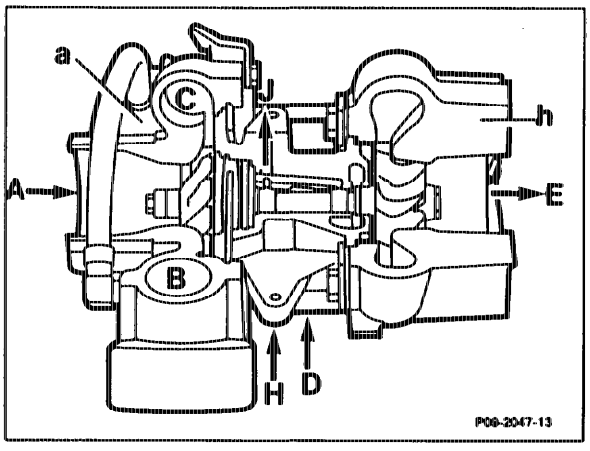
Survey of exhaust gas turbochargers

Engine	Designation
602.96	Garrett TB 025 (USA) 1990 or T 025 KKK K14 [2]) Garret T 025 [4])
603.96	Garrett TB 03 [1]) [3]) or T 03 [1]) [3]) KKK K24 [1]) [3]) KKK 24 [5])
603.971	Garrett TB 03

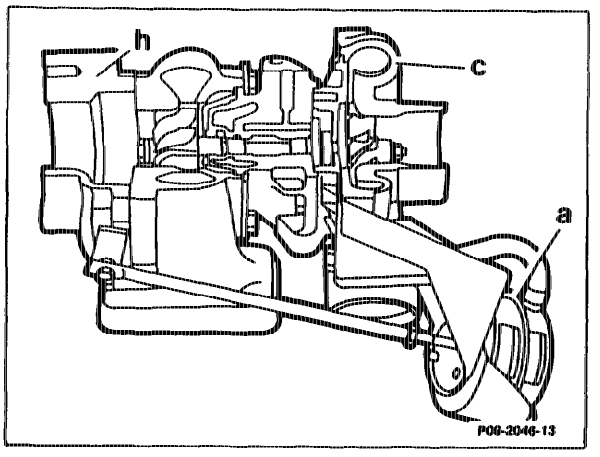
[1]) Optional
[2]) Production breakpoint at a later point in time
KKK = Kühnle, Kopp and Kausch.
[3]) For (USA) California with air recirculation valve.
[4]) With Basic Version Code 62/0 as of 06/91, (A) (FIN) (CH) (DK) (USA) Model Year 1992.
[5]) With Basic Version Code 62/0 as of 06/91, (A) (FIN) (J) Model Year 1992.

Engine 602.961, Garrett TB 025



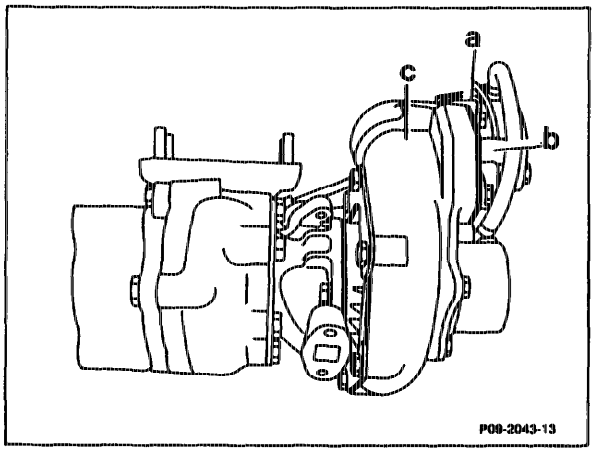
a	Charge pressure control
h	Turbine housing valve
A	Fresh air inlet
B	Compressed air
C	Bypass passage
D	Exhaust inlet
E	Exhaust outlet
H	Oil feed
J	Oil discharge

Engine 603.96, Garrett TB 03



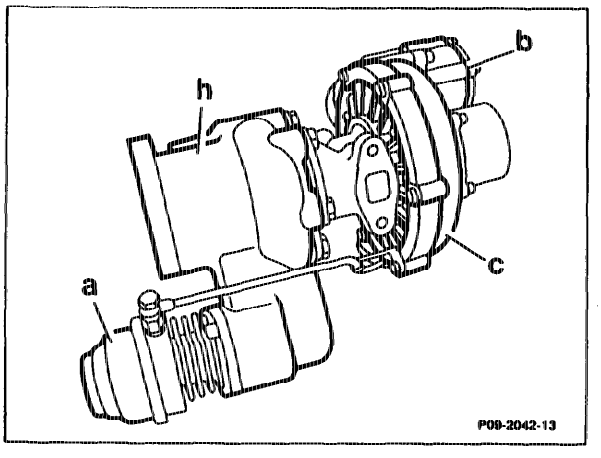
a Charge pressure control valve
c Compressor housing
h Turbine housing

Garrett TB 03 with air recirculation valve (USA)



a Charge pressure control valve
b Air recirculation valve
c Compressor housing

KKK-K24 with air recirculation valve (USA)



a Charge pressure control valve
b Air recirculation valve
c Compressor housing
h Turbine housing

General

The exhaust gas turbocharger (ATL) is a turbine machine. The flow energy of the engine exhaust gas is used for driving the turbine, which in turn drives the compressor via a shaft. The ATL is installed between the exhaust manifold and the exhaust pipe. It is connected to the engine oil circuit for lubrication and cooling.

A charge pressure control valve, fitted to the turbine housing or separately, ensures that a charge pressure of 0.95 bar is not exceeded.If the boost pressure control valve is faulty, engine failure is prevented by means of an engine overload protection (pay attention to note).

The exhaust gases of the engine are passed through the exhaust manifold into the turbine housing (h) and impinge on the turbine wheel (i). The flow energy of the exhaust gases starts the turbine wheel (i) rotating. This causes the compressor wheel (d) which is connected via the shaft (n) to the turbine wheel (i) to be driven at the same speed. The maximum rotation speed is approx. 135 000 rpm. The fresh air drawn in by the compressor wheel (d) is precompressed and passed to the engine.

Note

Engines 602.962, 603.960/963

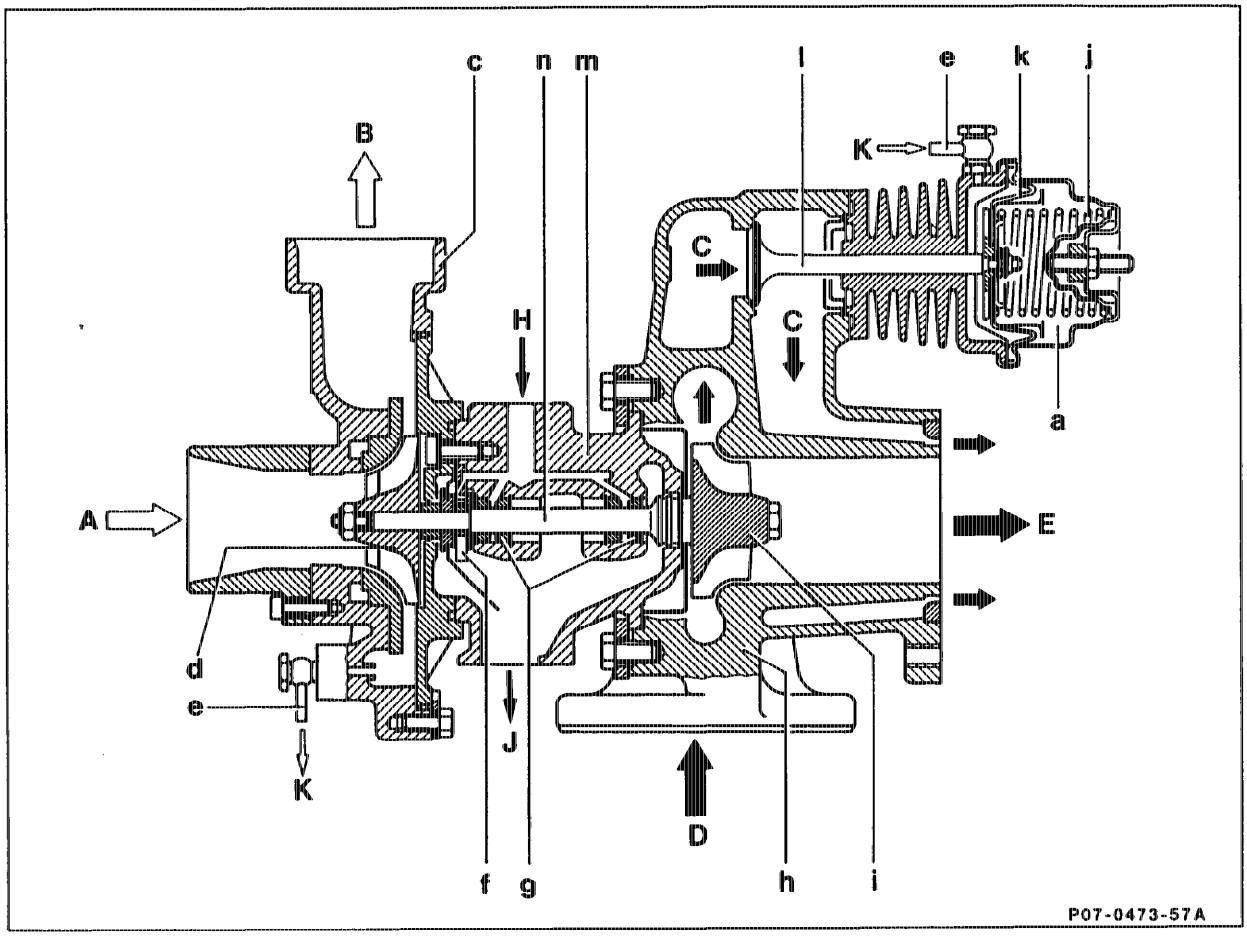
Discontinuation of engine overload protection.

Production breakpoint: as of January 1993

Model	Engine	Engine end no. Manual transmission	Engine end no. Automatic transmission
124.128/188	602.962	027382	-
124.333/393	603.963	-	004004

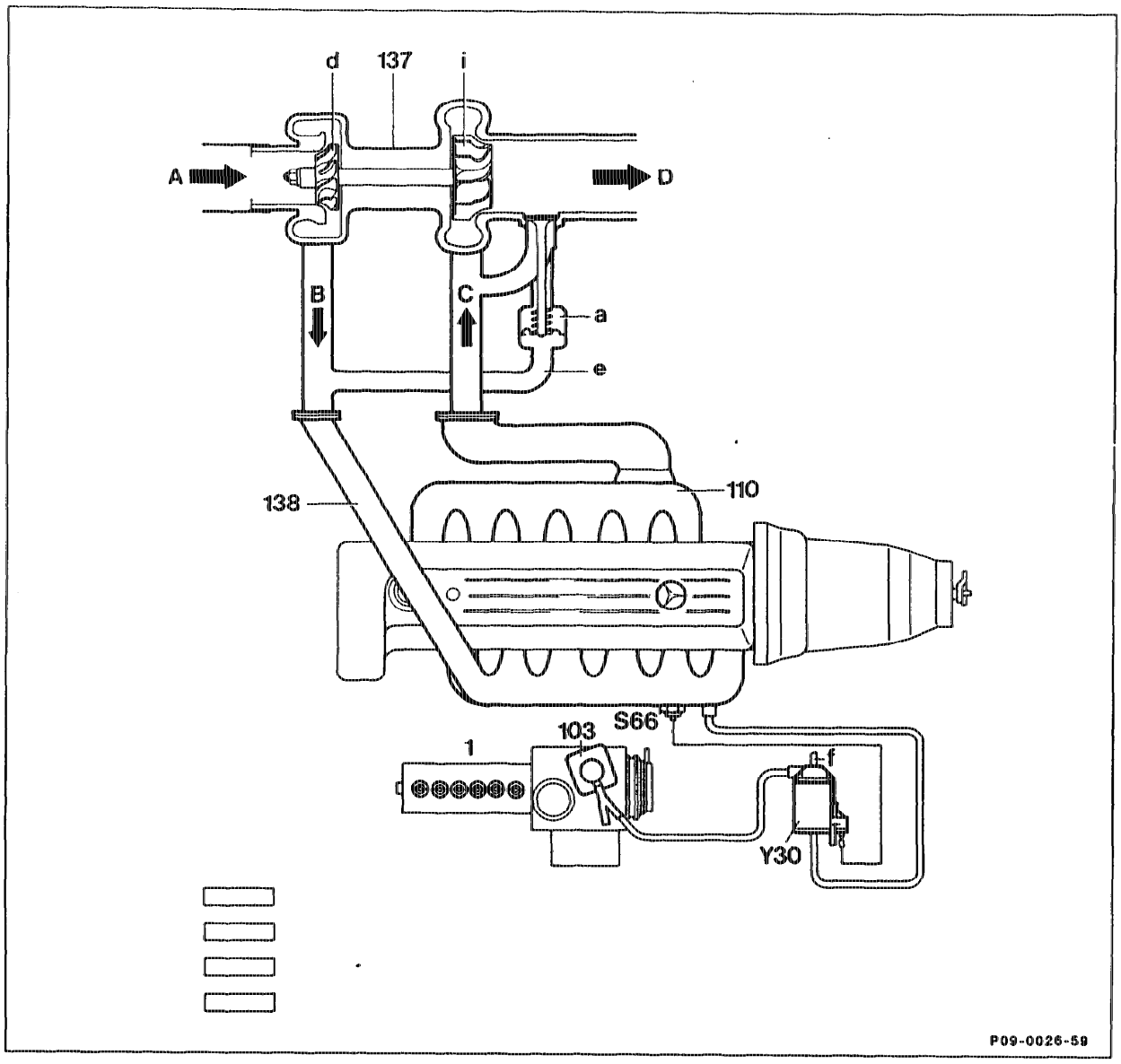
Production breakpoint: as of February 1993

Model	Engine	Engine end no. Automatic transmission
124.128/188	602.962	017181
124.133/193	603.960	046668



Functional diagram turbocharger KKK K24 (Engine 603.96)

a	Charge pressure control valve	m	Charge housing
c	Compressor housing	n	Shaft
d	Compressor wheel	A	Fresh air inlet
e	Control line	B	Compressed air (to engine)
f	Axial bearing	C	Bypass passage/charge pressure control valve
g	Bearing bush	D	Exhaust inlet
h	Turbine housing	E	Exhaust outlet
i	Turbine wheel	H	Oil feed
j	Spring	J	Oil discharge
k	Diaphragm	K	Control pressure
l	Valve		



Function diagram

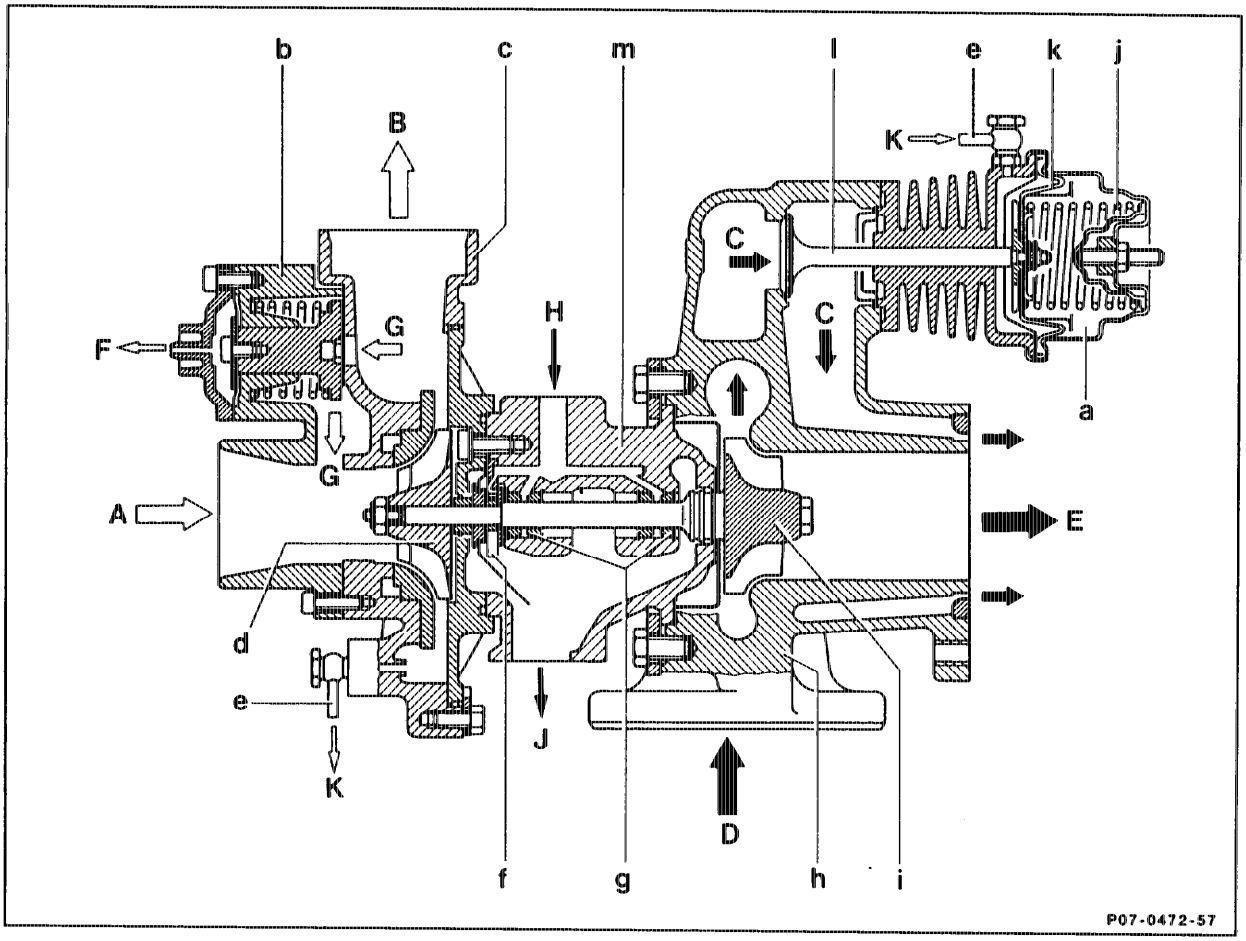
1	Injection pump	a	Charge pressure control valve
103	ALDA unit	d	Compressor wheel
110	Exhaust manifold	e	Control line
137	Exhaust gas turbocharger	f	Air admission
138	Charge air pipe	i	Turbine wheel
S66	Pressure switch, engine overload protection	A	Compressor inlet (fresh air)
Y30	Switchover valve, engine overload protection	B	Compressor outlet (precompressed air)
		C	Exhaust gases to turbine wheel
		D	Exhaust outlet

Air Recirculation Valve

(refer also to EDS Operation No. 07.1–010).

In order to create more favourable combustion conditions for the trap oxidizer, the air recirculation valve is continuously opened or closed in accordance with the performance characteristic map.

After the closing operation, a residual vacuum of approx. 30 mbar is retained at the air circulation valve.

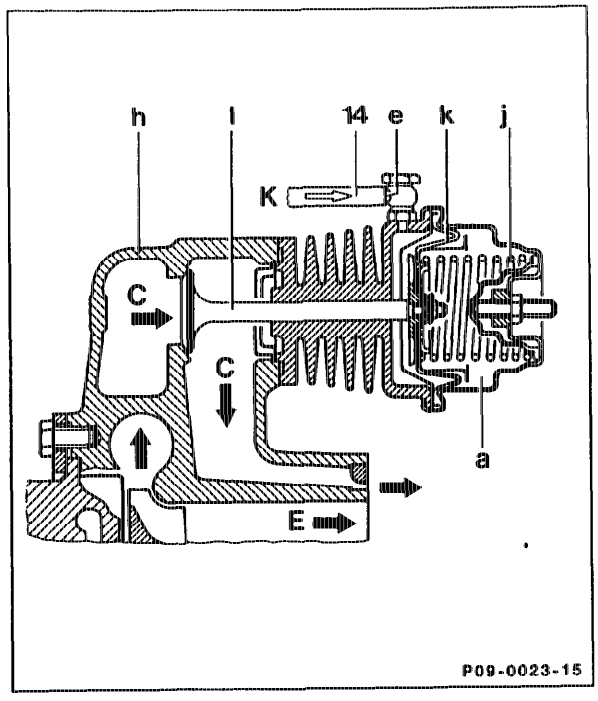


Function diagram turbocharger KKK with air circulation valve (USA) California
Model year 1986/87

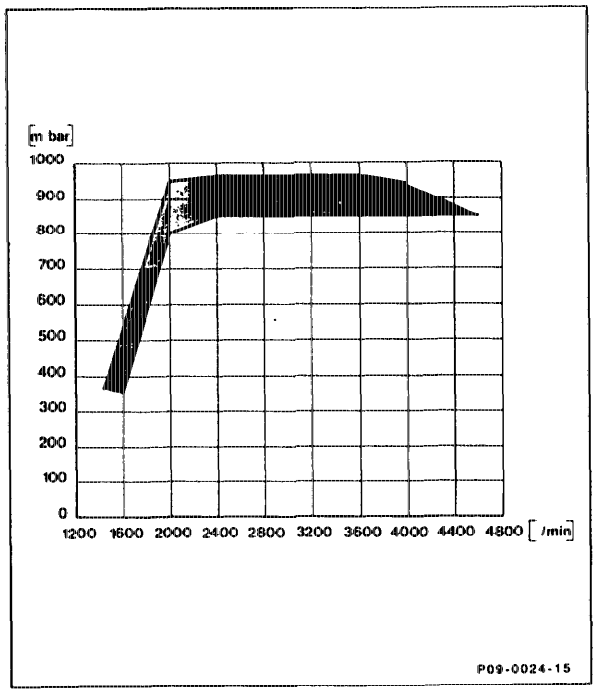
a	Control valve, exhaust gas control flap	A	Compressor inlet (fresh air)
b	Air recirculation valve	B	Compressor outlet (compressor air)
c	Compressor housing	C	Bypass passage, charge pressure control valve
d	Compressor wheel	D	Exhaust gas to turbine wheel
e	Connector hose	E	Exhaust gas outlet
f	Axial bearing	F	Vacuum connection to vacuum transducer
g	Bearing bush	G	Recirculated air
h	Turbine housing	H	Lubrication oil inlet
i	Turbine wheel	J	Lubrication oil outlet
j	Compression spring	K	Charge pressure (control valve exhaust gas control flap)
k	Diaphragm		
l	Charge pressure control valve		
m	Intermediate housing		

Charge Pressure Control Valve (KKK)

To prevent the charge pressure rising above a certain level, a charge pressure control valve (a) is attached to the turbine housing (h). The charge pressure is tapped at the compressor housing and passed through the connecting hose (14) to the charge pressure control valve. When the charge pressure is reached, the charge pressure valve begins to open and allows the exhaust gas to flow along the bypass passage (C). Part of the exhaust gas is now flowing directly to the exhaust pipe, with the result that the charge pressure remains at a constant level.

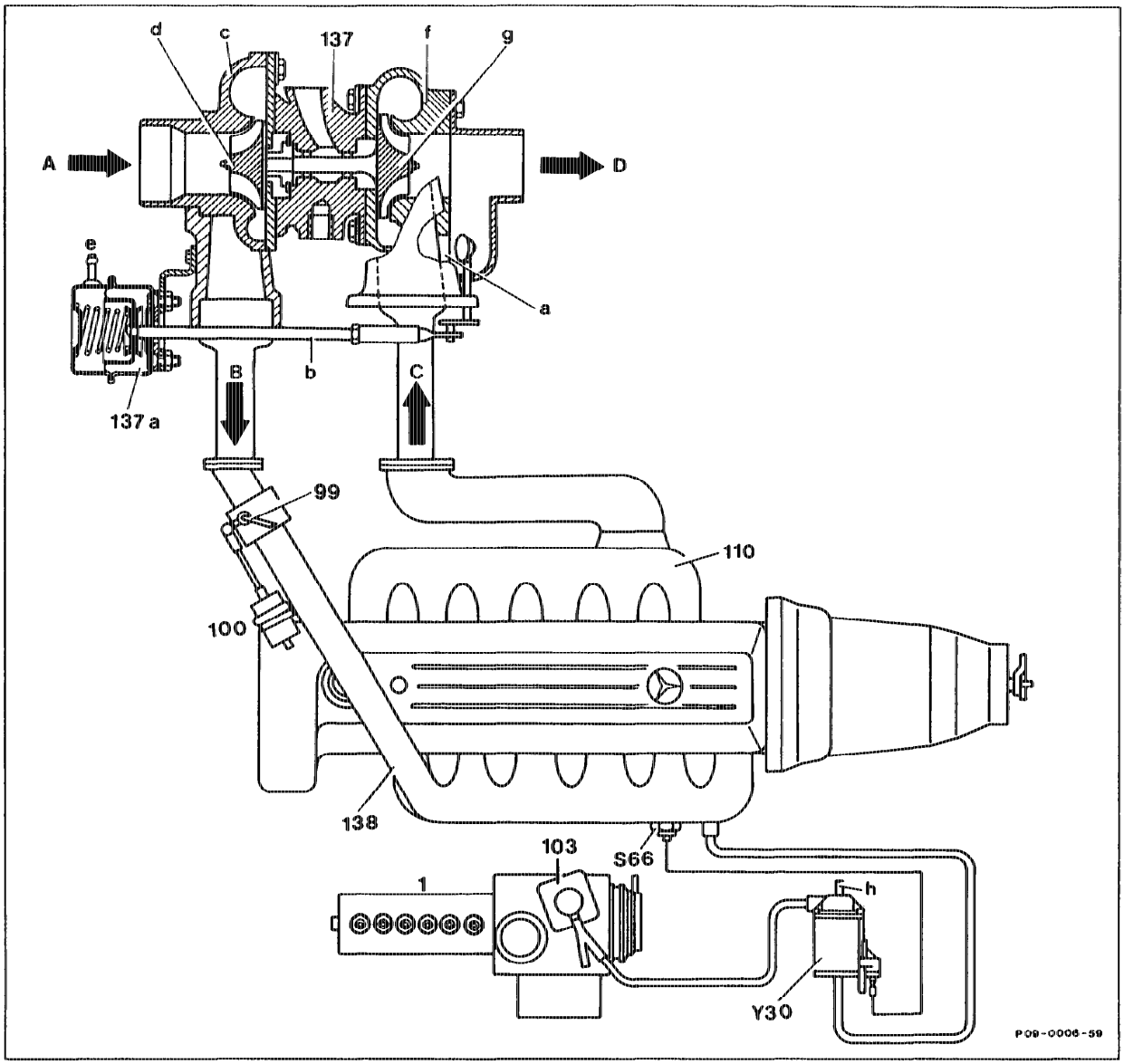


14 Connecting hose
a Charge pressure control valve
e Control line
h Turbine housing
j Spring
k Diaphragm
l Valve
C Bypass passage
E Exhaust gas outlet



Charge pressure diagram – full load

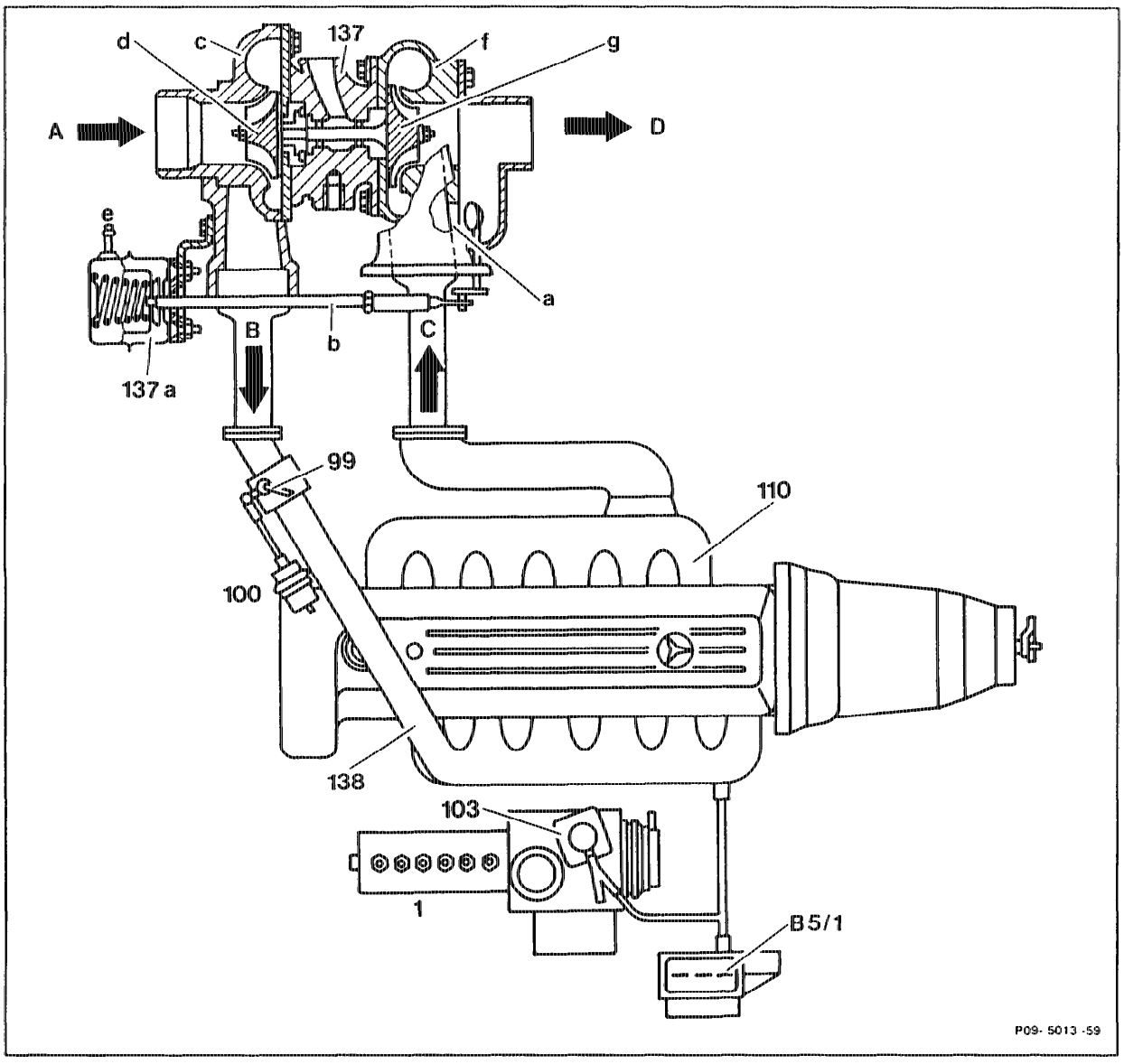
Boost pressure control by means of vacuum-controlled boost pressure control valve
Engine 602.96 (USA) Model Year 1990



Function diagram

1	Injection pump	A	Compressor inlet (fresh air)
99	Vacuum control flap	B	Compressor outlet (compressed air P2)
100	Vacuum control flap vacuum unit	C	Exhaust gases to turbine wheel
103	ALDA unit	D	Exhaust gas outlet
110	Exhaust manifold		
137	Exhaust gas turbocharger	a	Bypass passage
137a	Boost pressure control valve vacuum unit	b	Control linkage
138	Charge air pipe	c	Compressor housing
		d	Compressor wheel
S66	Engine overload protection pressure switch	e	Control line connection
Y30	Engine overload protection switchover valve	f	Turbine housing
		g	Turbine wheel
		h	Air admission

Boost pressure control by means of vacuum-controlled boost pressure control valve
Engine 602.96 (USA) as of Model Year 1991, (A) (FIN) (CH) (DK) as of Model Year 1992
Engine 603.971 (USA) as of Model Year 1992

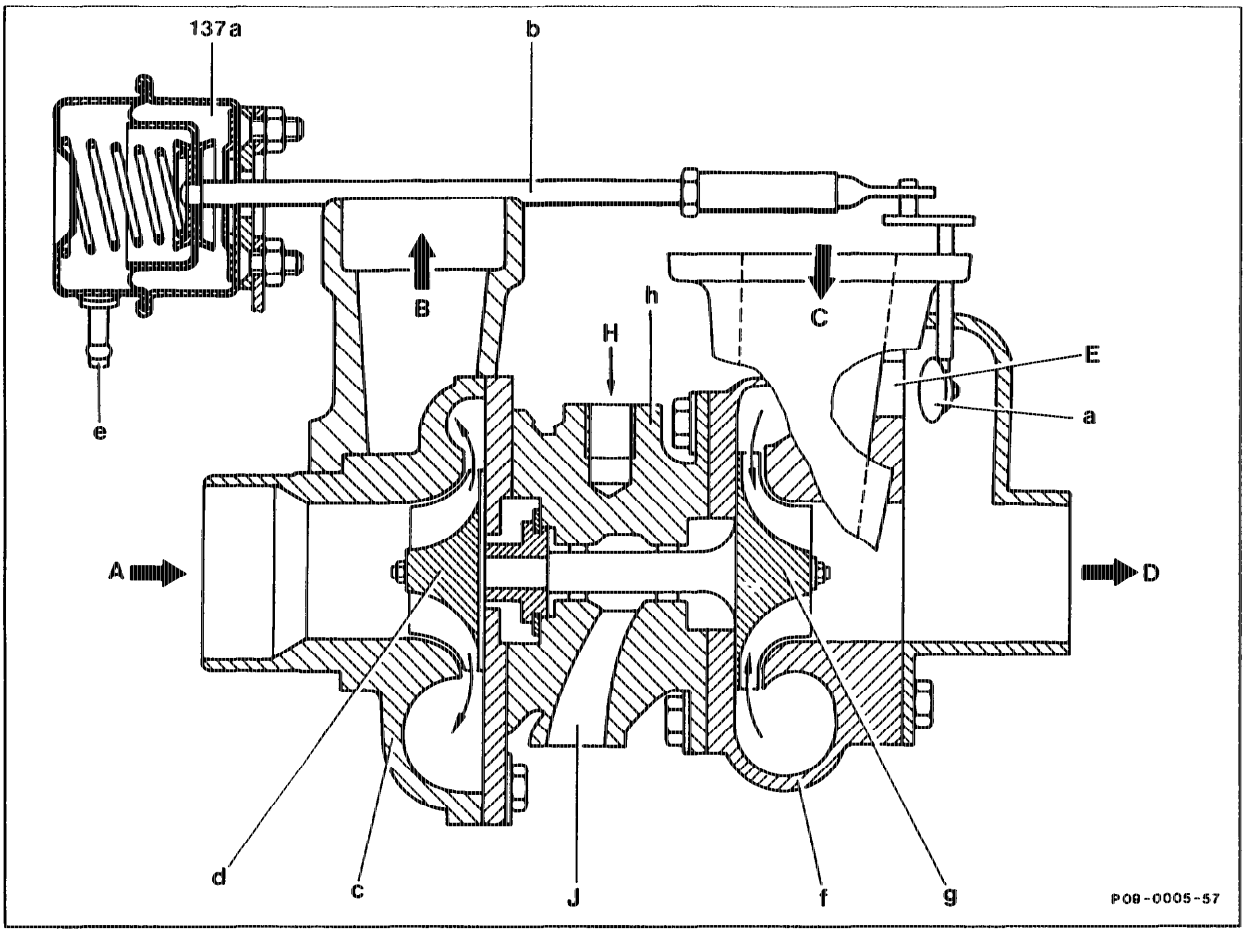


Function diagram

B5/1	EDS pressure sensor
1	Injection pump
99	Vacuum control flap (not M603.971)
100	Vacuum control flap vacuum unit (not M603.971)
103	ALDA unit
110	Exhaust manifold
137	Exhaust gas turbocharger
137a	Boost pressure control valve vacuum unit
138	Charge air pipe

A	Compressor inlet (fresh air)
B	Compressor outlet (compressed air P2)
C	Exhaust gases to turbine wheel
D	Exhaust gas outlet
a	Bypass passage
b	Control linkage
c	Compressor housing
d	Compressor wheel
e	Control line connection
f	Turbine housing
g	Turbine wheel
h	Air admission

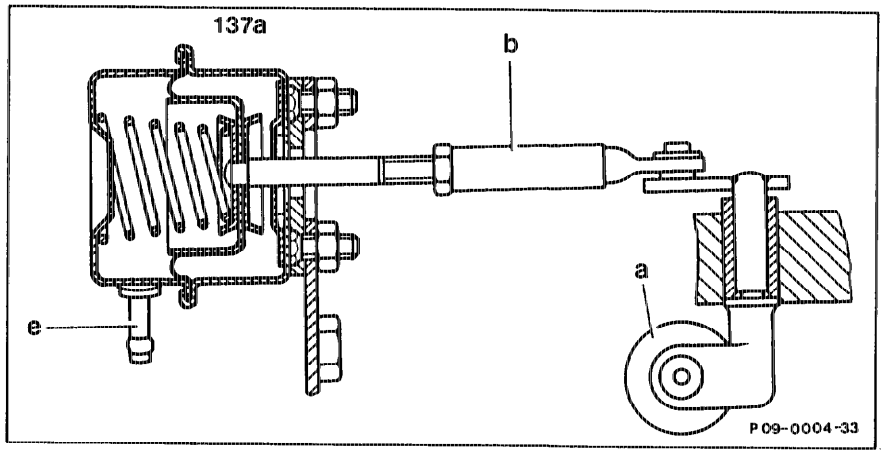
Function diagram exhaust gas turbocharger



137a	Boost pressure control valve vacuum unit	a	Bypass flap
		b	Control linkage
A	Fresh air inlet	c	Compressor housing
B	Compressed air (P2)	d	Compressor wheel
C	Exhaust gas inlet	e	Control line connection
D	Exhaust gas outlet	f	Turbine housing
E	Bypass passage	g	Turbine wheel
H	Oil supply	h	Turbocharger housing
J	Oil return		

Boost pressure control valve vacuum unit

With the boost pressure control, the bypass flap (a) from the turbocharger is opened with the controlled vacuum from the boost pressure control/vacuum control flap vacuum transducer (Y31/5), engine 602.96, or from the boost pressure control vacuum transducer (Y31/4), engine 603.971.
The flap is operated by the control linkage (b).



137a Boost pressure control valve vacuum unit
a Bypass flap
b Control linkage
e Control line connection

Idling and Lower Part Load

No compression occurs during idling and in the lower part load, the engine is operating as a naturally aspirated engine.

Upper Part Load and Full Load

As the engine load and speed increases, e.g. with an increase in the exhaust gas flow, the turbine wheel (i) is accelerated with the result that the compressor wheel (d) produces a charge pressure up to a certain value. The compressed charge air is passed through the charge air pipe to the individual cylinders. The charge pressure allows increased quantity of fuel to flow through the ALDA unit at the injection pump.

Although charge pressure exists in the deceleration mode, fuel injection is stopped as a result of the control rod position (decel fuel cutoff).