

Model 8336/8340
13 Cu. Ft., -40C UR Freezer
Manual 7018336

IMPORTANT!

READ THIS INSTRUCTION MANUAL.

**FAILURE TO READ, UNDERSTAND, AND FOLLOW MANUAL
INSTRUCTIONS MAY RESULT IN DAMAGE TO THE FREEZER,
INJURY TO OPERATING PERSONNEL, AND POOR FREEZER
PERFORMANCE.**

CAUTION!

**ALL INTERNAL ADJUSTMENTS AND MAINTENANCE MUST BE
PERFORMED BY QUALIFIED SERVICE PERSONNEL.**

February 1988

Do You Need Information or Assistance on Forma Scientific Products?

If you do, please contact us 8:00 a.m. to 7:00 p.m. (Eastern Standard Time) at:

1-740-373-4763	Direct
1-800-848-3080	Toll Free, U.S. and Canada
1-740-373-4189	FAX
http://www.forma.com	Internet Worldwide Web Home Page

Forma's **Sales Group** can provide information on pricing and give you quotations. We can take your order and provide delivery information on major equipment items or make arrangements to have your local sales representative contact you. Our products are listed on the Internet and we can be contacted through our Internet home page.

The **Forma Product Service Group** can supply technical information about proper setup, operation or troubleshooting of your equipment. We can fill your needs for spare or replacement parts or provide you with on-site service. We can also provide you with a quotation on our Extended Maintenance Program for your Forma products.

Whatever Forma products you need or use, we will be happy to discuss your applications. If you are experiencing technical problems, working together, we will help you locate the problem and, chances are, correct it yourself...over the telephone without a service call.

When more extensive service is necessary, we will assist you with the selection of a field service organization for on-the-spot repairs by a professional field technician. If your service need is covered by the Forma warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

Regardless of your needs, Forma's professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 7:00 p.m. Eastern Standard Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:

Forma Scientific, Inc.
PO Box 649
Marietta, OH 45750

International customers please contact your local Forma Scientific distributor.

TABLE OF CONTENTS

SECTION 1 - INTRODUCTION

- 1.1 Standard Features
- 1.2 Auxiliary Equipment

SECTION 2 - SPECIFICATIONS

- 2.1 Construction
- 2.2 Dimensions
- 2.3 Capacity
- 2.4 Shipping Weight
- 2.5 Refrigeration System
- 2.6 Temperature
- 2.7 Electrical Requirements

SECTION 3 - OPERATION

- 3.1 Fenwal Temperature Controller/Indicator
- 3.2 CH/P Performance Monitor System
- 3.3 Weksler Temperature Recorder

SECTION 4 - INSTALLATION & START-UP

- 4.1 Location
- 4.2 Checking Compressor Ventilation
- 4.3 Installing the Optional Temperature Recorder
- 4.4 Installing the Shelves
- 4.5 Preparing the Optional Temperature Recorder
- 4.6 Connecting the Performance Monitor Battery
- 4.7 Power Connection
- 4.8 Adjusting the HI and LO Limit Setpoints
- 4.9 General Recommendations
- 4.10 Initial Start-Up Procedure
- 4.11 Initial Loading

SECTION 5 - ROUTINE MAINTENANCE

- 5.1 Refrigeration System Maintenance
- 5.2 Defrosting
- 5.3 Clearing the Bottom Vent

SECTION 6 - SERVICE

6.1 Servicing the Refrigeration System

6.2 Troubleshooting Guide

SUPPLEMENTS, PARTS LIST, SCHEMATICS, WARRANTY INFORMATION

SECTION 1 - INTRODUCTION

Table of Contents

1.1 Standard Features

1.2 Auxiliary Equipment

1.1 STANDARD FEATURES

PRECISION CONSTRUCTION AND INTEGRATED DESIGN provide for optimal temperature conditions in the freezer chamber while also affording a new standard of convenience.

- ~ Five inches of foamed-in-place polyurethane guarantees excellent temperature stability even in a 90 degrees F ambient environment.
- ~ Lift-off access and side panels facilitate field maintenance and service procedures.
- ~ Pre-punched holes located optional of the cabinet are provided for connection of the optional CO2 or LN2 back-up system.
- ~ Four stainless steel inner doors minimize temperature rise in the cabinet when the outer door is opened.
- ~ Four double-wheel swivel casters allow for convenient transportation of the freezer, thus eliminating the need for a transfer dolly.

Forma's UNIQUE CH/P PERFORMANCE MONITOR SYSTEM features electronic, solid state technology to provide for precise monitoring of conditions in the cabinet and rapid response to temperature changes.

- ~ A totally independent safety system provides audible and/or visual alarms in the event of a power failure or an overtemp or undertemp condition.
- ~ A newly designed alarm test button can be used not only to simulate freezer warm-up whereby only the temperature probe is warmed, but also to simulate a probe failure.
- ~ An easy-to-read LCD digital display continually displays the actual temperature in the freezer chamber.
- ~ A slide switch on the Performance Monitor module provides the means of setting and displaying the high and low temperature limits.
- ~ Dry contacts (SPDT) are provided in the Performance Monitor module to permit connection to a remote alarm system.
- ~ An alarm silence switch disables the audible alarm for approximately forty minutes when an unacceptable temperature condition or a power failure occur.
- ~ An alarm keyswitch bypasses the audible alarm until normal conditions are restored in the chamber.

1.2 AUXILIARY EQUIPMENT

~ INVENTORY STORAGE RACKS will accomodate sets of water-repellent cardboard boxes to provide a conveniently organized biological sample storage system. Rack dimensions are 11" H x 5-1/2" W x 17" L and are supplied with handles. Freezer capacity is four racks per shelf or sixteen racks. Two types are available:

For 3" Boxes
(9 box capacity).....Stock #820009

For 2" Boxes
(15 box capacity).....Stock #820015

~ ALL-PURPOSE STORAGE CONTAINERS are equipped with dividers to provide eight compartments per container. Exterior dimensions are 5-5/16" x 7" W x 18-1/8" L. With seven shelves, the freezer capacity is twenty-four containers, with three containers per shelf. Containers and standard three-cell dividers are fabricated from stainless steel.

Stock #833630

~ EXTRA STORAGE BOXES AND DIVIDERS include 64-cell dividers which are supplied as standard equipment for Inventory Storage Racks. Also available are 100, 81, 49, 25, and 16-cell dividers:

2" Boxes Stock #820002
3" Boxes Stock #820003

DIVIDERS	NOMINAL OPENING	STOCK #
16 Cell	1.2"	820016
25 Cell	.97"	820025
49 Cell	.67"	820049
64 Cell	.58"	820064
81 Cell	.5"	820081
100 Cell	.45"	820100

~ The CO2 BACK-UP SYSTEM is designed to inject liquid CO2 into the freezer chamber if the temperature rises above a user-adjustable overtemp control value. The system is primarily composed of a thermostatic control, a solenoid injection valve, a rechargeable battery pack, and a built-in recharger. A switching device prevents CO2 when the door is opened, and the self-contained battery pack, injection k and recharger unit maintain the injection function during a power failure. The system is for connection to multiple CO2 supply cylinders if necessary. Information about manifolds which provide a means of connecting two or more cylinders is available upon request.

Stock #189050 (Model 8336)

Stock #189055 (Model 8340)

~ The DELUXE CO2 BACK-UP SYSTEM includes all additional equipment necessary for connecting the back-up system as well as the basic injection system itself. In addition to those components listed for the CO2 back-up system, the deluxe system includes:

- 1) a wall clamp assembly
(stock #950316)
- 2) a CO2 tank fitting (stock #380159), supplied with two washers (stock #380158)
- 3) a stainless steel CO2 connection hose
(stock #991505)
- 4) a 1/8" to 1/4" MPT reducer nipple
(stock #380509)

The wall clamp is designed to hold the CO2 tank against the wall in accordance with OSHA regulations. The CO2 hose has a stainless steel inner liner covered with a double-braided stainless steel sheath and is designed to accept working pressures as high as 2500 PSIG. The hose is supplied in a 72" (183 cm) length.

System parts may be purchased separately by the above listed stock numbers.

Complete System Stock #189051 (Model 8336)

Complete System Stock #189056 (Model 8340)

~ The LN2 BACK-UP SYSTEM is identical to the CO2 system except that the control solenoid valve has a larger orifice and a decreased pressure rating to conform with standard LN2 supply pressures.

Stock #189052 (Model 8336)

Stock #189057 (Model 8340)

NOTE: The low temperature limit of the CO2 System is -65 degrees C (-85 degrees F). If lower temperature values are desired, the LN2 system must be used. Availability of either CO2 or LN2 at the operation site is also a determining factor for the selection.

~ TEMPERATURE RECORDER CHART PAPER is available for 6" recorders. Both the -100 degrees C to +38.6 degrees C and the -150 degrees F to +100 degrees F ranges are available in boxes of 100 charts.

-100 to +38.6 Degrees C Range - Stock #17020

-150 to +100 Degrees F Range - Stock #17021

~ RECORDER PEN-TIPS may be purchased and stored to have on hand for immediate replacement.

Stock #245220

~ SAFETEMP GLOVES are insulated to protect the user in ultra-cold temperatures (down to -150 degrees C) or extremely hot temperatures (up to +260 degrees C). The outer portion of the glove is water-proof. Safetemp Gloves carry a 90 day warranty against defects in materials or workmanship.

Mid-Arm (Medium).....	Stock #189561
(Large).....	Stock #189562
(X-Large).....	Stock #189563
Elbow-Length (Medium).....	Stock #189564
(Large).....	Stock #189565
(X-Large).....	Stock #189566
Shoulder-Length (Medium)...	Stock #189567
(Large)....	Stock #189568
(X-Large)..	Stock #189569

SECTION 2 - SPECIFICATIONS

Table of Contents

- 2.1 Construction
- 2.2 Dimensions
- 2.3 Capacity
- 2.4 Shipping Weight
- 2.5 Refrigeration System
- 2.6 Temperature
- 2.7 Electrical Requirements

2.1 CONSTRUCTION

Exterior: 18 Gauge Cold Rolled Steel
Interior: Aluminum Inner Liner
Insulation: 5" Thick Foamed Urethane
Inventory System: Stainless Steel
Inner Doors: Stainless Steel

2.2 DIMENSIONS

Exterior: 36" W x 78.75" H x 33.625" F-B
91.4 cm W x 200 cm H x 85.4 cm F-B
Interior: 23" W x 51.5" H x 19.25" F-B
58.4 cm W x 130.8 cm H x 49 cm F-B

2.3 CAPACITY

13 Cubic Feet

2.4 SHIPPING WEIGHT

795 Lbs. (360.5 Kgs.)

2.5 REFRIGERATION SYSTEM

R502 Refrigerant, 24 oz. (680 grams)
Vapor Charge 50 to 15 and 50 to 20
1/2 HP Compressor

2.6 TEMPERATURE

Operating Low Limit: -40 Degrees C (-40 Degrees F)
Rated in at 32.2 Degrees C (90
Degrees F) Ambient Environment
Controller: Fenwal 400 Line

2.7 ELECTRICAL REQUIREMENTS

103-127 VAC, 1 Phase, 2 Wire, 60 Hz, 13 FLA

SECTION 3 - OPERATION

Table of Contents

- 3.1 Fenwal Temperature Controller/Indicator
- 3.2 CH/P Performance Monitor System
- 3.3 Weksler Temperature Recorder

3.1 FENWAL TEMPERATURE CONTROLLER/INDICATOR

Control action of the Fenwal Model 400 temperature controller/indicator is provided through the principle of liquid volume change. As air temperature varies in the freezer chamber, liquid in the sensing bulb probe, mounted at the lower left-hand side of the chamber, expands or contracts. Heat-produced expansion forces liquid through the capillary tube and causes a bellows device in the controller/indicator to actuate the temperature indicating needle and the switching mechanisms.

An adjustment knob located immediately below the dial on the controller/indicator is used to establish the operating setpoint temperature. The WHITE POINTER on the dial indicates the temperature setpoint established by the adjustment knob. The YELLOW POINTER indicates actual chamber air temperature.

The Fenwal controller/indicator also acts as the on/off switch for the compressors, and it cycles the compressors and the cooling fans on a demand for cooling to meet temperature setpoint requirements.

The controller/indicator incorporates a factory-set temperature set-stop which limits the minimum low temperature adjustment. Although the freezer is designed with sufficient refrigeration capacity to achieve temperatures below the low-temperature set-stop, prolonged operation below the low temperature limit will cause the compressors to operate at elevated temperatures and will shorten their effective lives. For this reason, no attempt should be made to defeat the set-stop adjustment or to reset the adjustment for a lower temperature.

CAUTION: ATTEMPTING TO DEFEAT THE SET-STOP BY WARRANTY DAMAGE THE CONTROLLER/INDICATOR AND WILL VOID THE WARRANTY.

For additional information, actuator adjustment instructions and calibration instructions for the temperature controller/indicator, see the Fenwal Model 400 Handbook included as a supplement at the rear of this manual.

3.2 CH/P PERFORMANCE MONITOR SYSTEM

The solid-state electronic Performance Monitor provides constant monitor of the freezer's operation. The numerical LCD display normally provides a readout of the actual freezer chamber temperature in increments of one degree Celsius. In the event of an over-temperature or under-temperature condition in the chamber, the display will flash and indicate either "HIGH LIMIT" or "LOW LIMIT" in the upper left-hand corner to indicate which of the two conditions triggered the alarm.

A two-position keyswitch ("NORMAL" & "STANDBY") activates the audible alarm system after the chamber temperature is within the alarm setpoint limits, or silences the audible alarm during an overtemp, undertemp, alarm test, and during the initial temperature pull-down.

Colored lights indicate which of the several functions, or systems, are in operation. The green "POWER" light is lit whenever the unit is receiving power.

The amber "NORMAL" light will be on while the freezer is operating within the set operating range. The "NORMAL" light will go out in the event of an over or undertemp condition.

The red "OVERTEMP" and "UNDERTEMP" lights are normally off. The red "OVERTEMP" light will come on (the amber "NORMAL" light will go out) in the event that chamber temperature rises above the upper temperature alarm setpoint. The red "UNDERTEMP" light will come on in the event that the chamber temperature falls below the low temperature alarm setpoint.

1. POWER INDICATOR LIGHT

The green "POWER" indicator light located at the top left of the monitor panel, is the only positive indication that the unit is receiving power. When the "POWER" light is lit, the unit is operational. If the green "POWER" light is not lit, the unit is without electrical power and is functioning on the battery backup.

NOTE: Loss of power to the unit will turn the green "POWER" indicator light off and the audible and remote alarms on.

2. NORMAL INDICATOR LIGHT

The amber "NORMAL" indicator light will be on when the freezer's chamber temperature is in the normal operating range, between the high and low alarm setpoints. In the event of an overtemp or undertemp condition, the "NORMAL" light will go out when either of the alarm lights comes on.

3. ALARM SELECTOR KEYSWITCH

With the "NORMAL/STANDBY" keyswitch in the "NORMAL" position, the alarm system is fully operational and will alert the operator of an overtemp condition, an undertemp condition, or a power failure. Both the audible and visual alarm systems will be activated in the event of an undertemp or overtemp condition.

The "STANDBY" mode is provided to silence the audible alarm after an alarm condition or a power failure. The "STANDBY" position will silence the audible alarm only, the alarm light will stay on until the condition that caused the alarm has been corrected. A built-in "ring-back" feature turns on the audible alarm to alert the operator that the selector switch should be returned to the "NORMAL" position once the problem has been corrected and the temperature in the chamber is within normal limits.

4. UNDERTEMP & OVERTEMP ALARM INDICATOR LIGHTS, AUDIBLE ALARM, & ALARM SILENCE BUTTON

Should the temperature in the chamber rise to the overtemp alarm setpoint, or drop to the undertemp alarm setpoint, the appropriate alarm light and the audible alarm will be activated (selector switch in the Normal position). The audible alarm can be silenced temporarily (approximately 20 minutes) by pushing the "ALARM SILENCE" button, or it can be silenced indefinitely by turning the the alarm keyswitch to the "STANDBY" position.

The "ALARM SILENCE" button, and the keyswitch "STANDBY" position, will silence the audible alarm only. The alarm light will continue to blink until the condition which caused the alarm has been corrected.

NOTE: If the door must remain open while adding to, or removing, the freezer contents, the overtemp alarm light and audible alarm may come on. Depressing the "ALARM SILENCE" button will silence the audible alarm for approximately 20 seconds.

5. ALARM TEST BUTTON

The alarm test button utilizes the temperature probe to test the "OVER TEMP" alarm.

To test the "OVER TEMP" alarm:

- 1) Depress the alarm test button for approximately two seconds.
- 2) Voltage is applied to the probe heating element while the test button is depressed, thus warming the sensor and SIMULATING chamber warm-up. The audible alarm and "OVER TEMP" light will be activated, and the amber "NORMAL" light will go out, when the temperature of the probe reaches the over temp alarm setpoint.

NOTE: During the over temp alarm test, the LCD digital display indicates the temperature of the warming probe. When the "ALARM TEST" button is released and the probe begins to cool, the display will begin to drop back to the chamber setpoint temperature. As soon as the probe temperature drops below the high limit alarm setpoint, the audible and visual alarms will turn off and the amber "NORMAL" will come back on.

6. LCD DIGITAL TEMPERATURE DISPLAY

The LCD digital temperature display provides a direct reading of chamber temperature in 0.1 degree increments. In the event of an overtemp or undertemp condition in the chamber, a "HI-LIMIT" or "LO-LIMIT" notation will appear in the upper left-hand corner of the digital display above the actual temperature reading in the chamber.

Overtemp (hi-limit) or undertemp (lo-limit) alarm setpoints may be displayed and adjusted, as desired. Refer to Section 4.8 for instructions on displaying and adjusting these alarm setpoints.

7. REMOTE ALARM CONTACTS

Clearly marked and identified remote alarm connections are located on the Performance Monitor PC Board at a screw type terminal block. Terminals are provided for either Normally Open (NO) or Normally Closed (NC) operation of the remote alarm relay.

NOTE: The remote alarm contacts are "dry" contacts. The remote alarm system must have its own power supply.

8. ELECTRONIC RECORDER CONTACTS

A set of electronic recorder contacts have been provided for installing electronic recorders capable of having an input signal from -999 to +999 millivolt. The electronic recorder connection is located beside the remote alarm connection on the back side of the Performance Monitor Board and is equipped with two screw type terminals marked (+) = positive, (-) = negative.

9. BATTERY

In the event of a power disruption, the "OVERTEMP", "UNDERTEMP", and "DOOR AJAR" alarms and the digital display will continue to operate under the power supplied by the 9-Volt Ni-Cad battery. After power is restored, the battery will recharge automatically through the freezer's electrical system.

NOTE: Units are shipped with the battery in place, but disconnected. The battery must be connected for proper operation of the performance monitor.

Check the battery at least every six months (twice a year) as follows:

1. Disconnect the unit from the power supply.
2. The green "POWER" light should go out, and the audible alarm should be activated.

NOTE: Turn the keyswitch to "STANDBY", or push the "ALARM SILENCE" switch, to turn off the alarm.

3. A good battery will continue to provide a readout for from ten to fifteen minutes. Replace the battery if the display fades out in less than ten minutes.
4. Reconnect the power supply to the freezer unit.

3.3 WEKSLER TEMPERATURE RECORDER

Operation of the temperature recorder motor chart drive is automatic when power is applied to the freezer.

Recording action relies on a liquid volume change principle similar to the underlying principle of the Fenwal controller/indicator.

Recording action does not require electrical power. In the event of a power failure, a high temperature record will be provided even though the chart drive is not operational.

For additional information on the temperature recorder, see the Weksler manual included as a supplement at the rear of this manual.

NOTE: The felt-tip pen on the Weksler recorder requires periodic replacement. Usually the pen will ink more faintly for about one to three weeks before replacement becomes necessary. Additional pen tips (Forma Stock #245220) should be purchased and stored to allow for quick replacement.

SECTION 4 - INSTALLATION & START-UP

Table of Contents

- 4.1 Location
- 4.2 Checking Compressor Ventilation
- 4.3 Installing the Optional Temperature Recorder
- 4.4 Installing the Shelves
- 4.5 Preparing the Optional Temperature Recorder
- 4.6 Connecting the Performance Monitor Battery
- 4.7 Power Connection
- 4.8 Adjusting the Hi and Lo Limit Setpoints
- 4.9 General Recommendations
- 4.10 Initial Start-Up Procedure
- 4.11 Initial Loading

4.1 LOCATION

Locate the freezer on a firm, level surface in an area of minimum ambient temperature fluctuation. Rubber-capped wall bumpers are provided at the rear of the freezer to assure a minimum 1-1/4" clearance for unobstructed air flow to the air-cooled condenser.

CAUTION: A MINIMUM CLEARANCE OF 4" (ON ALL SIDES OF THE UNIT) IS RECOMMENDED TO ENSURE ADEQUATE VENTILATION TO THE CONDENSER.

If the unit is to be transported through a narrow passageway, the front-to-rear dimensions may be reduced by swinging the door approximately 180 degrees to the full-open position and by removing the wall bumpers. If the bumpers are removed, they must be reinstalled before the freezer is placed in the desired location to insure adequate ventilation and air flow for the condenser.

4.2 CHECKING COMPRESSOR VENTILATION

CAUTION: DISCONNECT THE FREEZER FROM THE POWER SOURCE BEFORE CHECKING COMPRESSOR VENTILATION.

With the side ventilation panels removed, check to see that the fans move freely and are unobstructed by tubing, so that the compressor will be adequately cooled after starting.

4.3 INSTALLING THE OPTIONAL TEMPERATURE RECORDER

CAUTION: DISCONNECT THE FREEZER FROM THE POWER SOURCE BEFORE INSTALLING THE RECORDER.

A tool kit has been provided with the recorder kit containing all tools required for recorder installation.

- 1) Open the freezer outer door. Pull the entire control panel out from the freezer by loosening the two phillips screws securing the panel in place (one at each end under the panel) and lifting it off from the bottom. Take care not to disconnect any of the wiring behind the control panel.
- 2) Remove the panel recorder cover plate by removing the one screw that secures it in place from the back side of the control panel.
- 3) Remove the brackets provided on the recorder, and discard them as they will not be needed.

- 4) Slide the recorder in place, and secure it on the top and bottom sides with the bracket, screw, and wing nut with star lock washer. The star lock washer should be placed between the bracket and the recorder.
- 5) Open the two bottom inner doors, and remove the chamber probe cover located on the left side of the chamber.
- 6) With a screwdriver or similar instrument, CAREFULLY remove the permagum from the probe access hole. Avoid puncturing the Performance Monitor probe wires or the temperature control capillary.
- 7) Feed the recorder probe from the control panel area up through the access port, and carefully insert it through the black rubber grommets at the bottom of the probe mounting.

NOTE: If any permagum adheres to the probe, it can be removed with paint thinner or a similar solvent.
- 8) Pull any excess capillary tube back into the control panel compartment, carefully coil the excess, and use a tie wrap to secure the coil.
- 9) Replace the permagum, or use the silastic provided with the recorder kit to seal the access port, and replace the chamber probe cover.
- 10) Plug the recorder line cord into the electrical outlet on the right hand end of the relay enclosure. Coil any excess cord, and use the tie wraps and tie wrap anchors to secure the line cord in place.
- 11) Replace the control panel, taking care not to pinch any wiring.

4.4 INSTALLING THE SHELVES

Three shelves are provided as standard equipment. Normally the shelves are attached at the rear of the cabinet before shipping, and twelve mounting clips are placed in a bag inside the freezer chamber. The clips with tabs are intended for rear shelf support, while the clips without tabs are for front shelf support.

To install the shelves:

- 1) Install the tabbed clips in the vertical pilaster brackets at the rear of the chamber with the tabs pointing upward. Reference numbers on the four pilaster brackets may be used as a guide for installing the mounting clips so that the shelves will be level. Install the front tabs.
- 2) Place the shelves inside the freezer chamber so that the side with the holes at the corners is toward the rear of the chamber, and the front lip of the shelf points down. Fit the tabs of the rear clips into the shelf holes.

4.5 PREPARING THE (OPTIONAL) TEMPERATURE RECORDER

Prior to connecting the freezer to the power source, install a chart on the temperature recorder, and remove the protective cap from the pen. Make sure the pen is inking properly by manually rotating the chart. See the Weksler manual, included as a supplement at the rear of this manual, for additional information.

4.6 CONNECTING THE PERFORMANCE MONITOR BATTERY

The battery has been disconnected to prevent it from discharging during shipment. To connect the battery:

- 1) Pull the Performance Monitor module out of the control panel.
- 2) Locate the battery, snap the battery connector to the battery terminals, replace the cover plate, and reinstall the Performance Monitor module.
- 3) The alarm will sound to indicate a power failure as soon as the batteries are installed, since the freezer is not yet connected to a power supply. Turn the alarm keyswitch to "Standby" to silence the alarm.

4.7 POWER CONNECTION

With the Fenwal controller/indicator set to OFF, connect the freezer to an adequate power source. See the electrical data plate mounted on the unit for exact electrical specifications.

NOTE: On units used outside the United States, the addition of a proper plug is all that is necessary, provided that electrical requirements are met.

IMPORTANT: TO AVOID THE POSSIBILITY OF CIRCUIT OVERLOAD AND TO ENSURE PRODUCT SAFETY, IT IS RECOMMENDED THAT THE FREEZER BE OPERATED ON A DEDICATED CIRCUIT.

4.8 ADJUSTING THE HI AND LO LIMIT SETPOINTS

NOTE: The hi limit setpoint has been factory-set at -65 degrees C, and the lo limit setpoint has been factory-set at -95 degrees C.

If temperature limit setpoints other than those established at the factory are desired, they can be adjusted as follows:

- 1) Pull the Performance Monitor module out to gain access to the slide switch (labeled SW-2), the high alarm setscrew (R-61) and the low alarm setscrew (R-62) located at the top edge of the circuit board, to either side of the switch.
- 2) TO SET THE HIGH ALARM POINT, place the SW-2 switch in the left hand position to display the high alarm point on the readout. If adjustment is desired, turn (R-61) until the desired temperature is displayed on the readout.

NOTE: Clockwise adjustment of the R setscrews will raise the temperature reading, and counterclockwise adjustment will lower the reading. One revolution of a R setscrew will adjust the temperature approximately 2 degrees C.

- 3) TO SET THE LOW ALARM POINT, place the SW-2 switch in the center position to display the low alarm point on the readout. If adjustment is desired, turn R-62 until the desired temperature is displayed on the readout.
- 4) After checking and/or adjusting the alarm point(s), place the SW-2 switch in the right hand position to display the actual temperature.

4.9 GENERAL RECOMMENDATIONS

The refrigeration system is designed to maintain ultra-low temperatures with safety in a 90 degrees F ambient environment ONLY when the freezer is used for storage.

CAUTION: THE UNIT IS NOT A "QUICK-FREEZE" DEVICE. FREEZING LARGE QUANTITIES OF LIQUID, OR HIGH-WATER CONTENT ITEMS, WILL TEMPORARILY INCREASE THE TEMPERATURE AND WILL CAUSE THE LOW STAGE COMPRESSOR TO OPERATE FOR A PROLONGED TIME PERIOD. PRODUCT SAFETY MAY BE JEOPARDIZED.

Avoid opening the door for extended time periods since chamber air will escape rapidly. Room air, which is higher in humidity, replacing chamber may cause frost to develop more rapidly in the chamber.

CAUTION: ALLOWING THE DOOR TO REMAIN OPEN FOR EXTENDED TIME PERIODS WILL CAUSE THE CHAMBER TO "WARM-UP", PUTTING UNDUE STRESS ON THE COMPRESSORS. "OIL-LOGGING" OF THE COMPRESSORS MAY RESULT.

4.10 INITIAL START-UP PROCEDURE

- 1) Place the alarm selector switch in the "Standby" position to prevent the audible alarm from sounding during the initial start-up procedure.
- 2) Turn the Fenwal temperature controller from the OFF position to -20 degrees C, and allow the freezer to operate at this temperature for 12 hours.
- 3) After the 12-hour start-up period, reset the temperature controller to the desired operating temperature (minimum of -85 degrees C). The freezer is now ready for normal operation.

4.11 INITIAL LOADING

Before loading, follow instructions for initial start-up and pull-down as outlined in Section 4.10.

When loading the unit with "pre-frozen" materials, the temperature controller should be set no lower than the temperature of the "pre-frozen" material. Allow the unit to cycle at the setpoint for eight hours. The set-point may then be lowered in increments of 10 degrees C, with a stabilizing time of eight hours on each 10 degree setting, until the desired set-point or the low-end temperature set-point is reached.

CAUTION: FAILURE TO FOLLOW THE ABOVE PROCEDURE, OR OVERLOADING THE UNIT WILL CAUSE UNDUE STRESS ON THE COMPRESSORS. "OIL-LOGGING" OF THE COMPRESSORS WILL RESULT. THE UNIT WILL "WARM-UP" AND PRODUCT MAY BE LOST.

Any questions concerning this procedure should be directed to Forma Service at 1-800-848-3080 in the USA, or outside the USA, to your local Sales Representative.

SECTION 5 - ROUTINE MAINTENANCE

Table of Contents

- 5.1 Refrigeration System Maintenance
- 5.2 Defrosting
- 5.3 Clearing the Bottom Vent

5.1 REFRIGERATION SYSTEM MAINTENANCE

CAUTION: DISCONNECT THE FREEZER FROM THE POWER SOURCE BEFORE CLEANING THE REFRIGERATION SYSTEM.

The air-cooled condenser (the finned surface located in the lower rear center area of the refrigeration compartment) should be cleaned periodically with a vacuum or air-hose so that air will move freely through the fins. The efficiency of the refrigeration unit is a direct function of the efficiency of the air-cooled condenser; dust in the condenser fins slows the rate of heat dissipation, increases the operating temperature of the compressors (thereby decreasing their effective lives), and may reduce the overall performance of the refrigeration system in terms of recovery time and setpoint control accuracy.

Also periodically clean any accumulated dirt from the compressors and other refrigeration system parts. Dirt on the compressor housings will cause the compressors to operate at elevated temperatures.

Compressors and fan motors are permanently lubricated and do not require regular servicing.

5.2 DEFROSTING

The type of frost formed in the chamber is generally very soft and may be easily removed with a bristle brush. Do not use a wire brush as it will scratch the finish.

A complete defrosting may occasionally be required. To completely defrost the chamber, remove the product, disconnect the freezer from the power supply, open both the inner and outer doors, and wait until the frost melts. If a substantial amount of frost is present, towels should be placed on the floor of the chamber. Dry the chamber with a clean cloth after defrosting is completed.

5.3 CLEARING THE BOTTOM VENT

NOTE: If the door is difficult to re-open shortly after it has been shut, the bottom vent should be cleared of ice or frost.

A vent has been installed on the floor of the freezer under the probe cover. If the vent becomes clogged with ice and frost build-up, the vent must be cleared. Remove the probe cover, and clear the vent from the inside of the freezer, using a pencil or similar device to free the ice. Replace the probe cover.

SECTION 6 - SERVICE

Table of Contents

- 6.1 Servicing the Refrigeration System
- 6.2 Troubleshooting Guide

FOR SERVICE ON THIS EQUIPMENT

Call Forma Scientific Service Department
Toll Free 1-800-848-3080
Or Call 1-614-373-4763

6.1 SERVICING THE REFRIGERATION SYSTEM

In case of a unit malfunction, check all electrical components, including starting relays, thermal protectors, and starting capacitors on the compressor before examining the refrigeration system.

Electrical schematics and schematics with parts for the refrigeration system are included at the rear of this manual.

REPAIR WORK SHOULD BE PERFORMED ONLY BY PERSONNEL WHO HAVE HAD PRIOR EXPERIENCE WITH REFRIGERATION SYSTEMS.

6.2 TROUBLESHOOTING GUIDE

The following pages are intended to be a guide in troubleshooting the system if a problem occurs. Actual servicing of the freezer must be performed by qualified service personnel only.

PROBLEM 1: Freezer appears to be completely inoperative except that the audible alarm is activated; all pilot lights are off; chamber not being refrigerated.

POSSIBLE CAUSES:

- a) Power line cord is disconnected.
- b) Power source circuit breaker is open or the building fuse is open.

PROBLEM 2: Chamber temperature deviates substantially from setpoint; compressor and cooling fan are operational.

POSSIBLE CAUSES:

- a) Dirty condenser or air flow to the condenser is otherwise obstructed.
- b) Too much warm product has been placed in the chamber at one time.
- c) Chamber door has been open for an extended period of time or the door is not sealing properly against the
- d) Either the Fenwal controller/indicator or the Weksler recorder need calibration.
- e) Inadequate air circulation through the side ventilation panels.

PROBLEM 3: Freezer is noisy when operating.

POSSIBLE CAUSES:

- a) Fan bearing is worn and requires replacement.
- b) One or both of the cooling fan blades is either loose or bent.
- c) Either loose tubing supports or bolts in the refrigeration compartment.
- d) Tubing is in contact with compressor or frame.
- e) Defective compressor.

PROBLEM 4: Fenwal controller/indicator reads -100 degrees C, but chamber is not being refrigerated; compressor and fan are not operating.

POSSIBLE CAUSES:

- a) Temperature controller/indicator capillary is punctured or is otherwise defective.

PROBLEM 5: Audible alarm is silent and LCD is blank regardless of chamber temperature or position of alarm selector keyswitch; power is disconnected.

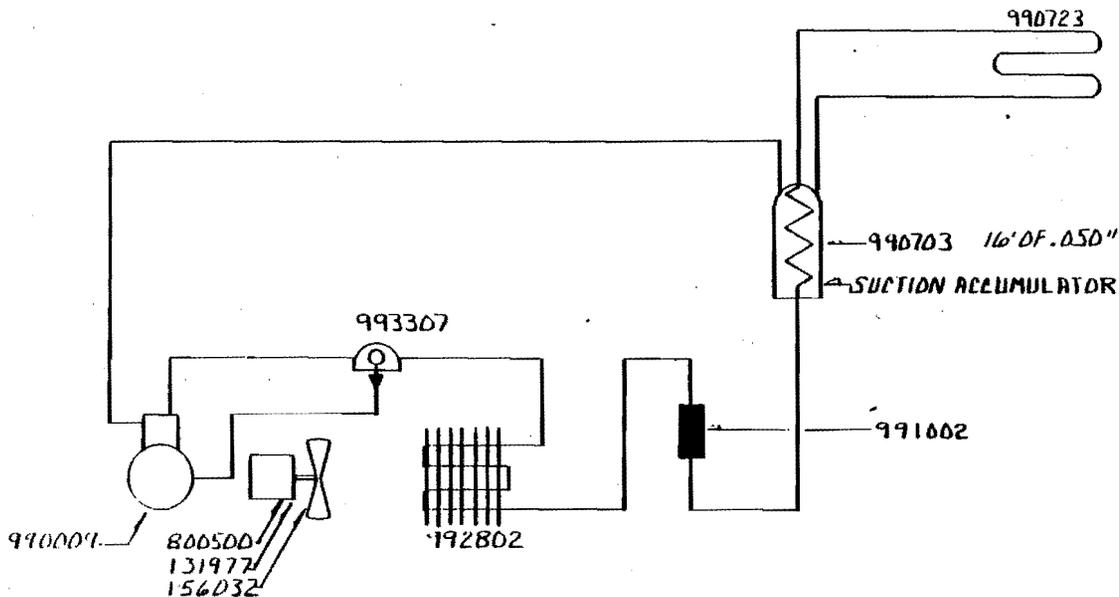
POSSIBLE CAUSE: a) Performance Monitor System batteries are in need of recharging or replacement.

PROBLEM 6: Audible alarm is silent and LCD is blank regardless of chamber temperature or position of alarm selector keyswitch; power is connected.

POSSIBLE CAUSES: a) Performance Monitor System batteries are in need of recharging or replacement.
b) Performance Monitor System power wires are broken or loose in the plug.

Model 8336 - Parts

QUANTITY	STOCK #	DESCRIPTION
1	231059	Temp Controller -100 to +65 Deg. C
1	245121	Recorder, 6" Chart, 7 Day, Inkless
1	285812	Plug 15A 120V Hospital Grade
1	290041	Probe 1000 OHM Platinum
1	400045	CH/P Digital Performance Monitor
1	800500	9W CW, 115V, Fan Motor
1	990009	Compressor Motor 1/2HP
1	991002	Dryer 1/4 SAE
1	993307	Oil Separator
1	7008336	Technical Manual



STANDARD REFRIGERATION

Set CPR Valve At ___ lbs.
 Set By-Pass Valve At ___ lbs.
 Set E.P.R. Valve At ___ lbs.
 Set Water Reg. Valve At ___ lbs.
 Set Low Pressure Control On ___ lbs. in. Off ___ lbs. in.
 Set High Pressure Control Out ___ lbs. In ___ lbs.
 Distributor Tubes ___ in. by ___ O.D.
 Refrigerant $\Delta 12$ Approx. ___ lbs. 20 ozs.

CASCADE REFRIGERATION

HIGH STAGE -

Set Low Pressure Control On ___ lbs. in. Off ___ in.
 Set High Pressure Control Out ___ lbs. In ___ lbs.
 Set By-Pass Valve At ___ lbs. in.
 Set High Temperature Control Out °F ___ In °F ___
 Set Water Reg. Valve At ___ lbs.
 Refrigerant ___ Approx. ___ lbs. ___ ozs.

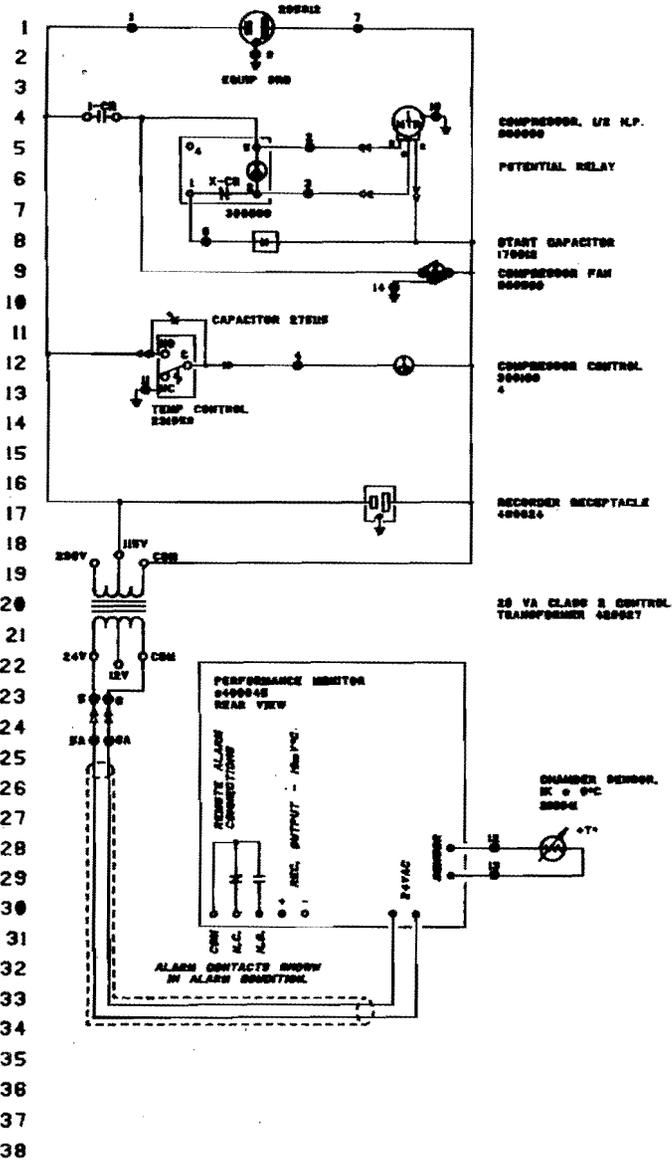
LOW STAGE -

Set Low Pressure Control On ___ lbs. Off ___ in.
 Set High Pressure Control Out ___ lbs. In ___ lbs.
 *Refrigerant 13 - 503 ___ lbs. PSIG
 *Refrigerant 290 ___ lbs. ___ ozs.
 *Normal Pentane ___ ozs.

*When Entire System is Warm

CUSTOMER APPROVAL/REFERENCE		REV.	ECR NO.	DATE	BY	APPD.	DESCRIPTION OF REVISION
APPROVED BY _____							
APPROVING FIRM _____							
DATE OF APPROVAL _____							
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM FORMA SCIENTIFIC							
 Forma Scientific DIVISION OF MALLINCKRODT, INC. <small>BOX 643 MAINEIA, OHIO 45750 TEL 614 24 5304 TEL FAX USA 800 848 3690, OHIO 614 373 4783</small>		DATE 8-12-83	DWN. R.T.T.	APPD.	SCALE NONI		
		CUSTOMER					
		JOB TITLE 8336 48342 -40°C FREEZER					
		DWG TITLE REFRIGERATION SCHLIMATIL					
JOB NUMBER			DRAWING NUMBER				
			8342-900 B				

POWER CONNECTION
200-100V, 1- ϕ , 50/60HZ, 10, 15/1A



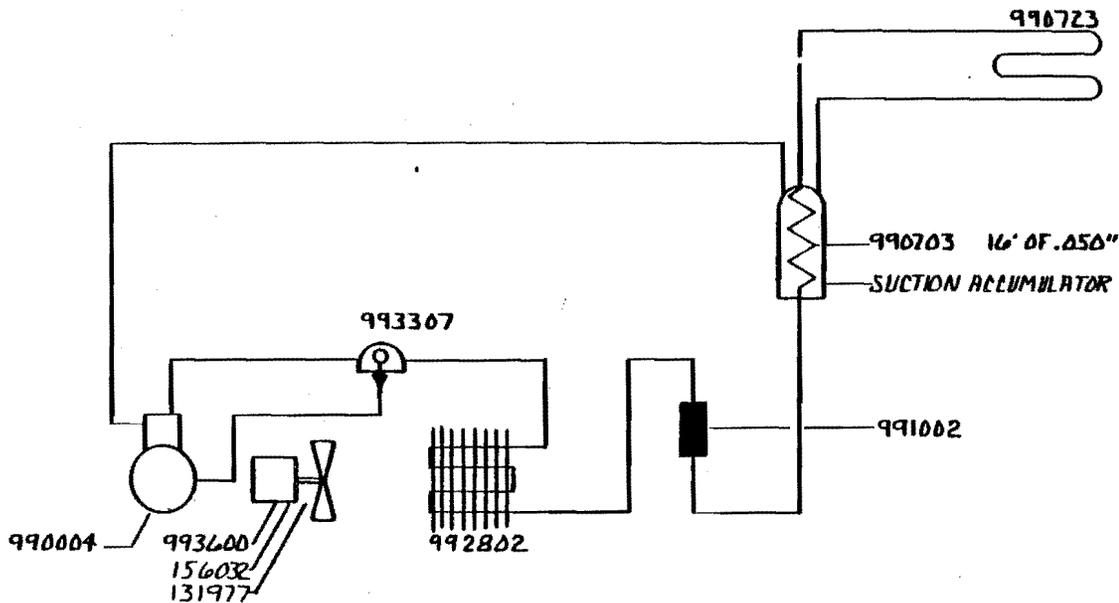
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55
- 56
- 57
- 58
- 59
- 60
- 61
- 62
- 63
- 64
- 65
- 66
- 67
- 68
- 69
- 70
- 71
- 72
- 73
- 74
- 75
- 76

WIRE NO.	REFERENCE GAUGE	CHART COLOR
1	16	BLK
2	16	RED
3	16	RED
4	16	SLP
5	16	YEL
6	16	BLK
7	16	SLP
8	16	CLJ
9	16	WHT
10	16	YEL
11	16	GRN
12	16	GRN
13	16	RED
14	16	GRN

- 77
- 78
- 79
- 80
- 81
- 82
- 83
- 84
- 85
- 86
- 87
- 88
- 89
- 90
- 91
- 92
- 93
- 94
- 95
- 96
- 97
- 98
- 99
- 100
- 101
- 102
- 103
- 104
- 105
- 106
- 107

MODELS COVERED (8336, 8342)

<p>NOTES:</p> <p>① - Energy Stored In Capacitors Refer to Safety Precautions</p> <p>1-CH Low Voltage Relay ② - Ground</p> <p>W/A Low Voltage Relay ③ - Fuse</p> <p>10 Low Volt Relay ④ - Switch</p>	<p>FORM 8-61 (REV. 1-65)</p> <p>Forma Scientific</p> <p>8242-70-0-0</p>	<p>DATE: _____</p> <p>BY: _____</p> <p>FOR: _____</p> <p>REVISIONS:</p> <table border="1"> <tr><th>NO.</th><th>DESCRIPTION</th><th>DATE</th></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>	NO.	DESCRIPTION	DATE									
NO.	DESCRIPTION	DATE												



STANDARD REFRIGERATION

Set CPR Valve At ___ lbs.
 Set By-Pass Valve At ___ lbs.
 Set E.P.R. Valve At ___ lbs.
 Set Water Reg. Valve At ___ lbs.
 Set Low Pressure Control On ___ lbs. in. Off ___ lbs. in.
 Set High Pressure Control Out ___ lbs. In ___ lbs.
 Distributor Tubes ___ in. by ___ O.D.
 Refrigerant Σ 2 Approx. ___ lbs. 2.0 ozs.

CASCADE REFRIGERATION HIGH STAGE -

Set Low Pressure Control On ___ lbs. in. Off ___ in.
 Set High Pressure Control Out ___ lbs. In ___ lbs.
 Set By-Pass Valve At ___ lbs. in.
 Set High Temperature Control Out °F ___ In °F ___
 Set Water Reg. Valve At ___ lbs.
 Refrigerant ___ Approx. ___ lbs. ___ ozs.

LOW STAGE -

Set Low Pressure Control On ___ lbs. Off ___ in.
 Set High Pressure Control Out ___ lbs. In ___ lbs.
 *Refrigerant 13 - 503 ___ lbs. PSIG
 *Refrigerant 290 ___ lbs. ___ ozs.
 *Normal Pentane ___ ozs.

*When Entire System is Warm

CUSTOMER APPROVAL/REFERENCE					
APPROVED BY _____					
APPROVING FIRM _____					
DATE OF APPROVAL _____					
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM FORMA SCIENTIFIC					
REV.	ECR NO.	DATE	BY	APPD.	DESCRIPTION OF REVISION
DATE 6-12-83		DWN. R.T.T.		APPD.	SCALE NONE
CUSTOMER					
JOB TITLE 8340 & 8345 -40°C FREEZER (220V)					
DWG TITLE REFRIGERATION SCHEMATIC					
JOB NUMBER			DRAWING NUMBER		
			8345-90-0-B		



Forma Scientific
 DIVISION OF MALLINCKRODT, INC.
 BOX 848 MARIETTA, OHIO 45750 TELE 74-5304
 TOLL FREE USA 800-648-3390 (IN OH) 614-373-4763

INSTALLATION, OPERATION AND SERVICE INSTRUCTIONS



6" TEMPERATURE, PRESSURE AND TIME-OF-OPERATION RECORDERS

RECEIVING INSPECTION

As soon as the recorder is received, visually inspect the shipping container for signs of damage or rough handling. If the container has been damaged, or if there is evidence of rough handling, inspect the recorder immediately to make certain that it is intact and has not been damaged in shipment.

TRANSIT LOSS

All Weksler instruments are insured against transit loss by breakage. To make this insurance effective all claims must be filed with the carrier at destination within one week of receipt of merchandise. No claims, regardless of the nature of same, will be accepted beyond this period.

PACKING

Each recorder is shipped together with accessory items listed below, as standard. When unpacking the recorder make certain that all of the items are accounted for, before disposing of the shipping container:

1. Charts: One box.
2. Ink: One bottle and applicator, for each pen.
3. One stainless steel pen cleaning wire (0.005 inch diameter).
4. One chart drive winding key (hand wound chart drive recorders only).

WEKSLER INSTRUMENTS CORPORATION

80 Mill Road, Freeport, NY 11520

GENERAL

Weksler Recorders are provided with universal mounting brackets, suitable for either surface (wall) or flush (panel) mounting. See page 4 for case mounting dimensions.

RECORDER CASE LOCATION

Select a location that is well lighted, free from dust, dirt and corrosive fumes. The instrument should not be located near any sources of heat or be subjected to sudden or extreme temperature changes. It should be mounted on a rigid support that is not subject to vibration. The case must be vertical and level.

TEMPERATURE RECORDER INSTALLATION

After the instrument has been mounted uncoil and stretch out the connecting tubing, placing the bulb at the location where the temperature is to be measured. Do not kink, twist or strain the connecting tubing. Remove the union bushing, separable socket, or other means of attachment from the bulb. Fasten the means of attachment to the process and insert the bulb and secure it in place. Starting at the bulb end, fasten the connecting tubing to a wall or other means of support where it will not be exposed to accidental damage. Avoid hot or cold pipes or any source of heat. Sufficient slack should be provided at the bulb so that it can be removed from the process. Do not bend connecting tubing on a radius of less than 3 inches. **IMPORTANT** — The connecting tubing cannot be extended or shortened. Any excess should be coiled and secured in place at the instrument end.

The bulb should be located in the process at the point that will provide the temperature indication that is most representative of the process. Adequate circulation of the measured medium around the bulb is necessary for fast response and accurate indication. Pockets or dead zones must be avoided. The bulb should not be placed in the path of the heating or cooling medium where it will be influenced by radiation losses to a cooler surface or radiation from a source of heat. It may be necessary to try several locations before final installation can be made.

When the bulb is to be installed at an elevation greater than 25 feet above the case the factory should be advised for calibration correction.

NOTE

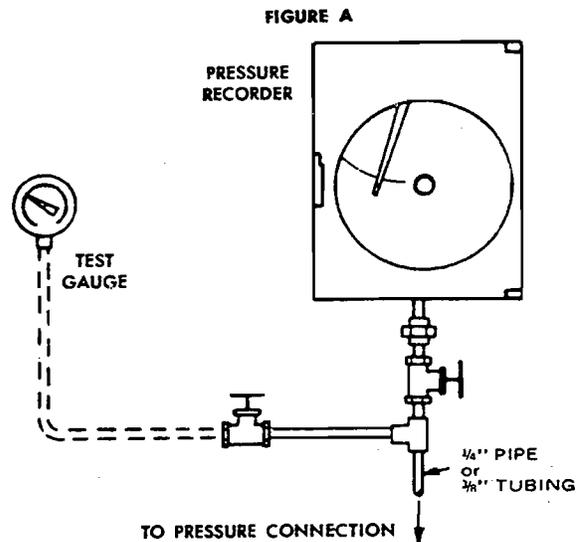
This does not apply to gas filled recorders as there is no volumetric change in differential elevation.

PRESSURE/VACUUM RECORDER INSTALLATION

After mounting the instrument and before it is connected to the process, check the zero position of the pen. If necessary, using the micrometer adjustment screw on the pen arm, adjust the pen to be on the zero line of the chart.

The pipe or tubing used to connect the instrument to the process should be thoroughly clean. These should be no scale, rust or other foreign matter to come loose and plug the line. A sediment trap should be installed in the line at the process.

Connect the instrument to the process at the point at which the pressure is to be measured. Use $\frac{1}{4}$ " pipe or $\frac{3}{8}$ " tubing with flared fittings. Slope all horizontal lines toward the process at least $\frac{1}{8}$ " per foot, to permit drainage. Install a shut off valve in the pressure line to facilitate removal of the instrument without shutting down the process. It is recommended that a connection be provided at the instrument so its accuracy can be checked periodically.



If the process equipment is subject to vibration while in operation a length of flexible tubing should be installed in the connecting line, to prevent vibration being transmitted to the instrument.

Where the measured pressure fluctuates rapidly or is of a pulsating nature a suitable pulsation damper or pressure snubber should be used.

If the measured medium is steam a pigtail siphon filled with water should be installed in the line near the process.

Where it is desired to record pressure of media which will corrode or clog the Bourdon tube element a diaphragm attachment is recommended. A factory installed diaphragm will prevent the media from entering the recorder, without impairing the accuracy or sensitivity of the instrument.

RENEWAL OF CHART

To change the chart, lift the pen manually to provide adequate clearance for its removal. Remove the knob at the center of the chart. Install a new chart on the arbor and replace the chart knob. Rotate the chart until the correct time line on the chart coincides with the pen. Then tighten the chart knob firmly against the chart. Lower the pen(s) onto the chart. A small dot of ink appearing where the pen(s) touch the chart will indicate that the ink is flowing properly. If the ink fails to flow try touching the end of the nib with a moistened finger. If it still fails to write, clean the pen as outlined in paragraph "Cleaning the Pen".

CHART DRIVE

Weksler Recording Instruments are furnished with either electric or hand wound chart drives. If the instrument is equipped with a hand wound chart drive a winding key is furnished. Before applying the chart, wind the drive by inserting the winding key through the hole provided in the chart plate. The balance wheel is visible through another hole in the chart plate. Observe if, after winding, the drive is going. There are provisions for starting and stopping the chart drive with your fingers through a cut out portion of the chart plate. It is usually necessary to wind the chart drive each time when changing the chart.

When the instrument is equipped with an electric chart drive a terminal block is provided to which the electric service of the correct specifications must be connected. (See serial plate) The electric chart drive is self-starting and will run continuously. An external on-off switch can be installed in service line if the instrument is not to be used continuously. Both the hand wound and electric drives are readily replaced in the field. To order replacement drive specify "Chart Drive" number that is stamped on serial plate. Also specify the "Type" and "Serial" numbers of the instrument for which the replacement is intended.

INKING THE PEN

Procedure for THE INITIAL FILLING of the recording pen: —

1. Remove the pen from the pen arm in the following manner: — Hold the pen arm firmly with one hand at a point just above the pen holder. Grasp the pen holder (tapered sleeve) which carries the ink cup, with other hand and pull.
2. Remove the red cap from the plastic ink bottle.
3. Insert the nib of pen into the small hole at the tip of the bottle cap.
4. Gently squeeze the bottle. When cup is half full, remove the nib from the bottle cap.
5. Replace pen by pushing the pen holder firmly onto the pen arm as far as it will go. **DO NOT BEND THE PEN ARM.** Check ink flow by gently pushing the pen, with finger, to the left or right about $\frac{1}{2}$ inch.

Refilling of the pen is accomplished by applying 3 or 4 drops of ink directly into the cup.

CLEANING THE PEN

Remove the pen as described above. A length of 0.005 inch diameter stainless steel wire is supplied with each recorder for the purpose of cleaning the nibs of the capillary type pen. Insert the wire into the opening at the tip of the nib. Move the wire in and out several times. Refill with ink as described above for initial filling. Replace pen onto pen arm.

NOTE

Only a clean pen will assure a good record. In order to obtain continuous clean records at all times, it is recommended that the pen be cleaned periodically by washing it in alcohol, ammonia or hot water. If necessary, soak it for several minutes in boiling water. Dry thoroughly before refilling with ink.

TO ARC THE PEN

The radius of the time lines on the chart is $3\frac{3}{8}$ ". The inner pen is adjusted to track along the time line. The outer pen is adjusted to pass the inner pen within $\frac{1}{16}$ ". If these lengths are not correct the instrument will be out of calibration. To re-establish the correct length of the inner pen arm mark off a distance of $3\frac{3}{4}$ " from the corner along the edge of a piece of fairly stiff paper. Cut the paper into a strip about $\frac{1}{4}$ " wide. Slide the paper up behind and parallel to the pen arm until the end is against the shaft about which the pen arm moves. Loosen the screws that hold the pen arm and lengthen or shorten it until the point coincides with the mark on the paper. Adjust the length of the outer pen arm so that it passes the inner one within $\frac{1}{16}$ ". Adjust the time of operation pen to track on the same line as the inner pen.

OVER/UNDER RANGE

All Weksler Recorders are provided with stops that limit the movement of the pen to slightly more than is required to traverse the chart. They are also provided with an over/under range link that will permit the Bourdon tube to move beyond the limits of the range without damage to the linkage or pen movement. Weksler recorders can safely withstand over-range to 50% of the range span. However, if the recorder has been subjected to over-range in excess of 50% of the range span, its accuracy should be checked, as outlined in paragraph "Temperature Recorder Calibration Check" or, "Pressure/Vacuum Recorder Calibration Check".

TEMPERATURE RECORDER CALIBRATION CHECK

To check the calibration of a temperature recorder a test thermometer of known accuracy and a well agitated constant temperature bath are required.

Remove the bulb from the process. Place it in the agitated temperature bath with the test thermometer as close to it as is possible. The temperature of the bath should be approximately equal to the mid-point of the range. The bath must be at the same elevation relative to the instrument case as the bulb is when it is installed in the process. Allow approximately five (5) minutes before comparing the temperature indication of recorder with that of the test thermometer. If the temperature indicated by the recorder does not agree with that indicated by the test thermometer, adjust the recorder, using the micrometer screw on the pen arm, if the amount of adjustment required does not exceed $\frac{3}{32}$ " on the chart.

If more than $\frac{3}{32}$ " adjustment is required initial adjustment should be made by shifting the take-off lever at the Bourdon tube. Remove the chart plate (as outlined under "Removing the Chart Plate") and loosen the large screw that holds the lever to the stud at the center of the Bourdon tube. Move the lever until the pen indication on the chart agrees with the test thermometer approximately and tighten the screw. Make final adjustment with the micrometer screw on the pen arm. After this adjustment (exceeding $\frac{3}{32}$ " on the chart) it is necessary to check the accuracy of at least two other points on the chart, preferably at 10% and 90% of the range span. If the instrument is not accurate within tolerance of one scale division, at all

FENWAL[®]

SERIES 400

INDICATING TEMPERATURE CONTROLLER

INSTALLATION INSTRUCTIONS

PRINCIPLE OF OPERATION

Control action of these mechanical indicating temperature controllers is provided through the principle of liquid volume change. See Figure 1. With a change in temperature, the liquid in the sensing bulb expands and contracts, causing the bellows to actuate the switching mechanism. Ambient compensation is provided by an expandable push rod assembly mounted on top of the lever arm which moves the pointer and switching mechanism. Changes in ambient temperatures through a range of 0 to 150°F (-18 to +65°C) expand or contract this push rod assembly to provide an operating balance for the expansion and contraction of the bellows assembly within the actuator housing.

PROCESS DIFFERENTIAL

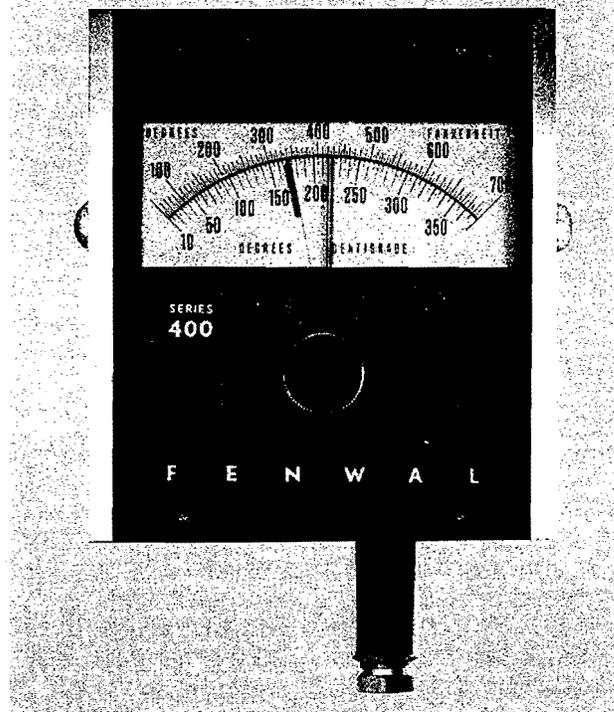
The process differential is minimum when the narrow differential switch is used, when the fastest responding (smallest diameter) bulb is used, when the narrowest scale range is used, and when the sensing bulb is installed in a suitably designed process and in a location which is close enough to the heater or cooling device to sense temperature changes quickly.

In general, it is difficult to predict the operating differential of a given process. The differential can either be increased or decreased within limits by changing one or more of the variables previously mentioned. An easy way to achieve this is to change the snapswitch since the snapswitches are all mechanically interchangeable.

SPECIFICATIONS

HOUSING

The housing (and cover assembly) is made of die cast aluminum with a gray baked enamel finish. It is designed to meet the requirements of NEMA Type 4 and 12 (IEC IP65 and IP62). Neoprene or cork neoprene gaskets seal all ports and covers. Even though the housing is watertight, a separate cover or shield is recommended to protect the controller from exposure in outdoor applications.



SNAPSWITCH ELECTRICAL RATINGS

Standard Differential

15 A, 125-250 VAC

0.50 A, 125 VDC

0.25 A, 250 VDC

Narrow Differential: 15 A, 125-250 VAC

Dielectric Strength: Not less than 1500 VDC or 1500 RMS-AC for one minute between the case and terminals connected in parallel

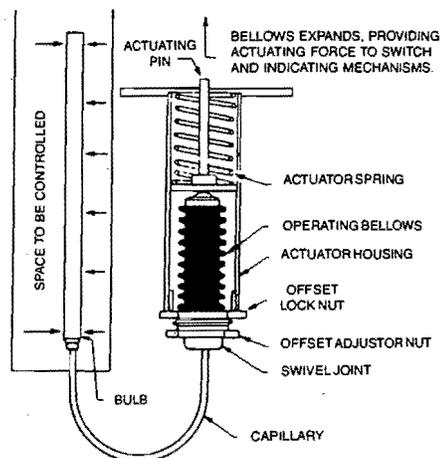


Figure 1

BULB AND CAPILLARY

Material: Type 316 Stainless Steel bulb and capillary are standard. Copper capillary is available upon request.

SERIES 400

SPECIFICATIONS Continued

Temperature Exposure Limits

- -175°F (-115°C) minimum for instruments with a top range limit of up to and including 200°F (100°C)
- -100°F (-75°C) minimum for instruments with a top range limit of 300 through 500°F (150 through 260°C)
- 25°F (5°C) minimum for instruments with a top range limit of 700°F (370°C)
- Maximum temperature is 25°F (15°C) above the top range limit

Pressure Exposure Limit: Bulb will withstand 400 psi (2.75 MPa) over any temperature range

INSTALLATION

CONTROLLER LOCATION

The Series 400 Controller housing (including the controller mechanism and actuator assembly) should be mounted where the ambient temperature is within the limits of -65 and +150°F (-55 and +65°C). The controller is ambient temperature compensated from 0 to 150°F (-18 to +65°C). The controller has high resistance to vibration. However, avoid mounting the unit in areas of extreme vibration if possible. If it is necessary to mount the controller in such a location, use a snapswitch with a maximum acceptable operating differential.

CONTROLLER MOUNTING

The controller can be surface mounted by using the three adjustable mounting brackets attached to the case sides and bottom. Fasten with #10 hardware. Series 400 Controllers (except those with Modification 110, Explosion-proof Housing) can also be panel mounted. The panel cutout should be 6.500 in (165.10 mm) wide by 6.625 in (168.28 mm) high. Four mounting holes are provided in the overhanging portion at the top and bottom of the case. The holes will accept #8 hardware and will be hidden by the cover. A template for the cutout and holes is located on Page 7.

BULB INSTALLATION

Temperature limitations for the bulb and capillary are listed in the SPECIFICATIONS section. For optimum control, the bulb and 6 in (15 cm) of capillary should be immersed in the process.

⚠ WARNING

In controllers with upper range limits of 700°F (370°C), plunging the bulb from a very cold temperature into a hot process could cause the bulb to stretch or even rupture, since the fluid is very viscous at temperatures below 25°F (-4°C).

⚠ CAUTION

Do not expose bulb to pressures greater than 400 psi (2.75 MPa). Beyond this point some creep in the bulb structure occurs which introduces offset into the system.

CAPILLARY INSTALLATION

1. Minimum bending radius is 1/4 inch (6 mm).
2. Do not bend capillary closer than 1/4 inch (6 mm) to the bulb-capillary weld.

3. Do not bend capillary closer than 1 1/4 inch (32 mm) to the actuator assembly. However, the capillary may be rotated 360° at the actuator assembly.
4. Where necessary, allow sufficient length to provide strain relief loops in the capillary.
5. Mount bulb and capillary so as to avoid flexing due to vibration.

WIRING

⚠ WARNING

High voltages may be present in the controller that could cause severe injury or death. Wiring should only be performed by qualified personnel. Turn off power before wiring. Wire in accordance with local codes.

Wiring Entrance

Entrance for wiring is provided by a knockout on each side of the housing. Remove knockout by applying one or two sharp blows with a metal or wooden dowel. Be careful not to damage switches.

To maintain the watertight and dusttight feature of the Series 400 Controller, proper conduit connector fittings should be used.

In controllers with Explosion-proof Housing (Modification 110), a separate housing for the snapswitches and wiring is located on top of the controller. To maintain the explosion-proof feature of the housing (Class I, Groups C and D, or Class II, Groups E, F, and G, Division 1 or 2), wiring must enter the housing through a pipe that is screwed into the 1/2 NPT port on the side of the housing. For additional moisture proofing, use a waterproof compound on the pipe threads. To gain access to the snapswitches in the housing, remove the knob and front panel of the controller to expose the four screws on the front of the housing. Remove these screws and the housing cover.

Wiring Connections

See Figures 2A and 2B for examples of wiring single and dual switch units respectively. Connections should be made with generous loops of wire so as not to impair switch operation or adjustment. Terminals are marked NO (open below set point), C (common), and NC (closed below set point). Avoid excessive force on snapswitch when making connections.

Controllers with additional snapswitches in the lower compartment (S.F. 75) have prewired and marked connections as follows:

Switch Number	Closed Circuit Above Setting Between Wires	Closed Circuit Below Setting Between Wires
1	1 and 3	2 and 3
2	4 and 6	5 and 6
3	7 and 9	8 and 9
4	10 and 12	11 and 12

Note: Switch 1 is nearest front of controller.

SERIES 400

WIRING Continued

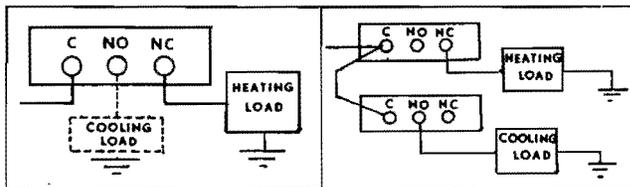


Figure 2A

Figure 2B

ADJUSTMENTS

KNOB TORQUE ADJUSTMENT

Knob torque is adjustable by means of the set screw A in the front shaft bearing. See Figure 3, 4, 5, or 6.

SWITCH ADJUSTMENTS

⚠ WARNING

Disconnect power when adjusting snapswitches to avoid possible electric shock.

Model 40-702 (See Figure 3)

When the set pointer is in exact alignment with the temperature indicating pointer, the switch should be midway between the Operate and Reset positions. The Operate position is the point where the switch clicks on; the Reset position is the point where the switch clicks off. The relationship will usually be upset if the snapswitch is replaced, but it can be easily restored as follows:

1. Remove top cover.
2. Bring set pointer (B) in alignment with indicating pointer (C).
3. Adjust screw (E) midway between the two positions where switch (F) clicks.
4. Check the setting by placing a screwdriver under lever (D) and simulate temperature changes by moving the lever.
5. If necessary, trim the setting by slight adjustment of screw (E).

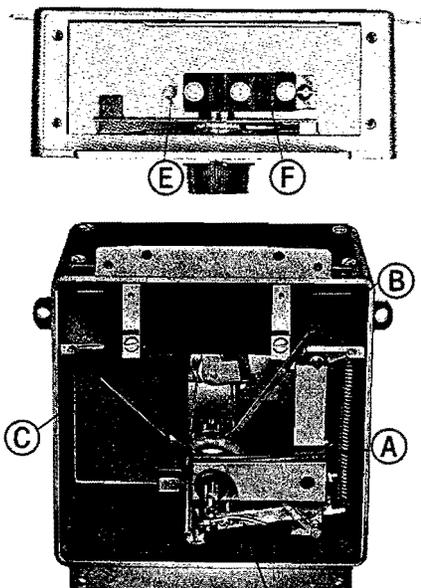


Figure 3

Model 40-703 (See Figure 4)

This controller has two switches, either one of which can be adjusted to operate when the pointers are in alignment. The other switch will either be above or below the indicated setting, depending on whether it is used for overheat alarm, warm-up heat, or some other auxiliary function. The procedures are as follows:

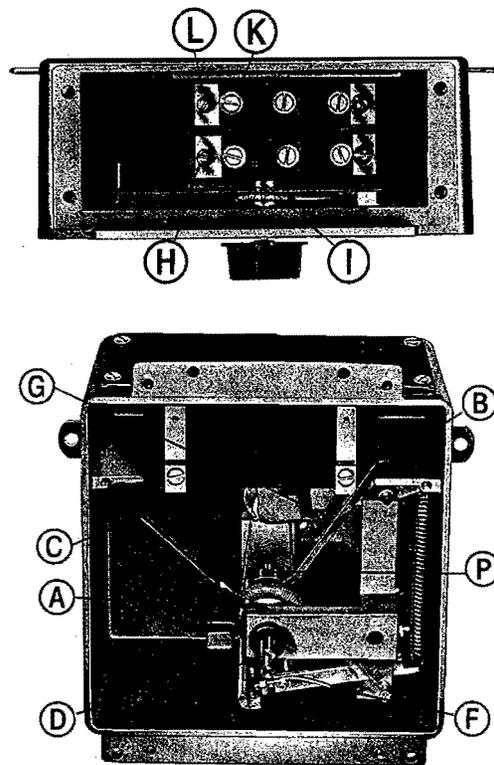


Figure 4

For Differential Up To $\pm 15\%$ of Scale Length

A. When the upper setting is indicated by the set pointer:

1. Remove top cover.
2. Bring set pointer (B) in alignment with indicating pointer (C).
3. Adjust screw (H) on the front switch to a point midway between the two positions where switch (I) clicks. This switch must always be the upper of the two settings. An attempt to do otherwise will cause the rear switch to be inoperative.

B. When the lower setting is indicated by the set pointer:

1. Remove top cover.
2. Adjust set pointer (B) the differential amount lower than the indicating pointer (C).
3. Adjust screw (H) on the front switch to a point midway between the two positions where switch (I) clicks.

SERIES 400

ADJUSTMENTS Continued

4. Bring set pointer (B) in alignment with indicating pointer (C).
5. Adjust screw (L) on the rear switch to a point midway between the two positions where switch (K) clicks.

For Wider Differentials (Up to 1/2 Scale Length)

1. Remove front cover, top cover, and temperature scale.
2. Adjust screws (H) and (L) to achieve 1/8 in (3 mm) between switch bracket and case shelf.
3. Turn set pointer (B) to extreme left.
4. Raise lever (F) with a screwdriver to move indicating pointer (C) to midscale.
5. Turn wide differential screw (G) so that rear switch just actuates.
6. Turn screw (G) counter-clockwise amount shown in Table 1.

Table 1

Differential	Screw Turns
3-15%	1/2
12-23%	1
23-41%	2
41-52%	2 1/2

Example: 125°F differential in an instrument with 50-700°F scale is approximately 20% of scale length, since $(125/650)(100\%) =$ approximately 19%. Therefore turn screw 1 turn.

7. Replace temperature scale.
8. Align set pointer (B) with indicating pointer (C).
9. Determine which switch is to be indicated.
10. Loosen set screw (P) and rotate pulley on shaft until the switch to be indicated just actuates. Tighten set screw.
11. Check settings by simulating temperature changes with the screwdriver under lever (F). Trim by adjustments to screws (H) and (L).

Model 40-704 (See Figure 5)

When set pointer (B) is in exact alignment with temperature indicating pointer (C), the REAR switch should be midway between the Operate and Reset positions. When set pointer (J) is in exact alignment with temperature indicating pointer (C), the FRONT switch should be midway between the Operate and Reset positions. The Operate position is the point where the switch clicks on; the Reset position is the point where the switch clicks off. The relationship will usually be upset if the snapswitch is replaced, but is easily restored as follows:

1. Remove top cover.
2. Bring set pointer (B or J) in alignment with indicating pointer (C).

3. Adjust screws (E) midway between the two positions where each switch clicks.
4. Check the setting by placing a screwdriver under lever (D) and simulate temperature changes by moving the lever.
5. If necessary, trim the setting by slight adjustment of screws (E).

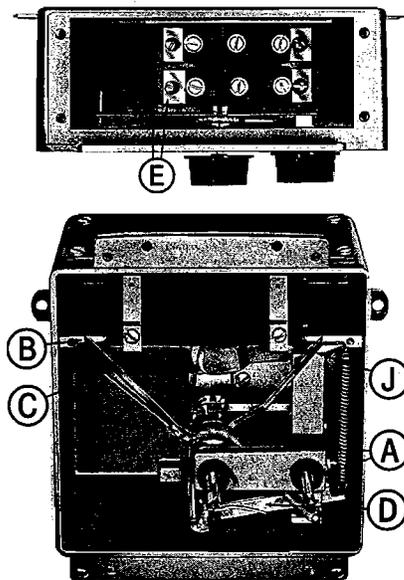


Figure 5

Explosion-proof Housing (See Figure 6)

When the set pointer (B) is in exact alignment with indicating pointer (C), switch (J) should be midway between the Operate and Reset positions. The Operate position is the point where the switch clicks on; the Reset position is the point where the switch clicks off. This relationship will usually be upset if the snapswitch is replaced, but is easily restored as follows:

1. Remove knob, front cover, and dial. Use care in removing dial so as not to deform pointers.
2. Bring the set pointer (B) into alignment with indicating pointer (C).
3. Adjust hex head screw (D) to a position midway between the two positions where the switch clicks.
4. Check the setting by placing a screwdriver under lever (F) and simulating temperature changes by movement of this lever.
5. If necessary, trim the setting by slight readjustment of screw (D).

.213 (5.41) DIA. (#3 DRILL)
(4) HOLES
MOUNT WITH
(4) #8-32 SCREWS

$\pm .015$
2.500
(63.5 \pm .38)

$\pm .015$
1.312
(33.33 \pm .38)

CUTOUT

PANEL MOUNTED TEMPLATE

NOTE: *Remove top cover plate before installing into cutout.*

$\pm .015$
.250
(6.35 \pm .38)

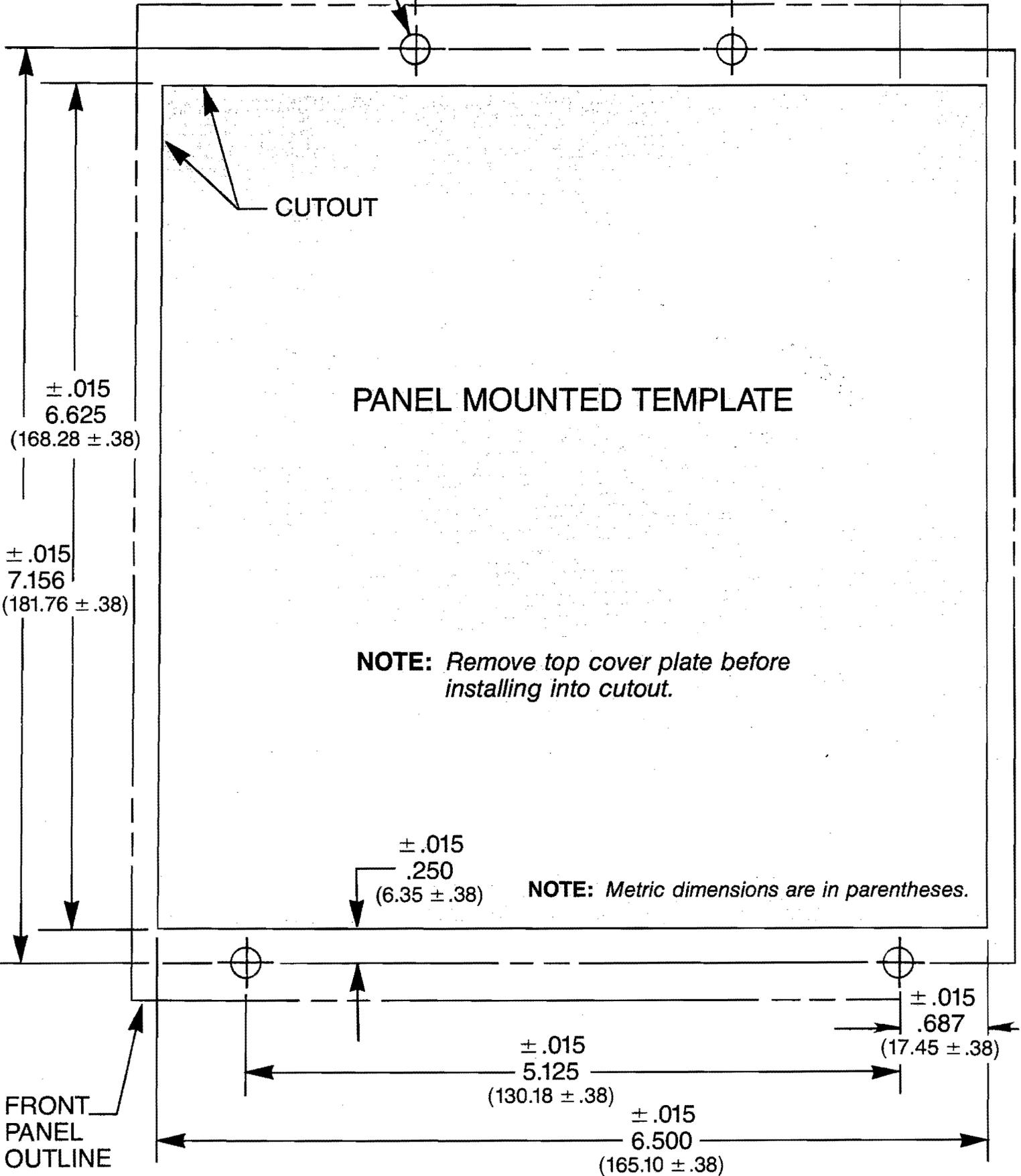
NOTE: *Metric dimensions are in parentheses.*

$\pm .015$
.687
(17.45 \pm .38)

$\pm .015$
5.125
(130.18 \pm .38)

$\pm .015$
6.500
(165.10 \pm .38)

FRONT
PANEL
OUTLINE



SERIES 400

ADJUSTMENTS Continued

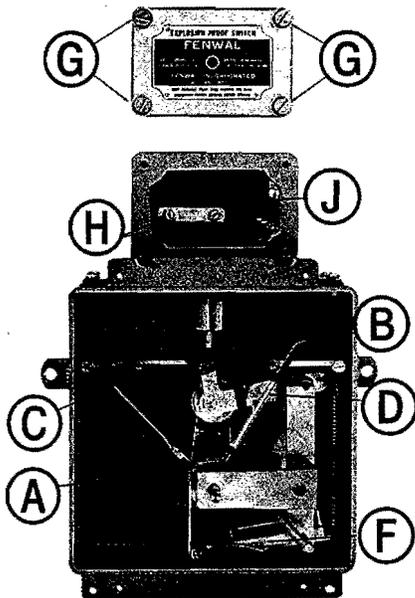


Figure 6

CALIBRATION (See Figure 7)

Every Series 400 Controller is carefully calibrated and tested before shipment, but recalibration may be required to nullify offsets resulting from differences between bench calibration and actual process measurement.

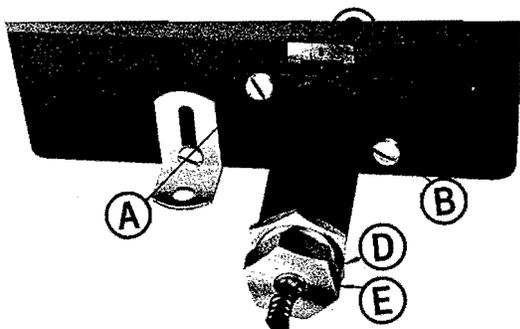


Figure 7

The entire actuator assembly (C) can be moved to the right or left to increase or decrease, respectively, the rate of travel of the indicating pointer. This is done by loosening screws (A) and (B). Adjustment of nut (E), after loosening locknut (D), raises or lowers the entire bellows by a fixed amount.

To calibrate the controller, use one of the following methods:

Method 1 (When the controller is normally used within a narrow range of temperatures)

1. With the process (or calibration bath) at the desired temperature, loosen locknut (D).
2. Adjust nut (E) until the indicating pointer agrees with the process temperature.
3. Tighten locknut (D).

Method 2 (For maximum calibration accuracy over the full temperature range)

1. With the process temperature (or calibration bath) near the center of the scale range, loosen locknut (D).
2. Adjust nut (E) until the indicating pointer agrees with the process temperature.
3. Tighten locknut (D).
4. With the process temperature (or calibration bath) near one end of the scale range, loosen screws (A) and (B) and move the actuator assembly left or right until the indicating pointer agrees with the process temperature.
5. Repeat steps 1 - 3.

MAINTENANCE

LUBRICATION

No lubrication is required.

GLASS REPLACEMENT

1. Remove broken glass and excess cement.
2. Line window frame with Dow Corning 732 RTV Rubber Cement.
3. Insert glass and apply light even pressure.
4. Allow cement to cure before subjecting controller to vibration or shock.

SNAPSWITCH REPLACEMENT

Snapswitches are unlikely to need replacement except when operated in a short circuit or continuously in a contaminated atmosphere. The procedures for replacing snapswitches are as follows:

In Standard Housing (See Figure 8)

1. Remove top cover.
2. Remove switch and mounting bracket by removing screw (A) and sliding switch to the right (away from screw (B)).
3. If the switch will not easily slide away from screw (B), reduce compression on the switch by depressing lever (F) in Figure 4.
4. Insert new switch. Ensure that insulation remains intact and in position.

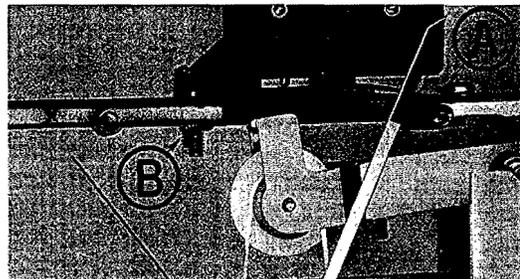


Figure 8

SERIES 400

MAINTENANCE Continued

In Explosion-proof Housing (See Figure 6)

1. Remove knob and front cover to expose screws (G).
2. Remove four screws (G).
3. Remove two screws (H), switch, and mounting bracket.
4. Insert new switch. Ensure that insulation remains intact and in position.

ACTUATOR ASSEMBLY REPLACEMENT

In the event that the liquid filled assembly has been damaged, it is necessary to replace the entire actuator assembly. See Figure 7.

1. Remove old assembly by removing screws (A) and (B).
2. Install new assembly. Tag on replacement assembly shows proper positioning to provide 1% accuracy. Position groove on actuator housing in relation to scale on housing as indicated on tag.

Note: If the original actuator assembly has a bulb larger than 0.375 in (9.53 mm), e.g., a "C" style (coiled) bulb, it is necessary to specify a packing gland (if required) when reordering the actuator assembly.

REPLACEMENT PARTS (See Figure 9)

Code	Description	Part Number
A	Snapswitch (Narrow Differential)	06-125723-004
B	Snapswitch (Standard Differential)	06-125723-005
C	Self Tapping Screw	06-250112-011
D	Locknut	06-133426-000
E	Adjusting Nut	06-250025-030
F	Glass Window	06-231187-001
G	Front Cover Gasket	06-231193-001
H	Front Cover Screws	06-250025-049
I	Top Cover	06-231869-001
J	Top Cover Gasket	06-231835-002
K	Top Cover Screw	06-250042-047
L	Mounting Bracket	06-136919-000
M	Mounting Bracket Screw	06-114829-000
N	Indicator Knob	06-114789-003
O	Temperature Dial	State complete model number and temp. range
P	Actuator Assembly	See Table 2.

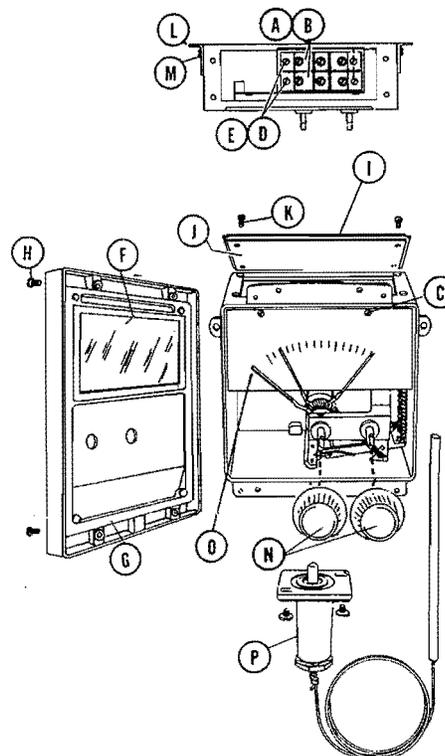


Figure 9

Table 2

°F	Range	°C	Catalog Number
-150 to +200		-100 to +100	40-10001X-001
-30 to +170		-35 to +75	40-10001X-008
-20 to +120		-30 to +50	40-10001X-002
50 to 200		10 to 95	40-10001X-003
50 to 300		10 to 150	40-10001X-024
50 to 400		10 to 200	40-10001X-025
50 to 500		10 to 260	40-10001X-029
50 to 700		10 to 370	40-10001X-016

Where X = the following (See Figure 10):

- 0 = Style A Bulb; 6 ft (2 m) capillary
- 1 = Style B Bulb; 6 ft (2 m) capillary
- 2 = Style C Bulb; 6 ft (2 m) capillary
- 3 = Style D Bulb; 6 ft (2 m) capillary
- 4 = Style A Bulb; 10 ft (3 m) capillary
- 5 = Style B Bulb; 10 ft (3 m) capillary
- 6 = Style C Bulb; 10 ft (3 m) capillary
- 7 = Style D Bulb; 10 ft (3 m) capillary

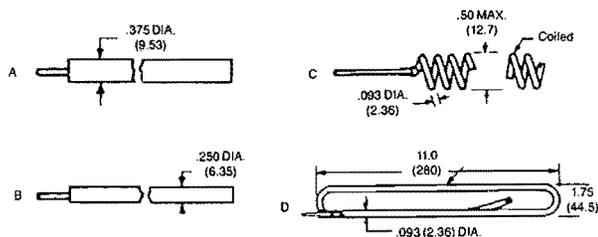
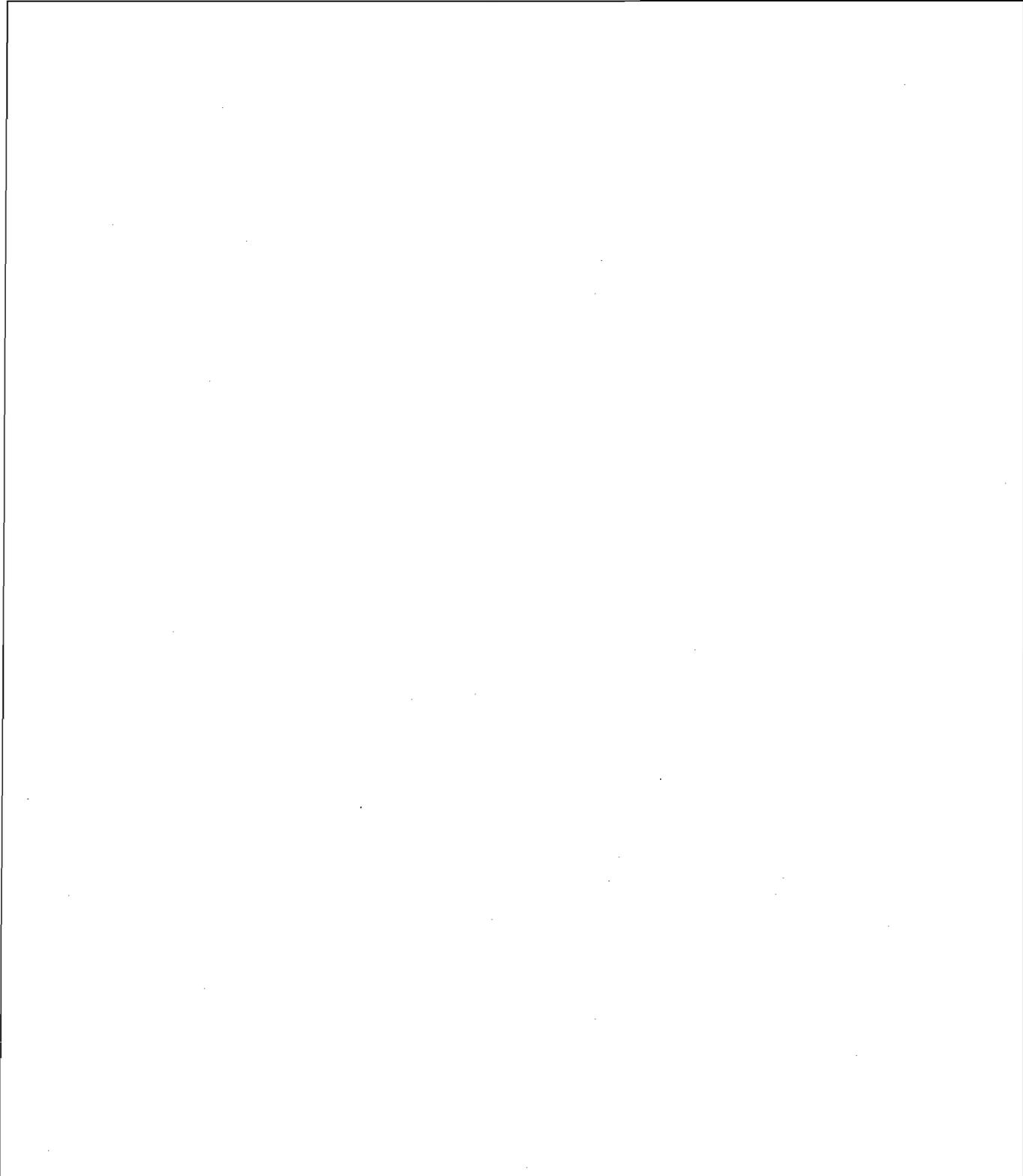


Figure 10

SERIES 400



This literature is provided for informational purposes only. Actual performance is based on proper application of the product by a qualified professional. Nothing herein shall constitute a warranty, expressed or implied, including any warranty of merchantability or fitness for a particular purpose.



KIDDE-FENWAL, INC.
400 MAIN STREET, ASHLAND, MA 01721
TEL: (508) 881-2000 FAX: (508) 881-6729