



Temperature Systems: Computer Based

INSTALLATION INSTRUCTIONS





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Purpose

These instructions provide guidance for the installation of a Safe-Grain, Inc. personal computer (PC) based temperature cable system, in a steel grain bin / silo with hard-wired or wireless communications.

These instructions are intended for persons with skills in the installation and assembly of grain storage bins / silos, and familiar with the necessary Personal Protective Equipment (PPE) and safe climbing requirements for a safe job site.

Tools and Supplies Required

- Personal Protective Equipment (PPE)
- Drill or screw gun
- Bits and socket drivers
- ¼" Self-tapping screws
- Conduit cutting and assembly tools
- Conduit and fillings
- Hole punch for conduit
- Lineman's pliers
- Screwdrivers
- Electrical tape³
- Wire ties
- Cable anchoring materials (see Figure 2, balloon 6)
- Ohmmeter



Introduction

Thank you for your purchase of a Safe-Grain temperature detection system. The installation of temperature detection cables in steel bins and silos varies depending on the manufacturer. All cables must be installed according to the manufacturer's recommended specifications.

IMPORTANT: Safe-Grain temperature systems will include an installation drawing with specific information for your system. Please use the drawing as your primary instruction and refer to this instruction manual for the details referenced on the drawing. Please do not hesitate to contact Safe-Grain (toll free 800-659-8250, or 513-398-2500, or email info@safegrain.com) if you have any questions about our recommended installation of cables while the roof is built at grade elevation.

Properly Installing Cables

The following general information is based on standard installation guidelines. Please note that the bin manufacturer's specifications may supersede the instructions in this manual. We strongly recommend that the temperature cables are installed when the steel bin roof is assembled prior to the side walls being erected. If the cables are not installed while the roof structure is a grade level, the cables can only be installed at a later date when the bin is full of grain or by erecting scaffolding. This means that the operator may not obtain grain temperature readings the first time the bin/ silo is filled.

IMPORTANT: It is up to the cable installer to follow the bin manufacturer's requirements on cable installation and cable brackets or cable supports. The bin roof and sidewalls may be damaged by the pull of the cables if the cables are not properly installed. Prevent roof and sidewall damage by following the bin manufacturer's recommendations for cable supports and cable locations.

General: There are several types of steel bins and it is possible that parts of these instructions may be modified to fit your bin. Proper caution should be used in handling the cables and the leadwire: avoid tangling, crushing, cuts, and knots. Protect the wires from welding splatter, too. A damaged cable or leadwire will not work. Cables should be identified and located by the cable identification tag located at the top of the cable. **DO NOT REMOVE THE TAG FROM THE CABLE.**

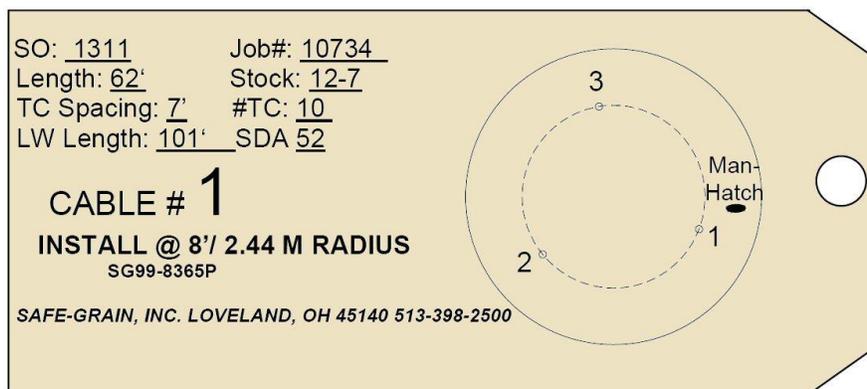


Figure 1 Typical Cable Tag- DO NOT REMOVE FROM THE CABLE

GENERAL INSTALLATION INSTRUCTIONS

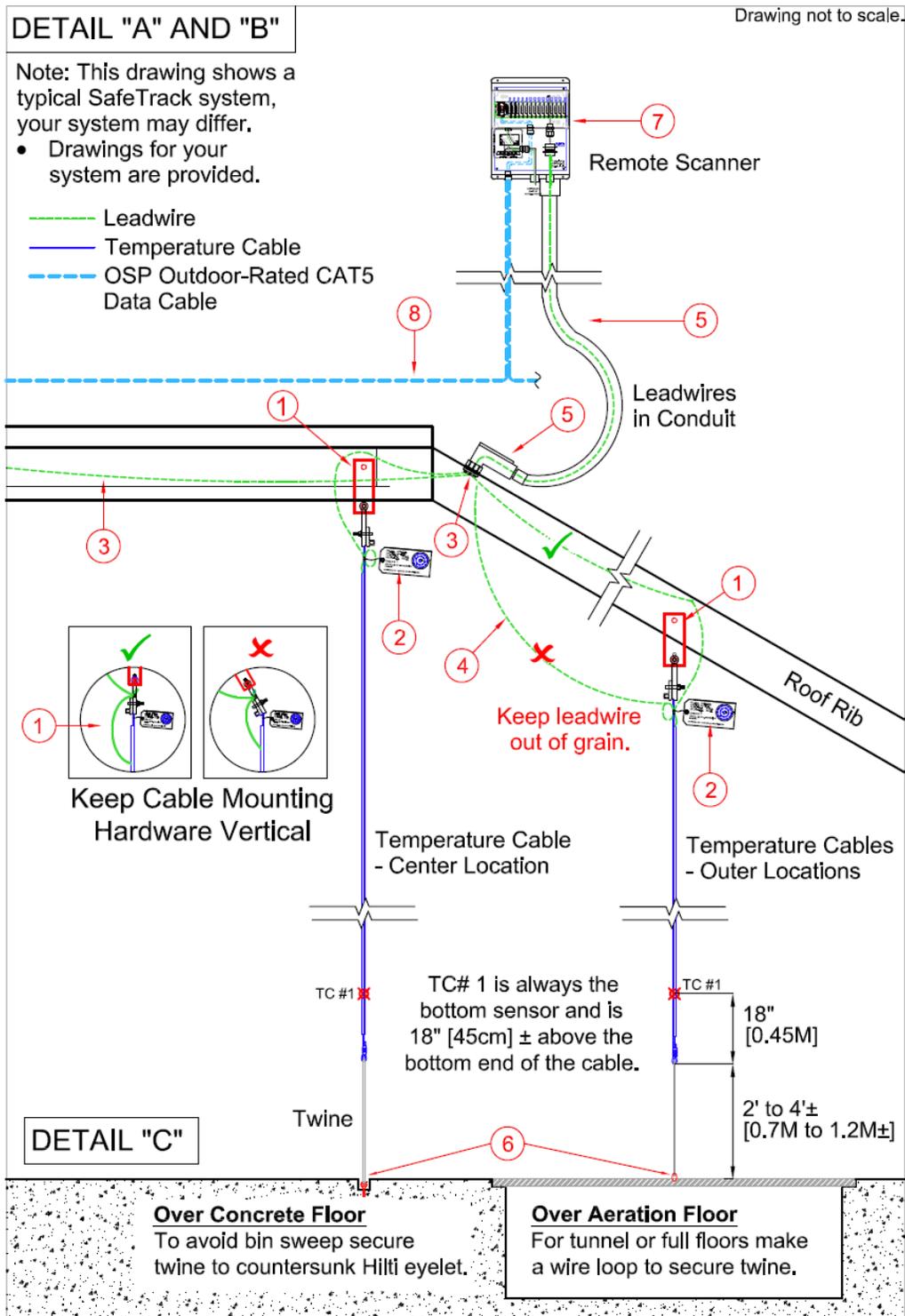


Figure 2



See Figure 2

- ① Cables must be hung and installed per bin manufacturer's specifications.
- ② See the "Temperature Cable Installation Detail" drawing for individual silo temperature detection cable lengths, locations, and general internal silo information. (Each silo size will have a separate detail drawing).
 - Every new Safe-Grain cable has a cable tag with a specific cable identification number and installation radius location.
 - Do not remove the cable tag.
 - Cables are numbered in a clockwise orientation starting at the silo center and moving to the outer wall. The center cable or first cable clockwise from the roof ladder/man-hatch is always # 1. See Figure 3 Temperature Cable Numbering
- ③ Run leadwires under the roof up to the roof peak and exit near the roof peak. Leadwires ends are factory identified with an ID wire-marker (Brady tag). Maintain identification if leadwire is field-cut or shortened.
 - Use wire-ties to hold leadwire tightly against the roof rib avoiding slack, to keep leadwire out of grain.
- ④ Keep leadwire out of grain and avoid any pinch points. Protect leadwires from welding splatter and other physical damage.
- ⑤ All external leadwire (starting at the Myers™ Hub¹ located near the silo roof peak) must be in conduit.
 - Systems with Plug & Play connectors require a minimum of 1.50" [41 mm] diameter conduit.
 - See Figure 4 Minimum Conduit Size for conduit details.
- ⑥ Avoid locating cables over unloading points or near any side draw unload systems.
 - See page 4 of "PC Based Temperature Cable Installation Instructions."
 - Secure bottom loop of temperature cable to wire loop or concrete anchor eyelet with light line or twine.
- ⑦ Please see your specific "Remote Scanner Wiring Detail" installation drawing(s) for wiring details and other important Remote Scanner installation information.
- ⑧ OSP Outdoor-Rated CAT5 Data Cable. See drawing B-06-43-S2d for wiring details.

¹ Myers™ is a trademark of Cooper Crouse-Hinds

Temperature Cable Numbering

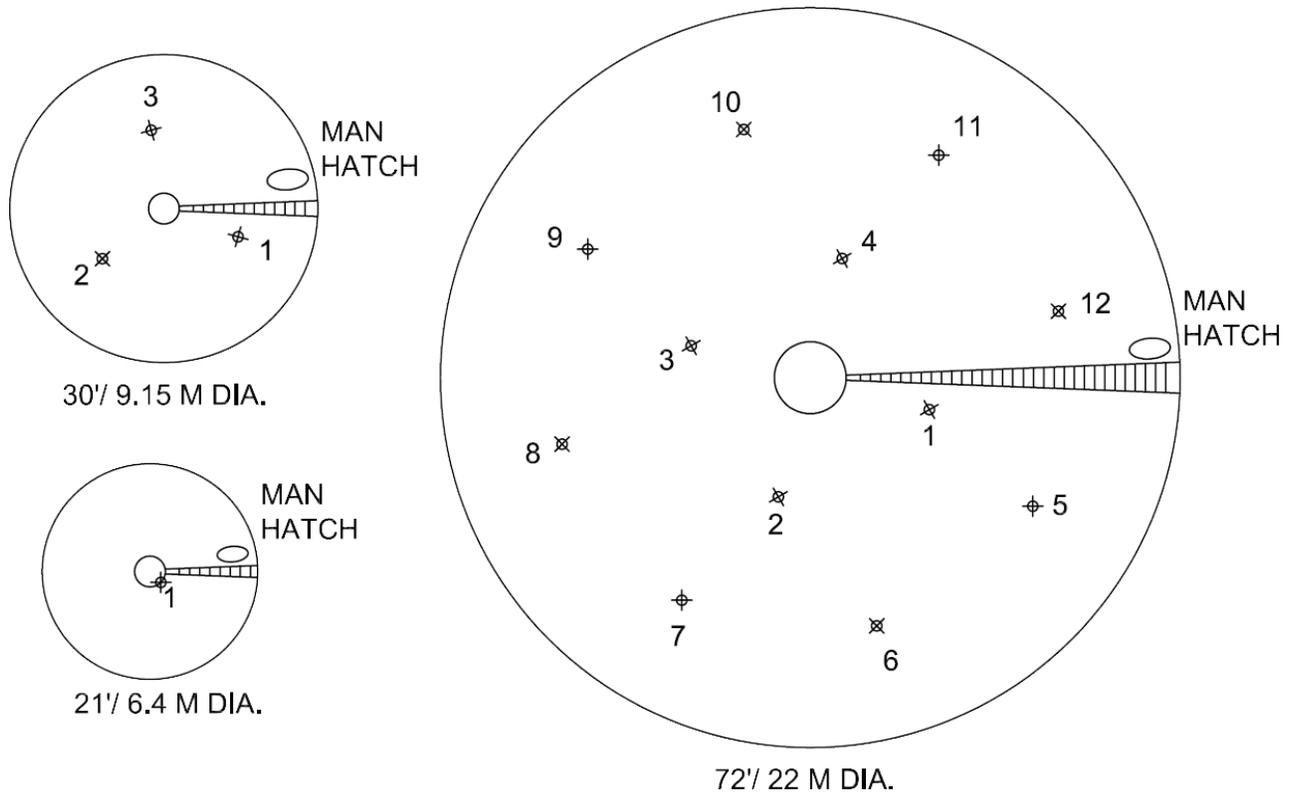
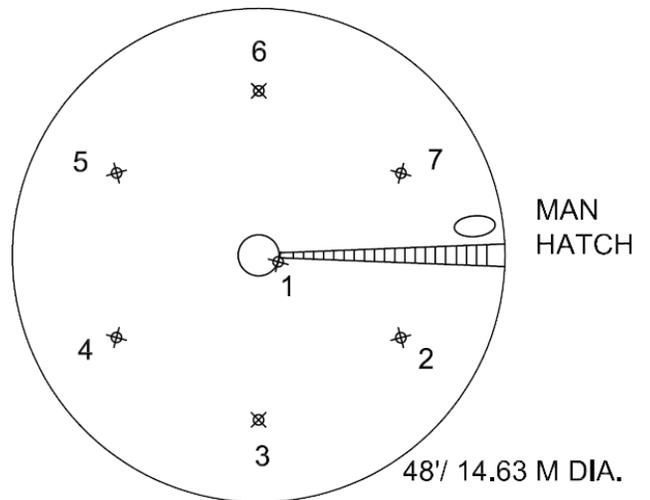


Figure 3 Temperature Cable Numbering

Standard identification of temperature cables is as follows for steel tanks:

1. See Figure 3 Temperature Cable Numbering
2. Cables are numbered in a clockwise orientation starting at the center and moving to the outer wall
3. The center cable OR first cable clockwise from the Roof Ladder / Man Hatch is always cable #1.
4. **Locate cables as distant from unloading points as possible!**
5. **Follow the manufacturer's cable installation instructions!**





6. Identify the end of the leadwire with the cable number so the leadwire may be properly identified when the leadwire splices are made at the Remote Switch or Scanner.
7. Run the leadwires to the peak of the roof in such a manner that they will not be in the grain stream or sag into the grain. The rib of the roof offers a convenient run for the leadwire.
8. **IMPORTANT:** Leadwire that comes in contact with the grain will probably be damaged and will not work.
9. Bring leadwires through the roof by installing a Myers™ hub or weatherproof splice box of sufficient size for all the leadwires. It is extremely important to seal the roof opening to prevent leakage. Avoid potential cable failure by avoiding cuts or pinching of the leadwire (such as by the roof cap). Coil leadwire outside the roof to protect from damaging the wire during the installation.
10. **IMPORTANT:** After the bin / silo is completed and before filling with grain – the cables should be secured to the bin / silo floor to keep cables vertical during grain storage use. Cables that are kept vertical will last much longer than cables that are allowed to “float” as the bin / silo is filled. Your temperature readings will be more accurate too.
11. Before the bin or silo is filled; attach the bottom cable loop to the bin floor.
 - a. Flat bottom silo – concrete floors See Figure 2 - #6.
 - b. Perforated aeration floor See Figure 2 - #6
 - c. Flat storage building option
 - d. Hopper bottom silos

External Conduit and Leadwire Installation

General: The leadwire supplied for each cable is sufficient to locate the scanner or remote switch as shown on your specific job installation drawing(s). Leadwire may be spliced as many times as required without affecting the quality of the temperature readings. Please contact Safe-Grain if additional leadwire and crimps are required to reach the scanner or remote switch.

We recommend rigid conduit to prevent damage to the external leadwires from weather, rodent, or physical damage. Thin wall conduit is usually used for inside runs not exposed to the weather and must not be used outside. Aluminum conduit is subject to distortion over time. **and may separate at connection points which will allow water entry and system damage. PVC conduit is not recommended since it will break and cracks at direction change locations.**

If PVC conduit is used the installer must use flexible connections such as SEALTITE® Liquid Tight Flexible Metallic Conduit at any direction change location such as the roof to eave location etc.

System damage caused by water or ice in a cracked or broken PVC, thin wall, or aluminum conduit system will not be covered under Warranty policy

Avoid any source of high voltage to avoid inductance “pick-up” that may affect temperature readings. Do not run any other wires (especially any 110, 220, 380 or 460 V wires) in conduit with Safe-Grain wires! Use general electrical requirements for fittings, supports, expansion joints, etc. See Figure 4 Minimum Conduit Size. Please provide an offset or short horizontal run on vertical runs over 60’ [20 M] tall.



Selecting Conduit Size

Using the correct conduit will simplify the installation. Conduit and fitting diameters should be based on the number of leadwires and the following table. **IMPORTANT:** *Systems with Plug & Play connectors require a minimum of 1.50" [41 mm] diameter conduit from the silo roof to any scanner or remote switch.*

MINIMUM CONDUIT SIZE

Leadwire Size	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
	[16 mm]	[21 mm]	[27 mm]	[35 mm]	[41 mm]	[53 mm]
6 T/C Leadwire	6	14	20	40	60	85
12 T/C Leadwire	3	5	11	20	30	44
18 T/C Leadwire	3	5	10	18	27	40

Figure 4 Minimum Conduit Size

After the roof and one ring of the bin are completed

Install the temperature detection cables in the silo per the silo manufacturer's requirements, Safe-Grain installation drawing, and section 2 of the Safe-Grain "Portable Temperature System Instructions." Please remember to identify the leadwire ends to indicate the cable location for each leadwire end.

Start the conduit installation by installing a Meyer™ hub with nipple connected to an LB (with the gasket and cover open) at a location near the roof peak next to the roof ladder. See Figure 2 - #5. Pull all identified leadwires from the inside of the silo to the outside of the silo through the LB cover opening. Keep the leadwires pulled out the LB gasketed opening at this time. Do not run the leadwire in any conduit at this time. Leadwire will be run in conduit after the roof and all rings are completed.

After the roof and all rings of the bin are completed

Install all roof conduit. See Figure 2. Inspect the conduit ends, remove any rough or sharp edges, and clean all conduit ends to avoid nicking or damaging the leadwires as they are pulled through the conduit. Remember to use sealant and fully tighten the conduit connectors.

IMPORTANT: Always bring leadwires into the scanner, remote switch, splice box, or pull boxes through the side or bottom of the enclosure to stop water from running on to the top of the enclosure. Drill a 3/8" [9 mm] weep hole in the bottom of enclosures to drain condensation from the bin / silo. Figure 2 - #7.



Scanner or Remote Switch Enclosure Locations

General: The scanner or remote switch enclosure should be located at a non-obstructed, convenient area for easy access. The standard leadwire supplied for each cable is sufficient to locate the enclosure as shown on your Safe-Grain project installation drawing. Avoid enclosure locations exposed to excessive vibration.

Mounting Procedure: Drill all conduit entry holes in the bottom (preferred) or side of the box. Size the conduit entry hole to 3/8" or 9 mm larger than the conduit size being used. (Example: 3/4" [20 mm] conduit plus 3/8" [9 mm] = 1-1/8" [29 mm] hole size.) Mount the enclosure with 1/4" [6 mm] self-tapping screws.

Pulling Leadwire Through Conduit

Leadwire is used to carry the signal generated by the cable thermocouples (TCs). DO NOT cut, nick or damage the leadwire. Avoid knots, tangles, or crushing.

Pulling all wires at the same time makes the job easier. Pull all leadwire(s) from the peak into the scanner or remote switch enclosure. Move up the Brady tags or cable number identification tags before cutting any excess leadwire. Keep a 3' [1 meter] length of extra leadwire per cable inside the enclosure.

IMPORTANT: There may be shared runs of communication or control wire and leadwires in the same conduit runs. Check your Safe-Grain project installation drawing and pull all wires in conduit at the same time.

Splicing Leadwire in the Scanner or Remote Switch Enclosure

Simply stated a good splice means a correct reading; a poor splice means an inaccurate or no reading at all. MAKE SURE ALL LEADWIRES ARE PULLED INTO THE ENCLOSURE, NOT THE CONDUIT, BEFORE SPLICING.

IMPORTANT:

You do **NOT** need to strip the insulation from the ends of the wires before crimping / splicing!

- Use SAFE-GRAIN supplied crimps only!
- Do **NOT** use 3M™ BRAND SCOTCH LOK™² connectors- they will **NOT** work and will void your warranty.
- Do **NOT** use "local" or "telephone" wire to extend the leadwires, it will not work and will void your warranty.
- Please contact SAFE-GRAIN 1-800-659-8250, 513-398-2500, or info@safegrain.com if additional crimps or leadwire are required.

² 3M™ and SCOTCHLOK™ are trademarks of the 3M Company



Plug and Play Connector Wiring Diagram

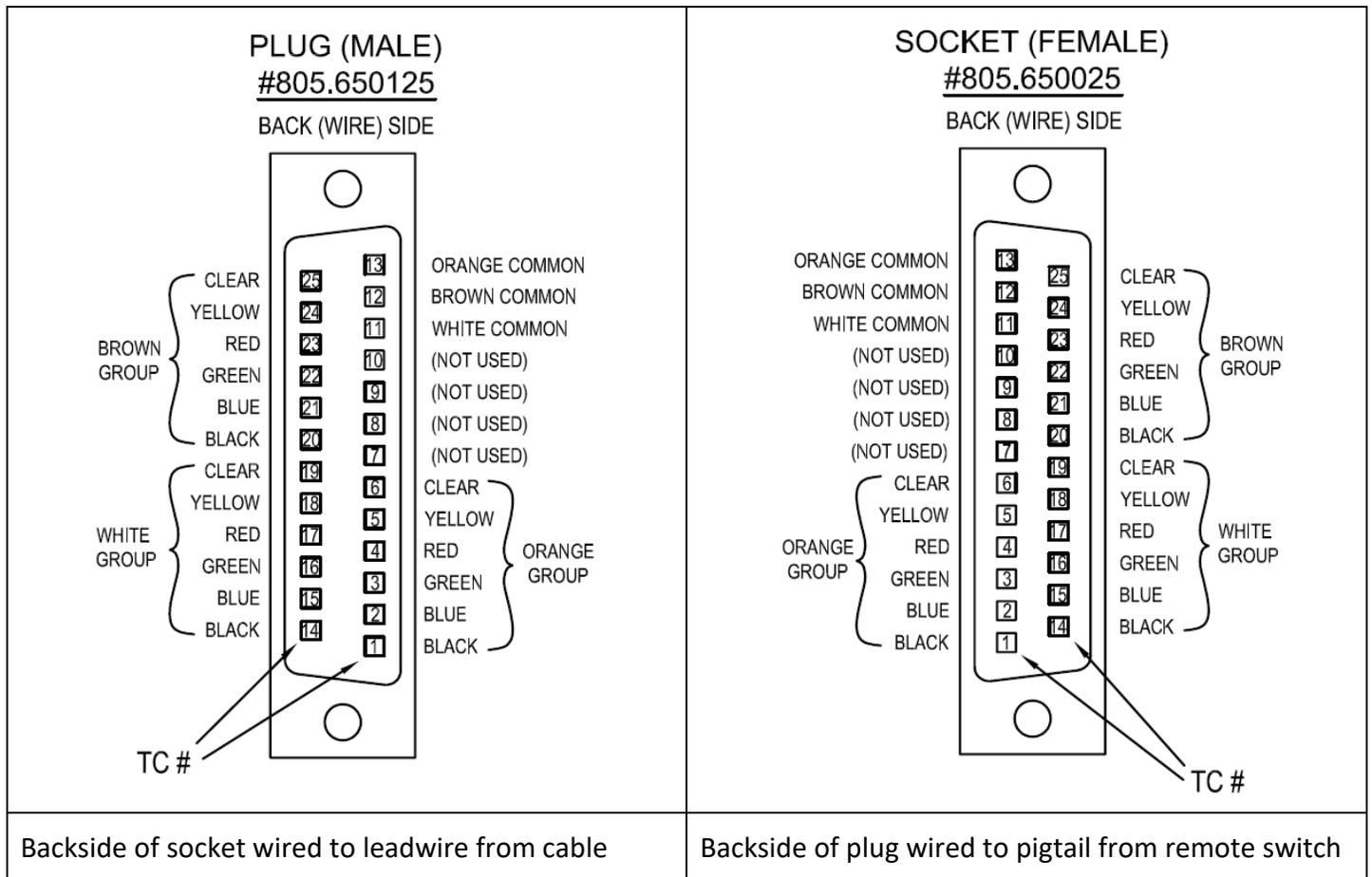


Figure 5



Leadwire and Pigtail Detail

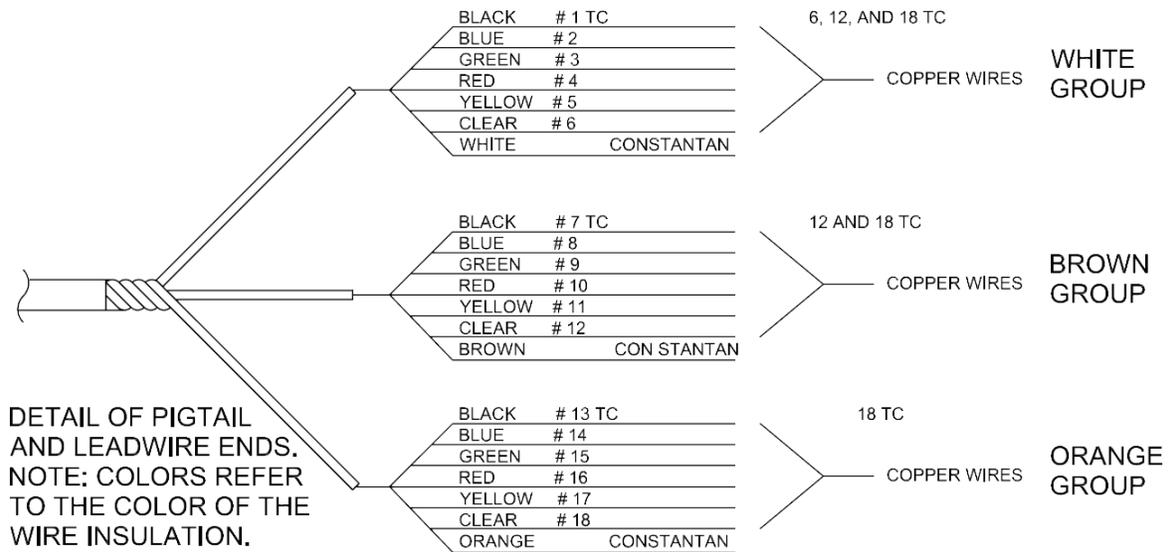


Figure 6

Splicing Wire: In Scanner or Remote Switch

The wires are spliced color-to-color and group-to-group. See Figure 6. Each pair of wires is inserted into Safe-Grain supplied grease filled connector crimp. See Figure 8 to Figure 13 . The grease retards corrosion and resists water, thus making a good insulated, conductive splice. The splice when completed is then taped to help prevent water infiltration and make for a neat appearance. The connectors may be crimped with a lineman's pliers or a Safe-Grain professional crimp tool. Please contact us for pricing on crimp tools (1-800-659-8250, 513-398-2500, or info@safegrain.com)



Figure 7

Simply separate the leadwire from cable #1 and the pigtail from the read out plug for cable #1. Tape together at the point where the black jackets end. Separate the groups of wires on the pigtail and leadwire.

The following steps are very important. Separate the individual groups about ¼" [30mm] so that the colors of each individual wire can be seen. Note that all groups have a black, blue, green, red, yell, and clear (copper) wire plus another wire that will be the WHITE, BROWN, or ORANGE (constantan) or the common wire.

- 6 TC Leadwires White common
- 13 TC Leadwires White and Brown commons
- 18 TC Leadwires White, Brown and Orange commons.



After separating the wires into their respective color groups, twist the wires together, color-to-color, one group at a time to keep the wires from being mixed up. Using a pair of side cutters cut off the excess wire to about 6" [20 mm] longer than the black jacket covering. Take two identical colors from the same group, insert a crimp over the two ends, and crimp with the crimp tool. **No stripping of the insulation is required.** Be sure that the crimps are seated as far as possible on the two wires and that the tool crimps the connector completely! Tape up the splice with a good grade of electrical tape after all crimps are completed. Tape back to the black outer jacket to prevent loosening and shorting of the wires. The splice or crimp is now complete. Gently coil up the slack on the leadwire and insert leadwire into the enclosure.

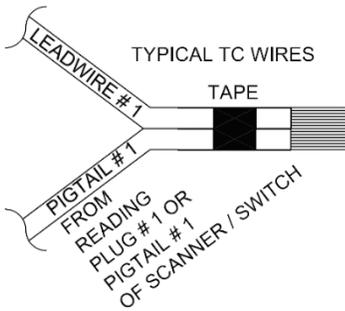
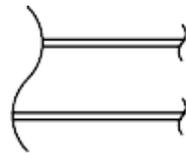
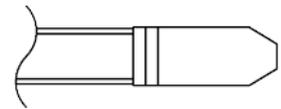


Figure 8



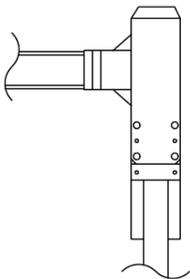
BLACK-BLACK WIRES of same length. Do Not Strip Insulation!

Figure 9



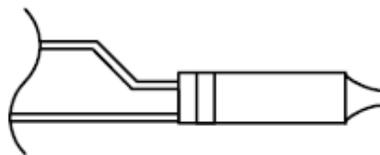
Insert wires fully into SAFE-GRAIN supplied crimp. YOU MUST USE SAFE-GRAIN CRIMPS. DO NOT USE 3M™ BRAND SCOTCHLOK CONNECTORS.

Figure 10



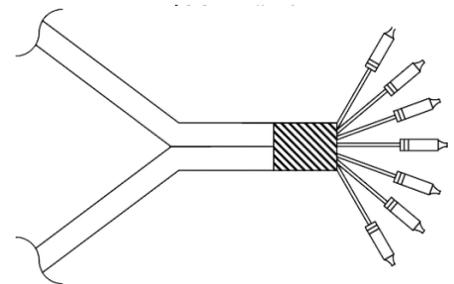
Use Linesman's Pliers, Radio Shack Crimp Tool, or SAFE-GRAIN Crimp Tool. Squeeze Crimp Tool until tool releases.

Figure 11



Completed BLACK-BLACK crimp / splice for White Group. Pull GENTLY on crimp to make sure that the wires remain in the plastic crimp. Repeat for all wires.

Figure 12



Shows all splices crimped. Now tape back from black jackets of wires to the end of the splices.

Figure 13



System Troubleshooting

Start troubleshooting temperature cable and leadwire problems by isolating the problem as described in the OHM testing section of the SafeTrack “HELP” section on the system PC.

There should be about 1.1 OHM per foot or 2-4 OHMs per meter of leadwire-cable length. The #1 thermocouple (TC) will have the highest resistance (OHMs) since it has the greatest physical distance. The balance of the TC’s will drop about 6-8 OHMs from the previous TC. The OHM values themselves are not important. What is important is that any short circuits, broken wires, or TC sensors wired out of order are found and corrected.

If problems with the temperature cable or leadwire are suspected:

1. Inspect all field splices and wire runs for obvious causes and correct. Re-splice as needed if a sensor is wired out of order, shorted, or a poor connection is found. If the cable continues to be defective inspect the factory-made connections at the top of the temperature cable.
2. Using an ohmmeter, measure the resistance between each TC wire in the temperature cable and a common (white, brown, or orange) constantan wire in the same group. Insert the ohmmeter probes into the back of the splice connector to measure the resistance. The temperature cable wire with the highest resistance is TC #1 and can be any color. It must be spliced to the black wire in the leadwire white group. The temperature cable wire with the second highest resistance must go to the blue wire in the white group, etc. See the color codes in Figure 6. Color codes sequences always follow the same order: black, blue, green, red, yellow, clear. If TC #1 in the temperature cable is green, TC #2 will be red. Re-splice as needed if a sensor is wired out of order, shorted, or a poor connection is found.

NOTE: A cable with 8 TC will only have 8 copper wires to test. A cable with 14 TC will only have 14 copper wires to test, etc.

Please do not hesitate to contact SAFE-GRAIN, INC. if further help is required.

Phone:	(513) 398-2500
Fax:	(513) 398-2536
Toll-Free:	(800) 659-8250
E-mail:	info@safegrain.com
Website:	www.safegrain.com



Safe-Grain, Inc.

417 Wards Corner Road
Loveland, OH 45140 USA

Tel 1-513-398-2500 | Fax 1-513-398-2536

Terms and Conditions of Sale

Shipment is made F.O.B. Safe-Grain plant, unless another point of origination is designated on the face hereof, in which case shipment is F.O.B. at such point of origination. Unless specified by Buyer in writing, shipment shall be made by carrier of Safe-Grain's choice. No insurance is provided for the goods unless requested by Buyer prior to shipment, and satisfactory arrangements for payment are made between Buyer and Safe-Grain. This sale is subject to, and Safe-Grain shall not be responsible or liable for, delay directly or indirectly resulting from or contributed to by any foreign or domestic embargoes, seizures, acts of God, insurrection, war, the adoption or enactment of any law, ordinance, regulation, ruling or order, directly or indirectly interfering with or rendering more burdensome the production or delivery hereunder, lack of usual means of transportation, fires, floods, explosions, strikes or other accidents or contingencies beyond Safe-Grain's control, either of the forgoing nature or of any other kind, nature or description Safe-Grain's or its suppliers' plants or elsewhere or otherwise affecting transportation or production of the goods or any components used in or in connection with their production. Any delivery quotations are estimates only and the failure to comply therewith shall in no manner subject Safe-Grain to incidental or consequential damages resulting from failure to meet any such estimated or requested delivery date. All prices are subject to change without notice prior to acceptance of order by Safe-Grain, unless the same are stated in writing by Safe-Grain to be firm for a definite period of time.

All invoices are due and payable within the time specified on the face hereof, unless subsequently modified in writing by Safe-Grain. In addition to purchase price, Buyer shall pay Safe-Grain the amount of all governmental taxes, excises and/or other charges that it may be required to pay with respect to the production, sale or transportation of any goods delivered hereunder; except as otherwise provided by law.

Safe-Grain warrants that the goods, described on the face hereof are free from defects in the electronic components of the goods for a period of three (3) years from the date of shipment of the goods. Safe-Grain's obligation under this warranty is limited to repairing or replacing the electronic components of the goods. Buyer shall at Safe-Grain's request, return for repair or replacement of the components of the goods, freight prepaid. No other express warranty is given and no affirmation of Safe-Grain, by words or action, shall constitute a warranty. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTIES INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND/OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND ANY OTHER OBLIGATIONS ON THE PART OF SAFE-GRAIN. Buyer's receipt of goods delivered hereunder shall be and constitute an unqualified acceptance thereof, and the waiver by Buyer of any and all claims with respect to such good other than a claim under the express warranty hereinabove set forth. Buyer assumes all risk and liability for the results and performance obtained by the use of the goods delivered hereunder. No claim of any kind, whether as to goods delivered or for non-delivery of goods and whether or not based on negligence, shall be in an amount greater than the purchase price of the goods described on the face hereof with respect to which such a claim is made. In no event shall either party be liable for consequential damages as defined in the Ohio Business and Commerce Code.

The risk of loss of the goods shall pass to Buyer as soon as the goods are properly loaded on the carrier shipping the same.

The terms and conditions on the face hereof and as set forth herein above shall constitute the entire agreement of the parties superseding any and all prior agreements, representations, communications, and/or understandings.

This contract shall be governed by and construed in accordance with the laws of the State of Ohio, and exclusive venue shall be in Clermont County, Ohio.

WARRANTY SGI 4042012