BMW Diagnose

Testing Instructions for K Models

BMW Motorrad GmbH + Co.

List of Contents

Instructions for Handling Engine Electronics

1. Always turn off the ignition (or disconnect the battery) for all jobs on the ignition or fuel injection systems, to avoid accidents – **danger!**

   Such jobs include:
   - Connecting and disconnecting adapter leads and BMW diagnosis tester
   - Replacement of ignition or fuel injection components (for example: hall transmitter, ignition coil, ignition leads, ignition control unit, injection control unit, etc.)

2. Always replace all components only with Genuine BMW Parts to guarantee complete operational safety of the engine electronics and the control units in particular.

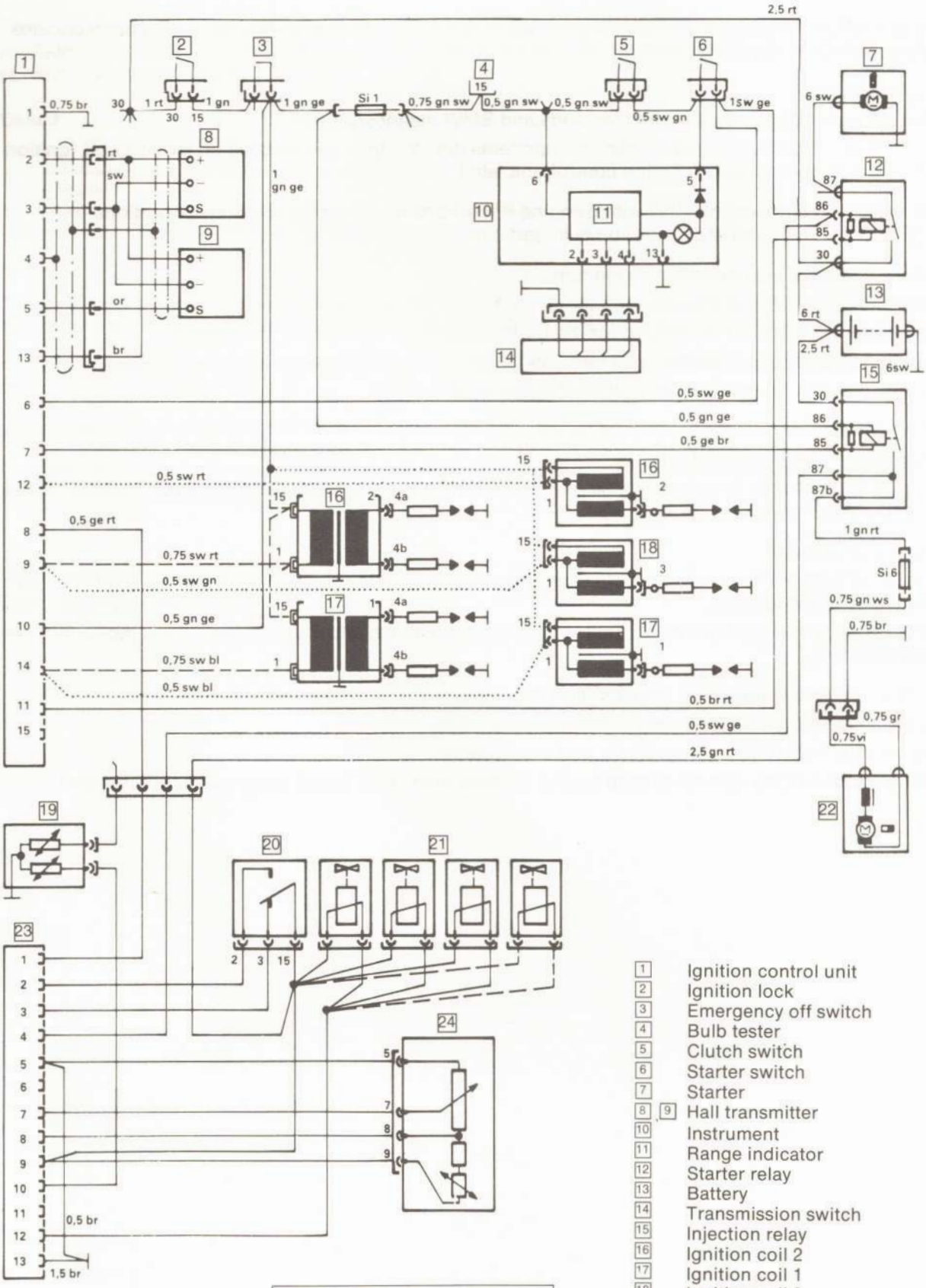
3. The following points are important on ignition coils.
   - Never connect a shielded capacitor on terminals 1 and 15.
   - Never connect terminal 1 on ground for the burglar alarm.
   - Never connect battery positive (+) on terminal 1.
   - Never disconnect the ignition leads while the engine is running.

4. Checking resistance:
   - Only with the ignition turned off.
   - Never on components, which comprise electronic components such as transistors etc., as well as hall transmitters and control units.

5. Checking compression:
   - Disconnect terminal 15 positive supply wire (green/yellow) on the ignition coils to shut down the high voltage side of the ignition.
   - Pull plug out of the injection control unit to stop injection of fuel into the cylinders (if not, the oil film will be washed out).

6. The following points concerning power supply are important to exclude destruction of control units.
   - Never disconnect the battery while the engine is running.
   - Never mix up battery pole connections (not even briefly!).
   - Never start the engine with an outside source of more than 16 volts and never use a fast charger!

General Wiring Diagram – Engine Electronics



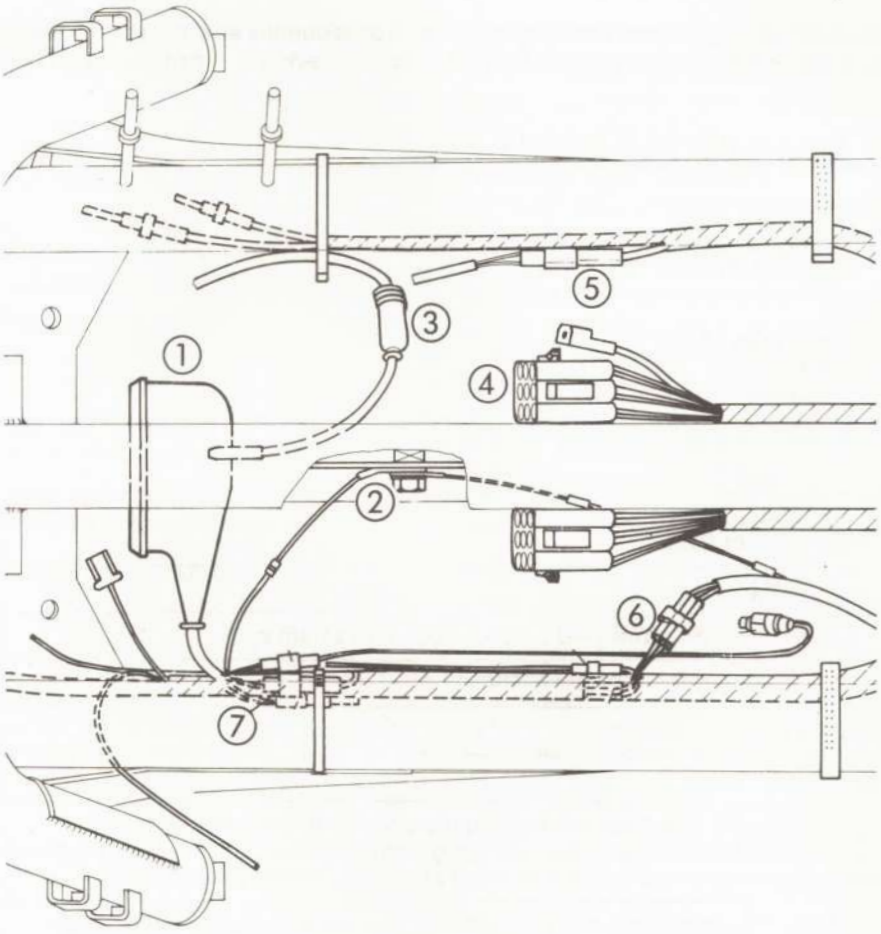
Colour codes:

br = brown	or = orange
rt = red	ws = white
gn = green	bl = blue
ge = yellow	vi = violet
sw = black	gr = grey

all K models
K 100
K 75

1 Ignition control unit
2 Ignition lock
3 Emergency off switch
4 Bulb tester
5 Clutch switch
6 Starter switch
7 Starter
8 9 Hall transmitter
10 Instrument
11 Range indicator
12 Starter relay
13 Battery
14 Transmission switch
15 Injection relay
16 Ignition coil 2
17 Ignition coil 1
18 Ignition coil 3
19 Engine temperature sensor
20 Throttle valve switch
21 Fuel injectors
22 Fuel pump
23 Injection control unit
24 Air flow sensor

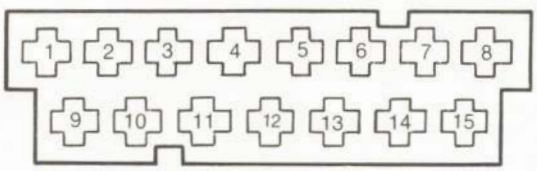
Arrangement of Most Important Plug Connections



① Ignition control unit plug
② Frame ground screw connection
③ Hall transmitter plug
④ Right combination plug
⑤ Ignition lock plug
⑥ Wire harness plug
⑦ Clutch plug

Terminal Designations (Top View of Wire Harness End)

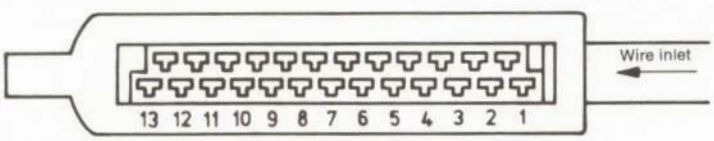
① Ignition control unit plug



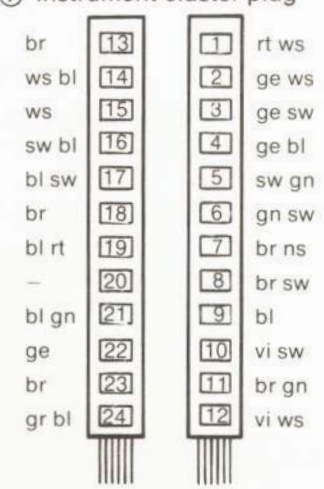
③ Hall transmitter plug

④ Right combination plug

⑧ Injection control unit plug



⑨ Instrument cluster plug



Colour codes:

br = brown	or = orange
rt = red	ws = white
gn = green	bl = blue
ge = yellow	vi = violet
sw = black	gr = grey

Instructions for Application of BMW Diagnosis

The tester can only be used to check voltage (V), timing (%) and resistance (ohms). Consequently all other engine technical data has to be checked separately, if applicable prior to application of the quick checklists – depending on the condition.

Ignition timing, static	6° before TDC ≙ 0.24 mm BTDC
Valve clearance of cold engine (max. 35 °C) Intake valve Exhaust valve	 0.15 to 0.20 mm 0.25 to 0.30 mm
Compression Good Normal Poor	 more than 10 bar 8.5 to 10 bar less than 8.5 bar
Ignition coil Secondary	K 100 ~2.2 ohm K 75 ~0.8 ohm ~10 k-ohm ~10 k-ohm
Spark plug connectors Ignition coil shielded connectors	5 K-ohm (only K 100) 1 K-ohm or 0 ohm
Spark plug electrode gap	0.6 mm (+ 0.1 mm)
Fuel pressure	2.5 bar with disconnected vacuum hose (3rd or 4th cyl.)
Idle speed	950 ± 50 rpm
CO value	2.0 to 2.5 % by volume
Synchronization	
Intake leak test	– Speed (or CO) rises when clamping crankcase vent: engine leaks. – Speed (or CO) rises when spraying a small (!) amount of fuel (e.g. with an oil can) on throttle valve housing and shaft: intake system leaks.
Ti signal on fuel injector (pulse duty factor)	Pulse duty factor test made direct on a fuel injector via two-pin adapter connection, choke in stage 1, ignition turned on, starter operated. Specified values at approx. 15 °C engine temperature:

	Engine does not start	Idle speed (= 950 rpm)
K 100	~4 % . . . (10 sec) . . . ~2 %	~6.5 %
K 75	~7 % . . . (10 sec) . . . ~3 %	~7.5 %

Troubleshooting

Condition		Check
Transmission in neutral, ignition turned on: indicator lamps on? (including idle control)	no →	– Battery, connections and charged condition – Fuse no. 1 (cause ??) – Transmission switch, plugs, leads – Test steps: ignition 1 and 6 – Instrument cluster: plug connections and range indicator printed circuit board
yes ↓ Operate starter button: starter relay working?	no →	– Test steps: ignition 1, 6, 7 and 8
yes ↓ Starter working?	no →	– Leads: battery positive – starter relay terminal 87 – starter relay terminal 30 – starter, starter bolting on transmission – Replace starter ralay
but only erratically (one hall signal missing)	→	– Leads: hall transmitter – ignition control unit terminals 5 and 13 – Replace hall transmitter – Replace ignition control unit
yes ↓ Injection relay working?	no →	– Test steps: ignition 2 and 14
yes ↓ Fuel pump working?	– no →	– Fuse no. 6 (cause ??), tank plug – Leads: battery positive (red) – fuel injection relay terminal 30, injection relay terminal 87b (green/red) – fuse no. 6 – fuse no. 6 (green/white) – tank plug, pump connections (approx. ~3 ohms) – Replace injection relay
but does not continue running (approx. ~1 second)	→	– Hall transmitter plug – Test steps: ignition 10, 11, 15 and 16
yes ↓ Cold engine starts?	no →	– Sufficient fuel in tank – ti signal approx. ~6 to 3 %, if not: • Test steps: LE-Jetronic (all), ignition 17 • Replace injection control unit (if test steps are okay) – Ignition spark, if not: • Test steps: ignition 3, 4, 5, 18 through 27 – Fuel pressure, if not: • Leakage on hoses and filter (in tank) • Pressure regulator • Return flow plugged (→ excessive fuel pressure) – Data in "Instructions for Application of BMW Diagnosis" – Fuel injectors dirty
yes ↓ Warm engine starts?	no →	– Sufficient fuel in tank – Fuel pressure – Test steps: LE-Jetronic 4 through 7
yes ↓ Engine running in all cylinders?	no →	– Temperature comparison on exhaust manifold: non-working cylinders – Spark plugs: broken insulators, electrode gaps – Ignition spark: stroboscope lamp and trigger clips – Fuel injectors: no leakage and equivalent flowrates – Test steps: LE-Jetronic 10 and ignition 15 through 27
yes ↓ Engine running without misfiring?	no →	– Spark plugs and spark plug connectors – Ignition (primary and secondary) – Loose contact on plugs, relays and leads – Test steps: LE-Jetronic 4 through 9 – Data in "Instructions for Application of BMW Diagnosis"
yes ↓ Engine power okay?	no →	– Fuel pressure – Test steps: LE-Jetronic 4 through 9 – Data in "Instructions for Application of BMW Diagnosis"
but . . . when there is a different condition, check the tank volume and data in "Instructions for Application of BMW Diagnosis" depending on the type of trouble. When in doubt, check the complete motorcycle. Also check the complete motorcycle in case of conditions, which occur only occasionally or in conjunction with certain driving conditions, whereby plugs and leads must be simultaneously loaded mechanically and moved.		

Checklist for Fuel Injection

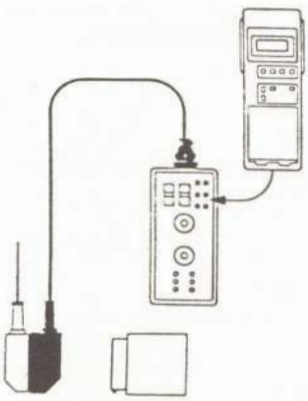
Test Step	Tested Terminals	Tested Item	V Switch Position	Ω Switch Position	LCD Display (Button) Connections *	Ignition On	Starter Operated	Nominal Value K 100	Nominal Value K 75	Actual Value	Remarks
1	9/1	TD signal	5	–	⊟◁%	X	X	≈20 %	≈34 %		X = yes – = no
2	5/9	Injection relay, power supply for injection control unit	6	–	V	X	X	≈10 V	≈10 V		with info on battery charge
3	5/4	Start signal Terminal 86	7	–	V	X	X	≈ 8 V	≈ 8 V		starting enrichment
4	5/8	Air flow sensor	↓	11	Ω	–	–	≈300 Ω	≈300 Ω		yellow plug on left Ω-jack, remove fuse no. 6
5	5/7	Air flow sensor / potentiometer	↓	12	V/Ω	X	X	≈1...3 V	≈1...3 V		voltage checked via blue ohm jacks (!), whereby yellow plug on left ohm jack. Value rises up to approx. 3 V when opening throttle valves.
6	5/10	Temperature sensor	↓	13	Ω	–	–	→	→		Nominal value for engine at operating temperature: 200 Ω ... 500 Ω; at ambient temperature: 2 kΩ ... 6 kΩ
7	5/13	Ground connection	↓	14	Ω	–	–	<0.5 Ω	<0.5 Ω		zero balance, see below!
8	2/9	Throttle valve sw. Idle contact	↓	16	Ω	–	–	<0.5 Ω	<0.5 Ω		throttle twist grip in idle position
9	3/9	Throttle valve sw. Full throttle contact	↓	17	Ω	–	–	<0.5 Ω	<0.5 Ω		throttle twist grip operated in full throttle range
10	12/9	Fuel injectors	↓	18	Ω	–	–	≈4 Ω	≈5.6 Ω		
11		Air flow sensor	–	–	Ω	–	–	≈200 Ω	≈200 Ω		Remove fuse no. 6; resistance tested (without adapter) direct on plug for injection control unit between terminals 8 and 9
12		Central ground	–	–	Ω	–	–	<0.05 Ω	<0.05 Ω		Check between central screw underneath tank and battery ground.

*** Connections**

– Pulse duty factor (⊟◁%): Yellow plug on jack 1, green plug on red jack

– Voltage test (V): Yellow plug on red jack, green plug on black jack

– Resistance test (Ω): Test leads on blue ohm jacks.



Zero balance required before testing.
This requires the following points on the universal test adapter:
– Volt switch in position ↓,
– Ohm switch in position 9,
– Button 5 pressed,
– Ohm button on motorcycle tester pressed simultaneously until 0 ohm is displayed digitally. Release this button first.

Repeat the zero balance as soon as a different LCD display (button) is selected
or
as soon as the display is cancelled.

Zero balance for resistance test without Adapter:
– Both test points pressed next to each other on blank metal (e.g. engine block)
– Ohm button on motorcycle tester pressed simultaneously until 0 ohm is displayed digitally.

Corrective Measures for LE-Jetronic

Test Step	Tested Terminals	Repair the following wires or replace the mentioned components when there is considerable deviation from the nominal value (more than 15 %).
1	9/1	Terminal 9 (green/red) wire harness plug ⑥ – Wire harness plug (green/red) socket for injection relay – Terminal 87 injection relay terminal 30 – Socket for injection relay (red) battery positive Terminal 1 (yellow/red) – wire harness plug ⑥ – Wire harness plug (yellow/red) plug for ignition control unit ①, terminal 8, this requiring that actual values of test steps 17 for ignition and 2 for LE-Jetronic are okay.
2	5/9	Terminal 5 (brown) frame ground ② – Ground connection frame/drive unit/battery ground Terminal 9 (green/red) – wire harness plug ⑥ – Wire harness plug (green/red) socket for injection relay – Socket for injection relay (red) battery positive, if wires are okay: if injection relay does not produce an operating noise, see test steps 2 and 14 of ignition; otherwise replace the injection relay
3	5/4	Terminal 4 (black/yellow) wire harness plug ⑥ – Wire harness plug (black/yellow) starter relay plug, requiring actual value of ignition test step 6 to be correct
4	5/8	Two possible causes: – Engine wire harness, wires terminal 8 (white/red) or terminal 5 (brown) with breaks – Air flow sensor defective
5	5/7	First apply the following test method (with the same adapter settings): Use an instrument tester (even better: stroboscope lamp) for the voltage test, connecting positive pole of test lead on left ohm jack and negative pole on right ohm jack. Pull off plug on starter relay and remove fuse no. 6 (for fuel pump) to protect the battery during the test. Operate the start button and simultaneously open the sensor plate of the air flow sensor slowly by hand (air filter removed): voltage rises continuously (without interruptions) from approx. 1 to approx. 8 volts; sensor plate must move without hesitation. Three possible causes for defect: – Engine wire harness, breaks in wires terminal 7 (white/gray), terminal 9 (green/red) or terminal 5 (brown) – Ground out on wire terminal 7 (white/gray) – Air flow sensor defective (mechanically or electrically), break in slip contact occasionally
6	5/10	Three possible causes: – Engine wire harness, breaks in wires terminal 10 (violet/green) or terminal 5 (brown) – Ground out in wire terminal 10 (violet/green) – Temperature sensor defective; nominal values:
7	5/13	Wire harness, breaks in wires terminal 13 or terminal 5 (brown)
8	2/9	Three possible causes: – Throttle valve switch maladjusted – Engine wire harness, breaks in wire terminal 2 (white/black) or terminal 9 on plug for injection control unit ⑦ to terminal 18 on throttle valve switch (green/red) – Throttle valve switch defective
9	3/9	Two possible causes: – Engine wire harness, break in wire terminal 3 (white/brown), requiring that actual value of test step 8 is okay. – Throttle valve switch defective
10	12/9	Two possible causes: – Engine wire harness, breaks in wires terminal 12 (yellow/green) or terminal 9 (green/red) to one or more fuel injectors – One or more fuel injectors defective (electrically)
11	8/9	Two possible causes: – Engine wire harness, breaks in wires terminal 8 (white/red) or terminal 9 (green/red) – Air flow sensor defective

Temperature (°C):	0	20	90
Resistance (Ω):	~5500	~2500	~250

Checklist for Ignition

Test Step	Tested Terminals	Tested Item	Ignition Control Unit Connected	V-Switch Position	LCD Display (Button) Connections*	Ignition On	Starter Operated	Engine Running	Nominal Value K 100	Nominal Value K 75	Actual Value	Remarks
1	1/10	Power supply for ignition control unit	–	1	V	X	–	–	$\approx U_B$	$\approx U_B$		X = yes – = no
2	7	Control voltage for injection relay (positive)	–	2	V	X	–	–	$\approx U_B$	$\approx U_B$		
3	14	Power supply for ignition coil 1	–	3	V	X	–	–	$\approx \frac{U_B}{2}$	$\approx \frac{U_B}{2}$		Only U_B will be displayed due to $\frac{}{2}$ resistor in test adapter.
4	9	Power supply for ignition coil 2	–	4	V	X	–	–	$\approx \frac{U_B}{2}$	$\approx \frac{U_B}{2}$		K 75: ignition coil 3
5	12	Power supply for ignition coil 3	–	5	V	X	–	–	/	$\approx \frac{U_B}{2}$		K 75: ignition coil 2
6	6	Starter switch	–	6	V	X	X	–	≈10 V	≈10 V		Starter not working
7	11	Control voltage for starter relay (pos.)	–	7	V	X	X	–	≈10 V	≈10 V		Starter not working
8	11	Ignition control unit (control for starter relay, negative)	X	7	V	X	X	–	<2 V	<2 V		Pull plug out of injection control unit.
9	4	Hall transmitter shield	X	8	V	X	–	–	0 V	0 V		
10	3	Power supply for hall transmitter (neg.)	X	9	V	X	–	–	0 V	0 V		
11	2	Power supply for hall transmitter (pos.)	X	10	V	X	–	–	≈11 V	≈11 V		
12	15	Vacuum switch (open)	X	11	V	X	–	–	≈11 V	/		
13	15	Vacuum switch (closed)	X	11	V	X	–	–	0 V	/		Pull off vacuum hose (cyl. 1) build up vacuum (app. 500 mbar)
14	7	Ignition control unit (control for injection relay, neg.)	X	2	V	X	X	X	<2 V	<2 V		Starter speed sufficient (for test steps 14 . . . 20)
15	5	Hall transmitter 1 outlet	X	12	⊟◁%	X	–	X	≈10 %	≈23 %		
16	13	Hall transmitter 2 outlet	X	13	⊟◁%	X	–	X	≈10 %	≈23 %		
17	8	TD signal	X	14	⊟◁%	X	–	X	≈20 %	≈34 %		
18		Primary signal for ignition coil 1	X	15	⊟◁%	X	–	X	≈10 %	≈5 %		Test at engine idle speed
19		Primary signal for ignition coil 2	X	16	⊟◁%	X	–	X	≈10 %	≈5 %		Test at engine idle speed
20		Primary signal for ignition coil 3	X	17	⊟◁%	X	–	X	/	≈5 %		Test at engine idle speed
21		Closed loop shutoff final stage 1	X	15	V	$\overline{X}$	–	–	$\approx \frac{U_B}{2}$	$\approx \frac{U_B}{2}$		Ignition off/ignition on
22		Closed loop shutoff final stage 2	X	16	V	$\overline{X}$	–	–	$\approx \frac{U_B}{2}$	$\approx \frac{U_B}{2}$		Ignition off/ignition on
23		Closed loop shutoff final stage 3	X	17	V	$\overline{X}$	–	–	/	$\approx \frac{U_B}{2}$		Ignition off/ignition on
24		Primary side of ignition coils	–	–	Ω	–	–	–	≈2,2 Ω	≈0,8 Ω		Resistance checked between terminals 1 + 15 of each coil.
25		Secondary side of ignition coils	–	–	Ω	–	–	–	≈10 kΩ	≈10 kΩ		Check between terminal 4a and 4b (K 100) or 4 and 1 (K 75)
26		Ignition coil 1 and ignition lead (cyl. 1 and 4)	–	–	Ω	–	–	–	≈20 kΩ	/		Check resistance from cyl. 1 plug connector to cyl. 4 plug connector.
27		Ignition coil 2 and ignition lead (cyl. 2 and 3)	–	–	Ω	–	–	–	≈20 kΩ	/		Check resistance from cyl. 2 plug connector to cyl. 3 plug connector.

The ohm switch is not required in this test plan.

*** Connections:**
– Voltage test (V): Yellow plug on red jack, green plug on black jack
– Pulse duty factor (⊟◁%): Yellow plug on jack 1, green plug on red jack

Corrective Measures for Ignition

Test Step	Tested Terminals	Check and, if applicable, repair the following wires or replace the mentioned components in case of considerable deviation from the nominal value (more than 15 %).
1	1/10	Terminal 1 (brown) frame ground ② – Ground connection frame/drive unit/battery negative Terminal 10 (green/yellow) right combination plug ④ terminal 2 – (green/yellow) emergency off switch (green) – Right combination plug terminal 9 (green) ignition lock plug ⑤ – (green) ignition lock (red) – Ignition lock plug (red) battery positive
2	1/7	Terminal 7 (yellow/brown) socket for injection relay – Terminal 85 injection relay (coil ~75 ohms) terminal 86 – Socket for injection relay (green/yellow) right combination plug ④ terminal 2, requiring that actual value of test step 1 is okay
3	1/14	Terminal 14 (black/blue) ignition coil 1 – Terminal 1 primary coil (~2.2 Ω or ~0.8 Ω) terminal 15 – Ignition coil 1 (green/yellow) – right combination plug ④ terminal 2, requiring that actual value of test step 1 is okay
4	1/9	K 100: terminal 9 (black/red) ignition coil 2 – Terminal 1 primary coil (~2.2 Ω) terminal 15 – Ignition coil 2 (green/yellow) right combination plug ④ terminal 2, requiring that actual value of test step 1 is okay K 75: terminal 9 (black/green) ignition coil 3 – Terminal 1 primary coil (~0,8 Ω) terminal 15 – Ignition coil 3 (green/yellow) right combination plug ④ terminal 2, requiring that actual value of test step 1 is okay
5	1/12	Terminal 12 (black/red) ignition coil 2 – Terminal 1 primary coil (~0,8 Ω) terminal 15 – Ignition coil 2 (green/yellow) right combination plug ④ terminal 2, requiring that actual value of test step 1 is okay
6	1/6	If idle control lamp does not come on, pull the clutch. If actual value still deviates, check the following wires. – Terminal 6 (black/yellow) right combination plug ④ terminal 1 – (black/yellow) starter switch (black/green) – Right combination plug terminal 6 (black/green) clutch plug ⑦ – Clutch switch – Clutch plug (green/black) fuse plate, fuse no. 1 – Fuse plate (green/yellow) right combination plug terminal 2 If actual value is okay when clutch is pulled, check the following wires. – Right combination plug terminal 6 (black/green) instrument cluster plug ④ terminal 5 – Plug contacts on and in instrument cluster – Instrument cluster plug terminal 6 (green/black) fuse plate, requiring that transmission switch and wire leading to instrument cluster as well as range indicator printed circuit board are okay
7	1/11	Terminal 11 (brown/red) plug for starter relay – Terminal 85 starter relay (coil ~20 Ω) terminal 86 – Plug for starter relay (black/yellow) right combination plug ④ terminal 1, requiring that actual value of test step 6 is okay
8	1/11	Ignition control unit defective, requiring that actual values of test step 1 through 7 are okay
9	1/4	Ignition control unit defective, requiring that actual value of test step 1 is okay
10	1/3	Ignition control unit defective, requiring that actual value of test step 1 is okay

Corrective Measures for Ignition

Test Step	Tested Terminals	Check and, if applicable, repair the following wires or replace the mentioned components in case of considerable deviation from the nominal value (more than 15 %).
11	1/2	Three possible causes: – Disconnect plug for hall transmitter ③ – Actual value still deviating: wire of terminal 2 (red) grounded out or ignition control unit defective – Acutal value now okay: hall transmitter defective
12	1/15	Three possible causes: – Vacuum switch does not open (closed permanently, defective) – Wire terminal 15 (violet/gray) to vacuum switch grounded out – Ignition control unit defective
13	1/15	Three possible causes: – Vacuum hose leaks – Vacuum switch does not close (defective) – Break in wire: terminal 15 (violet/gray) – wire harness plug ⑥ (violet/gray) vacuum switch
14	1/7	Ignition control unit defective, requiring that actual values of test steps 1 through 8 are okay
15	1/5	Three possible causes: – Breaks in wires of terminals 2, 3 or 5 (red, black, orange) from plug for ignition control unit ① to hall transmitter plug ③ – Hall transmitter defective – Ignition control unit defective
16	1/13	Three possible causes: – Breaks in wires of terminals 2, 3 or 13 (red, black, brown) from plug for ignition control unit ① to hall transmitter plug ③ – Hall transmitter defective – Ignition control unit defective
17	1/8	Three possible causes, requiring that actual values of test steps 1, 15 and 16 and LE-Jetronic test step 2 are okay: – Break in wire: terminal 8 (yellow/red) wire harness plug ⑥ (yellow/red) plug for injection control unit ⑧ terminal 1 – Ignition control unit defective – Injection control unit defective
18 ... 20		Ignition control unit defective, requiring that actual values for test steps 1, 3, 4, 5, 15 and 16 are okay
21 ... 23		Ignition control unit defective, requiring that actual values for test steps 3 through 5 are okay