INNOTECH
HOW YOU PROTECT LIVES

PLANNING & STATICS

The reference work for planning and statics. This booklet provides an overview of how the forces affect the safety system and the substructure in the event of a fall.

After a general introduction to the topic of calculation bases, the subject as it applies in particular to the AIO lifeline system, the IND lifeline system, and the TAURUS rail system is dealt with succinctly.

Find out more about the rated load, and discover useful information about the load tables, equipment classes, and determination of length. Industrial safety is a matter of quality and not of quantity. This has been INNOTECH®'s philosophy since the company was founded. For this reason we invest a large part of our revenue in our in-house product development, allowing us to keep our finger on the pulse of time and thus to improve and optimise our quality standards.

This is how our safety solutions always provide the maximum level of industrial safety. All fall protection equipment, i.e. all INNOTECH® products are certified to the latest state of the art. For this, the products are subject to continuous series of tests in our in-house testing laboratory at our headquarters in Kirchham, Austria.

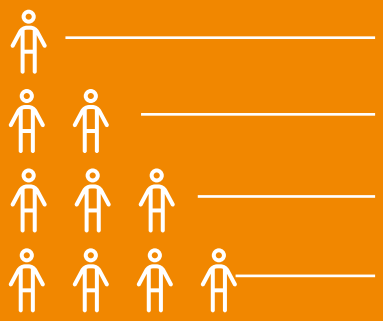
Calculation bases

General

The critical loading of the system (effect) results from the fact that the user must be equipped with PPE having a maximum fall arrest load of 6 kN.

This is also described in item 7b of the governing standard EN795:2012.

Accordingly, the following characteristic effect results, depending on the number of users:



6 kN (dynamic)	**= 6 kN**
6 kN (dynamic) + 1 kN (static)	**= 7 kN**
6 kN (dynamic) + 2 kN (static)	**= 8 kN**
6 kN (dynamic) + 3 kN (static)	**= 9 kN**

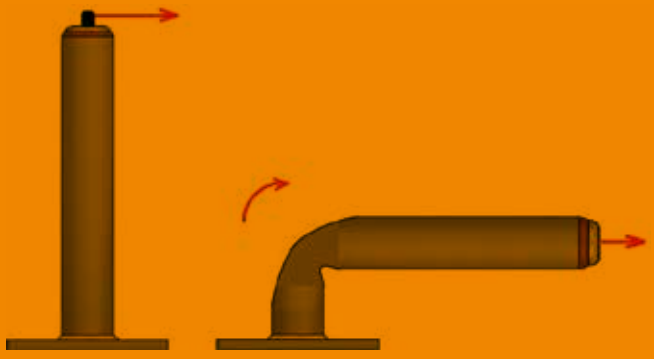
This effect acts on the respective anchor point. With single anchor points (EAPs), force dissipation takes place through the anchor point and the respective INNOTECH® product, directly into the base or substructure.

With the lifeline system (AIO lifeline system), the load introduced to the anchor point is transferred through the cable run to the anchor points or guide points of the AIO lifeline system. Due to the cable geometry and the components used in the lifeline system for energy absorption, the effects on the anchorage points (end/corner points of the system) vary. See page (currently 7), Load Tables for AIO (lifeline system).
The values stated for characteristic effect (as per Eurocode) have been verified in live tests on the respective predominant substructure. For this, the substructures were replicated in the test lab and tested in each case at the lowest values for load-bearing capacity.

An application of the characteristic comment through partial safety factors (e.g. "exceptional event = 1" as per Eurocode) was not intended by INNOTECH®. This is the responsibility of the engineer who makes further use of these values for the verification of the respective substructure. This is intended to avoid an arbitrary accumulation of safety factors, since the load in this case is a dynamic load introduction (pulse duration 200 ms) that can in no way be compared to a normal static load.

Rated load for STA universal posts

Since, due to the post's construction, the arrest process loads the post well beyond the limits of elasticity, the calculation must take into account the elastoplastic material behaviour.



A permanent deformation of the components after the load is a guarantee of high energy absorption and reduced load transfer into the substructure.

This material behaviour causes a certain amount of energy dissipation (comparable with the crumple zone in a motor vehicle) in the component, thus contributing to the reduction of the effect in the fastening substructure. The plastic deformation factor is assumed to be approx. 2 kNm for INNOTECH® STA products. This applies to all STABIL and AIO STA products (regardless of length). The characteristic effect in the case of purely static load (e.g. 4 persons are hanging from the system) is in any case always less than the respective underlying deformation factor.

Calculation bases

AIO lifeline system

The following specifications and conditions are prerequisites when considering the AIO lifeline system:

- 6 to 15 m cable span between the anchor points
- AIO 8 mm cable made from material 1.440
- The maximum dynamic effect per person is restricted to 6 kN by the strap fall attenuator
- Load from 4 persons: 6 kN (dynamic) + 3 x 1 kN (static) = 9 kN
- Force introduction into a mobile anchor point in the middle of a span length (worst case scenario)
- load-bearing substructure

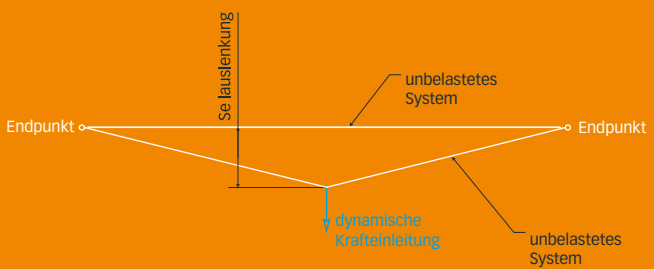
With some INNOTECH® products which are used as end or corner points, the use of a force absorber integrated into the cable system is prescribed. This is expressly specified in the AIO load tables (see page 7). By means of plastic deformation, the force absorber is intended to absorb some of the energy released in the fall, and thus to reduce the loads transferred into the substructure. The following INNOTECH® products are used as force absorbers in the AIO lifeline system:

- INNOTECH SHOCK-10
- INNOTECH SHOCK-11

Since this is a theoretical model of the AIO lifeline systems, the force situation may in practice differ accordingly. Here the following influencing factors may be stated:

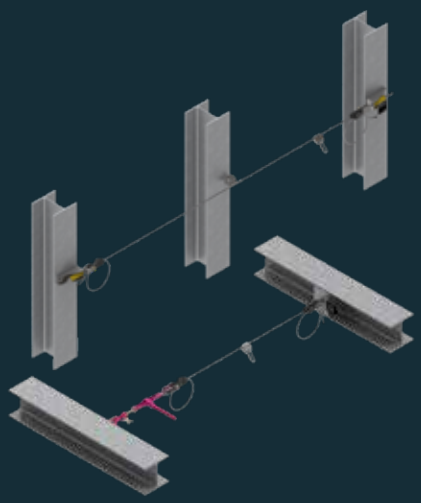
- Cable pre-tension
- Damping properties of the anchor points
- Characteristics of the roof structure
- Lengths of cables or cable sections
- Friction in the corner pass-through elements
- Fall behaviour of the person who falls

Accordingly, the maximum effect of 9 kN (4 persons) to be expected in the lifeline system acts on the mobile anchorage point(s) and is transmitted via the cable into the anchorage points. The effects arising here, which are also transmitted to the substructures, are listed in the AIO load tables (see page (currently 7)).



IND lifeline system

We developed our own special lifeline system with a cable diameter of 10 mm for industrial applications. It is used in all cases in which the attachment is made to massive steel girders. The IND lifeline system is always attached directly to the substructure. The cable deflection caused by the fall is restricted to 200 cm. This value applies regardless of the length or the fastening spacings of the lifeline system. Force-absorbing elements are already integrated into the cable end elements. The cable guides between the end points may become compressed (see test report). This simplifies pre-tensioning the individual cable sections during installation, and a higher pre-tensioning of the cable can be chosen. The advantages of this are a lower cable sag and reduced cable deflection in the event of a load. The fastening distances can be extended on request.



TAURUS rail system

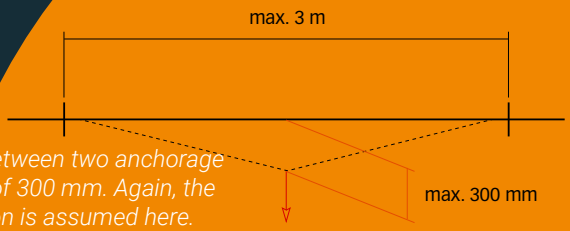
The following specifications and conditions are prerequisites when considering the TAURUS rail system:

- Maximum fastening spacing of the rails 3m
- The maximum dynamic introduction of force per person is restricted to 6 kN by the strap fall attenuator.
- Introduction of force into a mobile anchorage point: max. 4 persons per 10 m rail length
- Load-bearing substructure

Since this is a theoretical model of the TAURUS rail system, the force situation may accordingly vary in practice. Here the following influencing factors may be stated:

- Area of application (horizontal, vertical, overhead application)
- Damping properties of the anchor points
- Characteristics of the substructure
- System layout (straight or curved rail run)
- Fall behaviour of the person who falls

A fall directly at an anchorage point is seen as the worst-case load in the TAURUS rail system. Since, in this case, only one person can be connected to a mobile anchor point, a characteristic effect of 6 kN applies.



The level of the plastic deformation between two anchorage points is assumed to be a maximum of 300 mm. Again, the fall of a single person in this rail section is assumed here.

Load tables

Anchor points

Product name	Max. persons permitted	Rated load		
		Force [kN]	Deformation factor [kNm]	Dlbt
STA-10 + UNI-EAP-10-25	4		2	x
STA-12 + UNI-EAP-10-25	4		2	x
EAP-POINT-11	3	8		
EAP-POINT-12	3	8		
POINT-15 + UNI-EAP-10-25	3	8		
QUAD-11 + UNI-EAP-10-25	3	8		x
QUAD-13 + UNI-EAP-10-25	3	8		x
UNI-EAP-10-25	3	8		x
EAP-SPAR-11	3	8		
EAP-SPAR-15	1	6		
EAP-LOCK	2	7		x
EAP-SLING-11	2	7		x
SAND-01-A2 + UNI-EAP-10-25	3	8		
SAND-13-A2 + UNI-EAP-10-25	3	8		
FALZ-45 + UNI-EAP-10-25	3	8		
SYST-01 + UNI-EAP-10-25	3	8		
SYST-04 + UNI-EAP-10-25	3	8		
SYST-20 + UNI-EAP-10-25	3	8		
EAP-INDUSTRY-11	3	8		
EAP-INDUSTRY-19	3	8		
EAP-INDUSTRY-31	2	7		
SDH-31	2	7		
SDH-32	2	7		
SDA-35	2	7		
SDH-INDUSTRY-31	1	6		
SOPV-K2-EAP-SET-10	2	7		
SOPV-NOVO-EAP-SET-10	2	7		
ABP-10-30	3 (in use as single anchor points)	8		
VARIO-45 + UNI-EAP-10-25	1			
QUAD-30-300 + UNI-EAP-10-25	1			

*counts as cable-supported access technique. If Innotech ABP-10-30 is used as an abseiling eye, then the designated anchorage point must have an inherent stability greater than 400kg.

AIO (lifeline system)

Product name	Max. persons permitted	Max. field length [m]	Rated load		Max. cable deflection [cm]	SHOCK absorber°	DIbt[1]
			End point [kN]	Deformation factor [kNm]			
STA-XX	4	15		2	see table		x
STA-12 + BEF-210-A2	4	15		2	see table	2x	x
AIO facade	4	7.5* 15	22 25		see table		x
AIO BEF-411	4	10	20		105		
AIO BEF-810/-811	4	15	18		270	1x (2x)	
AIO BEF-830/-840	4	15	22		220	1x (2x)	
SAND-01-A2	4	7.5	17		80		
SAND-13-A2	4	12	15		200	1x (2x)	
FALZ-45	4	7.5	12		80		
SYST-01	4	7.5	17		80		
SYST-04	4	7.5	17		80		
SYST-20	4	12	20		125		
VARIO-45	2	10	-		350	1x (2x)	
KIT BOX (on STA-XX universal post)	4	15		2	330		
KIT BOX	4	7.5*	13		150		
TEMP	4	20	22		300		
AIO-IND-10	4	15	25		200	integrated	
AIO-IND-10-TEMP	4	7.5	25		120	integrated	
AIO-BKS	4	12	12		270	1x (2x)	
AIO-QUAD-13-END-600	4	15	12		305		x
SOPV-K2-AIO	2	7.5			150	1x (2x)	
SOPV-NOVO-AIO	2	7.5			150	1x (2x)	

* Field length recommended by INNOTECH, ° Straight cable span = 1x shock absorber. Cable span including curve = 2x shock absorbers
Lifeline system – not passable = no shock absorber (integrated into end lock) [1] All products with DIBt must be planned to use SHOCK-11.

AIO on STA-XX with post length l ≥ 600 mm

	Field length [m]				
	5	7.5	10	12	15
Cable deflection [cm]	165	195	225	260	285

AIO on facade

	Field length [m]				
	5	7.5	10	12	15
Cable deflection [cm]	55	75	87	100	120

Equipment classes

General

Category of use / Use and maintenance intensity → Professional group (groups of persons) ↓	A > 5 years Use and maintenance interval: very modest	B 2 to 5 years Use and maintenance interval: modest	C < 2 years Use and maintenance interval: moderate (e.g. snow clearing, ventilation maintenance, solar panels, etc.)	D Several times per year Use and maintenance interval: work at height even in bad weather and in the dark
Roof professions People who are trained in dealing with the set-up of temporary fall protection systems and cable protection. e.g. roofers, plumbers, carpenters, steel constructors,...	Equipment class 1	Equipment class 2	Equipment class 2	Equipment class 3
Atypical roof professions People who are trained in dealing with cable protection. e.g. ventilation engineers, gardeners, equipment engineers, installers, chimney sweeps,...	Equipment class 2	Equipment class 2	Equipment class 3	Equipment class 3
Private users People who not are trained in dealing with cable protection. e.g. building owners, tenants, domestic staff,...	Equipment class 3	Equipment class 3	Equipment class 3	Equipment class 3
Everyone Public pedestrian traffic e.g. in playgrounds, underground parking, generally accessible roof terraces, public buildings,...	Equipment class 4	Equipment class 4	Equipment class 4	Equipment class 4

Safety

with

Equipment class 01

Anchorage devices with single anchor points; permitted also for temporary use if there is a simple installation option

Lighting elements installed flush with the roof covering are to be secured against fall-through (e.g. plastic translucent corrugated sheets, the components of which are often difficult or impossible to recognise, because of dirt, snow, etc.)

Access to the roof surface via permanently installed roof access or via the building (e.g. internal or external steps, ladder with back and/or climbing protection). The use of simple ladders without additional measures is permitted up to a fall height of 5 m.

Equipment class 02

Anchorage devices with horizontal guides (e.g. lifeline systems, rails) as protection against fall. Supplementary anchorage devices with single anchor points may be permitted and/or required.

Lighting elements must generally be secure against fall-through (at least SB 300 as per EN 1873:2006)

Access to the roof surface via permanently installed roof access or via the building (e.g. internal or external steps, ladder with back and/or climbing protection); the use of simple ladders without additional measures is permitted up to a fall height of 5 m.

Electrical connection option in the maintenance area for use categories C and D

Equipment class 03

At fall edges, pedestrian traffic routes and workplaces are to be provided with collective protection devices (side protection of 1 m height as per EN13374).

Roof areas of lower equipment class are to be permanently and clearly visibly enclosed.

Access to the roof surface via permanently installed roof access or via the building (e.g. internal or external steps, ladder with back and/or climbing protection); the use of simple ladders without additional measures is permitted up to a fall height of 5 m; fixed lighting for frequent maintenance work in the dark. Electrical connection option in the maintenance area for usage categories C and D.

Equipment class 04

Pedestrian traffic routes and workplaces must be implemented as per the building regulations.

class

Determination of length

Determination of the correct post length

Formula

ROOF SYSTEM
(Thermal insulation + roof sealing)

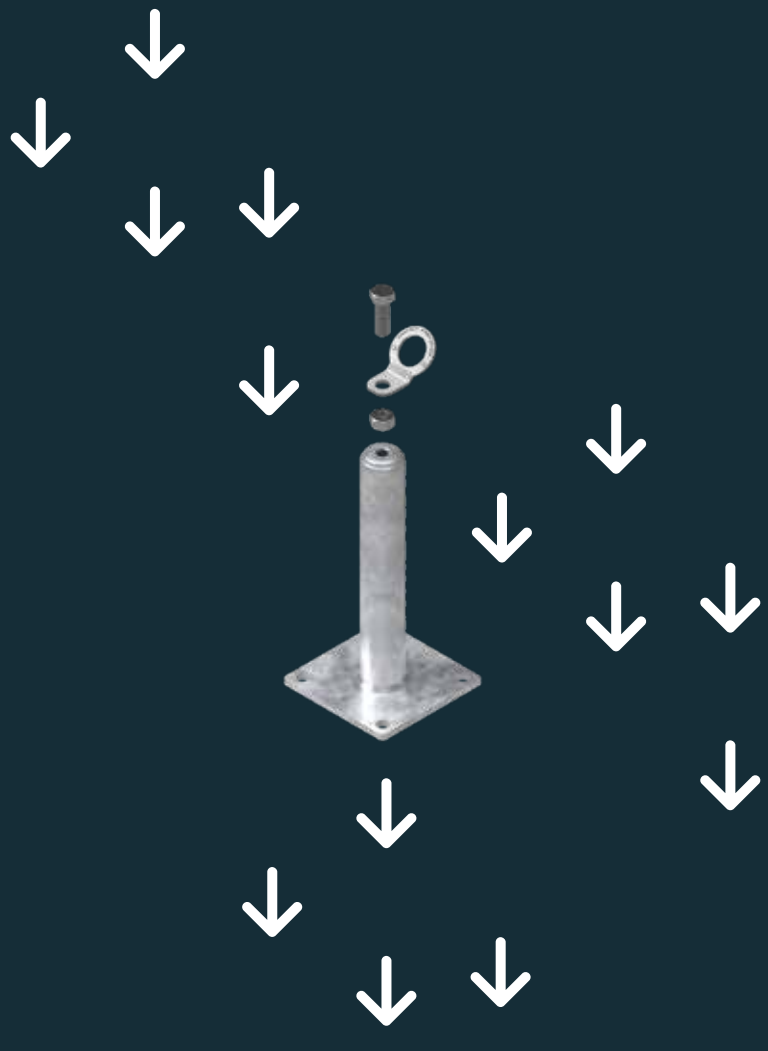
+ min. 200 mm
(max. 300 mm)

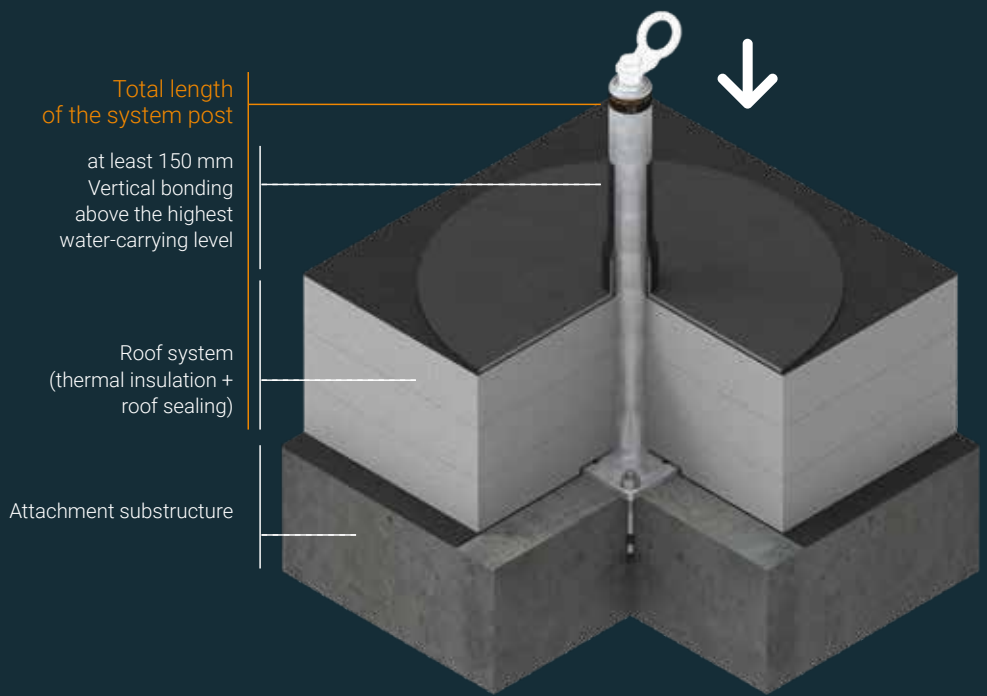
+ ROUND UP

= MIN. LENGTH

Example of use:

	370 mm	Roof system (thermal insulation + roof sealing)
+	200 mm	min. 150 mm vertical bonding + 50 mm post projection
	570 mm	Minimum length + rounding
=	600 mm	suitable post length





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