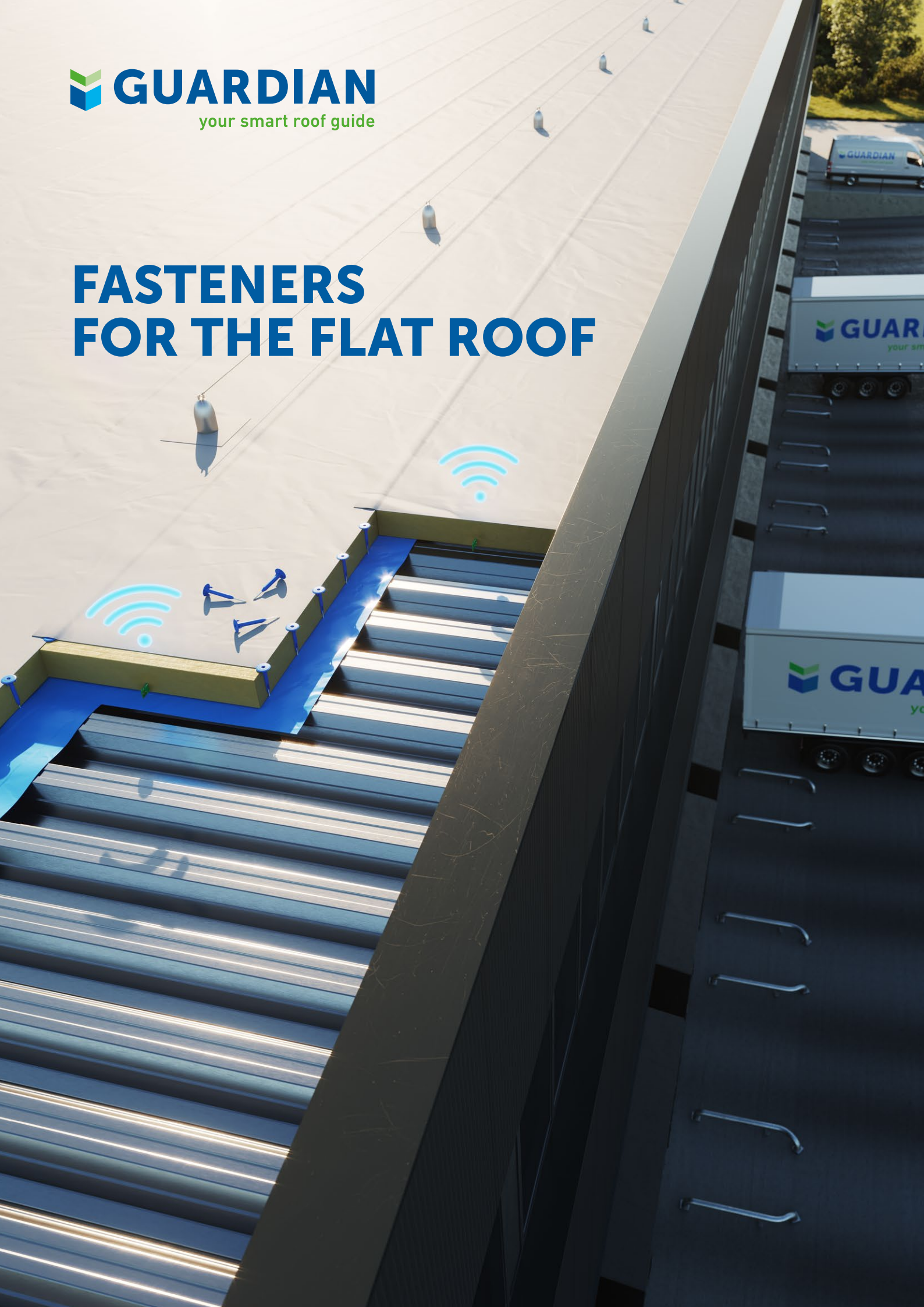
GUARDIAN
your smart roof guide

FASTENERS FOR THE FLAT ROOF



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GUARDIAN
WHO ARE WE

Guardian fastening systems are developed, produced and distributed by Guardian BV and are designed to fasten roof systems efficiently and safely.

Why choose Guardian?

No other part of a building is burdened as heavily as the roof. Storm, rain, and also loads from walking and working, result in flat roofs continually being exposed to severe loads. That is why it is very important to make sure the roof is constructed properly and safely. With Guardian fastening systems, you choose the certainty of optimal roof build-up fastening.

Why take big risks?

The costs of good, secure fastening of insulation and roof membranes amount to less than 2% of the total cost of the roof build-up. Using untested and uncertified products or not fastening roof build-ups completely leads to huge risks and can even result in claims into the millions of euros.

Many problems, for both contractors and clients, can be avoided by using high-quality fastening systems that have been tested and certified according to official guidelines by recognised, independent bodies.

Guardian is the ultimate specialist in fastening flat roofs. With our range of products, we offer you the certainty of top-quality products and customised service. Guardian fasteners have been tested extensively and are certified by recognised bodies according to the latest European directives.

Top quality products and customised service

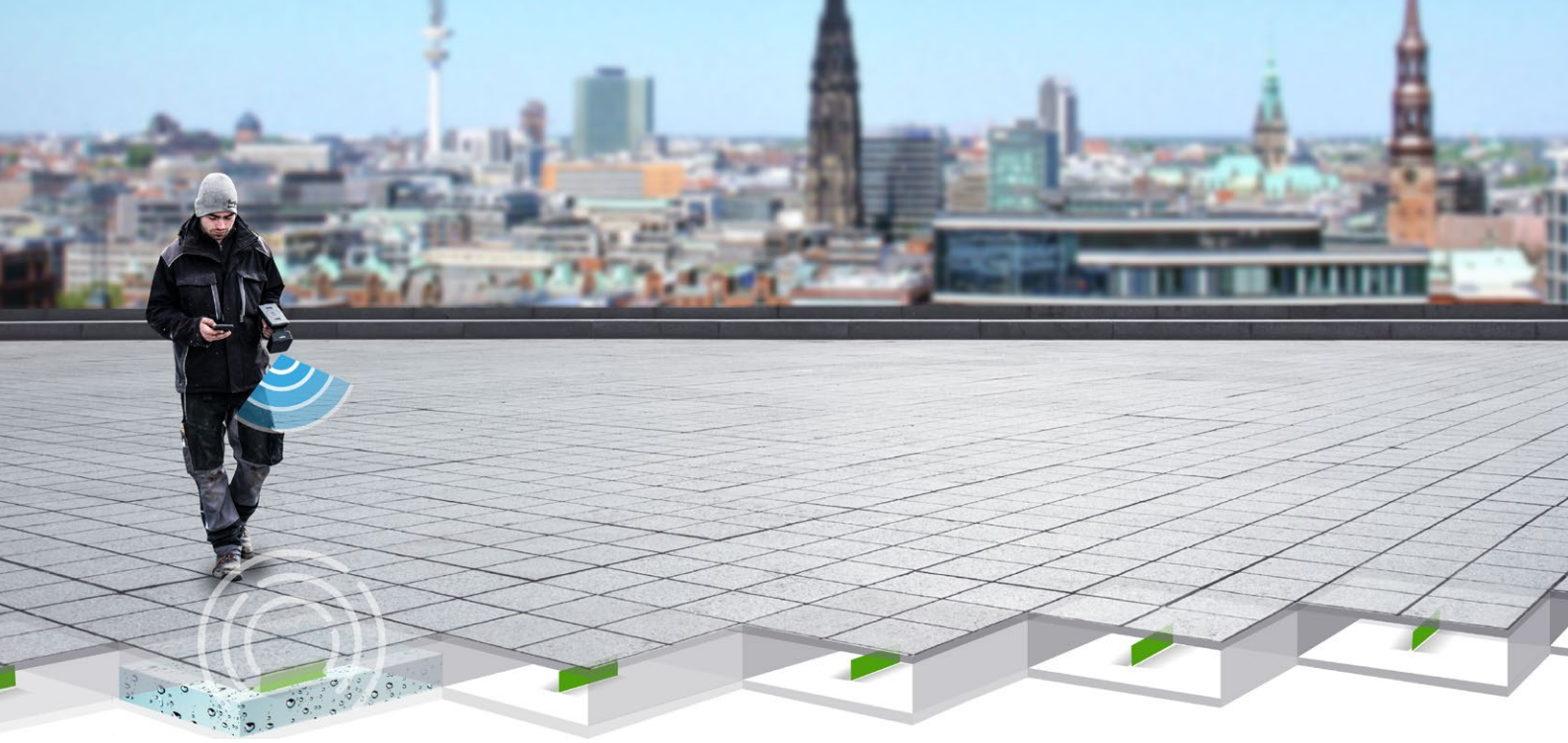
From Helmond (NL) our products and services are distributed by enthusiastic and skilled staff through specialist dealers and system manufacturers across Europe and beyond. With top quality products and customised service, Guardian has acquired an important position in the European roofing market. Guardian is located in Helmond, the Netherlands, and is a subsidiary of the Swiss SFS Group.

Exceptionally high design load values

Hundreds of test reports of official wind uplift tests according to EN 16002 performed by independent bodies, are available for the various Guardian roof-fastening systems. The unique design of the Guardian fastening systems guarantees exceptionally high design load values, both for roofs with bituminous membranes and roofs with synthetic roof membranes.

Maximum flexibility

Professional employees support customers with customised advice and service. Short lines of communication and just-in-time delivery provide maximum flexibility. And to avoid extra costs and long delivery times, most of the end products are also assembled and packaged in-house.



Roof with a future

The roof. It is much more than just the top protective layer of our buildings. A top layer with infinite possibilities today and in the future. The roof plays an increasingly important role in our society. It can be used to generate sustainable energy. To buffer rainwater, which relieves the drainage system. As a garden with plants or trees or to grow fruits and vegetables, or as a place to meet and relax.

Connecting with smart solutions

Plenty of opportunities for the roof. Good partnerships turn these opportunities into successes. With our specialised knowledge and expertise, we'll be happy to help you find the most intelligent solution for your flat roof. Guardian does more than manufacture fasteners for flat roofs: we make connections! Aside from systems, customers, suppliers and users, we also make smart and successful connections with data.

Get more out of your roof

Durable and functional connections

We love roofs. That much is clear. For a long time, this part of the building envelope has been underutilised while protecting the interior from the weather. Aside from safety and quality, durability and functionality are becoming increasingly important. We are keen to be part of this. Our partners' ideas and input are essential for this. We are open to be challenged with new initiatives. This is how we're working on a bright future for the roof. Together.

Specialised

Our customers have enjoyed our professional, personal and informal way of working for many years. Whether we are advising you on a complete roof system, offering a quotation, providing a wind load calculation, finding solutions for problems or starting up a local (European) project, our expert staff is ready to help you!

Guardian offers products and systems as well as service and advice. Our fastening systems are specially developed for mechanical fastening of insulation and synthetic and bituminous membranes on flat roofs. We can tell you which products are the best to use in various systems, or offer you a complete solution with our large database of information on the pull-out values of our fasteners in complete roof systems.

SERVICE
CUSTOMISED ADVICE

Guardian offers a wide range of services. Our professional employees are ready to support you with customised service and advice.

Technical advice

About products, systems and fasteners for various roof systems.

Pull-out tests

The pull-out value per substrate type is determined on site and the right fastener is recommended.

FM Approvals

Guardian has FM approvals available for both individual products as well as complete roof systems.

Wind uplift tests

Extensive international testing facilities to determine the wind resistance of a roof systems. More than 250+ wind uplift test with exceptionally high design load values according to EN 16002.

Machinery and tools

For an optimal and ergonomic installation of Guardian fastening systems, machines and tools are offered for rent or sale.

Demonstrations

Of products and systems on site or at Guardian BV in Helmond.

Wind load calculations

You will receive the specification of the number of fasteners per roof zone according to the current guidelines per country within 48 hours. Our technical department takes care of wind load calculations and designs a fixing pattern according to EN1991-1-4 or FM1-28.

European certification

The entire Guardian product range has been tested in accordance with the latest European regulations ETAG-006/EAD:030351-00-0402.
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Customer Service department

Our Customer Service department can be reached on business days from 7:30 a.m. to 5:30 p.m. at +31 (0)492 597400 and 24 hours on info@guardian.nl

PLASTIC TUBES

Guardian tubes can be used in combination with bituminous and synthetic roofing systems. High performance tube RB 48 is specially designed for synthetic roofing systems, with unique high design load values. High performance tube RBS 50 is specially designed for bituminous roofing systems, also with unique high design load values.

	R 45	RB 48
Product description	Standard tube to fasten synthetic membranes in overlap	High performance tube (barbed) for fastening of synthetic membrane systems in the overlap
Material	Polypropylene (On request available in PA)	Polypropylene (On request available in PA)
Size Ø	45 mm	48 mm
Length	20 - 730 mm	20 - 330 mm
Approvals		
Sintef approval 2516	yes	yes
ETA approval 08/0285	yes	yes
FM approved	yes	yes
Roofing system	Bitumen, one and two-layer systems + synthetic (pvc/tpo/epdm)	Synthetic (pvc/tpo)
Design load N*	600/700 Newton	700/900 Newton
Tube-screw combination		
Steel roof deck	BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8 BS 6,8	BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8 BS 6,8
Concrete roof deck	CS 6,1 CS-S 6,1 SS A2 BN 5,6 ASTL	CS 6,1 CS-S 6,1 SS A2 BN 5,6 ASTL
Wooden roof deck	TS 5,2 LBS 6,0	TS 5,2 LBS 6,0
Lightweight concrete roof deck	LBS 6,0/(8,0-LN version) LBS-S 6,0 SS A2	LBS 6,0/(8.0-LN version) LBS-S 6,0 SS A2
Machinery and tools	Bit-Extender PP 260	Bit-Extender

* Guideline: ask Guardian for the design load value of your system.

Pre-assembly possible

The 4 major advantages of using tubes are:

1. Step-security + telescopic solution
2. Cold bridge reduction
3. Price
4. Sustainability

R 75	RBS 50	R 23
Standard tube to fasten insulation or bitumen base layers	High performance tube (barbed) for fastening of bitumen membranes in the overlap and for fastening of insulation or base layers	Special tube for the fastening of steel bars (STB) and metal pressure plates
Polypropylene (On request available in PA)	Polypropylene	Polypropylene (On request available in PA)
75 mm	50 mm	23 mm
20 - 330 mm	20 - 330 mm	60 - 730 mm
yes yes yes	yes yes -	yes yes -
Insulation and synthetic (glued) and bituminous systems (base layer)	Bitumen, one and two-layer systems	Synthetic and bituminous systems
450/700 Newton	650-900 Newton	Dependent on combination/application
BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8 BS 6,8	BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8 BS 6,8	BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8 BS 6,8
CS 6,1 CS-S 6,1 SS A2 BN 5,6 ASTL	CS 6,1 CS-S 6,1 SS A2 BN 5,6	CS 6,1 CS-S 6,1 SS A2 BN 5,6 ASTL
TS 5,2 LBS 6,0	TS 5,2 LBS 6,0	TS 5,2 LBS 6,0
LBS 6,0/8.0-LN version) LBS-S 6,0 SS A2	LBS 6,0/(8.0-LN version) LBS-S 6,0 SS A2	LBS 6,0/(8.0-LN version) LBS-S 6,0 SS A2
Bit-Extender	Bit-Extender	Bit-Extender

PRESSURE PLATES & RAILS

Guardian supplies an extensive range of (metal) pressure plates for the fastening of single and multi-layer roof systems (field and overlap mounting / synthetic and bitumen roofing membranes).

Our metal pressure plates are also suitable for the attachment of insulation and bitumen base layers.

SP 40

Pre-assembly possible

SP 50

Pre-assembly possible

SP 70

	SP 40	SP 50	SP 70
Product description	Metal pressure plate for wooden and concrete substrates	Metal pressure plate for fastening single-layer roof membrane systems	Metal pressure plate for fastening insulation or bitumen base layers.
Material	Galvanised steel, 15 cycles Kesternich	Galvanised steel, 15 cycles Kesternich	Galvanised steel, 15 cycles Kesternich
Thickness	1,0 mm	1,0 mm	0,5 and 0,7 mm
Pre-drill diameter	6,0 / 7,5 mm	6,5 mm	5,0 / 6,5 mm
Underside	Flat and deep recess	Flat and with recess (shallow and deep). Also in barbed version for extra high performance	Flat and with recess (shallow and deep)
Approvals			
Sintef approval 2516	yes	yes	-
ETA approval 08/0285	yes	yes	yes
FM approved	-	-	-
Roof system	Synthetic (pvc, tpo, epdm) Bitumen	Synthetic (pvc, tpo, epdm) Bitumen	Insulation and synthetic (glued) and bituminous systems (base layer)
Screw			
Steel roof structure		BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8	BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8
Concrete roof structure	CS 6,1 CS-S 6,1 SS A2 BN 5,6	CS 6,1 CS-S 6,1 SS A2 BN 5,6	CS 6,1 CS-S 6,1 SS A2 BN 5,6
Wooden roof structure	TS 5,2 LBS 6,0	TS 5,2 LBS 6,0	TS 5,2 LBS 6,0
Lightweight concrete roof structure	LBS 6,0/(8,0) LBS-S 6,0 SS A2	LBS 6,0/(8,0) LBS-S 6,0 SS A2	LBS 6,0/(8,0) LBS-S 6,0 SS A2
Machinery and tools	Woodstick (With TS 5,2 for pre-assembly)	Woodstick (With BS 6.8 for pre-assembly)	

SP 8240

SPA 8240

STB

Metal pressure plate for fastening single-layer roof membrane systems	Metal pressure plate for use with single-layer systems with automatic setting tool.	Metal bar system for linear fastening and field fastening systems
Galvanised steel, 15 cycles Kesternich	Galvanised steel, 15 cycles Kesternich	Galvanised steel, 15 cycles Kesternich
1,0 mm	1,0 mm	1,25 mm
6,5 mm	4,85 - 7,00 mm	7,0 and 16,0 mm
Flat and with recess (shallow and deep). Also in barbed version for extra high performance	Flat and with recess (shallow and deep). Also in barbed version for extra high performance	STBS/STBT/STBS7T15
yes yes -	yes yes yes	- yes -
Synthetic Bitumen	Synthetic Bitumen	Synthetic and bituminous systems (base layer)
BS 4,8 / 6,1 / 6,8 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8	DBTA 4,8	BS 4,8 / 6,1 PS 4,8 BSRF 4,8 SS A4 BSHD 4,8
CS 6,1 CS-S 6,1 SS A2 BN 5,6		CS 6,1 CS-S 6,1 SS A2 BN 5,6
TS 5,2 LBS 6,0		TS 5,2 LBS 6,0
LBS 6,0/(8,0)		LBS 6,0/(8,0)
	IF 240	

FASTENERS FOR STEEL SUBSTRATES

PS 4,8

BS 4,8

BS 6,1

Product description	S-Point screw Coating, 15 cycles	Drill-point screw Coating, 15 cycles Reduced drill-point also available in stainless A4	Drill-point screw, Coating, 30 cycles Reduced drill-point
Application	Steel deck from 0.70 to 0.88 mm	Steel deck from 0.70 mm to 2 x 1.25 mm	Steel-deck from 0.6 mm to 2 x 1.25 mm
Head/tool	Tx-25 head For use with BIT-T25	Tx-25 head For use with BIT-T25	Tx-25 head For use with BIT-T25
Size Ø	4,8 mm	4,8 mm	6,1 mm
Length	40 - 200 mm	BS 4,8 : 50 - 300 mm BSRF SS A4: 80 mm	60 - 200 mm
Required length	Build-up + 20 mm	Build-up + 20 mm	Build-up + 20 mm
Homologations			
Sintef approval 2516	yes	yes	yes
ETA approval 08/0285	yes	yes	yes
FM approved	yes	yes (BS 4,8)	yes

BS 6,8

Drill-point screw
Coating, 30 cycles
Reduced drill-point
Length 80 mm combinable with tubes

0,50 - 2 x 1,25

Tx-25 head
For use with BIT-T25

6,8 mm

35 and 80 mm

Build-up + 20 mm

yes
yes
-

BSHD 4,8

Drill-point screw
Coating, 15 cycles
Larger drill-point

1,00 - 3,00

Tx-25 head
For use with BIT-T25

4,8 mm

90 mm

Build-up + 20 mm

yes
yes
-

DBTA

Belted drill-point screw
Step-secure
Coating, 15 cycles
Reduced drill-point
Stainless steel version available. Screw also available loose (DBT/DBT-S)

0.70 mm to 2x 1.25 mm

8 mm hexagonal head
For use with fully automatic tool IF 240

4,8 mm

60 - 240 mm

Build-up + 20 mm

yes
yes
yes

FASTENERS FOR CONCRETE AND LIGHTWEIGHT CONCRETE

Especially for concrete and aerated concrete roof constructions Guardian offers a wide range of fasteners. Especially for fastening of insulation on concrete roofs Guardian has developed the unique ASTL fastening system which covers up to 110 mm of tapered insulation on one length combination.

	ASTL	CS 6,1 (Also available in stainless steel)	BN 5,6
Product description	Tapered insulation fastener Pre-assembled R 45 or R 75 tube + concrete screw	Concrete screw Hi-Lo thread Coating, 15 cycles CS 6.1 is supplied with blunt point (length up to 100 mm) and with sharp point (length from 120 mm) **Also available in stainless steel A2** **Ideal for renovation projects**	Concrete nail with twisted lower end Coating, 15 cycles Also to be incorporated in tube
Application	Concrete Covers up to 110 mm Tapered insulation with one length combination	Concrete	Concrete
Head/tool	For use with special tools for working in upright position	Tx-25 head For use with BIT-T25	For use with hammer or hammer drill
Pre-drilling	Ø 5,0 mm drill with stopper	Ø 5,0 mm / 5,2 mm	Ø 5,0 mm
Size Ø	6,1 mm	6,1 mm	5,6 mm
Length	See www.guardian.nl/en	28 - 280 mm SS: 40 / 80 mm	28 - 160 mm
Required length	Depending on the thickness of the insulation. For more information, please check: www.guardian.nl/en/products/ASTL	Build-up + 25 mm, screw length <120 mm Build-up + 30 mm, screw length ›120 mm	Build-up + 30 mm
Approvals			
Sintef approval 2516	yes	yes	yes
ETA approval 08/0285	yes	yes	yes
FM approved	-	yes	-

CP50

LBS 6,0

Also available in stainless steel

LBS 8,0

Concrete plug with steel nail	Multi roofing-screw with S-point Coating, 15 cycles **Also available in stainless steel A2** **Ideal for renovation projects**	Multi roofing-screw with S-point Coating, 15 cycles LBS 8.0 combinable with all plastic Guardian LN version tubes
Concrete	Lightweight concrete min. 600 kg/m3	Lightweight concrete min. 450 kg/m3
For use with hammer	Tx-25 head For use with BIT-T25	Tx-25 head For use with BIT-T25
Ø 8,0 mm	Installation without pre-drilling in lightweight concrete	Installation without pre-drilling in lightweight concrete
50 mm / 8,00 mm	6,0 mm	8,0 mm
75 - 215 mm	60 - 240 mm SS: 100 mm	65 - 125 mm
Build-up + 30 mm	Lightweight concrete: build-up + 60 mm Wood: build-up + 20 mm	Build-up + 60 mm
yes yes -	yes yes -	yes yes -

FASTENERS FOR WOODEN SUBSTRATES

For fastening to wood, Guardian supplies roof screws with a wider diameter and coarser thread then the standard fasteners.

TS 5,2

Pré-assemblage possible

LBS 6,0

Pré-assemblage possible

MTS 4,8

	TS 5,2	LBS 6,0	MTS 4,8
Product description	Wood screw with S-point Coating, 15 cycles TS 5.2 - SP 40 combination, special for the direct fastening of roof membranes to wooden roofs	Multi roofing-screw with S-point Coating, 15 cycles	S-Point screw for fastening thin sheet metal (thickness up to 2 x 0.9 mm) to wood, such as roof trim. Flat screw head for flat finishing/Hi-Lo thread Coating, 15 cycles
Application	Wood	Wood	Metal to wood
Head/tool	Tx-25 head For use with BIT-T25/Woodstick	Tx-25 head For use with BIT-T25	PH2 / Tx-25 head
Pre-drilling	Installation without pre-drilling	Installation without pre-drilling	Installation without pre-drilling
Size	5,2 mm	6,0 mm	4,8 mm
Length	20 - 120 mm	60 - 240 mm	20 and 35 mm
Required length	Build-up + 25 to 40 mm dependent on wood type	Build-up + 25 to 40 mm dependent on wood type	
Approvals			
Sintef approval 2516	yes	yes	-
ETA approval 08/0285	yes	yes	yes
FM approval 3034551	-	-	-

LDF	GPR	DIVERS
Wood fiber cement fastener (nylon) Pressure plates: SP-LDF 51, SP-LDF 71	Peel rivet Clamp range: 13-180 mm For pressure plates with Pre-drill diameter: min. 7.0 mm	Nails, chipboard screws and plugs
Wood fiber cement boards	Thin steel profile plates min. 0.5 mm/Aluminium profile plates min. 0.6 mm/ Wooden substructures	Trim nail, galvanised/Ø: 3.8 mm Length: 25 and 32 mm
SD-4 shank	For use with: GPR Riveting tool / Gesipa Accubird	Hammer plug, nylon/Ø: 6.0 mm Length: 40, 60, 80, 100 and 120 mm
Installation without pre-drilling	Pre-drill in wooden and metal substrates: 7.0 mm	Asphalt nail, galvanised/Ø: 3.0 mm Length: 15, 20, 25, 30, 40 mm
18 mm	6,3 mm	Slate nail, aluminium/Ø: 3.4 and 3.8 mm Length: 40, 50, 60, 70, 80, 90 and 100 mm
76 - 178 mm	38 - 229 mm	Chipboard screw/Ø: 5.0 mm Length: 20 to 120 mm
Build-up + 55 mm		
- yes -	- yes -	

TOOLS

Bit-extender

Bit-extension piece for fastening of tubes

- Accessory for working in an up-right position
- To be used with screw gun ¼" recess
- To be used with battery-powered screw-gun
- Ergonomic
- Easy to use
- For use with all Guardian tubes over a length of 40 mm

Extender

HB-EXT-CON

- Accessory for working in an up-right position
- With SDS shank
- Lengths: 300, 500 and 750 mm
- To be used in combination with HB-CON drill

Woodstick

Accessory for working standing up with TS 5.2 - SP 40 combination and SPA 50 - BS 6.8 combination

- Application with (battery-powered) screw-gun
- 10 mm shank
- Ergonomic
- Easy to use
- Length 570 mm

Ergo-drill

Ergonomic extension piece for drills

- Drill accessory for drilling in an up-right
- To be used with drill fitted with Euroconus Ø 43 mm or DeWalt Ø 50 mm
- Ergonomic
- Depth setting

DRILLS & BITS

HB-CON

- Conical hammer drill with or without stopper
- Ø: 5.0 mm
- Effective drill depth:
- 25, 35, 45 and 55 mm
- For use in combination with: HB-EXT-CON 300, 500, 750, 1000

HB-SDS plus

- Hammer drill
- Ø: 5.0/5.2/5.5/6.0/8.0 mm
- Various lengths

Bits

Complete range in various dimensions and connections for all Guardian fasteners.

Lockin' Pocket

- Seal system for roof ducts
- Application on substrate: Modified bitumen, tpo/epdm, metal roofs
- Fast-drying, solvent free sealant Weather-Tite Hurricane Force®
- Prefabricated system
- Based on One Step Technology
- Watertight within minutes
- For use with: OS-BT battery tool

MACHINES & RELATED ITEMS

PP 260

Machine for fixing tube screw combinations while standing in an up-right

- Depth setting
- Easy to use
- Ergonomic
- To be used in combination with Guardian tube R 45, pre-assembled on strip
- Tube lengths 60, 90, 120, 150 mm, insulation thickness 70 to 260 mm

IF 240

Machine for fixing screw-pressure plate combinations while standing

- Depth setting
- Easy to use
- Ergonomic
- For use in combination with:
- Belted screws (DBTA 4.8), length 60 to 240 mm and SPA 8240 or SPA 7070

GPR

Tools for setting GPR Peel rivets

Scanner HDEXA
leak detection system

The HDEXA makes your smartphone a full sensor scanner

- RFID technology
- Reading distance up to 6 meters
- Bluetooth 4.2 (low energy) Class 2

IT belt

- Convenient bag for tubes and screws
- Ergonomic advantage
- Especially useful for TS-SP40 or SPA50 + BS 6.8

GuardianWeld™

Innovative induction welding device for fixing plastic roofing sheetsClass 2

- Work ergonomic with GuardianWeld™
- Induction welding device
- Light weight
- Robust and reliable machine
- Easy to handle

GWT™ Hand tool

Convenient induction welding device for fixing plastic roofing sheets

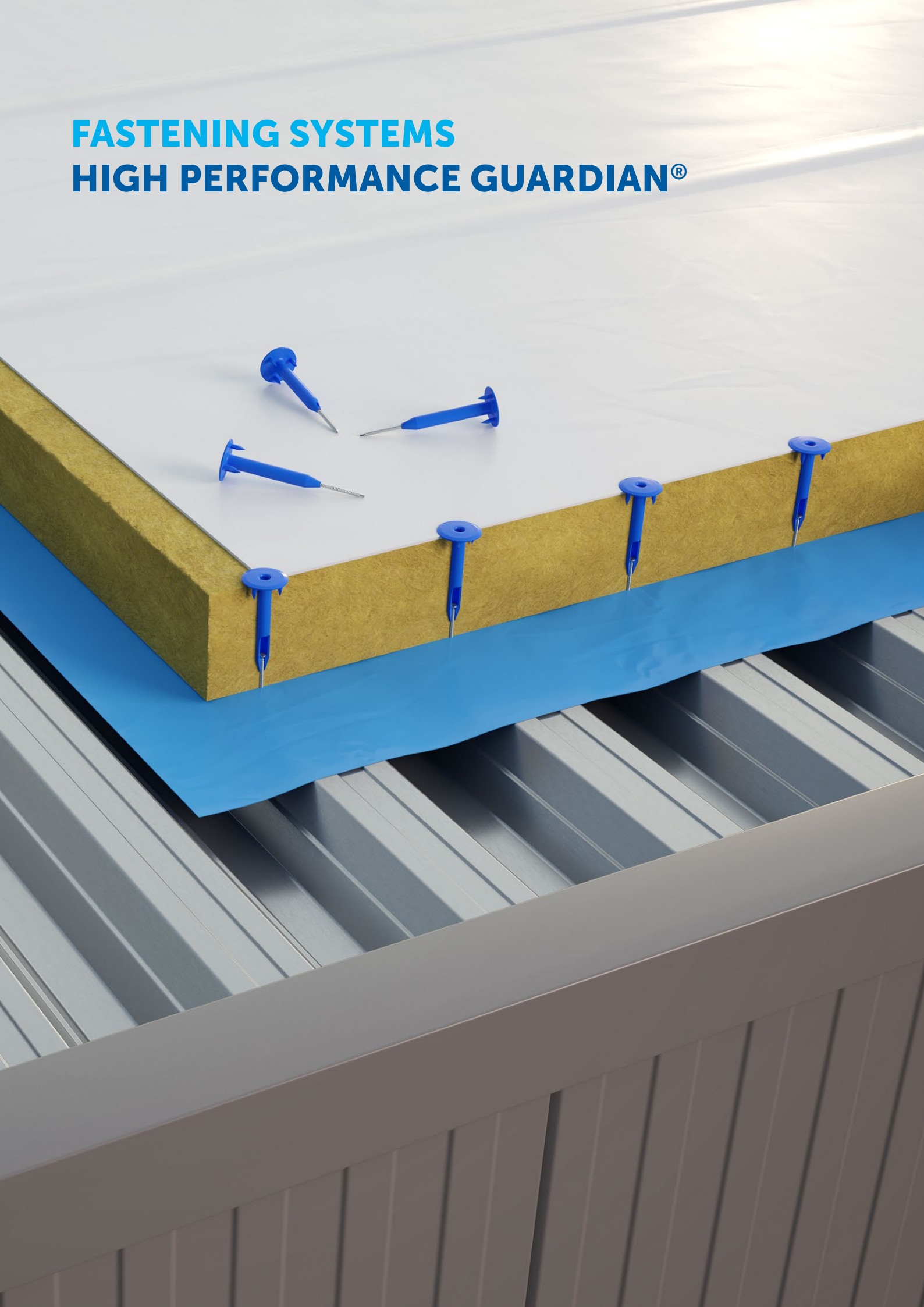
- Induction welding device
- Light weight
- Easy to handle

Sensor
leak detection system

The cable-free and battery-free sensors provide information to the scanner

- Wireless
- Fast
- Maintenance free

FASTENING SYSTEMS
HIGH PERFORMANCE GUARDIAN®



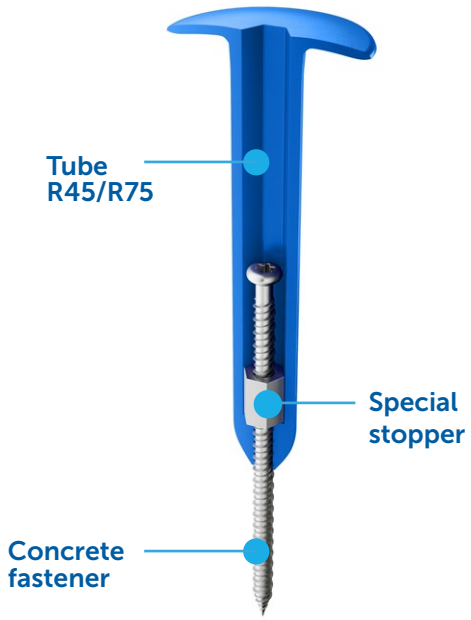
ASTL

Proven quality over 7 years

The fastener for tapered insulation, ASTL, is the tube screw combination, for the fixation of tapered insulation on concrete roof constructions.

Excellent for:

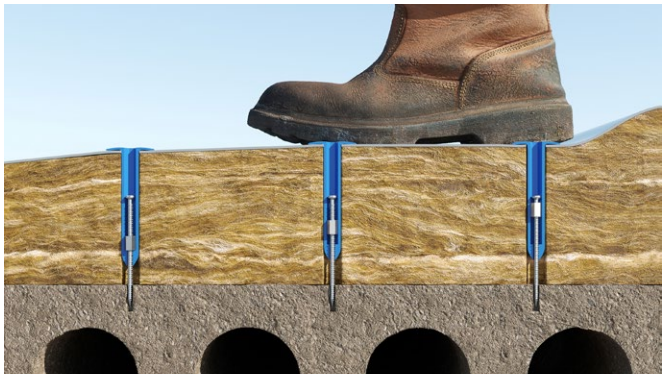
1. Tapered insulation
2. Fastening of roof systems on roofing constructions with height differences between the concrete floor slabs
3. Renovation projects with major differences in the existing roofing membrane/insulation thickness



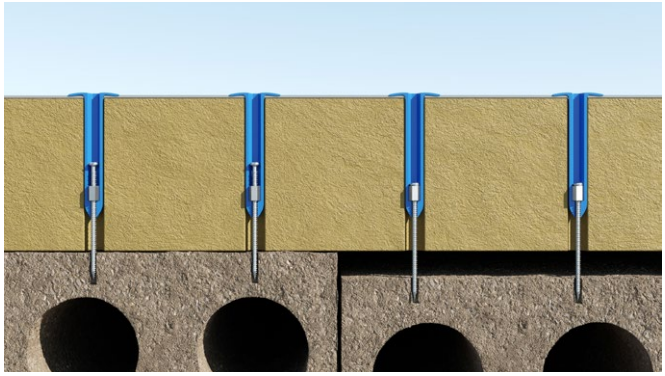
Unique advantages!

- 100 % step security with telescopic effect
- Two work steps: (1) drilling and (2) fastening
- Cover up to 110 mm of tapered insulation with a single length. Fewer lengths necessary in stock
- Speeds up and simplifies working on roofs with large height differences and renovation roofs with major differences in thickness in the existing roofing membrane/insulation
- Design load values of 600-800 Newtons!
- For insulation packages of 70 to 860 mm
- Pre-drill using Ø 5.0 mm drill with special stopper
- For use with Bit-Extender for working in an up-right position
- No drill dust in the drill hole
- Tube easy to push through the insulation

Application



- Fastener for tapered insulation
- Integrated telescopic effect makes it possible to push the insulation in (e.g. when walked on), without damaging the roof membrane.

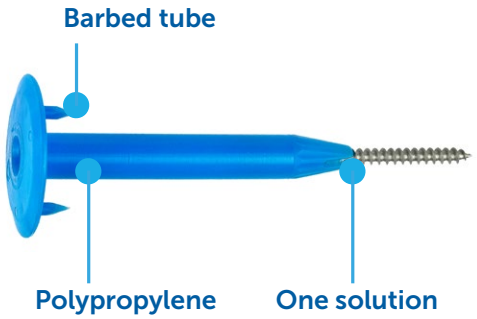


- Speeds up and simplifies working on roofs with large height differences between the concrete slabs.
- Accelerates and facilitates working on renovation roofs with large thickness differences in the existing roofing membrane/ insulation.

RB 48 (FM APPROVAL)

High performance tube for fastening of synthetic roof membranes in the overlap for a higher design load

- FM approvals
- Barbed tube for extra grip
- Uniquely high design load values
- Specially designed for synthetic roof membrane



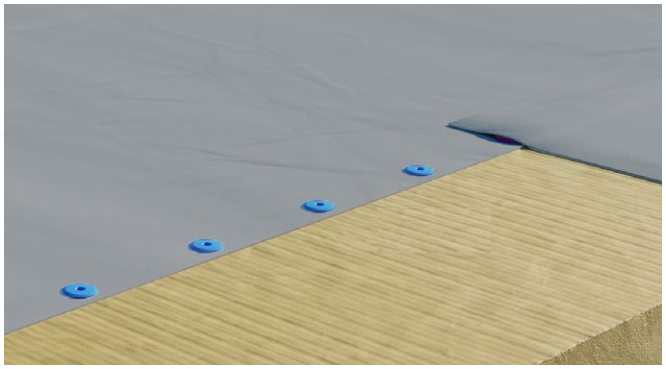
- Made of high-grade polypropylene
- Design load values up to 900 Newtons!
- Up to 45% fewer fasteners in comparison with standard systems
- Also available on request in slope (ASTL) variant.

Significant cost saving

- **Savings in material costs**
  Fewer fasteners per m^2
- **Savings in labour costs**
  Fewer fastening points, fast and easy fastening.
  See sample calculation on page 25

Curious about the advantages for your project?
Ask for a calculation!

Application



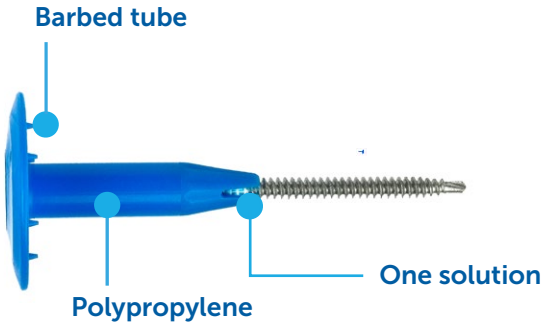
- Fastening of PVC roof membranes in overlap

- Fastening of TPO roof membranes in overlap

RBS 50

High performance tube for the overlap fastening of bitumen roof systems

- Barbed tube for extra grip
- Unique performance
- Specially designed for single and multi-layer bitumen roof systems



- Made of high-grade polypropylene
- **Design load values** of 600-930 Newtons!
- Up to 40% fewer fasteners in comparison with standard fasteners
- Also available on request in slope (ASTL) variant.

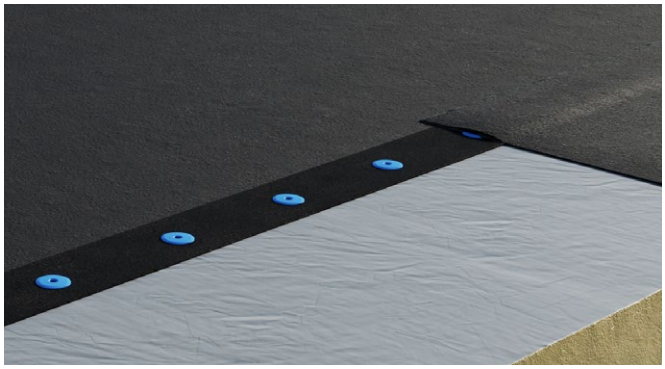
Significant cost saving

- **Savings in material costs**
  Fewer fasteners per m^2
- **Savings in labour costs**
  Fewer fastening points, fast and easy fastening.
  See sample calculation on page 25

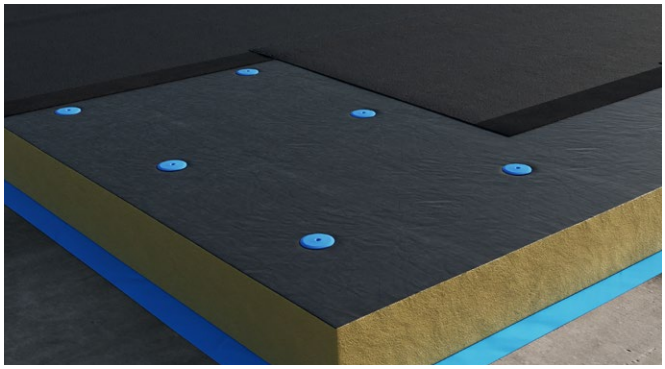
Curious about the advantages for your project?
Ask for a calculation!

Producer: Guardia
www.guardian.nl
ETAG 006
ETA 08/0285
FPC: 1071-CPR-15

Application



- Single and multi-layer bitumen roof systems in overlap



- Fastening of insulation and base layers

GUARDIANWELD™

Innovative induction welding system for fastening synthetic roof membranes

Induction technology is used to weld the bottom of a roof membrane on to specially developed GuardianWeld™ pressure plates with which there is no need to drill through the membrane.

Save up to 20% in costs!

- The number of fastening points is considerably smaller than with traditional, mechanical fastening systems;
  - Fewer thermal bridges, therefore less energy loss
  - Less material and labour costs
- Fewer and smaller overlaps of the roof membrane

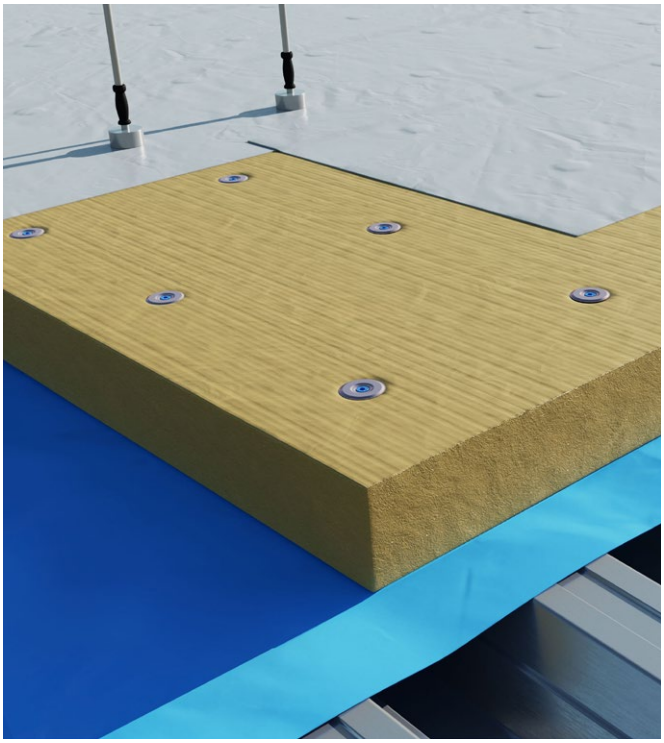
Other advantages

The fastening is made independent of the overlap, and you only need one (maximum) roof membrane width. The insulation layer does not need to be fastened separately.

The sealing/covering of the roof with roof membrane is independent of the progress of the roof membrane fastening. Aside from that, roofs are made watertight much more quickly and the application is much less dependent on weather conditions. When you work with the GuardianWeld system, you work ergonomically:

- Working in an up-right position with GuardianWeld
- Induction welding equipment
- Lightweight
- Easy to handle

For further information and processing instructions and video, visit www.guardian.nl



SAMPLE CALCULATIONS
HIGH PERFORMANCE GUARDIAN

Guardian offers a divers and complete range of uniquely performing pressure plates, tubes, and fasteners for the different roofing systems on the European market.

Choosing the right high-performance Guardian fasteners will save up to 45% on the number of fasteners needed for a roof. This gives roofers and OEM's options to save on material and labour costs.

To benefit fully from the performance of Guardian fasteners, and to support customers by offering optimum fastening solutions, we recommend that you make a wind load calculation for your project, or request one.

For more information, please contact us by telephone at:
+31 492 59 74 15 or at support@guardian.nl

Two sample calculations are given below, which clearly demonstrate that significant cost savings are possible by using high-performance Guardian fasteners.

Sample calculation - RB 48

Shipping warehouse

- Roof area 8,000 m²
- Wind area II
- Terrain roughness class II
- Steel roof 0.75 mm

Single-layer PVC roofing system

RBS 48 (high performance)

Design load: 864 N*
Number of fasteners per m²: 2,45

Number of fasteners required:
19 600

-49 %

Savings in
application costs: 49%
Savings in material costs
fasteners: 29%

Standard fastener

Design load: 450 N
Number of fasteners per m²: 4,80

Number of fasteners required:
38 400

Sample calculation - RB 50

Distribution centre

- Roof area 8,000 m²
- Wind area II
- Terrain roughness class III
- Steel roof 0.75 mm

Double-layer bitumen roofing system

RBS 50 (high performance)

Design load: 788 N*
Number of fasteners per m²: 2.23

Number of fasteners required:
17 840

-43 %

Savings in
application costs: 43%
Savings in material costs
fasteners: 23%

Standard fastener

Design load: 450 N
Number of fasteners per m²: 4.06

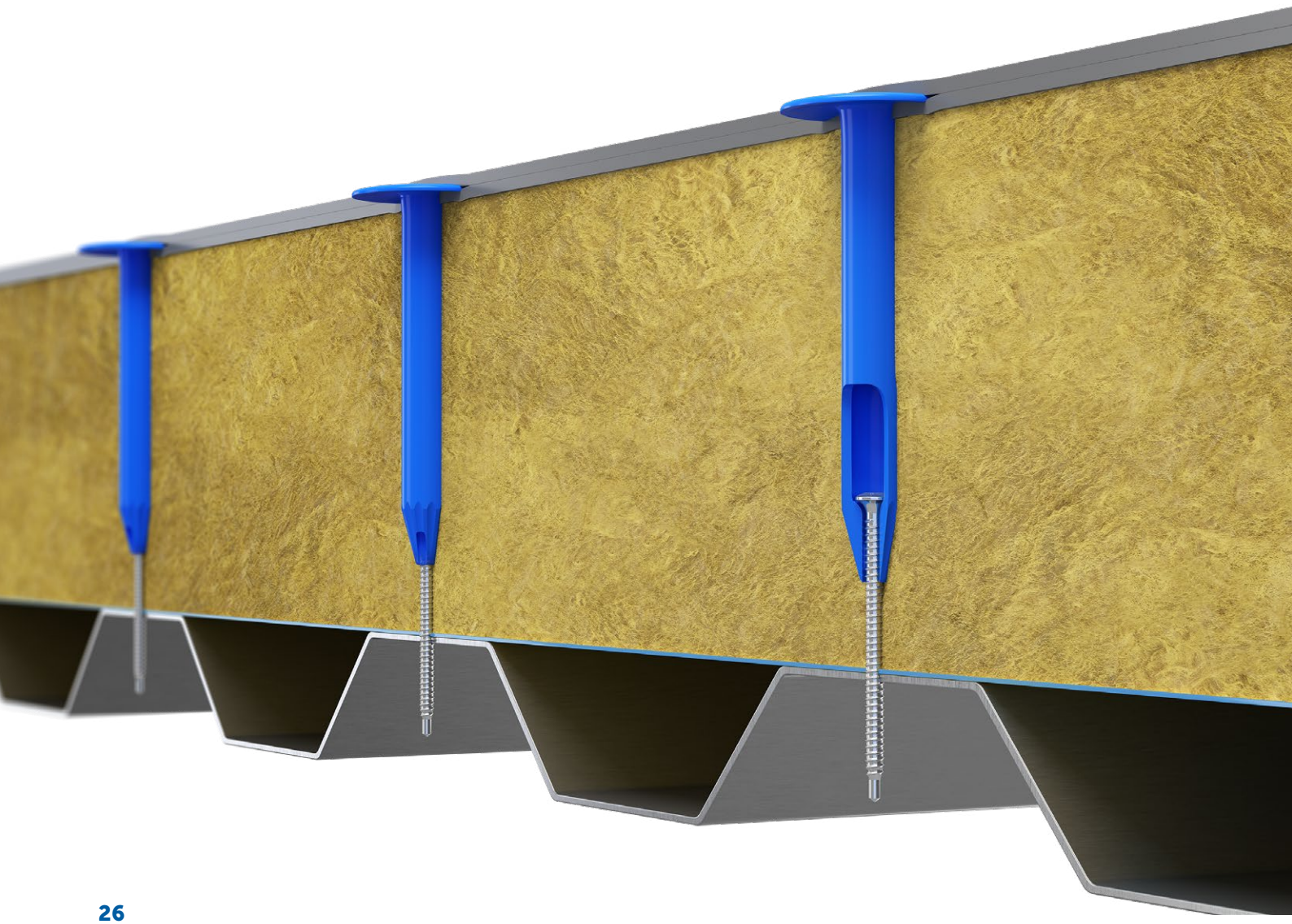
Number of fasteners required:
32 480

* Calculations on the basis of an official wind uplift test

ROOFING SYSTEMS & FASTENING SOLUTIONS

This chapter describes the most common mechanically fastened flat-roof systems, together with an overview of the efficient and durable Guardian fastening solutions for each system.

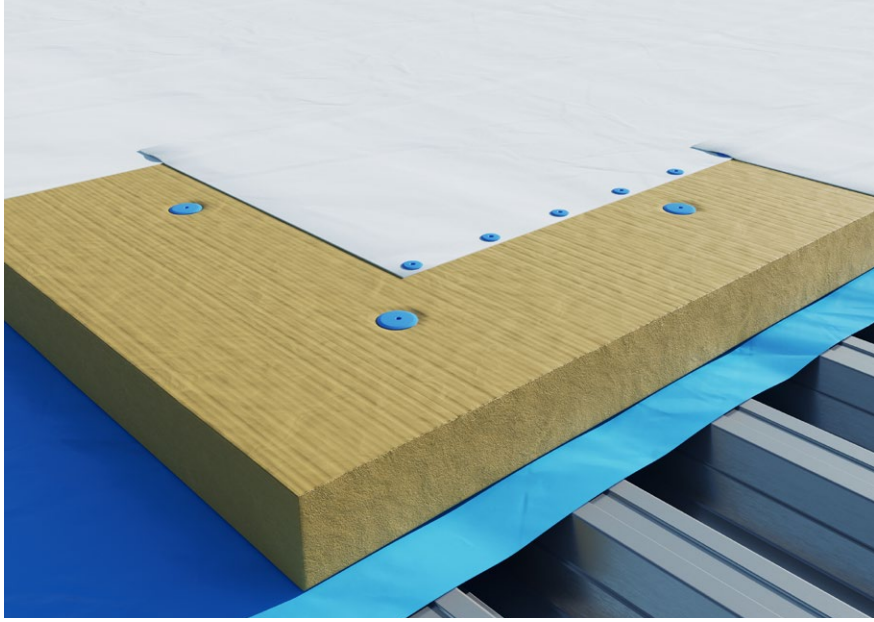
The European flat roof industry represents an annual volume of around 450 million m2. The ratio between synthetic and bitumen membranes varies from one country to the next. In many European countries, the market share of bitumen roof membranes still represents 60% or more of the total number of square metres. However, in most countries, a clear trend is visible towards a rising market share of synthetic roof membranes. Particularly involving large projects, such as distribution centres and warehouses, where synthetic materials are increasingly applied. The divers Guardian product range offers solutions for every roof build-up.



Mechanically attached single ply - synthetic roof membrane systems

Material
Reinforced PVC, thickness 1.2-2.0 mm
Reinforced TPO/FPO, thickness 1.2-2.0 mm
EPDM, thickness 1.1-2.1 mm

Common roof membrane widths:
1.0/1.5/1.6/2.0/2.1 meters



Mechanically attached single ply roof systems are applied on various building types, such as shopping centres, logistic centres, schools, hospitals, etc. 'Warm roof' constructions with an assembly made up of a structural roof deck, vapour barrier, insulation material, and covered with a synthetic roof membrane commonly used in the roofing market. The single ply reinforced synthetic roof membranes are applied with an overlap of approx 100/120 mm. The synthetic membranes are welded with hot air, with a 40-mm wide welding seam in the overlap. The remainder of the overlap, 60/80 mm, is used for the mechanical fastening of tubes that fasten the roof build-up to the roof structure. The producers of synthetic roof membranes manufacture their membranes in different widths. Wide rolls of 2 metres or more are used for roof zones with the lowest wind load. In perimeter and corner zones, smaller membrane widths are used to resist the higher wind loads in these zones better. The number of fasteners per m2 is determined by the actual wind load of the roof according to the European wind load standard EN 1991-1-4.

Guardian standard overlap fasteners for synthetic roof membrane systems
Design load values of 500-700 N/fastener
SP 40 membrane plate, flat and recessed design
SP 8240 membrane plate, flat and recessed design
R 45 membrane tube washer
SP 50 membrane plate, flat and recessed design
SPA 8240 membrane plate, recessed design

Guardian high-performance overlap fasteners for synthetic roof membrane systems
Design load values of 700-900 N/fastener
SPBA 8240 barbed pressure plate; rectangular For use with automatic setting tool
RB 48 barbed tube; round

Induction technology
GuardianWeld induction system for the fastening of PVC, TPO/FPO and EPDM roof membrane systems

Induction welding technology

An alternative to overlap fastening is the method with which the roof membrane is bonded to specially developed pressure plates using induction welding technology. In this case, the overlap width will be 60 mm. The pressure plates are not applied in the overlap but on the insulation material according to a predetermined pattern (field fastening) depending on the wind load.

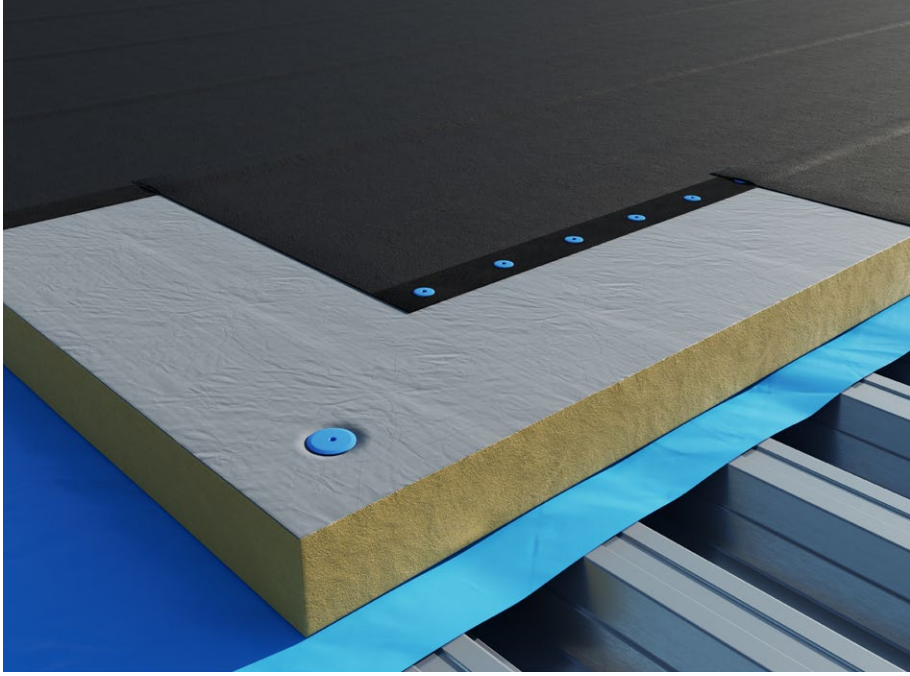
The membrane is then rolled out across the roof. Each plate is bonded to the bottom of the membrane using induction welding equipment (GuardianWeld), without perforating the roof membrane.

Guardian fastening solutions for synthetic roof membrane systems

Guardian offers a wide range of pressure plates and plastic tubes for the safe fastening of synthetic membrane systems, both on soft and hard substrates (insulation). The standard range of Guardian overlap fasteners has design load values of 500-700 N/fastener, depending on the type of membrane. The high-performance range from the Guardian range achieves design load values as high as 700-900 N/fastener. The design load values for each membrane - plate/tube combination has been determined on the basis of full-scale wind uplift tests according to EN 16002 testing method.

Mechanically attached single ply - bitumen roof membrane systems

Material
Reinforced SBS, thickness 3.5–5.5 mm
Reinforced APP, thickness 3.5–5.0 mm
Common membrane width: 1.0 m



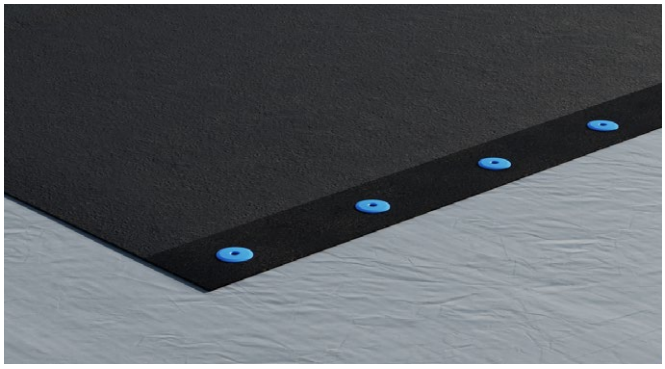
Mechanically attached bitumen single ply roof systems are used on residential buildings as well as on commercial and non-commercial buildings. Cold-roof systems with a wooden roofing floor, but mostly warm-roof structures made up of a roofing floor, (vapour barrier) insulation and topped with a single ply bituminous roof membrane, are often used in the Northern European market. An important feature of modern single ply bituminous membranes is that these are manufactured with a reinforcement of high-quality polyester. These roof membranes are normally installed with an overlap of approx 100 mm. The complete overlap is welded using a torch or hot air. The mechanical fasteners that are used to fix the roof build-up to the roof structure are integrated in the welded overlap. The most common membrane width is 1.0 m. The required number of fasteners depends on the wind load of the roof according to the European wind load standard EN 1991-1-4

Guardian fastening solutions for single ply bitumen based roof systems

Guardian offers a wide range of pressure plates, plastic tubes, and fasteners for the safe fastening of single-layer bituminous roof membrane systems, both on soft and hard substrates (insulation). The standard range of Guardian overlap fasteners has design load values of 450-650 N/fastener, depending on the membrane type.

The high-performance range of the Guardian assortment achieves design values of 650-850 N/fastener. The design load for each membrane-plate/tube combination is determined on the basis of full scale wind uplift tests according to EN 16002 testing method.

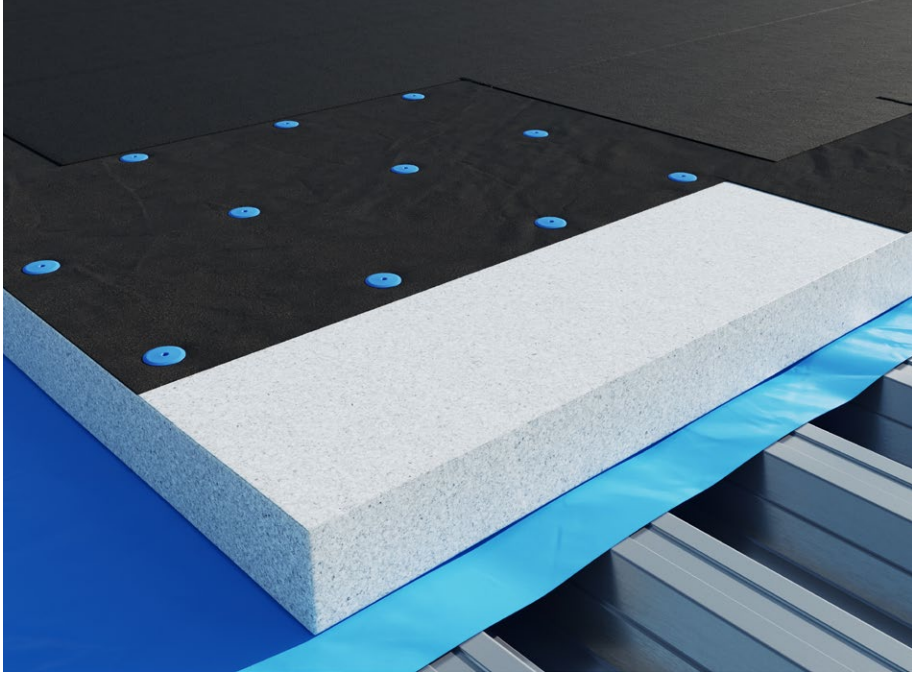
Guardian standard overlap fasteners for single ply bituminous systems
Design values of 450-650 N/fastener
SP 40 pressure plate; round, bottom side flat or recessed
SP 50 pressure plate; round, bottom side flat or recessed
SP 8240 pressure plate; rectangular, bottom side flat or recessed
SPA 8240 pressure plate; rectangular, bottom side flat or recessed, for use with automatic setting tool
R 45 plastic tube; round



Guardian high-performance overlap fasteners for single ply bituminous systems
Design values of 650-850 N/fastener
RBS 50 barbed plastic tube; round

Mechanically attached two layer - bitumen roof membrane systems

Material
Basic layer: Polyester-reinforced SBS or APP, thickness 2.5-3.0 mm (2500-3500 g/m2)
Top layer: Glass/polyester-reinforced SBS or APP, thickness 3.5-5.0 mm (4000-5000 g/m2)
Common membrane width: 1.0 m



Mechanically attached bitumen two layer roof systems are applied on residential buildings as well as commercial and non-commercial buildings. Cold-roof systems with a wooden roofing floor, but mostly warm-roof structures with an assembly of roof structure-vapour barrier-insulation and the multi-layer bituminous roof membrane system above that, are very common in the market.

The European roof membrane market has a wide variety of multi-layer bituminous systems. A distinctive feature of these systems is their base layer, which often has an improved polyester reinforcement compared to the traditional torch-on and bonded systems. This gives the membrane the required strength when tubes and pressure plates are used to fasten the build-up of the membrane system to the roof structure.

Guardian fasteners for multi-layer bituminous roof membrane systems
Design values of 700-900 N/fastener
Method 1
SP 70 membrane plate, flat and recessed design
R 75 standard tube
Method 2
SP-40
SP 50 pressure plate, flat and recessed design
R 45 standard tube
RBS 50 high performance barbed tube

There are 2 methods to mechanically fasten multi-layer bitumen roof systems

Method 1 Field fastening
The pressure plates or tubes are fastened in the base layer according to a predetermined pattern, independent of the overlaps of the base layer (field fastening). This is done in symmetrical patterns or in patterns adapted to the specific roof structure. When the base layer has been applied/installed, the top layer is then torched, or bonded with hot bitumen on the base layer.

Method 2 Overlap fastening
This method is widely used in Scandinavian countries. The plates or tubes are fastened in the 10-cm wide overlap of the base layer. The overlap is then torched in the same way as single-layer bituminous systems. The top layer is then burnt or bonded with hot bitumen on the base layer.

Guardian fastening solutions for multi-layer bitumen based roof systems

Guardian offers a wide range of pressure plates and plastic tubes for the safe fastening of multi-layer bituminous roof membrane systems, both on soft and hard substrates (insulation). The standard range of Guardian overlap fasteners has design values of 450-650 N/fastener, depending on the membrane type. The high-performance range of Guardian pressure plates and tubes achieves design values as high as 650-850 N/fastener. The design load for each membrane/plate-tube combination is determined on the basis of full-scale wind uplift tests according to the EN 16002 testing method.

Torch on / Pour & Roll single or two layer - bitumen roof membrane systems

Material
Base layer: glass-reinforced SBS or APP thickness 2.5-3.5 mm/m2)
Glass/polyester-reinforced SBS or APP thickness 2.5–3.5 mm/m2)
Top layer: glass/polyester-reinforced SBS or APP thickness 3.5-5.0 mm (4000-5000 g/m2)
Usual roof membrane width: 1.0 m

Torch on or Pour & Roll single or two layer - bitumen roof membrane systems are very common roof systems. The roof membranes are bonded onto the substrate. These systems are directly bonded onto the roof structure, for example on concrete, or on mechanically fastened insulation boards or underlayers (suitable for bonding).

The insulation boards are fastened to the roof structure by means of pressure plates or tubes. The required fastening pattern (number of fasteners per m2) is determined by the wind load of the roof according to the European wind load standard EN 1994-1-4.

Guardian fasteners for insulation boards and underlayers
SP 70 pressure plate; round, bottom side flat and recessed (thickness 0.70 mm)
R 75 tube

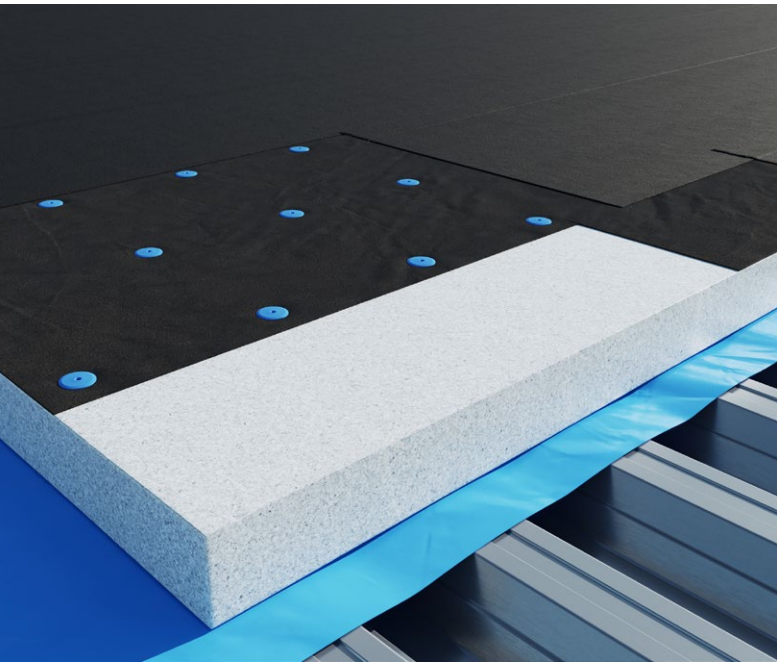
Adhered single-ply synthetic roof membrane systems

Material
PVC, TPO or EPDM, with or without lining on the underside.
Common roof membrane width: 1.0 m, 1.5 m, 2.0 m

Adhered single-ply synthetic roof membrane systems are popular in various European countries. Depending on the wind load and roofing system, the roof membrane is completely or partially glued onto the substrate. The systems are usually glued onto mechanically fastened insulation boards or underlayers, boards (suitable for gluing).

The insulation boards or underlayers are installed to the roof structure by means of pressure plates or tubes. The required fastening pattern (number of fasteners per m2) is determined by the wind load of the roof according to the European wind load standard EN 1994-1-4.

Guardian fasteners for insulation boards
SP 70 pressure plate; round, bottom side flat and recessed (0.70 mm)
R 75 tube



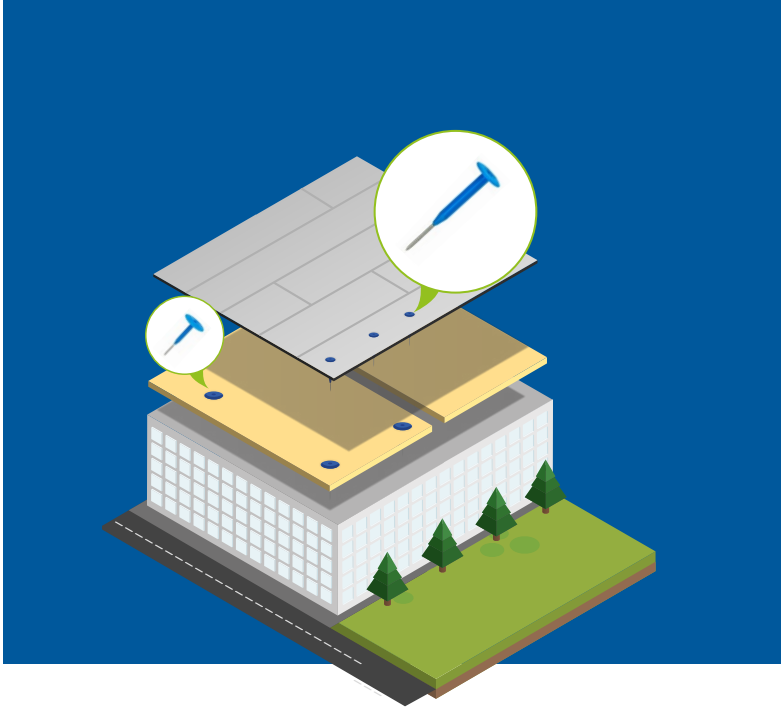
Insulation boards glued to roof structure

Insulation boards can be glued to the roof structure in various patterns depending on the wind load of the roof. Buildings with high humidity and high temperatures will benefit from insulation boards that are glued on the inside because this does not require fasteners that could penetrate the vapour barrier. For all other building types and roof structures, mechanical fastening of insulation boards using Guardian tubes and pressure plates provides a clear advantage compared to glued boards.

Advantages of mechanical fastening of insulation boards:

- Saves application time, especially when the insulation is made up of multiple layers
- Significant savings in application and material costs
- Application at low temperatures possible
- The substrate does not have to be completely dry
- It is possible to perform highly accurate wind load calculations
- Limited thermal bridges with plastic Guardian tubes

SYSTEMS
CIRCULAR CONSTRUCTION



The new circular economy revolves around the intelligent use of resources, products and commodities such that they can be reused over and over. A closed loop. For buildings for example, circular means that materials are reused. Guardian wants to contribute to this sustainable development.

To be able to use the various materials in the build-up of a roof circularly, mechanical fastening is the best (green) solution. The tube-screw combinations from Guardian can be disassembled (and are recyclable); they are easy to remove from the roof build-up. The Guardian tubes are made of polypropylene (PP). This material is not affected by moisture and also contains an anti-degradation filling, which makes the products very long-lasting compared to other ways of fastening the flat roof. Because our products can be removed from the roofing membrane and insulation, these components of the roof build-up are also recyclable.

When you choose Guardian products, you choose a completely removable and recyclable flat roof!

Aside from that, Guardian is starting production of tubes that contain 10% recycled material from old tubes and rejected batches. This percentage will increase further in the future.

After dismanteling, the screws and tubes must be separated, after which both products can be re-used if possible. If this is not possible, the tube and screw both will be recycled, with no new raw materials needed to be added to the production process.

Guardian is also an active partner in New Horizon Urban Mining. This is a network organisation with new and existing companies that believe in circular enterprise as the new economy. Together with other New Horizon partners, Guardian develops circular solutions in the whole building, among other things by making new connections, new forms of cooperation and highly targeted investments in technologically innovative solutions!

At Guardian, we look further than just making our own products more sustainable. It is important to us that the total build-up of the roof is built circularly. With the tube-screw combinations from Guardian, you can be ahead of this development!

Not affected by moisture

High impactpolypropylene and polyamidematerial (PP, PA)

Not subject to degradation

Guardian R45, RB48, R75

Removable = circular

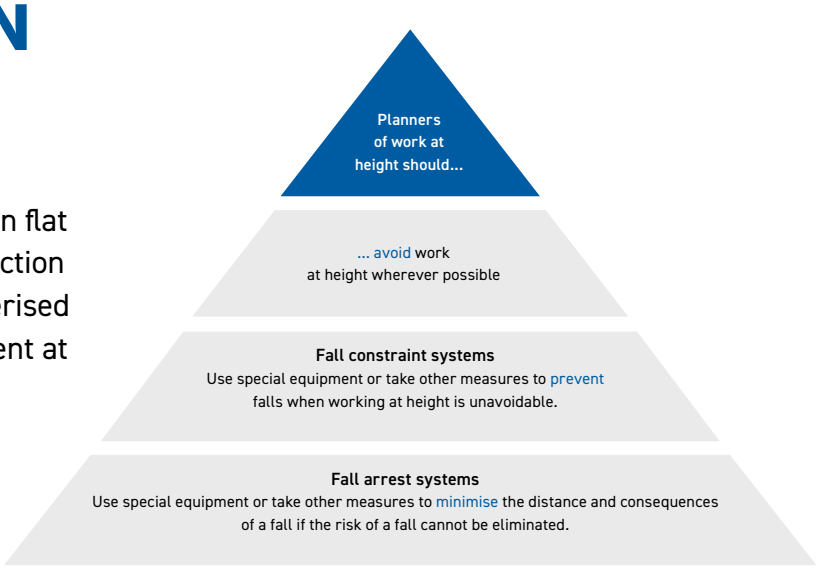
100% recyclable material

Mechanical fastening Steel, concrete, wood

NewHorizon

SYSTEMS
FALL PROTECTION

Guardian stands for protection, safety.
We want to contribute to working safely on flat roofs, our area of expertise. The fall protection systems offered by Guardian are characterised by high quality and continuous development at a competitive price.



The extensive knowledge and experience we have gained in developing our fastening solutions for flat roofs has helped us to develop these systems for working safely at height.

Alongside systems for horizontal applications, we also offer solutions for vertical systems and overhead applications. Guardian also provides comprehensive technical support such as installation assistance and on-site training.

Every year, 6,300 people report to a first-aid post after a fall from height during work. Some 20% (1,200) have to be admitted to hospital, and 3% (36) die. Our goal is to reduce these numbers as much as possible.

A well-known safety rule at locations where work at height is carried out is:

'Try to avoid working at height wherever possible!'

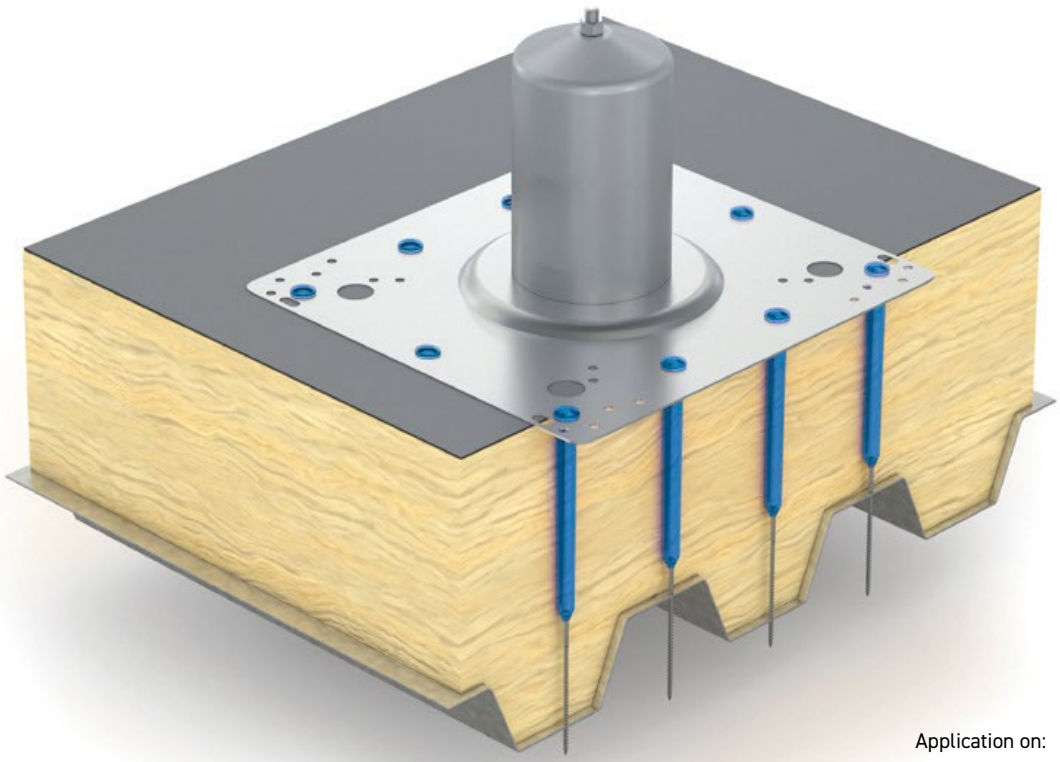
We must try to minimise the risks together. Current legislation and regulations stipulate that the best thing to do is use systems for 'workplace limitation' when working on roofs. The purpose of the fall protection systems offered by Guardian is to reduce the risk of falling to a minimum.

Fall arrest systems

Fall constraint systems

Structure of steel, concrete and wooden roofs

The fall protection systems we offer and apply are suitable for all sorts and types of flat roofs.



Application on:
Steel deck

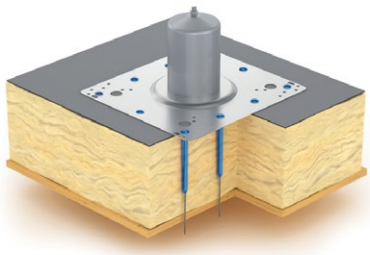
Special tube-screw combinations

For extremely fast fastening in concrete, steel and wooden roofs.

GWT tube
Made of modified PA
Available in length 60 mm to 330 mm

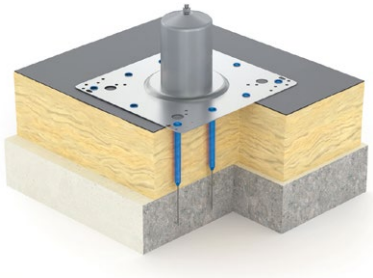
Insulation anchor point on flat roof

OSB/Plywood 18 mm



Insulation anchor point on flat roof

Concrete slab



ROOF SYSTEMS
LEAK DETECTION

Detect water on time and prevent water damage in the building with the sensors and scanner from Guardian.

The Leak Detection system has two components: the water detector (the sensor) and a handheld device (the scanner). The two units can communicate through various layers of the roof build-up. This system is based on RFID technology, which has the major advantage that the sensors do not need batteries.

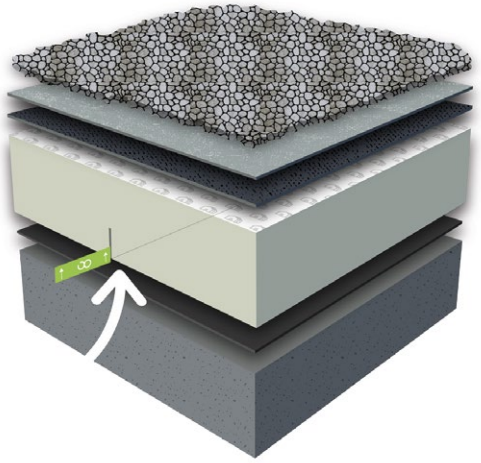
Handheld device - (the scanner)

The water detector - (the sensor)

The smart roof

Guardian is happy to work with you to create new and innovative solutions and products for a smart roof. Leak Detection is a perfect example of a product that helps you prevent damage: intelligent detection!

Protect your roof with the Leak Detection system from Guardian. Our expert employees are ready to help with additional information! Call +31 (0)492 597400 or send an e-mail to info@guardian.nl.



Installing system

First of all, you need to cut a groove of at least 100 x 30 mm in the underside of the thermal insulation. The edge of this groove must be cut at an angle on both sides with a knife. Place the sensor in the groove.

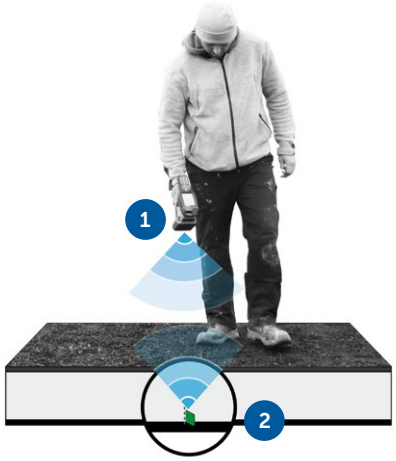
Finding a leak quickly and easily

After the installation, the sensors are ready for use immediately.
The number of sensors per project depends on many factors. This will often be 1 per m2 to 1 per 4 m2. We will be happy to advise you about this!

During a roof inspection or maintenance, you can easily read out the sensors with the scanner. With the long scanner range of about 6 m, a roof inspection is a piece of cake. You literally look through the roof.

What if you find a leak? The scanner will guide you to the precise location! The system is very user friendly and can be used and read-out by anyone. How long do the sensors last? As long as you need to protect your roof.

The system can be used in any traditional roof system. Ballast layers of tiles or gravel are no problem for the system. If you are planning to install a green roof, contact us about the possibilities.



Warm roofs	100 %
Ballast roofs	100 %
Roofs with solar panels (advice based on roof drawing)	100 %

CERTIFICATION & APPROVAL

Since July 2013, new European regulations for construction products are in force, with a mandatory CE marking for products covered by a harmonised standard and a voluntary CE marking for products covered by a European Assessment Document (EAD) (formerly ETAG (European Technical Approval Guideline).

The European NANDO database contains more than 550 harmonised standards for the various construction products. The European regulations for construction products are applied in the same way in all 28 member states, as well as in Norway, Liechtenstein, Switzerland, and Turkey.

Mechanically fastened, flexible, waterproof systems are not covered by a harmonised standard but by a European Assessment Document (EAD) (formerETAG 006). Based on the EAD 030351-00-0402 guidelines, the products are tested, the production process monitored, and then approved/certified in a European Technical Approval (ETA). When a manufacturer obtains an ETA certificate, he is obliged, according to the European building regulations, to provide the packaging of the certified products with a CE marking. In addition, a Declaration of Performance (DoP) has to be made available for these products. Guardian has DoPs available on the website: www.guardian.nl.

For flat-roof fasteners, it is very important that these products are tested according to the EAD 030351-00-0402 guideline. For each product, the performance and test results are stated in the ETA/DoP. The characteristic values for the fasteners, in combination with pressure plates and tubes, together with the wind uplift tests, determine the design load that is used for a wind load calculation according to EN 1991-1-4.

Guardian ETA-08/0285 represents 40 different products and offers fastening solutions for all types of roof structures. The different performance levels, including unique characteristic values for steel, concrete and wooden constructions, make it possible to choose the optimum fastener for each project.

Sintef

SINTEF is an independent Research organization, founded in 1950. SINTEF creates value through knowledge generation, research & innovation and develops technological solutions that are put into practice. Many of the Guardian products also have a SINTEF certification. See the product overview for the certifications achieved per product.

Producer: Guardian
www.guardian.nl
ETAG 006
ETA 08/0285
FPC: 1071-CPR-1510

FM APPROVAL

FM Approvals is one of the highest possible quality marks for risk reduction and damage prevention. It is issued by one of the biggest insurers in the industry worldwide: FM Global. This is how it works and what their quality mark means.

What is FM Approvals?

FM Approvals is the quality mark issued by FM Global for products that comply with the high demands FM Global makes. One of the requirements for taking out an insurance with FM Global is that the materials used for a building to be insured are FM Approved.

As one of the major property and real estate insurers in the world they want to have the certainty that anything they insure is of the highest possible quality. As a result, they reduce the chance of damage and eventually the chance of having to pay damages.

Constructing a building with FM Approved products is therefore favourable for the owner as well as for the insurer. These products are thoroughly tested by FM Approvals for construction safety, fire, wind load, etc.

How does this test work?

To get a product FM Approved, we need to go to the United States for the tests to be performed by FM Approvals exclusively in its own laboratories. For us, this is the location in Boston, where they have their wind laboratory.

There, the mechanical fasteners (manufactured by us), synthetic membranes and roof insulation (from other manufacturers) are tested in a system structure by FM Approvals and us together.

We send them the materials, we build the tests, and then we check the products on site, in cooperation with FM Approvals. This is one of the conditions FM Global has set to be able to guarantee the quality measured.

Once a product has passed the FM Approvals test, it is entitled to be called FM Approved, which is evidenced by the quality mark: the letters 'FM' in a diamond printed on the product or on the label of the pack.

FM
APPROVED

FM approvals

For an overview of all current Guardian fastening products in combination with various types of roof membranes with FM Approvals, look at the overview provided or visit our site: www.guardian.nl

All approved systems are in the Roofnav database.

DESIGN LOAD
WIND LOAD CALCULATIONS

To define the (system) design load for a mechanically fastened roofing system, it is important to study the strength of the various components.

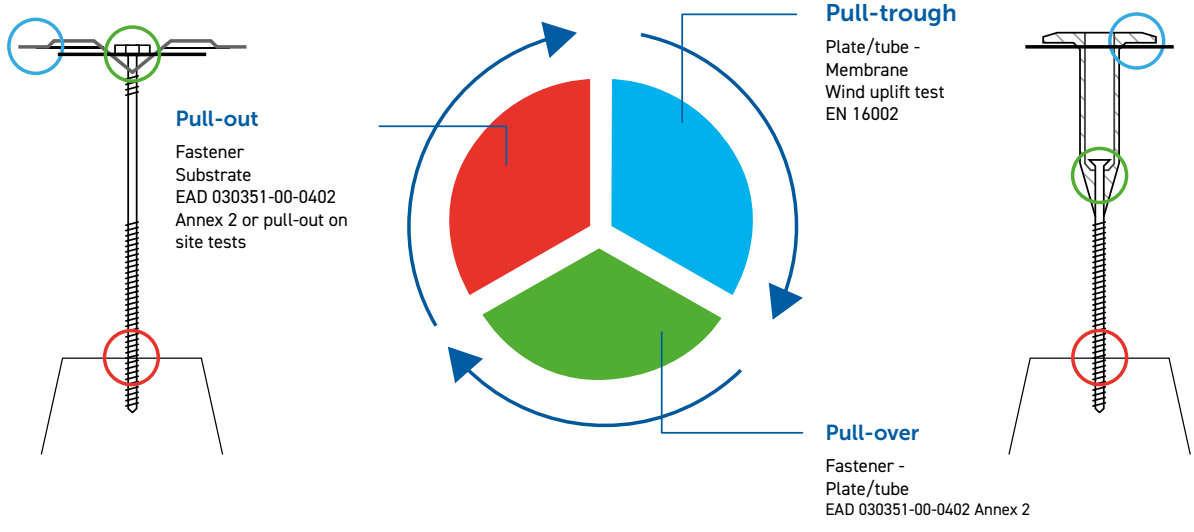
The weakest link determines the (system) design load. The characteristic value of the fastener is obtained from the Guardian ETA-08/0285. The characteristic value of the roof membrane and the tube or pressure plate is obtained by means of full-scale wind uplift tests according to EN 16002.

Always use the lowest design load (W_{adm}) when the pull-out, pull-through and pull-over values are to be compared.

W_{adm} = W_{char} / Y_m
W_{adm} = Design load
γ_m = Safety factor varies for each substrate and testing method
W_{char} = Characteristic load

It is important to compare the following values (see drawing):

- Pull-out strength of the fastener and substrate; small-scale test EAD 030351-00-0402 Annex 2.
- Pull-through strength between plate/tube and roof membrane, full-scale wind uplift test EN 16002
- Pull-over strength between fastener and plate/tube, small-scale test EAD 030351-00-0402 Annex 2.



The weakest link determines the (system) design load value

Example

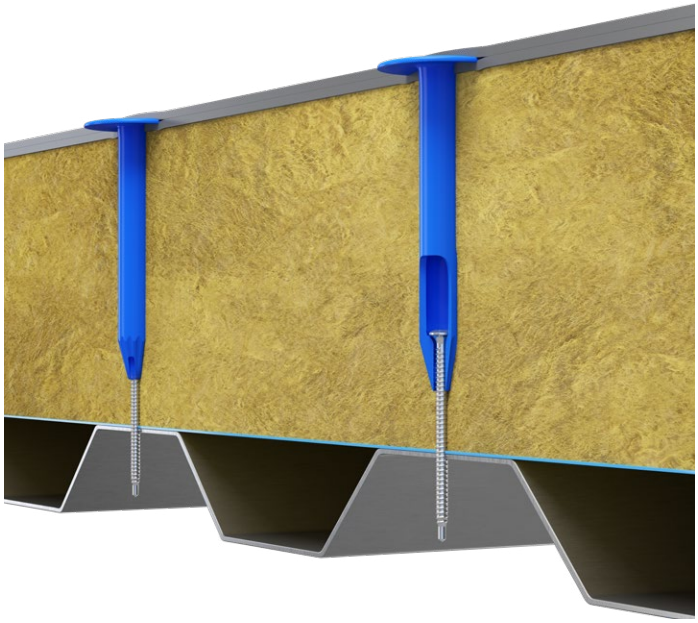
Roof membrane PVC 1.2 mm
Plate/tube: Guardian RB-48

Full-scale wind uplift test EN 16002, W_{char}: 1200 N
γ_m = 1,5
Design load: W_{adm} = 1200/1.5
Design load: W_{adm} = 800 N

Substrate: Steel deck 0.75 mm
Fastener: Guardian BS 6.1

Characteristic value, W_{char}: 1780 N
γ_m = 1.70
Design load: W_{adm} = 1780/1,70
Design load: W_{adm} = 1047 N

Compare
Design load 800 N vs Design load 1047 N
System design load = 800 Newton



Example

Safety factor γ_m	Type of testing method	γ_m value
γ_m Pull-through strength between plate/tube and roof membrane, full-scale test	EN 16002	1,5
γ_m Pull-over strength between fastener and plate/tube	ETAG 006 Annex 2	1,5
γ_m Steel > 0,7mm	ETAG 006 Annex 2.1	1,7
γ_m Concrete	ETAG 006 Annex 2.1	2,0
γ_m Wood	ETAG 006 Annex 2.1	2,0

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