

Project Name:
LOA No.:

5 TYPE TEST PROCEDURES FOR VIBRATION DAMPER FATIGUE TEST

Test Name: Fatigue test of vibration damper
Customer: Power Grid Corporation of India Limited, India
Manufacturer:
Standard: As per Vol. B Technical specification
Objective: To determine the fatigue of vibration damper.

TEST SET-UP

The Vibration damper fatigue test shall be conducted on a laboratory set up with a minimum effective span length of 30m. The fibre optic cable shall be tensioned at 25% UTS of OPGW and shall not be equipped with protective armour rods at any point.

Constant tension shall be maintained within the span by means of lever arm arrangement. After the fibre optic cable has been tensioned, clamps shall be installed to support the fibre optic cable at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the fibre optic cable. There shall be no loose parts, such as suspension clamps, U bolts, on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for step less speed control as well as step less amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

TEST PROCEDURE

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement.

The damper shall then be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies, tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than $\pm 25/f$ mm where f is the frequency in Hz.

The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the test, if resonance shift is observed, the test frequency shall be tuned to the new resonant frequency.

The clamp slip test as mentioned herein above shall be repeated after fatigue tests without re-torquing or adjusting the damper clamp, and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.

After the above tests, the damper shall be removed from fibre optic cable and subjected to dynamic characteristics test, the Graphs showing results for:

- a) Force Vs Frequency
- b) Phase angle Vs Frequency
- c) Power dissipation Vs Frequency

Shall be recorded as per test procedure of Dynamic characteristic test

Type Test Procedure of Vibration Damper

Project Name:
LOA No.:

There shall not be any major deterioration in the characteristics of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The fibre optic cable under clamp shall also be free from any damage.

ACCEPTANCE CRITERIA

1. There shall not be any resonant frequency shift before and after the test by more than $\pm 20\%$.
2. The power dissipation of the damper before and after test at the individual resonant frequencies do not differ by more than $\pm 20\%$.

OBSERVATIONS, IF ANY:

TEST RESULT:

The Hardware Fittings of OPGW cable met/not met the acceptance criteria for the Fatigue test of Vibration Damper.

(Tested by)
Sign & date

(Witnessed by)
Sign & date

Project Name:
LOA No.:

6 TYPE TEST PROCEDURE FOR ATTACHMENT OF WEIGHTS TO MESSENGER CABLE TEST

Test Name: Attachment Of Weights To Messenger Cable Test Of Vibration Damper

Customer: Power Grid Corporation of India Limited, India

Manufacturer:

Standard: IEC 61897-1998

Test Procedure:

On an assembled damper a tensile load shall be applied between the weights coaxial with the messenger cable. The load shall be gradually increased (100 N/s maximum) until it reaches 5.0 kN (specified minimum slip load). This load shall be kept constant for 60 s.

The load shall then be increased slowly until one weight has been pulled free of the messenger cable. The maximum load obtained during this process shall be recorded, for information purposes only.

Acceptance Criteria:

No relative movement greater than 1mm between each weight and the messenger cable shall occur at or before the end of the application of 5.0 kN for 60s.

OBSERVATIONS, IF ANY:

Test Results:

The Hardware Fittings of OPGW cable met/not met the acceptance criteria for the Attachment Of Weights To Messenger Cable Of Vibration Damper.

(Tested by)
Sign & date

(Witnessed by)
Sign & date

Project Name:
LOA No.:

7 TYPE TEST PROCEDURE FOR ATTACHMENTS OF CLAMP TO MESSENGER CABLE TEST

Test Name: Attachments Of Clamp To Messenger Cable Test Of Vibration Damper

Customer: Power Grid Corporation of India Limited, India

Manufacturer:

Standard: IEC 61897-1998

Test Procedure:

A tensile load shall be applied between the messenger cable and the clamp body, coaxial with the messenger cable. The load shall be gradually increased (100 N/s maximum) until it reaches 1.5 kN (specified minimum slip load). This load shall be kept constant for 60 s.

The load shall then be increased slowly until the clamp has been pulled free of the messenger cable. The maximum load obtained during this process shall be recorded, for information purposes only.

Acceptance criteria:

No movement of the clamp relative to the messenger cable greater than 1mm shall occur at or before the end of the application of 1.5 kN for 60s.

OBSERVATIONS, IF ANY:

Test Results:

The Hardware Fittings of OPGW cable met/not met the acceptance criteria for Attachments Of Clamp To Messenger Cable Test.

(Tested by)
Sign & date

(Witnessed by)
Sign & date

Type Test Procedure of Vibration Damper

Project Name:
LOA No.:

8 TYPE TEST PROCEDURE FOR CLAMP BOLT TIGHTENING TEST OF VIBRATION DAMPER

Test Name: Clamp Bolt Tightening Test Of Vibration Damper

Customer: Power Grid Corporation of India Limited, India

Manufacturer:

Standard: IEC 61897-1998

Test Procedure:

The test shall be performed using the conductor for which the clamp is intended to be used. The bolt(s) or nut(s) shall be tightened to a torque 10 % above the specified installation torque.

Lastly, the torque shall be increased to twice the specified installation torque. This increase shall not result in any breakage of threaded parts or other components.

Acceptance criteria:

Regarding 1.1 times torque, the test is passed if the threaded connection remains serviceable for any number of subsequent installation or removals, and all components comprising the clamp are undamaged.

Regarding 2 times, the test is passed if any breakage either to threaded parts or to the components connected to them does not occur.

OBSERVATIONS, IF ANY:

Test Results:

Damper No.	1.1 times torque Comment on condition of components	2 times torque Comment on condition of components
1		
2		
3		

The Hardware Fittings of OPGW cable met/not met the acceptance criteria for Clamp Bolt Tightening Test of Vibration Damper.

(Tested by)
Sign & date

(Witnessed by)
Sign & date

9 TYPE TEST PROCEDURE FOR DAMPER EFFECTIVENESS EVALUATION TEST OF VIBRATION DAMPER

Test Name: Damper effectiveness Evaluation Test of Vibration Damper

Customer: Power Grid Corporation of India Limited, India

Manufacturer:

Standard: IEC 61897-1998

Test Procedures

The damping efficiency test shall be conducted on a laboratory set up with a minimum free span length of 30m.

Install the OPGW on the test span, and the OPGW shall be tensioned at Every Day Stress (20% of UTS).

A rigid clamp shall be installed to support rigidly (but not to tension) the OPGW at both ends of the span and the damper and shaker shall be positioned in figure 1. The shaker shall be installed in such a way that its connection to the OPGW cable is located in the first loop for all frequencies to be employed.

The damper or dampers shall be installed in accordance with manufacturer recommendations, unless specified.

OPGW bending strain shall be monitored adjacent to the rigid clamp at the span end with the damper(s) and to both sides of the clamp of each damper. Two strain gauges shall be attached to the OPGW at each of the three positions; one each on the two uppermost strands and as close as practicable to, but not more than 2 mm from the last point of contact of the rigid clamp with strands and 5 mm from the last point of contact of the damper clamp with strands. The test span shall be excited to achieve stable cable motion at the frequencies for which resonance occurs within the range $0.18/d \sim 1.4/d$, where d is the OPGW diameter in metre. A maximum of 20 tuneable frequency span resonances shall be tested, they shall be reasonably spaced over the frequency range indicated above.

Adjust the input power at each tuneable frequency until the highest of the strain readings corresponds to 150 micro-strain (single peak).

At each of these test frequencies the following shall be recorded:

- a) Frequency;
- b) OPGW Bending strain;
- c) Power Input P_j from the shaker;
- d) OPGW antinode peak-to-peak amplitude Y_j in one of the loops near the damper.

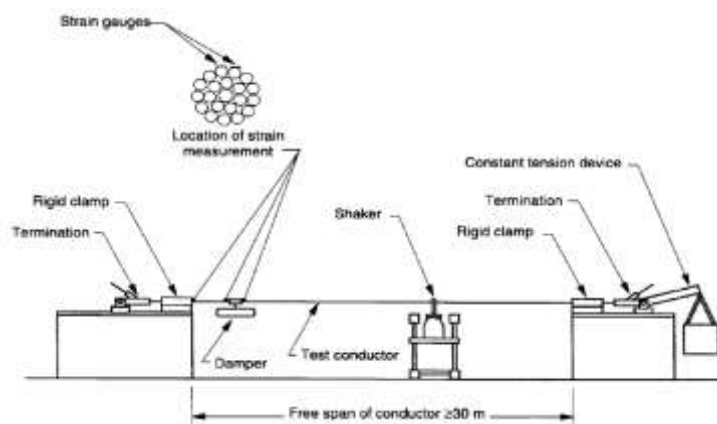


Figure 1-Test for laboratory test of damper effectiveness

Project Name:
LOA No.:

Acceptance Criteria

For each test frequency the power input P_j during the test shall exceed the assumed wind power input $P_{w,j}$ which shall be calculated from the equation:

$$P_{w,j} = L \cdot d^4 \cdot f_j^3 \cdot f_n(Y_j/d)$$

Where,

L is the maximum protectable conductor span length for the damper arrangement under test as agreed between purchaser and supplier (m);

d is the OPGW diameter (m);

f_j is the frequency (Hz);

Y_j the conductor antinodes peak-to-peak amplitude (m);

$f_n(Y_j/d)$ is the wind power input function;

OBSERVATIONS, IF ANY:

Test Results:

The Hardware Fittings of OPGW cable met/not met the acceptance criteria for Attachments of Clamp To Messenger Cable Test.

(Tested by)
Sign & date

(Witnessed by)
Sign & date

Type Test Procedure for Joint BoxProject Name-
LOA No.-

Following Type tests shall be demonstrated on the Splice Enclosure(s) (Splice Enclosure/Box). For certain tests, lengths of the fibre optic cable shall be installed in the splice box, and the fibres must be spliced and looped in order to simulate conditions of use. The attenuation of the fibres shall be measured, during certain tests, by relevant Fibre Optic Test Procedures (EIA/TIA 455 or IEC 60794-1 procedures).

List of test items

S.No.	TEST NAME	APPLICABLE STANDARD	TEST RESULT (PASS / FAIL)
1	Temperature cycling Test	EIA 445-20/IEC 60794-1-C 10	
2	Humid Heat Test	IEC 60794-1 or EIA/TLA 455	
3	Water Immersion Test	IEC 60060 or EIA/TLA 455	
4	Vibration Test	IEC 60794-1 or EIA/TLA 455	
5	Bending and Torsion Test	IEC 60794-1 or EIA/TLA 455	
6	Tensile Test	IEC 60794-1 or EIA/TLA 455	
7	Drop Test	IEC 60068-2-32	

Type Test Procedure for Joint Box

Project Name-
LOA No.-

Type Test procedure for Temperature Cycling Test

Test Name : **Temperature Cycling Test**
Final Customer : Power Grid Corporation of India Limited, India.
Project Name :
Manufacturer :
Box Type :
Standard : (EIA 455-20/IEC 60794-1-C 10).

TEST SET-UP

Fiber Optical cable is installed in the splice enclosure and optical fiber spliced and looped.

TEST PROCEDURE

The Joint box must be subjected to 5 cycles of temperature variations of -40°C to +65°C with a dwell time of at least 2 hours on each extreme.

Fibre loop attenuation shall be measured in accordance with EIA 455-20 / IEC 60794-1-C10.

The variation in attenuation will be recorded in the form of plots/graphs.

ACCEPTANCE CRITERIA

Variation in attenuation shall be less than ± 0.05 dB. The final humidity level, inside the box, shall not exceed the initial level, at the closing of the box.

Conclusion

The joint box meets the acceptance criteria of temperature cycling test

(TESTED BY)

Sign & Date

(WITNESSED BY)

Sign & Date

Type Test Procedure for Joint Box

Project Name-
LOA No.-

Type Test procedure for Humid Heat Test

Test Name : **Humid Heat Test**

Final Customer : Power Grid Corporation of India Limited, India.

Project Name :

Manufacturer :

: Box Type

Standard : (IEC 60794-1 or EIA/TLA -455).

TEST SET-UP

Fiber Optical cable is installed in the splice enclosure and optical fiber spliced and looped.

TEST PROCEDURE

The sealed Joint box , with fibres spliced and looped inside, must be subjected to a temperature of +55°C $\pm 2^\circ\text{C}$ with a relative humidity rate of between 90% and 95% for 5 days.

The variation attenuation of the fibres will be recorded through graphs.

ACCEPTANCE CRITERIA

The attenuation variation of the fibres during the duration of the test shall be less than $\pm 0.05\text{dB}$, and the Internal humidity rate measured, less than 2%.

Conclusion

The joint box meets the acceptance criteria of Humid Heat Test.

(TESTED BY)

Sign & Date

(WITNESSED BY)

Sign & Date

Type Test Procedure for Joint Box

Project Name-
LOA No.-

Type Test procedure for Rain Withstand Test/Water Immersion Test

Test Name : **Water Immersion Test.**

Final Customer : Power Grid Corporation of India Limited, India.

Project Name :

Manufacturer :

: Box Type

Standard : IEC 60060 or EIA/TLA 455

TEST SET-UP

Fiber Optical cable is installed in the splice enclosure and optical fiber spliced and looped.

TEST PROCEDURE

The Joint Box with optical fibres cable installed and fibres spliced fixed, is subjected to 24 hours of Water immersion in accordance with IEC 60060 testing requirements

ACCEPTANCE CRITERIA

1. No water seepage or moisture was detected in the joint box.
2. The attenuation variation of the fibres after the test shall be less than $\pm 0.05\text{dB}$.

Conclusion

The joint box meets the acceptance criteria of Rain withstand Test/Water Immersion Test.

(TESTED BY)

Sign & Date

(WITNESSED BY)

Sign & Date

Type Test Procedure for Joint Box

Project Name-
LOA No.-

Type Test procedure for Vibration Test

Test Name : **Vibration Test**

Final Customer : Power Grid Corporation of India Limited, India.

Project Name :

Manufacturer :

: Box Type

Standard : (IEC 60794-1 or EIA/TLA 455).

TEST SET-UP

The Joint box, with fiber united inside, is installed on vibration in the horizontal vertical direction separately with a frequency scanning of 5 to 50HZ.

TEST PROCEDURE

The amplitude of the vibrations shall be constant at 0.450mm, peak to peak, for 2 hours, for each of the Vibrations direction. Variation in attenuation shall be recorded.

ACCEPTANCE CRITERIA

1. The Variation in attenuation, of the fibres, shall be less than ± 0.05 dB.
2. The joint box shall be examined for any defects or deformation. There shall be no loosening or Visible damage of the OPGW cable at the entry point.

Conclusion

The joint box meets the acceptance criteria of Vibration Test.

(TESTED BY)

Sign & Date

(WITNESSED BY)

Sign & Date

Type Test Procedure for Joint Box

Project Name-
LOA No.-

Type Test procedure for Bending and Torsion Test

Test Name : **Bending and Torsion Test**
Final Customer : Power Grid Corporation of India Limited, India.
Project Name :
Manufacturer :
: Box Type
Standard : (IEC 60794-1 or EIA/TLA 455).

TEST SET-UP

OPGW is installed in the joint box and optical fiber are spliced and looped inside.

TEST PROCEDURE

The splice enclosure, with fibres spliced inside, shall be firmly held in place and be subjected to The Following sequence of mechanical stresses on the cable:

- a) 3 torsion cycles of $\pm 180^\circ$ shall be exercised on the cable. Each cycle shall be less than one minute.
- b) 3 bending cycles of $\pm 180^\circ$ shall be exercise on the cable. Each cycle shall be less than one minute.

ACCEPTANCE CRITERIA

1. The Variation in attenuation, of the fibres, shall be less than $\pm 0.05\text{dB}$.
2. The cables connection ring shall remain securely fixed to the box with the connection Maintained Firmly.
3. No defects and fissures shall be noted on the joint ring or on the joint box.

Conclusion

The joint box meets the acceptance criteria of Bending And Torsion Test.

(TESTED BY)
Sign & Date

(WITNESSED BY)
Sign & Date

Type Test Procedure for Joint Box

Project Name-
LOA No.-

Type Test Procedure for Tensile Test

Test Name : **Tensile Test.**

Final Customer : Power Grid Corporation of India Limited, India.
Project Name :
Manufacturer :
Box Type :
Standard : (IEC 60794-1 or EIA/TLA 455).

TEST PROCEDURE

The joint box with cable fixed to the boxes is subjected to a minimum tension of 448 N for a period of two minutes.

ACCEPTANCE CRITERIA

No fissure shall be noted in the connections or on the box.

Conclusion

The joint box meets the acceptance criteria of Tensile Test.

(TESTED BY)

Sign & Date

(WITNESSED BY)

Sign & Date

Type Test Procedure for Joint Box

Project Name-
LOA No.-

Type Test Procedure For Drop Test

Test Name : **Drop Test**

Final Customer : Power Grid Corporation of India Limited, India.
Project Name :
Manufacturer :
Box Type :
Standard : (IEC 60068-2-32).

TEST PROCEDURE

With 2 lengths of 11 meters of cable fixed to the box, it has to be dropped five times from a height of 10 meters.

ACCEPTANCE CRITERIA

There shall be no fissure, at all, of the box, and the connections shall remain tight.

Conclusion

The joint box meets the acceptance criteria of Drop Test.

(TESTED BY)

Sign & Date

(WITNESSED BY)

Sign & Date

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. Optical fibre continuity and fibre attenuation with OTDR at 1550 nm
 - c. Fibre Optic Cable length measurement using OTDR
- 2) Post-Installation Test
 - a. Optical fibre continuity and fibre attenuation with OTDR at 1550 nm
 - b. Fibre Optic Cable length measurement using OTDR
- 3) Splice Test
 - a. Per splice bi-directional average attenuation with OTDR
 - b. Physical inspection of splice box/enclosure for proper fibre / cable routing techniques
 - c. Physical inspection of sealing techniques, weatherproofing, etc.
- 4) Commissioning Test
 - a. End to End (FODP to FODP) bi-directional average attenuation of each fibre at 1310 nm and 1550 nm by OTDR.
 - b. End to End (FODP to FODP) bi-directional average attenuation of each fibre at 1310 nm and 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. Proper termination and labelling of fibres & fibre optic cables at FODP as per approved labelling plan.

Reference Documents:

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

PRE-INSTALLATION TEST (DRUM TEST)

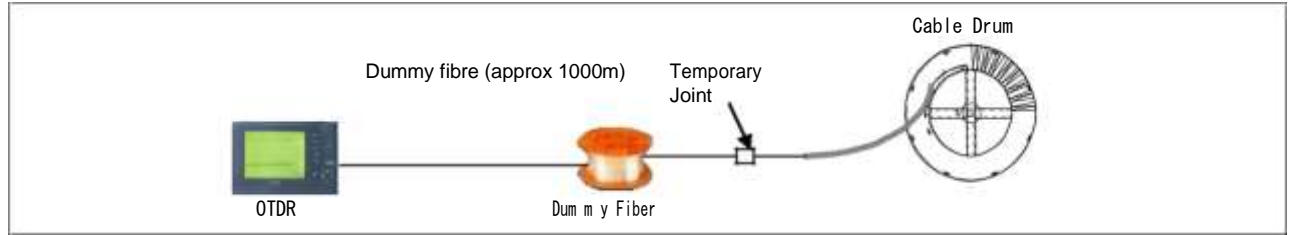
Title of Test	:	Pre-Installation Test (Drum Test)
Application	:	All FO Cables
Purpose of the Test	:	For precluding cable that may be damaged during shipment and transportation, every spooled FO cable segment shall be tested prior to installation.
Test Equipment	:	OTDR & physical inspection
Test Set-up & Procedure	:	First of all, check the appearance and marking of the Drums.

SHIPPING TAG

Package Name			
Employer 's Name	Power Grid Corporation of India Limited (A Government of India Enterprise)		
Employer 's Address			
Destination Address			
Vendor's Name			
Vendor's address			
Year of Manufacture	Xxxx	Batch No.	Xxxx
Drum No.	(As per 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 Date	Inspection Date
Factory Seal			

Xxxx – To be furnished by Sterlite Power Transmission Ltd Shall furnished before FAT.

- 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.

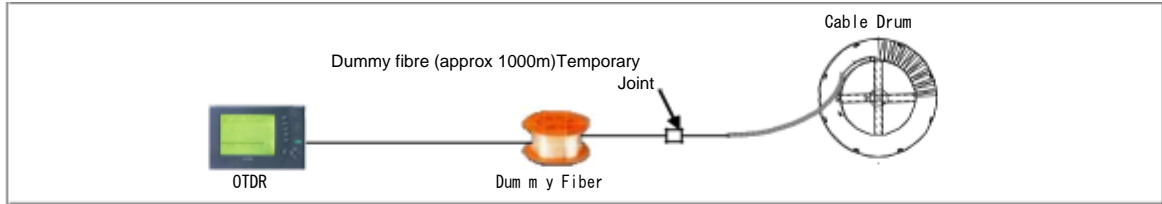
Result/Conclusion:

- Test result shall be filled in the respective test formats as enclosed for Pre -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 (24 F)

PRE-INSTALLATION TEST REPORT FOR OPGW CABLE (DRUM TEST)

Date:	Section:		
	Drum No:		
	Drum Length:	(As per Pre-shipment date)	
	Drum Length:	(Actual at site)	
Type of OTDR:	WAVELENGTH	REFRACTION INDEX	MAX ATTENUATION
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):

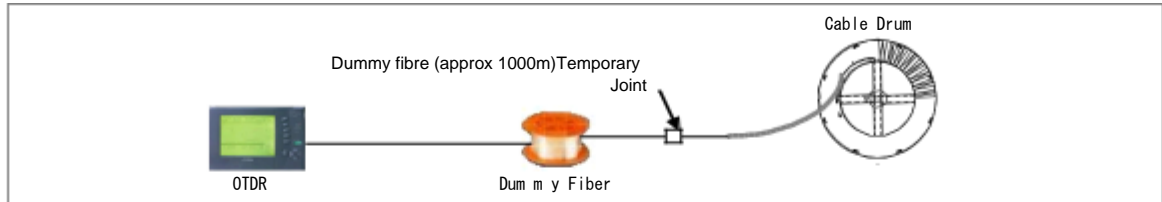
Tested By

Witnessed By

Approved By

SAT-01-A (48 F)
PRE-INSTALLATION TEST REPORT FOR OPGW CABLE (DRUM TEST)

Date:	Section:		
	Drum No:		
	Drum Length:	(As per Pre-shipment date)	
	Drum Length:	(Actual at site)	
Type of OTDR:	WAVELENGTH	REFRACTION INDEX	MAX ATTENUATION
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-INSTALLATION TEST

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

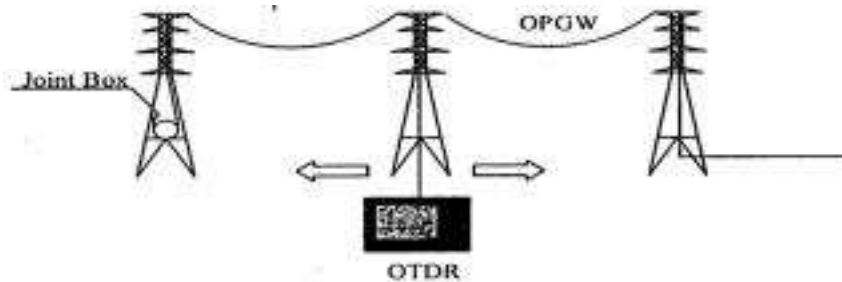
Application : All splicing points

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:

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

Tested By
(Sign with date)

Witnessed By
(Sign with date)

Approved By
(Sign with date)



SPLICE TEST

Title of Test : Splice Test

Application : All splicing positions

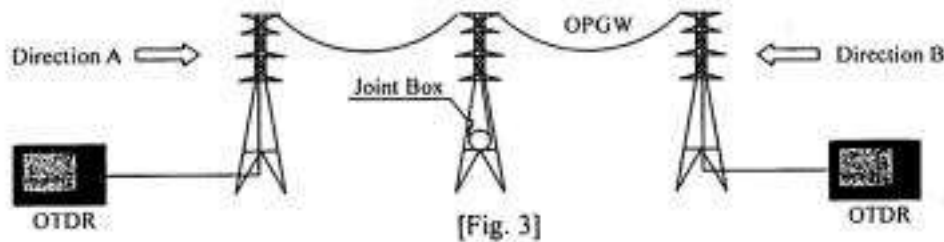
Purpose of the Test:

- Splicing as per approved splicing plan.
- Before closing the splice enclosure, splice loss shall be measured for checking the splicing condition.
- The treatment of surplus fibers on the splice tray and sealing condition shall be checked.

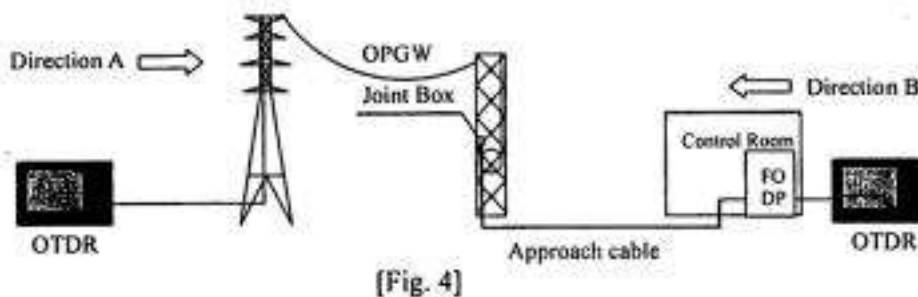
Test Equipment : OTDR & physical inspection

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.



- 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.



- 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 at 1550nm & 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.
- Splice enclosure shall have good sealing condition to prevent moisture and dust free environment and render it waterproof.
- Splicing is as per approved splicing plan.
- The connector loss shall be less than or equal to 0.5 dB per connector.

- 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
(Sign with date)

Witnessed By
(Sign with date)

Approved By
(Sign with date)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



COMMISSIONING TEST (LINK TEST)

Title of Test : Link Commissioning Test

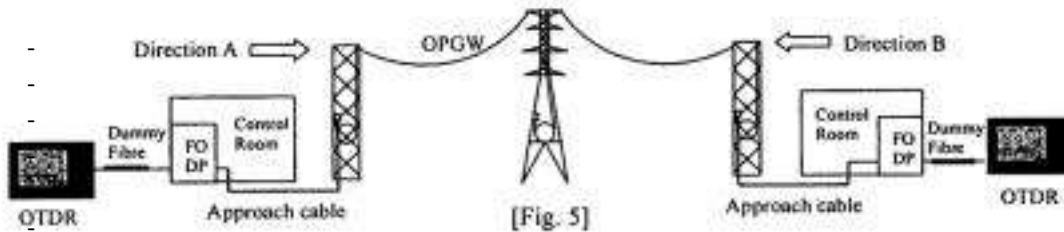
Application : All Links (FODP to FODP)

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.

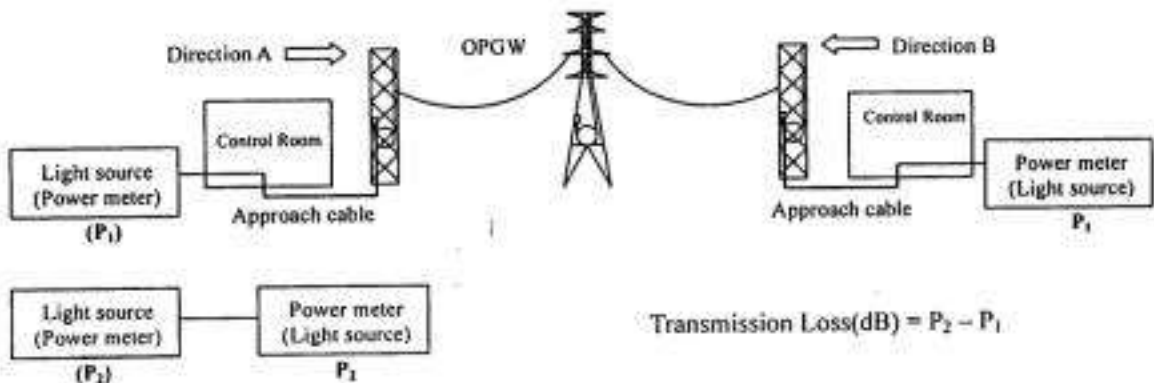
Test Equipment : OTDR, Power Meter & Light Source

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.



- 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.
- The overall optical fiber path attenuation at 1550 nm shall be $0.21 \text{ dB/km} + 0.05 \text{ dB/splice} + 0.5 \text{ dB/connector}$.
- The overall optical fiber path attenuation at 1310 nm shall be $0.35 \text{ dB/km} + 0.05 \text{ dB/splice} + 0.5 \text{ dB/connector}$.
- There are no point discontinuities in excess of 0.1 dB

Result/ Conclusion:

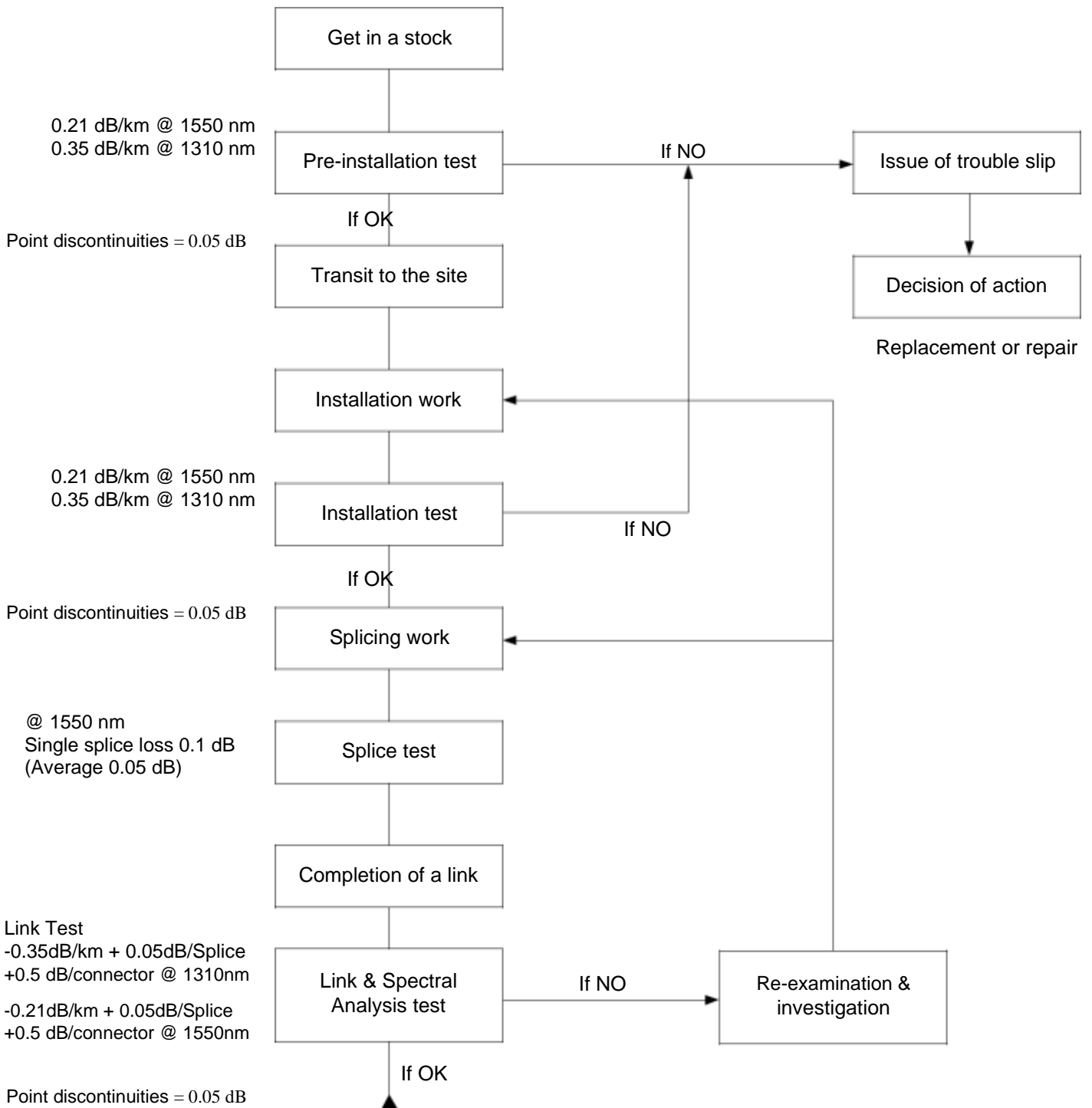
- Test result shall be filled in the respective test formats as enclosed for link commissioning test.
- Bidirectional averages splice loss by OTDR of each splice as well as for all splices in the link (including FODP also).
- Proper termination and labeling of fibers and fiber optic cables at FODP as per approved labeling plan.

Tested By
(Sign with date)

Witnessed By
(Sign with date)

Approved By
(Sign with date)

PROCEDURE CHART



PLAN FOR SAT

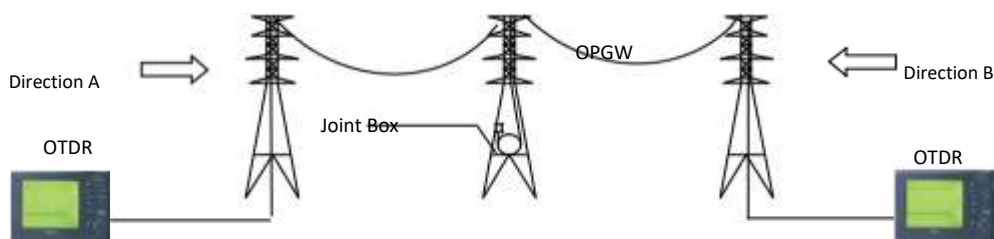
Test Title	Function/Parameter	Test Equipment	Criteria	Remarks
Installation Test (est)	The point is whether the cable shall be used for the installation or not. Appearance of drum and cable; Optical fiber continuity end-to-end and attenuation	OTDR	Attenuation: ≤0.21dB/km@1550nm ≤0.35dB/km@1310 nm Discontinuity: ≤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@1550 nm ≤0.35dB/km@1310 nm 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 of bi-directional splice loss shall be constituted at the other side. $S1=0 \leq \frac{A+B}{2} \leq 0.1dB$ Where, A is splice loss from 'A' direction. B is splice loss from 'B' direction.	OTDR	@ 1550 nm, Single splice loss 0.1 dB Average 0.05 dB.	
Commissioning 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 +---S _n)/N Where S ₁ , S ₂ ,---S _n is average splice loss at joint 1,2,----n etc.	

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



SAT-02-A (24 F) POST-INSTALLATION TEST REPORT FOR OPGW

Report No:	Sector:		
Date:	Section:	Drum No:	
	Drum Length:	Drum Length:	(As per Pre-shipment date)
	Drum Length:		(Actual at site)
Type of OTDR:	WAVELENGTH	REFRACTION INDEX	MAX ATTENUATION
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)

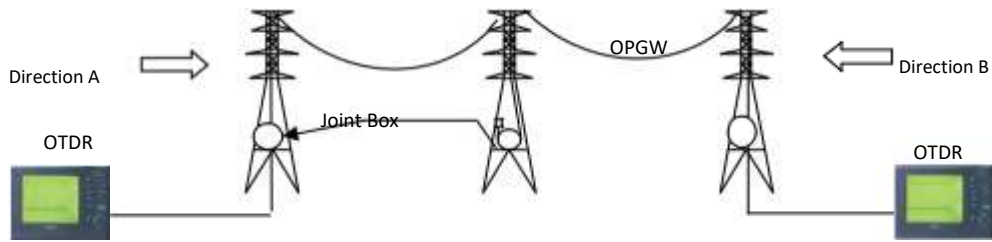
Site Acceptance Test Procedures And Plan For Optical Fibre Cables



SAT-03-B (24 F)

SPLICE LOSS TEST REPORT FOR OPGW @ 1550nm

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



Joint Box	Appearance		Fiber Routing	Sealing	Tower No.
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)

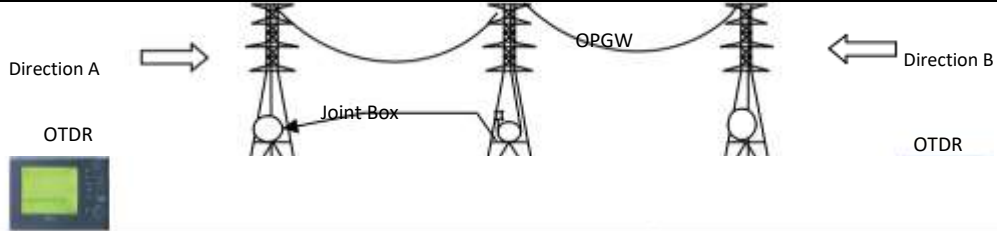
Site Acceptance Test Procedures And Plan For Optical Fibre Cables



SAT-03-A (24 F)

SPLICE LOSS TEST REPORT FOR OPGW @ 1310nm

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



Joint Box	Appearance	Fiber Routing	Sealing	Tower No.		
Tube Color	Fiber No	Fiber Color	Length (km)	SPLICE 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				
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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



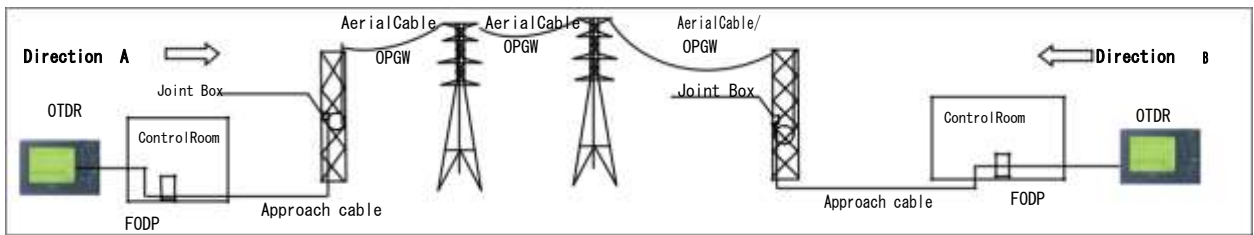
SAT-04-A (24 F)

FO CABLE END TO END TEST USING OTDR (1310 nm)

Report No: _____

Date: _____

SECTOR				
LINE LINK				
FODP to FODP				
Type of OTDR	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1310 nm	0.35 dB/km	$\sum 0.35\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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				
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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



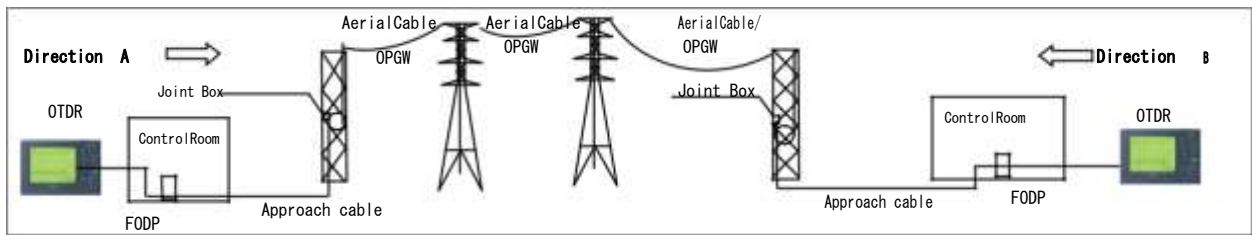
SAT-04-B (24 F)

FO CABLE END TO END TEST USING OTDR (1550 nm)

Report No: _____

Date: _____

SECTOR				
LINE LINK				
FODP to FODP				
Type of OTDR	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1550 nm	0.21 dB/km	$\sum 0.21\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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				
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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



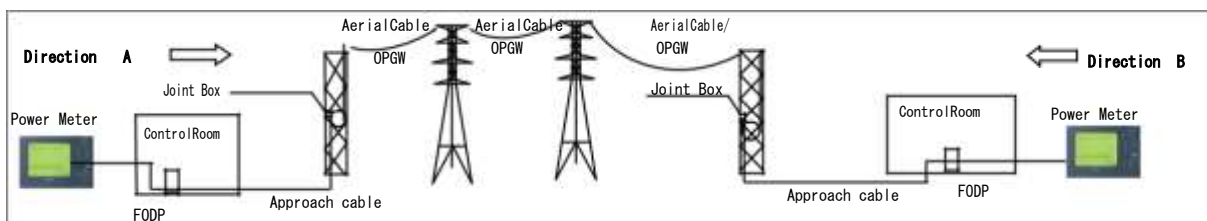
SAT-05-A (24 F)

FO CABLE END TO END TEST USING POWER METER (1550 nm)

Report No: _____

Date: _____

SECTOR	FODP to FODP			
LINE LINK				
REFERENCE POWER : Pr dBm				
A- Power measuring from A Direction dBm			P1: Pr - A dBm	
B- Power measuring from B Direction dBm			P2: Pr - B dBm	
Type of Power Meter	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1550 nm	0.21 db/km	$\sum 0.21\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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					
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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



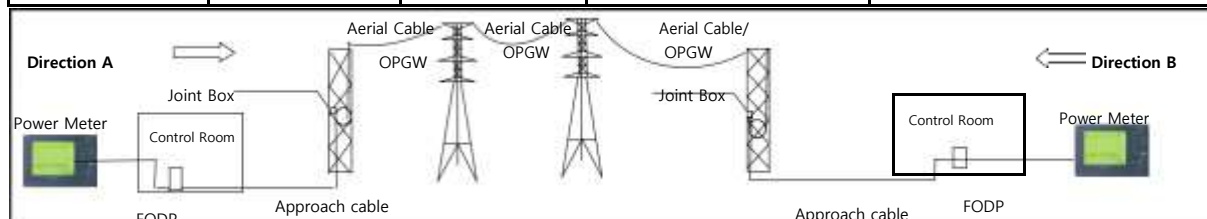
SAT-05-B (24 F)

FO CABLE END TO END TEST USING POWER METER (1310 nm)

Report No: _____

Date: _____

SECTOR	FODP TO FODP			
LINE LINK				
REFERENCE POWER : Pr dBm				
A- Power measuring from A Direction dBm			P1: Pr - A dBm	
B- Power measuring from B Direction dBm			P2: Pr - B dBm	
Type of Power Meter	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1310 nm	0.35 db/km	$\sum 0.35\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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					
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)

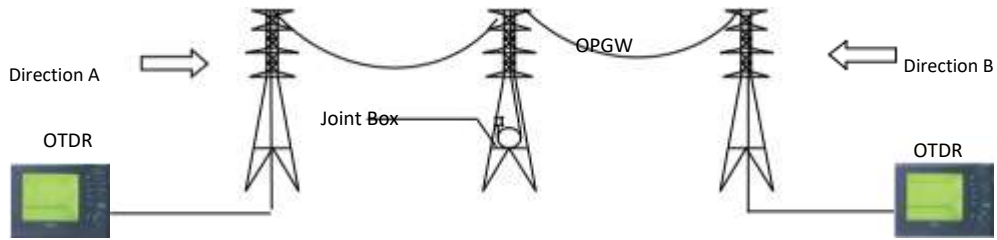
Site Acceptance Test Procedures And Plan For Optical Fibre Cables



SAT-02-A (48 F)

POST-INSTALLATION TEST REPORT FOR OPGW

Report No:	Sector:		
Date:	Section:		
	Drum No:		
	Drum Length:		(As per Pre-shipment date)
	Drum Length:		(Actual at site)
Type of OTDR:	WAVELENGTH	REFRACTION INDEX	MAX ATTENUATION
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				
BROWN	36	Aqua				
	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)

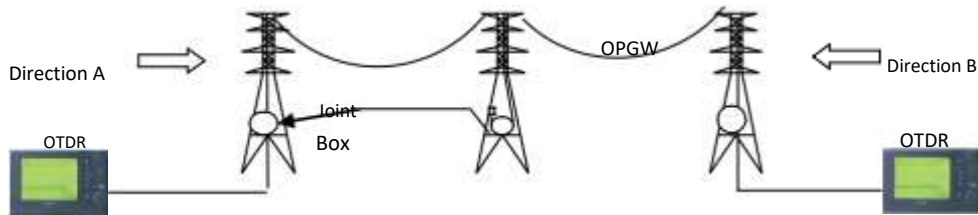
Site Acceptance Test Procedures And Plan For Optical Fibre Cables



SAT-03-B (48 F)

SPLICE LOSS TEST REPORT FOR OPGW @ 1550nm

Report No:	Sector:		
Date:	Section:		
	TOWER No:		
Type of OTDR:	WAVELENGTH	REFRACTION INDEX	Acceptance criteria
Testing Date:	1550nm	1.4675	Max.Splice Loss
			0.10dB(Individual splice)
			Average Splice loss in link
			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)	SPLICE 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)	SPlice LOSS (dB)		Actual Loss (dB)=(A+B)/2
				Direction A	Direction B	
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)

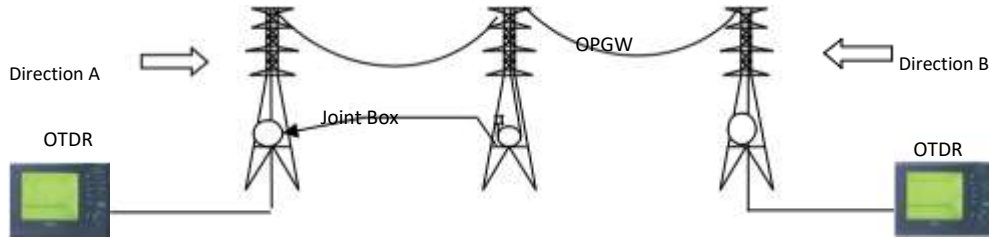
Site Acceptance Test Procedures And Plan For Optical Fibre Cables



SAT-03-A (48 F)

SPLICE LOSS TEST REPORT FOR OPGW @ 1310nm

Report No:	Sector:		
Date:	Section:		
	TOWER No:		
Type of OTDR:	WAVELENGTH	REFRACTION INDEX	Acceptance criteria
Testing Date:	1310nm	1.4670	Max.Splice Loss
			0.10dB(Individual splice)
			Average Splice loss in link
			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)	SPLICE 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)	SPlice LOSS (dB)		Actual Loss (dB)=(A+B)/2
				Direction A	Direction B	
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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



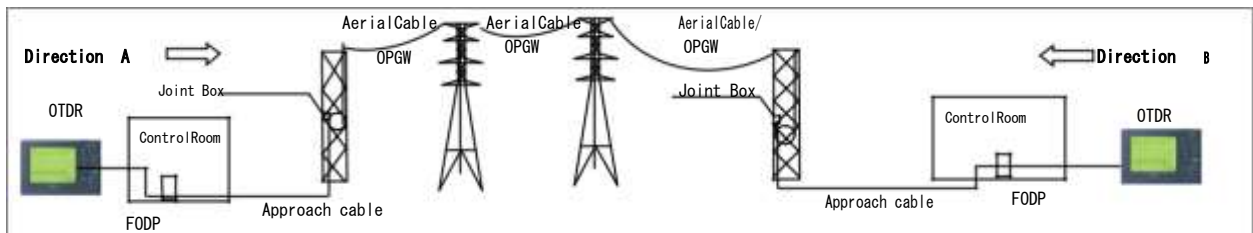
SAT-04-A (48 F)

FO CABLE END TO END TEST USING OTDR (1310 nm)

Report No: _____

Date: _____

SECTOR				
LINE LINK				
FODP to FODP				
Type of OTDR	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1310 nm	0.35 db/km	$\sum 0.35\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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)	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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



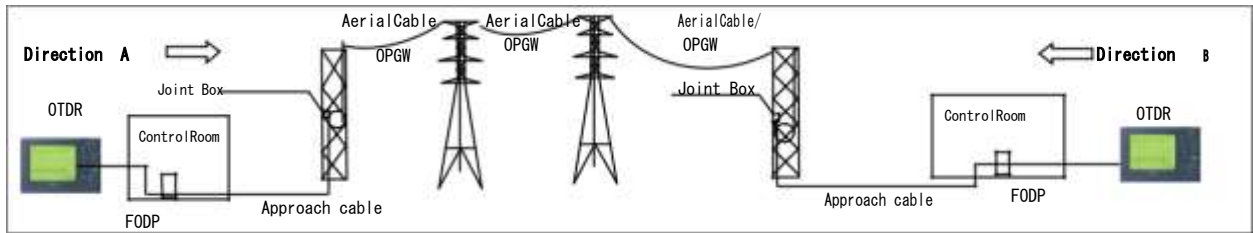
SAT-04-B (48 F)

FO CABLE END TO END TEST USING OTDR (1550 nm)

Report No: _____

Date: _____

SECTOR				
LINE LINK				
FODP to FODP				
Type of OTDR	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1550 nm	0.21 db/km	$\sum 0.21\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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				
BROWN	36	Aqua				
	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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



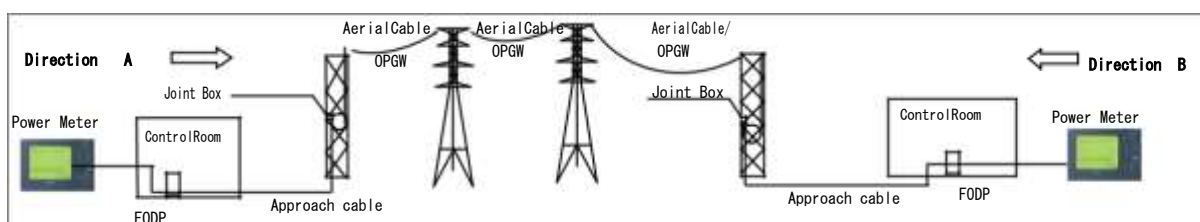
SAT-05-A (48 F)

FO CABLE END TO END TEST USING POWER METER (1550 nm)

Report No: _____

Date: _____

SECTOR	FODP to FODP			
LINE LINK				
REFERENCE POWER : Pr dBm				
A- Power measuring from A Direction dBm			P1: Pr - A dBm	
B- Power measuring from B Direction dBm			P2: Pr - B dBm	
Type of Power Meter	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1550 nm	0.21 db/km	$\sum 0.21\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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)

Site Acceptance Test Procedures And Plan For Optical Fibre Cables



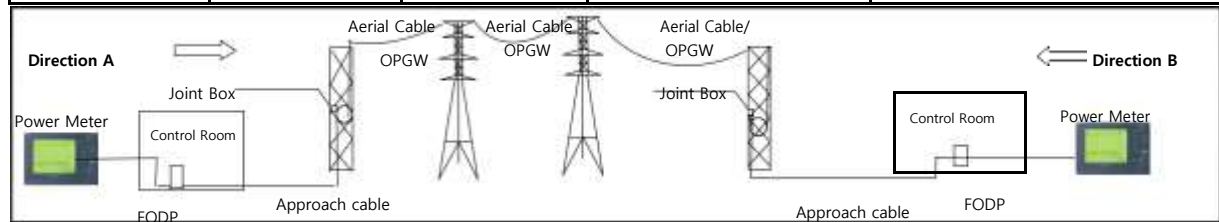
SAT-05-B (48 F)

FO CABLE END TO END TEST USING POWER METER (1310 nm)

Report No: _____

Date: _____

SECTOR	FODP TO FODP			
LINE LINK				
REFERENCE POWER : Pr dBm				
A- Power measuring from A Direction dBm			P1: Pr - A dBm	
B- Power measuring from B Direction dBm			P2: Pr - B dBm	
Type of Power Meter	Testing Date	Wave Length	Max Attenuation of Fiber	Specified Loss
		1310 nm	0.35 db/km	$\Sigma 0.35\text{dB/km} \times \text{Total FO length} + 0.05\text{dB/splice} \times \text{Total No. of splice} + 0.5\text{dB/connector} \times \text{No. of connectors}$



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)

Appendix-B

Data Requirement Sheets

Appendix-B

Data Requirement Sheets

The following sets of Data Requirement Sheets are required to be filled up by the bidders to aid in the evaluation process. The response shall be brief and to the point and shall be supported by the printed product description and other literature. The DRS duly filled and the relevant drawings shall also be submitted during the detailed engineering along with the relevant technical brochures.

DRS Form 1(a)

**DATA REQUIREMENTS SHEETS for
OVERHEAD FIBRE OPTIC CABLE**

OPTICAL GROUND WIRE (OPGW) – 24/48 Fibre:

Manufacturer: _____

Part #: _____

Configuration: _____

CABLE CONSTRUCTION			
Seq	Parameter:	As per Technical Specification	As per Bidder Offering
1.	No. of Fibres Dual Window Single-Mode:	24/48	
2.	Buffer Type:	As applicable	
3.	Buffer Tube material	As applicable	
4.	No. of Buffer Tubes:	As applicable	
5.	No. of Fibers per bufferTube:	As applicable	
6.	Expected Cable Life:	25 Year	
7. Parameters of OPGW			
(i)	UTS	In Kgf	
(ii)	Effective area	In mm ²	
(iii)	Weight	In kg/m	
(iv)	Diameter	In mm	
(v)	Modulus of elasticity	In kg/ mm ²	
(vi)	Coeff. Of linear expansion	In /°C	
(vii)	Central tube design	Al or Steel	

DRS Form 2
DATA REQUIREMENTS SHEETS for OPTICAL FIBRE
 DUAL-WINDOW SINGLE MODE (DW-SM)

OPTICAL PARAMETERS			
Seq	Parameter:	As per Technical Specification	As per Bidder offering
1.	Fiber manufacturer(s)/Type:		
2.	Attenuation Coefficient@ 1310 nm: @ 1550 nm:	≤ 0.35 dB/km ≤ 0.21 dB/km	
3.	Point discontinuity @ 1310nm: @ 1550nm:	≤ 0.05 dB ≤ 0.05 dB	
4.	Nominal Mode Field Diameter @ 1310 nm:	8.6 to 9.5 μm (± 0.6 μm)	
5.	Chromatic Dispersion Coefficient @ 1310 (1288-1339) nm: @ 1310 (1271-1360) nm: @ 1550 nm:	3.5 ps/(nmxkm) 5.3 ps/(nmxkm) 18 ps/(nmxkm)	
6.	Zero dispersion wavelength:	1300 to 1324 nm	
7.	Cutoff wavelength:	≤ 1260 nm	
Physical and Mechanical Properties			
8.	Bend Performance: (37.5 mm radius, 100 turns) @1310 nm (30 mm radius, 100 turn) @1550 nm (16mm radius, 1 turn) @ 1550nm	≤ 0.05 dB ≤ 0.05 dB ≤ 0.50 dB	
9.	Cladding Diameter (nominal ± deviation):	125.0 μm ± 1 μm	
10.	Polarisation mode dispersion coefficient	≤ 0.2 ps/km ^{1/2}	
11.	Proof test level	≥ 0.69 Gpa	

DRS Form 3

**DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)**

Manufacturer: _____

Model #: _____

Seq	Parameter:	As per Technical Specification	As per Technical Specification	As per Bidder Offering	As per Bidder Offering
		STM-4 Equipment	STM-16 Equipment	STM-4 Equipment	STM-16 Equipment
1.	SDH hierarchy level: Capacity Aggregate Bit-rate: CEPT E-1 Ports:	STM-4 620 Mbps 252 x E1	STM-16 2480 Mbps 1008 x E1		
2.	Minimum No. of protected (MSP) directions	Three	Three		
3.	No. of E1 Interfaces per card	minimum 16	minimum 16		
4.	No. of 10/100Mbps Ethernet Interfaces per card with layer 2 switching	minimum 8	minimum 8		
5.	Service Channel provision a) Voice Channel b) Data Channel	Yes Minimum 1 Minimum 1	Yes Minimum 1 Minimum 1		
6.	Cross Connection Capacity (Non Blocking & bi-directional) High Order: Low Order:	64 STM-1 64 STM-1	256 STM-1 128 STM-1		
7.	Power Supply cards of SDH equipment Common Control* Card of SDH equipment	1:1 APS or distributed power supply 1:1 APS	1:1 APS or distributed power supply 1:1 APS		

* = Common Control Cards which are essentially required for the operation of the equipment

DRS Form-4

**DATA REQUIREMENTS SHEETS for
Primary Multiplexer/Drop & Insert Multiplexer**

Manufacturer:

Model #:

Configuration:

Seq.	Parameter	As per Technical Specification	As per Bidder Offering
1.	Output Aggregate Rate	2.048 Mbps +/- 50 ppm	
2.	Interface Code	HDB3	
3.	Impedance	75 ohm unbalanced	
4.	Maximum Insertion Loss	6 dB	
5.	Power Supply card of multiplexer	1:1 APS or distributed power supply	

The detailed DRS for all equipments/items are required to be submitted along with brochures during detailed engineering.

-----End of the Appendix-----

Appendix-D
GUIDELINES FOR OPGW CABLE OFF-LINE
INSTALLATION

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. Off line installation to be carried out using power operated winch machines and pulley blocks on each tower using experienced installation team comprising of minimum 25 persons. The installation team shall have one team leader/crew in-charge along with 15 skilled and 10 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) Tools and Plant suitability
- b) Working conditions, specially following:
 - ☑ Strong winds more than 7 m/sec
 - ☑ Rain or snow
 - ☑ Foggy
 - ☑ Lightening

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.

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 in case of power line crossings 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 incharge 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.

3. Off-line Installation Process

3.1 Installation plan:

Following measures are to be taken in advance for smooth completion of the installation.

- ☑ Coordination with employer project manager
- ☑ Erection crew mobilization along with T&Ps
- ☑ Safety aspects
- ☑ Field quality aspects
- ☑ Transportation arrangement

3.2 Materials handling:

Check the material with respect to the approved documentation. All materials shall be visually examined 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 pay off 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 it is possible to bring OPGW up to the ground level for carrying out jointing work.

4. OPGW Stringing

- ☒ Hang the pulley blocks on one of the earth wire peaks for the whole section (Section is a consecutive group of towers needed to support the installation of scheduled length of OPGW Drum)
- ☒ Carry out paying of pilot wire for entire section and connect the same with OPGW on drum side and winch machine on other side suitably.
 - ☒ Pull the Pilot Wire with the use of winch machine to pay out the OPGW.
 - ☒ Maintain proper tension while pulling OPGW so as to avoid damage to fibers inside the OPGW. In no case pulling tension should exceed 15 % of UTS of OPGW.
- ☒ **Set the Come-along and Lever Block to the OPGW.** With this OPGW paying for a section gets completed.

5. OPGW sagging

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

5.1 Sagging:

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

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.

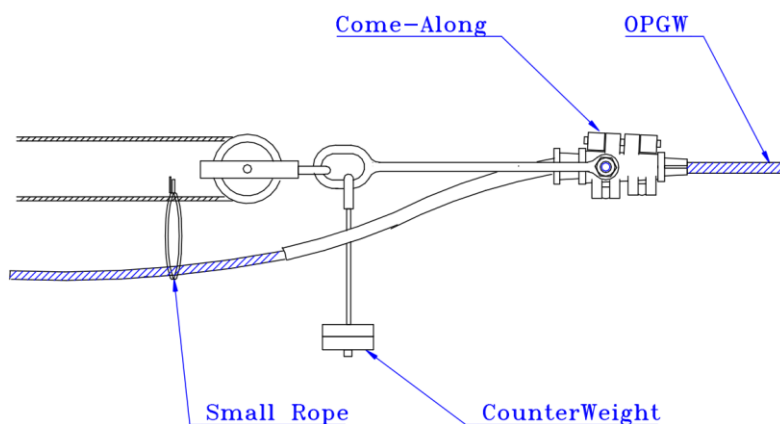
5) At the time of sagging OPGW, the sag should be within 6 inches of the theoretical value for existing temperature condition.

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) Personnel should be specifically deployed for keeping watch on sag at a different section of the line during stringing.

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

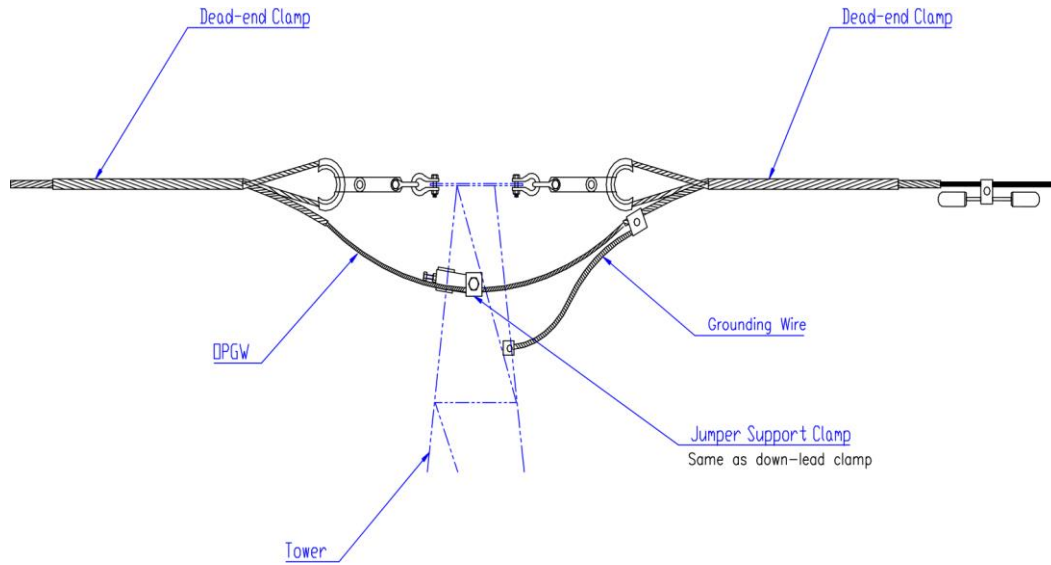


6. OPGW Clamping

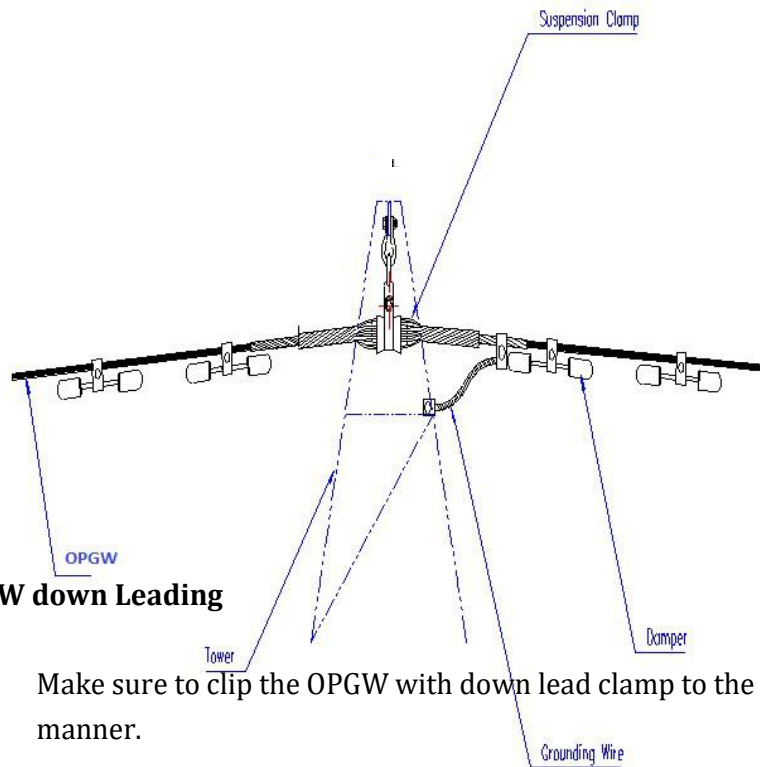
6.1 Make sure to install and tighten the bolt of clamp properly.

6.2 Tightening must be made sequentially from the support point.

TENSION TOWER



SUSPENSION TOWER

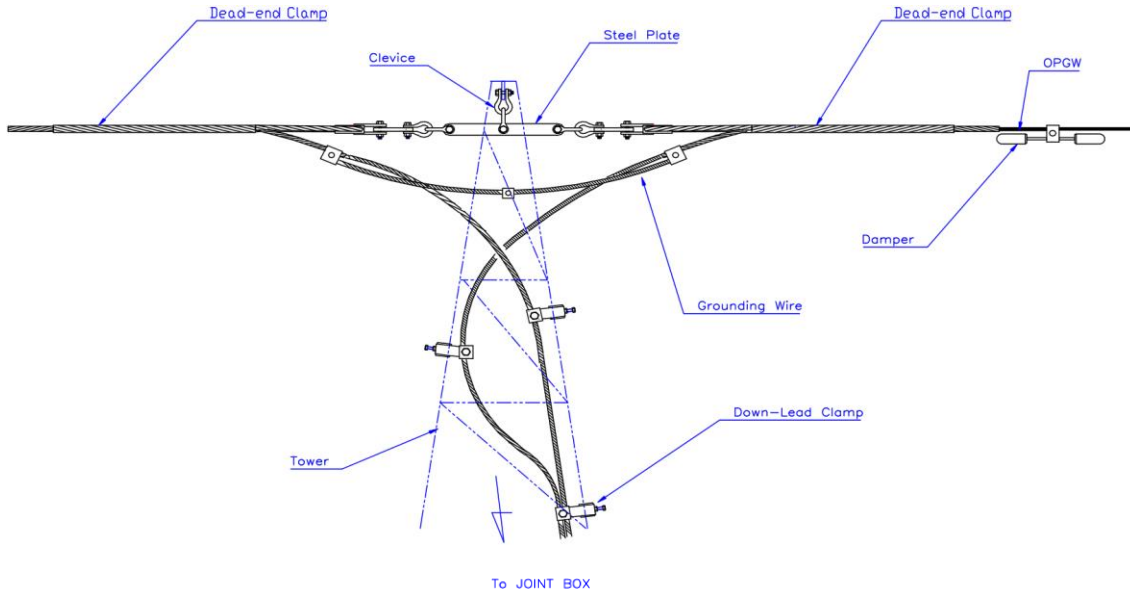


7. OPGW down Leading

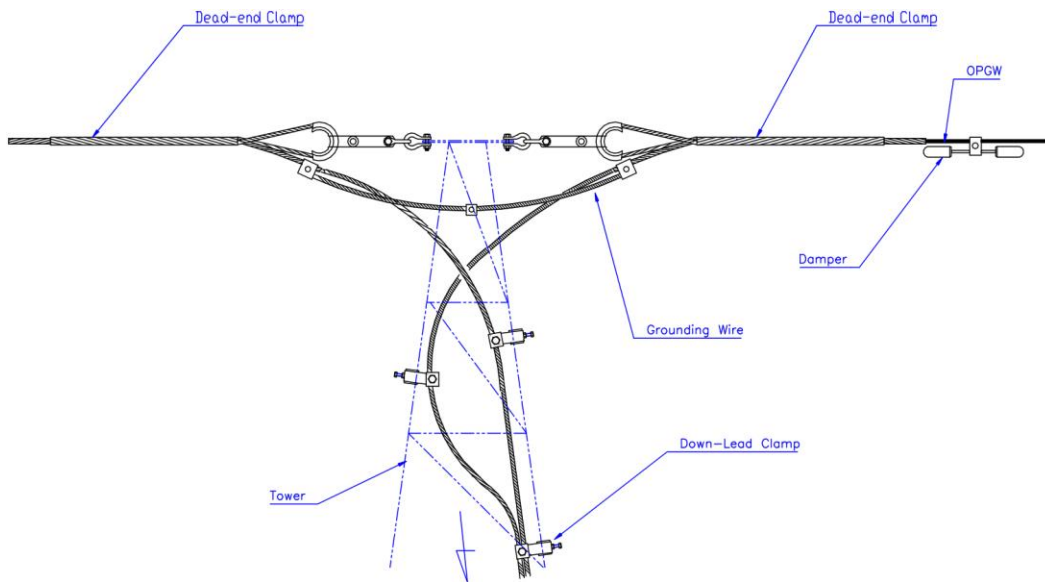
- 7.1 Make sure to clip the OPGW with down lead clamp to the tower in a careful manner.

- 7.2 Make sure to tighten the bolt of down-lead clamp properly.
- 7.3 Install the down-lead clamp at appropriate interval .

SUSPENSION TOWER FOR JOINTING TOWER



TENSION TOWER OF JOINTING TOWER



To JOINT BOX

Annexure-1
List of Tools:

S. No	Description	Specifications
01	Pulley block(Aluminum roller) 300 mm	20 Nos
02	Pulley block(Aluminum roller) 450 mm	20 Nos
03	Pulley block(Aluminum roller) 600 mm	6 Nos
04	Pilot Wire (14 mm)	1000 M
05	Pilot Wire (16 mm)	7000 M
06	Pilot Rope 12 mm Nylon Rope	600 M
07	Earthing roller	3-way roller
08	Winch machine (3 Tons)	2 Nos
09	Drum stand	2 sets
10	Reel winder	6 Nos
11	Come along clamp	8 Nos
12	Torque Wrench (1 Ton)	2 Nos
13	Running Board (20 Kg)	4 Nos
14	D-shackle	30 Nos
15	Snatch Block (1 way 2 ton)	8 Nos
16	Snatch Block (2 way 2 ton)	4 Nos
17	Chain Block (3 Ton)	4 Nos
18	Wire Connector	20 Nos
19	Braid Clamp	6 Nos
20	Wire Clamp	20 Nos
21	Swivel (3 ton)	10 Nos

Appendix - E

Guidelines for Splicing of Fibre Optic Cable

CONTENTS

1. General	3
2. Jointing of Optical Fibre	3
3. Flowchart of jointing procedure	4
4. Jointing works	
a) Preparing of materials, tools and equipment	5
b) Cutting and treatment of OPGW ends	5
c) Fixing OPGW in the pass cable	6
d) Application of thermo-shrinkable tube	7
e) Application of the pre room	8
f) Fixing of the pre room	8
g) Taking out of optical units	8
h) Splicing of optical fibers	8
i) Reinforcing of spliced parts	11
5. Treatment of surplus length of optical fibers	14
6. Measurement of splicing loss	14
7. Fixing the joint box lid	16
8. Installation of a joint box	18

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.1 For Testing :

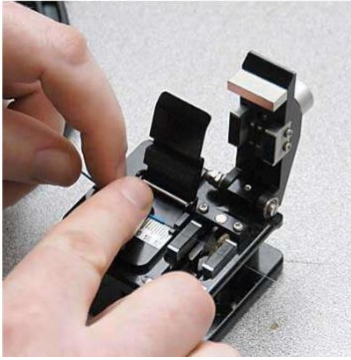
- (i) Lineman – 1
- (ii) Jointer & Tester – 1
- (iii) Unskilled labor -1

A.2 For Jointing :

- (i) Lineman- 1
- (ii) Jointer & Tester – 1
- (iii) Unskilled labor -1

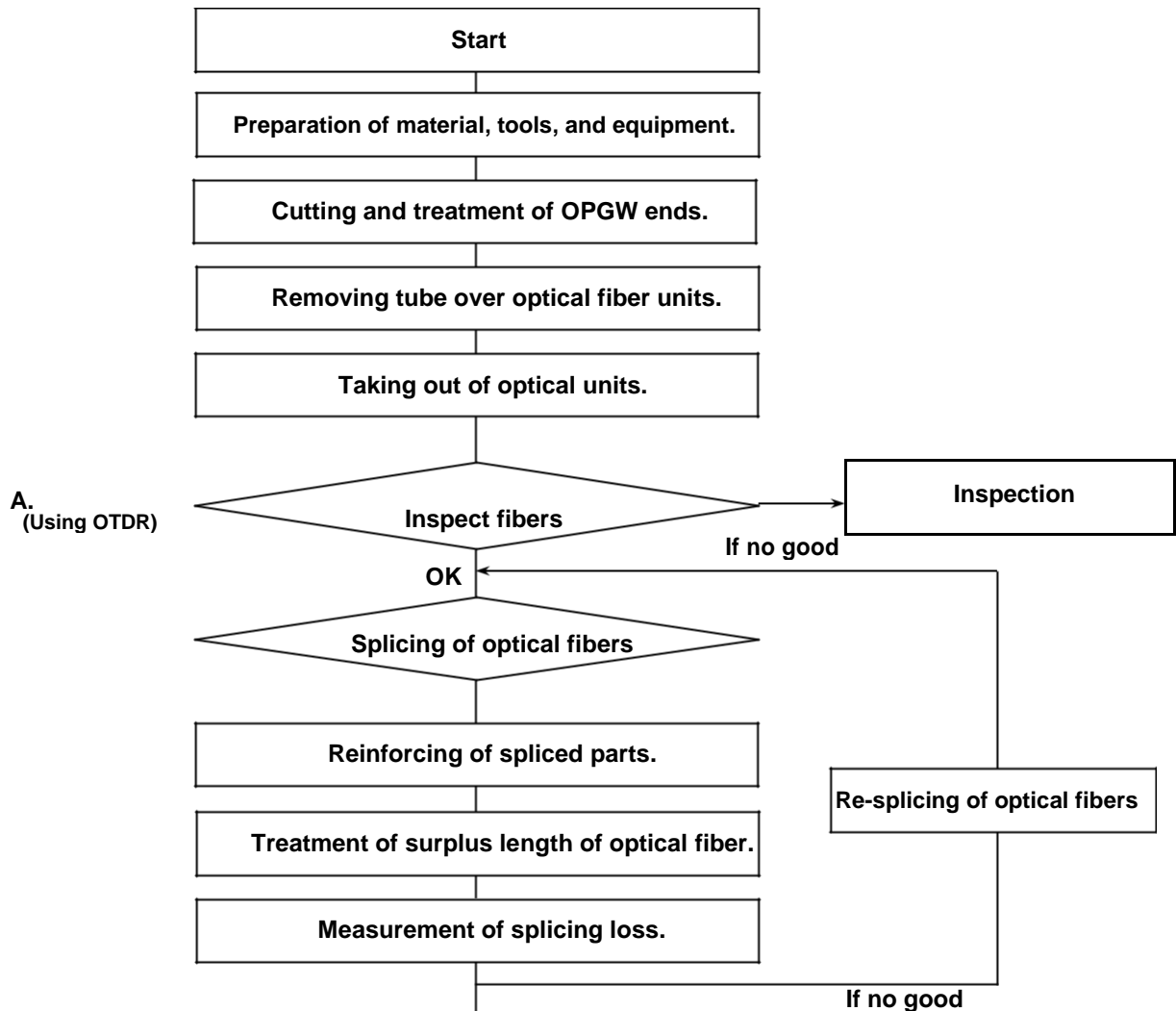
2. Jointing of optical fibre

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

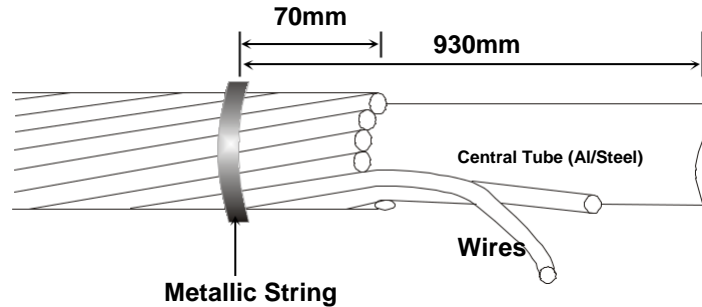
It may be ensured that all the materials, tools and equipment listed in the Table-1 are available. The Table-1 shows tentative list of required tools & material.

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).

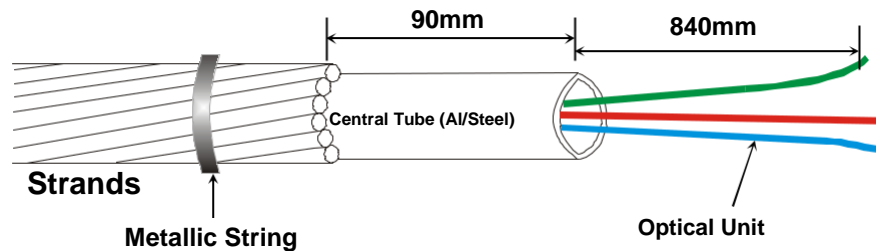


Table-1: Tools & Material

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

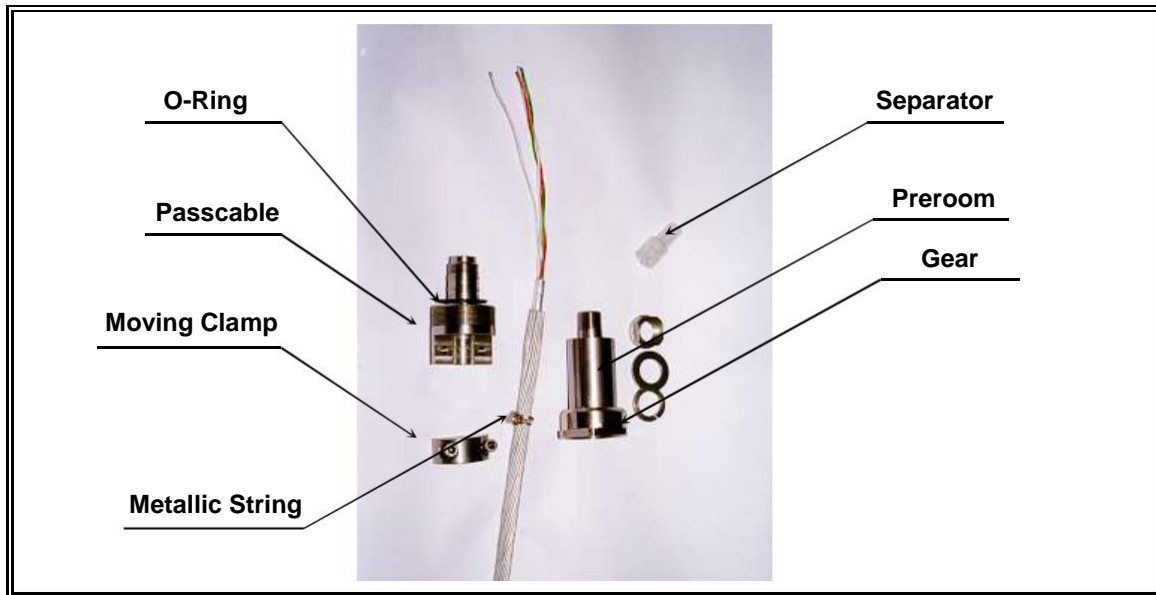


Fig. 4

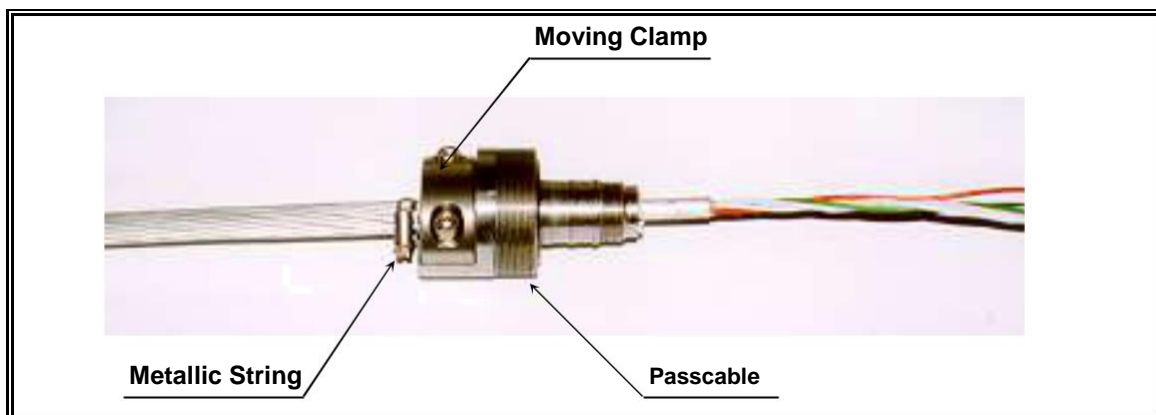


Fig. 5

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.

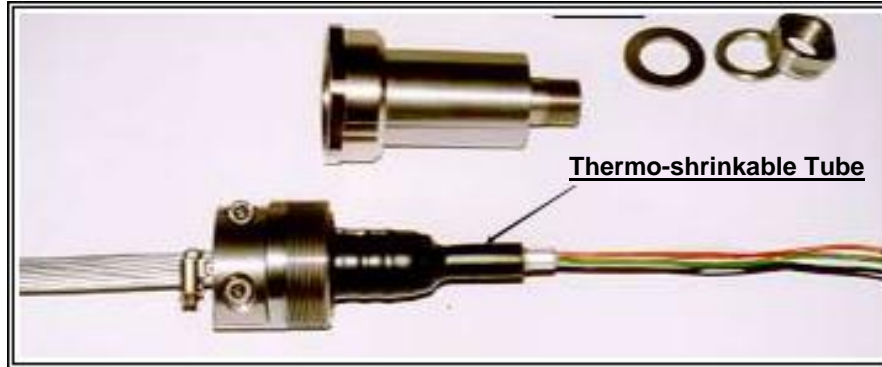


Fig. 6

e) Application of the preroom

Lock the passcable to the preroom.

Screw down the preroom to the passcable.

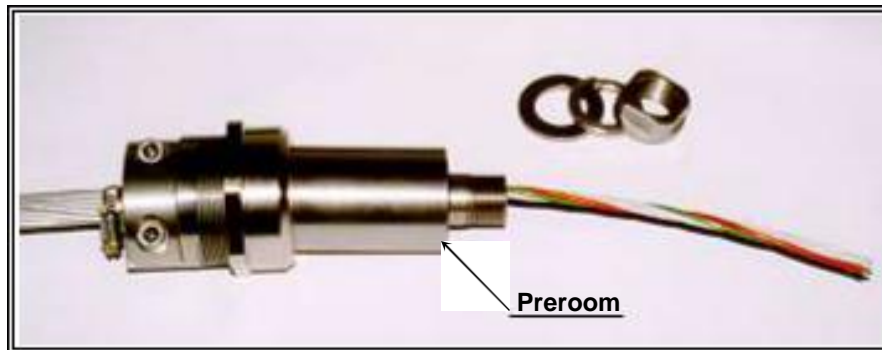


Fig. 7

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.

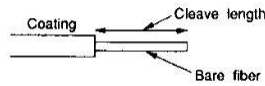
Make each optical unit into loops of about 5 to 10 cm diameter, and stick these optical unit loops at a suitable

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

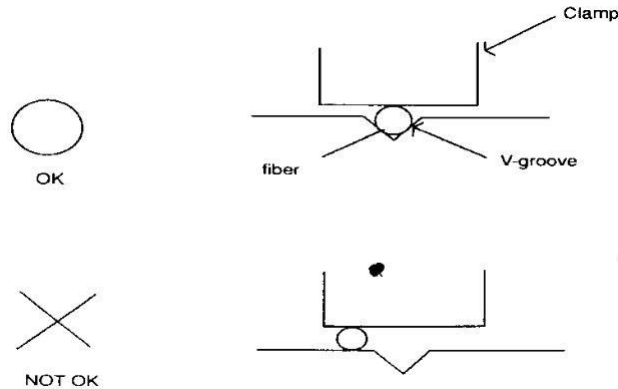
h) Splicing of optical fibers.

Cleave length

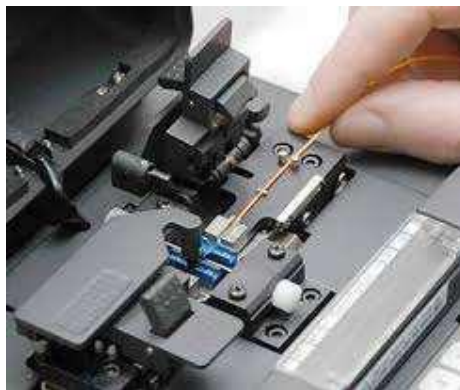
Bare fiber length should be $16\text{mm} \pm 5$ after cleaving.



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.



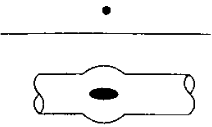

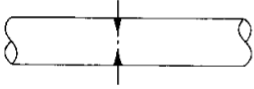
Clamp the prepared fiber exactly by pushing the clamp lever. After clamping the right and left fibers, close the hood. Make sure that the prepared fiber is not trapped by the hood, and not caught by any other part of the machine.



Evaluate the splice.

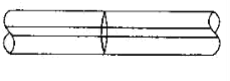
The evaluation of the splicing should be done by the splicing loss and the external appearance at the splice point.

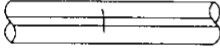


(1) Splicing having the following appearance shall be rejected.

<p>Bubble</p> 	<p>Be sure to remove this type of splice, because the splice loss can be extremely high.</p> <p>Caused by</p> <ol style="list-style-type: none"> 1. Dust on fiber end 2. Condensing 3. Bad cleaving 4. Pre-fusion time is too short. 5. Arc power is too strong.
<p>Thick black line</p> 	<p>In this case, make re-fusion by ARC Switch, and check it again. (*)</p>
<p>Black shadow</p> 	

(*) 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.

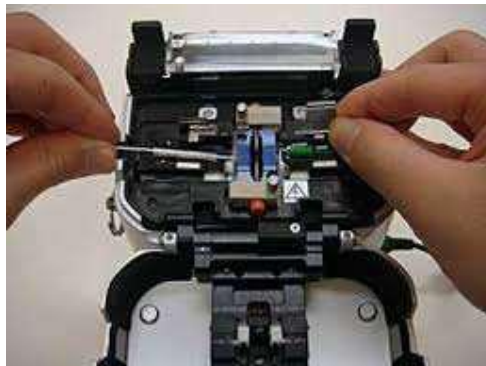
<p>White line</p> 	<p>It is all right if the estimated splice loss is within the specified value.</p> <p>This is due to optical causes upon observation, and there is no effect on the splice characteristics.</p>
--	---

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

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.

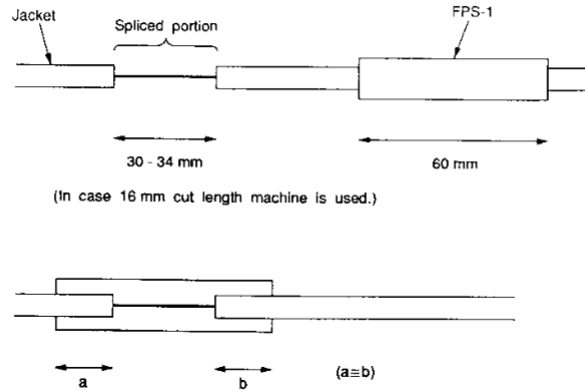


Fig. 5

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.

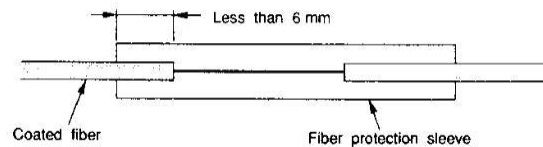
Take out the protected splice carefully while pulling the fiber slightly.

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

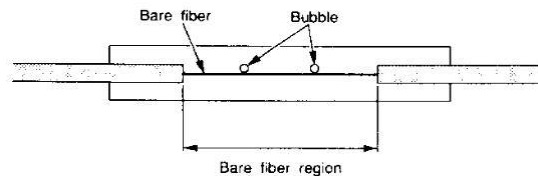
(IX) Check the appearance of the reinforced portion.

Bad protection examples

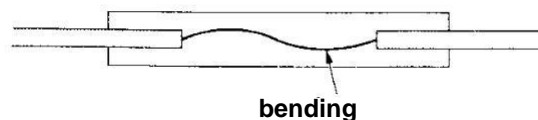
Short coverage of coated fiber.



Bubble on bare fiber.

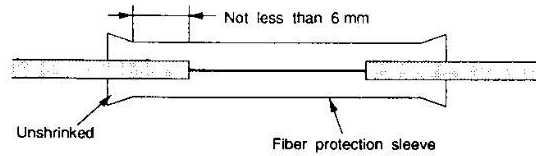


Bending bare fiber

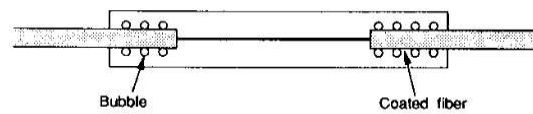


Good protection examples

Unshrink sleeve end



Bubble on coated fiber



5. Treatment of surplus length optical fibers.

Arrangement of loose tube

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

Arrangement of optical fiber

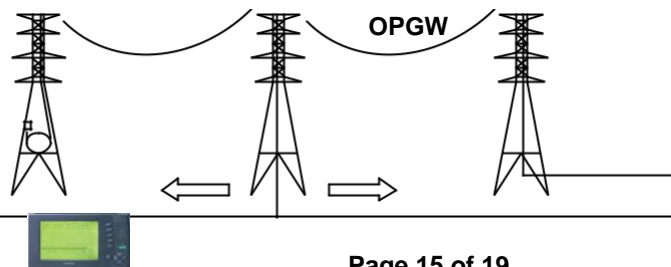
The spliced portion of optical fiber should be put in regular order in the fusion splice protector, and the extra length of optical fiber should be put on the splice tray.

The loop diameter of optical fiber is more than 50mm.

6. Measurement of splice loss: Splice loss shall be measured by

using OTDR. A. Test (Before splicing)

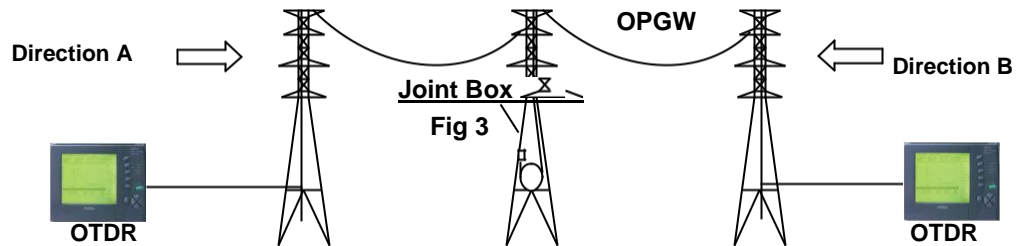
- After successfully completion of the installation, check for optical attenuation and discontinuity at every splicing points (Joint Box Locations).



- 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.



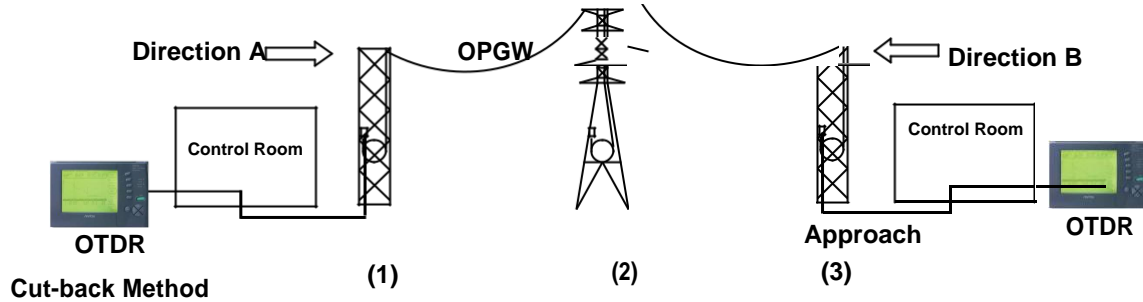
- Before closing the in-line splice enclosure, the splice test shall be executed at both sides (direction A & direction B) of jointing point.
- The average of bi-directional attenuation of fusion splices shall not be more than 0.05 dB and no single splice loss shall exceed 0.1 dB at 1550 nm.
- Appearance 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.

***No point discontinuities in excess of 0.1dB**

Every effort shall be taken to minimize the splice loss during splicing so that every splice loss in the link shall lie within 0.05 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.

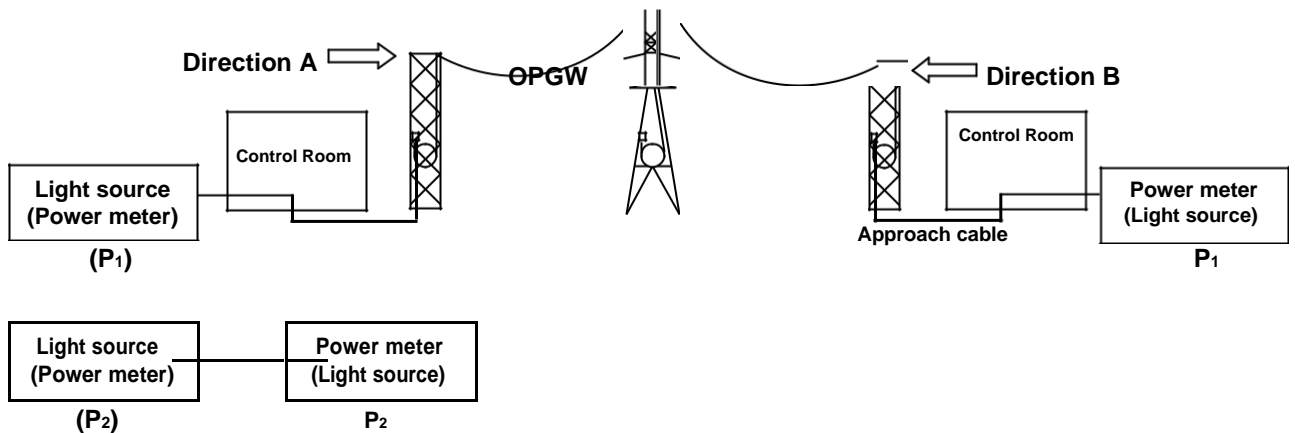
Measure the of splice loss by OTDR



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

P₁ : Power measured when light source is connected to power meter with the OPGW fibre in between.

P₂ : Power measured when light source and power meter are connected to one another with reference fibre in between.



7. 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. Lock the lid with the torque force of 10 NM.

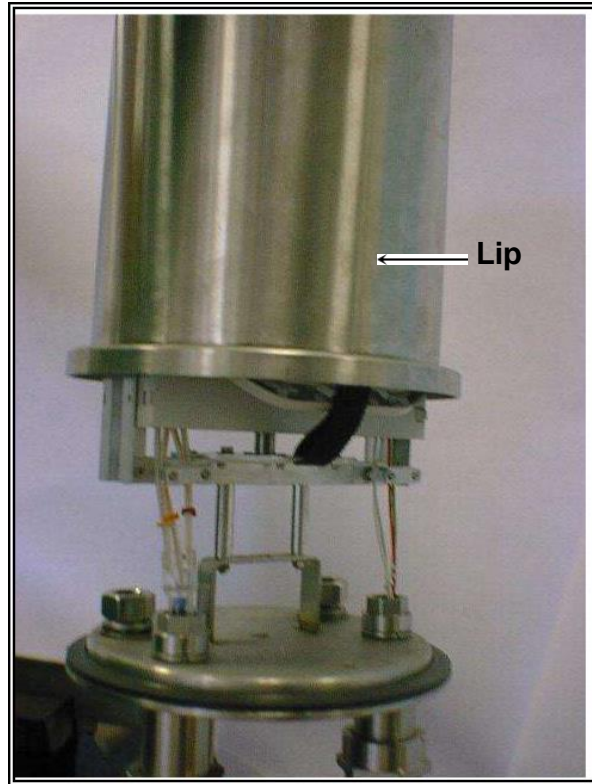
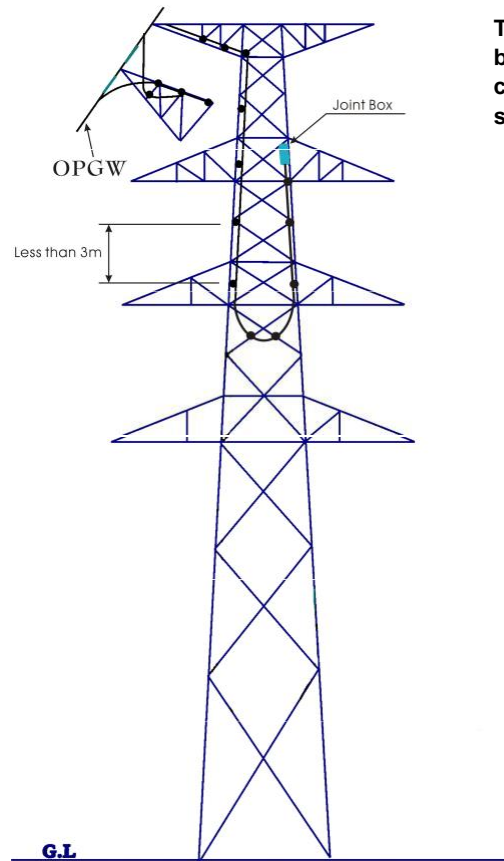


Fig. 6

8. Installation of a joint box.

SPLICING TOWER

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.

Check Point

Check the status of water proof.

Fusion splice working is protection it against dirt, grit and moisture. Lift the joint box using the eye bolt of lid.

Fixing condition of joint box on the tower.

Coiling condition of sur-plus(balanced) length of OPGW

FAT Procedure for OPGW Cable

FACTORY ACCEPTANCE TEST PROCEDURE FOR OPTICAL FIBRE (ITU-T G.652D)

**APPLICABLE
STANDARD
RELEVANT STANDARDS OF
EIA/TIA 455**

Sl. No.	Test Name	Test Procedure	Acceptance Criteria
1	Attenuation Coefficient	EIA/TIA 455-78A	≤0.35dB/km (1310nm) ≤0.21dB/km (1550nm)
2	Point Discontinuities of Attenuation	EIA/TIA 455-59	≤0.1 dB
3	Attenuation at Water Peak	EIA/TIA-455-78A	≤0.34dB/km at 1383nm
4	Chromatic Dispersion	EIA/TIA 455 -168A/169A /175A	≤18 ps/(nm·km) at 1550nm
			≤3.5 ps/(nm·km) from 1288 nm to 1339nm
			≤5.3 ps/ (nm·km) from 1271nm to 1360nm
			Zero Dispersion wavelength: 1300nm – 1324nm; Zero Dispersion slope: ≤ 0.092 ps/nm ² .km
5	Core - Clad Concentricity Error	EIA/TIA 455- 176	≤0.5 μm
6	Cladding Diameter	EIA/TIA 455-176	125 ± 0.7 μm
7	Fibre Tensile Proof Testing	EIA/TIA 455-31B	≥1.0%, 1 sec. ≥ 0.69 Gpa (100kpsi)

Note: The test report of the above tests for the fibres are to be carried out by the Fibre Manufacturer and used in the OPGW shall be shown to the inspector during OPGW FAT and shall be submitted along with the OPGW FAT reports.

FAT Procedure for OPGW Cable

**FACTORY ACCEPTANCE TEST PROCEDURE FOR OPGW
CABLES APPLICABLE STANDARD
IEEE 1138 : 2021 / IEC 60794**

Sl. No	Factory Acceptance Test on Manufactured OPGW Cable	Sampling Plan
1	Attenuation Coefficient (1310nm, 1550nm)	10% of offered OPGW drums/Lot and 100% of fibres in selected OPGW Cable drums(Minimum 2 drums).
2	Point Discontinuities of attenuation	10% of offered OPGW drums/Lot and 100% of fibres in selected OPGW Cable drums(Minimum 2 drums).
3	Visual Material verification and dimensional checks as per approved drawings	Quantity Verification: 100% of offered material.
4	Ultimate Tensile Strength	1 Sample from the selected OPGW drums/Lot.
5	Lay Length Measurements	10% of offered OPGW drums/Lot(Minimum 2 drums).

FAT Procedure for OPGW Cable

1. Attenuation Coefficient (1310nm, 1550nm)
2. Point Discontinuities of attenuation

Test Standard : IEC 60793-1-40, EIA/TIA-455-59 & EIA/T1A-455-61 and ITU-T G.652 D

Test Location :

Test Objective : To measure the optical attenuation at wavelengths 1310 nm and 1550 nm & Point discontinuities at both wavelength of 1310 nm and 1550nm.

Test Set-ups:

Prepare the sample under test as per the figure showing below the test setup. The test bench is connected with Optical Time Domain Reflectometer (OTDR) to measure the value of attenuation coefficient and Point discontinuities

Test Procedure:

1. Connect the test sample either to the instrument or to one end of end dead-zone fiber (if used).
Connect the other end of the dead-zone fiber (if used) to the instrument.
2. If the accurate locations of point defects are to be recorded, the effective group delay index of the test sample is required. If this value is not known, use FOTP-60 (Method A) to determine it.
3. Enter OTDR parameters such as source wavelength, pulse duration, length range, and signal averaging into the instrument, along with the test sample effective group index. The values of some of these parameters may be present in the instrument.
4. Adjust the instrument to display a backscatter signal from the test sample. It may be advantageous to begin with coarse vertical and horizontal scaling to maximize the length displayed. An example is given in Figure.
5. Examine the OTDR signal along the test sample for point defects. If increased resolution is needed, adjust the graphical display, if possible, to expand the section of interest to larger scale (exercising care to assure that proper reading of the true signal can still be distinguished from the noise points).
6. To determine that a point defect (rather than an attenuation non-uniformity situation) exist observe the area in question using two different pulse durations. If the shape of the loss or gain changes with the pulse duration, the anomaly is a point defect. If the shape does not change, the anomaly shall be considered to be attenuation non-uniformity to be measured by **FOTP-61**.
7. Report any point defect deviations which exceed the values specified in the Detail Specification. Describe the nature of these faults (e.g. apparent loss or gain, reflection, duration, etc.) as required by the Detail Specification.
 - 7.1 Determine the defect location, if required, by placing a cursor at the beginning (or at another point specified by the OTDR manufacturer) of a power rise or drop, this may be difficult to do at a drop. Obtain the distance coordinate via the alphanumeric display.
 - 7.2 Obtain the apparent loss or gain of the defect, if required, by the method described by the OTDR manufacturer. Some instruments required placement of a pair of cursors on each

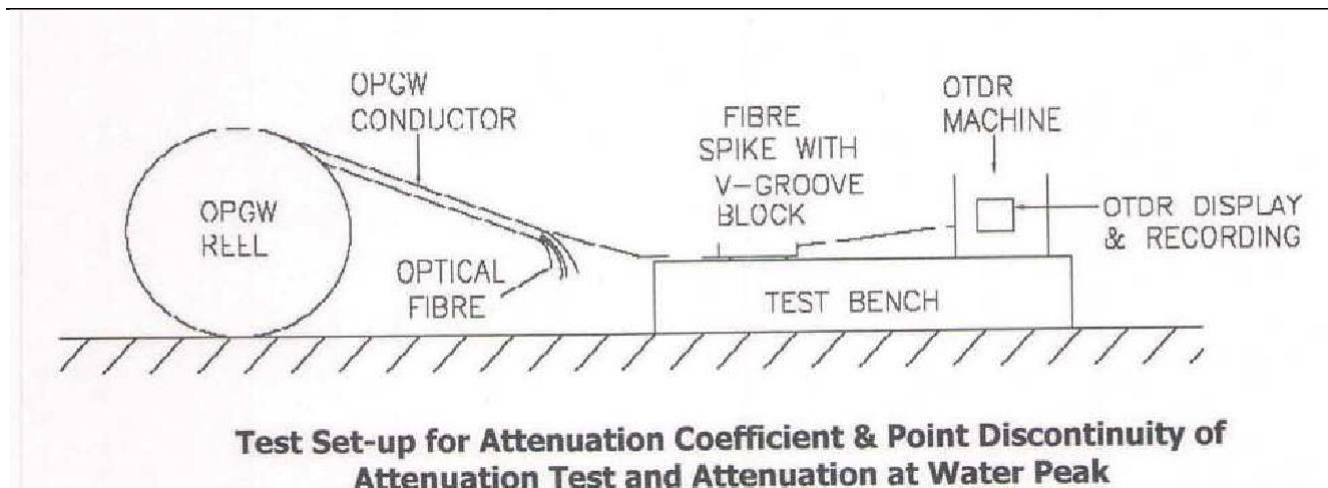
FAT Procedure for OPGW Cable

side of the defect. The two best-fit straight lines (from a two-point or least-squares fit for each) are extrapolated to the defect location. If available, the linear fit method should be chosen. The vertical separation of the lines gives the apparent loss or gain. Note any reflection peak.

7.3 When possible, repeat the test for a single launched into the test sample in the opposite direction. A more accurate loss estimate (and the elimination of apparent gain) is made by averaging

readings taken directionally at the same wavelength. This eliminates the effect of any backscatter different for the fiber sections on both side of the defect.

7.4 Repeat the test at another wavelength.



Acceptance Criteria:

For Attenuation

Wavelength	Attenuation
1310 nm	< 0.35 dB/Km
1550 nm	<0.21 dB/Km

For Point Discontinuity: Attenuation of fiber shall be uniform throughout its length such that there are no point discontinuity in excess of 0.1dB.

FAT Procedure for OPGW Cable

ATTENUATION AND POINT DISCONTINUITY

Ring Mark	Fiber id	At 1310 nm				Ring Mark	At 1550 nm				
		Optical Attenuation	Point Discontinuity	Pass or Fail	Remarks		Optical Attenuation	Point Discontinuity	Pass or Fail	Remarks	

Observations, if any:

Test Results:

The attenuation and point discontinuity measured have met/not met the acceptance criteria.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

FAT Procedure for OPGW Cable

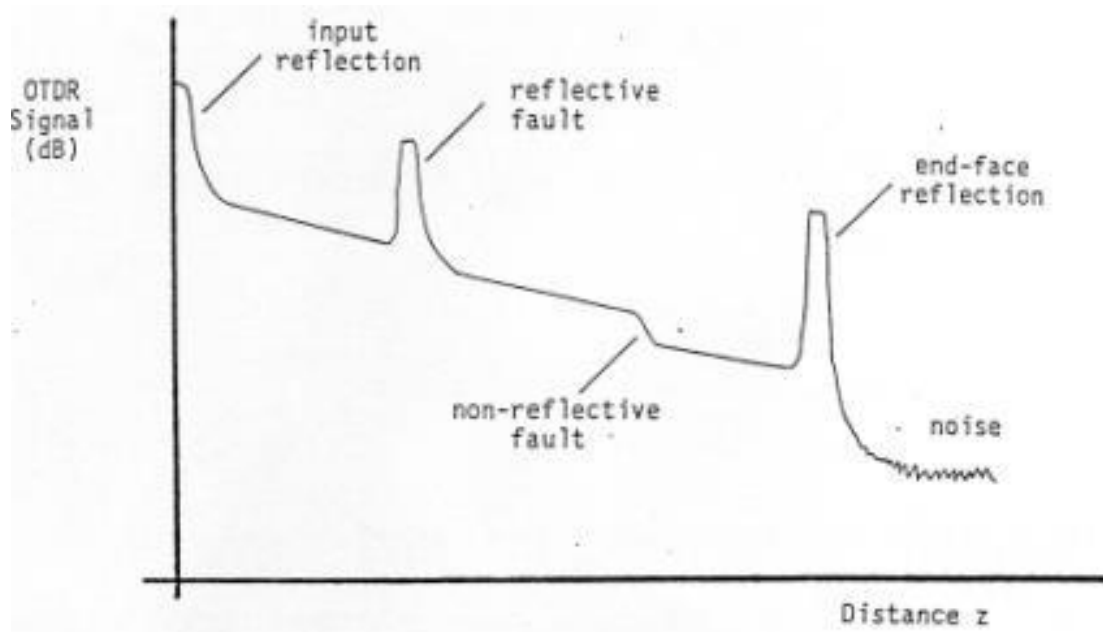


Figure 1. Schematic of an OTDR Trace. Point defects with apparent loss are shown, one reflective and one non-reflective.

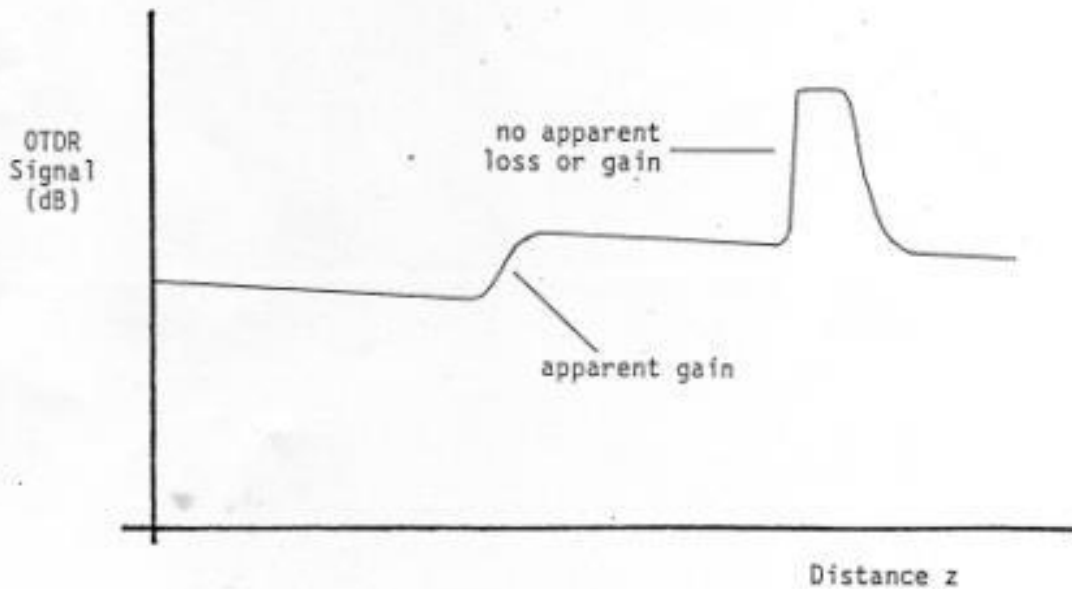


Figure 2. Schematic of an expanded OTDR trace. Two point defects are shown, one with apparent gain, and another with no apparent loss or gain.

FAT Procedure for OPGW Cable

3. VISUAL MATERIAL VERIFICATION AND DIMENSION CHECK & GENERAL TESTS

Standard: IEEE-1138:2021, IEC 61089, IEC 61232 & MFR's Technical Specification

Test Location:

Cable Type: OPGW

Reference Document Approved DRS & Drawings of OPGW.

Test Procedure:

1. Physical Verification for the 100% offered quantity of the offered reels/drums shall be carried out.
2. 100% physical verification of sealing of cable ends with end caps, check for provision of spare cable caps for each drum.
 3. 100% verification of Sealing/Pasting the drum details over the end cap with transparent tape.
4. Verification of drum details properly printed and pasted on each drum suitably as per approved document.
5. Measure the overall diameter at the outside end of the complete OPGW on 10% of offered reels/drums using Caliper/Micrometer of high accuracy.
6. The diameter recorded is the average of two readings, rounded to two decimals of millimeter, taken at right angles to each other at the same location.
7. The verification of the external aspect is made by checking appearance and finish of the completed OPGW. The sequence of the metallic wires/ACS strands and the Aluminium Tubes shall be in accordance with the approved DRS & Drawings.
8. The metallic wires are removed and the diameter of each wire is measured with a micrometer using the same method as referred at point no. 5.
9. The metallic wires are individually examined by eye. All the wires shall be free from imperfections such as fissures, roughness, grooves and inclusions.
10. The Aluminium Tubes are examined by eye. All Aluminium Tubes shall be free from corroding substances, pinholes, cracks, scratches, indentations and other surface imperfections. The inner & outer diameter of each Aluminium Tube is measured with a micrometer using the same method as referred at point no. 5.

Acceptance Criteria:

Acceptance criteria shall be as per Table Test No.5 for the offered OPGW cable.

FAT Procedure for OPGW Cable

Test Results: Visual Verification, Dimensional Checks & other requirements including physical parameters/values of complete OPGW cable, Metallic wires, ACS strands, Aluminium tube and complete optical unit measured/observed have met/not met the acceptance criteria.

Test Summary: The following tests are to be checked and verified under Visual Verification, Dimensional Check Tests and General tests on OPGW Cable.

Table Test-5

Visual Verification, Dimensional & General Tests	Acceptance Criteria
A. Aluminium Clad Steel Strands/Wires:	
1. Appearance	Circular
2. Diameter of each Strand	AS PER APPROVED Cat-1 DRS
3. Elongation at Fracture	AS PER APPROVED Cat-1 DRS
4. No. of ACS Strands	AS PER APPROVED Cat-1 DRS
5. Thickness of Al coating / % IACS	AS PER APPROVED Cat-1 DRS
6. Twist Test (for ACS Strand)	AS PER APPROVED Cat-1 DRS
7. Tensile Strength	AS PER APPROVED Cat-1 DRS
8. Resistance	AS PER APPROVED Cat-1 DRS
B. Complete OPGW Cable:	
1. Appearance	Circular
2. OPGW Cable Construction	AS PER APPROVED Cat-1 DRS
3. Overall cable diameter	AS PER APPROVED Cat-1 DRS
4. Pitch ratio (length (mm)/diameter (mm))	AS PER APPROVED Cat-1 DRS
5. Weight of OPGW Cable	AS PER APPROVED Cat-1 DRS
6. Attenuation Coefficient at 1310nm and 1550nm	AS PER APPROVED Cat-1 DRS
7. Rated Tensile Strength/UTS	AS PER APPROVED Cat-1 DRS
C. General Tests on Optical Unit:	
1. Total no. of fibres, No. of fibres per buffer tube & Color coding of optical fibres in each Tube	AS PER APPROVED Cat-1 DRS
2. No. of Buffer tubes, Color of Buffer tubes, Buffer tube Material	AS PER APPROVED Cat-1 DRS
3. Aluminium tube (Outer and Inner diameter)	AS PER APPROVED Cat-1 DRS
4. Binding Yarn/Tape (Thermal barrier)	AS PER APPROVED Cat-1 DRS
5. Filling Material	AS PER APPROVED Cat-1 DRS
6. Strengthening Member (FRP)	AS PER APPROVED Cat-1 DRS



FAT Procedure for OPGW Cable

Note: Elongation at Fracture, Thickness of Al coating; Twist Test will be carried out only once.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

FAT Procedure for OPGW Cable

4. ULTIMATE TENSILE STRENGTH TEST

Test Standard	:	IEEE 1138:2021
Test Location	:	
Cable Type	:	OPGW
Objective	:	To verify the actual (ultimate) tensile strength of the OPGW meets or exceeds the UTS of the OPGW.

Test Set-up:

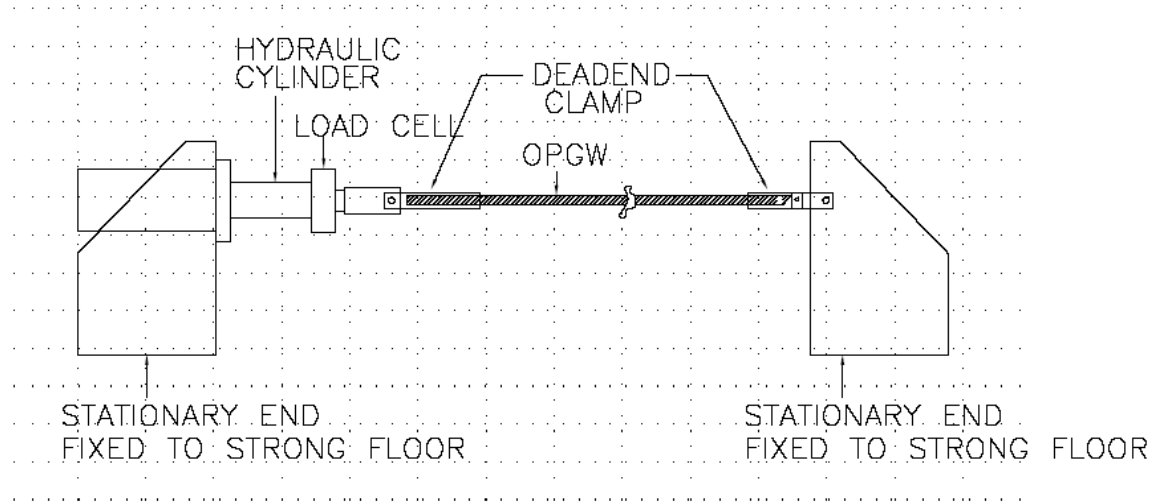
The OPGW sample shall be installed in a suitable tensile test machine. The length of the cable between the loading points of the tensile machine to be minimum 10m. Pre-tension at 2% UTS a suitable transducer

such as a load cell or dynamometer shall be used to measure the tension in the cable as per figure.

Test Procedure:

1. A tension is applied to the OPGW conductor until failure of the conductor occurs. The sample cable length is 10 mtrs minimum between the dead end clamps. Pre-tension the sample to 2% UTS of OPGW.
2. The load shall be applied at a uniform rate such that the time to reach UTS of the cable is at least 5 minutes and then hold for one(1) minute at 100% UTS. Record the continue plot/graph for applied force vs elongation/displacement/time. The observations of UTS test should meet or exceed the 100% UTS of the OPGW mentioned in DRS.
3. The ultimate tensile strength of the cable shall be defined as the maximum load the cable can withstand before failure. Individual strand failures do not necessarily constitute cable failure. However, no outer layer strands shall fail below 100% of the cable UTS. This is to ensure that the outer strands will not unravel below the maximum design loading conditions

FAT Procedure for OPGW Cable



Acceptance Criteria:

The OPGW should with stand not less than 100% of the UTS without failure of any outer strands or any component of OPGW for a period of at least one minute holdup at 100% UTS.

Observations, if any:

Test Results:

The OPGW withstood/did not with stand not less than 100% of the ultimate tensile strength without failure of any outer strands or any components of OPGW for a period of at least one minute holdup at 100% UTS.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

FAT Procedure for OPGW Cable

5. LAY LENGTH MEASUREMENT

Test Standard : TEC/GR/TX/OFC-021/01/SEP-11

Test Location :

Cable Type : OPGW

Test Set-up: See figure- 3.

Lay length measurement shall be made on a Straight length of OPGW cable while under tension load.

Test Procedure:

1. Measurements are taken at stranding operations between the closing die and capstan reel.
2. Take a piece of paper (onion skin quality) which is a length greater than three times the maximum lay length specified for the OPGW under measurement.
3. Lay the paper over the OPGW and run a lead pencil over the length of the paper to obtain strand marks on the tracing paper.
4. The lay length is determined by measuring the strand marks for N strands of the OPGW cable (N number of strands in layer).
5. Repeat for total of three measurements and average the measurements to determine lay length.

Acceptance Criteria:

Cable Type	Lay Length
OPGW	10 to 16 * OPGW outside Diameter

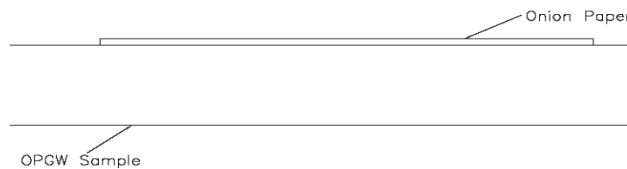


Figure 3 – TEST SET-UP for Lay Length Measurement Test

Test Results:

The lay length measurement for OPGW cable shall be between 10 to 16 times OPGW outside diameter.



FAT Procedure for OPGW Cable

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

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- Reference Documents:**
- 1) Approved DRS & Drawings in Category-I
 - 2) Applicable Standards - IEC 61284, 1997

SAMPLE SIZE AND CRITERIA FOR CONFORMITY as per IS:2486

1. SAMPLING

1.1 LOT

All fittings of same type and design manufactured under similar conditions of production, offered for acceptance. A Lot may consist of the whole or part of the quantity offered for FAT.

1.2

The number of fittings to be selected at random from the lot shall be in accordance with column I and col II of Table 1. If required {Point no. 2 Conformity) additional fittings as given in col III of Table 1 shall also be selected at random. In order to ensure the randomness of selection, random number tables shall be used (see IS 4905 : 1968).

2. CONFORMITY

Each of the fittings selected in the first stage in accordance with column I and column II of Table 1 shall be subjected to all acceptance tests. A fitting shall be declared defective if it fails in any of these tests. The lot shall be, considered as conforming to the requirements of acceptance tests if the number of defectives, in the sample is less than or equal to corresponding acceptance number (see column IV). The lot shall be rejected if the number of defectives is equal to or greater than first rejection, 'R1' (see column V). If the number of defective fittings are in between 'A' and 'R1', a second sample of same size (see column III) shall be selected from the lot at random and subjected to the tests. If the number of defectives in the two samples combined is less than 'R2' (see column VI), the lot shall be considered as conforming to the requirements of acceptance tests, otherwise the lot shall be rejected.

Table 1: Sampling Procedure (IS 2486)

S.No.	Lot Size	Sample Size		A	R1	R2
		I – Stage	II - Stage			
	(I)	(II)	(III)	(IV)	(V)	(VI)
1.	101 to 500	5	5	0	2	2
2.	501 to 1000	8	8	0	2	2
3.	1001 to 3000	13	13	0	2	2
4.	3001 to 10000	20	20	0	3	4
5.	10001 to 35000	32	32	1	4	5
6.	35001 and above	50	50	2	5	7

**VISUAL MATERIAL VERIFICATION AND DIMENSIONAL CHECKS
FOR HARDWARE FITTINGS OF OPGW CABLE
(Suspension Assembly, All types of Tension Assemblies & Downlead Assembly)**

Document : IEC 61284:1997, Approved DRS & Drawings

Manufacturer :

Test Location :

Test Sample : 100% of Quantity

- Suspension Assembly
- All types of Tension Assemblies- Dead End; Pass through; Splicing Location & Tension Assembly for Suspension Tower
- Parallel Groove clamp & Earth Lead Assembly/Grounding wire
- Vibration Dampers
- Downlead clamp Assembly

Objective : This test determines the factory acceptance of the batch quantity of fittings that they confirm to the relevant drawings and where appropriate/ have a sufficient galvanized coating.

Test Procedure:

1. Physical/Visual Verification for the part no. of all the materials as per approved DRS& drawings.
2. It shall be verified that the sample are in accordance with their relevant drawings, particularly as regards any dimensions to which special tolerance apply and indicated in the corresponding approved DRS/Drawings.
3. The following tolerance shall be allowed/on all dimensions to which special tolerance do not apply.

Appearance: To check all and ascertain to be appropriate as per DRS & Drawings.

Dimensions: (A) Forgings:

- i) Dimensions up to and including 30mm ± 1.5 mm.
- ii) Dimensions greater than 30 mm..... $\pm 5\%$ upto max. of ± 5 mm.

(B) Helical Fittings:

- i) Dimensions up to and including 30mm ± 1.5 mm.
- ii) Dimensions greater than 30 mm..... $\pm 5\%$ upto max. of ± 5 mm.

Galvanizing: i) Galvanized coatings shall be tested in accordance with as appropriate.

ii) All measurements shall be made after galvanizing where galvanizing is the normal finish. Galvanized coatings shall be tested and galvanized coating shall be minimum 85 μ m.

Acceptance Criteria:

Fittings shall be accordance with their relevant drawings within the tolerance Specified.
Galvanized coatings on general articles shall be minimum thickness of 85 μ m.

Observation, if any;

Test Results: The Hardware fittings, as tested met / did not meet the requirement as per approved DRS & Drawings.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

Assemble the Suspension Clamp on the OPGW using the Installation Instructions as a strict guide to ensure that the assembly is correctly fitted and is the same that will be carried out during actual installation.

Reduce the load applied to the OPGW to zero and detach the OPGW from the fixed end of the tension machine. Attach the Clamp to the fixed extremity mounting and secure with the approved bolt and nut, which must run down finger tight only to clear the split pin hole.

Test procedure:

1. A graph of Load (kN) and position(mm) shall be plotted.
2. The OPGW is loaded to 1 KN and the position scale on the recorder 'Zeroed'. The test rig is then tensioned to 2.5 KN and the relative positions of the Reinforcement rods, Armour rods and Suspension clamp were marked. The relative positions of the helical armour rods and associated reinforcing rods at each end were marked and also 2mm relative position between clamp body and armour rods was marked on one side.
3. The load is increased to the minimum slip window of 12 KN(Check for Minimum Slip Strength value for fitting in DRS) at a rate of 3 KN per minute and held constant for 60 seconds. At the end of this one minute, the relative displacement between clamp body and the armour rods will be observed. If the slippage is 2mm or above, the test shall be terminated . Otherwise at the end of the position of the clamp body and 2mm relative position between clamp body and armour rods are marked on the other side.
4. After 1 minute, pause, the load is further increased at a rate of 3 KN per minute until either the relative position between clamp body and armour rods reaches more than 2mm or the load reaches the maximum slip load of 17 KN(Check for Maximum Slip Strength value for fitting in DRS). Visual examination of all paint marks is recorded, and a measurement of any displacement recorded in the table of results.

On completion of the test, a graph of 'Load' (KN) against 'Position' (mm) shall be produced. This graph shall forms the test record and will be examined to ascertain the point that slip has occurred.

Acceptance Criteria:

The Suspension Clamp has passed the Slip Test if the following conditions are met:

1. No slippage* shall occur at or below the specified slip load of 12 KN(check Minimum Slip Strength value for fitting in DRS).
2. Slippage shall occur between the specified min. and maximum slip load of 12-17 KN (or as per Minimum & Maximum Slip strength value in DRS).
3. There shall be no slippage of the reinforcing rods over the cable, and no slippage of the armour rods over the reinforcing rods.

4. The relative movement (i.e. more than 2 mm between armour rods and clamp body) between minimum slip strength (as per DRS), 12 KN and maximum slip strength (as per DRS), 17 KN shall be considered as slip.

5. The armour rods shall not be displaced from their original lay or damaged ** .

*Definition of no slippage as defined in IEC 61284: 1997. Any relative movement less than 2mm is accepted. The possible couplings or elongations produced by the cable as the result of the test itself are not regarded as slippage.

** Definition of no damage in accordance with convention expressed in IEC 61284: 1997 no damage, other than surface flattening of the strands shall occur; any result outside these parameters shall constitute a failure.

For each sample tested there shall be Graphical records of Slip Load against Position Displacement Identification List of all components against relevant drawings Measurement of OPGW diameter.

Observation, if any;

Test Results: The Suspension Assembly, as tested, met / did not meet the requirement specified in technical specification.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

Mechanical Strength Test for Suspension Assembly

Manufacturer :

Test Location :

Test Standard : MFR's Technical Specification, IEC61284:1997

Test Sample : OPGW Cable
Suspension Assembly } As per approved DRS/Drawings

Objective: To determine the mechanical strength performance of the suspension assembly fitting for the OPGW.

Test Set-up:

The Items to be tested are installed into the hydraulic test machine and secured. The components being tested will be labeled to be exactly the same as the corresponding drawing in order to make identification clear.

The general arrangement for the Test Set-up is shown in Figure 1.

The Armour Rods and Protection Splice are assembled on to the approved OPGW using the Installation instructions as a strict guide to ensure that the assembly is correctly fitted and is the same that will be carried out during actual installation. The assembly shall be mounted in the hydraulic tensile test machine, with the Suspension Assembly suspended by the associated Clevis Eye in their normal working position. Suitable facilities to avoid bird-caging (twist) of the OPGW when tensioned shall also be provided.

Note: Care shall be taken to ensure that during the installation of the test fitting that the OPGW strands remain tight.

Test Procedure:

Part 1:

1. The suspension assembly shall be increased at a constant rate up to a load equal to 50% of the specified Minimum Failure Load as per DRS (MFL) increased and held for one minute for the test rig to stabilize.
2. The load shall then be increased at a steady rate 67% of minimum failure load and held for 5 minutes. The angle between the cable, the suspension assembly and the horizontal shall not exceed 16°.
3. This load shall then be removed in a controlled manner and the protection splice disassembled.

4. Examination of all the components shall be made and any evidence of visual deformation shall be documented.

Part 2:

1. The suspension clamp shall then be placed in the testing machine. The tensile load shall gradually be increased up to 50% of the specified minimum failure load of the suspension assembly and held for one minute for the Test Rig to stabilize.
2. The load shall be further increased at a steady rate until the specified minimum failure load is reached and held for one minute.
3. The applied load shall then be increased until the failing load is reached and value shall be documented.

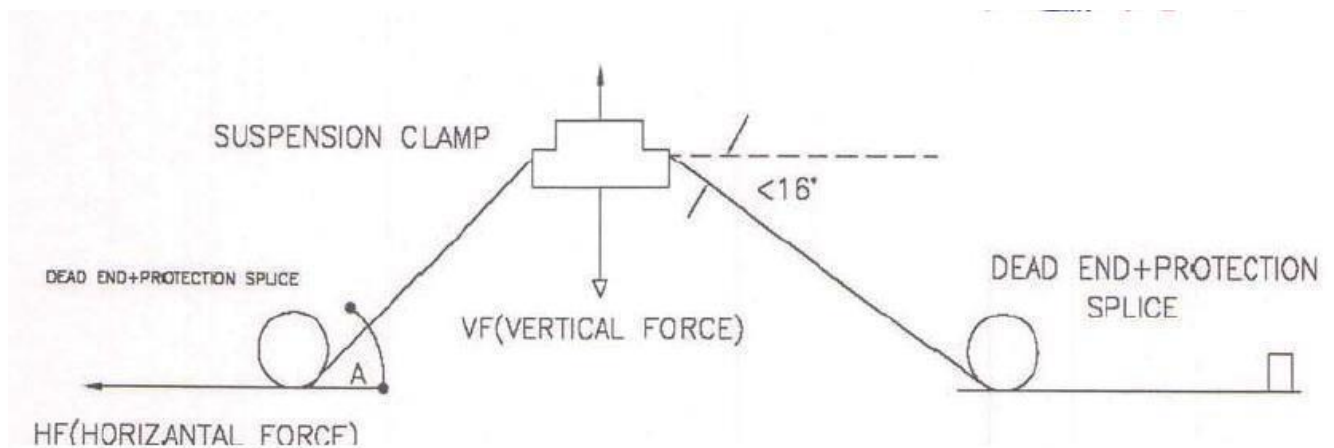


Figure 1: Test set up for mechanical strength test for suspension assembly

Acceptance Criteria:

The Suspension assembly has passed the Test if the following conditions are met:

- i) No evidence of Binding of the Nuts or Deformation of components at the end of Part 1 of test.
- ii) No evidence of Fracture up to 1 minute at Minimum Failure Load during Part 2 of the Test.
- iii) Any result outside these parameters shall constitute a failure.

Suspension clamp Shackle: Ultimate Strength (minimum) of fitting: as per approved DRS.

For each sample tested there shall be:-

Part 1:

Identification list of all components against relevant drawings and confirmation that the components meet the declared dimensions. Record of physical examination, specifically commenting on evidence of Binding of the Nuts, and deformation of the Suspension assembly components.



Part 2:

Confirmation record that the Clamp sustained a MFL load for one minute without fracture.
Recorded value of breaking load.

Identification of components against relevant drawing numbers:

Drawing Number	Issue	Description

Table of Suspension Assembly examination:

Sample Number	Part 1		Part 2	
	Possible to disassemble Assbly (Yes/No)	Comment on condition of components	Ass. sustained MFL for 1 minute (Yes/No)	Breaking Load (KN)
1				
2				
3				
4				
5				

Observations, if any:

Test Results: The Suspension Assembly, as tested, met/did not meet the requirement specified in the technical specification.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)



MECHANICAL STRENGTH TEST ON EACH COMPONENT OF SUSPENSION ASSEMBLY
&
MECHANICAL STRENGTH TEST ON ALL TYPES OF TENSION ASSEMBLIES i.e. Dead End or Pass through or Splicing Location or Tension fitting for Suspension Tower (Yoke plate)

Manufacturer :

Test Location :

Test Standard : IEC 61284: 1997

Test Sample : OPGW

Tension Assembly
or each component of Suspension Assembly



As per approved DRS
& Drawings

Objective: To assess the Mechanical strength (Failing Load) test on each component of All types of Tension Assemblies.

TEST SET-UP

The Tension assembly is correctly fitted and is the same that will be carried out during installation.

TEST PROCEDURE

Each component of the Tension/Suspension assembly shall be fixed with suitable fixing arrangement with-the test machine. The load shall be increased steadily up to their specified tensile strength and held for one minute. The load shall then be increased up to the breaking of the component.

Acceptance Criteria:

1. No evidence of the fracture after one minute at nominated rated load.
2. The Mechanical strength (failing load) shall not be less than the specified rated requirement of load for all components.
3. Any result outside these parameters shall constitute a failure.

In case of Tension fitting on Suspension Tower(Yoke Plate Type), the mechanical strength test is performed upto Failure Load/ breaking strength of Yoke Plate (as per value mentioned in DRS for Yoke Plate) during this Test. Additionally, the breaking strength of Yoke Plate should be more than the UTS of OPGW. Any evidence of fracture or deformation at the end of one minute at the minimum failure load/ breaking strength of



Yoke Plate shall be considered as failure. Any result outside these parameters shall also constitute a failure.

Observation, if any;

Test Results: Each component of tension assembly, as tested, met/did not meet the requirement specified in technical specification.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

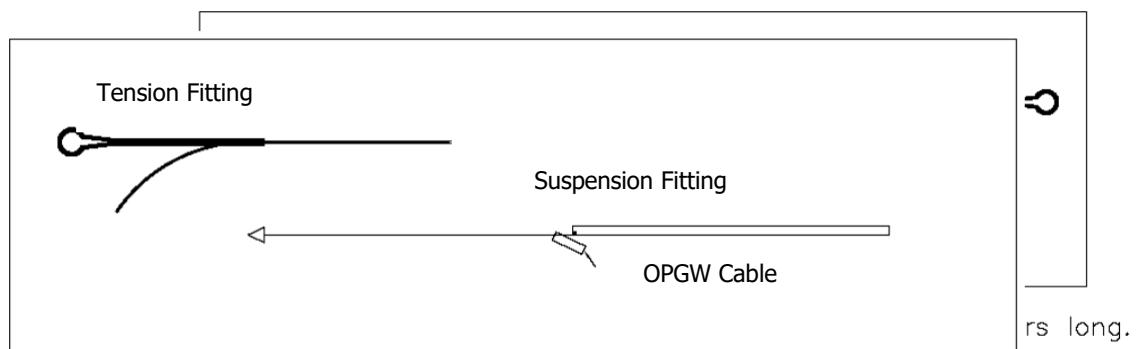
CLAMP SLIP STRENGTH TEST ON ALL TYPES OF TENSION ASSEMBLIES

**i.e. Dead End or Pass through or Splicing Location or
Tension fitting for Suspension Tower (Yoke plate)**

Manufacturer :
Test location :
Test Standard : IEC 61284-1997
Test Sample OPGW Cable }
 Tension Assembly } As per approved DRS/Drawings

Objective : To determine the clamp slip strength for the various types of tension assemblies proposed for the OPGW cable.

Test Set-up: The general arrangement for the Slip Strength Test of the Tension Assemblies is shown below



The Tension Assembly and associated components shall be identified against the relevant drawing and be uniquely marked for any future identification

The set-up for the slip strength for tension clamp is shown in Figure-2.

The tension assembly shall be fitted on a more than 8 m length of fibre optic cable on both ends. The assembly shall be mounted on a tensile machine and anchored in a manner similar to the arrangement to be used in service.

The Reinforcing Rods and Tension Assembly fitting is assembled on the OPGW using the Installation Instruction as a strict guide to ensure that the assembly is correctly fitted and is the same that will be carried out during actual installation. The assembly shall be mounted in the hydraulic tensile test machine, with suitable facilities to avoid bird caging (twist) of the OPGW when tensioned.

Note: Care shall be taken to ensure that during the installation of the test fittings the OPGW strands remain tight.

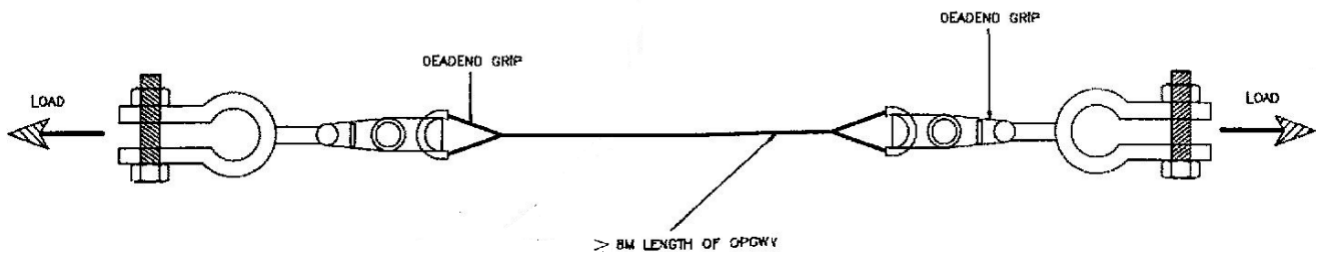


Figure 2: Schematic of slip strength test for tension assembly

Test Procedure:

A tension load shall gradually be applied up to 20% of the Ultimate Tensile Strength of the OPGW Cable.

1. Displacement transducers shall be installed to measure the relative movement between the OPGW relative to the reinforcing rods and the tension Dead-End relative to the reinforcing rods. In addition, suitable marking shall be made on the OPGW and Dead-End to confirm grip.
2. The load shall gradually be increased at a rate of 6 KN per minute until it reaches 50% of the specified UTS and the Position scale of the recorder is 'zeroed'.
3. The load shall gradually be increased at a rate of 6 KN per minute until it reaches 95% of the specified UTS and maintained for one minute.
4. After 1 minute pause, the load shall slowly be released to zero and the makings examined and measured for any relative movement.
5. On completion of the test a graph of Load (KN) against Position' (mm) shall be produced for each of the two measurements. This graph shall forms the test record and will be examined to ascertain the degree of any movement.

Acceptance Criteria:

The Tension Clamp has passed the Test if the following conditions are met:

No movement* shall, occur between the OPGW and the Reinforcing Rods, or between the Reinforcing Rods and the Tension assembly.

No failure or damage or disturbance to the lay of the Tension Clamp, Reinforcing Rods or OPGW.

*Definition of no movement as defined in IEC 61284: Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the OPGW as a result of the test itself are not regarded as slippage.

Any result outside these parameters shall constitute a failure.



Test Results:

The Tension Assembly, as-tested, met / did not meet the requirement specified in technical specification.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

STRUCTURE MOUNTING CLAMP STRENGTH TEST

(For Downlead Assembly)

- Lab Location** :
- Manufacturer** :
- Test Standard** : Technical Specification
- Test Sample** : OPGW Cable }
Down lead clamp } As per approved DRS & Drawings

Objective: To demonstrate the ability of the down lead bracket assembly to withstand a specified load.

Test Set-up:

The clamp and mounting assembly shall be assembled on a vertical 200mm x 200mm angle and a short length of fiber optic cable installed as shown in Figure 3.

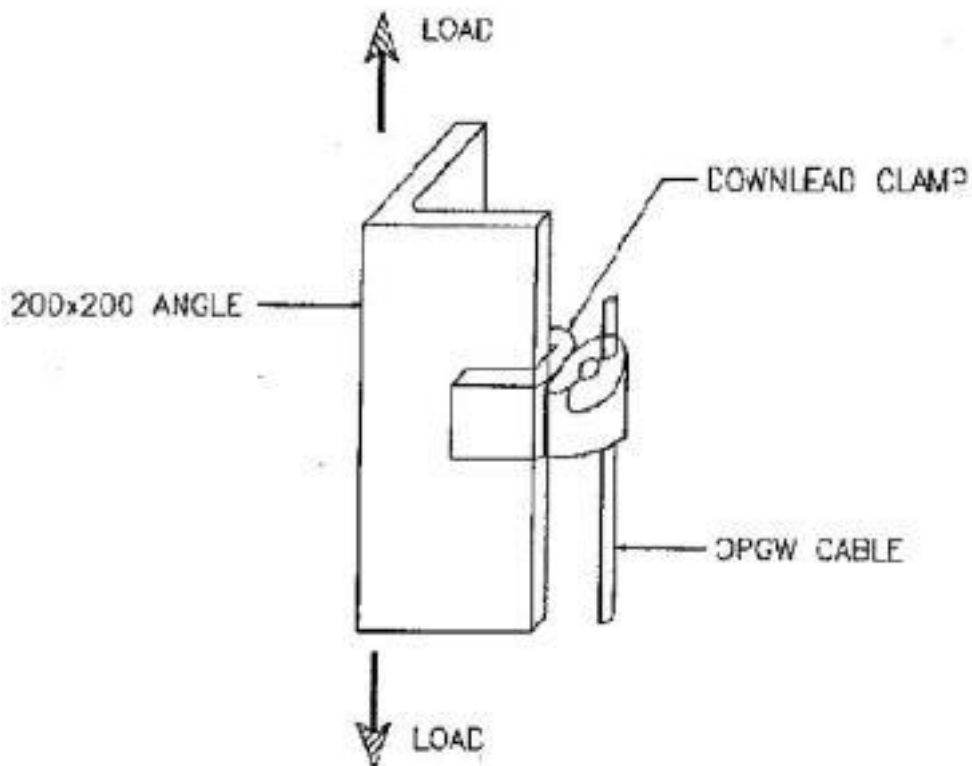


Figure 3: Schematic of structure mounting clamp strength test

Test Procedure:

1. A vertical load of 200 kg shall be applied at the end of the mounting clamp and held for 5 minutes.
2. The markings on the structure Down Lead Clamp and OPGW are examined for any signs of visible distortion, slipping or breaking of any components.
3. The load shall be increased to 400 kg and held for 30 seconds.
4. The load is then removed and the markings on the structure, Down Lead Clamp and OPGW are examined for any signs of visible distortion, slipping or breaking of any components.

Acceptance Criteria:

The down lead clamp has passed the test if the following conditions are met.
 No visible evidence of distortion / slipping or breaking of any components.
 Any result outside these parameters shall constitute a failure.

Observation, if any:

Test Results:

S/N	Load (kg)	Description	Comment
1	400		
2	400		
3	400		
4	400		
5	400		

The Structure mounting Clamps for OPGW tested, met / did not meet the requirement specified in technical specification.

Tested by:
 (Sign with date)

Witnessed by:
 (Sign with date)

STRUCTURE MOUNTING CLAMP FIT TEST

Lab Location :

Manufacturer :

Test Standard : Technical Specification

Test Sample : OPGW

Down lead clamp

} As per approved DRS & Drawings

Objective: To demonstrate the ability of the down lead assembly to withstand a specified load.

Test Set-up:

For structure mounting clamp, fit test shall be conducted with two OPGW cables installed.

Test Procedure:

Structure mounting clamp shall be installed including clamping compound as required on the OPGW cable. The nut shall be tightened on to the bolt by using torque wrench with a torque of 40Nm or supplier's recommended torque and the tightened clamp shall be held for 10 minutes. After the test remove the OPGW cable and examine all its components for distortion, crushing or breaking. Also the OPGW cable shall be checked to ensure free movement within the core to measure the diameter of the core tube.

Acceptance Criteria:

1. If any visible distortion, crushing, cracking or breaking of the core tube is observed, the test will be defined as a failed.
2. When the diameter of the core tube as measured at any location in the clamped area is more than 0.5 mm larger or smaller of the core diameter as measured outside the clamped area, the test will be defined as a failed.

Observations, if any

Test Results: The Structure mounting Clamps Fit tested, met/did not meet the requirement specified in technical specification.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

VISUAL/PHYSICAL VERIFICATION OF QUANTITIES AND SPECIFIC COMPONENT NUMBER FOR EACH COMPONENT OF SPLICE ENCLOSURES (JOINT BOX) & FODP AND DIMENSIONAL CHECKS AGAINST THE APPROVED DRAWINGS

Test location:

Manufacturer:

Test Sample: SPLICE ENCLOSURES (Joint Box)

FODP

} (As per approved DRS & Drawings)

Objective: This test confirms the appearance, Quantity and Dimension for Splice Enclosures & FODP for conformance to the relevant DRS/Drawings.

Test set-up:

It shall be verified that the sample are in accordance with their relevant drawings.

The following tolerance shall be allowed on all dimensions to which special tolerance do not apply.

SAMPLING: 100% of Items in the Lot

Dimensions:

The following tolerance shall be allowed on all dimensions to which special tolerances do not apply (i.e.) where tolerances are not indicated in the approved DRS/Drawings. Dimensions greater than 30 mm \pm 5% up to a max. of \pm 5 mm.

Visual & Quantity: To check the items in Lot & all found to be ok as per approved DRS & Drawings and the following.

No. of splice Trays

No. of holes for cable entry/ diameter of holes

IP Protection Class

Color shade

Specific Component Number

Acceptance Criteria:

Appearance should have no defect. All quantities should be correct.

Specific component number of each component shall be as per approved DRS/Drawings.

Dimensions shall be in accordance with their drawings with the tolerances specified.

Observations, if any:

Test Results : The Splice enclosure/FODP as tested met / did not meet the requirement specified.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

FAT Procedure for OPGW -Vibration Dampers

VISUAL MATERIAL VERIFICATION AND DIMENSIONAL CHECKS FOR VIBRATION DAMPER

Test Location:

Manufacturer:

Test Standard: IEC61284:1997, Approved DRS/Drawings in cat-I

Test Sample: Vibration Damper & associated hardware fittings

Objective : This test determines the factory acceptance of the batch quantity of fittings that they confirm to the relevant drawings and where appropriate/ have a sufficient galvanized coating.

Test Procedure:

1. Physical/Visual Verification for the part no. of all the materials as per approved DRS & drawings.
2. It shall be verified that the sample are in accordance with their relevant drawings, particularly as regards any dimensions to which special tolerance apply and indicated in the corresponding approved DRS/Drawings.
3. The following tolerance shall be allowed/on all dimensions to which special tolerance do not apply.

Appearance: To check all and ascertain to be appropriate as per DRS & Drawings.

Dimensions:

(A) Forgings:

- i) Dimensions up to and including 30mm.... ± 1.5 mm.
- ii) Dimensions greater than 30 mm..... $\pm 5\%$ upto max. of ± 5 mm.

(B) Helical Fittings:

- i) Dimensions up to and including 30mm..... ± 1.5 mm.
- ii) Dimensions greater than 30 mm..... $\pm 5\%$ upto max. of ± 5 mm.

FAT Procedure for OPGW -Vibration Dampers

Galvanizing (Vibration dampers, all nuts & bolts components as per approved DRS & Drawings):

- i) Galvanized coatings shall be tested in accordance with as appropriate.
- ii) All measurements shall be made after galvanizing where galvanizing is the normal finish. Galvanized coatings shall be tested and galvanized coating shall be minimum 85µm.

Acceptance Criteria:

Fittings shall be accordance with their relevant drawings within the tolerance Specified. Galvanized coatings on general articles shall be minimum thickness of 85µm.

Observation, if any;

Test Results: The Hardware fittings, as tested met / did not meet the requirement as per approved DRS & Drawings.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)

FAT Procedure for OPGW -Vibration Dampers

CLAMP SLIP TEST OF THE VIBRATION DAMPER

Test Location:

Manufacturer:

Test Standard: Technical Specification, IEC61897:1999

Test Sample: Vibration Damper
OPGW Cable

} As per approved DRS/Drawings

Objective: To demonstrate the ability of the vibration damper grip the conductor .

Test set up:

The test shall be performed using the conductor for which the clamp is intended. The conductor shall be “as new” (free of deterioration or damage). The minimum free length of test conductor between its terminating fittings shall be 2 meters. The conductor can be tensioned to 20% of its Ultimate tensile strength (the conductor is free that is accepted). Precautions shall be taken to avoid bird caging of the conductor.

The clamp shall be installed in accordance with their recommended instructions on a different portion of the conductor for each test.

Test Procedure:

The load shall be gradually increased (no faster than 100 N/s) until it reaches 2.5kN (specified minimum slip load). This load shall be kept constant for 60 seconds. Then the load value shall be gradually increased until slippage of the clamp occurs. The value of slip load shall be recorded. Clamp slip shall be considered as having occurred when a slip distance of 1mm is measured.

Acceptance Criteria:

- 1) No movement of the clamp relative to the conductor greater than 1mm shall occur at or before the end of application of 2.5kN for 60 seconds.
- 2) Surface flattening of the outer strands of the conductor is acceptable.

Observation, if any;

FAT Procedure for OPGW -Vibration Dampers

Test Results: The vibration damper tested, met / did not meet the requirement specified in technical specification.

Tested by:
(Sign with date)

Witnessed by:
(Sign with date)