BIDDING DOCUMENT

FOR

COMPETITIVE BIDDING DOCUMENT
OF
Installation of Live-Line 24F (DWSM) OPGW on existing 132KV Baghjhap –HPC line to connect the Upcoming 132KV/33KV TSAT substation with existing 132KV Baghjhap GSS by replacing the existing Ground wire with 24F OPGW

(Design, Engineering, Manufacture, Assembly, Inspection, Testing at Manufacturer's Works before Dispatch, Packing, Supply, Delivery at Site, Including Insurance During Transit, Subsequent Storage, Erection and Commissioning of 24F (DWSM) OPGW by replacing existing Groundwire in 132KV Baghjhap –HPC line with 24F DWSM;OPGW)

SINGLE STAGE TWO ENVELOPE
(e-Tender)
Under

VOLUME II

ASSAM ELECTRICITY GRID CORPORATION LIMITED
The State Transmission Utility of Assam
Regd.Office,Bijulee Bhawan
Paltanbazar, Guwahati - 781001

TENDER IDENTIFICATION NO.: AEGCL/MD/Tech-1142/OPGW/BID

Section	MAIN CONTENTS	*Page No.*
Error! Reference source not found.	Guideline for Live Line Installation	
Error! Reference source not found.	GTP of OPGW	
Error! Reference source not found.	Fiber Optic Approach Cable Installation	
Section – 4	Splicing Guidelines	
Error! Reference source not found.	SAT Procedures	

1. General

Installation procedure for OPGW is basically similar to that for conventional overhead ground wires in overhead transmission line construction, however particular care required to be taken for protection of optical fibers in OPGW cable from damage by handling the same properly during transportation, unloading and installation at site.
Live line installation to be carried out using traction machines and support rollers (hanging pully blocks) using experienced installation team comprising of minimum 30-35 persons. The installation team shall have one team leader/crew in-charge along with 15 skilled and 14 unskilled persons minimum in one installation crew.

List of Tools and Plants to be used are as per enclosed Annexure.

Following aspects are to be kept in mind before taking up live-line installation:

a) Condition of existing ground wire for its suitability for live-line OPGW installation
b) Tools and Plant suitability
c) Working conditions, specially following:

- Strong winds more than 7 m/sec
- Rain or snow
- Foggy
- Lightening

a) These guidelines for live line installation along with checklist enclosed at Annexure-II to be provided in local language to the erection team.

b) Peptalk snapshots & photos of erection team is to be shared with AEGCL site as a regular practice.

c) Team deployed for live line installation should have relevant experience of same or higher voltage level. Contractor to ensure the same.

2. Safety measures

All site workers must follow the Electricity Rules and Employer specified safety procedures. They must use safety belts, safety shoe, safety helmet and other safety items required.

Assign foremen/Crew In-charge for each erection crew for enforcing installation guidelines. It may be ensured that only authorized person is climbing the tower during live-line installation of OPGW. Fix the warning red flag on the tower in order to keep the workers from encroaching into unsafe zones.

Frequent verification of healthiness of T&P and ropes shall be carried out before start of work.

2.1 Permission to Work(PTW):

Permit to work to be obtained by the representative of installation agency from concerned sub-station staff in coordination with employer project manager prior to

Commencement of installation and the same is to be returned after completion of the work in all respect within the specified time duly following the PTW conditions.

2.2 Preparedness to tackle untoward incidents:

a) Safety Engineer has to make sure the availability of First Aid Box with each team.

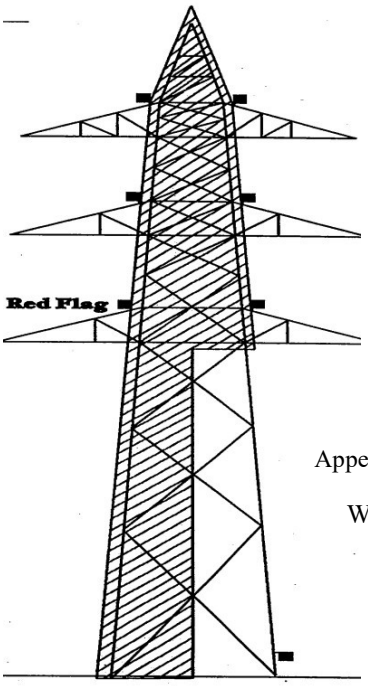
b) Maintain a record of the details of list of all nearby hospitals/clinics in each area, with contact details and Emergency contact nos. of Ambulances.

c) In case of any untoward situation, Safety engineer/crew in charge must act fast and provide the necessary first aid to the affected person(s). Ambulance to be arranged immediately from the nearby area and coordinate with hospital for immediate medical assistance as required..

2.3 Marking of Zones during OPGW Stringing:

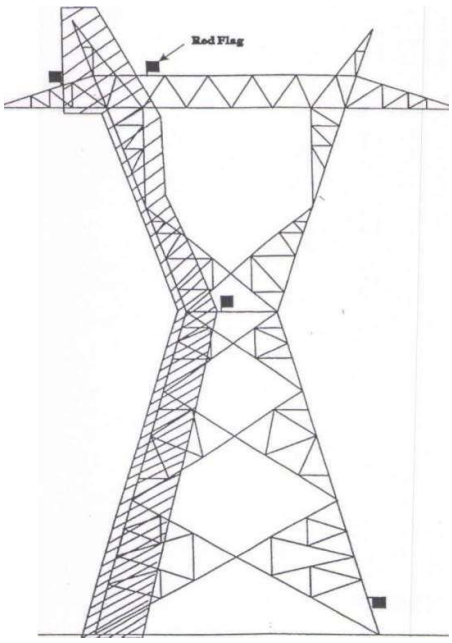
It is very essential for the installation agency to be aware of safe zones of the Tower while carrying out live-line installation. Generally crew members identified for preparation work on the ground, will not work on the tower and will remain within hazard-free zone.

The pictorial view of the working zone and the limitation of the restricted zone are shown below for your convenience



Appendix-C-Guideline for Live Line OPGW Installation

Working Area



Working Area

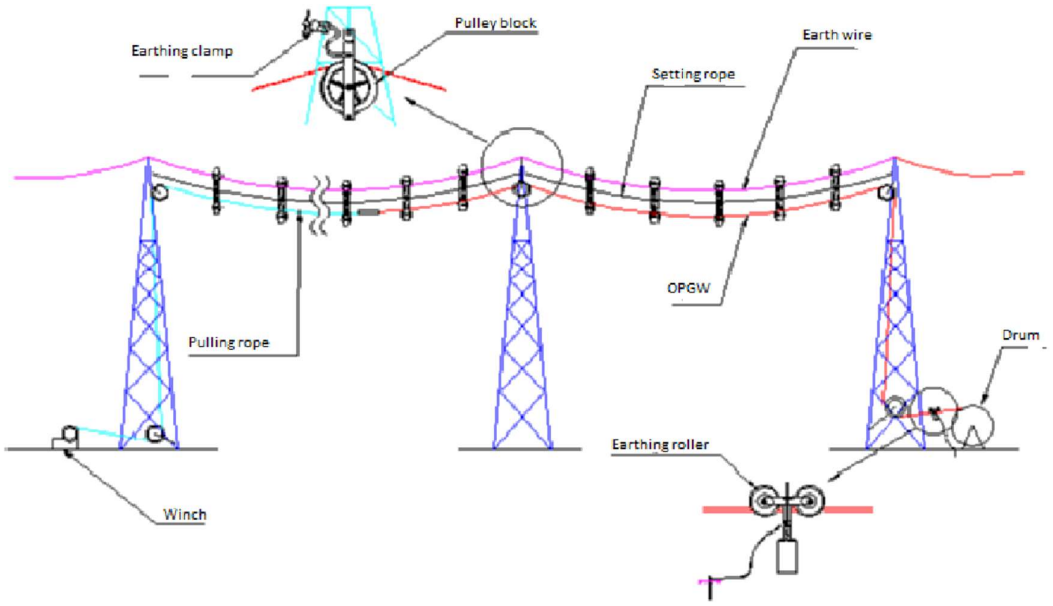
3. Grounding

Grounding of the following items must be ensured before starting work at site. Grounding devices include the following:

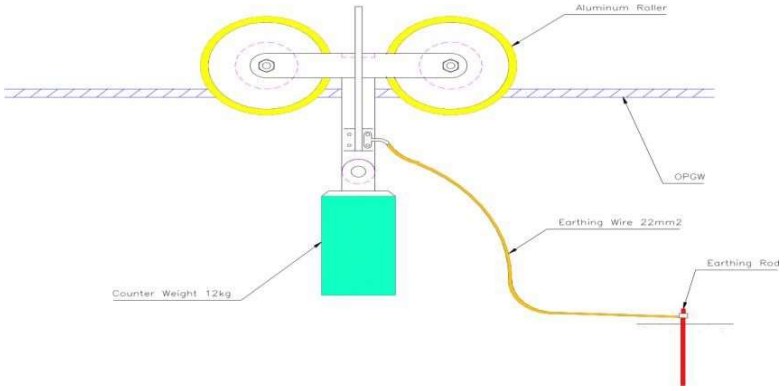
3.1 Equipment Grounding:

Equipment like OPGW and Existing Ground wire (GW), aerial rollers(pulley blocks) are connected with individual copper cable attached to the tower (with copper rod installed on the ground) or to the main grid if grounding system exists. Grounding clamp shall be cleaned well and ensure proper contact.

3.2 **Running Ground:**

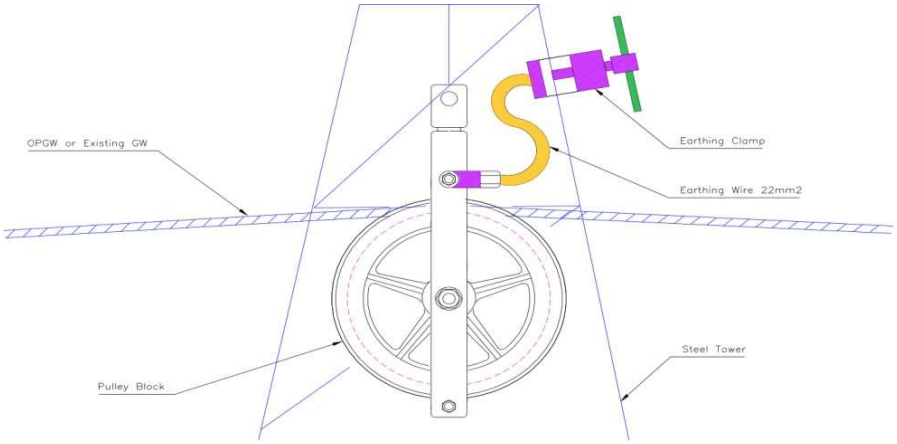


Running ground shall be installed on the OPGW at the drum side during OPGW stringing, and at the winch side on the existing ground wire during dismantling, for the entire stringing operation to avoid any induced electrical charges from the line..



3.3 **Pulley Block Grounding:**

For each tower grounding type pulley block must be used..



Grounding cable must be connected to the ground source first, and then to the object that needs to be grounded. When removing grounds, the cable must be disconnected from the grounded object first, and only then removed from the ground source. In case of any problems during the installation work, the person in charge of the section shall immediately contact the Sub-Station In-Charge of the line and the Employer's Project Manager for necessary support.

Further , in order to have proper earthing, one aluminum roller (hanging pulley block) shall be used for additional safety after every ten rollers (neoprene) used in the span/section.

4. Live-line Installation Process

4.1 Installation plan:

Following measures are to be taken in advance for smooth completion of the installation.
PTW availability and coordination with employer project manager

- Erection crew mobilization along with T&Ps
- Safety aspects
- Field quality aspects
- Transportation arrangement

4.2 Materials handling:

Check the material against the approved documentation. All materials shall be visually inspected for any physical damage. Any material, which is not as per documentation or is damaged, shall not be used.

OPGW Drums checks:

- Packing condition
- Packing list (Object, Type, Length, OPGW Weight, Drum No. etc)
- Attenuation results of OPGW

Hardware Fittings Checks:

- Bolts, Nuts Pitch
- Type& Quantity

Handling of OPGW:

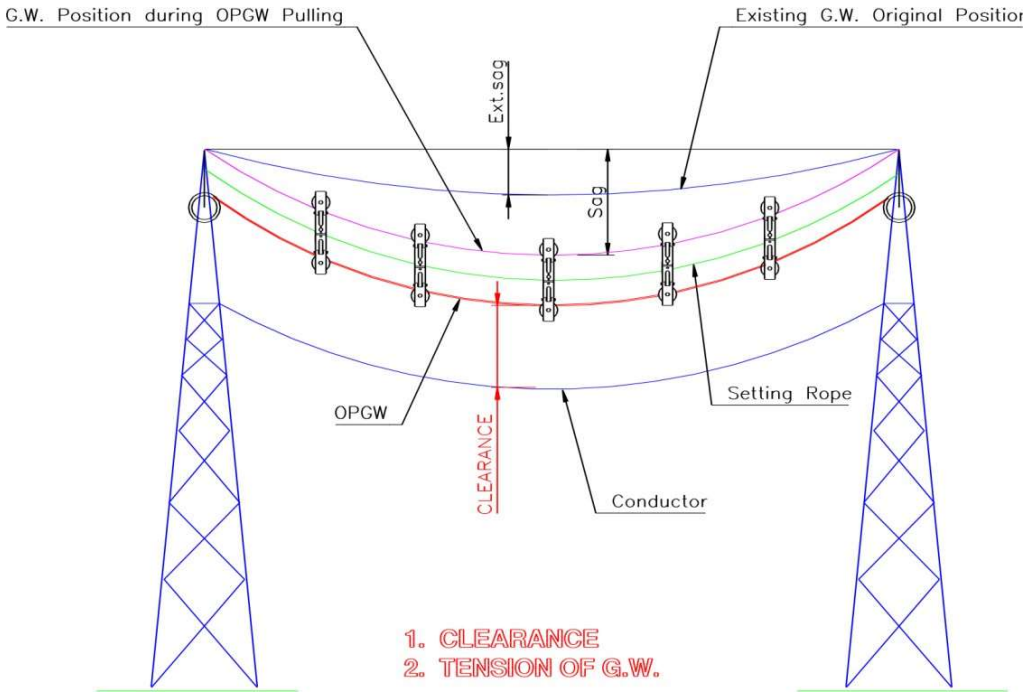
OPGW contains optical fibers which are very delicate and to be handled with due care. For the safety of optical fibers, it is very important to avoid the bending at sharp angle. Manufacturer guidelines are to be followed strictly while handling the same. In order to avoid undue tension on OPGW, it is not recommended to payoff OPGW together with phase conductors or other wires tied in parallel. The tension during stringing works should be well managed within permissible limits. Adequate length of OPGW shall be ensured as loop at each joint location after stringing so that itis possible to bring OPGW up to the ground level for carrying out jointing work.

Hardware fittings: The hardware fittings to be supplied should match the UTS of the OPGW supplied

5. Clearance Checking

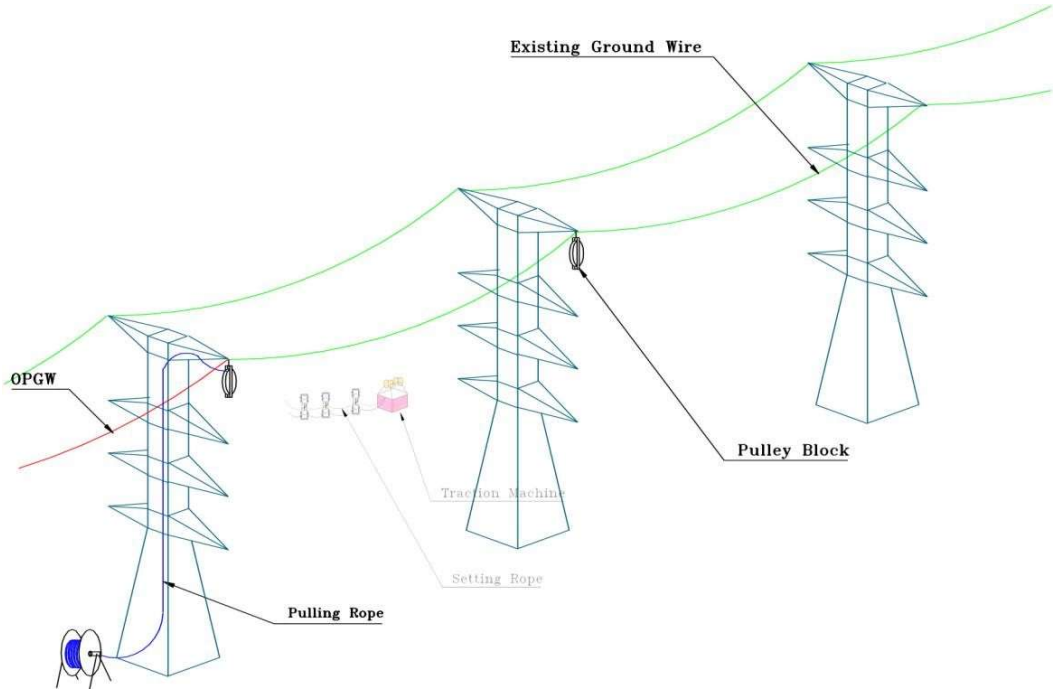
5.1 Checktheclearancebetweenexistingground-wireandliveconductorbefore Stringing.

Check the clearance between OPGW and live conductor. The minimum clearances, as per the pre-commissioning procedures for transmission lines, are mentioned at Annexure-III.


G.W. Position during OPGW Pulling
Existing G.W. Original Positior
Ext.sag
Sag
OPGW
CLEARANCE
Setting Rope
Conductor
1. CLEARANCE
2. TENSION OF G.W.

6. OPGW Stringing

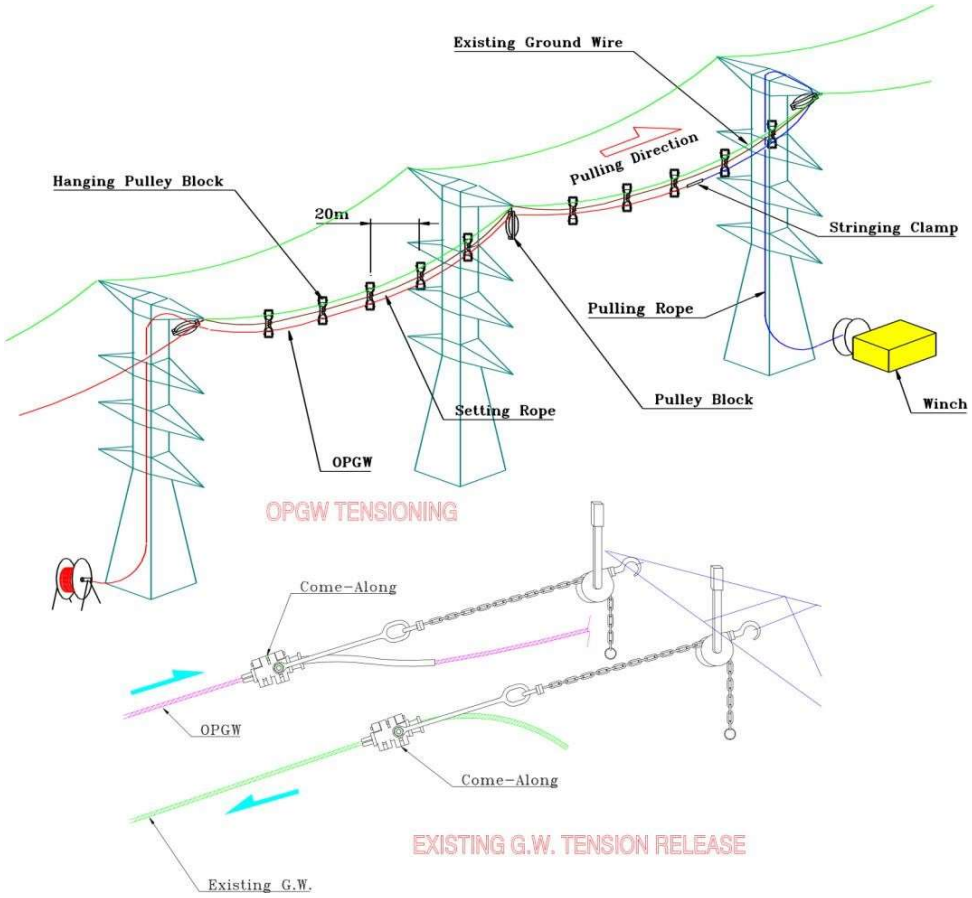
- Removal of Aviation globules in the spans (wherever applicable) by taking proper shutdown.
- Hang the pulley blocks on one of the earth wire peaks for the whole section (A section is defined as a consecutive group of towers required to support the installation of the scheduled length of an OPGW drum.)



- Set the Traction machine on the existing ground wire.
- Set the support rollers(hanging pulley blocks)on the existing ground wire where the OPGW is to be installed.
- Connect the Setting Rope and Pulling Rope to the Traction Machine.
- Pull the support rollers(hanging pulley blocks),Setting Rope and Pulling Rope with the use of Traction Machine. Support rollers (Hanging Pulley blocks) should be hanged at an interval depending on voltage level, which is mentioned below. (A mark with these specified interval shall be marked on setting rope)

Sl.no	Voltage level	Spacing
1	220kV	18-22m
2	400kV	15-18m
3	765kV	10-12m

- For every ten support rollers (hanging pulley blocks) made of neoprene used in a span/section, one aluminum roller (hanging pulley block) shall be provided
- Securing the pulling & setting rope at end towers of the stringing section.
- Connect the OPGW to the Pulling Rope with Stringing Clamp.
- Pull the Pulling Rope with the use of winch machine to pay out the OPGW.
- Set the Come-along and Lever Block to the existing ground wire.
- Release the tension of existing ground wire. At the same time, with a fixed come-along and Lever Block, give more tension to the OPGW.



- Position of OPGW and existing ground wire will interchange with above action. The OPGW will be in upper position and existing ground wire in lowerposition in support rollers (hanging pulley blocks).
- With this OPGW paying for a section gets completed.
- Finally after successful stringing of OPGW and dismantling of Earth wire along with all ropes, support rollers etc., proper shutdown may be taken to install aviation globules back in the respective spans. The installing agency to ensure healthiness of all ropes and T&Ps used for the stringing work.

Additional suggestive measures:

(a) Loosening of earth wire to be avoided.

(b) Cradle blocks of Aluminum type to be preferably usedin 765kV lines as per placement recommended in the guidelines.

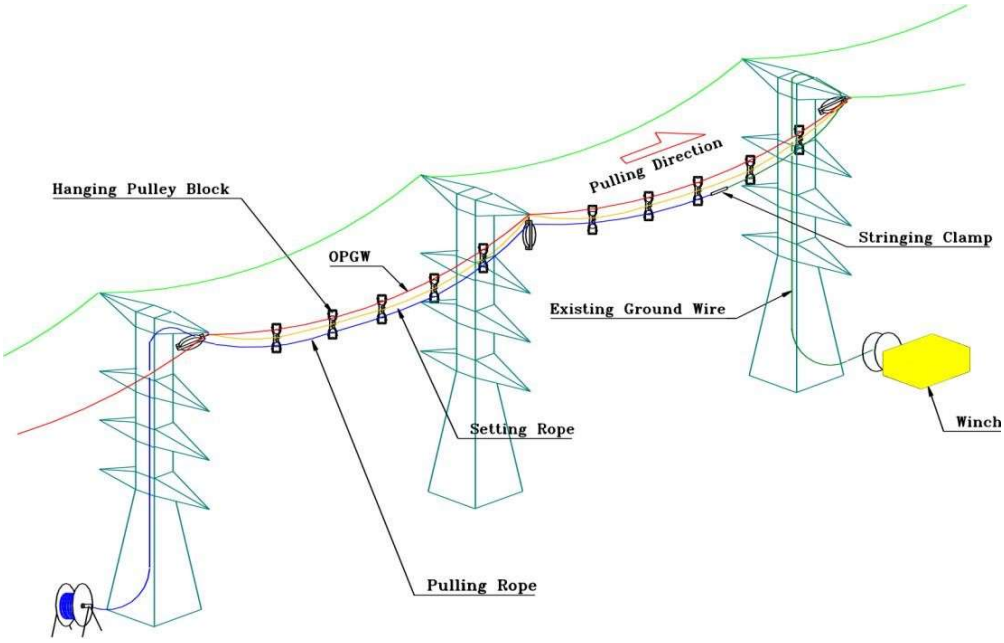
Special Provisions in case of inclement weather:

In case of sudden change in weather/possibility of rain, fog, storm etc coming to notice during stringing, the contractor may explore feasibility of pulling OPGW in possible sections and removal of pulleys/ropes etc from balance sections of drum. Use of approved Tension fitting (pass through) for Suspension tower (Yoke plate) for tension clamping of OPGW as an interim arrangement may be explored. This aspect may be used to facilitate removal of pulleys and ropes from all sections to avoid tripping of lines occurring in bad weather. This provision may be explored to limit the exposure of T&Ps/ropes/pulleys used in Live Line OPGW stringing during such bad weather to live line. This is to be done in consultation with Project Manager. This does not limits the contracting agencies from taking measures to avoid trippings of line and ensuring safety of their personnel.

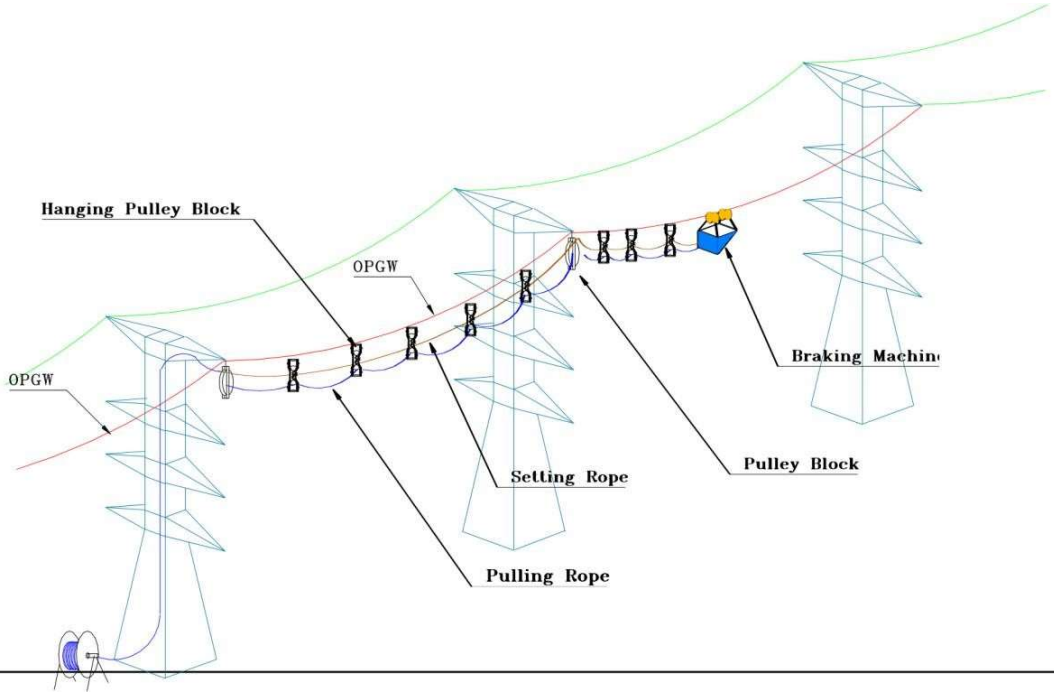
7. Dismantling process

7.1 Existing ground wire:

- Connect the existing ground wire with the Pulling Rope.
- Pull the Pulling Rope with winch to dismantle the ground wire.



7.2 Hanging Pulley Block, Setting Rope and Pulling Rope:



•Set the Breaking Machine on the OPGW of the span required for dismantling.

•Connect the Pulling Rope and Setting Rope to the Braking Machine.

•Pull the Setting Rope and Pulling Rope to dismantle. Collect and dismantle the support rollers (hanging pulley blocks) upon reaching the

succeeding tower.

OPGW sagging

- Use the pre-calculated Sag & Tension Table as sag reference.
- Avoid fixing the sag if the wind is strong.

8.1 Sagging:

1) Methods and procedures for sagging of OPGW are the same as those of normal overhead ground wire.

2) After stringing the OPGW shall be sagged using information furnished on the sag and tension chart. The sag of the OPGW should not exceed the existing ground-wire sag.

3) Sagging thermometers shall be used to determine accurate temperature and OPGW sag of each sag section. Sagging thermometer shall be used sufficiently prior to the actual sagging operation to represent the temperature of the OPGW.

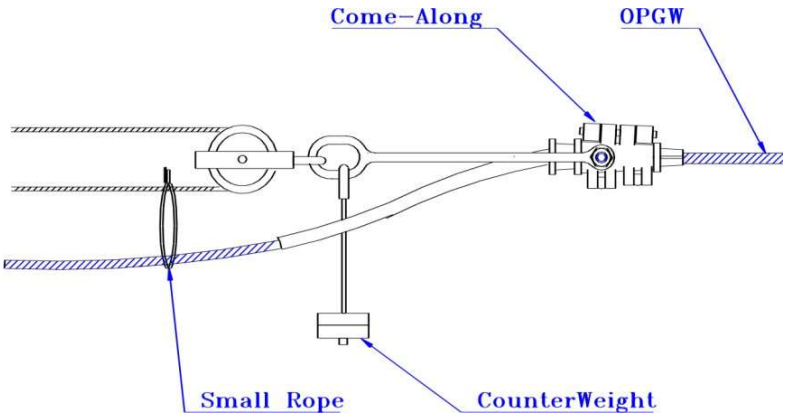
5) At the time of sagging OPGW, the sag should be within 6 inches of the theoretical value for existing temperature condition.

7) OPGW tension between each sag section shall be equalized and this shall be determined by the vertical position of the suspension clamps on the last clipped structure of the preceding sag section.

8) For pulling the OPGW with tension, the device of come-along is to be recommended.

9) Personnelshouldbespecificallydeployedforkeepingwatchonsagatadifferent section of the line during live line stringing.

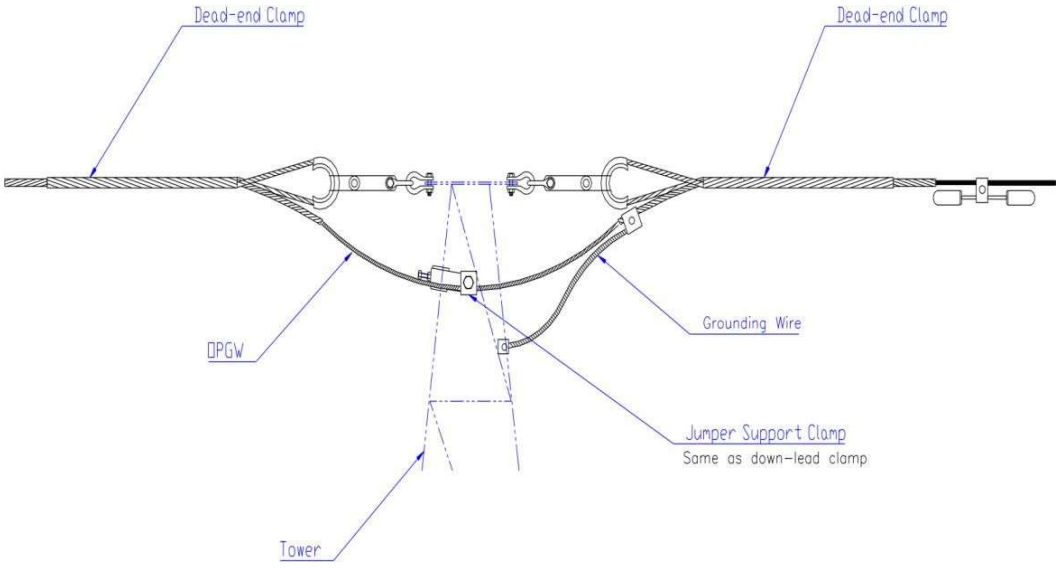
7) Waterproof caps shall be fixed at both ends of the OPGW cable after installation.



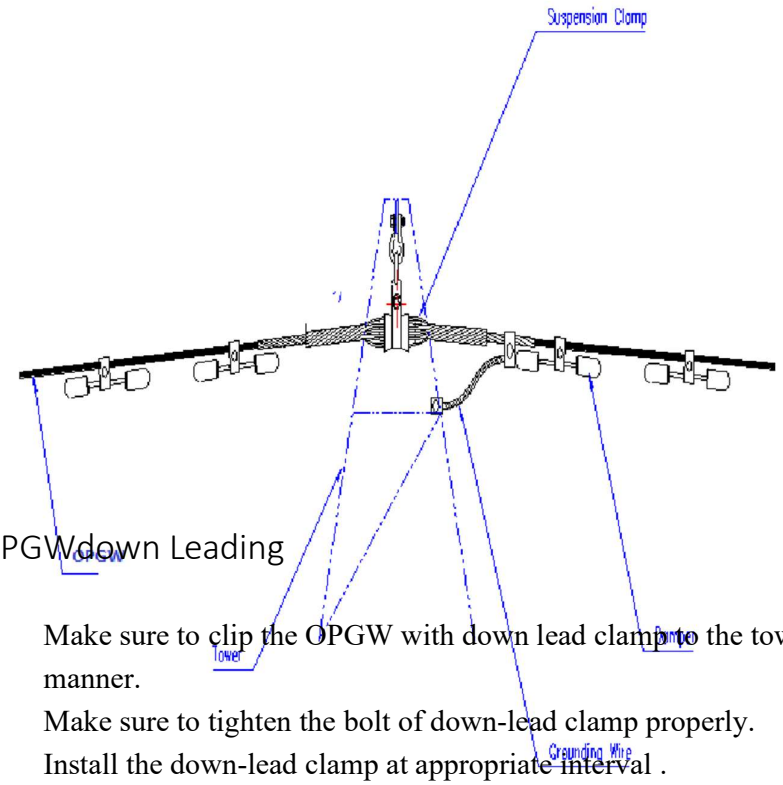
10) OPGW Clamping

a. Make sure to install and tighten the bolt of clamp properly.
b. Tightening must be made sequentially from the support point.

TENSION TOWER



SUSPENSION TOWER



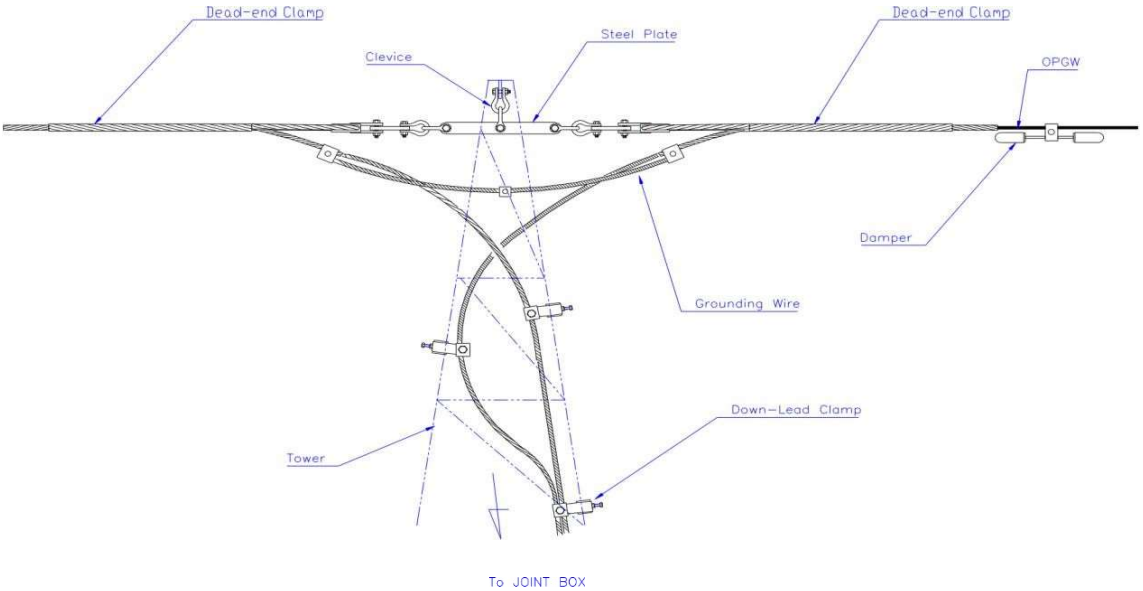
11) OPGWdown Leading

a. Make sure to clip the OPGW with down lead clamp to the tower in a careful manner.

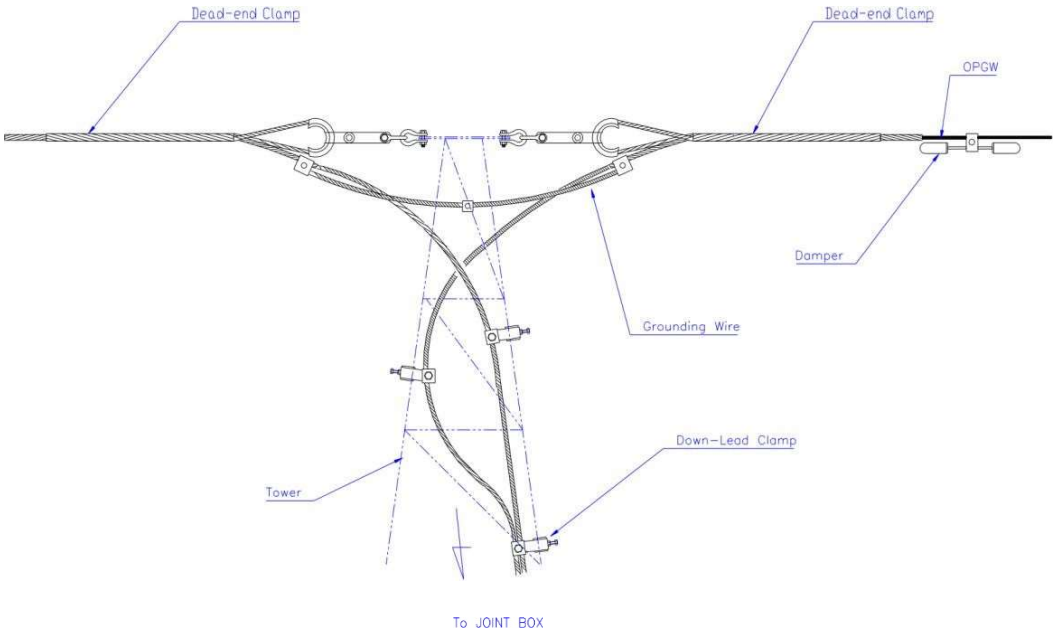
b. Make sure to tighten the bolt of down-lead clamp properly.

c. Install the down-lead clamp at appropriate interval .

SUSPENSION TOWER FOR JOINTING TOWER



TENSION TOWER OF JOINTING TOWER



Annexure-1

ListofTools:

S.No	Description	Specifications
01	Aerial Roller/Pulley-block (Aluminum)	300 mm
02	Aerial Roller/Pulley-block (Aluminum)	450 mm
03	Aerial Roller/Pulley-block (Aluminum)	600 mm
04	Setting rope	12mmPProperope Rope
05	Pulling Rope	(i)For Preparation: a) 12mm PP Rope Rope (for400kv and above); b) 12mmNylon rope (for220kV&below) (ii)ForOPGWPulling:14mm Nylon rope
06	Lifting/Supporting Rope	12mmPProperope
07	Earthing roller	3-wayroller
08	Traction machine	35 kg f
09	Winch machine	3 tons
10	Drum stand	
11	Wheel winder	
12	Come along clamp	
13	Kitto clamp	
14	D-shackle	
15	Sag-scope	
16	Support Rollers(Hanging Pulley block)	
17	Aluminum Roller (Aluminum Hanging Pulley Block)	
18	Earthing Lead	
19	Braking Machine	

Annexure-II CheckList for OPGW stringing work(Frequency-Daily)

SL No	Check Point	Remarks
	Before Start of Work	
1.	PTW is available	Yes/No
2.	Awareness among working gang on live-line installation procedure	Yes/No
3.	All Tool and plants are duly tested and certificates are available including healthiness of ropes.	Yes/No
4.	Weather condition is good i.e. No heavy wind/Lightning/Fog/rain/snow etc.	Yes/No
5.	First aid box is available	Yes/No
6.	Contact details of nearby Hospital is available	Yes/No
7.	Pep talk about OPGW stringing and safety requirement given	Yes/No
8.	Tower climbing persons certified for height work	Yes/No
9.	There is no aviation globule in the EW *(Note: aviation globule exist shutdown to be taken for its removal before hotline stringing. Similarly, after installation OPGW shutdown need to be taken for installation of aviation globule)*	Yes/No
10.	OPGW drum schedule is available	Yes/No
11.	There shouldn't be any uneven joint/twist/broken strands in the earth wire between stringing span.	Ensured/Not ensured
12.	Tower Footing Resistance(TFR) check as per Asset Management norms of POWERGRID. (In case of poor TFR, to be intimated to POWERGRID)	Ensure/Not Ensured
	During Work	
1.	Clearance of EW to Top conductor is adequate i.e. 9 meters (for 400kV and 765 kV system),8.5 meter for 220kV system	Ok/Not OK
2.	Running ground is installed on the OPGW at drum side during stringing (To neutralize the induction effect during stringing)	Yes/No
3.	Tension during stringing is within limit to avoid breakage of OPGW/PP rope	Ensured/Not ensured
4.	Support rollers (hanging pulley blocks) should be hanged at an interval of 18-22 meter for 220kV level,15-18 meter in 400kV level and 10-12 meter for 765kV Level	Ensured/Not ensured
5.	For every ten support rollers of neoprene one aluminum roller shall be used	Yes/No
6.	Pulling and setting rope is secured at the end of Tower of stringing section.	Ensured/Not ensured
7.	Sag of OPGW is equal to existing EW sag (it shouldn't be more than that)	Ensured/Not ensured
8.	Proper clamping of down lead clamp at appropriate interval is done at the jointing Tower (either Suspension/tension)	Ensured/Not ensured
9.	Healthiness of ropes	Ensured/Not ensured
	After completion of stringing work/each day target	

1.	There should not be any loose PP rope in the stringing span after completion of each day work. It should be tightened properly.	Ensured/Not ensured
2.	After final stringing Mid span clearance is adequate i.e. 9 meters (for 400kV and 765 kV system),8.5 meter for 220kV system (Actual value needs to be recorded for future purpose)	Ensured/Not ensured

Annexure-III MINIMUM CLEARANCES AS PER PRE-COMMISSIONING PROCEDURES FOR TRANSMISSION LINES

Electrical Clearance

All statutory electrical clearance of transmission lines w.r.t. ground, building, Structures, Power line crossings, River crossing, Railway & Road crossings etc. as stipulated under latest version of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations &A EGCL specification shall be ensured.

Minimum Ground clearance shall be as per clause 58.0 of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations,2010.

The ground profile at the time of commissioning shall be checked with the profile approved at the time of check survey.

Sag in one of the span in each section shall be measured and it should be ensured that sag & tension of the section is in line with specification and sag & tension calculation chart approved by Engg.

Ground clearance of lowest conductors at critical points shall be checked in thefieldfromanyoftheprevalentmethodandthevaluesofgroundclearance at these critical points including all powerline, railway line and road crossings shall be recorded in the prescribed format.

In case of hilly Terrain and for building clearance, the side clearance from conductors and jumpers at critical points shall also be checked and recorded for all phases of conductor/ earth wire/ OPGW towards hill building side.

Transmission voltage (in kV)	**66**	**132**	**220**	**± 320 HVDC**	**400**	**765**	**± 500 HVDC**	**± 800 HVDC**	**1200**
Minimum Ground Clearance (in meter)	5.5	6.1	7.015	8.5	8.84	18	12.5	18	24

Clearance of earth wire/ OPGW with Top conductor at mid span to Top conductor

Availability of required vertical clearances (as per design & AEGCL Specification) between conductor and earth wire /OPGW shall be ensured through random checking. Minimum clearances between conductor and earth wire/OPGW at mid-span shall be as indicated:

Voltage (kV)	66	132	220	+/- 320 HVDC	400	+/- 500 HVDC	765	+/- 800 HVDC	1200
Minimum mid span clearance (in meter)	3	6.1	8.5	8.5	9	9	9	12(pole) 6.1(DMR)	18

Record of such random checks shall be the part of pre-commissioning records.

Clearance between line crossings each other, the minimum clearances betweenthePowerlinecrossingeachothershallbeasperclauseno69.0, part-III, Sec-4 of CEA's Regulations 2010 (Measures relating to Safety and Electric Supply)

Where an overhead line crosses another over headline, clearances shall be as under:

(Minimum clearances in meters between AC lines crossing each other)

Sl. No.	Nominal System Voltage (kV)	11-66	110-132	220	400	765	1200
1.	Low and Medium	2.44	3.05	4.58	5.49	7.94	10.44
2.	11-66	2.44	3.05	4.58	5.49	7.94	10.44
3.	110-132	3.05	3.05	4.58	5.49	7.94	10.44
4.	220	4.58	4.58	4.58	5.49	7.94	10.44
5.	400	5.49	5.49	5.49	5.49	7.94	10.44
6.	765	7.94	7.94	7.94	7.94	7.94	10.44
7.	1200	10.44	10.44	10.44	10.44	10.44	10.44

Where an overhead direct current(DC)line crosses another overhead line, clearances shall be as under: -

Minimum clearances in meters between AC and DC lines crossing each other

Sl. No.	System Voltage (AC/DC)	100 kV DC	200 kV DC	300 kV DC	400 kV DC	500 kV DC	600 kV DC	800 kV DC
1	Low and Medium AC	3.05	4.71	5.32	6.04	6.79	7.54	9.04
2	11-66 kV AC	3.05	4.71	5.32	6.04	6.79	7.54	9.04
3	110-132 kV AC	3.05	4.71	5.32	6.04	6.79	7.54	9.04
4	220 kV AC	4.58	4.71	5.32	6.04	6.79	7.54	9.04
5	200 kV DC	4.71	4.71	5.32	6.04	6.79	7.54	9.04
6	300 kV AC	5.32	5.32	5.32	6.04	6.79	7.54	9.04
7	400 kV AC	5.49	5.49	5.49	6.04	6.79	7.54	9.04
8	400 kV DC	6.04	6.04	6.04	6.04	6.79	7.54	9.04
9	500 kV DC	6.79	6.79	6.79	6.79	6.79	7.54	9.04
10	600 kV DC	7.54	7.54	7.54	7.54	7.54	7.54	9.04
11	765 kV AC	7.94	7.94	7.94	7.94	7.94	7.94	9.04
12	800 kV DC	9.04	9.04	9.04	9.04	9.04	9.04	9.04
13	1200 kV AC	10.44	10.44	10.44	10.44	10.44	10.44	10.44

Provided that no guarding are required when line of voltage exceeding 33 kV crosses over another line of 250 V and above voltage or a road or a tram subject to the condition that adequate clearances are provided between the lowest conductor of the line of voltage exceeding 33 kV and the top most conductor of the overhead line crossing underneath the line of voltage exceeding 33 kV and the clearances as stipulated in regulation 58 from the topmost surface of the road maintained.

GTP of OPGW:

Technical Particulars of Optical Fiber

Description	Unit	Proposal Data
Applicable standard	-	ITU-T G.652D
Mode field diameter	µm	(8.6 to 9.5) ± 0.6
Cladding diameter	µm	125 ± 1.0
Coating diameter(uncolored)	µm	245 ± 15
Mode field concentricity error	µm	≤ 0.6
Cladding non-circularity	%	≤ 1.0
Attenuation coefficient at 1310 nm at 1550 nm	dB/km	≤ 0.35 ≤ 0.21
Chromatic dispersion at (1288-1339) nm at (1271-1360)nm at 1550 nm	ps/nm·km	≤ 3.5 ≤ 5.3 ≤ 18
Zero dispersion wavelength	nm	1300~1324
Zero Dispersion Slope	$Ps/(nm^2xkm)$	≤ 0.092
Cable cutoff wavelength(λ_{cc})	nm	≤ 1260

Polarization Mode Dispersion (PMD_Q)	ps/√km	≤ 0.2
Bend Performance; Induced attenuation		
@ 1310nm: (75±2mm dia. Mandrel), 100 turns		Induced attenuation ≤ 0.05dB
@ 1550nm: (75±2mm dia. Mandrel), 100 turns		Induced attenuation ≤ 0.10dB
@ 1550nm: (32±0.5mm dia. Mandrel), 1 turn		Induced attenuation ≤ 0.5dB
Temperature Dependence Induced attenuation		≤ 0.05dB/km @1550nm (-60 °C to +85 °C)
Proof Test Level	Kpsi	≥ 100Kpsi or ≥ 0.69GPa

3. Technical Particulars of OPGW

Description		Unit	Proposal Data
Applicable standard		-	IEEE 1138
Number of optical fibers SMF (G.652D)		Nos.	24
Construction Center: Aluminum Covered SSLT tube 1st Layer: Aluminum-clad steel wire		Nos./ dia. (mm)	1/5.53 ± 0.1 9/2.80 (20.3 %IACS)
Outer stranding direction		direction	Left-hand (S)
Ratio of length of lay of a layer to nominal outside diameter of that layer		times	10 ~ 16
Overall diameter		mm	11.10 ± 0.20
Total cross-section area for tension bearing		mm^2	55.42
Nominal weight		kg/km	432 ± 10
Minimum breaking load (RTS) / Ultimate tensile strength (UTS)		kN	70.27
Final modulus of elasticity for stress-strain calculus		kN/mm^2	118.94
Coefficient of linear expansion		$x\ 10^{-6}/°C$	14.0
D.C resistance at 20ºC		Ω/km	< 1.0
Short circuit current NOTE1) (for 1s)		kA.s	≥ 6.32
Maximum allowable temperature	Continuous for OPGW	ºC	85
	Instantaneous for optical unit	ºC	< 180

	Instantaneous for outer layer	ºC	230
Maximum everyday stress (EDS)		-	20%
Maximum allowable tension (MAT)		-	40%

Note: All hardware fittings to be supplied should match the supplied OPGW and supported with signed GTP and type tested document and from reputed suppliers like TAG, SICAME, LEGION etc.

APPROACH CABLE INSTALLATION AND HANDLING DOCUMENT

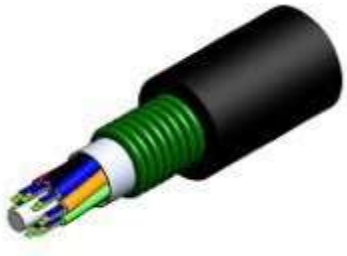
Introduction:-

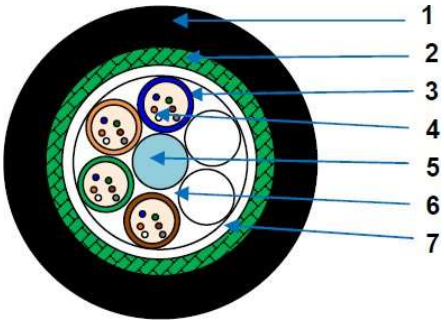
A fiber optic approach cable is defined as the Armored Underground fiber optic cable required to connect Overhead Fiber Optic Cable (OPGW) between the final inline splice enclosure on the gantry/ tower forming the termination of the fiber cable on the power lines and the fiber Optic Distribution Panel (FODP) installed within the building. The Supply and installation of optical fiber approach cable as required based on detailed site survey. The existing cable trenches/ cable raceways proposed to be used shall be identified in the survey report. Where suitable existing cable trenches are not available, suitable alternatives shall be provided after Employer approval. The approach cable shall be laid in the PLB HDPE duct in all conditions.

Overview:-

Optical fibers require special care during installation to ensure reliable operation. Installation guidelines regarding minimum bend radius, tensile loads, twisting, squeezing, or pinching of cable must be followed. Cable ends should be protected from contamination and scratching at all times. Violation of any of these parameters causes increased attenuation or permanent damage to the cable. Make sure you check the installation instructions of the module for the appropriate cable lengths to ensure proper operation.

Approach Cable Structure





Construction :

1. Outer sheath(PE,Anti-rodent)
2. Armor tape

3. Loose tube
4. Fiber and jelly
5. Center strength member (FRP)
6. Cable jelly
7. Water blocking tape

Technical Characteristics

Theuniqueextrudingtechnologyprovidesthefibersinthetubewithgoodflexibilityandbendingendurance. Theuniquefiberexcesslengthcontrolmethodprovidesthecablewithexcellentmechanicalandenvironmental propertiesmultiplewaterblockingmaterialfillingprovidesdualwaterblockingfunction provides good crush resistance.

Dimensions and Properties

Physical	Fib recount	24G652D	48G652D
	No.of Fiber Per Tube	4	8
	Cable OD	11.5mm	
	Cross Sectional Area	100mm	
	Cable Weight	Approx.130kg/Km	
	Operation Temperature Range	-30°Cto+70°C	
	Installation Temperature Range	-30°Cto+70°C	
	Transport and Storage Temperature Range	-30°Cto+70°C	
Mechanical	Max. Tensile Load	4.5KN	
	Crush Resistance	3000N/10Cm	
	Minimal Installation Bending Radius	20XOD	
	Minimal Operation Bending Radius	10XOD	

HANDLING AND LAYIN GO FPLB HDPE DUCT:

1. ThecoilofPLBHDPEductshallbeunloadedfromeitheracraneorbyanyothersuitablemeansvery carefully so as not to cause any damage to the duct. The coils at site shall be protected until they are laid. The duct shall be given the same care in handling as that given to the cable. The coils shall be kept as per the guidelines issued by the manufacturer. The coil shall not be set by jerks but shall be handled slowly and care. The walls of the ducts shall not be damaged while moving the coils, if required for unloading.
2. The coil shall normally be unrolled at the same place and the PLB HDPE duct carried by workmen near the trench. The coils shall not be dragged in any case. But where the drums/coils of duct have to be moved should always be rolled in the direction of the arrow, otherwise the coils tend to unwind and the same may get battered. In case no such direction of arrow is given see the direction of winding of the coil and the coil should be rolled pointing in the opposite direction in which the upper end is coiled.
3. All care should be taken in handling the coils with a view to ensure safety of the coils but also of the working party handling them. The coil should not be broken by standing in front of the coil but only from side.

INSTALLATION PROCEDURE OF PLB HDPE DUCT LAYING :

It is advisable to employ the people before commencement of the laying, inspection of the trench and inspection of protection works should be carried out so as to ensure their conformity with the specification. The trench bottom should be clean, smooth and free of small stone. When the soil contains stone or pieces or rock and therefore cannot be raddled, sieved earth about 10 cm. thick should be used both for the bedding on which the duct is being laid. The duct coil should be brought as close to the trench as possible. It should be lifted carefully with the aid of jacks

1. Supervisor in charge should stand in a commanding position where he can view the entire trenches and shout evenly and call his men to pull. If there is proper synchronization between the mates call in the pulling by the men the duct will leave the coil without difficulty. It is important that the duct shall be pulled with steady and even pulls and there should not be unnecessary twists. Care should be taken to avoid twist as this is likely to damage the PLB HDPE duct. When pulling around bends one or two men should be stationed to give the duct the correct bent when it passes.

2. While laying the duct employ adequate number of men so that the duct can be conveniently carried by them in both hands without stretched arms. The distance between any two persons carrying the duct shall be two to ten meters depending upon the weight such that the maximum sag of the PLB HDPE duct between any two persons is not more than 0.5 meters.

3. While laying work is in progress one man has to continuously observe the PLB HDPE duct along its line in order to determine indentations poles or other damaged parts are apparent. Such damaged parts have to be protected immediately.

4. The conditions of the PLB HDPE duct shall be visually inspected throughout its line and in case damage or defect is noticed, the trench shall be filled up only after ensuring that the damage is not likely to affect the cable.

5. The end of the duct should be sealed with flex to prevent entry of soil before filling back. Adjoining ducts shall be joined by couplers. Duct integrity testing shall be carried out when laying is completed in a block section (1 kms). In case the continuity is not achieved the fault shall be localized and rectified by providing PLB HDPE DUCT couplers/Compression couplers.

6. Tools necessary for laying PLB HDPE Duct is to be checked as physically available before starting the Duct laying. For efficient and safe laying, communication may be provided between following points using portable VHF Walkie talkie sets.

7. The Supervisor In charge of the duct laying. During PLB HDPE duct laying care must be taken not to twist duct in any direction. For this purpose, the survival (rotating hook) shall be attached between pulling line and pulling eye at the end of duct so as to avoid any possible twist during pulling and laying of the cable.

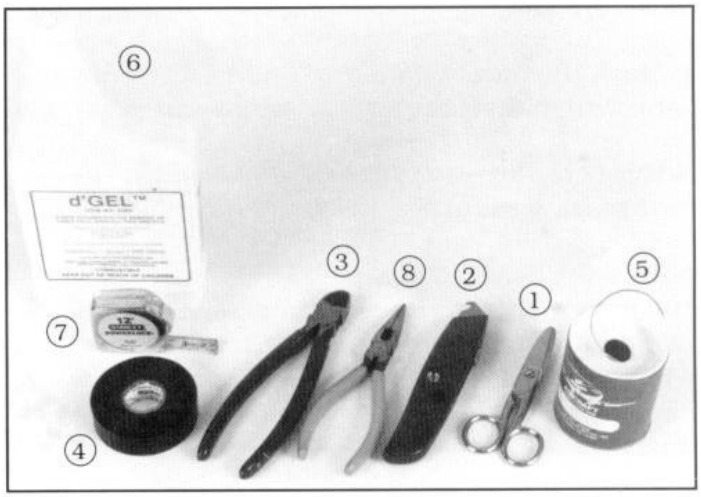
8. During duct laying care must be taken not to twist duct in any direction. For this purpose, the rotating hook shall be attached between pulling line and pulling eye at the end of duct so as to avoid any possible twist during pulling and laying of the cable. In case it is planned to lay the cable in duct by pulling the cable by using a winch; the duct should be provided with a nylon rope for pulling

PREPARATION FOR CABLE PULLING GRIP

1. Methods used for placing fiber optic cables in ducts are essentially. However, fiber optic cable is a high capacity data transmission medium which can have its communication characteristics degraded when subjected to excessive pulling force, sharp bends, and crushing forces. These losses may not be revealed until long after installation is complete. For these reasons extra care must be taken during the entire installation procedure.
2. Cable manufacturers install special strength members, usually aramid yarn, to absorb the stress of pulling the cable. Fiber optic approach cable should only be pulled by these strength members unless the cable design allows pulling by a grip on the jacket. Any other method may put stress on the fibers and harm them. Swivel pulling eyes should be used to attach the pulling rope or tape to the cable to prevent cable twisting during the pull.

3. A Cable pulling grip is installed on fiber optic cable to provide optimum load distribution during cable pulling. When correctly installed, the cable-pulling grip distributes the pulling force equally along the cable strength members. To prevent dangerous cable twisting during the pulling operation.

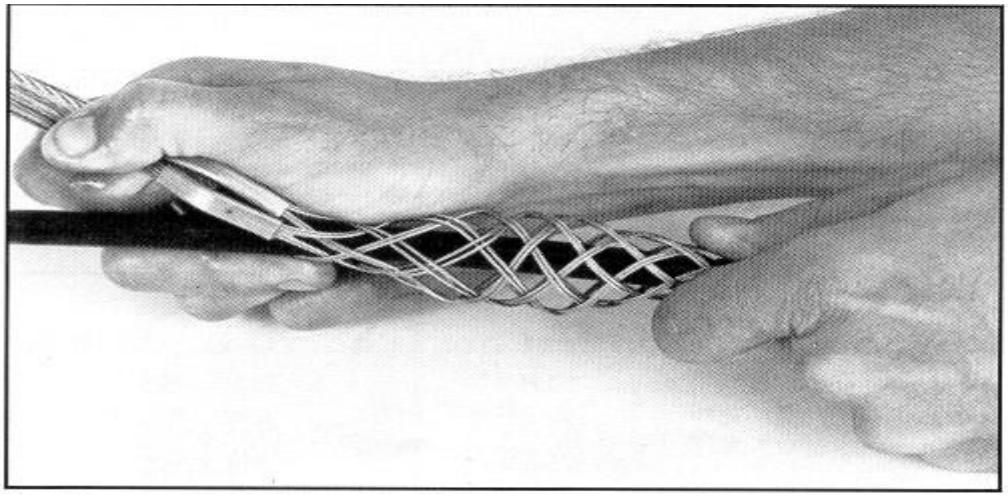
4. Tools and Materials Required
    - Scissors
    - Utility Knife/Hook Blade
    - Diagonal Pliers/Wire Cutters
    - Vinyl Tape
    - Stainless Steel Wire
    - Cable Cleaner or Approved Solvent
    - Tape Measure
    - Needle Nose Pliers



5. Prior to installation, the proper size grip must be chosen for the cable to be pulled. Grip selection is based on cable inner-outer jacket diameter. Generally, use the smallest grip that will fit over the inner

jacket without excessive difficulty. Measure the cable inner jacket diameter and determine the proper grip.

- Remove 1.25 meters (48 inches) or outer sheath exposing the polyethylene jacketed cable core. The length removed depends on pulling grip and should be roughly the length of the grip plus 12-16 inches.
- Mark the outer sheath 48 inches from the cable end with a piece of PVC tape or marking pen.
- Ring cut the outer jacket and armor at the tape mark with utility knife or hook blade.
- Flex the cable to completely server the jacket and armor sheath. Remove the cable sheath carefully.



- Slide the grip over the end of the cable core and push the cable out through the tape of the mesh leaving about 12 inches of core exposed. (Figure 4)

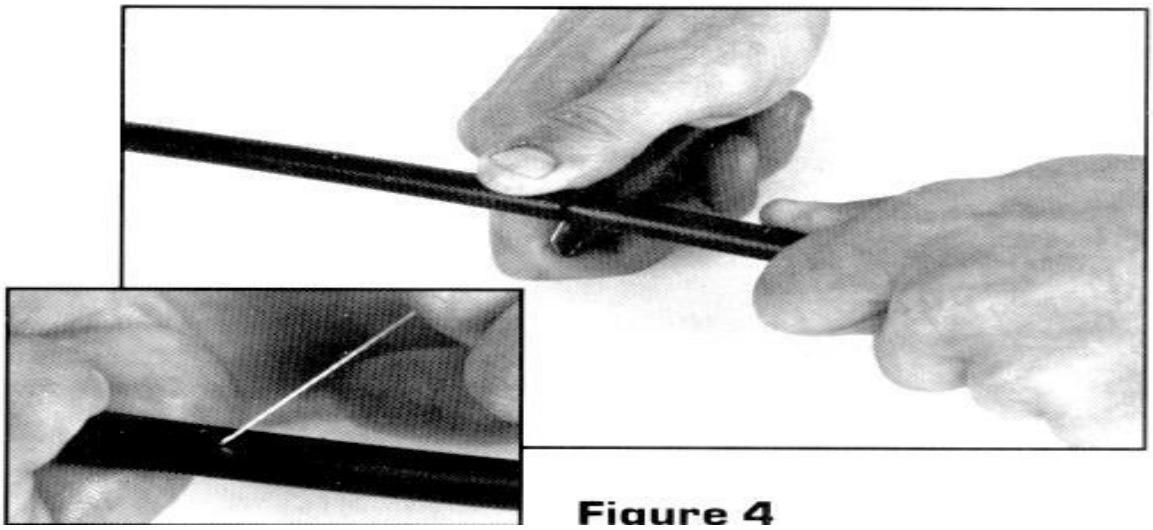


Figure 4

- Remove approximately 12 inches of cable inner sheath from the cable end Cut away all cable Components except the yellow aramid yarn. (Figure 5)

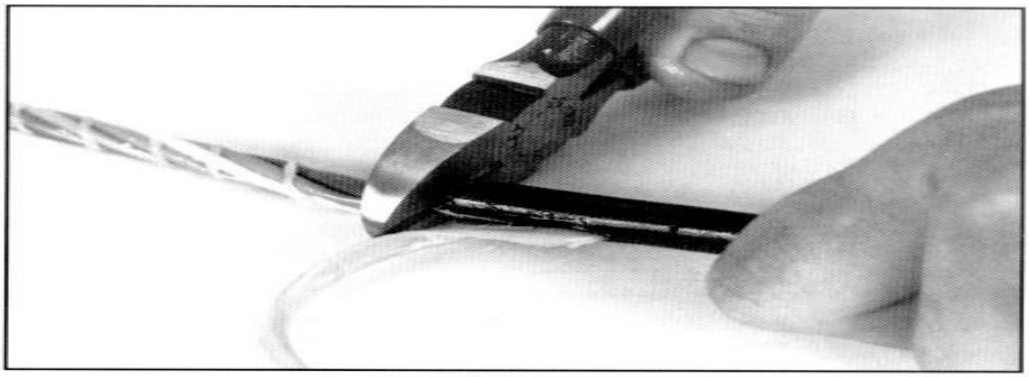


Figure 5

- Secure the yarns to the inner loop of the pulling grip using a square or bowknot. The yarn should be the same length as the pulling grip to insure that pulling forces are equally distributed. (Figure 6)

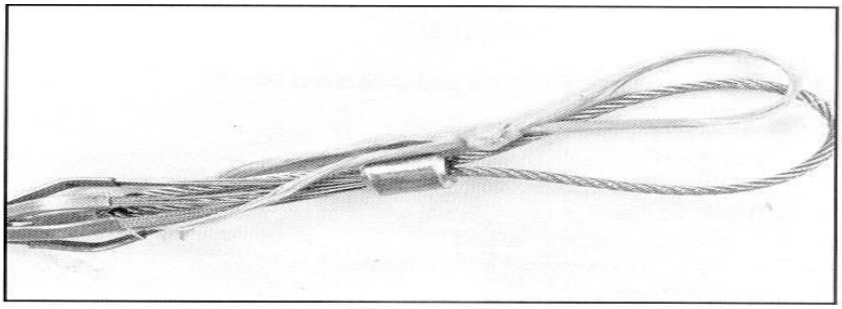


Figure 6

- Adjust the grip position on the inner sheath such that the wire mess section is completely over the cable. Anchor the grip into position by binding with stainless steel wire. (figure 7)

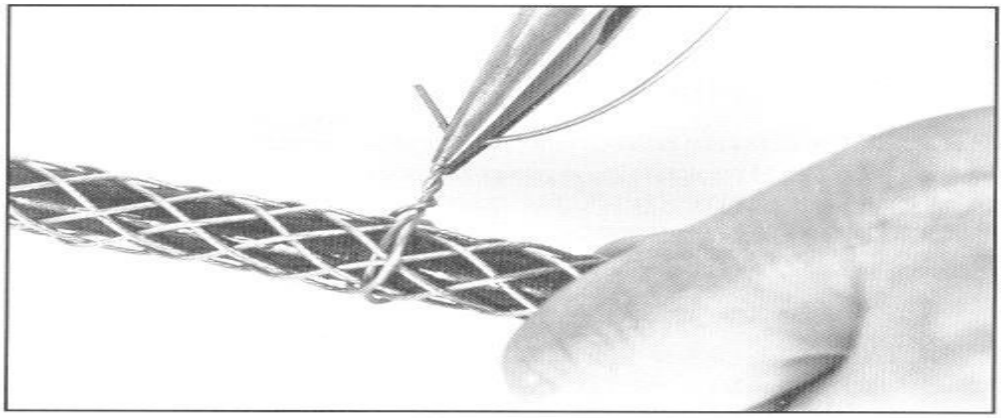
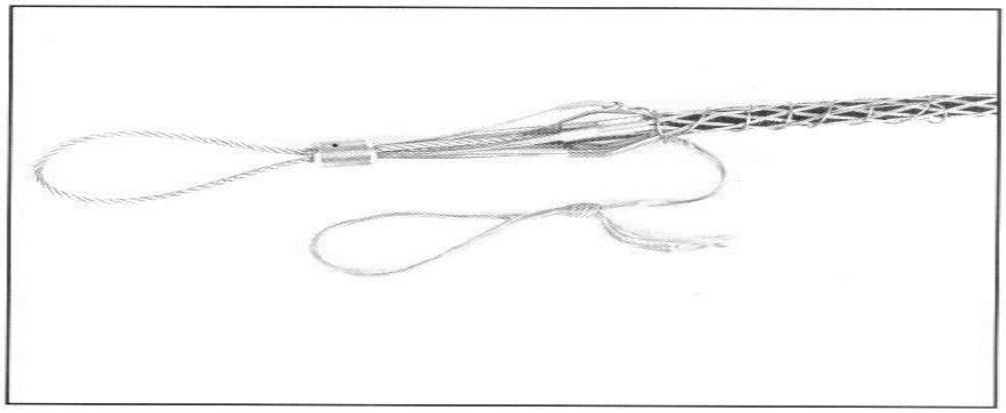
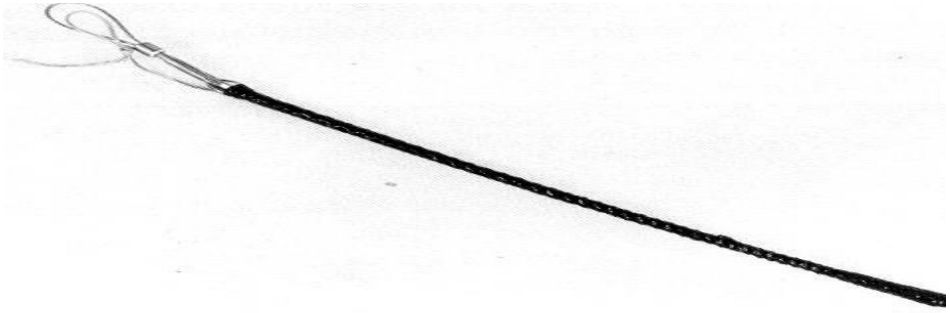


Figure 7

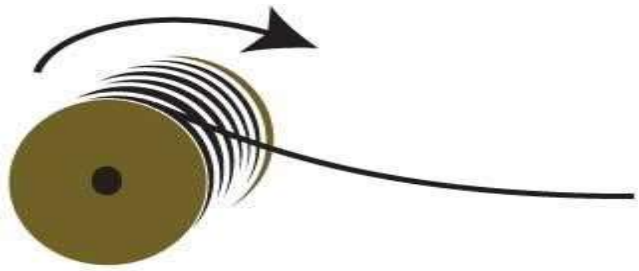
- Place PVC tape over the entire grip and over the junction of the outer sheath to inner sheath. The transition from inner to outer sheath should be smooth. Additionally, the grip ribbing and wire should not be exposed below the tape. The spiral wrap tape should lay from the pulling grip toward the cable to insure smooth pulling. (figure 8)



- Place PVC tape over the entire grip and over the junction of the outer sheath to inner sheath. The tape should lay from the top of the pulling grip toward the cable to insure smooth pulling without snags.
- If applicable, secure the aramid yarns to the inner loop of the pulling grip using a square or bowknot. The yarn should be the same length as the pulling grip to insure that pulling forces are equally distributed.



6. Cables should not be pulled by the jacket unless it is specifically approved by the cable manufacturers. These grips are usually tied to the strength members also. Tight buffer cable can be pulled by the jacket in premises applications if a large (~40 cm, 8 in.) spool is used as a pulling mandrel. Wrap the cable around the spool 5 times and hold gently when pulling.
   Do not exceed the maximum pulling tension rating. Consult the cable manufacturer and suppliers of conduit, innerduct, and cable lubricants for guidelines on tension ratings and lubricant use. If possible, use an automated puller with tension control and/or a breakaway pulling eye. When laying loops of fiber on a surface during a pull, use “figure-8” loops to prevent twisting the cable.
7. Twisting Cable :- Do not twist the cable. Twisting the cable can stress the fibers. Tension on the cable and pulling ropes can cause twisting. Use a swivel pulling eye to connect the pull rope to the cable to prevent pulling tension causing twisting forces on the cable.

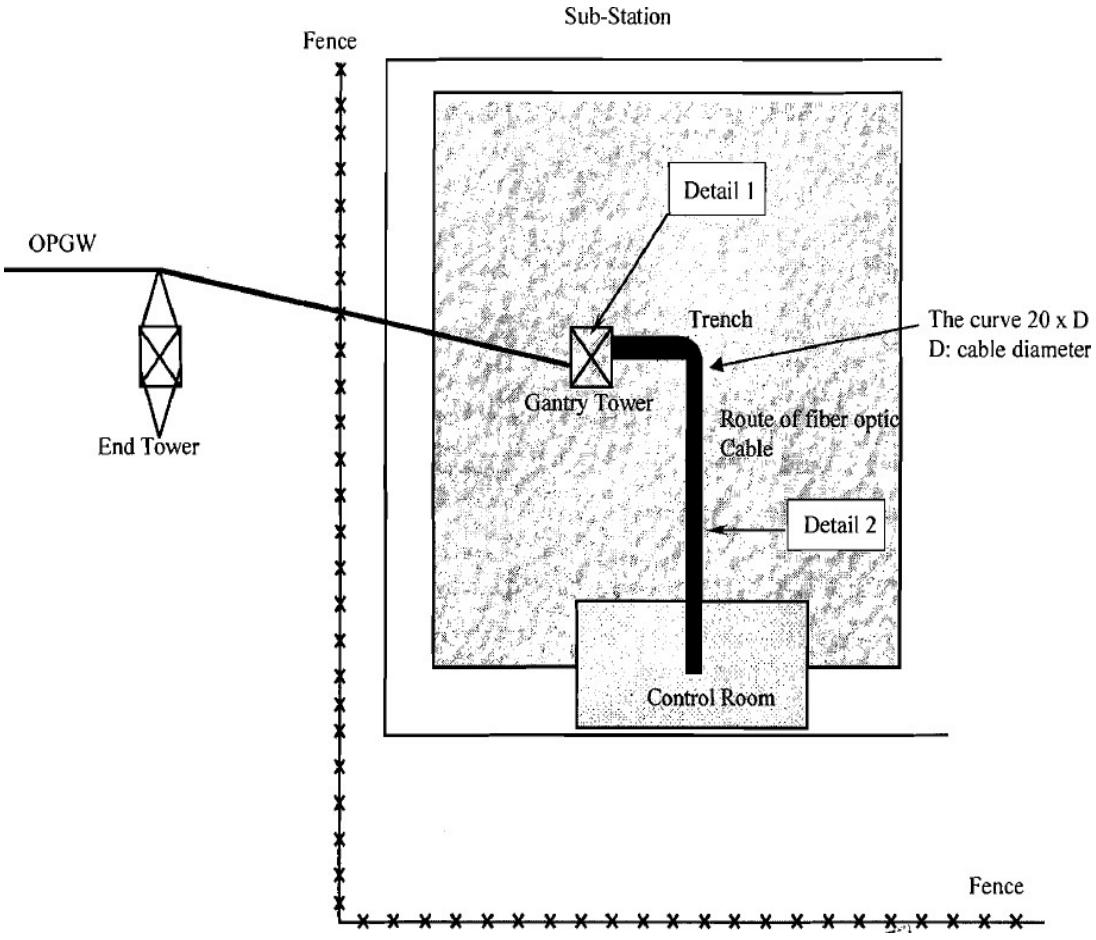


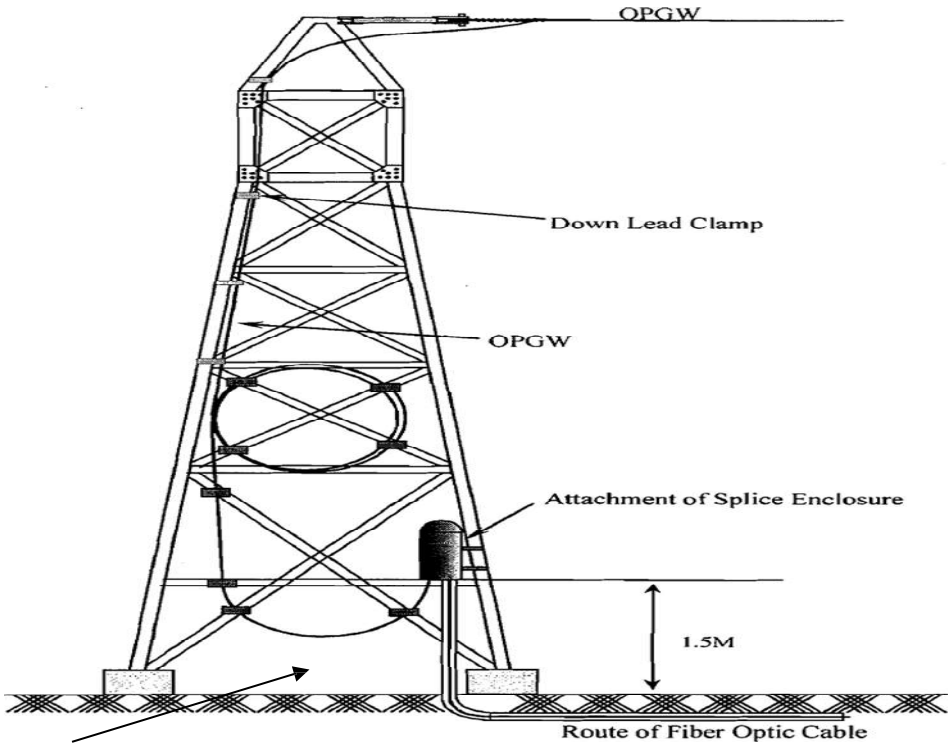
Roll the cable off the spool instead of spinning it off the spool end to prevent putting a twist in the cable for every turn on the spool. When laying cable out for a long pull, use a "figure-8" on the ground to prevent twisting. The figure 8 puts a half twist in on one side of the 8 and takes it out on the other, preventing twists.

PROCEDURE FOR PULLING OF OPTICAL FIBER CABLE:

1. Use pulling grip designed for pre-connected fiber optic cables. Grips with a fixed pull ring should use a swivel to attach the pulling rope.
2. Monitor pulling tension. Do not exceed the maximum pulling load rating. On long runs, use proper lubricants and make sure they are compatible with the cable jacket. On really long runs pull from the middle out to both ends. If possible, use an automated puller with tension control or at least a breakaway-pulling eye.
3. Always use a straight pull. Use cable guides to maintain the recommended bend radius. Do not exceed the cable bending radius otherwise it will harm the optical fibers. It may not be immediate but it may even take a few years but eventually by exceeding the recommended bending radius of the cable you reduce life of the cable.
4. Do not twist the cable; putting a twist in the cable can stress the fibers.
5. Roll the cable off the spool. Use the device to aid in uncoiling long cables. Do not spin it off the spool end. This puts a twist in the cable for very turn on the spool. Figure 8 for a long pull. If you are laying cable for a long pull, use a figure 8 on the ground to prevent twisting.
6. Bend Radius: - Do not exceed the cable bend radius. Fiber optic cable can be broken when kinked or bent too tightly, especially during pulling. If no specific recommendations are available from the cable manufacturer, the cable should not be pulled over a bend radius smaller than twenty (20) times the cable diameter. After completion of the pull, the cable should not have any bend radius smaller than ten (10) times the cable diameter.
7. Vertical Cable Runs: - Drop vertical cables down rather than pulling them up whenever possible. Support cables at frequent intervals to prevent excess stress on the jacket. Support can be provided by cable ties (tightened snugly, not tightly enough to deform the cable jacket) grips. Use service loops can to assist in gripping the cable for support and provide cable for future repairs or rerouting.

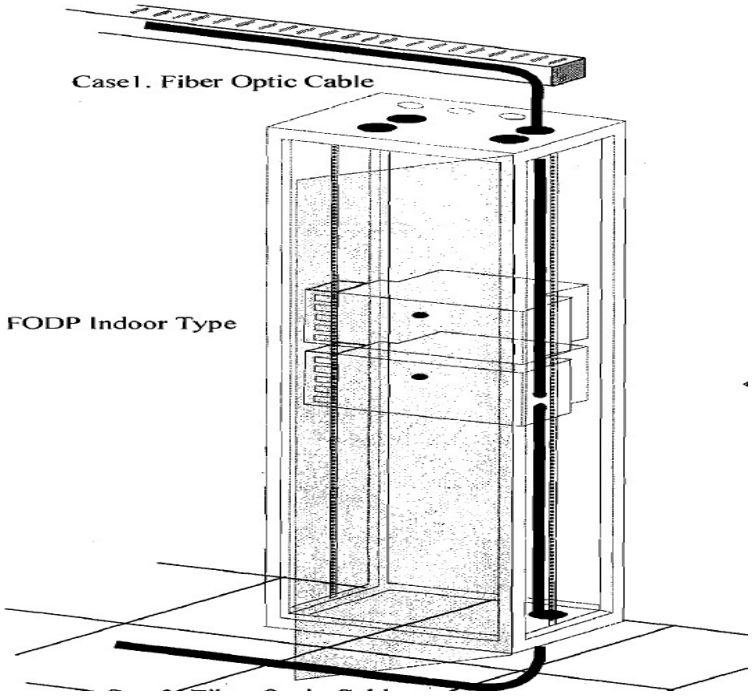
The route for the fiber optic cable and FODP Lay out in control room. Planned route for approach cable at switchyard of sub-station





ApproachcableinPLBHDPEDuct

GantryTowerinSub-station



FODP (Fiber Optic Distribution Panel in Control Room

Protect cables from excessive or frequent bending. Routing on a cabinet door should be used as a resort and special care must be taken to protect the cable and avoid exceeding the bending radius of the cable.
When routing the cable proper pulling techniques should be used earlier in this manual. When attaching cables with clamps use plastic clamps with large surface areas and avoid pinching or squeezing cable. Cable should be installed manually with gentle pressure.

Cleaning Fiber Optic Connections

We recommend always keep dust caps on connectors, bulkhead splices, patch panels or anything else that is going to have a connection made with it. Not only will it prevent additional dust buildup, but it will prevent contamination from being touched or damaged from dropping.

When testing, we recommend that connectors on both the reference and tested cables be cleaned before every test, as every time the connector is exposed to air, it can accumulate dust.

1. General

OPGW based Fibre Optic network being established by Power Utilities for catering data & voice communication requirements. OPGW is being supplied in number of drums for a link and required splicing for completing of a fibre optic link. Generally fusion method is being used for splicing of fibres in cable. For carrying out splicing work, experienced personnel is essential for handling splicing kit and necessary instruments such as OTDR etc.

a) Jointing of OPGW is usually carried out on the ground. For ease of jointing with accuracy, adequate space (with tent) to be ensured on the ground for jointer and equipment. This floor space should be protected against the heavy wind, strong sunshine, high temperature, rain and dusty atmosphere.

b) Attention must be paid so as not to damage OPGW including its optical components during handling, cutting, un-stranding of component wires and jointing.

c) Attenuation of optical fibers to be measured just before splicing and after splicing.

d) Typical organization chart for jointing work is given below:

A. Jointing In charge -1

A.1For Testing :

(i) Lineman – 1

(ii) Jointer & Tester – 1

(iii) Unskilled labor -1

A.2 For Jointing :

(i) Lineman- 1

(ii) Jointer & Tester – 1

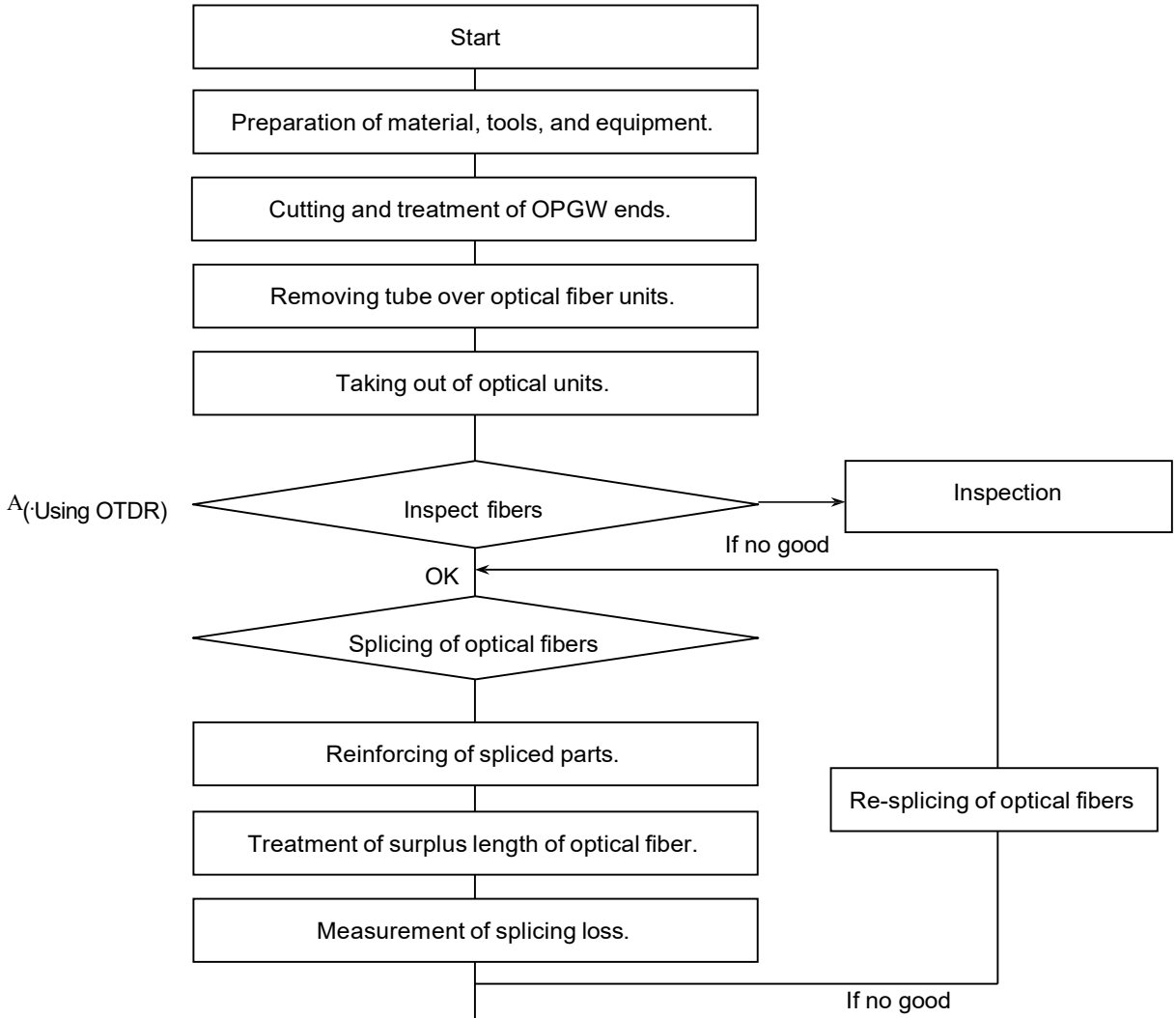
(iii) Unskilled labor -1

2. Jointing of optical fibre

Optical fibre are joined by using Fusion splicing. It is the process of fusing or welding two fibers together usually by an electric arc. Fusion splicing is the most widely used method of splicing as it provides for the lowest loss and least reflectance, as well as providing the strongest and most reliable joint between two fibers.

3. Flowchart of jointing procedure.

Process flow chart of OPGW jointing works is summarized briefly, as below:



Sealing and closing of the joint box

Installation of the joint box

End

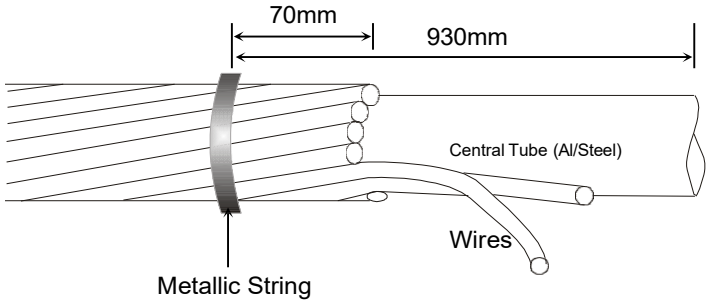
4. Jointing works

a) Preparation of materials, tools and equipment

It may be ensured that all the materials, tools and equipment listed in the Table-1 are available. The Table-1 shows tentative list of required tools & material.

b) Cutting and treatment of OPGW ends

- Coiled OPGW to be brought down and cut-off unnecessary lengths of the OPGW with a cable cutter.
- Put marks on OPGW at positions where OPGW is to be fixed to the glands of the joint box. Carryout mounting of OPGW at a position about 70mm below the cutting mark with a metallic string to prevent the stranded wires from becoming loose after cutting off the OPGW.



- Notch the Strand wires of the OPGW with a hacksaw to the depth of 1/3 or 1/2 of the Strand wire diameter. In this case, take care not to damage the inside Central Tube (AL/Steel) of the OPGW.
- Loose the Strand wires from the OPGW ends one by one and snap them off at the notched position.
- Cut the Central Tube (AL/Steel).

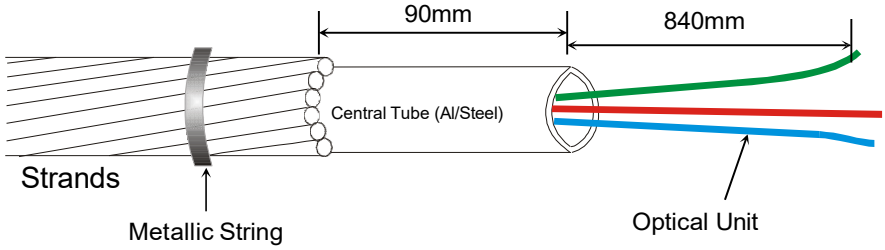


Table-1: Tools & Material

Description	Qt'y	Purpose
Stabilized light source	1	Measure loss
Optical power meter	1	Measure loss
Dummy fiber	1	Measure loss
Fusion splicer	1	Splicing fiber
Fiber cutter	2	Cutting fiber
Jacket stripper	2	Remove fiber jacket
Washing agent	2	Cleaning fiber
Ethyl alcohol	2	Cleaning fiber
Gauze	1 Set	Cleaning fiber
Dust remove	1	Cleaning splicer
Cable cutter	1	Cutting OPGW
Hacksaw	1	Cutting AW wire
Pipe cutter	1	Cutting al tube
Knife	1	
Screw driver set(+,-)	1	
Pliers	2	
Light stand	1	Lighting
Hexagon wrench	1	
Portable telephone set	2	
Engine generator(If need)	1	Power supply
OTDR	1	
Electric reel	1	
Optical telephone set	2	
Electric cord	1	

c) **Fixing OPGW in the Passcable** (see the Figure 4. for main assembling particulars)

- Insert OPGW in the pass cable until OPGW touch the internal clamping or until the Central Tube (AL/Steel) is outside from the pass cable of about 90 mm.
- Lock the moving clamping with torque force of 12 NM, like a Figure 5.

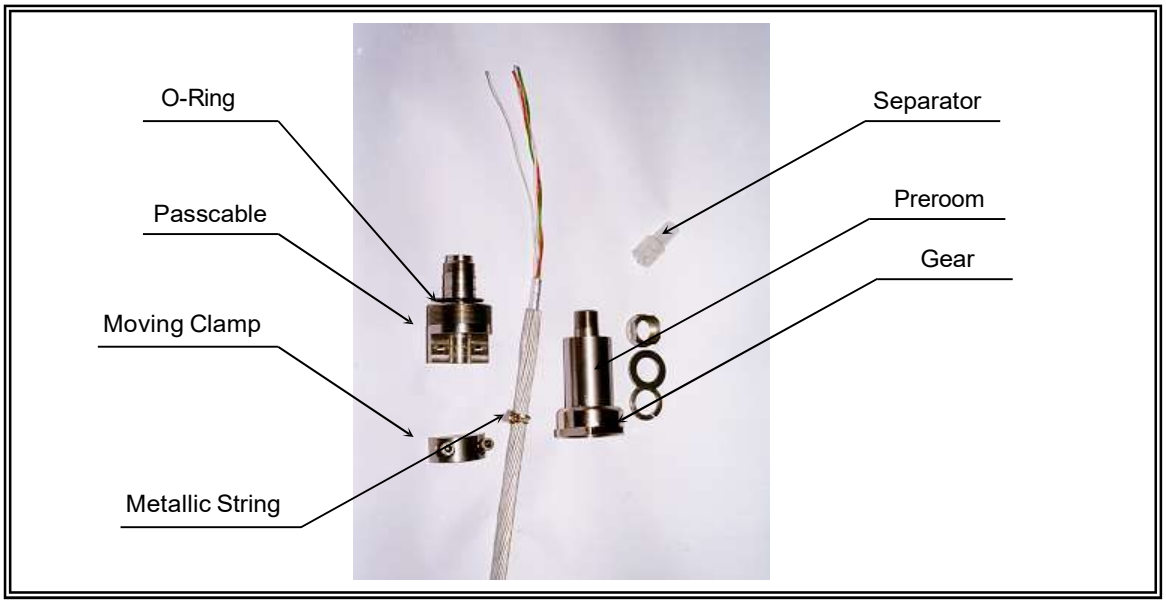


Fig. 4

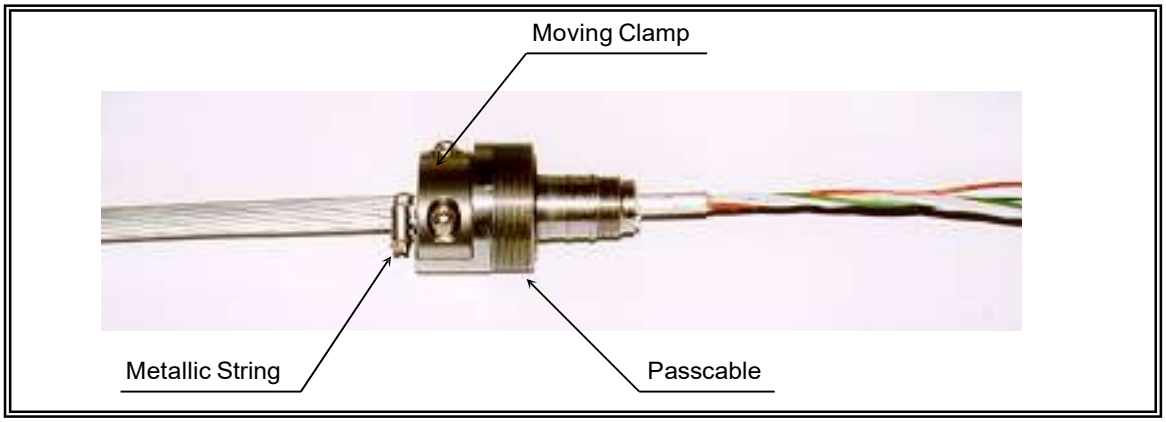


Fig. 5

d) Application of thermo-shrinkable tube

- Cover the Central Tube (AL/Steel) with aluminium sheet and put the thermo-shrinkable tube with heating gun

or lamp, like a Figure 6.

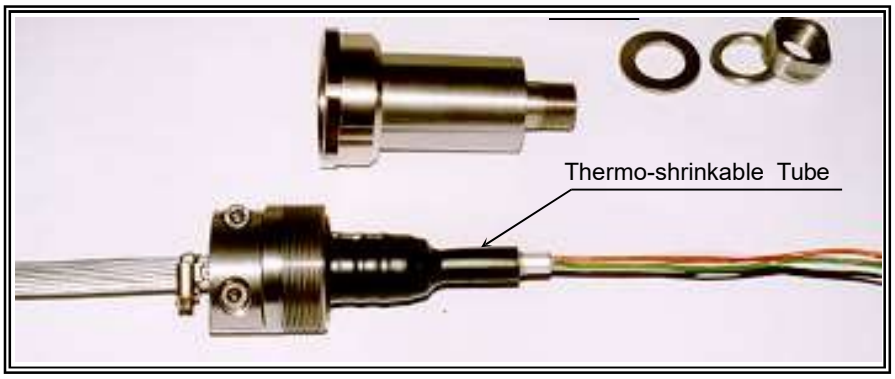


Fig. 6

e) Application of the preroom

- Lock the passcable to the preroom.
- Screw down the preroom to the passcable.

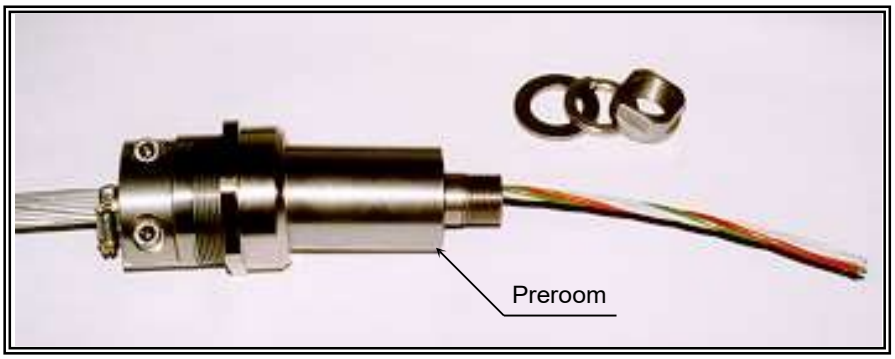


Fig. 7

f) Fixing of the preroom

- Put the preroom in the hole of the splice enclosure base.
- Give attention that the O-ring is in the right position and fix with the torque force of 50 NM

g) Taking out of optical units

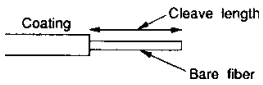
- Remove the PBT tube of optical units leaving a suitable distance (around 1m) from the edge of the AL tube.
- Make each optical unit into loops of about 5 to 10 cm diameter, and stick these optical unit loops at a suitable

position on the joint box with plastic adhesive tape in order to ensure that the optical unit is not damaged during splicing work.

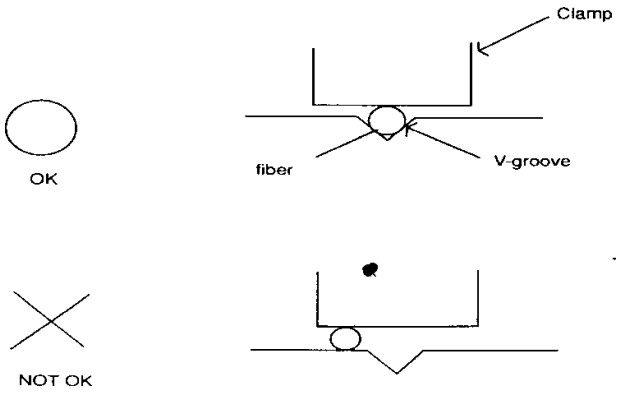
h) Splicing of optical fibers.

- Cleave length

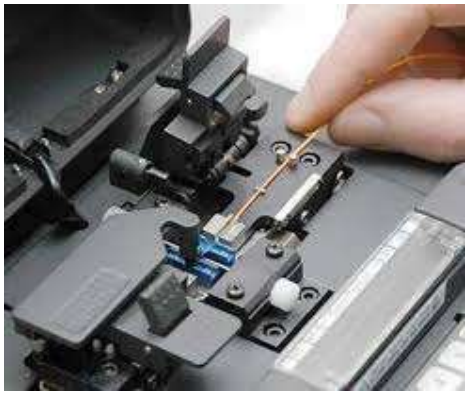
  Bare fiber length should be 16mm ±5 after cleaving.



- Remove the fiber coating. Clean the fiber and then cleave the bare fiber to the predetermined length. Slip a protection sleeve over one of the two fibers for reinforcement after splicing. Set the prepared fiber in the v grooves as shown in the figure below.



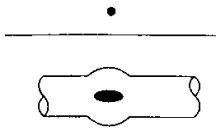
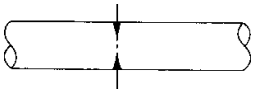
- Clamp the prepared fiber exactly by pushing the clamp lever. After clamping the right and left fibers, close the hood. Make sure that the prepared fiber is not trapped by the hood, and not caught by any other part of the machine.



- Evaluate the splice.

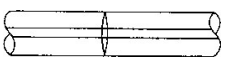
The evaluation of the splicing should be done by the splicing loss and the external appearance at the splice point.

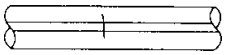
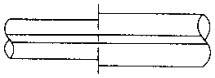
(1) Splicing having the following appearance shall be rejected.

Bubble 	Be sure to remove this type of splice, because the splice loss can be extremely high. Caused by 1. Dust on fiber end 2. Condensing 3. Bad cleaving 4. Pre-fusion time is too short. 5. Arc power is too strong.
Thick black line 	In this case, make re-fusion by ARC Switch, and check it again.(*)
Black shadow 	

(*) In the case where fluorine doped fiber is splicer, a black line will always appear at the splicing point, but does not cause any damage to the characteristics of the optical transmission.

(2) The following splices are acceptable, even if the external appearance at the splice point does not look good.

White line 	It is all right if the estimated splice loss is within the specified value. This is due to optical causes upon observation, and there is no effect on the splice characteristics.

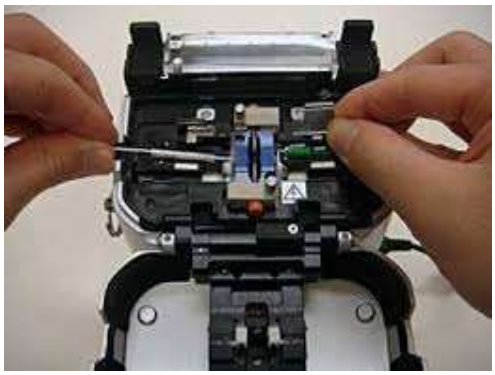
Blurred thin line 	Same as above
	Because of core alignment, this is possible for fiber with large core eccentricity.
	This appearance is due to differences in fiber diameter.

When the spliced portion is required to be observed in detail, "FIELD CHANGE" and "FOCUS UP" and "FOCUS DOWN" SW on top mounted console panel are useful.

i) Reinforcing of spliced parts.

(I) Open the heater cover, the left fiber clamp and right fiber clamp

(II) Open the hood, take out the spliced portion, close the hood, and press the "RESET" SW.



(III) Slide fiber protection sleeve over the spliced portion.

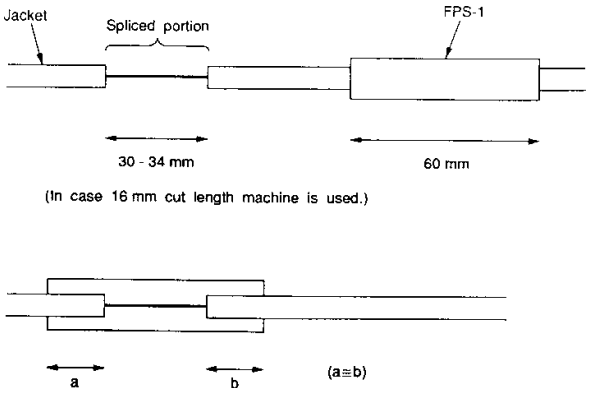


Fig. 5

Note

- Make sure fiber coating is clean.
- Put the sleeve over the splice as shown in Fig. 5.
- Don't twist the fiber.
- Protection sleeve should be straight.

(IV) Apply a slight tension and place the splice in the heater, close the right hand heater clamp by pressing down with the right hand fiber.

(V) Next, close the left hand heater clamp while pulling the fiber slightly, and close the heater cover.

Note

- Fiber should be straight.
- Make sure that there is no dust, or jelly in the protection sleeve.

(VI) Press the "HEATER SET" SW, and the "working" indicator will light up.

Fig. 5

(VII) After the tensile proof test (a few seconds), it will take a few minutes until the fiber protection sleeve is shrunk. A buzzer will indicate the finishing of shrinking the sleeve.

If the fiber breaks, or the fiber is loosely clamped or slips during the tensile proof test, the buzzer will beep intermittently. Correct the condition before proceeding.

Note 1

- Both the splicer and heater can be operated simultaneously.

Note 2

- The tensile proof strength can be set from 50 to 500 grams. This value is set to 200 grams normally.

(VIII) Open the heater cover and clamps.

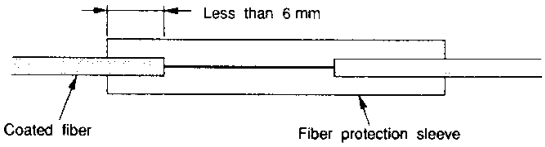
Take out the protected splice carefully while pulling the fiber slightly.

Cool the protection sleeve for a few minutes, as it is very hot just after reinforcement.

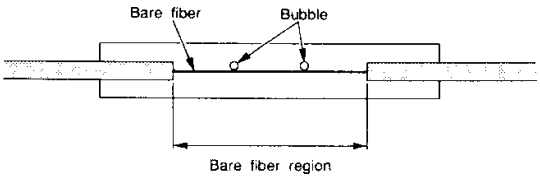
(IX) Check the appearance of the reinforced portion.

Bad protection examples

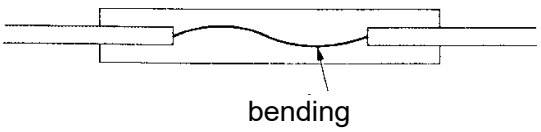
- Short coverage of coated fiber.



- Bubble on bare fiber.

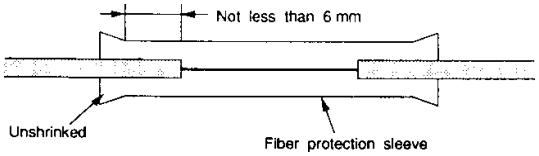


- Bending bare fiber

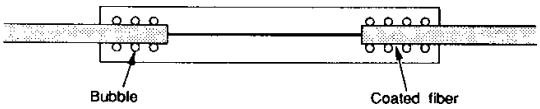


Good protection examples

- Unshrink sleeve end



- Bubble on coated fiber



1. Treatment of surplus length optical fibers.

- Arrangement of loose tube

  The loose tube should be dressed up while closing joint box so that itis protected against impact, corrosion and bend. The loop diameter of loose tube is more than 50mm.

- Arrangement of optical fiber

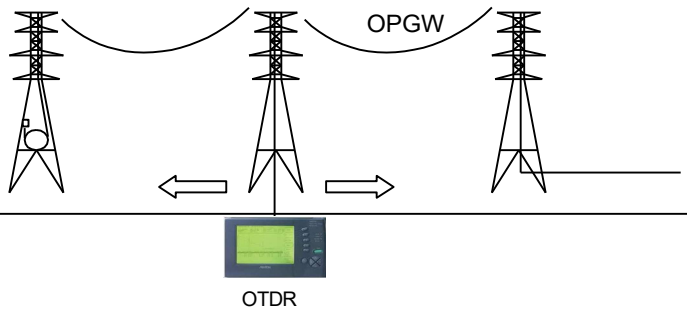
  The spliced portion of optical fiber should be put in regular order in the fusion splice protector, and the extra length of optical fiber should be put on the splice tray.

  Theloopdiameterofopticalfiberismorethan50mm.

2. Measurement of splice loss: Splice loss shall be measured by using OTDR.

A. Test(Before splicing)

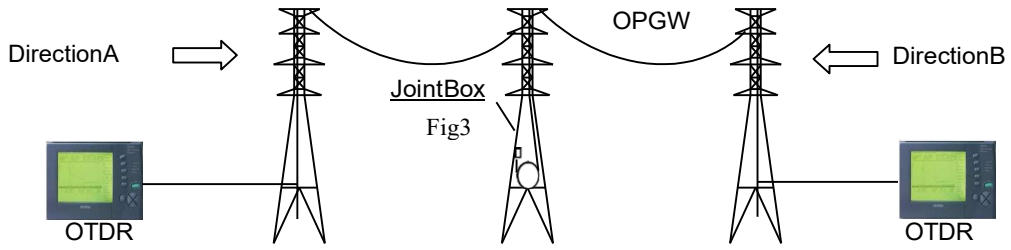
- After successfully completion of the installation, check for optical attenuation and discontinuity at every splicing points (Joint Box Locations).



- The attenuation of the fibres shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1dB.The overall optical fibres attenuation should be less than 0.21dB/km at 1550nm and 0.35dB/km at 1310nm.

B. Splicing Test(After splicing)

-Before closing the splice enclosure, splice loss shall be measured for checking the splicing condition.



- Before closing the in-line splice enclosure, the splice test shall be executed at both sides (direction A& direction B) of jointing point.

- The average of bi-directional attenuation of fusion splices shall not be more than 0.05 dB and no single splice loss shall exceed 0.1 dB at 1550 nm.

- Appearance of splice enclosure shall have no defect,

- Splice enclosure shall have good sealing condition to prevent moisture and dust free environment, and render it waterproof.

*Nopointdiscontinuitiesinexcessof0.1dB

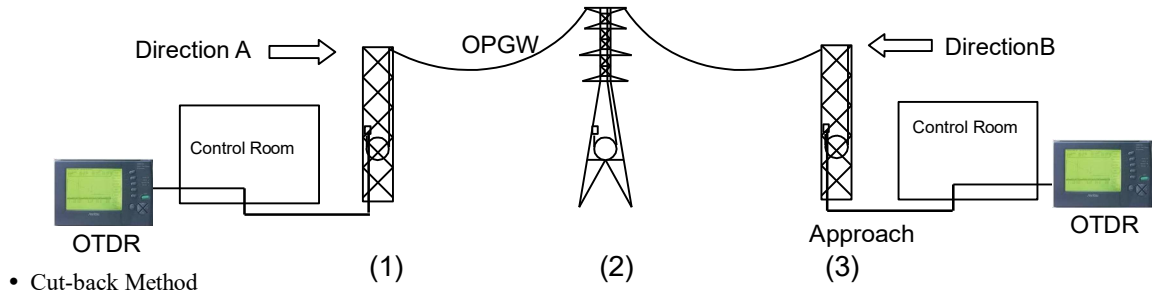
- Every effort shall be taken to minimize the splice loss during splicing so that every splice loss in the link

shall lies within o.o5 dB. Maximum splice loss at any splice joint may be permitted up to 0.1 dB.

However, such events shall be avoided to minimize the splice loss and total loss in the link.

c. Measurement of splicing loss.

Measure the of splice loss by OTDR

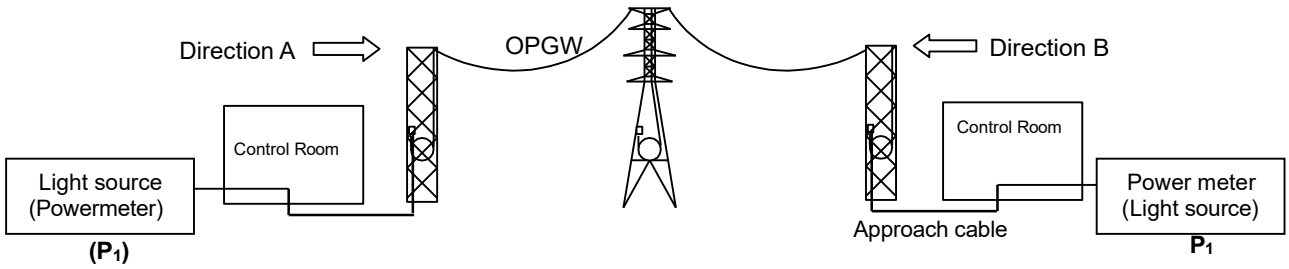


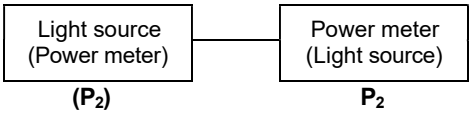
- Cut-back Method

$$\text{Transmission Loss(dB)} = P_2 - P_1$$

P_1:Power measured when light source is connected to power meter with the OPGW fibre in between.

P_2:Power measured when light source and power meter are connected to one another with reference fibre in-between.





3. Fixing the joint box lid

- Fix the cover to the joint box after having confirmed that nothing is left in the joint box such as tools and dusts.
- Lockthelidwiththetorqueforceof10NM.

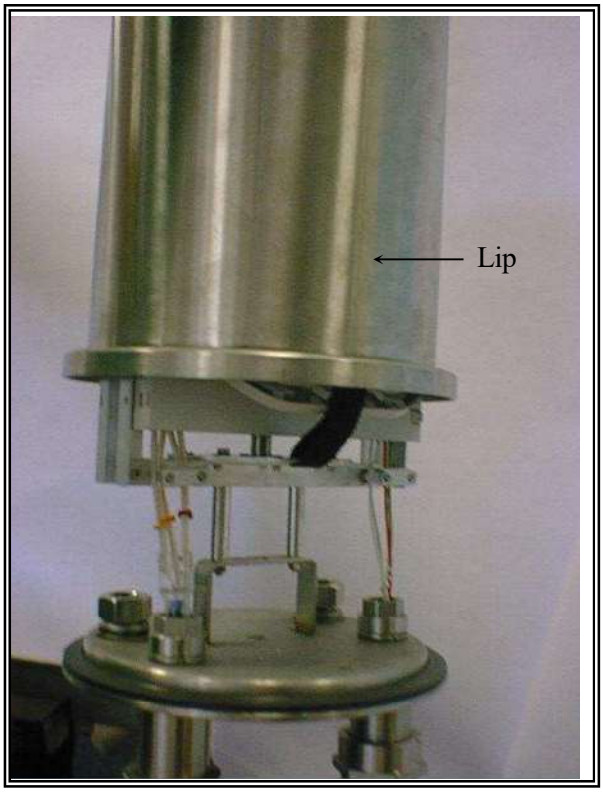
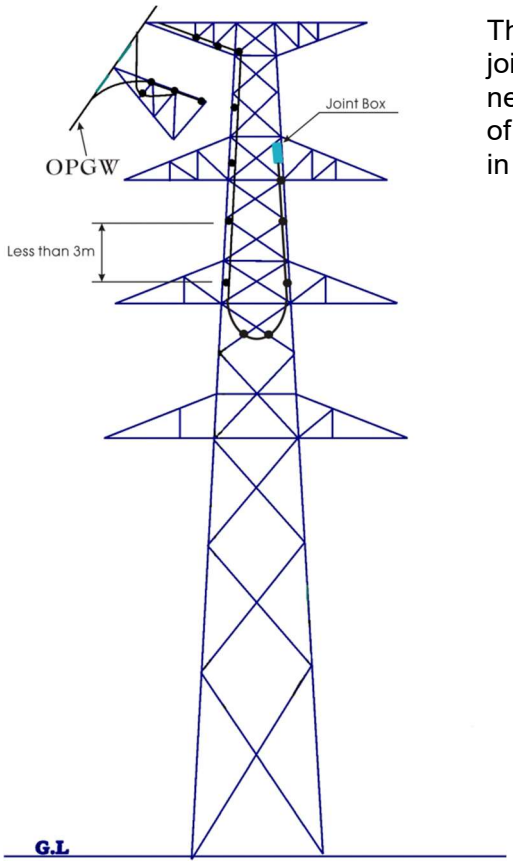


Fig.6

4. Installation of a joint box.

SPLICINGTOWER

The balanced length of OPGW should be coiled around a circle having a diameter of more than 1.5 meters after completion of jointing and firmly fixed to the tower as shown in figure.



The position of the joint box should be near the top cross-arm of the tower as shown in the figure.

CheckPoint

- Check the status of waterproof.
- Fusion splice working is protection it against dirt, grit and moisture.
- Lift the joint box using the eyebolt of lid.
- Fixing condition of joint box on the tower.
- Coiling condition of sur-plus(balanced)length of OPGW

SITE ACCEPTANCE TEST PROCEDURES AND PLAN FOR OPTICAL FIBRE CABLES

1. Introduction

The Site Acceptance Test Plan must stimulate the quality during the site work from the storage of materials to the complement of installation.
In addition to stimulating of quality control, it assists in keeping the record of test and remembering the major point of the site work,

2. List of Site Acceptance Test

1) Pre-Installation Test (Drum Test)
    a. Physical Inspection of the cable assembly for damage
    b. OpticalfibrecontinuityandfibreattenuationwithOTDRat1550nm
    c. Fibre Optic Cable length measurement using OTDR
2) Post-Installation Test
    a. OpticalfibrecontinuityandfibreattenuationwithOTDRat1550nm
    b. Fibre Optic Cable length measurement using OTDR
3) Splice Test
    a. Per splice bi-directional average attenuation with OTDR
    b. Physicalinspectionofsplicebox/enclosureforproperfibre/cableroutingtechniques
    c. Physical inspection of sealing techniques, weather proofing, etc.
4) Commissioning Test
    a. EndtoEnd(FODPtoFODP)bi-directionalaverageattenuationofeachfibreat1310nmand 1550 nm by OTDR.
    b. EndtoEnd(FODPtoFODP)bi-directionalaverageattenuationofeachfibreat1310nmand 1550 nm by Power meter
    c. Bi-directional average splice loss by OTDR of each splice as well as for all splices in the link (including at FODP also).
    d. Properterminationandlabellingoffibres&fibreopticcablesatFODPasperapprovedlabelling plan.

Reference Documents:

1) DRS of OPGW/Optical fiber.
2) Sag-Tension Chart.
3) OPGW Live-Line Installation Procedure.
4) Splicing/Jointing Manual.

PRE-INSTALLATIONTEST(DRUMTEST)

Title of Test : Pre-Installation Test (Drum Test)

Application : All FO Cables

Purpose of the Test : For precluding cable that may be damaged during shipment and transportation, every spooled FO cable segment shall be tested prior to installation.

Test Equipment : OTDR & physical inspection

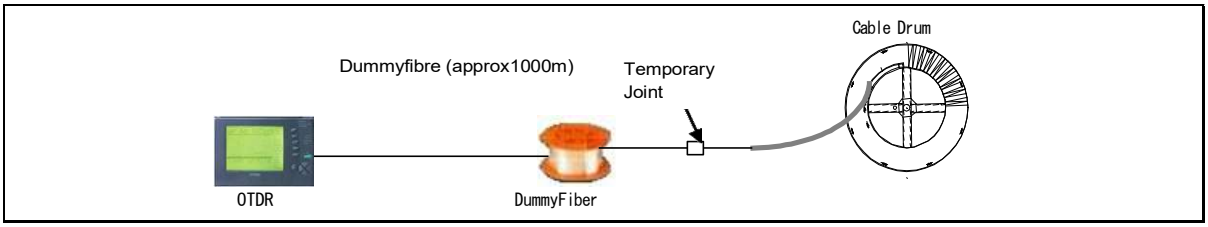
Test Set-up &Procedure : First of all, check the appearance and marking of the Drums.

SHIPPING TAG

Name of work			
Employer's Name	**Assam Electricity Grid Corporation Limited**		
Employer's Address			
Destination Address			
Vendor's Name			
Vendor's address			
Year of Manufacture	**Xxxx**	**Batch No.**	**Xxxx**
Drum No.	**(Asper the Drum Schedule)**		
Type of Cable			
Type of Fibres	**DWSM**		
No. of Fibres	**24F/48F**		
Total Cable Length	**Xxx Mtrs**		
Weight of the Drum	**Xxx kg**		
Year of Production	**Day-Month-Year**	**Factory Inspection Date**	**Day-Month-Year**
FactorySeal			

Xxxx–TobefurnishedbySterlitePowerTransmissionLtdShallfurnishedbeforeFAT.

- Check the sealing of the cable ends and spare cable caps
- Carry out the physical inspection of the cable assembly and then check the Fibre Length, continuity and attenuation of optical fibers by OTDR. Compare the observed attenuation data with respect to the pre-shipment / FAT data.



Acceptance Criteria:

- Appearance shall have no defect and drum marking shall be correct.
- The attenuation of the fibers shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1dB. The overall optical fibers attenuation should be less than 0.21dB/km at 1550nm and 0.35dB/km at 1310nm.
- Cable ends and spare cable caps shall be properly sealed.
- Every drum, OPGW cable shall be tested for compliance of fibre Length, Continuity & attenuation with the Pre-Shipment data received from manufacturer.

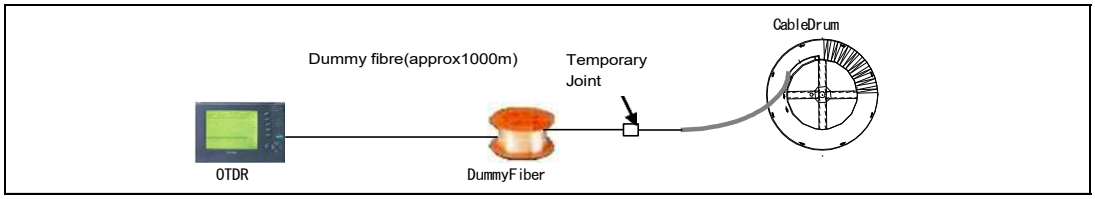
Result/Conclusion:

- TestresultshallbefilledintherespectivetestformatsasenclosedforPre -Installation test.
- If there is any excess of attenuation compared with the standard attenuation norms, then the test shall be re-conducted. If the result of retest does not meet the norm, proper action shall be taken promptly in accordance with the flow of trouble slip.

SAT-01-A(24F)

PRE-INSTALLATIONTESTREPORTFOROPGWCABLE(DRUMTEST)

Date:	Section:		
	Drum No:		
	Drum Length:		(Asper Pre-shipment date)
	Drum Length:		(Actual at site)
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	MAXATTENUATION
Testing Date:	1310nm	1.4670	0.35 dB/km
	1550nm	1.4675	0.21 dB/km



S.No:	Description	Result(Yes/No)	Remarks
1	Physical Appearance check		
2	Drum Marking check		
3	Sealing of Cable ends &provision of spare cable caps		

Tube Color	Fiber No	Fiber Color	Length(km)	Attenuation		Remarks
				1310nm dB/km	1550nm dB/km	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
ORANGE	7	Blue				
	8	Orange				
	9	Green				
	10	Brown				
	11	Slate				
	12	White				
GREEN	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
BROWN	19	Blue				
	20	Orange				
	21	Green				
	22	Brown				
	23	Slate				
	24	White				

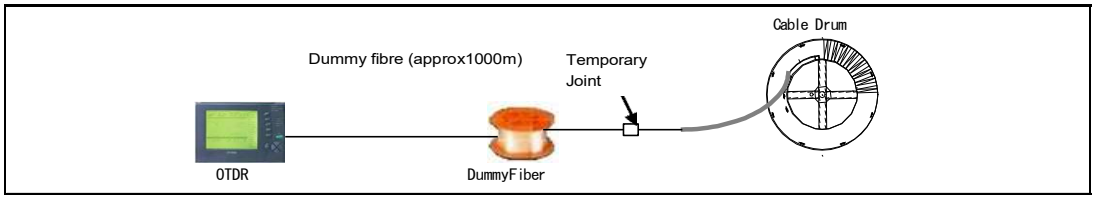
- OTDR Trace results attached for all fiber (Yes/No):

Tested By Witnessed By Approved By

SAT-01-A(48F)

PRE-INSTALLATIONTESTREPORTFOROPGWCABLE(DRUMTEST)

Date:	Section:		
	Drum No:		
	Drum Length:		(Asper Pre-shipmentdate)
	Drum Length:		(Actual at site)
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	MAXATTENUATION
Testing Date:	1310nm	1.4670	0.35 dB/km
	1550nm	1.4675	0.21 dB/km



S. No:	Description	Result(Yes/No)	Remarks
1	Physical Appearance check		
2	Drum Marking check		
3	Sealing of Cable ends& provision of spare cable caps		

Tube Color	Fiber No	Fiber Color	Length(km)	Attenuation		Remarks
				1310nm dB/km	1550nm dB/km	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
	7	Red				
	8	Black				
	9	Yellow				
	10	Violet				
	11	Pink				
	12	Aqua				
ORANGE	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
	19	Red				
	20	Black				
	21	Yellow				
	22	Violet				
	23	Pink				
	24	Aqua				

Tube Color	Fiber No	Fiber Color	Length(km)	Attenuation		Remarks
				1310nm dB/km	1550nm dB/km	
GREEN	25	Blue				
	26	Orange				
	27	Green				
	28	Brown				
	29	Slate				
	30	White				
	31	Red				
	32	Black				
	33	Yellow				
	34	Violet				
	35	Pink				
	36	Aqua				
BROWN	37	Blue				
	38	Orange				
	39	Green				
	40	Brown				
	41	Slate				
	42	White				
	43	Red				
	44	Black				
	45	Yellow				
	46	Violet				
	47	Pink				
	48	Aqua				

- OTDR Trace results attached for all fiber(Yes/No):

Tested By
(Sign with date)

Witnessed By
(Sign with date)

Approved By
(Sign with date)

POST-INSTALLATIONTEST

Title of Test : Post-Installation Test(After Stringing)

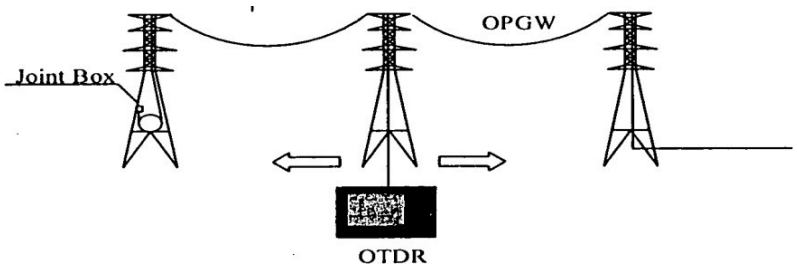
Application : All splicing points

Purpose of the Test : Before splicing work, check for any increase or step Discontinuity in attenuation that may have occurred during Transportation and installation.

Test Equipment : OTDR

Test Set-up & Procedure:

- After successfully completion of the installation work.
- Check for optical attenuation and discontinuity at every splicing point.



Acceptance Criteria:

- The attenuation of the fibers shall be distributed uniformly throughout its length such that there are no point's discontinuities in excess of 0.1dB. The overall optical fibers attenuation should be less than 0.21 dB/km at 1550nm and 0.35 dB/km at 1310nm.

Result/Conclusion:

- TestresultshallbefilledintherespectivetestformatsasenclosedforPostInstallationTest.

Tested By	**Witnessed By**	**Approved By**
(Sign with date)	(Sign with date)	(Sign with date)

SPLICETEST

Title of Test : Splice Test

Application : All splicing positions

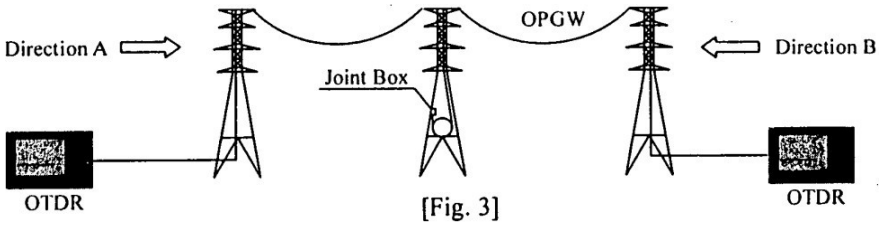
Purpose of the Test:

- Splicing as per approved splicing plan.
- Beforeclosingthespliceenclosure,splicelossshallbemeasuredforcheckingthe splicing condition.
- Thetreatmentofsurplusfibersonthesplicetrayandsealingconditionshallbechecked.

Test Equipment: OTDR & physical inspection

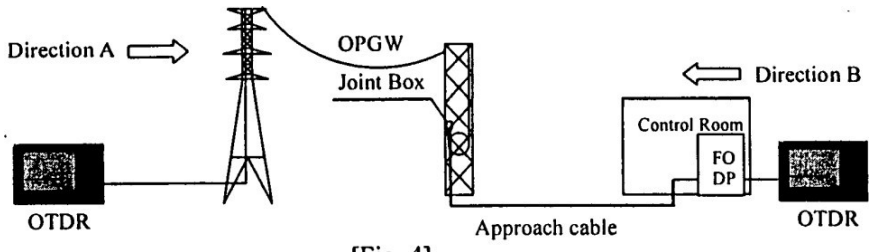
Test Set-up& Procedure:

- All in-line splices shall be encased in splice enclosures with a protective moisture and dust free environment and suitable for outdoor use. All fibers shall be accomplished through the fusion splicing, and then protected by heating shrinkable tube. All splices shall be neatly installed in covered splice trays with 0.5 meter of bare fiber service loop and 1 meter of fiber unit service loop. Before closing the in-line splice enclosure, the splice test shall be executed at both sides (direction A & direction B) of jointing point. The splicing shall be as per approved splicing plan.



[Fig. 3]

- the splice test in the sub-station is the same as that of the in-line splice. In this case, in-line splice enclosure shall be installed on the gantry tower and splicing is between OPGW and approach cable.



[Fig. 4]

- When closing the splice enclosure, the treatment of surplus fibers on the splice tray, sealing conditions and weather proofing shall be checked by physical inspection.

Acceptance Criteria:

- The average of bi-directional attenuation of each fusion splice shall not be more than 0.1 dB at1550nm & 1310nm. Adequate care shall be taken to minimize the splice loss so as to achieve the required bi-directional average attenuation of splice in the link less than 0.05 dB per splice.
- Appearance of splice enclosure shall have no defect.
- The fibers routing is proper inside the splice enclosure and FODP.
- Spliceenclosureshallhavegoodsealingconditiontopreventmoistureanddustfreeenvironmentand render it waterproof.

- Splicing is as preapproved splicing plan.
- Theconnectorlossshallbelessthanorequalto0.5dBperconnector.
- The warning sheet is properly fixed on the splice enclosure.

Result/Conclusion:

- Test result shall be filled in the respective test formats as enclosed for splice test.

Tested By	**Witnessed By**	**Approved By**
(Sign with date)	(Sign with date)	(Sign with date)

COMMISSIONINGTEST(LINKTEST)

Title of Test : Link Commissioning Test

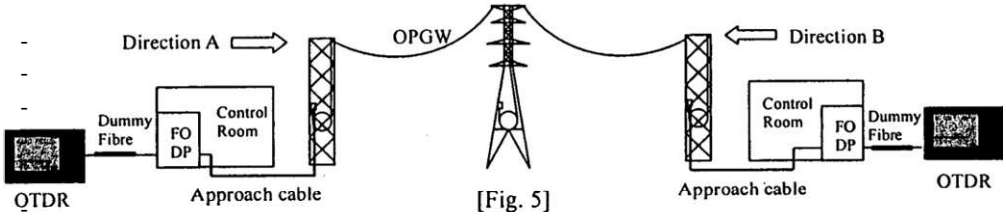
Application : All Links (FODP to FODP)

Purpose of the Test: After completion of splicing of installed section and termination at both ends , the optical fiber path attenuation shall be checked to ensure that the optical fiber shall be in operation satisfactorily.

Test Equipment: OTDR, Power Meter & Light Source

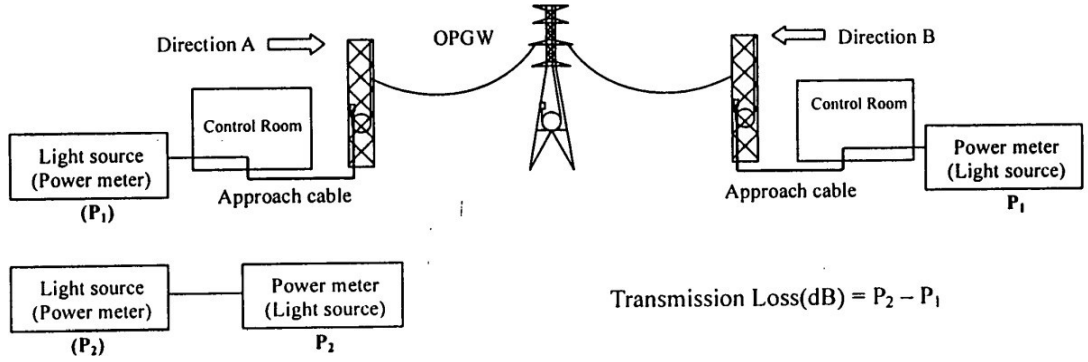
Test Set-up & Procedure:

- The numbering and labeling plan shall be checked at each FODP.
- The optical fiber path attenuation shall be measured at both ends of link by OTDR as well as Power meter and laser light at 1310nm and 1550 nm. The bi-directional average attenuation by both methods shall be calculated.



[Fig. 5]

- The measurement using the power meter is as below;



NOTE: The FODP to FODP link distance should be restricted to 70 Kms for the bidirectional test as the attenuation measurement using OTDR for the wavelength 1310nm may not be accurate for the link distances more than 70 Kms.

Acceptance Criteria:

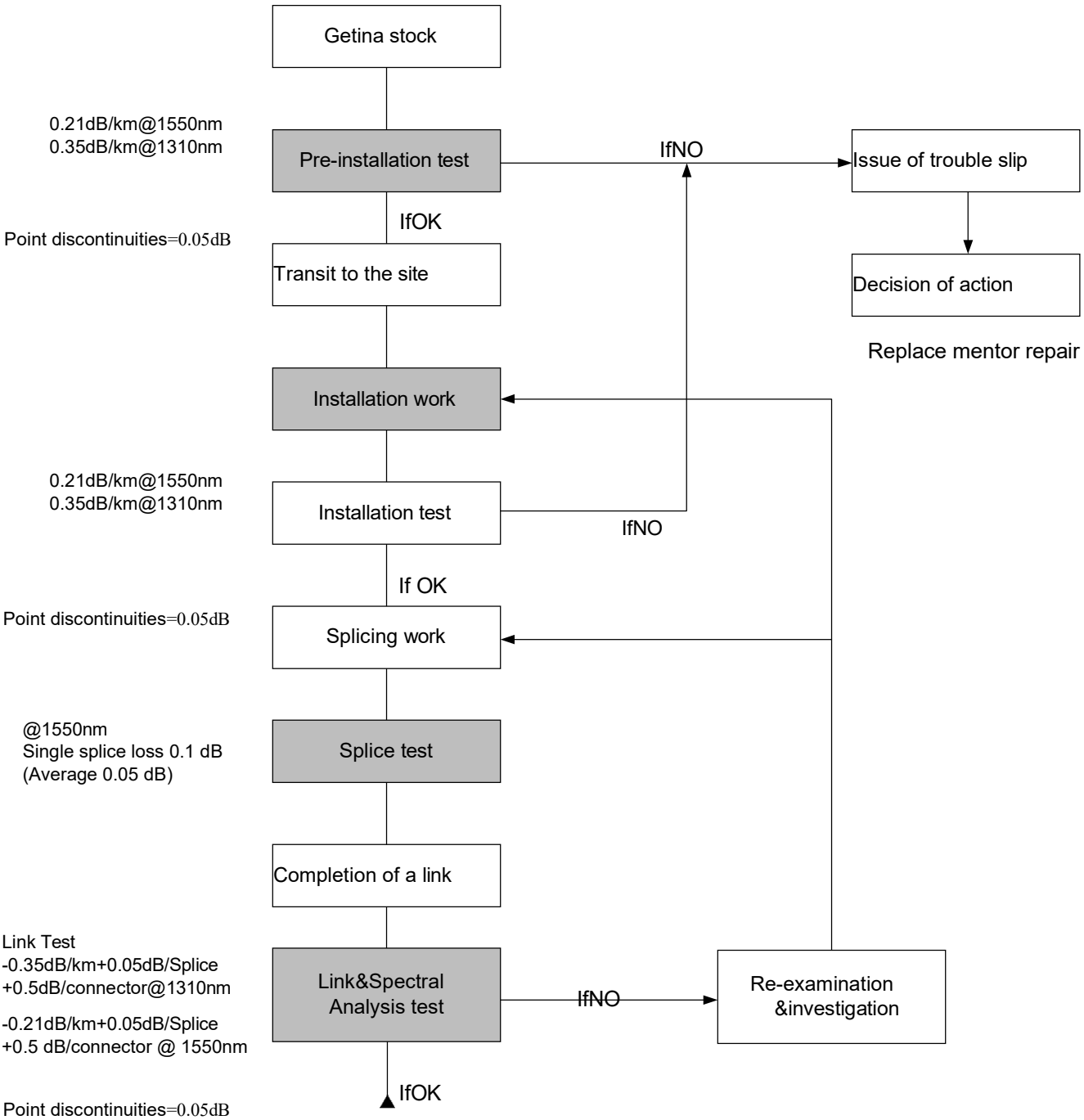
- The numbering and labeling plan at each FODP shall be as per approved plan.
- Theoverallopticalfiberpathattenuationat1550nmshallbe0.21dB/km+0.05dB/splice+0.5 dB/connector.
- Theoverallopticalfiberpathattenuationat1310nmshallbe0.35dB/km+0.05dB/splice+0.5 dB/connector.
- Therearenopointdiscontinuitiesinexcessof0.1dB

Result/Conclusion:

- Testresultshallbefilledintherespectivetestformatsasenclosedforlinkcommissioningtest.
- Bidirectional averages splice loss by OTDR of each splice as well as for all splices in the link (including FODP also).
- ProperterminationandlabelingoffibersandfiberopticcablesatFODPasperapprovedlabelingplan.

Tested By	**Witnessed By**	**Approved By**
(Sign with date)	(Sign with date)	(Sign with date)

PROCEDURECHART

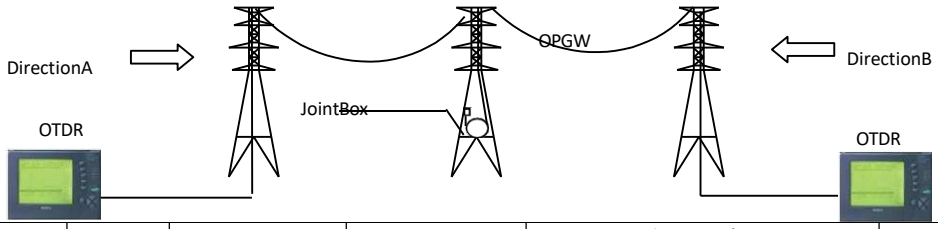


PLANFOR SAT

Test Title	Function/Parameter	Test Equipment	Criteria	Remarks
llation Test st)	The point is whether the cable shall be used for the installation or not. Appearance of drum and cable; Optical fiber continuity end-to-end and attenuation	OTDR	Attenuation: ≤0.21dB/km@1550nm ≤0.35dB/km@1310nm Discontinuity: ≤0.1 dB	
Installation Test	After completion of installation, check for any increase or step discontinuity in attenuation that may have occurred during transportation and installation.	OTDR	Attenuation: ≤0.21dB/km@1550nm ≤0.35dB/km@1310nm Discontinuity: ≤0.1 dB	
Splice Test	Before closing splice enclosure, splice loss shall be measured from both directions. OTDR Shall be located at the one side of splicing point, loop for measurement fbi-directional splice loss shall be constituted at the other side. S1=0 ≤ A+B ≤0.1dB 2 Where, A is splice loss from'A' direction. B is splice loss from 'B' direction.	OTDR	@1550nm,Singlespliceloss0.1dB Average 0.05 dB.	
Commissio ning Test (Link Test)	After installation and splicing Of each link ,path attenuation Shall be measured with the Help of OTDR & power meter. Splice loss shall be measured with OTDR and average splice loss shall be calculated	OTDR & Power Meter, Laser Source	<Link Test> **Path attenuation**: ≤0.21dB/km+0.05dB/splice +0.5db/connector@1550nm ≤0.35db/km +0.05dB/splice +0.5db/connector @1310 nm **Discontinuity**:≤0.05dB **Average splice loss** $=(S_1+S_2+---Sn)/N$ Where $S_1,S_2,---S_n$ is average splice loss At joint1,2, ---n etc.	

SAT-02-A(24F)
POST-INSTALLATIONTESTREPORTFOR OPGW

Report No:	Sector:		
Date:	Section:		
	Drum No:		
	Drum Length:		(As per Pre-shipment date)
	Drum Length:		(Actual at site)
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	MAXATTENUATION
Testing Date:	1310nm	1.4670	0.35 dB/km
	1550nm	1.4675	0.21 dB/km



Tube Color	Fiber No	Fiber Color	Length (km)	Attenuation dB/km		Remarks
				1550nm	1310nm	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
ORANGE	7	Blue				
	8	Orange				
	9	Green				
	10	Brown				
	11	Slate				
	12	White				
GREEN	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
BROWN	19	Blue				
	20	Orange				
	21	Green				
	22	Brown				
	23	Slate				
	24	White				

OTDR Trace results attached for all fiber(Yes/No):

Tested By
(Sign with date)

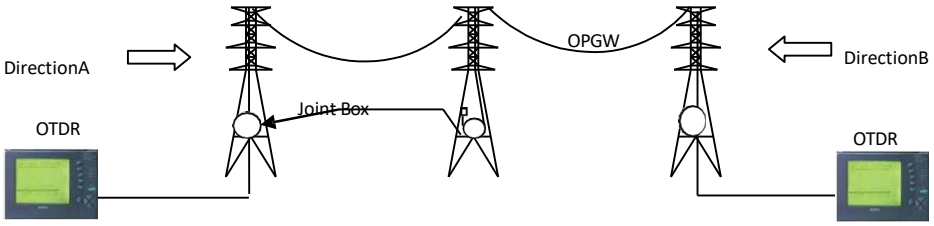
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-03-B(24F)

SPLICELOSS TESTREPORTFOR OPGW@ 1550nm

Report No:	Sector:		
Date:	Section:		
	TOWER No:		
			Acceptance criteria
			Max. Splice Loss
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	0.10dB(Individual splice)
Testing Date:			Average Splice loss in link
	1550nm	1.4675	0.05 dB/Splice



Joint Box	Appearance	Fiber Routing	Sealing	Tower No.

Tube Color	Fiber No	Fiber Color	Length(km)	SPLICELOSS (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
ORANGE	7	Blue				
	8	Orange				
	9	Green				
	10	Brown				
	11	Slate				
	12	White				
GREEN	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
BROWN	19	Blue				
	20	Orange				
	21	Green				
	22	Brown				
	23	Slate				
	24	White				

OTDR Trace results attached for all fiber(Yes/No):

Tested By
(Sign with date)

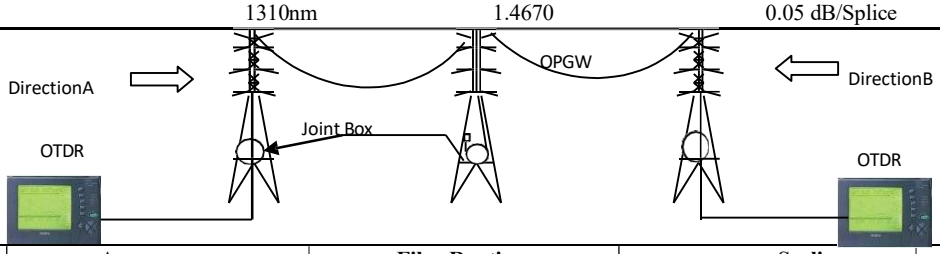
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-03-A(24F)

SPLICELOSS TESTREPORTFOR OPGW@ 1310nm

Report No:	Sector:		
Date:	Section:		
	TOWER No:		
			Acceptance criteria
			Max. Splice Loss
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	0.10dB(Individual splice)
Testing Date:			Average Splice loss in link
	1310nm	1.4670	0.05 dB/Splice



JointBox	Appearance	FiberRouting	Sealing	Tower No.

TubeColor	Fiber No	FiberColor	Length(km)	SPLICELOSS (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
ORANGE	7	Blue				
	8	Orange				
	9	Green				
	10	Brown				
	11	Slate				
	12	White				
GREEN	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
BROWN	19	Blue				
	20	Orange				
	21	Green				
	22	Brown				
	23	Slate				
	24	White				

OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

Witnessed By
(Sign with date)

Approved By
(Sign with date)

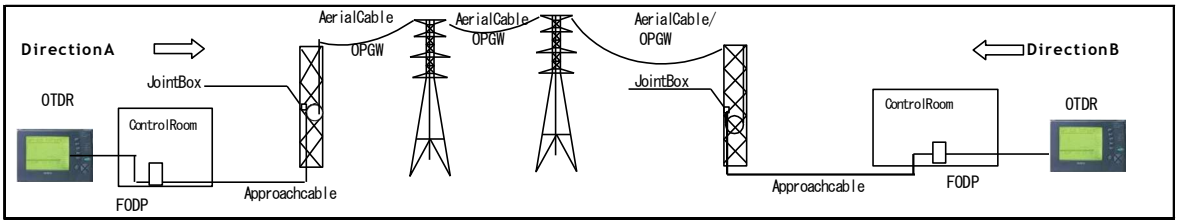
SAT-04-A(24F)

FOCABLEEND TOENDTESTUSINGOTDR(1310nm)

Report No: Date:

SECTOR	
LINELINK	
FODP to FODP	

Type of OTDR	Testing Date	Wavelength	Max Attenuation of Fiber	Specified Loss
		1310nm	0.35 dB/km	∑ 0.35dB/km**x** Total FO length+ 0.05dB/splice **x** Total No. of splice + 0.5dB/connector **x** No. of connectors



Tube Color	Fiber No	Fiber Color	Length (km)	Total LOSS (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
ORANGE	7	Blue				
	8	Orange				
	9	Green				
	10	Brown				
	11	Slate				
	12	White				
GREEN	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
BROWN	19	Blue				
	20	Orange				
	21	Green				
	22	Brown				
	23	Slate				
	24	White				

- OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

Witnessed By
(Sign with date)

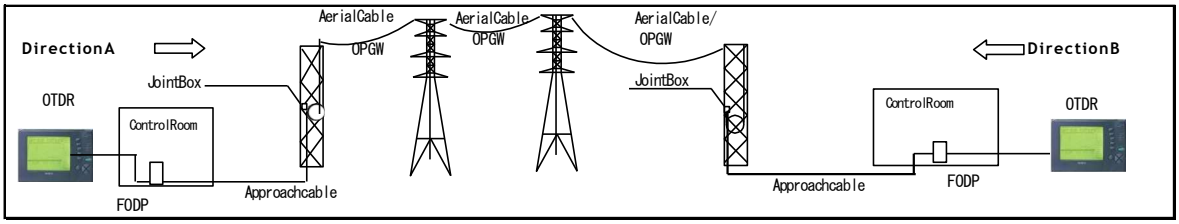
Approved By
(Sign with date)

SAT-04-B(24F)

FOCABLEEND TOENDTESTUSINGOTDR(1550nm)

Report No: Date:

SECTOR				
LINELINK				
FODP to FODP				
Type of OTDR	Testing Date	Wavelength	Max Attenuation of Fiber	Specified Loss
		1550nm	0.21 dB/km	∑ 0.21dB/km**x** TotalFO length+ 0.05dB/splice **x** Total No. of splice + 0.5dB/connector **x** No. of connectors



Tube Color	Fiber No	Fiber Color	Length(Km)	Total LOSS (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
ORANGE	7	Blue				
	8	Orange				
	9	Green				
	10	Brown				
	11	Slate				
	12	White				
GREEN	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
BROWN	19	Blue				
	20	Orange				
	21	Green				
	22	Brown				
	23	Slate				
	24	White				

- OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

Witnessed By
(Sign with date)

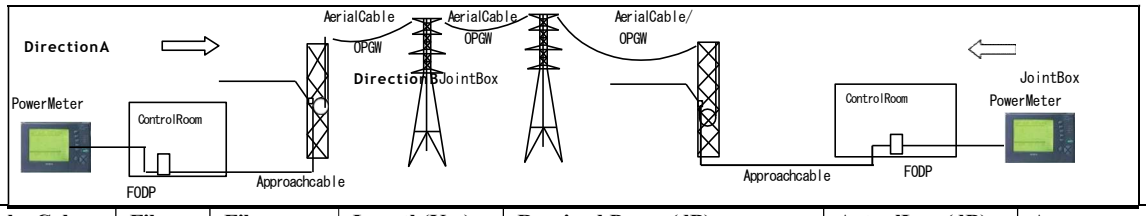
Approved By
(Sign with date)

SAT-05-A(24F)

FOCABLEENDTOENDTESTUSINGPOWERMETER(1550nm)

Report No: Date:

SECTOR	FODP to FODP			
LINELINK				
REFERENCEPOWER :Pr dB m				
A-Power measuring from A Direction dBm			P1:Pr-AdBm	
B-Power measuring from B Direction dBm			P2:Pr-BdBm	
Type of Power Meter	Testing Date	Wavelength	Max Attenuation of Fiber	Specified Loss
		1550nm	0.21db/km	∑ 0.21dB/km **x** Total FO length + 0.05dB/splice **x** Total No. of splice + 0.5dB/connector **x** No.of connectors



Tube Color	Fiber No	Fiber Color	Length(Km)	Received Power(dB)		ActualLoss(dB) P=(P1+P2)/2	Average Loss (dB/km) P/Section length
				Direction-A (P1)	Direction-B (P2)		
BLUE	1	Blue					
	2	Orange					
	3	Green					
	4	Brown					
	5	Slate					
	6	White					
ORANGE	7	Blue					
	8	Orange					
	9	Green					
	10	Brown					
	11	Slate					
	12	White					
GREEN	13	Blue					
	14	Orange					
	15	Green					
	16	Brown					
	17	Slate					
	18	White					
BROWN	19	Blue					
	20	Orange					
	21	Green					
	22	Brown					
	23	Slate					
	24	White					

Tested By
(Sign with date)

Witnessed By
(Sign with date)

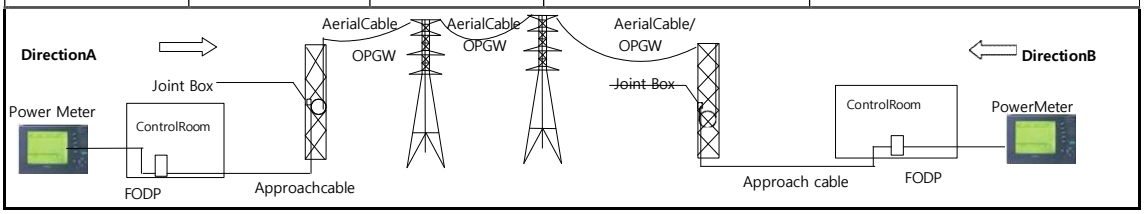
Approved By
(Sign with date)

SAT-05-B(24F)

FOCABLEENDTOENDTESTUSINGPOWERMETER(1310nm)

ReportNo: Date:

SECTOR	FODPTOFODP			
LINELINK				
REFERENCEPOWER :PrdBm				
A-Power measuring from A Direction dBm			P1:Pr-AdBm	
B-Power measuring from B Direction dBm			P2:Pr-BdBm	
Type of Power Meter	Testing Date	Wavelength	Max Attenuation of Fiber	Specified Loss
		1310nm	0.35db/km	∑0.35dB/km**x**TotalFOlength +0.05dB/splice**x**TotalNo.of splice + 0.5dB/connector **x** No.ofconnectors



Tube Color	Fiber No	Fiber Color	Length (Km)	ReceivedPower(dB)		ActualLoss(dB) P=(P1+P2)/2	Average Loss (dB/km) P/Sectionlength
				Direction-A (P1)	Direction-B (P2)		
BLUE	1	Blue					
	2	Orange					
	3	Green					
	4	Brown					
	5	Slate					
	6	White					
ORANGE	7	Blue					
	8	Orange					
	9	Green					
	10	Brown					
	11	Slate					
	12	White					
GREEN	13	Blue					
	14	Orange					
	15	Green					
	16	Brown					
	17	Slate					
	18	White					
BROWN	19	Blue					
	20	Orange					
	21	Green					
	22	Brown					
	23	Slate					
	24	White					

Tested By
(Sign with date)

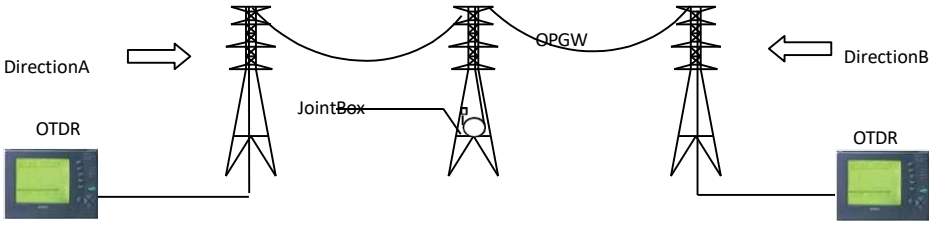
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-02-A(48F)

POST-INSTALLATIONTEST REPORTFOROPGW

Report No:	Sector:		
Date:	Section:		
	Drum No:		
	Drum Length:		(As per Pre-shipment date)
	Drum Length:		(Actual at site)
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	MAXATTENUATION
Testing Date:	1310nm	1.4670	0.35 dB/km
	1550nm	1.4675	0.21 dB/km



S.No:	Description	Result(Yes/No)	Remarks
1	Physical Appearance check		
2	Drum Marking check		
3	Sealing of Cable ends & provision of spare cable caps		

Tube Color	Fiber No	Fiber Color	Length(km)	Attenuation		Remarks
				1310nm dB/km	1550nm dB/km	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
	7	Red				
	8	Black				
	9	Yellow				
	10	Violet				
	11	Pink				
	12	Aqua				
ORANGE	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
	19	Red				
	20	Black				
	21	Yellow				
	22	Violet				
	23	Pink				
	24	Aqua				

Tube Color	Fiber No	Fiber Color	Length(km)	Attenuation		Remarks
				1310nm dB/km	1550nm dB/km	
GREEN	25	Blue				
	26	Orange				
	27	Green				
	28	Brown				
	29	Slate				
	30	White				
	31	Red				
	32	Black				
	33	Yellow				
	34	Violet				
	35	Pink				
	36	Aqua				
BROWN	37	Blue				
	38	Orange				
	39	Green				
	40	Brown				
	41	Slate				
	42	White				
	43	Red				
	44	Black				
	45	Yellow				
	46	Violet				
	47	Pink				
	48	Aqua				

- OTDR Trace results attached for all fiber(Yes/No):

Tested By
(Sign with date)

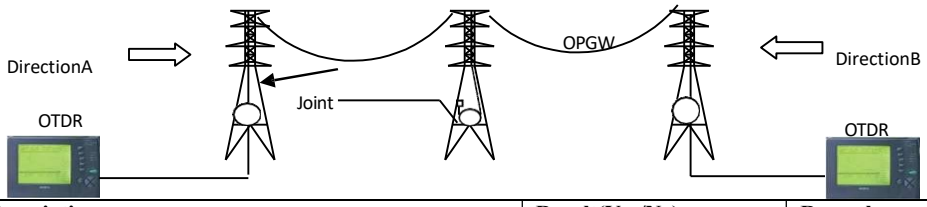
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-03-B(48F)

SPLICELOSS TESTREPORTFOROPGW@ 1550nm

Report No:	Sector:		
Date:	Section:		
	TOWER No:		
			Acceptance criteria
			Max. Splice Loss
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	0.10dB(Individual splice)
Testing Date:			Average Splice loss in link
	1550nm	1.4675	0.05 dB/Splice



S.No:	Description	Result(Yes/No)	Remarks
1	Physical Appearance check		
2	Drum Marking check		
3	Sealing of Cable ends & provision of spare cable caps		

Tube Color	Fiber No	Fiber Color	Length(km)	SPLICELOSS (dB)		Actual Loss (dB)=(A+B)/2
				DirectionA	DirectionB	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
	7	Red				
	8	Black				
	9	Yellow				
	10	Violet				
	11	Pink				
	12	Aqua				
ORANGE	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
	19	Red				
	20	Black				
	21	Yellow				
	22	Violet				
	23	Pink				
	24	Aqua				

Tube Color	Fiber No	Fiber Color	Length(km)	SPLICELOSS (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
GREEN	25	Blue				
	26	Orange				
	27	Green				
	28	Brown				
	29	Slate				
	30	White				
	31	Red				
	32	Black				
	33	Yellow				
	34	Violet				
	35	Pink				
	36	Aqua				
BROWN	37	Blue				
	38	Orange				
	39	Green				
	40	Brown				
	41	Slate				
	42	White				
	43	Red				
	44	Black				
	45	Yellow				
	46	Violet				
	47	Pink				
	48	Aqua				

- OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

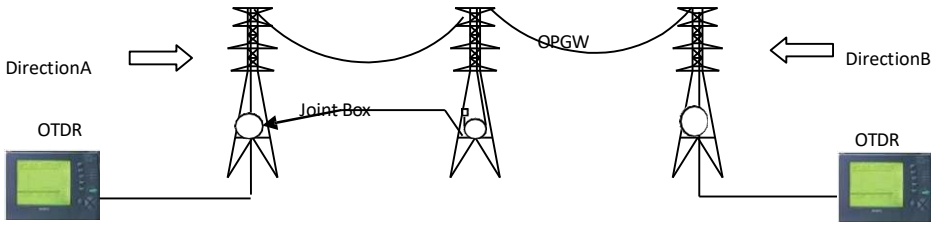
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-03-A(48F)

SPLICELOSS TESTREPORTFOROPGW@ 1310nm

Report No:	Sector:		
Date:	Section:		
	TOWER No:		
			Acceptance criteria
			Max. Splice Loss
Type of OTDR:	WAVELENGTH	REFRACTIONINDEX	0.10dB(Individual splice)
Testing Date:			Average Splice loss in link
	1310nm	1.4670	0.05 dB/Splice



S. No:	Description	Result (Yes/No)	Remarks
1	Physical Appearance Check		
2	Drum Marking Check		
3	Sealing of Cable Ends & Provision of Spare Cable Caps		

Tube Color	Fiber No	Fiber Color	Length(km)	SPLICELOSS (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
	7	Red				
	8	Black				
	9	Yellow				
	10	Violet				
	11	Pink				
	12	Aqua				
ORANGE	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
	19	Red				
	20	Black				
	21	Yellow				
	22	Violet				
	23	Pink				
	24	Aqua				

Tube Color	Fiber No	Fiber Color	Length(km)	SPLICELOSS (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
GREEN	25	Blue				
	26	Orange				
	27	Green				
	28	Brown				
	29	Slate				
	30	White				
	31	Red				
	32	Black				
	33	Yellow				
	34	Violet				
	35	Pink				
	36	Aqua				
BROWN	37	Blue				
	38	Orange				
	39	Green				
	40	Brown				
	41	Slate				
	42	White				
	43	Red				
	44	Black				
	45	Yellow				
	46	Violet				
	47	Pink				
	48	Aqua				

- OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

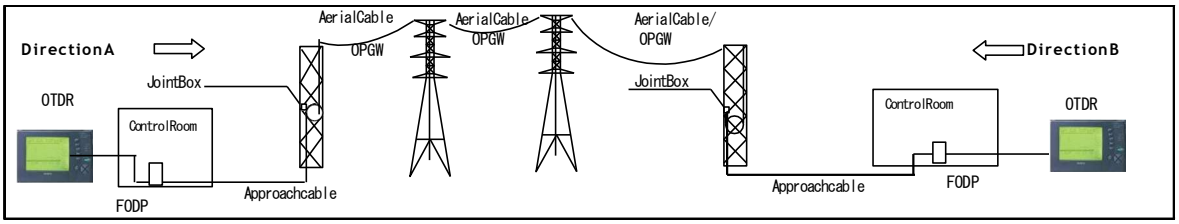
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-04-A(48F)
FO CABLE END TOENDTEST USINGOTDR(1310 nm)

Report No: Date:

SECTOR				
LINELINK				
FODP to FODP				
Type of OTDR	Testing Date	Wavelength	Max Attenuation of Fiber	Specified Loss
		1310nm	0.35db/km	∑0.35dB/km**x** TotalFOlength+0.05dB/splice **x** Total No. of splice + 0.5dB/connector **x** No. of connectors



Tube Color	Fiber No	Fiber Color	Length(km)	TotalLoss (dB)		Actual Loss(dB)=(A+B)/2
				DirectionA	DirectionB	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
	7	Red				
	8	Black				
	9	Yellow				
	10	Violet				
	11	Pink				
	12	Aqua				
ORANGE	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
	19	Red				
	20	Black				
	21	Yellow				
	22	Violet				
	23	Pink				
	24	Aqua				

Tube Color	Fiber No	Fiber Color	Length(km)	Total Loss (dB)		Actual Loss (dB)=(A+B)/2
				1310nm dB/km	1550nm dB/km	
GREEN	25	Blue				
	26	Orange				
	27	Green				
	28	Brown				
	29	Slate				
	30	White				
	31	Red				
	32	Black				
	33	Yellow				
	34	Violet				
	35	Pink				
	36	Aqua				
BROWN	37	Blue				
	38	Orange				
	39	Green				
	40	Brown				
	41	Slate				
	42	White				
	43	Red				
	44	Black				
	45	Yellow				
	46	Violet				
	47	Pink				
	48	Aqua				

- OTDR Trace results attached for all fiber(Yes/No):

Tested By
(Sign with date)

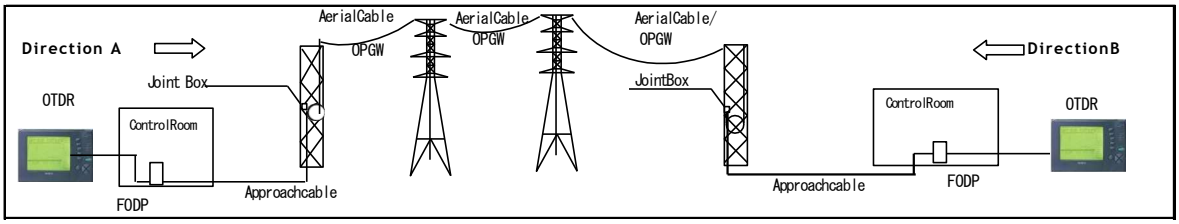
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-04-B(48F)
FO CABLE END TOENDTEST USINGOTDR(1550 nm)

Report No: Date:

SECTOR				
LINELINK				
FODP to FODP				
Type of OTDR	Testing Date	Wavelength	Max Attenuation of Fiber	Specified Loss
		1550nm	0.21db/km	∑0.21dB/km**x** TotalFOlength+0.05dB/splice **x** Total No. of splice + 0.5dB/connector **x** No. of connectors



Tube Color	Fiber No	Fiber Color	Length(km)	Total Loss (dB)		Actual Loss(dB)=(A+B)/2
				Direction A	Direction B	
BLUE	1	Blue				
	2	Orange				
	3	Green				
	4	Brown				
	5	Slate				
	6	White				
	7	Red				
	8	Black				
	9	Yellow				
	10	Violet				
	11	Pink				
	12	Aqua				
ORANGE	13	Blue				
	14	Orange				
	15	Green				
	16	Brown				
	17	Slate				
	18	White				
	19	Red				
	20	Black				
	21	Yellow				
	22	Violet				
	23	Pink				
	24	Aqua				

Tube Color	Fiber No	Fiber Color	Length(km)	Attenuation		Remarks
				1310nm dB/km	1550nm dB/km	
GREEN	25	Blue				
	26	Orange				
	27	Green				
	28	Brown				
	29	Slate				
	30	White				
	31	Red				
	32	Black				
	33	Yellow				
	34	Violet				
	35	Pink				
	36	Aqua				
BROWN	37	Blue				
	38	Orange				
	39	Green				
	40	Brown				
	41	Slate				
	42	White				
	43	Red				
	44	Black				
	45	Yellow				
	46	Violet				
	47	Pink				
	48	Aqua				

- OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

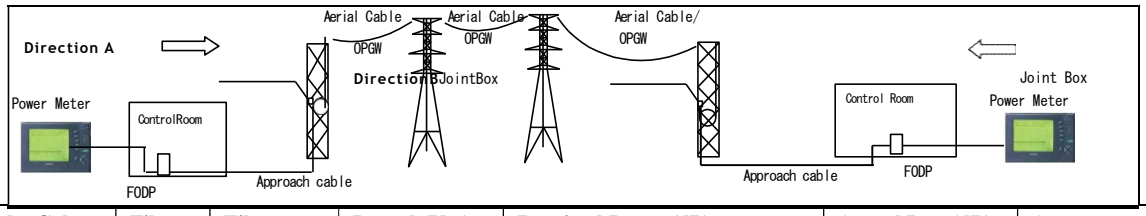
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-05-A(48F)
FOCABLE END TOENDTESTUSINGPOWER METER(1550nm)

Report No: Date:

SECTOR	FODP to FODP			
LINELINK				
REFERENCE POWER :Pr dBm				
A-Power measuring from A Direction dBm			P1:Pr-AdBm	
B-Power measuring from B Direction dBm			P2:Pr-BdBm	
Type of Power Meter	Testing Date	Wavelength	Max Attenuation of Fiber	Specified Loss
		1550nm	0.21db/km	∑ 0.21dB/km **x** Total FO length + 0.05dB/splice **x** Total No. of splice + 0.5dB/connector **x** No.of connectors



Tube Color	Fiber No	Fiber Color	Length(Km)	Received Power(dB)		Actual Loss(dB) P=(P1+P2)/2	Average Loss (dB/km) P/Section length
				Direction-A (P1)	Direction-B (P2)		
BLUE	1	Blue					
	2	Orange					
	3	Green					
	4	Brown					
	5	Slate					
	6	White					
	7	Red					
	8	Black					
	9	Yellow					
	10	Violet					
	11	Pink					
	12	Aqua					
ORANGE	13	Blue					
	14	Orange					
	15	Green					
	16	Brown					
	17	Slate					
	18	White					
	19	Red					
	20	Black					
	21	Yellow					
	22	Violet					
	23	Pink					
	24	Aqua					

Tube Color	Fiber No	Fiber Color	Length(Km)	Received Power(dB)		Actual Loss(dB) P=(P1+P2)/2	Average Loss (dB/km) P/Section length
				Direction-A (P1)	Direction-B (P2)		
GREEN	25	Blue					
	26	Orange					
	27	Green					
	28	Brown					
	29	Slate					
	30	White					
	31	Red					
	32	Black					
	33	Yellow					
	34	Violet					
	35	Pink					
	36	Aqua					
BROWN	37	Blue					
	38	Orange					
	39	Green					
	40	Brown					
	41	Slate					
	42	White					
	43	Red					
	44	Black					
	45	Yellow					
	46	Violet					
	47	Pink					
	48	Aqua					

- OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

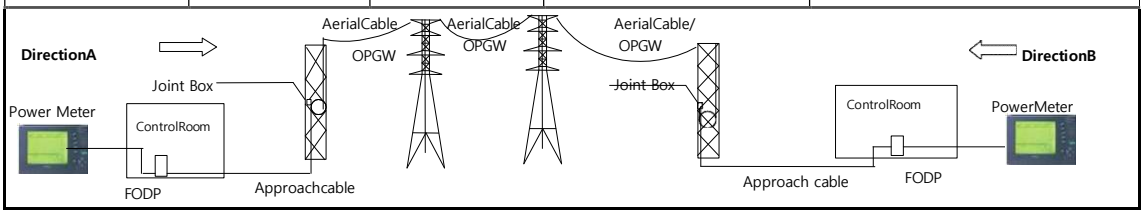
Witnessed By
(Sign with date)

Approved By
(Sign with date)

SAT-05-B(48F)
FOCABLE END TOENDTESTUSINGPOWER METER(1310nm)

Report No: Date:

SECTOR	FODPTOFODP			
LINELINK				
REFERENCE POWER :Pr dB m				
A-Power measuring from A Direction dBm			P1:Pr-AdBm	
B-Power measuring from B Direction dBm			P2:Pr-BdBm	
Type of Power Meter	Testing Date	Wavelength	MAX Attenuation of Fiber	Specified Loss
		1310nm	0.35db/km	∑0.35dB/km **x** Total FO length +0.05dB/splice **x** Total No. of splice + 0.5dB/connector **x** No. of connectors



Tube Color	Fiber No	Fiber Color	Length (Km)	Received Power(dB)		Actual Loss(dB) P=(P1+P2)/2	Average Loss (dB/km) P/Section length
				Direction-A (P1)	Direction-B (P2)		
BLUE	1	Blue					
	2	Orange					
	3	Green					
	4	Brown					
	5	Slate					
	6	White					
	7	Red					
	8	Black					
	9	Yellow					
	10	Violet					
	11	Pink					
	12	Aqua					
ORANGE	13	Blue					
	14	Orange					
	15	Green					
	16	Brown					
	17	Slate					
	18	White					
	19	Red					
	20	Black					
	21	Yellow					
	22	Violet					
	23	Pink					
	24	Aqua					

Site Acceptance Test Procedures And Plan For Optical Fibre

Tube Color	Fiber No	Fiber Color	Length(Km)	Received Power(dB)		Actual Loss (dB) P=(P1+P2)/2	Average Loss (dB/km)P/Section length
				Direction-A (P1)	Direction-B (P2)		
GREEN	25	Blue					
	26	Orange					
	27	Green					
	28	Brown					
	29	Slate					
	30	White					
	31	Red					
	32	Black					
	33	Yellow					
	34	Violet					
	35	Pink					
	36	Aqua					
BROWN	37	Blue					
	38	Orange					
	39	Green					
	40	Brown					
	41	Slate					
	42	White					
	43	Red					
	44	Black					
	45	Yellow					
	46	Violet					
	47	Pink					
	48	Aqua					

- OTDR Trace results attached for all fiber (Yes/No):

Tested By
(Sign with date)

Witnessed By
(Sign with date)

Approved By
(Sign with date)

Note: In addition to the above test the bidder should also submit CD,PMD and AP of the fibers post installation.