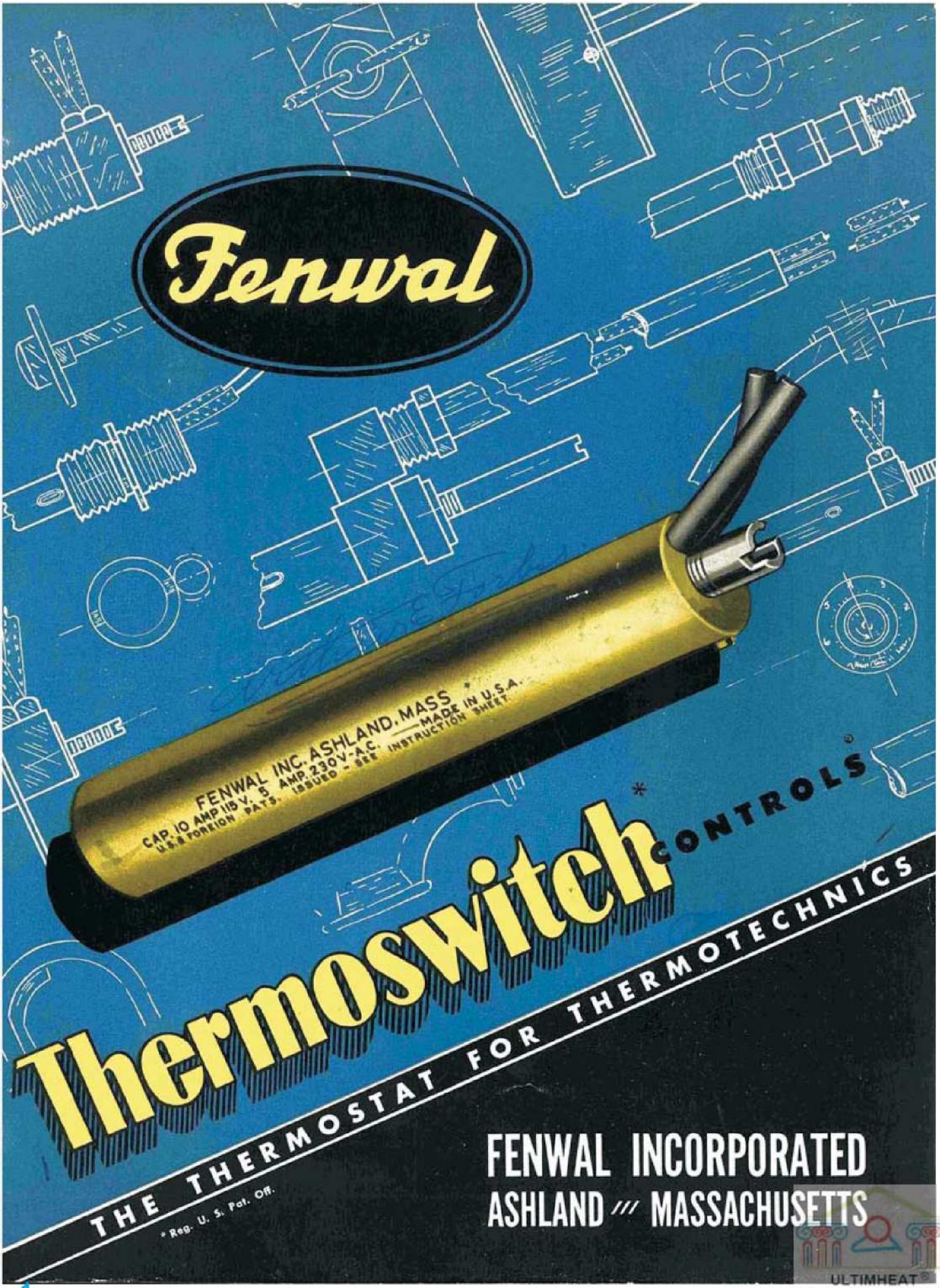

STANDARD FENWAL *Guarantee*

It is our ambition to have every article bearing the "Fenwal" trade mark give complete satisfaction. We maintain high standards for our workmanship and materials and for the inspection of our products, but it is not humanly possible to have every piece of merchandise perfect. Therefore, if within one year after it leaves our factory, any Fenwal Product sold under this standard guarantee shows any defect in material or workmanship, Fenwal Incorporated will gladly repair it or replace it without charge other than for transportation. We cannot be responsible for repairs not made at our factory, for apparatus, equipment or parts made by others, or for any consequential damages. No one is authorized to assume any liability for us except as set forth above.

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Introduction...

THERMOTECHNICS

For over a decade, Fenwal Engineers have been solving all kinds of heat control and temperature detection problems. The wide experience, data, and techniques developed during this period have led to the development of the modern art of Thermotechnics.

> Thermotechnics is a method of analyzing and coordinating process requirements, heating means, control devices and product design to insure best over-all performance of the complete thermal-control system.

This catalog represents the efforts of Fenwal Engineers to give you the facts necessary for the proper application of THERMOSWITCH* thermostats to your heat control problems.

Since a catalog cannot be all-inclusive, you may encounter problems not considered here. Our engineers will gladly assist you to custom-engineer your product. Kindly submit your problems on the enclosed data sheet to aid our engineers in analyzing your problem.

*THERMOSWITCH is a registered trade mark designating thermal responsive controls or switches made exclusively by Fenwal Incorporated.

THE BASIC FENWAL THERMOSWITCH *Principle*

The THERMOSWITCH Control is constructed with two silver contacts mounted on, but electrically insulated from, curved nickel-iron struts of low expansion coefficient. This assembly, known as the element assembly, is then mounted under tension or compression in a seamless drawn brass or stainless steel tube. The amount of tension or compression is variable, depending on the position of adjusting sleeve and the temperature of the shell. The control is calibrated at a given shell temperature by turning the adjusting screw until the contacts separate. Changes in temperature cause the shell to expand or contract which exerts more or less tension or compression on the struts causing the contacts to make or break.

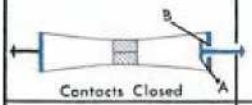
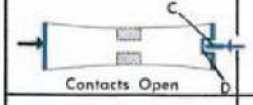
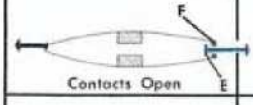
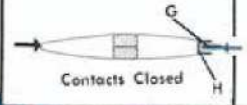
THERMOSWITCH Controls are manufactured as either "tension operated" or "compression operated." These terms are defined by the action which the expanding or contracting outer shell imparts on the element assembly of the unit. The chart below illustrates the four basic types of THERMOSWITCH Controls. It will assist you in selecting a THERMOSWITCH Control to suit your conditions. THERMOSWITCH Controls furnished with either "tension operated" or "compression operated" element assemblies which are termed *Regular Type*, make contact on a decrease in temperature; those furnished with either "tension operated" or "compression operated" element assemblies which are termed *Inverse Type*, make contact on an increase in temperature.

"Tension operated" THERMOSWITCH Controls may be subjected to momentary exposure temperature of 100°F. above their calibration point within their temperature range without damage. All "tension operated" THERMOSWITCH Controls have unlimited temperature undershoot. "Compression operated" THERMOSWITCH Controls may be exposed to temperatures of 450° *below* their calibration point without damage within their temperature range and may be overshot in temperature to the high limit of the temperature range without damage.

Correct engineering design and material specification make either of the above element assemblies unique. The mass of the element assembly is extremely light and possesses a high internal stiffness, therefore it is not responsive to ordinary mechanical vibration effects. The element assembly has a non-linear spring gradient so that the entire system has essentially no natural resonance.

Where operating conditions are such that repeated and prolonged overshoot or undershoot of greater magnitude is present, special units can be supplied. THERMOSWITCH Controls have maximum current ratings which are 10 amperes at 115V A.C. or 5 amperes at 230V A.C. (standard series) and 25 amperes at 115V A.C. or 12.5 amperes at 220V A.C. (heavy duty series). For direct current applications, please consult our factory. The THERMOSWITCH Control is not recommended for any voltage exceeding 250V A.C.

Schematic Drawings, with words "contacts open" and "contacts closed," show the elements when free from tension or compression.

Schematic Diagram 4 Types Elements	Type Element Assembly	Switch Operated By	Temperature Rise (Shell Expands)	Temperature Drop (Shell Contracts)
	Regular	Tension	Point A moves toward Point B. Tension Forces Contacts Open. Extreme Temperature Overshoot Would Fracture Element Assembly.	Point A Moves Away From Point B. Allows Contacts to Close. Unlimited Temperature Undershoot Merely Increases Distance Between Point A and Point B Without Affecting Element Assembly.
	Regular	Compression	Point C Moves Away from Point D. Allows Contacts to Open. Temperature Overshoot Does Not Damage Element Assembly.	Point C Moves Toward Point D. Compression Forces Contacts Closed. Temperature Undershoot Limited. Extreme Undershoot Damages Element Assembly.
	Inverse	Tension	Point E Moves Toward Point F. Tension Forces Contacts Together. Extreme Temperature Overshoot Would Fracture Element Assembly.	Point E Moves Away From Point F. Allows Contacts to Open. Unlimited Temperature Undershoot Merely Increases Distance Between Point A and Point B Without Affecting Element Assembly.
	Inverse	Compression	Point G Moves Away From Point H. Allows Contacts To Close. Temperature Overshoot Does Not Damage Element Assembly.	Point G Moves Toward Point H. Compression Forces Contacts Open. Temperature Undershoot Limited. Extreme Undershoot Damages Element Assembly.

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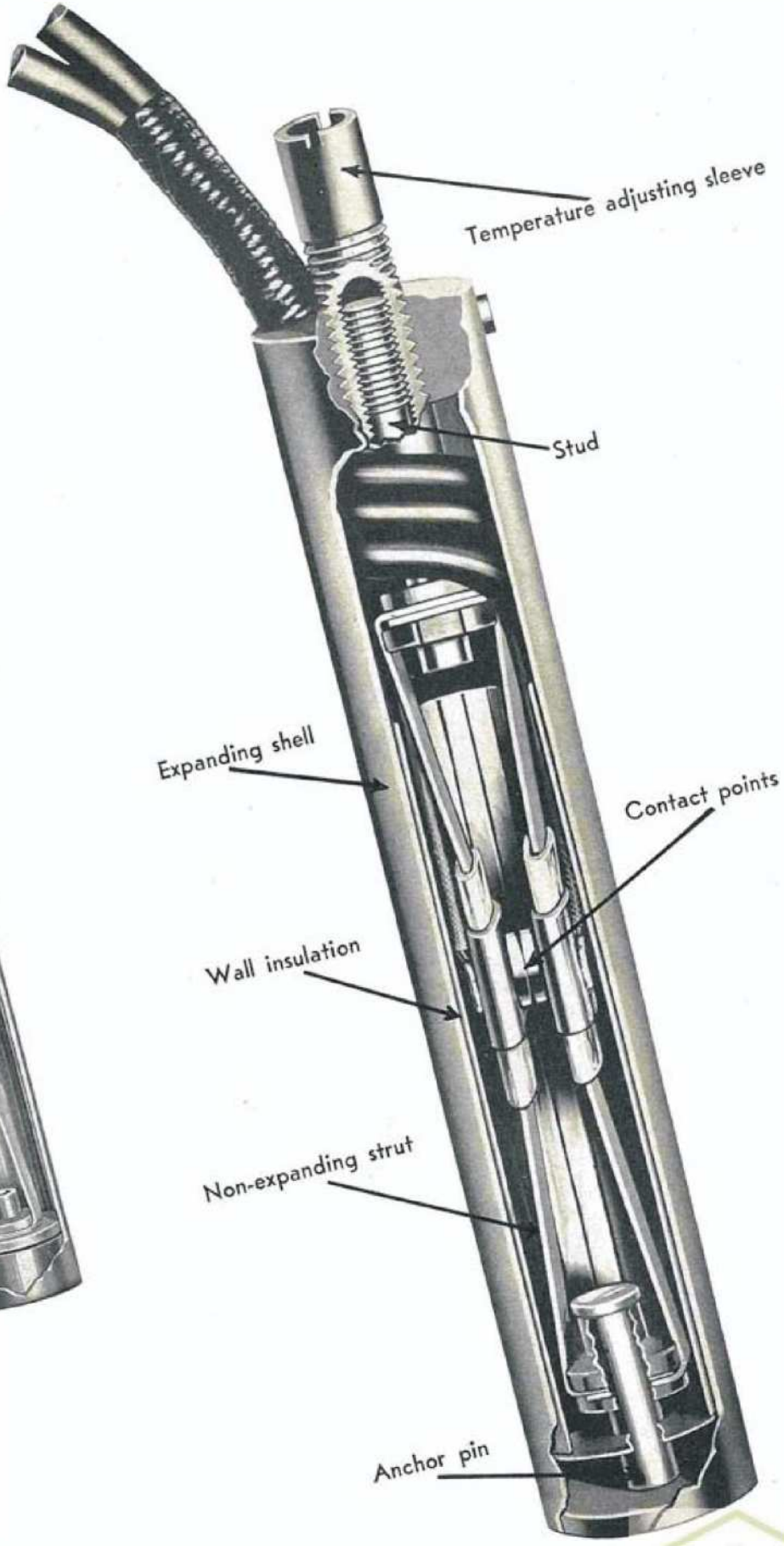
The following pages illustrate the Basic Cartridge THERMOSWITCH Control equipped with different style mounting heads for convenient application.



"THE FOURTEEN FACTS IN FENWAL'S FAVOR"

1 Fast Reaction Time

Inherent instrument delay or "lag" results in undesirable temperature control. To produce live control action this delay should be reduced to the absolute minimum. The chart shows the almost instantaneous response of the Fenwal THERMOSWITCH Control in comparison with two other thermostats. The reaction time shown is the measured time interval required for the switch to change 10°F. when suddenly subjected to temperatures 20° higher than the ambient temperatures.

2 Large Heat Responsive Area

In order to insure fast heat interchange between the controlled medium and the thermostat, the heat sensitive area should be as large as possible. The figure shows the much greater area of the heat responsive element of the Fenwal THERMOSWITCH Control in comparison with two other thermostats.

3 Short Heat Transfer Path

Extremely short heat transfer path eliminates the effects of heat gradients, and decreases the reaction time. The heat flow path of the Fenwal THERMOSWITCH Control is but a small fraction of that for conventional types of temperature controls.

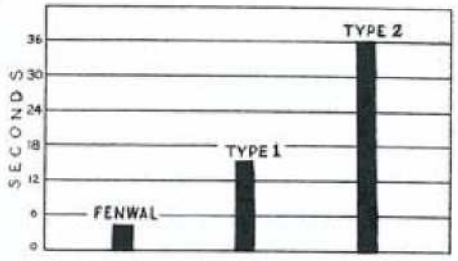
4 Small Temperature Differential

The temperature differential of a switch should be kept to an absolute minimum to reduce the temperature overshoot and undershoot effects. In conventional design the temperature differential is the result of internal moving parts such as levers, gears, etc., within the switch. All moving parts have been eliminated so that the THERMOSWITCH Control differential is negligible as shown on the adjacent chart.

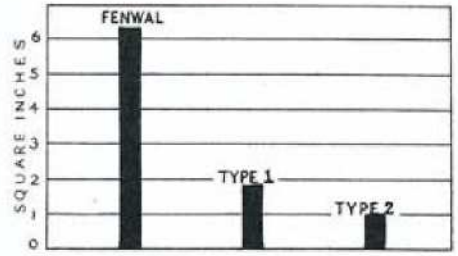
5 Built-in Temperature Anticipation

Thermostat anticipation helps to reduce undesirable effects of process lag. Conventional practice of using auxiliary heaters for producing anticipation effects always results in loss of control temperature with increased electrical load. The Fenwal THERMOSWITCH design has built-in anticipation and does not employ any type of auxiliary heater so that the controlled temperature does not change perceptibly with variations in electrical load.

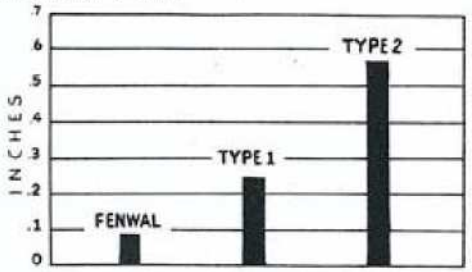
Response Time



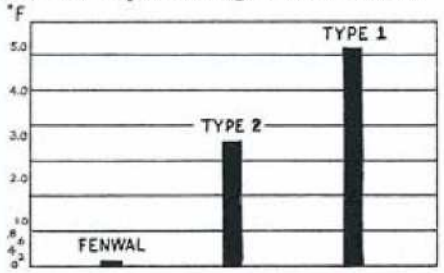
Area of Sensitive Element



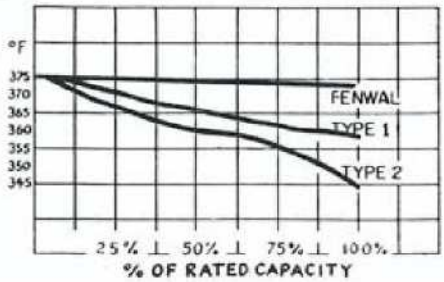
Heat Flow Path



Thermostat Operating Differential—°F



Effect of Load on Control Point



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6 Enclosed Assembly

Any thermostat assembly should be completely enclosed to protect the working parts from dust, contamination, etc. The enclosed design of the Fenwal THERMOSWITCH Control as shown in the cross-section insures freedom from contamination during the life of the switch. Positive seals are available as modifications for special applications.

7 Minimal Vibration Effects

Mechanical vibration should not effect the control point of a reliable thermotechnic instrument. The Fenwal THERMOSWITCH Control employs an extremely light and stiff bridge structure which resists vibration and possesses an extremely high natural frequency — far above vibration frequencies encountered in industrial applications. The chart shows the amount of motion in the switch element when subjected to an oscillatory motion of 1/10" at 2000 cycles per minute.

8 Tamper Proof

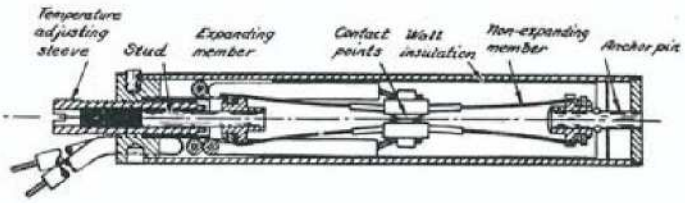
A satisfactory thermostat should have available means for preventing unauthorized readjustment of the control point. THERMOSWITCH Controls can be provided with a seal cover and lead seal to insure complete freedom from tampering.

9 Rugged Design

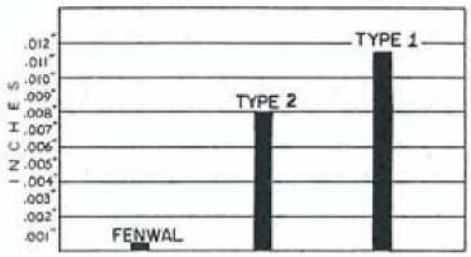
Reliable thermostats must be ruggedly designed to withstand abuse and severe mechanical shock during transportation or actual service. The figure shows the change in the set point of the Fenwal THERMOSWITCH Control in comparison with others due to a mechanical shock of 100 G.

10 Wide Operating Range

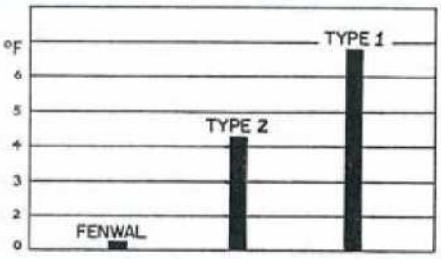
In many applications it is desirable for the thermostat to have a wide operating range which can be easily and quickly adjusted throughout the range. In the Fenwal THERMOSWITCH Control, the switch may be adjusted to any point by simply turning the calibration screw to the desired point. The curve shows the relationship between the standard screw settings and the corresponding controlled temperature. The slope of the curve can be changed with special thread ratios.



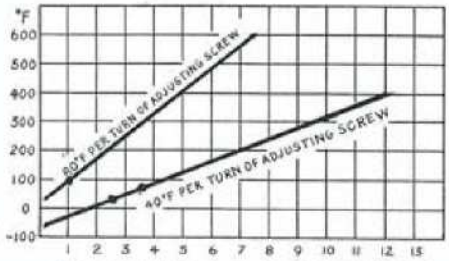
Vibration Effects



Change in Calibration Due to 100 G Shock

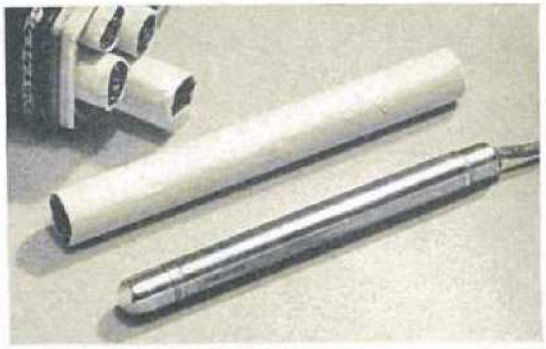


Calibration Range



11 Minimum Size

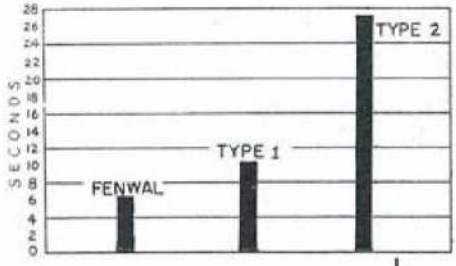
In many applications the space requirements are limited so that the physical size of the thermostat is extremely important. The Fenwal Midget THERMOSWITCH Control is smaller than a cigarette as shown in the accompanying photograph.



12 Direct Radiant Heat Reception

Since comfort level is determined by radiant energy, thermostats should be responsive to radiant heat. Also, many industrial applications, such as drying ovens, require detection of radiant energy for proper control. The THERMOSWITCH Control is designed to present a large heat responsive area to measure radiant energy. The corresponding chart shows the time required for the Fenwal THERMOSWITCH Control and two other thermostats to break contact following their sudden exposure to a source of radiant heat when adjusted approximately 10°F. above the ambient temperature.

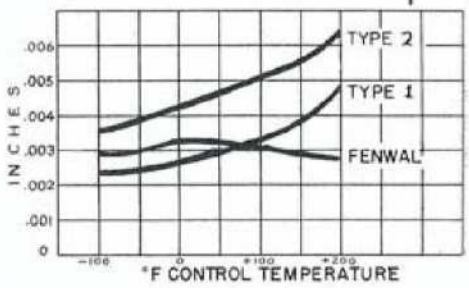
Response Time in Seconds



13 Uniform Sensitivity Throughout the Operating Range

In order to produce uniform control throughout the operating range the sensitivity of the instrument must be held constant throughout this range. In the Fenwal design the sensitivity (motion of the switch contacts per 10°F.) is extremely constant over the entire operating range compared with other types.

Sensitivity-Contact Motion Per 10 °F



14 Ease In Installation

The simplicity of installation is an important factor in the selection of any Fenwal Thermotechnic Instrument. Fenwal THERMOSWITCH Controls have a convenient shape lending itself to many types of installations with a minimum amount of effort. There are also many types of mounting heads available.

. . . AND ALL 14 FACTORS . . .

ARE IN THE THERMOSWITCH CONTROL

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SELECTION AND APPLICATION OF THERMOSWITCH Controls

It is of utmost importance in approaching any problem of temperature control that we recognize clearly that there are two distinct phases to the right solution—first, proper installation of the thermostat within a well designed control system; second, the proper design of the heat system which is utilized to provide the desired conditions and its relation to the thermostat which it in turn operates. Experience over a number of years in studying a multitude of applications has shown that the first phase is usually well considered, but that often the latter phase and its critical effect upon the success of the application is neglected. This section is designed to help you take full advantage of your thermostatic control and particularly the outstanding characteristics of a THERMOSWITCH through a study of the basic laws of heat application which are the foundations of thermotechnics. A study of these essential considerations will lead to more effective and successful heat control in your process.

TEMPERATURE CONTROL FUNDAMENTALS

A Regular THERMOSWITCH Control, when installed in a process to control the temperature within some pre-described limits, will close the heater circuit when the temperature at the THERMOSWITCH unit drops below the desired value, and open the circuit when the temperature rises above the desired value. The THERMOSWITCH Control can only turn the heat on and off in accordance with the temperature at the *THERMOSWITCH.*

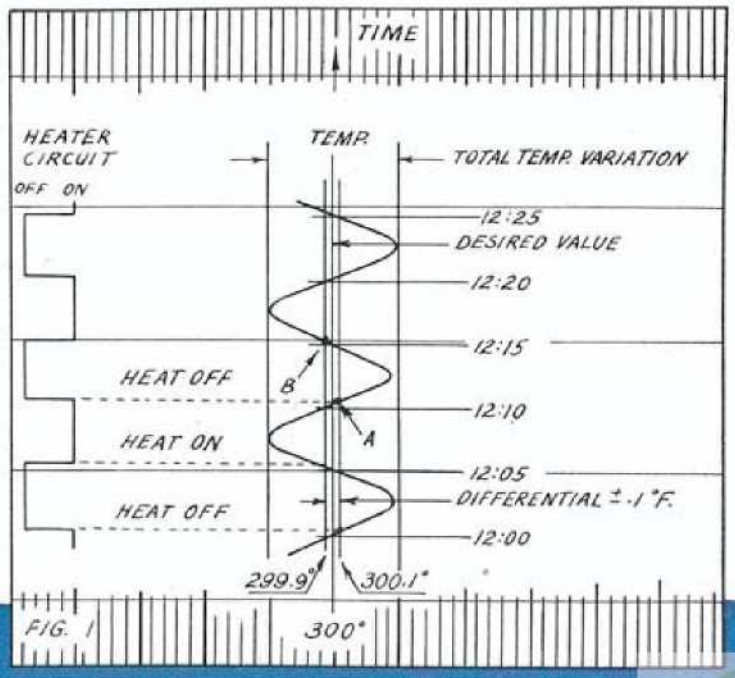
(Note: THERMOSWITCH controls can be furnished with "inverse" action; i.e. to *open* the circuit if the temperature drops to the desired value and *close* the circuit if the temperature rises to the desired value.)

SWITCH DIFFERENTIAL

The amount of temperature change necessary to cause a THERMOSWITCH Control to operate is defined as the switch differential. For example when a switch is adjusted to operate at 300°F. and the switch opens the circuit at 300.1°F. (point A. Fig. 1) and closes the circuit at 299.9°F. (Point B), the measured differential is then plus or minus .1°F. The differential of the switch itself is defined as its *sensitivity*. The total temperature variation of a thermal system, however, should not be confused with switch sensitivity.

TEMPERATURE VARIATION

The temperature variation in a regulated system is always considerably larger than the thermostat differential, as illustrated in Figure 1. In any typical thermal control application, the total variation of temperature about the desired value is larger than the switch differential. In particular, in controlling the temperature of stagnant air the variation may be as large as 20°F. even though the thermostat differential is only a fraction of one degree. The amount of this temperature variation about the mean value is determined by (1) *the individual characteristics of the heat source,* (2) *the process under control* and (3) *the controlling thermostat.* Large temperature variation may be due to any one of these three factors being engineered incor-



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rectly. Thus, it is important to note that (A) a delayed thermal response from the heat source, (B) a lagged process, or (C) a thermostat installed incorrectly, may produce *similar* unsatisfactory effects in so far as the temperature control record is concerned. It is impossible, therefore, to assign responsibility for poor control to any particular part of the system by merely observing the control temperature record.

LAG AND OVERSHOOT

Cyclic temperature variations greater than the differential of the THERMOSWITCH Control are simply the result of lag or delay between the application of heat and the resulting increase in temperature at the thermostat. To illustrate the effect of lag in a control system, such as a thermostatically controlled water bath, let us assume that the switch has a negligible amount of differential and is adjusted to regulate at 180°F. When the temperature drops below 180°F. at the THERMOSWITCH Control, the heater circuit is energized and the water temperature around the heater starts to rise. Due to the thermal transfer delay between the heater and switch, the temperature at the switch lags behind the rising temperature around the heat source. As the water temperature again reaches 180°F. at the switch, the temperature around the heater may be 190°F. Although the heater circuit is opened at this instant, surplus heat storage in the vicinity of the heater causes the water temperature at the THERMOSWITCH Control to continue to rise or "overshoot" beyond the set point of the switch.

Lag is in most cases something to be overcome but there are installations where it is desirable, and in these instances the THERMOSWITCH Control not only may be located in such a position as to produce lag, but actually partially shielded to increase this effect.

From the above, it is evident that lag and overshoot are caused by conditions outside the THERMOSWITCH Control, such as its location, the thermal capacity of the heat source, medium of heat transfer, ambient temperature variations, etc.

CHARACTERISTICS OF HEAT SOURCES

A. TYPE OF HEATER:

1. Cartridge or strip type heater: this type of heater consists of an insulated resistance wire encased in a metal sheath and can be purchased in various physical shapes. These heaters usually employ as little insulating material as possible, consistent with approved electrical design practice. Excessive *electric insulation or mass of associated metal component parts produce undesirable* heater lags. This type of heater is easy to apply, has long life, and for most applications will give satisfactory results. Intimate association of this type of heater with the process, such as an "immersion" or "cast in the process" installation, eliminates a large portion of this lag effect. (See Heater Installation.)

2. Radiant type heaters: a radiant heater transmits a substantial portion of the heat to the process by means of radiant energy. This type of heater consists of a resistance wire supported on an insulator and, to reduce lag, the mass of the insulator and of the wire should be as small as possible consistent with long life. In general, as the radiant type heater transmits heat by radiation, the resulting lag is very small.

B. DISTRIBUTION OF HEATERS:

In order to reduce the undesirable effects of non-uniformity of temperature within the volume to be heated, it is generally desirable to distribute the heat or heaters over as large a surface area as possible. If the heated medium is a liquid or a gas, agitation of the fluid will reduce the temperature gradients, and thereby result in closer control.

C. HEATER RATING:

The selection of an appropriate size heater is extremely important for good regulation. If the heater is too small, the process cannot be brought up to the temperature within a reasonable time, and if too large, overshoot of temperature will occur. *Figure 2* shows the temperature record for a process with three different size heaters.

D. MAINTENANCE HEATERS:

Whenever the heat demand is fairly constant over a long period of time, it is often desirable to install two separate heaters, one controlled by the THERMOSWITCH unit and the second installed directly across the line. A constant source of heat is produced by the maintenance heater and supplies the majority of heat for the process whereas the secondary heater, operated by the THERMOSWITCH Control, has sufficient wattage to effect the necessary control action. In designing such installations, the maintenance heater should be proportioned to maintain the temperature several degrees below the minimum desired temperature, under all operating conditions, when the controlled heater is not energized. In view of the decreased amount of heat storage in the controlled heater, lag and overshoot are minimized, resulting in improved temperature control.

PROCESS CHARACTERISTICS

A. HEATER INSTALLATION:

When installing the strip or cartridge type heater, it is important to make sure that the transfer of heat from the heater to the process is as effective as possible. If the process consists of a metal unit it is generally preferable to have the heater cast integral with the block itself. If this procedure is not possible, the heater should be firmly attached to the metal block and in contact over as large an area as possible to give the best possible heat flow.

When radiant heaters are installed, the radiant energy should be directed toward the process being heated by suitable reflectors and placed so as to distribute the heat uniformly over the surface.

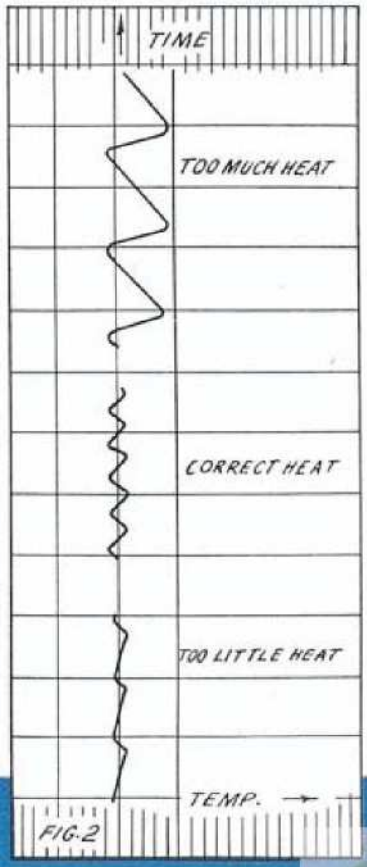


FIG. 2

B. TRANSFER LAGS:

In transferring the heat from its source to the point under control, various types of process lags are encountered. In order to produce accurate control action, these *lags should be reduced to an absolute minimum*. Inasmuch as there are many types of processes, it is not possible to describe in detail just how these lags may be reduced; it can be pointed out only in a general way. If the process consists of a metallic object, the material used should have high heat conductivity and a low value of specific heat. (Specific heat of a substance is the quantity of heat required to impart a unit increase in temperature to a unit mass of that substance compared to an equal weight of water.) The purpose of specifying high heat conductivity is to prevent excessive temperature gradients within the metal structure. In the transmission of heat, the heat storage effect should be minimized to reduce the transfer delay time.

If the structure consists of fabricated pieces of metal, it is important to insure intimate metallic contact between the faces of the material if the heat must flow through these parting faces to the THERMOSWITCH. Above all, it is important to *reduce all dead air transfer surfaces* as they invariably produce excessive lags due to the large temperature drop at these surfaces.

C. THERMOSWITCH CONTROL INSTALLATION:

It is usually good practice to install a THERMOSWITCH Control in the zone where the temperature of the medium is to be maintained constant. If the switch is installed in a metallic structure, the structure should completely surround the sensitive portion of the switch with a minimum amount of dead air between the switch and the switch well. Processes which inherently contain undesirable heat gradients demand a considerable amount of engineering attention in the selection and location of the thermostat.

In order to reduce transfer lags, the sensitive portion of the THERMOSWITCH should be placed as close to the heat source as possible. The THERMOSWITCH unit naturally controls the temperature in the region where it is located, and if there is some distance between the THERMOSWITCH and that portion of the device where the temperature should really be controlled, unsatisfactory temperature deviations may occur. The only case where it is advisable to install a THERMOSWITCH Control close to the heat source and not within the zone of control is when the heat load is fairly constant under all conditions of operation. Under these conditions the heat gradient between the heater, the switch, and the zone of control will remain constant, as shown on curve A, Figure 3. In this illustration, the average temperature at the heater location is 550°F. and the average temperature within the desired "control" zone is 455°F. If, however, the conditions change so that less heat energy is required, the gradient will be reduced as shown on curve B. Here, as before, the temperature at the switch location is the same (500°F.), inasmuch as this is the point controlled by the switch; the temperature at the heater has dropped to 520°F. and the desired "control" zone has increased to 480°F. If a thermometer were placed in the desired control zone, it would register a change of 20°F. in the previous example which in some instances would be unsatisfactory.

For these reasons it is recommended that the scheme of reducing transfer lag by placing the switch closer to the heater, thus reducing overshoot and undershoot, should be done only if

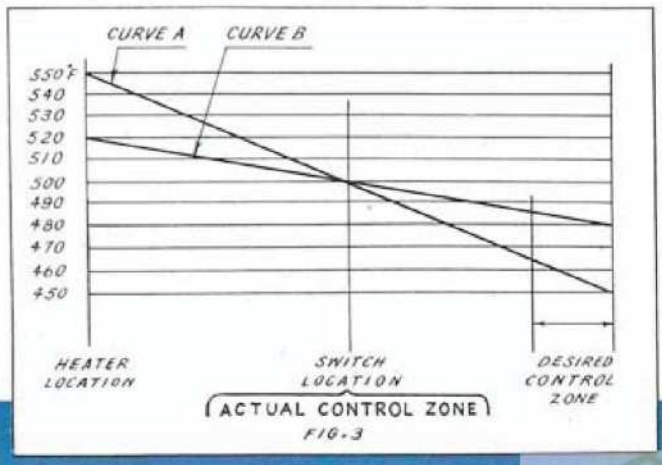


FIG. 3

the gradient within the structure is not excessive or if the process utilizes a fairly constant amount of heat energy under all operating conditions.
A compromise between the desirable effects of close proximity to the heat source and the undesirable effects of wandering control point due to heat gradient and variations in heat source output may be effected by utilizing a THERMOSWITCH Control with a long sensitive portion, so installed that a portion of the sensitive part of the switch is close to the heat source. This procedure will reduce both undesirable temperature control 'wandering' as well as the desirable proximity effect.

D. FREQUENCY OF SWITCH OPERATION:

In some types of control installations it is desirable to prevent the heater circuit from being energized at too frequent intervals. In any given system, lowering the frequency of operation tends to increase the deviation of temperature from the desired value. Precise control action requires frequent operation of the heat circuit. One can expect, therefore, considerable amount of undershoot and overshoot of the control medium if infrequent switch operation occurs. If it is desired to reduce the frequency of cycling, this may be accomplished by introducing thermal lag in the process or by insulating to a suitable extent the THERMOSWITCH from the process.

THERMOSWITCH Controls

A. DIFFERENTIAL:

The differential of the FENWAL THERMOSWITCH Control is extremely small (plus or minus .1°F.) for small electrical loads. This extremely small amount of switch differential reduces cyclic temperature variations to an absolute minimum. If the load requirements are large and at the same time close sensitivity is desired, it is generally advisable to interpose a relay between the heater and thermostat which, after all, is a detector of temperature and not a load carrying device. A THERMOSWITCH Control employed as a warning device, limit switch, control switch, etc., where extremely low differential is not important, can directly operate the heater or control circuits up to its name-plate rating.
When a relay is used in a THERMOSWITCH Control circuit, possible relay chatter may be eliminated by shunting the THERMOSWITCH unit with a small condenser (.001MFD—.01MFD) which in turn may have an adverse effect on high sensitivity. The sensitivity may be restored, however, by the addition of a 50 ohm resistor connected in series with the condenser as shown. (See Figure 4.)
When extreme accuracy is required, the temperature-sensitive outer shell of the THERMOSWITCH control can be increased in length. Doubling the length of the shell will double the sensitivity. (See Special Features Numbers 31 and 33). In a well-designed circulated water bath for example, the switch differential should be at least half the allowable variation in the temperature of the water. In air, however (such as controlling room temperature), the switch differential must be approximately one-tenth the permissible temperature variation because of the large process lag.

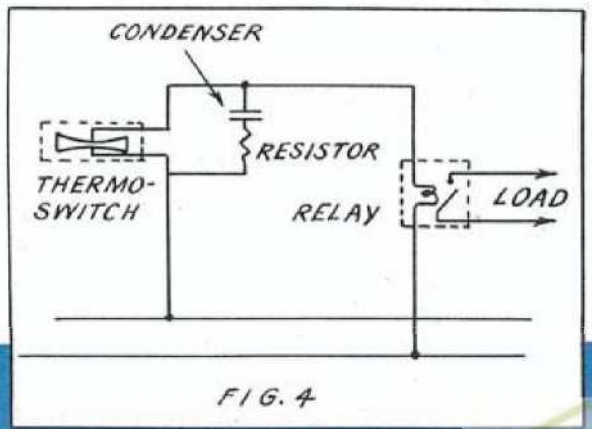


FIG. 4

B. ANTICIPATION:

The responsive control action of the FENWAL THERMOSWITCH Control is in part due to *its ability to anticipate a changing temperature* and operate the switch before the temperature actually reaches its desired value. The anticipatory action eliminates or minimizes the overshoot and undershoot which would otherwise occur if an ordinary thermostat were used. The THERMOSWITCH Control is designed with internal struts which have small expansion in comparison to the sensitive shell, and these struts are thermally lagged with respect to the shell. When the temperature in the shell is rising, the temperature at the struts lags the shell, and in doing so causes the heater to be de-energized before the desired temperature is reached. Likewise when the temperature around the shell is falling, the effect of the struts is in the reverse direction, energizing the heater circuit before the desired temperature is reached. This characteristic of the THERMOSWITCH is very desirable in many control applications and can be emphasized or minimized at will by the fundamental design of the THERMOSWITCH Control.

Special THERMOSWITCH Control

APPLICATION FEATURES

A. If moisture can collect on the adjusting stem, a seal can be provided to prevent moisture entering the switch and causing ultimate failure.

B. If moisture can collect on the lead wires or enter the switch by capillary action, an extended gland, properly packed, can be provided.

C. If there is oil, acid or excess moisture present, use Flamenol leads—but not at a temperature exceeding 170°F.

D. If the fluid is such that it would attack the brass shell either chemically or by electrolysis, it is recommended that a well of a metal which will not be affected be used in conjunction with the switch selected. If the fluid is water or of similar conductivity, the resulting control will not materially differ from the normal arrangement. Furthermore, this arrangement permits the removal of the switch at any time without the necessity of draining a tank in which it might be inserted.

E. In the control of freezing temperatures, the possibility of frost and condensation collecting on the head of the switch should be considered and proper means requested on an order so that the THERMOSWITCH Control will operate under these conditions. We have in mind an installation such that the shell of the THERMOSWITCH Control will be subjected to the low temperatures but the head would be at room temperature. Obviously, if the entire switch were located within the conditioned area there would be no problem of this kind.

CHECKING SYSTEM UNDER OPERATING CONDITIONS

When checking the operation of the FENWAL THERMOSWITCH Control, either with thermometers or thermocouples, it is important to place the temperature measuring device as close as possible to the THERMOSWITCH Contol. If this precaution is not observed, it is quite possible that the results obtained will not indicate the action of the THERMOSWITCH Control. In some instances it is not possible to find a suitable check point for a thermometer having a large bulb, and therefore we recommend the use of a thermocouple-type temperature measuring instrument so that the thermocouple can be attached in close proximity to or directly on the THERMOSWITCH unit.

In observing the action of the THERMOSWITCH Control it is often helpful to record the temperature when the switch closes the circuit and when the switch opens the circuit. The indication of a resistance, or glass-bulb, thermometer is in general lagged with respect to the actual temperature surrounding the thermometer. In fact, thermometers of this type might indicate a falling temperature when actually the temperature is rising at the THERMOSWITCH unit. For this reason, it is necessary to measure switch temperature differential with a thermocouple instrument, as small wire thermocouples have very little lag. The difference between the "make" and "break" temperatures is the switch differential; and if the load on the contacts of the switch is not excessive, it will always be a small fraction of 1°F. If this differential is small, but the cyclic variations of the controlled medium are excessive, it is often possible to find ways of reducing them to the point where control action is satisfactory by reducing system lags.

To determine the amount of heat gradient within the control zone, it is generally desirable to explore the zone by thermocouple under all conditions of operation. If during this work it is found that the gradients are excessive, means should be taken to minimize them as the control of the thermal system will then be greatly improved.

GENERAL INSTRUCTIONS

A. FOR DIRECT CURRENT APPLICATION:

It is necessary to use a molded mica or paper condenser across the leads of the switch. The capacity is from .25 to 1 MFD, depending on load; the lower capacity for smaller loads. We invite your correspondence on specific problems.

B. ADJUSTMENT:

Adjustment of the temperature setting of THERMOSWITCHES is by means of the adjusting sleeve. An H with an arrow through it on the head of the THERMOSWITCH indicates the direction the sleeve should be turned to increase the temperature setting.

The final factory test on FENWAL THERMOSWITCH Controls is made at room temperature unless special setting is required by the customer, and accordingly they are adjusted at this range and shipped. Each full turn of the adjusting screw will change the temperature the number of degrees indicated in the specification chart on the catalog page for the particular THERMOSWITCH unit.

C. FINAL ADJUSTMENT:

After the THERMOSWITCH unit has been installed, final adjustment can be made by allowing the unit to operate for several minutes to permit the controlled system to stabilize and then adjust to desired temperatures. The system should then be cooled to ambient temperature and reheated to check the setting.

Where extremely accurate temperature control is desired, several readjustments may be necessary to stabilize the THERMOSWITCH Control after which the adjustment will be maintained. When adjusting the THERMOSWITCH unit the adjusting screws should not be turned further than necessary to attain the desired setting.

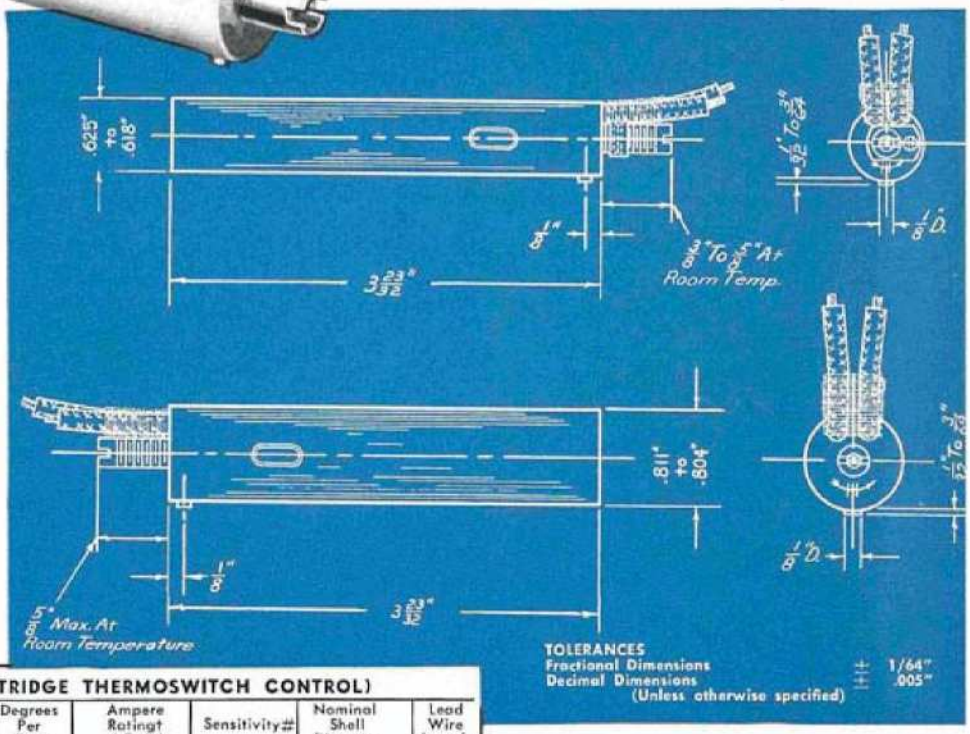
CARTRIDGE THERMOSWITCH Control

The Cartridge THERMOSWITCH Control is the basic unit of all other types of Fenwal THERMOSWITCH thermostats. All the desirable features of the ideal thermostat — high sensitivity, high load-carrying capacity, freedom from vibration effects, low thermal lag, wide adjustment range, rugged construction, ease of installation and low cost are included in the THERMOSWITCH thermostat control.

The Cartridge unit is generally used in the automatic temperature control of vulcanizers, gasoline heaters, crystal ovens, hot plates, engine bearings as well as many other similar applications where excessive moisture or other vapors are not present.

THE BASIC THERMOSWITCH Control

Two Types:
Standard Size
Heavy Duty Size



SPECIFICATIONS (CARTRIDGE THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangement*	Temperature Range °F	Degrees Per Turn	Ampere Ratingt AC (x) 115V	Ampere Ratingt AC (x) 230V	Sensitivity#	Nominal Shell Diameter	Lead Wire Length
17000	Regular	—100 to +400	80	10 amp.	5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	8"
17001	Inverse							
17002	Regular	+100 to +600	90					
17003	Inverse							
17010	Regular	—100 to +400	40					
17011	Inverse							
17050	Regular	—100 to +400	80	25 amp.	12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17051	Inverse							
17052	Regular	+100 to +600	90					
17053	Inverse							
17060	Regular	—100 to +400	40					
17061	Inverse							

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
#Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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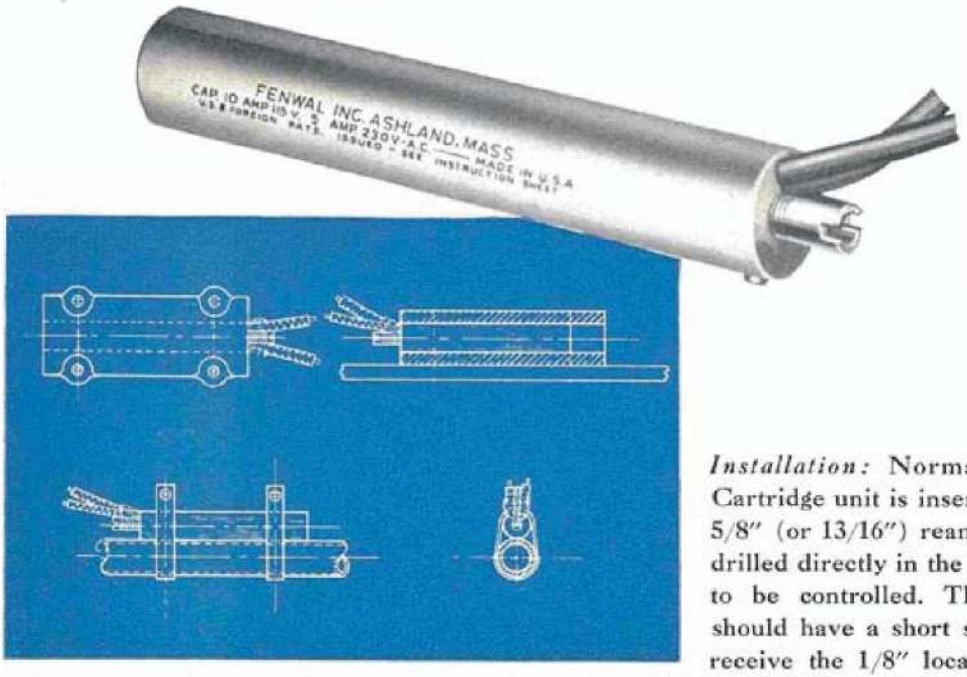


Installation: Normally the Cartridge unit is inserted in a 5/8" (or 13/16") reamed hole drilled directly in the medium to be controlled. This hole should have a short spline to receive the 1/8" locating pin which prevents the Cartridge unit from rotating when the adjusting sleeve is turned. The Cartridge unit may also be used to control or detect surface temperatures by inserting it into a suitable surface mounting block or properly clamping it to the surface as illustrated. Special surface mounting blocks are available. The Cartridge unit should enter the hole with a free sliding fit or be clamped firmly, but not so tightly that its temperature-sensitive expanding shell is restricted.

When ordering specify catalog number and such modifications and special features (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
2	Long leads, 42" limit
3	Calibration at any temperature within range
4	Locking device on adjusting sleeve
14	Extension of adjusting sleeve 10" limit

SPECIAL FEATURES**

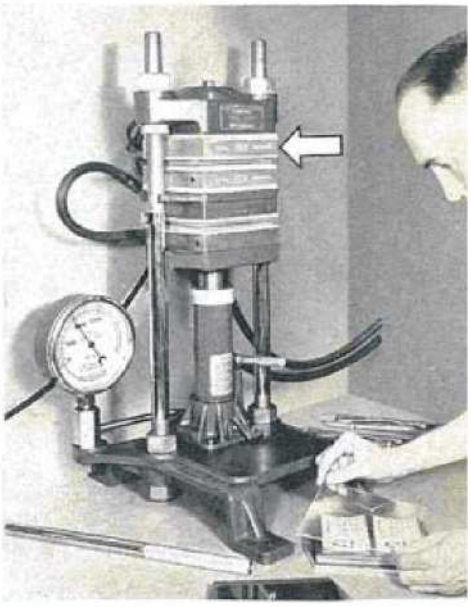
Available at extra charge
See Special Features Section

Code No.	
31	Extended shell
33	Increased sensitivity by shell extension
34	Plated shell
35	Special lead wires
37	Temperature overshoot feature

**When controls ordered carry Special Feature specifications, such switches are identified by special numbers to be assigned against your order.

This item is sold under the Standard FENWAL Guarantee.

. . . THERMOSWITCH Control warns of temperature rise in low temperature units,



. . . THERMOSWITCH Control regulates the temperature in this hydraulic laboratory press.

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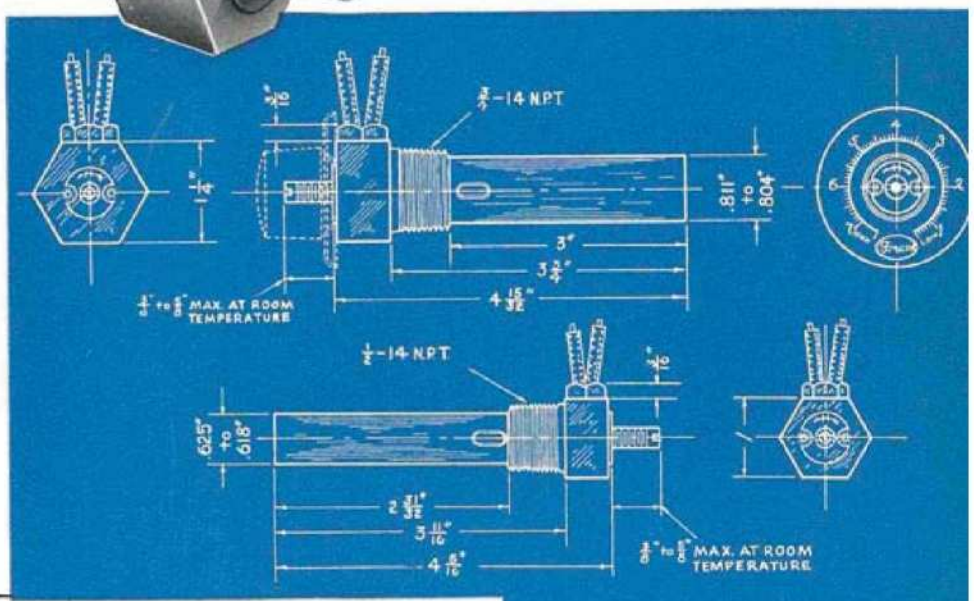
HEX HEAD THERMOSWITCH Control

The Hex Head THERMOSWITCH Control is furnished with a ½" (or ¾") standard pipe thread. This feature allows the Hex Head Unit to be inserted directly into a fluid by mounting it into a tapped hole in a container wall or into a suitable boss if the container wall is thin. The temperature adjusting screw, lead wires, knob and dial are outside the fluid container making them easily accessible.

If the fluid is corrosive to brass or silver solder then the Hex Head Control should be properly plated or a suitable well should be provided into which it can be inserted for protection against the corrosive action. This protective well introduces some thermal lag but due to the extreme sensitivity of the Hex Head THERMOSWITCH Control, the overall differential will not be greatly altered.

Two Types:
Standard Size
Heavy Duty Size



TOLERANCES
Fractional Dimensions ± 1/64"
Decimal Dimensions ± .005"
(Unless otherwise specified)

SPECIFICATIONS (HEX HEAD THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangements*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† AC (x) 115V	Ampere Rating† AC (x) 230V	Sensitivity‡	Nominal Shell Diameter	Lead Wire Length
17100	Regular	−100 to +400	80	10 amp.	5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	14"
17101	Inverse							
17102	Regular	+100 to +600	90					
17103	Inverse							
17110	Regular	−100 to +400	40					
17111	Inverse							
17150	Regular	−100 to +400	80	25 amp.	12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17151	Inverse							
17152	Regular	+100 to +600	90					
17153	Inverse							
17160	Regular	−100 to +400	40					
17161	Inverse							

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
‡Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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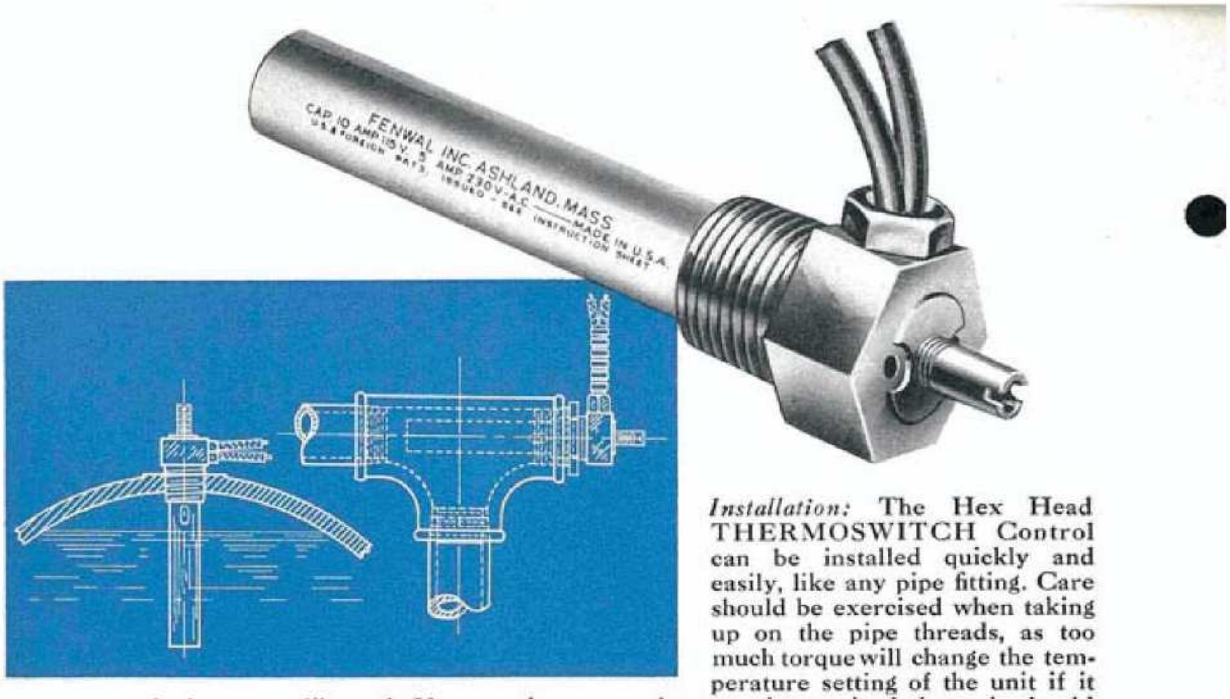

Installation: The Hex Head THERMOSWITCH Control can be installed quickly and easily, like any pipe fitting. Care should be exercised when taking up on the pipe threads, as too much torque will change the temperature setting of the unit if it is factory calibrated. If more than normal torque is required the unit should be calibrated after installation.

In applications where the Hex Head Unit is inserted in a pipe tee, the pipe tee should be large enough to allow adequate circulation of the fluid around the temperature sensitive section of the unit. The lead wires emerge from the unit through a bushing as shown in the illustration. When the wiring is exposed, flexible armored cable can be slipped over the lead wires and attached in place of the bushing.

When ordering, specify catalog number and such modifications and special features (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
2	Extra long lead wires, 42" max.
3	Calibration at any temperature within range
4	Locking device on adjusting sleeve
6	Graduated dial and knob
8	Moisture proof seal around adjusting sleeve
10	Moisture and tamper proof cap over adjusting sleeve
13	Packing gland on lead wires
14	Extension of adjusting sleeve 10" limit

SPECIAL FEATURES**

Available at Extra Charge
See Special Features Section

Code No.	
31	Extended shell
33	Increased sensitivity
34	Plated shell
35	Special lead wires
37	Temperature overshoot feature
39	Nickel plated Hex Head

**When controls ordered carry Special Feature specifications, such switches are identified by special numbers to be assigned against your order.

This item is sold under the Standard FENWAL Guarantee.

. . . action of pump for this low temperature oven is controlled by a Hex Head THERMOSWITCH unit attached to the coil.

. . . a Hex Head THERMOSWITCH control with dial and knob gives flexibility of temperature control in this poultry scalder and general purpose farm heater.

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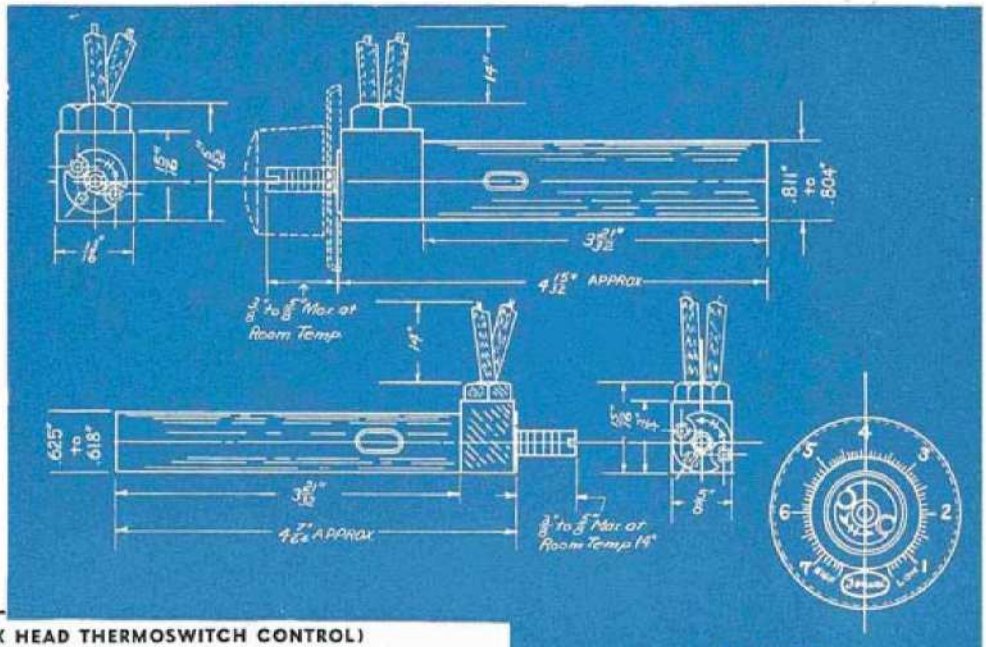
BLOCK HEAD THERMOSWITCH Control

The Block Head THERMO-SWITCH Control is provided with a suitable mounting to allow for the easy attachment of a dial and knob and armored lead wire cable, if such additions are a requisite of the application. The Block Head THERMO-SWITCH Control can be used where moisture is present by adding an adjusting sleeve seal and lead wire packing gland.

The Block Head THERMO-SWITCH Control is generally used to control the temperature of hot plates, platens, vulcanizers and similar equipment where more than one operating temperature is required or where armored lead wire protection is necessary. Temperatures are selected by turning the adjusting knob to previously determined points on the dial.



SPECIFICATIONS (BLOCK HEAD THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangements*	Temperature Range ° F	Degrees Per Turn	Ampere Rating† AC (x) 115V	Ampere Rating† AC (x) 230V	Sensitivity‡	Nominal Shell Diameter	Lead Wire Length
17200	Regular	−100 to +400	80	10 amp.	5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	14"
17201	Inverse							
17202	Regular	+100 to +600	90					
17203	Inverse							
17210	Regular	−100 to +400	40					
17211	Inverse							
17250	Regular	−100 to +400	80	25 amp.	12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17251	Inverse							
17252	Regular	+100 to +600	90					
17253	Inverse							
17260	Regular	−100 to +400	40					
17261	Inverse							

TOLERANCES

Fractional Dimensions	± 1/64"
Decimal Dimensions	± .005"

(Unless otherwise specified)

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
‡Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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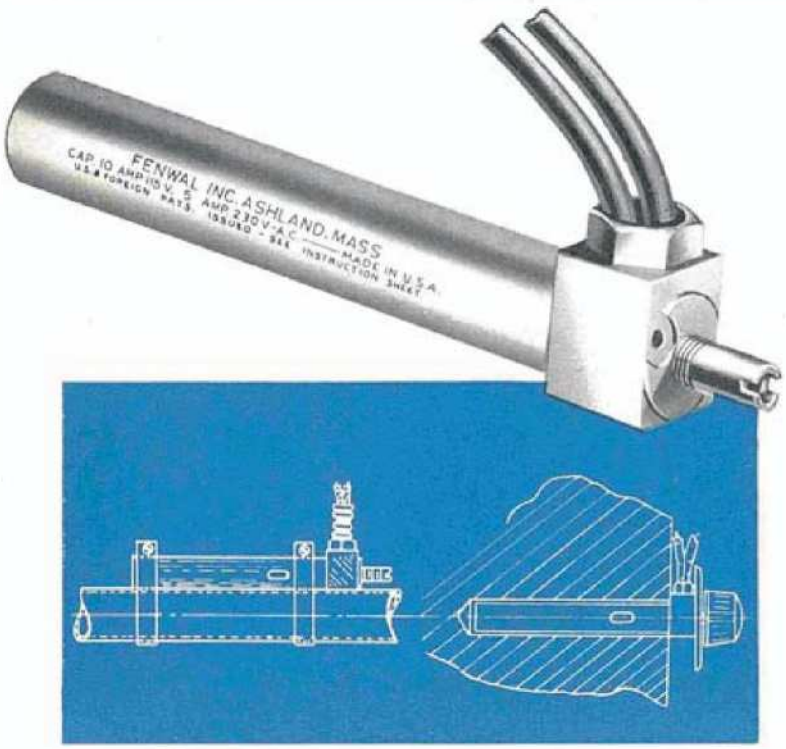


Installation:—The Block Head THERMO-SWITCH Control is generally installed in a 5/8" (or 13/16") reamed hole. It may also be strapped to a pipe or any flat surface if necessary as illustrated. Special surface mounting blocks are available. If the application calls for the insertion of the unit into a reamed hole, then two short pins should be mounted on either side of the hole so as to rest against the sides of the Block Head THERMO-SWITCH Control to prevent it from rotating where the temperature adjusting sleeve is turned.

When ordering specify catalog number and such modifications and special features (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
2	Extra long lead wires, 42" max.
3	Calibration at any temperature within range
4	Locking device on adjusting sleeve
6	Graduated dial and knob
8	Moisture proof seal around adjusting sleeve
10	Moisture and tamper proof cap over adjusting sleeve
11	Armored cable over lead wires
13	Packing gland on lead wires
14	Extension of adjusting sleeve 10" limit

SPECIAL FEATURES**

Available at Extra Charge
See Special Features Section

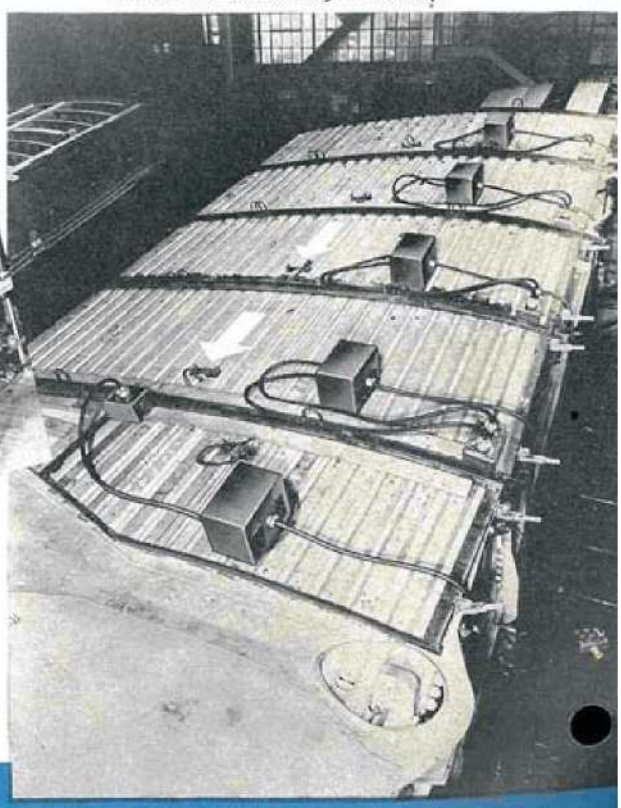
Code No.	
31	Extended shell
33	Increased sensitivity
34	Plated shell
35	Special lead wires
37	Temperature overshoot feature

**When controls ordered carry Special Feature specifications, such switches are identified by special numbers to be assigned against your order.

This item is sold under the Standard FENWAL Guarantee.

. . . in processing blood for plasma transfusions.

. . . airplane aluminum wing skin assembling to remove wrinkles and increase flight efficiency.



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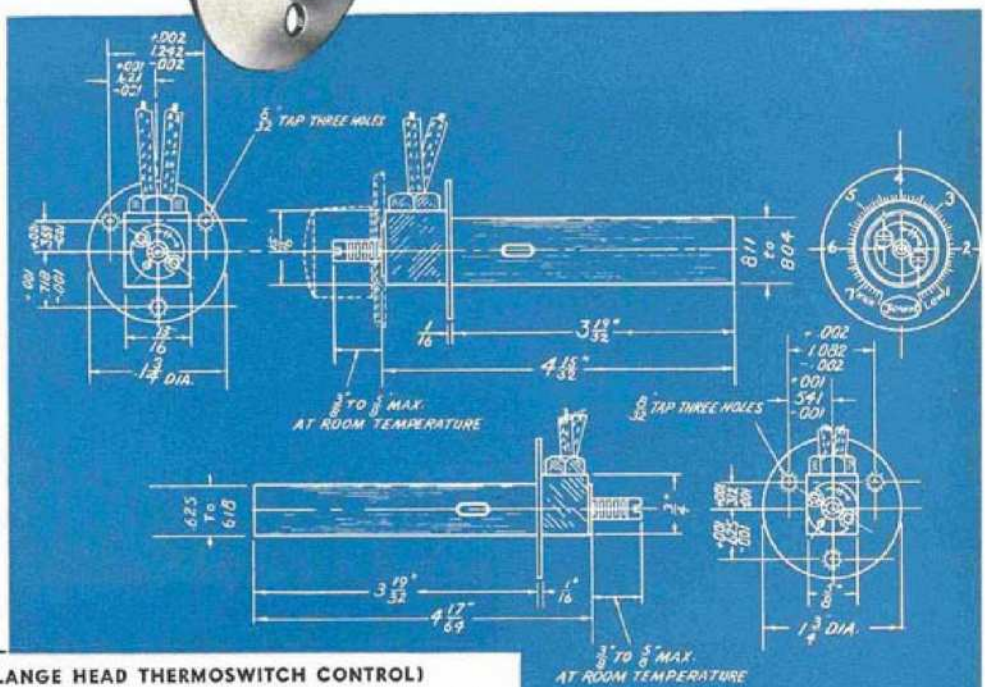
FLANGE HEAD THERMOSWITCH Control

The Flange Head THERMOSWITCH Control is provided with a mounting flange 1¾" in diameter. This flange has three tapped holes in order that it may be mounted against any flat surface with proper size screws. This type of mounting permits the insertion of the unit into the medium to be controlled leaving the lead wires and the adjusting sleeve accessible. A dial and knob as well as flexible leadwire cables can be attached to the unit. The unit can also be protected from excessive moisture by the addition of an adjusting sleeve seal and leadwire packing gland.

Designed primarily for air temperature control in ducts, ovens, incubators, cold chambers and similar applications, it operates in any position giving accurate temperature control.



SPECIFICATIONS (FLANGE HEAD THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangement*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† AC (x) 115V	Ampere Rating† AC (x) 230V	Sensitivity#	Nominal Shell Diameter	Lead Wire Length
17300	Regular	−100 to +400	80	10 amp.	5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	14"
17301	Inverse							
17302	Regular	+100 to +600	90					
17303	Inverse							
17310	Regular	−100 to +400	40					
17311	Inverse							
17350	Regular	−100 to +400	80	25 amp.	12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17351	Inverse							
17352	Regular	+100 to +600	90					
17353	Inverse							
17360	Regular	−100 to +400	40					
17361	Inverse							

TOLERANCES
Fractional Dimensions ± 1/64"
Decimal Dimensions ± .005"
(Unless otherwise specified)

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
#Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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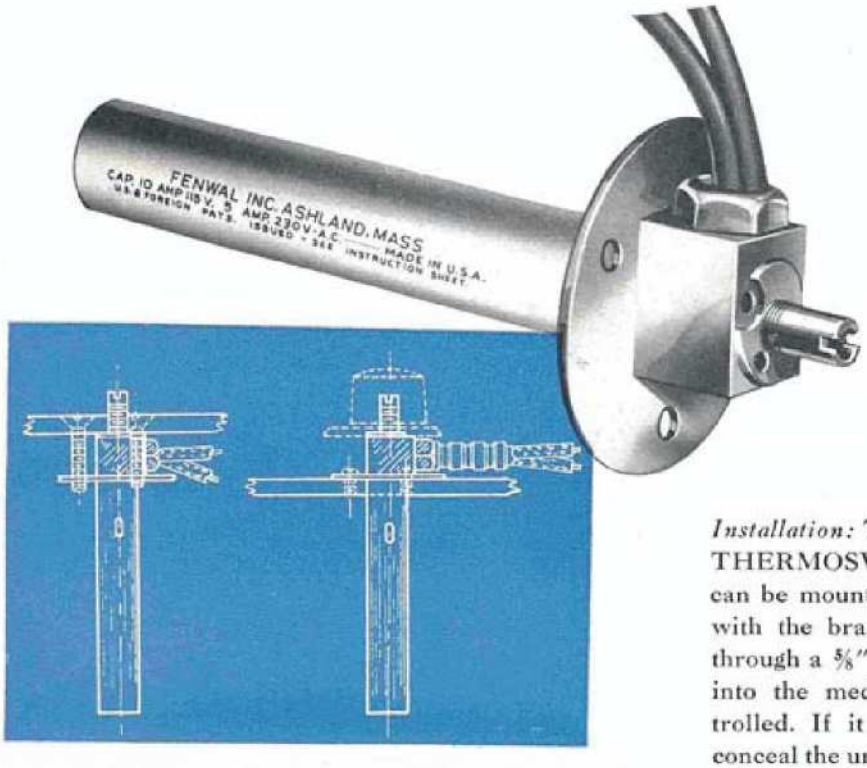


Installation: The Flange Head THERMOSWITCH Control can be mounted as illustrated with the brass shell inserted through a 5/8" (or 13/16") hole into the medium to be controlled. If it is necessary to conceal the unit as for example behind a thickly insulated oven wall, the adjusting sleeve may be extended to bring the dial and knob to the outer surface.

When ordering, specify catalog number and such modifications and special features (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
2	Extra long lead wires, 42" max.
3	Calibration at any temperature within range
4	Locking device on adjusting sleeve
6	Graduated dial and knob
8	Moisture proof seal around adjusting sleeve
10	Moisture and tamper proof cap over adjusting sleeve
11	Armored cable over lead wires
13	Packing gland on lead wires
14	Extension of adjusting sleeve 10" limit

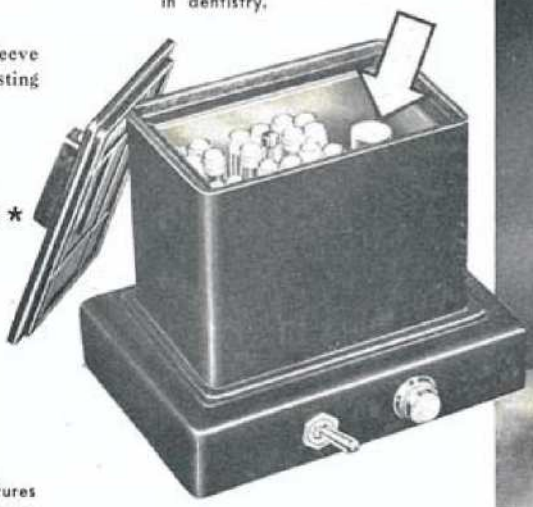
SPECIAL FEATURES**

Available at Extra Charge
See Special Features Section

Code No.	
31	Extended shell
33	Increased sensitivity
34	Plated shell
35	Special lead wires
37	Temperature overshoot feature
38	Special flange holes or special flange

**When controls ordered carry Special Features specifications, such switches are identified by special numbers to be assigned against your order. This item is sold under the Standard FENWAL Guarantee.

. . . modified flange head THERMOSWITCH control keeps procaine at body temperature for less pain in dentistry.



. . . in portable baby incubator.

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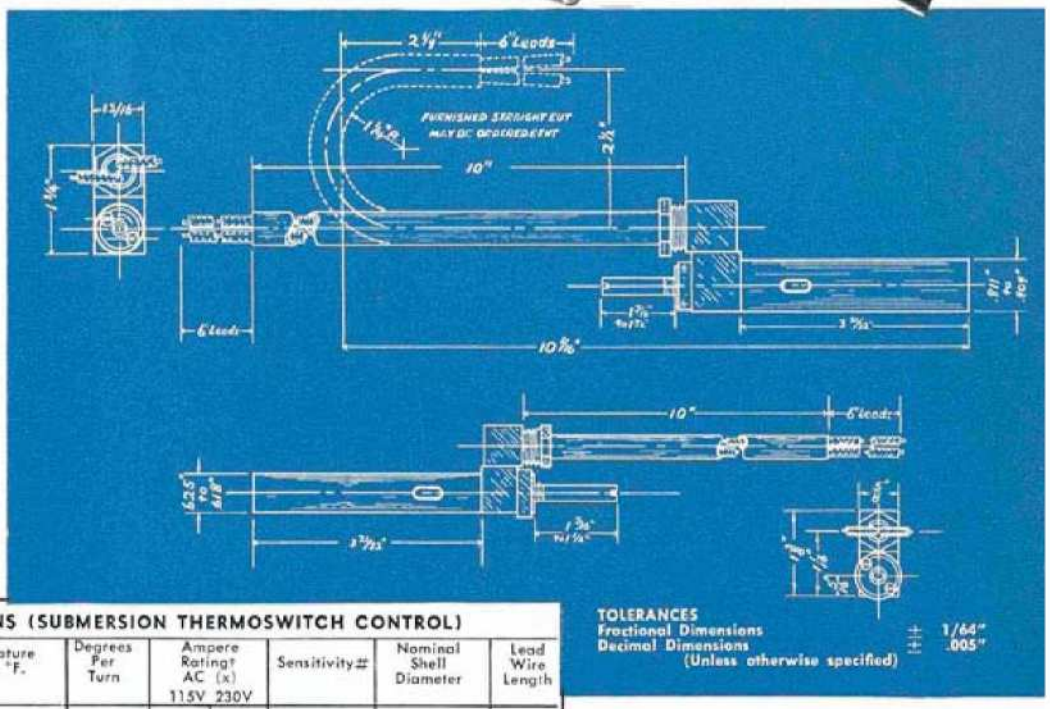
SUBMERSION THERMOSWITCH Control

The Submersion THERMOSWITCH Control is completely sealed to make it moisture proof for submersion operation. This unit will operate satisfactorily in a liquid medium having a high water content, but which is not corrosive to brass or silver solder or injurious to the moisture proofing sealant. It is not to be used in oil baths because of oil penetration through the seals due to the low surface tension of oil. A tinned copper conduit safely encases the lead wires so that the unit may be submerged in the liquid.

The temperature adjusting sleeve may be turned while the unit is completely submerged.



SPECIFICATIONS (SUBMERSION THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangement*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† AC (x) 115V	Ampere Rating† AC (x) 230V	Sensitivity#	Nominal Shell Diameter	Lead Wire Length
17400	Regular	−100 to +400	80	10 amp.	5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	16"
17401	Inverse							
17402	Regular	+100 to +600	90					
17403	Inverse							
17410	Regular	−100 to +400	40					
17411	Inverse							
17450	Regular	−100 to +400	80	.25 amp.	12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17451	Inverse							
17452	Regular	+100 to +600	90					
17453	Inverse							
17460	Regular	−100 to +400	40					
17461	Inverse							

TOLERANCES
Fractional Dimensions ± 1/64"
Decimal Dimensions .005"
(Unless otherwise specified)

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
#Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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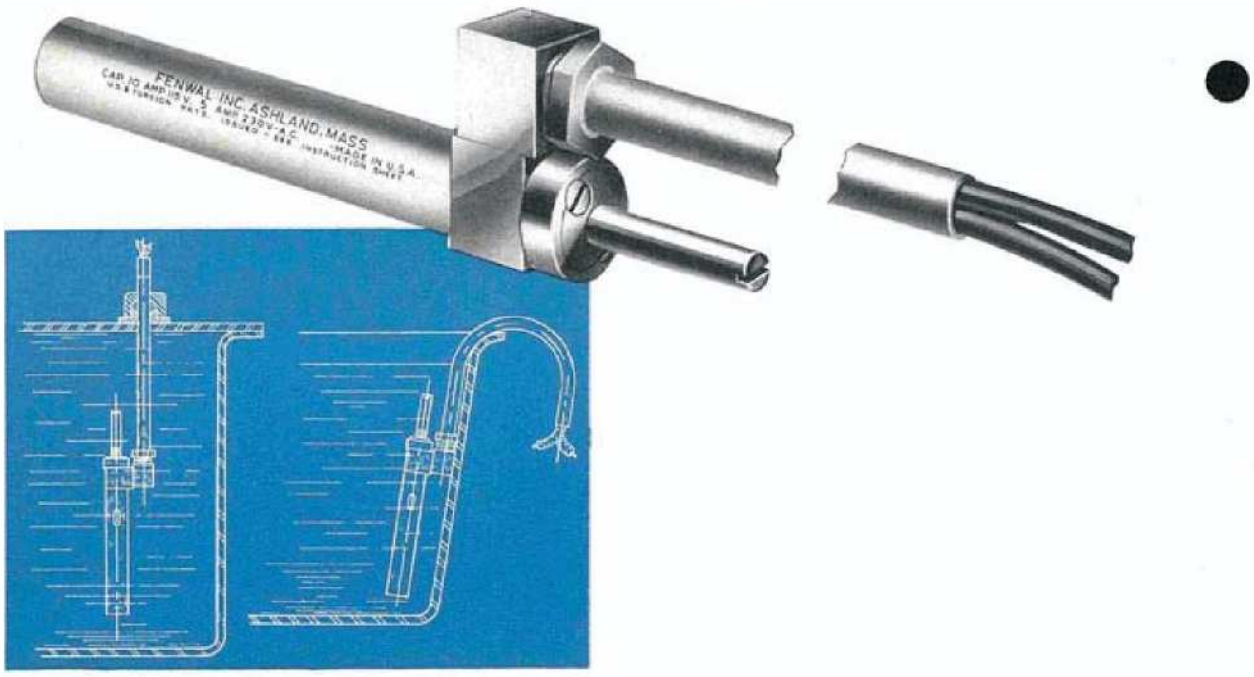


Installation: — The standard method of mounting the Submersion THERMOSWITCH Control is to suspend it in the fluid to be controlled using the lead wire conduit for a support as illustrated.

When ordering, specify catalog number and such modifications and special features (listed at left) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
2	Extra long lead wires, 42" max.
3	Calibration at any temperature within range
14	Extension of adjusting sleeve 10" limit
15	Bend in lead wire conduit

SPECIAL FEATURES**

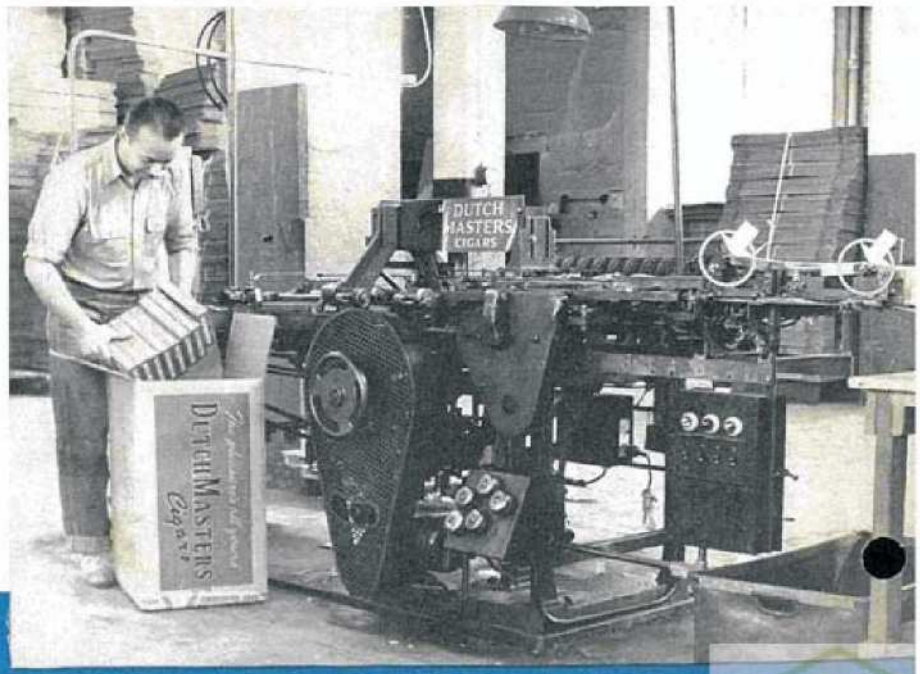
Available at Extra Charge
See Special Features Section

Code No.	
31	Extended shell
33	Increased sensitivity
34	Plated shell
35	Special lead wires

**When controls ordered carry Special Features specifications, such switches are identified by special numbers to be assigned against your order.

This item is sold under the Standard FENWAL Guarantee.

. . . Temperature control in wrapping and labeling machines results in fewer rejects.



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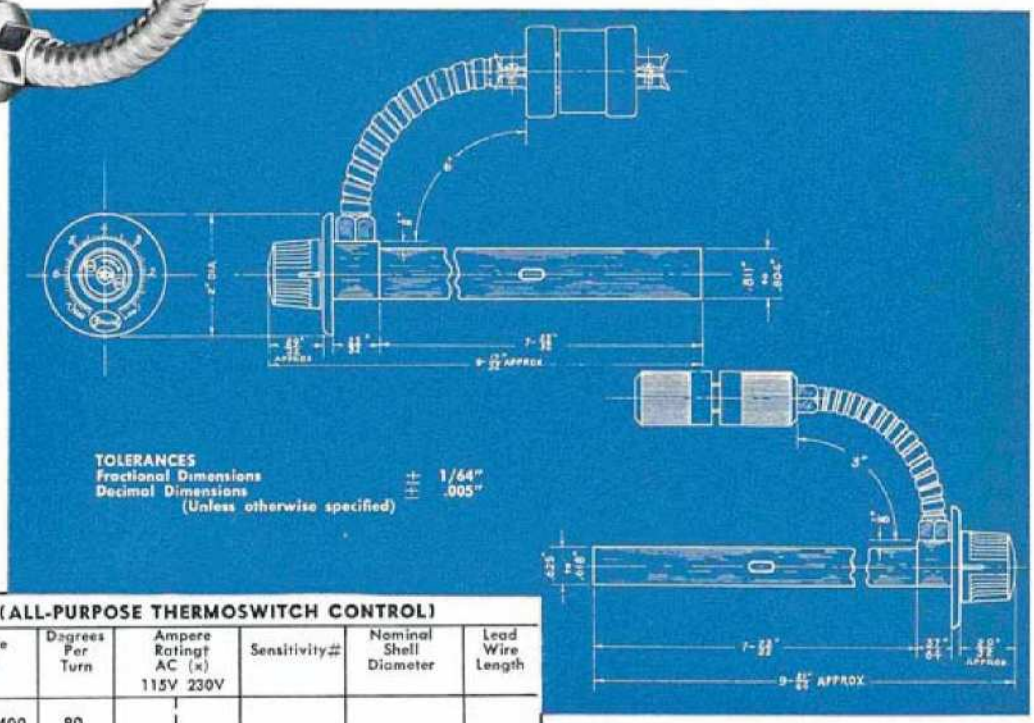
ALL-PURPOSE THERMOSWITCH Control

The All-Purpose THERMOSWITCH Control consists of a block head THERMOSWITCH unit with an extended shell, plus a dial and knob. An armored cable and connectors are provided for easy disconnection from the electrical load. The unit is generally used for experimental and laboratory test work. The wide adjustable temperature range of this unit makes it possible to use a single instrument in a great variety of test work. The brass shell is heavily nickel plated to prevent corrosion.



SPECIFICATIONS (ALL-PURPOSE THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangement*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† AC (x) 115V	Ampere Rating† AC (x) 230V	Sensitivity#	Nominal Shell Diameter	Lead Wire Length
17500	Regular	—100 to +400	80	10 amp.	5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	3"
17501	Inverse							
17502	Regular	+100 to +600	90					
17503	Inverse							
17510	Regular	—100 to +400	40					
17511	Inverse							
17550	Regular	—100 to +400	80	25 amp.	12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17551	Inverse							
17552	Regular	+100 to +600	90					
17553	Inverse							
17560	Regular	—100 to +400	40					
17561	Inverse							

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
#Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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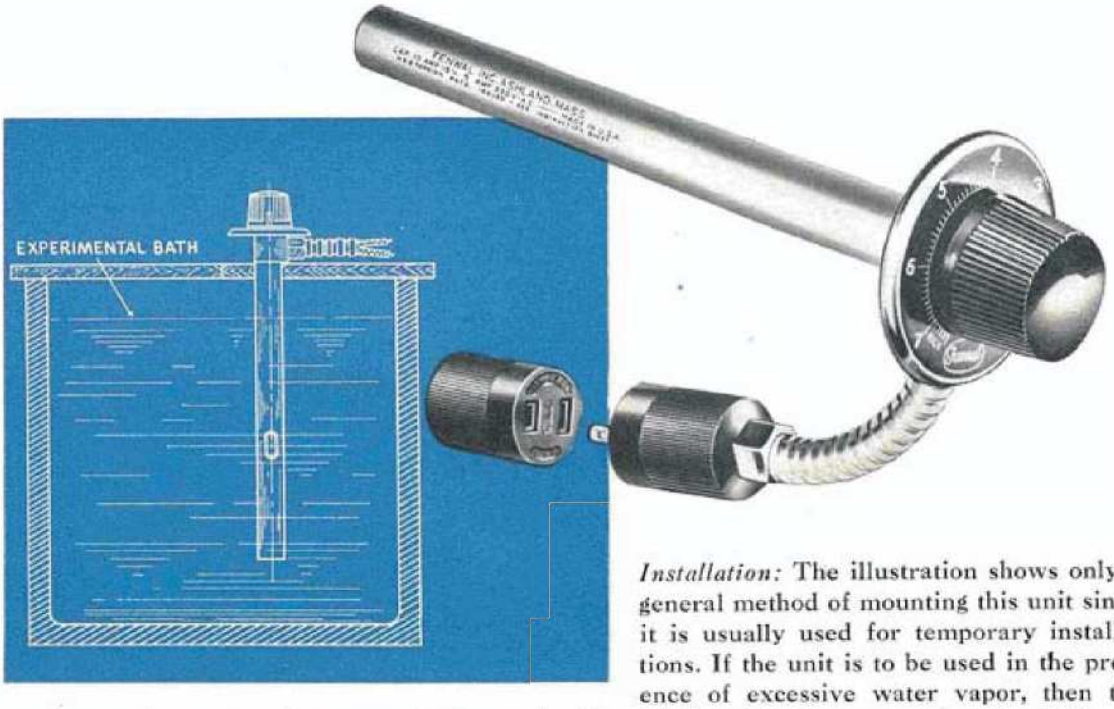


Installation: The illustration shows only a general method of mounting this unit since it is usually used for temporary installations. If the unit is to be used in the presence of excessive water vapor, then the unit must be protected to prevent damage by the addition of moisture proof seals which are available. The temperature sensitive section of the extended shell is about 3″ long and is located at the lower end of the unit. For good temperature control at least this much of the unit and preferably more must be immersed in the medium to be controlled.

When ordering specify catalog number and such modifications (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge

See Modifications Section

Code No.

1 Special marking

2 Extra long lead wires, 42″ max.

3 Calibration of temperature within range

8 Moisture proof seal around adjusting sleeve

13 Packing gland on lead wires

This item is sold under the Standard FENWAL Guarantee.

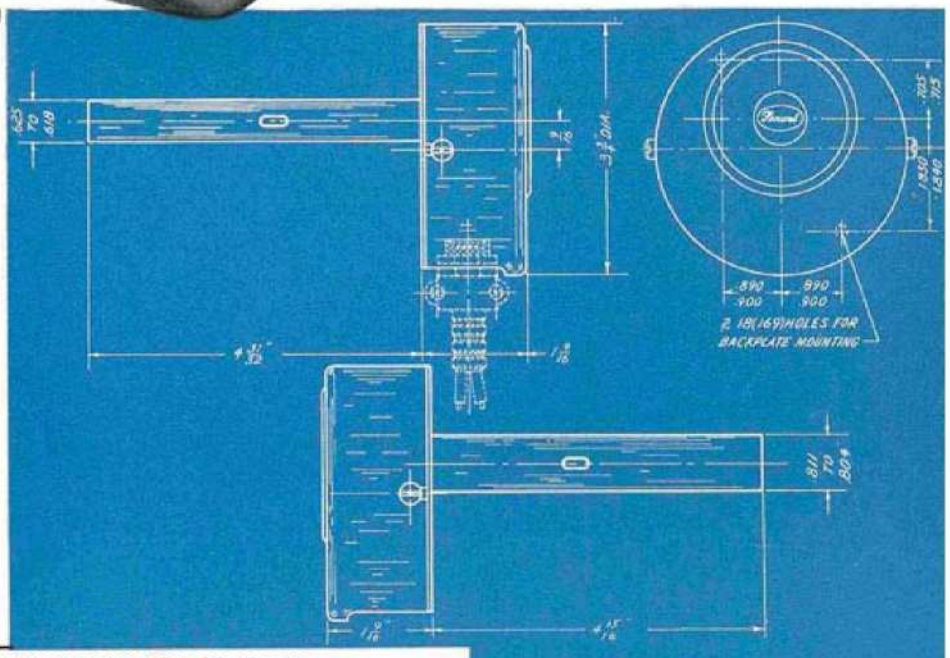
. . . in laboratory water baths the wide temperature range is particularly desirable.

JUNCTION BOX AIR THERMOSWITCH Control

The Junction Box Air THERMO-SWITCH Control consists of the basic cartridge unit with an extended shell to which an electrical conduit junction box has been added. This junction box contains a terminal block, graduated dial and knurled brass knob. (A dial and a bakelite knob may be installed on the outside of the cover if desired.) This unit is used to control air temperatures in air ducts, ovens, driers, etc. when a conduit junction box is required to facilitate electrical wiring.

Two Types:
Standard Size
Heavy Duty Size

The Junction Box Air THER-MOSWITCH Control will control temperatures at any point between 32°F. and plus 400°F. (or 600°F.) by merely selecting the desired range to be included between the stops on the graduated dial. Special modifications can be made for operation below freezing temperature.



SPECIFICATIONS (AIR THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangement*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† AC (x) 115V 230V	Sensitivity‡	Nominal Shell Diameter	Lead Wire Length
17700	Regular	Δ + 32 to +400	125	10 amp. 5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	Connect Load to Terminal Block Inside Junction Box Cover
17701	Inverse						
17702	Regular	+100 to +600	125				
17703	Inverse						
17710	Regular	Δ + 32 to +400	40				
17711	Inverse	Δ					
17750	Regular	Δ + 32 to +400	125	25 amp. 12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17751	Inverse	Δ					
17752	Regular	+100 to +600	125				
17753	Inverse						
17760	Regular	Δ + 32 to +400	40				
17761	Inverse	Δ					

TOLERANCES
Fractional Dimensions ± 1/64"
Decimal Dimensions .005"
(Unless otherwise specified)

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
‡Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.
Δ Available for use at temperatures below 32° F. on special order.

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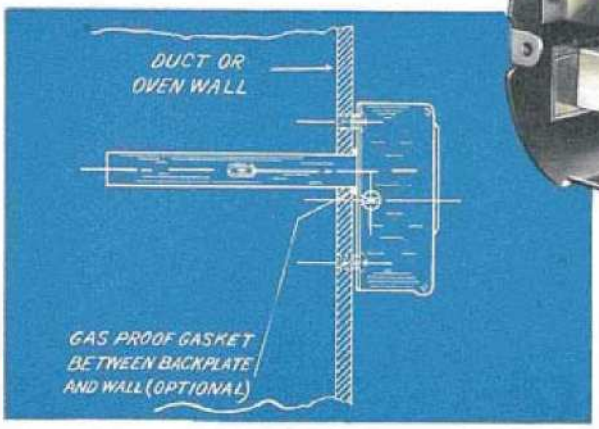

Installation: — The unit may be mounted by inserting the brass shell through a 5/8" (or 13/16") hole and fastening the back plate to a flat surface with screws through holes which are provided. It can also be inserted in a 5/8" (or 13/16") reamed hole when the support is of sufficient thickness to hold the unit in place. All units are furnished with a gas-proof gasket for installation around the shell between the backplate of the unit and the mounting surface.

A similar but slightly modified version of the unit has been approved by Underwriters Laboratories. Write for further details.

When ordering specify catalog number and such modifications and special features (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.

1 Special marking
3 Calibration at any temperature within range
16 Outside dial and knob

SPECIAL FEATURES**

Available at Extra Charge
See Special Features Section

Code No.

31 Extended shell
33 Increase sensitivity
34 Plated shell
35 Special lead wires
37 Temperature overshoot feature

**When controls ordered carry Special Feature specifications, such switches are identified by special numbers to be assigned against your order.

This item is sold under the Standard FENWAL Guarantee.

. . . economy in heating is increased by this THERMO-SWITCH-operated fuel saver.

. . . in a ceramic oven, a Junction Box Air THERMO-SWITCH Control gives close temperature regulation for extended periods.

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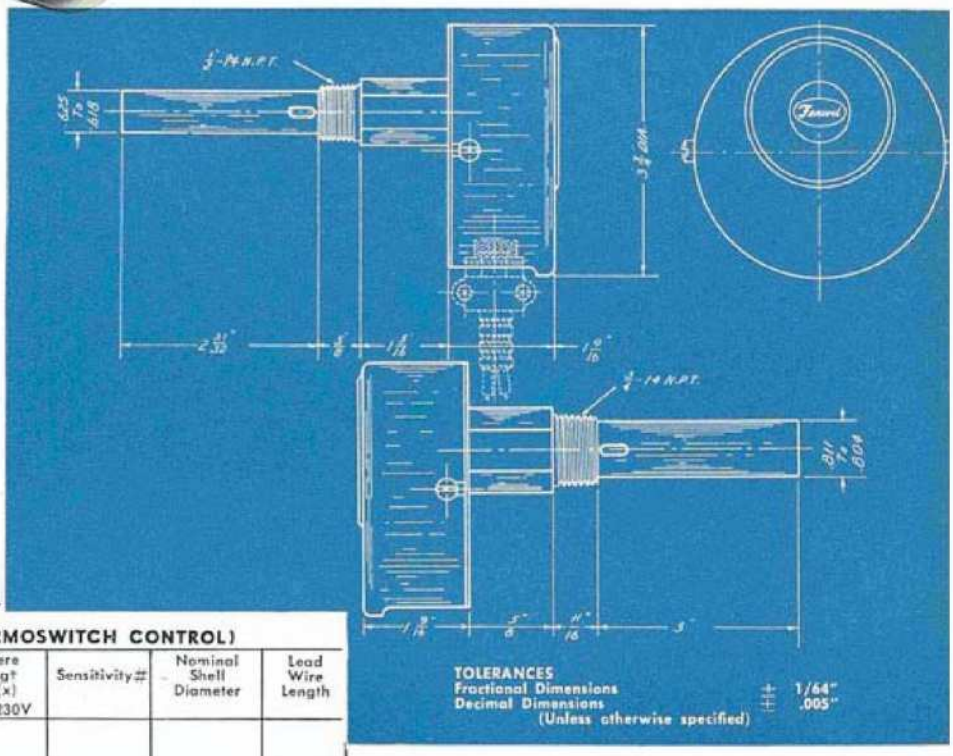
JUNCTION BOX IMMERSION THERMOSWITCH Control

Two Types:
Standard Size
Heavy Duty Size

The Junction Box Immersion THERMOSWITCH Control is the Hex Head THERMOSWITCH Control with an extended hexagon section to which has been added a conduit junction box. The threaded hexagon section (½" or ¾" standard pipe thread) is easily screwed into any properly sized tapped hole or boss so that the brass shell section may be immersed in the fluid medium to be controlled. Care should be exercised when taking up on the pipe threads as too much torque will affect the temperature setting if the unit is factory calibrated. If more than ordinary torque is required the unit should be calibrated after installation. The conduit junction box can be rotated to connect the electrical conduit in any radial position after the unit has been screwed in place. The cover houses a terminal block, graduated dial and knurled brass knob. (A dial and bakelite knob may be mounted on the outside of the cover if desired.)

Any portion of the total range (plus 32°F. to plus 600°F.) may be selected or changed at will. The unit can be modified for use at temperatures below 32°F. if required.



SPECIFICATIONS (IMMERSION THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangement*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† AC (x) 115V	Ampere Rating† AC (x) 230V	Sensitivity#	Nominal Shell Diameter	Lead Wire Length
17800	Regular	Δ + 32 to +400	125	10 amp.	5 amp.	±0.1° F.	Max. 0.625" Min. 0.618"	Connect Load to Terminal Block Inside Junction Box Cover
17801	Inverse							
17802	Regular	+100 to +600	125					
17803	Inverse							
17810	Regular	Δ + 32 to +400 Δ	40					
17811	Inverse							
17850	Regular	Δ + 32 to +400 Δ	125	25 amp.	12.5 amp.	±0.5° F.	Max. 0.811" Min. 0.804"	
17851	Inverse							
17852	Regular	+100 to +600	125					
17853	Inverse							
17860	Regular	Δ + 32 to +400 Δ	40					
17861	Inverse							

*Regular contacts close on temperature decrease — inverse close on temperature increase.
#Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.
Δ Available for use at temperatures below 32°F. on special order.

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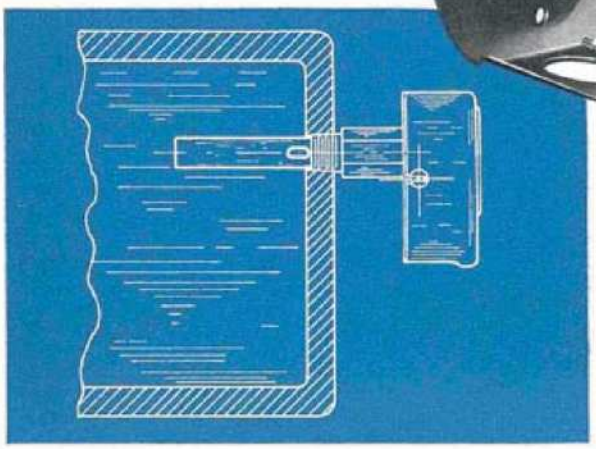


Installation: — The Unit is generally installed as illustrated. The electrical conduit may be connected directly to the junction box. The unit will operate in any position. If the unit is screwed into a pipe tee, the pipe tee should be sized to permit proper circulation of fluid around the temperature-sensitive brass shell.

A similar but slightly modified version of this unit has been approved by Underwriters Laboratories. Write for further details.

When ordering specify catalog number and such modifications and special features (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
3	Calibration at any temperature within range
16	Outside dial and knob

SPECIAL FEATURES**

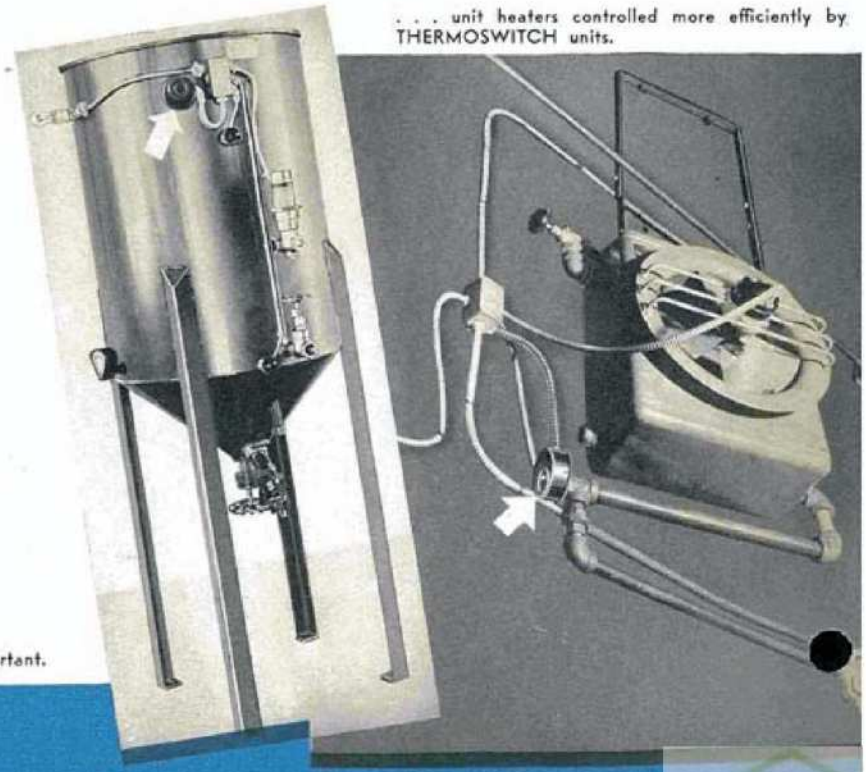
Available at Extra Charge
See Special Features Section

Code No.	
31	Extended shell
32	Extension of hex section
33	Increased sensitivity
34	Plated shell
35	Special lead wires
37	Temperature overshoot feature

**When controls ordered carry Special Features specifications, such switches are identified by special numbers to be assigned againt your order.

This item is sold under the Standard FENWAL Guarantee.

. . . unit heaters controlled more efficiently by THERMOSWITCH units.



in oil purifiers the sensitivity of the THERMOSWITCH is important.

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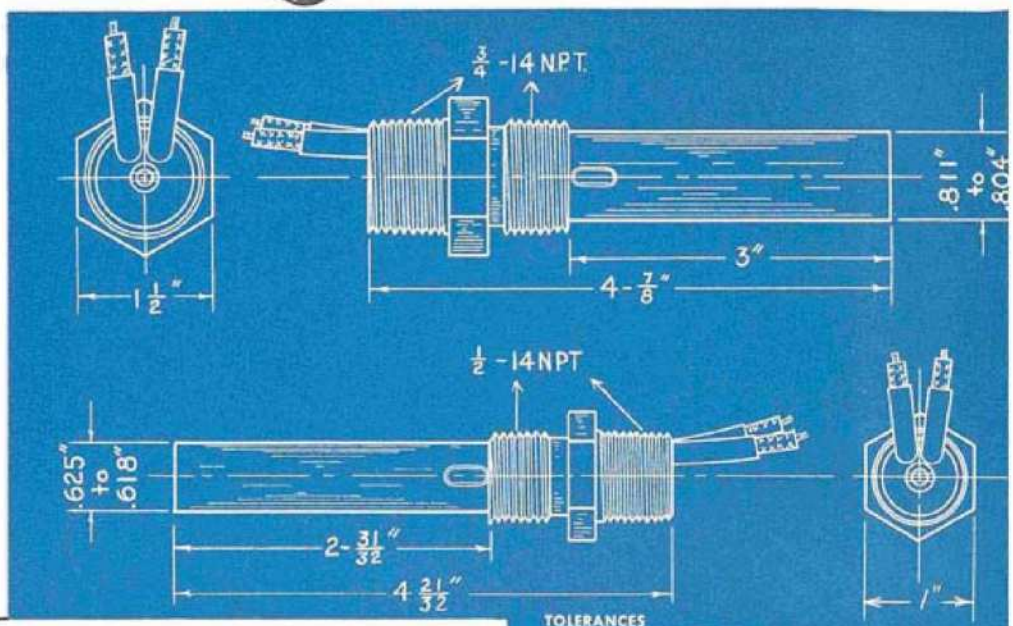
COUPLING HEAD THERMOSWITCH Control

The Coupling Head THERMOSWITCH Control has a hexagon mounting section with male pipe threads at each end of the hexagon section. Either of these threaded sections (½" or ¾" standard pipe threads) may be used to mount the unit by screwing it into a tapped hole in a fluid container wall or into a suitable boss if the container wall is thin. The Coupling Head THERMOSWITCH Control is generally used to control temperatures of closed liquid or gas systems by direct insertion in the medium to be controlled. It may be directly attached to electrical conduits or explosion proof fittings to develop explosion proof assembly.

Two Types:
Standard Size
Heavy Duty Size



In applications where hazard exists, explosion proof fittings should be attached to the Coupling Head Unit for protection.

SPECIFICATIONS (COUPLING HEAD THERMOSWITCH CONTROL)

Catalog Number	Contact Arrangement*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† AC (x) 115V	Ampere Rating† AC (x) 230V	Sensitivity‡	Nominal Shell Diameter	Lead Wire Length
18000	Regular	−100 to +400	80	10 amp.	5 amp.	±0.1°F.	Max. 0.625" Min. 0.618"	6"
18001	Inverse							
18002	Regular	+100 to +600	90					
18003	Inverse							
18010	Regular	−100 to +400	40					
18011	Inverse							
18050	Regular	−100 to +400	80	25 amp.	12.5 amp.	±0.5°F.	Max. 0.811" Min. 0.804"	
18051	Inverse							
18052	Regular	+100 to +600	90					
18053	Inverse							
18060	Regular	−100 to +400	40					
18061	Inverse							

TOLERANCES

Fractional Dimensions	± 1/64"
Decimal Dimensions	± .005"

(Unless otherwise specified)

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
‡Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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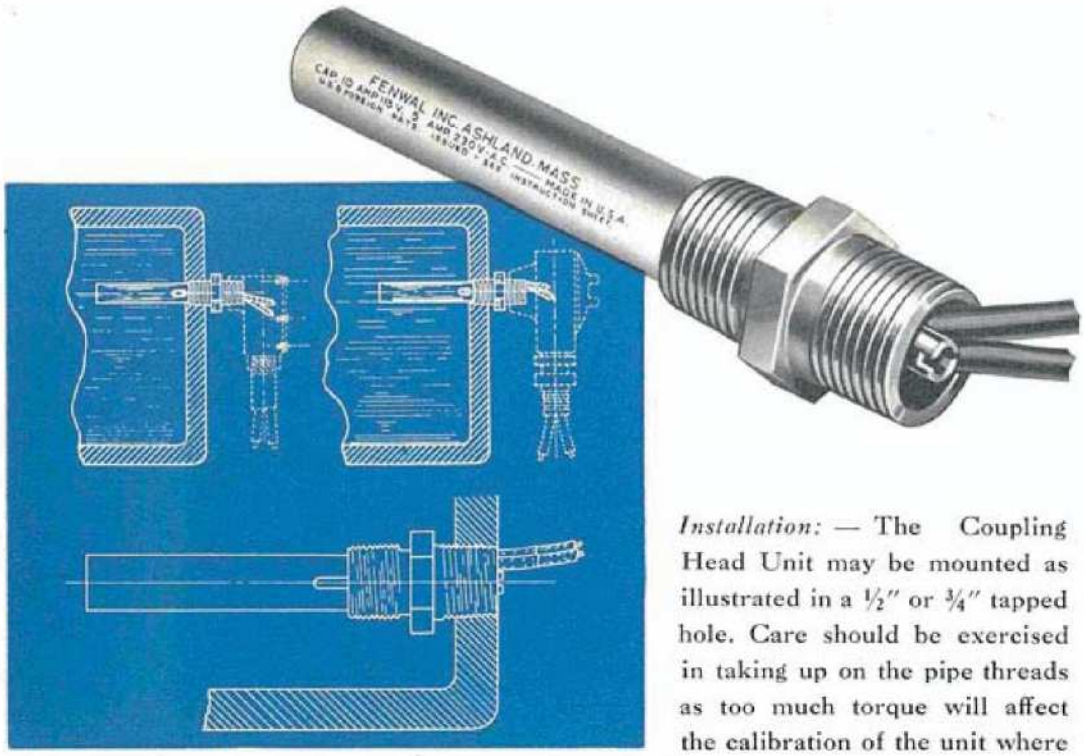


Installation: — The Coupling Head Unit may be mounted as illustrated in a ½" or ¾" tapped hole. Care should be exercised in taking up on the pipe threads as too much torque will affect the calibration of the unit where the temperature is factory preset. If more than ordinary torque on the threads is required, the unit should be calibrated after installation.

When ordering specify catalog number and such modifications and special features (listed below) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
2	Extra long lead wires, 42" max.
3	Calibration at any temperature within range
4	Locking device on adjusting sleeve
14	Extension of adjusting sleeve 10" limit.

SPECIAL FEATURES**

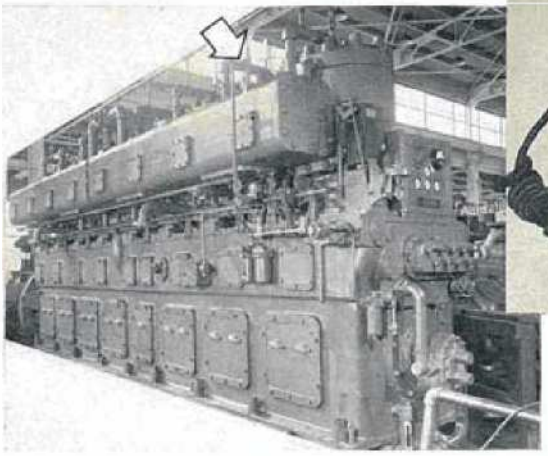
Available at Extra Charge
See Special Features Section

Code No.	
31	Extended shell
33	Increased sensitivity
34	Plated shell
35	Special lead wires
37	Temperature overshoot feature

**When controls ordered carry Special Feature specifications, such switches are identified by special numbers to be assigned against your order.

This item is sold under the Standard FENWAL Guarantee.

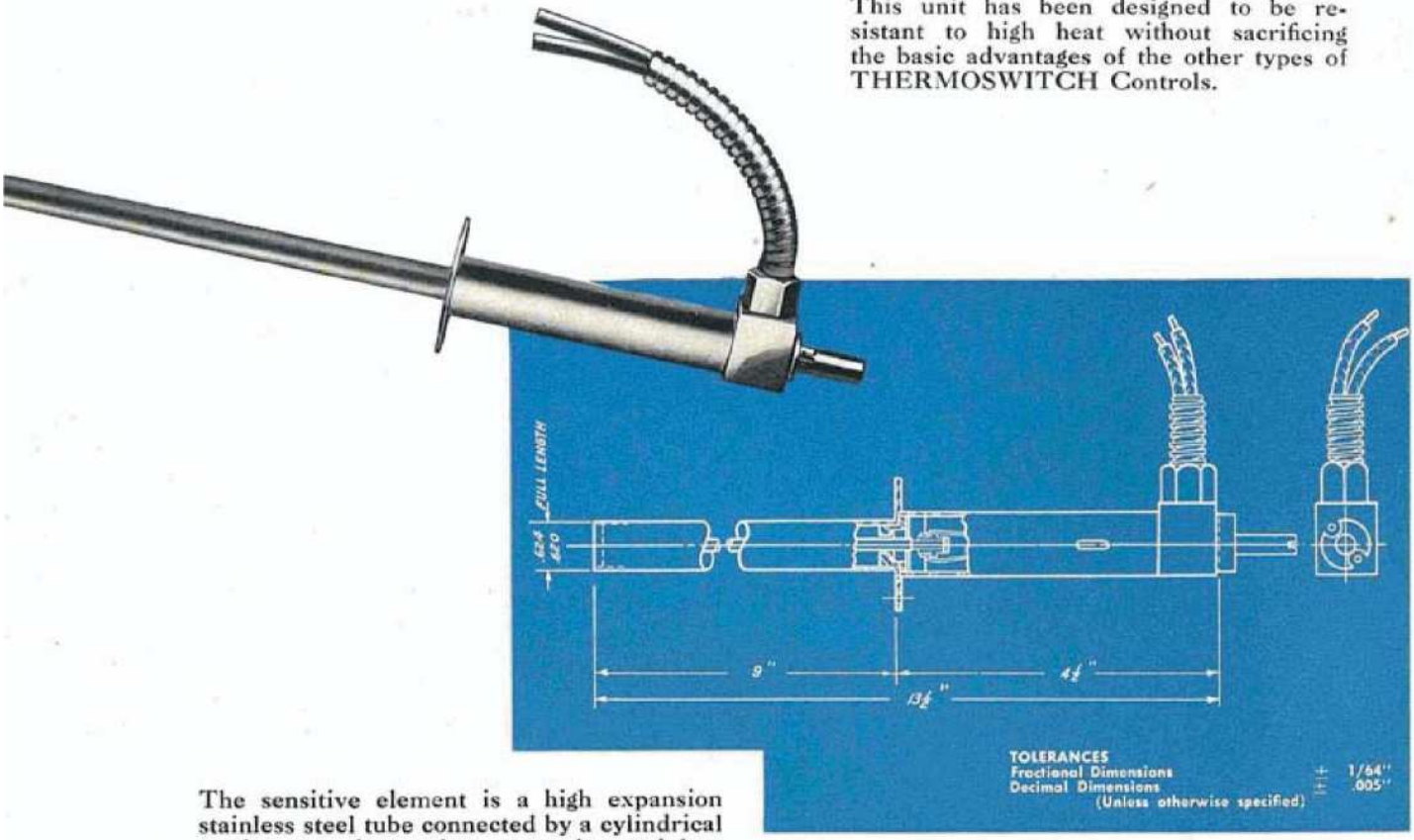
. . . Coupling Head THERMOSWITCH Control shuts down this 800 HP Diesel when water temperature in exhaust manifold water jacket exceeds a normal operating temperature.



. . . THERMOSWITCH Control regulates temperature of molten acetate in small round pot furnace.

HIGH TEMPERATURE THERMOSWITCH Control

The High Temperature THERMOSWITCH Control may be used to detect high temperatures or to control temperatures in high temperature applications. This unit has been designed to be resistant to high heat without sacrificing the basic advantages of the other types of THERMOSWITCH Controls.



The sensitive element is a high expansion stainless steel tube connected by a cylindrical section to a larger low expansion stainless steel sheath which houses the control mechanism. The high expansion stainless steel tube is the temperature sensitive portion of the unit and is inserted into the medium to be controlled. The low expansion stainless steel sheath remains exposed to ambient temperature.

SPECIFICATIONS (High Temperature Thermoswitch Control)

Catalog Number	Contact Arrangement*	Temperature Range °F.	Degrees Per Turn	Ampere Rating† A.C. (x) 115V	Ampere Rating† A.C. (x) 230V	Sensitivity‡	Nominal Shell Diameter	Lead Wire Length
13150	Regular	+300 to +1100	200° F.	25 amp.	12.5 amp.	±0.5° F.	Max. 0.625" Min. 0.618"	18"
13151	Inverse							

*Regular contacts close on temperature decrease — inverse close on temperature increase.
†All D.C. and some A.C. applications require a condenser. See Table of Condenser Values.
‡Sensitivity may be affected by electrical load — see section on Selection and Application of Thermoswitch Controls.
(x) For D.C. Ampere ratings please consult the factory.

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HIGH TEMPERATURE THERMOSWITCH Control

Installation: — This unit may be mounted by the flange section in a suitably reamed 5/8″ hole, and fastened in place by screws through holes in mounting flange.

When ordering specify catalog number and such modifications and special features (listed at left) as are desired.

MODIFICATIONS

Available at Extra Charge
See Modifications Section

Code No.	
1	Special marking
3	Calibration at any temperature within range
4	Locking device on adjusting sleeve
5	Moisture and tamper proof cap over-locking device
6	Graduated dial and knob
7	Dial and knob plus adjusting sleeve moisture-proof gland
8	Moisture proof seal around adjusting sleeve
9	Adjusting sleeve moisture proof gland plus tamper-proof cap
11	Armored cable over lead wires
12	Terminal connectors for armored cable
13	Packing gland on lead wires

SPECIAL FEATURES**

Available at Extra Charge
See Special Features Section

Code No.	
31	Extended shell (limit 12″)
37	Temperature overshoot feature
38	Special flange holes or special flange

**When controls ordered carry Special Feature specifications, such switches are identified by special numbers to be assigned against your order.

This item is sold under the Standard FENWAL Guarantee.

. . . In molding press platens the ability to withstand vibration leads to wide use of THERMOSWITCH Controls.

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AIRCRAFT THERMOSWITCH Control

The Aircraft THERMOSWITCH Control was developed for aircraft engine and other aircraft applications requiring temperature detection and control. Several different type units are available for use where extreme vibration exists. These units have been used successfully in such aircraft applications as: — carburetor air-intake temperature control, cowl flap control, safety warning overheat device in liquid cooled engines, oil cooler control, cabin temperature control, defroster control and many others. Consult us for assistance in your particular problem.

Aircraft applications require special electrical connectors for connection of the units to the electrical system. The illustration shows that special connectors are an integral part of the Aircraft THERMOSWITCH Control.

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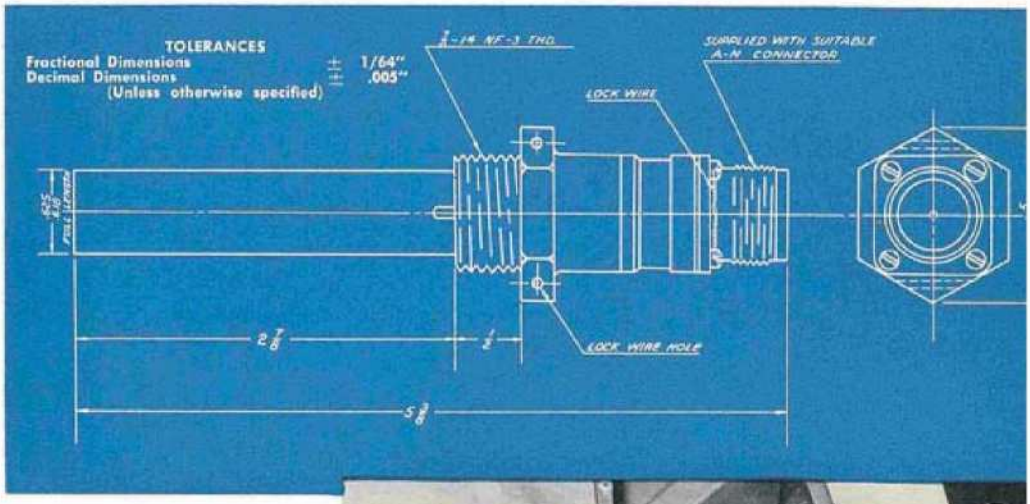
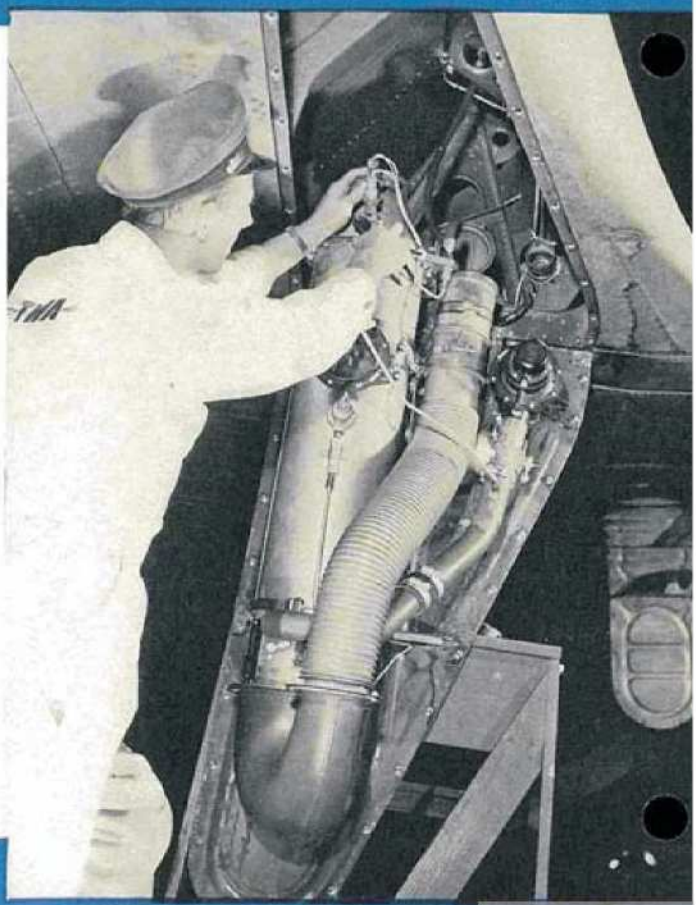
These units have been tested successfully up to 100 times gravity acceleration thus assuring a high safety factor above the normal maximum vibration of 25 times gravity experienced in most airplane engines. The particular "bridge" construction of Fenwal Aircraft THERMOSWITCH Control has a spring rating of 6000 pounds per inch enabling it to withstand these vibration effects successfully.



This item is sold under the Standard FENWAL Guarantee.



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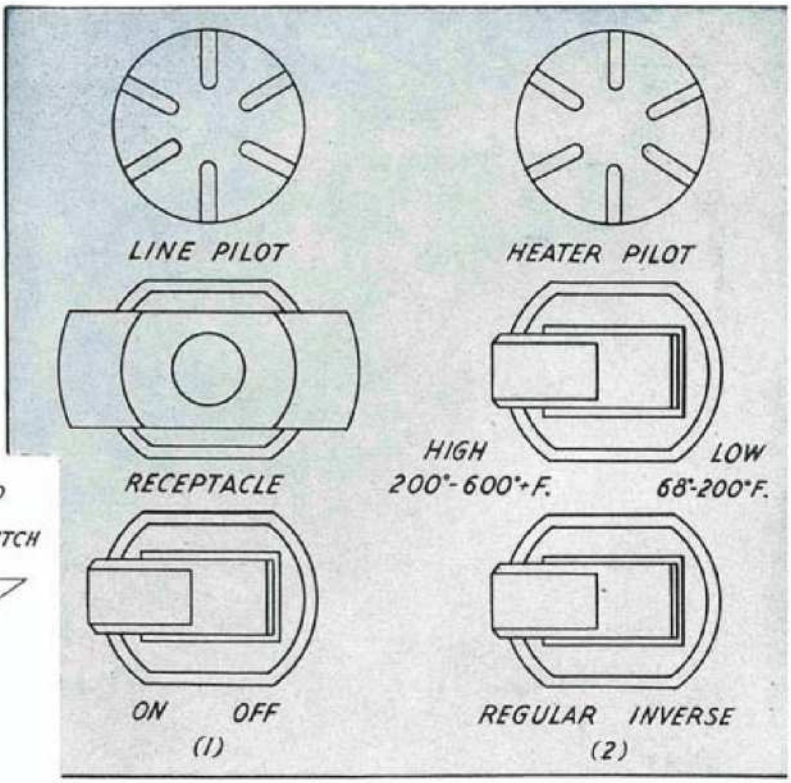
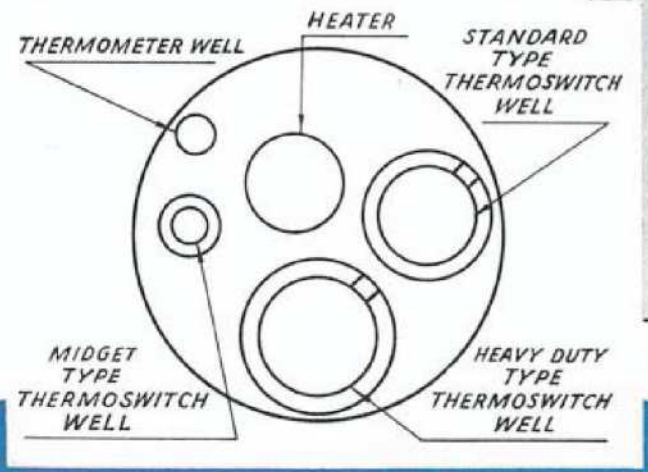
CALIBRATION KIT for THERMOSWITCH Controls

Control Panel

Description: The Calibration Kit is enclosed in a rugged case as illustrated — over-all dimensions 7" wide × 7¼" high × 15⅞" long. Cord and plug are supplied for connection to 110V A.C. current source. Clips are provided for ease in connecting the THERMOSWITCH to be calibrated. The control panel, thermometer and THERMOSWITCH wells are easily accessible.





Thermometer and switch test wells

Fenwal

The Calibration Kit for THERMOSWITCH Controls provides a precise means of —

1 Calibrating THERMOSWITCH Controls at any temperature within their operating temperature ranges.

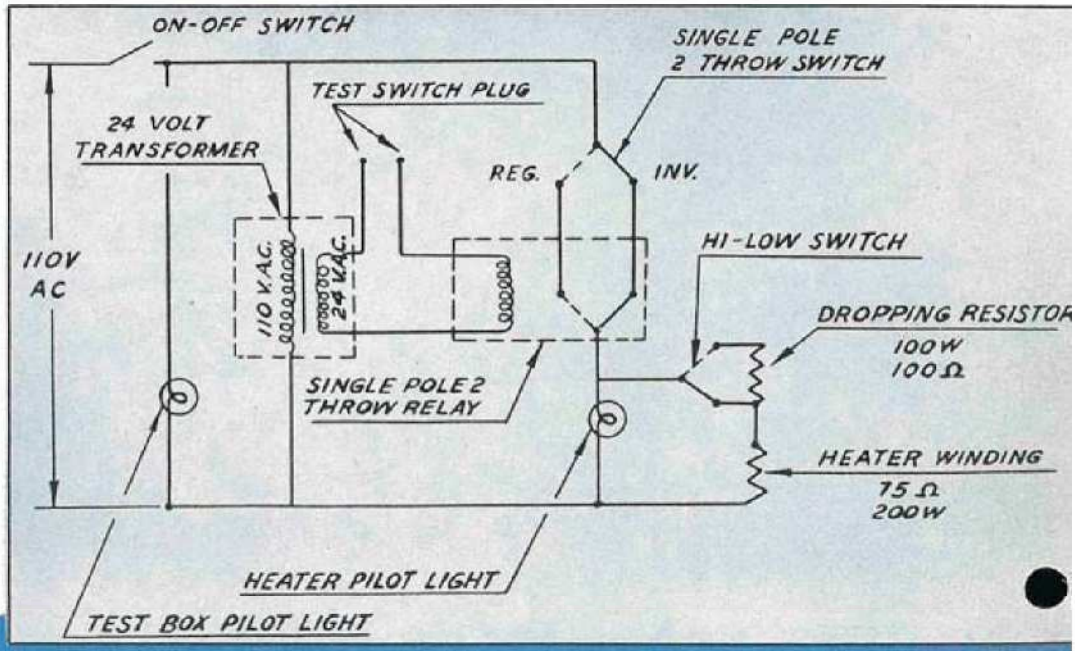
2 Checking adjustment of THERMOSWITCH Controls.

The Calibration Kit is designed for use with every type of THERMOSWITCH Control except the Appliance and the High Temperature (13100 Series) THERMOSWITCH Controls.

Detailed operating instructions are included with the kit.

250 watts. For 105-120 volt, 60 cycle, A.C., only.

This item is sold under the standard FENWAL Guarantee.



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MODIFICATIONS*

*Under each type of THERMOSWITCH Control shown in the catalog, the itemized modifications applicable to that particular type of THERMOSWITCH Control are listed. Price additions applying to the various modifications will be found in the price list.

SPECIAL MARKING (1)

Whenever it is necessary to mark the THERMOSWITCH Control with a customer's part number, special markings can be furnished. Due to limited space on the THERMOSWITCH Control such special marking should be as brief as possible.

EXTRA LENGTH LEAD WIRES (2)

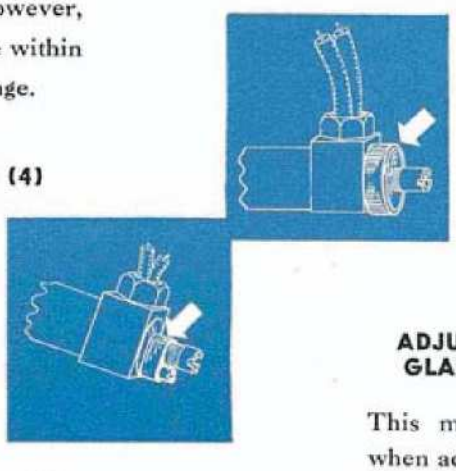
All THERMOSWITCH Controls, not equipped with terminal blocks, have a standard length of lead wires which is listed under each type of THERMOSWITCH Control shown in the catalog. Special lengths up to and including 42 inches can be supplied when necessary.

CALIBRATION (3)

Normally, when the THERMOSWITCH Control is shipped from the factory, it is adjusted to room temperature, or approximately 75° Fahrenheit. It can be furnished, however, calibrated at any specified temperature within its particular (listed) temperature range.

TEMPERATURE LOCKING DEVICE (4)

After a THERMOSWITCH Control has been calibrated, it is advisable to lock the adjusting sleeve in place so that unauthorized tampering cannot easily change the setting. This is also desirable if the unit will be subjected to extreme vibration in service.



TAMPER-PROOF CAP OVER TEMPERATURE LOCKING DEVICE (5)

A tamper-proof cap can be furnished to prevent tampering with a THERMOSWITCH Control equipped with Modification #4.

DIAL AND KNOB (6)

A graduated brass dial, marked from "1" to "7" for adjustment to higher or lower temperature, is available complete with bakelite knob. Adjustment is so arranged that the #4 marking on the dial indicates the mean (or average) operating temperature. Dials can be furnished in two sizes — 2" diameter and 1¼" diameter. Knobs can be furnished in two sizes — 1" diameter and ¾" diameter. Specify the size of dial and knob desired when ordering.

DIAL AND KNOB PLUS ADJUSTING SLEEVE MOISTURE-PROOF GLAND (7)

It is often desirable to use an adjusting sleeve moisture-proof gland on a THERMOSWITCH Control where a dial and knob are also required. When this combination is required, specify Modification #7.

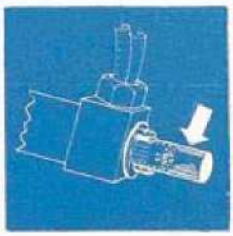
ADJUSTING SLEEVE MOISTURE-PROOF GLAND AND PLUG (8)

Under certain operating conditions where there is excessive moisture, vapor or dust, it may be necessary to protect the interior of the THERMOSWITCH Control from seepage. A packing gland around the adjusting screw and a plug in the top of the adjusting screw will give them protection.

ADJUSTING SLEEVE MOISTURE-PROOF GLAND PLUS TAMPER-PROOF CAP (9)

This modification is particularly desirable when adjustment of the THERMOSWITCH Control has to be made in the presence of moisture. This can be accomplished by removing the tamper-proof cap, making the required adjustment (in the presence of moisture with complete safety) and replacing the tamper-proof cap.

MOISTURE AND TAMPER-PROOF CAP (10)



To seal the THERMOSWITCH Control against moisture and tampering a moisture and tamper-proof cap can be furnished. This cap is placed over the adjusting sleeve and attached to the head of the THERMOSWITCH Control by screws. The heads of these screws are so drilled that a wire and seal can be installed for further protection.

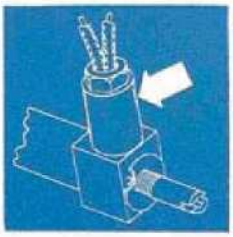
ARMORED CABLE (11)

The THERMOSWITCH Control in the majority of types, can be supplied with armored cable over the lead wires when additional protection from abrasion or other mechanical damage is required. This armored cable is not moisture-proof. Specify length of armored cable required up to a maximum of 36".

TERMINAL CONNECTORS FOR ARMORED CABLE (12)

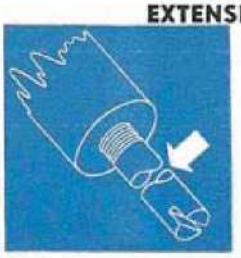
A THERMOSWITCH Control having armored cable (Modification #11) can be supplied with a terminal plug connector for quick disconnection. This is often desirable when the equipment in which the THERMOSWITCH Unit is used may have to be disconnected from the power source.

LEAD WIRE PACKING GLAND (13)



For installations where moisture may enter the THERMOSWITCH Control through the lead wire bushing, it is necessary to add an extended packing gland around the lead wire — sealed with special packing to prevent leakage. The lead wires should also be impregnated against moisture. Modification #8 or #9 should always be ordered whenever the above modification is necessary.

EXTENSION OF ADJUSTING SLEEVE (14)



Under certain conditions, it is desirable to extend the adjusting sleeve for convenience in adjustment. For example: a Flange Head THERMOSWITCH Control installed on the insulated wall of an oven may require the adjusting sleeve extended in order that the dial and knob location will be on the outside surface of the insulation, providing an extremely neat and workmanlike installation. A similar extension may also be used on Submersion or Coupling Head THERMOSWITCH Control with a conduit extension where adjustment may be required while the unit is submerged. In the latter case the adjusting sleeve extension can be of any reasonable length that may be required to bring it outside the tank in which the unit is located. The maximum length of the extended adjusting sleeve is 10" under this modification. Any length of the extended adjusting sleeve greater than 10" is a Special Feature.

CONDUIT BEND (15)

On the Submersion Thermoswitch Control, the lead wires are brought out through a tinned-copper tube. This unit may have the copper conduit bent in the form of a hook for support, when the Thermoswitch Control is to be hung over the side of a tank or vat.

DIAL AND KNOB OUTSIDE CONDUIT BOX COVER (16)

On the Immersion and Air Junction Box Thermoswitch Controls, the standard location for the dial and knob is inside the cover. This location may be changed to the outside of the Junction Box by an extension of the adjusting sleeve.

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Printed in U.S.A.

SPECIAL FEATURES*

*When Special Features are required it necessitates changing the standard identification catalog number to a special number which will be assigned to your special order. This change should not be overlooked when THERMOSWITCH controls are received bearing a different type number than the one specified on the original order. This only occurs when standard type numbers are used on the order and Special Feature specifications have been added by the customer.

EXTENDED SHELL (31)

There are two types of installations where a THERMOSWITCH control with an extended shell may be required. One is an application where the medium to be controlled is inside a thickly insulated wall or similar condition. In this case the temperature sensitive section of the extended shell is located at the lower end of the THERMOSWITCH unit. The other is an application where an average temperature control of the medium is required; for example, the control of the temperature of gases in a hot air duct. In such cases the entire extended shell should be temperature sensitive. When ordering a THERMOSWITCH control with an extended shell, specify whether only the lower portion of the THERMOSWITCH unit is to be temperature sensitive or whether the entire shell length is to be temperature sensitive.

HEX EXTENSION (32)

The hex section of the Immersion Junction Box THERMOSWITCH Control should be increased in length if the THERMOSWITCH unit is to be mounted through an insulated wall. When ordering specify length of hex section including threaded portion.

INCREASED SENSITIVITY (33)

The sensitivity of a THERMOSWITCH Control will be increased by extending the temperature sensitive section of the shell so that the extension plus the standard shell length will be temperature sensitive. The element section of the THERMOSWITCH unit will be located close to the head of the THERMOSWITCH control. See Special Feature #31.

PLATING (34)

There are many installations where the medium to be controlled has a corrosive effect on the brass shell of the THERMOSWITCH control. One method to overcome this condition, is to plate the shell with any commercially available plating which is resistant to such corrosive action (such plating must withstand the operating temperature of the THERMOSWITCH Control). Another method is to install a non-corrosive well into which the THERMOSWITCH unit can be inserted (see section on Thermo-Wells).

SPECIAL LEAD WIRES (35)

For applications where standard insulated lead wires are not suitable, special wire can be supplied for certain particular applications. For example, "Flamenol" can be supplied as a moisture-resistant lead wire for those applications where the operating temperature does not exceed 175°F. In the case of special problems of this nature, submit details for our recommendations.

TEMPERATURE OVERSHOOT (37)

In many temperature control applications and particularly in high limit safety applications the THERMOSWITCH control is often required to withstand a reasonable overshoot in temperature above its calibration point without affecting the temperature setting. Standard THERMOSWITCH controls, tension operated, will withstand a temperature overshoot of 100°F. above the operating set point without damage and may be undercooled to extremely low temperatures. THERMOSWITCH controls incorporating the temperature overshoot feature are compression operated. This overshoot feature allows them to be overshot in temperature to the high limit of the temperature range without damage. A THERMOSWITCH control having the temperature overshoot feature is limited in undercooling to approximately 450° below the calibrated operating temperature.

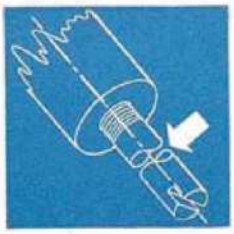
SPECIAL MOUNTINGS (38)

Special mountings and facilities can be provided for many of the THERMOSWITCH units shown in the catalog. Whenever special mountings are desired submit to us a sketch of the proposed mounting and other details for our engineering recommendations.

NICKEL PLATED MOUNTING HEADS (39)

If it is necessary that a mounting be nickel plated the order should so specify and should be marked special feature #39.

SPECIAL ADJUSTING SLEEVE EXTENSION (40)



Whenever it is necessary to extend the adjusting sleeve of any THERMOSWITCH control more than 10", special handling is required. Special feature #40 should be noted on the order and the desired length specified. Submit a sketch of the proposed extension and of the proposed installation to us for our engineering recommendations.

Thermoswitch Application
QUESTIONNAIRE

The Following Information Will Help Us With Quotations and Engineering Recommendations

DATE _____

Company Name _____

Address _____

City _____ State _____

Individual _____ Title _____

In view of the relatively large number of types of Fenwal Thermoswitches, there may be some doubt as to the best type to suit a particular application. We are prepared to analyze your answers to the following questions and to assist you in the selection of a Thermoswitch that can be best adapted to your particular application.

1. Is your application covered by government specifications? _____
   If so, give number of specification _____

   (NOTE: If your application is covered by government specifications and you have given us the number of such specification, it is unnecessary to fill out the balance of this questionnaire unless conditions beyond those in specifications are to be met.)

2. Is there a specific Fenwal Thermoswitch on which you request a quotation?

   _____

   If you can use a standard Thermoswitch you can omit replies to questions ____ to ____. Please note pages 26 and 27 of the catalog for accessories and standard modifications. Naturally, if a Standard Thermoswitch can be used the price and delivery will be more favorable than for a special design.

   Series No. _____ Catalog page No. _____

3. On how many units shall we quote? _____

4. How is the Thermoswitch to be used? _____

   _____

32 PLEASANT STREET **Fenwal** ASHLAND, MASS.

QUESTIONNAIRE

5. Is your problem one of temperature control, high limit or low limit detection, fire detection, or flame detection?
   Specify which _____
   _____

6. Temperature setting or range of settings _____
   _____ °F.

7. What temperature differential do you wish to maintain, if your problem is one of control? _____ °F.

8. What is maximum temperature to which Thermoswitch will be subjected? _____ °F.

9. What is minimum temperature to which Thermoswitch will be subjected? _____ °F.

10. Do you wish contacts to make _____ or break _____ on increase in temperature?

11. What is the electrical load? _____ Amps _____ Volts _____ A.C. or D.C.

12. Is load inductive or non inductive? _____

13. Will Thermoswitch head be immersed in fluid (requiring Submersion Type) and will Thermoswitch be subjected to a corrosive liquid or atmosphere?
    Specify _____

14. Will Thermoswitch be subjected to excessive vibration? _____

15. Give details of desired mounting or special dimensions of Thermoswitch, if no suitable type is listed in the catalog. A print or sketch is often helpful.

Printed In U. S. A. 8-25M

32 PLEASANT STREET Fenwal ASHLAND, MASS

PRICE LIST

for

Standard Series Thermoswitch Controls

Fenwal

FENWAL INCORPORATED

ASHLAND, MASSACHUSETTS

PRICE LIST

BASE LIST PRICE

CARTRIDGE TYPE
Series 17000

Cat. No.	*List Price*
17000	$6.00
17001	6.00
17002	6.60
17003	6.60
17050	7.25
17051	7.25
17052	8.00
17053	8.00

HEX HEAD TYPE
Series 17100

Cat. No.	*List Price*
17100	$7.00
17101	7.00
17102	7.70
17103	7.70
17150	8.75
17151	8.75
17152	9.60
17153	9.60

BLOCK HEAD TYPE
Series 17200

Cat. No.	*List Price*
17200	$6.70
17201	6.70
17202	7.40
17203	7.40
17250	7.90
17251	7.90
17252	8.70
17253	8.70

FLANGE TYPE
Series 17300

Cat. No.	*List Price*
17300	$7.00
17301	7.00
17302	7.70
17303	7.70
17350	8.75
17351	8.75
17352	9.60
17353	9.60

SUBMERSION TYPE
Series 17400

Cat. No.	*List Price*
17400	$11.00
17401	11.00
17402	12.10
17403	12.10
17450	13.00
17451	13.00
17452	14.30
17453	14.30

ALL-PURPOSE TYPE
Series 17500

Cat. No.	*List Price*
17500	$13.00
17501	13.00
17502	14.50
17503	14.50
17550	16.00
17551	16.00
17552	17.60
17553	17.60

AIR (Junction Box) TYPE
Series 17700

Cat. No.	*List Price*
17700	$8.50
17701	8.50
17702	9.50
17703	9.50
17750	10.20
17751	10.20
17752	11.20
17753	11.20

IMMERSION (Junction Box)
Series 17800

Cat. No.	*List Price*
17800	$9.50
17801	9.50
17802	10.50
17803	10.50
17850	11.50
17851	11.50
17852	12.50
17853	12.50

COUPLING HEAD TYPE
Series 18000

Cat. No.	*List Price*
18000	$7.00
18001	7.00
18002	7.70
18003	7.70
18050	8.75
18051	8.75
18052	9.60
18053	9.60

HIGH TEMPERATURE
Series 13100

Cat. No.	*List Price*
13150	$25.00
13151	25.00

MODIFICATIONS

ALL PRICES LIST

(1)	Special Marking	$ .50	
(2)	Extra long standard lead wires (36″ max.)	.20	per foot or fraction thereof
(3)	Calibration at any point within range (tolerance ±2% or ±3° F, whichever is greater)	10%	of base list price
(4)	Locking device	.80	
(5)	Tamper proof cap over adjusting sleeve	1.10	
(6A)	Dial and knob — Large	1.20	Knob $ .80 Dial .40
(6B)	Dial and knob — Small	.70	Knob .50 Dial .20
(7A)	Dial and knob — Large — with moisture proof seal around adjusting sleeve	3.00	
(7B)	Dial and knob — Small — with moisture proof seal around adjusting sleeve	2.50	
(8A)	Moisture proof seal around adjusting sleeve (two (2) hole type — dial CANNOT be added at later date)	1.10	
(8B)	Moisture proof seal around adjusting sleeve (four (4) hole type — dial can be added at later date)	1.80	
(9)	Adjusting sleeve moisture proof gland plus moisture and tamper proof cap	2.80	
(10)	Moisture and tamper proof cap over adjusting sleeve	1.00	
(11A)	Armored cable over lead wires (for #16 wires on standard THERMOSWITCHES)	1.30	per foot or fraction thereof
(11B)	Armored cable over lead wires (for #14 wires on heavy duty THERMOSWITCHES)	2.00	per foot or fraction thereof
(12A)	Regular connector	1.30	
(12B)	Heavy duty connector	3.00	
(13)	Packing gland on lead wires	1.50	
(14)	Extension of adjusting sleeve (10″ limit)	.80	first inch or fraction plus $.10 for each additional inch or fraction thereof
(15)	Bend in conduit	.50	
(16)	Dial and knob outside cover	1.10	

TERMS AND GUARANTEES APPLYING TO ALL SALES UNLESS OTHERWISE AGREED

TERMS:

To customers with credit approved by our Treasurer's Office, our terms are ½ per cent discount for cash within 10 days of date of invoice, 30 days net, interest after 30 days. Specifications, prices and discounts quoted are subject to change without notice. Prices are F.O.B. Ashland, Mass. All orders are accepted subject to delays occasioned by strikes, accidents, or causes beyond our control.

CLAIMS:

Claims for shortages or errors must be made within five (5) days after receipt of shipment and should be accompanied by our packing slip or photostatic copy of same.

RETURNS:

No goods are to be returned without our authorization.

DELIVERIES:

Delivery dates are estimates only.

CANCELLATION OF ORDERS:

Orders accepted by us may be cancelled only with our consent and subject to such cancellation charge as may be determined by us.

DEFERRED ORDERS:

Customer's change in delivery schedule on orders which are in process are subject to revision in price or a charge for the work already in process.

GUARANTEES:

Item 1. Standard Products Guarantee:

It is our ambition to have every article bearing the "Fenwal" trademark give complete satisfaction. We maintain high standards for our workmanship and materials and for the inspection of our products, but it is not humanly possible to have every piece perfect. Therefore, if we find that any Fenwal product sold under this guarantee shows a defect in material or workmanship within one year after it leaves our factory, Fenwal Incorporated will gladly repair it or replace it without expense to the customer, except for transportation charges. We cannot be responsible for repairs made by others, for apparatus, equipment or parts made by others or for consequential damages.

This guarantee does not apply to damage to our products resulting from corrosion, electrolysis or other injurious operating conditions. No one is authorized to assume for us any liability except as above set forth. Requests that we repair or replace products must be made within 10 days after discovery of a defect in material or workmanship.

Item 2. Appliance THERMOSWITCH Guarantee:

This guarantee is the same as Standard Products Guarantee except that it extends only 90 days after shipment.

APPLIANCE THERMOSWITCH Control

The Appliance THERMOSWITCH thermostat is designed for adaptation to most electrical appliances wherein temperature control is required; such as flat irons, automatic ironers, waffle irons, sterilizers, dairy water heaters, hot plates, etc. Because of careful selection of materials combined with unique design, the Appliance THERMOSWITCH Control will give accurate operation at required temperatures for long periods of time.

The Appliance THERMOSWITCH Control operates on the same unique principle as the Cartridge type and its variations. Its case is made of high-expanding stainless steel. A low-expansion nickel iron strut is welded at each end to the bottom of the case. Increase in temperature causes expansion of the case which results in a downward motion of the non-expanding strut. A ceramic button mounted on this strut normally holds spring biased contact support members in a closed position. The downward motion of the non-expanding strut permits the contacts to break when the required temperature is reached.

FEATURES . . .

- Positive location of the contact support members in a special ceramic locator prevents any detrimental shifting of these members when torque is applied to the terminal binding posts.

- The terminal binding posts are welded to the contact support members so that the terminals will not rotate when the hex nuts are tightened.

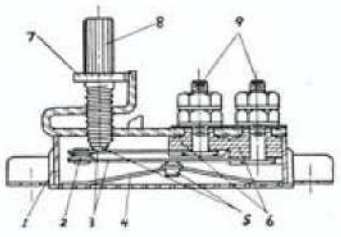
- The adjusting screw mounting yoke is preformed so that the threads of the upper and lower portion of the yoke are slightly out of phase. This prevents the threads from drifting under any normal vibration encountered in service.

- Will operate with either side or bottom mounting.

- Rigid strut construction insures positive motion of ceramic button with the expansive motion of the case.

- The case and cover are welded at assembly to form a one-piece unit, resulting in a rugged, tamper-proof unit. This rigid construction results in stability of temperature setting.

OVERALL CASE DIMENSIONS
½" high x ⅝" wide x 2⅛" long



1. Expanding stainless steel case.
2. Fine silver contacts.
3. Contact Supporting Members.
4. Low expansion metal bridge.
5. Ceramic Insulating Buttons.
6. Precision Ceramic Locator.
7. Stop Collar.
8. Adjusting Screw.
9. Terminal Binding Posts

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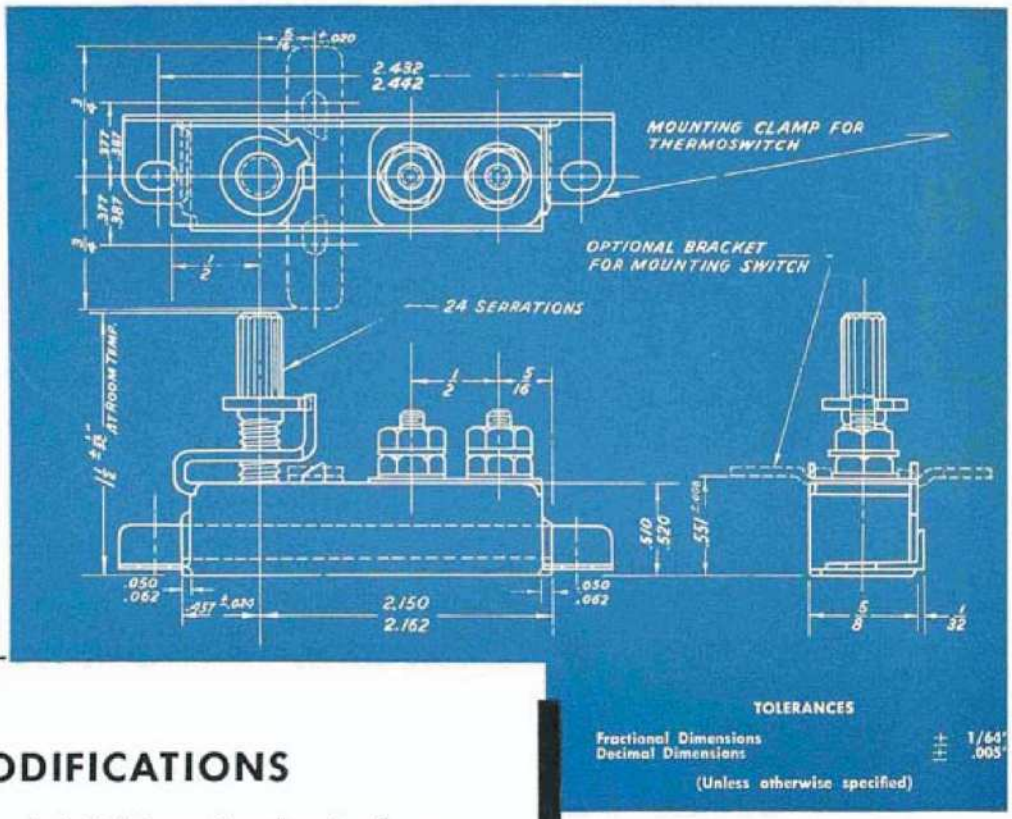
INSTALLATION

A mounting bracket is provided for easy attachment to a flat surface for either side or bottom mounting. The mounting holes are elongated to permit free movement of the case if there is a differential expansion between the mounting bracket and the device to which it is attached. A cross-mounting bracket is available at extra charge.

NOTE: When mounted on its side, the Appliance THERMOSWITCH Control will have an operating differential (overshoot and undershoot) approximately twice as large as when mounted on its bottom. In most installations this increase in differential is negligible.



MODIFICATIONS

The specifications included here for the Appliance THERMOSWITCH Control apply to the standard stock model. Modifications are possible to make this switch better fit your specific requirements. We will be glad to discuss with you methods of suiting our switch to your needs.

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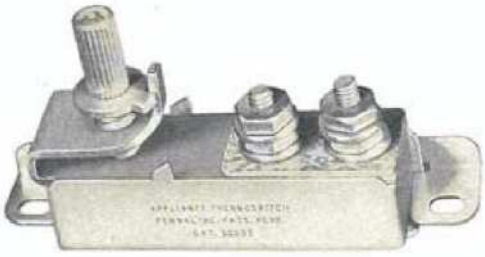

SPECIFICATIONS

Overall Case Dimension: ½" high x ⅝" wide x 2⅛" long. Maximum Load Rating: 1200 watts on 110 volt 60 cycles. For information on D.C. applications or higher wattage requirements consult our engineering department.

TEMPERATURE RANGE:

50°F. to 300°F. (Series 30003)

175°F. to 600°F. (Series 30002)

The number of degrees of temperature change per one full turn of the adjusting sleeve is approximately 400°F.

MATERIALS

Case — stainless steel

Contacts — fine silver

Insulating parts — high-temperature precision ceramics

Adjusting screw — non-galling, non-oxidizing material

Contact support members — specially selected high-temperature spring material

APPLIANCE THERMOSWITCH GUARANTEE

It is our ambition to have every article bearing the "Fenwal" trade mark give complete satisfaction. We maintain high standards for our workmanship and materials and for the inspection of our products, but it is not humanly possible to have every piece of merchandise perfect. Therefore, if within 90 days after it leaves our factory, any Appliance THERMOSWITCH Control shows any defect in material or workmanship, Fenwal Incorporated will gladly repair it or replace it without charge other than for transportation. We cannot be responsible for repairs not made at our factory, for apparatus, equipment or parts made by others, or for any consequential damages. No one is authorized to assume any liability for us except as set forth above.

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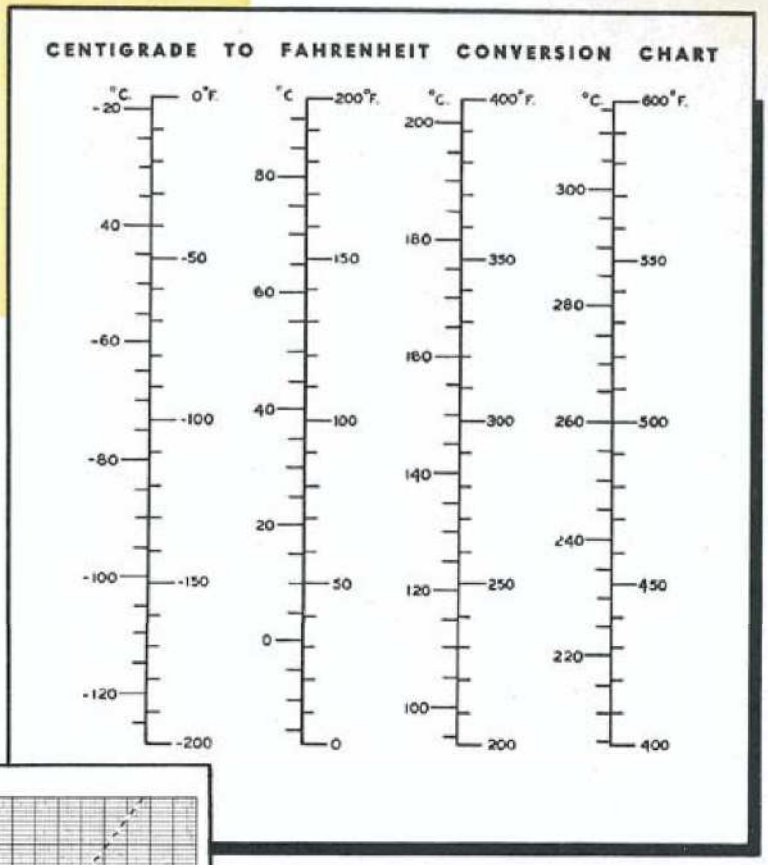
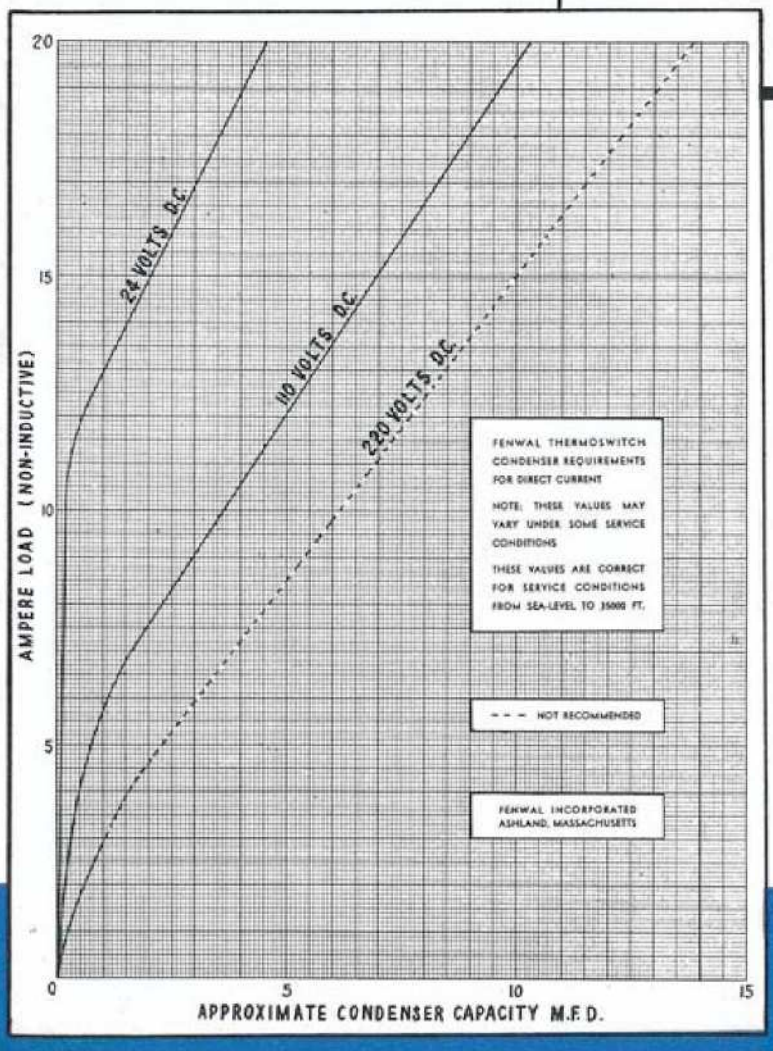
TEMPERATURE CONVERSION Chart



CONDENSER VALUES



The following table lists the values of recommended condenser capacitances for the conditions stated:

Current	Service	Capacitance MFD	
115 V. A.C.	Motor or Resistance	None required	A.C.
230 V. A.C.	General	.1	A.C.
115 V. or 230 V. A.C.	Relays Magnetic Contactors	.001 to .01	A.C.
15 V. — 25 V. A.C.	Relays	.02	A.C.

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Sales Representatives

- California, Los Angeles (21)
  MONTGOMERY BROTHERS
  741 E. 8th Street
- California, San Francisco (3)
  MONTGOMERY BROTHERS
  1122 Howard Street
- Colorado, Denver (2)
  PETERSON COMPANY
  1921 Blake Street
- Georgia, Atlanta
  MR. C. B. ROGERS
  1000 Peachtree Street, N.E.
- Illinois, Chicago (6)
  MR. H. TOM COLLINS
  605 W. Washington Blvd
- Indiana, Indianapolis (4)
  J. T. COUCHMAN COMPANY
  627–629 Architects and Builders Building
- Iowa, Des Moines (9)
  Midwest Equipment Co.
  906 Grand Avenue
- Kentucky, Louisville
  MR. WILLIAM F. SMYSOR
  Times-Star Tower
  800 Broadway
  Cincinnati 2, Ohio
- Maryland, Baltimore (2)
  PAUL V. RENOFF COMPANY
  211 N. Calvert Street
- Michigan, Detroit (21)
  CARMAN ADAMS COMPANY
  15476 James Couzens Highway
- Minnesota, Minneapolis (1)
  VOLCO COMPANY
  622 McKnight Building
- Missouri, Kansas City (6)
  MR. F. D. MOORE
  106 E. 14th Street
- Missouri, St. Louis (3)
  IND. ENGR. & EQUIP. CO.
  711 St. Theresa Avenue
- Nebraska, Omaha (8)
  MIDWEST EQUIPMENT CO.
  1112 Farnam Street
- New Jersey, Bloomfield
  MR. M. B. ROSEVEAR
  2 Broad Street
- New York, Albany (7)
  SCHIEFER ELECTRIC CO.
  100 State Street
- New York, Buffalo (3)
  SCHIEFER ELECTRIC CO.
  527 Ellicott Square
- New York, New York
  MR. M. B. ROSEVEAR
  2 Broad Street
  Bloomfield, New Jersey
- New York, Rochester (7)
  SCHIEFER ELECTRIC CO.
  311 Alexander Street
- New York, Syracuse (2)
  SCHIEFER ELECTRIC CO.
  204 State Tower Building
- North Carolina, Raleigh
  MR. W. R. PHILLIPS
  Route #3
- Ohio, Cincinnati (2)
  MR. WILLIAM F. SMYSOR
  Times-Star Tower
  800 Broadway
- Ohio, Cleveland (15)
  ANDERSON-BOLDS, INC.
  1836 Euclid Avenue
- Oklahoma, Tulsa (5)
  PAUL KING COMPANY
  1519 S. Boston St.
- Oregon, Portland (9)
  MONTGOMERY BROTHERS
  1104 N. W. 15th St.
- Pennsylvania, Philadelphia
  J. V. CALHOUN COMPANY
  349 Montgomery Avenue
  (Bala-Cynwyd)
- Virginia, Richmond (22)
  MR. W. R. PHILLIPS, JR.
  3125 Lamb Avenue
- Washington, Seattle
  MONTGOMERY BROTHERS
  911 Western Avenue
- Wisconsin, Milwaukee (3)
  GORDON HATCH COMPANY
  531 W. Wisconsin Avenue

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