Testing engine output at exhaust emissions on the roller dynamometer
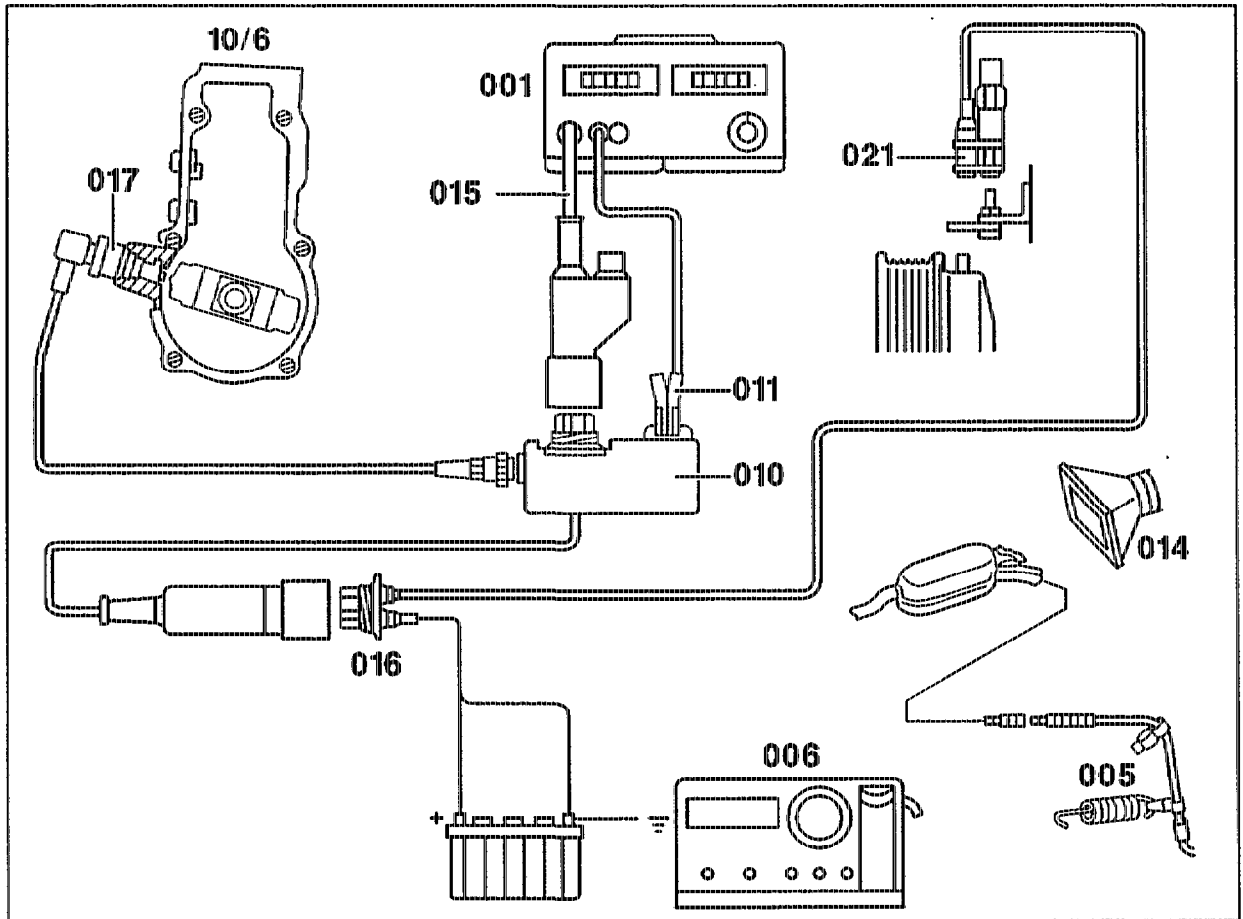
P07-6510-57

Connection diagram for testers with adapter

001	Digital tester	015	Test cable with connector
005	Exhaust probe	016	9-pin diagnostic socket at TDC pulse generator
006	Opacity analyzer		(021)
010	Adapter	017	RI generator
011	Trigger clamp	021	TDC pulse generator
014	Extraction device		

Fluid levels (engine oil, automatic transmission
fluid, coolant) . . . .   check, adjust to correct level.

Digital tester (001), TDC pulse generator (021)
and RI generator (017) . . . .   connect.

Front wheels . . . .   secure.
Place wheel chocks about 100 mm in front of
front wheels.

Inflation pressure of rear wheels	check, adjust to specified pressure.
Contents of trunk	check, remove any objects which are heavy or sensitive to heat.
Extraction device (014)	position behind exhaust pipe.
Air conditioner or automatic climate control	switch off.
Engine	warm up at part load, selector lever position "3" or third gear, approx. 25 kW, engine oil temperature about 80°C. Do not exceed 120°C.
Engine	cool with blower. Direct air flow onto radiator and underside of car (oil sump, exhaust, catalytic converter, tires). Maintain distance of about 1 m between blower and car.
Full load output	test (see table). Pay attention to barometer reading, coolant temperature and intake air temperature. Refer to notes regarding engine output tests.

⚠

Conduct full load test only for as long as
necessary for reading the instruments.

Test and adjustment data

Engine			605.911	606.910
Idle speed [rpm]	Pneumatic idle speed increase		650–750	–
	Electronic idle speed control		–	580–680
Output data [2]	Full load output [1] in kW at 4900 rpm	Manual transmiss. 3rd gear	62	76
		Automat. transmiss. position "3"	58	71
Exhaust opacity 1/m			< 1,6	

[1] The test data are minimum engine outputs.
[2] Speed in excess of 130 km/h; use shop test tires.

Special tools

603 589 00 21 00	617 589 09 21 00	617 589 10 21 00

126 589 11 63 00
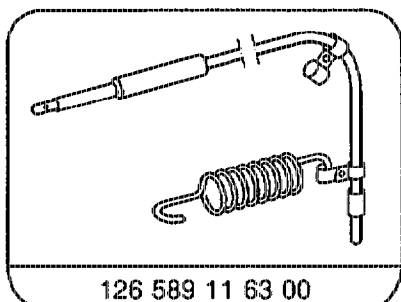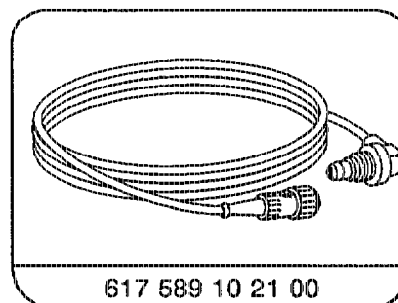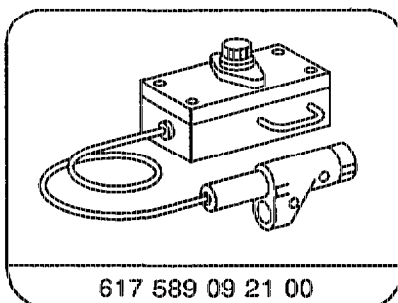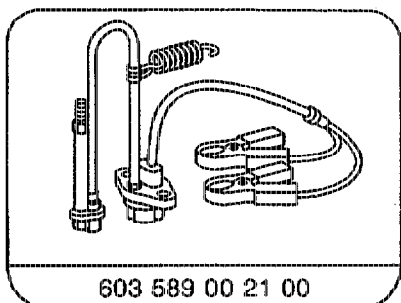
Commercially available tools and testers (see Workshop Equipment Manual)

Designation	e.g. Make, order no.
Opacity analyzer	Hermann DO 285 Electra Controll DST 200–DX Maha MDO 2

Use without adapter

Digital tester	Sun, DIT 9100 AVL, Diesel-Tester 873 Bosch, ETD 019.02

Use with adapter

Digital tester Engine diagnosis tester	Bosch, MOT 103, 002.02, 150, 250 Hermann D960, D980 Bear, DEACE

Instructions regarding engine output test on the roller dynamometer as well as output correction and driving instructions

Engine output test

This test should only be conducted if a complaint is received regarding engine output. The relevant output reference values are minimum outputs and apply to vehicles with power steering. Take into account barometer reading and intake air temperature (see annex). It is good practice to conduct an engine output test after a running-in period of about 5000–8000 km.

Driving instructions

It is essential to adhere to the following instructions in order to keep the tire stress within permissible limits.

1 Do not drive with winter tires on roller dynamometers. Only warming-up at part load is permissible.

2 Do not inflate the tires of the driving wheels of cars beyond the specified pressure (Owner's Manual).

3 A high axle load on the driven wheels is not permissible.

4 Restrict the driving period to the time absolutely necessary for reading the instruments (about 5 seconds for output test; about 20 seconds for exhaust opacity).

5 Do not exceed a speed of 130 km/h with original tires (120 km/h with SR tires). If the test speed is in excess of 130 km/h, use shop test tires.

6 Adhere to the test instructions and to the following sequence: warming-up - output test - exhaust test at full load, upper part load, lower part load - idle speed - exhaust opacity at idle speed. The full load test (output, exhaust opacity) should be conducted immediately after warming-up so long as the tire temperature is still low as the temperature rises most sharply during these measurements.
Two repeat measurements after adjustment work are permissible. Always maintain an interval (45 minutes) to allow the components to cool down before conducting further measurements.

Note

If the car is fitted with the catalytic converter, the test procedure must be interrupted immediately if combustion faults occur, otherwise damage may result to the catalytic converter.

7 Cool the vehicle with a blower (minimum capacity 15,000 m³/h). Direct the air flow to the radiator and the underside of the car (oil sump, exhaust, catalytic converter, tires). Maintain a distance of about 1 m between blower and car.

Note

The minimum air throughput of 15,000 m³/h is also adequate for cooling cars fitted with the catalytic converter.

Use of the correction table

General

The barometer of the weather station must be set to the atmospheric pressure as indicated by the local meteorological office.

The engine output measured must be corrected with the correction factors.
A distinction is made between 2 correction factors:
* altitude correction factor
* engine output correction factor

Determining engine output related to normal operating conditions

1   Take the readings of atmospheric pressure, altitude and intake air temperature of the test location on the weather station.

2   Determine engine output on the dynamometer.

3   Take the altitude figure of the test location in the altitude correction table and read off the altitude correction factor.

4   Atmospheric pressure figure of test location minus the altitude correction factor produces the atmospheric pressure (p) in hPa (mbar).

5   Take the calculated atmospheric pressure (p) in the engine output correction table to determine the output correction factor (K_H) on the basis of the intake air temperataure (t).

6   Take the engine output correction formula to determine engine output related to normal operating conditions as follows:

Engine output correction formula

$$Ne_o = Ne \times K_H$$

$Ne_o =$ output related to normal operating conditions in kW.

$Ne =$ output measured on dynamometer in kW.

$K_H =$ correction for intake air temperature, barometer reading at altitude of the test location.

Calculation example for correction table

1   Take the readings of atmospheric pressure, altitude and intake air temperature of the test location on the weather station.

In the example:
Atmospheric pressure of test location = 955 hPa (mbar)
Altitude of test location = 400 m
Intake air temperature of test location = + 20°C

2   Determine engine output on the dynamometer = 100 kW

3   Take the altitude figure of the test location = 400 m to obtain an altitude correction factor of 46 hPa (mbar) in the altitude correction table.

4   Atmospheric pressure of test location minus the altitude correction factor produces the atmospheric pressure figure (p):

955 hPa (mbar) – 46 hPa (mbar) = 909 hPa (mbar)

The atmospheric pressure (p) must be rounded in order to insert it in the table. In the example to 910 hPa.

5 On the basis of the atmospheric pressure
(p) = 910 hPa, we read off a correction factor
(K_H) of 1.0787 from the output correction table
at an intake air temperature K(t) = 20°C.
6 Engine output related to normal operating
conditions is obtained as follows:

$$Ne_o = Ne \times K_H$$
$$Ne_o = 100 \text{ kW} \times 1.0787 = 108 \text{ kW}$$

Note
The figures for this example are marked in the
correction table.

Output on dynamometer:
Ne = 100 kW

Atmospheric pressure of test location:
P = 955 hPa (955 mbar)

Intake air temperature of test location:
t = +20°C

Altitude of test location:
400 meters above sea level

Units: hPa = Hecto-Pascal
             1 hPa = 1 mbar
             1 Pa = 0.01 mbar

Engine output correction on dynamometer for diesel engines in accordance with 80/1269 EC

Atmospheric pressure p hPA (mbar)	Correction factor 0	5	10	15	20	25	30	35	40	45	50
1040	0.9111	0.9194	0.9277	0.9358	0.9439	0.9519	0.9599	0.9678	0.9756	0.9833	0.9910
1035	0.9155	0.9239	0.9321	0.9403	0.9485	0.9565	0.9645	0.9724	0.9803	0.9881	0.9958
1030	0.9200	0.9284	0.9367	0.9449	0.9531	0.9612	0.9692	0.9772	0.9851	0.9929	1.0007
1025	0.9245	0.9329	0.9412	0.9495	0.9577	0.9659	0.9739	0.9819	0.9899	0.9977	1.0056
1020	0.9290	0.9375	0.9458	0.9542	0.9624	0.9706	0.9787	0.9867	0.9947	1.0026	1.0105
1015	0.9336	0.9421	0.9505	0.9589	0.9672	0.9754	0.9835	0.9916	0.9996	1.0076	1.0155
1010	0.9382	0.9467	0.9552	0.9636	0.9719	0.9802	0.9884	0.9965	1.0046	1.0126	1.0205
1005	0.9428	0.9514	0.9600	0.9684	0.9768	0.9851	0.9933	1.0015	1.0096	1.0176	1.0256
1000	0.9476	0.9562	0.9648	0.9732	0.9817	0.9900	0.9983	1.0065	1.0146	1.0227	1.0307
995	0.9523	0.9610	0.9696	0.9781	0.9866	0.9950	1.0033	1.0115	1.0197	1.0278	1.0359
990	0.9571	0.9659	0.9745	0.9831	0.9916	1.0000	1.0084	1.0166	1.0249	1.0330	1.0411
985	0.9620	0.9708	0.9795	0.9881	0.9966	1.0051	1.0135	1.0218	1.0301	1.0383	1.0464
980	0.9669	0.9757	0.9845	0.9931	1.0017	1.0102	1.0186	1.0270	1.0353	1.0436	1.0517
975	0.9719	0.9807	0.9895	0.9982	1.0068	1.0154	1.0239	1.0323	1.0406	1.0489	1.0571
970	0.9769	0.9858	0.9946	1.0033	1.0120	1.0206	1.0291	1.0376	1.0460	1.0543	1.0626
965	0.9819	0.9909	0.9998	1.0085	1.0173	1.0259	1.0345	1.0430	1.0514	1.0598	1.0681
960	0.9870	0.9960	1.0050	1.0138	1.0226	1.0313	1.0399	1.0484	1.0569	1.0653	1.0736
955	0.9922	1.0013	1.0102	1.0191	1.0279	1.0366	1.0453	1.0539	1.0624	1.0709	1.0793
950	0.9974	1.0065	1.0155	1.0245	1.0333	1.0421	1.0508	1.0594	1.0680	1.0765	1.0849
945	1.0027	1.0119	1.0209	1.0299	1.0388	1.0476	1.0564	1.0651	1.0737	1.0822	1.0907
940	1.0080	1.0172	1.0263	1.0354	1.0443	1.0532	1.0620	1.0707	1.0794	1.0880	1.0965
935	1.0134	1.0227	1.0318	1.0409	1.0499	1.0588	1.0677	1.0764	1.0851	1.0938	1.1023
930	1.0189	1.0282	1.0374	1.0465	1.0555	1.0645	1.0734	1.0822	1.0910	1.0997	1.1083
925	1.0244	1.0337	1.0430	1.0522	1.0613	1.0703	1.0792	1.0881	1.0969	1.1056	1.1143
920	1.0300	1.0393	1.0487	1.0579	1.0670	1.0761	1.0851	1.0940	1.1028	1.1116	1.1203
915	1.0356	1.0450	1.0544	1.0637	1.0729	1.0820	1.0910	1.1000	1.1089	1.1177	1.1264
910	1.0413	1.0508	1.0602	1.0695	1.0787	1.0879	1.0970	1.1060	1.1150	1.1238	1.1326
905	1.0470	1.0566	1.0660	1.0754	1.0847	1.0939	1.1031	1.1121	1.1211	1.1300	1.1389
900	1.0528	1.0624	1.0720	1.0814	1.0907	1.1000	1.1092	1.1183	1.1273	1.1363	1.1452
895	1.0587	1.0684	1.0779	1.0874	1.0968	1.1061	1.1154	1.1246	1.1336	1.1427	1.1516
890	1.0647	1.0744	1.0840	1.0935	1.1030	1.1124	1.1217	1.1309	1.1400	1.1491	1.1581
885	1.0707	1.0805	1.0901	1.0997	1.1092	1.1186	1.1280	1.1373	1.1465	1.1556	1.1646
880	1.0768	1.0866	1.0963	1.1060	1.1155	1.1250	1.1344	1.1437	1.1530	1.1621	1.1712
875	1.0829	1.0928	1.1026	1.1123	1.1219	1.1314	1.1409	1.1503	1.1596	1.1688	1.1779
870	1.0892	1.0991	1.1089	1.1187	1.1283	1.1379	1.1474	1.1569	1.1662	1.1755	1.1847
865	1.0954	1.1054	1.1153	1.1251	1.1349	1.1445	1.1541	1.1636	1.1730	1.1823	1.1915
860	1.1018	1.1119	1.1218	1.1317	1.1415	1.1512	1.1608	1.1703	1.1798	1.1892	1.1985
855	1.1083	1.1184	1.1284	1.1383	1.1481	1.1579	1.1676	1.1772	1.1867	1.1961	1.2055
850	1.1148	1.1294	1.1350	1.1450	1.1549	1.1647	1.1744	1.1841	1.1937	1.2032	1.2126
845	1.1214	1.1316	1.1417	1.1518	1.1617	1.1716	1.1814	1.1911	1.2007	1.2103	1.2198
840	1.1281	1.1383	1.1485	1.1586	1.1686	1.1786	1.1884	1.1982	1.2079	1.2117	1.2270
835	1.1348	1.1452	1.1554	1.1656	1.1756	1.1856	1.1955	1.2054	1.2151	1.2248	1.2344
830	1.1416	1.1521	1.1624	1.1726	1.1827	1.1928	1.2027	1.2126	1.2224	1.2321	1.2418
825	1.1486	1.1590	1.1694	1.1797	1.1899	1.2000	1.2100	1.2200	1.2298	1.2396	1.2493
820	1.1556	1.1661	1.1765	1.1869	1.1971	1.2073	1.2174	1.2274	1.2373	1.2472	1.2569
815	1.1627	1.1733	1.1838	1.1942	1.2045	1.2147	1.2249	1.2349	1.2449	1.2548	1.2647
810	1.1698	1.1805	1.1911	1.2015	1.2119	1.2222	1.2324	1.2426	1.2526	1.2626	1.2725
805	1.1771	1.1878	1.1985	1.2090	1.2195	1.2298	1.2401	1.2503	1.2604	1.2704	1.2804
800	1.1845	1.1953	1.2060	1.2166	1.2271	1.2375	1.2478	1.2581	1.2683	1.2784	1.2884
795	1.1920	1.2028	1.2135	1.2242	1.2348	1.2453	1.2557	1.2660	1.2762	1.2864	1.2965
790	1.1994	1.2104	1.2212	1.2320	1.2426	1.2532	1.2636	1.2740	1.2843	1.2945	1.3047
785	1.2071	1.2181	1.2290	1.2398	1.2505	1.2611	1.2717	1.2821	1.2925	1.3028	1.3130
780	1.2148	1.2259	1.2369	1.2478	1.2585	1.2692	1.2798	1.2904	1.3008	1.3111	1.3214
	0	5	10	15	20	25	30	35	40	45	50

Intake air temperature t + °C

Altitude correction

If the atmospheric pressure related to sea level is read off (weather station), the following atmospheric pressure in the correction table should be deducted.

m	hPa (mbar)	m	hPa (mbar)	m	hPa (mbar)	m	hPa (mbar)	m	hPa (mbar)	m	hPa (mbar)
0	0	300	36	600	69	900	145	1400	159	2000	221
50	6	350	41	650	75	950	109	1500	170	2100	230
100	12	400	46	700	81	1000	115	1600	181	2200	239
150	18	450	52	750	86	1100	126	1700	192	2300	250
200	24	500	58	800	92	1200	137	1800	201	2400	259
250	30	550	63	850	98	1300	148	1900	210	2500	268

Preparing the repair order

Instructions for use of the operation numbers in the various workshop sectors.

Repair order processing

The repair orders should be prepared by the Service Advisor in the response to the customer complaint, taking into account the mileage of the vehicle and any maintenance service which may be due or which was recently performed. The customer complaint should be described precisely and clearly in the repair order for the information of the workshop personnel.

Two examples for specifying the operation numbers:

Example 1

Vehicles with engine running complaint if no maintenance service is due.

In this case, perform operation no. 07-1100 "Testing, adjusting engine."
Depending on the complaint, specify also combined operations, operation no. 07-1203 "Testing engine output and exhaust emissions on roller dynamometer."

Example 2

Vehicles with engine running complaint where maintenance service is due.

In order to avoid any overlapping, do not specify operation no. 07-1100 as "Testing, adjusting engine" is already contained in part II of the maintenance service.

In this case, it is good practice to have part II conducted in the test group in order to perform any additional work which may be required as a combined operation.

Instructions regarding work units book or standard texts and flat rates microfilm

The marking ∗ before the operation text in the work units documentation means that a detailed inclusive text is listed following the respective operation group.

The flat rates stated are matched to the operation procedures in the relevant microfilm Combustion I and II.

Notes for the workshop supervisor

The engine test program is structured in such a way that the repair order can be enlarged as required.

Enlargements as a result of additionally necessary combined operations must be justified by the results of tests and measurements.