VANTRUNK

SECTION 07: ENGINEERING DATA

This collection of Engineering Data is intended to supply essential technical information relating to Vantrunk's Cable Management Systems. Its aim is to ensure that the specified Cable Management installation is adequately protected against corrosion and has suitable strength & rigidity to provide reliable support at minimum installed cost.

Our Technical Team is available to answer any questions relating to particular site requirements which may not be answered in the following sections.

Contact our team here: info@vantrunk.co.uk

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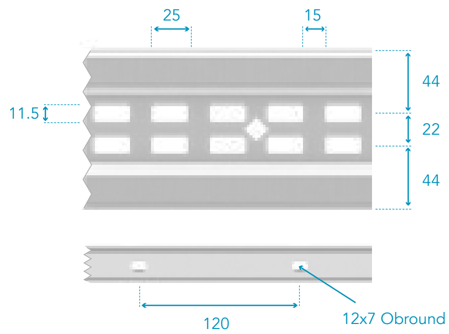
1. SPEEDWAY CABLE LADDER

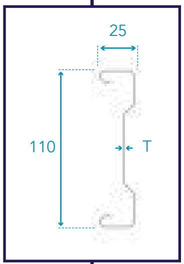
1.1 General Information

1.1.1 Slot Patterns

Details of the slot patterns for the Speedway cable ladder system are given in the following diagrams. These slot patterns are common for each Speedway cable ladder type, irrespective of material gauge.

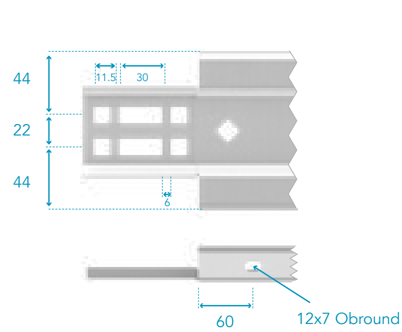
Speedway SW4 Straight Ladder





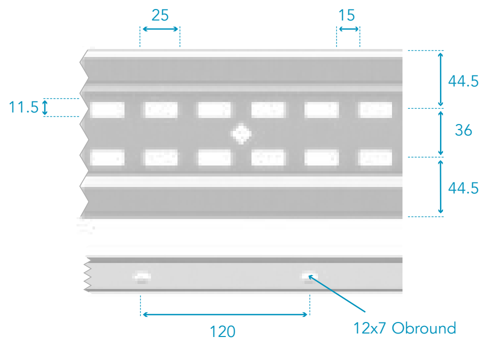
T = Side Wall Gauge (See section 1.1.2 for details).

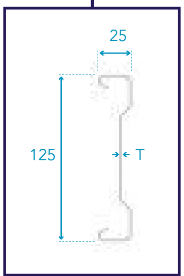
Speedway SW4 Fittings



The slot pattern for the Speedway SW4 fittings is repeated at each end of the fitting side wall and centrally on radial side walls (elbows, tees & crosses).

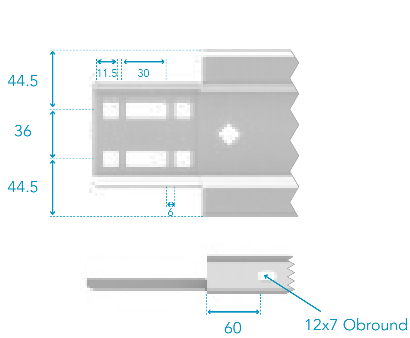
Speedway SW5 Straight Ladder





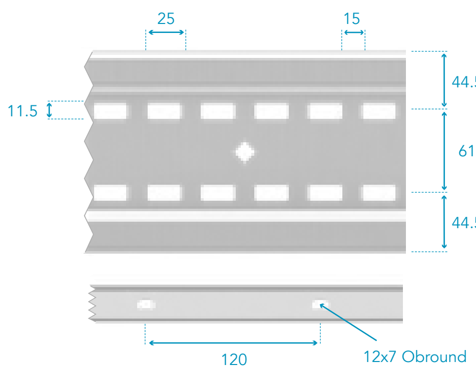
T = Side Wall Gauge (See section 1.1.2 for details).

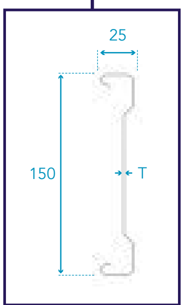
Speedway SW5 Fittings



The slot pattern for the Speedway SW5 fittings is repeated at each end of the fitting side wall and centrally on radial side walls (elbows, tees & crosses).

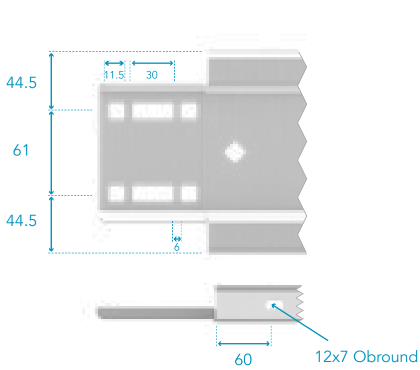
Speedway SW6 Straight Ladder





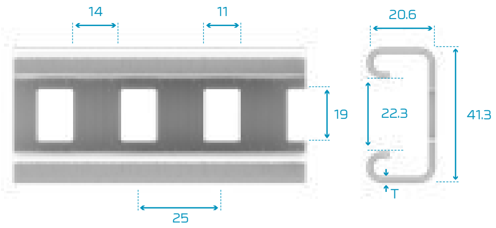
T = Side Wall Gauge (See section 1.1.2 for details).

Speedway SW6 Fittings



The slot pattern for the Speedway SW6 fittings is repeated at each end of the fitting side wall and centrally on radial side walls (elbows, tees & crosses).

Speedway Rung



T = Rung Gauge (1.5mm, 2.0mm Or 2.5mm)

1.1.2 Standard Material Gauges

The gauges for the standard Speedway cable ladder & fittings have been determined by providing the most cost effective and efficient combination of material gauges for the side walls and rungs to suit the designed application of each type of Speedway cable ladder system.

The following table shows the standard material gauges for the Speedway cable ladder system in Hot Dipped Galvanised Structural Steel (GY). These gauges are supplied as standard unless otherwise specified.

Standard Galvanised Gauges

Finish & Material	Ladder Type	Side Wall Gauge	Rung Gauge						
			150 mm	300 mm	450 mm	600 mm	750 mm	900 mm	1050 mm
GY	Speedway SW4	1.5mm	1.5mm				2mm		
	Speedway SW5	1.5mm							
	Speedway SW6	2mm	2mm						

The Speedway cable ladder system is available in a combination of side wall gauges (1.5mm & 2.0mm) and rung gauges (1.5mm, 2.0mm & 2.5mm) to suit specific installation requirements.

Consult our Technical Team for guidance on the correct selection of material gauge combinations.

Weights, where provided are for the Hot Dipped Galvanised Mild Steel item. The following correction factor should be used to determine the approximate weight for the corresponding item in an alternative Finish and Material. For exact weights please contact our Technical Team.

Material Correction Factor	
Hot Dipped Galvanised Silicon Rich Steel GX	Stainless Steel SS
1.06	0.95

1.1.3 Free Base Area

Speedway straight cable ladder has the following free base area (FBA):

Ladder Type	Free Base Area	Classification to BS EN ISO 61537
Speedway SW4	86.5%	Y
Speedway SW5		
Speedway SW6		

1.1.4 Cross Sectional Area

Speedway cable ladder has the following cross-sectional area (CSA):

Speedway SW4 Ladder	CSA mm²	Speedway SW5 Ladder	CSA mm²	Speedway SW6 Ladder	CSA mm²
SW4-SL-150-#	13780	SW5-SL-150-#	15975	SW6-SL-150-#	20075
SW4-SL-300-#	26740	SW5-SL-300-#	30975	SW6-SL-300-#	38825
SW4-SL-450-#	39700	SW5-SL-450-#	45975	SW6-SL-450-#	57575
SW4-SL-600-#	52660	SW5-SL-600-#	60975	SW6-SL-600-#	76325
SW4-SL-750-#	65620	SW5-SL-750-#	75975	SW6-SL-750-#	95075
SW4-SL-900-#	78580	SW5-SL-900-#	75975	SW6-SL-900-#	113825

Add Finish & Material.

1.1.5 Speedway Cable Ladder Specification

The following is a typical specification for a cable ladder system which embodies the key features of the Speedway Cable Ladder System:

1. The cable ladder system shall be based on two longitudinal outward facing side members (sidewalls) with return edge flanges to improve safety during handling, installation and cable pulling activities. The longitudinal side members shall form the main structural elements of the cable ladder system and shall be longitudinally ribbed for enhanced stiffness and rigidity
2. The profile of the side members shall remain constant for the straight cable ladder and the cable ladder fittings
3. The profile of the side members shall present a smooth surface to allow for easier cable pulling and to minimise the opportunities for damage to the cable insulation
4. The longitudinal side members shall have a height of:
   - Speedway SW4 = 110mm and a flange width of 25mm
   - Speedway SW5 = 125mm and a flange width of 25mm
   - Speedway SW6 = 150mm and a flange width of 25mm
5. The longitudinal side member shall have a wall thickness of:
   - 1.5mm*
   - 2.0mm*

   * Actual side member thickness is dependent on the projects exact requirements, please speak to our Sales Team for details
6. The side members of the straight cable ladder shall be fully slotted to minimise weight. The slot pattern in the side members shall allow for cutting of the straight cable ladder at any point along the length without the need to drill the side member when connecting to adjacent straight cable ladder and cable ladder fittings using the standard means of coupling
7. The two longitudinal side members shall be connected by individual transverse members (rungs) which shall be welded at the lowest point of the inside face of the side members to give a loading depth of:
   - Speedway SW4 = 85mm
   - Speedway SW5 = 100mm
   - Speedway SW6 = 125mm
8. The transverse members shall be evenly spaced at 300mm centres along the length of the straight cable ladder. The transverse members for horizontal bends (flat elbows) shall be located at either 0° or 7.5° and multiples there of around the fitting subject to a maximum spacing of 465mm between adjacent transverse members when measured as a linear distance along the outside face of the horizontal bend. The transverse members for horizontal intersection fittings (tees and crosses) shall be evenly spaced at intervals not exceeding 465mm. The transverse members for vertical bends (inside and outside risers) shall be evenly spaced at intervals not exceeding 300mm centres
9. The transverse members shall be of channel profile with a width of 41mm and a height of 21mm. The transverse members shall have a continuous open slot to suit the mounting of cable restraint devices (cleats, etc.) and other equipment using standard channel nuts and fixings. The base of the transverse members shall have slots of size 18mm x 11mm at 25mm centres to suit the use of cable ties and banding
10. The transverse members (rung) shall have a wall thickness of:
    - 1.5mm*
    - 2.0mm*
    - 2.5mm*

    * Actual rung thickness is dependent on the projects exact requirements, please speak to our Sales Team for details
11. The transverse members for straight cable ladder shall be orientated with the continuous slot facing alternately upwards and downwards. The transverse members for cable ladder fittings shall be orientated with the continuous slot facing upwards to allow for the securing of cable restraint devices (cleats, etc.) at every rung position

12. The width of the straight cable ladder and the cable ladder fittings shall be measured relative to the inside faces of the side members. The widths of the straight cable ladder and cable ladder fittings shall be 150mm, 300mm, 450mm, 600mm, 750mm, 900mm & 1050mm

13. The straight cable ladder shall have a length of 3000mm or 6000mm as specified

14. The cable ladder fittings shall have fixed angles of 90°, 60°, 45° and 30°

15. Radial cable ladder fittings shall have a radius of 300mm, 450mm, 600mm, 750mm, 900mm, 1050mm & 1200mm. The radius of the fitting shall be measured relative to the inside face on the radial side wall

16. The cable ladder system shall be manufactured using:

- **Hot Dipped Galvanised Structural Steel:** structural steel of a grade to BS EN 10025-2 and shall be hot dip galvanised up to a maximum average coating thickness of 85μm after manufacture to BS EN ISO 1461
- **Deep Galvanised Structural Steel:** structural steel of a grade to BS EN 10025-2 and shall be deep galvanised up to a maximum average coating thickness of 120μm after manufacture to BS EN ISO 1461
- **Deep Galvanised Silicon Rich Structural Steel:** silicon-rich steel (generally complying of a grade to BS EN 10025) and deep galvanised up to a maximum average coating thickness of 160μm after manufacture to BS EN ISO 1461.
- **Hot Dipped Galvanised Carbon Steel:** low carbon steel of a grade to BS EN 10111 or equivalent and shall be hot dip galvanised to 55μm after manufacture to BS EN ISO 1461
- **Marine Grade Stainless Steel:** stainless steel grade 1.4404 (316L marine grade) to BS EN 10088

17. The couplers shall be profiled to match the profile of the cable ladder. The couplers shall be secured using M10 square-shouldered bolts with rounded heads. The bolts shall be secured with M10 serrated flanged nuts as standard. The couplers shall have a slot pattern which greatly reduces slip between adjacent straight ladder lengths (including cut lengths of straight cable ladder) and between cable ladder fittings. The couplers shall have a slot pattern which allows for easy connection to cut lengths of straight cable ladder without the need for on - site drilling

1.2 Installation

1.2.1 Loads

A correctly designed and specified cable ladder installation should take into account the nature and extent of the loads which will be imposed on the cable ladder system. These loads comprise of dead loads including the self-weight of the cable ladder system, the weight of the cables and secondary equipment attached to the cable ladder, imposed loads which occur during installation of the cable ladder system and during cable pulling operations, and external loads such as wind, snow & ice.

Cable ladders are often employed in locations where the wind speeds may cause considerable lateral loading and careful consideration must be given to design to ensure a satisfactory installation. An awareness of the worst possible climate conditions is necessary when specifying the correct Speedway cable ladder system.

The load-deflection information given in section 1.3.3 is based on static loading of the Speedway cable ladder installation and does not take into account dynamic effects such as wind, etc.

In designing a cable ladder installation it is good practice to allow at least a 20% excess capacity in a new installation for future expansion. Such a provision is of great economic advantage when there is a later need for additional cables.

1.2.2 Support Spacing

The space between the supports of a cable ladder installation is referred to as the span. Supports for cable ladder should, as far as practicable, be spaced so as to create the most economical load-span ratio to suit the capacity of the cable ladder system.

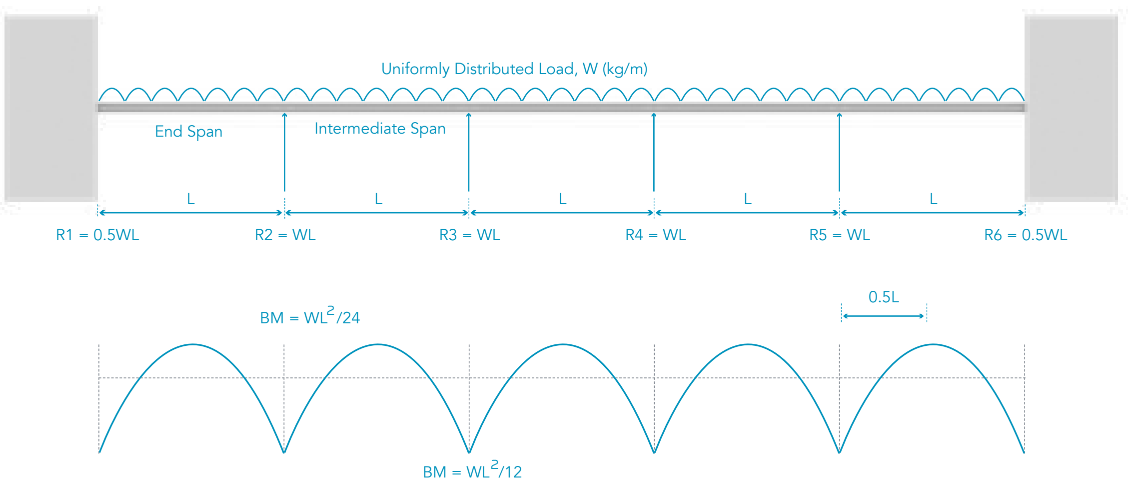
This will give the most advantageous solution when considering procurement and installation costs. As a general rule of thumb, the load-carrying capability of the Speedway Cable Ladder system increases as the span decreases, so a lighter duty cable ladder system can be specified for shorter spans. Conversely, a heavier duty Speedway Cable Ladder system will need to be specified for longer spans.

When considering support positions it should be remembered that it is necessary to support accessories when a change of direction takes place i.e. bends, tees, risers etc. This is to ensure that undue 'corner' cantilever reaction is minimised. Recommendations for the location of supports for Speedway Cable Ladder fittings are given in section 1.2.4.

1.2.3 Location of Couplers

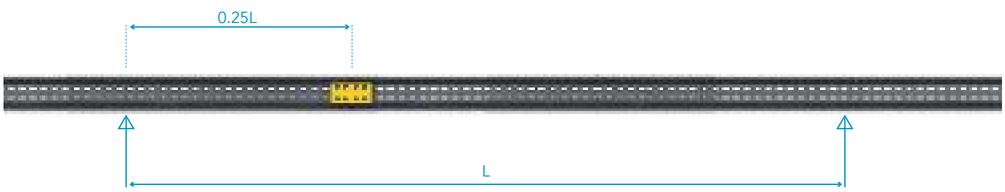
The maximum bending moments acting on a cable ladder run occur in the cable ladder side members at the supports and at the mid span position. For this reason it is good practice to avoid locating couplers in a cable ladder run either directly on supports or at the mid span position. It is also good practice to avoid locating couplers in the end span of a continuous beam installation as the bending moments in the end span are, for simple end support installations, much higher than those found in the intermediate spans.

These limitations cannot always be achieved in a cable ladder installation and are not a mandatory requirement for the Speedway coupling system. The ideal positions to locate the couplers in a cable ladder run are at approximately a quarter of a span from the supports where the bending moment, and hence the stress, is minimal. Positioning the couplers at the quarter span positions is of benefit during installation, assisting in alignment of the cable ladders and allowing unhindered securing of the cable ladder to the supports.



Bending Movement distribution for a continuous beam with fixed ends
(The Bending Movement for ends spans in a continous beam with simple end supports will be higher than that shown)

L = Span
W = Load
UDL = Uniformly Distributed Load
R = Reaction at Support
BM = Bending Movement



Location of couplers at point of least Bending Movement
(Approximately ¼ of the span away from the supports)

1.2.4 Support Locations for Speedway Fittings

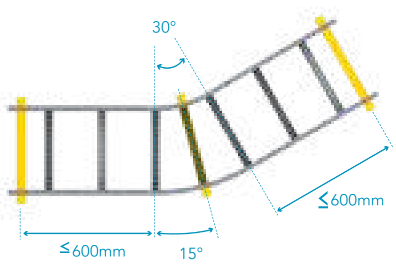
The following illustrations show the recommended support positions when installing Speedway cable ladder fittings. The supports should be fully fixed to provide maximum support for the Speedway cable ladder fitting.

For more specific recommendations relating to particular site installations please contact our Technical Team.

Speedway Flat Elbows

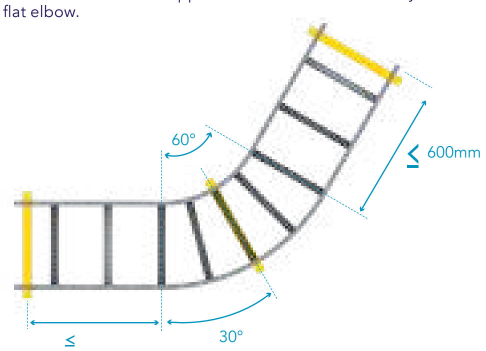
Speedway 30° Flat Elbows

For 30° flat elbows, supports should be placed within 600mm of the end of the flat elbow. For 30° flat elbows with radii of 450mm and above, an intermediate support should be located radially at 15° under the flat elbow.



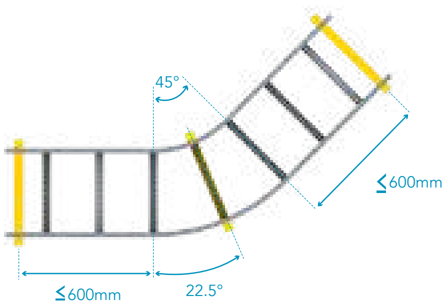
Speedway 60° Flat Elbows

For 60° flat elbows, supports should be placed within 600mm of the end of the flat elbow. An intermediate support should be located radially at 30° under the flat elbow.



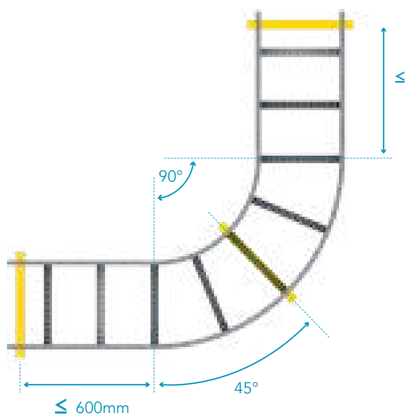
Speedway 45° Flat Elbows

For 45° flat elbows, supports should be placed within 600mm of the end of the flat elbow. For 45° flat elbows with radii of 450mm and above, an intermediate support should be located radially at 22.5° under the flat elbow.



Speedway 90° Flat Elbows

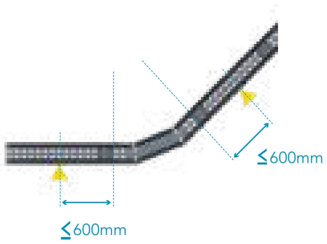
For 90° flat elbows, supports should be placed within 600mm of the end of the flat elbow. An intermediate support should be located radially at 45° under the flat elbow.



Speedway Inside & Outside Risers

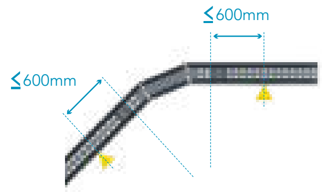
Speedway Inside Risers (all angles)

For inside risers (30°, 45°, 60° & 90°) supports should be placed within 600mm of the end of the inside riser.



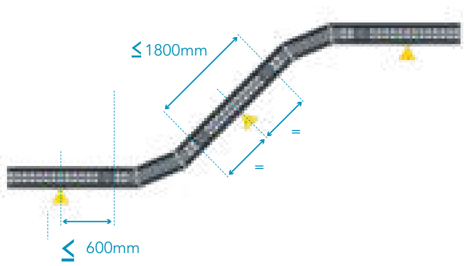
Speedway Outside Risers (all angles)

For inside risers (30°, 45°, 60° & 90°) supports should be placed within 600mm of the end of the inside riser.

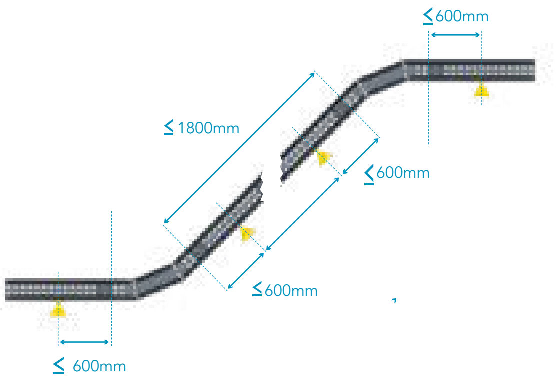


Speedway Inside & Outside Risers in Offset Arrangement

For inside & outside risers (30°, 45°, 60° & 90°) forming an offset of length up to 1800mm, supports should be placed within 600mm of the end of the offset and centrally on the inclined cable ladder.



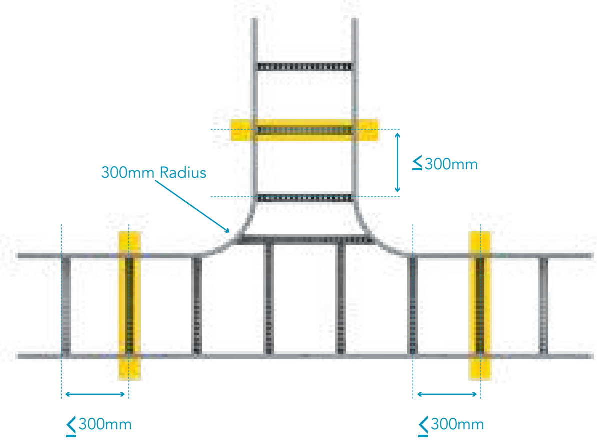
For inside & outside risers (30°, 45°, 60° & 90°) forming an offset of length over 1800mm, supports should be placed within 600mm of the ends of the inside & outside risers. The inclined cable ladder should be supported in accordance with the support recommendations for a straight cable ladder run.



Speedway Equal & Unequal Tees

Speedway Equal & Unequal Tees (300mm Radius)

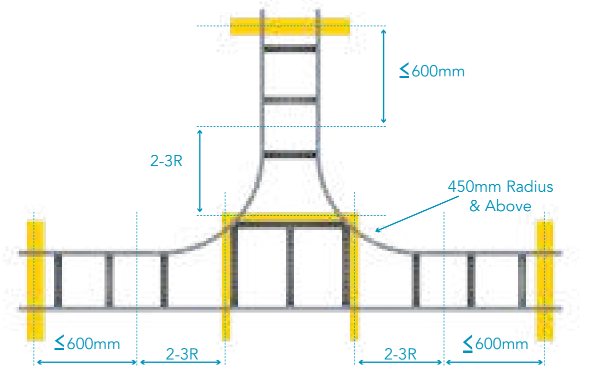
For equal and unequal tees with radii of 300mm, supports should be located within 300mm of the tee on each branch in the cable ladder run.



Speedway Equal & Unequal Tees (450mm Radius & Above)

For equal and unequal tees with radii of 450mm and above, supports should be located within 600mm of the tee on each branch in the cable ladder run.

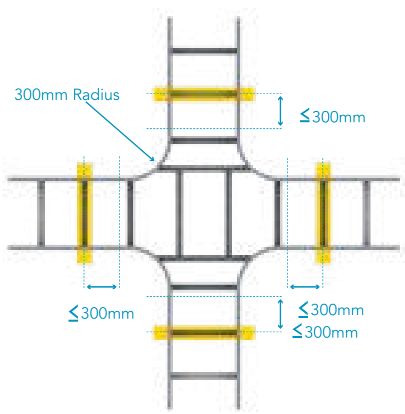
Intermediate supports should be placed at approximately 2-3 of the radius (R) on each branch of the tee as shown.



Speedway Crosses

Speedway Crosses (300mm Radius)

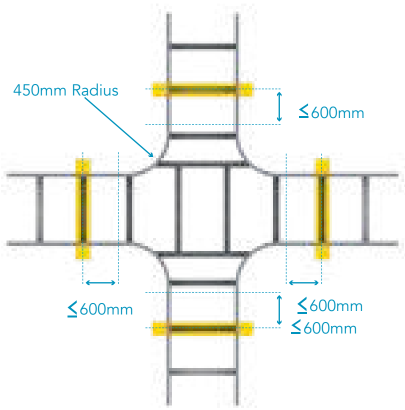
For crosses with radii of 300mm, supports should be located within 300mm of the cross on each branch in the cable ladder run.



Speedway Crosses (450mm Radius & Above)

For crosses with radii of 450mm and above, supports should be located within 600mm of the tee on each branch in the cable ladder run.

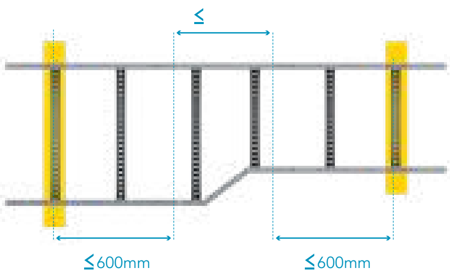
Intermediate supports should be placed at approximately 2-3 of the radius (R) on each branch of the cross as shown.



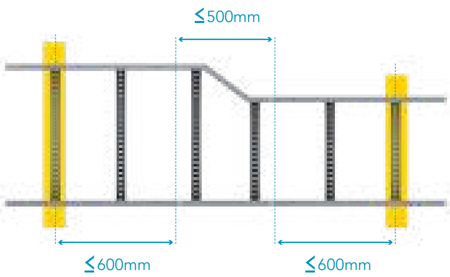
Speedway Reducers

For all widths of straight reducer, left-hand reducer, and right-hand reducer, supports should be located on the cable ladder run within 600mm of the reducer as shown.

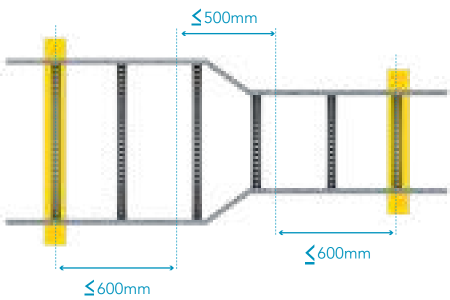
Speedway Right-Hand Reducer



Speedway Left-Hand Reducer



Speedway Straight Reducer



1.2.5 Loading of Supports

It is important that cable ladder and cable ladder supports are loaded in a symmetrical manner such that undue stresses are kept to a minimum.

The safe working load figures for the Speedway cable ladder and the Speedway cantilever type supports is based on a uniform loading within the Speedway cable ladder and on the assumption that the correct length of cantilever is used in each case.

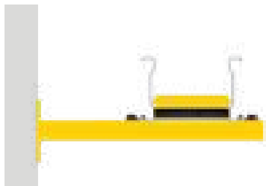
Where cantilevers of additional length are used to support Speedway cable ladder, care should be taken to position the cable ladder as close to the backplate of the cantilever as the installation routing will allow.

Where the Speedway cable ladder is not filled to capacity, or is carrying heavy cables, care should be taken to position the cables as close to the cantilever backplate as the installation routing will allow.

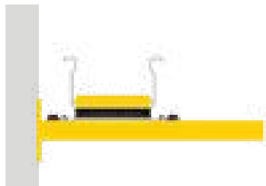
For those installations where the routing of the cable ladder or the position of heavy cable loads cannot be undertaken in accordance with the above, the IC-PROP-Size cantilever arm prop should be used to correctly support the cantilever arm.

More details on the Safe Working Load of Speedway supports can be found in the Supports Section.

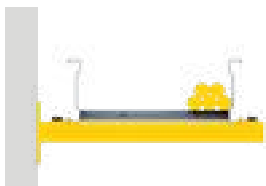
For further information and guidance on the loading of supports please contact our Technical Team.



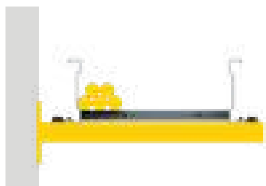
Avoid locating cable ladder on the end of cantilever support



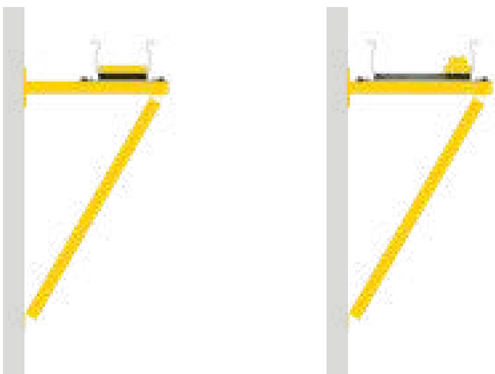
Locate cable ladder close to the cantilever backplate



Avoid placing unsymmetrical cable loads on the extremes of cantilever supports



Locate unsymmetrical cable loads close to the cantilever backplate



Use the cantilever prop (IC-PROP-Size – See page 177) to support offset cable ladder or unsymmetrical cable loads.

1.2.6 Electrical Continuity Characteristics

In tests conducted to verify the electrical continuity characteristics of the Speedway cable ladder it has been established that the standard Speedway coupling system provides adequate electrical continuity, ensuring equipotential bonding and connection to earth.

The Speedway cable ladder system has been tested for electrical continuity to BS EN 61537 (Section 11.1). Details are given in the following table.

Ladder Type	Material & Finish	Impedance across joint	Impedance per metre length
Speedway SW4	Hot Dip Galvanised	<50mΩ	<5mΩ
	Stainless Steel		
Speedway SW5	Hot Dip Galvanised		
	Stainless Steel		
Speedway SW6	Hot Dip Galvanised		
	Stainless Steel		

BS EN 61537 requires a maximum impedance of 50mΩ across the coupled joint and 5mΩ per metre length without a joint

The electrical continuity of the Speedway cable ladder joints has been tested to NEMA VE (Section 5.1). Details are given in the following table.

Ladder Type	Material & Finish	Resistance across joint
Speedway SW4	Hot Dip Galvanised	<33mΩ
	Stainless Steel*	
Speedway SW5	Hot Dip Galvanised	
	Stainless Steel*	
Speedway SW6	Hot Dip Galvanised	
	Stainless Steel	

NEMA VE 1 requires a net resistance of no more than 33mΩ across the coupled joint. * Requires use of earth bonding strap EBS01

Earth continuity bonding straps (part number EBS-01) of cross sectional area 16 mm^2 are available for use with Speedway cable ladder where a non-conductive surface finish i.e. epoxy coated etc, has been specified or where the installation requires an additional means of bonding.

1.2.7 Electromagnetic Compatibility (EMC)

In normal use Speedway cable ladder can be considered to be passive in respect of electromagnetic influences, emission and immunity. When Speedway cable ladder is installed as part of a wiring installation, the installation may emit or may be influenced by electromagnetic signals. The degree of influence will depend on the nature of the installation within its operating environment and the electrical equipment connected by the wiring. As a minimum precaution to minimise the occurrence of electromagnetic influences, power and data-signal cables should be run on separate cable routings or at least separated by means of dividers.

Our Technical Team should be consulted for further information on electromagnetic compatibility issues.

1.2.8 Assembly Recommendations

Instructions for the correct assembly of Speedway straight couplers and expansion couplers are given below.

Speedway Straight Couplers

The Speedway straight couplers are supplied with the correct number of fixing sets (4 for Speedway SW4 and 8 for Speedway SW5 & SW6), each comprising of an M10 x 20 square shouldered bolt and an M10 serrated flanged nut.

1 Locate the Speedway straight coupler on the outside of the two abutting components of the Speedway cable ladder installation (ladder to ladder) with the profile of the straight coupler aligned to the central ribbed profile on the abutting components.

2 Position the Speedway straight coupler over the two components such that a series of square apertures are created by the alignment of the slot patterns in the coupler and the slot patterns in the two abutting components. For joints between uncut Speedway cable ladders, the straight coupler should sit centrally across the joint. For connecting cut sections of Speedway cable ladder it may be necessary to reposition the coupler to create the series of square apertures.

3 Insert an M10x20 square shouldered bolt into one of the square apertures from the inside of the Speedway cable ladder with the threaded portion of the bolt protruding

4 Fit an M10 Serrated Flange Nut onto the threaded portion of the bolt.

5 Tighten the fixing assembly by hand.

6 Repeat for the remaining fixing sets.

7 Fully secure the abutting components to the supporting structure.

8 Check the alignment of the Speedway straight coupler and the abutting components and adjust as necessary to give a fair and true alignment.

9 Tighten the hex nuts on the Speedway straight coupler to a torque of 46Nm.

Speedway Integral Coupler Assembly

Speedlok Speedway Fittings are supplied with the correct number of fixing sets for that type of fitting, each comprising of an M10 x 20 square shouldered bolt, an M10 serrated flange nut.

1 Position the Straight Length of Speedway Cable Ladder on the inside of the Integral Couplers of the Speedway fitting with the Integral Coupler lying over the web of the Speedway profile.

2 Position the Speedway Integral Coupler so that a series of square apertures are created by the alignment of the slot patterns in the coupler and the straight ladder.

3 Insert an M10 x 20square shouldered bolt into one of the square apertures from the inside of the Speedway cable ladder with the threaded portion of the bolt protruding through the side wall of the ladder and the Speedway Integral Coupler.

4 Fit an M10 Serrated Flange Nut onto the threaded portion of the bolt.

5 Tighten the fixing assembly by hand.

6 Repeat for the remaining fixing sets.

7 Fully secure the abutting components to the supporting structure.

8 Check the alignment of the Speedway Integral Coupler and the abutting components and adjust as necessary to give a fair and true alignment.

9 Tighten the flange nuts on the Speedway straight coupler to a torque of 46Nm.

Speedway Expansion Couplers

The Speedway expansion couplers are supplied with 8 fixing sets, each comprising of an M10 x 25 square shouldered bolt, an M12 flat washer, an M10 shake-proof washer and 2 M10 hex nuts. Refer to page 246 for details on the spacing between expansion couplers and the required gap setting procedure at the time of installation.

1 Locate the Speedway expansion coupler on the outside of the two abutting Speedway cable ladders with the profile of the expansion coupler aligned to the central ribbed profile on the Speedway cable ladders. NOTE: the expansion coupler should not be used to connect cut sections of cable ladder.

2 Position the Speedway expansion coupler equally over the two abutting Speedway cable ladders such that a series of square apertures are created by the alignment of the slot pattern in the coupler and the slot pattern in the cable ladders.

3 Insert an M10 x 25 square shouldered bolt into one of the square apertures from the inside of the Speedway cable ladder with the threaded portion of the bolt protruding through the Speedway cable ladder and the Speedway expansion coupler.

4 Fit a M12 flat washer and a M10 hex nut onto the threaded portion of the M10x25 bolt.

5 Tighten the fixing assembly by hand such that it is free to move within the slots of the Speedway cable ladder and the Speedway expansion coupler (some light resistance to movement is preferable).

6 Repeat for the remaining fixing sets.

7 Check the alignment of the Speedway expansion coupler and the Speedway cable ladders and adjust as necessary to give a fair and true alignment.

8 Check the setting gap (See page 246)

9 Secure the Speedway cable ladders to the supporting structure using external flange clamps SW-EFC See Page 73) and nylon spacer pads (PAD See Page 200).

10 Fit a second M10 hex nut onto each of the hand tightened assemblies. Using a M10 spanner to hold the first M10 hex nut in place, tighten the second M10 hex nut to a torque of 46Nm. Check that the completed assembly is free to move (some light resistance to movement is preferable).

11 Repeat for the remaining fixing sets.

12 Check the installed Speedway expansion coupler for freedom of movement (some light resistance to movement is preferable).

Consult our Technical Team for installation instructions for the Speedway full moment expansion coupler.

1.3 Loading Information

To enable the selection of the most appropriate Speedway cable ladder for a particular installation it is necessary to consider the loads which must be supported and the distance between supports (the span). These loads are broadly classed as dead loads, imposed loads and point loads.

1.3.1 Dead Loads

Dead loads include the weight of any cables, pipes and secondary equipment carried on or installed on the cable ladder plus the self weight of the cable ladder and any component of the cable ladder (covers, connectors, accessories, etc.).

Weight data for cables is readily available from the cable manufacturer or supplier and is usually quoted in terms of kilograms per metre (kg/m). The weight per metre from the cables (or pipes, etc) is the sum of the individual cable (or pipe, etc) weights. Weight data for secondary equipment should also be readily available from the equipment manufacturer or supplier and is usually quoted in terms of kilograms (kg). The unit weight for the secondary equipment can be converted into a equivalent weight per metre by using the following formula:

$$\text{Equivalent weight per metre Wm (kg/m)} = \frac{2 \times \text{unit of equipment (kg)}}{\text{Span (m)}}$$

For example, a secondary item of equipment with a weight of 12kg has an equivalent weight per metre Wm of 8kg/m for a span of 3m. This figure should be added to the sum of the individual cable weights (or pipe, etc). When determining the location of secondary items of equipment, care should be taken to either mount these items centrally across the cable ladder using the Speedway mounting plates, or place these items adjacent to, or directly onto, the cable ladder side members and as close to the cable ladder supports as the installation will allow.

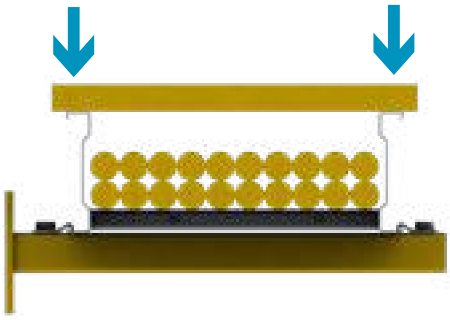
The allowable loading figures given in the tables overleaf include the self weight of the Speedway cable ladder. The weight data for additional installed components (covers, mounting accessories, etc) for the Speedway cable ladder system can be provided on request by our Technical Team.

1.3.2 Point Loads

Point loads are often applied to the cable ladder during installation, cable pulling and in-service inspection.

An allowance can be made for the influence of point loads at the design stage when determining the total load to be carried by the Speedway cable ladder system. Typical point loads are in the order of 75kg to 150kg. When specifying a point load requirement it should be noted that the value of the point load should be kept to a minimum as incorporating the point load will reduce the allowable cable load for the Speedway cable ladder. Loading graphs which include the influence of a mid span point load are available on request.

Speedway cable ladder is not intended to be used as a walkway and on no account should point loads be applied to the rungs. On those occasions where it is necessary to apply a point load care should be taken to apply the load evenly onto the two side members, preferably using a board or similar support to distribute the load over as long a section of the cable ladder as possible.



Correct application of point load onto Speedway cable ladder using a board to spread the load evenly onto the side members

1.3.3 Safe Working Load

When correctly mounted and secured, cable ladder can be considered to be a ‘continuous beam’. This implies that the cable ladder run is regularly supported and that the cable ladders at the extremities of the run are firmly anchored. The following tables are used to calculate the safe working load and have been verified by testing in accordance to BS EN 61537 .The load bearing capacity of a cable ladder is limited by the lesser of the maximum allowable stress induced in the side members and rungs or the maximum deflection acceptable in the same members. The maximum allowable stress is usually limited by the materials lower yield stress; this gives a safety factor of 1.7 against the ultimate tensile strength.

Maximum deflection, (in the absence of a particular customer need) is not allowed to exceed 1/100th of the distance between supports (span) longitudinally or 1/20th of the rung length (cable ladder width) transversely. Although unusual, there may be occasions when it is difficult or indeed impossible to anchor the cable ladder securely in position. Under these circumstances the ladder is ‘simply supported’ and its load bearing ability is substantially reduced. As a rough guide maximum loads should be limited to two thirds of those shown in the loading tables and increased deflection values should be accepted for each span.

The data given in the tables is for Vantrunk cable ladder installed as a continuous beam and allows for the weight of the ladder itself. The safe working load values represent a uniformly distributed load and a factor of 1.7 as recommended in the cable ladder European standard. This information is given for guidance only and larger safety factors can be used depending on the installation. The Speedway Cable Ladder system, components and accessories have been tested to BS EN ISO 61537.

Further details are can be provided by our Technical Team.

ENGINEERING DATA

Ladder Type	3m		4m		5m		6m	
	kg/m	N/m	kg/m	N/m	kg/m	N/m	kg/m	N/m
Speedway SW4	256	2511	175	1717	61	598	44	432
Speedway SW5	306	3002	206	2021	98	961	72	706
Speedway SW6	488	4787	295	2894	163	1599	129	1265

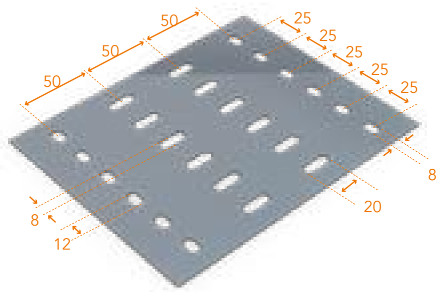
Loading data in Accordance with BS EN IEC 61537
Test Type II with a 0.75L end span.

2. VANTRUNK CABLE TRAY

2.1 General Information

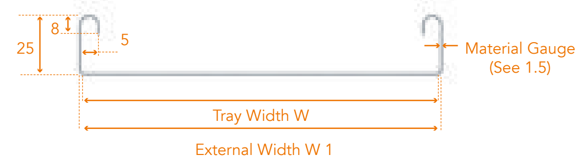
2.1.1 Slot Patterns

Details of the slot patterns for the Vantrunk cable tray system are given in the following diagram. These slot patterns are common for each Vantrunk cable tray type, irrespective of material gauge and finish.



2.1.2 Profiles

Medium Duty Return Flange



Heavy Duty Return Flange

2.1.3 Side Wall Heights

The Vantrunk cable tray range is available with the following side wall heights.

Tray & Fitting Type	Side Wall Height mm
Medium Duty Return Flange	25
Heavy Duty Return Flange	50
	75
	100

2.1.4 Cable Tray Fitting Radius

Vantrunk cable tray fittings are available with the following standard radii.

Standard Radius For Cable Tray Fittings

Tray Width (mm)	Flat Elbows, Tees & Crosses	Inside & Outside Risers
50	75	300
75		
100		
150		
200	150	
225		
300		
450		
600		
750		
900		

All Vantrunk cable tray fittings are available to order with radii of 300mm, 450mm & 600mm. Those cable tray fittings which have a standard radius of 75mm are also available to order with a radius of 150mm. Consult our Sales Team for details.

2.1.5 Material Gauges

The standard range of material gauges for the Vantrunk cable tray & fittings have been determined by providing the most cost effective and efficient gauge for each material type to suit the designed application of each of Vantrunk cable tray system types.

Straight Lengths

<table>
<tr><th rowspan="2"></th><th colspan="4">Medium Duty</th><th colspan="4">Heavy Duty</th></tr>
<tr><th>GA</th><th>SS</th><th>GX</th><th>GW</th><th>GA</th><th>SS</th><th>GX</th><th>GW</th></tr>
<tr><td>50</td><td rowspan="6">0.9mm</td><td rowspan="7">1.0mm</td><td rowspan="10" colspan="2">1.5mm</td><td rowspan="4">0.9mm</td><td rowspan="7">1.0mm</td><td rowspan="10" colspan="2">1.5mm</td></tr>
<tr><td>75</td></tr>
<tr><td>100</td></tr>
<tr><td>150</td></tr>
<tr><td>200</td><td rowspan="3">1.2mm</td></tr>
<tr><td>225</td></tr>
<tr><td>300</td><td>1.2mm</td></tr>
<tr><td>400</td><td rowspan="3">1.5mm</td><td rowspan="5">1.5mm</td><td rowspan="3">1.5mm</td><td rowspan="5">1.5mm</td></tr>
<tr><td>450</td></tr>
<tr><td>600</td></tr>
<tr><td>750</td><td rowspan="2">2.0mm</td><td rowspan="2" colspan="2">2.0mm</td><td rowspan="2">2.0mm</td><td rowspan="2" colspan="2">2.0mm</td></tr>
<tr><td>900</td></tr>
</table>

Fittings

<table>
<tr><th rowspan="2"></th><th colspan="4">Medium Duty</th><th colspan="4">Heavy Duty</th></tr>
<tr><th>GA</th><th>SS</th><th>GX</th><th>GW</th><th>GA</th><th>SS</th><th>GX</th><th>GW</th></tr>
<tr><td>50</td><td rowspan="6">0.9mm</td><td rowspan="7">1.0mm</td><td rowspan="10" colspan="2">1.5mm</td><td rowspan="4">0.9mm</td><td rowspan="7">1.0mm</td><td rowspan="10" colspan="2">1.5mm</td></tr>
<tr><td>75</td></tr>
<tr><td>100</td></tr>
<tr><td>150</td></tr>
<tr><td>200</td><td rowspan="5">1.2mm</td></tr>
<tr><td>225</td></tr>
<tr><td>300</td><td rowspan="3">1.2mm</td></tr>
<tr><td>400</td><td rowspan="5">1.5mm</td><td rowspan="5">1.5mm</td></tr>
<tr><td>450</td></tr>
<tr><td>600</td><td rowspan="3">1.5mm</td><td>1.5mm</td></tr>
<tr><td>750</td><td rowspan="2" colspan="2">2.0mm</td><td rowspan="2">2.0mm</td><td rowspan="2" colspan="2">2.0mm</td></tr>
<tr><td>900</td></tr>
</table>

Covers

<table>
<tr><th></th><th>GA</th><th>SS</th><th>GX</th><th>GW</th></tr>
<tr><td>50</td><td rowspan="6">0.9mm</td><td rowspan="7">1.0mm</td><td rowspan="10" colspan="2">1.5mm</td></tr>
<tr><td>75</td></tr>
<tr><td>100</td></tr>
<tr><td>150</td></tr>
<tr><td>200</td></tr>
<tr><td>225</td></tr>
<tr><td>300</td><td rowspan="3">1.2mm</td></tr>
<tr><td>400</td><td rowspan="5">1.5mm</td></tr>
<tr><td>450</td></tr>
<tr><td>600</td><td rowspan="3">1.5mm</td></tr>
<tr><td>750</td><td rowspan="2" colspan="2">2.0mm</td></tr>
<tr><td>900</td></tr>
</table>

The following table shows the standard material gauges for each width and type of Vantrunk cable tray system in a number of finishes. Consult our Technical Team for gauge details for other materials & finishes.

The standard material gauges are supplied for each tray and fitting type & width unless otherwise specified.

Consult our Technical Team for guidance on the appropriate selection of non-standard material gauges. Weights, where quoted in the catalogue, are for the standard hot dip galvanised carbon steel item. The following correction factors should be used to determine an estimated weight for the corresponding item in an alternative gauge and finish. For exact weight data please consult our Sales Team.

As an example:
A heavy duty return flange cable 90° flat bend, 300mm wide, hot dip galvanised finish in standard 1.2mm gauge weighs 2.32kg. The equivalent weight of the stainless steel item in 1.5mm gauge = 2.32kg x 1.2 = 2.78kg.

Material & Gauge Correction Factor

Standard Gauge	Required Gauge	Hot Dip Galvanised Mild Steel (GA)	Stainless Steel (SS)	Hot Dip Galvanised Silicon Rich, Steel (GX)
0.9	0.9	0.92	0.94	1.08
	1.0	1.02	1.04	1.20
	1.2	1.24	1.26	1.42
	1.5	1.58	1.60	1.76
	2.0	2.10	2.13	2.35
1.0	0.9	0.83	0.84	1.08
	1.0	0.92	0.94	1.20
	1.2	1.12	1.14	1.42
	1.5	1.42	1.44	1.76
	2.0	1.89	1.92	2.35
1.2	0.9	0.69	0.70	0.81
	1.0	0.77	0.78	0.90
	1.2	0.93	0.95	1.07
	1.5	1.18	1.20	1.32
	2.0	1.57	1.60	1.76
1.5	0.9	0.55	0.56	0.65
	1.0	0.61	0.62	0.72
	1.2	0.75	0.76	0.85
	1.5	0.95	0.96	1.05
	2.0	1.26	1.28	1.41
2.0	0.9	0.41	0.42	0.49
	1.0	0.46	0.47	0.54
	1.2	0.56	0.57	0.64
	1.5	0.71	0.72	0.79
	2.0	0.94	0.96	1.06

Consult our Technical Team for other material & gauge combinations.

2.1.6 Recommended number of fixings

Vantrunk cable tray fittings have integral jointing strips for connecting to straight lengths and for connecting cable tray fittings to cable tray fittings. The cable tray fixing set comprises of an M6 x 12 screw and an M6 nut (plus an M6 flat washer for stainless steel fixings).

Cable Tray Fixing Sets

Part Number	Description	
Hot Dip Galvanised Cable Tray		
M6x12-BN-GA	M6 x 12 Mushroom Head Bolt M6 Square Nut	
Stainless Steel		
M6x12PHS-SS-A4 M6-FW-SS-A4 M6-HN-SS-A4	M6 x 12 Pan Head Screw M6 Flat Washer M6 Hex Nut	

The following table gives the recommended number of fixings for each type of cable tray straight length, fish plate coupler & cable tray fitting.

Recommended Number of Fixings for Cable Tray

Item	Width mm	Number of Fixing Supplied	
Straight Lengths	50 to 150	0 (Fixings supplied with Couplers)	
	200		
	225		
	300		
	450		
	600		
	750		
	900		
Fish Plate Couplers	50 & 75	NA	
	100 & 150	5	
	200		
	225	6	
	300		
	450	8	
	600	10	
	750	12	
	900	16	
Flat Bends Risers	50 to 150		
	200	4	
	225		
	300	6	
	450		
	600	8	
	750		
	900		
Equal Tees Unequal Tees	50 to 150		
	200	6	
	225		
	300	9	
	450		
	600	12	
	750		
	900		
Four Ways	50 to 150		
	200	8	
	225		
	300	12	
	450		
	600	16	
	750		
	900		
Reducers	**Primary Width**	**Secondary Width < 200mm**	**Secondary Width > 200mm**
	75		
	100		
	150	4	
	200		
	225		
	300	5	
	450	6	7
	600		
	750	6	8
	900		

Speedway
Cable Ladder
Cabletray
Cable Tray
Intelok
Steel Framing
General
Mounting Frame
Fixings
Bespoke
Engineering
Index

2.1.7 Perforation Base Area

Vantrunk straight cable tray has the following perforation base area:

Perforation Base Area for Vantrunk Cable Tray

Tray Type	Perforation Base Area	Classification to BS EN 61537
Medium Duty Return Flange	9.14%	B
Heavy Duty Return Flange	9.14%	B

Consult our Technical Team for perforation base area classifications for Vantrunk cable tray fittings.

2.1.8 Cross-sectional Area

The Vantrunk cable tray has the following cross-sectional areas (CSA):

Cross-sectional Area for Vantrunk Cable Tray

Tray Type	Width	CSA mm²
Medium Duty Return Flange	50	1040
	75	1628
	100	2215
	150	3390
	200	4565
	225	5153
	300	6915
	450	10440
	600	13965
	750	17490
	900	21015
Heavy Duty Return Flange	50	2290
	75	3503
	100	4715
	150	7140
	200	9565
	225	10778
	300	14415
	450	21690
	600	28965
	750	36240
	900	43515

CSA information is based on standard gauges in a hot dip galvanised finish. Consult our Technical Team for other gauges and materials.

The cross sectional areas given in the table above exclude return flanges where appropriate – see the following illustration for the cross section which is included as part of the area calculation.

Consult our Technical Team for cross-sectional area information for Vantrunk cable tray fittings.

2.1.9 Vantrunk Cable Tray Specification

The following is a typical specification for a cable tray system which incorporates the key features of the Vantrunk cable tray system.

1 The cable tray system shall comprise a perforated base with longitudinal upward facing side walls. Medium duty and heavy duty cable tray shall have returned flanges on the side walls for improved strength.

2 The profile of the cable tray straight lengths shall remain constant for the straight cable tray and shall be compatible with that of the matching cable tray fittings.

3 The inside of the cable tray shall present a smooth surface to allow for easier cable pulling and to minimise the opportunities for damage to the cable insulation.

4 The cable tray side walls shall have an overall height of:

For medium duty return flange cable tray: 25mm for all tray widths.

For heavy duty return flange cable tray: 50mm (or required side wall height) for all tray widths.

5 The cable tray shall have a width of 50mm, 75mm 100mm, 150mm, 200mm, 225mm, 300mm, 450mm, 600mm, 750mm and 900mm as required. The width shall be measured internally between the side walls.

6 The cable tray shall have a minimum thickness as follows for hot dip galvanised finish, other finishes consult our sales team:

For medium duty return flange cable tray: 0.9mm for tray of widths 50mm to 225mm, 1.2mm for tray of width 300mm (1.0mm for stainless steel), 1.5mm for tray of widths 450mm and 600mm and 2.0mm for widths of 750mm and 900mm (1.5mm for stainless steel).

For heavy duty return flange cable tray: 0.9mm for tray of widths 50mm to 150mm, 1.2mm for tray of width 200mm to 300mm (1.0mm for stainless steel), 1.5mm for tray of widths 450mm and 600mm and 2.0mm for widths of 750mm and 900mm (1.5mm for stainless steel).

For silicon rich, deep galvanised tray – all types: 1.5mm for tray of width 50mm to 600mm, 2.0mm for tray of widths 750mm to 900mm.

7 Straight cable tray shall be fully slotted with longitudinal slots of size 20mm x 8mm and transverse slots of size 12mm x 8mm. The slots shall be pitched at 25mm centres across the width of the cable tray and at 50mm centres along the length of the cable tray.

8 Straight cable tray shall have a length of 3000mm

9 Cable tray fittings shall be suitable slotted to match the slot pattern in the straight cable tray and shall have integral joints to facilitate connection to straight tray lengths and to other cable tray fittings.

10 Cable tray flat bends shall have fixed angles of 90°, 60°, 45° and 30°.

11 Cable tray fittings (except risers) shall have a radius of 75mm for widths up to & including 150mm, & a radius of 150mm for widths of 200mm and above. Cable tray risers shall have a radius of 300mm when formed to the set angle.

12 Cable tray risers shall be of an angle, 90°, 60°, 45° and 30°.

13 The cable tray system shall be manufactured using:

For carbon steel, hot dip galvanised finish: carbon steel to BS EN 10111 and shall be hot dip galvanised after manufacture to BS EN ISO 1461.

For stainless steel: stainless steel grade, 1.4404 (316 marine grade) to BS EN 10088.

For silicon rich, deep galvanised finish: silicon-rich steel and shall be deep galvanised after manufacture to twice the coating thickness specified by BS EN ISO 1461.

14 Couplers for the cable tray system shall be either of flat bar type or profiled to match the profile of the cable tray. Couplers shall be secured using M6 x 12 fixings with smooth heads to minimise possible damage to cables.

2.2 Installation Recommendations

2.2.1 Loads

A correctly designed and specified cable tray installation should take into account the nature and extent of the loads which will be imposed on the cable tray system. These loads comprise of dead loads including the self-weight of the cable tray system, the weight of the cables and secondary equipment attached to the cable tray, imposed loads which occur during installation of the cable tray system and during cable pulling operations, and external loads such as wind, snow & ice.

Cable trays are often employed in locations where the wind speeds may cause considerable lateral loading and careful consideration must be given to design to ensure a satisfactory installation. An awareness of the worst possible climate conditions is necessary when specifying the correct Vantrunk cable tray system.

The load-deflection information given in 2.3.3 is based on static loading of the Vantrunk cable tray installation. This information does not take into account dynamic effects such as vibration, earthquake loading, etc.

In designing a cable tray installation it is good practice to allow at least a 20% excess capacity in a new installation for future expansion. Such a provision is of great economic advantage when there is a later need for additional cables.

2.2.2 Support Spacing

The space between the supports of a cable tray installation is referred to as the span. Supports for cable tray should, as far is practicable, be spaced so as to create the most economical load/span ratio to suit the capacity of the cable tray system.

This will give the most advantageous solution when considering procurement and installation costs. As a general rule of thumb, the load-carrying capability of the Vantrunk cable tray system increases as the span decreases, so a lighter duty cable tray system can be specified for shorter spans. Conversely, a heavier duty Vantrunk cable tray system will need to be specified as the span increases.

Vantrunk cable tray can provide cost-effective support for cable loads at spans of 0.5m to 3m depending on the type of cable tray system selected. For longer spans, or for carrying significantly increased cable loads, the Speedway cable ladder system should be used.

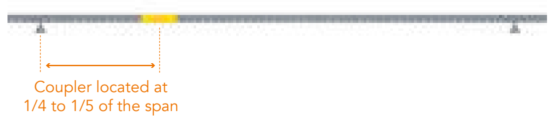
When considering support positions it should be remembered that it is necessary to support accessories when a change of direction takes place i.e. bends, tees, risers etc. This is to ensure that undue 'corner' cantilever reaction is minimised. Recommendations for the location of supports for Vantrunk cable tray fittings are given in section 2.2.4

2.2.3 Location of Couplers

The maximum bending moments acting on a cable tray run occur in the cable tray at the supports and at the mid span position. For this reason it is good practice to avoid locating couplers in a cable tray run either directly on supports or at the mid span position. It is also good practice to avoid locating couplers in the end span of a continuous beam installation as the bending moments in the end span are, for simple end support installations, much higher than those found in the intermediate spans. These limitations cannot always be achieved in a cable tray installation and are not a mandatory requirement for the Vantrunk cable tray coupling system where the loading information given in 3.3 is valid irrespective of the location of the couplers.

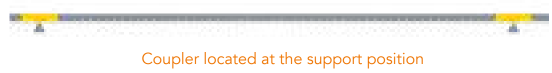
The ideal positions to locate the connections in a cable tray run are at approximately one fifth to one quarter of a span from the supports where the bending moments, and hence the stresses, are minimal. Positioning the couplers at the one fifth to one quarter span positions is of benefit during installation, assisting in alignment of the cable trays and allowing unhindered securing of the cable tray to the supports.

Ideal Coupler Location



Allowable Coupler Location

Inappropriate Coupler Location



Speedway
Cable Ladder
Cabletray
Cable Tray
Intelok
General
Steel Framing
Mounting Frame
Fixings
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2.2.4 Support Locations for Cable Tray Fittings

It is also important to consider support locations for cable tray fittings which are used as part of a cable tray installation to change direction, change width or create intersections.

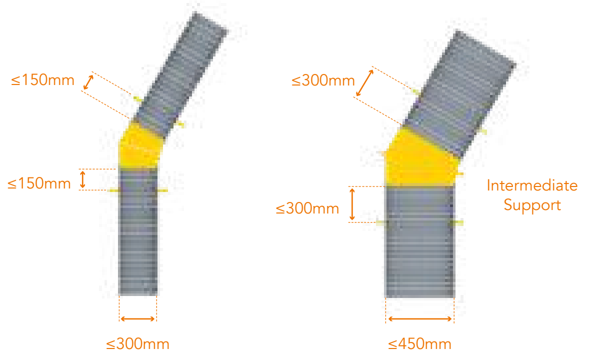
Vantrunk cable tray fittings are designed to carry loads comparable to that for the straight cable tray but will require local support to avoid undue stresses being applied to the fittings.

The following illustrations show the recommended support positions when installing Vantrunk cable tray fittings. The supports should be fully fixed to provide maximum support for the Vantrunk cable tray fitting.

Flat Elbows

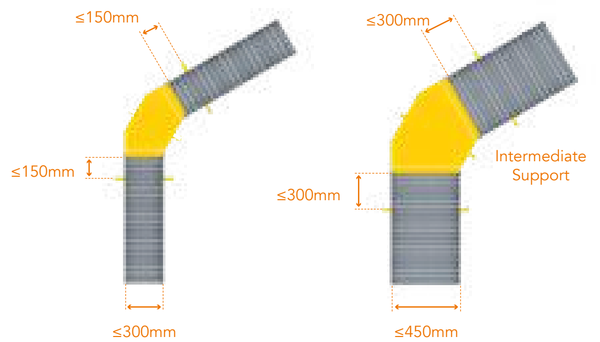
30° Flat Elbow

For 30° flat elbows, supports should be placed within 150mm of the fitting for widths up to 300mm. For fittings of width 450mm and above, supports should be placed within 300mm of the fitting and an intermediate support should be located radially at 15° across the centre of the fitting.



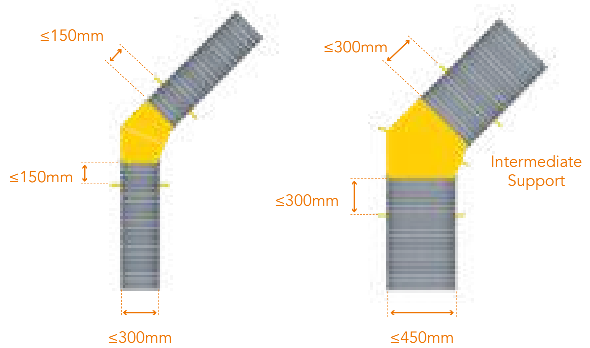
60° Flat Elbow

For 60° flat elbows, supports should be placed within 150mm of the fitting for widths up to 300mm. For fittings of width 450mm and above, supports should be placed within 300mm of the fitting and an intermediate support should be located radially at 30° across the centre of the fitting.



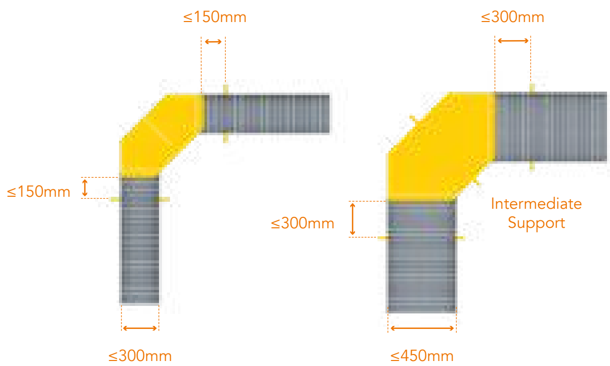
45° Flat Elbow

For 45° flat elbows, supports should be placed within 150mm of the fitting for widths up to 300mm. For fittings of width 450mm and above, supports should be placed within 300mm of the fitting and an intermediate support should be located radially at 22.5° across the centre of the fitting.



90° Flat Elbow

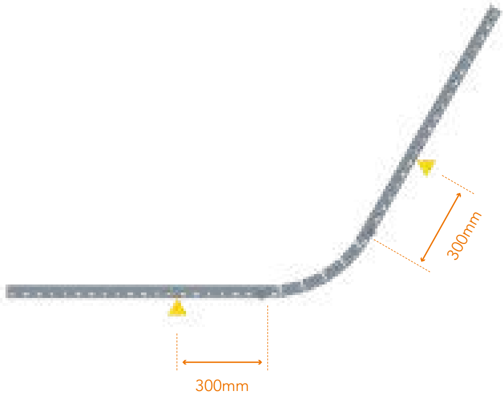
For 90° flat elbows, supports should be placed within 150mm of the fitting for widths up to 300mm. For fittings of width 450mm and above, supports should be placed within 300mm of the fitting and an intermediate support should be located radially at 45° across the centre of the fitting.



Internal & External Risers

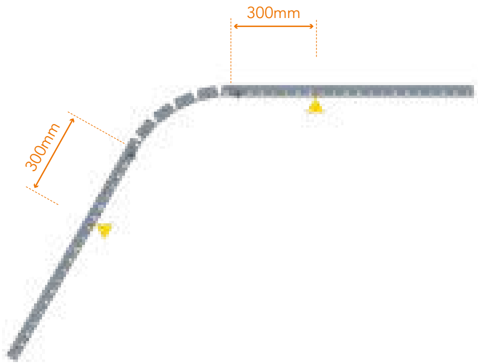
Internal Risers

For all widths of internal risers, supports should be placed within 300mm of the fitting.



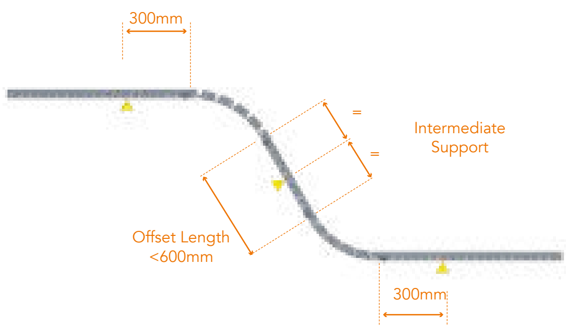
External Risers

For all widths of external risers, supports should be placed within 300mm of the fitting.



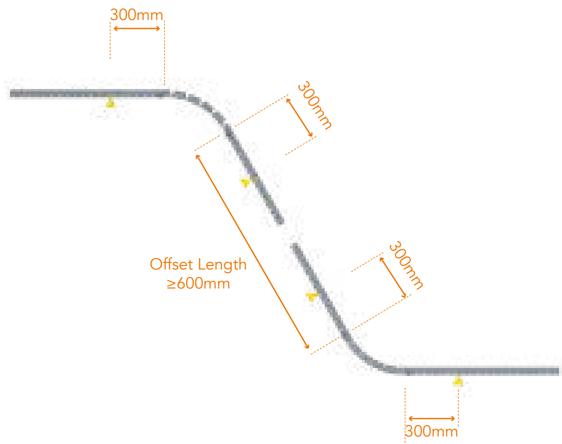
Internal & External Risers Used in Offset Arrangement

For internal & external risers used in an offset arrangement of length up to 600mm, supports should be located within 300mm of each end of the offset and centrally on the inclined cable tray.



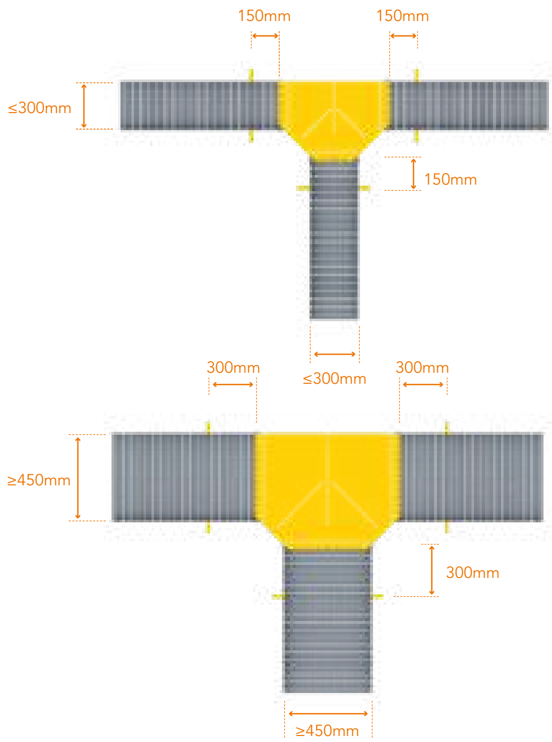
...continued

For internal & external risers used in an offset arrangement of length over 600mm, supports should be located within 300mm of each end of the internal & external risers. The inclined cable tray should be supported in accordance with the support recommendations for the straight cable tray run.



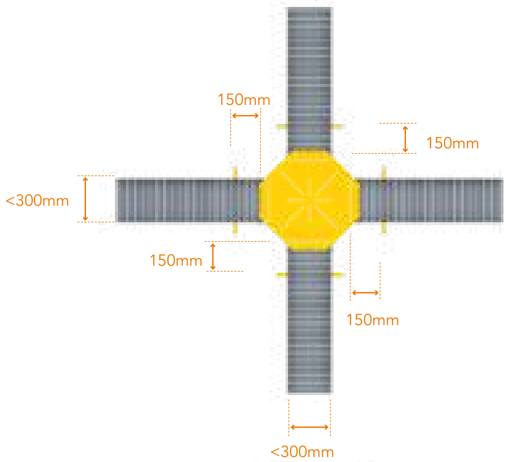
Equal & Unequal Tees

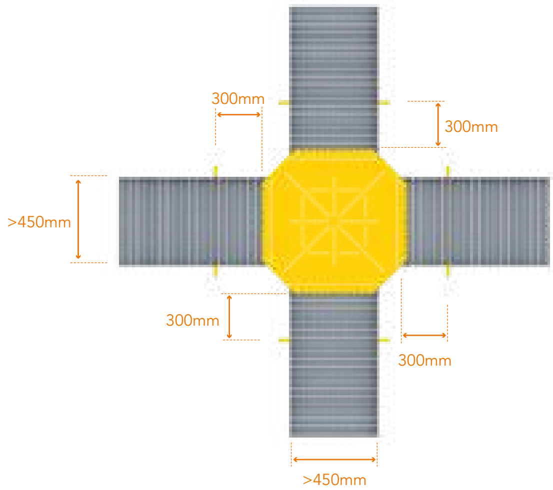
For equal and unequal tees, supports should be placed within 150mm of the fitting for main or branch widths up to 300mm. For fittings of main or branch width 450mm and above, supports should be placed within 300mm of the fitting.



Crosses

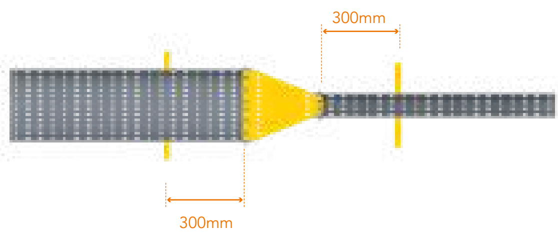
For crosses, supports should be placed within 150mm of the fitting for main or branch widths up to 300mm. For fittings of main or branch width 450mm and above, supports should be placed within 300mm of the fitting.





Reducers

For all widths of reducers (straight, left & right), supports should be placed within 300mm of the fitting.

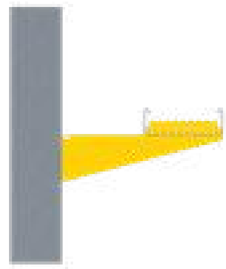


2.2.5 Loading of Vantrunk Cable Tray & Supports

It is important that cable tray and cable tray supports are loaded in a symmetrical manner such that undue stresses in both the cable tray and the supports are kept to a minimum.

The safe working load figures for the Vantrunk cable tray and support accessories are based on a uniform loading within the Vantrunk cable tray and on the assumption that the correct length of support is used in each case.

Wherever possible, cable tray should be loaded in a uniform manner across the full width of the cable tray, particularly when the cable tray is loaded to the recommended load carrying capacity.

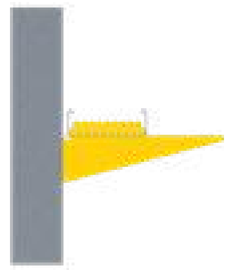


Avoid non-uniform loading

Load uniformly across the width of the cable tray

Where cantilever supports of additional length are used to support cable tray, care should be taken to position the cable tray as close to the backplate of the cantilever as the installation routing will allow.

Avoid unsymmetrical loading on cantilevers



Load cantilevers close to the backplate

Safe working load information for cable tray supports is given in the 'Supports' section of this catalogue.

For further information and guidance on the design and loading of supports please contact our Technical Team.

2.2.6 Electrical Continuity Characteristics

In tests conducted to verify the electrical continuity characteristics of the Vantrunk cable tray it has been established that the standard coupling system provides adequate electrical continuity, ensuring equipotential bonding and connection to earth.

The Vantrunk cable tray system has been tested for electrical continuity to BS EN 61537 (Section 11.1).

Details are given in the following table:

Material & Finish	Impedance across joint	Impedance per metre length
Hot Dip Galvanised (0.9mm)	2mΩ	2mΩ
Hot Dip Galvanised (1.5mm)	2mΩ	2mΩ
Stainless Steel (1.2mm)	2mΩ	2mΩ

BS EN 61357 requires a maximum impedance of 50mΩ across the coupled joint and a 5mΩ per metre length without a joint.

Earth continuity bonding straps (part number EBS-05) of cross sectional area 4 mm² are available for use with Vantrunk cable tray where a non-conductive surface finish i.e. epoxy coated etc, has been specified or where the installation requires an additional means of bonding. Consult our Technical Team for more details.

2.2.7 Electromagnetic Compatibility (EMC)

In normal use Vantrunk cable tray can be considered to be passive in respect of electromagnetic influences, emissionand immunity. When Vantrunk cable tray is installed as part of a wiring installation, the installation may emit or may be influenced by electromagnetic signals. The degree of influence will depend on the nature of the installation within its operating environment and the electrical equipment connected by the wiring. As a minimum precaution to minimise the occurrence of electromagnetic influences, power and data/signal cables should be run on separate cable routings or at least separated by means of dividers.

Our Technical Team should be consulted for further information on electromagnetic compatibility issues.

2.2.8 Assembly Recommendations

Instructions for the correct assembly of Vantrunk cable tray straight lengths and fittings are given below.

Cable tray couplers are supplied with the correct number of fixing sets, each comprising of an M6 x 12 screw and an M6 nut (plus an M6 flat washer for stainless steel fixings). Refer to section 2.1.6 for details on the recommended number of fixings for cable tray fittings.

When utilising the standard flat bar coupler as an expansion coupler it will be necessary to order M6x16 bolts and additional M6 nuts (4 per coupler).

Straight Cable Tray to Straight Cable Tray

1 Position the two straight cable trays onto the supporting structure.

2 For flat bar couplers, locate the cable tray flat bar coupler on the inside of the two abutting straight cable trays. For wrap over couplers, position the coupler on the outside of the two abutting straight cable trays.

3 Position the coupler across the joint between the two straight lengths. For flat bar couplers, align the slots in the coupler with those in the side wall of the cable tray. For wrap over couplers, align the slots in the coupler with those in the base of the cable tray.

4 From the inside of the cable tray insert the threaded portion of an M6 x 12 screw through one of the aligned slots.

5 Fit an M6 flat washer (where provided) and an M6 hex nut onto the protruding thread of the M6 x 12 screw.

6 Tighten the fixing assembly by hand.

7 Repeat for the remaining fixing sets.

8 Repeat the assembly procedure for the second coupler.

9 Fully secure the straight cable tray lengths to the supporting structure.

10 Check the alignment of the coupler and the abutting straight cable trays. Adjust as necessary to give a fair and true alignment.

11 Tighten the M6 hex nuts to a torque of 12Nm.

12 Where required, fit a fish plate coupler to the underside of the joint between the two straight cable trays.

Cable Tray Fitting to Straight Cable Tray

1 Position the straight cable tray and cable tray fitting onto the supporting structure and interlock the cable tray fitting into the straight cable tray.

2 Align the slots on the interlocked straight cable tray and cable tray fitting.

3 From the inside of the cable tray, insert the threaded portion of an M6 x 12 screw through one of the aligned slots.

4 Fit an M6 flat washer (where provided) and an M6 hex nut onto the protruding thread of the M6 x 12 screw.

5 Tighten the fixing assembly by hand.

6 Repeat for the remaining fixing sets.

7 Fully secure the straight cable tray and cable tray fitting to the supporting structure.

8 Check the alignment of the interlocked straight cable tray and cable tray fitting. Adjust as necessary to give a fair and true alignment.

9 Tighten the M6 hex nuts to a torque of 12Nm.

Cable Tray Expansion Joint

Refer to Page 248 for details on the spacing between expansion couplers and the required gap setting procedure at the time of installation.

1 Position the two straight trays onto the supporting structure.

2 Locate the cable tray flat bar coupler on the inside of the two abutting straight cable trays.

3 Position the coupler across the joint between the two straight lengths. Align the slots in the coupler with those in the side wall of the cable tray.

4 From the inside of the cable tray insert the threaded portion of an M6 x 16 screw through one of the aligned slots.

5 Fit an M6 flat washer (where provided) and an M6 hex nut onto the protruding thread of the M6 x 16 screw.

6 Tighten the fixing assembly by hand such that the fixing assembly is free to move within the slots (some light resistance to movement is preferable).

7 Repeat for the remaining fixing sets.

8 Repeat the assembly procedure for the second coupler.

9 Check the alignment of the coupler and the abutting straight cable trays. Adjust as necessary to give a fair and true alignment.

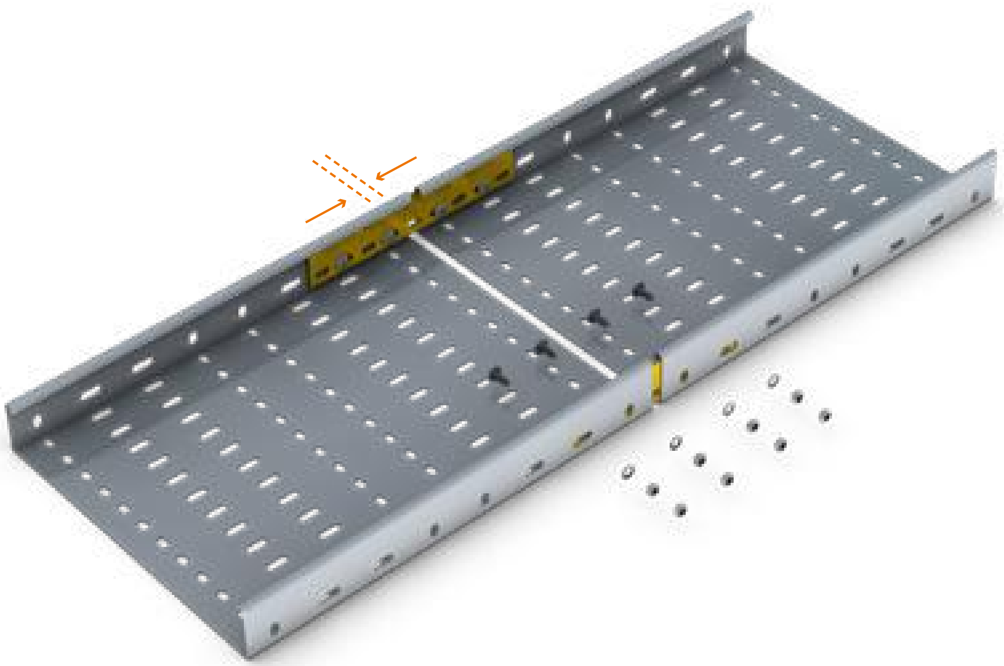
10 Check the setting gap between the straight cable trays and adjust as necessary.

11 Secure the straight cable trays to the supporting structure using nylon spacer pads and hold down brackets to permit movement relative to the structure.

12 Fit the second M6 nut onto the fixing assemblies. Lock the second M6 nut onto the first M6 nut. Check that the completed fixing assembly remains free to move within the aligned slots.

13 Tighten the 2nd M6 hex nut onto the 1sr M6 hex nut to a torque of 12Nm.

14 Ensure that the fixing assembly remains free to move within the slots, otherwise re-assembly as necessary.



2.3 Loading Information

To enable the selection of the most appropriate Vantrunk cable tray for a particular installation it is necessary to consider the loads which must be supported and the distance between supports (the span). These loads are broadly classed as dead loads, imposed loads and point loads.

2.3.1 Dead Loads

Dead loads include the weight of any cables, pipes and secondary equipment carried on or installed on the cable tray plus the self weight of the cable tray and any component of the cable tray (covers, connectors, accessories, etc.).

Weight data for cables is readily available from the cable manufacturer or supplier and is usually quoted in terms of kilograms per metre (kg/m). The weight per metre from the cables (or pipes, etc) is the sum of the individual cable (or pipe, etc) weights.

Weight data for secondary equipment should also be readily available from the equipment manufacturer or supplier and is usually quoted in terms of kilograms (kg). The unit weight for the secondary equipment can be converted into an equivalent weight per metre by using the following formula:

$$\text{Equivalent weight per metre } W_m = \frac{2 \times \text{unit weight of equipment (kg) kg/m}}{\text{Span (m)}}$$

For example, a secondary item of equipment with a weight of 12kg has an equivalent weight per metre Wm of 16kg/m for a span of 1.5m. This figure should be added to the sum of the individual cable weights (or pipe, etc). When determining the location of secondary items of equipment, care should be taken to either mount these items centrally across the cable tray or place these items adjacent to, or directly onto, the cable tray side walls and as close to the cable tray supports as the installation will allow.

The allowable loading figures given in the tables below include the self weight of the Vantrunk cable tray. The weight data for additional installed components (covers, mounting accessories, etc) for the Vantrunk cable tray system can be provided on request by our Technical Team.

2.3.2 Point Loads

Point loads are often applied inadvertently to the cable tray during installation and during in-service inspection. Care should be exercised to avoid these undue point loads, particularly on light duty & medium duty cable trays which are not designed for this type of loading.

In situations where point loads are applied to heavy duty cable trays, an allowance can be made for the influence of point loads at the design stage when determining the total load to be carried by the Vantrunk cable tray system. When specifying a point load requirement at the design stage it should be noted that the value of the point load should be kept to a minimum as incorporating the point load will reduce the allowable cable load for the Vantrunk cable tray. Loading graphs which include the influence of a mid span point load are available on request.

Vantrunk cable tray is not intended to be used as a walkway and on no account should localised point loads be applied onto the bed of the cable tray. On those occasions where it is necessary to apply a point load care should be taken to apply the load evenly onto both side walls of the cable tray, preferably using a board or similar support to distribute the load over as long a section of the cable tray as possible.

Where doubt exists, further guidance should be sought from our Technical Team.

2.3.3 Loading Graphs

When correctly mounted and secured, cable tray can be considered to be a 'continuous beam'. This implies that the cable tray run is regularly supported and that the cable trays at the extremities of the run are firmly anchored. The following tables are used to calculate the safe working load and have been verified by testing in accordance to BS EN 61537.

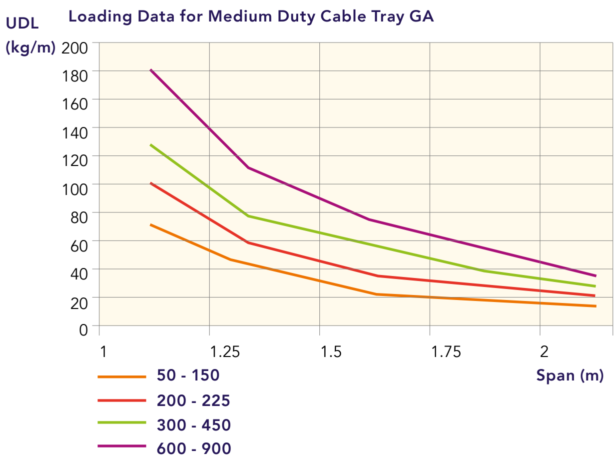
The load bearing capacity of a cable tray is limited by the lesser of the maximum allowable stress induced in the tray section or the maximum deflection acceptable between the supports. The maximum allowable stress is usually limited by the materials lower yield stress; this gives a safety factor of 1.7 against the ultimate tensile strength. Maximum deflection, (in the absence of a particular customer need) is not allowed to exceed 1/360th of the distance between supports (span).

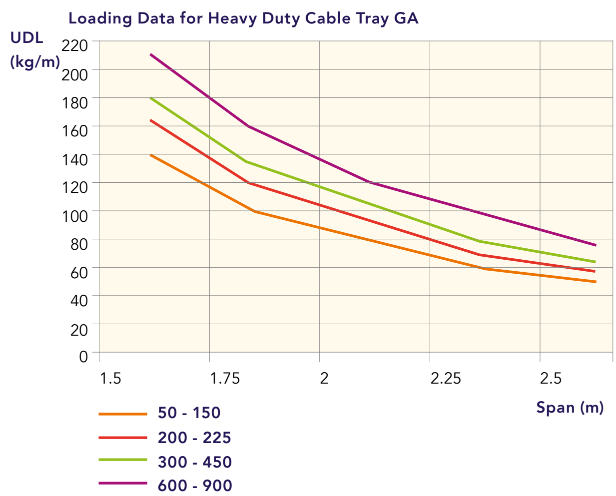
Although unusual, there may be occasions when it is difficult or indeed impossible to anchor the cable tray securely in position. Under these circumstances the tray is 'simply supported' and its load bearing ability is substantially reduced. As a rough guide maximum loads should be limited to two thirds of those shown in the loading tables and increased deflection values should be accepted for each span. The data given in the graphs is for tray installed as a continuous beam and allows for the weight of the tray itself.

Loading information is available for other gauges and for heavy duty cable trays with increased side wall heights – contact our Technical Team for details

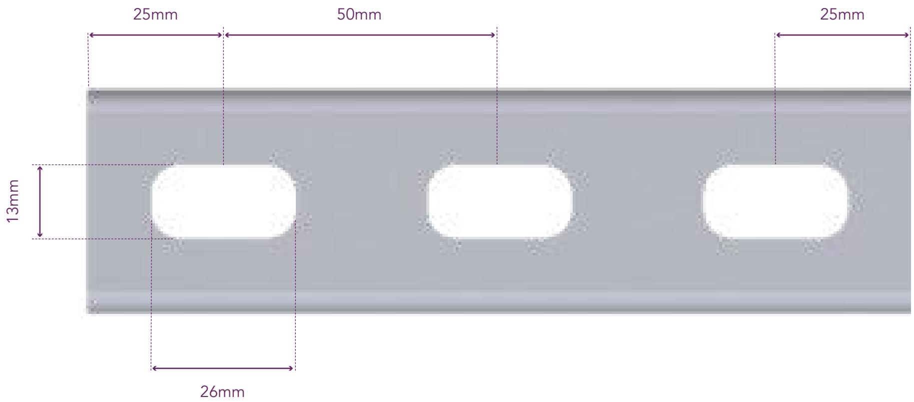
The Vantrunk cable tray system, components and accessories have been tested to BS EN IEC 61537.

Further details can be provided by our Technical Team.



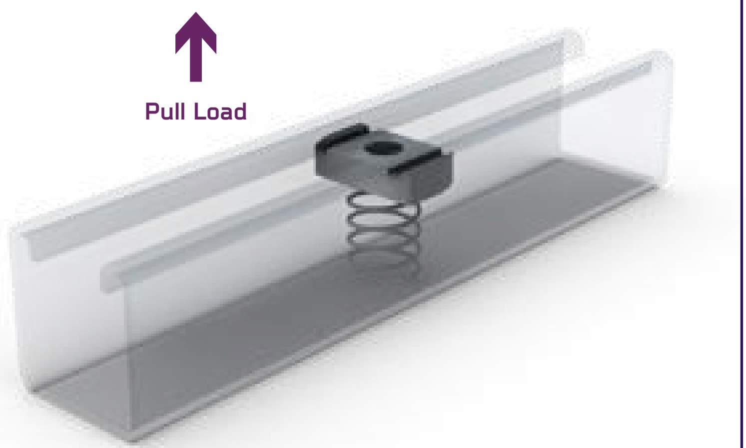


3. INTELOK STEEL FRAMING
3.1 General Information
3.1.1 Slot Information



3.2 Loading Information
3.2.1 Pull Test

In order to measure the safe working pull out load (SWL) for channel, a series of tests were conducted according to BS 6946:1988. The following are the set of results that were derived from the tests.

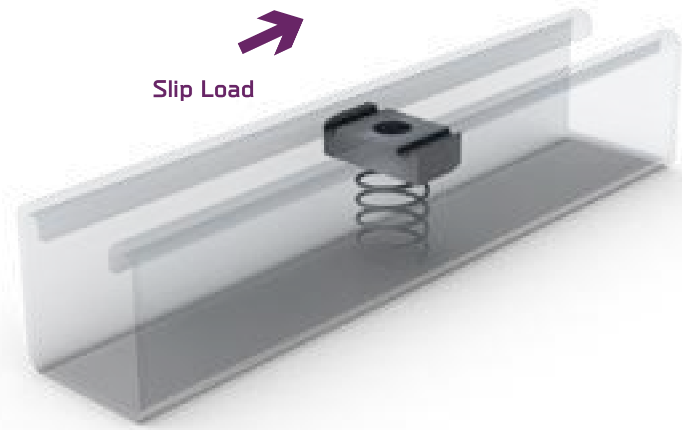


* The Results in the table have had a safety factor of 3 applied to the ultimate failure load
* The Results are in Kilogram (Kg)

Material	M10	M12
Hot Dip Galvanised	839	768
Pre-Galvanised	728	733
Stainless Steel	1052	1375

3.2.2 Slip Test

In order to measure the safe working slip load (SWL) for channel, a series of tests were conducted according to BS 6946:1988. The following are the set of results that were derived from the tests.



* The Results in the table have had a safety factor of 3 applied to the ultimate failure load

* The Results are in Kilogram (Kg)

Material	Nut Size	Torque	1mm Slip	Failure	Average SWL
Hot Dip Galvanised	M10	46Nm	662.6kg	733.9kg	286.5kg
Pre-Galvanised	M10	46Nm	632kg	978.6kg	425.9kg
Stainless Steel	M10	31Nm	336.4kg	540.3kg	188kg

3.3 Bracket Weights & Quickfit Fixing Quantities

Page Number	Part Number	Weight (g)	Quickfit				Former QF Reference
			Part Number	No of QF Fixings	M10 Weight (g)	Bracket Description	
162	325AJ02-GA	52	N-A		-	Internal washer	N-A
162	325AJ03-GA	75	N-A		-	Square washer M6	N-A
162	325AJ05-GA	73	N-A		-	Square washer M8	N-A
162	325AJ07-GA	72	N-A		-	Square washer M10	N-A
162	325AJ10-GA	69	325AJ10-GA-QF	1	132	Square washer M12	325QJ60
162	325AD11-GA	153	325AD11-GA-QF	2	279	Two hole plate	325QD61
162	325AC11-GA	229	325AC11-GA-QF	3	418	Three hole plate	325QC61
162	325AC13-GA	306	325AC13-GA-QF	4	558	Four hole plate	325QC63
162	325AY10-GA	382	325AY10-GA-QF	5	697	Five hole flat plate	325QY60
162	325AY11-GA	459	325AY11-GA-QF	6	837	Six hole flat plate	325QY61
162	325AY12-GA	535	325AY12-GA-QF	7	976	Seven hole flat plate	325QY62
163	325AG10-GA	207	325AG10-GA-QF	3	396	L bracket	325QG60
163	325AF13-GA	276	325AF13-GA-QF	3	465	T bracket	325QF63
163	325AF15-GA	418	325AF15-GA-QF	4	670	Fishplate-joiner four hole	325QF65
163	325AF26-GA	261	325AF26-GA-QF	3	450	Three hole angle plate	325QF76
163	325AF27-GA	207	325AF27-GA-QF	4	459	Four hole cross plate	325QF77
163	325AQ10-GA	610	325AQ10-GA-QF	4	862	Right angle bracket	325QQ60
163	325AQ11-GA	594	325AQ11-GA-QF	5	909	Right angle bracket	325QQ61
164	325AQ14-GA	401	325AQ14-GA-QF	4	653	Right angle bracket	325AQ14
163	325AQ12-GA	418	325AQ12-GA-QF	4	670	Right angle bracket	325QQ62
164	325AS10-GA	162	325AS10-GA-QF	2	288	Right angle bracket 1+1	325QS60
164	325AC09-GA	229	325AC09-GA-QF	3	418	Right angle bracket 2+1	325QC59
164	325AC10-GA	229	325AC10-GA-QF	3	418	Right angle bracket 2+1	325QC60
164	325AD10-GA	153	325AD10-GA-QF	2	279	Right angle bracket 1+1	325QD60
164	325AE10-GA	306	325AE10-GA-QF	4	558	Right angle brackets 3+1	325QE60
164	325AE11-GA	306	325AE11-GA-QF	4	558	Right angle bracket 2+2	325QE61
164	325AE12-GA	394	325AE12-GA-QF	4	646	Right angle shelf bracket 2+2	325QE62
165	325AH11-GA	219	325AH11-GA-QF	2	345	Acute angle bracket 45°	325QH61
165	325AD17-GA	188	325AD17-GA-QF	2	314	Obtuse angle bracket 45°	325QD67
165	325AF14-GA	276	325AF14-GA-QF	3	465	45° angle bracket	325QF64
165	325AF10-GA	276	325AF10-GA-QF	4	528	Channel support bracket	325QF60
165	325AF11-GA	276	325AF11-GA-QF	4	528	Channel support bracket (LH)	325QF61
165	325AF12-GA	276	325AF12-GA-QF	4	528	Channel support bracket (RH)	325QF62
165	325AG12-GA	207	325AG12-GA-QF	3	396	Channel support bracket (LH)	325QG62
166	325AG13-GA	207	325AG13-GA-QF	3	396	Channel support bracket (RH)	325QG63
166	325AG15-GA	231	325AG15-GA-QF	2	357	Channel support bracket (LH)	325QG65
166	325AG16-GA	231	325AG16-GA-QF	2	357	Channel support bracket (RH)	325QG66
166	325AV02-GA	324	325AV02-GA-QF	3	513	Corner bracket – 3 way	325QV52
166	325AV09-GA	688	325AV09-GA-QF	5	1003	Wing fitting – 3 leg	325QV59
166	325AV10-GA	595	325AV10-GA-QF	4	847	Wing fitting – 2 leg	325QV60
166	325AB10-GA	458	325AB10-GA-QF	3	647	Cross support bracket	325QB60
167	325AD28-GA	188	325AD28-GA-QF	2	314	Z shaped shallow bracket	325QD78
167	325AC12-GA	229	325AC12-GA-QF	2	355	Z shaped deep bracket	325QC62
167	325AU10-GA	306	325AU10-GA-QF	2	432	Z shaped B to B bracket	325QU60
167	325AT11-GA	306	325AT11-GA-QF	2	432	Back to back bracket	325QT61
167	325AJ13-GA	293	325AJ13-GA-QF	3	482	U shaped shallow bracket	325QJ63
166	325AJ12-GA	382	325AJ12-GA-QF	3	571	U shaped deep bracket	325QJ62
167	325AJ14-GA	535	325AJ14-GA-QF	3	724	Back to back channel bracket	325QJ64
167	325AJ11-GA	459	325AJ11-GA-QF	4	711	Double channel bracket	325QJ61
167	325AU15-GA	306	325AU15-GA-QF	3	495	W shaped deep bracket	325QU15
167	325AJ15-GA	306	325AJ15-GA-QF	2	432	U shaped deep bracket	325QJ65
168	325AR10-GA	454	325AR10-GA-QF	1	517	Base plate	325QR60
168	325AN10-GA	454	325AN10-GA-QF	1	517	Base plate	325QN60
168	325AT10-GA	984	325AT10-GA-QF	2	1110	Double base plate	325QT60
168	325AW01-GA	878	325AW01-GA-QF	2	1004	Wing fitting	325QW51
168	325AW02-GA	971	325AW02-GA-QF	4	1223	B to B Wing fitting	325QW52
168	325AW03-GA	428	325AW03-GA-QF	1	491	B to B Short wing fitting	325QW53
168	325AW04-GA	466	325AW04-GA-QF	2	592	Short wing fitting	325QW54
169	325AP10-GA	199	325AP10-GA-QF	1	262	Beam bracket	325QP60
169	325AP11-GA	169	N-A		-	Beam clamp	N-A
169	325AX11-GA	185	N-A		-	Beam clamp	N-A
169	325AX10-GA	528	325AX10-GA-QF	1	591	Beam clamp	325QX60
169	325AM10-GA	338	N-A		-	Beam clamp deep-shallow	N-A
170	325AM12-GA	386	N-A		-	Beam clamp (B TO B chnl)	N-A
170	325AM13-GA	691	N-A		-	Beam clamp H.Duty (B to B)	N-A
170	325AM14-GA	898	N-A		-	Beam clamp H.Duty (B to B)	N-A
170	325AL11-GA	390	N-A		-	Beam clamp shallow (window)	N-A
170	325AL10-GA	418	N-A		-	Beam clamp deep (window)	N-A
170	325AL09-GA	418	N-A		-	Beam clamp B to B (window)	N-A
187	325AK10-GA	435	325AK10-GA-QF	4	687	Deep external connector	325QK60
187	325AK11-GA	327	325AK11-GA-QF	4	579	Shallow external connector	325QK61
187	325AK13-GA	285	N-A		-	Shallow internal connector	N-A

ENGINEERING DATA

Part Number	Weight (g)	Quickfit				Former QF Reference
		Part Number	No of QF Fixings	M10 Weight (g)	Bracket Description	
325AJ02-SS	44	N-A		-	Internal washer	N-A
325AJ03-SS	64	N-A		-	Square washer M6	N-A
325AJ05-SS	62	N-A		-	Square washer M8	N-A
325AJ07-SS	62	N-A		-	Square washer M10	N-A
325AJ10-SS	59	325AJ10-SS-QF	1	124	Square washer M12	325XQJ60
325AD11-SS	131	325AD11-SS-QF	2	261	Two hole plate	325XQD61
325AC11-SS	196	325AC11-SS-QF	3	391	Three hole plate	325XQC61
325AC13-SS	262	325AC13-SS-QF	4	522	Four hole plate	325XQC63
325AY10-SS	326	325AY10-SS-QF	5	651	Five hole flat plate	325XQY60
325AY11-SS	392	325AY11-SS-QF	6	782	Six hole flat plate	325XQY61
325AY12-SS	457	325AY12-SS-QF	7	912	Seven hole flat plate	325XQY62
325AG10-SS	177	325AG10-SS-QF	3	372	L bracket	325XQG60
325AF13-SS	236	325AF13-SS-QF	3	431	T bracket	325XQF63
325AF15-SS	357	325AF15-SS-QF	4	617	Fishplate-joiner four hole	325XQF65
325AF26-SS	223	325AF26-SS-QF	3	418	Three hole angle plate	325XQF76
325AF27-SS	177	325AF27-SS-QF	4	437	Four hole cross plate	325XQF77
325AQ10-SS	521	325AQ10-SS-QF	4	781	Right angle bracket	325XQQ60
325AQ11-SS	508	325AQ11-SS-QF	5	833	Right angle bracket	325XQQ61
325AQ14-SS	343	325AQ14-SS-QF	4	603	Right angle bracket	325XAQ14
325AQ12-SS	357	325AQ12-SS-QF	4	617	Right angle bracket	325XQQ62
325AS10-SS	138	325AS10-SS-QF	2	268	Right angle bracket 1+1	325XQS60
325AC09-SS	196	325AC09-SS-QF	3	391	Right angle bracket 2+1	325XQC59
325AC10-SS	196	325AC10-SS-QF	3	391	Right angle bracket 2+1	325XQC60
325AD10-SS	131	325AD10-SS-QF	2	261	Right angle bracket 1+1	325XQD60
325AE10-SS	262	325AE10-SS-QF	4	522	Right angle brackets 3+1	325XQE60
325AE11-SS	262	325AE11-SS-QF	4	522	Right angle bracket 2+2	325XQE61
325AE12-SS	337	325AE12-SS-QF	4	597	Right angle shelf bracket 2+2	325XQE62
325AH11-SS	187	325AH11-SS-QF	2	317	Acute angle bracket 45°	325XQH61
325AD17-SS	161	325AD17-SS-QF	2	291	Obtuse angle bracket 45°	325XQD67
325AF14-SS	236	325AF14-SS-QF	3	431	45° angle bracket	325XQF64
325AF10-SS	236	325AF10-SS-QF	4	496	Channel support bracket	325XQF60
325AF11-SS	236	325AF11-SS-QF	4	496	Channel support bracket (LH)	325XQF61
325AF12-SS	236	325AF12-SS-QF	4	496	Channel support bracket (RH)	325XQF62
325AG12-SS	177	325AG12-SS-QF	3	372	Channel support bracket (LH)	325XQG62
325AG13-SS	177	325AG13-SS-QF	3	372	Channel support bracket (RH)	325XQG63
325AG15-SS	197	325AG15-SS-QF	2	327	Channel support bracket (LH)	325XQG65
325AG16-SS	197	325AG16-SS-QF	2	327	Channel support bracket (RH)	325XQG66
325AV02-SS	277	325AV02-SS-QF	3	472	Corner bracket – 3 way	325XQV52
325AV09-SS	588	325AV09-SS-QF	5	913	Wing fitting – 3 leg	325XQV59
325AV10-SS	509	325AV10-SS-QF	4	769	Wing fitting – 2 leg	325XQV60
325AB10-SS	391	325AB10-SS-QF	3	586	Cross support bracket	325XQB60
325AD28-SS	161	325AD28-SS-QF	2	291	Z shaped shallow bracket	325XQD78
325AC12-SS	196	325AC12-SS-QF	2	326	Z shaped deep bracket	325XQC62
325AU10-SS	262	325AU10-SS-QF	2	392	Z shaped B to B bracket	325XQU60
325AT11-SS	262	325AT11-SS-QF	2	392	Back to back bracket	325XQT61
325AJ13-SS	250	325AJ13-SS-QF	3	445	U shaped shallow bracket	325XQJ63
325AJ12-SS	326	325AJ12-SS-QF	3	521	U shaped deep bracket	325XQJ62
325AJ14-SS	457	325AJ14-SS-QF	3	652	Back to back channel bracket	325XQJ64
325AJ11-SS	392	325AJ11-SS-QF	4	652	Double channel bracket	325XQJ61
325AU15-SS	262	325AU15-SS-QF	3	457	W shaped deep bracket	325XQU15
325AJ15-SS	262	325AJ15-SS-QF	2	392	U shaped deep bracket	325XQJ65
325AR10-SS	388	325AR10-SS-QF	1	453	Base plate	325XQR60
325AN10-SS	388	325AN10-SS-QF	1	453	Base plate	325XQN60
325AT10-SS	841	325AT10-SS-QF	2	971	Double base plate	325XQT60
325AW01-SS	750	325AW01-SS-QF	2	880	Wing fitting	325XQW51
325AW02-SS	830	325AW02-SS-QF	4	1090	B to B Wing fitting	325XQW52
325AW03-SS	366	325AW03-SS-QF	1	431	B to B Short wing fitting	325XQW53
325AW04-SS	398	325AW04-SS-QF	2	528	Short wing fitting	325XQW54
325AP10-SS	170	325AP10-SS-QF	1	235	Beam bracket	325XQP60
325AP11-SS	144	N-A		-	Beam clamp	N-A
325AX11-SS	158	N-A		-	Beam clamp	N-A
325AX10-SS	451	325AX10-SS-QF	1	516	Beam clamp	325XQX60
325AM10-SS	289	N-A		-	Beam clamp deep-shallow	N-A
325AM12-SS	330	N-A		-	Beam clamp (B TO B chnl)	N-A
325AM13-SS	591	N-A		-	Beam clamp H.Duty (B to B)	N-A
325AM14-SS	768	N-A		-	Beam clamp H.Duty (B to B)	N-A
325AL11-SS	333	N-A		-	Beam clamp shallow (window)	N-A
325AL10-SS	357	N-A		-	Beam clamp deep (window)	N-A
325AL09-SS	357	N-A		-	Beam clamp B to B (window)	N-A
325AK10-SS	372	325AK10-SS-QF	4	632	Deep external connector	325XQK60
325AK11-SS	279	325AK11-SS-QF	4	539	Shallow external connector	325XQK61
325AK13-SS	244	N-A		-	Shallow internal connector	N-A

3.4 Classification to BS 6946:1988

The Metal Channels, Brackets and other components in this catalogue, are covered by this standard and are used to make load bearing frameworks.

For more details on the classification of the Vantrunk Steel Framing System, components and accessories to BS 6946:1988 please refer to the Vantrunk Technical Team.

3.5 Reference Standards

The following list of standards relating to Vantrunk's Cable Management products and associated support systems covered in this catalogue.

BS 729	Replaced by BS EN ISO 1461
BS 1449	Part 1 Replaced by BS EN 10111, 10130 & 10025
BS 1449	Part 2 Replaced by BS EN 10088-2
BS EN ISO 1461:2009	Hot Dip Galvanised coatings on fabricated on and steel articles. Specifications and test methods (formerly BS 729)
BS 2989	Replaced by BS EN 10147
BS 6946:1988	Specification for metal channel support systems for electrical installations
BS EN 10025:1993	Replaced by BS EN 10025-2:2004
BS EN 10025-2:2004	Hot Rolled Products of structural steels. Technical delivery conditions for non alloy structural steels (formerly BS 10025:1993)

BS 10088-2:2005	Stainless Steel. Technical Delivery conditions for sheet-plate and strip for general purposes (formerly BS 1449 Part 2)
BS EN 10111:2008	Continuously hot rolled low carbon steel sheet & strip for cold forming. Technical delivery conditions
BS EN 10130:2006	Cold Rolled low carbon flat products for cold forming. Technical Conditions
BS EN 10147:2004	Replaced by BS EN 10136:2004
BS EN 14713:2009	Protection against corrosion of iron and steel in structures – Zinc and aluminium coatings – Guidelines
BS EN 10327:2009	Continuously hot-dip coated strip & sheet of low carbon steels for cold forming. Technical Delivery Conditions

4. GENERAL ENGINEERING DATA

4.1. Extreme Environments

4.1.1 Low Temperature Applications

Consideration should be given to the likely affects of low temperatures when specifying cable management products for installation at a location subject to sub zero temperatures.

Manufactured using generic low carbon steels and austenitic stainless steels – general guidance on the low temperature performance of these materials is as follows:

Low Carbon Steels

Low carbon steels used in the manufacture of commercially available cable management systems exhibit a ductile to brittle transition at low temperatures. At these low temperatures an impact can cause cracking which will propagate faster than the elastic deformation, resulting in failure of the product by brittle fracture. Brittle fracture can be avoided by specifying structural grade steels that have certified minimum impact values. These structural steel grades are typically certified at temperatures of 0°C, -20°C, and -40°C, showing a decreasing impact value as the temperature decreases. Vantrunk has manufactured the Speedway cable ladder system for low temperature applications using structural steels that have been independently tested at temperatures of -46°C giving average charpy values of 20 joules for 2.0mm thickness.

Austenitic Stainless Steels

Austenitic stainless steels, including grade 1:4404 to BS EN 10088-2 (marine grade 316) which is used in the manufacture of Vantrunk Cable Management systems and accessories, are not affected by sub zero temperatures. These stainless steels do not suffer a loss in either ductility or toughness and are not susceptible to failure by brittle fracture at low temperatures below -50°C. Please contract our Technical Team for further information relating to low temperature applications.

4.1.2 Expansion & Contraction

When designing and installing a cable management installation it is important to take into consideration thermal expansion and contraction; even in relatively moderate climates there will be sufficient seasonal thermal movement which could easily place undue stresses on the cable ladder installation and the supporting structure.

To incorporate thermal movement in the design of a Cable Management System installation it is important to establish the maximum temperature differential which is likely to be encountered at the site of the installation. The temperature differential is based on the maximum and minimum seasonal temperatures. This temperature differential will determine the maximum spacing between expansion couplers within the Cable Management installation.

To facilitate correct installation of the expansion couplers it will be necessary to measure the temperature of the cable ladder at the time of installation and to use this temperature to determine the required 'setting gap' between the adjoining lengths of cable ladder and tray. This will ensure that the movement provided by the expansion coupler is not compromised by incorrect assembly at the time of installation.

Speedway Cable Ladder

The Speedway Expansion Coupler (SW-EXP) is designed to allow movement up to a maximum of 28mm and requires supporting 600mm either side of the joint.

For applications where it is not practical to support within 600mm on each side of the expansion joint, or for those installations where there is a requirement to provide an expansion coupler capable of accommodating more than 28mm of movement, the Support Reduction Expansion Coupler (SREC) should be used. The Speedway Support Reduction Expansion Coupler is capable of carrying the full load of the Speedway cable ladder at the expansion joint without the need to provide local support and can allow movement of 75mm.

In installations where an additional means of earthing or bonding is required Earth Bonding Straps (EBS-01 Page 85) should be used at expansion joints. The Speedway expansion couplers should be correctly assembled – refer to 1.2.8 for further details.

Maximum Distance between Expansion Joints

The maximum allowable spacing between expansion couplers is given in the below table for both hot dip galvanised and stainless steel Speedway Cable Ladder. Intermediate values can be obtained using the formula given under the table.

Temperature Differential at Location of Installation		Maximum Spacing Between Expansion Couplers							
		Expansion Couplers				Support Reduction Expansion Coupler			
		Hot Dip Galvanised		Stainless Steel		Hot Dip Galvanised		Stainless Steel	
°C	°F	m	ft	m	ft	m	ft	m	ft
10	50	216	693	175	561	577	1851	469	1505
20	68	108	346	88	282	289	927	235	754
30	86	72	231	59	189	193	619	157	504
40	104	54	173	44	141	145	465	118	379
50	122	44	141	35	112	116	372	94	302
60	140	36	115	30	96	97	311	79	253
70	158	31	99	25	80	83	266	67	215
80	176	27	87	22	71	73	234	59	189
90	194	24	77	20	64	65	209	53	170
100	212	22	71	18	58	58	186	47	151

The maximum allowable distance between expansion joints can also be calculated from the following formula:

$D = M / [K\, T_{diff}]$

Where:

D = maximum allowable distance between expansion joints (m)

M = allowable movement for each expansion joint (m)

- SW-EXP = 0.028
- SW-SREC = 0.075

K = coefficient of linear expansion of the material (°C-1)

- GY = 13 $\times 10^{-6}$
- GW = 13 $\times 10^{-6}$
- GX = 13 $\times 10^{-6}$
- SS = 16 $\times 10^{-6}$

T_{diff} = temperature differential at installation site [Maximum temperature – Minimum temperature] (°C)

As an example:

For a GY ladder installation using traditional expansion couplers-

M, SW-EXP = 0.028m
K, GY = 13 $\times 10^{-6}$ °C-1
Maximum temperature, **T_{max}** = +35°C
Minimum temperature, **T_{min}** = -15°C
Therefore, **T_{diff}** = (+35) – (-15) = 50°C

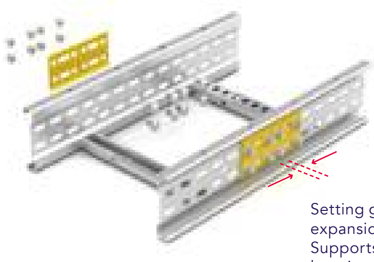
$D = 0.028 / [13 \times 10^{-6} \times 50] = 44m$

Therefore the maximum allowable distance between expansion joints is 44m, however, for ease of installation, expansion couplers should be fitted at every 14th 3m cable ladder, giving 42m between expansion couplers.

If the same installation was to use the Support Reduction Expansion Coupler instead then maximum allowable distance between expansion joints would be 116m; meaning an expansion joint would be required every 38th ladder giving 114m between SREC couplers.

If the cable ladder run was 500m in length then this would mean a saving of 44 couplers and 72 supports by using the Support Reduction Expansion Coupler instead of the traditional Expansion Coupler.

Setting Gap



Setting gap for Speedway full moment expansion coupler (CS/EXP). Supports are not required at the location of the expansion joint.

To determine the setting gap at the time of installation the following formula should be used:

$G = [T_{ins} - T_{max}] / [T_{diff} / M]$

Where:

G = setting gap (mm)

T_{ins} = temperature at the time of installation (°C)

T_{max} = maximum temperature (°C)

T_{diff} = temperature differential (°C)

M = allowable movement for each expansion joint (m)

- SW-EXP = 0.028
- SW-SREC = 0.075

Example:

Continuing the previous example -
Installation Temperature, **T_{ins}** = +20°C
Maximum temperature, **T_{max}** = +35°C
Temperature differential, **T_{diff}** = 50°C
Allowable movement, **M** = 0.028

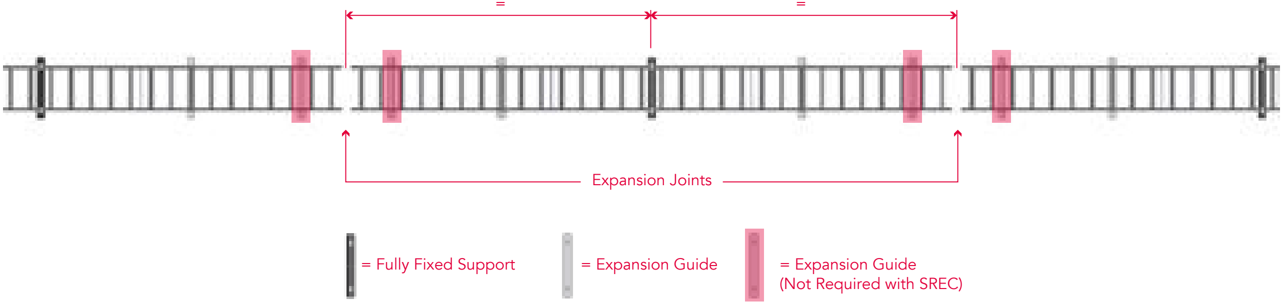
$G = [+20 - +35] / [+50 / 0.028] = 8.4mm$

Or for the Support Reduction Expansion Coupler = 22.5mm

Supports and Expansion Guides

If using traditional Expansion Couplers to ensure safe and correct installation, the Speedway Cable Ladder should be supported within 600mm on both sides of the expansion joint.

If using the Support Reduction Expansion Coupler (SREC), then the Speedway Cable Ladder does not need to be supported at the expansion joint.



The Speedway Cable Ladder should be fully fixed to the support nearest to the midpoint between expansion joints. At all other support positions Expansion Guides should be used, to ensure longitudinal movement.

Expansion guides (SW-EFC-EXP) comprise of a Speedway External Flange Clamp (EFC) and a nylon spacer pad), which will allow the Speedway Cable Ladder to expand and contract in a restrained manner.

Vantrunk Cable Tray

The standard flat bar coupler can allow movement up to a maximum of 14mm. This movement allowance is the basis for determining both the maximum allowable spacing between expansion joints and the required setting gap at the time of installation.

To ensure safe and correct installation, the Vantrunk Cable Tray should be supported within 300mm on each side of connections fitted with expansion couplers.

The flat bar couplers at each expansion joint should be correctly assembled – refer to 1.2 for further details. Where installed with expansion couplers, the Vantrunk Cable Tray should be secured to the supporting structure in a manner which will allow free movement.

Maximum Distance between Expansion Joints

The maximum allowable spacing between expansion joints is given in the following table for both galvanised (pre-, hot dip & deep) and stainless steel Vantrunk Cable Tray. Intermediate values can be obtained using the formula given under the table.

Temperature Differential		Maximum Spacing Between Expansion Couplers			
		Hot Dip Galvanised		Stainless Steel	
°C	°F	m	ft	m	ft
10	50	108	346	88	282
20	68	54	173	44	141
30	86	36	115	30	96
40	104	27	87	22	71
50	122	22	71	18	58
60	140	18	58	15	48
70	158	16	51	13	42
80	176	14	45	11	35
90	194	12	38	10	32
100	212	11	35	9	29

The maximum allowable spacing between expansion joints can also be calculated from the following formula:

D = M / [K Tdiff]

Where:

D = maximum allowable distance between expansion joints (m)

M = allowable movement for each expansion joint (m)

- M = 0.014

K = coefficient of linear expansion of the material (°C-1)

- GY = 13 x10^{-6}
- GW = 13 x10^{-6}
- GX = 13 x10^{-6}
- SS = 16 x10^{-6}

Tdiff = temperature differential at installation site [Maximum temperature – Minimum temperature] (°C)

As an example:

For a SS tray installation-

M = 0.014m

K = 16 x10^{-6} °C-1

Maximum temperature, T_{max} = +25°C

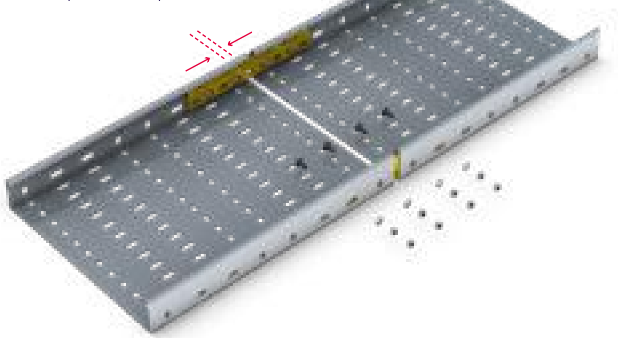
Minimum temperature, T_{min} = -5°C

Therefore, T_{diff} = (+25) – (-5) = 30°C

D = 0.014 / [16 x10^{-6} x 30] = 30m

Therefore the maximum allowable distance between expansion joints is 30m, however, for ease of installation, expansion couplers should be fitted at every 10th 3m cable tray..

Setting Gap



Setting gap for Cable Tray Flat Bar Coupler (FBC) used as an expansion coupler.

To determine the setting gap at the time of installation the following formula should be used:

G = [Tins - Tmax] / [Tdiff / M]

Where:

G = setting gap (mm)

T_{ins} = temperature at the time of installation (°C)

T_{max} = maximum temperature (°C)

T_{diff} = temperature differential (°C)

M = allowable movement for each expansion joint (m)

- SW-EXP = 0.028
- SW-SREC = 0.075

Example:

Continuing the previous example -

Installation Temperature, T_{ins} = +15°C

Maximum temperature, T_{max} = +25°C

Temperature differential, T_{diff} = 30°C

Allowable movement, **M** = 0.014

G = [+15 - +25] / [+30 / 0.014] = 4.7mm

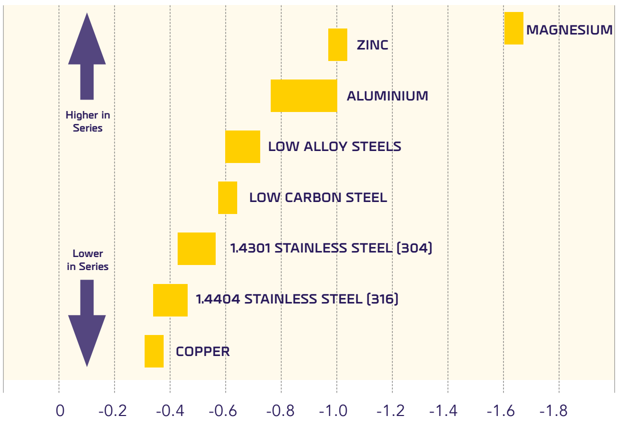
4.1.3 Bimetallic Corrosion

Bimetallic corrosion (also referred to as galvanic or electrolytic corrosion) occurs when two dissimilar metals are in close contact with an electrolyte. An electrolyte is a medium which allows the flow of an electrical current. The presence of water as moisture can act as an electrolyte. For further details see Pages 78-79 for Speedway Insulation Assemblies and Page 127 for Cable Tray Insulation Assemblies.

The rate of corrosion depends upon the differences in electrical potential of the metals as defined by the Galvanic Series (see chart below), the strength of the electrolyte, the period for which the electrolyte is present, and the geometry of the connection between the dissimilar metals. When corrosion occurs it is the anodic metal (which is higher in the galvanic series) that will corrode in preference to the cathodic metal (which is lower in the galvanic series).

If corrosion takes place between two dissimilar metals, the metal which is higher in the galvanic series will corrode in preference to the metal which is lower in the galvanic series.

Galvanic Series Chart



It is common to find dissimilar metals such as stainless steel and low carbon steel or zinc (as found on a hot dip galvanised item) in contact in a damp atmosphere (i.e. sea water, rain, etc.).

This arrangement is typically found in coastal and offshore applications where painted structures or heavyweight galvanised steel brackets are used to support stainless steel cable ladders on the exterior of an installation.

Whilst it is possible to use a layer of paint or grease to separate the stainless steel cable ladder from a zinc coating or any exposed low carbon steel arising from drilling of the support structure, these should not be considered as a long term means of providing electrical separation between the dissimilar metals.

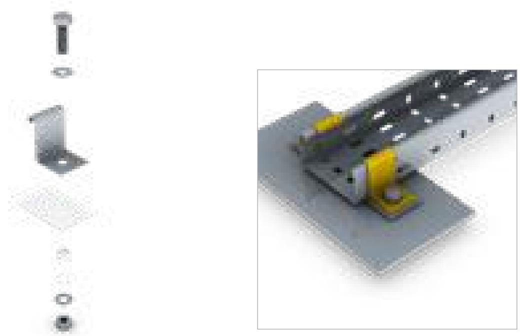
The best solution is to electrically isolate the two dissimilar metals. Vantrunk cable management systems include a range of nylon pads, bushes, and washers which entirely separates the cable ladder or tray and the fixings from the support structure to prevent bimetallic corrosion.

In a typical insulating assembly the ladder or tray securing device (external flange clamp, hold down bracket, or adaptable fixing bracket), securing bolt, nut, & washer are entirely of stainless steel and are therefore compatible with the stainless steel cable ladder.

Insulating assembly for External Flange Clamp (EFC)

Insulating assembly for Hold Down Bracket (HDB)

Insulating assembly for Adaptable Fixing Bracket (AFB)



Insulating assembly for Hold Down Bracket (HDB)

4.1.4 Imposed Loads

Imposed loads include wind, ice and snow. The effects of imposed loads will vary from one installation to another and further advice relating to the specific influences of each should be sought at the design stage. The following information on imposed loads is given as a general guide only.

Ice Loads

When determining the total load to be supported by the Speedway Cable Ladder or Vantrunk Cable Tray an allowance should be made for those locations where ice formation is likely.

The tables below shows the additional load imposed by a layer of ice 10mm thick and having a density of 916kg/m3.

Ice Load (10mm thick) on Speedway Cable Ladder

Width W mm	Ice Load kg/m		
	Speedway SW4	Speedway SW5	Speedway SW6
150	1.72	1.83	1.83
300	3.10	3.21	3.21
450	4.47	4.58	4.58
600	5.84	5.95	5.95
750	7.22	7.33	7.33
900	8.59	8.70	8.70
1050	9.97	10.08	10.08

Ice Load (10mm thick) on Vantrunk Cable Tray

Tray Width	Ice Load kg/m	
	Medium Duty	Heavy Duty
50	0.46	0.46
75	0.69	0.69
100	0.92	0.92
150	1.37	1.37
200	1.83	1.83
225	2.06	2.06
300	2.75	2.75
450	4.12	4.12
600	5.50	5.50
750	6.87	6.87
900	8.24	8.24

Snow Loads

The magnitude of the additional load imposed by snow will be influenced by a number of factors including the density of the snow, the degree of drifting which will alter the profile of the snow accumulating on the Speedway Cable Ladder or Vantrunk Cable Tray, and the nature of the cable ladder installation (i.e. covers fitted or percentage of cable loading area occupied by cables). The density of snow can vary from 160kg/m3 to 481kg/m3 depending on the level of wetness and compactness. The tables below assume that the snow has a density of 160kg/m3 and is applied to a uniform height of 100mm.

Snow Load (100mm thick) on Speedway Cable Ladder

Width W mm	Snow Load kg/m		
	Speedway SW4	Speedway SW5	Speedway SW6
150	3.01	3.20	3.20
300	5.41	5.60	5.60
450	7.81	8.00	8.00
600	10.21	10.40	10.40
750	12.61	12.80	12.80
900	15.01	15.20	15.20
1050	17.41	17.60	17.60

Snow Load (100mm thick) on Vantrunk Cable Tray

Tray Width	Snow Load kg/m	
	Medium Duty	Heavy Duty
50	0.80	0.80
75	1.20	1.20
100	1.60	1.60
150	2.40	2.40
200	3.20	3.20
225	3.60	3.60
300	4.80	4.80
450	7.20	7.20
600	9.60	9.60
750	12.00	12.00
900	14.40	14.40

Wind Loads

Wind loads exert a sideways force on the cable ladder or cable tray. The sideways force is based on the wind speed and is derived from the equation Vp (N/m²) = 0.6V2 where V is the wind speed in m/s. The wind speed will vary relative to the height above the ground and the degree of exposure. The following tables give an indication for the sideways force which will be exerted on Speedway Cable Ladder or Vantrunk Cable Tray in an exposed location at an ambient temperature of 20°C and average relative humidity for the United Kingdom.

The tabulated wind loads are based on Speedway Cable Ladder and Vantrunk Cable Tray that is installed in the horizontal plane. In this orientation the structural properties of the Vantrunk Cable Management Systems are sufficient to resist most normal wind loads. The wind loadings will be significantly higher for edge-mounted Speedway Cable Ladder and Vantrunk Cable Tray and for this reason edge-mounted ladder or tray should not be installed in areas of high wind exposure.

If covers are to be fitted to Speedway Cable Ladder or Vantrunk Cable Tray in locations subject to high wind loads further advice should be sought from our Technical Team regarding additional securing means.

Wind Loads on Speedway Cable Ladder

Beaufort Scale	Description	Wind Speed m/s		Pressure N/m²		Wind Loads - kg/m					
						Speedway SW4		Speedway SW5		Speedway SW6	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
0	Calm	0.00	0.20	0.00	0.02	0.00	0.00	0.00	0.0	0.00	0.00
1	Light air	0.30	1.50	0.05	1.35	0.00	0.01	0.00	0.02	0.00	0.02
2	Light breeze	1.60	3.30	1.54	6.53	0.01	0.06	0.02	0.07	0.02	0.09
3	Gentle breeze	3.40	5.40	6.94	17.50	0.06	0.16	0.08	0.20	0.10	0.24
4	Moderate breeze	5.50	7.90	18.15	37.45	0.16	0.34	0.20	0.42	0.25	0.52
5	Fresh breeze	8.00	10.70	38.40	68.69	0.35	0.62	0.43	0.77	0.53	0.95
6	Strong breeze	10.80	13.80	69.98	114.26	0.64	1.04	0.79	1.29	0.97	1.58
7	Near gale	13.90	17.10	115.93	175.45	1.05	1.59	1.31	1.98	1.60	2.43
8	Gale	17.20	20.70	177.50	257.09	1.61	2.34	2.00	2.90	2.45	3.56

Wind Loads on Vantrunk Cable Tray

Beaufort Scale	Description	Wind Speed m/s		Pressure N/m²		Medium Duty 25mm Height		Heavy Duty 50mm Height	
		Min	Max	Min	Max	Min	Max	Min	Max
0	Calm	0.00	0.20	0.00	0.02	0	0	0	0
1	Light air	0.30	1.50	0.05	1.35	0	0.1	0	0.5
2	Light breeze	1.60	3.30	1.54	6.53	0.2	0.7	0.5	2.3
3	Gentle breeze	3.40	5.40	6.94	17.50	0.7	1.8	2.4	6.1
4	Moderate breeze	5.50	7.90	18.15	37.45	1.9	3.9	6.3	13.1
5	Fresh breeze	8.00	10.70	38.40	68.69	4	7.2	13.4	24
6	Strong breeze	10.80	13.80	69.98	114.26	7.3	11.9	24.5	39.9
7	Near gale	13.90	17.10	115.93	175.45	12.1	18.3	40.5	61.3
8	Gale	17.20	20.70	177.50	257.09	18.5	26.8	62	89.8

4.2 Materials & Finishes

Details relating to the standard materials and finishes for Vantrunk Cable Management Systems, components, and accessories are given in the following sections. The choice of material and finish has been based on many years experience in providing cable management products and support systems for use in industrial and onshore/offshore installations.

Resistance Against Corrosion

The following table shows Vantrunk's range of standard materials and finishes and their classification for resistance against corrosion according to BS EN IEC 61537.

Class	Reference - Material and Finish	Vantrunk Finish & Material
0	None	
1	Electroplated to a minimum thickness of 5 mm according to ISO 2081	
2	Electroplated to a minimum thickness of 12 mm according to ISO 2081	
3	Pre-galvanised to grade 275 according to ISO 3575, ISO 4998 or EN 10346	QQ
4	Pre-galvanised to grade 350 according to ISO 3575, ISO 4998 or EN 10346	
5	Post-galvanised to a zinc mean coating thickness (minimum) of 45 mm according to ISO 1461 for zinc thickness only	GA
6	Post-galvanised to a zinc mean coating thickness (minimum) of 55 mm according to ISO 1461 for zinc thickness only	GA GM
7	Post-galvanised to a zinc mean coating thickness (minimum) of 70 mm according to ISO 1461 for zinc thickness only	
8	Post-galvanised to a zinc mean coating thickness (minimum) of 85 mm a ccording to ISO 1461 for zinc thickness only (usually high silicon steel)	GY GX GW
9A	Stainless steel manufactured to ASTM A240 / A240M - 95a designation S30400 or EN 10088 grade 1.4301 without a post treatment	
9B	Stainless steel manufactured to ASTM A240 / A240M - 95a designation S31603 or EN 10088 grade 1.4404 without a post treatment	
9C	Stainless steel manufactured to ASTM A240 / A240M - 95a designation S30400 or EN 10088 grade 1.4301 with a post treatment	
9D	Stainless steel manufactured to ASTM A240 / A240M - 95a designation S31603 or EN 10088 grade 1.4404 with a post treatment	SS

4.2.1 Materials

The following materials are used in the manufacture of the Vantrunk Cable Management Systems, components and accessories:

Structural Steels with Enhanced Suitability for Galvanising

Where it is beneficial Vantrunk products are manufactured using grades of structural steel that have a guaranteed minimum level of silicon, thereby increasing the zinc coating thickness and extending the time to first maintenance.

GY

Structural Steel to BS EN 10025-2
Vantrunk's GY structural steel is a weldable, high strength structural steel with good galvanising properties. Products manufactured from this grade of steel have a minimum average zinc coating of 85 microns.

GW

Structural Steel to BS EN 10025-2
Vantrunk's GW structural steel is a weldable, extreme strength structural steel with excellent galvanising properties. Products manufactured from this grade of steel have a minimum average zinc coating of 120 microns.

Silicon Rich Structural Steel to BS EN 10025-5

Vantrunk's GX silicon rich structural steel is a weldable, extreme strength structural steel suitable for deep galvanising. Ideal for environments where excellent corrosion resistance is required. A particular property of this material is the high silicon content which gives an affinity to attract even thicker coatings of zinc when galvanised (see Finishes – Deep Galvanising). Products manufactured from this grade of steel can achieve a minimum average zinc coating of up to 160 microns.

Mechanical Properties of Structural Steels with Enhanced Suitability for Galvanising

Material	Property		
	Yield Strength (N/mm^2)	Tensile Strength (N/mm^2)	Elongated A %
GY	275 minimum	430 - 580	15
GW	355 minimum	510 - 680	15
GX	355 minimum	510 - 680	15

Low Carbon Steel

Vantrunk Cable Management Systems are manufactured using two different types of low carbon steel, each of which is matched for performance and strength to the product and the intended application. These low carbon steel materials are hot-rolled steel and cold-rolled steel.

Hot-rolled Low carbon Steel to BS EN 10111

Hot-rolled low carbon steel is a cold forming material used for bending and drawing applications. This material is suitable for welding and hot dip galvanizing.

Cold-rolled Low Carbon Steel to BS EN 10130

Cold-rolled steel grade is a cold-forming material for forming and deep drawing applications. This material is suitable for welding and hot dip galvanizing.

The minimum average zinc coating thickness on the GA type materials is gauge dependant and in accordance with BS EN 1460.

Mechanical Properties of Low Carbon Steel

Material Grade	Type	Property		
		Yield Strength ReH (N/mm^2)	Tensile Strength Rm (N/mm^2)	Elongated A %
GA	Hot Rolled	170 – 360	440	23
	Cold Rolled	280 maximum	270 – 410	28

Stainless Steel

The Speedway Cable Ladder System, components and accessories are manufactured using 1.4404 marine grade stainless steel (316) which is matched for performance and strength to the product and the intended application.

The corrosion resistance of stainless steel arises from a passive, chromium-rich, oxide film that forms naturally on the surface of the steel. Although extremely thin at 1.5 nanometres (i.e. 1.5 x 10-9 metres) thick, this protective film is strongly adherent, and chemically stable (i.e. passive) under conditions which provide sufficient oxygen to the surface. The key to the durability of the corrosion resistance of stainless steels is that if the film is damaged it will normally self-repair in the presence of oxygen. In contrast to mild steel type materials which suffer from general corrosion where large areas of the surface are affected, stainless steels which have a passive oxide film are normally resistant to general corrosion. Stainless steels should not be considered to be indestructible, the oxide film can be broken down under certain conditions and corrosion can result, this typically taking the form of pitting or crevice corrosion.

The stainless steel used in the manufacture of Vantrunk Cable Management Systems, components and accessories has excellent corrosion and oxidation resistance due to the high chromium content. Grades 1.4404 stainless steel is an austenitic stainless steel which incorporate nickel to strengthen the oxide film and improve performance in more aggressive environments. The addition of molybdenum to 1.4404 marine grade improves resistance to pitting corrosion. The austenitic stainless steels have excellent resistance to attack by acids, alkalis and other chemicals.

Stainless steels offer excellent performance at both high and low temperatures and, unlike some mild steels, are not susceptible to brittle fracture arising from impact at low temperature. Independent tests have shown that stainless steel cable ladders and trays can withstand a temperature of 1000°C for a period of 5 minutes without collapse (contact our Technical Team for further details).

As the corrosion resistance of stainless steel is derived from the self-repairing oxide film it is important that the surface of the stainless steel remains uncontaminated, allowing the inherent corrosion resistance of the stainless steel to be maintained. Possible sources of contamination includes mild steel from cutting and drilling operations on site, and impingement of small particles created by welding and grinding of mild steel in close proximity to the stainless steel product. Care must be taken both during and after installation to avoid such contamination.

SS

Stainless Steel Grade 1.4404 (316L) to BS EN 10088-2
Marine grade 1.4404 stainless steel is a corrosion resistant steel ideally suited for aggressive environments where severe conditions are prevalent, i.e. coastal and offshore applications. 1.4404 is a molybdenum-bearing austenitic stainless steel with high corrosion resistant properties, particularly to pitting and crevice corrosion. 1.4404 has excellent forming and welding characteristics. Post-weld annealing is not required with welding the material gauges that are used in the manufacture of the Speedway Cable Ladder System.

Mechanical Properties of Stainless Steel

Material Grade	Property		
	Proof Strength 0.2% Rp0.2 (N/mm²)	Tensile Strength Rm (N/mm²)	Elongated A_{80} %
SS	240 Min	530 to 680	40

4.2.2 Finishes

The following are available for Vantrunk Cable Management Systems, components, and accessories:

Galvanising
Hot dip galvanised to BS EN ISO 1461 (post-galvanised) GY, GA, & GW
Deep Galvanised to BS EN ISO 1461 (post-galvanised) GX & GW

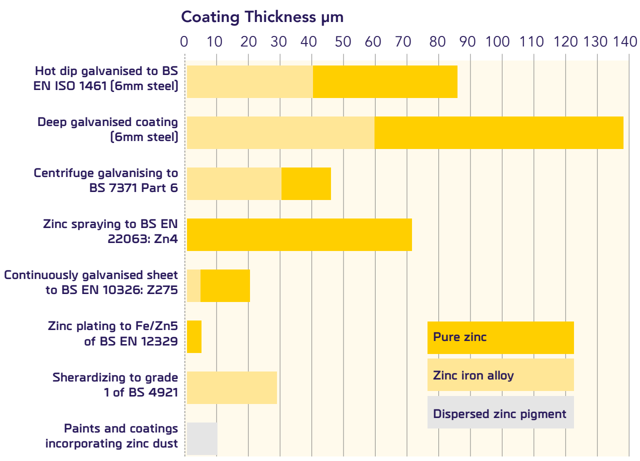
Coatings
Epoxy coated over low carbon steel EY & EA
Epoxy coated over hot dip galvanising FY & FA

Galvanising

The coating of steel using zinc, either before manufacture (pre-galvanised) or after manufacture (post-galvanised) is a cost effective and practical means of protecting the steel from corrosion. The zinc coating protects the steel in three ways. Firstly, the zinc coating weathers at a very slow rate giving a long and predictable life. Secondly, the zinc coating corrodes preferentially to provide sacrificial protection of any small areas of steel exposed through cutting, drilling, or accidental damage; scratches and small areas of damage are sealed by weathering products from the zinc. Thirdly, if the damaged area is larger, the sacrificial protection provided by the surrounding zinc prevents 'creepage' typically associated with other protective finishes such as paint coatings.

The thickness of the zinc coating is dependant on the method of application. The following table shows the typical zinc coating thicknesses for a number of galvanising and related processes, and includes zinc based paints for comparison purposes.

Zinc coatings compared in terms of coating thickness



Hot Dip Galvanised Finishes to BS EN ISO 1461

The hot dip galvanising process provides a continuous layer of zinc-iron alloys and zinc on the surface of the products manufactured in steel. The hot dip zinc coating provides a continuous barrier to moisture and other contaminants, thereby protecting the steel substrate.

During the galvanising process, a layer of zinc-iron alloy develops on the surface of the steel product. When the steel product is withdrawn from the zinc bath, a layer of pure zinc is left on the zinc-iron alloy. The layer of pure zinc gives a newly galvanised item a bright finish. This bright finish will gradually fade as the surface layer of the zinc oxidises, leaving a uniform dull grey appearance.

The average amount of zinc which can be deposited on a product is expressed in terms of thickness and is measured in µm. The actual zinc coating thicknesses will vary depending on the thickness of the steel, the chemical composition of the steel, and the period of immersion within the zinc bath. BS EN ISO 1461 specifies a number of thickness ranges for products to be galvanised, each of which has a specified minimum average local reading and minimum mean average reading. Details are given in the following table.

Zinc Coating Details to BS EN ISO 1461

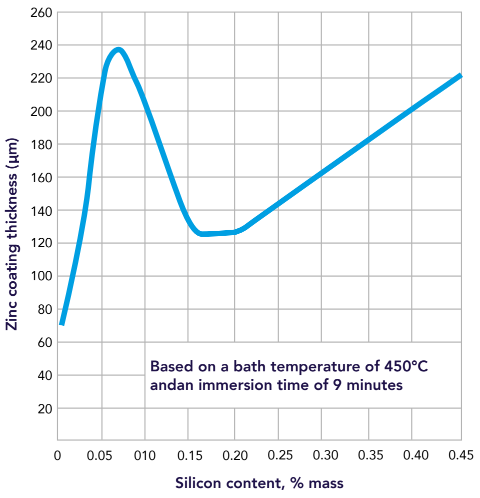
Coating Weight & Thickness – Dipped Articles				
Article & Thickness	Local Coating (minimum)		Mean Coating (minimum)	
	Mass (g/m²)	Thickness µm	Mass (g/m²)	Thickness µm
Steel t ≥ 6mm	505	70	610	85
Steel 3mm ≥ t < = 6mm	395	55	505	70
Steel 1.5mm =≥ t < = 3mm	325	45	395	55
Steel t < 1.5mm	250	35	325	45
Castings t ≥= 6mm	505	70	575	80
Castings t < 6mm	430	60	505	70

Coating Weight & Thickness – Centrifuged Articles				
Article & it's Thickness	Local Coating (minimum)		Mean Coating (minimum)	
	Mass (g/m²)	Thickness µm	Mass (g/m²)	Thickness µm
Articles with threads:				
Diameter ≥ 6mm	395	55	505	70
Diameter <= 6mm	325	45	395	55
Other articles (including castings):				
t ≥= 3mm	325	45	395	55
t < 3mm	250	35	325	45

Deep Galvanising to BS EN ISO 1461

The use of silicon-rich steels allows much heavier galvanised coatings to be obtained. Average coating thicknesses of two to three times that for low carbon steel can be achieved. It is for this reason that silicon-rich steels are termed 'reactive' steels and the galvanising process 'deep galvanising'.

The influence of the silicon does not increase consistently but rather follows a curve as shown in the following diagram. This curve gives average values and variations can be expected between different silicon-rich steels with the same silicon content but from different steel casts.



These variations are attributed to the fact that whilst the total silicon contents can be equal, the amount of silicon that is bound to oxygen within the steel can vary. More or less silicon is then dissolved in the steel, and it is only this amount that influences the reaction. The silicon can be unevenly distributed on the surface of the steel and this will lead to uneven variations in the coating thickness after galvanising.

Another property of the galvanised coatings on silicon-rich steels is the colour. During the galvanising process, a zinc layer builds up on the zinc-iron alloy layers which are adhering to the surface of the steel. The reaction rate can be such that this pure zinc layer is transformed completely to zinc-iron alloy before the article has had time to cool.

This results in a coating which can be much darker in appearance, varying in colour and thickness across the surface of the galvanised item. This appearance does not alter the corrosion resistance of the zinc coating. Due to the variations in coating thickness associated with deep galvanising of silicon-rich materials it is normal to specify the finish as 'deep galvanised to twice the coating thickness specified by BS EN ISO 1461'.

Wet storage stain

Galvanised steel is protected from corrosion by a layer of zinc-iron alloys and a layer of pure zinc. After galvanising, a protective zinc carbonate film forms over the surface of the zinc. The formation of this protective layer is only possible when the galvanised surface is exposed to free flowing air. Stacking freshly galvanised articles in contact with one another prevents the free circulation of air, and in wet or humid conditions, may result in the development of wet storage stain. Wet storage stain, often referred to as white rust, appears as a white, powdery covering. The white rust, comprising of zinc oxide and zinc hydroxide corrosion products, is voluminous and can appear to be more detrimental to the galvanised coating that it actually is.

Wet storage stain can be prevented by correct transport and storage provisions. For transportation over long distances, galvanised items should be protected by waterproof cover to prevent moisture ingress. For storage, galvanised items should be kept off the ground in a dry environment. If stacked in a potentially wet environment, the galvanised items should be separated from one another to provide free circulation of air. If possible, the stacking should be at an angle to facilitate drainage of water.

In normal use, light wet storage stain is not serious and does not reduce the life expectancy of the galvanised coating. The affected area should be dried and exposed to the atmosphere to allow the zinc to form a protective carbonate layer. The appearance of the wet storage stain will gradually fade to that of a normally weathered galvanised steel. Where more stubborn wet storage stain deposits are evident, these should be removed using a stiff bristle (non wire) brush and, if necessary, a cleaning solution should be used. Typical solutions would be ammonia A citric acid based clear such as Metsoak C4900 with a 10% dilution v/v, the cleaning solutions should be thoroughly rinsed off after treatment and the article allowed to dry.

Life expectancy of zinc coatings

The life expectancy of a zinc coating is largely determined by its thickness. Thicker coatings give longer life (the period to first maintenance). When exposed to atmosphere the zinc coating will weather and corrode, leading to a gradual diminution in the coating thickness. Under conditions of normal atmospheric exposure the level of corrosion is low and is typically at a rate which is between 1/10th and 1/40th of that of the steel base.

When subject to conditions of high humidity or condensation, the rate of corrosion of the zinc coating can be increased significantly.

The level of contamination in the atmosphere can also adversely affect the corrosion rate of the zinc coating. The most significant contaminant accelerating the corrosion rate of zinc is sulphur dioxide (SO2). The resistance of zinc to atmospheric corrosion is dependent on the protective zinc carbonate film which forms on the surface of the zinc.

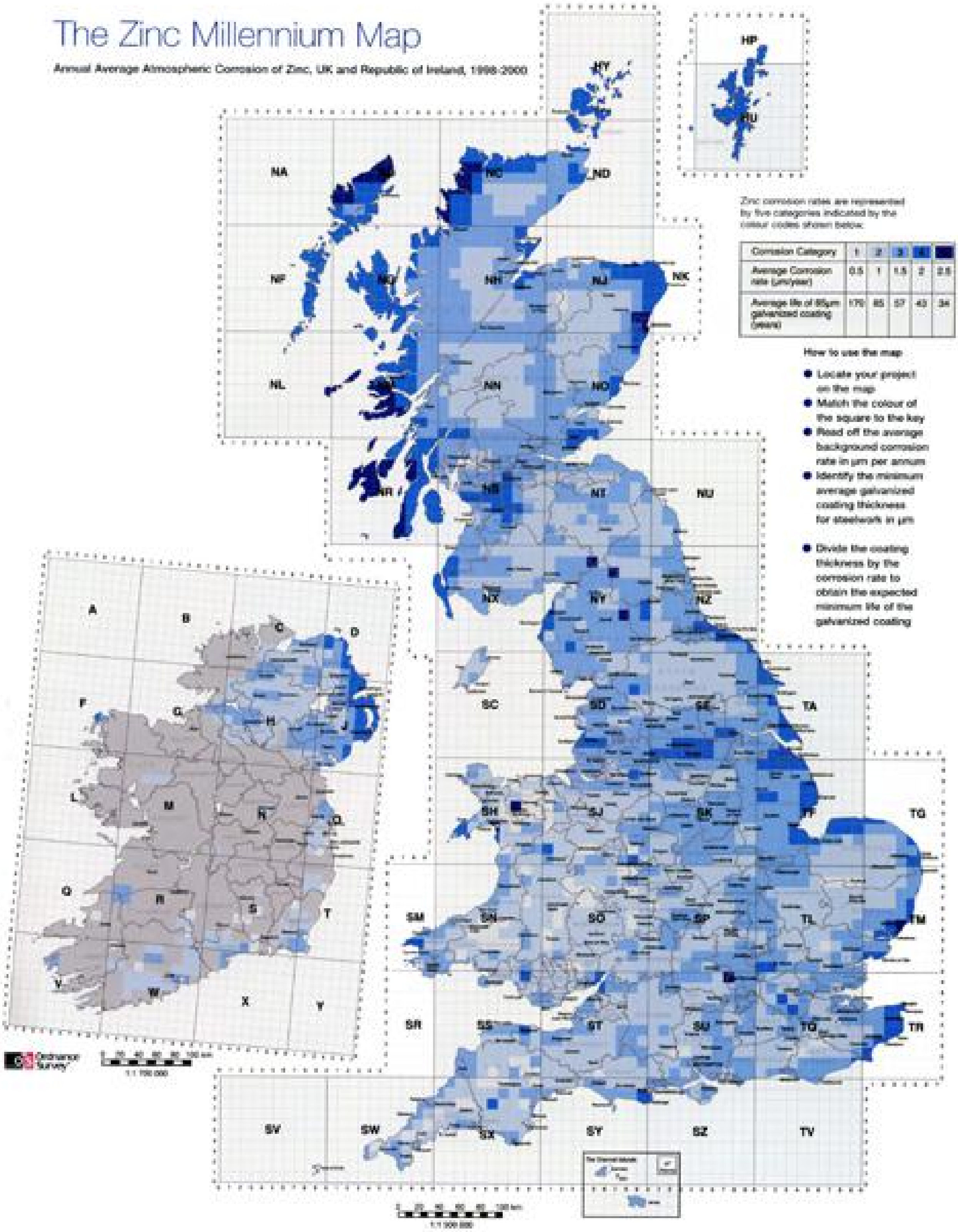
The sulphur dioxide reacts with moisture to destroy the protective film and this leads to the corrosion of the zinc coating.

Research undertaken by the Galvanizers Association has resulted in the publishing of a series of charts depicting the average atmospheric corrosion rate for zinc for the United Kingdom and Ireland. These charts indicate that the average local atmospheric corrosion rates for zinc have decreased, reflecting the general decrease in the levels of sulphur dioxide in the atmosphere.

Current atmospheric corrosion rates for zinc within the United Kingdom and the Republic of Ireland are given in the Zinc Millennium Map and are in the range of 0.5µm to 2.5µm per year (corrosion categories C2 – C3 to ISO 14713). Please see the following page for the Zinc Millennium Map.

The Zinc Millennium Map

Annual Average Atmospheric Corrosion of Zinc, UK and Republic of Ireland, 1998-2000



Zinc corrosion rates are represented by five categories indicated by the colour codes shown below.

Corrosion Category	1	2	3	4	5
Average Corrosion rate (µm/year)	0.5	1	1.5	2	2.5
Average life of 85µm galvanized coating (years)	170	85	57	43	34

How to use the map

- Locate your project on the map
- Match the colour of the square to the key
- Read off the average background corrosion rate in µm per annum
- Identify the minimum average galvanized coating thickness for steelwork in µm
- Divide the coating thickness by the corrosion rate to obtain the expected minimum life of the galvanized coating

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- All those who provided sample sites for the project

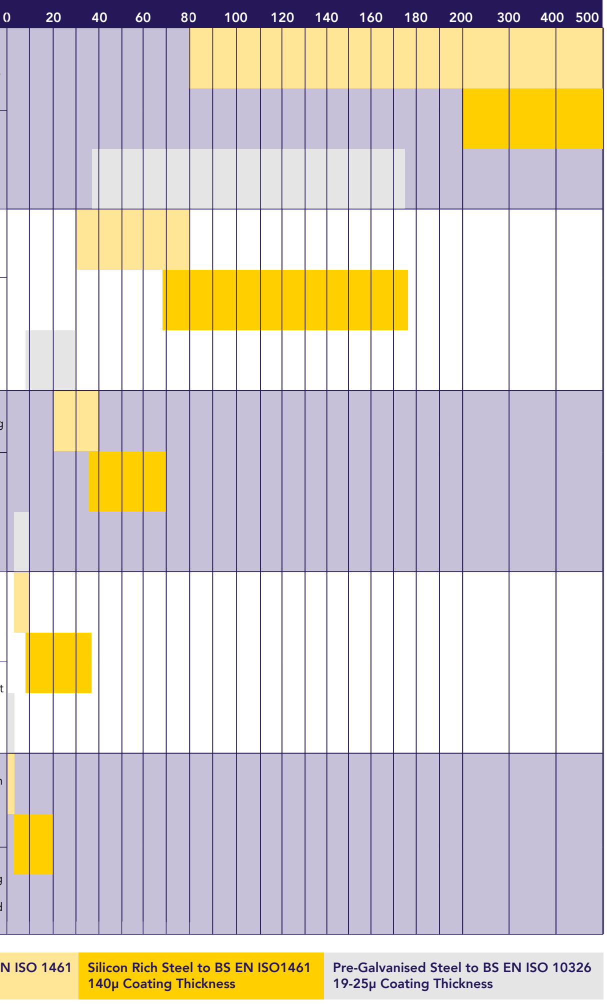
ADAS Consulting and GA are grateful to Orange Plc for provision of survey sites in the UK and the Irish Electricity Supply Board for survey sites that allowed corrosion rates at key Irish locations to be included in the Zinc Millennium Map. Further studies are planned to extend survey coverage in the Republic of Ireland. For areas not yet covered, the rates indicated for comparable areas may be used as an indication of likely corrosion rates.

The corrosion rate for zinc is generally linear for a given local environment. This allows predictions of the life expectancy of a galvanised product, to first maintenance, based on the zinc coating thickness and the zinc corrosion rates given in the Zinc Millennium Map. For example, a hot dip galvanised product with a coating thickness of 55μm will last approximately 110 years in a location where the atmospheric corrosion rate of zinc is 0.5μm per year, and approximately 22 years in a location where the atmospheric corrosion rate is 2.5μm per year.

Further information regarding hot dip galvanising and the Zinc Millennium Map can be obtained from the Galvanizers Association. The Zinc Millennium Map provides specific information for the United Kingdom and Ireland. For other locations, reference can be made to BS EN ISO 14713 (Protection against corrosion of iron and steel in structures – Zinc and aluminium coatings – Guidelines).

BS EN ISO 14713 provides general guidelines on corrosion rates for zinc in differing environmental conditions, details of which are given in the table below.

Category	Corrosion Rate μm/year	Environment	
C2	0.1 < rate ≤ 0.7 Low	Indoor	• Unheated spaces with varying temperature and relative humidity. Low frequency of condensation and low pollution, e.g. storage, sport halls
		Outdoor	• Temperate zone, atmospheric environment with low pollution, e.g.: rural areas, small towns • Dry or cold zone, atmospheric environment with short time of wetness, e.g. deserts, sub-arctic areas
C3	0.7 < rate ≤ 2.1 Medium	Indoor	• Spaces with moderate frequency of condensation and moderate pollution from production process, e.g. food processing plants, laundries, breweries, dairies
		Outdoor	• Temperate zone, atmospheric environment with medium pollution or some effect of chlorides, e.g. urban areas, coastal areas with low deposition of chlorides • Subtropical and tropical zones with atmosphere with low pollution
C4	2.1 < rate ≤ 4.2 High	Indoor	• Spaces with high frequency of condensation and high pollution from production process, e.g. industrial processing plants, swimming pools
		Outdoor	• Temperate zone, atmospheric environment with high or substantial effect of chlorides, e.g. polluted urban areas, industrial areas, coastal areas without spray of salt water, exposure to strong effect of de-icing salts • Subtropical and tropical zones with atmosphere with medium pollution
C5	4.2 < rate ≤ 8.4 Very High	Indoor	• Spaces with very high frequency of condensation and/or with high pollution from production process, e.g. mines, caverns for industrial purposes, unventilated sheds in subtropical and tropical zones
		Outdoor	• Temperate and Subtropical zones, atmospheric environment with very high pollution and/or important effect of chlorides, e.g. industrial areas, coastal areas, sheltered positions on coastline
CX	8.4 < rate ≤ 25 Extreme	Indoor	• Spaces with almost permanent condensation or extensive periods of exposure to extreme humidity effects and/or with high pollution from production process, e.g. unventilated sheds in humid tropical zones with penetration of outdoor pollution including airborne chlorides and corrosion-stimulating particulate matter
		Outdoor	• Subtropical and Tropical zones (very high time of wetness), atmospheric environment with very high pollution, including accompanying and production pollution and/or strong effect of chlorides, e.g. extreme industrial areas, coastal and offshore areas with occasional contact with salt spray



The corrosion rates should be considered as an indication only and provide a broad means of estimating the life expectancy of a zinc coating. This information should be treated as a general guide and further information should be sought relating to the specific zinc corrosion rates at the installation site. Using these broad corrosion rates, the above table shows the life expectancy of galvanised cable management products for corrosion categories C2 to CX.

Pickling and Passivation

Stainless steel is corrosion resistant because of the presence of a thin, dense, self-healing passive chromium-rich layer on the surface of the metal. This protective layer acts as a barrier between the metal and the environment and reduces the rate of dissolution of the metal. If this chromium oxide film is damaged the steel will, in most circumstances, oxidise and reform the protective layer (self-healing). When the surface of stainless steel is subject to mechanical treatments such as grinding or machining stresses, an increased roughness will occur in the outer surface layers damaging the oxide film, occasionally leaving impurities on the surface and preventing the passive film from reforming. This can also happen in general handling.

In addition, many grades of stainless steel are adversely affected by processes such as welding or heat treatment which can result in the formation of surface oxide films which can prevent the natural passive chromium oxide layer from forming. The heat discolouration marks found around the welds of stainless steel products is a form of oxide which does not necessarily adversely influence corrosion resistance unless the material is exposed to the most extremely aggressive environments e.g. when used for acid containment, etc. It should not be necessary to remove this discolouration in situations where the stainless steel offers satisfactory corrosion resistance for a particular installation.

If the passive oxide layer is damaged and the self-healing process does not occur the stainless steel will corrode, this will take the form of pitting, intercrystalline corrosion, or stress corrosion cracking. The rate of corrosion is accelerated in the presence of chloride compounds. Consequently, it is important to specify the correct grade of stainless steel, to use the correct welding techniques, and to avoid contamination with carbon steel during manufacturing processes. The use of 1.4404 marine grade stainless steel (316 grade) reduces the potential corrosion problems associated with the welding of stainless steel.

As standard, stainless steel Speedway Cable Ladder is treated by means of pickling and passivating. The pickling process removes the surface of the stainless steel by etching in a heated nitric/hydrofluoric acid solution. Pickling will remove surface debris, leaving the stainless steel clean and allowing the passive chromium oxide film to form; the surface of the stainless steel can then be described as being in the passive condition. A further treatment is then applied in which a solution of nitric acid is used to thicken the existing passive layer of chromium oxide whilst reducing the time taken to form the film. The entire process leaves the stainless steel with a uniform dull grey colour.

Coatings

A number of coatings have been used for the coating of cable management products. By far the most cost effective, versitile, and advantageous is epoxy. Epoxy coatings are based on thermosetting epoxy resins which are applied electrostatically as a powder spray which is cured and hardened in an oven. The powder spray application ensures complete and even coverage of the surface. Epoxy coatings give a thin, hard and durable finish which provides good chemical resistance, excellent adhesion, and coating flexibility. Epoxy coatings are available in a variety of colours. Black is supplied as standard unless otherwise requested.

Epoxy over Low Carbon Steel

Epoxy coatings can be applied directly to low carbon steel to give a corrosion resistant finish. The steel products are subject to a degreasing treatment to remove all surface contaminants and then epoxy powder coated to a dry film thickness of 75 microns.

Epoxy over Hot Dip Galvanised Low Carbon Steel

Whilst hot dip galvanising provides a long lasting and cost effective means of protecting steel from corrosion, the performance of the zinc coating can be enhanced by the addition of an epoxy coating. This type of finish is referred to as a duplex coating. The duplex coating can be used to add colour for aesthetic or safety purposes and provide additional protection for the steel in aggressive environments. The epoxy provides resistance to chemical degradation, and the underlying layer of zinc prevents creepage under the epoxy coating. The hot dip galvanised steel products are treated by an acid etch, a chromate pre-treatment and then epoxy powder coated to a dry film thickness of 75 microns.

4.3 Declarations in accordance to BS EN IEC 61537

As part of BS EN IEC 61537, Cable tray systems and cable ladder systems for cable management, Vantrunk supply the following information that is necessary for the proper and safe installation and use of Cable Management Systems:

a) **Installation / Assembly Instruction:**
   i. For **Speedway** see Page 215
   ii. For **Cable Tray** see Page 231

b) **Thermal Expansion:** See Page 245

c) **Classification:**

Clause	SS	GY	GA	GX	GW
6.1 According to material	6.1.1 Metallic system component				
6.2 According to resistance to flame propagation	6.2.2 Non-flame propagating system component				
6.3 According to electrical continuity characteristics	6.3.2 Cable ladder system with electrical continuity characteristics				
6.4 According to electrical conductivity	6.4.1 Electrically conductive system component				
6.5 According to resistance against corrosion	6.5.2 Class 9D	6.5.2 Class 8	6.5.2 Class 6	6.5.2 Class 8	6.5.2 Class 8
6.6 According to Temperature					
6.6.1 Minimum temperature for the system component	-50°C	-20°C	-20°C	-50°C	-40°C
6.6.2 Maximum temperature for the system component	+150°C	+150°C	+150°C	+150°C	+150°C
6.7 According to the perforation in the base area of the cable tray	Classification B: Over 2% and up to 15%				
6.8 According to the free base area of cable ladder length	Classification Y: Over 80% and up to 90%				
6.9 According to impact resistance	6.9.5 System component offering impact resistance up to 50 J				

d) **Relative Humidity:** Humidity does not affect classification

e) **Equipotential Bonding:**
   i. For **Speedway** see Page 221
   ii. For **Cable Tray** see Page 235

f) **Transport and Storage Precautions:** Materials can be used to temperature limits shown within theProduct Guide without taking any precautions (7.2)

g) **Product Dimensions:**
   i. For **Speedway** see Page 32
   ii. For **Cable Tray** see Page 101

h) **Torque Settings:**
   i. For **Speedway** see Page 222
   ii. For **Cable Tray** see Page 236

i) **End Span Limitations:** See Page 216

j) **Position and type of coupling along the span:** See Page 216

k) **Fittings Support Recommendations:**
   i. For **Speedway** see Page 217
   ii. For **Cable Tray** see Page 232

l) **Test Fixing Method:** Not fixed to supports

m) **Straight Length Safe Working Load:**
   i. For **Speedway** load data see Page 225
   ii. For **Cable Tray** load data see Page 239

n) **Cantilever Safe Working Load :**
   i. For **Speedway** cantilevers see Page 89
   ii. For **Cable Tray** cantilevers see Page 140
   iii. For **Intelok** cantilevers see Page 173 & 175

o) **Pendant Safe Working Load:** Not applicable.

p) **Material Specification:** See Page 252

For details relating to the CE marking of the Speedway Cable Ladder System and Vantrunk Cable Tray System, the associated Declaration and Technical File, please refer to our Technical Team.

4.4 Reference Standards

The following is a list of the standards relating to the cable management products covered by this catalogue:

BS 729	Replaced by BS EN ISO 1461.
BS 1449 Part 1	Replaced by BS EN 10111, 10130 & 10025.
BS 1449 Part 2	Replaced by BS EN 10088-2.
BS EN ISO 1461	Hot dip galvanised coatings on fabricated iron and steel articles. Specifications and test methods (formerly BS 729).
BS 2989	Replaced by BS EN 10147.
BS 6946	Specification for metal channel cable support systems for electrical installations.
ISO 9223	Corrosion of metals & alloys – Corrosivity of atmospheres.
BS EN 10025	Replaced by BS EN 10025-2
BS EN 10025-2	Hot rolled products of structural steels. Technical delivery conditions for nonalloy structural steels (formerly BS EN 10025:1993).
BS EN 10088-2	Stainless steels. Technical delivery conditions for sheet/ plate and strip for general purposes (formerly BS 1449 Part 2).
BS EN 10111	Continuously hot rolled low carbon steel sheet & strip for cold forming. Technical delivery conditions.
BS EN 10130	Cold rolled low carbon flat products for cold forming. Technical delivery conditions.
BS EN 10147	Replaced by BS EN 10136:2004.
BS EN 10326	Continuously hot-dip coated strip and sheet of structural steels. Technical delivery conditions.
BS EN ISO 14713	Protection against corrosion of iron and steel in structures – Zinc and aluminium coatings – Guidelines.
BS EN 10327	Continuously hot dip coated strip & sheet of low carbon steels for cold forming. Technical delivery conditions.
BS EN 50085-1	Cable trunking and cable ducting systems for electrical installations. General requirements (formerly BS 4678 Part 1).
BS EN IEC 61537	Cable tray systems & cable ladder systems for cable management.
NEMA VE 1	Metal Cable Tray Systems (also CSA International C22.2 No 126.1-98).
NEMA VE 2	Cable Tray Installation Guidelines.
BS EN 10346	Continously hot-dip coated strip & sheet of low carbon steels for cold forming. Technical delivery conditions.