INTER PLANT STANDARD IN STEEL INDUSTRY		
IPSS	**CODE OF PRACTICE FOR SELECTION OF ELECTRIC CABLES FOR USE ON EOT CRANES**	**IPSS: 2-02-005-18 (Second Revision)**
	Corresponding IS does not exist	Formerly: IPSS: 2-02-005-97 (First Revision)

0. FOREWORD

0.1 Interplant standardization in steel industry has been initiated under the aegis of the Indian Standards Institution (ISI) and the Steel Authority of India Limited (SAIL). This Interplant Standards is prepared by the Standard Committee on E O T Cranes, IPSS 2:2 with the active participation of the representatives of all the steel plants and leading consultants and was first revised in March, 1997. Thereafter, standard second revision done by the Standard Committee in March, 2018.

0.2 Interplant standardization for steel industry primarily aims at achieving rationalization and unification of parts and assemblies of process and auxiliary used in steel plants and these are intended to provide guidance to the steel plant engineers, consultants and manufacturers in their design activities.

0.3 This standard was first brought out in 1985 and revised in 1997. This revision has been carried out to incorporate various modifications to update the standard.

1. SCOPE

1.1 This interplant standard specifies the methods of selection of electric cables for use on EOT Cranes. The details of various correction factors and ratings are also covered in this standard.

1.2 This standard does not cover the requirements of special cables such as those used with load cells, thyristors etc.

2. REFERENCES

Standard Reference	Description
IS : 694-2010	PVC insulated cables for working voltages upto and including 1100V.
IS : 1554 (Part 1) - 1988	PVC insulated (heavy duty) electric cables : Part 1 for working voltage up to and including 1100 V.
IS : 3961 (Part 2) - 1967	Recommended current ratings for cables : Part 2 PVC insulated and PVC sheathed heavy duty cables.
IS : 3961 (Part 3) - 1968	Recommended current ratings for cables : Part 3 Rubber insulated cables.
IS : 3961 (Part 5) – 1988 (R2016)	Recommended current ratings for cables : Part 5 PVC insulated light duty cables.
IS : 3975 - 1999	Mild steel wires, formed wires and tapes for armouring of cables.
IS : 5831 - 1984	PVC insulated and sheath of electric cables.
IS : 6380 – 1984	Elastomeric insulated and sheath of electric cables
IS : 7098 (Part 1) - 1988	Cross linked polyethylene insulated PVC sheathed cables : Part 1 For working voltage up to and including 1100V.
IS : 8130 - 1984	Conductors for insulated electric cables and flexible cords.
IS : 9968 (Part 1) - 1988	Elastomer insulated cables : Part 1 For working voltage up to and including 1100 V.
IPSS : 1-04-041-03	General requirements for control panels for cranes.
IPSS : 1-04-042-03	Particular requirements for control panels for a c cranes.
IPSS : 1-04-043-03	Particular requirements of control panels for d c cranes.

3. CABLES FOR USE ON E O T CRANES

The cables as described in 3.1 and 3.2 shall be used for different applications on EOT cranes.

3.1 **CABLES FOR FIXED WIRING**

3.1.1 Cables for use in cranes in hot locations, such as hot metal, soaker, stripper and floor chargers and also for other cranes if specified.

a. **Power Cables for dc Cranes** : Unless otherwise specified by the purchaser, round, single core, unarmoured 1100 V grade, stranded, annealed high conductivity tinned copper conforming to Table 2 of IS : 8130 – 1984. The insulation shall be heat resisting general purpose based on duty 1 rubber / EPR complying with the requirement of type 1, sl. No. (iii) (a) of Table 1 of IS : 6380 – 1984. The sheathed shall be general purpose PCP/ CSP sheath type HOFR complying with the requirements specified in sl. No. (iv) (a) of Table 1 of IS : 6380 – 1984. If specified by the purchaser, armouring shall be provided in accordance with the agreement between the purchaser and the supplier.

b. **Power Cables for ac Cranes** : Unless otherwise specified by the purchaser, 3 core, armoured, 1100 V grade, stranded, annealed high conductivity double tinned copper conductor conforming to Table 2 of IS : 8130 – 1984. The insulation shall be heat resisting general purpose based on butyl rubber / EPR complying with the requirement of type – 1, sl. No. (iii) (a) of Table 1 of IS : 6380 – 1984. The sheath shall be general purpose PCP/ CSP sheath type HOFR complying with the requirements specified in sl. No. (iv) (a) of Table of IS : 6380 – 1984. Armouring shall be galvanized round steel wire / steel tape conforming to IS : 3975 – 1988. If specified by the purchaser, unarmoured cables shall be provided in accordance with the relevant Indian Standard given above.

c. **Control Cables for ac and dc Cranes** – Round multicore unarmoured, 1100 v grade, stranded 2.5 sq. mm annealed high conductivity double linned copper conductor conforming to Table 2 of IS : 8130 – 1984. The insulation shall be heat resisting general purpose, based on butyl

rubber . EPR complying with the requirements of type 1, sl. No. (iii) (a) of Table 1 of IS : 6830-1971. The seath shall be general purpose PCP/CSP, sheath type HOFR complying with the requirements specified in sl. No. (iv) (a) of Table 1 of IS : 6380 – 1984.

d. **Lighting Cables** – Round multicore unarmoured / armoured, 1100 V grade, stranded, H grade copper conforming to Table 2 of IS : 8130 – 1984 and HRPVC insulated conforming to type 4 of IS 5831-1984. Inner sheath of thermoplastic material and outer sheath of PVC congorming to type 6 of IS : 5831 – 1984.

e. **Panel Wiring** – Round, single core, unarmoured 1100 V grade, stranded (with minimum 3 strands), annealed high conductivity double tinned copper conforming to Table 2 of IS : 8130 – 1984, of minimum 2.5 sq. mm cross sectional area, HRPVC insulated conforming to IS : 5831-1984, Type 4. Panel wiring shall generally be conforming to the provision of IPSS : 1-04-041-03.

3.1.2 **For other cranes**

a. **Power Cables for dc Cranes** : Unless otherwise specified by the purchaser, round, single core, unarmoured 1100 V grade, stranded H grade aluminium or high conductivity copper wire conforming to Table 2 of IS : 8130 – 1984, PVC insulation conforming to IS : 5831 – 1971, type 1. Inner sheath of thermoplastic material and outer sheath of PVC conforming to type 6 of IS : 5831 – 1971

b. **Power Cables for ac Cranes** : Unless otherwise specified by the purchaser, 3 core, armoured, 1100 V grade, stranded H grade aluminium conforming to Table 2 of IS : 8130 – 1984, PVC insulationconforming to IS : 5831 – 1984, type 1. Inner sheath shall be thermoplastic material. Outer sheath shall be PVC conforming to type 6 of IS : 5831 – 1984. Armouring shall be galvenised round steel wire conforming to IS : 3975 – 1988.

c. **Control Cables** – Round multicore unarmoured/ armoured, 1100 v grade, stranded 2.5 sq. mm annealed high conductivity double tinned

copper conductor conforming to Table 2 of IS : 8130 – 1984, PVC insulation conforming to IS : 5831 – 1984, type 1..

d. **Lighting Cables** – Round multicore unarmoured / armoured, 1100 V grade, stranded, 2.5 sq. mm annealed high conductivity double tinned copper conductor conforming to Table 2 of IS : 8130 – 1984 and PVC insulation conforming to type 1 of IS 5831-1984.

e. **Panel Wiring** – Round, single core, unarmoured, 1100 V grade, stranded (with minimum 3 strands), annealed high conductivity double tinned copper conforming to Table 2 of IS : 8130 – 1984, 2.5 sq. mm nominal area, PVC insulated conforming to IS : 5831-1984, Type 4, IPSS : 1-04-041-03 shall be followed in general.

3.1.3 **Lifting Magnet Cables** – Round two core , unarmoured, 1100 V grade flexible cable with annealed high conductivity tinned copper conductor conforming to Table 2 of IS : 8130-1984, 16 sq. mm or higher nominal area according to requirement, rubber insulated, heavy duty, PCP sheathed, conforming to IS : 9968 (Part 1) – 1988.

3.1.4 **Flexible Trailing Cable** – 1100 V grade heat resistant tinned, annealed flexible copper conductor, coloured butyl rubber insulated, core laid up and sheathed overall with black coloured RPCP.

3.2 **CABLES FOR FESTOONED WIRING**

3.2.1 Cables for use in cranes in hot location, such as hot metal, soaker, stripper and floor chargers and also for other cranes, if specified.

a. **Power Cables for dc Cranes** : Round, single core / multicore, unarmoured flexible power cable, 1100 V grade, annealed high conductivity double tinned copper conductor conforming to class 5 in accordance with 7 of IS : 8130 – 1984. The insulation shall be heat resisting elastomeric based on butyl rubber / EPR conforming to 6.1.1. of IS : 6380 – 1984. The sheathed shall be general purpose PCP/ CSP sheath type HD HOFR conforming to Table 1 of IS : 6380 – 1984.

b. **Power Cables for ac Cranes** : Round, 3 core, unarmoured flexible power cable, 1100 V grade, annealed high conductivity double tinned copper conductor conforming to class 5 in accordance with 7 of IS : 8130 – 1984. The insulation shall be heat resisting elastomeric based on butyl rubber / EPR conforming to 6.1.1. of IS : 6380 – 1984. The sheathed shall be general purpose PCP/ CSP sheath type HD HOFR conforming to Table 1 of IS : 6380 – 1984. Interstices of the core shall be filled with non- hygroscopic material. If the diameter of 3 core cableis more for arranging in the festooned cable system, single core cable, may be used by mutual agreement between the supplier and the purchaser.

c. **Control Cables for ac and dc Cranes**: Round, multicore, unarmoured flexible power cable, 1100 V grade, annealed high conductivity double tinned copper conductor conforming to class 5 in accordance with 7 of IS : 8130 – 1984. The insulation shall be heat resisting elastomeric based on butyl rubber / EPR conforming to 6.1.1. of IS : 6380 – 1984. The sheathed shall be general purpose PCP/ CSP sheath type HD HOFR conforming to Table 1 of IS : 6380 – 1984.Interstices of the core shall be filled with non- hygroscopic material.

d. **EarthingCables for ac Cranes** – Earthing cables shall be single core, otherwise same as power cables for dc cranes in hot location [see item 3.2.1 (a) above]

3.2.2 **For other Cranes**

a. **Power Cables for dc Cranes** – Power cables shall be flexible otherwise same as power cables for dc cranes in hot location [see item 3.2.1 (a)].

b. **Power Cables for ac Cranes** – Power cables shall be flexible otherwise same as power cables for ac cranes in hot location [see item 3.2.1 (b)].

c. **Control Cables for ac and dc Cranes** – Control cables shall be flexible otherwise same as power cables for dc cranes in hot location [see item 3.2.1 (c)].

d. **Earthing Cables for ac Cranes** – Cables shall be same as power cables for dc cranes in hot location [see item 3.2.1 (a)].

4. METHOD OF SELECTION

4.1 Cable selection shall take into consideration the ambient temperature specified, grouping factor, duty factor of the drive and the voltage drop on the crane up to the motor terminals which shall not exceed 3 % with the largest drive motor starting and second largest motor running. The cables at 40 deg ambient temperature according to IS : 3961 (Part 2) – 1967, IS : 3961 (Part 3) – 1968 and IS : 3961 (Part 5) – 1968 with the correction factor given in 4.1.1 to 4.1.3.

4.1.1 Ambient Temperature Corrections (C1)

4.1.2 Group rating Factor (C2)

4.1.3 Duty Rating factor – If the equipment is rated to intermittent duty or short time duty, the correction factor shall be as follows :

a. For intermittent, duty factor (C3) shall be 10 / CDF where CDF is cyclic duration factor in percentage (such as 25, 40 or 60 etc.).

b. For short time duty, factor (C3) shall be 1.7 in case of ½ hour rating and in case 1 hour rating.

4.2 The required current rating shall be computed by dividing the current rating of the equipment by the product of the correction factors, listed above. The cable with the nearest higher current rating shall be selected.

$$I_{required} = \frac{I_{equipment}}{C1 \times c2 \times c3}$$

4.2.1 To find the cable rating for supplying a motor with the following details:

Motor details

7.5 kW, 415 V, 3 phase, 1000 rev / min, full load current 14 A, squirrel cage induction motor, cyclic duration factor 60 %, reference ambient 40^0 C, site condition 50^0 C ambient , Cable laid on surface with 3 other cables having 30 horizontal clearance between the cables.

a. Current rating of 7.5 kW, 1000 rev. / min motor at 40 0 C ambient is 14 A. Since the motor is being operated at 50 0 C ambient, the motor actually expected to deliver 90 % of its rated output, namely 7.5 x 0.9 = 6.75 kW (approx.). The current rating for this output is 12.5 A. It is assumed that 12.5 A is the full load current of the motor.

b. Suppose a three core aluminium conductor cable with PVC insulated and sheath is sufficient.

c. Correction Factors

i) Ambient (C1) = 0.82 (according to 5.2)

ii) Group Rating (C2) = 0.8 (according to 6.1.5)

iii) Duty (C3) = 10/ 60 = 1.29

Product of the correction factors © = C1 x C2 x C3

= 0.8 x 0.8 x 1.29 = 0.846

Required current is 12.5 / 0.846 = 14.7 A

Hence we should select an aluminium conductor PVC insulated and sheathed cable which is capable of carrying current more than 14.7 A. Size of the conductor shall be rechecked for voltage drop and short circuit protection.

5. RATING FACTORS FOR AMBIENT CORRECTIONS

5.1 Correction factors for air temperature of single core and multicore cables are the same.

5.2 **For PVC Insulated Cables**

Reference ambient air temperature - 40^0 C

Maximum conductor temperature - 70^0 C

Air Temperature	Rating Factor	
	For Cables	For Flexible Cords
25 deg C	1.22	-
30 deg C	1.15	1.09
35 deg C	1.08	1.04
40 deg C	1.00	1.00
45 deg C	0.91	0.95
50 deg C	0.82	0.77
55 deg C	0.70	0.54

5.3 **For Heat Resisting Insulated Cables**

Reference ambient air temperature - 40 deg C

Maximum conductor temperature - 85 deg C.

Air Temperature	Rating Factor
30 deg C	1.10
35deg C	1.05
40deg C	1.00
45deg C	0.94
50deg C	0.88
55deg C	0.82
60deg C	0.74
65deg C	0.67
70deg C	0.58

5.4 **Heat Resisting Elastomeric (Butyl & EPR) Insulated Cables**

5.4.1 **Standard Cables for Fixed Wiring**

Reference ambient air temperature = 40 deg C.

Maximum conductor temperature = 90 deg C for EPR insulated cable

Maximum conductor temperature = 85 deg C for butyl insulated cables

Air Temperature	Rating Factor	
	For Cables	For Flexible Cords
30 deg C	1.10	1.12
35 deg C	1.05	1.07
40 deg C	1.00	1.00
45 deg C	0.94	0.94
50 deg C	0.88	0.88
55 deg C	0.82	0.82
60 deg C	0.74	0.77
65 deg C	0.67	0.70
70 deg C	0.58	0.63

5.3.2 **Flexible Cables for Festooned Wiring**

Reference ambient air temperature = 40 deg C.

Maximum conductor temperature = 90 deg C for EPR insulated cable

Maximum conductor temperature = 85 deg C for butyl insulated cables

Rating factors are same as given in 4.2.1.

6. GROUP RATING FACTORS

Group rating factors are same irrespective of the type of the cables and depend on condition of installation only.

6.1 Multicore Cables

6.1.1 Cables laid on cable trays Exposed to Air – The cables spaces by one cable diameter and tray in tiers by 300 mm. The clearance between the wall and the cable is 25 mm.

No. of Cable Trays in Tier	Group RatingFactors No. of Cables				
	1	2	3	6	9
1	1.00	0.98	0.96	0.93	0.92
2	1.00	0.95	0.93	0.90	0.89
3	1.00	0.94	0.92	0.89	0.83
6	1.00	0.93	0.90	0.87	0.86

6.1.2 Cables laid on Cable Trays Exposed to Air – The cables touching and trays in tiers spaced by 300 mm. The clearance between the wall and the cable in 25 mm.

No. of Cable Trays in Tier	Group Rating Factors No. of Cables				
	1	2	3	6	9
1	1.00	0.84	0.80	0.75	0.73
2	1.00	0.80	0.76	0.71	0.69
3	1.00	0.78	0.74	0.70	0.68
4	1.00	0.76	0.72	0.68	0.66

6.1.3 Cables Laid in Exposed Air with Maintained Spacing of ¼ to 1 Cable Diameter

No. of Cable Trays in Tier	Group Rating Factors No. of Cables					
	1	**2**	**3**	**4**	**5**	**6**
1	1.00	0.93	0.87	0.84	0.83	0.82
2	0.89	0.83	0.79	0.76	0.75	0.74
3	0.77	0.76	0.72	0.70	0.69	0.68
4	0.77	0.72	0.68	0.67	0.66	0.65
5	0.75	0.70	0.66	0.65	0.64	0.63
6	0.74	0.69	0.64	0.63	0.62	0.61

6.1.4 Cable Laid Inside Trenches with Covers on Cable Trays where Air Circulation is Restricted – The cables spaced by one cable dia and the trays in tiers by 300 mm. The clearance of the cable from the wall is 25 mm.

No. of Cable Trays in Tier	Group Rating Factors No. of Cables				
	1	**2**	**3**	**6**	**9**
1	0.95	0.90	0.88	0.85	0.84
2	0.90	0.85	0.83	0.81	0.80
3	0.88	0.83	0.81	0.79	0.78
6	0.86	0.81	0.79	0.77	0.76

6.1.5 Cables Laid in Single Way Duct / Pipes in Horizontal Formation

No. of cables in groups	Group Rating Factors Spacing between trefoils			
	Touching	30 mm	45 mm	60 mm
2	0.88	0.90	0.92	0.94
3	0.82	0.84	0.87	0.89
4	0.77	0.80	0.84	0.87
5	0.74	0.78	0.82	0.85
6	0.71	0.76	0.81	0.84

6.2 Single Core Cables Laid in Trefoil Formation

6.2.1 Cable Laid in Ducts in Horizontal Formation

No. of Cables in Groups	Group rating Factors Spacing between trefoils		
	Touching	45 mm	60 mm
2	0.87	0.90	0.91
3	0.79	0.83	0.86
4	0.74	0.79	0.82
5	0.71	0.76	0.80

6.2.2 Cables Laid on Racks / Trays in Covered Trench Where Air Circulation is Restricted – Trefoils are separated by 2 cable dia horizontally and the trays in tiers with 300 mm gap between them.

No. of racks /Trays in Tiers	Group rating Factors No. of Trefoils in Horizontal Formation		
	1	2	3
1	.95	0.90	0.88
2	.90	0.85	0.83
3	.88	0.83	0.81
6	.86	0.81	0.79

6.2.3 Cables Laid on Racks / Trays Exposed in Air – Trefoils are separated by 2 cable dia horizontally and the trays in tiers with 300 mm gap between them.

No. of racks /Trays in Tiers	Group rating Factors No. of Trefoils in Horizontal Formation		
	1	2	3
1	1.00	0.98	0.96
2	1.00	0.95	0.93
3	1.00	0.94	0.92
6	1.00	0.93	0.90

6.3 For any other condition of the installation, manufacturer of the cable may be consulted.

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