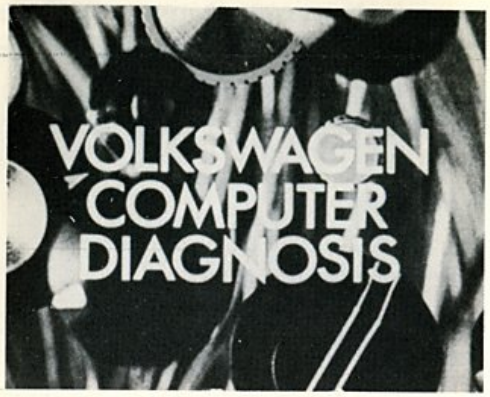
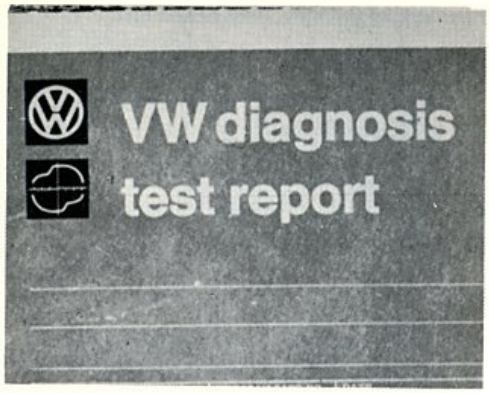
COMPUTER DIAGNOSIS

Dealer Level Training

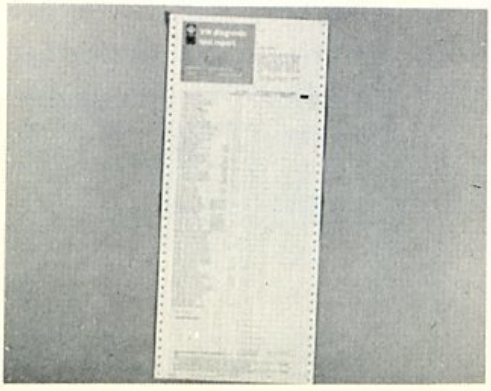


NARRATOR:
Volkswagen Computer Diagnosis. Just what is Computer Diagnosis? Well, according to a statement of the test report or print out . . .

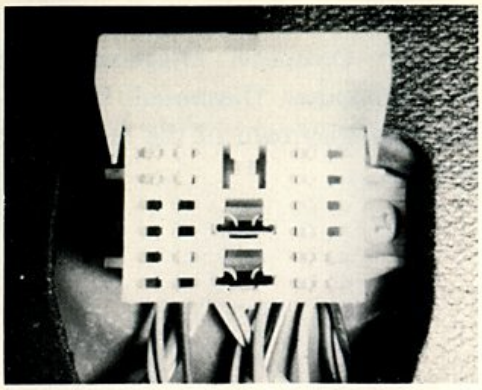


. . . "The Volkswagen Computerized Self-Analysis System gives you a print out which measures input information from your Volkswagen and compares it with factory standards."

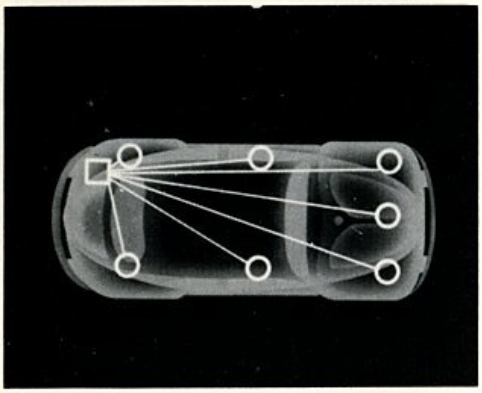
The result is this. Now a specially trained diagnostician, within 20 or 25 minutes, can check over a car completely and end up with information on a computer print out that will enable him and the Service Adviser to know immediately what repairs are necessary.



More than 70 separate tests are made and the results are very impressive. Of course, some tests do not apply to some cars. For example, automatic transmission tests do not apply to standard shift cars.



The key to the system is in the diagnosis plug, whether installed at the factory or added by means of the adapter cable.

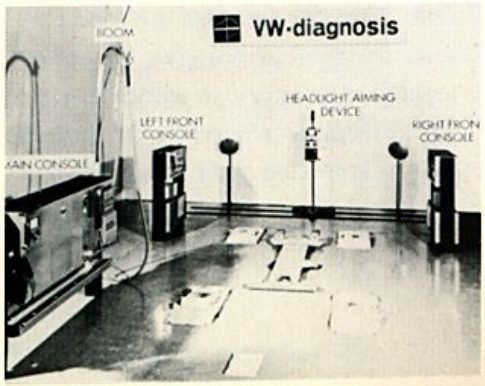


It has 28 contacts although all of them are not used at the present time. The active contacts are connected to various electrical points and sensors in the car, such as battery positive terminal, battery ground strap, ignition coil, generator terminal D+ etc.

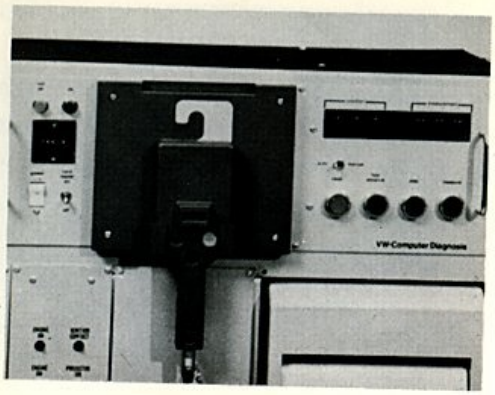
MAJOR COMPONENTS

Main Console
Right Front Console
Left Front Console
Headlight Tester
Tire Pressure Tank

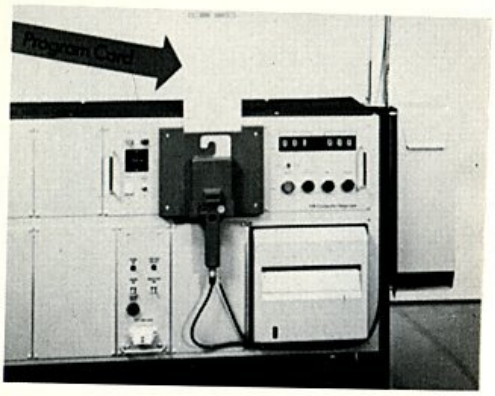
The major components of the Volkswagen computer diagnosis equipment are the main console, the right and left front consoles, the headlight tester and the tire pressure tank.



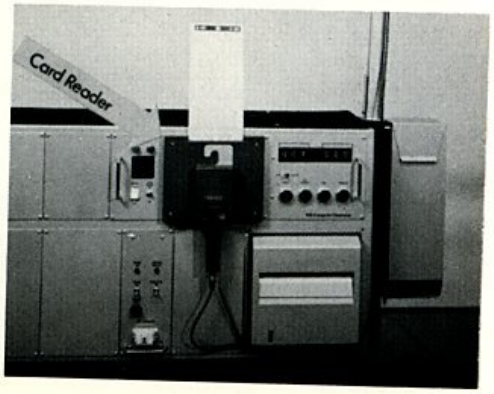
Here is the way they appear in the stall. The right and left front consoles are for checking wheel alignment. You will also note the familiar hoist and floor plates. And the corner mirrors . . . for checking lights from the driver's seat.



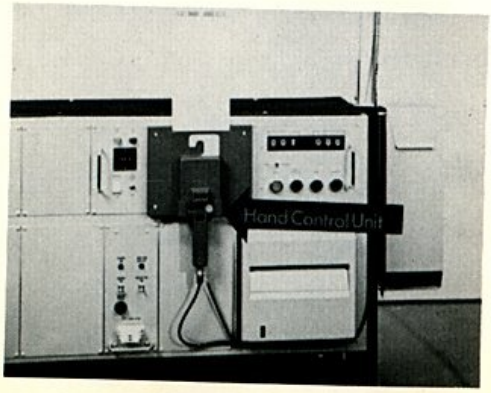
The computer is the heart of the diagnosis system. It is capable of storing information for recall later on.



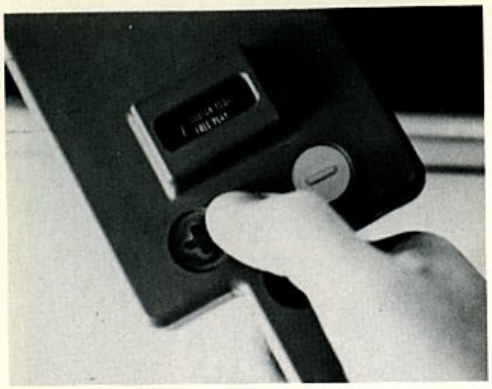
There is a separate program card for each Volkswagen model which is inserted in the top . . .



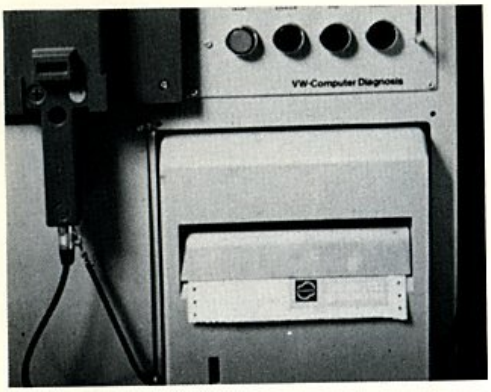
. . . of the Card Reader. The card comes pre-programmed and by automatically advancing as each test is performed, it tells the computer what the factory specifications are for each automatic test.



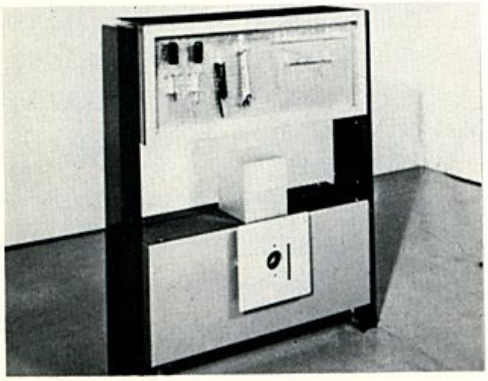
The Hand Control unit is the remote control used by the diagnostician when making visual tests.



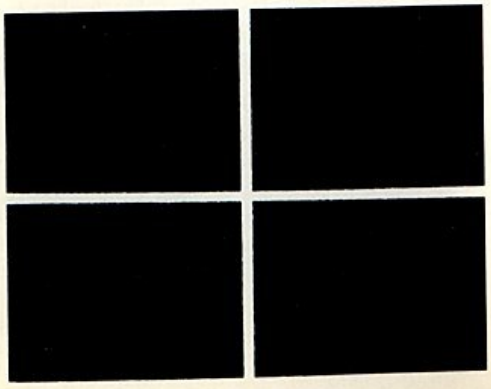
Inside this window, the operator can read the instruction of the next test to be performed. If it is a visual test such as "free play in clutch pedal" and in his judgment it is OK, he pushes the + sign, and a plus is recorded on the test report on line 7 by the printer.



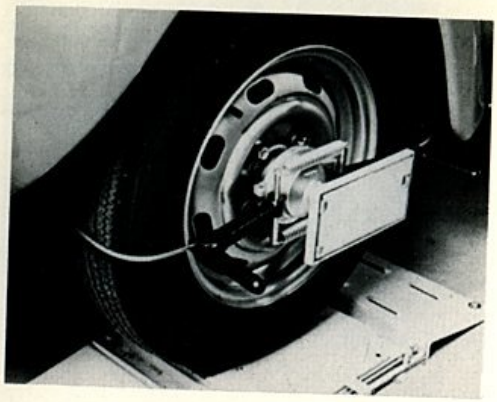
The printer is mounted in its own panel below the computer controls. It prints out the test data for evaluation and recommendation.



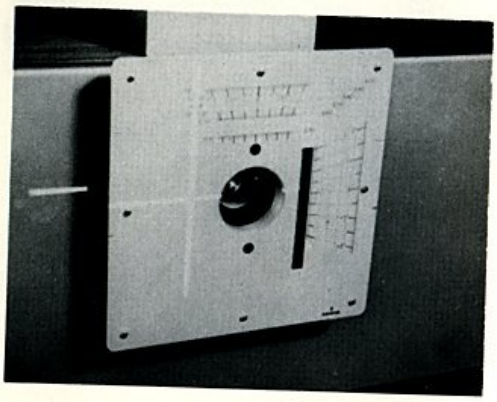
This is one of the two front consoles which are similar, each containing a projector with a special lamp and a measuring panel.



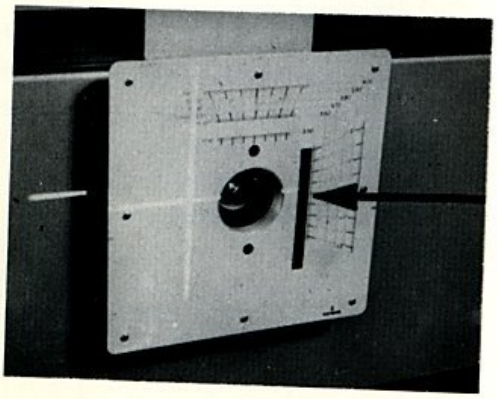
Each lamp projects a light cross like this onto a mirror . . .



. . . which is mounted on the wheel with special brackets.

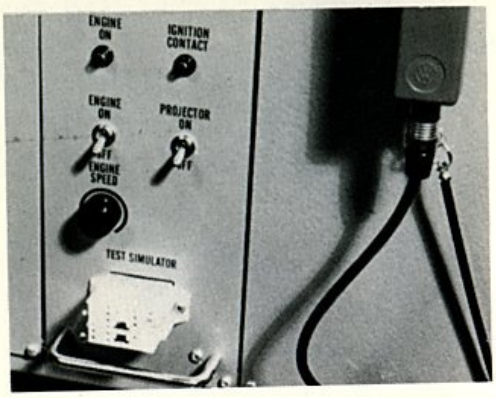


The image is reflected back to a measuring panel containing rows of photo-cells.

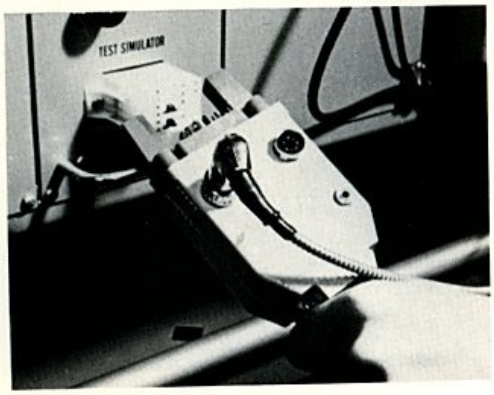


As the wheel is turned from left to right, the projected cross sweeps across these photocells and gives a reading on camber. The right front console also measures total toe.

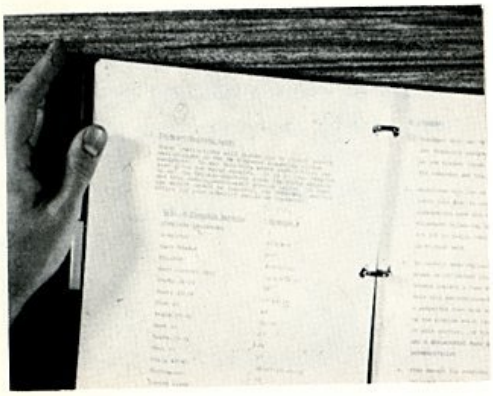
When not in use, the wheel mirror bracket is stored in the front console.



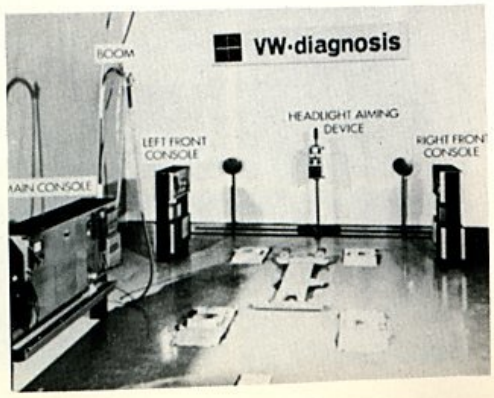
The last major component of the computer diagnosis system is the simulator. As its name suggests, this unit is used to check the diagnosis equipment electronically.



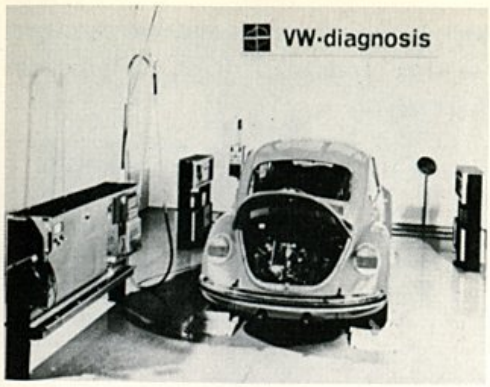
The plug on the umbilical cord is inserted into the socket of the simulator.



In the event all readings do not measure up to factory standards, a trouble shooting guide is provided to locate simple malfunctions.



Now that we have had a look at the components of the Volkswagen Computer Diagnosis System, let's see how they operate.



This is how the computers findings and the diagnosticians evaluations are turned into concrete recommendations for the customer.

The first 17 tests are visual and manual checks. The computer is used to remind the diagnostician of the test to be performed and to record (OK) or (NOT OK) on the test report form. Everything that meets specifications gets a plus and everything that doesn't gets a minus.

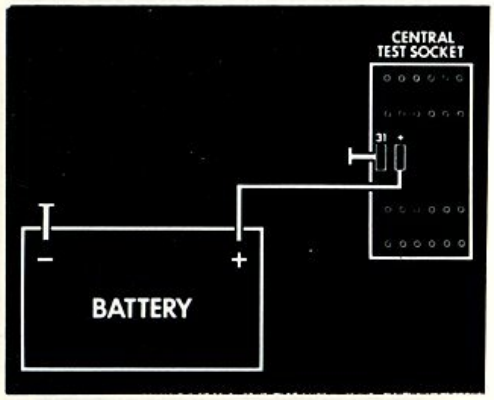
Test
1 Engine Oil—level
2 Tire Pressure
3 Spare Wheel Tire Pressure
4 Spare Wheel Tire—condition
5 Brake Fluid—level
6 Brake Pedal—free play
7 Clutch Pedal—free play
8 Steering—free play
9 Parking Brake—travel

These are simple checks which are often neglected otherwise. Engine oil level, tire pressure including spare, spare tire condition, brake fluid level and brake pedal free play, clutch free play, steering free play.

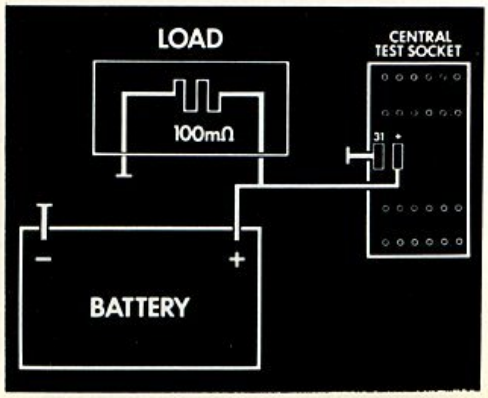
6 Brake Pedal—free play	
7 Clutch Pedal—free play	
8 Steering—free play	
9 Parking Brake—travel	
10 Windshield Washer System	
11 Windshield Wiper System	
12 Parking, Tail, License, Side Lights	
13 Low Beam	
14 High Beam and Indicator Light	
15 Back-up Lights	
16 Emergency Flasher System	
17 Brake Warning Light	
18 Battery Voltage	Vol
19 Battery Voltage Under Load	Vol

Parking brake travel, windshield wiper and washer and all driving, emergency and warning lights.

Depressing the plus or minus button of test 17 will automatically initiate the first automatic sequence 18-25.



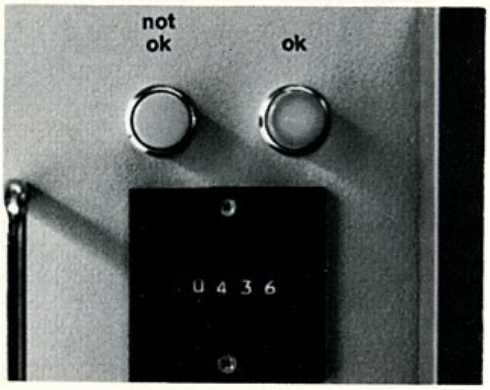
First, battery voltage will be measured between positive and negative terminals of the battery.



Next, the computer puts a 100 milli-ohm load across the battery. After approximately 10 seconds a measurement is taken again automatically.

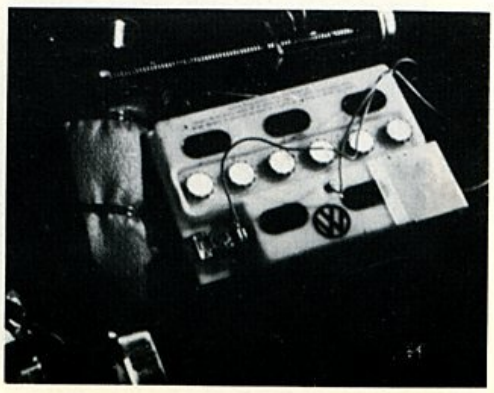
10	Windshield Washer System		0 0 0
11	Windshield Wiper System		0 0 0
12	Parking, Tail, License, Side Lights		0 0 0
13	Low Beam		0 0 0
14	High Beam and Indicator Light		0 0 0
15	Back-up Lights		0 0 0
16	Emergency Flasher System		0 0 0
17	Brake Warning Light		0 0 0
18	Battery Voltage	Volts	1 2 2
19	Battery Voltage Under Load	Volts	1 0 3
20	Stop Lights	units	0 6 4
21	Battery Electrolyte—level		0 0 0
22	Turn Signal Lights Left	units	0 6 8
23	Turn Signal Lights Right	units	0 7 8
24	Rear Window Defogger	units	2 1 1
25	Oil Temperature	Degrees Centigrade	0 3 8
26	Starting Current	units	2 1 2

The numbers printed out mean that under no-load the battery measured 122 or twelve point two volts.



Of course, the diagnostician can not see the print out numbers at that time, but he can see the digital display and the green OK or red NOT OK lights.

Under a heavy load, the battery still put out 103 or ten and three tenths volts. Since both load and no-load voltages were in the acceptable range, the computer gave them a plus.

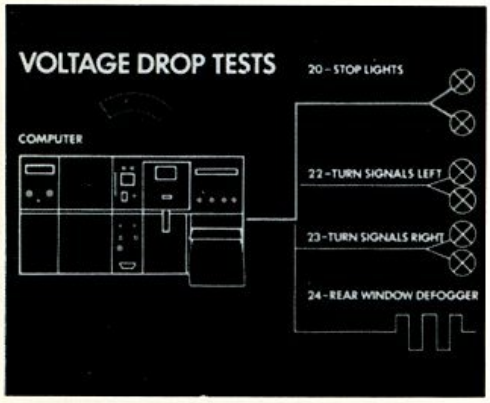


The computer continues automatically to the electrolyte level test. All batteries are now coming through with a factory installed electrolyte level probe. If the probe touches the electrolyte, a plus will be recorded on the print out.

If a minus appears, the battery must later be checked visually.

14	High Beam and Indicator Light		0 0 0
15	Back-up Lights		0 0 0
16	Emergency Flasher System		0 0 0
17	Brake Warning Light		0 0 0
18	Battery Voltage	Volts	1 2 2
19	Battery Voltage Under Load	Volts	1 0 3
20	Stop Lights	units	0 6 4
21	Battery Electrolyte—level		0 0 0
22	Turn Signal Lights Left	units	0 6 8
23	Turn Signal Lights Right	units	0 7 8
24	Rear Window Defogger	units	2 1 1
25	Oil Temperature	Degrees Centigrade	0 3 8
26	Starting Current	units	2 1 2
27	Cylinder No. 1-compression	units	2 9 8
28	Cylinder No. 2-compression	units	3 0 6
29	Cylinder No. 3-compression	units	3 3 6
30	Cylinder No. 4-compression	units	3 6 5

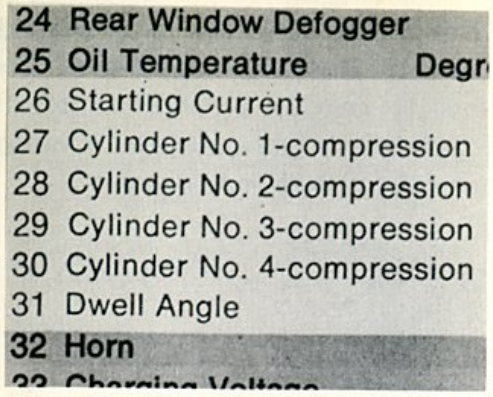
Steps 20-22-23-24 are voltage drop tests on the stop lights, turn signal lights and rear window de-fogger circuits.



The computer sends out an electric current which produces a voltage drop in the item tested. This voltage drop is measured and gives a printed value.

14	High Beam and Indicator Light		0 0 0
15	Back-up Lights		0 0 0
16	Emergency Flasher System		0 0 0
17	Brake Warning Light		0 0 0
18	Battery Voltage	Volts	1 2 2
19	Battery Voltage Under Load	Volts	1 0 3
20	Stop Lights	units	0 6 4
21	Battery Electrolyte—level		0 0 0
22	Turn Signal Lights Left	units	0 6 8
23	Turn Signal Lights Right	units	0 7 8
24	Rear Window Defogger	units	2 1 1
25	Oil Temperature	Degrees Centigrade	0 3 8
26	Starting Current	units	2 1 2
27	Cylinder No. 1-compression	units	2 9 8
28	Cylinder No. 2-compression	units	3 0 6
29	Cylinder No. 3-compression	units	3 3 6
30	Cylinder No. 4-compression	units	3 6 5

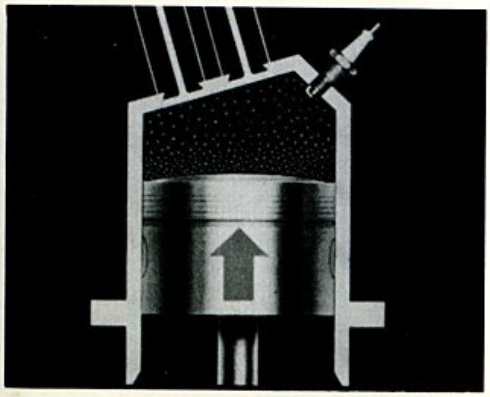
The printed values are computer language and do not reflect the proportional soundness of the filament and associated wiring. However, a plus on the print out shows continuity and is the important guide for this test.



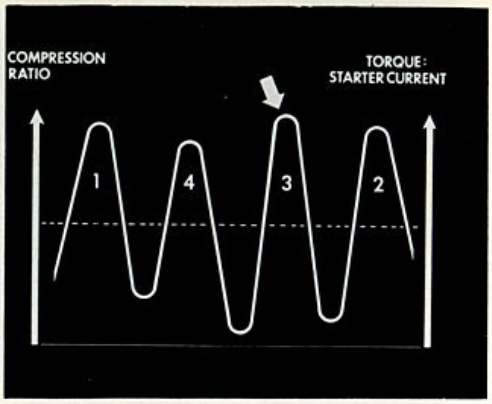
Now the program switches automatically to step 26 and will continue through step 31 before it stops for the next manual test.

Step 26, for starter current, calls for the diagnostician to start the car. The ignition circuit is bypassed by a 5 ohm resistance during the first 3 to 5 seconds of cranking, which prevents starting. While the engine is turning over, starting current is measured and printed out in units.

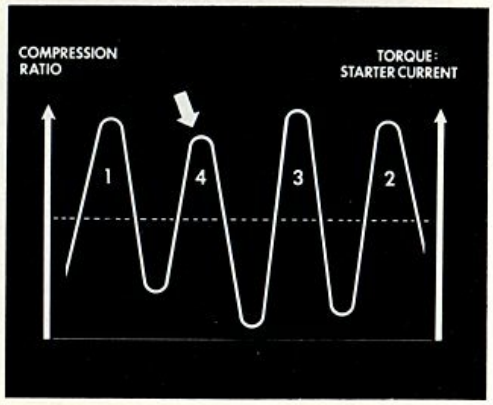
Very quickly (after starting current measurement) the compression of each cylinder is indicated by measuring the peak value of the starter current required to move that piston through its firing stroke.



Here's how it works. In order to compress the fuel/air mixture in the cylinder, energy must be expended in the form of starting current.



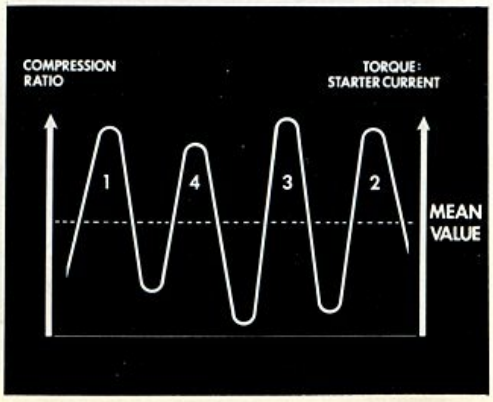
A high compression ratio requires a high torque to turn the engine over. This torque is directly proportional to the starter current, represented by a voltage drop at the battery ground strap.



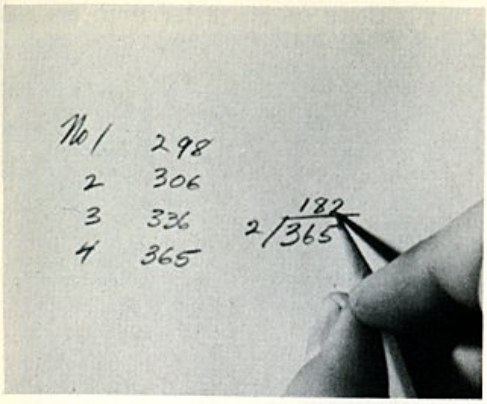
Conversely, when compression is lower, less torque is required. The starter will not have to work as hard, and the voltage drop will not be as much.

20	Stop Lights	units	0 6 4
21	Battery Electrolyte—level		0 0 0
22	Turn Signal Lights Left	units	0 6 8
23	Turn Signal Lights Right	units	0 7 8
24	Rear Window Defogger	units	2 1 1
25	Oil Temperature	Degrees Centigrade	0 3 8
26	Starting Current	units	2 1 2
27	Cylinder No. 1-compression	units	2 9 8
28	Cylinder No. 2-compression	units	3 0 6
29	Cylinder No. 3-compression	units	3 3 6
30	Cylinder No. 4-compression	units	3 6 5
31	Dwell Angle	Degrees	4 7 2
32	Horn		0 0 0
33	Charging Voltage	Volts	1 3 8
34	Charging Current	units	2 2 5
35	Kick-down Switch		
36	Kick-down Solenoid		
37	Basic Ignition Timing	Degrees BTDC	

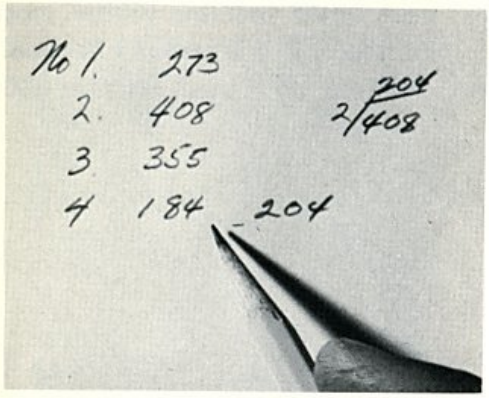
On this test, the numbers are very important, however, the numbers do not correspond to compression pressure. They are units the computer uses to compare with factory standards on the test card.



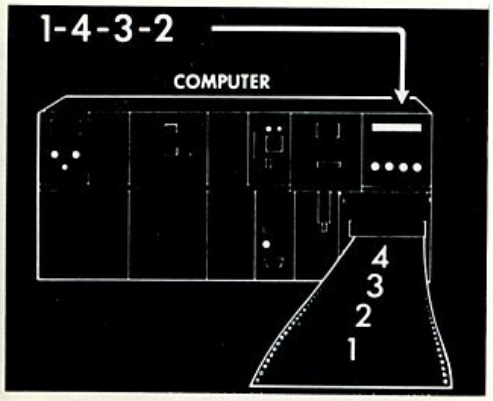
Tests show that there is a reasonable wear limit and that it will fall within a mean value of compression for a properly running engine. A simple way to calculate the variation from the mean value is to . . .



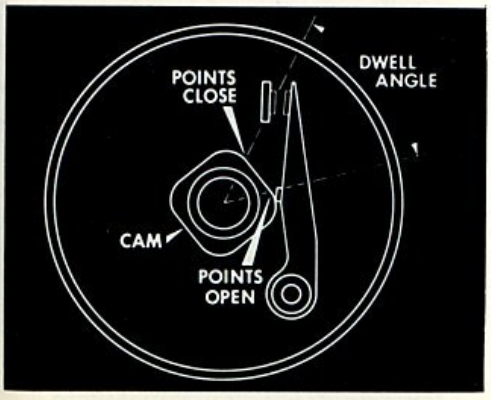
. . . take the highest value and divide by 2. If the lowest figure for a cylinder is not below that, the compression balance is OK.



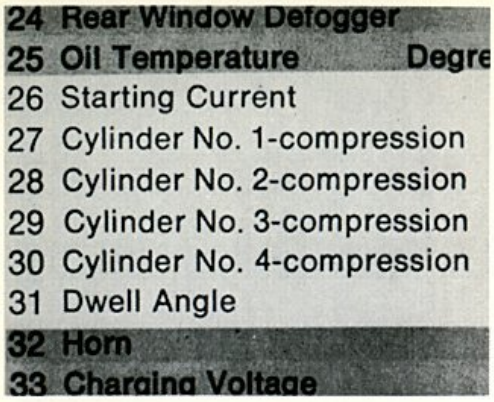
Supposing though, that these were the figures: ½ of 408 is 204. 184 is below 204, so the compression in #4 cylinder would be below specifications and should be noted in the space provided.



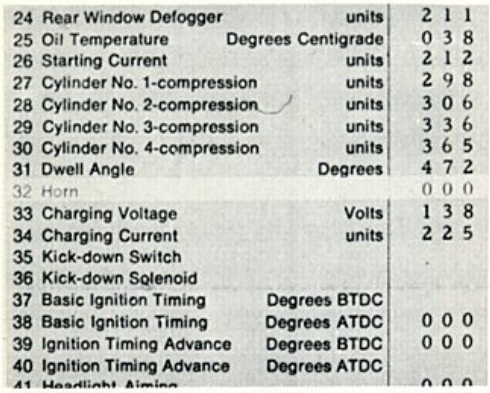
It is interesting that compression is measured in firing order 1-4-3-2, but this information is stored in the computer and then sorted out so that it is printed out numerically, 1-2-3-4.



After the compression tests are completed, ignition point dwell angle is measured. The computer automatically removes the 5 ohm resistance that had prevented the engine from starting while being cranked. The engine starts and the dwell angle is measured and printed out.

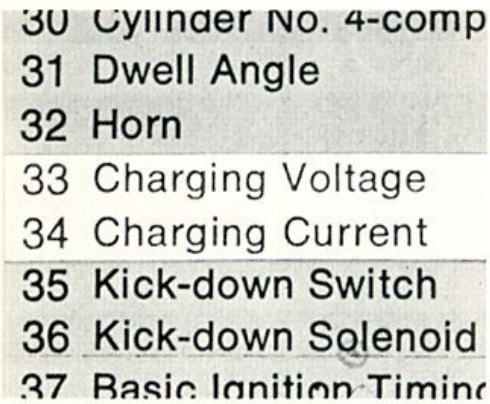


All this is done much faster than we can describe it. All five tests from starting current through compression tests on all four cylinders and dwell angle are completed and printed out within six seconds.

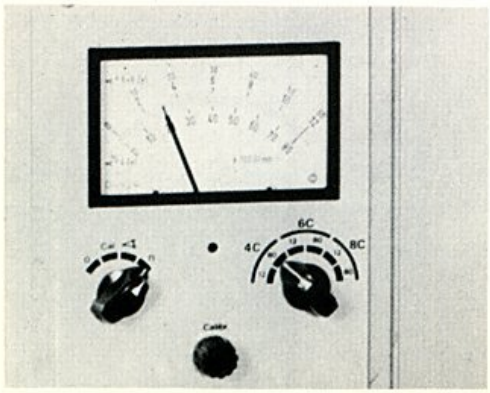


24	Rear Window Defogger	units	2 1 1
25	Oil Temperature	Degrees Centigrade	0 3 8
26	Starting Current	units	2 1 2
27	Cylinder No. 1-compression	units	2 9 8
28	Cylinder No. 2-compression	units	3 0 6
29	Cylinder No. 3-compression	units	3 3 6
30	Cylinder No. 4-compression	units	3 6 5
31	Dwell Angle	Degrees	4 7 2
32	Horn		0 0 0
33	Charging Voltage	Volts	1 3 8
34	Charging Current	units	2 2 5
35	Kick-down Switch		
36	Kick-down Solenoid		
37	Basic Ignition Timing	Degrees BTDC	
38	Basic Ignition Timing	Degrees ATDC	0 0 0
39	Ignition Timing Advance	Degrees BTDC	0 0 0
40	Ignition Timing Advance	Degrees ATDC	
41	Headlight Aiming		0 0 0

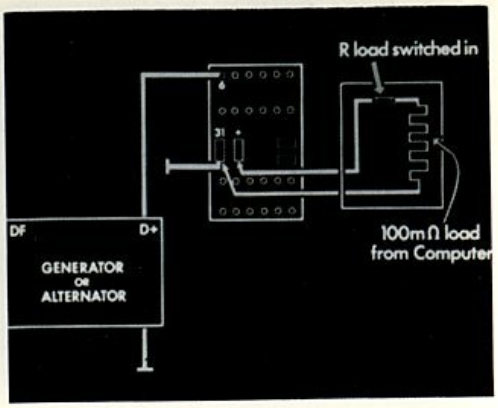
It has been noted that the printer must put some figures in the measurement column. Therefore, all manual tests get 000.



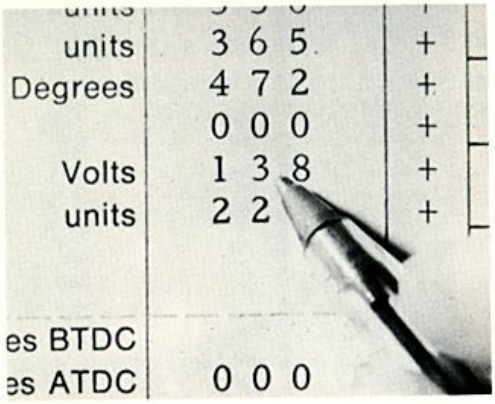
The diagnostician is now ready for the charging voltage and charging current tests.



He slowly accelerates to at least 2000RPM but not more than 2200. At this speed, the computer measures the voltage of the regulator and stores this information in the memory bank.

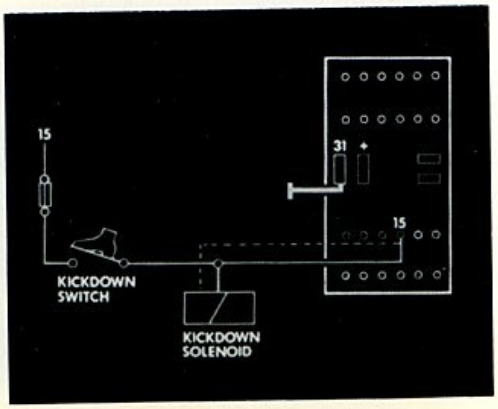


Two-tenths of a second after this, a 100 milli-ohm resistance is switched in and the generator output or charging current is measured, evaluated and printed out.

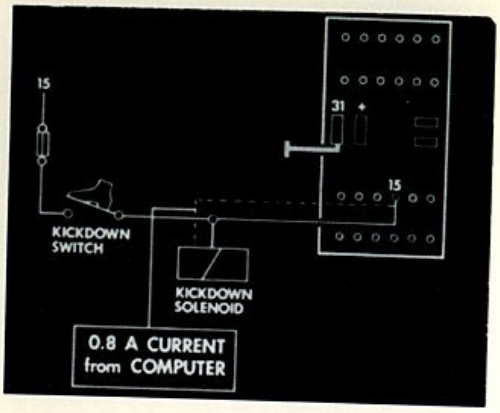


When looking over these measurement figures, it is necessary to apply your experience to tell where the decimal point belongs. Obviously, this generator is not putting out at a hundred-thirty-eight volts, but 13 point 8 sounds reasonable.

Tests number 35 and 36 are obviously for automatic transmissions only and are skipped on cars with standard shift.



The operator presses down on the accelerator through the "hard spot" with the ignition on. The change in current triggers a flip-flop switch in the computer and the print out is either a plus or minus.

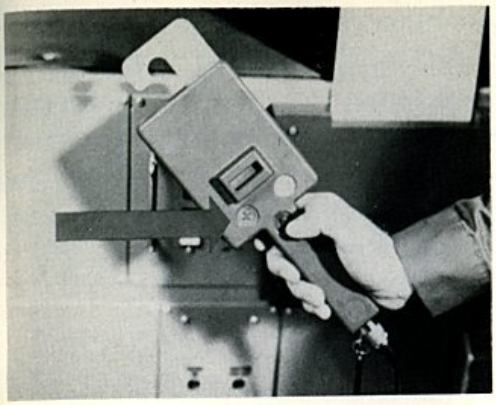


For the solenoid, the computer actuates the electromagnet with an 0.8 current, then measures the voltage drop across the electromagnet. This tells the condition of the solenoid.

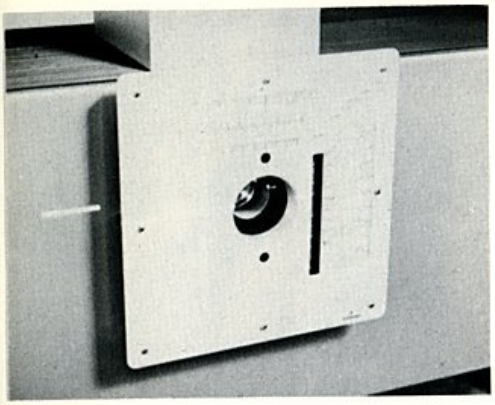
Ignition timing is the next test. It's a manual test, done the same way as it would be without the computer.

The headlight aiming check is also a manual test. It must be done with care in order to get accurate readings.

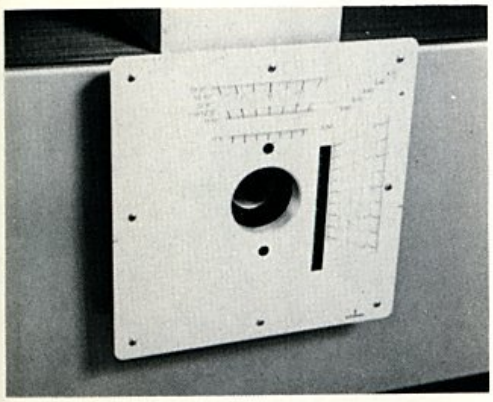
Now comes one of the most interesting of all the tests. Wheel alignment. When he prepared the vehicle for computer diagnosis, the diagnostician placed the brackets containing the mirrors on each wheel and turned the wheels slightly to the left.



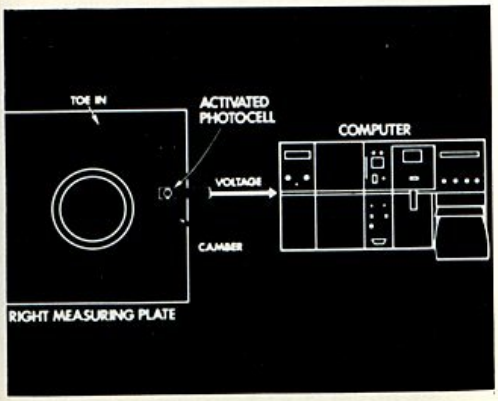
Then when he pushed the plus or minus button to evaluate headlight alignment, the projectors in both left and right consoles were automatically turned on.



When turning the wheel to the right, the reflected light beam in the shape of a cross sweeps across the array of photo cells.



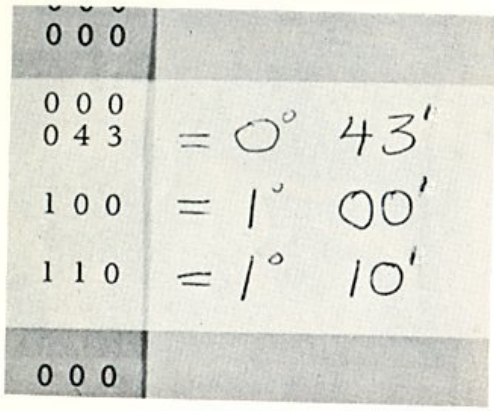
As the light beam strikes the trigger photo cell, the measured values are stored in the computer, and the light beam goes out.



The computer now takes the measured values in the form of voltage drops in resistors corresponding with the activated photocells and transforms them into degrees and minutes.

37 Basic Ignition Timing	Degrees BTDC	
38 Basic Ignition Timing	Degrees ATDC	0 0
39 Ignition Timing Advance	Degrees BTDC	0 0
40 Ignition Timing Advance	Degrees ATDC	
41 Headlight Aiming		0 0
42 Total Toe-in Front	Degrees/Min.	0 4
43 Total Toe-out Front	Degrees/Min.	
44 Pos. Camber Frt. left	Degrees/Min.	1 0
45 Neg. Camber Frt. left	Degrees/Min.	
46 Pos. Camber Frt. right	Degrees/Min.	1 1
47 Neg. Camber Frt. right	Degrees/Min.	
48 Upper Torsion Arms—axial play		
49 V-Belt—tension and condition		0 0
50 Air Intake Housing Bellows		
51 King and Link Pins—free play		
52 Ball Joint—free play left lower		

The print out has two lines for each measurement; total toe in and total toe out, positive camber left and right and negative camber left and right. Since one of the two lines for each is plus and the other minus, only three of the six lines will receive a print out.



043 means 0 degrees and 43 minutes toe in.
100 means 1 degree and no minutes.
110 means 1 degree and 10 minutes.

After the alignment diagnosis, the wheel mirror bracket is returned to its storage space in the front console.

This is the last automatic test, and the car is now raised for manual inspection of all underneath parts.

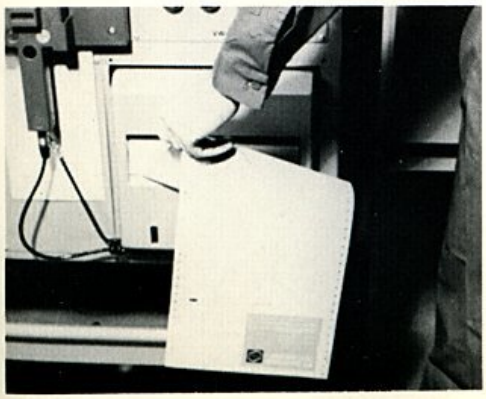
44 Pos. Camber Frt. left	Degrees/Min.	1 0 0
45 Neg. Camber Frt. left	Degrees/Min.	
46 Pos. Camber Frt. right	Degrees/Min.	1 1 0
47 Neg. Camber Frt. right	Degrees/Min.	
48 Upper Torsion Arms–axial play		
49 V-Belt–tension and condition		0 0 0
50 Air Intake Housing Bellows		
51 King and Link Pins–free play		
52 Ball Joint–free play left lower		
53 Ball Joint Dust Seal–left lower		0 0 0
54 Ball Joint–free play left upper		
55 Ball Joint Dust Seal–left upper		
56 Ball Joint–free play right lower		
57 Ball Joint Dust Seal–right lower		0 0 0
58 Ball Joint–free play right upper		
59 Ball Joint Dust Seal–right upper		
60 Tie Rods–free play		**0 0 0**
61 Tie Rods, Dust Seals		**0 0 0**
62 Steering Gear Leakage		
63 Front Brake Linings–thickness		**0 0 0**

Every part subject to wear is inspected. If there is any doubt as to its condition, it gets a minus and a notation.

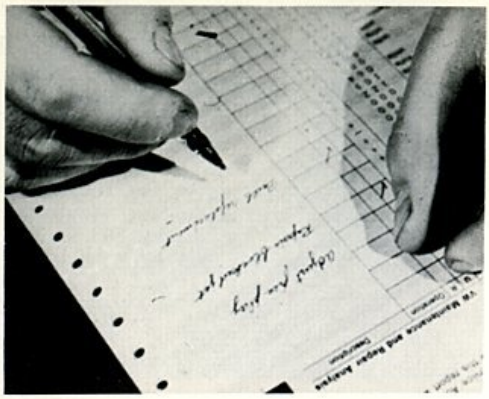
For example, the specs say that a bias ply tire must have at least 2/32nds inches of tread. If the tire shows exactly that amount, the operator might note that it is on the borderline.

52 Steering Gear Leakage	
53 Front Brake Linings–thickness	**0 0 0**
54 Front Brake Lines and Connections	**0 0 0**
55 Left Front Tire–condition	**0 0 0**
56 Right Front Tire–condition	0 0 0
57 Muffler, Tail Pipes and Connections	0 0 0
58 Rear Brake Lines and Connections	0 0 0
59 Rear Brake Linings–thickness	0 0 0
70 Left Rear Tire–condition	0 0 0
71 Right Rear Tire–condition	0 0 0
72 Water Drain Flaps	
73 Drive Shaft Boots	0 0 0
74 Clutch Servo Rod–free play	
Test drive by _____	
Additional observations	

So the final visual checks are completed. Nothing is left to chance. The diagnostician, relying on his knowledge and experience, evaluates each item and records OK/NOT OK with the hand unit.

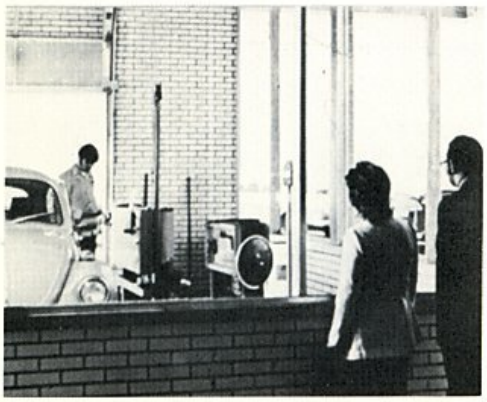


When he has finished the complete series of tests, he removes the test report from the printer . . .



. . . and notes his comments and recommendations at this time.

The diagnostician then signs the test report indicating that he will be responsible for his evaluations and recommendations.



Volkswagen computer diagnosis *is* truly revolutionary. Many dealers take advantage of its sales appeal by putting it in a showcase, where customers can see for themselves, the extra care that Volkswagen dealers take in protecting their customers investment.

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