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# NOTES ON CEA 2010

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MUTUAL TRANSFER FORUM

### Permissible Voltage Limits -

For transmission of power into below ground workings of a mine and quarry of O/C mine	11 KV
For use in mine	6.6 KV
Special limits for use	
(i) Hand held portable apparatus	125 V
(ii) Lighting	
underground mines	125 V
surface of the mine or in opencast mine (mid and neutral point earthed)	250 v
(iii) Portable hand-held lamp in underground mines	30 V
(iv) Circuit for remote control or or electric inter-locking of apparatus	30 V
In fixed plant, if a bolted type plug is used	650 V

(There is no limit for transmission or use of energy on surface of U/G or O/C mine)

### What is meant by low, medium, high and extra high voltage

Low voltage	upto 250 V
Medium voltage	over 250 to 650 V
High voltage	over 650 to 33,000 V

Extra high voltage	over 33,000 V
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Permissible variation of supply voltage from declared voltage is :

+/- 6% for low and medium voltage

+ 6% and 9% for high voltage

**\*Insulation Resistance\***

low and medium voltage equipment - \*1 MO\*

Insulation resistance phase to earth

(when voltage if 500 V DC is applied

for one minute) shall not be less than

In case of high voltage equipment - \*5 MO\*

Insulation resistance phase to earth

(when voltage if 2500 V DC is applied

for one minute) shall not be less than

## PERMISSIBLE LENGTH OF FLEXIBLE CABLES

100 m	length of flexible cable with any portable and transportation apparatus shall not exceed
250 m	length of flexible cable with any portable and transportation apparatus when used with coal cutting machine or cutter or loader or AFC for longwall operation or shuttle car or load haul dumper or cutter loader or like equipment for development and depillaring operation it may be upto
300 m	with electricity operated HEMM in opencast mines
1,000 m	with bucket wheel excavator at 11 KV

**Note** - The above provision is as per amendment GSR 274 dt. 10th July 2002

01) Permissible length for UG machinery was increased from **90 to 100 m** in 1977

For **longwall operation**, it was increased from **180 to 200 m** in 1977

Permissible length for use with **shovels and excavators** in OCM's was specified as **300 m** in 1977

The word **shovels and excavator** were replaced by **electrically operated heavy earth moving machinery** in 1933

02) DMS electrical has granted relaxation under Rule 134 to some dragline mine to use **upto 600 m length pliable armoured cable with draglines.**

## OVERHEAD LINES - CLEARANCES, SAFETY PRECAUTIONS

### Clearance above ground of O/H line in opencast mine

Permissible maximum voltage at which power can be transmitted in a mine is 11 KV.

Assuming the O/H line to be of **11 KV**

the minimum clearance of the lowest conductor of the O/H line above ground in the mine should be	4.6 m
Condition for haul road	
if the line is to cross a haul road the clearance of the lowest conductor above the raised body of maximum size of dumper plying in the circuit shall not be less than	3.0 m
<b>but</b> in no case shall the clearance from the ground be less than	12.0 m

## OVERHEAD LINES

**1. Conductors and Supports** (strength, joints, factor of safety) Conductors of overhead line shall have a breaking strength of **not less than 350 kg, but in case of low voltage and span less than 15m**, it shall be **not less than 150 kg**. The joints shall be mechanically and electrically secure; ultimate strength of joints shall not be less than 95% of that of the conductor, cradle and conductivity not less than that of the conductor. No conductor shall have more than two joints in a span.

(**Breaking load of cradle guard 635 kg**)

### Factor of safety

S. No.	Structure	Minimum factor of safety
1	Metal supports	1.5
2	Mechanically processed concrete supports	2.0
3	Hand moulded processed concrete supports	2.5
4	Wooden supports	3.0
5	Stay wire/guard wires	2.5

6	Conductors	2.0
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## 2. Clearance above ground of the lowest conductor (Rule - )

S.No.	Type of line	Minimum Clearance (m) (at the point of maximum sag)		
		Across the street	Along the street	Elsewhere along or across
1	Low and medium voltage (upto 650 V)	5.8	5.5	
2	High voltage	6.1	5.8	
3	All voltages upto 11kV			
	bare			4.6
	insulated			4.0
4	High voltage >11kV upto 33kV			5.2

## 3. Clearance between conductors (Rule - )

S. No.	Type of line	Clearance between conductors
1	Low and medium voltage (upto 650 V)	1.2 m if bared
		0.6 m if insulated
2	H.V. upto 11kV	1.8
3	H.V. >11kV upto 33kV	2.5
4	Extra H.V. lines	3.0

#### 4. Minimum clearance from buildings (Rules 79-80)

S. No.	Voltage	Vertical clearance above roof (at max. sag.)	Horizontal clearance adjacent to roof (at max deflection due to wind)
1	Low and medium voltage (upto 650 V)	2.5	1.2
2	High	3.7	1.2 m upto 11kV
			2.0 m upto 33kV
3	Extra high voltage	3.7 + 0.3 for additional 33kV or part	2.0 + 0.3 for additional additional 33kV or part

#### Metallic covering of power cable

Metallic covering के all parts and joints की conductivity, cable के largest conductor की conductivity के 50% से कम नहीं होगी।

#### Metallic covering of flexible cable

But seperately (individually) screened flexible cable की each screen की conductivity, power conductor की conductivity के 25% से कम नहीं होगी तथा सभी (all such) screens की combined (total) conductivity 0.15 cm<sup>2</sup> copper conductor की conductivity से कम नहीं होगी।

#### Clearances : General (Rule )

(1) In calculating clearances of O/H lines, the sag and deflection shall be taken into account.

**For vertical clearance:** maximum sag shall be sag in still air and at maximum temperature specified by the sate govt.



**For horizontal clearance:** maximum deflection of any conductor shall be that at wind pressure specified by the state govt. or 35 ° whichever is greater.

(2) No blasting for any purpose shall be done within 300 m from the boundary of sub-station or from the High Voltage or Extra High Voltage electric supply lines or tower structure without consultation of the owner of such sub-station, electric supply line or tower structure, and in case of mining leasehold area, without written permission of the Chief Inspector of Mines or the Electrical Inspector of Mines.

#### **Maximum interval between supports (Rule 85)**

Safe interval between supports shall be based on ultimate tensile strength of conductors and factor of safety as per Rule . But in case of low/medium voltage lines erected in, over, along or across a street, the interval shall not exceed 65m (unless permitted by the Inspector).

#### **Guarding (Rule )**

(a) Every guard wire shall be connected with earth at each point at which its electrical continuity is broken

(b) Every guard wire shall have an actual breaking strength of not less than 635 kg and it shall be galvanised.

(c) Guard wire shall have sufficient current-carrying capacity to ensure the rendering dead, without risk of fusing, of the guard wire till the contact of any live wire has been removed.

#### **Notices (Rule )**

The following notices / returns shall be sent to the Inspector :

**Annual Returns**, on or before 1st February, giving type and size of apparatus in use.

**Seven (07) days' notice** before bringing into use any new installation, giving details of apparatus to be installed and their proposed location.

**Immediate notice**, in case of additions/alterations to existing low or medium voltage installation before they are brought into use.

Returns / notices are not required for telecommunication or signalling apparatus.

## **Plans (Rule )**

A plan, on the same scale as the mine plan as per Regulations, showing the position of all fixed apparatus and conductors for the same (other than lighting, tele-communication or signalling apparatus and cables for the same) shall be maintained.

It shall be examined and corrected as often as necessary to keep it reasonably up-to-date. Dates of updation shall be entered by the manager.

Date of examination/correction shall be entered on the plan.

### **Note :**

1. The electrical plan must show (a) cable route; different grades of cables should be shown in different colours; size of cable should be marked; (b) fixed installations such as sub-stations, transformers, haulages, belt conveyers and pumps. (c) ventilation circuit showing intake, return, faces and goaf edges; quantity of air flowing at sub-stations; and pumping stations. Equipment of different voltages should be shown by different colours.

2. To facilitate understanding of the network of installation and their interrelationship, a schematic line diagram should also be maintained indicating the following particulars :

- Location of equipment-Intake, Return, levels.
- Details of equipment-voltage, current, HP/KW, manufacturer, FLP or non FLP
- Details of cables-route, length, cross section, voltage and type.
- Rating of switches-carrying capacity, O/L current, E/L current, voltage, rupturing capacity.

3. Portable and transportable apparatus, and lighting/telecommunication/signalling apparatus and cables for the same need not be shown on the electrical plan.

**Protective equipment** (for automatic power cut off in the event of fault including earth fault) (Rule )

(1) For safety, appropriate switchgear with necessary protective devices shall be suitably placed in the mine for automatically disconnecting the supply to any part of the system, when a fault, including earth fault, occurs. Fault current shall not be more than 750 milliamps in 550/1100 volt systems for u.g. and 50 amps in 3.3kV/6.6kV systems in O.C mines. The magnitude of the earth fault current shall be limited to these specified values by employing suitably designed restricted neutral system of power supply.

(2) Operation of switchgear and relays shall be recorded daily at the generating station, sub-station or switch station in a register kept for the purpose.

(3) Effectiveness of the switchgear and relays shall be checked once in three (03) months and results recorded in a separate register kept for the purpose.

### **Cables (other than flexible cables for portable and transportable apparatus) (Rule )**

1. Cables other than flexible cables shall be

- (a) covered with insulating material,
- (b) efficiently protected from mechanical damage, and
- (c) supported at sufficiently frequent intervals and in such a manner as to prevent damage to such cables.

2. (a) Where the voltage exceeds 125V, or where an Electrical Inspector of Mines considers that there is a risk of igniting coal dust, CH<sub>4</sub> etc. and so directs, no cables other than the following shall be used :

- (i) concentric cables, or
- (ii) 2-core/multicore cables protected by a metallic covering, or
- (iii) single core cables protected by a metallic covering which contains all conductors of a circuit.

However, where a medium voltage d.c. system is used, 2 single-core cables, protected by metallic covering, may be used for any circuit if their metallic coverings are bonded together by earth conductor, so placed that the distance between any two bonds is not greater than 30m measured along either cable.

(b) The sheath of a metal sheathed cable, and the metallic armouring of armoured cable, shall be of a thickness not less than that given in the Indian Standards.

3. The metallic covering of every cable shall be -

- (i) electrically and mechanically continuous throughout,
- (ii) earthed, if required by Rule 117, by connection to the earthing system of a conductivity not less than that of the same length of the said metallic covering,
- (iii) efficiently protected against corrosion where necessary because of its position,
- (iv) of a conductivity, at all parts, and at all joints, at least equal to 50% of the conductivity of the largest conductor enclosed therein, and
- (Metallic covering के all parts and joints की conductivity, cable के largest conductor की conductivity के 50% से कम नहीं होगी।)
- (v) So constructed, where there may be a risk of igniting CH<sub>4</sub>, coal dust or other inflammable material as to prevent, as far as practicable, the occurrence of open sparking in event of any fault / leakage from the live conductor (i.e. double armoured).

4. Where necessary, properly constructed glands shall be provided to prevent abrasion or to secure gas tightness.
5. Cables and conductors, where connected to motors, transformers, switchgear, and other apparatus, shall be so installed that-
  - (a) their metallic covering is securely attached to the apparatus, and
  - (b) the insulating material at each cable end is efficiently sealed to prevent reduction of its insulating property by entry of moisture.
6. Unarmoured cables/conductors shall be covered in metallic pipes, or metal casings, or suspended from insulators by such non-conducting material which

### **Flexible cables (Rule )**

1. Flexible cables, for portable and transportable apparatus, shall be two core or multi core type, heavily insulated, and efficiently protected against mechanical injury. Metallic covering provided to protect the flexible cable from mechanical injury, shall not be used as sole earthing conductor, but may be used for that purpose in conjunction with an earthing core.
2. Flexible cables shall not be connected to the system and apparatus except by properly constructed connectors. For HV machine, bolted type connector shall be used, and the trailing cable shall be suitably anchored at the machine end.

Provided that where there are space limitations for multiple on-board motors and equipment for transportable or portable machines, direct entry flexible cable with elastometric sealing ring, compression gland, packing gland or sealing box which does not alter the flameproof property, may be permitted if the cable entry can accept any sealing ring which has a minimum compressed axial height of 20 mm upto 200mm cable and 25 mm for higher sizes.

[12:50 PM, 2/2/2021] PYARE LAL PATEL: Flexible cables (Rule 123)

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which does not alter the flameproof property, may be permitted if the cable entry can accept any sealing ring which has a minimum compressed axial height of 20 mm upto 200mm cable and 25mm for higher sizes.

Note : When a plug and socket coupling is used, an electrical interlock or other approved device shall be provided to prevent opening of coupling while conductors are live. [Rule 125 (9)]

3. Joining of flexible cable to the main cable shall be through a circuit- breaker capable of disconnecting supply automatically from the flexible cable.

4. Flexible cable shall be examined periodically by competent person, and, if used belowground, atleast once in each shift by the operator. Defective or damaged cable shall be replaced forthwith by a cable in good condition. No flexible cable with a temporary joint shall be used.

5. If voltage of circuit exceeds low voltage (i.e. above 250V),

- - Flexible cables for transportable apparatus shall be provided with metallic screening or pliable armouring.
- - Flexible cables for portable apparatus shall have flexible metallic screening on all the power and pilot cores.

However, this shall not apply to flexible cables attached to any transportable apparatus used in opencast mines if reeling and un-reeling of such cable is necessary as per design features of the equipment.

6. When individually screened cable is used, conductance of each screen shall not be less than 25% of that of the power conductor, and the combined conductance of all screens, shall be not less than 0.15 cm<sup>2</sup> copper conductor.

{But seperately (individually) screened flexible cable की each screen की conductivity, power conductor की conductivity के 25% से कम नहीं होगी तथा सभी (all such) screens की combined (total) conductivity 0.15 cm<sup>2</sup> copper conductor की conductivity से कम नहीं होगी। }

7. Length of flexible cable with any portable/transportable apparatus shall not exceed 100 m. But it may be upto-

**250 m**

when used for longwall operation, with coal cutting machine or cutter loader or armoured face conveyor, or with shuttle car or load haul dumper, or cutter loader or like equipment for development/ de-pillaring operations.

**300 m**

with electrically operated heavy earth moving machinery in opencast mines, and

**1000 m**

with bucket wheel excavator at 11kV

8. When installed in a mine, flexible cable shall be efficiently supported and, protected from mechanical injury (by roof fall, shot firing, crushing by moving machinery or tubs).

9. Flexible cables shall not be used with apparatus other than portable / transportable apparatus.

10. When not in use, flexible cable shall be detached or otherwise isolated from the supply, and arrangements shall be made to prevent its energising by unauthorised persons.

**Note : 1. Flexible cables fall into two main categories :**

- (a) **Trailing cables** used with portable apparatus such as coal cutters, Load Haul Dumpers (LHDs), Side Discharge Loaders (SDLs) etc.
- (b) **Pliable wire armoured cables** used with transportable apparatus such as pumps, conveyors, auxiliary fans etc.

2. **Use of 600m length trailing cable with dragline.** In suitable cases, DMS (Electrical) has granted exemption under Rule 132 for 600m long pliable armoured trailing cable with draglines.

**Precautions where gas exits (Rule )**

Equipment to be FLP	Deg.I	Inbye of LVC
	Deg.II	Inbye of LVC, or Within 90 m of working face, or goaf, or In return airway
	Deg.III	Inbye of LVC, or Within 270 m of working face, or goaf, or In return airway

Signaling & telecommunication circuits o be Intrinsically safe	Deg.I	Inbye of LVC
	Deg.II	All places in the seam
	Deg.III	All places in the seam
Electric lights to be in FLP enclosures	Deg.I	Inbye of LVC
	Deg.II	All places in the seam
	Deg.III	All places in the seam

**LOCKOUT** means to physically neutralize all energies in a piece of equipment before beginning any maintenance or repair work.

Lock out involves stopping all energy flows by turning off switches on supply lines.

It also involves locking physically the switches and securing the machine, device or supply lines in a de-energised state.

**TAGOUT** means placing a warning (alert) tag or sign (TAGOUT device) on an energy isolating device, warning not to operate the machinery until the TAGOUT device is removed.

The LOCKOUT purpose is to alert other employees about the status of a machine or a system, why It has been taken out of service and identity of the individual who has applied the LOCKOUT.

## Chapter VII

### Safety requirements for overhead lines, underground cables and generating stations

- 55. Material and strength.**- (1) All conductors of overhead lines other than those specified in regulation 68 shall have a breaking strength of not less than 350 kg.
- (2) Where the voltage does not exceed 250 V and the span is of less than fifteen metres and is drawn through the owner's or consumer's premises, a conductor having an actual breaking strength of not less than 150 kg may be used.
- 56. Joints.**- (1) No conductor of an overhead line shall have more than one joint in a span and joints between conductors of overhead lines shall be mechanically and electrically secure under the conditions of operation.
- (2) The ultimate strength and the electrical conductivity of the joint shall be as per relevant Indian Standards.
- 57. Maximum stresses and factors of safety.**- (1) The load and permissible stresses on the structural members, conductors and ground wire of self supporting steel lattice towers for overhead transmission lines shall be in accordance with the specifications laid down, from time to time, by the Bureau of Indian Standards.
- (2) Overhead lines not covered in sub-regulation (1) shall have the following minimum factors of safety, namely:-
- |   |   |     |
|---|---|-----|
| (i) for metal supports                            | - | 1.5 |
| (ii) for mechanically processed concrete supports | - | 2.0 |
| (iii) for hand-moulded concrete supports          | - | 2.5 |
| (iv) for wood supports                            | - | 3.0 |
- (3) The minimum factors of safety shall be based on such load as may cause failure of the support to perform its function, assuming that the foundation and other components of the structure are intact.
- (4) The load shall be equivalent to the yield point stress or the modulus of rupture, as the case may be, for supports subject to bending and vertical loads and the crippling load for supports used as strut.
- (5) The strength of the supports of the overhead lines in the direction of the line shall not be less than one-fourth of the strength required in the direction transverse to the line.
- (6) The minimum factor of safety for stay-wires, guard-wires or bearer-wires shall be 2.5 based on the ultimate tensile strength of the wire.
- (7) The minimum factor of safety for conductors shall be two, based on their ultimate tensile strength, in addition, the conductor's tension at 32° C, without external load, shall not exceed the following percentages of the ultimate tensile strength of the conductor:-



(4) For lines of voltage exceeding 33 kV the clearance above ground shall not be less than 5.2 metres plus 0.3 metre for every 33,000 Volts or part thereof by which the voltage of the line exceeds 33,000 Volts;

Provided that the minimum clearance along or across any street shall not be less than 6.1 metres.

(5) For High Voltage Direct Current (HVDC) lines, the clearance above ground shall not be less than:-

Sl.No.	DC Voltage(kV)	Ground Clearance (mtrs.)
1.	100 kV	6.1
2.	200 kV	7.3
3.	300 kV	8.5
4.	400 kV	9.4
5.	500 kV	10.6
6.	600 kV	11.8
7.	800 kV	13.9

(6) Ground clearances shall be as specified in schedule-X.

**59. Clearance between conductors and trolley wires.-** (1) No conductor of an overhead line crossing a tramway or trolley bus route using trolley wires shall have less than the following clearances above any trolley wire-

(i) lines of voltage not exceeding 650 Volts - 1.2 metres

Provided that where an insulated conductor suspended from a bearer wire crosses over a trolley wire the minimum clearance for such insulated conductor shall be 0.6 metre.

(ii) lines of voltage exceeding 650 Volts up to and including 11,000 Volts - 1.8 metres

(iii) lines of voltage exceeding 11,000 Volts but not exceeding 33,000 Volts - 2.5 metres

(iv) lines of voltage exceeding 33 kV - 3.0 metres

(2) In any case of a crossing specified in sub-regulation (1), whoever lays his line later in time, shall provide the clearance between his own line and the line which will be crossed in accordance with the provisions of the said sub-regulation:

Provided that if the later entrant is the owner of the lower line and is not able to provide adequate clearance, he shall bear the cost for modification of the upper line so as to comply with this sub-regulation.

**60. Clearance from buildings of lines of voltage and service lines not exceeding 650 Volts.-** (1) An overhead line shall not cross over an existing building as far as possible and no building shall be constructed under an existing overhead line.

(2) Where an overhead line of voltage not exceeding 650 V passes above or adjacent to or terminates on any building, the following minimum clearances from any accessible point, on the basis of maximum sag, shall be observed, namely:-

- (i) for any flat roof, open balcony, varandah roof and lean-to-roof-
  - (a) when the line passes above the building a vertical clearance of 2.5 metres from the highest point, and
  - (b) when the line passes adjacent to the building a horizontal clearance of 1.2 metres from the nearest point, and
- (ii) for pitched roof-
  - (a) when the line passes above the building a vertical clearance of 2.5 metres immediately under the line, and
  - (b) when the line passes adjacent to the building a horizontal clearance of 1.2 metres.

(3) Any conductor so situated as to have a clearance less than that specified above shall be adequately insulated and shall be attached at suitable intervals to a bare earthed bearer wire having a breaking strength of not less than 350 kg.

(4) The horizontal clearance shall be measured when the line is at a maximum deflection from the vertical due to wind pressure.

(5) Vertical and horizontal clearances shall be as specified in schedule-X.

*Explanation:-* For the purpose of this regulation, the expression "building" shall be deemed to include any structure, whether permanent or temporary.

**61. Clearances from buildings of lines of voltage exceeding 650 V.-** (1) An overhead line shall not cross over an existing building as far as possible and no building shall be constructed under an existing overhead line.

(2) Where an overhead line of voltage exceeding 650 V passes above or adjacent to any building or part of a building it shall have on the basis of maximum sag a vertical clearance above the highest part of the building immediately under such line, of not less than-

- (i) for lines of voltages exceeding 650 Volts - 3.7 metres  
upto and including 33,000 Volts
- (ii) for lines of voltages exceeding 33 kV - 3.7 metres plus 0.30 metre  
for every additional 33,000  
Volts or part thereof.

(3) The horizontal clearance between the nearest conductor and any part of such building shall, on the basis of maximum deflection due to wind pressure, be not less than-

- (i) for lines of voltages exceeding 650 V - 1.2 metres  
upto and including 11,000 Volts
- (ii) for lines of voltages exceeding 11,000 V - 2.0 metres  
and up to and including 33,000 V
- (iii) for lines of voltages exceeding 33 kV - 2.0 metres plus 0.3  
metre for every  
additional 33kV  
or part thereof.

(4) For High Voltage Direct Current (HVDC) systems, vertical clearance and horizontal clearance, on the basis of maximum deflection due to wind pressure, from buildings shall be maintained as below:

Sl.No	DC Voltage (kV)	Vertical Clearance (mtrs.)	Horizontal Clearance (mtrs.)
1.	100 kV	4.6	2.9
2.	200 kV	5.8	4.1
3.	300 kV	7.0	5.3
4.	400 kV	7.9	6.2
5.	500 kV	9.1	7.4
6.	600 kV	10.3	8.6
7.	800 kV	12.4	10.7

(5) Vertical and horizontal clearances shall be as specified in schedule-X.

*Explanation:-* For the purpose of this regulation the expression "building" shall be deemed to include any structure, whether permanent or temporary.

**62. Conductors at different voltages on same supports.-** Where conductors forming parts of systems at different voltages are erected on the same supports, the owner shall make adequate provision to guard against danger to linemen and others, from the lower voltage system being charged above its normal working voltage, by leakage from or contact with the higher voltage system and the methods of construction and the applicable minimum clearances between the conductors of the two systems shall be as specified in regulation 69 for lines crossing each other.

(i)	Initial unloaded tension	.....	35 per cent
(ii)	Final unloaded tension	.....	25 per cent

Provided that for the conductors having a cross section of a generally triangular shape, such as conductors composed of 3-wires, the final unloaded tension at 32° C shall not exceed thirty per cent of the ultimate tensile strength of such conductor.

(8) For the purpose of calculating the factors of safety in sub-regulation (2), the following conditions shall be observed, namely:-

- (i) the maximum wind pressure shall be as specified in the relevant Indian Standards;
- (ii) for cylindrical conductors the effective area shall be taken as full projected area exposed to wind pressure; and
- (iii) the maximum and minimum temperatures shall be such as specified in the relevant Indian Standards.

(9) Notwithstanding anything contained in sub-regulation (2) to (8) in localities where overhead lines are liable to accumulations of ice or snow, the load and permissible stresses on the structural members, conductors and ground wire of self supporting steel lattice towers for overhead transmission lines shall be in accordance with the specifications laid down, from time to time, by the Bureau of Indian Standards or as specified by Appropriate Government, by order in writing.

**58. Clearance above ground of the lowest conductor of overhead lines.-** (1) No conductor of an overhead line, including service lines, erected across a street shall at any part thereof be at a height of less than-

- (i) for lines of voltage not exceeding 650 Volts - 5.8 metres
- (ii) for lines of voltage exceeding 650 Volts but not exceeding 33 kV - 6.1 metres

(2) No conductor of an overhead line, including service lines, erected along any street shall at any part thereof be at a height less than-

- (i) for lines of voltage not exceeding 650 Volts - 5.5 metres
- (ii) for lines of voltage exceeding 650 Volts but not exceeding 33 kV - 5.8 metres

(3) No conductor of an overhead line including service lines, erected elsewhere than along or across any street shall be at a height less than -

- (i) for lines of voltage upto and including 11,000 Volts, if bare - 4.6 metres
- (ii) for lines of voltage upto and including 11,000 Volts, if insulated - 4.0 metres
- (iii) for lines of voltage exceeding 11,000 Volts but not exceeding 33 kV - 5.2 metres

(4) No person shall construct brick kiln or other polluting units near the installations or transmission lines of 220 kV and above within a distance of 500 metres.

**66. Routes proximity to aerodromes.-** Overhead lines shall not be erected in the vicinity of aerodromes unless the Airport Authorities have approved in writing the route of the proposed lines as per relevant Indian Standards.

**67. Maximum interval between supports.-** All conductors shall be attached to supports at intervals not exceeding the safe limits based on the ultimate tensile strength of the conductor and the factor of safety specified under regulations 57.

Provided that in the case of overhead lines carrying conductors of voltage not exceeding 650 V when erected in, over, along or across any street, the interval shall not, without the consent in writing of the Electrical Inspector, exceed 65 metres.

**68. Conditions to apply where telecommunication lines and power lines are carried on same supports.-** (1) Every overhead telecommunication line erected on supports carrying a power line shall consist of conductors each having a breaking strength of not less than 270 kg.

(2) Every telephone used on a telecommunication line erected on supports carrying a power line shall be suitably guarded against lightning and shall be protected by cut-outs.

(3) Where a telecommunication line is erected on supports carrying a power line of voltage exceeding 650 V, arrangement shall be made to safeguard any person against injury resulting from contact, leakage or induction between such power and telecommunication lines.

**69. Lines crossing or approaching each other and lines crossing street and road.-** Where an overhead line crosses or is in proximity to any telecommunication line, the owner of either the overhead line or the telecommunication line, whoever lays his line later, shall arrange to provide for protective devices or guarding arrangement and shall observe the following provisions, namely:-

(i) when it is intended to erect a telecommunication line or an overhead line which will cross or be in proximity to an overhead line or a telecommunication line, as the case may be, the person proposing to erect such line shall give one month's notice of his intention so to do along with the relevant details of protection and drawings to the owner of the existing line;

(ii) guarding shall be provided where lines of voltage not exceeding 33 kV cross a road or street;

(iii) where an overhead line crosses or is in proximity to another overhead line, guarding arrangements shall be provided so to guard against the possibility of their coming into contact with each other;

(iv) where an overhead line crosses another overhead line, clearances shall be as under:-

(Minimum clearances in metres between lines crossing each other)

Sl. No	Nominal System Voltage	11-66 kV	110-132 kV	220 kV	400 kV	800 kV
1.	Low and Medium	2.44	3.05	4.58	5.49	7.94
2.	11-66 kV	2.44	3.05	4.58	5.49	7.94
3.	110-132 kV	3.05	3.05	4.58	5.49	7.94
4.	220 kV	4.58	4.58	4.58	5.49	7.94
5.	400 kV	5.49	5.49	5.49	5.49	7.94
6.	800 kV	7.94	7.94	7.94	7.94	7.94

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

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

(Minimum clearances in metres between AC and DC lines crossing each other)

Sl. No.	System Voltage AC/DC	100 kV DC	200 kV DC	300 kV DC	400 kV DC	500 kV DC	600 kV DC
1.	Low and Medium AC	3.05	4.71	5.32	6.04	6.79	7.54
2.	11-66 kV AC	3.05	4.71	5.32	6.04	6.79	7.54
3.	110-132 kV AC	3.05	4.71	5.32	6.04	6.79	7.54
4.	220 kV AC	4.58	4.71	5.32	6.04	6.79	7.54
5.	200 kV DC	4.71	4.71	5.32	6.04	6.79	7.54

(c) any exploration or interspaced well-head being drilled in the area where abnormal pressure conditions are known to exist;

(iv) any area within four and one half meters of :

(a) any producing well-head where a closed system of production is employed such as to prevent the emission or accumulation in the area in normal circumstances of a hazardous atmosphere; or

(b) exploration or interspaced well-head being drilled in an area where the pressure conditions are normal and where the system of drilling employed includes adequate measures for the prevention in normal circumstances of emission or accumulation within the area of a hazardous atmosphere; or

(c) an oil-well which is being tested other than by open flow.

(3) "hazardous atmosphere" means an atmosphere containing any inflammable gases or vapours in a concentration capable of ignition.

(4) "Zone 0 hazardous area" means "an area in which hazardous atmosphere is continuously present."

(5) "Zone 1 hazardous area" means "an area in which hazardous atmosphere is likely to occur under normal operating conditions".

(6) "Zone 2 hazardous area" means "an area in which hazardous atmosphere is likely to occur under abnormal operating conditions".

**111. Shot-firing.** - (1) When shot-firing is in progress adequate precautions shall be taken to protect apparatus and conductors, other than those used for shot-firing, from injury.

(2) Current from lighting or power circuits shall not be used for firing shots.

(3) The provisions of regulation 107 shall apply in regard to the covering and protection of shot-firing cables, and adequate precautions shall be taken to prevent such cable touching other cables and apparatus.

**112. Signaling.** - Where electrical signaling is used,-

(i) adequate precautions shall be taken to prevent signal and telephone wires coming into contact with other cables and apparatus;

(ii) the voltage used in any one circuit shall not exceed 30 V;

(iii) contact-makers shall be so constructed as to prevent the accidental closing of the circuit; and

(iv) bare conductors, where used shall be installed in suitable insulators.

**113. Haulage.** - Haulage by electric locomotives on the overhead trolley-wire system, at voltage not exceeding 650 V and haulage by storage battery locomotives may