SECTION I

CABLE WORKS

2.1 Design Concept

2.1.1 General

2.1.1.1 The local telephone cable network shall be designed carefully based on the fact that it involves on major portion of investment on the telecommunication network.

2.1.1.2 The design work shall aim at optimum plant provision taking quality, flexibility, reliability, practicability, economy and maintainability into consideration.

2.1.1.3 The design work shall be based on field survey, corresponded to various conditions and external environment in the coverage area concerned, and shall base as much as possible on the attached detailed drawings.

2.1.2 Cable Facilities

2.1.2.1 For distribution system on the local cable network; cross-connecting cabinet shall be proposed at the appropriate position in the distribution area to be served by it. Cables in the cabinet are generally classified with either Primary cable connected with Exchange, or Secondary cable connector with DP sections.

2.1.2.2 For security purpose or in the closed vicinity area from the exchange office, the cable may be directly distributed to the distribution point.

2.1.2.3 Cables to be placed and installed shall be applied in consideration of the following

(1) Type of Cable

1) Duct:	Fully Filled Foam Skin Polyethylene insulated, Aluminum laminated sheathed Unarmored paired cable
2) Direct buried:	Fully Filled Foam Skin Polyethylene insulated, Aluminum laminated sheathed armored-paired cable
3) Aerial:	PE sheath and air-core solid Polyethylene insulated air-cored paired self-supporting cable

Table 2 Cable Size

Type	Conductor Gauge	Cable Pairs
Duct Cable	0.4mm	2400,2000,1600,1200,1000 800,600.400,300,200 100,50,30,20,10
	0.5mm	1600, 1200,1000,800,600, 400,300,200,100,50, 30,20,10
	0.6mm	800,600,400,300,200,100, 50,30,20,10
Buried Cable	0.4mm	200,100,50,30,20,10
	0.5mm	200,100,50,30,20,10
	0.6mm	200,100,50,30,20,10
Aerial Cable	0.4mm	100,50,30,20,10
	0.5mm	100,50,30,20,10

2.1.2.4 The cable conductor gauges for local cable network shall be determined in consideration of the following stipulated values, and as far as the design is concerned.

A) DC Loop Resistance Limitation: 1,500 ohms

(Direct line)

b) Reference Equivalent Limitation

Under 800Hz: 7 dB (direct line)

2.1.2.5 Primary cable as a rule shall be installed in underground ducts.

2.1.2.6 Regarding Secondary cable, the steel armored cable shall be directly buried under the ground, whereas the aerial cable shall be installed on wooden poles.

2.1.2.7 The two (i.e. 0.4mm and 0.5mm) gauges are applicable for subscriber loops i.e. the primary and secondary cables.

2.1.2.8 Cable units distributed to each cross-connecting cabinet along the primary cable route shall be grouped together by each conductor gauge on the way from the farthest side on the primary cable route to the telephone exchange.

2.1.2.9 Cable pairs distributed to each distribution box shall be grouped to the cross-connecting cabinet from the farthest side of Secondary cable route.

2.1.2. 10 A cross-connecting cabinet area shall be served by a single cabinet. The selection of the cabinet location as a rule shall be nearer to the telephone exchange in the area.

2.1.3 Transfer of Subscribers

2.1.3.1 all transfer of Subscribers to the new DP’s and recovery of unused line material will be done by the contractor.

2.2 Installations and Construction Standard

2.2.1 General

2.2.1.1 Installation/construction of the outside plant shall be carried out in accordance with Specifications provided herein.

2.2.1.2 Other installation/construction details not specified in this section shall be governed by the Contractor's own technical specifications, subject to the approval of ETC.

2.2.1.3 The Contractor shall be responsible for any claims or damages due to his implementation of work.

2.2.1.4 Safety guards and other proper warning devices shall be provided at all times, particularly during cable laying and splicing at any location, also placed in such manner as to warn vehicles and pedestrians in advance of an obstruction laying ahead.

2.2.1.5 The Bidder shall state details in relation to "Safety Procedure" during installation in his Tender Proposal.

2.2.1.6 The Contractor shall obtain all the necessary permissions from authorities concerned prior to the installation. ETC will cooperate with the Contractor in obtaining the required permissions.

2.2.1.7 The sidewalk shall be occupied as right-of-way for all facilities in principle, unless the occupancy is problematic due to:

1) The difficulty of excavation because the side-walk has already been occupied by other underground utilities; and

2) The existence of obstructions in or on the sidewalk.

The carriageway of roads shall be applied as right-of-ways in inevitable cases. Private premises or lands shall never be applied as right-of-ways except that the occupancy is inevitable considering utilization of existing facilities. Permission can be sought from the owner.

2.2.1.8 The joint construction shall be taken into account. Prior to the construction, advance planning and close coordination with parties involved shall be required for the successful operation.

2.2.1.9 All materials provided by the Contractor for this Project shall be brand new and firsthand, and shall comply with Equipment Specifications unless otherwise instructed by ETC.

2.2.1.10 Cable drum shall be rolled in the direction as indicated on drums. Cables shall not be dragged on the ground, over fences, walls or any other abrasive objects. Cable shall be drawn out from the cable drum at the time to install.

2.2.1.11 Cable must not be bent with a radius less than Ten (10) times of the outer diameter of the filled cable. Precaution shall be taken to prevent slippage of the cable sheath over the core.

2.2.1.12 In case that the damaged cable is discovered before or during installation, or tests or observations after installation, the Contractor shall inform immediately to ETC. The damaged cable section shall be repaired or replaced promptly at the expense of the Contractor. Cable found faulty after being pulled into a duct shall be replaced with a new undamaged cable.

2.2.1.13 When the cable sheath is opened, the cable core shall be protected to prevent the ingress of moisture. If splicing or other work has to be interrupted, the cable core shall be effectively sealed by an approved method.

2.2.1.14 Cable placing shall be arranged in such a manner that the number of splice closures can be minimized.

2.2.1.15 Cable shall be always delivered to the site with reeling on cable drums.

2.2.1.16 ETC will at any time when deemed necessary during the construction periods, carry out inspections and/or tests on the facilities under construction and/or the portions of facilities completed by the Contractor.

2.2.1.17 Should any errors in constructions, faulty materials and goods and other evidences of unsatisfactory construction and installation be discovered in the course of such inspections and/or tests, the Contractor shall repair, replace and/or remedy immediately such unsatisfactory items.

2.2.2 Direct Buried Cable Installation

2.2.2.1 Description for buried cable installation

1) Direct buried cables are placed as follows:

a) Buried directly under the ground without mechanical protection

b) Buried in excavated trenches with mechanical protection by PVC ducts, where the cable is crossing to or placed under carriageways, and when the normal covering depth cannot be obtained.

2) The installation works can be categorized mainly as follows:

a) Digging and excavating to make a trench.

b) Placing sand bed.

c) Placing a buried cable in the trench.

d) Placing sand covering.

e) Placing concrete slabs.

f) Placing a warning tape.

g) Back filling of the trench.

h) Mechanical protection, where necessary.

In addition to these works, incidental works are as follows:

i) Mechanical protection for splice closure.

j) Installation of buried cable entrance to manhole and hand hole.

k) Marking post for splicing portion or at the bending run.

L) Placing the cable at riser portion and its protection including the distribution.

2.2.2.2 For secondary cables, direct-buried system shall be applied, in principle.

2.2.2.3 Splicing portions shall be protected by suitable concrete plates or equivalents.

2.2.2.4 Splicing shall be carried out immediately after the cable placing. If this is impracticable, the

cable end shall be sealed with suitable caps.

2.2.2.5 Cable shield shall be electrically continuous throughout an entire cable route.

2.2.2.6 The Splicing point shall be recorded by offset lines on the as-built drawings and marked by the mark post.

2.2.2.7 The minimum depth from the ground of the directly buried cable at normal condition is 0.8m.

2.2.3 Duct Cable Installation

2.2.3.1 Ducts shall be of PVC Pipes.

2.2.3.2 Ducts shall be roded by an acceptable method and cleaned before cables are pulled in. Duct cables shall be pulled in after completion of the Acceptance Test of chambers and ducts, in case that they are newly installed.

2.2.3.3 Duct cables shall be pulled into ducts with sufficiently slippery methods. The pulling tension shall be constantly checked so that the cable will be pulled within allowable pulling tension to be specified by the Contractor.

2.2.3.4 Duct assignment shall always be done carefully so as to avoid crossovers between the duct entrance and cable bearer, and blockage of future access to vacant ducts. Placing shall always start at the bottom row and chamber wall side of the duct arrangement in principle.

2.2.3.5 The distance between two manholes or hand holes should not be more than 200m.

2.2.2.6 Cables shall be placed in chambers or cable vaults/trenches in such a manner that they do not block vacant ducts and/or restrict the working space.

2.2.3.7 Duct cables shall be placed as to be directed from MDF to Cross-Connection Cabinets. Such cables shall be reeled with due regard to the placing direction at the site.

2.2.3.8 Splicing shall be carried out as soon as possible after placing of cables.

2.2.3.9 Cable shield shall be electrically continuous throughout an entire cable route. Cable shield shall be bonded to the exchange grounding system.

2.2.3.10 In every chamber, each cable shall be provided with the cable identification tags or stencils on which the cable type, gauge, cable name, name of manufacturer and the date of installation shall be indelibly inscribed.

In a chamber where the cable is spliced, the cable identification tag shall be provided on the cable at both sides of the splice closure. In case where cable is pulled through without splicing in the chamber, one (1) cable identification tag shall be provided on the cable.

2.2.3.11 Upon the completion of placing and setting up cables in the cable vault/trench and adjacent chambers of the cable vault/trench, ducts occupied with cables shall be sealed in such a manner as to be water-tight. Vacant ducts in the cable vault/trench shall be plugged with rubber plug or equivalent.

2.2.4 Aerial Cable Installation

2.2.4.1 Aerial Cable route is composed of mainly aerial cables, guys or braced poles, and other accessories, which shall meet individually the requirement Specified in Equipment Specifications. Serial cable route shall be arranged to keep the standard of pole span and sag as mentioned in clause 2.2.4.2. And shall be so designed as to be limited in the design strength, even under the worse environmental condition, stipulated in clause 2.2.4.2.

Aerial Cable shall be regularly suspended at 50 cm from the top of each pole. The cable may also be suspended at not less than 30 cm from the top in consideration of vertical clearance of

cable line.

2.2.4.2 Environmental and Physical Requirements for aerial cable routes are as follows:

(1) Wind Pressure

Transversal wind pressure of forty (40) kg per square meter of projected area on pole facility's surfaces, fifty (50) kg per square meter on cylindrical surfaces.

Such as cables and wires, and eighty (80) kg per square meter on flat surfaces, shall be assumed.

(2) Temperature

The temperature shall be considered to be 10^0C at the time of maximum loading. The maximum ambient temperature shall be assumed as 45^0C in the design of sag under this condition.

(3) Standards of pole span and sag

1) Pole Span

The optimum pole span shall be approximately forty (40) meters and shall not exceed 50 meters without any strengthening measure for keeping the specified strength.

2) Allowable sag

Allowable sag of an aerial cable installed shall be limited to less than 0.8 meters at 45 ^{o}C in ambient temperature under windless situation.

(4) Minimum Clearance

The minimum clearance between ground surface and the aerial cable installed shall be at least 4.5 meters along the road and 5.5 meters at road crossings.

2.2.4.3 Shield of the cable shall be electrically continuous throughout the entire cable route.

2.2.4.4 Suspension strand shall be electrically continuous throughout its entire length.

2.2.4.5 Bonding and Grounding of Aerial Cable.

(1) The suspension strands shall be bonded to the cable shield every 300-500 meters and shall be grounded at the interval of approx. 1 km.

(2) The suspension strands shall be bonded to each other at each crossover and branch point.

(3) The distribution boxes mounted on poles shall be bonded to the strand.

(4) The suspension strand and the cable shield shall be bonded to shield of underground/buried cable and grounded at aerial-underground junctions and at end of aerial line (last pole).

2.2.4.6 Splicing shall be carried out immediately after placing the cable. The splices shall in all cases be situated in the vicinity of pole.

2.2.4.7 Cable guards shall be applied over the cable at points of potential abrasion such as locations where tree trimming is not permitted.

2.2.4.8 adequate anti-dancing method for aerial cable shall be taken into account.

2.2.4.9 Minimum separations from the Cable are as follows:

Power Cable Voltage	Minimum Separation
< 600Volts	60 cm
600-7,000Volts	120 cm
7,000-15,500Volts	200cm

2.2.4.10 Guy

(1) When the guy is installed at the private land, the Contractor shall obtain permission from the owner of the land prior to installation.

(2) The lead/height ratio of guys shall not be less than 0.7.

(3) Overhead guy shall be used at location where site conditions do not permit the use of a guy or the lead/height ratio of guy is less than 0.7

(4) The overhead guy requires the setting-up of an extra pole suitably located and guyed. A steel strand shall be placed between the poles and tightened in the suitable way.

(5) The hole for anchor rod for guying shall be dug to a depth of approximately 1.5m.

(6) The anchor rod shall be installed in line with the guy. The eye of the rod shall be above the ground surface.

(7) A concrete block or its equivalent shall be applied to an anchor.

(8) Electrical continuity shall be maintained between the guy wires and the cable suspension strand(s), except electrically insulated guys.

(9) Guys shall be electrically insulated at crossings with overhead power lines.

(10) Guy guards shall be attached to the guys installed at locations where they cause hazard to vehicles and pedestrians.

2.2.5 Pole Installation

2.2.5.1 The Contractor shall mark the location where to set-up wooden poles upon approval of authorities concerned, prior to installation.

2.2.5.2 wooden poles shall be handled with care.

2.2.5.3 The length of the wooden pole to be mounted with the distribution box shall be of 8.0 meter (with top diameter 140 - 170mm) as per standard, if nothing interferes.

2.2.5.4 Pole holes to be excavated shall be of sufficient diameter to permit proper compaction of the backfill at every point around the pole foot and throughout the entire depth of the hole.

2.2.5.5 The shape of pole hole shall be cylindrical. The stepped or conical hole may be applied only with attaching under-brace to the pole.

2.2.5.6 The depth of setting poles shall be one-sixth of the pole length as per standard.

2.2.5.7 Backfill shall be thoroughly compacted to the full depth of the hole.

2.2.5.8 Poles shall be set up at following locations not to cause obstruction to vehicles and pedestrians. Existing poles shall be utilized only for drop wiring, if applicable.

1. Where sidewalk exists: the premises side on the sidewalk.
2. Where no sidewalk exists: the edge of road
3. Where the power line already exists: as per 2.2.4.9

2.2.5.9 Poles shall be marked following information at three (3) meter above the bottom;

1. Species code
2. Year of preservation treatment.
3. Length of pole in meter

2.2.5.10 Existing wooden poles shall be re-used, if the location of existing pole is available for the installation of new drop wires.

2.2.6 Local Cable Termination at MDF

2.2.6.1 Primary and/or Secondary cable shall be spliced with moisture damming to the tip cable at the cable vault/trench as per standard.

2.2.6.2 The tip cable shall be terminated to the main distributing frame (MDF) in alphabetical or numerical order of the cable name.

2.2.6.3 The termination splice, in principle, shall be horizontally mounted in the cable vault and/or cable trench.

2.2.6.4 The shield of cables shall be bonded to the grounding system of the exchange by the suitable method approved by ETC.

2.2.6.5 Pairs in the tip or termination cable to be connected to the terminal on MDF shall be fixed by adequate means, so as not to be loosed easily.

2.2.7 Cross - connection Cabinet Installation

2.2.7.1 The capacity of cross - connection cabinets shall be three types as for 1,200 cable pairs, for 1,800 cable pairs and for 2400 cable pairs.

2.2.7.2 The maximum capacity of the standard cabinet plan shall be of 500 primary cable pairs and 700 secondary cable pairs for 1,200-cable pairs type, 800 primary cable pairs and 1,000 secondary cable pairs for 1,800-cable pairs type also of 1000 primary cable pairs and 1400 secondary cable pairs for 2400 cable pairs type.

2.2.7.3 The capacity of the terminal block shall be for 100 cable pairs. In case of terminal block, without stub cable type shall be applied.

2.2.7.4 Cross - Connecting cabinet shall be placed on the side- walk away from the carriage way in principle. Locations shall be carefully determined so as to minimize the public inconvenience and to avoid damages to cabinets by the third party.

2.2.7.5 Permission for the installation of cabinets on the right - of - way shall be acquired from authorities concerned prior to placing the cabinet at the site.

2.2.7.6 Cabinets to be installed in open area shall be protected from traffic by suitable guards.

2.2.7.7 The height of the cabinet foundation shall be 0.50 m above the level of the road as a standard.

2.2.7.8 The Cabinet foundation shall be set up horizontally and along the road.

2.2.7.9 The cabinet shall be firmly bolted to the foundation.

2.2.7.10 The 1,200, 1,800 and 2400 cable pairs type of cabinet shall be connected with chambers by four (4) PVC pipes, which have 110 mm nominal outer diameter and 5.5 mm in wall thickness.

2.2.7.11 The suitable grounding rod shall be installed for the cabinet grounding. Cabinet shall be bonded to the grounding rod. The depth of grounding rods measured from top of the rod to the ground surface shall be more than 50 cm.

2.2.7.12 PVC pipes whether are vacant or occupied shall be sealed at both cabinet end and manhole end by rubber caps, waterproof compounds or other adequate materials.

2.2.7.13 Shields of all cables terminated in the cabinet shall be bonded to the grounding tag of the cabinet or grounding rods.

2.2.7.14 Following items shall be durably stenciled on the cabinet door:

A. Abbreviation of Ethiopian Telecommunications Corporations “ETC”

B. Authorized abbreviation of the exchange name.

C. Cabinet number with four digits.

2.2.7.15 The durable cabinet card shall be attached to the inside of the cabinet. The format of cards shall be specified in Paragraph 1.6 in Section 1 and clause 2.4.3 in Section 2.

2.2.8 Distribution boxes Installation

2.2.8.1 Distribution boxes to be installed shall be classified as follows:

1) Pole - mounted type used for direct burial and aerial applications.
2) Wall - mounted type used for direct burial and aerial applications on the wall of buildings.
3) Indoor type used for the termination inside of the building.

2.2.8.2 The capacity of distribution boxes shall depended on the required cable pair to accommodate active subscribers. For pole types, the capacity shall be for 10 cable pairs each. For wall types, the capacity shall be for 10 and 20 cable pairs. As for indoor types the capacity shall be for 20, 30, 50, 100, 200 and 400 pairs.

2.2.8.3 All Distribution boxes shall be without stub cable type.

2.2.8.4 In case of the termination to the indoor type distribution box, the contractor shall submit the detail of the installation method so as to stop the jelly to flow out from the inside of distribution cable.

2.2.8.5 All distribution boxes shall be electrically bonded to the secondary cable shield.

2.2.8.6 Distribution boxes shall be firmly fixed on pole or wall by means of suitable method.

2.2.8.7 When installing the distribution box on the wall or inside of the building, the contractor shall install upon obtaining permission from the building owner prior to the installation.

2.2.8.8 The following items shall be clearly and durably stenciled on the cover of distribution boxes.

A. Name of Exchange in authorized abbreviation
B. Cabinet number (XX 4 digits)
C. Distribution box number (YY ... 2 digits)

2.2.8.9 Only the distribution box number shall be durably put on the cover of distribution boxes by the distinct color paint so as to be visible from far. The numbering of distribution boxes shall be given sequential numbers in each cross - connecting cabinet distribution area.

2.2.8.10 Pole type distribution boxes shall be placed on pole, side of direction to the cabinet at a location higher than 4.5 m above the ground.

2.2.8.11 The rise portion of secondary cables to the pole type distribution box shall be bonded to the pole with anti corrosive steel band at intervals not exceeding 1.0 m.

2.2.8.12 Wall type distribution boxes shall be placed at a location higher than 2.3 m from the ground, wherever possible.

2.2.8.13 Where the secondary cable is terminated to the pole or wall-type distribution box, the shield of the cable shall be bonded to the pole or wall-type distribution box, and grounded at ends of each aerial cable route.

2.2.8.14 The indoor type distribution box shall be installed at the location inside of the building subject to the owner, and the shield of cables shall be grounded and bonded to the grounding tag of the distribution box.

2.2.8.15 The location of indoor type distribution box shall be dry and provided with good illumination. Working clearance shall be 1.2 m in front of the distribution box and at least 0.3 on each side of the box.

2.2.9 Cable Splicing

2.2.9.1 For cable conductor splicing, the mechanical splicing method that requires no special skill shall be applied instead of conventional manual twisting.

2.2.9.2 For buried cable splicing, the heat-shrinkable joint closure system shall be used for this project and shall provide environmental and mechanical protection.

2.2.9.3 The system shall consist of a wraparound; heat-shrinkable, hot-met precoated sleeve combined with a supporting liner. The joint closure shall be either re-enterable or removable for joint re-arrangement or cable addition. Reclosure shall be done using a wraparound re-entry kit or a new closure.

2.2.9.4 All cable splicing works shall be performed in strict conformity with the standards and/or practices approved by ETC. The Bidder shall submit details of splicing method and splices closure in this connection.

2.2.9.5 Splice portion shall have sufficient strength to withstand vibrations and tensions. Re-enterable compound shall be filled into the closure.

2.2.9.6 The shield of cables shall be electrically continuous throughout the entire cable route and it shall be grounded in cable vaults and cabinets.

2.2.9.7 Both exudation and penetration of filling compound to/from the cable shall be prevented in the sheath closure.

2.2.9.8 In principle, the cable sheath opened for splicing portion shall be completely closed with the splice closure before finishing the work for the day. Otherwise the cable sheath shall be closed temporarily according with the approved method.

2.2.9.9.1 Pair treatment for non-spliced pairs shall be always done in splice closure according to the suitable method approved by ETC.

2.2.10 Drop wire installation

2.2.10.1 The minimum clearance from the ground to the lowest point in the span of drop wire shall be more than 4.5 along roads and 5.5 m at crossing of roads.

2.2.10.2 The minimum clearance from the ground to the lowest point in the span of drop wire shall be more than 4.5 m along roads and 5.5 m at crossing of roads. Minimum separations from the drop wire are as follows:

Power Cable Voltage	Minimum Separation
< 600 Volts	60 cm
600 - 7000 Volts	120 cm
7,000 - 15,000 Volts	200 cm

2.2.10.3 Minimum separations from the drop wire are as follows:

Power Cable Voltage	Minimum Separation
< 600 Volts	60 cm
600 - 7000 Volts	120 cm
7,000 - 15,000 Volts	200 cm

2.2.10.4 With respect to drop wire installations, optional pole span, minimum clearance above the ground and the minimum separation from power cables or wires shall meet with those of design concepts and standards for the pole line and aerial cable installation. The sag of the one-pair drop wire shall not exceed 0.4 m in pole span respectively, under 45°C of the ambient temperature.

2.2.10.5 Installation of drop wire shall be so carried out that no damage or loss of subscriber's properties occurs.

2.2.10. 6 Where the drop wire is suspended and attached to the subscriber premise, the following shall be taken into account:

1) To attach the drop wires steadily to the premise with hardware keeping minimum clearance above the ground.
2) To select the place where a station protector or wire terminal can be installed easily.
3) The drop wire shall be held suitably by cleats or equivalents at every one (1) meter intervals in case that the laying length between the first attaching point and a station protector or wire terminal is longer than 1.5 m.

2.2.10.7 the drop wire shall be covered with adequate insulated protectors whenever the contact and/or friction with power line; houses, trees and other obstacles are encountered.

2.2.10.8 Intermediate joint on the one-pair drop wire shall not be permissible in principle. When intermediate joint on the drop wire must be exceptionally required, jointing both conductors with each other shall be firmly done by adequate method, so as not to incur deterioration of tensile strength.

2.2.11 Cable Transfer

2.2.11.1 The transfer procedure in all cases shall be consistent with the following requirement.

1) The intervention in the subscriber service must be minimized.
2) Existing subscriber, who will be transferred, in principle, shall be multiplied at each connecting point of the drop wire and the internal wire with new drop wire before cut over of the existing line.
3) For transferring of existing subscriber from existing plant to new plant, the jumper wire installation shall be done at MDF and/or Cross-Connecting cabinet.
4) The closest attention must be exercised to special lines and leased lines.
5) Subscriber must be notified when any interruption of service is expected.
6) If any faulty line is in the subscriber premise, as a result of testing, ETC shall be responsible to repair it before transferring the subscribers.
7) For transferring the existing subscriber, the close coordination with ETC must be taken.
8) For transferring the existing subscriber from the exchange to another exchange, drop wires shall be duplicated until the connecting point of the drop wire and inside wire before the cut over of existing circuits

2.2.12 Installation for Protection of Riser Cable

2.2.12.1 Riser cable to distribution box shall be mechanically protected with the 25 mm and/or 50-mm

anti-corrosive steel pipe or U-guard of the height of 2.0 m above the ground and the depth of 0.30 m beneath the ground, as a rule.

In case of the riser cable to the indoor type distribution box, the riser cable portion on the building wall shall be protected by the anti-corrosive steel pipe or U-guard having no exposure of the cable.

2.2.12.2 The anti-corrosive steel pipe or U-guard shall be fastened to the pole with anti corrosive steel band at intervals not exceeding 0.6 m when cable to be led into the building is of 100 pairs or more, steel pipe of 50 mm inner diameter shall be applied.

2.2.12.3 The anti-corrosive steel pipe or U-guard shall be attached to the wall of buildings by fasteners and/or screws at intervals not exceeding 0.6 m and from the above ground level.

2.3 INSPECTIONS AND ACCEPTANCE TEST

2.3.1 General

2.3.1.1 Visual inspection in the interim inspection and/or test as well as acceptance test for cable installation work shall be performed.

2.3.1.2 Electrical performance test, which is the most important for accepting the cable facilities, installed shall be carried out by the Contractor under the witness of ETC.

2.3.2 Test Procedure

2.3.2.1 Visual Inspection Procedure

Visual inspection procedure shall be mutually agreed with ETC and the Contractor immediately after the Contractor's installation and construction standards has been approved by ETC. For this purpose, the Contractor shall prepare draft procedure. If revision or modification of the installation and construction standards is required, this procedure shall also be revised to meet the proposed revision.

2.3.2.2 Electrical Performance Test Procedure

1) The Bidder shall state in his Tender Proposals the method and procedure for the electrical performance test specified in clause 2.3.6 of this Section.
2) The format of the test report for electrical performance tests shall be submitted to ETC by the Contractor for ETC's approval immediately after the Contractor's Installation and Construction Standards have been approved by ETC.
3) The approved test procedure and format of the test report shall be applied for Interim Inspection and/or Test and Acceptance Test.

2.3.3 Testing and Measuring Equipment

2.3.3.1 The Bidder shall state in his Tender Proposals the testing and measuring equipment for the electrical performance test specified in clause 2.3.6 of this section.

2.3.3.2 It shall be desirable that all the proposed equipment are of up-to-date devices and calibrated well in site.

2.3.4 Interim Inspection and/or Tests (IIT) for Cable Work

2.3.4.1 Visual Inspection, Continuity and Insulation Tests (IIT)

The Interim inspection and/or tests shall include:

(1) Visual inspection

To check visually the cable facility installed and constructed by comparing with installation standards and specifications.

(2) Continuity Test

For 100 percent of Specified pairs at both cable ends through any splicing Points and termination's of cable, this test shall be performed in accordance with the Contractor's test procedure subject to approval of ETC, in order to ensure that:

1) Specified pairs are terminated properly and correctly on
2) Cable shields are properly bonded and grounded, and
3) Terminals and pairs in the cable are free from open, short, ground, cross, split and transportation.

This test shall also be repeated later through out the completed cable system in the section and/or segment specified in clause 2.3.2 of this section, and the test result shall meet those as specified in clause 2.3.6.2 of this section.

(3) Insulation resistance test

Whenever and wherever required on cable facilities, this test shall be performed in accordance with the Contractor's test procedure subject to ETC's approval. The test results shall meet those as specified in clause 2.3.6.3 of this section.

2.3.4.2 Repair, Replacement and/or Correction

When partly or complete repair, replacement and/or correction are found necessary, the Contractor shall carry out such works at the stage of interim inspection and/or tests.

2.3.5 Acceptance Test for Cable Work

2.3.5.1 General

The Contractor under witness of ETC shall execute the acceptance test. When all the tests have been completed by the Contractor and approved by ETC, an "Acceptance Certificate" for whole cable facilities installed by the Contractor shall be issued by ETC.

2.3.5.2 Minimum Cable Section and/or Segment for Acceptance Test

(1) Primary Cable

The acceptance test shall be carried out on one (1) complete primary cable from the terminal on MDF to the terminal in either cross-connecting cabinets concerned or distribution boxes in the direct service area.

(2) Secondary Cable

The acceptance test shall be carried out on one (1) cross-connecting cabinet area of

the section from the terminal in the cross-connecting cabinet to the terminal in distribution boxes concerned.

2.3.5.3 Preparation for Acceptance Test

The Contractor shall propose an implementation schedule of acceptance test with the following documents before the test:

1) Latest interim inspection and/or test results including rectification's, if any (2 copies)

2) Latest plans, as built drawings, lists of the bill of quantity, modification if any related to the section and/or segment of the acceptance test concerned (1 copy)

3) Documents for repair, replacement and/or correction, if any (2 copies).

4) Any other documents required for the acceptance test.

In addition to the above, ETC may request to provide extra copies of the above-mentioned documents. The Contractor shall prepare such extra copies, if needed.

2.3.5.4 Relation-ship with Civil Works

It is essential that all cables shall be installed in the duct system after the acceptance test for the civil works is conducted and the duct system is accepted. Cables installed before such acceptance tests shall not be acceptable even though the result of the interim inspection and/or tests for the cable installed is satisfactory.

2.3.5.5 Acceptance Test Items

The acceptance test for cable works, in principle, shall be performed in witness of ETC on the following items:

(1) Check and examination of documents mentioned in clause 2.3.5.3.

(2) Examination and analysis of document contents and/or test results.

(3) Visual inspection of installed plants and facilities.

(4) Electrical performance tests specified in clause 2.6.3.6.

(5) Photographs showing clearly the cable installation in all chambers and cable frame shall be maintained.

2.3.5.6 Items subject to refusal of Acceptance Test

The acceptance test shall be refused, if one (1) of the following items are found:

(1) The documents to be prepared in clause 2.3.5.3 are not complete or their contents are insufficient.

(2) Unprepared or defective facilities indicated by the result of interim inspection and/or test are found.

(3) The result of visual inspection is unsatisfactory or not complied to the specification concerned.

(4) The result of the electrical performance test specified in clause 2.3.6 of this Section does not meet with the standard and/or tolerance.

2.3.5.7 Relationship with Interim Inspection/Tests.

When the Acceptance Tests (FAT) are carried out as per sequential works to the Interim Inspection and/or Test (IIT), several portions or all of the following performance tests in FAT may be omitted, or the Cable pairs to be tested or measured may be reduced, regardless of the requirements specified in the clause 2.3.4.1.

a) Visual Inspection

b) Continuity test,

c) Insulation resistance test.

On the condition that following items are satisfactory to ETC and/or the Consultant:

(1) IIT have been implemented under 100 percent in witness of ETC,

(2) The result of 100 percent visual inspection by IIT is satisfactory,

(3) The result of continuity and insulation resistance tests for 100 percent pairs of the cable section and/or segment concerned by IIT are satisfactory, and

(4) The period between the completion date for IIT and scheduled date of FAT is within thirty (30) days.

2.3.5.8 Electrical Performance Test in FAT

(1) Number of pairs to be tested and measured in cables in the section and/or segment concerned for the electrical performance test is specified in clause 2.3.6 of this Section.

(2) If the result of the electrical performance test in the FAT carried out on sampling basis is unsatisfactory, all cables and facilities to be tested or measured on one (1) lot basis shall be considered unacceptable.

2.3.5.9 Repair, Replacement and/or Correction

If partial or complete repair, replacement and/or correction are found necessary at the time of FAT, the Contractor shall carry out the recovery work immediately.

After completion of the recovery work, the Contractor shall repeat the FAT until satisfactory results are obtained.

2.3.6 Electrical Performance Test

2.3.6.1 General

(1) The test and measurement items of electrical performance test, and number of pairs to be tested or measured in specified cables terminated on MDF, cross-connecting cabinets or distribution boxes are specified herein.

(2) The electrical performance test shall be performed on new cables installed by the Contractor and on the existing cables repaired, spliced or transferred by the Contractor, if any.

(3) The electrical performance test shall include all test items specified below for new cables.

2.3.6.2 Continuity Test

(1) At the IIT:

All cable pairs and cables shields shall be tested.

(2) At the FAT:

The number of cable pairs and cable shield to be tested shall be ten (10) percent on a random sampling basis in principle, by the direction of ETC. Reserved pairs in primary cables and secondary cables shall be witnessed by ETC upon request of the Contractor during the period of construction.

2.3.6.3 Insulation Resistance Test

(1) Completely steady 250 volts in DC after rectification shall measure insulation resistance.

(2) Insulation resistance tests shall be performed as follows:

1) At the IIT:

All cable pairs shall be tested.

2) At the FAT:

The number of cable pairs to be tested, in principle, shall be ten (10) percent on a random sampling basis by the direction of ETC.

3) The value of the insulation resistance shall be more than 50 meg-ohms.km by the measurement of Megger, 1000V/2000 meg-ohms.

2.3.6.4 DC Loop Resistance Measurement

(1) DC Loop resistance's shall be measured on a basis of ten (10) percent sampling and the pairs sampled shall include one (1) pair in each decadal-pair subunit for each local cable.

(2) Measured DC Loop resistance shall not be exceeding the value calculated based on the value as shown in the following table.

Loop Resistance

Conductor Diameter (mm)	Loop Resistance per Kilometer at 20°C (Ohms)
0.4	290
0.5	192
0.63	136

Temperature correction for measured values shall be made, if necessary.

2.3.6.5 Resistance Unbalance Measurement

(1) DC resistance unbalance measurement shall be performed on the same pairs specified in clause 2.3.6.4.

(2) DC resistance unbalance between individual conductors of each pair shall not exceed 3% of DC loop resistance specified in clause 2.3.6.4 and average value for all measured pairs shall not exceed 1%.

2.3.6.6 Preparation of Test Result

After completion of the acceptance test, the Contractor shall submit the test report including all the results, as specified in clause 2.3.5.3.

2.4 MANUALS AND AS-BUILT DRAWINGS

2.4.1 Manuals and As-built Drawings

2.4.1.1 Manuals and drawings of the equipment shall be in a book form. Manuals and drawings shall not be packed together with the corresponding materials, equipment and instruments for shipment to Ethiopia.

2.4.1.2 The Bidder shall submit the same number of copies of explanation books and instruction manuals describing the manipulation of outside plant facilities and other necessary Equipment for installation works as a " Technical Proposal" specified in "General Condition of Bidder and Contract".

The Contractor shall submit additional three (3) copies of such explanation books and instruction manuals. If revised, the Contractor shall submit amended five (5) copies of approved drawings & manuals by ETC.

2.4.2 Detailed Construction Drawings and/or Plans

2.4.2.1 Kinds of Drawings and/or Plans

The Contractor shall prepare the following detailed construction drawing and/or plans and any other necessary design documents:

(1) Local cable work design

1) CONTENTS AND SYMBOL
2) KEY MAP FOR COVERAGE AREA
3) EXCHANGE SITE LAYOUT PLAN
4) STRUCTURE DRAWINGS IN CABLE VAULT
5) MDF TERMINATION
6) DUCT ROUTE PLAN
7) PRIMARY CABLE PLAN
8) SECONDARY CABLE LOCATION PLAN
9) SECONDARY CABLE SCHEMATIC PLAN
10) CABINET JOINTING PLAN
11) MANHOLE RACKING PLAN
12) CUT-OVER POINT PLAN
13) MANHOLE CONSTRUCTION PLAN
14) SPECIAL DESIGN (IF REQUIRED)
15) SCHEME OF CHAMBER AND ACCESSORIES

2) Any other special drawings and technical documents

a) Subscriber Card, DP Card, MDF Card and Cabinet Card.
b) Other special drawings and technical documents.

2.4.2.2 Size of Detailed Construction Drawings and or Plans

The Contractor shall prepare detailed construction drawings and/or plans and technical documents on either white or transparent paper respectively, which are called "original". The size of papers shall be dimensioned as follows:

(1) Construction drawings and/or Plans: A1 size

(2) Technical documents: A4 size

2.4.2.3 Number of Copies of Drawings/Plans and Technical Documents

The Contractor shall submit the following number of copies of the detailed construction drawings and/or plans and technical documents to ETC according to the procedure specified in clause 2.4.2.1:

1) For examination and review: Two (2) copies each.

2) For signing one (1) original of each.

3) For approval with covering letter: Two (2) Sets of book-form with signed copies.

4) For supervision after approval: Four (4) sets of book-form with approved copies.

The copy size shall be in accordance with that of the original.

2.4.3 "As-Built" Drawings

2.4.3.1 Kinds of "As-Built" drawings, Test Report and Line Application Card

Upon completion of the acceptance test and regarding issuance of the acceptance certificate, the Contractor shall prepare the following "As-Built" drawings, test reports and line application cards and any other technical documents, if required, as follows:

(1) "As-Built" drawings

a) CONTENTS AND SYMBOL

b) KEY MAP FOR COVERAGE AREA

c) EXCHANGE SITE LAYOUT PLAN

d) STRUCTURE DRAWINGS IN CABLE VAULT

e) MDF TERMINATION

f) DUCT ROUTE PLAN

g) PRIMARY CABLE PLAN

h) SECONDARY CABLE LOCATION PLAN

i) SECONDARY CABLE SCHEMATIC PLAN

j) CABINET JOINTING PLAN

k) MANHOLE RACKING PLAN

l) CUT-OVER POINT PLAN

m) MANHOLE CONSTRUCTION PLAN

n) SPECIAL DESIGN (IF REQUIRED)

o) SCHEME OF CHAMBER AND ACCESSORIES

They shall be sufficiently reproducible for copying.

(2) Test report

On the previously approved format of the test report for electrical performance tests, the Contractor shall prepare an original of the test report including test results.

(3) Line application card

On the previously approved format of the line application card specified in

Paragraph 1.6 in Section 1, the Contractor shall fill the line connection data necessary for the test desk.

2.4.3.2 Size of "As-Built" Drawings, Test Report and Line Application Card

The Contractor shall produce the following sized "As-Built" drawings, test reports and line application cards:

(1) "As-Built" drawings

Same size as the detailed construction drawings and/or plans specified in clause 2.4.2.2.

(2) Test report

Previously approved format size (A4).

(3) Line application card

Previously approved format size.

2.4.3.3 Number of copies of "As-Built" Drawings, Test Reports and Line Application Cards.

Prior to issuance of the Acceptance Certificate, the Contractor shall submit the following number of original and its copy which have been signed by ETC and/or the Consultant, to ETC:

(1) "As-Built" drawings.

- One (1) set of original.

- Six (6) sets of book-formed copies.

(2) Test reports and lines application cards.

- One (1) set of Original.

- Two (2) sets of each copy.

2.5 FACTORY INSPECTION AND TEST

2.5.1 General

2.5.1.1 The Contractor shall allow ETC's inspectors or representatives to make inspections at the manufacturer's factories concerned.

2.5.1.2 The Contractor or the Manufacturer shall provide all the necessary data regarding quality control for the manufacturing of all materials and equipment to be supplied for the outside plant works.

2.5.1.3 The data taken through the manufacturers own factory test shall be submitted to ETC.

2.5.2 Factory Test Procedure

2.5.2.1 The Manufacturer in witness of ETC on a sampling basis shall carry out 2.5.2.1 Factory test.

The Contractor shall, within three (3) months after signing of Contract, propose the sampling standards, test standards and test procedures for all kinds of materials and equipment concerned for approval by ETC.

2.5.2.2 The factory test is to check whether all technical requirements and workmanship of the material and equipment are fulfilled or not. However, completion of the factory test is not the final acceptance of the material and equipment. Any faults found during the installation, the Contractor at his own expense shall remedy guaranteed period.

2.5.2.3 Test data shall be submitted to ETC immediately after the completion of tests.

SECTION II

CIVIL WORKS

3.1 DESIGN CONCEPT

3.1.1 General

3.1.1.1 The Contractor shall carry out the detailed site survey, and shall prepare the construction drawings and submit to ETC for approval before commencement of the work.

3.1.1.2 The kinds of construction drawings are as follows:

1) Key map.
2) Duct route plan
3) Design of the chamber with calculation data.
4) Structure Plan in Cable Vault.

3.1.2 Chamber and Duct

3.1.2.1 Underground conduit route shall be selected under sidewalks, in principle, but not to select carriage-ways as far as possible.

3.1.2.2 Standard types of chambers shall be applied as shown in the Table 3-1.

3.1.2.3 Spacing of chambers shall be determined in consideration with cable branching, location of the cross-connecting cabinet, and topographic conditions. For chamber spacing, the maximum limit shall be as mentioned below:

Straight section: 200 m for local cable route

3.1.2.4 In the Underground conduit to be newly constructed, ducts shall be composed of PVC pipes. In case where the use of PVC pipes is inappropriate as in the case of crossing road, a river, railway, and bridge attachment, steel pipes shall be used.

Table 3-1 Type and Dimension of Chamber

Type	Number of Ducts	Length (M)	Width (M)	Depth (M)	Type of Cover	Cable Bracket
Hand–hole HH-1	1 - 4	1.20	0.60	1.10	□	One Side
Manhole						
S-1	4	1.80	1.30	1.80	O	One Side
S-2	5 - 8	2.30	1.30	1.80	O	Both Side
S-3	9 - 16	3.00	1.40	1.80	O	Both Side
S-4	17 - 24	3.20	1.40	2.10	O	Both Side
L-1	4	1.90	1.30	1.80	O	One Side
L-2	5 - 8	2.50	1.30	1.80	O	Both Side
L-3	9 - 16	3.40	1.40	1.80	O	Both Side
L-4	17 - 24	3.60	1.40	2.10	O	Both Side
T-1	4	2.30	1.30	1.80	O	Both Side
T-2	5 - 8	2.50	1.30	1.80	O	Both Side
T-3	9 - 16	3.40	1.40	1.80	O	Both Side
T-4	17 - 24	3.60	1.40	2.30	O	Both Side

3.1.3 Direct Buried Cable

3.1.3.1 Direct Buried cable shall be installed on the sidewalk away from the carriage in principle.

3.1.3.2 The excavation of trenches shall be carried out in such a manner as to minimize the

interference with existing pipes, cables, trees or any other underground objects.

3.1.3.3 The pilot excavation shall be required where the congestion of underground objects is found.

3.2 INSTALLATION AND CONSTRUCTION STANDARDS

3.2.1 General

3.2.1.1 Civil works shall be performed in accordance with the specification stipulated hereinafter.

3.2.1.2 Other installation and/or construction works, the detail of which is not specified in this section, shall be based on this specification and/or the Contractor's own Technical Specifications, subject to the approval by ETC.

3.2.1.3 ETC shall obtain permission for the excavation and site occupancy from proper authorities and shall inform the Contractor in writing. The Contractor shall provide for ETC the necessary drawing and/or data if it is required.

3.2.1.4 The Contractor shall provide adequate safety guards and warning signs, such as indicating boards, lights, barricades and other proper warning signs as required during excavation, chamber construction and all other constructions and/or installation activities.

3.2.1.5 ETC shall notify the other utilities and local authorities concerned upon request of the Contractor when construction shall be commenced, and shall start his work after ETC's approval.

3.2.1.6 ETC shall, at any time when deemed necessary during the construction period, carry out inspections and/or tests on the facility under construction and/or the portions of facilities completed by the Contractor.

Should any discrepancy in construction, faulty materials and/or other evidence of unsatisfactory constructions and installations be discovered in the course of such inspection and/or tests, the Contractor shall immediately repair, replace and remedy such unsatisfactory items.

3.2.1.7 The Contractor shall demonstrate the proof that the quality and quantity of the hidden portion have been complied with the specification, at his own expense.

3.2.2 Chamber

3.2.2.1 Chambers shall be equipped with covers and frames, inner-cover, keyhole plug, duct plug, ladders, steps, cable bearers, cable brackets, sump covers, nameplates and pulling irons.

3.2.2.2 Chambers shall be watertight.

3.2.2.3 The Contractor shall comply with the following specifications for mixing, pouring and curing of the concrete.

(1) All chambers shall be constructed with a ready-mixed or site-mixed.

(2) The concrete, when made with a normal Portland cement, shall attain a minimum compressive strength of 210 kg/cm in 28 days, or when made with a high rapid strength Portland cement, it shall acquire the same strength in 7 days.

(3) Slump range for the concrete used in the construction of chamber shall be between 5 and 12 cm.

ETC may require the slump test for every batch of the concrete.

(4) ETC may order three (3) test pieces (cubic type) from any batch of the concrete to

be taken and properly marked for the laboratory test, as required.

3.2.2.4 The concrete shall be slowly poured around the molds or forms up to adequate level evenly and tamped into all parts of the molds or forms by using a vibrator until a densely solid mass without cavities are obtained.

3.2.2.5 The concrete, once mixed, shall be used within 60 minutes (one hour). After one hour, any remaining concrete shall be removed and shall not be used.

3.2.2.6 Bottom of the pit shall be tamped and carefully leveled and shall be covered with approximately 10 cm of the foundation aggregate.

3.2.2.7 Cement mortar shall consist of one (1) measure of Portland Cement and two (2) measures of sand. Materials shall be thoroughly mixed in a dry state on a non-absorbent base and then worked up with sufficient water to form a stiff paste. Mortar, once mixed, shall be promptly used. If not used within one hour, the mixture shall be removed and shall not be used.

3.2.2.8 The concrete shall be covered with saturated sackcloth or similar materials and shall be sprinkled with water to keep the sufficient moisture; adequate times a day for 7 days.

3.2.2.9 Removal of inner and outer forms shall not be permitted before 7 days and 4 days respectively after pouring the concrete.

3.2.2.10 No traffic shall be permitted over chambers earlier than 7 days after the concrete pouring.

3.2.2.11 All chamber construction including concrete mixing and pouring shall be done in the presence of or under the supervision of ETC.

3.2.3 Excavation for Chamber and/or Conduit

3.2.3.1 All excavation shall be done in a thorough and workmanlike manner in accordance with detailed plans and specifications under the direction of ETC and subject to the approval and acceptance of ETC.

3.2.3.2 ETC shall obtain permission for the excavation and site occupancy from proper authorities and shall inform the Contractor in writing. The Contractor shall provide ETC the necessary drawing and/or data if it is required. Permission shall include property owners' approvals for necessary work on their properties.

3.2.3.3 The Contractor shall obtain all pertinent records from the Electric, Water Supply, and Sewer Authority and other organizations for underground utilities in order to proceed his work and safe-guard to other utilities.

3.2.3.4 The Contractor shall take all countermeasures necessary for public safety and protection to any and all temporary or permanent utilities.

3.2.3.5 The Contractor shall be directly responsible for all damages to existing utilities including telecommunication facilities and shall restore these services immediately at his own expense.

3.2.3.6 During the execution of the work, existing underground facilities are damaged, or any part there-of is disturbed, the Contractor shall immediately notify of the facts to ETC and owner of the utility.

3.2.3.7 Where other underground facilities are expected, the Contractor shall dig test pits at the location in question at his own expense. If any obstructions, which interfere with the excavation of the chamber site or the duct trench in conformance with detailed drawings, are encountered, the Contractor shall consult with ETC about possible modification of the

design.

3.2.3.8 The Contractor shall strictly take the countermeasure for safety at all times to prevent the accident by the sudden cave-in during the excavation.

3.2.3.9 The Contractor shall confirm with the road administrative authority to ensure about the proposed depth of chambers to the final grades and level of carriageways and footways.

3.2.3.10 The contractor shall excavate in so far as possible to comply with the trench width requirement as detailed in the construction drawings of attachment. Any excess in width shall be at his own expense. This includes the extra restoration expenses for pavements.

3.2.3.11 The Contractor shall, at his own expense, protect and support any pipe, conduit, cable, wire or any other items of telephone or foreign plant exposed or encountered during the excavations. The Contractor shall be obliged to restore all items to their original conditions and to the satisfaction of ETC and the owners of such plants.

3.2.3.12 Minimum clearance between telephone facilities and other utilities in ground shall be given as follows:

Utilities	Parallel	Crossing
Power lines	45-cm (shorts span)	45 cm
Water pipes	30 cm	15 cm
Sewage pipes	30 cm	15 cm

Where the minimum clearance cannot be given, the Contractor shall consult with ETC and/or the Consultant about the solution.

3.2.4 Installation of Ducts

3.2.4.1 Installation of ducts shall be carried out in accordance with the specification provided hereinafter.

3.2.4.2 Other installation details not specified herein shall be governed by the Contractor's own specifications approved by ETC and/or ETC standard

3.2.4.3 Trenching, backfilling and restoration shall be carried out in accordance with the approved construction drawings and the Specification.

3.2.4.4 The Contractor shall proceed the duct placing work upon ETC's confirmation of both the duct quality and trench to be properly prepared according to the specification.

3.2.4.5 Ducts shall be installed in a straight line, horizontally and vertically, wherever practicable.

3.2.4.6 The covering depth from the top of PVC ducts to the surface of ground shall be as follows:

a) Side-walk, farmland, forest 80 cm or more

b) Carriage-way 100 cm or more

In special cases, the depth shall be determined in consultation with ETC.

3.2.4.7 The clearance between the conduit formation and trench wall shall be at least 5 cm.

3.2.4.8 Main duct runs must be completed from the chamber without interruptions or breaks and must be installed with perfect alignment of the duct way.

3.2.4.9 The warning tape shall be laid throughout the duct trench, approximately 30-cm above the uppermost pipe.

3.2.5 Laying Practice for Rigid PVC Ducts

3.2.5.1 Bedding

Excavation of trenches shall be made in strict accordance with the approved construction drawing and the Specification. The bottom of trench shall be flattened after removing stones and other protrusion.

The bedding of 5cm thickness shall be made by fine sand or equivalent, free from pebbles and other foreign material, and shall be well tamped.

3.2.5.2 Laying Work

1) Pipes laying on the trench bed shall be straightened. Then the spacer shall be placed on ducts for horizontal and approximately 3 meters along the ducts run.

2) Fine sand or equivalent shall be placed and tamped with adequate water.

3) Backfilling with sand or equivalent shall be carried out in layers as mentioned above, unit the top of uppermost pipes are covered with at least 10 cm of tamped such sand.

4) All opening ends of PVC pipes shall be tightly plugged in order to prevent ingress of sands and other obstacles during the work.

3.2.5.3 Application of short Pieces of the PVC Pipe

Any pieces of the PVC pipe shorter than 0.5 meter shall not be used in laying of main duct run.

If any piece of the PVC pipe is used, the inside edge of the cut end of the pipe shall be chamfered about 3 mm, before jointing the pipe to another PVC pipe.

3.2.5.4 All PVC pipes shall be chamfered on inside edges.

3.2.5.5 Installation of Curved Pipe

The pipe shall be bent in such manners to protect the pipe from the flattening distortion.

3.2.6 Duct Termination to Chamber

3.2.6.1 The duct generally shall be installed to the chamber wall, facing the wall at right angles; the allowable deviation of angle shall be less than 20 degrees.

3.2.6.2 The duct termination shall be flush with the inside surface of the chamber wall. The edge shall be chamfered and smoothed.

3.2.7 Jointing Practice for Rigid PVC Pipes

3.2.7.1 Jointing of the PVC pipe shall be carried out one by one successively, as a rule, in the duct trench.

3.2.7.2 Each section of duct shall be securely connected to each adjoining section of the duct in a manner that prevents the ingress of dirt or the penetration of water.

3.2.7.3 When more than one layer of ducts are installed, each layer shall be installed so as to stagger joints of each layer.

3.2.8 Arrangement of PVC Ducts in Adjacent Chamber and/or Cable Vault.

3.2.8.1 The end of PVC duct shall be terminated in Chamber and/or Cable Vault. The opening of

ducts shall be located on the specified position of the wall of chamber and/or Cable Vault.

3.2.8.2 PVC duct shall be fixed tightly to the wall of chamber and/or Cable Vault. For this purpose, incoming duct shall be reinforced by concrete (of the mixing ratio, cement sand: gravel= 1: 2: 4).

3.2.9 Mandrel Test

Upon completion of conduit sections, loose materials such as concrete, mud dirt, sand, etc. Shall be cleaned out from new ducts before testing. The Contractor shall pull a test mandrel, 87 mm in diameter and 600 mm length through all ducts. 300-mm mandrel may be used for conduit sections with sharp curve under the condition of the prior approval of ETC.

3.2.10 Direct Buried Cable

3.2.10.1 Direct Buried cable shall be installed on the sidewalk away from the carriageways in principle.

3.2.10.2 The excavation of trenches shall be carried out in such a manner as to minimize the interference with existing pipes, cable, trees or any other underground objects.

3.2.10.3 The covering depth of the direct buried cable measured from the top of cable to the surface of ground or pavement shall be 80 cm or more.

3.2.10.4 The trench shall be of sufficient width to permit adequate compaction of backfilling materials.

3.2.10.5 The trench bed shall be well leveled off without sharp cutting stones, which may cause damages to the cable. Sand or equivalent shall be placed on the trench bed and well compacted. The thickness of sand shall be at least 5 cm after the compaction.

After the placing of cables, backfilling with sand or equivalent shall be carried out with adequate compaction, until top of the cable is covered with a layer or well compacted sand at least 10 cm in thickness after the compaction.

3.2.10.6 Trench shall be promptly backfilled with the soft soil. The backfilling shall be carried out in layers not exceeding 20 cm in thickness. Each layer shall be well compacted with adequate water, before the soil or sand for next layer is placed. Backfilling for the trench in asphalted carriageway or paved footways shall be in accordance with the stipulation in clause 3.2.11 and 3.2.12.

3.2.10.7 Trench shall be restored to the original grade in accordance with the specification of authorities concerned.

3.2.10.8 The Contractor shall, as a rule, install the protective PVC pipe for direct buried cables according to the number of cable and/or the cable size under road crossing section(s).

3.2.10.9 Warning tapes shall be laid throughout the cable trench, approximately 20 cm above the cable(s).

Suitable concrete plates shall protect 3.2.10.10 Splicing portions.

3.2.10.11 Splicing shall be carried out immediately after the cable placing. If this is impracticable, the cable end shall be sealed with suitable caps.

3.2.10.12 Cable shield shall be electrically continuous throughout an entire cable route.

3.2.10.13 Mark post shall be installed near the location where the cable splice is installed.

3.2.10.14 Minimum clearance between the buried cable and other utilities shall be given as follows.

Utility	Parallel	Crossing
Power lines 45-cm (short span)	45 cm	45cm
Water supply pipes	30 cm	15 cm
Sewage pipes	30 cm	15 cm

3.2.10.15 Where the minimum clearance cannot be observed, the Contractor shall consult with ETC about the solution.

3.2.10.16 Stockpile of backfilling materials, excavated soil or any other materials shall not be left. Excess materials or soil shall be repaved of before finishing the work.

3.2.10.17 The pulling tension shall be constantly checked so that the cable will be pulled by the tension within an allowable range to be specified by the Contractor.

3.2.10.18 For placing of direct-buried cable from or to chamber, the dead-end pipe shall be placed at the outlet and/or inlet of the chamber. The dead-end pipe shall be protected with the concrete for reinforcement, and also the direct-buried cable shall be properly wrapped to protect with yarn or equivalent at the edge of the dead-end pipe. The size and length of dead-end pipe are as follow:

a) Diameter .....100 mm

b) Length .....50 cm

3.2 11 Backfilling

3.2.11.1 Prior to the backfilling work, the inspection or various underground works shall be made and, if any faulty items are discovered, necessary measure to replace or restore the fault shall be taken immediately.

3.2.11.1 Backfilling shall be commenced after mortification to ETC and/or the Consultant.

3.2.11.3 When carrying out the backfilling work, following procedures shall be proceeded:

1) Before backfilling, all foreign objects shall be removed from the excavation.

2) In asphalted carriageway and asphalted concrete or tiled footways, the specification of each authority concerned shall be applied to construct the base course.

3.2.12 Restoration of Road and Side-Walk

3.2.12.1 The restoration for excavated roads shall be done in accordance with the following:

1) Unpaved Road

For restoring of unpaved roads, the Contractor shall carry out the restoration to be its original condition. The permanent restoration of the excavated road shall be checked and certified by authorities concerned.

2) Paved Road

For restoring of paved roads, the Contractor shall carry out to restore temporarily in accordance with the direction of the authority concerned. For the restoration to its original paved condition on the excavated paved road, authorities concerned shall carry out with responsibility upon receiving the disbursement of the restoration cost from ETC.

3.3 INSPECTIONS AND ACCEPTANCE TEST

3.3.1 General

3.3.1.1 Site inspection specified herein shall be performed throughout installation and constructions of the various types of civil facilities.

3.3.1.2 Should any errors in construction, faulty materials or other evidence of unsatisfactory construction and installation are found in the course of tests, the Contractor shall immediately repair, replace and/or remedy such unsatisfactory items.

3.3.1.3 The Contractor shall perform the civil facility inspection by himself every time to see and check if the work meets the requirement before the acceptance test.

3.3.1.4 Acceptance test specified shall be performed by the contractor or ETC depending on the will of ETC. The Contractor at his own expense shall provide necessary equipment and materials for the site inspection and the acceptance test. Written reports including the test results shall be prepared by the Contractor and verified by ETC.

The Contractor shall submit one (1) original and five (5) copies of the test data to ETC.

3.3.2 Chamber

3.3.2.1 The following test shall be carried out in the presence of ETC and/or the Consultant:

1) Slump of concrete mixture.
2) Compressive strength of concrete.
3) Materials for chamber.

3.3.2.2 Dimension and structure of the chamber shall be within the following tolerance:

1)	Inside dimension	Manhole	Handhold
	Length	-5 cm	-2 cm
	Width	-3 cm	-2 cm
	Height	-3 cm	-2 cm
2)	Wall thickness	± 0 cm	
3)	Covering of reinforcing bar	± 1 cm	

3.3.2.3 Walls of the chamber shall be free from cracks and water infiltration, and inner walls of the chamber shall be smoothed.

3.3.2.4 Duct edge in the duct window shall be chamfered and smoothed.

3.3.2.5 Level of the chamber cover shall be flush with the road surface level.

3.3.3 Conduit

3.3.3.1 Mandrel passage test shall be carried out for all ducts.

3.3.3.2 Compaction and material test for backfilling according to the specification of the road administrative authorities may be carried out.

3.3.3.3 No foreign materials shall remain in all ducts.

3.3.3.4 Earth covering of ducts shall conform to the detailed plan.

3.3.4 Restoration

Result and process of restoration shall conform to the specification of road administrative authorities.

SECTION III

DEFINITIONS OF ASSEMBLY

4.1 General

4.1.1 This annex sets forth the definitions of the assembly units that constitute

Segments of the Project.

4.1.2 The assembly units consist of:

1) Section MH - Chambers (Manhole and Hand hole) Unit
2) Section FR - Frame Unit
3) Section UC - Underground PVC ducts or steel pipes
4) Section PU - Pole Unit
5) Section SU - Support Unit
   - Stay Wire
   - Pole Supporter
6) Section GU - Grounding Unit
7) Section DC - Duct Cable Unit
8) Section DBC - Direct-Buried Cable Unit
9) Section AC - Aerial Cable Unit
10) Section CCC - Cross-Connecting Cabinet Unit
11) Section DP - Distribution Point Unit
12) Section CS - Cable Splicing Unit
13) Section JS - Cable Jointing Unit
14) Section CT - Cable Termination Unit
15) Section TW - Transfer work Unit
16) Section MP - Mark Post

4.1.3 Each assembly unit comprises of inseparable sub-elements of Material, Equipment and the Work.

4.2.3 In making out the quotation for each unit, the bidder's attention is directed to the "Explanation of each Item", and the following matters:

1) Ocean freight, marine insurance, storage and inland transportation costs shall be separately quoted with these assembly units.

2) Insurance for installation work shall be included in labor portion.

3) Warehouse fees for materials, tools, measuring equipments and vehicles shall be included in the respective material portion of each item.

4) Expenses for damage or loss concerning consumable tools shall be included in the respective labor portion.

5) Expenses for field survey and construction drawing shall be included in labor portion.

6) Expenses for intermediate test and acceptance test shall be included in labor portions.

7) Tools and Measuring instrument Costs shall be quoted separately with these assembly units.

4.2 Section MH Chamber (Manhole & Hand Hole) Unit

This assembly unit shall be identified by the letter MH suffixed by the manhole/hand hole

type and/or other sub-units.

The designation of manholes is as MH-S-1, S-2, S-3, S-4, L-1, L-2, L-3, L-4, T-1, T-2, T-3 and T-4 as manhole.

4.2.1 Section MH includes all the material, equipment and the work associated with the installation, rehabilitation and/or removal of manhole/hand holes adjustment of manhole covers and frames, etc.

4.2.2 These assembly units include ancillary items such as the chamber cover and frame, inner cover, key hole plug, duct plug, cable hearer (rack), pulling- in iron, ladder, step, name plate, sump, sump cover and other hardware shown on the construction drawings.

4.2.3 These assembly units include temporary resurfacing of the road surfaces and/or pavements.

4.2.4 These assembly units include excavation, backfill, sheeting as required and site cleaning.

4.3 Section UC. Underground PVC Ducts or steel pipes

Section PVC includes all the material, equipment and the work associated with construction of underground PVC ducts. These assembly units shall be identified by the letter PVC suffixed with the type of the road and number of pipes.

PVC - G - PVC pipe to be installed on unasphalted road

PVC - A - PVC pipe to be installed on asphalted road

GS - B - Galvanized steel pipe to be installed on bridges

4.3.1 These assembly units include all the work, material and equipment necessary for duct termination to the chamber or cross connecting cabinet, application of duct plugs and/or sealing materials to new duct openings and occupied of the chamber, cross connecting cabinet. The concrete reinforcement of the duct, the placement of warning tapes and the placement of spacers are also included in this assembly unit.

4.3.2 The length of duct shall be measured as follows

1) Center of one chamber to center of another chamber, or

2) Center of the chamber to end of riser for the distribution point.

4.3.3 These assembly units include temporary resurfacing of pavements and/or drive ways, and the repair to pre-existing condition of fences, lawns, shrubbery, water pipes, underground power, telephone facilities and any other property damaged during the construction and installation of under ground ducts.

4.3.4 These assembly units include the excavation, backfilling, sheeting as required and site cleaning.

4.4 Section PU-Pole Unit

These assembly units shall be identified by the letter PU Suffixed with the Sub-Units. The use of the poles shall be indicated as follows:

Unit designator

P-S Pole with Suspension Clamp. The sign ‘#’ shows number of suspension clamp

P-D Pole with distribution support

P-T Pole with Terminal box

P-D-T Pole with distribution support and Terminal box.

P-D-S-T Pole with Distribution support, Suspension clamp and Terminal box

4.4.1 Section PU includes all the work, material and equipment associated with installation of pole.

4.4.2 These assembly units include all the work, materials and equipment necessary for installation of one wooden pole, eight (8) meters in height, in place. It also includes any concrete base, treated planks, logs or other materials to be used to stabilize the pole and prevent sinkage.

4.4.3 These assembly units also includes any parts (bracket, bolts, etc) attached to the pole to support cables, steps, marking plates, hardware for burglar proofing, and also the disposal for soil and temporally resurfacing of the ground.

4.4.4 This assembly unit also includes the reinforcement of concrete in soft soil at the base of the pole.

4.5 Section SU - Support Unit

Section SU includes all the work, material and equipment associated with installation of stays and supporting poles. The assembly units shall be identified by the letter SU suffixed by the subunits as follows.

SU - S Supporting unit with stay wire

SU - P Supporting unit with pole supporter

4.5.1 Installation of stay wire (SU - S)

This assembly unit includes all the work, material and equipment necessary for installation of one stay wire, anchor rod and plank or block anchor in place, including grounds, connectors, insulators, stay wire grips, stay grounds and tensioning device, etc. This assembly unit also includes digging, backfilling, restoration and site cleaning and bending to suspension strand (where requested).

4.5.2 Installation of pole supporter (SU - P)

This assembly unit includes the work, material and equipment necessary for installation of supporting pole where it is difficult to install stay wire.

4.6 Section GU - Grounding Unit

This assembly unit includes all the work, material and equipment necessary for installation of ground system for outside plant facilities, except the grounding to be included in the respective sections concerned.

4.7 Section DC - Duct Cable Unit

The letter DC suffixed by the diameter and the number of pairs shall identify this assembly unit.

Example: DC-D4-600 means Duct cable, 0.4mm, and 600 pair

4.7.1 Section DC includes all the work, material and equipment associated with cable placement in ducts, chambers, tunnels, exchange building, and also includes installation of cable racks in existing chambers and exchange building.

4.7.2 The measurement of each length of duct cable shall be based on the sum of distance

between centers of the chamber, and also between center of the first chamber and termination point in the exchange building.

4.7.3 This assembly unit includes all the work material and equipment necessary for installation of one (1) meter of one cable placed in duct, chamber, tunnel and exchange building. It also includes cable brackets (rack hooks), cable tags, watertight sealing, rodding and cleaning of ducts to be used.

4.8 Section DBC - Direct Buried Cable Unit

This assembly unit shall be divided into two portions; one covers trenching works and another covers cable laying works.

4.8.1 Placement of Direct- Buried Cable

The assembly unit shall be identified by the letter DBC sufficed by the sub-units to indicate conductor gauge and number of pairs.

For example, DBC-D4-100: Direct buried cable 100 pair, 0.4 mm

4.8.1.1 This assembly unit includes all the work, material and equipment necessary for installation of one (1) meter of direct buried cable in the trench. This assembly unit also includes the cable works in vertical point or to the splicing of all guards, hardware and accessories.

4.8.1.2 The measurement of each length of direct- buried cable shall be the sum of cable length between points based on the horizontal cable run.

4.8.2 Trenching Work

This assembly unit shall be identified by the letter DBC - TR and includes all the work, material and equipment necessary for trenching of one (1) meter such as excavation, making the bed for cables, backfilling and temporary resurfacing of roads and/or pavements and the removal of surplus materials. The quantities of the assembly unit is measured based on the horizontal trench length.

The assembly unit also includes all the work, material and equipment necessary for the installation of protective pipes in the crossing, for direct buried cable to chambers, and for the placement of the warning tape.

4.9 Section AC - Aerial Cable Unit

Section AC includes all the work, material, and equipment associated with aerial cable installation. The aerial cable is composed of the polyethylene single sheath and self-supporting type.

4.9.1 This assembly unit shall be identified by the letter AC Suffixed with the conductor diameter and number of pairs.

For example, AC-D4-30 installation of a 0.4mm gauges aerial cable having 30 pairs capacity.

4.9.2 The length of the respective types of cable shall be measured as the sum of horizontal distances between supporting structures.

4.9.3 This assembly unit includes all the work material and equipment necessary for the installation of self-supporting aerial cable including the bonding/grounding of suspension strand and/or cable shied where necessary. It also includes all the work; installation of hard was for the suspension of aerial cable, cable on poles or building, and protective guards for cable.

4.9.4 This assembly unit does not include labor or materials for the installation of splice closures, splicing of cable, gas dams and moisture blocks. Please refer 4.12 for splicing.

4.10 Section CCC - Cross Connection Cabinet Unit

Section CCC includes all the work, material and equipment associated with a cross-connecting cabinet. This assembly unit shall be identified by the letter CCC. Suffixed with the capacity of the cabinet.

For example, CCC - 1200 (installation cross connecting cabinet of 1200 pair capacity)

This assembly unit includes all the work; material and equipment necessary for installation of one (1) cross-connecting cabinet for outdoor type including cabinet foundation. It also includes fixing the cabinet frame to the foundation, mounting the hardware, name and/or number plates, guard posts where required, cabinet foundation, grounding and associated hardware.

4.11 Section DP - Distribution Point Unit

Section DP includes all the work, material and equipment associated with distribution point. This assembly unit shall be identified by the letter DP followed by the pair number as follows:

DP - 10 (installation of outdoors terminal box, 10 pairs)

DP - 100 (installation of indoors terminal box in the cabinet, 100 pairs)

The assembly unit includes all the work, material and equipment necessary for installation of one outdoor terminal box and one indoor terminal box. It also includes termination of riser cable conductors, connection of cable shield to distribution box, housing, stenciling of name of exchange in authorized abbreviation, cabinet area number, distribution box number on the cover of the distribution box, fixing accessories for drop wiring on the pole.

4.12 Section JS - Jointing Section Unit

Section JS includes all the work, material and equipment necessary for jointing of one cable with others.

The assembly unit shall be identified by the letter A and U to identify aerial cable and underground jelly filled cable followed by gauge of the conductors and number of pairs. For exampleJS-4 A10-A10 (jointing of one aerial cable, 0.4mm diameter and 10 pairs with another cable of the same gauge and number of pairs). The assembly unit shall include all the work, necessary for installation of one (1) cable splice, complete and in place and include all the cable sheath and shields, internal bonding, splicing conductors, filling with filling compound, closing the closure, external bonding. It shall also include excavation, backfill, placement of mechanical protection, marking post, site cleaning and as may be applicable temporary and permanent resurfacing of pavements and repair to their pre-existing condition of fence, lawn, shrubbery, water pipes, underground power lines, telephone facilities, and any other property damaged during the installation of splice closure.

4.13 Section CT - Cable Termination Unit

Section CT includes all the work, material and equipment associated with termination of cable. The assembly unit shall be identified by the letter CT suffixed with the gauge of the conductor and number of pairs.

For example CT - 4 - 600 (Termination of a 600p cable, 0.4mm diameter.)

The assembly unit includes all the work, material and equipment necessary for termination of one (1) primary cable at the MDF - It also includes grounding to the exchange grounding bar (on MDF) and securing the primary cable to walls, racking etc in tunnel/ trench (cable supporting structure).

4.14 Section TW - Transfer Work Unit

This assembly unit includes all the work, material and equipment necessary for transfer any type of existing cable to another cable & transfer of subscriber up to connector on premises, and also jumping at cross-connecting and MDF. This assembly unit shall be identified by the letter TW and suffixed by the Sub units as follows.

TW - C transfer work at the cable

TW - D transfer work at distribution point

4.14.1 TW - C transfer work at the cable

This assembly unit includes opening cable sheath and shields or existing cable closure, splicing and capping conductors, connection of internal bonding wire to make parallel joint, closing the closure, installation of testing valves for flash test and filling the compound as required, rearrangement of existing cables in manhole and/or hand hole, fixing the name plate, and verification test before and after transfer of working pairs.

This assembly unit also includes the placing and fixing of the closure on the cable bearer (rack) in the manhole and/or hand hole, necessary jumping work in cross-connecting cabinet and MDF.

4.14.2 TW - D transfer work at distribution point

This assembly unit includes all the work, material and equipment necessary for installation of one (1) pair drop wire of 100 meter length for transferring of subscriber up to connector on premises, and jumpering in cross-connecting cabinet and MDF.

4.14.2 MP Mark Post Unit

This assembly unit includes all the work, material and equipment necessary for indication (Mark post) of under ground facility (i.e. under ground cable jointing point, under ground cable curving point, etc) in cable network.

SECTION IV

TECHNICAL SPECIFICATIONS OF MAJOR ITEMS

_ Underground cables

_ Aerial cables

_ Drop wire

_ Heat shrinkable splice closure

_ PVC pipe and Accessories

Under Ground Cable Specification

1. Scope:

This specification covers the essential requirements for full-filled telecommunication cables intended for direct burial and duct installation. The cable core consists of solid cylindrical copper wire, insulated with cellular polyethylene surrounded by fully colour coded skin layer of high density polyethylene.

2. Conductors:

2.1 Each conductor in a cable shall be a single, pure perfectly annealed copper, circular in cross-section, uniform in quality and diameter and free from any defects.

2.2 The nominal conductor diameter shall be 0.4mm, o.5mm and 0.6mm. Deviations shall be within the range of ± 3% of the nominal diameter.

2.3 A test piece of conductor 275mm in length, taken from a finished cable, when subjected to a uniform tensile test shall give an elongation before fracture not less than the specified in table 2 column 3.

In the manufacture, joints shall be avoided as far as possible. In case of accidental breakage, joints shall be made with silver soldering, end against end of wire, or by welding.

2.4.1 The tensile strength of such jointed conductor shall be not less than 90% of that of a similar adjacent sample having no joint.

2.4.2 The electrical resistance of a jointed conductor shall be not greater than 105% of a similar adjacent conductor having no joint.

3. Insulation:

3.1 Each conductor shall be uniformly insulated with smooth and continuous cellular polyethylene surrounded by skin layer of high density polyethylene. The radial thickness, degree of blowing and the colouring of the insulation shall be such that the cable will meet all electrical requirements of this specification.

3.2 The cells shall be expanded and uniformly dispersed circumferentially and shall have an average diameter of approximately 30 micrometer. The cells produced should be subsequently non-intercommunicating.

3.3 The solid layer, skin, shall have a nominal thickness of 0.05mm.

3.4 The basic insulation shall be a specially formulated high density high molecular weight polyethylene compound, polyethylene compound, the linear density shall be 10.941gm/cm and above.. It shall be stabilized with suitable antioxidant, applied in cellular form.

Note:- Reclaimed material shall not be used.

3.5 The insulated conductor shall easily be identifiable by fully readable and durable colour coding. Colours shall correspond reasonably with the standard colours shown in IEC publication 304, and are shown on table-1.

3.6 The insulation as extruded, shall satisfy the following mechanical requirements.

3.6.1 Elongation:-

A suitable length of insulation carefully removed from the conductor shall be inserted in a suitable tensile strength testing machine such that the gap between the grips are 50mm. When extended at the rate of 250mm per minute, the elongation at break shall be not less than 150%.

3.6.2 Ultimate tensile force;-

The ultimate tensile force of the specimen used in sub-clause

3.6.1 shall be not less than that shown on table 2 column 4.

3.6.2 Resistance of compression:-

Two insulated conductors shall be twisted together so that there are 12 evenly spaced 360-degree turns in a length of 100mm. The mid 50 mm of the twisted pair shall be placed between polyethylene coated flat surfaced rigid metal plates. The polyethylene coating shall be a film of 0.25mm. By means of lever system or any suitable means a force of 65 N shall be applied for one minute. With the force still applied, no evidence of short circuit shall be observed when tested with 1.5v D.C.

3.6.4 Retraction:

When the insulation of the conductor cut at a point not less than one meter from the end, it shall show a retraction of not more than 2.5mm after one minute, at temperature of (20±5) degree centigrade.

3.6.5 Stress Cracking:

Six continuous turns of insulated conductor shall be wound on a 6mm mandrel. The samples shall show no sign of crack after immersion for 24 hrs. In an approved stress crack agent at (55±5) degree centigrade.

4. Twisting:

4.1. Two conductors, insulated as described in clause 3 shall be uniformly twisted together with a suitable twisting length to make a pair.

Each pair in a basic group shall have a different lay length so that the pair to pair capacitance unbalance requirement shall be within the limit prescribed in this specification.

5. **Stranding:**

5.1 The pairs in a " basic group" unit, colored in accordance with table 1 shall be bunched together to form a " basic unit". An open spiral of binders of colored plastic tape or textile shall be placed over each " basic groups".

5.2 The colors of the spiral lapping plastic tape or textile hall reasonably correspond with the standard colors in ICE publication 304 and be as in table 3. A cable consisting only one " basic group" may not have a colored lapping. However a lapping of natural color plastic tape or textile may be applied between center and layers.

5.3 The groups stranded into units shall have different sizes of unit as follows:

50-pair units: Five "basic groups" helically assembled to form a compact "50-pair unit"

100-pair units: Ten "basic groups" helically assembled to form a compact "100-pair unit".

Colored plastic or textile binders applied in an open spiral around each unit identify the units.

The spiral plastic or textile binder around the first (marker) "basic group" in the center and each layer shall be red.

The last (reference) "basic group" shall be identified by green colored binding and the other groups shall be identified by bindings of contrasting color.

The marker and reference " basic group" shall be adjacent and the counting of the "basic group" in each layer of the cable shall be in the same direction.

5.4 For cables up to and including 100-pairs are formed by helically assembling of 10 pair "basic group" together. The cabling plan shall be according to table 4.

5.5 Helically assembling 50 pair unit or 100-pair unit forms Cable consisting of more than 100-pairs together. The cabling formation plan shall be according to table 5.

5.6 The lay length of the binders shall not exceed 100mm when laid in the same direction as the pairs. When laid in opposite direction to the pairs the lay length shall not exceed 200mm.

5.7 1% of the nominal pair number shall be provided as spare pair group and shall be placed in the outer interstices of the cable core.

Using the same color code as for the standard cable pairs shall identify the spare pairs. Only one spare pair or group shall be placed between any two given groups or units.

The binding color for the spare pairs provided, as a group shall be natural.

Each spare pair shall meet all requirements of the specification as for the standard pairs.

6. Filling:

6.1 Interstices between conductors, groups, units, sheath, generally the cable core and core wrapping shall be filled completely with permanent effective water blocking or repellent filling compound, which is compatible with other materials in the cable.

6.2 The filling compound shall be non-toxic, non-derma tic generally physiologically unobjectionable and shall not have unpleasant or irritating odor.

6.3 The filling compound shall not change or impair the insulated conductors or bindings when stored at a temperature of 70 degree centigrade.

6.4 The filling compound shall not contain any contamination or water and shall be free from dirt, metallic particles and other foreign matters. The compound shall not void oil when stored at a temperature of up to 70 degree centigrade.

6.5 The filling compound shall be easily removable from the polyethylene insulating by wiping or otherwise.

6.6 The filling compound shall not move within or drain from, the cable at any time during storage, installation or service in a normal range of temperature of up to 70 degree centigrade.

6.7 The filling compound shall not bring about mechanical break down of the insulation when exposed for a long period of time.

6.8 The filling compound shall not migrate into the cells of cellular polyethylene insulation at any service temperature up to 70 degree centigrade.

6.9 The filling compound and insulation shall show adequate resistance to oxidation, both before and after prolonged contact.

6.10 The filling compound shall have the following mechanical and electrical properties:

6.11 Viscosity:

The viscosity shall be not less than 10 cp at 100 degree centigrade

6.12 Drop point:

The drop point of the filling compound shall be in accordance with Appendix H of the amendment 3 to IEC 708-1 for type 1, that is >=50°C and, =70°C.

6.13 Drip point:

The drip point shall be not less than 60 degree centigrade.

6.14 Flash point:

The flash pint shall be not less than 230 degree centigrade.

6.10.5 Volume resistively:

The specific volume resistively shall be not less than 1000G.Ohm-cm when measured at 25 degree centigrade.

6.10 Dielectric constant:

The dielectric constant or the permitivity at audio frequency shall not exceed 2.3 when measured at 20 degree centigrade.

6.11 Dissipation factor:

The dissipation factor shall not exceed 0.0014 at a frequency of 50 Hz.

6.11 Longitudinal water penetration test. Test prece of the filled card shall meet the requirement stated in appendix A.

7. Core covering (wrapping):

7.1 The cable core shall be wrapped with a continuous layer or layers of suitable paper or non-hygroscopic tape that forms the core to a solid round shape.

7.2 The wrapping shall be applied helically or longitudinally with an overlap so that all electrical requirements of this specification are met.

7.3 The wrapping shall be easily peeled and without adhesion and separated from the insulation, the wrapping and the sheath.

8. Identification: -

The name of the manufacturer and year of manufacture shall be indelibly marked at an interval of not more than 300mm either on polyester or on other approved tape. The marking tape shall be laid longitudinally under the wrappings throughout the length of the cable.

9. Moisture barrier:

9.1 The cable core shall be completely covered with a plastic coated aluminum tape applied longitudinally with a minimum overlap of not less than 6mm. For small diameter cables the overlap shall not be less than 20% of the moisture barrier circumference.

9.2 The polyethylene part of the sheath shall adhere completely to the protective polymer coating of the aluminum tape and the sheath shall be applied to fit closely to the protected core of the cable.

9.3 Aluminum tape:

9.3.1. The thickness of the aluminum tape without the polymer coating shall be (0.2±0.025) mm.

9.3.2 The thickness of the protective polymer coating on both side of the aluminum tape shall be not less than 30 micrometer.

9.3.2. All Joints of the aluminum tape shall have good mechanical strength and electrical continuity and allow the specified cable diameter sheath thickness requirement to be met.

9.4 Polyethylene sheath:

9.4.1 The sheath shall consist of a tough weather resistant, high stress-crack resistant and low density polyethylene compound containing a minimum of 2.5% by weight carbon black with satisfactory dispersion and meeting the requirements of ASTM D 1248 type 1 class C, cat. 5.

9.4.2 The polyethylene sheath shall be extruded as a continuous seamless close filling tube and shall be free from pinholes, joints, mended parts and any other defects.

9.4.3 The sheath thickness shall be not less than the values shown on table 6, column 2.

9.4.4 The average thickness of the sheath at any cross section shall be not less than 90% of the specified thickness.

The minimum spot thickness shall be not less than 80% of the specified thickness.

9.4.5 The sheath shall be reasonably circular and the curvature of the external surface shall not be concave and cornered at any point.

9.4.6 Resistance to cracking:

When tested by the method described in appendix B, no crack shall occur in the cable sheath.

9.5 Tensile stress at yield:

Tensile stress at yield shall be not less than 8 MN/m2. The thickness of the test sample shall be (1.50±0.05) mm. The rate of the tensile testing machine grip separation shall be (480±60) mm/min.

9.5.1 The sheath and moisture barrier shall show no sign of cracks or ripples when the cable is coiled for at least one complete turn round a mandrel of diameter not more than 12 times the specified maximum diameter.

9.5.2 A ripcord having minimum breaking load of 150 N shall be laid under the moisture barrier.

10. Armoring (only for armored cable):

10.1 The armoring consists of two galvanized soft steel tape with a nominal thickness of 0.3 mm to be applied over bedding consisting of two helically applied PE tape.

10.2 The weight of the zinc coating on each side of the steel shall have a minimum of 250 gr/m2.

10.3 Before armoring a wrapping of suitable tape shall be applied for bedding layer.

10.4 Over the steel tapes armoring sufficient flooding compound shall be applied so that voids and air spaces between the outer jacket and Armour will be sealed.

10.5 The two tapes shall be laid in one helix in the same direction over bedding so that the outer tape is almost central over the gap left by the inner tape.

10.6 The outer tape shall overlap the inner tape on both sides by at least 20% of the tape width.

10.7 The minimum tensile strength of the steel tape shall be 350 N/mm2.

11. Outer jacket (Only for armored cables):

11.1 The jacket for the armored cable shall consist of a though weather resistant, high stress-crack resistant of low density polyethylene, which shall be in accordance with ASTM D 1248 type 1, class C, cat 5.

11.2 The nominal thickness of the outer covering shall be as shown on table 6, column 3.

11.3 The average thickness at any cross-section and the minimum spot thickness at any point shall not be less than, respectively of, 90% and 75% of the specified thickness.

11.4 The sheath shall withstand a spark test voltage at least 8 KV r.m.s. or 12 KVd.c.

12. Length Marking

12.1 The length number shall be marked in factory at regular intervals of one meter along the outer sheath (jacket) of the completed cables. " ETC mark shall be applied just at the half point between the numbers to be marked.

12.2 Continuos sequential number shall be employed for any single piece of the cable. The accuracy of the length marking shall be within ±1 percent of the limit.

13. Electrical requirements:

13.1 Conductor resistance:

The d.c. resistance of a single conductor and the resistance unbalance between the two conductors of a pair in a completed cable, when measured at 20 degree centigrade shall not exceed the values stated on table 7.

13.2 Insulation resistance:

The insulation resistance measurement shall be made with a potential of not less than 500 V.d.c. After steady electrification for one minute, the insulation resistance of each conductor in the cable, measured with all the other conductors connected to the aluminum tape shall not be less than 10,000 Mohm-km at a temperature of 20 degree centigrade.

13.3 Mutual capacitance:

13.3.1 The mutual capacitance in each completed cable shall be measured at a frequency of 800Hz. During the measurement the aluminum tape with all conductors, other than those under test shall be connected to earth.

13.3.2 The maximum average mutual capacitance for all cables more than 10 pairs shall be 45nfkm. Maximum individual values shall be not more than 53nf/km.

13.4 Capacitance unbalance.

13.4.1 Pair to pair capacitance unbalance measurements shall be made at 800Hz. During the measurement the aluminum tape with all conductors, other than those under test shall be connected to earth.

13.4.2 The capacitance unbalance between pairs shall not exceed the following values per 500-m length of cable.

Pair to pair – 250 pf.

Pair to earth – 800 pf.

The measured values shall be corrected as follows:

The correction is made by dividing the measured capacitance unbalance by.

$$1/2\ (L/5000 + (L/500)\ 1/2$$

Where:

L is the length in meters of the cable under test. Lengths less than 100m being considered as 100m.

Note: - Balancing the cable through shifting of the wires in the pairs is not allowed.

13.5 Dielectric strength:

The dielectric strength of the insulation shall be checked on finished cable.

The insulation between conductors shall withstand a d.c. test voltage not less than the values shown on table 8, at least for three seconds.

Note: - During the dielectric strength test the binding tape shall be floating.

14. **Tests:**

14.1 The manufacturer shall carry out all electrical measurements and mechanical tests, as described in the specification, and send the result to ETC.

14.2 ETC shall reserve the exclusive right to call for schedule of all tests and measurements, or hire inspection and /or test staff in its behalf, and check the results on any test piece (s).

15. **Delivery:**

15.1 The cable shall be delivered tightly rolled on a cable drum of strong construction to

withstand rough handling during transportation and installation. The drum shall be covered with closely fitted battens and are rot proof.

15.2 The cable ends shall be well sealed to prevent moisture ingression and securely tied and well protected during transportation.

15.3 The ends of the cable should be available for test without uncoiling the cable.

15.4 The standard drum length for each type of the cable to be supplied shall be in accordance with length given in table 9.

15.5 The drum shall have big enough inner diameters so that the cable is not damaged when placed in the drum. The inner diameter shall be at least 20 times the diameter over the APL sheath.

15.6 Maximum drum diameter allowed is 2.60 m and maximum width (including bolts) is 1.35 m.

15.7 The drum should indelibly be marked with:Factory name

a) Drum number

b) Cable type and length

c) Gross weight and net weight

d) An arrow applied to show the direction of winding should mark each flange.

16. Certificate:

16.1 Each supplier shall provide ISO 9000 quality assurance certificate with its proposal.

16.2 The certificate to be provided shall be of the latest date.

TABLE 1- COLOR SCHEME WITHIN A 10 PAIR BASIC GROUP

Pair number	Color of conductor insulation	
	A-wire	B-wire
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey

TABLE 2 – CONDUCTOR AND INSULATION DIMENSIONS AND MECHANICAL PROPERTIES

Nominal conductor diameter(mm)	Nominal insulated conductor diameter(mm)	Minimum conductor elongation(%)	Minimum ultimate tensile force of insulation(N)
0.4	0.85	14	1.5
0.5	1.00	14	2.0

TABLE 3- IDENTIFICATION FOR 50 PAIR AND 100 PAIR UNITS USING 10 PAIR BASIC GROUP TYPE

Basic unit number	Color of binder
1	Blue
2	Orange
3	Green
4	Light Brown
5	Grey
6	Blue
7	Orange
8	Green
9	Brown
10	Grey

TABLE 4- LAY-UPOF CABLES UP TO 100 PAIRS

Number of pairs in a cable	Number of 10 pair basic group in the	
	center	layer
10	1	-
20	2	-
30	3	-
50	5	-
100	3	7

TABLE 4- LAY-UPOF CABLES MORE THAN 100 PAIRS

Nominal number of pairs	Number of pairs in a unit	Number of unit(s)			Number of spare pairs
		center	First layer	Second layer	
150	50	3	-	-	2
200	50	4	-	-	2
300	50	1	5	-	3
400	50	2	6	-	4
600	100	1	5	-	6
1200	100	4	8	-	12
1800	100	2	6	10	18

TABLE 6 – THICKNESS OF THE POLETHYLENE SHEATH

Diameter of cable under sheath(mm)	Nominal sheath thickness with moisture barrier(mm)	Nominal thickness of the outer jacket(mm)
Up to-20	1.6	1.6
20.1-25	1.7	1.7
25.1-30	1.8	1.8
30.1-35	1.9	2.0
35.1-40	2.0	2.2
40.1-45	2.1	2.4
45.1-50	2.2	2.6
50.1-55	2.3	2.8
55.1-60	2.4	3.0
60.1-65	2.5	3.2
65.1-70	2.6	3.4
70.1-75	2.7	3.6
75.1-80	2.8	3.8

TABLE 7 – CONDUCTOR RESISTANCE AND RESITANCE UNBALANCE

Conductor diameter(mm)	0.4	0.5
Single conductor resistance mean value (Ω/km)	140	89.5
Maximum resistance of individual conductor (Ω/km)	145	92.5
Resistance unbalance of individual conductor(%)	5	4
Average resistance unbalance of the cable(%)	1.5	1.5

TABLE 8 - DIELECTRIC STRENGTH

Conductor diameter(mm)	Between conductor to conductor (Kv d.c.)	Between conductor to earth (Kv d.c.)
0.4	2.0	10
0,5	2.4	10

TABLE 9 – STANDARD DRUM LENGTH

Number of pairs	Standard length (m)	
	Conductor diameter(mm)	
	0.4	0.5
10	500	500
20	500	500
30	500	500
50	500	500
100	500	500
150	500	500
200	500	500
250	500	500
300	250	250
400	250	250
600	250	250
1200	250	200
1800	200	200

APPENDIX A

LONGITUDINAL WATER PENETRATION TEST

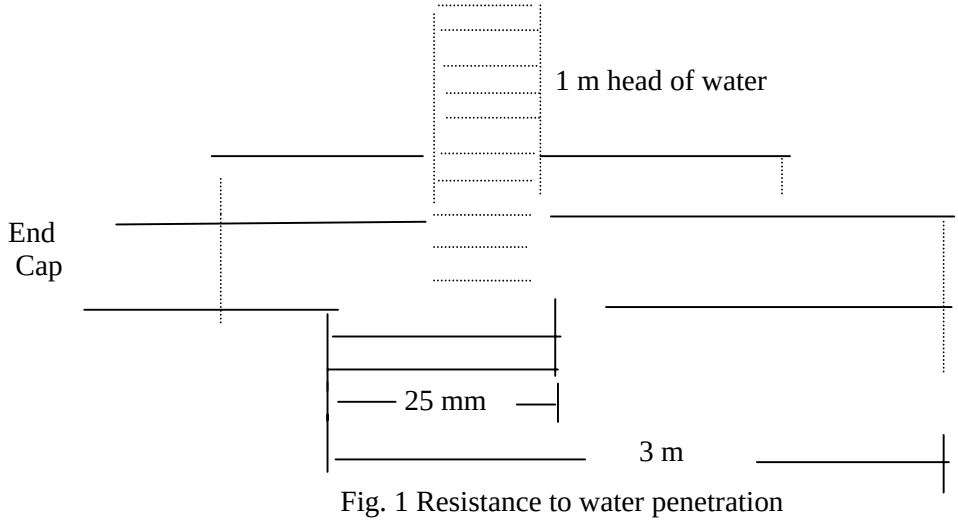

Fig. 1 Resistance to water penetration

A circumferential portion of sheath and wrapping 25 mm wide shall be removed from one end of a 3 m length of cable and a watertight sleeve shall be applied over the exposed core so as to bridge the gap in the sheath. The sleeve shall not be placed over the gap so tightly that the flow of water through preexisting voids of air space within the core is restricted.

The cable shall be placed horizontally and loaded with a pressure corresponding to a 1 meter head of water containing a sufficient amount of water soluble fluorescent dye for the detection of seepage shall be applied to the core 2x24 hours at a test temperature between 15 and 25 degree centigrade.

The sheath shall then be removed and the core carefully dissected and examined under ultraviolet light for water penetration.

No dye shall be detected when the end of the 3m length is examined for cracks.

Aerial Cable Specification

The specification covers the construction properties, testing and packing of figure 8 self-supporting polyethylene insulated polyethylene sheathed cables.

1. Construction

1.1 Conductor

Annealed solid cooper wire.

Diameter; as shown in Table 1

1.2 Insulation

Colored solid polyethylene

Material of insulation; High-density polyethylene

Nominal thickness: 0.4 mm dia. : 0. 21 mm

0.5 mm dia. : 0.24 mm

O.6 mm dia. 0.38 mm

1.3 Twisting

Conductor file shall be twisted in pair type.

1.4 Pair identification

As shown in Table 2.

1.5 Stranding

1.5.1 Unit

10 pairs shall be assembled into a unit

Colored polyethylene tape binder as shown shall identify each unit

Table 3-1.

1.5.2 Cable

The cable shall be formed with units in accordance with Table 3-2.

1.6 Core Covering

The cable shall be wrapped with one or more suitable tape

Helically and/or longitudinally with an overlap.

1.7 Supporting Steel Wire

Material: Galvanized steel wire

Size: 7 Strands of 1.2-mm dia. galvanized steel wire.

1.8 Polyethylene Sheath

The cable core and the steel wire shall be covered and be connected

To form figure 8 cross-section.

Material sheath: Black weather resistant low-density polyethylene.

Dimension: As shown Table 4.

1.9 Marking

1.9.1 The name of manufacturer and year of manufacture shall be printed on a sheath.

1.9.2 Length: Interval: 1m.

Accuracy: +1%.

2. Electrical Properties at 20^0C

2.1 Conductor Resistance: As shown in Table 1

2.2 Mutual Capacitance: Ind. mzx.64 nF/Km at 1000 Hz

: Ave. max. 56 nF/km at 1000 Hz

2.3 Insulation Resistance: Min. 8,000-m. km

2.4 Capacitance Unbalance: Ave. max. 800 pF/1000m

2.5 Dielectric Strength: 0.4 mm dia.: 2.400 V/D.C. for 2 sec.

Between Conductors 0.5-mm dia.: 3,000 V/D.C. for 2 sec

0.6 mm dia.: 3,600 V/D.C. for 2 sec.

3. Physical and Mechanical Properties

3.1 Tensile Strength and Elongation As shown Table 5.

3.2 Aging Test: As shown in Table 5

3.3 Bending Test: As shown in table 5

4. Packing

Wooden Drum

Table 1. Conductor Diameter and Conductor Resistance

Conductor Diameter (mm)			Conductor Resistance (/km)	
Nom.	**Min.**	**Ind.**	**Max. Ave.**	**Max.**
0.4	0.425	0.385	150	145
0.5	0.525	0.485	96	92
0.6	0.625	0.585	68	64

Table 2. Color Scheme, within a 10 pair Unit

Pair Number	Color of Conductor	
	A-wire	B-wire
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey

Table 3-1. Identification for 10 Pair Unit Binder

Unit Number	**Color of Binder**
1	Blue
2	Orange
3	Green
4	Brown
5	Grey
6	White
7	Red
8	Black
9	Yellow
10	Violet

Table 3-2 Make - Up of Cable

Number of Pairs In Cable	**Number of Units (s) in the Center Ist Layer**	
10	1	-
20	2	-
30	3	-
50	5	-
100	3	7

Table 4. Physical Dimensions

Number and Dia. Of Conductors	Nominal Sheath Cable Core	Thickness (mm) Suspension (mm) Strand	Approx Dimension (mm) D	D	H
10x2x0.4	1.0	1.3	6.2	7.3	17.0
29x2x0.4	1.0	1.3	6.2	9.4	19.1
30x2x0.4	1.1	1.3	6.2	10.8	20.5
50x2x0.4	1.2	1.3	6.2	13.4	23.1
100x2x0.4	1.3	1.6	6.8	17.8	28.1
10x2x0.5	1.0	1.3	6.2	7.9	17.6
20x2x0.5	1.1	1.3	6.2	10.2	19.9
30x2x0.5	1.1	1.3	6.2	11.8	21.5
50x2x0.5	1.2	1.3	2	14.7	24.4
100x2x0.5	1.4	1.6	6.8	9.9	30.2
10x2x0.6	1.1	1.3	6.2	9.2	18.9
20x2x0.6	1.1	1.3	6.2	11.7	21.4
30x2x0.6	1.2	1.3	6.2	13.9	23.6
50x2x0.6	1.3	1.6	6.8	17.2	27.5
100x2x0.6	1.5	1.6	6.8	23.4	33.7

d: Dia. of Sheathed Strand
D: Dia. Of Sheathed cable
H: Total Height of Sheathed Cable
Width of Web: 2.6 mm Nominal
Height of Web: 3.5 mm Nominal

Table 5. Physical and Mechanical Properties

Item	Properties	
Tensile Strength	Insulation : Min. 15.000 kpa Sheath: Min. 10.000 kpa	
Elongation	Conductor:	Min.
	: 0.4 mm dia.	: 14 %
	: Min. 0.5 mm dia.	: 14 %
	: Min. 0.6 mm dia.	: 18 %
	Insulation : Min. Sheath:	 :250 % Min. 300 %
Aging Test 90^0C. 96 Hrs	Insulation: Sheath: Min.	Min 80 % 80 %

4) Tests

4.1) Bending Test

No Visible Crack on Sheath Surface after 3 times bending with bending radius 6 times of cable dia.

4.2) The manufacturer shall carry out all electrical measurements and mechanical tests, as described in the specification, and send the result to ETC.

4.3) ETC shall reserve the exclusive right to call for schedule of all tests and measurements, or hire inspection and /or test staff in its behalf, and check the results on any test piece (s).

5) Delivery: -

5.1) The cable shall be delivered tightly rolled on a cable drum of strong construction to withstand rough handling during transportation and installation. The drum shall be covered with closely fitted battens and are rot proof.

5.2) The cable ends shall be well sealed to prevent moisture ingression and securely tied and well protected during transportation.

5.3) The ends of the cable should be available for test without uncoiling the cable.

5.4) The standard drum length for each type of the cable to be supplied shall be 500m.

5.5) The drum shall have big enough inner diameters so that the cable is not damaged when placed in the drum. The inner diameter shall be at least 20 times the diameter over the APL sheath.

5.6) Maximum drum diameter allowed and the bidder shall specify maximum width (including bolts).

The drum should indelibly be marked with:

a) Factory name

b) Drum number

c) Cable type and length

d) Gross weight and net weight

e) An arrow applied to show the direction of winding should mark each flange.

6) Certificate:

6.1) Each supplier shall provide ISO 9000 quality assurance certificate with its proposal.

6.2) The certificate to be provided shall be of the latest date.

Specification for Drop Wire

1. Scope

Drop wire is used for connecting distribution boxes (terminal boxes) and subscriber premises equipment.

2. Technical Requirement

2.1 Each conductor shall consist of copper-covered steel wire complying international standards of nominal diameter 0.81mm; grade1, 30% of conductivity.

2.2 Two conductors shall be laid up parallel and insulated with PVC to form a figure “8” cross-section to the dimension which shall be provided by the supplier.

2.3 The nominal thickness of insulation on each conductor shall be 1.02mm and it shall be not less than 0.79mm at any point. The supplier shall state the nominal thickness of insulation.

2.4 The color of the insulation jacket shall be black or gray. A molded ridge at one side of the jacket shall be applied for identification of cores.

2.5 The mean and maximum conductor resistance of a single conductor at 20 degree centigrade shall be provided by the supplier.

2.6 The minimum insulation resistance at 20 degree centigrade after being kept in water for 24 hours shall be 5000 MΩ/Km.

2.7 The minimum breaking strength per conductor shall be provided by the supplier.

2.8 The mutual capacitance per Km at 800 Hz shall be provided by the supplier.

2.9 The net weight per kilometer shall be provided by the supplier.

3. Delivery

3.1 Drop wire having a length of 250 m shall be formed in coil with a nominal eye size of 300 mm.

3.2 Each coil shall be protected with a layer of hassion or an equivalent material

3.3 Eight coils shall be packed in card boxes.

3.4 Each coil shall be marked with metal or plastic label noting the following:

- Type and diameter of drop wire.
- The length & weight of the coil
- The manufacturer’s name
- The date of manufacturing

Technical Specification for Heat Shrinkable Splice

Closure

1) Scope

This Specification describes the essential requirements for a complete system of Heat Shrinkable splice closure and end caps intended for environmental and mechanical protection for air cored and petroleum jelly filled local telephone cable for duct and direct buried application.

2) General requirement

The splice closure system consists of an inner supporting liner combined with heat shrinkable adhesive pre-coated parts assuring a bond to supporting liner and to the extended cable ends. The splice case is either re-enterable or removable for repair of the splice. Reclosure is completed by a wrap-around , or a new heat shrinkable spice closure system. Branch- off clips for branching cables and earth continuity clip assembly shall be available.

2.1 The Heat shrinkable parts used in the kits shall be manufactured from a cross-linked thermally stabilized, modified polyolefin material.

2.2 The inner heat shrinkable parts shall completely be coated with a flexible heat activated adhesive. Particles with a thin plastic removable sheet.

2.3 The whole part shall be capable of being stored at a temperature of at least as high as +60 and as low as -30°c.

2.4 The heat shrinkable parts shall be coated with a temperature indicating point which disappears when the proper boldline temperature have been reached.

2.5 Dimensions of major parts shall be provided by the supplier.

2.6 The closure channel shall be manufactured from stainless steel in accordance with DIN 17740(mat. 1.4303)

2.7 The alloy of the branch - off clip shall be Mg 9, Al, Mg 35 or equivalent. The clip shall be protected by a thermo hardening coating. The coating shall be bonded to the clip.

2.8 The complete splice closure system shall be supplied in kit, which consists all-important parts, and ancillaries as indicated below. Other necessary parts could be included in the kit:

- Heat shrinkable sleeve
- Metal canister

- Flexible channel, retention clip
- Abrasive strip
- Cleaning cloth
- Shield continuity
- Armour continuity
- Aluminum cable tape
- Self-sheathing
- Branching clip (Three, for branch joints only)
- Drying agent
- Instruction leaflet

3. Delivery

3.1 Each kit shall have a label with the following information:

- Supplier’s Name
- Product Designation
- Batch Number
- Order Number

Technical Specification for Rigid Polyvinyl Chloride (PVC) Pipe

1. **The pipe shall have the following features**

- Impact Resistant
- Resistance against corrosion /Frost
- Low weight
- Coupling joint system 100% water resistant

2. **Material**

2.1. The pipe shall be manufactured by extraction process from a material composed of polyvinyl chloride (PVC) polymer to which suitable additives are added.

2.2. The PVC compound shall contain stabilizer, lubricant and pigment consisting of 5-6 parts per 100 of polymer.

3. Requirements

3.1. The pipe shall have smooth outside and inside surface and shall be free from injurious flaws, streaks, cracks, twists, and other defects.

3.2. Both ends of the pipe shall be cut exactly perpendicular to the pipe axis and shall be free form clips and rough edges.

4. **Dimensions**

Outside diameter	110mm
Inside diameter	100 mm ± 0.5mm
Length (including coupling)	6000mm
Tolerance for length	± 10mm
Wall thickness	5.5mm
Tolerance for wall thickness	+0.5

4.1 the socket in one end (10cm length) shall be coupled with another pipe by applying Adhesive with solvent cement.

4.2 The dimensions of the pipe are attached herewith.

5. Properties

5.1. It is indicated in the attached drawing

5.2. The properties of the pipe shall be in accordance with relevant international standards.

6. Color

6.1 The color of the pipe shall be gray.

RIGID POLYVINYL CHLORIDE (PVC) PIPE

Outside Diameter	110mm
Tolerance for Mean outside diameter	+03mm, -0mm
Tolerance for Length	±10mm
Wall Thickness	5.5mm
Tolerance for wall Thickness	0.5mm-0mm
Color	Gray
Specific Gravity (gr/cm3)	1.40-1.45
Water Absorption (mg/ cm2)	Maxo.06
Tensile Strength (kg/cm2)	Min500-550
Elongation at Break %	Min40
Compressive Strength (kg/cm2)	Min600
Modulus of Elasticity (kg/cm2)	30,000
Hardness (kg/cm2)	Min90
Impact Strength (kg.cm/cm2)	Min3

Specification for PVC duct Spacer

The Spacer shall be made of plastic or similar materials. The dimension and forms of the spacer is shown in bellow.

Specification for Adhesive

The Adhesive to be used on PVC pipes shall be made of vinyl chloride resin or polymer based vinyl chloride, dissolved in a suitable solvent. The Adhesive shall be packed in tin can or suitable material of lkg capacity. The bidder as mandatory shall provide the shelf life of the adhesive with its suitable solvent and other relevant technical details.

Specification for Rubber Plugs and Sealing Materials

The rubber plugs shall be able to seal all new PVC ducts and vacant pipes (ducts) in manholes and chambers completely. It shall be made of suitable material and the dimension should fit exactly the rigid PVC Pipe. The bidder shall propose a proper Sealing Material for the ducts with cable in order to stop possible water flow.

Specification for Rigid PVC bend pipe

The properties shall be the same as that of rigid PVC pipe, however the bend PVC pipe shall be provided with 90° angle 800mm bending radius and straight lengths of 400 mm and 150mm at both ends of the pipe.

Specification for Warning Tape

The warning tape to be used for telecommunications outside plant cable network shall be made of

polyethylene tape having width of approximately 15 cm and minimum thickness of 0.15mm The tape is a pigmented polyolefin film with a printed message on one side. The ink used to print the material is permanent and cannot be removed by normal handling or upon underground burial. The polyethylene is chemically inert and will not degrade when exposed to alkalis. The tape shall be orange in color and shall be durably printed with letters indicating telephone facility of Ethiopian Telecommunications Corporation (ETC) and attention in English at intervals of one meter for example.