



# FTTH Network Installation Guide and Mobile Requirements

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[www.etisalat.ae/FTTHguides](http://www.etisalat.ae/FTTHguides)





## Table of Contents

1	Introduction	2
2	Test equipment and installation tools	5
3	FTTH components recommended brands	8
4	Product Approval Certification	9
5	FDH Installation and fibre cable termination	10
6	Multicore riser termination in mini ODF	18
7	Outdoor fibre distribution installation	20
8	Fibre drop cable installation	26
9	Fibre optic cable connector installation	27
10	Termination of fibre drop cable in micro ODF	30
11	UTP cable installation and termination	31
12	Fibre optic testing	35
13	UTP cable testing	38
14	Safety in working with optical fibre	39
15	Mobile requirements	43

# 1. Introduction

This document is intended to serve as a general guide for installing and termination of in-building network, including testing procedures. The contractor/installer must always refer to manufacturer's specifications and instructions for high quality standard installations.

Updates of this document are likely, as more FTTH components are introduced in the field with improved specifications and installation technique.

## The document covers the following topics:

- Test equipments and installation tools
- FTTH Components recommended brand
- Product approval certification
- Direct fibre architecture termination
- Multicore riser termination
- Outdoor cable (loose tube) termination in indoor FDH and Drop closure
- Drop fibre cable termination in mini ODF & micro ODF
- Fibre drop cable installation
- Installation of fast-field connector
- UTP cable installation and termination standard
- Fibre and UTP testing
- Safety in Handling Fibre Optic cables
- Mobile requirements

## Version Control

Version No.	Reason	Date
1.0	New document	04.04.12
1.2	FO drop cable installation added	16.04.12
1.3	Revised RJ45 connector installation procedure	01.05.12
1.4	Outdoor fibre distribution added	14.05.12
1.5	Recommended brand list updated Product approval process added	16.07.12
1.6	Mobile requiremnts	26.11.12

## References:

- Etisalat FTTH Development Manual
- Etisalat O&M Manual
- Nexans snap-in connector installation guide
- Net-rite Ethernet cable tester

## Design Guide Changes "Highlights/Key points"



FTTH Network Installation Guide and Mobile Requirements is a support document to **Design Guide for Fiber-to-the-Home (FTTH) Requirements in New Buildings**.

As a quick reference, the changes made in Etisalat Design Guide for FTTH Requirements in New Buildings are summarized below, emphasizing the building owner responsibility and requirement changes.

Description	Change in size or dimension/New Requirements	Responsibility
CIVIL REQUIREMENTS:		
• Entry box	Size changed	Building owner
• Entry pipe (lead-in pipe)	Size & Qty. changed	Building owner
• Main telecom room	Size changed	Building owner
• Indoor equipment cabinet (including its accessories)	New	Building owner
• Mobile-service room	New	Building owner (if required)
FTTH REQUIREMENTS:		

• FDH Cabinet and unrack modules (splitters, patch panel, patch cords) including installations	New	Building owner
• Multicore fibre cable (for riser cabling) including installation, termination and testing	New	Building owner
• Fibre drop cable including installation, termination and testing	1F or 2F	Building owner
• Structure ID Plate including printing of FTTH details	New	Building owner
FIBRE FOR MOBILE TELECOM:		
• Multicore fibre cable including installation, termination and testing	New	Building owner (if required)
• Mini-ODF including installation and termination	New	Building owner (if required)
OTHERS:		
• Fire extinguishers (in telecom rooms)	New	Building owner

## 2. Test Equipments & Installation Tools

### 2.1 Test equipments



- **Optical Time Domain Reflectometer (OTDR)**

OTDR provides various applications such as normal (point-to-point) fibre cable construction testing and fault location, splice verification, quickly locate breaks or measure fibre length as well as measure optical power (1310, 1490 & 1550 wavelengths) or fibre loss, to name a few.



- **Power Meter**

Used to measure the received optical power and it is a standard tester in a typical FO technician's toolkit.



- **Light Source**

Provides continuous wave and stable source of energy for attenuation measurements, fibre tracing and macro bend identifying.



- **Multi-network Cable Tester**

Verifies cable continuity, polarization, mis-wiring and others.



- **Fibre Optic Inspection Scope**

Provides clear inspection of connector end faces for damage and debris.



- **Copper Cable Tracer**

A device used to identify conductive cables and locating faults.

### 2.2 Installation tools



- **Cable Cutter**



- **RJ45/RJ11 Universal Crimping Tool**



- **Universal Stripping Tool with UTP Cartridge**



- Universal Comfort Tool



- IDC Punch Down Tool



- Side Cutter

### 2.3 Fibre Cleaner



- Fibre Connector Cleaner Reel



- Pen-Style Fibre Cleaner

## 3. FTTH Component Recommend Brands

In-building network performance not only relies on the kind of installations made, but also depending on the quality of the components used in a building. At present, some of the leading brands of FTTH components used by Etisalat are listed below.

Local and International supplier for the following brands can be inquired from Etisalat, when needed.  
Note: List will be revised yearly if required.

### FDH Cabinet

- Corning
- Canovate
- Samsung
- PCT
- Huawei

### Optical Splitter

- Huawei
- Samsung
- R&M
- PCT (Pearl Communication Technology)
- Canovate
- Fiberon – USA
- Lindsay & Cube Optics - Germany

### Optical Patch Panel

- R&M
- DME ProLink
- Canovate
- Huawei
- PCT

### Mini ODF

- Canovate
- R&M
- PCT

### Micro ODF

- Comtech
- PCT
- Paragon

### Multicore Cable

- Corning
- Sumitomo
- Fujikura

### Fibre Drop Cable

- Fujikura
- Sumitomo
- Corning
- Prusman
- Sterlite

### Patch Cord

- Canovate
- Fostec
- Corning
- Sumitomo
- Fujikura
- Fiberon
- PCT (Pearl Communication Technology)
- R & M

### SC/APC Adaptor

- Samsung
- Corning
- Sumitomo
- 3M
- Fujikura
- Canovate

### SC/APC Fast-Field Connector

- Fujikura
- Sumitomo
- Corning

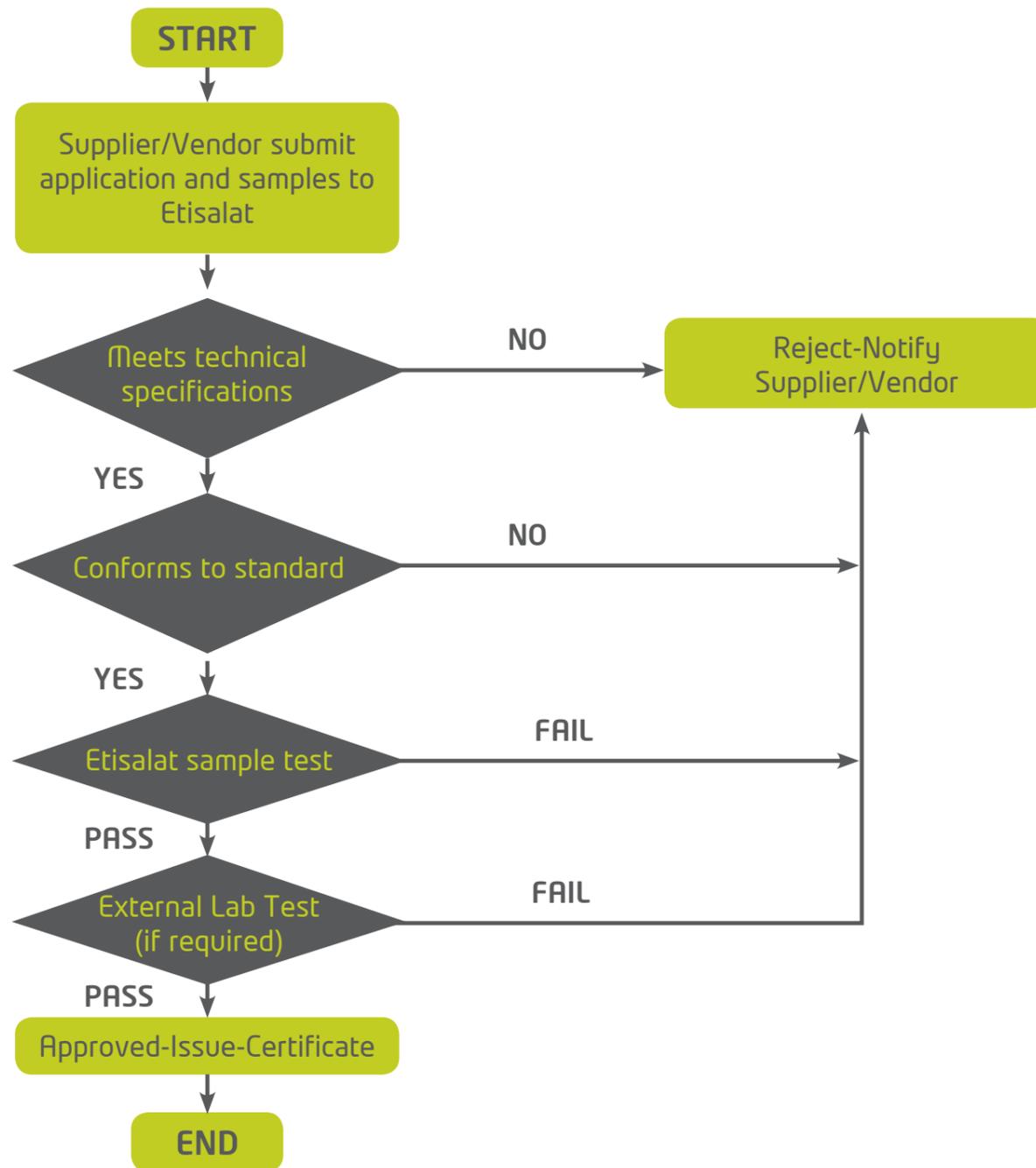
### Outdoor Drop Closure

- 3M
- Sumitomo

## 4. Product Approval Certification

FTH components that are not in Etisalat recommended brands must be certified through "Product Approval" process as shown below before the building owner/developer can purchase and install.

### 4.1 Product Approval Process



### 4.2 Product Approval Application form

EMIRATES TELECOMMUNICATION CORPORATION

Application for Product Approval



#### A. COMPANY PROFILE

Company Name .....

Previous Authorisation if any .....

Address .....

P.O.Box ..... Emirate .....

Street ..... City .....

Web site .....

Authorised Signatory Name .....

Designation .....

Tel: ..... Mob: .....

Fax: ..... Email: .....

Single point of contact .....

Designation .....

Tel: ..... Mob: .....

Fax: ..... Email: .....

**B. PRODUCT INFORMATION**

Product Name .....

Product Category ( Select from the list-Section D) .....

Model No. ....

Part No. ....

Manufacturer Name .....

Manufacturer Address .....

Manufacturing Country .....

(In case of multiple manufacturing units, specify the country from which import is intended)

Conforming Standards .....

Brief Product Description .....

**C. DECLARATION BY APPLICANT**

I hereby declare that all the information and documentation provided in this application are correct. On authorisation of the product, me and my organisation will abide and follow the standards and conditions specified by Etisalat, TRA and UAE Government on the import, sale and deployment of the product. I authorise Etisalat to conduct third-party tests on the product. All expenses thereof shall be borne by me and my organisation.

I have understood that the mis-use of the authorisation obtained for one product for another will result in the forfeiture of the authorisation.

Name ..... Designation .....

Signature ..... Company Stamp .....

**D. PRODUCT CATEGORIES**

FDH Cabinet - Floor Mount .....

PFDH Cabinet - Wall Mount .....

Mini ODF .....

Micro ODF .....

PLC Splitter .....

Unirack Module ( Patch Panel) .....

Pig Tail .....

Patch Cord .....

Fibre Optic Drop Cable .....

Fibre Optic Connector .....

Fibre Optic Bulkhead Adapter .....

Others (Specify) .....

**E. TEST LAB REPORT (For Official Use Only)**

**F. AUTHORISATION DETAILS (For Official Use Only)**

Supplier Reg. No. .... Product Registration No. ....

Certificate No. .... Date .....

Authorised Signatory ..... Stamp .....

## 5. FDH Installation and Fibre Cable Termination

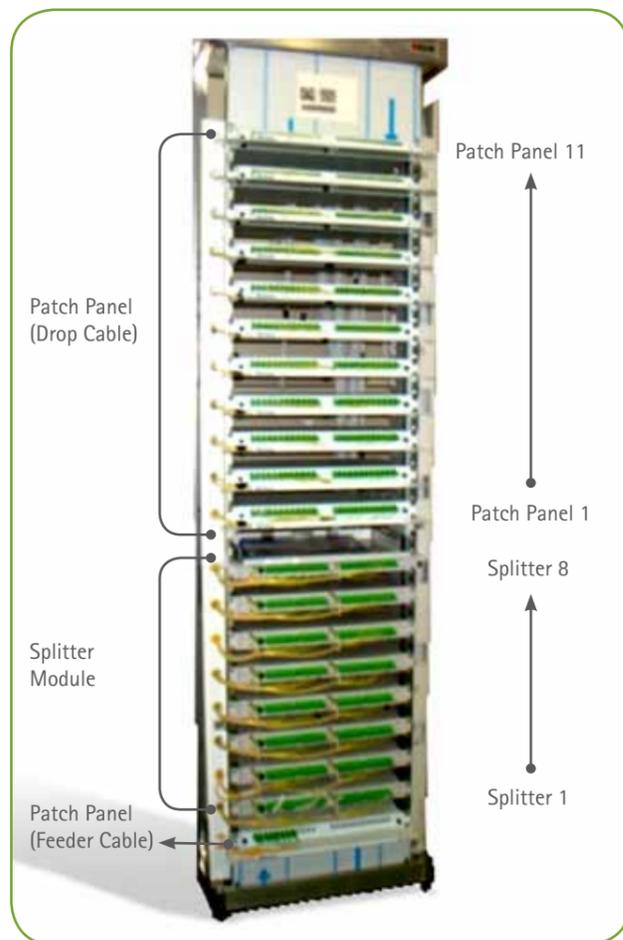
### 5.1 One 42U Rack frame cabinet, free standing

Single rack frame cabinet is recommended for buildings with tenancies ranging from 100 to 256 where all optical modules shared.

This type of FDH is an empty cabinet where the following 19" rack mountable optical modules and accessories are required.

- Optical patch panel for main or feeder cable and fibre drop cable
- Optical Splitter
- Patch cord
- SC/APC adaptors

#### Optical Module Placements

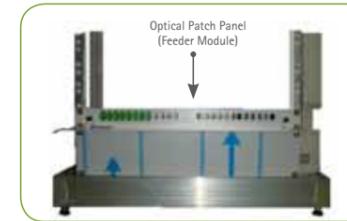


#### FDH Cabinet Installation

Install the rack frame according to the instruction guide that comes with the item. Keep it sturdy and maintain a suitable working distance within the main telecom room.

#### Optical Module Installation

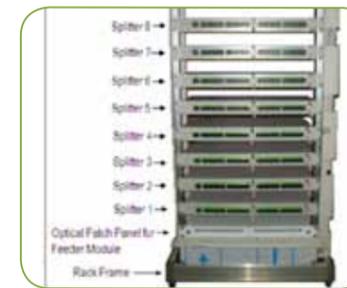
##### Patch Panel for feeder or main cable



- Install the patch panel at the bottom part of the cabinet. All unused ports must be fitted with SC/APC adaptors with caps to avoid ingress of dust
- Etisalat will provide the feeder or main cable including fusion splicing and termination in the patch panel

##### Optical Splitter

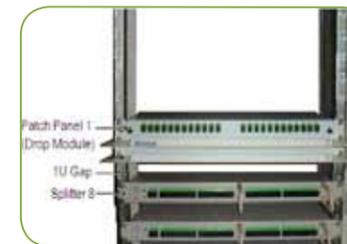
- Install the splitter after the patch panel for main cable. Keep 1U gap in between modules.



##### Patch Panel for drop fibre cable



- Both patch panels for main or feeder cable and for fibre drop cable are similar. In order to make more room for drop cable movements when opening and closing, the splice cassette must be removed including screw studs



- The patch panel for fibre drop cable must be installed after the last splitter or in 20U mark of the cabinet
- Keep 1U gap in between modules



##### Access holes in trunking

- Drill a 38mm diameter holes in the trunking. The number of holes depends on the number of patch panel to install

Note: The holes must be in-line with the patch panel.



### Fibre Cable Arrangement in trunking

- For direct fibre distribution, arrange the cable in the trunking as shown. Keep enough cable loops
- For multicore riser distribution, keep enough cable loops as well in the trunking



### Cable arrangement in patch panel

- Insert the cable in the access hole then to the patch panel. Mark the cable at least 1 meter from the patch panel entry point. Then cut the excess cable lengths



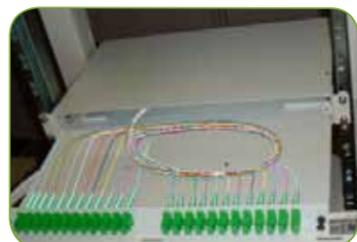
- For direct fibre distribution - Arrange the drop cables in circular loops in the patch panel, and then install SC/APC connector. Make sure to clean the before connecting to SC/APC adaptor

Note: It is important to test the cable using visual light fault locator in order replace any faulty cables



- Install spiral plastic wrap and cable tie to secure the cables in the patch panel

Note: Don't pull the cable tie too tight that may result to fibre cable damage.



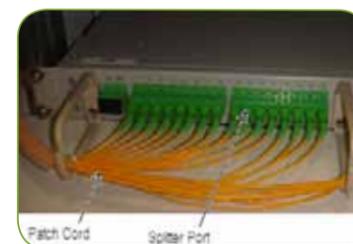
- For multicore riser distribution- Arrange the cable in circular loop. Remove the cable outer sheath and prepare the individual cable for connector installation. Clean connector and connect to SC/APC adaptors based on EIA/TIA 598 fibre color codes

Note: For termination of multicore in floor telecom room, refer to "multicore riser termination in mini ODF".



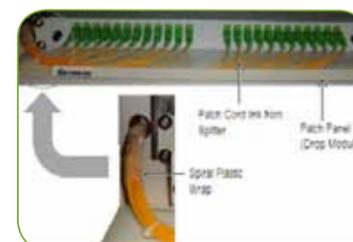
### Additional trunking for patch cord

- Install additional trunking (50mm X 100mm) on the left portion of the cabinet. Patch cord from splitter output to patch panel for fibre cable drops will be routed here
- Provide an access hole (38mm) in the trunking. The holes must be in-line with the splitter and patch panel modules

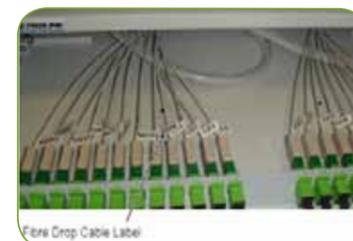


### Patch Cord installation

- Using appropriate patch cord lengths connect splitter output ports to corresponding patch panel ports. Route the patch cord in the trunking



- Secure the patch cord using spiral plastic wrap and Velcro strap



### Labeling

- Provide the necessary labels to patch cords, multicore cable, fibre drop cables and optical modules

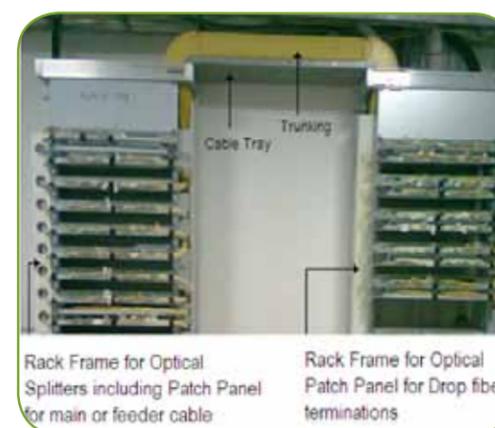
Note: Fibre connection details must be provided for easy identification of the cable from and to connections.



## 5.2 Two 42U Rack frame cabinet, free standing

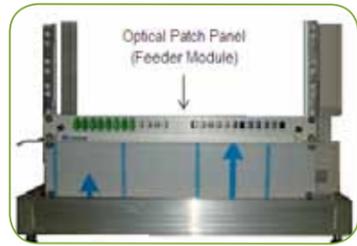
This type of set-up is recommended for buildings with tenancies between 256 and 480. Optical splitter module and patch panel modules are in two separate rack frame.

### Module Placements



Two Rack Frames must be linked by a cable tray where trunking for patch cords will be routed. The frame must be at least 1 meter apart.

## Optical Module Installations



### Patch Panel for Main Cable

- Installation of patch panel for main or feeder cable must be at Rack Frame 1 and at the bottom location
- Etisalat will provide the feeder or main cable including fusion splicing and termination in the patch panel

### Optical Splitter

- Splitters must be installed in Rack Frame 1 after the Patch Panel for main cable. It must be installed with 1U gap in between modules.

Note: Maximum 15 splitter modules can be installed in Rack Frame.

### Patch Panel for Fibre Drop Cable

Installation of Patch Panel for fibre drop cable termination must be at Rack Frame 2. The order of installation starts at the bottom going up.

Note: Maximum 20 Patch Panel modules can be installed in one Rack Frame.

### Patch Panel Preparation



- Remove the splice cassette including the screw studs in order for the drop cable to move freely when sliding the patch panel

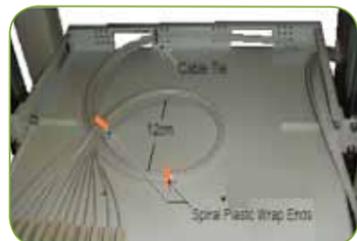
### Cable arrangement in patch panel

In this case, the trunking will be used for Patch Cord routing and management. The cable will be routed at the back of the rack frame.



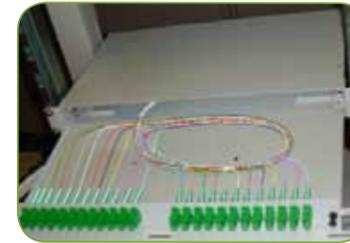
- For direct fibre distribution- Arrange the cable in circular loops in the patch panel, and then install SC/APC connector. Make sure to clean the before connecting to SC/APC adaptor

Note: It is important to test the cable using visual light fault locator in order replace any faulty cables.



- Install spiral plastic wrap and cable tie to secure the cables in the patch panel

Note: Don't pull the cable tie too tight that may result to fibre cable damage.



- For multicore riser distribution- Arrange the cable in circular loops as well. Remove the outer cable sheath and prepare cable for connector installation
- Install SC/APC connector. Clean connector then connect to SC/APC adaptor of the patch panel based on EIA/TIA 598 fibre color codes

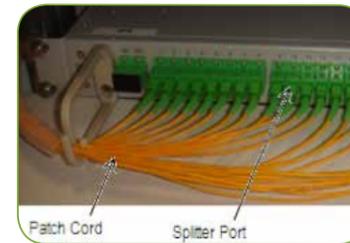
Note: For termination of multicore in floor telecom room, refer to "multicore riser termination in mini ODF".

### Additional trunking for patch cord

- Install additional trunking in both frames where patch cords will be routed. Then drill an access hole to the trunking.

Note: Holes must be in-line with the optical modules.

### Patch Cord installation



- Using appropriate patch cord lengths connect splitter output ports to corresponding patch panel ports. Route the patch cord in the trunking. Then secure it using spiral plastic wrap and Velcro straps.

Note: Etisalat will provide and install the patch cord linking the patch panel for main cable up to splitter inputs.

### Patch Cord routing



- In rack frame cabinet 1, patch cords from splitters to patch panel for fibre drop cable/multicore riser to be routed on the trunking located at the right side of the frame.
- In rack frame cabinet 2, patch cords will be routed as per the following;
- Patch Panel 1 to 10 – patch cord to route on the left side trunking
- Patch Panel 11 to 20 – patch cord to route on the right side trunking

### Labeling

Provide all the necessary labeling to cables, patch cords and optical modules. Also, fibre connection details must be provided.

### 5.3 Wall-mount FDH Cabinet with modular splitter

The type of FDH shown in this installation is 128-port capacity cabinet with 1 pre-installed splitter.



#### Cabinet mounting

- Select the appropriate location for the cabinet. Using a drawing template, mark the wall where the holes are to be drilled.
- Fix the cabinet using anchor bolts that comes with the cabinet and securely tighten it.

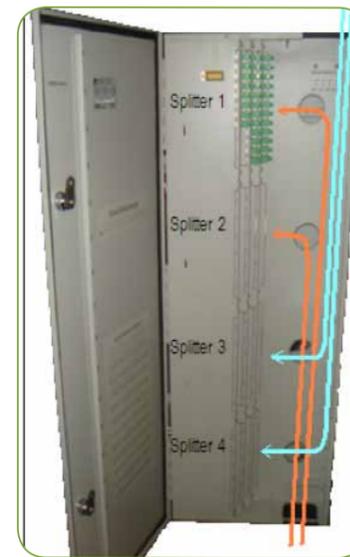


#### Cable tray for cable loops



- Since the design of the cabinet is a two layer, suitable cable loops must be maintained and must be released to avoid strain on the cable when accessing the splitter part of the cabinet
- Install cable tray both on top and at the bottom side of the cabinet location. Entry point for fibre drop cable shall be at the top and at the bottom of the cabinet

#### Fibre cable arrangement



- Route the cable into the cabinet as shown based on the splitter number to connect to
- Arrange the cable in the tray in circular loops as shown. Secure the cables using Velcro strap



- Arrange the cable in the tray in circular loops as shown. Secure the cables using Velcro strap



#### Installation of connector & labeling

- Cut the excess cable lengths then install SC/APC connector. Then test the cable using visual fault locator and replace faulty cables
- Clean connector first before connecting to cabinets SC/APC adaptors. And provide cable labeling

## 6. Multicore Riser Termination in Mini ODF

Termination of multicore cables must be based on EIA/TIA 598 fibre color codes.

Buffer Tube/Fiber	Color
1	Blue
2	Orange
3	Green
4	Brown
5	Grey
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua
13	Blue with Black Dash
14	Orange with Black Dash
15	Green with Black Dash
16	Brown with Black Dash
17	Gray with Black Dash
18	White with Black Dash
19	Red with Black Dash
20	Black with Yellow Dash
21	Yellow with Black Dash
22	Violet with Black Dash
23	Rose with Black Dash
24	Aqua with Black Dash

### Multicore riser cable Installations

- Install the cable from the FDH up to mini ODF location in the floor telecom room.



- Install the mini ODF in the designated floor telecom room. Arrange the cable, mark and cut the excess lengths



### Cable preparation & connector installation

- For better working position, remove the mini ODF from the wall and put it on the table.



- Remove the cable outer sheath and prepare individual fibres for connector installation



- Install SC/APC connector to individual fibre



- Connect the fibres in the SC/APC adaptors according to individual port assignments.



- Re-install the mini ODF in its previous location and provide cable labeling

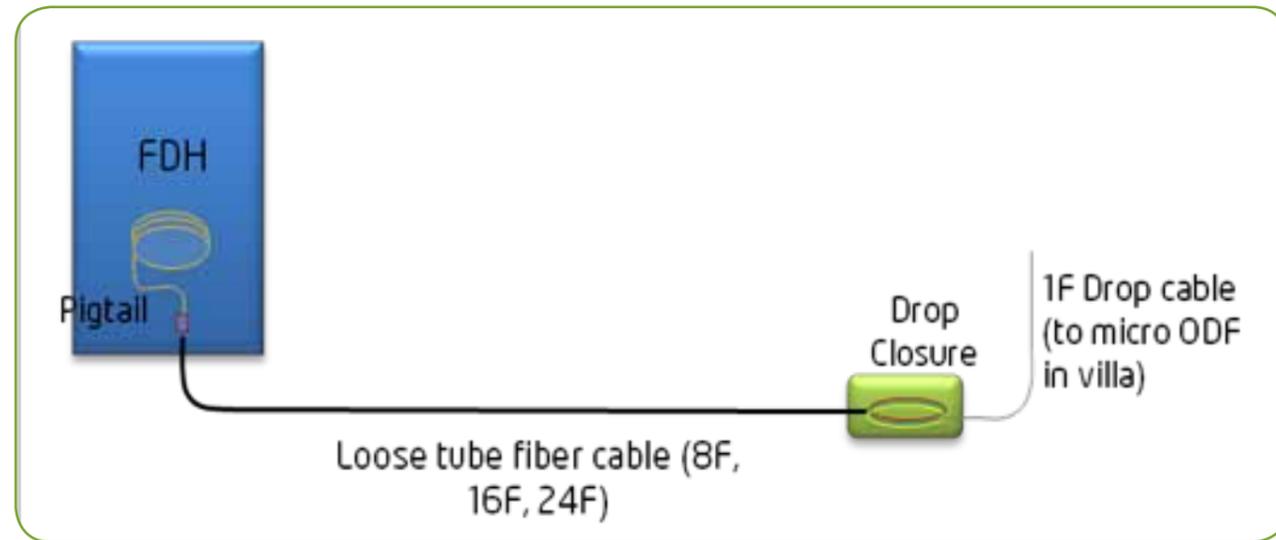
Note: For drop cabling to each flat, fibre drop cable to be pulled from the designated mini ODF up to indoor equipment cabinet.

## 7. Outdoor Fibre Distribution Installation

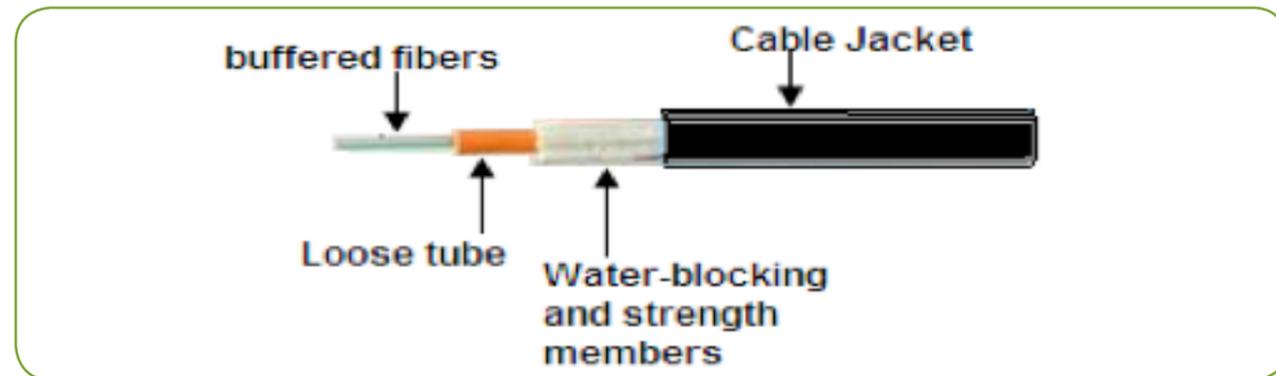
Installing distribution cables in complex of villas or compound for 20 villas or more may be necessary. This is to avoid long span of drop cable to be pulled from FDH to individual villa.

The installation scenario is for indoor FDH in the main telephone room and drop closures provisioned in the manhole within the compound serving several villas.

### Schematic diagram for outdoor fibre distribution



### Loose tube cable-outdoor type



### Wall-mount type indoor FDH for outdoor distribution

This type of wall-mount FDH is recommended if an outdoor distribution is required. This is due to rack mountable patch panel and splitter can be installed.

In case, different type of wall-mount FDH will be used, then a mini ODF may be required in order to keep the splices of the distribution cable.

- 19" rack mountable
- Removable side door, easy installation and maintenance
- Double section structure

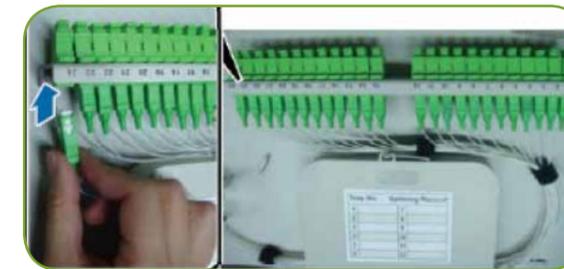
### Installation

- Fix the cabinet and install the following 19" unrack modules;
  - Optical patch panel for feeder module
  - Optical splitter
  - Optical patch panel for distribution cables
- Pull the fibre distribution cable (loose tube-type) from the FDH up to the proposed location of the drop closure.
- Keep enough cable loops in the manhole where the drop closure is placed. This is to enable drop closure movement during fibre drop cable fusion splicing.

Notes: Ensure that the allowable length of outdoor cable from the telephone room point of entry up to the FDH locations should not exceed 15 meters.

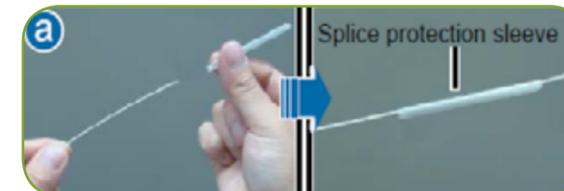
Also, specified bending radius must be observed when installing the fibre.

### Distribution cable preparation & splicing in FDH patch panel



- Measure and mark the cable required to route in the FDH cabinet and into the patch panel
- Remove the cable jacket, and cut the strength member. Then secure the cable with cable fastener in the FDH
- Route the protective tube into the splice cassette and ready for fusion splicing
- Insert the pigtails into the ports of the adapters

### Splicing the fibre

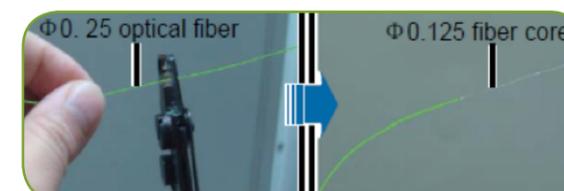


### Pigtails

a) Install the splice protection sleeve

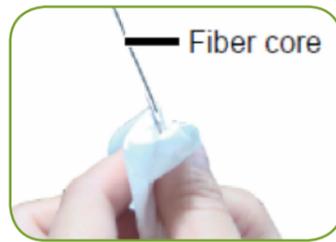


b) Strip the pigtails into 0.125 fibre cores

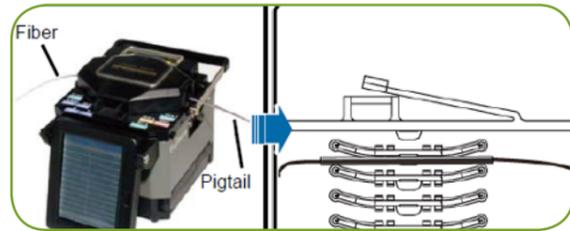


### Fibers

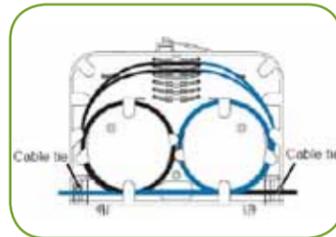
- Strip the fibres into 0.125 fiber cores.



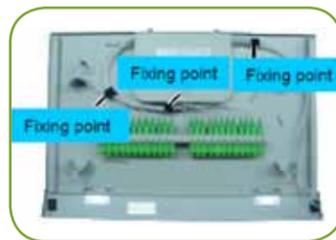
- Clean the fibre cores



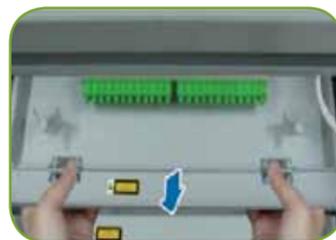
- Splice the fibre cores with the fusion splicing tool. Then insert the splice protection sleeve into the fixing base



- Store the fibres in the splice cassette



- Fix the fibres with optical fibre fastener



### Laying the patch cords

- Open the front panels of the units



- Take out the dustproof covers of the adapters

- Lay the patch cords. Connect the splitter output ports to the patch panel module leading to distribution cables

### Drop closure installation and drop cable connection

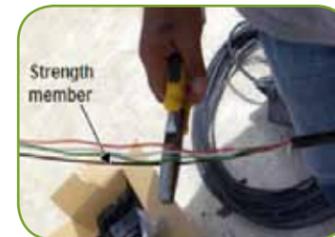


1. Distribution cable entry
2. Drop cables entry
3. Cable clamp/cable press board
4. Split bolt for strength member
5. Splice cassette
6. Drop closure cover



### Distribution cable preparation and installation

- Remove the cable jacket (approximately 2 meters) using cable's rip cord



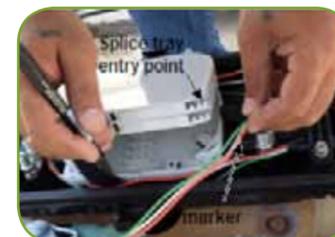
- Cut the strength member



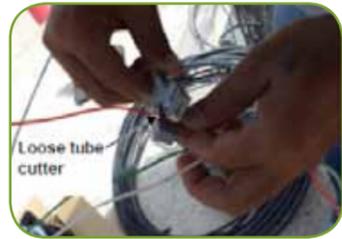
- Wrap the cable end using electrical tape



- Insert the rubber grommet to the cable and then place the cable in to the drop closure
- Secure the strength member in the split bolt. Tighten the cable clamp or cable press board, and then clean the loose tubes using alcohol



- Route the loose tubes in the splice tray entry point and mark



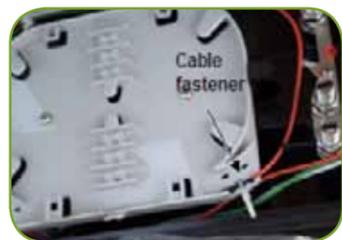
- Cut the protective tubes using loose tube cutter



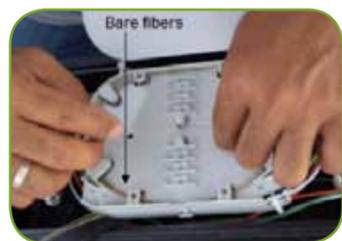
- Remove the protective tubes and clean the bare fibre using alcohol



- Wrap each protective tube's end using electrical tape



- Route the fibre in the splice tray and secure the protective tube using cable fastener



- Arrange the bare fibres in the splice trays, and then close the splice trays

Note: Each splice trays can hold up to 12 splices



- Install the drop closure cover & fix cable label, and then secure the drop closure in the manhole.

## Connecting the drop cable



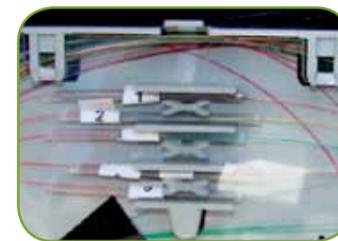
- Pull about 1.5 meters of drop cable into the closure



- Cut the cable about 1 meter from the cable end to remove the over stressed fibre due to pulling tension
- Strip-open the messenger wire and cut it, then insert and secure it to split-bolt



- Measure and mark the cable required to loop around the splice tray
- Remove the PVC jacket and expose the fibre. Then, prepare the cable for fusion splicing with the distribution fibre
- Splice the fibre drop cable with the distribution cable



- Arrange the fibre in the splice cassette tray. Then close the drop closure

## 8. Fibre Drop Cable Installation

As shown is Fujikura 1F low friction indoor/outdoor drop cable. This type of cable is suitable for indoor and outdoor use. It has a steel strength member for long term vertical resistance, flame retardant and passed the water penetration test.

### Cable Cross-section view



- Arrange the fibre in the splice cassette tray. Then close the drop closure

### Installation- in conduit



- For pulling the fibre using draw rope, expose and bend the steel strength members to form two hooks, and tape it firmly on the swivel link pulling shackle. This pulling shackle will prevent cable from twisting and damaging the fibre core



- Ensure that the pulling tension shall not exceed the rated value. Refer to cable specification for the pulling tension limitations
- Recommended lubricants such as polywater gel can be used if required
- Use bell-mouth on conduit ends to avoid cable scraping from conduit's sharp edges when pulling the cable

- Keep appropriate cable loops and remove the over-stressed fibre. Cut at least 1 meter from the pulling end
- In complex of villa, Etisalat must be notified prior to drop cable pulling. This is to ensure that the cable will be pulled in the right location, whether from the Drop Closure in manhole or straight from the FDH location.

## 9. FO Cable Fast-field Connector Installation

The following steps detail the termination procedure for the Fujikura Fast-SC connector.

Connectors from other manufacturers will have similar requirements; the installation team must ensure they are following the correct procedures for terminating the particular connectors they have been issued with.



### Typical Tools for Fujikura SC connector termination

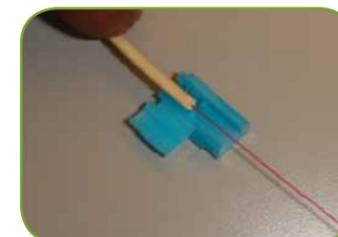


### Cable Preparation

- Cut first the stressed cable ends brought about by cable pulling leaving enough cable loops. Measure 50mm and mark the cable



- Strip 50mm of the cable jacket by cutting the tension member and removing the cable sheath with an appropriate tool



- Set the cable jacket in the cable clamp as shown; ensure that the end of the cable sheath is correctly located in the cable clamp by pressing the cable sheath into the guide before closing the cover on the cable clamp



- Mount the cable clamp in the cable holder, ensuring there is no gap between the end of the cable clamp and the corresponding hole in the cable holder



- Mount the cable holder assembly into the mechanical stripper cradle as shown



- Press and hold the jaws of the mechanical stripper firmly before pulling the cradle assembly to the side to carry out the stripping operation



- Check the fibre has not been damaged by the stripping operation by bending the fibre 60 degrees both up and down and left and right. If the fibre breaks start all over again



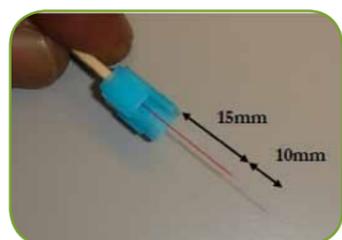
- Clean the stripped fibre with a suitable solvent and a lint free pad. The cleaning should continue until the fibre squeaks while being cleaned. This indicates the fibre is clean and ready for the next step

Note: Do not touch the bare fibre after the cleaning operation.

### Cable Cleaving



- Mount the cable holder containing the cable clamp assembly into the fibre cleaver. Ensure the end of the fibre coating is in line with the edge of the spacer. Close the cleaver using a smooth action once only

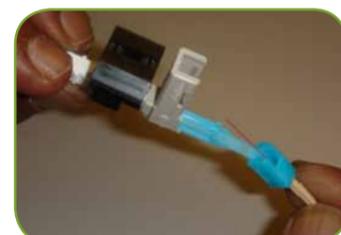


- Remove the cable clamp assembly from the cable holder and check the dimensions as shown. If the measurements are not correct a good termination will be impossible to achieve

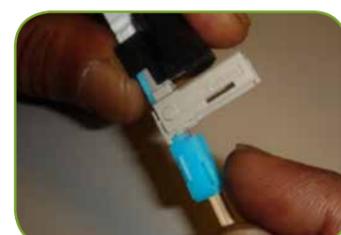
### Connector Preparation



- Holding the connector in both hands verify that the front edge followed by the rear edge of the wedge unit is engaged. This is done by pressing the top and bottom of the wedge unit. If a "Click" is heard then the wedge is Not properly engaged



- Pull the guide all the way out and insert the fibre by sliding the cable clamp along the guide



- Ensure there is no gap as shown and that the fibre bend does not extend above the top of the cable clamp



- Push the lever down to lock the cable clamp to the main body of the connector until a "click" is heard indicating a successful operation



- Cable clamp locked in position.



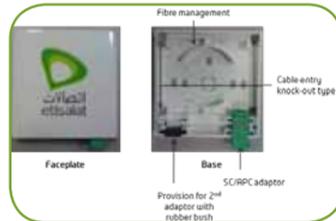
- Disengage the wedge unit by squeezing both sides of the wedge unit



- Slide the front housing over the main body of the connector ensuring correct orientation. Until a "click is heard.

## 10. Termination of Fibre Drop Cable in Micro ODF

### Micro ODF View



#### Cable entry preparation

- Knock out or cut the side for the fibre drop cable entry



#### Micro ODF mounting

- Mark the location where the micro ODF to be installed or in indoor equipment cabinet backplate. Drill and fix the base using accessory screws



#### Cable loop and connector installation

- Insert the fibre drop cable. Provide cable loops with length 500mm. Cut the excess length and install connector



#### Connecting to adaptor

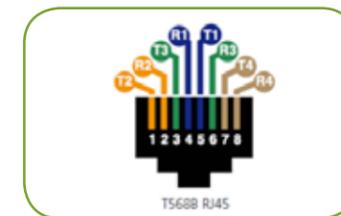
- Wind the cable loop in the base's cable management and then connect to the SC/APC adaptor. Install the faceplate

## 11. UTP Cable Installation and Termination

Unshielded Twisted Pair (UTP) cabling provides immunity to electromagnetic interference or EMI. This is due to the properties of the two conductors that make up a transmission pair being twisted together.

### EIA/TIA 568B - Color Coding

Pair Number	Pair Color	Color Coding	Tip and Ring
1		White/Blue Blue/white	Tip1 Ring1
2		White/Orange Orange/white	Tip2 Ring2
3		White/Green Green/white	Tip3 Ring3
4		White/Brown Brown/white	Tip4 Ring4



### Jack Pin-outs

### UTP Installation

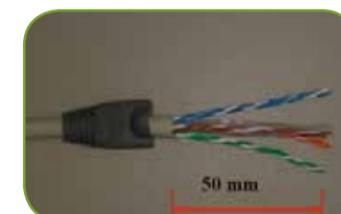
#### DO'S

- Pull cables to minimize the distance and not to exceed the limits (90m)
- Follow manufacturer's recommendations for cable bend radius when pulling the cable
- Use specified cable lubricant designed for UTP cable pulling in conduit if necessary
- Use low to moderate force when pulling cable
- Bundle cables in a neat, orderly and hook and loop ties

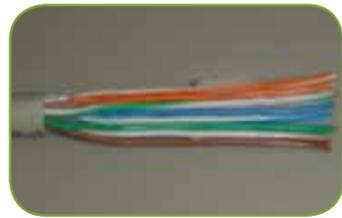
#### DON'TS

- Don't pull the cable exceeding its specified pulling tensions
- Don't bend or kink cable too sharply
- Don't tie cable too tightly

### RJ45 Plug connector installation



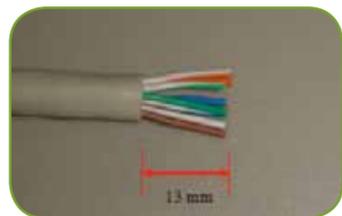
- Slide the rubber connector boot onto the end of the cable. Next, strip and remove 50mm of cable sheathing. Then, cut the plastic spine



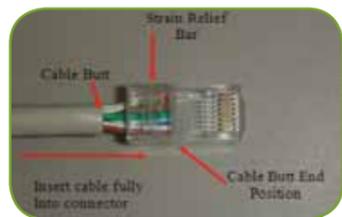
- Arrange the pairs into correct configuration for the 568B wiring standard



- Using the crimp tool, trim the wires to the correct length of 13mm



- Ensure wires are in the correct order and untwisting of wires is minimized to prevent cross-talk and reduced performance



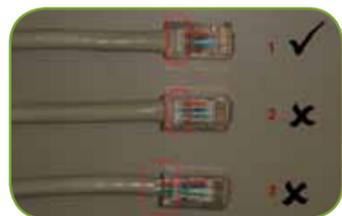
- Insert the wires carefully into the connector. Make sure the wire pattern is not disturbed. Ensure the wires are fully inserted and the cable butt has been pushed beyond the strain relief bar



- With the wires fully inserted into the connector, place the assembly into the crimp tool. Make sure the connector is fully inserted into the crimp tool before crimping



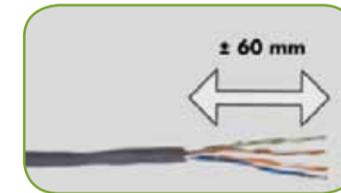
- After crimping, inspect the connector to ensure the cable sheath has been correctly inserted into the connector body and the strain relief bar is pressing onto the cable sheath and not to the wires



1. Sheath fully inserted into the connector
2. Strain relief bar pressing onto the wires
3. Sheathing not inserted correctly and no strain relief to connector

## UTP jack connector installation

The following procedure uses a LANmark EVO series snap-in connector for wall socket termination.



- Cut off the cable jacket to approximately 60mm. Then remove the spine or cable separator



- Arrange the cable and keep the length of untwist of the cable pairs to as little as possible



- Prepare the cables for termination. For 568B terminations position the pairs of the cable shall be as follows:

Brown	Orange
Green	Blue



- Slide the cable holder over all 4 pairs at the same time
- Do not untwist any of the individual pairs for this part of preparation
- Follow the color code on the cable holder
- The distance between the outer sheath of the cable must be as short as possible (less than 5mm is advised)



- Pull each pair over the pair splitter following the color code. For 568B terminations the Orange conductor is at the outer side. The Blue, Brown and Green conductors are all on the inner side



- Use a pair of side cutters to cut off the excess length of the pairs. Cut as short as possible. A maximum over length of 3mm is allowed



- Position the cable holder correctly oriented on the back of the connector. The guiding central member must slide over the central pin. The wire organizer will only fit in one orientation



- Push the wire organizer evenly onto the back of the connector until you feel that both sides have clicked down



- Make sure that the universal comfort tool is set to the short EVO position



- Put the assembly in the universal comfort tool (with the "N" marking) and close it.

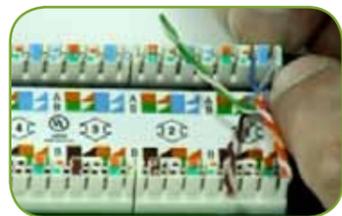


- Do not exert any lateral strain on the connector and cable assembly. A second "click" will be heard.



- The Snap-in is now installed and can be installed in our modular hardware. An optional key-stone clip can be added on the front of the connector to allow it to be fitted in key-stone format structural hardware.

### UTP termination in RJ45 Patch Panel



- Strip the cable sheath off and remove the spine or cable separator
- Arrange the cable and place the cables based on 568B color arrangement in the Patch Panel



- Install all the cables in its corresponding slots. Keep the untwist cable pairs as short as possible



- Using punch tool, punch the individual cables properly

## 12. Fibre Optic Testing

### Visual Fault locator

This type of test is used to verify if the cable is damaged either due to physical stress, mishandling and by not following the guidelines and procedures during the installation process.

It is better to test the installed cable first before making the final arrangement in the FDH. In this case you will determine if there are some faulty cables that may require replacements.



- Connect one cable end to the light source, and then switch it on



- On the other end of the cable, check if the light is visible or not. If light is not visible, check the cable for bends and replace cable if necessary

### Cable testing using Optical Loss Test Set (OLTS)

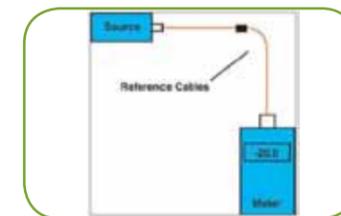
As the drop fibre is comparatively of shorter length, the cable attenuation becomes lower, but the connector insertion loss remains the same.

Most fibre optic connectors are specified as having an insertion loss of less than 0.5dB. Since there are two connections for each fibre, up to 1dB of attenuation can be expected to be added to the installed cable.

If the cable is installed properly, most of the measured attenuation will come from the connectors.

During testing the following must be observed in order to get accurate results.

- Ensure that the connectors are cleaned each time they are used and the same reference cables are used.
- The reference cables used shall be of the highest quality; factory terminated, single mode fibre and shall always be stored with the respective parts of the OLTS.
- The quality of the reference cables shall be frequently tested. One end of the reference cable shall be terminated with the type of connector on the meter while the other end shall be SC/APC connectors.
- The mating adaptor used shall also be of highest quality and always stored in dust-free containers. The testing shall be carried out at 1550nm.
- The test shall be started only after ensuring that the optical source output has stabilized after switching on the source. This time is to be taken from the manufacturers recommendations.



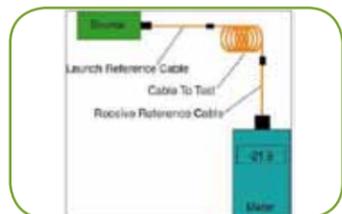
### Testing procedures

- The terminated drop fibre shall be tested using an Optical Loss Test Set (OLTS). The loss of each of the drop fibre shall be determined using two reference cables.

## Reference cable connection

- Attach the launch reference cable to the source while the receive reference cable to the meter
- The value obtained will be the reference value against which the insertion loss of the fibre drop will be measured

## Connecting the cable to test



- Connect the reference cables to the fibre drop cable as shown below

- Set the Source output power level greater than -30dBm
- Take at least three readings from each side then averaged it to find the loss of the cable

Note: The time interval between the readings shall be greater than the averaging time of the power meter.

## Test Result

- As the drop fibre being tested is small in length, the loss measured would be mainly the losses introduced by the two connectors

If the loss is greater than 1dB of the expected loss (2Xconnector loss of 0.5dB each connector + cable loss at 0.5dB per km.) the cable shall be analyzed using OTDR.

## Cable testing using OTDR

OTDR measures all the characteristics of a fibre link and it used in fibre link construction, acceptance and trouble shooting. When testing a fibre cable or link, you may refer to the OTDR manual when conducting test.

## Fibre connector endface visual inspection

Before making the final connections an additional test may be performed to ensure that the connector installed are clean and passed IEC 61300-3-35 standard.

Under this standard damage to the optic and the area within a specific diameter of the ferule endface around the optic is compared to a micron-accurate, laser-etched test pattern or artifact. Based upon this type of visual inspection, field of view, microscope types and magnifications, the PASS/FAIL criteria for scratches and pits for both multimode and single-mode fibre types can be determined.

Shown below is Fons probe fibre microscope inspection with LCD display.

## Fibre microscope and cleaning kit



- 1 – Probe fibre microscope inspection (200x magnification including M/F tip for 2.5 & 1.2mm)
- 2 – Pen-style fibre cleaner universal 2.5mm & 1.25mm
- 3 – Fibre connector cleaner reel
- 4 – Cleaning cotton swabs
- 5 – Visual fault locator

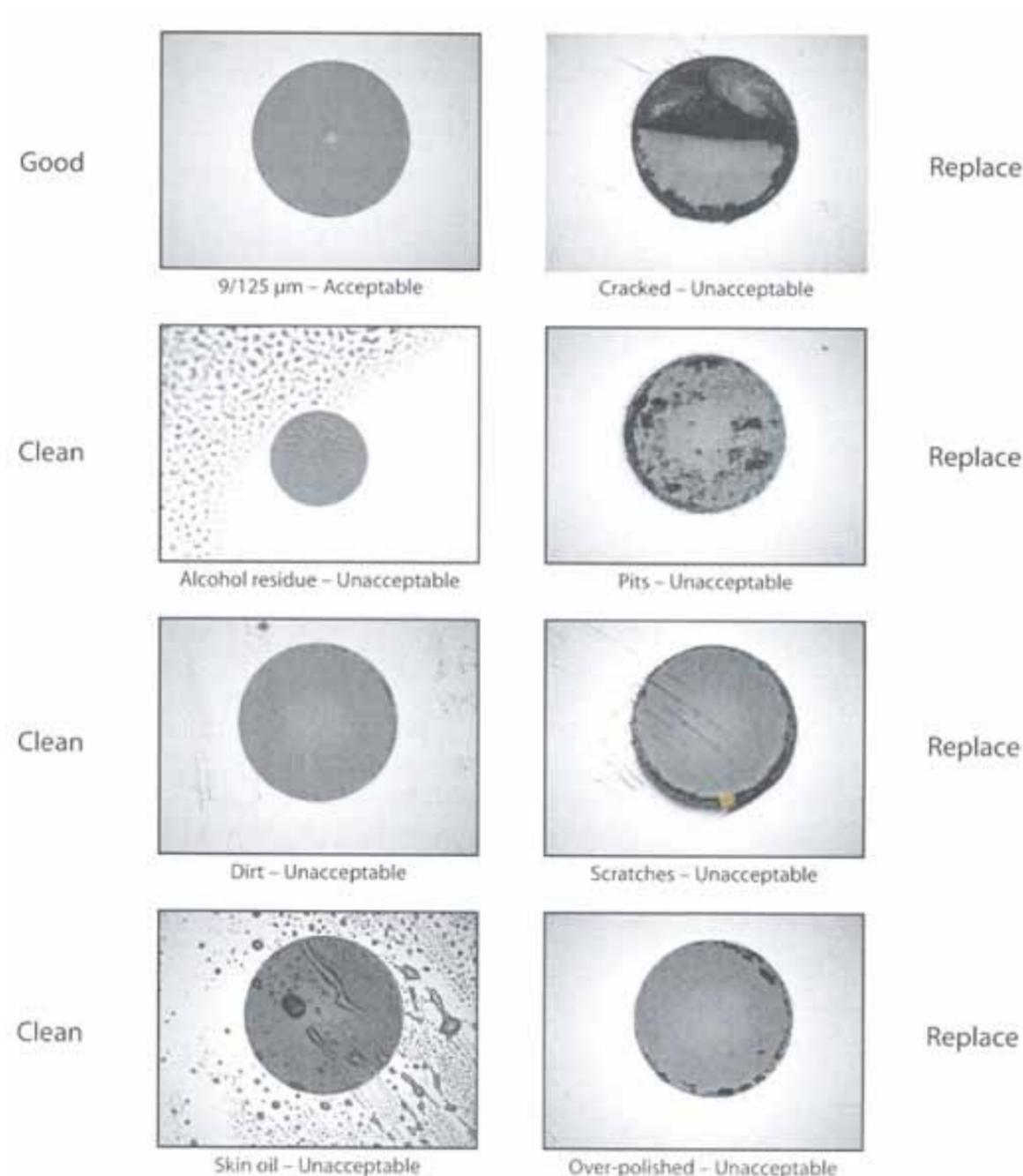
## Inspection procedure

- Connect the probe to the device
- Power on and connect the connector to test to the probe
- Rotate the probe until a clear view of the connector endface is showing

## Visual examples

The following are some samples of acceptable and unacceptable fibre optic and connector endface conditions.

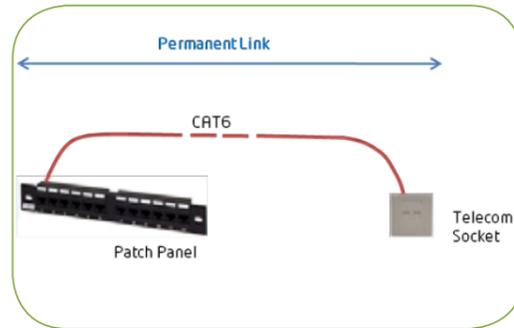
Note: Clean connector when alcohol residue, dirt and skin oil is present. Then, replace if signs of cracks, pits, scratches and over polished is found in the connector endface.



## 13. UTP Cable Testing

After completing the installation, verification of the permanent link of the UTP network can be performed using wire mapping.

A permanent link is the fixed part of the cabling which is tested after installation; these test results give information on installation quality. The permanent link extends from the patch panel in the indoor equipment cabinet to the telecom outlet at the user side.



### Wiremap Testing

Explanation for some wiremap errors are as follows:

**Miswire** - One or more pins or pairs are not connected to the correct pins at the other end of the cable, i.e., one-to-one - pin 1 to pin 1, pin 2 to pin 2, etc.

**Split** - A split pair is an error in the twisting of the wires together within the cable. The cables generally are made up of eight wires twisted together in 4 pairs. These 4 pairs are designated as pairs by the wiring standards and are intended to carry a signal and its return. 1 & 2, 3 & 6, 4 & 5 and 7 & 8 are the pairs designated by T568A/B for a RJ45 jack or plug. A cable can be wired with correct continuity, but not with correct pairing. This often happens when the cable is terminated consistently at both ends, but in the wrong order. A dynamic or AC test is required to detect this type of error. If the only error is a split pair error, the cable has correct continuity. If cross talk is not a concern, as in flat satin cable, the cable is good if the only error is the split pair error.

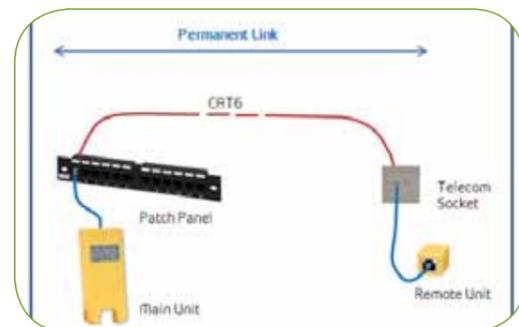
**Open** - The pair is not connected.

**Short** - The pair has a low resistance connection between wire pairs or the shield. The wire pairs involved displays on the LCD screen.

**Reverse** - A reverse (Rev) pair is a special case of a Miswire, and both icons will be flashing. The wires are connected to the correct pair of pins, but the two leads are reversed.

**Voltage** - When voltage is detected on any of the pins. Disconnect from the cable as soon as possible.

### Permanent link test procedure



- a) Using factory connectorized patch cord, connect the meter in the patch panel port and connect the remote unit to telecom socket.
- b) Run the test and check results.

## 14. Safety in Working with Optical Fibre

Safety on the job site must be the number one concern of everyone. Besides the usual safety issues for construction, fibre optics adds concerns for eye safety, chemicals, sparks from fusion splicing, disposal of fibre shards and more.

Before beginning any installation, safety rules should be posted on the job site and reviewed with all onsite personnel. All personnel must wear the usual construction safety gear plus everyone must wear eye protection whenever working with fibre.

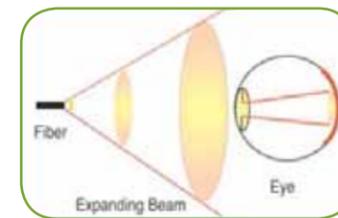
### Eye Safety

Many people are concerned that the most dangerous part of fibre optic work was the chance you might get your eyeballs burned out by laser light in the fibre. They had confused optical fibres to the output of high powered lasers used in labs. Or perhaps they had been going to the doctor to get warts burned off their skin using lasers with fibre optic probes or even seen too many science fiction movies.

In fact, most fibre optic systems do not have sufficient power to cause harm to your eyes and the light coming out of a fibre is expanding so the farther you are away from the end of the fibre, the lower the exposure. Having said that, consider yourself warned. In more recent times, some fibre optic systems are carrying sufficient power to be dangerous and some fibre optic inspection techniques increase the chance of harm. But that's not the biggest danger facing installers. Let's look at the issues.

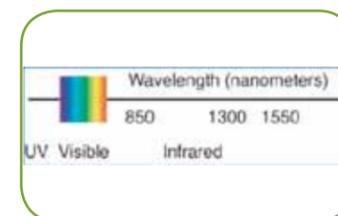
The key to understanding the power issue is to understand power levels, wavelength of the light and the nature of light transmission in optical fibre.

Two types of links have high power, as much as 100 times more than other communications systems, and they are CATV or video links at 1550 nm and Telco long distance links using dense wavelength division multiplexing (DWDM). The CATV or video links used in fibre to the home (FTTH) may use fibre amplifiers that boost the power to very high levels, potentially dangerous to the eye. Telco DWDM links are used on extremely long distance links. They not only use fibre amplifiers for boosting the power, but they have many different signals operating at different wavelengths carried in one single mode fibre. Any one wavelength may not be a problem, but the sum of 16, 32 or 64 individual wavelengths can be very powerful.



The next issue is focusing the light from a fibre into your eye. Light exiting an optical fibre spreads out in a cone, the angle of which is determined by the transmission characteristics of the fibre as defined by the numerical aperture. As your eye is further from the end of the fibre, the amount of radiation it receives is inversely proportional to the square of the distance - double the distance and cut the power by 1/4, ten times the distance reduces the power to about 1%. You do not have to be far away from the fibre for the power to be reduced to low levels.

Because the light is exiting the fibre in a cone-shaped beam, your eye cannot focus it on the retina. This is unlike the typical lab laser or laser pointer that shines a narrow, collimated beam that does not spread out; a beam your eye can easily focus on the retina, causing temporary blindness.



Finally, there is an issue of wavelength. Your eye cannot see many of the wavelengths used in fibre optics because the eye is sensitive to light in the blue to red region of the spectrum while fibre optic systems operate in the infrared. The liquid in your eye which is mostly water absorbs light in the infrared heavily. Light from most fibre optic sources will be absorbed by this liquid, so any potential harm is likely to come to the lens or cornea, not the retina



Finally, there is an issue of wavelength. Your eye cannot see many of the wavelengths used in fibre optics because the eye is sensitive to light in the blue to red region of the spectrum while fibre optic systems operate in the infrared. The liquid in your eye which is mostly water absorbs light in the infrared heavily. Light from most fibre optic sources will be absorbed by this liquid, so any potential harm is likely to come to the lens or cornea, not the retina.

While the expanding beam of the light exiting the fibre makes it less of an issue for direct viewing, using a fibre inspection microscope can be a problem. This hypothesis has been tested, and can confirm that a microscope will focus virtually all the light back into the eye. Many microscopes used in fibre optics, therefore, have filters to absorb any infrared (IR) light that could be harmful. Be wary of inexpensive microscopes, which may not have IR blocking filters.

To be certain fibres are safe to inspect or work with, always check fibres in an operating network with a fibre optic power meter to ensure no light is present before inspecting any connector with a microscope.

Preferably, a fibre scope with an LCD viewfinder can be used. You can easily inspect installed fibre connectors on patch panels and hardware devices. Also, it eliminates the hazards of inspecting live fibre.



## Bare Fibre Safety

Fibre optics installation, however, is not without risks. The more common problem is getting scraps of fibre in your eye when working with fibre. While few fibre optic systems have harmful levels of power, every termination and splice produces shards (scraps) of optical fibre which is potentially very harmful to your eyes and skin or may stick in your clothing and be carried to other locations where it may be harmful to others.

These shards of fibre are tiny, thin and often very sharp where they broke off the fibre. They can easily puncture your skin, burying them deep enough to be difficult to pull out, if only you could see them. Being transparent they practically disappear once imbedded in your skin. In most parts of your body, they merely become a nuisance, perhaps infecting or causing an irritating bump, until they eventually work themselves out.

Around your eye, however, they can be much more difficult to find and remove. The tears that wet your eyes make the transparent glass shards practically impossible to find and remove. The sharp ends of the fibre may cause it to imbed itself in the eye or surrounding tissue, making it even more difficult to remove. Unlike metallic particles, they cannot be removed with magnets.



It is imperative to follow procedures that minimize the dangers to the eye. Always wear protective eyewear with side shields, even if you normally wear glasses, to prevent any flying shards from getting near your eyes. Do not trust normal eyeglasses, since taking them off for a second allows a fibre shard to land on the lower eyelash, where it is difficult to be found and removed.



Be extremely careful whenever handling fibres, especially when stripping fibre or scribing and breaking fibre extending out of an adhesive connector. Instead of breaking it, scribe it gently, and then slide your fingers up the connector ferrule, grasping the fibre and pulling it off. Then dispose of it carefully.



Most cleavers used for splicing or terminating pre-polished/splice connectors hold the fibre after cleaving, so the only problem is disposing of it. It is recommended to use disposable containers like those used for soups at carry-out restaurants. Use it for all your fibre scraps and then seal it and dispose of it properly.

You can also set up your workplace to make it easier to avoid problems. Use a black plastic mat for a work surface. The dark background will make it easier to see the fibres you are working with and handle them more carefully. Any broken fibres that fall on the mat are easily found for disposal.

Some technicians like to place a length of double stick tape or a loop of black electrical tape on the mat and stick fibres to the adhesive surface, then dispose of the tape when finished. It is recommended to simply use a disposable container and place every fibre scrap into that container rather than leave them exposed on the work surface.

**Always keep tools clean of fibre fragments**

**Never throw loose fibre on floor or ground**

**Never wave fibre ends around**

## Other Considerations for Safety

**Chemicals:** Fibre optic splicing and termination use various chemical cleaners and adhesives as part of the processes. Normal handling procedures for these substances should be observed. Even simple isopropyl alcohol, used as a cleaner, is flammable and should be handled carefully and be used in small amounts. Manufacturers will supply "material safety data sheets" (MSDS) on request or they may be found on the Internet.

**When cleaning fibre, make sure room is ventilated**

**Always store chemicals safely away from eating/drinking areas in secure containers**

**Care should be taken when opening containers as pressure may have built up**

**Use cotton buds or fibre cleaning tissue for fibre cleaning**

**Splicing hazards:** Fusion splicers use an electric arc to make splices, so care must be taken to insure no flammable gasses are present in the space where fusion splicing is done.

**No Smoking:** Smoking should also not be allowed around fibre optic work. The ashes from smoking contribute to the dirt problems with fibres, in addition to the possible presence of combustible substances (and, of course, the health risks.)

**First Aid:** As the majority of people reading these notes are not qualified first aiders, or members of the medical profession, it is advised that in case of emergency the designated company first aider should be called at once. Under no circumstances should anyone try and administer first aid without prior training.

Fibre cannot be detected by x-rays so it is most important that fibre fragments do not reach the eye. If however they do, never try to remove it yourself. Find a first aider or take the injured person to a doctor or direct to the hospital. Do not put anything in the eye as this will only cause pain and push the fragment in further.

**This is all very important - important enough to have a few workplace rules for all fibre optic technicians that can prevent workplace accidents**

## Fibre Optic Installation Safety Rules



- Keep all food and beverages out of the work area. If fibre particles are ingested they can cause internal hemorrhaging
- Work on a black work surface as it helps to find fibre scraps
- Wear disposable aprons to minimize fibre particles on your clothing. Fibre particles on your clothing can later get into food, drinks, and/or be ingested by other means
- Always wear safety glasses with side shields and protective gloves. Treat fibre optic splinters the same as you would treat glass splinters
- Never look directly into the end of fibre cables until you are positive that there is no light source at the other end. Use a fibre optic power meter to make certain the fibre is dark. When using an optical tracer or continuity checker, look at the fibre from an angle at least 6 inches away from your eye to determine if the visible light is present.
- Only work in well ventilated areas.
- Avoid setting up fibre optic cable splicing and terminating work areas directly under or near heating or air conditioning outlets, as dust or dirt on connectors is a major cause of scratches on polished connectors that can cause high loss measurements.
- Contact lens wearers must not handle their lenses until they have thoroughly washed their hands.
- Do not touch your eyes while working with fibre optic systems until your hands have been thoroughly washed.
- Keep all combustible materials safely away from the curing ovens.
- Put all cut fibre pieces in a properly marked container for disposal.
- Do not kneel on the floor or sit on benches in a fibre optic area.
- Do not pick up shards of fibre with your fingers.
- Do not brush up pieces of fibre with your hands. Use a small brush.
- Thoroughly clean your work area when you are done.
- Do not smoke while working with fibre optic systems.
- Keep dust caps on connectors, and patch panels.
- Wash your hands before and after working with fibre optic cables.

## 15. Mobile Requirements

### 15.1 TELECOM ROOMS – general

A number of telecom mobile rooms will be required in a development depending on the characteristics of the buildings. The following room types are required and the details of these rooms are included in the text below.

**The following room types are covered:**

- Mobile-service room.
- Roof-top mobile-service room

All telecom rooms must be dedicated for the use of Etisalat. The rooms must be easily accessible to their personnel 24 hours a day and secured from unauthorised entry.

**Mobile Telecom rooms must not be in close proximity to any sources of the following:**

- Heat
- Moisture
- Corrosive atmospheric or environmental conditions
- High voltages,
- Radio frequency interference (RFI)
- Electro-magnetic interference (EMI)

**The rooms must not be directly beneath or next to wet areas such as:**

- Showers
- Washrooms
- Swimming pools
- Garbage areas

If for any reason it is proposed that any part of a telecom room will be located below the water table then this must be raised at the design stage. This situation will require a floor drain fitted with an automatic submersible pump to counter any risk of water ingress.

**The rooms must be clean and free from any of the following items unless otherwise specified in this document.**

- Equipment
- Utility pipes
- Cables
- Sprinkler systems
- Windows
- Pests

In the case of pests it should be noted that rodents often gnaw cables resulting in damage and the potential of service disruption. Special attention must be given to preventing pests entering telecom spaces and pathways. This should be through the use of best practice pest control methods. An additional measure could involve the installation of covers to cable trays; if this is the case these covers must be removable to allow for the installation of additional cables.

In order to move equipment into and out of telecom rooms no access from outside of the building to these rooms must be less than 900mm x 2100mm (WxH)

### 15.1.1 TELECOM ROOMS – roof-top mobile-service room (up to G+10)

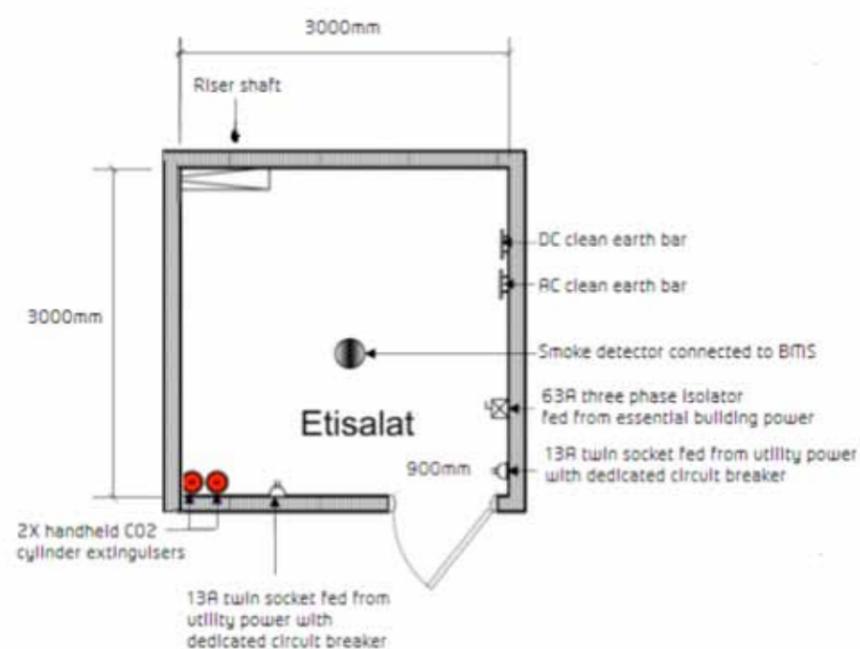
Roof-top mobile-service rooms must be provided on the roof of all multi-tenant buildings up to G+10. The specifications and drawings are provided below. The doors to this room must open outwards and have a minimum opening of 900mm x 2100mm (WxH).

The floors of the roof-top mobile-service rooms must have a minimum distributed load rating of 10kn/m<sup>2</sup>.

Openings must be provided to allow cables to connect to external antennas. These openings must be 600mm x 400mm (WxH), 500mm below the room ceiling in walls facing the building's roof-top area.

An access pathway must be provided to the building riser system.

Space must be reserved on the roof-top of the building for the installation of mobile-service antennas. This will vary from building to building, but will typically be at the corners of the building or on any raised structure on the roof-top. The exact details will be decided at the design stage.



### 15.1.2 TELECOM ROOMS – mobile-service rooms

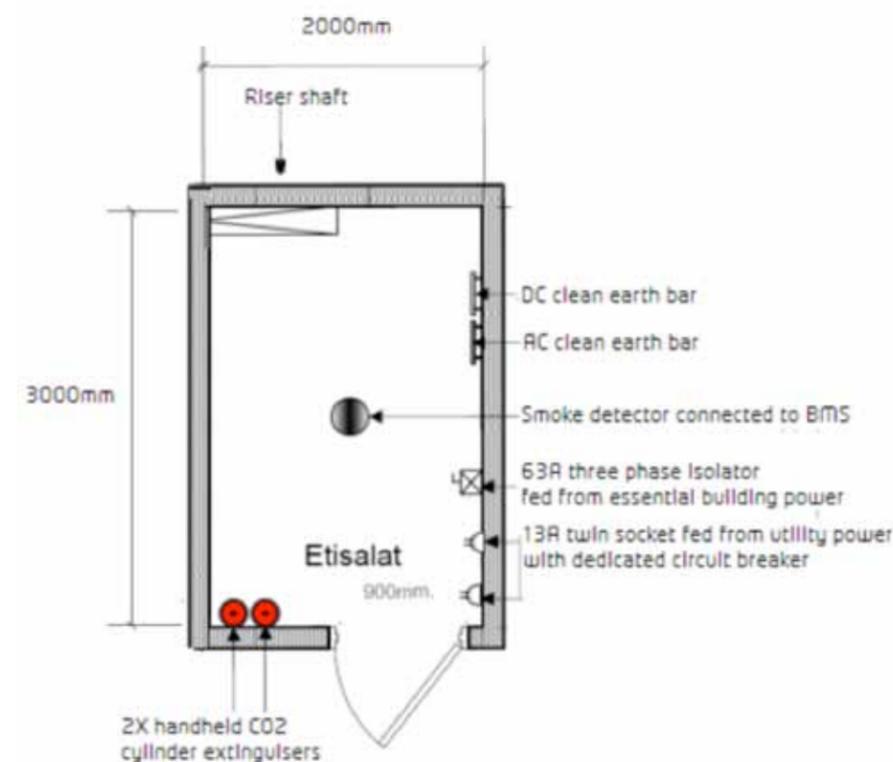
Mobile-service rooms must be provided in all multi-tenant buildings. The specifications and drawings are provided below.

Mobile-service rooms to be placed every 10 floors starting at the lowest basement level with a size 2m x 3m x 3m (LxWxH) having secured access.

However, for special projects (Hotels, Furnished Apartments, Shopping Malls, Airports, Etc) the requirements will be defined at the design stage.

The doors to these rooms must be outward open outwards and have a minimum opening of 900mm x 2100mm (WxH).

The floors of the mobile-service rooms must have a minimum distributed load rating of 10kn/m<sup>2</sup>.



### 15.1.3 TELECOM ROOMS – Remote Units Rooms

Remote Units rooms are normally the riser rooms where the RF cables are passing through and shall be allocated as per the Distribution Antenna System approved design.

In some cases, Remote Units will be located in other than risers rooms where the requirements of riser rooms will be applied.

### 15.2 TELECOM ROOMS – safety and general fit-out

All telecom rooms must comply with all municipality and national authority standards and regulations; such as those issued by civil defence and utility companies. Notwithstanding this, it is expected that following will be provided:

- All areas must be fitted with smoke detectors connected to the building management system
- All areas must be fitted with normal and emergency lighting
- All containment openings to mobile telecom rooms must be sealed with a regulation fire retardant material

- All doors to mobile telecom rooms to be of solid wood core or steel construction, fire retardant with a minimum rating of 2 hours.
- All doors to mobile telecom rooms must be outward opening with an automatic door closer system fitted on the hinged edge
- All doors to telecom rooms to be labelled. For example,
- **"Mobile-Service Room B4 (Etisalat)"**
- The room must be free from contaminants and pollutants as defined below.

Contaminant	Maximum acceptable concentration
Chlorine	ppm 0.01
Dust	µg/m <sup>3</sup> /24h 100
Hydrocarbons	µg/m <sup>3</sup> /24h 4
Hydrogen sulphide	ppm 0.05
Nitrogen oxides	ppm 0.1
Sulphur dioxide	ppm 0.3

Each room, area must be provided with two hand-held CO2 fire extinguishers of minimum 10kg capacity. The developer may provide additional fire suppression systems so long as they do not reduce room space. Wet pipe sprinkler systems are not allowed as false triggering may damage any installed telecommunications facilities and interrupt services.

If the building developer has any concerns over safety, especially fire protection and suppression systems, this should be raised with the Licensees at the design stage.

The walls, floor, and ceiling must be finished so as to minimize dust and static electricity and the walls and ceilings must be painted with a primer and light coloured finish coat.

### 15.3 Mobile TELECOM ROOMS – temperature and humidity

All the mobile telecom rooms, with the exception of the floor telecom closets, must be provided with an air conditioning system to maintain the temperature at 22°C ± 1°C and the relative humidity at 50% ± 10%.

**Whilst the detailed design of the air conditioning system is the responsibility of the building developer the following design principles must be followed:**

- Dedicated duty and stand-by units
- Units to be interlocked based on sensing power failure or over temperature
- Stand-by unit to be connected to emergency electrical supply
- Direct eXchange (DX) or chilled water based systems are both acceptable
- All units to be located outside the telecom rooms
- Both units to be connected to the building management system
- Air flow to feed each caged area via dedicated ducting
- ELECTRICAL SUPPLY

All mobile telecom rooms must be provided with electrical supplies. The details of the requirements for the various rooms are included in the text below.

### 15.4 EARTH BARS – all rooms

**Each mobile telecom room must be fitted with two clean earth bars of the following specifications:**

- One for AC
- One for DC
- Minimum length of 500mm available in each area
- Minimum of 10 holes of 12mm diameter
- Each must be connected to its own earth pit with a resistance of less than 1 ohm
- Clearly labelled as AC and DC respectively

**However, Remote Units Rooms must have one clean earth bar of the following specifications:-**

- One for AC
- Minimum length of 150mm available in each area
- Minimum of 5 holes of 12mm diameter
- Must be connected to its own earth pit with a resistance of less than 1 ohm
- Clearly labelled as AC

### 15.5 ELECTRICAL SYSTEMS – roof-top mobile-service room

**The following electrical systems must be provided in each of the mobile-service rooms:**

- 63A 3 phase isolator fed from essential building power
- Two 13A twin sockets fed from the normal building supply on spurs with dedicated circuit breakers rated at 20A

### 15.6 ELECTRICAL SYSTEMS – mobile-service room

The following electrical systems must be provided in each of the mobile-service

- 63A 3 phase isolator fed from essential building power
- Two 13A twin sockets fed from the normal building supply on spurs with dedicated circuit breakers rated at 20A

### 15.7 ELECTRICAL SYSTEMS – Remote Unit Rooms

Two 13A twin sockets fed from the normal building supply on spurs with dedicated circuit breakers rated at 20A

## 15.8 CONTAINMENT – general

The following requirements must be applied to all containment systems:

- The containment system must be designed such that installed cables do not exceed the minimum specified bend radius in mm
- All metal containment parts must be free from sharp edges and must be earthed / earth bonded
- Telecom riser openings must be sealed with a suitable fire retardant material
- Cable trays must be easily accessible in common areas to facilitate any future provision of additional cables
- Any cable trays that are in publically accessible areas less than 4.8m above the floor must be covered
- Containment systems must not run through areas exposed to excessive heat, moisture, corrosive atmospheric or environmental conditions, high voltages, radio frequency interference (RFI) or electro-magnetic interference (EMI)
- For all containment systems a minimum separation must be maintained from sources of electromagnetic interference.
- The building developer may want to consider redundant containment systems, particularly in commercial or prestigious developments. The Licensees must be contacted at the design stage to discuss any such requirements

## 15.9 VERTICAL CONTAINMENT – multi-tenant buildings

Risers must be provided in multi-story multi-tenant buildings to allow the installation of mobile telecom cables (Fiber Optic cables) from the main telecom room to each Mobile Telecom Room and between the mobile Telecom rooms themselves. RF-coaxial cables will be laid between the mobile Telecom rooms and the different units in the Distribution Antenna System (DAS) as per the approved Design which shall be shared with the client/consultant. Hot-Dip Galvanised (HDG) slotted steel cable trays must be provided in the risers to carry the telecom cables between all of the telecom rooms. The dedicated trays for mobile services must have the following minimum dimensions:

200mm x 50mm (WxH) with Heavy Duty Return Flange (HDRF)

The trays must run continuously between all of the mobile telecom rooms. If it is not possible to provide all of the cable trays runs vertically then horizontal trays of the same size should be provided.

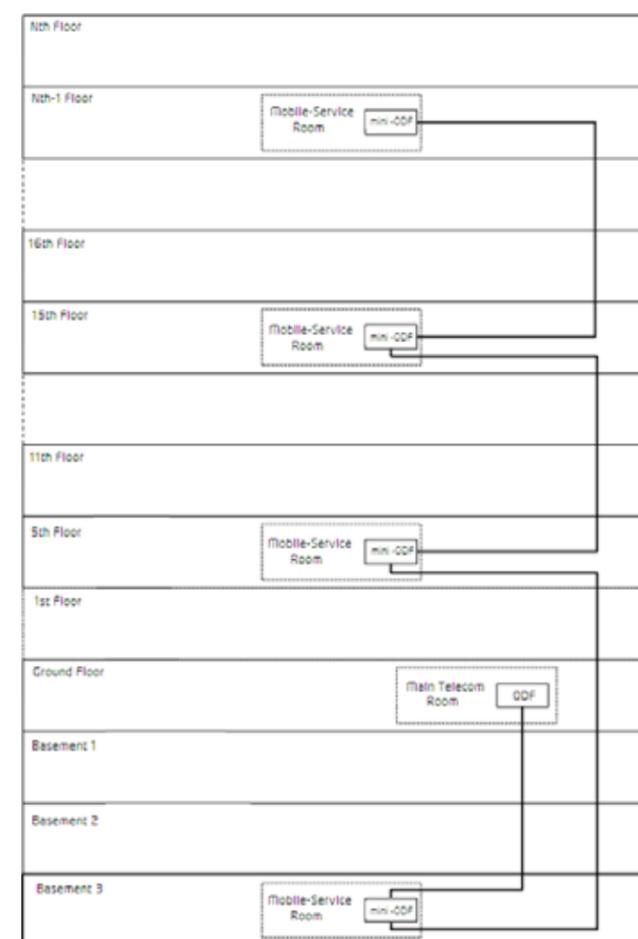
## 15.10 HORIZONTAL CONTAINMENT – mobile-service antennas

Cable trays must be provided to route mobile-service antenna cables from the riser used for the vertical cables to the antenna locations. One dedicated cable tray with the following minimum dimensions must be provided:

200mm x 50mm (WxH) with Heavy Duty Return Flange (HDRF)

## 15.11 FIBRE OPTIC CABLES –mobile-service rooms

For buildings with mobile-service rooms fibre optic cables must be provided by the building developer. The exact fibre topology between the mobile-service rooms will depend on the room distribution option.



### Main telecom room to all mobile-service rooms

16F fibre cables must be provided from each main telecom room and loop through every mobile-service room ending at the last mobile-service area. The fibre must be terminated in a wall mounted mini-ODF in each of the mobile-service rooms and on the main ODF in the main telecom room area.

### Main telecom room to roof-top mobile-service room

8F fibre cables must be provided between the main telecom room and the roof-top mobile-service room. 10m of spare fiber must be left in main telecom room. The fibre must be terminated in a wall mounted mini-ODF in each of the roof-top mobile-service rooms, and on the main ODF in the main telecom room area

## 15.12 RADIO FREQUENCY (RF) CABLES – from mobile-service rooms to antenna locations

Etisalat will be responsible for the installation of the RF cables as per the approved design.

