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OPTICAL FIBRE SPLICING MACHINE

**GENERIC REQUIREMENTS
NO. TEC/GR/TX/OSM-001/04/SEP-12**

(Supersedes GR No. GR/OSM-01/03. APR 2005)

©
TEC

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HISTORY SHEET

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Optical Fibre Splicing Machine	G/OSM-01/01. JAN 94	Ist issue
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REFERENCES

TEC STANDARDS

1. TEC/TX/GR/ORM-01/04/SEP-09 (Section-I) GR for Raw Material used in manufacturing of Optical Fibre Cable.
2. TEC/GR/TX/PTS-01/03/JAN-2011 GR for Splice protection sleeve for Optical fibre
3. No. GR/OFT-01/03 APR 2006 (Section XVII, XVIII & XIX) GR of Stripper for Primary & Secondary Coating and Precision Cleaver
4. TEC/EMI/TEL-001/01/FEB-09 EMC Standard for Telecommunication Equipment
5. SD:QM-333 (March 2010) Standards for Environmental Testing of Telecommunication Equipment.

OTHER STANDARDS (CISPR/IEC/ISO/ASTM etc.)

1. IS 8437 (1993) Guide on the effects of current passing through the human body (equivalent to IEC publication 60479-1 {1984}).
2. IEC 61000-1 (2001) with corrigendum 1 (2002) and corrigendum 2 (2003) Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use”
3. CISPR 11 (2004) Industrial Scientific and Medical (ISM) radio frequency Equipment – Electromagnetic disturbance characteristics- Limits and methods of measurement ”;
4. IEC 61000-4-2 (2001) Testing and measurement techniques of Electrostatic discharge immunity test”
5. IEC 61000-4-3 (2006) "Testing and measurement techniques-Radiated RF Electromagnetic Field Immunity test"
6. IEC 61000-4-4 (2004) Testing and measurement techniques of and electrical fast transients/burst immunity test"
7. IEC 61000-4-5 (2005) “Testing & Measurement techniques for Surge immunity test"

8. IEC 61000-4-11 (2004) “Testing & measurement techniques- voltage dips, short interruptions and voltage variations immunity tests”
9. ISO 9001-2008 International quality standards
10. D 2794 and D2197 ASTM Standards

PART 1 - TECHNICAL SPECIFICATIONS

1.0 Introduction :

This document describes the Generic requirements of the Optical Fibre Splicing machine used for splicing the optical fibres. The Optical Splice Machine is designed to splice fibres by fusing the fibres together using localised heating at the interface of the butted fibres. An electric arc is generated by the electrodes contained in the unit. The splicing consists of fusion cycles resulting in permanently jointing of the optical fibres with minimum splice loss and low reflection.

2.0 Functional Requirements:

- 2.1 The instrument shall be designed for continuous operation. The manufacturer shall indicate the period of continuous operation for which it shall be checked.
- 2.2 The instrument shall guarantee the satisfactory performance of the instrument without any degradation at an altitude up to 5000 meters above mean sea level. A test certificate from the manufacturer shall be acceptable.
- 2.3 The instrument shall have the facility for altitude compensation such that stable splicing can be done even at high altitudes or at low altitude. The method used for the altitude compensation shall be indicated by the manufacturer.
- 2.4 Power cord shall have moulded plug.
- 2.5 Visual indication to show power ON/OFF status shall be provided.
- 2.6 Provision for self check of the instrument shall be provided.
- 2.7 The software/hardware in instrument shall not pose any problem in the normal functioning of the instrument due to changes in date and time caused by events such as leap year etc.
- 2.8 The instrument shall provide error message information.
- 2.9 All controls shall be clearly marked or labelled with an easy to understand symbol or key word to indicate its intended use.
- 2.10 It shall have the facility to view the fibres on X-axis and Y-axis before splicing.
- 2.11 It shall have the facility of perfusion/pre-arcing for cleansing the fibre before actual splicing.
- 2.12 It shall have the facility of assessment of splice loss in dB.
- 2.13 It shall have the provision of cover during splicing to avoid the entry of dust and for the safety of operating personal during fusion.

- 2.14 The splicing machine shall have an override capability to bypass the automatic controls.
- 2.15 It shall have facility for proof testing the strength of fibre joint. The device to test the strength shall be capable of applying a stress of 4.1 Newton's for a minimum period of one second and shall be able to test the strength of the fibre joint
- 2.16 It shall have facility for easy replacement & cleaning of electrodes.
- 2.17 Marking of the push buttons shall be such that their functions are clear in both the extended and depressed position.
- 2.18 It is desirable for the marking on the operating knobs to be done in a raised relief design or with etched and filled characters to enhance the permanence of the identification.
- 2.19 It is desirable to have recessed push buttons or touch screen to avoid damage.
- 2.20 The manufacturer shall state the minimum requirements for the safe operation of the splicing machine.
- 2.21 It shall have high frequency AC, tungsten or equivalent electrodes with long life. The manufacture shall provide the information for the life (number of splices) of a single set of electrodes.
- 2.22 It shall have arc test function with automatic compensation for easy setting of optimum splice condition
- 2.23 It shall have facility to illuminate the V-groove for easy setting of fibre.
- 2.24 It shall have easy operation by splice menu (user friendly) selected on large size monitor.
- 2.25 It shall be possible for the user to down load the information and again the splicer shall be able to store the data from the starting.
- 2.26 It shall have the facility for viewing fibres in focus.

3.0 Technical Requirements:

- 3.1 Principle of operation : Direct core monitoring using Profile Alignment
- 3.2 Type of fibres : Conforming to Section - I of TEC GR No. TEC/GR/TX/ORM-01/04/SEP-09
- 3.3 Nominal Cladding diameter : $125 \pm 1 \mu\text{m}$
- 3.4 Fibre coating diameter : a) Primary coated : $245 \pm 10 \mu\text{m}$
b) Secondary coated : $900 \pm 50 \mu\text{m}$
(Tight jacket)
- 3.5 Fibre strip length : 16 mm maximum
- 3.6 Operating mode : Auto and Manual Mode
- 3.7 Fibre Alignment : 3 Axis alignment capability
- 3.8 Splice Loss for splicing following types of Single Mode fibres at 1310 nm and 1550 nm
 - a) Homogeneous : $\leq 0.03 \text{ dB}$
 - b) Heterogeneous : $\leq 0.05 \text{ dB}$

Note: 25 samples of both types of fibres shall be spliced and all the samples shall have to meet the following requirements

- i. The splice loss of 80 % of fibres of homogeneous fibre shall be $\leq 0.03 \text{ dB}$, and of 20 % of the fibres shall be $\leq 0.10 \text{ dB}$.
- ii. The splice loss of 80 % of fibres of heterogeneous fibre shall be $\leq 0.05 \text{ dB}$, and of 20 % of the fibres shall be $\leq 0.10 \text{ dB}$.

3.9 Splice Loss Estimation system:

- a) The splicing machine shall provide a mean for estimating the splice loss.
- b) The splice loss estimation device shall not cause damage to the splice or fibre.
- c) The difference between the estimated loss measured by splicing machine & average loss measured by OTDR shall be within $\pm 0.02 \text{ dB}$.
- d) Splice reflectance: better than or equal to 60 dB at 1310 & 1550nm.

Note: Splice loss Estimation shall be Optional in Manual Mode

- 3.10 Arc Current adjustment : Auto/Manual adjustable for different fibre type, altitude and temperature
- 3.11 Display Monitor : Minimum 3.5 inches LCD or any equivalent display
- 3.12 Viewing method : CMOS camera

- 3.13 Reinforcement of the splice : By Heat shrinkable sleeve
(GR No.TEC/GR/TX/PTS-01/03/JAN-2011)

Note: The heat shrinkable sleeve shall not stick to the walls of the heater after specified cooling time.

- 3.14 No. of Splice Program : The splicing machine should have sufficient splice programs i.e. min. 40 Factory installed, 50 User program and min. 10 Heating program

- 3.15 Splice Time : ≤ 9 Second

- 3.16 Splice Memory : Minimum 2000 splice data

- 3.17 Heater : In-built (For fibre protection sleeve)
a) Sleeve length : Up to 60 mm
b) Heating time : < 35 Second

- 3.18 Size & Weight : Light & Compact

- 3.19 Interface : USB

- 3.20 Operating Environment : As per clause No.5.3 of this document

- 3.21 Power Supply:

- a) The instrument shall work from the single phase AC power supply without any degradation with nominal 230V AC with voltage variation from 150V to 270V at $50\text{Hz} \pm 2$ Hz.

OR

The instrument shall work from AC/DC adopter without any degradation with input voltage from 150V to 270V, $50\text{Hz} \pm 2\text{Hz}$ AC. The manufacturer shall furnish the output DC voltage of the AC/DC adopter and safe operating input voltage for the instrument.

- b) The Splicing Machine shall be supplied along with suitable in-built/external rechargeable battery source, capable of working continuously at least for six hours or for 100 splices with heating and shall have charging facilities. Indication of low battery shall be provided and the unit shall be protected against battery reversals.
- c) The power consumption shall be minimal and its consumption shall be furnished by the manufacturer.
- d) It shall have External DC input port of 12 Volts for operating the Splicing machine (Optional).

3.22 Setting and Adjustment:

3.22.1 The splicing machine shall have facility to pre-program and select the programmes. It shall have the capability of adjusting the fibre parameters and other parameters required for best results. The adjustments shall be available to user by suitable settings:

- a) To allow the joining of homogeneous and heterogeneous fibres from different manufacturers.
- b) To allow the joining of fibres at different altitudes.
- c) To allow the joining of fibres at different humidity conditions.
- d) The manufacturer shall provide the settings for splicing the dissimilar fibre combinations currently available and update of these settings shall be made available for new fibre designs.

Note:

Homogeneous fibre - In homogeneous splicing, the fibre is cut and re-spliced retaining the same orientation.

Heterogeneous fibre - In heterogeneous splicing, the fibres are of the same type but may come from different lots and from different manufactures

3.22.2 It shall have menu driven settings (minimum) for:

- a) Splice mode i.e. Auto, Manual & Arc Test
- b) Electrode Mode i.e. Manual arc
- c) Heater Mode i. e. Selection of type of protection sleeve
- d) Function Mode i.e. Easy function setting menu for operation.
- e) Fibre name mode i.e. Editing fusion program name for each fibre.
- f) Parameter mode i.e. Renewal of parameter settings.
- g) Maintenance mode i.e. Menu for maintenance operator.

3.23 Additional Consumable Items:

The following consumable items shall be supplied along with splicing machine:

- | | | | |
|----|---|---|---|
| 1. | Electrodes | : | 2 sets (Total four pieces) |
| 2. | Precision Cleaver | : | 1 no. |
| 3. | Primary Coating Stripper | : | 1 no. |
| 4. | Secondary Coating stripper | : | 1 no. |
| 5. | Optical Fibre Protection Sleeves | : | 1000 or as per order
for Optical Fibre |
| 6 | Spare Battery | : | One |
| 7. | Brush | : | One |
| 8. | Mid-span Loose tube Cutter | : | One |
| 9. | Any other items required like special tools, etc., for fixing and removing the electrodes and maintenance of the splicing machine, etc. | | |

Note: The Stripper for Primary & Secondary Coating, Precision Cleaver and Splice Protection Sleeves supplied along with splicing machine shall meet the TEC GR No. GR/OFT-01/03.APR.2006 (Section-XVII, XVIII & XIX respectively) and TEC/GR/TX/PTS-01/03/JAN-2011 respectively and subsequent amendment issued, if any.

PART-II GENERAL REQUIREMENTS

4.0 Engineering Requirements:

- 4.1 The instrument shall adopt state of the art technology.
- 4.2 The instrument shall be light for splicing of aerial and underground cables. The dimensions and weight of the instrument shall be specified by the manufacturer.
- 4.3 All switches shall be reliable and of standard type to ensure failure free operation over 1000 on-off operations for switches. This shall be under specified environmental conditions.
- 4.4 The instrument shall be compact and composite in construction. The mechanical design and construction of each card or unit shall be inherently robust and rigid under all conditions of installation operation, adjustment, replacement, storage and transport and conforming to TEC document no. SD: QM 333 {March 2010} "Standards for Environmental Testing of Telecommunication Equipment".
- 4.5 The instrument shall have self cooling arrangement including usage of internal fans, if required.
- 4.6 Important Do's and Don'ts about the operation of the instrument shall be clearly indicated at a convenient place on the instrument.

5.0 Quality Requirements:

- 5.1 The manufacturer shall furnish the MTBF and MTTR values and warranty for a period of minimum 1 year with free repair and replacement unless otherwise specified in tender. The minimum value of MTBF shall be 10,000 hrs.
- 5.2 The instrument shall be manufactured in accordance with international quality standards ISO 9001- 2008 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted by the manufacturer.

5.3 Environmental Requirements:

- a) The instrument shall conform to the requirements for Environment specified in TEC document SD: QM-333 (March 2010) "Standards for Environmental Testing of Telecommunication Equipment. The applicable tests shall be for environmental category "B2" including Drop, Topples, Vibration tests (instrument kept in carrying case) and Corrosion test, if applicable.
- b) The instrument shall be able to work without any degradation in coastal areas & should be protected against corrosion.
- c) The Splicing machine is required to work in Indoor environments like Central offices, equipment huts and outside environments like manhole, open trench and a splicing van. It is required to work in bright sunlight, poorly lit or dark areas.

6.0 Maintenance Requirements:

- 6.1 The instrument shall have facility for power-on self test.
- 6.2 The instrument shall have easy access for servicing and maintenance.
- 6.3 All parts used shall be capable of being repaired by the supplier with turnaround time of maximum 2 weeks from the date it is handed over to supplier. If this turnaround time cannot be met then a loaner unit should be provided for the duration of the repair period.

7.0 Accessories:

- 7.1 The supplier shall provide one complete set of:
 - a) All the necessary interfaces, connectors, connecting cables (including power cord) and accessories required for satisfactory and convenient operation of the instrument. Types of connectors, adapters to be used and the accessories of the approved quality shall be clearly indicated in the operating manuals.
 - b) Software (if any), along with software version and the arrangement to load the software at site. Any updating of software shall be supplied free of cost. (Additional sets may be ordered optionally). This upgrade shall be done at the site via internet, if required.
- 7.2 Special tools, extender boards, extender cables and accessories essential for installation, operation and maintenance of the instrument shall be clearly indicated and supplied along with the instrument.
- 7.3 The source of the components/ accessories, from where these have been procured, is also to be submitted by the manufacturers.
- 7.4 Detailed information for components/module accessories used shall be clearly indicated.

8.0 Documentation:

Technical literature in English language shall be provided. All aspects of installation, operation, maintenance and repair shall be covered in the manuals. The soft copy as well as hard copy of the manuals shall also be provided. The manuals shall include the following:

Installation, operation and maintenance manual - This manual shall include the following in addition to other details:

- a) Safety measures to be observed in handling the Testing Instrument.
- b) Precautions for setting up, measurements and maintenance.
- c) Test equipment required for routine maintenance and calibration including their procedures.
- d) Illustration of internal and external mechanical parts.

- e) The detailed description about the operation of the software used in the equipment including its configuration procedure, installation, loading and debugging etc.

9.0 Protection Requirements:

- 9.1 The instrument panel shall have a terminal for grounding the chassis, if required.
- 9.2 The plug-in units, if provided, shall have suitable protection to allow their removal/insertion while the instrument is in energized condition.
- 9.3 Protection against short circuit and open circuit in the accessible points for measurements shall be provided.
- 9.3 All switches and controls on front panel shall have suitable safeguards against accidental operation.
- 9.4 The instrument shall be adequately safeguarded to prevent entry of dust, insects and lizards.

10.0 Safety requirements:

- 10.1 The operating personnel should be protected against shock hazards as per IS 8437 {1993} "Guide on the effects of current passing through the human body" [equivalent to IEC publication 60479-1 {1984}]
- 10.2 The instrument shall conform to the relevant clauses of the IEC 61010-1(2001) with corrigendum 1 (2002) and corrigendum 2 (2003) "Safety requirements for Electrical Equipment for Measurement, Control and laboratory use"

11.0 Electromagnetic Compatibility (EMC) Requirements: - The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report shall be furnished from an accredited test agency.

a) Conducted and radiated emission:

Name of EMC Standard: "CISPR 11 {2004}- Industrial, scientific and medical (ISM) radio- frequency equipment-Electromagnetic disturbance characteristics- Limits and methods of measurement"

Limits:

- i) To comply with the category of Group 1 of Class A of CISPR 11 {2004}
- ii) The values of limits shall be as per clause No. 8.5.2 of TEC Standard No. TEC/EMI/TEL-001/01/FEB-09.

b) Immunity to Electrostatic discharge:

Name of EMC Standard: IEC 61000-4-2 {2001} "Testing and measurement techniques of Electrostatic discharge immunity test".

Limits:

- i) Contact discharge level 2 { ± 4 kV} or higher voltage;
- ii) Air discharge level 3 { ± 8 kV} or higher voltage;

c) Immunity to radiated RF:

Name of EMC Standard: IEC 61000-4-3 (2006) "Testing and measurement techniques-Radiated RF Electromagnetic Field Immunity test"

Limits:-

Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz

d) Immunity to fast transients (burst):

Name of EMC Standard: IEC 61000- 4- 4 {2004) "Testing and measurement techniques of electrical fast transients/burst immunity test"

Limits:-

Test Level 2 i.e. a) 1 kV for AC/DC power lines; b) 0. 5 kV for signal / control / data / telecom lines;

e) Immunity to surges:

Name of EMC Standard: IEC 61000-4-5 (2005) "Testing & Measurement techniques for Surge immunity test"

Limits:-

For mains power input ports : (a)1.0 kV peak open circuit voltage for line to ground coupling (b) 0.5 kV peak open circuit voltage for line to line coupling

f) Immunity to voltage dips & short interruptions:

Name of EMC Standard: IEC 61000-4-11 (2004) "Testing & measurement techniques- voltage dips, short interruptions and voltage variations immunity tests"

Limits:-

- i) a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e. 70 % supply voltage for 500 ms)
- ii) a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms (i.e. 40% supply voltage for 200ms)
- iii) a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s.

Note 1: The test agency for EMC tests shall be an accredited agency and details of accreditation shall be submitted.

Note 2: For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. TEC/EMI/TEL-001/01/FEB-09 and the references mentioned therein unless otherwise specified specifically. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that frequency range and test level are met as per above mentioned sub clauses (a) to (f) and TEC Standard No. TEC/EMI/TEL-001/01/FEB-09. The details of IEC/CISPR and their corresponding Euro Norms are as follows:

IEC/CISPR	Euro Norm
CISPR 11	EN55011
IEC 61000-4-2	EN61000-4-2
IEC 61000-4-3	EN61000-4-3
IEC 61000-4-4	EN61000-4-4
IEC 61000-4-5	EN61000-4-5
IEC 61000-4-11	EN61000-4-11

12.0 Surface finish and Marking, Packaging and Shipping

12.1 Marking

12.1.1 Splicing machine and its carrying case shall be marked for the following and shall be legible:

- a) The name of the product, manufacturer's model and serial number.
- b) The name of the supplier / manufacturer
- c) The date of manufacture
- d) Any other relevant information

12.2 Surface finish

12.2.1 The inside and outside surfaces shall have uniform colour and texture.

12.2.2 The painted finish on metallic surfaces shall be resistant to impact and shall not exhibit radial cracking when subjected to 2.8 N-meter load and tested as ASTM D 2794 or any other equivalent International Standard.

12.2.3 The finish and markings shall adhere to the base metal and shall not show any separation of coats when tested as per ASTM D 2197 or any other equivalent International Standard.

12.2.4 The surface finish and markings shall be resistant to chemicals that are normally found in the telephone plant and shall not exhibit any perceivable changes when exposed to ultra violet light. In particular the surface shall not be affected by the following:

- a) Cable Filling compound
- b) Isopropyl Alcohol
- c) Cable cleaning solutions.

12.3 Packaging & shipping

- 12.3.1 Packaging of the instrument shall be adequate to ensure that no damage will occur under normal shipping, handling and storage in reasonably dry unheated quarters. The supplier shall also ensure proper protection against bumps etc.
- 12.3.2 The splicing machine shipping container and packaging should be reusable recyclable and biodegradable.

12.4 Portability

- 12.4.1 A suitable hard rugged moulded carrying case (suitable for air, Rail & Road transport) for the instrument shall be provided. The carrying case used for transporting the instrument to a field location shall be equipped with carrying handle so that it may be carried with one hand.
- 12.4.2 It is desirable the splicing system be packaged as a single unit.
- 12.4.3 The Optical Fibre Fusion splicing machine shall be compact and light weight, with a minimum sub-assemblies, in order to provide a reasonable degree of portability and simplicity of operation.

Note: Manufacturers/Traders having approval certificate against existing TEC GR No. GR/OSM-01/03.APR 2005 can apply for approval certificate against revised TEC GR No. TEC/GR/TX/OSM-001/04/SEP-12 but the period of validity shall remain the same as applicable for the earlier certificate. In case there is no change in Hardware/Software and Make & Model No. of the instrument remains the same then all the tests may not be repeated in next approvals and tests will be conducted only for the modified/inserted clauses. However, if the Manufacturer/Trader has made any Hardware/Software changes then the case will be considered for fresh Approval against the new GR.

GUIDELINES FOR THE PURCHASER

Following guidelines are for the reference of the purchaser only, and are not to be tested during Evaluation/Testing:

- a) As and when bugs are found/determined in the software, the manufacturer shall provide patches and firmware replacement if involved free of cost for three years. Modified documents wherever applicable shall also be supplied free of cost.
- b) The manufacturer/supplier shall furnish the list of recommended spares for three years maintenance.
- c) The supplier shall have maintenance/repair with calibration facility in India.
- d) Supplier shall guarantee the supply of spares so long as the instrument is in service, at least for seven years from the date of supply. The purchaser would like to stock spares as and when the supplier decides to close down the production of the offered instrument. In such an event, supplier shall give a two years notice to the purchaser so as to stock the spares.
- a) Purchaser can order additional measurement options separately.

Ordering information:

- Clause no. 3.21(d) The provision for External DC input port of 12 Volts for operating the splicing machine is an Optional requirement. The purchaser may, however, ensure its feasibility and order accordingly.
- Clause no. 3.23 The typical spares/accessories requirement has been mentioned. The purchaser may, however, ensure its adequacy and order accordingly.

ABBERIVATIONS

AC	- Alternating Current
ASTM	- American Society for Testing Materials
CISPR	- International Special Committee on Radio Interference
EMC	- Electromagnetic Compatibility
GR	- Generic Requirement
IEC	- International Electro -Technical Commission
IS	- Indian Standards
ISO	- International Standard Organisations
ITU	- International Telecommunication Union
MTBF	- Mean Time Between Failure
MTTR	- Mean Time to Restore Service
OTDR	- Optical Time Domain Reflectometer
QA	- Quality Assurance
QM	- Quality Manual

----- **End of Document** -----