

6. TRANSMISSION CONTROLLED SPARK (TCS) SYSTEM

CONTENTS

	Page
Description	6-1
Operation	6-1
Inspection	6-8

6. TRANSMISSION CONTROLLED SPARK (TCS) SYSTEM

DESCRIPTION

The TCS controls the vacuum ignition timing in accordance with the coolant temperature, vehicle speed, and catalytic converter temperature (4M only) for the purpose of minimizing the generation of NO_x (nitrogen oxides) and HC (hydrocarbon).

The method of control differs with the engine family as follows:

Engine Family	Method
2T-C (for California only)	Vacuum advance cut
20R	Vacuum advance bleed
4M (Except for California)	Vacuum advance cut
4M (For California only)	Vacuum advance cut + vacuum retard
2F	Vacuum retard

OPERATION

1. TCS operation (2T-C engine for California only)

["ON" condition]

- When the vehicle speed and coolant temperature reach the "ON" range, the computer turns the VSV "ON".
- Turning "ON" the VSV causes the vacuum circuit between the distributor diaphragm and carburetor advancer port to close, and at the same time, allows the atmosphere to act on the distributor diaphragm.
- The diaphragm is returned by spring tension so that there is no vacuum advance (vacuum advance cut).

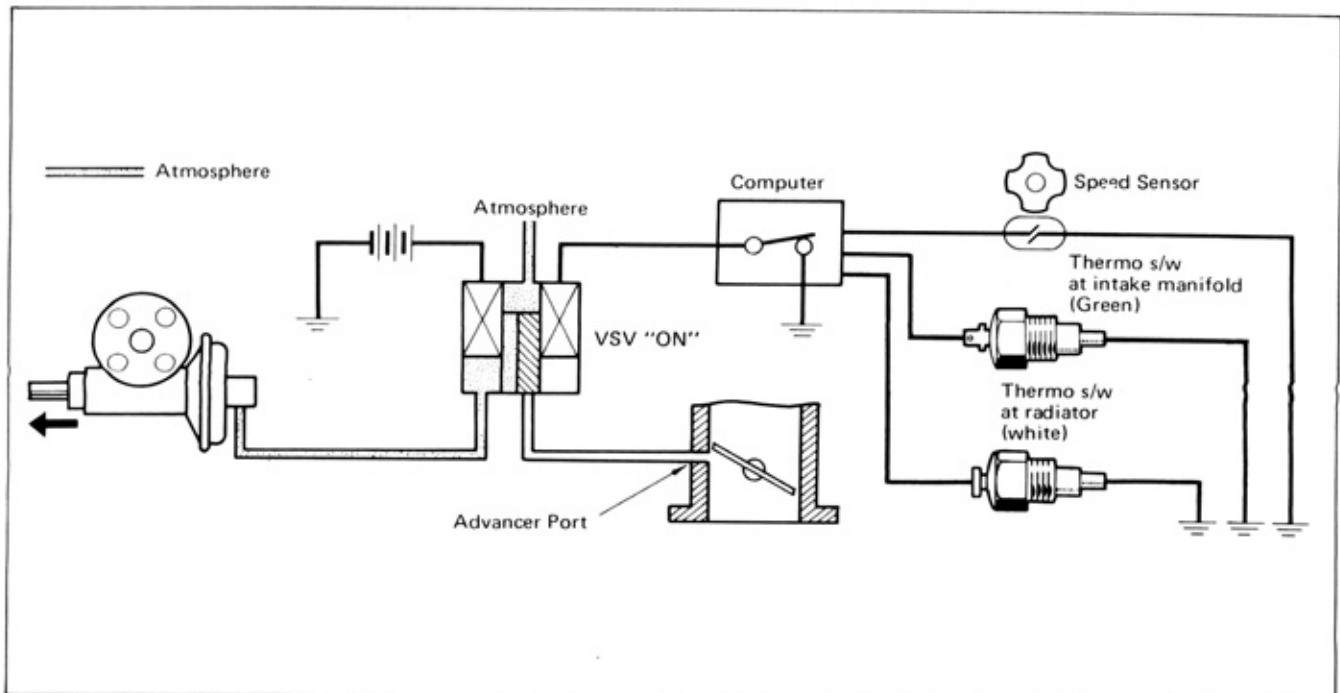


Fig. 6-1 TCS System Operation ("ON" Condition)

["OFF" condition]

- When the vehicle speed and/or the coolant temperature enters in the "OFF" range, the computer turns "OFF" the VSV.
- Turning "OFF" the VSV causes the passage between the distributor diaphragm and atmosphere to close, and the vacuum passage between the diaphragm and carburetor advancer port to open.
- If at this condition, the throttle valve is opened so that the intake manifold vacuum acts on the advancer port, the vacuum will also act on the distributor diaphragm for normal vacuum advance action.

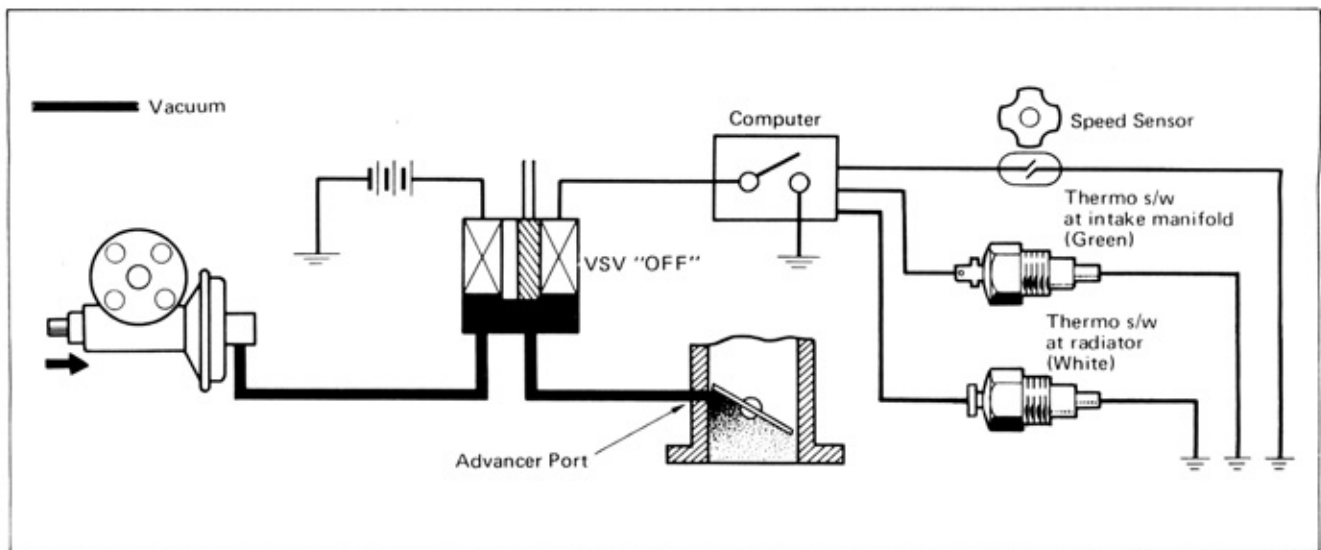


Fig. 6-2 TCS System Operation ("OFF" Condition)

2. TCS Operation (20R engine only)

["OFF" condition (1)]

At coolant temperature below 122°F, the thermostatic vacuum switching valve (TVSV) will be "OFF" so that the vacuum from the advancer port will act on the distributor diaphragm and perform normal vacuum advance action, regardless of whether the VSV is "ON" or "OFF".

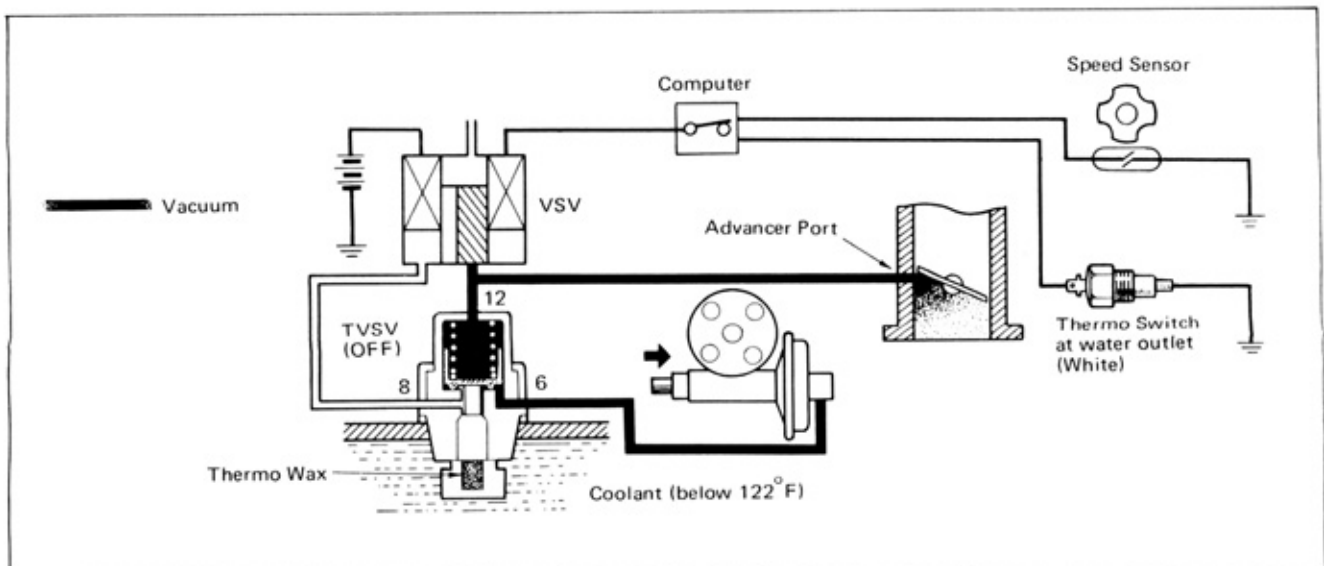


Fig. 6-3 TCS System Operation ("OFF" Condition (1))

["OFF" condition (2)]

- When coolant temperature rises above 122°F, the thermo wax expands and pushes up the valve, so that the TVSV will be "ON".
- If the vehicle speed and/or coolant temperature are in the "OFF" range, the VSV will turn "OFF"
- Turning "OFF" the VSV causes the bleeding by the atmosphere to shut off. Therefore, the vacuum from the advancer port acts on the distributor diaphragm and the system will be in normal advance condition.

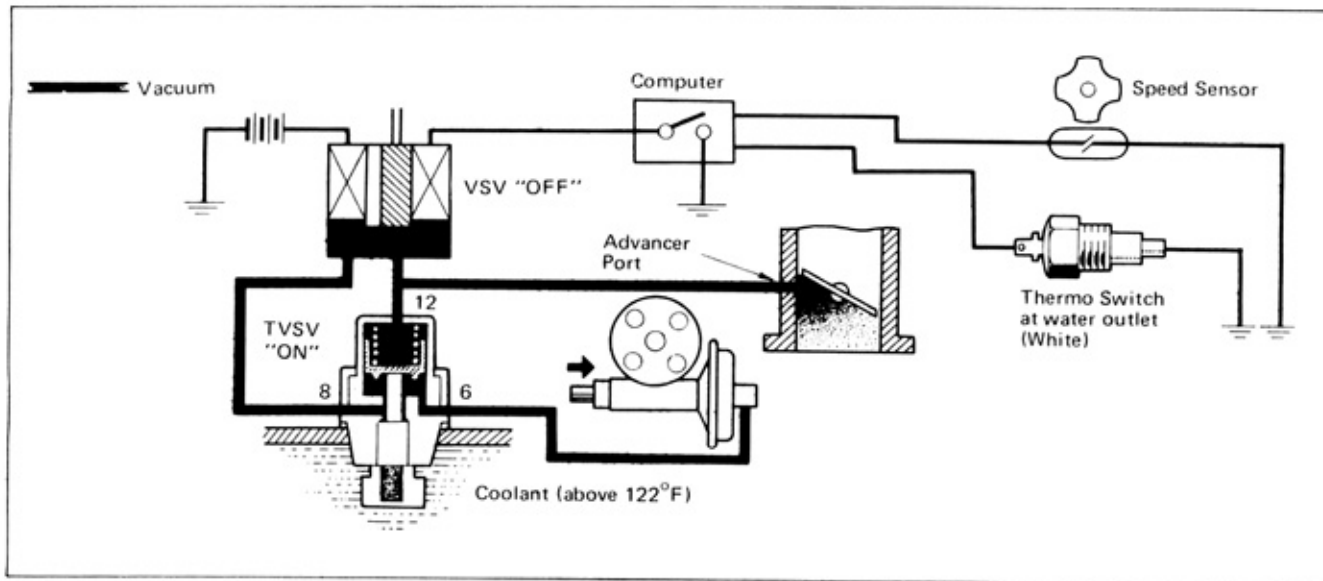


Fig. 6-4 TCS System Operation ("OFF" Condition (2))

["ON" condition]

- If under this condition, the vehicle speed and coolant temperature are in the "ON" range, the VSV will turn "ON".
- Turning "ON" the VSV causes the atmosphere from the canister to act on the distributor diaphragm. Thus, the vacuum advance will fail to advance by the amount bled by the atmosphere.

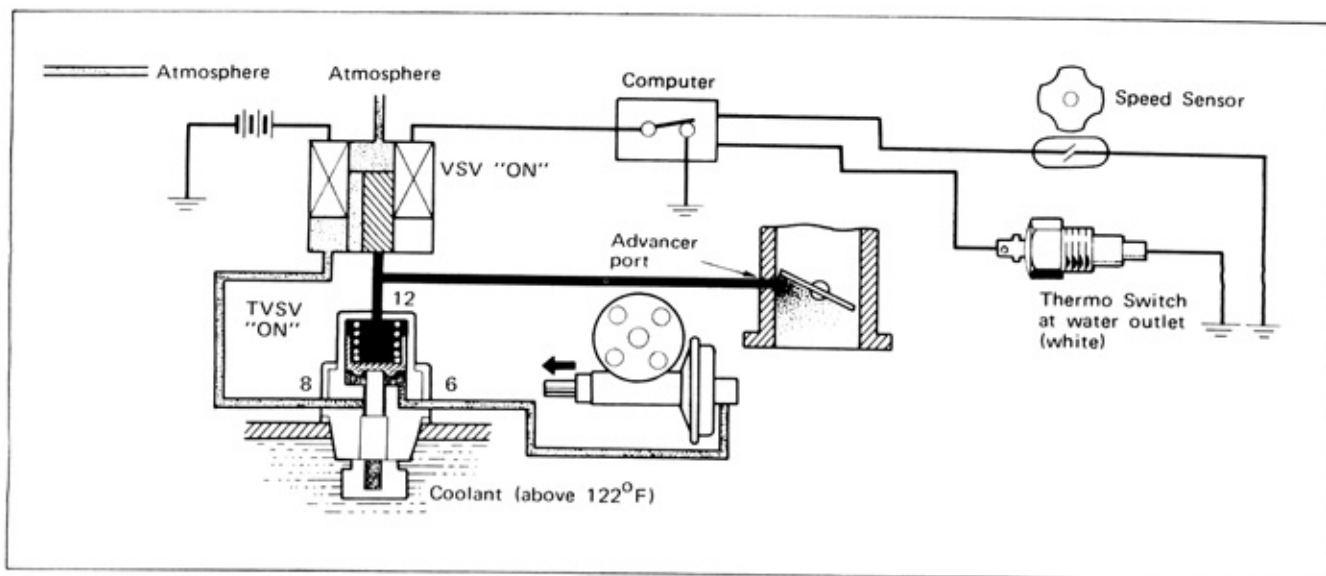


Fig. 6-5 TCS System Operation ("ON" Condition)

3. TCS system operation (4M engine only)

["ON" condition]

- When the vehicle speed, coolant temperature, and catalytic converter temperature are in the "ON" range, the computer turns the VSV "ON"
- Turning "ON" the VSV causes the atmosphere to act on the advance side of the distributor diaphragm and to cut off the vacuum advance.
- In addition to the above, in the engines for California, the intake manifold vacuum acts on the retard side of the distributor diaphragm, resulting in a vacuum advance cut and a vacuum retard.

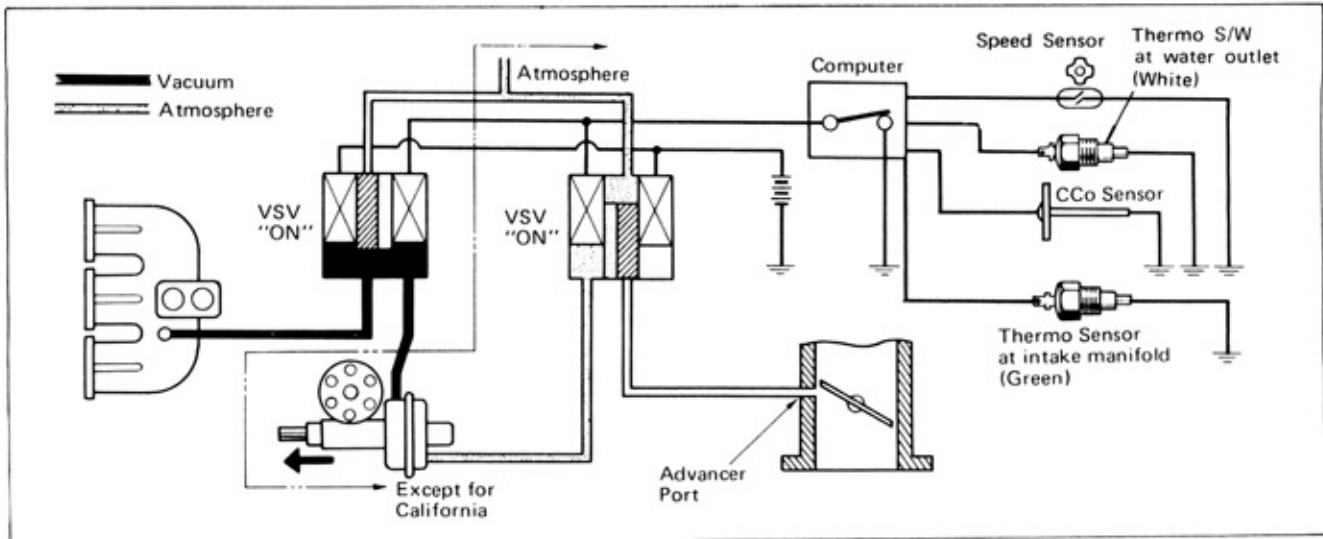


Fig. 6-6 TCS System Operation ("ON" Condition)

["OFF" condition]

- If any one of the above three conditions is in the "OFF" range, the computer turns the VSV "OFF".
- Turning "OFF" the VSV causes the passage between the advance side of the distributor diaphragm and carburetor advancer port to clear, and in the engines for California, also causes the atmosphere to act on the retard side of the distributor diaphragm.
- Thus, the system returns to normal vacuum advance condition.

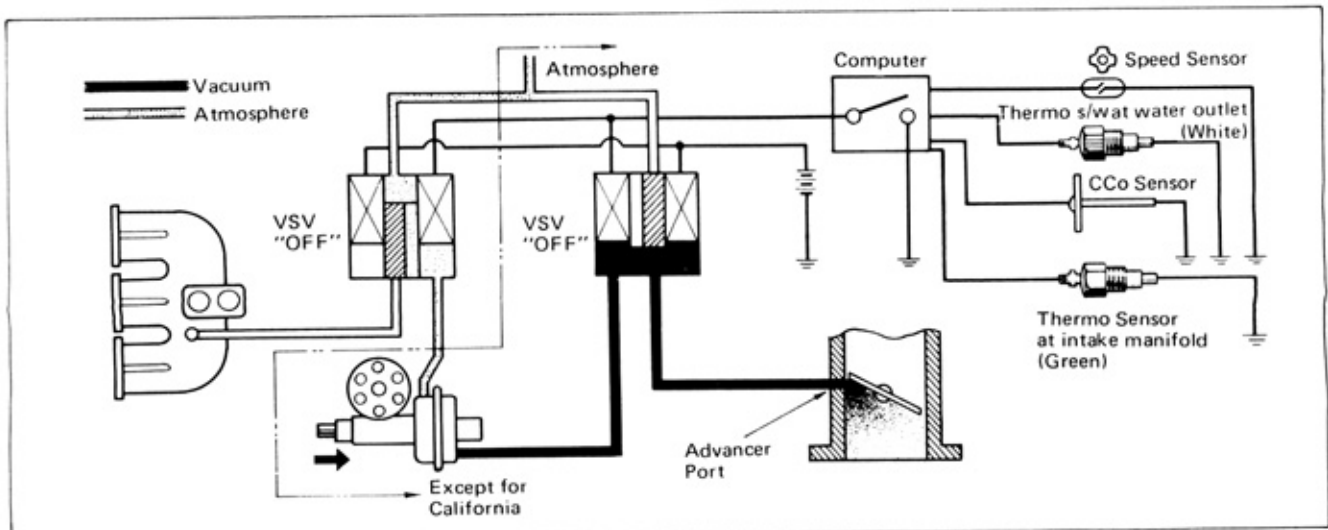


Fig. 6-7 TCS System Operation ("OFF" Condition)

4. TCS system operation (2F engine only)

["ON" condition]

- When the vehicle speed and coolant temperature are in the "ON" range, the computer turns the VSV "ON".
- Turning "ON" the VSV causes the intake manifold vacuum to act on the retard side of the distributor diaphragm, and retard the ignition timing.

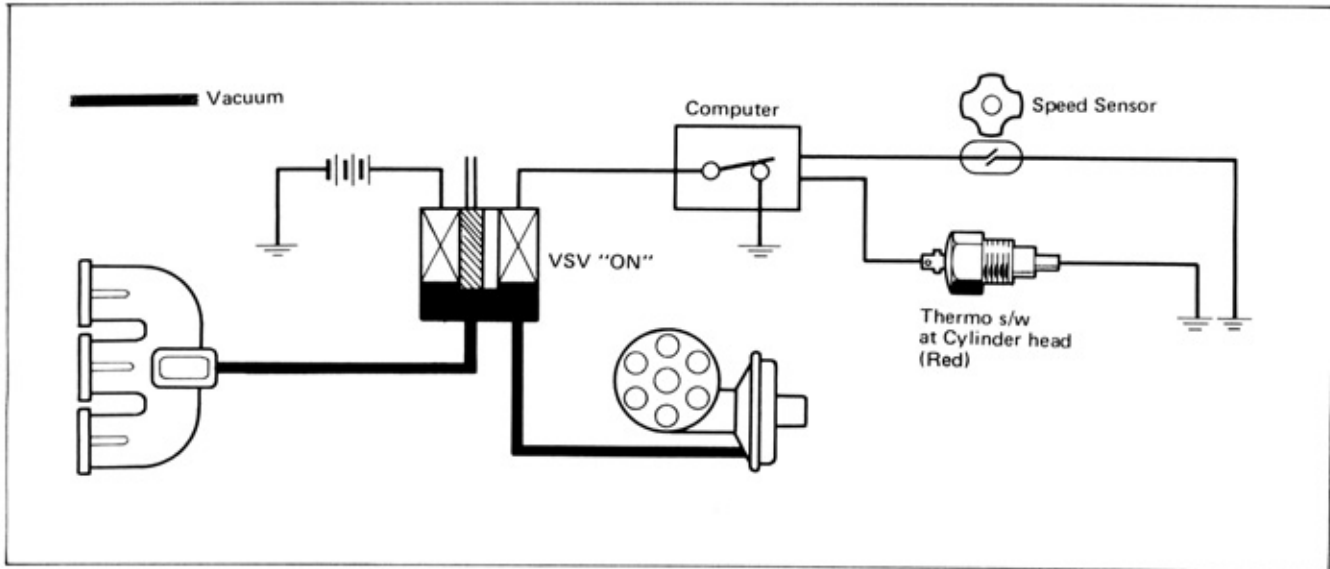


Fig. 6-8 TCS System Operation ("ON" Condition)

["OFF" condition]

- If any one of the above conditions is in the "OFF" range, the computer turns the VSV "OFF".
- Turning the VSV "OFF" causes the atmosphere to act on the retard side of the distributor diaphragm so that there will be no vacuum retard.
- The ignition timing of the 2F engine will then be controlled by governor advance alone.

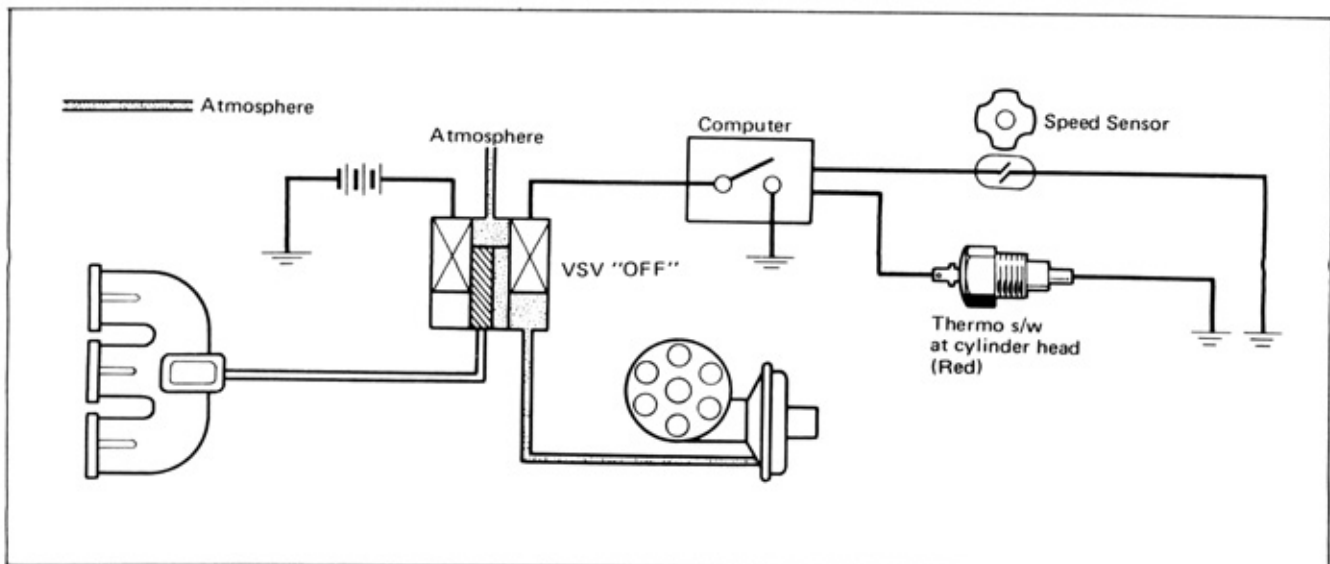


Fig. 6-9 TCS System Operation ("OFF" Condition)

5. **Thermostatic vacuum switching valve (TVSV) operation (20R engine only)**

(1) "ON" condition

At high coolant temperature, the thermo wax expands so that the valve is raised up. Thus, there will be continuity among the pipes "A", "B" and "C".

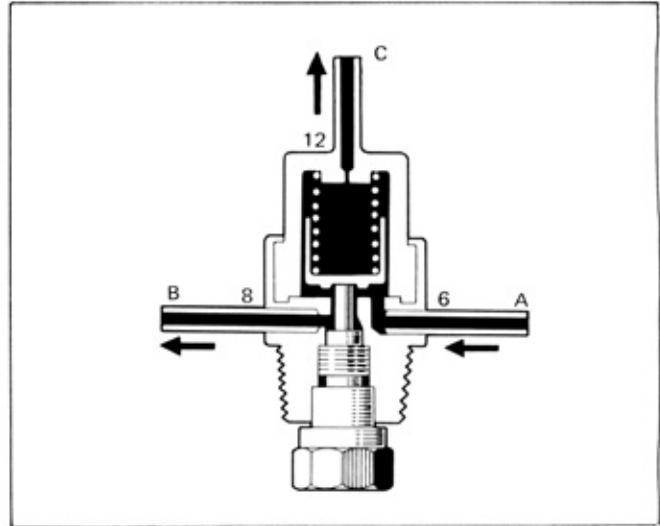


Fig. 6-10 TVSV Operation "ON" Condition

(2) "OFF" condition

When the coolant temperature drops, the thermo wax contracts and allows the spring tension to lower the valve. Thus, there is continuity between pipes "A" and "C" only.

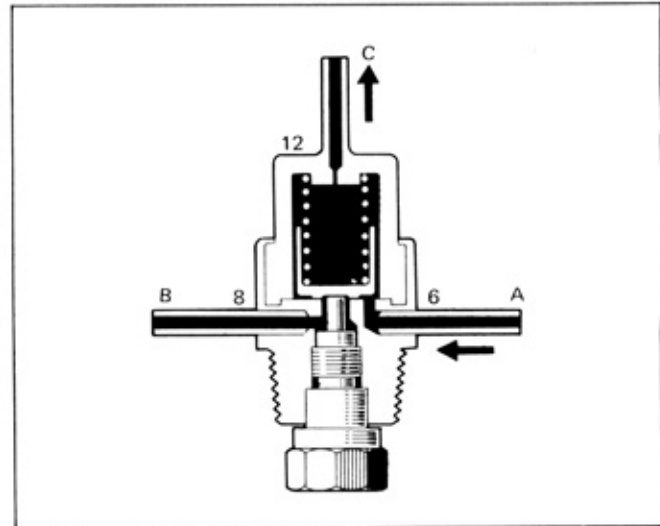


Fig. 6-11 TVSV Operation "OFF" Condition

(3) Operating temperature range.
As shown in Fig. 6-12.

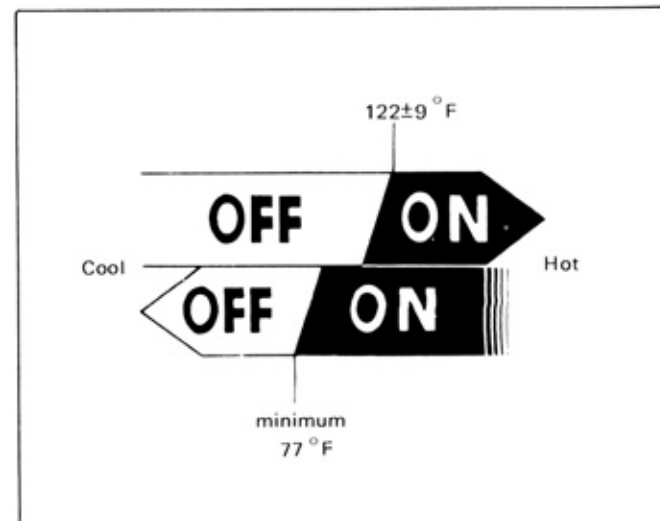


Fig. 6-12 TVSV Operating Range

6. TCS system operating ranges

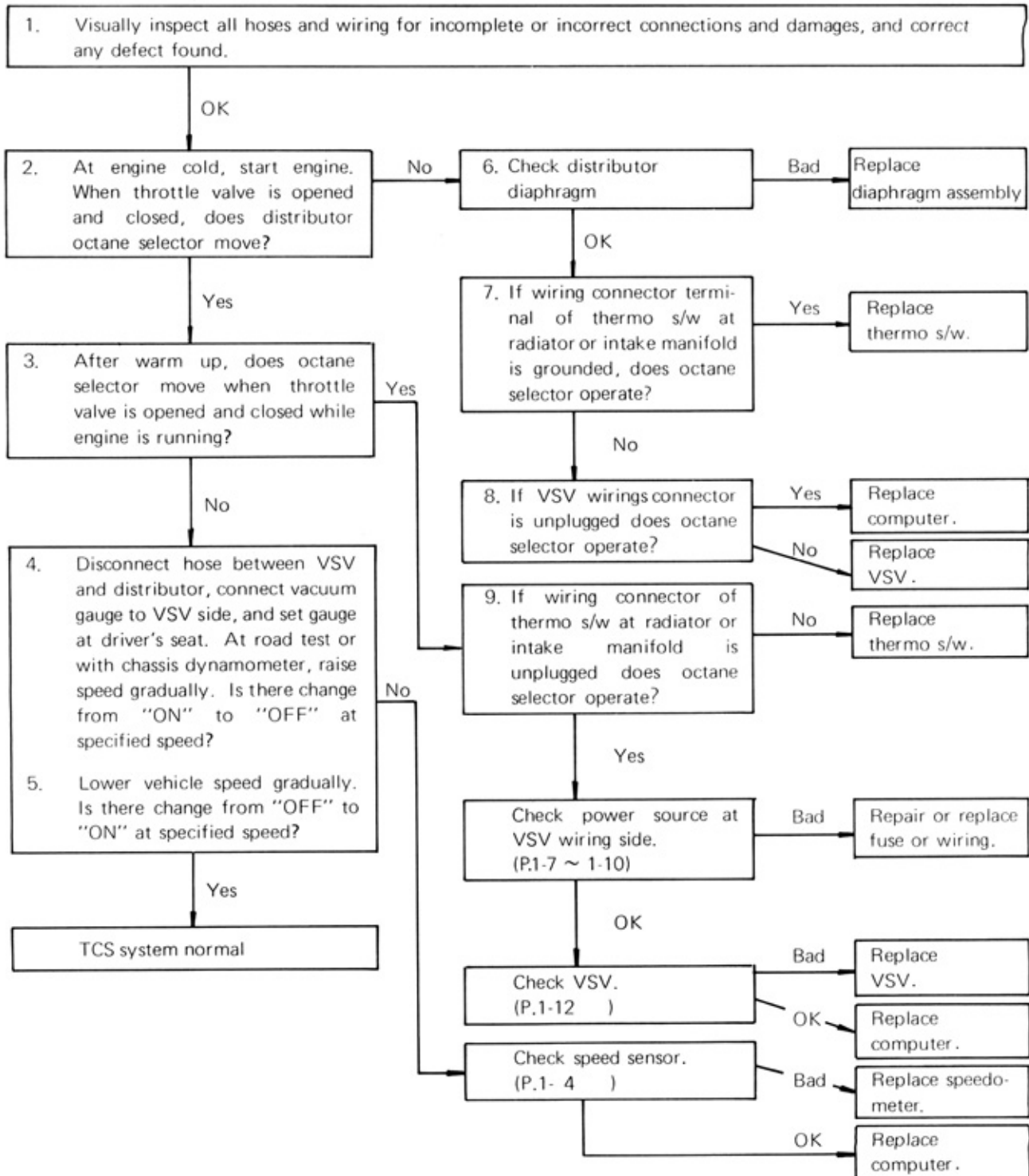
TCS system "ON" – When all following conditions are "ON"

TCS system "OFF" – When any one of following conditions is "OFF"

Note: In the following, thermo switch "ON" denotes cut out condition and "OFF" denotes continuity condition.

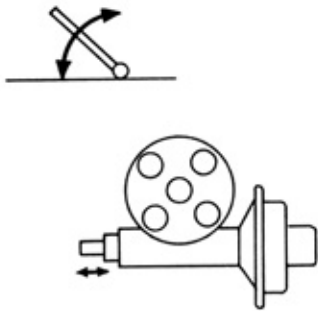
2T-C Engine (for California)	Vehicle Speed – Speed Sensor	Coolant Temp. – Thermo s/w (at In. Manifold)	Coolant Temp. – Thermo s/w (at Radiator)	
	<p>M/T : 41 ± 3 A/T : 65 ± 3 20 ± 3 (mph)</p>	<p>Cool Hot 140 ± 9 minimum 117 (°F)</p>	<p>Cool Hot 55 ± 9 221 ± 9 minimum 43 minimum 208 (°F)</p>	
20R Engine	Vehicle Speed – Speed Sensor	Coolant Temp. – TVSV	Coolant Temp. – Thermo s/w (at Water Outlet)	
	<p>41 ± 3 20 ± 3 (mph)</p>	<p>Cool Hot 122 ± 9 minimum 77 (°F)</p>	<p>Cool Hot 55 ± 9 221 ± 9 minimum 43 minimum 208 (°F)</p>	
4M Engine	Vehicle Speed – Speed Sensor	Coolant Temp. – Thermo Sensor (at In. Manifold)	Coolant Temp. – Thermo s/w (at Water Outlet)	CCo Temp. – Thermo Sensor
	<p>65 ± 3 20 ± 3 (mph)</p>	<p>Cool Hot 140 ± 9 minimum 117 (°F)</p>	<p>Cool Hot 55 ± 9 221 ± 9 minimum 43 minimum 208 (°F)</p>	<p>Cool Hot $1380 + 65$ -45 minimum 1200 ± 90 (°F)</p>
2F Engine	Vehicle Speed – Speed Sensor		Coolant Temp. – Thermo s/w (at Cylinder Head)	
	<p>3 ± 2 41 ± 3 9 ± 2 20 ± 3 (mph)</p>		<p>Cool Hot 122 ± 9 minimum 109 (°F)</p>	

TCS SYSTEM INSPECTION PROCEDURE (2T-C Engine for California)

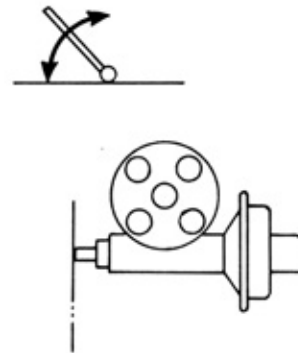


Note
 Test 2 cannot be performed if the coolant temperature does not drop below 40°F even if the vehicle is left out in the shade for more than one hour. In such case, perform test 2 by grounding the thermo switch connector terminal and forcibly assuming cold condition.
 Unit test of the thermo switch will be required later (P. 1-6).

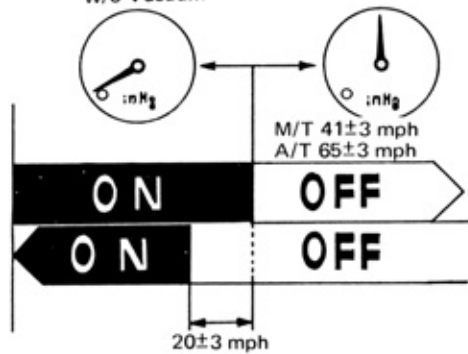
2 Coolant Temp.: below 40°F



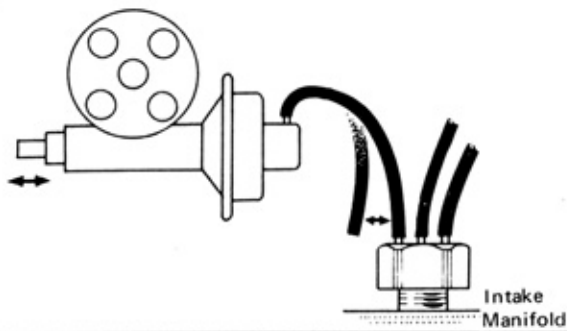
3 after Warming-up



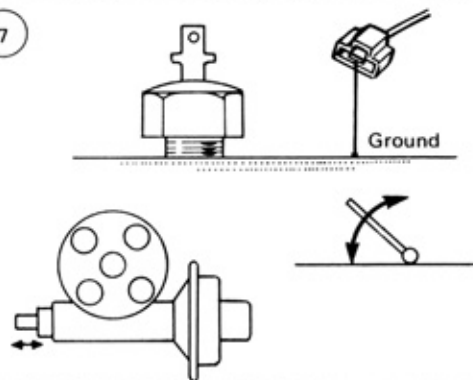
4 5 after Warming-up
w/o Vacuum



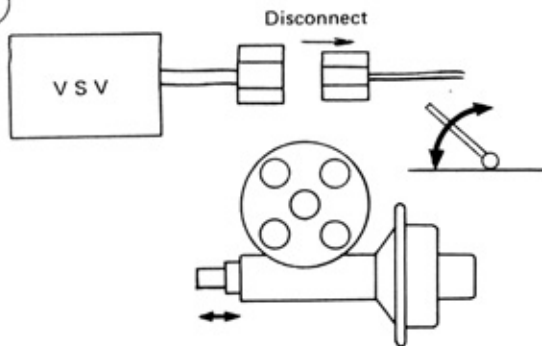
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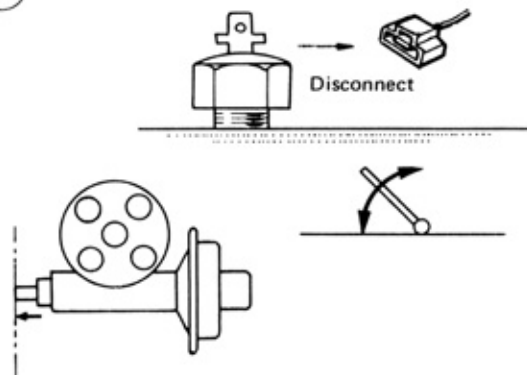
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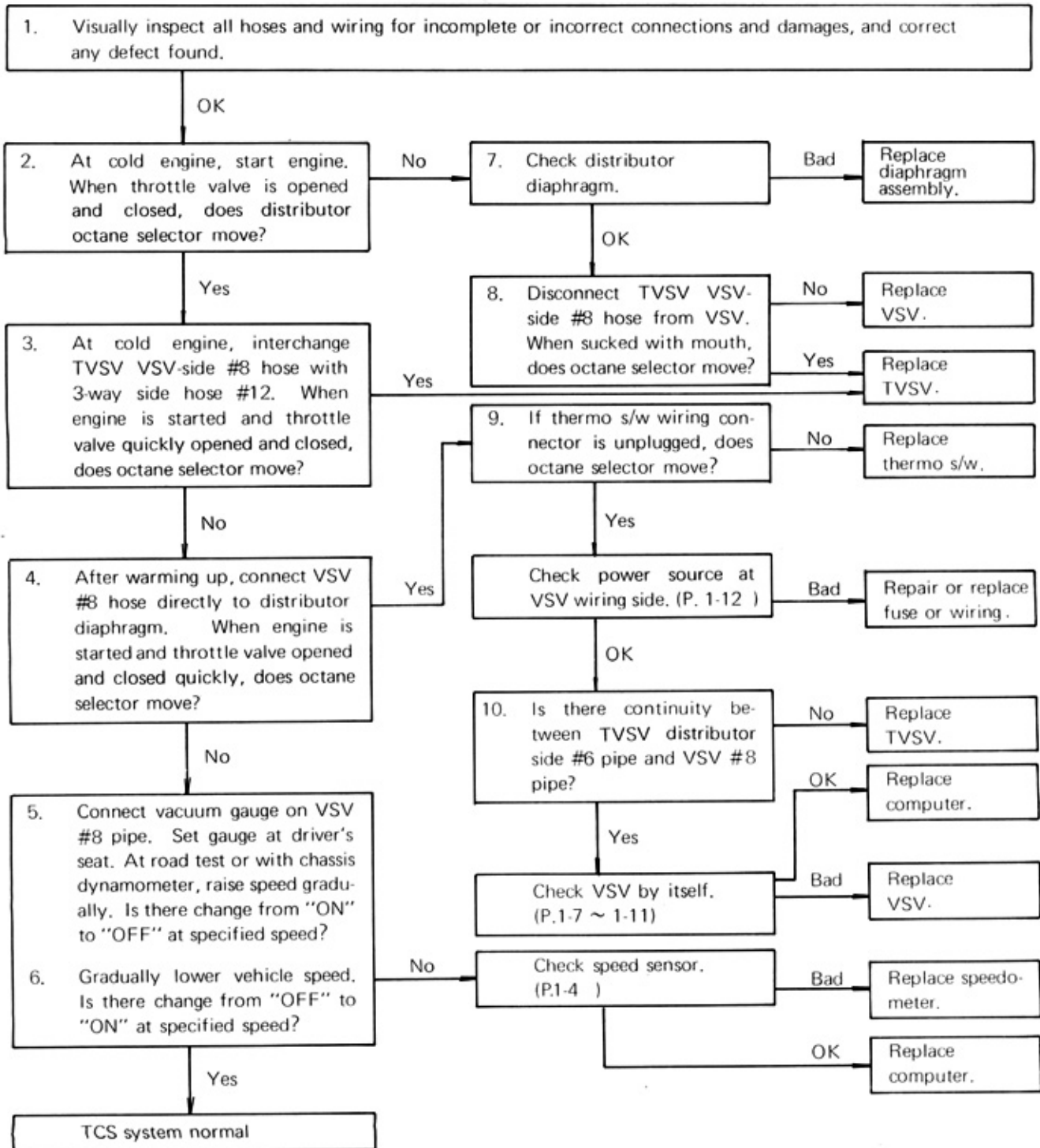
8



9



TCS SYSTEM INSPECTION PROCEDURE (20R Engine)

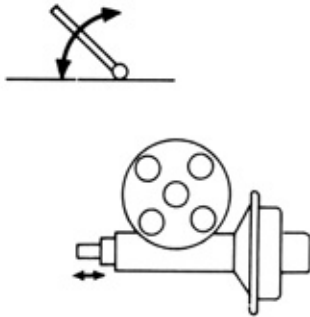


Note

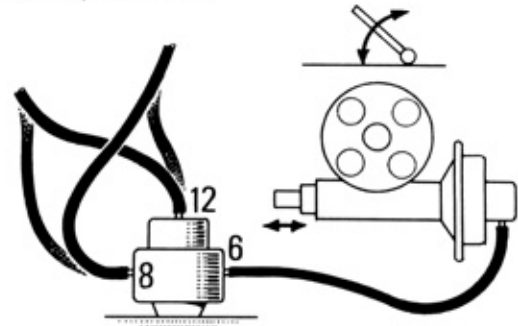
Test 2 cannot be performed if the coolant temperature does not drop below 40°F even if the vehicle is left out in the shade for more than one hour. In such case, perform test 2 by grounding the thermo switch connector terminal and forcibly assuming cold condition.

Unit test of the thermo switch will be required later (P. 1-6).

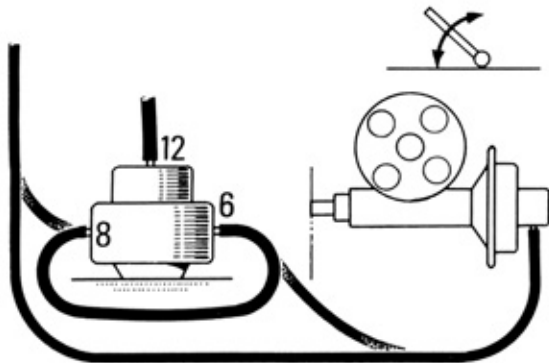
2 Coolant Temp.: below 40°F



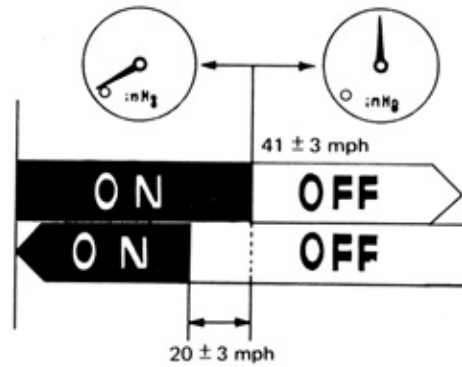
3 Coolant Temp.: below 40°F



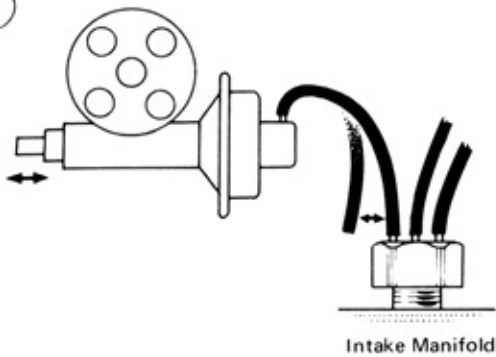
4 after Warming-up



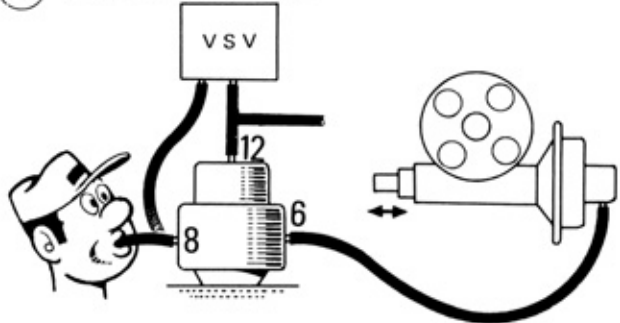
5 6 after Warming-up



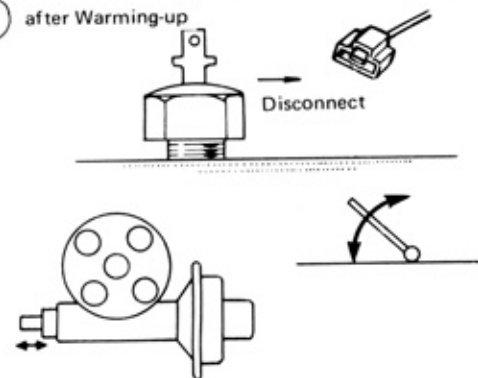
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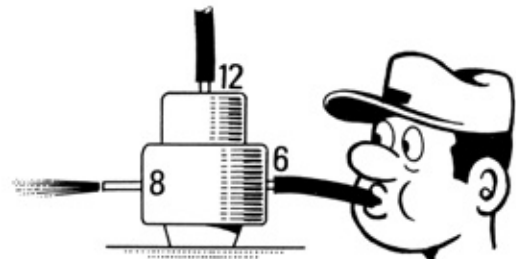
8 Coolant Temp.: below 75°F



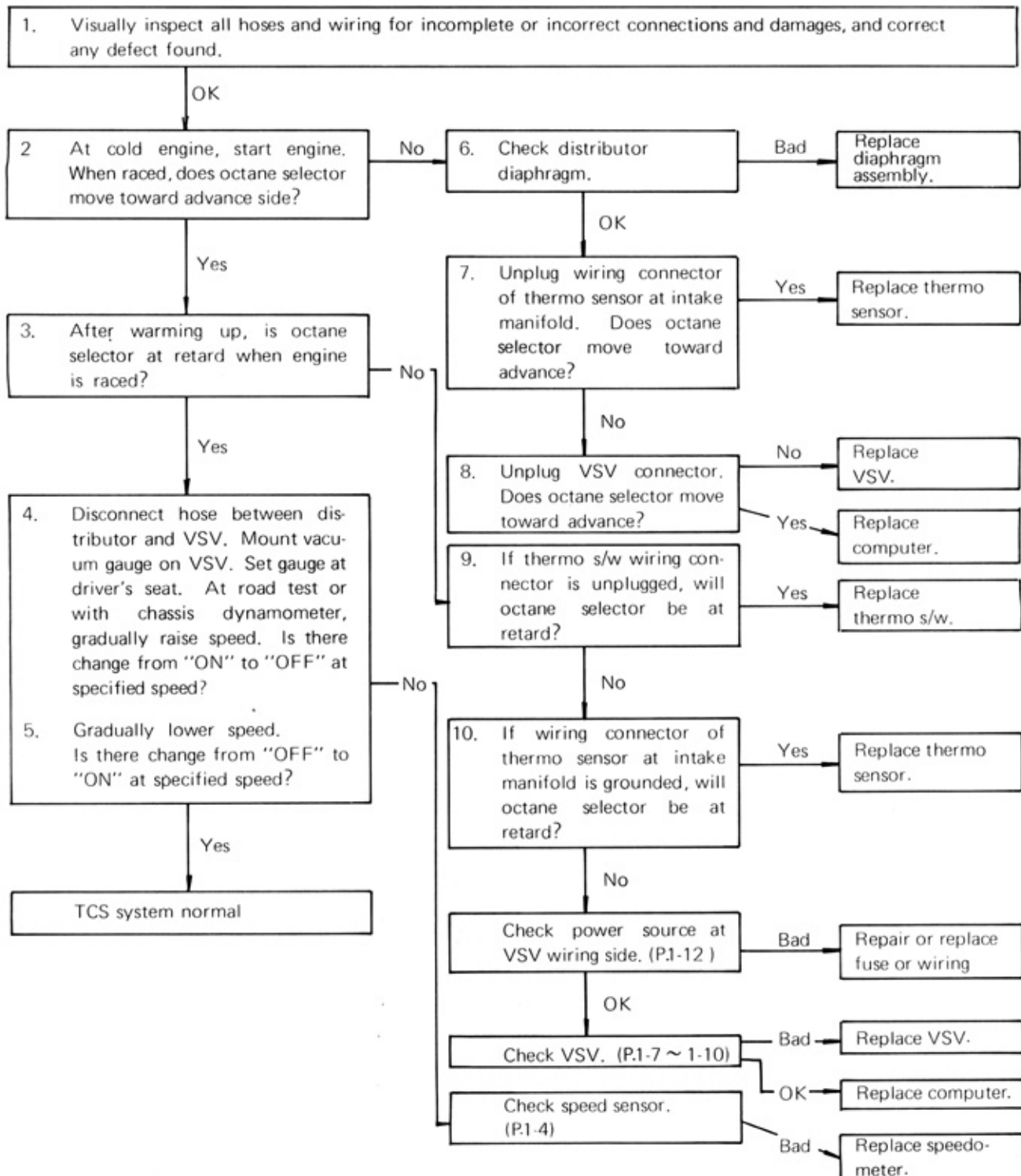
9 after Warming-up



10 after Warming-up

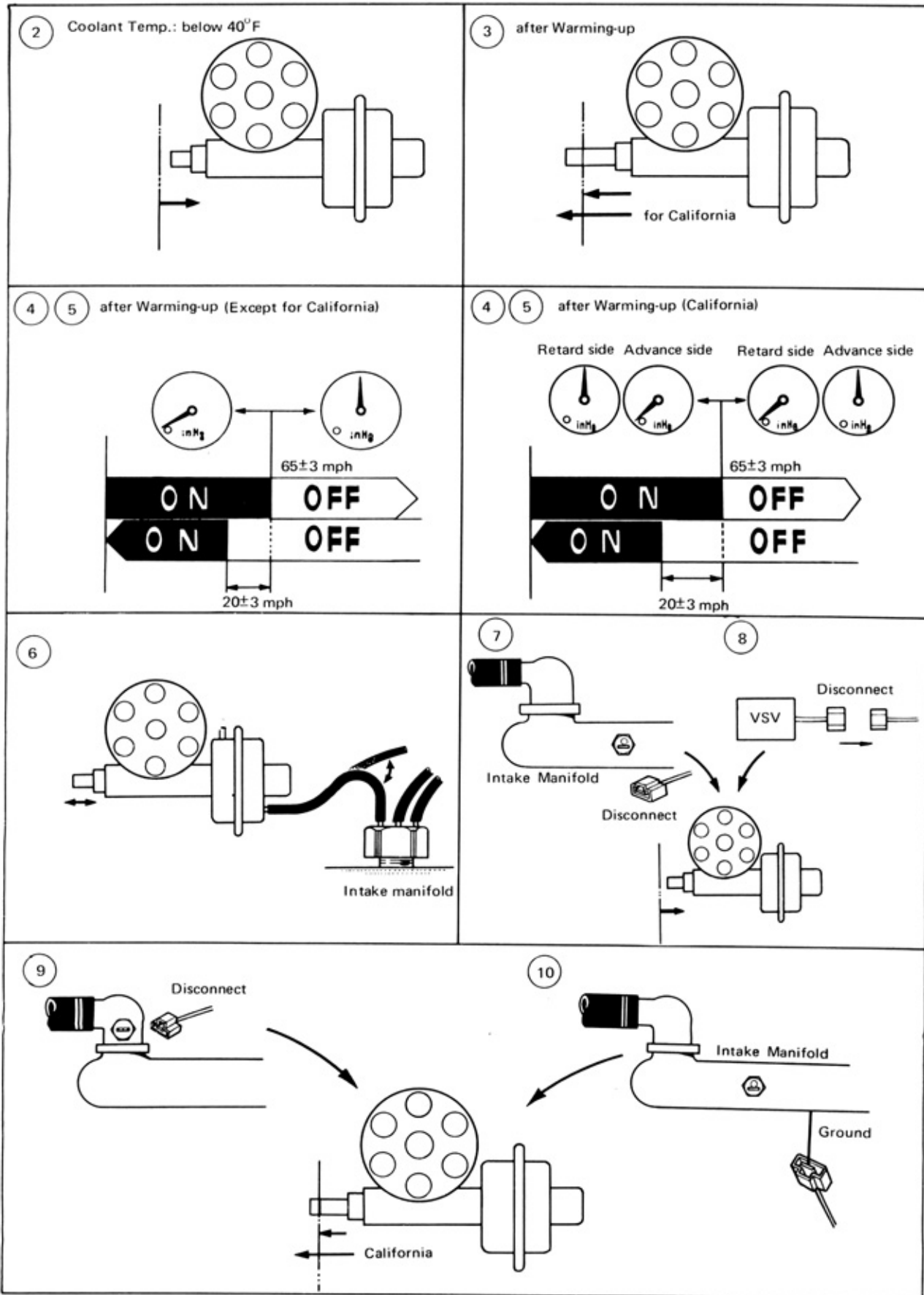


TCS SYSTEM INSPECTION PROCEDURE (4M engine)

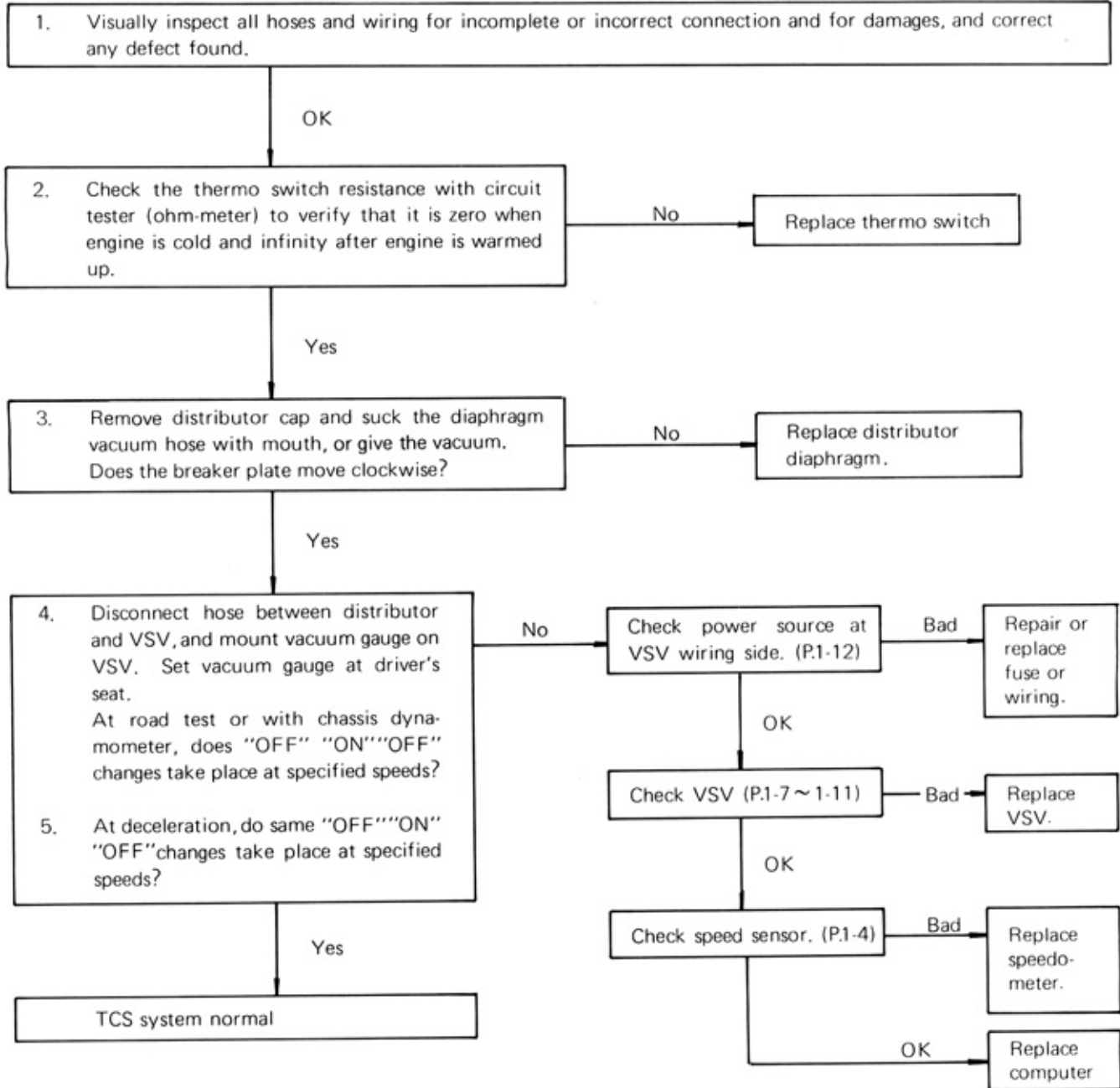


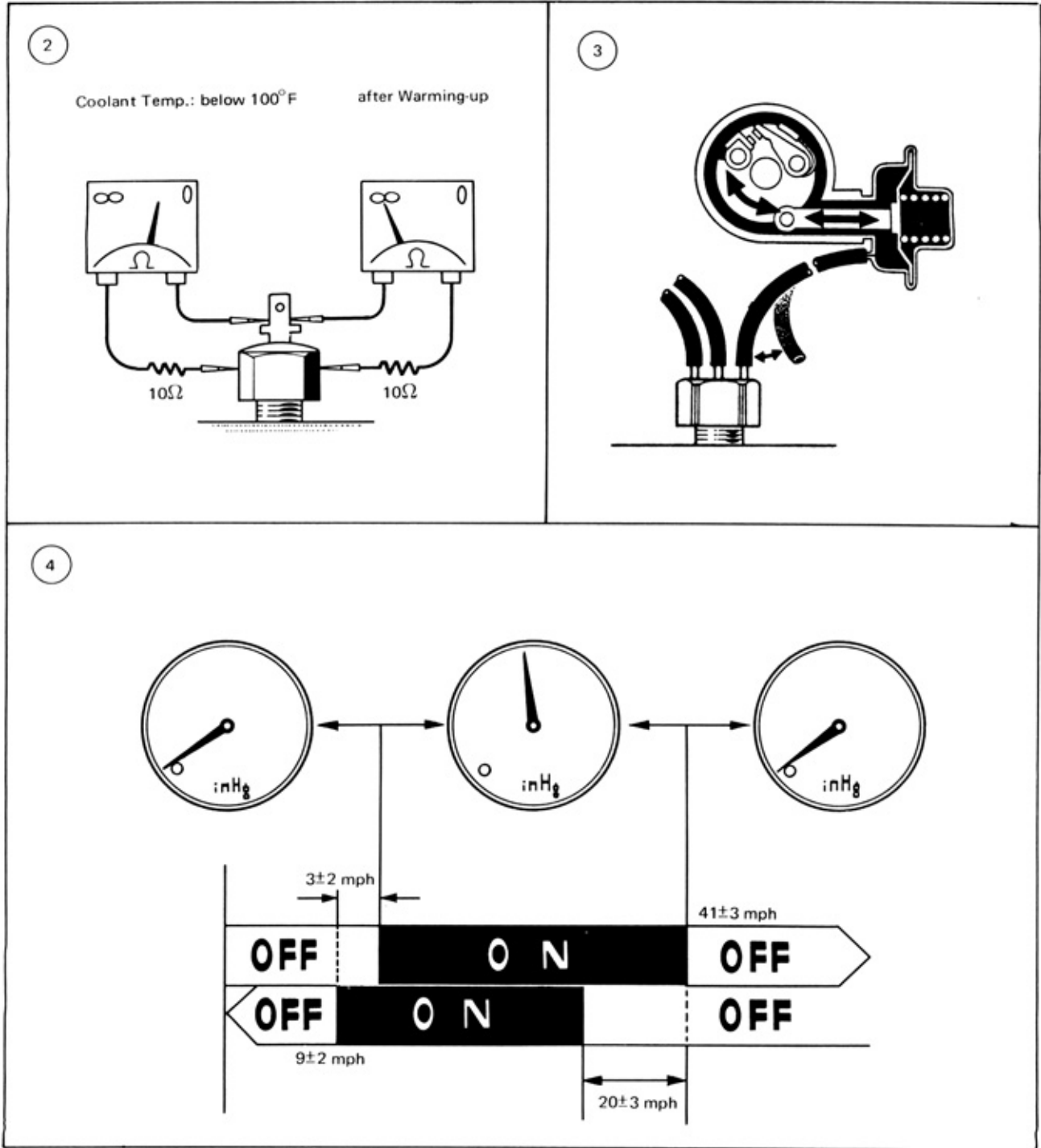
Note

In case the "EXH. TEMP" warning light should turn on, or inspection and replacement in 2 and 3 above do not correct the trouble, check the catalytic converter thermo sensor. (Refer to P. 1-5)
 Test 2 cannot be performed if the coolant temperature does not drop below 40°F even if the vehicle is left out in the shade for more than one hour. In such case, perform test 2 by grounding the thermo switch connector terminal and forcibly assuming cold condition. Unit test of the thermo switch will be required later (P.1-6).

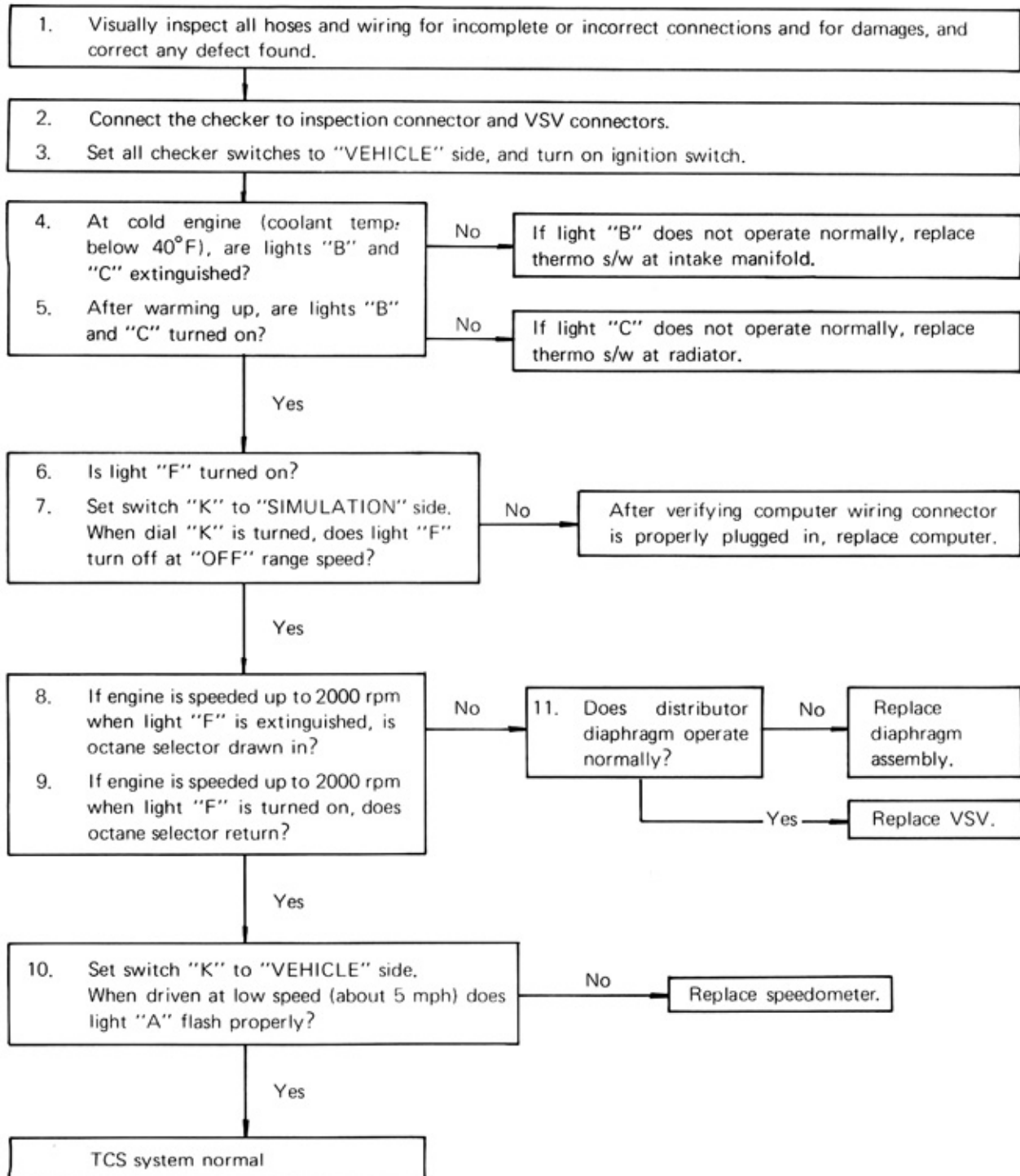


TCS SYSTEM INSPECTION PROCEDURE (2F Engine)





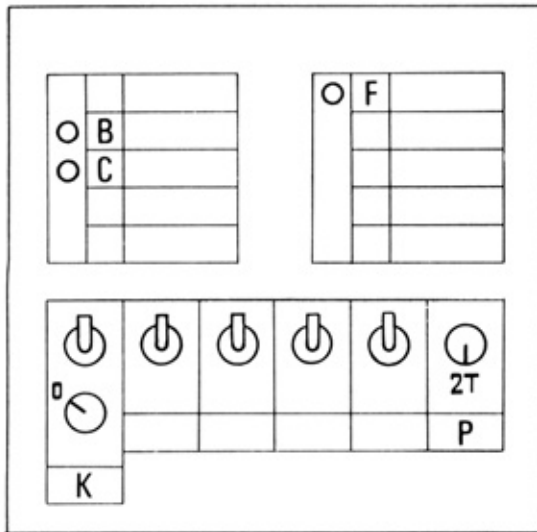
TCS SYSTEM INSPECTION PROCEDURE (Using Checker – 2T-C Engine for California)



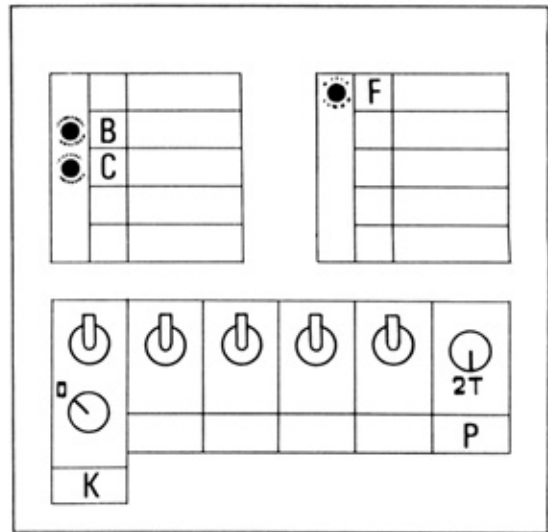
Note

After dismantling checker, have the VSV connector plugged in properly.

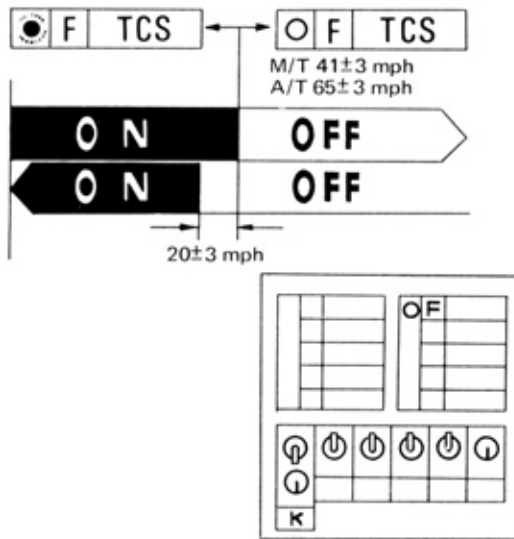
4 Coolant Temp.: below 40°F



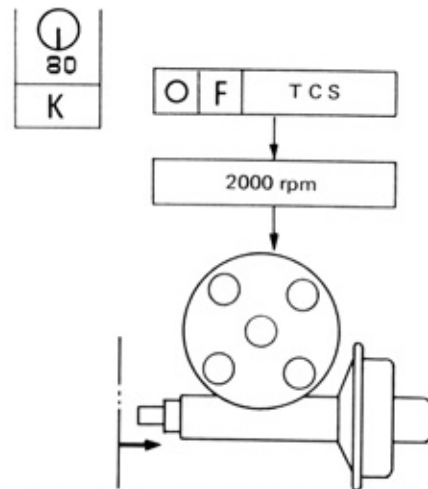
5 6 after Warming-up



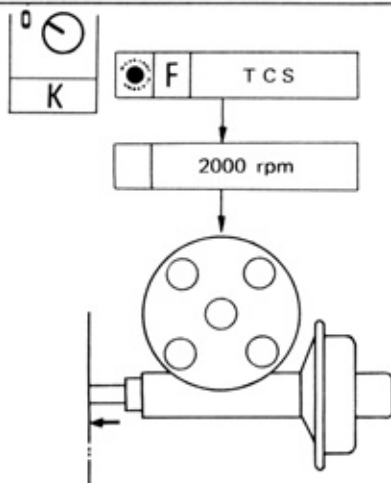
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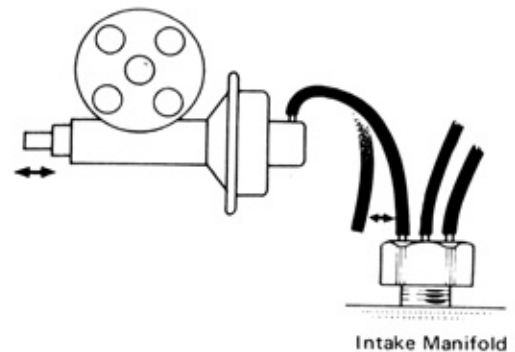
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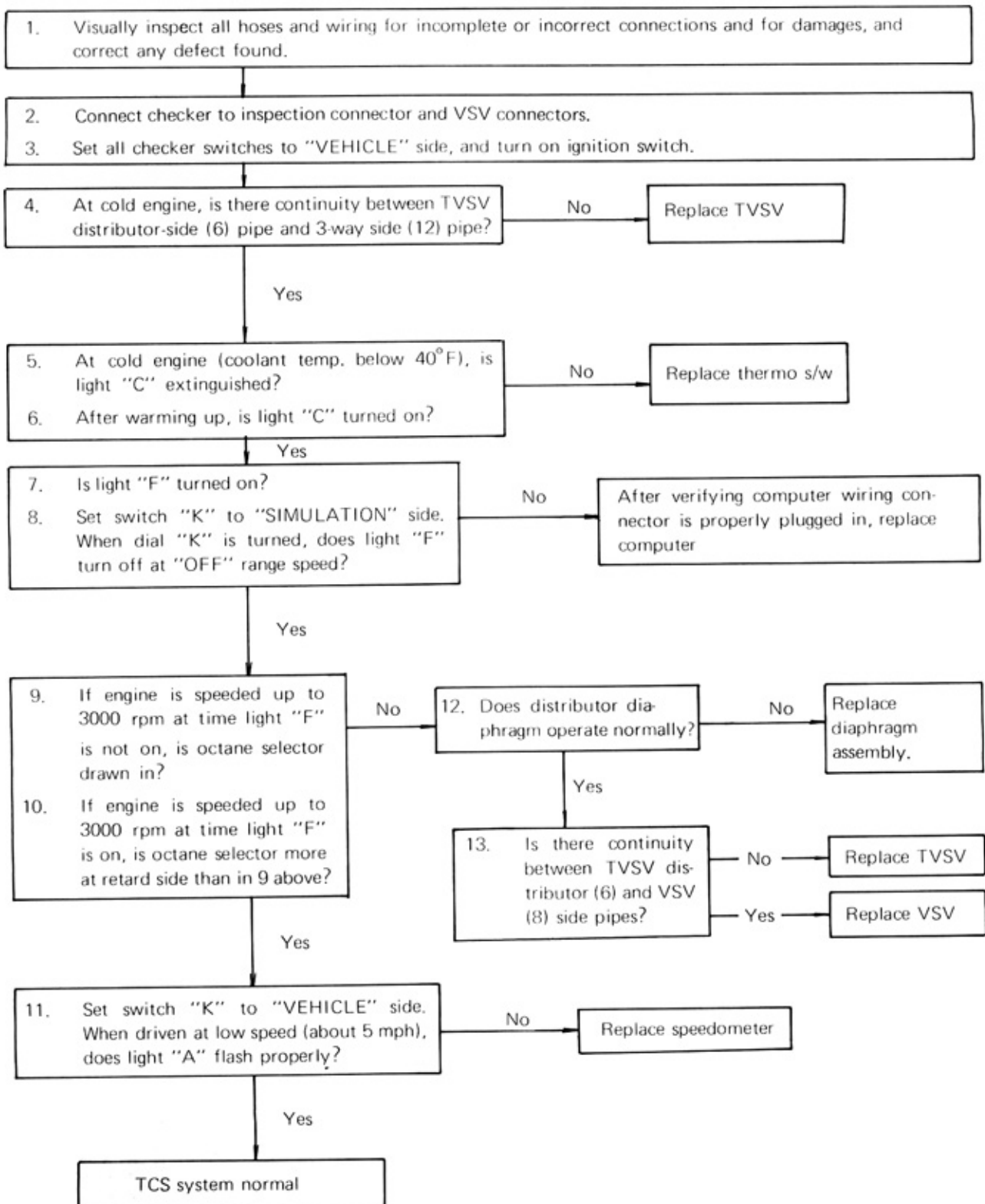
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11



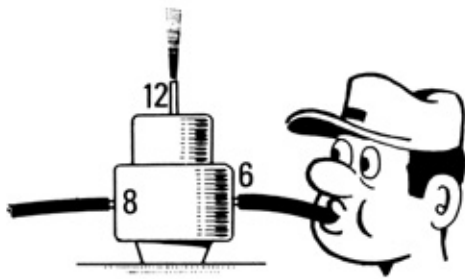
TCS SYSTEM INSPECTION PROCEDURE (Using Checker – 20R Engine)



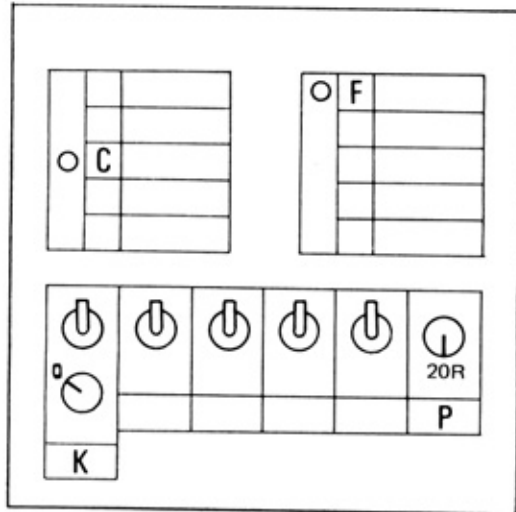
Note

After dismantling the checker, have the VSV connector properly plugged in.

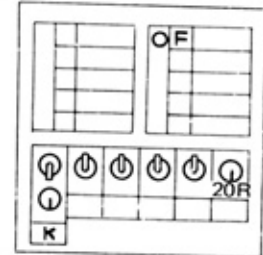
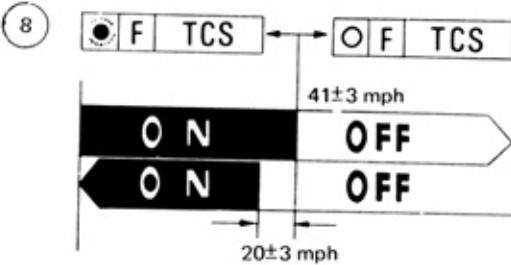
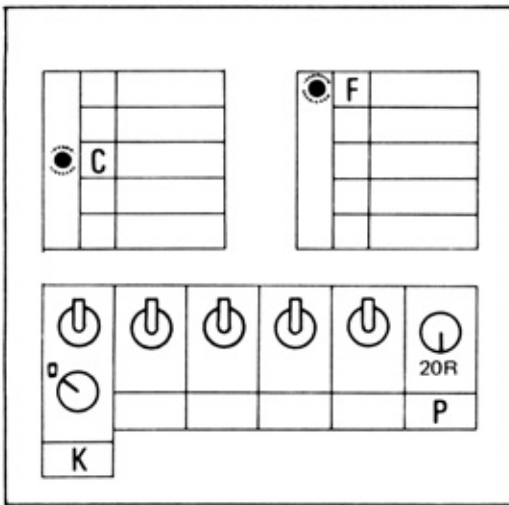
4 Coolant Temp.: below 75°F



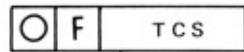
5 Coolant Temp.: below 40°F



6 7 after Warming-up



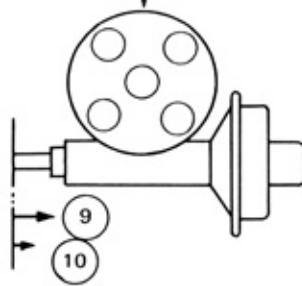
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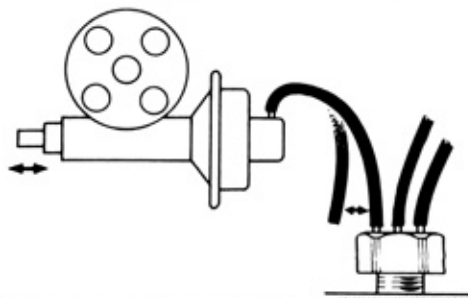
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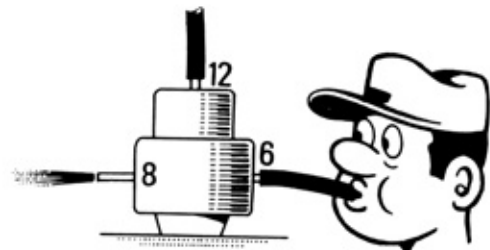
3000 rpm



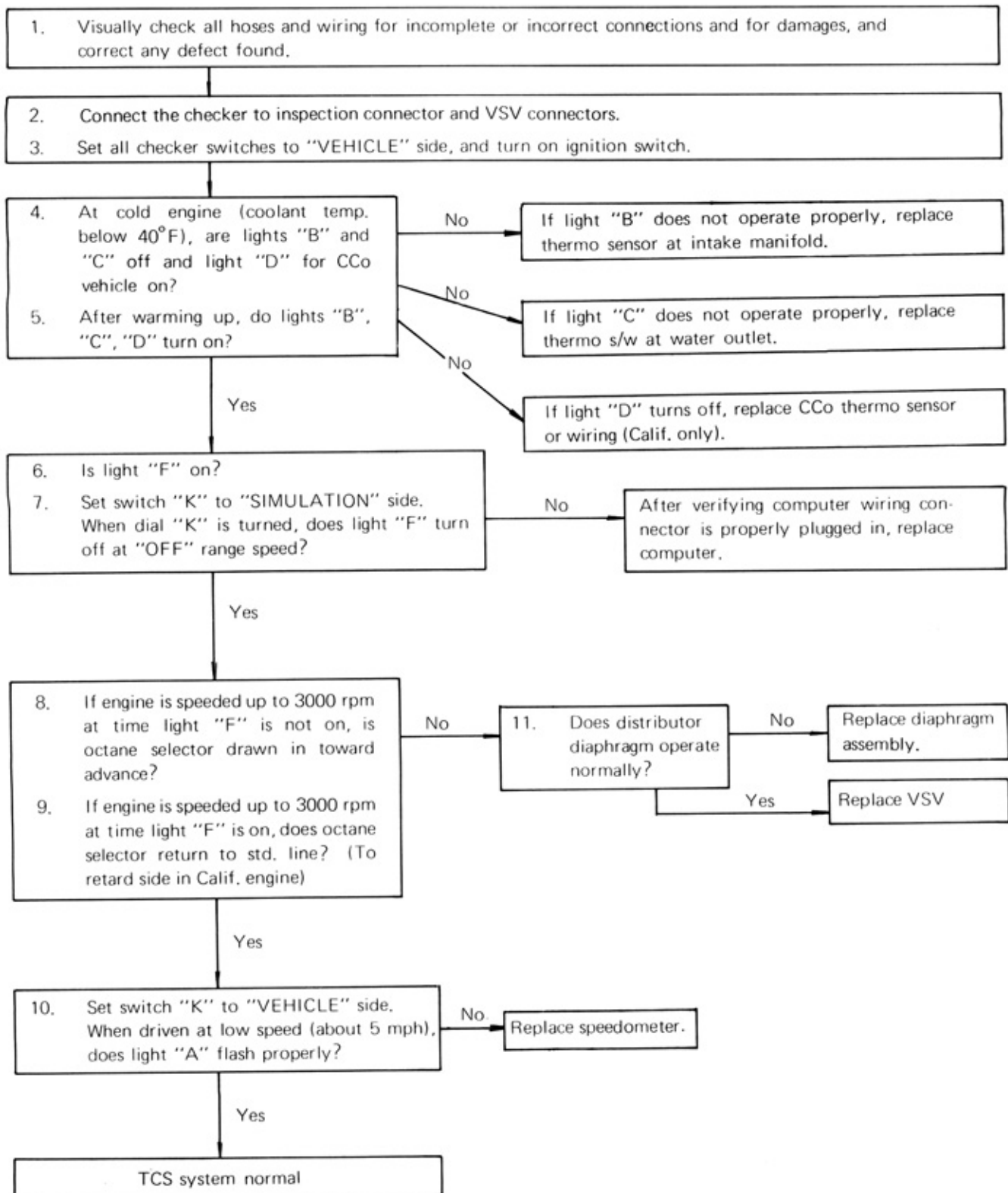
12



13

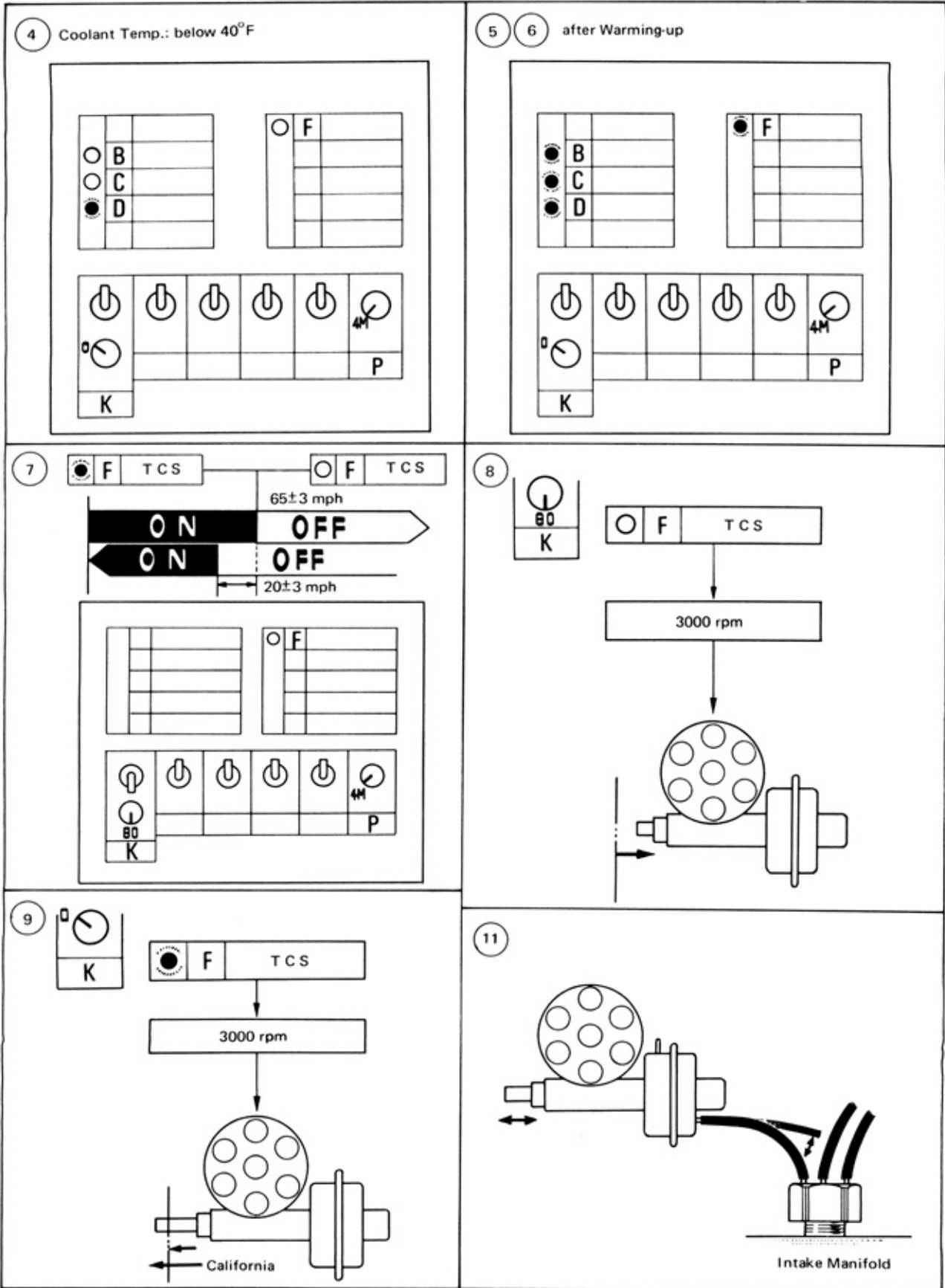


TCS SYSTEM INSPECTION PROCEDURE (Using Checker - 4M Engine)

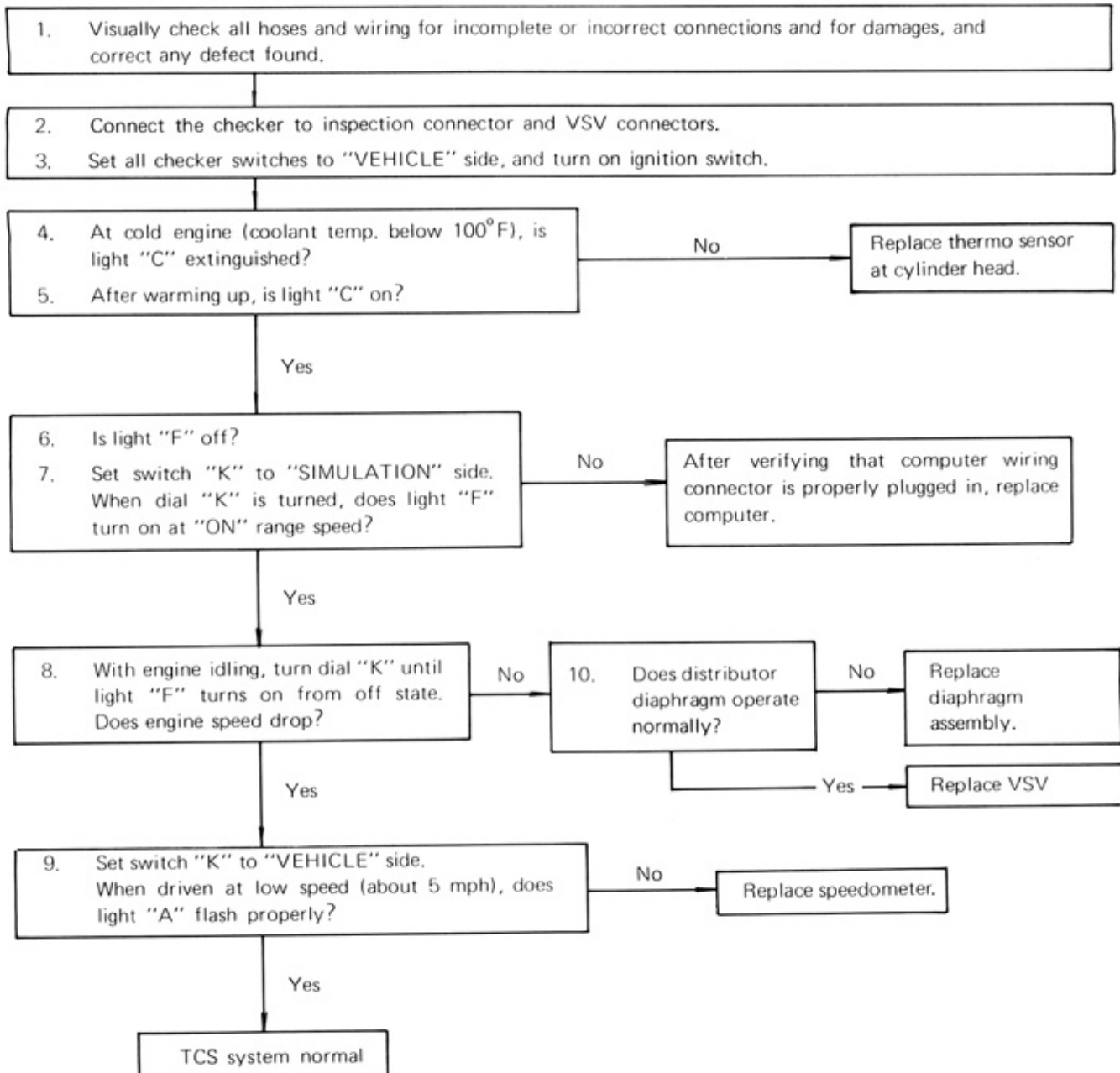


Note

After dismantling the checker, have the VSV connector properly plugged in.



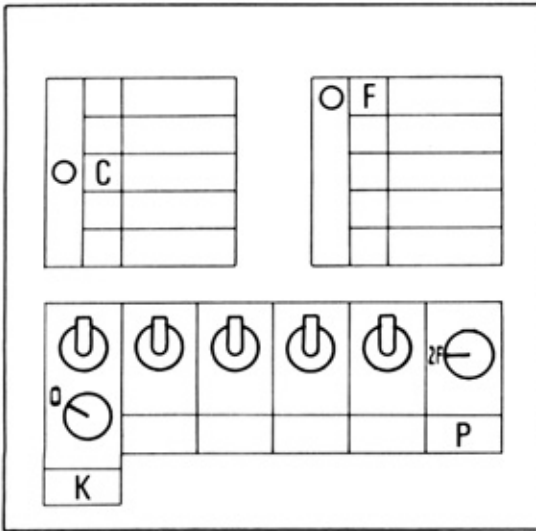
TCS SYSTEM INSPECTION PROCEDURE (Using Checker – 2F Engine)



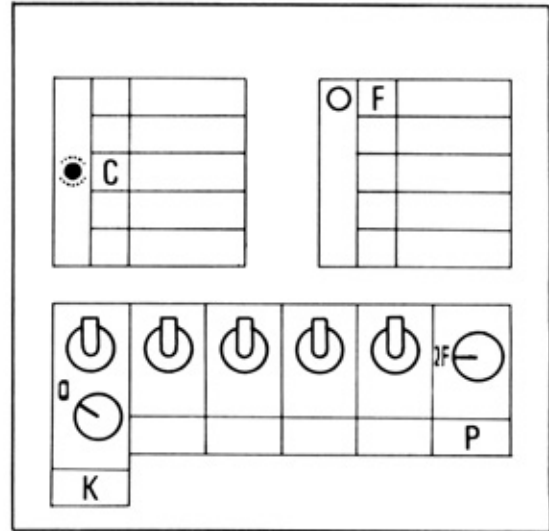
Note

After dismantling the checker, have the VSV connector properly plugged in.

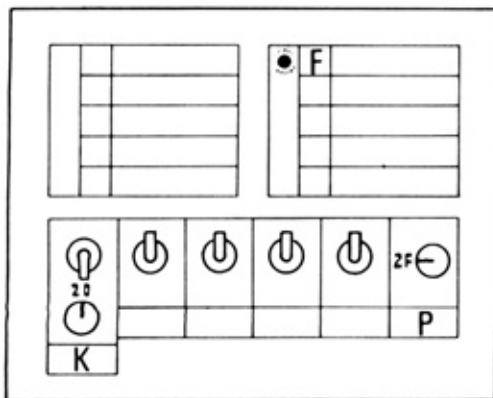
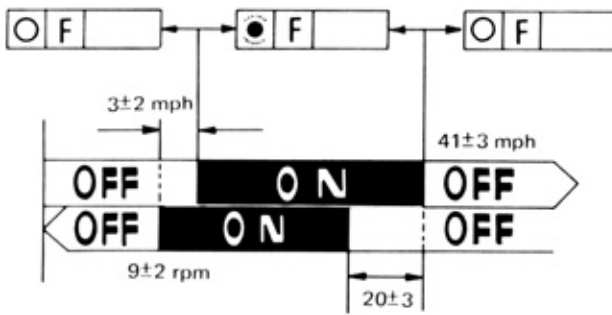
4 Coolant Temp.: below 100°F



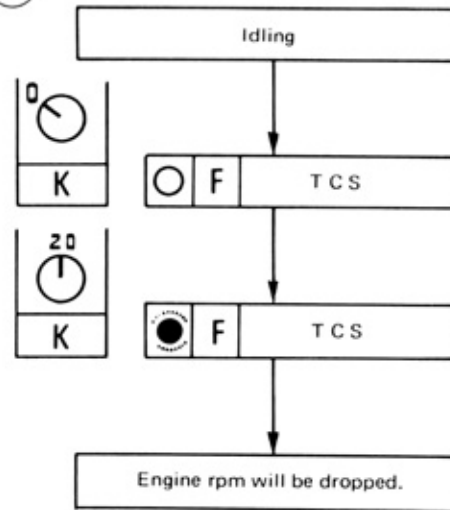
5 6 after Warming-up



7



8



10

