

12 Engine Electrical Equipment

Model 318 i/A

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12 - 0

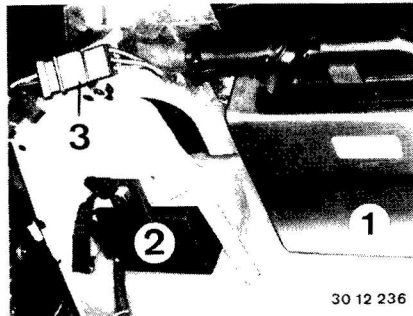
INSTRUCTIONS FOR WORKING ON TRANSISTORIZED COIL-TYPE IGNITION (TCI) AND DIGITAL MOTOR ELECTRONICS (DME)

- o Always disconnect battery or interrupt power supply to ignition control unit and ignition coil when working on the electrical system (charging battery or welding, etc.) — dangerous primary and secondary voltage as well as danger of destroying the ignition system.
- o Never start the engine after removal of distributor cap and/or disconnection of wire on ignition coil term. 4 — pull off plug on ignition control unit.
- o Never disconnect the battery or leads on the alternator and starter while engine is running.
- o Only install specified original BMW parts.
- o Never connect a shielded capacitor or test lamp on term. 1 of the ignition coil.
- o Never connect wire of ignition coil term. 1 on ground or B +. Consequently the ignition coil term. 1 wire must not be used to prevent engine starting when service installing a burglar alarm system.
- o When checking the compression, pull off plug on control unit for TCI or master relay for fuel injection (relay no. 2) for DME.
- o The secondary side (high voltage side) of the ignition system must be shielded with at least 4 k-ohms, whereby the original distributor rotor with 1 k-ohm shielded resistor must be installed. Do not use a 5 k-ohm distributor rotor for the shielding of radio and/or communication equipment!

ENGINE ELECTRICAL LAYOUT

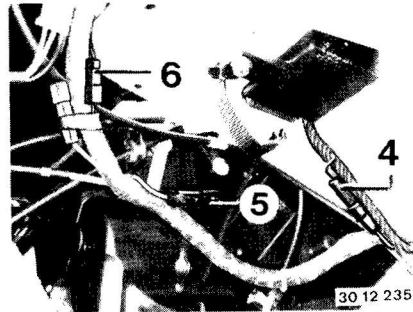
Model 318 i

- 1 Control unit - L-Jetronic (see Gr. 13)
- 2 Control unit - idle speed (see Gr. 13)
- 3 Plug - car electric system, fuel pump relay

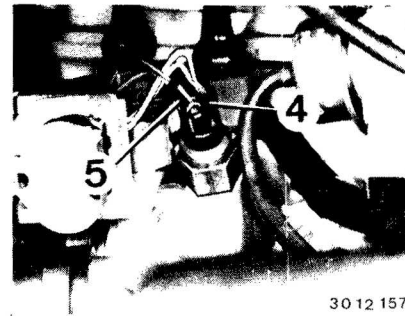


30 12 236

- 4 Plug (white) for transmission versions (wire colors: green/yellow — blue/yellow) — not used for automatics (lean mixture) — connected for manuals
- 5 Plug (black) for air conditioner (wire colors: blue/white)
- 6 Plug (red) for control unit coding (wire colors: brown/violet)

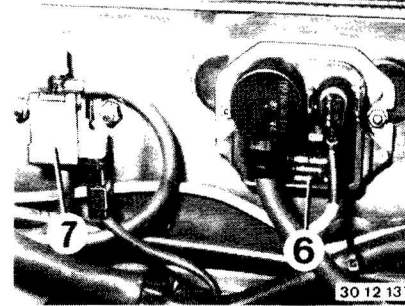


30 12 235



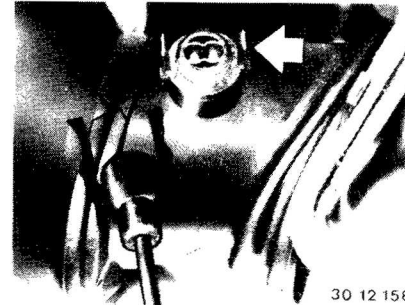
30 12 157

- 4 Temperature transmitter
- 5 Temperature switch for ignition switchover and idle speed control



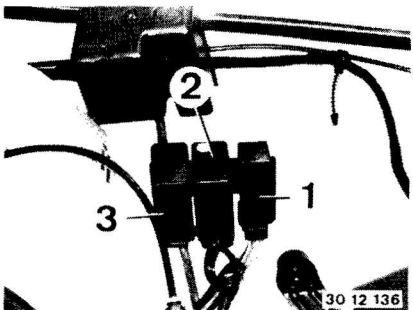
30 12 137

- 6 TCl-S control unit
- 7 Solenoid valve for ignition switchover



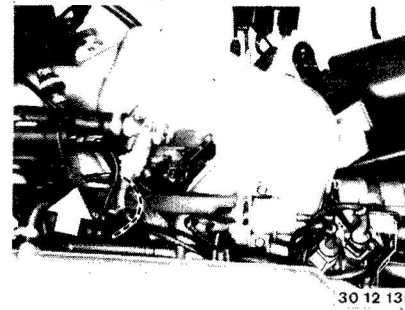
30 12 158

Air temperature sensor for ignition switchover



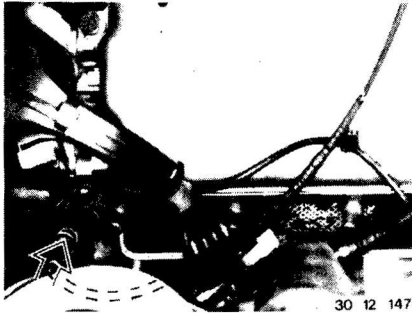
30 12 136

- 1 Relay for fuel injection, fuel pump, oxygen sensor heating
- 2 Relay for idle speed stabilization (see Group 13)
- 3 Relay for ignition switchover



30 12 135

Ground point for engine electrics



12 11 005 CHECKING / ADJUSTING IGNITION TIMING

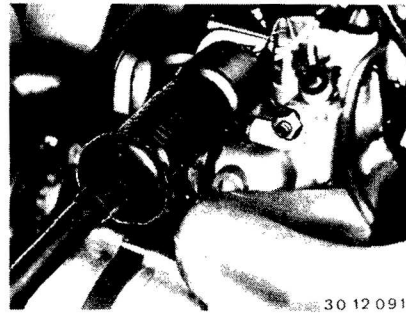
Important!

Conform with instructions for working on engine electrical systems – see page 12 - 0.

Testing Requirements:

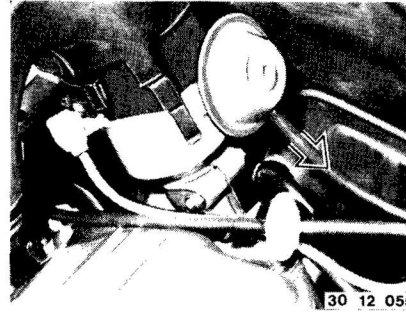
- Plug-in TDC transmitter installed.
- Engine at operating temperature = oil temperature > 60° C (140° F).
- Distributor number** same as specified on the nominal value microfiche.

Connect BMW service tester or BMW digital tester to operating instructions.

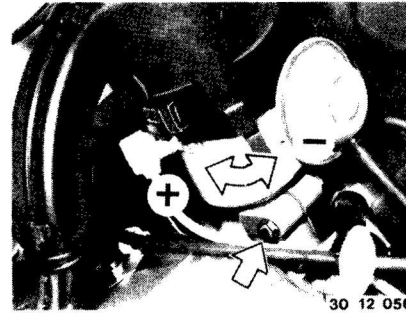


Checking Dwell Angle:

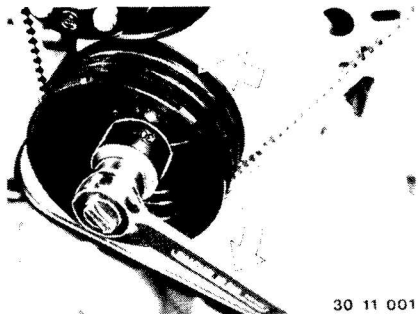
The dwell angle is given by design and can be checked, but not adjusted.
The TCI control unit is no longer ready for operation in case of malfunction.



Checking/Adjusting Ignition Timing*:
Pull off vacuum hose for advance control.



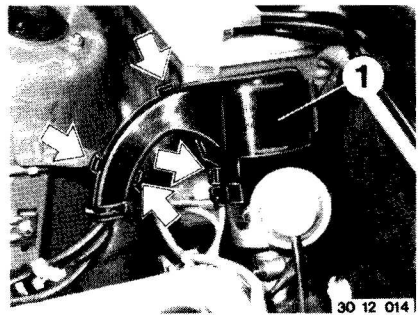
Start and run engine at test speed*.
Check ignition timing*, adjusting if necessary.
Correct by loosening the bolt and turning the distributor accordingly.
+ = advanced ignition timing
- = retarded ignition timing.



30 11 001

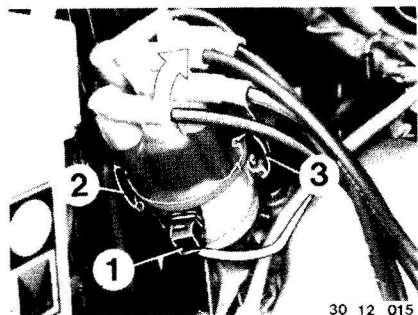
12 11 060 REMOVING AND INSTALLING DISTRIBUTOR

Turn crankshaft to TDC mark (ignition in cylinder no. 1) with a 30 mm wrench socket.



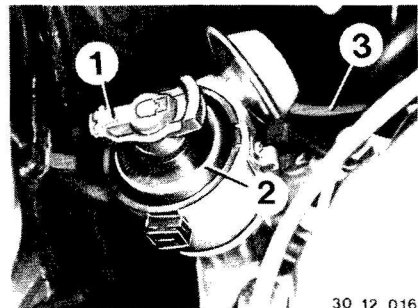
30 12 014

Take off cap (1).



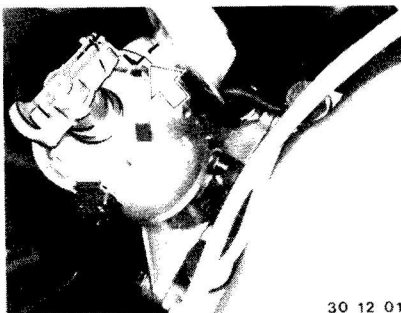
30 12 015

Pull off plug (1).
Lift off clamps (2 and 3).
Remove distributor cap.



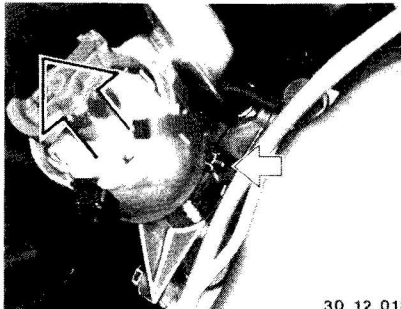
30 12 016

Remove distributor rotor (1) and dust cap (2).
Pull off vacuum hose (3).



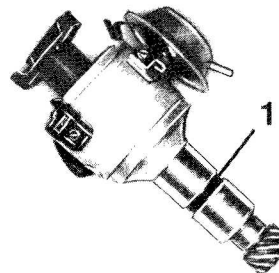
30 12 017

Check position of distributor rotor — it should point to notch on distributor.
Correct by turning crankshaft, if necessary.



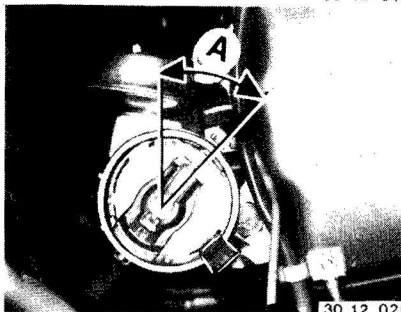
30 12 018

Loosen nut.
Pull out distributor.



30 12 019

Installation:
Check seal (1), replacing if necessary.



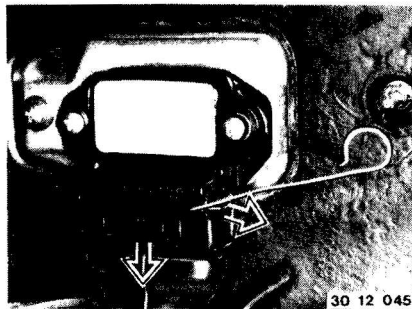
30 12 020

Installation:
Turn distributor rotor clockwise toward mark on housing approx. 30° (A).
Insert distributor.
Adjust ignition timing (see 12 11 005) after finishing installation.

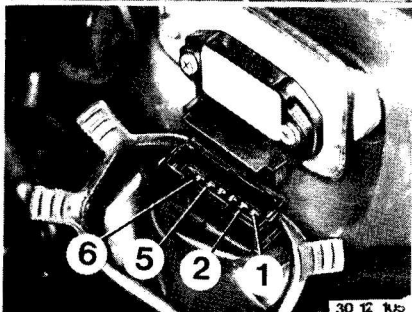
12 11 150 CHECKING PULSE TRANSMITTER IN DISTRIBUTOR

Caution!

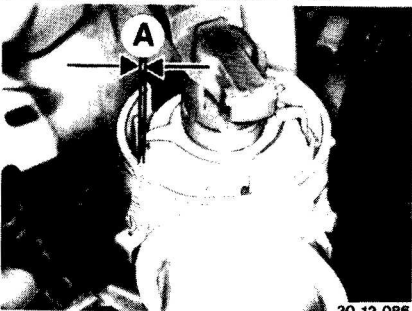
Always turn off ignition before working on dangerous high power ignition systems!
Refer to page 12 -- 1 for working on transistor coil ignition system.
Take off protective cap.
Pull off plug on ignition control unit.



30 12 045



30 12 115

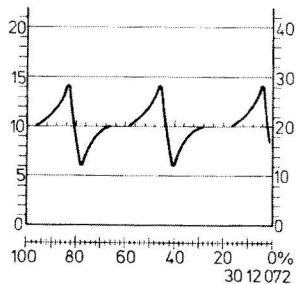


30 12 086

Connect BMW service test unit (M 06) or ohmmeter on plug pins (term. 5 and 6) of plug.
Check coil resistance*.
If nominal value is not reached, check plug connection on distributor or, if necessary, replace pulse transmitter coil.

Check distance (A)* between pulse transmitter and pulse transmitter gear, adjusting if necessary.

Connect multimeter (M 02) and oscilloscope (M 22) of BMW service test unit on disconnected ignition control unit plug (term. 5 and 6) according to operating instructions.
Crank engine with starter — approx. 200 to 300 rpm.
Voltage of 1.0 to 2.0 V should be produced.
Figure shows oscillograph which should appear on screen.

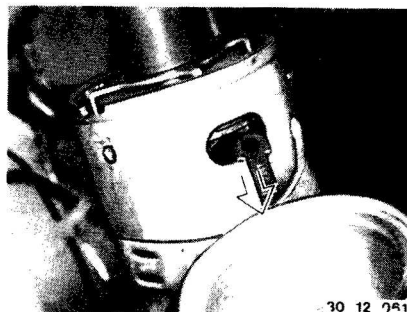


30 12 072

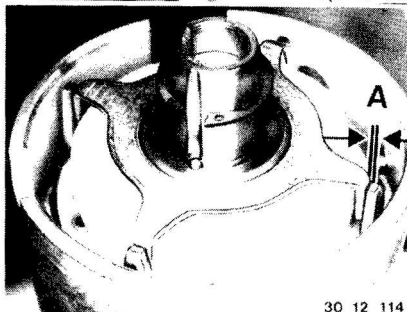
* See Specifications

12 11 151 REPLACING PULSE TRANSMITTER

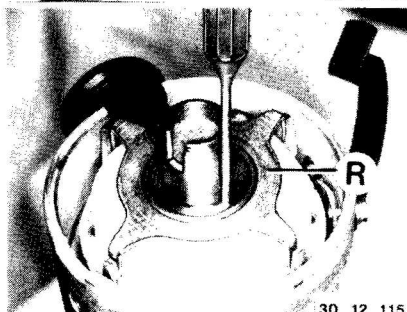
Remove distributor — see 12 11 060.
Unscrew vacuum control and let it hang down.
Installation:
Lubricate connecting rod with grease at opening.



30 12 051



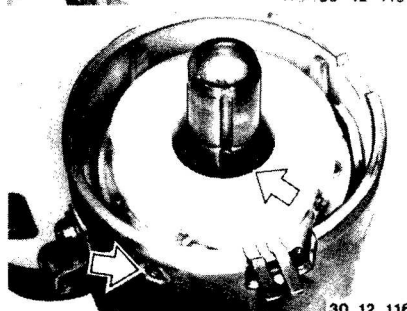
30 12 114



30 12 115

Remove circlip.
Installation:
Press distributor shaft in direction of pulse transmitter tooth (stator) and check pulse transmitter distance (A)*.
Correct by loosening and centering the carrier plate.

Knock down dowel pin with an impact mandrel and take off pulse transmitter gear (rotor).



30 12 116

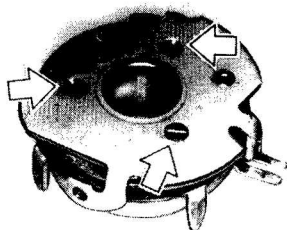
Remove circlip.
Unscrew plug receptacle and screws.

* See Specifications

Unscrew pulse transmitter on carrier plate.

Installation:

Check arrangement of carrier plate connections as shown.



30 12 117

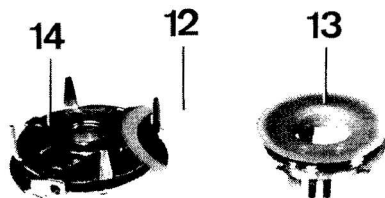
Arrangement:

12 Insulator

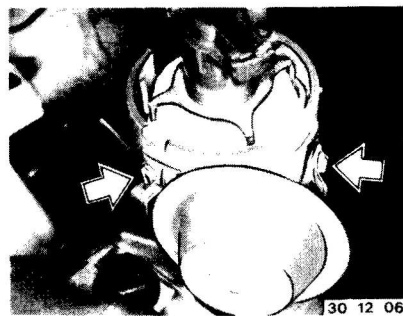
13 Pulse transmitter

14 Carrier plate

Adjust ignition timing (see 12 11 005) after finishing installation.



320 12 047

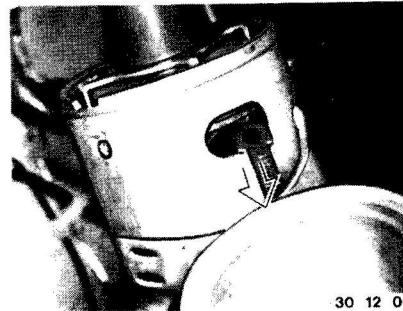


30 12 060

12 11 201 REPLACING VACUUM CONTROL

Take off protective cap and distributor cap. Unscrew and turn distributor for better accessibility.

Unscrew vacuum control.



30 12 061

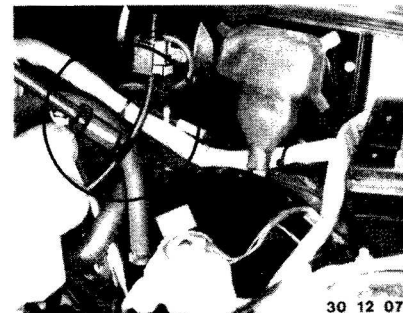
Disconnect pull rod from below.

Installation:

Lubricate eye of pull rod with grease.

Check that pivoting plate moves easily after connecting the pull rod.

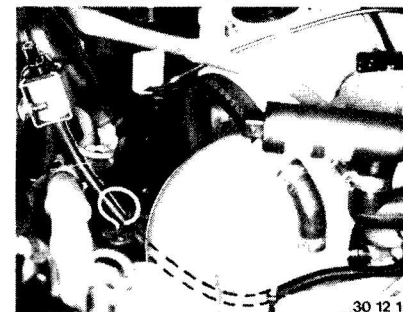
Complete installation and adjust ignition timing* - 12 11 005.



30 12 073

Checking:

Connect BMW service test unit according to operating instructions and perform test step "08 Engine"***.



30 12 10r

** Perform test step "06 Engine", if vacuum hose is connected on the intake air manifold.

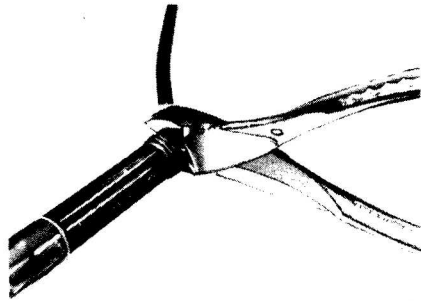
Note difference in ignition timing between disconnected and connected vacuum hose - 13 to 17° before TDC on crankshaft.

* See Specifications

12-5

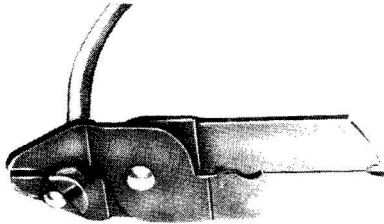
12 12 072 REPLACING ONE SPARK PLUG CONNECTOR

Non-disconnectable Version – 30 kV System:
Cut off ignition lead as shown.



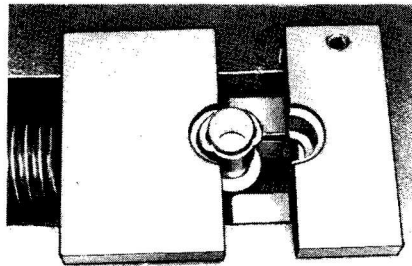
28 12 106

Strip ignition lead end by 6 mm with a stripping pliers (1.5 mm wire cross section size).



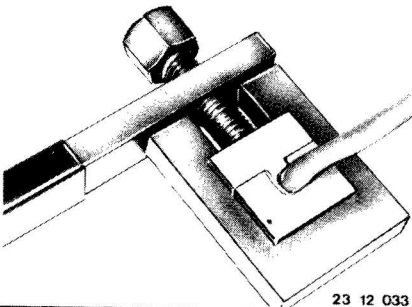
23 12 031

Place connector on ignition lead and insert in Special Tool 12 1 091 as shown. Move clamping jaws together by turning screw against stop.

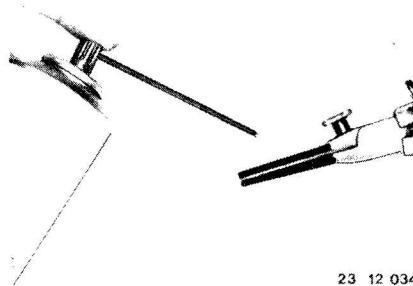


23 12 032

After squeezing, release jaws and take out the ignition lead. Perform tear-out test by hand (tearing-out force: ≥ 200 N / 44 lbs.).

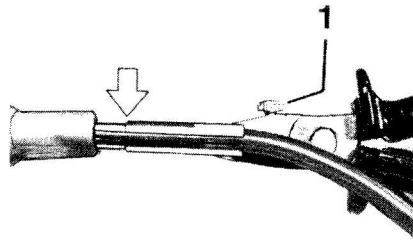


23 12 033



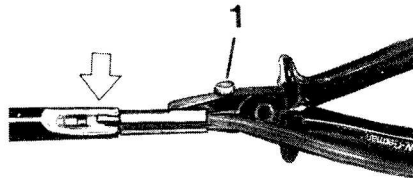
23 12 034

Spray a thin coat of lubricant 12 1 098 on guiding sleeve of Special Tool 12 1 092.



28 12 109

Unscrew screw (1)
Slide in ignition lead against stop (see picture). Follow with pliers and slide in ignition lead further until connector is heard to engage.



28 12 110

Tighten screw (1) enough, that the pliers can be pulled back.

Caution!

Opening the pliers too much could cause the plug receptacle to break.

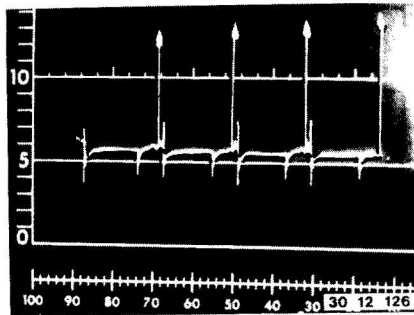
The plug receptacle is shown cut open for better demonstration.

Note:

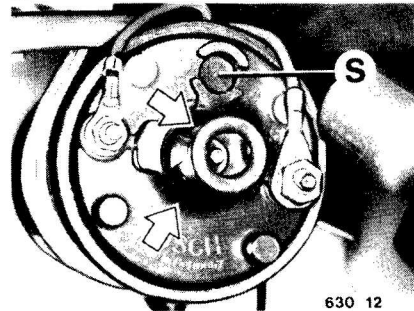
The required special tools 12 1 091/092/098 are also available as a complete set 12 1 090.

12 13 009 CHECKING IGNITION COIL

Connect BMW service test unit.
 Carry out engine test step 09.
 Observe oscillograph — ignition voltage and ignition voltage deviation must agree with nominal values**.

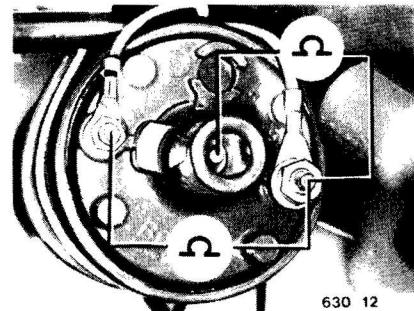


Multimeter Test (M 06):
 Measure resistance* of primary coil (term. 1/15) and secondary coil (term. 15/4).



630 12

Check for hairline cracks and signs of burning.
 Check plug (S) for tight fit — if pressed out, replace ignition coil.

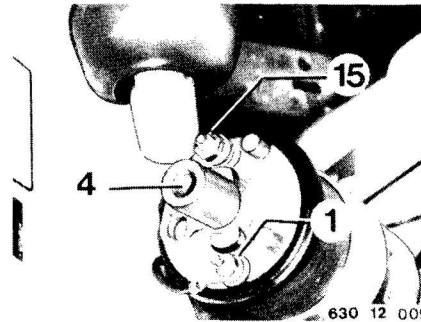


630 12

* See Specifications
 ** See nominal value microfiche

12 13 011 REPLACING IGNITION COIL

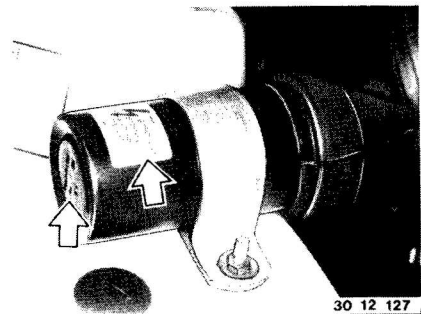
Caution!
 Always turn off ignition before working on the ignition system — dangerous high voltage!
 Refer to page 12 - 0 for instructions for working on ignition system.



Pull off protective cap and ignition lead (term. 4).
 Unscrew connections (term. 1 and 15).
 Unscrew holder and take off ignition coil.

630 12 009

Installation:
 Check new ignition coil for correct code number* and color label*.



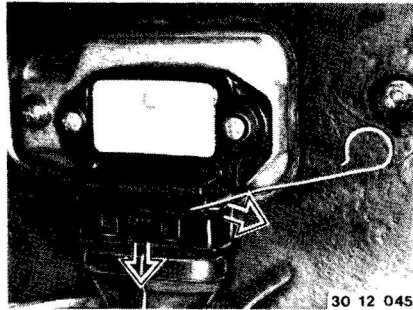
30 12 127

* See Specifications

12 14 010 REMOVING AND INSTALLING CONTROL UNIT FOR TCI

Caution!

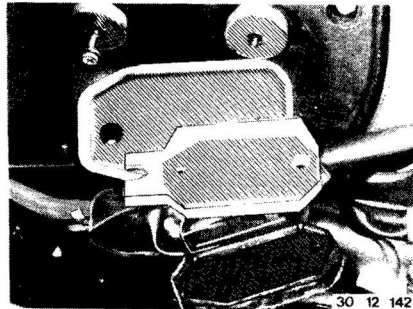
Always turn off ignition before working on ignition systems!
Refer to page 12 - 0 for instructions for working on transistor coil ignition systems.



30 12 045

TClI Control Unit (Bosch):

Take off cap.
Unlock lock wire and pull off plug.
Unscrew screws and remove control unit.

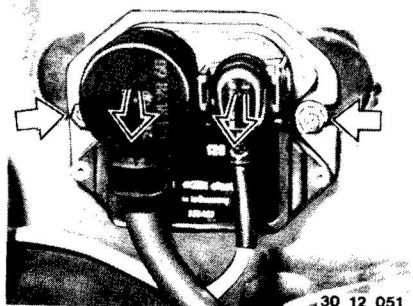


30 12 142

Installation:

Clean sealing surfaces, grinding down with sandpaper if necessary to guarantee good thermal carrying-off.

Also coat back of control unit with Curil K 2** before installation of the control unit.
Check ignition timing* after installation, correcting if necessary.



30 12 051

TClI-S Control Unit (Siemens/Telefunken):

Pull off plug.
Unscrew nuts and remove control unit.

Installation:

Check ignition timing* after installation, correcting if necessary.

* See Nominal Value Microfiche

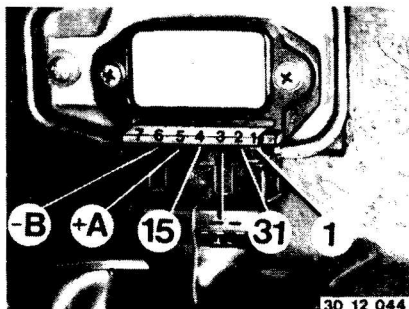
** Source: HWB Product Range
(Division of BMW)

TRANSISTOR IGNITION CONTROL UNIT CONNECTION PLAN

TClI Control Unit (Bosch):

No. Terminal Description

1	1	To ignition coil
2	31	Ground
3	---	Shielding
4	15	Power supply
5/6	A+/B-	Pulse transmitter



30 12 044

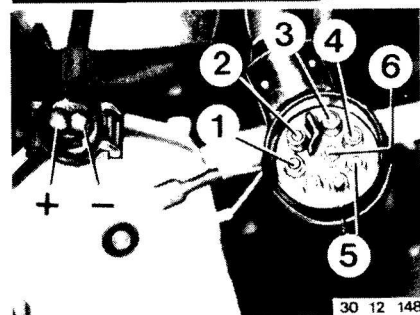
TClI-S Control Unit (Siemens/Telefunken):

No. Terminal Description

1	-	-
2	1/16	To ignition coil
3	15	Power supply
4	TD	- to fuel pump relay - to L-Jetronic contr. unit - to tachometer
5	S	To starter term. 50
6	31	Ground
	+/-	Pulse transmitter



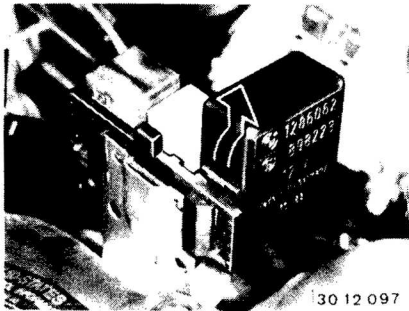
30 12 050



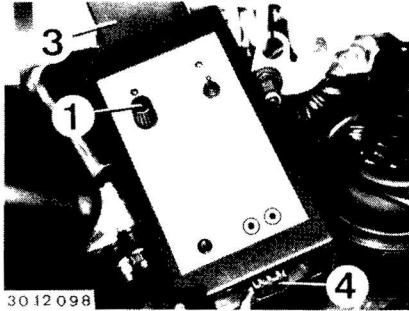
30 12 148

12 63 075 CHECKING VACUUM ADVANCE CONTROL

Take off protective cap.
Remove advance control relay and pull off plug.

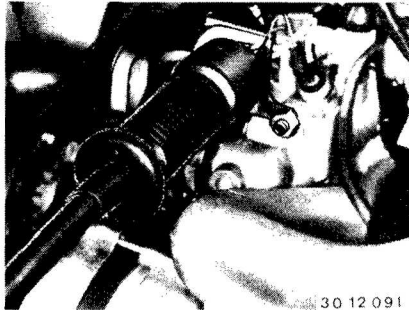


30 12 097



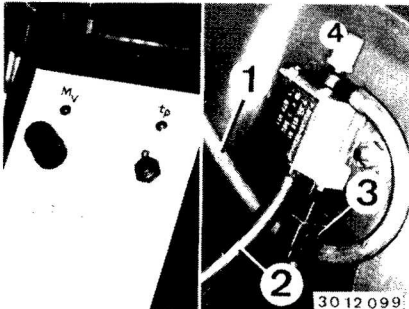
30 12 098

Connect relay (3) and plug (4) on advance control simulator 12 1 460.
Set switch (1) on simulator to position A.



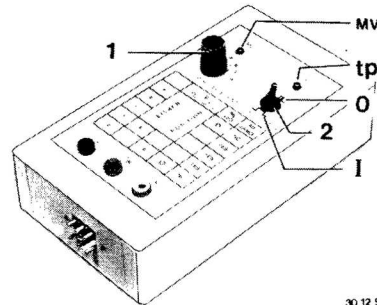
30 12 091

Connect BMW service test unit or BMW digital tester.
Perform engine test step 06 or check ignition timing.
The ignition timing value displayed now will be "retarded" approx. 20° on crankshaft by the simulator.



30 12 099

Lamp "MV" on the simulator comes on — the solenoid is activated.
Hose (1) is vented (cap 4).
1 To advance control box on distributor
2 To intake air manifold or throttle housing
3 Electric activation of simulator



30 12 901

Lamp "tp" (load signal) will flash throughout the entire test.

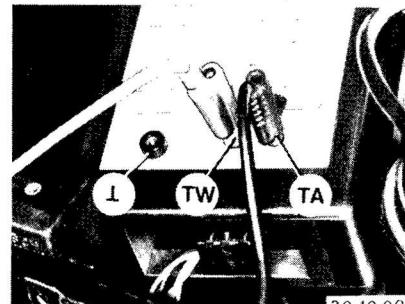
VACUUM ADVANCE CONTROL SIMULATOR

	tp	MV LED	ADVANCE
A	⎓	⬤	NO
B	⎓	⬤	YES
C	⎓	⬤	YES
D	⎓	⬤	YES
	X	⬤	NO

TP = Pulse
 MV = Lamp
 ADVANCE = Lamp
 X = Lamp
 TW = Water temperature
 TA = Intake air temperature

30 12 092

Perform test steps A through D according to procedures printed on the simulator.
Example:
Switch 1 set to position D.
Switch 2 set to position O.
Lamp MV not on, so that this means the advance control box has vacuum.
Refer to troubleshooting chart for vacuum advance control, if the specified conditions are not found in the tests.



30 12 093

The resistance values* for the coolant temperature and intake air temperature transmitters can be taken at the jacks.
⊥ = Ground
TW = Water temperature
TA = Intake air temperature

* See Specifications

If the coolant temperature switch is checked at a temperature below 45° C (113° F), pull off plug on idle control unit (in glove box above L-Jetronic control unit).

TROUBLESHOOTING VACUUM ADVANCE CONTROL SYSTEM

Connect vacuum advance control simulator 12 1 460.
Run engine at idle speed.

* Lamp "tp" not flashing

— No tp signal.
No power supply for simulator.
L-Jetronic control unit, connections or wire harness defective.
Engine not running correctly or at all.

* Lamp "MV" not on

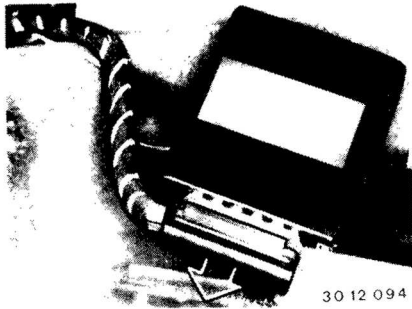
— No power supply for simulator.
Wire harness to simulator defective.
Vacuum advance control relay defective.

* No advance control

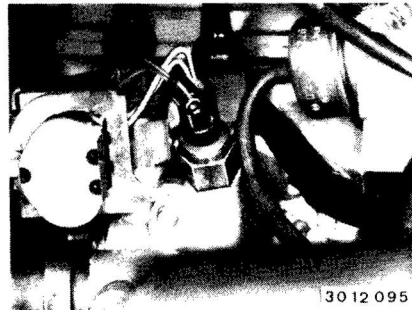
— Vacuum advance control relay defective.
Connections or wire harness for solenoid defective.

* Ignition timing not reached when vacuum is supplied to advance control box.

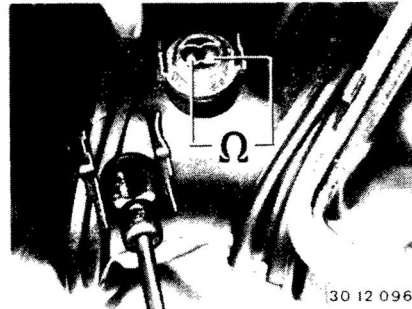
— Solenoid defective.
Vacuum hose leaks.
Distributor defective.



30 12 094



30 12 095



30 12 096

Check resistance* on coolant temperature switch.

Check resistance* on intake air temperature switch.
The switches should be connected during the check with control simulator.

TROUBLESHOOTING TRANSISTOR COIL IGNITION (TCI)**Testing Requirements:**

- Battery charged (voltage > 12 V)
- Specified fuel in tank (octane rating lead content)
- Ambient temperature approx 20° C (68° F); considerable deviation would change the measured values

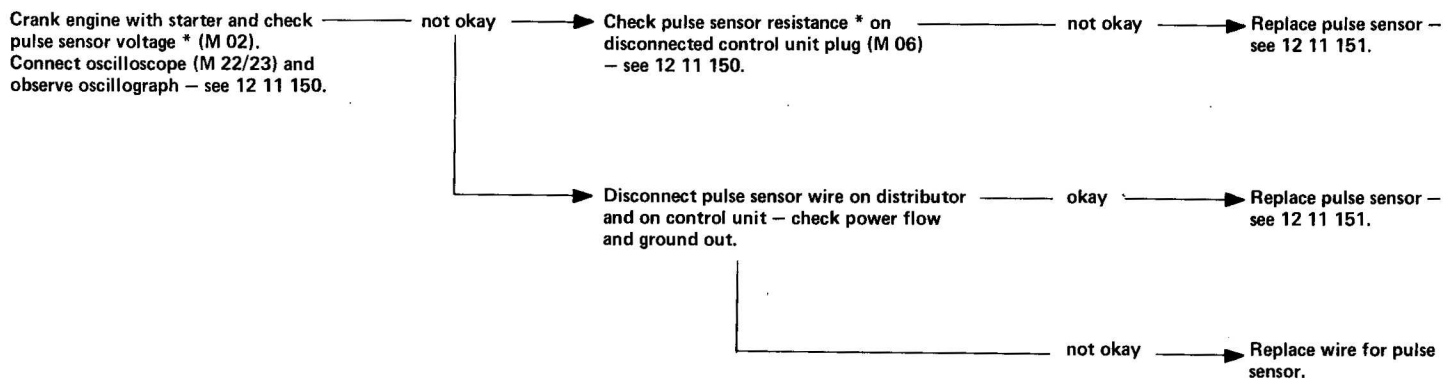
Testing instructions refer to the BMW SERVICE TEST, e.g. engine test/test step 05 (P 05) or multimeter 02 (M 02). Make connections according to operating instructions.

Important!

Refer to instructions for working on TCI and DME – see page 12 - 0.

Faults in TCI will be indicated by:

- a) Engine not starting running incorrectly
- b) Misfiring in different operating conditions
- c) Poor engine output

Test 1 – PULSE SENSOR in Distributor

Test 2 – Voltage Supply for TCI Control Unit

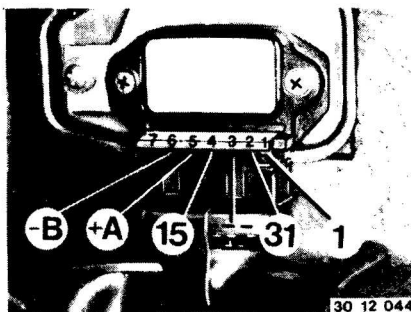
Pull off plug on control unit and turn on ignition.
 Check voltage (approx. 12 V) on connection terminals 15 and 31
 (as shown in figures) of plug.

Not okay

Routing of terminal 15u wire*:

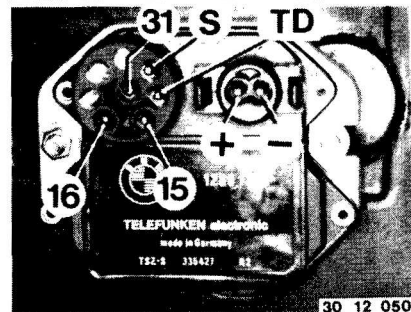
Ignition lock – plug connection on wire harness for car electric system –
 connector (soldered point) in wire harness – engine wire harness plug connection –
 – connector (soldered point) in engine wire harness –
 – TCI control unit

The ground wire is routed to the ground point on air collector (4th cylinder).



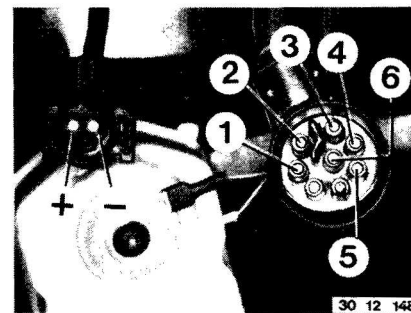
TClI Control Unit (Bosch):

No.	Term.	Description
1	1	To ignition coil
2	31	Ground
3	---	Shielding
4	15	Power supply
5/6	A+/B-	Pulse transmitter



TClI-S Control Unit (Siemens/Telefunken):
 (S = ignition timing retard while starting)

No.	Term.	Description
1	-	-
2	1/16	To ignition coil
3	15	Power supply
4	TD	- to fuel pump relay - to L-Jetr. control unit - to tachometer
5	S	To starter term. 50
6	31	Ground
	+/-	Pulse transmitter



* See car or engine electric system wiring diagram.

Test 3 – IGNITION COIL and POWER SUPPLY LEAD

Turn on ignition.
Check voltage (> 10 V) on TCI control
unit term. 1 (M 01).
Also contained in engine test (P 01).

not okay

→ Check wire from ignition coil (terminal 1)
to control unit for breaks and ground out
(M 06).

↓
Check ignition coil – see 12 13 009.
Check resistance * of primary and secondary
coils
In engine test (P 09) check ignition voltage

not okay

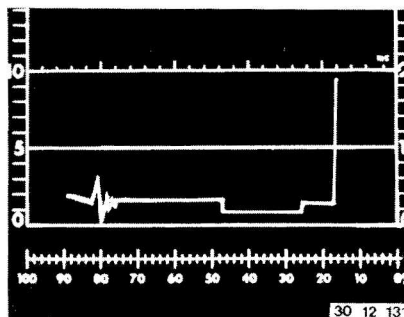
→ Replace ignition coil.
If casting compound has run out or the
is missing, also replace the TCI control unit.

Test 4 – TCI CONTROL UNIT

Requirement: Test 1 through 3 completed and
no malfunction.

Carry out engine test (P 05).

** Crank engine with starter (approx. 250 rpm).
Primary display on oscilloscope should conform
with that illustrated here – if necessary, replace
control unit.



↓
Check primary current (M 03) – this is only
necessary when the primary oscillograph
deviates.
Connect ammeter in power supply lead (term.
15/green, on plug for engine wire harness).
Operate engine at 1000 ± 50 rpm.
Value should be 1.2 to 1.7 A – if necessary,
replace control unit.

* See Specifications

** Only if engine does not start

Test 5 – DISTRIBUTOR CAP / ROTOR and IGNITION LEADS

Bend ignition leads in a tight radius and check for cracks and traces of burning. Check connection and tightness of plugs and connections. ——— not okay ———> Replace ignition leads and connections — see 12 12 072.



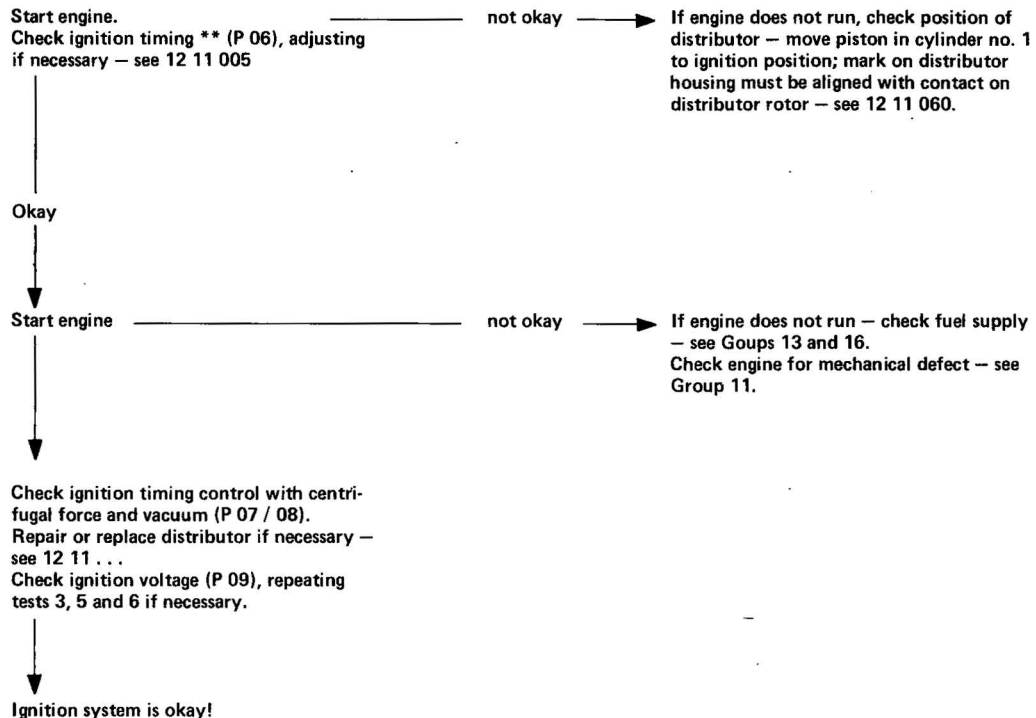
Check distributor cap and distributor rotor for cracks and traces of burning. Measure resistance * in distributor rotor. ——— not okay ———> Replace distributor cap and / or rotor

Test 6 – SPARK PLUGS and CONNECTORS

Measure resistance * of shields and spark plug connectors. Check for cracks and traces of burning. ——— not okay ———> Replace shielded and / or spark plug connectors — see 12 12 072.



Check spark plugs for electrode erosion and electrode gap *. Check insulator for traces of burning. ——— not okay ———> Replace spark plugs — only install specified types *.

Test 7 – IGNITION TIMING / IGNITION TIMING CONTROL

** See Nominal Value Microfiche

* See Specifications

TROUBLESHOOTING ALTERNATOR

Test Requirements: — Correct connections on battery, starter and alternator.
 — Good ground connection between engine and body.
 — Tight drive belt.

Charge Indicator Lamp NOT On with Ignition Turned On

Pull off connection plug D+/61 and connect with ground (term. 31).

Charge lamp on.

Take off voltage regulator. Check carbon brushes, replacing if necessary — see 12 32 000. Check slip rings for dirt or oxidation coat.

Connect BMW service test unit and perform engine test — see 12 31 009.

Charge lamp not on.

Check connections and wires** for charge ind. lamp or replace light bulb — see 62 99 . . .

Charge Indicator Lamp ON with Ignition Off

Remove alternator. Replace diode plate — see 12 31 691.

Charge Indicator Lamp GLOWS or ON with Engine Running

Connect BMW service test unit and perform engine test (P 02).

Check regulating voltage*.
Check charging current*.

not okay

Replace voltage regulator — see 12 32 000.

Check oscillograph and harmonic wave ratio — see 12 31 009.

not okay

Replace or disassemble alternator and inspect components.

Battery is CHARGED INSUFFICIENTLY Charge Indicator Lamp Off with Engine Running

Connect BMW service test unit and perform engine test (P 02).

not okay

Regulating voltage not as specified*.

Replace voltage regulator — see 12 32 000.

okay

Check battery, replacing if necessary. Check power drain with equipment switched off.

Charging current* with equipment on too low.

Replace or disassemble alternator and inspect components — see 12 31 020.

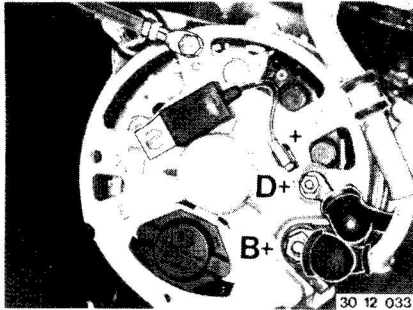
* See Nominal Value Microfilm

** See Wiring Diagram

12 31 009 CHECKING ALTERNATOR AND VOLTAGE REGULATOR

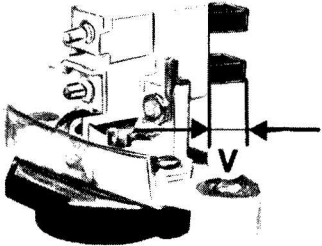
Testing Requirements:

- Correct connections on charged battery
- Correct connections on alternator and starter
- Good ground connection between engine and body.
- Tight drive belt



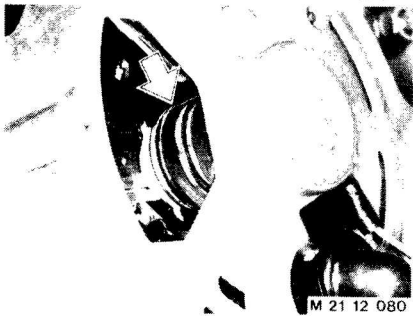
Indicator Lamp On Continuously:

Remove voltage regulator and check carbon brushes, replacing if necessary - 12 31 200. Distance "V" for new condition = approx. 12 mm (0.472").

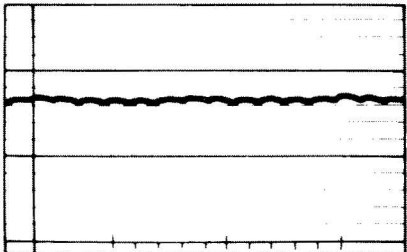


Installation:

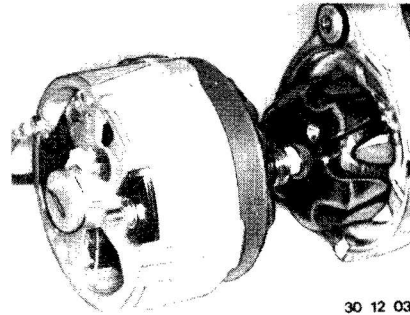
Check slip rings for wear, fine grinding and polishing if necessary. Connect BMW service test unit. Start engine and compare test values with nominal values*.



If the battery charge indicator lamp goes out while engine is running and the regulating voltage* is not reached - harmonic wave ratio and oscillograph okay (as shown) - the voltage regulator has to be replaced, see 12 32 000.

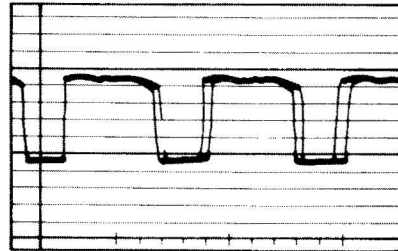


* See nominal value microfiche

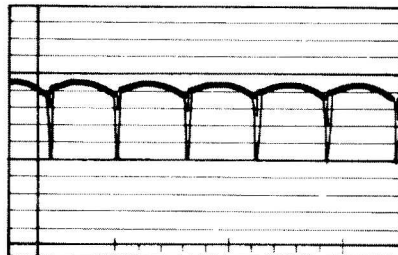


Repeat test. If the specified charging current is not reached, remove and disassemble alternator, and inspect components - 12 31 020 / 513.

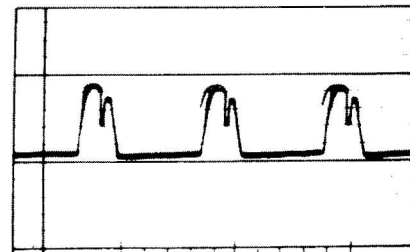
Oscillographs of Defective Alternator: Defective power or exciter diode.



Shorted turn of stator coil.



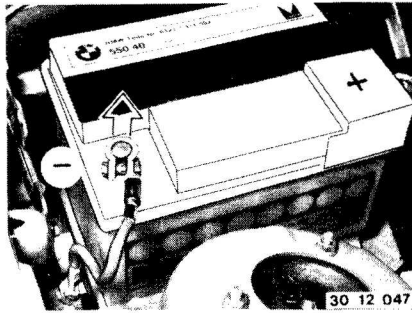
Break in one exciter diode.



12 31 020 REMOVING AND INSTALLING ALTERNATOR

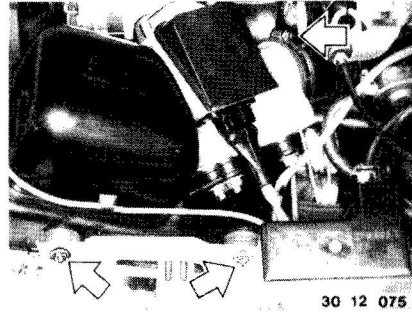
Disconnect battery.

Caution!
Disconnect wire between battery and alternator only when engine is stopped.



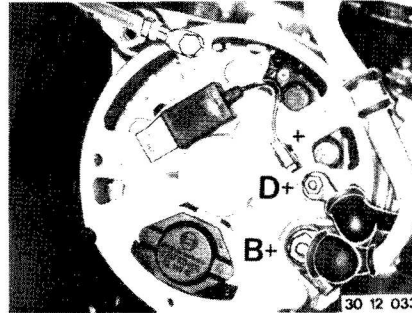
30 12 047

Remove air cleaner and air flow sensor.



30 12 075

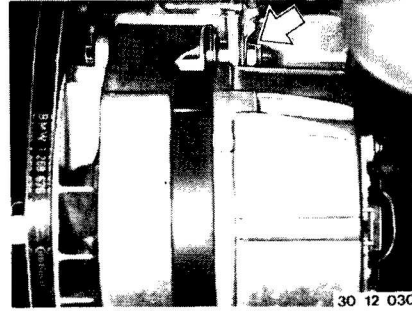
Unscrew connections B + and D +.
Disconnect ground wire.



30 12 033

Unscrew mounting bolts.
Remove alternator.

Installation:
Don't forget the ground wire (see arrow).
Tighten drive belt – 12 31 299.

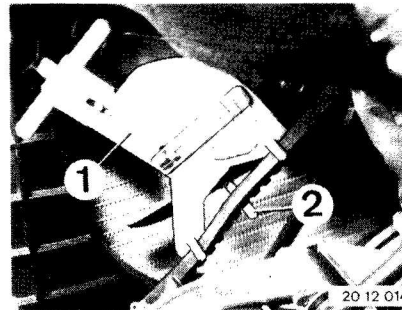


30 12 030

12 31 299 CHECKING / TIGHTENING ALTERNATOR DRIVE BELT

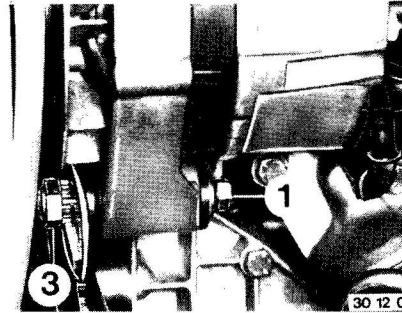
Check drive belt tightness with Special Tool 11 5 020 (1), tightening if necessary. This requires pulling hook (2) to be in center of teeth.

Indicator must be located in scale above the green or yellow field.



20 12 014

Tighten drive belt.
Unscrew nut (1) and turn tensioning wheel (3) with a torque of approx. 7 Nm (5 ft.lbs.)
Tighten nuts (1).
Recheck tightness with the tester, correcting if necessary.



30 12 070

12 - 43

12 31 513 DISASSEMBLING/ASSEMBLING ALTERNATOR — Alternator Removed —

Alternator 80 A:
Remove voltage regulator — 12 32 000.
Hold pulley with Special Tool 12 31 000 and unscrew nut.
Take off fan.

Arrangement of Washers

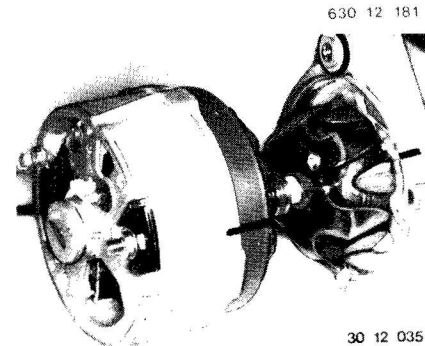
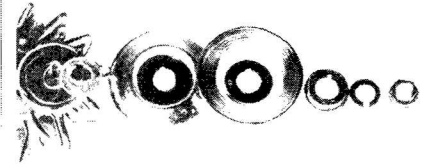
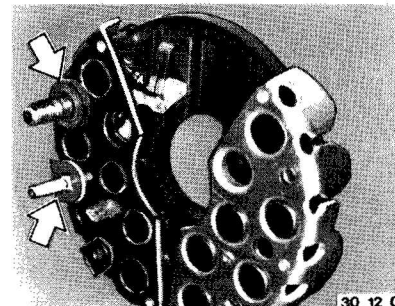
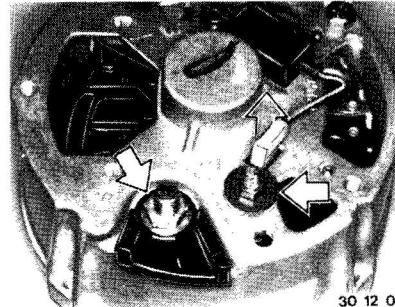
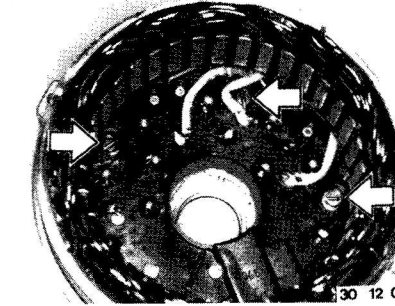
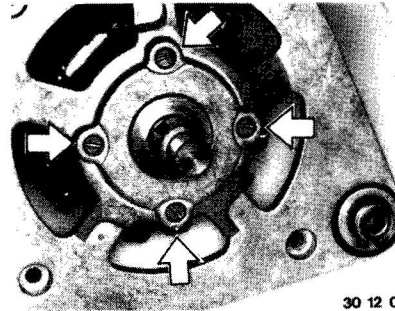
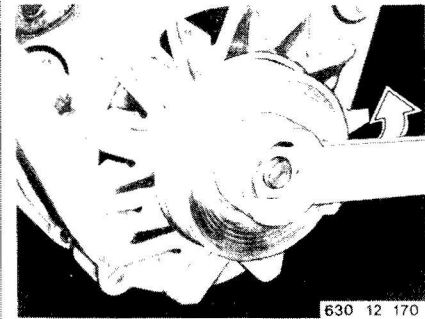
Mark housing sections to each other.
Unscrew bolts and pull housing sections apart.

Unscrew bearing cap screws and take off end plate.

Unscrew screws for diode plate.

Unscrew shielded capacitor.
Unscrew nuts on B + and D + terminals.
Remove diode plate with stator coil.

Installation:
Check condition of insulating sleeves and washers, replacing if necessary.



12 31 581 REPLACING BALL BEARING - Alternator Removed and Disassembled -

Pull off bearing with Special Tool 00 7 500.

630 12 171

Installation:

Replace cover for bearing, if it had been damaged through application of special tool.

630 12 172

Installation:

Check installed position of washer — collar faces bearing.

30 12 039

12 31 691 REPLACING DIODE PLATE Alternator Removed and Disassembled -

Unsolder stator coil on diode plate.

Caution!

Excessive heat from soldering iron would destroy the diodes.

630 12 178

Unscrew bolts.

Remove diode plate.

630 12 173

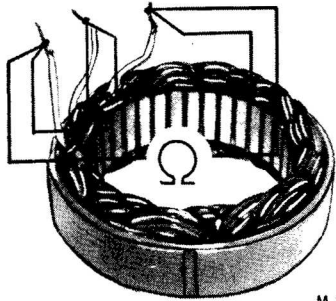
Installation:

Check condition of insulating sleeves and insulators.

630 12 179

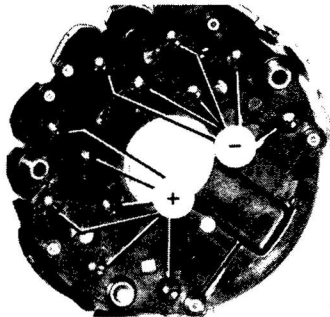
12 31 ... INSPECTING COMPONENTS OF ALTERNATOR

Perform tests with a BMW service tester.
Checking Rotor Coil for Breaks and Shorted Turns:
 Connect test leads for resistance test on slip rings.
 For 80 A alternator: 2.8 to 3.0 ohms.



M 21 12 086

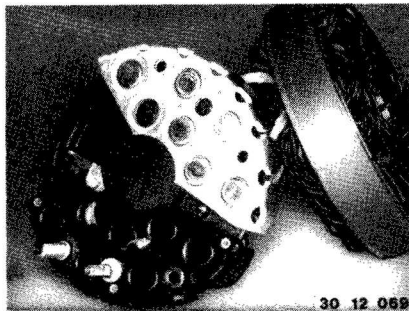
Checking Rotor Coil for Ground Contact:
 Connect test leads for resistance test on slip ring and rotor shaft.
 Nominal value: ∞ = 999 k-ohm display.
 Check slip rings, fine grinding if necessary – see 12 31 200.



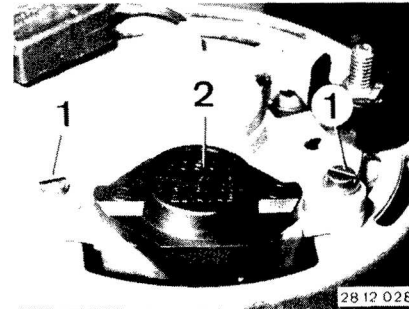
30 12 043

Checking Stator Coil for Ground Contact:
 Connect test leads for resistance test on solder point and stator (coil carrier).
 Nominal value: ∞ 999 k-ohm display.

Checking Stator Coil for Breaks:
 Compare resistance values of wires 1/2, 1/3 and 2/3 with an ohmmeter – they should be identical.
 The shorted turn test can be performed with a standard tester.

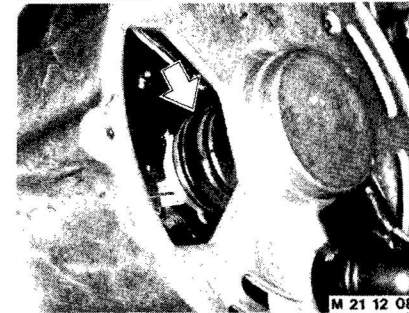


30 12 069



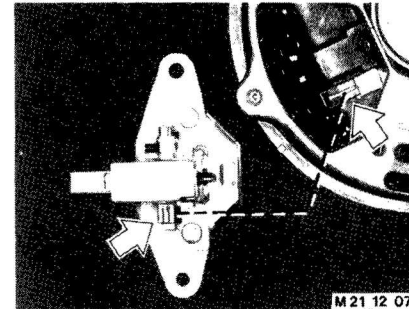
28 12 028

Checking Negative Diodes:
 Connect test leads for diode test.
 Negative lead on cooler and positive lead on one of the negative diode connections.
 Display with perfect condition diodes: polarity "--".



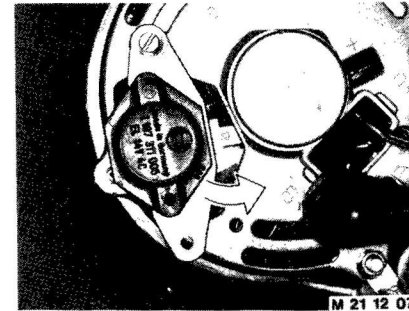
M 21 12 080

Checking Positive Diodes:
 Connect negative lead on B + connection pin and positive lead on one of the positive diode connections.
 Display with perfect condition diodes: polarity "+".

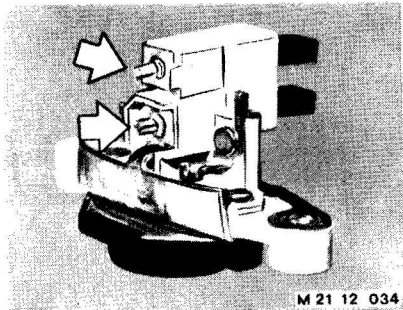


M 21 12 076

If a diode is defective, replace entire diode plate – 12 31 691.



M 21 12 078

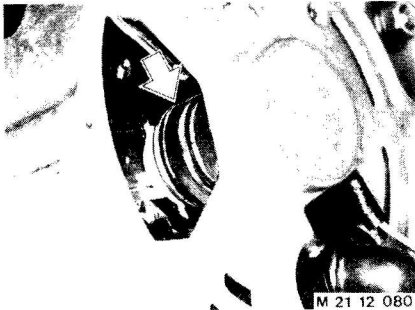


M 21 12 034

12 31 200 REPLACING CARBON BRUSHES

Remove voltage regulator 12 32 000. Unsolder leads on carbon brush holder.

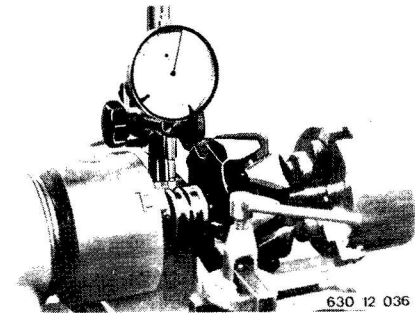
Note:
Only use a small amount of solder for soldering to prevent hardening of leads.



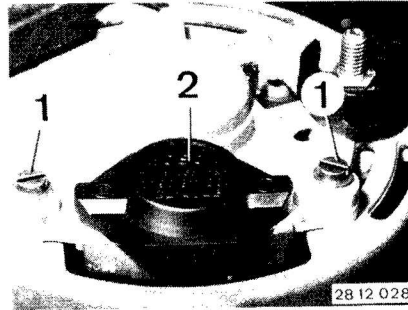
M 21 12 080

Installation:
Check slip rings for wear. If necessary, remove rotor and fine grind as well as polish the slip rings — part of Pos. 12 31 201.

Void excessive out of true.
Max. slip ring out of true = 0.03 mm (0.0012").



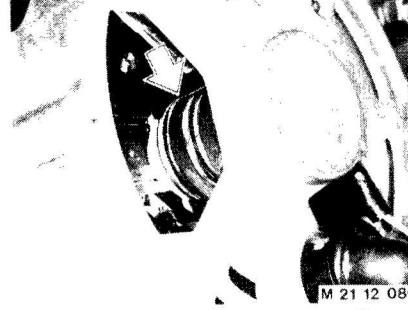
630 12 036



28 12 028

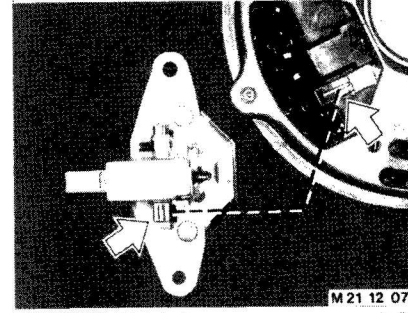
12 32 000 REMOVING AND INSTALLING/REPLACING VOLTAGE REGULATOR

Unscrew bolts (1) and take off regulator (2) carefully.



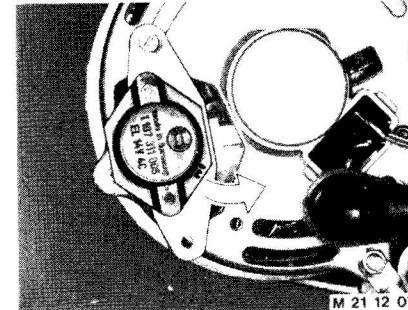
M 21 12 080

Check slip rings for wear, fine grinding if necessary.



M 21 12 076

Clean contact surfaces and check tension of spring contacts, correcting if necessary.



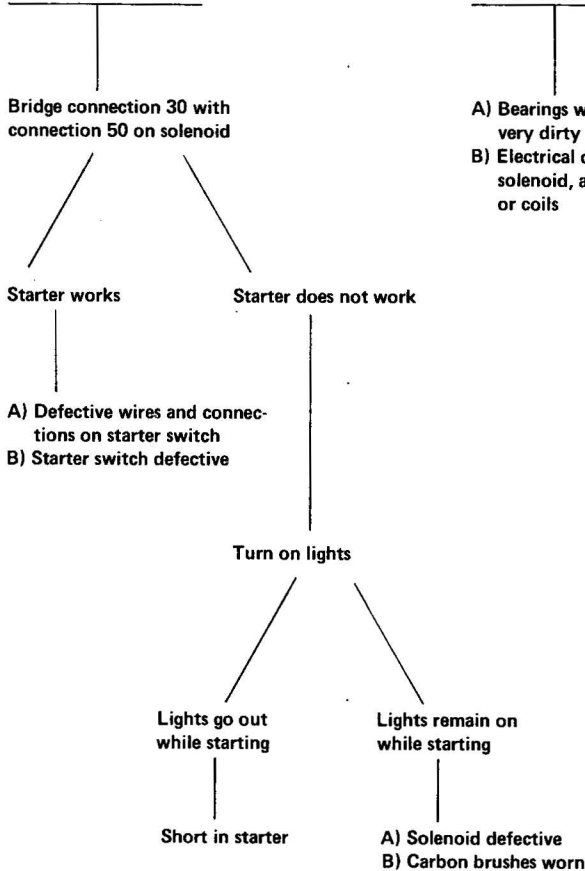
M 21 12 078

Installation:
Mount regulator at first with one bolt screwed in finger tight, then press alternator to final installed position carefully, install and tighten all bolts.

TROUBLESHOOTING STARTER

- Testing Requirements:
- Correct connections on battery and starter
 - Good ground connection between engine and body
 - Charged battery

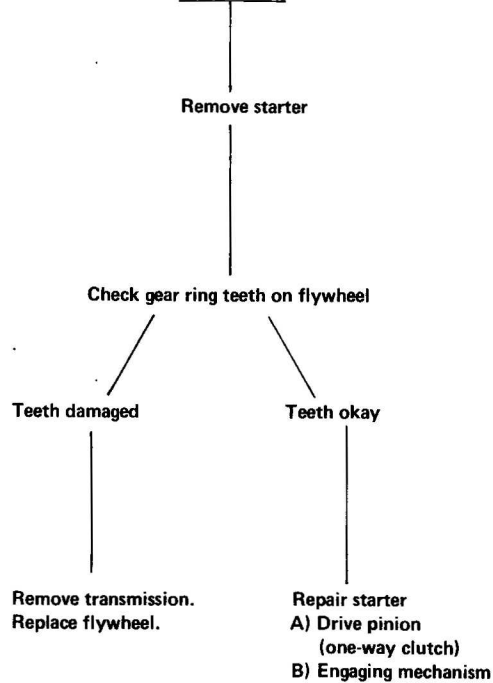
Starter Does Not Work



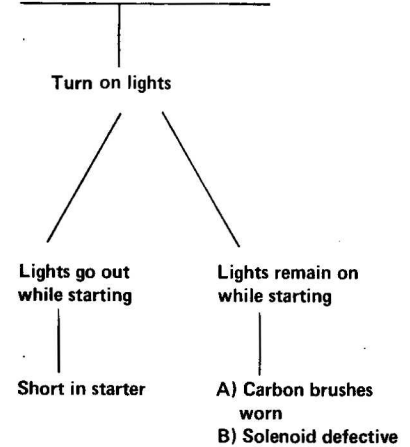
Starter Turns Too Slow

- A) Bearings worn or very dirty
B) Electrical defect in solenoid, armature or coils

Starter Slips



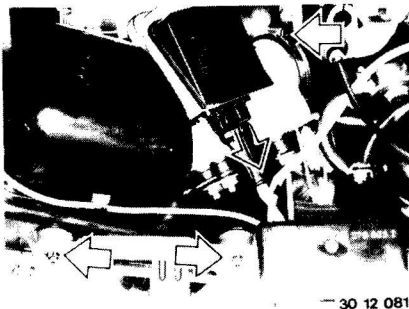
Starter Does Not Turn — Only Click in Solenoid Heard



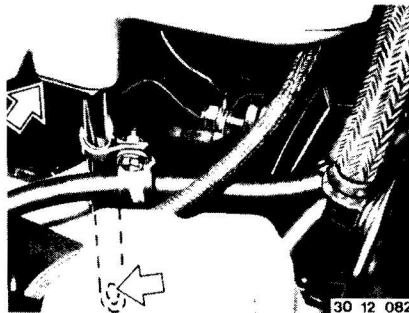
12-51

12 41 020 REMOVING AND INSTALLING STARTER

Disconnect battery ground lead.
Remove air cleaner with air flow sensor.



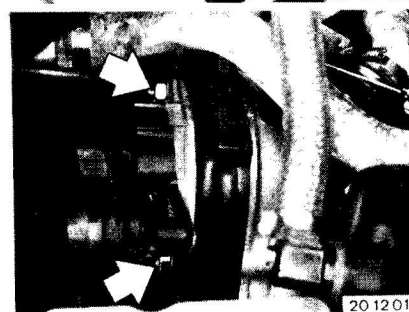
Unscrew bracket for air collector.



Unscrew holder.
Disconnect lines.



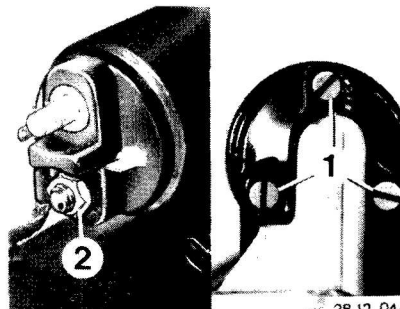
Drain coolant.
Disconnect heater hose, unscrewing coolant pipe if necessary.
Unscrew nuts and remove starter from above.
Installation:
Pour in coolant* and bleed cooling system 17 00 039.



* See Service Information of Gr. 00

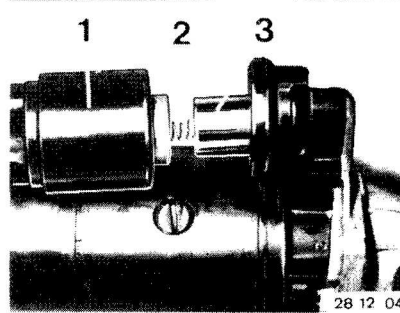
12 41 041 REPLACING SOLENOID SWITCH

Remove and install starter 12 41 020.
Unscrew bolt (1).
Unscrew nut (2).



Remove solenoid switch (1) with spring (2).
Disconnect and remove armature (3).

Installation:
Check armature (3) for wear (scoring, deep spots, etc.), replacing if necessary.
Lubricate with grease before installing.



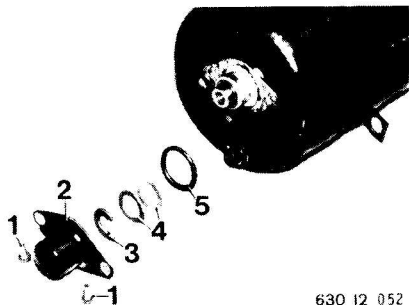
12 41 103 DISASSEMBLING/ASSEMBLING STARTER

Remove starter — see 12 41 020.
Remove solenoid switch — see 12 41 041.
Unscrew dust cap (2).

Take off circlip (3), shims (4) and seal (5).

Installation:

Check axial play* of armature, correcting with shims if necessary.



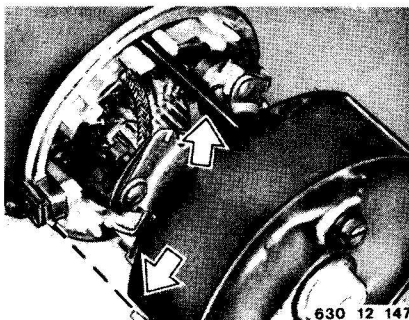
630 12 052

Unscrew housing bolts and take off cover.

Installation:

Align openings for housing bolts and insulator to each other.

Check bearing sleeve, lubricating with oil before installing.



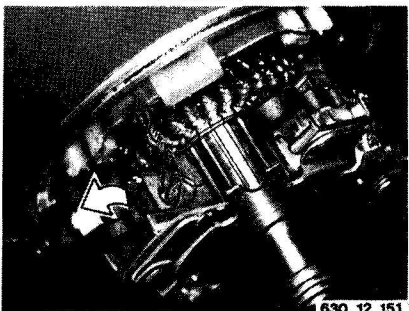
630 12 147

Lift springs and pull out carbon brushes.

Remove holder.

Installation:

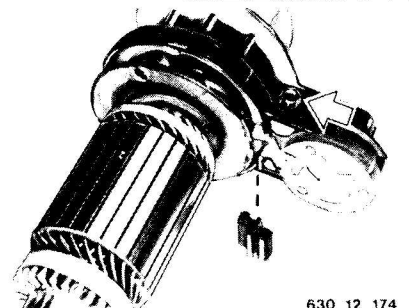
Check carbon brushes and commutator for wear, repairing if necessary — see 12 41 551.



630 12 151

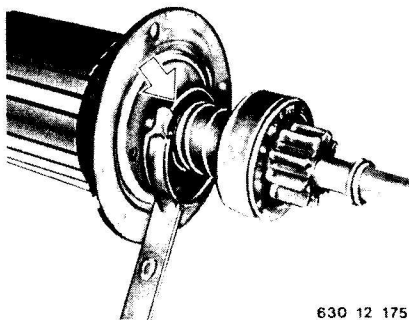
Remove pole housing.

Unscrew engaging lever bolt and remove rubber seal.



630 12 174

* See Specifications

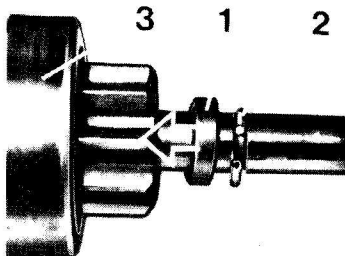


630 12 175

Lift out armature with drive pinion and engaging fork.

Installation:

Lubricate guide for engaging fork with grease. Check bearing sleeve in drive bearing bracket, lubricating with oil before installing.



Push back bearing race (1) with a piece of suitable pipe.

Pry circlip (2) apart and pull it off of the shaft.

Remove burrs with a file.

Take off drive pinion (3).

Installation:

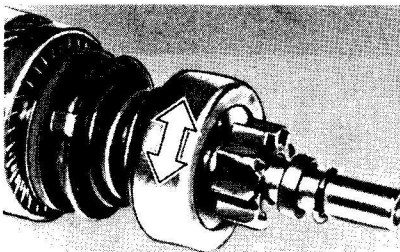
Use new circlip (2).

Lubricate bearing surface for drive pinion with grease.

28 12 049

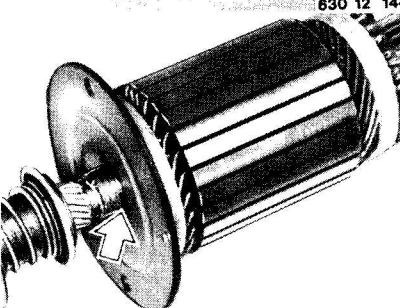
Installation:

Check pinion for wear (on teeth, bearings, one-way clutch), replacing if necessary.



630 12 144

Check sleeve in intermediate bearing, replacing if necessary.

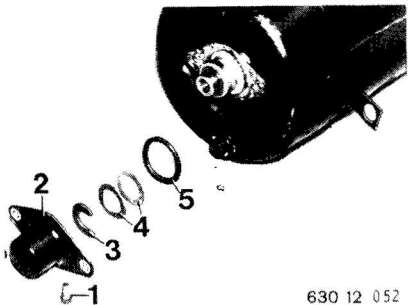


630 12 187

12 41 551 REPLACING CARBON BRUSHES — STARTER REMOVED —

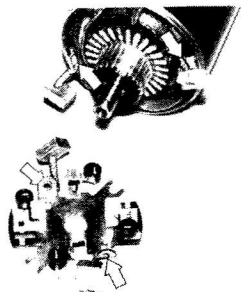
Unscrew mounting bolts (1).
Remove dust cap (2).
Remove lock washer (3), shims (4) and seal (5).

Installation:
Take up axial play* with shims (4).



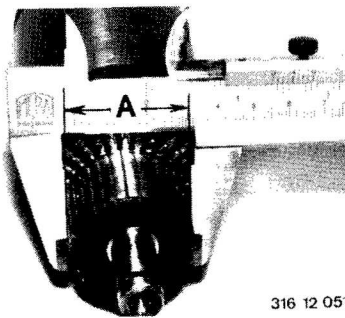
630 12 052

Remove holder and pole housing.
Unsolder or cut off all carbon brushes.
When soldering in new carbon brushes, make sure that copper leads are not hardened with flowing solder.



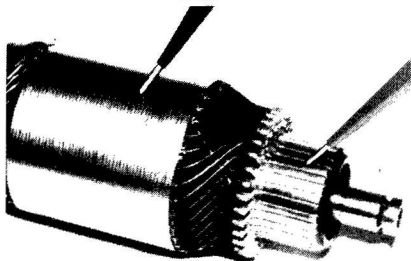
630 12 060

Check commutator for wear, fine grinding if necessary.
Diameter must be at least 33.5 mm (1.319").
Machine insulation between plates approx. 0.5 to 0.7 mm (0.020 to 0.028") deep.



316 12 051

Check armature for shorted turns after repairing.

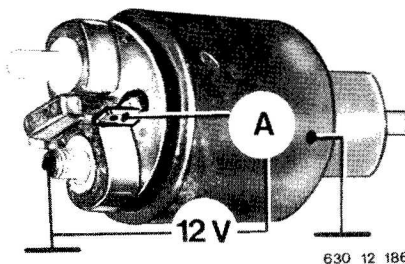


316 12 053

12 41 ... INSPECTING COMPONENTS OF STARTER

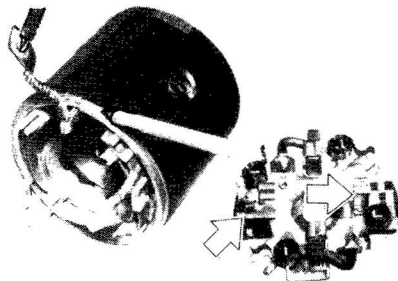
— Electric Test —

Check power input* of engaging and holding coils in solenoid switch.

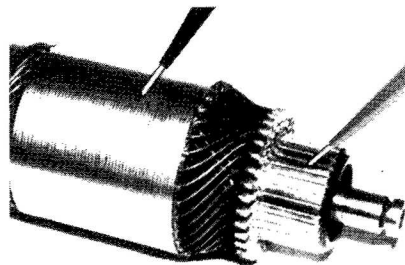


630 12 186

Check exciter coil, carbon brush holder and armature coil for ground contact.
Check armature for shorted turns.
Use a standard tester.



63012145



316 12 053

* See Specifications

12-100

INSTRUCTIONS FOR WORKING ON TRANSISTORIZED COIL-TYPE IGNITION (TCI) AND DIGITAL MOTOR ELECTRONICS (DME)

Always disconnect battery or interrupt power supply to ignition control unit and ignition coil when working on the electrical system (charging battery or welding, etc.) — dangerous primary and secondary voltage as well as danger of destroying the ignition system.

Never start the engine after removal of distributor cap and / or disconnection of wire on ignition coil term. 4 — pull off plug on ignition control unit.

Never disconnect the battery or leads on the alternator and starter while engine is running.

Only install specified original BMW parts.

Never connect a shielded capacitor or test lamp on term. 1 of the ignition coil.

Never connect wire of ignition coil term. 1 on ground or B +. Consequently the ignition coil term. 1 wire must not be used to prevent engine starting when service installing a burglar alarm system.

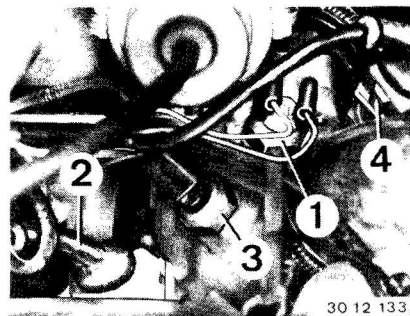
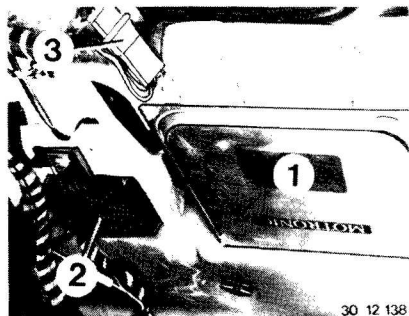
When checking the compression, pull off plug on control unit for TCI or master relay for fuel injection (relay no. 2) for DME.

The secondary side (high voltage side) of the ignition system must be shielded with at least 4 k-ohms, whereby the original distributor rotor with 1 k-ohm shielded resistor must be installed. Do not use a 5 k-ohm distributor rotor for the shielding of radio and / or communication equipment!

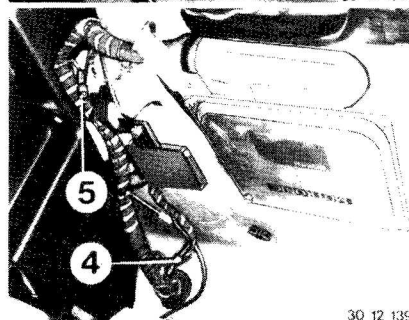
ENGINE ELECTRIC LAYOUT

1984/1985 Models:

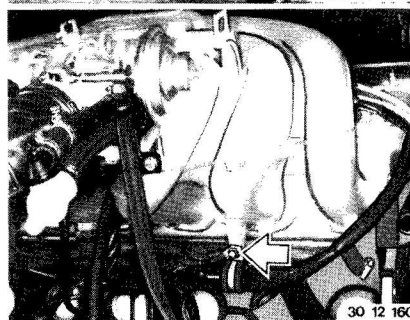
- 1 Control unit for DME (see Gr. 13)
- 2 Control unit for idle speed (see Gr. 13)
- 3 Plug for car electric system, fuel pump relay



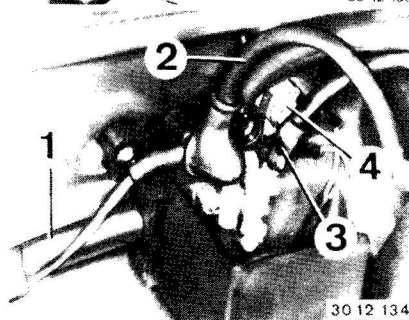
- 1 Temperature switch 45° C (113° F) for idle speed control
- 2 Coolant temperature sensor for DME
- 3 Temperature transmitter
- 4 Temperature time switch



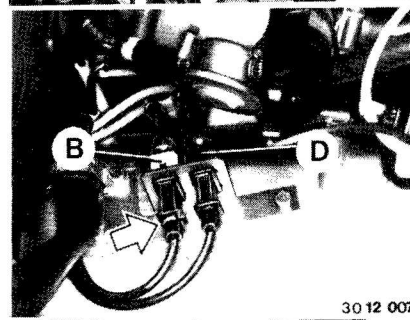
- 4 Plug – transmission versions (wire colors: green/yellow – blue/brown) – not used for automatics (lean mixture) – connected for manuals
- 5 Plug – air conditioner (wire colors: blue/white)



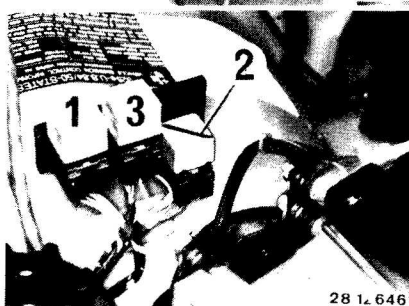
Ground point for engine electric system



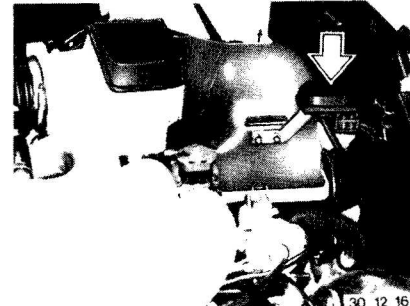
- 1 Battery positive lead
- 2 To engine electric system
- 3 To car electric system
- 4 Switch 0° C (32° F) for idle speed control



Plug for (gray) reference mark sensor (B) and speed sensor (D)



- Relay 1 for fuel pump
Relay 2 for DME
Relay 3 for oxygen sensor heating

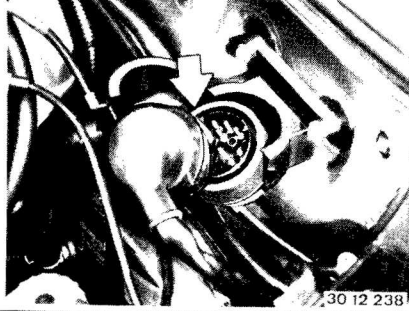
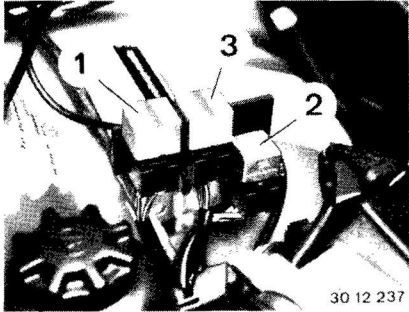
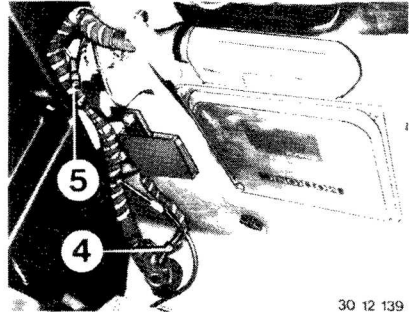
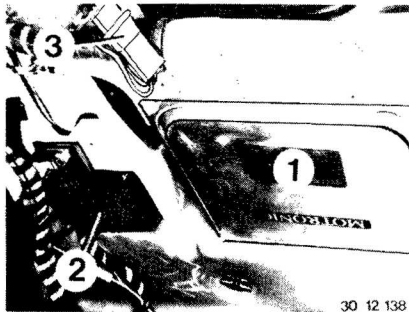


Pressure sensor (see Gr. 13)

ENGINE ELECTRIC LAYOUT

1986 Models:

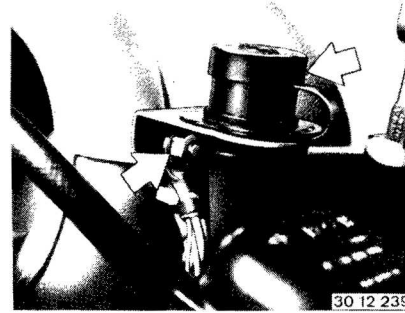
- 1 Control unit for DME (see Gr. 13)
- 2 Control unit for idle speed (see Gr. 13)
- 3 Plug for car electric system, fuel pump relay



- 4 Plug – transmission versions (wire colors: green/yellow – blue/brown) – not used for automatics (lean mixture) – connected for manuals
- 5 Plug – air conditioner (wire colors: blue/white)

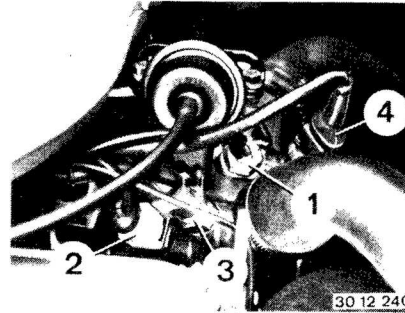
Relay 1 for fuel pump
Relay 2 for DME
Relay 3 for oxygen sensor heating

Twenty pin engine wire harness plug
Installation:
The screw-on cap engages in final position.

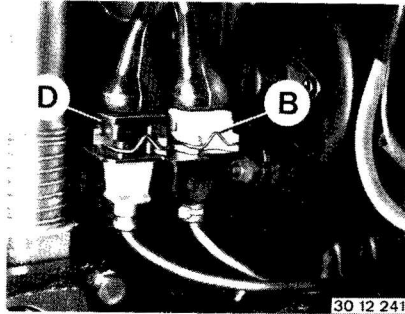


Ground point for engine electric system

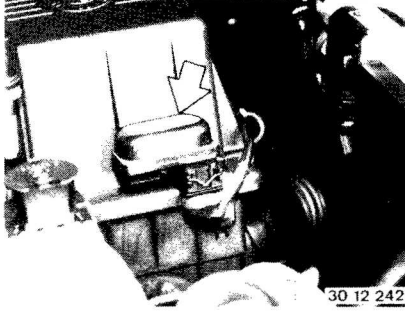
Diagnosis plug



- 1 Temperature switch 45° C (113° F) for idle speed control
- 2 Coolant temperature sensor for DME
- 3 Temperature transmitter
- 4 Temperature time switch



Plug (gray) for reference mark sensor (B) and plug for speed sensor (D)



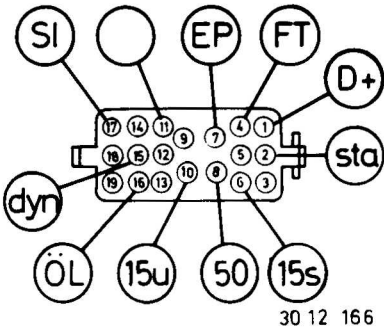
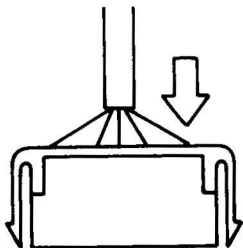
Pressure sensor (see Gr. 13)

CONNECTION PLAN FOR ENGINE WIRE HARNESS PLUG

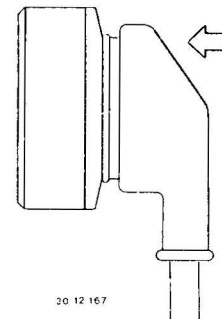
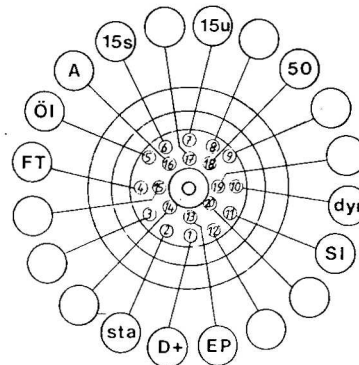
Until 1985 Models

No. Term. Description

1	D+	Alternator charge indicator
2	sta	Oil level static
3	—	—
4	FT	Coolant temperature transmitter
5	—	—
6	15s	Power supply with ignition turned on — fuse protection
7	EP	Electric fuel pump
8	50	Power while starting
9	—	—
10	15u	Power supply with ignition turned on — wire without fuse protection
11	—	—
12	—	—
13	—	—
14	—	—
15	dyn	Oil level dynamic
16	Öl	Oil pressure
17	SI	Service indicator reset
18	—	—
19	—	—



30 12 166

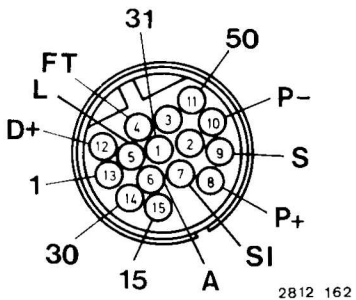


20 12 167

Since 1986 Models

No. Term. Description

1	D+	Alternator charge indicator
2	sta	Oil level static
3	—	—
4	FT	Coolant temperature transmitter
5	Öl	Oil pressure
6	15s	Power with ignition turned on — fuse protection
7	15u	Same as 6, but wire without fuse protection
8	—	—
9	—	—
10	dyn	Oil level dynamic
11	SI	Service indicator reset
12	—	—
13	EP	Electric fuel pump
14	—	—
15	—	—
16	A	Diagnosis lead for airbag
17	—	—
18	50	Power while starting
19	—	—
20	—	—

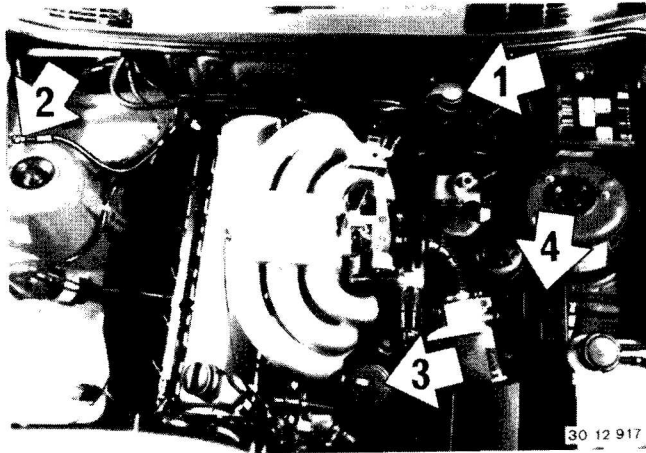


2812 162

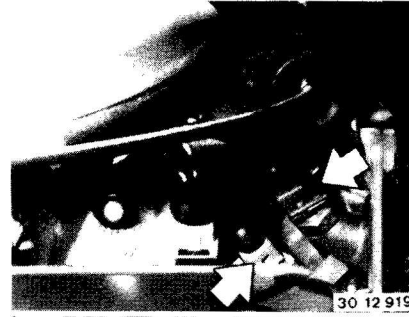
CONNECTION PLAN FOR DIAGNOSIS PLUG

No.	Term.	Description
1	31	Ground
2	-	-
3	-	-
4	FT	Temperature gage
5	L	Oxygen sensor signal
6	A	Diagnosis lead for airbag
7	SI	Service indicator
8	P+	TDC position transmitter
9	S	Lead shielding
10	P-	TDC position transmitter
11	50	Power while starting
12	61	Alternator charge indicator
13	1	Speed signal
14	30	Battery +
15	15	Power with ignition turned on

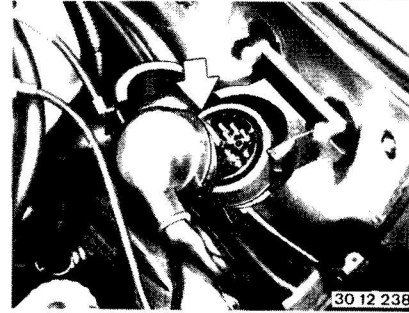
Engine Electric Layout M 20 (M 1.1) / 325 i



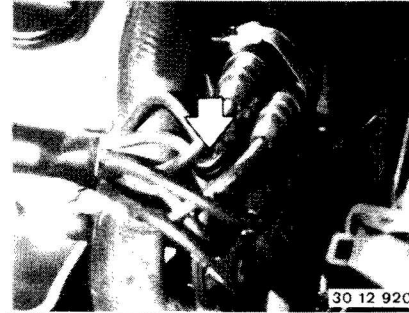
- Layout:**
- 1 = Engine wire harness plug
 - 2 = Engine electric/electronic ground point
 - 3 = Diagnosis socket
 - 4 = Relay connection point



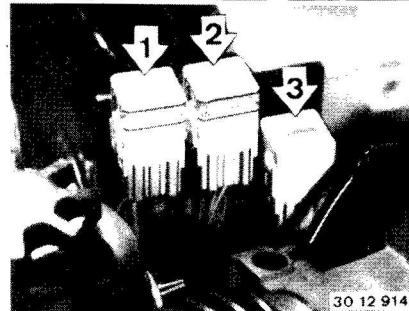
Coolant temperature sensor (DME) blue
Temperature gage



20-pin engine wire harness plug
Installation:
Screw-on cap engages in final position.

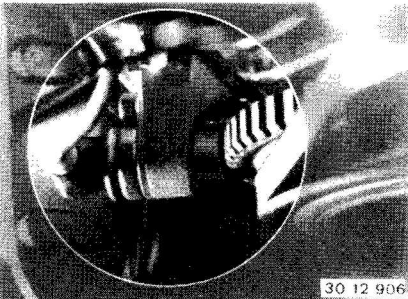


Cylinder identifying sender



Relay Survey:

- 1 = DME
- 2 = Electric fuel pumps
- 3 = Oxygen sensor

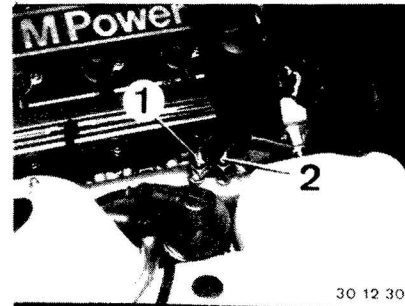


Inductive pulse sender

**Engine Electric Layout
Model M 3 / S 14
Underneath trim panel in glove box**

- 1 DME control unit (see Gr. 13)
- 2 Car wire harness plug
- 3 Air conditioner plug
- 4 Fuel version plug (see Gr. 13)

30 12 308



30 12 307

- 1 Coolant temperature sensor
- 2 Temperature gage



30 12 238

20-pin engine wire harness plug
Installation:
Screw-on cap engages in final position.

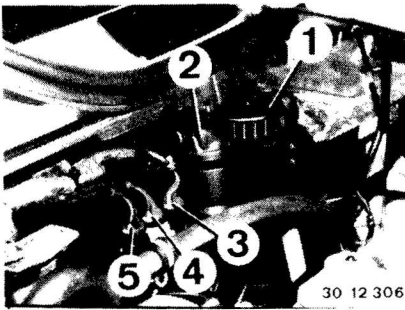
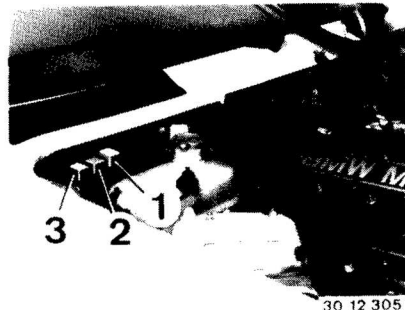
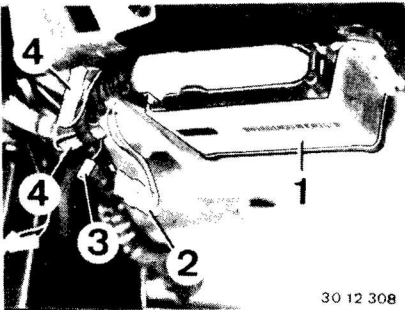
Relays Behind Trim Panel

- 1 Fuel pump relay
- 2 Master relay
- 3 Tank venting relay

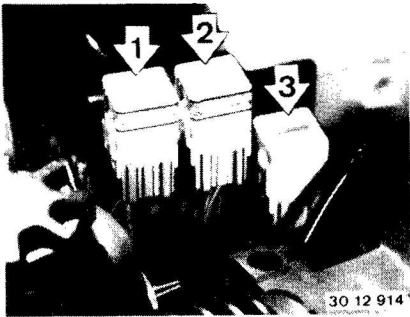
30 12 305

- 1 Diagnosis socket
- 2 Engine wire harness plug
- 3 Position sender plug
- 4 Reference mark plug (gray)
- 5 Speed sender plug

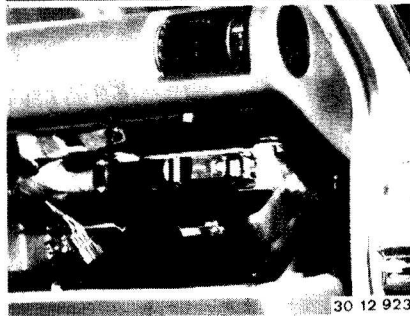
30 12 306



- Relay Survey:
M 20
1 Master relay
2 Fuel pump relay
3 Oxygen sensor relay

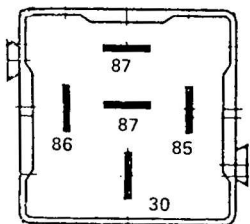


30 12 914

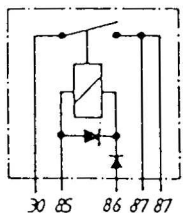


30 12 923

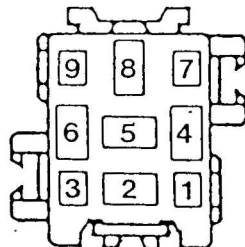
- M 20
DME control unit (in glove box)



32 12 139



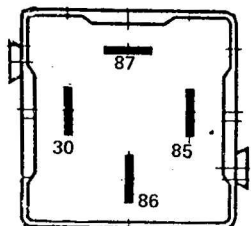
32 12 141



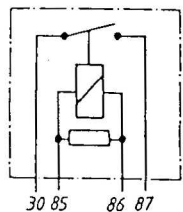
32 12 140

Master Relay / M 20:
(plugs, wiring diagram, socket)

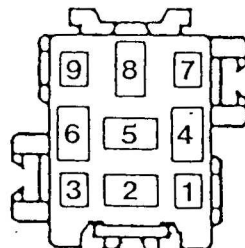
Jack No.	Term. No.	Wire Color (Size in mm ²)
2	87	red/white (0.75/4)
4	85	brown (0.5)
5	87	red/blue (4)
6	86	red (0.5)
8	30	red (4/0.5)



32 12 142



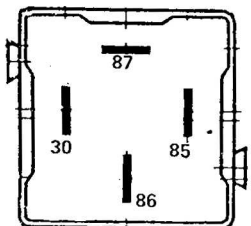
32 12 143



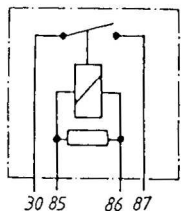
32 12 140

Fuel Pump Relay / M 20:

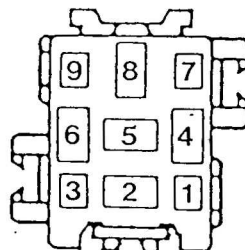
Jack No.	Term. No.	Wire Color (Size in mm ²)
2	87	green/violet (1.5/1)
4	85	brown/green (0.5)
6	30	red (1.5)
8	86	red/white (0.75)



32 12 142



32 12 143



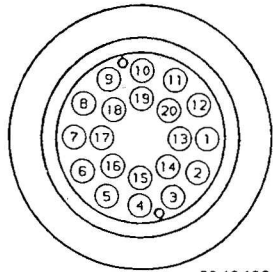
32 12 140

Oxygen Sensor Relay / M 20:

Jack No.	Term. No.	Wire Color (Size in mm ²)
2	87	green/blue (0.5)
4	85	brown/green
6	30	green/white (1/0.5)
8	86	green/white (0.5)

12-107/1

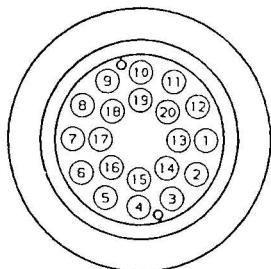
ENGINE PLUG CONNECTIONS (in Installed Position Seen From Above) M 20



32 12 126

Pin No.	Description	Wire Colors
1	D+ Generator charge indicator	blue
2	STAT Oil level static	green/yellow
3	TXD	
4	FT Coolant temperature gage	brown/violet
5	OELD Oil pressure	brown / green
6	15 S Voltage with ignition on – fuse protection	green / white
7	15 U Same as 6, but lead without fuse	green
8	TI DME control unit/idle speed control	white / green
9	TD Speed signal	black
10	DYN Oil level dynamic	blue
11	SI Service indicator reset	white / green
12	CARB DME control unit/engine plug	green
13	EKP Electric fuel pump	green / violet
14	TACH Speedometer signal	black / white
15	P / N Starter / engine plug	black / green
16	Airb. Engine plug / diagnosis plug	white / black
17		
18	50 Voltage while starting	black / yellow
19	PGSP	
20	FTM	brown

ENGINE PLUG CONNECTIONS (in Installed Position Seen From Above) S 14



32 12 126

Pin No.	Description	Wire Colors
1	D+ Generator charge indicator	blue
2	STAT Oil level static	white
3	TI Injection signal	white / black
4	FT Coolant temperature gage	brown / white
5	OELD Oil pressure	brown / green
6	15 S Voltage with ignition on -- fuse protection	yellow / blue
7	15 U Same as 6, but lead without fuse	green
8	DWA Burglar alarm	black/violet
9	TD Speed signal	black
10	DYN Oil level dynamic	yellow
11	SI Service indicator reset	white / blue
12	CARB Fault display only for US models	gray
13	EKP Electric fuel pump	green/violet
14	TACH Speedometer signal	black/white
15	P / N Selector lever position	brown/black
16	RXD Self-diagnosis transmitting lead	white/yellow
17	TXD Self-diagnosis transmitting lead	white/violet
18	50 Voltage while starting	black/yellow
19	Oeltemp Oil temperature sender	brown/violet
20	FTM Temperature gage ground	brown/yellow

55 PIN PLUG CONNECTIONS

Pin Number	M = Ground A = Output E = Input	Connections for Control Unit M 1.1
1	A	Ignition term. 1
20	A	-
38	E	Interface ASC (S - ASC / S - DWA)
2	M	Ignition ground
21	A	-
39	E	Programming voltage input
3	A	EKP relay and crankshaft reference
22	A	LLR (ZWD) "locking"
40	E	A/C compressor switch (S - KO)
4	A	LLR (ZWD) "unlocking"
23	A	-
41	E	Air cond. switch (S - AC)
5	A	Tank venting (AKF valve)
24	M	Ground for final stages
42	E	Driving range switch (S - FS)
6	A	ID (standard interface)
25	A	-
43	E	-
7	E	Signal LMM
26	M	Ground LMM
44	E	Air temperature TANS
8	E	Cylinder identification
27	E	Terminal 15
45	E	Engine temperature TMOT
9	E	-
28	E	Oxygen sensor signal
46	E	-
10	(2)	Ground oxygen sensor
29	E	Speedometer signal from Instr. cluster
47	E	IIG connection positive
11	E	-
30	M	-
48	M	IIG connection B negative
12	A	Power supply LMM
31	(2)	Ground cylinder identification
49	E	-
13	E/A	Diagnosis wake lead (S - DIA, RxD)
32	A	ti (standard interface, KVA)
50	E	Interface MSR (S - MSR)
14	M	Ground fuel injectors
33	-	-
51	E	Transmission tap (S - GE)
15	A	Fault lamp
34	A	-
52	E	Idle switch (S - LL)
16	A	Fuel injector group 2 (cyl. 1, 3, 5)
35	A	-
53	E	Full load switch (S - VL)
17	A	Fuel injector group 1 (cyl. 2, 4, 6)
36	A	DME relay (relay 2)
54	E	Switch - clutch lockup (S - WK)
18	UB	Perm. pos. (power supply (MOS - RAM))
37	UB	Battery voltage from DME relay
55	E/A	Serial diagnosis lead (TxD)
19	M	Ground electronics of control unit

Explanations:

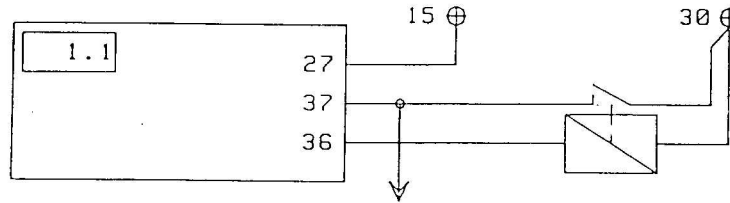
S = Switch
 ASC = Autom. Stability Control
 DWA = Burglar alarm
 EKP = Electric fuel pump
 KW = Crankshaft
 LLR = Idle speed control
 ZWS = Double-coil control
 LMM = Air flow sensor
 HLM = Hot-wire air mass sensor
 IIG = Inductive pulse sender
 MSR = Engine drag torque control
 EV = Fuel injector

(1) I_{max} (0.2 A) / U_{max} (150 V)
 (2) Ground Input without potential

12-107/4

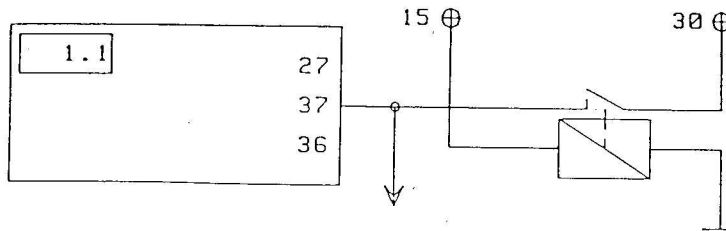
HOLDING CIRCUIT WIRING DIAGRAM (M 1.1 – Motronic)

Motronic with Holding Circuit Since 12.86 – Terminals 27 and 36 Used



The holding circuit makes sure that the Motronic master relay remains activated for another 3 sec. after switching off ignition lock terminal 15 and stopping the engine.

Motronic without Holding Circuit Before 12.86

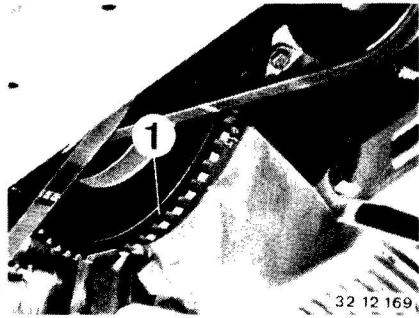


Terminals 27 and 36 Not Used

12-108

TROUBLESHOOTING ENGINE ELECTRIC AND DME

Accomplished with BMW Diagnosis Test since
introduction of M 1.1.



Recognizable on increment wheel (1) for
single-sender Motronic.

ENGINE ELECTRIC/ELECTRONIC BRIEF TEST LIST — Without Application of Self-Diagnosis — **

This brief test list refers to important points, which are required for correct function of the engine electric/electronics.

Tests are arranged to support each other and therefore should be carried out in the given order.

Testing Requirements:

- Starting system okay (battery charged, starting motor and ignition lock).
- Good ground connections between engine and body and engine wire harness okay.
- Specified gasoline in tank (octane number, leaded/unleaded, not contaminated).
- Engine in good operating condition (timing, compression, etc.).

Preparations:

Connect universal adapter* on DME control unit and wire harness with 55-pin connecting leads.

* Source of Supply: HWB

** Alternatively with BMW Diagnosis Tester

SURVEY FOR TROUBLESHOOTING DIGITAL MOTOR ELECTRONICS

— See application information on next page. --
Testing Requirements:
 Engine in perfect running condition (timing, compression, oil carbon deposits, etc.).
 Starting system in perfect condition (battery voltage, starter, ignition lock, etc.).
 Correct fuel in tank (octane rating, leaded/unleaded, dirt, etc.).
 Connections, plugs and ground points according to wiring diagram.
 Refer to "Troubleshooting Fuel Injection" in Group 13 for other test positions.

- 1) Cold engine will not start (oil temp. $\leq 20^{\circ}\text{C} / 68^{\circ}\text{F}$)
- 2) Engine starts, but stops again
- 3) Cold engine hard to start (oil temp. $\leq 20^{\circ}\text{C} / 68^{\circ}\text{F}$)
- 4) Warm engine will not start
- 5) Warm engine hard to start
- 6) Erratic idling during warm-up phase
- 7) Idle speed not correct
- 8) Splashing in intake
- 9) Hesitation while accelerating
- 10) Knock when accelerating
- 11) Hesitation while coasting
- 12) Misfiring at constant speed
- 13) Poor acceleration/final output
- 14) Fuel consumption too high
- 15) CO/HC not correct

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TEST POSITION	REFERENCE	
X			X								X									1	Speed sensor/reference mark sensor	
X	X	X	X	X			X				X									2	Ignition coil	
		X		X	X	X	X	X	X		X	X		X						3	Spark plugs	
		X		X	X		X	X			X									4	High voltage distributor	
		X		X	X		X	X			X									5	Ignition lead connectors and leads	
X	X	X	X	X					X	X		X	X							6	DME control unit / ignition timing	
																				7		
																				8		
																				9		
													X	X						10	Oxygen sensor/emission control and EGR	Group 11
														X						11	Active carbon filter/purge valve	Group 13/16
																				12		
	X			X				X			X									13	Tank vent system	Group 16
																				14		
X		X		X	X						X									15	Fuel supply	Group 16
		X		X	X	X		X	X	X	X	X		X						16	Intake system	Group 13
														X						17	Catalytic converter	Group 11
														X						18	Exhaust system	Group 18
		X		X	X	X					X		X							19	Crankcase vent/air hoses	Group 13
				X	X															20	Cooling system	Group 17
																				21		
																				22		
																				23		
																				24		
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																				26		
																				27		
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																				30		

TEST POSITIONS TO TROUBLESHOOT DIGITAL MOTOR ELECTRONICS

Application Information:

This survey can be applied for troubleshooting and consequently finding sources of defect more quickly.

The checked causes of malfunction might not always be sufficient to eliminate a defect, so that under certain circumstances additional tests could be necessary.

Testing instructions refer to the BMW SERVICE TEST, e.g. engine test/test step 05 (P 05) or a multimeter function (M). See operating instructions for connections.

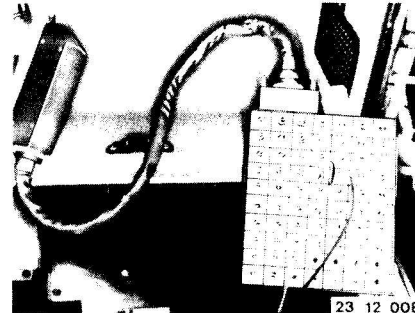
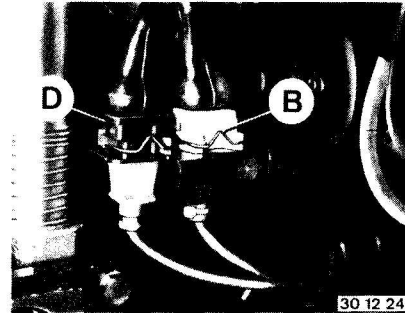
Test 1 – SPEED AND REFERENCE MARK SENSORS

Check wires for tight fit and damage.

Check connections and arrangement of plug connections.
Reference mark sensor (B) is marked with a ring – see 12 14 510 / 515.

Turn engine with the starter. Check resistance (M 06) and oscillograph (M 22/23) on disconnected pulse sensor plug with BMW service tester, see 12 14 510.

Check wires leading to DME control unit:
Take off trim panel.
Pull off plug on control unit and connect on universal adapter** with (35-pin) test lead – see illustration.
Check power flow and insulation (M 06) in wires on specified pins***.



* See Specifications

** Source: HWB (= Division of BMW)

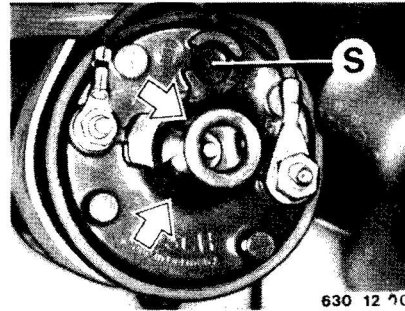
*** See engine wiring diagram

Test 2 – IGNITION COIL

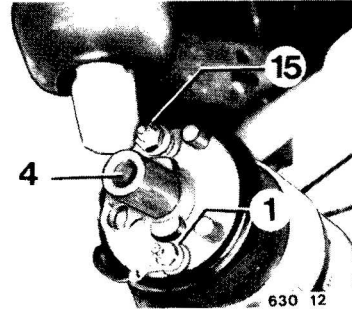
Check wires for tight fit.
 Check connection plate and ignition lead contacts for traces of burning, cracks and oxidation.
 Check code number* of ignition coil – see 12 13 009.

↓

Check resistance* (M 06) and inductivity* (M 07) of primary and secondary coils – see 12 13 009.



630 12 107



630 12

Test 3 – SPARK PLUGS

Check spark plugs for tight fit and leaks.
 Check insulator for signs of leakage current.

↓

Check spark plug type* and electrode gap*.
 Check resistance*.

12-112/2

Testing Connections on Universal Adapter	Test	Corrective Measures
Pin 18 / ground (19) Battery positive supply for control unit	Measure voltage ≈ 12 V	Check battery and lead via relay 2 (master relay) to control unit.
Pin 37 / ground (19) Power supply for control unit	Measure voltage with ignition ON > 10 V	Check / repair relay 2 (master relay) and electronics ground point.
Pins 2, 14, 19, 24 / body ground Ground supply for control unit	Measure resistance against battery negative or ground < 1 ohm	Check / repair connections and leads on ground point.
Pins 47 / 48 Inductive pulse sender	Check resistance of sender and plug connection 540 ohms ± 10 % Check speed signal (one signal for each revolution) with an oscilloscope	Repair leads, replacing pulse sender if necessary.
Pin 3 / ground Fuel pump relay activation	Check speed signal with oscilloscope	If pulse sender (pins 47 / 48) is okay, replace DME control unit

Testing Connections on Universal Adapter	Test	Corrective Measures
<p>Pin 1 (term. 1) / ground Ignition final stage</p>	<p>Crank engine with starting motor and check signal with an oscilloscope. Other Tests: Power supply for ignition coil Ignition coil Distributor and leads Spark plugs</p>	<p>Replace DME control unit, if tests up to this point are okay.</p>
<p>Pins 17 / 14 Final stage of fuel injectors for cyl. 2-4-6 (M 20)</p>	<p>Check signal with an oscilloscope. Other Tests: Plug connections and leads for fuel injectors Fuel injectors</p>	<p>Replace DME control unit, if tests up to this point are okay.</p>
<p>Pins 16 / 14 Final stage of fuel injectors for cyl. 1-3-5 (M 20)</p>	<p>Check signal with an oscilloscope. Other Tests: Plug connections and leads for fuel injectors Fuel injectors</p>	

Test 4 – HIGH VOLTAGE DISTRIBUTOR

Check distributor cap and rotor for correct fit, damage and hairline cracks as well as signs of burning.

Check wire connections for oxidation and good contact – see 12 11 091 / 111.

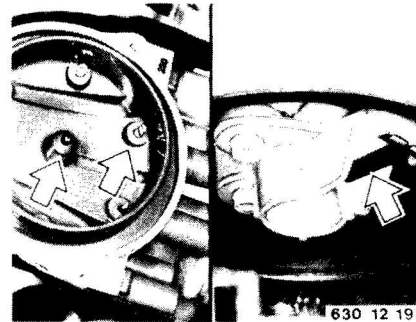


Check resistance* (M 06) from distributor peak to corresponding contact in distributor cap.

Resistance must be approximately 0 ohm.



Check resistance* (M 06) of distributor rotor.



Test 5 – IGNITION LEADS AND LEAD CONNECTORS

Check spark plug connectors and shielded connectors for damage, tightness and good contact.

Bend ignition leads in a tight radius and check for cracks.



Check resistance* (M 06) of spark plug connectors and ignition leads.

Test 6 – DME CONTROL UNIT AND POWER SUPPLY

Check code number* and manufacturing date* of DME control unit – see Group 13.

Check power supply**:

Pull off plug on control unit and connect universal adapter*** (see illustration) with (35-pin) test lead.

Car wire harness plugs remain connected.

Turn on ignition.

Check voltage of pins**, e.g. on connections 17 (–) and 35 (+).

Pull off relay 2 and bridge terminals 87 and 30 with a piece of wire. This supplies power to the control unit.

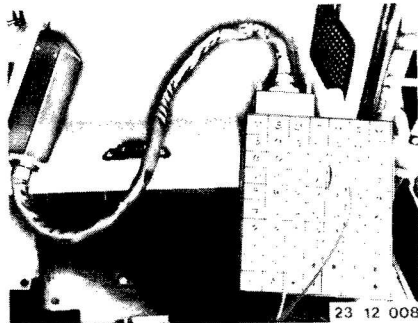
Check activation** for relay 2:

Turn on ignition.

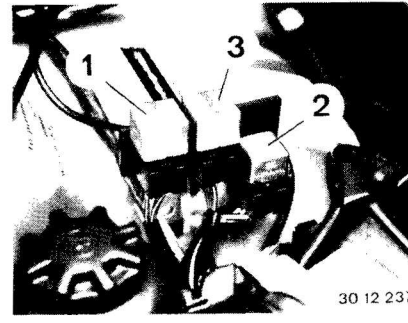
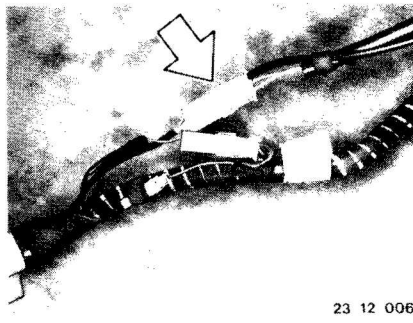
Terminals 85 (–) and 86 (+) should have voltage (approx. 12 V).

If necessary, check ground point and plug connection (near DME control unit) – see figure.

If test results indicate the necessity to replace the control unit, first make the periphery test with an universal adapter***.



Test 6a – IGNITION TIMING



Check ignition timing¹⁾ (P 06).

no

Replace DME control unit.


* See Specifications


** See engine wiring diagram

*** Source: HWB (= Division of BMW)

1) See nominal value microfiche

Test 15 -- FUEL SUPPLY

Check fuel feed to electric fuel pump.  Check filter screen in fuel intake
-- also refer to Group 16.

 Check electric fuel pump, fuel pipes, pressure regulator and fuel pressure -- see TROUBLE-SHOOTING FUEL INJECTION in Group 13.

Test 16 -- INTAKE SYSTEM

Check intake manifold and air cleaner for tight fit and damage.
Check connections and caps for tight fit and leaks.
Replace a dirty air cleaner filter element.

Test 17/18 – EXHAUST SYSTEM / CATALYTIC CONVERTER

Check exhaust system and catalytic converter for damage, tight fit and leaks.

Test 19 – CRANKCASE VENT

Check hoses for crankcase vent and oil dipstick for tight fit and leaks.

Test 20 – COOLING SYSTEM

Check coolant level and concentration**.
If necessary, fill and bleed cooling system – see Group 17.

12 11 031 REPLACING / CHECKING TDC POSITION TRANSMITTER

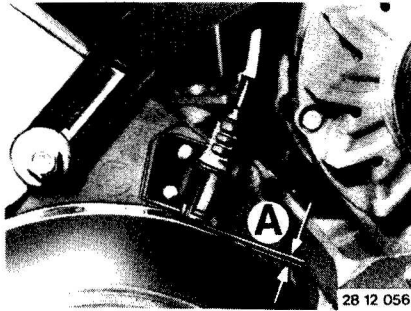
Lift position transmitter out of clamp.

Installation:

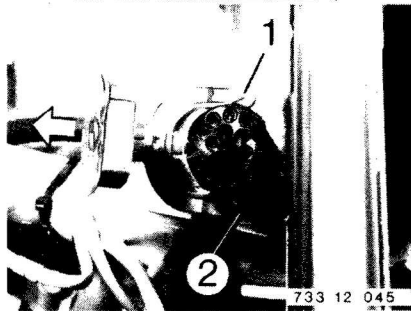
Make sure transmitter fits correctly.

Clearance A = 0.2 to 2.0 mm (0.008 to 0.080").

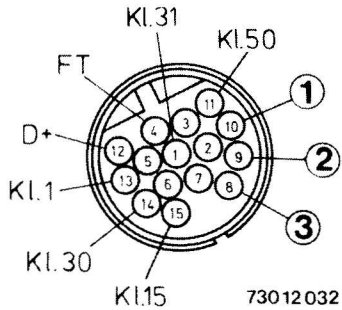
Mount wire.



28 12 056



733 12 045



73012032

Unlock hooks and push round female plugs (1 -- 3) for transmitter lead out of receptacle.

1 = Black wire

2 = Shielding

3 = Yellow wire

Checking:

Check resistance* of coil and insulation.

Maintain distance of 0.2 to 2.0 mm (0.008 to 0.080") to vibration damper.

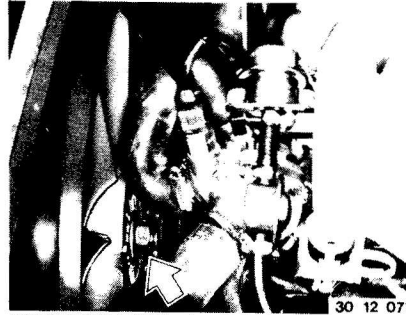
* See Specifications

12 11 091 REPLACING / CHECKING DISTRIBUTOR CAP

Caution!

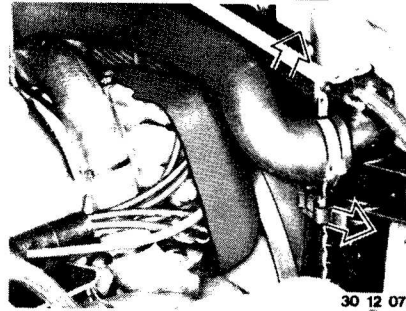
Always turn off ignition before working on dangerous high power ignition systems!

Unscrew fan – left-hand threads!



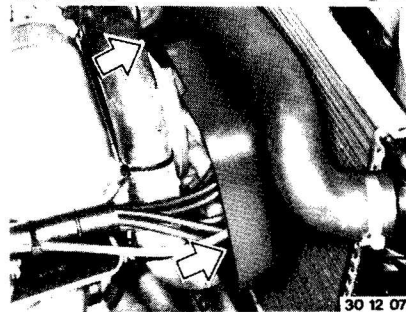
30 12 077

Unscrew fan cowl and lift out together with unscrewed fan.



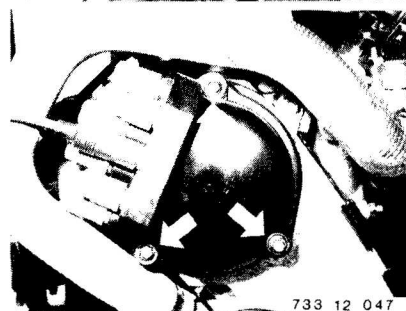
30 12 078

Take off retainers.
Pull off cover.

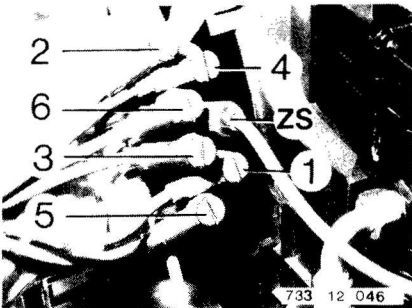


30 12 076

Unscrew screws for distributor cap.



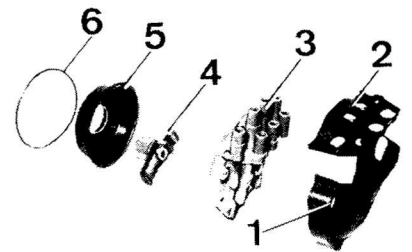
733 12 047



Pull off ignition lead plugs.

Installation:

Make sure plugs fit tight on ignition leads and in distributor cap.
Check firing order.



Checking:

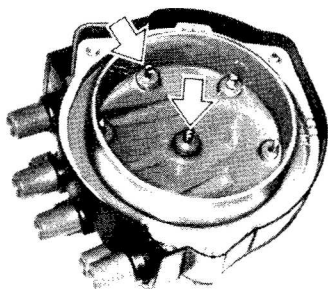
If the distributor cap only has to be removed and not replaced, check points and slip ring carbon brushes.
Inspect inside for hairline cracks.

730 12 023

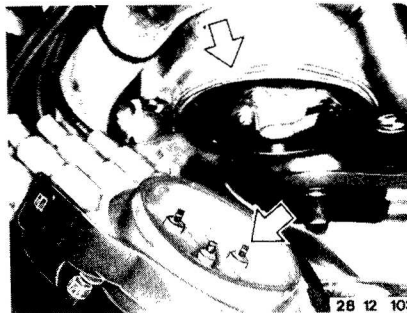
Take off protective caps (1 and 2).

Installation:

Check seal (6).



630 12 134



12 11 111 REPLACING / CHECKING DISTRIBUTOR ROTOR

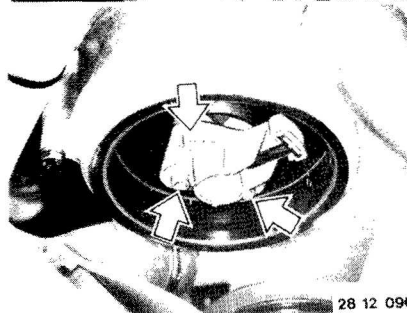
Caution!

Always turn off ignition before working on dangerous high power ignition systems!
Remove distributor cap - 12 11 091.

Installation:

Check seal.

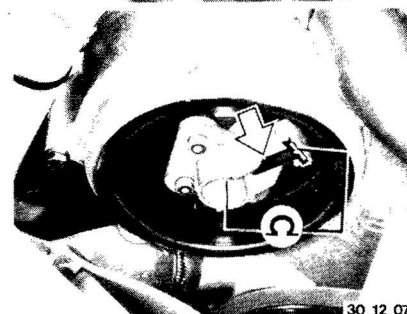
Inspect inside of distributor cap.



Unscrew distributor rotor.

Installation:

Tightening torque *



Checking:

Check resistance* in distributor rotor.

Check casting compound for cracks and burns.

12 12 071 REPLACING ONE SPARK PLUG CONNECTOR — 1988 Models —

M 3 / M 5 / M 6 Models:
Unscrew ignition lead tube.
Pull out spark plug connectors.

Testing:
Measure shielded resistance*.

Pull off rubber cap toward rear.
Unscrew spark plug connector.

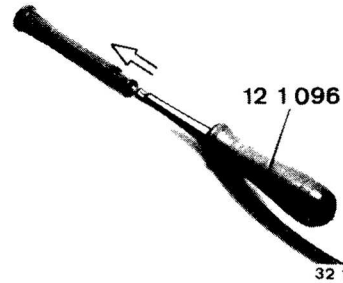
Installation:
Give rubber cap a thin coat of lubricant** to make installation easier.

Replacing Connection (Screwed) for Ignition Lead:

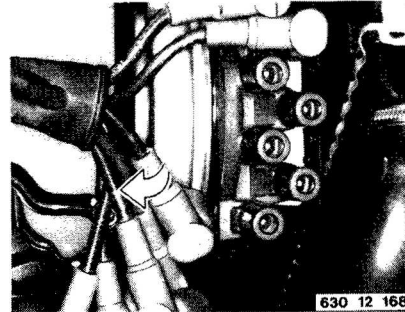
Strip the ignition lead insulation by about 12 mm (1/2") with a stripping pliers** after cutting off the connection.
Bend wire at length of about 6 mm (1/4").

Place connection flush with pliers and press on.

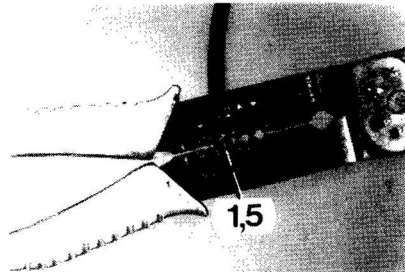
* See Specifications
** Source of Supply: HWB



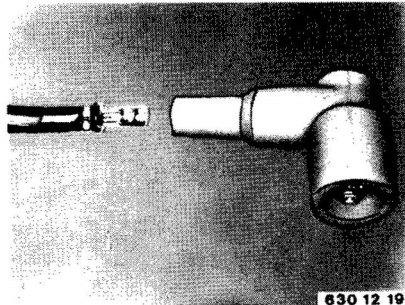
32 12 137



630 12 168



630 12 192



630 12 193

Place ignition lead in Special Tool 12 1 096 and slide into spark plug connector until connection is heard to engage.
Spray with lubricant (12 1 098) if necessary.

12 12 ... REPLACING SHIELDED CON- NECTOR AND IGNITION LEAD CONTACT (on Ignition Lead for Ignition Coil or Distributor)

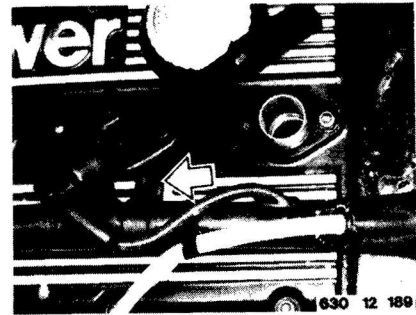
M 3 / M 5 / M 6 Models:
Pull off shielded connector and unscrew on
ignition lead.

Testing:
Measure shielded resistance*.

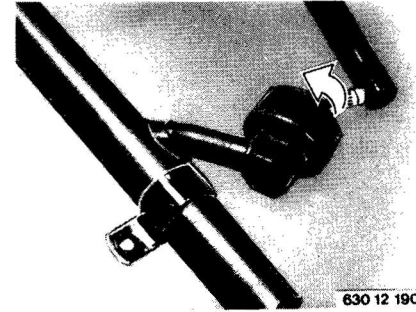
Strip insulation on ignition lead with an insula-
tion stripping pliers** after cutting off the old
lead contact.

Install new lead contact with pliers for ignition
lead contacts**.
Perform tear out test.
Apply a thin coat of lubricant** to make
installation easier.
Screw shielded connector on ignition lead

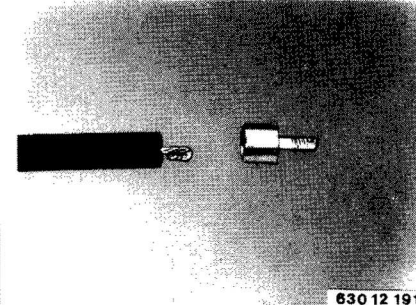
* See Specifications
** Source of Supply: HWB



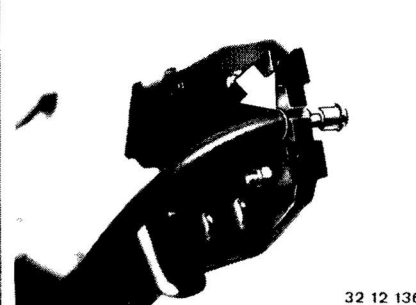
630 12 189



630 12 190



630 12 191



32 12 136

12 12 ... REPLACING CYLINDER IDENTIFYING SENDER

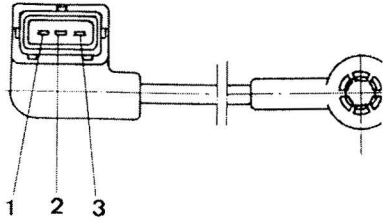
Take off cover.
 Pull off ignition lead shielded plug of cylinder no. 6 on M 20 engines and cut off ignition lead.
 Cut off sender on ignition lead.

28 12 009

M 20:
 Disconnect plug underneath the diagnosis socket.
 Take off leads.
 Plug on new sender.

30 12 926

Checking Sender:
 Measure resistance of coil between leads 1 and 2.
 Nominal value*.



32 12 105

12 1 080/081

Install shielded connector.
 See 12 12 072 in Group 12.

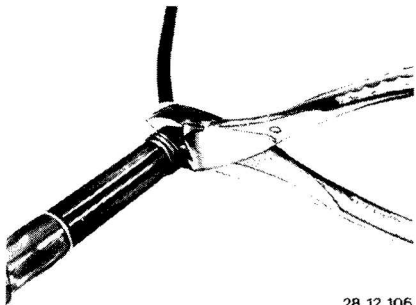
32 12 135

* See Specifications

12-132/2

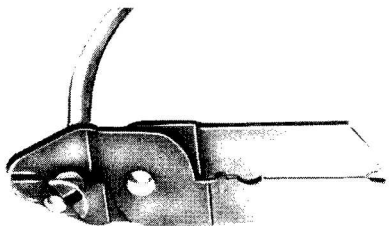
12 12 072 REPLACING ONE SPARK PLUG CONNECTOR

Non-disconnectable version — 30 kV System:
Cut off ignition lead as shown.



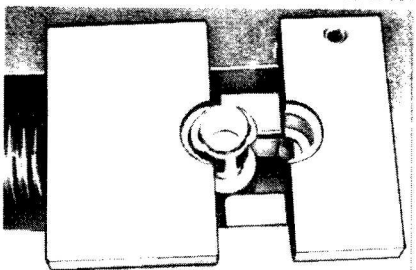
28 12 106

Strip end of ignition lead by 6 mm with a stripping pliers (1.5 mm wire cross section size).



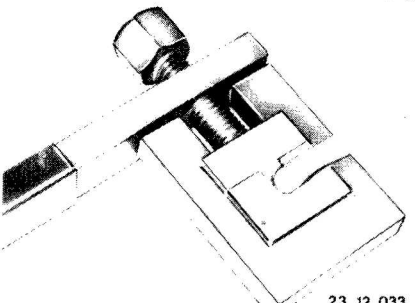
23 12 031

Place connector on ignition lead and insert in Special Tool 12 1 091 as shown. Move clamping jaws together by turning screw against stop.

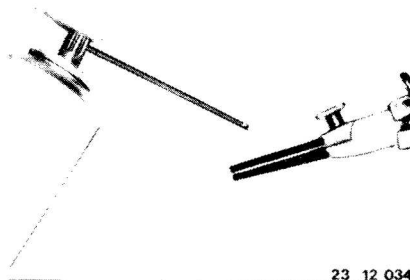


23 12 032

After squeezing, release jaws and take out the ignition lead. Perform tear-out test by hand (tearing-out force: ≥ 200 N / 44 lbs.).



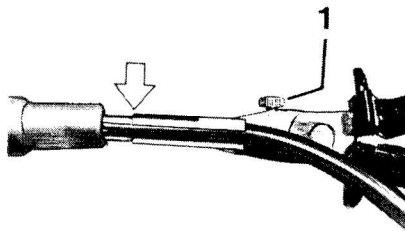
23 12 033



23 12 034

Spray a thin coat of lubricant 12 1 098 on guiding sleeve of Special Tool 12 1 092.

Unscrew screw (1). Slide in ignition lead against stop (see picture), follow with pliers and slide in ignition lead further until connector is heard to engage.



28 12 109

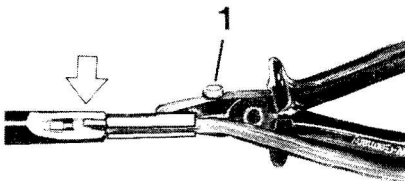
Tighten screw (1) enough, that the pliers can be pulled back.

Caution!

Opening the pliers too much could cause the plug receptacle to break. The plug receptacle is shown cut open for better illustration.

Note:

The required special tools 12 1 091/092/098 are also available as a complete set 12 1 090.



28 12 110

12 13 009 CHECKING IGNITION COIL

Connect BMW service test unit.
Carry out engine test step 09.
Observe oscillograph — ignition voltage and ignition voltage deviation must agree with nominal values **.

Multimeter Test (M 06):
Measure resistance * of primary coil (term. 1/15) and secondary coil (term. 15/4).

Check for hairline cracks and signs of burning.
Check plug (S) for tight fit — if pressed out, replace ignition coil.

12 13 011 REPLACING IGNITION COIL

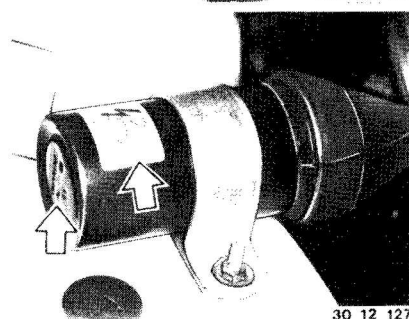
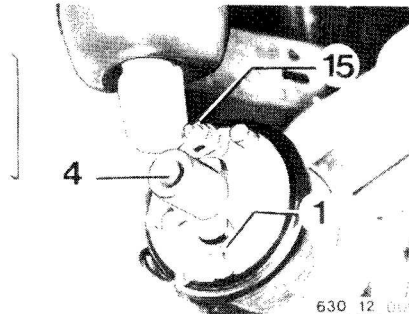
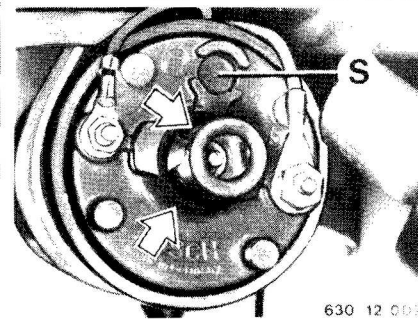
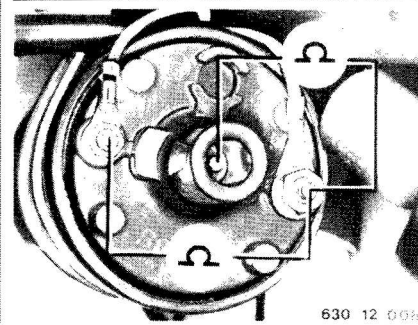
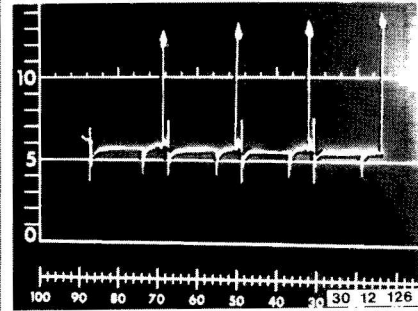
Caution!
Always turn off ignition before working on the ignition system — dangerous high voltage!
Refer to page 12 - 0 for instructions for working on ignition system.

Pull off protective cap and ignition lead (term. 4).
Unscrew connections (term. 1 and 15).
Unscrew holder and take off ignition coil.

Installation:
Check new ignition coil for correct code number * and color label *.

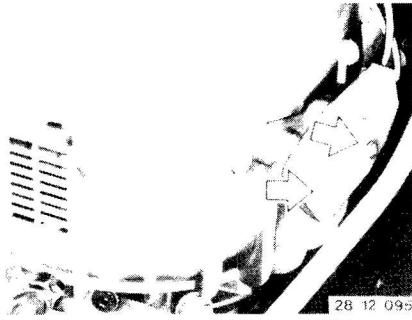
* See Specifications
** See nominal value microfiche

* See Specifications



12 14 510/ REPLACING/CHECKING SPEED 515 AND REFERENCE MARK SENSORS

Unscrew shield.

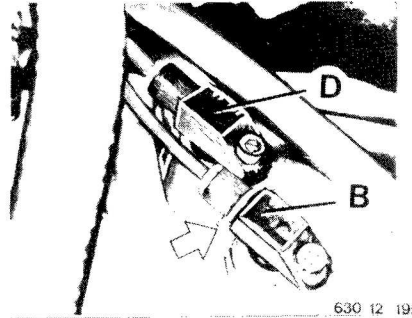


28 12 095

Unscrew screws of speed and reference mark sensors (D and B) and pull out sensors.

Installation:

Mark new reference mark sensor (B) with a piece of tape.



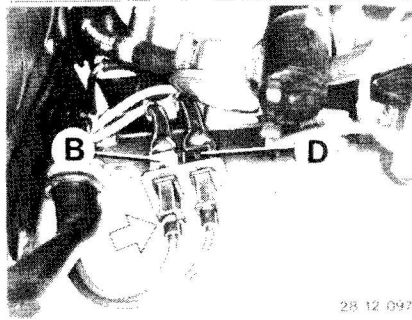
630 12 195

Pull off plugs on speed sensor (D) and reference mark sensor (B).

Press plug of sensor lead out of holder.

Installation:

Plug marked with tape belongs to gray plug.



28 12 097

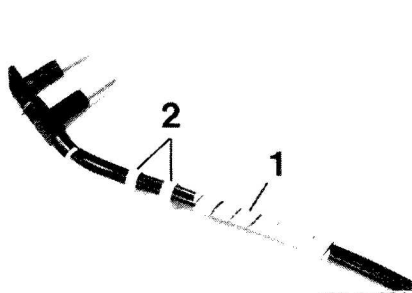
Pull off protective sleeve (1).

Lift out clip (2).

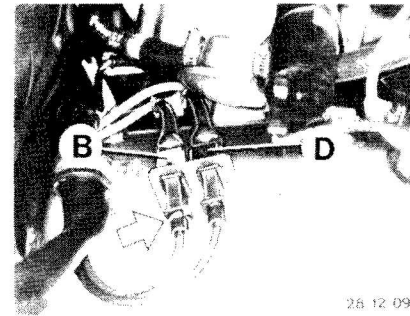
Installation:

Coat seals with Molykote paste.

Keep grease and dirt off of face surface on sensors.



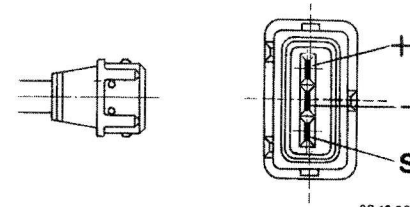
733 12 054



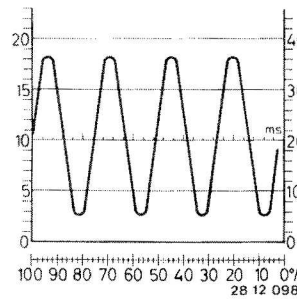
28 12 097

Testing:
Disconnect plug.
Connect BMW service test unit to operating instructions (M 06/22/23).
Use universal test leads.
B = Reference mark sensor
D = Speed sensor

Measure resistance* of sensor coil (M 06) on + and - of plug.

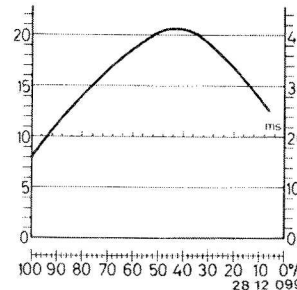


28 12 089



28 12 098

Connect oscilloscope (M 22/23) on + and - connections of speed sensor.
Turn engine with the starter.
Signal shown in the figure should be displayed.
Only the shape is important when evaluating the signal - not the amplitude height.



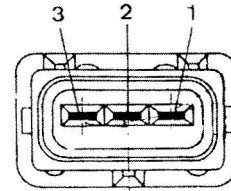
28 12 099

Check reference mark sensor in same manner.
If oscillograph deviates, remove sensor and check for dirt (grease, burrs, dust), cleaning if necessary.
Check reference mark, replacing pin for flywheel if necessary.

* See Specifications

12 14 . . . PULSE SENDER

Check pulse sender for tight fit and damage.



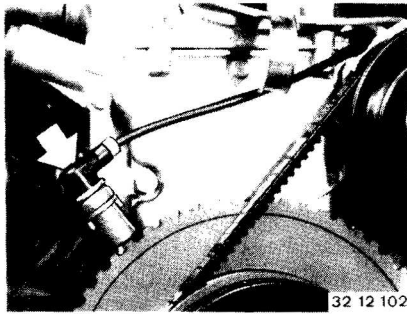
Multimeter Test (M 06):

Disconnect plug.

Measure resistance between 1 and 2.

520 ohms \pm 5 %.

Perform insulation test = > 100 k-ohms.



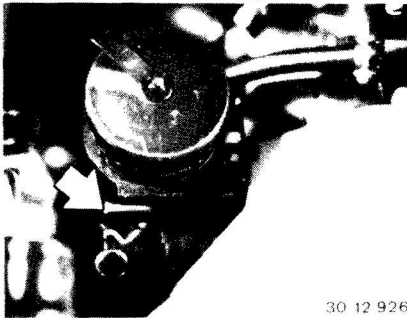
32 12 102

Disconnect plug.

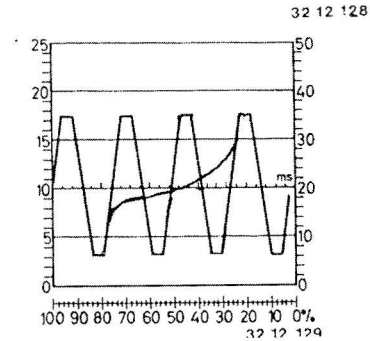
M 20

Note:

Remove guard rail on face.



30 12 926



32 12 128

Connect oscilloscope on connections 1 and 2 of pulse sender (M 22/23).

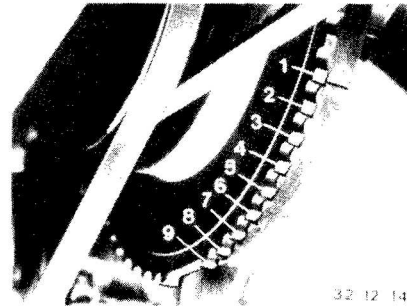
Crank engine with the starting motor.

The illustrated signal should appear in the oscilloscope screen.

Checking Increment Wheel:

1. TDC mark must be in middle of a tooth.
2. Gap must be located 9 teeth away from the TDC mark in engine's direction of rotation.

If not, replace vibration damper.



32 12 145

TROUBLESHOOTING ALTERNATOR

- Test Requirements: – Correct connections on battery, starter and alternator.
 – Good ground connection between engine and body.
 – Tight drive belt.

Charge Indicator Lamp NOT On with Ignition Turned On

Pull off connection plug D+/61 and connect with ground (term. 31).

Charge lamp on.

Take off voltage regulator. Check carbon brushes, replacing if necessary – see 12 32 000. Check slip rings for dirt or oxidation coat.

Connect BMW service test unit and perform engine test – see 12 31 009.

Charge lamp not on.

Check connections and wires ** for charge ind. lamp or replace light bulb – see 62 99 . . .

Charge Indicator Lamp ON with Ignition Off

Remove alternator. Replace diode plate – see 12 31 691.

Charge Indicator Lamp GLOWS or ON with Engine Running

Connect BMW service test unit and perform engine test (P 02)

Check regulating voltage *.
Check charging current *.

not okay

Replace voltage regulator – see 12 32 000.

Check oscillograph and harmonic wave ratio – see 12 31 009.

not okay

Replace or disassemble alternator and inspect components.

Battery is CHARGED INSUFFICIENTLY Charge Indicator Lamp Off with Engine Running

Connect BMW service Test unit and perform engine test (P 02).

not okay

Regulating voltage not as specified.

Replace voltage regulator – see 12 32 000.

okay

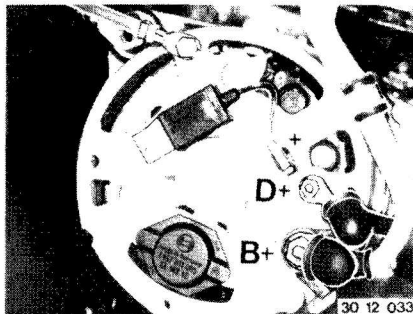
Check battery, replacing if necessary. Check power drain with equipment switched off.

Charging current * with equipment on too low.

Replace or disassemble alternator and inspect components – see 12 31 020

* See nominal value microfiche

** See wiring diagram

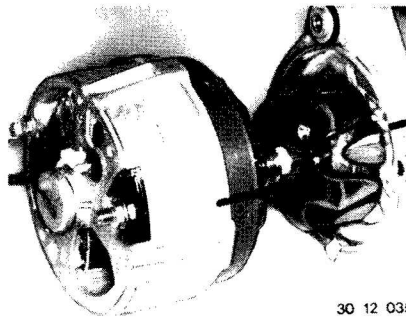


30 12 033

12 31 009 CHECKING ALTERNATOR AND VOLTAGE REGULATOR

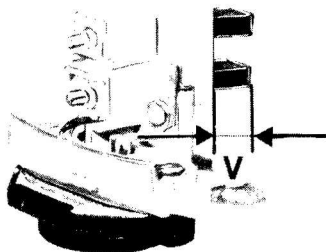
Testing Requirements:

- Correct connections on charged battery
- Correct connections on alternator and starter
- Good ground connection between engine and body.
- Tight drive belt.



30 12 035

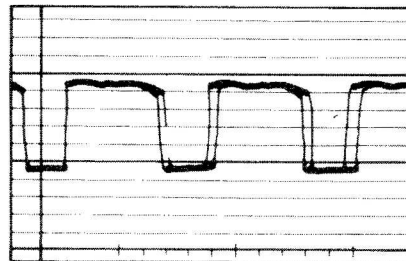
Repeat test.
If the specified charging current is not reached, remove and disassemble alternator, and inspect components - 12 31 020 / 513.



30 12 049

Indicator Lamp On Continuously:

Remove voltage regulator and check carbon brushes, replacing if necessary - 12 31 200. Distance "V" for new condition = approx. 12 mm (0.472").



630 11 031

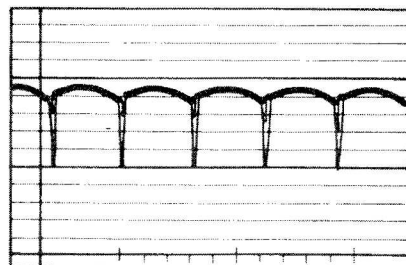
Oscillographs of Defective Alternator: Defective power or exciter diode.



M 21 12 080

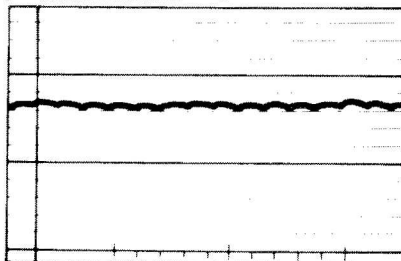
Installation:

Check slip rings for wear, fine grinding and polishing if necessary.
Connect BMW service test unit.
Start engine and compare test values with nominal values *.



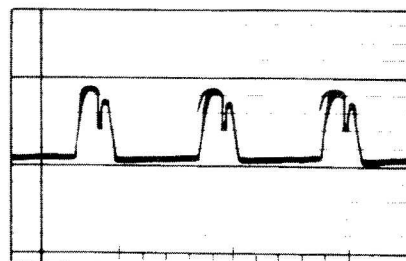
630 11 032

Shorted turn of stator coil.



630 11 025

If the battery charge indicator lamp goes out while engine is running and the regulating voltage * is not reached - harmonic wave ratio and oscillograph okay (as shown) - the voltage regulator has to be replaced, see 12 32 000.



630 11 027

Break in one exciter diode.

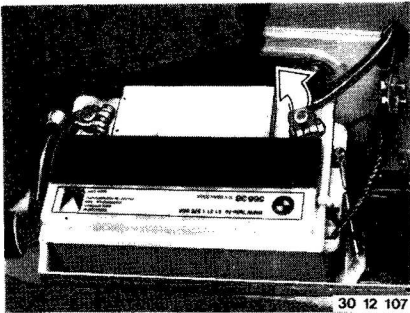
* See nominal value microfiche

12 31 020 REMOVING AND INSTALLING ALTERNATOR

Unscrew negative terminal on battery (in trunk).

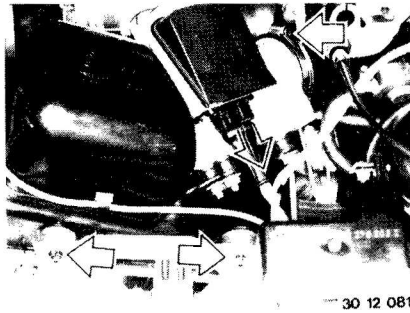
Caution!

Only disconnect leads on battery, alternator and starter when engine is stopped. Also disconnect positive and negative leads when charging battery with a charger.



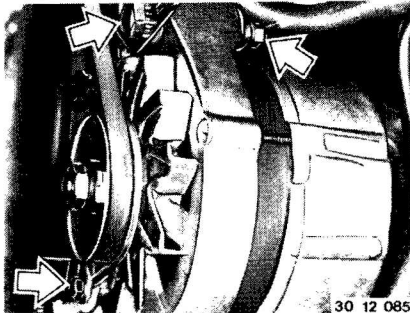
30 12 107

Take off air cleaner with air flow sensor.



30 12 081

Unscrew mounting bolts.



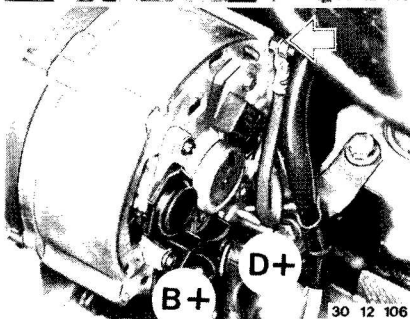
30 12 085

Unscrew leads.
Remove alternator.

Installation:

Tighten drive belt — 12 31 299.

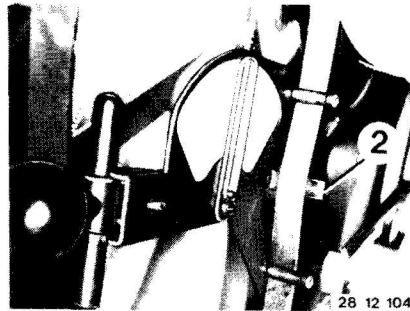
If alternator was replaced, check and, if necessary, discharge gas tank — see Group 61, Pos. 61 21 015.



30 12 106

12 31 299 CHECKING/TIGHTENING ALTERNATOR DRIVE BELT

Check tightness of drive belt with tester 11 5 020, adjusting if necessary. Pulling hook (2) must rest on center of tooth. The tester needle must be in the scale above green or yellow section.



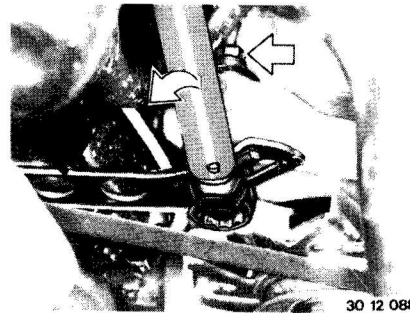
30 12 104

Tightening Drive Belt:

Unscrew nut and turn tensioning wheel with a torque of approx. 7 Nm (5 ft. lbs.).

Tighten nut.

Recheck tightness with tester, correcting if necessary.



30 12 088

12-142/1

12 31 513 DISASSEMBLING AND ASSEMBLING ALTERNATOR — Alternator Removed —

Bosch 65 A Alternator:
Remove voltage regulator -- see 12 32 000.
Remove pulley and fan, using Special Tool 12 31 000.

Installation:
Tightening torque*.

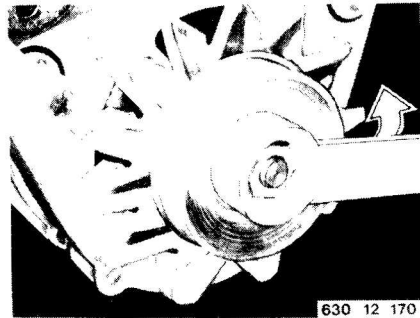
Take off washers (1 and 2), fan (3) and woodruff key (4).

Unscrew bolts (1).
Mark position of housing sections to each other.

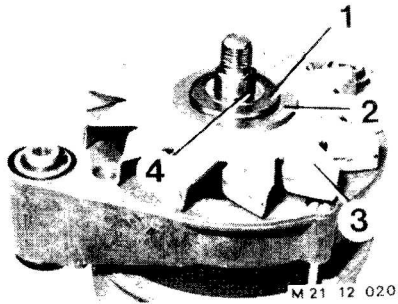
Installation:
Install longer bolt for the ground lead correctly.

Pull out bearing bracket (1) with rotor (2).

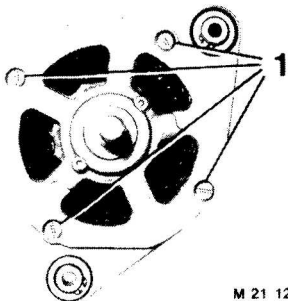
* See Specifications



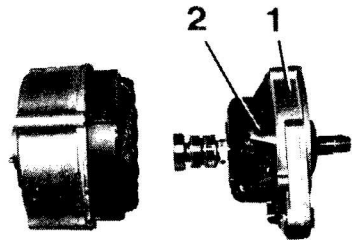
630 12 170



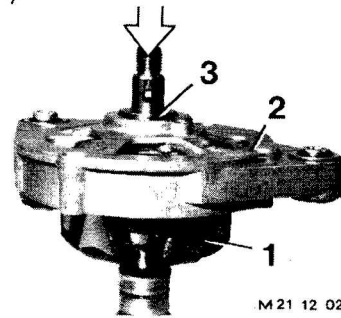
M 21 12 020



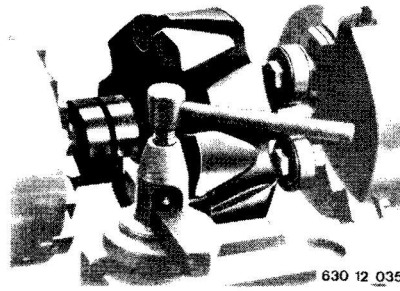
M 21 12 022



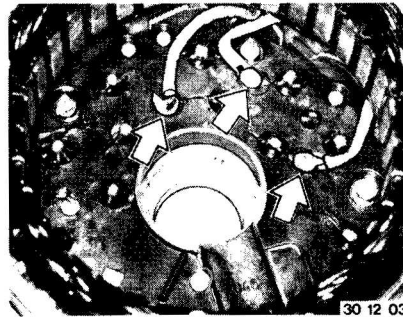
M 21 12 023



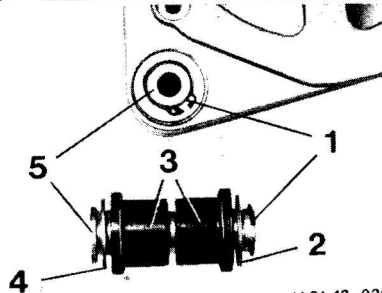
M 21 12 024



630 12 035



30 12 037



M 21 12 026

Press on rotor (1) and take off washer (3).
Check installed position of washer (3).

Check slip rings for wear, fine grinding and polishing if necessary see 12 31 201.

Unsolder stator coil on diode plate.

Caution!

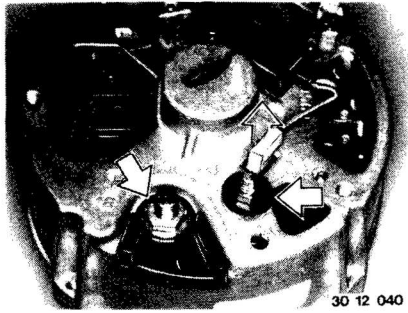
Excessive heat from soldering iron could destroy the diodes.

Press rubber mounts out of housing if necessary.

- Layout:
- 1 Circlip
- 2 Washer
- 3 Rubber mount
- 4 Washer
- 5 Bushing

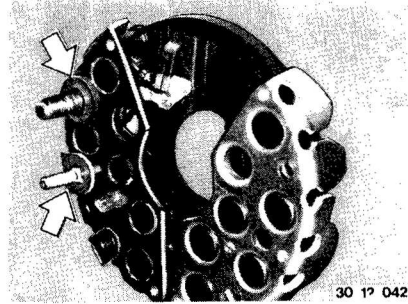
12/142/2

Unscrew shielded capacitor.
Unscrew nuts on B+ and D+ studs.
Take off diode plate with stator coil.



30 12 040

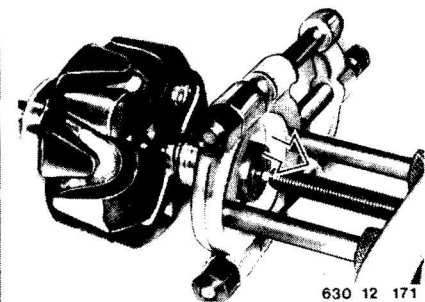
Installation:
Check condition of insulating sleeves and
washers, replacing if necessary.



30 12 042

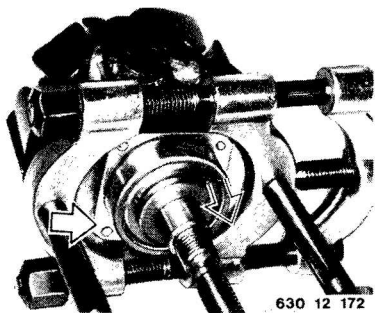
12 31 581 REPLACING BALL BEARING — Alternator Removed and Disassembled —

Bosch Alternators:
Pull off bearing with Special Tool 00 7 500.



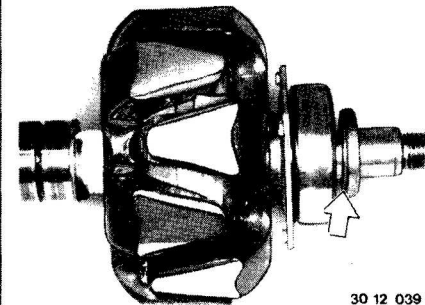
630 12 171

Installation:
Replace cover for bearing, if it is damaged by
the special tool while pulling off the bearing.



630 12 172

Installation:
Check location of washer — collar faces the
bearing.



30 12 039

12 31 . . . CHECKING BOSCH ALTERNATOR IN ELECTRIC TEST

— Alternator Disassembled —

Check with a BMW Service Tester.
Rotor Coil Break and Shorted Turn Test:
 Hold test leads for resistance tests on slip rings.

Alternator	80 A = 2.8 ohms ± 10 %
	65 A = 3.4 ohms ± 10 %
	90 A = 2.9 ohms ± 10 %
	115 A = 2.65 ohms ± 10 %
	140 A = 2.65 ohms ± 10 %

Rotor Coil Ground Contact Test:
 Hold test leads for resistance tests on slip ring and rotor shaft.
 Nominal value: ∞ display 999 k-ohms.

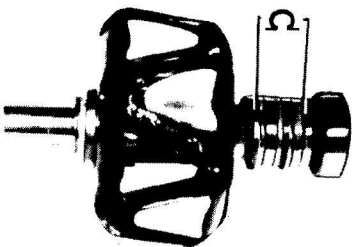
Stator Coil Ground Contact Test:
 Hold test leads for resistance tests on soldering point and stator (coil carrier).
 Nominal value: ∞ equal to display of 999 k-ohms.

Stator Coil Break Test:
 Compare resistance values of leads 1/2, 1/3 and 2/3 with an ohmmeter — they should be the same.
 Checking for shorted turns can be performed with a standard tester.

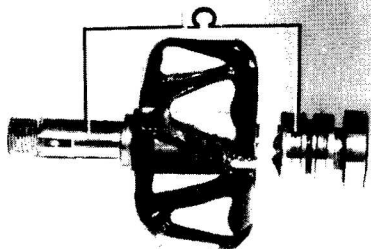
Checking Negative Diodes:
 Connect test leads for diode test.
 Hold negative lead on cooler and positive lead on one of the negative diode connections.
 Display with good diodes: "—" polarity.

Checking Positive Diodes:
 Hold negative lead on B+ stud and positive lead on one of the positive diode connections.
 Display with good diodes: "+" polarity.

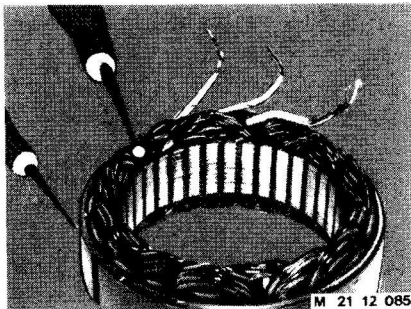
Replace entire diode plate in case of a faulty diode — see 12 31 691.



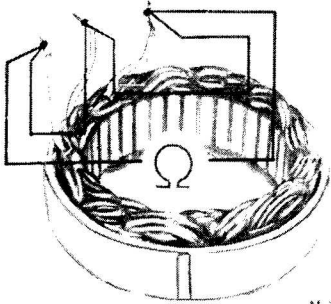
M 21 12 083



M 21 12 084



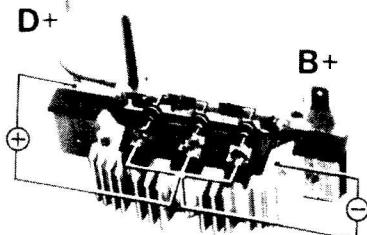
M 21 12 085



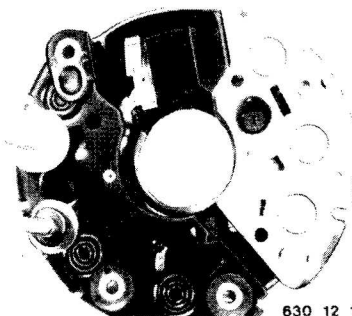
M 21 12 086



630 12 177



30 12 199

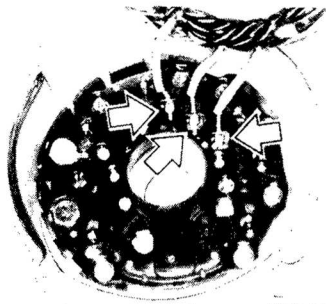


630 12 176

12-143-1

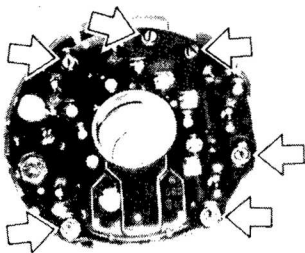
12 31 691 REPLACING DIODE PLATE — Alternator Removed and Disassembled —

Bosch Alternators:
Unsolder stator coil on diode plate.
Caution!
Excessive heat from the soldering iron would
destroy the diodes.



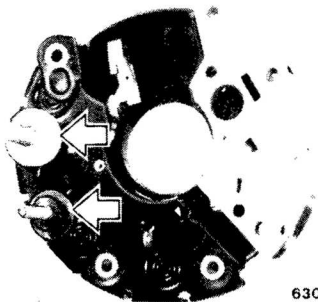
630 12 178

Unscrew screws.
Take out diode plate.

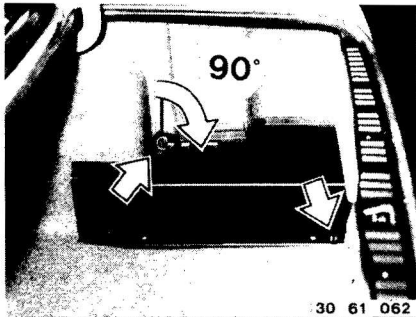


630 12 173

Installation:
Check condition of insulating sleeves and
washers, replacing if necessary.

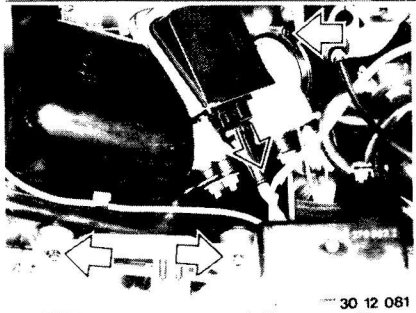


630 12 179

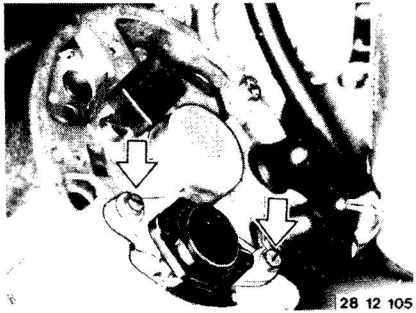


12 32 000 REMOVING AND INSTALLING OR REPLACING VOLTAGE REGULATOR

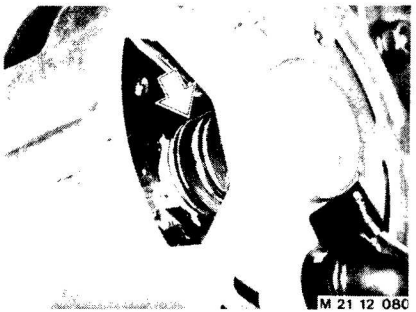
Unscrew negative terminal on battery (in trunk).



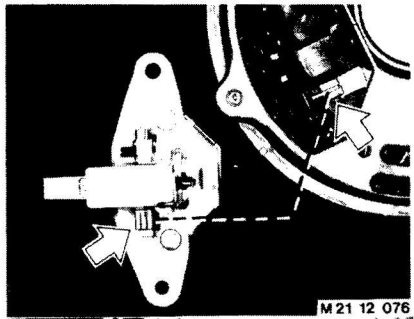
Take off air cleaner with air flow sensor.



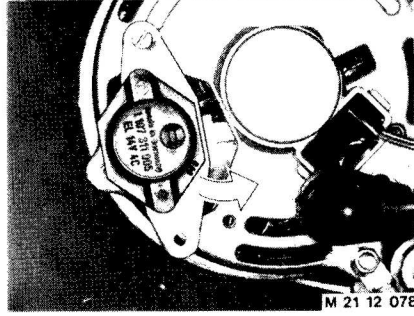
Unscrew bolts and take off voltage regulator carefully.



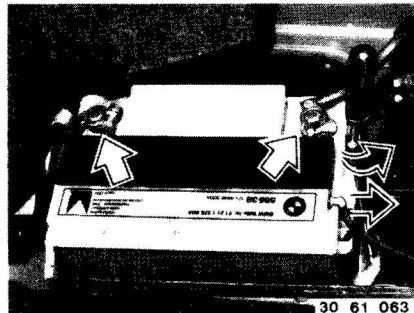
Check slip rings for wear, fine grinding if necessary.



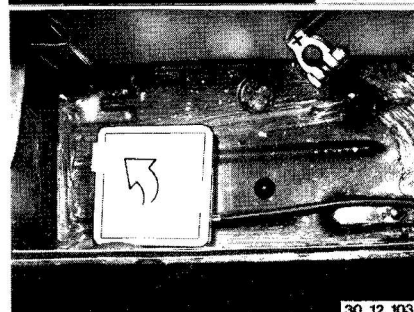
Clean contact surfaces and check tension of spring contacts, correcting if necessary.



Installation:
Mount regulator at first with one bolt screwed on finger tight, then press alternator to final installed position carefully, install and tighten all bolts.

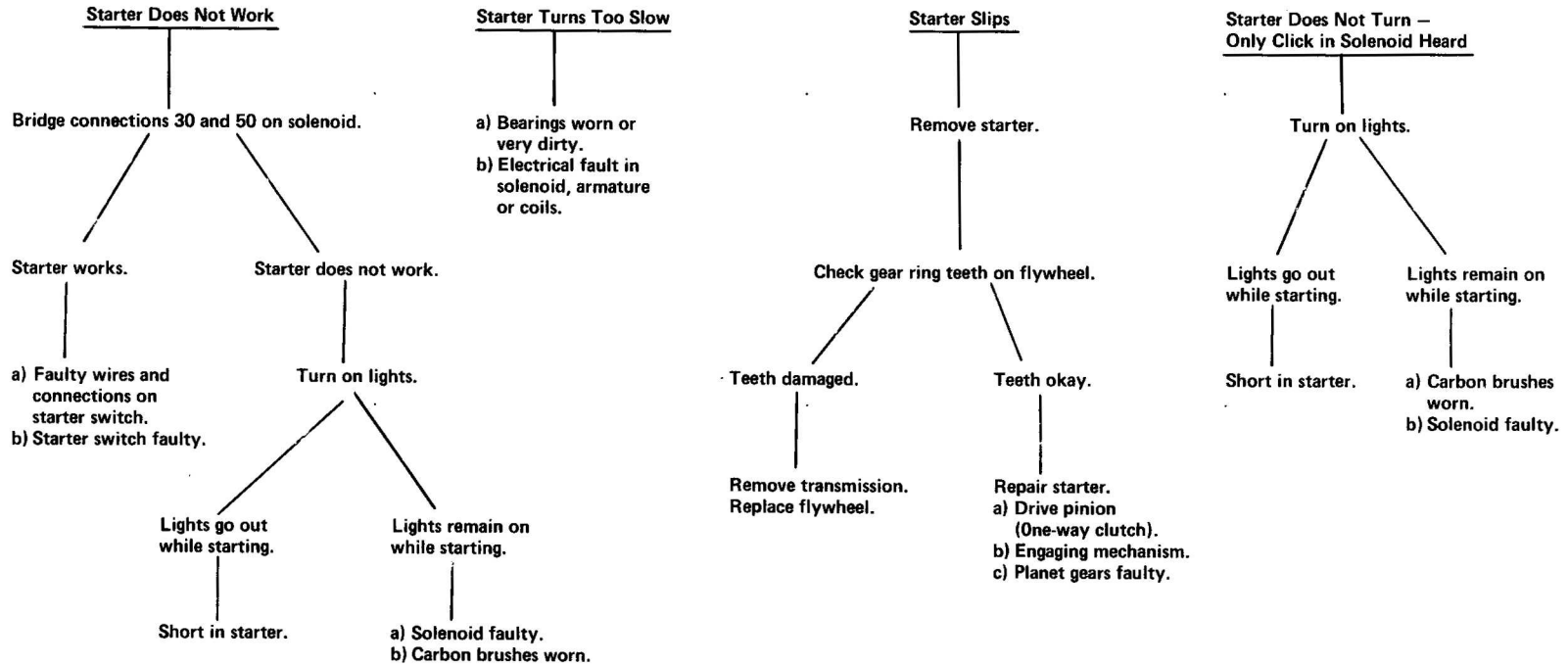


Remove battery.
Check gas discharging tank for battery, discharging if necessary see 61 21 015.



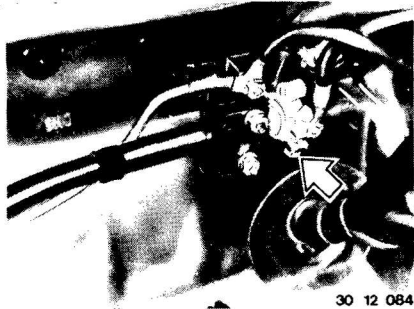
TROUBLESHOOTING STARTER

- Testing Requirements: – Correct connections on battery and starter.
 – Good ground connection between engine and body.
 – Charged battery.

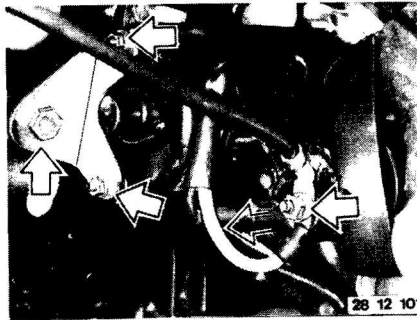


12 41 020 REMOVING AND INSTALLING STARTER

Disconnect positive terminal on connector.

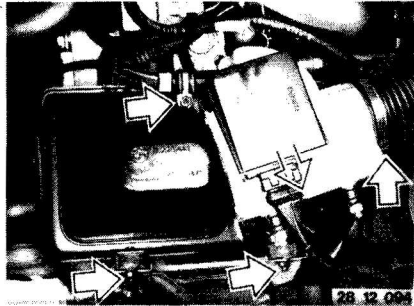


30 12 084



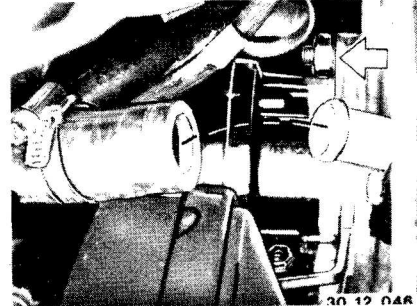
28 12 101

Unscrew support and lines.



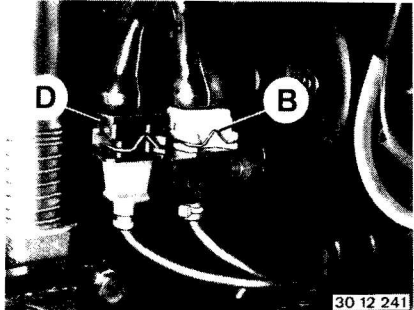
28 12 084

Take off air cleaner with air flow sensor.
M 3:
Remove intake manifold and air cleaner — see 11 61 050.



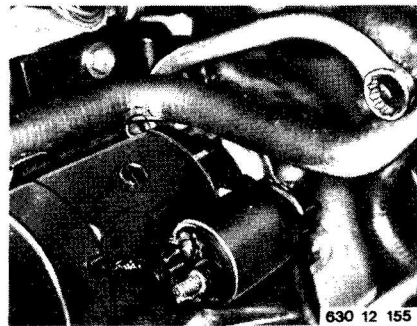
30 12 048

Drain coolant.
Disconnect heater hoses.
Unscrew starter mounting nuts.
Bottom nut could also be unscrewed from below for better accessibility.
Installation:
Pour in coolant*.
Bleed cooling system — see 17 00 039.



30 12 241

Since 1986 Models:
Disconnect plugs for reference mark sensor B (gray) and speed sensor D.



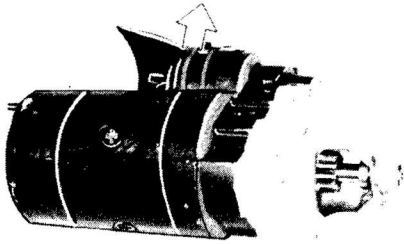
630 12 155

Unscrew nuts with a starter wrench**.

* See Service Information of Group 00
** Source of Supply: HWB

12 41 041 REPLACING SOLENOID

Remove starter — see 12 41 020.
Take off cover.

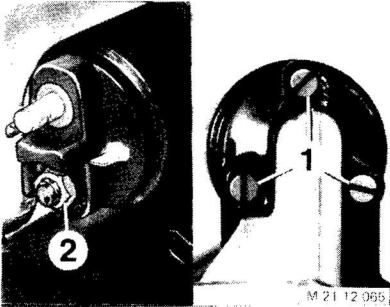


M 21 12 095

Unscrew solenoid (1 and 2).

Installation:

Don't turn wire connector while tightening
— danger of short circuit.

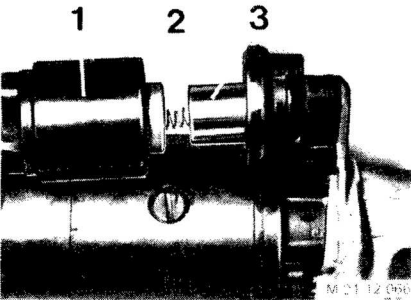


M 21 12 098

Take off solenoid (1) and spring (2).
Disconnect pin (3).

Installation:

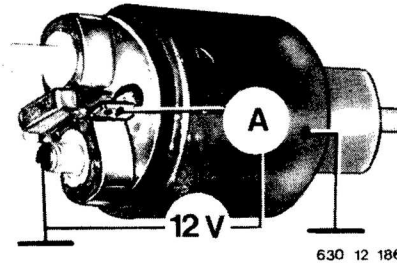
Check pin (3) for wear and lubricate with
grease.



M 21 12 099

12 41 . . . CHECKING STARTER PARTS (Electric Test)

Check power consumption* of activating and
holding coils in solenoid.

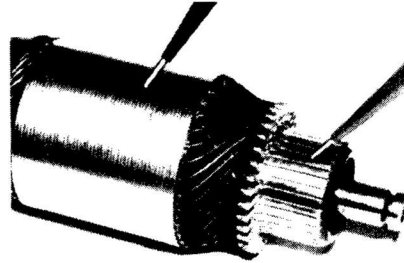


630 12 186

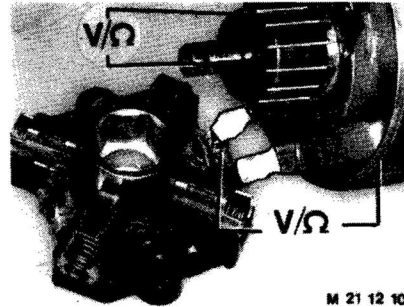
Check exciter coil, carbon brush holder and
armature coil for ground contact.

Check armature for shorted turns with a
standard tester.

Checking exciter coil is not applicable to cars
with permanent magnets (M 3).



316 12 053



M 21 12 107

12 41 513 DISASSEMBLING AND ASSEMBLING STARTER — Starter Removed —

Remove solenoid — see 12 41 041.
 Unscrew dust cap (2).
 Take off retainer (3), shims (4) and seal (5).
Installation:
 Check axial play* of armature, correcting with shims if necessary.

630 12 052

Unscrew housing bolts and take off cover.
Installation:
 Align openings for housing bolts and insulator to each other.
 Check bearing sleeve, lubricating with oil before installing.

630 12 147

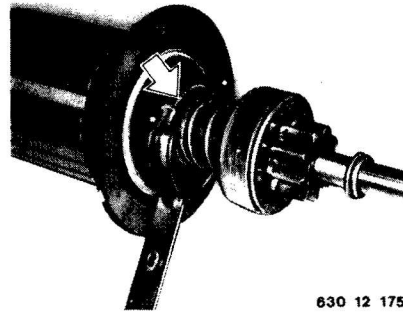
Lift springs and pull out carbon brushes.
 Remove holder.
Installation:
 Check carbon brushes and commutator for wear, repairing if necessary — see 12 41 551.

630 12 151

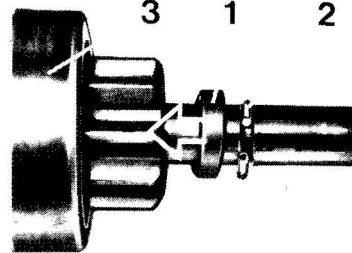
Remove pole housing.
 Unscrew engaging lever bolt and remove rubber seal.

630 12 174

* See Specifications



630 12 175

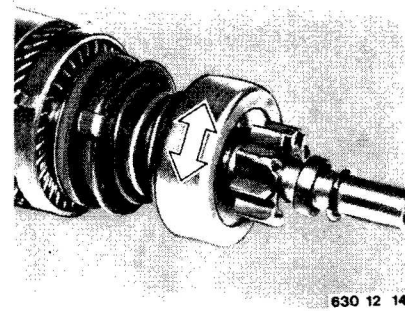


28 12 049

Lift out armature with drive pinion and engaging fork.
Installation:
 Lubricate guide for engaging fork with grease.
 Check bearing sleeve in drive bearing bracket, lubricating with oil prior to installation.

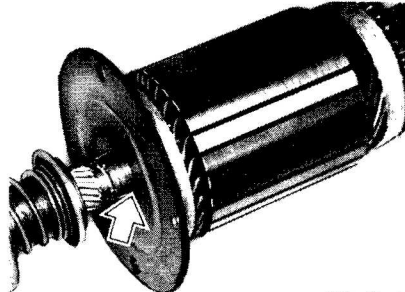
Push back bearing race (1) with a piece of suitable pipe.
 Pry circlip (2) apart and pull it off of the shaft.
 Remove burrs with a file.
 Take off drive pinion (3).
Installation:
 Use a new circlip (2).
 Lubricate bearing surface for drive pinion with grease**.

Installation:
 Check pinion for wear (on teeth, bearings, one-way clutch), replacing if necessary.



630 12 144

Check sleeve in intermediate bearing, replacing if necessary.

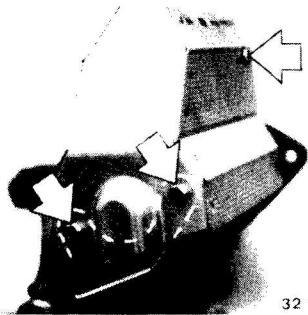


630 12 187

** Source of Supply: HWB

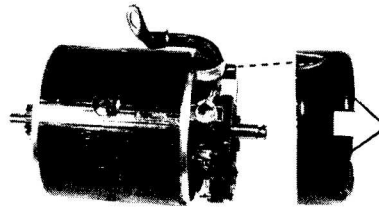
12 41 513 DISASSEMBLING AND ASSEMBLING STARTER LAYSHAFT -- Starter Removed --

Unscrew heat shield (if applicable).
Unscrew bracket.
Check spacers.



32 12 159

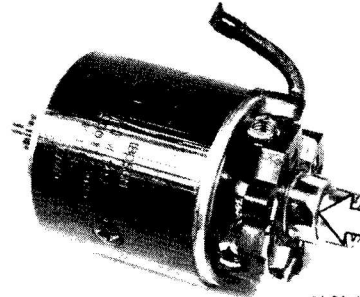
Remove solenoid — see 12 41 041.
Unscrew both studs.
Installation:
Clean all components thoroughly prior to assembling.



M 21 12 044

Inspect armature shaft, removing burrs if necessary.
Take off cover.

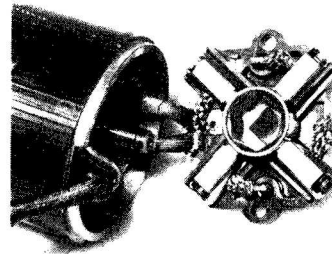
Prevent the carbon brushes from popping out by inserting a 22 mm wrench socket or a pipe with an outside diameter of approx. 30 mm (1.181").



M 21 12 045

Separate motor (1) and gearbox (2).
Installation:
Groove (3) must be aligned with rubber part (4).

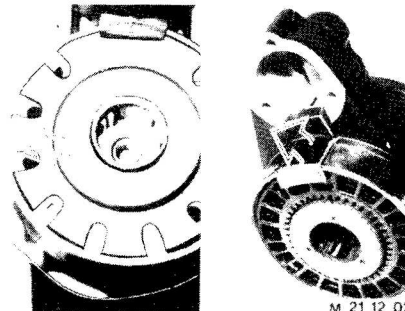
Installation:
Use wrench socket or pipe again to make installation easier.
Mount entire unit on the gearbox case and then tighten the wire connector.



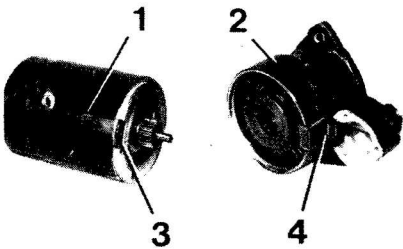
M 21 12 046

Take off cap.
Take off retainer (1) and shims (2).
Installation:
Check axial play*, correcting if necessary.

Take off cover and rubber pad.

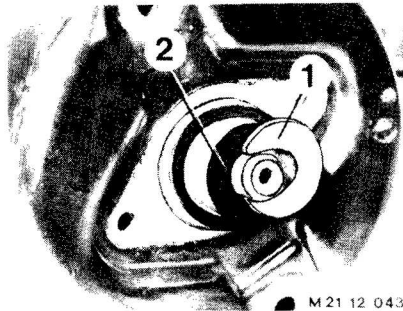


M 21 12 021



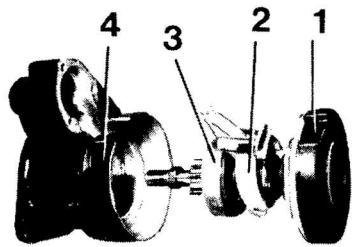
M 21 12 039

M 21 12 040



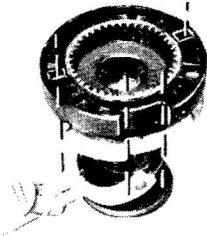
M 21 12 043

* See Specifications



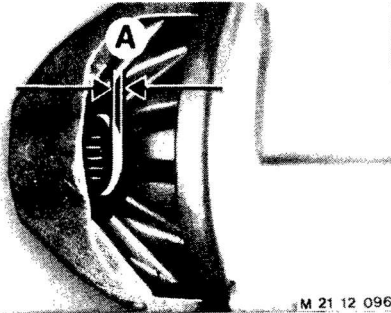
- Pull out gearbox unit.
Take off toothed ring on planet gearbox and release.
- 1 Planet gearbox
 - 2 Release
 - 3 Pinion
 - 4 Gearbox case

M 21 12 054



Installation:
Openings and bores must be aligned.

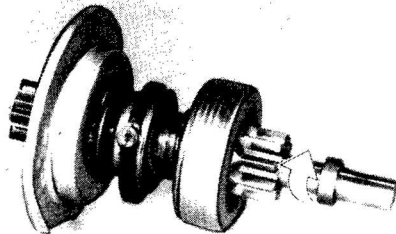
M 21 12 057



Check bearing, driving it out with a suitable mandrel if necessary.

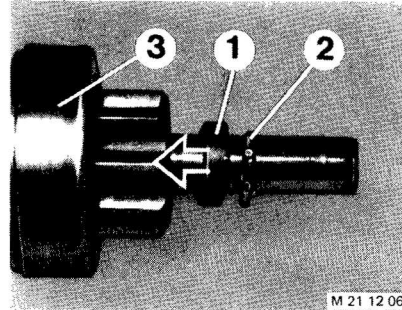
Installation:
Lubricate new bearing with grease and press in.
Distance A = approx. 1 mm (0.039").

M 21 12 096



Turn drive pinion against stop.
Pinion will be very easy to turn, if the one-way clutch is worn.
Check bearing sleeve and teeth of pinion for wear.

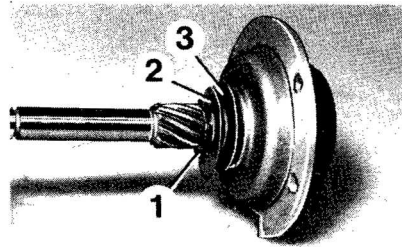
M 21 12 097



M 21 12 067

Knock back thrust ring (1).
Pull off retainer (2) forward.
Remove burrs if applicable.
Then take off drive pinion.

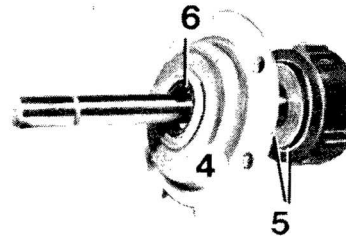
Installation:
Clean bearing surface for pinion thoroughly and lubricate with grease.



M 21 12 059

Pull off retainer (1) and take off washers.

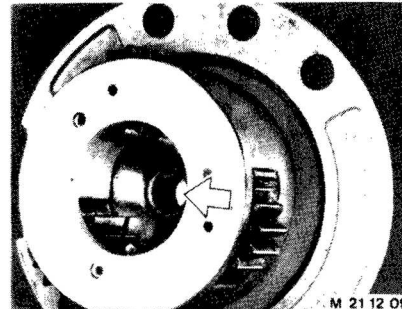
- 2 Metal washer
- 3 Plastic washer



M 21 12 060

Take off bearing cover (4) and washers (5).
Check bearing sleeve (6), replacing if necessary.

Installation:
Lubricate sleeve with oil after pressing in.



M 21 12 098

Check bearing sleeve, removing with a suitable puller if necessary.
Check planet gears for wear.

Installation:
Lubricate sleeve with oil after pressing in.

12 41 551 REPLACING CARBON BRUSHES — Starter Removed and Disassembled —

Lift springs and pull out carbon brushes.

Take off holder and pole housing. Unsolder or cut off all carbon brushes. When soldering in new carbon brushes, make sure that copper leads are not hardened with flowing solder.

Check commutator for wear, fine grinding if necessary. Diameter must be at least 33.5 mm (1.319"). Machine insulation between plates approx. 0.5 to 0.7 mm (0.020 to 0.027") deep.

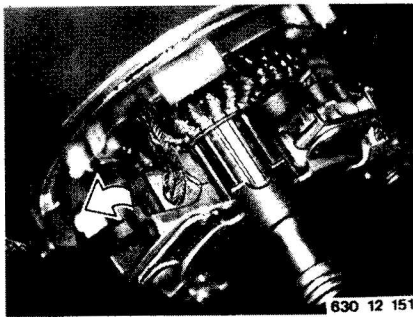
12 41 551 REPLACING CARBON BRUSHES — Starter and Layshaft Disassembled —

Fine grind and polish commutator. File or machine insulation between commutator plates to depth of 0.5 to 0.7 mm (0.020 to 0.027"). Check for shorted turns after machining.

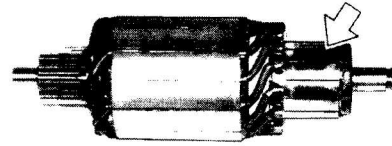
Slide carbon brush holder to center and lift off.

Installation:
Engage hooks of carbon brush holder completely.

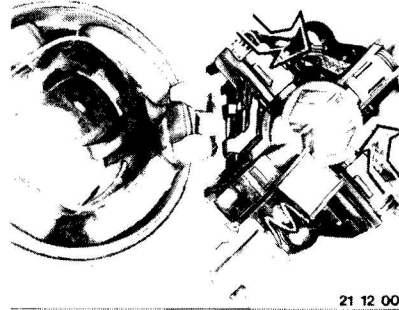
Two carbon brushes must be cut off of the leads. Solder in new carbon brushes.



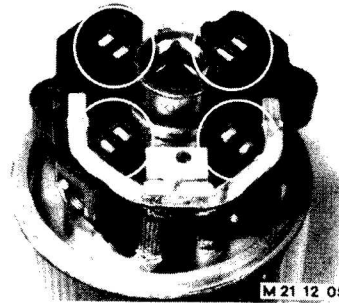
630 12 151



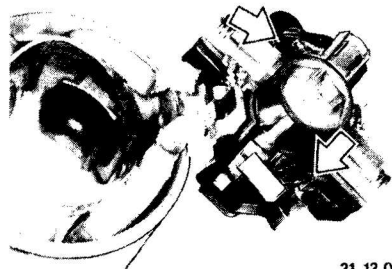
21 12 008



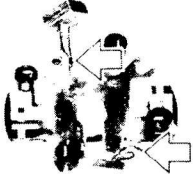
21 12 001



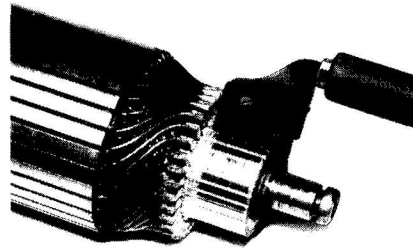
M 21 12 050



21 12 002



630 12 060

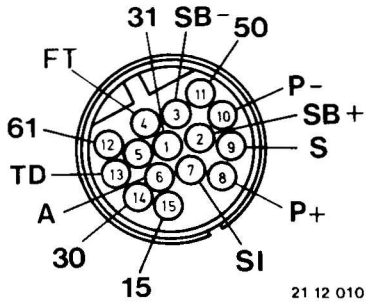


630 12 065

DIAGNOSIS PLUG CONNECTIONS

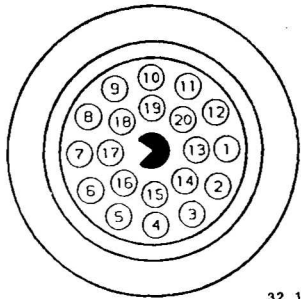
No. Terminal Designation

1	31	Ground
2	-	-
3	-	-
4	FT	Temperature gage
5	L	- Engine M 10 B 18 Integrator output for CO adjustments - Engine M 30 B 34 Oxygen sensor signal
6	A	Diagnosis lead for SRS
7	SI	Service indicator
8	P+	Position sender
9	S	Shielding
10	P-	Position sender
11	50	Starting pulse for starter
12	61	Alternator charge indicator
13	1	Ignition signal
14	30	Battery +
15	15	Power supply for ignition



DIAGNOSIS SOCKET CONNECTIONS

Pin No.	Description	Wire Colors
1	Terminal 1	black
7	Service indicator reset	white / green
11	Terminal 50	black / yellow
12	D+ alternator charge indicator	blue
14	Terminal 30	red
15	RXD lead	white / yellow
16	15 s voltage with ignition ON	green / white
18	PGSP for DME control unit programming	green / blue
19	Terminal 31	brown
20	TXD data lead	white / violet



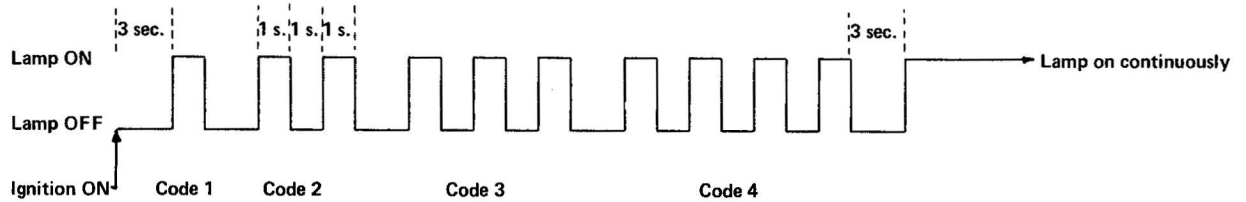
ON-BOARD DIAGNOSIS

Critical emission control relevant faults, which do not impair handling of the car, are displayed in the instrument cluster by the "Check Engine" control lamp coming on and staying on continuously.

Four different faults will be detected while driving or operating the car. They can be read out with the help of a flashing code prior to starting the engine with the ignition key in "ignition on" position.

The fault lamp will then be switched off and on in accordance with the fault number (see diagram).

FLASHING CODE OUTPUT:



Code 1 = Faulty air flow sensor

Code 2 = Faulty oxygen sensor

Code 3 = Faulty engine temperature sensor

Code 4 = Faulty idle speed switch

A fault is cancelled in the memory after repairing automatically after the engine has been started five or at the most ten times.