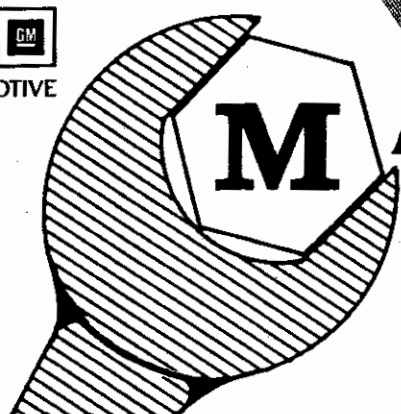


ELECTRO-MOTIVE



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CODELCO-CHILE
División Salvador
SUPERINTENDENCIA
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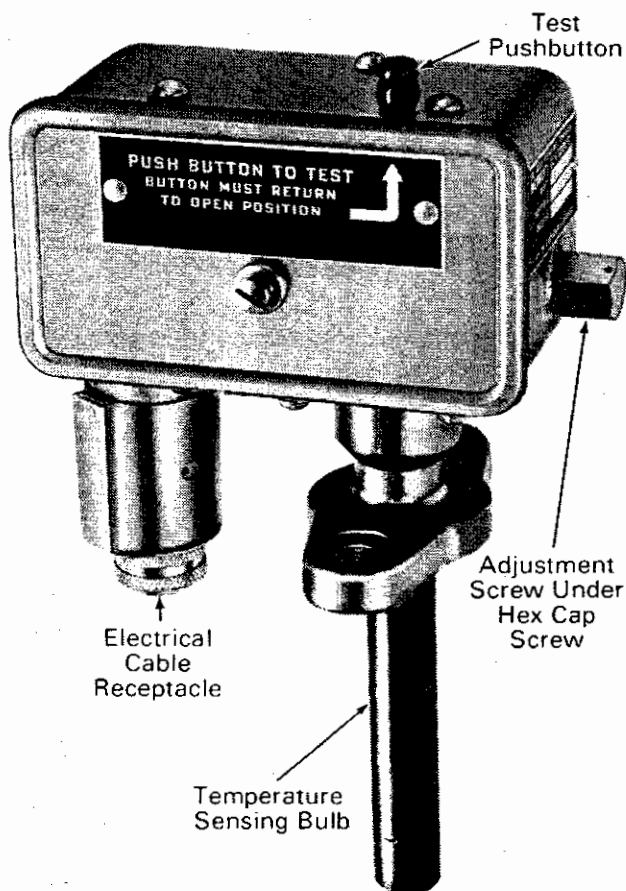
TEMPERATURE SENSITIVE SWITCHES

DESCRIPTION

This type of switch, Fig. 1, is extremely flexible in design to the extent that minor adjustments allow for its use in many applications.

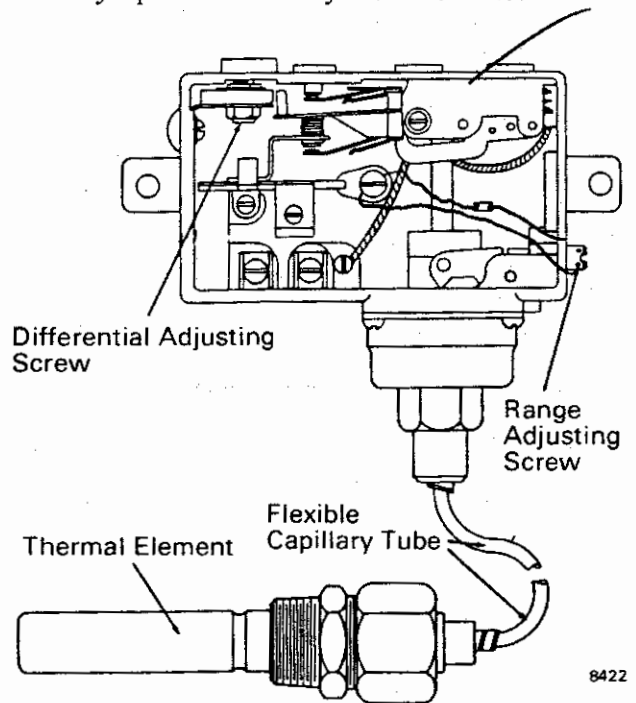
A thermal responsive element and an electrical contact switch actuated by the thermal element are the two major components of these switches. The thermal responsive element is contained in a sealed bulb which is inserted in the engine water or oil system.

Closing of the contact is caused by temperature increasing to a value set by the switch range adjustment. The point of making or breaking of contacts on temperature decrease is determined by the setting of the differential adjustment screw, see Fig. 2. Individual circuit designs may employ normally open or normally closed contacts.



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Fig.1 - Typical Temperature Control Switch



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Fig.2 - Switch Adjustments

*This bulletin is revised and supersedes previous issues of this number.

Areas of change are indicated by vertical bars.

OPERATION

The switch operates on the principle of the liquid in the thermal element bulb boiling and giving off a gas. This gas develops a pressure through a capillary tube to a set of metal bellows in the coupling between the element assembly and the switch. These bellows force a plunger up which in turn causes the contact arm to make or break the circuit, see Fig. 2.

MAINTENANCE

The switches, Fig. 3, require very little maintenance or attention. Generally all that needs to be done is to inspect them for proper operation and current pickup and dropout settings. Such inspections should be made at intervals prescribed in the Scheduled Maintenance Program or when cooling or lube oil difficulties are encountered.

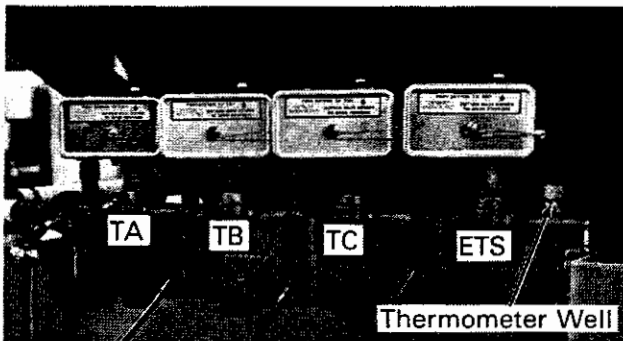


Fig.3 – Typical Multiple Switch Installation

The operation and settings of these switches can be easily checked using either of two methods. They are:

1. Using the bulb immersion method whereby the switch is removed from the engine system and the thermal element is immersed in a container of fluid at suitable temperatures.
2. With switches installed in the piping, by operating the diesel engine to obtain desired temperatures.

The bulb immersion method is the more accurate and should be used whenever time and equipment permit. Both methods, however, are described here.

Should adjustments be found necessary during such inspections, they can be easily made with a minimum of tools and equipment. The two adjustments provided on these switches are:

RANGE – The range adjustment determines contact closing with increasing temperatures.

DIFFERENTIAL – The differential adjustment determines the contact opening with decreasing temperature. This will generally need no adjustment unless a large change in pickup (range) is made.

It is important to note however, that in certain applications the contact arrangement is the reverse of the above.

The tolerances to be observed when inspecting or adjusting these switches will be found on the Service Data page. Switches which do not respond normally and cannot be adjusted should be replaced.

SWITCH ADJUSTMENTS BY BULB IMMERSION

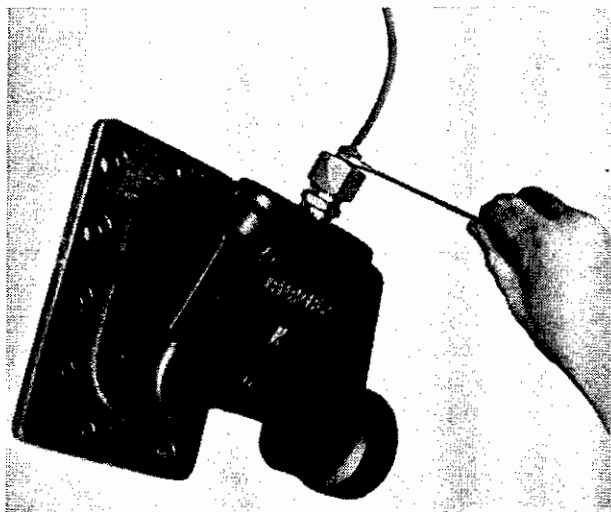
This method of adjustment requires the removal of the switch from its mounting, Fig. 3.

On units that have switches with sufficient flexible capillary tubing between the switch and thermal bulb, set up the container near the switch mounting. Then the thermal bulb needs only to be removed from the engine system to perform the adjustment.

Extreme care should be exercised in removing the thermal element from the engine piping. The slightest damage to the element itself, the connection between the element and capillary tube, or the seal between the element and packing nut will result in a malfunctioning device necessitating replacement.

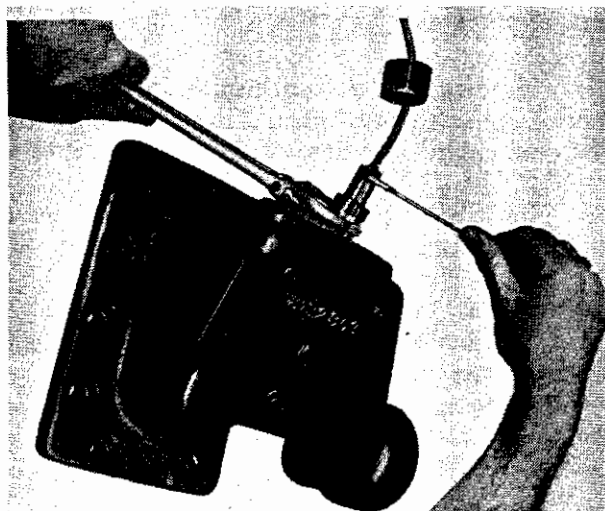
To remove the element of the capillary tubing type from the engine piping proceed as follows:

1. Place an open end or crescent wrench on the two flats of the thermal element extending above the packing nut, Fig. 4. Holding this in its original position, apply a crescent wrench on the packing nut and unscrew it from the adapter fitting.
2. When loose, slide the packing nut out of the way and attempt to remove the thermal element from the engine piping, Fig. 5. Do not apply excessive force for this removal as it will damage the "O" ring seal. In most cases it will be necessary to also remove the adapter fitting from the pipe itself to effect removal.



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Fig. 4 - Holding Element In Place



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Fig. 5 - Packing Nut Removed

3. Again apply an open end or crescent wrench to the flats on the element and hold in place. Unscrew the adapter fitting from the pipe.
4. Remove the thermal element bulb from the piping being cautious not to hit or scratch it against any foreign object.
5. See section titled - Test Setup And Procedure.

To remove the element, without capillary tubing, from the engine piping proceed as follows:

1. Unscrew coupling holding electrical cable plug to receptacle; remove cable plug from receptacle.
2. Remove two hex head bolts and lockwashers holding switch mounting flange to engine piping.

3. Remove switch and gasket from engine piping, being careful not to damage element during removal.
4. See section titled - Test Setup And Procedure.

Upon completion of the checking and/or recalibration, reassemble the thermal element into the engine piping, reversing the above procedures. Be sure to hold the element in place when re-applying the adapter fitting and packing nut on flexible tubing type switch.

TEST SETUP AND PROCEDURE

In most cases, water temperature switches must be tested in a water bath and oil switches in oil due to boiling point differences. A 104°C (220°F) oil switch will not trip in water because boiling water can never be heated above 100°C (212°F). In some cases where an installation is located at high altitude, it may be necessary to test a water switch in oil; that is, if an ETS is set for 99°C (210°F) and the water at that altitude boils at 90.6°C (195°F), the trip temperature will never be reached regardless of how long the water is boiled.

Refer to Fig. 6. The type of container and heat source is unimportant and any suitable equipment can be used. A thermometer (accurate to $\pm .56^{\circ}\text{C}$ (1°F)) and stirring rod (paint stick) will be needed. The thermometer bulb should be fastened next to the sensing element so that the true sensor temperature is measured. The sensor and thermometer should be submerged in the bath up to the flange.

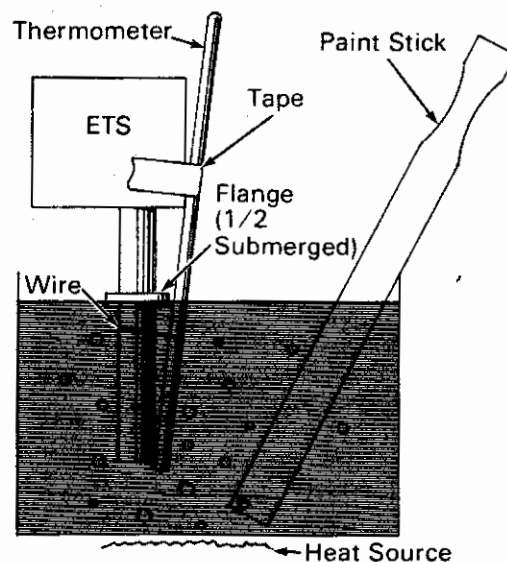


Fig. 6 - Test Setup

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As the bath temperature rises to within 8° C (15° F) of the trip value, the tester should begin mixing to provide a uniform bath temperature. At the same time, the heat source must be regulated to produce a temperature rise of .56° C (1° F) per minute to allow for the switch time response. Mixing and temperature regulation should continue until the switch trips, at which instant the temperature should be recorded.

In no case should the thermometer or sensor be allowed to touch the bottom of the container or the sides, for these surfaces will be much hotter than the actual fluid. In addition, continuous mixing is important to dispel convection currents which can produce hot and cold regions within the bath.

Due to heat transfer characteristics, switches rated above 99° C (210° F) will trip about 2.2° C (4° F) higher in a test bath than when mounted in a manifold. For this reason, switches in this category should be set to trip 2.2° C (4° F) higher than the nameplate rating.

TEMPERATURE SWITCH ADJUSTMENTS

1. Bring the water temperature up to the specified temperature for closing the contacts. When the temperature has been reached, screw in the range screw to open the contacts, then back out slowly just closing the contacts to complete the circuit, see Fig. 2. This fixes the switch closing point. The temperature increase should be closely controlled so that the rate of change is approximately .56° C (1° F) per minute.
2. Raise or lower the water temperature, depending on the type of switch, until the contacts drop out. Here again, the temperature change must be controlled to obtain approximately .56° C (1° F) per minute.
3. In the event that the dropout point has to be adjusted, turn the differential screw to its wider

limit and bring the temperature of the liquid to the desired switch setting, see Fig. 2. At this point, slowly turn the differential adjusting screw in the opposite direction until the switch contacts just open. This fixes the opening point and opens the circuit.

Some models of this switch have a spline head set screw holding the differential adjustment screw in place. On these models, loosen this set screw, adjust the differential screw by using an "offset" screwdriver, and retighten the set screw upon completion.

4. Again change the temperature and check the switch closing point. Also, recheck the opening point. If necessary reset for proper values.

SWITCH ADJUSTMENTS WHILE INSTALLED

It is recommended that in all installations where this method of switch adjustment is used it only be done when the engine is loaded to perform other tests.

Operate the engine loaded for a sufficient time to allow water and oil temperatures to stabilize.

In some installations a thermometer well, Fig. 3, is located by the switches. This well can be filled with oil and a thermometer inserted. In installations where there is no thermometer well, connect an engine temperature gauge into the engine discharge piping as near to the temperature switches as possible. An engine temperature gauge connected to the engine inlet piping can be used if desirable, however, temperatures in the inlet piping will be approximately 4.4° C (8° F) below those in the discharge piping so set the switches accordingly.

In order to obtain the proper temperatures for switch settings it may be necessary to close shutters and temporarily cause the fan and/or heat exchanger to be inoperative.

SERVICE DATA

Temperature switch settings can be found on nameplate attached to device. Local operating conditions may require that other settings be used. In such cases, refer to the wiring diagram or specific instructions for a particular installation.

Tolerances	
Pickup	± .56° C (1° F)
Dropout	± 1.1° C (2° F)

A Service Department Publication

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