

Saudi Electricity Company



الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION

12-SDMS-05

DATE: 02-07-2011

12-SDMS-05

**SPECIFICATION
FOR
OPTICAL FIBER CABLE SPLICING**

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1.0 SCOPE

This specification covers the minimum standards and requirements for water proof type, re-enterable optic fiber cable splice closure kits to be supplied to Saudi Electric Company (SEC).

And provides the general procedures for splicing and splice racking of Optical Fiber Cable.

2.0 CROSS-REFERENCES

This specification shall always be read in conjunction with SEC General Specification No.01-SDMS-01 (latest revision) titled "General Requirements for all Equipments/ Materials", which shall be considered as an integral part of this SDMS. This SDMS shall also be read in conjunction with SEC non metallic fiber OPTIC CABLES specification No.11-SDMS-05 This SDMS shall also be read in conjunction with SEC Purchase Order or Contract schedules and scope of work/technical specifications for projects, as applicable.

3.0 APPLICABLE CODES AND STANDARDS

The latest revision/amendments of the Codes and Standards listed hereunder shall be applicable for the equipment/material covered in this specification. In case of conflict, the vendor/manufacturer may propose equipment/materials conforming to one group of Industry Codes and Standards quoted hereunder without jeopardizing the requirements of this TMSS.

IEC 60793-1-1 Optical Fibers - Part 1-1 : Measurement methods and test procedures- General and Guidance

IEC 60794-1 Optical Fiber Cables - Part 1 : Generic Specification

EIA 440A Fiber Optic Terminology

EIA/TIA 455 Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components

EIA 472 Sectional Specification for Fiber Optic Communication Cables for Underground and Buried Use



ITU-TG.652	Characteristics of a Single-Mode Optical Fiber and Cables
ITU-TG.655	Characteristics of Non-Zero Dispersion-Shifted Single-Mode Optical Fiber and Cables
ITU-TG.656	Characteristics of a fiber and cable with non-zero dispersion for wideband optical transport
ITU-TG.657	Characteristics of Bend Insensitive Single-Mode Optical Fiber.

4.0 MATERIAL, DESIGN & CONSTRUCTION REQUIREMENTS:

4.1 General

4.1.1 High quality fiber optic splices are required to ensure the quality and integrity of communications transmission network which utilizes fiber optic cable as part of its path.

4.1.2 Procedures indicated in this standard in conjunction with fiber optic cable manufacturer's recommendations for installation and splicing of fiber optic cable will ensure that the highest reliability will be achieved in utilizing fiber optic cable as part of a communications network.

4.2 Description

Splice closure for fiber optic cable may be exposed to severe environmental conditions. The splice closure for fiber optic cable shall provide excellent durability and long-term reliability in those severe conditions.

4.3 Reliability

The quality of fiber optic patch cord and connector are critical to reliable optical transmission performance. The product shall be produced with ISO-9001 certified production facilities and quality control system is applied the process from product design to packaging.

4.4 Technical Requirements

4.4.1 Number of capacity shall be up to (96) fibers.

4.4.2 The metal parts of closures shall be resistant to corrosion.



4.4.3 The product components shall withstand the storage temperatures.

4.4.4 The components of the closures shall be free from defects that would adversely affect on product performance.

4.4.5 The splice closures shall allow the accommodation of the fibers with a nominal bending radius of 30mm.

4.4.6 The kits shall contain all the necessary components for a complete installation.

5.0 TESTING AND INSPECTION:

All test results shall be provided for review and acceptance by SEC.

Mechanical, Environmental and Chemical Test Certification

Item	Test Conditions	Requirements
Compression	<ul style="list-style-type: none"> • Condition the closure at -18±2 for 2 hr. • Measure the diameter or vertical dimension. • Apply a weight of 136kg on 2ft² area for 15minutes. • Unload a weight and measure the dim. • Repeat the above procedure at 40±2 . 	No mechanical damage No greater than 1Psi
Cable Torsion	<ul style="list-style-type: none"> • Mount the closure and condition the assembly at -18±2 for 2 hours. • Inner pressure: 6Psi • Twist the cable at 1m±0.03m point • Cycle; CW90°-> CCW180°- 	No mechanical damage No greater than 1Psi Loss variation less than 0.05dB



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	<ul style="list-style-type: none"> >CW90° • Repeat 10cycles. • Repeat the above procedure at 40±2 . 	
Impact	<ul style="list-style-type: none"> • Condition the closure at -18±2 for 2 hr. • Impact a closure using a drop-tube from 100ft • Impact level: 100lbs 	<p>No mechanical damage No greater than 1Psi</p>
Vertical Drop	<ul style="list-style-type: none"> • Condition the closure at -18±2 for 2 hrs. • Drop the closure onto a 1/2inch thick concrete floor from 75cm height 	<p>No mechanical damage No greater than 1Psi</p>
Water resistance	<ul style="list-style-type: none"> • Put the closure into a 20ft depth- water tank for 7days 	<p>No evidence of water intrusion.</p>
Temperature and Humidity	<ul style="list-style-type: none"> • Measure the loss after 3 fiber splicing. • Assemble the closure • Temp. cycle -40~65 , RH 95% • 120Cycle (1cycle is 6 hours) 	<p>No mechanical Impairment</p>
UV Resistance	<ul style="list-style-type: none"> • Prepare 10 test bar • Expose UV lamp: 8 hours 65 	<p>No reduction of tensile strength Greater than 20%</p>



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Chemical resistance	<ul style="list-style-type: none"> • Inner pressure: 6Psi • solution: pH2 HCL, NaCl, 10% IGEPAL • Submerge for 120hours into the solution. 	No corrosion of mechanical
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6.0 PACKING AND SHIPPING:

6.1 Packing and shipping shall generally be as per SEC General Requirements 01-SDMS-01, latest revision.

6.2 Marking:

6.2.1 All components of splice closures shall be packed with a complete kit containing all components necessary for installation. Each item shall be covered with protective materials to prevent scratching or damages during shipping or storage. Complete assembly and installation instructions in English shall be provided with each packaged unit. The final shipping box shall have sufficient strength and durability to protect the contents in the process of handling during storage and shipping by land, sea, or air.

6.2.2 Each hard box shall be printed with the following information:

- a) Purchase order number/tender
- b) splice closures catalogue number
- c) Manufacturer's name
- d) Year of manufacture
- e) SEC item number

6.2.3 Each wooden box shall be fixed with an aluminum plate bearing the following information:

- a) Purchase order number/tender
- b) Manufacturer's name
- c) Year of manufacture
- d) splice closures catalogue number
- e) Gross weight in kilograms (pounds)



7.0 OVERVIEW

7.1 Core Alignment

When splicing optical fibers, it is essential that the cores should be aligned so that as much light as possible travels from one fiber to the next, see Figure 3.

7.2 Splice Loss

7.2.1 The following explains the way, due to which splice loss is affected by factors controlled by the:

7.2.1.1 Fiber Manufacturer

- a. Different core diameters (Figure 4)
- b. Cores not in the center of the fiber (Figure 5)
- c. Noncircular cores (Figure 6)

7.2.1.2 Cable Splicer

Fiber ends that are improperly cleaved before splicing, including:

- a. Angled ends (Figure 7a)
- b. End spurs (Figure 7b)
- c. Fracture on chipped ends (Figure 7c)

NOTE: A properly cleaved end shall be vertical. (Figure 7d)

- d. Not keeping the fiber ends clean.

NOTE: The fiber ends must be free of dust or other particles that can block light from being coupled from one fiber to another fiber.

8.0 PRECAUTIONS

8.1 Safety Guidelines

8.1.1 Avoid damaging the cable during handling, making sharp bends, and crushing the cable.

8.1.2 Any damage may change the transmission characteristics to the extent that



the cable section must be replaced.

- 8.1.3 Observe all safe practices for work location setup, placing warning signs and all other safety devices.

8.2 Handling Glass Fiber

- 8.2.1 Scrap pieces of fiber are dangerous if mishandled and can penetrate the skin. therefore, all scrap pieces of bare fiber shall be cleaned up by using the sticky side of a piece of tape to pick up and discard any loose ends in a container or disposed of in safe-place.
- 8.2.2 After the protective coating has been removed from the fiber, the bare glass fiber shall be handled very carefully to avoid introducing flaws and breaking or scratching the fiber surface.

CAUTION: Wear safety glasses and gloves when handling glass fibers. Do not view open-ended fibers with the naked eye or a magnifying glass.

8.3 Pulling Tension and Bending Radius

The maximum pulling tension and maximum bending radius shall be in accordance with manufacturer's recommendations.

9.0 PREPARING THE CABLE

9.1 Introduction

- 9.1.1 Each cable design suits different installation requirements (i.e., duct, aerial, direct buried, nonmetallic). Therefore, cable end preparations differ slightly from cable to cable.
- 9.1.2 In addition to the normal splicing tools, the following may be required:
- Optical Fiber Splicing Kit
 - Lint free tissue
 - Isopropyl alcohol
 - Approved cable cleaner
 - Means of communications
 - Approved mechanical stripping tool (to remove fiber coating)



9.2 Cable Preparation Procedure

9.2.1 A typical cable preparation procedure is listed below:

9.2.1.1 Use the engineering design construction print to determine the length of cable required for racking, splicing and slack.

9.2.1.2 Use side cutters, cut the cable at the appropriate mark to remove excess lap.

9.2.1.3 Record the footage and/or meter markings on the engineering construction prints.

9.2.1.4 Determine the length of cable jacket to be removed for splicing.

9.2.1.5 Mark the length with tape, see Figure 8.

9.2.1.6 Based on the kind of cable used, follow the steps listed below:

9.2.1.6.1 If the cable contains a rip cord, then:

- a. Ring cut the cable jacket 125 to 150 mm (5 to 6 inches) from the end.
- b. Pull off the cable jacket to expose the rip cord.
- c. Using the rip cord, slit the jacket to the mark.

9.2.1.6.2 If the cable does not contain a rip cord, then:

Slit the cable jacket using an approved sheath splitter.

CAUTION: Do not cut into the cable core and do not damage any buffer tubes.

9.2.1.7 Peel back and cut off the jacket at the end of the slit.

CAUTION: Be sure to avoid cutting, kinking, bending, or crushing the exposed buffer tubes.

9.2.1.8 Remove the binder tape, and secure the cable, being careful not to crush or deform it in any way.



9.2.1.9 Carefully unstrand the buffer tubes one by one.

9.2.1.10 Cut off all but 380 mm (15 inches) of the central strength member.

9.2.1.11 Soak a paper towel or rag with cable cleaner.

9.2.1.12 Wipe each buffer tube to remove all the filling compound.

NOTE: Filling compound left on the tube can cause poor splices if it gets on the splicing equipment or bare fiber ends.

9.2.1.13 Inspect each tube for such things as kinks, cuts and flat spots.
If any damage is visible:

- a. Remove an additional length of cable jacket.
- b. Cut off all buffer tubes at the point of damage.

9.2.1.14 Repeat the entire procedure for the cable end.

10.0 SPLICING THE CABLE

10.1 Before Splicing

Before beginning the splicing operation:

10.1.1 Secure the cable in an optical fiber organizer. For instructions on the organizer and splice closure being used, refer to Section 7.0 of this standard.

10.1.2 Take care to avoid damage when bending the buffer tubes and fibers into the organizer.

10.1.3 When metallic sheath is used, bond and ground the cable sheath only at the required splice points, and other points as directed by SEC concerned department.

NOTE: Measured ground resistance must be 25 ohms or less.

10.1.4 For all splices of fiber optic cables within SEC, only Fusion Type Splices



which are completed using a Fusion Splicing Machine (which is acceptable to SEC) , shall be performed.

Mechanical type fiber optic splices is not acceptable to SEC.

10.2 Splicing Configurations

10.2.1 Set the cables up in a straight splice configuration, see Figure 9.

10.2.2 Set the cables up in a butt splice configuration, see Figure 10.

10.3 Splicing Procedures

10.3.1 Once preparations are complete and the splicing equipment set up, begin the splicing operation as described in the instructions for the splicing equipment being used and appropriate outside plant telephone cable practices.

10.3.2 The following procedure applies to approved fusion splicing methods:

10.3.2.1 Remove the appropriate length of buffer tube using an approved buffer stripper.

10.3.2.2 Use a tissue soaked in isopropyl alcohol to wipe the coated fiber clean of any filling compound.

10.3.2.3 According to the splicing method, determine:

- a. How much of the coating to remove
- b. The removal method

NOTE: - Use an approved coating stripper for a 250 micron coating on a one (1) millimeter tight buffer.

10.3.2.4 Before cleaving, wipe the fiber twice with a new tissue dampened with 90% grade alcohol, or a cleaning solvent approved by the fiber optic cable manufacturer. The cleaning will remove any coating debris from the stripped fiber.

CAUTION: To minimize damage to the bare fiber, avoid excessive wiping (more than five (5) times).

10.3.2.5 Cleave the fibers using an approved cleaving tool.



NOTE: Do not use hand scribes for checking.

10.3.2.6 After cleaving, if required, wipe the fiber as in paragraph 10.3.2.4 above.

CAUTION: Avoid excessive wiping.

10.3.2.7 Proceed with fusion splicing, using an approved fusion splicer.

10.4 Removing the Buffer Tube

10.4.1 When removing the buffer tube, proceed according to the directions below:

10.4.1.1 Using a scrap piece of buffer tube containing fiber, determine the (gauge) setting that will cut the buffer tube without damaging the fiber coating.

NOTE: Do not remove more than 460 mm (18 inches) at one time.

10.4.1.2 The preferred method to remove the buffer tube is through use of a buffer tube stripping tool recommended by the fiber optic cable manufacturer. However, if the recommended buffer stripping tool is not available, removal of the buffer tube will be accomplished using either a stranded wire stripper, or a coaxial cable cutter.

10.4.1.2.1 If buffer tube stripping tool is recommended by the manufacturer, follow the directions for stripping the buffer tube provided by the manufacturer.

CAUTION: Do not pull the buffer tube off with the tool.

10.4.1.2.2 If you are using a Stranded Wire Stripper, then

- a. Cut perpendicular to the buffer tube.
- b. Lay the tool aside.
- c. Pull the buffer tube off by hand, being careful not to damage the internal fiber optic cable during the pulling process.



CAUTION: Do not pull the buffer tube off with the tool.

10.4.1.2.3 If you are using a Coax Cable Cutter, then:

- a. Place the tool over the buffer tube.
- b. Rotate the tool one(1) to two(2) turns.
- c. Lay the tool aside.
- d. Remove the buffer tube by hand.

CAUTION: Do not let the tool drops onto the fibers.

10.4.1.3 Repeat the procedure until the desired length of buffer tube has been removed.

10.5 Typical Underground Splicing Arrangements

Two types of set-up are used for underground cable splicing arrangements. They are the:

- a. Straight splice (Figure 11).
- b. Butt splice (Figure 12).

NOTE: Fusion splicing is performed out of the manhole in a controlled environment. In all cases, maintain the minimum bending radius.

11.0 FIBER OPTIC SPLICE ORGANIZER DESCRIPTION AND INSTALLATION INSTRUCTIONS

11.1 Scope

11.1.1 This section provides and gives instructions for installing fiber optic organizer.

11.1.2 When working in the area of energized lines, take extra care to prevent from accidental electric contact.

11.1.3 For proper performance and personal safety, be sure to select the proper size product and follow the safety instructions.



11.2. General

11.2.1 The Fiber Optic Organizer is designed to help organize the optical fibers.

11.2.2 The Fiber Optic Organizer is designed to facilitate the splicing operation and store the surplus fiber.

11.3 Preparing Fiber Optic for Installation

11.3.1 Refer to the manufacturer's literature for information concerning fiber optic cable measurement and preparation.

11.3.2 For information concerning end plate hole cutting and cable application, refer to manufacturer's manuals.

11.3.3 The following provides preparation tips for splicing fiber optic cable:

11.3.3.1 If strength members need positioning, be sure to cut the cable entry hole in the endplate for a position some what below the mainframe.

11.3.3.2 If metallic members are present, place a temporary bonding jumper across the splice opening, when splicing armored cable as a safety precaution.

11.3.4 Remove enough of the fiber optic cable jacket to expose approximately 2.08 m (82 inches) of the buffer tube.

11.4 Installing Fiber Optic Organizer

This section provides guidelines and general instructions for installation of a fiber optic organizer. Also, refer to the splice organizer/splice case manufacturer's specific instructions to cover the specific installation detail of his product.

11.4.1 Positioning the Mainframe Assembly

To position the mainframe assembly, proceed according to the instructions below:

- a. Position the mainframe assembly between the torque bars of the splice case.
- b. Position the mainframe assembly offset slightly to the left or the right center.



- c. Place the four (4) fasteners (holding clips) in the groove of the mainframe over the flat portion of the torque bars.

NOTE: Where necessary, remove and discard the plastic tubing from the torque bars.

11.4.2 Centering and Securing the Mainframe Assembly

To center and secure the mainframe assembly, proceed according to the instructions below:

- a. Center the mainframe between the splice case and plates.
- b. Slide all fasteners away from the center so they lock into the offset of the torque bars.

11.4.3 Positioning the Buffer Tubes

To position the buffer tubes, proceed according to the instructions below:

- a. Route the buffer tubes into mainframe assembly.
- b. Loop the buffer tubes around the studs so that a sufficient amount of excess fiber slack is taken up.
- c. Secure the buffer tubes to the mainframe with the buffer clips.

NOTE: Because of the holding capabilities of the end plates, additional fastening is not required for the outer sheath.

11.4.4 Positioning the Strength Member

If there is a strength member to be mechanically joined:

- a. Route it underneath the mainframe.
- b. Use a suitable connector.

11.4.5 Exposing the Fiber Needed



To expose the amount of fiber needed, proceed to the instructions below:

- a. Place the splice tray assembly onto the studs that extend from the mainframe assembly.
- b. Lay the buffer tube on to the splice tray.
- c. Check to make sure the location is correct.
- d. Check to make sure that enough fiber is exposed.
- e. Remove approximately 915 mm (36 inches) of buffer tube so there is a sufficient glass fiber for splicing and splice tray placement.

11.4.6 Positioning and Securing the Buffer Tube

Proceed according to the instructions below, to properly position and secure the buffer tube:

- a. Thoroughly clean the buffer tube from any grease, etc. for a width of 50 mm (2 inches) from the glass fiber.
- b. Cut 16 mm to 19 mm (5/8 to 3/4 inch) section of foam type.
- c. To properly cushion and secure the buffer tube, apply the foam tape around the section of buffer tube that has been cleaned.
- d. Position the foam tape covered section of buffer tube onto the end of the splice tray assembly so that it lies between a set of cable tie holes.
- e. Insert a cable tie through both holes and secure the cushioned buffer tube.

NOTE: The locking section of the cable tie must be on top of the tray.

- f. Lead the glass fiber into the splice tray assembly.
- g. To take up the fiber slack, use a maximum radius and loop the glass fiber around the tray inside the retainer walls.

11.4.7 Securing the Splice and the Fiber Slack



To secure the splice and the fiber slack, proceed according to the instructions below:

- a. Place a small drop of the ultraviolet adhesive into one section of the grooved splice block.
- b. Apply a protective cover over the spliced area.
- c. Position the spliced area into the grooved splice block section treated with ultraviolet adhesive.

NOTE: Carefully use thumb pressure to secure it.

- d. Secure the fiber slack inside the splice tray with vinyl tape strips.

12.0 INSTALLATION

Cable splice closures shall be installed in accordance with the manufacturer's instruction unless otherwise directed in this Standard.

13.0 TESTING AND INSPECTION

All quality assurance (QA) inspections shall be done by a qualified Communication Inspector. All splice closures shall be tested and inspected for proper seal.

14.0 CONFLICTS AND DEVIATIONS

14.1 In case there are conflicts between this Standard and other relevant SEC Engineering Standards, SEC Materials Standard Specifications (SDMS), SEC Standard Drawings and Industry Codes & Standards, SEC concerned department shall be consulted and a ruling in writing shall be obtained.

14.2 Any exceptions or deviations to the minimum requirements of this Standard require written approval from the SEC concerned department.

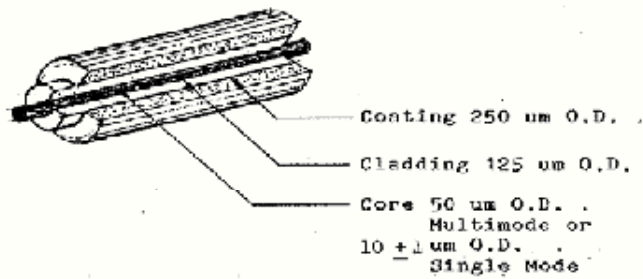


FIGURE 1: FIBER OPTIC CABLE COMPOSITION



FIGURE 2: SINGLE MODE FIBER OPTIC CABLE

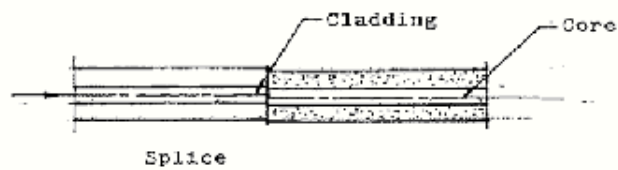


FIGURE 3: CORE ALIGNMENT

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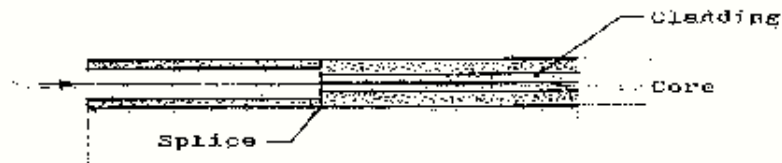


FIGURE 4: DIFFERENT CORE DIAMETER



FIGURE 5: CORES NOT IN THE CENTER OF THE FIBER

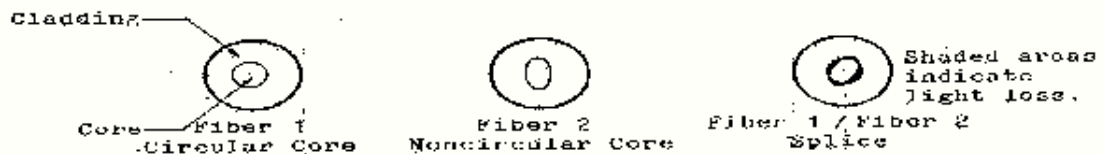


FIGURE 6: NONCIRCULAR CORES

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FIGURE 7a: ANGLED ENDS



FIGURE 7b: END SPUR

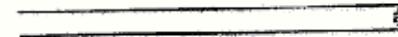


FIGURE 7c: FRACTURED OR CHIPPED END

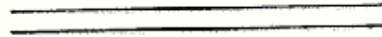


FIGURE 7d: VERTICAL ENDS

FIGURE 7: FIBER ENDS THAT ARE IMPROPERLY CLEAVED BEFORE SPLICING

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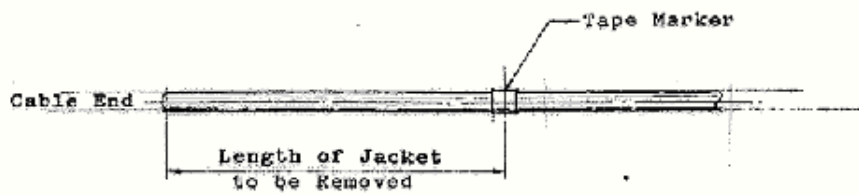


FIGURE 8: MARK THE LENGTH WITH TAPE

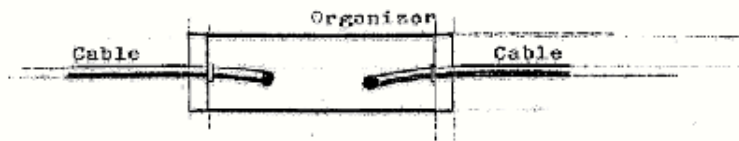


FIGURE 9: STRAIGHT SPLICE CONFIGURATION

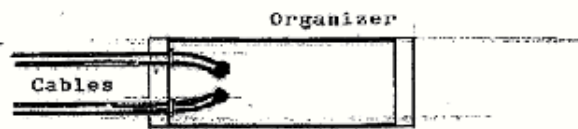


FIGURE 10: BUTT SPLICE CONFIGURATION

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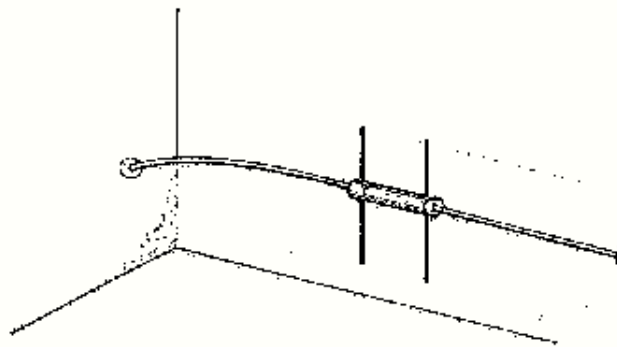


FIGURE 11: STRAIGHT SPLICE

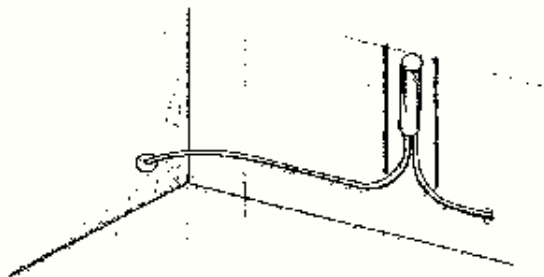


FIGURE 12: BUTT SPLICE

TYPICAL UNDERGROUND ARRANGEMENTS

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