CONNECT AND PROTECT

nVent ERICO Isolated Downconductors ISOnV Lightning Protection Systems

nVent

ERICO

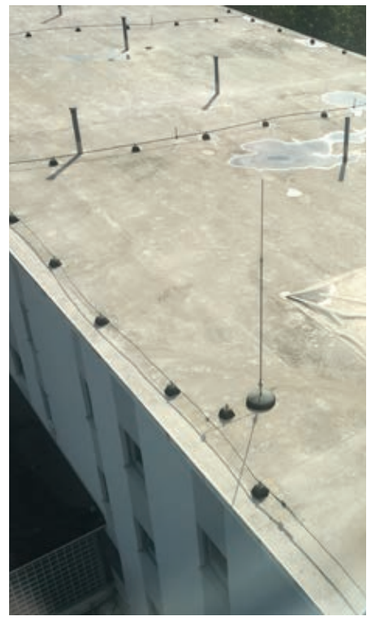
The Importance of Protecting Rooftop Equipment

Today's building rooftops are valuable real estate and have become home to an increasingly complex array of electrical equipment such as mobile telephone system antennas, digital transmission equipment and HVAC systems. Rooftops are also vulnerable to lightning strikes and that equipment can easily be damaged.

Traditionally, structures have been protected by the use of air terminals placed on the actual structure, with an emphasis on protecting the building itself from the damaging effects of the lightning strike. These air terminals served to intercept the strike with downconductors, safely conveying the energy to the earth termination system. These systems have been used for more than a century. In more recent times, methods, such as those described in the IEC 62305 series of lightning protection standards, have specified the placement of the air terminals and the downconductors together with details of the earth termination system. Items of metal on the rooftop, like flagpoles, handrails and plumbing are usually bonded (connected) to the lightning protection system.

However, contemporary buildings often have much sensitive electrical equipment mounted on the exposed rooftop. The traditional building lightning protection techniques are not well suited to protect such modern rooftop devices. With the possibilities of large currents that can be conducted by the lighting protection system, the close proximity of this electrical and electronic equipment is of paramount concern. That is, when the equipment is unavoidably close to the lightning conductors, the traditional practice is to bond the equipment frames, masts and cable sheaths to the lightning protection system. These now form part of the lightning discharge path, and damage to the equipment can result.

The IEC Lightning Protection Standards provide two approaches to lightning protection, the traditional bonding of metallic items in order to minimize potential differences, or the use of an isolated system where the lightning protection system is insulated from the structure and equipment. One method of constructing an isolated system is to use insulated brackets and fixings to hold the air terminals, and downconductors at some distance away (typically from 300 mm to 1000 mm) from the equipment and structure. Despite being a technically correct approach, the appearance, complexity, susceptibility to damage and cost limit its use. In some applications, when protecting smaller structures, a completely separate and taller mast is built adjacent to the structure. An air termination on the taller mast can provide coverage over the smaller structure, whereas the downconductor runs down the mast, physically away from the structure and its contents. This is often not practicable, especially for the telecommunication industry in which mounting a second taller mast for the protection of the first one is not a realistic solution.



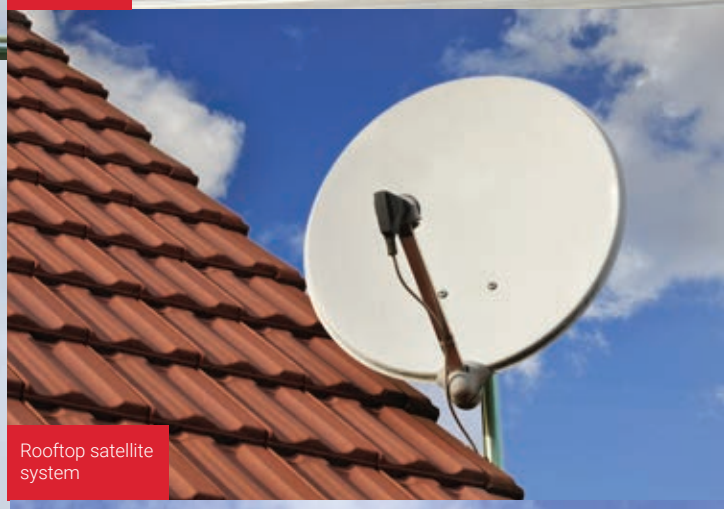
Simple lightning protection system before the proliferation of rooftop equipment

The Importance of Protecting Rooftop Equipment

Rooftop mobile telephony system antennas

Rooftop PV systems

Rooftop digital transmission equipment



Rooftop satellite system

Rooftop or exposed electronic signage

Rooftop surveillance equipment

Rooftop HVAC equipment

The nVent ERICO Isolated Downconductors (ISOnV) System

To be protected from the damaging effects of lightning, rooftop equipment has to, firstly, be within the protective area of an elevated air terminal to avoid being directly struck by lightning. Secondly, it must be sufficiently far enough away from the lightning protection system (LPS) conductors connecting those air terminals, including being far enough away from any metallic objects deliberately, or unavoidably, connected to the LPS, to avoid lightning flashing over from the LPS to the equipment.

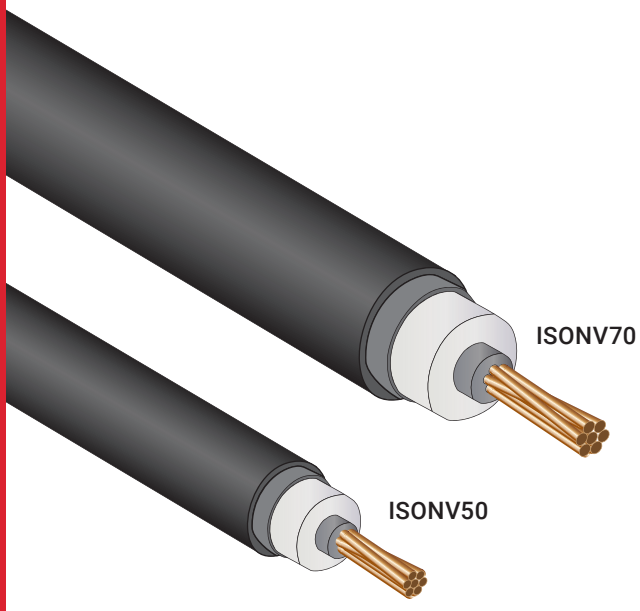
The IEC lightning protection system calls that "sufficiently far enough away" distance the Separation Distance, and has a calculation method to determine the separation distance required at all points on the lightning protection system. If the equipment is closer than the separation distance, it must be bonded to the LPS. That might seem strange, but if it weren't connected, lightning would flash over anyway, potentially causing even more damage. Either way, bonded or unbonded, there is the potential for damage to the equipment.

Is there a way of avoiding a lightning flash over to the equipment when it is unavoidably too close to an LPS conductor without having to bond it and without having the resulting damage possibility?

The ISOnV system is designed as a solution to this problem.

At the heart of this system is the use of LPS conductors that are constructed with a high performance insulation to prevent electrical breakdowns (flashovers) even with the high voltages from a lightning strike. Since their development, nVent ERICO insulated downconductors, with their pioneering use of a semi-conductive sheath, have proven their reliability on tens of thousands of structures over several decades.

The ISOnV conductors have been specifically designed and tested to IEC TS 62561-8 for use with an isolated LPS as described in the IEC 62305 series of Lightning Protection Standards.



The ISOnV System

The performance of the insulation is tested in a laboratory to IEC TS 62561-8, with the result being expressed as the conductor having an "equivalent separation distance" to that provided by that distance of air. The ISOnV conductors have this equivalence as follows:

ISOnV Conductor	Equivalent Separation Distance in Air
ISONV50	50 cm (0.50 m)
ISONV70	70 cm (0.70 m)

The center conductor is stranded copper, of cross sectional area 35 mm², exceeding the standard requirements.

Sometimes, for appearance reasons, traditional LPS conductors are coated with colored PVC. This PVC does not provide any significant insulation at lightning voltages, and such conductors are not to be confused with these specialty conductors.

The cable needs to be terminated using the special terminating kits. The termination at the upper end features a threaded hole to receive the 16mm thread of the air terminal, and the lower end termination provides a 10 mm diameter stainless steel stud for connection into the existing LPS, or into the earth termination system. Two connector models are provided to facilitate a wide range of conductor connection possibilities at the lower end.

High voltages can cause tracking along object surfaces and cause breakdowns through solid objects such as walls, more easily than sparking through the air, so the IEC 62305-3 standard says that the separation distance along surfaces or through brick, concrete, or wooden walls should be double that needed for a breakdown through air.

Upper termination of ISOnV conductor

Lower termination of ISOnV conductor provides a 10 mm stud

The ISOnV System

Since the ISOnV conductors are designed to connect to air terminals, the separation distance concept needs to be applied around the air terminal. The ISOnV system includes special masts that feature an insulating support structure. The overall system LPS design determines the size of the air terminals required and the mast heights. How the masts are mounted depends on the structure, but freestanding masts with concrete blocks, and various mounting bracket arrangements are available.

The mast stands feature an easy procedure that allow the mast to be readily positioned in place with the air terminal and conductors, saving time and complexity on the job site.

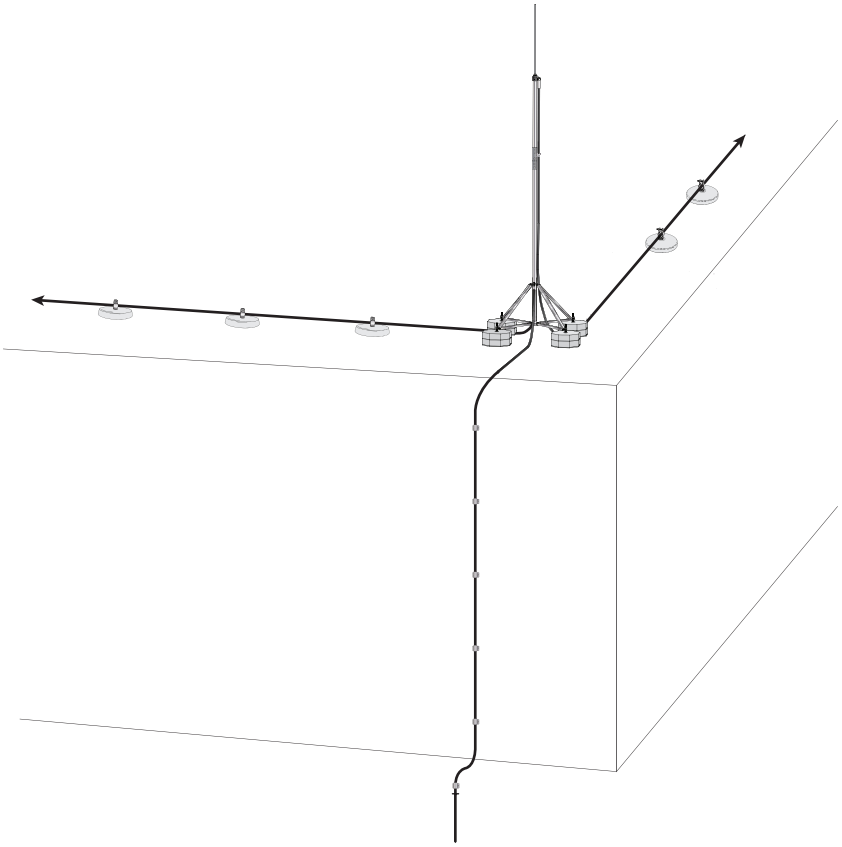
Masts of different sizes, and many bracket mounting arrangements are available

The innovative mast stands allow the fully assembled mast to be positioned and locked into place

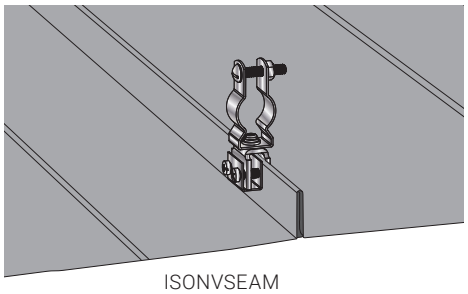
The ISOnV System

In addition, more comprehensive ISOnV isolated system designs require that multiple ISOnV conductors connect to the air terminal on a single mast, and the system accommodates that too. The conductor within the mast is always used, and up to four additional conductors can be mounted down the outside of the supporting mast. A comprehensive installation manual gives more details on the aspects of these installation variants.

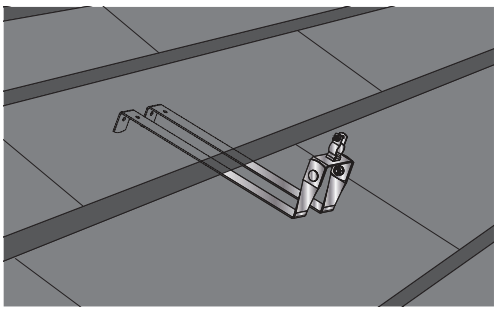
Up to four conductors can be added around the outside of the mast, in addition to the conductor that must always be present inside the mast.



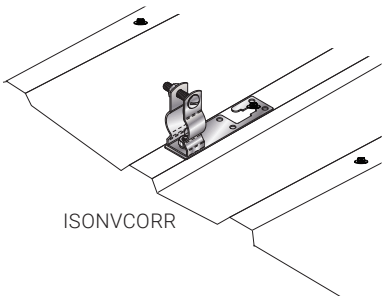
A number of fastening solutions are available to fasten the conductor as per the requirements of the standard



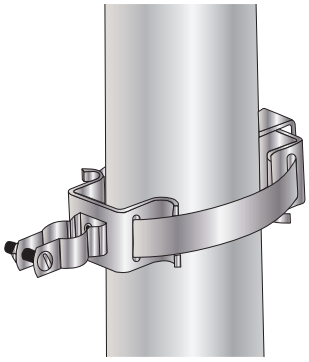
ISONVSEAM



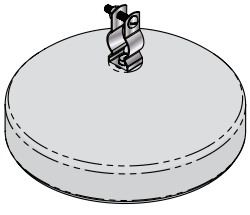
ISONVTILE



ISONVCORR



ISONVSTRAPFS



ISONVBLOCK4KG

Your Partner for Innovative Lighting Protection Solutions

THE SIX POINT PLAN OF PROTECTION

1. **Capture the lightning strike.**
   Capture the lightning strike to a known and preferred attachment point using a purpose-designed air terminal system.
2. **Convey this energy to ground.**
   Conduct the energy to the ground via a purpose-designed downconductor.
3. **Dissipate energy into the grounding system.**
   Dissipate energy into a low impedance grounding system.
4. **Bond all ground points together.**
   Bond all ground points to eliminate ground loops and create an equipotential plane.
5. **Protect incoming AC power feeders.**
   Protect equipment from surges and transients on incoming power lines to prevent equipment damage and costly operational downtime.
6. **Protect low voltage data/telecommunications circuits.**
   Protect equipment from surges and transients on incoming telecommunications and signal lines to prevent equipment damage and costly operational downtime.

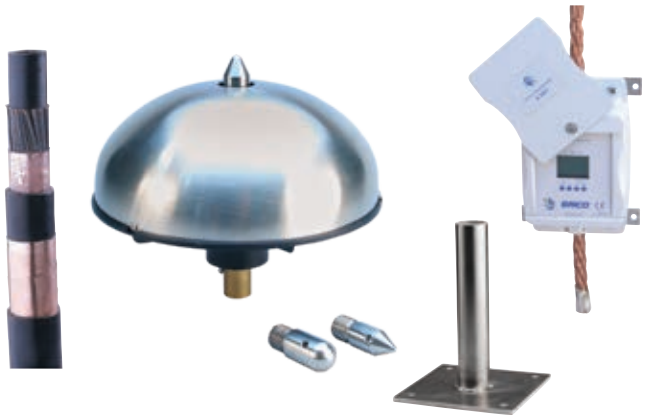
For decades, nVent ERICO has been a global leader in lightning protection. In the 1980s, when we developed a six point plan for the coordinated protection of a facility from lightning damage, our integrated systems have been used to protect many thousands of critical facilities around the globe. The six point plan recognized the importance of combining external direct strike lightning protection and internal surge protection with a good equipotentially bonded earthing system to maximize the protection achieved.

A critical part of the plan was recognizing the role that insulated downconductors play in protecting equipment from damage. Unlike non-insulated conductors, using insulated conductors allows complete control of where the damaging lightning current flows. Our dedicated application engineers help our customers design these systems, and today there are now some tens of thousands of installed systems worldwide using nVent insulated lightning conductors.

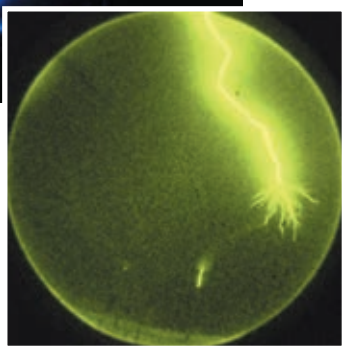
Your Partner for Innovative Lighting Protection Solutions

DID YOU KNOW?

While the ISOnV product family excels at providing a cost effective solution for many difficult lightning protection problems, the nVent ERICO System 3000 lightning protection system features the nVent ERICO Ericore coaxial insulated lightning downconductor that is able to achieve single conductor lengths in excess of 70 to 80 m.



NVENT INVOLVEMENT IN LIGHTNING PROTECTION RESEARCH



nVent has investigated the lightning protection process through years of research involving long term field studies. Laboratory testing, using some of the largest outdoor test laboratories, and countless research study programs, including joint ventures with accomplished scientists in the field have also been used in the research process. This extensive research has resulted in some of the most up-to-date published technical papers and journals. nVent is committed to the development of a range of lightning protection standards around the world.

ISOnV System Design

LPS DESIGN STEPS:

Step 1

An LPS design using the ISOnV system begins by ensuring the coverage of the rooftop equipment and the building that will be protected, by using the Protection Angle Method, the Rolling Sphere Method or both methods. The ISOnV system inherently uses masts and longer rods, enabling greater protective areas with fewer rods, compared with traditional methods using shorter rods without masts. This design aspect is similar to both an isolated and non-isolated system with a difference being that the design of the isolated system uses only dedicated air terminations rather than including natural elements of the building to ensure the LPS isolation in the area where isolation is required.

Step 2

Having completed the LPS design as far as the position of the air terminals and conductors to ensure correct coverage, the "separation distance" calculation is executed. For this exercise, a computer simulation software is often used.

IEC Lightning Protection Standards' formula:

$$s = k_i \frac{k_c}{k_m} l$$

IEC 62305-3 Ed.2.0 Section 6.3, equation 4

Where:

k_i depends upon the selected class of LPS

k_c depends upon the lightning current flowing on the downconductors (k_c = 1 for a single downconductor)

k_m depends upon the electrical insulation material (k_m = 1 for air, or 0.5 for concrete, bricks, and wood)

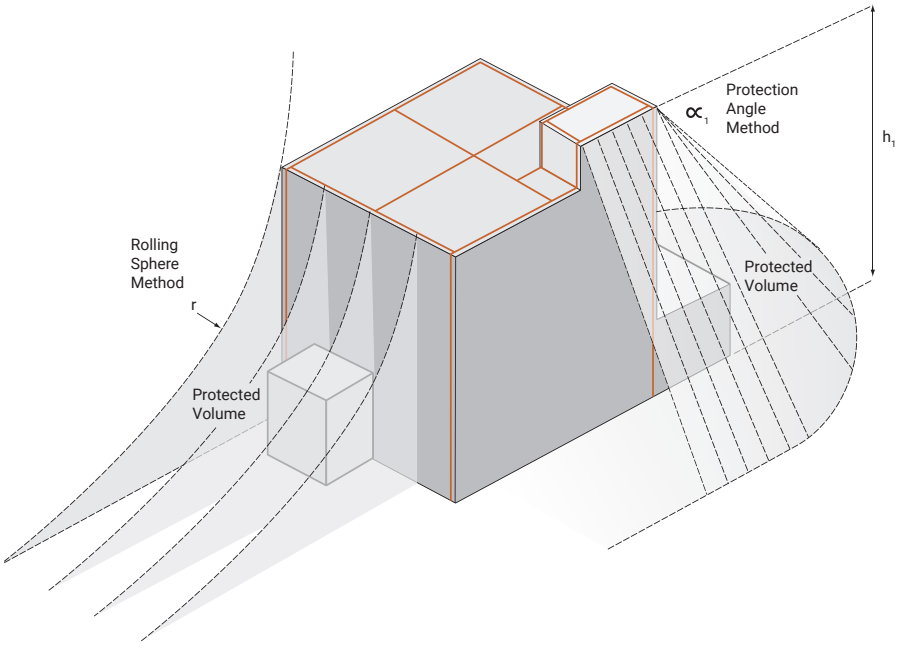
l is the length, in meters, along the downconductor (from nearest equipotential bonding point, i.e. normally from lower termination), to the point where the separation distance is being considered.

Class of LPS (LPL Lightning Protection Level)	k_i
I	0.08
II	0.06
III	0.04
IV	0.04

The factor, k_c, can be difficult to calculate, but where the proposed insulated conductor is just a single length going from the air terminal to the nearest equipotential bonding point (a single downconductor), k_c = 1, and the maximum length allowable for the ISOnV conductors is as follows:

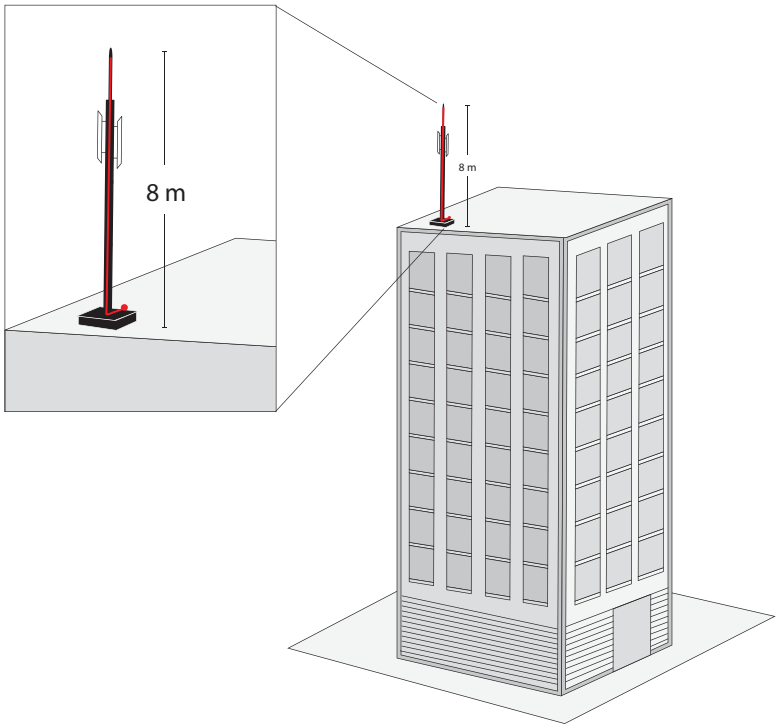
	Class of LPS		
Conductor	I	II	III and IV
ISONV50	6.3 m	9.4 m	12.5 m
ISONV70	8.8 m	13.1 m	17.5 m

Maximum conductor length for individual non-interconnected conductors



ISOnV System Design

These maximum lengths would apply in the following examples:

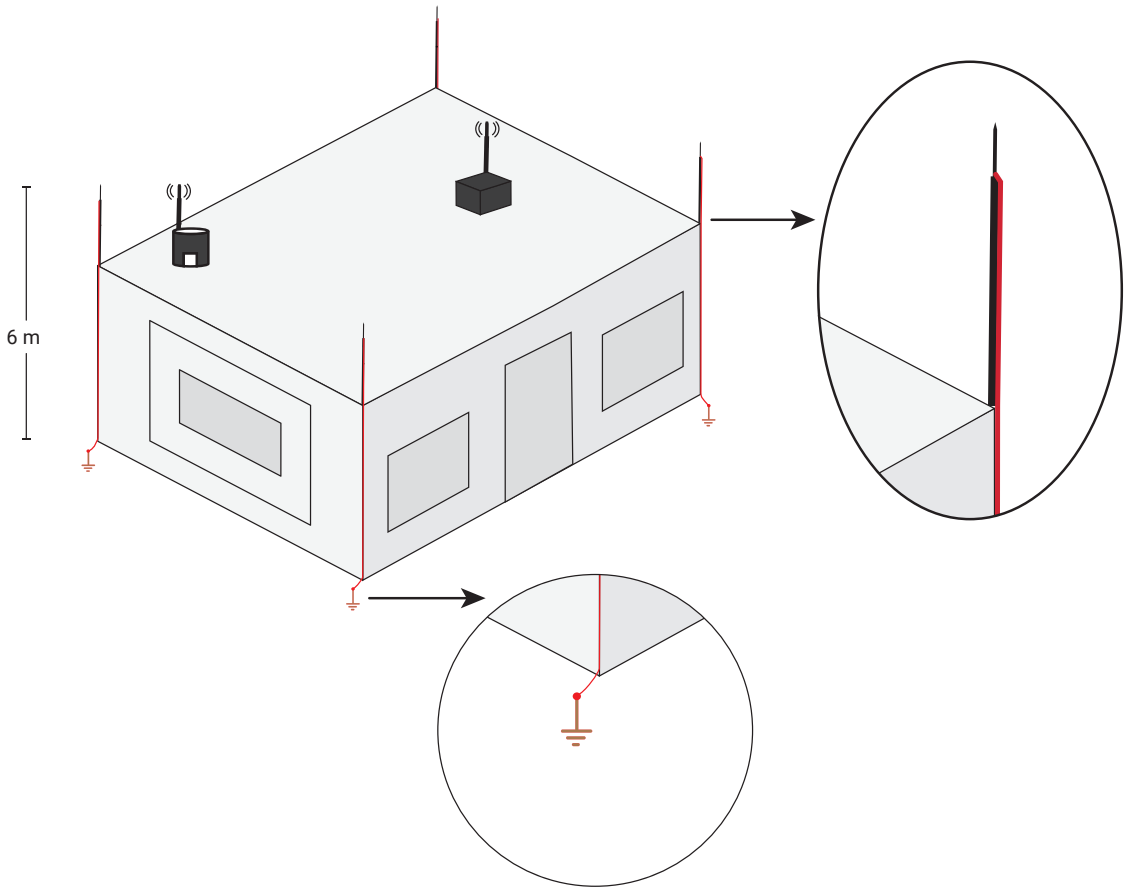


The illustration on the left shows a conductive building and roof. The base of the antenna mast, where the insulated conductor connects, is an equipotential bonding point. The conductor length is 8 m, so that for a Class I LPS, ISONV70 conductor must be used, but for a Class II to IV LPS, ISONV50 could be used.

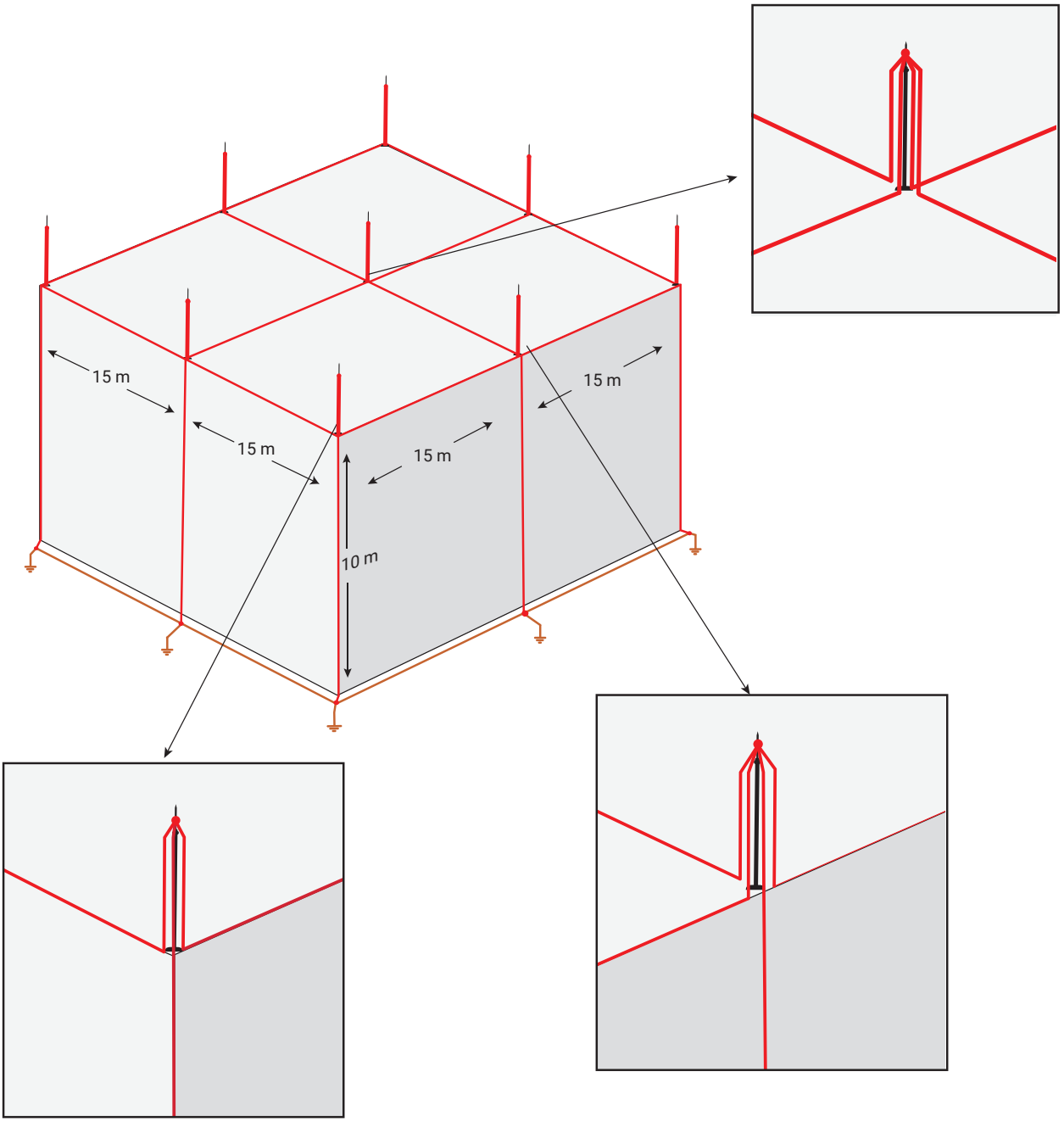
The illustration on the right shows an insulated conductor that goes all the way to the earth termination network. Since the total insulated conductor length is only 6 m, ISONV50 conductor could be used for any Class of LPS.

Adding a second insulated conductor to the same air terminal mast allows the maximum lengths to be doubled.

In the following example, 9 masts are installed to provide an isolated LPS over the complete rooftop and building. The building has a height of 10 m, and has a width and length of 30 m.



ISOnV System Design



Allowing for the heights of the air terminations, computational software calculated the separation distances for the corner, edge, and center air terminations to be as follows.

Air Termination	Class of LPS		
	I	II	III and IV
Corners	0.56 m	0.42 m	0.28 m
Edges	0.48 m	0.36 m	0.24 m
Centre	0.60 m	0.45 m	0.30 m

Separation distances required at each Class of LPL

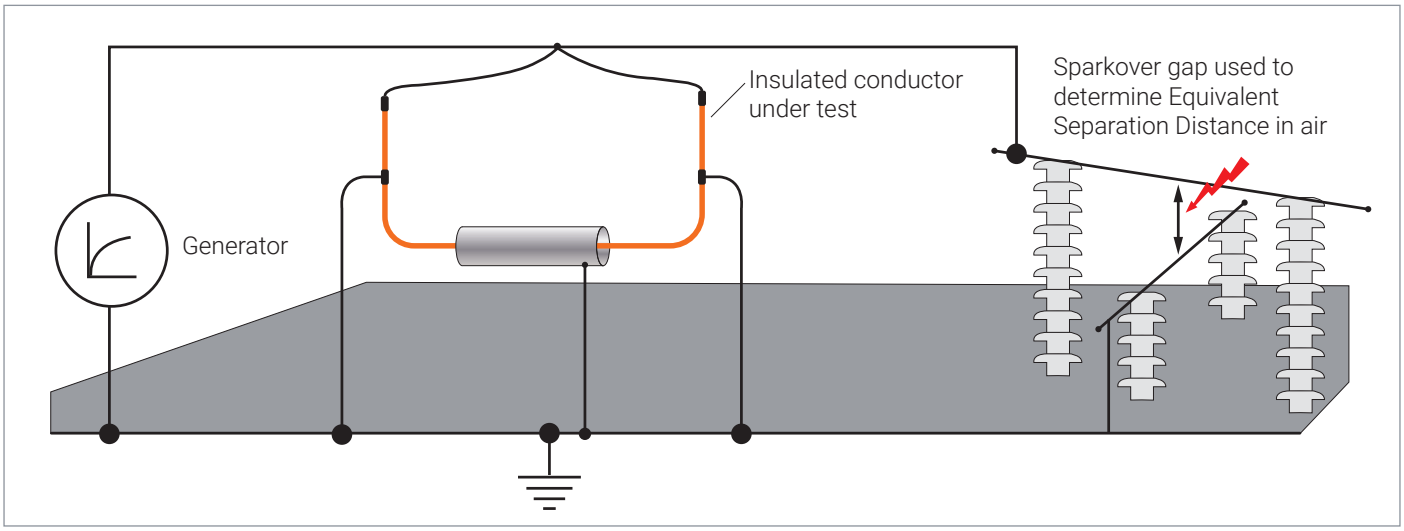
Depending on the Class of the LPS, the appropriate ISOnV conductor can be chosen. This is an example where the simple single downconductor method of calculating the separation distance does not apply, since the lightning current splits between the network of interconnected conductors, and the factor, kc, is difficult to calculate manually at each air terminal. nVent is able to offer design assistance with these more complex designs.

ISOnV System Design

Step 3

Having verified that the separation distances are within that possible with the ISOnV conductors, the Bill of Material is completed. More detailed information for that can be found in the installation manual for the system, which contains a part selection guide. If the separation distances required exceed the ISONV70 conductor, the design can be modified to shorten conductor lengths, or to add more air terminals and interconnecting conductors to split, and hence lower, the currents further.

Testing



Test method for determining the Equivalent Separation Distance

Laboratory testing to verify the 200kA 10/350us rating for the cable with connectors and fasteners

In 2018, the first edition of the IEC TS 62561-8 specification was released, and it provides a standardized way to test the electrical performance of insulated lightning conductors intended to help system designers overcome separation distance challenges.

nVent has had the ISOnV system tested in independent test laboratories. The primary tests involve verification of the claimed equivalent separation distances. The conductor itself and the installation arrangements are tested. The method involves applying the same high voltage impulse to both the conductor under test and to a comparison air gap. A successful test result occurs when the air gap breaks down rather that the conductor insulation failing.

The standard requires other tests, including a high current impulse test sequence. The ISOnV conductors passed this test at the maximum value of 200kA 10/350us.

Our extensive experience in the industry pioneering innovative solutions, verified through scientific investigation and laboratory testing, demonstrates our skills and knowledge to solve your lightning protection problems. We have a proud history of working with lightning protection installation companies around the world, many of whom have worked with us for more than 30 years.

Laboratory testing to verify Equivalent Separation Distance including cable and freestanding mast

ISOnV System Parts

ISONV INSULATED CONDUCTOR

- Provides protection of equipment against lightning strike flashover by providing an insulated path to ground via an equivalent separation distance

Part Number	Equivalent Separation Distance	Material
ISONV50	50 cm	Copper, Polyethylene
ISONV70	70 cm	

ISONV CONDUCTOR CLAMP FOR SEAMED METAL ROOF

- Secures conductors to standing seam profiles
- Suits both ISONV50 and ISONV70

Part Number	Material
ISONVSEAM10	Stainless Steel 304 (conductor clamp), Galvanized Steel (seam clamp)

ISONV CONDUCTOR CLAMP FOR INTERLOCKING ROOF TILE

- Secures ISOnV Insulated Conductor to roof tiles
- Suits both ISONV50 and ISONV70

Part Number	Material
ISONVTILE	Stainless Steel 304

ISONV CONDUCTOR CLAMP FOR CORRUGATED ROOF

- Secures ISOnV Insulated Conductor to corrugated metal roofs

Part Number	Material
ISONVCORR10	Stainless Steel 304

ISONV CONDUCTOR FASTENER

- Secures lightning protection conductors and prevents displacement

Part Number	Material
ISONVFS	Stainless Steel 304

ISONV CONDUCTOR SUPPORT BLOCK

- Weighted ballast with cable fastener to support ISOnV Insulated Conductor along rooftop
- Suits both ISONV50 and ISONV70

Part Number	Unit Weight	Material
ISONVBLOCK4KG	4 kg	Concrete (block), Stainless Steel 304 (conductor clamp)

ISONV CONDUCTOR STRAP BRACKET

- Secures conductors to round objects such as masts, pipes and columns
- Suits both ISONV50 and ISONV70
- Use in conjunction with ISONVSTRAP and ISONVSTRAPC

Part Number	Material
ISONVSTRAPFS	Stainless Steel 304

ISOnV System Parts

ISONV UPPER TERMINATION KIT, INSIDE MAST

- Kit includes upper termination, heat shrink tubing, hex key wrench, air terminal washers and crimp ring terminal for bonding to mast

Part Number	Conductor Type	Material
ISOTMN50KITU	ISONV50	316L
ISOTMN70KITU	ISONV70	

ISONV UPPER TERMINATION KIT, OUTSIDE MAST

- Kit includes upper termination, heat shrink tubing, hex key wrench, air terminal washers, multi-cable adapter and an equipotential bond

Part Number	Conductor Type	Material
ISOTMN50KITUA	ISONV50	316L
ISOTMN70KITUA	ISONV70	

ISONV LOWER TERMINATION KIT

- Kit includes lower termination, heat shrink tubing, and a hex key wrench

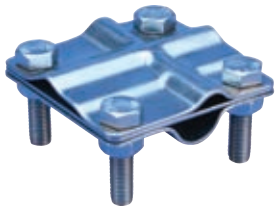
Part Number	Conductor Type	Material
ISOTMN50KITL	ISONV50	316L
ISOTMN70KITL	ISONV70	

ISONV EQUIPOTENTIAL BOND KIT

- Used with ISOnV lower terminations when equipotential bonding is required

Part Number	Conductor Type	Material
ISONVEBL50	ISONV50	Stainless Steel 304 (Conductor Bond), Tinned Copper (Terminal)
ISONVEBL70	ISONV70	

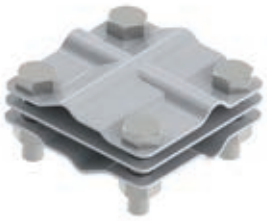
MULTI-PURPOSE GROUNDING CLAMP, STAINLESS STEEL



- Convenient multi-purpose clamp designed to accommodate round conductors, flat conductors, ground rods and rebar

Part Number	Earth Rod	Material
MPSC404SS	14.2–19.0 mm Diameter, Actual (Ø)	Stainless Steel 304

MULTI-PURPOSE GROUNDING CLAMP, STAINLESS STEEL



- Cross connector for round-to-round, round-to-tape, and tape-to-tape connections

Part Number	Conductor Size	Material
MPSC404SSA	8 mm Solid-10 mm Solid, 35 mm² Stranded-50 mm² Stranded 40 mm x 4 mm max. Tape	Stainless Steel 304

ISONV STRAP CLAMP

- Fastens ISOnV Strap
- Use in conjunction with ISONVSTRAP and either ISONVSTRAPBKT or ISONVSTRAPFS

Part Number	Material
ISONVSTRAPC	Stainless Steel 304

ISONV STRAP

- Provides variable fastening on poles, masts and pipes
- Use in conjunction with ISONVSTRAPC and either ISONVSTRAPBKT or ISONVSTRAPFS

Part Number	Length	Material
ISONVSTRAP	50 m	Stainless Steel 304

ISOnV System Parts

ISONV STRIPPING TOOL HANDLE

- For use with ISOnV Stripping Tool Bushings to provide precise strip length of ISOnV Insulated Conductor

Part Number	Material
ISONVSTRIPT	Thermoplastic, Steel and Brass

ISONV STRIPPING TOOL BUSHING

- For use with ISOnV Stripping Tool Handle to provide precise strip length of ISOnV Insulated Conductor

Part Number	Conductor Type	Material
ISONVSTRIP50	ISONV50	Thermoplastic, Stainless Steel Blades
ISONVSTRIP70	ISONV70	

ISONV STRIPPING TOOL CARRYING CASE

- Designed to carry ISOnV stripping tool handle, bushing and replacement blades

Part Number	Material
ISONVSTRIPCS	Polyethylene

ISONV STRIPPING TOOL REPLACEMENT BLADE

- Replacement blades for ISOnV Stripping Tool Bushing

Part Number	Material
ISONVSTRIPBL	Stainless Steel

ISONV AIR TERMINAL

- Lightning strike termination points for use with air terminal bases

Part Number	Height	Material
LPAAT0500	500 mm	Aluminum
LPAAT1000	1,000 mm	
LPAAT1500	1,500 mm	
LPAAT2000	2,000 mm	
LPSAT1000	1,000 mm	Stainless Steel 304
LPSAT2000	2,000 mm	

ISONV LOWER MAST

- For use with ISOnV Upper Mast Assembly in vertical cantilever installations

Part Number	Material
ISONVMAST11	Aluminum
ISONVMAST24	
ISONVMAST37	

ISONV LOWER MAST WITH OUTLET

- For use with ISOnV Upper Mast Assembly in mast stand installations

Part Number	Material
ISONVMASTA11	Aluminum
ISONVMASTA24	
ISONVMASTA37	

ISOnV System Parts

ISONV UPPER MAST ASSEMBLY

- For use with ISOnV lower masts

Part Number	Material
ISOMASTASSY	Polypropylene (cap), Fiberglass (mast), Stainless Steel 304 (coupler)

ISONV MAST STAND

- Used to support ISOnV mast assemblies with an outlet

Part Number	Material
ISONVSTAND10	
ISONVSTAND15	Stainless Steel 304
ISONVSTAND25	

ISONV ADJUSTABLE OFFSET MAST BRACKET

- Telescoping mast support for mounting under roof overhang

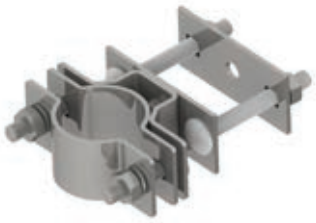
Part Number	Offset Distance	Material
ISONVBKTXL	800 – 1,000 mm	Stainless Steel 304

ISONV FIXED OFFSET MAST BRACKET

- Use for cantilevered mounting ISOnV masts

Part Number	Offset distance	Material
ISONVBKT15	15 mm	
ISONVBKT80	80mm	Stainless Steel 304
ISONVBKT200	200 mm	

ISONV SQUARE RAILING MAST BRACKET



- Secures masts to square railing

Part Number	Rail Size	Material
ISONVBKT50X50	50 mm x 50 mm	Stainless Steel 304

ISONV MAST TO PIPE BRACKET

- For mast-to-mast or pipe-to-mast mounting connections

Part Number	Pipe Outside Diameter	Material
ISONVBKTR40	40 – 50 mm	
ISONVBKTR50	50 – 60 mm	Stainless Steel 304
ISONVBKTR70	70 – 80 mm	

ISONV MAST STRAP BRACKET

- Secures masts to round objects such as masts, pipes and columns

Part Number	Material
ISONVSTRAPBKT	Stainless Steel 304

ISOnV System Parts

THREADED ROD EXTENSION

- Used with concrete block supports for inclined surfaces for level installation of mast stands

Part Number	Material
ISONVROD200EXT	Stainless Steel 304
ISONVROD240EXT	
ISONVROD270EXT	
ISONVROD300EXT	

ISONV EARLY STREAMER EMISSION TERMINAL ADAPTOR

- Adaptor to interface Early Streamer Emission Terminal with ISOnV Insulated Conductor

Part Number	Material
ISONVESE	Stainless Steel

ISONV CONCRETE BLOCK SUPPORT ASSEMBLY

- Used to ballast mast stands on horizontal surfaces

Part Number	Material
ISONVBLOCKSET1	Concrete (Block), Stainless Steel 304 (Threaded Rod)
ISONVBLOCKSET2	
ISONVBLOCKSET3	
ISONVBLOCKSET4	
ISONVBLOCKSET5	

ISONV CONCRETE BLOCK SUPPORT ASSEMBLY, INCLINED SURFACE

- Used to ballast mast stands on inclined surfaces
- Use in conjunction with Threaded Rod Extensions.

Part Number	Material
ISONVBLOCKSET1K	Concrete (Block), Stainless Steel 304 (Threaded Rod), Aluminum (Knuckle Joint)
ISONVBLOCKSET2K	
ISONVBLOCKSET3K	
ISONVBLOCKSET4K	
ISONVBLOCKSET5K	

CABLE TIE

- Strap for securing downconductor

Part Number	Length	Material
LPTIESS25	360 mm	Stainless Steel 316 with Black Polyester/Epoxy Coating

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