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INSTRUCTIONS FOR MODEL 971-C SYRUP CONCENTRATION MONITOR & PROBE WITH 24V MOTOR

FOR PARTS AND INFORMATION CONTACT:

ZIEGLER & ASSOCIATES
11180 Ranchette Dr.
Jackson CA 95642
USA
PHONE 209-223-1090
FAX 209-223-1090
Email: info@zieglerassociates.com
Web: www.zieglerassociates.com

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NOTE: This manual is for use with Model 971-C Syrup Concentration Monitor & Probe with 24V motor (serial #1027 and higher). For lower serial numbers using the 130V motor, please visit www.zieglerassociates.com to download the appropriate manual.

DESCRIPTION

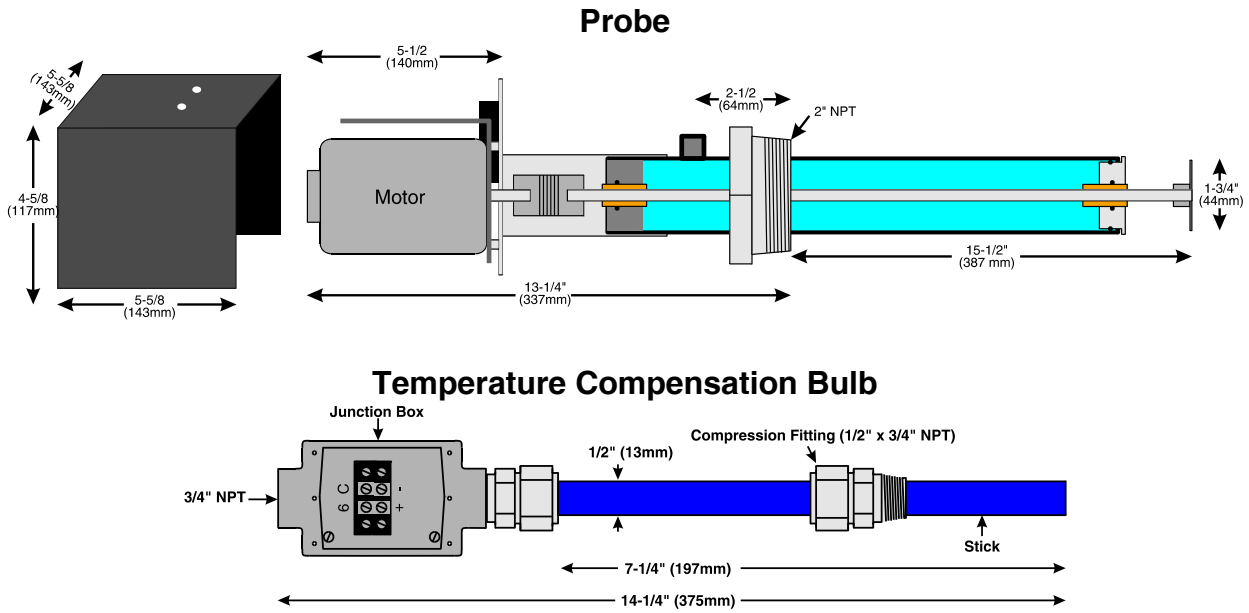
The Model 971-C Monitor is designed to measure the viscosity of syrups and convert to a direct reading of syrup concentration as percent sucrose (in the 45% to 95% Brix range).

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, PLCs, etc. 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 25 watts. There are two models: the 971-CA provides automatic compensation for changing syrup temperatures in the range of 40 to 100^{0}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.

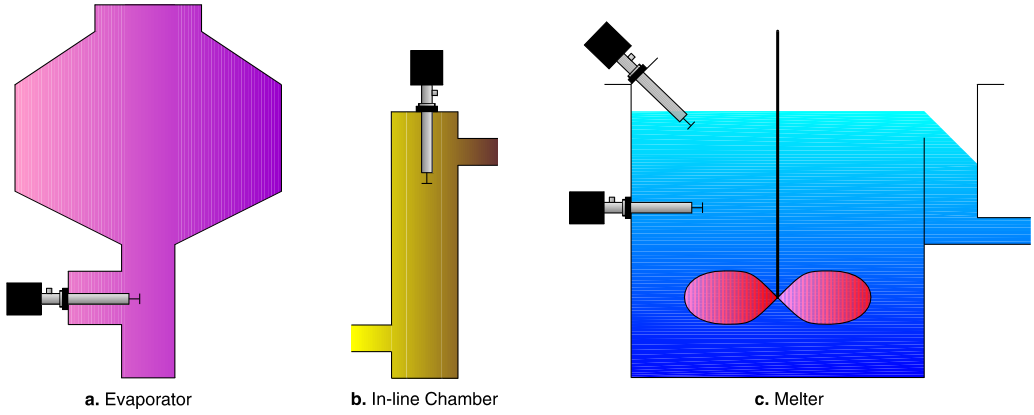
Figure 1: Mounting Dimensions for Sensor



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: Probe Mounting Configurations



a. Evaporator **b.** In-line Chamber **c.** Melter

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.

If the 3” rotor cannot be mounted onto the sensor shaft after the sensor is installed, a 3” or larger fitting on the process line must be available. If necessary, mount a bushing onto the sensor to connect the sensor to the process line. Always use the hex fitting on the sensor to tighten, rather than the sensor barrel. Before connecting the sensor to the process line, install the rotor onto the sensor shaft.

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,

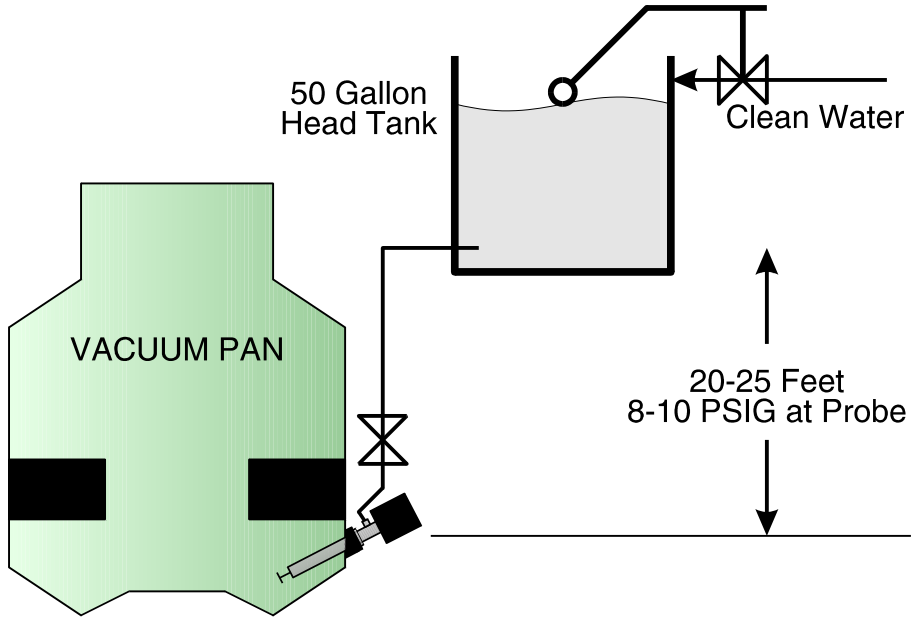
and rotate the motor so that the access and drain hole are at the lowest point, allowing the leakage water to drain freely as it accumulates. Re-tighten the three screws in the mounting sleeve.

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.

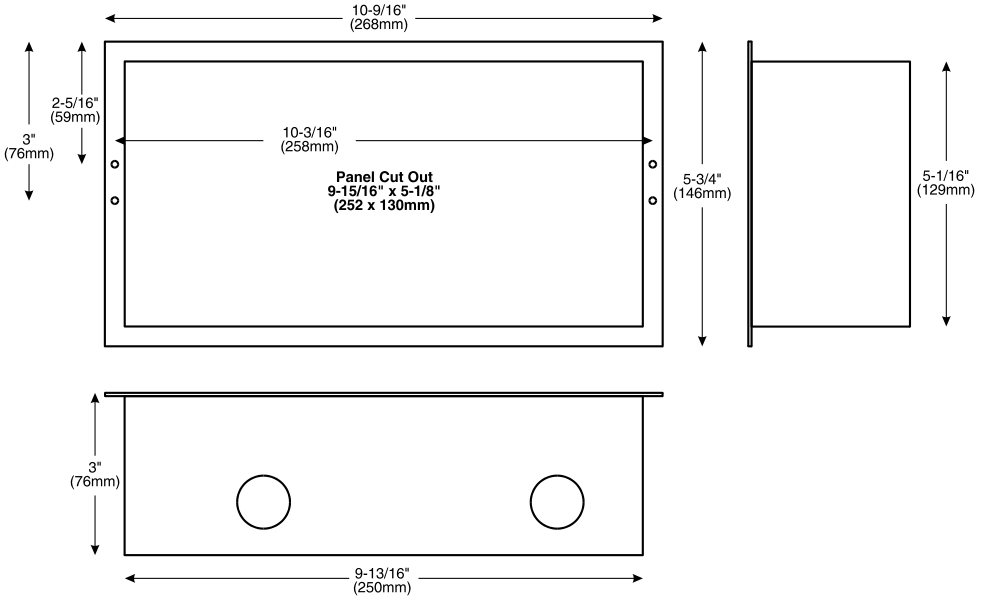
WIRING

Locate the monitor at a point convenient for observation by the pan operator. Panel cut-out dimensions are given in Figure 4. Two #6-32 flat head mounting screws are furnished. Suitable stand-offs may be fashioned for face mounting. It should not be located at a place subject to excessive vibration. Remove the front panel (2 screws), pull out the plug on the circuit board and set the panel aside while mounting and wiring.

Connect the monitor to the probe with a 2-wire cable. Select the wire gauge from the table below to be sure the resistance of the wire will not affect the readings. Using wire that is too small will also cause the electronics to run hot.

Wire Length	**Wire Gauge**
Up to 25 feet (8m)	#22 or larger
25 – 40 feet (12m)	#20 or larger
40 – 60 feet (18m)	#18 or larger
60 – 100 feet (30m)	#16 or larger
100 – 160 feet (50m)	#14 or larger

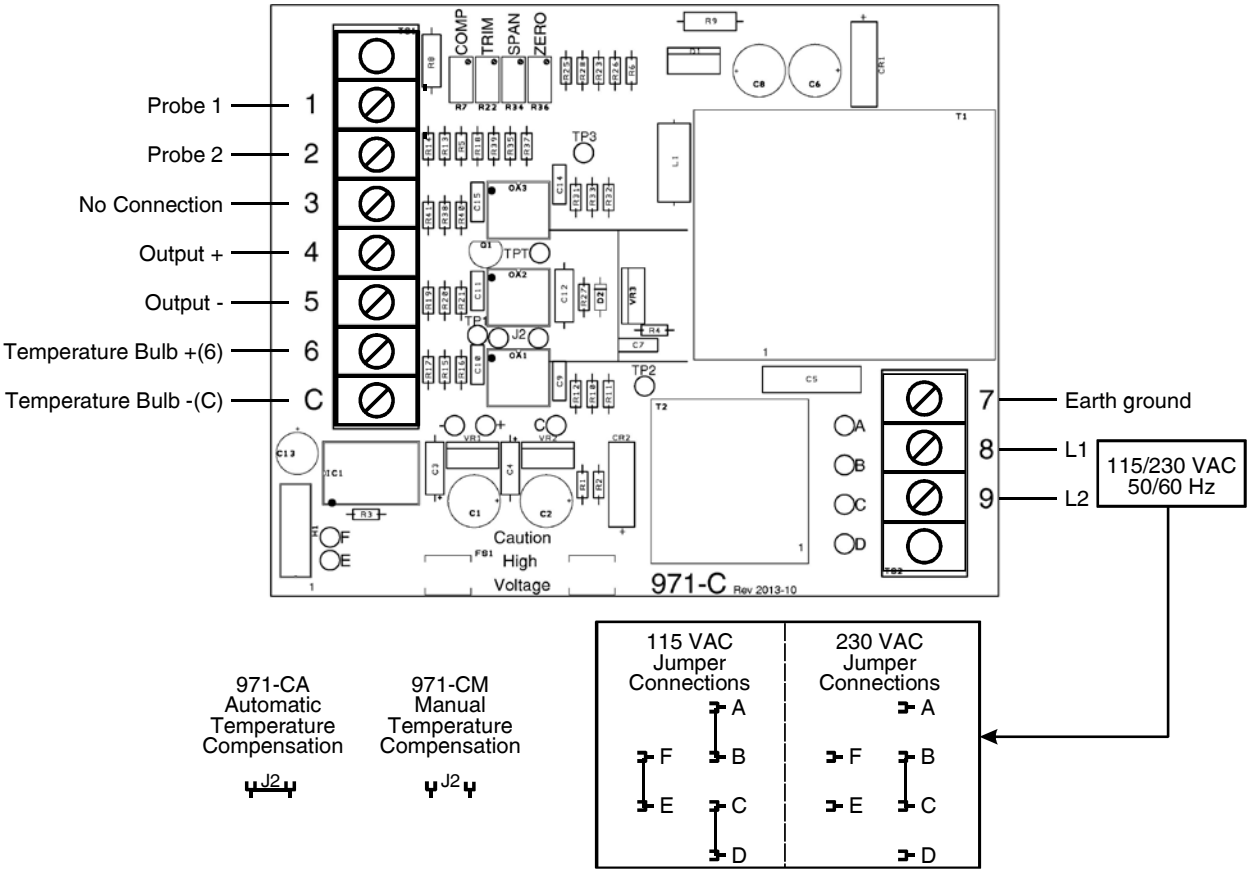
Figure 4: Mounting Dimensions for Monitor



The wiring diagram is shown in Figure 5. Terminals 1 and 2 of the probe connect to the corresponding terminals of the monitor. Terminal 3 is not used. **Before connecting power, be sure solder terminals A, B, C & D on the circuit board are jumpered for the proper line voltage as shown in Figure 5.** Bring 115/230VAC power to terminals 8 and 9. Maximum load is approximately 25 watts. It is suggested that power leads be brought through the right-hand case access hole and the probe and output cables through the left-hand inlet.

Supply voltage variations below 100 VAC or above 135 VAC will introduce appreciable errors. If voltages are expected to drop below 100 VAC or rise above 135 VAC a constant voltage transformer such as SOLA Type 23-22-112-2 is recommended.

Figure 5: 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 the plastic motor splash cover, insert the meter panel plug, making sure the arrow on the plug aligns with the 1 on the circuit board, and replace the front panel.

STARTUP AND CALIBRATION

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 70^0C. 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 70^0C 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 (70^0C 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 "TRIM" on the circuit board (see Figure 5) to bring the meter 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 establish the zero setting. From then on, the monitor readings will be stable.

TRANSMITTER OUTPUT

The 971-C Monitors are factory-calibrated to produce a 4 to 20 mA signal at terminals 4(+) and 5(-). The ZERO and SPAN trimpots 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, the output may be adjusted for 0 to 10 mA through a 100 ohm resistor.

CAUTION: Turn power off and disconnect the sensor before calibrating the output.

To change the factory-calibrated 4-20mA output range, connect the supplied 36-ohm 5-watt resistor across terminals 1 and 2 on the circuit board (see Figure 5). Power on and set the temperature dial on the front panel so that the meter reading is 45 Brix. Then adjust ZERO on the circuit board so that the current between terminals 4(+) and 5(-) is at the low end of the desired range. Disconnect the 36-ohm resistor and connect the supplied 1-ohm 5-watt resistor across terminals 1 and 2. Set the temperature dial on the front panel so that the meter reading is 95 Brix. Then adjust SPAN on the circuit board so that the current between terminals 4 and 5 is at the high end of the desired range.

Adjusting the SPAN will have an effect on the ZERO, so it is advisable to repeat the above process once or twice to ensure that both ends of the desired output range are set correctly.

Turn power off, disconnect the resistor and reconnect the sensor.

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 6 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 groves. 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.

TROUBLESHOOTING

If the motor fails to run, see if shaft and rotor are free by turning with a finger through the access hole. Check to see the voltage across test points A and D on the circuit board (see Figure 4) is 120 VAC (or 240 VAC if applicable). If not, check continuity of the 0.25 ampere fuse and the on-off switch on the front panel. Wiring terminals 1(-) and 2(+) and should be about 6 VDC when the motor is stalled and about 25 VDC when the motor is running free. A voltage greater than 26 VDC indicates either a faulty motor connection or an open circuit motor. An open circuit motor can be caused by excessively worn motor brushes.

Changes in armature current with rotor load actuate the indicating meter and supply the 4-20 mA output signal. With the motor running free, the armature current is at a minimum. The voltage between terminal 1(+) and test point C(-) is a good measure of the armature current. With the motor running free, this voltage should be about 0.35 volts. With the motor at stall, the voltage should be about 2.0 volts. Armature current changes from about 280 mA to 1,500 mA as load is applied.

The motor should never stall completely in normal operation, even in very heavy massecuite. If it does, it could indicate worn motor brushes or a dirty commutator segment. Check brushes and replace if badly worn. Remove back end bell of motor and inspect the commutator, cleaning with fine sandpaper if needed. To be sure that external friction is not the cause, disconnect the probe shaft near the flexible coupling and check for dirty or scaled bearings or compaction of sugar crystals around the rotor.

The Bodine motors have special brushes that should be ordered from the supplier listed inside the front cover of this manual. When ordering replacement brushes, specify the motor manufacturer, motor type, voltage and brush dimensions.

The circuit board is protected by a 0.25 ampere fuse. Do not over-fuse, as circuit board damage can result.

INFORMATION

For additional information regarding parts for older models, installation or service, please visit www.zieglerassociates.com or contact the distributor listed inside the front cover of this manual.

MODEL 971-C SUGAR CONSISTENCY MONITOR PARTS LIST

PART#	ITEM	DESCRIPTION
970C009	Barrel	Sensor/probe shaft barrel
970C012	Bearing	Sensor/probe bearing
971C011	Circuit Board 24V	Circuit board for use with 24 Volt motor
970C014	Flex Coupling	Sensor/probe flex coupling with set screws
971C008	Front Panel Assembly 24V	Front Panel Assembly for use with 24V motor (serial #1027 & higher)
970C029	Inner bearing retainer	Sensor/probe inner bearing retainer
970C026	Meter (Digital)	Digital indicating meter for front panel
970C037	Motor 24A2BEPM 24 Volt	Motor 24 Volt (Bodine type 24A2BEPM) For use with serial #1027 & higher
970C034	Motor Adaptor	Motor Adaptor for 24A2BEPM motor
970C017	Motor Bearing (Bodine Z99038)	Motor ball bearing (Bodine Z99038)
970C036	Motor Brush (24V Bodine 49/)	Brush & Spring for Bodine Motor 24 Volt 49/ (1/4" x 3/16")
970C010	Motor Mount	Sensor/probe motor mount
970C033	Motor Spacers	Sensor motor spacers 1/8" for 24A2BEPM Motor (set of 4)
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")
970C027	Potentiometer	10k ohm potentiometer for front panel
970C016	Rotor 3"	Sensor/probe rotor 3"
970C031	Screws	SS screws and washers for splash hood (2)
971C002	Sensor	Sensor/probe unit
970C024	Set Screw	Set Screw 8-32 x 3/16" Spline Head SS
970C008	Shaft	Sensor/probe shaft
970C028	Splash Hood	Sensor/probe motor splash hood
971C104	Temperature Bulb	Temperature Bulb for 971-CA
970C013	Terminal Block	Sensor/probe terminal block
971C009	Transmitter Manual 24V	Transmitter for 971-CM (manual temp comp.) with 24V motor
971C010	Transmitter Auto 24V	Transmitter for 971-CA (automatic temp. comp.) with 24V motor
970C030	Wrench	Spline head wrench

Figure 6: Probe Component Locations

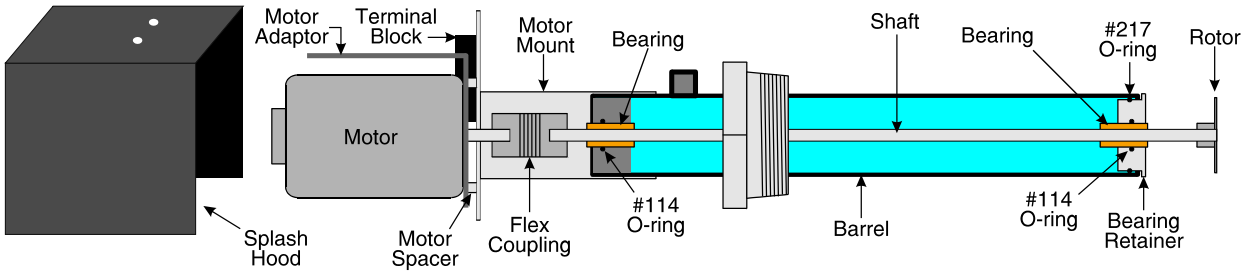


Figure 7: PCB Component Locations

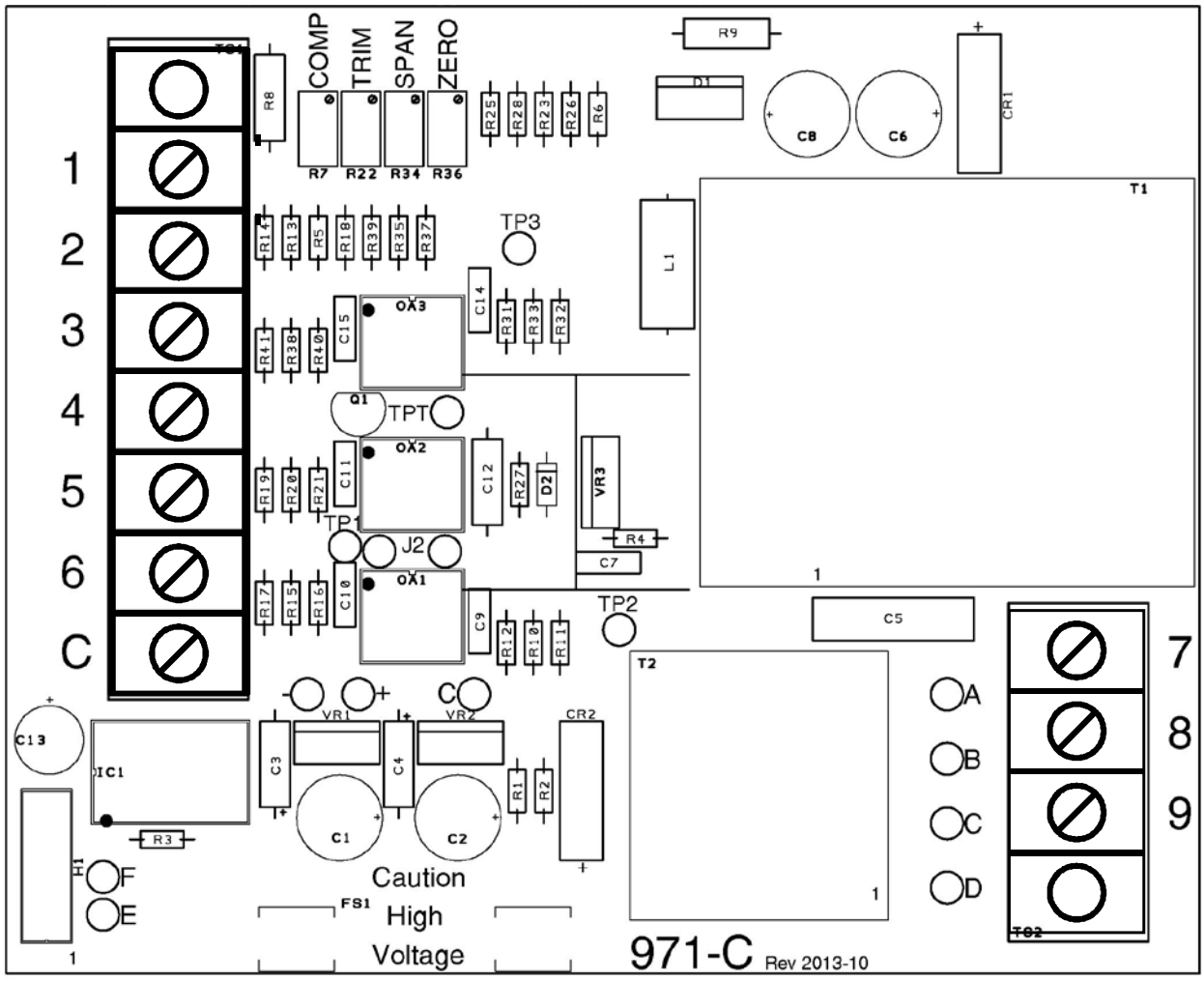
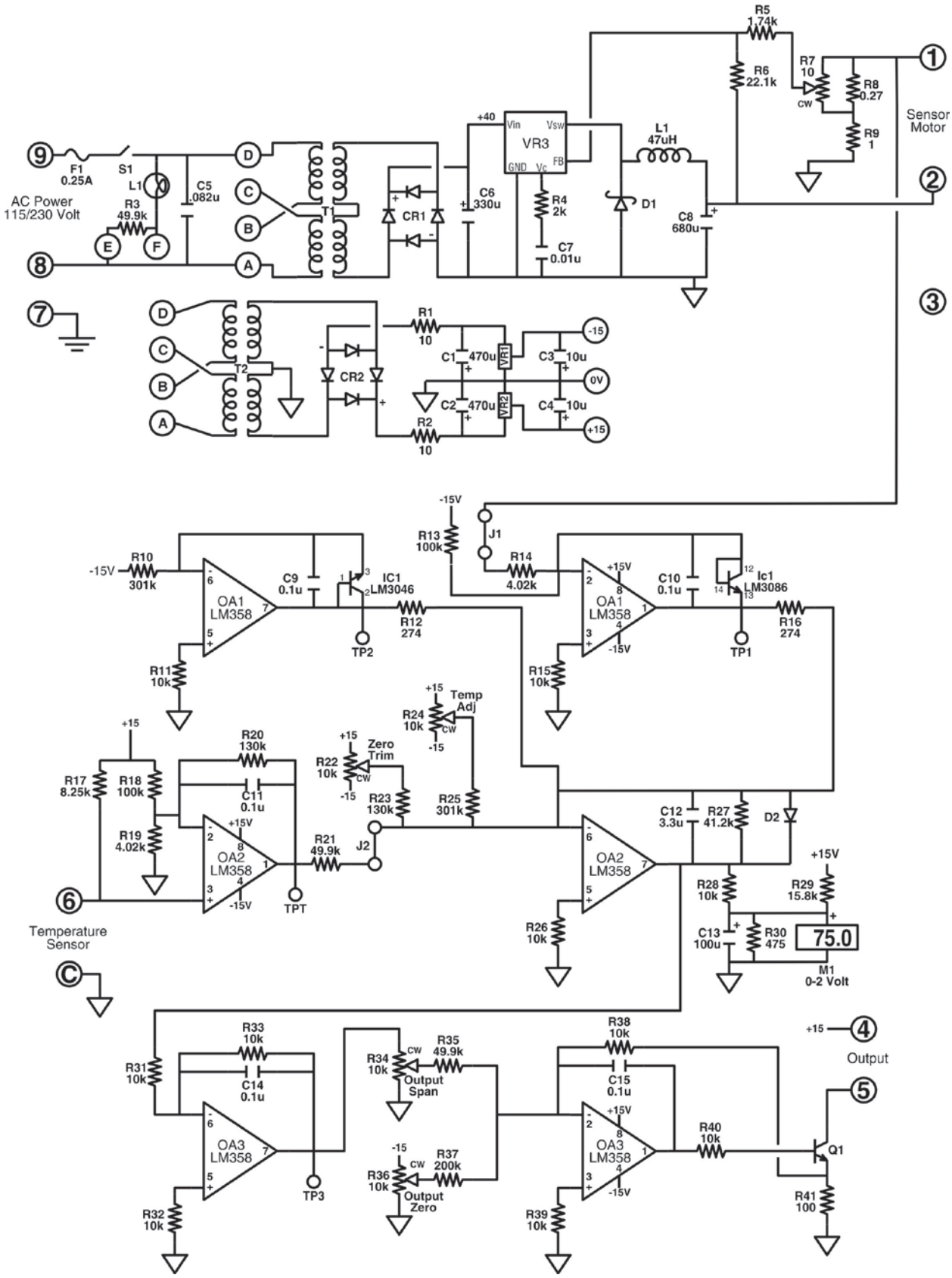


Figure 8: Circuit Diagram



WARRANTY

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