

# Ziegler and Associates

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## INSTRUCTIONS FOR MODEL 971-C SYRUP CONCENTRATION MONITOR & PROBE



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# DESCRIPTION

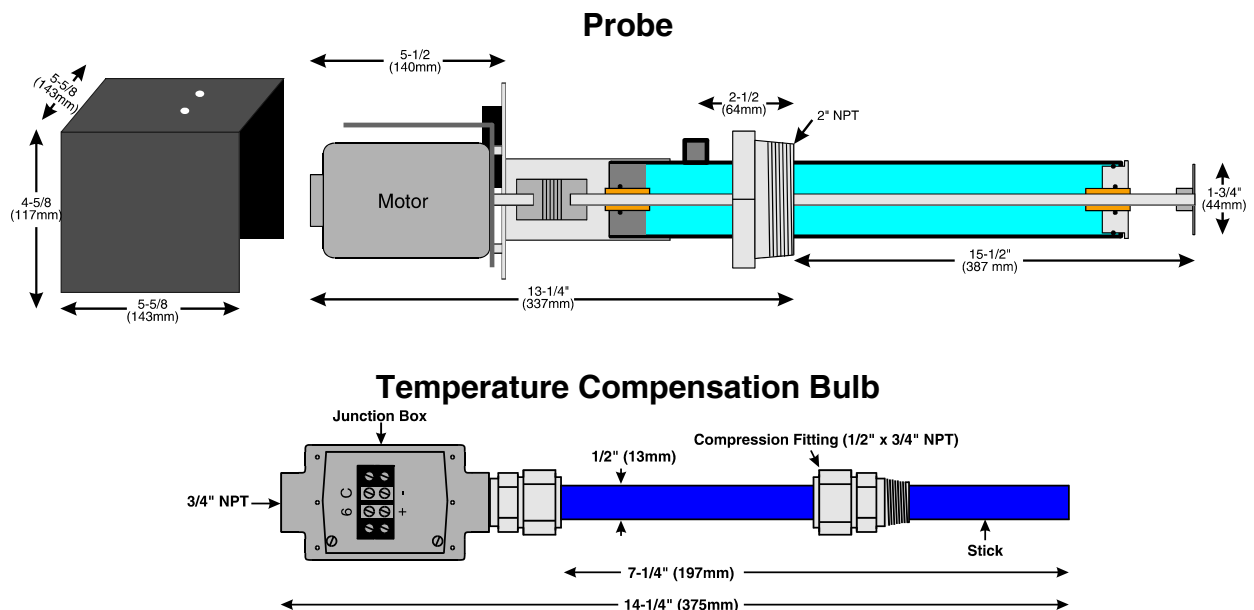
The Model 971-C Monitor is designed to measure the viscosity of syrups and convert to a direct reading of syrup concentration as percent sucrose (In the 50% to 75% Brix range). It can be used for other solutions where the viscosity-temperature-concentration is known.

The unit consists of a probe with a rotating disk, driven by a small DC motor. A power supply is housed in the monitor case with an indicating meter calibrated in percent sucrose. In addition, the 971-C provides a standard 4 to 20 milliampere signal for actuating external recorders or current-to-air transducers. The transformer isolated power supply can be arranged to accept either 115 VAC or 220 VAC, 50/60 Hz power by simply switching jumpers on the circuit board. Maximum load is approximately 70 watts. There are two models: the 971-CA provides automatic compensation for changing syrup temperatures in the range of 40 to 100°C and has an external sensing element that installs in the fluid near the viscosity probe. The 971-CM is used for applications such as melters and evaporators, where the syrup temperatures are quite constant, and the normal operating temperature is manually set with a calibrated dial on the monitor face.

# CONSTRUCTION

Wetted probe parts are 316 Stainless Steel with shaft bearings of a Teflon-ceramic compound for proper coefficient of thermal expansion. Wetted parts of the temperature sensing element are also 316 Stainless Steel. The monitor case is powder coated steel. The electronic circuitry uses only high quality components for long, trouble-free life. The probe dimensions are given in Figure 1.

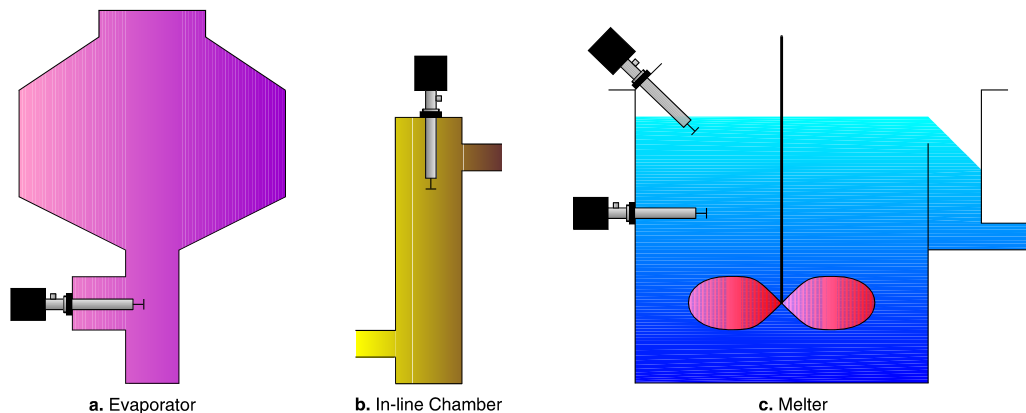
**Figure 1 - Mounting Dimensions for 971-C Monitor**



# INSTALLATION

The probe rotor must be completely immersed in syrup at a point where concentration changes will be quickly sensed. For inline installation, a minimum pipe or chamber size of 4" is required since the rotor disk is 3" diameter. Horizontal mounting is preferred but the probe can be mounted with the drive motor above the rotor at any angle up to vertical. With the motor below the probe, the maximum angle should not exceed 75 degrees from horizontal or there is danger of purge water from the outer shaft bearing leaking into the motor ball bearings. Typical installation arrangements are shown in Figure 2.

**Figure 2 - 971-C Probe Mounting Configurations**



Syrup from an evaporator body, Figure 2a, tends to be stratified as it flows to the outlet pipe, so it is better to have the probe in the line just below the body so that the heavy and light streams will be mixed and averaged by the spinning rotor. Even though outflow is stopped entirely, the heavier syrup streams will settle to the rotor area and show the increasing concentration so that feed and withdrawal can be increased before the syrup rises excessively. Shut-off and bypass valves are recommended in the event that the probe must be withdrawn for examination or maintenance without interrupting evaporator operation.

Typical horizontal and vertical sample chamber installations are shown in Figure 2b. These installations are suitable for lines carrying small or moderate syrup flow.

Syrup tanks and melters are generally open vessels so a variety of probe mounting arrangements is possible. Figure 2c shows some mounting arrangements.

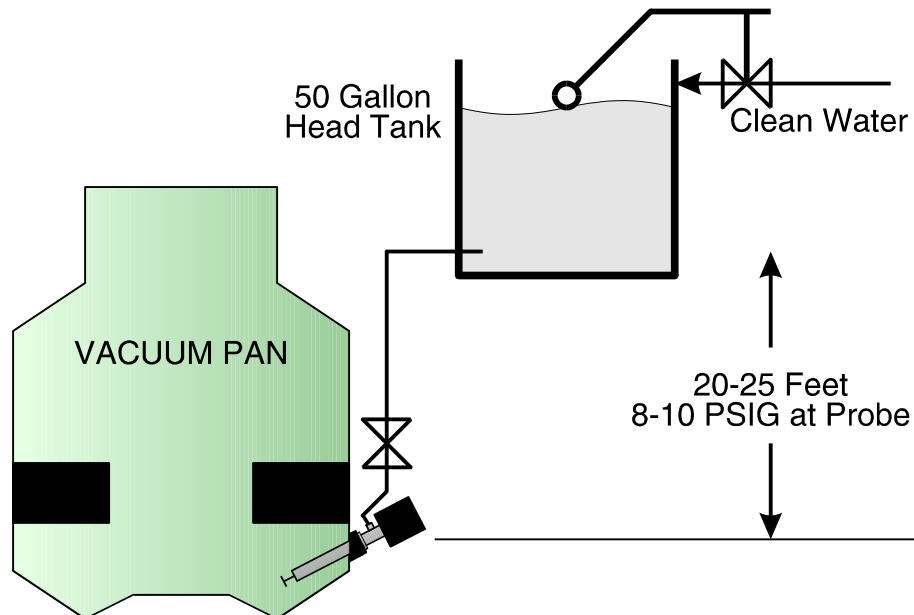
When screwing the probe into a 2" NPT connection, use the hex-head bushing to tighten, not the probe barrel, and position the 1/4" NPT water connection for convenient access. If the elongated access hole in the motor mounting sleeve does not face directly downward, loosen the three #8-32 set screws holding the barrel in the mounting sleeve with the wrench provided, and rotate the motor so that the access and drain hole is at the lowest point so that the leakage water will drain freely as it accumulates. Re-tighten the three screws in the mounting sleeve.

If clearance is restricted so that the motor mounting plate can not be turned freely when installing, loosen the three set screws in the mounting sleeve and the two set screws in the motor end of the flex coupling (through the access hole) and carefully slide the motor assembly off the barrel. The barrel and shaft assembly may then be installed and the motor assembly replaced in the proper position with the access hole facing downward. Before tightening the three barrel retaining screws, push the flex coupling onto the motor shaft to full immersion and tighten the two coupling screws securely being certain that one screw is over the flat on the motor shaft. Secure the motor and barrel assemblies with the three set screws.

## WATER PURGE

Probes must be continuously supplied with relatively clean water at a pressure higher than that of the syrup around them to provide bearing lubrication and to keep syrup from entering the shaft bearings. The water pressure can be maintained with a suitable small reducing valve but the recommended method is to locate a head tank of about 50 gallons capacity at a sufficient height above the probes to supply the required head. If fitted with a small float valve, the tank provides a safety reservoir for several hours in the event of water supply loss. The required flow is so small that several probes can be supplied through 1/4" OD tubing. On evaporators the tank must be high enough to maintain flow, even though vacuum is broken, with syrup still in the body. In open tanks, it need be only a few feet above maximum syrup level. Figure 3 shows a typical head tank installation for supplying water to a probe in a vacuum pan.

**Figure 3 - 971-C Head Tank Location**



If water supply fails, turn off power to all operating probes until it is restored to prevent bearing and shaft damage. Adequately lubricated and purged bearings will not show excessive wear for over one year running time. Worn bearings are easily replaced. A spare set of bearings with mounting O-rings is furnished. See section titled "Bearing Replacement".

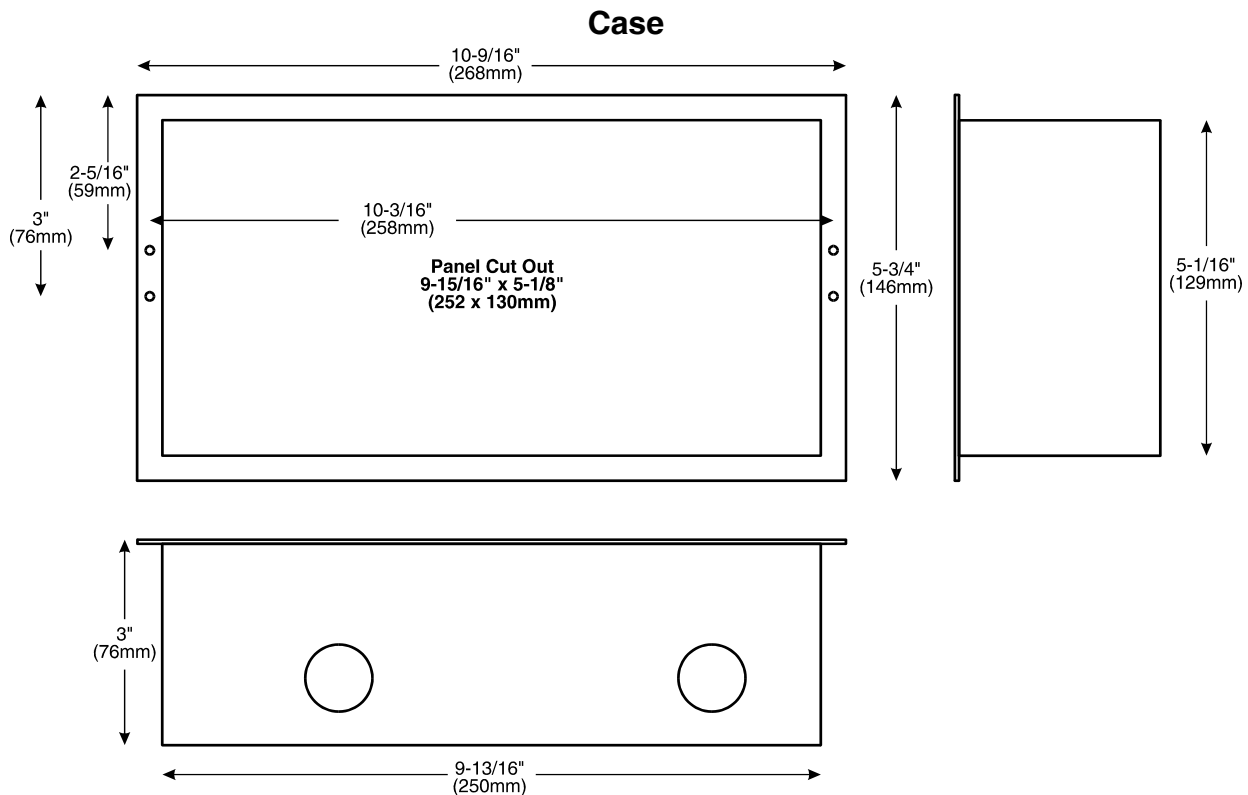
If probes are to be tested on the bench, fill the barrel with clean water before running them to provide lubrication.

Syrup leakage into bearings will not normally cause damage, but will cause high meter readings until the contaminating syrup is slowly washed out by the purge water flow.

## WIRING

Locate the monitor at a convenient point for observation. Panel cutout dimensions are given in Figure 4. Two #6-32 flat head screws are furnished for mounting the monitor case. Suitable stand-offs may be fashioned for face mounting the monitor. Choose a location with minimal vibration to prolong meter life. The monitor should not be located at a place subject to excessive vibration or readability and meter life will suffer. Remove the front panel (2 screws), pull out the circuit board plug and set the cover aside while mounting and wiring.

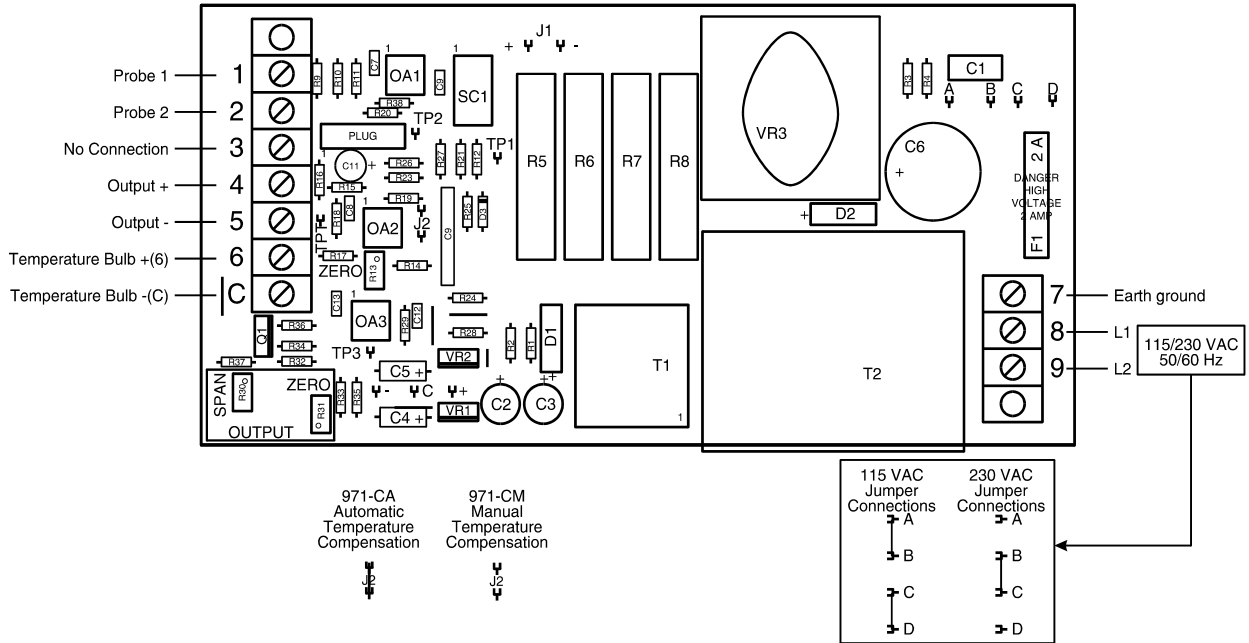
**Figure 4 - Mounting Dimensions for 971-C Monitor**



Connect the monitor and probe with 2 wires, #22 or larger. Beldon #8441 cable is very adequate and, although the shielding is not necessary, it gives added mechanical protection. Follow the wiring of Figure 5. Bring AC power to L1 and L2. Maximum load is 70 watts. Power leads should be brought in through the right hand case access hole and other wires through the left hand inlet. 971-C Monitors are furnished wired for 115 VAC

service. If 220 VAC is to be used, remove jumpers AB and CD on the circuit board and solder a jumper between BC as shown in Figure 5. Transient or minor sustained AC voltage variations will not introduce appreciable errors in the 971-C indication of syrup concentration, but if sustained changes over 10% are anticipated, a constant voltage transformer such as SOLA Type 23-22-112-2 is recommended.

**Figure 5 - 971-C Jumpers and Wiring**



If the instrument was ordered as a 971-CM for manual temperature compensation, jumper J2 on the circuit board should not be installed (see Figure 5). On a 971-CA using a temperature compensating bulb, J2 should be installed and the bulb should be installed in the syrup near the probe rotor through a 3/4" NPT connection. Wires from the bulb connect to terminals C(-) and 6(+) as shown in Figure 5.

After wiring is complete, check all connections, install motor splash cover, insert the meter plug on the circuit board and replace the front panel. With the power off, see that the meter reads on the lowest line on the Brix scale. If the meter does not read zero, zero it with the mechanical zero screw on the meter.

## STARTUP

When installation is complete, turn on purge water supply to the probe and allow 15 minutes or so for the barrel to fill or until a slow drip of water from the sleeve access hole indicates that it is full. Turn on AC power to the monitor.

If the probe rotor is immersed in syrup, turn the power switch on. Set the front panel temperature dial as follows. If the unit has automatic temperature compensation, the dial is always set at 70°C. If the unit has manual compensation, check the syrup temperature and set the dial to the corresponding value. After the probe has run for about 5 minutes

and the indication is steady, note it, withdraw a syrup sample and check the actual concentration. If the readings do not agree, make a temporary adjustment of the temperature dial to raise or lower the indication to the measured value. Even on the 971-CA automatic units, the temperature dial will change the reading if moved to either side of the 70°C normal setting.

After the probe has run a few minutes in the syrup, take another sample and run a lab check on its concentration. If the monitor reading does not agree, set the temperature at the proper position (70°C for automatic compensation) and make a final zero setting as follows: Take off the front panel (2 screws) and, holding the panel, adjust the trimpot marked "ZERO" on the circuit board (see Figure 5) to bring the pointer to the correct reading. Replace the front panel. When new bearings are installed in a probe, it may take a day or two for them to wear into their final fit and the setting of ZERO established. From then on the monitor readings will be stable.

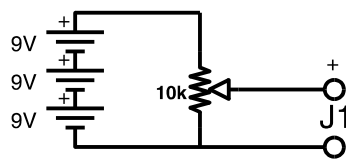
## TRANSMITTER OUTPUT

The 971-C Monitors are set to produce a 4 to 20 mA signal at terminals 4(+) and 5(-). Zero and Span trimpots OUTPUT ZERO and SPAN on the circuit board (Figure 5), allow this output to be adjusted for other ranges such as 0 to 16 mA, 0 to 5 mA etc. By applying a resistor across the output terminals, voltage outputs are produced. For example, if a 0 to 1 Volt signal is needed for a specific recorder or transducer, the output may be adjusted for 0 to 10 mA through a 100 ohm resistor. If, say, a Rustrak #288 recorder is to be powered which has a 1 mA movement with 100 ohm resistance, it would be best to shunt the recorder with approximately 10 ohms and adjust OUTPUT ZERO and SPAN to make its readings agree with the monitor meter.

CAUTION- Turn power off and disconnect the probe before calibrating the output.

The most convenient way to adjust monitor output signals is to make a voltage source as shown in Figure 6 which can be set between 0 and 27 VDC. Snip jumper J1 (Figure 5) and connect the voltage source in its place. With power on the amplifier, the 10k ohm potentiometer can be adjusted to get any meter pointer position and corresponding output current. First set the potentiometer to make a voltage that brings the meter to read 50 Brix and adjust Z for the minimum required output current. Adjust the 10k ohm potentiometer to bring the meter to 75 Brix and set S for the maximum required output current. Repeat if necessary until both ends of the scale are correct. Typical voltages across J1 for meter readings of 50, 62.5 and 75 are 13, 17.5 and 23.5 respectively. Disconnect the voltage source and replace J1 before putting the 971-C back in service.

**Figure 6 - Voltage Source for Output Calibration**



## MAINTENANCE - BEARING REPLACEMENT

The 971-C Monitor is designed for long life but any device with moving parts will eventually require maintenance. Excessive wear of probe bearings will be indicated by an increase in water leakage through the bearings. Initially, water flow will be only a few ml/minute. When leakage approaches 200 ml/minute the bearings should be replaced with the spare set furnished.

Bearing replacement is quite simple but it is best to perform the operation in the instrument shop. Refer to Figure 7 on page 11 for probe component locations.

1. Disconnect the water supply, remove the motor splash cover and disconnect the incoming wires. Remove the probe and wash off adhering syrup, protecting the motor from splashing.
2. Loosen the two spline head set screws in the motor end of the flex coupling and back off the three set screws in the motor mount sleeve. Carefully pull the barrel and shaft assembly out of the motor mounting sleeve.
3. Remove the rotor and pull the shaft out from the flex coupling end. Remove the three set screws at the rotor end of the barrel and pull out the inner bearing retainer bushing.
4. Inspect the shaft and inside of the barrel for possible scale or dirt accumulation and clean them.
5. Press the old bearings out of their retaining O-rings using finger pressure or a 5/8" rod if necessary. Inspect the two internal O-rings and the one external O-ring on the inner bearing retainer and replace if needed with the spares furnished. Grease the O-rings lightly with silicone lubricant.
6. Press new bearings into the retainers until the O-rings snap into the bearing grooves. Be very careful not to get grease on the inside bearing surfaces or it will cause erratic and high readings until it is finally washed out by the water purge.
7. Inspect the shaft for excessive wear or scoring and replace if necessary. Wipe the shaft clean and slide it through the outer bearing. Slip on the inner bearing retainer and press it into the barrel until it seats. Replace the three set screws that hold the inner bearing retainer in place. See that the shaft is seated in the flex coupling and set screws are tight. Replace the rotor.
8. Slide the barrel and shaft assembly into the motor mount sleeve and tighten the three set screws with the water connection at the required angle.
9. Push the flex coupling fully onto the motor shaft seeing that one set screw is over the flat and tighten the two set screws through the access hole.
10. Install the probe. Connect the water and wires. Be sure the barrel fills with water before operating. If the probe is ever to be run on the bench, fill the barrel with

water and keep the probe horizontal so that the bearings are both wetted continuously.

11. New bearings and shafts sometimes give a high reading until they have "run in" for an hour or more. After the readings have stabilized, recheck the calibration as described in STARTUP.

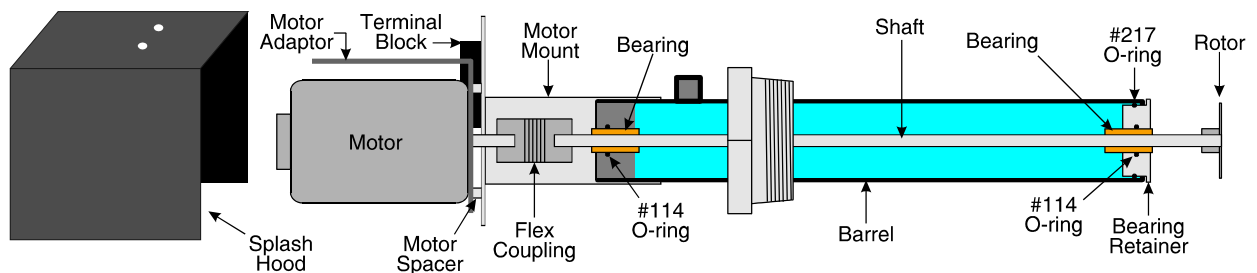
# INFORMATION

For additional information regarding installation, parts, or service please contact *Lieglert and Associates* at the address on the back of the front cover.

## MODEL 971-C SUGAR CONSISTENCY MONITOR PARTS LIST

PART#	ITEM	DESCRIPTION
971C001	Transmitter	Transmitter for 971-CM (manual temp comp.)
971C002	Sensor	Sensor/probe unit
971C003	Circuit Board	Circuit board
971C005	Front Panel Assembly	Front Panel Assembly
971C006	Meter (Analog)	Analog indicating meter with dial
971C007	Motor NSH-12	Sensor/probe motor (Bodine type NSH-12)
971C032	Motor conversion Kit	Kit to convert 971-C with NSH-12 motor to use 24A2BEPM motor
971C101	Transmitter	Transmitter for 971-CA (automatic temp. comp.)
971C104	Temperature Bulb	Temperature Bulb for 971-CA
970C007	Motor 24A2BEPM	Sensor/probe motor (Bodine type 24A2BEPM)
970C008	Shaft	Sensor/probe shaft
970C009	Barrel	Sensor/probe shaft barrel
970C010	Motor Mount	Sensor/probe motor mount
970C011	Motor Spacers	Sensor/probe motor spacers (set of 4)
970C012	Bearing	Sensor/probe bearing
970C013	Terminal Block	Sensor/probe terminal block
970C014	Flex Coupling	Sensor/probe flex coupling with set screws
970C015	Rotor 1-3/4"	Sensor/probe rotor 1-3/4"
970C016	Rotor 3"	Sensor/probe rotor 3"
970C017	Motor Bearing (Bodine - Z99038)	Motor ball bearing (Bodine - Z99038)
970C018	Motor Bearings (Carter - C8008)	Motor ball bearing (Carter - C8008)
970C019	Motor Brush (Carter)	Motor brush with spring for Carter motor
970C020	Motor Brush (Bodine F83)	Motor brush with spring for Bodine motor (1/4" x 1/8")(F 83)
970C021	Motor Brush (Bodine F83X)	Motor brush with spring for Bodine motor (1/4" x 3/16")(F 83X)
970C022	O-Ring #114	O-Ring Bearing Retainer #114 - 5/8 x 13/16"
970C023	O-Ring #217	O-Ring Barrel Seal #217 - 1 3/16 x 1 7/16"
970C024	Set Screw	Set Screw - 8-32 x 3/16" Spline Head SS
970C027	Potentiometer	10k ohm potentiometer for front panel
970C028	Splash Hood	Sensor/probe motor splash hood
970C029	Inner bearing retainer	Sensor/probe inner bearing retainer
970C030	Wrench	Spline head wrench
970C031	Screws	Screws and washers for splash hood (2)
970C033	Motor Spacers	Sensor/probe motor spacers 1/8" for 24A2BEPM Motor (set of 4)
970C034	Motor Adaptor	Motor Adaptor for 24A2BEPM motor

**Figure 7 - 971-C Probe Component Locations**



# Circuit Diagram for 971-C

