
Fully open	°C	102	
Coolant	VW	G12+	(according to VW 774D)

8. Lubricating oil circuit

Oil quality

Use only oils according to the oil specifications in the owners manual.

Oil capacity	Ltr	4.0	
Dipstick min-max marking	Ltr	+/- 1,0 Ltr	
Oil pressure	bar	2,0	(relative at 2000 rpm at 80 °C)

9. Temperature limits.

Cold start	°C	-15	(depending on fuel)
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Engine oil temperature (in the sump)

On constant operation	°C	120	
Limit range	°C	130	

Coolant temperature

On constant operation	°C	90	
Limit range	°C	105	

10. Service recommendations (subject to clearing by VW K-VSI)

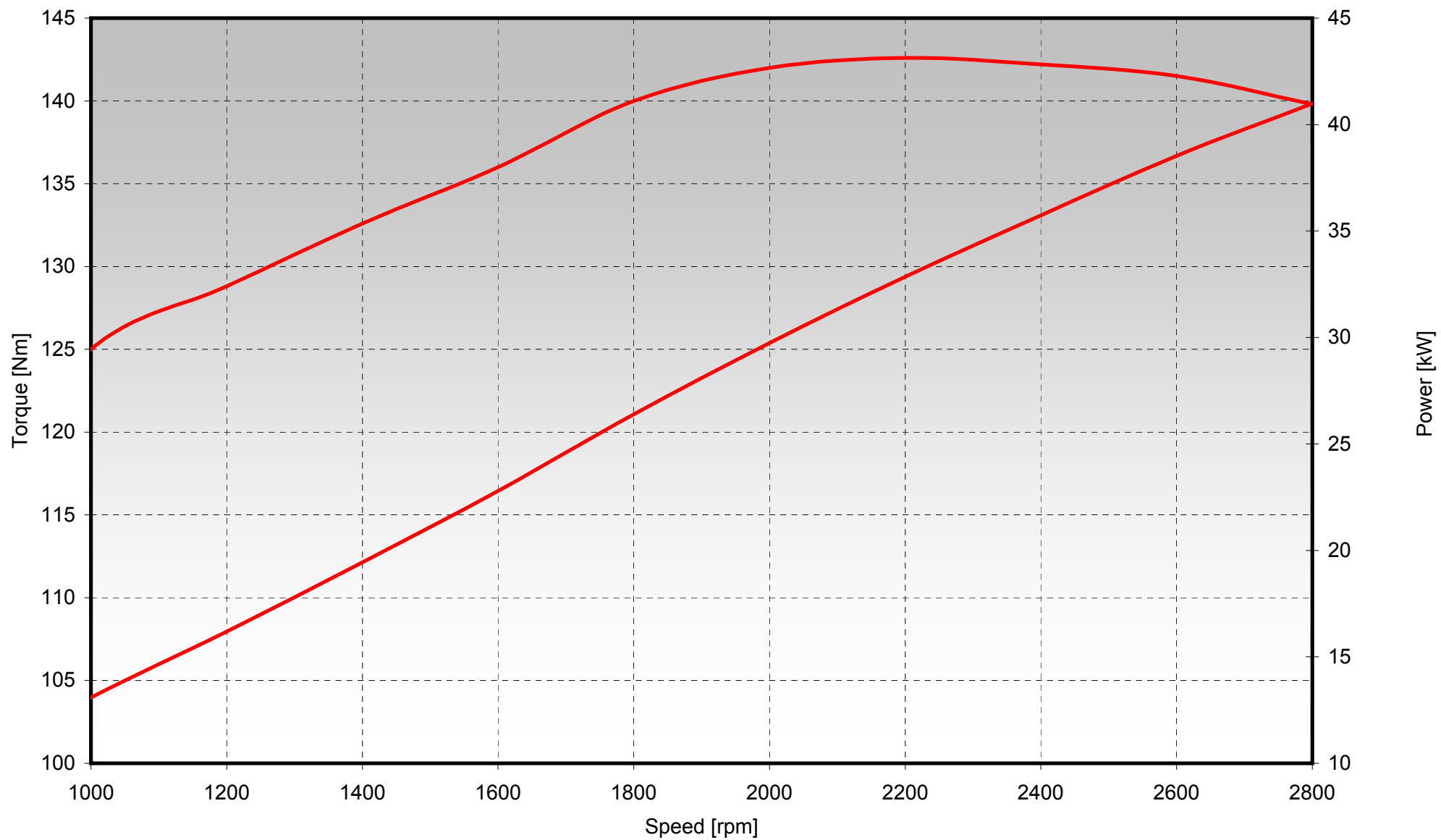
Oil/Oil filter	hr.	500	SAE 5W30 VW504.00
	hr.	500	SAE 5W30 VW 500.00/501.01/502.00
	hr.	300	SAE 5W30 API SF/SG ACEA A2/A3
Spark plugs	hr.	1000	NGK BKUR 6 ET-10
Toothed drive belt	hr.	2000	Normal operation. *)
Poly-V-belt	hr.	3000	Normal operation. *)
Coolant pump	hr.	6000	Normal operation. *)
Coolant	hr.	12.000	No brass parts in cooling system.
Fuel system	hr.	1000/yearly	Depending on fuel and safety regulations

*) Dirty environment to be cleared with EST.

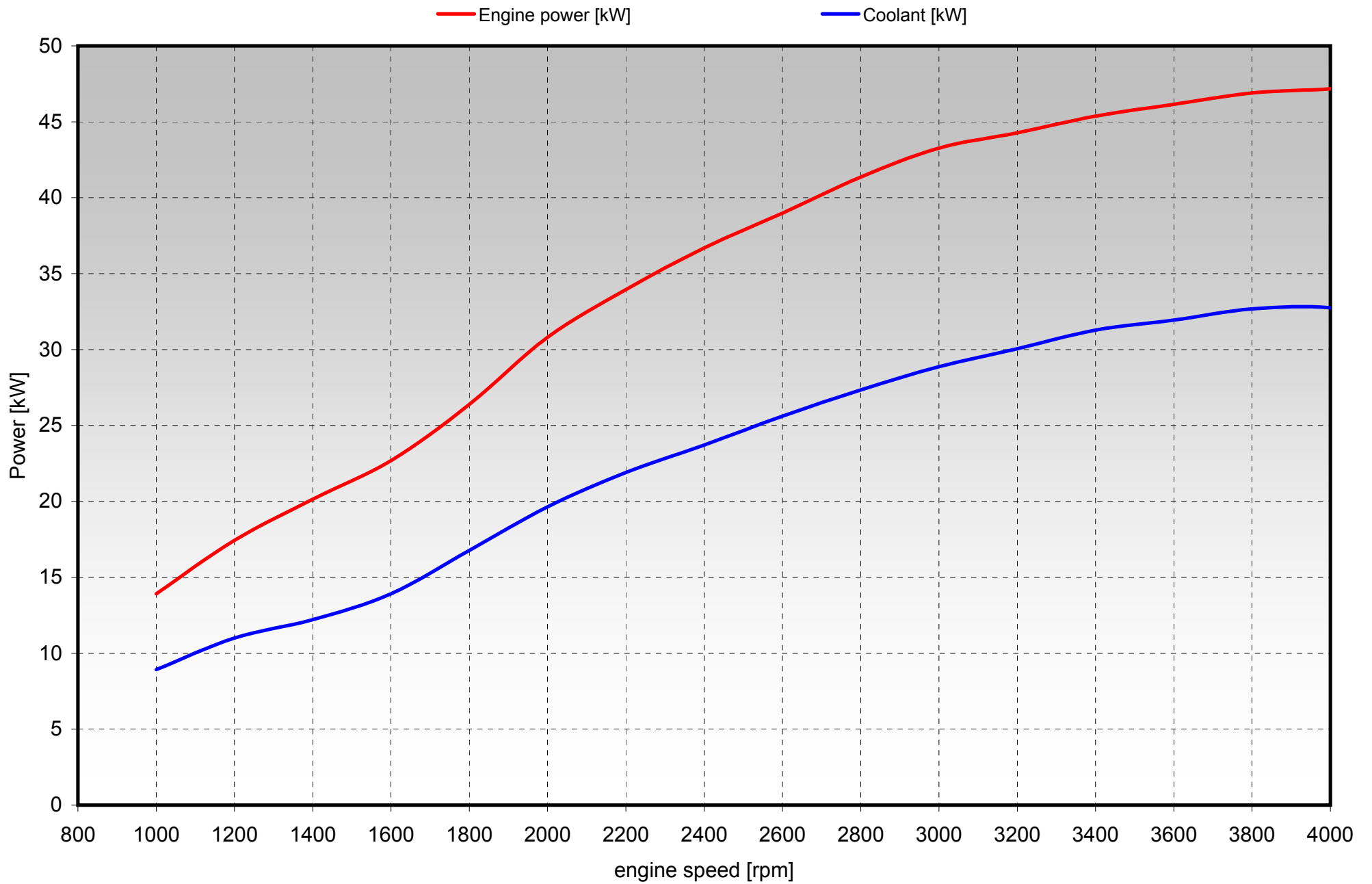
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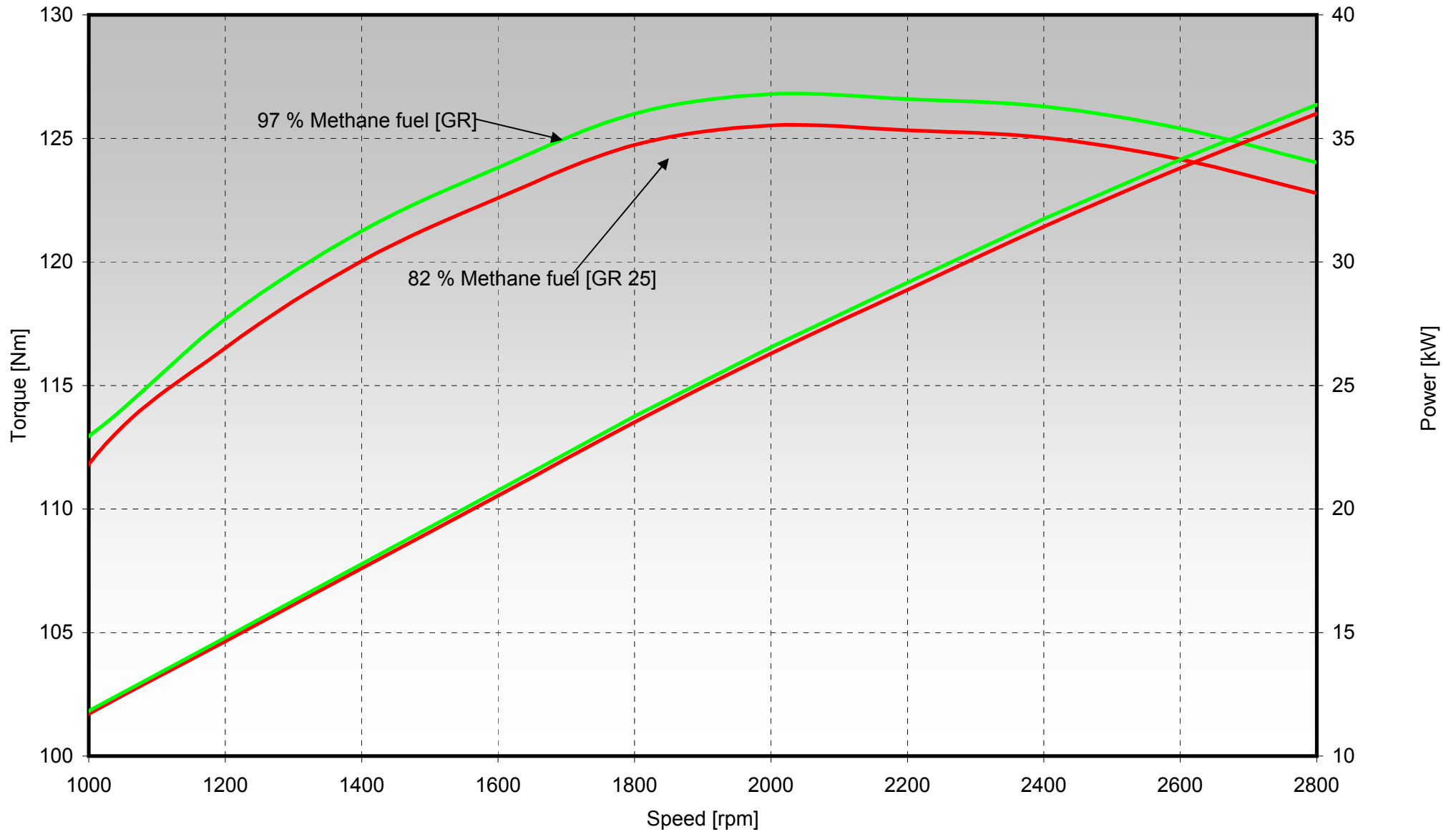
VW BEF Propane [stoich, 55 series]



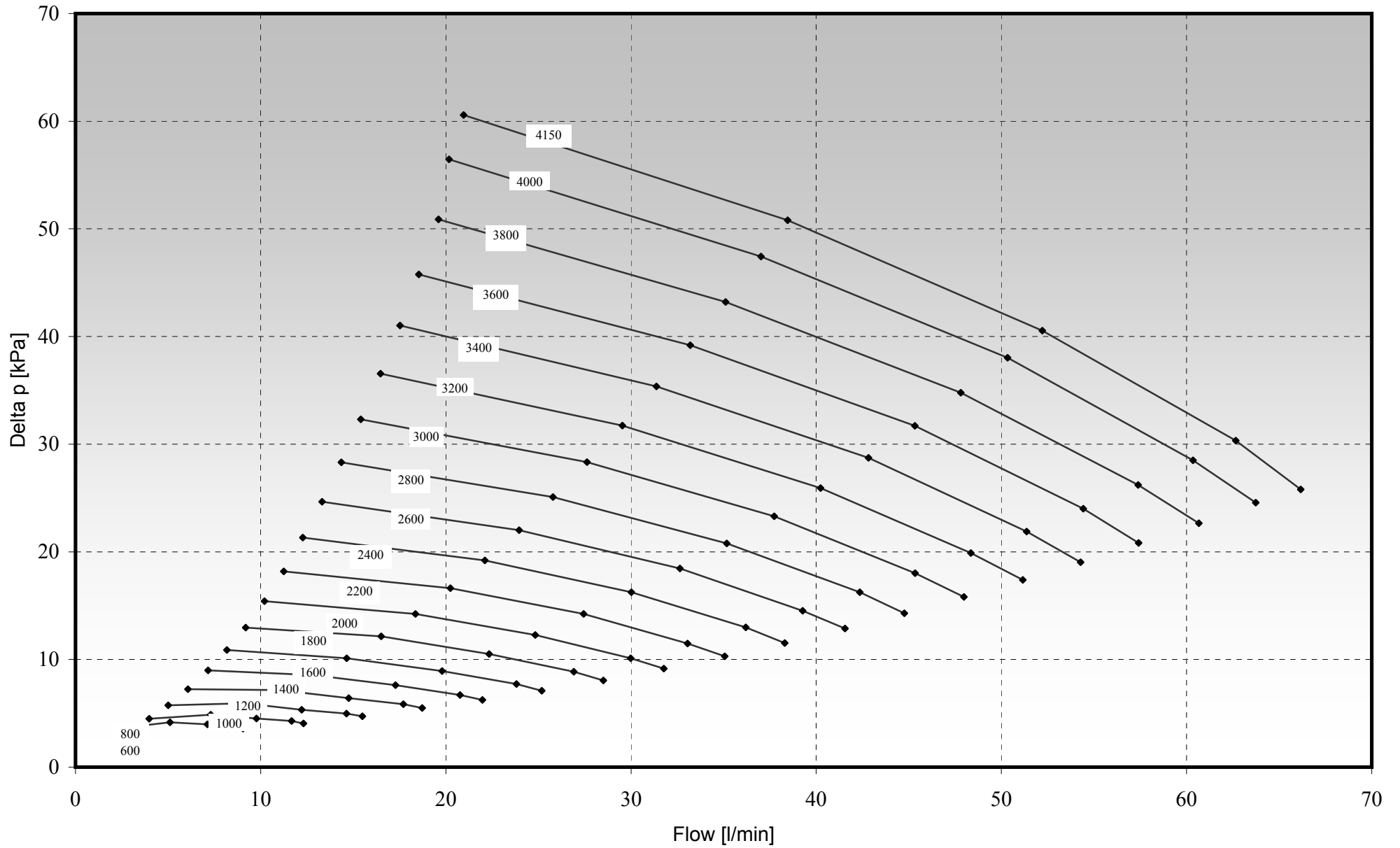
VW BEF, coolant heat release [Propane open loop].



VW BEF Nat. gas [stoich, 55 series]

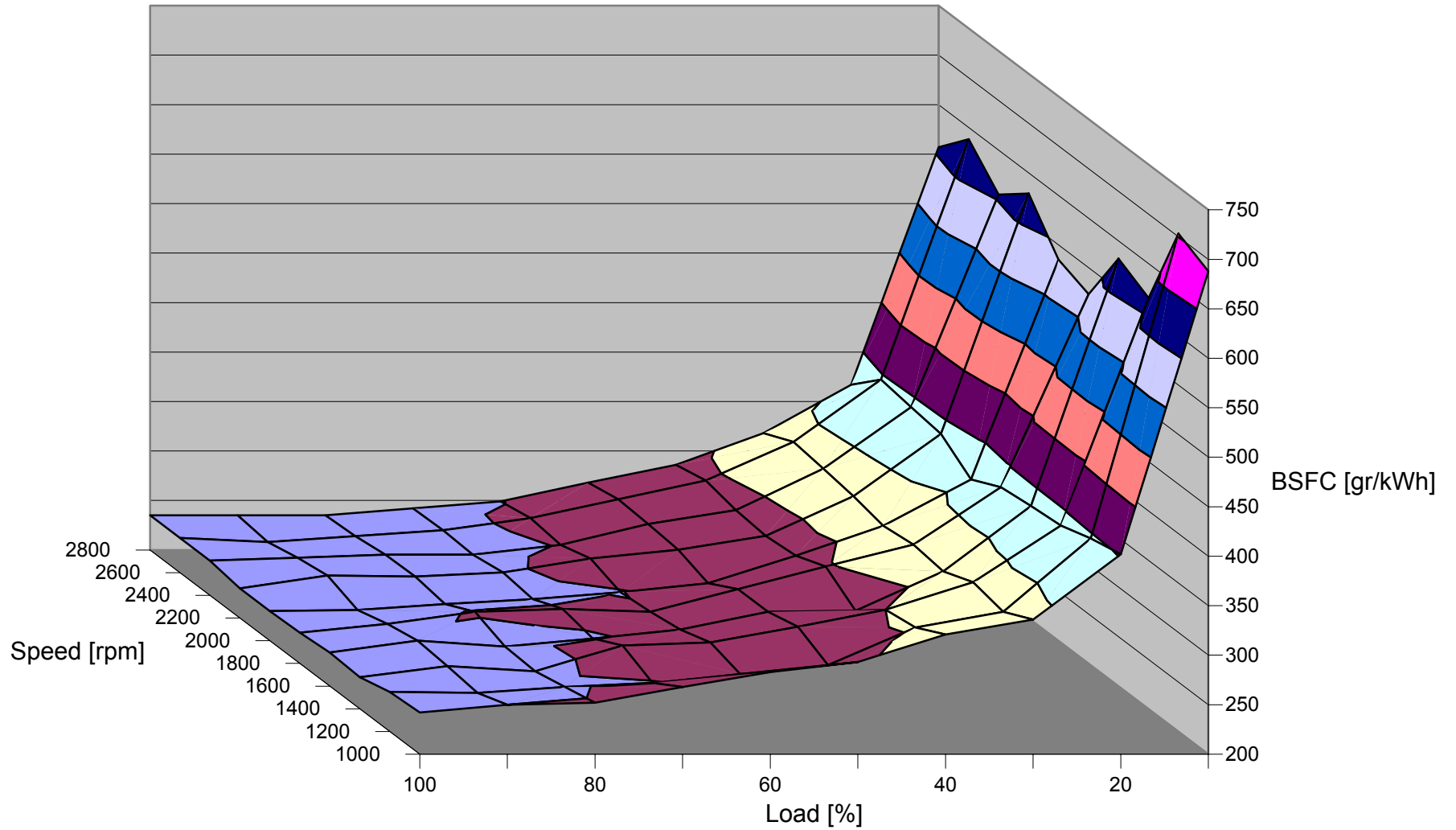


VW BEF, coolant pump flow versus / restriction [thermostat gap 7 mm].



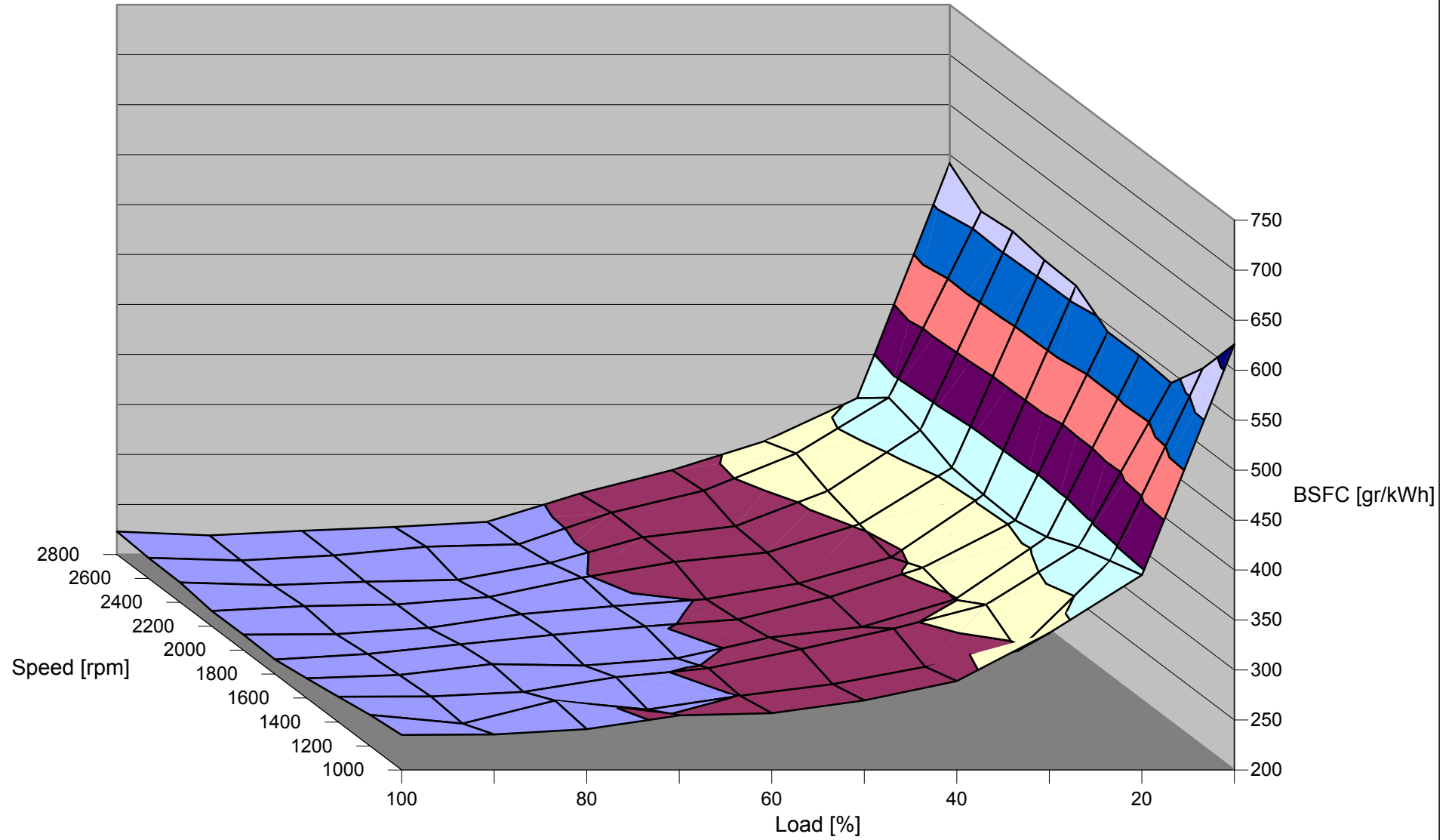
Closed loop [propane]

- 700-750
- 650-700
- 600-650
- 550-600
- 500-550
- 450-500
- 400-450
- 350-400
- 300-350
- 250-300
- 200-250

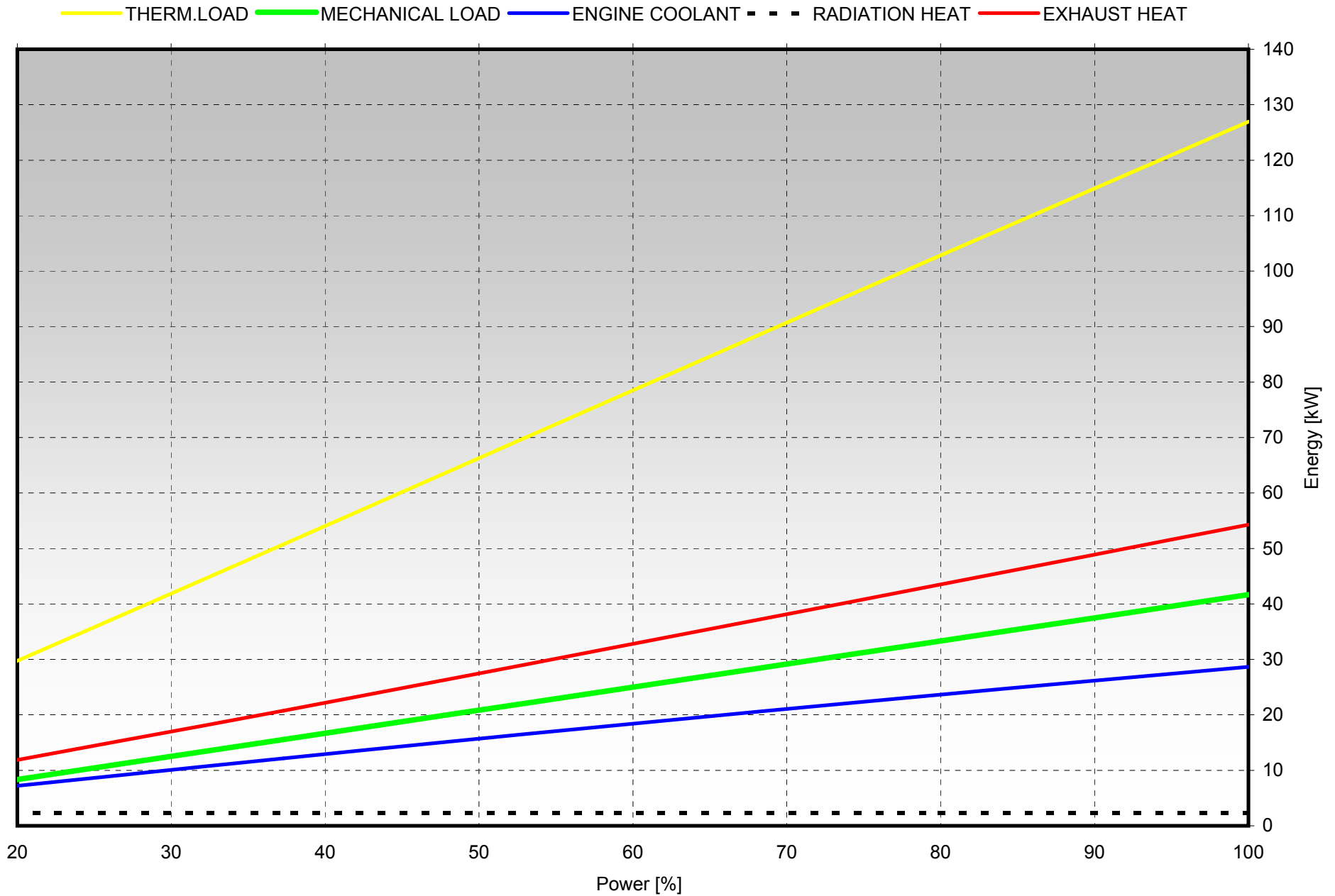


Open loop [Propane]

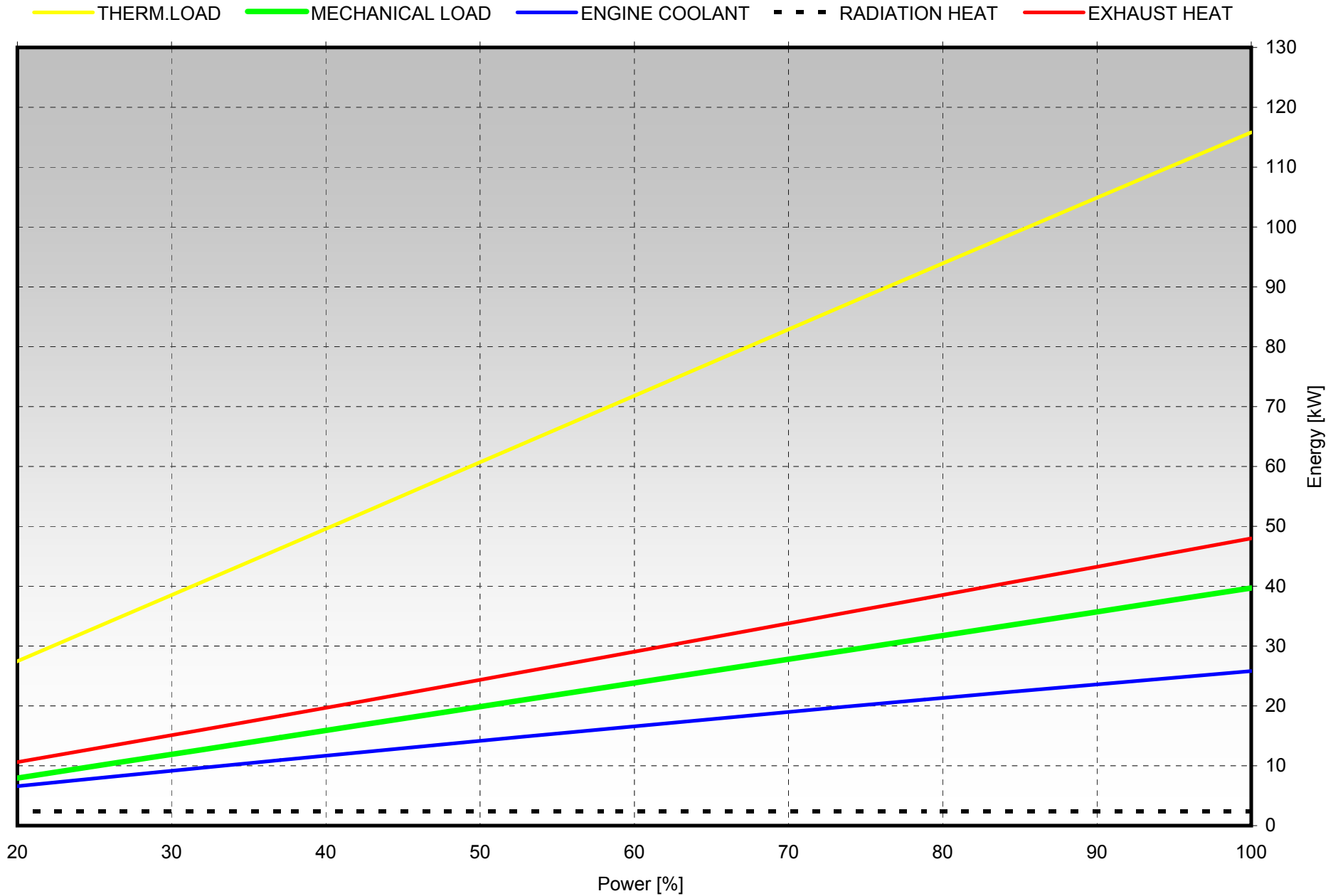
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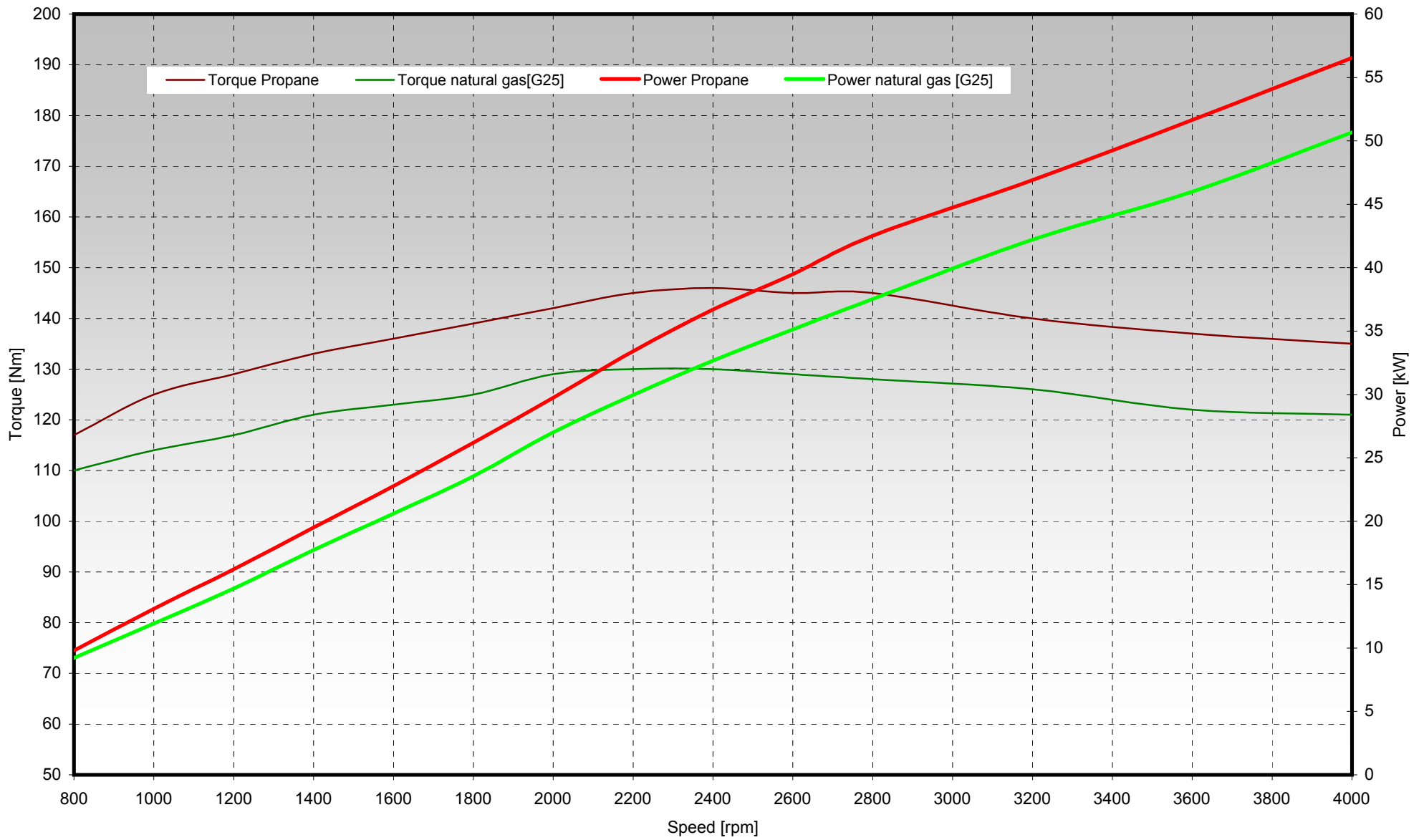
Calculated heat balance [stoich].



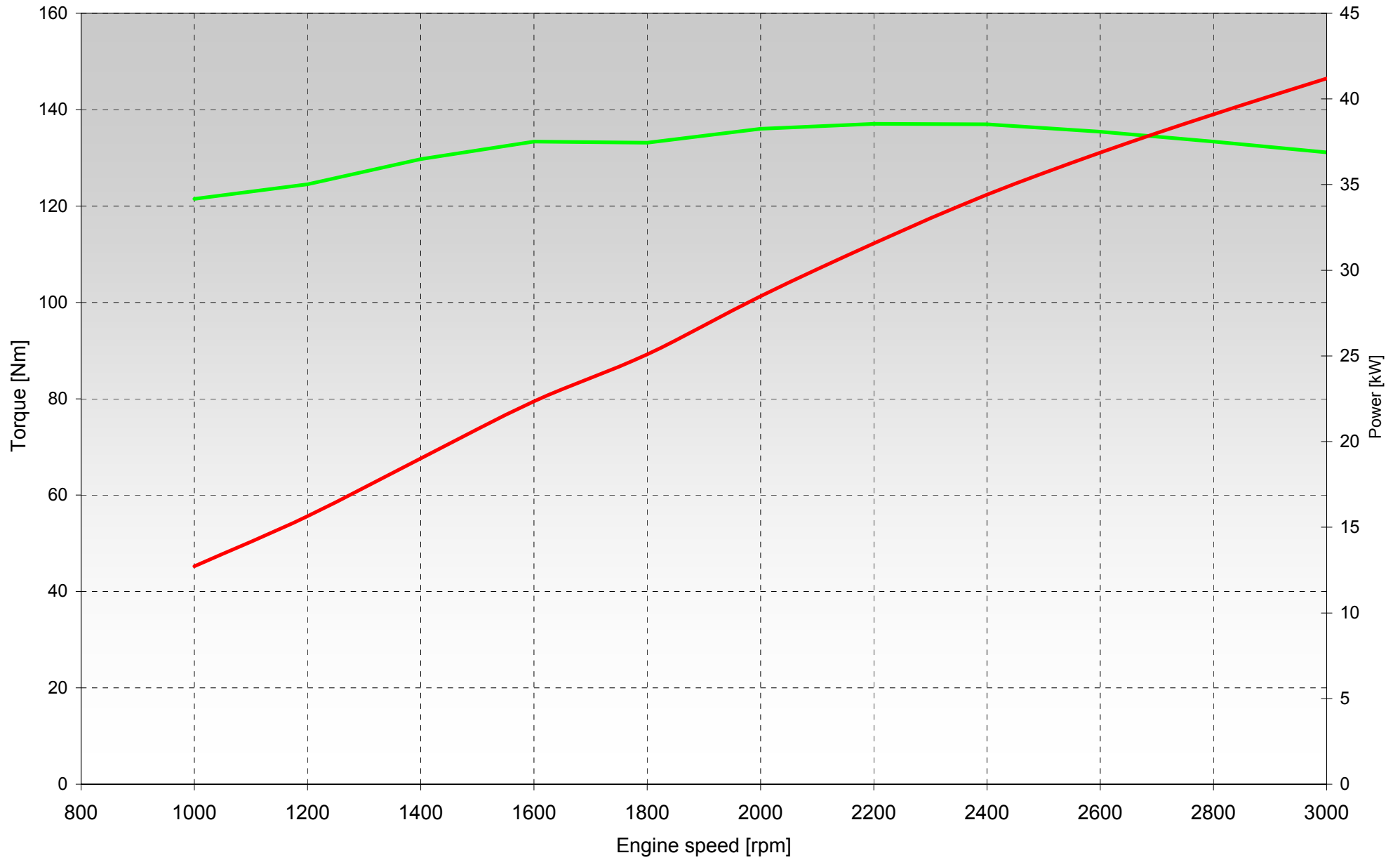
Calculated heat balance [lean]

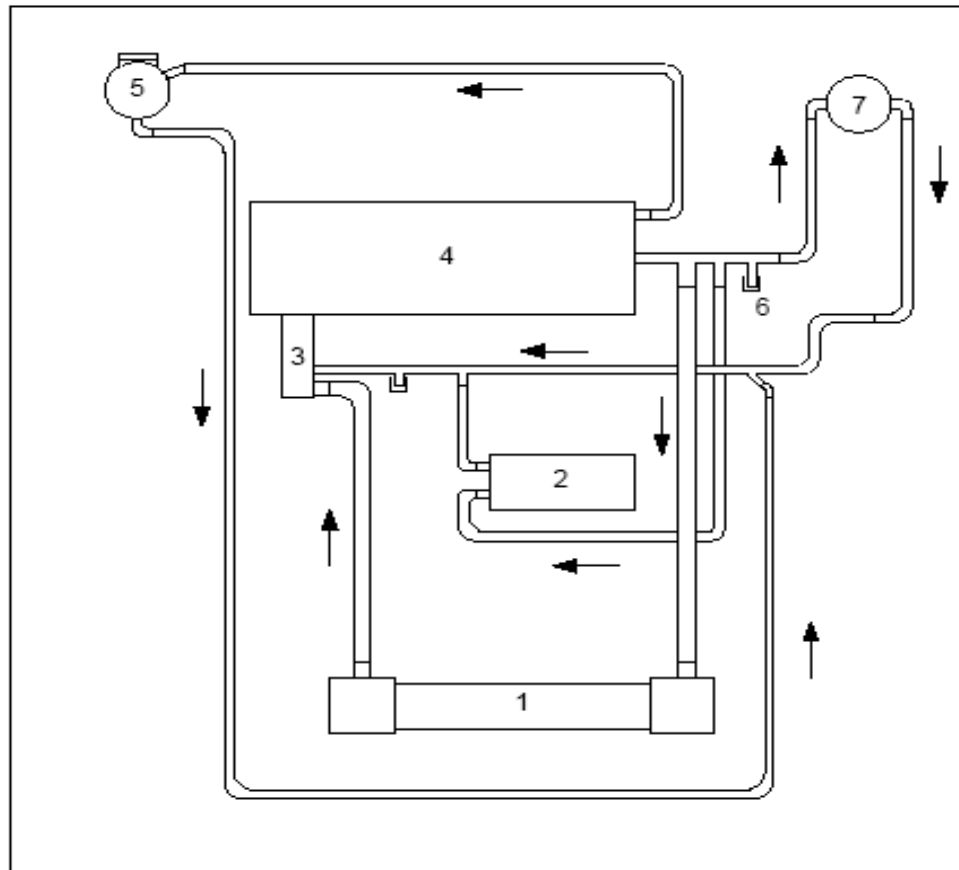


VW BEF Propane, [stoich, 100 series].



Natural gas HCR engine [GR stoich].





- 1 : Cooler
- 2 : Oil cooler
- 3 : Waterpump / Thermostat
- 4 : Engine
- 5 : Expansion tank
- 6 : Connection
- 7 : Evaporator