



*Technology Training that Works*

---

# Practical HV Cable Jointing & Terminations for Engineers and Technicians

---

## Contents

---

<b>1</b>	<b>Overview</b>	<b>1</b>
1.1	Introduction	1
1.2	Need for high voltage cables	3
1.3	Advantages over overhead transmission lines	4
1.4	Disadvantages of cables in power transmission	5
1.5	Various types of high voltage cables	5
1.6	Need for cable jointing (splicing)	6
1.7	Need for termination kits	8
1.8	Summary	9

---

<b>2</b>	<b>Constructional aspects of cables</b>	<b>11</b>
2.1	Introduction	11
2.2	PVC insulated high voltage cables	12
2.3	Polyethylene insulated Cables	13
2.4	Cross- Linked Polyethylene (XLPE) Cables	14
2.5	Paper insulated lead sheathed cables (PILC)	20
2.6	Oil-filled cables	22
2.7	Application Areas	24
2.8	Good Installation practices	24
2.9	Summary	25

---

<b>3</b>	<b>Cable connections in joints and terminations</b>	<b>27</b>
3.1	Introduction	27
3.2	Types of connectors used in cables	28
3.3	Current Path	29
3.4	Methods of conductor connections	31
3.5	Contact resistance	40
3.6	Preferred methods in practice for different cable ratings	41



*Technology Training that Works*

3.7	Galvanic Corrosion and use of Bimetals	41
3.8	Summary	42

---

<b>4</b>	<b>Joints and terminations–theory</b>	<b>45</b>
----------	---------------------------------------	-----------

---

4.1	Basic Approach	45
4.2	Classification of joints	46
4.3	Pre-moulded (slip on) joints	50
4.4	Slip-on terminations	53
4.5	Cold shrink terminations	56
4.6	Heat shrinkable joints	60
4.7	Extrusion molded joints	61
4.8	Additional requirements for outdoor terminations	62
4.9	Reconstitution of cable properties	63
4.10	Connectivity for cable screen and armour	66
4.11	Mechanical protection of joint and terminations	66
4.12	Special joints	66
4.13	Summary	72

---

<b>5</b>	<b>Stress control in cable joints and terminations</b>	<b>73</b>
----------	--	-----------

---

5.1	Stress gradients in cable joints and terminations	73
5.2	Areas requiring stress control	79
5.3	Terminations	80
5.4	Joints	81
5.5	Basics of stress control approach	81
5.6	Summary	86

---

<b>6</b>	<b>Practical aspects of cable jointing and termination</b>	<b>87</b>
----------	--	-----------

---

6.1	Kits for joints and terminations	87
6.2	Shelf Life	92
6.3	Issues with prefabricated kits	93
6.4	Preparation of cable for termination and jointing	93
6.5	Connection and Reconstitution of cable properties	101
6.6	Continuity and grounding aspects	107
6.7	Sealing, Healthiness of joint/termination & Repairs	107
6.8	Installation aspects for cables and joints	110



*Technology Training that Works*

6.9	Safety issues and access for repairs	111
6.10	Summary	113

---

<b>7</b>	<b>Cable termination to equipment</b>	<b>115</b>
----------	---------------------------------------	------------

---

7.1	Basics of equipment terminations	115
7.2	Termination to indoor switchgear	116
7.3	Termination to electrical machines	121
7.4	Termination of outdoor HV installation	123
7.5	Terminations to GIS installation	125
7.6	Importance of correct orientation of terminations	127
7.7	Summary	128

---

<b>8</b>	<b>Standards and testing</b>	<b>131</b>
----------	------------------------------	------------

---

8.1	International/National standards	131
8.2	Standards for high-voltage and extra high-voltage cables	132
8.3	Type tests	134
8.4	Routine tests	141
8.5	Field Tests	143
8.6	Limitations	144
8.7	Training and certification	144
8.8	Summary	146

---

<b>9</b>	<b>Failures and analysis</b>	<b>147</b>
----------	------------------------------	------------

---

9.1	Reasons for failures in high voltage cables	147
9.2	Documentation of work done	149
9.3	Documentation of failures	149
9.4	Analysis of failures	150
9.5	Predictive approach	153
9.6	Summary	160

---

<b>10</b>	<b>New trends</b>	<b>161</b>
-----------	-------------------	------------

---

10.1	Increasing use of underground cables	161
10.2	New technologies for very high capacities and voltages	165
10.3	EHV XLPE cable systems	167



*Technology Training that Works*

10.4	High temperature superconductivity cables	168
10.5	Summary	174

---

Self Assessment quiz with answers	175
-----------------------------------	-----

---

---

Appendices	Technical papers	193
------------	------------------	-----

---