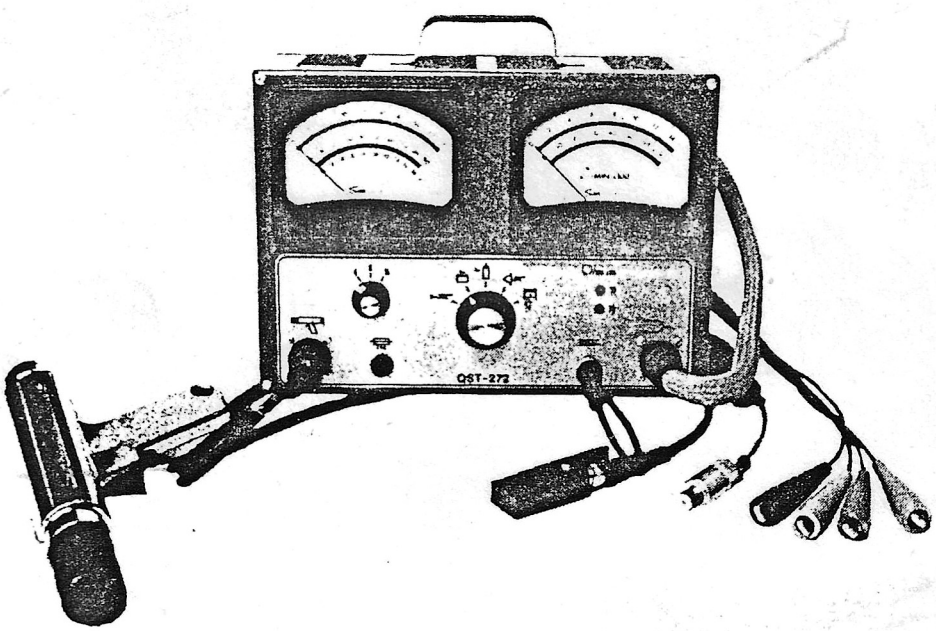
OPERATING MANUAL

SUN TSI III



I N D E X

	Page
Control units and operation	2
Test preparations and connecting up	3
Quick test	4-5
Detailed test	6
Distributor resistance	6
Rest- and starting voltage of the battery	7-8
Charging voltage	9
Dwell angle	10-11
Ignition timing	12-16
Extra equipment	17

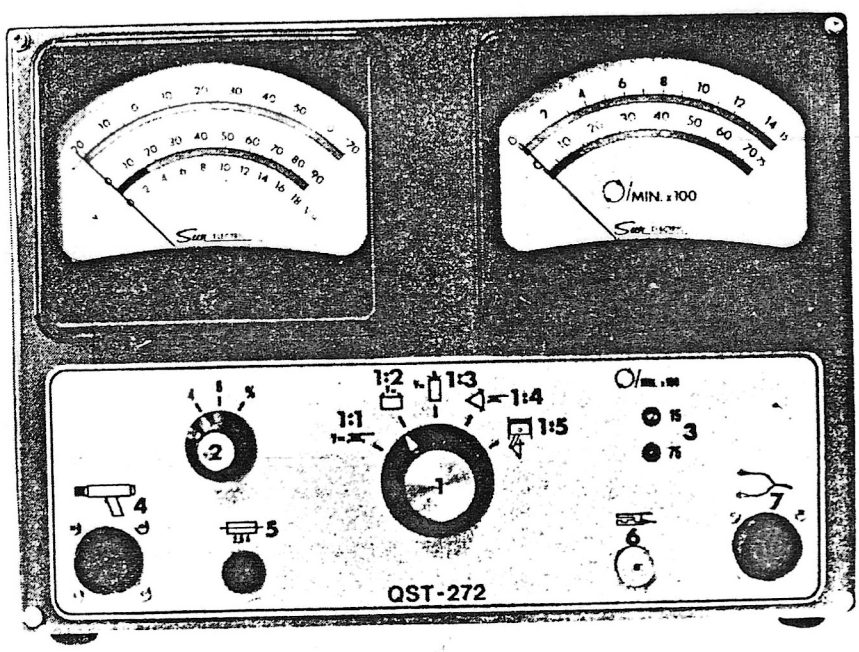
S U N TSI-III

Quick service instrument for adjusting and checking of the ignition system in connection with periodic servicing.

The TSI-III is equipped for checking of the ignition timing on cars with ignition position indicators. Another very good feature is that the rev counter changes scale ranges automatically, a light emitting diod indicates the range.

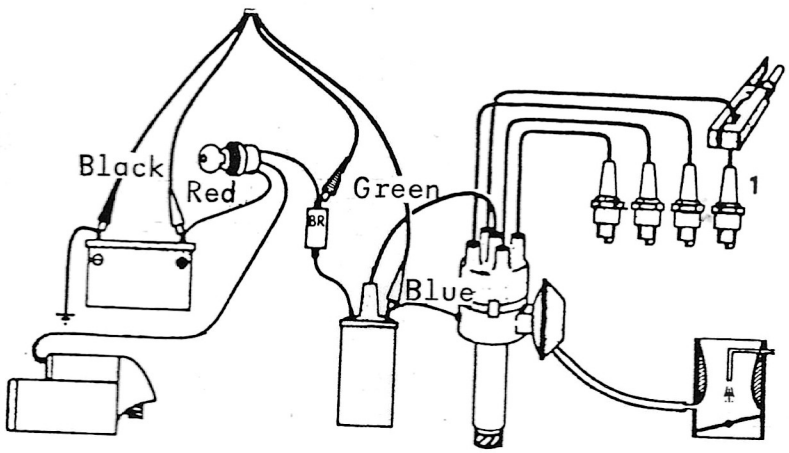
Main control 1

Positions	1:1	Contact resistance. Black scale on left-hand meter.
	1:2	Battery control. Red scale on left-hand meter.
	1:3	Ignition coil. Red scale on left-hand meter.
	1:4	Dwell angle. Red scale on left-hand meter.
	1:5	Ignition advance. Blue scale on left-hand meter.
Controls	2	Calibration dwell angle. 4 cyl/ 6 cyl/ percentage of scale value.
Light emitting diods	3	Number of revolutions right-hand meter.
	4	Connection for ignition timing light.
	5	Fuse.
	6	Connection for control cable.
	7	Quick connection for test cables.



TEST PREPARATIONS

This instruction will help you to use all the possibilities the equipment gives you. A summary shows that the instruction is divided up into two main sections. The first one includes a proposal for the quick testing procedure which can be used for trouble shooting or quick servicing. The other one describes in detail the use and connection of each testing possibility.



CONNECTING UP (Universal)

1 Connect the tester, the red + and black - clamps, respectively to a 12 V battery.

2 Connect the blue cable (dwell angle and distributor resistance) to the low-voltage socket of the ignition coil.

3 Connect the green cable to the battery connection of the ignition coil.

4 Connect the control pick-up to the 1:st ignition cable of the cylinder in the firing order.

5 If there is an ignition position indicator it is connected with a plug adapted to it.

CONNECTING UP OF DIAGNOSTIC CABLE

Direct connection between the tester and vehicle can be done on vehicles equipped with ignition timing indicators. (e.g. Saab). Diagnostic cables are available as extra equipment.

NOTE!

Erroneous control may occur. This means that the rev counter becomes unstable with the tendency to fall below the correct value. It may also happen that the light flash of the ignition timing light becomes unstable or weak. This may be due to the following:

a) Unsteady control is obtained when the control pick-up is connected to the first ignition wire, perfect control is obtained when connecting to the other ignition wires. (Dirty ignition plugs or abnormally big resistance in the ignition cable.) In that case the defect is to be found in the ignition plug or ignition cable.

b) Unsteady control is obtained when the control pick-up is connected to all ignition wires. In that case the ignition system is defective. (Abnormally big resistance in the rotor or the secondary winding of the ignition coil.) In any case, the defect must be remedied before going on with the test.

On certain cars the ignition cables are placed together and unsteady control may occur when the control pick-up is connected near the ignition plug. This is shown by the rev counter rising above the correct value. In that case, move the control pick-up nearer the distributor.

Warning

In order to avoid damages to the tester never touch the battery terminals or any other live connection with any part of the control pick-up.

QUICK ENGINE TEST

By following the proposed procedure in the quick test schedule and through the efficient and logical testing order the operation of the engine and its attachments can be tested quickly and exactly. The test is carried out in a few minutes.

Quick test schedule

1. Engine not working. (Ignition switched on)

   a. Turn the main control 1 to position contact resistance 1:1 read the contact resistance. Should be within the black range of the left-hand meter.

   b. Turn the change-over switch to the 18 volt position 1:2 and read the battery voltage on the voltmeter scale.

   c. Disconnect one low tension cable or the high tension cable at the ignition coil. Crank the engine by means of the starter motor and read the voltmeter while the battery is charged by the starter motor.

d. Turn the change-over switch to position 1:3 and read the voltage at the ignition coil + side.

2. Engine working. (approx. 2 500 rev/min)

a. Reset the change-over switch to position 1:2.

b. Increase the engine speed to approx. 2 500 rev/min. NOTE! Automatic change-over switch between high speed and low speed. The light emitting diod indicates the range.

c. Read the charging voltage on the voltmeter scale.

3. Idling.

a. Adjust the idling to specified number of revolutions.

b. Turn main control 1 to position dwell angle and control 2 on 4, 6 cyl. alt. %.

c. Read the dwell angle on the red scale of the left-hand meter. 4, 6 cyl. direct in degrees, other cylinder figures in %.

d. Check the variation of the dwell angle by gradually increasing the engine speed and watch the dwell angle meter.

e. Check the ignition position, blue scale of left-hand meter by means of the ignition position indicator or ignition timing light.

NOTE! Vacuum regulator disconnected.

4. High speed.

a. Increase the engine speed to the point specified by the manufacturer for checking of ignition advance.

b. Check the centrifugal ignition setting.

c. Connect the vacuum regulator and check the vacuum ignition timing.

5. Cylinder balance test

a. Adjust the number of revolutions to 1 200 rev/min.

b. Short-circuit the 1:st ignition plug. Note the decrease of the number of revolutions on the 1 500-rev scale. Then short-circuit other cylinders in proper order and compare the decrease in number of revolutions.

c. Adjust the idling speed to specified number of revolutions.

DETAILED SYSTEMS TEST

This part of the instruction thoroughly describes all the testing possibilities available on the tester. For each unit of the tester there is a detailed instruction both concerning quick testing and separate testing. Explanation of the test results is available in order to help the service man with the trouble shooting problems indicated by the tester.

Distributor resistance test

Too high resistance in the low tension circuit of the ignition system from the distributor side of the ignition coil through the breaker contact and to the ground contact of the distributor does not allow the ignition coil to develop enough capacity for satisfactory ignition in the whole range. All resistance in this part of the ignition system is indicated on the dwell angle meter during this test.

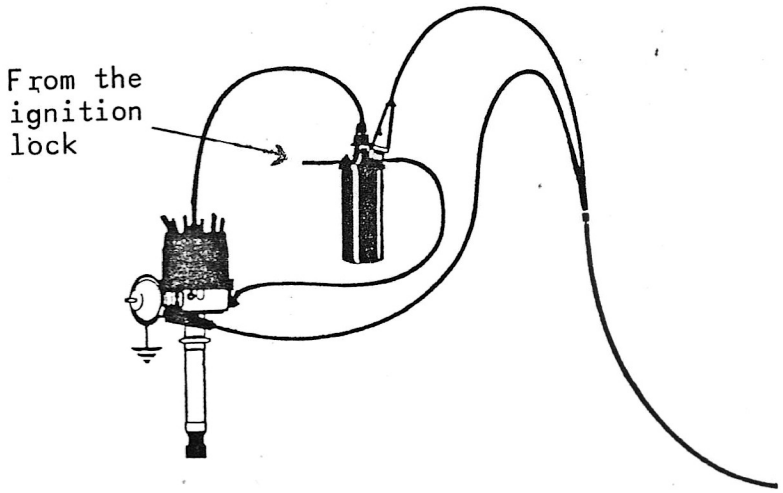
1. Turn to position distributor resistance 1:1.

2. Observing the correct polarity one test cable is connected to the low-voltage socket of the distributor at the ignition coil and the other cable to the ground.

3. Switch on the ignition of the vehicle.

4. The dwell angle meter is read when the engine is non-operative.

If the meter gives full reading on the whole scale the engine is cranked a little so that the breaker contact is closed.



RESULTS AND INDICATIONS

The pointer of the dwell angle meter flickers in the black range - the distributor resistance remains within normal limits of tolerance.

The pointer of the dwell angle meter does not flicker in the green range - too high resistance in the inner distributor connections, the outer distributor connections, breaker contact or the suspension of the distributor.

In order to be able to locate the high resistance the low-tension circuit is checked by moving the test cable step by step through the distributor towards the grounded cable.

STARTING VOLTAGE TEST

This test quickly shows whether enough voltage is delivered to the ignition system when the engine is started. Normal meter deflection confirms that the general condition of the battery, cables, and starter system is satisfactory. Unsatisfactory meter deflection shows that further tests are required within this area.

1. Observing the polarity the voltameter cables are connected to the battery connection of the ignition coil and ground or battery +- terminals and to ground, depending on which is easiest to do.

2. Put the main control in position 1:2 voltage.

3. Disconnect one of the primary wires or the high tension cable at the ignition coil.

4. With the ignition key switched on crank the engine by means of the starter motor.

5. Observe the starting voltage, engine speed and the regularity of the starter motor running.

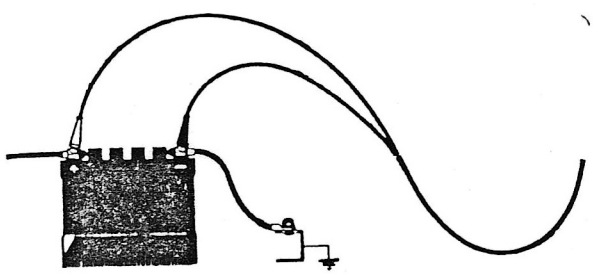
RESULTS AND INDICATIONS

The meter shows specified voltage or more. The number of revolutions is normal and regular - the battery, starter motor, cables, and switch work satisfactorily.

The meter shows lower voltage than specified - weak battery, defective cables, connections, motor starting switch or starter motor.

Starting speed below the normal - too high resistance in cables or starter motor, too big mechanical resistance in the engine.

Irregular engine speed - irregular compression, defective starter motor or starter motor operation.



TEST OF CHARGING VOLTAGE

This test is a good measuring of the voltage available for the whole electric system of the vehicle. The voltage supplied to the ignition system is an important factor to count on when breaker contacts in the distributor are burnt and also when other electric components seem to have abnormally short service life.

In case abnormal charging voltage values occur it is to be recommended that each separate component of the charging system be tested in order to find out exactly where in the charging system the defect is.

1. Put the main control in position 1:2.

2. Observing the polarity, the test cables are connected to the non-grounded battery terminal and to the grounded terminal respectively, or to the battery connection of the regulator and to ground respectively, depending on which one is most easily accessible.

3. With the rev counter switched on the engine is run at a speed of 1 500 to 2 000 rev/min.

4. Note the voltmeter reading when the pointer is stable.

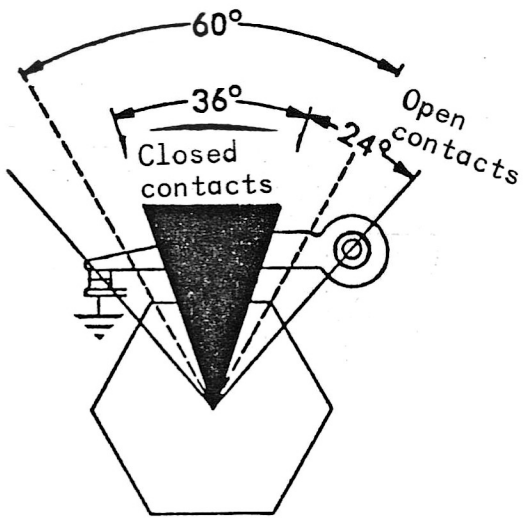
RESULTS AND INDICATIONS

The charging voltage within the prescribed area for the tested vehicle in question - the charging system and voltage regulator operate satisfactorily.

The charging voltage is lower than the specified value - defective generator or generator operation, defective or maladjusted voltage regulator, too high resistance in the electric circuits.

The charging voltage higher than the prescribed value - defective or maladjusted regulator, too high resistance in the ground circuit of the regulator or defective field circuit.

DWELL ANGLE



The dwell angle indicates the period during which the breaker contact of the distributor is closed during each ignition period. The dwell angle meter calculates this period electrically and registers the average of each cylinder in degrees of the camshaft revolutions of the distributor.

The total number of degrees of each ignition period is 360^{o} divided by the number of cylinders in the engine. The adjoining picture of a 6-cylinder engine shows 60 degrees (between the dashed lines) for each cylinder and 36 degrees (the hatched part) for the dwell angle. If you study this picture more in detail you can see that a position with larger distance in the breaker results in smaller dwell angle whereas on the other side a position with shorter distance between the contacts gives a larger dwell angle.

When the measured value is indicated in %, the closure time of the contacts in relation to total break-time is meant. The number of cylinders does not affect the value. Example: the contacts are never opened. The value will be 100 %, normal value is 70-75 %.

DWELL ANGLE TEST

1. Turn the main control to position dwell angle and control 2 to 4,6 cylinder alt. %.

2. Run the engine at an idling speed and note the reading on the dwell angle meter. The dwell angle is read for 4- and 6-cylinder engines respectively, direct in degrees, other numbers of cylinders in %.

RESULTS AND INDICATIONS

The dwell angle reading within prescribed limit values - the switch contacts operate normally and have correct gap width between their points.

The dwell angle reading not within the specified limits - wrong breaker distance, wrong breaker switch mounting, broken or worn breaker arm, distorted breaker arm, worn distributor cam.

DWELL ANGLE VARIATION

The dwell angle variation is determined by noting each change of the dwell angle when the engine is run at different speeds. Too high a variation means a change in the opening of the breaker contact which may be due to deterioration of the timing shaft or bushing or a displacement of the breaker plate because of wear or too much play.

1. Measure the dwell angle of the distributor at idling speed.

2. Increase the engine speed to 3 000 rev/min.

3. Note the dwell angle reading at 3 000 rev/min and then decrease the speed slowly to idling speed observing the meter. The reading should not change more than 2 degrees/% on most vehicles. Compare however with the manufacturer's specifications before rejecting the distributor.

RESULTS AND INDICATIONS

The dwell angle variation within the manufacturer's specification values - the distributor in good mechanical condition.

The dwell angle variation exceeds the maximum values prescribed by the manufacturer - worn timing shaft, loose timing shaft, worn bushings, loose or worn breaker plate.

IGNITION TIMING

The position of the electric ignition pulse in relation to the crankshaft is measured by means of two methods.

1. Ignition timing light is treated below.

2. The inductive ignition timing indicator was introduced on a number of car makes in the mid 70s. The ignition timing indicator works as a mechanical reference of the position of the crankshaft. The control pick-up connected to the first ignition cable in the firing order is the electric reference.

   The timing advance at a special speed can then easily be read on the blue scale of the left-hand meter.

   Spark control test can be carried out by varying the number of revolutions in accordance with the specification.

IGNITION TIMING LIGHT

The ignition timing light gets its control impulses from the control pick-up which is connected to an ignition plug, as a rule the first plug in the firing order. The light is easy to operate with one hand and is switched on by pressing the handle. The ignition position and ignition advance are to be read on the ignition position scale, blue scale of the left-hand meter.

Basic ignition position

Timing of the basic ignition position is a mechanical adjustment of the exact position in which the plug is to give a spark at a specified speed. The ignition position is fixed and specified by the manufacturer for exact position in the ignition cycle. At the same moment as the ignition takes place the light flash will light up the ignition marking so that the ignition timing can be read.

When using the ignition timing light there are two methods for adjusting of the basic ignition position on an engine. Which method that should be used is determined by the directions for ignition timing given by the car manufacturer.

CONNECTING UP OF IGNTION TIMING LIGHT

1. Connect the control pick-up to the plug which is the basis for ignition timing marking.

2. Turn the ignition advance wheel to "TIME" position.

Should the manufacturer prescribe that the ignition is to be timed so that the ignition mark is in line with the index (e.g. a mark in the belt pulley in front of the elevation of the gear case) the ignition advance wheel should remain in "TIME" position 0, blue scale, of the left-hand meter and the light should be used in the usual way as follows:

1. Start the engine and adjust the engine speed to the number of revolutions specified by the manufacturer for basic ignition position. Disconnect the vacuum lead of the distributor if specified so.

2. Press the button of the handle of the ignition timing light and use the light flash to be able to observe the ignition marking position in relation to the ignition point.

3. Should the ignition position not be as specified, loosen the distributor and turn it until the markings coincide as seen with the ignition timing light.

   Check the change of the number of revolutions and readjust if required. The number of revolutions must absolutely be equal to the specified one when the markings coincide. - Then fasten the distributor.

In case the factory prescribes that the ignition should be timed so that the ignition marking is moved a fixed number of degrees from the marking for the top dead center proceed as follows:

1. Start the engine and adjust the prescribed number of revolutions. Disconnect the vacuum lead of the distributor if specified so.

2. Turn the ignition advance wheel on the rear of the light to "ADVANCE" position. Adjust by means of the ignition advance wheel until the blue scale of the left-hand meter shows the degree to which the basic ignition position is to be adapted according to the directions.

3. Press the button of the handle of the ignition timing light and use the light flash to be able to observe the position of the ignition mark in relation to the mark of the top dead center.

4. Should the ignition position not be as specified the distributor is to be loosened and turned until the marks coincide as seen with the ignition timing light.

   Check the change of the number of revolutions and readjust if required. The number of revolutions must absolutely be equal to the specified one when the markings coincide. - Then fasten the distributor.

5. If you now turn back the control of the "TIMING" position you can see that the position really has moved the number of degrees the meter was adjusted to according to item 2 above and which consequently is the basic ignition position according to the directions.

RESULTS AND INDICATIONS

Ignition mark in line with the marking at specified number of revolutions; the ignition is correctly timed.

The ignition mark not in line with the marking according to the manufacturer's specifications; the ignition is not correctly timed.

The position of the ignition marking is not stable; burnt or oblique contacts, low spring-tension, worn or loose breaker plate or worn timing shaft or bushings.

SPARK CONTROL TEST

It is very important for the performance and economy that spark control is carried out at exactly the right point of time at all engine speeds and charges. When the engine speed increases the centrifugal- and vacuum control of the distributor works so that the ignition plug ignites earlier. As a result of this the ignition marking will be moved which can be observed by means of the ignition timing light. By means of the ignition advance wheel the ignition mark can be reset to index electronically. When the markings coincide the instrument indicates how many degrees before the basic ignition position the ignition takes place.

1. If the distributor is equipped with both centrifugal- and vacuum control it is suitable to disconnect the vacuum hose so that the measuring of the centrifugal- and vacuum control can be carried out separately.

2. Start the engine and drive at low, specified speed. Use the light flash to check the position of the ignition marking in relation to the index. Adjust by means of the ignition advance wheel in the position "ADVANCE" until the markings coincide. Check the degrees shown by the instrument.

3. Increase the engine speed to the prescribed one for testing of ignition control. It is suitable to adjust the engine speed by means of the idler screw so that the number of revolutions remains constant.

4. Adjust by means of the ignition advance wheel until the markings coincide again.

5. Read how many degrees the scale of the instrument shows and decrease the value by the number of degrees obtained when checking the basic ignition position as described in item 3. Compare with the manufacturer's specifications.

6. The vacuum control is checked by fixing the engine speed between 2 000 - 2 500 rev/min and the instrument of the light is read in the usual way. Then the vacuum hose is connected (the number of revulotions is readjusted if required) and a new reading is taken. The difference between the two readings is equal to the total vacuum control. Compare with the manufacturer's specifitions.

Should the ignition advance values obtained with the distributor mounted in the vehicle not be within the specified ranges the distributor should be dismounted for complete testing and examination in a Siegl distributor bench.

RESULTS AND INDICATIONS

Total ignition advance correct at specified engine speed: the centrifugal- and vacuum advance mechanism works satisfactorily.

Total ignition advance is not within the specification: broken or blocked vacuum hose, vacuum control not working, jamming breaker plate, worn or jamming centrifugal control. The distributor should be dismounted for complete testing and examination in a Sun distributor bench.

NEGATIVE VACUUM CONTROL

For the purpose of obtaining cleaner exhaust gases when idling certain distributors have got a vacuum control directed by the negative pressure direct from the inlet manifold of the engine and which decreases the ignition when the engine is idling, so called negative vacuum control. A thorough check of the negative vacuum control can be carried out by means of the ignition timing light as follows:

1. Start the engine and adjust the number of revolutions to the specified number for ignition position control.

2. Turn the ignition advance wheel counter-clockwise to position "TIME" and press the button of the handle of the ignition timing light. Direct the light flash towards the ignition marking. Check the position of the marking in relation to the index (or scale). Draw a stroke with a chalk on the engine block if necessary.

3. Disconnect the hose at the vacuum control outlet for negative control. Bend or plug the hose so that the engine does not suck in air through the hose. Note the removal of the ignition mark in relation to its previous position.

4. Turn the ignition advance wheel clockwise until the mark coincides again with the starting position (see under item 7). Take the reading on the instrument of the ignition timing light and compare with the manufacturer's specifications.

RESULTS AND INDICATIONS

The negative vacuum control is within the manufacture's specifications. The vacuum control works satisfactorily.

The negative vacuum control is not within the manufacturer's specifications. Blocked or leaking vacuum hose, defective vacuum control mechanism or jamming breaker plate.

No change of the ignition position of the engine. The hose between the inlet manifold and vacuum control is blocked or broken. The diaphragm of the vacuum control is broken.

EXTRA EQUIPMENT

To make the adjustment of contact clearance easier (dwell angle).

The adjustment is easy to carry out when the engine is rotating. An adapter box is then required, order No. 2981-021-1056N. This is equipped with a switch for ignition current and a push button for activation of the starter motor. A separate cable is connected to the starting solenoid (takes place internally on a Saab if the ignition service instrument outlet is connected).

Diagnostic/adapter cables with ignition position indicator and switches are available for existing car models. See separate list!