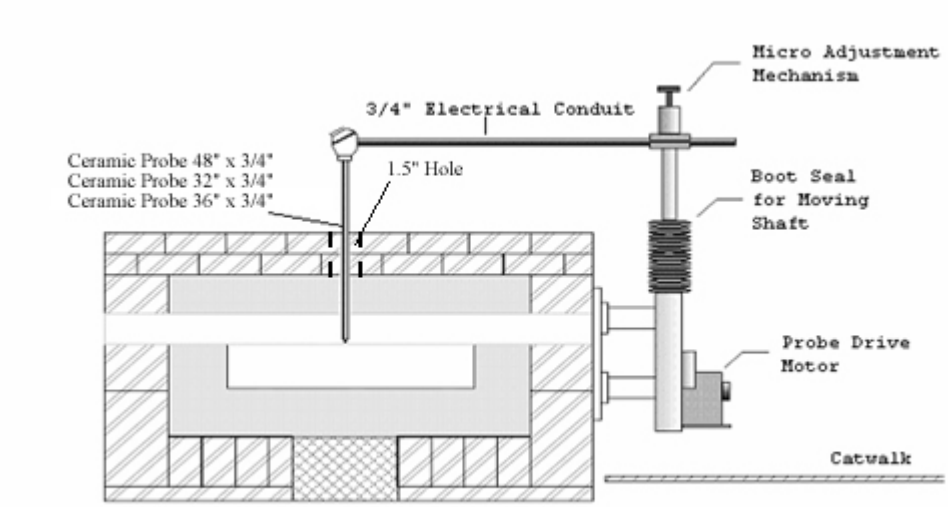
Glass Level Sensor

Operations Manual

Highlights:

- Components
- Specifications
- Mounting Instructions
- Alignment & Adjustment
- Operating Instructions
- Troubleshooting
- Maintenance Instructions



Forehearth

Voltage	Plant Power	ACSI Control Box	Actuator Motor Power	Probe Tip/ Glass Contact Light
24v				
120v				
240v				

ADVANCED CONTROL SOLUTIONS, INC.

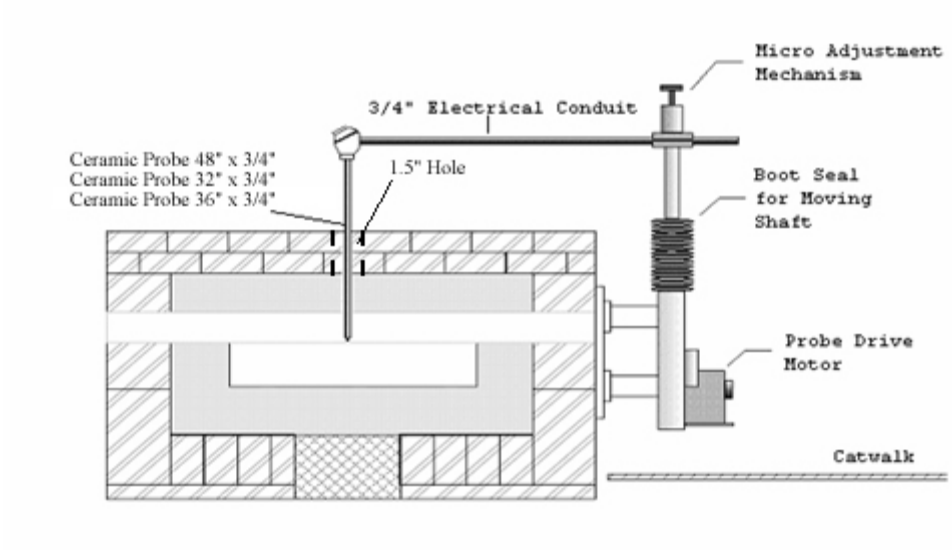
8750 RESOURCE PARK DRIVE

SYLVANIA, OHIO 43560

3-Feb-05

The ACSI Glass Level Sensor provides highly accurate glass level measurements from reliable, design-simplified, and cost effective equipment. The ACSI Sensor measures glass level up to .0004" (0.01 mm) resolution and can be adjusted throughout the range of operation. Accessible components and basic design simplicity result in easy operation; self-lubricating fittings and durable, high temperature construction reduce maintenance downtime. The ACSI Glass Level Sensor provides uncomplicated reliability, and requires none of the paperwork associated with nuclear measuring devices.

Figure 1: Glass Level Sensor



DESIGN COMPONENTS

The *Probe* consists of the following major components:

- Platinum Probe Tip
- Ceramic Protection Tube
- Threaded Probe Wiring Connection Head

The *Probe Mechanism* contains the following specifications:

- Micro Adjustment Mechanism – enables adjustment to .0004" (0.01 mm) during operation.
- Clamping Block – utilizes high temperature insulating material designed to secure up to 1-1/2" (38.1 mm) conduit for probe support.
- High Temperature Bellows – high temperature silicon impregnated cloth bellows protects shaft and spring.
- Self-lubricating Fittings – provide low maintenance and less downtime.

The *Probe Drive Motor* includes the following:

- Honeywell #10260 – standard type motor should replacement ever be necessary. Other motor types available as option.
- Large Handwheel – enables quick, simple height adjustment.
- Auto/Manual Switch – allows local control of the electrical Raise and Lower functions during installation
- Glass Contact Light – gives local indication of probe glass contact.

PRODUCT SPECIFICATIONS

Probe Type: Ceramic protection tube, platinum electrode. Thermocouple-type connection head, threaded to receive 3/4" (19 mm) thick-wall conduit.

Probe Mounting Arm: Standard 3/4" (19 mm) thick-wall electrical conduit. (Not supplied).

Resolution: 0.0004" (0.01mm)

Resolution specifications based on 12-bit A/D conversion. Usable resolution depends on choice of position feedback device (solid-state 4-20 milliamp sensor or wirewound slidewire), stability of mounting, and length of probe mounting arm.

Typical Control: 0.01" (.25 mm)

Control depends on furnace type, location of glass level sensor, stability of furnace pressure, and accuracy of level control tuning +/-0.01" (+/-.25 mm) observed. With higher resolution input capability, +/- 0.002 (+/- 0.05 mm) observed.

Output Signal: Linear with position based on 0-5, 1-5 Volt or 4-20 Milliamps. The *calibrated* travel limits are -.5 to +.5; however, the overall mechanical travel limits are -.8 to +.8.

Ambient Temperature: 120° F (50° C) Normal; 160° F (70° C) Peak

Dimensional Information		
Probe Height	**Shipping Weight**	**Power Requirements**
43" (1.09 meters)	231 lbs (105 kg)	110/220 VAC 50-60 Hz (correct voltage must be specified when ordering)
58" inverted (1.47 meters)		
59" (1.5 meters)		
73" (1.85 meters)	280 lbs (127 kg)	

* The 43" probe is ACSI's standard size; however, additional sizes are available on request.

UNPACKING

➲ Prior to unpacking, check for damage to crate; notify shipper if the crate is not intact or is visibly damaged.

Parts List

- Probe Mechanism
- 36" (0.91 m) Probe Sensor in ceramic protection tube. **Handle With Care!**
  - The 36" probe sensor is standard; however, other lengths are available upon request
- Probe Controller (panel box, if supplied)
- Micro Adjustment Mechanism (2 parts)
  - T-bar
  - Cylinder
- Hardware
  - Eight 1/2" (12.7 mm) square head bolts for adjusting plumb

➲ Inspect all parts, especially the ceramic probe, for damage.

MOUNTING INSTRUCTIONS

CAUTION

Use proper safety equipment and protective eyewear when mounting probe mechanism.

Guidelines

- Select a location that best suits the specific glass process. The glass level probe is usually located in Forehearth, distributor, or refiner. Actual mounting may vary with the size and type of forehearth or refiner. The mounting surface for the probe mechanism must be strong enough to support the device without any stress on the refractory. The mechanism should be kept as free from vibration as possible – the sturdier the mounting, the more accurate sensor readings will be.
- Choose a mounting location where "cold glass" does not occur to eliminate the possibility of false sensor readings.
- Ambient temperature for probe motor cannot exceed 150° F (65.5° C). If the mounting location is exceptionally hot, ACSI recommends installing cooling air on the probe motor by installing a tap into a nearby cooling line with 2" (51 mm) duct and adding a slide gate for air flow control.
- Modify steelwork at the location to receive the mounting brackets; mount the probe mechanism. Refer to drawing #008 on page #20.

IMPORTANT NOTE

Tighten only the four 9/16 in. (14.3 mm) bolts; the eight 1/2 in. (12.7 mm) bolts are used for positioning and pivoting the angle of the probe mechanism, if necessary.

- Drill a 1.5" hole on the centerline of the forehearth or refiner, as shown in Figure 1, to allow for entrance of the probe; if the drillhole is located away from the centerline, the probe reading will not be as accurate.
- After the probe mechanism has been mounted, ACSI recommends installing a molybdenum probe into the glass to provide a reliable ground and to create a good electrical return path for the probe glass contact circuit. A steelwork connection can be sufficient but is not as reliable.

Electrical Installation

CAUTION

110/220 Volts AC – Use extreme care when installing or servicing to avoid physical harm or possible death. The Panel Box contains line voltage potentials inside; turn off power first!

Materials Necessary

- For Power Wires: High temperature wire insulation - #14 A.W.G.
- For Probe Wires: High temperature wire insulation - #14 A.W.G.
- For Feedback Wires: High temperature wire insulation - 2 conductor shielded cable #18 A.W.G. or larger

NOTE

Probe Wire and Power Wire may be run in the same conduit, while the low level 2 conductor shielded cables should be run in separate conduit.

Mounting of Panel

➲ Mount the panel on a wall using 4 mounting holes on back of panel box.

NOTE

ACSI suggests that the control panel should be mounted in the furnace control room. This results in optimal performance by providing a cleaner and cooler environment for the equipment and also enables the operator to monitor the process. The microprocessor must be located where the temperature does not exceed 140° F (60° C).

Terminations

Power to the Control Box

- Refer to drawing #001 to provide power to the panel.

Without Box	With Box
	Refer to drawings #002 and 005 for wiring connections. To feed power to the box, supply 110/220 VAC power from a circuit breaker distribution panel, using a 5 amp circuit breaker. User #14 A.W.G. wires and a high quality ground wire.

NOTE
ACSI recommends installing an 8" x 8" (200 mm x 200 mm) junction box within 6 feet (1.8 m) of the probe so low temperature cable can be run from the control room to the junction box, and high temperature cable can be run from the junction box to the probe mechanism.

Actuator Power And Motor Connections

- Refer to drawing #002 and #005 for probe motor connections.
- Use #14 A.W.G. wire.

Without Box	With Box
Refer to drawing #003 for wiring connections. ▪ Connect PLC Raise output to Motor Terminal #10 ▪ Connect PLC Lower output to Motor Terminal #11 ▪ Connect Control System 110/220 VAC Neutral to Motor Terminal N (or 2) ▪ Connect Control System Ground to Motor Housing (Ground) ▪ Connect Control System 110/220 VAC to Motor Terminal L (or 1), protected at 2 amps	Refer to drawings #002, #003 and #005 for wiring connections. ▪ Connect Terminal Strip 1 (TB1) – 2261 to Motor Terminal #10 ▪ Connect Terminal Strip 1 (TB1) – 2281 to Motor Terminal #11 ▪ Connect Terminal Strip 1 (TB1) – N to Motor Terminal N (or 2) ▪ Connect Terminal Strip 1 (TB1) – GND to Motor Housing (Ground) ▪ Connect Terminal Strip 1 (TB1) – 110/220 VAC AC to L (or 1)

Actuator Feedback Connections

This refers to the signal feeding back to the PLC or MicroLogix. It compares the actual glass level to the setpoint.

- Refer to drawing #002 and #005 for probe feedback connections.
- Use 2 conductor shielded cable.

Without Box	With Box
Refer to drawing #003 for wiring connections. ▪ Connect PLC Analog Input (+) to Motor Terminal 33 ▪ Connect PLC Analog Input (–) to Motor Terminal 32 ▪ Connect Shield to control system Ground. Do NOT connect field end; trim the shield and wrap with electrical insulating tape to avoid a ground loop.	Refer to drawings #002, #003 and #005 for wiring connections. ▪ Connect Terminal Strip 1 (TB1) – 2171 to Motor Terminal 33 ▪ Connect Terminal Strip 1 (TB1) – 2191 to Motor Terminal 32 ▪ Connect Shield to Terminal Strip 1 – SHLD. Do NOT connect field end; trim the shield and wrap with electrical insulating tape to avoid a ground loop.

Probe Wire Connections

- Refer to drawing #001 for probe wire connections.
- Use #14 A.W.G. gauge high temperature insulation wire – pull through the ¾"conduit connected to the probe head.

Without Box	With Box
Refer to plc drawing set for wiring connections. ▪ Connect "Contact" relay coil to level probe terminal in the head. ▪ Connect control system 120v Neutral to steel ground at level bay.	Refer to drawings #1 for wiring connections. ▪ Connect Terminal Strip 1 (TB1) – 1121 to actuator terminal #37. ▪ Connect level probe tip to actuator terminal #37 ▪ Connect Terminal Strip 1 (TB1) – N to steel ground at level bay (may be done by grounding actuator terminal N in the actuator).

Calculated Output for Glass Level Control

This refers to ACSI's calculated output for glass level control. The value is used for controlling the batch chargers.

- Refer to drawings #002 and 005 for wiring connections.

With Box Only
▪ Connect Terminal Strip 1 - 2391 to **+**4-20 milliamp Terminal. ▪ Connect Terminal Strip 1 - 2401 to **-**4-20 milliamp Terminal. ▪ Connect Shield to Terminal Strip 1 - SHLD. Do NOT connect shield field end. Trim shield and wrap with electrical insulating tape to avoid a ground loop.

NOTE

Output wires send a sampled 4-20 milliamp signal representative of actual glass level to the glass level control system. A 2 conductor shielded cable, minimum #18 A.W.G. wire should be used.

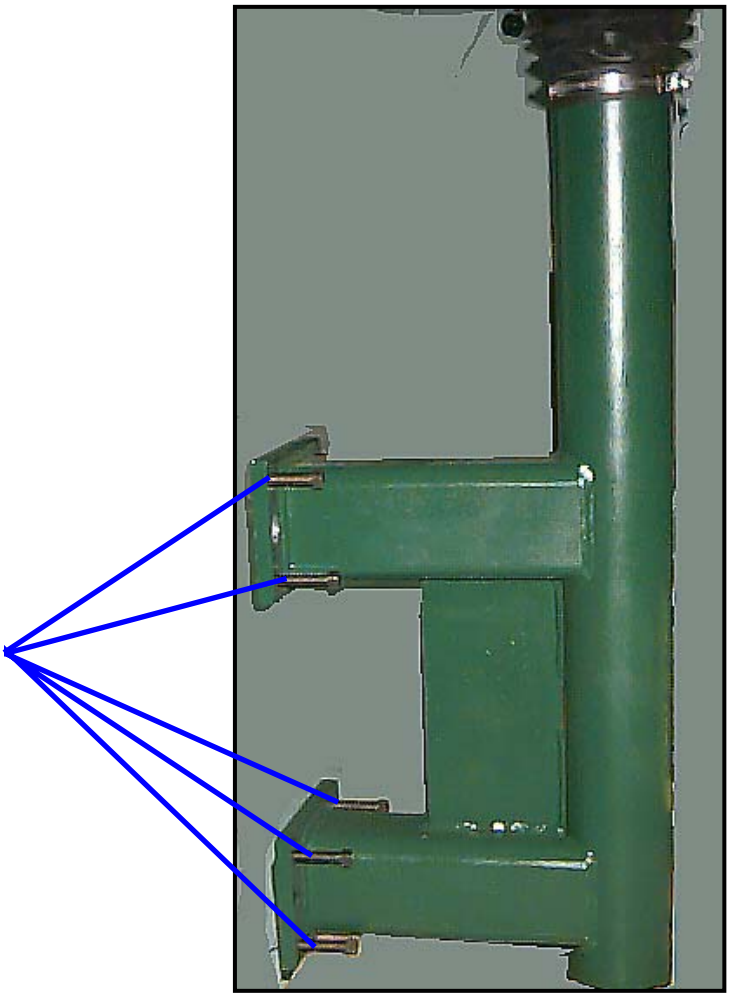
4-20 milliamp is the ACSI standard; however, 0-10v DC and 0-5v DC signals are also available via Micro Logix processor through the ACSI box.

MECHANICAL ALIGNMENT AND ADJUSTMENT

CAUTION

To avoid physical harm or possible death, turn off power before servicing or installing probe – **110/220 Volts AC is present**. Always wear appropriate protective equipment when installing or servicing glass level probe.

1. Probe mechanism must be mounted plumb with the refractory; use a level and manipulate the 1/2" (12.7 mm) pivoting bolts to secure the desired position.



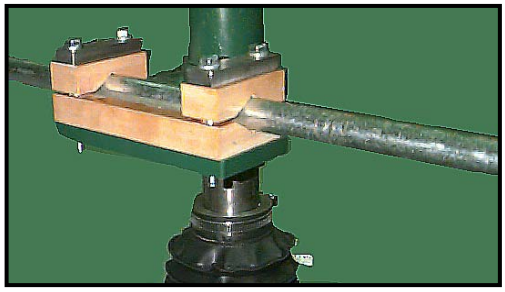
2. After the probe mechanism has been made plumb with the refractory, measure the distance between the probe mechanism and the 1.5" hole, which has been drilled in the top of the FH crown, to determine the length of 3/4" (19 mm) conduit, adding approximately 10" (254 mm) to this measurement for horizontal/slide adjustment.

Cut the conduit; thread one end and screw carefully into head. *Use care when handling the ceramic probe to prevent cracking.*

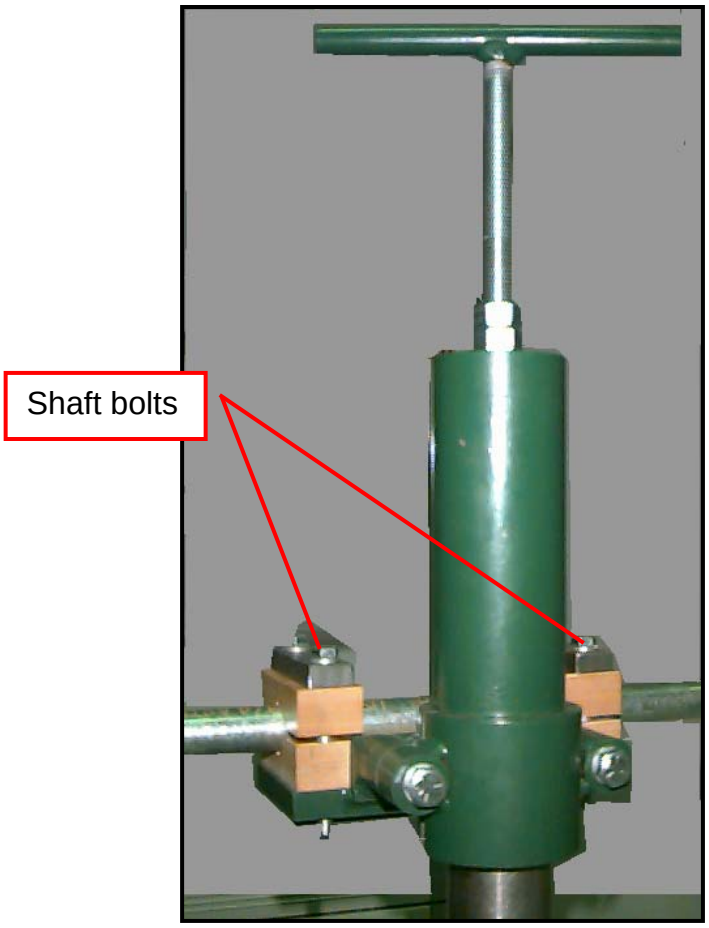
IMPORTANT

To avoid thermal shock damage, be sure to carefully preheat the ceramic probe.

3. Insert the conduit into the clamping blocks, as shown to the right. This is best achieved utilizing two installation personnel, with one installer holding the probe conduit in position, while the other tightens down the clamping blocks. Be sure to tighten the clamp bolts so the conduit cannot rotate or slip.



4. Next, the probe tip must be calibrated. To achieve this, complete the following steps:
   - Slightly loosen the shaft bolts that clamp the clamping block to the probe mechanism shaft. These bolts should not be so loose as to let the clamp slide easily on the shaft, but they should be loose enough to allow the Micro Adjustment Mechanism to move the clamp down the shaft.
   - Set the Honeywell actuator (using the handwheel or the *Auto/Manual* switch on the motor) so that the mechanical pointer indicator is at the "O" position (the controller feedback should equal 12MA).
   - Fit the Micro Adjustment Mechanism cylinder onto top of the probe mechanism.



   - Insert the T-bar into the cylinder and tighten.
   - Start with the probe above the glass. Rotate the Micro Adjustment Mechanism Tee-handle to force the clamp down the shaft until the probe contacts glass.
   - Begin cycling in *Manual* mode.
     - Set *Auto/Man* switch (at the motor or on the cover of the panel box) to *Man* (Manual).
     - Press *Lower Probe* button until *Glass Contact* light illuminates.
     - Immediately press *Raise Probe* button for approximately 5 seconds.
     - Check sampled reading; make adjustments as necessary.

5. Once desired setting has been reached, tighten down the shaft bolts.
6. Glass level sensor can now be switched into *Auto* mode of operation if desired.

Basic Functions

NOTE

This section only refers to sensors with the ACSI panel box.

Five controls are located on the front cover of the ACSI panel box:

1. **Auto/Man:** This switch indicates whether the glass level sensor is currently running in Automatic mode (*Auto*) or Manual mode (*Man*).
2. **Alarm:** This red light illuminates if a problem occurs during the cycling of the glass level sensor. In the event that an alarm has occurred, the glass level sensor will automatically raise to its uppermost position, and stop cycling until a solution to the problem is found. Possible causes and solutions to alarm situations are discussed in greater detail in the *Troubleshooting* section of this manual.
3. **Glass Contact:** This light illuminates when the glass level probe has made contact with the glass (light on probe mechanism motor will also light).
4. **Raise Probe:** Pressing this button will raise the glass level probe. The button will illuminate when the probe is being raised in either Auto or Manual mode.
5. **Lower Probe:** Pressing this button will lower the glass level probe. The button will illuminate when the probe is lowering in either Auto or Manual mode.

Operating the ACSI Glass Level Sensor using the Controls Located on the Front Cover of the Panel Box

NOTE

This section only refers to sensors with the ACSI panel box.

Operating in Manual (Man) Mode to Sample Glass Level

1. Switch the Auto/Man toggle switch to *Man* position.
2. If power has been turned off, turn on by using the circuit breaker located inside the panel box.
3. Press and hold the Lower Probe button. The probe will continue to lower until the button is released.

IMPORTANT

Watch for Glass Contact light to illuminate.

4. Immediately release the Lower Probe button when the Glass Contact light illuminates. Failure to do so will drive the probe directly into the glass, resulting in possible damage to the probe tip and ceramic protection tube.
5. Glass level can be read directly from the mechanical pointer located on the base of the probe mechanism or from the PLC output (located in control room).
6. Press and hold the Raise Probe button until the probe has reached its uppermost position, or until the Contact light is no longer illuminated.

Operating in Automatic (Auto) Mode to Sample Glass Level

1. Switch the Auto/Man toggle switch to *Auto*.
2. When the glass level sensor is in *Auto* mode, the probe will cycle continuously at intervals of 10 seconds.
3. Glass level can be read directly from mechanical pointer located on base of probe mechanism or from the PLC output (located in the control room).
4. To stop the glass level sensor from operating in *Auto*, switch to *Man*, or turn off power from circuit breaker located in panel box.

Understanding and Determining Alarm Signal Causes

The ACSI Glass Level Sensor has been equipped with an alarm signal, located on the front panel of the ACSI control box. The glass level sensor has been programmed to automatically stop cycling if it runs for more than 90 seconds without achieving glass level contact. This illuminates the red alarm light on the panel box, and the glass level sensor will raise to its highest position and not continue to cycle until a resolution to the problem has been found. To restart the system, it must be switched into *Man* (Manual), and back to *Auto* (Automatic) once the situation has been resolved.

Possible Alarm Causes

CAUTION
Always take appropriate safety precautions before servicing.

Cold Glass

If the probe is located in an area where the glass is not hot enough, probe readings may be inaccurate. For example, small amounts of glass (known as "stringers") may stick to the platinum probe tip as it is raised after glass contact. This can be caused by cold glass. Failure to break glass contact in 90 seconds causes an alarm.

Suggested Resolution: To avoid alarms caused by cold glass and the problems associated with it, be sure to locate probe in an area known to have consistently "hot" glass.

Bad Ground

If the AC Neutral is connected to the steelwork of the forehearth, it may not necessarily provide a sufficiently direct electrical path. This can result in a failure to detect glass contact.

Suggested Resolution: Inserting a grounded molybdenum probe directly into the glass will result in a much more reliable electrical connection.

Broken Ceramic Protection Tube

In this case, the ceramic protection tube is broken or cracked and must be replaced.

Suggestion: After replacement, this problem can be avoided by

- Always handling the ceramic protection tube with care.
- Always preheating ceramic protection tube before insertion to avoid thermal shock.

Problems with the Honeywell Actuator Motor

Possible causes of motor failure:

Tripped Circuit breaker: This can occur from failure to turn off power when changing the probe.

Overheated Motor: This can occur if the ambient temperature at the location of the glass level sensor is above 150° F (65 ° C).

Suggested Resolution: This problem can be resolved by blowing cooling air onto the motor or by building a heat shield between the heat source and the level sensor assembly.

As a result of the hot working environments found around glass melters, refiners and forehearths, the ACSI glass level probe mechanism may require special measures to keep it cool and operating properly.

Areas of concern for the probe mechanism include the actuator and the shaft bearings.

The actuator, usually a Honeywell Model 10260 series with electronic position feedback, has a manufacturer-specified operating temperature range of -20 to +185° F (-30 to +85° C). The special oil-impregnated shaft bearings have an upper operating temperature specification of +300° F (+149° C).

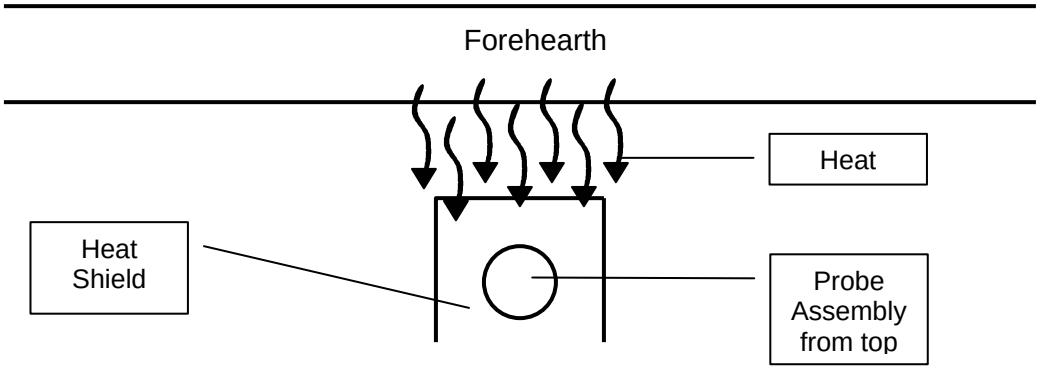
ACSI recommends two ways to remain within the specified temperature range. First, shielding the probe from heat of radiation helps to lower the temperature. This is accomplished by fabricating sheet metal shields, covered with high temperature mill board insulation, and installing them so the probe mechanism is shielded from the radiated heat. The heat shields shall be placed between the heat source and the probe mechanism.

Second, installing fan cooling air (usually a 2- to 3-inch diameter duct is adequate) and directing the air flow onto the actuator and the bearings also aids in cooling the probe mechanism.

Each probe installation is unique; therefore, it may be necessary to use one of these solutions or a combination of the two cooling methods to achieve the desired temperature.

Reference ACSI dwg. XXXXXXX

NOTE
Consult the Honeywell manual for further instructions.



Electrical Problems

Suggested Resolutions:

- Check for any loose wiring connections.
- Check the probe contact relay.
- The control panel may be in a location that is too hot; the microprocessor cannot be in an area exceeding 140° F (60° C).

MAINTENANCE AND REPAIR

The ACSI Glass Level Sensor has been designed to require minimal maintenance.

Maintenance

Lubrication: Do NOT lubricate; bearings are self-lubricating. If any mechanical binding is seen in the probe mechanism, it is typically caused by overheating. Install cooling air to avoid this problem.

Repairs

CAUTION

110/220 Volts AC – Always turn off power to glass level sensor before servicing to avoid physical harm or possible death.

Handle ceramic protection tube with care. It is extremely **HOT.**

Ceramic Protection Tube Repair

If the ceramic protection tube breaks or cracks, replace the entire ceramic protection tube.

NOTE

It is important to keep the probe tip free of glass. Under normal operating circumstances, glass should not adhere to the probe tip. If the tip should become encrusted with glass, it will need to be cleaned, because even minimal adherent glass (known as "stringers") can result in false level readings. Remove glass from platinum tip and/or ceramic protection tube if possible. If this is not possible, replace with new probe.

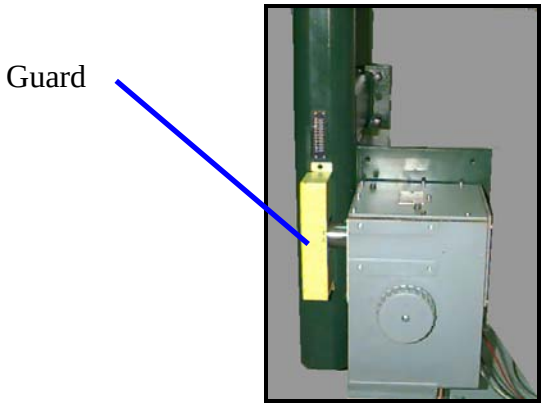
After repairs have been made, use *Man* mode from the Auto/Man switch to restart glass level sensor. When satisfactory results have been observed, switch to *Auto* mode if desired.

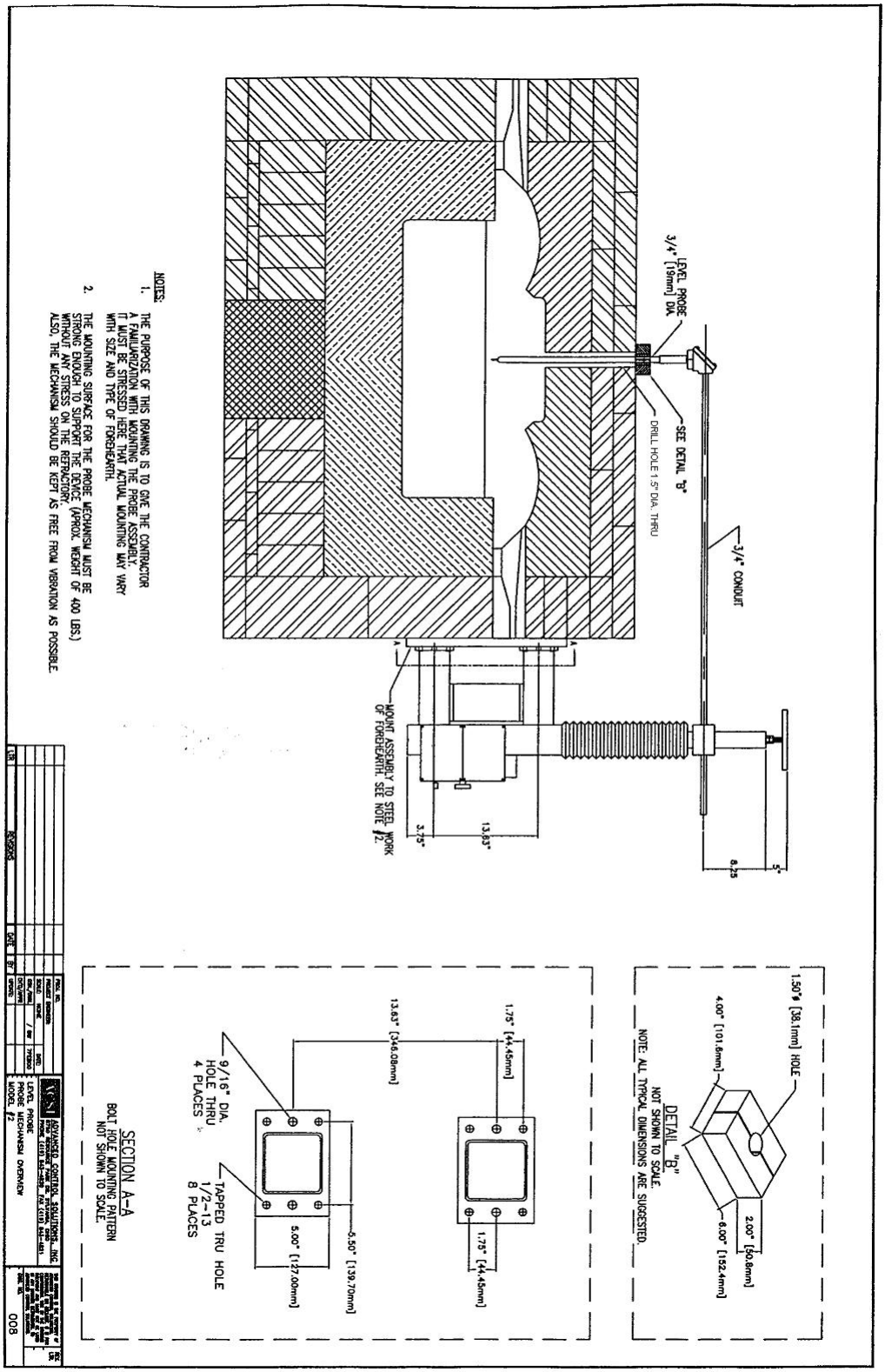
Honeywell Motor Repairs

See Honeywell Manual.

CAUTION

Do not remove yellow guard from Honeywell motor from its location over rack and pinion gears. Also, should the probe mechanism ever be completely disassembled, use caution with the shaft because it is spring-loaded and could release, causing possible physical injury.




NOTES:
1. THE PURPOSE OF THIS DRAWING IS TO GIVE THE CONTRACTOR A FAMILIARIZATION WITH MOUNTING THE PROBE ASSEMBLY. IT MUST BE STRESSED HERE THAT ACTUAL MOUNTING MAY VARY WITH SIZE AND TYPE OF FOREHEARTH.
2. THE MOUNTING SURFACE FOR THE PROBE MECHANISM MUST BE STRONG ENOUGH TO SUPPORT THE DEVICE (APROX. WEIGHT OF 400 LBS.) WITHOUT ANY STRESS ON THE REFRACTORY. ALSO, THE MECHANISM SHOULD BE KEPT AS FREE FROM VIBRATION AS POSSIBLE.
LEVEL PROBE 3/4" [19mm] DIA.
SEE DETAIL "B"
DRILL HOLE 1.5" DIA. THRU
3/4" CONDUIT
MOUNT ASSEMBLY TO STEEL WORK OF FOREHEARTH. SEE NOTE #2.
13.63"
3.75"
8.25
5"
1.50" [38.1mm] HOLE
4.00" [101.6mm]
2.00" [50.8mm]
6.00" [152.4mm]
DETAIL "B"
NOT SHOWN TO SCALE.
NOTE: ALL TYPICAL DIMENSIONS ARE SUGGESTED.
1.75" [44.45mm]
13.63" [346.08mm]
1.75" [44.45mm]
5.50" [139.70mm]
5.00" [127.00mm]
9/16" DIA. HOLE THRU 4 PLACES
TAPPED THRU HOLE 1/2-13 8 PLACES
SECTION A-A
BOLT HOLE MOUNTING PATTERN
NOT SHOWN TO SCALE.
ADVANCED CONTROL SOLUTIONS, INC.
LEVEL PROBE
PROBE MECHANISM OVERVIEW
MODEL #2
008