

**INSTALLATION
AND
INSTRUCTION MANUAL

FOR**

Boone

**PORTABLE-TYPE
TEMPERATURE
DETECTION SYSTEM**

SPECIAL NOTE

**READ THIS ENTIRE BOOKLET
BEFORE PROCEEDING WITH
THE INSTALLATION**

**BOONE CABLE WORKS & ELECTRONICS, INC.
1773-219TH LANE - P.O. BOX 429
BOONE, IOWA 50036
PHONE (515) 432-2010 FAX (515) 432-5262
TOLL FREE NUMBER - 1-800-265-2010**

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1. General

Boone Cable Works and Electronics, Inc. offers a comprehensive line of temperature monitoring equipment. This complete product range and extensive systems experience allows us to offer effective solutions to a wide spectrum of your practical requirements. Our extensive background in temperature monitoring along with a constant program of innovation and technological development, allows us to offer cost-effective and user-orientated solutions.

Please read all the instructions for system installation before beginning.

A. Portable Systems

The portable temperature system is designed to manually select thermocouple temperature sensors for reading. The temperature sensors are located in cables suspended from the ceilings of grain storage facilities. The suspended temperature sensing cables are available in many different total lengths and thermocouple spacings. The cables on your site will have been selected by determining the requirements of your storage facilities.

The cables are connected through leadwire to the CRB Box. The user then plugs the instrument into the desired cable plug and reads the temperatures on the cable.

B. Grain Temperature Systems and Their Use

Stored grain is constantly threatened by the hazards of mold activity, insect infestation and moisture migration. When grain goes out of condition, regardless of the cause, there is almost always a rise in temperature in the critical areas.

All stored grain is infected to a certain extent with various types of grain storage molds. The correct conditions of moisture and temperature will stimulate their activity. The optimum temperature is about 85 degrees Fahrenheit for most prevalent species. The growth of storage mold lowers the usefulness of grain and grain products by the development of off-odors and various types of kernel discoloration. If there is a high percentage of damaged kernels, often caused by "turning", the grain is more likely to go out of condition.

Insect activity is also directly related to temperature and moisture content of the stored grain. Generally speaking, the dampest and warmest part of the bulk, and not the average, is the determining factor with respect to insect growth and reproduction. Infestation can be controlled by fumigants, but reduction in fumigant cost is possible if storage temperature can be maintained at a lower level. Most insects thrive in temperature above 70 degrees Fahrenheit, particularly, in high-moisture grain. Insects not only consume the grain, causing damaged kernels, but generate heat and ultimately develop a temperature in the grain which may cause further serious damage. Below 50 degrees Fahrenheit, most insects become dormant and may die of exposure to low temperatures after a few weeks.

When warm grain is put in storage, it is essential to reduce the temperature of the grain as soon as possible. When this cannot be done within a matter of weeks, it is wise to treat the grain with an insecticide if there is any possibility of insect infestation. If the grain is to be stored for any length of time before the temperature is reduced, further fumigation may be necessary.

The moisture in a mass of grain stored at a uniform moisture content may move within the mass because of differences in grain temperature. During the winter, the grain next to the bin wall becomes cooler than that at the center of the mass. Convection air currents pick up moisture from the warm areas and transfer it to cooler parts of the grain mass. The increase in moisture content may cause a corresponding increase in the respiration of the grain and associated micro-organisms, and this oxidation of the grain carbohydrates produces added moisture and heat. Heating from one cause may trigger another, which will contribute to the total heat produced; the combined action may result in serious damage, unless the heated grain is removed, or the temperature reduced. When sufficient moisture is concentrated in the top layer of the stored grain, it may mold and cake. This often occurs, even in grain which was considered to be of safe moisture content when it was stored.

C. Thermocouple Theory

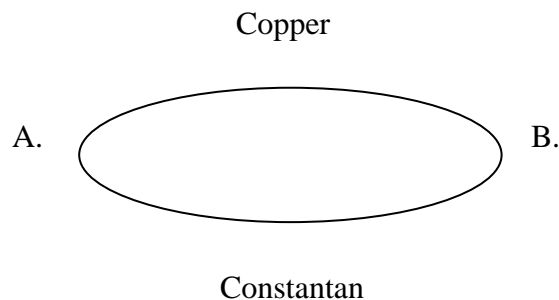
The principles, or theory, underlying thermoelectric effects were not established by one man at one time, but by several scientists working over a span of many years beginning with Alessandro Volta, who concluded in 1800 that the electricity which causes Galvani's frog to twitch was due to a contact of two dissimilar metals. This conclusion was the forerunner of the principle of the thermocouple.

When a circuit is formed consisting of two dissimilar conductors, and one of the formed junctions of these two conductors (A) is at a temperature higher than the temperature of the other junction (B), a minute voltage is generated, and a current will flow in the circuit.

The current will flow in one direction if the temperature at (A) is higher than (B). The current will flow in the opposite direction if the temperature at (B) is higher than (A). No voltage will exist and no current will flow when the temperature of junctions (A) and (B) are the same.

A single junction, such as (A) or (B), is commonly called a thermocouple. The common abbreviation for thermocouple is TC.

Many different metals are used for thermocouples in various applications; however, copper and constantan are the most practical for temperatures below 600 Degrees F. Constantan is an alloy approximately 57% copper and 43% nickel. The junction of copper and constantan is called a type T thermocouple.



2. Cable Installation

Care must be taken to hang the correct length cables in respective bins. Check cable length with print supplied to correspond with proper height of respective bin. See tag on cable for length.

A. Steel Tanks

There are several types of steel tanks and parts of these instructions may be modified to fit the circumstances. Care should be taken in handling the cables and leadwire to avoid crushing, cuts and knots.

The cables must be hung according to the bin manufacturer's specifications. Due to the many differences between steel tanks, no specific location instructions can be given. In most cases, the roof itself is not strong enough to support the cables. Some have beams or trusses; and some have special braces for hanging cables. If the cables are not properly hung, the bin roof and sidewalls can be damaged by the pull of the cables. Refer to bin manufacturer's recommendations to determine the structural strength of the bin or cable supports supplied by the manufacturer to be sure that it is adequate and will not permit damage to the roof or sidewalls. The client is totally responsible that the steel bin is of proper design and strength to support the temperature detection cables.

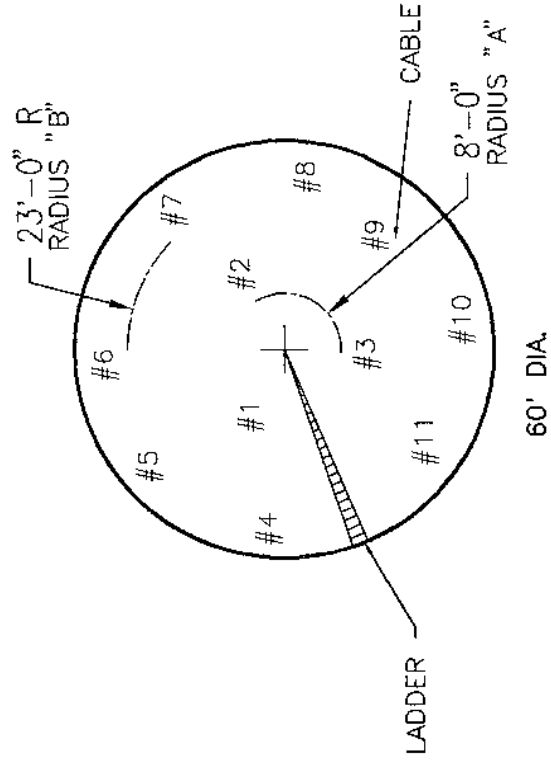
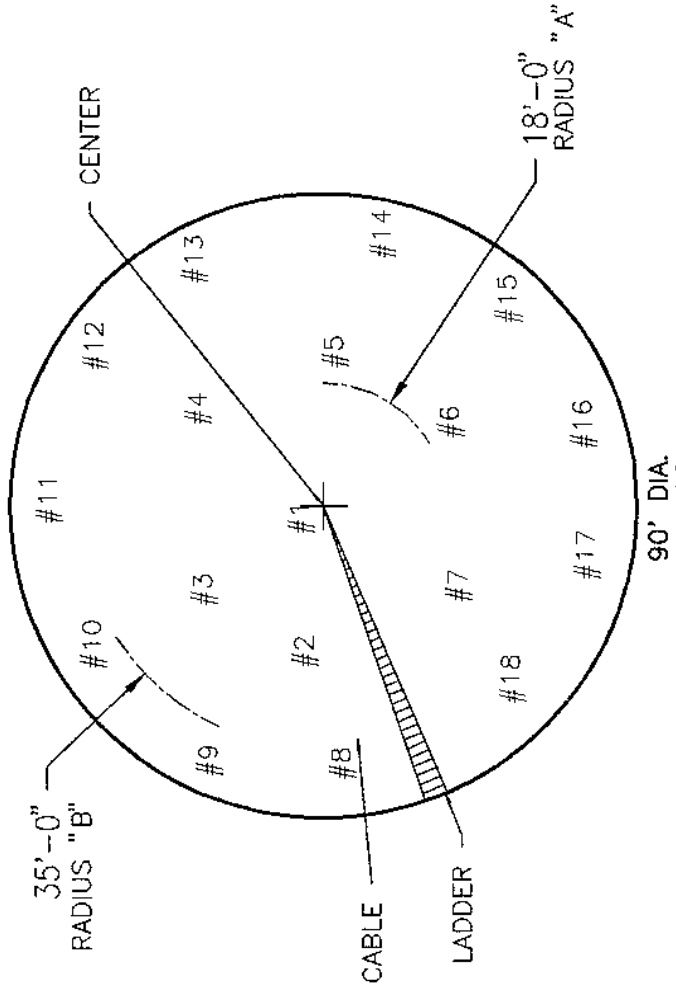
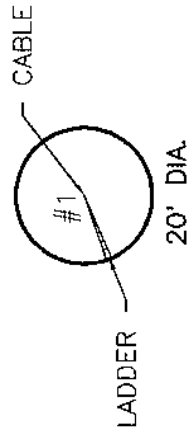
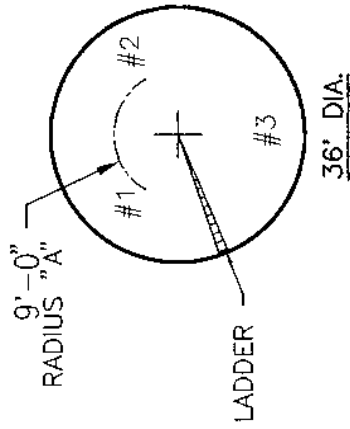
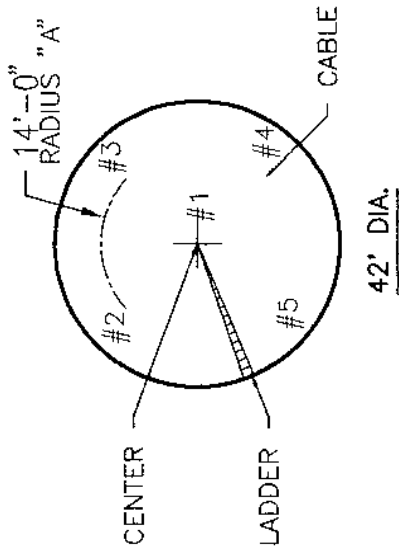
The numbering sequence of cables in steel tanks is standardized. The center cable or first cable clockwise from the ladder is always number 1. If more than one radius is required by the coverage pattern, the inner circle will have the smaller numbers in clockwise sequence and the lowest number of the other radii will be the first cable clockwise from the ladder. See drawing #180010.

Cables should be sorted according to length and put in the respective tanks before adding other hardware.

Locate the position for the respective cables on the bin top, making sure that no cables will be hanging in the grain stream when the bins are being filled.

Arrange the cables according to length. The shortest cables are for the outer circle and the longest are for the inner circle.

Lay the outer circle of cables on the bottom of the steel tank in line with the hanging points, but next to the wall. Lay the inner circle of cables on the bottom of the steel tank in line with their hanging points, but about 10 feet to the outside.



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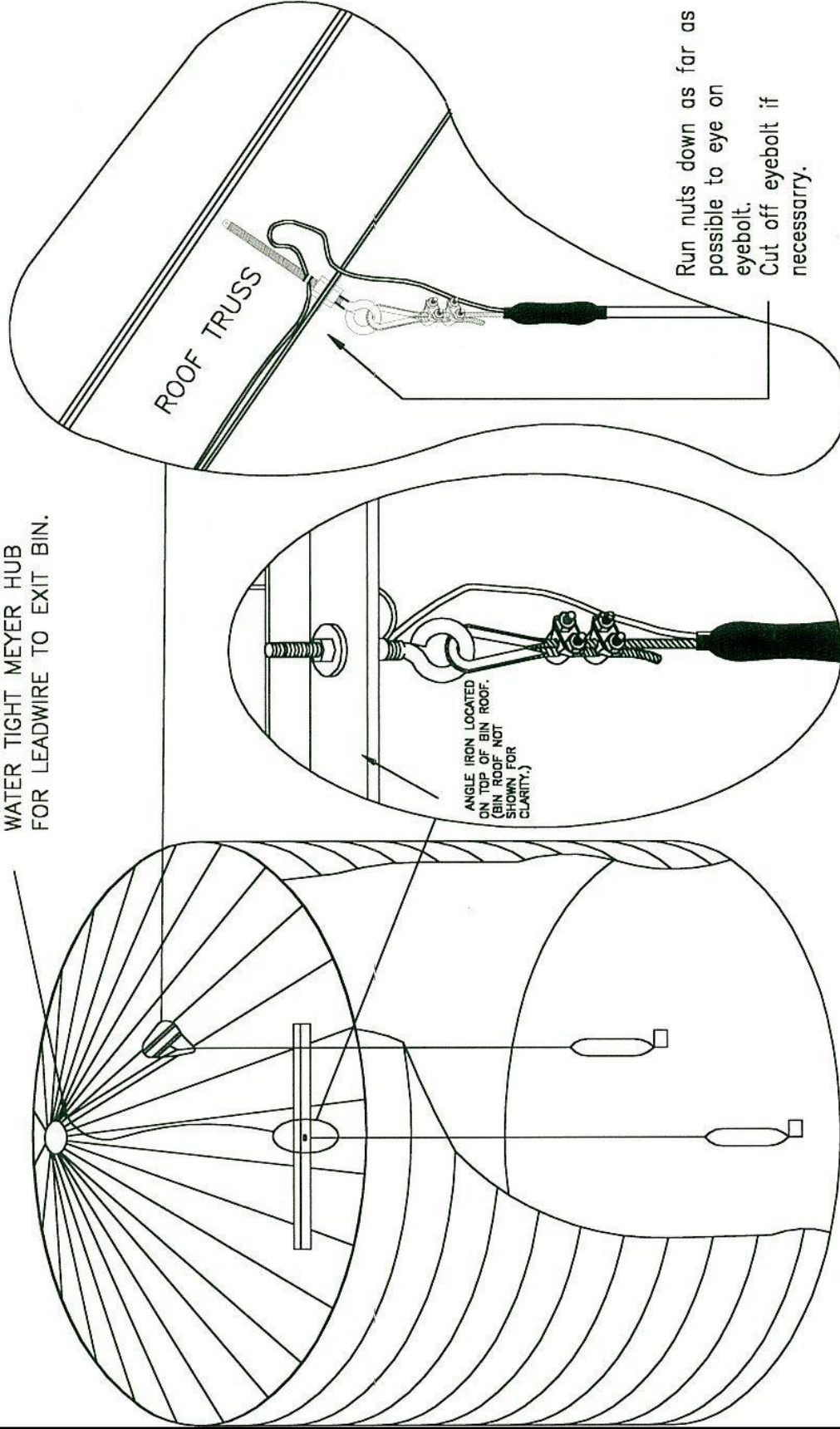
P.O. BOX 369 1773-219th LANE BOONE, IOWA 50036 USA (515) 432-2010 (800) 265-2010 FAX (515) 432-5282

TITLE: SCALE: NONE DATE: 12-8-94

REF. CABLE NUMBERING SEQUENCE OF STORAGE TANKS DWN. BY: R. NELSON

DWN. NO. 180010

WATER TIGHT MEYER HUB
FOR LEADWIRE TO EXIT BIN.



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TITLE:

SCALE: NONE DATE: 1-31-02

REF.

DWN. BY: Rick H

STEEL TANK
CABLE INSTALLATION

DWN. NO. 180012

Attach the eyebolt to the hanger (Quicklink). See the drawings of typical cables #180016 for 6TC Cable, #180017 for 12TC Cable, #180018 for 18-6TC Cable.

Tape leadwire to the eyebolt. Leave enough slack in leadwire so that the cable may swing without pulling splice at top of cable apart.

Screw one nut and washer down on the eyebolt just above where the leadwire is taped. Place the eyebolt through the hole, in the beam, roof support or roof where the cable should be hung and secure with a washer and nut. See drawing #180012. In some tanks, angle or channel is used to span roof ribs for load distribution.

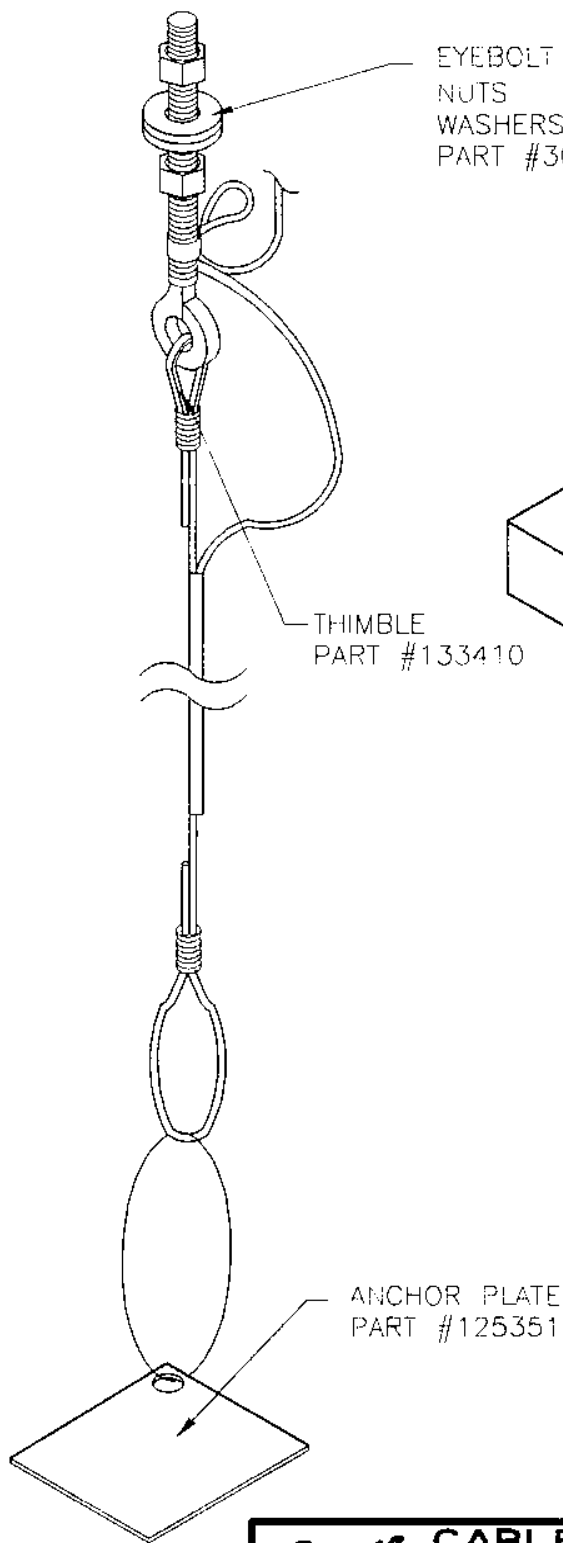
Tie the bottom of the cable to the anchor plate, using the loop at the bottom of the cable and hole in the anchor plate. See drawing #180026 for other tie-down methods. Use a maximum of 110 lb fishing line or baling twine. This will hold the cable in place while the bin is filling.

If the roof itself is drilled through, seal the roof, the washer, the nut and eyebolt with roofing cement to prevent water leaks.

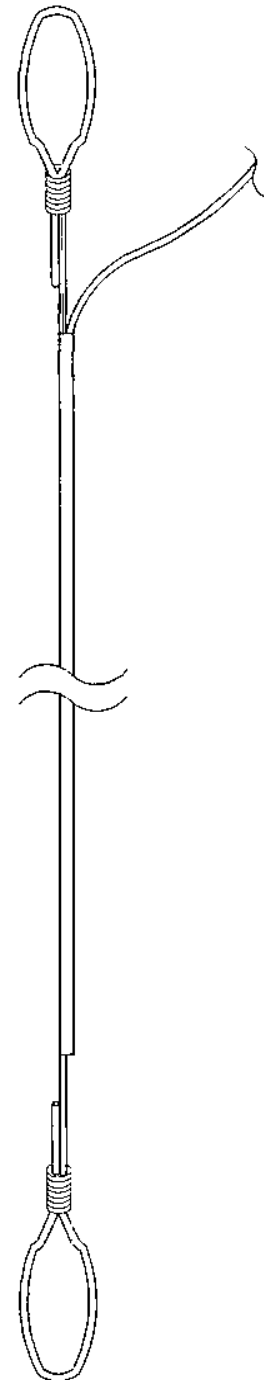
Number each leadwire to correspond with the cable layout print with a "Brady" number about 18 inches from each end. Number one will be on the inside circle of cables. Cables are numbered clockwise looking down from the top. This general numbering system is for round steel tanks. See drawing #180010. Specific layouts will be prepared for other buildings.

An ideal time to hang cables in a steel tank is when the roof is assembled on the ground before erection. The cables can be hung either thru the roof with "I" bolts or hung from tank reinforcements. Leadwire can be routed thru reinforcements and fastened with plastic tie bands. Thus, keeping leadwire from sagging and getting into the grain.

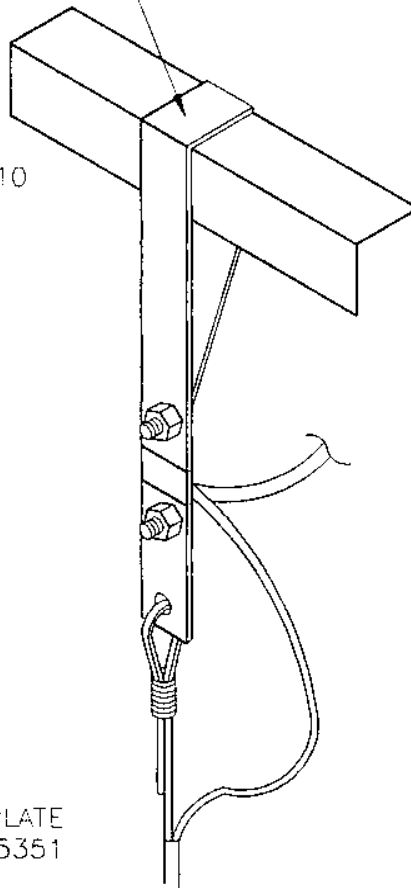
HANGING STYLE



PROBE STYLE



UNIVERSAL STRAP
OPTIONAL
PART #300092



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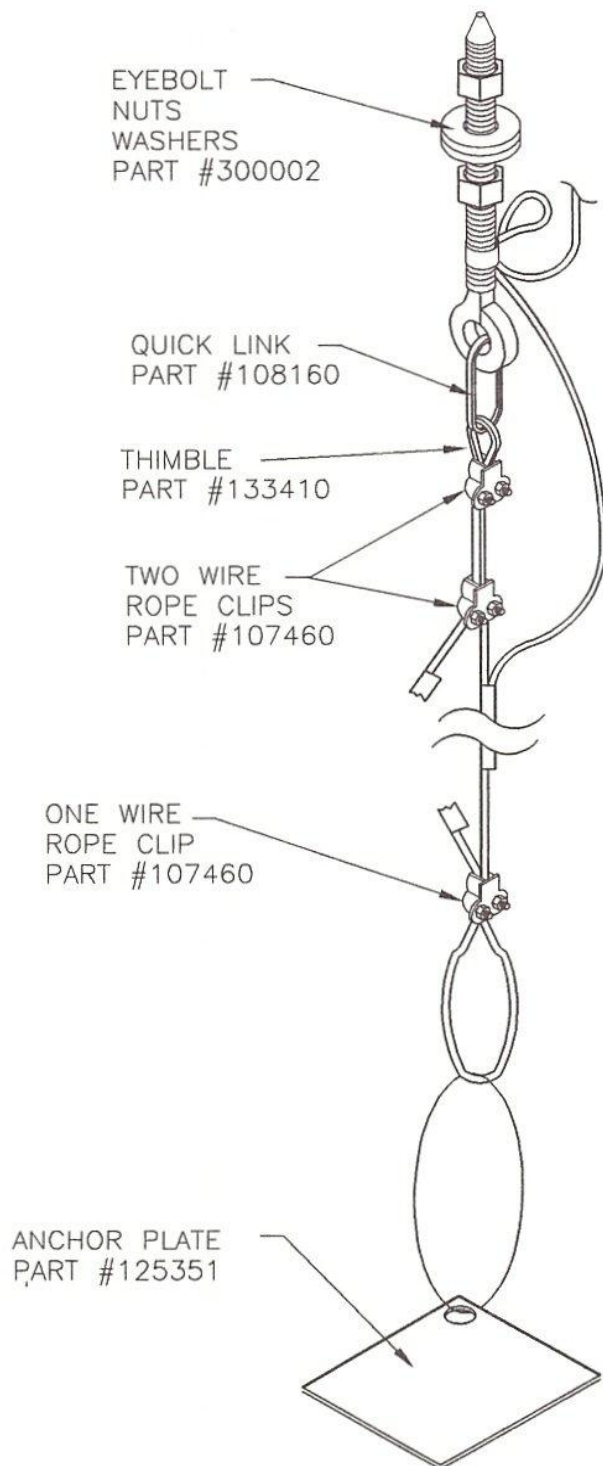
P.O. BOX 369 1773-219th LANE BOONE, IOWA 50036 USA (515) 432-2010 (800) 255-2010 FAX (515) 432-5262

TITLE:
REF. TYPICAL 6 TC CABLE

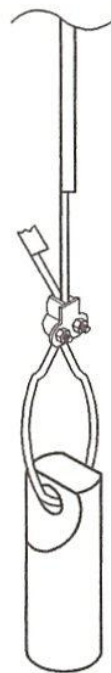
SCALE: NONE DATE: 12-8-94

DWN. BY: R. NELSON

DWN. NO. 80016



WEIGHT #137680
OPTIONAL



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TITLE:

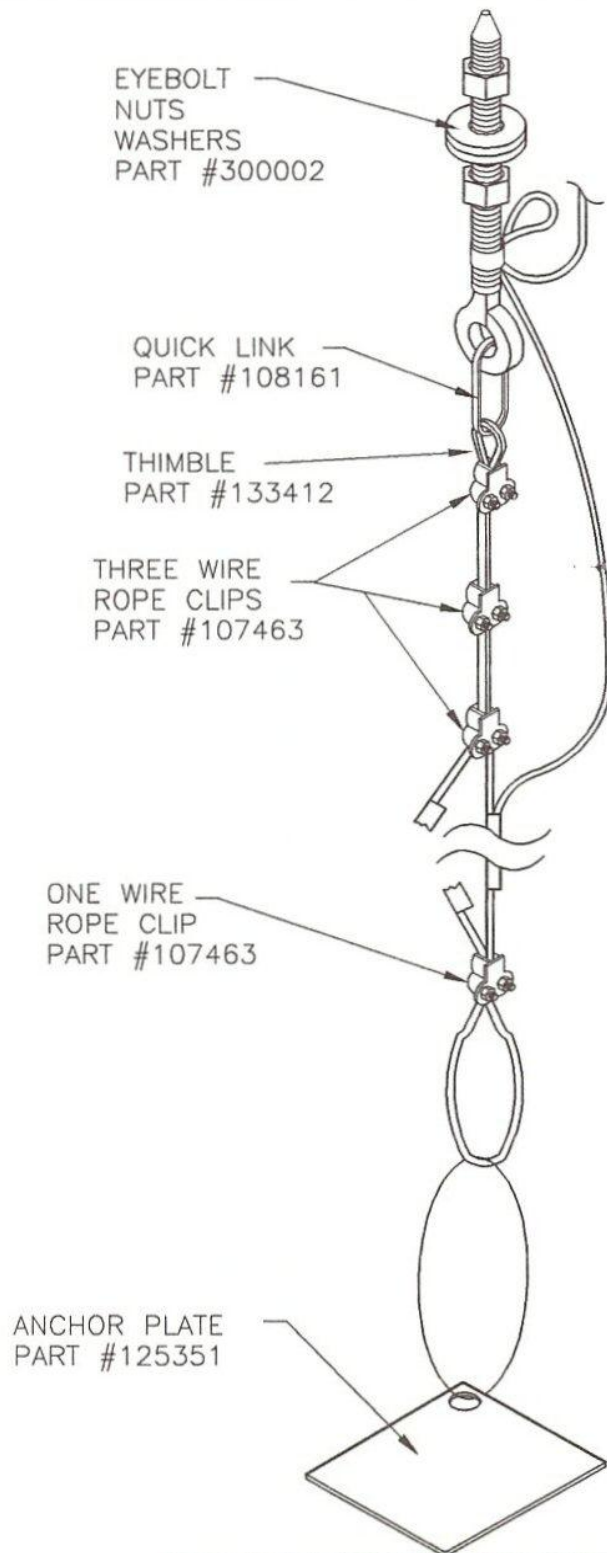
REF. TYPICAL 12 TC CABLE

SCALE: NONE

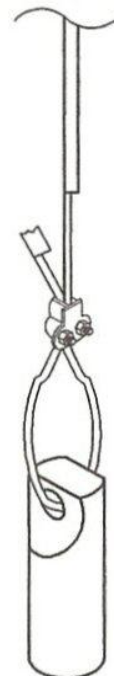
DATE: 12-8-94

DWN. BY: R. NELSON

DWN. NO. 180017



WEIGHT #137680
OPTIONAL



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TITLE:

REF. TYPICAL 18-6 TC CABLE

SCALE: NONE

DATE: 12-8-94

DWN. BY: R. NELSON

DWN. NO. 180018

B. Concrete Storage Bins

1. Concrete Structure Without Hanger Boxes

Lay out of holes for the hangers is very important. The cable must be hung approximately in the center of the bin, or as per print furnished with the cables. However, the cable must not be hung in the grain fill stream, nor hung nearer than one foot to any obstruction such as a beam. This is so normal "working" of the cable will not chafe the cable or leadwire. See drawing #180021.

When drilling the hanger holes, make sure not to drill more holes than can be used in one day without making provision for waterproofing overnight if there is grain in the bin.

In concrete storage, if the hole is inside the gallery or headhouse, the hole must be countersunk enough to allow the eyebolt top to be flush with the floor. After hanging the cable, the holes are to be filled with silicon sealer.

The cable assembly is drawn up with a wire or chain through the eyebolt tip. A large washer and nut are put on top for load distribution. The inside installation is countersunk to keep the bolt tip out of the way. The leadwire is taped to the eyebolt to prevent strain on the splice. When the installation is outside, roofing mastic is applied under and over the washer to make it waterproof.

2. Concrete Structure With Hanger Boxes

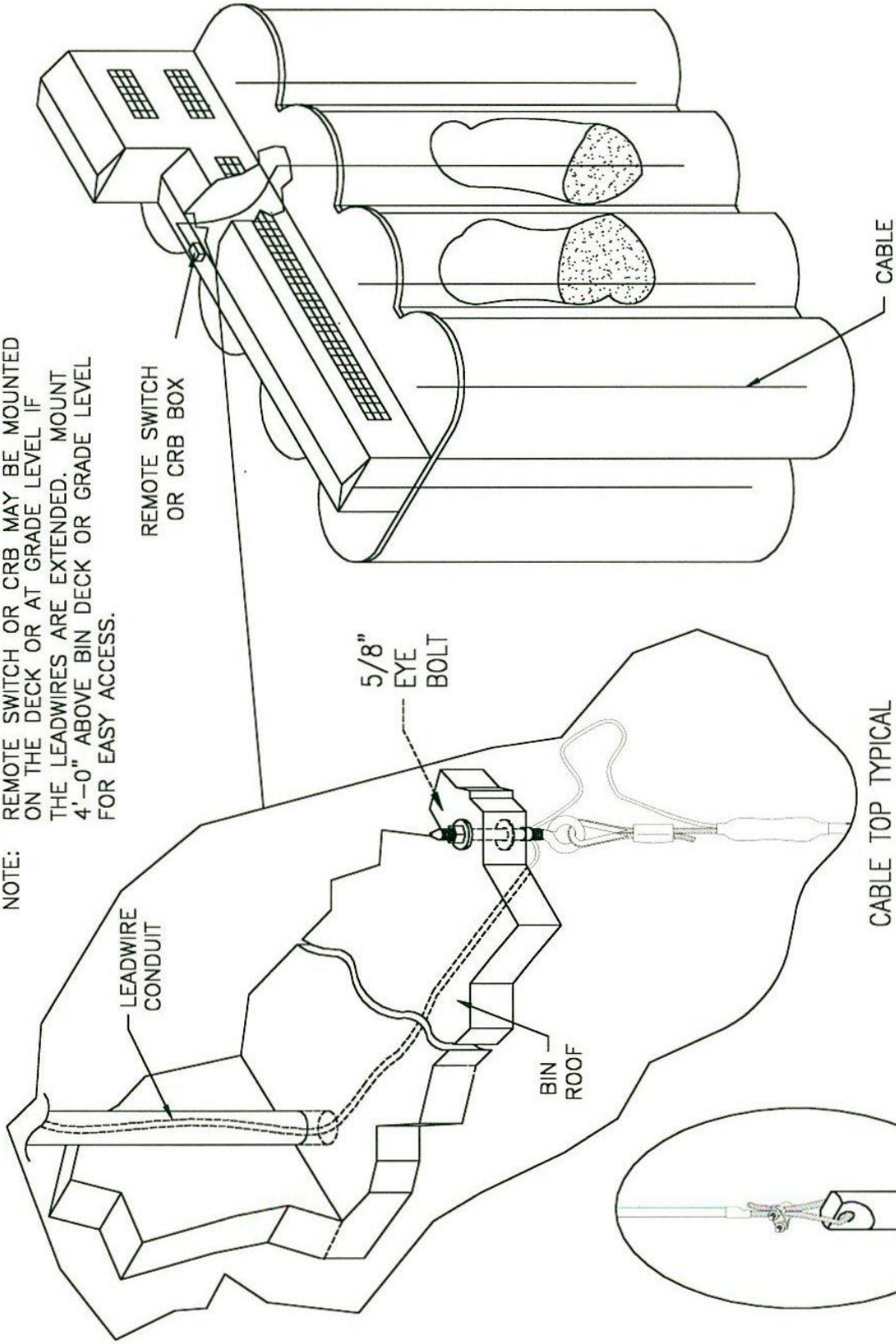
The concrete hanger box is installed during construction. The box is placed on the form in the proper place before pouring. A 5/8" x 3' rod is run through the box for the hanger.

Two types of cable hardware is normally used to hang the cables, strain clamps and quicklinks. If the cable has a strain clamp, remove the cotter key from the pin in the hanger and slip the pin out. If the cable has a quicklink, loosen the opening of the quicklink.

Insert the bottom of the temperature cable through the hanger box on either side of the 5/8" steel rod. Uncoil the cable and lower into bin, being careful not to tangle, scrape, or otherwise damage it.

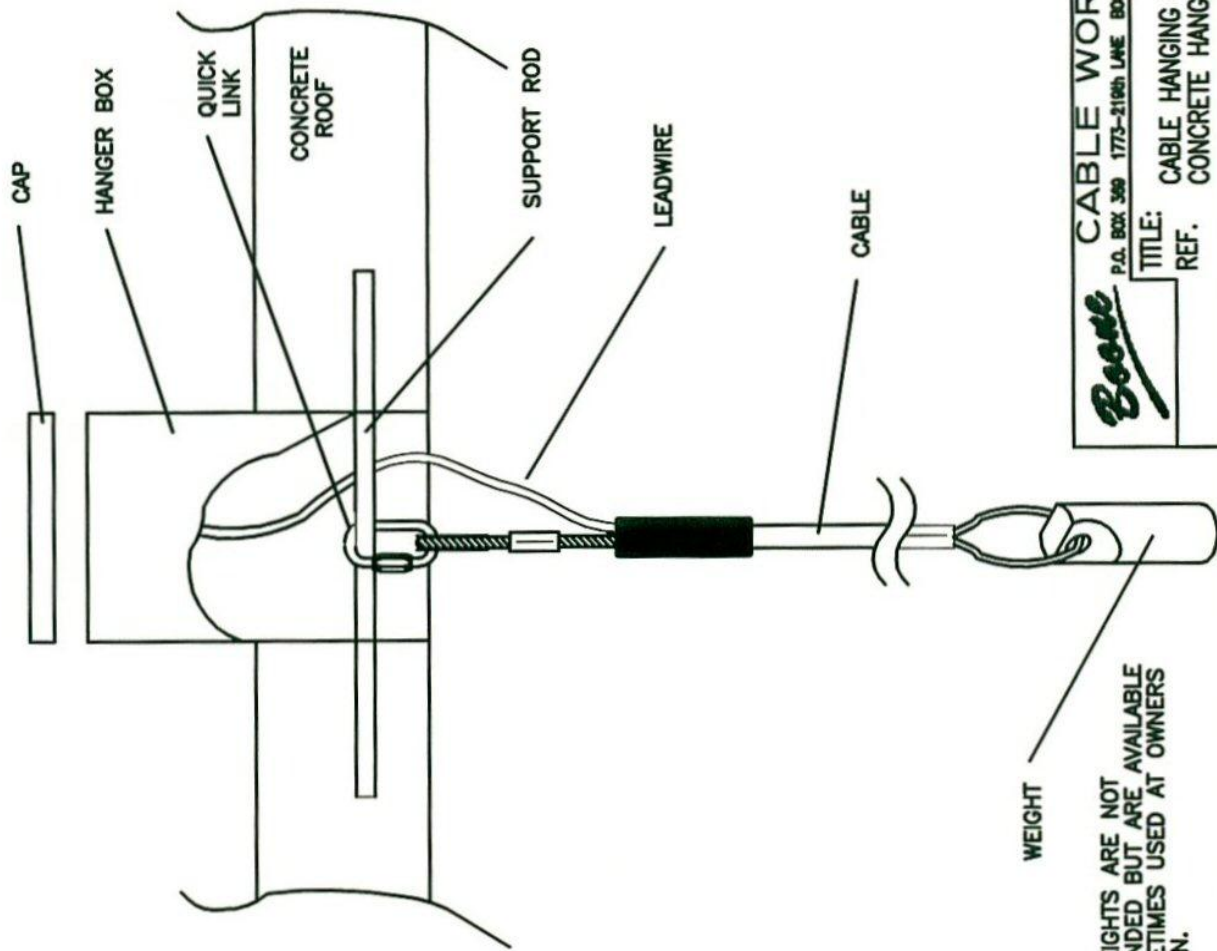
If a strain clamp is being used, lower the cable hanger slightly below the 5/8" steel rod, then raise it so that an "ear" is on each side of steel rod. Replace pin and cotter key. The design of the cotter key makes it unnecessary to spread the ends. If a quicklink is being, place the quicklink over the 5/8" steel rod and tighten the latching nut.

NOTE: REMOTE SWITCH OR CRB MAY BE MOUNTED ON THE DECK OR AT GRADE LEVEL IF THE LEADWIRES ARE EXTENDED. MOUNT 4'-0" ABOVE BIN DECK OR GRADE LEVEL FOR EASY ACCESS.



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TITLE:	CONCRETE TANK	SCALE:	NONE	DATE:	5-8-02
REF.	CABLE INSTALLATION	DWN. BY:	RICK H		
	WITHOUT HANGER BOX	DWN. NO.	180021		



NOTE: MAKE SURE THAT THE HANGER BOXES ARE INSTALLED AS PER THIS DRAWING SO THAT THERE ARE NO PROBLEMS AFTER THE CABLES ARE HUNG.

AFTER BOXES ARE INSTALLED CUT OUT THE WOODEN OR METAL ROOF SUB-FLOORING SO THE CABLES CAN BE HUNG AND DROPPED INTO THE BIN.

NEVER SUBSTITUTE RE-ROD OR ANY OTHER MATERIAL FOR THE COLD-ROLLED ROD WHICH IS SUPPLIED WITH THE HANGER BOX. NEVER SHORTEN THE 30" ROD. THIS LENGTH IS NECESSARY FOR PROPER SUPPORT.

NEVER CUT OR NOTCH THE ROD IN ANY WAY.

NEVER WELD ON OR NEAR THE 5/8" COLD-ROLLED ROD. THIS WILL WEAKEN THE ROD AND COULD CAUSE FAILURE.

ANY MODIFICATION TO HANGER BOX, ROD, OR LID WILL VOID WARRANTY AND RELEASE BOONE CABLE WORKS FROM ALL RESPONSIBILITY.

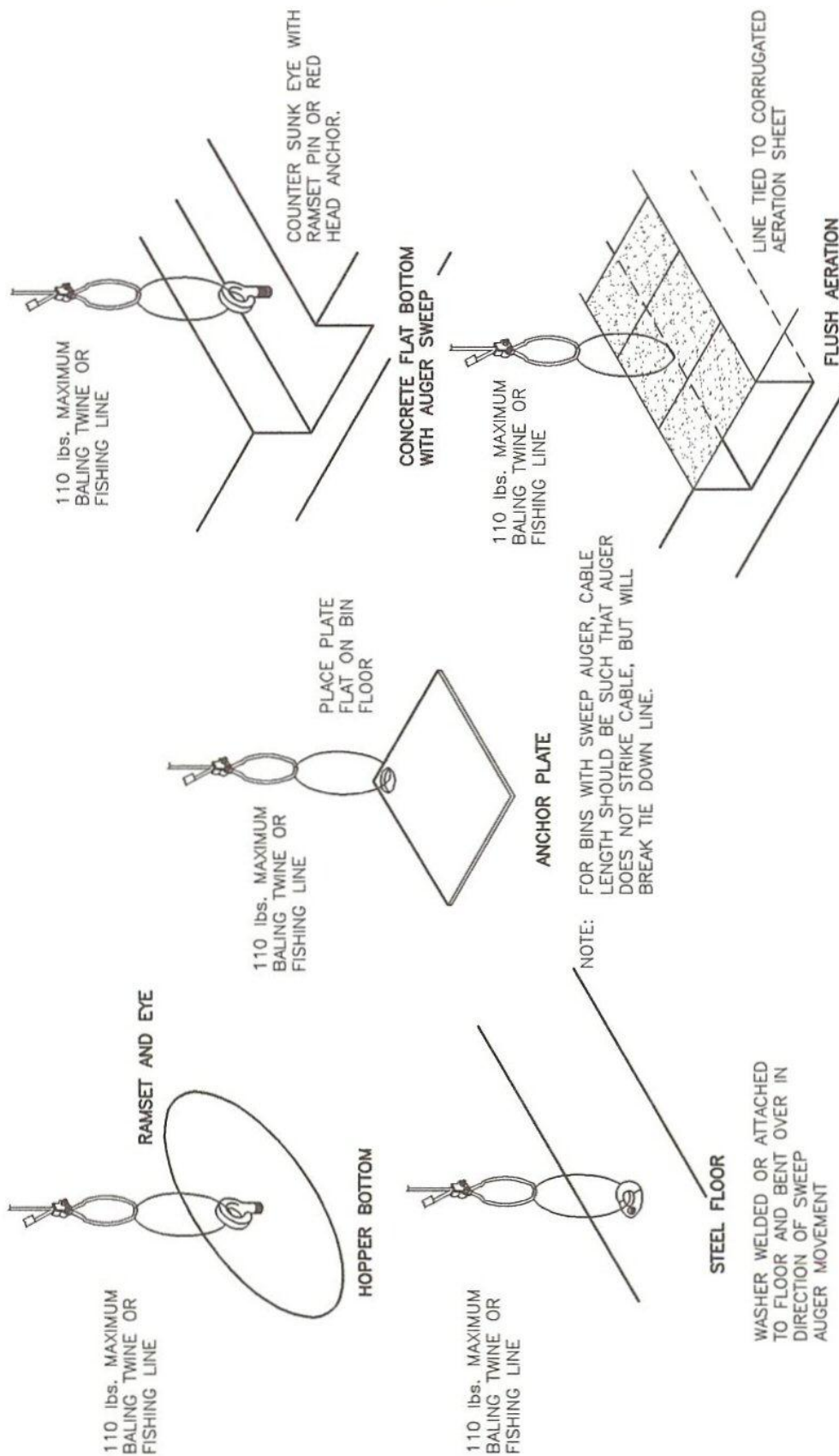
NOTE: CABLE WEIGHTS ARE NOT RECOMMENDED BUT ARE AVAILABLE AND SOMETIMES USED AT OWNERS DISCRETION.

		CABLE WORKS & ELECTRONICS, INC. P.O. BOX 360 1773-219th LANE BOONE, IOWA 50038 USA (515) 432-2010 (800) 285-2010 FAX (515) 432-2022	
TITLE: CABLE HANGING INSIDE REF. CONCRETE HANGER BOX		SCALE: NONE	DATE: 5-8-02
DWN. BY: RICK H		DWN. NO. 180023	

C. Cable Tie-down Methods

On large diameter steel or concrete tanks, there is a tendency for the cables to drift to the outside of the tank during filling. This same thing occurs when truck or rail loadout spouts are located in tank sidewall, only in this case the cables often times come out the spout.

To correct this drift or out the spout condition, it is necessary to tie the cables to the bin floor. This can be done in several ways depending on type of floor, is there a sweep auger, aeration duct or flush duct and is floor flat or hoppered. Refer to print #180026.



Boone CABLE WORKS & ELECTRONICS, INC. P.O. BOX 369 1773-219th LANE BOONE, IOWA 50036 USA (515)432-2010 (800) 265-2010 FAX (515) 432-5262	
TITLE: TYPICAL CABLE REF. TIE DOWN METHODS	
SCALE: NONE	DATE: 12-8-94
DWN. BY: R. NELSON	DWN. NO. 180026

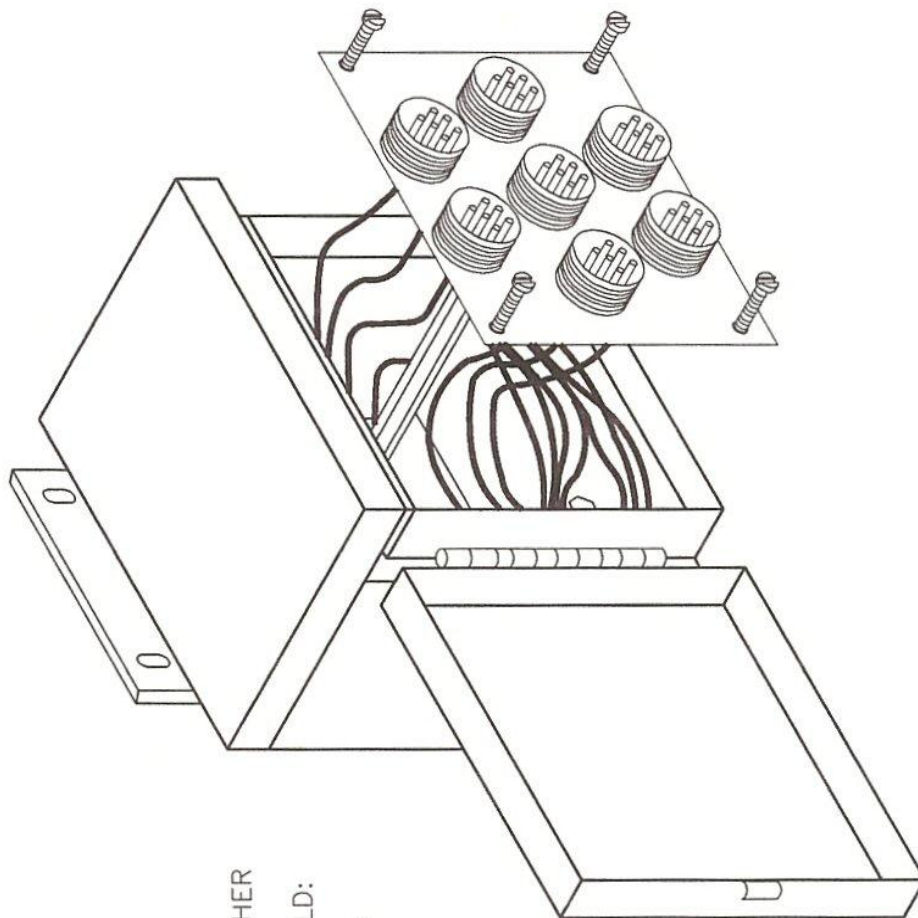
3. Central Reading Box (CRB) Installation

General:

The central reading (CRB box) should be located at a convenient, non-obstructed area for easy access. Normally, it is mounted on the sidewall of the tank approximately 4' above grade.

Mounting Procedure:

- A. Remove the reading plug panel from the enclosure.
- B. Drill or punch a hole in the side of the box. This is for the conduit entrance. The hole should be sized according to the size of conduit being used. To determine hole size, add 3/8" to the conduit size being used. (Example: 1" conduit, plus 3/8" = 1-3/8" hole size.)
- C. Mount box to sidewall of bin with 1/4" self-tapping screws or bolts.
- D. Splice the leadwire from the cables to cable plugs.
- E. Re-attach the reading plug panel.

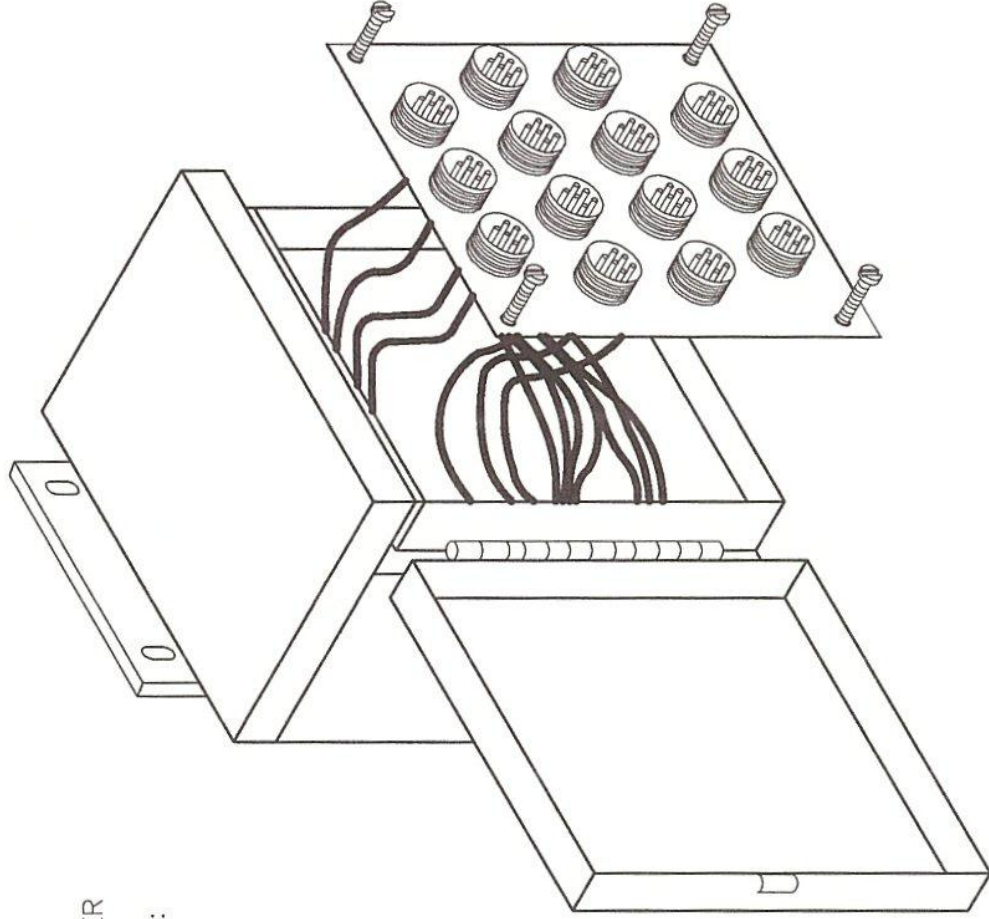


ALSO AVAILABLE IN OTHER
PLUG ARRANGEMENTS.
#0 CRB BOX WILL HOLD:
1) 7 - 6 TC PLUGS
2) 5 - 12 TC PLUGS

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TITLE:	SCALE: NONE	DATE: 12-8-94
REF. CRB #0 WITH 6 TC PLUGS	DWN. BY: R. NELSON	
	DWN. NO. 180030	

ALSO AVAILABLE IN OTHER
 PLUG ARRANGEMENTS.
 #1 CRB BOX WILL HOLD:
 1) 26 - 6 TC PLUGS
 2) 18 - 12 TC PLUGS
 3) 14 - 18 TC PLUGS



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TITLE:	SCALE: NONE	DATE: 12-8-94
REF. CRB #1	DWN. BY: R. NELSON	
WITH 12 TC PLUGS	DWN. NO. 180031	

4. Conduit and Leadwire

A. Install Conduit

Conduit is used to protect wires from weather or mechanical damage. Thinwall conduit is usually used for inside runs which will not be exposed to the weather. Rigid conduit must be used for any outside work which will be exposed to the weather, and may be required on some installation for inside runs as well.

Selecting Size of Conduit:

Conduit size is regulated by the mass of wires being housed. The maximum should be 75% filled. Proper type and size of fittings must be used in each raceway for ease in pulling wires.

The conduit size is determined by the maximum number of leadwires which must run through it and the size of the leadwire.

Leadwire and conduit table below:

<u>Conduit Size</u>	<u>1/2"</u>	<u>3/4"</u>	<u>1"</u>	<u>1-1/4"</u>	<u>1-1/2"</u>	<u>2"</u>
6TC Leadwire	9	16	27	50	70	100
12TC Leadwire	3	5	12	20	30	60
18 TC Leadwire	3	5	12	18	28	46
21TC Leadwire	3	5	12	18	28	46

Installing Conduit:

All conduit runs must be kept away from high-voltage wires as much as possible to prevent inductance "pick-up".

No more than two 90 degree bends or combination of bends totaling 180 degrees should be in the raceway between pull boxes.

Requirements regarding perpendiculars, horizontal, supports, fittings, and "expansion joints" are the same as for general electrical work.

When conduit is exposed to weather, joint compound and proper gaskets must be used; special precautions should be taken to keep moisture out of the conduit, so control wire and/or leadwire are kept dry.

B. Run Leadwire

Leadwire should be run in accordance with print.

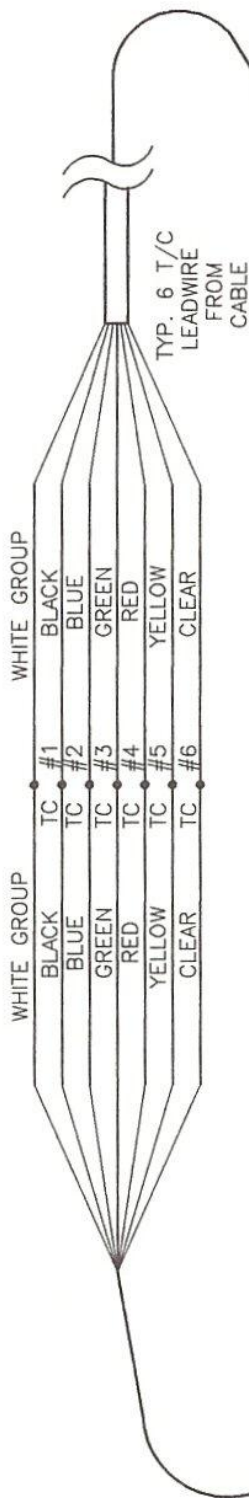
A short length of leadwire is attached to each cable at the factory.

There should be as few splices as possible. All splices must be made in places where they are readily accessible.

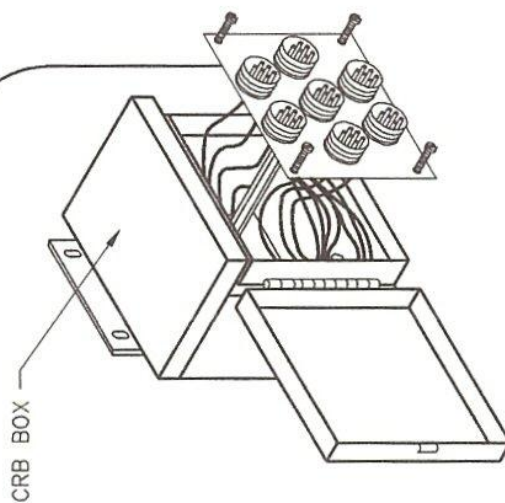
Leadwire must be handled with care when installing. Special care should be given so the leadwire is not nicked when it is pulled through the conduit.

Leave extra leadwire where splices will occur to make neat splices. A length of at least 5 feet is recommended at an instrument, multiplexer or CRB.

The Brady numbering tags should be moved up before trimming leadwire. This is important to keep the leadwire labeled correctly.



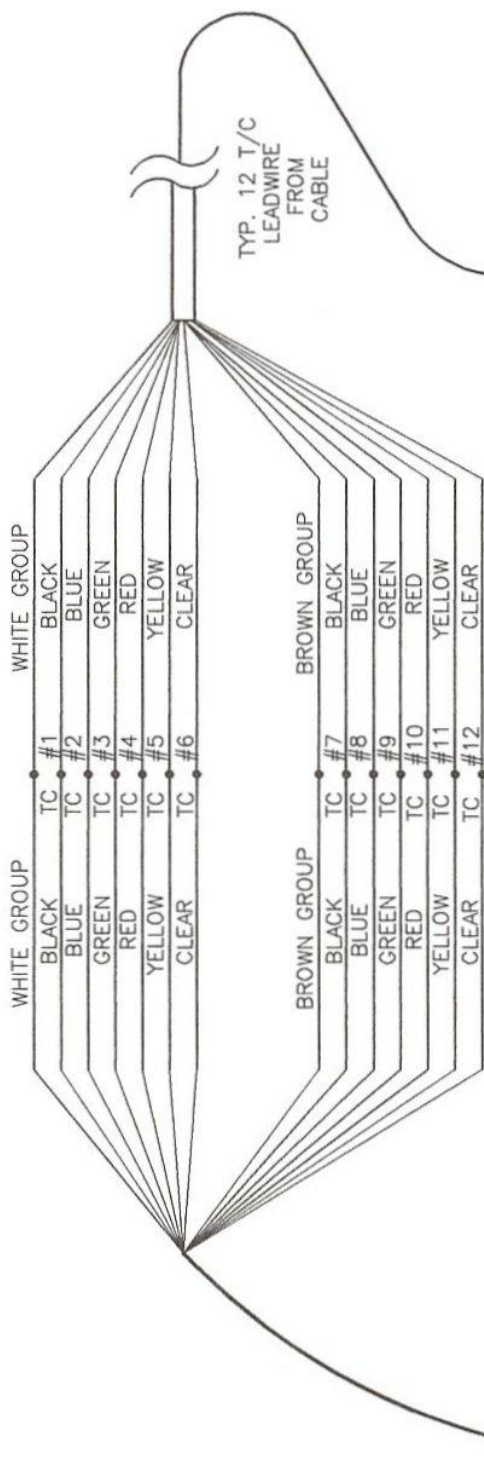
- NOTE:
- 1) SPLICE WIRES COLOR TO COLOR USE LINE B GREASE FILLED CRIMPS.
 - 2) THE WHITE WIRE CONSTANTAN AND THE REMAINING WIRES COPPER.



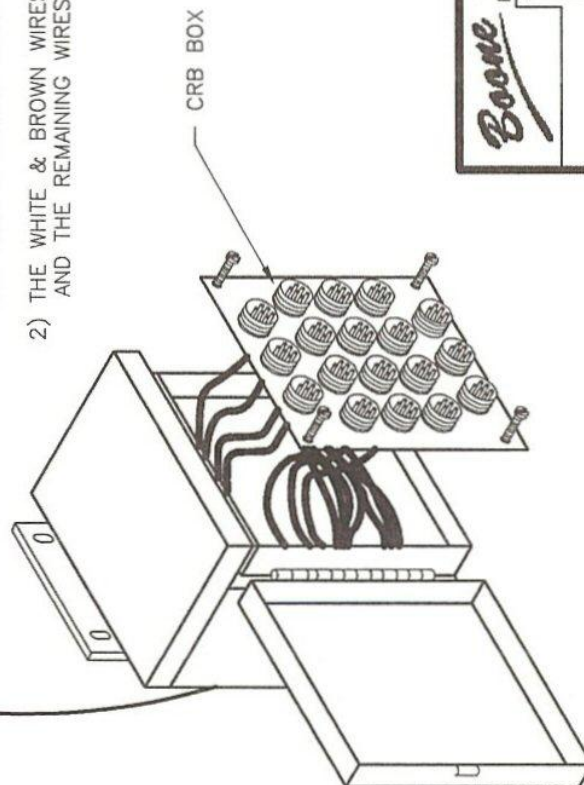
TYPICAL BIN

Boone CABLE WORKS & ELECTRONICS, INC.
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TITLE:	SCALE: NONE	DATE: 12-8-94
REF. WIRING OF 6 TC CRB TO 6 TC CABLE	DWN. BY: R. NELSON	
	DWN. NO. 180033	



- NOTE: 1) SPlice WIRES COLOR TO COLOR
USE LINE B GREASE FILLED CRIMPS.
- 2) THE WHITE & BROWN WIRES ARE CONSTANTAN
AND THE REMAINING WIRES COPPER.

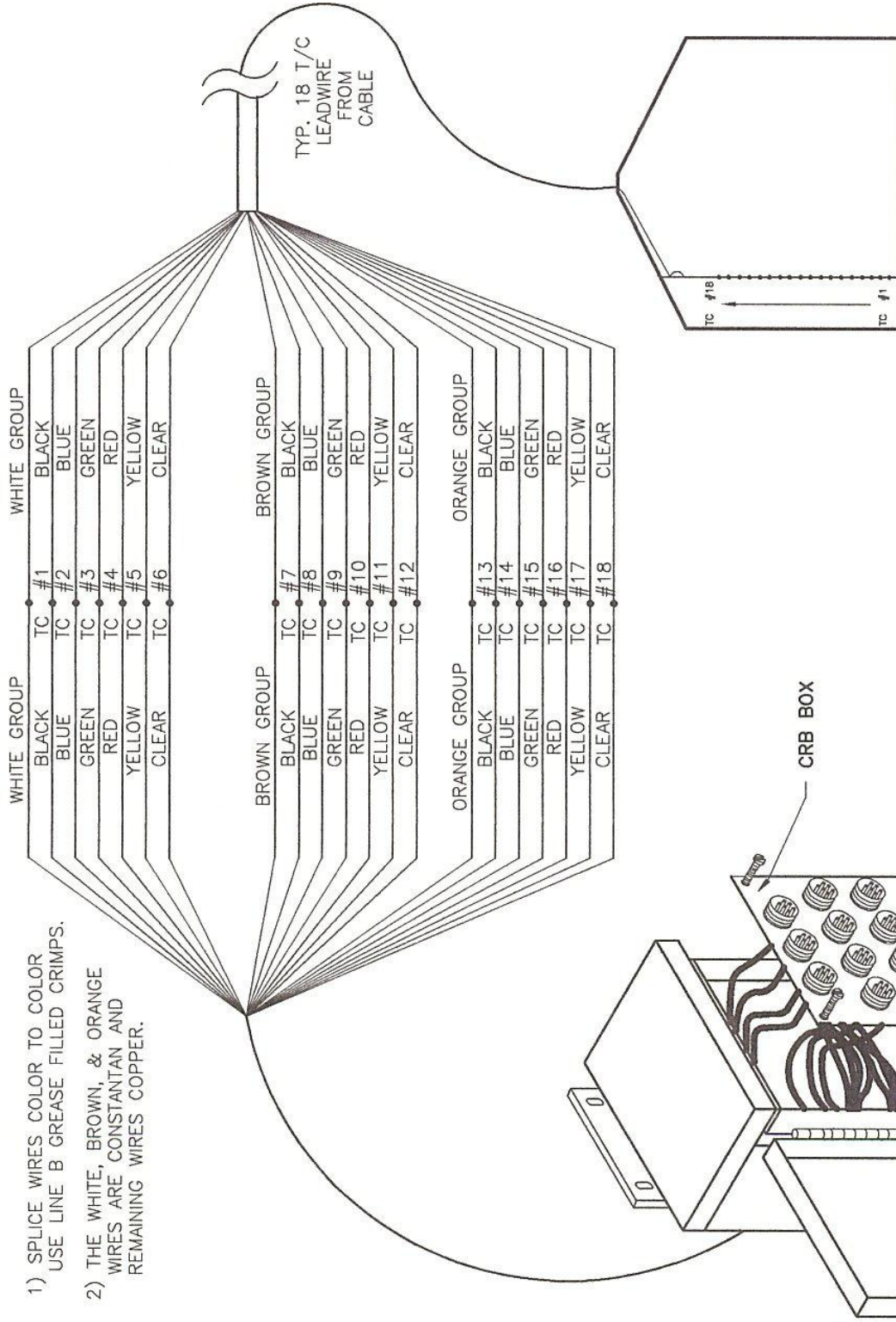


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TITLE: _____ SCALE: NONE DATE: 12-8-94

REF. WIRING OF 12 TC CRB TO 12 TC CABLE DWN. BY: R. NELSON DWN. NO. 180034

- NOTE:
- 1) SPLICE WIRES COLOR TO COLOR
USE LINE B GREASE FILLED CRIMPS.
 - 2) THE WHITE, BROWN, & ORANGE
WIRES ARE CONSTANTAN AND
REMAINING WIRES COPPER.



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TITLE: WIRING OF 18 TC CRB TO 18 TC CABLE

SCALE: NONE DATE: 12-8-94

DWN. BY: R. NELSON

DWN. NO. 180035

C. Splicing Leadwires

Leadwire splices are very important to the integrity of the system. Open Thermocouples (OT's) will occur in the system if the splices are not made correctly. Splices must only be made in pull boxes, condulets or where a leadwire run is terminated, such as an instrument or multiplexer. The leadwires from a multiplexer are numbered from 1 to 24 for easy identification when splicing to cable leadwire. Splices must not be pulled into the conduit. See drawings #180033 for 6TC, #180034 for 12TC, and #180035 for 18 TC leadwire splicing.

All leadwire splices made by the installation personnel will be made color to color and group to group. Never change the factory-made connections at the top of the cable. Splices at the top of the temperature cable are not color to color generally.

The detailed steps listed below to make splices use an 18TC leadwire as the example. These same instructions can be crossed over to 6, 12 and 21TC leadwire. 6TC leadwire has only one group and the constantan is white. 12 TC leadwire has two groups with white and brown constantans. 18TC leadwire has three groups with white, brown and orange constantans. 21TC leadwire is also composed of three groups with the same color constantans as 18TC. 21TC leadwire has 7 wires per group instead of 6, for a total of 21 thermocouples. Refer to drawing #180040 as you follow the steps.

Two types of splicing methods are described below. The first method uses Line B grease filled crimps and the second method is a solder splice.

1. Splicing with Line B grease filled crimps

The compression tool and crimps are available through the Boone Cable Works and Electronics, Inc. and can be purchased with the temperature equipment. The crimps offer a higher degree of insulation from moisture than soldering, due to the grease filled liner. They are also effective in hazardous areas where soldering equipment is not allowed or due to remoteness of electrical power.

The crimps are insulated outside and grease filled inside. The grease retards corrosion and resists water, thus making a good conductive splice that is well insulated. The splice, when completed, is taped to improve abrasion resistance and to keep the splice looking neat.

Tool required:

Compression Tool
Diagonal cutting pliers
Long nose pliers
Knife

Material required:

Line B grease filled crimps
Electrical tape

Detailed Steps: Refer to drawing #180040

Step 1. Using a sharp knife, cut along the ridge on the leadwire for one inch exposing the ripcord. Do this to both pieces of leadwire.

Pull the ripcord with the long nose pliers, slitting the outer covering of the leadwire back five inches. Cut off the outer covering. Do this to both pieces of leadwire. (NOTE: Should the ripcord break, then slit the outer covering open along the top of the ripcord ridge.)

Step 2. Tape the two pieces of leadwire together about four inches from the ends with two or three turns of electrical friction tape.

The next steps are important. Remember, a successful splice is one that has the correct wires joined so that the system will read the thermocouples in correct order.

Separate the three groups in each leadwire. Wrap the white, brown and orange wires around the wires in their respective groups. A 6TC leadwire will only have one white group. A 12 TC leadwire will have two groups, white and brown.

Step 3. Separate the individual wires of each group about 1/4" back so that the colors of each individual wire can be clearly seen. Note that all groups have a black, a blue a green, a red, a yellow, and a clear (copper-colored) wire, (21TC leadwire also has a purple wire) as well as another that may be WHITE, ORANGE, or BROWN. These white, orange, or brown wires are the constantan wires and also serve to identify the groups.

Select the two groups (one from each leadwire) that have the WHITE identifying wire. Fold the other groups back out of the way. Check again to be sure the two groups both have the white wire. Separate individual wires.

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Select any two wires that have the same color (ie. black and black). Without removing the insulation, twist the ends tightly at least eight (8) half-turns (should be twisted for a length of about 3/4").

Repeat until all seven (7) wires are twisted, including the white wires.

Repeat the process for the two groups having the brown identifying wires. Be sure both groups have the brown wire.

Repeat the process for the two groups having the orange identifying wires. Be sure both groups have the orange wire.

Cut the untwisted wire ends of all the twisted wires off and to approximately the same length.

Place the grease crimp over each pair of twisted wires, one from each leadwire. Be sure that the wires are inserted into the crimp as far as possible. This will assure that the wires make good connection after the crimp is compressed. Using the crimp tool, compress the crimp tightly closed. The tool is designed so that it will not open up again until the tool has squeezed the connector fully. Continue this operation until all the connections have been made.

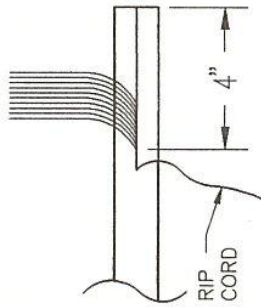
Step 4. This step shows two splicing types. The first type is a leadwire termination at a piece of equipment or splice box. The second is a leadwire splice for feed through, such as with a messenger wire.

For the termination splice, cover the completed splice with one layer of good quality electrical tape. Overlap each turn about half-way to get a good cover. The splice is now complete.

For the feed through splice, gently remove the tape holding the leadwires together. Carefully divide the splices into two groups. Straighten the leadwire out and form the splice into a straight line. Keep the outer covering ends close together, not more than 3/4" apart. Tape the splices to the leadwire.

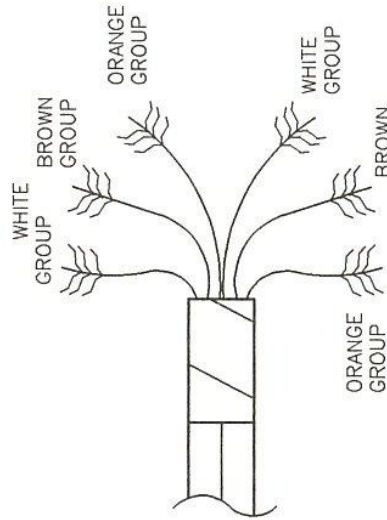
Cover the completed splice with one layer of good quality electrical tape. Overlap each turn about half-way to get a good cover. The splice is now complete.

STEP 1



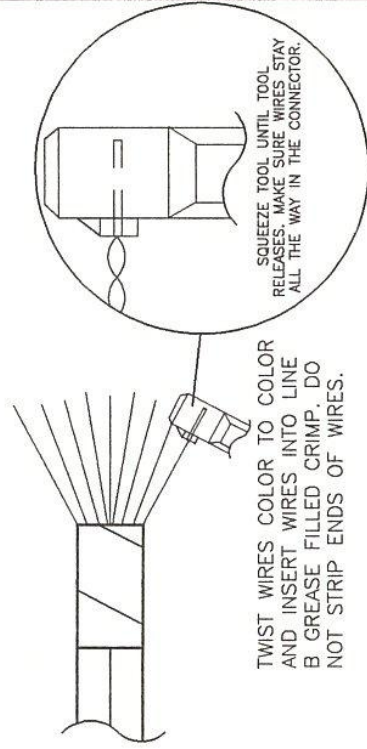
REMOVE OUTER JACKET

STEP 2



TAPE LEADWIRES TOGETHER AND SEPARATE GROUPS

STEP 3

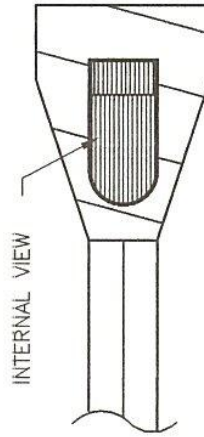


TWIST WIRES COLOR TO COLOR AND INSERT WIRES INTO LINE B GREASE FILLED CRIMP. DO NOT STRIP ENDS OF WIRES.

SQUEEZE TOOL UNTIL TOOL RELEASES. MAKE SURE WIRES STAY ALL THE WAY IN THE CONNECTOR.

STEP 4 OR

LEADWIRE TERMINATION AT A PIECE OF EQUIPMENT OR BOX SPLICE.



COVER SPLICE WITH LAYER OF GOOD QUALITY ELECTRICAL TAPE.

LEADWIRE SPLICE FOR FEED THROUGH SUCH AS WITH A MESSENGER WIRE.



DIVIDE SPLICES INTO TWO GROUPS AND STRAIGHTEN LEADWIRE. TAPE SPLICES TO LEADWIRE.



COVER WITH ONE LAYER OF GOOD QUALITY ELECTRICAL TAPE.

Boone		CABLE WORKS & ELECTRONICS, INC.	
P.O. BOX 369 1773-219th LANE BOONE, IOWA 50036 USA (515) 432-2010 (800) 265-2010 FAX (515) 432-5262			
TITLE:	SCALE: NONE	DATE: 12-8-94	
REF.	LINE B GREASE FILLED CRIMP INSTALLATION	DWN. BY: R. NELSON	
		DWN. NO. 180040	

2. Splicing with solder connections

Tool required:

- Soldering iron
- Diagonal cutting pliers
- Long nose pliers
- Knife

Material required:

- Rosen core solder (Do not use acid core solder)
- Electrical Tape
- Fiberglass sleeves (Spaghetti)

Detailed Steps: Refer to drawing #180041

- Step 1.** Using a sharp knife, cut along the ridge on the leadwire for one inch exposing the ripcord. Do this to both pieces of leadwire.

Pull the ripcord with the long nose pliers, slitting the outer covering of the leadwire back five inches. Cut off the outer covering. Do this to both pieces of leadwire. (NOTE: Should the ripcord break, then slit the outer covering open along the top of the ripcord ridge.)

- Step 2.** Tape the two pieces of leadwire together about four inches from the ends with two or three turns of electrical friction tape.

The next steps are important. Remember, a successful splice is one that has the correct wires joined so that the system will read the thermocouple in correct order.

Separate the three groups in each leadwire. Wrap the white, brown and orange wires around the wires in their respective groups. A 6TC leadwire will only have one white group. A 12TC leadwire will have two groups, white and brown.

- Step 3.** Separate the individual wires of each group about 1/4" back so that the colors of each individual wire can be clearly seen. Note that all groups have a black, a blue, a green, a red, a yellow, and a clear (copper-colored) wire, (21TC leadwire also has a purple wire) as well as another that may be WHITE, ORANGE, or BROWN. These white, orange, or brown wires are the constantan wires and also serve to identify the groups.

Select the two groups (one from each leadwire) that have the WHITE identifying wire. Fold the outer groups back out of the way. Check again to be sure the two groups both have the white wire. Separate individual wires.

Select any two wires that have the same color (ie. black and black). Without removing the insulation, twist the ends tightly at least eight (8) half-turns (should be twisted for a length of about 3/4").

Repeat until all seven (7) wires are twisted, including the white wires.

Repeat the process for the two groups having the brown identifying wires. Be sure both groups have the brown wire.

Repeat the process for the two groups having the orange identifying wires. Be sure both groups have the orange wire.

Each individual splice must be soldered properly. Place a hot soldering iron under the twisted portion very near where the twisting starts. Melt a small amount of solder on the iron to give good heat transfer to the jacket material. Using the stick of solder applied to the splice, gently float the melted jacket material to the end of the splice. The "glob" of insulation should fall off the end. Repeat process until all individual splices are soldered.

Trim the ends of the individual splices with cutters. Soldered joints should be a minimum of 1/2" long.

Step 4. Apply fiberglass insulating tubing (spaghetti) to each individual splice. The spaghetti should be slipped on far enough to cover the solder splice and about one quarter of the wire insulation. The spaghetti should not be slipped on so far that the soldered splice is exposed. The spaghetti is most easily slipped on by spinning between thumb and finger while gently pushing. The tubing is made to expand and ensure a good fit.

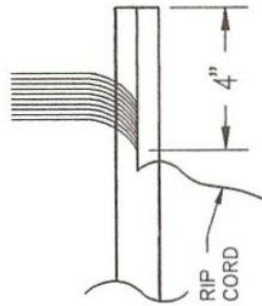
Step 5. This step shows two splicing types. The first type is a leadwire termination at a piece of equipment or splice box. The second is a leadwire splice for feed through, such as with a messenger wire.

For the termination splice, cover the completed splice with one layer of good quality electrical tape. Overlap each turn about half-way to get a good cover. The splice is now complete.

For the feed through splice, gently remove the tape holding the leadwires together. Carefully divide the splices into two groups. Straighten the leadwire out and form the splice into a straight line. Keep the outer covering ends close together, not more than 3/4" apart. Tape the splices to the leadwire.

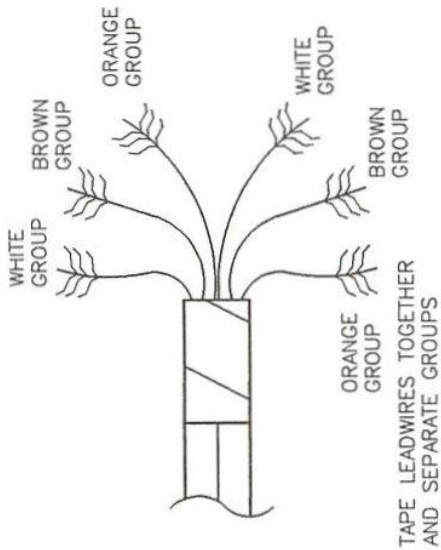
Cover the completed splice with one layer of good quality electrical tape. Overlap each turn about half-way to get a good cover. The splice is now complete.

STEP 1



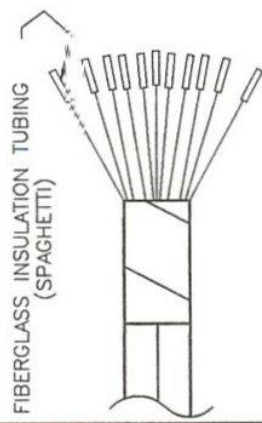
REMOVE OUTER JACKET

STEP 2



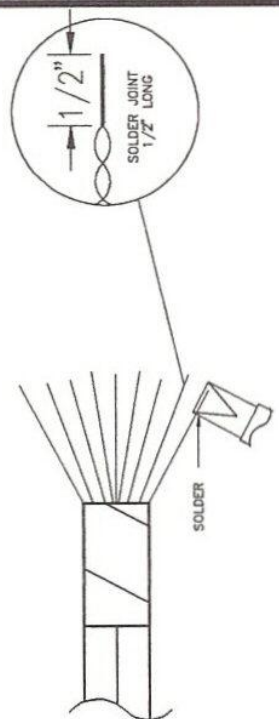
TAPE LEADWIRES TOGETHER AND SEPARATE GROUPS

STEP 4



PLACE SPAGHETTI OVER SOLDER JOINT

STEP 3

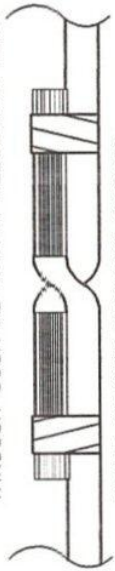


TWIST WIRES TO COLOR AND SOLDER EACH CONNECTION INDIVIDUALLY.

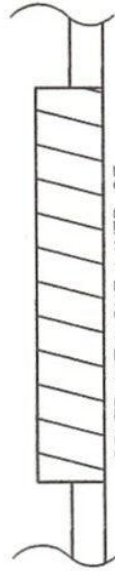
STEP 5

OR

LEADWIRE SPLICE FOR FEED THROUGH SUCH AS WITH A MESSENGER WIRE.



DIVIDE SPLICES INTO TWO GROUPS AND STRAIGHTEN LEADWIRE. TAPE SPLICES TO LEADWIRE.



COVER WITH ONE LAYER OF GOOD QUALITY ELECTRICAL TAPE.

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SOLDERING LEADWIRE SPLICE INSTALLATION			

5. System Checkout

Upon completion of the installation, all thermocouples (TC's) should be checked. This check is done by simply plugging your portable instrument into the plug (s) and reading through each TC on each cable. If an open or non-functioning TC is discovered, remove the CRB Box Panel and check the relative splice to make sure a good connection has been made. An open TC will show the same display as if your instrument is not plugged into a cable.