PORSCHE



AfterSales Training

General Servicing & Repair – Sports Cars

P001

Porsche AfterSales Training

Student Name: _____

Training Center Location: _____

Instructor Name: _____

Date: _____

Important Notice: The contents of this AfterSales Training brochure was originally written by Porsche AG for its rest-of-world English speaking market. The electronic text and graphic files were then imported by Porsche Cars N.A, Inc. and edited for content. Some equipment and technical data listed in this publication may not be applicable for our market. Specifications are subject to change without notice.

We have attempted to render the text within this publication to American English as best as we could. We reserve the right to make changes without notice.

© 2007 Porsche Cars North America, Inc. All Rights Reserved. Reproduction or translation in whole or in part is not permitted without written authorization from publisher. AfterSales Training Publications

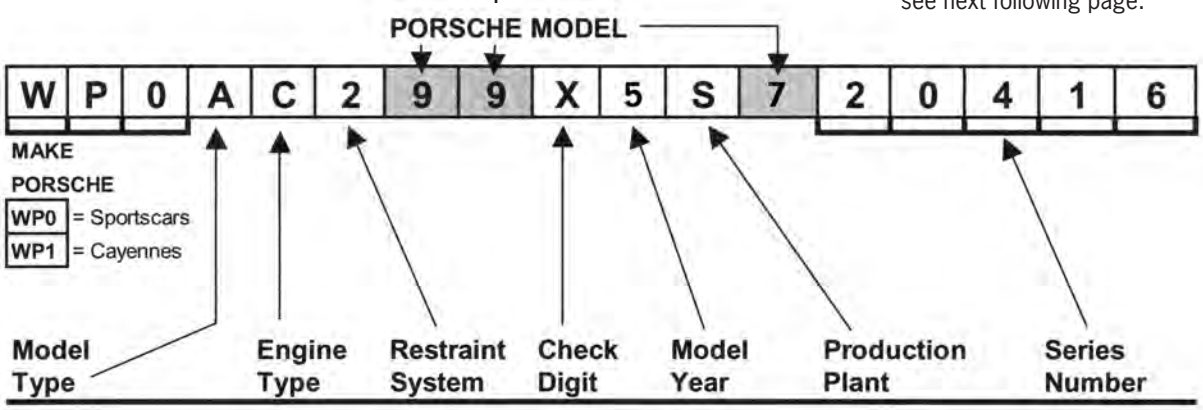
Dr. Ing. h.c. F. Porsche AG is the owner of numerous trademarks, both registered and unregistered, including without limitation the Porsche Crest®, Porsche®, Boxster®, Carrera®, Cayenne®, Cayman™, Tiptronic®, VarioCam®, PCM®, 911®, 4S®, and the model numbers and distinctive shapes of Porsche's automobiles such as, the federally registered 911 automobile. The third party trademarks contained herein are the properties of their respective owners. Porsche Cars North America, Inc., believes the specifications to be correct at the time of printing. However, specifications, standard equipment and options are subject to change without notice.

Part Number - PNA P00 103 Edition - 5/07

Description	Section
Section 0 – General Information	0
Section 1 – Engine	1
Section 2 – Fuel, Exhaust and Engine Electrics	2
Section 3 – Transmission/Clutch	3
Section 4 – Chassis and Brakes	4
Section 5 – Body	5
Section 6 – Body Equipment, Exterior	6
Section 7 – Body Equipment, Interior	7
Section 8 – Heating and Air Conditioning	8
Section 9 – Electical System	9
Conversion Charts	10

Porsche Vehicle Identification Number (VIN) Structure

Example
980 = Carrera GT
986 = Boxster
987 = Boxster/Cayman
996 = 911 Carrera (996)
997 = 911 Carrera (997)
9PA = Cayenne
For additional model information see next following page.



A
911 Coupe
911 Carrera 2,4
911 Turbo Coupe
924S Coupe
928 S4 Coupe ('91 MY)
944 Coupe
944 S Coupe
944 S Turbo Coupe
911GT2
Cayenne S
Cayenne Turbo

B
911 Carrera 2,4 Targa

C
911 Carrera 2,4 Cabriolet
Boxster

D
911 Targa ('96MY →)

E
911 Targa + Cabriolet
911 Turbo, Targa, Cabriolet (Prior to '99MY)

J
928 S4 Coupe
911 Turbo Coupe

A
B
C

A= Normally Aspirated
B= Normally Aspirated
C=Turbo

Note: Letters D, E, F, etc. have also been used in various years and they are not necessarily model specific.

0 Active

2 Passive

Per NHTSA Code

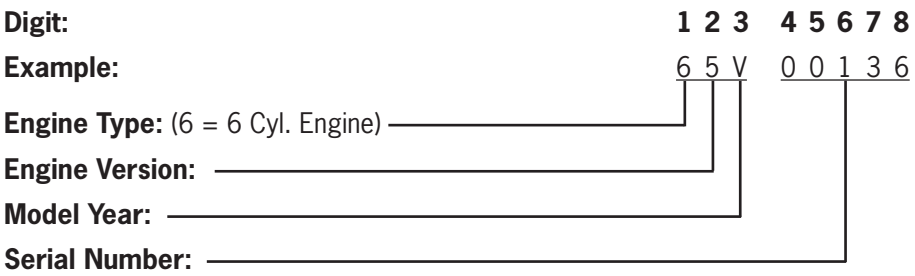
B = 1981
C = 1982
D = 1983
E = 1984
F = 1985
G = 1986
H = 1987
J = 1988
K = 1989
L = 1990
M = 1991
N = 1992
P = 1993
R = 1994
S = 1995
T = 1996
V = 1997
W = 1998
X = 1999
Y = 2000
1 = 2001
2 = 2002
3 = 2003
4 = 2004
5 = 2005
6 = 2006
7 = 2007
8 = 2008
9 = 2009
A = 2010

N Neckarsulm
S Stuttgart
U Finland Production (Boxster)
L Leipzig (Cayenne Models)

Model Year 1981-on USA Model Designations Used In The 17 Digit VIN

911 .....911 (Various models 1981-89)
924 .....924 (Various models 1981-88)
928 .....(Various models 1981-95)
930 .....911 Turbo (1981-1989)
931 .....924 Turbo (1981-82)
944 .....(Various models 1985-91)
951 .....944 Turbo (1986-89)
964 .....911 Carrera (Various models 1989-94)
968 .....968 (1992-1995)
980 .....Carrera GT (2004-on)
986 .....Boxster (Various models 1997-04)
987 .....Boxster (Various models 2005-on)/Cayman (2006-on)
993 .....911 Carrera (Various models 1995-98)
996 .....911 Carrera (Various models 1999-05)
997 .....911 Carrera (Various models 2005-on)
9PA .....Cayenne (Various models 2003-06)
9PA .....Cayenne – Second Generation (Various models 2008)

Engine Number Identification



Sports Cars Engine Type Designations Since Model Year 1984

Model Year	Engine Type	Displ. Liters	Engine Power kW / HP *	Installed In
1984	930.20	3.2	170/231	911 Carrera - RoW
	930.21	3.2	152/207	911 Carrera - USA/Canada/Japan
	930.66	3.3	221/300	911 Turbo - Worldwide
1985	930.20	3.2	170/231	911 Carrera - RoW
	930.21	3.2	152/207	FRG/USA/Canada/Japan (with catalytic converter)
	930.26	3.2	170/231	Sweden /Switzerland /Australia
	930.66	3.3	221/300	911 Turbo - Worldwide
1986	930.20	3.2	170/231	911 Carrera - RoW
	930.21	3.2	152/207	911 Carrera USA/Canada/Japan
	930.26	3.2	170/231	911 Carrera Sweden./Switzerland/Australia
	930.66	3.3	221/300	ROW/Canada
	930.68	3.3	208/282	911 Turbo - USA (with catalytic convverter)
1987	930.20	3.2	170/231	911 Carrera - RoW
	930.25	3.2	160/217	USA / Japan
	930.26	3.2	170/231	Sweden
	930.66	3.3	221/300	RoW/Canada
	930.68	3.3	210/282	USA (with catalytic converter)
1988	930.20	3.2	170/231	911 Carrera - RoW
	930.25	3.2	160/217	USA/Japan/Canada/Australia/RoW (with catalytic conv.)
	930.26	3.2	170/231	Sweden
	930.66	3.3	221/300	Turbo RoW
	930.68	3.3	210/282	Turbo USA/Canada
1989	930.20	3.2	170/231	911 Carrera - RoW
	930.25	3.2	160/217	USA/Canada/Japan/Australia/RoW (with catalytic conv.)
	930.66	3.3	221/300	911 Turbo - RoW
	930.68	3.3	210/282	911 Turbo - USA
	M 64.01	3.6	184/250	911 Carrera 4 (964) - Worldwide
1990	M 64.01	3.6	184/250	911 Carrera (964) 2/4 with manual transmission - Worldwide
	M 64.02	3.6	184/250	911 Carrera (964) 2 with tiptronic transmission - Worldwide
1991	M64.01	3.6	184/250	911 Carrera (964) 2/4
	M64.02	3.6	184/250	911 Carrera (964) 2
	M30.69	3.3	235/320	911 Turbo (964)

Sports Cars Engine Type Designations Since Model Year 1984 (cont'd)

Model Year	Engine Type	Displ. Liters	Engine Power kW / HP *	Installed In
1992	M64.01	3.6	184/250	911 Carrera (964) 2/4
	M64.02	3.6	184/250	911 Carrera (964) 2
	M64.03	3.6	191/260	911 Carrera (964) RS
	M30.69	3.3	235/320	911 Turbo (964)
1993	M64.01	3.6	184/250	911 Carrera (964) 2/4
	M64.02	3.6	184/250	911 Carrera (964) 2
	M64.03	3.6	191/260	911 Carrera (964) RS
	M64.50	3.6	265/360	911 Turbo (964)
1994	M64.01	3.6	184/250	911 Carrera (964) 2/4 USA
	M64.02	3.6	184/250	911 Carrera (964) 2 USA
	M64.05	3.6	200/272	911 Carrera (964) RoW
	M64.06	3.6	200/272	911 Carrera (964) RoW & Taiwan with Tiptronic
	M64.50	3.6	265/355	911 Turbo USA/CDN
1995	M64.05	3.6	200/272	911 Carrera (964) RoW
	M64.06	3.6	200/272	911 Carrera (964) RoW
	M64.20	3.7	220/300	911 Carrera (993) RS RoW
	M64.07	3.6	200/272	911 Carrera (993) USA
	M64.08	3.6	200/272	911 Carrera (993) USA
1996	M64.21	3.6	210/285	911 Carrera (993) /C4 /C4S RoW
	M64.22	3.6	210/285	911 Carrera (993) RoW Tiptronic
	M64.23	3.6	210/285	911 Carrera (993) /C4/C4S USA
	M64.24	3.6	210/285	911 Carrera (993) USA Tiptronic
	M64.60	3.6	300/408	911 Turbo (993) RoW and USA/CDN
1997	M64.21	3.6	210/285	911 Carrera (993) /C4 /C4S RoW
	M64.22	3.6	210/285	911 Carrera (993) RoW Tiptronic
	M64.23	3.6	210/285	911 Carrera (993) /C4/C4S USA
	M64.24	3.6	210/285	911 Carrera (993) USA Tiptronic
	M64.60	3.6	300/408	911 Turbo (993) RoW and USA/CDN
	M96.20	2.5	150/204	Boxster (986)
1998	M64.21	3.6	210/285	911 Carrera (993) /C4/C4S RoW
	M64.22	3.6	210/285	911 Carrera (993) RoW Tiptronic
	M64.23	3.6	210/285	911 Carrera (993) /C4 & C4S USA/CDN
	M64.24	3.6	210/285	911 Carrera (993) USA/CDN Tiptronic
	M64.60	3.6	300/408	911 Turbo (993) RoW and USA/CDN
	M96.20	2.5	150/204	Boxster (986)
1999	M96.01	3.4	220/296	911 Carrera (996)
	M96.20	2.5	150/204	Boxster (986)
2000	M96.01	3.4	220/296	911 Carrera (996)
	M96.02	3.4	220/296	911 Carrera (996) 4
	M96.04	3.4	220/296	911 Carrera (996) 2/4
	M96.22	2.7	162/217	Boxster (986)
	M96.21	3.2	185/250	Boxster S (986)

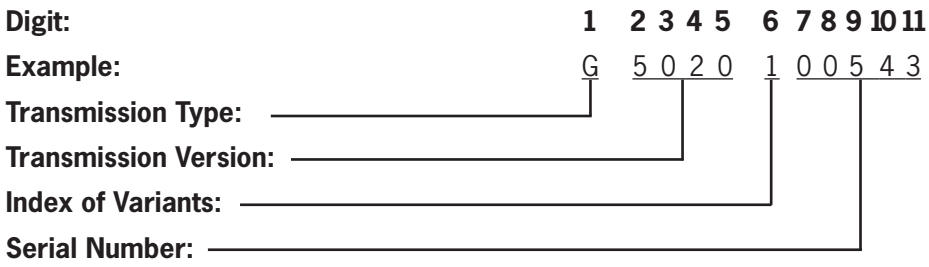
Sports Cars Engine Type Designations Since Model Year 1984 (cont'd)

Model Year	Engine Type	Displ. Liters	Engine Power kW / HP *	Installed In
2001	M96.01	3.4	220/296	911 Carrera (996)
	M96.02	3.4	220/296	911 Carrera (996) 4
	M96.04	3.4	220/296	911 Carrera (996) 2/4
	M96.22	2.7	162/217	Boxster (986)
	M96.21	3.2	185/250	Boxster S (986)
	M96.70	3.6	309/414	911 Turbo (996)
	M96.70S	3.6	340/456	911 GT2 (996)
2002	M96.03	3.6	232/310	911 Carrera (996) 2/4/4S
	M96.22	2.7	162/217	Boxster (986)
	M96.21	3.2	185/250	Boxster S (986)
	M96.70	3.6	309/414	911 Turbo (996)
	M96.70S	3.6	340/456	911 GT2 (996)
2003	M96.03	3.6	235/315	911 Carrera (996) 2/4/4S
	M96.23	2.7	168/225	Boxster (986)
	M96.24	3.2	191/256	Boxster S (986)
	M96.70	3.6	309/414	911 Turbo (996)
	M96.70S	3.6	340/456	911 GT2 (996)
2004	M96.03	3.6	235/315	911 Carrera (996) 2/4/4S
	M96.23	2.7	168/225	Boxster (986)
	M96.24	3.2	191/256	Boxster S (986)
	M96.70	3.6	309/414	911 Turbo (996)
	M96.70S	3.6	340/456	911 GT2 (996)
	M96.79	3.6	280/381	911 GT3 (996)
2005	M96.03	3.6	235/315	911 Carrera (996) 2/4/4S
	M96.05	3.6	239/325	911 Carrera (997)
	M97.01	3.8	261/355	911 Carrera S (997)
	M96.25	2.7	176/240	Boxster (987)
	M96.26	3.2	206/280	Boxster S (987)
	M96.70	3.6	309/414	911 Turbo (996)
	M96.70S	3.6	340/456	911 GT2 (996)
	M96.79	3.6	280/381	911 GT3 (996)
2006	M96.05	3.6	239/325	911 Carrera 2/4 (997)
	M97.01	3.8	261/355	911 Carrera 2/4 S (997)
	M96.25	2.7	176/240	Boxster (987)
	M96.26	3.2	206/280	Boxster S (987)
	M97.21	3.4	217/295	Cayman S (987)
2007	M96.05	3.6	239/325	911 Carrera 2/4 (997)
	M97.01	3.8	261/355	911 Carrera 2/4 S (997)
	M97.20	2.7	180/245	Boxster (987)
	M97.21	3.4	217/295	Boxster S (987)
	M97.20	2.7	180/245	Cayman (987)
	M97.21	3.4	217/295	Cayman S (987)
	M97.70	3.6	353/480	911 Turbo (997)
	M97.76	3.6	305/415	911 GT3 (997)

***** The HP number over the years has been listed in SAE or DIN. (Kw to SAE HP factor is x 1.34, SAE HP to DIN HP factor is x 1.014)

General Information

Transmission Number Identification



Sports Cars Transmission Type Designations Since Model Year 1989

Model Year	Transmission Type	Technical Data	Installed In
1989	G50.00	5-Speed M/T	911 Carrera - RoW
	G50.01	5-Speed M/T	911 Carrera - USA, Australia, Japan
	G50.02	5-Speed M/T	911 Carrera - Switzerland
	G50.50	5-Speed M/T	911 Turbo - World-Wide
	G64.00	5-Speed M/T	911 Carrera (964) - RoW, USA/Canada
	G64.01	5-Speed M/T	911 Carrera 4 (964) - Switzerland
1990	A50.01	4-Speed A/T	911 Carrera 2 (964) - RoW, USA/Canada
	G50.03	5-Speed M/T	911 Carrera 2 (964) - RoW, USA/Canada
	G50.04	5-Speed M/T	911 Carrera 2 (964) - Switzerland
	G64.00	5-Speed M/T	911 Carrera 4 (964) - RoW, USA/Canada
	G64.01	5-Speed M/T	911 Carrera 4 (964) - Switzerland
1991	A50.01	4-Speed A/T	911 Carrera 2 (964) - RoW, USA/Canada
	G50.03	5-Speed M/T	911 Carrera 2 (964) - RoW, USA/Canada
	G50.04	5-Speed M/T	911 Carrera 2 (964) - Switzerland
	G50.52	5-Speed M/T	911 Turbo (964) - World-Wide
	G64.00	5-Speed M/T	911 Carrera 4 (964) - RoW, USA/Canada
	G64.01	5-Speed M/T	911 Carrera 4 (964) - Switzerland
1992	A50.02	4-Speed A/T	911 Carrera 2 (964) - RoW
	A50.03	4-Speed A/T	911 Carrera 2 (964) - USA/Canada
	G50.03	5-Speed M/T	911 Carrera 2 (964) - RoW
	G50.04	5-Speed M/T	911 Carrera 2 (964) - Switzerland
	G50.05	5-Speed M/T	911 Carrera 2 (964) - USA/Canada
	G50.10	5-Speed M/T	911 Carrera 2 RS (964) - RoW
	G50.52	5-Speed M/T	911 Turbo (964) - World-Wide
	G64.00	5-Speed M/T	911 Carrera 4 (964) - RoW, USA/Canada
	G64.01	5-Speed M/T	911 Carrera 4 (964) - Switzerland
	G64.02	5-Speed M/T	911 Carrera 4 (964) - Taiwan

Sports Cars Transmission Type Designations Since Model Year 1989 (cont'd)

Model Year	Transmission Type	Technical Data	Installed In
1993	A50.02	4-Speed A/T	911 Carrera 2 (964) - RoW
	A50.03	4-Speed A/T	911 Carrera 2 (964) - USA/Canada, Taiwan
	G50.03	5-Speed M/T	911 Carrera 2 (964) - RoW
	G50.04	5-Speed M/T	911 Carrera 2 (964) - Switzerland/Taiwan
	G50.05	5-Speed M/T	911 Carrera 2 (964) - USA/Canada
	G50.10	5-Speed M/T	911 Carrera 2 RS (964) - RoW
	G64.00	5-Speed M/T	911 Carrera 4 (964) - RoW, USA
	G64.01	5-Speed M/T	911 Carrera 4 (964) - Switzerland
	G64.02	5-Speed M/T	911 Carrera 4 (964) - Taiwan
1994	A50.02	4-Speed A/T	911 Carrera 2 (964) - RoW
	A50.03	4-Speed A/T	911 Carrera 2 (964) - USA/Canada, Taiwan
	G50.03	5-Speed M/T	911 Carrera 2 (964) - RoW
	G50.04	5-Speed M/T	911 Carrera 2 (964) - Switzerland/Taiwan
	G50.05	5-Speed M/T	911 Carrera 2 (964) - USA/Canada
	G50.10	5-Speed M/T	911 Carrera 2 RS (964) - RoW
	G50.52	5-Speed M/T	911 Turbo 3.6 (964) - World-Wide
	G64.00	5-Speed M/T	911 Carrera 4 (964) - RoW, USA
	G64.01	5-Speed M/T	911 Carrera 4 (964) - Switzerland
	G64.02	5-Speed M/T	911 Carrera 4 (964) - Taiwan
1995	A50.04	4-Speed A/T	911 Carrera 2 (993) - RoW
	A50.05	4-Speed A/T	911 Carrera 2 (993) - USA/Canada, Taiwan
	G50.20	6-Speed M/T	911 Carrera (993) - USA/Canada
	G50.21	6-Speed M/T	911 Carrera (993) - RoW
1996	A50.04	4-Speed A/T	911 Carrera 2 (993) - RoW
	A50.05	4-Speed A/T	911 Carrera 2 (993) - USA/Canada, Taiwan
	G50.20	6-Speed M/T	911 Carrera 2 (993) - USA/Canada
	G50.21	6-Speed M/T	911 Carrera 2 (993) - RoW
	G64.20	6-Speed M/T	911 Carrera 4 (993) - USA/Canada
	G64.21	6-Speed M/T	911 Carrera 4 (993) - RoW
	G64.51	6-Speed M/T	911 Turbo (993) - World-Wide
1997	A50.04	4-Speed A/T	911 Carrera 2 (993) - RoW
	A50.05	4-Speed A/T	911 Carrera 2 (993) - USA/Canada, Taiwan
	G50.20	6-Speed M/T	911 Carrera 2 (993) - RoW, USA/Canada
	G64.20	6-Speed M/T	911 Carrera 4 (993) - RoW, USA/Canada
	G64.51	6-Speed M/T	911 Turbo (993) - World-Wide
	A86.00	5-Speed A/T	Boxster (986)
	G86.00	5-Speed M/T	Boxster (986)
1998	A50.04	4-Speed A/T	911 Carrera 2 (993) - RoW
	A50.05	4-Speed A/T	911 Carrera 2 (993) - USA/Canada, Taiwan
	G50.20	6-Speed M/T	911 Carrera 2 (993) - RoW, USA/Canada
	G64.20	6-Speed M/T	911 Carrera 4/4S (993) - RoW, USA/Canada
	G64.42	6-Speed M/T	911 Turbo (993) - Taiwan
	G64.51	6-Speed M/T	911 Turbo (993) - RoW, USA/Canada
	A86.00	5-Speed A/T	Boxster (986)
	G86.00	5-Speed M/T	Boxster (986)

Sports Cars Transmission Type Designations Since Model Year 1989 (cont'd)

Model Year	Transmission Type	Technical Data	Installed In
1999	A86.00	5-Speed A/T	Boxster (986)
	G86.00	5-Speed M/T	Boxster (986)
	A96.00	5-Speed A/T	911 Carrera 2 (996) - RoW, USA/Canada
	A96.30	5-Speed A/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.00	6-Speed M/T	911 Carrera 2 (996) - RoW, USA/Canada
	G96.30	6-Speed M/T	911 Carrera 4 (996) - RoW, USA/Canada
2000	A86.05	5-Speed A/T	Boxster (986)
	A86.20	5-Speed A/T	Boxster S (986)
	G86.01	5-Speed M/T	Boxster (986)
	G86.20	6-Speed M/T	Boxster S (986)
	A96.00	5-Speed A/T	911 Carrera 2 (996) - RoW, USA/Canada
	A96.30	5-Speed A/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.00	6-Speed M/T	911 Carrera 2 (996) - RoW, USA/Canada
	G96.30	6-Speed M/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.90	6-Speed M/T	911 GT3 (996) - RoW
2001	A86.05	5-Speed A/T	Boxster (986)
	A86.20	5-Speed A/T	Boxster S (986)
	G86.01	5-Speed M/T	Boxster (986)
	G86.20	6-Speed M/T	Boxster S (986)
	A96.00	5-Speed A/T	911 Carrera 2 (996) - RoW, USA/Canada
	A96.30	5-Speed A/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.00	6-Speed M/T	911 Carrera 2 (996) - RoW, USA/Canada
	G96.30	6-Speed M/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.50	6-Speed M/T	911 Turbo (996) - World-Wide
	A96.50	5-Speed A/T	911 Turbo (996) - World-Wide
	G96.88	6-Speed M/T	911 GT2 (996) - World-Wide
	G96.90	6-Speed M/T	911 GT3 (996) - RoW
2002	A86.05	5-Speed A/T	Boxster (986)
	A86.20	5-Speed A/T	Boxster S (986)
	G86.01	5-Speed M/T	Boxster (986)
	G86.20	6-Speed M/T	Boxster S (986)
	A96.10	5-Speed A/T	911 Carrera 2 (996) - RoW, USA/Canada
	A96.35	5-Speed A/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.01	6-Speed M/T	911 Carrera 2 (996) - RoW, USA/Canada
	G96.31	6-Speed M/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.50	6-Speed M/T	911 Turbo (996) - World-Wide
	A96.50	5-Speed A/T	911 Turbo (996) - World-Wide
	G96.88	6-Speed M/T	911 GT2 (996) - World-Wide
	G96.90	6-Speed M/T	911 GT3 (996) - RoW

Sports Cars Transmission Type Designations Since Model Year 1989 (cont'd)

Model Year	Transmission Type	Technical Data	Installed In
2003	A86.05	5-Speed A/T	Boxster (986)
	A86.20	5-Speed A/T	Boxster S (986)
	G86.01	5-Speed M/T	Boxster (986)
	G86.20	6-Speed M/T	Boxster S (986)
	A96.10	5-Speed A/T	911 Carrera 2 (996) - RoW, USA/Canada
	A96.35	5-Speed A/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.01	6-Speed M/T	911 Carrera 2 (996) - RoW, USA/Canada
	G96.31	6-Speed M/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.50	6-Speed M/T	911 Turbo (996) - World-Wide
	A96.50	5-Speed A/T	911 Turbo (996) - World-Wide
	G96.88	6-Speed M/T	911 GT2 (996) - World-Wide
2004	A86.05	5-Speed A/T	Boxster (986)
	A86.20	5-Speed A/T	Boxster S (986)
	G86.01	5-Speed M/T	Boxster (986)
	G86.20	6-Speed M/T	Boxster S (986)
	A96.10	5-Speed A/T	911 Carrera 2 (996) - RoW, USA/Canada
	A96.35	5-Speed A/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.01	6-Speed M/T	911 Carrera 2 (996) - RoW, USA/Canada
	G96.31	6-Speed M/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.50	6-Speed M/T	911 Turbo (996) - World-Wide
	A96.50	5-Speed A/T	911 Turbo (996) - World-Wide
	G96.88	6-Speed M/T	911 GT2 (996) - World-Wide
	G96.96	6-Speed M/T	911 GT3 (996) - USA/Canada
2005	A87.05	5-Speed A/T	Boxster (987)
	A87.20	5-Speed A/T	Boxster S (987)
	G87.01	5-Speed M/T	Boxster (987)
	G87.20	6-Speed M/T	Boxster S (987)
	A96.10	5-Speed A/T	911 Carrera 2 (996) - RoW, USA/Canada
	A96.35	5-Speed A/T	911 Carrera 4 (996) - RoW, USA/Canada
	G96.01	6-Speed M/T	911 Carrera 2 (996) - RoW, USA/Canada
	G96.31	6-Speed M/T	911 Carrera 4 (996) - RoW, USA/Canada
	A97.01	5-Speed A/T	911 Carrera/S (997) - RoW, USA/Canada
	G97.01	6-Speed M/T	911 Carrera/S (997) - RoW, USA/Canada
	G96.50	6-Speed M/T	911 Turbo (996) - World-Wide
	A96.50	5-Speed A/T	911 Turbo (996) - World-Wide
	G96.88	6-Speed M/T	911 GT2 (996) - World-Wide
	G96.96	6-Speed M/T	911 GT3 (996) - USA/Canada
2006	A87.05	5-Speed A/T	Boxster (987)
	A87.20	5-Speed A/T	Boxster S (987)
	G87.01	5-Speed M/T	Boxster (987)
	G87.20	6-Speed M/T	Boxster S (987)
	A87.21	5-Speed A/T	Cayman S (987)
	G87.21	6-Speed M/T	Cayman S (987)
	A97.01	5-Speed A/T	911 Carrera 2/S (997) - RoW, USA/Canada
	G97.01	6-Speed M/T	911 Carrera 2/S (997) - RoW, USA/Canada
	A97.31	5-Speed A/T	911 Carrera 4/S (997) - RoW, USA/Canada
	G97.31	6-Speed M/T	911 Carrera 4/S (997) - RoW, USA/Canada

Sports Cars Transmission Type Designations Since Model Year 1989 (cont'd)

Model Year	Transmission Type	Technical Data	Installed In
2007	A87.02	5-Speed A/T	Boxster (987)
	A87.20	5-Speed A/T	Boxster S (987)
	G87.01	5-Speed M/T	Boxster (987)
	G87.20	6-Speed M/T	Boxster S (987)
	A87.02	5-Speed A/T	Cayman (987)
	A87.21	5-Speed A/T	Cayman S (987)
	G87.01	6-Speed M/T	Cayman (987)
	G87.21	6-Speed M/T	Cayman S (987)
	A97.01	5-Speed A/T	911 Carrera 2/S (997) - RoW, USA/Canada
	G97.01	6-Speed M/T	911 Carrera 2/S (997) - RoW, USA/Canada
	A97.31	5-Speed A/T	911 Carrera 4/S (997) - RoW, USA/Canada
	G97.31	6-Speed M/T	911 Carrera 4/S (997) - RoW, USA/Canada
	G97.50	6-Speed M/T	911 Turbo (997) - World-Wide
	A97.50	5-Speed A/T	911 Turbo (997) - World-Wide
	G97.90	6-Speed M/T	911 GT3 (997) - USA/Canada

911 Carrera (997) & Boxster/Cayman (987) ID Number Locations

Vehicle Identification

When ordering spare parts or making inquiries, please always quote the vehicle identification number.

Vehicle identification label

Vehicle identification label is attached to the inner side of the front luggage compartment hood below the hood lock. It contains all important data about your car.

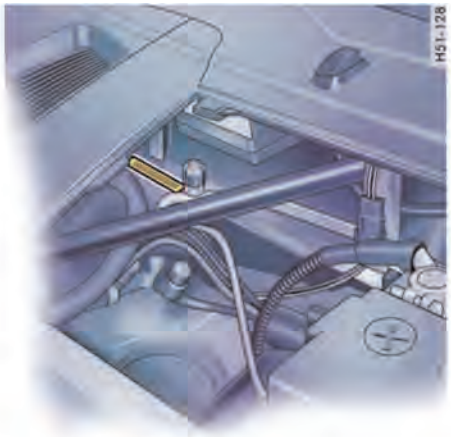
This label contains the following information:

1. Vehicle Identification No.
2. Type/Type description
3. Engine code/Transmission code
4. Paint No./Interior
5. Optional equipment

A duplicate of this label is in your Maintenance Booklet.

Note

This data bank cannot be re-ordered if it is lost or damaged.



Vehicle identification number

In accordance with Federal Safety Regulations, the vehicle identification number of your car is located at the bottom left of the windshield frame and can be seen from the outside.

The vehicle identification number is in the front luggage compartment under the battery cover and at the bottom left behind the windshield.

> Please observe the chapter "BATTERY" on Page 229.



Safety compliance sticker

The safety compliance sticker is your assurance that your new Porsche complies with all applicable Federal Motor Vehicle Safety Standards which were in effect at the time the vehicle was manufactured.

The sticker also shows the month and year of production and the vehicle identification number of your car (perforations) as well as the **G**ross **V**ehicle **W**eight **R**ating and the **G**ross **A**xle **W**eight **R**ating.

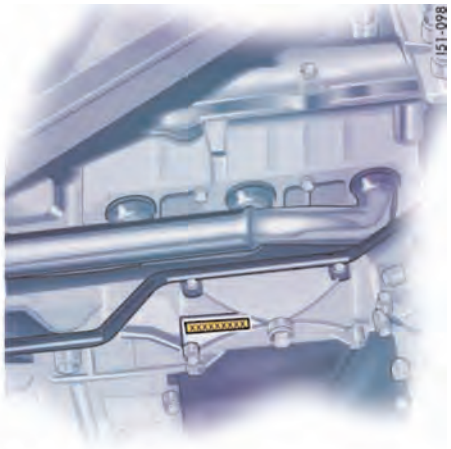


Tire pressure plate

The tire pressure plate is attached to the left-hand door aperture.

Paint data

The paint data can be found on the tire pressure plate.

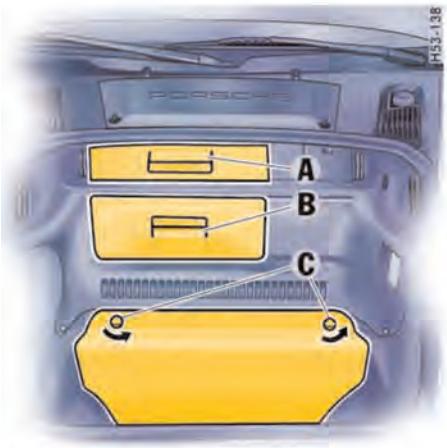


Engine number

The engine number is stamped on the underside of the crankcase.

Boxster (987) shown, Cayman (987) & 911 (997) in same location.

911 Carrera (997) & Boxster/Cayman (987) – Front Luggage Compartment



Luggage Compartment

Access covers

(on vehicles with DVD navigation or CD changer)

Opening

> Grasp access cover **A** or **B** at the handle and open.

> The drive for DVD navigation and the CD changer can be found behind the access cover **B**.

Caution!

Risk of damage.

> Do not store any heavy, damp or heat-sensitive objects behind the access covers.

Tool box

Opening

> Unlock turn-locks **C**.

> Open tool box and place it on the floor of the luggage compartment.



E - *Adapter for security wheel bolts*
F - *Tire filling compressor*
G - *Towing hook*
H - *Tool kit*
I - *Tire sealant*

Closing

> Insert tool box into the guide pegs in the luggage compartment floor.

> Close tool box and lock the turn-locks **C.**

Boxster (987) – Rear Luggage Compartment



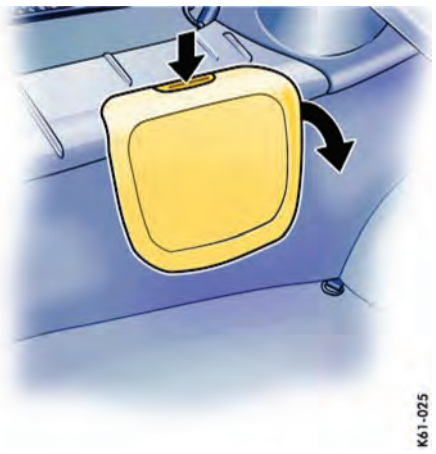
Rear luggage compartment

A Topping up engine oil

B Topping up coolant

C Coolant level

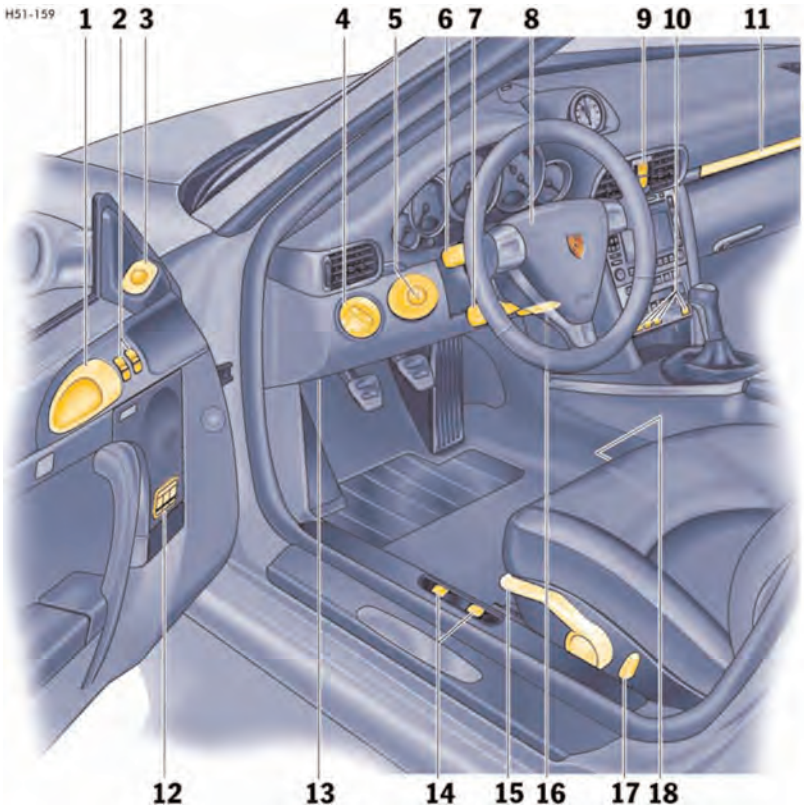
Cayman (987) – Rear Luggage Compartment



Cayman Engine Service Cover

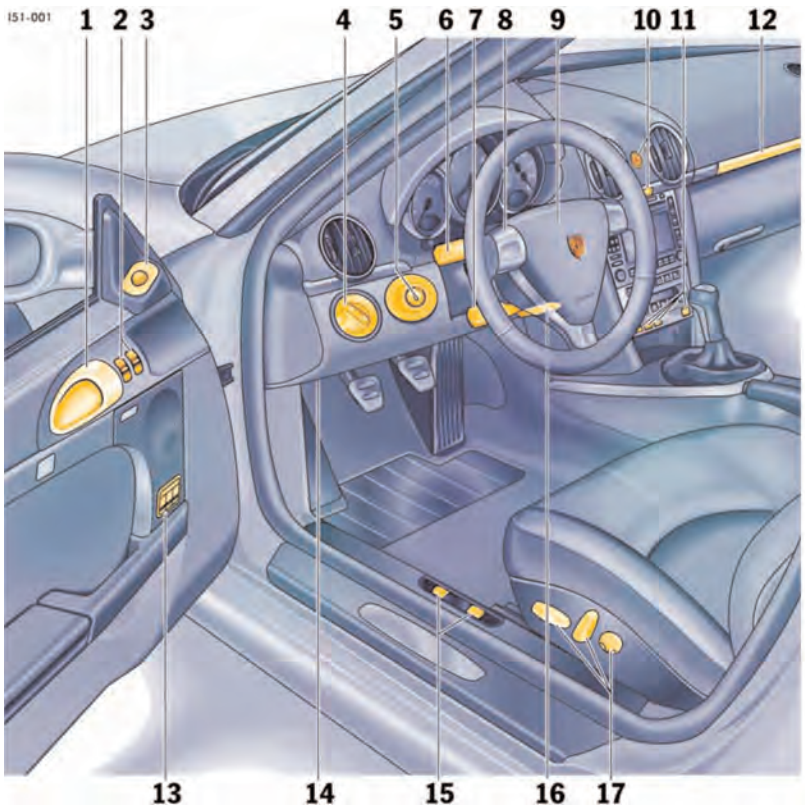
Behind this cover you will find the engine oil filler and coolant cap caps.

911 Carrera (997) – Interior Controls (May Vary Depending on Model and Equipment)



1 Inner door handle
2 Power windows
3 Door mirror control
4 Light switch
5 Ignition/starter switch with steering lock
6 Turn signal/headlight dimmer, flasher lever
7 Operating lever for on-board computer
8 Horn
9 Emergency flasher switch, central locking switch
10 Switches for rear spoiler, Porsche Active Suspension Management (PASM), Sport mode, Porsche Stability Management (PSM)
11 Cupholder
12 Switch for seat memory
13 Diagnostic socket (OBD)
14 Lid release
15 Seat height adjustment
16 Steering-wheel adjustment
17 Backrest angle adjustment
18 Seat fore and aft adjustment

Boxster/Cayman (987) – Interior Controls (May Vary Depending on Model and Equipment)



1 Inner door handle
2 Power windows
3 Door mirror control
4 Light switch
5 Ignition / starter switch
6 Turn signal / headlight dimmer, flasher lever
7 Operating lever for on-board computer
8 For vehicles with Tiptronic: Toggle switches for Tiptronic
9 Horn
10 Emergency flasher switch, central locking switch
11 Switches for rear spoiler, Porsche Activ Suspension Management (PASM), Sport mode, Porsche Stability Management (PSM)
12 Cupholder
13 Switch for seat memory
14 Diagnostic socket
15 Lid release
16 Steering-wheel adjustment
17 Seat adjustment

PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ❑ Diagnosis system: Read out fault memory
- ❑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Power-assisted steering: Check fluid level
- ❑ Engine: Check oil level
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ❑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ❑ Change engine oil: (oil filter change is not required)
- ❑ Air Filter: Check the air filter condition, and if necessary, replace
- ❑ Diagnosis system: Read out fault memory
- ❑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Power-assisted steering: Check fluid level
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze protection level
- ❑ Pollen filter: Replace filter element
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ❑ Vehicle lights: Check operation
- ❑ All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ❑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ❑ Change engine oil and oil filter
- ❑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ❑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ❑ Diagnosis system: Read out fault memory
- ❑ Polyrib belt: Check condition
- ❑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ❑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ❑ Power-assisted steering: Check fluid level
- ❑ Parking brake: Check free play of the parking brake lever
- ❑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ❑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Clutch: Check play or final position of pedal
- ❑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Check tightness on the front and rear suspension adjustment points
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Seat belts: Check operation and condition
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ❑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ❑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ❑ Replace Polyrib belt
- ❑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ❑ Manual transmission: Change oil
- ❑ Automatic transmission: Change ATF and ATF-filter
- ❑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ❑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ❑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ❑ Check airbag system
- ❑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

❑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.

❑ Change engine oil and oil filter

❑ Air Filter: Check the air filter condition, and if necessary, replace

❑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage

❑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze

❑ Pollen filter: Replace filter element

❑ Brake system: Visual inspection of the brake pads and brake discs for wear

❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion

❑ Drive shafts: Visual inspection of the dust boots for leaks and damage

❑ Tires: Check condition and tire pressure

❑ Check firewall and cabrio section body drains for debris

❑ Check the door, lid locks and safety hook of the front lid for secure seating and function

❑ Vehicle lighting: Check function
All headlights: Check setting

❑ Horn: Check function

❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)

❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
❑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
❑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

❑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
❑ Change engine oil and oil filter
❑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
❑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze
❑ Air filter: Replace filter element
❑ Pollen filter: Replace filter element
❑ Fuel lines and connections: Visual inspection for damage and leaks
❑ Brake system: Visual inspection of the brake pads and brake discs for wear
❑ Parking brake: Check free play of parking brake lever
❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
❑ Clutch: Check the pedal play and end position
❑ Steering gear: Visual inspection of the dust boots for damage
Tie rod ends: Check play and dust boots
❑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
❑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
❑ Tires: Check condition and tire pressure
❑ Check firewall and cabrio section body drains for debris
❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
❑ Vehicle lighting: Check function
All headlights: Check setting
❑ Horn: Check function
❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
❑ Seat belts: Check function and condition
❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
❑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
❑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms “inspect” and “check” include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be performed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ____/____/____

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

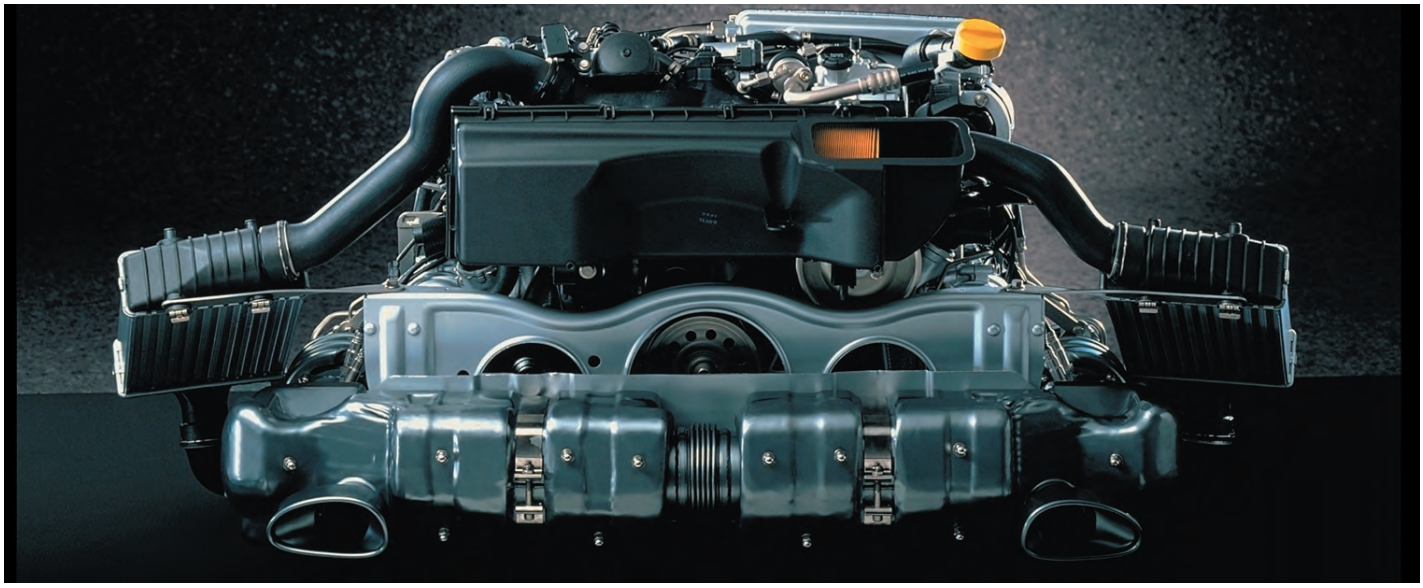
Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Notes:



Subject	Page
General Information – Boxster (986) & Boxster/Cayman (987) Engines	1.3
General Information – 911 Carrera (996) & (997) Engines	1.11
Engine Components – 911 Carrera (996) & Boxster (986)	
Crankcase	1.15
Chain Drive	1.19
VarioCam	1.20
Engine Lubrication	1.25
Cooling Systems	1.27
Service Tray – Boxster	1.28
Engine Components – 911 Carrera (997) & Boxster/Cayman (987)	
Crankcase	1.29
Valve Train	1.30
Vacuum Pump	1.31
Oil Supply	1.32
Cooling	1.32
Checking Engine Oil	1.34
Checking Engine Coolant	1.38
General Information – 911 Turbo (996) Engine	1.41
Crankcase	1.42
VariocCam Plus	1.45
Engine Lubrication	1.48
General Information – 911 Turbo (997) Engine	1.51
Crankshaft	1.52
Camshafts	1.53
Cooling	1.54
Checking Engine Oil	1.55
Checking Engine Coolant	1.57
Maintenance Sheets	1.58

Notes:

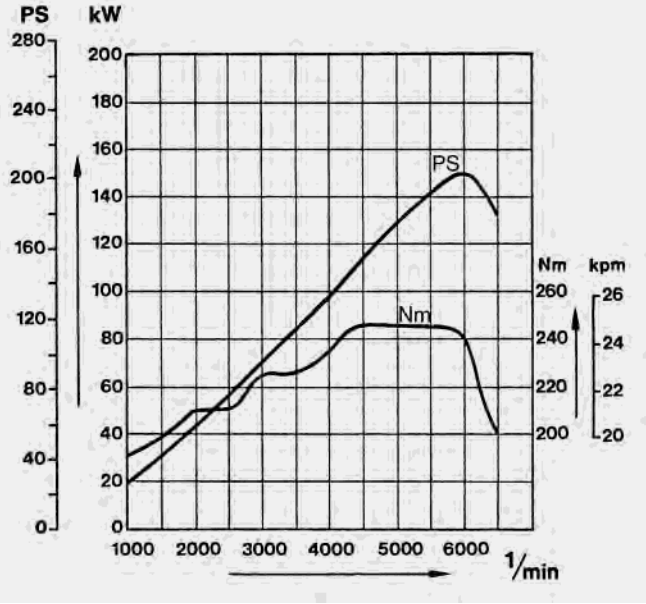
Boxster/Boxster S

Boxster (986) Engine M96.20 (1997-99)

The 2.5 liter engine of the Boxster is a completely new water-cooled, 6-cylinder, 4-stroke Boxer type engine with the following special features:

- Four-part and vertically split “open-deck” crankcase with LOKASIL cylinder sleeves and Graphal-coated pistons
- Crankshaft-bearing shells made of aluminum with nodular cast iron components
- Integrated dry-sump lubrication
- Four overhead camshafts with camshaft adjustment (VarioCam)
- Four-valve technology
- Three-part cylinder head
- Hydraulic valve-clearance compensation

Full-Load Curves M96.20



Engine Data:

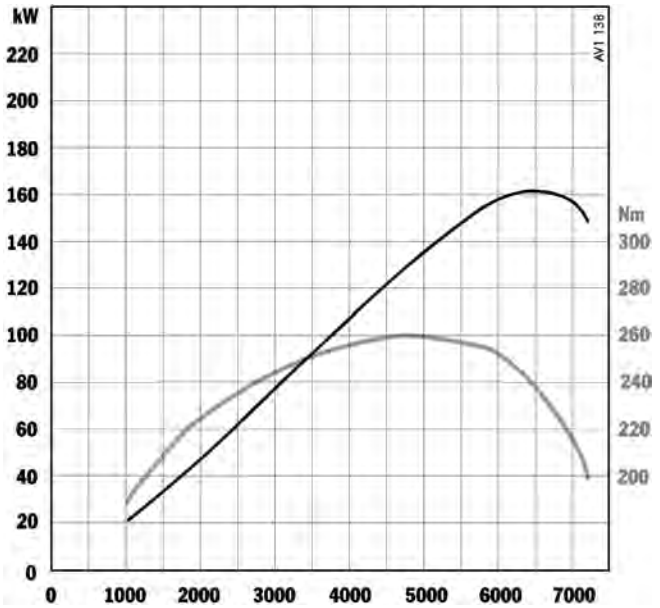
Displacement	2.5 l (stroke 72 mm, bore 85.5 mm)
Power output	SAE 201 HP (150 kW/204 PS)
at engine speed	6,000 rpm
Max. torque	181 ft lb (245 Nm)
at engine speed	4,500 rpm
Compression ratio	11.0 : 1
Fuel grade	93 octane ($\frac{R+M}{2}$)
rpm limit	6700

Boxster Engine (986) M96.22 (2000-02)

The displacement of the Boxster (986) engine has been increased from 2.5 liters to 2.7 liters beginning with the model year 2000.

The increase in displacement was achieved by lengthening the stroke from 72 mm to 78 mm. The pistons were shortened by 3 mm from 56 mm to 53 mm to keep the compression ratio at the same level as that of the previous 2.5 liter engine.

Full-Load Curves M96.22



Engine Data:

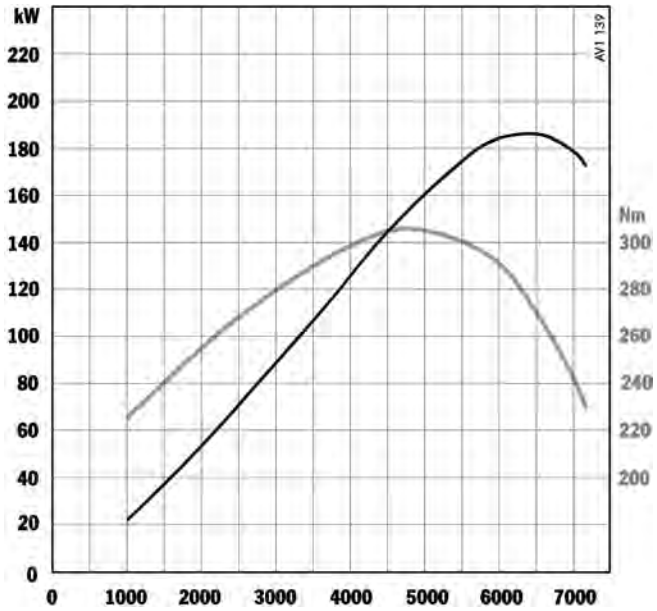
Displacement	2.7 l (78 mm stroke x 85.5 mm bore)
Output	217 HP (162 kW) @ 6,400 rpm
Torque	192 ft lb (260 Nm) @ 4,750 rpm
Compression ratio	11.0:1
rpm limit	7,200

Engine – Boxster (986)

Boxster S (986) Engine M96.21 (2000-02)

The engine of the new Boxster S is a further development of the familiar 6-cylinder boxer type engine. The cylinder bore was enlarged by 7.5 mm to 93 mm to increases the displacement to 3.2 liters. This larger displacement guarantees a significant gain in performance and torque.

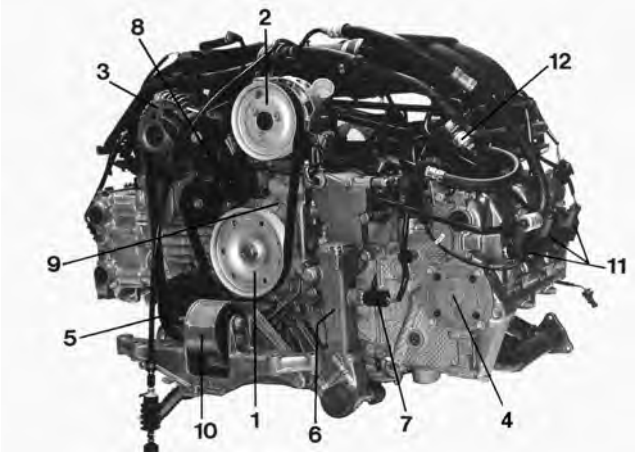
Full-Load Curves M96.21



Engine Data:

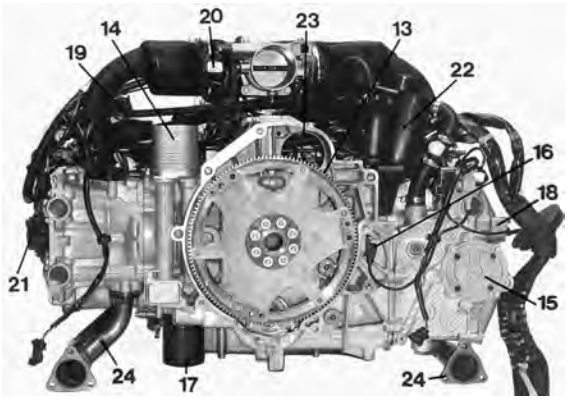
Displacement	3.2 l (93 mm bore x 78 mm stroke)
Output	248 HP (185 kW) at 6250 rpm
Torque	225 ft lb (305 Nm) at 4500 rpm
Compression ratio	11.0:1
rpm limit	7,200 rpm

Notes:



Engine Type M96.20/21/22 Component Locations

1 - Belt Pulley
2 - Power Steering Pump
3 - Alternator
4 - Oil Return Pump For Cylinder Head 4-6
5 - Coolant Pump
6 - Coolant Duct Case
7 - Engine Temperature Sensor
8 - Belt Tensioner
9 - TDC Mark
10 - Front Engine Mount
11 - Ignition Coils
12 - Pressure Regulator

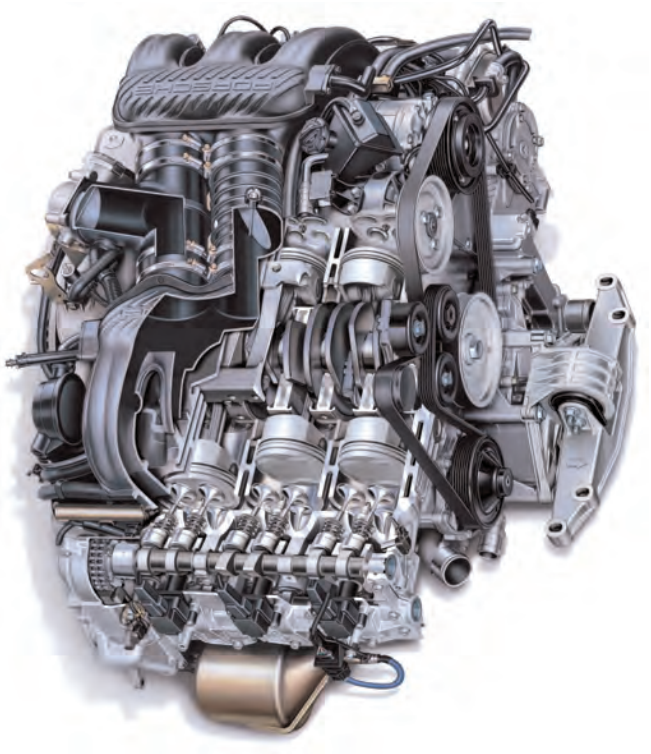


Engine Type M96.20/21/22 Component Locations

13 - Starter Ring Gear
14 - Oil to Water Heat Exchanger
15 - Oil Return Pump For Cylinder Head 1-3
16 - Engine Speed and Reference Mark Sensor
17 - Oil Filter Housing
18 - VarioCam Valve
19 - Tank Venting Valve
20 - Throttle Potentiometer
21 - Ignition Coils
22 - Oil Separator
23 - Starter Housing
24 - Exhaust Manifold

Boxster/Boxster (986) (2003-04)

The engines for the Boxster and Boxster S for the 2003 model year continue the development of previous engines. Particular attention was paid during development to reducing fuel consumption while simultaneously increasing power and torque.



Changes at a Glance:

- Crankcase
- Valve train operation
- Cylinder head construction
- Continuously variable camshaft adjustment

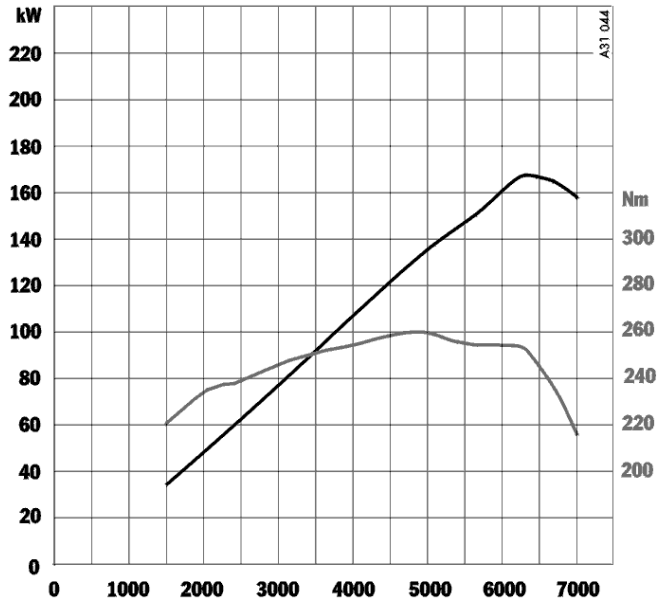
Notes:

Boxster (986) M96.23 (2003-04)

Advances in data compared with previous engines:

Power: 225 hp (168 kW) at 6,300 rpm
Torque: 192 ft lb (260 Nm) at 4,700 rpm

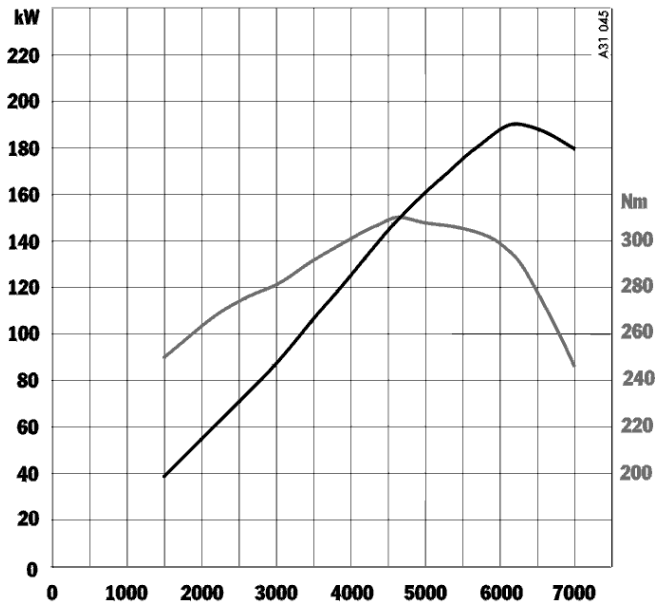
Full-Load Curves M96.23



Boxster S (986) M96.24 (2003-04)

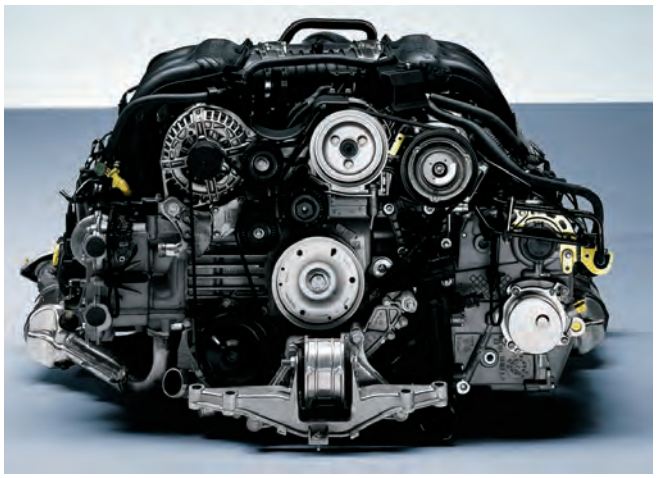
Power: 258 hp (191 kW) at 6,200 rpm
Torque: 229 ft lb (310 Nm) at 4,600 rpm

Full-Load Curves M96.24



Engine – Boxster (987)

Boxster (987) M96.25 (2005-06)



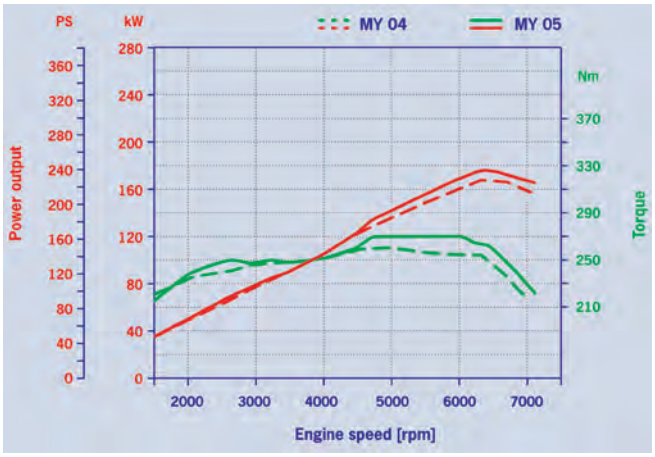
General

The engines have been revised in the course of developing the new Boxster generation. The Boxster now has a 2.7 liter engine with a power output of 240 hp (176 kw). Even more impressive than the actual power ratings is the extra acceleration which the new engines offer in the low and middle rev range.

Important changes:

- All-aluminium bearing cradle
- Reinforced bearing shells
- Crankshaft with deeper center bore at flywheel end
- Mechanical vacuum pump
- Tension and idler pulley in plastic on vehicles with manual transmission
- New oil level measuring system
- Optimized cooling system
- Extended maintenance intervals

Full-Load Curves M96.25



A - Power rating in hp
B - Power rating in kW
C - Torque in Nm
nM - Engine speed in rpm

Engine Data:

Displacement	2.7 Liter
Bore	85.5 mm
Stroke	78 mm
Power output	240 hp (176 kW)
at rpm	6400 rpm
Max. torque	199 ft lbs (270 Nm)
at rpm	4700 – 6000 rpm
Compression ratio	11,0
Cut-off speed	7200 rpm
Idle speed	680 +/- 40 rpm

Notes:

Boxster (987) M97.20 (2007)

General

The Boxster (987) engine from the 2006 model year serves as the basis for the 2007 model year Boxster. It was possible to increase both the horsepower and torque with further development measures. This was primarily due to the 2007 Boxster model getting the VarioCam **Plus** system.

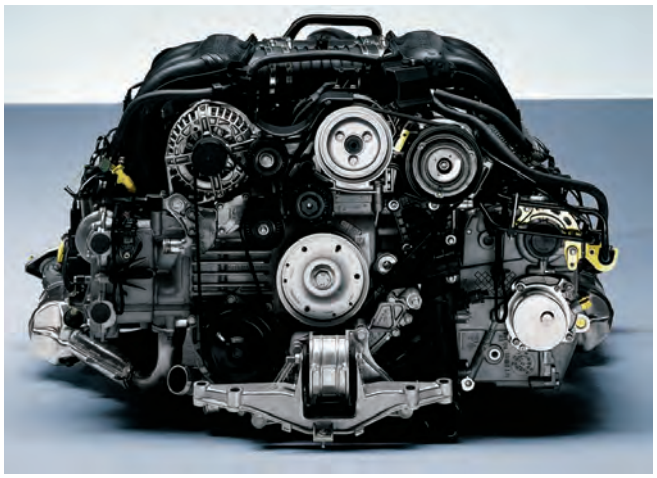
Engine Data:

Displacement	2.7 Liter
Bore	85.5 mm
Stroke	78 mm
Power output	245 bhp (180 kW)
at engine speed	6,500 rpm
Max. torque	201 ft lb. (273 Nm)
at engine speed	4,600 to 5,500 rpm
Compression ratio	11.3
Cutt-off speed	7,300 rpm
Idling speed	680 +/- 40 rpm

Notes:

Engine – Boxster (987)

Boxster S (987) M96.26 (2005-06)



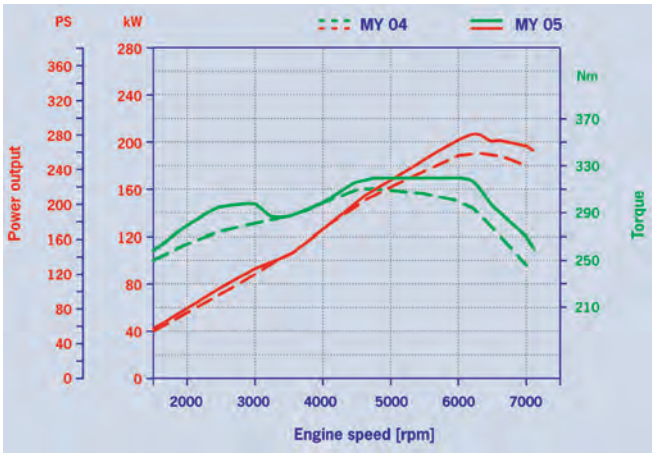
General

The liquid-cooled 3.2 liter 6-cylinder horizontally opposed engine in the new Boxster S features outstanding balancing of masses. Structural design measures have been applied to achieve a high level of rigidity for the camshaft and crankshaft drive. The engine features the minimal vibration and typical sports car sound which are a Porsche hallmark.

Important changes:

- Crankshaft with deeper center bore at flywheel end
- Reinforced pistons
- Mechanical vacuum pump
- Tension and idler pulley in plastic on vehicles with manual transmission
- New oil level measurement system
- Optimized cooling system
- Extended maintenance intervals

Full-Load Curves (Boxster S 3.2)



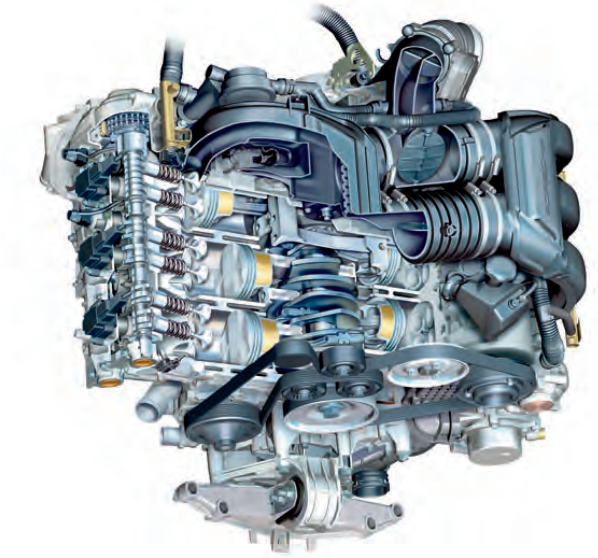
A – Power rating in hp
B – Power rating in kW
C – Torque in Nm
nM – Engine speed in rpm

Engine Data:

Displacement	3.2 Liter
Bore	93 mm
Stroke	78 mm
Power output	280 hp (206 kW)
at rpm	6200 rpm
Max. torque	236 ft lbs (320 Nm)
at rpm	4700 – 6000 rpm
Compression ratio	11,0
Cut-off speed	7200 rpm
Idle speed	680 +/- 40 rpm

Notes:

Boxster S (987) M97.21 (2007)



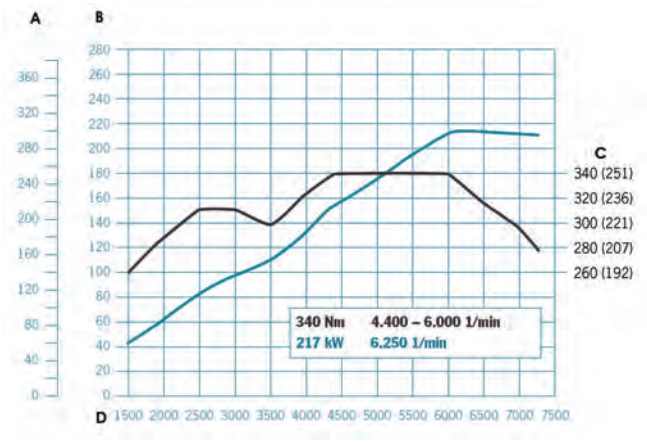
General

The Boxster S (987) for the model year 2007 will be equipped with the engine of the Cayman S (987). The liquid-cooled 3.4 liter 6-cylinder horizontally opposed engine in the Cayman S is based on the current engine family of the 911 Carrera and Boxster. Structural design measures ensure high rigidity for the crankshaft and camshaft drive.

Important changes:

- Displacement of 3.4 liters.
- Introduction of VarioCam Plus.
- Revision of the exhaust system and the air filter.
- Revised exhaust system.
- Adaptation of the Motronic system

Full-Loads Curves



A – Power rating in bhp
B – Power rating in kW
C – Torque in Nm (ft lb.)
D – Engine speed in rpm

Engine Data:

Displacement	3.4 Liter
Bore	96 mm
Stroke	78 mm
Power output	295 hp (217 kW)
At engine speed	6,250 rpm
Max. torque	251 ft lb. (340 Nm)
At engine speed	4,400 - 6,000 rpm
Compression ratio	11.1 : 1
Cut-off speed	7,300 rpm
Idle speed	680 +/- 40 rpm

Notes:

Engine – Cayman (987)

Cayman (987) M97.20 (2007)

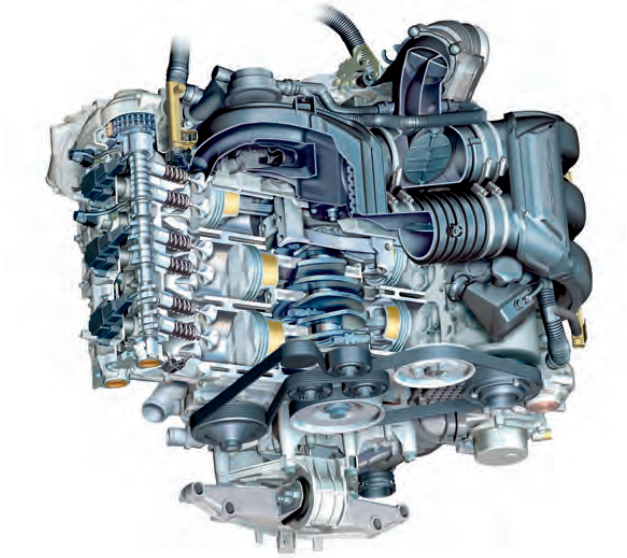
General

In model year 2007 the Cayman (987) will be available in the North American market along with the Cayman S (987). The Boxster (987) engine from the 2006 model year serves as the basis for the 2007 model year Cayman (987). It was possible to increase both the horsepower and torque with further development measures. This was primarily due to the 2007 Cayman model getting the VarioCam **Plus** system.

Engine Data:

Displacement	2.7 Liter
Bore	85.5 mm
Stroke	78 mm
Power output	245 bhp (180 kW)
at engine speed	6,500 rpm
Max. torque	201 ft lb. (273 Nm)
at engine speed	4,600 to 5,500 rpm
Compression ratio	11.3
Cutt-off speed	7,300 rpm
Idling speed	680 +/- 40 rpm

Cayman S (987) M97.21 (2006-on)



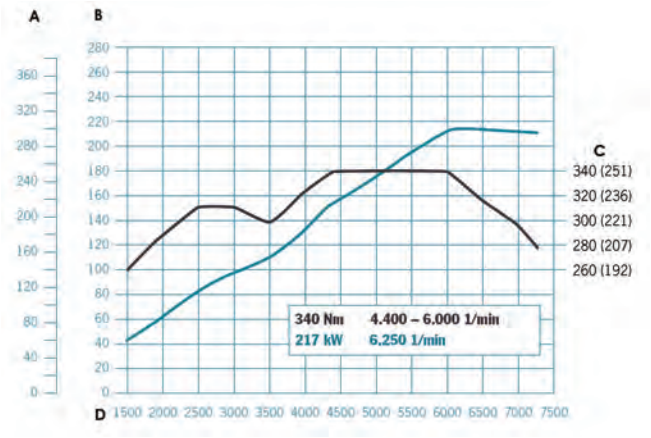
General

The liquid-cooled 3.4 liter 6-cylinder horizontally opposed engine in the Cayman S is based on the current engine family of the 911 Carrera and Boxster. Structural design measures ensure high rigidity for the crankshaft and camshaft drive.

Important changes:

- Displacement of 3.4 liters.
- Introduction of VarioCam Plus.
- Revision of the exhaust system and the air filter.
- Revised exhaust system.
- Adaptation of the Motronic system

Full-Loads Curves



A – Power rating in bhp
B – Power rating in kW
C – Torque in Nm (ft lb.)
D – Engine speed in rpm

Engine Data:

Displacement	3.4 Liter
Bore	96 mm
Stroke	78 mm
Power output	295 hp (217 kW)
At engine speed	6,250 rpm
Max. torque	251 ft lb. (340 Nm)
At engine speed	4,400 - 6,000 rpm
Compression ratio	11.1 : 1
Cut-off speed	7,300 rpm
Idle speed	680 +/- 40 rpm

911 Carrera Engines

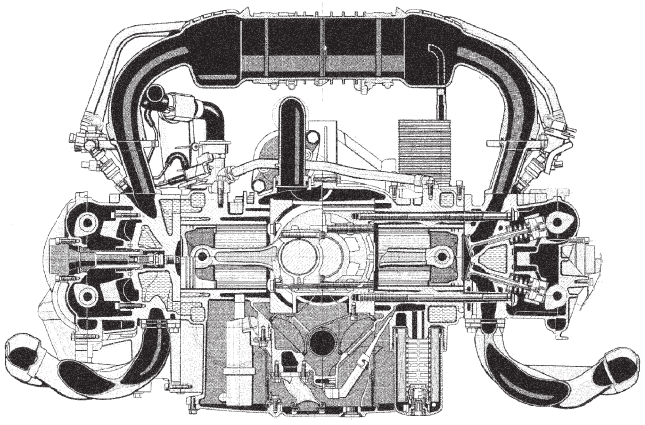
911 Carrera (996) M96.01/02/04 (1999-2001)



General

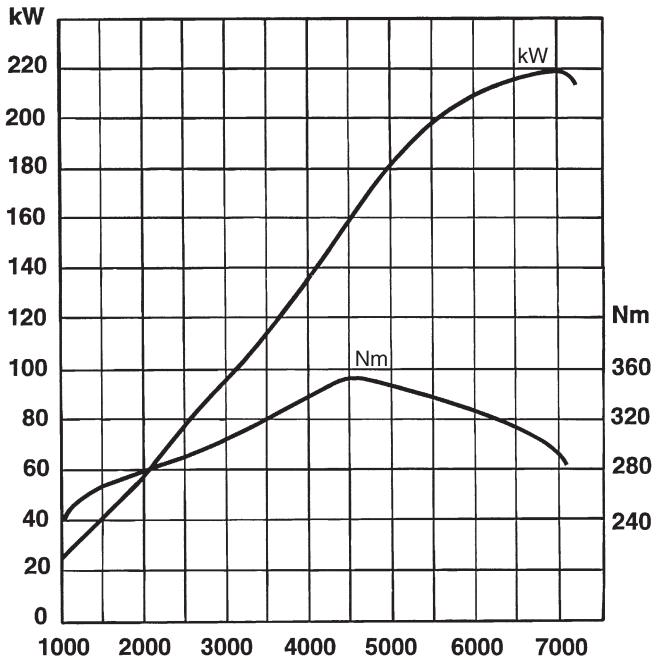
The 3.4 liter 911 Carrera (996) has a water-cooled, 6-cylinder, 4-stroke Boxer engine with the following special features:

- Four-part, vertically split “open-deck” aluminum crankcase with LOKASIL cylinder sleeves and Graphal-coated pistons.
- Crankshaft-bearing shells made of aluminum with nodular cast-iron components.
- Integrated dry-sump lubrication.
- Four overhead camshafts with camshaft adjustment (VarioCam).
- Four-valve technology.
- Three-part cylinder head.
- Hydraulic valve-clearance compensation.



Engine Type M96.01 Cross-Section Cutout

Full-Load Curves M96.01/02/04



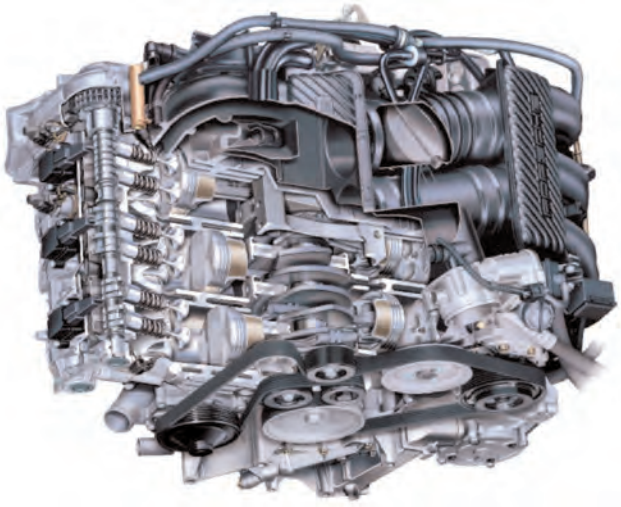
Engine Data:

Displacement	3.4 l (stroke 78 mm, bore 96 mm)
Power output	296 hp (221 kW)
at engine speed	6,800 rpm
Max. torque	258 ft lb (350 Nm)
at engine speed	4,600 rpm
Compression ratio	11.3 : 1
Fuel grade	93 octane ($\frac{R+M}{2}$)

Notes:

Engine – 911 Carrera (996)

911 Carrera (996) M96.03 (2002-05)



General

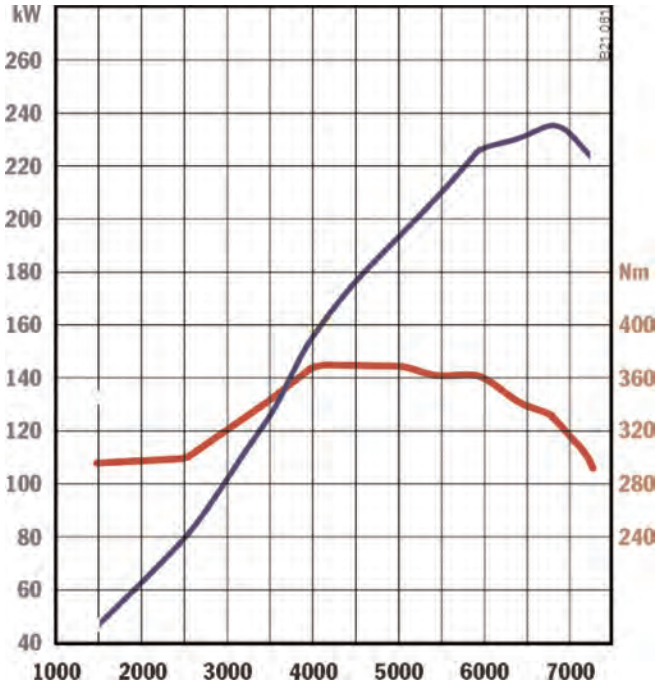
The 3.6 liter engine for the 911 Carrera (996) in model year 2002 is a further development of the previous engine.

During the development of this engine, particular attention was directed at reducing fuel consumption while simultaneously increasing engine performance and torque.

Important Changes:

- Crankshaft - bearings and stroke
- Crankcase
- Pistons with Graphal coating
- Valve gear
- Cylinder head
- Valve stroke control on intake side with axial variable camshaft timing (VarioCam Plus)

Full-Load Curves M96.03

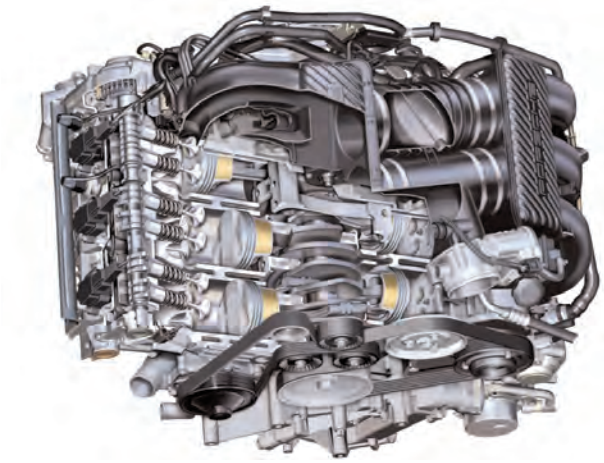


Engine Data:

Displacement	3.6 l (stroke 82.8 mm x bore 96 mm)
Power output	320 hp (235 kW)
at engine speed	6800 rpm
Max. torque	273 ft lb (370 Nm)
at engine speed	4250 rpm
Compression ratio	11.3 : 1
Governed speed	7300 rpm
Fuel grade	93 octane ($\frac{R+M}{2}$)

Notes:

911 Carrera (997) M96.05 (2005-on)



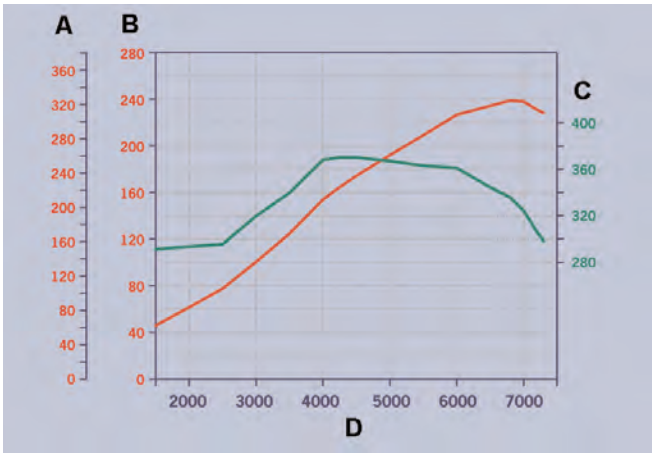
General

The engine of the 911 Carrera (997) corresponds largely to the 3.6 liter engine of the 911 Carrera (996) from model year 2004. The increase in power is mainly from optimization of the exhaust system and the consequently improved volumetric efficiency.

Important changes:

- Optimized cooling system
- Fine tuning of performance critical components
- Mechanical vacuum pump
- Extended maintenance intervals
- Oil spray collector
- Oil level measurement

Full-Loads Curves



A - Power output in hp
B - Power output in kW
C - Torque in Nm
D - Engine speed in rpm

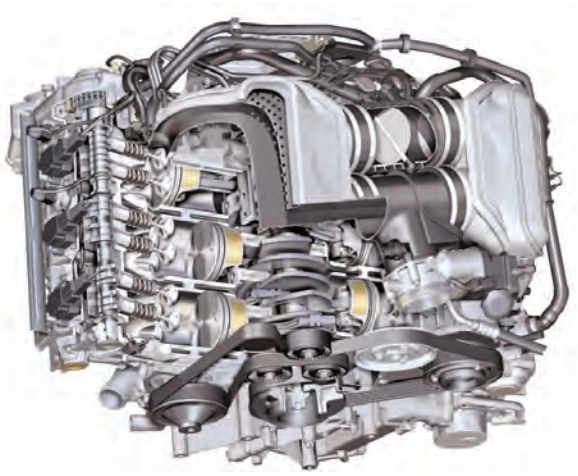
Engine Data:

Displacement	3.6 Liter
Bore	96 mm
Stroke	82.8 mm
Power output	325 hp (239 kW)
At engine speed	6800 rpm
Max torque	273 ft lbs (370 Nm)
At engine speed	4250 rpm
Compression	11.3 : 1
Cut-off speed	7300 rpm
Idle speed	670 +/- 40 rpm

Notes:

Engine – 911 Carrera (997)

911 Carrera S (997) M97.01 (2005-on)



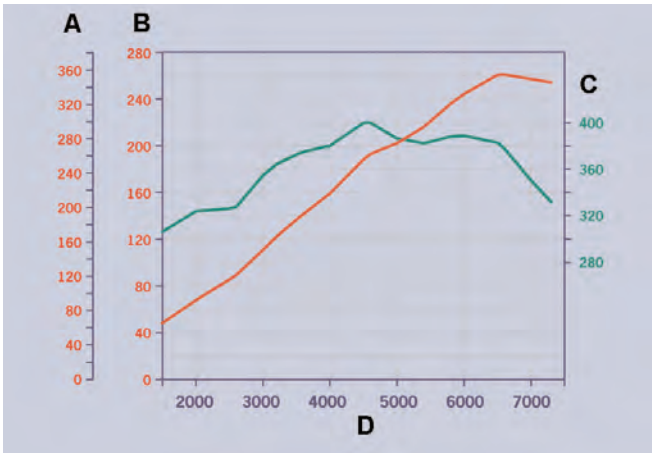
General

The engine of the 911 Carrera S (997) is based on the 3.6 liter engine. The increase in displacement to 3.8 liters has been achieved by enlarging the bore diameter from 96 mm to 99 mm.

Important changes:

- Displacement increased to 3.8 liters
- Fine tuning of Vario Cam
- Incorporation of a vibration balancer
- Optimized cooling system
- Increased compression
- Fine tuning of performance-critical components
- Mechanical vacuum pump
- Extended maintenance intervals
- Oil spray collector
- Oil level measurement

Full-Load Curves



A - Power output in hp
B - Power output in kW
C - Torque in Nm
D - Engine speed in rpm

Engine Data:

Displacement	3.8 Liter
Bore	99 mm
Stroke	82.8 mm
Power output	355 hp (261 kW)
At engine speed	6600 rpm
Max torque	295 ft lbs (400 Nm)
At engine speed	4600 rpm
Compression	11.8 : 1
Cut-off speed	7300 rpm
Idle speed	670 +/- 40 rpm

Notes:

911 Carrera (996) & Boxster (986) Engine Components

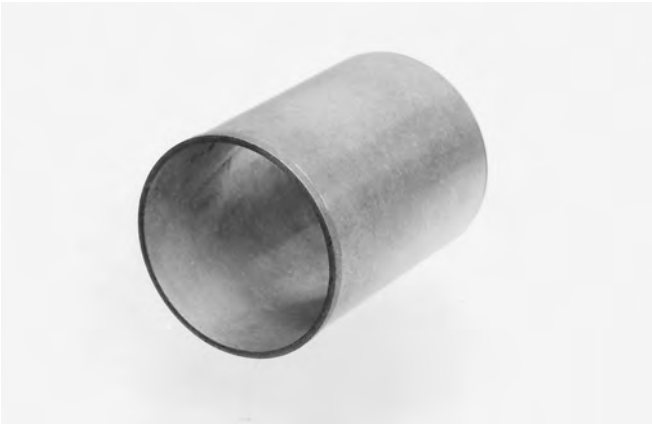
Crankcase

The crankcase comprises the two crankcase halves as well as the vertically split (along center of crankcase) bearing case. The bearing case is made of aluminum, but 7 bearing shells are made of nodular cast iron (see arrows).



911 Carrera (996) and Boxster Crankcase Components

This construction means that changes in the bearing clearance resulting from thermal fluctuations are reduced by a considerable degree, which, in turn, reduces mechanical noise. An additional benefit is that, when the engine is warm, the oil flow at the main bearings is not significantly increased by the constant bearing clearance (virtually identical thermal expansion coefficients between steel/crankcase and nodular cast iron/bearing shells).



Cylinder Sleeve

To reduce the wear along the cylinder sleeves to a minimum, a production method was chosen whereby a highly porous sleeve (25% silicon and 75% air) is cast directly into the crankcase.

When the sleeve is cast, the air escapes and the silicon remains locally along its path (hence the name LOKASIL).



Bearing Case

The engine has oil-spray nozzles, used for cylinder cooling to reduce the piston temperature. The injection nozzles are inserted in the bearing case (arrow). To ensure that the engine oil pressure is retained at low engine speeds and at high engine oil temperatures, the nozzle has an opening pressure of 26 psi (1.8 bar).

Crankcase Changes (911 Carrera 996 Model Year 2002 and Boxster (986) 2003)

The constructional design of the four-part crankcase with separate bearing sleeve and LOKASIL cylinder sleeves, along with the 96 mm bore was retained. To reduce pump losses in the crankcase, the lower ends of the cylinder sleeves (see arrow) were provided with arches which allow a low-loss circulation of gasses in the crankcase. This reduces the ventilation losses and consequently the power losses at higher engine speeds thereby increasing the overall power in this engine speed range.



New Version Crankcase Showing Cylinder Sleeve Arches

The crankshaft bearings were modified due to the displacement increase and subsequent increase of power unit loading. The bearing diameter was increased from 60 to 63 mm, the lubricating-oil feed optimized by partial grooving.

Crankshaft



911 Carrera (996) and Boxster (986) Crankshaft

The drop-forged crankshaft has seven bearings and has counter weights. The main bearing #4 is a thrust bearing. The axial clearance is determined by two stop disks which are inserted into the bearing case halves of cylinder line 4 - 6.

Changes to Crankshaft (Boxster/Boxster S, M.Y. 2000)

The crankshaft stroke was lengthened from 72 mm to 78 mm to increase displacement. A bore size of 85.5 mm gives a displacement of 2.7 liters while a bore of 93 mm yields 3.2 liters.

Changes to Crankshaft (911 Carrera (996) M.Y. 2002)

The stroke of the drop-forged crankshaft was increased from 78 mm to 82.8 mm. The crankshaft journals were also thickened to 63 mm.

Notes:

Connecting Rods

The forged connecting rods are broken apart at the large connecting-rod eye after processing. Due to the breaking pattern, the two parts are centered in relation to each other. Since each breaking pattern has a different shape, no pairing number is necessary.



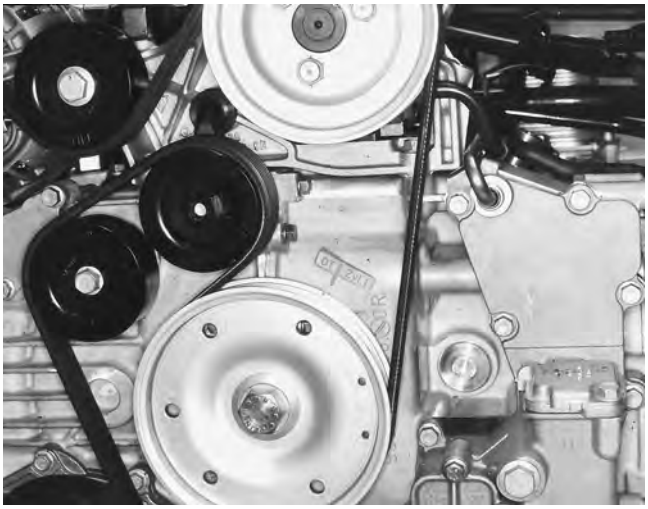
911 Carrera (996) and Boxster (986) Connecting Rod

Changes to Connecting Rods (911 Carrera (996) M.Y. 2002)

Because of the altered stroke, the forged and cracked connecting rods were shortened by 3 mm and have now a length of 142 mm (measured from respective bore center).

Belt Pulley

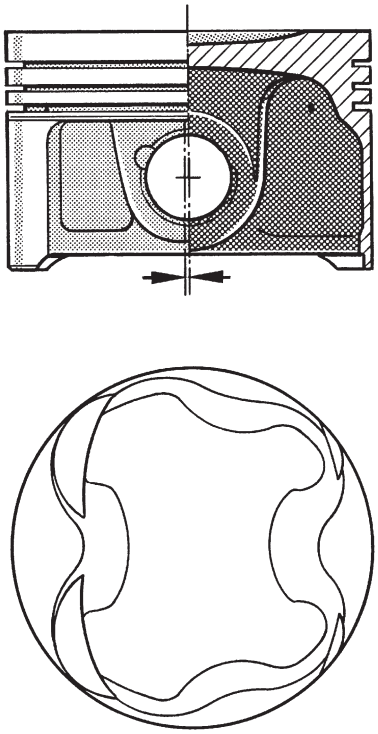
Marks can be found on the belt pulley and the crankcase to facilitate maintenance and repair work.



911 Carrera (996) and Boxster (986) Crankshaft Pulley Reference Marks

Pistons

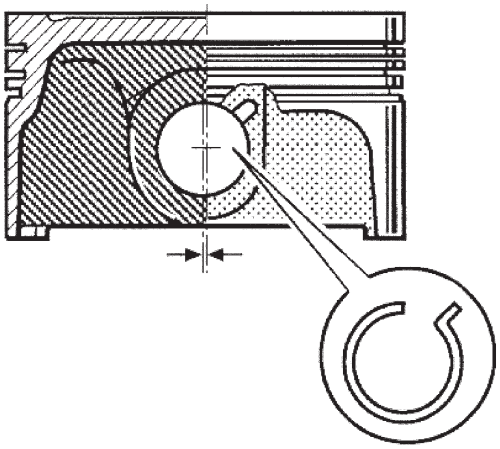
The cast aluminum pistons are covered with an iron coating serving as the sliding layer. The piston-pin hole is offset by 0.8 mm towards the intake side.



Boxster (986) 1997-99 Original Piston

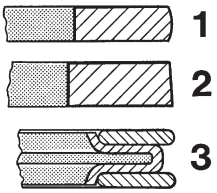
Changes to Pistons (Boxster/Boxster S (986), M.Y. 2000)

To achieve a compression ratio of 11.0:1 on the 2000 Boxster S (986) the piston length was reduced from 56 mm to 53 mm. The piston-pin lock ring now has a torsion lock, similar to the lock ring used on the 911 Carrera pistons.



Boxster/Boxster S (986) New Style Piston Beginning in 2000

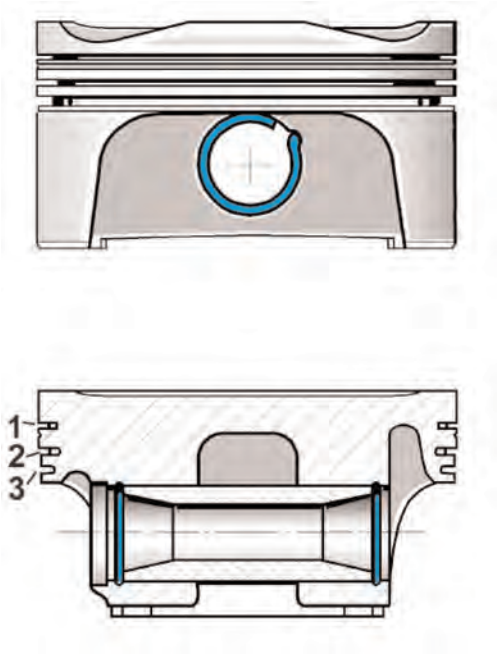
Piston Ring Configuration



1 - Rectangular ring, nitrided steel, 1.2 mm symmetrically crowned
2 - Taper face ring, gray cast iron, 1.5 mm
3 - Three-part oil ring, nitrided steel, and 2.0 mm

Changes to Pistons (911 Carrera (996) M.Y. 2002)

The moulded light-alloy pistons have a diameter of 96 mm. The pistons are Graphal coated for acoustic reasons. The piston pin is on a fully-floating bearing and lubrication is via oil spray. The piston-pin circlip is twist-locked and must be fitted in the installation position as shown in the drawing.

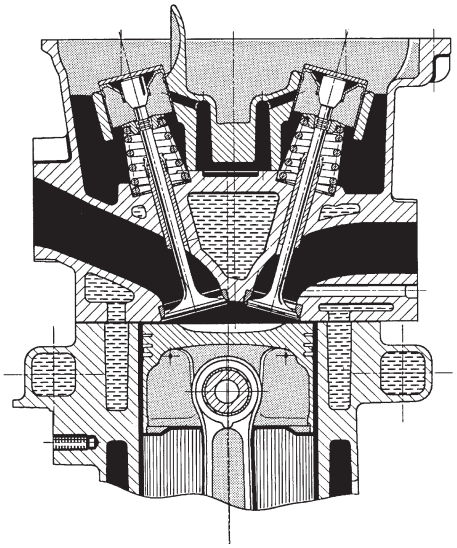


911 Carrera (996) Piston as of M.Y. 2002

1 - Rectangular compression ring
2 - Stepped taper-face ring
3 - ST band oil scraper ring

Cylinder Head

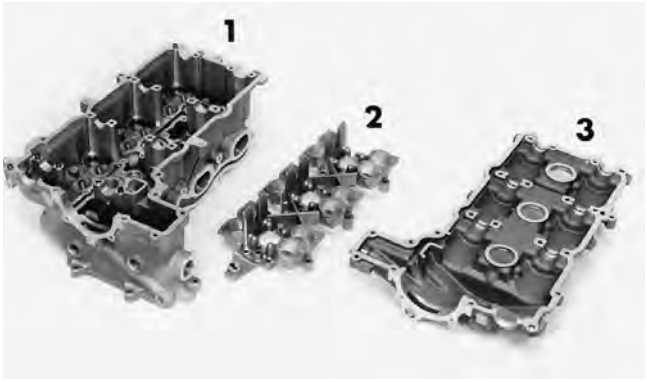
The cylinders have a range of special construction features, e.g. four-valve technology, camshaft adjustment, and hydraulic valve clearance compensation that helps to reduce necessary maintenance.



Cylinder Head Cutout

The four-valve technology improves cylinder filling. The implementation of liquid cooling in this engine which can compensate the increased thermal load placed on the engine resulting from the multi-valve concept allows four valves per combustion chamber to be used.

The cylinder head construction comprises the actual cylinder head, the camshaft housing, and the cylinder-head cover. Since the cylinder head comprises three parts, all of the oil channels can be formed in the casting process which means that virtually no holes have to be drilled. The cleaning processes during production are no longer necessary and process safety is increased. The materials and production processes for the individual components are selected to suit the specific application. As a result, parts used for flat-base tappet bearings have a more wear-resistant material composition than those, which take the valve seats. A distinction is therefore made according to the specific function and material.



Cylinder Head Components

Changes to Cylinder Head (911 Carrera (996) M.Y. 2002, Boxster/Boxster S (986), M.Y. 2003)

The introduction of VarioCam Plus necessitated a new design of the cylinder head and the camshaft control. As in the previous model the cylinder head is in three parts, consisting of basic cylinder head, bucket tappet guide housing and cylinder head cover. The oil protection tubes are now part of the bucket tappet guide housing and are sealed at the cylinder head cover side with fitted sealing rings.

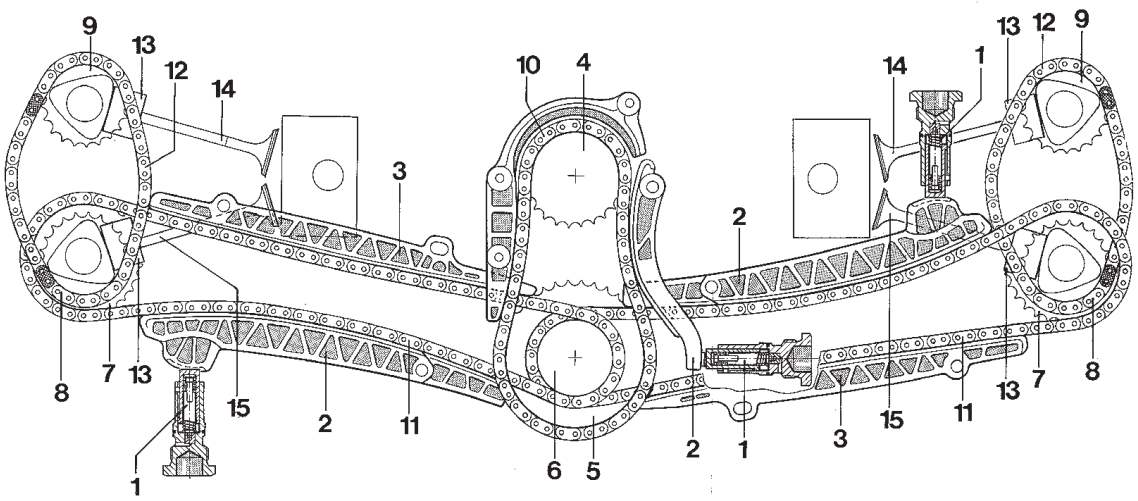
The valve springs of the exhaust valves are single valve springs and of tapered design, the intake valves are designed as a double valve spring set due to the increased forces. For immediate lubrication of tappets when starting engine, the bucket tappet housing is provided with oil chambers on the intake side.

Changes to Cyinder Head Gasket (911 Carrera (996) M.Y. 2002, Boxster/Boxster S (986), M.Y. 2003)

The multi-layer steel gasket is covered with high-temperature-resistant plastic in order to enhance the sealing quality of its surface. The advantage of this steel gasket is that heat can be dissipated from the cylinder head very efficiently.

Notes:

Chain Drive



Chain Drive Components

1 - Chain Tensioner
2 - Tensioning Rail
3 - Sliding Rail
4 - Drive Wheel, Crankshaft (24 teeth)
5 - Drive Wheel, Intermediate Shaft (36 Teeth)
6 - Drive Wheel, Intermediate Shaft (21 Teeth)
7 - Drive Wheel, Exhaust Camshaft (28 Teeth)
8 - Drive Wheel, Exhaust Camshaft (28 Teeth)
9 - Drive Wheel, Intake Camshaft (21 Teeth)
10 - Duplex, Roller Chain
11 - Duplex Roller Chain
12 - Simplex, Roller Chain
13 - Flat-base Tappet
14 - Intake Valve
15 - Exhaust Valve

Intermediate Shaft

The crankshaft drives the intermediate shaft via a duplex roller chain with a transmission ratio of 0.67: 1 (24 teeth on the crankshaft and 36 teeth on the intermediate shaft).



Intermediate Shaft

Camshaft

The intermediate shaft drives the exhaust camshaft via a duplex roller chain with a transmission ratio of 0.75: 1 (21 teeth on the intermediate shaft and 28 teeth on the camshaft). So, that the overall transmission ratio of 0.5: 1 is produced for the crankshaft relative to the camshaft.



Camshaft

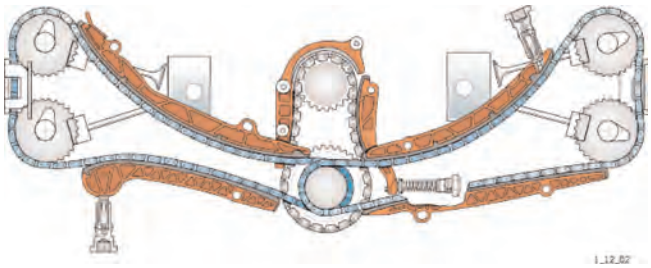
The exhaust camshaft drives the intake camshaft via a simplex roller chain with a transmission ratio of 1:1. All four camshafts are hollow-cast from high-quality hard-chilled steel.

Changes to Camshaft (911 Carrera (996) M.Y. 2002

The camshafts are hard-chilled components and hollow-cast to reduce weight. The shank diameter of all camshafts is 26 mm. The intake valve stroke is variable (3.0 mm or 10.0 mm).

Changes to Chain Drive (911 Carrera (996) M.Y. 2002

A separate intake and exhaust camshaft is used for each cylinder bank. These camshafts are driven directly by a double roller chain. The chains are guided by plastic guide rails and hydraulic chain tensioners located at the untensioned end of the chain.



Chain Drive Tensioner Layout

The intake camshafts in the new 911 Carrera (996) also have a valve stroke control on the intake side in addition to the VarioCam Plus system (the system is described in a separate section). The respective solenoid valves are fitted in the cylinder head.

This optimizes the compromise between maximum power output and maximum torque while simultaneously reducing fuel consumption and improving running smoothness of the engine. A driving flange for the oil suction pump is attached on the input side of each exhaust camshaft.

Notes:

Valves & Valve Springs

The exhaust and intake valves have a shaft diameter of 6 mm. The valve springs are single, conical springs.



Valve Spring Assembly

Changes to Intake & Exhaust Valves (Boxster/ Boxster S (986) , M.Y. 2000)

The valve head diameter of the intake valve was changed from 33.3 mm to 37.1 mm, and the exhaust valve from 28.1 mm to 31.5 mm.

VarioCam



VarioCam Adjuster

Function (Example based on early Boxster (986) VarioCam)

VarioCam, the adjustment of the intake camshafts, produces a major part of the engine power output, the engine torque as well as the good exhaust values at idling speed in the case of engine speeds of 1,200 rpm* and 5,120 rpm.

Engine speeds below 1,200 rpm produce a slight overlap in the valve stroke curves for the intake valves in relation to the exhaust valves.

This particularly affects low proportions of hydrocarbons (HC proportions) in the exhaust gas before the catalytic converters. If the engine exceeds the 1,200 rpm mark the intake camshafts are adjusted by 12.5° (by 25° if measured at the crankshaft).

* The value 1,200 rpm increase to 1,480 rpm with engine oil temperature at approximately 265° F. (130° C) and above.

VarioCam Plus – Variable Camshaft Timing With Valve Stroke Control (911 Carrera (996) M.Y. 2002)

The demands placed on the design of an engine, i.e. increased performance, improved driving comfort, observance of legal emission limits and reduced fuel consumption, result in contradictory construction criteria.

The idea behind the development of the VarioCam Plus was to create a variable engine which can be optimized both for maximum performance and for frequent use in urban traffic or on main roads.

A system to adjust the intake camshaft to vary the opening and closing time combined with a valve stroke adjustment system is the solution to this problem.

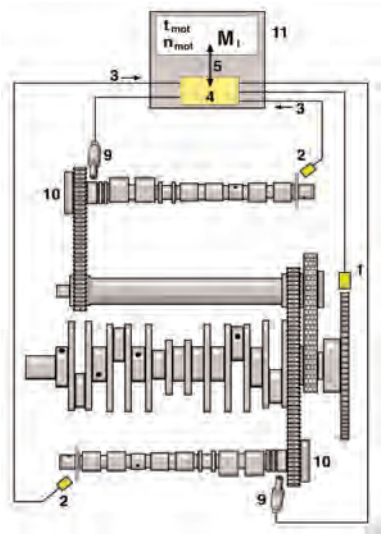
Shifting Options Of VarioCam Plus System



A - Cam stroke in mm
B - ° Crank angle
1 - Exhaust medium
2 - Intake medium, retard
3 - Intake medium, advanced

Camshaft Adjuster (911 Carrera (996) M.Y. 2002, Boxster/Boxster S (986), 2003)

Camshaft adjustment at the intake camshaft is based on the principle of the vane-type adjuster. The DME control module determines the current position of the camshaft to the crankshaft (actual angle) from the engine speed sensor and Hall sensor signals. The position control in the control module receives the desired specified angle via the programmed map values (rpm, load, engine temperature). If there is a difference between the specified and actual angle, a regulator in the DME control module actuates a hydraulic solenoid valve according to the desired adjustment. The intake camshaft timing can be infinitely varied within a range of 40° of crankshaft rotation.



1 - RPM Speed Sensor-
2 - Hall Sensor
3 - Camshaft Actual Angles (L&R)
4 - Camshaft Regulation Value
5 - DME Specified Camshaft Angle
tmot - Engine Temperature
MI - Engine Load
n - Engine Speed
9 - 4-way Proportioning Solenoid Valve
10 - Camshaft Adjuster

Notes:

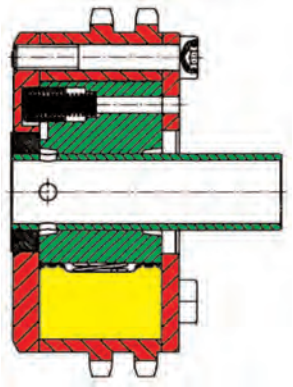
Camshaft Vane-Type Adjuster (911 Carrera (996) M.Y. 2002, Boxster/Boxster S (986), 2003)



Camshaft Vane Adjuster Front View Cutout

The vane cell adjuster mainly consists of the stator (red, above the chain sprocket, crankshaft-fixed), the rotor (green, camshaft-fixed) and the inserted vanes (yellow, inserted in rotor) and two covers. The stator is fitted with the chain sprocket on the outer diameter. It interlocks with the crankshaft via the chain drive. The rotor is securely bolted to the camshaft.

Repositioning between rotor and stator is possible (inner bearing of adjuster). This repositioning is limited by the vanes inserted into the rotor and by the stops on the stator. The vanes also split the recesses on the stator into two chambers each. These chambers can be filled with oil via oil holes and oil guides in the rotor. To ensure efficient sealing, small springs are fitted between vanes and rotor.



Camshaft Vane Adjuster Side View Cutout

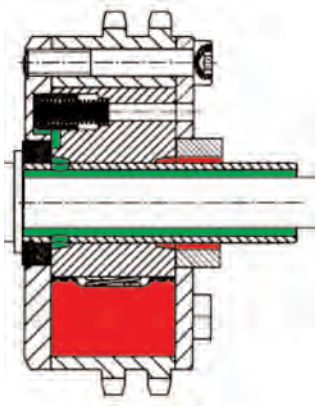
The chambers are each sealed laterally by a chain sprocket fixed cover. The adjuster is locked at a stop (retard stop). For this a spring-loaded pin in the retard stop of the adjuster moves into a hole in the cover. This creates a interlocking connection between the stator and rotor during the engine starting process. Noise during this oil pressure free period is avoided by this locking process.

In the adjuster, two chamber types with differing directions of action are employed. Filling one chamber type causes rotation of the rotor against the stator. Filling the other chamber type, the rotor and with it the camshaft can be returned to its initial position. The oil of the non-pressurized chamber returns via the 4-way proportioning valve back into the crankcase.



Camshaft Vane Adjuster Filling

If during the filling of a chamber the oil supply and the oil return flow at the 4-way proportioning valve is interrupted (center position of valve) , the adjuster remains in the currently assumed position. The chambers lose oil through leakage and the adjuster leaves its position. The 4-way proportioning valve is activated accordingly via the control unit and the adjuster returns to the desired position.



Camshaft Vane Adjuster Center Position



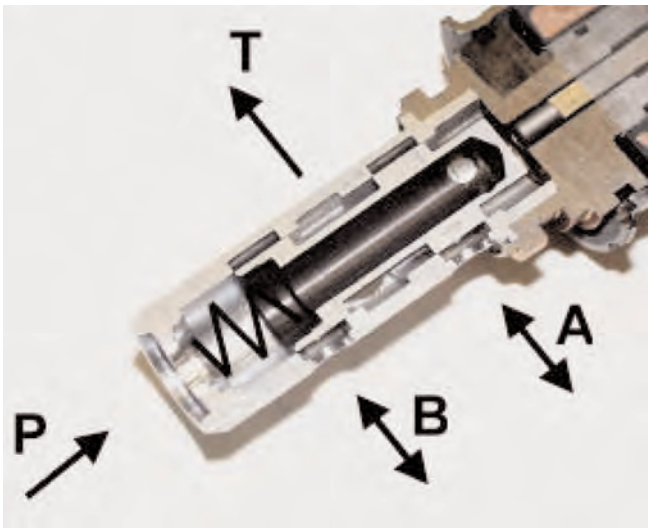
Cutout View of Boxster (986) (without VariCam Plus) Cam Timing Function

Solenoid Hydraulic Valve

The camshaft adjustment solenoid oil control valve is a 4-way proportional valve that connects control lines (A and B) to the stator chambers with the oil supply line (P). When one control line is receiving pressurized oil from the supply line, the other control line is opened to exhaust to the crankcase (T).

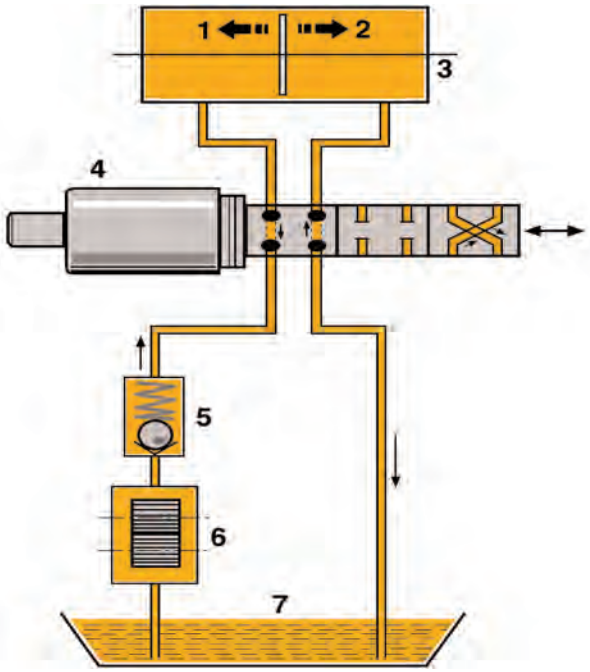
If oil pressure is admitted to control line A, the adjuster moves to advance valve timing. If oil pressure is admitted to line B, the adjuster moves to retard valve timing. Both control lines are closed when the valve is in the center or neutral position. This holds the camshaft in the current adjustment.

The solenoid oil control valve is capable of rapid large adjustments and also slow fine adjustments based on signals from the control module.



Solenoid Valve Operation

Non-return Valve



Non-return Valve Operation

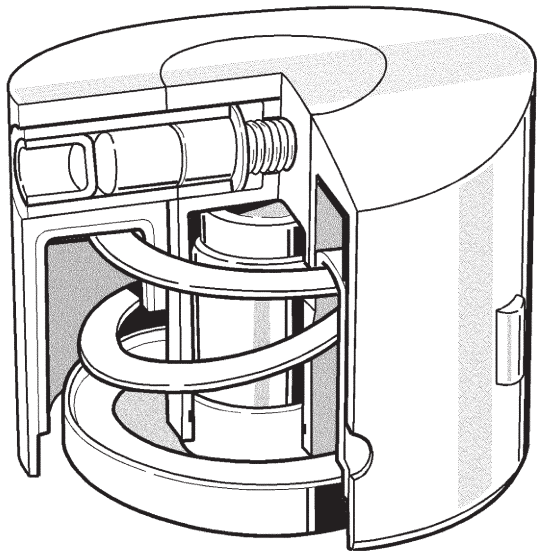
1 - Direction of Adjusment - Retard
2 - Direction of Adjustment - Advance
3 - Camshaft Adjuster
4 - 4-way Solenoid Valve
5 - Non-return Valve
6 - Oil Pump
7 - Oil Sump

Due to the valve operation, the camshaft requires a high drive torque at times, at other times the camshaft runs independently (changer-over torque). If a non-return valve is operated in the P-line and the 4-way valve is energized (adjustment in advanced valve timing direction), the adjuster, with the camshaft running on, independently draws oil via the feed line, the 4-way proportioning valve and the non-return valve. If the camshaft then stays behind due to the high drive torque, the non-return valve closes and the oil cannot escape. During this period, the camshaft is taken over the oil cushion by the chain sprockets, as when free-wheeling.

The advancing and retarding of the camshaft repeats itself, so that the camshaft independently moves progressively towards advanced valve timing. As the above described principle only functions on very leak-tight adjustment systems and low friction valve gears, oil pressure is required. To avoid the necessity of an extremely large oil pump, the above described principle is exploited, with a

hot engine and low engine speed i.e. with low oil pressure, through the use of the non-return valve. The non-return valve is used to increase the adjustment speed at low oil pressures.

Variable Camshaft Timing – VarioCam Plus (911 Carrera (996) M.Y. 2002) Variable Camshaft Timing With Valve Stroke Control



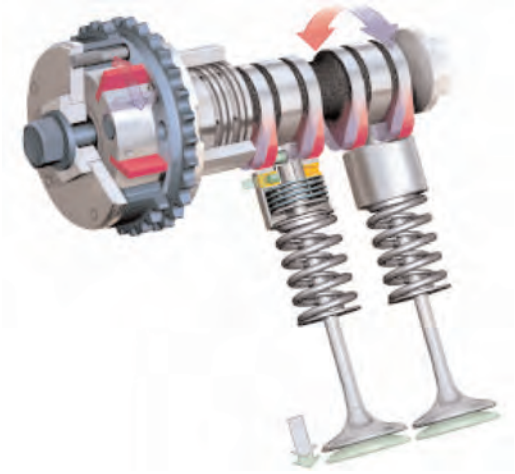
Flat-base Tappet Cutout

Functional Description Of Valve Stroke Adjustment

The valve stroke adjustment system consists of switchable flat-base tappets which are actuated by means of an electrohydraulic 3/2-way valve. Since two different cam shapes are used on the camshaft, it is possible to select the different cams (by switching the flat-base tappets) so that their respective valve stroke characteristics act on the engine.

These flat-base tappets are mounted on the inlet side of the engine. The flat-base tappets consist of two nested tappets which can be interlocked hydraulically by means of a pin. Once interlocked, the inner tappet comes into contact with the small cam and the outer tappet with the large cam. An element for compensating the valve clearance is always integrated in the power flow of the tappet.

The variable camshaft timing has a variable adjustment range of 0 - 40° kW (crankshaft). The valve stroke control facilitates decreased or increased valve strokes. When idling or near idling, the engine control is optimized by switching the intake valve stroke to a small cam with 3.6 mm and an adjustment of the valve timing for minor valve overlap. This results in a frictional loss reduction due to the small valve stroke, decreased charge-exchange losses by extremely decreased opening times and few exhaust fumes from previous combustion in the combustion chamber for an even and rapid combustion. These measures produce a clear reduction in consumption together with noticeably improved idling quality.

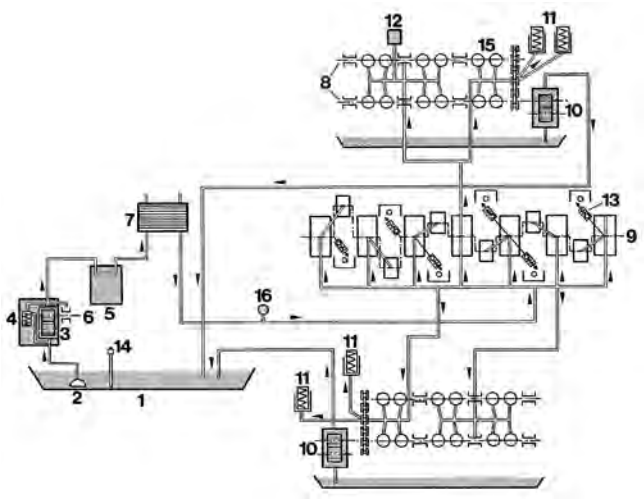


As the valve timing is variable, the decreased valve stroke can be maintained in the partial load range and the valve overlap can be optimized.



In full-load conditions, a high torque and high peak power output is achieved through low-loss charge exchange process and precision designed cam contour at an intake valve stroke of 11 mm. Furthermore, the opening and closing times of the valve lift are also adjusted towards advanced.

Engine Lubrication



Oil Circuit Layout

1 - Oil Sump
2 - Oil Intake Snorkel
3 - Oil Pump
4 - Pressure Relief Valve
5 - Full-flow Oil Filter
6 - Intermediate Shaft
7 - Oil/water Heater Exchanger
8 - Camshaft
9 - Crankshaft
10 - Oil Return Pump
11 - Chain Tensioner
12 - Oil Pressure Sensor
13 - Valves For Piston Cooling
14 - Oil Level Probe
15 - Hydraulic Valve Tappet
16 - Oil Temperature Sensor

Notes:

Oil Supply – Boxster/S (986)

In order to ensure a reliable engine oil supply even with extreme longitudinal and lateral acceleration, the Boxster has an integrated dry-sump lubrication system (without external oil tank); i.e. the oil sump is situated below the crank gear.



Boxster (986) Integrated Oil Dry-Sump System Components

A special die-cast method means that it is possible to cast the oil channels into the crankcase. As a result, drilling as well as the subsequent cleaning processes are no longer necessary.

The oil pump (3) driven via the intermediate shaft (6) draws the oil out of the oil sump (1) via the oil suction tube (2) and then transfers it to the lubricating points.



Boxster (986) Oil Collection Channel

The oil repeller leads the returning oil back to the oil sump via the oil collection channel and collection edges.

Changes To The Oil Supply System (911 Carrera (996) M.Y.2002)

To ensure a reliable engine oil supply even during extreme longitudinal and lateral acceleration, the 911 Carrera (996) also has integral dry sump lubrication (without external oil tank).

By restricting the axial play tolerance of the impellers, the delivery rate of the oil pump has been increased by approx. 5 %.

Oil Return Pump

Since there is no drop between the cylinder heads and oil sump in the Boxer engine, the oil is drawn out of each of the cylinder heads by and oil return pump.



Oil Pump

Notes:

Oil Separator

The oil drawn off via the return pumps is fed into “swirl pots”. In these containers, the oil is centrifuged and defoamed, i.e. the gases, which the oil has picked up on the way to the lubricating points, are removed. This ensures that the oil always has a good consistency, which is necessary to guarantee the reliability of the hydraulic valve clearance compensation. Gases could bring about changes in the engine timing, which would have an effect on the performance and exhaust-emission behavior of the engine.



Oil Separator Components

Oil Filter



An exchangeable filter cartridge is used as the oil filter.

- Oil capacity is 8.25 liters.
- The engine oil must be changed every 15,000 miles.
- The filter cartridge must be changed every 30,000 miles.

Oil Level Sensor

Information regarding the oil level displayed on the instrument cluster is provided via a measuring sensor screwed into the crankcase.



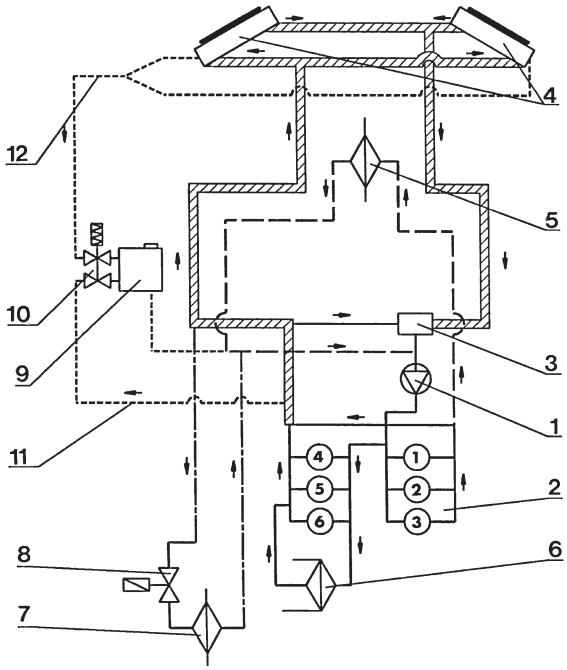
Oil Level Sensor

Notes:

Cooling System – Boxster/S (986)

The principle of cross-flow cooling with integrated cooling-water channeling was implemented to ensure that the cooling water is distributed evenly to all of the cylinders. A temperature drop between the individual cylinders is thus prevented. The cooling fluid is supplied through integrated lines.

As already described in the casting techniques under oil circulation, all of the cooling channels in the engine are produced in the casting process. Additional lines or hoses in the engine are no longer required which, in turn, results in high reliability and low servicing requirements.



Boxster (986) Cooling System Layout

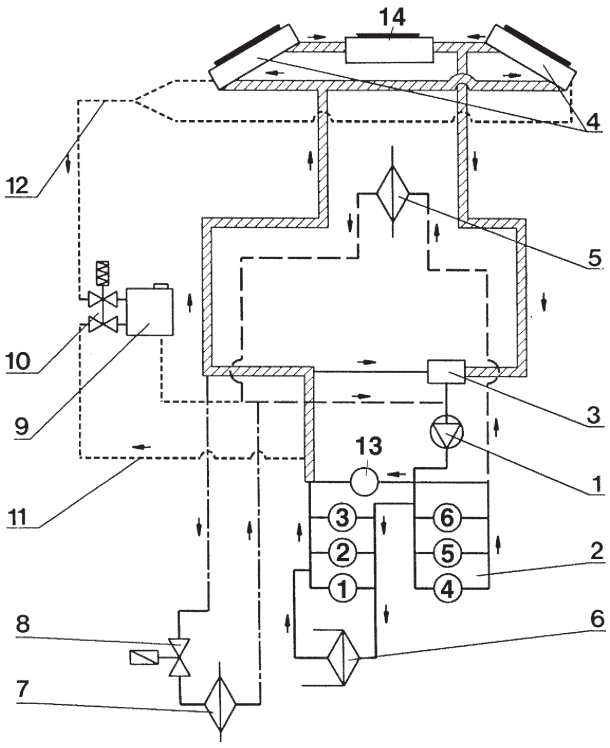
1 - Water pump
2 - Crankcase
3 - Thermostat
4 - Radiators *
5 - Heat exchanger, heating
6 - Oil-to-water heat exchanger
7 - ATF heat exchanger (Tiptronic only)
8 - Electric shut-off valve (Tiptronic only)
9 - Expansion tank
10 - Shut-off valve
11 - Venting line (engine)
12 - Venting line (radiator)

* Boxster S (986) (3.2 l) M.Y. 2000-04 have an additional front center radiator.

Cooling System (911 Carrera (996) **

To achieve uniform distribution of coolant for all cylinders, the same principle of cross-flow cooling circuit with fully integrated coolant ducting is used on the 911 Carrera (996). This prevents temperature differences between the individual cylinders. The coolant is fed through integral lines.

On models with manual transmission, the cooling takes place via two coolers (4). These are fitted in the wings in front of the front wheels. On models with Tiptronic transmission, an additional 3rd cooler (14) is located in the front of the vehicle. This facilitates cooling of the ATF via an additional oil/water heat exchanger in the common water circuit. To avoid icing up of oil separator at low temperatures, the oil separator is flushed with coolant. Because of the special coolant, a coolant change on the 911 Carrera (996) is also not necessary. Ensure to fill up or top-up only with the coolant specified by Porsche.



911 Carrera (996) Cooling System Layout

1 - Water pump
2 - Crankcase
3 - Thermostat
4 - Radiator
5 - Heat exchanger, heating
6 - Oil/water heat exchanger
7 - ATF heat exh. (only Tip.)
8 - Elec. shut-off valve (only Tip)
9 - Expansion tank
10 - Shut-off valve
11 - Bleeder pipe (engine)
12 - Bleeder pipe (radiator)
13 - Oil separator
14 - Radiator

** M.Y. 911 1999-01, engine types M96.01/02/04 had an additional center front radiator. 2002-05, engine type M96.03 the center radiator was deleted, except on vehicles with Tiptronic transmission (M249) and on vehicles with the increased engine power option X51.

Service Tray – Boxster/S (986)



In the luggage compartment (bottom right), there are the filling spouts for the cooling fluid (right, blue cap) with expansion tank as well as for the engine oil (left, yellow cap) and the oil dipstick.

Notes:

911 Carrera (997) & Boxster/Cayman (987) Engine Components

Crankcase – Cayman S (987)

The crankcase concept, featuring a high level of component integration, separate crankshaft bearing with cast-in cast iron elements and Lokasil cylinder barrels, has been adopted from the 911 Carrera. In order to reduce horsepower loss caused by compression of the air below the piston during downward movement, air passages (see arrow in 911 crankcase image) have been incorporated between the individual cylinders.

In order to attain a displacement of 3.4 liters, the 96 mm bore of the engine from the 911 Carrera has been combined with the 78 mm stroke of the engine from the Boxster. This results in an extremely short stroke, which is conducive to true sports car performance.

Crankcase – 911 Carrera S (997)



The larger piston diameter in the 911 Carrera S (997) 3.8 liter engine displaces more air during the downward movement, the cross-sections of the connections between the individual cylinders have been increased.

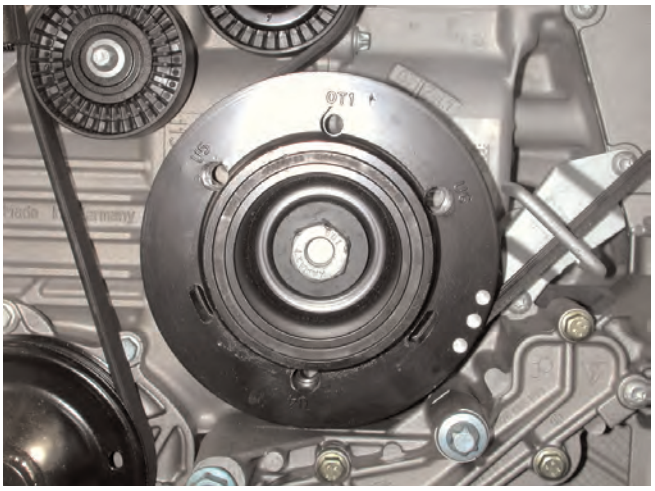
Crankshaft – Boxster/S (987)

In order to reduce weight on the crankshaft, the center bore is deeper on the flywheel side. This results in a weight reduction of approx. 0.6 lbs (0.3 kg).

Pistons – Boxster S (987) 3.2)

The pistons of the Boxster S (987) have been reinforced in the area of the valve reliefs. This results in a weight increase of 0.28 oz (8 g). The increased piston weight is offset by lighter wrist pins designed with a conical design and thinner walls.

Torsional Vibration Damper – 911 Carrera S (997)



The higher cylinder gas pressures in the 3.8 liter engine leads to torsional vibrations in the engine as a result of the transmissions of these forces via the pistons and the crankshaft drive (connecting rod and crankshaft). To reduce these torsional vibrations, the vibration damper material was changed from steel to aluminum.

The previous 3.8 liter torsional vibration dampers were made from steel, which was a disadvantage since the heavy weight compromises revving ability and spontaneity. To reduce this disadvantage, the 3.8 liter engine of the 911 Carrera S incorporates a torsional vibration damper made of aluminium. This reduces the crankshaft drive's mass moment of inertia and enhances the engine's revving ability and spontaneous response.

Valve Train – Boxster (987) 2007, (Cayman (987) 2007

Timing Intake opens, large lift,
early/late . . . . . .19° before TDC/21° after TDC
Intake closes, large lift,
early/late . . . . . .13° after BDC/53° after BDC
Intake opens, small lift,
early/late . . . . . .TDC/40° after TDC
Intake closes, small lift,
early/late . . . . . .58° before BDC/17° before BDC
Exhaust opens . . . . . .36° before TDC
Exhaust closes . . . . . .2° after TDC

Valve Train – Boxster S (987) 2007, (Cayman S (987)

Timing in retarded setting at 1 mm valve lift and zero play:

Intake opening, large stroke . . . . . .11° after TDC
Intake closing, large stroke . . . . . .60° after BDC
Intake opening, small stroke . . . . . .39° after TDC
Intake closing, small stroke . . . . . .19° before BDC
Outlet opening . . . . . .50° before BDC
Outlet closing . . . . . .4.5° after TDC

Valve Train – 911 Carrera S (997)

While the 3.8 liter engine retains the same valve lift and the same diameters for the intake and exhaust ports, the timing has been duly adapted to the modified gas exchange. This enables high torque and power output combined with a smooth torque curve.

Timing in retarded setting at 1 mm valve lift and zero play:

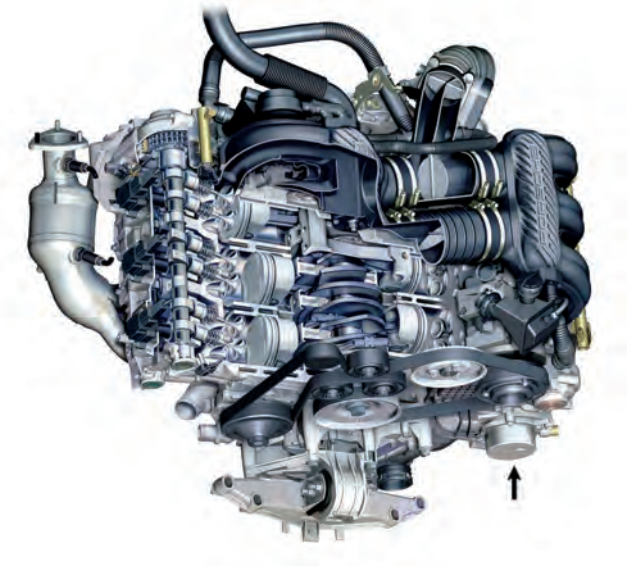
Intake opening, large stroke	9° after TDC
Intake closing, large stroke	61° after BDC
Intake opening, small stroke	39° after TDC
Intake closing, small stroke	19° after BDC
Exhaust opening	50° before TDC
Exhaust closing	4° before TDC

Notes:

Vacuum Pump



The 911 Carrera/S (997), Boxster/S and Cayman/S (987) engines employ a mechanical vacuum pump instead of a conventional vacuum amplifier to provide the vacuum for the brake booster. This pump is driven in tandem configuration together with the oil extraction pump of the left cylinder head of Boxster/Cayman engines (see arrow) and right cylinder head of 911 Carrera engines.



This design enables a high and constant level of vacuum supply and subsequent effective brake boost even when the most unfavorable underlying conditions apply, e.g. low external air pressure at high altitudes, and in highly dynamic driving involving a high proportion of full-load operation, e.g. on race tracks.

Belt Drive – Boxster/S & Cayman/S (987)



Boxster (987) and Boxster S (987) with manual transmissions feature tension and idler pulleys made of plastic in order to reduce weight. This results in a weight reduction of approx. 1.1 lbs (0.5 kg). It has not been possible to implement this change on vehicles with Tiptronic, due to the different mass on the power output side of Tiptronic vehicles in comparison to vehicles with manual transmission, which would result in vibration and subsequent noise.

Belt Service Life – 911 Carrera/S (997), Boxster/S & Cayman/S (987)

On the basis of the excellent service life with the belt drive, Porsche has extended the replacement interval from 48,000 miles (80,000 km) to 60,000 miles (90,000 km).

Notes:

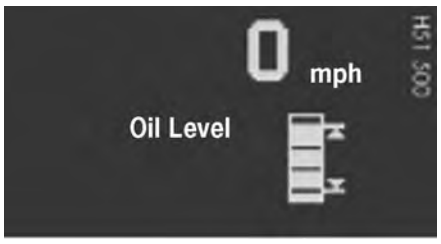
Oil Supply/Oil Level Measurement – 911 Carrera/S (997), Boxter/S & Cayman/S (987)

The oil supply system as a whole has been adopted from the previous models. A change applies in the area of oil level measurement. Continuing with the positive experiences with electrical oil level measurement and a changeover in measuring habits away from manual measurement via the oil dipstick to electrical oil level measurement, the new engines do not have an oil dipstick.



The hole on the crankcase for the oil dipstick is closed with a plug.

In order to speed up the process of measuring the oil level in certain operating states and in the interests of measuring convenience, map compensation has been introduced. Previously, all of the engine oil had to return to the oil pan after the engine was shut off before the oil level could be measured. To enable accurate measurement of the oil level, the necessary time required to achieve this state was ensured by means of a waiting time for oil level measurement, determined according to the oil temperature and the length of time the engine has been off.



With map compensation, the actual measured oil level in the oil pan is compensated to take in account the oil temperature and the length of time the engine has been off. The oil that has not yet returned to the oil pan is electronically calculated and theoretically added, and the calculated oil level is displayed in the instrument cluster as quickly as possible. This results in a substantial reduction in measuring times compared with the previous system.

Cooling – Boxster/S (987)



Due to the increase in power of the new Boxster (987) and Boxster S (987) models and the resultant higher thermal load, the cooling system had to be revised. The Boxster and Boxster S with manual transmission are equipped with two radiators from the 911 Carrera (997).

Similar to the previous Boxster (986) models, the new Boxster (987) radiators are mounted in the front fenders in front of the front wheels. These radiators have been enlarged in terms of both surface area (approx. 5 %) and depth (approx. 20 %). The two powerful electric fans also include a control system designed to meet the cooling requirements in conjunction with a modified exhaust air concept. This ensures flow optimized control of the exhaust air flow and aerodynamic optimization of the cooling system. This new feature permits infinite control of the fan speed as a function of the coolant temperature and the system pressure in the air conditioning system instead of two-stage control. It has the advantages of requiring less current and therefore creates less of a load on the vehicle electrical system, in addition to quieter operation.

The coolant pump is identical to that used on the 911 Carrera (997) and ensures a higher coolant flow rate. The more efficient operation means that the smaller oil/water heat exchanger of the Boxster (987) 2.7 liter engine can now be used on the Boxster S (987) as well, resulting in a weight reduction of 12.7 oz (360 g).

The Boxster S (987) with Tiptronic S features an additional radiator at the front of the vehicle. This enables cooling of the automatic transmission oil via an additional oil/water heat exchanger in a common coolant circuit.

Cooling – Cayman/S (987)

The familiar cross-flow cooling system is also employed on the new Cayman/S, providing for the efficient and even distribution of coolant to all cylinders. The coolant pump, which is identical to that on the 911 Carrera and the Boxster, ensures a high coolant flow rate.

Aerodynamic optimization of the cooling-air guides on the 911 Carrera and Boxster has improved the performance of the cooling system adopted from these vehicles, thereby enabling this system to meet the high cooling requirements resulting from the stated power output.

The Cayman/S with manual transmission is equipped with two radiator modules like those of the 911 Carrera (997), located in the front fenders in front of the front wheels. Two powerful electric fans also possess a control system designed to meet the cooling requirements in conjunction with an adapted exhaust air concept. This ensures flow-optimized control of the exhaust air flow and aerodynamic optimization of the cooling system.

This new feature permits infinite control of the fan speed as a function of the coolant temperature and the refrigerant pressure in the air conditioning system. It has the advantages of minimizing the required current input, thereby imposing only a minimal load on the vehicle electrical system and also generating a low level of noise.

On the Cayman/S with Tiptronic S, an additional third radiator is used at the front of the vehicle to facilitate cooling of the automatic transmission oil via an additional oil-water heat exchanger in the common water circuit.

Cooling – 911 Carrera/S (997)

Since the 911 Carrera (997) is available in two engine types and the 3.8 liter engine has a higher cooling requirement than the 3.6 liter engine, the entire cooling system has had to be revised. A coolant pump with an approx. 13% increase in capacity is employed to this end. This increase in capacity results from an approx. 3 mm larger impeller and an enlarged coolant inlet on the crankcase. This necessitated corresponding modifications of the seals. The oil-water heat exchanger has been enlarged to incorporate two additional cooling fins. The efficiency of the front radiators also had to be improved.

Enlarging the radiators was not an option due to lack of space. A third radiator for cars with manual transmissions also was deemed unviable due to weight concerns. Taking these concerns into consideration, optimizing the existing cooling concept was the best option available.

Fine-tuning has improved the radiator core and increased the efficiency of the supply and exhaust channels in the body. In addition, variable speed control for the radiator fans has been introduced for the 911 Carrera (997) models.

The total of all the implemented measures resulted in a substantial improvement in cooling capacity. In order to reduce the extent of diversification, these modifications have been incorporated into both engine types.

Notes:

911 Carrera (996) – Checking Engine Oil w/Dipstick (Not 911 Turbo (996), See Turbo Engine Section)

Engine Oil Level

Follow the instructions in the "Cautions" chapter.

▷ Regularly check the oil level using the on-board computer each time the vehicle is refuelled.
Refer to the chapter "On-board computer".

⚠ Warning!

Engine oil is hazardous to your health and may be fatal if swallowed.

▷ Keep engine oil out of children's reach.

Used engine oil contains chemicals that have caused cancer in laboratory animals.

▷ Always protect your skin by washing thoroughly with soap and water.

The dipstick and oil filler are in the engine compartment.

Preconditions for correct oil level measurement with the dipstick

- Vehicle must be level.
- Engine must be switched off and at operating temperature.
- Let engine oil flow into the oil pan for a few minutes after the engine has stopped running.





Checking the oil level

1. Withdraw dipstick and wipe it with a clean, lint-free cloth.
2. Push dipstick fully home, withdraw again and read off the oil level.
   Push dipstick in as far as the stop.

The oil level must in no case fall below the minimum or exceed the maximum oil level on the dipstick.
The difference between the two marks is approximately 1.25 liters/1.33 quarts.

Topping off engine oil

1. If necessary, add engine oil half a liter at a time. Unscrew the cap of the oil filler.
2. Check oil level with the dipstick again after a few minutes.
3. Push dipstick in as far as the stop.
   Push filling aid in with the cap and close cap carefully.

Boxster (986) – Checking Engine Oil w/Dipstick

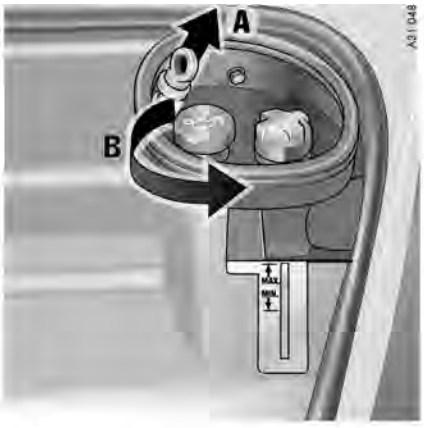
Preconditions for correct oil level measurement with the dipstick

- Vehicle must be level.
- Engine must be switched off and at operating temperature.
- Let engine oil flow into the oil pan for a few minutes after the engine has stopped running.

⚠ Caution!

Risk of damage from overflowing engine oil.

▷ Take care while checking and topping off engine oil not to soil the luggage compartment or items of luggage.



A - *Dipstick*
B - *Cap of oil filler*



Checking the oil level

1. Withdraw dipstick and wipe it with a clean, lint-free cloth.
2. Push dipstick fully home, withdraw again and read off the oil level.
   Push dipstick in as far as the stop.

The oil level must in no case fall below the minimum or exceed the maximum oil level on the dipstick.
The difference between the two marks is approximately 1.25 liters/1.33 quarts.

Topping off engine oil

1. If necessary, add engine oil half a liter at a time. Unscrew the cap of the oil filler.
2. Check oil level with the dipstick again after a few minutes.
3. Push dipstick in as far as the stop.
   Push filling aid in with the cap and close cap carefully.

911 Carrera (996) – Checking Engine Oil w/Gauge (Not 911 Turbo (996), See Turbo Engine Section)

"OIL"
Display and measurement of the engine oil level

Caution!

Risk of engine damage.

- ▷ Regularly check the oil level each time the car is refuelled.
- ▷ Do not allow the oil level to fall below the minimum mark.

Conditions for measuring the oil level

1. Vehicle is level.
2. Engine is off.
3. Ignition on.

Oil return time

Before the oil level is measured, the engine oil has to have flowed back into the oil pan.
The time taken for the engine oil to flow back depends on the engine temperature and how long the engine has been stopped.

This waiting time is counted down in the on-board computer display when the ignition is switched on. The oil level display segments start to "cycle".

It is best to measure the engine oil level with the engine at operating temperature. Correct measurements and short waiting times are achieved in this way.

Initiating oil level measurement

- ▷ Switch ignition on (do not start the engine). The engine-oil level measurement display appears in the on-board computer.



- ▷ Allow waiting time to elapse.



Once the measurement has been completed, you can read off the engine oil level on the segment display.
If the oil level has fallen below the min. mark, the segment below the min. mark flashes.

The difference between the min. and max. marks on the segment display is approx. 1.25 litres. One segment of the display corresponds to a quantity of approx. 0.2 litre.

- ▷ Add engine oil if necessary.
  Please refer to the chapter "ENGINE OIL LEVEL" on page 173.
  Before adding oil, switch ignition off.

Never add more engine oil than required to reach the max. mark.

Oil level measurement during refuelling

The oil level is automatically measured during refuelling. If the oil level is too low, "Check oil level" appears in the on-board computer display.

However, this measurement is performed only if the following preconditions are met:
Engine is at operating temperature, ignition is off, refuelling is completed within 15 minutes.

Failure

A failure of the oil level display is indicated by a warning message in the on-board computer.

Oil level measurement can also be initiated in the "OIL" menu:

Switching on selection field "A"

- ▷ Push operating lever forward.

Initiating measurement

- ▷ Select "OIL" with the operating lever.



- ▷ Push operating lever forward.



- ▷ Push operating lever forward.
  Measurement is started.

Info

The "Info" function allows you to call the pre requisites for oil level measurement.

▷ ▷ ▷

Boxster (986) – Checking Engine Oil w/Gauge



A - *Waiting time display for oil level measurement*
B - *Engine oil level segment display*

Engine Oil Level Gauge

When the ignition is switched on, the odometer display changes temporarily to the waiting time mode for oil level measurement.

The engine oil level is not displayed when the engine is running.
The segment display **B** serves to measure and display the oil level.

The oil level should lie between the minimum and maximum marks. The difference between the two marks is approximately 1.25 liters.
If the level falls below the minimum mark, the segment underneath flashes.

⚠ Caution!

To prevent engine damage, the oil level should not fall below the minimum mark.

▷ Check engine oil level with every fuel filling.

Before the oil level is measured, the engine oil has to have flowed back into the oil pan.
The time taken for the engine oil to flow back depends on the engine temperature and how long the engine has been stopped.

This waiting time **A** is displayed when the ignition is switched on, as a count-down in minutes and seconds. In addition, the segment display begins to "cycle".

Short waiting times for a measurement are achieved

- when the engine has been stationary for some hours, **before starting** a cold engine
- or when the engine is at operating temperature.

If a waiting time of more than 5 minutes is displayed, it makes sense not to make the oil level measurement until the engine is at operating temperature.

Initiate oil level measurement

1. Stop the vehicle in a level position.
   Switch ignition on (do not start the engine).
2. Allow waiting time to elapse.
   The waiting time and the cycling segments are displayed.
3. Then read off oil level from the segment display, top up engine oil if necessary.
   Before adding oil, switch ignition off.
   Follow the warnings and instructions in the "Engine oil level" chapter.

Oil level measurement during refuelling

The oil level is automatically measured during refuelling. If the oil level is too low, the segment display appears. The segment below the min. mark flashes.

However, this measurement is performed only if the following preconditions are met:
Engine is at operating temperature, ignition is off, refuelling is completed within 15 minutes.

The engine oil level must also be regularly checked between service intervals.
See your "Maintenance" manual.

Fault display

If the whole segment display flashes, there is a fault in the measuring device.

▷ In this event, use the dipstick to check the oil level.

911 Carrera (997) & Boxster/Cayman (987) – Checking Engine Oil w/Gauge

OIL
Display and measurement of the engine oil level

Caution!

Risk of engine damage.

- Regularly check the oil level after refuelling.
- Do not allow the oil level to fall below the minimum mark.

Conditions for measuring the oil level

1. It is important to ensure that the vehicle is **horizontal** for correct oil level measurement to occur.
2. Engine is off.
3. Ignition on.



- If the bottom segment is filled in, the oil level has reached the minimum mark.
- Add engine oil immediately.
- If the segment flashes, the oil level has dropped to below the minimum mark.
- Add engine oil immediately.

The difference between the minimum and maximum marks on the segment display is approx. 1.2 liters.
Each segment of the display corresponds to approx. 0.4 liter.

- Add engine oil if necessary.
  Please observe the chapter "ENGINE OIL LEVEL" on Page 173.
  Before adding oil, switch ignition off.
- **Never add more engine oil than required to reach the maximum mark.**

Oil return time

Before the oil level is measured, the engine oil has to have flowed back into the oil pan.
The time taken for the engine oil to flow back depends on the engine temperature and how long the engine has been stopped.

This waiting time is counted down in the on-board computer display when the ignition is switched on. The oil level display segments start to "cycle".

- It is best to measure the engine oil level before embarking on a journey (if the vehicle has not been driven for an extended period) or with the engine at operating temperature. Shorter waiting times are achieved in this way.

Oil level measurement during refuelling

The oil level is automatically measured during refuelling.

Preconditions

1. Ignition is switched off.
2. If the engine is at operating temperature, at least 5 minutes must elapse between parking the vehicle and starting the engine.
3. Refuelling completed within 15 minutes.

When the ignition is switched on, the engine oil level is shown on the segment display.

Measurement will be stopped if the above requirements are not met.

- Start oil level measurement in the "OIL" menu **or**
- Start oil level measurement by switching on the ignition.

Failure

A failure of the oil level display is indicated by a warning message in the on-board computer.

Initiating oil level measurement

- Switch ignition on (do not start the engine).
  The engine-oil level measurement display appears in the on-board computer.



- Allow waiting time to elapse.
- Once the measurement has been completed, you can read off the engine oil level on the segment display.



- If the segments are filled in up to the top line, the oil level has reached the maximum mark.
- Under no circumstances add engine oil.

The oil level measurement can also be initiated in the "OIL" menu:

Switching on selection field "D"

- Push operating lever forward.

Initiating measurement

- Select "OIL" with the operating lever.



- Push operating lever forward.



- Select "Start" and push the operating lever forward.
  Measurement is started.

911 Carrera (996)/(997) – Checking Engine Coolant



Coolant Level

Follow the instructions in the "Cautions" chapter.

The cooling system is filled at the factory with a permanent coolant.
It provides year-round protection from corrosion and freezing down to – 31°F/– 35°C (Nordic countries – 40°F/– 40°C).

Only use antifreeze authorized by Porsche.

Checking coolant level

The expansion tank with its filler orifice is in the engine compartment.

▷ Check the coolant level regularly through the transparent expansion tank.

When the engine is cold and the car is level the fluid level must lie between the "Min." and "Max." markings.

Topping off coolant

⚠ Warning!

Danger of serious personal injury from scalding. Coolant is hazardous to your health, and may be fatal if swallowed.

▷ Do not open the cap of the expansion tank while the engine is hot.

▷ Allow the engine to cool down before opening the cap and protect your hands, arms and face from any possible escape of hot coolant.

▷ Keep coolant out of children's reach.

▷ Also, keep coolant away from your pets. They can be attracted to it should there be a spill, or to used coolant left in an open container. Coolant can be deadly to pets if consumed.

1. Switch engine off and let it cool.
   See the chapter on the "Cooling system".

2. Cover the expansion tank cap with a thick rag.
   Open cap slowly and carefully and allow overpressure to escape.
   Then unscrew cap completely.

3. Only add a mixture of antifreeze and water in equal parts, and do not exceed the "Max." mark.

   Antifreeze in coolant:
   50% gives protection down to – 31°F/– 35°C
   60% gives protection down to – 58°F/– 50°C

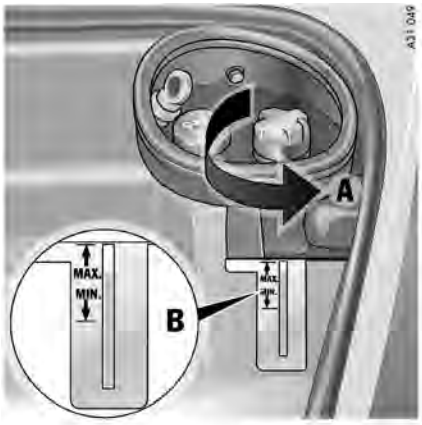
4. Screw cap firmly on.

If in an emergency pure water has been added, the mix ratio must be corrected at an authorized Porsche dealer.

Marked loss of coolant indicates leakage in the cooling system.
The cause should immediately be remedied at an authorized Porsche dealer.

▷ ▷ ▷

Boxster (986/987) – Checking Engine Coolant



A - *Coolant expansion tank cap*
B - *Coolant level*

Coolant Level

Follow the instructions in the "Cautions" chapter.

The cooling system is filled at the factory with a permanent coolant.
It provides year-round protection from corrosion and freezing down to – 31°F/– 35°C (Nordic countries – 40°F/– 40°C).

Only use antifreeze authorized by Porsche.

1. Switch engine off and let it cool.
   See the chapter on the "Cooling system".

2. Cover the expansion tank cap with a thick rag.
   Open cap slowly and carefully and allow overpressure to escape.
   Then unscrew cap completely.

3. Only add a mixture of antifreeze and water in equal parts, and do not exceed the "Max." mark.

   Antifreeze in coolant:
   50% gives protection down to – 31°F/– 35°C
   60% gives protection down to – 58°F/– 50°C

4. Screw cap firmly on.

If in an emergency pure water has been added, the mix ratio must be corrected at an authorized Porsche dealer.

Marked loss of coolant indicates leakage in the cooling system.
The cause should immediately be remedied at an authorized Porsche dealer.

Checking coolant level

The expansion tank with its filler orifice is in the rear luggage compartment.

▷ Check the coolant level regularly at the transparent window of the expansion tank.

When the engine is cold and the car is level the fluid level must lie between the "Min." and "Max." markings.

Topping off coolant

⚠ Warning!

Danger of serious personal injury from scalding. Coolant is hazardous to your health, and may be fatal if swallowed.

▷ Do not open the cap of the expansion tank while the engine is hot.

▷ Allow the engine to cool down before opening the cap and protect your hands, arms and face from any possible escape of hot coolant.

▷ Keep coolant out of children's reach.

▷ Also, keep coolant away from your pets.
They can be attracted to it should there be a spill, or to used coolant left in an open container. Coolant can be deadly to pets if consumed.

Risk of damage from overflowing coolant.

▷ Take care while topping off coolant not to soil the luggage compartment or items of luggage.

Engine-compartment blower, radiator fan

The radiator and radiator fans are in the front of the car.
The engine-compartment blower is mounted in the engine compartment.

⚠ Warning!

Risk of injury.
After the engine is switched off, the engine-compartment and coolant temperatures are monitored for approx. 20 minutes.
During this period, and depending on temperature, the engine-compartment blower and radiator fans may continue to run or start to run.

▷ Carry out work in these areas only with the engine off and exercise extreme caution.

Cayman (987) – Checking Engine Coolant

Coolant Level

▷ Please observe the chapter "EXERCISE EXTREME CAUTION WHEN WORKING ON YOUR VEHICLE" on Page 172.

The cooling system is filled at the factory with a permanent coolant.
It provides year-round protection from corrosion and freezing down to –31°F/–35°C.

Only use antifreeze authorized by Porsche.

Checking coolant level

The expansion tank for the coolant is located in the rear luggage compartment under the service flap.

▷ Check the coolant level regularly at the transparent window of the expansion tank.

When the engine is cold and the car is level the fluid level must lie between the "Min." and "Max." markings.

Topping off coolant

⚠ Warning!

Danger of serious personal injury from scalding. Coolant is hazardous to your health, and may be fatal if swallowed.

▷ Do not open the cap of the expansion tank while the engine is hot.

▷ Allow the engine to cool down before opening the cap and protect your hands, arms and face from any possible escape of hot coolant.

▷ Keep coolant out of children's reach.

▷ Also, keep coolant away from your pets. They can be attracted to it should there be a spill, or to used coolant left in an open container. Coolant can be deadly to pets if consumed.

Risk of damage from overflowing coolant.

▷ Take care while topping off coolant not to soil the luggage compartment or items of luggage.

1. Switch engine off and let it cool.
   Please observe the chapter "COOLING SYSTEM" on Page 86.



2. Press catch button on the service flap and open flap.



3. Cover the expansion tank cap with a thick rag. Open cap slowly and carefully and allow overpressure to escape.
   Then unscrew cap completely.
4. If necessary, add a mixture of equal parts antifreeze and water.
   Do not fill over the "max" marking.

   Antifreeze in coolant:
   50% gives protection down to –31°F/–35°C
   60% gives protection down to –58°F/–50°C
5. Screw cap firmly on.
6. Close service flap.

If in an emergency pure water has been added, the mix ratio must be corrected at an authorized Porsche dealer.

Marked loss of coolant indicates leakage in the cooling system.
The cause should immediately be remedied at an authorized Porsche dealer.

Radiator fans

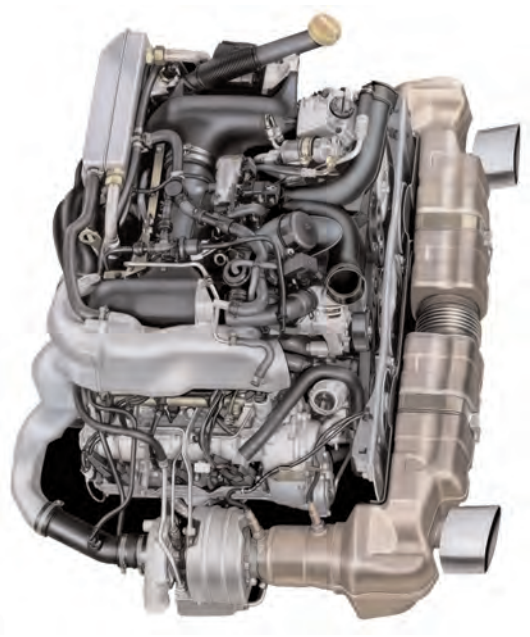
The radiator and radiator fans are in the front of the vehicle.

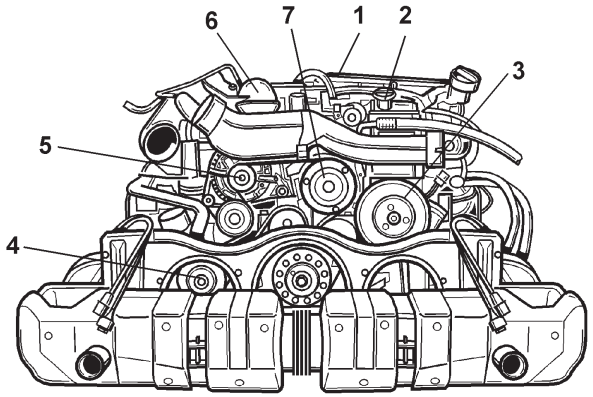
⚠ Warning!

Risk of injury. The fans can start running as a function of temperature, even with the engine switched off.

▷ Exercise extreme caution when working in the area of the radiator fans.

911 Turbo (996) Engine





Component Location

1 - Oil reservoir
2 - Servo reservoir
3 - Steering hydraulics pump
4 - Coolant pump
5 - AC generator
6 - Oil filter housing
7 - Air conditioning compressor

General

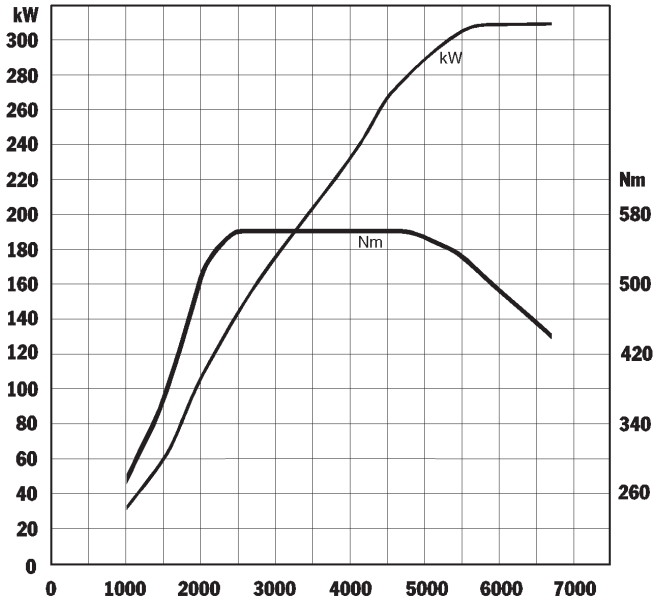
M96.70

The engine of the 911 Turbo is an evolution of the 6-cylinder Boxer engine from the 911 GT1. During development of this new turbo engine, special attention was directed at reducing fuel consumption while simultaneously increasing the power output of the engine.

The outstanding features of the engine are:

- two-piece crankcase
- crankcase with 8 bearing points
- four-valve technology
- valve stroke control on inlet side with axial camshaft adjustment (VarioCam Plus)
- flat-base tappets with hydraulic valve clearance compensation
- solid-state HT distribution with separate ignition coils for each cylinder
- dry-sump lubrication with oil reservoir attached to engine, oil returned via two suction pumps per cylinder head, and one central oil return pump
- on-board diagnostic system world-wide
- reduction of fuel consumption

Full-Load Curve of the M96.70 Engine

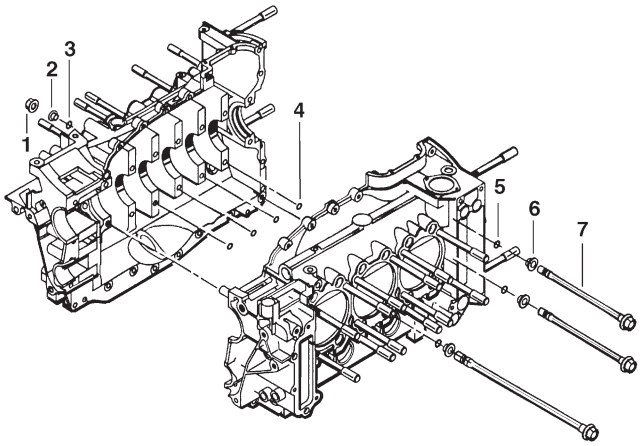


Engine Data:

Displacement	3.6 l
Bore	100 mm
Stroke	76.4 mm
Power output	309 kW/414 HP
at engine speed	6000 rpm
Max. torque	560 Nm (413 ft lb)
at engine speed	2700 - 4600 rpm
Compression ratio	9.4 : 1
Governed speed	6750 rpm
Fuel grade	93 octane ($\frac{R+M}{2}$)

Crankcase

The crankcase is divided into two sections and is made of an aluminum/silicon alloy. The two halves of the crankcase are machined together. It is, therefore, important to ensure that the pairing numbers match when the crankcase is assembled.



Crankcase Components

A ring groove has been cut into the hole for the through bolt of main bearing seat 7. It is a relief groove and prevents oil from being discharged from the joint between the two crankcase halves. It is important to ensure that this groove is free of sealing compound and dirt particles.

The crankcase is bolted together with through bolts (7) which are sealed by means of round seals (3 and 5) and sealing washers (2 and 6). In addition, O-rings (4) are also attached to the lower part of main bearing seats 2, 3, 4 and 5 in order to reduce vibration along the through bolts.

Crankshaft

The crankshaft is drop-forged. The shaft has full bearing support, i.e. every connecting rod pin is supported by 2 main bearings, resulting in 8 main bearing points. Main bearing 1 (flywheel end) is configured as a thrust bearing so that it can absorb the axial forces acting on the crankshaft. The structural design restricts the axial clearance to 0.11...0.20 mm.

The main bearings are supplied with lubricating oil directly from the main oil gallery of the crankcase, whereas connecting rod bearings 4, 1 and 5 are supplied with oil from main bearing 1 and connecting rod bearings 3, 6 and 2 from main bearing 8 via a channel in the crankshaft. This ensures a constant supply of oil to the rod bearings.

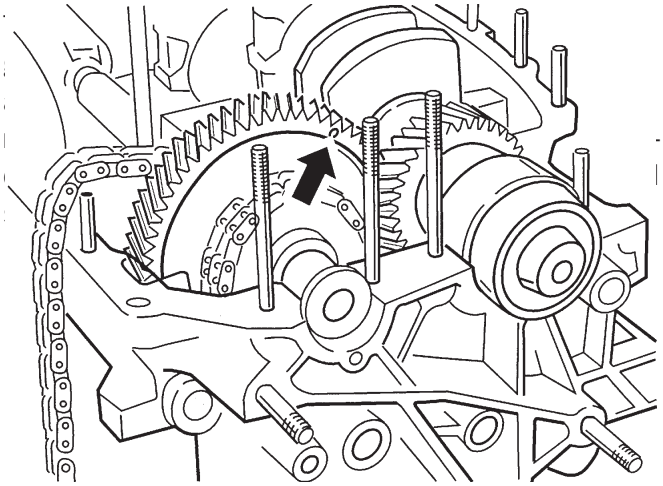
After machining, the crankshaft is plasma-nitrided. This elaborate surface treatment technique gives the main and connecting rod bearing pins excellent surface properties. The crankshaft has a stroke of 76.4 mm.

Torsional Vibration Damper

The torsional vibration damper is attached to the crankshaft cone and is also designed as a belt pulley. Its task is to absorb the torsional vibrations of the engine which are produced by inertia and gas forces.

This is achieved by means of a rotating mass which is attached to the steel hub via a torsionally resilient element. The characteristic vibrations of the torsional vibration damper counter and thus absorb the vibrations along the crankshaft.

Intermediate Shaft



Location of Intermediate Shaft Code

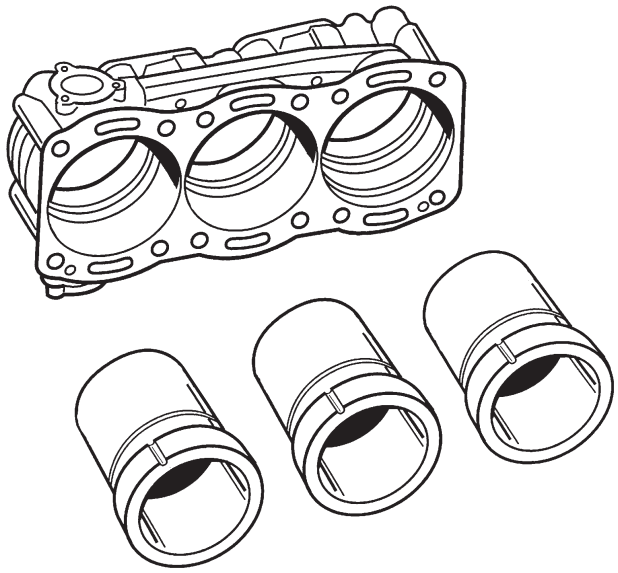
The code on the intermediate shaft gear (arrow) and on the left half of the crankcase indicate tolerance group 0 or 1 (eccentricity in the crankcase). At the end of the intermediate shaft is an intermediate part which is linked to and drives the oil pump. When the intermediate shaft and the oil pump are fitted, it is important to ensure that the intermediate part has axial clearance. As with the 911 Turbo (993), the double oil pump for the turbocharger is driven via TORX gearing.

Connecting Rods

The connecting rods are the same as those used in the 911 Turbo (993).

Cylinders

In order to increase torsional rigidity, the two cylinder banks (each with 3 cylinders) are housed in a single cylinder case. In contrast to the previous model, these cylinder cases are separate components and are not joined to the crankcase.



Cylinder Case and Sleeves

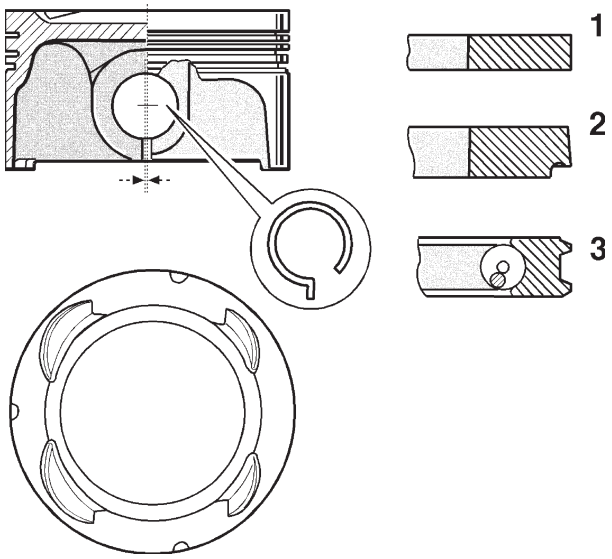
Cylinder sleeves made of aluminum and coated with Nikasil are used in the light-alloy cylinder cases. The coolant chamber between the cylinder sleeves and cylinder case is sealed by means of O-rings. The joint between the crankcase and cylinder case is sealed using coated triple-layer sheet-metal gaskets.

Piston Cooling

Oil spray jets are fitted in the crankcase to reduce the temperature of the pistons. The jets have an opening pressure of approx. 1.8 bar to ensure that the engine oil pressure is maintained at low engine speeds and high engine oil temperatures.

Pistons

The molded light-alloy pistons have a diameter of 100 mm. The fire land of the pistons is not smooth but rather grooved in order to increase its surface area and thus to reduce the thermal load on the fire land. Furthermore, the bearing surface of the pistons is coated with graphite to reduce the level of noise. The piston pin is on a full-floating bearing and oil spray is used for lubrication. The piston-pin circlip is twist-locked.

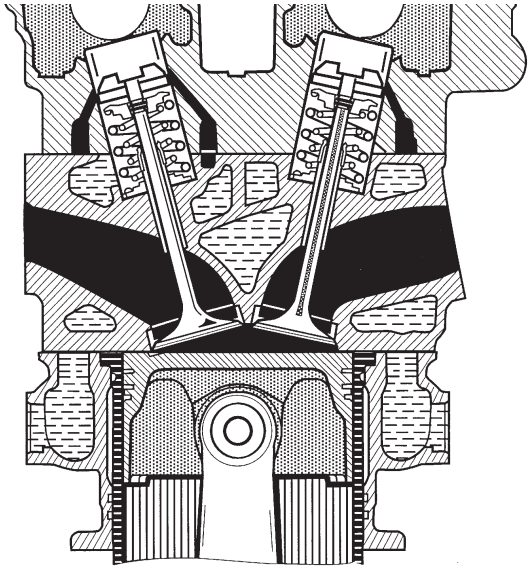


Ring 1 - Taper-face ring 100 x 1.75mm
Ring 2 - Stepped taper-face ring 100 x 1.75mm
Ring 3 - Bevel-edged ring with spiral-type expander (SSF ring)

Notes:

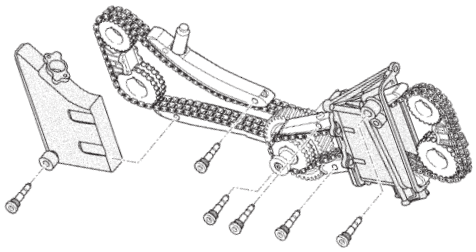
Cylinder Head

The cylinder heads are made of the extremely heat resistant light alloy RR350. The intake and exhaust ports are machined to improve the charge cycle and thus power output. The combustion chambers are designed as spherical cups.



Cylinder Head Cut-out

The two intake and two exhaust valves serving each cylinder have a diameter of 41 mm and 35 mm respectively around the valve disc. They are arranged in a "V" at an angle of 27.4°. The diameter of the valve stem is 6 mm in order to keep the moving masses of the valve gear as low as possible. The exhaust valve stem is hollow and filled with sodium to improve heat dissipation. Due to the power-oriented valve timing and the associated high forces, double valve springs are used to close the inlet and exhaust valves. This also safeguards the engine speed stability of the 911 Turbo engine which is designed for high engine speeds.



VarioCam Plus System Layout

A separate intake and exhaust camshaft is used for each cylinder bank. These camshafts are driven directly by a double roller chain. The chains are guided by plastic guide rails and hydraulic chain tensioners located at the untensioned end of the chain. The intake camshafts in the 911 Turbo also have a valve stroke control on the intake side in addition to the VarioCam Plus system (the system is described in a separate section). This optimizes the compromise between maximum power output and maximum torque while simultaneously reducing fuel consumption and improving running smoothness. A driving flange for the oil suction pump is attached on the input side of each exhaust camshaft.

Cylinder Head Gasket

The multi-layer steel gasket is completely covered with high-temperature resistant plastic in order to enhance the sealing quality of its surface. The advantage of this steel gasket is that heat can be dissipated from the cylinder head very efficiently.

Notes:

Camshaft Housing

The light-alloy camshaft housing is attached to the cylinder head. The inlet and exhaust camshafts are held in the camshaft housing by means of bearing brackets. The bearing brackets and camshaft housing are machined together and have pairing numbers.

Camshafts

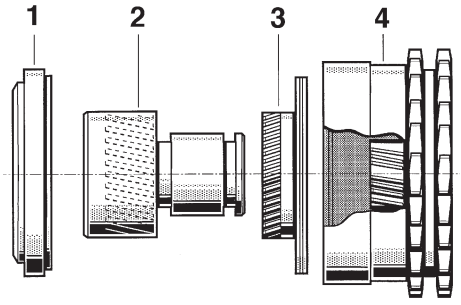
The camshafts are hard-chilled components and hollow-cast to reduce weight. The shank diameter of all camshafts is 26.6 mm. The inlet valve stroke is variable (3.0 mm or 10.0 mm).

Camshaft adjustment with valve stroke control (VarioCam Plus)

The demands placed on the design of an engine, i.e. increased performance, improved driving comfort, observance of legal emission limits and reduced fuel consumption, result in contradictory construction criteria.

The idea behind the development of the VarioCam Plus was to create a variable engine which can be optimized both for maximum performance and for frequent use in urban traffic or on country roads. A system to adjust the inlet camshaft to vary the opening and closing time combined with a valve stroke adjustment system is the solution to this problem.

Functional description of camshaft adjuster

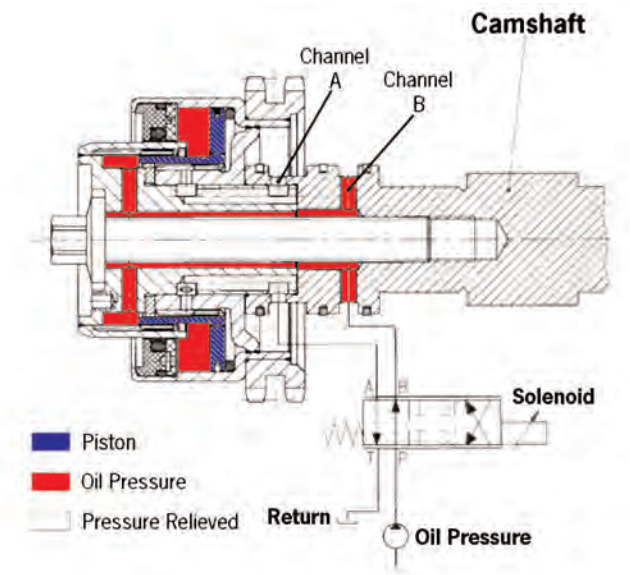


The camshaft adjustment system is based on the principle of a helical sliding gear which has a cylindrical component (3) between the camshaft gear and camshaft stub. The cylindrical component has helical gearing both inside and outside. The inner gearing engages with matching gearing on the inside of the camshaft gear (4). The outer gearing engages with gearing (2) mated to the camshaft stub. At the same time, the cylinder (3) forms a piston on the side facing away from the camshaft. This piston can be moved by oil pressure. A number of teeth have been removed from the gearing to ensure that the oil pressure can act on the piston instantaneously without loss. The component is sealed with a sealing ring (1) and cannot be disassembled. The oil pressure is regulated on both sides by means of a 4/3-way valve.

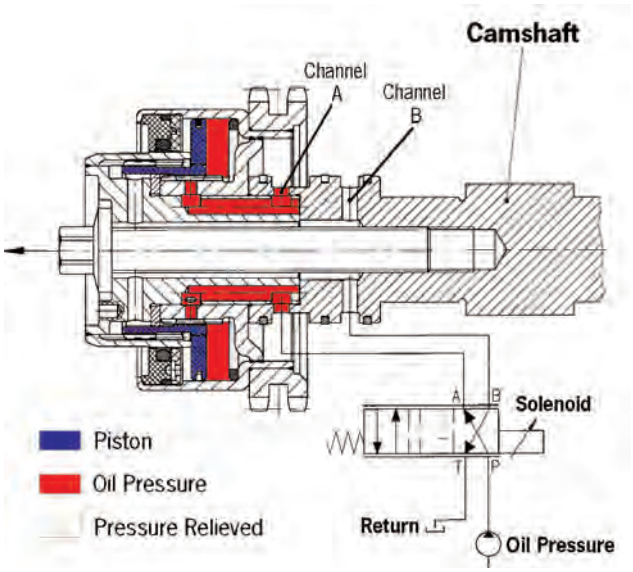
Solenoid Valve

The solenoid valve is configured as a 4/3-way valve. It is actuated by the DME control unit.

Piston position: retarded (minor valve overlapping)

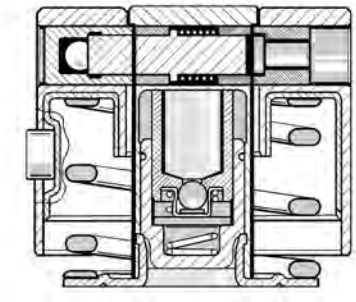


Piston position: advanced (major valve overlapping)



Functional Description of Valve Stroke Adjustment

The valve stroke adjustment system consists of switchable flat-base tappets which are actuated by means of an electrohydraulic 3/2-way valve. Since two different cam shapes are used on the camshaft, it is possible to select the different cams (switching the flat-base tappets) so that their respective valve stroke characteristics act on the engine. These flat-base tappets are mounted on the inlet side of the engine. The flat-base tappets consist of two nested tappets which can be interlocked hydraulically by means of a pin. Once interlocked, the inner tappet comes into contact with the small cam and the outer tappet with the large cam. An element for compensating the valve clearance is always integrated in the power flow of the tappet.

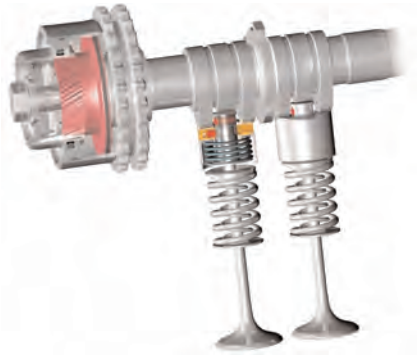


Flat-base Tappet Cutout

Notes:

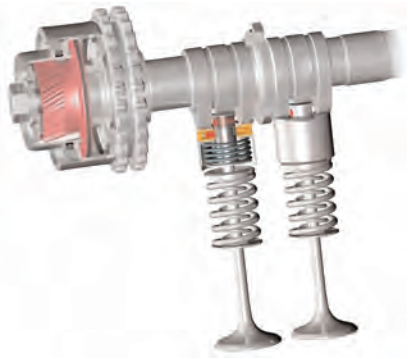
Switching Strategy of VarioCam Plus

In **idle speed range**, the valve stroke is switched to a small cam of 3.0 mm and the cam timing is set to minor valve overlap to optimize engine efficiency. This results in reduced friction due to the small valve stroke; a greater charge movement due to the short opening times, and reduced exhaust gas scavenging into the combustion chamber. These measures result in reduced fuel consumption and lower exhaust emissions while simultaneously improving idle speed quality.



VarioCam Plus shown in idle speed range – inner tappet controls valve stroke (3mm valve lift) and camshaft adjuster unit is in "retard" position (minor overlap).

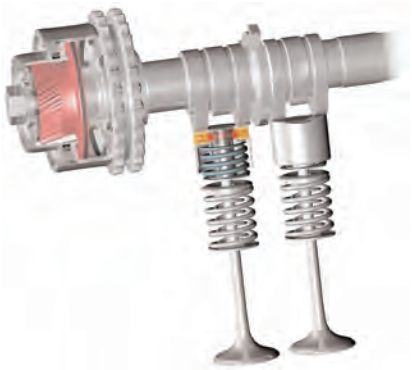
In the **part-load range**, the small valve stroke remains, but engine timing is set to major valve overlap. As a result, a large volume of exhaust gas is drawn back for very smooth combustion and a reduction in consumption.



VarioCam Plus shown in part-load range – inner tappet controls valve stroke (3mm valve lift) and camshaft adjuster unit is in "advance" position (major overlap).

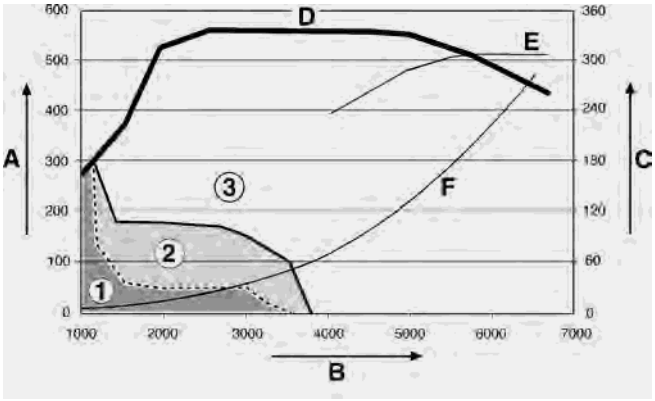
In the **upper full-load range**, the system is switched over to both the large valve stroke and major valve overlap which results in an uncompromising high torque and peak power output.

The two individual systems of the VarioCam Plus (camshaft adjustment and valve stroke control) are activated by the DME 7.8 engine control unit.



VarioCam Plus shown in upper full-load range – tappet is interlocked (10mm valve lift) and camshaft adjuster unit is in "advance" position for peak torque and power.

The ME 7.8 engine control unit has been specially developed for the requirements of the VarioCam Plus system. The input variables (engine speed, position of accelerator pedal, engine oil temperature, coolant temperature and gear detection) are needed to control the VarioCam Plus. The driver's torque and power requirements are compared with the control unit maps and then a decision is made as to whether the VarioCam Plus system has to be switched and, if so, which configuration is necessary.



VarioCam Plus Operation Chart

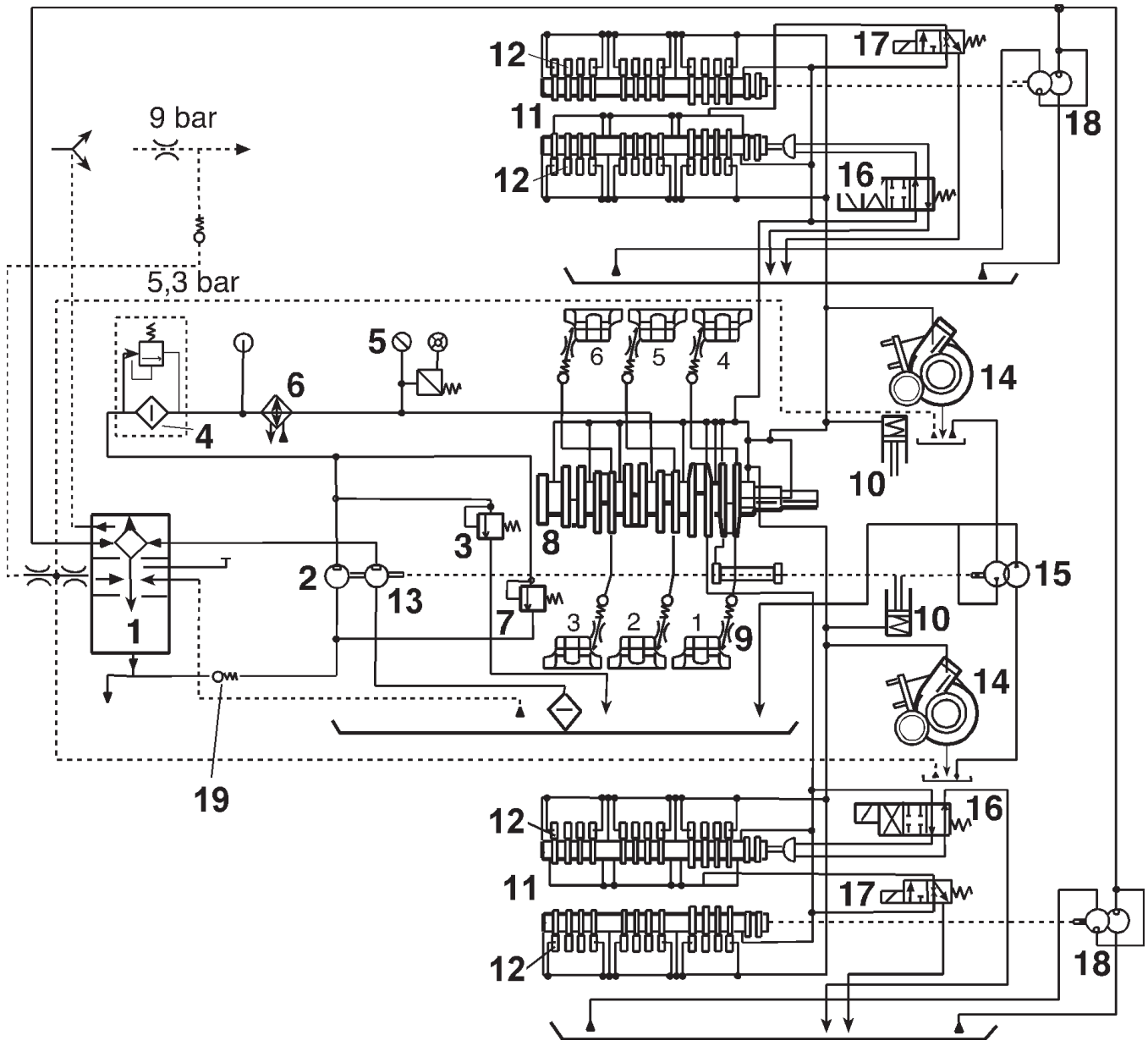
1 - Idle-speed range
2 - Part-load range
3 - Full-load range

A - Torque (Nm)
B - Engine speed (rpm)
C - Power output (kW)
D - Torque curve
E - Power output curve
F - Road resistance in top gear

To ensure that the engine runs smoothly during a switching operation, major adjustments are required in the engine control system. The engine is designed in such a way that maximum vehicle speeds of approx. 150 km/h (90 mph) are possible with the small valve stroke. In the case of the large valve stroke with power-oriented engine timing, speeds of over 300 km/h (180 mph) are possible.

The switching operation inside the engine must, however, go unnoticed by the driver, despite the major change in configuration. This is only possible with modern control units and powerful processor technology. In addition, an electronic accelerator pedal is also required.

Notes:



Oil Circuit

1 - Oil reservoir
2 - Pressure pump
3 - Safety valve
4 - Oil filter
5 - Oil pressure sensor
6 - Oil-to-water heat exchanger
7 - Pressure limiting valve
8 - Crankshaft
9 - Piston spray jet
10 - Chain tensioner
11 - Camshaft
12 - Flat-base tappet
13 - Suction pump
14 - Turbocharger
15 - Double suction pump
16 - Camshaft adjuster
17 - Valve stroke adjuster
18 - Oil return pump
19 - Non-return valve

The 911 Turbo engine has a dry-sump lubrication system with separate oil reservoir (1). A double oil pump, which is driven by the intermediate shaft, is fitted in the crankcase. The pressure pump (2) draws the oil out of the oil reservoir (1) and supplies oil to all bearing points, chain tensioners (10), cam surfaces, hydraulic flat-base tappets, camshaft adjusters (16) and the piston spray jets (9) used to cool the pistons. The suction pump (13) is fitted in the same housing as the pressure pump (2). It draws the foaming oil out of the crankcase via two suction snorkels and feeds it back to the oil reservoir (1).

Since the pump has a low level of efficiency (on account of the air in the oil that it pumps), it must be dimensioned accordingly. A double suction pump (15), which draws oil out of the two turbochargers and is driven via the intermediate shaft, is fitted in the coolant pump housing.

The engine oil is filtered before it enters the engine by means of a filter (4) fitted on top of the engine in the main oil gallery. For safety reasons, a pressure relief valve (7) and safety valve (3) are fitted in the main oil gallery. The pressure relief valve (7) is located in the right-hand half of the crankcase, opens at 5.3 bar and then allows the oil to pass into the inlet port until the pressure drops again. The safety valve is fitted in the oil circuit immediately downstream of the pressure pump outlet. Its task is to function as a safety valve if the pressure relief valve should fail. The opening pressure is 9 bar in order to prevent damage to the sealing rings, oil-to-water heat exchanger (6) and the oil circuit.

Non-return Valve

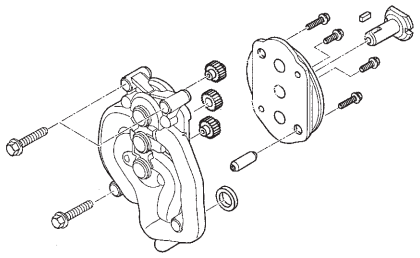
Due to the extremely low position of the turbochargers, an additional non-return valve (19) has been integrated in the engine oil circuit to prevent the oil in the oil reservoir from emptying into the crankcase. This ensures that the turbochargers are not flooded with oil from the crankcase when the vehicle is parked on an incline. The non-return valve is located in the intake pipe of the engine.

Engine Oil Change Interval

The change interval for the engine oil is 20,000 km (12,000 miles). The change interval for the filter is 40,000 km (25,000 miles).

Oil Pumps

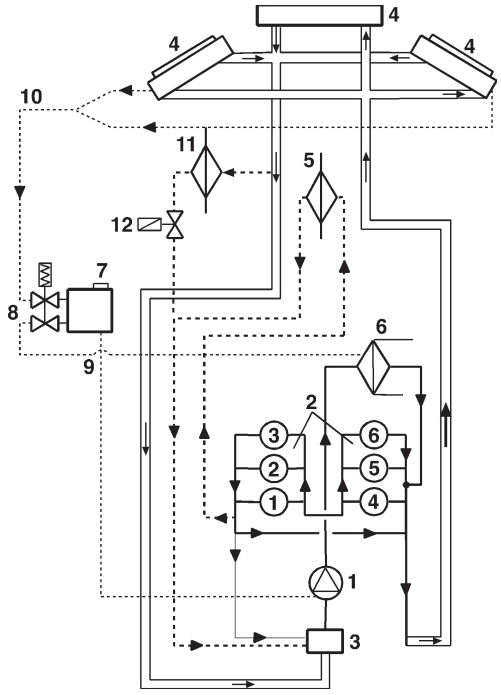
Due to the design of the engine, a large quantity of oil could collect in the cylinder head during extreme cornering. To prevent this, each cylinder head has its own oil scavenging pump (18) to draw off any excess oil.



Oil Pump Construction

The principle of cross-flow cooling is implemented to ensure uniform distribution of the coolant. This prevents a difference in temperature between the individual cylinders.

Cooling System

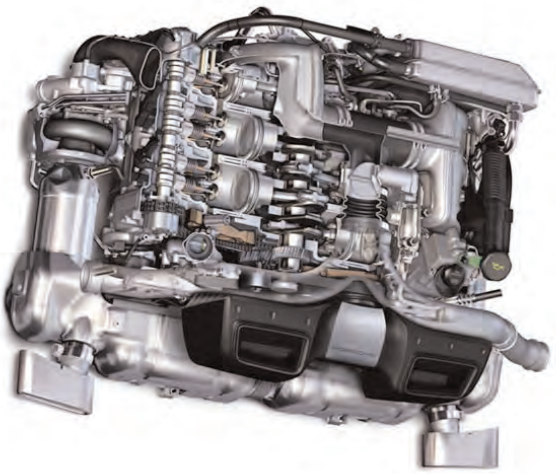


1 - Coolant pump
2 - Crankcase
3 - Thermostat
4 - Radiator
5 - Heat exchanger
6 - Oil-to-water heat exchanger
7 - Expansion tank
8 - Shut-off valve
9 - Bleeder pipe (engine)
10 - Bleeder pipe (radiator)
11 - Oil-to-water heat exchanger (Tiptronic only)
12 - Shut-off valve (Tip.only)

The coolant expansion tank is located on the left-hand side of the engine compartment.

Notes:

911 Turbo (997) Engine



General

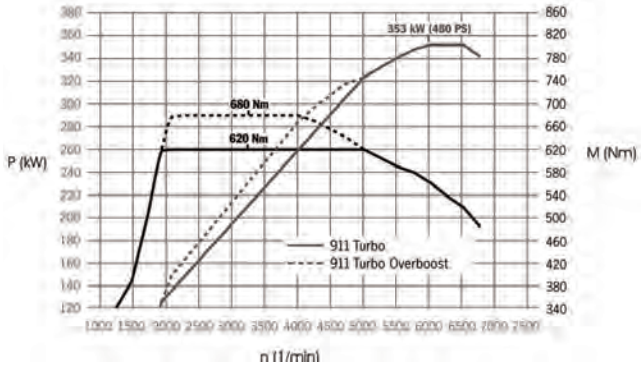
M97.70

The engine of the new 911 Turbo, with its 3.6 liter displacement, is a further development based on the 911 Turbo (996). Porsche used a variable-geometry turbocharger for the first time with this engine. This technology permits extremely fast boost pressure build-up with good response characteristics, high torque values even at low engine speeds and over a wide rpm range, as well as high maximum power combined with low fuel consumption.

Summary of Modifications

- Variable-geometry turbocharger
- Higher power and torque values
- Component reinforcement
- Overboost function in conjunction with the “Sport Chrono Package Turbo” option
- Advanced VarioCam Plus
- Further developed dry sump lubrication with 9 oil pumps
- Increased cooling performance, including 2-stage oil cooling
- Enhanced charge air cooling

Power/Torque Diagram



The most important data at a glance:

Displacement . . . . . .3,600 cm^3
Bore . . . . . .100 mm
Stroke . . . . . .76.4 mm
Power output . . . . . .480 bhp (353 kW)
At engine speed . . . . . .6,000 rpm
Max. torque . . . . . .460 ft lb. (620 Nm)
At engine speed . . . . . .1,950 - 5,000 rpm
Max. torque (Overboost) . . .505 ft lb. (680 Nm)
At engine speed . . . . . .2,100 - 4,000 rpm
Compression ratio . . . . . .9.0 : 1
Governed speed . . . . . .6,750 rpm (6th gear 6,800 rpm)
Idling speed . . . . . .740 +/- 40 rpm

Crankshaft

A reduction in weight was achieved through a deeper central bore in the crankshaft on the pulley side.

Connecting Rod Bearings

"Sputtered bearings" are mounted on the rod side as connecting-rod bearings. Sputtered bearings are high-performance bearings. Higher engine output powers require materials with a significantly higher fatigue strength, lower wearing rate, and good corrosion resistance at high temperatures, particularly for the connecting-rod bearings.

These complex requirements are met by way of cathode sputtering. Micro-particles are ejected from a donor material in a high vacuum. These particles are applied uniformly to the part which is to be coated using electromagnetic fields. These magnetron layers are characterized by extremely fine distribution of the individual structural elements. The basis is the already known three-component bearing. The sputtered bearing has a conventional bearing structure, with the top plated layer replaced with a sputtered lining.

Note:
Two lugs are provided for the twist lock in order to ensure that the sputtered bearings are mounted on the rod side. In addition, the identification "Sputter" is provided on the rear of the bearing.

Connecting Rods

The connecting rods have been left practically unchanged, apart from the fact that two grooves have been incorporated on the rod side for the sputtered bearing twist lock.

Pistons

The pistons are of a symmetrical design; arrows are provided on the piston crown to indicate the installation position. When installing the pistons, it must be ensured that these arrows point in driving direction.

Piston Rings

Three-part rail rings are used as oil scraper rings on the new 911 Turbo in order to reduce the "blow by" gases, which results in a reduction of oil consumption. These very thin rings are able to adapt themselves optimally to the cylinder shape, thereby optimizing sealing quality.

Cylinder Base Seal

A three-part cylinder base seal is used here in order to improve the sealing quality between the crankcase and the cylinder housing. The seal of the new 911 Turbo is 0.3 mm thicker than the seal used in the past.

Cylinder Housing

The cylinder housing and cylinder sleeves have been shortened by 0.3 mm in order to maintain the same overall cylinder height and compression ratio.

Valve Drive

The new 911 Turbo uses a rotary-vane vane actuator, familiar from the 911 Carrera, for continuous adjustment of the intake camshaft. The adjustment range of the actuator is 40° crank angle.

The small valve lift was increased from 3.0 mm to 3.6 mm in order to make more efficient use of the advantages of VarioCam Plus with continuous camshaft adjustment and a larger adjustment range compared with the 911 Turbo (996) with respect to consumption, output and exhaust emissions. The large valve lift was left at 10.0 mm.

Valve Springs

The exhaust backpressure is also increased as a result of the increase in the boost pressure in order to achieve higher torque and power output in the middle rev range. The valve spring assembly was modified in order to ensure that the exhaust valves are reliably closed.

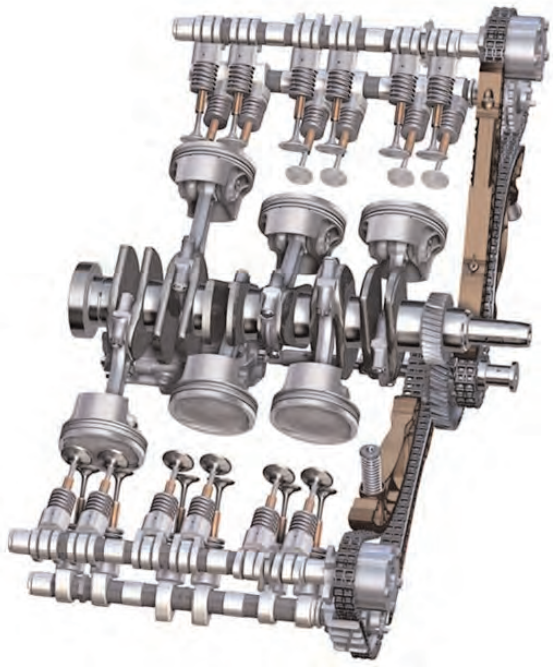
This was achieved by a progressive design without increasing the friction losses or producing excessive pressure at the contact point between the cam and tappet.

Flat-base Tappets

The shape of the hydraulic tappets on the exhaust side has been optimized by providing them with a reinforced base while leaving the overall weight unchanged in order to guarantee the service life of the tappets.

Camshafts

The camshafts and timing have been optimized for the new engine.



Timing in retarded setting at 1 mm valve lift and zero play:

Intake opens, large stroke . . . . . .20° before TDC
Intake closes, large stroke . . . . . .50° after BDC
Intake opens, small stroke . . . . . .30° after TDC
Intake closes, small stroke . . . . . .30° before BDC
Exhaust opens . . . . . .40° before BDC
Exhaust closes . . . . . .9° before TDC

Chain Drive

The timing chains have been lengthened by two chain links compared with the previous engine in order to compensate for the thermal expansion of the engine. As a result, it was also necessary to adapt the guide rails and chain tensioners.

Vacuum Pump

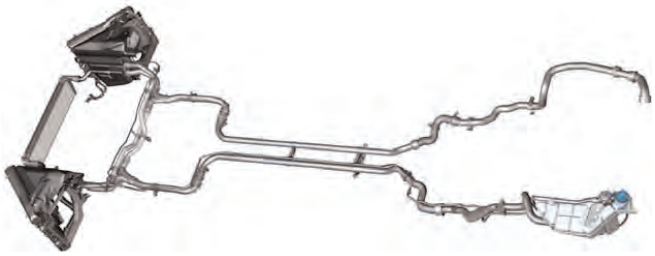
Similar to the current 911 generation, the new 911 Turbo also has a mechanically driven vacuum pump that uses rotary vane technology. This replaces the conventional vacuum amplifier to provide the vacuum for the brake booster and for activating various switching valves. It is located on the cylinder head of cylinder bank 1-3 and is driven by the corresponding exhaust camshaft.

Oil Supply

The oil supply of the new 911 Turbo is provided by way of the familiar and proven dry sump lubrication. An additional oil extraction pump is installed in the front area of the crankcase since the extreme deceleration values of this vehicle can result in oil collecting in this area.

Notes:

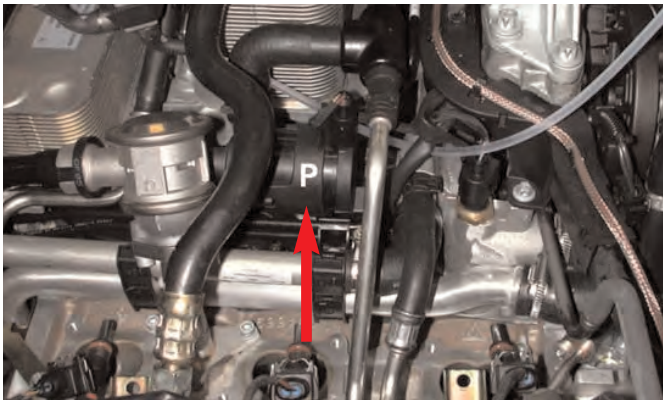
Cooling



In order to take into account the higher cooling requirement of the engine oil on the new 911 Turbo, the waste heat is now dissipated into the coolant by way of two oil-water heat exchangers instead of one (996 Turbo). As a result, it was possible to increase the cooling performance by more than 15 %.

The second heat exchanger is located in the return line to the oil tank. This arrangement reduces any possibility of increased resistance from the second heat exchanger, and ensures that the engine is adequately supplied with oil. In addition, heat transfer to the coolant and therefore also the cooling performance is increased since the temperature in the return line is higher than in the oil pressure line. Routing of the coolant lines ensures optimum distribution to the heat exchangers and other fluid-cooled components.

The heat from the coolant is dissipated to the environment by way of side radiator modules located on the left and right in front of the front wheels, as well as a center radiator in the front end. During aerodynamic development of the front end, particular attention was paid to increasing the cooling air throughput in order to permit dissipation of the additional heat produced by the increased engine power while keeping the radiator dimensions unchanged.



For the first time the bearing housings of the turbochargers on the new 911 Turbo are cooled with coolant . This takes place by way of a separate electrically operated pump, which is mounted on the engine behind the secondary air pump (see illustration below, red arrow “P”). This increases coolant throughput at low engine speeds in accordance with the cooling requirement, and also permits efficient cooling of the highly loaded turbochargers when the engine is stopped after the vehicle has been driven with high power demands.

Notes:

911 Turbo (996/997) – Checking Engine Oil w/Gauge

"OIL"
Display and measurement of the engine oil level

⚠ Caution!

Risk of engine damage.

- ▷ Regularly check the oil level before refuelling.
- ▷ Do not allow the oil level to fall below the minimum mark.

Conditions for measuring the oil level

1. Engine idling.
2. Engine is at operating temperature.
3. Vehicle is level.
4. Vehicle stationary.

Switching on selection field "A"

- ▷ Push operating lever forward.

Initiating oil level measurement

- ▷ Select "OIL" with the operating lever.



- ▷ Push operating lever forward.



- ▷ Push operating lever forward. Measurement is started.



The waiting time for oil level measurement is indicated by a time display and "cycling" segments of the oil level display.



Once the measurement has been completed, you can read off the engine oil level on the segment display.
If the oil level has fallen below the min. mark, the segment below the min. mark flashes.

The difference between the min. and max. marks on the segment display is approx. 1.5 litres (1.6 quarts).
One segment of the display corresponds to a quantity of approx. 0.25 litre (0.26 quart).

- ▷ Top up engine oil. Please observe the chapter "ENGINE OIL LEVEL" on Page 163.
  Never add more engine oil than required to reach the max. mark.

Info

The "Info" function allows you to call the pre requisites for oil level measurement.

Failure

A failure of the oil level display is indicated by a warning message in the on-board computer.

Display "Check oil level"

The computer display "Check oil level" is an additional reminder to you to check the oil level.

The display depends on the distance travelled and the operating conditions, and does not indicate whether or not the oil level is correct.

▷ ▷ ▷

911 Turbo (996/997) – Checking Engine Oil

Engine Oil Level

▷ Regularly check the oil level using the on-board computer each time before refuelling. Refer to the chapter "On-board computer".

The difference between the min. and max. marks on the segment display of the on-board computer is approx. 1.5 liters (1.6 quarts).
One segment of the display corresponds to a quantity of approx. 0.25 liter (0.26 quart).

Topping off engine oil

⚠ Warning!

Risk of burning from hot parts in engine compartment. Risk of injury by rotating parts. The engine compartment blower on the engine compartment lid can start up even with the engine off.

▷ Exercise extreme caution when working on the engine compartment.
Follow the instructions in the chapter "Notes on maintenance".

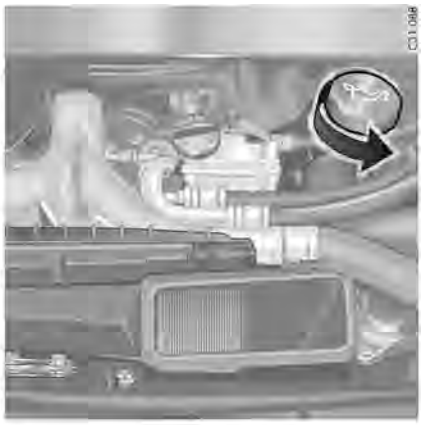
▷ Top off engine oil only with the engine off.

Engine oil is hazardous to your health and may be fatal if swallowed.

▷ Keep engine oil out of children's reach.

Used engine oil contains chemicals that have caused cancer in laboratory animals.

▷ Always protect your skin by washing thoroughly with soap and water.



1. The on-board computer indicates how much oil must be added.
2. Switch off the engine.
   Unscrew cap of the oil filler opening.
3. Add at most half a liter of engine oil at a time.
4. Measure oil level again.
   Add more engine oil if necessary.
   Never add more engine oil than required to reach the max. mark.
5. Close cap of the oil filler opening.

911 Turbo (996/997) – Checking Engine Coolant



Coolant Level

Follow the instructions in the "Cautions" chapter.

The cooling system is filled at the factory with a permanent coolant.
It provides year-round protection from corrosion and freezing down to – 31°F/– 35°C (Nordic countries – 40°F/– 40°C).

Only use antifreeze authorized by Porsche.

Checking coolant level

The expansion tank with its filler orifice is in the engine compartment.

▷ Check the coolant level regularly through the transparent expansion tank.

When the engine is cold and the car is level the fluid level must lie between the "Min." and "Max." markings.

Topping off coolant

⚠ Warning!

Danger of serious personal injury from scalding. Coolant is hazardous to your health, and may be fatal if swallowed.

▷ Do not open the cap of the expansion tank while the engine is hot.

▷ Allow the engine to cool down before opening the cap and protect your hands, arms and face from any possible escape of hot coolant.

▷ Keep coolant out of children's reach.

▷ Also, keep coolant away from your pets. They can be attracted to it should there be a spill, or to used coolant left in an open container. Coolant can be deadly to pets if consumed.

1. Switch engine off and let it cool.
   See the chapter on the "Cooling system".

2. Cover the expansion tank cap with a thick rag.
   Open cap slowly and carefully and allow overpressure to escape.
   Then unscrew cap completely.

3. Only add a mixture of antifreeze and water in equal parts, and do not exceed the "Max." mark.

   Antifreeze in coolant:
   50% gives protection down to – 31°F/– 35°C
   60% gives protection down to – 58°F/– 50°C

4. Screw cap firmly on.

If in an emergency pure water has been added, the mix ratio must be corrected at an authorized Porsche dealer.

Marked loss of coolant indicates leakage in the cooling system.
The cause should immediately be remedied at an authorized Porsche dealer.

▷ ▷ ▷

PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ☑ Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Power-assisted steering: Check fluid level
- ☑ Engine: Check oil level
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ☑ Change engine oil: (oil filter change is not required)
- ❑ Air Filter: Check the air filter condition, and if necessary, replace
- ❑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Power-assisted steering: Check fluid level
- ☑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ☑ Coolant: Check level and antifreeze protection level
- ❑ Pollen filter: Replace filter element
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ❑ Vehicle lights: Check operation
- ❑ All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ☑ Change engine oil and oil filter
- ❑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ❑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ☑ Diagnosis system: Read out fault memory
- ☑ Polyrib belt: Check condition
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ☑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ☑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ❑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ❑ Power-assisted steering: Check fluid level
- ❑ Parking brake: Check free play of the parking brake lever
- ❑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ❑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Clutch: Check play or final position of pedal
- ❑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Check tightness on the front and rear suspension adjustment points
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Seat belts: Check operation and condition
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ❑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ☑ Replace Polyrib belt
- ❑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ❑ Manual transmission: Change oil
- ❑ Automatic transmission: Change ATF and ATF-filter
- ❑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ❑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ☑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ❑ Check airbag system
- ❑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
☑ Change engine oil and oil filter
❑ Air Filter: Check the air filter condition, and if necessary, replace
☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
☑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze
❑ Pollen filter: Replace filter element
❑ Brake system: Visual inspection of the brake pads and brake discs for wear
❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
❑ Tires: Check condition and tire pressure
❑ Check firewall and cabrio section body drains for debris
❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
❑ Vehicle lighting: Check function
All headlights: Check setting
❑ Horn: Check function
❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

☑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
☑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
☑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

☑ Replace drive belt
❑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

- ☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
- ☑ Change engine oil and oil filter
- ☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
- ☑ Coolant hoses: Check condition
  Radiators and air intakes: Visual inspection for external debris and blockage
  Coolant: Check level and antifreeze
- ❑ Air filter: Replace filter element
- ❑ Pollen filter: Replace filter element
- ❑ Fuel lines and connections: Visual inspection for damage and leaks
- ❑ Brake system: Visual inspection of the brake pads and brake discs for wear
- ❑ Parking brake: Check free play of parking brake lever
- ❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ❑ Clutch: Check the pedal play and end position
- ❑ Steering gear: Visual inspection of the dust boots for damage
  Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
- ❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ❑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ❑ Tires: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
- ❑ Vehicle lighting: Check function
  All headlights: Check setting
- ❑ Horn: Check function
- ❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ❑ Seat belts: Check function and condition
- ❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

- ❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

- ❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

- ☑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
- ☑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
- ☑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

- ❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

- ☑ Replace drive belt
- ❑ Replace fuel filter (Turbo only)
- ❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

- ❑ Change manual transmission oil
- ❑ Change Tiptronic transmission oil and ATF filter
- ❑ Change Tiptronic transmission final drive oil
- ❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms “inspect” and “check” include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be performed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Notes:



Subject	Page
911 Carrera (996) and Boxster (986)	
ME 7.2	2.3
ME 7.8	2.6
Functions of VarioCam Plus in ME 7.8 System	2.11
Exhaust Systems	2.15
Starter and Generator – Boxster	2.16
911 Carrera (997) and Boxster/Cayman (987)	
Boxster/S (987) General Information	2.17
Boxster/S & Cayman/S (987) General Information	2.18
911 Carrera/S (997) General Information	2.19
Motronic ME 7.8_40 & ME 7.8	2.20
Sports Chrono	2.22
Fuel System	2.23
Intake System	2.32
Exhaust System	2.35
911 Turbo (997)	
General Information	2.42
Vairiable Turbocharger	2.49
Boost Pressure Control	2.52
Replacing Battery	2.61
Emergency Jump Starting	2.62
Maintenance Sheets	2.66

Notes:

911 Carrera (996)/Boxster (986)

ME 7.2 – General

When the 911 Carrera (996) and Boxster models were introduced they came with Motronic DME version, M 5.2.2 to generate the injection signal, to calculate the ignition angle as well as to provide adaptive control functions for various systems and to carry out diagnostic functions.

In model year 2000 the 911 Carrera (996) and Boxster/S (986) came with Motronic ME 7.2 (first introduced on the M.Y. 1999 911 Carrera 4). This new version Motronic contains the functions already familiar from the Version 5.2.2.

The important differences concern the operation of the throttle valve (a throttle adjustment valve instead of a throttle cable - E-Thottle*) and a torsion-orientated control unit for governing engine induction with the appropriate amount of fresh mixture.

This eliminates the need for mechanically transferring the movement of the accelerator (throttle cable) to the throttle. Components such as the idle speed controller and cruise control actuator are also no longer required.

This simplifies the controlling of additional functions such as PSM (Porsche Stability Management, if designed as I-number), reducing torque for TC or Tiptronic intervention, increasing torque when using the air conditioning, or rapid heating-up of the exhaust system (catalytic converter) for reducing exhaust emission.

The ME 7.2 can naturally be fully diagnosed. The necessary diagnosis software is supplied with the Porsche System Tester 2. Amendments to the diagnosis function of the control unit and the diagnostic capabilities are described in the Technical Handbook.

* E-Throttle = Electrically Operated Throttle

The principle features of the Motronic ME 7.2 are:

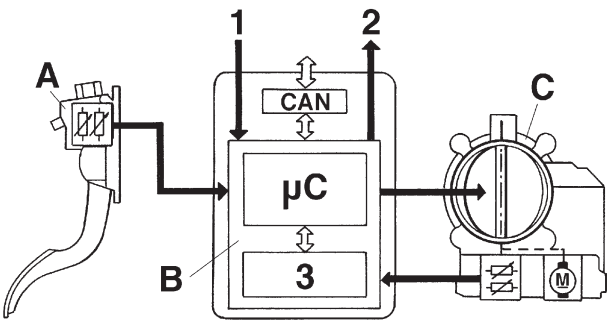
- Torque-orientated function structure
- Registering and controlling engine induction
- Sequential fuel injection for each cylinder
- Direct ignition knock control for each cylinder
- Adaptive stereo oxygen sensor control
- Rapid warming-up of the catalytic converters after a cold start
- Tri-metal catalytic converters
- An integrated secondary air injection system (D4-compliant) for reducing exhaust emission while the engine is warming up (not ROW)
- Carried load-dependent tank ventilation
- Idling induction control using the throttle adjuster
- Monitoring of combustion faults which could damage the catalytic converters with activation of the "Check Engine" warning indicator
- Fundamental monitoring of all Motronic functions with protocolling in the fault memory
- Activation of the VarioCam valves
- Actuation of the resonance flap integrated in the intake system

USA Vehicles

The engine management employed in USA vehicles varies in comparison to ROW cars as follows:

- Additional Hall sensors fitted to the intake camshaft in cylinder rows 4 - 6
- Additional oxygen sensors installed respectively behind the catalytic converters. They permanently monitor the level of efficiency of the catalytic converters are functioning
- One shut-off valve for each of the scavenging air pipes and a pressure sensor for measuring the tank pressure or underpressure (for the compulsory tank sealing check)
- Onboard Refueling Vaporation Recovering System (ORVR) with tank sealing check
- A dual chamber active carbon canister with increased volume (approx. 2000 cm^3) for the ORVR System for passing the Shed test
- Starter catalytic converter for fulfilling LEV (Low Emission Vehicle) standards in addition to the main catalytic converters

System Principle



A - Accelerator pedal module
B - Motronic control unit
C - Throttle adjuster to the Motronic control unit
1 - Informer to the Motronic control unit
2 - Setting elements/actuators
3 - Monitoring module

This Information only deals with the specific functions of the Motronic ME 7.2. These are:

- Torque-orientated function structure of the Motronic control unit on the basis of physical values
- Motronic control unit with integrated pressure sensor, monitoring module and new connector generation
- Accelerator pedal module with pedal valuator
- Throttle adjuster unit with electric motor actuator
- Additional functions such as idle control, vehicle speed control or rapid warm-up of the catalytic converter by the Motronic
- The secondary air injection system

Torque-Orientated Function Structure

A system architecture has been introduced with the ME 7.2 which is characterized by:

- The employment of physical functions. This means that both the values of an individual function (e.g. the determination of cylinder induction), as well as the interfaces between function and function groups, are defined as physical values.
- Another feature is the introduction of torque control: numerous part systems within the Motronic, for instance the idle control or rpm limiter, as well as the drive and complete vehicle control systems (Tiptronic, Porsche Stability Management etc.), all place requirements upon the basic Motronic system. In the past, these acts of intervention used to be defined and controlled independently of one another on the basis of available control variables, such as cylinder induction, ignition angle and fuel weight.
- As this intervention can be physically designated, based on torque requirements, a torque-guided system is being introduced with the ME 7.2 which coordinates the afore-mentioned requirements, coupled with the resultant nominal torque, by using the available control variables throttle valve and ignition angle.
- The system architecture is completed by an oxygen sensor coordination system, which coordinates the mixture intervention (enrichment or weakening of the air/fuel mixture by means of various functions) in a similar manner.

Notes:

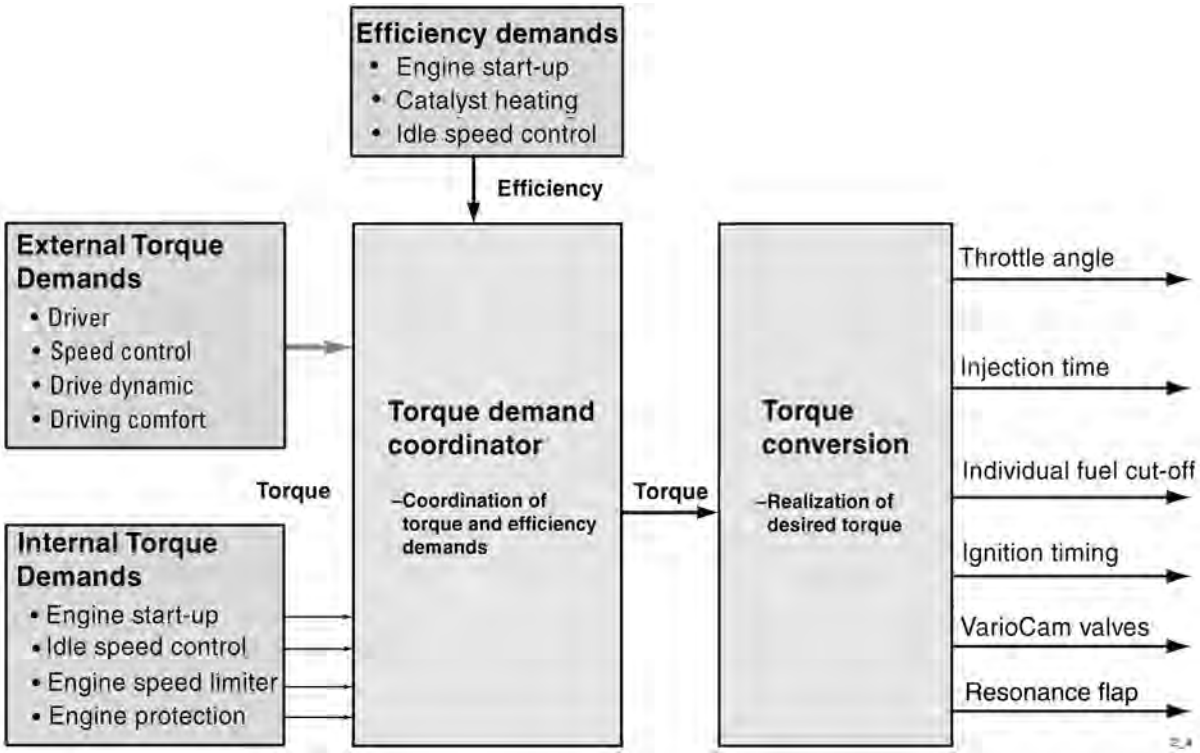
The Principle of Torque Guidance

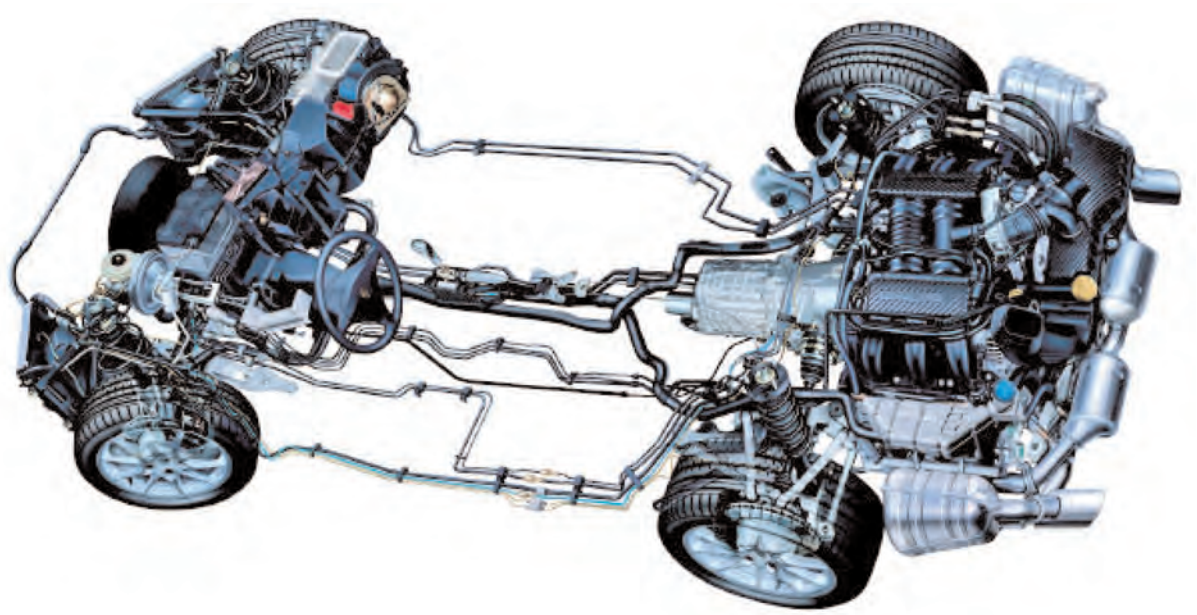
The engine torque being produced must correspond to the driving condition desired by the driver (determined via the pedal actuator) and ensure that every component and accessory unit can function. External requirements placed by the drive train and drive dynamics control systems are additional factors. The fundamental idea of the ME 7.2 system is based on coordinating the demands being made on the engine on a uniform physical level. This can be formulated as torque requirement.

The actual torque requirement is determined from the position of the accelerator pedal (pedal actuator). The speed control unit, the Porsche Stability Management (PSM), if fitted, or the Tiptronic control unit can transmit their torque requirements to the Motronic control unit in exactly the same way. Protective functions such as the electronic rpm controller or the catalyst overheating protection system can also be defined so that they limit the permitted engine torque. The engine management with E-Gas has the task of coordinating the different torque requirements of the individual users and protective functions in order to calculate the necessary setting interventions for the engine, whereby the ignition angle and the throttle position are the largest control variables available.

The advantage of this design is that individual power consumers can communicate their torque require-ments to the "coordinator" integrated in the control unit indepen-dently of the current operating status of the motor. They do not need to concern themselves with the actual setting intervention and do not required any information about the status of other functions. This excludes the possibility of mutual interference between the individual functions on the level of the control variables.

The fact that the torque coordination is the only instance which intervenes in the motor settings means that the map systems and the characteristics, the core functions necessary for the operation, are solely dependent on the engine. As a result there are no cross-links between the individual function groups, which simplifies the coordination of the new control unit generation.





ME 7.8

General

The 911 Carrera (996) 3.4 liter engine displacement was increased to 3.6 liter for model year 2002 and received ME 7.8. This displacement increase and the variable valve timing VarioCam Plus, which includes valve stroke control (see 911 Turbo 996 section for additional information).

The Boxster (986) and Boxster S (986) were equipped with ME 7.8 in M.Y. 2003.

The Motronic engine management system ME 7.8 controls the mixture preparation electronically.

Development aims:

- Increased power output and torque.
- Lower fuel consumption
- Acoustic optimization of exhaust system
- Ensuring compliance of all legal emission requirements.

The following technical aspects have been achieved:

- Displacement increase from 3.4 l to 3.6 l by increasing stroke from 78 mm to 82.8 mm (911 Carrera only)
- The fuel system has no return line from engine to fuel tank
- Incorporation of Motronic ME 7.8
- VarioCam Plus with variable camshaft timing and valve stroke control
- Silencer with sound-optimized interior
- "New Look" tail pipes

Notes:

Non-Return Flow Fuel Supply System (RF)

In the non-return flow fuel supply system (Returnless Fuel-system) the fuel pressure regulator and the fuel filter are integral with the fuel tank. Therefore, the fuel return line from the fuel rail in the engine compartment to the fuel tank is not needed. The surplus fuel delivered from the electric fuel pump consequently enters the fuel tank directly from the pressure regulator. Only the fuel quantity injected from the injection valves is delivered to the fuel rail in the engine compartment. Dispensing with the return line has the advantage that no fuel warmed in the engine compartment returns to the fuel tank thereby raising the temperature in the fuel tank. This results in a further decrease in hydrocarbon emissions (HC) in the fuel tank and also less strain on the tank ventilation.

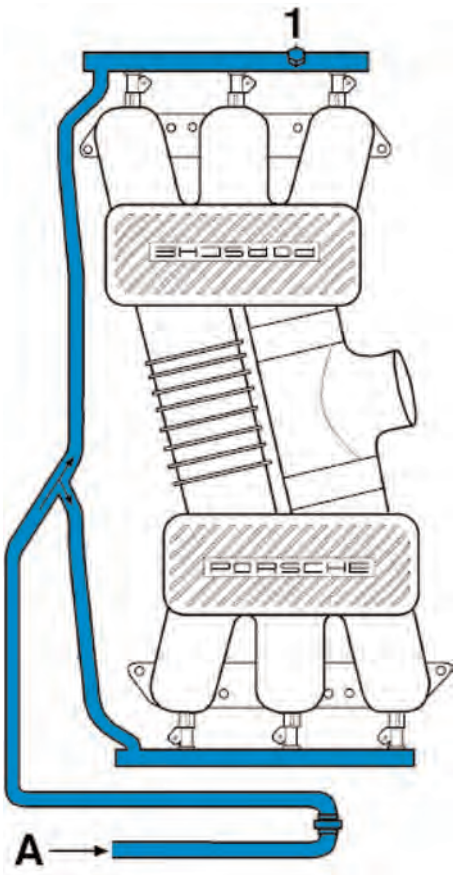
Tasks such as checking fuel pressure, holding pressure and delivery rate of fuel pump and any special tools requirements are described in the Technical Manual.

Control Unit for the Demand Control of Fuel Delivery Rate (EKPSM)

Only 911Carrera 4 models for the USA have an additional electronic control unit installed below the fuel tank cover located between the fuel pump relay and the fuel pump. This allows reduction of the fuel pump delivery rate during low fuel consumption, which also reduces the warming of fuel in the fuel tank. Activation of the electronic fuel pump control module (EKPSM) through the Motronic ME 7.8 is carried out via an ground switched PWN signal with a frequency of 10 Hz. This realizes an engine speed dependent, two-stage control. Up to approx. 2000 rpm the delivery rate is reduced to approx. 50 l/h. At a higher engine speed the delivery rate is increased to approx. 80 l/h.

Notes:

Fuel Routing in Engine Compartment



A - Fuel supply (system pressure 55 psi, 3.8 bar)
1 - Connection for pressure test

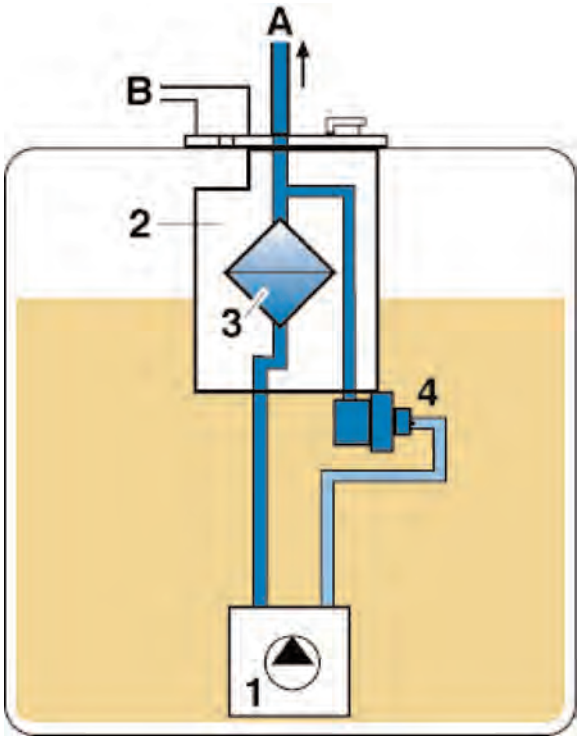
Fuel Filter

The fuel filter is integral in the tank unit and no longer requires changing. A reduction in deliver rate can be detected via the mixture adaption.

Fuel-pressure Regulator

The fuel pressure regulator is integral in the tank unit and has no connection for the intake-pipe pressure. The fuel pressure is 55 psi (3.8 bar) from idling to full load. The injection rate is then also dependent on the intake pipe pressure. This is taken into consideration by the Motronic control unit when calculating the injection period.

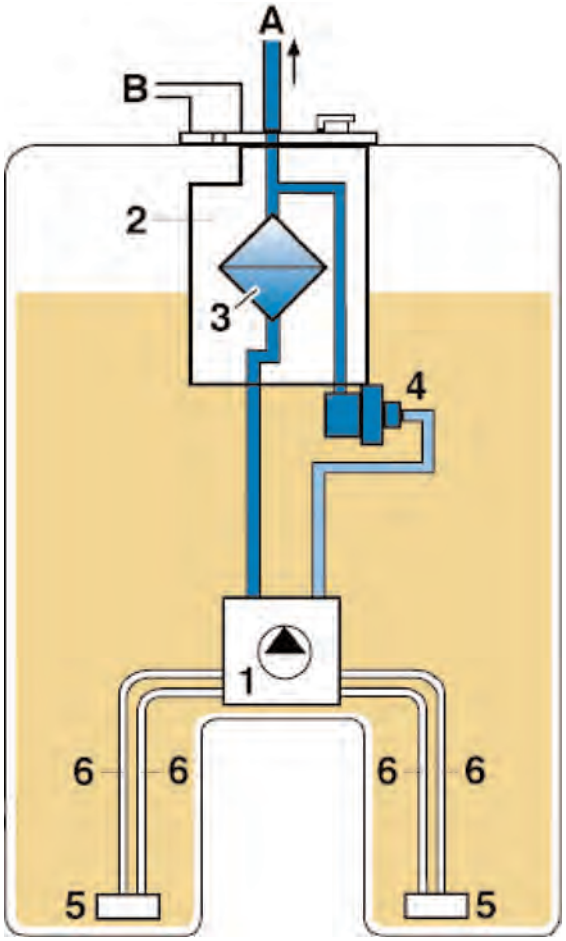
Functional Diagram 911 Carrera (996) & Boxster/S (986)



A - Fuel pressure line (55 psi, 3.8 bar)
B - Tank ventilation
1 - Fuel pump
2 - Filter housing
3 - Fuel filter
4 - Pressure regulator

Notes:

Functional Diagram 911 Carrera 4 (996)



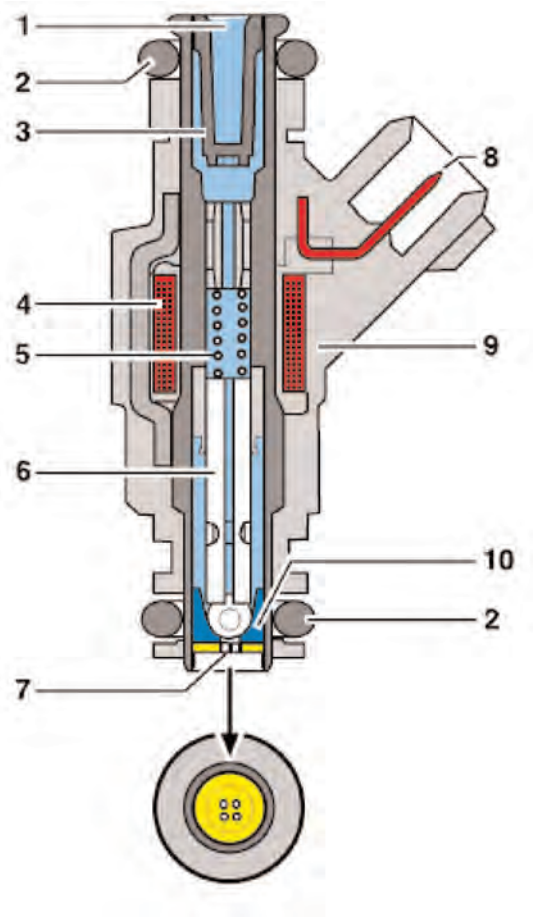
A - Fuel pressure line (55 psi, 3.8 bar)
B - Tank ventilation
1 - Fuel pump
2 - Filter housing
3 - Fuel filter
4 - Pressure regulator
5 - Sucking jet pumps
6 - Lines to and from sucking jet pumps

Notes:

Injection Valve (EV-6)

A feature of this injection valve is its small overall size and low weight. Also on this injection valve, there is very low risk of vapor lock with hot fuel. This makes it very suitable for use on non-return fuel supply systems, as the fuel temperature in the injection valve here is higher compared to systems with return flow.

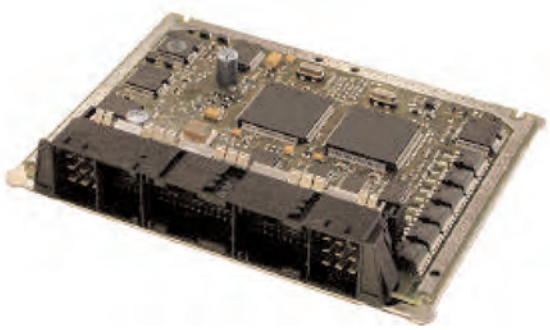
The atomization of the fuel is carried out by a spray-hole disk with 4 holes. The punched injection holes achieve high fuel injection rate consistency, as well as insensitivity to fuel deposits. Good valve sealing in the valve seat area is ensured by the cone/ball sealing principle.



1 - Hydraulic connection
2 - Sealing rings (O-rings)
3 - Filter screen
4 - Coil
5 - Spring
6 - Valve needle with magneto armature and sealing ball
7 - Spray-hole disk (4 hole)
8 - Electrical connection
9 - Valve housing
10 - Valve seat

ME 7.8 Motronic Engine Management System

As of model year 2002, the 911 Carrera (996) and 2003 Boxster/S (986) were equipped with ME 7.8 Motronic. This Motronic is derived from the 911 Turbo (996) and adapted to the engine specific requirements (without boost pressure control).



The ME 7.8 provides the following new functions and components:

- Extended diagnosis facilities of the Motronic management system
- On-board diagnosis (wordwide)
- Actuation of continuous closed-loop position control of intake camshafts
- VarioCam Plus control (valve stroke)
- Modified Hall sensor signal
- Oxygen sensor, LSF
- Modified hot film air mass flow sensor HFM-5
- Injection valves EV-6
- Non-return fuel supply system

Notes:

New Diagnosis Facilities of ME 7.8 Motronic

- Compared to ME 7.2, the ME 7.8 Motronic as of software version 12.0 of the Porsche System Tester 2, extended diagnosis facilities can by used.
- To protect the catalytic converter on vehicles with Tiptronic, the engine speed with vehicle stationary is restricted to approx. 4000 rpm.

Actual Values:

- When directly entering the actual values, only a reduced number of actual values are displayed.
- The full range of actual values can be read out via the "Filter" soft key and "All Actual Values".
- The filters can also be selected according to systems or functions, or individual ones can be created via "New" filter.

System Check

- Valve stroke control, shorter stroke:
  Unlike on the 911 Turbo (996), with this vehicle the check must be carried out in a workshop, in accordance with instructions of the Porsche System Tester 2.
- Valve stroke control, longer stroke:
  As on the 911 Turbo (996), this test is carried out during a test drive in accordance with instructions of the Porsche System Tester 2.

Actuator Activated

- Valve stroke control, cylinder bank 1 and 2:
  In this test, the engine speed must be increased to a value which will be registered on the tester, otherwise the engine will stall.

Control Unit Programming

Additional functions

- Control unit type:
  This checks, if the data status of the control unit is current or not current.
- Saving document field in working protocol:
  All completed Motronic control unit programming is shown with vehicle identification number, service number, part number, date and program status.

OBD (EOBD)

World-wide via the on-board diagnosis system (OBD – USA) or Europe on-board diagnosis system (EOBD – Europe/RoW) the driver is informed by an appropriate warning (Check Engine light) in the instrument cluster. The functions are adapted to the different world-wide legal regulations.



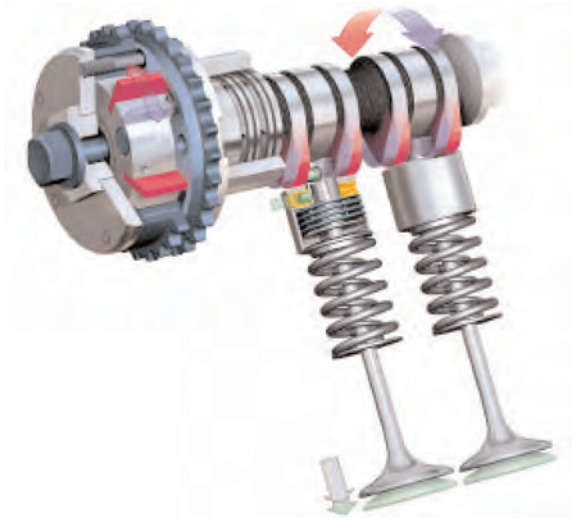
- A permanently lit "Check Engine" light indicates an emission-related fault
- A flashing "Check Engine" light indicates a combustion fault which may damage the catalytic converter

Notes:

Functions of VarioCam Plus in ME 7.8 Motronic Engine Management System

Both individual systems of the VarioCam Plus (valve timing and valve stroke) are actuated by the Motronic engine management system.

Control of the VarioCam Plus requires as input variables, the engine speed, accelerator pedal position, engine oil temperature, coolant temperature and gear recognition (Tiptronic and manual transmission). The driver's torque and power requirements are compared with the control unit maps and then a decision is made as to whether the VarioCam Plus system has to be switched. The switch-over point is then calculated from these values.



Elements of the following functions run simultaneously during a switch-over process:

- Throttle valve position (E-Throttle)
- Mixture formation
- Ignition
- Actuation of solenoid hydraulic valve to adjust valve timing
- Actuation of solenoid hydraulic valve for valve stroke

Actuation of Solenoid Hydraulic Valve to Adjust Valve Timing

The control unit determines the current position of the intake camshafts in relation to crankshaft (actual angle) using the engine speed signal and Hall sensor signal. The position control in the control unit receives the desired angle via the programmed map values (engine speed, load, engine temperature). If the desired angle and actual angle differ, the control electronics in the control unit actuates the solenoid hydraulic valve to move the control element for the intake camshaft in the desired direction.

Actuation of the valve takes place via a pulse-width-modulated square-wave signal. The voltage is switched between 0 volts and 12 volts in 4ms cycles (250 Hz), while the proportion of switch-on and switch-off time is changed. A control current adjusts itself according to this proportion, which sets the piston position in the solenoid hydraulic valve and thereby releases the different oil lines, facilitating an adjustment range of 0°kW up to approx. 40 °kW.

Valve Stroke Control on Bucket Tappets of Intake Camshafts

The map of the valve stroke control is adapted to the engine-specific requirements. The valve stroke control facilitates switching of the valve stroke of the intake camshaft from 3.6 mm to 11.0 mm.

Notes:

Engine Speed Sensor

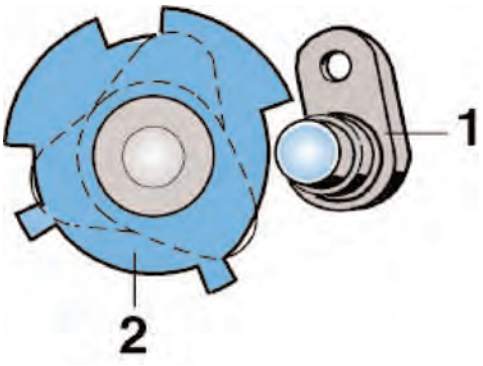
The engine speed sensor on the crankshaft detects the engine speed and current position of the crankshaft via 60 – 2 teeth and relays the information to the ME 7.8 control unit.



1 - Solenoid hydraulic valve (for variable camshaft timing) valve timing
2 - Solenoid hydraulic valve (for valve stroke)
3 - Ignition coil
4 - Hall sensor
5 - Injection valve

Hall Sensor and Camshaft Rotor

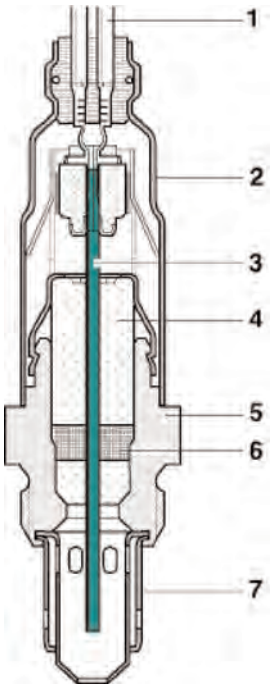
A modified rotor is fitted to the intake camshafts of both cylinder banks. Due to the rotor position, the Hall sensor determines the current position of the intake camshaft 4 times per camshaft revolution and relays this value to the control unit. This determines precisely the position of both intake camshafts.



1 - Hall sensor
2 - Camshaft rotor

Oxygen Sensor (LSF)

The planar oxygen sensor LSF is a further development of the heated oxygen sensor LSH. It equates functionally to the heated oxygen sensor (Lambda probe) with a step map at Lambda 1. Unlike the LSH, on the oxygen sensor LSF the solid-state electrolyte is made up of ceramic sheets. The oxygen sensors up and downstream of the catalytic converter have different part numbers.



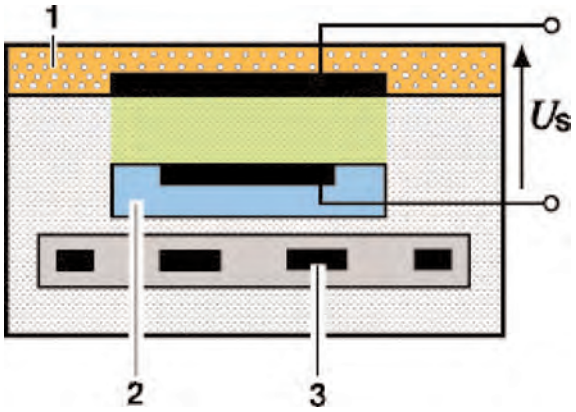
1 - Connection cable
2 - Protective sleeve
3 - Planar sensor element (ceramic sheets)
4 - Ceramic supporting tube
5 - Sensor housing
6 - Ceramic sealing pack
7 - Protective tube

Notes:

Special Characteristics of the New Oxygen Sensor

- Brief on-times of oxygen sensing
- Stable regulating characteristics
- Low heating power demand
- Quickly operational
- Small overall size, low weight

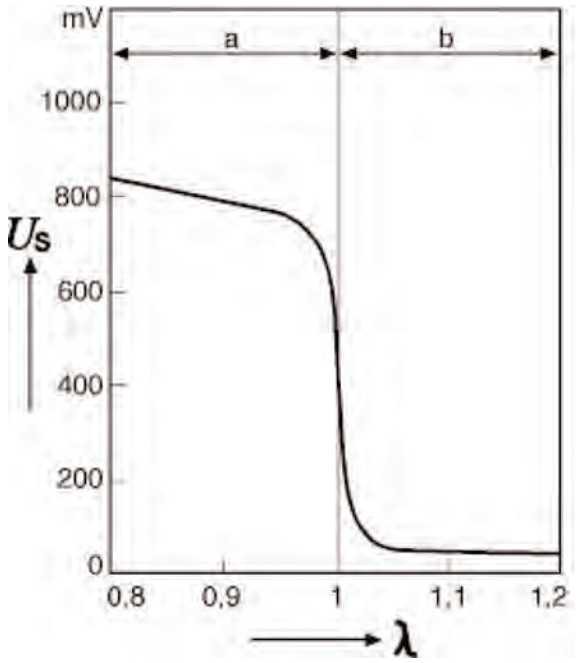
The sensor element of the planar oxygen sensor is made up of ceramic sheets and has the form of a rectangular wafer with rectangular cross section. The individual function layers (electrodes, protective layers, etc.), are produced with screen printing technique. The laminating of various printed sheets on top of each other allows for a heater to be integrated in the sensor element.



Design of the planar oxygen sensor (Lambda probe)

1 - Exhaust gas
2 - Reference air channel
3 - Heating element
Us - Voltage of oxygen sensor

Voltage Characteristics of Oxygen Sensor



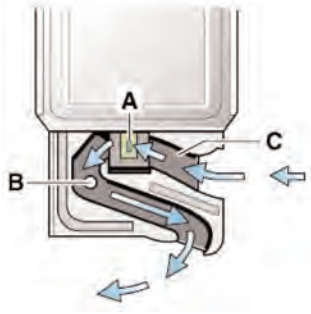
Us - voltage of oxygen sensor
l - air/fuel ratio
a - rich mixture (air deficiency)
b - lean mixture (excess air)

Notes:

Hot Film Air Mass Flow Sensor (HFM 5)

The modified hot film air mass flow sensor HFM 5 is used, as was already installed in the Boxster (986) in model year 2000. With the C-shaped air duct, this air mass flow sensor is more resistant to contamination and water droplets, since these can only reach the sensor element after deflexion. A cross bore through the air duct reduces pulsation faults.

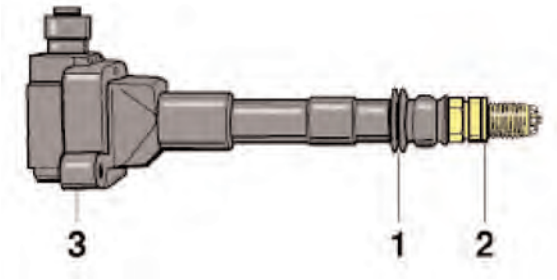
Note:
When replacement of the air mass flow sensor becomes necessary, only the appropriate one based on vehicle M.Y. and engine type can be installed.



A - Sensor element
B - Cross bore
C - C-shaped air duct

Spark-plug Connector

The spark-plug connectors are equipped with additional sealing lips above the spark plug.

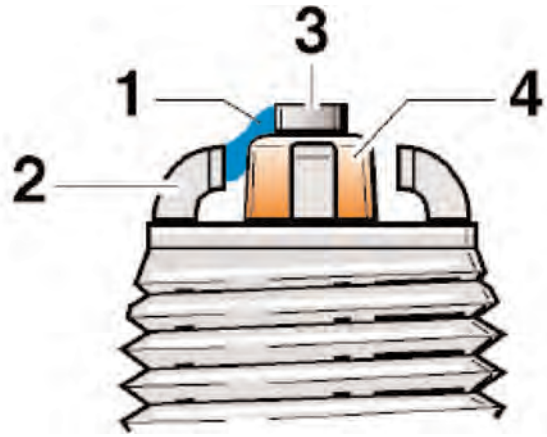


1 - Spark-plug connector with sealing lip
2 - Spark plug
3 - Ignition coil

Spark Plugs

On these surface-gap spark plugs, the 4 ground electrodes are arranged laterally to the ceramic. This makes the sparks (1) glide over the insulation surface and jump across a short air gap to the ground electrode, which achieves improved combustion characteristics.

The spark plugs must be changed every 50,000 miles (80,000 km).



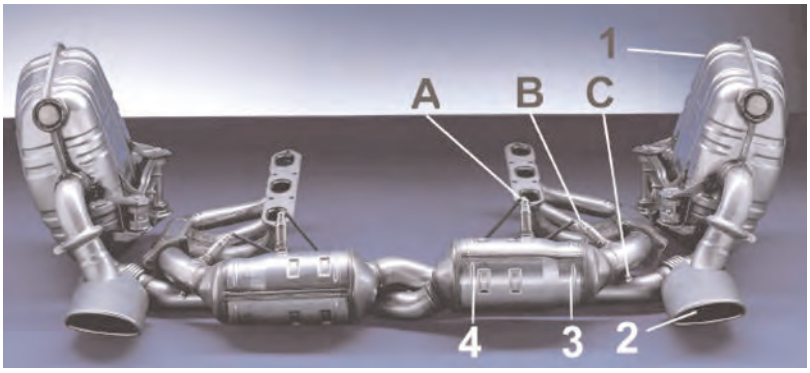
Surface-gap Spark Plug

1 - Surface gap
2 - Ground electrode
3 - Center electrode
4 - Insulator

Notes:

Exhaust System – 911 Carrera (996)

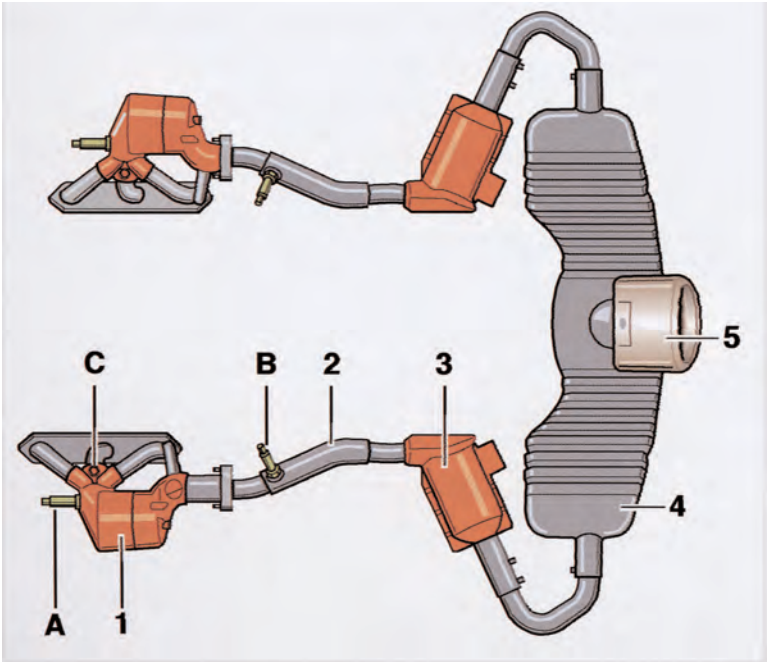
1 - Muffler
2 - Tail pipe tip
3 - Primary catalytic converter
4 - Main catalytic converter
A - Oxygen sensor, downstream of catalytic converter
B - Oxygen sensor, upstream of catalytic converter
C - Measuring point upstream of catalytic converter



The exhaust system is arranged as a 2-stream, 3-way catalytic-converter exhaust system with 2 end mufflers. This proven concept was adapted to the new cylinder heads and the different installation position of the drive units/accessories.

Exhaust System – Boxster/S (986)

1 - Exhaust header
2 - Catalytic converter pre-pipe
3 - Primary catalytic converter
4 - Muffler
5 - Tail pipe tip
A - Oxygen sensor, upstream of catalytic converter
B - Oxygen sensor, downstream of catalytic converter
C - Measuring point upstream of catalytic converter



Exhaust Sound

The engine sound was optimized for all operating ranges within the permissible noise limit values through specific sound engineering of the mufflers. The look of the tail pipe trims was also modified.

Exhaust Emission Standard

All vehicles comply with world-wide legal requirements. Due to the design of Vario-Cam Plus and the catalytic converters, the exhaust emission standard Euro3/D4 is also achieved.

USA LEV - Oxygen sensing + post catalyst sensing (4 sensors) 3-way catalytic converter system with 1 cascade catalyst both left + right (with two metal supports) secondary air system.

EURO 2 - Oxygen sensing with 2 pre- catalyst sensors, 3-way catalytic converter with one catalytic converter on both left + right (RoW).

EURO 3 - Additional secondary air system and post catalyst sensing (4 sensors) EOBD, (Germany EURO III and D 4).

Starter – Boxster/S (986)



The Boxster has a pre-engaged drive starter with counter-shaft gear, permanent energization, and freely protruding pinion. Power output - 1.2 kW.

Vehicles with a Tiptronic transmission have the 1.8 kW version.

A starter with a protruding pinion is used, and as a result, there is no bearing on the pinion shaft end. To reduce noise, and load, an automatic starter ejector has been installed.

Function

The DME control module stops operation of the start inhibit release and also operation of the starter solenoid via terminal 50. The starter disengages.

Effect

When the engine is started, the speed of the engine becomes faster than that of the still engaged starter. The time taken for the engine speed to exceed the starter speed is considerably shorter compared to a manual start.

This feature means that the starting behavior is more spontaneous. A possible second start is performed manually. Interruption of the start inhibit relay occurs when the following engine speeds are reached.

600 rpm at an engine temperature of 54° F (12° C)
1,000 rpm at an engine temperature 54° F (12° C)

Generator – Boxster (986)



The Boxster has a compact alternating current generator.

Features:

- Power output: 65 A at 1,800 rpm alternator speed
  105 A at 6,000 rpm alternator speed at ambient temperature 176° F (80° C)
- Weight: 14 lbs (6.5 kg)
- Optimum ventilation to reduce component temperatures
- Zener diodes in rectifier: protect regulator and on-board electric system against overvoltage and voltage surges over approximately 33 volts in negative and positive direction.
- Multifunction regulator BR1
- Closed-circuit current approx. 0.5 mA

Notes:

911 Carrera (997)/Boxster/Cayman (987)

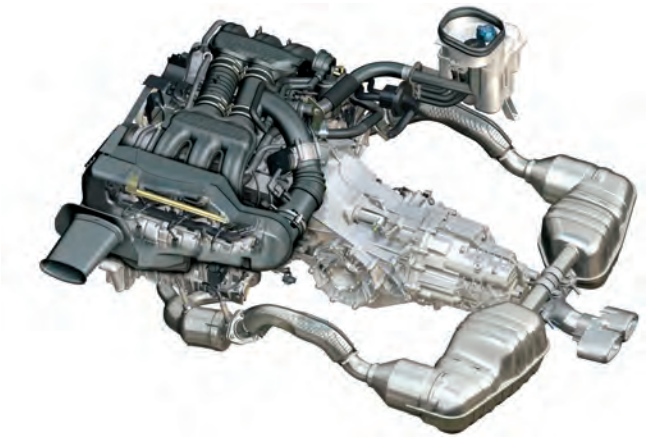
General – Boxster/S (987)

The Boxster (987) 2.7 liter and Boxster S (987) 3.2 liter engines are designed for a high specific output with high torque over a wide rpm range as well as extremely good emission and fuel consumption values. The fuel/air mixture is electronically controlled by the Motronic control module ME 7.8_40.

A further improvement in the gas cycle has been attained by redesigning the exhaust systems, in particular the rear mufflers. These measures have been instrumental in increasing power output, reducing weight and ensuring compliance with the statutory requirements regarding exhaust emissions. The increased torque in the lower rpm range results from a double-flow distribution pipe with induction flap, which is also instrumental in ensuring that the maximum torque is available over a broad rpm range.



Boxster (987)



Boxster S (987)

The Boxster (987) 2.7 liter engine and the Boxster S (987) 3.2 liter engines are basically similar in design to the previous model year Boxster/S (986) 2004 2.7 and 3.2 versions. As a result of optimization measures in the areas of intake air routing, fuel/air mixture preparation and the exhaust system, the gas cycle has been further improved and the power output has been increased by 12 hp (8 kW) for the Boxster 2.7 liter, and 20 hp (15 kW) for the Boxster S 3.2 liter engines when compared to the previous 2004 versions.

Even more impressive than the actual power ratings is the extra acceleration which the new engine offers in the low and middle rpm range. The maximum torque is available over a broad rpm range. This enables high performance and good flexibility. Both engine have the typical Porsche sports car sound and meet all emission requirements.

Development aims for the Boxster (987) and Boxster S (987):

- High specific performance and driving dynamics.
- High torque over a wide rpm range
- Reliable fulfillment of all regulatory emission requirements
- Low specific fuel consumption
- Attractive, Porsche exhaust note
- Reduction in maintenance costs
- Reduction in overall weight

Boxster 2.7 liter Engine Data: (MY 2005-06)

Engine power	240 hp (176 kW) at 6400 rpm
Max. torque	199 ft lbs (270 Nm) at 4700-6000 rpm
Idle speed	680 rpm
Cut-off speed	7200 rpm

Boxster S 3.2 liter Engine Data: (MY 2005-06)

Engine power	280 hp (206 kW) at 6,200 rpm
Max. torque	236 ft lbs (320 Nm) at 4700-6000 rpm
Idle speed	680 rpm
Cut-off speed	7200 rpm

General – Boxster/Cayman (987) M97.20

The Boxster (987) engine from the 2006 model year serves as the basis for the Boxster (987) and Cayman (987) engines in the 2007 model year. It was possible to further increase both the power and torque with further development measures.

The technical data of the 2.7 liter engine as well as the switching points of the distribution pipe flap and tuning flap are described in the Technical Manual.

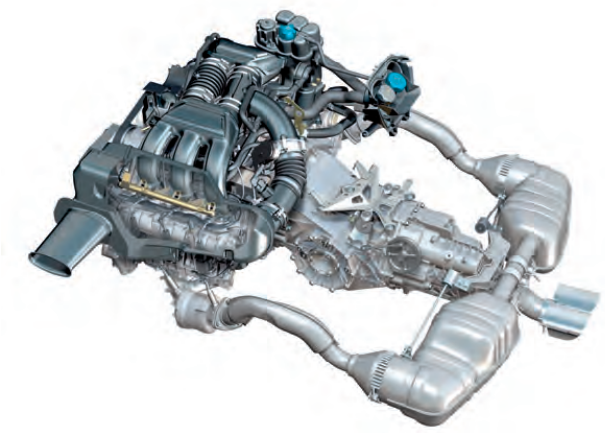
Key features:

- There are two different DME control units installed on a country specific basis depending on the oxygen sensor installed ahead of the catalytic converter.
- Porsche VarioCam Plus (with valve lift switching).
- Double-flow distribution pipe.

General – Boxster S/Cayman S (987) M97.21

The 3.4-liter engine of the Cayman S offers a high specific output with high torque over a wide rpm range as well excellent emission and fuel consumption values. Fuel/air mixture preparation and the VarioCam Plus system are electronically controlled by the Motronic control module ME 7.8_40.

The 3.4 liter 6-cylinder horizontally opposed engine is based on the current engine family of the 911 Carrera (997) and Boxster (987). The increased torque in the lower rpm range results from the VarioCam Plus system and a double-flow distribution pipe with induction flap, which is also instrumental in ensuring that the maximum torque is available over a wide rpm range.



Boxster S/Cayman S (987)

Development objectives for the engine:

- High specific performance and driving dynamics.
- High torque over a wide rpm range.
- Reliable fulfilment of all world-wide emission regulations.
- Low specific fuel consumption.
- Attractive, typical Porsche sound.
- Low maintenance costs.

As a result of optimization measures in the areas of intake air routing, fuel/air mixture preparation and the exhaust system, the gas cycle has been improved and a power output of 217 kW/ 295 bhp has been achieved. These measures have been instrumental in increasing power output, reducing weight and ensuring compliance with emission regulations. In addition to the actual power ratings, another impressive feature is the extra acceleration which the new engine offers in the low to middle rpm range.

Boxster/Cayman 2.7 liter Engine Data: (MY 2007)

Engine power	245 hp (180 kW) at 6500 rpm
Max. torque	201 ft lbs (273 Nm) at 4600-5500 rpm
Idle speed	680 rpm
Cut-off speed	7300 rpm

Boxster S/Cayman S 3.4 liter Engine Data: (MY 2007)

Engine power	295 hp (217 kW) at 6,250 rpm
Max. torque	251 ft lbs (340 Nm) at 4400-6000 rpm
Idle speed	680 rpm
Cut-off speed	7300 rpm

Notes:

General – 911 Carrera (997) M96.05

The Carrera 911's 3.6 liter engine is designed for a high specific output with a high torque over a wide rpm range as well as for very low emission levels and fuel consumption values. The fuel/air mixture is electronically controlled by the Motronic control module ME 7.8 (M.Y. 2005) & ME 7.8_40 (M.Y. 2006).

Development goals for the 911 Carrera:

- High specific output
- High torque over a wide rpm range
- Compliance to emission regulations, world-wide
- Low specific fuel consumption
- Unique Porsche exhaust note
- Reduction of maintenance costs

The 911 Carrera's (997) 3.6 liter engine is basically the same as the engine from the previous M.Y. 2004, 911 Carrera (996). Thanks to the optimization of the air cleaner as well as the exhaust system (especially the mufflers), the volummetric efficiency was improved further and the output, compared to the 911 Carrera (996) 3.6 liter, was increased by 5 HP to 239 kW (325 HP).

The engine is characterized by the unique Porsche exhaust note and fulfills the emission demands EU4 or LEV (USA).

Engine Compartment



Engine Data:

Output	239 kW (325 HP) at 6,800 rpm
Max torque:	370 Nm (273 ft lbs) at 4,250 rpm
Idle speed	670 rpm
Cut-off speed	7,300 rpm

General – 911 Carrera S (997) M97.01

The 3.8 liter engine of the 911 Carrera S (997) is designed for a high specific output with a high torque over a wide rpm range as well as for very low emission levels and consumption values. The fuel/air mixture is electronically controlled by the Motronic control module ME 7.8 (M.Y. 2005) & ME 7.8_40 (M.Y. 2006).

Development goals for the 911 Carrera S:

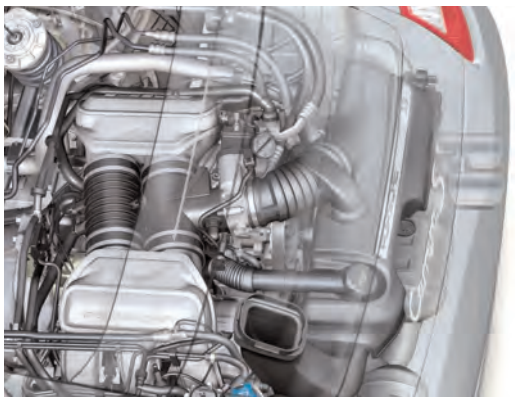
- High specific output
- High torque over a wide rpm range
- Reliable fulfilment of all statutory emission demands
- Low specific fuel consumption
- Unique Porsche exhaust note
- Reduction of maintenance costs
- To offer an additional 911 Carrera S model with even greater performance thanks to a new engine with a significantly higher equipment level than the basic model

The 911 Carrera S (997) has a newly developed 3.8 liter engine and is essentially based on the 3.6 liter engine of the 911 Carrera (996). An increase in displacement and extensive fine-tuning work, particularly on the gas cycle, has resulted in a maximum output of 355 bhp (261 kW) and a maximum torque of 295 ft lbs (400 Nm). The high specific torque of 77.3 ft lbs (104.6 Nm)/l (911 Carrera 3.6: 76 ft lbs (102.9 Nm)/l) and the balanced torque curve of the 3.8 liter engine, which is considerably above the values of the 3.6 liter engine across the rpm range, facilitate better performance and superior flexibility.

The engine is characterized by the unique Porsche exhaust note and fulfills the emission demands EU4 or LEV (USA).

Notes:

Engine Compartment



Engine Data:

Output	261 kW (355 HP) at 6,600 rpm
Max torque	400 Nm (295 ft lbs) at 4,600 rpm
Idle speed	670 rpm
Cut-off speed	7,300 rpm

Motronic Control Module ME 7.8_40 – Boxster/S (987) & /Cayman/S (987)

The familiar Motronic ME 7.8 control module is employed as the engine control system. The processor speed has been increased to 40 MHz, with a memory capacity of 1 MB. These enhancements are required on the new models to ensure the enhanced OBD scopes and to facilitate the Sport Chrono function. The Motronic control module is also designed for operation with the LSU wideband Lambda probes upstream of the catalytic converters and for switching the double-flow distribution pipe in the intake system.

Data records for programming the Boxster/Cayman (987) Motronic control module:

987, LEV, MT5; 987, LEV, MT6; 987, LEV, AT. (North American)

Data records for programming the Motronic control module on the Boxster S/Cayman S (987):

987 S, LEV, MT; 987 S, LEV, AT. (North American)

Motronic ME 7.8 – 911 Carrera/S (997)

The 911 Carrera (997) and 911 Carrera S (997) are equipped with the familiar Motronic ME 7.8 engine control system. Innovations here include increased computing power and greater memory capacity. These enhancements are required on the new models to ensure the enhanced OBD scopes and to facilitate the Sport Chrono function.

Enhancement of On-Board Diagnostics OBD (USA) and EOBD – 911 Carrera/S (997) & Boxster/S (987) & Cayman/S (987)

The familiar On-Board Diagnostics system (OBD -> USA) or the European On-Board Diagnostics system (EOBD -> Europe/RoW) for emission monitoring is also used on the 911 Carrera/S (997) and Boxster/S (987) models. This system is designed to warn drivers anywhere in the world, via an appropriate signal in the instrument cluster, of any emission- or engine-related faults.

Each system is fully compliant with all world-wide governmental regulations.

- Check engine light is on **–** emission-related fault
- Check engine light is flashing **–** fault causing damage to catalytic converter

There will also be an enhancement to the On-Board Diagnostics systems worldwide for the model year 2005. Any occuring faults with additional information displays are stored in the fault memory of the Motronic control module and can be read out with the PIWIS Tester.

The additional scopes required specifically for California include:

- More complex sensor diagnostics.
  The operating range and plausibility of emission-related sensor signals such as ambient pressure, oil temperature, ambient temperature, etc. must be verified.
- Increased number of fault paths.
  Each fault type of a signal fault must be stored in a separate fault path.
- Enhanced field monitoring of the vehicle fleet.
  The function and fault management systems of the diagnostics system on standard production vehicles must be tested and documented every year.

The Motronic 911 Carrera/S (997) ME 7.8 (M.Y. 2005), ME 7.8_40 (M.Y. 2006), Boxster/S (987) & Cayman/S (987) ME 7.8_40 control module was adapted to the engine-specific requirements of the following components and systems:

- Electronic accelerator pedal (electronic throttle)
- Sequential fuel injection
- Cylinder-specific knock control
- Static high-voltage system with individual ignition coils
- Load measurement using hot film mass air flow sensor (HFM 5 CL)
- Two-stage resonance intake system
- Stereo oxygen sensor closed-loop control
- Oxygen sensor heating
- 2 three-way catalytic converters
- Secondary air control
- Fuel tank leakage check using excess pressure (USA)
- Continuous camshaft position adjustment using vane cell adjuster
- "VarioCam Plus" valve lift control - 911 (997) only
- Force coordination for Tiptronic and PSM
- On-Board Diagnostics system for monitoring emission control system (OBD II and EOBD)
- Infinitely variable activation of the electronic radiator fans
- Engine compartment scavenging blower
- Air conditioning compressor control
- Cruise control function (via electronic throttle)
- Rear spoiler activation (dependent on vehicle speed and engine compartment temperature, Boxster is vehicle speed only)
- Sport Chrono Package Plus (optional)

The following input signals are available to the Motronic control module:

- Power supply terminal 15, terminal 30, terminal 87 and ground
- Engine speed senders
- Hall sender inlet camshaft, bank 1 & bank 2
- Hot film mass air flow sensor HFM 5 (load signal and intake air temperature)
- Coolant temperature sensor (NTC) knock sensor, bank 1 & bank 2
- Oxygen sensors LSF in front of catalytic converter, bank 1 & bank 2
- Oxygen sensors LSF behind catalytic converter, bank 1 & bank 2
- Pedal sensor potentiometers 1 & 2 (in accelerator pedal unit)
- Throttle potentiometers 1 & 2 (in the electronic throttle)
- Oil temperature and oil level
- Oil pressure sensor
- Engine compartment temperature sensor (NTC)
- Tank leakage diagnostics module DM-TL (USA only)
- CAN information
- Brake light switch
- Clutch pedal switch
- Fuel level
- Immobilizer

The Motronic control module activates the following outputs:

- Starter relay
- Fuel pump relay
- Injection valves for cylinders 1 to 6
- Individual ignition coils for cylinders 1 to 6
- Throttle position adjuster (electronic throttle)
- Cruise control (Speed Adjustment System SAS)
- Oxygen sensor heating
- Valve for intake camshaft adjuster, bank 1 and bank 2
- Valve for valve lift switchover, bank 1 and bank 2 - 911 (997) only
- Switching valve for tuning flap
- Tank vent valve
- Tank leakage diagnostics module DM-TL (USA only)
- Secondary air pump
- Cooling water fan right and left (via auxiliary control module)
- Engine compartment scavenging blower
- Cooling water shutoff valve (Tiptronic only)
- Air conditioning compressor relay

Effects of the Sport Chrono function on the Motronic

The optionally available Sport Chrono Package notably increases driving pleasure and the vehicle's performance. The engine is also affected when the Sport Chrono button is activated.



After pressing the Sport button, Sport mode is indicated by a symbol on the middle display of the instrument cluster.

The following features are initiated:

Sportier load cycle properties – When the Sport Chrono function is selected, the transfers between acceleration and deceleration become sportier. This means that injection and ignition are switched on and off more directly when accelerating and particularly when decelerating, resulting in a more spontaneous and dynamic load cycle.

More abrupt engine speed cut-off – To increase driving comfort a 'gentle' cut-off is generally used when accelerating and reaching the engine speed cut-off setting. In the process the throttle is continuously closed when approaching the engine speed cut-off level.

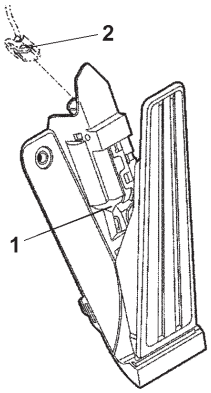
The Sport Chrono function facilitates additional acceleration potential through the use of an abrupt engine speed cut-off by switching off individual cylinders (injection and ignition) in a rotating fashion just shortly before the engine speed limit. The perceptible limit of acceleration lets the driver know if an upshift is executed too late. This allows the driver to learn how to identify the optimum shift point with more accuracy and to take fuller advantage of the engine's potential for acceleration. When the Sport Chrono button is pressed, the abrupt cut-off is active in 1st to 5th gears for the manual gearbox (without Sport Chrono function only in 1st and 2nd gears) and in the manual gate "M" for Tiptronic transmission.

More dynamic accelerator pedal characteristic – The electronic accelerator pedal (electronic throttle) has been used on the Boxster (986) and 911 Carrera (996) models since model year 2001. With this system, the accelerator pedal position is converted into electrical signals via potentiometers and forwarded as a control signal to the electromechanical throttle via the Motronic control module. The "conversion" between accelerator pedal angle and throttle angle is performed in the Motronic control module. Sensitivity and therefore driveability in the lower speed and load range are factors here, as well as across the entire throttle pedal travel range.

When the Sport Chrono button is active, a more dynamic accelerator pedal characteristic produces a more spontaneous engine response, enhancing the sporty character. This is achieved via a steeper rise for the electronic throttle characteristic by means of a shorter "conversion" between accelerator pedal and throttle angle. This means that the throttle is opened further or faster with the same accelerator pedal travel and selected Sport Chrono function (with Tiptronic S only in the manual "M" position).

Accelerator Pedal Unit

The accelerator pedal unit is also new. It was redesigned with the aim of reducing the individual components which in turn reduced the unit's weight by 60% (approx. 600g). This was achieved through the integration of the potentiometers 1 and 2 into the accelerator pedal unit as well as through the elimination of the short throttle cable.



1 - Accelerator pedal unit with integral potentiometers 1 and 2
2 - Electrical plug connection

Power Pupply For The Motronic Section

The Motronic control module is installed under the storage tray in the rear.

On the Cayman S it is located on the left at the partitioning panel separating the luggage compartment from the engine.

Important fuses for the Motronic section can be found in the following positions:

Current distributor:	SI F7
Fuse carrier in left footwell:	Fuse carrier B) SI B1, as well as D): SI D1, D4, D6, D7.
Fuse carrier in rear:	SI F1 (fuse position 6 on relay carrier 2)

Important relay fuses for the Motronic section can be found in the following positions:

Relay carrier 1 in left footwell:	Fuse position 8, 12, 14, 16
Relay carrier 2 in rear:	Fuse position 8, 9

Note: above fuse and relay positions are for general class discussion only. Refer to technical manual for specific locations.

Notes:

CAN Networking

The electronic networking facilitates the exchange of data and electronic information between the various control modules throughout the vehicle with the internal high-speed network, CAN-BUS (Controller Area Network).

Via the CAN, the Motronic control module communicates with the following control modules:

- Gateway control module
- Driver authorization controller (PAS control module)
- Tiptronic control module
- PSM control module
- Steering angle sensor
- Yaw velocity sensor
- Airbag control module
- Air conditioning control module

Starting The Engine

In order to start the engine it is necessary, after the ignition key has been identified, to also actuate the clutch pedal (vehicles with manual transmission) or the brake pedal (Tiptronic vehicles). in Tiptronic vehicles, the selector lever must additionally be set to either “P” or “N”.

Fuel System, Fuel Supply – 911 Carrera/S 997), Boxster/S (987) & Cayman/S (987)

Fuel

Concerning power and fuel consumption, the engines were designed ideally for unleaded fuel 93 octane ($\frac{R+M}{2}$). When fuel with 90 octane ($\frac{R+M}{2}$) is used, the ignition timing is automatically adjusted towards late by the knock control.

Returnless Fuel System (RF)

In Returnless Fuel (RF) supply systems, the fuel-pressure regulator and the fuel filter are installed in the fuel tank. When this system is used, the fuel return line connecting the fuel distributor in the engine compartment with the fuel tank can be eliminated. The excess fuel supplied by the electric fuel pump directly enters the fuel delivery unit’s storage vessel from the pressure regulator. Only the quantity of fuel injected by the injection valves is pumped to the fuel distributor in the engine compartment. The advantage of eliminating the return line is that fuel heated in the engine compartment does not flow back into the

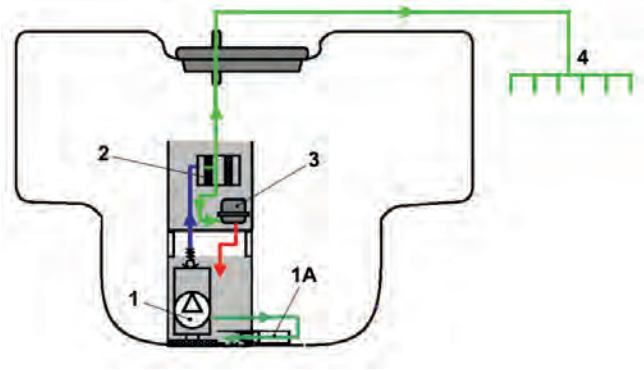
fuel tank and increase the fuel temperature. This leads to a further decrease in the HC emissions in the fuel tank and thus relieves the tank ventilation.

Fuel Tank – 911 Carrera/S 997), Boxster/S (987) & Cayman/S (987)

The tank holds 16.9 gallons (64 liters). As before, the tank is filled via a filler neck over the right-hand front wheel. Apart from minor modifications, the tank has been directly adopted from the previous 911 Carrera (996) and Boxster (986) models.

The fuel delivery unit integrated in the tank is designed to allow the fuel volume stored in the tank to be used without misfires even in dynamic driving situations. The fuel tank meets all country-specific requirements. For the American market, a multi-layered tank lining is used.

Fuel Tank Layout



1 - Fuel pump

1A - Venturi nozzle (for filling the pump vessel)

2 - Fuel filter

3 - Fuel-pressure regulator

4 - Fuel pressure line to the injection valves

Fuel Filter

In the Returnless Fuel systems, the fuel filter is located inside the fuel tank and does not need to be changed.

Fuel Pressure Regulator

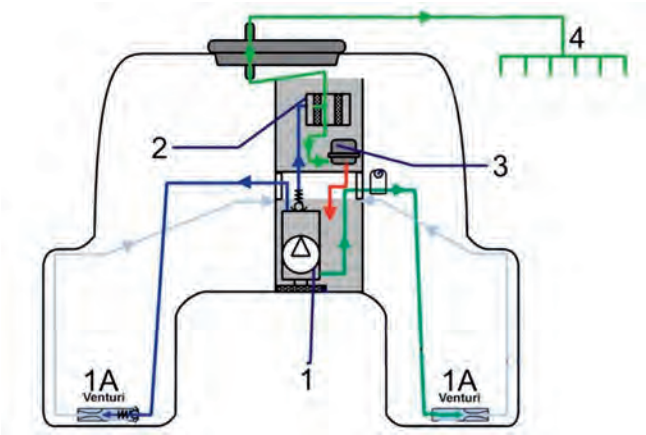
The fuel-pressure regulator does not have a connection for the intake manifold pressure and is integrated into the tank installation unit. It's nominal pressure is set at 55 psi +/- 1.5 (3.8 +/- 0.1 bar) for a flow rate of 21 gph (80 l/h).

Fuel Tank – 911 Carrera 4/4S (997)

The fuel tank's refill capacity has been increased by .75 gal. (3 liters) in comparison to the Carrera 2 and now stands at 17.6 gal (67 liters), including a reserve of 2.6 gal. (10 liters).

Design Of The Fuel Supply System With RF System

On Carrera 4 vehicles the fuel is transported into the pump chamber of the fuel pump by the sucking jet pumps (1A) which are located in the low-lying tank pockets on the left and right.



1 - Fuel pump (for building up fuel pressure)

1A - Venturi nozzle/sucking jet pumps in the tank pockets on the left and right

2 - Fuel filter

3 - Fuel pressure regulator 55 psi (3.8 bar)

4 - Fuel pressure line to the injection valves

To check the fuel pump's delivery volume, the special tool 9705 (pressure regulator 36 psi/2.5 bar) is used. A holding pressure of > 29 psi (2 bar) should still apply one hour after switching off the engine.

Electronic Fuel Pump Control Module (EKPSM)

911 Carrera 4/4S (997) vehicles for USA feature this additional control unit, which is installed in the luggage compartment over the fuel tank. In order to further reduce heating-up of the fuel in the fuel tank, the fuel pump current and, consequently, the delivery rate are reduced at low engine rpm.



Note:

A suitable measuring point to check the current consumption is the fuse slot for the fuel pump. After starting the engine, the fuel pump's current consumption stands at > 7A for several seconds, after which it is reduced to < 5A, thereby lowering the delivery rate.

The following switching conditions subsequently apply:

At > 3,000 rpm > 7 A.
At < 2,800 rpm > 5 A.

Injection Valve EV-6 – Boxster S (987) MY 2005-06, Boxster/Cayman (987) MY 2007

As on the previous Boxster/S (986) models, the new Boxster/S (987) are equipped with the familiar EV-6 injection valves. These injection valves meet all the requirements of modern fuel injection systems in supporting the reduction of pollutant emissions and ensuring compliance with worldwide emission regulations.

Injection Valve EV-14 – Boxster S (987) MY 2007, Cayman S (987) & 911 Carrera/S (997)



To support the reduction of emissions and the compliance with emission classification, EV-14 injection valves are employed. These injection valves fulfill all requirements of modern fuel injection.

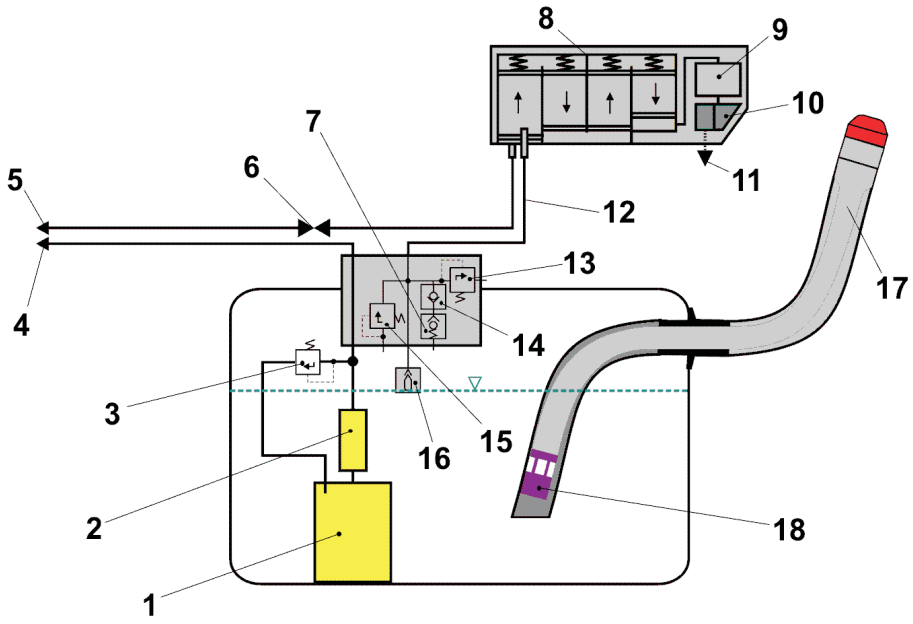
Features of the injection valve:

- Slender valve shape (flexible installation and optimal adaption to engine requirements)
- Great variant diversity (geometry, shape of spray pattern modified injection angles)
- Improved fuel/air mixture for reduction of emissions (finest spray mist)
- Low weight (approx. 25 grams)

Construction of Injection Valve

Compared to the EV-6 injection valve from the 911 Carrera (996) model year 2002-05 and Boxster/Cayman (987), the outer diameter of the valve is reduced, the solenoid coil and the valve grouping are redesigned and the injection point is 5 mm deeper. The EV-14's valve housing in the fuel delivery area is made of rust-resistant steel.

This comprises the coil, the electric and the hydraulic connection. Located in the valve housing are the filter strainer, the movable injection needle, the armature and the valve seat with the perforated spraying disc. The EV-14's perforated spraying disc determines the jet shape, the fuel proportioning and the mixture formation – in other words, the optimal atomization of the fuel in the intake manifold. Two o-rings seal off the injection valve from the fuel distributor and the intake manifold.



1 - Fuel pump with pre-chamber
2 - Fuel filter
3 - Fuel-pressure regulator
4 - Fuel pressure line to the injection valves
5 - Purging line to the intake manifold
6 - Evaporative emissions purge valve
7 - Roll-over valve
8 - Four chamber carbon canister
9 - Tank leakage diagnostics module DM-TL
10 - Filter for DM-TL
11 - Vent to atmosphere
12 - ORVR vapor line
13 - Overpressure control valve (max. 130 mbar)
14 - Pressure control valve
15 - Excess-pressure control valve
16 - Fuel limit control valve
17 - Fuel filler pipe
18 - Anti-spitback valve

Tank Ventilation

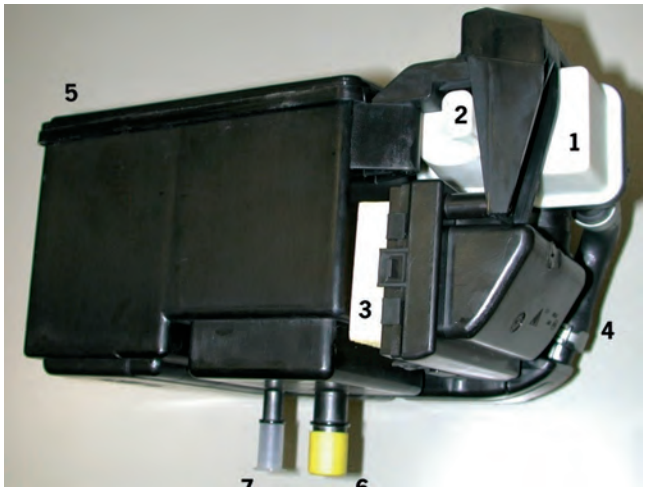
Vapors containing hydrocarbon (HC) are formed inside the fuel tank. These HC emissions are controlled by the Evaporative Emission (EVAP) control system in order to prevent their emission into the environment. The fuel tank is ventilated via an active charcoal canister and the HC vapors are purged by the evaporative emissions purge valve that is controlled by the Motronic control module. The tank ventilation system fulfills the respective requirements worldwide with regard to preventing evaporative emissions. The release of fuel vapors into the environment has been further reduced for both the plastic safety tank and the plastic line system. The current model's tank ventilation system has been simplified compared to the system used in the 911 Carrera (996) and Boxster (986) through the elimination of components and lines.

Tank Ventilation (ORVR) **With Tank Leak Diagnosis**

USA vehicles are equipped with a tank-leakage diagnostics module (DM-TL). This system allowed the elimination of various components such as lines and valves which further increases reliability of the evaporative emission system.

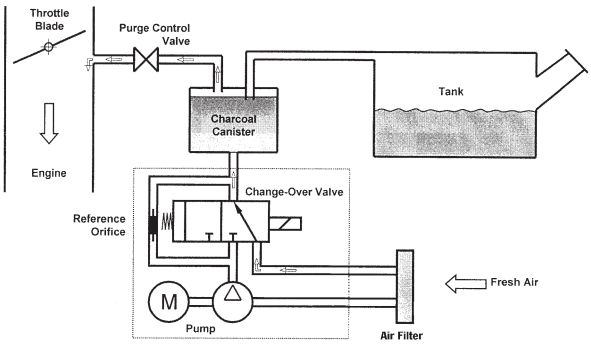
Carbon Canister

In USA vehicles, the 4-chamber carbon canister with OVRV is installed next to the battery in USA vehicles.



1 - Tank leakage diagnostics module DM-TL
2 - Electrical plug connection DM-TL
3 - Air filter DM-TL
4 - Hose to 4-chamber active charcoal filter
5 - 4-chamber active charcoal filter
6 - Tank ventilation line connection (ORVR)
7 - Purge line to intake manifold via evaporative emissions purge valve

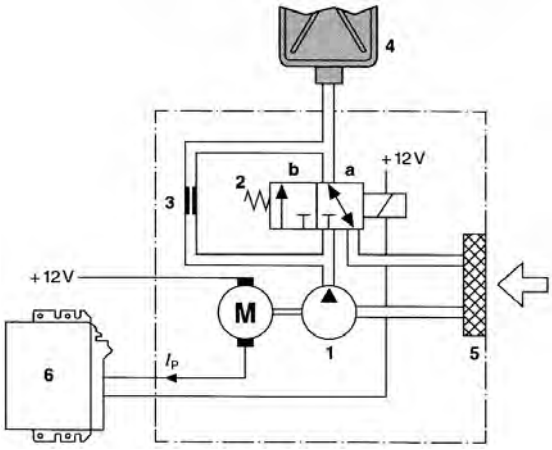
Diagnosis Inactive Purging Canister



Construction and Operating Principle of the Tank Leakage Diagnostics Module (DM-TL)



The diagnostics module consists of an electromechanically driven excess pressure pump as well as a switching valve with an integrated reference orifice.



1 - Excess-pressure pump
2 - Switching valve (with valve positions a and b)
3 - Reference oriface
4 - Active charcoal filter (ACF)
5 - Fresh air filter
6 - Motronic control module
Ip - Pump current

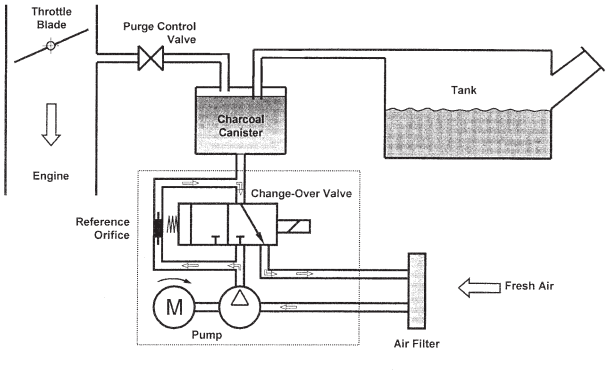


Figure 1

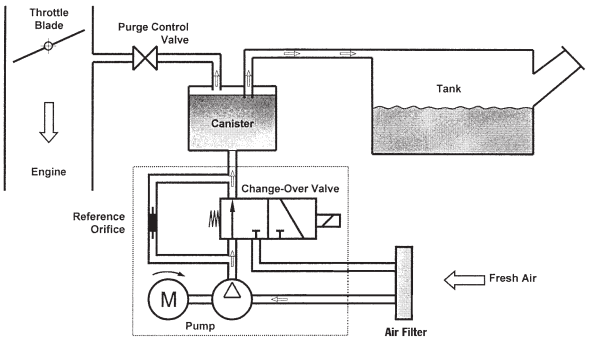


Figure 2

When the Switching valve is in the position shown in figure 1. The pump operates against the 0.02-inch reference orifice and the carbon canister is connected to fresh air through the air filter. This is the position of the switching valve when the leak detection system is not operating. The fresh air inlet for purge has a large cross section, this has a favorable effect on vapor flow especially at high purge rates. In addition, the air filter protects the pump during diagnosis. The purge air does not flow through the pump when the system is venting the carbon canister, this increases the system reliability and service life.

Leak Detection

The DM-TL system utilizes the current flow of the diagnosis pump motor to determine tank leakage. The DM-TL system can detect small leaks greater than 0.02 inch and large leaks greater than 0.04 inch. For a reference current measurement the diagnosis pump motor is switched on for a short period of time with the switching valve in the position shown in figure 1. The only path for the air pumped by the diagnosis pump is through the 0.02-inch reference orifice. The current of the diagnosis pump motor is measured while fresh air is being drawn in through the air filter and pumped through the reference orifice to atmosphere. This determines the current that is required to pump air through a 0.02-inch leak this will be used to establish the lowest current allowable for a leak tight system.

The diagnosis will be aborted if the current does not stabilize after a predetermined period has elapsed. To prevent damage to the diagnosis module, after a preset number of stabilization failures a fault will be recognized. If the current stabilizes in the allotted time period the diagnosis will proceed and the diagnosis module will perform a rough leak check. To perform this check the control unit will activate the switching valve. The changeover valve will be in the position shown in figure 2. In this position the direct line from the carbon canister is closed off and the diagnosis pump is connected to the fuel tank across the carbon canister. The diagnosis pump continues to run and the evaporative emissions valve is closed. Initially the motor current will drop to a very low level (zero load). As air is pumped into the tank and the pressure rises the diagnosis pump motor current will rise as well, if the current rises above a threshold value this indicates a system without a leak greater than 0.04 inch see figure 3.

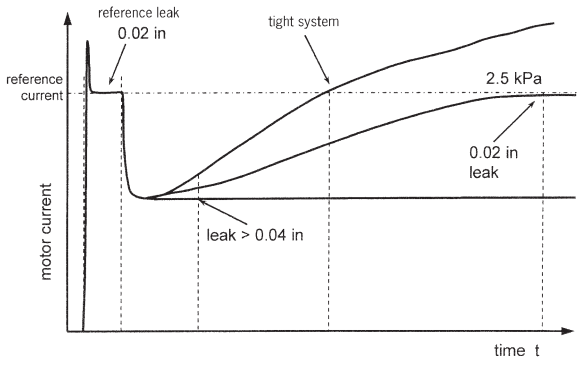


Figure 3

If the rough leak check is passed and certain conditions are met then a small leak check is preformed. In the small leak check the diagnosis pump motor runs until the current level reached is equal to or greater than the current reached while pumping against the 0.02 inch reference orifice. When this occurs the system is considered leak tight. If the diagnosis pump motor current decreases during one of the tests, the test is aborted. If the number of aborted test exceeds a threshold a fault will be recognized.

The Motronic control module measures the respective power consumption of the pump. The result of the comparison of flow rates is the measurement for tank leakage. A leak the size of the reference oriface exists if the power consumption is equal when the valve is in either position. The comparison with the reference oriface ensures that the procedure is independent from the tolerances of the excess pressure pump and from environmental influences.

Ignition System

Engine speed sender, hall sender, individual ignition coils as well as the knock sensors have been adopted from the previous 911 Carrera (996) and Boxster (986) models.

Individual Ignition Coils

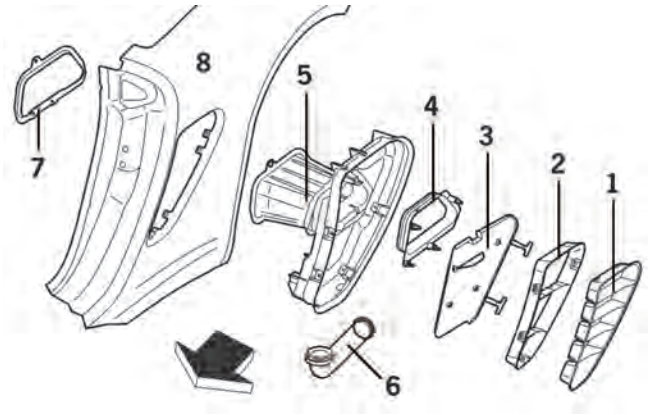
The familiar static high-voltage distribution with individual ignition coils has the following advantages: high ignition reliability, low electro-magnetic irradiation of other electrical components and the elimination of ignition leads and distributor.

Spark Plugs

The change interval for surface-gap spark plugs with 4 ground electrodes is 60,000 miles (90,000 km) or 4 years under normal operating conditions.

Left Side Air Inlet – Boxster/S (987)

The intake air inlet in the rear side section has been redesigned. The positioning and the opening cross-section of the air inlet have been carefully optimized to ensure the maximum possible increase in air flow rate combined with the minimum possible effects on lift and resistance. In addition, an effective labyrinth-type system which is isolated from the body has been located behind the left air inlet. The engine intake air is forced to flow around a deflecting distance plate, as a result of which water and particles are largely separated for the air stream via the water drain at the bottom. This air routing results in a marked improvement in the level of water separation forward of the air filter (when driving on wet surfaces with a lot of water spray), thereby protecting the hot-film airflow sensor from failures resulting from the intake of ultra fine water droplets.



1 - Air inlet grille

2 - Reinforcement for air inlet grille

3 - Air deflection

4 - Distance piece for air deflection

5 - Air duct to air filter housing (rubber)

6 - Water drain to wheel housing

7 - Connection to air cleaner housing

8 - Left side section

Right Side Air Inlet – Boxster/S (987)

The newly designed side air inlet in the rear side section on the right leads to a marked improvement in engine compartment ventilation. The engine compartment scavenging blower draws cooling air through the opening and into the engine compartment.

Left Side Air Inlet – Cayman/S (987)

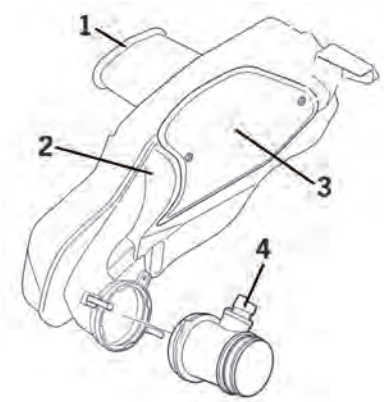


The air inlets integrated in the rear side panels differ from those on the Boxster (987) in that they incorporate vertical vanes. The intake air for the engine is drawn in via the opening on the driver's side. The positioning and the opening cross-section of the air inlet have been carefully optimized to ensure the maximum possible increase in air flow rate combined with the minimum possible effects on lift and resistance. In addition, an effective labyrinth system which is isolated from the body has been located behind the left air inlet. The engine intake air is forced to flow around a deflecting distance plate, as a result of which water and particles are largely drawn off via the water drain at the bottom.

This air routing results in a marked improvement in the level of water separation up-line of the air cleaner (when driving on surfaces which throw up a lot of spray), thereby protecting the hot-film air flow sensor from failures resulting from the intake of ultra-fine water droplets.

Air Filter Housing – Boxster/S (987) & Cayman/S (987)

The air filter housing and the air filter have been completely redesigned. Flow optimization measures and the resultant reduction in counterpressure in the intake duct are instrumental to the improvement in performance. The increase in the air filter element's surface area to 14.5 sq. ft. (1.35 m^2) (as compared to 6.1 sq. ft./0.57 m^2 on the previous Boxster 986) leads to a reduction in the specific load on the air filter, as a result it has been possible to extend the change interval to 40,000 miles (60,000 km) or every 4 years.



1 - Air intake (from the air duct in the left side section)
2 - Air filter housing
3 - Cover (for changing the air filter element)
4 - Hot film mass airflow sensor HFM 5 CL

Notes:

Air Filter Housing With Sound Openings –
911 Carrera/S (997)



Sound openings on underside of the air filter housing.

To avoid a possible intake of warm air from the engine compartment even under critical engine operating conditions (e.g. high ambient air temperature), the sound openings on the underside of the air filter housing have been modified. By using openings with a large surface area with inserted, almost airtight fabric, the intake of warm air from the engine compartment is nearly completely prevented while the intake sound typical for Porsche is retained.

911 Carrera (997) Air Filter Housing

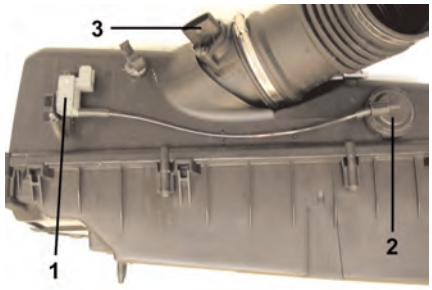
The construction of the air filter basically corresponds to that of the 911 Carrera (996) from model year 2004. The redesign of the scoop and the upper part of the air cleaner with the integrated "PORSCHE 3.6" logo as well as the rerouting of the hoses and lines are essential elements for the upgrading of the engine compartment with an attractive look.

911 Carrera S (997) Air Filter Housing

The construction of the air filter of the 911 Carrera S (997) basically corresponds to that of the 911 Carrera (996) model year 2004. The redesign of the scoop and the upper part of the air cleaner with the integrated "PORSCHE 3.8" logo as well as the rerouting of the hoses and lines are essential elements for the upgrading of the engine compartment with an attractive look.

911 Carrera S (997) Switchable Resonance Reservoir

The air filter of the 3.8 liter engine differs from that of the 3.6 liter engine through an active on-demand resonance reservoir integrated in the upper part of the air filter.



1 - Electropneumatic switching valve
2 - Vacuum unit for opening and closing the flap
3 - Hot film mass air flow sensor HFM 5 CL

Undesired noises can be insulated by adjusting the volume of the reservoir according to engine speed, whereby sound in the passenger compartment is optimized. One of the goals in adjusting the passenger compartment sound has been to reduce background noise in the higher frequency range and to greater emphasis, the sporty, load-related exhaust and intake noises between 300 and 600 Hz. Opening and closing the resonance reservoir produces an improvement in the intake sound of the 3.8 liter engine, particularly in combination with the specific intake system of the 3.8 liter engine.



1 - Flap for switching the resonance reservoir
2 - Vacuum unit for opening and closing the flap
3 - Hot film mass air flow sensor HFM 5 CL

This reservoir is activated via a vacuum-controlled flap as a function of engine speed and using temperature compensation. The flap operates in the temperature range between 32° F. (0° C.) and 90° F. (30° C.), opening between approx. 4,600 and 4,800 rpm and closing between approx. 6,000 and 6,250 rpm.

Intake System – Boxster/S (987) & Cayman/S (987)

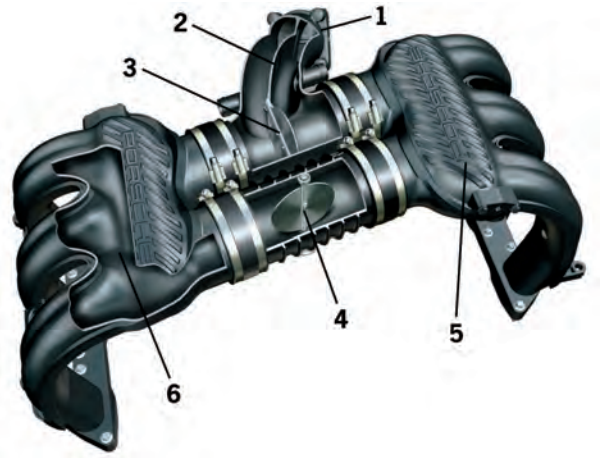
Double Flow Distribution Pipe

The new engines are equipped with a new intake system featuring a double flow distribution pipe. With this new system, the distribution pipe flap in the intermediate pipe connecting the two intake air distributors is closed in the low rpm range. The distribution pipe is designed with a partition wall running along its length (between the electronic throttle and the distribution pipe flap in the intermediate pipe), as a result of which the 6-cylinder engine behaves like two 3 cylinder engines running in parallel in the low rpm range (when the distribution pipe flap is closed), leading to an improved torque characteristic in the low rpm range.

Boxster/Cayman (987) – The distribution pipe flap is opened in the two rpm ranges from 3100 to 5000 rpm and from 5600 to 7200 rpm.

Boxster S (987) MY 2005-06 – The distribution pipe flap is opened in the two rpm ranges from 3500 to 4700 rpm and from 5400 to 7200 rpm.

Boxster S (987) MY 2007 & Cayman S (987) – The distribution pipe flap is opened in the two rpm ranges from 3500 to 4900 rpm and from 5200 to 7300 rpm.



1 - Flange to electronic throttle

2 - Partition wall of double-flow dist. pipe

3 - Distribution pipe flap

4 - Tuning flap

5 - Intake distributor, left bank

6 - Intake distributor, right bank

Tuning Flap – Boxster/S (987) & Cayman/S (987)

As with the engines in the previous Boxster (986), model year 2004, the resonance intake system on the new engines is again designed with a switchable tuning flap in the perpendicular resonance pipe between the intake distributors. This resonance intake system can be used to adjust the air oscillations in the intake system to the respective engine speeds to ensure high torques even at low rpms, an even torque curve and high maximum output. The tuning flap is closed in the low rpm range.

Boxster/Cayman (987) – The tuning flap is closed at full throttle between 5000 and 7200 rpm.

Boxster S (987) MY 2005-06 – The tuning flap is closed at full throttle between 4700 and 7200 rpm.

Boxster S (987) MY 2007 & Cayman S (987) – The tuning flap is closed at full throttle between 4900 and 7300 rpm.

Notes:

Intake System – 911 Carrera (997)

The plastic intake system of the 3.6-liter engine with the approx. 60-mm long aluminium intake manifold runners was adopted from the 911 Carrera (996) model year 2004 3.6-liter engine. The basic construction principle of the intake system with the elements distribution pipe, switchable resonance pipe, lateral containers and intake runners was retained.

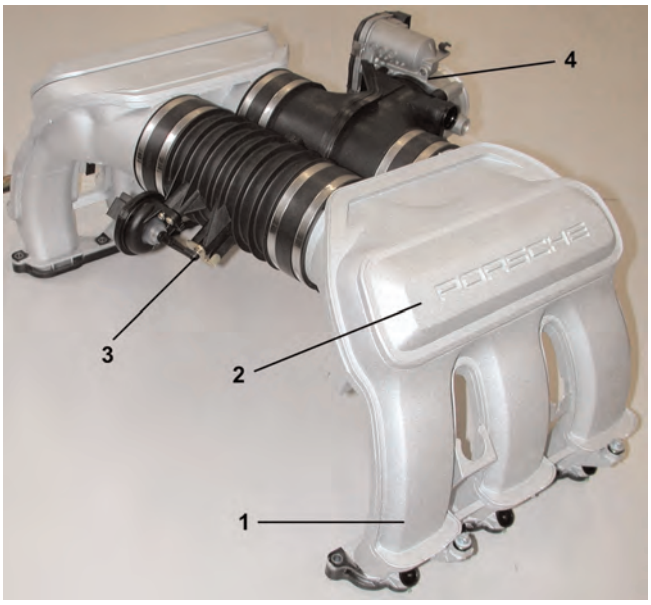
Intake System – 911 Carrera S (997)

The same essential intake system design with distributor pipe, switchable resonance tube, lateral reservoirs and individual intake manifold runners as the 3.6 liter engine.

The intake system of the 3.8 liter engine is made entirely of plastic and is therefore lighter than the intake system of the 3.6 liter engine with approx. 60 mm intake runner supports made of aluminium. The omission of the separation points and the additional aluminium intake runner supports has been enabled through the use of a new design, making repair work easier. The dimensions of the intake system have also been redesigned to take into account the increased output and torque and therefore the higher air throughput of the 3.8 liter engine. Intake runners with a constant cross section have been used to achieve the specific output and torque characteristics of the 3.8 liter engine. In contrast, conical intake runners are used for the 3.6 liter engine.

The completely redesigned intake system of the 3.8 liter 911 Carrera S (997) engine differs from that of the 3.6 liter engine in the following ways:

- New design
- Made entirely of plastic (3.6 liter engine: unchanged with approx. 60 mm intake runner supports made of aluminium)
- Intake manifold on left and right with half-shell design painted with silver structural paint
- Volume optimized to the resonance chambers
- Adapted intake runner lengths and diameters
- Lower flow resistances thanks to the harmonious curve of the intake runners
- Flow-optimized distributor pipe
- Dethrottling of the distributor pipe (middle section) by means of double-shell design



911 Carrera S (997) Intake Components

1 - Plastic manifold including intake runner fittings
2 - Resonance chambers integrated in the intake manifolds
3 - Resonance flap
4 - Throttle valve (E-Throttle)

Resonance Chambers – 911 Carrera S (997)

The intake system of the 911 Carrera S is complemented by additional resonance chambers integrated in the two intake manifolds. These chambers muffle the resonance sounds of the 3.8 liter engine in the rev range between 5,000 rpm and 6,000 rpm and make a significant contribution to the harmonious and powerful sound of the 3.8 liter engine when the throttle is fully open. The resonance chambers are connected with the respective intake reservoirs via a multitude of circular openings whose cross section and number have been precisely calculated to produce this effect.



1 - Resonance chambers (bores) in intake manifold

Tuning Flap – 911 Carrera/S (997)

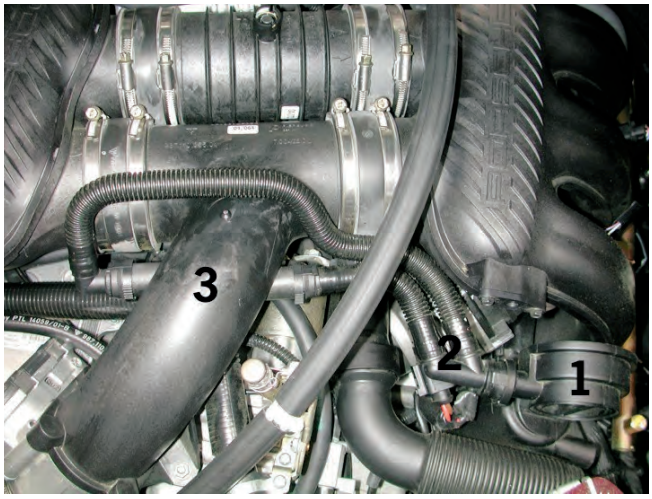
The resonance intake system is a two-stage version through the switchable tuning flap between the intake distributors inside the perpendicular resonance pipe. This switchable, two-stage resonance intake system can be used to adjust the air oscillations in the intake system to the respective engine speeds to ensure high torques even at low rpms, an even torque curve and high maximum output. This is achieved by having the tuning flap closed at full throttle between 2,600 rpm and 5,100 rpm, but open at lower and higher rpms.

Hot Film Mass Air Flow Sensor HFM 5 – 911 Carrera/S (997), Boxster/S (987) & Cayman/S (987)

The HFM 5 hot film mass air flow sensor with the C-shaped air duct was adopted from the previous model.

Crankcase Ventilation – Boxster/S (987) & Cayman/S (987)

The hose routing for the crankcase ventilation system has been altered. Downstream of the oil separator, the crankcase ventilation system is routed to either side of the double low distribution pipe, so as to attain identical mixture formation for bank 1 and bank 2 when the distribution pipe flap is closed.



1 - Oil separator
2 - Split line to distribution pipe
3 - Double-flow distribution pipe

The ventilation hose of the tank vent valve leads directly behind the electronic throttle into the distribution pipe from below.

Crankcase Ventilation – 911 Carrera S (997)

The crankcase ventilation system and oil spray collector have been revised to take account of the increased requirements of the 3.8 liter engine. The ability of the system to remove engine oil from the crankcase vapors has been improved. The cleaned ventilation gases are then routed behind the throttle to the intake system.

Vacuum Pump – 911 Carrera/S (997), Boxster/S (987) & Cayman/S (987)

All engines both use a mechanical vacuum pump with a tandem design instead of a conventional vacuum amplifier to provide the vacuum for the brake booster and for activation of the switching elements on the engine and gearbox side (e.g. the tuning flap of the intake system). This pump will provide sufficient vacuum regardless of loads.

Notes:

Exhaust System/Emission Control – Boxster/S (987) & Cayman/S (987)

Sound/Acoustics

The Boxster/S (987) and Cayman S (987) are recognizable by a typical Porsche load related exhaust note both outside and inside the vehicle and has been brought into line with regulatory vehicle noise limitations. Porsche engineers have managed to comply with all worldwide noise regulations. Suppressing wind and tire noises has allowed greater emphasis to be placed on the engine sound. The insulation (for the passenger compartment) has been developed to optimize the typical Porsche interior sound while retaining the interior noise level. The absorbing effect of the components has been improved without fundamentally impairing the insulating effect through the selective use of new insulating materials. One of the goals in adjusting the passenger compartment sound has been to reduce background noise in the higher frequency range and to emphasize more strongly the sporty, load-related exhaust note and intake sound between 300 and 600 Hz.

Exhaust Emission Standard

Boxster/S (987) and Cayman/S (987) comply with exhaust emission standard EU4, and in the USA with TIER 2 (FED).

Exhaust System – Boxster/S (987)

The Boxster (987)/Boxster S (987) both feature a totally new exhaust system. Heat resistant damping elements between the exhaust system and the engine system serve to damp all drive related vibration (e.g. idling, component, engine vibrations) and provide for a particularly smooth running engine, which is conducive to comfort. Also, exhaust system vibrations caused by driving on "washboard" road surfaces (due to reduced torsional rigidity) are reduced by the Stop Shock elements used to suspended the exhaust system in the area of the mufflers.

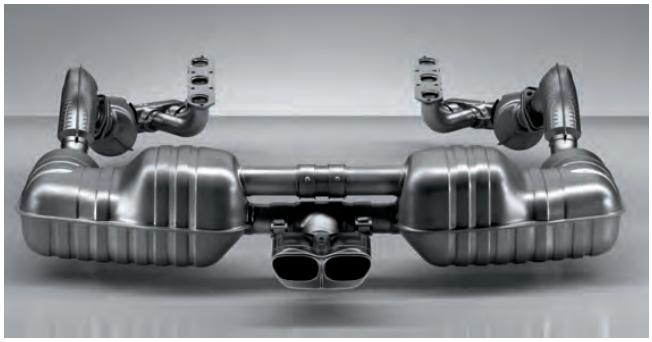


Stop Shock Element

Through the use of thin wall technology for the pipes and catalytic converters (wall thickness of 1.2 mm instead of 1.5 mm) and for the mufflers (double wall technology with 2 x 0.5 mm instead of 2 x 0.75 mm), the weight of the new exhaust gas systems has been reduced by approx. 9.1 lbs (4.15 kg). The exhaust gas system possesses larger cross-sections and a resultant lower level of exhaust back pressure, which has a positive effect on power output.

Notes:

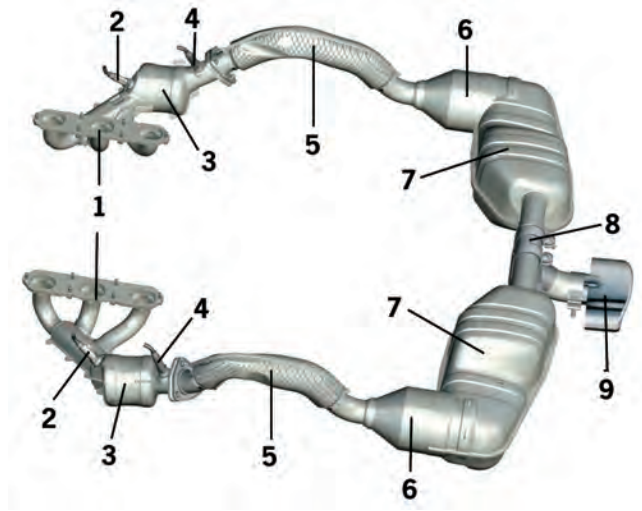
Exhaust System – Cayman S (987)



The dual-flow exhaust system of the Cayman S possesses large cross sections and a resultant lower level of exhaust back pressure. The improvement in the gas cycle has led to higher power output.

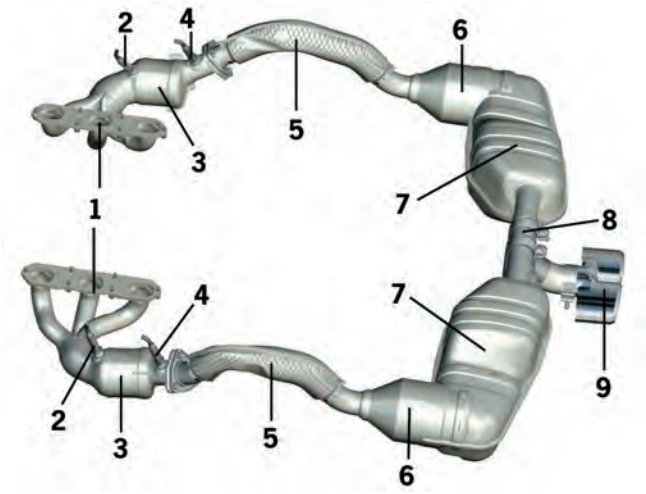
The weight of the exhaust system has been optimized through the use of thinwall technology for the pipes, catalytic converters and the silencer. Heat-resistant damping elements between the main muffler and the engine system serve to damp all drive-related vibration (e.g. idling, component, engine vibrations) and provide for a particularly smooth running engine.

Exhaust System Components – Boxster/Cayman (987)



1 - Standard exhaust manifold
2 - LSU wideband Lambda probe
3 - Pre-catalytic converter
4 - LSF Lambda probe
5 - Front pipe insulation ceramic matting lamination
6 - Main catalytic converter
7 - Mufflers
8 - Connecting pipe
9 - Individual tailpipe cover

Exhaust System Components – Boxster S (987) & Cayman S (987)



1 - High performance exhaust manifold
2 - LSU wideband Lambda probe
3 - Pre-catalytic converter
4 - LSF Lambda probe
5 - Front pipe insulation ceramic matting lamination
6 - Main catalytic converter
7 - Mufflers
8 - Connecting pipe
9 - Individual tailpipe cover

Exhaust Manifold – Boxster/Cayman (987)

On the 2.7 liter engine it has been possible to adapt the standard manifold from the the M.Y. 2004 2.7 liter engine, which is designed in accordance with the engine's torque and power characteristic, as a lower level of raw emissions applies here (on account of the displacement) and required exhaust emission levels are attained without additional pre-mixing. The pre-catalytic converter is integrated in the standard manifold.

Exhaust Manifold – Boxster S (987) MY 2005-2006

Compared to the standard manifold of the 2.7 liter engine, the new high performance manifold on the Boxster S engine permits better mixing and therefore better preconditioning of the raw emissions before they are converted in the catalytic converter. An improved gas cycle additionally results in a marked increase in performance. The pre-catalytic converter is integrated in the high performance manifold.

Exhaust Manifold – Boxster S (987) MY 2007, Cayman S (987)

The engine of the Cayman S incorporates an exhaust manifold designed in accordance with the engine's torque and power characteristic. The pre-catalytic converter is integrated in the standard manifold.

Pre-catalytic Converter/Main Catalytic Converters

The use of modern catalytic converter technology with ceramic pre and main converters ensures optimum emission control values and reduced weight, as-well-as greater temperature durability. Front pipe insulation between the pre and main converter shortens the light off time of the main converters and limits the level of heat radiated into the luggage compartment.

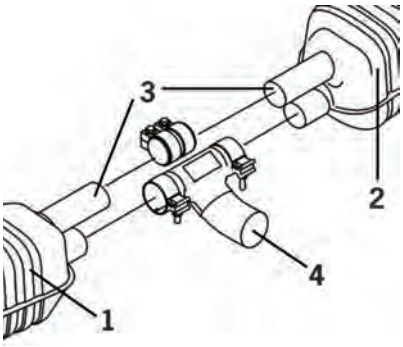
In order to ensure that the pre-catalytic converter is heated up rapidly and that the conversion of pollutants begins quickly (the converters' light off point has been lowered to approx. 660° F/350° C), the pre-catalytic converter is relatively small, with a diameter of approx. 102 mm and a length of approx. 75 mm. The downstream main catalytic converter, which has been integrated in the main muffler for reasons of space, has a diameter of 118 mm and a length of 90 mm.

Mufflers

There is no need for different muffler versions for vehicles with manual transmission and vehicles equipped with Tiptronic S. Different front pipe dimensions are necessary on the Boxster (987) 2.7 and Boxster S (987) 3.2 liter engines, due to the different (displacement-related) gas dynamics. The mufflers for the 3.4 liter engines have been adapted accordingly.

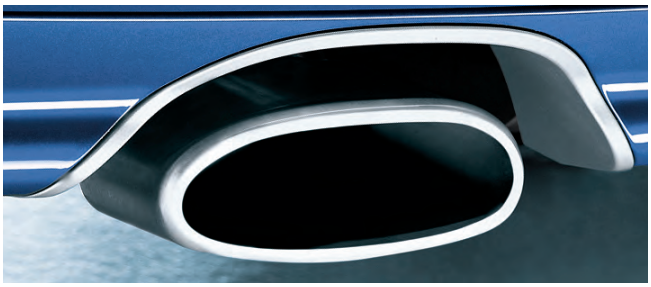
Muffler Connecting Pipe

Mixing of the exhaust gases between the right and left mufflers takes place by way of a connecting pipe (as the cross coupling point). This cross coupling point helps to produce the ideal sound.



1 - Left muffler
2 - Right muffler
3 - Connecting pipe (cross coupling point) for left and right mufflers
4 - Tailpipe

Boxster (987) Tailpipe Cover



Restyled oval individual tailpipe cover in a brushed surface finish.

Boxster S (987) Tailpipe Cover



Twin tailpipe cover with brushed surface finish.

Cayman (987) Tailpipe Cover



Restyled oval individual tailpipe cover in a brushed surface finish.

Cayman S (987) Tailpipe Cover



Dual tailpipe cover with brushed surface finish.

Exhaust System/Emission Control – 911 Carrera/S (997)

Sounds/Acoustics

The 911 Carrera and the 911 Carrera S are intended to be indentifiable as a Porsche by their load-related sound from the outside as well as from the inside of the vehicle. This goal has of course been brought into line with statutory requirements. Porsche engineers have managed to comply with all legal regulations worldwide. Reducing wind and tire noises has allowed greater emphasis to be placed on the engine sound. The 911 Carrera and the 911 Carrera S supply a sound typical of Porsche vehicles in every imaginable situation.

Exhaust Emission Standard

The 3.6 liter as well as the 3.8 liter engines both fulfill the EU4 exhaust emission standard as well as the LEV in the USA.

Exhaust System

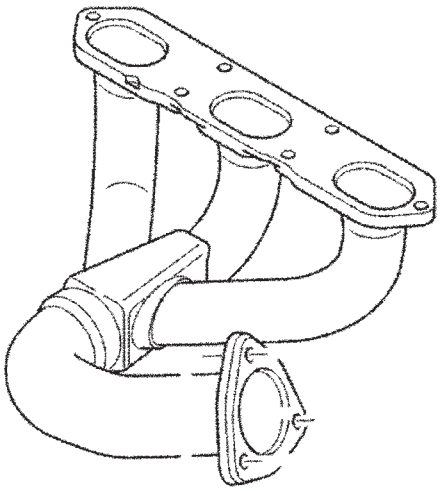
The construction of the exhaust system of the 911 Carrera (997) and the 911 Carrera S (997) is as same as that of the 911 Carrera (996), model year 2004, including manifold, catalytic converter and mufflers.



Using thin-wall technology for the pipes, catalytic converters and mufflers have permitted a reduction in weight of approx. 12 lbs (5.5 kg) in comparison with the 911 Carrera (996) model year 2004.

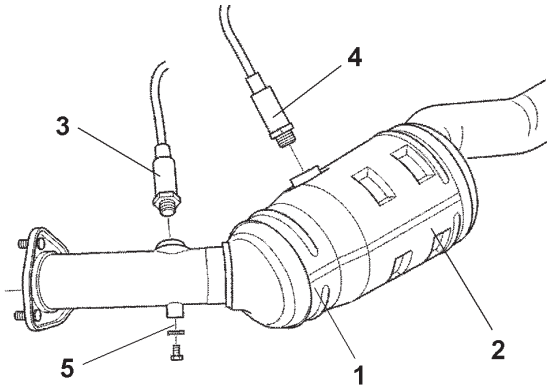
High Performance Manifold – 911 Carrera S (997)

The high-performance manifolds of the 3.8 liter engine permit optimum mixing and hence better preconditioning of the emissions before they are passed on to the catalytic converter.



Catalytic Converters

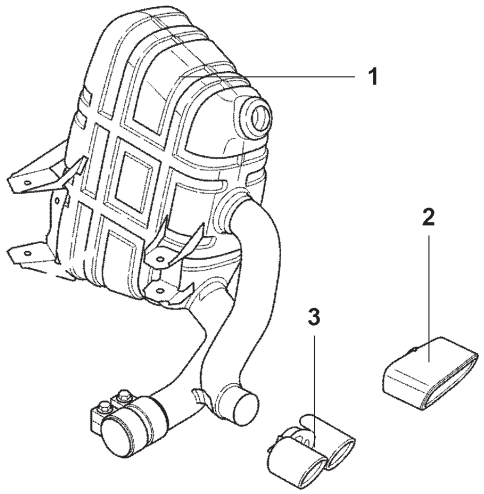
Two-stage catalytic converters (cascade catalytic converters) with pre- as well as main catalytic converters are employed worldwide.



1 - Pre-catalytic converter
2 - Main catalytic converter
3 - Oxygen sensor LSF in front of catalytic converter
4 - Oxygen sensor LSF behind catalytic converter
5 - Measurement point in front of catalytic converter

Muffler

To comply with the country-specific noise regulations, three different country variants of the mufflers are used.



1 - Muffler
2 - 911 Carrera (997) tailpipe trim
3 - 911 Carrera S (997) dual tailpipe trim

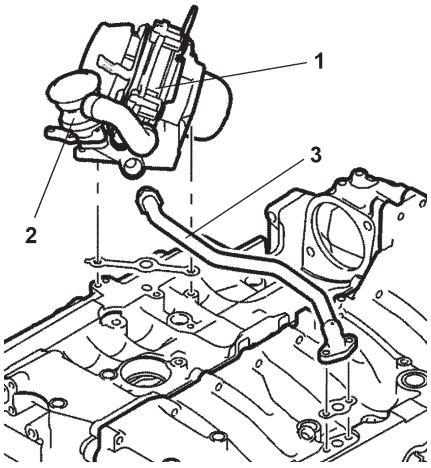
Tailpipe Trim

Distinguishing features of the 911 Carrera (997) and the 911 Carrera S (997) are the different tailpipe trims. Two newly shaped single tailpipes are installed in the 3.6-liter engine, the 3.8-liter engine of the 911 Carrera S has two dual tailpipes.

Notes:

Secondary Air Injection – 911 Carrera/S (997), Boxster/S (987) & Cayman/S (987)

Secondary air injection is activated by the Motronic control module. The air supplied by the secondary air injection opens the check valve when the pressure exceeds 80 mbar, the air is then blown through the lines to behind the exhaust valves of the respective cylinder heads.

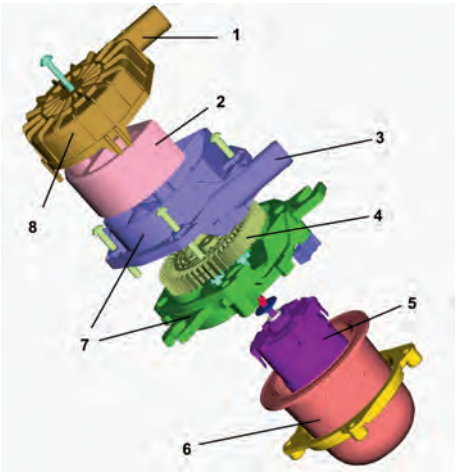


1 - Secondary air pump
2 - Check valve
3 - Air line to opposite cylinder bank

The injection of secondary air leads to a reduction of the CO and HC pollutants that are increased by operating with Lambda < 1 while the engine is operated in cold start mode. Additionally, the catalytic converters achieve their activation temperature of approx. 662° F. (350° C.) more quickly due to the waste heat created during the afterburning. Activation conditions are achieved during the first cold start process if the coolant temperature is between 14° F. (–10° C) and 107° F, (42° C.). When running close to idle speed, secondary air injection is active for approx. 60 seconds, for a partial load up to 80 seconds.

If during secondary air injection an intake air mass of approx. 732 lbs per hour (332 kg per hour) is exceeded, the secondary air injection is deactivated.

Internal Design of Secondary Air Injection Pump



1 - Intake air side
2 - Air filter
3 - Outlet (pressure side)
4 - Impeller
5 - Electric motor
6 - Motor housing
7 - Impeller housing
8 - Air filter housing

Infinite Fan Control – 911 Carrera/S (997), Boxster/S (987) & Cayman/S (987)

An infinite fan control for the radiators has been introduced to sports cars. This new feature permits infinite control of the fan speed depending on the coolant temperature and the system pressure in the air conditioning system instead of a two-stage control. The air volume required is calculated by the Motronic control module which transmits the information to the gateway control module via the CAN. Gateway then sends the signal to the front control module. The front control module activates the radiator fan control module using a pulse-width modulated (PWM) activation signal which activates the left and right radiator fans correspondingly via the power output.

This has the advantage of requiring less current and therefore creates less of a load on the vehicle electrical system. With staged control, when a temperature threshold was exceeded the next fan speed had to cover the entire allocated temperature range. With infinite control, the fan speed can be continuously adjusted to the actual requirement. This means that the fan speeds can often be reduced, thereby decreasing noise and vibrations.

Engine Compartment Blower – Boxster/S (987) & Cayman/S (987)

The engine compartment scavenging blower draws cooling air into the engine compartment through the opening on the right hand side (direction of travel). **The engine compartment scavenging blower is switched on and off at the following temperatures:**

Engine compartment temp.: ON at > 158° F (70° C),
OFF at < 131° F (55° C).
Coolant temperature: ON at > 216° F. (102° C),
OFF at < 210° F. (99° C).

It can also be activated at high intake air temperatures / ambient temperatures.

Engine Compartment Blower – 911 Carrera/S (997)

The engine compartment blower on the engine compartment lid is activated in two stages.

Stage 1 (permanent operation) is activated by the fuel pump relay as well as a change over relay and a shutoff relay. Behind the fuel pump relay, a resistance lead (limiting the power to approx. 10 watts) leads to the engine-compartment blower via the shutoff relay.

In stage 2, the engine-compartment blower is activated directly by the Motronic control module via the change over relay and the shutoff relay (power approx. 33W) depending on coolant temperature, engine temperature and a ratio between intake and ambient air temperature. Stage 2 is also activated during sporty acceleration when detected by the Motronic control module. Once temperatures fall below the respective temperature parameters, the engine-compartment blower is set back to stage 1.

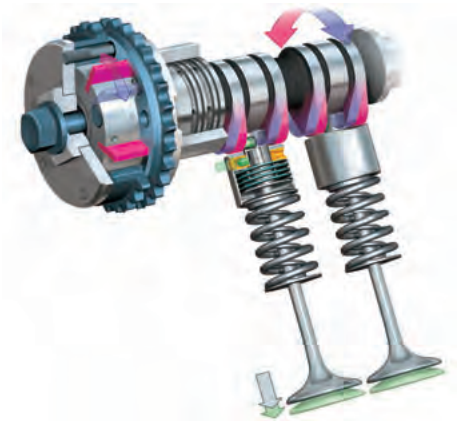
If the engine compartment lid is opened while the engine-compartment blower is active, the shutoff relay deactivates the engine-compartment blower. After the engine is switched off, the engine compartment temperature is monitored for approx. 30 minutes. During this period, and depending on temperature, the engine-compartment blower may continue to run or start to run.

If no reduction of temperature is detected after 5 minutes of the engine-compartment blower running in stage 2, the temperature warning light of the coolant temperature display in the instrument cluster starts flashing. Additionally, a “Failure – engine-compartment blower” warning is displayed in the on-board computer.

VarioCam Control – Boxster/S (987) MY 2005-2006

The Boxster (987) and Boxster S (987) engines use the familiar VarioCam camshaft adjustment system. This system features the familiar “vane-type adjusters”, via which map controlled adjustment of the timing of the intake camshafts is carried out. To improve gas exchange, the map for VarioCam in the Motronic control module has been retuned. This is instrumental to achieving the high specific output and torque values.

Activation of VarioCam Plus – Boxster/S (987) MY 2007, Cayman/S (987) & 911 Carrera/S (997)



The MY 2007 Boxster/Cayman 2.7 liter, Boxster/Cayman S 3.4 liter and the 911 Carrera 3.6 and 3.8 liter engines all use the VarioCam Plus camshaft adjustment system. It features the familiar 'vane type adjuster’ and 'switchable hydraulic tappet' control elements for adjusting the timing of the intake valves and switching the maximum valve lift of the intake valves between 3.6 mm and 11.0 mm controlled by a map in the Motronic control module. To improve volumetric efficiency, the map for VarioCam Plus in the Motronic control module was fine tuned. This contributes to achieving the high specific output and torque values.

Notes:

911 Turbo (997) Fuel & Ignition System

General

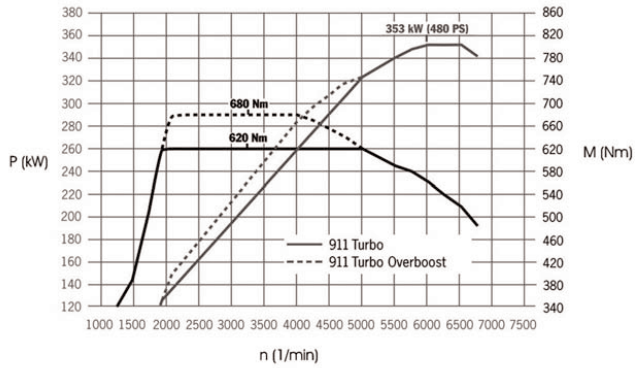
With the new 911 Turbo, Porsche is using a turbocharger with variable turbine geometry on an gasoline fueled engine for the first time. The new 911 Turbo demonstrates once again the pioneering expertise of Porsche, particularly in engine and drive engineering. Exhaust-gas turbocharging is the characteristic feature of a 911 Turbo. The new 911 Turbo sets new standards in the competitive arena with a turbocharging technology for gasoline engines which represents a new development for Porsche. The focus here is on new developments and modifications compared with the 911 Turbo (996). Additional detailed information can be found in the Service Information Technik booklets for the 911 Turbo (996), 911 Carrera (997) and 911 Carrera 4 (997).

Development Objectives

The goal for the new 911 Turbo was to maintain the leading position against the competition, particularly in the areas of Porsche's expertise.

The following modifications were made in Group 2 compared with the 911 Turbo (996):

- Use of a turbocharger with variable turbine geometry to improve response.
- Fuller torque curve, particularly in the lower rpm range.
- Increased maximum torque + 45 ft lb. (60 Nm) and + 90 ft lb. (120 Nm) with Overboost in conjunction with the option Sport Chrono Package Turbo).
- Increased engine power (+ 60 bhp).
- Significantly improved driving performance.
- Reduced fuel consumption.
- Low exhaust emissions (environment).



Key engine data:

n – Engine speed (rpm)
P – Engine power (kW)
M – Engine torque (Nm)

Max. power:	480 bhp (353 kW) at 6000 rpm
Max. torque:	460 ft lb. (620 Nm) at 1950 to 5000 rpm
with Overboost *:	505 ft lb. (680 Nm) at 2100 to 4000 rpm
Max. engine speed:	6750 rpm (6th gear 6800 rpm)
Idling speed:	740 +/– 40 rpm

* Only in conjunction with the "Sport Chrono Package Turbo" option

Motronic Control Unit ME 7.8.1

The further-developed Motronic control unit ME 7.8.1 is used worldwide. It is based on the ME 7.8 of the 911 Turbo (996) and the further development of the current 911 generation. The new Motronic control unit features a processor speed of 40 MHz with a memory capacity of 1 MB.

Electronic Accelerator Pedal Unit

The 911 Turbo (997) is provided with an electronic accelerator pedal unit from the current 911 (997) series.

DME Power Supply

The power supply of the DME control unit is the same as in the current 911 (997) series. The assignment of the fuse carrier, as well as relay carriers 1 and 2, can be found in the circuit diagram on the PIWIS Tester.

Starting The Engine

In order to start the engine it is necessary, after the ignition key has been identified, to fully depress the clutch pedal (vehicles with manual gearbox) or the brake pedal (Tiptronic vehicles). In Tiptronic vehicles, the selector lever must additionally be set to either “P” or “N”.

CAN Networking

As in current (987/997) models, electronic networking in the new 911 Turbo facilitates the exchange of data and electronic information between the various control units throughout the vehicle via the internal high-speed network, the CAN bus (Controller Area Network).

CAN Communication For The Motronic Control Unit (DME)

On the 911 Turbo (997), diagnosis of the DME control unit is performed for the first time via CAN.

The DME control unit communicates with the following control units via CAN:

- Gateway control unit
- Driver authorization control unit
- Tiptronic control unit
- PSM control unit
- PTM control unit
- Steering angle sensor
- Yaw velocity sensor
- Airbag control unit
- Air conditioning control unit

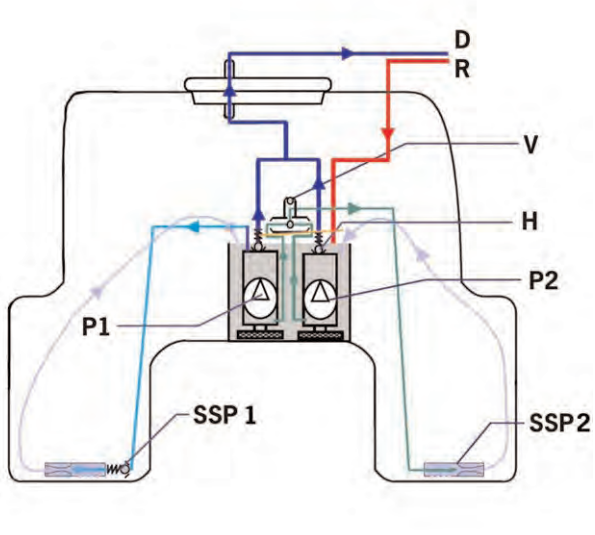
Fuel Supply

Fuel

The engine is designed for operation with unleaded Premium Plus fuel (RON 98), (RON 95 with restricted performance).

Fuel Tank

The tank of the new 911 Turbo corresponds to that of the current 911 Carrera 4 models. With a refill volume of approx. 17.6 gals. (67 liter), this has a capacity of approx. .75 gal. (3 liter) more than the tank of the 911 Turbo (996). The fuel level for the fuel reserve is 2.6 gals. (12 liters). The 911 Turbo (997) still has a return line from the pressure regulator in the engine compartment to the fuel tank. The battery and the battery tray must be removed in order to access the new position of the return line connection.



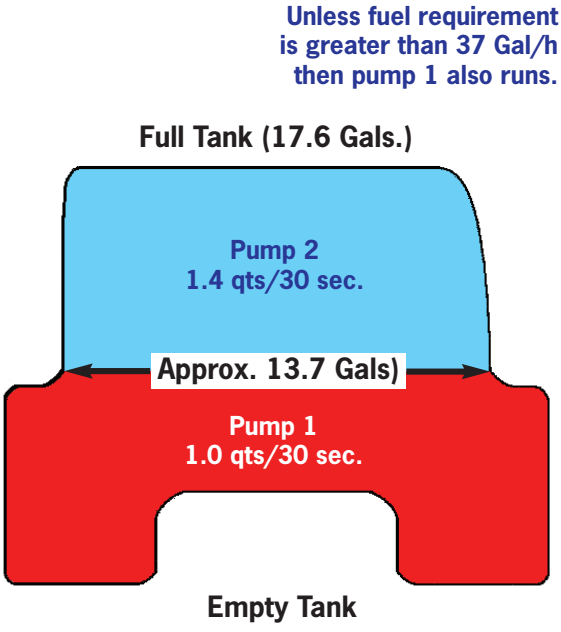
P1	Fuel pump 1
P2	Fuel pump 2
SSP1	Sucking jet pump, right
SSP2	Sucking jet pump, left
H	Pressure holding valve
V	Distributor valve
D	Pressure side to engine
R	Return line from pressure regulator

Fuel Pumps

The fuel tank of the 911 Turbo (997) has 2 fuel pumps which are integrated into the common pump chamber (tandem pump). The fuel pump 1 delivers 1 qt. (1.1 liters) in 30 seconds, and fuel pump 2 delivers 1.4 qts. (1.5 liters) in 30 seconds. The two fuel pump relays are activated as required by way of switching points in the DME control unit.

Fuel pump 1 runs with a tank content of less than 13.7 gal. (52 liters). Fuel pump 2 is activated when a computed fuel requirement of greater than 26 gal/h (100 l/h).

Fuel pump 2 runs with a tank content of greater than 13.7 gal (52 liters). Fuel pump 1 is activated when a computed fuel requirement of greater than 37 gal/h (140 l/h).
The fuel is pumped out of the tank pockets by the two sucking jet pumps. The high-pressure sucking jet pump on the right side of the vehicle is supplied only by fuel pump 1. The low-pressure sucking jet pump on the left side of the vehicle is operated by one or both pumps depending on the fuel level and load condition. The quantity of fuel delivered by both fuel pumps can be checked as described in the Technical Manual.



Fuel Filter



The fuel filter is located on the left-hand side of the engine compartment and must be changed every 60,000 miles (90,000 km) or after 6 years.

Fuel Pressure Regulator

The fuel pressure regulator is installed on the fuel distributor rail on the right (cylinder row 4 - 6 or bank 2) in the engine compartment. A return line runs from the fuel pressure regulator to the fuel tank. The Technical Manual describes how to check the fuel pressure. The holding pressure should be > 29 psi (2 bar) after 1 hour.

Notes:

New EV-14 ST Injection Valve



The advanced EV 14 ST Extended Tip injection valve from the EV series is used. This new 6-hole injection valve has another injection point located in the intake pipe, which results in an even better mixture preparation and therefore a reduction in emissions.



Tank Ventilation System

The compact tank vent valve (TEV-5) in the engine compartment is designed for a higher throughput, especially in the case of small pressure differences compared with the previously installed valve (TEV-2). The tank vent line is routed directly from the tank vent valve into the intake pipe.

Carbon Canister

The functionality of the tank vent systems/carbon canister corresponds to that of the 987/997 vehicles. USA vehicles have a carbon canister with tank leakage diagnostic module (DM-TL) which is located in the front luggage compartment.

Ignition System

The individual ignition coils and spark plug connectors are the same as for the previous model.

Spark Plugs

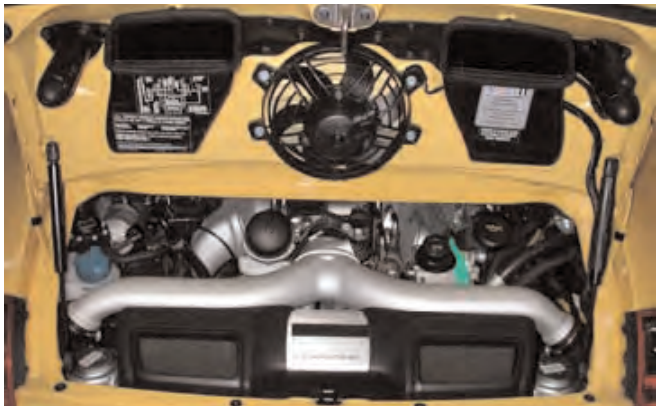


New spark plugs are installed. These double-platinum spark plugs (center and ground electrodes are made of platinum) operate in accordance with the air gap principle. The change interval for the spark plugs is 40,000 miles (60,000 km) or after 4 years.

Notes:

Intake Air Side, Air Routing

Rear Lid



The inner part of the lid has two separate intake ducts which are routed to the air cleaner housing.

Air Cleaner

The air cleaner housing and the air cleaner element were newly developed for the new 911 Turbo. The air cleaner housing was lined inside with foam in order to obtain an optimum intake sound. It was possible to reduce the intake resistance and optimize the charge cycle by way of the 2-channel intake via the rear lid, the new air cleaner element and two separate intake pipes to the turbochargers on the left and right.

In addition, it was also possible to reduce the frequency of cleaner replacement. The air cleaner element now has to be replaced only every 40,000 miles (60,000 km) or after 4 years. The top part of the new air cleaner (housing) has been provided with a design cover made of aluminium to visually upgrade the engine compartment. This cover is embossed with the logo “VARIABLE TURBINE GEOMETRY”.

2 Hot-film Mass Air Flow Sensors HFM 5-6.4



One hot-film mass air flow sensor HFM 5-6.4 is located in each of the turbocharger intake pipes on the left and right behind the air cleaner. The mass air flow sensors are matched to the overall air mass of the engine. Each of the two mass air flow sensors can measure an air mass of up to 800 kg/h.

Diverter Control



When the throttle is closed quickly (deceleration), the boost pressure increases in the pressure system in front of the throttle because the compressor of the turbocharger continues running. The new 911 Turbo (997) is also equipped with a diverter valve for each cylinder bank to blow off the excess boost pressure. In contrast to the 911 Turbo (996), however, this is not accommodated separately, but is integrated in a space-saving and compact manner in the compressor housing of the turbocharger. The Motronic control unit activates the electro-pneumatic switching valve, which then opens the diverter valve by means of a vacuum.

Charge Air Cooling

Flow Duct To Charge Air Cooler

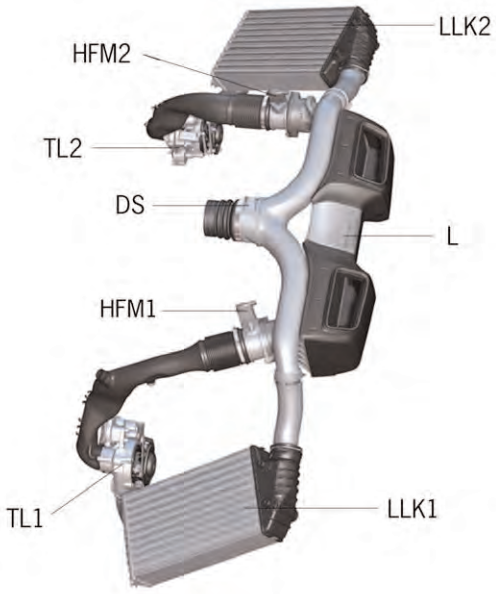


The inlet trim elements in the rear side panels were modified. These possess a characteristic design for the new 911 Turbo, including an additional bar in the middle of the inlet duct. The form and position of this bar were specially designed, and the bar does not hamper air flow into the flow duct in spite of the slight reduction in the cross-section of the inlet. In addition, the manufacturing method for the plastic parts was modified to achieve an increased duct cross-section with lower production tolerances. The result is a reduction in flow resistance by approx. 10 % combined with a higher air throughput.



Charge Air Coolers

The charge air coolers have been further developed compared with the 911 Turbo (996) and the air flow onto the cooler surfaces improved. The result is more efficient charge air cooling and therefore higher power and torque values.



L - Air cleaner
HFM 1 - Mass air flow sensor, left
HFM 2 - Mass air flow sensor, right
TL 1 - Turbocharger, left
TL 2 - Turbocharger, right
LLK 1 - Charge air cooler, left
LLK 2 - Charge air cooler, right
DS - Boost pressure sensor

Outgoing Air Routing Through The Rear Apron



The outlet openings for the outgoing air of the charge air coolers were provided with a new design in the completely newly developed rear apron.

Boost Pressure Sensor/Intake Air Temperature Sensor



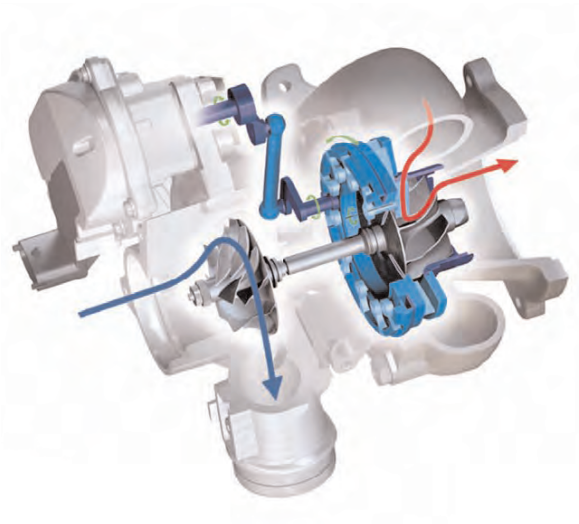
The boost pressure sensor measures the pressure upstream of the throttle adjusting unit (electronic throttle) as well as the air temperature before the air enters the intake system, and supplies this information to the DME control unit. The boost pressure is controlled by way of the position of the vanes in the turbocharger. Throttle adjusting unit (electronic throttle) The throttle adjusting unit (electronic throttle) has a diameter of 74 mm.

Intake System



Both the intake pipes from the air cleaner to the turbocharger and the pressure pipes from the turbocharger to the throttle were modified with respect to their flow properties and the flow resistances reduced. The intake distributor is still made of plastic and is now produced in one piece. Compared with the intake distributor of the 911 Turbo (996) with a separate intake pipe support made of aluminium, the one-piece design offers weight advantages and improved flow transitions to the cylinder head. In addition, the dimensioning of the intake distributors was adapted to the new turbocharger concept. The intake distributor of the new 911 Turbo has a silver paint finish to improve the engine compartment design. A weight saving of approx. 4.4 lbs. (2 kg) was achieved for the intake system compared with the 911 Turbo (996).

Turbocharger With Variable Turbine Geometry



The exceptional driving performance is due above all to the newly developed turbocharger technology of the six-cylinder engine. By using extremely high-temperature resistant materials, it was possible to develop an exhaust turbocharger with variable turbine geometry which is capable of withstanding the high exhaust temperatures produced by gasoline fueled engines of up to 1832° F (1000° C). A turbocharger with variable turbine geometry combines the respective advantages of small and large turbochargers, and permits optimum utilization of the exhaust energy for charging at any engine operating point; in addition, there is no longer any need for wastegate valves.

The result of the new technology is a significant increase in torque and performance: the opposed cylinder engine delivers 480 bhp (353 kW) at 6,000 rpm, 60 bhp (44 kW) more than the engine of the previous model, and this with an unchanged displacement of 3.6 l. At the same time, the nominal torque increases from 415 ft lbs (560 Nm) to 460 ft lbs (620 Nm) in a much wider rpm range: On the new Turbo, the maximum value is now in the range between 1,950 and 5,000 rpm.

Variable Turbine Geometry

The greatest development potential for exhaust turbochargers is solving the conflict between good response at low engine speeds and high specific performance values at high engine speeds. Variable turbine geometry with variable vane adjustment in front of the turbine wheel has shown itself to be the optimum solution for further improving turbocharger response and thereby the response of the turbocharged engine.

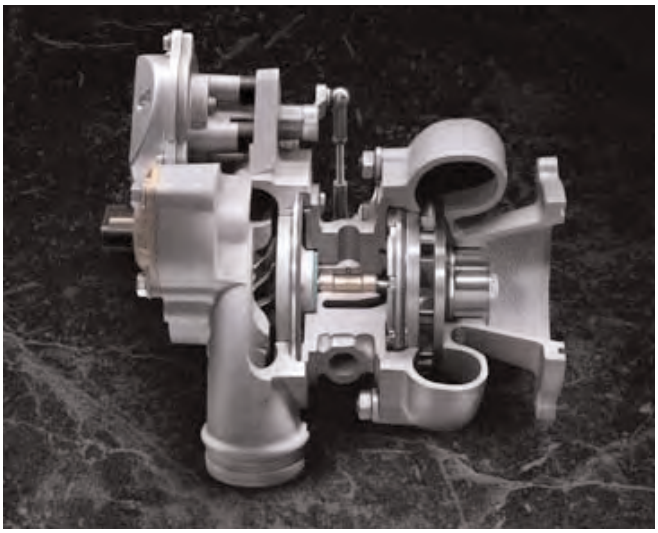
The new 911 Turbo with variable turbine geometry again sets new standards for Otto engines with exhaust turbocharging.

Technical Challenge

The design of variable turbine geometry is based on adjustable vanes which guide the exhaust mass flow from the engine onto the turbine of the turbocharger in a variable and targeted manner. The use of variable turbine geometry for Otto engines is made more difficult by the significantly higher exhaust temperatures. Compared with temperatures of approx. 1472° F (800° C) in the case of diesel engines, the maximum exhaust temperatures at the turbine inlet on Otto engines with exhaust turbocharger are significantly higher at approx. 1832° F (1,000° C). This leads to considerable additional stressing of the material and high demands on design realization. The delicate adjusting elements of the vanes in the hot exhaust stream are particularly critical. In addition to the high-temperature resistance of individual components, it is also necessary to take into account high temperature fluctuations in design.

In view of a possible temperature range from cold starting at -20 F (-30° C) up to a maximum regulated exhaust temperature (at the turbine inlet) of approx. 1832° F (1,000° C), it is necessary to take into account the different material expansion factors and safeguard the functioning of the entire adjustment system, including the many individual components. This is guaranteed, by selection of suitable materials, oil cooling, as well as by additional water cooling of the bearing housing. This can be activated via the Motronic system by an electric coolant pump both at low speed (< 2,000 rpm) combined with high coolant temperature (> 208° F/98° C) as well as after the engine is switched off.

Technical Principle



On the new 911 Turbo, the boost pressure is controlled only by adjusting the vanes (without bypass valve). This is done by way of an adjusting ring, which is actuated by an electric servo motor via a coupling rod (one "boost pressure adjuster" per turbocharger).

Notes:

Small turbochargers have good response characteristics (small "turbo lag") due to the small acceleration mass of the turbine wheel and the high flow momentum of the exhaust gas. This momentum is generated in the turbine housing in the transition to the turbine wheel by way of small flow cross-sections with high flow speeds. However, the small flow cross-sections in both the turbine housing and turbine wheel increase the flow resistance for high air throughputs and therefore high engine speeds, and also produce high exhaust backpressures ("choking"). As a result, the maximum engine power is limited.

Large turbochargers have poor response characteristics (large "turbo lag") due to the high acceleration mass of the turbine wheel and the low flow momentum of the exhaust gas. In contrast to small turbochargers, however, the exhaust backpressures are lower for high air throughputs due to the larger flow cross-sections in the turbine housing and turbine wheel. This results in less exhaust work for the pistons, as well as an improved charge cycle with a lower residual gas amount in the cylinder and better cylinder filling, for example. This results in a higher maximum engine power.

Vane Adjustment System

The principle of variable turbine geometry is essentially based on the following two physical characteristics:

- Variable vane gap
- Variable air impact angle

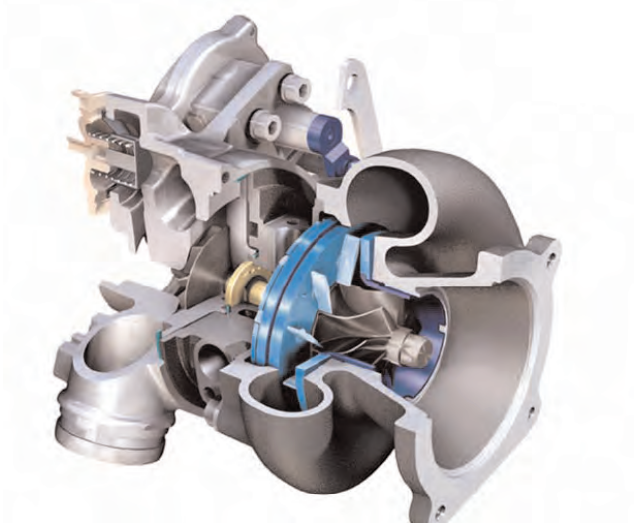
The adjustment system with adjusting ring and movable vanes is the mechanical heart of an exhaust turbocharger with variable turbine geometry. It consists of 11 adjustable vanes which are interconnected by the adjusting ring. The adjusting ring is connected in turn via a coupling rod with the electric servo motor which is responsible for controlling adjustment of the vanes.

With variable turbine geometry, small turbochargers are simulated by closed vanes (small vane gap) and large turbochargers by open vanes (large vane gap). With the respective advantages, variable turbine geometry permits both very good response with high torque values even at low speeds, as well as high output values at high speeds. The high torque is therefore available for a significantly larger rpm range.

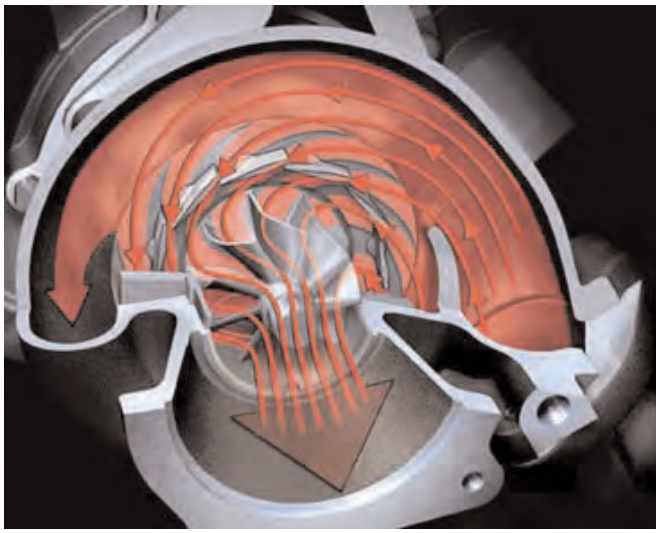
The variable vane gap is achieved by turning the adjusting ring and thus turning the vanes. A small vane gap reduces the flow cross-section. The resultant higher gas speeds mean that the exhaust gas is directed onto the turbine vanes with high momentum. The turbine wheel therefore rotates more quickly and drives the compressor wheel located on the same shaft. This in turn compresses the air which is supplied to the engine for combustion. As a result, the engine receives more air more quickly and accelerates more dynamically.

Vane Adjustment

Adjustment of the vane system and of the vane gap allows the exhaust mass flow to be directed onto the turbine wheel with maximum effectiveness for every operating point throughout the whole rpm range, thereby allowing the boost pressure to be adjusted to the corresponding setpoint value. This control technology combined with selection of a suitable turbine size makes it possible to dispense with the bypass valve (wastegate) usually required for engines with exhaust gas turbocharging. Adjustment of the turbine vanes does not just change the vane gap, it also changes the impact angle of the exhaust gas on the vanes. This variable impact angle assists the dynamic response of turbocharging using variable turbine geometry.

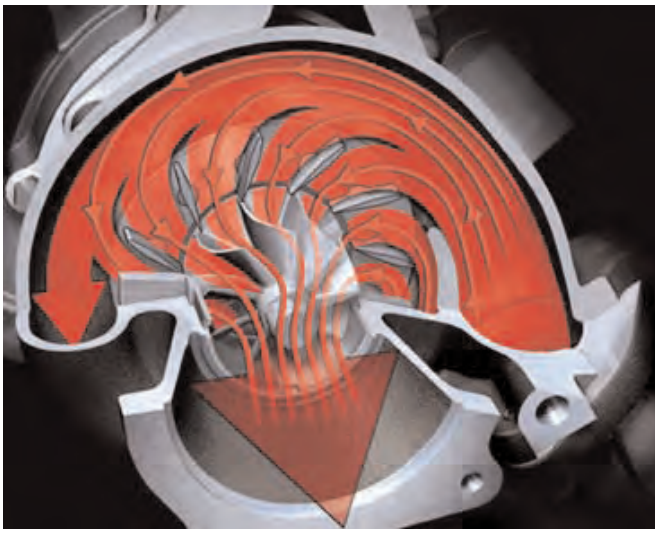


Vanes Closed



Small vane gaps do not just result in higher gas speeds in the vane gap. In this vane position, the impact angle of the exhaust gas on the turbine vanes is more direct and therefore produces higher angular momentum of the turbine wheel. If the vanes are closed at low engine speeds, the exhaust gas is accelerated in the small air gap and impacts on the turbine wheel radially with high energy. As a result, the compressor wheel located on the same shaft is accelerated quickly and increases the boost pressure. This in turn leads to good response characteristics of the turbocharger and thus high dynamic engine and vehicle acceleration.

Vanes Open



If the exhaust mass flow increases (increasing engine speed and load), the vanes are opened by the DME control unit according to a control map when the desired (maximum) boost pressure is reached. The adjustment duration for the vanes from open to closed and vice versa is only approx. 100 milliseconds.

Notes:

Electric Boost Pressure Adjuster



A precondition for optimum functioning of a turbocharger with variable turbine geometry in conjunction with an gasoline fueled engine is adjustment or control by an electric boost pressure adjuster. This is bolted directly onto the turbocharger and actuates the above-described adjusting ring with the integrated, electronically controlled servo motor via a short coupling rod.

The most important advantages compared with the pneumatic adjusting devices used for diesel engines are as follows:

- Fast reaction time (delay max. 100 ms).
- Optimum response characteristics.
- Freely selectable vane position independently of the pressure in the system.
- Optimum control quality of the desired boost pressure.
- Control possible without overshoot.
- Optimum diagnosis and fault detection.

Design Of Electric Boost Pressure Adjuster

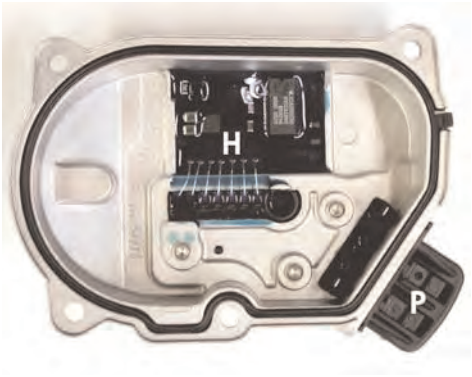


M - Electric motor (DC)
S - Sensor magnet
G - Spur gear drive

The boost pressure adjuster consists of an aluminium housing, which accommodates the DC motor with sensor magnet as well as a two-stage spur gear drive with a drive shaft/lever. A two-stage spur gear drive is connected between the DC motor and drive shaft. An aluminium cover with glued-in bonded hybrids and a screwed-in four-pin connector is screwed onto the housing. The hybrid electronic components are designed for an operating temperature from - 40° F (- 40° C) to 266° F (130° C).

Notes:

Position Sensor



A contactless incremental Hall sensor is used to detect the position of the output shaft. The hybrid electronics integrated in the adjuster housing is responsible for position control and control of the DC motor. The sensor magnet wheel is mounted on the DC motor shaft, while the sensor (pick-up) itself is located on the hybrid electronics. The main advantage of the contactless sensor is freedom from wear.

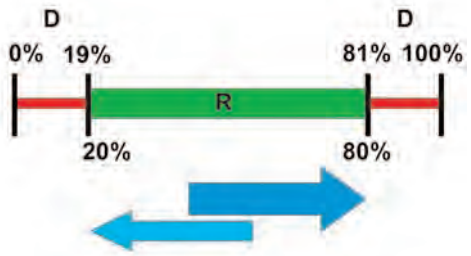
In addition to digital position control and related setpoint/actual value evaluation and driver control, the electronic components also perform actual value output as well as diagnostic and fault detection routines.

Each boost pressure adjuster is connected to the DME control unit by two signal lines. The DME control unit sends a setpoint (PWM signal) or special pulse/duty ratios (e.g. command to travel to and learn end stops) via one of the lines. The electric boost pressure adjuster then sends the actual value (PWM signal) and special pulse/duty ratios (self-diagnosis of electric adjuster for fault memory entry in the DME) to the DME via the other line.

Control By The Motronic Control Unit ME 7.8.1

Optimum adjustment angles are set by way of functions in the engine control unit depending on the engine operating point, so that the target engine torque is reached as quickly as possible. The optimum vane positions for maximum efficiency were determined for the complete engine map as part of extensive application work. The goal was above all to optimize the response behavior particularly for dynamic acceleration. Variable turbine geometry allows a full torque characteristic to be achieved even at low engine speeds and also provides a wide power spectrum in the nominal output range.

Diagnosis Of Electric Boost Pressure Adjuster



The electric boost pressure adjuster features an integrated diagnostic function which transmits a fault to the DME control unit by way of a corresponding pulse/duty ratio.

- The nominal mechanical adjustment range or control range (R) extends from 20 % (vanes open) to 80 % (vanes closed).
- The pulse/duty ratio is approx. 40 % when the ignition is switched on.
- The pulse/duty ratios 0 % to 19 % and 81 % to 100 % are special pulse/ duty ratios for diagnostic routines (D) and for teaching the adjusting device.

Boost Pressure Adjuster Test

When the ignition is switched on, the function "Test boost pressure adjuster" is available on the PIWIS Tester in the DME control unit under the system test function. A corresponding fault is entered after this test in the event of malfunctions.

In order to check functioning of the adjusting device, the electric boost pressure adjuster is supplied with a pulse/duty ratio of 16 % and 84 % after the ignition is switched off. The function test is also audible for the customer.

Teaching The Electric Boost Pressure Adjuster

It is necessary to perform adaptation of the electric boost pressure adjuster if a turbocharger or the electric boost pressure adjuster itself is replaced. When the ignition is switched on, the function "Boost pressure adjuster adaptation" is available on the PIWIS Tester in the DME control unit under the system test function. During this adaptation, the mechanical limit stops (20 % and 80 %) are taught again and stored in the boost pressure adjuster.

Adaptation Of Boost Pressure Control

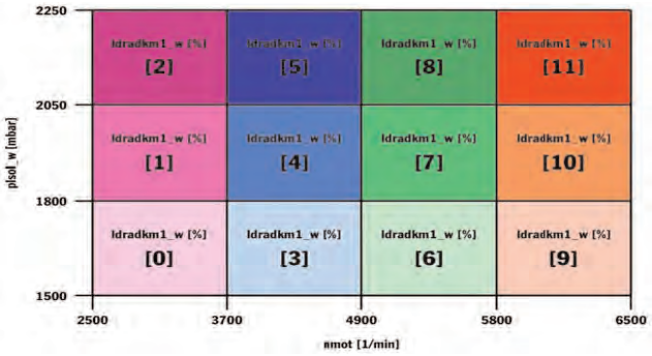
The boost pressure is a variable which is influenced by engine tolerances and ambient conditions. The following ambient conditions influence the boost pressure with respect to the maximum engine torque, protection of the engine and turbocharger as well as fault entries.

- Air pressure (the boost pressure is adapted from an altitude of
  > 5,900 ft (1,800 m) in order to protect the components of the turbocharger).
- Ambient temperature and intake air temperature (charge air temperature) (the boost pressure is reduced at an ambient temperature
  < approx. 32° F (0° C), or a charge air temperature < approx. 50° F.
  (10° C).
- Fuel quality (knock resistance under thermodynamic loading).

The adaption ranges 0 to 11 are available for boost pressure adaptation. These are divided into 3 load ranges (boost pressure) and 4 engine speed ranges. Adaptation of +/- 15 % is possible for each range before a fault is entered.

Notes:

Table Of Boost Pressure And Speed Thresholds



plsol – Boost pressure in mbar
nmot – Engine speed in rpm

Partial Load Adaptation

The adaptation ranges 0 / 3 / 6 / and 9 are available for partial load or reduced full load due to ambient conditions (e.g. poor fuel quality).

Full Load Adaptation

The adaptation ranges 1 / 4 / 7 / and 10 are provided for full load under normal conditions.

Full Load With Overboost

The adaptation ranges 2 and 5 are available for full load with Overboost (Sport Chrono activated). The adaptation ranges 8 and 11 are not normally adapted.

Sport Chrono Package Turbo (Optional)



The Sport Chrono Package Turbo is offered for the first time for the new 911 Turbo. The package contents correspond to those of the Sport Chrono Package Plus from the current 911 Carrera (997) generation, but are supplemented by the functions, Overboost , PTM control and modified starting program for the optional Tiptronic S.

The "Sport Chrono Package Plus" offers the driver distinctively sporty settings for various vehicle functions, therefore providing a completely new sporty driving experience. The accelerator pedal characteristic, engine behavior at the speed limit and in the event of load changes, PSM intervention thresholds as well as the characteristics of PASM and Tiptronic S are all changed at the push of a button. The Sport Chrono program also allows the driver to control these advantages as required to take into account contemporary conditions.

Additional Function – Overboost

Overboost is a brief excess increase in the boost pressure (max. 10 s) for acceleration under full load (fully depressed accelerator pedal). The function is activated after operation of the Sport button on the center console and fast depression of the accelerator pedal. Overboost is performed with the assistance of the boost pressure control and results in an increase in the maximum boost pressure by approx. 2.9 psi (0.2 bar) (20 %). As a result, the maximum torque is increased from 460 ft lb (620 Nm) to a maximum of 505 ft lb (680 Nm) between 2,100 rpm and 4,000 rpm (the torque is regulated linearly to the "normal" full-load value between 4000 and 5000 rpm) and permits a significant improvement in acceleration performance and elasticity. The higher boost pressure does not just result in an abrupt increase in mechanical loading of the components, but above all also significantly increases thermal stressing. This is due in particular to the continuously rising charge air and combustion chamber temperatures.

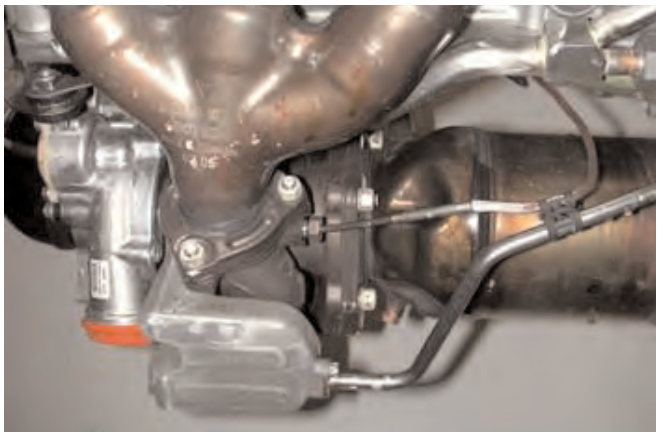
The Overboost function is restricted to 10 seconds in order to take these factors and the maximum component loading into account. After this time, the original full-load boost pressure without Overboost is restored. The Overboost function can be reactivated again as soon as the engine load is relieved briefly by the throttle closing (e.g. after a gearshift).



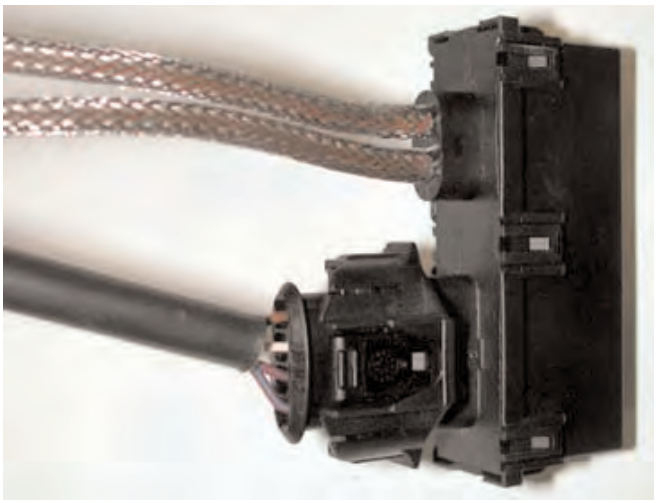
Overboost operation is indicated by an arrow symbol in the boost pressure display of the instrument cluster. The arrow next to the boost pressure display indicates the brief Overboost operation, which is possible only in conjunction with activated Sport function (text "SPORT" shown on display). The boost pressure indication is shown as a digital value and as a graphic representation in the multi-function display. The boost pressure can increase up to approx. 1.2 bar (17.4 psi) when the Sport button is pressed; a pressure of approx. 1.0 bar (14.5 psi) is reached when this function is not activated.

Notes:

Exhaust Temperature Sensors, Banks 1 and 2



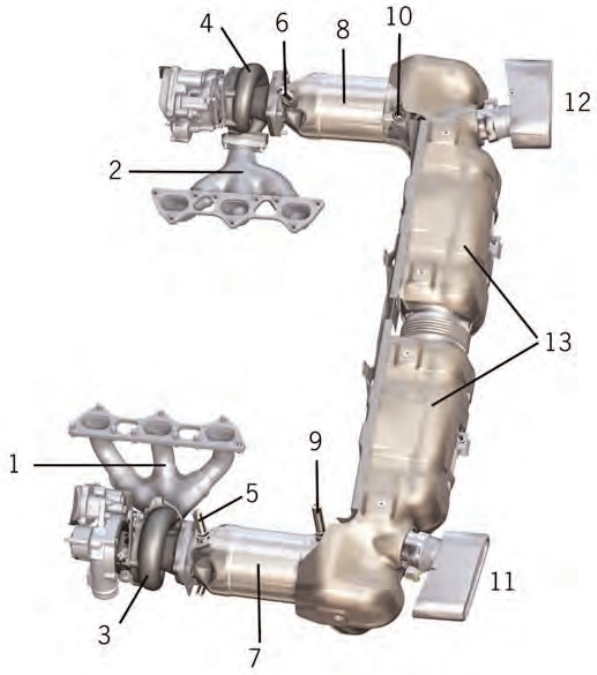
The signal from the exhaust temperature sensors of banks 1 and 2 installed at the turbine inlet is used in the DME control unit for component protection. The exhaust temperature is evaluated for each bank in the DME control unit, and is restricted to a maximum temperature of 1,767° F. (980° C) by enrichment or boost pressure adjustment. The two sensors are combined into one component unit together with their control unit. The measured signals are evaluated in this control unit.



The control unit sends a pulse/duty ratio (PWM) to the DME. The pulse/duty ratio range is from 4 % (corresponds to 25° F/- 4° C) to 96 % (corresponds to 2,030° F/1,110° C). The control unit has a self-diagnosis function. If the control unit detects a cable break/short-circuit to the sensor or in the evaluation circuit, it sends the special pulse/duty ratio of 98 % to the DME and this leads to an entry in the fault memory.

Exhaust System/Emission Control

The exhaust system has been partially newly developed. The new 911 Turbo complies with all worldwide emission regulations with a standard exhaust system. The weight was reduced by using thin-wall technology for the muffler and ceramic main catalytic converters. It was therefore possible to reduce the overall weight of the exhaust system by approx. 8.8 lb/4 kg (16 %) compared with the 911 Turbo (996).



1 – Air-gap insulated exhaust manifold left
2 – Air-gap insulated exhaust manifold right
3 – Turbocharger, left
4 – Turbocharger, right
5 – LSU broadband oxygen sensor, left
6 – LSU broadband oxygen sensor, right
7 – Ceramic main cat. converter, left
8 – Ceramic main cat. converter, right
9 – LSF step oxygen sensor, left
10 – LSF step oxygen sensor, right
11 – Tailpipe cover, left
12 – Tailpipe cover, right
13 – Muffler

Ceramic Main Catalytic Converter

It was possible to further improve the emission values by the use of state-of-the-art catalytic converter technology with one 3-way ceramic main catalytic converter for each cylinder bank and by improved secondary air injection after cold starting (Europe: EU4; USA: LEV II).

Tailpipe Covers



The rear apron of the new 911 Turbo was completed redesigned. In addition to modified side outlet openings for the outgoing air of the charge air coolers, the new 911 Turbo is also equipped with integrated exhaust tailpipes. The tailpipes were relocated to a higher position compared with the 911 Turbo (996), and are integrated in the rear apron of the new 911 Turbo as a distinguishing feature and characteristic design element – analogous to the Carrera GT. In order to protect the rear apron against the high temperatures of the exhaust tailpipes, a shield made of high-temperature-resistant plastic capable of withstanding temperatures up to 536° F (280° C) is installed in the area surrounding the tailpipe.

Secondary Air Injection

The function of the secondary air injection system, with one secondary air valve per cylinder bank, each of which is pressure opened by a pump, is the same as in the current 997 vehicles. The secondary air valves with additional check valve were adopted from Cayenne Turbo.

The following switch-on conditions apply to activation of secondary air injection when the engine is started for the first time:

- Engine temperature (coolant): 14° F (- 10° C) to 108° F (42° C).
- Time: Max. 120 seconds after engine start
- Mass air flow as switch-off condition:
  Secondary air injection is switched off after a time delay as from a mass air flow of > 200 kg/h.



S - Secondary air valve, left
V - Electrically operated switching valve for air recirculation control
P - Auxiliary electrical water pump

Notes:

VarioCam Plus

The new 911 Turbo (997) is provided with the latest development version of the variable valve control VarioCam Plus with continuous adjustment of the intake camshafts and valve lift switching of the intake valves. This system permits optimization of engine output and torque on the one hand and, on the other, also makes it possible to reduce fuel consumption and exhaust emissions while improving running smoothness.

Both individual systems of the VarioCam Plus (camshaft adjustment and valve lift switchover) are controlled by the Motronic control unit ME7.8.1. This control unit has been designed specifically for these requirements with a high processor capacity. This is necessary because the input values for “engine speed”, “accelerator pedal position”, “engine oil and water temperature” as well as gear speed detection are required to control VarioCam Plus. The demand for torque or power is compared with the stored program maps. A decision on how VarioCam Plus must react is made in milliseconds.

Camshaft Adjustment Of The Intake Camshafts

The 911 Turbo (997) features continuous adjustment of the intake camshafts by vane adjusters. The load and speed dependent adjustment range of the intake camshafts is 0 to 40 ° crankshaft angle.

Valve Lift Switching Of The Intake Camshafts

The small valve lift was increased from 3.0 mm (996) to 3.6 mm in order to make more efficient use of the advantages of VarioCam Plus with continuous camshaft adjustment and a larger adjustment range with respect to consumption, output and exhaust emissions. The valve lift adjustment system consists of switchable flat-base tappets on the intake side of the engine which are operated by means of an electrohydraulic 3/2-way switching valve.

Since there are two different cam forms on the intake camshaft, the corresponding valve lift curves act on the engine when the respective cams are switched. The flat-based tappets consist of two nested tappets which can be locked against each other by way of a pin. The inner tappet is in contact with the small cam and the outer tappet with the large cam. A hydraulic compensating element for the valve clearance is always integrated in the power flow of the tappet.

Cold Start

VarioCam Plus already significantly improves cold starting of the engine, and also allows emissions to be reduced during the warming-up phase.

Idle Speed

The engine is operated with the small intake cam (3.6 mm) at idle speed. Optimum timing is guaranteed thanks to fully variable camshaft adjustment. The small valve lift permits a reduction in fictional loss, a significantly increased charge movement thanks to the extremely short opening times, as well as lower emissions from previous combustions in the combustion chamber. This results in consumption and emission reductions of up to 10 % at the same time as significantly improved idling quality.

Partial Load

Operation with internal exhaust gas recirculation is optimum under partial load conditions for the purpose of dethrottling and in order to reduce the engine consumption. For this purpose, the camshaft phasing for the small valve lift is adjusted in order to achieve a large overlap, therefore allowing a large proportion of time for exhaust recirculation.

Full Load

In full-load operation, a high torque and high maximum output are achieved on the one hand through a low-loss charge cycle and, on the other, by an uncompromising cam contour design with a maximum valve lift of ten millimeters and correspondingly adapted opening and closing times of the valve strokes.

Positive Crankcase Ventilation

The positive crankcase ventilation and turbocharger ventilation are routed into the oil tank. In idling operation, the oil tank ventilation is routed to the intake manifold. Under full-load condition (with boost pressure), the oil tank ventilation is routed to the intake side of the left turbocharger.

Vacuum Pump

Like the current 911 Carrera (997) generation, the new 911 Turbo also has a mechanically driven vacuum pump that uses rotary vane technology. This replaces the conventional vacuum amplifier and provides the vacuum for the brake booster as well as various switching valves for the exhaust turbocharger (pop-off control) and the coolant. The vacuum pump is located on the left cylinder head, and is driven by the corresponding exhaust camshaft.

Electric Auxiliary Water Pump

The new Turbo is equipped with an electric auxiliary water pump which is installed on the left under the intake manifold. This pump can be activated as required by the DME control unit (also when the ignition is switched off) for the purpose of coolant circulation and in order to cool the watercooled turbochargers.

There are three conditions for auxiliary water pump activation:

1. Defined pump operation after engine start. 10 seconds after the engine is started, the pump runs for 10 seconds. This guarantees that the pump starts after every engine start, and therefore allows final stage diagnosis to be performed.
2. Support of cooling in an applied range during engine operation. The pump is switched on when the engine speed is < 2,000 rpm and the water temperature is > 208° F (98° C). It is switched off as soon as the engine speed exceeds 2,500 rpm or if the water temperature falls to below 203° F (95° C). Since both switch-on conditions are linked, it is sufficient if one condition is not satisfied for the pump to be switched off.
3. Cooling during control unit after running after the engine is switched off or stalled. The higher of the two exhaust temperatures is sent through a low pass filter with a filter time constant of 256 seconds. This filtered exhaust temperature value and the water temperature are the input variables which are evaluated in the DME control unit. On the basis of this information, the DME control unit calculates as the output variable the pump after-run time (function of engine temperature and filtered exhaust temperature) in seconds. The pump after-run time may be between 0 to 600 seconds, depending on the engine temperature (185° F/84.8° C to 248° F/120° C) and exhaust temperature (1,260° F/700° C to 1,922° F/1,050° C).

The engine oil temperature is routed through a different low-pass filter with a filter time constant of 64 seconds. This filtered engine oil temperature value and the water temperature represent the input variables for a different map. Output variable: Pump after-run time (function of engine water temperature and filtered engine oil temperature) in seconds.

The pump after-run time may be between 0 to 600 seconds, depending on the engine temperature (194° F/90° C to 248° F/120° C) and engine oil temperature (194° F/90° C to 302° F/150° C).

Example: The after-run time is 300 seconds for an oil temperature of 248° F (120° C) and a water temperature of 194° F (90° C). The engine compartment temperature and ambient temperature do not have any effect on these functions.

Notes:

Electric Fans

The 911 Turbo (997) is provided with a infinite fan control. The electric fans behind the radiators are controlled by the front-end control unit. The front-end control unit receives the information about the desired fan output (in %) via CAN from the DME control unit. The desired fan output is determined in the DME control unit on the basis of a program map as a function of the refrigerant pressure (CAN message from air-conditioning control unit) and engine water temperature. The requested output in % can be read out from the actual values with the PIWIS Tester (e.g. refrigerant pressure = 15 bar, tmot = 194° F (90° C) = > 50 %).

Engine Compartment Fan

The DME control unit switches the 2 relays for the engine compartment fan.

Stage 1 (with low fan speed) is activated from an engine compartment temperature of > 77° F (24.8° C).

Stage 2 (with full fan speed) is activated additionally from an engine compartment temperature of > 158° F (69.8° C) or a coolant temperature of > 221° F (105° C).

When the engine is stopped:

Stage 2 is activated for 180 seconds from an engine temperature of
> 163° F (72.8° C). The fan runs again for 180 seconds if the temperature is exceeded again. This continues until the temperature is no longer exceeded again or for a maximum of 40 minutes.

Notes:

Replacing Battery – 911/T (996) & Boxster (986)

Removing the battery

The requisite tool is in the tool kit.

The battery is located in the luggage compartment under a black plastic lid.

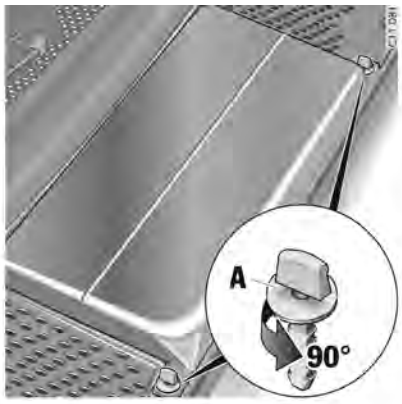
⚠ Warning!

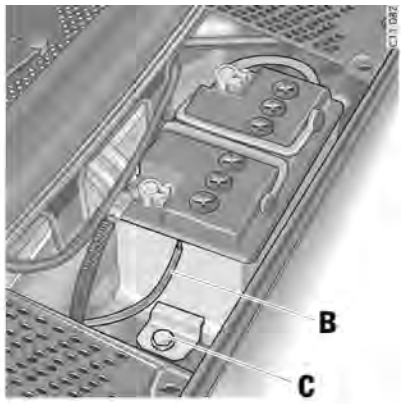
Risk of damage to alternator and electronic control units.

- ▷ Do not disconnect the battery while the engine is running.
  This also applies to cars equipped with a battery main switch.
- ▷ Never drive the car with a disconnected battery.

Risk of caustic burns from escaping acid.

- ▷ Keep vent caps on to avoid spillage.
- ▷ Do not tilt the battery when removing and installing it.





1. Switch off engine and all electrical loads.
2. Open turn-locks **A**.
   Remove plastic lid.
3. Pull off central vent hose **B**.
4. Important: disconnect the negative (–) ground wire first, and then the positive (+) cable – danger of short circuit!
5. Unscrew fastening screw **C**.
6. Remove battery.

Installing the battery

1. Put battery in.
2. Screw in fastening screw **C**.
3. Important: connect the positive (+) cable first, and then the negative (–) ground wire – danger of short circuit!
4. Push on central vent hose **B**.
5. Fit plastic lid. Lock turn-locks **A**.
6. Enter the radio code again.

Replacing Battery – 911/T (997), Boxster/Cayman (987)

Removing the battery

The required tool is in the tool kit.

The battery is located in the luggage compartment under a black plastic lid.

⚠ Warning!

Risk of damage to alternator and electronic control units.

- ▷ Do not disconnect the battery while the engine is running.
  This also applies to cars equipped with a battery main switch.
- ▷ Never drive the car with a disconnected battery.

Risk of caustic burns from escaping acid.

- ▷ Keep vent caps on to avoid spillage.
- ▷ Do not tilt the battery when removing and installing it.





1. Switch off engine and all electrical loads.
2. Open turn-locks **A**.
   Remove plastic lid.
3. Pull off central vent hose **C**.

⚠ Danger!

Risk of short circuit and explosion.

- ▷ Important: disconnect the negative (–) ground wire first, and then the positive (+) cable.

4. Unscrew fastening screw **B**.
5. Remove battery.

Installing the battery

1. Put battery in and push it all the way to the stop.
2. Screw in fastening screw **B**.

⚠ Danger!

Risk of short circuit and explosion.

- ▷ Important: connect the positive (+) cable first, and then the negative (–) ground wire.

3. Push on central vent hose **C**.
4. Fit plastic lid. Lock turn-locks **A**.

Emergency Starting with Jumper Cables

If the battery is discharged, e.g. in winter or after the car has been parked for a long time, the battery of another car can be used for starting with the help of jumper cables.
Make sure the voltage of both batteries is the same.
The capacity (Ampere hours, Ah) of the booster battery must not be substantially less than that of the discharged battery.
The discharged battery must be correctly connected to the vehicle's electrical system.

See the chapter "Battery" and "Emergency unlocking of the luggage compartment lid and engine compartment lid".

Note

- Do not try to start the car by pushing or towing. Damage to the catalytic converters and other components of the car may result.

⚠ Warning!

Risk of damage and serious personal injury due to short circuit.

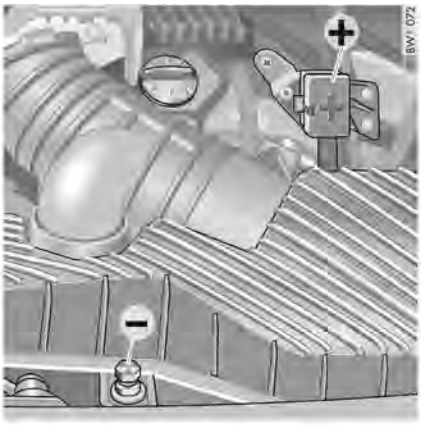
- Use only jumper cables of adequate diameter cross-section and fitted with completely insulated alligator clips.
- Follow all warnings and instructions of the jumper cable manufacturer.
- When connecting jumper cables, make sure that they cannot get caught in any moving parts in the engine compartment.
  The jumper cables must be long enough so that neither vehicles nor cables touch another.
- The vehicles must not be in contact, otherwise current might flow as soon as the positive terminals are connected.
- The cable clamps must not be allowed to contact each other when one end of the jumper cables are connected to a battery.
- Ensure that tools or conductive jewellery (rings, chains, watch straps) do not come into contact with live parts of the vehicle.
- Improper hook-up of jumper cables can ruin the alternator.

Danger of caustic burns.

- Do not lean over the battery.

Danger of gas explosion.

- Improper use of booster battery to start a vehicle may cause an explosion, resulting in severe personal injuries.
- Keep sources of ignition away from the battery, e.g. open flame, burning cigarettes or sparking due to cable contact or welding work.
- A discharged battery can freeze even at –10°C/14°F.
  Before connecting jumper cables, a frozen battery must be thawed out.



\+ = *Positive terminal for jump starting*
– = *Grounding point for jump starting*

Connect jumper cables in the following sequence:

1. Check electrolyte level of each cell. If necessary, fill with distilled water to just above plates.
2. On a vehicle with a discharged battery: turn off all consumers and accessories, move the gear shift lever into the neutral position and set the parking brake.
3. Open the cap of the positive terminal for jump starting (+).
4. Attach the **positive cable** first to the positive terminal for jump starting (+),
   then to the positive terminal of the booster battery.
5. Connect the **negative cable** first to the negative terminal of the booster battery,
   then to the grounding point for jump starting (–).
6. Run the engine of the booster car at a higher speed.
7. Start the engine.
   An attempted start using jumper cables should not last more than 15 seconds. Then allow a waiting period of at least one minute.
8. With the engine running, disconnect both jumper cables in reverse order.
   Close the lid of the jump start box.

Boxster/S (986)

Emergency Starting with Jumper Cables

See the chapter "Battery" and "Emergency unlocking of the luggage compartment lids".

If the battery is discharged, e.g. in winter or after the car has been parked for a long time, the battery of another car can be used for starting with the help of jumper cables.
Make sure the voltage of both batteries is the same.
The capacity (Ampere hours, Ah) of the booster battery must not be substantially less than that of the discharged battery.
The discharged battery must be correctly connected to the vehicle's electrical system.

Note

- Do not try to start the car by pushing or towing. Damage to the catalytic converters and other components of the car may result.

⚠ Warning!

Risk of damage and serious personal injury due to short circuit.

- Use only jumper cables of adequate diameter cross-section and fitted with completely insulated alligator clips.
- Follow all warnings and instructions of the jumper cable manufacturer.
- When connecting jumper cables, make sure that they cannot get caught in any moving parts in the engine compartment.
  The jumper cables must be long enough so that neither vehicles nor cables touch another.
- The vehicles must not be in contact, otherwise current might flow as soon as the positive terminals are connected.
- The cable clamps must not be allowed to contact each other when one end of the jumper cables are connected to a battery.
- Ensure that tools or conductive jewellery (rings, chains, watch straps) do not come into contact with live parts of the vehicle.
- Improper hook-up of jumper cables can ruin the alternator.

Danger of caustic burns.

- Do not lean over the battery.

Danger of gas explosion.

- Improper use of booster battery to start a vehicle may cause an explosion, resulting in severe personal injuries.
- Keep sources of ignition away from the battery, e.g. open flame, burning cigarettes or sparking due to cable contact or welding work.
- A discharged battery can freeze even at 14°F (–10°C).
  Before connecting jumper cables, a frozen battery must be thawed out.



A - *Booster battery*
B - *Discharged battery*

Connect jumper cables in the following sequence:

1. Check electrolyte level of each cell. If necessary, fill with distilled water to just above plates.
2. On a vehicle with a discharged battery: turn off all consumers and accessories, move the gear shift lever into the neutral position and set the parking brake.
3. Attach the **positive cable** first to the positive terminal **1** of the booster battery **A**, then to the positive terminal **2** of the discharged battery **B**.
4. Connect the **negative cable** first to the negative terminal **3** of the discharged battery **B**,
   then to a suitable earthing point **4** on the body of the vehicle with the booster battery.
   This earthing point must lie as far as possible from the battery.
5. Run the engine of the booster car at a higher speed.
6. Start the engine.
   An attempted start using jumper cables should not last more than 15 seconds. Then allow a waiting period of at least one minute.
7. With the engine running, remove both jumper cables in the reverse order.

Emergency Starting with Jumper Cables

If the battery is discharged, e.g. in winter or after the car has been parked for a long time, the battery of another car can be used for starting with the help of jumper cables.
Make sure the voltage of both batteries is the same. Both batteries must be 12 volt types.
The capacity (Ampere hours, Ah) of the booster battery must not be substantially less than that of the discharged battery.
The discharged battery must be correctly connected to the vehicle's electrical system.

- ▷ Please observe the chapter "BATTERY" on Page 236.
- ▷ Please observe the chapter "EMERGENCY UNLOCKING OF THE LUGGAGE COMPARTMENT LID" on Page 235.

Note

- ▷ Do not try to start the car by pushing or towing. Damage to the catalytic converters and other components of the car may result.

⚠ Warning!

Risk of damage and serious personal injury due to short circuit.

- ▷ Use only jumper cables of adequate diameter cross-section and fitted with completely insulated alligator clips.
- ▷ Follow all warnings and instructions of the jumper cable manufacturer.
- ▷ When connecting jumper cables, make sure that they cannot get caught in any moving parts in the engine compartment.
  The jumper cables must be long enough so that neither vehicles nor cables touch another.
- ▷ The vehicles must not be in contact, otherwise current might flow as soon as the positive terminals are connected.
- ▷ The cable clamps must not be allowed to contact each other when one end of the jumper cables are connected to a battery.
- ▷ Ensure that tools or conductive jewelery (rings, chains, watch straps) do not come into contact with the positive jumper cable or the positive battery post.
- ▷ Improper hook-up of jumper cables can ruin the alternator.

Danger of caustic burns.

- ▷ Do not lean over the battery.

Danger of gas explosion.

- ▷ Improper use of booster battery to start a vehicle may cause an explosion, resulting in severe personal injuries.
- ▷ Keep sources of ignition away from the battery, e.g. open flame, burning cigarettes or sparking due to cable contact or welding work.
- ▷ A discharged battery can freeze even at 23°F/–5°C.
  Before connecting jumper cables, a frozen battery must be thawed out.

Connect jumper cables in the following sequence:

Always observe the sequence below:

1. Connect the **positive lead (red)** to the positive terminal of the discharged battery first, then connect it to the positive terminal of the donor battery.
2. First connect the **negative cable (black)** to the negative terminal of the donor battery, then connect it to a suitable grounding point on the vehicle with the discharged battery.
   This grounding point must lie as far as possible from the battery.
   For example, a solid metal part or the engine block are suitable grounding points.

   If no suitable grounding points are to be found on either vehicle, the negative cable must carefully be connected directly to the negative terminal of the battery.

   If a suitable grounding point is to be found only on the donor vehicle, the negative cable must first be connected to the terminal of the discharged battery, then to the grounding point of the donor vehicle.
3. Run the engine of the donor car at a higher speed.
4. Start the engine.
   An attempted start using jumper cables should not last more than 15 seconds. Then allow a waiting period of at least one minute.

Note
Before disconnecting the jumper cables, electrical loads such as the heated rear window and the heating fan blower should be switched on (the vehicle's lights must **not** be switched on). This reduces voltage peaks which may occur when disconnecting the jumper cables.

With the engine running, remove both jumper cables in reverse order.

Emergency Starting with Jumper Cables

If the battery is discharged, e.g. in winter or after the car has been parked for a long time, the battery of another car can be used for starting with the help of jumper cables.
Make sure the voltage of both batteries is the same.
The capacity (Ampere hours, Ah) of the booster battery must not be substantially less than that of the discharged battery.
The discharged battery must be correctly connected to the vehicle's electrical system.

See the chapter "Battery" and "Emergency unlocking of the luggage compartment lid and engine compartment lid".

Note

- Do not try to start the car by pushing or towing. Damage to the catalytic converters and other components of the car may result.

⚠ Warning!

Risk of damage and serious personal injury due to short circuit.

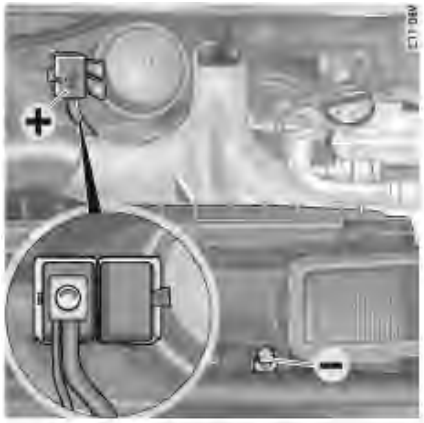
- Use only jumper cables of adequate diameter cross-section and fitted with completely insulated alligator clips.
- Follow all warnings and instructions of the jumper cable manufacturer.
- When connecting jumper cables, make sure that they cannot get caught in any moving parts in the engine compartment.
  The jumper cables must be long enough so that neither vehicles nor cables touch another.
- The vehicles must not be in contact, otherwise current might flow as soon as the positive terminals are connected.
- The cable clamps must not be allowed to contact each other when one end of the jumper cables are connected to a battery.
- Ensure that tools or conductive jewellery (rings, chains, watch straps) do not come into contact with live parts of the vehicle.
- Improper hook-up of jumper cables can ruin the alternator.

Danger of caustic burns.

- Do not lean over the battery.

Danger of gas explosion.

- Improper use of booster battery to start a vehicle may cause an explosion, resulting in severe personal injuries.
- Keep sources of ignition away from the battery, e.g. open flame, burning cigarettes or sparking due to cable contact or welding work.
- A discharged battery can freeze even at –10°C/14°F.
  Before connecting jumper cables, a frozen battery must be thawed out.



\+ = *Positive terminal for jump starting*
– = *Grounding point for jump starting*

Connect jumper cables in the following sequence:

1. Check electrolyte level of each cell. If necessary, fill with distilled water to just above plates.
2. On a vehicle with a discharged battery: turn off all consumers and accessories, move the gear shift lever into the neutral position and set the parking brake.
3. Open the cap of the positive terminal for jump starting (+).
4. Attach the **positive cable** first to the positive terminal for jump starting (+), then to the positive terminal of the booster battery.
5. Connect the **negative cable** first to the negative terminal of the booster battery, then to the grounding point for jump starting (–).
6. Run the engine of the booster car at a higher speed.
7. Start the engine.
   An attempted start using jumper cables should not last more than 15 seconds. Then allow a waiting period of at least one minute.
8. With the engine running, disconnect both jumper cables in reverse order.
   Close the lid of the jump start box.

PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ☑ Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Power-assisted steering: Check fluid level
- ❑ Engine: Check oil level
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ❑ Change engine oil: (oil filter change is not required)
- ☑ Air Filter: Check the air filter condition, and if necessary, replace
- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Power-assisted steering: Check fluid level
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze protection level
- ❑ Pollen filter: Replace filter element
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ❑ Vehicle lights: Check operation
- ❑ All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ❑ Change engine oil and oil filter
- ☑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ☑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ☑ Diagnosis system: Read out fault memory
- ❑ Polyrib belt: Check condition
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ☑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ❑ Power-assisted steering: Check fluid level
- ❑ Parking brake: Check free play of the parking brake lever
- ❑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ❑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Clutch: Check play or final position of pedal
- ☑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Check tightness on the front and rear suspension adjustment points
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ☑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Seat belts: Check operation and condition
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ☑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ❑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ☑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ❑ Replace Polyrib belt
- ☑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ❑ Manual transmission: Change oil
- ❑ Automatic transmission: Change ATF and ATF-filter
- ❑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ❑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ❑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ❑ Check airbag system
- ❑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.

❑ Change engine oil and oil filter

☑ Air Filter: Check the air filter condition, and if necessary, replace

☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage

❑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze

❑ Pollen filter: Replace filter element

❑ Brake system: Visual inspection of the brake pads and brake discs for wear

❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion

❑ Drive shafts: Visual inspection of the dust boots for leaks and damage

❑ Tires: Check condition and tire pressure

❑ Check firewall and cabrio section body drains for debris

❑ Check the door, lid locks and safety hook of the front lid for secure seating and function

❑ Vehicle lighting: Check function
All headlights: Check setting

❑ Horn: Check function

❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)

❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

☑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

☑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
☑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

- ☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
- ❑ Change engine oil and oil filter
- ☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
- ❑ Coolant hoses: Check condition
  Radiators and air intakes: Visual inspection for external debris and blockage
  Coolant: Check level and antifreeze
- ☑ Air filter: Replace filter element
- ❑ Pollen filter: Replace filter element
- ☑ Fuel lines and connections: Visual inspection for damage and leaks
- ❑ Brake system: Visual inspection of the brake pads and brake discs for wear
- ❑ Parking brake: Check free play of parking brake lever
- ❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ❑ Clutch: Check the pedal play and end position
- ❑ Steering gear: Visual inspection of the dust boots for damage
  Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
- ❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ☑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ❑ Tires: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
- ❑ Vehicle lighting: Check function
  All headlights: Check setting
- ❑ Horn: Check function
- ❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ❑ Seat belts: Check function and condition
- ❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

- ☑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

- ☑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

- ❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
- ❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
- ❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

- ❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

- ❑ Replace drive belt
- ☑ Replace fuel filter (Turbo only)
- ❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

- ❑ Change manual transmission oil
- ❑ Change Tiptronic transmission oil and ATF filter
- ❑ Change Tiptronic transmission final drive oil
- ❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be performed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

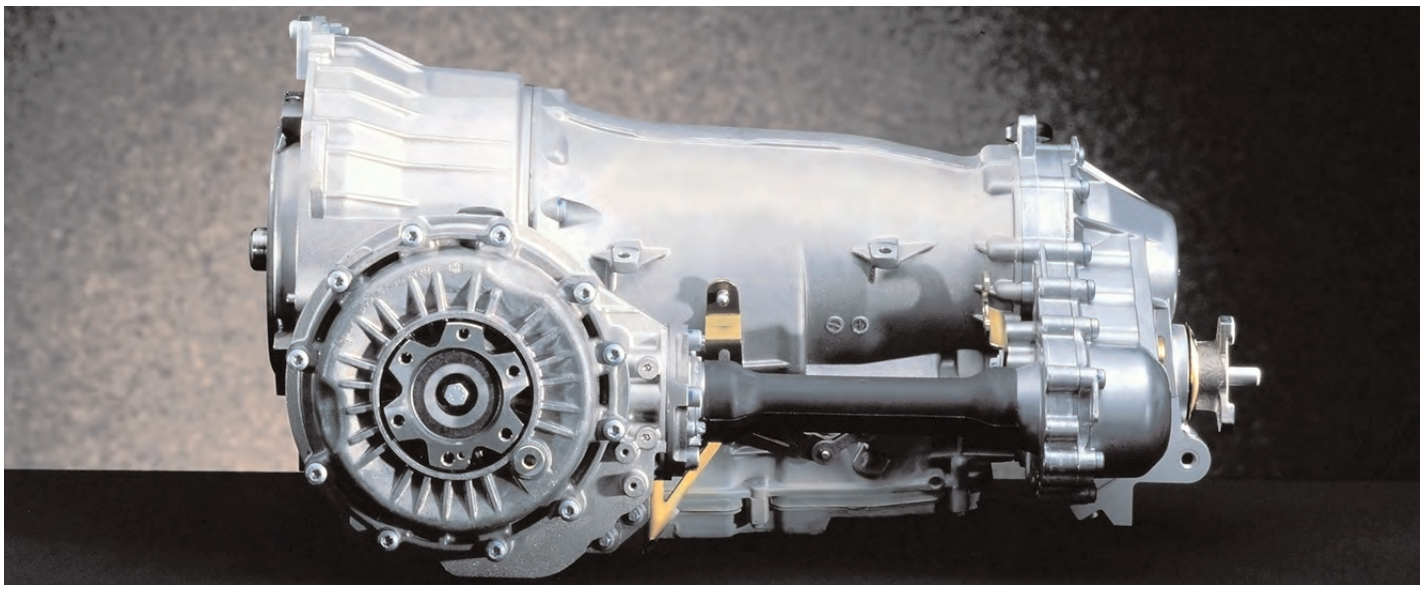
Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Notes:



Subject	Page
911 Carrera (996)	
General Information	3.3
Gear Ratios	3.7
Viscous Clutch and Front Differential	3.8
911 Carrera (997)	
General Information	3.9
Gear Ratios	3.11
Boxster (986)	
General Information	3.14
Gear Ratios	3.17
Boxster (987)/Cayman (987)	
General Information	3.19
Gear Ratios	3.20
911 Turbo (996)	
General Information	3.22
Gear Ratios	3.24
911 Turbo (997)	
General Information	3.25
Gear Ratios	3.25
Porsche Traction Management (PTM)	3.26
Tiptronic Transmissions	
General Information	3.29
Maintenance Sheets	3.40

Notes:

911 Carrera (996)

General

The 911 Carrera 2/4 (996) came equipped with a 6-speed Manual Transmission or optional Tiptronic automatic transmission.

A completely new transmission has been developed for use in the new 911 Carrera (996). The most important development objectives were:

- One transmission variant worldwide
- Adaptation to the engine power
- Smooth shifting
- Reduction of transmission noise by means of ground gearwheels and cable shifting

Manual Transmission Types:

911 Carrera 2 (996)

- G96.00 RoW/USA/Canada M.Y. 1999 - 2001
- G96.01 RoW/USA/Canada M.Y. 2002 - 05

911 Carrera 4/4S (996)

- G96.30 USA/Canada M.Y. 1999 - 2001
- G96.31 USA/Canada M.Y. 2002 - 05

Tiptronic Transmission Types:

911 Carrera 2 (996)

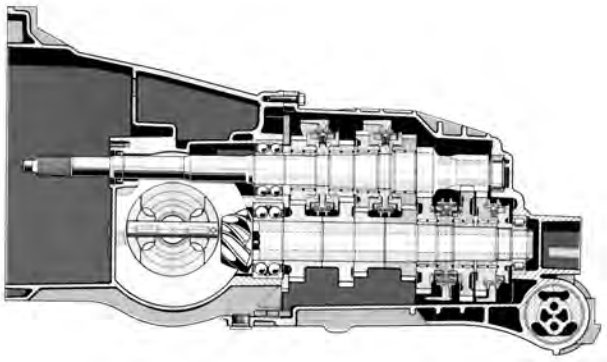
- A96.00 RoW/USA/Canada M.Y. 1999 - 2001
- A96.10 RoW/USA/Canada M.Y. 2002 - 05

911 Carrera 4/4S (996)

- A96.30 USA/Canada M.Y. 1999 - 2001
- A96.35 USA/Canada M.Y. 2002 - 05

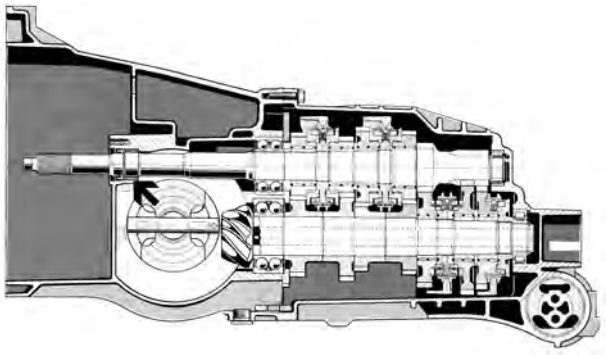
Basic Tiptronic servicing and diagnosis is covered in a seperate section.

Transmission G96.00 – 911 Carrera 2 (996)



The 6th gear has been configured to allow the maximum possible vehicle speed to be reached. The relatively short 1st gear relieves the load placed on the clutch when the vehicle moves off and also ensures a favorable crawling speed. The reverse gear has been considerably shortened.

Transmission G96.01 – 911 Carrera 2 (996)



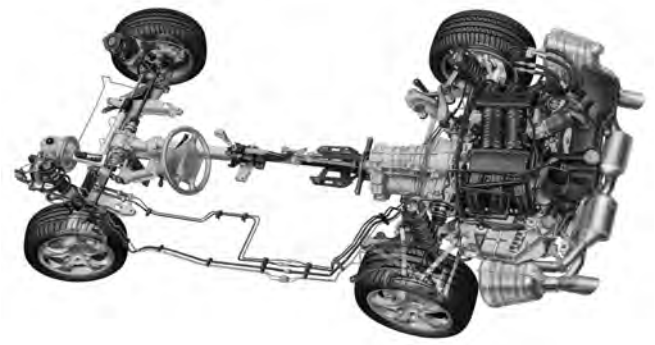
Additional 3rd Bearing on Input Shaft, See Arrow

The manual transmission for the rear wheel drive vehicle and the four-wheel drive vehicle is based on the 911 Carrera of the previous model. The manual transmission has been adapted to the higher engine torque of the 3.6 l engine with the dimensions and transmission ratios remaining unchanged. The necessary higher dynamic strength of the components has been achieved through the use of higher alloy steels and precision shot blasting at the pinion shafts. The aluminium die-cast housing has been further optimized with regard to acoustics and vibration and has been adapted to the new installation position due to the standardising of the transmission mounts (manual and Tiptronic).

Improved transmission cooling through directed air flow in the underbody of the vehicle, an open ventilator with labyrinth sealing and waxed sealing rings completes the optimization.

Transmission G96.30 – 911 Carrera 4 (996)

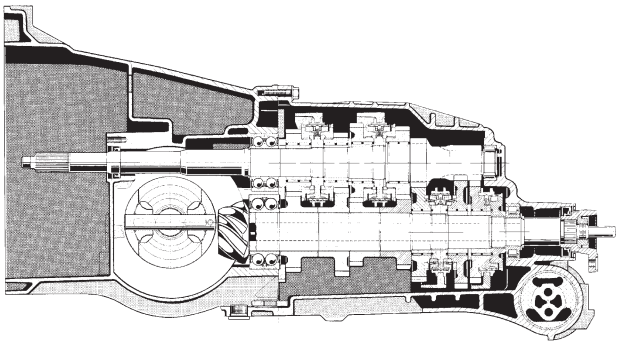
Driveline



911 Carrera 4 (996) Driveline Configuration

Power is transmitted to the front axle from the transmission via a single-piece propeller shaft and a central shaft to the viscous multi-disk clutch integrated in the front-axle final drive.

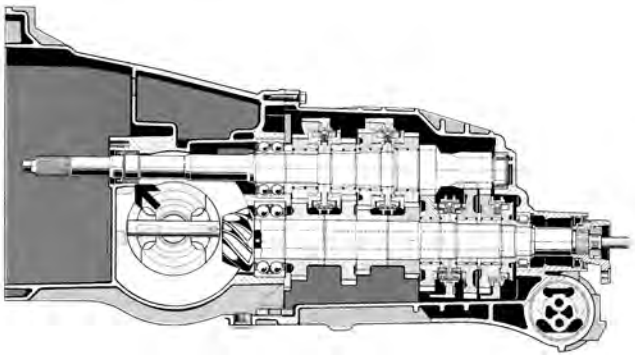
The advantages of this concept-propeller shaft plus central shaft are the reduced weight and the increased ease of repair. For example, after the propeller shaft has been removed, it is then possible to remove the transmission without the engine.



As a standard feature, the new 911 Carrera 4 (996) is fitted with a six-speed manual transmission. This transmission was redesigned for the 911 Carrera 4 with cable shifting and both units are largely identical.

The drive shaft has been extended towards the front for the all-wheel drive of the front axle. The shaft emerges through an additional opening in the front section of the transmission housing and drives the front axle via a single-piece propeller shaft and a central shaft.

Transmission G96.31 – 911 Carrera 4 (996)



Additional 3rd Bearing on Input Shaft, See Arrow

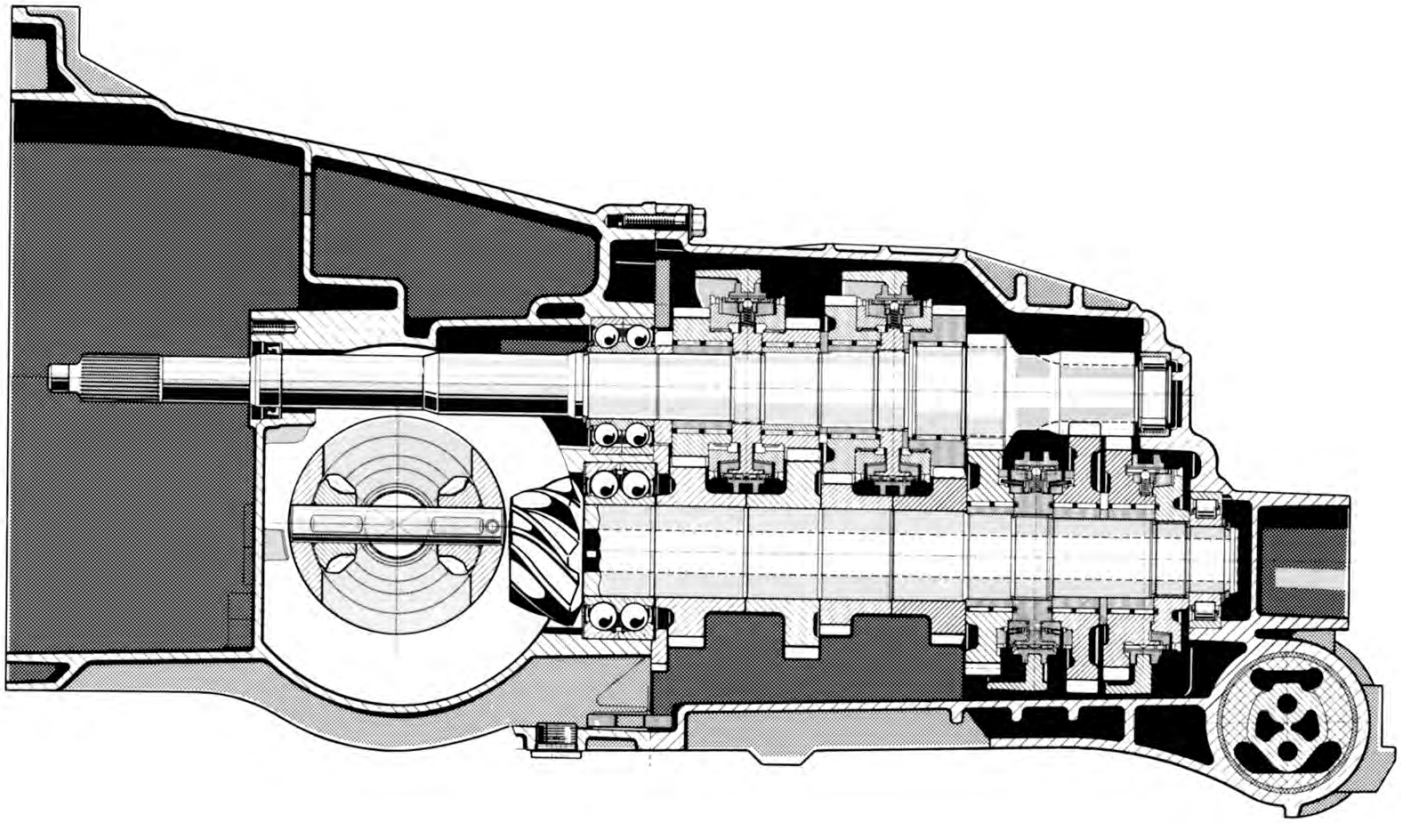
The manual transmission for the rear wheel drive vehicle and the four-wheel drive vehicle is based on the 911 Carrera of the previous model. The manual transmission has been adapted to the higher engine torque of the 3.6 l engine with the dimensions and transmission ratios remaining unchanged. The necessary higher dynamic strength of the components has been achieved through the use of higher alloy steels and precision shot blasting at the pinion shafts. The aluminium die-cast housing has been further optimized with regard to acoustics and vibration and has been adapted to the new installation position due to the standardising of the transmission mounts (manual and Tiptronic).

The efficiency has been improved by reducing the drag factor through decreased preloading on the tapered roller bearings. For vibration reasons, the input shaft has been converted from a 2-bearing to a 3-bearing arrangement (see arrow).

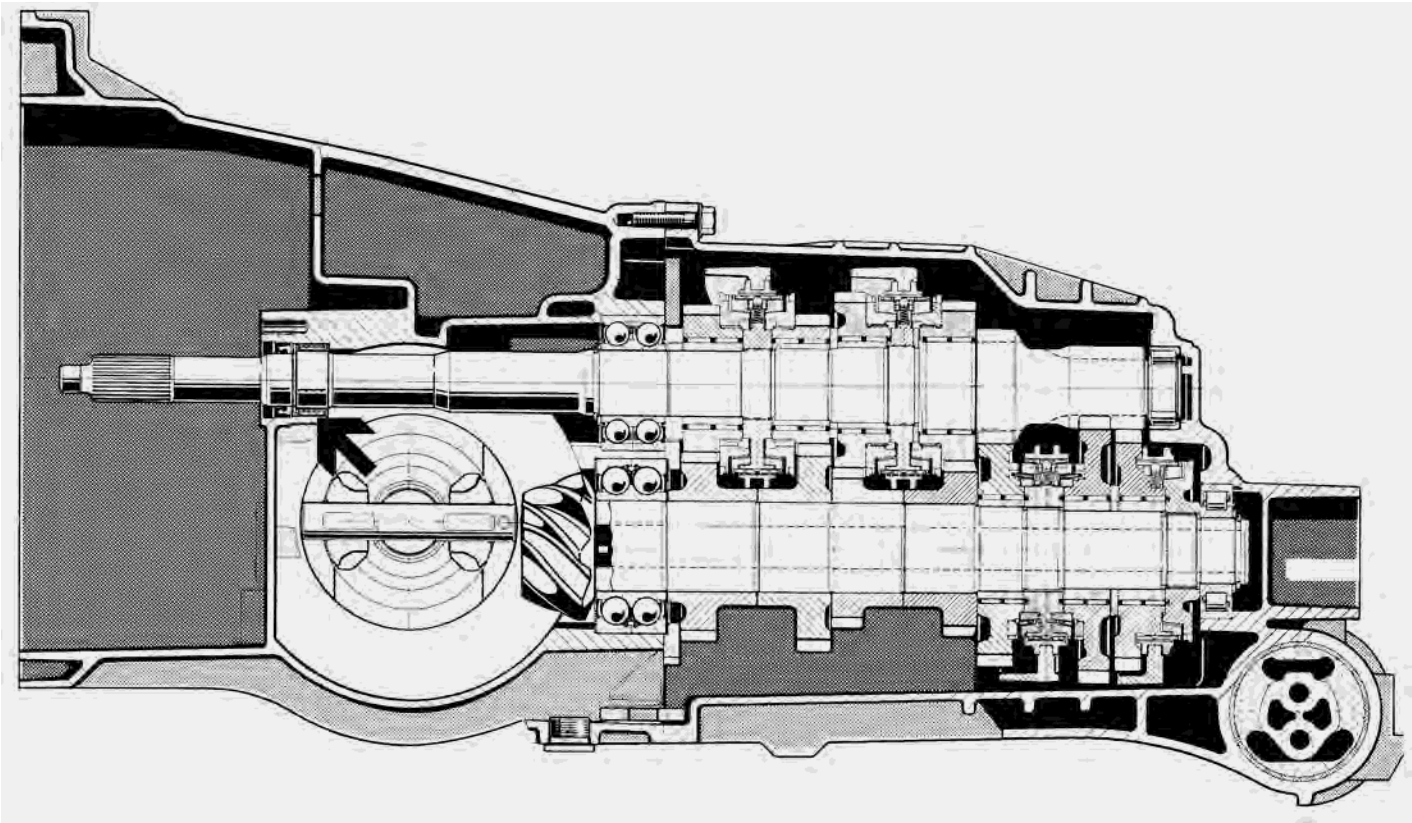
Improved transmission cooling through directed air flow in the underbody of the vehicle, an open ventilator with labyrinth sealing and waxed sealing rings completes the optimization.

Notes:

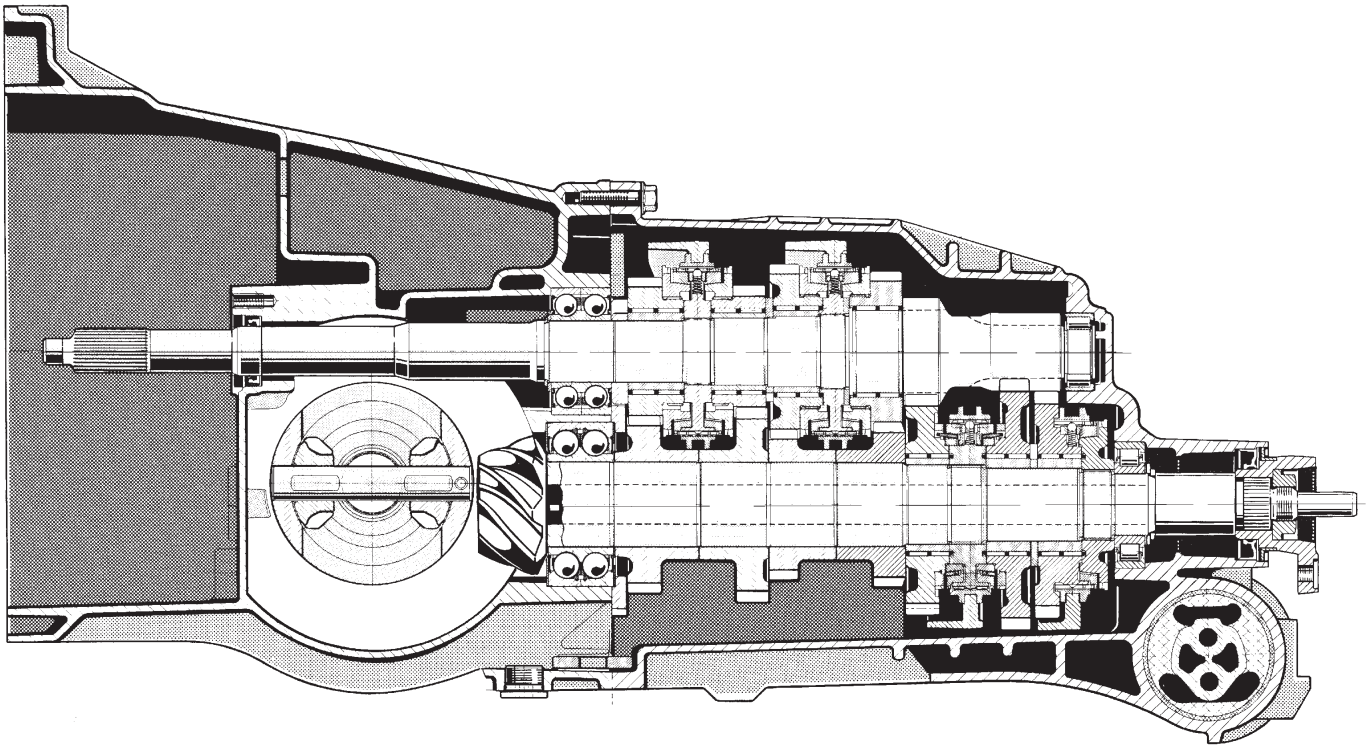
G96.00 Transmission Cutout



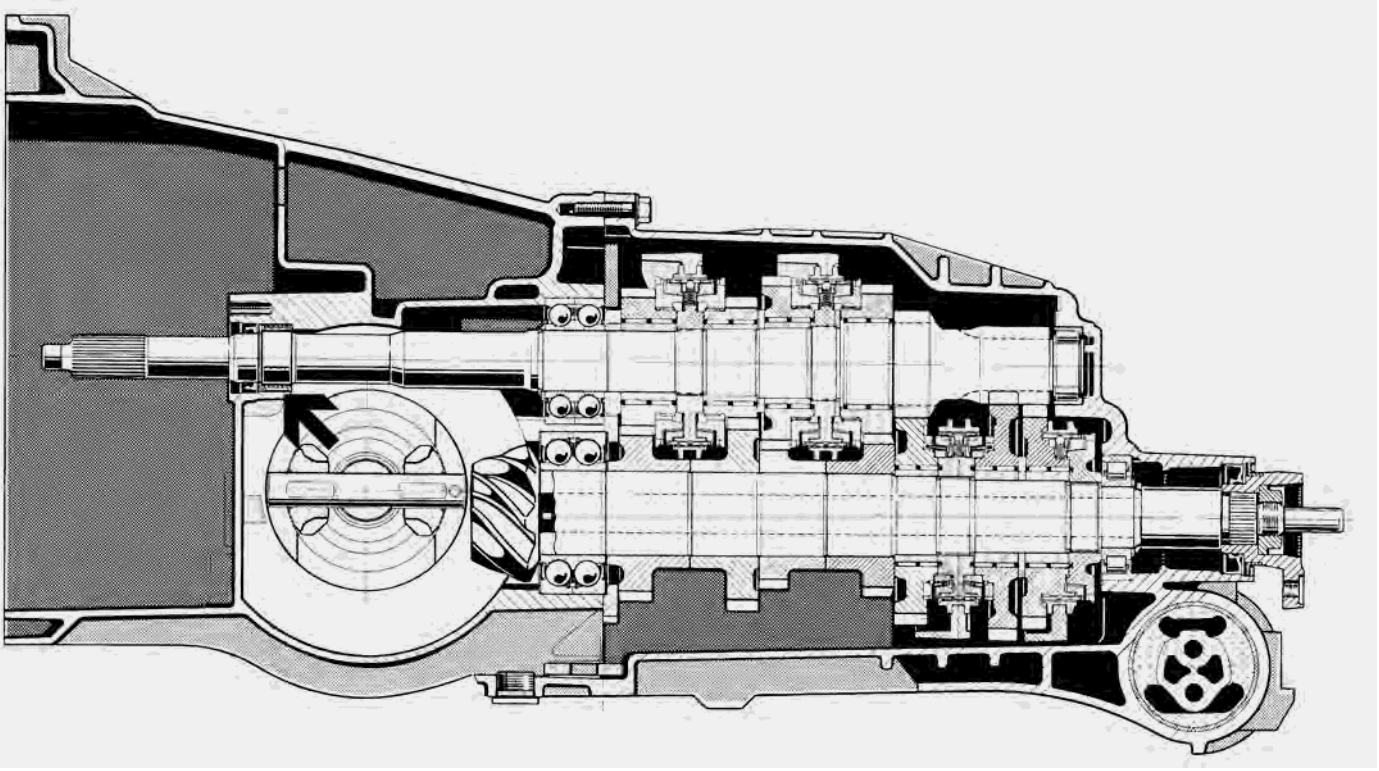
G96.01 Transmission Cutout



G96.30 Transmission Cutout



G96.31 Transmission Cutout



G96.00/30 Transmission Ratio – 911 Carrera 2/4 (996)

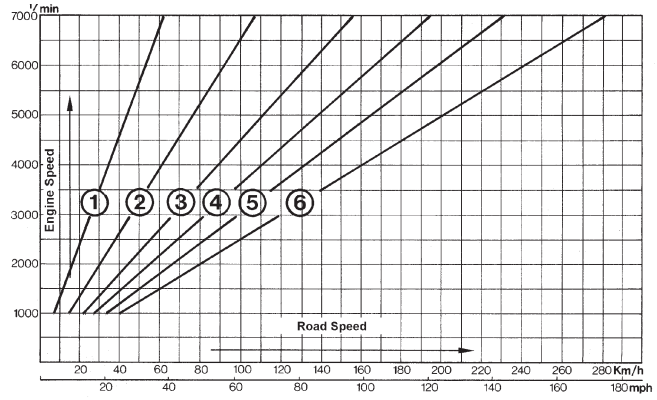
	Z1	Z2	iz Z2:Z1	ia	itot iz:ia	V1000 km/h	V6000 km/h
1st Gear	11	42	3.818	3.444	13.149	8.8	53.1
2nd Gear	20	44	2.200	3.444	7.577	15.4	92.2
3rd Gear	31	47	1.516	3.444	5.221	22.3	133.3
4th Gear	37	45	1.216	3.444	4.188	27.8	166.8
5th Gear	41	42	1.024	3.444	3.527	33.0	198.0
6th Gear	44	37	0.841	3.444	2.896	40.2	241.2
Rev. Gear	11	39	3.545	3.444	12.209	9.5	57.2

Z1 = Number of teeth in 1st gearwheel in power flow of corresponding gear
Z2 = Number of teeth in 2nd gearwheel in power flow of corresponding gear
iz = Transmission ratio
ia = Final drive ratio
V1000 = Calculated vehicle speed at 1,000 rpm engine speed
V6000 = Calculated vehicle speed at 6,000 rpm engine speed

With 225/40 ZR 17 rear tires, rolling circumference 1,940 mm, (rdyn 295 + 1.5% - 2.5%)

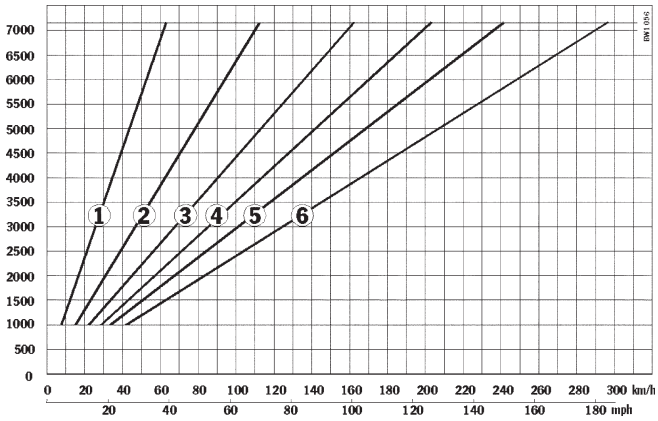
Note:
The values in the transmission diagram are indicative and are based on a mean effective rolling radius. Slight deviations due to the tolerance of the tires, change of rolling radius, wear, and slip of tires have not been taken into consideration.

Transmission Ratios – 911 Carrera 2/4 (996) G96.00/30



Gear Versus Road Speed Graph

Transmission Ratios – 911 Carrera 2/4 (996) G96.01/31



Gear Versus Road Speed Graph

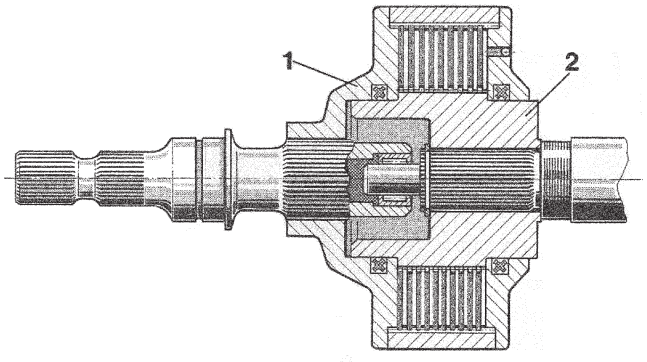
Notes:

Viscous Multi-disc Clutch – 911 Carrera 4 (996)

In order to prevent high temperatures at the viscous multi-disc clutch, the unit has been integrated in the front-axle final drive. No additional space in the manual or Tiptronic transmission has had to be provided as a result of this measure.

In contrast to the previous model, the new 911 Carrera 4 (996) has a stiffer viscous clutch. This is achieved by using a more viscous silicon oil. This measure results in a further improvement with regard to traction. The internal toothing has been modified in order to prevent confusion between the new and old viscous clutches.

Functioning



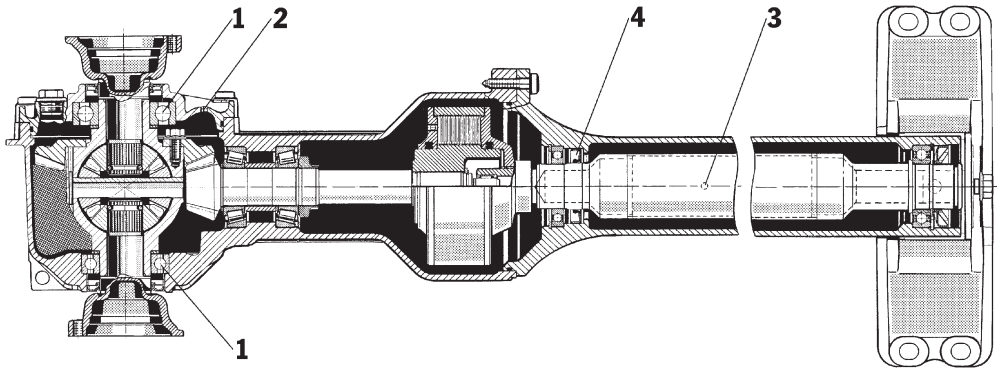
Viscous Clutch

The housing (1) (connected to the drive shaft of the front-axle final drive) is supported by plain bearings in the hub (2) (connected to the central shaft) and the interior is sealed with sealing rings.

The viscous multi-disc clutch is filled with a precisely defined quantity of high-viscosity silicon oil. The clutch is sealed which means that it is not possible to add more silicon oil or check the oil level. If there is a speed differential between the outer and inner discs, a torque is transmitted from the fast to the slow rotating side due to the internal fluid friction.

The discs are fully separated by the oil so that they are not subjected to abrasion or wear. Since distribution occurs according to the difference between the traction slippage at the front and traction slippage at the rear wheels and to the resulting speed differential, a variable torque distribution exists, i.e. the distribution adapts to the given requirements.

However, since tire slippage exists whenever drive torque is transmitted, it is possible to speak of a permanent all-wheel drive with variable torque distribution to the front axle of approx. 5 - 40%.



Front Axle Differential (Z96/00) – 911 Carrera 4 (996)

The axle is driven via a spiral bevel gear which is ground and lapped to narrow the production tolerances. To reduce drag losses, grooved ball bearings (1) are used in the differential gear instead of tapered roller bearings. A hole with M8 thread (2) is drilled into the side cover of the differential. This is required to allow noise measurements to be carried out during production and can be disregarded by Service personnel. There is a bleeder hole (3) in the underside of the long-neck tube. This hole should not be sealed. The discharge of transmission oil from this hole indicates that the sealing ring (4) is damaged. The front-axle final drive is filled with Shell Transaxle Oil 75W90.

Performance Test

Performance tests should only be carried out on four-roller test stands with speed decoupling. If testing is performed on two-roller test stands, the propeller shaft must first be removed.

911 Carrera/S/4/4S (997)

General Information

A completely new six-speed manual transmission has been developed for the 911 Carrera (997) series. The same transmission is used for both engine types.

Dual-mass Flywheel

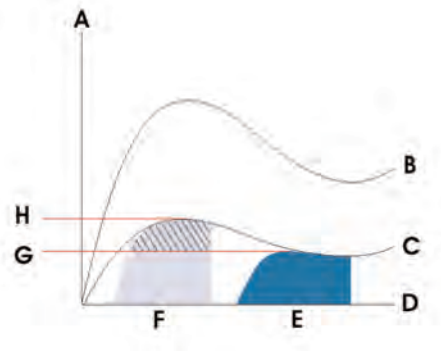
The working cycles and ignition sequence of the engine result in speed fluctuations which induce torsional vibration throughout the drivetrain as a result of irregularities. These torsional vibrations can induce rattling or chattering in all loose parts subject to play which are not incorporated into the power flow (loose gearwheels, synchronization parts). This may lead to unpleasant noise, particularly at low engine speeds combined with high transmission oil temperatures. Similarly to previous Porsche vehicles, the new 911 Carrera/S and 911 Carrera 4/4S incorporate a dual-mass flywheel (DMF) to prevent such noise.

Clutch – 911 Carrera/4 (997)

A single-plate dry clutch is used in the 911 Carrera/4 with a diameter of 240 mm. In accordance with the change of materials in mid-2003, the clutch linings are lead-free.

Clutch – 911 Carrera S/4S (997)

The 911 Carrera S/4S is provided with a self-adjusting clutch. This substantially extends the service life and ensures that the required amount of pedal pressure remains constant throughout the service life of the clutch.

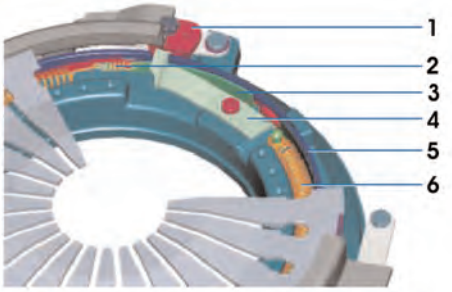


A - Force
B - Contact pressure
C - Release force
D - Travel
E - Clutch in new condition
F - Clutch in worn condition
G - Constant force/travel ratio
H - Maximum rise in release force without wear compensation

Clutch linings are inevitably subject to wear. This, in turn, influences key parameters:

- The positions of the diaphragm springs alter in the course of time as the thickness of the lining diminishes. This results in an increase in contact pressure, release force, and, subsequently, the required pedal pressure.
- In order to compensate for the wear which occurs to the lining within the actuating system, the release system must include provision for the maximum possible wear distance. This increases the required axial space.
- Increasing the service life is of major importance. The possible working strokes of the diaphragm springs limit the scope for improving the service life of the linings via the use of thicker linings. A further increase in the wear thickness would lead to a decrease in contact pressure or would exceed the permissible level of stress on the material.

The self-adjusting clutch solves the above-mentioned problems by separating the lining wear from the diaphragm spring movement. The compensating mechanism continually registers the reduction in lining thickness and compensates the reduced distance resulting from the lining wear by turning an adjusting ring accordingly.



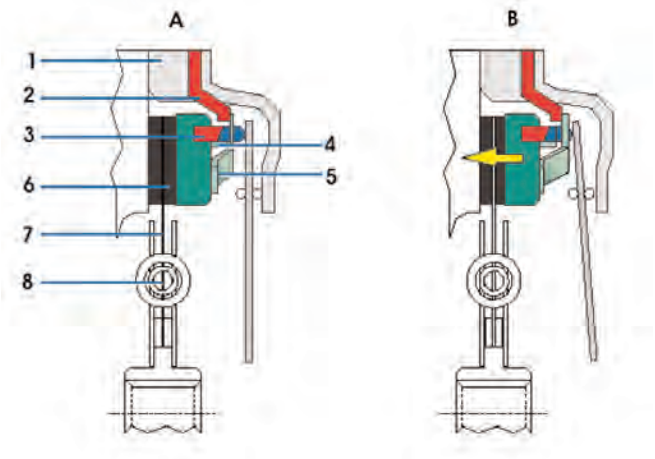
1 - Stop
2 - Tension spring, slide
3 - Slide
4 - Retaining spring
5 - Adjusting rings
6 - Tension spring, adjusting rings

Pressure plate features:

- This mechanism requires only a small number of simple components:
- Two adjusting rings
- Two tension springs
- One retaining spring
- One wedge-shaped slide
- One housing stop

Each time the clutch is engaged, a stop checks whether any reduction has occurred in the lining thickness. If so, the stop lifts the retaining spring from the adjusting rings by precisely this wear distance, such that the slide can be pulled into the gap by its tension spring, thereby locking the retaining spring in this position. The next time the clutch is released, the diaphragm spring is able to take up its original position again – the clutch system has adjusted once again to its optimum force/travel condition.

Wear adjustment during a clutching operation.



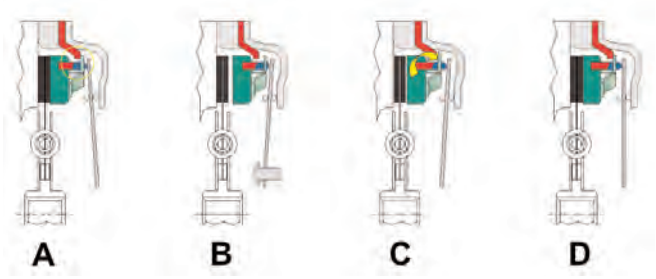
A - Clutch in new condition
B - As wear occurs, the contact plate moves in the direction of the flywheel
1 - Thrust plate housing
2 - Housing stop
3 - Adjusting ring
4 - Slide
5 - Retaining spring
6 - Linings
7 - Clutch plate
8 - Torsional vibration damper

The principle of wear compensation.



A - Spring preload
B - Play inducer

Wear compensation also taps reserves by reducing the maximum travel, as the release force characteristic which applies in new condition is maintained throughout the entire life of the clutch, thereby enabling higher torque transmission.



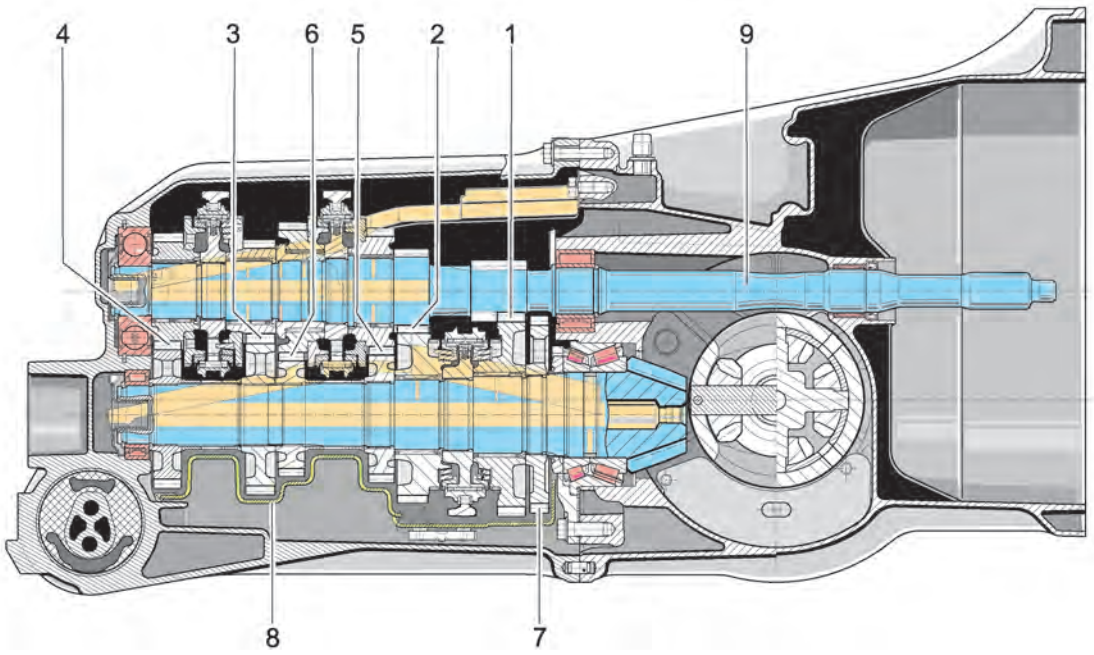
A - The stop lifts the retaining spring from the adjusting springs, the slide fills the gap.
B - The next time the clutch is released....
C - The red adjusting ring compensates the wear.
D - The clutch has compensated the wear, travel and forces correspond to the values for the clutch system in new condition.

Notes:

Six-speed Manual Transmission, G 97.01 – 911 Carrera /S
Six-speed Manual Transmission, G 97.31 – 911 Carrera 4/4S *
* 911 Carrera 4/4S G97.31 transmission is identical to the 911 Carrera/S G97.01, with the exception that it has the additional shaft for the front wheel drive cardan shaft.

911 Carrera/S (997) transmission, tan color illustrates oil circuit.

1 - 1st gear
2 - 2nd gear
3 - 3rd gear
4 - 4th gear
5 - 5th gear
6 - 6th gear
7 - Reverse gear
8 - Gear set shell
9 - Drive shaft



Ratios - G97.01/31 Transmission

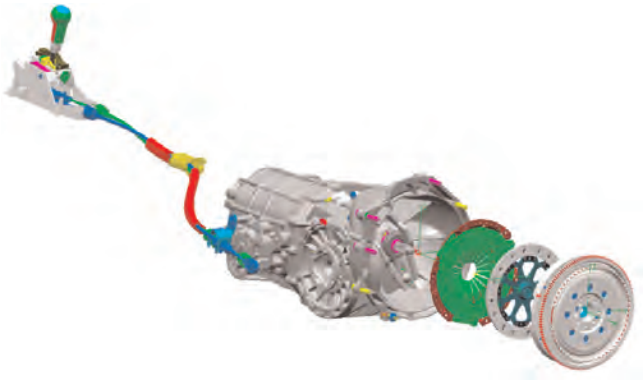
	Z_1	Z_2	i_Z $Z_2 : Z_1$	i_A 9/31	$i_{ges.}$	V_{1000} km/h	V_{7000} km/h
1st gear	11	43	3.909	3.444	13.463	9.1	63.7
2nd gear	19	44	2.316	3.444	7.976	15.3	107.5
3rd gear	28	45	1.607	3.444	5.534	22.1	154.9
4th gear	32	41	1.281	3.444	4.412	27.8	194.3
5th gear	37	40	1.081	3.444	3.723	32.9	230.2
6th gear	43	38	0.884	3.444	3.044	40.2	281.6
Reverse gear			3.590	3.444	12.364	9.9	69.3

Z1 = Number of teeth of first gearwheel in the power flow of the gear concerned
Z2 = Number of teeth of second gearwheel in the power flow of the gear
iZ = Gear ratio
iA = Axle ratio
V1000 = Calculated vehicle speed at engine speed of 1000 rpm
V7000 = Calculated vehicle speed at engine speed of 7000 rpm
With tires: = Rear 295/30 ZR 19, rolling circumference 2041 mm (rdyn 325 mm + 1.5 – 2.5)

Transmission – 911 Carrera (997)

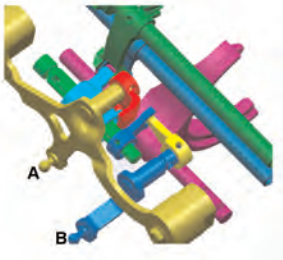
The new models have the same ratio spread as the 911 Carrera (996) from model year 2004. However, the larger wheels and approx. 5% larger rolling circumference (rear) on the new models mean that the individual gear transmission levels have had to be reduced accordingly by 5%. This design results in a sporty setup for the new models and enables high performance with optimum exploitation of the engine torque and the maximum output.

Gear Shifting



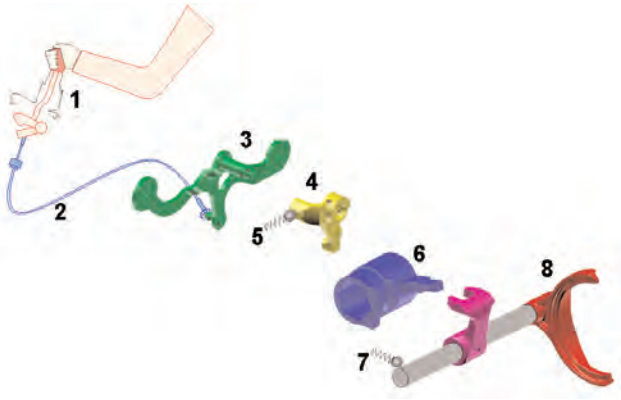
Similar to other Porsche vehicles, the 911 Carrera/S (997) also employs cable shifting. This prevents the transfer of engine movements and vibrations to the shift lever. As opposed to the previous shift linkage, shift and selector cables (which are able to withstand tension and pressure), form the connection between shift lever and transmission. The advantages of this system is reduced space requirements, low weight and above all, the effective prevention of the transfer of engine movements or vibrations to the shift lever, without impairing shifting precision.

A shift throw reduction of approx. 15% has been achieved on the new 911 Carrera/S models while retaining the same ergonomic characteristics by moving the deflection point on the shift lever (see Synchronization). On top of this play in the shift module under the shift lever has been reduced, resulting in a more precise gear shifting gate.



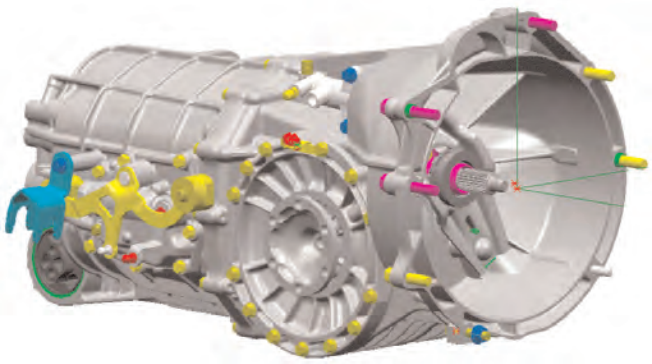
To allow preselection of the gear level, the selector cable is connected to the selector lever shaft (B). The shift cable is connected to the outer shift lever (A) to engage a gear.

Shift Module



1 - Gear-shift lever
2 - Shift cable
3 - Outer shift lever
4 - Inner shift lever
5 - Central catch
6 - Inner shift/selector lever
7 - Gearshift rod catch
8 - Shift fork

Transmission Housing



The transmission housing consists of two parts which are produced in a light metal alloy. In order to ensure direct air heat exchange, the surface of the housing is provided with cooling fins. Cooling is supported by air routing with defined air inlet on the front underbody paneling.

Front-axle Final Drive Z 97.00

The front-axle final drive of the new 911 Carrera 4/4S corresponds to that on the four-wheel-drive predecessor models. Only the transmission ratio has been changed. On the 911 Carrera 4/4S (996) the rolling circumference of the tires is identical on the rear and front axle. As on the 911 Carrera/S (997), the rolling circumference of the tires on the new 911 Carrera 4/4S (997) is 2.5 % larger on the front axle and 5 % larger on the rear axle when compared to the 996 model. The transmission ratio of the front-axle final drive has been adapted to compensate the resultant difference in wheel speeds on the front and rear axles. A transmission ratio of 3.33 now applies.

The shaping of the driveshaft housing has also been modified. On the predecessor models (type 996), this consisted of a closed tubular profile. In order to achieve a further reduction in noise, the tubular profile on the 911 Carrera 4/4S (type 997) forms a resonant body with a large acoustic emission surface.

Notes:

Boxster/S (986)

General

The Boxster (986) came equipped with a Five-speed and the Boxster S (986) with a Six-speed manual transmission, both models offered the optional Tiptronic automatic transmission.

Manual Transmission Types:

Boxster (986)
- G86.00 M.Y. 1997 - 99
- G86.01 M.Y. 2000 - 04

Boxster S (986)
- G86.20 M.Y. 2000 - 04

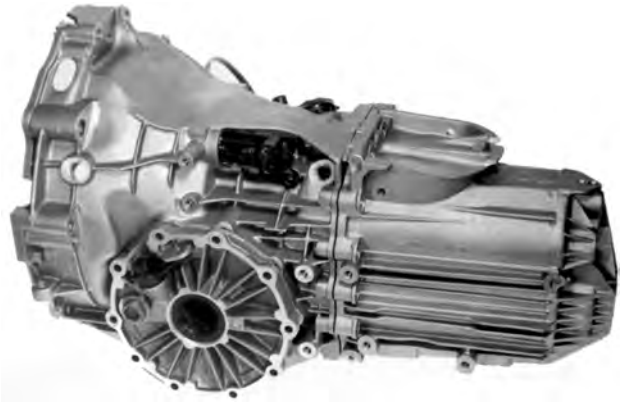
Tiptronic Transmission Types:

Boxster (986)
- A86.00 M.Y. 1997 - 99
- A86.05 M.Y. 2000 - 04

Boxster S (986)
- A86.20 M.Y. 2000 - 04

Basic Tiptronic servicing and diagnosis is covered in a seperate section.

Manual Transmission G86.00 – Boxster (986)



Special Features:
- Five forward gears with external cone synchronization
- Fully synchronized reverse gear
- Precise and smooth shifting
- Thermal expansion controlled longitudinal adjustment for bevel pinion bearing
- Increased efficiency by reducing losses due to splashing

Manual Transmission G86.01 – Boxster (986)

The transmission ratios of the 5-speed Boxster manual gearbox have been adapted to the increased engine performance respectively the higher engine torque.

Manual Transmission G86.20 – Boxster S (986)

General

The Boxster S (986) comes equipped standard with a 6-speed manual gearbox based on the 911 Carrera (996) gearbox. By implementing the already familiar dual-mass flywheel, the comfort level has been considerably increased by avoiding gearbox noises. The flywheel is made of two components with torsional elastic elements between them.

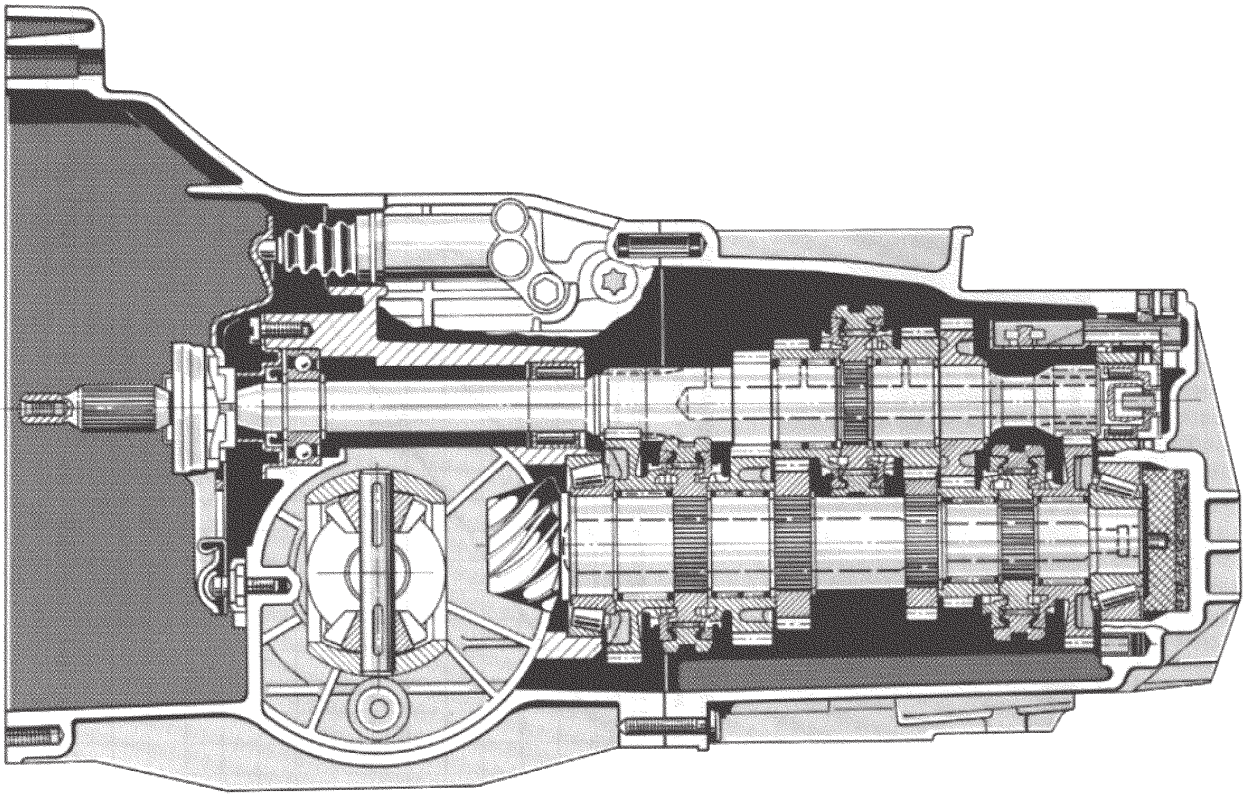
The 6th gear has been designed to satisfy customer demands for reaching the highest possible maxumum speed. The relatively short 1st gear reduces strain on the clutch during acceleration and makes an economical crawling speed possible.

This spring/mass system suppresses to a large extent the engine speed fluctuations created by the working cycles and firing order of the engine, which induces torsional vibrations in the gearbox and can then lead to disruptive gearbox noises. Special attention has been paid to the smooth running of the gear wheels. Careful development and manufacturing (the gear wheels are ground and honed) has resulted in a further reduction in gearbox noise.

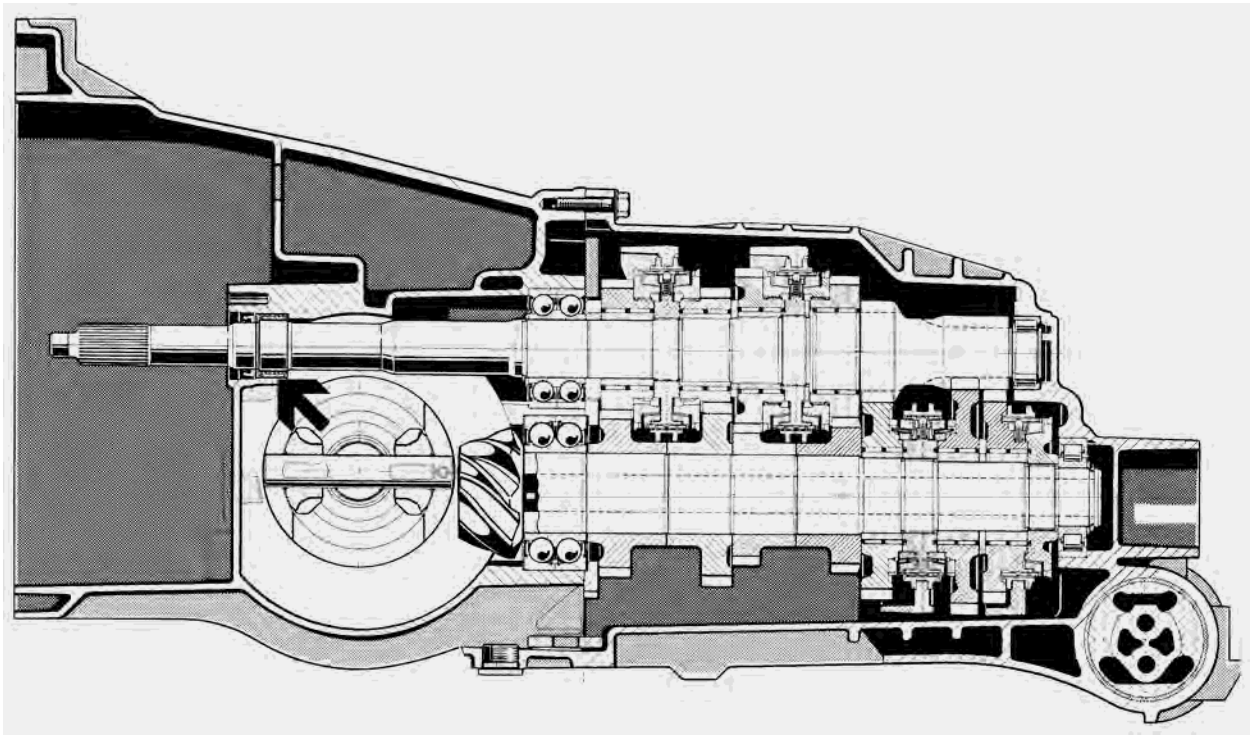
The cable shift familiar from the Boxster (986) basic model is used. This prevents unit motion and vibrations from being transferred to the gear lever. The advantages of this system are the minimum space requirements, low weight and above all the effective decoupling of unit motion and vibrations from the gear lever.

Notes:

G86.00 Transmission Cutout



G86.20 Transmission Cutout



Dual-Mass Flywheel/Clutch



Dual-mass Flywheel, Pressure Plate and Clutch Disk

The working cycles and the firing order of the engine cause speed fluctuations resulting in irregularities which lead to torsional vibrations along the entire drive train.

These torsional vibrations may cause all loose parts not powered and with play to rattle, chatter, or bounce (loose gearwheels, parts of the synchronization system, switch components). This may result in annoying transmission noise, especially at low engine speeds.

As with previous Porsche vehicles, the Boxster has a two-mass flywheel (TMF) to prevent these noises.

The single-disk dry clutch with asbestos-free clutch plates is bolted to the TMF.
Clutch – Boxster S (986) M.Y. 2003

With the Boxster S (986) increase in engine power and torque, the clamping force of the pressure plate was increase. The clutch disk diameter of 240 mm remain unchanged.

Notes:

G86.00 Transmission Ratio

	Z1	Z2	iz Z2:Z1	ia	itot iz:ia	V1000 km/h	V6000 km/h
1st Gear	10	35	3.500	3.889	13.612	8.5	51.0
2nd Gear	17	36	2.118	3.889	8.237	14.1	84.3
3rd Gear	28	40	1.429	3.889	5.557	20.8	125.0
4th Gear	34	35	1.029	3.889	4.002	28.9	173.6
5th Gear	38	30	0.789	3.889	3.068	37.7	226.5

Z1 = Number of teeth in 1st gearwheel in power flow of corresponding gear
Z2 = Number of teeth in 2nd gearwheel in power flow of corresponding gear
iz = Transmission ratio
ia = Final drive ratio
V1000 = Calculated vehicle speed at 1,000 rpm engine speed
V6000 = Calculated vehicle speed at 6,000 rpm engine speed

With 225/50 ZR 16 rear tires, rolling circumference 1,930 mm, (rdyn 307 + 1.5% - 2.5%)

Note:
The values in the transmission diagram are indicative and are based on a mean effective rolling radius. Slight deviations due to the tolerance of the tires, change of rolling radius, wear, and slip of tires have not been taken into consideration.

G86.01 Transmission Ratio

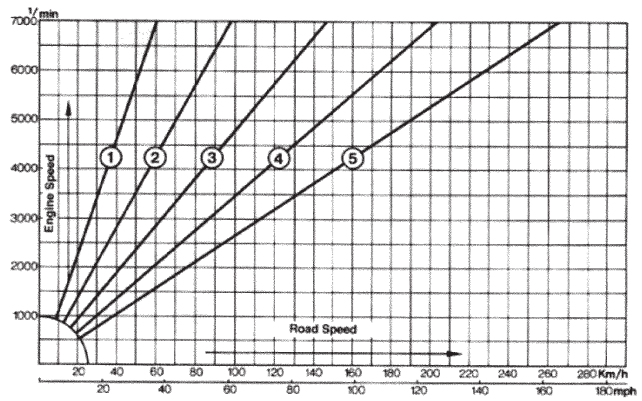
	Z1	Z2	iz Z2:Z1	ia	itot iz:ia	V1000 km/h	V6500 km/h
1st Gear	10	35	3.500	3.555	12.443	8.3	60.5
2nd Gear	17	36	2.118	3.555	7.529	15.4	100.0
3rd Gear	28	40	1.429	3.555	5.080	22.8	148.2
4th Gear	33	36	1.091	3.555	3.879	29.8	194.0
5th Gear	37	31	0.838	3.555	2.979	38.9	252.7

Z1 = Number of teeth in 1st gearwheel in power flow of corresponding gear
Z2 = Number of teeth in 2nd gearwheel in power flow of corresponding gear
iz = Transmission ratio
ia = Final drive ratio
V1000 = Calculated vehicle speed at 1,000 rpm engine speed
V6500 = Calculated vehicle speed at 6,500 rpm engine speed

With 255/40 ZR 17 rear tires, rolling circumference 1,948 mm, (rdyn 295 + 1.5% - 2.5%)

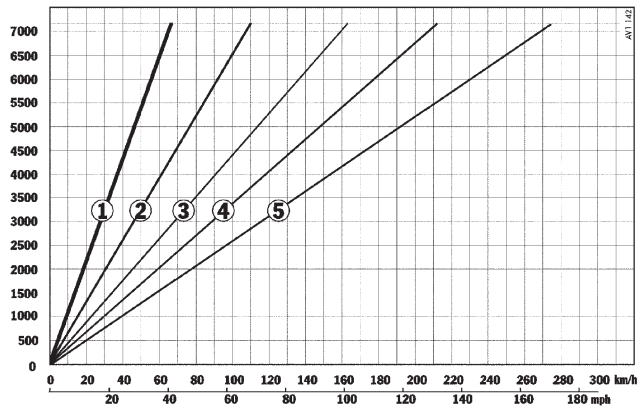
Note:
The values in the transmission diagram are indicative and are based on a mean effective rolling radius. Slight deviations due to the tolerance of the tires, change of rolling radius, wear, and slip of tires have not been taken into consideration.

Transmission Ratios – Boxster (986) G86.00



Gear Versus Road Speed Graph

Transmission Ratios – Boxster (986) G86.01



Gear Versus Road Speed Graph

Transmission – Boxster (986)

G86.20 Transmission Ratio

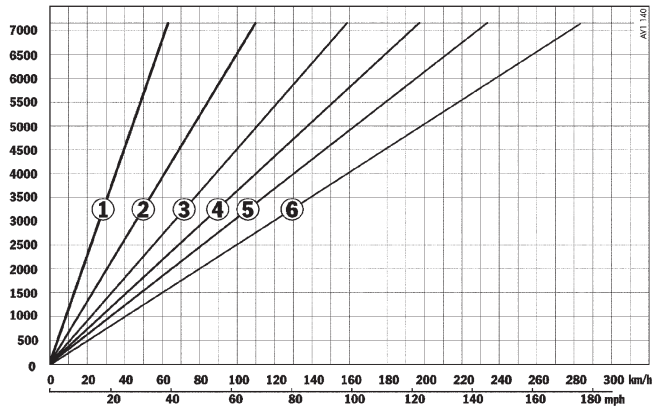
	Z1	Z2	iz Z2:Z1	ia	itot iz:ia	V1000 km/h	V6500 km/h
1st Gear	11	42	3.818	3.444	13.152	8.9	57.8
2nd Gear	20	44	2.200	3.444	7.578	15.4	100.2
3rd Gear	31	47	1.516	3.444	5.222	22.4	145.5
4th Gear	37	45	1.216	3.444	4.189	27.9	181.4
5th Gear	41	42	1.024	3.444	3.528	33.1	215.3
6th Gear	44	37	0.841	3.444	2.896	40.4	262.3
Rev. Gear	11	39	3.545	3.444	12.212	9.6	62.2

Z1 = Number of teeth in 1st gearwheel in power flow of corresponding gear
Z2 = Number of teeth in 2nd gearwheel in power flow of corresponding gear
iz = Transmission ratio
ia = Final drive ratio
V1000 = Calculated vehicle speed at 1,000 rpm engine speed
V6500 = Calculated vehicle speed at 6,500 rpm engine speed

With 255/40 ZR 17 rear tires, rolling circumference 1,948 mm, (rdyn 285 + 1.5% - 2.5%)

Note:
The values in the transmission diagram are indicative and are based on a mean effective rolling radius. Slight deviations due to the tolerance of the tires, change of rolling radius, wear, and slip of tires have not been taken into consideration.

Transmission Ratios – Boxster (986) G86.20



Gear Versus Road Speed Graph

Notes:

Boxster/S (987) & Cayman/S (987)

General – Boxster/Cayman (987), G87.01

The Boxster/Cayman (987) features a revised 5-speed manual transmission, type G87.01 as standard. Additional options are a 6-speed manual transmission, type G87.20.

General – Boxster S (987), G87.20

In model year 2005, the Boxster S (987) features a totally new 6-speed manual transmission, type G87.20. Optional on the Boxster (987).

General – Cayman S (987), G87.21

The 6-speed manual transmission which was developed for the Boxster S comes as standard equipment on the Cayman S. The gear ratio spread have been adapted to the higher engine power of the Cayman S.

Dual-mass Flywheel

The working cycles and ignition sequence of the engine result in speed fluctuations which induce torsional vibration throughout the drivetrain. These torsional vibrations can induce rattling, chattering or floating in all loose parts subject to play which are not incorporated into the power flux (loose gearwheels, synchronization parts). This may lead to unpleasant noise, particularly at low engine speeds combined with high transmission oil temperatures. Similar to previous Porsche vehicles, the Boxster/S (987) and Cayman/S (987) incorporate a dual-mass flywheel (DMF) to prevent such noise.

Clutch

The Boxster/S (987) and Cayman/S (987) features a hydraulically actuated single plate dry clutch unchanged from the previous Boxster/S (986), with a pressure plate in nodular cast iron GGG 60 and a clutch disk diameter of 240 mm. The contact pressure has been adapted to the engine torque and the hub of the clutch disk has been adapted to the new transmission input shaft.

Boxster/Cayman (987) – When the optional 6-speed transmission is installed, the clutch disk of the Boxster S features a modified hub adapted to the transmission input shaft.



Boxster S & Cayman S – To optimize the friction characteristics when operating the clutch, the Boxster S features a release bearing with a plastic contact surface.

Manual Transmission G87.01 – Boxster/Cayman (987) 5-Speed

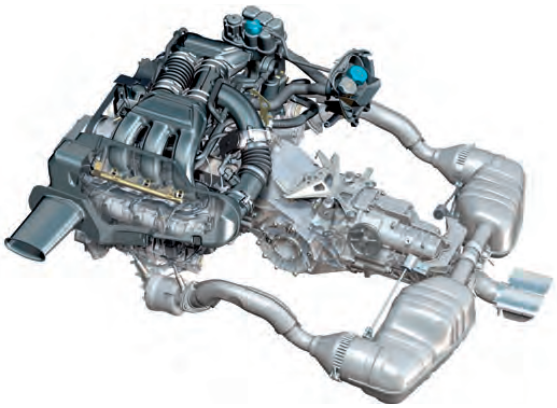
Transmission Ratio

The rear axle transmission ratio has been adapted to compensate for the 5 % larger rolling circumference of the rear wheels and now stands at 3.75. This transmission ratio results in a sporty setup and enables high performance with optimum exploitation of the engine torque and the maximum output.

Manual Transmission 6-Speed – Boxster S (987), G87.20 & Cayman S (987), G87.21



Boxster S (987)



Cayman S (987)

The transmission is bolted directly onto the engine. The surface of the transmission is additionally provided with cooling fins to ensure direct heat exchange.

Transmission – Boxster/Cayman (987)

Transmission Ratio, G87.20 – Boxster S (987)

	Z_1	Z_2	I_Z $Z_2 : Z_1$	i_A 8/31	i_{Total}	V_{1000} mph	V_{7000} mph
1st gear	9	33	3,667	3,875	14,208	5.3	37.5
2nd gear	20	41	2,050	3,875	7,944	9.6	67
3rd gear	27	38	1,407	3,875	5,454	14	97.6
4th gear	30	34	1,133	3,875	4,392	17.3	121.3
5th gear	36	35	0,972	3,875	3,767	20.1	141.4
6th gear	45	37	0,822	3,875	3,186	23.9	167.2
Reverse gear	9/13	13/30	3,333	3,875	12,917	5.9	41.2

The new Boxster S (987) model has the same ratio spread as the previous model year Boxster S (986). However, the larger wheels and approx. 5 % larger rolling circumference (rear) on the new models mean that the individual gear transmission levels have had to be reduced accordingly by 5 %. This design results in a sporty setup for the new models and enables high performance with optimum exploitation of the engine torque and the maximum output.

Z1 = Number of teeth of first gearwheel in the power flow of the gear
Z2 = Number of teeth of second gearwheel in the power flow of the gear
iZ = Gear ratio
iA = Final drive ratio
V1000 = Calculated vehicle speed at engine speed of 1000 rpm
V7000 = Calculated vehicle speed at engine speed of 7000 rpm
Tires: = Rear 265/40 ZR 18, rolling circumference 2,042 mm (rdyn 325 mm + 1.5 – 2.5)

Transmission Ratio, G87.21 – Cayman S (987)

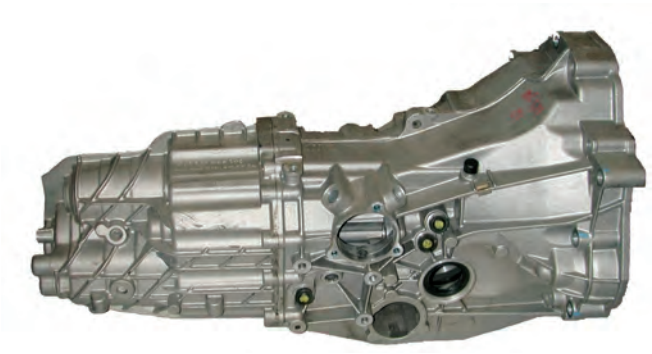
	Z_1	Z_2	i_Z $Z_2:Z_1$	i_A 8/31	i_{total}	V_{1000} km/h	V_{7000} km/h
1st gear	13	43	3.308	3.875	12.817	9.6	66.9
2nd gear	29	39	1.950	3.875	7.556	16.2	113.5
3rd gear	27	38	1.407	3.875	5.454	22.5	157.2
4th gear	30	34	1.133	3.875	4.392	27.9	195.3
5th gear	36	35	0.972	3.875	3.767	32.5	227.7
6th gear	45	37	0.822	3.875	3.186	38.5	269.2
Rev. gear	13	13/39	3.000	3.875	11.625	10.5	73.8

On the Cayman S, the ratios of the 3rd and 6th gear have been adopted from the Boxster S, which has the same rolling circum-ferences at the rear axle. The 1st and 2nd gear and reverse gear have been designed specifically for the Cayman S. This design results in a sporty setup and enables high performance with optimum exploitation of the engine torque and the maximum output

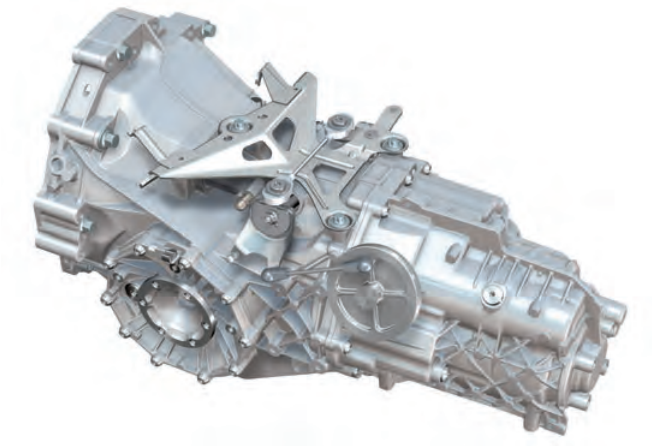
Z_1 = Number of teeth of first gearwheel in the power flow of the gear concerned
Z_2 = Number of teeth of second gearwheel in the power flow of the gear concerned
i_Z = Gear ratio
i_A = Final drive ratio
V_{1000} = Calculated vehicle speed at engine speed of 1000 rpm
V_{7000} = Calculated vehicle speed at engine speed of 7000 rpm
Tires: = Rear 265/40 ZR 18, rolling circumference 2,042 mm (rdyn 325 mm + 1.5 ¬ 2.5)

Transmission Housing

The transmission housing consists of two parts which are produced in a light metal alloy. In order to ensure direct air heat exchange, the surface of the housing is provided with cooling ribs. Cooling is supported by effective air routing with defined air inlet on the front underbody paneling.



Boxster S (987)



Cayman S (987)

Notes:

911 Turbo (996)

General

The 911 Turbo (996) came equipped with a six-speed manual transmission or optional Tiptronic automatic transmission used in the new 911 Turbo (996) is an evolution of the transmission from 1996 911 Turbo (993) G50.51.

To adapt the transmission to the new vehicle, all of the housing components have been redesigned and the gearshift mechanism converted to cable operation.

The major changes are as follows:

- Viscous clutch relocated to front-axle final drive (as with 911 Carrera 4)
- New transmission shaft mounting
- New differential
- New transmission ratios with stronger and quieter running gear sets

Note:
The Porsche Stability Management system (PSM) is standard equipment on the new 911 Turbo (996). As a mechanical locking differential would have an adverse effect on the PSM system, the 911 Turbo (996) cannot be equipped with a locking differential.

Manual Transmission Types:

911 Turbo (996)

- G96.50 World-Wide 2001 - 05

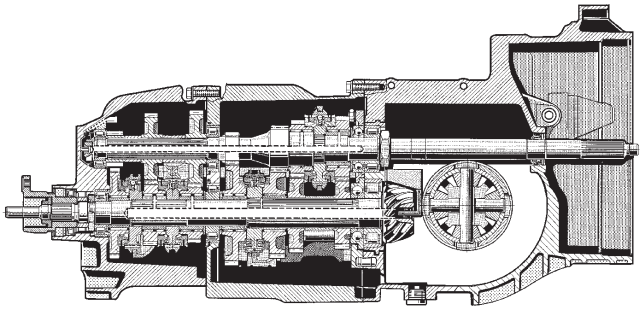
Tiptronic Transmission Type:

911 Turbo (996)

- A96.50 World-Wide 2001 - 05

Basic Tiptronic servicing and diagnosis is covered in a seperate section.

Transmission G96.50 – 911 Turbo (996)



The pinion shaft has been lengthened for the fourwheel drive configuration. The pinion passes through the front transmission case and drives the front axle via a single-piece drive shaft. The frontaxle final drive is identical to that used in the 911 Carrera 4.

Dual-Mass Flywheel/Clutch

The working cycles and the firing order of the engine cause speed fluctuations resulting in torsional vibrations along the drive train. These torsional vibrations may cause loose (nondriven) gear sets and parts of the synchronizers to rattle, chatter or bounce. This can result in annoying transmission noise, especially at low engine speeds and high transmission oil temperatures. To prevent these noises, the 911 Turbo (996) has a two-mass flywheel (TMF).

Clutch Ventilation

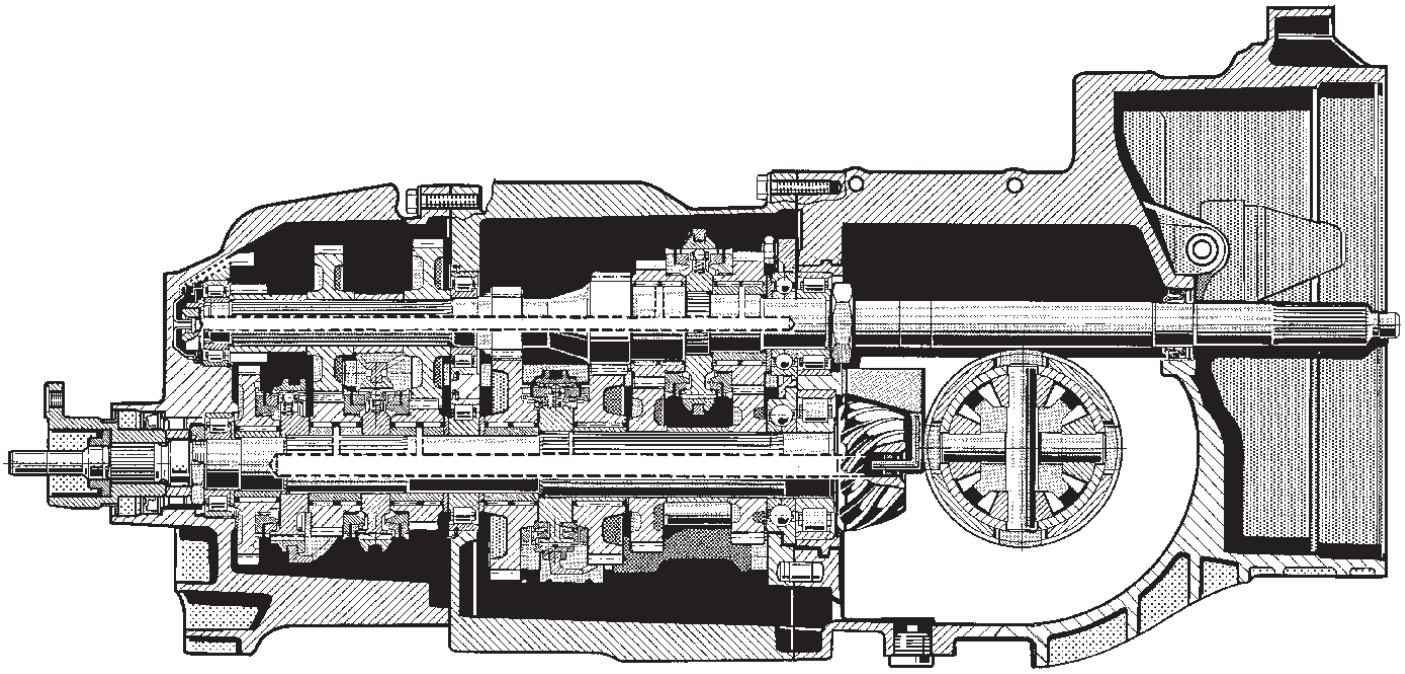
Clutch ventilation is used in the 911 Turbo (996). Radial vanes arranged on the back of the clutch pressure plate act as a blower when the engine is running.

Design

The clutch bell housing is completely sealed except for an inlet opening and an air extractor flange. Fresh air is drawn in via the inlet opening and flows through the pressure plate radially for cooling of the clutch friction surfaces.

The exhaust air is expelled through the air extractor flange integrated in the clutch housing. This clutch ventilation design reduces the temperature in the clutch bell housing, resulting in less clutch wear and a longer clutch service life.

G96.50 Transmission Cutout



Power-Assisted Clutch

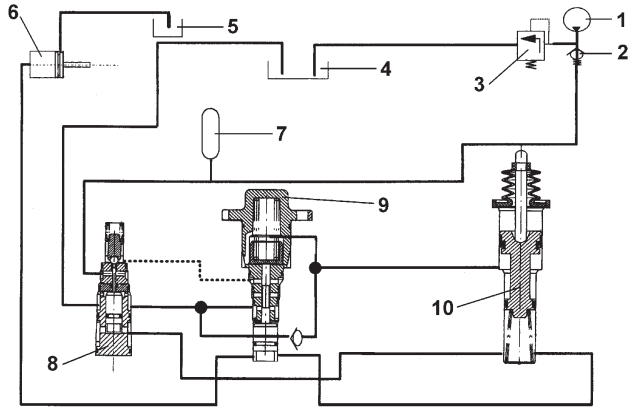
The new 911 Turbo (996) is equipped with a power assisted hydraulic clutch.

Design

A tandem power steering pump is used to provide the pressure for the power-assisted clutch. The pressure is generated in the second circuit of the pump and is limited to approx. 80 bar. The accumulator (7) is filled via a pressure limiting valve (3), which is located in the expansion tank. The power-assist servo unit consists of the accumulator (7), poppet valve (8), power valve (9), and slave cylinder (10).

The fluid reservoir for the clutch master cylinder is located in the fresh-air chamber (in front of the luggage compartment). The system is filled with Pentosin hydraulic fluid.

Note:
The threads of the caps for the windshield washing fluid reservoir (blue), brake fluid reservoir (black/yellow) and Pentosin fluid reservoir (green) are identical. **The caps could be mixed up by mistake.**



Power-assisted hydraulic clutch components.

1 - Tandem pump
2 - Non-return valve
3 - Pressure limiting valve
4 - Expansion tank for servo pump
5 - Fluid reservoir for clutch master cylinder
6 - Master cylinder
7 - Accumulator
8 - Poppet valve
9 - Power valve
10 - Slave cylinder

G96.50 Transmission Ratio – 911 Turbo (996)

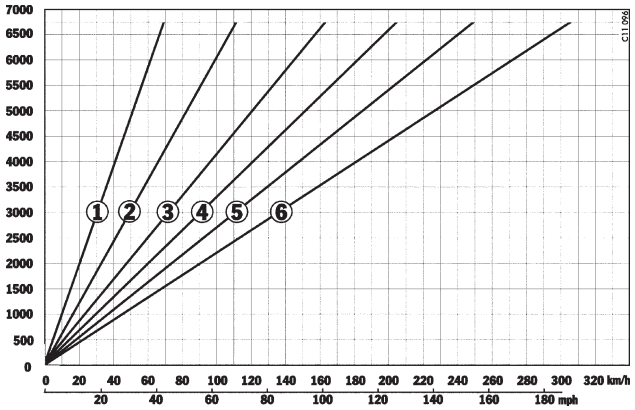
	Z1	Z2	iz Z2:Z1	ia	itot iz:ia	V1000 km/h	V6500 km/h
1st Gear	11	42	3.818	3.444	13.149	9.1	59.2
2nd Gear	21	43	2.045	3.444	7.043	17.0	110.5
3rd Gear	27	38	1.407	3.444	4.864	24.7	160.6
4th Gear	34	38	1.118	3.444	3.850	31.1	202.2
5th Gear	37	34	0.919	3.444	3.165	37.9	246.4
6th Gear	40	30	0.750	3.444	2.583	46.4	301.6
Rev. Gear	14	40	2.857	3.444	9.839	12.2	79.3

Z1 = Number of teeth in 1st gearwheel in power flow of corresponding gear
Z2 = Number of teeth in 2nd gearwheel in power flow of corresponding gear
iz = Transmission ratio
ia = Final drive ratio
V1000 = Calculated vehicle speed at 1,000 rpm engine speed
V6500 = Calculated vehicle speed at 6,500 rpm engine speed

With 295/30 ZR 18 rear tires, rolling circumference 1,998 mm, (rdyn 304 + 1.5% - 2.5%)

Note:
The values in the transmission diagram are indicative and are based on a mean effective rolling radius. Slight deviations due to the tolerance of the tires, change of rolling radius, wear, and slip of tires have not been taken into consideration.

Transmission Ratios – 911 Turbo (996) G96.50



Gear Versus Road Speed Graph

Viscous Clutch – See 911 Carerra (996) page 3.8.

Front Differential – See 911 Carerra (996) page 3.8.

Notes:

911 Turbo (997)

Manual Gearbox G 97.50 – General

The new 911 Turbo (997) is equipped with a 6-speed manual gearbox with hydraulic clutch assistance as standard. The gearbox has been reinforced and cooling improved due to the higher power and torque demands compared with the 911 Turbo (996).

The most important modifications:

- Reinforcement measures
- Improved cooling
- Adapted transmission ratios
- Shorter shift travels
- Synchronization rings with carbon coating
- Multiple synchronization

Transmission Ratios of G97.50

	Z_1	Z_2	i_Z $Z_2 : Z_1$	i_A 9/31	$i_{tot.}$	V_{1000} km/h	V_{6500} km/h
1st gear	11	42	3.818	3.444	13.149	9.5	62.0
2nd gear	22	47	2.136	3.444	7.358	17.0	110.8
3rd gear	27	40	1.481	3.444	5.102	24.6	159.8
4th gear	33	39	1.181	3.444	4.070	30.8	200.4
5th gear	38	37	0.974	3.444	3.353	37.4	243.2
6th gear	43	34	0.791	3.444	2.723	46.1	299.5
Rev. gear	15	40	2.67	3.444	9.195	13.6	88.7

Gear Versus Road Speed Graph

Z1 = Number of teeth of first gearwheel in the power flow of the gear concerned

Z2 = Number of teeth of second gearwheel in the power flow of the gear concerned

iZ = Gear ratio

iA = Final drive ratio

V1000 = Calculated speed at 1,000 rpm

V6500 = Calculated speed at 6,500 rpm

*With tires:= rear 305/30 ZR 19, rolling circumference 2,091 mm

Gearshift Mechanism

It was possible to shorten the shift travel by approx. 15 % by moving the deflection point at the gearshift lever, and the travel now corresponds to the current 911 (997) generation.

Gear Sets

All gear sets and the drive set are shot-peened in order to increase loading capacity.

Synchronization

The new 911 Turbo is provided with a triple carbon-coated synchromesh device in the first and second gears and a double carbon-coated synchromesh device in the third to sixth gears. The use of carbon improves the load capacity and shift comfort while maintaining the same service life.

Cooling

The cooling has been improved by modifying the ribbing on the gear housing and providing a new, additional ventilation opening in the underbody panel.

Rear Differential Lock

A mechanical rear differential lock with asymmetrical split is available as an option for the new 911 Turbo. The lock values are 22 % under traction and 27 % under deceleration, simlar to the previous 911 Turbo (996). On the 911 Turbo, the mechanical rear differential lock supports the driving dynamics of the controlled all-wheel system Porsche Traction Management (PTM), and offers the following advantages:

- Higher traction on changing road surfaces and when cornering in the limit range.
- Improved driving stability in the event of load changes when cornering in the limit range.
- Improved agility in curves in the event of high lateral acceleration in the limit range.

The rear differential lock is offered exclusively in conjunction with manual gearboxes for the new 911 Turbo.

Filling Capacity

The new filling quantity of the gearbox is 3.3 qts (3.5 liters), the change quantity is approx. 2.9 qts (3.1 liters).

Porsche Traction Management (PTM)

General

The intelligent all-wheel control Porsche Traction Management (PTM) for active control of longitudinal and lateral dynamics is used as standard for the first time in the 911 Turbo high-performance sports car. PTM enables optimum use of the high power output of the new 911 Turbo. The system provides increased driving stability, traction or more agile handling, depending on the driving situation. As a result, the vehicle is very agile on narrow country roads, offers exceptional traction and provides a high level of driving safety in the high-speed range, even in the case of extreme driving manoeuvres.

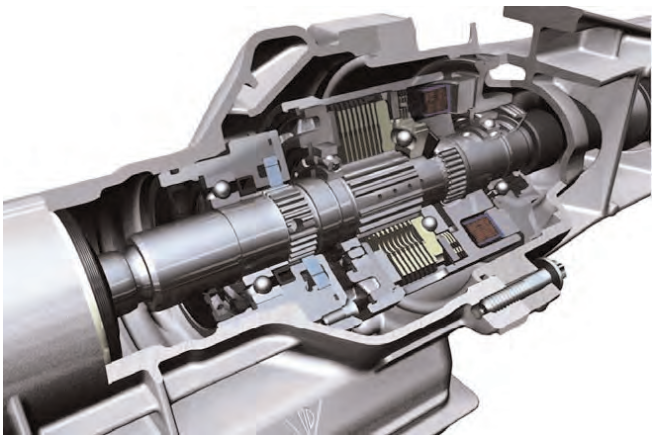
Porsche Traction Management is made up of the following systems:

- Full-time all-wheel drive with electronically controlled center differential lock for torque distribution between the front and rear axles
- Automatic Brake Differential (ABD) for traction improvement
- Anti-Slip Regulation (ASR) for slip control during acceleration and improved driving stability

PTM can optionally be supplemented by a mechanical rear differential lock.

PTM Control

The intelligent all-wheel control used in the new 911 Turbo actively controls drive torque distribution between the front and rear axles depending on the current driving situation and driver wishes. The PTM control unit evaluates different input variables such as the wheel speeds of all four wheels, lateral acceleration, longitudinal acceleration and steering angle. The aim of this torque distribution is to provide the driver with excellent driving dynamics and traction as well as maximum driving safety at all times. Several function sequences are checked in parallel in the control unit of the PTM, and are then evaluated and combined in order to define a control strategy. This strategy determines the required locking torque of the longitudinal clutch for the respective driving situation.



The PTM incorporates the following basic functions:

Basic Torque Distribution

The engine torque is distributed steplessly between the front and rear axles depending on the driving situation.

Derivative Action Control

If a driveaway situation is detected and rear wheel slip assumed on the basis of various input variables such as accelerator pedal position and change duration, the PTM clutch is already closed to such an extent that wheel spin is prevented as far as possible. This means that the maximum possible drive power is applied to all four wheels when driving away, therefore ensuring the best possible acceleration.

Slip Controller

If excessively high slip is detected between the two axles on the basis of the wheel speeds, additional torque and therefore increased drive power is supplied to the front axle through greater intervention of the multi-plate clutch.

Understeer Correction

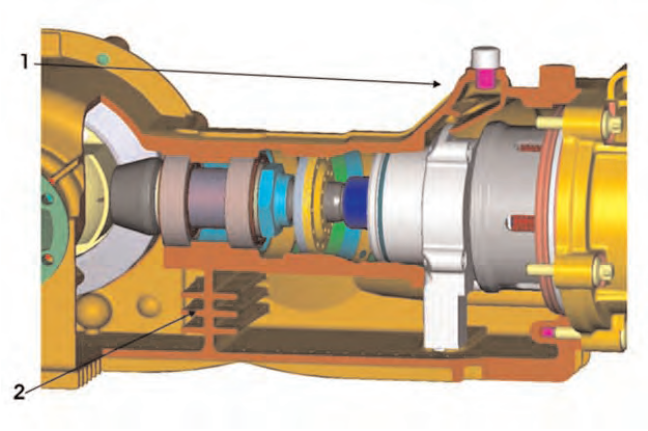
If the comparison between steering angle and yaw speed indicates vehicle understeer, less torque is supplied to the front axle and more torque to the rear axle in order to ensure dynamic vehicle stabilization.

Oversteer Correction

If the comparison between steering angle and yaw speed indicates vehicle oversteer, more torque is supplied to the front axle and less torque to the rear axle in order to ensure dynamic vehicle stabilization.

Front Axle Housing

The front axle housing is divided into two different oil chambers. The front area accommodates the front axle differential, which is filled with hypoid oil. The rear area accommodates the clutch chamber with the PTM clutch, which is filled with special ATF. Information on the oil types and oil quantity is provided in the list of approved oils.



1 - Labyrinth ventilation 2 - Heat exchanger

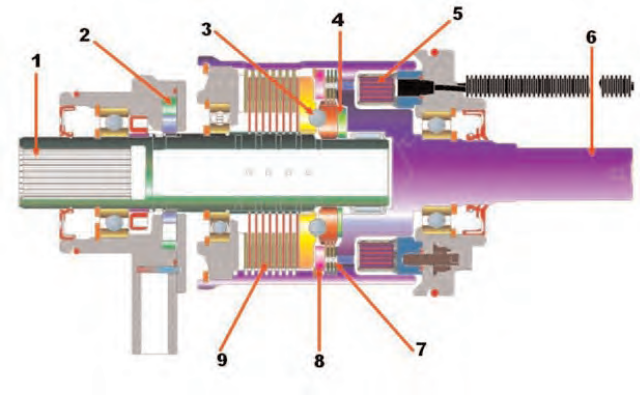
There is a heat exchanger (2) between the two oil chambers. If the multi-plate clutch has to compensate for different wheel speeds on loose ground, for example, the oil in the clutch chamber becomes warmer than the oil in the differential chamber, and the oil in the clutch chamber is therefore cooled by the oil in the differential chamber. In the case of higher driving speeds and therefore higher speeds in the differential housing, for example, the oil in the differential housing becomes warmer and is cooled by the oil in the clutch housing.



The front axle housing is cooled by the air stream by way of cooling fins.

PTM Function

One torque distribution in each case is calculated and summed in parallel in the PTM control unit from different input information. This results in a requested, summed torque distribution which is checked once more in the control unit and reduced again depending on the driving situation and/or ambient conditions. The actual setpoint torque distribution is then calculated and a pulse-width-modulated signal generated from this. This signal is used to control the solenoid (5) in the PTM clutch.



1 - Output shaft
2 - Oil pump
3 - Ball ramp
4 - Support element
5 - Solenoid
6 - Drive shaft
7 - Primary clutch
8 - Pick-up plate
9 - Main clutch

When the solenoid (5) is energized, the active pick-up plate (8) is pulled towards the primary clutch (7), thereby generating a torque in the clutch. The support element (4) provides the support required. The pick-up plate (8) is referred to as “active” because it simultaneously functions as a friction plate, which has the advantage that more torque can be transferred. The ball ramp (3) turns when a torque is generated in the primary clutch (7), thereby actuating the main clutch and producing a controlled frictional connection between the drive shaft (6) and output shaft (1).

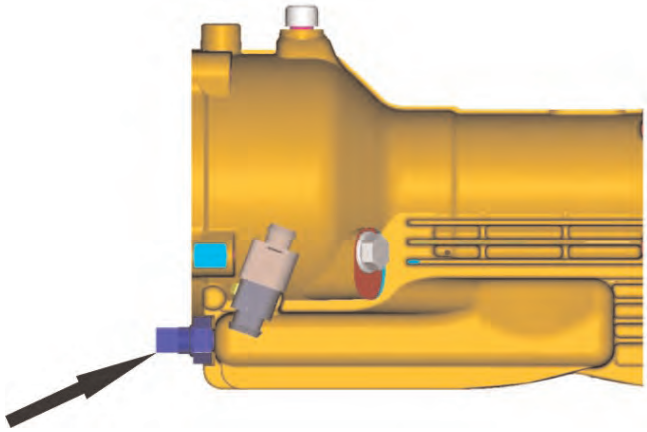
The advantage of this arrangement of primary clutch (which is controlled) and main clutch (which transfers the torque) is that the primary clutch is operated with a small current and only a small force is necessary in order to operate a large clutch capable of transferring a large force. For this reason, the reaction time of this system is also very short. This system can be compared with a working relay which switches a high working current with a small control current.

Lubrication



An oil pump (Figure 2 on previous page) is driven by the gearing of the output shaft. This oil pump supplies the plate assemblies with lubricating oil. The oil is sucked in through the oil suction snorkel in the oil sump and are supplied from there to the hollow output shaft. The output shaft is provided with cross bores to permit targeted lubrication.

Temperature Sensor



A temperature sensor (arrow) is screwed into the housing and measures the oil sump temperature directly so that the oil temperature in the clutch housing can be transmitted to the PTM control unit. If the oil temperature reaches a critical level, various measures are implemented in different stages in order to prevent clutch overheating. Diagnostics The PTM control unit is diagnostics-capable and can be read out with the PIWIS Tester.

Notes:

Tiptronic Transmissions

Porsche Tiptronic, a load-shiftable four speed sport transmission, became available in January, 1990, as an alternative to the conventional five-speed manual transmission.

Tiptronic Transmission Types:

911 Carrera 2 (964)
- A50.01 RoW/USA/Canada M.Y. 1990 - 91
- A50.02 RoW M.Y. 1992 - 94
- A50.03 USA/Canada M.Y. 1992 - 94

911 Carrera 2 (993)
- A50.04 RoW M.Y. 1995-98
- A50.05 USA/Canada M.Y. 1995 - 98

911 Carrera 2 (996)
- A96.00 RoW/USA/Canada M.Y. 1999 - 2001
- A96.10 RoW/USA/Canada M.Y. 2002 - 05

911 Carrera 4/4S (996)
- A96.30 USA/Canada M.Y, 1999 - 2001
- A96.35 USA/Canada M.Y, 2002 - 05

911 Turbo (996)
- A96.50 World-Wide 2001 - 05

911 Turbo (997)
- A97.50 World-Wide 2007

911 Carrera/S (997)
- A97.01 USA/Canada M.Y, 2005-on

911 Carrera 4/4S (997)
- A97.31 USA/Canada M.Y, 2006-on

Boxster (986)
- A86.00 M.Y. 1997 - 99
- A86.05 M.Y. 2000 - 04

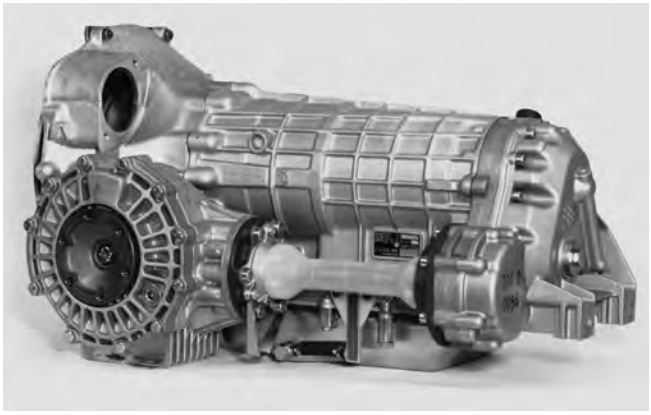
Boxster S (986)
- A86.20 M.Y. 2000 - 04

Boxster/Cayman (987)
- A87.01 M.Y. 2005-on

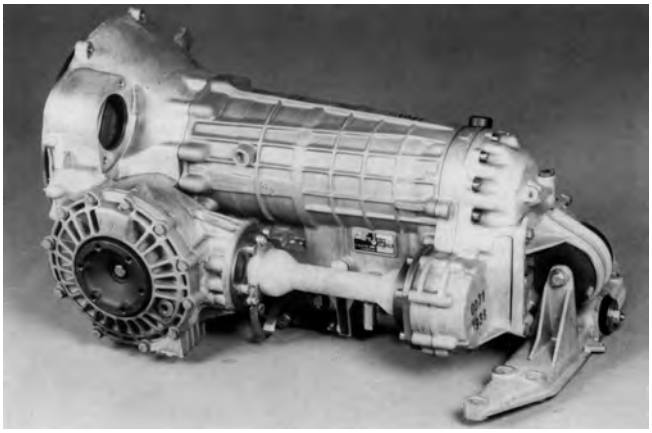
Boxster S (987)
- A87.20 M.Y. 2005-on

Cayman S (987)
- A87.21 M.Y. 2006-on

Transmission A50.01/02/03/04/05 – 4-speed



Tiptronic Transmission Type A 50.01



Tiptronic Transmission Type A 50.02/03/04/05

Repairing

With the introduction of the Tiptronic transmission on the 1990 911 Carrera 2 (964), repair work on Tiptronic transmission type A50 is limited to:

- Torque converter
- Front cover
- Spur gears, bearings and intermediate plate
- Valve body
- ATF Filter, pan and gasket
- Sensors
- Differential

Repair to the automatic section was not permited and required replacement of complete units.

Changes and Modifications

In 1992 the transmission front mount was changed.

In model year 1996 tuning as well as upshift and downshift points of the transmission were revised to improve engine output, environmental compatibility and comfort. As an additional feature, the transmission electronics were modified to incorporate the OBD II system for the USA market. Major modifications were:

- Retarded activation of reverse light by approx. .05 sec.
- Coding via PIWIS Tester
- Modified hydraulic control unit
- Gear monitoring based on computing of transmission ratio
- Shift lock control unit deleted
- Lateral acceleration sensor deleted
- Fault memory can only be erased with PIWIS Tester
- Reduced tooth backlash

Capacities

Fluid capacities and types can be found in each models Owner's Manual, Technical Manual and Technical Information Bulletins. Always refer to these before performing maintenance service.

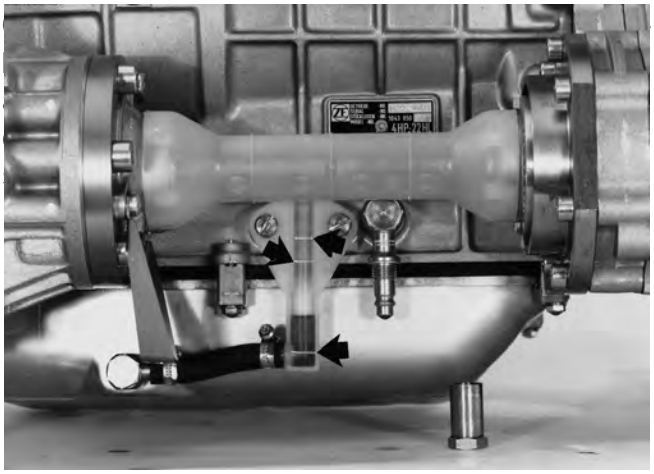
Diagnosis

PIWIS Tester is used.

Notes:

Changing ATF

Torque converter and series connected four speed planetary gear with control unit are filled with ATF DEXRON II D known from the eight cylinder automatic transmission program. ATF volume is 9 liters. ATF is cooled by an ATF cooler in the right front wheel house, in front of the engine oil cooler.



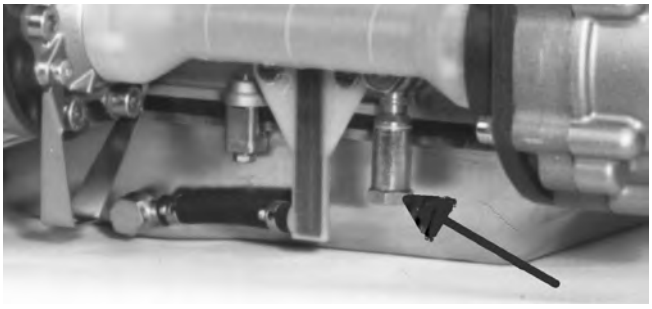
Checking ATF Level

Maximum at operating temperature

Minimum at operating temperature

Level at 68° F (20° C) ATF temperature

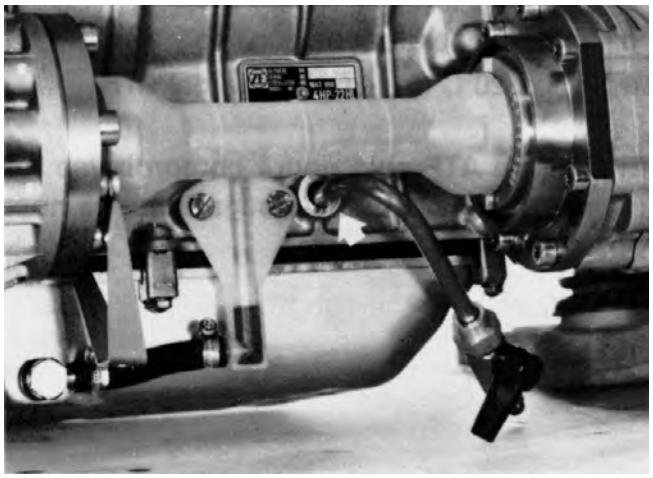
Filling ATF



ATF DEXRON II D can be filled in very easily through a fast-filling device on the right-hand side of the transmission case (arrow).



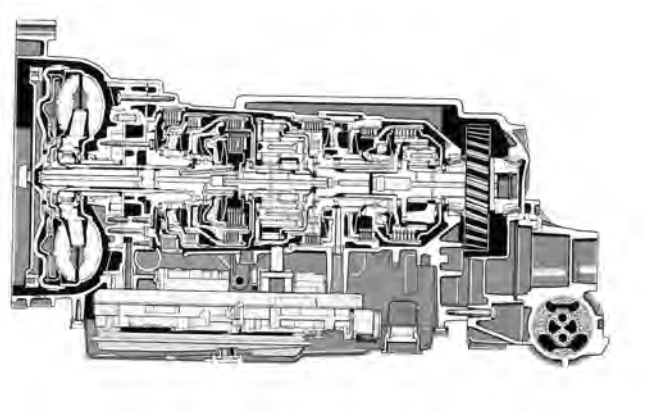
Adapters, which are suitable for all filling systems and depend on the filling hose diameter, are available for fast filling of the transmission.



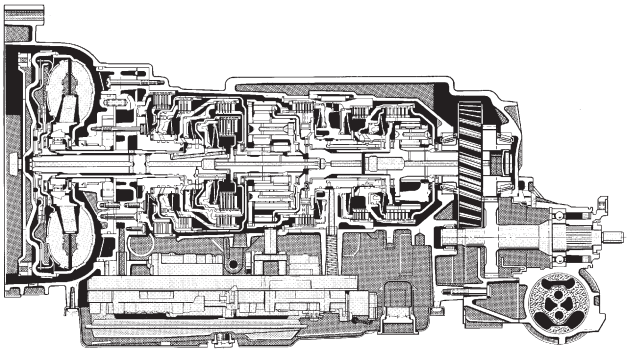
The fast-filling device can be unscrewed for emergency filling, so ATF can be poured in through a bent pipe (arrow).

Notes:

Transmission A96.00/30 – 5-speed



Tiptronic Transmission Type A 96.00 – 911 Carrera 2 (996)



Tiptronic Transmission Type A 96.30 – 911 Carrera 4 (996)

As an alternative to the six-speed manual transmission with mechanical disengaging clutch, a power-shifted five-speed sports transmission, Porsche Tiptronic, is also available. The principal advantage of this drive system is that it is possible to shift to a lower and higher gear both automatically and manually without a break in the tractive force.

The transmission is produced at the firm ZF in Saarbrücken, and is an automatic five-speed sports transmission with integrated hypoid axle drive with manual and automatic shifting.

Repairing

Similar to Tiptronic transmission type A50, repair work on transmission type A96 is limited to replacing or repairing:

- Selector lever switch
- Selector lever cable
- Valve body
- ATF Filter, pan and gasket
- Solenoid valves

Repairing (cont'd)

- Pressure regulator for modulation pressure
- Leak repair at the filler and drain plugs
- Differential
- ATF lines
- ATF cooler on transmission
- Torque converter
- Driveshaft flanges and seals

Repair to the automatic section was not permited and required replacement of complete units.

Capacities

Fluid capacities and types can be found in each models Owner's Manual, Technical Manual and Technical Information Bulletins. Always refer to these before performing maintenance service.

Diagnosis

PIWIS Tester is used.

Torque Converter

The converter comprises the impeller, turbine, stator, and the oil required for torque transmission. The impeller driven by the engine causes the oil in the converter to be pumped in a circular flow. This oil flow reaches the turbine and its flow direction is changed. The oil leaves the turbine at the hub and flows to the stator where its direction is once again changed. The oil is thus supplied to the impeller in the appropriate flow direction.

The change in direction creates a lock-up of at the stator. The reaction of the fluid increases the turbine speed. The ratio of turbine speed to impeller speed is known as the torque increase.

The greater the difference in speed between the impeller and turbine, the greater the torque increase which is at its maximum when the turbine is stationary. The torque increase drops as the turbine speed increases.

If the turbine speed reaches approx. 85% of the impeller speed, the torque increase is 1, i.e. the turbine speed is equal to the impeller speed.

The stator which is supported by the overrun clutch and the stator shaft to the transmission housing now runs free parallel to the flow and the overrun clutch overruns. From this point onwards, the converter functions as a pure flow clutch. During conversion, the stator is stationary and is supported by the overrun clutch to the housing.

Regulated Converter Lockup Clutch

The converter lockup clutch (CLC) is a device which eliminates slippage of the converter and thus contributes to the optimization of fuel consumption and to a sporty style of driving.

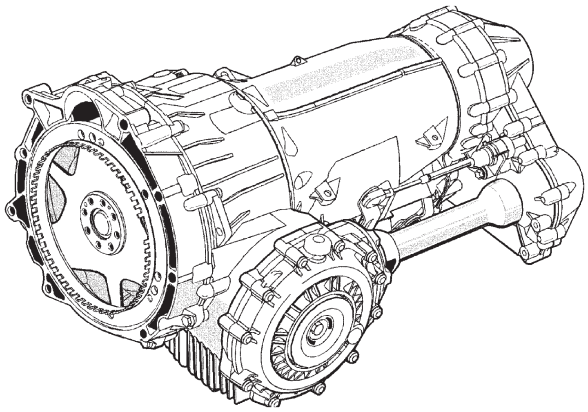
In the new 911 Carrera (996), control of the CLC actuation has been replaced by a regulation function. Intervention and opening of the CLC is regulated. During the regulation phase, a differential speed of approx. 50 rpm between pump and turbine is set. This prevents the torsional vibrations from the engine from being transmitted to the transmission which, in turn, optimizes shifting smoothness.

Pressure regulation at the CLC pistons is determined by an electronic pressure control valve (EPCV 4). When open (conversion range), the oil pressure is adjusted after the CLC pistons as well as in the turbine range. The direction of flow is determined by the turbine shaft through the area behind the pistons to the turbine chamber.

To close the CLC, the direction of flow is changed (reversed) by a valve in the hydraulic control unit (EPCV 4). At the same time, the space behind the CLC piston is bled. The oil pressure moves from the turbine chamber to the CLC piston and forces it against the cover (outer shell) of the converter. As a result, the turbine is locked by the lining disk between the piston and cover and allows rigid through-drive to the planetary transmission without slippage or slippage (in the case of regulated operation).

Notes:

Transmission A96.10/35/50 – 5-speed



Tiptronic Transmission Type A 96.10 – 911 Carrera 2 (996)

In model year 2001 911 Turbo came equipped with a optional Tiptronic transmission, type A96.50. It was a completey new design when compared to the previous 911 Carrera (996) Tiptronic transmission type A96.00/30.

In model year 2002 this new transmssion also replaced the previous ZF built transmission type A96.00/30 in the 911 Carrera 2/4 (996). The new type designation became A96.10 and A96.35.

The basic transmission A96.10/35/50 is manufactured by DaimlerChrysler under the internal type designation W5A 580.

W - Hydraulic torque converter
5 - Number of forward gears
A - Internal mode code
580 - Max. input torque in Nm

In order to satisfy handling dynamics requirements, the familiar shift strategies and special functions have also been adopted here.

Repairing

Similar to previous Tiptronic transmissions, repair work on transmission types A96.10/35/50 is limited to replacing or repairing:

- Sealing rings
- Valve body
- ATF Filter, pan and gasket
- Torque Convertor

Repair to the automatic section is not permited and requires replacement of complete units.

Capacities

Fluid capacities and types can be found in each models Owner's Manual, Technical Manual and Technical Information Bulletins. Always refer to these before performing maintenance service.

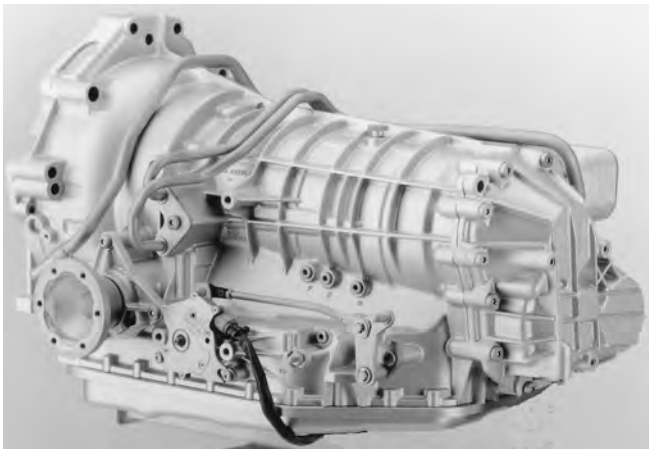
Diagnosis

PIWIS Tester is used.

Notes:

Transmission – Tiptronic

Transmission A86.00/05/20 – 5-speed



Tiptronic Transmission Type A86.00 – Boxster

The Boxster/S Tiptronic transmission is similar in design and concept to that of the 911 Carrera (996) Tiptronic transmision type A96.00.

The transmission is produced at the firm ZF in Saarbrücken, and is an automatic five-speed sports transmission with integrated hypoid axle drive with manual and automatic shifting.

Repairing

Similar to Tiptronic transmission type A50, major repair work on transmission type A96 is limited to replacing or repairing:

- Selector lever switch
- Selector lever cable
- Valve body
- ATF Filter, pan and gasket
- Solenoid valves
- Pressure regulator for modulation pressure
- Leak repair at the filler and drain plugs
- Differential
- ATF lines
- ATF cooler on transmission
- Torque converter
- Driveshaft flanges and seals

Repair to the automatic section is not permited and requires replacement of complete units.

Capacities

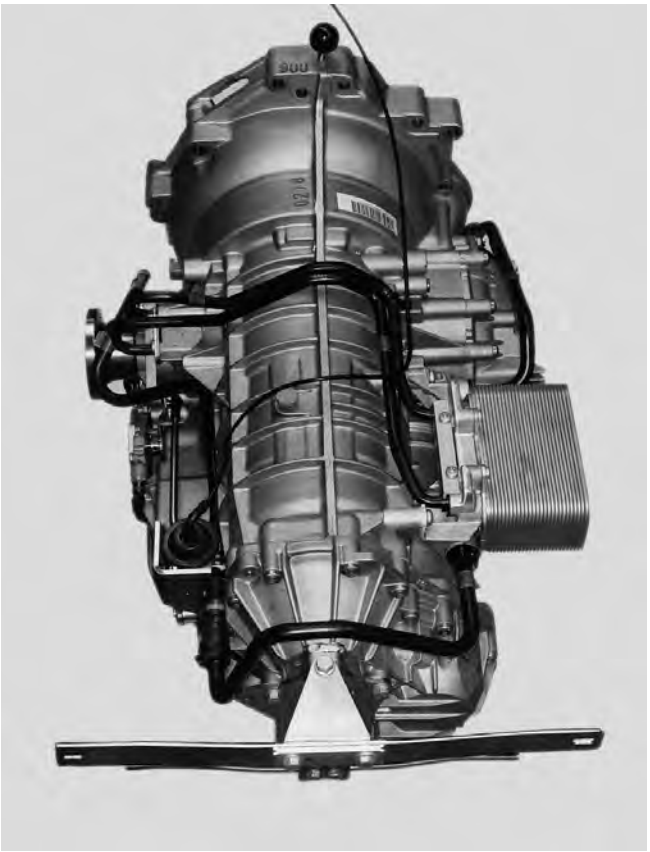
Fluid capacities and types can be found in each models Owner's Manual, Technical Manual and Technical Information Bulletins. Always refer to these before performing maintenance service.

Diagnosis

PIWIS Tester is used.

ATF Cooling

During operation with open converter lockup clutch, the ATF fluid heats up and must be cooled. An ATF-to-water heat exchanger is attached to the transmission.



Location of Boxster ATF Heat Exchanger

Notes:

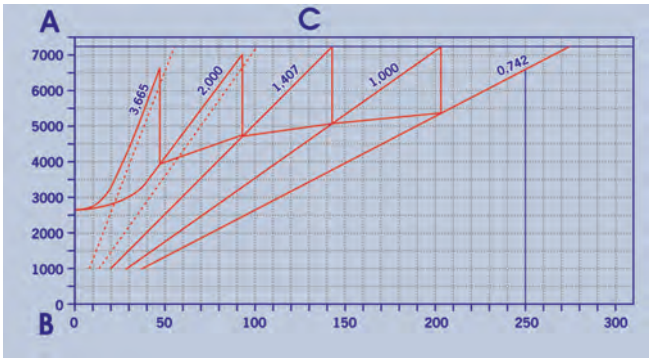
Tiptronic S, Type A87.01 – Boxster/Cayman (987)

General

The Boxster/Cayman (987) employ the established and proven 5-gear Tiptronic S transmission used on the previous M.Y. 2004 Boxster (986) model. The torque and performance potential of this transmission also covers the higher requirements of the new engine. The shift pressures have been increased to adapt to the transmission of the higher torque.

Transmission Ratio

In order to ensure attractive performance and a high level of driving dynamics, the ratio spread has also been adopted for the new models. The ratio spread has had to be adjusted since the dynamic tire rolling circumference of the new Boxster and Boxster S has been increased by 5 %. This adjustment has been achieved by reducing the axle and spur pinion ratio.



A - Engine speed
B - Speed in km/h
C - Constant transmission ratio = 4.379
Dynamic rolling radius = 0.324

Gearshift Strategies

The Boxster/Cayman (987) features the established Tiptronic S gearshift strategies. The tuning has been further improved with regard to upgrade and downgrade detection (longest possible use of low gears during uphill or downhill driving) and the height function. Adaptation of the shifting characteristic has been tuned for considerably sportier performance.

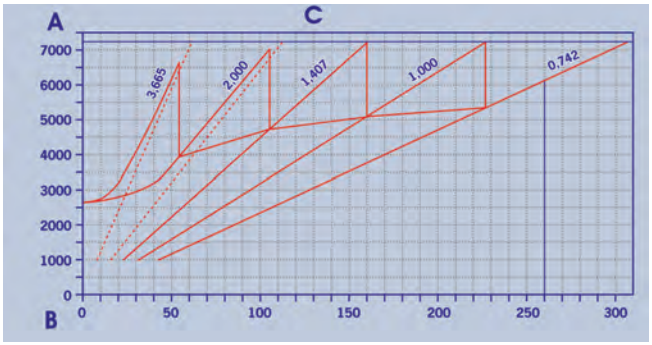
Tiptronic S, Type A87.20 – Boxster S (987)

General

The Boxster S (987) employ the established and proven 5-gear Tiptronic S transmission used on the previous M.Y. 2004 Boxster S (986) model. The torque and performance potential of this transmission also covers the higher requirements of the new engine. The shift pressures have been increased to adapt to the transmission of the higher torques, in particular those of the 3.2 liter engine.

Transmission Ratio

In order to ensure attractive performance and a high level of driving dynamics, the ratio spread has also been adopted for the new models. The ratio spread has had to be adjusted since the dynamic tire rolling circumference of the new Boxster and Boxster S has been increased by 5 %. This adjustment was achieved by reducing the spur pinion ratio by approx. 5%.



A - Engine speed
B - Speed in km/h
C - Constant transmission ratio = 3.908
Dynamic rolling radius = 0.324

Gearshift Strategies

The Boxster S (987) features the established Tiptronic S gearshift strategies. The tuning has been further improved with regard to upgrade and downgrade detection (longest possible use of low gears during uphill or downhill driving) and the height function. Adaptation of the shifting characteristic has been tuned for considerably sportier performance.

Tiptronic S, Type A87.21 – Cayman S (987)

General

The familiar and proven 5-speed Tiptronic S transmission from the Boxster model range is available for the new Cayman S as an option and the range of functions has been increased. The hydraulic and electronic control systems have also been fully revised.

The torque and performance potential of this gearbox also covers the higher requirements of the Cayman S engine.

Changes in comparison to the Boxster models:

– Transmission Ratio
In order to attain attractive performance and high driving dynamics, the ratio spread (spur gearing and final drive) has been adapted to the Cayman S. The ratio spread (spur gearing x final drive) stands at 4.161.

– Gearshift Strategies
Variable gearshift programs have been created for the Cayman S, as opposed to fixed shifting characteristics.

New Light-running Oil

In order to make gear changing as comfortable as possible and to keep the ATF change interval at 120,000 miles (180,000 km), a light-running oil is used.

Cruise Control Function

Another Tiptronic S function on the Cayman S is active downshifting when travelling downhill with the cruise control function selected. This ensures that the selected speed is maintained when travelling downhill, too.

Tiptronic S, Type A97.01 – 911 Carrera/S/4/4S (997)

General Information

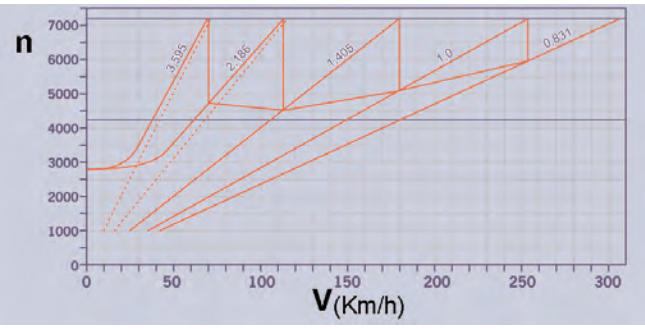
The 911 Carrera (997) and 911 Carrera S (997) use the proven 5-speed Tiptronic transmission from the 911 Carrera (996), model year 2004. The torque and performance potential of this transmission covers even the higher requirements of the new engines. The shift pressures have been increased to adapt to the transmission of the higher torques, in particular those of the 3.8 liter engine. An improvement in shifting comfort has been achieved through the fine-tuning of oil pressure buildup during the course of shifting. For the new four-wheel-drive 911 Carrera 4/4S (997) vehicles, the transmission has an additional connection for the cardan shaft to drive the front axle.

Overview of modifications:

- Adaptation of transmission ratio
- Upshift suppression in manual gate when "PSM OFF" is activated
- Revving function in overrun state
- Additional Sport Chrono function resulting in shorter shifting times
- Modified torque converter characteristic curve
- Engine can be revved up to rpm limitation in "P" and "N"
- Modified plates to improve shifting comfort
- New light-running oil and extended oil-changing interval
- Modified cruise control function

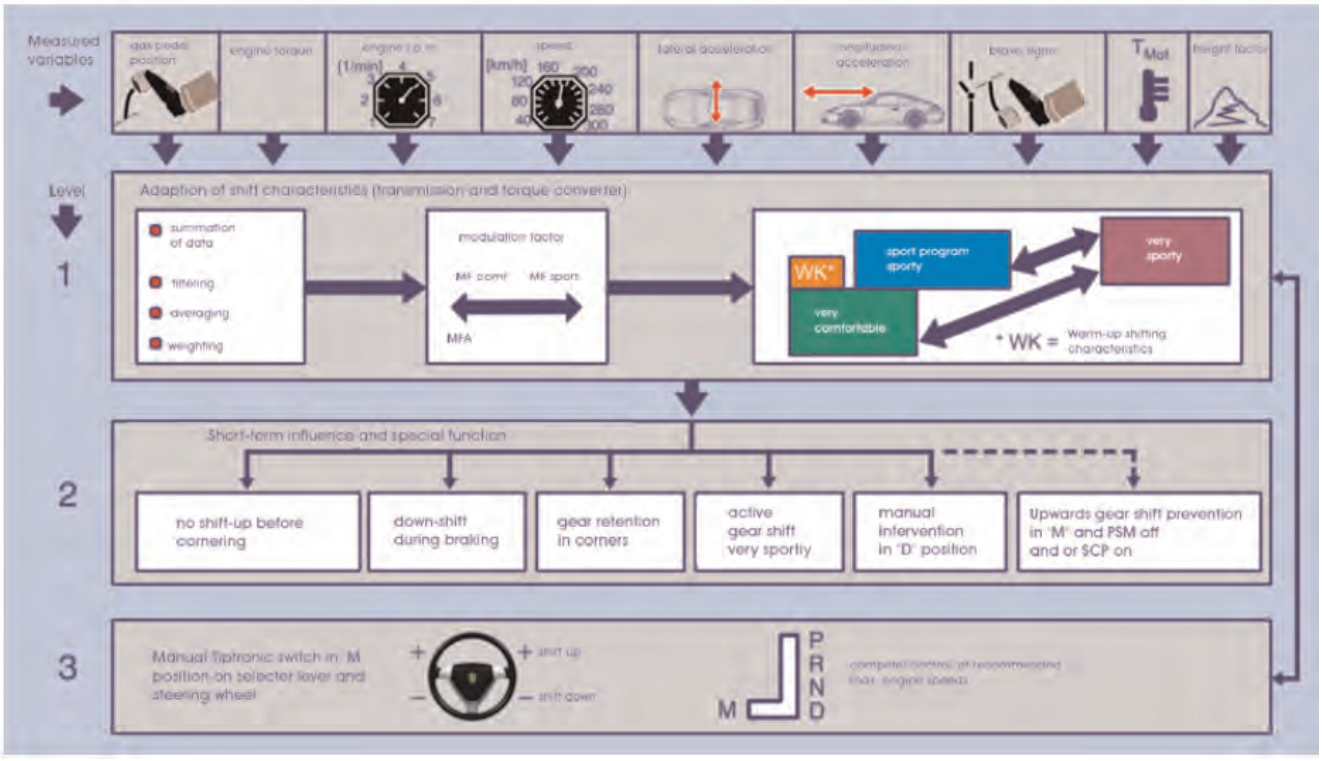
Transmission Ratio

To ensure performance and a high level of driving dynamics, the transmission ratio has had to be adjusted since the dynamic tire rolling circumference of the new 911 Carrera and 911 Carrera S was increased by 5%. This adjustment was achieved by reducing the spur pinion ratio by 5%.



Final drive ratio = 3.562, dynamic scrub radius = 0.325 m

Gearshift Strategies



Torque Converter/Starting Acceleration

Starting performance has been improved by altering the characteristic of the torque converter. To further improve acceleration when the accelerator pedal is pressed quickly followed by a downshift into 1st gear, the converter's bridging coupling is now closed in this situation, thereby reducing slip. A further improvement in acceleration when shifting from first to second gear has been produced by increasing the rpm of the shift point (from approx. 5800 rpm to 6300 rpm), thereby realizing a higher shifting speed (7200 rpm instead of 6900 rpm) and a shorter shifting time.

In order to further enhance the sporty character of Tiptronic S, in the 911 Carrera (997) and the 911 Carrera S (997) the engine can also be revved up to the engine speed limit when the vehicle is stationary, when the selector lever is set to "P" and "N".

Important:
If the engine is revved to over 2500 rpm when the selector lever is set to "P" or "N" and a gear is then engaged, the injection signal will be blocked until the engine speed drops to a level which cannot cause any damage to the transmission.

New Light-running Oil/Modified Plates

As a model improvement, all Tiptronic transmissions in the 911 series for model year 2005 use a new ATF light-running oil as well as modified plates. The modified plates improve shifting comfort and the light-running oil reduces friction losses in the gearbox. The new light-running oil also enables the ATF change intervals to be extended from 100,000 miles (160,000 km) to 120,000 miles (180,000 km).

Cruise Control Function

An additional new function of Tiptronic S for the 911 Carrera (997) and 911 Carrera S (997) is active downshifting when travelling downhill with the cruise control function selected. Previously, acceleration of the vehicle to a speed beyond the selected setting could occur in high gears when travelling downhill (without active downshifting by the driver) despite a cruise control function being selected. The new function for downshifting in cruise control mode ensures a constant speed, even when travelling downhill.

The established gearshift strategies of Tiptronic S have been largely retained for the new 911 Carrera and 911 Carrera S. These are complemented by the new special function Sport Chrono as well as modified shifting functions for when the PSM function is OFF.

The automatic program provides the familiar programs which are activated automatically or via the corresponding driving strategy. The shift points are continuously adjusted between the user-friendly basic gearshift program and the sporty program, according to the style of driving.

Similarly to the 911 Carrera (996), model year 2004, the automatic program is also influenced by the following functions:

- Suppression of upshifts during rapid throttle lift, for example before a corner.
- Earlier downshifts when braking depending on the driving speed and deceleration.
- Adjustment of the shift points due to incline detection. Here gradients or ascents are identified by comparing the actual and desired acceleration.
- Adjustment of the shift points as a function of the geographic elevation.
- Suppression of upshift in corners depending on the driving speed and lateral acceleration.

Tiptronic S, A97.50 – 911 Turbo (997)

General

The 5-speed Tiptronic S available as an option for the new 911 Turbo (997) is a further development of the transmission used in the 911 Turbo (996). It was necessary to make mechanical improvements and modifications to the dynamic gearshift operations due to the higher power and torque. The Tiptronic S for the new 911 Turbo has become even sportier thanks to shortened gearshift and reaction times and the new function “Downshift before braking”.

Torque Converter Lockup Clutch

The torque converter lockup clutch is also activated in 2nd to 5th gears on the new 911 Turbo with Tiptronic S. Control has been significantly enhanced compared with the 911 Turbo (996) with less slip and faster speed adaptation control, e.g. in the event of load changes. The response behaviour of the accelerator pedal commands is therefore even more spontaneous and the acceleration dynamics are increased.

Upshift Suppression, e.g. Before Curves (Fast Off)

The accelerator pedal no longer needs to be completely released in order to activate the upshift suppression function. This further increases driving dynamics, particularly on windy roads.

Downshift Before Braking (Fast Back)

The new additional function permits faster downshifting for braking operations in the case of a sporty, dynamic driving style. Immediate downshifting by one gear takes place if a change from the accelerator pedal to brake pedal occurs within 1.5 seconds. This additional function is available only for Tiptronic S on the new 911 Turbo (997) and assists the familiar function “Braking downshift”.

Normal braking downshifts are performed only corresponding to the braking deceleration. This results in a time delay from the start of braking until a downshift is initiated. This delay is significantly reduced by the Fast Back function. The first downshift occurs much more spontaneously compared with a normal braking downshift. Further downshifts are performed corresponding to the normal braking downshift function.

Notes:

PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Power-assisted steering: Check fluid level
- ❑ Engine: Check oil level
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ☑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ☑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ❑ Change engine oil: (oil filter change is not required)
- ❑ Air Filter: Check the air filter condition, and if necessary, replace
- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Power-assisted steering: Check fluid level
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze protection level
- ❑ Pollen filter: Replace filter element
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ☑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ❑ Vehicle lights: Check operation
- ❑ All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ❑ Change engine oil and oil filter
- ❑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ❑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ☑ Diagnosis system: Read out fault memory
- ❑ Polyrib belt: Check condition
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ❑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ❑ Power-assisted steering: Check fluid level
- ❑ Parking brake: Check free play of the parking brake lever
- ❑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ❑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ☑ Clutch: Check play or final position of pedal
- ❑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Check tightness on the front and rear suspension adjustment points
- ☑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Seat belts: Check operation and condition
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ❑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ❑ Replace Polyrib belt
- ❑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ☑ Manual transmission: Change oil
- ☑ Automatic transmission: Change ATF and ATF-filter
- ☑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ❑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ❑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ❑ Check airbag system
- ❑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.

❑ Change engine oil and oil filter

❑ Air Filter: Check the air filter condition, and if necessary, replace

☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage

❑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze

❑ Pollen filter: Replace filter element

❑ Brake system: Visual inspection of the brake pads and brake discs for wear

❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion

☑ Drive shafts: Visual inspection of the dust boots for leaks and damage

❑ Tires: Check condition and tire pressure

❑ Check firewall and cabrio section body drains for debris

❑ Check the door, lid locks and safety hook of the front lid for secure seating and function

❑ Vehicle lighting: Check function
All headlights: Check setting

❑ Horn: Check function

❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)

❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
❑ Replace fuel filter (Turbo only)
☑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

☑ Change manual transmission oil
☑ Change Tiptronic transmission oil and ATF filter
☑ Change Tiptronic transmission final drive oil
☑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

- ☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
- ❑ Change engine oil and oil filter
- ☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
- ❑ Coolant hoses: Check condition
  Radiators and air intakes: Visual inspection for external debris and blockage
  Coolant: Check level and antifreeze
- ❑ Air filter: Replace filter element
- ❑ Pollen filter: Replace filter element
- ❑ Fuel lines and connections: Visual inspection for damage and leaks
- ❑ Brake system: Visual inspection of the brake pads and brake discs for wear
- ❑ Parking brake: Check free play of parking brake lever
- ❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ☑ Clutch: Check the pedal play and end position
- ❑ Steering gear: Visual inspection of the dust boots for damage
  Tie rod ends: Check play and dust boots
- ☑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
- ☑ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ❑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ❑ Tires: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
- ❑ Vehicle lighting: Check function
  All headlights: Check setting
- ❑ Horn: Check function
- ❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ❑ Seat belts: Check function and condition
- ❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

- ❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

- ❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

- ❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
- ❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
- ❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

- ❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

- ❑ Replace drive belt
- ❑ Replace fuel filter (Turbo only)
- ☑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

- ☑ Change manual transmission oil
- ☑ Change Tiptronic transmission oil and ATF filter
- ☑ Change Tiptronic transmission final drive oil
- ☑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms “inspect” and “check” include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be performed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Notes:



Subject	Page
General Information	4.3
Front Suspension	4.3
Steering	4.6
Rear Suspension	4.7
Checking Power Steering Fluid	4.10
Brakes	4.11
Porsche Stability Management 8 (PSM)	4.14
Steering Angle Sensor	4.16
Porsche Active Suspension Management (PASM)	4.18
Tires	4.22
Tire Pressure Monitoring System (TPM)	4.22
N-Specification Tire Information	4.26
Maintenance Sheets	4.28

Notes:

General Information

911 Carrera/S (997) & Boxster/S (987)

The new 911 Carrera (997) and Boxster (987) chassis are an evolution of the previous 911 (996) and Boxster (986) designs. The revised standard chassis tuning gives the new models sportier performance than the previous versions, without affecting driving comfort. The new chassis can transmit significantly higher forces to the road in longitudinal and transverse direction than the previous 911 Carrera (996) and Boxster (986). This results in increased requirements for the chassis as a whole and particularly for the axle components.

911 Carrera 4/4S (997)

The chassis concept has been adopted from the 911 Carrera/S and adapted to the specific requirements pertaining to the four-wheel drive and the driving characteristics of the 911 Carrera 4/4S. Including the four-wheel-drive-specific tuning of the springs, dampers and anti-roll bars, the new four-wheel-drive models also further enhance the combination of driving enjoyment and practicality, offering maximum driving safety and comfort in conjunction with outstanding dynamic performance.

Boxster/S (987)

The Porsche Boxster (987) situates the engine between the axles, but behind the driver, with the vehicle's weight proportioned for nearly neutral handling. Because the Boxster is mid-engined, not rear-engined as is the 911, the rear suspension of the Boxster differs from the 911.

Cayman/S (987)

In terms of the essential design concept, the chassis of the Cayman/S corresponds to that of the Boxster/S. The special Cayman/S tuning in conjunction with the high torsional and flexural rigidity of the body leads to totally distinctive, sportier handling of the Cayman/S, combined with good ride comfort and generous safety reserves. The large track width underscores the vehicle's dynamic, sporty appearance. Virtually all moving parts in the axle assemblies are made of aluminum.

Suspension Overview

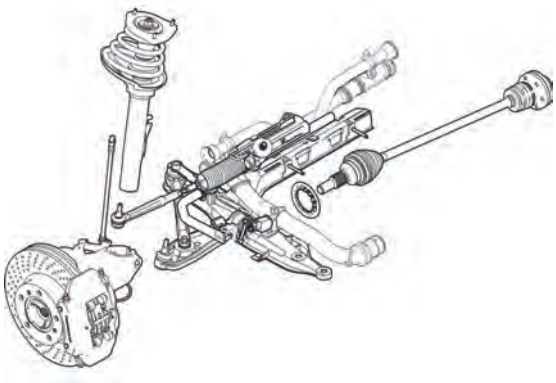
Front Suspension – 911 Carrera/S (997)



911 Carrera (997) *911 Carrera S (997)*

Similar to the previous 911 (996) models, the front axle consists of a strut suspension with longitudinal and transverse control arms. Some components of the front axle have been redeveloped for increased performance and to further increase crash safety. The track of the front axle has been increased by 30 mm) in comparison with the previous model.

Front Suspension/Axle – 911 Carrera 4/4S (997)



The basis is provided by the proven front-axle concept for the new 911 Carrera/S models. For the additional front-axle drive shafts, four-wheel drive specific wheel bearing housings are used which take into account the space requirements of these shafts. The special spring, damper and anti-roll bar tuning has been adapted to the higher front-axle loads and the driving dynamics of the four-wheel drive. This adaptation has been carried out for all available chassis variants (basic, PASM, sports chassis). The anti-roll bars have also been redesigned on account of the available space at the front axle as a result of the four-wheel-drive concept.

Running Gear

Front Suspension – Boxster/S (987)



Boxster (987)



Boxster S (987)

Similar to the previous Boxster (986) models, the front axle consists of a strut suspension with longitudinal and transverse control arms. This concept ensures very precise wheel guidance in combination with a high degree of rolling comfort.

Some components of the front axle have been redeveloped to take account of the increased performance and to further increase crash safety. As part of this redevelopment, the track of the front axle has been increased by 24 mm on the Boxster S (987) (between 24 and 35mm on the Boxster depending on optional wheels selection) in comparison with the previous Boxster (986) models. This measure, together with the larger and wider tires, helps to further reduce the tendency of the body to tilt, particularly when the vehicle's performance is exploited to the fullest, thereby improving support against transverse forces.

Front Suspension – Cayman/S (987)



Cayman (987)



Cayman S (987)

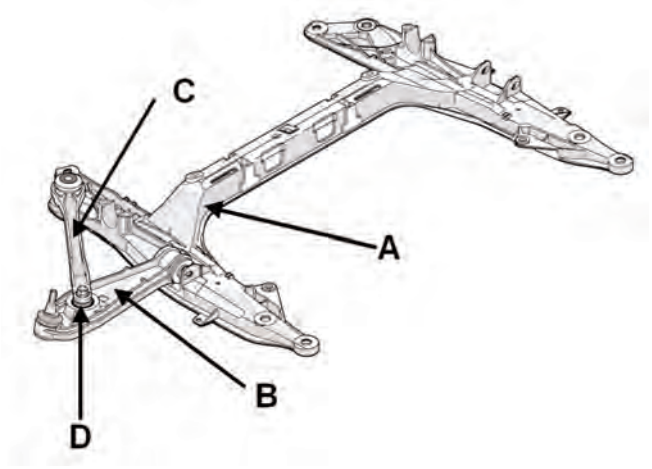
The design concept for the front axle on the Cayman/S originates from the Boxster/S. Many points of detail have been specially adapted to the requirements pertaining to a 2-seater mid-engine coupé and its high body rigidity.

The Cayman/S is provided with its own chassis set-up featuring special springs, dampers and anti-roll bars to ensure even sportier performance while maintaining the same level of comfort.

Similar to the Boxster, the front axle consists of a strut suspension with longitudinal and transverse control arms. This concept ensures very precise wheel guidance in combination with a high degree of rolling comfort. Components such as cross members, springs, dampers and anti-roll bar have been revised with regard to their effect on the front axle for improved crash safety.

Notes:

Front-axle Cross Member (A)



The front-axle cross member (A) for both models (911 and Boxster) has been completely based on crash requirements, particularly in an offset crash. At the same time, the cross member has been widened by 15 mm on each side. This has allowed the axle attachment points to be moved out by 30 mm to widen the track.

Boxster/S (987) – This has enabled the attachment points to be positioned correspondingly further towards the outside for the purpose of track widening in the range of 30 mm, resulting in an actual widening of the track by 24 mm (Boxster S) (between 24 and 35mm on the Boxster), depending on the wheel size and rim offset.

In order to reduce weight, the casting procedure for the front-axle cross member was switched from die-casting to pressure casting. Pressure casting makes it possible to cast generally thinner wall thicknesses, and material can be applied with high precision according to the areas exposed to stress.

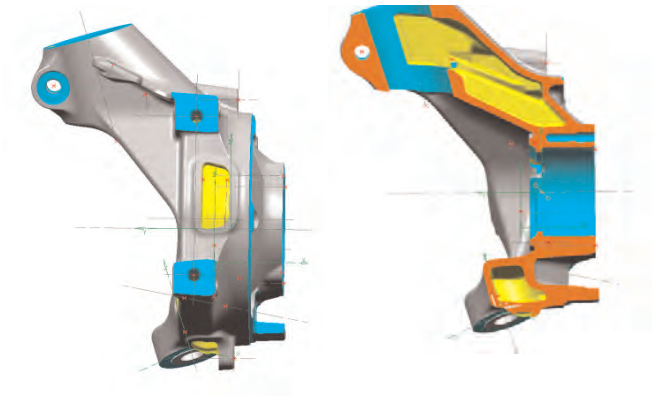
Control Arm (B)

The previous conventional rubber-bonded bushing which connected the trailing link and control arm has been replaced by a hydraulic mount (D) to increase driving comfort. This new mount ensures that high-frequency vibrations are suppressed more effectively, with less vibration transmitted to the steering wheel.

Control Arm (C)

By using the hydro mount in the transverse control arm, the mounting (fork) on the control arm was enlarged.

Wheel Bearing and Wheel Bearing Housing



To reduce weight, the wheel bearing housing is a rigid hollow-cast unit. The design of the wheel bearing housing was modified in order to optimize the supply of cool air to the brakes. Together with an enlarged brake air deflector on the cross member, this provides improved brake cooling.

The installation position of the ABS sensor has been adapted to fit the new style sensors. Depending on the brakes version (gray cast iron/PCCB), the brake caliper mounts are machined differently.

Reinforced wheel bearings with a larger diameter are used. In addition, the wheel bearings now also add the function of the former ABS pulse rings. They are fitted with a “multi pole” seal. This is a seal with a magnetized layer, which generates the torque impulses for the ABS rpm sensors.

Repairs:
The multipole seal must not come into contact with highly magnetic parts. On installing, it must be ensured that the magnetic side is facing the ABS sensor.

Wheel Bearings – 911 Carrera 4/4S (997)

Reinforced wheel bearings (diameter 80 mm) are used in order to reliably transmit the increased transfer forces generated by the higher performance. These offer the major advantage of firmer wheel guidance in transverse direction and thus contribute to the extremely precise driving behavior. In addition, the wheel bearings now also adopt the function of the former ABS pulse rings. They are also with a “multi-pole” seal.

Running Gear

Stabilizers

The stabilizer installation position above the front axle cross member improves crash safety. The relocation of the stabilizer attachment points has increased the transmission ratio of the stabilizer. The stabilizer responds more directly as a result to reduce the tendency of the vehicle to roll when cornering.

Spring Struts



911 Carrera (997)
Boxster/S & Cayman/S (987)

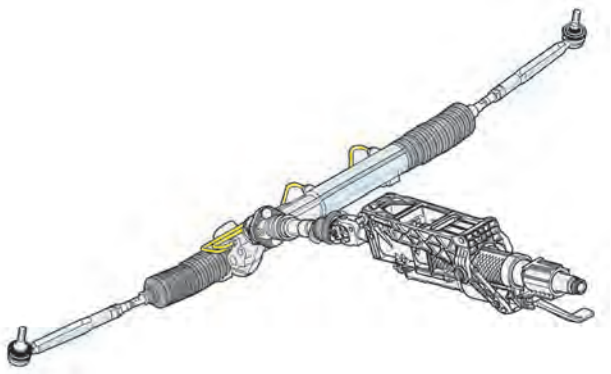


911 Carrera S (997)

The spring strut consists of a double-tube, gas-filled shock absorber and a new conical spring which has been adapted to the different vehicle variants. The springs have a color coding which indicates the spring tolerance and/or the chassis version.

Notes:

Steering



The 911 Carrera (997), Boxster (987) and Cayman (987) use hydraulically assisted rack-and-pinion steering with variable steering ratio. The near center ratio (17.11:1) remains similar to that of the previous models. The steering ratio becomes increasingly more direct with steering wheel movements of greater than approx. 30° (up to 13.76:1 for a steering wheel revolution of more than three-quarters). Total steering wheel revolutions from stop to stop have been reduced from 2.98 on the previous 996/986 to 2.62 on the new 997/987 models.

Another new feature is manual steering wheel height adjustment. In addition to the existing 40 mm (1.57 in.) reach adjustment; the steering wheel is now also height-adjustable by 40 mm (1.57 in.) (measured in extended state).

The steering wheel lock has been changed from mechanical to electric locking. This is a component in the networked immobilizer system and offers increased anti-theft protection. It also increases convenience since the electric steering wheel lock detects whether the steering cable is strained when the wheel is locked. When the ignition key is turned in the lock, the strain is detected and reported to the driver via a text message ("Unlock steering") in the display in the instrument cluster. The driver can then respond by turning the steering wheel slightly to release the strain. This prevents the ignition key "sticking" when turned in the lock with locked steering.

Tie Rod End

The tie rod ends were each lengthened by 15 mm.

Rear Suspension – 911 Carrera/S/4/4S (997)



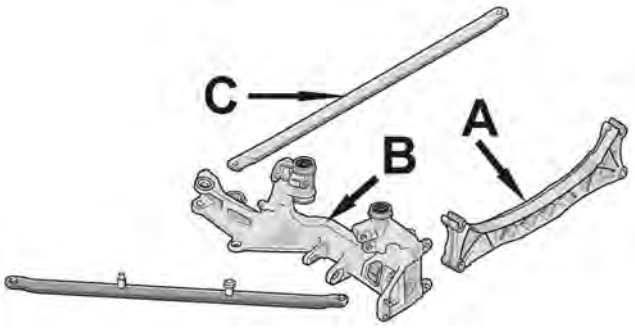
911 Carrera/4 (997)



911 Carrera S/4S (997)

The existing multi-link rear axle from the previous model has been enhanced for the 911 Carrera (997). The rear axle track has been widened by 30 mm (1.18 in.) and the rigidity of individual axle components has been increased. A reworked kinematic mechanism (with displacement of the axle attachment points) has significantly reduced vehicle deflection when accelerating.

The following components have been modified:



Rear Axle Bracket (A)

The design has been revised, and the cross member has been widened by 15 mm (0.59 in.) on each side. This has allowed the axle attachment points to be moved out by 30 mm (1.18 in.) to widen the track. In order to reduce weight, the casting procedure for the rear-axle cross member was changed from die-casting to pressure casting.

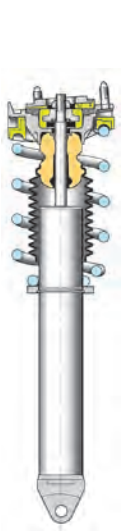
Rear Axle Side Section (B)

The aluminum side section has been redesigned and made more rigid, and lighter. The attachment points of the upper control arm have also been moved up 10 mm (0.39 in.) and the attachment points of the lower control arm moved down 5 mm (0.20 in.) (enlarged camber basis). This provides increased rigidity against transverse forces, which are introduced into the vehicle via the wheels. The screw connection to the body now consists of a stud and two collar screws.

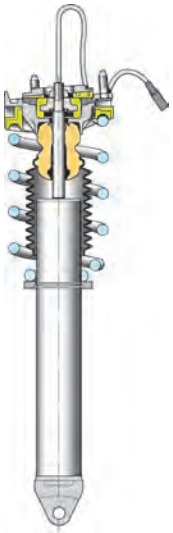
Cross Member (C)

The cross member has been lengthened by 30 mm (1.18 in.) in accordance with the broadened track.

Suspension Strut



Standard



PASM

The suspension strut consists of a single-tube gas-filled shock absorber and a coil spring that in turn is adapted to the different vehicle variants.

The springs are color coded to indicate spring tolerance and/or the chassis version. A single-tube aluminum shock absorber is used in order to reduce weight. To improve comfort, new support bearings with optimized shock absorption characteristics are used. The support bearings and the lower spring retainer are manufactured in different versions corresponding to the three chassis designs.

Wheel Carrier

To reduce weight, the wheel bearing housing is a hollow-cast unit. The dimensions and construction of the wheel bearing are identical to those of the front axle.

Stabilizer, 911 Carrera (997)

The stabilizers' setup in diameter and strength is designed to match the vehicle's weight and driving dynamics.

Basic chassis:	Tube 18.5 x 2.5 mm
PASM chassis:	Tube 18.5 x 2.5 mm

The relocation of the stabilizer attachment points from the suspension strut to the wheel carrier has increased the transmission ratio of the stabilizer. The stabilizer responds more directly as a result, which more effectively reduces the tendency of the vehicle to tilt when cornering.

Stabilizer, 911 Carrera S (997)

The stabilizers' setup in diameter and strength is designed to match the vehicle's weight and driving dynamics.

PASM chassis:	Tube 19.6 x 2.6 mm

The relocation of the stabilizer attachment points from the suspension strut to the wheel carrier has increased the transmission ratio of the stabilizer. The stabilizer responds more directly as a result, which more effectively reduces the tendency of the vehicle to tilt when cornering.

Stabilizer, 911 Carrera 4 (997)

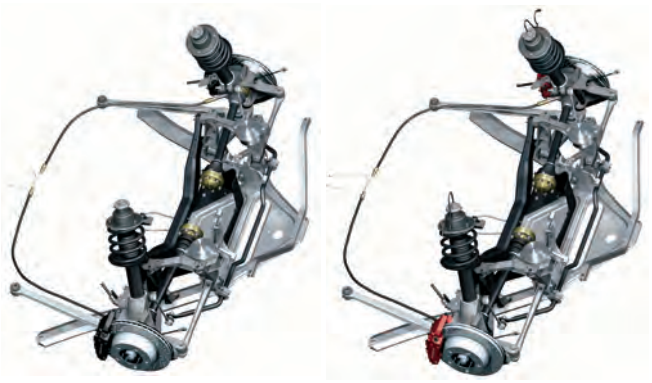
Basic chassis:	Tube 22.5 x 5.5 mm
PASM chassis:	Tube 18.5 x 2.5 mm
Sport chassis:	Tube 19.6 x 2.6 mm

Stabilizer, 911 Carrera 4S (997)

PASM chassis:	Tube 18.5 x 2.5 mm
Sport chassis:	Tube 19.6 x 2.6 mm

Notes:

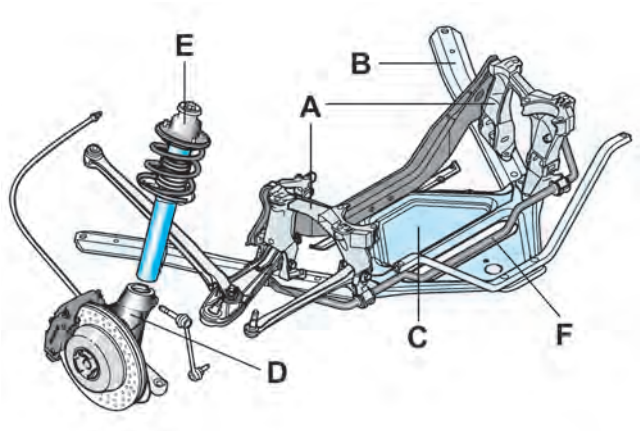
Rear Suspension – Boxster/Cayman (987)



Boxster/Cayman (987) *Boxster S/Cayman S (987)*

Certain details of the McPherson rear axle concept which is familiar from the previous Boxster/S (986) models have been optimized for the new Boxster/S (987) & Cayman/S (987). The main objectives here have been to increase transverse rigidity while at the same time reducing weight through the consistent use of light weight construction techniques and to improve driving comfort.

The following component modifications have been made:



Carrier Side Part (A)

The carrier side part is now produced in diecast aluminum for the purposes of weight optimization. This results in a weight reduction of approx. 2.2 lbs (1 kg). The kinematics has also been optimized in conjunction with the tie rod bearing, thereby improving the response of the chassis and providing for more agile driving characteristics.

Diagonal Strut (B)

The incorporation of a new diagonal strut consisting of an aluminum extruded section, which differs from its predecessor in that it is closed at the bottom, improves the torsional rigidity and the c_W/c_A value of the rear axle.

Cross Member Panel (C)

For reasons of weight, the cross member panel is produced in aluminum and is designed to improve ventilation of the transmission.

Wheel Carrier (D)

The steering arm has been enlarged to increase toe-in rigidity, which in turn is conducive to more precise wheel guidance. The camber rate has been increased by 30%. Another central development objective was weight reduction. In pursuit of this aim, the wheel carrier is now hollow instead of the previous solid piece. **The dimensions and construction of the wheel bearing are identical to those of the front axle.**

Suspension Strut (E)

The suspension strut consists of a coil spring with internal twin tube gas filled shock absorber. The springs have been adapted to the driving dynamics and are provided with color coding indicating the chassis version / spring tolerance.

Boxster (987)		
• Basic chassis	Spring rate	30 N/mm
• PASM chassis	Spring rate	40 N/mm
Boxster S (987)		
• Basic chassis	Spring rate	33 N/mm
• PASM chassis	Spring rate	40 N/mm
Cayman (987)		
• Basic chassis	Spring rate	37 N/mm
• PASM chassis	Spring rate	46 N/mm
Cayman S (987)		
• Basic chassis	Spring rate	40 N/mm
• PASM chassis	Spring rate	46 N/mm

The twin tube gas filled shock absorber has a larger outer tube than on the predecessor model. In conjunction with a longer guide length for the shock absorber, this results in an improved camber rate and enhanced response.

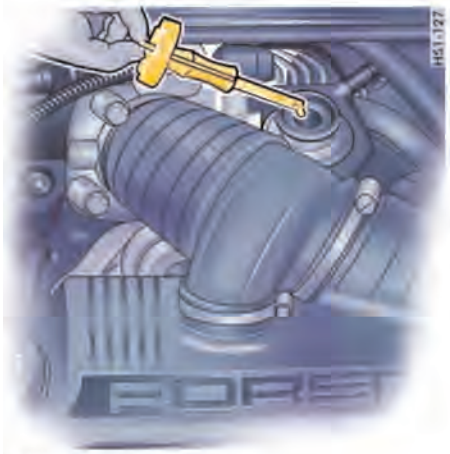
Stabilizer (F)

The stabilizers' setup in diameter and strength is designed to match the vehicle's weight and driving dynamics.

Boxster (987)		
• Basic chassis	Tube	19.0 x 2.7 mm
• PASM chassis	Tube	18.5 x 2.5 mm
Boxster S (987)		
• Basic chassis	Tube	19.6 x 2.6 mm
• PASM chassis	Tube	18.5 x 2.5 mm
Cayman (987)		
• Basic chassis	Tube	18.5 x 2.5 mm
• PASM chassis	Tube	18.5 x 2.5 mm
Cayman S (987)		
• Basic chassis	Tube	19.0 x 2.7 mm
• PASM chassis	Tube	19.0 x 2.7 mm

Notes:

Checking Power Steering Fluid – 911 Carrera/S (997) pictured below, Boxster/S (987) & Cayman/S (987) similar.



Power Steering

Power steering is assisted by hydraulic auxiliary forces.
The hydraulic fluid reservoir is located in the engine compartment.

Note

The flow noise heard at full steering lock is design-related and does not indicate a defect in the steering system.

⚠ Warning!

Risk of accident.
When the engine is stopped (e.g. when being towed) or the hydraulic system fails, there is no assistance for steering.
Therefore, substantially more force will have to be exerted in order to steer.

- ▷ Exercise great care when being towed.
- ▷ Have the fault remedied at your nearest authorized Porsche dealer.

Checking hydraulic fluid

- ▷ Please observe the chapter "EXERCISE EXTREME CAUTION WHEN WORKING ON YOUR VEHICLE" on Page 178.
- ▷ Only use hydraulic fluid authorized by Porsche. Specification:
  Please observe the chapter "CAPACITIES" on Page 268.

Check the fluid level with the engine stopped and **cold** (approximately 68°F/20°C).

1. Open the engine compartment lid.
2. Open the reservoir cap.
3. Wipe measuring rod.
   Close cap and reopen. The fluid level should lie in the area below the "Cold" marking.
   Add hydraulic fluid if necessary.
4. Close cap carefully.
   Close engine compartment lid.

Noticeable loss of fluid indicates leakage in the system.
The cause should be remedied immediately at an authorized Porsche dealer.

Brakes – 911 Carrera (997)

The 911 Carrera uses the same brake system as the previous model 911 Carrera (996). Improvements were in brake response behavior and brake cooling.

The system includes; black anodized aluminum 4-piston monobloc fixed calipers, cross drilled and internally ventilated brake discs, and brake pads matching the brake dynamics.

Brakes – 911 Carrera S (997)

Due to its increased performance, the 911 Carrera S uses a brake system with extra power boosting. The system is based on the brake system of the 911 Turbo (996).

The system includes reinforced 4-piston monobloc fixed calipers on the front and rear axle. The calipers are painted red to distinguish them from the calipers on the 911 Carrera model. The internally ventilated and cross drilled brake discs have also been enlarged, to 330 mm x 34 mm (diameter x width) on the front axle and 330 mm x 28 mm on the rear axle. The use of larger brake pads in comparison with the 911 Carrera model increases the effective total brake pad surface by approx. 24% on the front axle and 30% on the rear axle, which extends the service life of the brake pads.

Combined with improved brake cooling, the brake system of the 911 Carrera S provides excellent stability and consistent short stopping distances time after time without any noticeable brake fade.

Brakes – 911 Carrera 4/4S (997)

The brake systems from the new 911 Carrera/S models have undergone further development for the four-wheel drive 911 Carrera 4/S models. A higher-performance brake booster in tandem design and an enlarged brake master cylinder are employed here.

Brakes – Boxster/S (987)

The Boxster (987) and Boxster S (987) uses the same brake system as the previous Boxster/S (986) models with the exception that the brake response behavior and the brake cooling have been improved.

Brakes – Cayman (987)

The brake system originating from the Boxster (987) has been adopted for the Cayman (987) to take into account the high performance potential. Black anodized monobloc fixed calipers are used on the front and rear axles. PCCB is not planned for the Cayman (987).

Brakes – Cayman S (987)

The Cayman S brake system based on the Boxster S system. Large 4-piston monobloc fixed calipers are employed on the front axle. The calipers are provided with a red paint finish on the front and rear axle.

Brake Cooling

Brake ventilation for the new 911 Carrera (997), Boxster (987) and Cayman (987) models has been improved in comparison with the previous 996 & 986 models through a new front axle wheel carrier design, a 30 % larger brake air deflector and an optimized underbody lining. With these measures, more air reaches the brake rotor and the brakes are cooled more effectively. The cooling ducts and the cross drilled brake rotors support this effect. A wheel design with large openings has an additional positive influence on the cooling. The end result is a very stable brake system with a spontaneous response and low operating forces.

Brake Master Cylinder – 911 Carrera (997)

The brake master cylinder with a 23.81 mm piston diameter and a 20.5 mm stroke has improved brake fluid flow from the master cylinder to the PSM hydraulic unit. This measure and additional optimizations in the hydraulic unit made it possible to omit the pre-charge pump.

Brake Master Cylinder – 911 Carrera S (997)

The 911 Carrera S brake system offers an enhanced pedal feel with a more precise working point than that of the 911 Carrera model. This has mainly been achieved by enlarging the diameter of the brake master cylinder to 25.4 mm.

Brake Master Cylinder – 911 Carrera 4/4S (997)

In order to attain an optimum pedal feel with a more precise working point, the diameters of the brake master cylinder have been increased to 25.4/25.4 mm on the Carrera 4 and 26.99/26.99 mm on the Carrera 4S.

Brake Master Cylinder – Boxster/Cayman (987)

The brake master cylinder with a piston diameter of 23.81 mm and a stroke of 18 mm has been optimized primarily in the area of the central valves. This has improved the flow rate from the expansion tank to the PSM hydraulic unit. This measure and further optimizations in the hydraulic unit have made it possible to omit the pre-charge pump.

Brake Booster – 911 Carrera/S (997)

The 911 Carrera/S brake booster "boosting" factor has been increased i=4.5 (previously i=4.35) to ensure a spontaneous braking response.

Brake Booster – 911 Carrera 4/4S (997)

A compact, higher-performance 9/9" tandem brake booster with a transmission factor of i = 5.5 is used instead of the 10" single brake booster which features on the 911 Carrera/S. The total surface area of the tandem brake booster is around 45 % larger than that of the single brake booster. This results in a noticeable improvement in braking performance and thus in active safety.

Brake Booster – Boxster/S (987)

The boosting factor of the brake booster has been increased to i = 4.5 in comparison with the previous Boxster (986) model. This means that less force has to be applied when braking and a more spontaneous brake response is produced than was previously the case.

Porsche Ceramic Composite Brake (PCCB)



The Porsche Ceramic Composite Brake (PCCB) is available as an option for the first time for the 911 Carrera (997), 911 Carrera S (997) and the Boxster S (987). And also available as a option on the new Cayman S (987).

The PCCB provides increased performance in comparison to the standard brake system.

The main advantages of the PCCB are:

- Faster response
- Very high fading stability thanks to consistently high friction values
- Large safety reserves, even under extreme loads
- 50 % reduction in the rotating mass and unsprung weight compared to cast iron brake discs of the similar construction
- Long service life of brake components

The PCCB is the result of years of experience of Porsche as a technological leader in the field of brake systems, and is based on carbon fiber-reinforced ceramic brake discs with evolvent cooling ducts as well as specially matched brake pads made from composite material. The ceramic brake discs are manufactured by silicating specially treated carbon fibers in a vacuum process at around 3100° F. (1,700° C.).

The brake package comprising of ceramic discs with 350-mm diameter for all four wheels and the composite brake pad, together with the 6-piston aluminum monobloc fixed calipers on the front and 4-piston aluminum monobloc fixed calipers on the rear axle, ensures high and, above all, constant friction values – whether the brake system is hot or cold. This provides a good foundation for a short braking distance even under very high loads.

The brake discs are equipped with several small arch-shaped cooling ducts. This results in greater rigidity and improved cooling of the brake disc.

The PCCB sets definite standards in the areas of weight, fading stability and responsiveness. The ceramic disc is perforated and internally ventilated like conventional cast iron brake discs, but weighs approx. 50% less than a cast iron disc of the same design.

Since this weight reduction refers to the unsprung weight, as well as having a positive effect on fuel consumption it actually improves driving behavior with regard to agility and handling.

The PCCB retains its excellent fading stability even under extreme loads to offer a high level of safety, particularly when braking from high speeds. The brake system also exhibits excellent characteristics in relation to braking response with considerably reduced pedal force requirement.

Another advantage of the PCCB is its long service life. Abrasion of the ceramic brake disc is exceptionally low due to the disc's extreme surface hardness in comparison with a cast iron brake disc. The new brake pads also have a long service life. However wear on the components of the brake system, particularly pads and brake discs, is very much dependent on how the vehicle is driven and the conditions of use.

As a result of its outstanding brake fade stability, and particularly its very low weight, the PCCB is ideal for use at high temperatures and use on race circuits. It is on the race circuit or as a result of similar extreme driving that wear on the brake, and in particular on the brake pads, will increase sharply. After an intensive weekend on the race track, as in the case of high-performance steel brakes, the brakes components will need to be checked for wear and replaced as necessary.

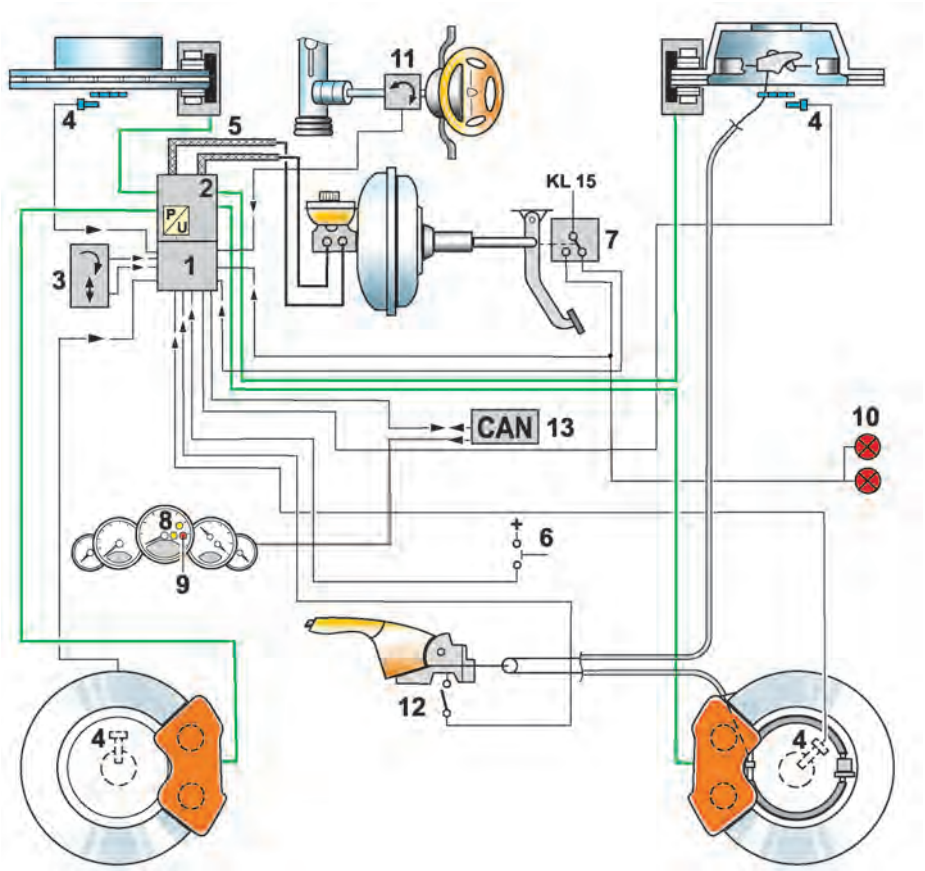
As a technical innovation, the PCCB offers a high level of quality, safety and driving pleasure, even under extreme driving conditions, thanks to its characteristics of reducing the unsprung weight, its consistently high friction values and its low wear.

Vacuum Pump



The 911 Carrera/S (997), Boxster/S (987) and Cayman/S (987) all have a mechanical vacuum pump installed on the engine instead of a vacuum amplifier for providing the brake booster vacuum. This design enables a high and constant level of vacuum supply and subsequent effective brake boost even when the most unfavorable underlying conditions apply, e.g. low external air pressure at high altitudes, and in highly dynamic driving involving a high proportion of full-load operation, e.g. on race tracks.

Notes:



PSM 8 Components

1 - PSM control unit
2 - Hydraulic unit
3 - Yaw velocity/lateral acceleration-sensor
4 - Speed sensor
5 - Flexible lines
6 - PSM OFF switch
7 - Brake light switch
8 - Instrument cluster with PSM warning and function lights
9 - ABS warning light
10 - Brake lights
11 - Steering angle sensor
12 - Switch for parking brake warning light
13 - CAN

Porsche Stability Management 8 (PSM)

Porsche Stability Management (PSM 8) is a standard equipment on the 911 Carrera (997), Boxster (987) and Cayman (987) models. This system is a revision to PSM 5.7. PSM 8 comprises ABS (anti-lock braking system), ASR (anti-slip regulation), EDC (engine drag torque control), ABD (automatic brake differential), EBD (electronic brake-force distribution) and VDC (vehicle dynamic control).

A special Sport mode is available for the first time in PSM as part of the optional Sport Chrono Package Plus. With this system, the driver is allowed more freedom before PSM intervenes than on the previous system. PSM deliberately waits until the last moment to intervene, particularly at low speeds up to around 43.5 mph (70 km/h).

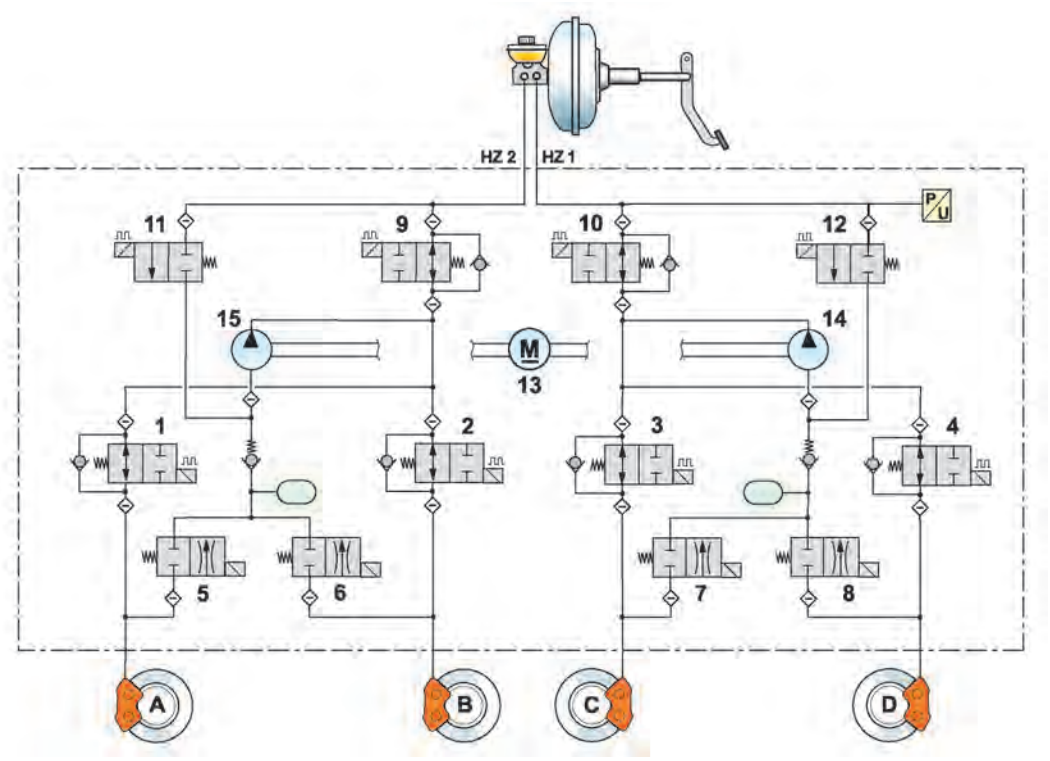
Increase in Comfort

Control comfort has been noticeably improved. PSM interventions with the new system are noticeably smoother and more harmonious thanks to enhanced control algorithms. PSM control noises have been significantly reduced in comparison with the previous PSM.

Three measures were implemented to reduce the control noise:

- Specific PSM software customization to control the PSM hydraulic pump as required. The full pump performance and thereby pump speed, which is the main source of the noise, is only requested when absolutely necessary for the driving situation or the PSM intervention.
- Use of hydraulic damping elements in vicinity of the PSM hydraulic pump. These ensure that pressure pulsations caused inside the brake system during the PSM interventions are reduced.
- Fitting of new, softer brake line holdings to detach the brake line from the body to reduce structure-borne noise.

The sum total of the implemented measures results in a noticeable reduction of the control noises during PSM intervention when compared to the previous system.



Hydraulic Unit Components

1-4 - Inlet valves
5-8 - Outlet valves
9-10 - Switchover valves connection
11-12 - Intake valves
13 - Pump motor
14-15 - Pumps
P/U - Internal pressure sensor
HZ1 - Inlet for front axle brake circuit
HZ2 - Inlet for rear axle brake circuit

Hydraulic Unit



The hydraulic unit consists of the control unit, electronic circuit breakers for the pump and the solenoid valves, linear solenoid valves and a pump unit. The pre-charge pump has been omitted. These measures, in conjunction with an optimized brake master cylinder, allow for simplified intake of brake fluid, particularly in cold state. In order to reduce transmitted noise, the lines between the brake master cylinder and the hydraulic unit are flex lines.

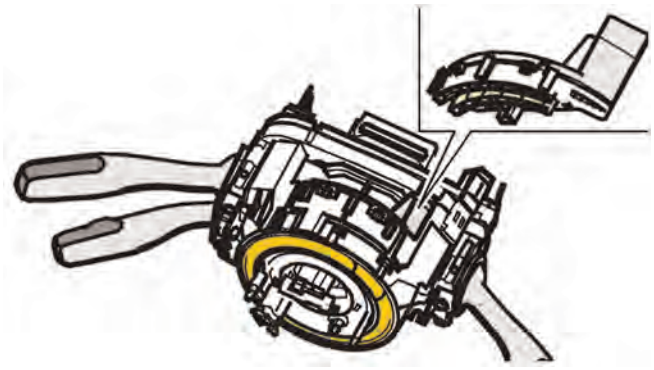
Within the respective brake circuit, the isolating valves (9, 10) enable pressure increase via the pump to the ABD and VDC controls. The pump's suction side is switched to the tandem brake master cylinder fluid reservoir using the electrical switchover valves (11, 12).

Reduced Weight

The introduction of the PSM has permitted a significant reduction of the system's weight. As a result, the hydraulic priming pump including bracket and hydraulic connecting line is no longer required. The PSM 8.0 pump can now ensure the dynamics required for the entire system (brake pressure build-up for PSM interventions) on its own without pre-charging, which has allowed the PSM system weight to be reduced.

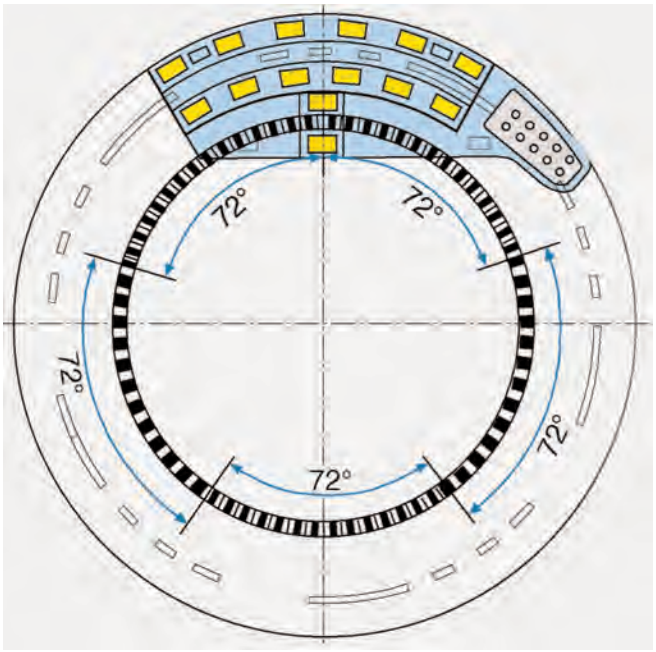
Notes:

Steering Angle Sensor



The steering angle sensor previously mounted on the steering column of the earlier system has been replaced by the one from the Cayenne for the purpose of standardization.

The steering angle sensor consists of an optical segment sensor and code plate which are integrated with the steering column switch. The light emitted by the segment sensor is interrupted by the inner ring in a specific sequence, so that 5 segments of 72 degrees per revolution will result. The outer ring is configured in such a way that interruptions of different lengths occur, from which the system can calculate the exact steering angle. Sensor data is sent to the PSM control unit via the CAN bus.



The steering angle sensor must be initialized or calibrated after:

- Initialization after interruption of power supply terminal 30
- Calibration after any suspension work (alignment, parts replacement)

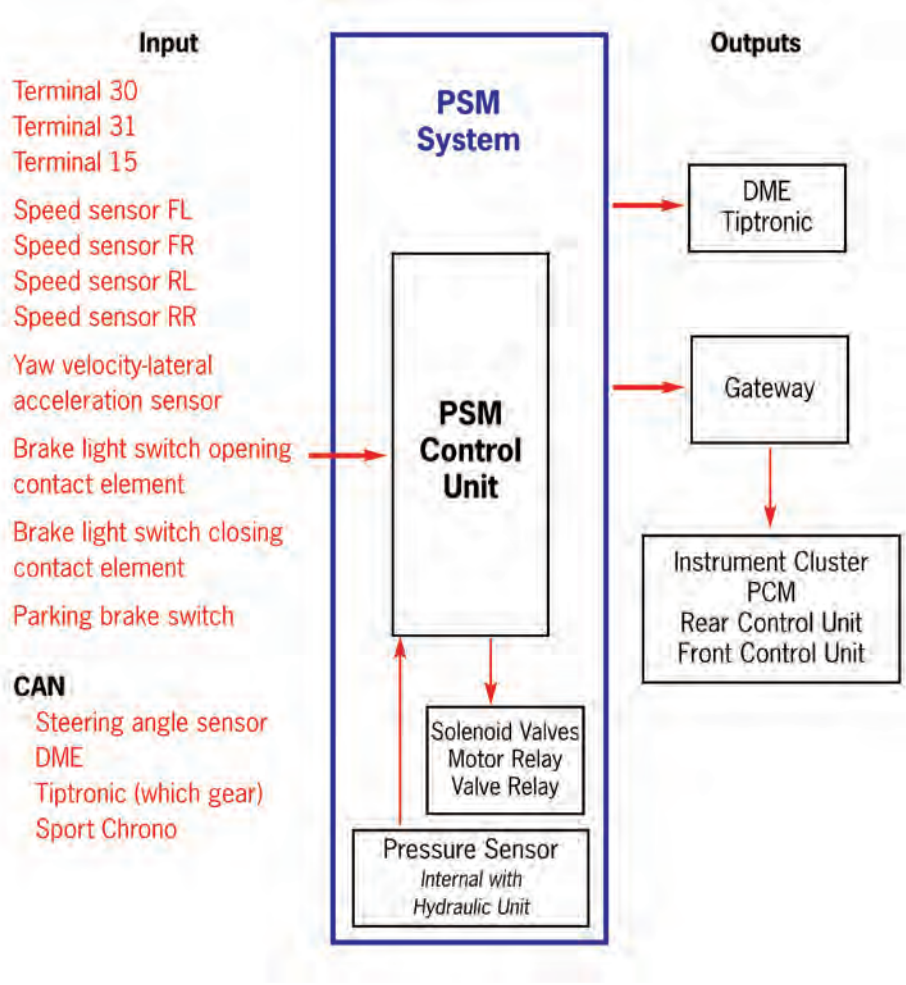
PSM Off Switch



PSM can be switched off via a switch in the center console (PSM Off switch). ABD remains active when PSM is switched off to ensure good traction when accelerating out of corners and on surfaces with different friction values.

The vehicle dynamic control can be reactivated in emergency situations by pressing the brake. PSM 8 is different in that the brake pedal must be pressed with more force than before to activate the system. This affords the sporty driver more scope since gentle pressure on the brake will not result in vehicle dynamic control interventions thus allowing the driver to brake the vehicle into corners. If Sport Chrono is active at the same time, the vehicle dynamic control will intervene at an even later point, i.e. at even higher brake pressure, if necessary.

The system switch-off is indicated to the driver via the PSM function light in the instrument cluster and the indicator light in the PSM switch. A gong also sounds and the text "PSM OFF" appears in the multi-function display in the instrument cluster. The lights go out and the text message "PSM ON" appears when PSM is switched back on. The text messages automatically disappear after 10 seconds, but can also be acknowledged using the on-board computer lever.



PSM 8 Control Module

The PSM Control Module is integral with the hydraulic unit, and is permanently attached to the valve block. The incoming signals are processed inside the control module and forwarded directly to the integrated valves and to the relays.

PSM 8 Diagnosis

All components such as sensors, solenoid valves, the return pump and all functions are constantly monitored by the control unit. The return pump can be repeatedly activated for short periods when driving and the pressure sensor can send test signals to the control unit when the vehicle is stationary.

If the fault detection is activated, PSM is not shut down completely after a fault evaluation. Instead, certain systems are retained if the relevant signals are still available.

For example:
If the yaw velocity sensor fails, only the vehicle dynamic control is deactivated. ABS, ABD, EDTC and EBD remain active. If a wheel sensor fails at the same time, ABS, ABD and EDTC are also switched off. EBD still remains active.

Faults are entered into the fault memory where they remain permanently stored. The fault memory can be read out and deleted via the PIWIS Tester. Further functions such as controlling the drive links, gate inputs and system tests are also carried out.

Notes:

Porsche Active Suspension Management (PASM)



While Porsche Stability Management (PSM) monitors the forces acting on the vehicle to help maintain the ideal line through a corner, Porsche Active Stability Management (PASM) also continuously modifies the damping force on all four struts to compensate for steering inputs and road conditions.

Porsche Active Suspension Management (PASM)
911 Carrera (997), Boxster (987) & Cayman (987) Models

The 911 Carrera (997) & Boxster (987) Models are the first vehicles in both series to offer a chassis with actively adjustable dampers. The PASM chassis is optional on the 911 Carrera (997), Boxster/S (987) and Cayman/S (987), and standard on the 911 Carrera S (997). The PASM springs are shorter and stiffer than the standard chassis.

The driver can choose between two programs, 'Normal' and 'Sport', via a button on the center console. The function light in the button comes on with the Sport setting. At the same time, a damper icon appears in the instrument cluster display together with the text "PASM Sport". When the normal program is reactivated, the damper icon appears accompanied by the text "PASM Normal". The text and icon remain visible for 4 seconds and then disappear.

PASM combines two chassis in one; one with equal measures of sportiness and comfort; and one entirely dedicated to sportiness and the race circuit.

Normal mode (the basic setting when the vehicle starts) provides the same comfort as the standard chassis, while approximating the sportiness of the sport chassis when interventions are made with active PASM.

Operating Principles of PASM

PASM selects the required damper hardness for each individual wheel from a stored map in both the Normal and the Sport program. Possible damper settings range from comfortable to very sporty. Both programs, which overlap slightly in some areas, are additionally superimposed with five software modules to provide optimum damper settings for all driving conditions.

The system automatically selects the appropriate damper setting based on the PASM program selected and the driving condition identified. The Normal program offers comfortable settings with low damper forces. Special control algorithms in the PASM software modules enable the chassis to offer greater active driving safety in extreme driving situations, even with the Normal program.

To increase driving safety at higher speeds, the dampers are automatically switched to a harder damper setting as speed increases.

The dampers switch to a hard setting when Sport mode is activated. This improves agility and steering precision on uneven surfaces. If the system detects an uneven driving surface in Sport mode, it immediately switches to a softer setting to improve contact with the road surface. PASM selects the optimum damper setting from the Sport map.

Extremely hard damping is not always the ideal solution in every driving condition (for example, softer damping may prevent bouncing and shifting of the vehicle, depending on the driving surface). The intentional overlap between the Normal and Sport maps allows a noticeably soft setting to be selected even in the Sport map, if necessary. The customer gets an "active sports chassis" which automatically responds to the actual road surface and switches from a hard, sporty damping setting to a comfortable range as necessary. PASM switches back to the original characteristic as soon as the road surface is smooth enough.

The following is a detailed description of the five software modules overlapping Normal and Sport mode:

Lane Change Module

The damper forces at both axles are immediately increased in response to rapid steering movements, for example sudden evasive maneuvers. This reduces body tilt and instability, thereby significantly improving vehicle control even in extreme situations.

Vertical Control Module

In the Normal program, the damper force is increased as soon as the vertical movement of the body, for example when driving over uneven surfaces, rises over a specific threshold value. This prevents body instability.
In the Sport program, the damping is slightly reduced automatically to improve contact between the road and the wheels as body movements increase. This also results in a noticeable increase in comfort.

Lateral Acceleration Module

If specific, speed-dependent thresholds for lateral acceleration are exceeded when cornering in the Normal program, the damper force is increased by different, defined amounts for each side of the vehicle. This prevents vehicle instability and significantly increases driving precision. In the event of large vertical movements and high lateral acceleration coinciding, the higher of the vertical-control and lateral-acceleration damping values is set. This happens if, for example, the damping in the Sport program was previously decreased by the vertical-control module.

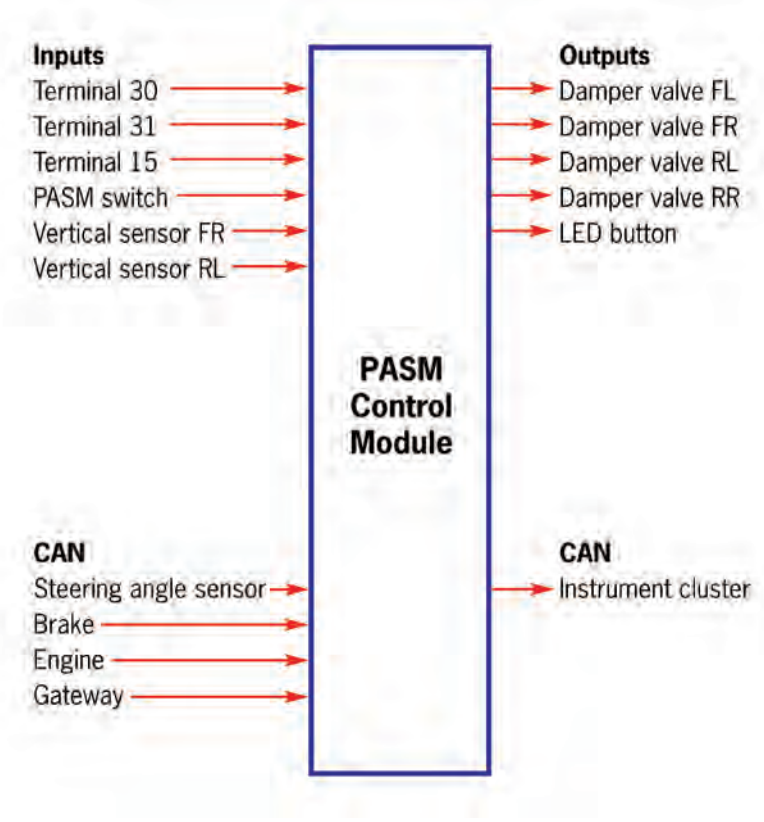
Brake Module

PASM switches to harder damping at the start of a braking operation to reduce vehicle nose-dive when braking. This way, higher brake forces can be transmitted to the road faster. It switches back to a softer setting (this setting is different for the front and rear axle) after a specific amount of time. The result is improved road contact, and thus a shorter braking distance, particularly when braking on uneven surfaces.

Load Change Module

Damper characteristics for the front and rear axle are individually switched when accelerating heavily, releasing the throttle or changing lanes. In Normal mode, the dampers are briefly switched to a harder damping setting in these driving conditions. This avoids excessive lifting or diving at the front of the vehicle ("pitching"). In Sport mode, a softer damper characteristic is briefly selected if necessary to improve traction when accelerating, particularly on uneven surfaces.

Notes:



911 Carrera (997), Boxster (987) & Cayman (987) PASM Components

The PASM system comprises the following components:

- PASM control unit
- One button for selecting the program (Normal or Sport)
- Two acceleration sensors for detecting vertical movement of the body (one at the damperdome at the front right and one at the rear left). Further signals such as lateral acceleration, steering angle, travel speed, brake pressure, engine torque, etc. are read in via the CAN bus.
- Four dampers with continuously adjustable damping force (each with one bypass valve)

The system measures body movements via one acceleration sensor on each axle (front and rear). Values such as lateral acceleration, steering wheel angle, vehicle speed and information on possible braking operations are provided by the PSM via the CAN bus. Engine rpm and torque values are provided by the Motronic via the CAN bus. The PASM control unit is installed on the front wall (footwell passenger's side) at the right.

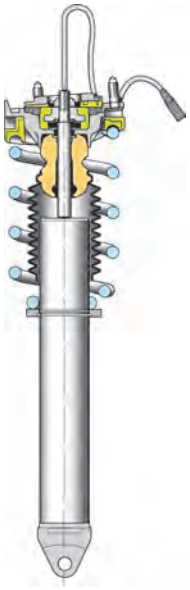
Acceleration Sensor



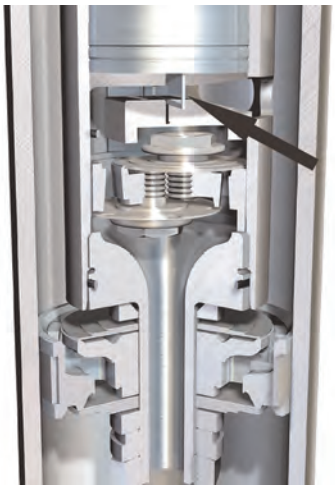
Acceleration Sensor (arrow)

The acceleration sensors are attached to the front right and rear left spring strut domes, respectively. This arrangement allows lift, pitch and roll movements of the body to be measured.

PASM Shock Absorbers



Unlike conventional dampers, PASM map-controlled dampers also have an electrically actuated hydraulic bypass valve (arrow in image below).



The damping effect is provided by the oil in the damper flowing through a piston valve when the vehicle moves. The smaller the valve cross section, the harder the damping. With the PASM damper, oil can flow through a bypass valve as well as through a fixed valve in the main piston. The flow can be increased or reduced by opening and closing the valve via a slide, producing continuous adjustment of the damper force.

In the event of a system failure, the valve automatically closes. PASM is then in the hardest damper setting and thus the safest mode from a driving dynamics point of view (fail-safe principle).



Rebound Stage Soft



Rebound Stage Hard



Pressure Stage Soft



Pressure Stage Hard

Notes:

Tires



A new tire generation with larger rolling circumferences has been developed for the 911 Carrera (997), Boxster (987) and Cayman (987) to complement the new wheels. The main objective in the redevelopment of the tires was to achieve a significant improvement in performance in relation to traction during acceleration, braking and lateral acceleration.

The rolling circumference on the front axle is increased by 2.5 % and 5 % on the rear axle. The larger rolling circumference increases the side-wall height/tire width ratio in comparison with the previous 911 Carrera (996) and Boxster/S (986) model to assure an appropriate level of comfort despite the larger wheels.

The new tires have permitted a noticeable increase in the amount of force that can be transmitted both in the longitudinal and transverse direction. This results in a high level of agility and, at the same time, driving safety. The combination of PASM, PSM and the new tires reduces the braking distance significantly.

Run-flat Systems

The 911 Carrera (997), Boxster (987) and Cayman (987) do not have a spare wheel or a jack. Instead, they are equipped with a tire sealing compound and an electric air compressor.

The introduction of the tire sealing compound means that most flat tire situations can be handled without having to actually change a “flat tire”. Small punctures caused by a nail or screw can be temporarily repaired by filling them with the tire sealing compound, thereby enabling the vehicle to be driven at a reduced speed (up to max. 50 mph/80 km/h) to the nearest Porsche dealer and/or tire retailer without damaging the wheel.

Tire Pressure Monitoring System (TPM)

For the first time, a tire pressure monitoring system (TPM) is available as an option (I no.) on the new 911 Carrera (997) and Boxster (987). And is also available as an option on the Cayman (987)

The TPM offers a significant improvement in safety by continuously monitoring the air pressure of each tire. The system gives the driver an early warning of a pressure loss within the tire, creeping (normal reduction in pressure caused by diffusion) or even sudden pressure loss in the tires. A tire blowout due to heat build up from drivng with a underinflated tire can be prevented with this system. It also does away with the need for regular air pressure checks.

Another advantage is that having the correct air pressure reduces tire wear (a pressure reduction of 4.3 psi/0.3 bar from the recommended tire pressure can reduce the service life of tires by up to 25%).

TPM System Design

The tire pressure monitoring system comprises the following components:

- 4 wheel transmitters
- 4 digital antennas
- TPM control module

Wheel Transmitters

The wheel transmitter is secured to the metal valve with a self-locking Torx screw in the wheel rim. The additional weight of approx. 1oz (30 grams) can be counterbalanced with wheel balancing weights.



433 MHz Wheel Sensor

The wheel transmitter can also be re-used in case wheel replacement becomes necessary.

The following components are integrated in the wheel transmitter:

- Transmitting antenna
- Pressure sensor
- Temperature sensor
- Measuring and control electronics
- Battery

Pressure sensor, temperature sensor as well as the measuring and control electronics are integrated into one sensor unit. Depending on the country version, two different carrier frequencies are used for radio transmission, frequencies 315 MHz and 433 MHz, the 433 MHz being assigned for the North American market. The carrier frequency is printed on the sensors, antennas and control modules. It can also be identified by the part number. The tire pressure monitoring system only functions with system components that have the identical carrier frequency.

The following data is transmitted by the wheel transmitter:

- Individual identification number (ID)
- Current tire pressure (absolute pressure)
- Current tire air temperature
- Condition of the integrated battery
- As well as the status, synchronization and control data required for safe data transmission

TPM Digital Antenna



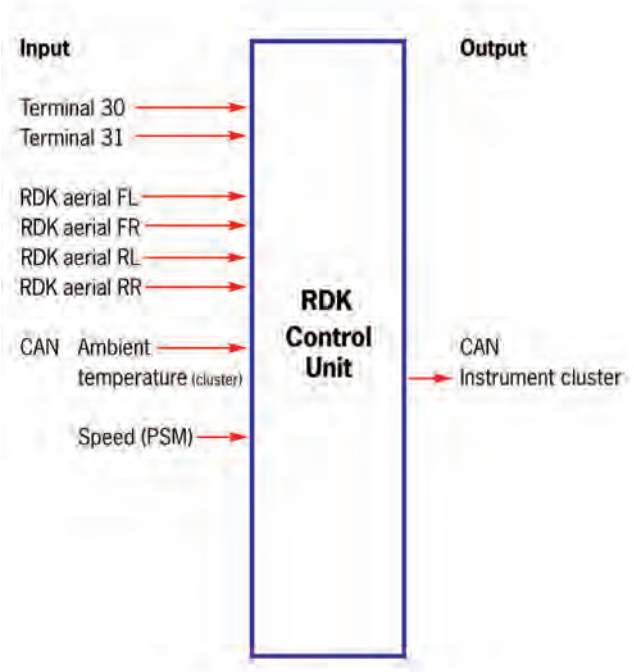
The tire pressure monitoring system includes 4 antennas which are installed inside the wheel housings behind the wheel arches. The antennas receive the radio signals from the wheel transmitters and process them in an internal electronics unit. The data is transferred to the TPM control module for further processing via normal cable LIN – bus (Local Interconnect Network).

The antennas receive all radio signals entering their reception and frequency area, i.e. each antenna also receives the radio signals of all wheel sensors within range. The radio signals are filtered and selected inside the control module in order to ensure that the correct data is processed. The digital antennas have an integrated self-diagnosis facility. This means that when a fault is identified, it is stored in the fault memory and displayed on the PIWIS Tester.

TPM Control Module

The TPM control module analyzes the incoming signals from the antennas before prioritizing and forwarding the information to the instrument cluster. The TPM control module is installed in the luggage compartment on the left next to the PSM hydraulic unit.





TPM Control Unit (In German TPM = RDK)

Learning Phase

After basic setting, the TPM must first “recognize” the wheels and allocate the wheel position of each individual wheel. For this purpose, every wheel electronics unit transmits a fixed, distinctive code. The learning process only takes place when the vehicle is in motion due to the fact that if another vehicle nearby is equipped with TPM, that vehicle’s sensor data could be picked up. The system takes approximately 6 minutes to recognize the wheels. For this reason, it can happen that a non-positioned tire pressure warning is initially sent. After an overall maximum of 30 minutes driving, the control module knows the position of each individual wheel and also shows warnings accordingly. The wheel positions remain stored until either another tire is selected in the TPM menu, or until the system registers that different wheel electronics units are installed in one or more wheel positions (e.g. by changing wheels without renewed selection via the menu).

If the TPM registers that wheels have been changed without renewed selection, the driver is automatically alerted via the TPM display “Wheel change? Check settings”. Once the wheels have been “learned” by the TPM system, further warnings are immediately indicated for each individual wheel each time the vehicle is started, regardless of whether it is stationary or in motion.

Actual Pressure Display

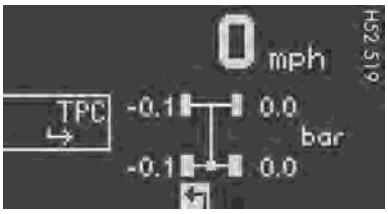


The actual pressures (without temperature compensation) of each individual wheel are shown in the display as soon as the tire pressure monitoring system has completed its learning phase.

This information is displayed both while the vehicle is stationary and when it is moving. It provides the driver with information on the current actual pressure in the tire. The display is not intended to be used to correct the tire pressure since the air temperature within the tire is not accounted for in this case.

The temperature has a major influence on the pressure. For this reason, it is mandatory to take the temperature into account for the correct setting. Higher tire temperatures increase the interior tire pressure. The temperature increase is caused by the tire’s flexibility (resulting deformation energy) when driving. For example, a temperature increase of 50° F. (10° C) within the tire results in a pressure increase of 1.5 psi (0.1 bar).

Display For Setting The Correct Tire Pressure



When the vehicle is stationary, the driver can view the desired pressure (temperature-compensated differential based on 68° F/20° C) for the front and rear axles for new tires via the "Pressure Info" option in the TPM menu. If the wheels have already been entered in the system, it displays the temperature-compensated differential tire pressures for each wheel position instead. The values displayed specify the deviations from the desired pressures.

A negative sign (minus) in front of the value denotes that the pressure falls short by the displayed value. In order to set the correct value, the driver must act accordingly to these values and increase the tire air pressure, or release air pressure if the pressure is in excess of the correct value.

The advantage of the temperature-compensated differential pressure display is that the tires can be inflated to the correct pressure even when warm, with the temperature compensation function.

Low Tire Pressure Warnings

Two different display levels are used to inform the driver of a low tire pressure level: the first level is the "gentle" warning, the second the "stern" warning.

Both displays can be confirmed. The warning light with the TPM icon remains in the instrument cluster as a reminder until the cause of the problem has been eliminated. The warning message is displayed again each time the ignition is switched on.

"Gentle" Warning



A "gentle" warning in white text is output if the deviation in air pressure is more than 2.9 psi (0.2 bar), but not above 5.8 psi (0.4 bar). It is first displayed for 10 seconds after the ignition is switched off and afterwards, every time the vehicle is started. The air pressure should, be corrected at the next opportunity (e.g. the next time fuel tank is filled up).

Air must be added at the value displayed in the tire pressure monitoring system. The warning in the display automatically disappears as soon as the pressure corresponds to the desired pressure once more.

"Stern" Warning (puncture)



A "stern" warning in red text is output if the deviation in air pressure is more than 5.8 psi (0.4 bar) or the pressure is falling by more than 2.9 psi (0.2 bar) per minute. This warning appears as soon as the respective values are exceeded, whether the vehicle is stationary or moving. Driving safety is no longer guaranteed. The driver should stop immediately to inspect the tire in question.

Additional Warnings

In case of a puncture, the TPM also provides the possibility of issuing a speed warning if 50 mph (80 km/h) is exceeded. This is helpful since adherence to the maximum speed is crucial for the remaining service life of the repaired tire. Selecting the run-flat system in the TPM menu is prerequisite for the speed warning.

Basic Setting



The TPM menu is selected via the on-board computer lever. The system must first be informed of the type of tires currently mounted on the vehicle via the "Settings" menu option. This option provides a choice of summer or winter tires together with the relevant tire dimensions. The basic configuration only has to be entered once after a wheel or tire change and is then saved. For reasons of safety, the TPM menu can only be called up when the car is stationary.

Porsche Approved Original Equipment
N-Specification Tire Information



Design and Testing

Porsche designs and manufacturers some of the highest performance vehicles in the world. Because of the essential role that tires play in vehicle performance, Porsche has integrated tires in the design process throughout vehicle development. Porsche original equipment tires must successfully pass the tire company's laboratory tests, road tests and race track evaluations to confirm that the prototype tires meet Porsche's noise, hydroplaning, handling and high-speed durability requirements. Only upon successful completion of these tests, will tires be released for production.

Branded as N-Spec

Production tires that have passed all of the tests and received Porsche's engineering department's release can be branded with an N-specification. The N-specification brandings include: N-0 (N-zero), N-1, N-2, N-3, N-4, N-5 or N-6. These markings on a tire's sidewall clearly and permanently identify them as approved by Porsche for their vehicles. The N-0 marking is assigned to the first approved version of a tire design. As that design is refined externally or internally, the later significant evolutions will result in a new generation of the tire to be branded with N-1, N-2, N-3, etc., in succession. When a completely new tire design is approved, it receives the N-0 branding and the succession begins again.

Mixing N-Spec Tires

Use only tire types tested by Porsche. Only tires with the same manufacturer and with the same specification code (e.g. "N0", "N1" …) should be mounted on the vehicle. Tires should be replaced no less than in pairs on one axle at a time. Only tires of the same tire make and type must be used. Since many Porsche vehicles are fitted with different sized tires on their front and rear axles, this requires matching the tire brand, tire name and N-specification front to rear.

While the tire manufacturers may also build other tires featuring the same name, size and speed rating as the N-specification tires for non-Porsche applications, these tires may not be branded with the Porsche N-specification because they do not share the same internal construction and/or tread compound ingredients as the N-specification tires. Mixing tires are not permissible and will affect vehicle performance, safety and can affect vehicle warranty.

Replacing N-Spec Tires

If a vehicle was originally delivered with N-specification tires that have been discontinued and are no longer available, it is recommended to replace all four tires to a higher numeric N-specification design appropriate for that vehicle.

In case of tire damage such as cuts, punctures, cracks or sidewall bulges that cause a single tire to be replaced for safety reasons, the remaining matching tire on that axle must not exceed 30 percent wear. If the remaining tire has more than 30 percent wear from new, it should also be replaced. This rule applies to all four tires on all wheel drive vehicles. Handling inconsistencies may result if this is not done.

Break-in of New Tires

Initially, new tires do not offer their full traction. Drivers should therefore drive at moderate speeds during the first 60-100 miles (100-200 km). If new tires are installed on only one axle, a noticeable change in handling occurs due to the different tread depth of the other tires. This happens especially if only rear tires are replaced. However, this condition disappears as new tires are broken in. Drivers should adjust their driving style accordingly.

Tire Aging

Additionally, even though only the world's highest performance tires can earn the Porsche N-Spec approval, eventually all tires will either wear out or age out. The chemical additives that make rubber elastic lose their effectiveness in the course of time and the rubber becomes brittle and cracks. Considering the performance capabilities of a Porsche, under no circumstances should tires older than 6 years be used.

How is a Tire Selected for a Porsche?

The tires selected for a Porsche are chosen based on the model (sports car or SUV), and the job the tires are asked to do.

The 911 Carrera (996/997), Boxster (986/987) and Cayman S (987) are examples of the world's finest exotic performance cars with some of the same capabilities found in previous generations of racecars. For these vehicles Porsche selects Maximum Ultra High Performance Summer tires from the world's leading tire manufacturers: Bridgestone, Continental, Michelin, Pirelli and Yokohama.

And since Cayenne puts the sport in sport utility vehicle, emphasis is placed on high limits of performance balanced with the utility demanded by the Cayenne owner. Pirelli Scorpion A/T All-Terrain tires are chosen for highway use in all weather conditions, including snow and cold climates, as well as for off-road use. Continental 4X4 Contact and Pirelli Scorpion Zero tires are designed for highway use in all weather conditions including snow and cold climates. Bridgestone Turanza tires target a balance of performance and ride comfort for highway summer conditions. Continental 4X4 SportContact, Michelin 4x4 Diamaris, and Pirelli PZero Rosso tires are chosen for sports car-like handling in both wet and dry summer conditions.

Porsche Dealers Have the Performance Tires You Need

Decades of engineering excellence and racing heritage are designed into each Porsche vehicle. All the technology and innovation has to work through the four small contact patches that allow the performance potential to be realized. Many vehicle owners forget these four critical performance points are so important to their driving expectations, pleasure and safety.



PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Radiators and air inlets: Visual inspection for external debris and blockage
- ☑ Power-assisted steering: Check fluid level
- ❑ Engine: Check oil level
- ☑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ☑ Brake fluid: Check level
- ☑ Steering gear: Visual inspection of the bellows for signs of damage
- ☑ Tie rod ends: Check play and dust boots
- ☑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ☑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ☑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ❑ Change engine oil: (oil filter change is not required)
- ❑ Air Filter: Check the air filter condition, and if necessary, replace
- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ☑ Power-assisted steering: Check fluid level
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze protection level
- ❑ Pollen filter: Replace filter element
- ☑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ☑ Brake fluid: Check level
- ☑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ☑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ❑ Vehicle lights: Check operation
- ❑ All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ❑ Change engine oil and oil filter
- ❑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ❑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ☑ Diagnosis system: Read out fault memory
- ❑ Polyrib belt: Check condition
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ❑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ☑ Power-assisted steering: Check fluid level
- ☑ Parking brake: Check free play of the parking brake lever
- ☑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ☑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ☑ Brake fluid: Check level
- ❑ Clutch: Check play or final position of pedal
- ❑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ☑ Steering gear: Visual inspection of the bellows for signs of damage
- ☑ Tie rod ends: Check play and dust boots
- ☑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ☑ Check tightness on the front and rear suspension adjustment points
- ☑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ☑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Seat belts: Check operation and condition
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

---

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ❑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ❑ Replace Polyrib belt
- ❑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ❑ Manual transmission: Change oil
- ❑ Automatic transmission: Change ATF and ATF-filter
- ❑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ☑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ❑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ❑ Check airbag system
- ❑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
❑ Change engine oil and oil filter
❑ Air Filter: Check the air filter condition, and if necessary, replace
☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
❑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze
❑ Pollen filter: Replace filter element
☑ Brake system: Visual inspection of the brake pads and brake discs for wear
☑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
☑ Tires: Check condition and tire pressure
❑ Check firewall and cabrio section body drains for debris
❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
❑ Vehicle lighting: Check function
All headlights: Check setting
❑ Horn: Check function
❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
❑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

☑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

☑ Replace tire sealant

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

- ☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
- ❑ Change engine oil and oil filter
- ☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
- ❑ Coolant hoses: Check condition
  Radiators and air intakes: Visual inspection for external debris and blockage
  Coolant: Check level and antifreeze
- ❑ Air filter: Replace filter element
- ❑ Pollen filter: Replace filter element
- ❑ Fuel lines and connections: Visual inspection for damage and leaks
- ☑ Brake system: Visual inspection of the brake pads and brake discs for wear
- ☑ Parking brake: Check free play of parking brake lever
- ☑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ❑ Clutch: Check the pedal play and end position
- ☑ Steering gear: Visual inspection of the dust boots for damage
  Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
- ❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ❑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ☑ Tires: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
- ❑ Vehicle lighting: Check function
  All headlights: Check setting
- ❑ Horn: Check function
- ❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ❑ Seat belts: Check function and condition
- ❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

- ❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

- ❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

- ❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
- ❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
- ❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

- ❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

- ❑ Replace drive belt
- ❑ Replace fuel filter (Turbo only)
- ❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

- ❑ Change manual transmission oil
- ❑ Change Tiptronic transmission oil and ATF filter
- ❑ Change Tiptronic transmission final drive oil
- ❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 2 years

☑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

☑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms “inspect” and “check” include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be performed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ____/____/____

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Notes:



Subject	Page
General Information – Boxster/S (987)	5.3
General Information – Cayman/S (987)	5.5
General Information – 911 Carrera/S (997)	5.8
General Information – 911 Targa 4/4S (997)	5.8
Body Components – 911 Targa 4/4S (997)	5.11
Front Luggage Compartment	5.12
Rear Luggage Compartment – Boxster & Cayman (987)	5.13
Rear Engine Lid – 911 (997)	5.14
Doors	5.14
Door Handle	5.15
Maintenance Sheets	5.16

Body

Notes:

General – Boxster/S (987)

The exterior immediately reveals the car to be a totally new yet typical Boxster/S. The new Roadster has a more powerful, attractive and fascinating appearance, without abandoning the classic lines. Practicality and comfort have undergone further improvement.

The interior has been completely redesigned, incorporating Porsche design elements and observing the very highest standards of ergonomics and quality to make the new Boxster/S (987) a study in automobile evolution par excellence.



Aerodynamics and Air Routing

One objective in developing the new vehicle was to further expand the competitive lead of the Boxster/S (987) in the area of aerodynamics and that was to focus on reducing the aerodynamic lifting forces to enhance performance. Another aim in this connection was to achieve a further reduction in the drag coefficient, despite the high levels of cooling air required for the brakes and engine.

The main challenges to be faced in enhancing the aerodynamics of the new Boxster series were:

- The larger frontal area, caused by flared wheel housings and in particular the wider tires
- The lower lift coefficients and therefore the increased wheel load
- The higher cooling air requirement of the brakes due to the increase in performance
- A more efficient cooling system required on account of the increased engine power

The development objectives have been attained in particular by:

- Aerodynamic optimization of the styling
- Optimization of the cooling-air guide
- New underbody paneling
- Optimization of add-on parts

The result of the efforts to optimize aerodynamic is a marked improvement in aerodynamic coefficients in comparison with the previous Boxster/S (986) models. The drag coefficient has been reduced to cw = 0.29 on the new Boxster (987) (previous Boxster 0.31) and to cw = 0.30 on the Boxster S (987) (previous Boxster S 0.32), while the lift coefficients at the front and rear axles of the Boxster and Boxster S have been reduced to cAV = 0.09 and cAH = 0.07 respectively. These are unique, exceptional levels which are unrivalled by any competitors in the international arena.



The redesigned air inlet in the rear quarter panel takes up the graceful geometric lines of the Carrera GT. The positioning and the opening cross section of the air inlet have been carefully optimized to ensure the maximum possible increase in air flow rate combined with the minimum possible effects on lift and resistance. This way, it has been possible to improve the flow of air through the engine compartment, to lower the temperature in the engine compartment and to optimize the intake of combustion air.

Body

Underbody Paneling

The area covered by underbody paneling has been increased by around 70% in comparison to the previous Boxster/S (986) models. This enables an effective, largely unimpeded flow of air under the entire floor of the car.



The benefits of such measures and effects is an increase in maximum speed and a reduction in fuel consumption at high speeds. Such measures help to improve the vehicle's balance, above all at higher speeds.

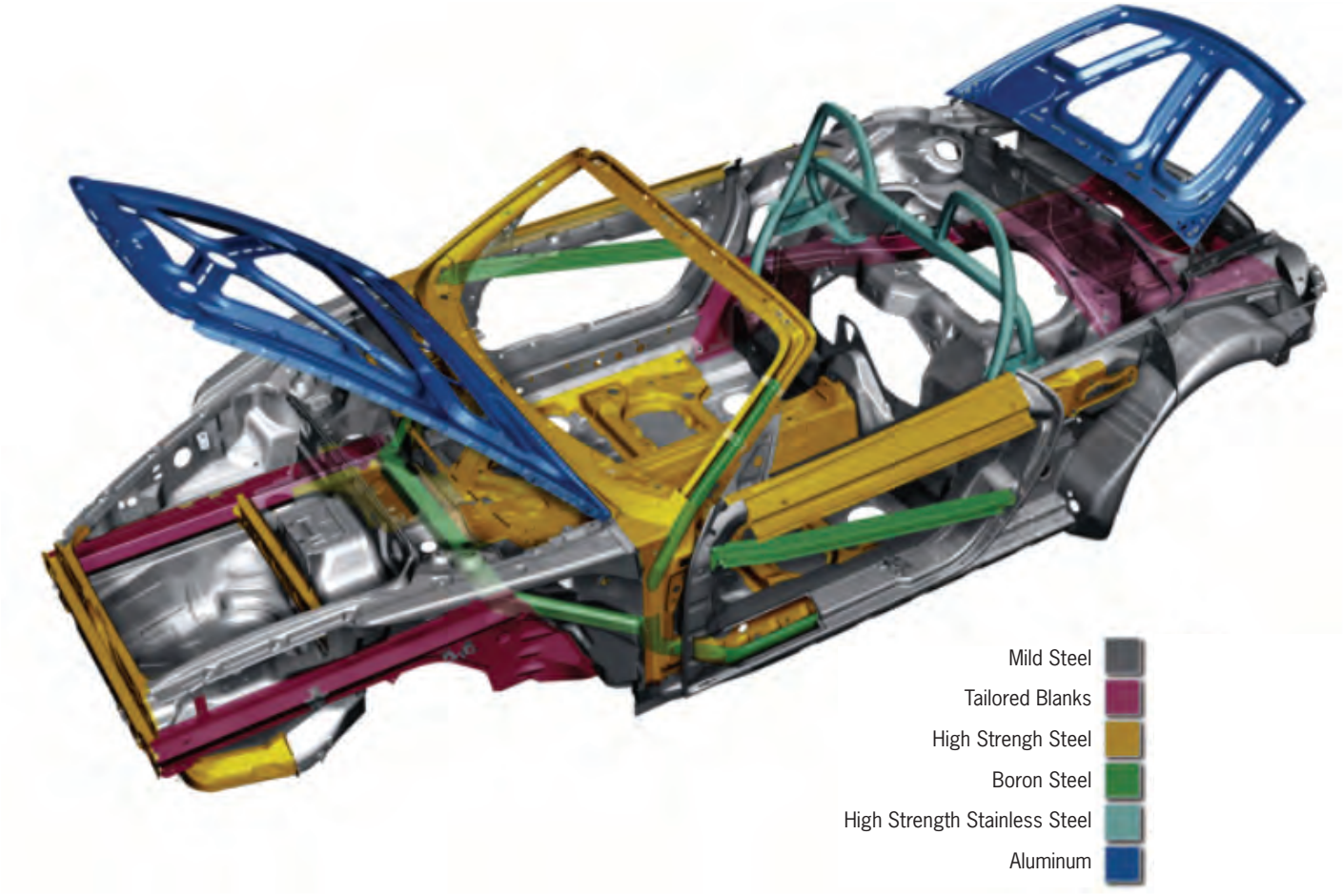
Body Structure

The purpose of redesigning the body structure of the new Boxster/S (987) series was to increase torsional and flexural rigidity in comparison with the previous Boxster/S (986) and also to further improve crash safety in a frontal or offset crash (frontal crash with head-on collision on one side of the vehicle).

Additional objectives were improved body seams and an increase in the space available to the vehicle's occupants, particularly taller persons.

These improvements have been achieved by means of seven main changes:

- Use of the spot welding/bonding method
- Redesigning of the joint areas (A-pillar, sills)
- Use of a new bulkhead cross member made of boron steel
- Repositioning of the pedals towards the front
- Use of "tailored blanks" for the front side members
- Integration of an additional load path at the level of the upper door trims



General – Cayman/S (987)

The Cayman/S is instantly recognizable as a new, original and highly dynamic vehicle. A mid-engine coupé which is clearly distinguishable from the Boxster and the 911 Carrera while at the same time remaining clearly recognizable as a Porsche. It has proven possible to successfully combine a high level of suitability for everyday use with the sportiness expected of a Porsche, all without sacrificing Porsche's classic lines.





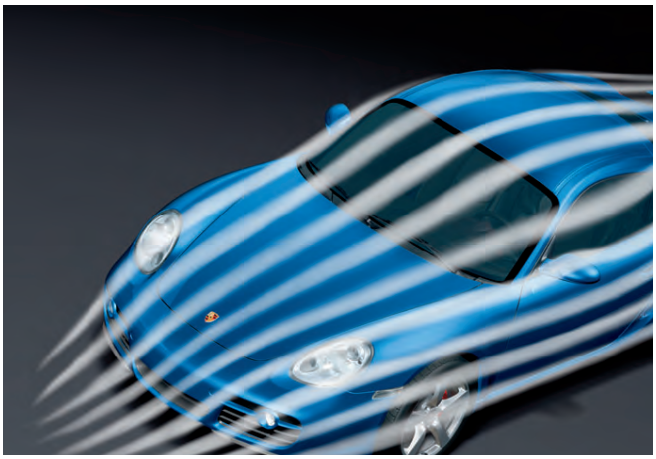
Aerodynamics and Air Routing

One aim in developing the Cayman/S has been to take up a leading position in the competitive field with regard to aerodynamics. To this end, efforts focused on reducing the aerodynamic lifting forces to take due account of the high performance. At the same time, the drag coefficient had to be maintained at a very low level, despite the high volumes of cooling air required to cool the brakes and engine.

The main challenges relating to the aerodynamics of the Cayman/S were:

- The large frontal area, caused by a high and arched roof contour in particular.
- The lower lift coefficients and therefore the increased wheel load.
- The high cooling air requirements of the brakes due to the vehicles high performance.
- Efficient engine cooling in line with the high power output.

The development objectives have been attained in particular by:



- Aerodynamic optimization of the styling
- Rear spoiler/extendable rear wing
- Optimization of the cooling-air guide
- Large-scale underbody lining
- Optimization of add-on parts

The result has been a further marked improvement in aerodynamic coefficients in comparison to the Boxster S. The drag coefficient has been reduced to Cd= 0.29 (Boxster S: 0.30) and the lift coefficients at the front and rear axles have been cut by over 20 % in comparison to the Boxster S.

The excellent aerodynamic coefficients provide the basis for unique positioning of the new Cayman/S in its segment. The optimized aerodynamics of the Cayman/S are instrumental in achieving outstanding driving dynamics, performance and fuel economy.

Body

Optimization of the Styling of the Outer Skin



In designing the exterior, the goal was on reconciling stylistic and aerodynamic requirements. Key focuses of the work on the outer skin were optimization of the front section, rear end, fenders and rear side panels and integration of the coupé roof.





The sweep and the radii of the front apron have been optimized to produce an aerodynamically efficient air flow at the front end and a significantly better cooling air flow without affecting the styling of the contours. In order to further reduce front-axle lift, fins/spoiler lips have been integrated into the sides of the front end.

The lateral front apron radii and wheel houses are designed to shield the front wheels from the air flow in an optimum manner and to provide effective wheel housing ventilation. These measures reduce drag and, by providing greater wheel housing ventilation, also reduce lift at the front axle.



The newly designed air inlet grille in the rear side panel takes up the geometric design featured on the Carrera GT and sports two vertical vanes by way of contrast to the Boxster. The positioning and the opening cross-section of the air inlet have been carefully optimized to ensure the maximum possible increase in air flow rate combined with the minimum possible effects on lift and resistance. In this way, it has been possible to improve the flow of air through the engine compartment, to lower the temperature in the engine compartment and to optimize the intake of combustion air.



In the rear area, the rear end, the roof with its sloping contour, the rear lid, the rear side panel and its connection to the coupé line have all undergone optimization. The radii of the rear side panel, the B-pillar and the rear wing have been designed so as to achieve an aerodynamically efficient air flow around the rear wheels and the rear section in combination with the flared wheel housings.

Underbody Lining



The underbody lining covers virtually the entire underbody. As a result, the air routed along the lined underbody is now much less prone to turbulence and loss. The benefits are an increase in top speed and lower fuel consumption as a result of reduced drag. The lift coefficients are also reduced as a result of the higher air speed under the vehicle.

The smooth underbody means that air hitting the rear of the vehicle is less prone to deceleration and turbulence. As a result, the flexible deflection blades located here are able to collect a larger mass flow of cooling air from the flow of air under the body, which permits extremely efficient engine cooling from the point of view of aerodynamics and thermodynamics, and also contributes to cooling of the engine and transmission.

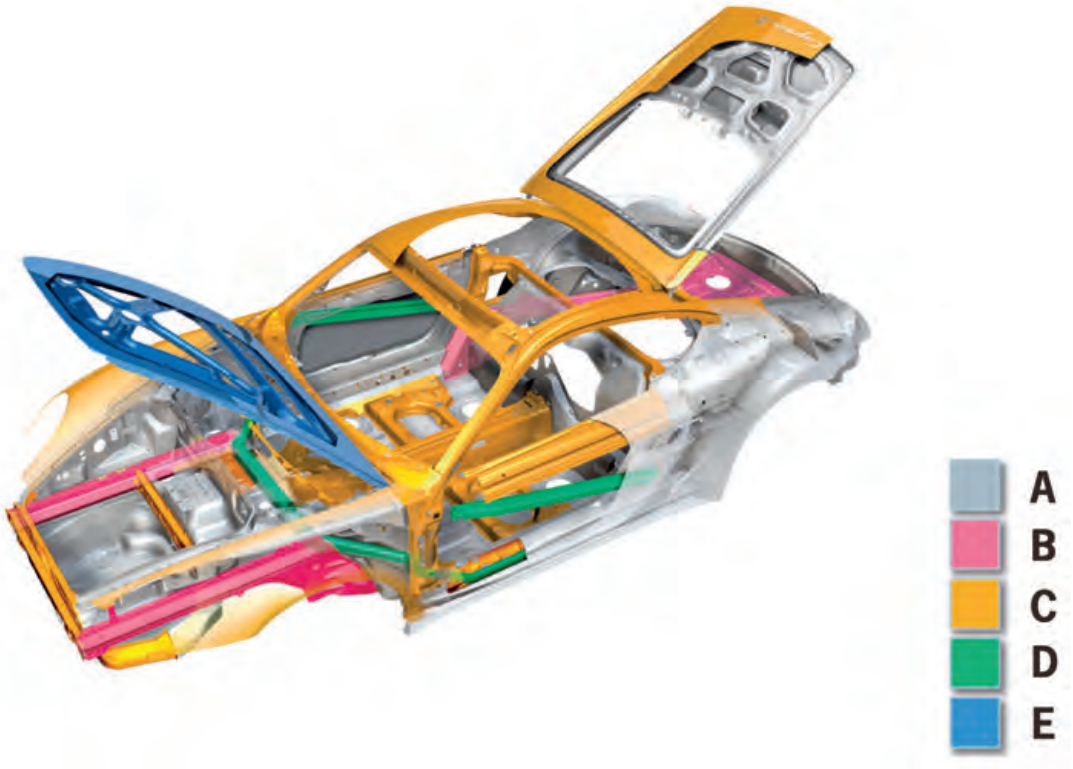
Body Shell

The body shell of the Cayman/S has a closed sidewall and roof structure. Through the accomplished integration of the roof structure and the use of a cross member in the area of the B-pillar it has been possible to achieve an outstanding level of torsional and flexural rigidity which is virtually on a par with that of the 911 Carrera Coupé, despite the large opening for the rear lid. This is confirmed by both static and dynamic measurements.

The vehicle's occupants, particularly taller individuals, enjoy adequate space and a feeling of spaciousness which is unique to the Cayman/S. This has been accomplished very effectively by ensuring good access to the rear luggage compartment area from the interior.

The body shell of the Cayman/S is once again produced as a lightweight construction with high-strength and maximum-strength steels. This concept offers excellent passive safety by virtue of its rigidity and its capacity to absorb impact energy. Special importance has also been accorded to optimizing the joint lines.

A - Sheet steel
B - Tailored blanks
C - High-strength steel
D - Maximum-strength steel
E - Aluminum



Body

General – 911 Carrera/S (997)



The exterior design has been completely revised. The 911 Carrera (997) and 911 Carrera S (997) have acquired an even more dynamic appearance. The track has been widened in comparison with the previous model 911 Carrera (996) and the mid-section has been made narrower. Some of the most striking features of the exterior include the new headlights with additional headlights in the front end, a more pronounced wing, a new double-arm door mirror, an aerodynamically optimized rear spoiler and a clearly defined joint style, particularly on the rear end.

General – 911 Carrera 4/4S (997)



The majority of the body features from the 911 Carrera/S (997) have been adopted on the new 911 Carrera 4/S (997) models. The distinguishing features are the 44 mm wider body at the rear and the new model logos “Carrera 4” (titanium-colored, corresponding to 911 “Carrera”) and “Carrera 4S” (silver-colored, corresponding to “Carrera S”) on the rear lid. The flexural and torsional rigidity and crash safety of the four-wheel-drive vehicles has also undergone further improvements, similarly to on the 911 Carrera/S Coupé and Cabriolet.

General – 911 Targa 4/4S (997)



The new 911 Targa 4/4S (997) has an unique glass roof design, which combines the benefits of turbulence-free “open-top driving” with the comfort and safety features of a Coupé – in other words: a more rigid body combined with a greater sense of safety. When closed, the new 911 Targa 4/4S models with their bright, light immersed interior guarantee a unique driving experience. For the first time ever, the new 911 Targa 4/4S models are available exclusively with full time four-wheel drive and a body that is 44 mm wider in the rear area than the rear wheel drive 911 Carrera models.

Bodyshell

The bodyshell of the new 911 Targa 4/4S corresponds below the window line to the ‘wide body’ shape of the four-wheel drive 911 Carrera 4 Coupés. The rear quarter panels, which are 22 mm wider on both sides in the rear area, and the adapted rear and side skirts are characteristic of this body shape. The bodyshell is constructed as a light-weight design with high strength and ultra-high strength steel. Despite the glass roof assembly and the additional body reinforcements, the new 911 Targa 4 weighs only 3329 lbs. (1510 kg) while the Targa 4S weighs 3384 lbs. (1535 kg) (with manual transmission).

The roof assembly is bolted all the way around to the structurally optimized and higher-strength bodyshell. Gusset plates connect the roof structure to the adopted 911 Carrera 4 Coupé base. Together with the 30 mm thick, high-strength steel reinforcement tubes, which are integrated in the A-pillar and in the roof pillars, excellent body rigidity is achieved that is almost on a par with the Coupé models. The B-pillar goes from the body side panel to the roof pillar, where it is welded in. The roof pillars form a continuous line from the A-pillar to the end of the C-pillar – with no gaps or connection points whatsoever.

Aerodynamics and Air Routing

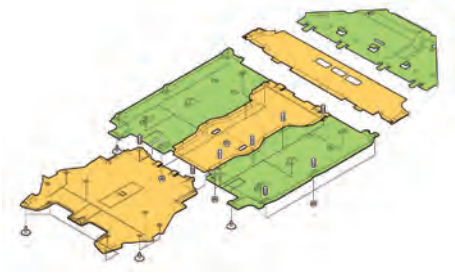
During development of the new vehicle it became obvious that further enhancement of the aerodynamic properties of the 911 Carrera (996) was required. The objective in so doing was to take in account the increased performance by reducing the aerodynamic lifting forces and at the same time further reduce the drag coefficient (despite the higher cooling air requirement for brake and engine cooling).

The result was a significant improvement in aerodynamic coefficients in comparison with the previous model 911 Carrera (996). The drag coefficient was reduced to cd = 0.28 (previous model 0.30) and the lift coefficients at the front and rear axle were each reduced by 0.01 to cLF = 0.05 and cLR = 0.02 respectively.

The main challenges facing the aerodynamics engineers of the 911 Carrera/S (997) were:

- The larger frontal area, caused by flared wheel housings and wider tires.
- The lower lift coefficients and hence the increased wheel load
- The engine's higher cooling air requirement.
- The higher cooling air requirement of the brakes due to the increase in performance.
- The more efficient cooling of the gearbox, and of the 6-speed manual gearbox in particular, due to the higher engine output.

Underbody Lining



The underbody lining has been enlarged to counteract the increased drag caused by the larger frontal area as well as the higher cooling air requirement. As a result, the air routed along the lined underbody is now much less prone to turbulence and loss. This significantly reduces drag and lift.

The underbody lining from the previous model 911 Carrera (996) has been extended and optimized to the aerodynamic requirements of the 911 Carrera/S (997). The underbody lining at the front has been extended to the front side members to compensate for the aerodynamic drawbacks of the new brake air deflector.

The revised underbody design resulting in a smoother surface means that air passing the rear of the vehicle is less prone to deceleration and turbulence. This means that there is a greater air flow mass available to the cooling air openings located in the underbody, which permits extremely efficient engine cooling from the point of view of aerodynamics and thermodynamics.

Three openings have been integrated in the underbody lining to ensure ventilation of the transmission. Part of the air flowing along the underbody is routed upwards through these openings in the direction of the transmission and used to cool the transmission. The air is directed and channeled between the transmission and the lining so that a large section of the transmission housing is hit by cool air from the underbody. A additional opening has also been added to route cool air to the transmission differential via an air duct.

Body

Body Structure

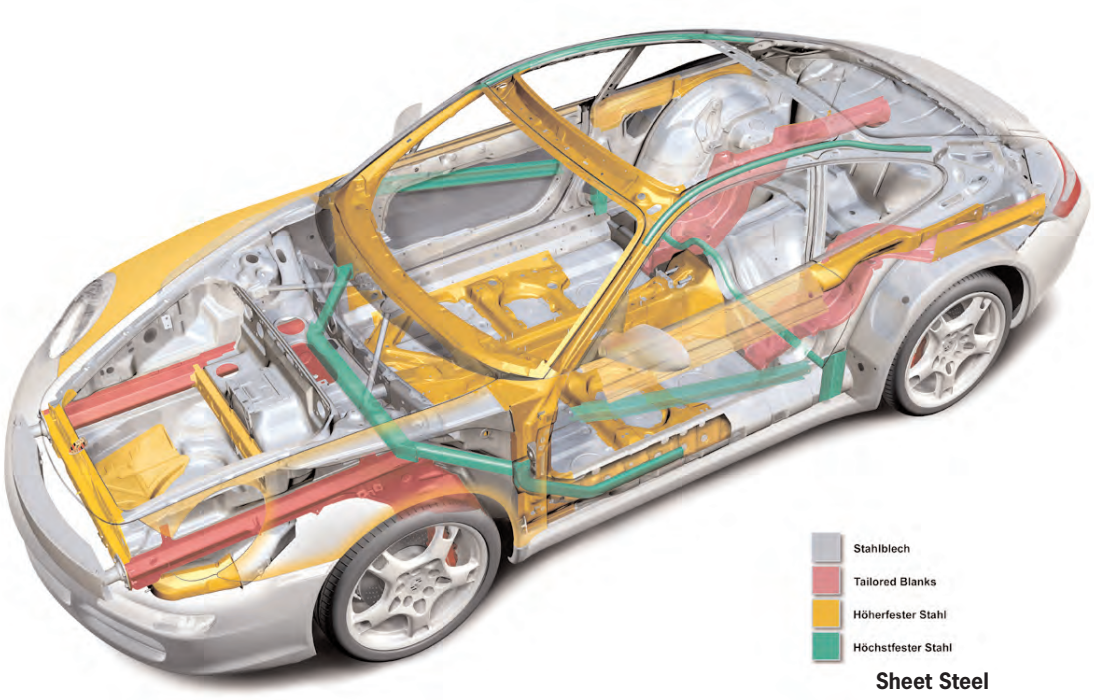
The purpose of redesigning the body structure of the new 911 Carrera/S (997) was to increase torsional and flexural rigidity in comparison with the previous 911 Carrera (996) and also to further improve crash safety in a frontal or offset crash (frontal crash with head-on collision on one side of the vehicle). The designers also managed to enlarge the passenger compartment without changing the exterior dimensions.

These improvements were achieved with four main changes:

- Use of the spot welding/bonding method
- Redesigning of the joint areas (A-pillar, roof frame connection)
- Use of a new bulkhead cross member made of boron steel
- Optimization of the upper load path for transmission of forces in frontal and side impacts

The Porsche body structure is still executed as a light-weight design with high-strength and maximum strength steels. This concept ensures excellent passive safety.

The spot welding/bonding method used to join the side sections and the floor assembly has further increased the torsional and flexural rigidity of the body structure (torsional values increased by 8% while flexural rigidity rose by 40%). The redesigned joint areas (A-pillar joins, connection for the roof frame tube) have also contributed to these excellent results.



Body Components – 911 Targa 4/4S (997)

1 - Upper cowl panel frame, bottom half (new part for 997 Targa)
2 - Upper cowl panel frame, top half (existing part modified)
3 - Rear center panel reinforcement (new part for 997 Targa)
4 - Rear center panel (new part for 997 Targa)
5 - Rear center panel sealing strip (new part for 997 Targa)
6 - A-pillar gusset plate (new part for 997 Targa)
7 - Inner A-pillar (existing part modified)
8 - Rear roof frame, side
9 - Top inner side section (existing part for 996)
10 - Complete reinforcement tube (existing part for 996)
11 - Side panel (new part for 997 Targa)
12 - Top outer side panel (new part for 997 Targa)
13 - Bottom outer side panel (new part for 997 Targa)

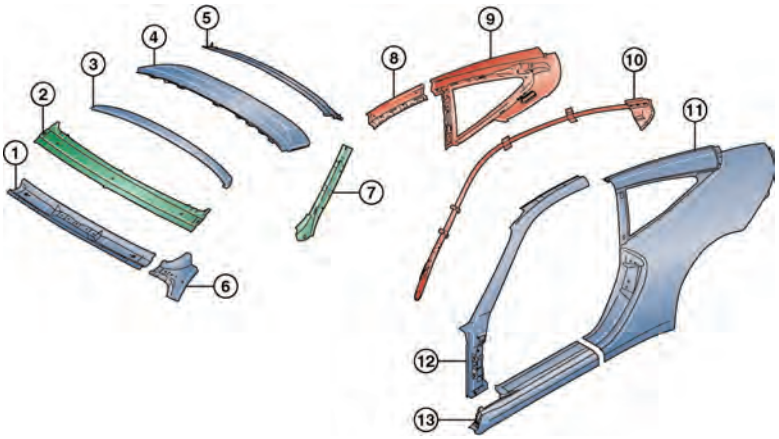
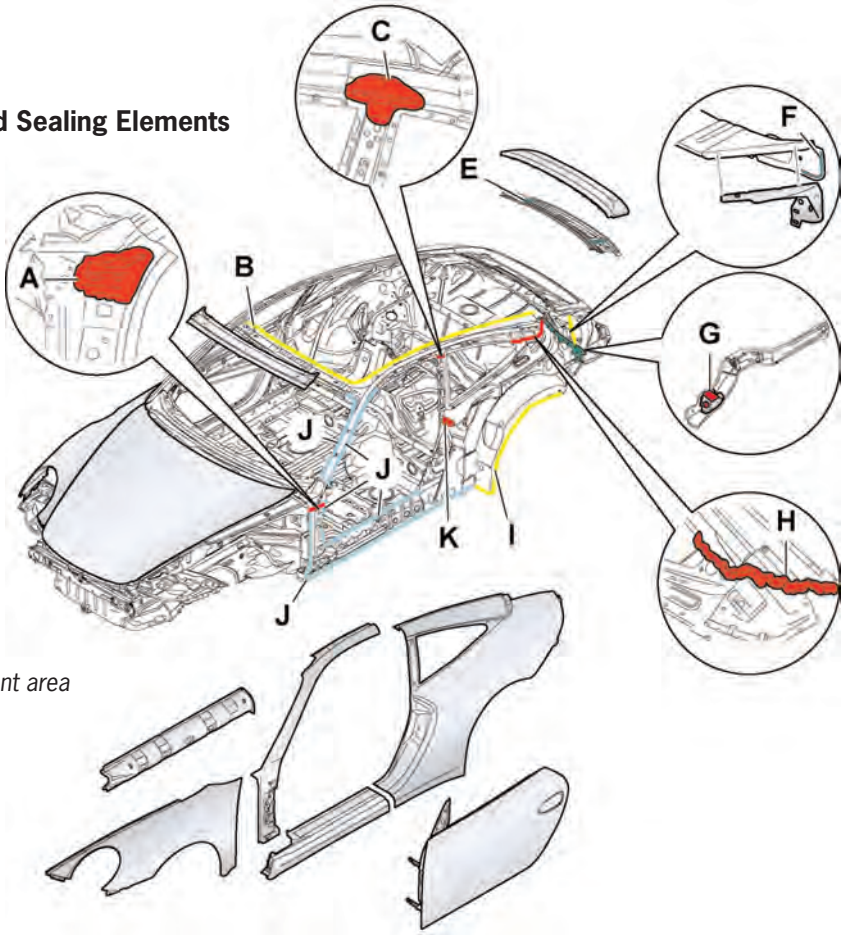
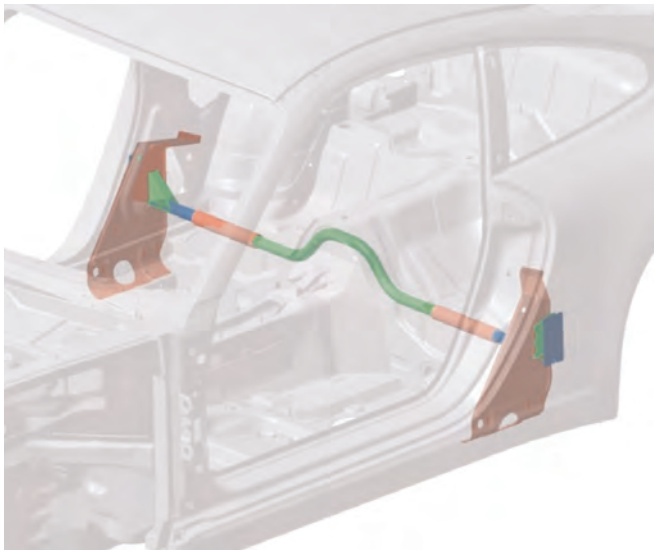


Diagram Of Targa Body Bonding Points And Sealing Elements



A - Bonding area for A-pillar
B - Bonding area for window slot reinforcement
C - Bonding area for upper B-pillar
E - Expanded sealant on rear center panel
F - Spot welding/bonding method in side reinforcement area
G - Expanded sealant in side member
H - Bonding area for B-pillar
I - Spot-welding/bonding method for wheel housing
J - Spot-welding/bonding method for A-pillar
K - Bonding area for box reinforcement

B-pillar Tube Reinforcement – 911 Targa 4/4S (997



The joint between the B-pillar reinforcement and inner wheel housing has been modified by inserting a gusset plate. In addition to the 3-point automatic seat belts with belt pre-tensioners and force limiters on the front seats, the new 911 Targa 4/4S is equipped with six airbags as standard. These include two-stage full-size front airbags for driver and front-seat passenger and the Porsche Side Impact Protection system (POSIP) comprising one thorax airbag in the front seat backrests, a separate head airbag in the door trim panels and side impact protection in the doors on each side of the vehicle.The linings on the side roof pillars are designed as energy absorbing elements and provide even greater protection for the occupants.

The glass in the sliding sunroof is made of two-sheets of partially prestressed laminated safety glass and complies with DOT requirements. With the 6.3 mm thick laminated safety glass, a plastic film sandwiched between two 2.6 mm thick panes of laminated safety glass prevents the glass from shattering, thereby reducing the risk of injury to occupants in the event of an accident.

Front Luggage Compartment – 911 Carrera /S (997), Boxster/S & Cayman/S (987)



The elimination of the spare wheel, which was previously housed near the bulkhead, and the new bulkhead cross member have facilitated a redesign of the luggage compartment. As a result of this redesign, it has been possible to increase the luggage compartment volume by approx. .75 cu ft (20 liters) to approx. 5.3 cu ft (150 liters) (basic equipment).

A new trim concept has been developed to enhance the appearance of the luggage compartment as a whole. In addition to new, large area trims on the inside of the luggage compartment, it also includes full trim on the areas around the luggage compartment up to the lower frame of the windshield (cross panel, side section and radiator tank trim).

Items such as the audio amplifier (optional), DVD navigation drive (optional), the tire sealing compound and compressor and the tool bag (including wheel nut wrench and towing eye) are concealed behind a vertical trim running over the entire width of the luggage compartment. This provides for a clearly laid out luggage compartment which presents a very neat appearance. At the bottom edge the trim is slotted flush with the luggage compartment floor in a holding rail and is easy to open and fold forward so as to provide good access to all the items.

Vehicles with CD autochanger, Sound Package Plus or Navigation and all USA vehicles are provided with a full trim covering the entire bulkhead area.

The active carbon filter which is mandatory in the USA is additionally installed in USA vehicles. The brake fluid reservoir is accessible via a separate flap on the left as seen in driving direction, for the purposes of checking the brake fluid level.

An emergency release device for the luggage compartment lid has been developed especially for USA vehicles. This is installed inside the luggage compartment (trunk entrapment). This device is mandatory in the USA and enables a child who has inadvertently been locked in the luggage compartment, to open the luggage compartment from the inside. The release handle is located at the front as seen in the direction of travel, in the area of the right-hand side member.

The new fender flange and radiator tank cover ensures that screws and metal edges which were previously visible are now neatly covered. The choice of material for the trim and the applied production process ensure a feeling of quality. Particularly scratch resistant plastics are used. These are injection molded by way of a two component technique (harder main part with directly molded on soft sealing lip). The sealing lips enable smooth transitions between the respective components and between the components and the body.

As a result of the redesigned lock cover with defined water drainage openings the trim is markedly less susceptible to soiling than previously. The trim package provides for an attractively stylish, high-quality appearance.

Front Luggage Compartment – 911 Carrera 4/4S & 911 Targa 4/4S (997)

The general revision of the vehicle's front section has enabled the luggage compartment to be redesigned, leading to an increase in the luggage compartment capacity. As a result, the luggage compartment capacity has been increased by 0.17 cu. ft. (5 liters) in comparison to the predecessor four-wheel drive models, to 3.7 cu. ft. (105 l) (type 996: 3.5 cu. ft./100 l). The new luggage compartment design enhances the vehicle's practicality by facilitating loading and increasing the loading depth by 10 cm.

Front Hood – 911 (997) & Boxster/Cayman (987)

The luggage compartment lid shell has been constructed out of aluminum to reduce weight. This has resulted in a weight saving of 13 lbs (6 kg), or a reduction of 40%.

Rear Luggage Compartment – Boxster/S (987)

The mid engine design provides the ideal basis for the familiar “2 luggage compartment principle” on the Boxster/S. Even with the top open, the volume of the rear luggage compartment, which is ideally designed for easy loading, stands at approx. 4.6 cu ft (130 liters). Convenient opening of the luggage compartment lid is possible via a switch inside the vehicle or directly via a button on the ignition key. The two luggage compartments together offer approx. 9.9 cu ft (280 liters) of storage space – sufficient to store the luggage of two people on a vacation.



The engine service tray is located in the front area on the right and includes filling points for engine oil and coolant.

Rear Luggage Compartment – Cayman/S (987)

The coupé concept and the wide-opening rear lid provide for approx. 9.2 cu. ft. (260 liters) of storage space, effectively arranged on two levels. The luggage compartment lid can be opened conveniently by way of a switch in the interior or directly via a button in the ignition key. It can be pushed up beyond a defined point to facilitate comfortable loading by taller people.



The rear, lower area of the luggage compartment can be described as the basic luggage compartment, which is equipped as standard with four tie down rings in which a luggage net which is available from Tequipment can be installed. When the rear lid is closed, a standard, removable screen on the lid protects this area from view.

The upper level of the luggage compartment, in the area of the engine cover, is likewise equipped with four tie down rings in which a luggage net is standard equipment. A securing clip prevents luggage from sliding into the passenger compartment. The luggage compartment concept also offers the option of being able to unload the luggage compartment from the passenger compartment in a convenient manner by folding the seat backs forward. It is also possible to transport long, flat objects such as a snowboard, whereby the screen can simply be pulled back over the items of luggage.

Rear Engine Lid – 911 (997)

Similar to the previous 911 (996), the rear engine lid is made from sheet steel. Its styling has been adapted to the new body design. The integrated rear spoiler has also been restyled. The spoiler extends at 75 mph (120 km/h) to reduce lift coefficients at the rear axle, thereby increasing driving stability.

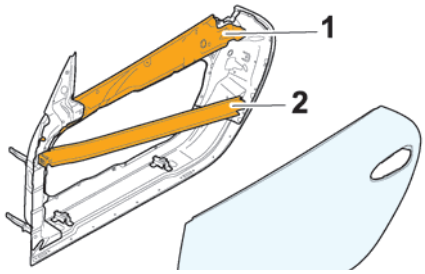


Since aerodynamic forces are rather less important at low speeds, it retracts at speeds below 38 mph (60 km/h) as a function of the engine compartment temperature. The logo on the rear lid of the 911 Carrera/S/4/4S, Targa 4/4S or Turbo is finished in titanium.

Doors – 911 (997) & Boxster/Cayman (987)

The doors have been modified in the following areas in relation to the predecessor with the objective of further improving crash safety:

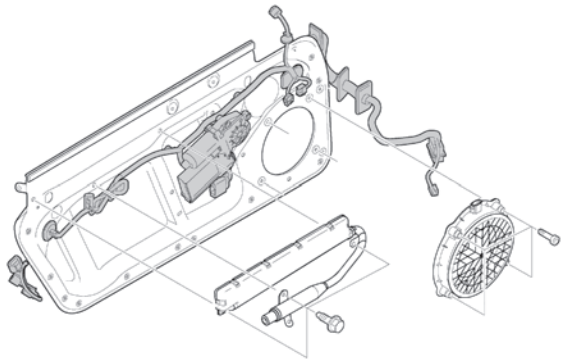
In order to reinforce the passenger cell in the event of a frontal or offset crash, the upper load path has been optimized. The upper load path distributes the energy acting on the body in the event of a frontal crash very effectively between the front and rear parts of the car via the door. To accomplish this, the upper part of the door has been strengthened by the high strength steel door channel reinforcement (1). In the event of a crash, this reinforcement transmits the attendant forces via a support on the rear side section to the rear part of the car. This has further improved the deformation behavior and the integrity of the passenger cell (important for protecting passengers).



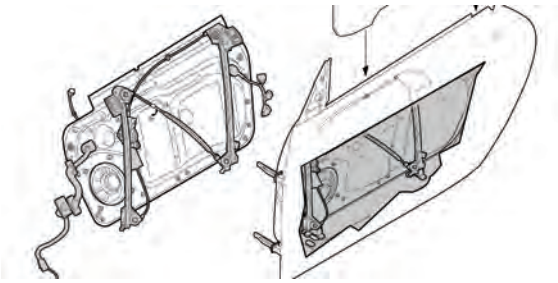
1 - Door channel reinforcement
2 - Door reinforcement

Door reinforcement (2) consists of high strength steel profiles and is also integrated into the door construction. In conjunction with the rigid side structure, it provides for increased penetration resistance and improved side protection. The door arrester has been equipped with an additional, third index position for more precise positioning of the doors during opening.

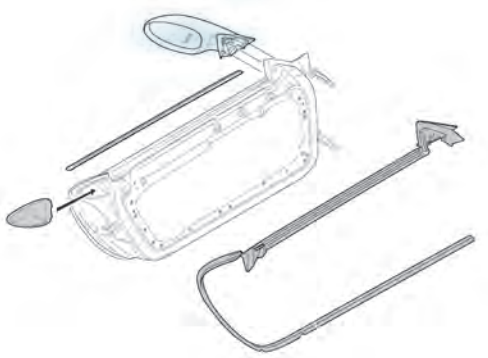
The doors are modular in structure. The side airbag, loud-speakers, wiring harness, power window motor, etc. are attached to the aluminum inner door paneling. The inner door paneling is screwed to the door.



The window lifter assembly is attached to the inner door paneling and fitted in the appropriate mountings at the bottom of the door shell.

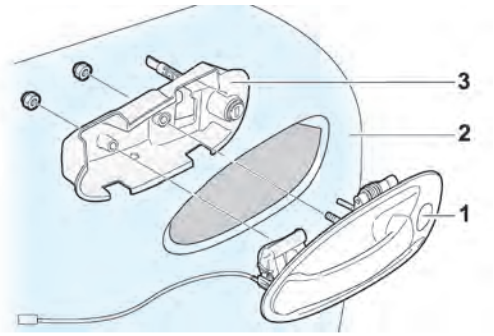


The door seal comprises the mirror seal, the interior door channel seal and the door fold seal. The door seal is slotted into place in the area of the door channel and is held in place by clips in the door fold. The outer door channel seal is slotted into position.

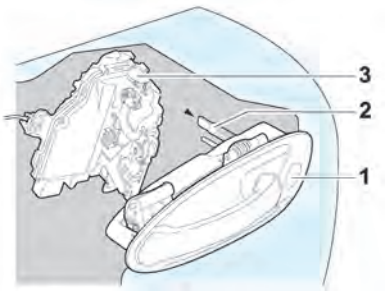


The door mirror assembly is mounted to the mirror triangle by three screws. The rear cover conceals the point at which the door channel reinforcement is screwed into place at the rear. The door window is inserted in the fixtures on the window lifter from above by sliding it through the door panel.

Door Handle



The door handles of the 911 Carrera/S (997), Boxster/S & Cayman/S (987) have been newly developed. They now have a curved design and as before are matched to the exterior color so that they blend in well with the vehicle design. The handhold (1) of the outside handle is fixed to the door panel (2) together with the underpart (3) of the door handle by means of two flanged nuts.



The actuating shaft (2) of the lock cylinder (1) slots into the corresponding recess in the door lock without any play.

PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Power-assisted steering: Check fluid level
- ❑ Engine: Check oil level
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ☑ Check firewall and cabrio section body drains for debris
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ❑ Change engine oil: (oil filter change is not required)
- ❑ Air Filter: Check the air filter condition, and if necessary, replace
- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Power-assisted steering: Check fluid level
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze protection level
- ❑ Pollen filter: Replace filter element
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ☑ Check firewall and cabrio section body drains for debris
- ☑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ☑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ❑ Vehicle lights: Check operation
- ❑ All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ❑ Change engine oil and oil filter
- ❑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ❑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ☑ Diagnosis system: Read out fault memory
- ❑ Polyrib belt: Check condition
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ❑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ❑ Power-assisted steering: Check fluid level
- ❑ Parking brake: Check free play of the parking brake lever
- ❑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ❑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Clutch: Check play or final position of pedal
- ❑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Check tightness on the front and rear suspension adjustment points
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ❑ Tires and spare wheel: Check condition and tire pressure
- ☑ Check firewall and cabrio section body drains for debris
- ☑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ☑ Seat belts: Check operation and condition
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

---

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ❑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ❑ Replace Polyrib belt
- ❑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ❑ Manual transmission: Change oil
- ❑ Automatic transmission: Change ATF and ATF-filter
- ❑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ❑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ❑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ☑ Check airbag system
- ☑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.

❑ Change engine oil and oil filter

❑ Air Filter: Check the air filter condition, and if necessary, replace

☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage

❑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze

❑ Pollen filter: Replace filter element

❑ Brake system: Visual inspection of the brake pads and brake discs for wear

❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion

❑ Drive shafts: Visual inspection of the dust boots for leaks and damage

❑ Tires: Check condition and tire pressure

☑ Check firewall and cabrio section body drains for debris

☑ Check the door, lid locks and safety hook of the front lid for secure seating and function

❑ Vehicle lighting: Check function
All headlights: Check setting

❑ Horn: Check function

❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)

❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
❑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
☑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

☑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

- ☑ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
- ❑ Change engine oil and oil filter
- ☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
- ❑ Coolant hoses: Check condition
  Radiators and air intakes: Visual inspection for external debris and blockage
  Coolant: Check level and antifreeze
- ❑ Air filter: Replace filter element
- ❑ Pollen filter: Replace filter element
- ❑ Fuel lines and connections: Visual inspection for damage and leaks
- ❑ Brake system: Visual inspection of the brake pads and brake discs for wear
- ❑ Parking brake: Check free play of parking brake lever
- ❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ❑ Clutch: Check the pedal play and end position
- ❑ Steering gear: Visual inspection of the dust boots for damage
  Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
- ❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ❑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ❑ Tires: Check condition and tire pressure
- ☑ Check firewall and cabrio section body drains for debris
- ☑ Check the door, lid locks and safety hook of the front lid for secure seating and function
- ❑ Vehicle lighting: Check function
  All headlights: Check setting
- ❑ Horn: Check function
- ❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ☑ Seat belts: Check function and condition
- ❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

- ❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

- ❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

- ❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
- ❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
- ❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance for convertible top Labor operation 03 70 00 .. (911 Carrera only)

- ❑ Maintain and care for convertible top at 20,000 miles (30,000 km) or every 2 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

- ❑ Replace drive belt
- ❑ Replace fuel filter (Turbo only)
- ❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

- ❑ Change manual transmission oil
- ❑ Change Tiptronic transmission oil and ATF filter
- ❑ Change Tiptronic transmission final drive oil
- ❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
☑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

☑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be performed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 5/06 AfterSales Publications Part Number - PNA 000 162 EB

Notes:





Subject	Page
General Information – Boxster/S (987)	6.3
General Information – Cayman/S (987)	6.3
General Information – 911 Carrera/S (997)	6.3
General Information – 911 Targa 4/4S (997)	6.4
Targa Glass Sliding Roof	6.5
Bumper System	6.6
Door Mirrors	6.7
Occupant Protection	6.8
Child Restraint System	6.9
Side Airbags	6.10
Seat Belts	6.10
Passive Safety – 911 Targa 4/4S (997)	6.10

Notes:

General – Boxster/S (987)



The exterior has been completely redesigned. The new Boxster (987) and Boxster S (987) now cuts a more powerful appearance. In addition to the 21 mm wider body, the track has also been widened in comparison to the previous Boxster/S (986) models, by up to 35 mm at the front and up to 24 mm at the rear, depending on the tire size.

Particularly striking details are the new headlights with additional separate headlights at the front end (fog light/marker light), more pronounced fenders, a new double arm door mirror, a new aerodynamically optimized rear spoiler.

General – Cayman/S (987)



The new coupé front is emphasized by the slightly oval main headlights of the Boxster and the striking air inlets. The upper edge of the windshield which is 25 mm lower than that of the 911 Carrera combined with the eye catching roof contour give the Cayman/S its unique front view.

The new coupé line is characterized by a pronounced roof curvature and a long wheelbase, a gently sloping rear section and side windows which appear to surge upwards – an effect that is also taken up by the air inlet on the rear side section. The side air inlets each feature three vertically arranged vanes in the vehicle color. All of these features combine to give the Cayman S its characteristic silhouette, which is further underlined by the large, flat-lying rear lid.

General – 911 Carrera/S (997)



The front view of the vehicle is dominated by the new, redesigned headlight module, the air inlets and the new contour of the front hood. The oval shape of the main headlights in particular defines the character of the 911 Carrera/S (997). Their deeper and wider position makes the front end look shorter, yet wider and more powerful.

The side view is dominated by the design of the front fender and rear quarter panels. This shape is further enhanced by the narrower doors. The wheel openings provide space for the larger wheels. The roof contour has been further increased through a sturdier C-pillar. A new seal design with narrower cross sections permits exposed glass edges at the front and rear window and emphasizes the clean lines of the window.

The rear view of the 911 Carrera/S (997) is dominated by the flared quarter panels and the rear lights. The raised rear lid joint between the lights lends the rear added impact. The rear lights feature a new, brilliant look and a clean division between the red and silver/grey area. As with the front lights, the brilliance has also been increased when the lights are switched on in the dark.

Body Equipment, Exterior

General – 911 Targa 4/4S (997)



The glass roof assembly integrated in the body gives the 911 Targa 4/4S (997) models a unique look. The silhouette appears elegantly long thanks to the rear side windows, which converge in a point towards the rear, and differentiates it from the 911 Carrera models. The side drip mouldings and the cowl panel cover are always finished in high-gloss black regardless of the exterior color. This Plexiglas cowl panel cover is located between the windshield and glass sliding roof and gives a continuous glass-roof look all the way from the windshield to the back window. The elegant design of the rigid roof line is further accentuated by the polished and anodized aluminum side trim strip along the roof frame.



The roof line and the division of glass areas is designed to achieve as flat a look as possible when the glass sliding roof is moved back under the rear window. A compact guide mechanism in the sliding sunroof ensures comfortable interior dimensions without forfeiting the roof line that is typical of the 911.

The maximum transport volume in the interior with the rear seat backrests folded down is 8.1 cu. feet (230 liters), thanks to the modified roof line guide and the further recessed trim panel on the rear cross member, thereby offering almost 1 cu. foot (25 liters) more space than in the Coupé.



The backbone of the glass roof assembly is an integral steel-plate assembly frame, which accommodates the glass sliding roof with drive mechanism, air deflector, roller blind and hinged rear window as well as the closing aid.

The design and mechanics of the roof assembly are essentially the same as on the previous model (996). The assembly frame has an integrated water management system, which clears away any water that drops down when the sliding sunroof or rear window is open. A bar between the glass sliding roof and rear window is used for fitting center-joint and rear lid seals and for securing the sliding roof seal.

The complete roof assembly is secured to the roof pillars, the windshield frame and the rear cross members from below. Black tinted Plexiglas covers, with their thinly protruding rubber lips overlapping the glass elements, form a flush transition to the body. They not only minimize wind noise, but their black, high-gloss surface also adds to the glass look.

The lift mechanism joins the glass sliding roof to the assembly frame and its guides. On the new 911 Targa 4/4S (997) models, this lift mechanism has an optimized spring mechanism with three cup springs, which absorbs transverse acceleration caused by vehicle movements and prevents noises, particularly on bad road surfaces. When lowering the roof, the lift mechanism is guided in a two-section plastic gate link, which is riveted to the sides of the assembly frame.

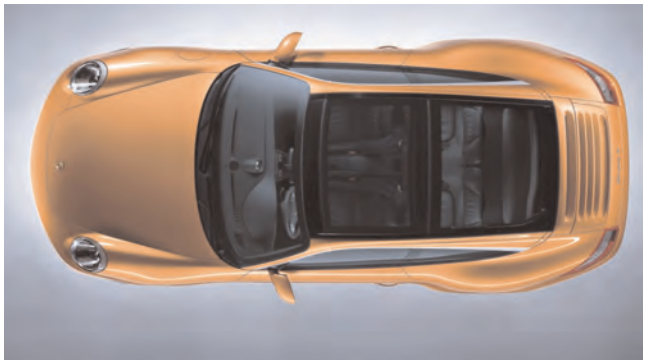
Guide rails are riveted to the retaining frame of the roof assembly at the left and right to facilitate longitudinal movement of the glass sliding roof. Two sliding blocks, which carry the sliding roof, run to the left and right in

each of these aluminum rails. Damping with respect to the vertical axis has been improved by using a new limit stop in the guide rail

Glass Sliding Roof

The glass sliding roof on the new 911 Targa 4/4S (997) is made of 6.3 mm thick partially prestressed laminated safety glass. The glass is 1.15 mm thinner (996 was 7.45 mm) compared to the previous model (996), thereby saving approx. 4.2 lbs (1.9 kg) in weight. This reduced weight in the roof area results in a lower center of gravity and increases anti-rolling stability compared to the previous model (996).

The use of tinted sun protection glass ensures that the passenger compartment does not heat up any more than in a Coupé in direct sunshine despite. When the air conditioning is on, comfortable interior climate control is possible even at outside temperatures of 86° F. (30° C) and higher.



The glass light penetration value of 31.2 % ensures a bright, light-immersed interior and gives the unmistakeable Targa interior feeling even with the roof closed. When necessary a blind can be closed to enhance the heat insulating effect of the glass. It also absorbs UV rays.





The new 911 Targa 4/4S (997) is the only 911 model variant with a hinged rear window. It offers extremely convenient access to the rear luggage space, which has a capacity of 8.1 cu. feet (230 liters) when the rear seats are folded down, and therefore makes loading and unloading easier. The heating wires for the standard rear window heating are integrated into the window. A rear window wiper is available as an option.

The hinged rear window, which can be locked and unlocked electrically, is made of 3.8 mm thick tinted single-sheet safety glass and can be opened and closed manually. The rear window can be unlocked when the vehicle is stationary either by pressing a button on the door sill at the driver's side or from the outside by remote control by pressing a button on the vehicle key. For safety reasons, this is only possible when the glass sliding roof is closed. When you unlock the rear window, it is raised by approx. 20 mm and can be opened slightly manually. This eject height has been increased by 10 mm compared to the previous model (996) to make it easier to grasp the bottom of the rear window.

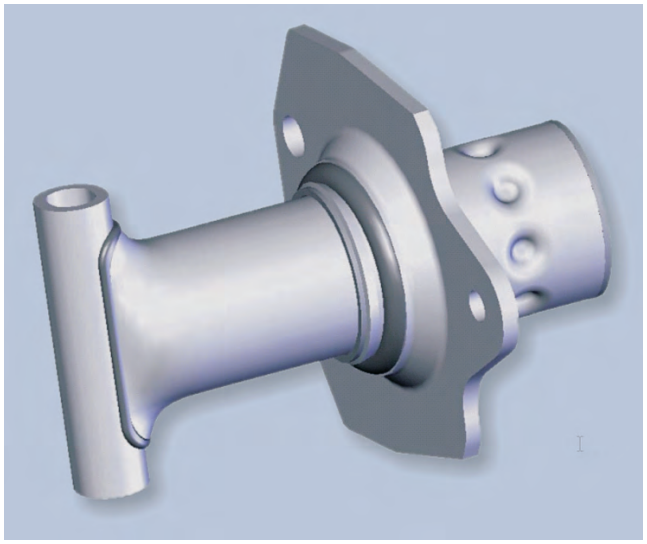
Once the rear window is lifted slightly, the two pneumatic springs, located inconspicously behind the side window trims, which are painted black, support the rear window by raising it up by approx. 60°.

Loading and unloading the luggage storage area behind the rear seat backrests, which has a capacity of approx. 3.5 cu. feet (70 liters), is considerably easier thanks to the hinge function of the rear window. At the same time, two interior lights come on when you open the rear window. These are integrated into the belt covers in the rear area of the rear side trim panels. When you lift up the rear window, any water lodging there is drained away via the water collection groove integrated at the rear end of the glass sliding roof.

Bumper System – 911 (997) & Boxster/Cayman (987)

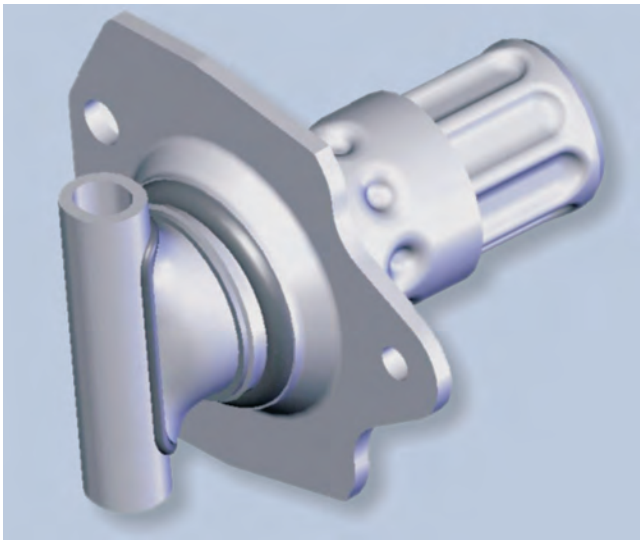
Key features of the proven bumper system have undergone further development and improvement. The area of the impact elements on the front bumper has undergone substantial modification. The objective of this modification was to increase protection for the body structure in the front of the vehicle at low impact speeds. This is important for a favorable insurance classification (comprehensive insurance).

Improvement in this area has been achieved through the use of new, energy absorbing impact elements with a stroke of 50 mm. These impact elements now consist of two tubes, one inserted into the other, instead of just one tube as was previously the case. At the same time they are now secured to the front body cross member using three threaded connections instead of two. As a result they are more resistant to oblique impact.



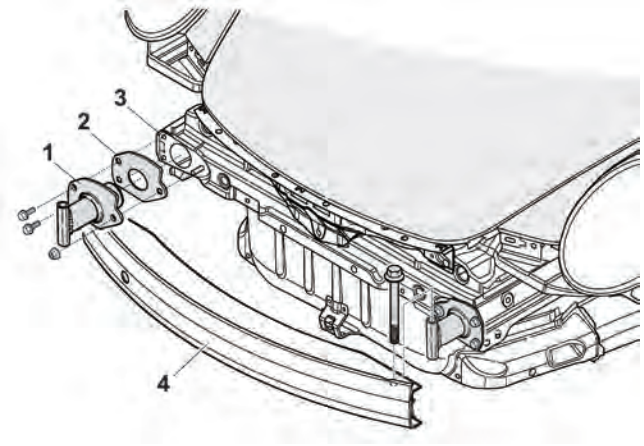
New Impact Absorber

The outer, thicker walled tube is equipped with specially defined impressions. In a crash, the inner tube is pushed into the outer one. In doing so it must “push past” the impressions which form a star-shaped narrowing. This process reduces energy and therefore also minimizes intrusion into the front body structure of the vehicle.



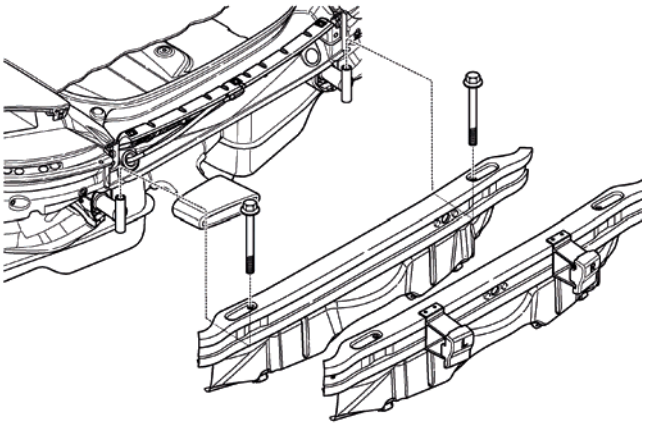
Impact Absorber After Collision

In addition to the impact element, the cross member in the front bumper has also been reinforced. This provides for improved crash characteristics. A seal (2) is installed between the impact element (1) and the body (3). The bumper (4) is screwed to the impact element from above.



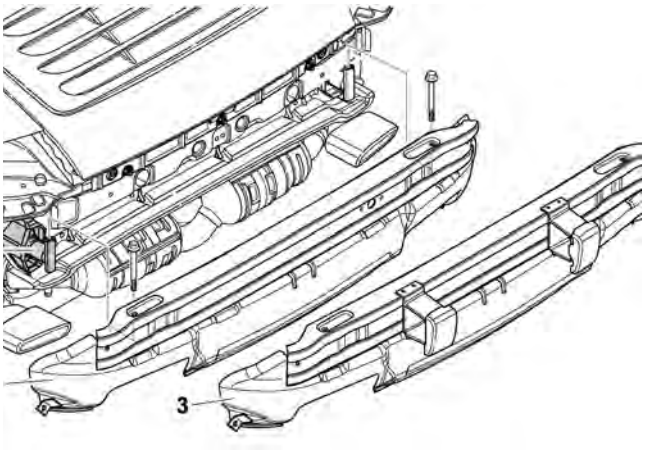
Notes:

Rear Bumper – Boxster/S (987)



The rear bumper concept has been adopted from the previous Boxster/S (986) models and adapted to the new rear section.

Rear Bumper – 911 (997)



1 - Impact element
2 - Bumper, rest of the world
3 - Bumper, USA

The bumper system and the impact elements (1) at the rear correspond to the previous 911 (996) design.

Similar to the previous model 911 Carrera/Boxster, the towing lug which is supplied with the tool kit is screwed into the front or rear cross member in the bumper when required. The thread cover now works like a small rocker switch and can be removed without any tools, simply by pressing in the bottom half.

Door Mirrors– 911 (997) & Boxster/Cayman (987)

The door mirrors have been completely redesigned and represent a key element of the new exterior styling. The mirrors are connected to the mirror attachment point mount by way of a double arm. The design of the mirror housing has been revised, enabling the mirror glass to be positioned deeper inside the housing. The mirror glass itself is now protected more effectively from turbulence and possible vibrations at high speeds.

Both door mirrors are electrically heated and adjustable and, in the case of fully electric sports seats or adaptive sports seats, are connected to the memory function. On request, both door mirrors and the interior rearview mirror can be provided with an automatic an anti-dazzle function (optional in combination with the rain sensor).



Figure 1

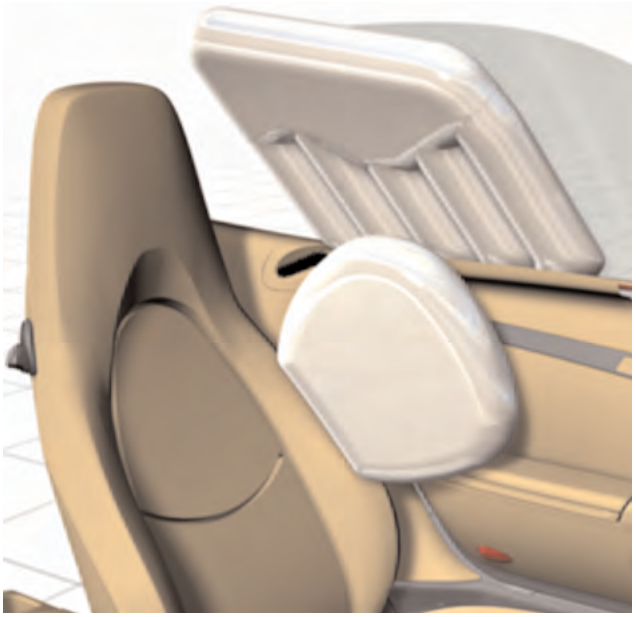


Figure 2

The door mirror can be folded in towards the door manually (Figure 1). To this end, the mirror is pushed towards the door and held in this position (high spring force). The locking lever is then pushed as far as it will go and the mirror is released (Figure 2).

Notes:

Occupant Protection



The 911 (997), Boxster/S (987) & Cayman/S (987) come with full size airbags for driver and passenger as standard equipment. In addition to the crash sensor integrated in the airbag control unit on the center tunnel, there are two sensors in the front of the vehicle mounted near the headlights for detecting the point and direction of impact. This enables earlier and more accurate sensing of crashes, particularly complex impact scenarios such as offset crashes. This has the major advantage of further reducing passenger injuries in a crash.

As on the previous 911 (996) and Boxster (986) models, the passenger airbag is housed in the upper area of the dashboard. The airbag flap, which used to be visible, has now been integrated in the dashboard to produce a more homogenous styling effect. In combination with the leather interior, decorative seams feature on the airbag cover as a stylistic element.







Child Restraint System

Risk of serious or fatal injury from passenger airbag if not switched off when using a child restraint system. If children weighing up to 60 lbs (27 kg) are going to be transported in a child restraint system, the passenger airbag must be switched off. If the weight is more than 60 lbs (27 kg), the passenger's airbag should be switched on (see Owner's manual).

Switching Passenger Airbag On and Off



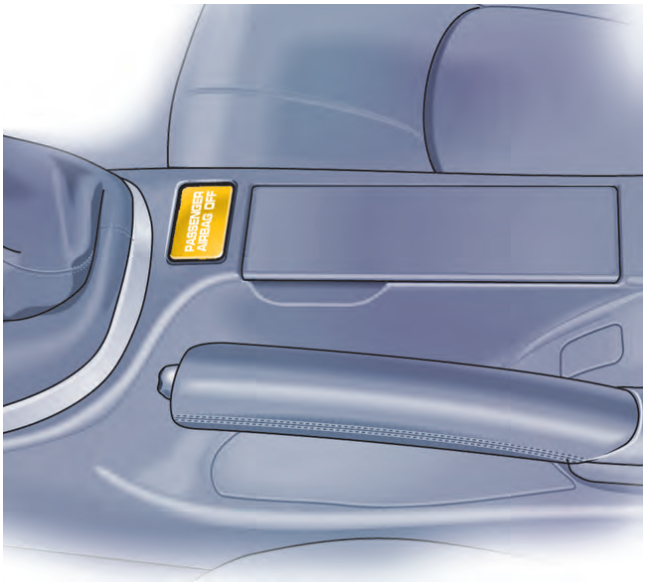
Switch off the passenger airbag on the key switch using the vehicle key (see Owner's Manual).

A - Switch setting ON – Airbag switched on
B - Switch setting OFF – Airbag switched off

Caution

Risk of serious or fatal injury for passenger if passenger airbag remains switched off after the child seat is removed. The passenger airbag must be switched on when the child seat has been removed.

Airbag Warning Light "PASSENGER Airbag OFF"



When the airbag on the passenger's side is switched off (see driver's manual):

- Warning light "PASSENGER AIRBAG OFF" is continuously lit when the ignition is switched on
- The message PASSENGER AIRBAG OFF is displayed by the on-board computer. Deactivation is acknowledged with an acoustic signal.

Notes:

Side Airbags

The new generation of the standard Porsche Side Impact Protection System (POSIP) is a unique new development on the market. It now comprises two airbags per side: One thorax airbag and one head airbag.

A specially adapted thorax airbag is now integrated in the backrest of both the driver's and the passenger's seat to protect the upper body in a side impact. In the event of a crash the airbag, which has a volume of approx. 8 liters, is inflated by a gas generator based on hybrid technology. In addition to the thorax airbag, a separate head airbag is additionally installed in each door – a world first in an open car. Head airbags are available in closed vehicles in the form of "curtain" airbags, which drop down from the roof frame.

No such solution was previously available for open vehicles. Instead, large side airbags were installed either in the seat or in the door trim panel, as on the previous model.

For the new 911 (997) and Boxster/S (987) a separate head airbag has been developed which functions in a similar manner to a curtain airbag, but which inflates up from the door window channel in the door trim panel, rather than dropping down from the roof. This airbag again has a volume of approx. 8 liters, offering effective head protection. In the event of side impact, the head airbag inflates in the form of a protective cushion. Like the thorax airbag, the head airbag is also inflated using a hybrid generator. The sensors for detecting a side impact and thus for activating the side airbags are located in the airbag control unit on the center tunnel and in the area of the side sills.

Seat Belts – Boxster/S (987) & Cayman/S (987)

The 3-point automatic belts have been adopted from the previous model and are equipped with pyrotechnic belt tensioners and belt force limiters for the driver and passenger. Installation of the upper belt guide point on the roll-over bar at the level of the B-pillar ensures a proper seat belt fit.

Seat Belts – 911 (997)

The seat belts for the 911 Carrera/S (997) have been retained from the previous 911 Carrera (996) model. The belts for the driver and front passenger are equipped with pyrotechnic belt tensioners and belt-force limiters. As on the previous 911 Carrera (996) Coupé, the belt height is adjusted at the B-pillar to ensure an optimum seat belt fit. Rear passengers are also provided with 3-point automatic belts.

Roll-over Bar – Boxster/S (987)

The newly developed roll-over bar is produced by way of an internal high-pressure forming process in a special stainless steel alloy which fulfils the very highest strength requirements. Through material and geometric optimization, the strength of the bar has been increased by 30 %. The roll-over bar is now positioned higher and further towards the rear. Thanks to the new seats with higher headrests, the previously generous occupant survival space has been further enlarged.

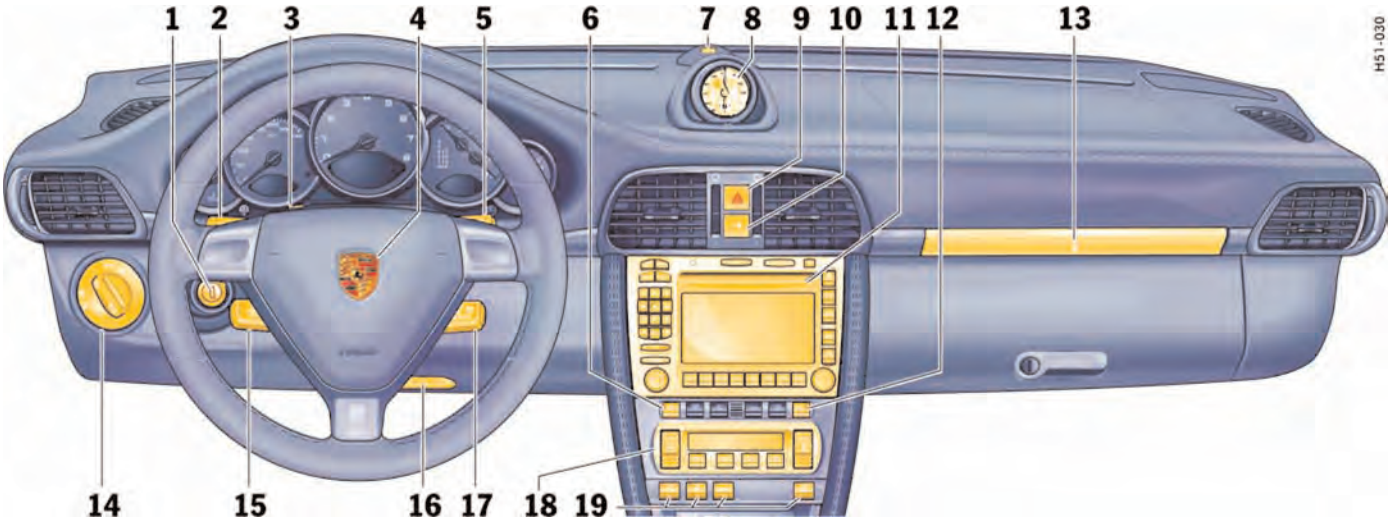
Passive Safety – 911 Targa 4/4S (997)

Both 911 Targa 4/4S models have a bodyshell structure designed to suit the specific requirements of a vehicle with a large roof opening area. This bodyshell structure is light-weight, has extremely high torsional rigidity and includes all the design features required to provide excellent passive safety.

High-strength steel tubes and panels were used to guarantee the required body rigidity despite the large bodyshell opening in the roof, particularly in the event of a rollover. These 30 mm thick reinforcement tubes run through the A-pillar, then through the entire roof pillar and end at the C-pillar, where they are joined to the body base by strong gusset plates.

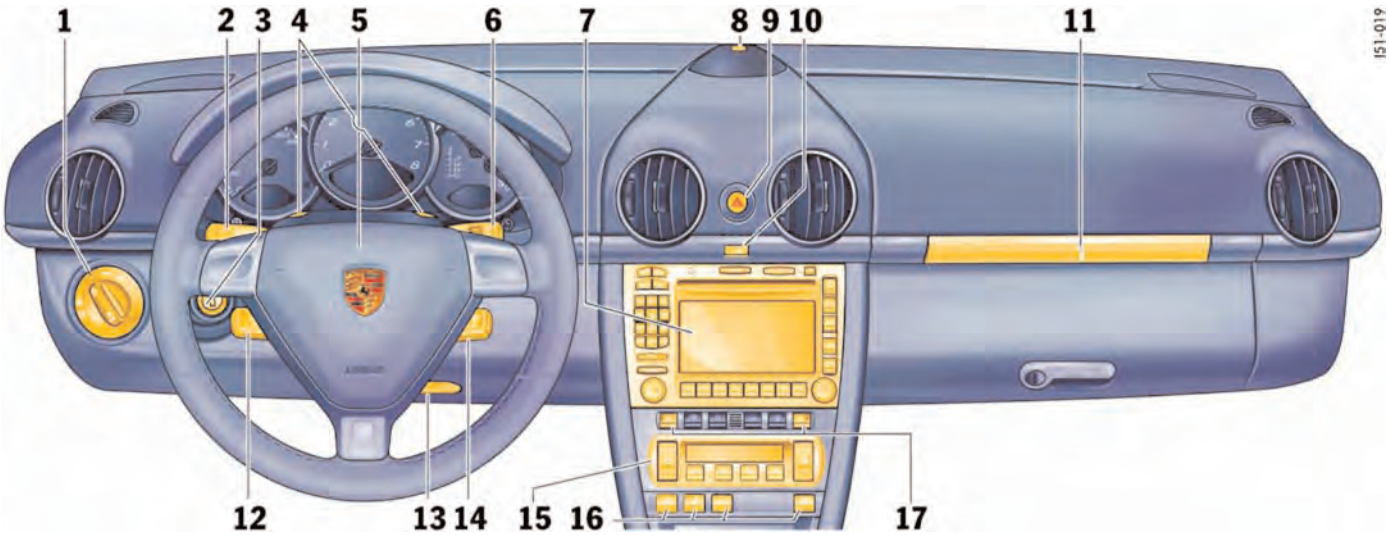


Subject	Page
911 Carrera/S (997) Dashboard Layout	7.2
Boxster/S (987) Dashboard Layout	7.3
Cayman/S (987) Dashboard Layout	7.4



Operation, Instruments

1. Ignition lock/steering lock
2. Turn signals/high beam/headlight flasher stalk
3. Hands-free microphone for telephone
4. Horn
5. Wiper/washer stalk, rear window wiper
6. Button for seat heating, left
7. Interior temperature sensor/GPS antenna
8. Stopwatch
9. Emergency flasher switch
10. Central locking button, readiness display for alarm system
11. Porsche Communication Management (PCM)
12. Button for seat heating, right
13. Cupholder
14. Light switch
15. Operating lever for on-board computer
16. Locking lever for steering-wheel adjustment
17. Operating lever for automatic speed control
18. Operating panel for air conditioning
19. Buttons for rear spoiler, Porsche Active Suspension Management (PASM), Sport mode, Porsche Stability Management (PSM)



Operation, Instruments

1 Light switch

2 Turn signals/
headlight dimmer/flasher lever

3 Ignition Lock/locking the steering column

4 Hands-free microphone for telephone

5 Horn

6 Windshield wiper/washer lever

7 Porsche Communication Management/Radio

8 Interior temperature sensor, GPS antenna

9 Emergency flasher switch

10 Central locking button,
Readiness display for alarm system

11 Cupholder

12 Operating lever for on-board computer

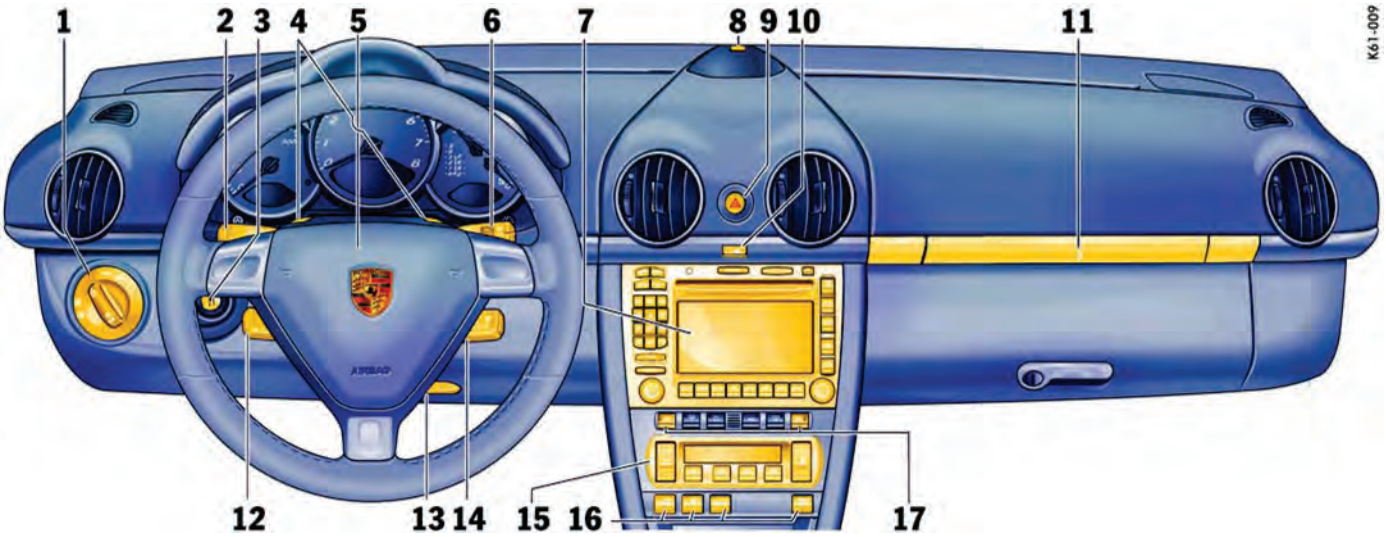
13 Locking lever for steering-wheel adjustment

14 Operating lever for cruise control

15 Control panel for heating, ventilation and air conditioning system

16 Buttons for rear spoiler,
Porsche Active Suspension Management (PASM),
Sport Mode,
Porsche Stability Management (PSM)

17 Seat heating, left/right



Operation, Instruments

1 Light switch

2 Turn signals/
headlight dimmer/flasher lever

3 Ignition lock/locking the steering column

4 Hands-free microphone for telephone

5 Horn

6 Windshield wiper/washer lever
Rear window wiper

7 Porsche Communication Management/Radio

8 Interior temperature sensor, GPS antenna

9 Emergency flasher switch

10 Central locking button,
Readiness display for alarm system

11 Cupholder

12 Operating lever for on-board computer

13 Locking lever for steering-wheel adjustment

14 Operating lever for cruise control

15 Control panel for heating, ventilation and air conditioning system

16 Buttons for rear spoiler,
Porsche Active Suspension Management (PASM),
Sport Mode,
Porsche Stability Management (PSM)

17 Seat heating, left/right



Subject	Page
General Information	8.3
Manual Air Conditioning – Boxster/S (987) & Cayman/S (987)	8.4
Automatic Climate Control	8.6
Compressor	8.8
Condenser	8.9
Receiver Drier	8.9
Sensors and Actuators	8.10
Temperature Mixing Flap	8.12
Condenser Fan	8.12
CAN Interface	8.13
Maintenance Sheets	8.14

Notes:

General – Boxster/S (987) & Cayman/S (987)

The Boxster/S (987) and Cayman/S (987) feature manual air conditioning with combined interior filter (active carbon and pollen filter) as standard equipment. Automatic climate control is available as an option.

Both systems; air conditioning and automatic climate control are further developments of the respective previous systems. They have been revised to ensure more even and more comfortable ventilation of the passenger area and to improve the user friendliness of all air conditioning functions.

General – 911 Carrera/S (997)

In contrast to the previous 911 Carrera (996) model, the 911 Carrera/S (997) features automatic climate control with a combined interior air filter (active carbon and pollen) as standard. The automatic climate control used in the 911 Carrera/S (997) is a further development of the previous system. It was revised to ensure more even and more comfortable ventilation of the passenger area and to improve the user-friendliness of all air conditioning functions.

The advantages of the new air conditioning systems:

- Ensures more even ventilation of the passenger area
- Is considerably less prone to drafts
- Is quieter
- and offers increased functionality.

The air conditioning system employs a CFC-free refrigerant. In order to ensure an adequate supply of electrical energy (taking additional facilities into consideration), the 70 Ah battery is more powerful than its predecessor and has been weight optimized.

Ventilation – 911 Carrera (997) & Boxster/Cayman (987)

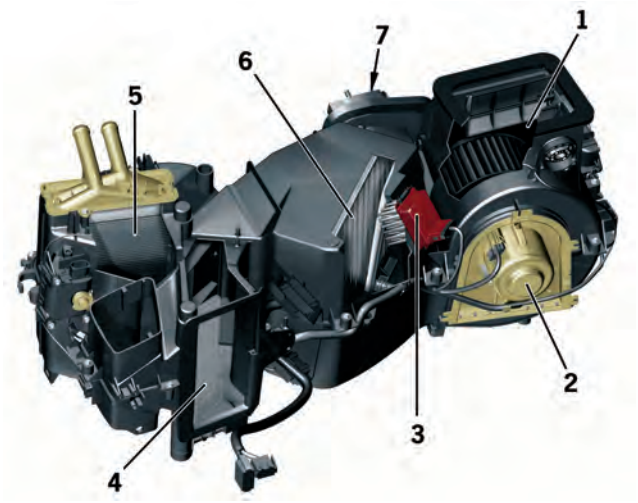
Air Routing

The newly designed passenger vents in the dashboard enable a high degree of individual adjustment. The increased vertical and horizontal adjustment range of the vents and the separate left/right knurled wheel for the center vent permit more specific adjustment of the air flow than was previously possible.

The advantages of this revised system are:

- Reduced drafts
- Reduced air flow noise
- A larger volume of air is available for to ensure sufficient heating and cooling requirements are met in extreme conditions.

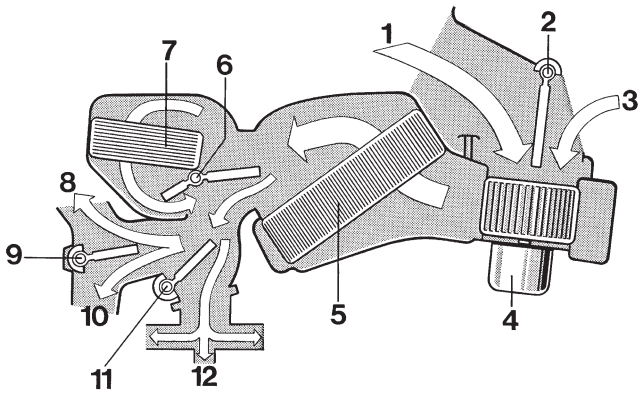
Air and Flap Controls (heater box)



1 - Fresh air intake port
2 - Fan motor
3 - Fan regulator / output stage
4 - Central distributor flap
5 - Heat exchanger
5 - Central distributor flap
6 - Evaporator
7 - Expansion valve (on rear side)

The design of the heater box is basically the same to that on the previous 911 Carrera (996) and Boxster (986) models.

Recommended air distribution:



1 - Fresh air intake port
2 - Distributor flap for fresh air/recirc. air
3 - Recirculating air intake port
4 - Fan motor
5 - Evaporator
6 - Temperature mix flap
7 - Heat exchanger
8 - Defrost air outlet vent
9 - Footwell/defrost distributor flap
10 - Footwell air outlet vent
11 - Central distributor flap
12 - Central and side vents

In summer – Air distribution to central and side vents
In winter – Air distribution to the footwell and the front windshield

Back Pressure Compensation (Not used in Boxster/S & Cayman/S (987) manual A/C System)

The air throughput is influenced by the back pressure which arises in the area of the fresh air inlet according to the vehicle speed. In order to compensate for this dependency, the distributor flap for fresh air/recirculated air (back pressure flap) is moved in the direction of "closed" (recirculated air) according to the vehicle speed (from 55 mph/90 km/h). The flap setting is also dependent on the fan voltage.

Center Air Outlet Vent Shut-off Flaps

The increased vertical and horizontal adjustment range of the vents and the separate left/right knurled wheel for the center vent permit more specific adjustment of the air flow than was previously possible. The vents should be closed when a high level of heating is required and opened when a high level of cooling is necessary.

Air Conditioning, Manual Air Conditioning – Boxster/S (987) & Cayman/S (987)

Functions – This air conditioning system, which enables continuous adjustment and setting of the desired cooling power and air flow rate (fan speed) via rocker switches according to individual wishes, controls the temperature of the conditioned air mixture by mixing warm and cold air in the heater box.

Operation (manual air conditioning system)

The air conditioning system is operated by way of a control panel (a/c controls) with integrated control unit in the center console. The appearance of the control panel for the manual air conditioning system is based on that of the control panel for the automatic climate control system.

The key features of the control panel are:

- Integration of the interior temperature sensor (required for the seat heating functions)
- Integration of the switches for heating the driver's and passenger's seats (previously in the center console)
- Integration of the button for heating the rear window (previously located beside the operating unit)
- Introduction of switches for adjusting the temperature and fan power (higher setting = switch up, lower setting = switch down)
- "ECO" marking (ECOnomy mode) on the button for switching the air conditioning compressor on and off (snowflake symbol on display goes on /off accordingly).

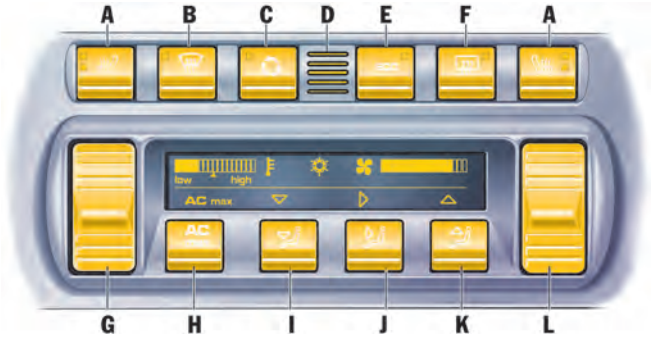
As a result of these changes, all of the heating functions in the vehicle are now together in a single unit.

The following items of information can be called up on the air conditioning display:

- Temperature and air flow rate (fan speed)
- A/C compressor on/off
- AC max mode
- Air distribution

The temperature is presented on the display by way of a bar display. When no bar is visible, the temperature is set to the maximum cold setting (low) When all the bars are visible, the temperature is set to the maximum warm setting (high)

Control Panel (Manual A/C)



A - Seat heating (left / right)
B - Defrost windshield
C - Recirculating air
D - Interior temperature sensor is motor ventilated (behind the slotted cover) and is only used to stop seat heating when temperature gets above 104° F. (40° C)
E - ECObutton (ECOnomy mode), the compressor is switched off via a relay at the touch of a button
F - Defrost rear window
G - Temperature setting
H - AC max mode
I - Button for air distribution in the footwell
J - Button for air distribution to the air outlet vents (central and side vents)
K - Button for air distribution in the direction of the windshield
L - Air flow rate adjustment (fan speed)

E - ECO Button (air-conditioning compressor off/on)

The ECO button enables the selection of ECOnomy mode, which functions without the a/c compressor. ECOnomy mode permits cooling to values down to the exterior temperature.

H - AC Max Mode

This button can be pressed in any other operating mode to cool the vehicle's interior as quickly as possible.

- The temperature display indicates the lowest value and the fan is activated at maximum speed
- Distribution flap for fresh air/recirculated air is closed
- Air flow is directed to the defrost air outlet vents (front windshield) and the central and side vents

Other button functions on the control panel are explained in the section on "Automatic climate control"

Notes:

Air Conditioning - Automatic Climate Control – Standard on the 911 Carrera/S (997) and optional on the Boxster/S (987) & Cayman/ (987)

Functions – This air conditioning system controls the interior temperature preselected on the control panel completely automatically. The desired interior temperature can be set between 61° F. (16° C) and 85° F. (29.5° C). It is generally recommended to set the interior temperature to approx. 72° F. (22° C).

The system detects operating and ambient conditions of relevance to the interior climate via sensors and CAN. Automatic control is carried out primarily by way of the interior temperature sensor, the exterior temperature sensor and the solar radiation energy as detected by a sun sensor. This information is processed in the control unit (control panel) and converted into output signals for temperature control, the air distribution flaps (temperature and air distribution flaps are DC drive motors with position feedback), the fan and the compressor.

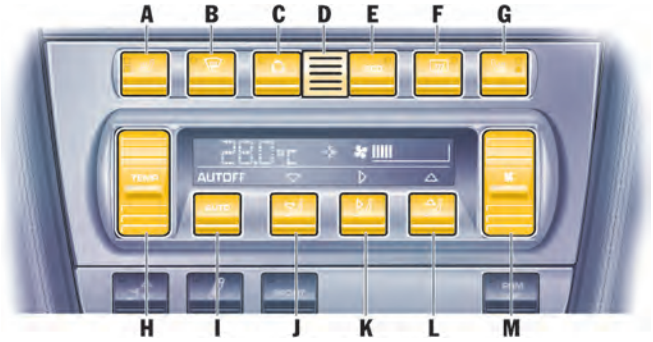
In addition to automatic climate control, the control panel also enables manual selection of the desired system status at any time. Changes regarding:

- temperature
- air flow rate
- air distribution

can be carried out by way of the control panel.

The cooling output of the air conditioning system is generated by a volume controlled swash plate (adjustable) compressor. Demand dependent metering of the refrigerant delivery rate helps to save energy, while continuous power consumption of the compressor helps to optimize idle speed.

Operation (automatic climate control panel)



A - Seat heating (left / right)

The air conditioning system is operated by way of a control panel (a/c controls) with integrated control unit in the center console. The control panel differs visually from that on the previous Boxster (986) models because of the addition of a new control interface.

The main changes to the control panel are:

- Integration of the interior temperature sensors (previously in the dashboard on the passenger's side)
- Integration of the switches for heating the driver's and passenger's seats (previously in the center console).
- Integration of the button for heating the rear window (previously located beside the operating unit)
- Introduction of switches for adjusting the temperature and fan power (higher setting = switch up, lower setting = switch down).
- "ECO" marking (ECOnomy mode) on the button for switching the air conditioning compressor on and off (snowflake symbol on display goes on /off accordingly).

As a result of these changes, all of the heating functions in the vehicle are now together in a single unit.

Control Panel

Information is displayed by means of an LCD display and signalling lights (LEDs) in some buttons. When "LO" or "HI" appear on the display of the a/c control unit, this indicates that the system is operating at maximum cooling or heating power (the temperature control function is deactivated). "LO" and "HI" are displayed by the nominal temperature value segments.

"OFF" on the display indicates that the fan is off.

A - Seat Heating on/off

The seat heating settings can be adjusted individually for the left (button A) and right (button G) side. Apart from OFF level, two heating levels can be selected. When the appropriate button is pressed, the air conditioning control unit (control panel) transmits the altered button status (pressed 1x or 2x) to the vehicle electrical system control unit. The vehicle electrical system control unit controls the heating elements in the seat directly (heating-up phase) and reports the relevant heat status (setting 2 or setting 1) back to the control panel. This heating status is indicated to the user via the LED in the seat heating button.

The operating time during the heating up phase is based on the interior temperature (CAN signal) according to the selected heat setting:

- Level 2 (at 104° F. (40° C) to <-4° F. (-20° C) from 2.2 to a maximum of 11.0 minutes
- Level 1 (at 104° F. (40° C) to <-4° F. (-20° C) heats from 0.5 to a maximum of 9.2 minutes

After the heating up phase the control unit switches to the continuous heating phase. The vehicle electrical system control unit now reduces the heating power of level 2 to 40 % and level 1 to 14 %.

B - Windshield

The defrost function can be activated immediately in all operating modes. On activation of this function, the temperature is switched to “HI”, the air flow rate is increased and the air is distributed primarily towards the windscreen. ECO mode is additionally ended, if the intake temperature conditions (fresh air intake temperature sensor >37° F.
(3° C) permits. If the compressor cannot be activated, recirculation air mode will be started.

C - Recirculation Mode

1 – Mode of functioning of manual recirculation mode
The fresh/recirculated air distributor flap can be activated at any time to prevent odour nuisance. However, recirculation mode is limited to max. 3 minutes when the air conditioning compressor is switched off (ECOnomy mode).

2 – Mode of functioning of automatic recirculation mode
At exterior temperatures of >79° F. (26° C), recirculation mode is selected automatically by the program after a ventilation time of 30 seconds in order to accelerate the cooling-down phase - with the air conditioning switched on.

E - ECO Button (air conditioning compressor off/on)

The ECO button enables the selection of ECOnomy mode, which functions without the a/c compressor. ECOnomy mode permits cooling to values down to the exterior temperature.

F - Defrost Rear Window/Door Mirrors

The heated rear window button in the control panel generates an electrical impulse, which is sent to the vehicle electrical system control unit via CAN. Once the vehicle electrical system control unit has activated the heated rear window relay (in relay holder 2), it sends the switch on status of the heated rear window back to the air conditioning control panel. The LED in the button on the control panel is then activated. The ON status of the heated rear window on the CAN bus causes the two door control units (in parallel with the window heating) to directly control the heating elements for the defrost function of the door mirrors. The maximum heating time for the rear window and door mirrors is 15 minutes.

I - Automatic Mode

Air distribution is controlled automatically. In addition to the state variable “Energy Requirement Level” (see section “Actuators and sensors”), the program also evaluates the outside temperature and engine temperature in order to take due account of cold start conditions and possible icing of the windows. Automatic mode is confirmed by the word “AUTO” on the display.

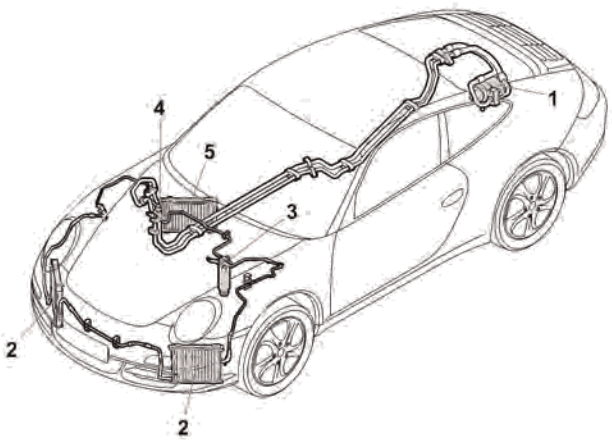
M - Manual Fan Adjustment

In addition to automatic control, the fan output can also be adjusted manually by way of the rocker switches. The current air flow rate is indicated by a 19-bar indicator on the display.

Pressing the rocker switch up increases the fan output. Pressing the rocker switch down reduces the fan output down to a minimum of zero bars on the display. After releasing the switch and then pressing it down again, the fan is switched off (OFF mode). “OFF” appears on the display. When the fan is switched off, a compressor shutdown function protects the evaporator from icing.

In fan OFF mode, air distribution is set to defrost (defrost/footwell distributor flap) and recirculation (fresh/recirc. air distributor flap) and all other actuators are shut down.

Refrigeration Circuit



911 Carrera (997) and Boxster/Cayman (987) have the same layout.

1 - Air conditioning compressor
2 - Condenser (left and right)
3 - Coolant tank/filter drier
4 - Expansion valve
5 - Evaporator

Compressor



An infinitely variable 7-cylinder (adjustable) swash plate compressor is used for the air conditioning. The working volume stands at 3 cm^3 at 100 % output. Refrigeration oil capacity = 195 ± 15 cm^3 ND8

Functions

The compressor output varies between 5 % and 100 %. The working volume and the output are changed by altering the setting of the swash plate (the set angle alters in relation to the drive axle). The higher the required cooling power, the greater the intake pressure.

The piston stroke is controlled by way of the high pressure/low pressure ratio. The control valve in the compressor is diaphragm controlled via the intake pressure and connects the high pressure side with the crankcase. The crankcase pressure is determined by way of the high and low pressure prevailing at the control valve and an internal throttle bore. The pitch of the swash plate is thus dependent on the crankcase pressure and subsequently on the pressure conditions at the top side and the underside of the piston. The delivery rate is thus influenced by the control valve. This pressure control process ensures that the compressor normally remains operative at all times.

Air Conditioning Compressor Control System

The DME system activates the compressor via a relay at the earliest approx. 8 seconds after starting the engine. This relay is located in relay carrier 2.

The following conditions result in "Shut-down of the a/c compressor":

- **Temperature conditions**
  – At outside temperatures of <37.4° F. (3° C) (see also section on "Temperature sensor for fresh air intake") the compressor is shut down. The control unit only allows the compressor to be switched on again at 38° F. (3.5° C).
  – The compressor is shut down at coolant temperatures of >244° F. (118° C) and restarted at <239° F. (115° C).

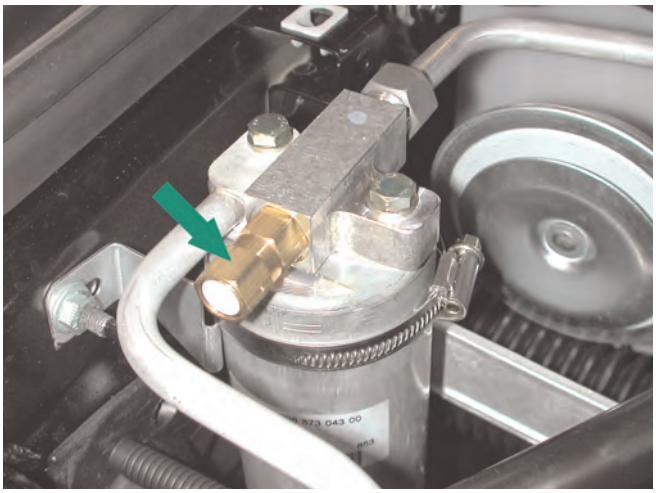
- **Pressure conditions**
  The compressor is switched off at coolant pressures of <29 psi (2 bar) (low pressure) and >406 psi (28 bar) (high pressure).

- **Kickdown conditions** (acceleration)
  At a pedal travel of >92 % (shortly before pedal stop), the compressor is - when the pedal travel deviation is <6 seconds - switched off for 6 seconds or for a maximum of 9 seconds (duration of pedal travel deviation >6 seconds). Classic full load cut-off is not incorporated.

Condenser

The condensers of the air conditioning system are installed together with the radiators in space saving configuration on the left and right sides at the front end of the vehicle (see also section "Refrigeration circuit").

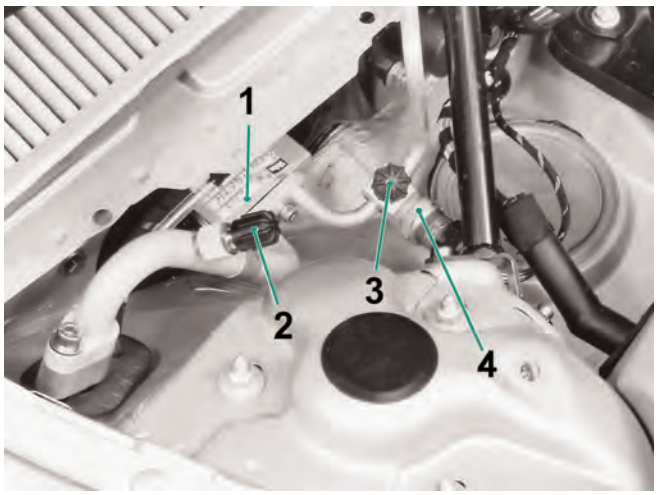
Receiver Drier



The refrigerant tank is installed in the fresh air chamber at front left, next to the battery. The pressure relief valve (see arrow) for the refrigerant system is also located here.

Notes:

Expansion Valve and Additional Components



1 - Expansion valve
2 - Service connection suction side
3 - Service connection pressure side
4 - Air conditioning system pressure sensor (located on the high-pressure side of the cooling circuit)

Sensors and Actuators

The following lines are connected to the a/c control panel (control unit) to supply the necessary inputs for individual functions:

- Terminal 15
- Terminal 30
- Terminal 31
- Signal ground
- Reference voltage 5.0 V
- CAN interface

The remainder of the air conditioning system breaks down into actuators and sensors. The software of the control panel (control unit) monitors all of the system's measurement and control operations.

The sensor system comprises the following components:

- Interior temperature sensor (integrated into the control panel)
- Temperature sensor for fresh air intake (in the fresh air intake port)
- Temperature sensor for footwell air outlet
- Sun sensor
- Check back signals from the drive motors (see section "Air and flap controls")
- Check back signal - actual fan voltage
- Check back signals - a/c compressor status (compressor voltage)
- Pressure sensor

Interior Temperature Sensor

The interior temperature sensor which is integrated in the middle of the a/c control panel (behind the slotted cover) ensures that the automatic air conditioning control system responds to temperature changes with a substantially greater degree of precision. In order to avoid measuring errors resulting from heating-up of the control panel area, the interior air is extracted over the sensor by way of a micro fan.

Temperature Sensor for Fresh Air Intake

The fresh air intake temperature serves as a reference variable to control the compressor. The outside temperature also serves as a control variable. This value is supplied from the front end control unit via the CAN bus. The lower of the two measurements from the fresh air intake sensor or the outside air sensor (behind the ribs on the right hand opening at the front end) is employed to assess the system (system outside temperature).

In the case of a falling temperature, assessment of the system outside temperature is subject to a time constant of t = 1 second. When the system outside temperature rises, a vehicle speed dependent filter is employed. At speeds under 9.3 mph (15 km/h), the evaluation of temperature changes is "frozen". A change to the temperature value will only be accepted if the speed exceeds 9.3 mph (15 km/h) for a duration of at least t = 2 seconds. This prevents stop and go traffic from leading to incorrect system outside temperature values (incorrect measurements due to heat emitted from the engine, for example).

Sun Sensor



This sensor is located in the middle of the dashboard. The sensor is supplied with a reference voltage of 5.0 V. The measured values are subject to 2 different time constants so as to rule out any disruption in the system if the sun intensity changes briefly (e.g. driving through a tunnel, on tree lined streets, etc.). This means that the system only responds to changes in sun intensity after this time has elapsed. A different mean time constant applies for increasing and decreasing sun intensity respectively.

- Increasing sun intensity (t in seconds): t(1/3) = 60, t(1/3) = 120, t(1/3) = 240
- Decreasing sun intensity (t in seconds): t(1/3) = 60, t(1/3) = 60, t(1/3) = 120

The evaluation of these changes in sun intensity is employed to control the drive motor of the temperature mix flap and to correct the air flow rate (fan adjustment).

Notes:

Pressure Sensor

The pressure sensor is an essential instrument in assessing the air conditioning system. It detects the current pressure in the system and supplies a PWM signal (**P**ulse**W**idth**M**odulation) to the a/c control unit. The a/c control unit relays this signal to the CAN bus for further use.

This PWM signal is employed for the purposes of:

- Low-pressure shut-down (p < 29 psi/2 bar)
- High-pressure shut-down (p > 406 psi/28 bar)
- Condenser cooling (see also section “Condenser fan”)

The following components serve as actuators:

- Drive motor for temperature mix flap
- Drive motor for central distributor flap
- Drive motor for defrost/footwell distributor flap
- Drive motor for fresh air/recirc. air distributor flap
- PWM - fan motor voltage

Main State Variable (Energy Requirement Level)

When the air conditioning system is in operation, all control functions for the system are dependent on this main state variable, ERL.

The main state variable to determine the thermal energy requirement level in the vehicle, in the form of the ERL signal, is derived from the key influencing variables:

- Set interior temperature
- Actual interior temperature
- Outside temperature
- Solar radiation energy
- A/C compressor on/off

The main state variable for determining the thermal energy requirement in the vehicle - the ERL signal - is derived. The ERL state variable varies as a digital number in the range from 0 to 255 (8 bit). This corresponds to the extreme cases of “0” for maximum cooling requirement and “255” for maximum heating requirement.

The influencing variables ’coolant temperature’ and ’engine running time’ serve as additional reference values to adapt the control functions in special cases, e.g. start-up of the air conditioning, cold start, hot start of the vehicle.

Temperature Mix Flap

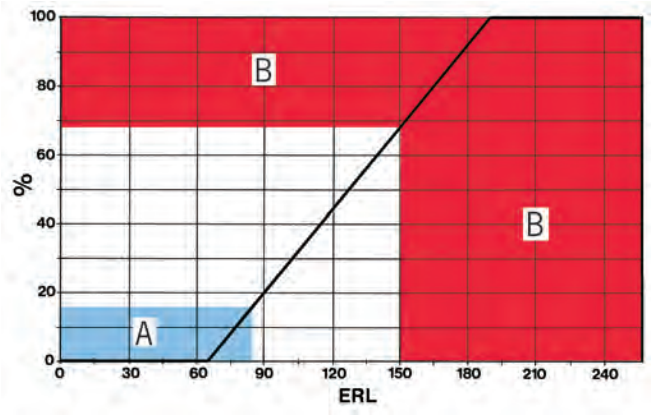
The temperature mix flap is presented here as an example of flap control based on the main state variables and also serves to illustrate how all the other flaps function.

Cooling mode applies below state variable ERL < 85
The command variable for the mix flap position is directly dependent on the result of the flap position calculation (check back from potentiometer of the drive motor).

Heating mode applies above ERL 150
In this case, the position of the mix flap is determined solely by a subordinate footwell air outlet vent temperature sensor.

At ERL > 85, the mix flap control system is overridden by the initiated footwell air outlet vent temperature sensor.

Diagram - Temperature Mix Flap Position (without footwell air outlet vent temperature sensor)



Air Flow Control (fan)

The air flow rate is set by way of control program according to the ERL state signal by way of voltage control of the fresh air fan. Corresponding characteristics are defined both for automatic mode and for manually selected air distribution.

Condenser Fan (radiator fan)

The required speed for the cooler fan is calculated in the DME engine control unit according to the refrigerant pressure (supplied via CAN from the a/c control panel) and the coolant temperature sensor (see also section “DME”). The DME control unit sends this speed data via CAN Drive to the gateway and via CAN Comfort to the front end control unit. The front end control unit controls the radiator fans (right and left) together via an output module. To this end, the front end controller transmits a pulse width modulated (PWM) signal to this output module. The output module evaluates and processes the PWM signal and relays it to the fans.

For the purposes of the air conditioning system, the fans are controlled in linear mode according to the recorded value from the coolant pressure sensor.

Notes:

Information Transmitted via the CAN Interface

The system communicates the following climate relevant operating and ambient conditions via the CAN interface:

- Outside temperature (via CAN from the front end control unit)
- Coolant temperature
- Vehicle speed (to assess the fresh air intake temperature)
- Engine speed
- Request 'Defrost rear windshield/door mirrors' (status on/off via CAN on the vehicle electrical system control unit)
- Cabriolet top open/closed
- Sun sensor
- Dimming (from instrument cluster)
- Wipe/wash signal
- Request 'Seat heating left' (status: on/off via CAN on the vehicle electrical system control unit)
- Request 'Seat heating right' (status: on/off via CAN on the vehicle electrical system control unit)
- Interior temperature (actual temperature via CAN to vehicle electrical system control unit)
- Request - a/c compressor (status on/off via CAN on the DME engine control unit)
- Pressure signal (indirect request for condenser cooling through provision of coolant pressure via CAN)
- A/C shutdown (e.g. high and low pressure shutdown)
- Diagnosis
- Stationary period since "ignition off" (from instrument cluster)
- Steering angle sensor - If control module detects lots of steering angle changes it drops the temperature a little without changing the driver's selection (for comfort of driver)

Diagnosis

Diagnosis with the PIWIS Tester is carried out via the CAN interface (diagnosis socket). Further key functions are available via the diagnosis interface:

- Readout and erasure of fault memory
- Output of measurement and operating data (e.g. actual values)
- Actuator control
- Coding
- Calibration processes

Fault Detection

The system incorporates a self-diagnosis facility which continuously monitors certain functions of the control unit or system components and records faults in a non volatile fault memory (EEPROM).

Sensor Default Values

As on the previous 911 Carrera (996) and Boxster/S (986) models, in the event of a short-circuit or interruption of a sensor default values are employed to maintain operation of the a/c control system in emergency mode.

Parameter	Possible Fault Location	Default Values
Outside temperature	Sensor/front-end control unit	50° F. (10° C.)
Interior temperature	Sensor/air con. control panel	72° F. (22° C.)
Footwell temperature	Sensor	122° F. (50° C.)
Engine temperature	Sensor/engine control unit	176° F. (80° C.)
Sun intensity	Sensor	150 W/m^2
Speed	Sensor/PSM	43 mph (70 km/h)
Engine speed	Sensor/engine control unit	1000 rpm

PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ☑ Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Power-assisted steering: Check fluid level
- ❑ Engine: Check oil level
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ❑ Change engine oil: (oil filter change is not required)
- ❑ Air Filter: Check the air filter condition, and if necessary, replace
- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Power-assisted steering: Check fluid level
- ☑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze protection level
- ☑ Pollen filter: Replace filter element
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ❑ Vehicle lights: Check operation
- ❑ All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ❑ Change engine oil and oil filter
- ❑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ❑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ☑ Diagnosis system: Read out fault memory
- ❑ Polyrib belt: Check condition
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ☑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ☑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ❑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ❑ Power-assisted steering: Check fluid level
- ❑ Parking brake: Check free play of the parking brake lever
- ❑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ❑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Clutch: Check play or final position of pedal
- ❑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Check tightness on the front and rear suspension adjustment points
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Seat belts: Check operation and condition
- ❑ Vehicle lights: Check operation. All headlights: Check alignment
- ❑ Horn: Check operation
- ❑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ❑ All other electrical equipment as well as indicator and warning lights: Check operation

---

During road or dynamometer test:

- ❑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ❑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ❑ Replace Polyrib belt
- ❑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ❑ Manual transmission: Change oil
- ❑ Automatic transmission: Change ATF and ATF-filter
- ❑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ❑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ❑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ❑ Check airbag system
- ❑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

☑ Diagnosis system: Read fault memory / Read and record range information on R.O.

❑ Change engine oil and oil filter

☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage

☑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze

☑ Pollen filter: Replace filter element

❑ Brake system: Visual inspection of the brake pads and brake discs for wear

❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion

❑ Drive shafts: Visual inspection of the dust boots for leaks and damage

❑ Tires: Check condition and tire pressure

❑ Check firewall and cabrio section body drains for debris

❑ Check the door, lid locks and safety hook of the front lid for secure seating and function

❑ Vehicle lighting: Check function
All headlights: Check setting

❑ Horn: Check function

❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)

❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
❑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

- ☑ Diagnosis system: Read fault memory / Read and record range information on R.O.
- ❑ Change engine oil and oil filter
- ☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
- ☑ Coolant hoses: Check condition
  Radiators and air intakes: Visual inspection for external debris and blockage
  Coolant: Check level and antifreeze
- ❑ Air filter: Replace filter element
- ☑ Pollen filter: Replace filter element
- ❑ Fuel lines and connections: Visual inspection for damage and leaks
- ❑ Brake system: Visual inspection of the brake pads and brake discs for wear
- ❑ Parking brake: Check free play of parking brake lever
- ❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ❑ Clutch: Check the pedal play and end position
- ❑ Steering gear: Visual inspection of the dust boots for damage
  Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
- ❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ❑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ❑ Tires: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
- ❑ Vehicle lighting: Check function
  All headlights: Check setting
- ❑ Horn: Check function
- ❑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ❑ Seat belts: Check function and condition
- ❑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

- ❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

- ❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

- ❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
- ❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
- ❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

- ❑ Replace drive belt
- ❑ Replace fuel filter (Turbo only)
- ❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

- ❑ Change manual transmission oil
- ❑ Change Tiptronic transmission oil and ATF filter
- ❑ Change Tiptronic transmission final drive oil
- ❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

- ❑ Change brake fluid
- ❑ File Condition Report for Long-life guarantee
- ❑ Check roll-over protection system (911 Cabriolet only)

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

❑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms “inspect” and “check” include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be pereformed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EB

Notes:



Subject	Page
Wiring Diagrams	9.3
Instrument Cluster Layout, 911 Carrera (997), Boxster (987) & Cayman (987)	9.9
Replacing Fuses	9.11
Emergency Unlocking of the Lids	9.12
Porsche Communication Management (PCM), Second Generation	9.13
Antenna Systems	9.17
Introduction to CAN Data Bus	9.18
Introduction to MOST Bus	9.23
911 Carrera (997) & Boxster/Cayman (987)	
Multifunction Control Units	9.24
Immobilizer/Central Locking	9.31
Electromechanical Steering Lock	9.32
Lighting System	9.34
Wiper Systems	9.40
Instrument Cluster	9.41
Steering Column Module	9.46
Park Assist	9.47
Integrated Home Link Garage Door Opener	9.47
Audio/Communication	9.50
Sports Chrono	9.59
Maintenance Sheets	9.66

Notes:

Wiring Diagrams

The wiring diagram consists of individual wiring diagrams and overview sheets for ground points, components, plug connections, connection points, relay carriers and fuses.

General Guidelines

- The individual wiring diagrams are subdivided into coordinate fields.
- The ground points are identified with “GP” and their locations are shown in a vehicle diagram.
- The plug connections are identified with X and a number.
- In the case of wires that branch off onto another sheet, the coordinates and, in some cases, the terminal designations are specified.

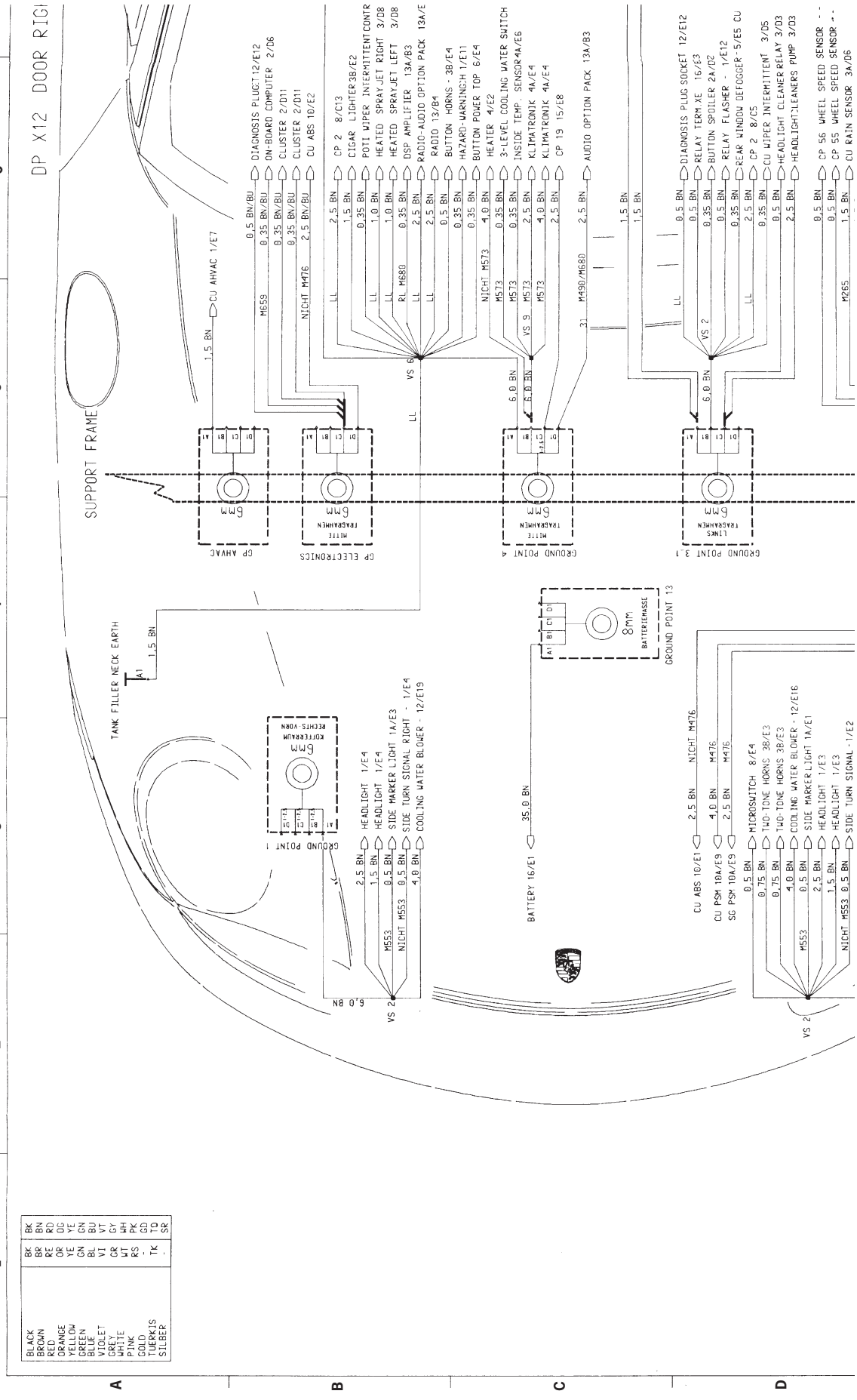
Wiring diagram for '00 model Boxster (986)

	Contents
Sheet 1	Lights RoW
Sheet 2	Lights USA/Canada
Sheet 3	Instrument cluster, sensor
Sheet 4	Wiper and washer system, two-tone horns, power windows
Sheet 5	Engine cooling, heating, air conditioning
Sheet 6	Mirror adjustment, seat heating, heated rear window
Sheet 7	Convertible top drive
Sheet 8	Retractable spoiler, ParkAssistent
Sheet 9	Central locking, alarm system, passenger compartment monitoring
Sheet 10	ABS
Sheet 11	Tiptronic
Sheet 12	
Sheet 13	Cruise control, airbag
Sheet 14	Radio, telephone
Sheet 14A	PCM
Sheet 15	Seat and mirror memory
Sheet 16	Power supply
Sheet 17	Ground points
Sheet 18	DME ME7.2
Sheet 19	DME ME7.2
Sheet 20	Components
Sheet 21	Plug connections, abbreviations
Sheet 22	Connection points
Sheet 23	Relay carriers
Sheet 24	Fuses

The wiring diagram consists of individual wiring diagrams and overview sheets for ground points, components, plug connections, connection points, relay carriers and fuses. The individual wiring diagrams are subdivided into coordinate fields.

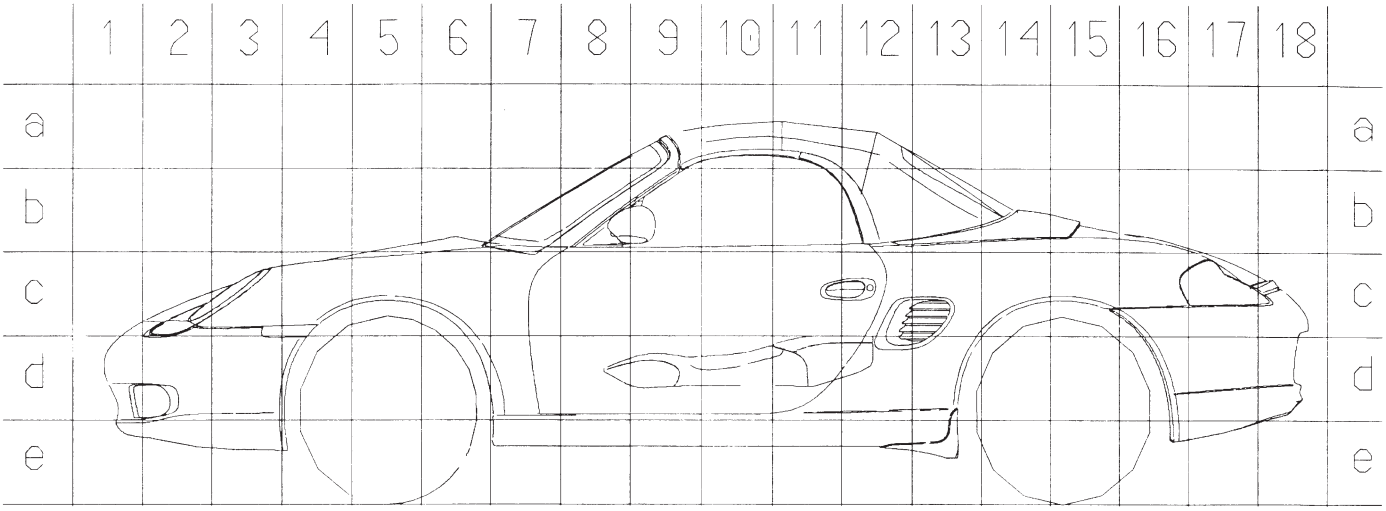
The ground points are identified with "GP" and their locations are shown in a vehicle diagram.

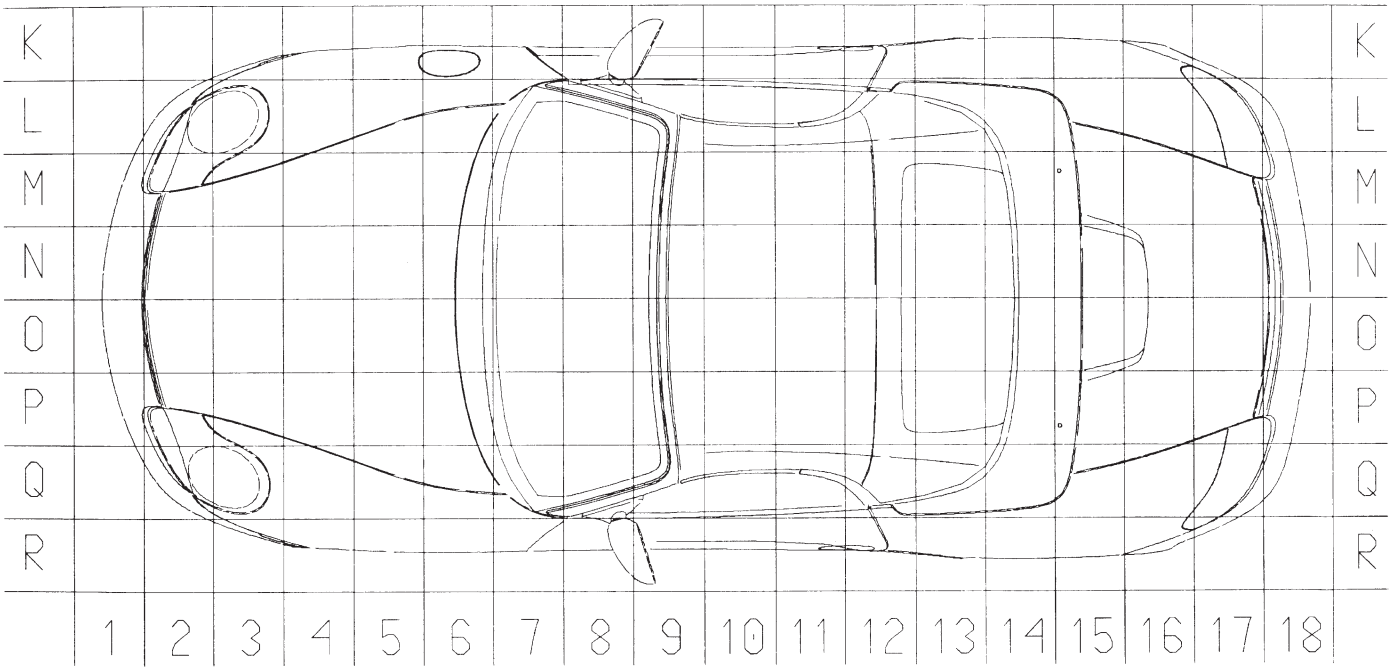
The plug connections are identified with X and a number.

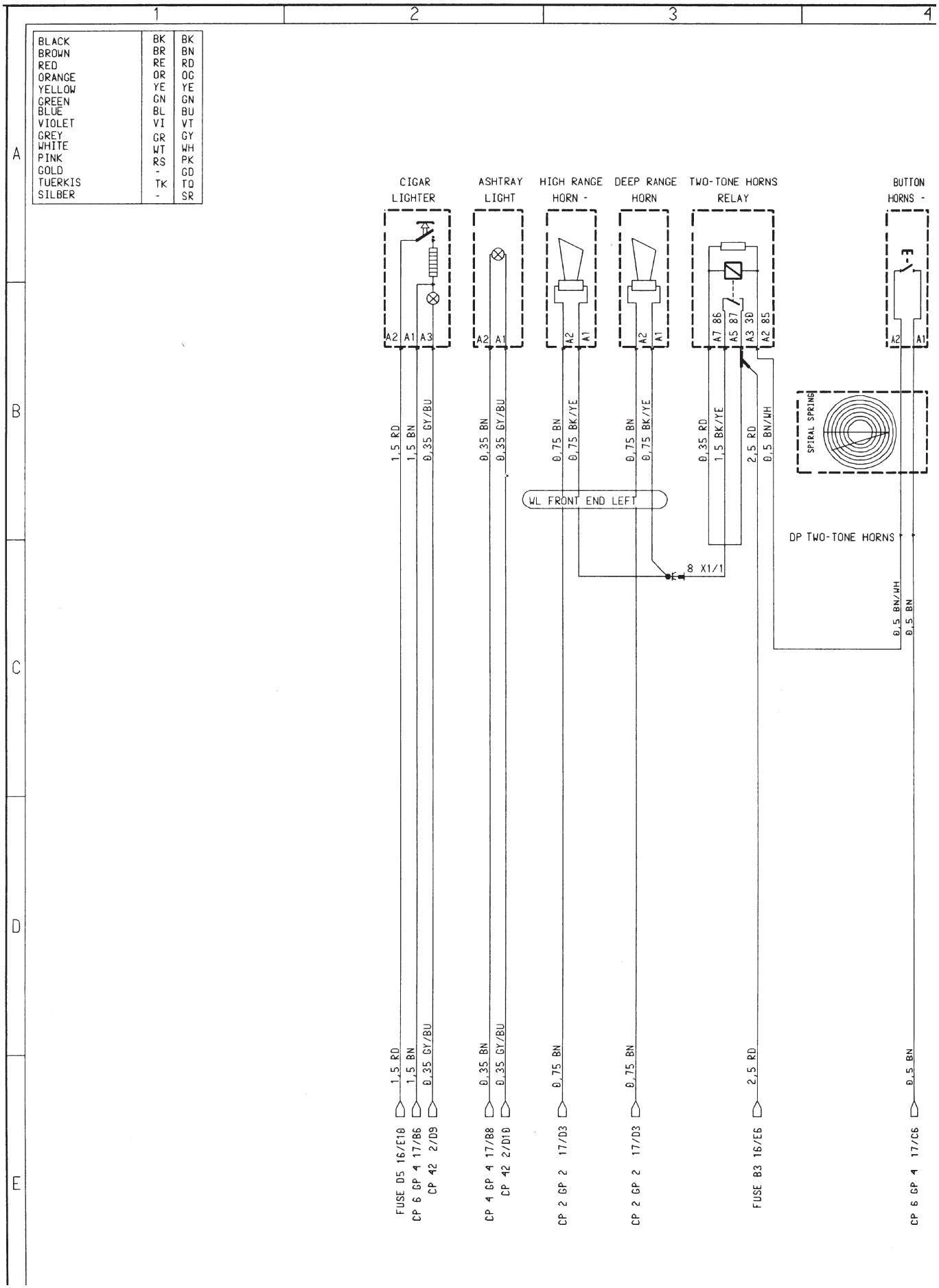

DP X12 DOOR RIGHT
SUPPORT FRAME
TANK FILLER NECK EARTH
BATTERY 16/E1
CU AHVAC 1/E7
DP AHVAC
DP ELECTRONICS
GROUND POINT 4
GROUND POINT 3/1
GROUND POINT 1
GROUND POINT 13
BATTERIEMASSE
DIAGNOSIS PLUG 12/E12
ON-BOARD COMPUTER 2/D6
CLUSTER 2/D11
CLUSTER 2/D11
CU ABS 10/E2
CP 2 8/C13
CIGAR LIGHTER 3B/E2
POTI WIPER INTERMITTENT CONTR
HEATED SPRAYJET RIGHT 3/D8
HEATED SPRAYJET LEFT 3/D8
DSP AMPLIFIER 13A/B3
RADIO-AUDIO OPTION PACK 13A/E
RADIO 13/B4
BUTTON HORNS - 3B/E4
HAZARD-WARNINGCH 1/E11
BUTTON POWER TOP 6/E4
HEATER 4/E2
3-LEVEL COOLING WATER SWITCH
INSIDE TEMP. SENSOR 4A/E6
KLIMATRONIK 4A/E4
KLIMATRONIK 4A/E4
CP 19 15/E8
AUDIO OPTION PACK 13A/B3
DIAGNOSIS PLUG SOCKET 12/E12
RELAY TERM.XE 16/E3
BUTTON SPOILER 2A/D2
RELAY FLASHER - 1/E12
REAR WINDOW DEFOGGER-5/E5 CU
CP 2 8/C5
CU WIPER INTERMITTENT 3/D5
HEADLIGHT CLEANER RELAY 3/D3
HEADLIGHTCLEANERS PUMP 3/D3
CP 56 WHEEL SPEED SENSOR - -
CP 55 WHEEL SPEED SENSOR - -
CU RAIN SENSOR 3A/D6
HEADLIGHT 1/E4
HEADLIGHT 1/E4
SIDE MARKER LIGHT 1A/E3
SIDE TURN SIGNAL RIGHT - 1/E4
COOLING WATER BLOWER - 12/E19
CU ABS 10/E1
CU PSM 10A/E9
SG PSM 10A/E9
MICROSWITCH 8/E4
TWO-TONE HORNS 3B/E3
TWO-TONE HORNS 3B/E3
COOLING WATER BLOWER - 12/E16
SIDE MARKER LIGHT 1A/E1
HEADLIGHT 1/E3
HEADLIGHT 1/E3
SIDE TURN SIGNAL - 1/E2
BLACK BK
BROWN BR
RED RE
ORANGE OR
YELLOW YE
GREEN GN
BLUE BL
VIOLET VI
GREY GR
WHITE WT
PINK RS
GOLD TK
TUERKIS TQ
SILBER SR

KURZZEICHEN	POLZAHL	BENENNUNG, FUNKTION	LAGE IM FAHRZEUG	BEMERKUNG	FELD IM SCHALTPLAN
X 1/1	21	CONNECTION WL PASSENGER C(WL FRONT END LEFT	4cP	IN LUGGAGE COMPARTMENT FRONT LEFT WHITE	D7/8, J17, D24, C48, M84, B96, J96
X 1/2	21	CONNECTION WL PASSENGER C(WL FRONT END RIGHT	4cQ	BLACK	D4/5, C49,
X 3/1	30	CONNECTION WL PASSENGER C(WL MOTOR T/	15cP	BLACK	J8, G13, M47, L118, F124, L157, M185
X 3/2	21	CONNECTION WL PASSENGER C(WL MOTOR T/	15cP	BLUE	J103-106
X 10	4	CONNECTION WL PASSENGER C(WL MOTOR`POWER TOP		BLACK	B63,
X 11	46	CONNECTION WL PASSENGER C(WL DOOR N`LEFT	7cQ	BLACK	J23-24, C56, H-K88, LM129, F137, L143
X 12	46	CONNECTION WL PASSENGER C(WL DOOR N`RIGHT	7cL	BLACK	N23-24, C54, H-K83, LM129 H137, E143
X 15	3	CONNECTION WL PASSENGER C(HARDTOP NT/	12cQ	BLACK	H58
X 16	6.8 (2X4)	CONNECTION WL PASSENGER C(WL SEAT HEATING LEFT	9dP	WHITE	F53, G123,
X 17	6.8 (2X4)	CONNECTION WL PASSENGER C(WL SEAT HEATING RIGHT	9dM	BLACK	M53, H123,
X 20	4	CONNECTION WL PASSENGER C(HEATER ENT/	6cQ	BLACK	K44
X 20/1	12	CONNECTION WL PASSENGER C(HEATER / AC PLUG Y	6cQ	BLACK	C-D43
X 20/1	10	CONNECTION WL PASSENGER C(HEATER E PLUG X	6cQ	BLACK	A-B43
X 24	2	CONNECTION WL PASSENGER C(WL AIHIGH MOUNTED STOP LIGHT		BLACK	MB,
X 59	21	CONNECTION WL MOTOR/L REAR	15cP	WHITE	M17, L13, M48, H112, L158, C-G185,
X 65	15	CONNECTION WL DOOR DRIVER'S SIDE/ OUTSIDE MIRROR RIVER'S SIDE	7bR	WHITE	C59,
X 66	15	CONNECTION WL DOOR PASSENGER'S SIDE/JTSIDE MIRROR>ASSENGER'S SIDE	7bK	WHITE	C52,
X 2/1	21	CONNECTION WL PASSENGER COMPARTMENT/	15cP	BLACK	M6, M14, J48, N113, J157, J185,
X 2/2	21	CONNECTION WL PASSENGER COMPARTMENT/	15cP	YELLOW	F18,J46,M76,M87,G96,N96,N114,H185
X 2/3	6	CONNECTION WL PASSENGER C(WL REAR NT/	15cP	BLACK	GB

Location Grids






1
2
3
4
A
B
C
D
E
BLACK BK BK
BROWN BR BN
RED RE RD
ORANGE OR OG
YELLOW YE YE
GREEN GN GN
BLUE BL BU
VIOLET VI VT
GREY GR GY
WHITE WT WH
PINK RS PK
GOLD - GD
TUERKIS TK TQ
SILBER - SR
CIGAR LIGHTER
ASHTRAY LIGHT
HIGH RANGE HORN -
DEEP RANGE HORN
TWO-TONE HORNS RELAY
BUTTON HORNS -
A2 A1 A3
A2 A1
A2 A1
A2 A1
A7 86
A5 87
A3 30
A2 85
A2 A1
SPIRAL SPRING
1,5 RD
1,5 BN
0,35 GY/BU
0,35 BN
0,35 GY/BU
0,75 BN
0,75 BK/YE
0,75 BN
0,75 BK/YE
0,35 RD
1,5 BK/YE
2,5 RD
0,5 BN/WH
0,5 BN/WH
0,5 BN
WL FRONT END LEFT
8 X1/1
DP TWO-TONE HORNS
FUSE D5 16/E10
CP 6 GP 4 17/B6
CP 42 2/D9
CP 4 GP 4 17/B8
CP 42 2/D10
CP 2 GP 2 17/D3
CP 2 GP 2 17/D3
FUSE B3 16/E6
CP 6 GP 4 17/C6



Instrument Panel USA Models

Also refer to the corresponding chapters in the Owner's Manual.

1. Engine oil temperature gauge
2. Speedometer with analogue display
3. Turn signal indicator light, left
4. Tachometer
5. High beam indicator light
6. Turn signal indicator light, right
7. ABS warning light
8. Cooling system
   Temperature gauge, warning light
9. Fuel
   Level gauge, warning light
10. Engine oil pressure gauge
11. Adjustment button for instrument illumination and trip counter
12. Odometer and daily trip mileage display
13. Automatic speed control indicator light
14. Light sensor for instrument illumination
15. Airbag warning light
16. Emission control warning light (Check Engine)
17. Central warning light
18. On-board computer display
19. Porsche Stability Management Multifunctional PSM light
20. Brake warning light
21. Safety belt warning light
22. Tiptronic indicator
23. Clock and outside temperature display
24 Adjustment button for clock

When the ignition is switched on, the warning lights light up for a lamp check.

Note

Warnings that have been given are stored in the appropriate control unit memory and can be read out at an authorized Porsche dealer.

This information can help to warn you about situations which may be hazardous to you or your car.



Instrument Panel USA Models

Also refer to the corresponding chapter in the Owner's Manual.

1 Speedometer with analogue display

2 Tire pressure warning light

3 Turn signal indicator light left

4 Tachometer

5 High beam indicator light

6 Turn signal indicator light right

7 ABS warning light

8 Cooling system
Temperature gauge, warning light

9 Fuel
Level gauge, warning light

10 Adjusting button for instrument illumination and trip counter

11 Odometer and daily trip mileage display

12 Automatic speed control indicator light

13 Light sensor for instrument illumination

14 Airbag warning light

15 Emission control warning light (Check Engine)

16 Central warning light

17 On-board computer display

18 Porsche Stability Management
Multifunctional PSM light

19 Brake warning light

20 Safety belt warning light

21 Tiptronic indicator

22 Clock and outside temperature display

23 Adjustment button for clock

When the ignition is switched on, the warning lights light up for a lamp check.

Note

Warnings that have been given are stored in the appropriate control unit memory and can be read out at an authorized Porsche dealer.

This information can help to warn you about situations which may be hazardous to you or your car.

911 Carrera(997) & Boxster/Cayman (987)



A - *Diagnostic socket*



A - *Plastic gripper*
B - *Spare fuses*

Replacing fuses

In order to prevent damage to the electrical system due to short circuits and overloads, the individual circuits are protected by fuses.
The fuse box is located in the driver's footwell.

1. Switch off the load with the defective fuse.
2. Pull off plastic cover at the finger hole (**arrow**). The **fuse plan** and **instructions for emergency unlocking of the luggage compartment lid** can be found on the inner side of the cover.
3. Remove the corresponding fuse from its slot using the plastic gripper **A** in order to check it. A blown fuse can be identified by the melted metal strip.
4. Replace only with fuses of the same rating.

Note

- If a fuse blows repeatedly consult an authorized Porsche dealer.
- Never try to "repair" fuses: you may cause serious damage to other parts of the electrical system.

Notes:

911 Carrera/S (997)

Emergency unlocking of the luggage compartment lid

If the battery is discharged, the lid can be opened only with the aid of a donor battery.

Unlocking lid

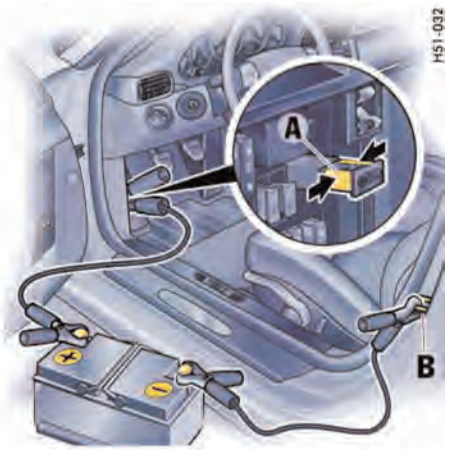
1. Use the key to unlock the vehicle at the door lock.
2. Remove plastic cover over the fuse box.
3. Pull out positive terminal **A** in the fuse box.
4. Use a jumper cable to connect the positive terminal of the donor battery with positive terminal **A** in the fuse box.



Note

If the vehicle was locked, the alarm horn will sound when the negative cable is connected.

5. Use the second jumper cable to connect the negative terminal of the donor battery with latch striker **B**.
6. Unlock the luggage compartment lid with the remote control.
   The alarm system is switched off.



7. Disconnect the negative cable first, then the positive cable.
8. Push the positive terminal **A** into the fuse box and push on the plastic fuse box cover.

Note

The engine cannot be started with this method.

▷ Please observe the chapter "EMERGENCY STARTING WITH JUMPER CABLES" on Page 242.

Boxster/S (987) & Cayman S (987)

Emergency unlocking of the front luggage compartment lid

If the battery is discharged, the lid can be opened only with the aid of a donor battery.

Unlocking lid

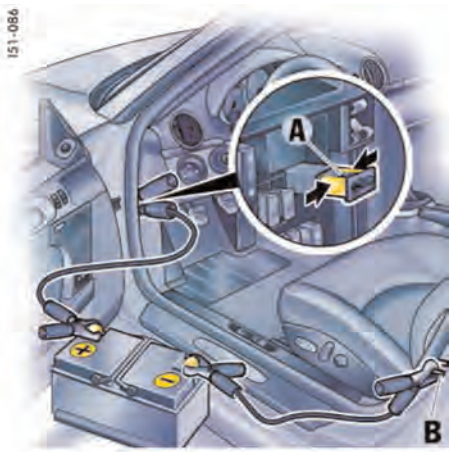
1. Use the key to unlock the vehicle at the door lock.
2. Remove plastic cover over the fuse box.
3. Pull out positive terminal **A** in the fuse box.
4. Use a jumper cable to connect the positive terminal of the donor battery with positive terminal **A** in the fuse box.



Note

If the vehicle was locked, the alarm horn will sound when the negative cable is connected.

5. Use the second jumper cable to connect the negative terminal of the donor battery with latch striker **B**.
6. Unlock the front luggage compartment lid with the remote control.
   The alarm system is switched off.



7. Disconnect the negative cable first, then the positive cable.
8. Push the positive terminal **A** into the fuse box and push on the plastic fuse box cover.

Note

The engine cannot be started with this method.

f Please observe the chapter "JUMP LEAD STARTING" on Page 236.

Porsche Communication Management (PCM)
(second generation)



General Overview and Operating Concept

After a very extensive and thorough development phase, the new generation PCM was installed in all Porsche model versions beginning in model year '03.

The following new, or noticeably improved, functions are included in the standard module:

- 2-tuner top-radio
- CD-ROM drive
- 5.8" TFT (Thin-Film-Transistor) color monitor in 16:9 resolution
- 12-button strip for the most important operations
- Detailed and easy to operate board computer in combination with a dot matrix instrument cluster and diversity antenna
- Completely new navigation module concept

A CD-storage compartment below the PCM in the center console is installed as standard.

As with the previous version, the buttons below the monitor with fixed allocation make it possible to access the individual main menus. The main operating procedures within the menus are accessed via the turning reset button at bottom right.

To facilitate operation, two buttons for direct access to the function "Settings" (SET button) and "Return" (button with arrow) have been added. It is no longer necessary to "scan" through the respective menu.

The display occurs via a new color monitor, which can also be clearly viewed from different view angles and under sun irradiation. The map display can be more easily recognized and offers the most important information in one view.

Basic information regarding the audio and navigation menus is available in central driver information field of the dot matrix instrument cluster.

Radio/Audio Components in PCM

Innovations in audio domain of the PCM, compared to the previous model:

- Top-double-tuner radio with very good reception characteristics, as well as channel selection via a channel list, three memory levels including Auto-Store and extensive individual adjustment options via the operating surface.
- CD-ROM drive, which can also play audio CDs. The drive serves for retaining the navigation CD-ROM, which can be removed after the route has been mapped out and replaced by an audio CD.
- Driver information display in dot matrix instrument cluster (standard for PCM) as parallel display for basic information such as e.g. channel names, CD-track, etc.
- Two unit versions for each, USA or RoW (with or without integrated amplifier) (same as for CDR 23)
- Menu domain buttons for separate operation of the audio sources and amplifier. This results in reduced menu depth and therefore more operating comfort.
- Audio for tuners, CDS (CD single), CDC (CD-changer)
- Sound for sound adjustment, balance and fader
- Fiber optic network to the sound packages, CD-changer, etc. via MOST (See „MOST" chapter)

Notes:

Function overview of the new PCM for audio-menu pages:

Audio Equipment General		**PCM**
Operation of tuner, CDS, CDC and amplifier via uniform surface		new
Menu operation via turning reset button (right)		X
10 direct selection buttons for radio channels in FM and AM (3 memory levels for each) as well as selection of CDs in changer (via button 1 – 6)		new
Automatic 2-directional search function (FM, AM or title for CDS and CDC)		new
Display of audio information via the full graphic color display		X
Display of the most important audio information in instrument panel on demand		new
Separate SOUND-menus for sound adjustments including sound package amplifier as well as balance, fader		new
Tuner		
Global-double tuner adjustable to country parameters (via PST 2)		new
FM		X
AM		X
Permanent memory per wave frequency	FM: FM – A (10), FM – B (10) MW: AM – A (10), AM – B (10)	 new new
AutoStore memory options:	FM – AS (10) AM – AS (10)	new new
Channel selection from channel list, compiled by reception strength, alphabetical or user defined		new
Tuning out channels in channel list (via “SET” – button)		new
Channel list with default of the PTY (Program Type via “SET” – button)		new
RDS for RoW or RBDS for USA		new
Display of channel name for RDS channels		X
RDS-function „EON“ (RoW)		X
RDS function “PTY” (Program Type)		new
Search function “Seek”		X
Search function channel scanning “Scan”		X
Hand adjustment (manual) via the right turning reset button or the 10-button strip (menu “Frequency Selection”)		new
Direct input of the frequency via the 10-button strip (menu “Frequency Selection”)		new

Single CD (new)

CD-ROM drive useable for audio-CDs (see also chapter “Copyright”)	new
Title skip up and down (FF and FR)	X
Play title “Scan”	X
Title sequence by chance “random”	X
Display of CD-text	new
Burning CDs	new
Title selection via list	new

Traffic Information (RoW)

Evaluation via RDS and RBDS	X
Automatic and manual selection of the traffic information channel	new
Traffic information –connection without music function (Mute)	x
Traffic information also for AM and CD-operation	new
Volume increase for traffic information during announcement or adjustable via menu	new
Evaluation of RDS-TMC (digital Traffic Information) for display and route dependancy	new

X = Known function

Notes:

Driving Data Display (TRIP) in PCM

Three optionally adjustable speed warning limits can be switched on or off. The limit-gong is integral with the audio function, therefore a complete interruption of the current audio-output does not occur.

Instrument cluster (on-board computer) driving data can also be displayed on the monitor of the PCM for a better overview, and reset simultaneously.

Main function button "TRIP" for accessing driving data is allocated in the lower menu list.

Navigation Unit with PCM

Innovatons compared to the previous model:

- Substantially enlarged 5.8" monitor with precise representation and noticeably enhanced map
- Display of the complete route including present location and target destination
- Display of TMC-messages (Traffic Message Channel). The current traffic congestions, which are received via a TMC traffic information channel, as well as the length and progression are displayed on the map. This function allows dynamic navigation, at least on highways. Therefore, the messages are processed in the route calculations within seconds. Also, all traffic congestion messages can be displayed. For active target guidance, only the congestion regarding this route will be displayed. (RoW)
- Very fast map setup. Moreover, an intersection zoom is integrated in the active target guidance. Here, the turning situation at intersections is enlarged automatically and intelligently, supporting and relieving the driver in a targeted manner, especially in complex situations.
- Very flexible in the display, configurability and selection of navigation functions regarding the POIs (Points Of Interest), also in the map display. For example, it is possible to display only parking garages, restaurants, etc.
- Separate navigation menu adjustment options for distinctly simplified operation.
- The separate "INFO" button on the operating panel allows quick access to current traffic congestion information, which is displayed in text form. (RoW)
- It is possible to store the navigation as a target point or actual position via a line-cross. A target point can be selected and stored by moving the map, scrolling and setting without having to enter the specific address. POIs, e.g. gas stations, can also be searched for and entered as a target via this function.
- The target memories was expanded considerably. "Last Targets" and "Most Frequent Targets" now have 50 memory positions. A connection to the PCM-address book can also be used for target input.
- "Tour Planning" is possible by entering at least four targets in sequence.
- Expansion of route establishment for preference or avoidance of dynamic fast or short route such as highway, ferry and tolls.
- Supplement of current altitude readings. It is an enhancement of the position specifications, e.g. when driving on passes in the mountains.
- Display in 7 languages with two voices for each (woman/man) selectable via the operating menu. The navigation directions are perfectly blended into the current audio channel. Therefore, unpleasant interruptions no longer occur during voice output. Volume adjustment for mixing ratio can be changed as desired.
- Navigation-CD-ROM: USA 2 CDs. M.Y. 2005 vehicles are now DVD.

Notes:

Antenna Systems

Vehicles are equipped with the following antenna systems depending on the equipment version:

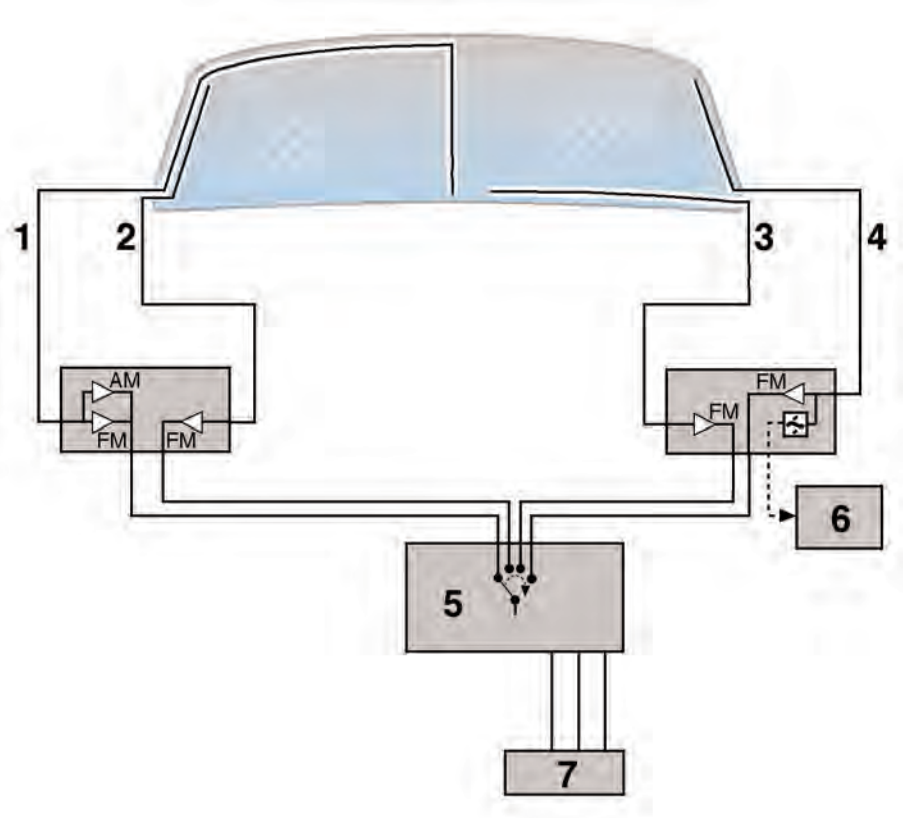
Antenna	Function/Allocation	Installed location
Antenna wire with amplifier	FM-reception for radio CDR 23	Windshield
Diversity antenna with 4 wires and special amplifier	FM-reception for PCM	Windshield
GPS-antenna	Satellite reception for navigation w/ PCM	On center of instrument panel below the cover
Telephone antenna	GSM 900/GSM 1800 AMPS/PCN 1900	Integrated below the cowl cover

Diversity Antenna

This system consists of 4 antenna wires integrated into the windshield and always ensures that the best positioned antenna receives the FM-signals. Since audible interference would develop during switchover of the antenna, it is not designed for AM reception. If one antenna does not have a sufficient signal, or too much interference, another antenna will be accessed. One of the antenna is defined as the main antenna and is directly activated. Therefore, quality fluctuations in this frequency are further minimized.

The diversity antenna is controlled via a special antenna amplifier and is part of the PCM scope.

1 - Antenna 1
2 - Antenna 2
3 - Antenna 3
4 - Antenna 4
5 - Diversity unit
6 - Central locking
7 - Interfaces on radio



Introduction To The CAN Data Bus

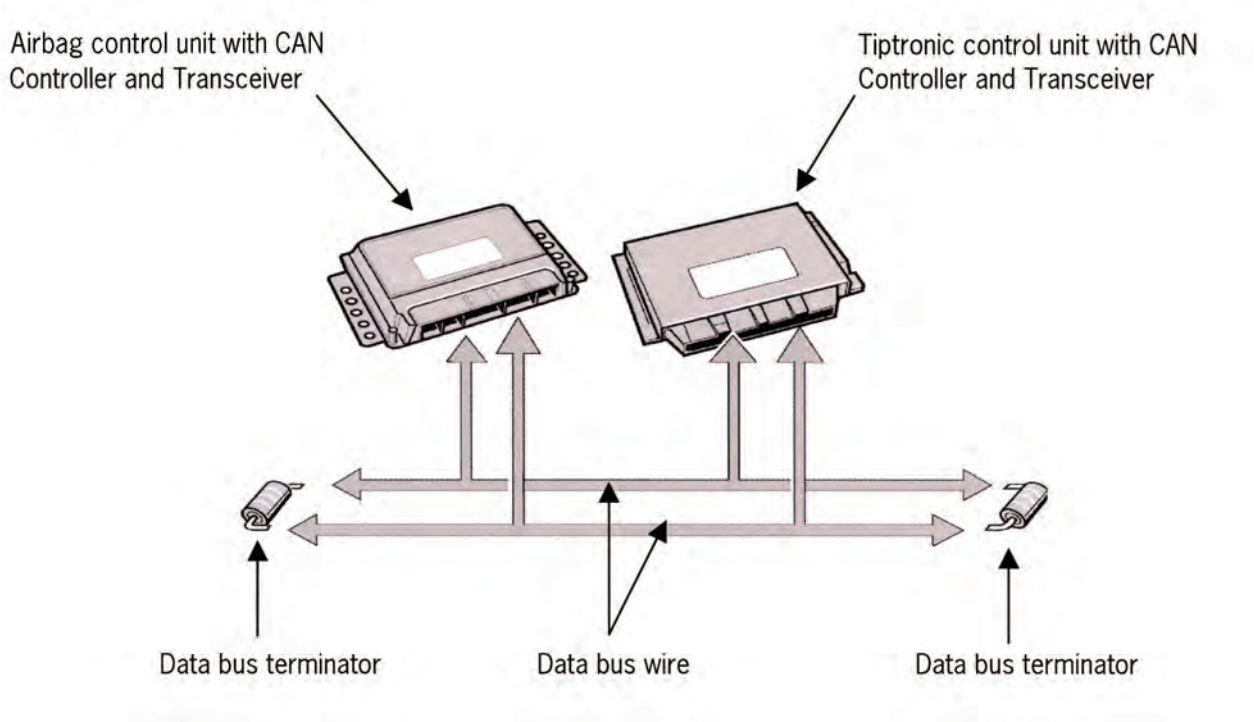
Design and Functionality

The CAN bus is a serial bus system on which all connected systems have equal rights, i.e. each control unit can send and receive. Simply expressed, the connected control units can “talk” to each other via the bus and exchange information. Because of the linear construction of the network, the bus system remains fully available for all other devices should one device fail.

CAN Bus Components

The CAN data bus consists of the following components:

- Controller
- Transceiver
- Two data bus terminators
- Two data bus wires.



Notes:

CAN Controller

The CAN controller receives the data to be sent from the microcomputer in the control unit. It prepares the data and gives it to the CAN transceiver. The data is converted in the controller to a high frequency square wave voltage modulated with a small DC voltage (e.g. 5 V). The controller also receives data from the CAN transceiver, prepares it and gives it to the microcomputer in the control device.

CAN Transceiver

The CAN transceiver consists of a transmitter and a receiver. It converts the data from the CAN controller and sends it to the data bus lines. In exactly the same way, it receives data and converts it for the CAN controller.

Data Bus Terminators

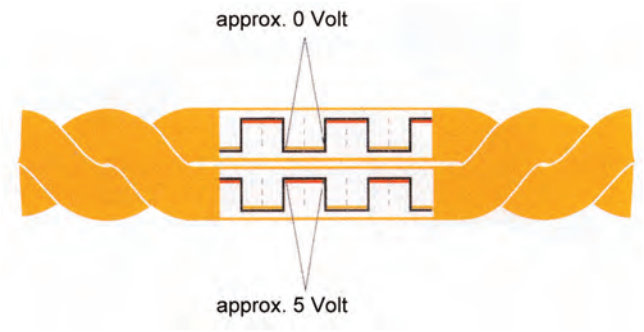
The data bus terminator is a resistor that prevents sent data from being returned as an “echo” and corrupting data. This resistor is also needed for diagnostic purposes.

Data Bus Wires

The data bus wires are bi-directional and are used for the transmission of data. They are defined as CAN-High (for 1) and CAN-Low (for 0). To prevent interference from affecting data transmission, the two wires take the form of a twisted pair. This also prevents the data bus line from radiating interference.

Both wires carry an counter-opposing voltage, i.e. when the voltage on one wire is 5 V, then the other wire carries a voltage of 0 V and vice-versa.

The sum of the voltages is kept constant and the electro-magnetic fields of both wires cancel each other out.



Notes:

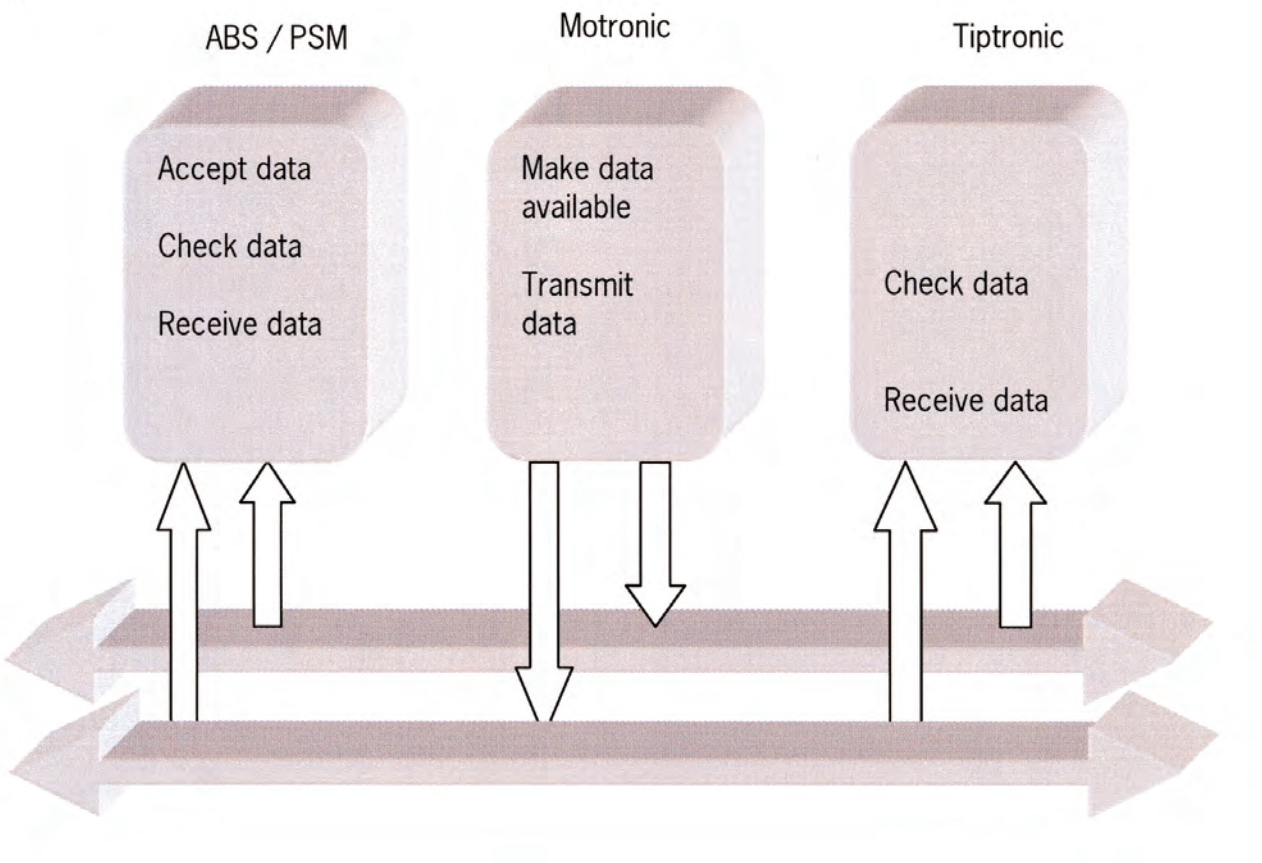
Data Transmission

In CAN bus data transfers, data from all components (control units) is sent on the bus and all components receive and decoded data.

Data Transfer Process

- Data availability – The control unit makes the data available to the CAN controller for transmission.
- Transmitting data – The CAN transceiver receives the data from the CAN controller, converts it into electrical signals and transmits it.
- Receiving data – All other control units connected to the bus receive the data.
- Checking data – The control unit checks whether the data received is needed by the control unit to carry out its function or not.
- Accepting data – If the data is relevant, it is accepted and processed, otherwise it is ignored.

Example:

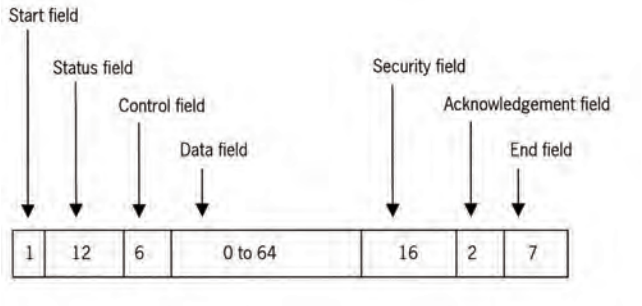


CAN Protocol

The CAN data bus carries, at short time intervals, a data protocol between the control units. The data protocol consists of a large series of bits following one another. A bit (binary digit) is the smallest unit of information (one switched condition per time interval) in digital technology and in a data processing system.

In electronics, this information can only have the value of a logical 1 ("yes") or a logical 0 ("no"). Eight bits together form one byte. In a byte, there are 256 different bit patterns possible and therefore 256 different pieces of information can be coded or represented.

In a CAN system, the information is exchanged with the help of messages. The CAN transmitters and receivers know the exact structure of the message and can therefore correctly interpret the individual bits and bytes in a bit stream being received. The following illustration shows the structure of a data protocol ("data frame"), this being identical for both wires.



Start field (1 bit)

The start field marks the beginning of the data record or message. A bit is sent with 5 V on the CAN-High line and 0 V on the CAN-Low line. When all stations connected to a bus system recognize a start bit, they switch to receive.

Status field (12 bit)

The status field determines the priority of the data or message. If, for example, two control units attempt to transmit their data message at the same time, the one with the highest priority will take precedence.

Control field (6 Bit)

The control field contains the number of data bits contained in the data field. Each receiver can thus check if it has received all the data.

Data field (max. 64 Bit)

The data field contains the information transmitted to the other control units.

Security field (16 Bit)

This field is used to recognize transmission failures.

Acknowledgement field (2 Bit)

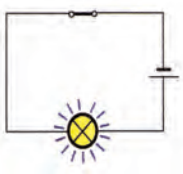
In the acknowledgement field, the receiver signals the transmitter that it has correctly received the data message. If a failure has been recognized, it is immediately sent to the transmitter. The transmitter then repeats the transmission.

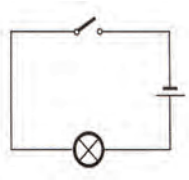
End field (7 Bit)

The end field marks the end of the data message. This is the final way of announcing a failure, leading to a retransmission of the data.

A light switch can serve as an **example** of how the values "0" or "1" can be generated:

It allows the light to be switched on or off, i.e. there are two different statuses of the light switch.





Status of light switch with value "1"
- Switch closed
- Light on

Status of light switch with value "0"
- Switch open
- Light off

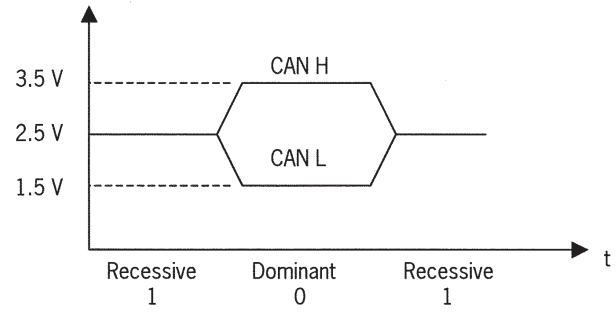
The CAN data bus also works on this principle. The transceiver can also generate two fifferent statuses of a bit.



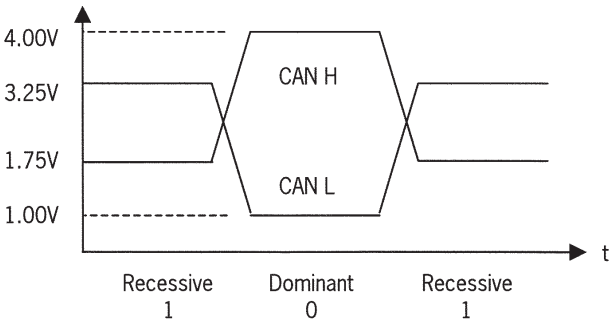
Bus Signal Level

To guarantee reliable transmission in the vehicle which is at the same time free from electromagnetic interference (EMI), data transmission on the CAN lines is carried out by means of differential signals. CAN C (high speed) and CAN B (low speed) use different kinds of differential signals.

The following diagram shows the signal level of a high-speed bus.



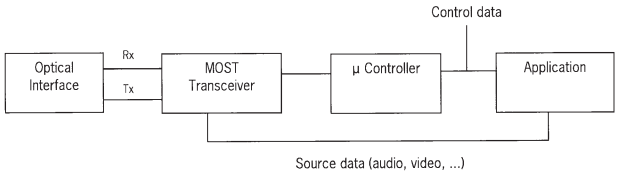
I
n comparison, here is the signal level of a low-speed bus.



Notes:

Introduction To The MOST Bus

MOST Hardware



Basic Structure of a MOST Control Unit:

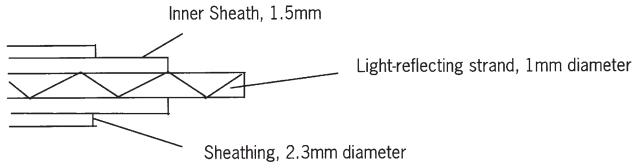
A gateway to the Comfort CAN bus is implemented in the head unit to allow exchange of data between control units on the MOST network and those on the CAN network.

MOST Transceiver

Each MOST control unit contains at least one MOST transceiver or a manufacturer-specific chip with integrated MOST transceiver functionality. These chips generate the MOST protocol. In the transceiver, the source data (audio, video,...) and the control data is either added or read out of the transceiver.

Integrated into MOST transceivers is all important network management functions such as determination of the node position, data delay with regard to the timing master and fault recognition mechanisms with automatic message repeating, etc.

Electro-optic and Opto-electric Converters



Transmission of the MOST protocols from one control unit to another is done by means of a plastic fiber-optic cable. So-called FOT (Fiber Optic Transmitting)units are used for electro-optic and opto-electric conversion.

An optical interface consists of a transmitter and a receiver. An optical wake-up function to wake the network up is integrated into the receiver. As soon as light is received at the receiver input, the receiving unit switches its status outputs to 0 volts. The optical output power can be set by adjusting the current flowing through the transmitter diode by means of the transmitting unit's control input.

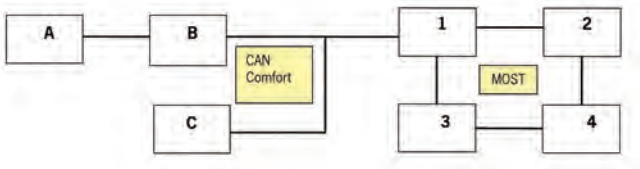
Control Data Channel

Telegrams are sent via the MOST transceiver's control data channel for control of individual components in the MOST loop. The control data is mainly used for communication between the individual bus components.

Commands, status and diagnostic messages and gateway messages are transmitted. To make a complete control message, 2 bytes per frame from each of 16 sequential frames are put together to form one block. This gives a control message with a length of 32 bytes. A faulty message is rejected by the

MOST receiver when it recognizes a transmission fault. The transmitter then independently repeats the transmission. A transmission fault is only indicated when a defined maximum number of repeat attempts have been made without success.

MOST Network Components



A - Diagnostics Tester
B - Instrument Cluster
C - Air Conditioner
1 - Radio/PCM
2 - Amplifier
3 - Telephone
4 - CD Changer

Notes:

Multifunctional Control Units – 911 Carrera (997) & Boxster/Cayman (987)

For this section we used the Boxster/S (987) information as the example. Both systems for the 911 Carrera (997) and Boxster/Cayman (987) are identical in design with the exception of some minor equipment differences.

Vehicle Electrical System Control Unit



Located under the dashboard, driver side.

The vehicle electrical system control unit converts various analog signals from the functional groups:

- Exterior lights
- Front / rear lid opener

into digital CAN messages and outputs them on the CAN bus.

Notes:

At the same time, the vehicle electrical system provides the switching outputs for the functional groups:

- Interior light
- Filler flap lock/unlock
- Heated rear window
- Heated seats
- Chassis wake-up
- Front wiper/washer system
- Headlight cleaning system

either in part or in their entirety. As functions of relevance to the customer are controlled and activated via the vehicle electrical system control unit, a large number of input data are required on this unit.

Diagnosis

The diagnosis interface is provided on the diagnosis connector via a diagnosis CAN bus and provides the PIWIS Tester with access to control unit data and functions. All input signals on the control unit can be read out and all actuating elements can be operated via the interface. Any stored faults can also be read out and deleted. Vehicle-specific parametric data can be encoded via the PIWIS Tester.

Some functional features of the vehicle electrical system are restricted or disabled in production and transportation mode.

Functions	Effects
Exterior lights	No automatic coming home function
Interior light	No OFF delay
	No orientation light
Wiper system	No activation via rain sensor
Headlight washer system	Function off
Heated seats	Function off

Vehicle Electrical System Control Unit

Inputs

Analog
Automatic lights (coming home lighting)
Fog light
Rear fog light
Bckup light
Terminal 30
Electronic ignition lock (terminal 15)
Terminal 15 redundant
Ground
Ground 2 (terminal 31 redundant)
Terminal 50 (if not via CAN)
Button – front lid opener
Button – rear lid opener
Button – rear spoiler (voltage encoded input)
Button – Sport (voltage encoded input)
Rain sensor, line 1
Rain sensor, line 2
Rain sensor, line 3

Inputs

Signals via CAN
Terminal 50
Key contact (terminal 86S)
Driver's door open / closed
Front passenger door open / closed
Driver's door locked / unlocked
Front passenger door locked/unlocked
Interior light afterglow
Dimming value, orientation light
Sun intensity
Status, anti-theft alarm system
Filler flap locked
Filler flap unlocked
Status, button for left seat heating
Status, button for right seat heating
Interior temperature
Status, rear spoiler function
Button – flick wiping
Switch – intermittent wiping
Switch – wiper level 1
Switch – wiper level 2
Button – washing
Step switch – interval sensitivity
Headlight washer system
Dipped beam
Outside temperature
Button – rear window heating
Tank check value from instrument cluster
Vehicle speed

Internal Connection
Terminal 15
Terminal 30 (internal power supply)



Bi-directional Connections
CAN Comfort high
CAN Comfort low

Outputs

Analog
Interior light (terminal 30 G)
Interior light, dimmable, LowSide switch
Orientation light (dimmable)
Drive motor, filler flap lock
Heated rear window
Seat heating, left
Seat heating, right
Function light, rear spoiler button
Function light, Sport button
Wake-up signal, chassis
Wiper motor, level 1
Wiper motor, level 2
Washer pump
Headlight washer system pump

Outputs

Signals via CAN
Status - automatic lights switch
Status - fog light switch
Status - rear fog light switch
Status - back-up light switch
Status - central locking button
Status - front lid opener button
Status - rear lid opener button
Functional check, left seat heating
Functional check, right seat heating
Rear window heating
Status - tank check on instrument cluster

Electrics

Front End Control Unit (Located in the front luggage compartment, passenger side)

The front end control unit converts various analog signals from the functional groups:

- Exterior lights with direction indicator functions
- Outside temperature detection
- Front lid monitoring

into digital CAN messages and outputs them on the CAN bus. At the same time, the front end system provides some or all of the switching outputs for the functional groups:

- Exterior lights (front)
- Horn
- Luggage compartment lighting (front)
- Indicator lights
- Luggage compartment release (front)
- Safety catch release
- Automatic headlight beam level adjustment
- Fan output stage.

either in part or in their entirety. As functions of relevance to the customer are controlled and activated via the front end control unit, a large number of input data are required here.

Diagnosis

As for the vehicle electrical system control unit, diagnosis is carried out via the diagnosis CAN bus at the diagnosis plug.

Some functional features of the vehicle electrical system are restricted or disabled in production and transportation mode.

Functions	Effects
Exterior lights	No parking light function, no automatic coming home lights function, no fog light function
Luggage compartment light	No luggage compartment light function



Basic Unit w/o Alarm (Not USA)



With Alarm



With Alarm & Bi-Xenon Headlights

Notes:

Front End Control Unit

Inputs

Analog

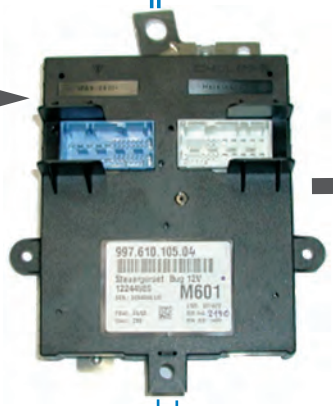
Switch, marker light
Driving lights (dipped/high beam)
Button, hazard warning lights
Power supply
Front lid switch
Outside temperature sensor
Emergency release inside luggage compartment
Height sensor system, axle sensors (front / rear)
Wheel speed

Inputs

Signals via CAN

Parking light on (left / right)
Switch, automatic lights
Switch, front fog light
Switch, rear fog light
High beam switch
Headlight flasher button
Direction indicators (left / right)
Crash intensity
Hazard warning lights
Driver feedback, automatic coming home function
Door open (left / right)
Sun intensity
Afterglow time, automatic coming home function
Daytime running lights active
Engine running
“Engine” message failure
Terminal 50
Terminal 86S
Horn button
Load switch-off
Vehicle reference speed
“Brake” message failure
Button – front lid opener
Remote control for front lid opener
Radiator fan control

Internal Connection
Terminal 15
Terminal 30 (internal power supply)



Bi-directional Connections
CAN Comfort high
CAN Comfort low

Outputs

Analog

Indicator light - hazard warning lights
Side indicators/side marker lights
Direction indicators (front/rear)
Side lights (front)
High beam
Dipped beam
LED - direction indicators (front)
Fog light
Horn
Luggage compartment light
Luggage compartment release/catch
Radiator fan output stage
Stepping motors for automatic headlight beam level adjustment
Safety catch release

Outputs

Signals via CAN

Switch - parking light
Switch - dipped beam
Left/right marker lights
Activation of instrument & location lighting
Status - dipped beam
Status - high beam
Hazard warning lights button
Bulb failure
Left/right direction indicators on
Daytime driving lights off
Status - front lid
Status - PWM signal for left radiator fan (PWM - pulse width-modulated)
Status - PWM signal for right radiator fan (PWM - pulse width-modulated)
Outside temperature, unfiltered
Automatic headlight beam level adjustment defective

Rear Control Unit



Located under driver seat.

The rear control unit converts various analog signals from the functional groups:

- Tray / glove compartment lock
- Rear lid lock
- Spoiler controller
- Interior sensor system
- Inclination sensor system

into digital signals and outputs them on the CAN bus.

At the same time, the rear control unit provides some or all of the switching outputs for the functional groups

- Hazard warning lights
- Cabrio top controller
- Spoiler controller
- Rear lights

either in part or in their entirety.

Diagnosis

As for the vehicle electrical system control unit, diagnosis is carried out via the diagnosis CAN bus at the diagnosis plug. Some functional features of the vehicle electrical system are restricted or disabled in production and transportation mode.

Functions	Effects
Window lifter enable	Function from terminal 15 ON
Comfort lighting	Luggage compartment light off Rear trunk light off
Parking light	Deactivated

Networking/Data Communication

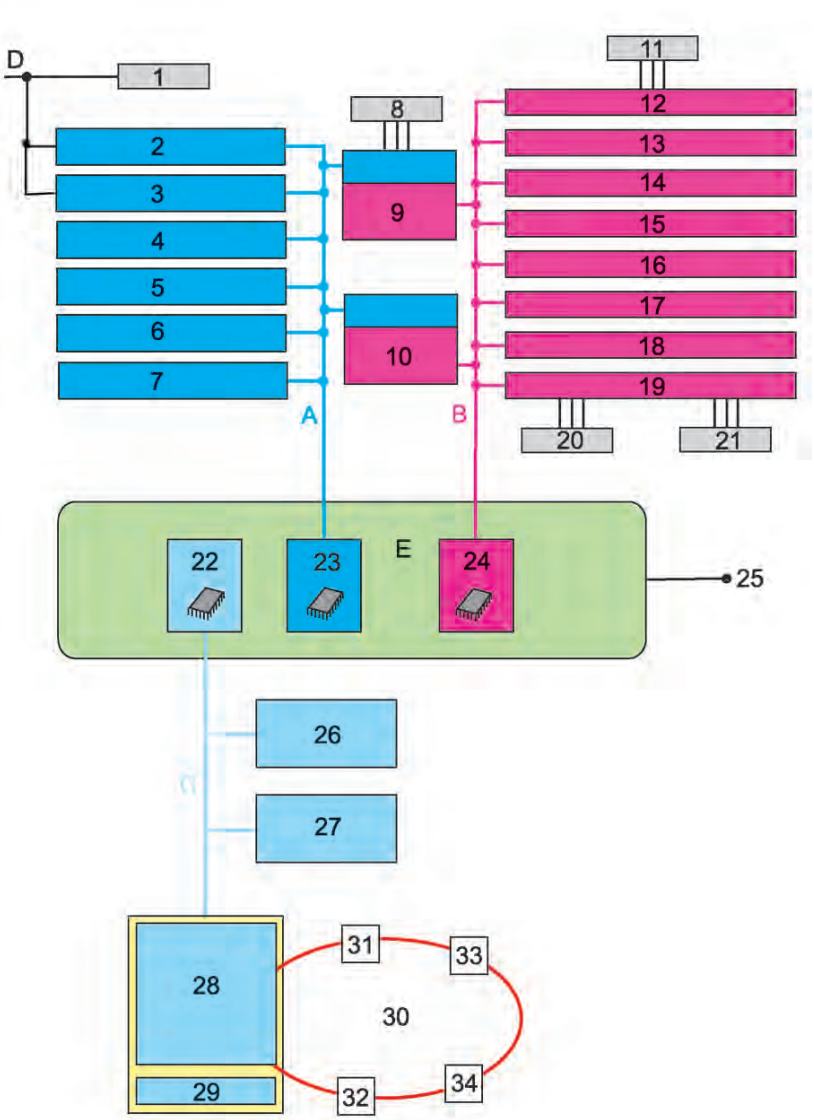
Electronic networking in the 911 Carrera (997) and Boxster/Cayman (987) allows data and electrical information to be exchanged between various control units throughout the vehicle. This is realized with the aid of the internal high speed network, the CAN BUS (Controller Area Network), and the fiber optic network, the MOST BUS (Media Oriented System Transport). Networking reduces the number of connections required so that the total length of cabling required can be kept significantly shorter.

Most of the network connections can be found in the following areas:

- In the area of engine management for high speed information exchange.
- In the area of coordination of networked control engineering. Therefore a PSM braking operation, for example, involves the control units for the brakes (PSM), engine, tire pressure monitoring system and Tiptronic S.
- In the area of audio/communication for the joint transmission of digital audio and control data via the MOST bus.
- The use of network connections has enabled a reduction in weight.

Notes:

Basic topology of the data bus systems in the 911 Carrera (997) & Boxster/Cayman (987)



A - CAN drive
B - CAN Comfort
C - CAN display
D - K-line
E - Gateway controller

1 - ParkAssist control unit
2 - Motronic control unit
3 - Transmission control unit
4 - PSM control unit
5 - Yaw velocity/lateral acceleration sensor
6 - PASM control module
7 - Airbag control unit
8 - Electromechanical steering lock
9 - Driving authorization control unit (PAS)
10 - Steering column switch module
11 - Cabrio top control unit
12 - Rear control unit
13 - Vehicle electrical system control unit
14 - RDK control module
15 - Air conditioning control module
16 - Seat control unit
17 - Door control unit (driver's side)
18 - Door control unit (passenger side)
19 - Front-end control unit
20 - Radiator fan control unit
21 - Bi-Xenon control unit
22 - Gateway - CAN display
23 - Gateway - CAN drive
24 - Gateway - CAN Comfort
25 - CAN diagnosis
26 - Instrument cluster
27 - Analog clock (Sport Chrono)
28 - PCM 2.1
29 - Gateway - PCM
30 - MOST bus
31 - Amplifier
32 - Telephone module
33 - CD autochanger
34 - Navigation module

Gateway Controller



The gateway controller is actively involved with all CAN buses in the Boxster/Cayman (987). The gateway controller is a separate unit, similar to the 911 Carrera (997). It relays all messages and signals which are transmitted by control units for transmission via various buses. The transfer protocol of the gateway controller is defined in a routing table. It also supports the test unit in diagnosing the vehicle by transmitting, collecting and supplying numerous items of information on the vehicle.

The individual items of information concerned here are:

- Transmission of specified installation information on all bus systems
- Provision of actual installation information (CAN control units)
- Collection and provision of error bits for tester
- Acquisition and provision of information on control units which do not switch to sleep standby mode after terminal 15 “off”
- Acquisition and provision of general CAN bus information (e.g. single-wire operation, fault location info, etc.)

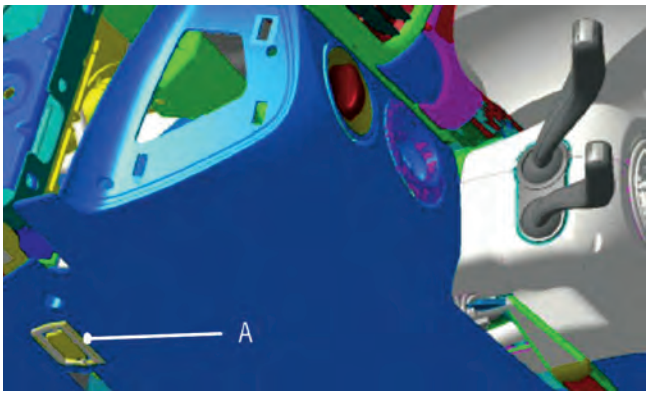
Configuration is carried out with the aid of the PIWIS Tester.

When putting the gateway into operation in the vehicle, the following operations and settings need to be carried out with the PIWIS Tester:

- Check identification
- Encode specified installation
- Encode vehicle data (e.g. vehicle type etc.)
- Delete overflow counter (warning thresholds of an internal counter for storage overflows)
- Encode overshoot time
- Delete fault codes

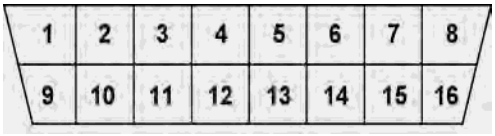
Diagnosis

Diagnosis of the electrical and electronic systems in the 911 Carrera (997) & Boxster/Cayman (987) is carried out by way of the Porsche diagnosis systems.



A - Diagnosis Socket

Diagnosis Socket Assignments



Pin

1 - Terminal 15 (power)

2 - Not freely assignable [2)]

3 - Not freely assignable [2)]

4 - Terminal 31 (ground)

5 - Terminal 31 (electronic ground)

6 - Diagnosis CAN high

7 - K-line

8 - Freely assignable [1)]

9 - TN signal

10 - Not freely assignable [2)]

11 - Freely assignable [1)]

12 - Freely assignable [1)]

13 - Freely assignable [1)]

14 - Diagnosis CAN low

15 - K-line

16 - K-line

[1)] Pins 1, 3, 8, 9, 11, 12 and 13 are freely assignable by the vehicle manufacturer.

[2)] Fixed assignments apply for pins 2, 6, 7, 10, 14 and 15 on the diagnosis socket.

Fast Sleep Mode

In order to enable swift parasitic draw current measurement, all control units feature a diagnosis facility entitled "fast sleep mode". After activation of this mode by the tester, all control units terminate their activities after terminal 15 "off" in < 5 seconds plus any one off overshoot times. Safety critical functions and component protection have priority, however.

The control units on the CAN Comfort bus and the CAN Display bus transmit their sleep standby mode via the bus immediately after the end of the overshoot time and also terminate their activities after bus non-operation.

Prerequisites for activation of fast sleep mode:

- Terminal 15 "on"
- Vehicle speed = 0 mph (km/h)

Specified Installation List

A specified installation list is cyclically transmitted from the gateway controller into all bus systems The control units are able to carry out automatic configuration on the basis of this message (e.g. CAN timeout monitoring).

Actual Installation List

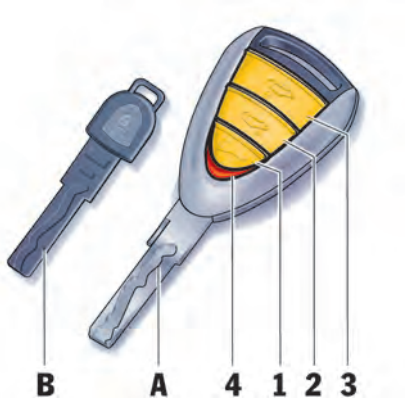
An actual installation list in which all networked control units enter their configurations (MOST or CAN control units) is stored in the gateway controller.

Notes:

Immobilizer/Central Locking

Ignition Lock With One Key System

The ignition key of the 911 Carrera/S (997) and Boxster/S (987) has been redesigned and their ergonomics optimized. The buttons to unlock the vehicle and the luggage compartment lid retain their functions. They are made of ABS plastic.



A - Main key
B - Spare key
1 - Central locking button
2 - Front luggage compartment lid button
3 - Rear luggage compartment lid button (Not on 911)
4 - Light emitting diode

The remote control standby function switches off after 7 days. If the vehicle is not started or unlocked with the remote control within seven days, the remote control standby function is switched off (to save the vehicle battery).

1. In this case, unlock the driver's door with the key at the door lock. Leave the door closed in order to prevent the alarm system from being triggered.
2. Press button 1 on the remote control. The remote control is now activated again.

Immobilizer/Electromechanical Steering Lock

The electronic immobilizer is intended to protect the vehicle from unauthorized use. In order to achieve a higher degree of security, the immobilizer is distributed over several components:

- Vehicle key
- Driver authorization controller (PAS - Porsche Access System)
- Electromechanical steering lock
- Engine control unit

Mode of Functioning Via Key

Once the key is inserted in the ignition, the data is read out via an inductive radio link. It is encrypted and transmitted to the driving authorization control system, where it is evaluated.

Following a positive result:

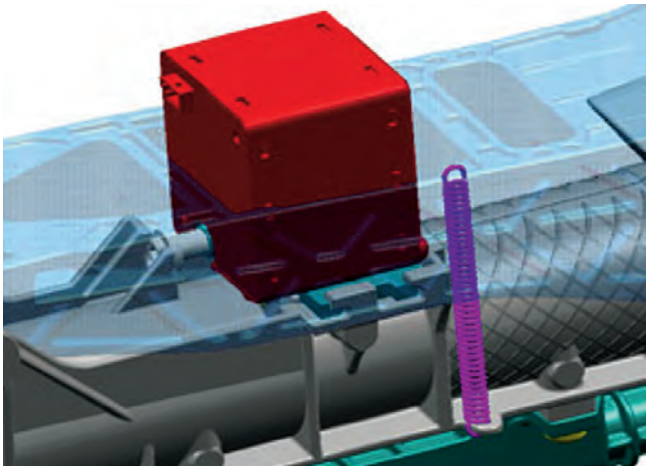
- the power supply for Porsche Communication Management (PCM) is enabled,
- communication is established with the electromechanical steering column lock and another exchange of encrypted data takes place with the driving authorisation system. The steering column is unlocked if the key is positively identified. If the steering wheel is strained, a warning is displayed in the instrument cluster and the driver is asked to move the steering wheel so that the strain can be released and the steering wheel unlocked.

When the ignition key is turned clockwise, communication is established with the engine control unit (Motronic) and the key is identified once more. If the key is positively identified, the immobilizer is deactivated, the ignition switched on and the engine functions released.

Once the initial resistance is overcome with the key, the starter is activated and the engine starts. In order for this to happen, the clutch pedal must be depressed in vehicles with manual gearbox or the brake pedal depressed and the selector lever set to “P” or “N” in vehicles with Tiptronic S. The key returns to its initial position once the starter is actuated.

When the engine is running, the status of the immobilizer is no longer evaluated. It is not possible to influence running of the engine.

Electromechanical Steering Lock



The electromechanical steering lock serves to lock the steering by mechanical means in order to prevent unauthorized use of the vehicle. The lock is installed in the steering system and can only be removed after dismantling the steering system. Removal is only possible in an unlocked state. The actuator test for locking/unlocking is only possible with a “trained” electromechanical steering lock. Identification via diagnosis is not possible.

When the vehicle is parked after a trip, the electromechanical steering lock is locked upon deactivation of terminal S. Locking is carried out at the very latest when the vehicle is locked from outside via the key remote control.

Anti-theft Alarm System

The anti-theft protection system is essentially the same as in the previous 911 Carrera (996) and Boxster/S (986) models. Interior surveillance is now executed using a radar sensor instead of an infrared sensor and mounted inside the center console next to the parking brake lever. The advantage of the radar sensor is that it is insensitive to reflections from particularly bright interior leathers. This means that interior leathers in colors to sample can be used without any false signal problems.

Information: Radar stands for ’radiation detecting and ranging’. Radar is a method of locating objects in space with the aid of concentrated electromagnetic waves which are emitted from a transmitter, reflected and rendered visible on a display unit via a receiver or evaluated in a control unit.

As well as unlocking via remote control, the car can also be unlocked via the door lock cylinder. The driver's door is then opened mechanically. Only the interior surveillance system and the door contact on the driver's side are deactivated, however - not the anti-theft alarm system.

If the ignition key is not inserted and successfully identified using the transponder housed in the key within 15 seconds, the alarm will be triggered. If the vehicle is unlocked by remote control and none of the car doors are opened within approximately 60 seconds, automatic relocking takes place. This relocking period can be adapted to individual needs (4 - 120 seconds).

One Touch Window Operation

Press the rocker switch upwards or downwards to the second stage. Window moves to its final position. Press again to stop the window in the desired position. One touch operation for closing the passenger's window is available once the window is approximately halfway closed.

Battery Status Monitoring for the Remote Control

The battery of the remote control is monitored in the key itself. During actuation of a button on the remote control, the battery voltage is measured and compared against a programmed threshold value. This value is communicated to the driver authorization control unit (Porsche Access System).

When the control unit receives a "battery low" signal from the key, a warning message "Replace battery" and a key symbol is indicated in the instrument cluster.

Notes:

Lighting System – 911 Carrera (997) & Boxster/Cayman (987)

Main Headlight



Boxster (987)



Cayman (987)



911 Carrera (997)

The main headlight has been completely redesigned as part of the development of the new exterior styling. The new design has the marker light and fog light housed in a separate module. This has enabled the main headlight to be made more compact and rendered in a typical Porsche oval shape. By separating the light modules, it has also been possible to realize the classic, trademark Porsche night time design. The 911 Carrera (997) & Boxster/Cayman (987) are immediately recognizable as a Porsche.

Similar to the previous 911 Carrera (996) & Boxster (986) models, the main headlight is equipped with a clear plastic cover and projects its luminous flux onto the road using a projector module and free form reflector.

The new main headlight uses halogen technology as standard. The dipped beam is emitted from an H7 long-life bulb (12V/55W) while the high beam is provided by an H9 bulb (12V/65W). The range and road illumination properties of both these beams have been adapted to the specific model. There is also an additional reflector around the dipped beam module. It is illuminated by a portion of the dipped beam and serves to brighten the surroundings.

The option of using the dipped beam as daytime running lights (in combination with the optional Sport Chrono Package Plus) is also new.

The H7 projection system offers the following advantages for dipped beam:

- High luminous flux
- Considerably more light in the extreme range of the light/dark limit
- More defined light/dark limit resulting in less dazzle for other road users
- Homogenous illumination of the entire lane
- Broader lateral illumination than when compared to the previous models resulting in greater safety, particularly when driving around tight corners
- Reduction of dazzle for oncoming traffic through the imposition of an upper restriction for the light/dark limit at the outer edge of the road. This limit is lower than on the previous models (here the 15° illumination cone is limited to the right, not in upward direction). The result is a broader range at the outer edge of the road, however as the light is below the point of sight of oncoming traffic it does not cause dazzling.
- Longer dipped beam range than offered by competitors (approx. 70 m). This is due to the high installation position of the headlight above the road and the arrangement of the lighting components.

The front light contains the marker light and fog light. Like the main headlight, the front light is also equipped with clear glass and free form reflectors.

A blue bulb (12V/5W, “blue vision”) ensures that the light spectrum of the marker light is very similar to that of the main headlight, creating a uniform night time design.

Bi-Xenon Main Headlights (optional)



In addition to the automatic dynamic range adjustment mechanism, the gas discharge light system also includes the headlight washer system. The Bi-Xenon main headlight is similar in structure to the halogen version. The gas discharge light replaces the halogen bulb of the dipped beam at the top. (The gas discharge light assumes the function of both the dipped beam and the high beam). The free form reflector with halogen bulb (H11/55W, long-life) mounted at the bottom of the main headlight is connected as an auxiliary main beam headlight. It is designed as a spot for better long-range illumination of the road.

The Bi-Xenon system offers the following additional advantages in comparison with the halogen headlight for dipped beam:

- Even higher luminous flux
- High color temperature for good color perception

Like the halogen headlight, the Bi-Xenon headlight can also be used for daytime running lights.

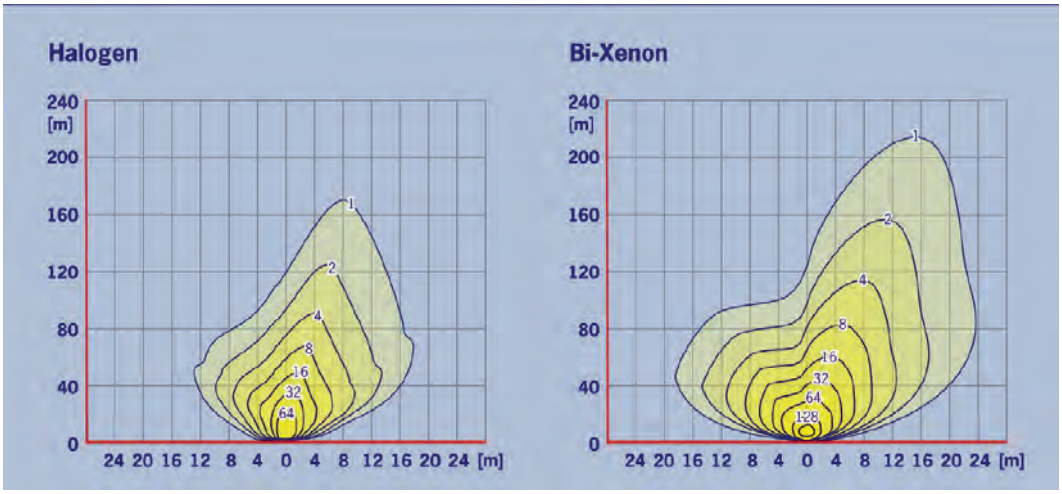
Headlight Cleaning System

The headlight washer system has been moved from the new main headlight and integrated in the front end (standard in the Bi-Xenon main headlight). It uses a chrome colored cylinder that, when the system is activated, extends 83 mm with the pressure of the spray water. The position of the spray jet has been further optimized in comparison with the previous Boxster/S (986) models and is now located in front of the headlight. As a result the water spray now moves with the direction of movement of the vehicle. This means that instead of deflecting the spray water, the air flow can now in fact be used to increase its speed of delivery.

Fog Light

The front fog lights have been separated from the main headlight module to enable them to be positioned considerably closer to the road surface. The improved lateral illumination and lower position help the driver to navigate more easily in foggy driving conditions.

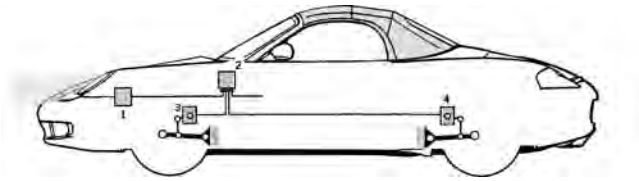
Illumination Range for Dipped Beam



Automatic Headlight Beam Adjustment

The automatic headlight beam adjustment function is integrated into the front end control unit. Dynamic automatic headlight beam adjustment automatically corrects the level of the headlight beam such that neither the vehicle's load nor the pitching movements resulting from the vehicle's driving dynamics can dazzle oncoming traffic when dipped beam is switched on, while at the same time ensuring an adequate range of vision for the driver.

This results in increased driving safety while at the same time reducing the strain on the driver.



The system comprises the following components:

1 - Stepping motors in the headlight
2 - Controller in front-end control unit
3, 4 - Rotation angle sensor on rear and front axles

Functions

The sensors on the front and rear axles (3, 4) supply signals to the controller (2) which are proportional to the spring deflection of the body at these points. This results in a non-linear characteristic for the front and rear axle sensors. On the basis of this characteristic, a microprocessor controller calculates the vehicle's pitch angle and the required positions of the actuators (1) in the headlight for the purposes of headlight beam adjustment.

A signal proportional to the vehicle speed (wheel speed) is supplied directly via a signal line from the ABS / PSM control unit. The system distinguishes between cruising and accelerated driving by evaluating the wheel speed signal. During driving, interfering signals which are superimposed over the sensor signals as a result of the road surface (bumps and pot holes) are filtered out. The system detects poor road surfaces and responds accordingly by reducing actuation of the stepping motors or shutting them down completely.

The system responds very quickly to braking or acceleration. The response time lies in the range of 0.1 seconds, i.e. the motor begins to adjust the headlights no later than 0.1 seconds after commencement of the pitching movement. This eliminates the risk of dazzling oncoming traffic and ensures the maximum depth of illumination for the driver.

When the vehicle is stationary, the vehicle's inclination is calculated from the sensor signals and the headlight settings are corrected according to the difference between their required and actual positions. The full scope of functions is maintained when high beam is switched on.

The system functions on the basis of the following input values from the vehicle:

- Ignition, terminal 15 (power supply for the control unit)
- Wheel speed signal, supplied via CAN data line or signal line
- Dipped beam, terminal 56b (or parking light, terminal 58)
- High beam, terminal 56a, data supplied via CAN data line
- Ambient brightness, supplied as CAN signal from the air conditioning control unit/sun sensor

Ignition "ON" – When switching on the ignition, referencing of the stepping motors is carried out, i.e. the motor moves the reflector in the direction of "maximum dip" up to the stop incorporated in the motor. The calculated position is then reached. Renewed referencing is carried out only after terminal S has been inactive. The referencing frequency is tested during the trial phase and the pertinent conditions are finalized.

Dipped beam "ON" – When dipped beam (or daytime driving lights) are switched on and an appropriate degree of darkness applies, the control unit switches to normal operational status, i.e. the stepping motors are operated in accordance with the spring deflection values detected by the sensors and the subsequently determined vehicle inclination values. Suitable filters are employed according to the characteristics of the road surface and the vehicle speed, providing the driver with sufficiently smooth response.

High beam "ON" – Automatic headlight beam adjustment remains active when high beam is switched on.

Rear Lights



Boxster (987)



Cayman (987)



911 Carrera (997)

Particular attention has also been paid to the new night time design of the 911 Carrera (997) and Boxster/ Cayman (987) when it comes to the rear view. The tail light, which always featured a very simple design on previous models, now lights up three tail light chambers to create a new characteristic Porsche night time look at the rear, as well.

The third brake light is a new development in LED technology and is integrated into the styling of the Boxster's rear section. A striking feature is the light's silver grey cover panel, which lends the vehicle's rear an even more powerful appearance.

The new LED technology has a number of clear advantages in terms of service life and response time. The response time of bulbs is around 100 ms. By comparison, LEDs respond after around 0.1 ms. This difference translates to a distance of almost 10 ft (3 m) at a speed of 62 mph (100 km/h). Earlier indication of an intention to brake means more time for other drivers to react. LEDs also have a considerably longer service life (generally in excess of 10,000 hours) than conventional bulbs that need to be replaced after only 200-1000 hours.

Brake Light Switch

The PSM control unit identifies a brake light request from the redundant switch combination consisting of "brake light switch" (BLS) and "brake test switch" (BTS). The PSM control unit also checks the sequence of opening/closing operations performed by these switches for plausibility.

The brake test switch must open first when actuated, following which the brake light switch must close after a short delay.

The PSM control unit relays this information via CAN Drive and passes on the messages to the Motronic control unit. In parallel with the PSM control unit, the rear control unit and the driving authorization control unit (Porsche Access System - PAS) read in the signal from the brake light switch.

Notes:

Light Failure Monitoring

Most exterior lights are equipped with a failure checking facility. In the event of a problem (e.g. bulb failure, wire defect), a corresponding message is displayed in the instrument cluster.

The following lights are monitored:

- Dipped beam
- High beam
- Marker light
- Indicator light
- Brake light
- Rear fog light
- Backup light

In case of light failure during “ignition off”, the fault is stored and subsequently transmitted via CAN in conjunction with the next “ignition on” cycle. The light failure checking facility is not active during “sleep” mode. In case of light failure during “ignition on”, the fault is transmitted directly.

Interior Lights

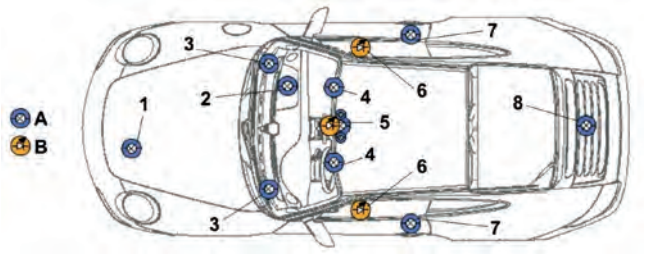
The interior lighting in the 911 Carrera (997) and Boxster/Cayman (987) models is based closely on the concept used in the previous models. New are the white LEDs for instruments and controls, which offer better illuminating power than the yellow LEDs used in the previous model. This has improved the readability of the instruments, particularly at dawn and dusk. The white color of the new LEDs is also substantially more comfortable for the human eye due to its composition. Another advantage is that it makes yellow and red warning symbols and lights stand out more. Lastly it gives the interior a higher quality appearance and creates a more pleasant ambiance. Two footwell lights have additionally been incorporated for improved illumination of the interior.

Interior Light

The interior lights and footwell lights are supplied with negative potential. This takes the form of a PWM (pulse width modulated) signal which is altered accordingly with a programmed dimming time.

Orientation Lighting

The LEDs in the interior light and in the footwell lights are supplied with positive potential. This also takes the form of a PWM (pulse width-modulated) signal which is altered accordingly with a programmed dimming time.



Boxster/Cayman (987) are basically the same as a 911 Carrera (997) with the exception of position 8.

A - Light
B - Orientation LEDs

1 - Luggage compartment
2 - Glove compartment
3 - Footwell
4 - Make-up mirror
5 - Reading light, interior light, LED in mirror base plate
6 - Interior door control
7 - Door safety lighting
8 - Engine compartment (Not used on Boxster)

Safety and Exit Lighting

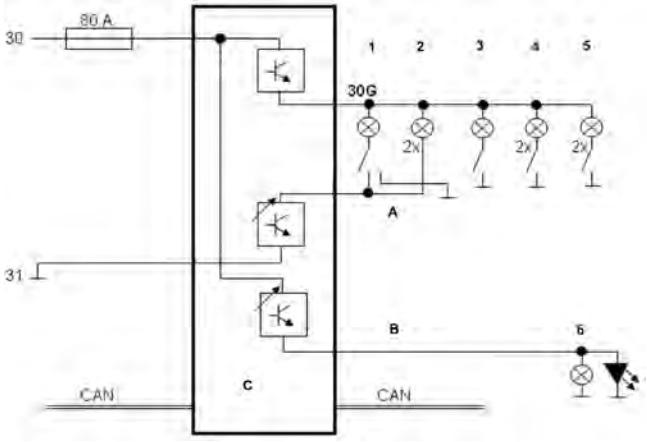
The addition of automatic coming home lighting to the exit lighting represents yet another major increase in convenience. Automatic coming home lighting is preselected via the light switch. When the door is opened or the vehicle is unlocked using remote control, the front fog lights, tail lights and license plate lights come on for 30 seconds to illuminate the surroundings. In vehicles with the Sport Chrono Package Plus, the duration for which the lights stay on can be changed in the “Individual Setting/Light” menu option.

The sun position sensor in the automatic climate control system monitors the ambient brightness to prevent the lights being switched on unnecessarily.

Bulbs rated at 12 V, 10 W are used for the safety and exit lighting. These bulbs are activated by the respective door control units.

Power Saving Cut-off

The interior lights are supplied centrally with positive potential via terminal 30G. In order to prevent interior lights which are left on permanently from draining the battery, terminal 30G is switched off when the CAN signal "load switch-off" is active. This CAN signal is generated centrally in the driver authorization controller (PAS - Porsche Access System).



A - Interior light (dimmable)
B - Orientation light (dimmable)
C - Vehicle electrical system control unit

1 - Interior light
2 - Footwell light
3 - Glove compartment light
4 - Make-up mirrors
5 - Luggage compartment lights
6 - Orientation LEDs

Notes:

Front Wiper System

The front wiper system features two wiping speeds and an interval setting. They are controlled by way of a three positions of the right hand steering column stalk. The individual wiping intervals are set via a potentiometer in the steering column stalk.

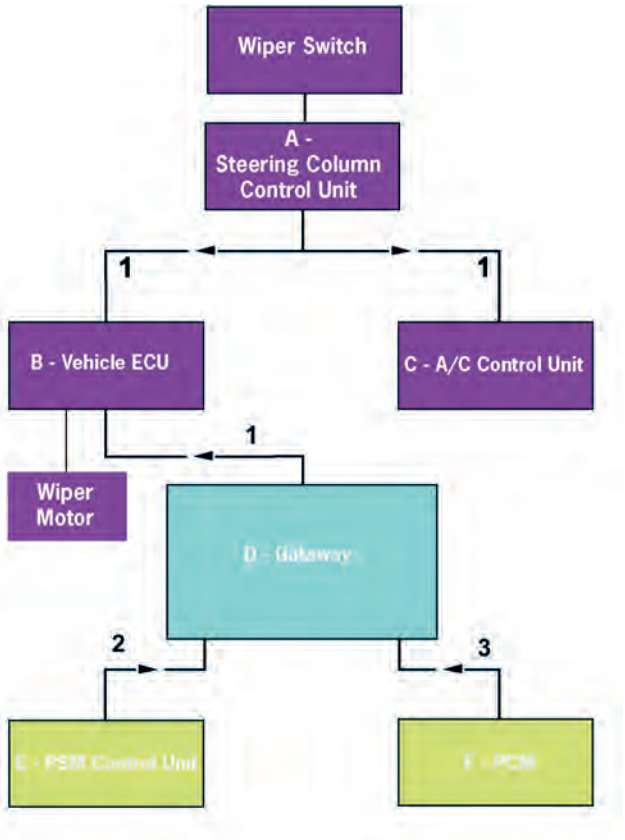
A rain sensor integrated in the foot of the interior mirror is available as an option. When it rains, the wiping speed is automatically and continuously selected to suit the conditions. In vehicles with rain sensor, the sensitivity of the rain sensor is adjusted via the potentiometer in the steering column stalk. Having the wiper controlled via the vehicle electrical system control unit means that additional information is available for automatic regulation of the wiping speed and for error diagnosis. For example, the control unit can tell from data transmitted by the sun position sensor in the automatic climate control system that it is night and can then regulate the wiper mode more sensitively if the rain sensor is activated. The wiping speed for the wipe/wash function is also variably controlled. The wiper function is automatically set to level 2 at speeds above 67 mph (110 km/h) to provide the driver with a clear view as quickly as possible.

Operation of The Wiper Motor

The front wiper system is supplied with the necessary voltage from the vehicle electrical system control unit, via a short circuit proof output module and a reverse voltage protection and changeover relay. The wiper/washing functions of the stalk control are read in in the steering column module and converted here into CAN signals which are subsequently evaluated in the vehicle electrical system control unit. Power supply to the wiper motor is interrupted immediately when “ignition off” state applies. When the ignition is switched on again, the wiper is moved into its end position, provided that the wiper functions (intermittent, wiper 1, wiper 2) are off.

The wiper motor is permanently connected to ground and is supplied with positive potential in its respective switching positions. After deactivation of the respective switching positions and in intermittent mode, the wiper motor continues to be supplied with positive potential until it reaches its home position. A load switched ground signal is sent to the level 1 terminal immediately after cut-off of the positive potential. The wiper motor operates as a generator in short circuit operating mode and is decelerated.

Home position is scanned by a disk cam integrated in the wiper motor. If home position is not detected within the time t_{END} as a result of a malfunction, the control system will switch to direct operating mode. Operation of the wiper can then only be continued in positions 1 and 2, whereby the wiper is shut down by way of the wiper switch without returning to its home position.



A - Steering column control unit
B - Vehicle electrical system control unit
C - Air conditioning control module
D - Gateway controller
E - PSM control unit
F - PCM

1 - CAN Comfort
2 - CAN drive
3 - CAN display

Rear Wiper System (optional) – 911 Carrera/S (997) & Cayman/S (987)

A flat aerodynamic wiper blade is being used for the first time for the rear wiper of the 911 Carrera/S (997) and Cayman/S (987). The low height of this new rear wiper blade and its connection via a specially shaped wiper arm mean that the rear wiper has a smaller frontal area. The wiper arm is now mounted directly on the rear window, which enables it to blend in more seamlessly with the lines of the vehicle.

The rear wiper is activated by pressing the upper right steering column stalk. Intermittent wiping commences when the lever is engaged. Like the front wiper system, the rear wiper is also connected to the vehicle network via the rear control unit. It is automatically switched off at speeds above 124 mph (200 km/h) (real speed). The main reason for this is that the rear window does not get wet at these speeds and the rear wiper would be wiping a dry surface. It is also to prevent the aerodynamics of the vehicle being unnecessarily influenced by the wiping operation. As the speed dropping below the cut-off speed once again, the rear wiper is reactivated only on reaching a constant speed 3 mph (5 km/h) below the threshold, i.e. at 121 mph (195 km/h) (real speed).

Rear Wiper System (optional) – 911 Targa 4/4S (997)

A rear window wiper is available as an option. The mount for this rear wiper is connected in the rear window and via a servo coupling to the drive motor on the roof assembly.

Instrument Cluster – Boxster/S (987)

The instruments and dash layout in the Boxster/S (987) have been reworked during the redesign of the interior, and, are now illuminated with white light, The Cayman S (987) is similar in layout to the Boxster S. The three individual instruments are now spaced further apart in the new instrument cluster. This enlarges the display area and thereby improves readability. The dials in the Boxster S (987) model are Light Grey in color, while the dials in the Boxster (987) model are finished in Black. There are permanent indicators for speed (analog), tachometer, fuel level, coolant temperature, total mileage, trip mileage, time, outside temperature and, centered under the tachometer, the current speed (digital).

The on-board computer, which now comes as standard, enables the driver to call up the average speed, average fuel consumption, remaining range, tire pressure (with TPM option from M.Y. 06) and navigation information (with PCM option) by way of the bottom left lever on the steering wheel. In addition to the permanent digital display of the speed at the top of the computer display under the tachometer, a host of other information can be called up and displayed in the lower two fields. The available items information vary according to the range of equipment installed in the vehicle. The warning lights, which were previously located underneath the round instruments, have been incorporated into the dials so that they are more directly in the driver's field of vision. The dot matrix display is still integrated in the center dial underneath the tachometer and now displays additional functions such as the TPM menu (option from M.Y. 06) or the stopwatch from the optional Sport Chrono Plus package (optional).

When the ignition is switched on, the warning lights light up for a light check.

Instrument Cluster – 911 Carrera/S (997)

The instrument layout in the 911 Carrera/S (997) was redesigned along with the interior. All of the instruments are now illuminated with white light. The five individual instruments are spaced further apart. This enlarges the display area and improves readability. The dials in the 911 Carrera S are aluminium colored while the dials in the 911 Carrera model are finished in black. There are permanent indicators for total mileage, trip mileage, time, exterior temperature, centered underneath the tachometer and speedometer.

The voltmeter has been replaced by the oil temperature indicator in the left-hand round instrument. The warning lights, which were previously located underneath the round instruments, have been incorporated into the dials so that they are more directly in the driver's field of vision. The dot matrix display is still integrated in the center round instrument underneath the tachometer and now displays additional functions such as the tire pressure monitoring menu or the stopwatch from the optional Sport Chrono Plus package.

When the ignition is switched on, the warning lights light up for a light check and remain on for about 10 seconds.

The instrument cluster employs the following output elements to display information:

Analog Instruments

- Speedometer
- Tachometer
- Coolant temperature, fuel level

Digital Indicators

- Selector lever position and gear indicator
- Trip counter and total mileage indicator
- Time, outside temperature
- Speed
- Range, average fuel consumption, average speed
- Oil level
- Menu displays for radio, navigation, vehicle check
- Alarm indications

Inputs and Input Data

The instrument cluster evaluates the following input data:

- Clock adjusting knob, dimming adjusting knob
- Oil level, fuel level sensor
- Parking aid sound, brake lining, clutch switch, selector lever position, washer fluid level, central locking
- Wake-up line

Notes:

The following input data are received from the CAN bus:

Description	Transmitting device
Movements on the steering column switch, multi-function steering wheel	Steering column switch module
Wheel speed, direction indicator pilot light, distance pulse counter, PSM info light, ABS warning light, PSM warning light, brake indicator light, light in PSM OFF switch, brake fluid level, parking brake, lateral acceleration, airbag indicator light	PSM control unit
Key contact, remote control key, warning texts,	Driving authorisation control unit (PAS)
Outside temperature, direction indicator statuses, high beam statuses, parking light statuses, dipped beam statuses, fog light statuses, side marker light statuses, fault – automatic headlight beam adjustment, fault - wiper, fault – rain sensor, front lid status, activation of instrument illumination	Front end control unit
Top multiplex signal, top status, top system error, top indicator light, rear lid open, rear spoiler pilot light, window opening, door open, automatic coming home lighting check-back	Rear control unit
Engine speed, target or actual gear, selector lever position	Transmission control unit
Transmission emergency mode, driving speed regulator, engine temperature, country code	Motronic control unit
Sun intensity	Air conditioning control panel (control unit)
Belt warning	Airbag control unit
Specified installation list	Gateway controller
GPS time	PCM
Tire warnings, tire pressure, recommended maximum speed, differential pressure	RDK control module

The following data are output on the CAN bus:

Description	Receiving device
Stationary period	Air conditioning control panel, RDK control module, Motronic control unit
Fuel level	Motronic control unit
Outside temperature displayed, average fuel consumption, remaining range, displayed average speed, trip counter, time, total mileage, brake fluid, brake force distribution, engine diagnosis, engine/coolant temperature	PCM
Refuelling warning, required tire pressure	RDK control module
Top button	Rear control unit

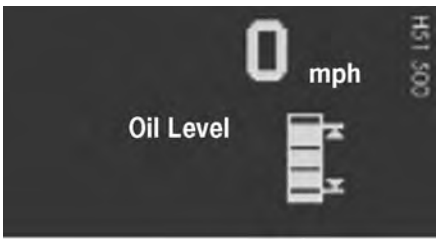
The instrument cluster has the following PWM outputs:

- LED dimming

Maintenance Computer

The 911 Carrera (997) and Boxster/Cayman (987) incorporates a maintenance computer which indicates the due time for servicing on the on-board computer of the instrument cluster on a time and mileage basis.

Oil Level Indicator



Oil level measurement is initiated via terminal 15 or manual selection via the “OIL” menu in the instrument cluster.

The instrument cluster reads out and displays the oil level.

Enabling a measurement after unintentionally starting the engine:

- Following terminal 15 on, automatic measurement is carried out and the measured value is stored, subject to compliance with all the necessary conditions.
- If no wheel speeds are detected, the engine is switched off within
  20 s of starting the engine (terminal 15 off) and a “normal” measurement operation is started via terminal 15 within a further 20 s, the previously measured value will be displayed (after the minimum measuring time of 6 s has elapsed).
- If one of these times is exceeded, the stored measurement will be discarded and a corresponding time will be indicated, e.g. 59:59 min.

Cruise Control

Cruise control serves to keep the speed of the vehicle constant irrespective of road resistance without requiring the driver to operate the accelerator pedal. The Motronic system implements the speed set by the driver by adjusting the throttle accordingly. The throttle can thereby be adjusted independently of the accelerator position in cruise control mode. Cruise control is active in the speed range from approx. 19 mph (30 km/h) to approx. 149 mph (240 km/h). Cruise control can be used in all gears.

Cruise control is operated by way of a lever on the stalk control. Apart from maintaining the current speed (cruising), cruise control also enables a stored target speed to be approached (Resume function), acceleration and deceleration, increase or reduction of the set speed in small steps (tap up and tap down) and selection of the current vehicle speed as the set speed (Set function).



A - Cruise control readiness off/on
1 - Accelerate and save
2 - Decelerate
3 - Interrupt (OFF)
4 - Resume

The speed can be changed in constant steps via the steering column stalk while cruise control is active:

- Per pulse from the control lever as a result of pressing briefly forward
  +1 mph (2 km/h)
- Per pulse from the control lever as a result of pulling briefly
  -1 mph (-2 km/h)

Particularly when driving downhill, the vehicle speed can differ from the stored set cruise speed. To enable more effective compliance with the set speed, vehicles equipped with Tiptronic are able to improve the braking effect by initiating a maximum of two downshifts. Downshifting by a maximum of two gears is also effected when only minimum deceleration is attainable by pulling and holding the lever in the direction of the driver when driving downhill, for example.

A maximum of two downshifts may also be performed when more than three tap down operations are carried out by the driver and the resultant deceleration is inadequate.

Notes:

Combined Steering Column Module/Multi-function Steering Wheel

The combined steering column module reads in the button and switch signals generated by module levers and outputs this on the Comfort CAN.

Lever Functions



Direction Indicators

- Left indicators
- Right indicators
- High beam
- Headlight flasher

Wipers

- Intermittent
- Wiping level 1
- Wiping level 2
- Headlight cleaning
- Washing
- Intermittent wiping potentiometer
- Wash before wiping

On-board Computer

- Scroll down
- Scroll up
- Set
- Reset

Cruise Control

- On / off
- Set
- Deceleration
- Acceleration

Multi-function Steering Wheel (optional)



The multifunction steering wheel is based on the basic steering wheel and requires the PCM option. Unlike the basic steering wheel, however, it has four function buttons and two function rollers evenly divided between the left-hand and right-hand spokes.

These controls allow the driver to operate essential audio, telephone and navigation functions without having to take their hands off the wheel. This means less distraction and better concentration on what is happening on the road. The black function buttons are embedded in bezels painted with an Aluminum Look finish. This clearly emphasizes the controls, both visually and functionally. They are also ergonomically arranged to ensure the driver can easily operate them using their left or right thumb.

The steering wheel electronics system comprises two switch modules, a multi-function control unit, an airbag module and a horn contact. The signals from the Tiptronic rocker switches and the buttons are fed into the multi-function control unit in voltage encoded form. In the multi-function control unit the individual signals are combined into a protocol and relayed serially via single core cable, volute springs to the combined steering column module, where they are processed for CAN transmission.

Diagnosis

Diagnosis is carried out with the PIWIS Tester under menu option “Steering wheel electronics”. Some functional features of the vehicle electrical system are restricted or disabled in production and transportation mode.

ParkAssist (optional)

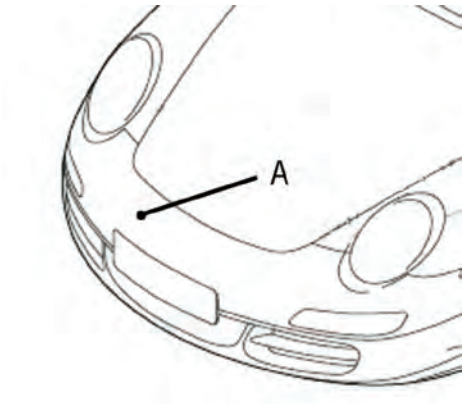
Parking sensors which are integrated even more discreetly into the rear are optionally available for the new Boxster/S (987). They are inserted from the back into a bracket attached to the rear apron and clipped into place. This further improves the homogeneous appearance of the rear apron.

ParkAssist acts as a safety function for the rear of the vehicle only. 4 ultrasonic sensors in the rear bumper monitor the area behind the vehicle for obstacles. The system emits acoustic warnings via a tone generator in the instrument cluster and cannot be deactivated. ParkAssist is activated when the ignition is on and reverse gear is engaged. A brief signal tone is sounded for 0.5 s (1200 Hz) upon activation.

When the vehicle approaches an obstacle, an intermittent tone (1 kHz) is emitted from a distance of approx. 59″ (150 cm). The pulse and interval of this tone become increasingly shorter as the distance to the obstacle decreases, until the stop warning is sounded in the form of a continuous tone (1 kHz) of unlimited duration at a distance of approx. 12″ (30 cm).

In the event of an error, a continuous tone sounds at 60 Hz for 3 sec. The system can be diagnosed via the K-line and is not CAN capable.

Integrated Home Link Garage Door Opener (optional)



An integrated garage door opener is available for the first time as an option for the 911 Carrera/S (997), Boxster/S Cayman/S (987) models. The integrated garage door opener replaces up to three hand held transmitters with a system that is permanently installed in the vehicle and operated from the vehicle interior. It can be programmed to the frequencies of most normal hand held transmitters used to actuate garage door and gate systems. It can also be used to control lighting and alarm systems once these are equipped with the appropriate radio receivers.

Two control units manage the entire system. The vehicle electrical system control unit reads in the three control buttons and the status LEDs and, as the master control unit, integrates the system in the vehicle network. The advantage of integration in the vehicle network is that it enables direct activation of the acknowledgement display for successful/unsuccessful learning and straightforward error diagnosis that can be performed using the PIWIS Tester.

The control unit of the integrated garage door opener is accommodated in the front end in the vicinity of the luggage compartment lock. It includes the radio module and controls the coding for the different country variants on the basis of the information provided by the vehicle electrical system control unit.

Fixed Code Programming

1. Press the two outer buttons (button 1 and 3) of the keypad and hold for approx. 20 seconds until the indicator light begins to flash rapidly. Then release both buttons. This deletes the factory set codes and all previously programmed transmitter channels. This operation does not require to be repeated for the other programming buttons.
2. Press the Home Link button which is to be programmed until the LED begins to flash slowly. Then release the button. The control unit of the garage door opener will now remain in learning mode for 5 minutes.
3. Then hold the original transmitter in front of the vehicle, approx. 0-12″ (0-30 cm) from the radio module (see learning position). Depending on the original system concerned, it may be necessary to carry out several attempts at different distances. Each attempted learning position should be maintained for at least 15 to a maximum of 45 seconds before trying out another position.
4. Successful completion of the learning process is indicated by three flashes of the fog lights, signaling the end of the learning procedure.
5. The fog lights will light up once if the five minute period for learning mode is exceeded.

Repeat steps 2 to 4 to program other buttons.

Alternating Code Programming

Check whether the garage or gate drive (or another system) is equipped with an alternating code system.

The following must be noted in this connection:

1. Refer to the instruction manual for the garage door drive.
2. The hand-held transmitter appears to have completed the learning process correctly, but does not activate the garage door.
3. Press and hold the Home Link button which has been programmed with the original transmitter. In the case of an alternating code system, the Home Link LED will flash rapidly for 2 seconds and then remain constantly lit for 3 seconds. This pattern is repeated for a maximum of 20 seconds.
4. If the integrated garage door opener has been programmed with an alternating code system, after programming it must be synchronized with this system before it will work properly.

Alternating Code Synchronization

The vehicle must be within radio range of the garage door drive, with ignition on.

1. Locate the setting button of the garage door drive. The precise location and color of the button may vary according to manufacturer (see operating instructions for the garage door drive: “Teaching additional hand-held transmitters”).
2. Press the setting button of the garage door drive (note: after step 2, step 3 must normally be started within 30 seconds).
3. Press and release the previously programmed Home Link button. It may be necessary to press the programmed Home Link button several times in order to end the synchronization process. This is dependent on the type of garage door system and must be ascertained by referring to the operating instructions for the garage door drive.

Home Link should now have learned the complete alternating code system and it should be possible to operate the garage door drive via Home Link.

Deleting Channels

Individual channels can only be reprogrammed individually, they cannot be deleted individually. The three programmed channels can be jointly deleted as follows: Press the 2 outermost buttons (button 1 and 3) on the keypad simultaneously and hold for 20 seconds until the indicator light begins to flash rapidly. Then release both buttons within 10 seconds. The Home Link channels are now deleted.

Reprogramming An Individual Channel

In order to program a different remote controlled system on a currently assigned Home Link button, proceed as follows. The existing programming for this button will be lost as a result.

1. Press the button to be programmed. The indicator light will either flash rapidly for 2 seconds and then light up in continuous mode for 3 seconds (alternating code system), or it will light up in continuous mode from the outset. After 20 seconds the LED will begin to flash slowly. Then release the button. The garage door opener system will now remain in learning mode for 5 minutes.
2. Continue the procedure as described above (fixed code programming/alternating code programming).

The previous programming will then be deleted and the newly programmed device can be operated.

Note:
A list of all Home Link compatible hand-held transmitters are available on the following website:

www.homelink.com

Home Link is a registered trademark of Johnson Controls.

Notes:

Seat Memory (optional)



In conjunction with an electrically adjustable seat, the seat memory (programmable seat adjustment) enables individual setting of the seat position and the two door mirrors. The ideal settings can be stored and subsequently retrieved via the station preset buttons. 8 individual positions can be stored and called up via 2 person buttons and 6 remote control keys. The positions of the seat motors are determined by way of Hall sensors. There is also a controlled output, whose current is monitored. This output remains active as long as the seat memory controller is alert. An internal self-diagnosis facility monitors the system functions and stores any errors in a non-volatile memory.

Note:
Adjustment of the seat position and the two door mirrors via the seat memory preset buttons is only possible at a speed of up to 4 mph (7 km/h).

The following seat motors can be actuated:

- Fore and aft adjustment
- Backrest adjustment
- Top lumbar support
- Bottom lumbar support
- Seat height, front
- Seat height, rear

Diagnosis

Diagnosis is carried out with the PIWIS Tester. Some functional features of the vehicle electrical system are restricted or disabled in production and transportation mode.

Notes:

Audio and Communication – Boxster/S (987)

Basic Scope of Equipment, CDR 24 CD Radio with Sound System



The Boxster/S (987) line is equipped with the new CDR 24 CD radio as standard equipment. This radio has the same technical features as the previous CDR 23 CD radio, but now has a considerably larger control panel which provides for markedly improved clarity and operation. In addition, the radio comes in the standard white interior lighting color, which enhances the appearance substantially. All the previous features, such as double tuner, 30 presets (20 FM, 10 MW, plus 9 for Autostore), background traffic station, high-end CD drive etc., have been retained from the previous Boxster/S (986) models.

The new interior has enabled new, higher quality speakers are installed on the dashboard, while the doors each house one 165 mm low frequency speaker, ensuring an excellent sound even in the basic version.

Sound Package Plus (optional)

The Porsche Sound Package Plus is available as the first upgrade option for the new Boxster/S (987). With it's 7 speakers and external analog amplifier, it offers a superior sound experience and plentiful sound reserves for all driving conditions. This is ensured by using large, superior quality loudspeakers.

The following loudspeakers are used:

Speakers

Dashboard:	2 x 19 mm high-frequency speakers
	1 x 70 mm mid-frequency speaker (center speaker)
Door:	2 x 100 mm mid-frequency speakers
	2 x 200 mm low-frequency speakers

The tweeters and mid-frequency speakers are powered by the 2 x 25 W power amplifier integrated in the CDR 24 CD radio. An external analog amplifier which is accommodated in the luggage compartment powers the low-frequency speakers (2 x 70 W) and the center speaker (40 W). Extensive tuning work has been carried out on the amplifiers to adapt them to the Boxster's specific interior acoustics.



BOSE Surround Sound System (optional) **–** Boxster/S (987)



The BOSE Surround Sound system represents a completely new development which writes another page in the history of BOSE sound systems in Porsche vehicles. A surround sound system is available for the first time as an option in the Boxster. Eleven speakers and a 7-channel digital amplifier integrated in the digital MOST bus ensure a sound experience never before experienced in the Boxster segment.

The BOSE Surround Sound system, the second upgrade option for the Boxster, incorporates the following components:

The following speakers are used:

Speakers

Dashboard:	2 x 25 mm neodymium high-frequency speakers
	1 x 70 mm neodymium mid-frequency speakers
Door:	2 x 80 mm neodymium mid-frequency speakers
	2 x 200 mm neodymium low-frequency speakers
Subwoofer on engine cover:	2 x 64 mm wide-band speakers
	2 x 130 mm low-frequency speakers

Audio Electronics

- 7-channel MOST digital amplifier with 5x25 W linear amplifiers for tweeters and mid-frequency speakers and 1x100 W switching amplifiers for the low-frequency speakers.
- Additionally 1x100 W switching amplifier integrated in the active subwoofer.
- External microphone (housed in the steering column cover) for detecting background noise in the passenger compartment

Signal Processing

- Center fill and surround stage
- Centerpoint signal processing technology
- Active electronic equalization
- Dynamic loudness function
- BOSE AudioPilot

Functionality

The following settings are to be carried out in the sound menu of the PCM:

- Adjustment of the sound using base and treble setting
- Adjustment of the sound focus using fader and balance
- Activation of AudioPilot
- Activation of Surround Sound (BOSE Centerpoint technology)
- Fine adjustment of 3-D impression when Surround Sound is active.
- Setting of the listening position in stereo mode (left, symmetrical, right)

Center Fill and Surround Stage

The additional center fill speaker in the center of the dashboard is activated using data from the left- and right-hand channel via a special signal processing system (surround stage). This ensures an optimum and balanced sound for all passengers.

Centerpoint Signal Processing Technology

The Centerpoint system is a surround decoder specially developed for the limited auditory environment in vehicles. The algorithm used by this proprietary BOSE technology delivers an exclusive sound experience with exhilarating Surround Sound pleasure. The technology also converts

conventional audio sources such as CDs, or even stereo recordings, into five separate audio channels.

Active Electronic Equalization

In order to achieve a high fidelity sound experience, BOSE active electronic equalization exactly adapts acoustic reproduction to the specific acoustics of the vehicle interior. The reproduction of all frequencies is adapted so as to ensure that all passengers enjoy the same superior sound quality, regardless of where they are sitting.

Dynamic Loudness Function

The dynamic loudness function enables the bass tones to be amplified at low volume levels. This compensates for the reduced sensitivity of the human sense of hearing in the bass range. This process functions much more precisely than conventional loudness control systems. The base tones are amplified in such a way that there is no audible change.

BOSE AudioPilot

The AudioPilot automatically controls the sound and volume as a function of background noises in the passenger compartment such as wind, tire noise and conversation. This function thus ensures a constant sound experience in all driving conditions, which means that the driver does not have to continuously readjust the sound. The background noises are picked up by a special microphone in the steering column cover and processed. A considerable improvement in comparison with the system in the previous model has been achieved through the use of additional information (speed, etc.) in the control algorithm. As a result, the volume control is now much more robust and almost all unwanted fluctuations in volume have been eliminated.

Surround Sound (BOSE Centerpoint Technology)

BOSE Automotive Surround Sound can be switched on at the touch of a button. This system uses additional independent audio channels in the front and rear of the vehicle to produce a lifelike and high-fidelity 360° sound experience. The BOSE patented signal processing system increases the stereo sound of stereo recordings. This results in a much more refined sound experience. The intensity of the surround effect can be precisely set in the Sound Set menu (from -12 to +9).

CD Autochanger (optional)

The CDC 4 CD autochanger module has been adopted from the previous Boxster/S (986) model. The Boxster is equipped with a CD autochanger preparation, comprising a prelaid fiber optic cable (MOST) and a cable for the power supply in the luggage compartment as standard so that a CD autochanger can be easily retrofitted.

Porsche Communication Management (PCM)

The PCM has been given a facelift to fit in with the overall design of the new interior and features white LED lighting with one-touch buttons. The navigation system is no longer available as an additional module in the PCM and has been removed from its location. As a result of removal of the two modules, it is possible to design the PCM CD drive purely as an audio CD drive. This means that the driver no longer has to make the tedious switch between audio and navigation CDs.

Various functions of PCM are supported by the new, optional multi-function steering wheel. Among other things, this multi-function steering wheel has a screen key that can be assigned different PCM functions. These functions are programmed in the Set menu of PCM.

Navigation (optional)

The navigation module has also been thoroughly revised in the course of development of the new PCM. The new navigation module includes a DVD navigation drive in the luggage compartment. As it is now possible to incorporate all the necessary data on one DVD, DVD navigation now enables navigation guidance throughout an entire continent for the first time (e.g. western Europe or USA/Canada). The high storage density of the DVD means that the full digitization depth of the underlying map can now be accessed. The DVD drive has much faster data access times than the CD drive. This allows for faster identification of navigation routes and faster map refresh rates. Furthermore the digital map has considerably more zoom levels for greater magnification of the map material.

Audio and Communication – Cayman/S (987)

Basic Scope of Equipment, CDR 24 CD Radio with Sound System



The Cayman/S is equipped with the CDR-24 CD-radio as standard. This unit has been in use in the new Boxster line since M.Y. 2005, offering features such as a double tuner, 30 presets (20 FM, 10 AM, plus 9 for Autostore), background traffic information and a high-end CD drive.

The interior offers the necessary scope for installing high-quality loudspeakers. The dashboard contains two tweeters, while each of the doors houses a 165 mm low-range loudspeaker that delivers excellent sound even in the basic version.

Sound Package Plus (option)

The Porsche Sound Package Plus is available as the first upgrade option in the Cayman/S. With its nine loudspeakers and external analog amplifier, it offers a superior sound experience and plentiful sound reserves for all driving conditions. This is ensured by using large, superior-quality loudspeakers.

The following loudspeakers are used:

Speakers

Dashboard:	2 x 19 mm high-frequency speakers
	1 x 70 mm mid-frequency speaker (center speaker)
Door:	2 x 100 mm mid-frequency speakers
	2 x 200 mm low-frequency speakers
Rear Sides	2 x 100 mm mid-frequency speakers

The tweeters and mid-range loudspeakers are powered by the 2 x 25 W power amplifier integrated in the CDR-24 CD-radio. An additional, external analog amplifier which is accommodated in the luggage compartment powers the low-range loudspeakers (2 x 70 W) and the center speaker (40 W).



Extensive tuning work has been carried out on the amplifiers to adapt them to the specific interior acoustics of the Cayman/S.

BOSE Surround Sound System (option)

The newly developed BOSE® Surround Sound System from the new sports car lines is also available for the new Cayman/S. 10 loudspeakers and a 7-channel digital amplifier designed in accordance with the vehicle's specific acoustics and integrated into the digital MOST bus provide for a perfect audio experience.



The BOSE® Surround Sound system incorporates the following components:

Loudspeakers

- Dashboard – 2 x 25 mm neodym tweeters (“soft-dome spherical cap”),
  1 x 70 mm neodym mid-range loudspeaker (center speaker)
- Door – 2 x 80 mm neodym mid-range loudspeaker, 2 x 200 mm Nd®
  low-range loudspeakers
- Rear sides – 2 x 80 mm neodym mid-range loud-speakers
- Subwoofer in separate housing in footwell, one 102 x 153 mm low-range loudspeaker

Audio Electronics

- 7-channel MOST digital amplifier with 5 x 25 W linear amplifiers for tweeters and mid-range loudspeakers and 1 x 100 W switching amplifier for the low-range loud-speakers.
- Additionally one 100 W switching amplifier in the active subwoofer.
- External microphone (housed in the steering column cover) for detecting background noise in the passenger compartment. A detailed description of the mode of functioning and the control functions is to be found in the Service Information Technik on the 911 Carrera/S (997) and Boxster/S (987).

CD Autochanger (option)

A CD autochanger is optionally available for installation in the front luggage compartment. Each vehicle is equipped with CD autochanger preparation as standard. This consists of an optical waveguide (MOST) and a cable for the power supply so that a CD autochanger can be easily retrofitted.

Integrated Antenna System

The Cayman/S has an effective window antenna system. Antenna diversity forms part of the optional PCM package. The antennas are housed in the windshield and improve FM reception in the event of interference, for example when slowly driving up to traffic lights.

Note:
The system is not designed to receive AM since the switchover of the antennas would result in audible interference. In order to optimize AM reception, an external antenna is available as an option at no extra charge. This antenna is mounted to the right front fender.

Porsche Communication Management (PCM)

The PCM system available in the Cayman/S is based on the updated version “PCM 2.1 Model Level B”, which has also been installed in the Boxster/S (987), 911 Carrera/S and 911 Cabriolet (997) since April 15, 2005. The separate USA version of the PCM Head Unit is no longer necessary because of the changeover to a triband phone module. This means that a world-wide Head Unit is now available.

Basic information on the PCM can be found in the Service Information Technik for the 911 Carrera/S (997) and the Boxster/S (987).

The following functions have been implemented in the areas of audio, telephone and navigation:

Audio - Playback facility for compressed MP3 audio data (including WMA) in the PCM's single disk drive.

The quality of reproduction via the audio system is known to be generally dependent on the compression process employed in converting the music source into MP3 files.

In order to attain very high audio quality, the CDs containing MP3 files need to be compressed at 128 kbps at the minimum.

- The drive is operated in the same manner as the CD autochanger.
- The title selection function has been increased to 3 digits on account of the MP3 functionality and the attendant high memory capacity.
- Broadening of the displayed scope of CD info for CD text and MP3.

Telephone – Improved Mute Function

Similar to before, telephone conversations, voice output of the navigation system and traffic information remain audible when the mute function is active. The mute function for audio playback will not be cancelled if the volume is turned up during output of navigation instructions or traffic information.

Navigation

- Overall optimization of the navigation system's precision with regard to vehicle location, route calculation, route guidance strategy and calculation of arrival time.
- The arrival time and distance from the destination are now also displayed when the user zooms in on junctions.
- When a turn-off is imminent, the name of the next road into which the driver needs to turn is indicated on the map.
- Entry of destinations (towns) in the navigation system is possible by way of zip codes (post codes).

The navigation DVDs supplied with the vehicles contain the latest data from 2004:

- USA with Canada and Mexico, now with major expansion of the digitized road network from 2.2 to 3.6 million miles to (3.5 million km to 5.8 million km) with the inclusion of roads whose properties are not defined in full. On-road navigation is possible for the first time in these areas, which are mostly located in rural areas. These roads are displayed on the maps in brown.

Notes:

Audio and Communications – 911 Carrera/S (997)

Basic Equipment, Porsche Communication Management (PCM) including Sound Package Plus



Porsche Communication Management (PCM) is standard in the 911 Carrera/S (997). It has been given a facelift to fit in with the overall design of the new interior and features white LED lighting with one-touch buttons. The navigation system is no longer available as an additional module in the PCM and has been removed from its location. As a result of removal of the two modules, it is possible to design the PCM CD drive purely as an audio CD drive. This means that the driver no longer has to make the tedious switch between audio and navigation CDs.

Various functions of PCM are supported by the new, optional multi-function steering wheel. Among other things, this multi-function steering wheel has a screen key that can be assigned different PCM functions. These functions are programmed in the Set menu of PCM.

Also standard in the new 911 Carrera/S (997) is Porsche Sound Package Plus. With its 9 loudspeakers and external analog amplifier, it offers a superb sound experience and plentiful sound reserves for all driving conditions. This is further reinforced by a considerably larger loudspeaker grilles.

The following loudspeakers are used:

Speakers

Dashboard:	2 x 19 mm high-frequency loudspeakers
	1 x 70 mm mid-frequency loudspeaker
Door:	2 x 100 mm mid-frequency loudspeakers
	2 x 200 mm low-frequency speakers
Rear:	2 x 100 mm mid-range loudspeakers

The loudspeakers are powered by a 4x25 watt amplifier integrated in PCM as well as an external analog amplifier accommodated in the luggage compartment. The external amplifier supplies the power for the low-frequency loud-speakers (2 x 70 watts) and the mid-frequency loud-speakers in the dashboard (40 watts). Filter stages in the analog amplifiers match the audio characteristics to the special interior acoustics of the 911 Carrera/S (997).

The following sound settings must be made in the sound menu of the PCM:

- Adjustment of the sound using base and treble setting
- Adjustment of the sound focus using fader and balance
- The loudness function serves to boost base and treble at low volumes
- The GAL function incorporates a speed-adapted volume control facility. Precision setting of this facility from 1 to 7 is possible in the Sound Set menu.

CD Autochanger (optional)

The CDC-4 CD autochanger module has been carried over from the 911 Carrera (996) model. The 911 Carrera/S (997) is equipped with CD autochanger preparation, comprising a prelaid fiber optic cable (MOST) and a cable for the power supply in the luggage compartment as standard equipment. This allows for easier CD autochanger installationlater on.

Navigation (optional)

The navigation module has also been thoroughly revised in the course of development of the new PCM. The new navigation module includes a DVD navigation drive in the luggage compartment. As it is now possible to incorporate all the necessary data on one DVD, DV navigation now enables navigation guidance throughout an entire continent for the first time (e.g. western Europe or USA/Canada). The high storage density of the DVD means that the full digitization depth of the underlying map can now be accessed. The DVD drive has much faster data access times than the CD drive. This allows for faster identification of navigation routes and faster map refresh rates. Additionally, the digital map has considerably more zoom levels for greater magnification of the map material.

BOSE Surround Sound System (optional) **–**
911 Carrera/S (997)



The completely re-engineered digital BOSE Surround Sound system writes another page in the history of BOSE Sound Systems in Porsche vehicles. This confirms the position of Porsche and BOSE as leaders in their respective industries. This is the first time that a Surround Sound system has been offered in a 911 Carrera. Thirteen loudspeakers and a 7-channel digital amplifier integrated in the digital MOST bus ensure a sound experience never before experienced in the sports car segment.

The BOSE Surround Sound system incorporates the following components:

Speakers

Dashboard	2 x 25 mm neodym high-frequency speakers ("soft-dome spherical cap") 1 x 70 mm neodym mid-frequency loudspeaker
Door	2 x 80 mm neodym mid-frequency loudspeaker 2 x 200 mm neodym low-frequency loudspeakers
Rear	2 x 25 mm neodym high-frequency speakers ("soft-dome spherical cap") 2 x 80 mm neodym mid-frequency loudspeakers
Rear Shelf	1 x Active subwoofer with 2x 130 mm low-frequency loudspeakers (bass reflex system)

Audio Electronics

- 7-channel MOST digital amplifier with 5x25 watt linear amplifiers and 1x100 watt switching amplifier
- Additionally 1x100 watt switching amplifier integrated in the active subwoofer
- External microphone (housed in the steering column cover) for detecting background noise in the passenger compartment

Signal Processing

- Center fill and surround stage
- Centerpoint signal processing technology
- Active electronic equalisation
- Dynamic loudness function
- BOSE AudioPilot

Functionality

The following settings must be made in the sound menu of the PCM:

- Adjustment of the sound using base and treble setting
- Adjustment of the sound focus using fader and balance
- Activation of AudioPilot
- Activation of Surround Sound (BOSE Centerpoint technology)

Center Fill and Surround Stage

The additional center fill loudspeaker in the center of the dashboard is activated using data from the left- and right-hand channel via a special signal processing system (surround stage). This ensures an optimum and balanced sound for all passengers.

Centerpoint Signal Processing Technology

The Centerpoint system is a surround decoder specially developed for the limited auditory environment in vehicles. The algorithm used by this proprietary BOSE technology delivers an exclusive sound experience with exhilarating Surround Sound pleasure. The technology also converts conventional audio sources such as CDs, or even stereo recordings, into five separate audio channels.

Active Electronic Equalization

In order to achieve a high-fidelity sound experience, BOSE active electronic equalization exactly adapts acoustic reproduction to the specific acoustics of the vehicle interior. The reproduction of all frequencies is adapted so as to ensure that all passengers enjoy the same superior sound quality, regardless of where they are sitting.

Dynamic Loudness Function

The dynamic loudness function enables the bass tones to be amplified at low volume levels. This compensates for the reduced sensitivity of the human sense of hearing in the bass range. This process functions much more precisely than conventional loudness control systems. The base tones are amplified in such a way that there is no audible change.

BOSE AudioPilot

The AudioPilot automatically controls the sound and volume as a function of background noises in the passenger compartment such as wind, tire noise and conversation. This functionality ensures a constant acoustic impact in all driving conditions, which means that the driver does not have to continuously re-adjust the sound. The background noises are recorded by a special microphone in the steering column cover and processed. A considerable improvement in comparison with the system in the previous 911 Carrera (996) model has been achieved through the use of additional information (speed, etc.) in the control algorithm. As a result, the volume control is now much more robust and almost all unwanted fluctuations in volume have been eliminated.

Surround Sound (BOSE Centerpoint Technology)

BOSE Automotive Surround Sound can be switched on at the touch of a button. This system uses additional independent audio channels in the front and rear of the vehicle to produce a lifelike and high-fidelity 360° sound experience. The BOSE patented signal processing system increases the stereo sound of stereo recordings. This results in a much more refined sound experience. The intensity of the surround effect can be precisely set in the Sound-Set menu (from -12 to +9).

Notes:

Sport Chrono Plus Package With Performance Display, Individual Memory and Stopwatch (optional) **–** 911 Carrera (997) & Boxster/Cayman (987)



The engine, transmission and chassis functions of the Sport Chrono package are intended to enable faster lap times (e.g. on the Northern Loop of the Nürburgring) and to provide the driver with an even sportier feel behind the wheel.

The Sport Chrono Plus package incorporates the following functions:

1. Stopwatch
2. Sport button/Sport mode
   For intervention in functions of Motronic, transmission control system, PSM, PASM*
   * **P**orsche **A**ctive **S**uspension **M**anagement
3. PCM performance display (only with Sport Chrono Plus package in conjunction with PCM from M.Y. 05).

Stopwatch

- Indicates that the vehicle is equipped with the Sport Chrono package.
- Stopwatch hinged for horizontal adjustment, in driver's and/or front passenger's line of vision
- A digital stopwatch in the instrument cluster runs in parallel with the stopwatch, also indicating intermediate times
- Shows the measured hours, minutes and seconds in analog form
- Shows the measured seconds, tenths and hundredths of seconds in digital form

Sport Button/Sport Mode

After pressing the Sport button, Sport mode is indicated by a symbol on the middle display of the instrument cluster.





Notes:

Activation of the stopwatch function in the instrument cluster:



The stopwatch functions are accessed by selecting the combined main menu.

Start stopwatch by **pressing** steering column stalk.

The analog stopwatch runs. Instrument cluster displays the time in the primary display field. The time can be stopped by pressing.

A stopped time can be resumed or reset to zero by pressing.

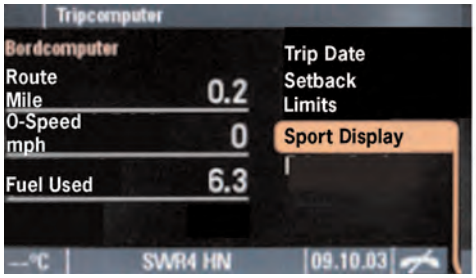
Press 1x to take an intermediate time.

Press again within 5 seconds to store the lap time (for PCM evaluation).

PCM Performance Display (Operating concept)

In addition to operation of the stopwatch via the instrument cluster and stalk control, the PCM can also be used as an additional information system. The performance display and the stopwatch can be used to record the fastest lap times or route times and archive them for subsequent analysis. They also allow the driver to race against a stored fastest reference lap.

In order to use the additional PCM functions, the corresponding software module is accessed under menu option "Sport display" in the "Trip" main menu.





Functions

Users can record racing laps and call up the following information on each lap:

a - How fast their fastest lap was and the current lap time.

b - Whether they are faster than, equally as fast as or slower than their fastest lap (orange, yellow green).

c - The number of laps drive.

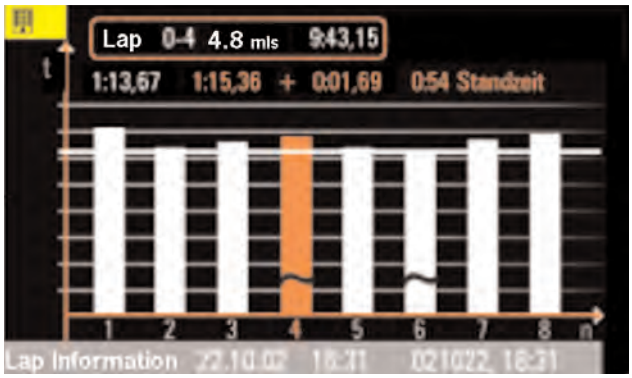
d - What percentage of the current lap they have covered (100 % = full lap).

e - How many more laps can be driven on the remaining fuel.



Electrics

Users can also use these functions for any route (e.g. the drive to work), treating the route concerned as a lap. Each recording can be stored to enable the data to be viewed again at a later juncture. The "Evaluation" function is available for this purpose.



Additional Sub-functions



- Recording of any section of a route.
- Definition of a reference lap.
- Display of the fastest lap time.
- Display of the current lap time.
- Display of the distance travelled in relation to the reference lap.
- Time comparison between reference and current lap by means of color indication (orange, yellow, green).
- Display of the remaining range in terms of miles and number of laps.
- Display of an evaluation of the recorded trip.
- Storage of recordings and reference laps

Recording Procedure

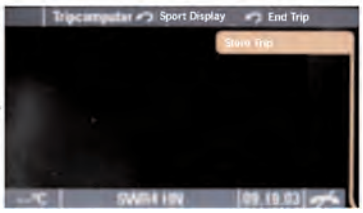
Begin Drive



The recording is started by starting the stopwatch.



The recording is ended by stopping the stopwatch.



Afterwards the drive can be stored or immediately reviewed.



The recording is started by starting the stopwatch.



The recording is ended by stopping the stopwatch.



Afterwards the drive can be stored or immediately reviewed.

Mode Of Use For The Performance Display

Definition

The reference is a lap which serves as the benchmark for all remaining laps to be driven. On the basis of this reference, the system knows how long a lap is and how fast this lap has been driven. This means that it is possible to compare the time for the current lap and the percentage of the lap distance covered so far while driving.

Generating A Reference

A lap from any stored race can be extracted from the trip memory as the "reference lap". This lap can be stored under a name and is then available in the reference memory.

Selecting The Reference

In the reference memory the user can select from a list of all stored reference laps. The data is then displayed under "Current reference lap" in the main menu of the sport display. This reference is adopted as the fastest lap for each "new trip". The driver thus drives "against" the reference.

Resetting The Reference

The menu option "Reset ref." is to be found in the main menu of the sport display. This enables the user to reset the current reference to zero. When no reference is selected for a new trip, the system defines the first lap as the reference, so as to enable the times for all subsequent laps to be compared with one another. After resetting the reference, the first lap of a new trip is again determined as the reference.

PCM Individual Memory

The individual memory allows extended vehicle settings to be made via PCM. These settings are individually assigned to the respective ignition key. Each time the key is inserted in the ignition lock, the stored settings are automatically activated via PCM.

The following settings are available:

- Daytime running lights on/off
- Afterglow time adjustable from 10 s to 120 s
- Automatic climate control: Save basic setting (e.g. 73° F. fan set to maximum output and defrost on)
- Unlocking opens all doors or just the driver's door
- Autolock: off, on upon ignition or active after moving off

All settings are accessible via "Set" in the "Individual memory" menu.

Notes:

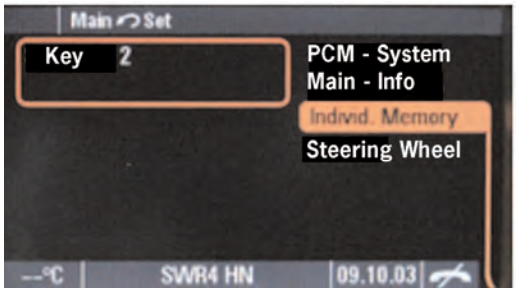
PCM Individual Memory

The individual memory allows extended vehicle settings to be made via PCM. These settings are individually assigned to the respective ignition key. Each time the key is inserted in the ignition lock, the stored settings are automatically activated via PCM.

The following settings are available:

- Daytime running lights on/off
- Afterglow time adjustable from 10 s to 120 s
- Automatic climate control: Save basic setting (e.g. 73° F. fan set to maximum output and defrost on)
- Unlocking opens all doors or just the driver's door
- Autolock: off, on upon ignition or active after moving off

All settings are accessible via "Set" in the "Individual memory" menu.





Notes:

PORSCHE

Maintenance Schedule – 911 Carrera (996), 911 Turbo (996), Boxster (986) (USA/Canadian Vehicles Only)

Required Maintenance and Lubrication Service – See Technical Manual, Binder 0, Section 03 - Maintenance

Yearly maintenance intended for vehicles driven less than 9000 miles per year.

No oil change is required for this service. However, an oil and filter change is required at least every 2 years for vehicles not receiving a scheduled major maintenance. Yearly maintenance for vehicles driven more than 9000 miles per year, wait and perform the 15,000 mile maintenance at the scheduled mileage interval.

- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Power-assisted steering: Check fluid level
- ❑ Engine: Check oil level
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ☑ Vehicle lights: Check operation. All headlights: Check alignment
- ☑ Horn: Check operation
- ☑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ☑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Minor maintenance at 15 000, 45 000, 75 000, 105 000 miles etc. / 24 000, 72 000, 120 000, 168 000 km etc.

- ❑ Change engine oil: (oil filter change is not required)
- ❑ Air Filter: Check the air filter condition, and if necessary, replace
- ☑ Diagnosis system: Read out fault memory
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Power-assisted steering: Check fluid level
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze protection level
- ❑ Pollen filter: Replace filter element
- ❑ Brake hoses and lines: Visual inspection for signs of damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Check inner release of front luggage compartment on 2002-on vehicles ('03-on Boxster). See Technical Manual, Section 03-5.1.
- ☑ Vehicle lights: Check operation
- ☑ All headlights: Check alignment
- ☑ Horn: Check operation
- ☑ Windshield washer, headlight washer: Check fluid level, nozzle settings, and antifreeze protection level
- ☑ All other electrical equipment as well as indicator and warning lights: Check operation

During road or dynamometer test:

- ☑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc.

- ❑ Change engine oil and oil filter
- ❑ Replace spark plugs: **Only On** 911 (996) and Boxster up to 2000 and 911 Turbo 2001 (For 2001 911 (996) and Boxster, see 60 000 mile schedule)
- ❑ Air filter: Replace filter element

© Porsche Cars North America, Inc., Porsche Publications – Edition 2-06

Part Number – PNA 000 162 B

Major maintenance at 30 000, 60 000, 90 000, 120 000 miles etc. / 48 000, 96 000, 144 000, 192 000 km etc. (Cont'd)

- ☑ Diagnosis system: Read out fault memory
- ❑ Polyrib belt: Check condition
- ☑ Underside of vehicle & engine compartment: Visual inspection for leaks (oils & fluids) & chafing (wires, lines & hoses) Check that the underbody paneling is securely fastened – replace any damaged and/or missing panels
- ❑ Coolant hoses: Check condition. Radiators and air inlets: Visual inspection for external debris and blockage
- ❑ Coolant: Check level and antifreeze
- ❑ Pollen filter: Replace filter element
- ❑ Fuel system: Visual inspection for damage, correct routing and firm seating of the line connections
- ❑ Power-assisted steering: Check fluid level
- ❑ Parking brake: Check free play of the parking brake lever
- ❑ Brake system: Visual inspection of the brake pads and brake discs for signs of wear
- ❑ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion
- ❑ Brake fluid: Check level
- ❑ Clutch: Check play or final position of pedal
- ❑ Throttle actuation: Check smoothness of operation, full-throttle position with the tester
- ❑ Steering gear: Visual inspection of the bellows for signs of damage
- ❑ Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play, visual inspection of the dust boots for signs of damage
- ❑ Check tightness on the front and rear suspension adjustment points
- ❑ Drive shafts: Visual inspection of the boots for leaks and signs of damage
- ❑ Exhaust system: Visual inspection for leaks and signs of damage, check mounts
- ❑ Tires and spare wheel: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Door locks, lid locks & safety hook of the front lid: Check to ensure that they are adjusted and function properly
- ❑ Seat belts: Check operation and condition
- ☑ Vehicle lights: Check operation. All headlights: Check alignment
- ☑ Horn: Check operation
- ☑ Windshield washer, headlight washer: Check fluid level & nozzle settings, make sure to check the antifreeze during winter months
- ☑ All other electrical equipment as well as indicator and warning lights: Check operation

---

During road or dynamometer test:

- ☑ Remote control, front seats, foot brake & parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, TC/PSM switches, heater, air-conditioning system & instruments: Check operation
- ☑ Oils, fluids: Visual inspection for leaks

Additional maintenance every 60 000 miles / 96 000 km

- ❑ Replace spark plugs: 2001 911 (996) and Boxster (earlier 911 (996), Boxster and Turbo see 30 000 mile schedule)
- ❑ Replace Polyrib belt
- ❑ Fuel Filter: Replace filter

Additional maintenance every 90 000 miles / 144 000 km

- ❑ Manual transmission: Change oil
- ❑ Automatic transmission: Change ATF and ATF-filter
- ❑ Differential: Change oil (includes front differential if equipped)

Maintenance every 2 years

- ❑ Change brake fluid (only use Genuine Porsche Brake Fluid)
- ❑ Change engine oil and filter (on low mileage vehicle that have not received a scheduled major maintenance)

Maintenance after 4, 8 and 10 years, thereafter every 2 years

- ❑ Check airbag system
- ❑ Check rollover protection system (if equipped)

Scheduled maintenance points

The terms "inspect" and "check" include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Customer Name: _____ **VIN:** _____

Dealer Name: _____ **Dealer Code:** _____

Date: _____ **Mileage/Kilometers:** _____ **Repair Order #:** _____

Technician Name: _____ **Technician Signature:** _____
(Print)

© Porsche Cars North America, Inc., Porsche Publications – Edition 2/06

Part Number – PNA 000 162 B

PORSCHE

Minor Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Minor Maintenance** (Labor Operation 03 24 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, minor maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

☑ Diagnosis system: Read fault memory / Read and record range information on R.O.

❑ Change engine oil and oil filter

☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage

❑ Coolant hoses: Check condition
Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze

❑ Pollen filter: Replace filter element

❑ Brake system: Visual inspection of the brake pads and brake discs for wear

❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion

❑ Drive shafts: Visual inspection of the dust boots for leaks and damage

❑ Tires: Check condition and tire pressure

❑ Check firewall and cabrio section body drains for debris

❑ Check the door, lid locks and safety hook of the front lid for secure seating and function

☑ Vehicle lighting: Check function
All headlights: Check setting

☑ Horn: Check function

☑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)

☑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

❑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

❑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

❑ Replace drive belt
❑ Replace fuel filter (Turbo only)
❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

❑ Change manual transmission oil
❑ Change Tiptronic transmission oil and ATF filter
❑ Change Tiptronic transmission final drive oil
❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

❑ Change brake fluid
❑ File Condition Report for Long-life guarantee
❑ Check roll-over protection system (911 Cabriolet only)

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EA

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

☑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ **Date:** ____/____/____

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EA

PORSCHE

Major Maintenance Checklist – 911 Carrera (997), 911 Turbo (997) & Boxster/Cayman (987)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only, Not For 911 GT3 (997), use separate checklist)

❑ **Major Maintenance** (Labor Operation 03 26 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

- ☑ Diagnosis system: Read fault memory / Read and record range information on R.O.
- ❑ Change engine oil and oil filter
- ☑ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, installation and damage
- ❑ Coolant hoses: Check condition
  Radiators and air intakes: Visual inspection for external debris and blockage
  Coolant: Check level and antifreeze
- ❑ Air filter: Replace filter element
- ❑ Pollen filter: Replace filter element
- ❑ Fuel lines and connections: Visual inspection for damage and leaks
- ❑ Brake system: Visual inspection of the brake pads and brake discs for wear
- ❑ Parking brake: Check free play of parking brake lever
- ❑ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ❑ Clutch: Check the pedal play and end position
- ❑ Steering gear: Visual inspection of the dust boots for damage
  Tie rod ends: Check play and dust boots
- ❑ Axle joints: Check play; visual inspection of the dust boots for damage. Check the screw connections of the front and rear running gear adjustment points are secure
- ❑ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ❑ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ❑ Tires: Check condition and tire pressure
- ❑ Check firewall and cabrio section body drains for debris
- ❑ Check the door, lid locks and safety hook of the front lid for secure seating and function
- ❑ Vehicle lighting: Check function
  All headlights: Check setting
- ❑ Horn: Check function
- ☑ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ☑ Seat belts: Check function and condition
- ☑ Electrical equipment, warning and indicator lights: Check function

Additional maintenance for spark plugs Labor operation 03 81 00 .. (Except Turbo)

- ☑ Replace spark plugs every 60,000 miles (90,000 km) or every 4 years

Additional maintenance for spark plugs Labor operation 03 81 00 .. (911 Turbo (997 only)

- ☑ Replace spark plugs every 40,000 miles (60,000 km) or every 4 years

Additional maintenance for drive belt Labor operation 03 60 00 ..

- ❑ Check drive belt at 40,000 miles (60,000 km) or every 4 years
- ❑ Check drive belt at 100,000 miles (150,000 km) or every 10 years
- ❑ Check drive belt at 160,000 miles (240,000 km) or every 16 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years Labor operation 03 83 00 ..

- ❑ Replace drive belt
- ❑ Replace fuel filter (Turbo only)
- ❑ Change all-wheel drive controller oil – 911 Turbo (997) model only, not 911 Carrera 4/4S 4-wheel drive models

Additional maintenance every 120,000 miles (180,000 km) or 12 years

- ❑ Change manual transmission oil
- ❑ Change Tiptronic transmission oil and ATF filter
- ❑ Change Tiptronic transmission final drive oil
- ❑ Change front differential oil – 911 Carrera 4/4S & 911 Turbo (997) 4-wheel drive models only

Every 2 years

- ❑ Change brake fluid
- ❑ File Condition Report for Long-life guarantee
- ❑ Check roll-over protection system (911 Cabriolet only)

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EB

Every 4 years

❑ Replace tire sealant

After 4, then every 2 years

❑ Check battery for the tire pressure monitoring system

After 4, 8, 10, then every 2 years

❑ Inspect airbag system
❑ Unit mount: Visual inspection of all hydraulic mounts for damage

Inspection Performed - Technician Signature: _____

Road Test Check

☑ Remote control, seats, foot and parking brake (also actuation travel), engine, clutch, steering, transmission, rear spoiler, heating, air-conditioning system and instruments: Check function
☑ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Scheduled Maintenance Points

The terms “inspect” and “check” include all associated work such as checking the condition, adjustments, readjustments, corrections and replenishment. They do not include the repair, replacement or overhaul of components or assemblies. The maintenance points are valid for all vehicle types of the model line in question.

The recommended service intervals and scope of work apply under normal driving conditions and do not take into account all optional equipment. Dusty areas require more frequent checking and possible replacement of the air filter elements. The radiators and cooling air inlets in the front should be checked and cleaned regularly if the car is driven on very dirty roads. Tire, clutch and brake wear as well as the condition of the engine oil are all largely dependent on driving habits, and operating conditions. You should perform maintenance on these items more frequently under such operating conditions. Proper care and maintenance will preserve the value of your Porsche and safeguard its functional capability.

Note: If the mileage for scheduled maintenance is not reached, major maintenance must be pereformed no later than after 2, 6, 10..... years.

Customer Name: _____ **Date:** ___/___/___

VIN: WPO _____

Mileage (check one) ❑ **Miles** ❑ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

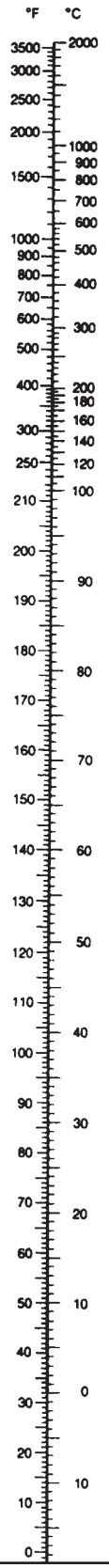
Technician Name: _____

Technician Signature: _____

© Porsche Cars North America, Inc., Edition 2/06 AfterSales Publications Part Number - PNA 000 162 EB

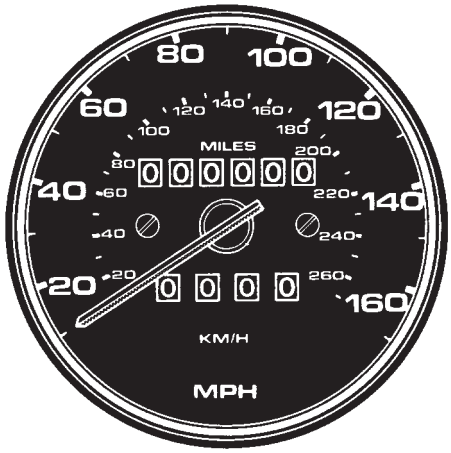
Notes:

Temperature Conversion



Metric Conversion Formulas

INCH	X	25.4	=	MM
MM	X	.0394	=	INCH
MILE	X	1.609	=	KILOMETER(KM)
KM(KILOMETER).	X	.621	=	MILE
OUNCE	X	28.35	=	GRAM
GRAM	X	.0352	=	OUNCE
POUND(lb).	X	.454	=	KILOGRAM(kg)
kg(KILOGRAM)	X	2.2046	=	lb(POUND)
CUBIC INCH	X	16.387	=	CUBIC CENTIMETER(cc)
cc(CUBIC CENTIMETER)	X	.061	=	CUBIC INCH
FOOTPOUND(ft lb).	X	1.3558	=	NEWTON METER(Nm)
Nm(NEWTON METER)	X	.7376	=	ft lb(FOOT POUND)
HORSEPOWER(SAE). . . .	X	.746	=	KILOWATT(Kw)
HORSEPOWER(DIN)	X	.9861	=	HORSEPOWER(SAE)
Kw(KILOWATT).	X	1.34	=	HORSEPOWER(SAE)
HORSEPOWER(SAE) . . .	X	1.014	=	HORSEPOWER(DIN)
MPG(MILES PER GALLON)	X	.4251	=	Km/l(KILOMETER PER LITER)
BAR.	X	14.5	=	POUND/SQ. INCH(PSI)
PSI(POUND SQUARE INCH)	X	.0689	=	BAR
GALLON.	X	3.7854	=	LITER
LITER.	X	.2642	=	GALLON
FAHRENHEIT	-	32÷1.8	=	CELSIUS
CELSIUS	X	1.8+32	=	FAHRENHEIT



Notes:



WE SUPPORT VOLUNTARY TECHNICIAN CERTIFICATION THROUGH

National Institute for

AUTOMOTIVE SERVICE EXCELLENCE