

OKONITE

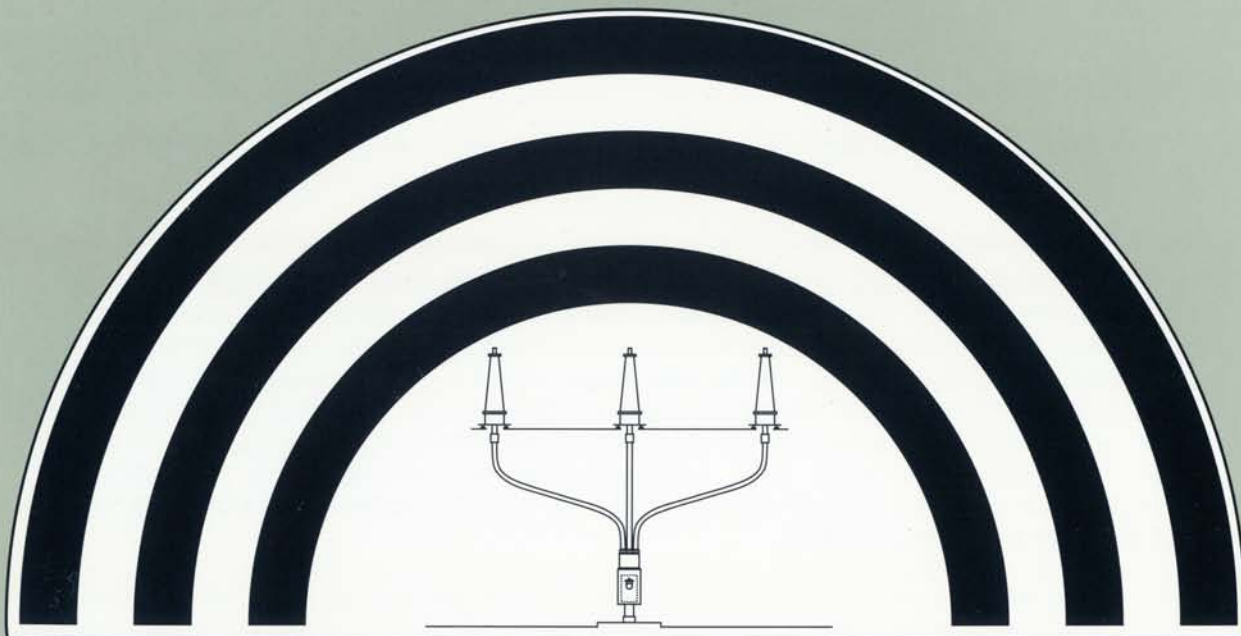
H.P.G.F.

HIGH PRESSURE GAS FILLED

CABLES



**TYPICAL DRAWINGS
AND
INSTALLATION INSTRUCTIONS
FOR
HIGH PRESSURE GAS FILLED
PIPE-TYPE CABLE SYSTEMS**



THE OKONITE COMPANY

Ramsey, New Jersey 07446

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SECTION 1



PIPE INSTALLATION POLYETHYLENE COVERED PIPE

1.0 SCOPE

The intent of this specification is to cover The Okonite Company's recommended practice for the field handling, installation, and testing of the steel pipe and its corrosion protective covering used in pipe-type cable systems.

2.0 PIPE DESCRIPTION

Pipe furnished shall be in accordance with ASTM Specification A 523, latest revision, titled "Plain End Seamless and Electric Resistance Welded Steel Pipe for High Pressure Pipe Type Cable Circuits". Pipe shall be Grade A. The lengths shall be double random lengths averaging not less than 45 feet. Each length shall be flared on both ends so as to be suitable for welding with chill rings. Each pipe flare shall be uniform with a 5° concentric inside taper to a diameter equal to the original O.D. of the pipe as shown on Okonite Drawing OS-5722. A chart is enclosed at the end of this section providing the outside diameter and wall thickness of pipe recommended for use on normal pipe-type cable installations.

3.0 REQUIREMENTS FOR PIPE COATING

3.1 PIPE CLEANING

The interior and exterior surfaces of the pipe shall be preheated, thoroughly dried, and steel grit blasted or sand blasted to remove all moisture, mill scale and other foreign matter, then cleaned of residue before applying any primer or coating.

3.2 PIPE EXTERIOR

After cleaning as specified above, the exterior surface of the pipe shall be coated with a layer of adhesive followed by a layer of high density polyethylene (Pritec or equal). At the ends of the pipe, approximately four (4) inches shall be left free of all coating materials. The approximate O.D. over the pipe and coating may be determined from the specification chart at the end of this section.

The pipe is then flared with a 5° taper for use with a Wedge Products Type P-421 chill ring as shown on Okonite Drawing OS-4339.

3.3 PIPE INTERIOR COATING

The interior surface shall be thoroughly cleaned of any loose foreign matter and spray-coated with Dearborn Endcor 745 Epoxy coating. Dry coating thickness shall be 1.5 mils minimum.

When the interior coating is dry, the ends of the pipe shall be covered with suitable caps to prevent entrance of moisture and foreign matter. The caps shall be vented to prevent buildup of internal pressure.

3.4 PIPE COATING TEST

The completed coating on the exterior of the pipe shall be tested at 15kV before shipment with a Holiday Detector. This test shall be made only after the pipe coating is dry. Lengths failing this test shall be repaired and retested to ensure passage before shipment.



4.0 PIPE AND COATING WEIGHTS

(See chart at end of this section)

5.0 NECESSARY INSTALLATION AND TESTING EQUIPMENT

Before the installation of pipe is started, the equipment required to carry out the work efficiently should be available at the jobsite.

The following special tools and equipment are recommended for pipe installation and testing:

- Pipe plugs for temporarily sealing the pipe ends in the trench
- Pipe mandrel
- Dew point measuring device
- Dry nitrogen for storage and high pressure testing of pipe
- Hoists for handling pipe
- Pressure gauges for 30 and 500 lbs. per sq. inch
- Propane torches (Raychem FH 2601 with AD-1358 regulator or equal) for applying heat shrinkable joint sleeves
- Holiday Detector (10,000 V) for testing exterior pipe coating
- Valves for 500 lbs. pressure test
- Nitrogen gas pressure regulators - 2 stage (0-60 and 0-4000 lbs. per sq. inch)
- Standard welding equipment
- Pipe cutter
- Trailer truck for transportation of steel pipe
- Small crane or boom truck for loading steel pipe and lowering same in the trench
- Nylon slings - (3" wide x 4' long) for adjusting pipe position
- Rubber mats, sandbags, straw bags, or equal for temporary bedding of pipe
- Flaring tool for rounding pipe ends per Okonite Drawing OS-4435
- 12 pound sledge hammer
- Vacuum pump (approximately 135 CFM), trap tank, and 20 ft. of 2" vacuum hose
- Vacuum pump oil
- Vacuum gauge (0 to 5000 microns)
- Pipe coating insulation megger (Simpson VOM or equal)
- Trichloroethane 1, 1, 1 inhibited grade or similar degreasing solvent
- 50' long x 1/4" wide metal snake
- Pipe grinder for pipe ends
- Steel wire brushes for cleaning pipe ends
- Pipe swabs

6.0 PIPE HANDLING

Any transit damage to the pipe or pipe coatings as received must be immediately reported to the carrier and noted on the delivery receipt. Pipe shall be unloaded, handled, stock-piled, hauled and installed in a manner that will protect the coating against damage. The coated



pipe should at all times be supported on suitable protective padding until it is finally installed in the trench. It may be stored, however, on a level pad of sand not less than 6 inches deep and nested no more than 6 layers high with padding. The number of tiers is dependent on the size of the pipe and the expected temperature conditions at pipe handling locations.

In very warm weather, the coating can soften and flatten, thus reducing the thickness and insulation resistance. In freezing weather, protection must be given to coating to prevent it from freezing to the ground, thus preventing removal without damaging the coating. No chains or ropes shall be allowed to come in contact with the pipe coating during handling operations.

CAUTION:

Polyethylene is a rugged coating but it will damage if subjected to abuse or not shielded from sharp objects.

7.0 STEPS AND SEQUENCE OF OPERATION

Installation and testing of the pipe can be broken down into the following number of steps. These steps pertain to the usual practice of welding successive lengths of pipe above the trench. However, due to the presence of services or other obstructions across the excavation, it may be necessary to make some welds after the pipes have been positioned in the trench (See Paragraph 13.0). Steps are given in logical sequence but do not have to be conducted separately. Each operation may be going on at the same time at various locations along the route. Assuming the route has been determined and all materials are on hand, the following steps shall be taken:

- 7.1 Test polyethylene coating on exterior of pipe, inspect the pipe interior for dirt and condensation, cleaning if necessary.
- 7.2 Dig trench for pipe.
- 7.3 Weld steel pipe.
- 7.4 Radiograph test pipe welds.
- 7.5 Apply heat shrinkable sleeves to pipe joints.
- 7.6 Test full length of coating including joints for holidays.
- 7.7 Lay pipe in trench.
- 7.8 Backfill trench.
- 7.9 Check coating resistance of installed pipe at start of each work day with VOM.

8.0 PIPE TRENCHING

Make ready all necessary material and labor for trenching, shoring, bridging, tunneling under railroad tracks, backfilling trench, etc.

Excavate pipe trench to correct dimensions as required for pipe installation. The depth may vary from 3 ft. to 10 ft. or more depending upon findings at time of excavation. The desirable minimum coverage is 3 ft. over pipe.



The bottom of the trench shall be smooth, uniform and free from rocks, stones or other foreign matter. Nothing shall be left in the bottom of the trench which might damage the pipe coating. When the presence of rock or other conditions prevent a satisfactory bed for the pipe, at least 6 inches of clean sand shall be backfilled on the bottom of the trench and well tamped around the pipe. Wherever acid, oil, ashes, cinders or other injurious materials are encountered in the trench, the pipe shall be embedded on all sides in one (1) foot of screened sand. The pipes shall be installed so as to eliminate contact with any types of obstruction. A minimum of 6" clearance and preferably more should be maintained between the pipe and any obstructions. Where services or other obstructions are encountered near the bottom of the trench, it is required that the trench be graded for a sufficient distance on both sides to allow the pipe to lay of its own accord without field bending to prevent contact with services or obstructions.

Remove all excess earth and clean up.

9.0 INSTALLATION HANDLING OF PIPE

For bends with a radius of approximately 50 feet or more, the pipe can be trained to conform without machine bending. Bends of shorter radii shall be made with suitable bending equipment. During bending operations, adequate measures shall be taken to prevent damage to the pipe coating. An electric Holiday Detector voltage set at 10 kV shall be used to detect faults in the polyethylene coating. The electrode for applying this test shall be a rolling spring that will completely encircle the pipe, so arranged that it will contact the pipe coating. Tests with a Holiday Detector shall be made only when the pipe coating is dry and in the presence of the supervising engineer or his representative. If any holes in the coating are found, it is good practice to circle the faults with marker pen so that those personnel doing repair work will know their exact location. Patching of the coating is done with heat shrinkable sleeves or polyethylene tape. Retest all repairs.

It is recommended that a suitable wide belt type sling be used in handling the pipe above the trench for position welding. A suitable belt sling is one that has a width no less than the outside diameter of the coated pipe, and of sufficient length to avoid contact between its end links and the coating. In the removal of the belt sling from under the coating, care should be exercised to avoid dragging the free end link against the coating if the sling does not have a removable end link. Pipe lengths should be bedded on straw bags or rubber sheets and transported on trucks or trailers to the trench. The pipe may be layered on timbers or saddles over the trench. There should be bedding for the pipe on timbers. A rubber or canvas mat, straw bags, or sand bags are satisfactory. The pipes are to be laid over the trench with ends butted, to form a continuous pipe line. The caps or plugs are removed from the ends of two (2) adjacent pipe lengths, the ends examined for roundness and a chill ring inserted to check the dimensions of the flared ends. The opening of the chill ring should not exceed 1/8 inch unless approved by the supervising engineer. If the end of the pipe is not round or the chill ring collar does not fit up to the end of the pipe, the end of the pipe should be flared to meet these requirements. A steel mandrel should be used for this purpose and should be forced into the end of the pipe with a sledge hammer. At this time, the inside of the pipe end should again be examined. If there is dirt or rust, the pipe end should be cleaned.



Pipe shall be lowered into the trench in a manner that will not damage the coating. Where it is necessary to pull pipe into or along the bottom of the trench, suitable rollers, straw bags or other means shall be used to prevent damage to the coating. The leading edge of the coating should be temporarily protected to prevent damage during the pipe pulling operation. Where coated pipe is installed in a sleeve or casing, spacers shall be used to support the pipe through the sleeve or casing.

CAUTION:

The pipe coating will normally resist damage; however, it is recommended that great care be exercised in handling as indicated under Paragraph 6.0 to prevent damage in the field.

10.0 WELDING

The edge of the pipe should be cleaned with a steel brush to facilitate welding. A pipe end with and a pipe end without a chill ring shall be brought together, aligned and securely clamped so that the axis of the pipes coincide and so that the space between the pipe ends is not greater than $7/32$ " nor less than $3/16$ " at any point around the circumference of the pipe. This shall be accomplished in a manner that will insure against canting or stressing of the chill ring. The opening of the chill ring shall not be more than $1/8$ ". Care should also be taken to insure that the chill ring, in its final position in the trench, shall have the opening 90° off the vertical perpendicular of the pipe. The chill ring opening should not be located on the inside of a bend in the pipe.

Welding of the pipe shall begin and once begun, welding shall proceed continuously until all passes have been completed.

All welding shall be performed and all welders qualified as prescribed in American Petroleum Institute Specification #1104 (latest edition) "Standard for Field Welding of Pipe Lines", except burn-throughs are not permitted under any circumstances.

In general, all welds shall be not less than three pass electric welds. The filler material shall conform to A.W.S. Class E-6010 welding rod and shall be Fleetwood #5 or equal. It is recommended that the first two passes be made with $1/8$ " rod and the third pass with $5/32$ " rod. The current required will be approximately as noted below:

| | | |
|-----------------|---|----------------|
| $1/8$ inch rod | - | 90 - 100 amps |
| $5/32$ inch rod | - | 110 - 120 amps |

These values are approximate only and can be varied to give best results.

Pipe ends shall not be left open in the trench. All open ends of the pipe shall be sealed with an airtight pressure cap and the pipe filled at a pressure above atmospheric and kept filled with dry nitrogen to a pressure of $1/2$ psi per foot of maximum burial depth but not less than 5 psig.



11.0 TESTING WELDS

After the weld is completed, it is to be tested before the heat shrinkable sleeve coating is applied, by radiographic inspection in accordance with American Petroleum Institute Specification Standard #1104 (latest edition) "Standard for Field Welding of Pipe Lines", except burn-throughs are not permitted under any circumstances. The testing of the welds will be performed by a laboratory designated by the installer and at the expense of the installer. The laboratory will submit to the installer the film of each weld for approval. Each unacceptable defect in a weld shall be removed and the joint then rewelded and reinspected.

When the coated pipe is installed through a steel sleeve or casing, it is imperative that the pipe coating be holiday tested before it enters the steel sleeve or casing.

In addition, after a section between manholes has been completed, reducers should be welded on in final positions. The test cap should then be installed and 400 to 500 psig pressure applied to the entire section for a minimum of one (1) hour (local codes must be checked first). Either nitrogen or dried air may be used for this test.

After proof testing at this high pressure for one (1) hour, the pressure can be reduced to approximately 275 psig. Pipe should be maintained under this pressure for 72 hours and readings taken twice a day or a recording pressure gauge used, to insure pipe is tight. Ambient temperature changes may result in some variation and should be taken into account. It is a good practice to tape a thermometer to each bare end of the pipe next to the reducer and record the temperature readings and pressure readings.

12.0 COATING WELDED JOINTS

After the welds have been successfully tested, carefully wire brush the pipe weld area. Burrs, weld splatter, or other sharp points should be filed or peened.

Any coating not firmly bonded to the pipe should be cut away.

Remove any foreign matter from the area between the two cut back ends of the polyethylene coating. Thoroughly clean and dry the polyethylene coating for at least 8" on each side of the joint.

During hot weather it is recommended the heat shrink sleeves be stored in a cool environment to prevent the release paper from sticking.

A double layer of 2" wide tape (Polyken #934-35, Polyken #930-35 or equal) should be centered over the pipe weld and wrapped around the pipe. The finishing end of the second layer should butt up against the starting end of the first layer. This tape serves as a cushioning layer to cover the rougher surface at the pipe weld area, prior to installation of the heat shrinkable sleeve.

Slide the heat shrinkable polyethylene sleeve into place and adjust it so an equal amount of the sleeve will extend over the polyethylene pipe coating on both sides in the final shrunk position. It is recommended that a few trial runs be made on scrap pipe lengths to get the installation procedure and adjustment dimensions down pat before starting in on the actual installation.



Wraparound heat shrinkable type sleeves are used in some cases instead of tube type sleeves. Either type produces a satisfactory installation when carefully and properly installed.

The weld can be warm (hand left on) but not hot when wrapping the 2" wide tape over the weld or installing the heat shrinkable sleeve over the weld.

After the sleeve has been installed and cooled, it should be tested with the Holiday Detector, same as the pipe coating.

It is usual practice to wrap polyethylene tape around the front end of the heat shrinkable sleeve when pulling the pipes in the trench or into a sleeve or casing.

13.0 LAYING OF PIPE IN THE TRENCH

Although it is not necessary, the usual practice is to start the laying of the pipe at a manhole. In order to have the pipe straight in the manhole, it may be laid through both sides of the manhole and cut after backfilling. This alignment of the pipes in the manhole is important since improper alignment will cause a great deal of difficulty later when the steel joint sleeves are assembled.

A large enough sleeve should be used in the manhole walls to accommodate "link seals" or appropriate caulking to prevent water leakage and holidays in the pipe coating. It is recommended that an extra heat shrinkable sleeve or wrapping of tape be applied over the coated pipe where it passes through the manhole walls.

If there are no transverse services through the trenches, one end of the pipe may be lowered into the trench while the other end is above the trench. Before lowering the pipe into the trench, the polyethylene coating should be given a voltage test for detection of holidays. One end of the completed pipe will lay in the trench while the other end will be above the trench. Pipe lengths are then welded to the end above the trench, which will permit additional pipe to be lowered into the trench. There should be one (1) length straight above the ground and at least 100 feet for flexing the pipe from above the ground to the bottom of the trench.

If there are transverse services, the pipe may be welded above the ground, then lowered. Depending on the size, length of pipe, and number of lengths joined together, etc., the pipe can be moved under services by a pulling winch, hoist or other suitable means. The pipe is then pulled into final position. To facilitate welding, extra soil should be dug out around the joint to permit the welder to get under the pipe.

The pipe in the trench should be holiday tested before backfilling the installed pipe with fluidized thermal backfill (FTB), sand or concrete.

In order to be able to use two welders in one location, one welder may be welding two lengths together while the other is welding two previously jointed pipe lengths to the pipe in the ground or pipe to be laid in the ground.



14.0 FINAL TESTING OF COATING BEFORE BURIAL

Before placing pipe in position in the trench, the polyethylene coating on the welded pipe, including coated joints shall be tested in the manner already described. Coating areas shown by this test to be defective shall be immediately repaired and retested until found to be satisfactory. It is also recommended that a final check for holidays in the coating be made prior to backfilling.

15.0 BACKFILLING THE TRENCH

The Engineer will determine whether the excavated materials shall be used as backfill. All backfill shall be clean and free of any stones or objects that may damage the pipe coating. Backfilling material within one (1) foot of the pipe shall be clean sand for best thermal characteristics. Other backfilling material shall be free of stones greater than 12 inches of their maximum diameter,

Tamping is required for the first 12 inches over coated pipe. Backfill must be thoroughly compacted.

Sand backfill may be compacted by flushing. When the flushing method is used, backfill to one foot above the pipe. Flush about the pipe and allow the pipe to settle before adding more fill. Backfill material above the first layer should be flushed in 2 foot layers to the top of the trench.

16.0 ACCEPTANCE TEST OF PIPE COATING

After each manhole to manhole section of pipe has been installed and the trench is backfilled, the Engineer will measure the insulation resistance of the polyethylene coating with a suitable insulation tester. This test may not necessarily be made immediately after the backfill is complete but will be made prior to pavement installation. If the insulation resistance is less than 10 megohms per square foot of pipe surface area, an over-ground survey should be made to locate any points which might have low insulation resistance. The contractor shall expose the pipe at such point or points and make the necessary repairs to the coating.

NOTE:

The 10 megohms value is not to be considered as a minimum acceptance coating value, but instead only a dividing line to determine whether or not an over-ground survey should or should not be made.

17.0 PIPE JOINT REDUCERS

Refer to the assembly drawing of the straight normal joint prior to installing reducers on the pipe in the manhole.

Determine the exact location to install the reducers and cut the pipe using a pipe cutter in a manner so as not to reduce the inner diameter of the pipe and still leave a clean cut in a plane perpendicular to the axis of the pipe. After removal of the cut section of pipe, position the two reducers in place and align in position. It is important that these reducers be squared off to pipe, and aligned properly with respect to each other so that the sleeves can be slid into position without binding. One bolt hole should be at the 12 o'clock position before welding the reducer to the pipe.



NOTE:

There are times when the ends of the pipe will spring apart after a section is cut out for installing pipe joints. In these cases, it is recommended that a jack be used to keep both cut ends of the pipe in alignment. Recheck the alignment and spacing required between the face of both reducers. Weld both reducers in position and secure the test caps in place to seal up the sections of pipe.

18.0 PIPE DRYING

As soon as the two ends of a pipe section are accessible (after completion of the high pressure test), the section shall be evacuated to an absolute pressure of 75 microns or less of mercury. After reaching 75 microns, the vacuum pump shall be kept running for a minimum of four (4) more hours. It is preferable to take this vacuum reading at the end opposite from the vacuum pump, if only one (1) vacuum pump is used. After completion of the 4-hour pumping period, the vacuum pump shall be stopped and isolated from the line, and a vacuum drop test run. If the rise in pressure in one hour, after isolating the vacuum pump, exceeds 75 microns, the vacuum treatment shall be repeated. When the vacuum test is acceptable, the vacuum shall be broken by admitting super dry nitrogen (minus 67°F dew point) to a 7 to 10 pound positive pressure and maintained at this pressure until the entire line is accepted by the Engineer. If the pressure in any section is reduced to 0 psig, the entire evacuation procedure shall be repeated before the line is re-pressurized.

19.0 PIPE TERMINATIONS

Each end of the pipe cable system shall terminate above ground in a spreaderhead assembly or below ground at a trifurcating assembly. Each of the three (3) cables continues from there in separate non-magnetic stainless steel riser pipes to the terminators (potheads) on the terminal structure. It is suggested that the related drawings be studied and understood before starting this phase of the work.

19.1 ABOVE GROUND SPREADERHEAD TYPE

A 90° pipe bend assembly is furnished to make the transition between the buried pipe and the spreaderhead assembly in above ground terminations. It is necessary to position this pipe bend to suit the terminal location.

Anchors and/or concrete footings may or may not be used depending on local soil conditions and pipe circuit routing. The pipe bend has a flared end at the bottom to accommodate a chill ring for welding to adjacent pipe. The top of the pipe has a straight end and is cut in the field to fit into the bottom of the spreaderhead. After the welding has passed the required examination and the joint covered with a heat shrinkable sleeve, the entire pipe bend and joint shall be tested for holidays as described before. Assuming there are no holidays, the concrete footing (if used) can be poured. Extreme care should be exercised not to damage the polyethylene while building the form or pouring concrete. After the concrete has set sufficiently, the spreaderhead can be located in position but not welded yet. The riser pipes and terminator (pothead) baseplates should be pre-fitted, adjusted and assembled in their final positions prior to final welding and assembly. The riser pipe bends are furnished with a little extra length in order that they may cut in the field to suit during final assembly. These riser pipes should be swabbed thoroughly prior to final assembly.



19.2 BELOW GROUND TRIFURCATING ASSEMBLY

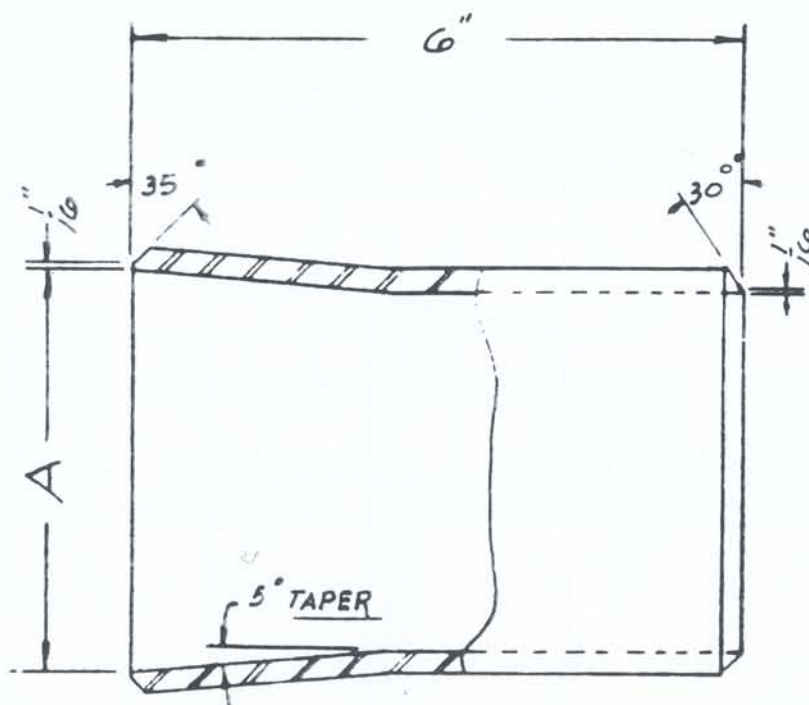
Nitrogen gas piping should be 1" Schedule 160 (.250" wall thickness) steel pipe per ASTM A53, A120, or equal. Fittings should be 2000 lb. forged socket weld type. The pipe and fittings must have an external corrosion covering such as extruded polyethylene, or taped polyethylene in all buried portions of the run.

All welds in the nitrogen gas interconnecting piping should be checked with gas pressure and "Leak Tec" or soap solution prior to covering with the corrosion protective covering.

20.0 PROCEDURE AND SEQUENCE OF OPERATIONS

The instructions given in this manual are intended to cover what might be considered a typical pipe-type cable installation. They are not intended to cover every condition which might occur on every installation. It should be recognized that each installation has its own special characteristics and features. Thus, these instructions can be modified or interpreted to cover contingencies at the discretion of the Okonite Field Advisor and/or the owner's Engineering Department Representative.

| SPECIFICATIONS FOR POLYETHYLENE COATED PIPE FOR PIPE-TYPE CABLE INSTALLATION | | | | | |
|---|-------|--------|-------|-------|--------|
| NOMINAL PIPE SIZE | 4 | 5 | 6 | 8 | 10 |
| Pipe O.D. - Inches | 4-1/2 | 5-9/16 | 6-5/8 | 8-5/8 | 10-3/4 |
| Pipe Wall Thickness - Inches | .237 | .258 | .250 | .250 | .250 |
| Surface Area of Bare Pipe-Sq.Ft./Lin.Ft. | 1.18 | 1.46 | 1.73 | 2.26 | 2.82 |
| Nominal Adhesive Thickness - Inches | .010 | .010 | .010 | .010 | .010 |
| Nominal Coating Thickness - Inches | .040 | .060 | .060 | .060 | .060 |
| Weight of Bare Pipe - Lbs./Lin. Ft. | 10.8 | 14.7 | 17.0 | 22.4 | 28.0 |
| Approx. Weight of Pipe Plus Coating - Lbs./Lin.Ft. | 11.1 | 15.2 | 17.6 | 23.2 | 29.0 |
| Minimum End Overlap of Field Joint - Inches | 2 | 2 | 2 | 2 | 2 |



~NOTE~

DEPTH OF FLARE SHALL VARY
WITH THICKNESS OF PIPE

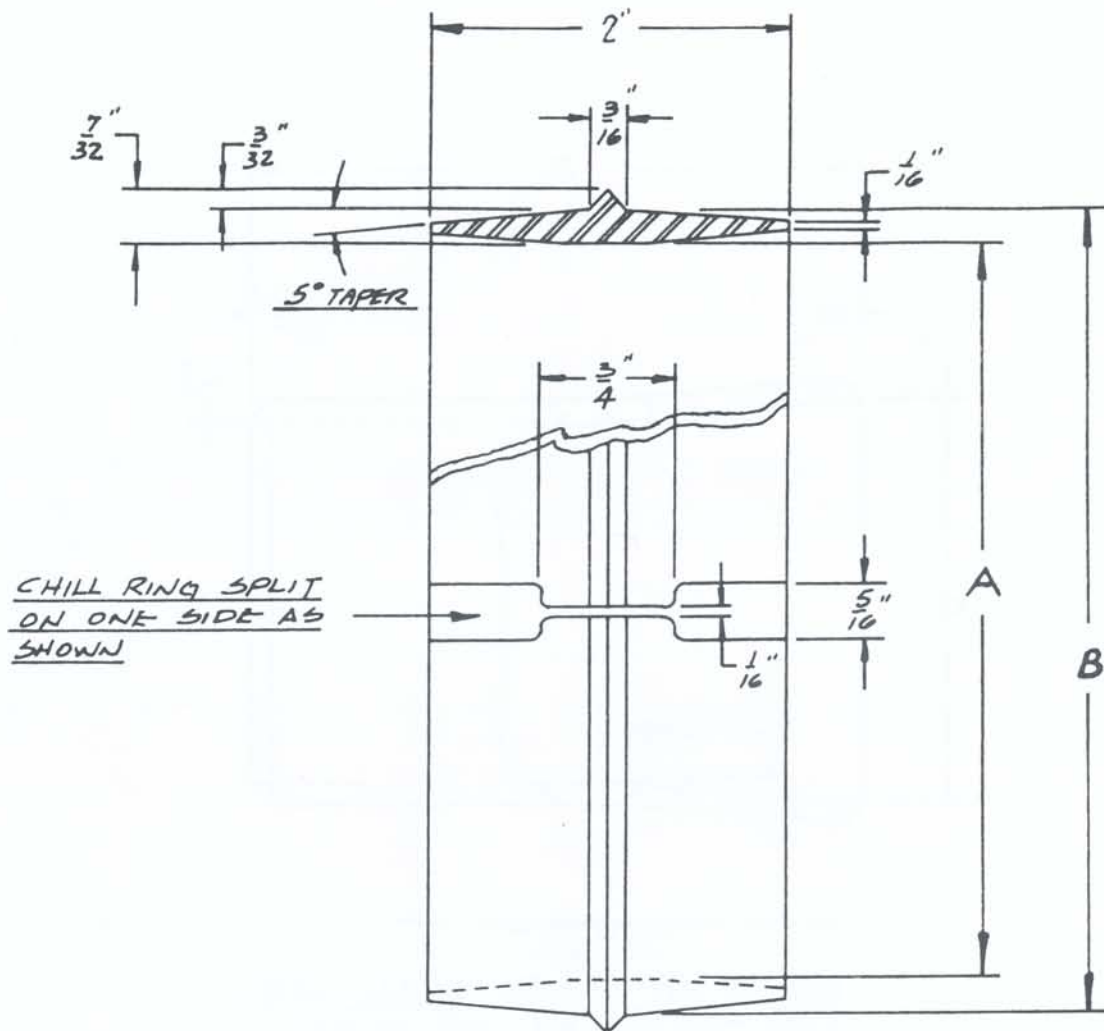
| FIG. NO. | PIPE O.D. | DIM. - "A" |
|----------|-----------|------------|
| 1 | 4 1/2" | 4.500" |
| 2 | 5 9/16" | 5.5625" |
| 3 | 6" | 6.000" |
| 4 | 6 5/8" | 6.625" |
| 5 | 7" | 7.000" |
| 6 | 8 5/8" | 8.625" |
| 7 | 10 3/4" | 10.750" |

ISOSTATIC
DETAIL - FIELD FLARE

THE OKONITE COMPANY
RAMSEY, N.J., U.S.A.

DATE 11-1-63 SCALE —
DR. NEW TR.
APP.

REVISIONS 1 3-12-65
DRAWING NO.
05-4338



| FIG. NO. | PIPE SIZE-O.D. | DIMENSIONS | |
|----------|----------------|------------|---------|
| | | A | B |
| 1 | 4 1/2" | 4.250" | 4.500" |
| 2 | 5 9/16" | 5.3125" | 5.5625" |
| 3 | 6" | 5.750" | 6.000" |
| 4 | 6 5/8" | 6.375" | 6.625" |
| 5 | 7" | 6.750" | 7.000" |
| 6 | 8 5/8" | 8.375" | 8.625" |
| 7 | 10 3/4" | 10.500" | 10.750" |
| 8 | 12 3/4" | 12.500" | 12.750" |

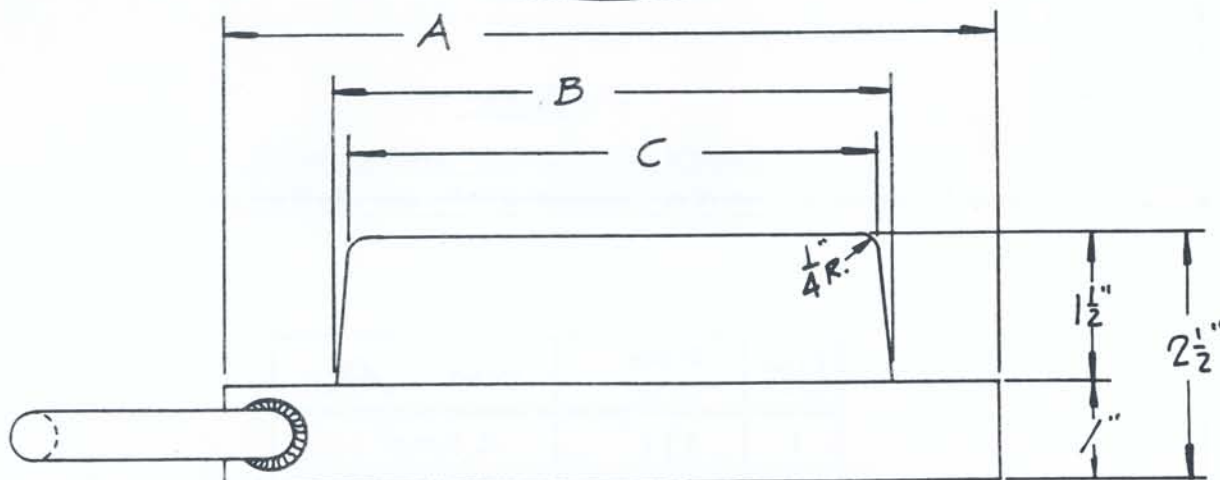
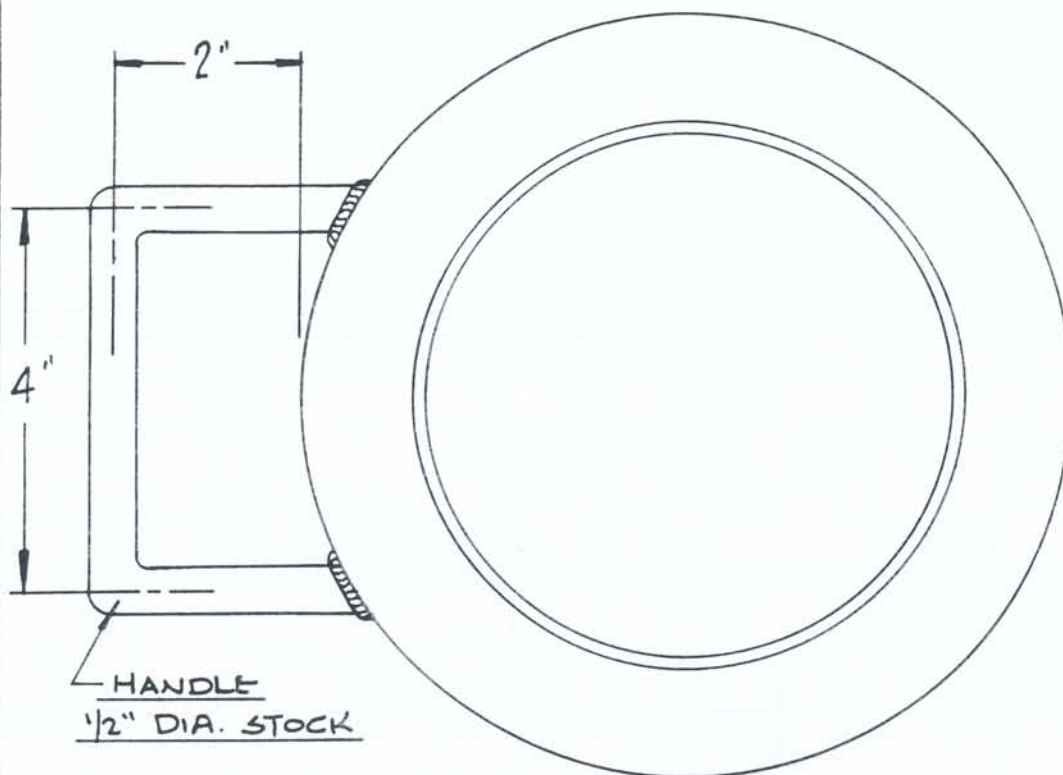
-DETAIL- CHILL RING

THE OKONITE COMPANY
RAMSEY, N. J., U. S. A.

DATE 10-31-63 SCALE ~
DR. H.R.H. TR. J.P.P.
CH. H.R.H. APP.

REVISIONS

DRAWING NO.
05-4339



MATERIAL - STEEL

| FIG. NO. | PIPE SIZE O.D. | DIMENSIONS | | |
|----------|----------------|------------|---------|----------|
| | | A | B | C |
| 1 | 4 1/2" | 7" | 4 3/8" | 4 1/8" |
| 2 | 5 9/16" | 8" | 5 3/8" | 5 5/16" |
| 3 | 6" | 8" | 6 1/32" | 5 25/32" |
| 4 | 6 3/8" | 9" | 6 3/4" | 6 7/16" |
| 5 | 7" | 10" | 7 1/8" | 6 3/16" |
| 6 | 8 5/8" | 11" | 8 3/4" | 8 3/8" |
| 7 | 10 3/4" | 13" | 10 7/8" | 10 1/2" |

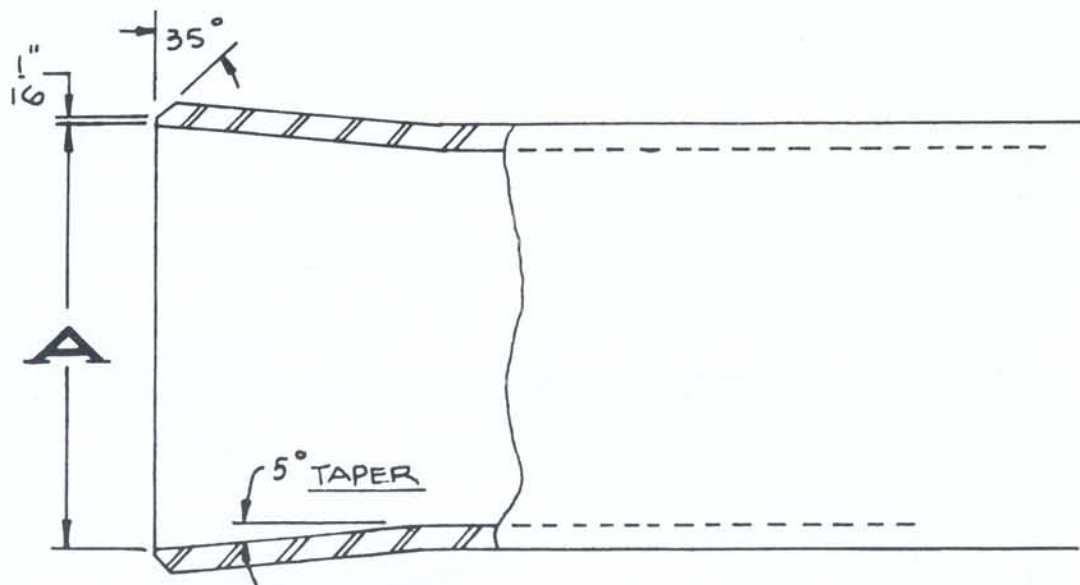
DETAIL - FLARE OUT TOOL

THE OKONITE COMPANY
RAMSEY, N.J., U.S.A.

DATE 10-30-63 SCALE NCS
DR. H.R.H. TR. J.R.
CH. G.H. APP.

REVISIONS

DRAWING NO.
OS-4435



← NOTE →

DEPTH OF FLARE SHALL VARY
WITH THICKNESS OF PIPE

| FIG Nº | PIPE O.D. | DIM. A |
|-----------|--------------|---------------|
| 1 | 4 1/2" | 4.500" |
| 2 | 5 9/16" | 5.5625" |
| 3 | 6" | 6.000" |
| 4 | 6 5/8" | 6.625" |
| 5 | 7" | 7.000" |
| 6 | 8 5/8" | 8.625" |
| 7 | 10 3/4" | 10.750" |

DETAIL-PIPE END FLARE

THE OKONITE COMPANY
RAMSEY, N.J., U.S.A.

DATE 1-15-65 SCALE N.T.S.
DR. H.R.H. TR.
CH. APP.

REVISIONS

DRAWING NO.
05-5722



SECTION 2



INSTALLATION OF WELDED TYPE TERMINATION ASSEMBLY

1.0 SCOPE

The intent of this specification is to cover The Okonite Company's recommended practice for the installation of an all welded type stainless steel termination assembly, as used on HPGF pipe type cable systems.

2.0 DESCRIPTION

The termination assembly consists of a spreaderhead, riser pipes, and weld type couplings.

The spreaderhead is made of carbon steel except for the spreaderhead plate which is type 304 non-magnetic stainless steel. The riser pipes and weld type couplings are made of type 304 non-magnetic stainless steel.

The terminator (pothead) baseplates must be available for welding to the riser pipes. Pressure plates for the baseplates must also be available to permit pressure testing all welds after completion.

3.0 WELDING

The following welding rods are recommended for assembling the termination assembly:

Stainless steel to stainless steel: Use rod AWS and ASTM
Class No. 308-16, Airco rod No. 19-9 (ac-dc) or equal

Stainless steel to carbon steel: Use rod AWS and ASTM
Class No. 310-16, Airco rod No. 25-20 (ac-dc) or equal

Carbon steel to carbon steel: Use rod AWS Class E-6010,
Fleetwood #5 or equal

4.0 ASSEMBLY

Refer to the various drawings showing details of the termination assembly and the component parts before starting assembly of any of these parts.

All component parts should be kept clean and free of contamination. Check all components for cleanliness and swab interiors if contamination exists.

Mount the spreaderhead with its temporary Dresser coupling on the previously prepared pipe end and check to make sure it is in its proper rotational position (location of 3 couplings), level and plumb. Tack weld it to the pipe temporarily.

Install riser pipes using either of the two following applicable arrangements as shown on the drawings furnished for this installation:



Installation: Section 2

A) Where a coupling is used to join the riser pipe to the terminator (pothead) stub, slide a coupling up over the terminator (pothead) stub and secure it temporarily in this position. Cut the ends of the riser pipe as necessary so they will properly fit. Round off the inside edge of all cut ends and make sure interior of pipe is clean. Slide the bottom end of riser pipe into the spreaderhead and align the top end of the pipe with the baseplate stub. Lower the weld type coupling and temporarily secure in final position.

B) Where no coupling is used at the terminator (pothead) stub, cut the ends of the riser pipe as necessary so the top end of the riser pipe is below the top surface of the baseplate. Round off the inner edge of the top end of the pipe to a 1/8" radius to prevent damage to cable during pulling. Slightly round off the inner edge of the bottom end of the riser pipe. Slide the top end up into the baseplate stub and then slide the bottom end into the spreaderhead.

Repeat this operation for the other two (2) riser pipes. Be sure to install each pipe in its proper coupling at the spreaderhead since this determines cable phase-out.

After all three (3) riser pipes have been properly fitted into place, the spreaderhead should be welded to the main line pipe. The individual riser pipes can then be welded into their position. Use caution when welding the riser pipes to avoid overheating and warping the baseplate or spreaderhead plate.

Upon completion of all welding, check the inside of the riser pipes at all weld areas for burn-throughs and cleanliness. Swab if necessary.

Close the spreader opening with the Dresser sleeve and test the welds for leaks using nitrogen pressure. The system should then be evacuated and pressurized with nitrogen until cable pulling operations are started.

5.0 FINAL OPERATIONS

After the cable pull has been completed, the Dresser coupling end rings and gaskets should be cut away and discarded. The flared end portions of the Dresser sleeve should also be cut off and discarded. The sleeve should then be welded into place over the openings in the spreader chamber. Stagger the welding of each pass to allow sufficient time for cooling between each pass. This will prevent undue heating of the cables.

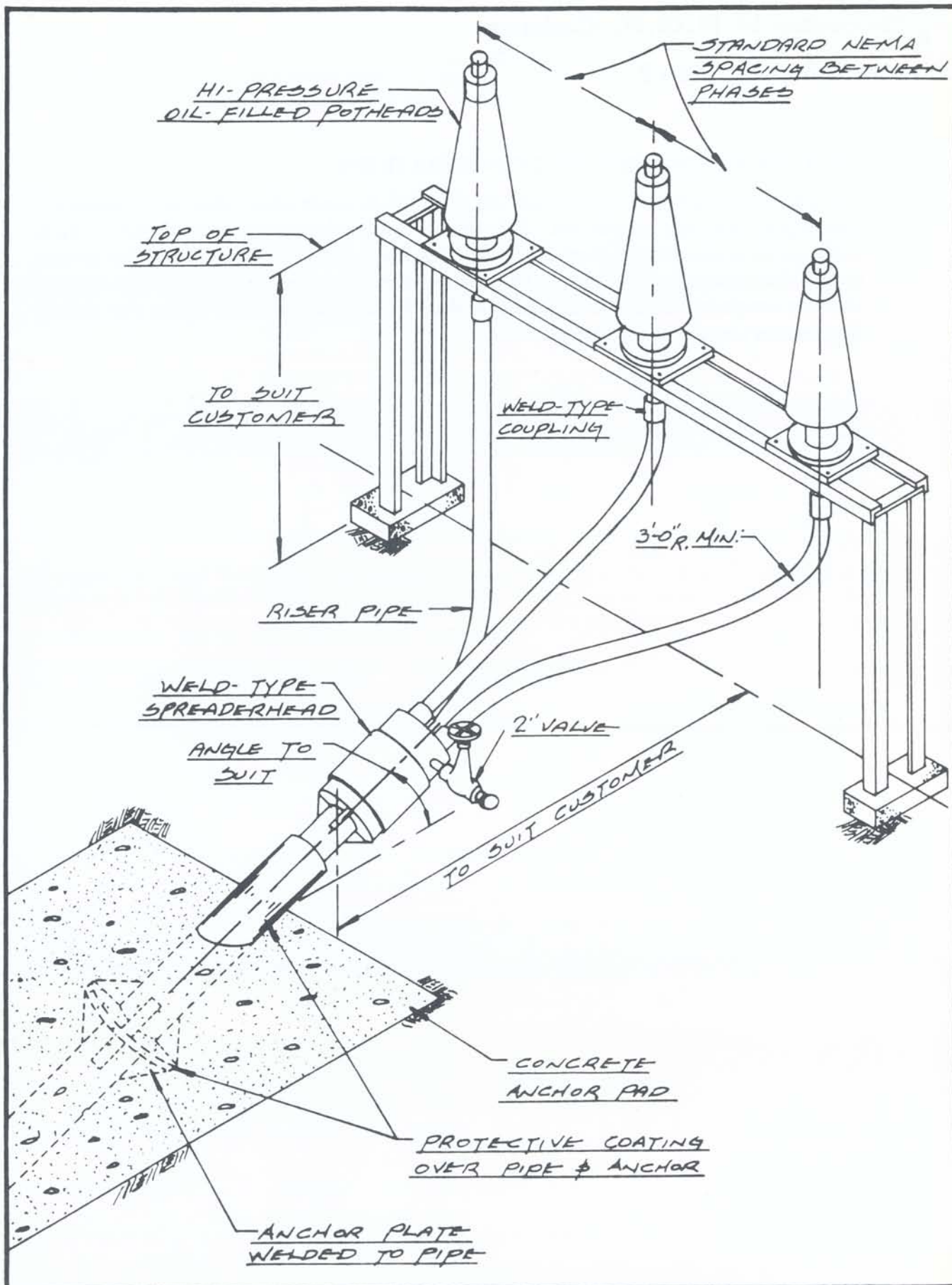
6.0 FINAL CLEANING

After the cable has been installed and the terminal assembly completely welded, some localized rust spots may be noticed on the stainless steel riser pipes. This occurs where the stainless steel has come into contact with plain steel during processing or handling operations. Scrub these areas using a stainless steel brush and wash the stainless steel parts with a strong detergent and rinse.



7.0 PROCEDURE AND SEQUENCE OF OPERATIONS

The instructions given in this manual are intended to cover what might be considered a typical pipe type cable installation. They are not intended to cover every condition which might occur on every installation. It should be recognized that each installation has its own special characteristics and features. Thus, these instructions can be modified or interpreted to cover contingencies at the discretion of the Okonite Field Advisor and/or the owner's Engineering Department representative.

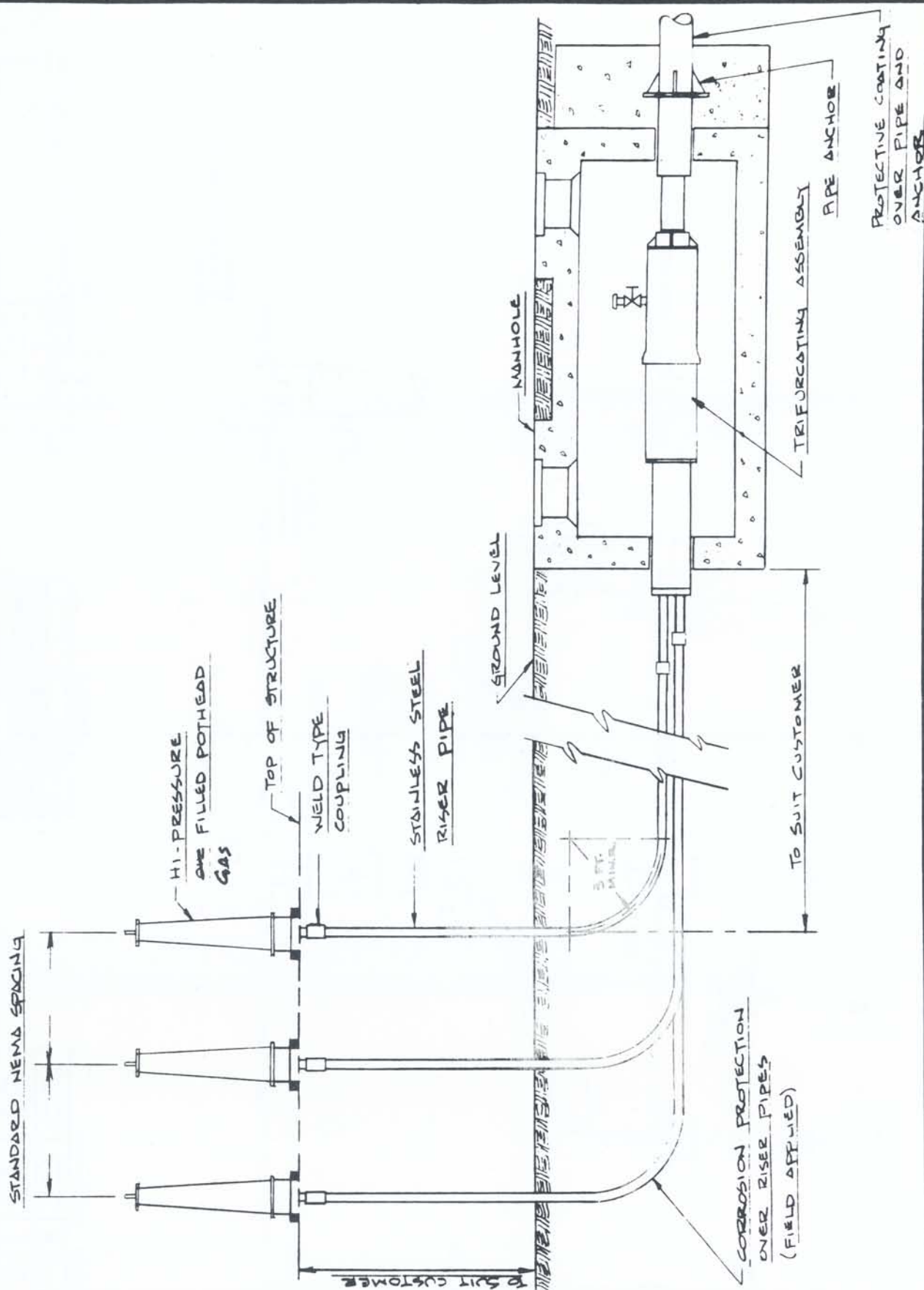


TYPICAL- TERMINATION ASSEMBLY - ANGLE TYPE

THE OKONITE COMPANY
RAMSEY, N.J., U.S.A.

| | | |
|-------------|----------------|-----------|
| DATE 1-9-64 | SCALE N.T.S. | REVISIONS |
| DR. RAN | TR. <i>APR</i> | |
| CH. DRW. | APP. | |

DRAWING NO.
OS-5467



TYPICAL - BELOW GROUND TERMINATION

THE OKONITE COMPANY
RAMSEY, N.J., U.S.A.

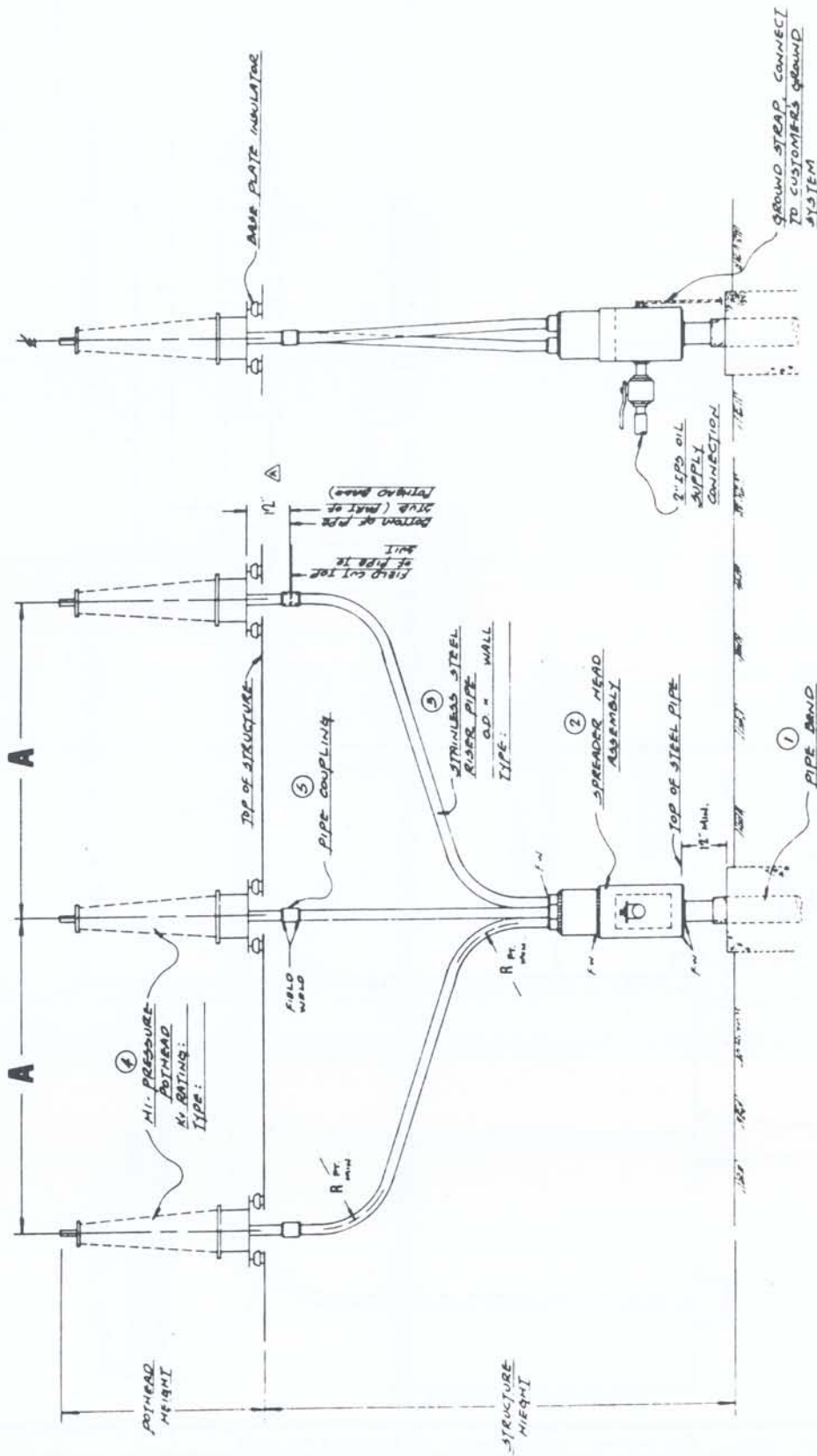
DATE 5-9-73
DR. J.E.R. TR.
CH.

SCALE
APP.

REVISIONS

DRAWING NO.

OS-7010



- NOTES**
1. REFER TO LIST OF MATERIALS FOR PART NUMBERS
 2. RADI & DIMENSIONS OF RISER PIPE ASSEMBLY ARE APPROXIMATE AND SHOULD BE VERIFIED TO SUIT FIELD CONDITIONS

| TYPICAL DIMENSIONS | | | | | |
|--------------------|-----|----------|-------|--------------------|---------------------|
| F14 NO | KV | R | | Polehead Height | Structure Height |
| | | name STD | | | |
| 1 | 69 | 4'-6" | 3' | 5'-0" | 11'-0" |
| 2 | 92 | 5'-0" | 3' | 5'-8" | 11'-0" |
| 3 | 115 | 6'-0" | 3' | 6'-2" | 12'-6" |
| 4 | 138 | 7'-0" | 3'-6" | 7'-1" | 13'-6" |
| 5 | 161 | 8'-0" | 4' | 7'-6" | 15'-6" |
| 6 | 230 | 11'-0" | 4' | 10'-0" | 19'-6" |
| 7 | 345 | 16'-0" | 6" | 12'-6" | 21'-0" |

| | | | | | | | | | | | | | | | |
|---|--|---------|---------------------------------|---------|---------------------------------|----------------|--|-------|-------------|-------|--------|---------|---------------------------------|----------|--------|
| D | C | B | A | DATE | DESCRIPTION | | | | | | | | | | |
| | | | | 5/17/79 | CORRECTED BASE PLATE DIMENSIONS | | | | | | | | | | |
| <table border="1"> <tr> <td>REVISION</td> <td>BY</td> <td>DATE</td> <td>DESCRIPTION</td> </tr> <tr> <td>1</td> <td>RAMSEY</td> <td>5/17/79</td> <td>CORRECTED BASE PLATE DIMENSIONS</td> </tr> </table> | | | | | | REVISION | BY | DATE | DESCRIPTION | 1 | RAMSEY | 5/17/79 | CORRECTED BASE PLATE DIMENSIONS | | |
| REVISION | BY | DATE | DESCRIPTION | | | | | | | | | | | | |
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| <table border="1"> <tr> <td>THE OKONITE CO</td> <td>RAMSEY N J</td> </tr> </table> | | | | | | THE OKONITE CO | RAMSEY N J | | | | | | | | |
| THE OKONITE CO | RAMSEY N J | | | | | | | | | | | | | | |
| <table border="1"> <tr> <td>DATE</td> <td>5/17/79</td> </tr> <tr> <td>SCALE</td> <td>N/A</td> </tr> <tr> <td>DRAWN</td> <td>RAMSEY</td> </tr> <tr> <td>CHECKED</td> <td>RAMSEY</td> </tr> <tr> <td>APPROVAL</td> <td>RAMSEY</td> </tr> </table> | | | | | | DATE | 5/17/79 | SCALE | N/A | DRAWN | RAMSEY | CHECKED | RAMSEY | APPROVAL | RAMSEY |
| DATE | 5/17/79 | | | | | | | | | | | | | | |
| SCALE | N/A | | | | | | | | | | | | | | |
| DRAWN | RAMSEY | | | | | | | | | | | | | | |
| CHECKED | RAMSEY | | | | | | | | | | | | | | |
| APPROVAL | RAMSEY | | | | | | | | | | | | | | |
| <table border="1"> <tr> <td>TITLE</td> <td>ABOVE GROUND PIPE TERMINATION ASSEMBLY</td> </tr> </table> | | | | | | TITLE | ABOVE GROUND PIPE TERMINATION ASSEMBLY | | | | | | | | |
| TITLE | ABOVE GROUND PIPE TERMINATION ASSEMBLY | | | | | | | | | | | | | | |
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| OS-7011 | | | | | | | | | | | | | | | |



SECTION 3



HIGH PRESSURE GAS FILLED (HPGF) CABLE INSTALLATION

1.0 SCOPE

The intent of this specification is to cover The Okonite Company's recommended practice for the field handling, installation and testing of the HPGF cable used in the High Pressure Gas Filled cable transmission system.

2.0 CABLE DESCRIPTION

The cable furnished shall be in accordance with the latest edition of the AEIC CS2-90 "Specification for Impregnated Paper and Laminated Paper Polypropylene Insulated Cable, High Pressure Pipe Type", 5th edition, May 1990, for gas pressure type cables.

3.0 CABLE HANDLING

The cable will be shipped via truck on Okonite sealed reels, as required by the schedule, and shall be routed as directly as possible to the job location with a minimum of rehandling and storage from the time of manufacture until installation is complete.

Reels containing cable shall under no circumstances be dropped or allowed to roll uncontrolled down skids or runways in the process of loading or unloading. Reels shall not be rolled over obstructions that may break the lagging or injure the cable. Reels should be unloaded using a lifting beam with flange hooks, or using a solid steel rod through the arbor hole with spreader bar.

Upon arrival of each shipment from the manufacturer and before unloading and taking delivery, a thorough visual inspection should be made of each reel to determine whether any damage may have occurred during transit. Any damage detected shall be immediately reported to the delivering carrier and noted on all copies of the delivery receipt. The Okonite Company area representative should also be immediately notified.

The cable is shipped on sealed reels with a metallized "blanket" covering designed to keep the cables in an atmosphere of dry nitrogen.

4.0 CABLE STORAGE

Precautions shall be taken during storage and installation to protect the cable from moisture, dirt, grit and physical damage.

The cable should be stored above flood level in a dry building or under temporary cover which will keep rain, snow, sunlight off the reels. If temperatures below 14°F are expected during storage, the cables should be stored in a heated building.

Space should be allowed between each reel for checking of dew points and purging with dry nitrogen while in storage.



The dew point of each reel should be checked after unloading and transportation to the storage area. If the dew point is higher than 40°F below the average daily ambient temperature, the reel should be slowly purged with dry nitrogen gas to attain this dew point. A specification for the dry nitrogen gas recommended for this purging operation is attached. Dew points should be checked at two (2) week intervals while the cable is in storage.

The metallized "blanket" covering is not designed to maintain or withstand pressure, and in no case should any pressure be applied to the covering during the purging operation. To prevent rupturing the metallized blanket, a flow meter gauge should be used when purging reels and taking dew points.

5.0 CABLE PULLING EQUIPMENT

Three (3) solid steel axle rods or extra heavy pipe and collars of sufficient strength for the weight of the cable and long enough to go through the center of the cable reel and rest on the jacks or other supports. Plus a sufficient amount of axle grease to lubricate the arbor hole and axle rods prior to cable pulling.

Six (6) jacks, reel stands, or other means of support for the cable reels during pulling.

Crane and suitable slings for unloading the cables from the trucks to the supports for the cables at the pulling location.

V-guide reel with a V-groove not less than 6 ft. diameter at bottom of "V" to align the cables in triangular formation before they enter the feed-in tube (For manhole-to-manhole pulls).

Feed-in tube of pipe or flexible tubing to be connected to the steel pipe in the manhole and extend above the ground at the manhole. When using the flexible feed-in tube, always use a stiffback to reinforce and prevent the tube from moving during pulling (For manhole-to-manhole pulls).

"A" frame with a bar and roller for support of the three cables. This is to be placed between the V-guide reel and first cable reel.

Three (3) arced feed-in tubes, or three (3) V-guide reels same size as above, or three (3) caterpillar type quadrant blocks (For terminal-to-manhole pulls).

A pulling yoke and shackle suitable for the pipe and cable size involved.

Pulling winch (gasoline motor driven type) with sufficient length of 1" minimum size steel pulling cable, geared to permit pulling the cable at different speeds, mounted on a trailer. The steel cable should be of 3 strand - flattened strand type and not have a hemp core center.

Dynamometer, indicating tensions up to 50,000 lbs.

Footage indicator.

Tarpaulins to cover the three (3) cables up to and including the feed-in tube. For use in the event of unexpected inclement weather.

Frame for support of tarpaulins.



V-roller for guiding the steel pulling cable at the reducer in manhole.

Deflection shoe for guiding the HPGF cables clear of the pipe end in the pull-out manhole.

Telephone or radio service for communicating between the feeding and pulling ends of the section.

Flexible roller chain of sufficient length to fit in 90° termination bends. To prevent 1/4" steel cable from cutting into the 90° bend.

Sufficient amount of suitable cable oil (OCS, 06CS polybutene or DF100, DF 500 alkylbenzene) for lubricating the pipe and cable (Approximately 15 gallons for each manhole section).

Projectile bullet to blow a 1/4" (minimum size) steel cable through the pipe line section. The 1/4" steel cable is to be used for pulling the steel winch cable into the pipe.

End cap with nipple for nitrogen gas connection and a gland for 1/4" steel cable.

Sufficient number of lengths of 1/4" (minimum size) steel cable.

Pulling shackle assembly with slings and swing links for use on end of cable.

Dry nitrogen gas per attached specification.

Low pressure nitrogen regulators 60 psig, and 1/4" hose.

Water pumps and blowers for drying and ventilation of manholes.

An electronic monitoring device or miner's safety lamp for monitoring the oxygen supply in the manholes.

CAUTION:

Adequate ventilation must be provided at manholes into which nitrogen enters in the operations described below and at pull out end. Severe injury or death can result if proper safety procedures are not followed in entering or working in such manholes.

Vacuum pump of approximately 135 cubic feet per minute capacity and capable of attaining a vacuum of 50 microns when blanked off.

Vacuum trap tank and vacuum hoses.

Vacuum gauge with Tygon or rubber hoses.

Sufficient number of night caps, gaskets and bolts to enclose the cable ends in the manholes after the cables have been pulled in. These night caps must have fittings for connecting to 2" vacuum hose and admitting and releasing nitrogen gas.

Sufficient number of night caps, gaskets and bolts to enclose cables at terminals.

White cotton gloves and rags.

Standard welding equipment.



6.0 PREPARATIONS BEFORE CABLE PULLING

It is recommended that the manhole be thoroughly cleaned, dried, and the manhole blower started prior to cable installation.

It is assumed that there is a nitrogen gas pressure of approximately 5 psig in the pipe section. The gas is to be released only in the one pipe section into which the 1/4" steel cable is to be blown by means of a bullet. After the end seals have been removed from the pipe section, the bullet is inserted into one end. The 1/4" cable is threaded through the gland in the end cap and attached to the bullet. This steel cap is then fastened to the pipe line with a clamp. The gas needed for this operation may be obtained from gas stored at a high pressure in the adjacent pipe section or from nitrogen cylinders. The pipe section should be prelubricated prior to cable pulling by inserting 10 gallons of cable oil in front of the pneumatic bullet if the pull is long or high tensions are expected.

IMPERATIVE:

No one shall be permitted in the manhole at the remote end of the pipe section during the blowing of the bullet through the pipe. After the bullet has been blown through, ventilate thoroughly, and before entering manhole use the electronic monitoring device or miner's safety lamp to check for lack of oxygen.

The 1/4" cable will be used later for drawing the pulling cable through the pipe before the HPGF cables are installed.

After the 1/4" cable is pulled in, the ends of the pipe shall be temporarily sealed while preparations are being made to pull in the steel pulling winch cable.

Attach the V-roller to the face of the reducer in the manhole.

As a final check on the suitability of the pipe for cable installation, cloth swabs and a steel mandrel should be drawn through the pipe between the lead line and the steel pulling cable. The mandrel shall have a diameter 3/8" smaller than the pipe I.D., and 8" minimum length with a 1" minimum radius on each end.

Clean and lubricate the steel pulling winch cable as it is being pulled into the pipe. When it reaches the far end, remove the swabs and mandrel. Carefully examine the swabs for any water, tears, or foreign matter which might indicate a hazard to cable installation.

Set the cable reels into position so that the "Pull This Direction" arrows on the reels are toward the manhole. The "dogholes" on the reels should be on the left side when you are standing at the manhole and looking at the reels. Both these checks must be made when setting the reels into position.

Cable reels shall be set-up to conform to the pulling directions as specified by the Project Engineer. During pulling, all exposed cable shall be sheltered in a suitable reel house of such design that can quickly and easily be made rain-tight, if necessary. The pulling line and reel on the pulling rig shall also be suitably shielded at all times against rain. If dew points haven't been taken in the previous two (2) weeks, dew points should be taken on each reel prior to removing the protective lagging and blankets.



Installation: Section 3

Cable pulling shall not start if there is any indication that there may be precipitation before the cable can be completely installed and the pipe section in which it is installed can be sealed.

The installation of cable in any section of pipe when once started shall proceed without interruption until the installation is complete and the section of pipe in which the cable is installed is sealed. If no precipitation (rain, snow, sleet, hail) has occurred during the pulling operation while cables were exposed, the pipe section can be purged with dry nitrogen for 10 minutes after cable pulling, then temporarily packed with dry nitrogen, and evacuation performed within the next three (3) days. If precipitation (rain, snow, sleet, hail) has occurred during the pulling operation while cables were exposed, the pipe shall be evacuated immediately after completion of the pull and pipe filled with dry nitrogen at a pressure of 5 psig or 1/2 psig per foot of maximum depth of burial (whichever is greater).

The three (3) cable reels shall be set-up and the three (3) single conductor cables fed into the pipe simultaneously, supported on suitable sheaves, in such a manner as to provide a minimum of cable bending. The type of rigging at the pulling end is optional; but in any case, it must be secure and so set-up that the pull is as straight out from the pipe as possible. Rigging shall be installed in such a manner that the necessary cable slack for splicing will be provided without additional hitches and without subjecting the cable to excessive bearing pressures.

Lags shall be removed from the cable reels only after the reels are in pulling position and removed in such fashion as to not damage the cable. One recommended method of doing so is by 1) stapling the banding straps to the two lags in the plane of the hub, 2) fastening the stapled lags to the reel flanges with 4 "C" clamps, 3) cutting the banding straps just below the stapling points to free the lags on the lower half of the reel then clearing the lags away and 4) turning the reel one-half turn and removing the "C" clamps to drop the remaining lags. Another method is to secure the lagging on the reel with a rope, then cut the banding straps and remove the lagging from the bottom. If space permits, the tekboard from the reel should be placed under each reel (staple ends facing down), to protect the cable from damage or dirt should it touch down under the reel.

After the lagging and tekboard are removed from the cable reels, the inner seal (blanket) on the cable should be left in place until after the steel pulling winch cable is pulled through the pipe and ready for attaching to the pulling yoke.

Each length of cable will be furnished with a pulling bolt (or eye) attached to the leading (outside) end and a tie eye fastened to the trailing (inside) end. This tie eye is fastened to a 1/8" steel wire rope which is wrapped around the drum and fastened to the reel.

Assemble the pulling bolts (or eyes) of the three (3) cables to the pulling yoke at the end of the steel pulling winch cable.

A thorough visual inspection for flaws, breaks, or abrasions of the exterior of the cable shall be made as it leaves the reel and the pulling speed shall be low enough to allow for that inspection.



The pulling speed should not exceed 40 ft. per minute and pulling tension should not exceed the specified limits. The pulling equipment should permit a smooth change of speed down to almost a stand-still. If pulling is interrupted, the re-start should be made at low acceleration, to avoid high pulling tension.

During installation of the first 500 ft. of cable in each section, the cable should be lubricated with 5 gallons of cable oil if the pipe was not lubricated previously, or if the pull is long and high tensions are expected.

Extreme care shall be taken at all times to prevent sharp bends in the cable. After removal from the reel, the cable shall not be bent to a radius of less than 12 times its diameter under any conditions. A reliable, accurately calibrated direct reading dynamometer shall be used in the pulling mechanism to indicate the pulling tension of all pulls. A measuring device that will continuously indicate the length of the cable pulled into the pipe shall also be used during pulling.

A reliable telephone or radio telephone communication between the two (2) ends of the section of pipe in which the cable is to be installed must be established and maintained during all cable pulling operations.

7.0 CABLE PULLING — GENERAL

The dynamometer readings should be recorded every 100 feet during the cable pull.

Before the cable pull is started, a brakeman must be stationed at each cable reel for the purpose of controlling the cable slack and preventing the reel from over-running during the pulling operation.

During pulling, the cable shall not be permitted to touch the ground nor to form loops having a radius of less than 12 X cable O.D. which might cause kinking or damage to the paper tapes of the cable.

Assuming all of the foregoing is in order, the actual cable pull is ready to commence. Once the cable pull is started, it is recommended it be continued without interruption.

After all cables are pulled, and splicing and terminating operations are under way, the phasing must be checked in the last manhole prior to making up the last splice. This is an absolute necessity. The owner should advise the Project Superintendent the phasing arrangement at each terminal end, in order that cables are properly phased out to match in the last manhole.

7.1 CABLE PULLING — MANHOLE PULLS

Pull the HPGF cables through the pipe to a point where the pulling yoke is at the reducer in the manhole. Stop the cable pull and remove the V-roller from the face of the reducer. Install the deflection guide shoe on the face of the reducer and continue with the cable pull until at least 12" of usable cable has been pulled beyond the centerline of the joint.



When the required amount of cable is pulled through the reducer, stop the cable pull. Support the cable extending out of the reducer and secure D-Wires on all three (3) cables where they are to be cut. Cut the three (3) cables so a minimum of 12 inches of usable cable extends past the centerline of the joint. Seal the cut ends with Saran Wrap (or equal) and tape each end. Remove the deflection guide shoe from the face of the reducer. Install the night cap with gasket over the cable ends, in such a position that it will not interfere with the adjacent pull in the same manhole, and secure with bolts to the reducer.

7.2 CABLE PULLING — TERMINAL PULLS

The bolts should be removed from the Dresser assembly at the spreaderhead and the sleeve lowered or elevated to expose the windows in the spreaderhead. The pneumatic bullet will be blown from the spreaderhead to the manhole. The 1/4" wire rope will be connected to the steel pulling cable at the manhole and pulled back to the opening in the spreaderhead.

A roller chain must be used in the 90° termination bend to prevent the 1/4" wire rope from cutting into the wall of the pipe bend during the pulling of the steel pulling cable from the manhole back to the spreaderhead opening.

It is good practice to paint the 1/4" wire rope 50 ft. from the lead end. When this marker appears in the opening of the spreaderhead, the pulling operation is stopped, the chain is removed from the pipe bend, and the remaining 50 feet are pulled.

Feed-in tubes, V-guide reels or caterpillar type quadrant blocks are used for feeding the cables into the riser pipes. Necessary sheaves or rollers to support and guide the cables should be placed between the cable reels and the feed-in tubes, V-guide reels or caterpillar type quadrant blocks.

Each cable is pulled into the feed-in tube, or over the V-guide reel or caterpillar type quadrant blocks and attached to the pulling yoke at the opening in the spreaderhead.

Lubricate each cable with cable oil as it enters the riser pipe.

A polypropylene rope or steel wire rope (1/4" to 3/8" diameter) should be used to pull the cable into each riser pipe down to the spreaderhead window.

When V-guide reels or caterpillar type quadrant blocks are used, they must be positioned and secured in a manner that will prevent their movement during the cable pull.

It is imperative that each cable has sufficient clearance at entry into the base plate opening to prevent damage to the cables at this entry point.

Upon completion of the termination cable pull, the cables should be cut and sealed, and the night caps installed in the manhole and at the terminator (pothead) baseplates.

The cuts should be made so a minimum of 1 foot of extra cable extends above the top of the terminator (pothead).



After the cable pull has been completed, the Dresser coupling end rings and gaskets should be cut away. The flared end portions of the Dresser sleeve should also be cut off and removed. The sleeve should then be welded into place over the openings in the spreaderhead. Stagger the welding of each pass to allow sufficient time for cooling between each pass. This will prevent undue heating of the cable. A nitrogen purge should be applied to the section during the welding.

8.0 EVACUATION PROCEDURE — AFTER PULLING CABLE AND PRIOR TO SPLICING AND TERMINATING

After the cable is completely installed in each section, the ends of the pipe shall be sealed with air-tight protective caps and the pipe shall be evacuated to a value of 500 microns of mercury. After reaching 500 microns, the evacuation shall be continued for a minimum of four (4) hours. Vacuum readings shall be taken at the end opposite from the vacuum pump if a single vacuum pump is used. At the end of the 4-hour pumping period, the vacuum pump shall be stopped and isolated from the lines. A vacuum drop test shall be run. If the rise in pressure in one (1) hour after disconnecting the vacuum pump exceeds 500 microns of mercury, the entire vacuum treatment shall be repeated. When the vacuum test is acceptable, the vacuum shall be broken by admitting dry nitrogen to approximately 5 psig and maintained at this pressure until splicing or terminating operations are begun. If the pressure in any section is reduced to 0 psig, the entire evacuation procedure shall be repeated before the section is re-pressurized. After a pull (no precipitation during pull), it is permissible to purge the installed cable section with dry nitrogen and fill the section to 5 psig with dry nitrogen. The evacuation of this section must then be done within the next three (3) days.

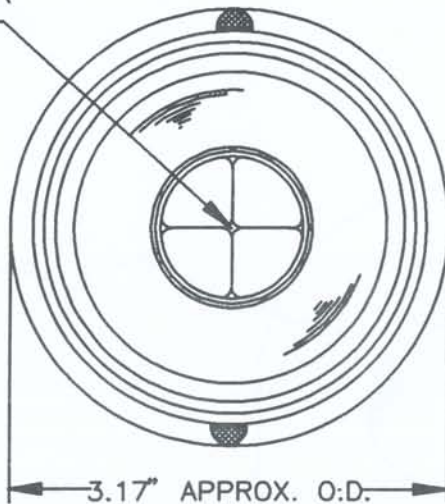
9.0 EVACUATION PROCEDURE — AFTER COMPLETION OF ALL SPLICING AND TERMINATING AND PRIOR TO FINAL NITROGEN FILLING

When the pipe system is complete, including the installation of the cable, splices, terminators (potheads), and nitrogen gas pressure control unit(s), the completed pipe system shall be evacuated to an absolute pressure of 250 microns or less. After reaching 250 microns, the vacuum pump shall be kept running an additional eight (8) hours. Vacuum readings shall be taken at the end remote from the end where the vacuum pump is located. At the end of the eight (8) hour pumping period, the vacuum pumps shall be isolated from the system and a one (1) hour vacuum drop test run. If the rise in pressure exceeds 250 microns for the one-hour period, the entire vacuum treatment and drop test shall be repeated. If the drop test is acceptable, the system is then ready for final filling with nitrogen.

10.0 PROCEDURE AND SEQUENCE OF OPERATIONS

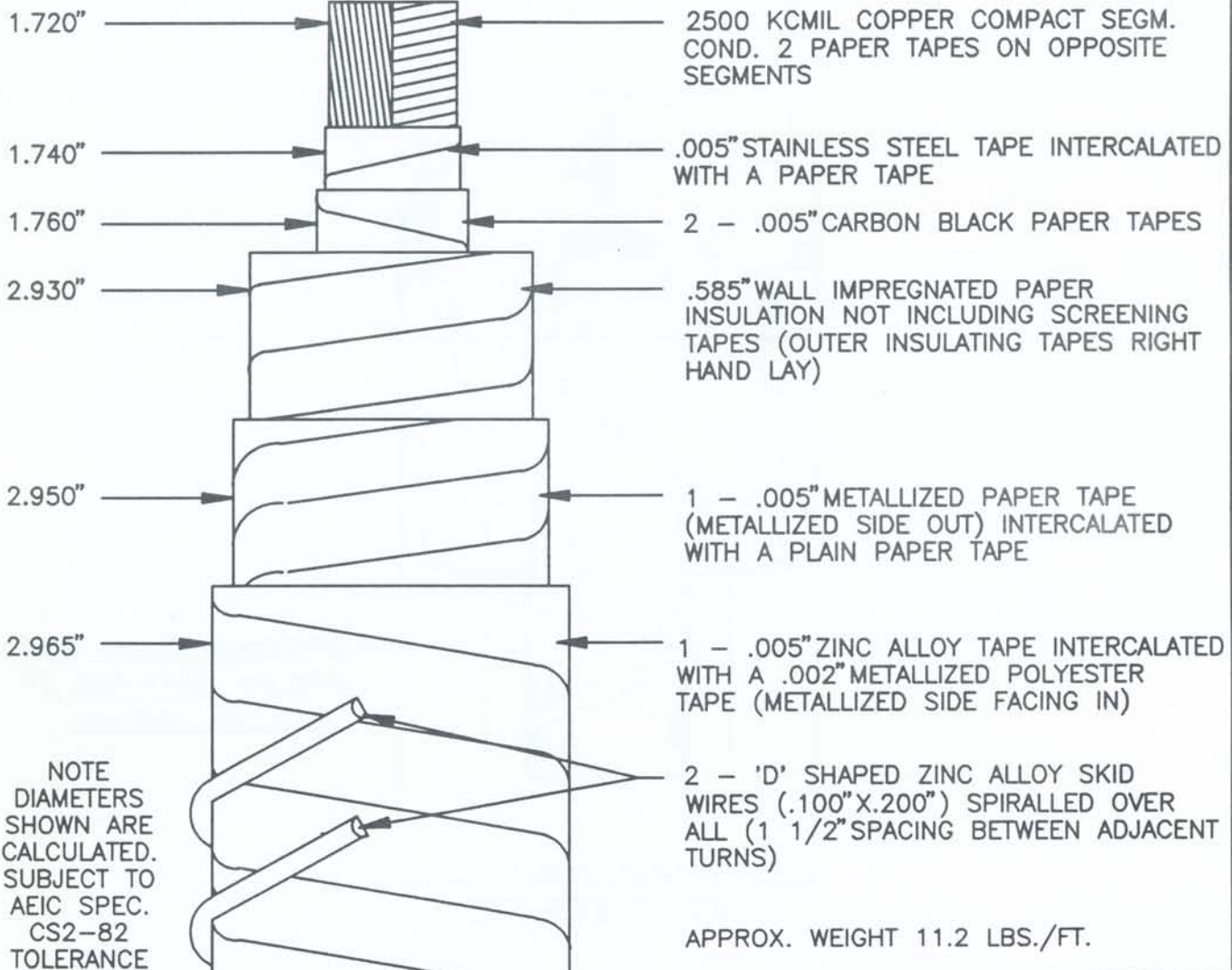
The instructions given in this manual are intended to cover what might be considered a typical pipe type cable installation. They are not intended to cover every condition which might occur on every installation. It should be recognized that each installation has its own special characteristics and features. Thus, these instructions can be modified or interpreted to cover contingencies at the discretion of the Okonite Field Advisor and/or the owner's Engineering Department representative.

NYLON FILLER
IN CENTER



HIGH PRESSURE GAS FILLED
PIPE TYPE CABLE
138kV RATING - 100% INS. LEVEL
PER: AEIC CS2-90 5th EDITION

3000 SUS AT 210F
HIGH VISCOSITY IMPREGNANT



2500 KCMIL COPPER COMP. SEGM. COND. .585" WALL PAPER INSUL. PIPE TYPE CABLE

THE OKONITE COMPANY
RAMSEY, N.J. U.S.A.

DATE 9/7/94

SCALE NTS

REVISIONS

DR. J.E.R.

TR.

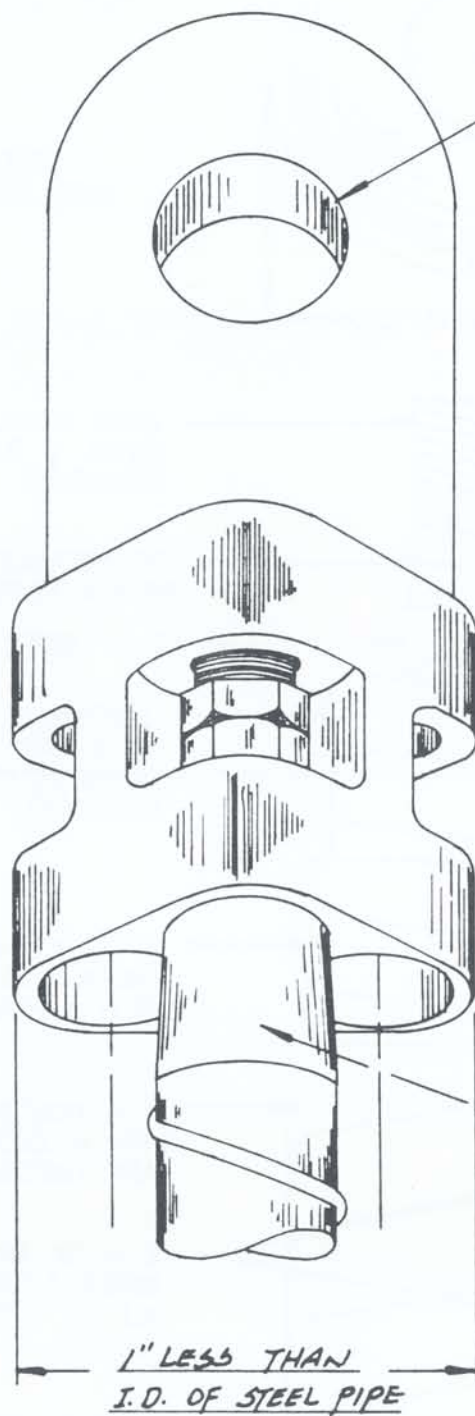
CH.

APP.

J.T.Z.

DRAWING NUMBER

OCS-D-1615

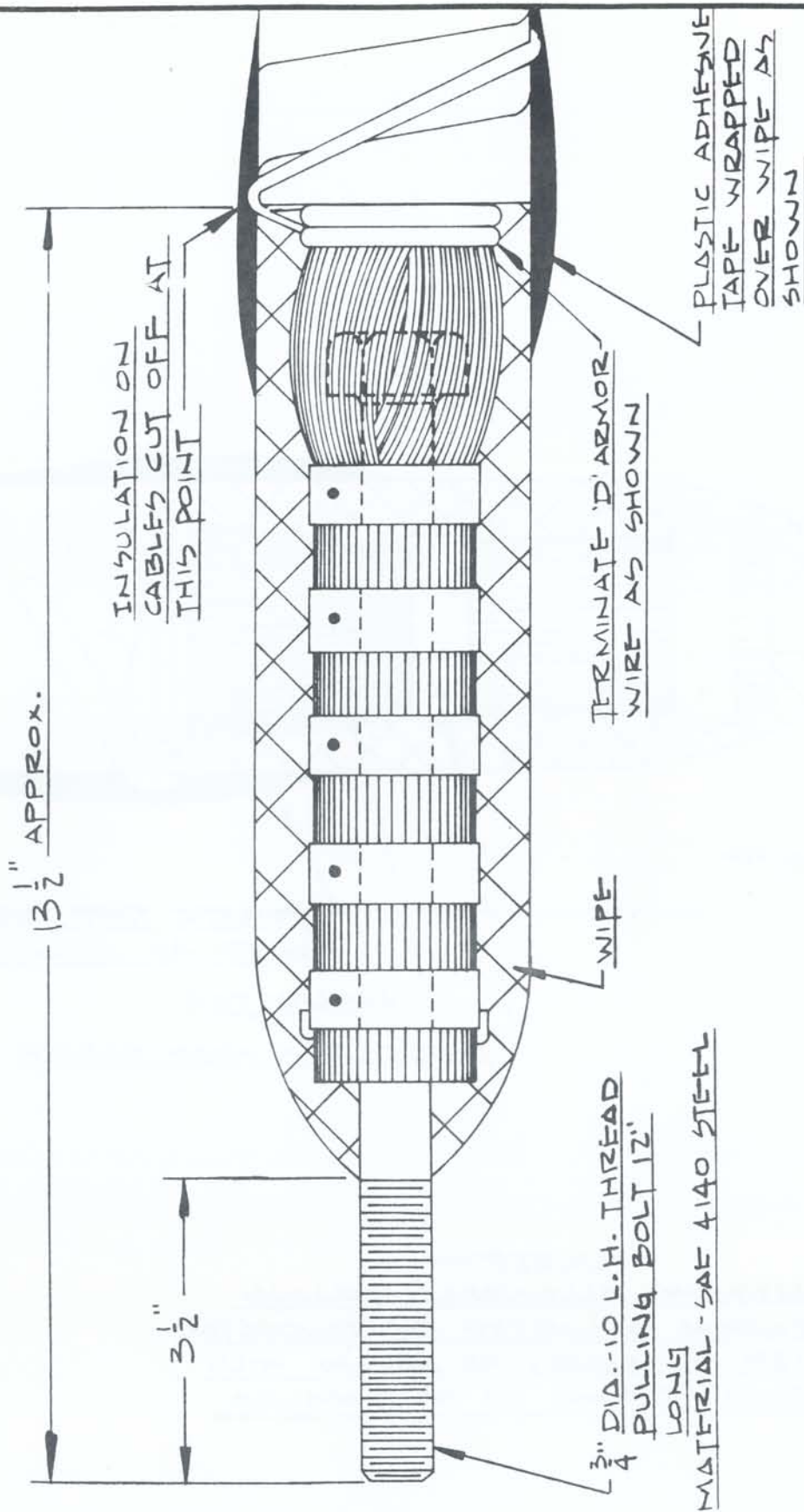


PULLING YOKE - TYPICAL

THE OKONITE COMPANY
RAMSEY, N. J., U. S. A.

| | |
|-------------|---------|
| DATE 4-1-63 | SCALE ~ |
| DR. RAH | TR. |
| CH. | APP. |

| |
|------------------------|
| REVISIONS |
| DRAWING NO. 05-5470 |



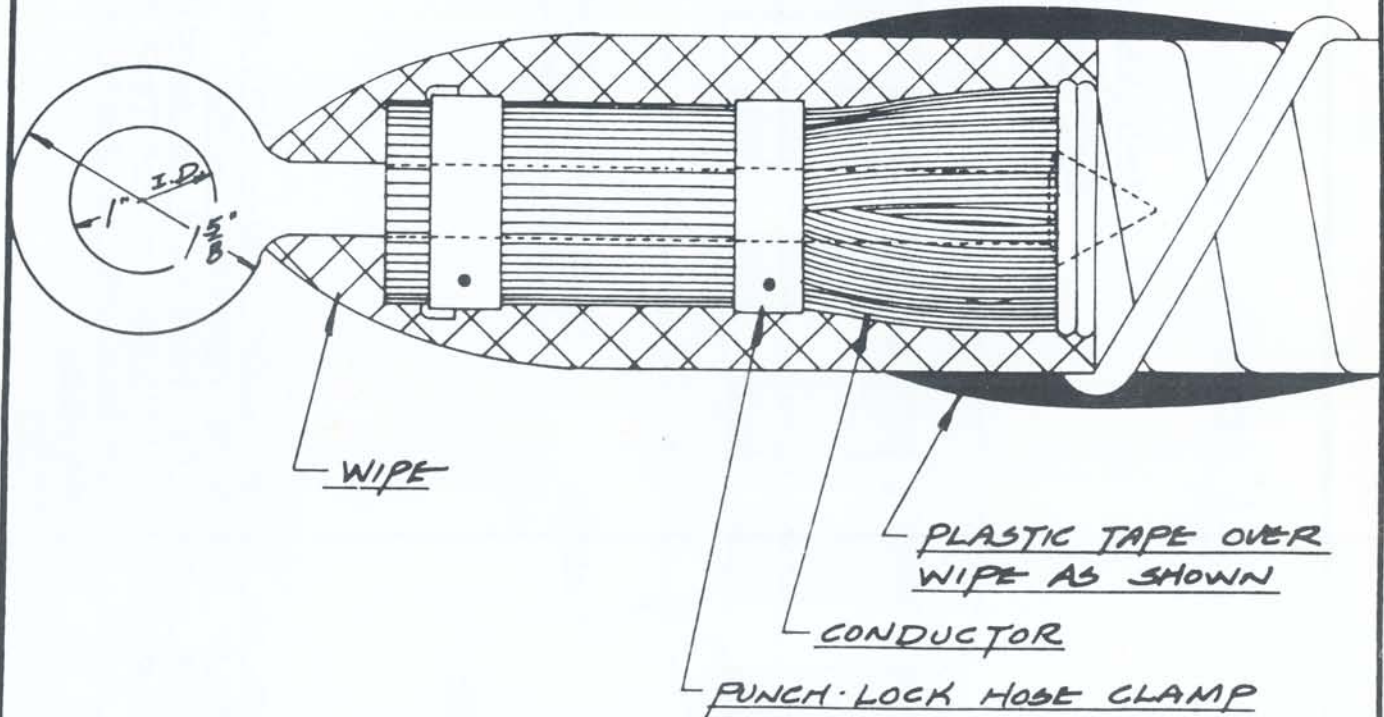
- NOTE—
- 1.- MAXIMUM O.D. OF LEAD WIPE SHALL NOT EXCEED O.D. OF CABLE OVER 'D' ARMOR WIRE
 - 2.- FOR CONDUCTOR SIZES OF 2000 KCM TO 4000 KCM
 - 3.- MAXIMUM ALLOWABLE TENSION IS LIMITED BY CONDUCTOR SIZE. ASSEMBLY AS SHOWN WILL STAND TENSIONS UP TO 20,000 LBS.
 - 4.- FURNISH WITH TWO NUTS

PIPE TYPE CABLE 3/4" DIA. PULLING BOLT ASSEMBLY

THE OKONITE COMPANY
RAMSEY, N.J., U.S.A.

DATE 12-15-71 SCALE 2
DR. CLK. TR.
CH. APP. 428

REVISIONS
DRAWING NO.
05-6626



NOTE
 MAXIMUM ALLOWABLE PULLING
 TENSION IS LIMITED BY CONDUCTOR
 SIZE. ASSEMBLY AS SHOWN WILL
 STAND TENSIONS UP TO 5,000 LBS.

OILOSTATIC TRAILING END EYE ASSEMBLY

THE OKONITE COMPANY
 RAMSEY, N.J., U.S.A.

DATE 10-7-70

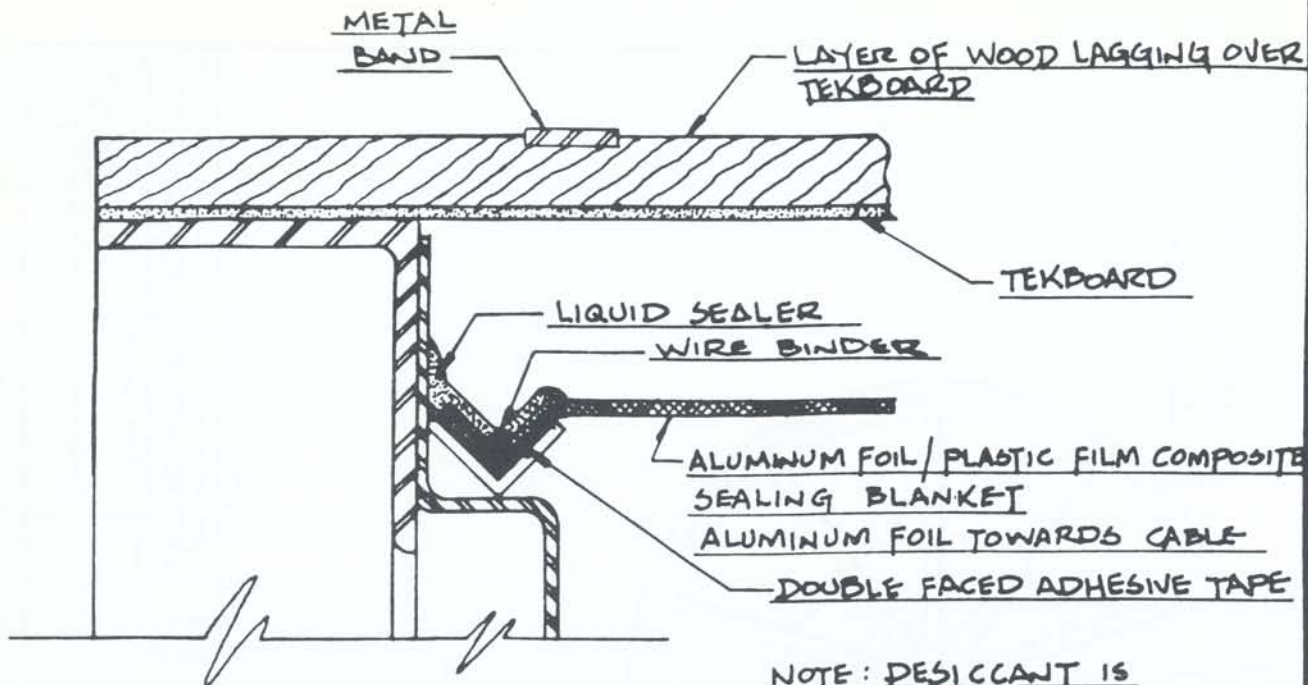
SCALE 2

REVISIONS

DR. JEP.
 CR. F

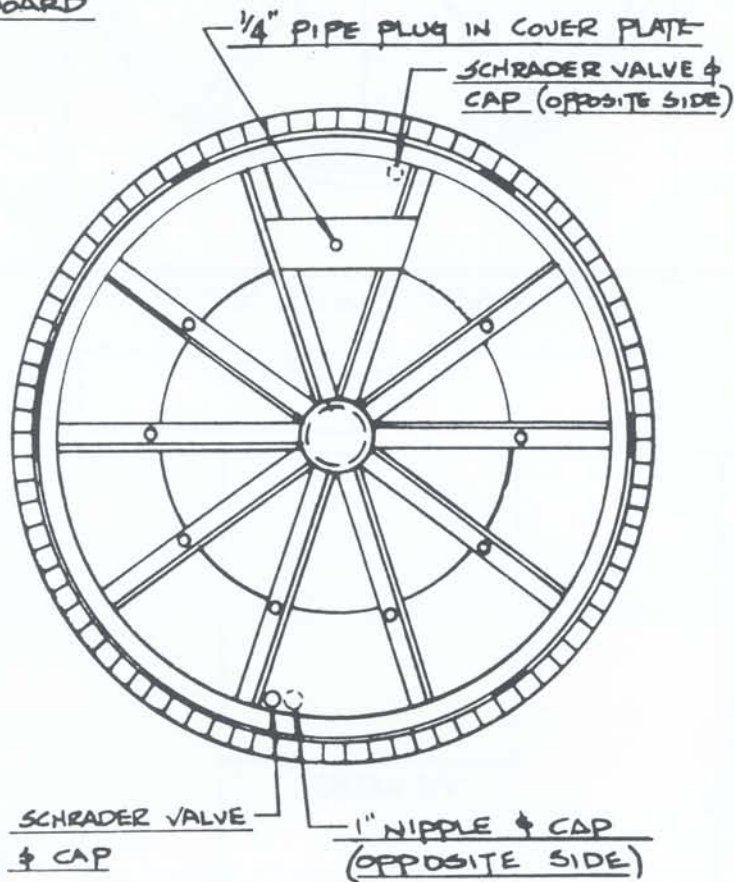
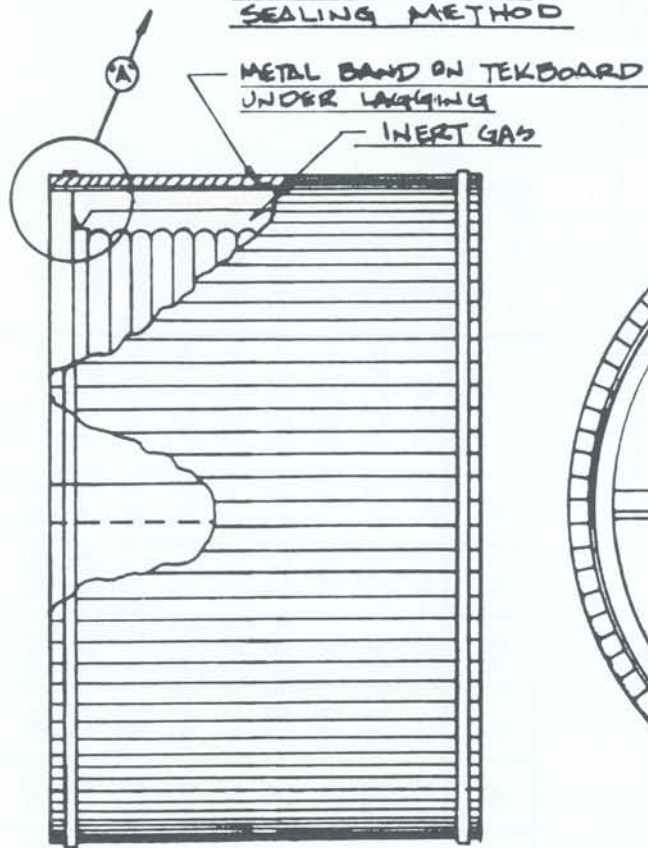
TR.
 APP. B

DRAWING NO.
 05-6354



NOTE: DESICCANT IS
PACKED INSIDE SEALED
AREA OF REEL

DETAIL "A"
SEALING METHOD

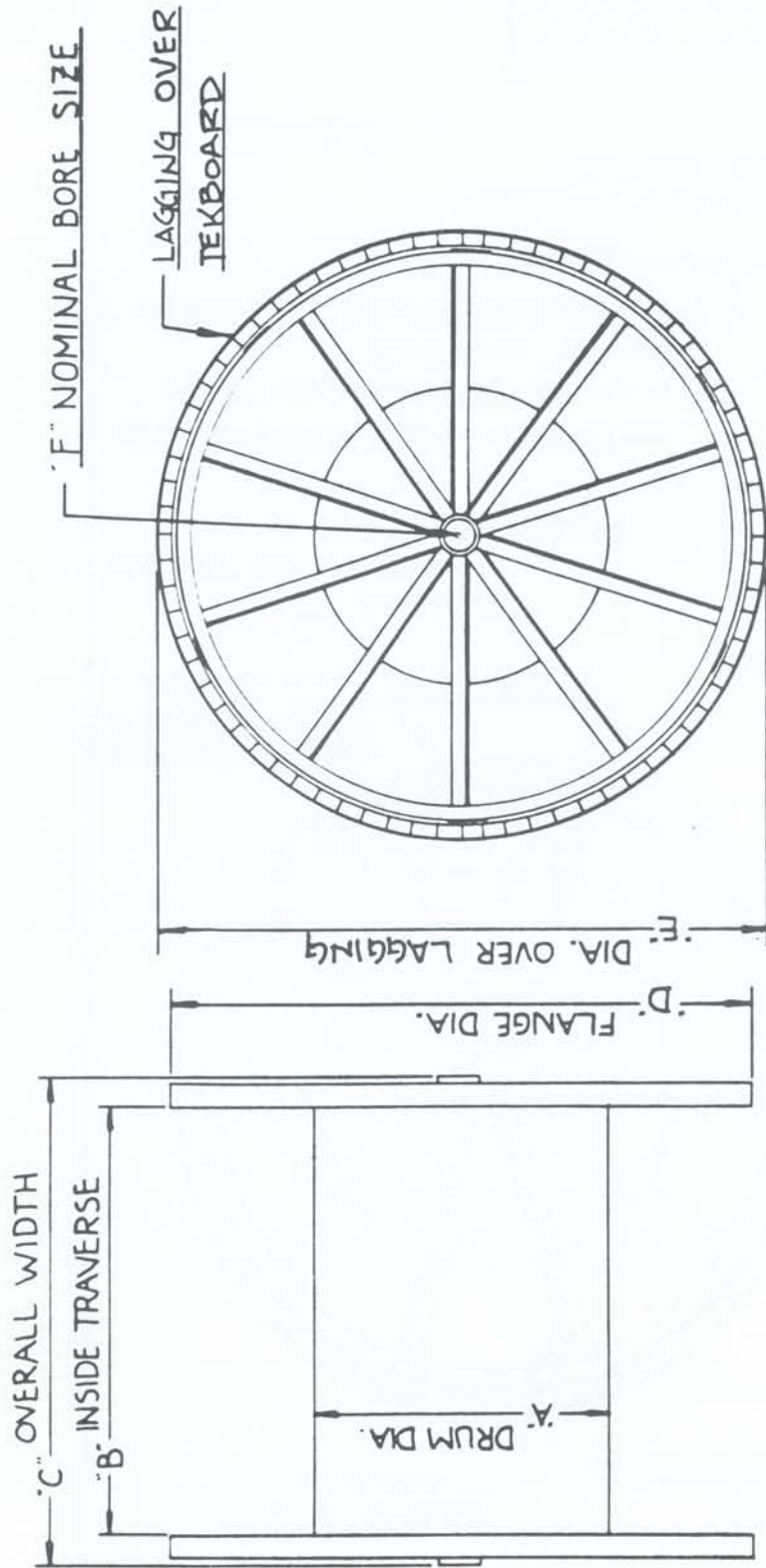


SEALED SHIPPING REEL FOR NON-LEADED OILOSTATIC CABLES

THE OKONITE COMPANY
RAMSEY, N.J., U.S.A.

DATE 3-19-82 SCALE NTS
DR. J.E.R. TR.
CH. APP. J.Z.

REVISIONS A 3-22-84
DRAWING NO.
OS-7517



NOTE: DIMENSIONS IN INCHES

| REEL NO. | REEL SIZE | A | B | C | D | E | F | REEL WEIGHT | REEL LAG WEIGHT |
|----------|---------------|----|----|----|-----|-----|-------|-------------|-----------------|
| 1 | 96 x 60 x 56 | 56 | 60 | 71 | 96 | 102 | 5 1/4 | 2160 # | 3560 # |
| 2 | 96 x 60 x 60 | 60 | 60 | 74 | 96 | 102 | 5 1/4 | 2500 # | 3900 # |
| 3 | 96 x 54 x 56 | 56 | 54 | 67 | 96 | 102 | 5 1/4 | 1835 # | 3100 # |
| 4 | 96 x 54 x 60 | 60 | 54 | 69 | 96 | 102 | 5 1/4 | 2480 # | 3740 # |
| 5 | 108 x 60 x 60 | 60 | 60 | 75 | 108 | 114 | 5 1/4 | 2920 # | 4580 # |
| 6 | 112 x 72 x 72 | 72 | 72 | 87 | 112 | 118 | 5 1/4 | 3250 # | 5380 # |
| 7 | 120 x 72 x 72 | 72 | 72 | 87 | 120 | 126 | 5 1/4 | 3650 # | 5950 # |
| 8 | 142 x 82 x 90 | 90 | 82 | 96 | 142 | 148 | 6 1/4 | 6475 # | 9625 # |
| 9 | 142 x 82 x 96 | 96 | 82 | 97 | 142 | 148 | 6 1/4 | 6500 # | 9650 # |

| | | | | | | | | | |
|--------------------------------|----|------|-------------|--|--|--|--|--|--|
| D | | | | | | | | | |
| C | | | | | | | | | |
| B | | | | | | | | | |
| A | | | | | | | | | |
| REVISION | BY | DATE | DESCRIPTION | | | | | | |
| THE OKONITE CO. RAMSEY N.J. | | | | DATE 3-19-62 SCALE 1/4" = 1'-0" DRAWN BY CHECKED APPROVAL TITLE STANDARD OILOSTATIC STEEL SHIPPING REEL LAGGING | | | | | |



SECTION 4

INSTALLATION INSTRUCTIONS

FOR

115-KV H.P.G.F.
NORMAL STRAIGHT JOINT
3000 kcmil, Copper Conductor

DECEMBER 1994

for

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CA

PG&E SPECIFICATION #3470
PG&E ORDER #ZS-3470-AA4
RELOCATE NEWARK-SAN JOSE "B" 115kV

OKONITE Order No.: 2-94-193
MAC Order No.: 78307, Item 1

* PLEASE NOTE: *
* Read instructions carefully and familiarize yourself *
* with the drawing before performing any work. *

MAC ORDER No. 78307, ITEM 1
PG&E ORDER No. ZS-3470-AA4

Page 1 of 13

SPLICE KIT DESCRIPTION

These instructions are for splicing 115 kV rated (550 kV BIL) three (3) 1/C High Pressure Gas-Filled (HPGF) cable, with 3,000 kcmil copper conductor, compact segmental, and 485 mils of impregnated paper insulation (See cable cross-section drawing attached). Connector is designed for installation with a 4-Ram press.

INTRODUCTION

The following instructions are not intended to cover every possible detail or difficulty to be met in connection with assembling this joint. The splice should be made by a qualified, experienced splicer. Should particular problems or difficulties arise which are not sufficiently covered, the matter should be referred to the proper engineering channels. In using these instructions it is assumed that the joint reducers are welded in place, the cable has been pulled into the pipes, night caps installed, and the pipes are filled with dry nitrogen at a positive pressure.

REFERENCE MATERIALS

The following documents are attached for review and reference to aid in the proper installation of the 115-kV HPGF joint kit:

| <u>ATTACHMENT</u> | <u>DRAWING NO.</u> | <u>DESCRIPTION</u> |
|-------------------|--------------------|---|
| A | N/A | Bill of Material, 78307, Item 1 |
| B | D-12721 | Joint Ass'y Details, 115 kV Normal HPGF . 3000 kcmil - 3000 kcmil, Compact Seg. |
| C | D-12722 | Outer Taper Template, 115 kV, 3000 kcmil |
| D | C-12723 | Inner Taper Stepping Diagram, 115 kV HPGF, 3000 kcmil |
| E | B-12733 | Connector, 3000 kcmil, 4-RAM type |
| F | D-12734 | Joint Assembly, EHV & DUMMY with Split Steel Casings |
| G | B-427-3 | Spider, Cable Support, 3" Wide |
| H | B-9137-3 | Spider, Cable Support, 6" Wide |
| I | OCS-D-1607* | Cable Cross-section drawing (*OKONITE Cable drawing) |

GENERAL INSTRUCTIONS

1. Avoid bending the cable or mistreating it in any way. Never bend the cables to a radius less than 20 times the cable diameter.
2. Provide suitable temporary supports and covers to protect the cable ends, splicing materials, and tools from foreign matter and mechanical damage.
3. Use only non-acid soldering flux, as provided in this kit.
4. All oil used during the splicing operation must be approved cable oil.
5. Never use oil from the bath for flushing the outer cable shielding. All oil for this flushing should be heated separately in a double boiler to 220 degrees F, then cooled to 180 degrees F.
6. The temperature of the oil bath should not exceed 160 degrees F. The temperature of the oil in the tape cans should not exceed 140 degrees F. If the oil temperature in a tape can exceeds 190 degrees F, discard the can and its contents.
7. Never place a closed tape can in the oil bath.
8. Keep splicing materials and tools at a temperature above ambient in order to prevent moisture condensation on their surfaces.
9. Materials, tools, equipment and splicing area are to be kept clean and be protected from the weather.
10. Whenever work is stopped, cover all exposed cable with poly or silk tape or saran wrap. It is not necessary to cover cable that has manufacturer's outer shielding intact.
11. A properly functioning oxygen deficiency meter is required at all times to indicate an adequate supply of oxygen in the manhole.
12. A Dry Air or Grade A nitrogen feed must be maintained at all times to the cables on both sides of the joint through fittings on the rubber barriers.
13. The manhole must be dry and clean, with adequate ventilation and light during all splicing operations.

TOOLS

The following tools and equipment should be gathered in the work area prior to starting:

1. Splicer's kit, including knives, files, calipers, side cutters, diameter tapes, stepping weights with piano wire, etc.
2. Cleaning solvent (such as Freon TF), with squeeze bottle applicator;
3. Clean, dry, lint and dye free wiping rags;
4. Furnace;
5. Thermometers (0 - 250 F range);
6. Container , such as double boiler, for heating oil;
7. Oil bath for heating insulation tapes in cans;
8. Drip pans;
9. Nitrogen or Dry Air tanks, regulators and fittings;
10. Wrenches to fit any bolt sizes indicated on joint drawing;
11. 4-Ram press for attaching copper connector to conductors;
12. Electric soldering iron;
13. Hand electric belt sander, band saw and/or hand hacksaw;
14. Jacks, cable supports, and slings for training & supporting cables;
15. Oxygen deficiency indicating meter with alarm; and
16. Company approved flushing oil.

PRELIMINARY PREPARATIONS

1. Bleed off the positive nitrogen in both pipes through valves in the night caps. WARNING: Do not remain in manhole during this operation -- DANGER OF ASPHYXIATION. Check manhole with oxygen deficiency meter to insure manhole is safe before re-entering manhole.
2. Remove the night caps, making sure that cables are properly supported at all times (leather slings, jacks, etc.). Note: The manhole area must be cleaned and dry prior to removal of the night caps.
3. Inspect each cable for soft spots and damage. If there is any damage or defect, notify the persons concerned before proceeding!
4. Wrap three turns of 1/4" wide tinned copper braid over each cable at a distance from the reducer faces as shown on the appropriate drawing. Solder the braid in place to hold both skid wires. Flush the soldered area with hot oil after each tacking is completed.
5. Cut the skid wires just before the taped ends of the cables and unwrap the skid wires to the copper braid. Cut off all but 3 feet of the free ends of the skid wires; the remaining ends are looped and inserted into the servit posts in the reducers, after the splice is completed.
6. Fasten the flexible bond wires to the same servit post.
7. Wipe the inside and outside of all the sleeves until thoroughly clean.
8. Slide the sleeves onto each reducer, being sure that the cables are properly supported at all times.
9. Using wood covered with cotton tape, block the cables inside the reducers to the proper positions.
10. Pass the temporary gas barriers over the cables and bolt them to the reducers with back up rings. Wrap a few layers of non-adhesive vinyl tape on each cable to help form a gas seal with the barriers. Band the gas barriers to the cables with hose clamps or non-adhesive vinyl tape to prevent gas flow out of the pipe into the working manhole.
11. Attach a nitrogen or Dry Air feed hose to the fittings on each gas barrier and turn on the gas to a small positive pressure.

PREPARING THE CABLE ENDS

For convenience, it is suggested that all the steps in each paragraph should be completed, except as noted, on all the legs before proceeding to the next paragraph. The bottom leg nearest the wall should be done first and the bottom leg farthest from the wall last.

1. Arrange cables in pairs, one from each pipe, on tripod jacks which will insure proper spacing between legs.
2. Determine the centerline of the joint, measuring from the face of the reducers. Mark the cable cutting points as shown on the appropriate drawing. REVIEW THE DRAWING CAREFULLY BEFORE MARKING THE CABLE CUTTING POINTS.
3. Bind the cables with tape on both sides of the cutting point to hold the insulation in place. Cut the cables.
4. Determine the distance from the cable ends to the end of insulation stepping and mark the cable.
5. Bind the cable with tape adjacent to the mark and remove all insulation down to the conductor shield, as shown on the drawing. Remove the semi-conductive tape and shielding tape to the conductor strands for a distance of 3-7/8" from the end of the cable, as shown on the appropriate detail drawing.
6. Chamfer the ends of both conductors. Remove the paper insulation from segments as far as possible.
7. Wrap the bared ends with poly tape or saran wrap and proceed with the other legs in the same fashion.

APPLYING THE CONNECTOR

1. Remove the protective tape and flush the cable ends with hot oil.
2. Fill the center between conductor segments of copper conductor using a clean #8 AWG solid copper wire, clean pieces of conductor strand from the cut off conductor, or skid wire pieces.
3. Slip the connector completely over the long cutback conductor. Align and butt the conductors and slide the connector into its final position as shown on the appropriate drawing. Be sure no segment paper insulation remains under the connector.
4. The copper (indent) connector is designed to fit loosely over the copper conductor before compression. If the fit is too loose, center the connector around the conductor using pieces of copper conductor strand (from the cut off conductor), until the first compression with the hydraulic press fixes it in place.
5. Wrap a half-lapped layer of yellow VC tape around the conductor between the connector and the edge of the cut down insulation. Insert hose clamps over the tape a small distance from the connector and tighten.
6. VERIFY THE MEASUREMENT between the cut down insulation edges, check the connector for proper position, and press the connector to the conductor. Follow company procedures and instructions applicable to the hydraulic press to be used.
7. Copper conductors 1000 kcmil or larger are to be attached using a 4-Ram press. One set of indents (with 4-Ram press) is pressed into the periphery of the connector, the depth of the deepest indent to be 150% of the connector wall thickness. At least two sets of indents (with 4-Ram press) per cable end are required, with the position of indents to be as shown on the drawing. Press the indents in the sequence indicated

APPLYING THE CONNECTOR (Cont.)

on the drawing. The press shall be rotated after each indentation so that adjacent indents are not aligned axially. The first indent shall be positioned 15 degrees from the edge of the conductor segment to insure that the indenting is not done between the segments. The press should be rotated an additional 30 degrees for each subsequent indentation.

8. Cover the connector and adjacent insulation with poly tape or saran wrap. Proceed with the other two legs in the same fashion.
9. Fill indents on connectors with lead plugs or connector filler compound.
10. If lead plugs are used:
 - a) Polish connector with aluminum oxide abrasive cloth.
 - b) Flush connector with hot oil.
11. If connector filler compound is used:
 - a) Trim the connector shield (annealed copper sheet, 0.010" thick) so that it is 1/2" shorter than the straight section of connector and overlaps slightly when placed around the connector. Fit shield to connector, solder the over-lapped edge and dress the soldered edge.
 - b) Flush the connector surface with hot oil being careful that filler compound is not washed out.
12. Cover the connector and adjacent insulation with poly tape or saran wrap to protect the connector area from foreign matter.
13. The manhole and all tools should be cleaned at this time to remove all conducting contaminants generated during the cutting and polishing tasks.

STEPPING THE CABLE INSULATION

1. Bind the cables with plastic tape at the point at which the insulation pencil will begin. Remove the metal shielding tape and semi-conductive tapes as far as the binding tape.
2. Remove the proper number of tapes at each step using piano wire and weights according to the inner jacket stepping table, diagram or the stepping template provided for this cable. Measure each step to the table.
3. Apply poly or silk tape or saran wrap to exposed steps during the stepping operation to keep the insulation from becoming loose or contaminated. Continue insulating this leg; do not step other legs or remove their protective jackets or wrap until this leg is completed.
4. Remove poly tape or saran wrap from connector area. Terminate the semi-conductive and strand binding tapes as shown in the appropriate detail drawing.
5. Apply lead foil at the ends of the connectors to build a smooth solid taper as shown on the appropriate drawing. This lead foil taper must be tight and smooth.
6. Apply two butt-wrapped layers of semi-conductive crepe paper tape over the connector and lead foil. Terminate semi-conductive crepe paper as shown on the appropriate detail drawing of the connector.

INSULATING THE JOINT

Insulating tape with reference to the following instructions is oil impregnated, crepe paper tape as shown on the appropriate drawing. Use tape which has been preheated to a temperature not exceeding 140 degrees F in the tape can. Remove one roll of tape from the can at a time. Tape is to be applied as tightly as possible in order to obtain a solid splice, however, there should not be more than one tape break in a layer of tape. Check the diameter over the insulation periodically to insure an equal diameter build up. ALL TAPE is to be applied with the roll so that the tape will remain on the joint after breaking or tearing.

1. Remove the poly tape or saran wrap covering from the stepped down leg progressively as the insulation is applied so that the minimum amount of cable insulation is exposed while taping.
2. Apply 1/2" x 3 mil tape on each side of connector to the connector diameter. Taping is to be continuous and half-lapped. Care must be taken to insure that the taped area is hard and smooth. A soft portion here will result in a soft inner jacket, which is unacceptable.
3. The remainder of the inner jacket is built up with 1" x 3 mil. tape, which is to be applied one way in the same rotational direction. Apply the tape so that each layer covers the butts in the previous layer. Each layer is torn with wire to butt with the edge of step. The inner jacket is built up to the cable diameter. A maximum of 100 mil. difference in diameter is permitted over the length of the inner jacket.
4. Remove the metal shielding tape to the shielding termination as shown on the appropriate drawing. Wrap the 3/4" copper band and solder tack it in place. Terminate the semi-conductive tapes according to the dimensions on the drawing. Remove two layers of factory insulation and terminate it at the end of the semi-conductive tapes.
5. Using 1-1/2" x 5 mil. tape, build the outer jacket and stress cones. Build the outer jacket to the specified diameter over the conductor as shown on the appropriate drawing. The outer stress cone shall be shaped according to the template provided.

SHIELDING THE JOINT

1. Apply one half-lapped layer of semi-conductive crepe paper tape over the entire joint, joining the factory semi-conductive tape on each side. Start in the middle of the joint and tape down each slope making sure the layers are continuous.
2. Solder two perforated tinned copper anchor strips (alligator clips) together so that the points of the strips point toward the center. Flush off flux with hot oil. Apply three of these strips on the joint, evenly spaced (120 degrees apart) about the circumference of the joint. (Be sure the points of the strips point up each slope.) These strips can be held in place with tape, but this tape must be removed as the mesh is applied. Do not solder the ends of the strips toward the sleeves until the copper mesh is applied.
3. Apply one half-lapped layer of tinned copper mesh starting at the centerline of the joint and terminating on the cable shielding. Tack rolls of mesh together and flush soldered mesh with hot oil, being careful not to allow the wash oil to come in contact with any semi-conductive tapes on the joint.
4. After applying the mesh for approximately 3-3/4" on either side of the center of the joint, place the 4" x 3" copper sheet for the flexible bond wires (skip ropes) over the mesh. This sheet may be placed on top of the two bottom legs, but must be placed on the side on the top leg to prevent interference with sliding the sleeves. Go back with the mesh, catching the edges of the plate securely. Continue applying mesh, terminating it on the cable shielding and solder mesh to the shielding all the way around. Terminate the mesh at the 3/4" copper band as shown on the appropriate detail drawing. Do not allow any voids in the mesh covering.
5. Bend points on the anchor tape toward center of the joint, up each slope, to secure the mesh.
6. Apply one half-lapped layer of cotton tape over the entire joint except for the area over the copper plate.

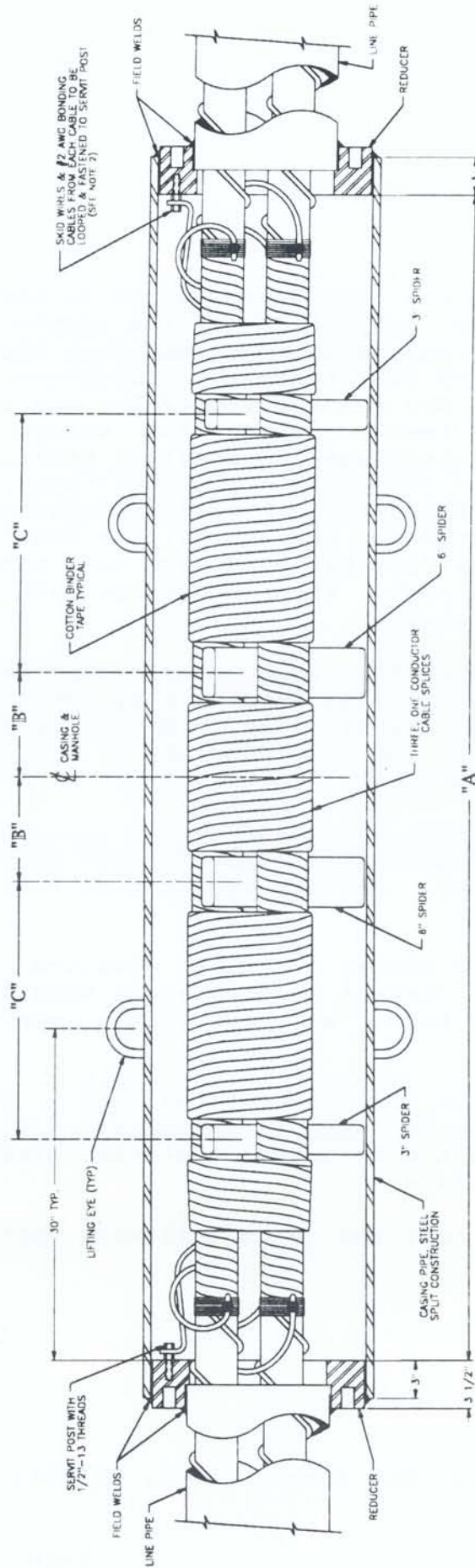
COMPLETING THE JOINT

1. Insulate the other two legs as specified in the above instructions. Upon completion of the joints in all three legs, remove any saran coverings from the joints that had been applied for temporary protection. Shut off nitrogen gas or dry air and remove the gas barriers and the nitrogen feed. Remove the wooden blocks covered with cotton tape used to position cable.
2. Insert three servit posts into each reducer in the threaded holes provided. Fasten the free end of the skid wire and the flexible bond wire for that same phase to the servit post. This is done on each side of the joint for each phase.
3. Bind the skip ropes for each phase together with binding wire. Solder this joining point of the skip rope to the tinned copper plate. At the same time solder the plate to the shielding braid. Flush the soldered area with hot oil.
4. Apply a tie of several layers of cotton tape over the straight portion of each joint and over the skip ropes near each stress cone, putting excess skip rope in the intermediate sleeves.
5. Insert the required number of split aluminum spacers (spiders) in their correct locations and bind the legs together with nylon tape, as shown on the appropriate drawing.
6. Slide the sleeves to their proper position. In this operation care must be taken to adequately support the joint at all times and to insure that the sleeves do not dig into the splice.
7. Weld and pressure test the joint following appropriate company procedures.

MAC PRODUCTS, INC.

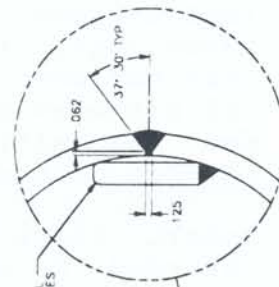
60 Pennsylvania Avenue, Kearny, New Jersey 07032, 201-344-0700

| REV | DESCRIPTION | DATE | BY | CHK |
|-----|-------------------------|----------|----|-----|
| 1 | 3.00011110 FOR APPROVAL | 10/18/72 | | |



- NOTES
1. CASING SUPPLIED BY PG & I
REV. PG & I DRAWING 2-1972 REV. II.
 2. ON DUMMY JOINT (NO SPLICE) DO NOT
REMOVE THE SPIDERS FROM THE JOINT.
CABLES TO BE PULLED THROUGH JOINT.
3. BIND ALL SPIDERS AS SHOWN USING 2\"/>

CUSTOMER: DONKUT/PG & I
WAL #78307



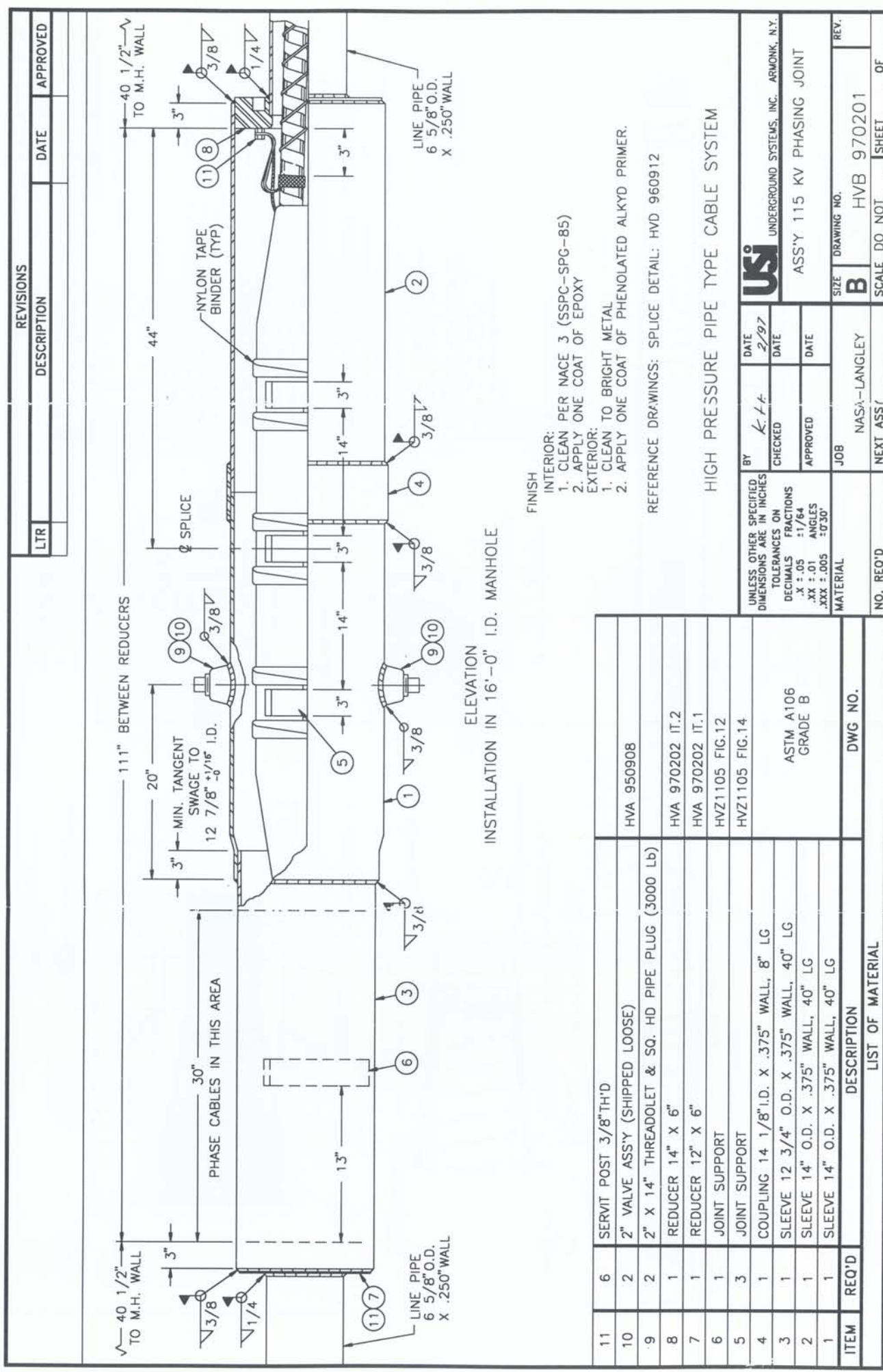
CASING SECTION

| DRAWING NO. | "A" REDUCER TO REDUCER OPENING | "B" CENTER SPIDER POSITIONS | "C" OUTER SPIDER POSITIONS | CASING PIPE PIPE O.D. | CASING PIPE WALL THK |
|-------------|--------------------------------|-----------------------------|----------------------------|-----------------------|----------------------|
| D-12734 | 90" | 9" | 18" | 14" | 0.375" |

| | | | |
|-----------------------------------|--|---|--|
| REF. JOINT: DUAL DRAWING D-12721 | | | |
| PG & I SPECIFICATION 13470 | | VAL PRODUCTION, INC. 4500 W. 10TH AVE. DENVER, CO 80202 | |
| PG & I ORDER #75-3470-MA4 | | ORDER NO. 10 ORDER DATE 10/18/72 | |
| RELOCATE NEWARK-SAN JOSE-B' 1154W | | ORDER NO. 10 ORDER DATE 10/18/72 | |

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| REVISIONS | | |
|-----------|-------------|------|
| LTR | DESCRIPTION | DATE |
| | | |
| | | |

| DATE | APPROVED |
|------|----------|
| | |
| | |

| ITEM | REQ'D | DESCRIPTION | LIST OF MATERIAL |
|------|-------|--|------------------|
| 11 | 6 | SERVIT POST 3/8"TH'D | |
| 10 | 2 | 2" VALVE ASS'Y (SHIPPED LOOSE) | |
| 9 | 2 | 2" X 14" THREADED & SQ. HD PIPE PLUG (3000 Lb) | |
| 8 | 1 | REDUCER 14" X 6" | |
| 7 | 1 | REDUCER 12" X 6" | |
| 6 | 1 | JOINT SUPPORT | |
| 5 | 3 | JOINT SUPPORT | |
| 4 | 1 | COUPLING 14 1/8" I.D. X .375" WALL, 8" LG | |
| 3 | 1 | SLEEVE 12 3/4" O.D. X .375" WALL, 40" LG | |
| 2 | 1 | SLEEVE 14" O.D. X .375" WALL, 40" LG | |
| 1 | 1 | SLEEVE 14" O.D. X .375" WALL, 40" LG | |

| NO. REQ'D | DWG NO. | ASTM A106 GRADE B |
|-----------|---------|-------------------|
| | | |
| | | |

| BY | CHECKED | APPROVED | DATE |
|----|---------|----------|------|
| | | | |
| | | | |

| UNLESS OTHER SPECIFIED DIMENSIONS ARE IN INCHES | TOLERANCES ON DECIMALS | FRACTIONS | ANGLES |
|---|------------------------|-----------|---------|
| | .X ± .05 | ± 1/64 | ± 0°30' |
| | .XX ± .01 | | |
| | .XXX ± .005 | | |

| MATERIAL | JOB | NAS - LANGLEY | SCALE | DO NOT | SHEET | OF |
|----------|-----|---------------|-------|--------|-------|----|
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| NO. REQ'D | NO. ASS'Y | SCALE | DO NOT | SHEET | OF |
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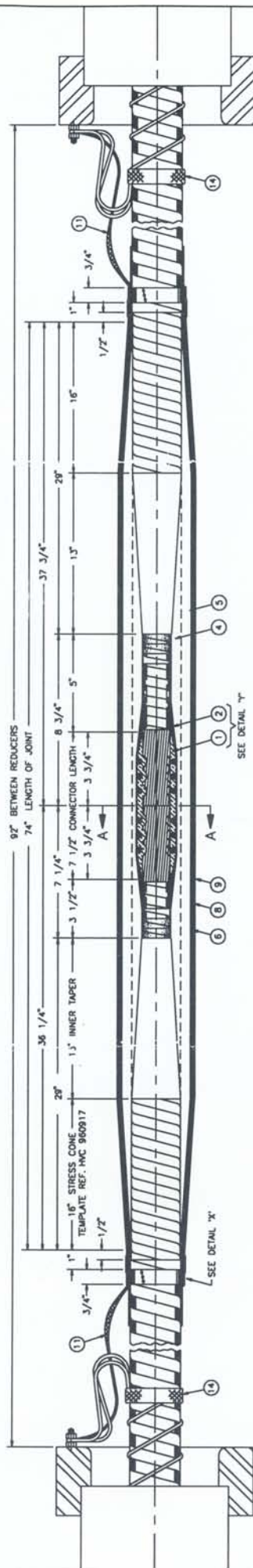
| NO. REQ'D | NO. ASS'Y | SCALE | DO NOT | SHEET | OF |
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| NO. REQ'D | NO. ASS'Y | SCALE | DO NOT | SHEET | OF |
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| REVISIONS | | | |
|-----------|----------------------------------|--------|----------|
| LTR | DESCRIPTION | DATE | APPROVED |
| A | REV. TITLE TO COMP. S/CAL. COND. | 3.4.87 | |



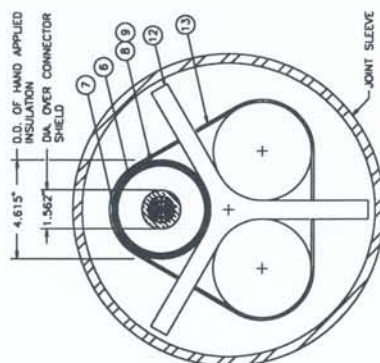
NOTES:

BEFORE CUTTING CABLE REFER TO INSTALLATION INSTRUCTIONS

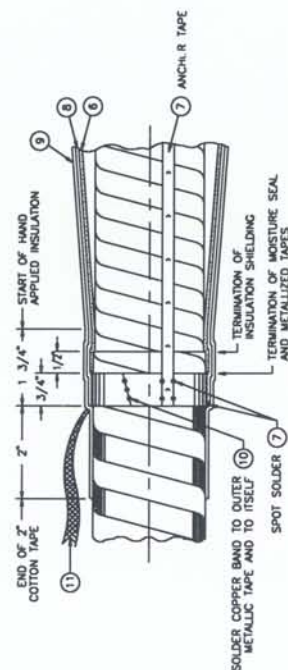
1. COPPER CONNECTOR-CONNECTION TYPE FOR USE WITH 4 B.M. PRESS. REF. DWG. H446809/19
FALL MOMENTS WITH LEAD PLUGS. EACH END OF COPPER CONNECTOR TO HAVE 3 INCHENTS.
SECOND INCHENT ON EACH END ROTATED 30° FROM SECOND INCHENT.
THIRD INCHENT ON EACH END ROTATED 30° FROM FIRST INCHENT.
2. FILLER OF .063" THICK LEAD FOIL APPLIED TO FORM A SMOOTH TRANSITION FROM THE TOP
OF THE CONNECTOR TAPER TO THE CONDUCTOR AS SHOWN IN DETAIL "A".
3. TWO BUTT-JLAPPED LAYERS OF CREPED CARBON BLACK TAPE HALF-LEAD AND CONNECTOR. 1" WIDE.
4. 1" WIDE x .063" THICK IMPREGMATED CREPE PAPER TAPE HALF-LAPPED TO DIA. OF 2.130"
5. 1 1/2" WIDE x .005" THICK IMPREGMATED CREPE PAPER TAPE HALF LAPPED
1. TO EQUAL O.D. OF WIND APPLIED INSULATION SPECIFIED IN SECTION A-A.
6. HALF LAPPED LAYER OF 1" WIDE CREPED CARBON BLACK TAPE OVER HAND APPLIED O.O.
7. THREE .010" x 1/2" WIDE PERFORATED COPPER ANCHOR TAPES APPLIED LONGITUDINALLY
120° APART. THICK SOLIDER TO COPPER BAND AND MESH TAPE EACH END.
8. TINNED AL. CUPPER MESH TAPE HALF-LAPPED STARTING AT CENTER AND OVER PERFORATED
ANCHOR TAPES TOWARD EACH END. PRESS AND FLATTEN TIPS OF ANCHOR TAPE OVER MESH TAPE.
9. 2" WIDE x .010" THICK IMPREGMATED COTTON TAPE, HALF LAPPED OVER MESH TAPE. SEE DETAIL "X".
AND TO TISSUE.
10. 3/4" WIDE TINNED COPPER BAND WRAPPED AROUND AND SOLDERED TO OUTER METALLIC TAPES
AND TO TISSUE.
11. TWO LAYERS OF 1 1/4" WIDE 240/28 TINNED COPPER BAND AROUND EACH 3/4" WIDE
TINNED COPPER BAND. ALLOW SUFFICIENT LENGTH AT EACH END TO REACH SERV. POST.
12. JOINT SUPPORTS (SPIGOTS).
13. 2" WIDE COPPER BANDER. B.M.O. ALL PHASES INTERMITTENTLY TOGETHER FROM
RENDER TO 6" ENDERS.
14. SECURE SKID WIRE IN PLACE WITH 1/4" WIDE 240/28 TINNED COPPER BAND--EACH END.
SUFFICIENT LENGTH ALLOWED TO REACH SERV. POSTS WITH A SLACK LOOP.

OWG REFERENCES:

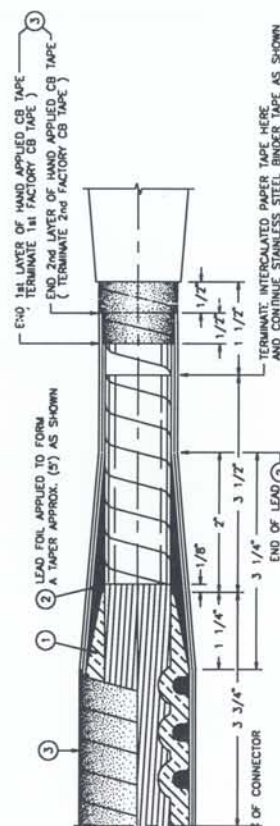
ASSY NORMAL JOINT: HMB 980916



SECTION A-A



DETAIL "X"



DETAIL 'Y'

115 KV HIGH PRESSURE GAS FILLED PIPE TYPE CABLE SYSTEM

| | | | | | |
|----------|--------------|-----------------|-------------|---|--|
| BY | DATE | US ¹ | | UNDERGROUND SYSTEMS, INC. ARMONK, N.Y. | |
| CHEKED | DATE | | | | |
| APPROVED | DATE | | | SPLICE DETAIL 115KV-1/C 1000KCMV COMPACT SEC. CU COND. | |
| JOB | NASA/JANGLEY | SIZE | DRAWING NO. | REV. | |
| | | D | HVC 960912 | A | |



SECTION 5



G&W ELECTRIC CO.

INSTALLATION INSTRUCTIONS

CUSTOMER ORDER NUMBER:

G & W ORDER NUMBER:

CATALOG NUMBER:

CABLE DATA:

INDEX:

This information is transmitted by G&W and accepted by you subject to the following understanding and agreement: By accepting this drawing you agree that all rights to the drawing and information contained herein, as well as the proprietary and novel features of the subject matter, are reserved by G&W and that devices embodying such features or information derived from these disclosures will not be manufactured by or for you or disclosed to others without the expressed written consent of G&W. These drawings and information contained thereon are and remain the property of G&W and are not to be copied, reproduced or disclosed to others without the expressed written consent of G&W.

WARRANTY

The Seller warrants all devices to be free from defects in workmanship or material under normal use and service for a period of one year from date of shipment from the factory. Liability under this warranty is limited to replacement F.O.B. point of original destination of any parts which proved to be defective within that time. All technical advice, recommendations and services are based on technical data and information which the Seller believes to be reliable and are intended for use by persons having skill and knowledge of the business, at their own discretion. It appears after written notice to Seller received by Seller during the period of the warranty provided for above that equipment shipped does not comply with the warranty, the Seller will at its option remedy the defect by replacement or repayment of the purchase price. In no case is Seller liable beyond replacement of equipment F.O.B. carrier at point of original destination or the full purchase price. This express warranty is in lieu of and excludes all other representations made by advertisements or by agents and all other warranties both express and implied. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE FOR GOODS COVERED HEREUNDER.

BUYER'S REMEDIES

THE BUYER'S EXCLUSIVE AND SOLE REMEDY ON ACCOUNT OR IN RESPECT OF THE FURNISHING OF NON-CONFORMING MATERIAL SHALL BE TO SECURE REPLACEMENT THEREOF AS AFORESAID. THE SELLER SHALL NOT IN ANY EVENT BE LIABLE FOR THE COST OF ANY LABOR EXPENDED ON ANY NON-CONFORMING MATERIAL OR FOR ANY SPECIAL DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES TO ANYONE BY REASON OF THE FACT THAT SUCH MATERIAL SHALL HAVE BEEN NON-CONFORMING.



SECTION I

GENERAL

The following instructions are designed for average installation instruction conditions and do not purport to cover all possible contingencies. Any important modifications in the installation procedure that may be deemed necessary by the supervisory engineer should be referred to G&W Electric Company.

The instructions and recommended techniques, in general, are to be strictly adhered to in principal. Carelessness, improper handling of material, tools or equipment or performing unauthorized procedures during installation will not be tolerated.

It is of prime importance that moisture be excluded from the exposed cable and pothead insulation during the installation. Cable splicers shall not do any work on the cable, internal parts of the pothead or any material used inside of the pothead while their hands are moist or perspiring. A protective tent or structure over the assembly during construction is recommended. Normal precautions attendant to the installation of high voltage equipment and cable are included as an essential part of these instructions.

The cable shall be securely supported in a vertical position in line with the center of the pothead base plate to insure against excessive bending and abraiding of the cable during installation and to facilitate the taping operations. The stress cone dimensions are to be adhered to closely, necessitating a relatively straight cable section during taping.

Each pothead shall be completely installed before another cable end is opened unless, in the opinion of the supervisory engineer, there is sufficient labor, materials, tools and equipment at the job site to install two or more potheads simultaneously with the minimum practical exposure of cable installation to the atmosphere. If it is impossible to complete an installation without extended periods of inactivity, the exposed cable end must be covered with a night cap or other suitable protection. However, it cannot be over-emphasized that an installation worked to completion is to be desired. Flushing oil that has been heated to a temperature in excess of 120°C, or that which is cloudy or discolored, shall not be used in the installation of potheads. A thermometer with a range of 0 to 150°C shall be kept in the oil at all times while it is being heated. During heating, the oil container shall not be in direct contact with the heating source; a double boiler is recommended.

MATERIAL

In addition to the standard materials supplied as component parts of the pothead, the following items will be required for each pothead installation.

Dry, bias-cut varnish cambric tape for miscellaneous use
1,1,1-Trichloroethane (inhibited grade) or other suitable solvent
50/50 string solder
G.E. non-acid soldering flux sticks
Complete splicer's kit
Torque wrench - range 0 to 50 ft-lbs or greater
Press with indenting and rounding dies
Two 5/8" - 11 eye bolts for lifting pothead
Crane or hoist for lifting pothead
Vacuum pump, hoses, traps, gages, etc
Double boiler for heating oil
Furnace
Thermometer (0 - 150°C)
Nitrogen gas with regulating equipment or bone dry carbon dioxide
Suitable shelter for protection of potheads during installation

All materials, tools and equipment used during the installation of potheads shall be thoroughly cleaned before each use in a manner that will insure against contamination of the pothead, cable or oil. Potheads and all tools, material and equipment that are used in or may contact the inner surface of the pothead or cable shall be maintained in a dry atmosphere during all pothead installation operations. A suitable enclosure with proper light and power facilities shall be prepared for the pothead installation.

PRELIMINARY WORK

These instructions assume that any assembly work on spreader piping, spreader stop glands, current transformers, base plates and night caps, etc, has been completed and that all of the necessary material, labor, tools, etc, are at the site and are immediately available for use.

DBR
3/4/93

GW1 1-10 REV.2

SECTION II

CABLE PREPARATION AT BASE PLATE WITH SET SCREW GROUND

1. Locate and support cable so that the section at the base plate is in the final desired position. Be sure cable is pushed down into final position so settling does not occur during cable preparation.
2. Secure the skid wires and binder tape (if any) approximately 1 foot above the top of the base plate, with some VDG or cotton tape.

NOTE: The skid wires should be securely taped to prevent the wires from receding down into the cable pipe when the excess length of the skid wires are trimmed or shortened.
3. Cut off the excess length of the skid wires just above the VDG or cotton tape build-up.
4. Just above the base plate, wrap a serving (3 or 4 turns) of tinned copper wire around the skid wires and binder tape (if any). Leave a tail on one end of the wire so eventually it can be attached to the set screw on the base plate. Spot solder the wire serving to the skid wires. Avoid indiscriminate heating of the wire serving as it may damage the cable insulation. Attach the copper wire tail to the set screw and washer on the base plate.
5. Remove the VDG or cotton tape build-up. Bend the skid wires back over the wire serving, as the excess length on the skid wires are cut off.
6. Slide the wire serving assembly down the cable until it's located approximately 1/4" below the top of the base plate. Remove the binder tape (if any) to a point just above the base plate.
7. Apply several layers of half-lapped, straight-cut, VDG tape to the section above the skid wires as shown on the cable-end preparation drawing. Build-up diameter to the dimension shown on the preparation drawing.
8. Carefully clean surface on the base plate to remove all traces of oil and dirt. Bolt the semi-stop and gasket to the base plate; use a lock washer and a flat brass washer on each one. Torque bolts to the recommended ft-lbs.
9. Slide the washers and gaskets in proper order down into semi-stop collar. Thread compression nut into collar and tighten hand tight. Screw down the socket type set screws to compress gland gaskets. Tighten the set screws until the gaskets begin to extrude out, between the cable and the compression plate washers, forming a good oil seal.

SECTION III

PREPARING THE CABLE

1. Position the ferrule in cap of pothead so that the distance between the top of the cap and the top of the ferrule is "F" inches. Refer to the detail stress cone drawing for "F" dimension.
2. Measure the distance between the effective bottom of the drilled hole in the ferrule and the base of the pothead body. (The effective bottom of the ferrule is that point to which the cable conductor will extend). Use this measurement for dimension "X" shown on the stress cone drawing. Cut off the cable "X" inches from the flange of the base plate.

NOTE: Where circumferential die presses (T&B etc.) are to be used to press the connector to the cable conductor an allowance must be made for elongation of the connector during the pressing operation. An elongation of 10% to 20% of the barrel length can be expected depending on the number of dies used, hardness of material, etc. It is recommended that an extra pothead connector be pressed to a piece of the cable conductor and the elongation measured. The amount of elongation must be subtracted from the "X" dimension before the cable is cut off.

3. Remove the cable shielding and insulation for "D" inches from the end of the cable. Press the ferrule onto the cable conductor. Any segmental conductor insulating tapes should be removed. On segmental cable insert a 3" long #6 copper wire in the center of the conductor between segments. The cable should be held straight during the indenting operation. Observe press manufacturer's recommendations where applicable. Refer to the stress cone drawing for the "D" dimension. NOTE: Before the ferrule is placed over the cable conductor make sure the "O" ring is in the groove in the ferrule to avoid necessity of sliding the "O" ring over the threaded surface. Lubricate the "O" ring with flushing oil to facilitate assembly.
4. Pencil the cable insulation at the ferrule end of the cable and fill in with oil packed varnished cambric tape.
5. Remove the carbon black, metallized tapes and cable shielding tapes down to the point indicated on the stress cone drawing. Trim the shielding tapes to form a perfectly uniform, even edge around the cable. Be certain no burrs are left to puncture cable tapes. Secure cable shielding temporarily with VC tape.
6. Assemble a nut on each end of the 5/8"-11 studs. Screw the studs into four holes 90° apart on the base plate. Lock studs in place with nut. Assemble two metal straps onto studs and allow to rest against the top nuts. Assemble the split metal support on the studs. Be sure the split in the support is perpendicular to the straps. Adjust the top surface of the split support so it is "E" inches from the top of the base plate. Assemble a nut on each support stud to lock support in position. Refer to the stress cone for dimension "E".

SECTION III

Connector Preparation for Installation of Spare "ATA" or "ATRA" Type Terminator

(use only when new connector must be used on existing cable)
Not applicable to new installations (for emergency repair only.)

1. Cut off cable just below the old connector as shown on Figure 1.
2. Measure the remaining cable cut-off length. This becomes the new "X" dimension. NOTE: DO NOT use semi-stop housing as a reference, measurement must be made to the base plate flange as shown on cable end preparation drawing.
3. Measure the "AA" dimension (from body base flange to top of terminator cap plate) of the spare terminator as shown in Figure 2.

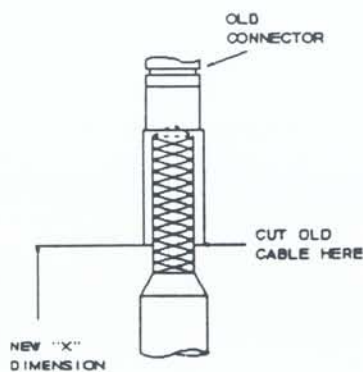


Fig. 1

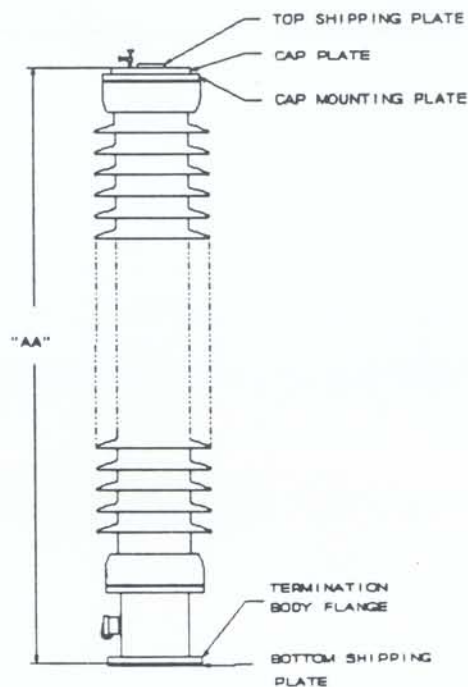


Fig. 2

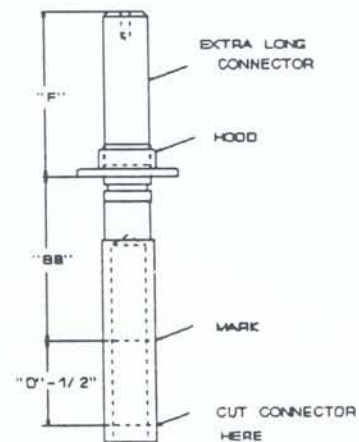


Fig. 3

4. Temporarily assemble the hood onto the extra-long connector. Set the connector to the dimension "F", as specified on the cable end preparation drawing.
5. The "BB" dimension for the extra-long connector is obtained from the "AA" dimension, as measured in step 3, subtracting the new cable "X" dimension ("BB" = "AA" minus "X"). Mark the extra-long connector a distance "BB" below the hood as shown in Figure 3. This marks the final position of the cable end inside the barrel.
6. From this mark, go a distance "D" less 1/2" further down the barrel and cut the ferrule barrel squarely at that point. (Dimension "D" can be found on cable end preparation drawing). The mark made in step 5 will be at the point the conductor extends into the connector. This will aid during the crimping operation. Continue installation according to instructions.

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SECTION IV

STRESS CONE PREPARATION

Preliminary

The stress cone consists mainly of one perforated paper roll applied to the cable. Paper rolls are made of the same material as cable tapes and, therefore, provide a high grade of insulation that may easily be formed to the slopes specified. The roll, if applied immediately over the cable insulation, forms the bottom and top contour of the stress cone.

The technique used in applying the rolls must be carefully followed because the correct application of the paper roll is imperative for the successful operation of the pothead. Especially close attention must be exercised in forming the slopes at the cone cable junction.

General Notes:

Application of Paper Roll

The paper rolls consist of a single sheet of high quality kraft paper that has been dried and impregnated in the same manner as high voltage cable insulation. The rolls are transported and stored in oil filled cylinders or tanks. It is important to keep the paper rolls completely sealed and covered with oil until they are used. Refer to the above application instructions.

Paper roll containers should be maintained between 120⁰ F. and 140⁰ F. for several hours prior to installation. The rolls should not be heated above 140⁰ F. Rolls maintained between 120⁰ F. and 140⁰ F. are easier to apply because the viscosity of the oil allows proper drainage as the roll is tightened on the cable.

A 1-1/2" tab has been attached to the first inner layer of paper on both ends of the paper roll. The tabs are held against the cable insulation during the tightening of the paper roll to prevent the inner layer from turning. The tabs are removed after the roll is installed.

The roll is supplied with 1/16" Bakelite disc on each end of the roll to prevent telescoping of the roll during installation. The bakelite discs are tied to the roll with cotton tape. Cotton tape lifting loops are attached before the roll has been set in position on the supporting plate. The inside diameter of the roll and bakelite discs are larger than either the ferrule or the cable insulation.

The first inner layer of the paper roll is free from any ties. This permits guiding the tab between the cable insulation and the split metal support during application of the roll.

Each roll has four factory perforated slopes, two each end. Rolls are slipped into place so that the tightening direction of the roll is in the same rotational direction as the cable tapes. This is necessary to keep the cable tapes tight and prevent wrinkling.

Use two strap wrenches to tighten the paper roll. Place the wrenches 180⁰ apart, in the middle of the roll first and gradually work one toward the top and the other toward the bottom.

It is necessary to pause at intervals during tightening to allow the excess oil to drain out from between the layers of paper. The proper amount of torque is reached when the tendency of the roll to unroll has diminished and the roll will support its own weight upon the cable. A strap wrench can be used to apply torque to tighten the paper roll. The stress cone contour is formed by tightening the rolls on the cable and then tearing the perforated ends to form the stress cone contour.

Stress Cone Construction

1. Tighten the cable paper tapes from shielding termination up to the connector. Remove one or two layers of cable insulation down to the shielding termination. Determine the lay of the remaining outer layers of cable tapes.
2. Remove the paper roll from the container using the lifting loops. The 1-1/2" tabs on each end of the paper roll have been folded inside the roll for shipment. Pull the tabs out straight. Select the correct lay of paper roll to match cable lay. Using the lifting loops lower the paper roll over the cable end and support on the paper roll support plate. The 1-1/2" tab on the bottom end of the roll should be slipped between the cable insulation and the support plate. Remove the cotton binding tapes and the bakelite disc from the top end of the roll.
3. Hold the bottom Bakelite disc against one side of the cable. Align red lines on each tab with the cable axis. The top end of the paper roll should be square and flat. Secure the tabs against the cable insulation with several layers of V D G tape. Tighten the paper roll onto the cable insulation.
4. Remove the outer layers of paper down to the point where the perforation starts. Secure paper roll with several turns of V D G tape on lower end of the roll.
5. Start tearing off the perforated top end of the paper roll. These perforations start at point 1 shown on the stress cone drawing. Remove the paper down to diameter "H" on stress cone drawing. Make a vertical cut from the end of the back slope up to the end of the paper roll. Secure the paper roll in the middle of the flat on the "H" diameter with several turns of V D G tape.
6. Remove the binding tape from the lower end of the roll. Tighten the paper roll on the lower end only. Remove the outer layers of paper from the roll until diameter "J" shown on the stress cone drawing is reached. Secure the paper roll in the flat area with V D G tape.
7. Remove the bakelite disc, paper roll support and studs. Start tearing the perforated lower end of the roll at point 2. Remove the paper down to the last layer of paper next to the cable insulation. The last layer of paper and tab should be torn against the piano wire to form an even edge.
8. Apply one half-lapped layer of semi-conducting crepe paper tape over stress cone starting at "Y" inches above the base plate and wrapping down from this point to butt against cable shielding. Arrange perforated tinned copper straps around the stress cone with perforations bent away from cable and secure.

9. Wrap the shielding braid over the semi-conducting tape and perforated tinned copper straps with half-lap layers down the contour of the stress cone and over the cable shielding tapes. Bend up the tab ends on the perforated copper strips against the shielding braid. Tack solder the shielding braid to cable shielding and tack solder perforated strips to cable shielding. Immediately flush the shielding with hot flushing oil to remove any residual flux.
10. Apply cover insulation of half-lapped low loss varnished cambric tape over stress cone to the dimension on stress cone drawing.
11. Lay a brass strap with open end of punch-outs up along the axis of the stress cone. Position the top end of the strap 2" below the stress cone shielding edge. Bend the bottom end of the strap at a right angle so that it rests against the top surface of the semi-stop nut. Cut off any excess length. Repeat the above process with other straps.

Uniformly space the straps around the stress cone and bind them in place with three turns of #14 AWG tinned copper wire at each punch-out. Solder the end of the flexible ground braid to the shielding braid cable shield junction. Attach the other end of the flexible ground braid under one of the bolts holding the semi-stop plate to the base plate. Flush the assembly with hot flushing oil to remove any residual flux.

SECTION V

POTHEAD ASSEMBLY

1. Clean internal surface of the pothead porcelain with clean rags to remove any contamination. Slip the flat gasket over the cable end and into the retained gasket groove in the base plate. DO NOT lubricate. Add any missing semi-stop bolts.
2. Remove the 5/8" cap screws at the cap and remove the cap. Thread two eye bolts into the upper bronze adaptor for lifting the pothead. Remove the cast hood and "O" ring from the cap. Lubricate the "O" ring on the ferrule with flushing oil to facilitate the cap assembly. NOTE: To change the "O" ring out, the threads on the connector should be taped over with varnished dacron glass tape.
3. Raise pothead with adaptor (if supplied) assembled to body to clear top of cable assembly.
4. Carefully lower the pothead over cable and stress cone.
5. Before completely sealing pothead onto gasket, thread all the 5/8" - 11 bolts into the base plate. Torque bolts to 40 ft.-lbs.
6. The eye bolts can now be removed. Slip the cap and flat gasket carefully over the ferrule into position on the top of the porcelain. Bolt the cap to the bronze adaptor. Torque bolts to 40 ft. lbs.
7. Slip the "O" ring carefully over the ferrule into place (see note in step 2). Screw the cast hood onto the ferrule until it makes contact with the cap. Bolt the hood to the cap. Torque bolts to 15 ft.-lbs. Measure the distance between the top of the ferrule and the top surface of the stainless steel plate. This dimension must be with $\pm 1/4$ " of dimension "F" shown on the stress cone drawing to insure proper sealing of the "O" ring gasket.
8. Assemble fittings to ferrule for vacuum treating and filling of pothead. A vacuum treating plug is supplied with each pothead for this use.

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Rev. 2-28-83

SECTION VI

TREATING & FILLING POTHEAD

1. The pothead will be treated and gas filled according to the cable manufacturer's specifications for treating and filling the cable.
2. Assemble bottom section of corona shield to pothead per drawing A6155-16. Assemble aerial lug on ferrule and torque bolts.
3. Final Inspection Before Application of High Pressure:
 - A) Recheck torque on all bolts of the gasketed joints, approximately 24 hours after assembly and again approximately 48 hours after assembly, retorquing to the values shown each time.

BOLTS THREADED INTO STAINLESS STEEL OR BRONZE

3/8"-16 Cap screws should be torqued to 15 ft.-lbs.
1/2"-13 Cap screws should be torqued to 35 ft.-lbs.
5/8"-11 Cap screws should be torqued to 40 ft.-lbs.
3/4"-10 Cap screws should be torqued to 45 ft.-lbs.

- B) A field acceptance pressure test should be made on the pothead at the same time as the cable system.

4. Periodic Maintenance Check

Retorquing of bolts is not normally required, unless leakage occurs. Potheads should be de-energized and high pressure reduced to 50-70 PSIG for torque checking. Checking should be done annually, if possible.

BOLTS THREADED INTO STAINLESS STEEL OR BRONZE

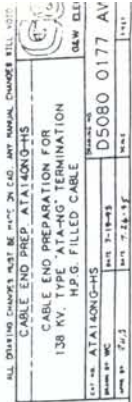
- A) 3/8"-16 bolts - no retorquing of bolts is required until torque has dropped to 10 ft.-lbs. Retorque to 12 ft.-lbs.
- B) 1/2"-13 bolts - no retorquing of bolts is required until torque has dropped to 25 ft.-lbs. Retorque to 30 ft.-lbs.
- C) 5/8"-11 bolts - no retorquing of bolts is required until torque has dropped to 30 ft.-lbs. Retorque to 35 ft.-lbs.
- D) 3/4"-10 bolts - no retorquing of bolts is required until torque has dropped to 35 ft.-lbs. Retorque to 40 ft.-lbs.

SECTION VIII

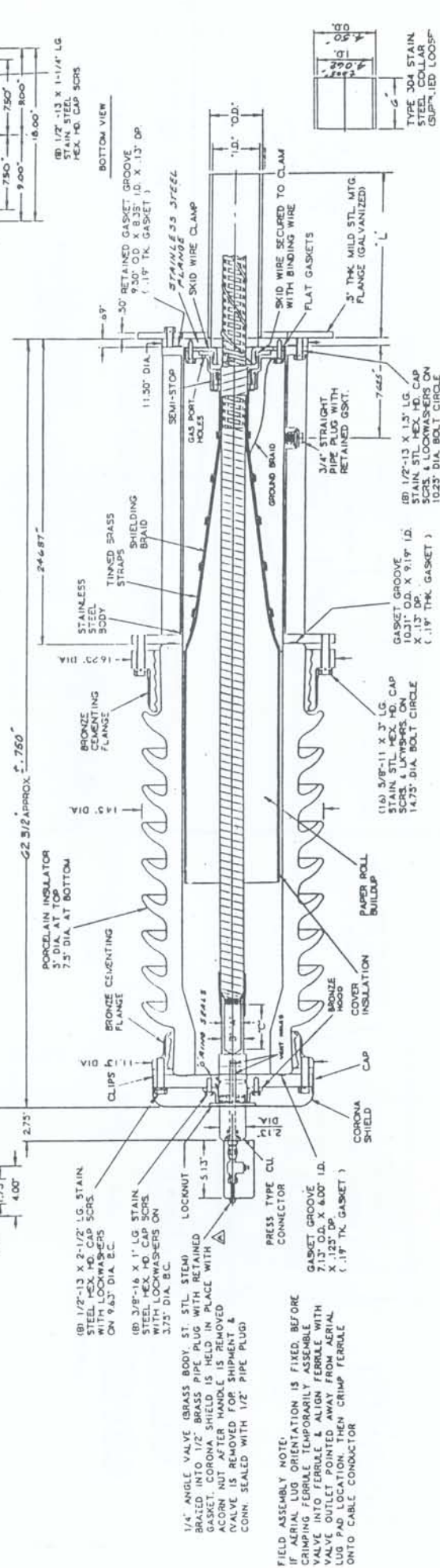
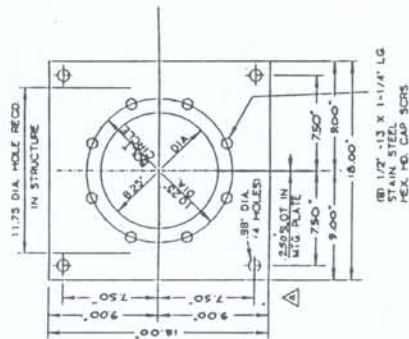
RECEIVING, STORING AND HANDLING OF PAPER ROLLS FOR ATA/ATL TERMINATIONS

- 1 Paper rolls are normally shipped in separate crates or pallets. Immediately upon receiving of the shipment, it should be inspected for any signs of damage or rough handling. If damage is found, it should be noted on the freight bill.
- 2 Paper roll containers should be stored indoors whenever possible. Dry and cool location at an ambient temperature is strongly recommended, particularly for a long-time storage.
- 3 When storing paper rolls, containers should be stood on their lid, so if an oil leak develops, it will be easily noticed.
- 4 Moisture entry in the container stored on the lid is also minimized.
- 5 Moisture seeping into a container could affect and contaminate the paper roll, causing it to lose its high grade of insulation characteristics, thus rendering the roll unsuitable for use.
- 6 If containers are stored on the side, an oval condition on paper roll ID could set-in, thus making the paper roll assembly over the cable very difficult.
- 7 Paper rolls are packed and shipped in oil filled and sealed containers, when properly stored, the shelf life is indefinite.

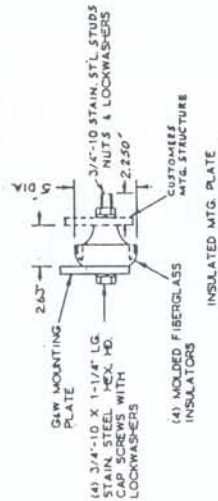
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5/13/92



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FIELD ASSEMBLY NOTE:
IF AERIAL LUG ORIENTATION IS FIXED, BEFORE
CRIMPING FERRULE TEMPORARILY ASSEMBLE
VALVE INTO FERRULE & ALIGN FERRULE WITH
VALVE OUTLET POINTED AWAY FROM AERIAL
LUG PAD LOCATION, THEN CRIMP FERRULE
ONTO CABLE CONDUCTOR



| PISTON ITEM NO. | QTY. | CABLE SIZE ØCAB | CON. DIMENSIONS "A" "B" "C" : : : " | PIPE STUB SIZE & MATL. | PIPE STUB DIMS L D O D L | SEMI-STOP GASKET CUT | TYPE OF PRESS | STRESS CONE DRAWING NO. | REMARKS |
|-----------------------|------|--------------------|---|--|-----------------------------|----------------------------|-----------------------|----------------------------|---------|
| 1 | 1 | 41/80 S | 12 | 1/500 MCMT 1.387" 1.838" 3.156" 3.191" 1.832" 3.041" 2.012" 40 STRAIN 3/16" 1/8" 1/4" | 3.548" 4.000" 20" | 2.2 50 | 1/4" 4 8/10 10 TON | D50800 20-4600 | |

DIELECTRIC CHARACTERISTICS

PHYSICAL CHARACTERISTICS

| | |
|--|----------|
| INTERNAL PRESSURE * | |
| NOM. OPERATING PRESSURE | 300 PSI |
| MAX. CONTINUOUS OPERATING PRESSURE (OVER 10 IN.) | 410 PSI |
| MAX. TRANSIENT PRESSURE (up to 10 IN.) | 430 PSI |
| MAX. PEAK TRANSIENT | 400 PSI |
| MAX. FIELD (proof) | 525 PSI |
| FACTORY TEST (1 IN.) | 750 PSI |
| BROOKLYN WEIGHT | 700 LBS. |

LONG ISLAND LIGHTING CO.

SEE "B" SIZE FOR B/M B72630013F00

| REVISIONS | |
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| 100 | ADDED 3 VALVE / CORRECTED |

POTHEAD, TYPE "ATA-NG 1/C.
69 KV, 2,500 KCM (MAX).
300 PSI GAS PRESSURE.



| | | | | | |
|---------------------|--------------|-------------|--------------|-------------|--------------|
| LIT. NO. A1A100G-HS | | PLANNED NO. | | A | |
| DATE | 9-13-90 | DATE | 9-13-90 | DATE | 9-13-90 |
| TIME | 10:00 | TIME | 10:00 | TIME | 10:00 |
| LOCATION | 1000 | LOCATION | 1000 | LOCATION | 1000 |
| PLANNED NO. | 072630013F00 | PLANNED NO. | 072630013F00 | PLANNED NO. | 072630013F00 |



SECTION 6

BROOKLYN NAVY YARD
COGENERATION PARTNERS, L.P.
BROOKLYN, NEW YORK

138KV HPGF UNDERGROUND
TRANSMISSION LINE

STATIONS:

SPECIFICATION NO: 520700-0230.

THE OKONITE COMPANY
RAMSEY, NEW JERSEY

P. O. NUMBER: 2-95-36

| A | BG | 3/22/95 | RELEASED FOR |
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| SYM | BY | DATE | APPROVAL |
| | | | REVISION |

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JEROME, INC.

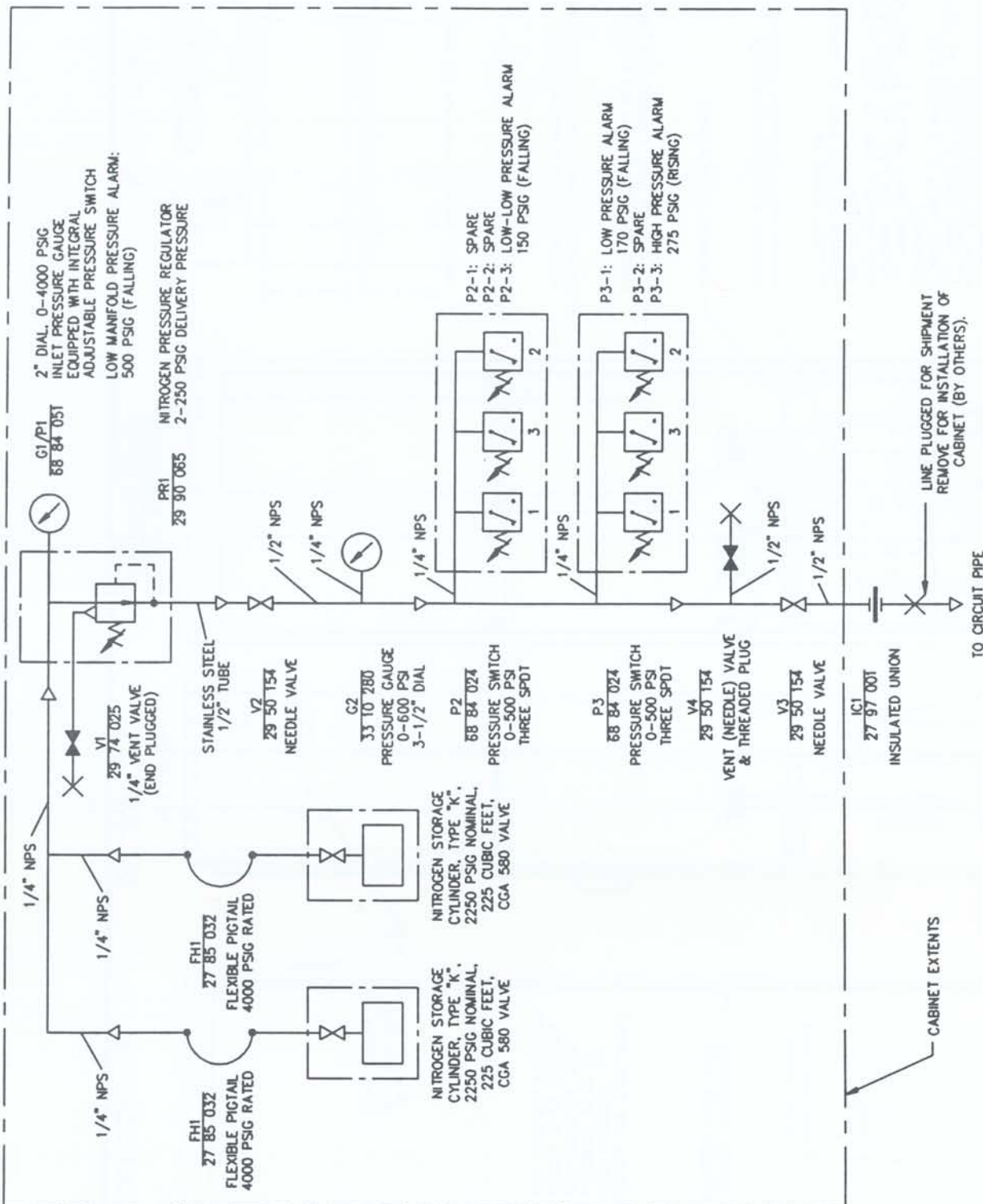
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SAD CORPORATION.

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NITROGEN GAS SUPPLY CABINET PIPING SCHEMATIC

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| BY: BG | DATE: 3/22/95 |
| SCALE: FULL | CHECKED: BG |
| SHEET: 2 | OF 3 |
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| | REV A |



BROOKLYN NAVY YARD
COGENERATION PARTNERS, L.P.
BROOKLYN, NEW YORK

138KV HPG UNDERGROUND
TRANSMISSION LINE

STATIONS:

SPECIFICATION NO: 520700-0230.01

THE OKONITE COMPANY
RAMSEY, NEW JERSEY

P. O. NUMBER: 2-95-36

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| SYM | BY | DATE | REVISION |



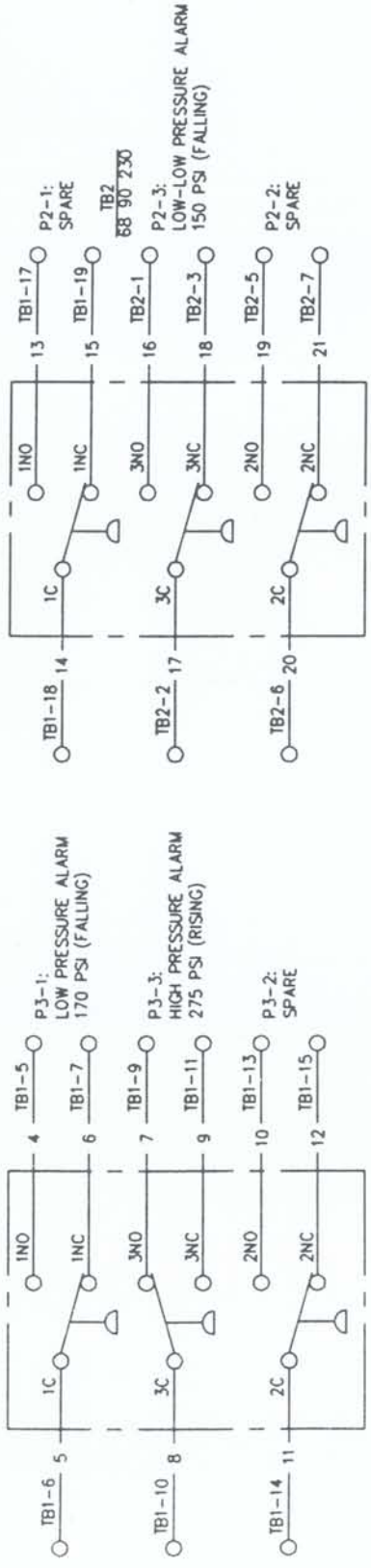
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NITROGEN GAS
SUPPLY CABINET
ELECTRICAL DETAILS

| | |
|---------------|---------------|
| BY: BG | DATE: 3/23/95 |
| SCALE: N.T.S. | CHECKED: BG |
| SHEET: 3 | OF 3 |
| B 96 01 | 011 |
| | REV. A |



- NOTES:
1. ALL WIRING SHALL BE #14 AWG, TYPE THHN.
 2. ALL WIRING SHALL BE RUN IN FLEXIBLE METAL ("GREENFIELD") CONDUIT.
 3. THE OPERATIONAL SETPOINTS LISTED ON THIS DRAWING ARE BASED ON A NORMAL SYSTEM OPERATING PRESSURE OF 200 PSIG.
 4. ALL WIRES SHALL BE TAGGED (EACH END) WITH BRADY MARKERS.
 5. ALL PRESSURE SWITCH CONTACTS ARE SHOWN IN THE ALARM POSITION.
 6. TERMINAL POINTS TB1-3, 4, 8, 12, 16 & 20, TB1-4, 8, 9 & 10 ARE SPARES.
 7. PRESSURE SWITCH CONTACT RATINGS:
P1: 0.5 AMPS AC/DC MAX. CURRENT (NON-INDUCTIVE), 28V AC/DC MAX. VOLTAGE
P2, P3 AND P4: 15 AMPS, 125/250/480 VAC RESISTIVE

P2

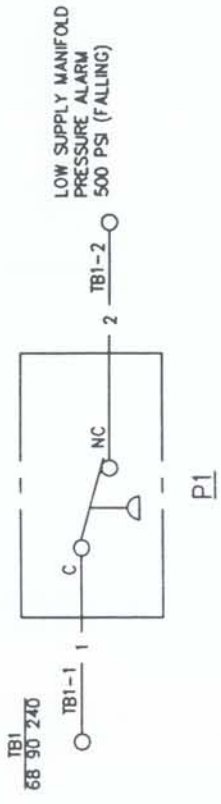
TOP

P3

| INTERNAL WIRING CONNECTIONS (BY PRELLI JEROME, INC.) | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |

| INTERNAL WIRING CONNECTIONS (BY PRELLI JEROME, INC.) | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |

PHYSICAL ARRANGEMENT OF JUNCTION BOX







EVACUATION OF HPGF PIPE-TYPE CABLE SYSTEM AND FINAL FILLING WITH NITROGEN GAS

1.0 PRELIMINARY WORK

Before proceeding with the evacuation and filling of the line, the gas pressure control unit should be installed and checked for proper operation. The alarm contacts on the nitrogen pressure switches in the gas pressure control unit should be set as follows:

| | |
|--|----------|
| High Pressure Alarm | 275 psig |
| Low Pressure Alarm | 175 psig |
| Low-Low Pressure Alarm (Circuit Breaker Trip) | 125 psig |

Note that this unit has been provided with two (2) sets of low pressure alarms. We recommend that these be connected to your alarm system so that when both alarms are received (first the 175 psig followed by the 125 psig), the circuit breaker will automatically trip this circuit from service. We do not recommend this system be operated continuously at pressures below 125 psig. The above method of alarming the system will assure that the circuit does not remain energized if a gas leak ever occurs and pressure falls through two (2) levels (175 psig and 125 psig) before corrective action is taken.

The first alarm at 175 psig would signify the need for corrective action and if it is taken before the pressure falls to 125 psig, the circuit can, of course, remain energized.

The pressure regulator on the nitrogen cylinder (manifold) should be set at 150 psig to feed nitrogen into the system should the pressure ever drop to this level.

Operation of the regulator and alarms may be checked by raising the pressure on the regulator to check high pressure operation and opening a vent to determine that the regulator and two (2) low pressure alarms are operating properly. The circuit should temporarily be valved off from the nitrogen pressure control unit during these tests but be sure to restore the valve to its normal position upon conclusion of the test.

2.0 FINAL EVACUATION

After all cables, joints, terminators (potheads) and pressure control units have been installed and checked, the entire system should be evacuated.

The vacuum pump is connected to one of the spreaderheads and vacuum readings taken at the opposite end of the line. For long circuits, multiple vacuum pumps can be used at both spreaderheads and intermediate manholes along length of line. In this case, vacuum readings should be taken at all pumping locations.

Evacuation can be continued until a pressure of 250 microns is reached. After reaching 250 microns, the vacuum pump(s) shall be kept running for a minimum of 8 additional hours. At the end of the 8-hour pumping period, the vacuum pump(s) shall be isolated from the system and a 1-hour vacuum drop test run. If the rise in pressure exceeds 250 microns for the 1-hour



period, the entire vacuum treatment and drop test shall be repeated. If the drop test is acceptable, the system is then ready for final filling with nitrogen gas.

3.0 FINAL FILLING WITH NITROGEN GAS

After a proper vacuum drop test has been obtained on the system, the system should be filled with dry nitrogen gas meeting the attached specification. Tube trailers are generally used to provide the large volume of nitrogen needed for the final filling operation. A certified test report showing the nitrogen complies with the specification should be obtained from the nitrogen supplier.

The line should be slowly filled and pressurized at a rate of not more than 25 cubic feet per minute at each filling location. Use of a flowmeter to monitor the gas rate is recommended at each filling location. Admit nitrogen through the valves on spreaderheads or joint casings where there is a wrap of nylon tape over the three (3) cables under the valve openings. This will act as a baffle for the incoming gas flow. After the line is filled and begins to build pressure:

Increase nitrogen pressure to 25 psig and hold for 3 hours minimum.

Increase nitrogen pressure to 50 psig and hold for 3 hours minimum.

Increase nitrogen pressure to 100 psig and hold for 3 hours minimum.

Increase nitrogen pressure to 150 psig and hold for 3 hours minimum.

Increase nitrogen pressure to final 210 psig pressure.

CAUTION;

Adequate ventilation must be provided at manholes into which nitrogen can enter the operations described above. Severe injury or death can result if proper safety procedures are not followed in entering or working in such manholes.

Any questions pertaining to the hookup of temporary equipment or evacuating and filling the system, testing, etc., can be referred to the Okonite Field Advisor and/or owner's Engineering Department representative.

We recommend a 15 minute high voltage DC installation acceptance test be done on the completed system prior to placing it in regular service, as permitted by the AEIC CS2-90 (latest edition) cable specification. The system should be at a minimum of 200 psig nitrogen pressure for a period of at least 24 hours before performing this test.

4.0 PROCEDURE AND SEQUENCE OF OPERATIONS

The instructions given in this manual are intended to cover what might be considered a typical pipe type cable installation. They are not intended to cover every condition which might occur on every installation. It should be recognized that each installation has its own special characteristics and features. Thus, these instructions can be modified or interpreted to cover contingencies at the discretion of the Okonite Field Advisor and/or the owner's Engineering Department representative.



NITROGEN GAS SPECIFICATION

PURPOSE

To specify the various requirements for the nitrogen gas used during installation and for filling of a High Pressure Gas Filled (HPGF) pipe-type cable system.

REQUIREMENTS

The nitrogen gas shall be Type III, produced from air by the liquefaction process, and shall comply with ASTM Standard Specification for Nitrogen Gas as an Electrical Insulating Material D-1933, latest edition and as listed in Table I.

TABLE I

| | |
|-----------------------------|--------|
| Nitrogen, % by volume, min. | 99.993 |
| Hydrogen, % by volume, max. | 0.005 |
| Oxygen, % by volume, max. | 0.002 |
| Dew Point, °F, max. | -75 |

Cylinders shall be charged with a pressure of 2200 psig at 70°F. Under these conditions, the cylinders shall contain 224 cubic feet of free nitrogen at atmospheric pressure. In case the cylinders are delivered at a temperature above or below 70°F, the gauge pressure shall be in accordance with Table II.

TABLE II

| Temperature, °F | Gauge Pressure, Psig |
|------------------------|-----------------------------|
| 0 | 1910 |
| 10 | 1950 |
| 20 | 1990 |
| 30 | 2035 |
| 40 | 2080 |
| 50 | 2120 |
| 60 | 2160 |
| 70 | 2200 |
| 80 | 2240 |
| 90 | 2280 |
| 100 | 2320 |



THE OKONITE COMPANY

Ramsey, New Jersey 07446