1. Termination box

1.1 Description

Optical fibre termination box acts as an interface between the optical fiber cable coming from the line side & the pigtails to be taken to the fiber distribution frame i.e. it is made for terminating the OFC from the field and connecting it to pigtail by splicing. The other end of the pigtail having the optical connector is terminated inside the fibre distribution frame. It is similar to MDF in telephone exchanges.

Fibres from both of these after fusion splicing are kept safely in the cassettes provided inside this box. The termination box also acts as a storage unit for extra length of fibre from the line side & the pigtails. It serves for bunching & rerouting of optical fibre cable.

1.2 Construction

Optical fibre termination box is made for mounting on wall or on 483 mm wide instrument cabinet racks made of steel frame and is suitable for general weather and environmental conditions prevailing in country. It is suited for loose tube, central tube as well as slotted core type of optical fibre cable.
The housing of termination box is of rugged design. It is made of M.S.sheet and welded electrically by machines to take care the requirement of transport, installation, operation and maintenance. The entire box is painted with epoxy base white paint to give a smooth, durable and pleasing finish.

The wall mounted type termination box has front accesses. By removing the front cover having four captive screws at each of the four corners. It is designed for easy installation on the wall or 483 mm standard instrument racks made of steel. The general arrangement of the termination box is shown in figure 1.

OFC from the field enters the termination box from the two holes at the bottom fitted with rubber diaphragm in each at the inlet hole.

The cable is clamped at the first cable clamp. The second clamp has been provided with two-fibre guides and clamping facility to clamp inner strength member and allow easy exit of all loose tubes and transports tube through relief.

The splice tray is made of ABS material with capacity to hold 12 splices are provided without any undue pressure on the fibre protection sleeve. A cover is provided on the last splice tray made of ABS material. The splice trays are stacked one on the top of the other. All slacked splice trays are hinged together to open up like the pages of book.
A stainless steel wire mechanism has been provided for fixing and holding of splice tray. This mechanism also adds to the convenience in managing the splice etc. because the splice tray rests firmly on this mechanism.

The splice holder is made to house fusion type of joints with fibre protection sleeve and strength member.

The splice tray shall have the fibre from the cables joined in a predetermined order with the respective pigtails.

Holes have been provided at both the ends of the splice tray to use a plastic clamping strap to hold and clamp sleeved fibre or pigtails.

The splice tray provides facility for rejoining, rearrangement or realignment of the fibres.

Each fibre coming out of the cable is spliced with a pigtail and these spliced joints inside fibre protection sleeve are securely push fitted in the splice holder. Excess length of the fibre can be stored in the splice tray by holding the stored fibre’s loop through guide ways in the splice tray and self-adhesive pads, if so required.

Generally up to 6 splices are stored in each splice tray resulting in the connection of up to 24 optical fibres to the respective pigtails.
The pigtails are taken out through outlet holes provided with plastic glands similar to the ones used on fibre distribution frame so that, if need be, the flexible plastic conduit can be fitted between termination box & fibre distribution frame to cover the pigtails. This feature is an extra cost option and supplied against specific order. It is expected that the un-connectorised end of the pigtail will be inserted through the plastic gland for fusion with the fibre coming out of OFC to avoid any possible difficulty of passing the connectorised end with FC/PC connector through the cable gland hole. All entry and exit holes remain normally closed except when in use.

Suitable fibre identification ferrules are also provided for ease of identification, installation and rearrangement of pigtails/optical fibres.

1.3 Specifications

1.3.1 Mechanical Dimension:

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>310 mm ± 1 mm</td>
</tr>
<tr>
<td>Width</td>
<td>482.6 mm ± 1 mm</td>
</tr>
<tr>
<td></td>
<td>(With collar for rack mounting)</td>
</tr>
<tr>
<td>Depth</td>
<td>100 mm ± 1 mm</td>
</tr>
<tr>
<td>Thickness</td>
<td>&gt;2 mm</td>
</tr>
</tbody>
</table>

OFC Accessories

March '2004
Wall mounting hole : 324(W)±2mm x 196(H)± 2 mm
Centre distance for hole of dia 8.7 mm.

For 19” rack mounting hole : 465 mm ± 1.6 mm

1.3.2 Capacity of the optical fibre cable termination box

**Line side** : Maximum capacity to terminate 2 OFC through two entry holes fitted with rubber diaphragm to suit the cable up to 20 mm dia.

**Equipment Side** : Maximum capacity to take out and terminate up to 48 pigtails each of dia 3 mm max through six separate holes.

1.4 Capacity of Splice Tray (Fibre organiser)

Number of splice trays provided in : 4 nos. Termination box.

Number of fusion type of splices : 12 nos. With fibre protection sleeves that Can be stored in each splice tray
1.5 Installation Procedure

1.5.1 Mounting

Optical fibre termination box is mounted on the wall or on the 483 mm (19 inch) wide standard rack such that the front panel is easily accessible with cable entry from the bottom.

1.5.2 Cable end preparation

Before starting the cable entry in Optical fibre termination box, cable end is to be prepared. The cable end preparation procedure is available from the supplier. It is extremely important at this stage to protect the bare fibres, which get exposed after following the cable end preparation specially in case of slotted core cable.

1.5.3 Cable Entry

Before inserting the cable in Optical fibre termination box the rubber diaphragm at cable entry hole is pierced which will allow the cable entry in Optical fibre termination box. Normally these opening are blocked, therefore, it is necessary to pierce the blockade before the cable entry.
1.5.4 Cable end strength member clamping

After the above step the relevant cable should be clamped as shown in figure 2.
Figure – 2

OFC Accessories

March '2004
In case of slotted core cable where, if, 12 grooves are on the slotted core then after all the optical fibres have been sleeved, they are placed individually in each of the 12 grooves and then fixed in the position with the sleeve clamping rings as shown in figure 2 at C.

The fibre in sleeves also called transport tubes are routed through several plastic fibre guide posts mounted in Optical fibre termination box. All excess length of transport tube is accommodated between these guideposts and finally brought into the selected splice tray. The transport tube is clamped at the entry point of splice tray using plastic clamping strap provided as accessory. Bare fibre will now come out of these transport tube and ready for splicing.

1.5.5 Splicing

Splicing of the optical fibre from the cable to the fibre of the pigtails is the most important part of the installation.

A table of a height approximately equal to the height of the lower part of the Optical fibre termination box is placed adjacent to it. Splicing machine is placed on the table, the required splice tray is opened simply by releasing the stainless steel wire mechanism from its spring catch.

Splice the fibre of the pigtails with the fibre ends coming out of the cable in a sequence by using splicing machine then push fit the fused splice with its
protection sleeve in the splice tray at the grooves provided in the spiced holder. The additional length of the fibre can be stored in the splice tray as shown in the figure 3, in such a way that the fibre does not bend below the critical value of 75 mm dia. The process is repeated till all the splices have been stored in splice trays and splice trays finally placed back inside the termination box in a stack. When all the four splice trays have been stacked as above the stack is fixed with stainless steel wire mechanism.

Figure – 3
1.5.6 Organisation of pigtails exit

The bunch of pigtails entering in the Optical fibre termination box through PVC glands are routed through plastic guide posts provided inside the termination box which help in storing spare length of pigtails. These pigtails are then routed to the fibre distribution frame. In order to give protection to the pigtails either a flexible plastic conduit is provided which fits into the pigtails outlet gland provided on the termination box or bunch of pigtails are tied together with PVC strap and tape as shown in figure 4. The plastic flexible conduit and PVC strip tie can be provided if separately ordered. During the handling of the fibres and pigtails care should be taken that they are not stretched or bent beyond the limits.

Figure – 4
2. Fibre Distribution Frame (FDF)

2.1 Description

Optical Fibre distribution frame is designed for organising the optical fibre pigtails from the field cable side to the optical fibre patch cords on the exchange equipment side. The inputs of fibre distribution frame are fibre optic pigtails originating from the termination box and the outputs are the fibre patch cords connected to optical line terminating equipment. Fibre distribution frame also facilitates the connection of any optical line test equipment to test the proper functioning of field cable or the exchange equipment.

Some space has provided to store the extra length of pigtails and patch cords. Fibre distribution frame provides following facilities:

i. To terminate the optical fibre pigtails originating from termination box.

ii. To connect the fibre optic equipment.

iii. To store the excess lengths of pigtails and patch cords.

A verity of connectors and accessories options are available for compatibility of existing or future optical fibre system. Each fibre distribution frame has capacity up to 24 numbers of FC/PC type optical
adopters where pigtails or patch cords could be interconnected to the respective equipment.

In case 48 fibres are to be handled, two units of fibre distribution frame are to be used. They can be mounted either back to back on a 483 mm wide standard instrument rack or side by side on the wall.

2.2 Construction

Fibre distribution frame is designed and made in housing compatible to 483 mm (19 inch) wide instrument rack or wall mounting. It is made out of steel sheet to provide a robust and reliable construction for operation, adjustment, replacement, storage, transport and is not effected by minor fire. The general arrangement of Fibre distribution frame is shown in figure 5.

The Fibre distribution frame is designed to meet the general weather and climatic conditions. The interior of Fibre distribution frame has front access and it can be mounted on a 483-mm wide standard instrument racks. In addition, four holes of 8.7 mm dia are provided to fix the FDF on the wall, if required.
Figure – 5
The front of FDF has four cover screws at each of the four corners as shown in figure 6.

After opening the front cover an access to optical connector adopters and fibre guide posts is obtained. Two set of vertical fibre guide posts are fitted inside the FDF on both the side walls and middle plate of the FDF. The F.O. connector adopter holding angle strips are fitted between the top/ bottom walls of the fibre distribution frame. If required and specially ordered the back wall of FDF is provided with four blanked off holes to route fibre pigtails / patch cords to or

Figure – 6
from other FDF mounted back to back in an instrument rack.

Each of FO adopter holding angle strip are modular in construction and have a provision for 12 nos. fibre routes. Two such fibre optic adopters can be provided in each Fibre distribution frame making the total capacity to 24 nos. of fibre routes.

The top and bottom walls have 12 holes, in which 3 holes on the left are meant for incoming fibre optic pigtails and the other for outgoing fibre optic patch cords. Each hole is provided with a PVC gland which permits up to 4 connectorised pigtails / patch cords to enter through these holes.

Pigtails coming out of the termination box enter into the FDF through inlet holes and are routed to the vertical fibre guide posts fitted inside FDF on the left wall. These pigtails travel downward in the guideposts and take upward turn to form a complete loop thus storing the extra length of pigtail around fibre guide posts. The connector of the pigtail is terminated on the desired connector adopter after taking it out from the nearest guide post. On the other side of connector adopter a converse method is adopted to take out the patch cords. The routing of the fibre is such that it does not bend below the critical bend dia. of 75 mm.
2.3 Specifications

2.3.1 Mechanical Dimension : 

Height : 443 mm ± 1 mm

Width : 482.6 mm ± 1 mm

Depth : 180 mm ± 1 mm

Thickness : ≥ 2 mm

Wall mounting hole : 324(W)±2mm x 325(H)± 2 mm for hole of dia 8.7 mm.

For 19” rack mounting hole : 465 mm ± 1.6 mm distance centre

2.3.2 Capacity

Line side : Maximum capacity to terminate 24 pigtails or patch cords through different suitable inlets. Each pigtail/patch cord inlet shall cater for 4 nos of FC/PC type connectorised pigtails or patch cords each having diameter of 3 mm maximum.

Equipment Side : Same as on line side.
2.3.3 Connector adopters

Type of connector – FC/PC to FC/PC or as specified.

Opening temperature range - 0 to 50 deg. C.

2.4 Installation

2.4.1 Grouting of FDF on wall

Position the FDF at the predetermined location where grouting bolts have been fixed at a hole centre distance of 324 (width) ± 2mm X 325 (Height) ± 2mm and tighten the FDF using four plain washer, spring washer and nut.

2.4.2 Entry of pigtails and patch cords

Not more than 4 pigtails / patch cords of diameter 3 mm maximum are threaded through the inlet and the outlet holes respectively via plastic glands provided on the top and bottom plate.

In order to give protection to the pigtails or patch cords either a flexible PVC conduit is provided which fits in to the cable inlets provided on the top or bottom plate and the termination box or bunch of pigtails coming out of each hole is tied together with PVC tape. The PVC flexible conduit can be provided with FDF. During the handling of the pigtails / patch cords care is to be taken that they are not stretched or bent beyond the limits.
2.4.3 Mounting on 483 mm rack

Mount the Fibre distribution frame on a standard instrument cabinet rack using 4 nos of screws with washer on either side of the front of FDF.

Take out the connector mounting angle from the FDF by loosening three of its mounting screws and sliding it upward till the screw head is cleared through the key hole provided. Fix the FC / PC adopters on the angle and replace it at its original position and tighten the screw.

Do not remove the protective caps over the connectors till they are ready for connection in order to avoid any dust or foreign particle sticking to the polished faces of the connectors. All the pigtails Patch cords and end connector faces be cleaned using suitable solvent and lint free tissues before connection.

3. Fiber Distribution Management System (FDMS)

Fiber distribution management system (FDMS) is designed to full fill the needs of modern optical communication system. It is made to terminate a large number of optical fibre cables and manage the subsequent distribution of the fibres. It is a combination of optical termination box & FDF.
3.1 Construction

The Fibre distribution management system is compact and robust to meet with the conditions of operation, adjustment, storage and transport. It is made of fire retarding material and can withstand saline atmosphere.

The basic unit of FDMS is consist of sub-rack suitable for 19 inch standard rack mounting having two pull out shelves. One shelf is called “splicing Shelf” and the other is called “Patching Shelf”.

The basic building block of FDMS is modular in nature and is capable of storing up to 24 optical fibre splices and subsequently patching them with the optic fibre patch cords. Additional units of FDMS can be mounted on the 19-inch rack. At the back of Fiber distribution management system two stainless steel clamps are provided to clamp up two numbers of optical fibre cables and their strength members.

The optical fibres in loose tubes / transport tubes eminating from the cable are passed through a flexible PVC duct which terminates on the splicing shelf. The loose tubes are then stored around self aligning guide posts and terminated on the selected splicing tray. There are four splice trays provided on the splicing shelf which open up like the pages of a book and held in closed position with spring loaded catch. The top splice tray is covered with a cover, which is tightened with a pair of captive screws. The ends of loose tubes
are fastened to the selected splice tray and fibres emanating from the loose tubes are stored in the splice tray and identified with numbered ferrules provided as accessories.

The pigtails are threaded into the optical fibre sub-rack, has also its fibre end available in the splice tray. The fibre from the cable and the pigtail are spliced and fused together. The fused joint is then spliced into the pre-threaded splice protection sleeve and exposed to hot air so that it shrinks and grabs the fibres & joint for safety. It is then stored in the slot provided on the splice tray. Such 12 splices can be stored in each splice tray. The process is repeated for other fibre ends of the OFC and the corresponding pigtail.

The connectorised end of all the pigtails are terminated on the FC/PC adopters fixed in the patching shelf. The other end of the FC/PC adopters are connected the patch cord, which eventually terminates on OLTE.

The general arrangement of optical fibre distribution management system is shown in figure 7.
Figure – 7
The Fiber distribution management system is fully accessible from front side and is mounted on a 19 inch standard rack using the mounting hardware provided with the optic fibre sub-rack. The design is such as to manage the slackness of pigtails, fibres or patch cords by providing adequate storage space in the shelves so that bend radius at any place does not fall below 35 mm or 70 mm dia.

Identification arrangement for optical fibre cable, optical fibre, adopters, pigtails & patch cords is also provided. The Fiber distribution management system may be supplied by supplier with 24 numbers of optical fibre pigtails having FC / PC connector at one end and 24 numbers of FC / PC adopters.

3.2 Specifications

3.2.1 Mechanical Dimension :

Height : 177 mm ± 2 mm

Width : 430 mm ± 3 mm
(Without collar)

Depth : 275 mm ± 3 mm

Thickness : ≥ 1.6 mm

Width of sub rack : 482.6 mm ± 1 mm
(With collar)
3.2.2 Capacity of the optical fibre cable termination

**Line side**: Maximum capacity to terminate 2 OFC each of < 20 mm nominal dia.

**Equipment Side**: Maximum capacity to take out and terminate up to 24 pigtails / patch cords each of dia 3 mm and having FC/PC connector.

3.2.3 Capacity of Splice Tray

Number of splice trays provided in: 4 nos.
Splicing shelf.

Number of fusion type of splices: 12 nos.
With fibre protection sleeves that can be stored in each splice tray.

3.3 Capacity of Patching Shelf

Number of optical fibre circuit: 24 Nos.

Number of FC/PC adopters: 24 Nos.

Maximum capacity to accommodate 3 mm dia patch cords: 24 Nos.
3.4 Installation Procedure

Fibre distribution management system is mounted on 19-inch standard rack.

3.4.1 Cable End Preparation

Before starting to fix the optical fibre cable with its clamp provided at the back of the FDMS unit, cable ends preparation and stripping of cable has to be completed according to the procedure as supplied by supplier.

3.4.2 Cable Entry

Cable is clamped at the cable clamp provided at the back of FDMS such that it is firmly gripped at the cable clamp and the strength member at strength member clamp as shown in given figure 8.

The loose tubes are first threaded in to the flexible fibre duct through the gland provided near the strength member clamp and taken in to the splicing shelf and stored. The end of the loose tubes near the entry gland of flexible duct are tied using the plastic clamping strap, provided with the accessories, such that the bend radius does not fall below 35 mm. The other end of the loose tube is fastened to the splice tray and fibres are taken out from the loose tube and stored in the splice tray. Each fibre is threaded through the numbered plastic ferrules for identification.
Figure – 8
The un-connectorised end of the pigtail is entered through the lower right hand slot on the optical fibre sub-rack and brought to the splicing shelf where it is fastened to the splicing shelf using plastic clamping straps.

The excess length of the pigtail is stored in splicing shelf around the fibre guides posts and finally its end is fastened to the selected splice tray using plastic clamping strap. The fibre eminating from this pigtail is fusion spliced with the selected fibre of the cable. The resulting fusion splice is stored in the splice tray. The process is repeated for other fibres and pigtails.

3.4.3 Splicing

The splicing of the optical fibre from the cable to the fibre of the pigtails is the most important part of the installation.

A table of suitable height is placed adjacent to FDMS rack. The splicing machine is kept on this table. The required splice tray is opened by simply pulling the springed catch towards the operator.

Using the splice machine, splice the fibre of the pigtails with the fibre ends eminating from the cable in a sequence then push fit the joint with heat shrunk splice protection sleeve in one of the slot provided on the spliced trays. Additional length of the fibre can be stored in the splice tray in such a way that the fibres does not bent below the critical bent diameter of 70
mm as shown in the figure 9. The process is repeated till all the fibres are spliced and stored in the splice trays.

Figure – 9
3.4.4 Organisation of pigtails & patch cords

The connectorised end of the pigtail is routed to the “patching shelf” through the upper slot on the right hand side of the FDMS and terminated on the FC/PC adopters pre-fixed in the patching shelf. The excess length of pigtails is stored in the splicing shelf and the ends entering into the patching shelf are fastened to it using plastic clamping strap. Once again care is to be taken that pigtails are not bent beyond the critical value of 70 mm dia of bent. A small storage through two guide posts is provided to shape the pigtails and ensure bending radii. Each pigtail is tagged with a plastic identification tag to provide route identification.

The other end of the FC/PC adopter is connected to one end of the optical fibre cord. The extra length of patch cord is stored in the patching shelf using the outer loop formed by the guide posts. The patch cord could be taken out from upper left side slot on FDMS side to OLTE or could be taken from the front as convenient.

Care is to be taken while threading pigtails from splicing shelf to the patching shelf that a small loop is formed outside FDMS such that it provides the desired length when any of the shelves are pulled out. All the pigtails could also be bunched together using a plastic clamping strap.
4. **Joint closure**

4.1 **Description**

The optical fibre cable joint closure is used to connect two, three or more optical fibre cables of an optical fibre route. Fibres of different cables are fusion spliced and kept safely inside the splice organizers (cassettes) provided inside the OFC joint closure. The closure is buried inside the earth or hanged on a pole in case of aerial cable.

Closures are two types, straight through Joint closure (SJC) & branched type joint closure (BJC). Closures are sufficiently strong & robust to resist the environmental / weather effect. After assembly / heat shrinking it is moisture free, dust free & insect free.

4.2 **Construction Details**

- It mainly consist of a moulded shell (pipe shaped with one end closed) with an end cap having 4 parallel ports and 1 oval port for the cable entries / exits.

- The end cap contains a base plate/main plate which holds the sheath clamp, FRP holder and cassettes. At the other end of the end cap there is an end disc which is also mounted on the base plate itself. The cable is entered from the entry ports provided in the end cap and is
gripped in the sheath clamp. FRP holder holds the FRP strength member of the cable. Aramid yarn holder, if needed can be mounted at the place of FRP holder in case of mono tube cables.

- The lower most cassette is mounted on the base plate using screws and all other cassettes including cover is mounted by cassette pins over each other. The cassettes can be mounted on both sides of the main plate/base plate.

- The housing of the cassette is designed so as to ensure that fibres should have bending radius of 37.5 mm or more.

- Grounding strip made up of copper is provided beneath the main plate/base plate over the entire length of the joint closure for enabling the splice closure to resists a current surge of 1000 amp. for 5 seconds in case if current surge in the cable due to lightening etc.

- The grounding terminal / port extends outside the body of the splice closure from where grounding may be done for main earthing in the field.
Figure – 10
4.3 Installation procedure

- These joint closures can be kept inside the manhole or mounted on to the pole in case of aerial cable.
- Firstly the cables are taken and inserted through the end cap using suitable inlets provided.
- Mark a length of 550 mm on the cable and from this point strip the cable to obtain the following:
  
  a) HDPE sheathing of minimum of 40 mm length to be gripped in the sheath/sheath clamp.
  b) FRP strength member of the cable approx. 40 mm length to be held in the FRP holder which itself is 15 mm wide.
  c) Loose tubes coming of the cables should be at least 150-200 mm long.
  d) Loose tubes are stripped to obtain the fibre length of about 300 mm.

- The cable is inserted through the cables entry ports, the HDPE / Nylon sheath is gripped with the sheath clamp and FRP strength member is gripped with the FRP holder.
- The steel wires if present as strength member are tied on the 0.8 mm holes provided on the main plate. For earthing the lugs are used with proper wire.
The cassettes are used for housing fusion spliced joints after complete stripping and fusion splicing of the optical fibre.

5. **Patch Cord**

Patchcords are generally called jumper cables. These are available in different sizes such as 5 metre, 10 metre, 20 metre, 40 metre or as per requirement. Patchcords have connectors on both sides and are normally used for giving connections from fiber distribution frame to the equipment. In figure 11 given below simple sketches of pigtails and patch cords are shown.

6. **Pigtail**

Pigtails have connector on one side and are used as single fibre connection from cable by splicing in the termination box. These are also available in different sizes as required.
7. **FC / PC Adopter**

FC / PC adopters are used for connecting patch cords and pigtails in the fibre distribution frames. Whenever required to increase the capacity of fibre distribution frame, FC/PC adopters are used. These are available in two types, one fitted with ceramic sleeve and the other fitted with Be-Cu sleeve.

8. **Fibre Protection Sleeves**

Fibre Protection Sleeves are used for splicing the fibres. They protect the fibre after splicing. These are small in size but has an important role. Fibre protection sleeves are supplied with joint closure and termination box as part of consumables in sufficient quantity.

![Figure – 12](image)