

## Test Data with Ignition ON and Starting RPM

Engine	102 CFI	103 CFI	104 CFI, LH-SFI	104 HFM-SFI	111 HFM-SFI	116/117 CFI	119 LH-SFI	119 ME-SFI	120 LH-SFI	120 ME-SFI
<b>Battery voltage</b> V	≥ 11.5	≥ 11.5	≥ 11.5	≥ 11.5	≥ 11.5	≥ 11.5	≥ 11.5	≥ 11.5	≥ 11.5	≥ 11.5
<b>Voltage at ignition coil, Ignition: ON</b>										
Ignition coil Circuit 15 V	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11
Ignition coil Circuit 1 V	≥ 11	≥ 11	≥ 11	≥ 10.5 3)	≥ 10.5 3)	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11
<b>Voltages at starting RPM</b>										
Battery voltage V	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	9.6	9.6
Ignition coil Circuit 15 V	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	≥ 9.5	≥ 9.5	≥ 9.5	9.4	9.4
Ignition coil Circuit 1 V	8.5-10.5	8.5-10.5	8.5-10.5	8.5-10.5	8.5-10.5	8.5-10.5	8.5-10.5 1)	8.5-10.5 1)	8.7	8.7
Primary ignition voltage V	200-350	200-350	200-350	200-350	200-350	200-350	200-350 1)	200-350 1)	190-350	190-350
Secondary ignition voltage, ignition cable 4 kV	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20 1)	-	8 - 20 1)	-
Secondary ignition voltage cylinder 1 2) kV	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20 1)	-	8 - 20 1)	-

1) Set engine tester to 4 cylinder position on engine 119; 6 cylinder position on engine 120. Dwell and ignition voltage can only be checked for one ignition circuit at a time by using the appropriate diagnostic socket.



Test data are attained only with a fully charged battery and ambient temperature of 68° F.

2) kV-Clamp connected to cylinder 1 or on HFM-SFI kV clamp or kV probe connected per coils

3) Measured with adapter CD 1222. The voltage is approx. 0.5-0.6 V lower at circuit 1 than at circuit 15.

## Test Data with Ignition ON and Starting RPM

Engine	102 CFI	103 CFI	104/111	116/117	119 LH-SFI	119 ME-SFI	120 LH-SFI	120 ME-SFI
<b>Starter current draw at starting RPM</b> (min. 180 rpm) A	100 - 150	100 - 180	100 - 180	180 - 240	180 - 240	180 - 240	180 - 300	180 - 300
<b>Ignition timing and dwell at starting RPM (&gt;180 rpm)</b>								
Dwell Δ	9 - 49	1 - 30	1 - 30	1 - 18	9 - 49 1)	-	1 - 30	-
Dwell %	10 - 54	2 - 50	2 - 50 5)	1 - 40	10 - 54 1)	-	2 - 50	-
Ignition timing °CKA	-2 to 2	-2 to 2	-2 to 2	3 - 7	3 - 7	-	-2 to 2	-
<b>Hydrocarbon (HC) level at starting RPM</b> after 15 second cranking period HC ppm	> 2000 2)	> 2000 2)	> 2000 2) 3)	> 2000 2)	> 2000 2) 3)	3)	3)	3)
<b>Injection time at starting RPM</b> ms	-	-	8 - 10 4)	-	8 - 10 4)	8 - 10 4)	8 - 10 4)	8 - 10 4)
<b>Fuel pressure at starting RPM</b> bar	-	-	3.2 - 3.6 4)	-	3.2 - 3.6 4)	3.2 - 3.6 4)	3.2 - 3.6 4)	3.2 - 3.6 4)

1) A Set engine tester to 4 cylinder position on engine 119; 6 cylinder position on engine 120. Dwell and ignition voltage can only be checked for one ignition circuit at a time by using the appropriate diagnostic socket.

2) HC levels climbs during the cranking period.

3) On LH-SFI, HFM-SFI, ME-SFI engines, the fuel pressure is turned off by the control module if there is no ignition.

4) LH-SFI, HFM-SFI, ME-SFI systems.



Test data are attained only with a fully charged battery and ambient temperature of 68° F.

5) On HFM-SFI engines, dwell measurement is only possible using oscilloscope.

## Test Data with Engine Running

Engine	102	103	104/111	116/117	119 LH-SFI	119 ME-SFI	120 LH-SFI	120 ME-SFI
<b>Voltages at idle</b>								
Battery voltage V	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5
Ignition coil Circuit 15 V	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5
Ignition coil Circuit 1 V	12.5 - 14	12.5 - 14	12.5 - 14	12.5 - 14	12.5 - 14	12.5 - 14	12.5 - 14	12.5 - 14
Primary ignition voltage V	200 - 350	200 - 350	200 - 350	200 - 350	200 - 350	200 - 350	190 - 350	190 - 350
Secondary ignition voltage kV	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20	8 - 20 3)	10 - 20	10 - 20 3)
<b>Ignition voltage</b>								
Mean value kV	6 - 16	6 - 16	6 - 16 2)	5 - 14	5 - 14	5 - 14 2)	6 - 16	6 - 16 2)
Difference between cylinders kV	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3
<b>Ignition voltage increase</b>								
Brief acceleration to 3000 rpm kV	6 1)	6 1)	6 1) 2)	6 1)	6 1)	6 1) 2)	6 1)	6 1) 2)
Difference between cylinders kV	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3

<b>Start of combustion line</b> ..... <b>kV</b> Difference between cylinders ..... <b>kV</b>	0.6 - 1.2 ≤0.3	0.6 - 1.2 ≤0.3	0.6 - 1.6 <sup>2)</sup> ≤0.3	0.6 - 1.2 ≤0.3	0.6 - 1.6 ≤0.3	0.6 - 1.6 ≤0.3	0.6 - 1.8 ≤0.3	0.6 - 1.8 ≤0.3
<b>Combustion duration</b> ..... <b>ms</b> Difference between cylinders ..... <b>ms</b>	1.9 - 2.5 ≤0.3	1.9 - 2.5 ≤0.3	1.5 - 1.9 <sup>2)</sup> ≤0.3	1.9 - 2.5 ≤0.3	1.5 - 1.9 ≤0.3	1.5 - 1.9 ≤0.3	1.2 - 1.7 ≤0.3	1.2 - 1.7 ≤0.3

- 1) When accelerating to 3000 rpm, the ignition voltage should not exceed the idle speed voltage by more than 6 kV.  
Example: idle speed voltage, 7 kV; 3000 rpm, 13 kV = an increase of 6 kV.
- 2) Use only the oscilloscope images for diagnosis on HFM-SFI, ME-SFI engines.
- 3) Measurable only with capacitive pick-up.

## Test Data with Engine Running

### Ignition coil test (Bear-Diagnostic equipment only)

Engine at idle

Engine	102	103	104 CFI/LH-SFI	116/117	119/120
Battery voltage ..... <b>V</b>	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	13.0 - 14.5	-
Voltage Circuit 15 (static) ..... <b>V</b>	12.0 - 13.5	12.0 - 13.5	12.0 - 13.5	12.0 - 13.5	-
Voltage Circuit 1 (static) ..... <b>V</b>	1.3 - 2.5	1.3 - 2.5	1.3 - 2.5	1.3 - 2.5	-
Primary resistance ..... <b>Ω</b>	0.3 - 0.6	0.3 - 0.6	0.3 - 0.6	0.2 - 0.4	-
Circuit 15 wiring resistance ..... <b>Ω</b>	≤0.1	≤0.1	≤0.1	≤0.1	-
Primary current ..... <b>A</b>	6.5 - 8.5	6.5 - 8.5	8.5 - 11	8.5 - 11	-
Ignition voltage ..... <b>kV</b>	>25	>25	>25	>25	-

## Test Data with Engine Running

### Idle quality

Engine	102	103	104/111	116/117	119 LH-SFI	119 ME-SFI	120 LH-SFI	120 ME-SFI
RPM difference/Cylinder <sup>1)</sup> ..... <b>rpm</b>	≤8	≤8	≤7	≤8	≤8	-	≤6	-
Mean value of combustion duration <sup>2)</sup> ..... <b>ms</b> (Bear diagnostic equipment only)	1.9 - 2.5	1.9 - 2.5	1.5 - 1.9	1.9 - 2.5	1.5 - 1.9	-	1.2 - 1.7	-

- 1) Before starting repairs based on test results, the closed throttle running quality should be judged from the driver's seat and compared with typical production vehicles (in transmission range D). Test results may vary.
- 2) Deviations of more than ±0.5 ms per cylinder should be cross checked by alternate measurements.

### Intake system tightness

Allowable increase in previously measured values (after spraying with ISO-octane)

Engine	102, 103, 104, 116, 117, 119, 120
Idle rpm ..... <b>rpm</b>	≤80 <sup>1)</sup>
Lambda control ..... <b>Control range %</b>	≤20 <sup>1)</sup>

- 1) Disable closed throttle speed control by clamping idle air hose shut (CFI injection systems only). All electrical consumers should be switched off.

## Test Data with Engine Running

### Compression

Engine	102	103	104/111	116/117	119 LH-SFI	119 ME-SFI	120 LH-SFI	120 ME-SFI

<b>Starter current/Cylinder</b> Allowable difference between cylinders <sup>1)</sup> ..... A	<4	<5	<5	<8	<10	-	<10	-
<b>Starter current</b> Difference between cylinder banks ..... A	-	-	-	<7	<7	-	<7	-
<b>RPM/Cylinder</b> Allowable difference between Cylinders ..... rpm	<7	<7	<7	<7	<7	-	<7	-

1) If a problem is found during the dynamic compression test, a **manual compression test** using the compression recorder must be performed.

## Fuel Pressures CFI Injection System

Engine	102	102.983	103	104	116/117	119
<b>System pressure</b> ..... bar	5.3 - 5.5	5.7 - 5.9	5.3 - 5.5	6.2 - 6.4	6.2 - 6.4	6.2 - 6.4
<b>Lower chamber pressure</b> ..... bar >80° C engine oil temperature	0.4 <sup>1)</sup>	0.4 <sup>1)</sup>	0.4 <sup>1)</sup>	0.4 <sup>1)</sup>	0.4 <sup>1)</sup>	0.4 <sup>1)</sup>
<b>Lower chamber pressure</b> ..... bar +20° C engine coolant temperature at closed throttle	0.5 <sup>1)</sup>	0.5 <sup>1)</sup>	0.5 <sup>1)</sup>	0.5 <sup>1)</sup>	0.5 <sup>1)</sup>	0.5 <sup>1)</sup>
<b>Lower chamber pressure</b> ..... bar +20° C engine coolant temperature during acceleration enrichment	≥3.8	≥3.8	≥3.8	≥3.8	≥3.8	≥3.8
<b>Lower chamber pressure</b> ..... bar during deceleration shut-off	5.3 - 5.5	5.7 - 5.9	5.3 - 5.5	6.2 - 6.4	6.2 - 6.4	6.2 - 6.4
<b>Fuel rest pressure</b> ..... bar after more than 30 minutes	≥2.8	≥2.8	≥2.8	≥2.8	≥2.8	≥2.8

1) Below the previously measured system pressure.

## Fuel Pressures LH-SFI, HFM-SFI, ME-SFI Systems

Engine	104/111	119	120
<b>Fuel pressure at closed throttle (with vacuum)</b> bar	3.2 - 3.6	3.2 - 3.6	3.2 - 3.6
<b>Fuel pressure at closed throttle (without vacuum)</b> bar	3.7 - 4.2	3.7 - 4.2	3.7 - 4.2
<b>Fuel rest pressure</b> bar after more than 30 minutes	≥2.5	≥2.5	≥2.5

## Fuel pump

Engine	102 103.942	111.961	103, 104, 111 116, 117, 119, 120	104, 119, 120
Model	201	202 as of 1994	124 up to 10/94, 129, 140 up to 8/94, 202 up to 1993	124 as of 11/94, 129, 140 as of 9/94
Version	1 pump	1 pump	2 pumps	1 pump
MB part no.	002 091 97 01	000 470 63 94	002 091 88 01	000 470 59 94
Bosch-Nb.	0 580 254 943 (EKP 4)	-	0 580 254 950 (EKP 6)	-
Pierburg two stage designation	-	E3TS (two-stage)	E2T	E3L (screw-type)
Test conditions	engine stopped and voltage at pump of at least 11.5 Volts	engine stopped and voltage at pump of at least 11.5 Volts	engine stopped and voltage at pump of at least 11.5 Volts	engine stopped and voltage at pump of at least 11.5 Volts
Output <sup>1)</sup> Measurement point	fuel return line after pressure regulator	fuel return line after pressure regulator	fuel return line after pressure regulator	fuel return line after pressure regulator
min. 1 liter	40 seconds	40 seconds	40 seconds	40 seconds
Current draw A	6 - 10	8 - 12	4 - 8	5 - 9
Return flow quantity at the restrictor in the fuel distributor cm <sup>3</sup> /min	130 - 150	-	130 - 150	-

1) Fuel tank must be at least half full in order to measure output.

## Injectors CFI

Engine	102, 103 up to 08/88	102, 103 as of 09/88	116, 117	104, 116, 117, 119
MB-part no. Bosch-no.	000 078 40 23 0 437 502 010	000 078 56 23 0 437 502 047	000 078 57 23 0 437 502 035 (Steel seat)	000 078 58 23 0 437 502 035 (Viton seat)
Opening pressure with new injection valves	bar 3.5 - 4.1	3.7 - 4.3	4.3 - 4.6	4.3 - 4.6
Opening pressure with used injection valves minimum	bar 3.0	3.2	3.7	3.7

## Fuel Quantity Comparison Measurement Values (CFI engines)

Load range	Sensor plate deflection at approx. ...cc/min	max. deviation in cc/min
Closed throttle (idle)	4	0.4
Part load	30	4.0
Wide open throttle (full load)	100	10.0

## Engine Coolant Temperature (ECT) and Intake Air Temperature (IAT) Sensors

### Engines 102, 103, 104, 116, 117, 119, 120 CFI, LH

Engine coolant temperature sensor (e.g. B11/2)			Intake air temperature sensor (e.g. B17/1 or B17/2)		
°C	Ω	V	°C	Ω	V
-20	15700	5.12 - 5.60	-20	15700	2.85 - 3.49
-10	10000	4.49 - 5.11	-10	10000	2.50 - 3.06
0	5900	4.12 - 4.48	0	5900	2.10 - 2.56
10	3700	3.77 - 4.12	10	3700	1.65 - 2.07
20	2500	3.36 - 3.76	20	2500	1.32 - 1.62
30	1700	2.92 - 3.35	30	1700	1.03 - 1.25
40	1170	2.51 - 2.91	40	1170	0.77 - 0.94
50	830	2.09 - 2.50	50	830	0.57 - 0.69
60	600	1.69 - 2.08	60	600	0.42 - 0.52
70	435	1.36 - 1.68	70	435	0.32 - 0.40
80	325	1.09 - 1.35	80	325	0.25 - 0.31
90	245	0.88 - 1.08	90	245	0.18 - 0.22
100	185	0.75 - 0.87	100	185	0.14 - 0.17

## Engine Coolant Temperature (ECT) and Intake Air Temperature (IAT) Sensors

### Engines 104, 111, 119, 120 HFM, ME

Engine coolant temperature sensor (e.g. B11/2)			Intake air temperature sensor (e.g. B17/1 or B17/2)		
°C	Ω	V	°C	Ω	V
20	2500	3.32 - 3.68	20	6060	2.47 - 2.73
30	1700	2.94 - 3.26	30	3900	1.99 - 2.21
40	1170	2.56 - 2.84	40	2600	1.52 - 1.68
50	830	2.18 - 2.42	50	1760	1.14 - 1.26

60	600	1.80 - 2.00			
70	435	1.42 - 1.58			
80	325	1.14 - 1.26			
90	245	0.95 - 1.05			
100	185	0.76 - 0.84			

## Spark Plug Chart

Maximum allowable speed 100 mph (160 km/h)

Engine	102 as of 1984	103 as of 1986	104	111	116.962/963 117.967/968	116.965 117.963	119 LH-SFI 119 ME-SFI	120
BERU	14K-8DU or 14K-8DUO	14K-9DU or 14K-9DUO	14F-9DUO or 14F-8DU4 1)	14F-9DUO	14-9DU or 14-9DUO	14-8DU or 14-8DUO	14F-9DUO or 14F-8DU4 1)	14F-9DUO or 14F-8DU4 1)
BOSCH	H8DC or H8DCO	H9DC or H9DCO	F9DCO or F8DC4 1)	F9DCO	W9DC or W9DCO	W8DC or W8DCO	F9DCO or F8DC4 1)	F9DCO or F8DC4 1)
CHAMPION	S10YC or S10YCC	S12YC or S12YCC	C12YCC or C11YCC 1)	C12YCC	N12YC or N12YCC	N11YC or N11YCC	C12YCC or C11YCC 1)	C12YCC or C11YCC 1)

1) Starting as of 06/95

Spark plug gap 0.8 mm.

Torque values:

- with flat seat and gasket: 20 - 30 Nm.
- with tapered seat: 10 - 20 Nm.