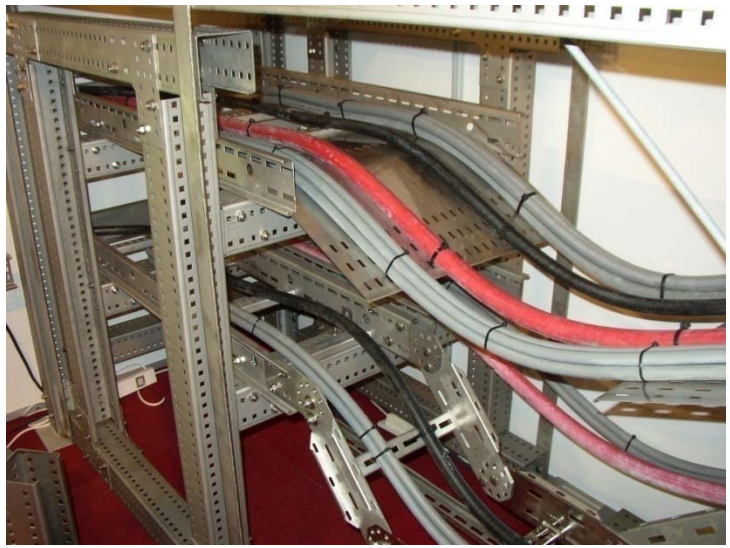
Session 14 – Cable Support Systems

Cable Support Systems in the International World

IEC61537-2004

If full details of the cabling layout are available then the likely cable load can be calculated using either manufacturer's published information or the tables of Cable Weights and Diameters which are given below. However it is often necessary to select a tray or ladder design in the absence of accurate information on the likely cable load. To assist this selection process a useful approach can be to choose a likely size of tray or ladder and then to estimate the maximum cable weight which is capable of being contained within it. This estimate may be arrived at using the following guide:-

Max. cabling capacity (kg/m) = Cable laying area (m2) x 2800



SOURCE IEx

International Cable Support Standards & How they compare vs. NEC/NEMA Requirements and standards

CABLE TRAY AND LADDER RACK	
IEC	**ANSI/NEMA/NFPA 70**
Definition	
Ladder Rack	Ladder Cable Tray
Cable Tray	Cable Tray (6" and bigger)
	Channel : one piece tray, solid or ventilated, ((4" and smaller)
Description	
Ladder Rack	Ladder Cable Tray
Designed, constructed, tested and installed in accordance with BS6946 & IEE Wiring Regulations (BS7671)	Designed, constructed, tested and installed in accordance with NEC article 318 & NEMA VE 1 & 2 METAL CABLE TRAY SYSTEMS or NEMA FG 1 FIBREGLASS CABLE TRAY SYSTEMS
For installation refer to IEE Wiring Regulations. BS7671	For Installation refer to NEMA VE 2 For permissible cable types to be installed in cable trays refer to NFPA 70 article 318-3 For cable tray allowable fill refer to NEC article 318-9 & 10

International Cable Support Standards & How they compare vs. NEC/NEMA Requirements and standards

CABLE TRAY AND LADDER RACK	
IEC	**ANSI/NEMA/NFPA 70**
Typical rung spacing 300mm; other spacings are available as standard	Typical rung spacing is 9"
Standard length 3m or 6m	Standard length 12ft or 24ft
Standard widths 150, 300, 450, 600, 750 and 900mm	Standard widths 6", 12", 18", 14", 30", and 36"
Materials typically hot dipped galvanised steel, aluminium, or GRP	Materials typically hot dipped galvanised steel, aluminium, fibreglass
Classified as, Medium, Heavy, and Extra Heavy Duty	Classification is in accordance to NEMA VE 1
Tray	Channel or Trough
Designed, constructed, tested, and installed in accordance with BS6946, Specification for Metal Channel Cable Support Systems, BS7671 Requirements for Electrical Installations, and IEE Wiring Regulations.	Designed, constructed, tested, and installed in accordance with NEC article 318 and NEMA VE 1 Metal Cable Systems or NEMA FG 1 Fibreglass Cable Tray Systems. Installation Guidance NEMA VE 2. For permissible cable types to be installed in trays NEC article 318-3.

Support Load Calculation
Per IEC 61537

Even spread load and point weights
All load tests are done with evenly distributed load. To be able to calculate from an evenly distributed load to a point load this formula is used

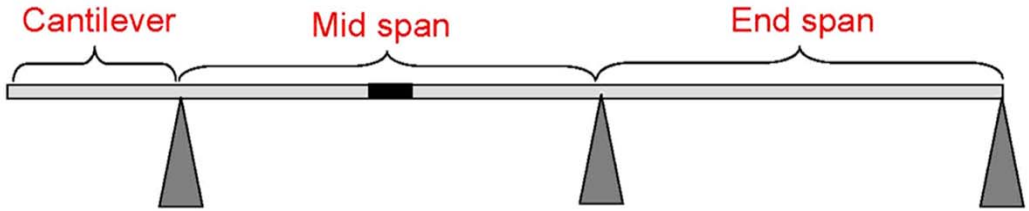
$$\text{Evenly Distributed Load} = \frac{\text{2 X Point Load}}{\text{Support Distance}}$$

When using this formula point loads can be counted for and used as design basis. Even if this
equation takes into account that the point load is placed on worst part of the span, i.e. the mid
point, it should always be a goal to place the equipment as close to the supports as possible.

Support Load Calculation
Per IEC 61537

One or more spans (IEC 61537 7.3i)

For installations with more than one span it is important to notice that the loading capacity is not the same form one end to the other. The middle span will be able to handle more load than the two spans on the end. It can therefore be necessary to reduce the distance between the supports for the end spans. For some of the installations the end span will have less load to carry than the mid spans, however if the load is evenly distributed from one end to the other the support distance have to be reduced with ¼ on both ends. The load capacity is reduced a great deal by setting up just one single span.



For all the tests according to IEC61537 both the mid span and the end span are tested in terms of safe working load and deflection. For those cases where splice connectors have been used on the end span, it's been placed ¼ from the support point, i.e. the most favourable position.

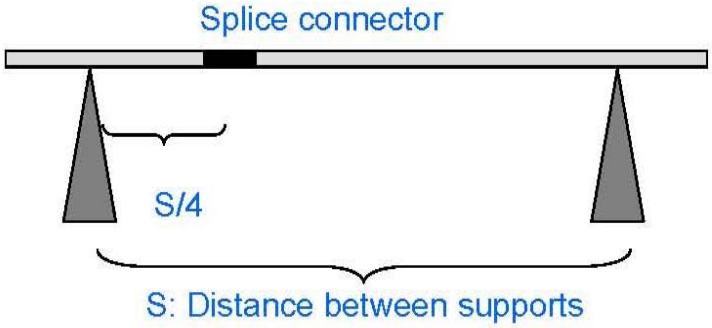
Support Load Calculation
Per IEC 61537

Deflection

Deflection will vary over the spans. The mid span will have less deflection than the end spans and the single spans. Deflection tests according to IEC 61537 have been carried out. The tests are done on single spans, i.e. “a worst case” approach. According to the standard the deflection must not be more than 1:100, i.e. that deflection for example on a span on 3 meters can’t be more than 3 cm.

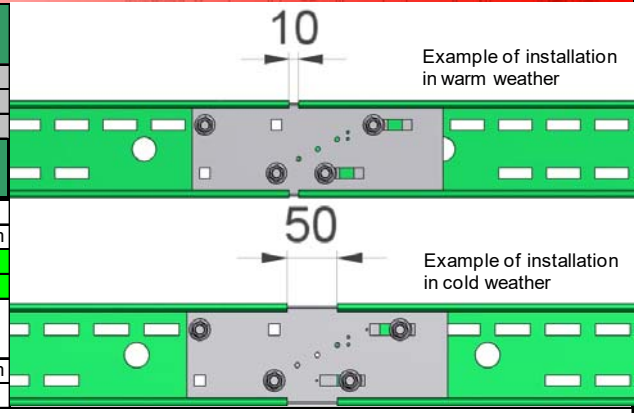
Placing of splice connector (IEC 61537 7.3j)

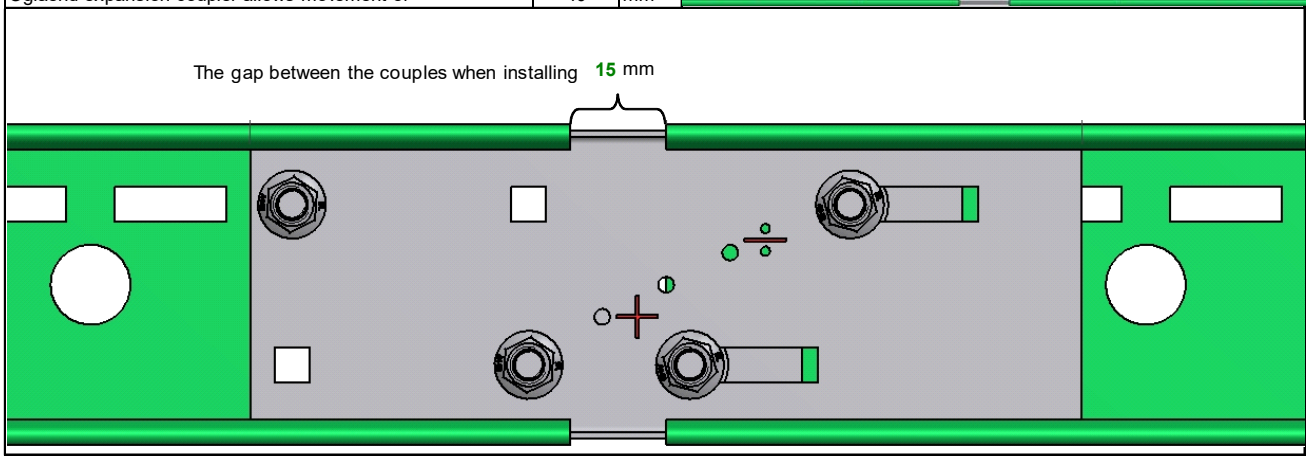
In reality it is hard to plan the locations of the splice connectors, but it is however important to be aware of this. The least beneficial location for the splice connectors are at the mid point of the span or right over the support. Placing the splice connector in these two places should be avoided, especially on end spans. If possible, it is preferred to put the splice connectors ¼ of the span length from the support.



Expansion Splice Plates
Recommended Uses

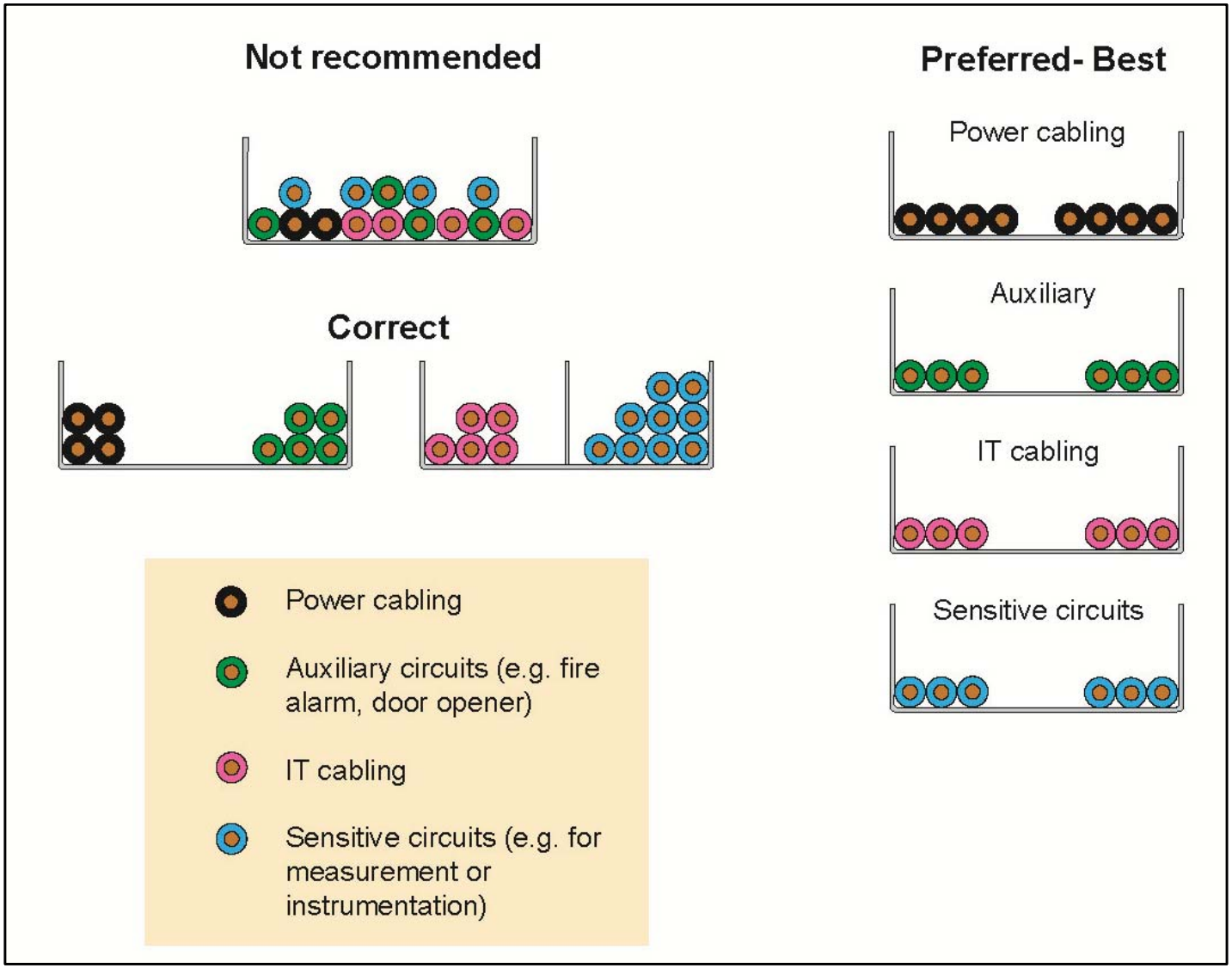
Temperature data	Fill in values in grey cells	
Minimum temperature at site	-15	°C
Maximum temperature at site	25	°C
Temperature when installing cable ladders	20	°C
Calculations	**Calculate**	
Temperature differential	40	°C
Expansion of stainless steel for this temperature range	0.69	mm/m
Expansion coupler gap when installing (Including safety factor)	15.0	mm
Minimum distance between expansion couplers	58	m
Constants		
Expansion of steel per increased °C:	0.0173	mm/m
Oglaend expansion coupler allows movement of	40	mm





SOURCE IEx

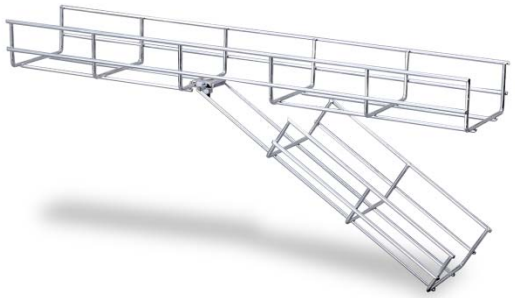
Cable separation within cable management systems



Cable Tray Wiring

More use of protection by location than is typical in US installations. The use of basket tray is typical for light weight last meter cable runs in onshore applications. The use of ventilated cable tray is common for heavier weight cables and offers more protection in offshore applications.

Cable ladder is typically used in feeder applications for longer runs of multiple cables or of higher ampacity and weight.



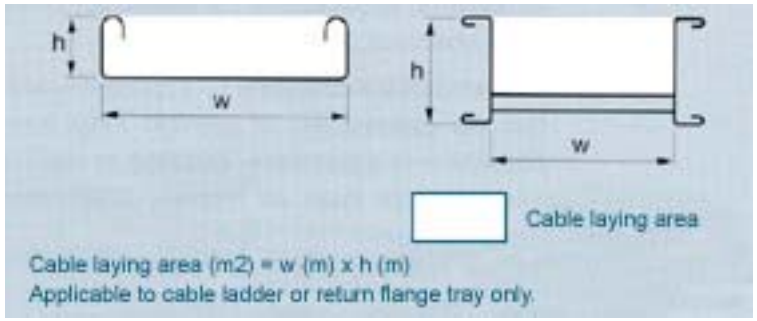
Cable Support Systems in the International World

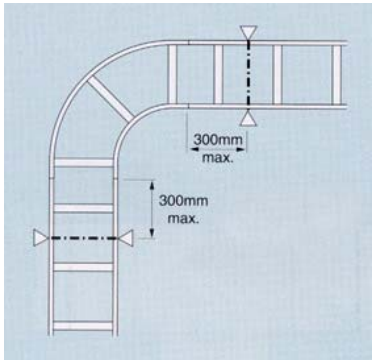
Typical Cable Weight Information…

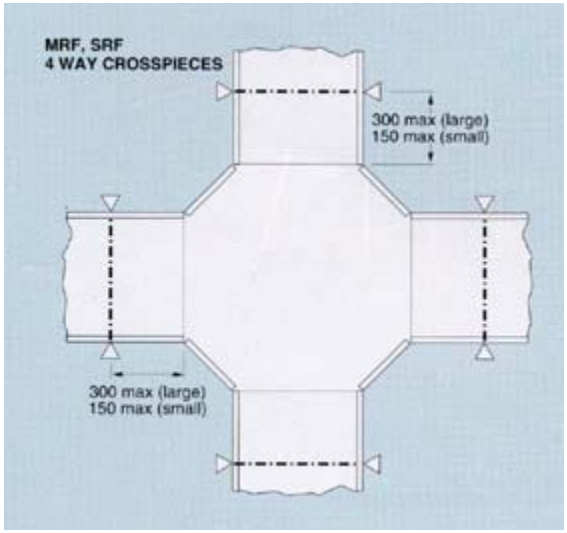
PVC Unarmored Stranded Copper Power Cables to BS6346						
Nom. Area of Conductor, mm^2	2 core		3 core		4 core	
	kg/m	D mm	kg/m	D	kg/m	D mm
25	0.7	18.4	1.0	20.4	1.3	22.7
35	0.9	20.0	1.3	22.4	1.7	25.0
50	1.2	22.2	1.7	25.4	2.3	28.6
70	1.7	24.6	2.4	28.4	3.1	32.2
95	2.3	28.2	3.3	33.1	4.3	37.2
120	2.8	30.9	4.0	36.0	5.3	40.6
150	3.5	34.1	4.9	39.7	6.5	45.0
185	4.2	37.8	6.1	44.1	8.0	49.8
240	5.5	43.2	8.0	49.6	10.6	56.2
300	7.0	47.2	9.7	55.0	13.2	62.5
400	8.5	53.2	12.6	61.4	16.7	69.6

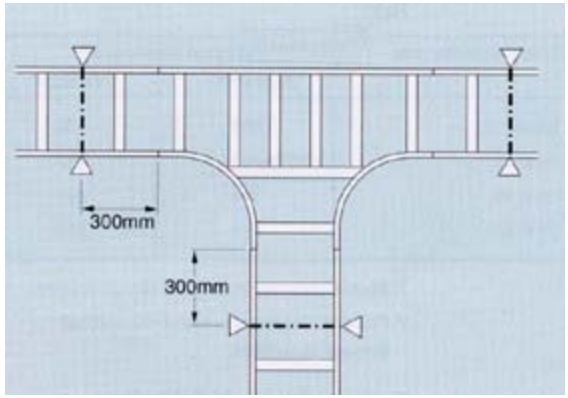
Cable Support Systems in the International World

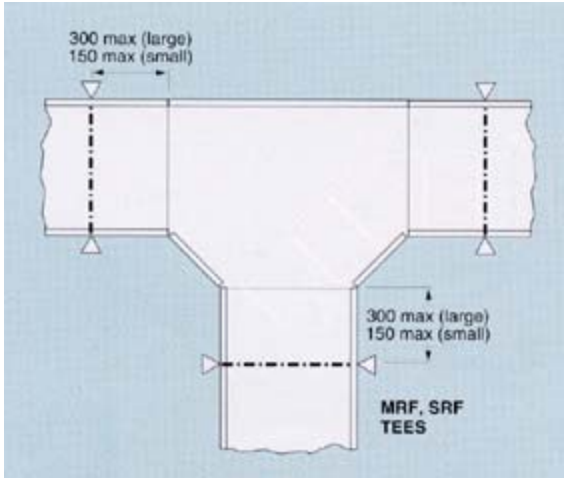
Support of cable tray and ladder is typically done in the same fashion as US installations but generally has fewer restrictions as to loading design. Calculations for loading of cable into tray is based upon manufacturers cable data compared to loading data for tray manufacturer.



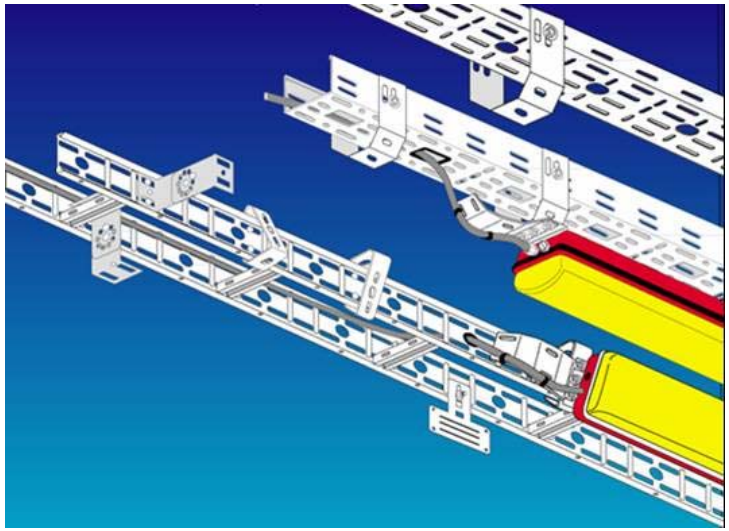




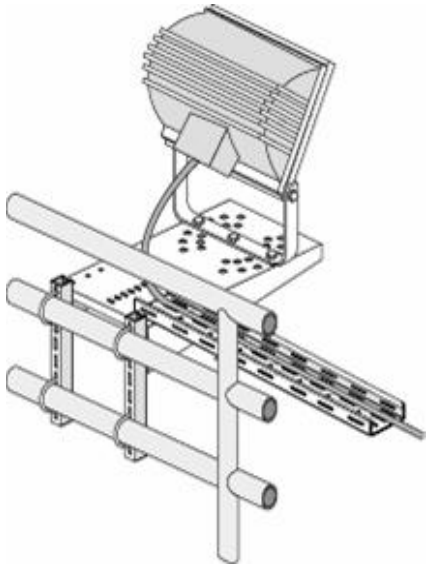




Cable Support Systems in the International World



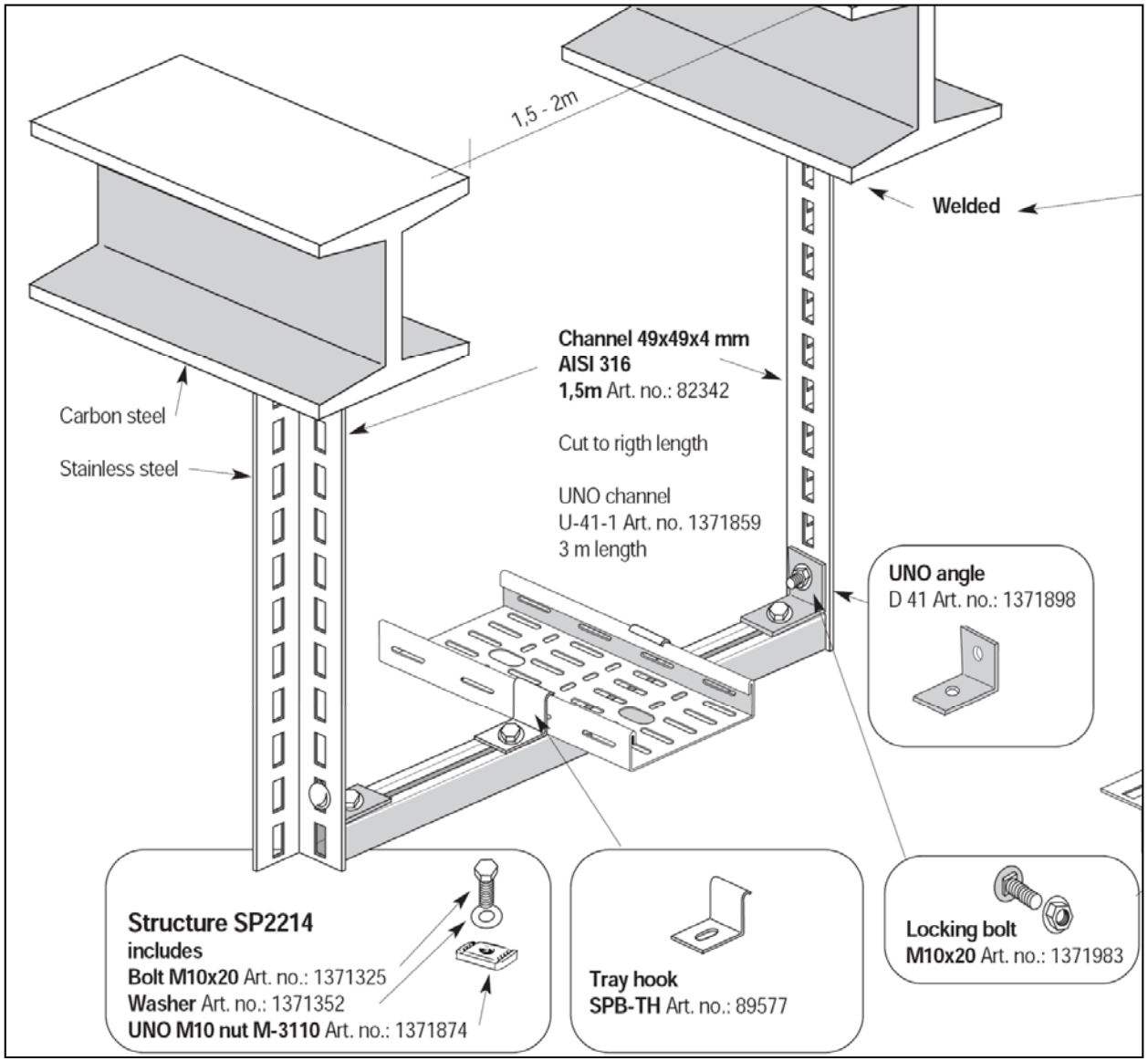
It is not uncommon to use either the cable tray or ladder to be used as a means to directly mount lighting fixtures to the support structure. Special bracketry is designed for various brands of products to be supported in this fashion. Examples of these types of installations are shown here….



Stretch preventors are typically used to relieve strain on the cable as the enter light fittings.

SOURCE IEx

Cable Support Systems in the International World - Typical



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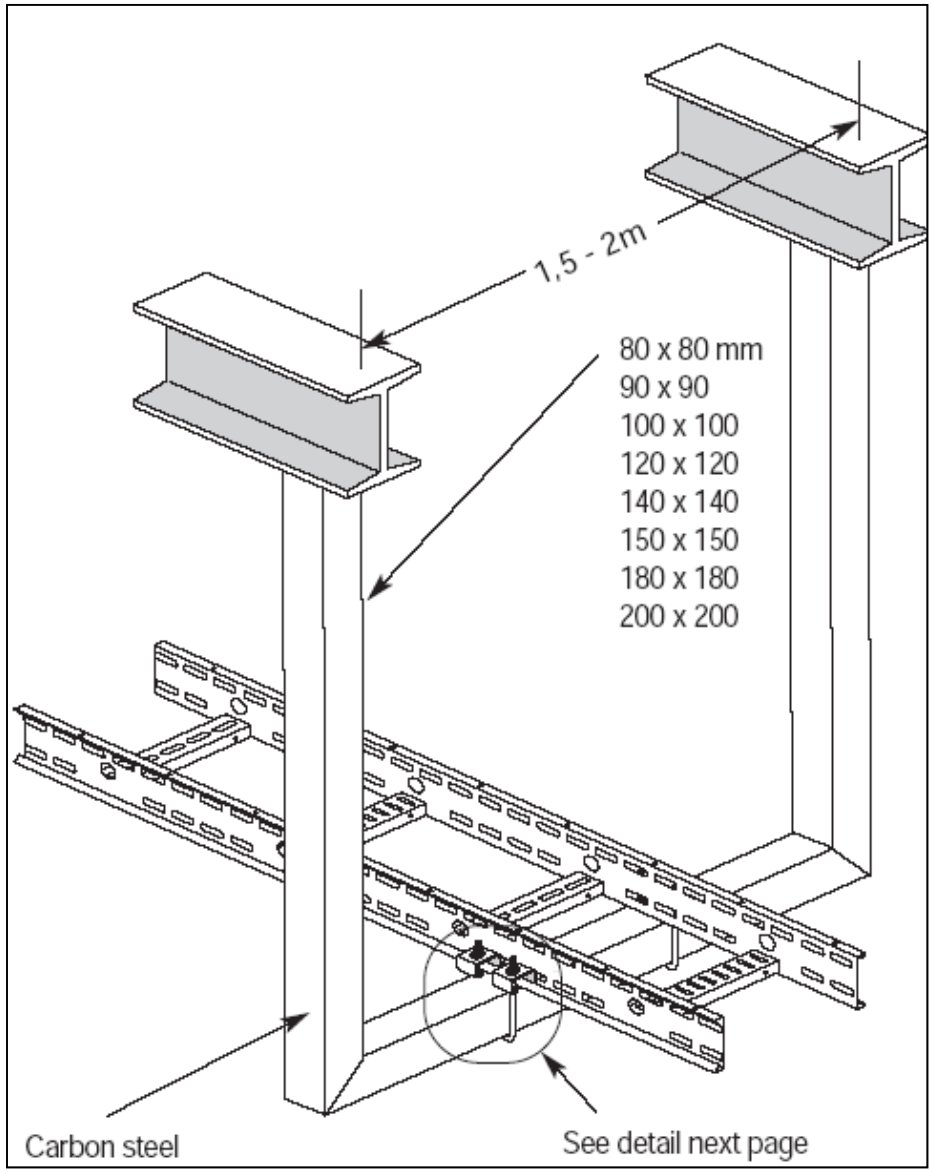

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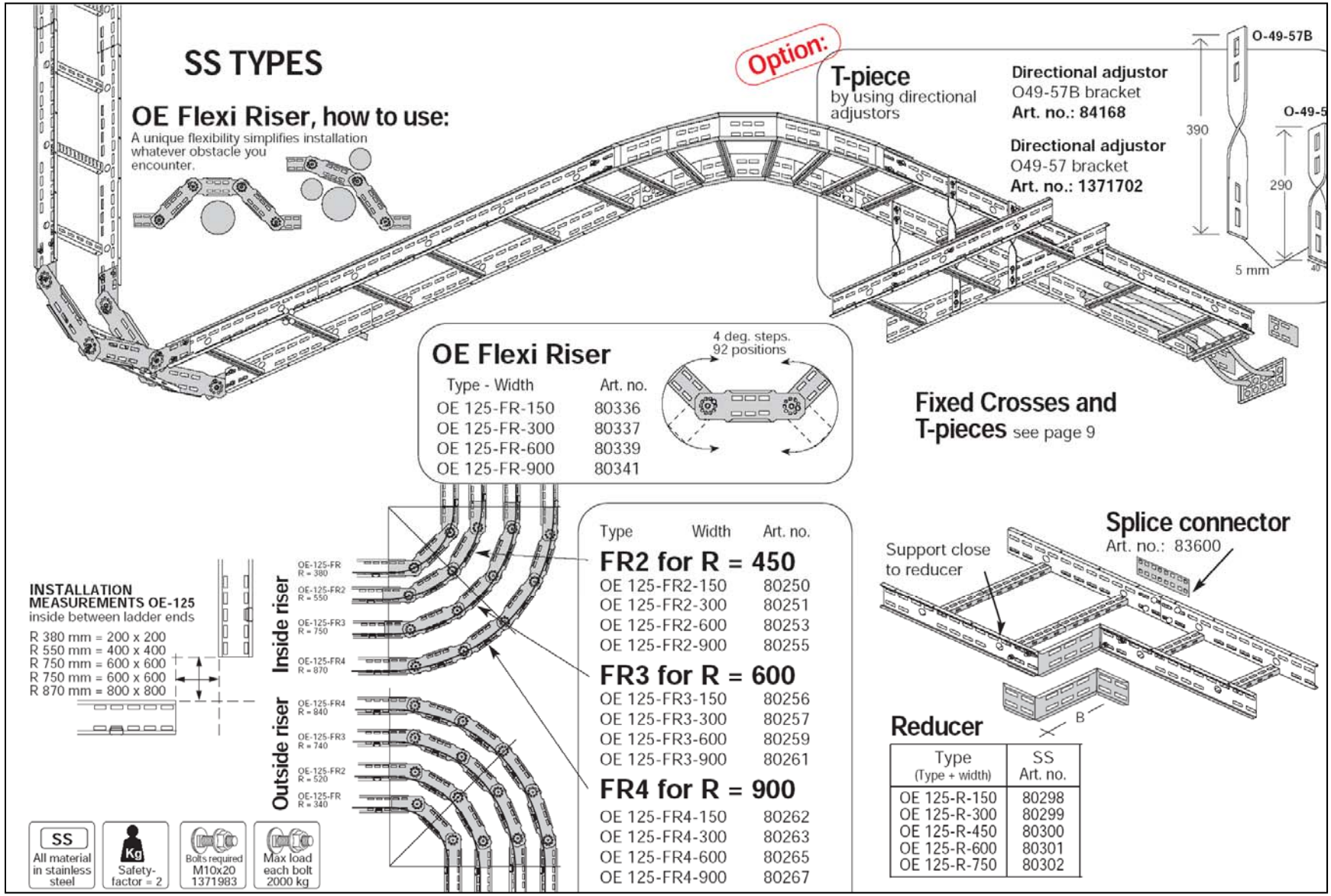
Cable Support Systems in the International World - Typical



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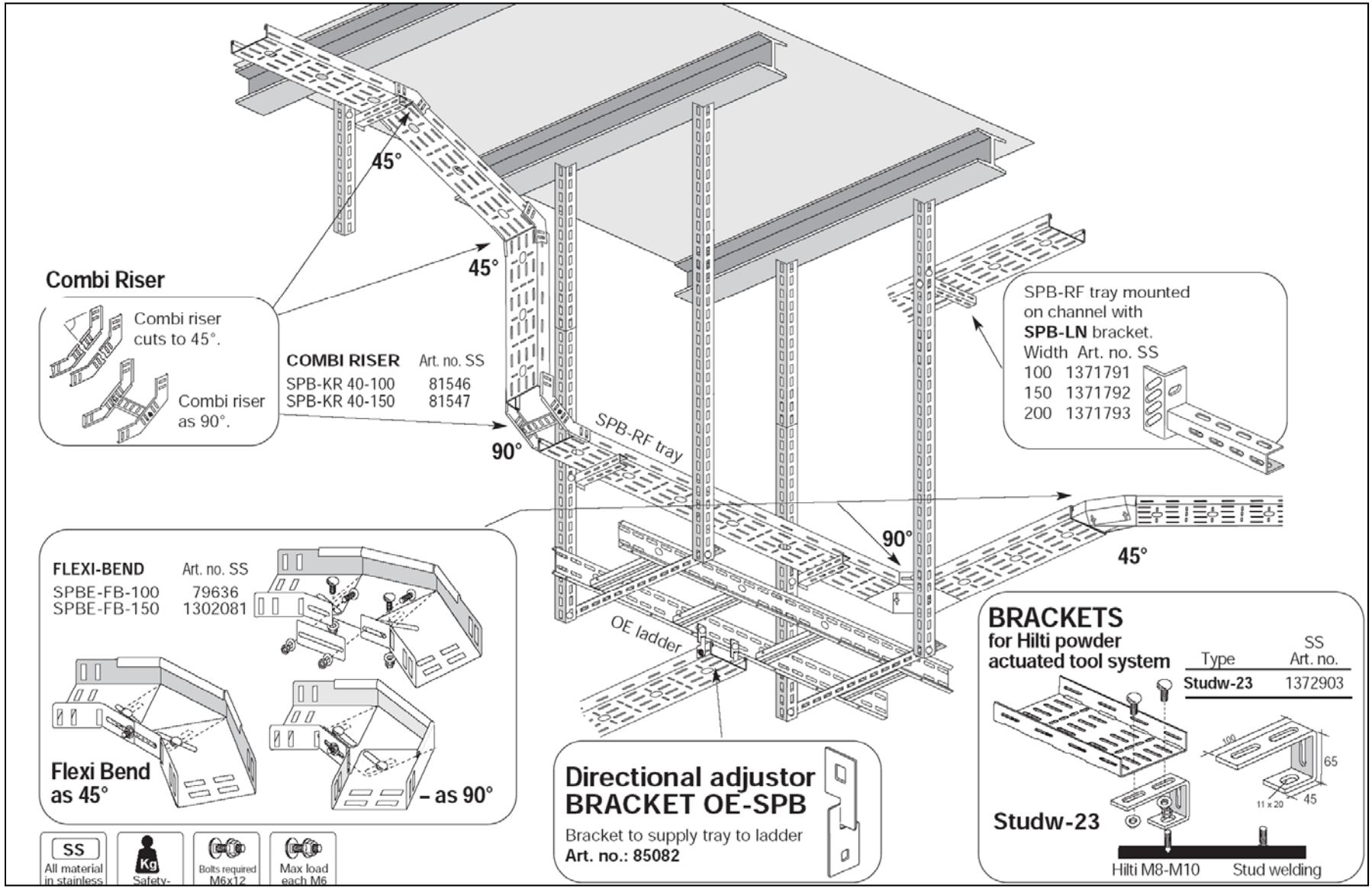

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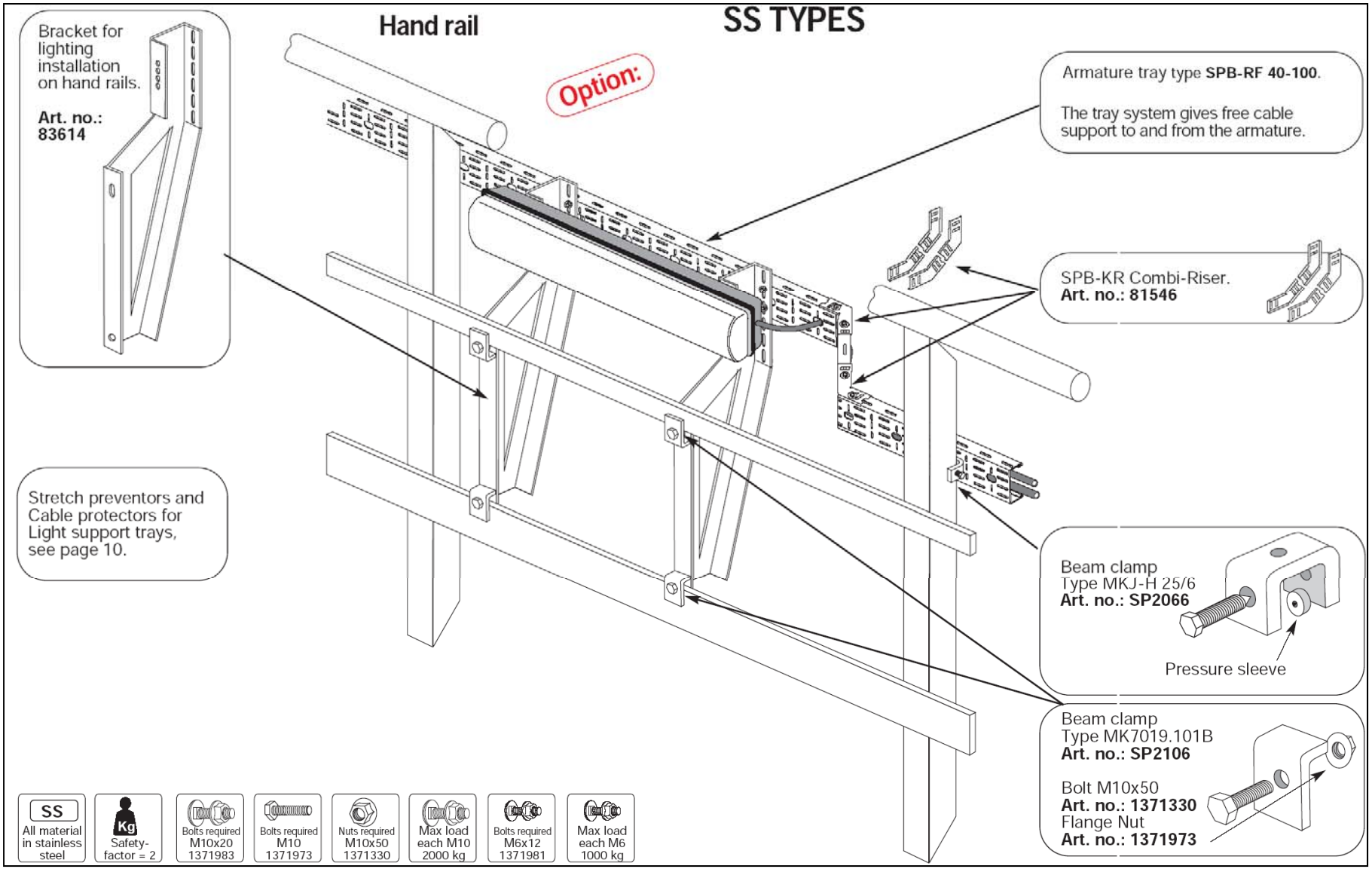

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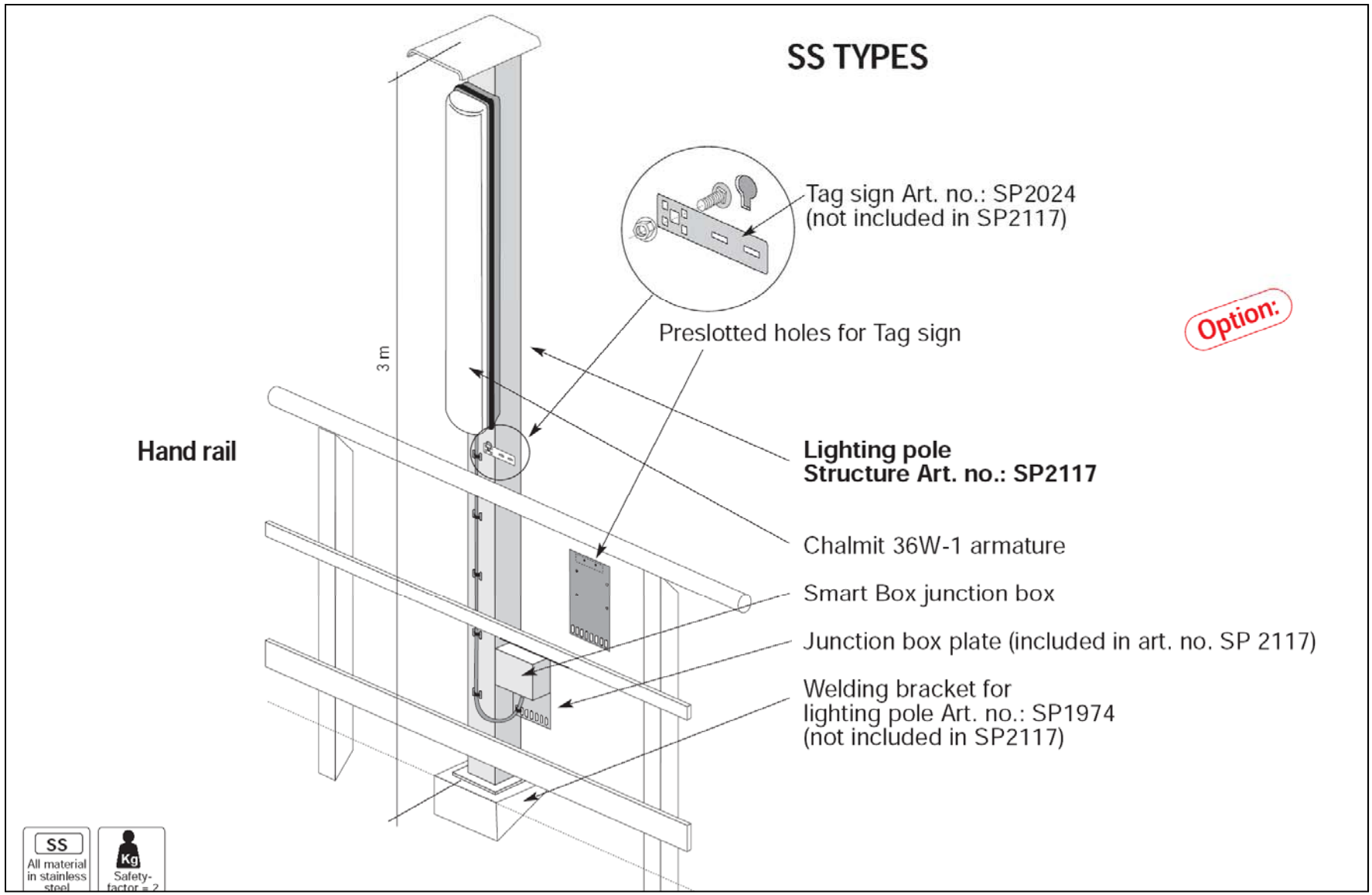

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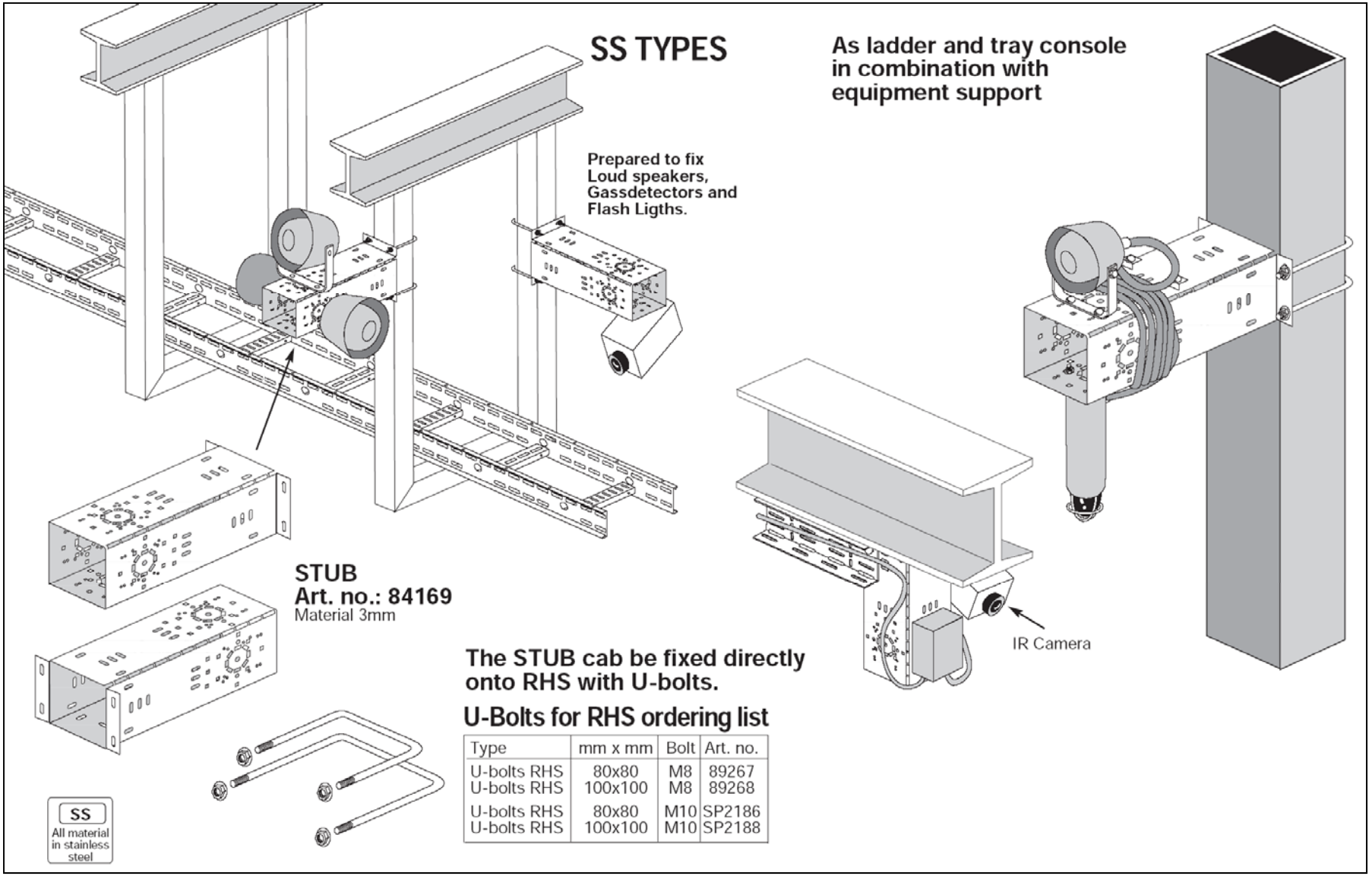
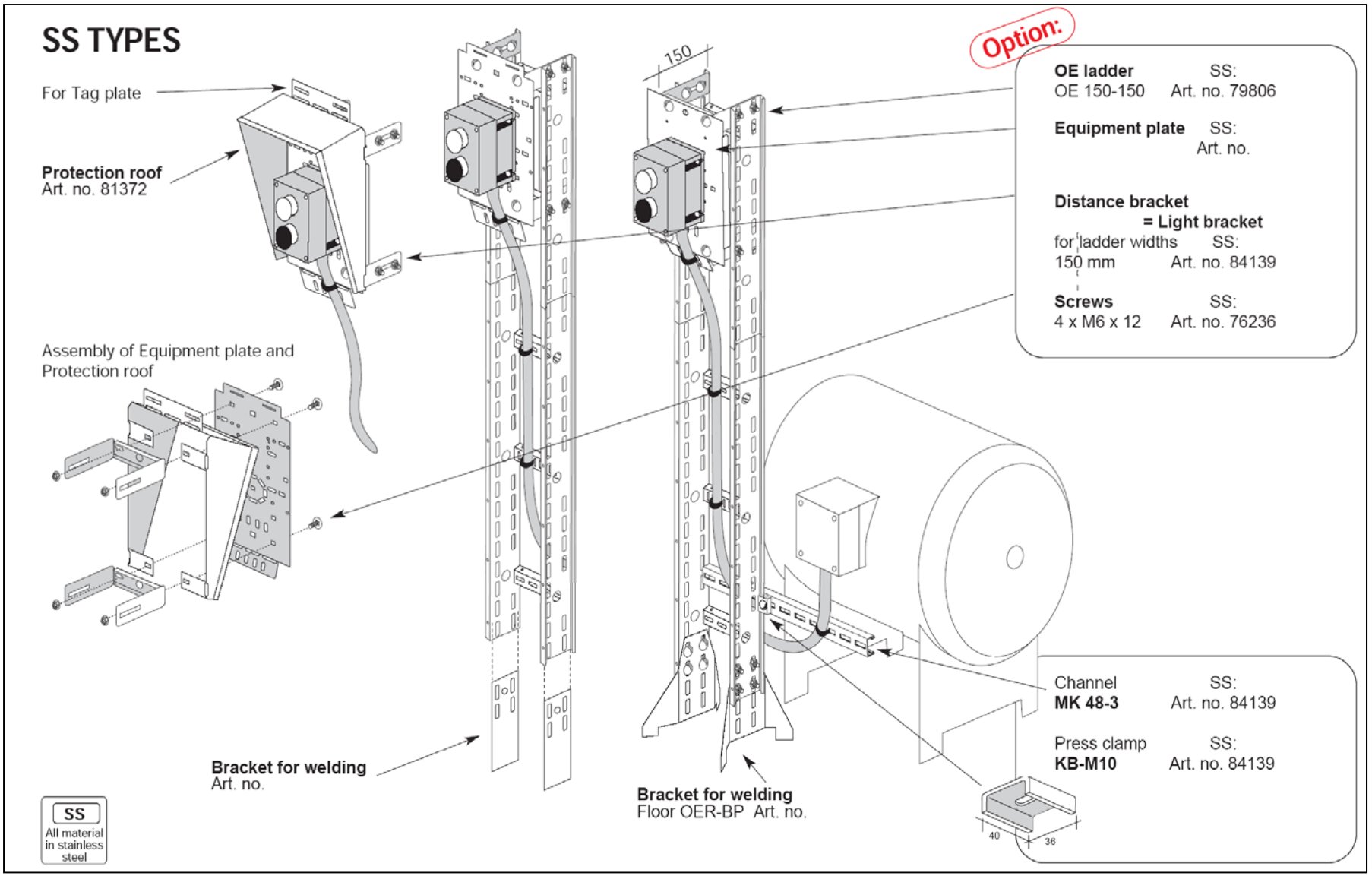
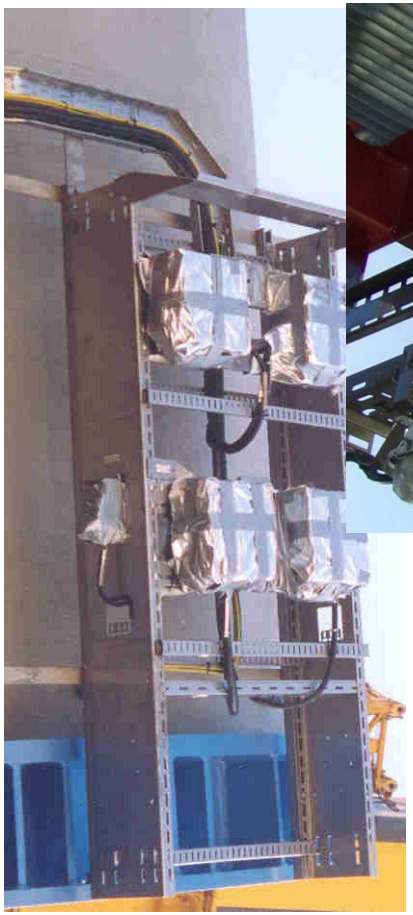


Type	mm x mm	Bolt	Art. no.
U-bolts RHS	80x80	M8	89267
U-bolts RHS	100x100	M8	89268
U-bolts RHS	80x80	M10	SP2186
U-bolts RHS	100x100	M10	SP2188

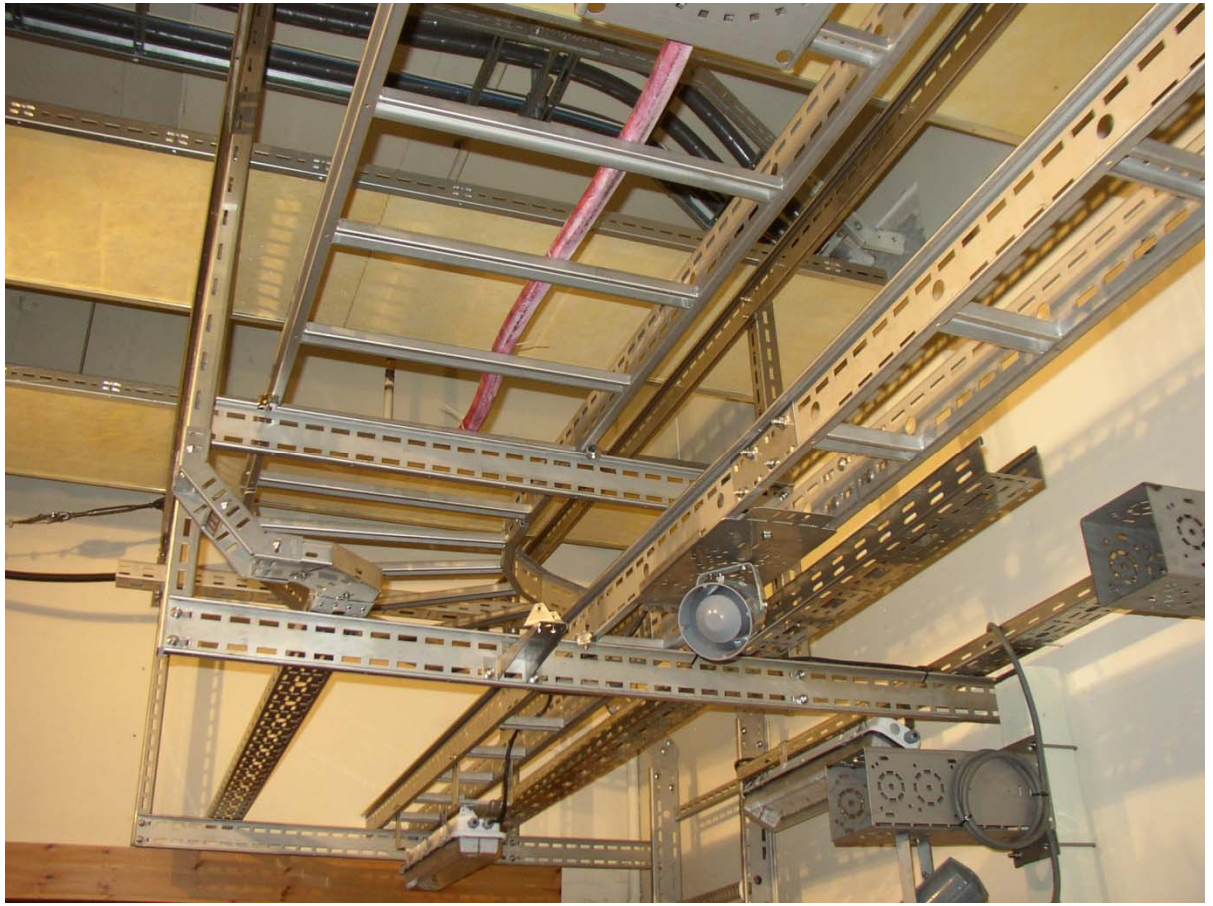
Cable Support Systems in the International World - Typical



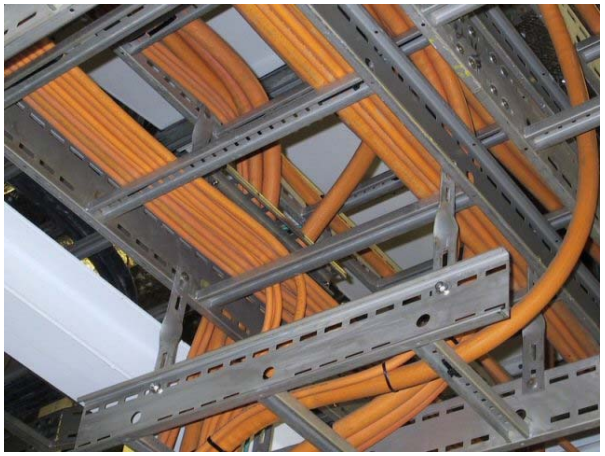
Support Systems Installation Examples

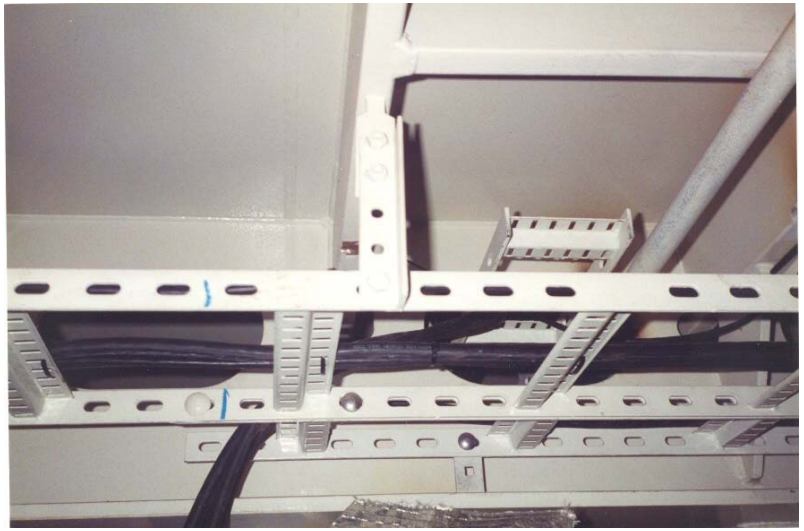


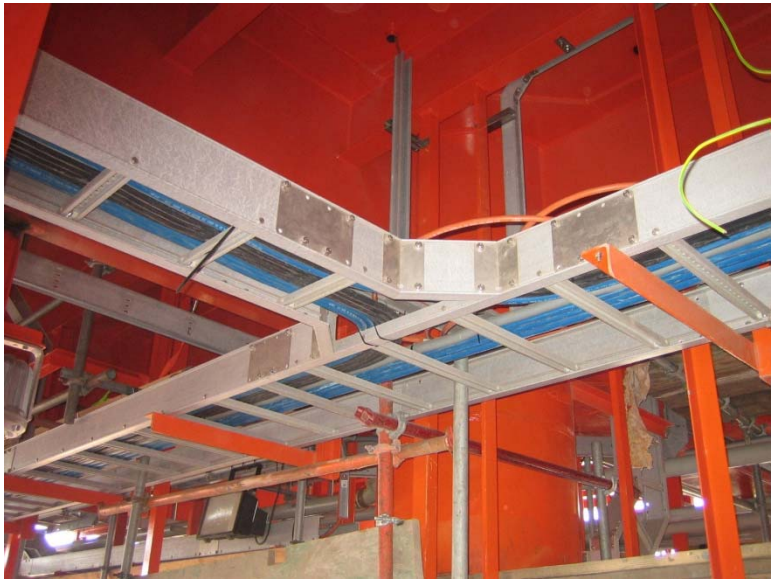
Support Systems Installation Examples



Support Systems Installation Examples







Support Systems Installation Examples

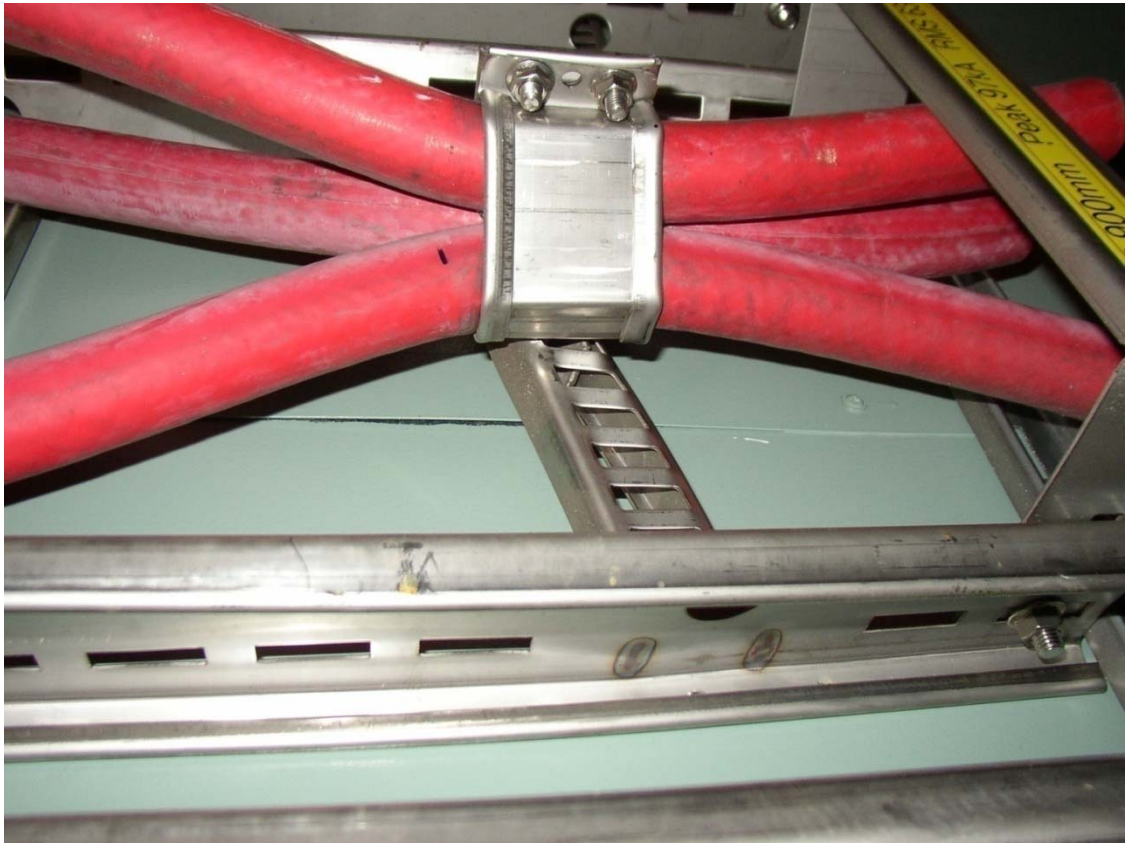
Cable Cleats Trefoils for Single Core Cables

Power cables under short-circuit conditions (especially three-phase, single conductor cable arrangements) are subject to significant forces as a result of induced magnetic fields. For three-phase, single conductor cables, these forces cause violent thrashing of the individual conductors, frequently resulting in inadequately supported cables jumping out of their cable tray or raceway systems. Such unrestrained cable movement can cause cable damage, damage to surrounding equipment and possible injury.

A European Standard now exists – EN 50368:2003, Cable Cleats for Electrical Installations. This Standard was approved by CENELEC (the European Committee for Electrotechnical Standardization) in September 2003 and published in October 2003. EN 50368:2003 has the status of an approved British Standard.

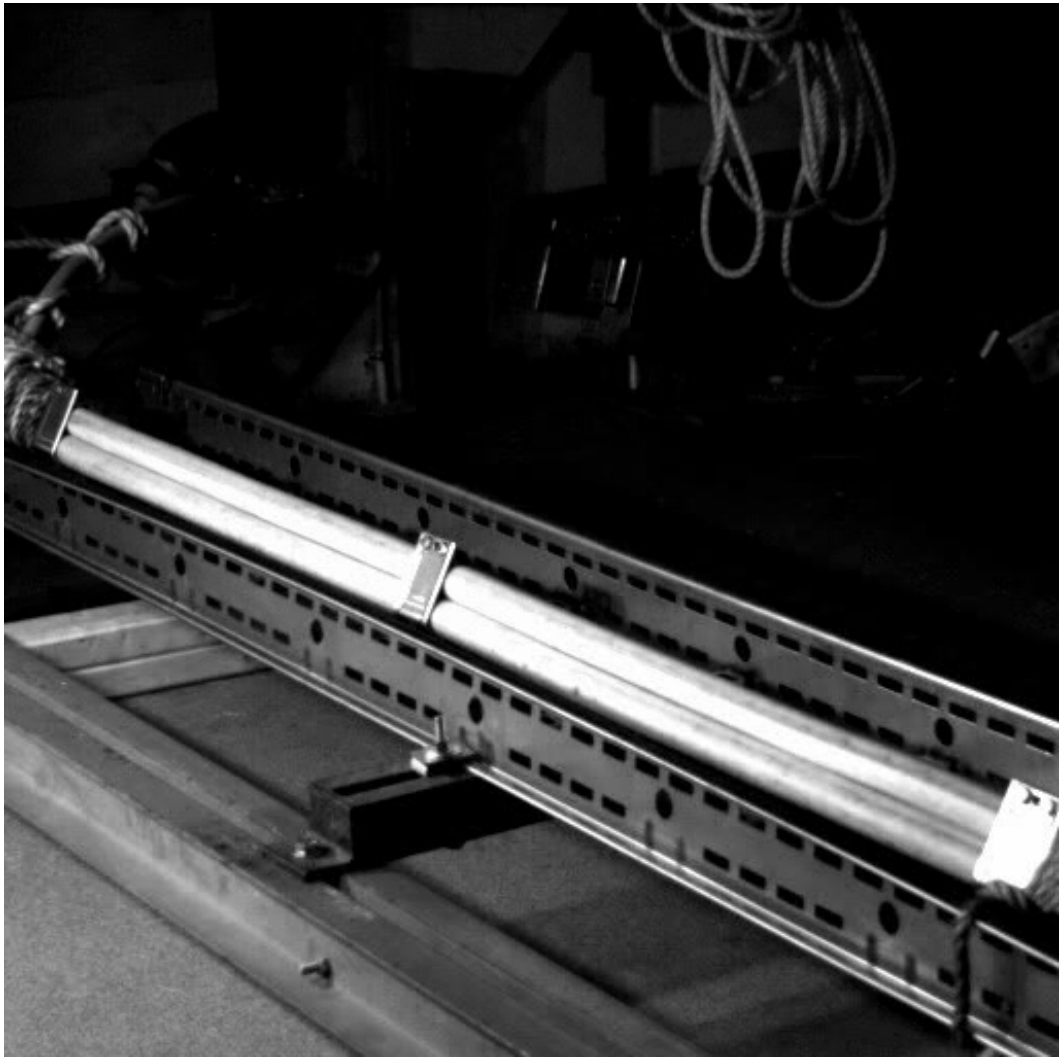
Cable Cleats Trefoils for Single Core Cables

Good engineering practice for the use of single core cables without the use of conduit systems is to use cable cleats to minimize downtime and potential dramatic destruction of the cable systems and surrounding environment

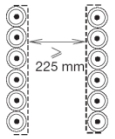
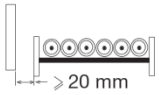
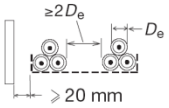
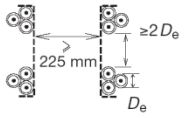
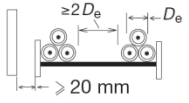


Cable Cleats Trefoils for Single Core Cables

Cable Cleats Trefoils for Single Core Cables



Typical Installation of single core cable

Method of installation in Table 3			Number of trays	Number of three-phase circuits (note 4)			Use as a multiplier to rating for
				1	2	3	
Perforated trays (note 2)	31	Touching 	1 2 3	0.98 0.96 0.95	0.91 0.87 0.85	0.87 0.81 0.78	Three cables in horizontal formation
Vertical perforated trays (note 3)	31	Touching 	1 2	0.96 0.95	0.86 0.84	– –	Three cables in vertical formation
Ladder supports, cleats, etc. (note 2)	32 33 34	Touching 	1 2 3	1.00 0.98 0.97	0.97 0.93 0.90	0.96 0.89 0.86	Three cables in horizontal formation
Perforated trays (note 2)	31		1 2 3	1.00 0.97 0.96	0.98 0.93 0.92	0.96 0.89 0.86	
Vertical perforated trays (note 3)	31	Spaced 	1 2	1.00 1.00	0.91 0.90	0.89 0.86	Three cables in trefoil formation
Ladder supports, cleats, etc. (note 2)	32 33 34		1 2 3	1.00 0.97 0.96	1.00 0.95 0.94	1.00 0.93 0.90	

NOTE 1 Factors are given for single layers of cables (or trefoil groups) as shown in the table and do not apply when cables are installed in more than one layer touching each other. Values for such installations may be significantly lower and must be determined by an appropriate method.

NOTE 2 Values are given for vertical spacings between trays of 300 mm. For closer spacing the factors should be reduced.

NOTE 3 Values are given for horizontal spacing between trays of 225 mm with trays mounted back to back and at least 20 mm between the tray and any wall. For closer spacing the factors should be reduced.

NOTE 4 For circuits having more than one cable in parallel per phase, each three phase set of conductors should be considered as a circuit for the purpose of this table.