Customer Manual

C-Level
Model CL-100A
Continuous Level Indicator

REC 4027 REV D 2/03
Part No. 056978

ELECTRON CORPORATION

REVISION HISTORY

REVISION A	JUNE 1997	
REVISION B	JUNE 1999	
REVISION C	MARCH 2003	
REVISION D	NOVEMBER 2003	ECO 0076

PLEASE READ AND OBSERVE THE FOLLOWING SAFETY PRECAUTIONS FOUND THROUGHOUT THIS MANUAL.

DANGER

FAILURE TO OBSERVE WILL CAUSE VERY SERIOUS PERSONAL INJURY OR DEATH.

WARNING

FAILURE TO OBSERVE COULD CAUSE SERIOUS PERSONAL INJURY.

CAUTION

FAILURE TO OBSERVE MAY CAUSE MINOR OR MODERATE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT.

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THERMO RAMSEY PRODUCTS

CONTINUOUS LEVEL INDICATOR

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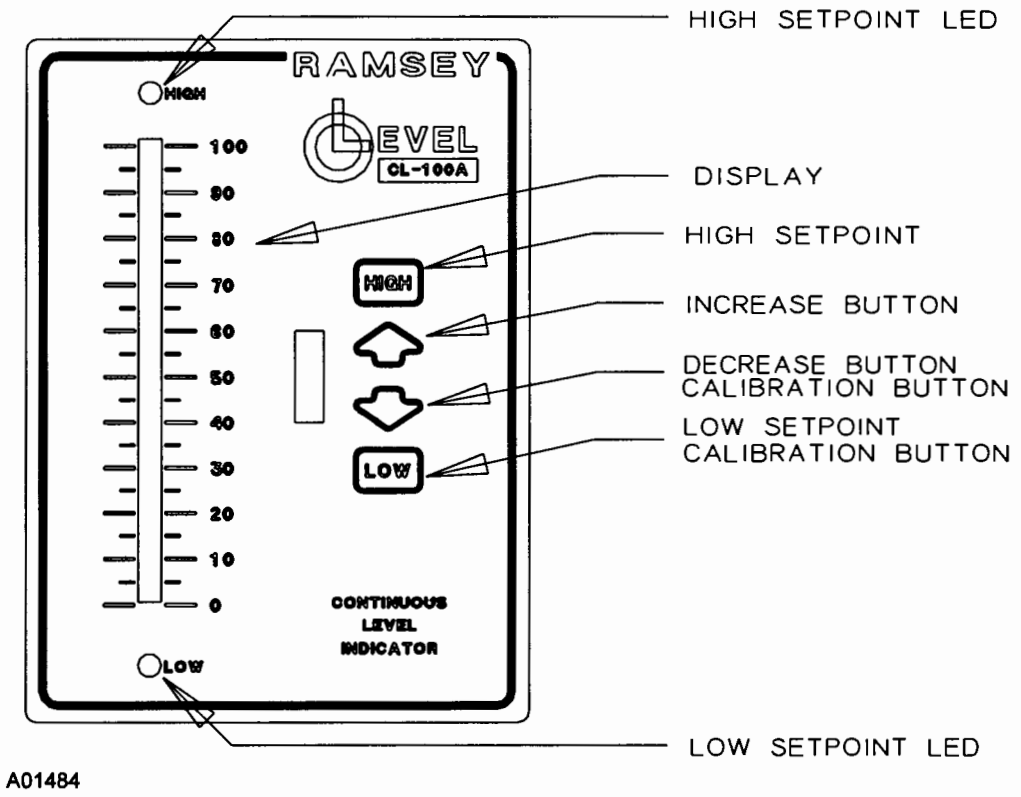
CHAPTER 1.0
INTRODUCTION

1.1 GENERAL

This instruction manual contains information on the installation, operation, and maintenance of your Thermo Ramsey Model CL-100A Continuous Level Indicator for non-hazardous applications.

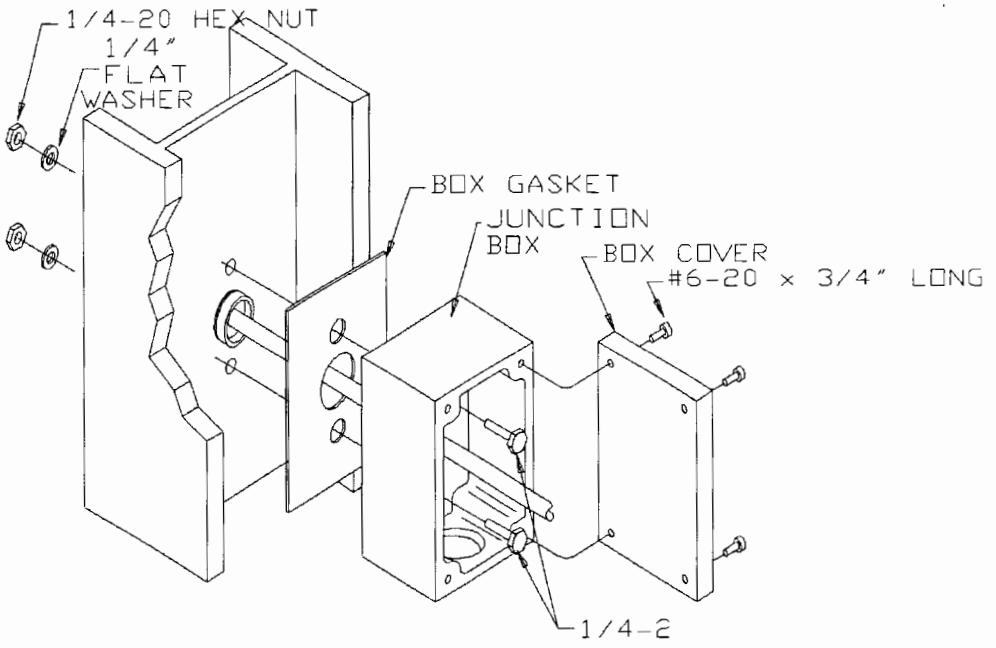
The C-Level is a micro-processor based, continuous level indicator. It monitors strain sensor(s) located in the support legs of a bin or storage vessels, and displays the level of material in them. The C-Level has customer adjustable low and high alarm setpoints. In addition to the low and high adjustable alarms is a non-adjustable overflow alarm, factory set at 102 percent (Figure 1-1).



C-LEVEL FRONT PANEL
FIGURE 1-1

1.2 JUNCTION BOX AND STRAIN SENSOR

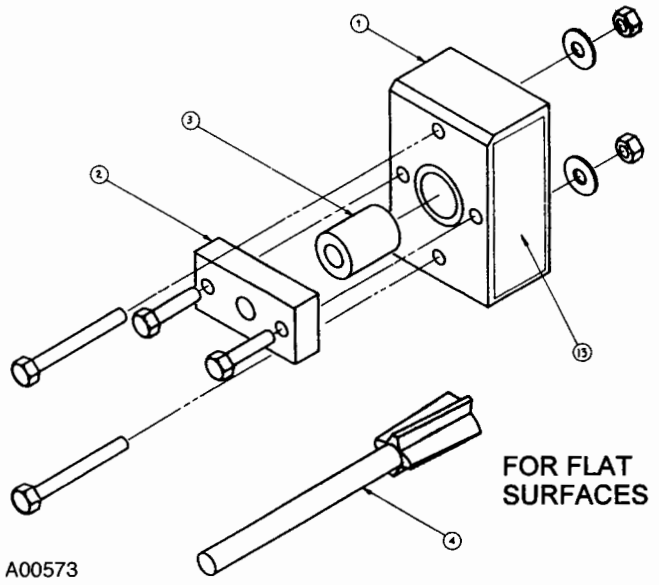
The typical C-Level system consists of up to eight strain sensors (U.S. Patent No. 4530245). Each strain sensor comes with an individual junction box.

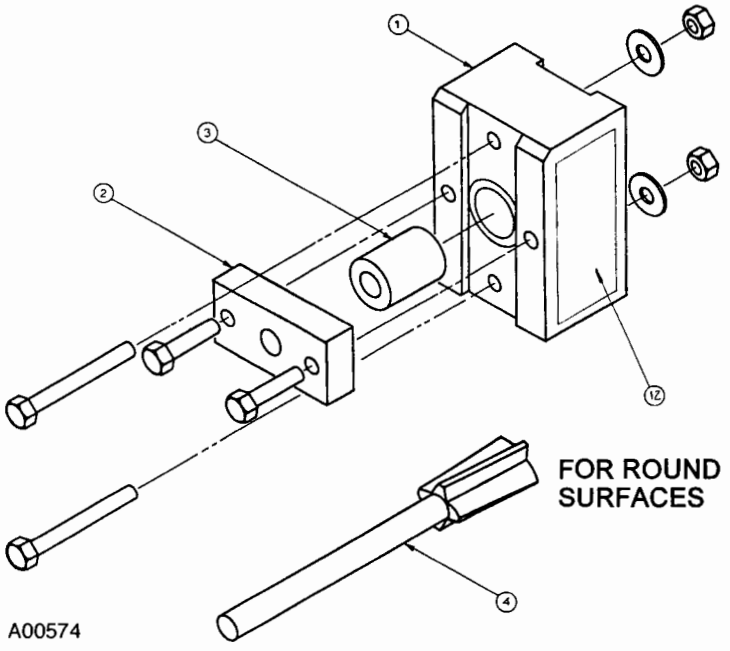


NON-HAZARDOUS AREA

STRAIN SENSOR, JUNCTION BOX
FIGURE 1-2

A strain sensor mounting/installation tool (U.S. Patent No. 4738135) is included with each system. The mounting tool assures correct sensor installation. (See Figure 1-3).

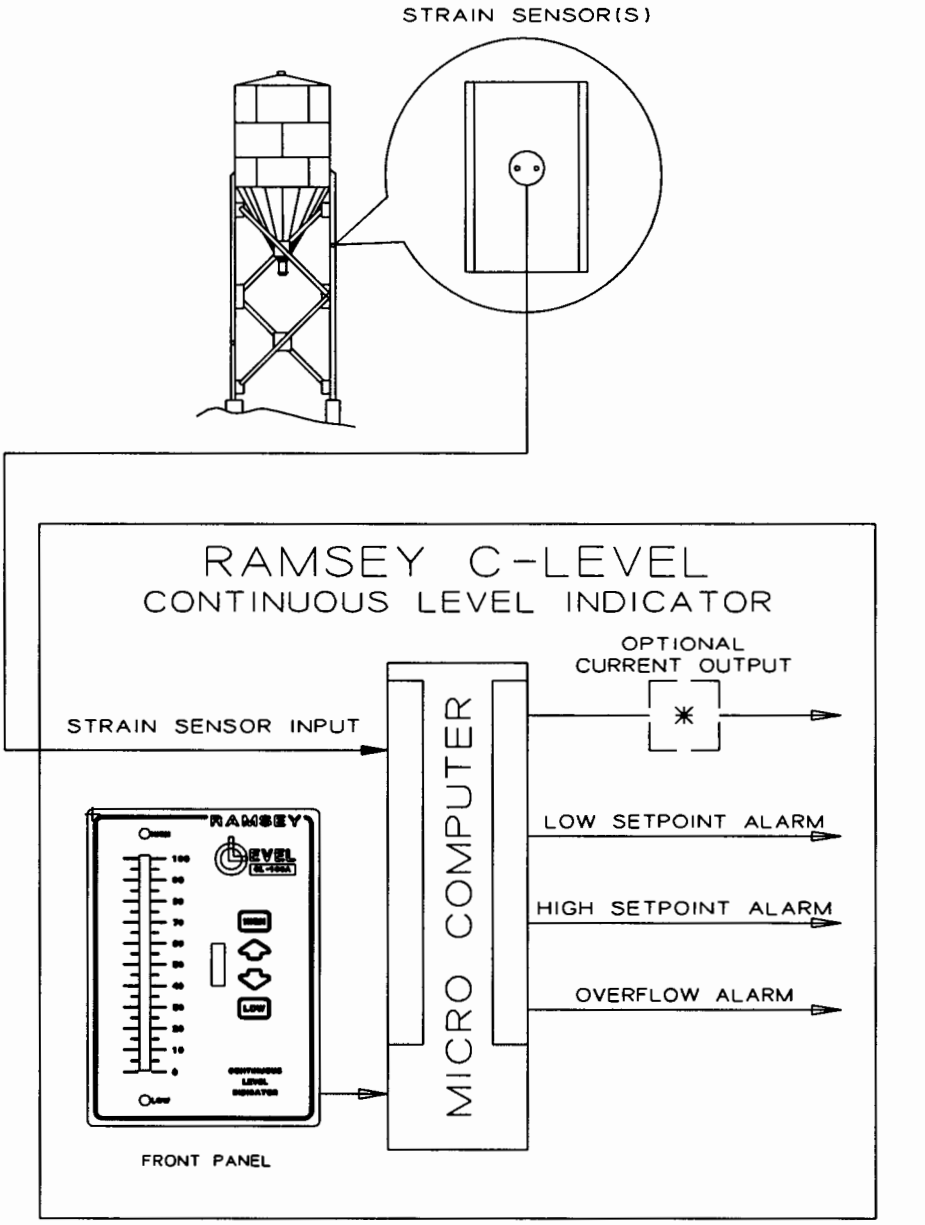




SENSOR INSTALLATION TOOL
FIGURE 1-3

1.3 CURRENT OUTPUT (OPTION)

An optional current output board (0-20 mA, 4-20 mA) can be installed in the electronic package to provide remote level indication (Figure 1-4).



✳ 20mA CURRENT LOOP FOR REMOTE READOUT OR CONTROL FUNCTIONS

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SIMPLIFIED SYSTEM DIAGRAM
FIGURE 1-4

TABLE 1-1

C-LEVEL MODEL CL-100A
TECHNICAL SPECIFICATIONS

1.4 SPECIFICATIONS

Power Requirements:

Voltage:	
120/240 VAC unit:	120 VAC or 240 VAC, -0 15% to +10% (Switch Select)
100/200 VAC unit:	100 VAC or 200 VAC, -15% to +10% (Switch Select)
Frequency:	48 to 62 Hz
Input Power:	Less than 15 VA
Fusing/Switching:	Internal 1/4" x 1 1/4" Slo-Blo, type 3AG; 3/16 amp for 100 VAC or 120 VAC; 1/8 AMP for 200 VAC or 240 VAC; fuse opens H side of power input; internal switch on H side of power input.

Outputs:

Alarm Outputs:	High, low, and overflow setpoints. High, low customer settable (0-100%); overflow factory set at 102%. 1 form C (SPDT) rated 5 amp at 250 VAC; 5 amp at 28 VDC.
Current Output:	Optional. Selectable 0-20 mA or 4-20 mA output into 800 ohms maximum; 0.1% minimum resolution (10 bit).

Enclosure and Poly Junction Box:

Type:	Field, Surface Mount
Construction:	Structural foam polystyrene; conforms IP64, per British Standard S490:1966, IEC 529: 1976 and DIN 4005D (weather-tight, splash-proof, dust-tight).
Finish:	Textured surface, Thermo Ramsey blue.
Size: (Overall)	10.0 H x 8.4" W x 5.6" D
Material:	UL Listing 94HB

Environment:	
Temperature Range:	Control storage -40° to +70° C Operating -10° to +50° C
Humidity:	Up to 95% relative humidity, non-condensing sensor; Sensor is hermetically sealed; storage/operation -40° to +70° C
Strain Sensor Interface:	
Excitation Voltage:	10 VDC
Sense Input Impedance:	50 kΩ
Excitation Cable Length:	1000 ft. maximum with Belden 9553 cable or equivalent (6 conductor, 18 gauge)
Number of Sensors:	Up to 8 - 700 ohm strain sensors
Signal Input:	Full scale ±10.0 mV Max. zero offset ±10.0 mV Max. usable input ±20.0 mV
Stress Range	1500 to 14,300 psi
Display:	Red LED bar graph; .2W x .06H, 50 segment with .1" LED for high/low indications, 6-8 ft. viewing distance.
Electronics/Accuracy:	
Accuracy:	Sum of all electronic system errors is less than 2.0% of full scale
Micro-Processor:	8 bit, 8049 AH HMOS micro-computer, 196,000 instructions/second, 9.8 MHZ clock. Non-volatile NVRAM memory. 14 bit A/D resolution, A/D linearity less than 0.1% of net.
Shipping Weights:	
C-Level with Tool:	15 lbs.
Sensor with Junction Box:	3 lbs.
Optional Current Output Board:	2 lbs.

1.5 WARRANTY

THERMO ELECTRON

WARRANTY

The seller agrees, represents, and warrants that the equipment delivered hereunder shall be free from defects in material and workmanship. Such warranty shall not apply to accessories, parts, or material purchased by the seller unless they are manufactured pursuant to seller's design, but shall apply to the workmanship incorporated in the installation of such items in the complete equipment. To the extent purchased parts or accessories are covered by the manufacturer's warranty, seller shall extend such warranty to buyer.

Seller's obligation under said warranty is conditioned upon the return of the defective equipment, transportation charges prepaid, to the seller's factory in Minneapolis, Minnesota, and the submission of reasonable proof to seller prior to return of the equipment that the defect is due to a matter embraced within seller's warranty hereunder. Any such defect in material and workmanship shall be presented to seller as soon as such alleged errors or defects are discovered by purchaser and seller is given opportunity to investigate and correct alleged errors or defects and in all cases, buyer must have notified seller thereof within one (1) year after delivery, or one (1) year after installation if the installation was accomplished by the seller.

Said warranty shall not apply if the equipment shall not have been operated and maintained in accordance with seller's written instructions applicable to such equipment, or if such equipment shall have been repaired or altered or modified without seller's approval; provided, however, that the foregoing limitation of warranty insofar as it relates to repairs, alterations, or modifications, shall not be applicable to routine preventive and corrective maintenance which normally occur in the operation of the equipment.

"EXCEPT FOR THOSE WARRANTIES SPECIFICALLY CONTAINED HEREIN, SELLER DISCLAIMS ANY AND ALL WARRANTIES WITH RESPECT TO THE EQUIPMENT DELIVERED HEREUNDER, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE. THE SOLE LIABILITY OF SELLER ARISING OUT OF THE WARRANTY CONTAINED HEREIN SHALL BE EXCLUSIVELY LIMITED TO BREACH OF THOSE WARRANTIES. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF THE WARRANTIES SET OUT ABOVE SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE ACCESSORY, PART OR MATERIAL WITH A SIMILAR ITEM FREE FROM DEFECT, AND THE CORRECTION OF ANY DEFECT IN WORKMANSHIP. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES."

FIELD SERVICE

Purchaser agrees to underwrite the cost of any labor required for replacement; including time, travel, and living expenses of Thermo Electron Field Service Engineer at closest factory base.

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CHAPTER 2.0
INSTALLATION

2.1 GENERAL

This chapter contains information necessary to locate and install the strain sensor and electronics. Correct location and installation of the strain sensor is important for optimum performance.

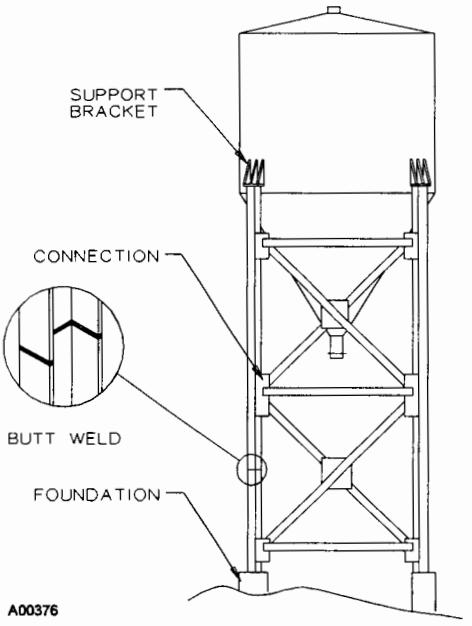
2.2 SENSOR LOCATION

The strain sensor must be installed in the correct location for best C-Level performance. This chapter discusses sensor location requirements, mounting areas to avoid, multiple sensor advantages, locations on vertical supports, and locations on horizontal supports.

2.2.1 General Mounting Rules

The following mounting rules should be adhered to:

1. Physical Constraints:
   - A. Support members must be made of structural steel.
   - B. Bin contents of relatively uniform density.
   - C. Bin has one compartment only.
   - D. Avoid shock loading.
   - E. Avoid sources of high electrical noise.
2. General Mounting Rules: (Figure 2-1)
   - A. Avoid foundations.
   - B. Avoid vessel support brackets.
   - C. Avoid structural connections.
   - D. Avoid welded supporting members.
   - E. Stay above or between horizontal leg braces.
   - F. Stay away from welded or bolted joints if skirted bins.
3. Multiple Sensor Advantages
   - A. Allows for strain averaging.
   - B. Eliminates uneven loading errors.
   - C. Eliminates wind loading errors.
   - D. Reduces thermal gradient effects.
   - E. Improves overall system accuracy.



GENERAL MOUNTING RULES
FIGURE 2-1

2.2.2 Bin Support Stress Level

The strain sensor must see a pounds per square inch (psi) stress change, between 0 and 100% bin full, of more than 1500 psi but less than 14,300. The sensor accuracy is limited if 1500 psi change is not seen. Damage due to overloading can occur on stress levels of more than 14,300 psi.

1. Vertical Structure Stress Levels:

   For vertically supported structures, normal stress is found using the following formula: (Figure 2-2)

$$Normal\ Stress = \frac{P}{(N)\ (A)}$$

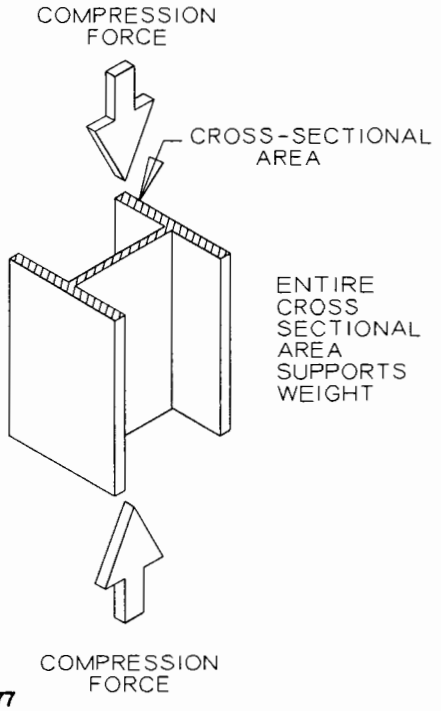
   Where P = Total Bin Material Capacity (lbs.)
   N = Total Number of Supports
   A = Cross-Section Area for Each Leg (sq.in.)

2. Horizontal Structure Stress Levels:

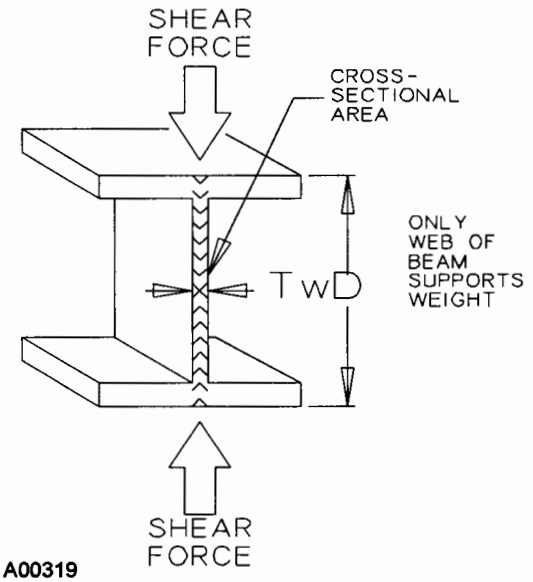
   For horizontally supported structures, shear stress is found using the following formula: (Figure 2-3)

$$Shear\ Stress = \frac{P}{2(N)\ (D)\ (TW)}$$

   Where P = Total Bin Material Capacity (lbs.)
   N = Number of Bin Support Gussets
   D = Depth of Beam (in.)
   TW = Web Thickness (in.)



VERTICAL NORMAL STRESS
FIGURE 2-2



HORIZONTAL SHEAR STRESS
FIGURE 2-3

3. Skirt Supported Stress Levels

$$Stress = \frac{P}{(12)\ (\pi)\ (d)\ (st)}$$

Where P = Total Bin Capacity (lbs.)
d = diameter in feet
π = 3.14 (Pi)
st = skirt thickness (in.)

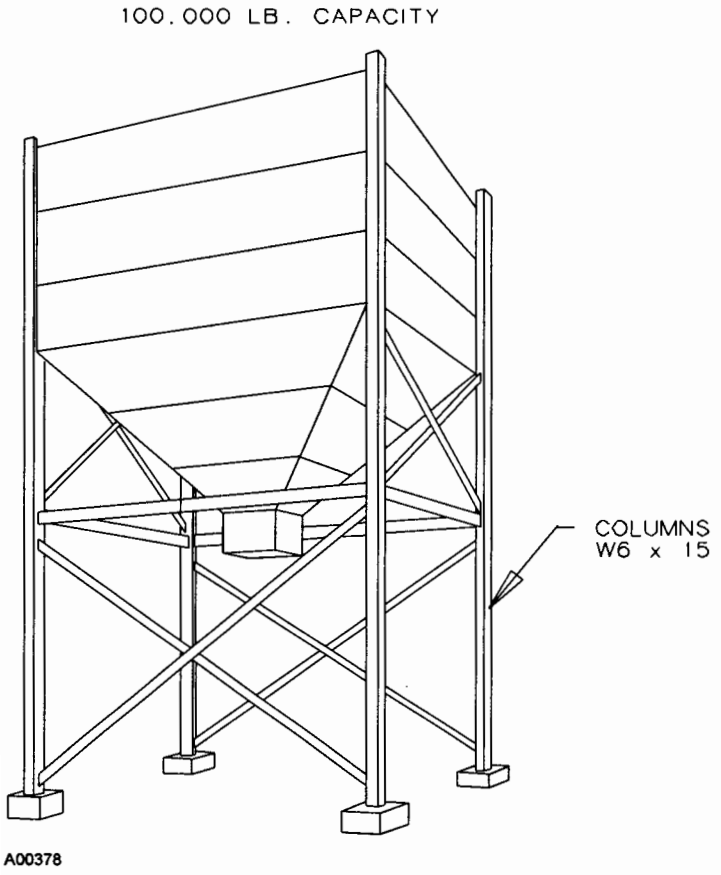
EXAMPLE #1:

Find the normal stress in the supports of Figure 2-4 given the bin has a capacity of 100,000 lbs. and W6 x 15 legs.

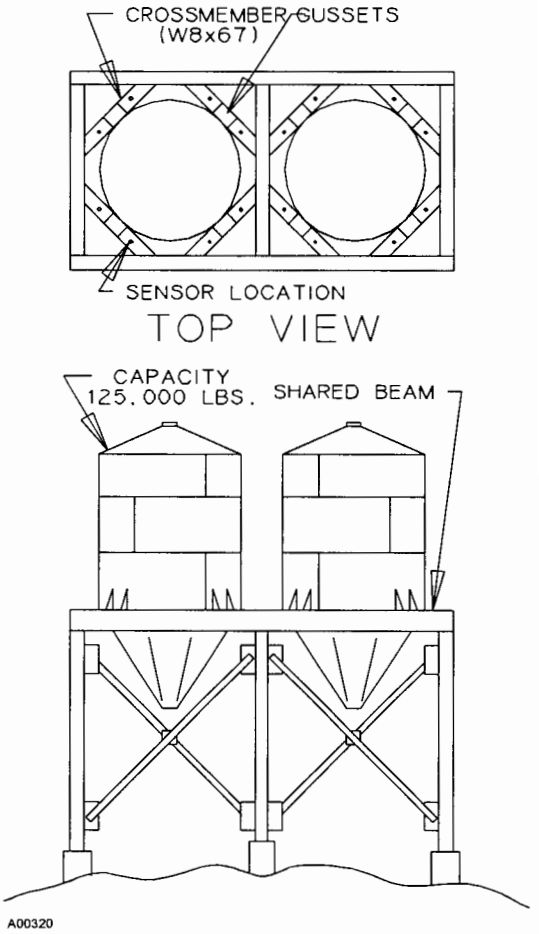
This structure has four legs and a capacity of 100,000 lbs.

Normal Stress = 5643 psi

$$Normal\ Stress = \frac{100{,}000\ lbs.}{(4)\ (4.43\ sq.\ in.)}$$



VERTICAL SUPPORTS NORMAL STRESS
FIGURE 2-4



HORIZONTAL BEAMS SHEAR STRESS
FIGURE 2-5

EXAMPLE #2:

Find the shear stress in the horizontal beam supports of the bin on the left in Figure 2-5 given the bin has W8 x 67 cross-members and a capacity of 125,000 lbs.

This structure has four gusset supports and a capacity of 125,000 lbs.

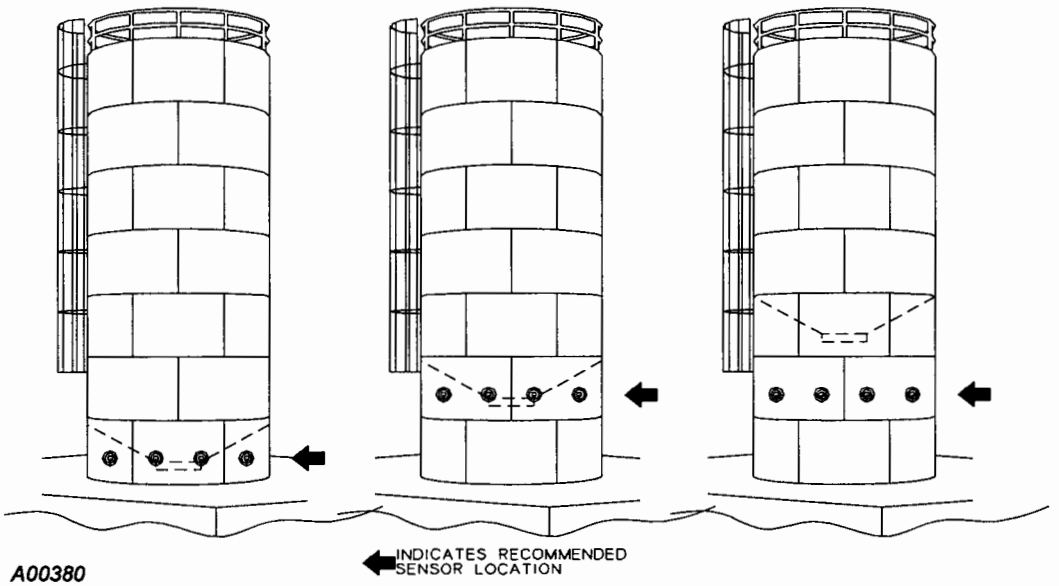
$$Shear\ Stress = \frac{125{,}000\ lbs.}{2(4)\ (9.00\ in.)\ (0.57\ in.)}$$

Shear Stress = 3046 psi

EXAMPLE #3:

Find the stress in a skirted silo which holds 100 ton of material. Skirted silo (Figure 2-6) is 12 feet in diameter with 3/16 skirting.

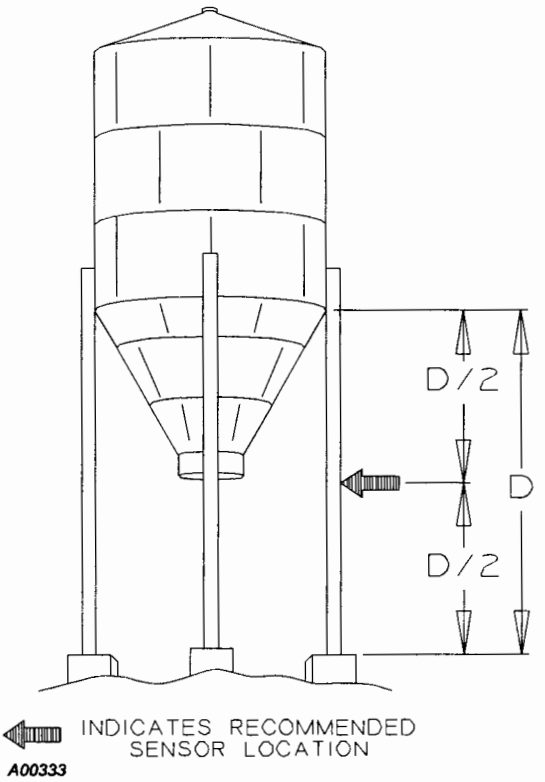
$$Stress = \frac{200{,}000}{(12)\ (\pi)\ (12)\ (.187)} = 2{,}367\ psi$$



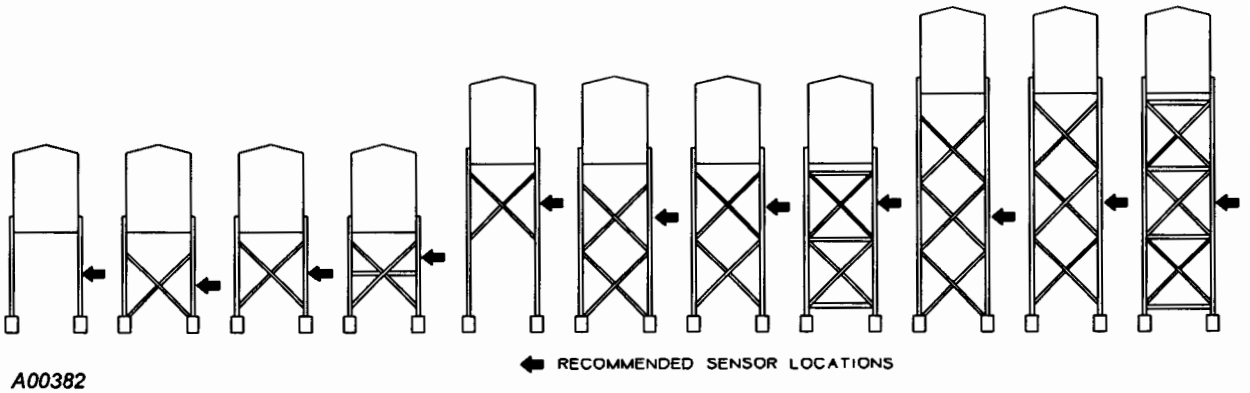
SKIRTED SILO
FIGURE 2-6

2.2.3 On Vertical Supports

Vertical structures transfer bin forces through columns to the foundation. Mount the sensor in the center of the longest free-standing section of the column. If cross bracing or diagonal members are present, mount the sensor between the bracing connection on the column web (Figures 2-7 and 2-8).

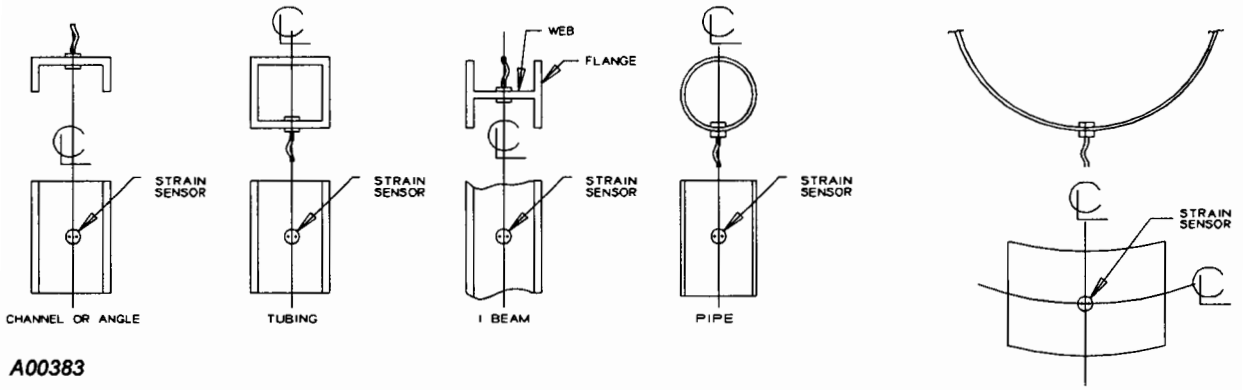


VERTICAL APPLICATION - NO BRACING
FIGURE 2-7



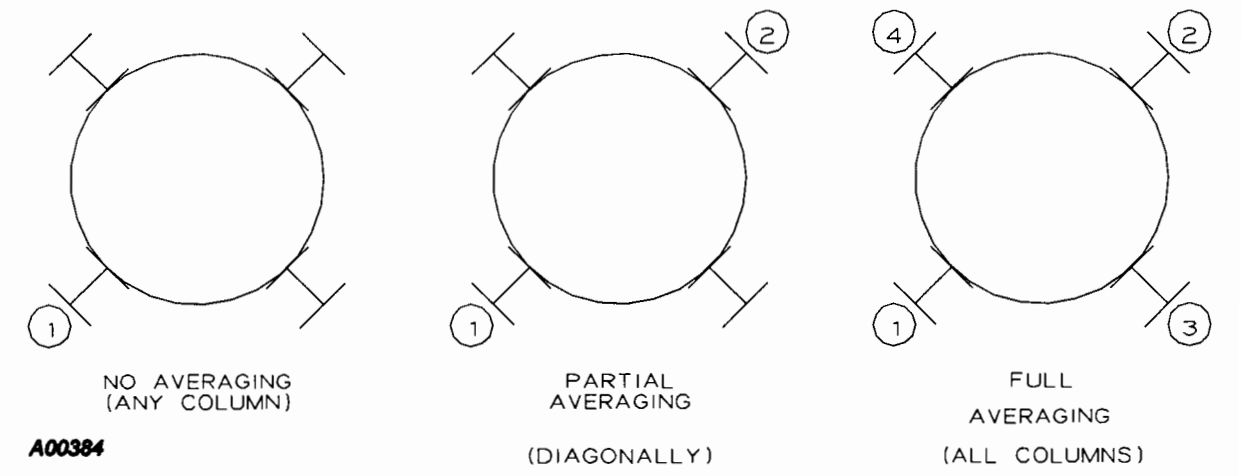
TYPICAL SENSOR LOCATIONS - VERTICAL
FIGURE 2-8

1. Always mount the strain sensor in the middle of the column web. Never place the sensor in the column flange (Figure 2-9).



STRAIN SENSOR MOUNTING
FIGURE 2-9

2. Using multiple sensors lets the sensor average uneven loads, wind, and improves accuracy (Figure 2-10).



MULTIPLE SENSOR CONFIGURATION - COLUMNS
FIGURE 2-10

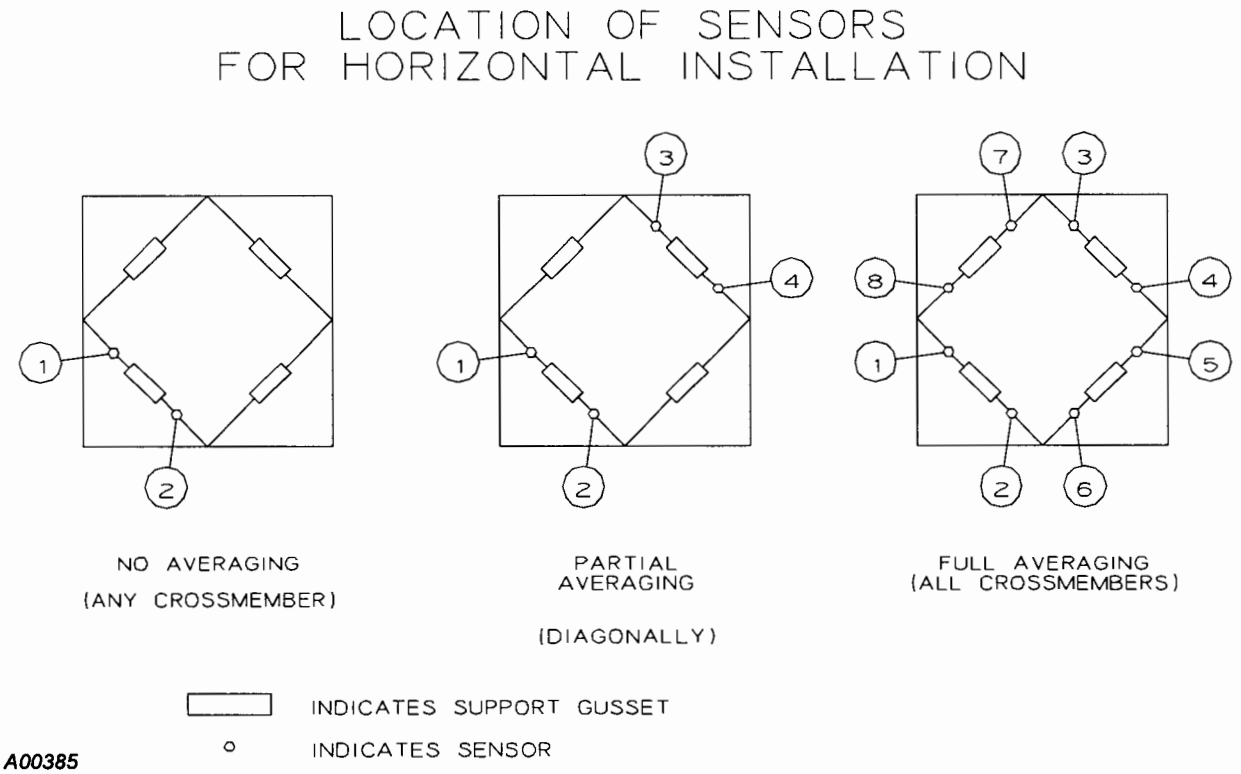
2.2.4 Location On Horizontal Supports

Horizontal structures transfer bin forces through beams. Vessels that share common columns and beams normally require horizontal member installations. Do not install the sensor on multiple vessel structures that share common columns and beams unless the vessel support brackets rest on corner braces. Consult your Thermo Ramsey representative regarding horizontal support structure layouts not illustrated in Figures 2-11 and 2-12.

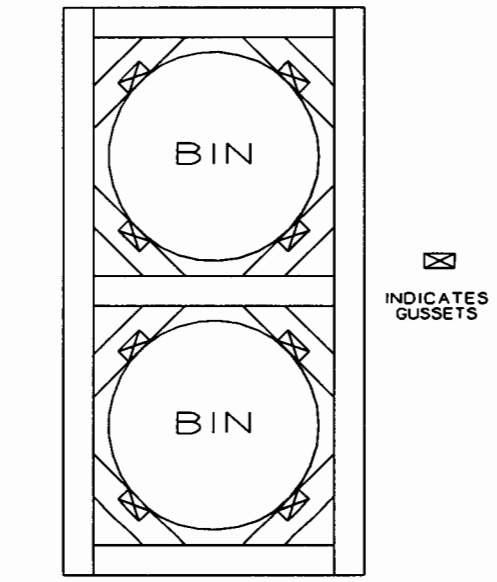
The sensors are mounted on the support beam or corner braces, located in pairs, one on each side of the support bracket or gusset. The sensors are aligned at a 90 degree angle with stress force line (Figure 2-12). Mount the sensor in the center of the longest free-standing section of the support beam or corner bracing between the bracket and fixed end.

NOTE: Always mount the sensor in the middle of the beam web. NEVER place the sensor in the beam flange (Figure 2-9).

1. Using multiple sensors lets the sensor average uneven loads, wind, and improves accuracy (Figure 2-11).

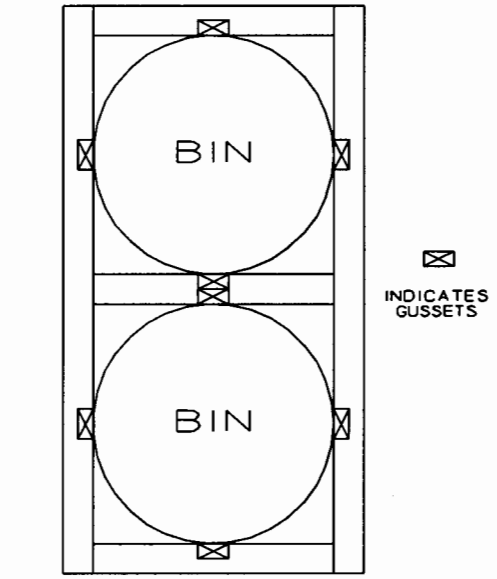


STRAIN SENSOR PLACEMENT
FIGURE 2-11



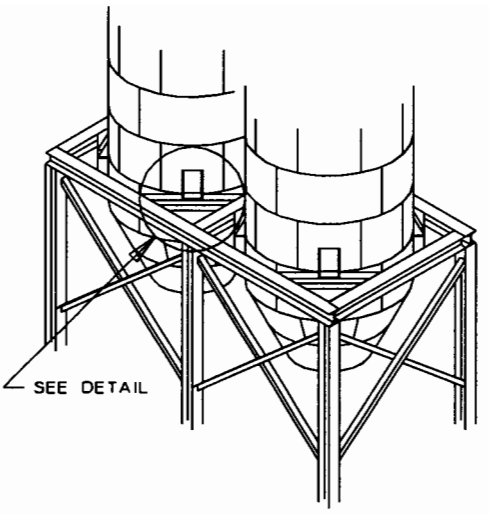
GOOD APPLICATION

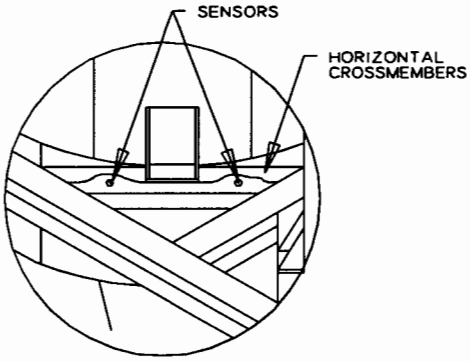
GUSSETS ON CORNER BRACING
(INDIVIDUALLY SUPPORTED)



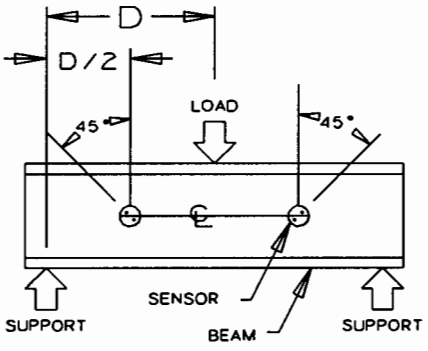
POOR APPLICATION

GUSSETS ON HORIZONTAL SUPPORTS
CAUSES INTERACTION BETWEEN BINS
(SHARED BEAM SUPPORT)





DETAIL



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HORIZONTAL APPLICATIONS AND LOCATION
FIGURE 2-12

2.3 SENSOR INSTALLATION

The strain sensor must be installed correctly for best C-Level system performance. Proper installation requires the following steps:

1. Selecting the best column or beam location see Section 2.2.3 or 2.2.4.
2. Properly drilling the precision hole.
3. Correctly installing the strain sensor (for horizontal or vertical beams).

2.3.1 Tools Required

Several tools are required to install the strain sensor properly. Special tools are included in the installation package and several common hand tools are provided by the customer.

1. Installation Package Tools

   The following items are included in the single sensor installation tool package.

   - 1-1/4 Inch 1/4"-20 Bolts (4)
   - 2 Inch 1/4"-20 Bolts (2)
   - 2-3/4 Inch 1/4"-20 Bolts (2)
   - 3/4 Inch Installation Bushing
   - 3/4 Inch Counterbore Drill Bit
   - Installation Tool for Curved Surface or Flat Surface (Figure 2-15)
   - Electrical Junction Box
   - Electrical Junction Box Cover
   - Electrical Junction Box Gaskets (2)
   - Open Gear Lubricant - NOTE: DO NOT use as cutting oil.
   - 1/4"-20 Nuts (4)
   - Pushplate
   - Strain Sensor
   - Sensor Location Template
   - 1/4" Flat Washers (4)

2. Customer Provided Tools

   The following items must be provided by the customer.

   - Cutting Oil
   - Hammer
   - ½ Inch Drill Motor - 300 - 400 RPM
   - 1/8 Inch Drill Bit
   - 17/64 Inch Drill Bit
   - 3/8 Inch Drill Bit
   - 7/16 Inch Open Ended Wrench
   - Paper Towels (or Cloth)
   - Center Punch
   - Putty Knife (or Screwdriver)
   - Scratch Awl (or Pencil)
   - Straight Edge
   - 7/16 Inch Socket & Handle
   - Tape Measure (as Needed)

   NOTE: The list of customer supplied tools serves as a guide where substitutions can be made. However, for best results, use the suggested tools.

2.3.2 Using The Strain Sensor Template

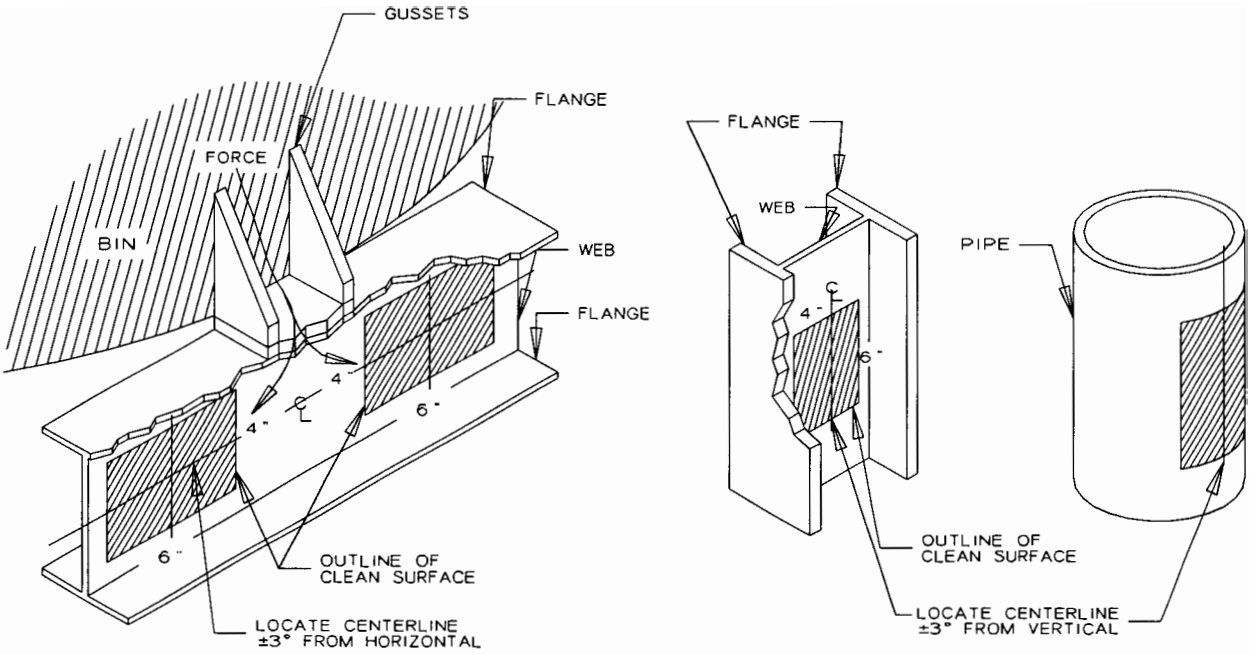
The strain sensor template is used to correctly mark the location of the installation tool mounting holes. The correct strain sensor mounting location must be selected before sensor installation. Review Section 2.2 if needed.

The following procedure describes how to locate the template:

1. Locate the column web area where the sensor is to be placed. Clean any accumulated material from the column web area using a putty knife or screwdriver. A 4 inch by 6 inch area is recommended (Figure 2-13).

   NOTE: The beam surface does NOT have to be prepared by grinding.

2. Locate the center of the column web in the approximate location where the sensor is to be placed. Using a scratch awl and straight edge, make a vertical line, about 6 inches in length, in the center of the column web. This is the vertical centerline (Figure 2-13).



WEB SURFACE PREPARATION
FIGURE 2-13

2.3.3 Drilling Tool Mounting Holes

Place the sensor location template on the column web so its notches are aligned with the vertical centerline. Be sure that the middle hole of the template is placed over the approximate location where the sensor is to be placed.

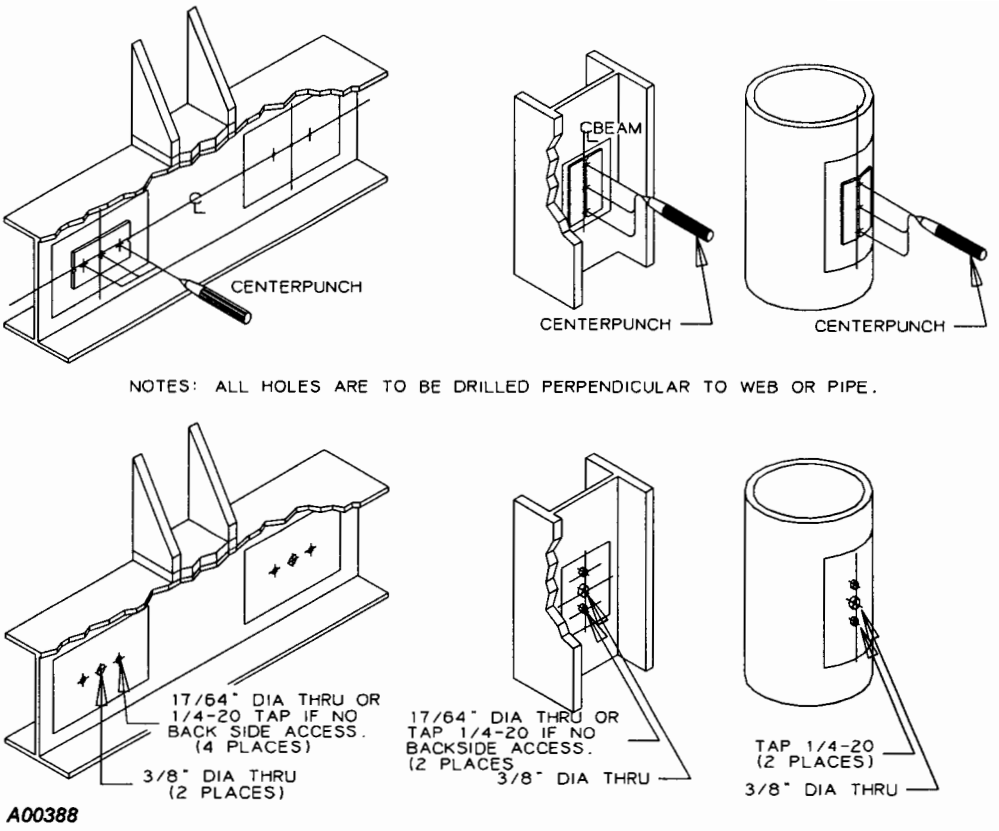
1. Center punch through the three holes in the sensor location template (Figure 2-14).

CAUTION

BE CAREFUL TO PUNCH THE HOLES ACCURATELY.

Drill the tool mounting holes using the following procedure:

2. Drill three 1/8 inch pilot holes through the column web at the location of the punch marks.
   A. If you do not have access to the back side of the column (pipe or tubing), drill the holes out using a 13/64 inch drill bit and then tap the two outside holes (tool mounting holes) to 1/4-20.



TOOL MOUNTING HOLES
FIGURE 2-14

B. If you have access, drill the two outside holes using a 17/64 inch drill bit. The center hole should be drilled out to 3/8 inch.

C. If the beam is more than ½ inch thick, drill out center hole to ½ inch.

2.3.4 Drilling Sensor Hole

Mount the installation tool on the column web (Figure 2-15).

NOTE: The installation tool must be mounted with the chamfered or notched side against the column web.

Make sure that the tool is bolted down tightly. A loose tool will produce holes that are too large for the strain sensor.

A precision counterbore is used to drill the sensor hole because the hole must be round and the right size.

Drill the sensor hole using the following procedure:

1. With the tool bolted securely against the column web, lubricate the inner bushing of the installation tool with cutting oil.

   NOTE: Do not use GEAR LUBRICANT provided with installation kit as cutting oil.

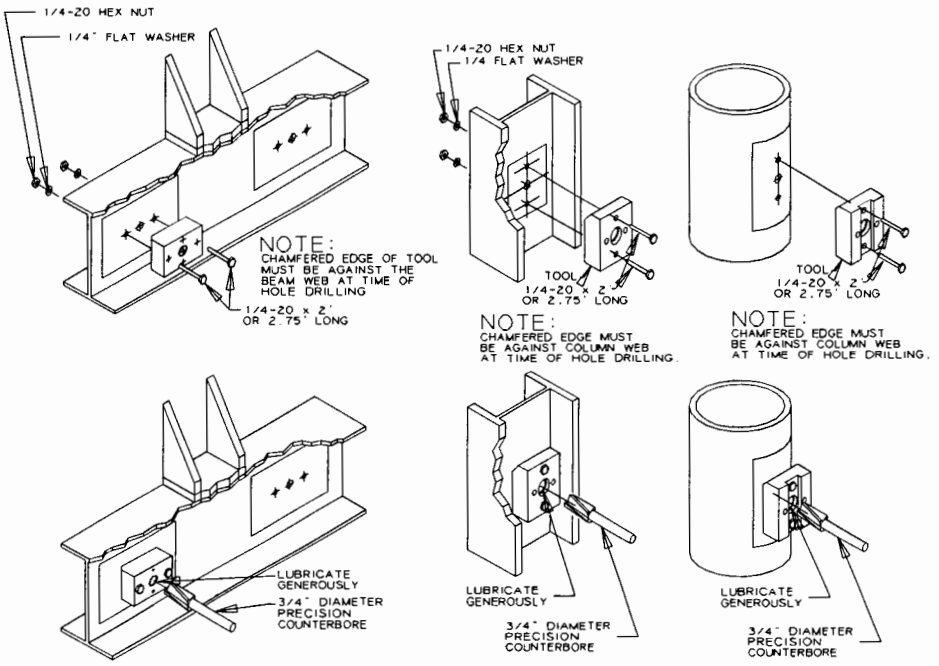
2. Carefully insert the 3/4 inch counterbore drill bit into the inner bushing of the installation tool. A drill speed of 300-400 RPM is recommended.

3. About every 15 to 20 seconds, remove the drill from the installation tool. Clear the drill bit and installation tool of excess metal shavings and use cutting oil. Be sure drill bit is completely reset in the hole before restarting drill.

CAUTION

REDUCE DRILL PRESSURE AND BE CAREFUL AS THE DRILL BREAKS THROUGH THE OTHER SIDE OF THE COLUMN WEB. THIS WILL PROTECT THE PRECISION HOLE FROM DAMAGE DUE TO DRILL BINDING.

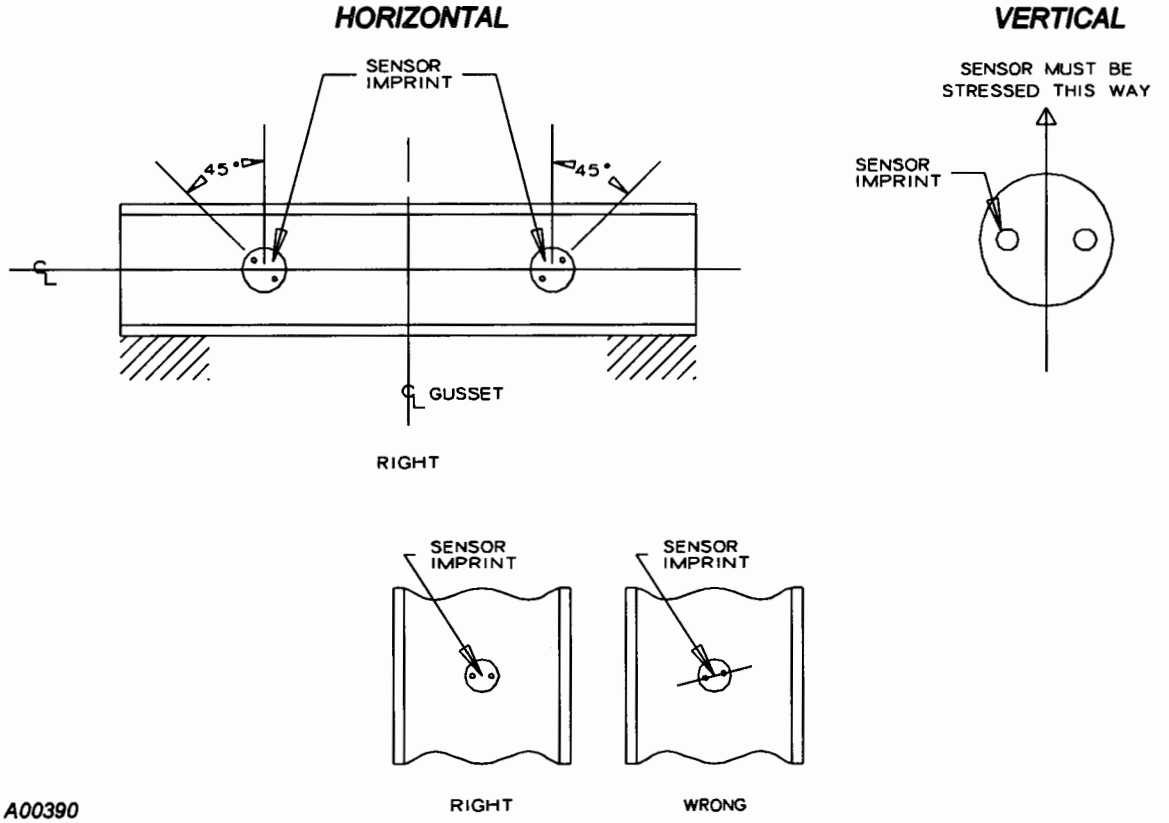
4. Unbolt and remove the installation tool from the column web.
5. Using a cloth or paper towel, thoroughly clean the hole, installation tool and column web of oil and metal shavings.



MOUNTING INSTALLATION TOOL
FIGURE 2-15

2.3.5 Sensor Alignment Mark

Make a strain sensor alignment mark on the beam using a pencil or scratch awl. The strain sensor must be installed so the strain sensor dimple is at a right angle with the force change. If the sensor is out of angular alignment, maximum stress cannot be measured. Mark both sides of web if possible (Figure 2-16).



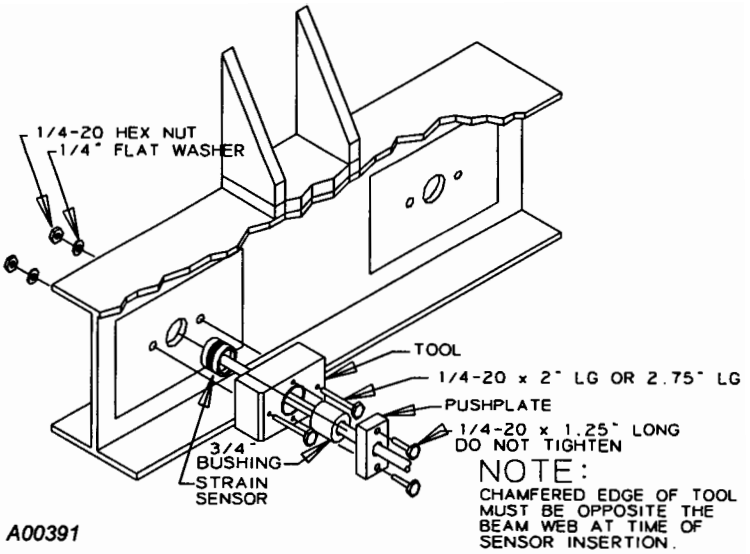
SENSOR ALIGNMENT
FIGURE 2-16

2.3.6 Sensor Installation

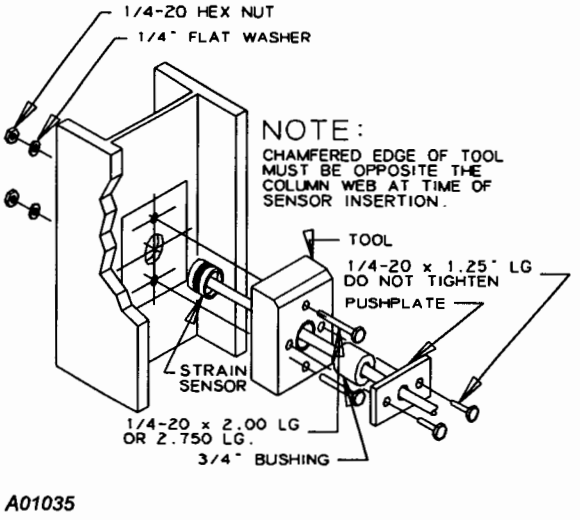
The installation tool is used to press-fit the sensor into the beam web. It aligns and installs the strain sensor without damaging it (Figure 2-17).

Install the sensor using the following procedure:

1. Position the installation tool so the chamfered or notched side is away from the beam web.
2. Place the installation tool pushplate over the installation tool holes. Insert the 1.25 inch 1/4-20 bolts through the pushplate into the installation tool about two turns.
3. Insert the 3/4 inch bushing into the inner bushing of the installation tool from the rear.
4. Brush the entire knurled surface of the sensor with the open gear lubricant supplied with the tool.



BEAMS



COLUMNS

STRAIN SENSOR MOUNTING
FIGURE 2-17

5. Draw the cable of the strain sensor through the center of the installation tool including the 3/4 inch bushing and pushplate.
6. Align the sensor imprint with the alignment mark made in Section 2.3.5.
7. Mount the installation tool on the beam web and tighten the bolts that hold the tool to the beam. Alternate 1/4"-20 x 2.75" tool mounting bolts are used for thicker beams.

   NOTE: Make sure that the installation tool is bolted down tightly. Incorrect strain sensor seating will result if the bolts are not tight.
8. Look at the opposite side of the column web. Align the sensor imprint with alignment mark. Then finger tighten the pushplate bolts until they are snug.

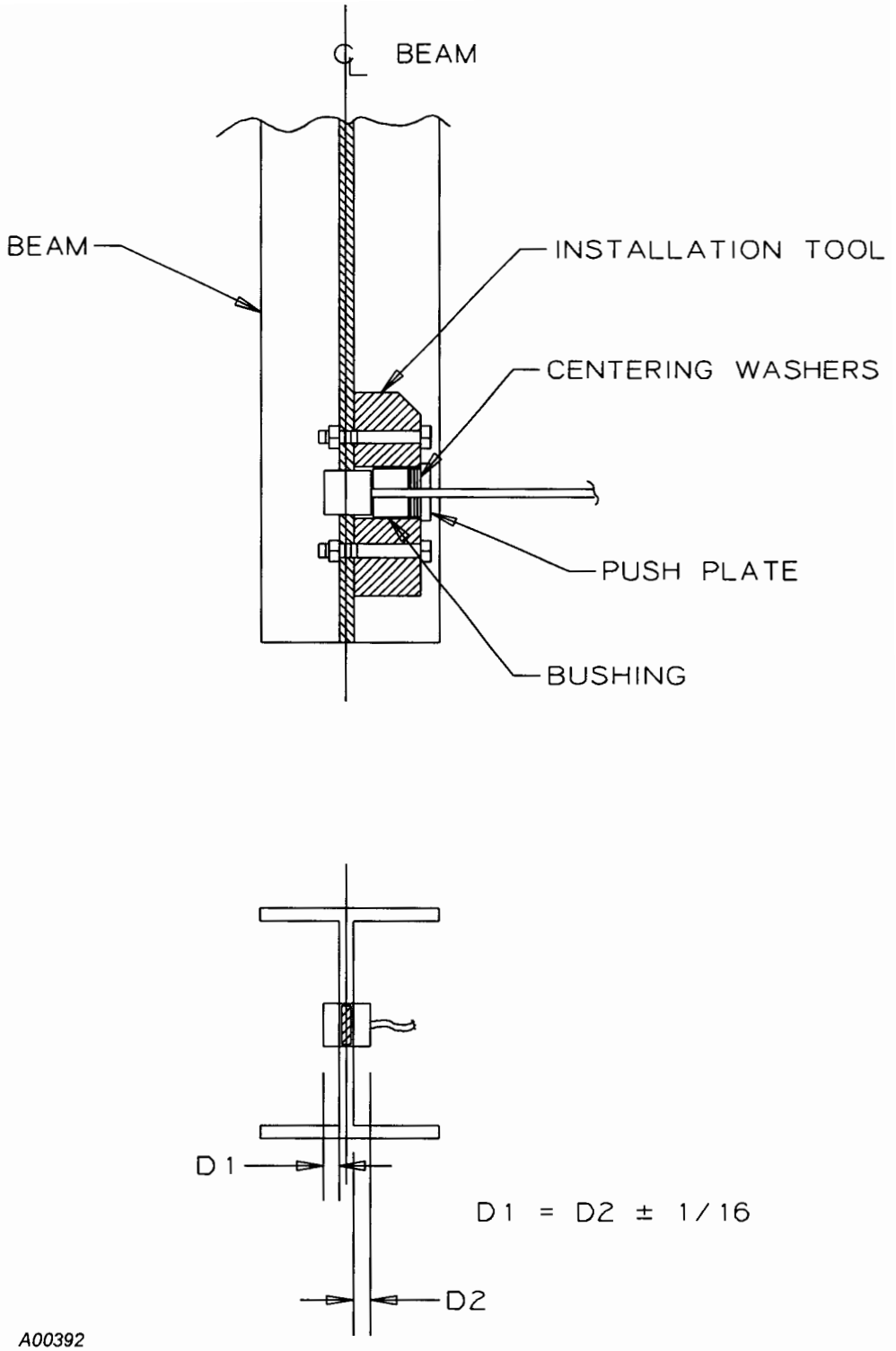
   NOTE: Keep the strain sensor imprint within 3 degrees of the alignment mark. If the sensor is out of angular alignment, maximum stress levels cannot be measured.

   NOTE: On a structure where you cannot see the back side to check sensor alignment, use the following alignment:

   a. Align the sensor imprint with the alignment mark and seat into the hole by pushing it in with your fingers.

   b. Mount the installation tool and press the sensor in 0.02 to 0.04 inch (about ½ turn of the bolts on the push plate).

   c. Check alignment by removing push plate and bushing. If not correct, pull sensor out by the metal case and re-seat. When the sensor imprint is within 3 degrees of alignment, finish inserting the sensor.
9. Tighten one pushplate bolt one-quarter turn. Then tighten the other pushplate bolt one-quarter turn.
10. Repeat above step until the bolts cannot be tightened further.
11. The strain sensor must now be pushed into the center of the beam (Figure 2-18). Measure the beam's wall thickness and determine from Table 2-1 the number of washers needed for the centering push.
12. Remove the pushplate and add the washers.
13. Tighten one pushplate bolt one-quarter turn, then tighten the other pushplate bolt one-quarter turn.
14. Repeat until the bolts cannot be tightened further.
15. If a second centering push is required because of beam thickness, add washers as required by Table 2-1 and repeat.
16. Remove the installation tool from the column web. The strain sensor should now be press-fit into the structural member.
17. Brush both sides of the column web around the sensor with lubricant to prevent corrosion.
18. Repeat the sensor installation procedure for each additional strain sensor.



CENTERING STRAIN SENSOR
FIGURE 2-18

TABLE 2-1
CENTERING WASHERS

BEAM WEB THICKNESS	AMOUNT OF 1/4' SAE WASHERS .062 REQUIRED FOR CENTERING PUSH
1/8 - 5/16"	0
3/8 - 7/16"	1
½ - 9/16"	2
5/8 - 11/16"	3
3/4 - 13/16	4
7/8 - 5/16"	5
1 - 1-1/16"	6
1-1/8 - 1-3/16"	7 *
1-1/4 - 1-5/16"	8 *
1-3/8 - 1-7/16"	9 *
1-1/2"	10 *
1-5/8"	11 *
1-3/4"	12 *
1-7/8"	13 *
2"	14 *

* Installation tool can only push 3/8 inch at a time. More than 6 washers will require two or more centering pushes.

2.4 JUNCTION BOX INSTALLATION

The junction box is mounted directly to the beam protecting the sensor and wiring connections. Use the following procedure to install the junction box:

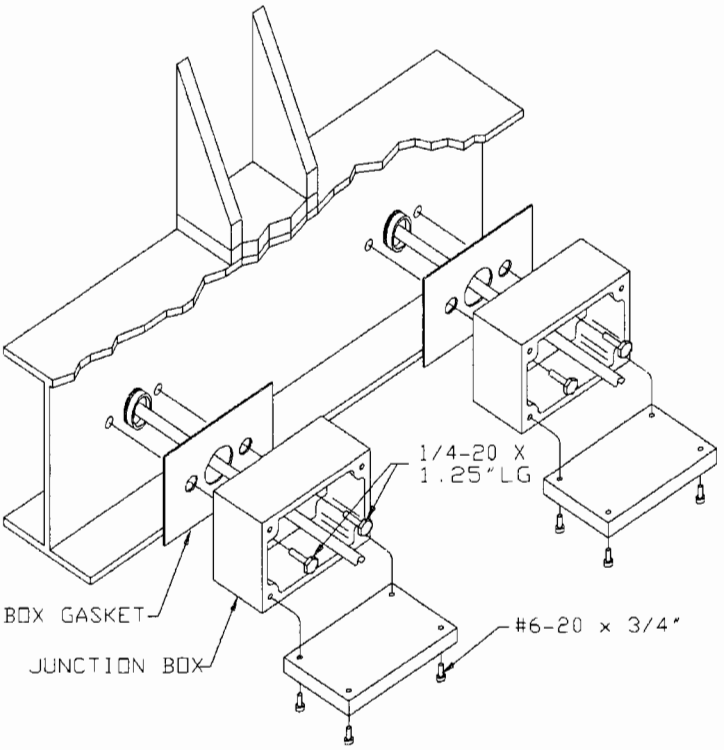
1. Clean drill residue from the cable side of the beam web.
2. Mount the junction box and junction box gasket firmly to the beam web. Make sure that the 3/4 inch conduit connector is pointing sideways, beams or down, columns (Figure 2-19).

NOTE: The junction box uses the same mounting holes as the installation tool.

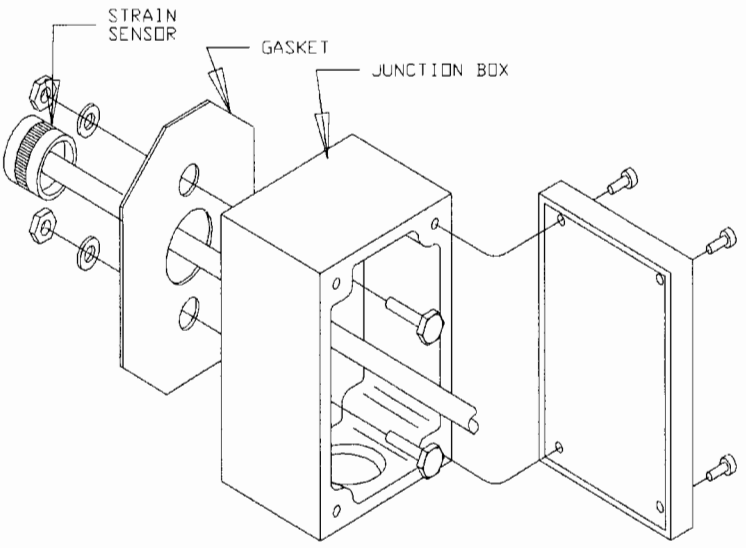
3. Coil the strain sensor cable into the junction box. Conduit and connecting cable will be run to the box after the remaining strain sensors are installed.
4. Repeat the junction box installation procedure for each additional strain sensor in the system.
5. The terminal strip floats loose in the box.

CAUTION

JUNCTION BOXES MOUNTED ON SURFACES THAT ARE NOT FLAT SHOULD BE CAULKED TO PREVENT MOISTURE ENTRY.



BEAMS



COLUMNS

JUNCTION BOX INSTALLATION
FIGURE 2-19

2.5 C-LEVEL JUNCTION BOX INSTALLATION

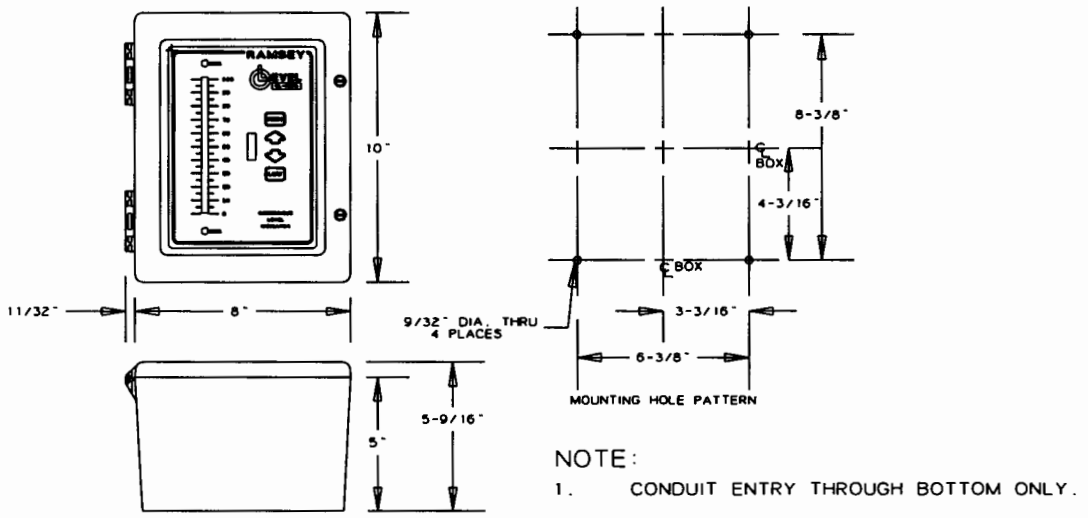
The C-Level electronics (CL-100A) enclosure shall be mounted on a relatively vibration free surface and should not be exposed to excessive heat or moisture. The unit should be shielded from direct sunlight for ease of viewing the displays. In a typical bin-weigh application, the ideal mounting location would be in an area that allows for comfortable display viewing and button operation. The unit can be mounted up to 1000 ft. from the strain sensors (using the remote sense lines, 6 conductor shielded cable). Signal wires and power wires must be in separate conduit with entry holes in the bottom of the enclosure only (Figure 2-20).

CAUTION

It is recommended that the front door containing the control printed circuit board be removed during the hole punching procedure to prevent possible damage.

WARNING

C-Level electronics must be mounted in a non-hazardous area. All wiring between hazardous and non-hazardous areas must conform to all local and national electrical codes.



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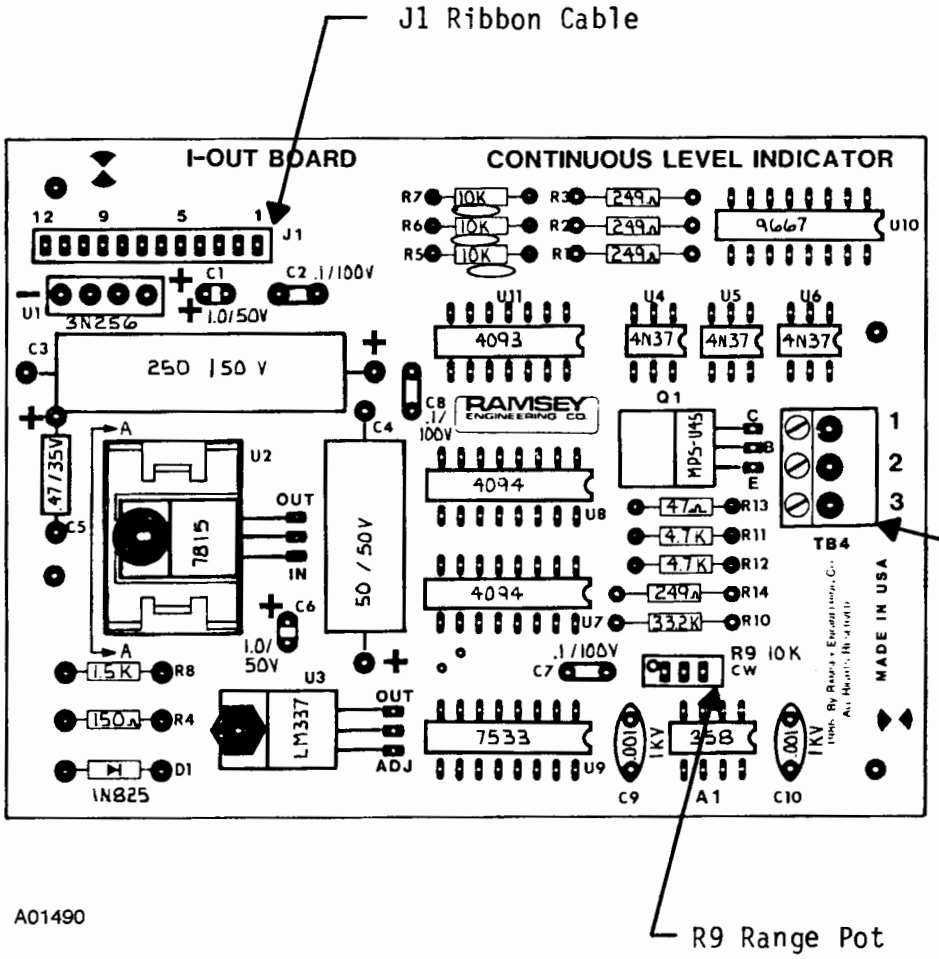
ELECTRONICS OUTLINE AND MOUNTING
FIGURE 2-20

2.5.1 Remote Level Board (Optional)

The optional (remote level) current output board is mounted piggy-back on top of the main C-Level electronic board. To install the current output board, first open the enclosure and turn the power switch off. The board is then plugged into the attached standoffs and the J1 ribbon cable is attached to the J1 connector on the main board. The R9 range pot is factory set at 20 mA. Damping is the same as the front panel display. Current output wiring is terminated on TB4. See Figure 2-21.



CURRENT OUTPUT BOARD
FIGURE 2-21

2.6 FIELD WIRING

Use the typical field wiring diagram as a guide if you do not have a specific wiring diagram for your system. Follow local electrical codes and regulations for minimum wire size and routing (Figure 2-22).

CAUTION

Stranded wire, rather than solid, should be used inside the enclosure of the C-Level Model CL-100A (field mount). The wiring should be long enough, and routed to allow for free movement of the enclosure door.

WARNING

Wiring crossing between hazardous and non-hazardous areas must conform to appropriate national and local codes and practices.

Other critical wiring considerations:

Make sure that the power is OFF.

Do not route signal cables in the same conduit with power lines.

Terminate the cable shields ONLY where illustrated.

Earth ground all enclosures and conduit.

Remote excitation sense lines must be used when sensors are farther than 200 feet from the electronics.

1. Main Power Wiring

   Main power connections are made to the terminal strip TB3 located below the power slide switch. The terminals are labeled H, N, and G signifying the normal hot, neutral and earth ground, respectively, of most systems.

2. Strain Sensor/Junction Box Wiring

   The sensors are wired in parallel using the terminal strip provided with the installation kit (Figure 2-22).

   The junction box terminal strip floats loose in the box.

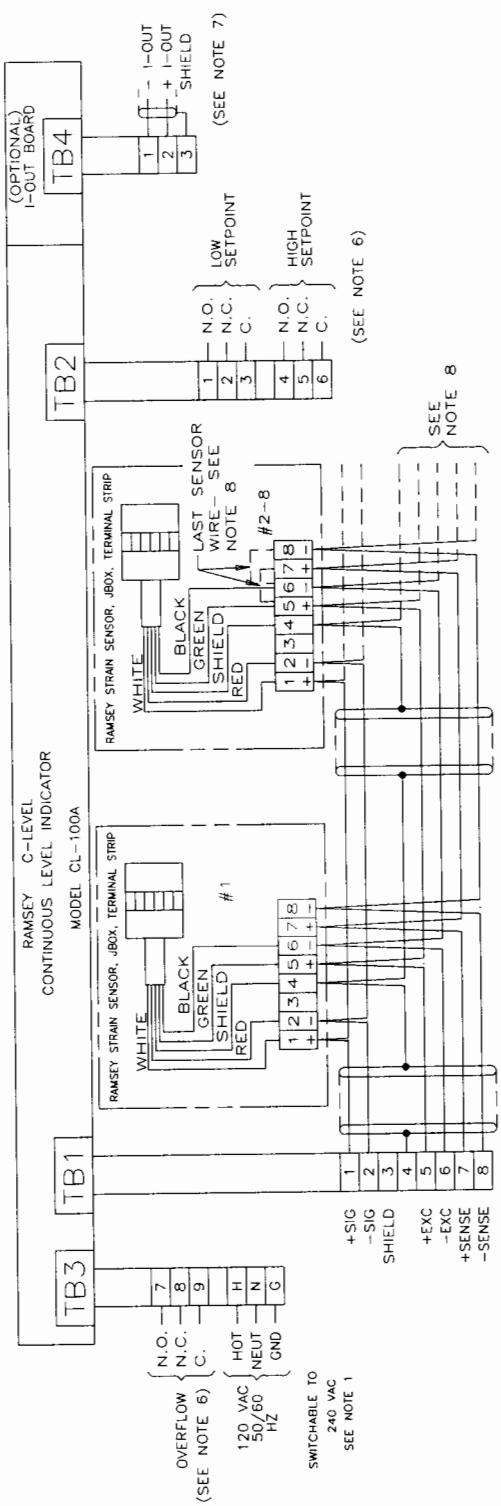
   Remote excitation sense lines are required for all installations. Use 22 - 24 gauge if less than 200 ft. and 18 gauge if farther than 200 ft. away from the electronics package. Always connect the remote sense lines to the furthest sensor away from the electronics package.

   If the junction box is mounted on curved or rough surfaces, a sealant should be applied to the back to prevent moisture entry.

3. Other Wiring

   All wiring is terminated at the unit's "lugless" terminal blocks.

   Note that TB4 is located on the optional current output board attachment.



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NOTES:

1. The CL-100A C-Level is shipped configured for use with 102 - 132 VAC. When using 204 - 264 VAC, the voltage selector switch on the unit must be moved to the 240 VAC position and the internal fuse must be changed to 1/8 Amp.
2. Connect shields only where indicated.
3. Do not run signal lines in same conduit as power lines.
4. Earth ground all electrical enclosures.
5. Strain sensor field wiring cable - 6 conductor shielded less than 200 ft. use 22 - 24 ga. Belden 8786 or equivalent. More than 200 ft., use 18 ga. Belden 9553 or equivalent.
6. Relay contacts rated - 5 amps at 250 VAC.
7. Maximum loop resistance, 800 ohms. Cable - 2 cond. 18 ga. Belden No. 8760 or equivalent.
8. Continue to loop strain sensor field wiring through each junction box/sensor until you come to the last one, when the loop stops. On the last sensor, tie the sense lines to the excitation line: 7 to 5, 8 to 6.

TYPICAL FIELD WIRING
FIGURE 2-22

CHAPTER 3.0
CALIBRATION

3.1 GENERAL

The C-Level must be calibrated correctly for proper system operation. Calibration allows the unit to show the correct value of level.

The standard procedure is the preferred method of calibration. If the bin cannot be fully emptied and filled during the calibration, use the 2-point calibration procedure found in Section 3.3.

The calibration procedure consists of two steps: zero and span.

1. Zero: the bin is emptied and the zero is set.
2. Span: the bin is filled to some known amount, preferably 100% capacity, and the span is set.

The calibration must be completed in order.

NOTE: Always zero first.

After the calibration has been completed, the zero and span settings are stored in the permanent memory of the unit. The C-Level does not need to be recalibrated in the event of a power outage.

3.2 STANDARD EMPTY - FULL CALIBRATION

This procedure is only to be used if the bin can be completely emptied and filled. If not, proceed to Section 3.3.

You may wish, although not required for calibration, to measure and record sensor signal levels at empty and full bin level calibration points. These reference levels would be helpful if a troubleshooting need should arise.

Using a millivolt meter measure empty and full bin levels at TB1-1(+) and TB1-2(-). Typical empty bin level would be between minus (-) 10 and plus (+) 10 millivolts. Full bin level must be more positive than empty level by at least 0.8 millivolts.

3.2.1 Zero Calibration

The first step of the empty-full calibration procedure is zero adjustment (bin empty).

1. The electronics should be on at least 30 minutes prior to calibration.
2. Empty the bin or vessel completely.
3. Open the enclosure and locate calibration switch SW1 on the controller printed circuit board (Figure 3-1).

   Set SW1-1, 2, and 3 to open (off) position.
4. Set the calibration switch SW1-4 to the closed (calibrate) position.

NOTE: The display will blink while in the calibration mode.

5. While pressing the LOW (setpoint calibration) button, use the INCREASE and DECREASE buttons to adjust the display until it indicates zero percent (Figure 3-2).

CAUTION

Do not touch the "High" button while setting zero, as system will freeze after calibration. Repeat Step 5 if necessary.

The low setpoint LED will flash if the display is below zero percent. If this happens, press the INCREASE button until the display reads zero percent. The low setpoint LED will stop flashing.

6. Check the display. It should indicate zero percent. The low setpoint LED should not be flashing.
7. Return calibration switch SW1-4 to the OFF (run) position.

3.2.2 Span Calibration

The second step of the empty-full calibration procedure is the span adjustment.

1. Completely fill the bin.
2. Set calibration switch SW1-1, 2, and 3 to the open (off) position and SW1-4 to the ON (calibrate) position.
3. While pressing the HIGH (setpoint calibration) button, use the INCREASE and DECREASE buttons to adjust the display until it indicates one hundred percent.

CAUTION

At no time touch the "LOW" button while setting full bin level as this will zero bin level at full setting.

The high setpoint LED will flash if the display is above one hundred percent. If this happens, press the DECREASE button until the display indicates one hundred percent. The high setpoint LED will stop flashing.

4. Check the display. It should read one hundred percent. The high setpoint LED should not be flashing.
5. Set calibration switch SW1-4 to OFF (run) position.
6. Close the enclosure and secure the cover screws.

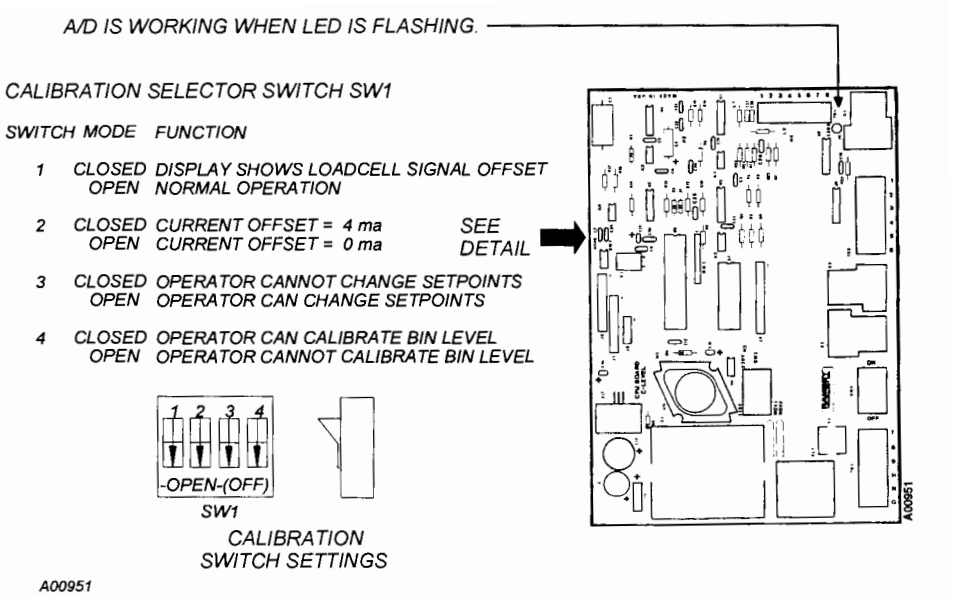
3.3 TWO-POINT CALIBRATION

Incorrect estimation of bin level during the two-point calibration procedure will result in large level indication errors. The standard calibration procedure is ALWAYS the EMPTY-FULL method. See Section 3.2.

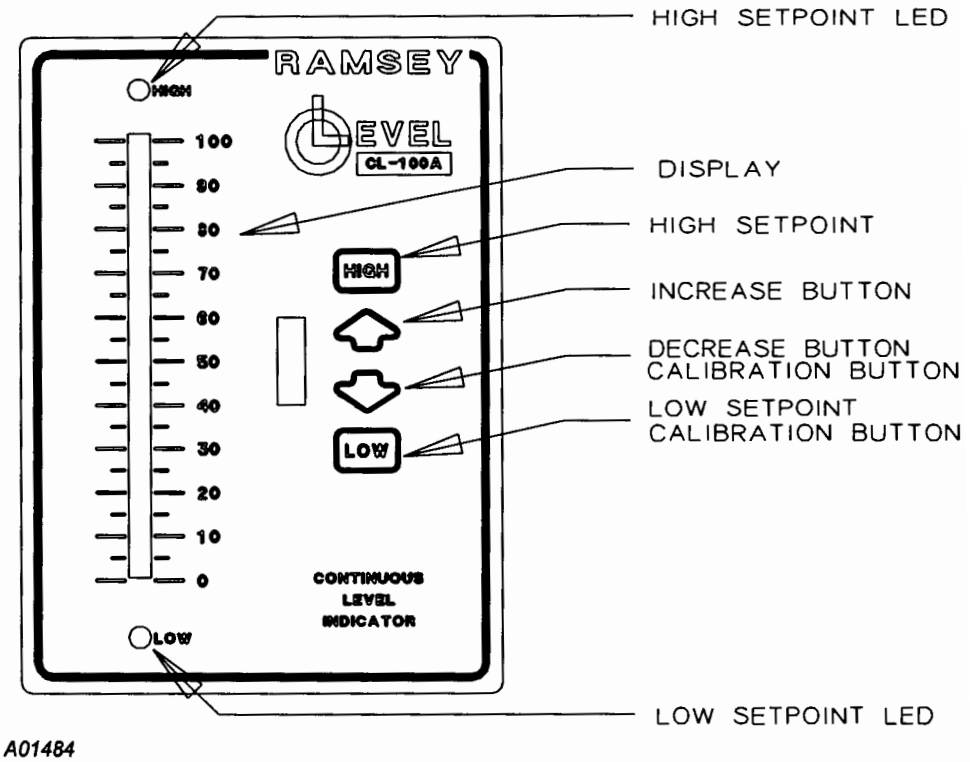
The two-point calibration procedure must be completed in order. Always set calibration point 1 (low level) before calibration point 2 (high level).

You may wish, although not required for calibration, to measure and record sensor signal levels at empty and full bin level calibration points. These reference levels would be helpful if a troubleshooting need should arise.

Using a millivolt meter measure empty and full bin levels at TB1-1 (+) and TB1-2 (-). Typical empty bin level would be between minus (-) 10 and plus (+) 10 millivolts. Full bin level must be more positive than empty level by at least 0.8 millivolts.



SWITCH CONFIGURATION
FIGURE 3-1



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FRONT PANEL CONFIGURATION
FIGURE 3-2

3.3.1 Calibration Point 1 (Low Level)

The first step of the two-point calibration procedure is to set calibration point 1 (low level).

1. The unit should be on at least 30 minutes prior to calibration.
2. Lower the bin level to thirty percent full or less.
3. Open the enclosure and locate the calibration switch SW1 on the controller printed circuit board (Figure 3-1).

   Set SW1-1, 2, and 3 to the open (OFF) position.
4. Set the calibration switch SW1-4 to the ON (calibrate) position.

   NOTE: The display will blink while in calibration mode.
5. While pressing the LOW (setpoint calibration) button, use the INCREASE and DECREASE buttons to adjust the display until it indicates the actual level in the bin (Figure 3-2).

CAUTION

Do not touch the "HIGH" button while setting low bin level as system will freeze after calibration. Repeat Step 5 if necessary

6. Check the level indicator on the display. It should indicate the actual bin level.
7. Return calibration switch SW1-4 to the OFF (run) position.

3.3.2 Calibration Point 2 (High Level)

The second step in the two-point calibration procedure is to set calibration point 2 (high level).

1. Increase the bin level to 70 percent or higher.
2. Set the calibration switch SW1-1, 2, and 3 to the open (off) position and SW1-4 to the ON (calibrate) position.
3. While pressing the HIGH (setpoint calibration) button, use the INCREASE and DECREASE buttons to adjust the display until it indicates the actual bin level.

CAUTION

At no time touch the "LOW" button while setting high bin level as this will zero bin level at high setting.

4. Check the display. It should indicate the actual bin level.
5. Set calibration switch SW1-4 to the OFF (run) position.
6. Close the enclosure door and secure the cover screws.

3.4 LEVEL ALARMS

The C-Level is equipped with high, low, and overflow level alarms that can be monitored from the front panel. Remote indication or control is available by relay contacts. Refer to Field Wiring Diagram Figure 2-22 for alarm connections.

The C-Level also indicates the underflow (empty) condition by flashing the low setpoint LED. This output CANNOT be remotely monitored; however, this indication will signal the operator to re-zero or refill the vessel.

3.4.1 High and Low Alarm Setpoints

Both the high and low alarm setpoints may be set at any bin level from zero to one hundred percent. In all cases the high setpoint should be set above the low setpoint.

The following procedure will allow you to calibrate the low setpoint:

1. All calibration switches SW1-1 through 4 must be in the open (off) position, RUN mode.
2. Press the LOW pushbutton on the front panel (Figure 3-1).
3. While pressing down the LOW pushbutton, use the INCREASE and DECREASE pushbuttons to adjust the display indication to desired setpoint.

   NOTE: When you press either the HIGH or LOW button, only one bar indicating the high or low setpoint is illuminated.
4. Press the LOW button to re-check the low setpoint.

At this point the low alarm setpoint is automatically stored in the C-Level's memory. Should the material level in your bin fall below the low setpoint, the low alarm LED will illuminate and the low setpoint relay will actuate. If you want to change the low setpoint, simply repeat steps 1 through 4.

The following procedure will allow you to calibrate the high setpoint:

1. All calibrate switches SW1-1 through 4 must be in the open (off) position, RUN mode.
2. Press the HIGH (setpoint calibration) button on the front panel (Figure 3-1).
3. While holding down the HIGH button, use the INCREASE and DECREASE buttons to adjust the display to the desired setpoint.

   NOTE: When you depress either the HIGH or LOW button, only one bar indicating the high or low setpoint is illuminated.
4. Press the HIGH button to re-check the high setpoint.

At this point the high setpoint is automatically stored in the C-Level's memory. Should the material level in your bin raise above the high setpoint, the high setpoint LED will illuminate and the high setpoint relay will actuate. If you want to change the high setpoint, simply repeat steps 1 through 4.

3.4.2 Overflow Alarm

Should the material level in your bin exceed 102 percent, the overflow alarm is activated. At this point the high setpoint LED will begin to flash and the overflow alarm relay will activate. These signals will continue until the bin level is reduced or the unit is recalibrated.

3.4.3 Setpoint Lock-Out Switch

The C-Level comes equipped with a setpoint lock-out switch. This prevents unauthorized or inadvertent changes in the setpoint levels.

The following procedure will outline disabling the setpoint lock-out switch:

1. Open the enclosure and locate Switch SW1-3 setpoint lock-out switch on the control printed circuit board (Figure 3-1).
2. Place the setpoint lock-out switch SW1-3 in the closed position.
3. Close the enclosure and secure the front panel screws.

At this point both the high and low setpoints are placed in the C-Level's memory. These setpoints cannot be changed from the front panel without enabling the setpoint lock-out switch; however, the setpoints can be checked from the front panel in either mode.

3.5 REMOTE LEVEL (CURRENT OUTPUT)

The current output zero is switch selectable 0 or 4 mA. Locate switch SW1-2 current output zero switch and set it to the proper value: 0 or 4 mA. OFF equals 0-20 mA, ON equals 4-20 mA (Figure 3-1). The R9 range pot is factory set for 20 mA. Current output damping is the same as the front panel display.

CHAPTER 4.0
MAINTENANCE

4.1 GENERAL

The Thermo Ramsey C-Level Model 11-100 continuous level indicator is one hundred percent solid-state and should require little, if any, maintenance.

To assist you in servicing your C-Level, information in this section includes:

A preventive maintenance plan with recommended cleaning and sensor protection schedule.

Diagnostic and troubleshooting procedures.

Factory service and repair information.

4.2 SERVICE AND REPAIR

The maintenance information in this manual is adequate to meet your service needs. However, if you run into problems requiring technical assistance, please call (763) 783-2500 and ask for C-Level technical service.

When returning parts for repair, please use the Return Material Authorization form located in the parts section of this manual.

4.3 PREVENTIVE MAINTENANCE

The C-Level requires a minimum amount of maintenance, but this maintenance is important to insuring the best performance of your level control.

4.3.1 Electronics

The front panel can be wiped clean with a damp cloth and, if necessary, a mild detergent should be used. To prevent scratches or damage to the front panel, never use abrasives or solvents.

Enclosure cover gasket should be checked and replaced when necessary to prevent excessive moisture and contamination entry.

4.3.2 Strain Sensor

As a preventive measure, brush the sensor installation location yearly with the open gear lubricant provided with the unit. This will inhibit corrosion between the structural member and sensor.

4.4 DIAGNOSTIC PROCEDURES

The C-Level has two (2) built-in diagnostic features to help you in isolating problems in the electronics.

A DC voltmeter capable of reading millivolts will be necessary for isolating strain sensor or field wiring problems.

4.4.1 Lamp Test

The lamp test, when enabled, will illuminate all fifty (50) display bars as well as both the high and low alarm indicators.

Should the unit fail the lamp test, the control printed circuit board should be replaced.

The lamp test procedure is as follows:

1. While in the RUN mode, press both the HIGH and LOW pushbuttons at the same time (Figure 3-2).
2. Check that all fifty (50) bars of the display, the high alarm indicator, and low alarm indicator are illuminated.

4.4.2 A/D Operation Test

The A/D operation test will indicate if the analog to digital converter is correctly functioning.

The A/D operation test procedure is as follows:

1. Open the enclosure and locate LED3 on the control printed circuit board (Figure 3-1).
2. Normal indication is when the LED is flashing.

Should the LED not be flashing it could mean the following:

1. Faulty control board.
2. Calibration factors entered are in error.
3. Faulty field wiring.

   Example:

   Strain sensor output wires reversed causing increasing bin levels to reverse and go lower than zero bin level.

4.5 TROUBLESHOOTING

The most common C-Level problems and causes are outlined in this section. Thermo Ramsey suggests all field wiring and connections be verified before replacement parts are used.

4.5.1 Visual Inspection

Often a quick visual inspection leads to the source of trouble. If a problem does develop, check the following before proceeding to more specific troubleshooting procedures:

1. Check Power:
   a. Check that the power is ON.
   b. Check that the fuse is NOT blown.
2. Check Field Wiring and Connections:
   a. Check that all field wiring is complete and correct.
   b. Check that all field wires are tight in their field terminals or connections.
   c. Check that the optional current output board flat cable connector is firmly seated in its socket.
   d. Check that all socketed integrated circuits are fully seated in their sockets.

4.5.2 Faulty Calibration

Symptom:

System won't calibrate using calibration procedures.

Display blanks or stops at one level indication after span setting is completed.

Probable Cause:

Level input (span) is the same or lower than zero due to:

1. Loose terminal connections.
2. Reversed field wiring or incorrect strain sensor connections (Figure 2-23).
3. Improper orientation of strain sensors (Chapter 2.0).
4. Faulty control board.

4.5.3 System Drifts

Symptom:

Level indication is unstable when bin level is constant.

Probable Cause:

1. Strain sensor(s) are not being stressed under load due to improper loading, location, installation or orientation of the strain sensors (Chapter 2.0).
2. Moisture or loose connections in the wiring systems. TB1-1 (+) and TB1-2 (-) should be at least 0.8 millivolts positive at 100% level with respect to 0 level.

Symptom:

Level indicator drifts over three (3) bars with sunlight.

Probable Cause:

1. Under stressed strain sensors (Section 2.2.2).
2. Interaction between bins because of shared structural connections.
3. Being too close to or below a single horizontal brace.
4. Cells not centered into the web of the beams.
5. Less than a fully averaged system:

   Normally a (4 leg - 4 sensor) system is twice as accurate as a (4 leg - 2 sensor) system. A (4 leg - 2 sensor) system is ±5 percent which is five (5) bars total movement from acceptable high and low deviation.

4.5.4 Strain Sensor Test

If calibration or drifting problems still prevail, it will be necessary to check each strain sensor for possible failure.

Test all strain sensors using the following procedure:

1. Leave power applied to the system.
2. Disconnect the red and white wire in the junction box coming from each strain sensor.

3. With the bin empty, at zero level, check the millivolt reading of each strain sensor by measuring the signal output. White is positive and red is negative lead. The reading can range between ±10 mV.

4. After all the strain sensors are read at 0 level, add the actual millivolt readings together and divide by the total number of strain sensors.

   Example:

   Sensor #1 = -(0.7) mV
   Sensor #2 = + 2.3 mV
   Sensor #3 = -(1.1) mV
   Sensor #4 = + 4.2 mV
   Sensor #5 = + 0.2 mV
   Sensor #6 = + 0.7 mV

$$\frac{-0.7+2.3-1.1+4.2+0.2+0.7}{6} = \frac{+5.6}{6} = +0.93mV$$

   rounded up to +1.0 mV

5. The above calculation should match the reading obtained during initial zero calibration across TB1-1 and 2. If not, one sensor was not connected to the system or the wiring between sensors has a problem.

6. Repeat the above procedure with the bin at 100% level.

7. If each sensor shows a positive increase of more than 0.8 millivolts, the problems likely are structural.

4.5.5 Alarm Relay Outputs

The high and low alarms, as well as the overflow alarm, provide for remote indication. These outputs may be tested in the following manner:

1. When the bin level is below the low alarm setpoint, the low alarm LED is on and the low alarm relay actuates.

2. When the bin level is above the high alarm setpoint, the high alarm LED is on and the high alarm relay actuates.

3. When the bin level is above 100% (overflow conditions), the high alarm LED flashes and the overflow alarm relay actuates.

If any of these alarm relay outputs fail to function while the corresponding condition is indicated on the display, replace the control printed circuit board.

4.5.6 Current Output Board

The current output is checked by measuring the output at zero bin level (0 or 4 mA) and at a known span.

Check current output zero using the following procedure:

1. The unit must be in the RUN mode and with zero bin level in order to check the current output zero.

2. Open the enclosure and locate the current output terminal block TB4.

3. Replace the wires on the current output terminals 1 and 2 (terminal 1 is negative) with the leads of a DC milliamp meter (0 to 50 mA range).
4. Determine the current output zero setting by locating the current output zero selection switch SW1-2 and reading its setting (0 or 4 mA) (Figure 3-1).
5. If the meter connected to the current output terminals does not read correctly (0 or 4 mA or very close), the current output board is faulty and must be replaced.

Check current output span using the following procedure:

1. While in the RUN mode, add material in order to produce a known level signal.
2. The meter on the current output should indicate the same percentage of its range as the known signal level. The R9 range pot on the current output board is factory set for 20.0 mA.

   EXAMPLE:

   If the current output zero selection was set to 4 mA and the bin level was set to 50%, the meter should indicate:

   Meter = 0.50(20 mA - 4 mA) + 4 mA

   Meter = 12 mA
3. If the meter does not indicate correctly, the current output board is faulty and must be replaced.

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CHAPTER 5.0
REPLACEMENT PARTS

5.1 GENERAL

This chapter gives information on how to order replacement parts for your Model CL-100A C-Level.

5.2 ORDER INFORMATION

For faster service when ordering parts, write or telephone Thermo Electron Pro-Line Products. Thermo Electron maintains a complete stock of parts and normally will ship within one (1) working day after receipt of order.

The recommended procedure for ordering parts is as follows:

1. Determine the broken or faulty part(s).
2. Locate the part(s) in the parts list given.
3. Find the part number(s) for the item(s) needed and determine the quantity you require.
4. Write or telephone:

   Thermo Electron
   Pro-Line Products
   501 90th Avenue N.W.
   Minneapolis, MN 55433
   Telephone: 800-227-8891
   Telefax: (763) 780-2525

   Repair Parts: 800-227-8891

   Normal Customer Service hours are 8:00 A.M. to 4:30 P.M., Central Time.

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5.2.1 Return Material Authorization

Thermo
ELECTRON CORPORATION

501 90th Avenue N.W. Minneapolis MN 76683-2500

Return Material Authorization
RMA No. : -

(This RMA Number Must Be Marked On All Paperwork And On Outside Of Package)

Req'd. By: _____
Date: _____
Customer Contact: _____
Phone: ( ) _____
Area Code

Return, Freight Prepaid To:
ThermoElectron
501 90th Avenue N.W.
Minneapolis, MN 55433

Bill To Customer # : _____ Ship To # : _____

Returned From: Return To:

Description Of Material Being Returned:

Describe Equipment Malfunction Or Defect If Any: Symptoms:

Minimum Charge
☐ Informed Customer of_____ Inspection Charge Per Item

Service Requested:
☐ Repair & Return ☐ Estimate Required P.O. No.: _____
☐ Return for Credit ☐ Original P.O. or Thermo Order No.: _____

☐ Warranty Repair or Replacement Serial No: _____
Original P.O. # _____ Original Order/Job # _____
☐ Return Warranty/Exchange Unit Shipped on Thermo Order No.: _____
☐ Other: _____

Disposition/Comments: (ThermoElectron Internal Use Only)

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5.3 PARTS LIST

EQUIPMENT	PART NUMBER
Strain Sensor, .5 meter	083042
Fuse, .19 Amp Slo Blo (100/120 VAC)	022898
Fuse, .12 Amp Slo Blo (200/240 VAC)	011169
Control Board, 120/240 VAC	055529
Control Board, 100/200 VAC	055530
Current Output Board	014757