BUILDING RESEARCH INSTITUTE
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# NATIONAL TECHNICAL ASSESSMENT
# ITB-KOT-2021/1725, edition 1

This national technical assessment has been issued on the grounds of the decree of the Minister of Infrastructure of 17 November 2017 on national technical assessments (Polish Journal of Law of 2016, item 1968) by the Building Research Institute in Warsaw upon request of the company

**Trutek Fasteners Poland, ltd.**
**Al. Krakowska 38, Janki, 05-090 Raszyn**

The National Technical Assessment ITB-KOT-2021/1725, edition 1, represents a positive assessment of the functional performance characteristics of the following construction products for their intended use:

## STEEL EXPANSION FASTENERS
## TSA, TSA P, TSA L, TSAE and TSAH

Term of validity of the National Technical Assessment:

2 June, 2026

INSTYTUT TECHNIKI BUDOWLANEJ

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Warsaw, 2 June, 2021

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## 1. TECHNICAL DESCRIPTION OF THE PRODUCT

The subject of this National Technical Assessment are steel bolt fasteners type TSA, TSA P, TSA L, TSAE and TSAH manufactured by Trutek Fasteners Poland, ltd., based at Al. Krakowska 38, Janki, 05-090 Raszyn, Poland, production plant in China.

This National technical Assessment is applicable to the following types of fasteners:

- TSA06, TSA06P, TSA06L, TSAE06 and TSAH06,
- TSA08, TSA08P, TSA08L, TSAE08 and TSAH08,
- TSA010, TSA010P, TSA010L, TSAE010 and TSAH010,
- TSA012, TSA012P, TSA012L, TSAE012 and TSAH012,
- TSA16, TSA16P, TSA16L.

The TSA, TSA P, TSA L, TSAE and TSAH fasteners consist of a body, including an expansion sleeve with a flange and a wedge cone, and threaded rods, pins or bolts inserted into the body, with accompanying nuts and washers.

The body of the TSA, TSA P, TSA L, TSAE and TSAH fasteners are made of ordinary carbon steel of the mechanical strength class not lower than 4.8 acc. to the PN-EN-ISO 898-1:2013 standard, with at least 5 μm thick protective zinc coating acc. to PN-EN ISO 4042:2018 or PN-EN ISO 2081:2018 standard.

Fasteners type TSA P, TSA L, TSAE and TSAH shall be used in sets as supplied by the manufacturer.

Fasteners type TSA P, acc. to Fig. A1, consist of a body and a threaded rod driven into it, with accompanying nut and washer.

Fasteners type TSA L, acc. to Fig. A2, consist of a body and a threaded bolt driven into it, with accompanying washer.

Fasteners type TSAE, acc. to Fig. A3, consist of a body and an eye-ended threaded bolt driven int it, with accompanying nut and washer.

Fasteners type TSAH, acc. to Fig. A4, consist of a body and an hook-ended threaded bolt driven int it, with accompanying nut and washer.

The fastening elements of the TSA P, TSA L, TSAE and TSAH, as well as nuts and washers are made of ordinary carbon steel of the mechanical strength class not lower than 4.8 acc. to the PN-EN-ISO 898-1:2013 standard, with at least 5 μm thick protective zinc coating acc. to PN-EN ISO 4042:2018 or PN-EN ISO 2081:2018 standard.

Fasteners type TSA, acc. to Fig. A5, consist of a body and a threaded rod to be driven into it, with accompanying nut and washer, their components to be purchased separately. The threaded rods shall be made of ordinary carbon steel of the mechanical strength class not lower than 4.8 acc. to the PN-EN-ISO 898-1:2013 standard, with at least 5 μm thick protective zinc coating acc. to PN-EN ISO 4042:2018 or PN-EN ISO 2081:2018 standard. Nuts and washers shall be of the mechanical strength class acc. to the PN-EN-ISO 898-1:2012 standard, suitable for the mechanical strength and diameter of the rod. Threaded rods to be used shall conform to the applicable local regulations.

The shape and dimensions of the TSA, TSA P, TSA L, TSAE and TSAH fasteners are given in Annex A.

## 2. INTENDED USE OF THE PRODUCT

The steel expansion TSA, TSA P, TSA L, TSAE and TSAH fasteners are designed for non-structural multiple fastening of construction elements with static loading in base materials:

- ordinary concrete class C20/25 – C50/60, cracked or non-cracked, acc. to the PN-EN 206+A1: 2016 standard,
- hollow-core slabs of common concrete class C40/50 acc. to the PN-EN 206+A1:2016 standard, with wall thickness not less than 30 mm.

For the reason of the corrosive aggressiveness of the environment, the steel expansion fasteners TSA, TSA P, TSA L, TSAE and TSAH shall be used according to the requirements given in the PN-EN ISO 12944-2:2018 and PN-EN ISO 9223:2012 standards.

In order to determine the calculated load capacities of the TSA, TSA P, TSA L, TSAE and TSAH steel expansion fasteners, the load capacities provided in Annex C shall be divided by partial safety factors equal to 2.5 in the case of tensile capacity and 1.25 for shear capacity.

The installation and spacing parameters of the TSA, TSA P, TSA L, TSAE and TSAH steel expansion fasteners are given in Annex B.

To install an expansion fastener, insert it into a predrilled hole in the substrate. The hole shall be drilled perpendicularly to the substrate surface. The fastener body should enter the hole using light taps of a hummer. When tightening the nut, the anchoring element will move backward together with the wedge cone in the fastener body, resulting in wedging action against the sections of the expansion sleeve and firm anchoring in the hole. Screw or nut tightening shall be made with use of a torque wrench. Care should be taken that the washer under the nut be firmly pressed to the element being fastened.

Steel expansion fasteners TSA, TSA P, TSA L, TSAE and TSAH shall be used according to the technical design developed for the particular project, taking into account:

- the requirements of the respective Polish standards, construction related regulations, conforming in particular to the decree of the Minister of Infrastructure of 12 April 2002 on the technical requirements concerning buildings and their arrangement (Polish Journal of Law of 2019, item1065, with later amendments)
- provisions of this National Technical Assessment,
- manufacturer's instructions concerning the conditions of making fastening with use of the fasteners, delivered to the customers.

## 3. FUNCTIONAL CHARACTERISTICS OF THE PRODUCT AND METHODS OF THEIR ASSESSMENT

### 3.1. Functional characteristics of the product

**3.1.1. Characteristic load capacities of fastenings made with use of the fasteners**. The characteristic tensile and shear load capacities of fastenings are given in Annex C.

**3.1.2. Characteristic load capacities of fastenings made with use of the fasteners in the case of fire.** The tensile and shear characteristic load capacities of fastenings made in concrete in the case of fire are given in Annex C.

**3.1.3. Durability of the fasteners.** The 5 μm zinc coating ensures fastener durability as results from section 2.

### 3.2. Methods used for functional characteristics assessment

**3.2.1. Characteristic load capacities of fastenings made with use of the fasteners**. The testing of the tensile and shear characteristic load capacities of fastenings is carried out acc. to EAD 330747-00-0601 on fasteners installed in base material as described in Annex C.

**3.2.2. Characteristic load capacities of fastenings made with use of the fasteners in the case of fire.** The determination of the tensile and shear characteristic load capacities of fastenings is carried out acc. to EOTA TR 020.

**3.2.3. Durability of the fasteners.** The testing of the zinc coating thickness is carried out acc. to the PN-EN ISO 2178:2016 or PN-EN ISO 3497:2004 standard.

## 4. PACKING, STORING AND SHIPPING

Steel expanding fasteners TSA, TSA P, TSA L, TSAE and TSAH shall be supplied in sets in manufacturer packaging and stored and shipped in a way ensuring stability of their technical characteristics.

Labelling with the construction conformity mark shall conform to the decree of the Minister of Infrastructure and Construction of 17 November 2016 on the way of declaring the functional characteristics of construction products and their labelling with the construction conformity mark (Polish Journal of Law of 2016, item1966, with later amendments).

The following information shall accompany the construction conformity mark:

- two last digits of the year, when the construction conformity mark was given to the construction product for the first time,
- manufacturer name and address or identification mark permitting to explicitly determine the manufacturer's name and their head office address,
- construction product name and designation,
- number and date of the national conformity assessment according to which the functional characteristics of the product were declared (ITB-KOT-2021/1725, edition 1),

- functional characteristics national declaration number,
- level and class of the declared functional characteristics,
- name of the certifying entity that participated in the assessment and verification of the stability of the functional characteristics of the construction product,
- manufacturer's www address, if the national declaration of the functional characteristics is available there.

A characteristics card or information concerning hazardous substances contained in the construction product, as required in article 31 or 33 of the decree (WE) No 1907/2006 of the European Parliament and the Council on the classification, marking and packaging of substances and mixtures (CLP), changing and repealing directives 67/548/EWG and 1999/45/WE, as well as changing decree (WE) No 1907/2006.

## 5. ASSESSMENT AND VERIFICATION OF THE STABILITY OF FUNCTIONAL CHARACTERISTICS

### 5.1. National system of the assessment and verification of functional characteristics

According to the decree of the Minister of Infrastructure and Construction of 17 November 2016 on declaring the functional characteristics of construction products and their labelling with the construction conformity mark (Polish Journal of Law of 2016, item1966, with later amendments), the assessment system 2+ shall be applicable for assessing and verifying the stability of the functional characteristics.

### 5.2. Type tests

The functional characteristics assessed in section 3 constitute the product type test unless changes in materials, components, production line or production plant take place.

### 5.3. Factory production inspection

The manufacturer shall have a factory production inspection system implemented in the production plant. All the elements of this system, requirements i provisions adopted by the manufacturer shall be documented in a systematic manner in the form of rules and procedures, including annotations of conducted tests. The factory production inspection shall be adjusted to the production engineering and ensure that the declared functional characteristics of the product are maintained.

Factory production process inspection includes specification and checking of materials and product components, as well as tests in the production process and inspection checks (acc. to section 5.4) carried out by the manufacturer according to a predetermined test plan and complying to the rules and procedures stipulated in the factory production inspection documentation.

The results of production inspection should be registered on a regular basis. The register shall confirm that the products meet the assessment and verification criteria. The individual products or their batches and related production details must be fully possible to identify and reconstruct.

### 5.4. Inspection tests

**5.4.1. Test program**. The inspection test program includes:

a) routine tests,
b) periodical tests.

**5.4.2. Routine tests.** Routine tests shall include:
a) checking the shape and dimensions,
b) checking the thickness of the zinc coating.

**5.4.3. Periodical tests.** The periodical tests shall include checking of the characteristic load capacities of fastening made with use of the fasteners.

### 5.5. Frequency of tests

Routine tests shall be carried out according to the predetermined test plan, but at lest once for each batch of the product. The volume of the product batch to be tested shall be defined in the respective documentation of the factory production inspection system.

Periodical test shall be conducted at lest once per three years.

## 6. FORMAL INSTRUCTIONS

**6.1.** The National Technical Assessment ITB-KOT-2021/1725, edition 1, makes a positive assessment of the principal functional characteristics of the TSA, TSA P, TSA L, TSAE and TSAH steel expansion fasteners which, according to the intended use resulting from the assessment provisions, have impact on the fulfilment of principal requirements by construction works where the products are used.

**6.2.** The National Technical Assessment ITB-KOT-2021/1725, edition 1, is not a document that qualifies for labelling a construction product with the construction conformity mark.
According to the act of 16 April 2004 on construction products (Polish Journal of Law of 2020, item 215, with later amendments), products to which this National Technical Assessment applies can be put into commercial traffic or made available on the domestic market, provided their manufacturer has conducted an assessment and verification of the stability of their functional characteristics acc. to the National Technical Assessment ITB-KOT-2021/1725, edition 1, and marked the products with the construction conformity mark as required by the respective regulations.

**6.3.** The National Technical Assessment ITB-KOT-2021/1725, edition 1, does not breach the rights resulting from the respective industrial property regulations, in particular those resulting from the act of 30 June 2000 – Industrial Property Law (Polish Journal of Law of 2021, item 324). Compliance with those rights is legal obligation of the users of this National Technical Assessment.

**6.4**. Issuing this National Technical Assessment, the Building Research Institute does not take responsibility for possible violation of exclusive or acquired rights.

**6.5**. This National Technical Assessment does not absolve the manufacturer from responsibility for the proper quality of products, and the executors of construction works – from responsibility for their proper use.

**6.6.** The validity of the National technical Assessment can be extended for subsequent periods not longer than 5 years

## 7. LIST OF DOCUMENTS

### 7.1. Research and test reports, assessments and classifications

1) 01775/21/Z00NZK. *Technical opinion concerning the fire resistance of steel expansion fasteners TSA, TSA P, TSA L, TSAE and TSAH*. Building Research Institute, Research Unit for Construction Structures, Geotechnics and Concrete. Katowice, 2021
2) LZK00-02844/21/R35NZK. *Test report. TSA steel expansion fasteners*. Building Research Institute, Research Unit for Construction Structures, Geotechnics and Concrete. Katowice, 2021
3) LZK00-02844/20/R32NZK/B. *Test report. Steel expansion fasteners*. Building Research Institute, Research Unit for Construction Structures, Geotechnics and Concrete. Katowice, 2021
4) LOK00-02844/14/R12OSK. *Test report. TSA SHIELD steel expansion fasteners*. Building Research Institute, Research Unit for Construction Structures and Construction on Mining Terrains. Katowice, 2015
5) LOK-906/A/07. *Test report. TSA steel expansion fasteners.* Building Research Institute, Laboratory of Fasteners and Construction Products, Katowice, 2007

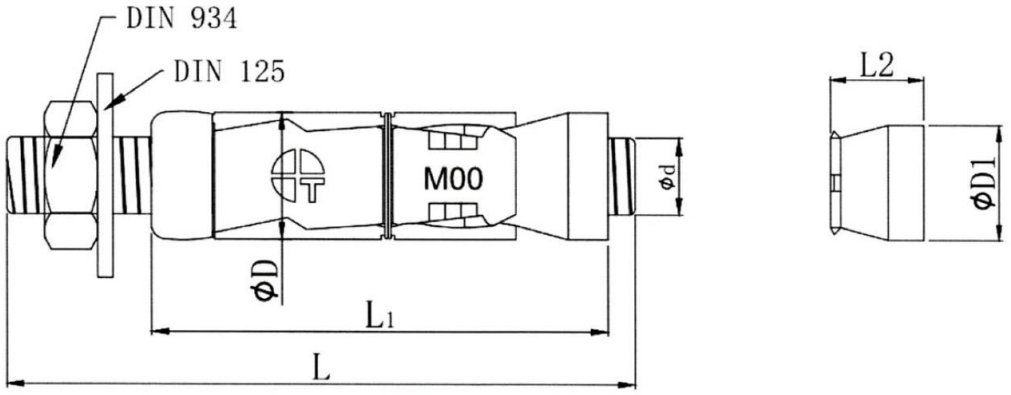
### 7.2. Related standards

| | |
|---|---|
| PN-EN 206-1:2016 | *Concrete. Part 1: Requirements, properties, production and conformity* |
| PN-EN ISO 898-1:2013 | *Mechanical properties of fasteners made of carbon and alloy steel. Part 1: Bolts and double-nutted bolds of specified classes of properties. Coarse and fine thread* |
| PN-EN ISO 4042:2018 | *Fastening elements. Electrolytic coating.* |
| PN-EN ISO 2081:2018 | *Metal coating and other non-organic coating. Electrolytic zinc coating with additional processing on iron and steel* |
| PN-EN ISO 2178:2016 | *Non-magnetic coating on magnetic materials. Measurement of coating thickness. Magnetic method for steel* |
| PN-EN ISO 3497:2004 | *Metal coating. Measurement of coating thickness. Roentgen spectrometry methods* |

| | |
|---|---|
| PN-EN ISO 9223:2012 | *Corrosion of metals and alloys. Corrosivity of atmospheres. Classification, definition and assessment* |
| PN-EN ISO 12944-2:2018 | *Paints and lacquers. Corrosion protection of steel constructions by means of protective painting systems. Part 2: Classification of environments* |
| TR 020 | *Evaluation of anchorages in concrete concerning resistance to fire* |
| EAD 330747-00-0601 | *Fasteners for use in concrete for redundant non-structural systems* |

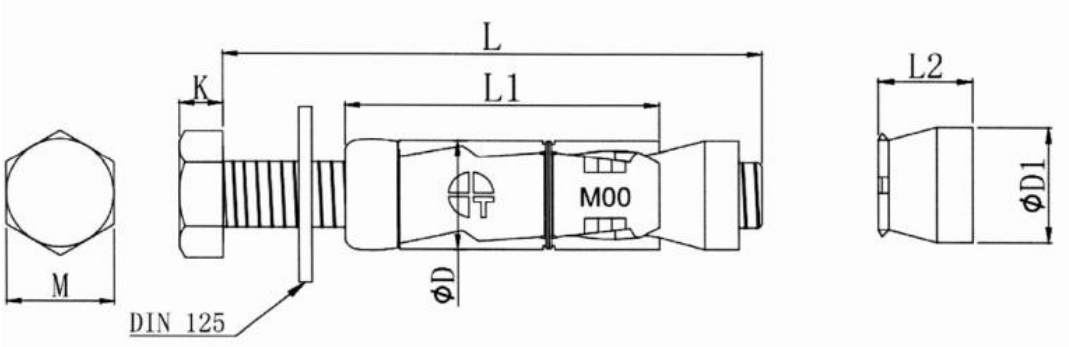
**ANNEXES**

## Annex A



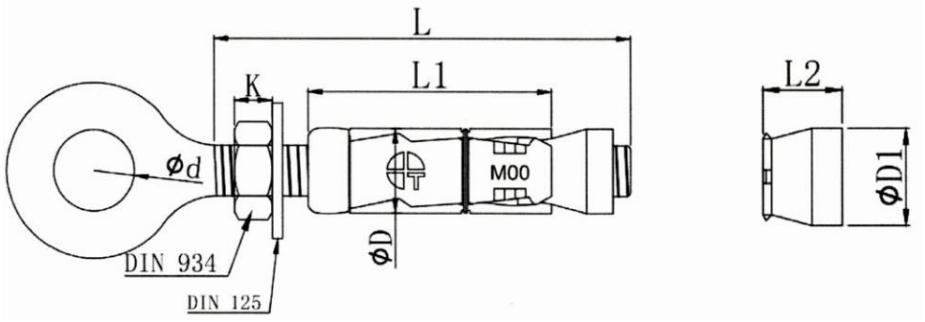

| Ref. | Fastener symbol | Dimensions, mm | | | | | |
|---|---|---|---|---|---|---|---|
| | | ØD | Ød | ØD1 | L | L1 | L2 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | TSA06060P | 11,25 (±0,25) | 6 | 10,8 (±0,5) | 60 (±2) | 45 (±2) | 12 (±1) |
| 2 | TSA06075P | 11,25 (±0,25) | 6 | 10,8 (±0,5) | 75 (±2) | 45 (±2) | 12 (±1) |
| 3 | TSA06100P | 11,25 (±0,25) | 6 | 10,8 (±0,5) | 100 (±2) | 45 (±2) | 12 (±1) |
| 4 | TSA08075P | 13,3 (±0,3) | 8 | 12,7 (±0,5) | 75 (±2) | 50 (±2) | 14 (±1) |
| 5 | TSA08085P | 13,3 (±0,3) | 8 | 12,7 (±0,5) | 85 (±2) | 50 (±2) | 14 (±1) |
| 6 | TSA08100P | 13,3 (±0,3) | 8 | 12,7 (±0,5) | 100 (±2) | 50 (±2) | 14 (±1) |
| 7 | TSA08120P | 13,3 (±0,3) | 8 | 12,7 (±0,5) | 120 (±3) | 50 (±2) | 14 (±1) |
| 8 | TSA08140P | 13,3 (±0,3) | 8 | 12,7 (±0,5) | 140 (±3) | 50 (±2) | 14 (±1) |
| 9 | TSA10080P | 15,5 (±0,3) | 10 | 14,7 (±0,5) | 80 (±2) | 60 (±2) | 16 (±1) |
| 10 | TSA10100P | 15,5 (±0,3) | 10 | 14,7 (±0,5) | 100 (±2) | 60 (±2) | 16 (±1) |
| 11 | TSA10120P | 15,5 (±0,3) | 10 | 14,7 (±0,5) | 120 (±3) | 60 (±2) | 16 (±1) |
| 12 | TSA10140P | 15,5 (±0,3) | 10 | 14,7 (±0,5) | 140 (±3) | 60 (±2) | 16 (±1) |
| 13 | TSA10160P | 15,5 (±0,3) | 10 | 14,7 (±0,5) | 160 (±3) | 60 (±2) | 16 (±1) |
| 14 | TSA12100P | 18,9 (±0,3) | 12 | 16,8 (±0,5) | 100 (±2) | 70 (±2) | 17,4 (±1) |
| 15 | TSA12110P | 18,9 (±0,3) | 12 | 16,8 (±0,5) | 110 (±3) | 70 (±2) | 17,4 (±1) |
| 16 | TSA12135P | 18,9 (±0,3) | 12 | 16,8 (±0,5) | 135 (±3) | 70 (±2) | 17,4 (±1) |
| 17 | TSA12155P | 18,9 (±0,3) | 12 | 16,8 (±0,5) | 155 (±3) | 70 (±2) | 17,4 (±1) |
| 18 | TSA16145P | 23,7 (±0,3) | 16 | 22,7 (±0,5) | 145 (±3) | 95 (±2) | 24,3 (±1) |
| 19 | TSA16155P | 23,7 (±0,3) | 16 | 22,7 (±0,5) | 155 (±3) | 95 (±2) | 24,3 (±1) |
| 20 | TSA16195P | 23,7 (±0,3) | 16 | 22,7 (±0,5) | 195 (±3) | 95 (±2) | 24,3 (±1) |

Fig. A1. TSA P fasteners




| Ref. | Fastener symbol | Dimensions, mm | | | | | |
|---|---|---|---|---|---|---|---|
| | | ØD | ØD1 | L | L1 | L2 | M |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* |
| 1 | TSA06055L | 11,25 (±0,25) | 10,8 (±0,5) | 55 (±2) | 37 (±2) | 12 (±1) | 10 (-0,2) |
| 2 | TSA08060L | 13,3 (±0,3) | 12,7 (±0,5) | 60 (±2) | 42 (±2) | 14 (±1) | 13 (-0,2) |
| 3 | TSA08075L | 13,3 (±0,3) | 12,7 (±0,5) | 75 (±2) | 42 (±2) | 14 (±1) | 13 (-0,2) |
| 4 | TSA10070L | 15,5 (±0,3) | 14,7 (±0,5) | 70 (±2) | 50 (±2) | 16 (±1) | 18 (-0,2) |
| 5 | TSA10085L | 15,5 (±0,3) | 14,7 (±0,5) | 85 (±2) | 50 (±2) | 16 (±1) | 18 (-0,2) |
| 6 | TSA10110L | 15,5 (±0,3) | 14,7 (±0,5) | 110 (±2) | 50 (±2) | 16 (±1) | 18 (-0,2) |
| 7 | TSA12085L | 18,9 (±0,3) | 16,8 (±0,5) | 85 (±2) | 61 (±2) | 17,4 (±1) | 18,8 (±0,1) |
| 8 | TSA12100L | 18,9 (±0,3) | 16,8 (±0,5) | 100 (±2) | 61 (±2) | 17,4 (±1) | 18,8 (±0,1) |

Fig. A2. TSA L fasteners




| Ref. | Fastener symbol | Dimensions, mm | | | | | |
|---|---|---|---|---|---|---|---|
| | | ØD | ØD1 | L | L1 | L2 | Ød |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* |
| 1 | TSAE06050 | 11,25 (±0,25) | 10,8 (±0,5) | 50 (+2) | 37 (±2) | 12 (±1) | 10 (±0,5) |
| 2 | TSAE08065 | 13,3 (±0,3) | 12,7 (±0,5) | 65 (+2) | 42 (±2) | 14 (±1) | 11,5 (±0,5) |
| 3 | TSAE10075 | 15,5 (±0,3) | 14,7 (±0,5) | 75 (+2) | 50 (±2) | 16 (±1) | 14 (±0,5) |
| 4 | TSAE12090 | 18,9 (±0,3) | 16,8 (±0,5) | 90 (+2) | 61 (±2) | 17,4 (±1) | 16 (±0,5) |

Fig. A3. TSAE fasteners

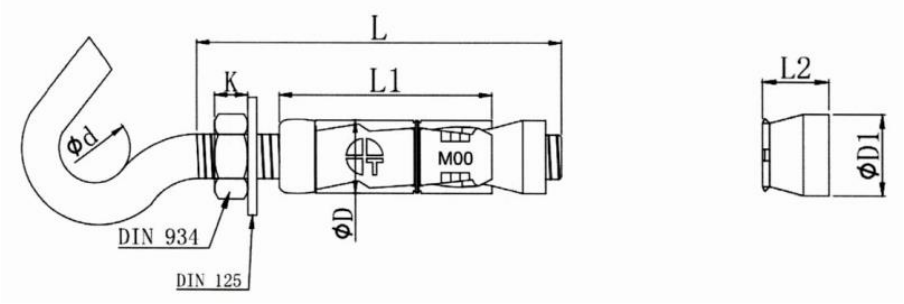
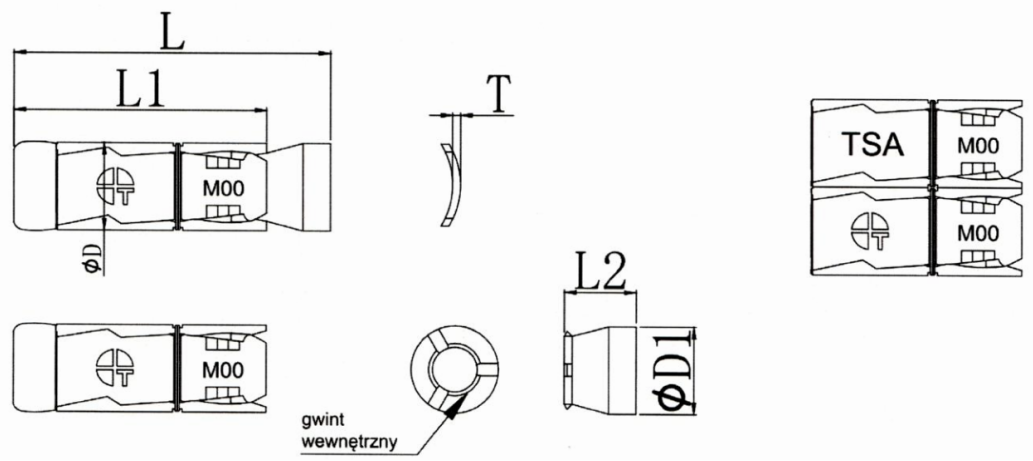



Fig. A4. TSAH fasteners

| Ref. | Fastener symbol | Dimensions, mm | | | | | |
|---|---|---|---|---|---|---|---|
| | | ØD | ØD1 | L | L1 | L2 | Ød |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* |
| 1 | TSAH06050 | 11,25 (±0,25) | 10,8 (±0,5) | 50 (+2) | 37 (±2) | 12 (±1) | 9,5 (±0,4) |
| 2 | TSAH08065 | 13,3 (±0,3) | 12,7 (±0,5) | 65 (+2) | 42 (±2) | 14 (±1) | 11 (±0,5) |
| 3 | TSAH10075 | 15,5 (±0,3) | 14,7 (±0,5) | 75 (+2) | 50 (±2) | 16 (±1) | 14 (±0,6) |
| 4 | TSAH12090 | 18,9 (±0,3) | 16,8 (±0,5) | 90 (+2) | 61 (±2) | 17,4 (±1) | 16,2 (±0,2) |




**inner thred**

| Ref. | Fastener symbol | Dimensions, mm | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ØD | ØD1 | L | L1 | L2 | T | Inner thread size |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* |
| 1 | TSA06 | 11,25 (±0,25) | 10,8 (±0,5) | 45 (±2) | 37 (±2) | 12 (±1) | 1,4 (±0,2) | M6 P1.0 |
| 2 | TSA08 | 13,3 (±0,3) | 12,7 (±0,5) | 50 (±2) | 42 (±2) | 14 (±1) | 1,4 (±0,2) | M8 P1.25 |
| 3 | TSA10 | 15,5 (±0,3) | 14,7 (±0,5) | 60 (±2) | 50 (±2) | 16 (±1) | 1,7 (±0,2) | M10 P1.5 |
| 4 | TSA12 | 18,9 (±0,3) | 16,8 (±0,5) | 70 (±2) | 61 (±2) | 17,4 (±1) | 2,4 (±0,2) | M12 P1.75 |
| 5 | TSA16 | 23,7 (±0,3) | 22,7 (±0,5) | `95 (±2) | 82 (±2) | 24,3 (±1) | 2,4 (±0,2) | M16 P2.0 |

Fig. A5. TSA fastener body

**Annex B**

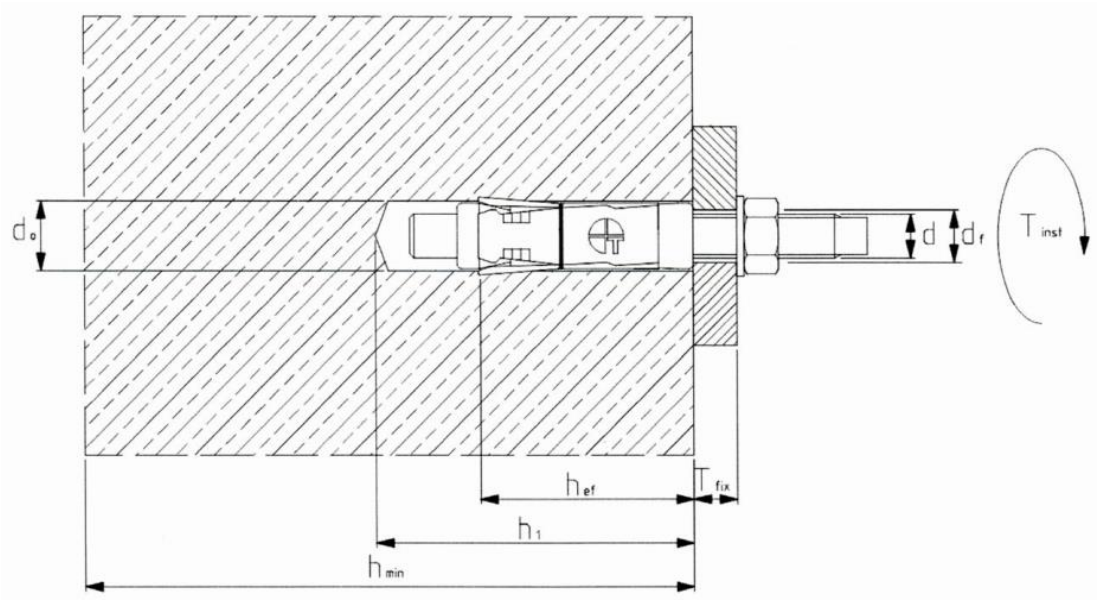



Fig. B1. Installation parameters of TSA, TSA P, TSA L, TSAE and TSAH fasteners in concrete

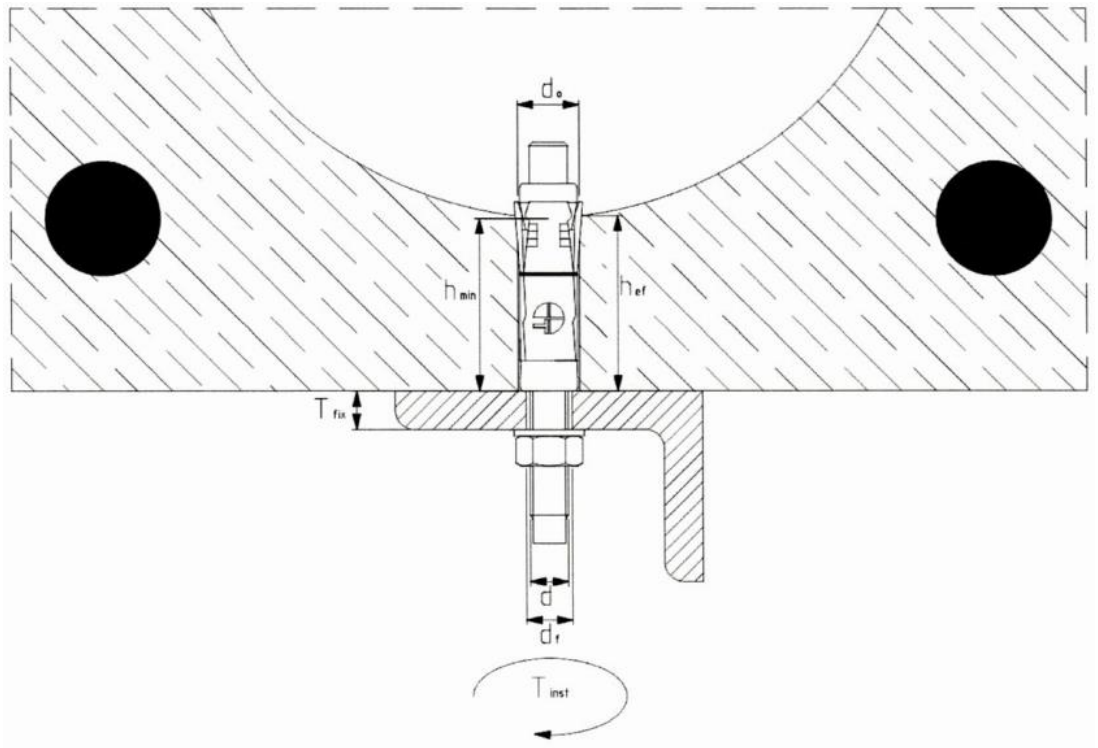



Fig. B2. Installation parameters of TSA, TSA P, TSA L, TSAE and TSAH fasteners in a concrete hollow-core slab

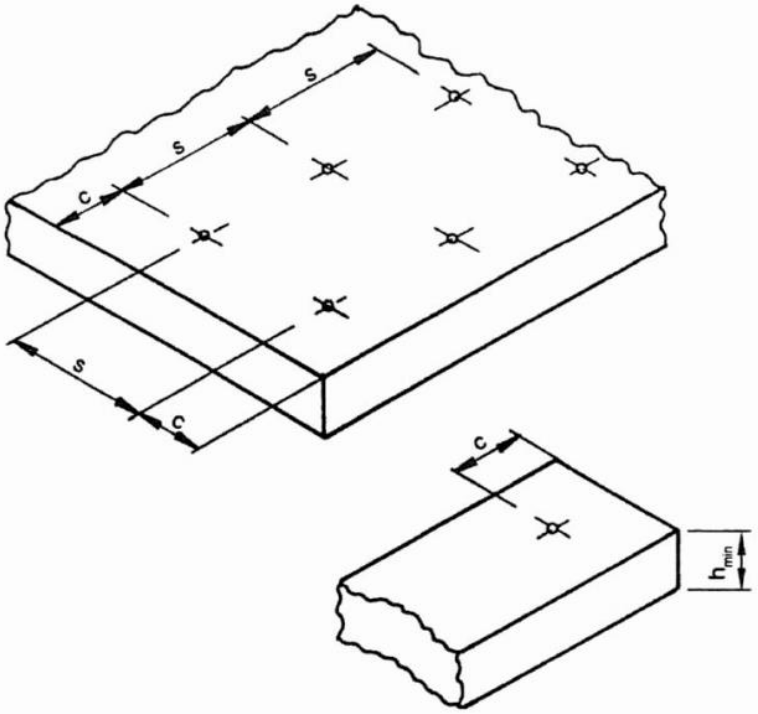



Fig. B3. Parameters of TSA, TSA P, TSA L, TSAE and TSAH fasteners spacing and edge distance

Table B1. Spacing and edge distance of TSA, TSA P, TSA L, TSAE and TSAH steel expansion fasteners

| Ref. | Parameters | TSA, TSA P, TSA L, TSAE and TSA fasteners | | | | |
|---|---|---|---|---|---|---|
| | | M6 | M8 | M10 | M12 | M16 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | Nominal drill diameter $d_0$, equal to nominal hole diameter $d_{nom}$ | 12 | 14 | 16 | 20 | 25 |
| 2 | Minimum hole depth $h_1$, mm | 50/35 [1)] | 55/35 [1)] | 65/35 [1)] | 85/35 [1)] | 125 |
| 3 | Installation depth, $h_{nom}$, mm | 45 | 50 | 60 | 70 | 95 |
| 4 | Effective anchorage depth $h_{ef}$, mm | 35/30 [2)] | 40/30 [2)] | 50/30 [2)] | 60/30 [2)] | 85 |
| 5 | Tightening torque, $T_{inst}$, Nm | 6 | 14 | 27 | 46 | 110 |
| 6 | Minimum thickness of substrate $h_{min}$, mm | 100/30 [2)] | 100/30 [2)] | 100/30 [2)] | 120/30 [2)] | 190 |
| 7 | Minimum fastener spacing s, mm | 100/200 [2)] | 120/200 [2)] | 150/200 [2)] | 180/240 [2)] | 285 |
| 8 | Minimum edge distance c, mm | 100/105 [2)] | 100/112 [2)] | 100/150 [2)] | 120/180 [2)] | 190 |

[1)] applies to hollow-core concrete slabs (through hole)
[2)] applies to hollow-core slabs

Annex C

Table C1. Characteristic tensile land shear load capacity of fastenings with use of TSA, TSA P, TSA L and TSAE fasteners

| Ref. | Fastener symbol | Substrate type | Effective anchorage depth $h_{ef}$, mm | Characteristic tensile ($N_{rk}$) and shear ($V_{rk}$) load capacity ($N_{rk} = V_{rk}$) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 1 | TSA06 [1)]<br>TSA06P<br>TSA06L<br>TSAE06 | Ordinary concrete, cracked or non-cracked, class C20/25 [2)] | 35 | 5.5 |
| 2 | TSA08 [1)]<br>TSA08P<br>TSA08L<br>TSAE08 | | 40 | 6.5 |
| 3 | TSA10 [1)]<br>TSA10P<br>TSA10L<br>TSAE10 | | 50 | 8.5 |
| 4 | TSA12 [1)]<br>TSA12P<br>TSA12L<br>TSAE12 | | 60 | 12.0 |
| 5 | TSA16 [1)]<br>TSA16P<br>TSA16L | | 95 | 15.0 |
| 6 | TSA06 [1)]<br>TSA06P<br>TSA06L<br>TSAE06 | Hollow-core slabs of concrete class C40/50 [2)] | 30 | 3..5 |
| 7 | TSA08 [1)]<br>TSA08P<br>TSA08L<br>TSAE08 | | 30 | 9.5 |
| 8 | TSA10 [1)]<br>TSA10P<br>TSA10L<br>TSAE10 | | 30 | 13 |
| 9 | TSA12 [1)]<br>TSA12P<br>TSA12L<br>TSAE12 | | 30 | 16 |

[1)] with threaded rod, nuts and washers acc. to section 1
[2)] ordinary concrete acc. to PN-EN 206+A1:2016 standard

Table C2. Characteristic tensile load capacities of fastening with use of TSAH fasteners

| Ref. | Fastener symbol | Substrate type | Effective anchorage depth $h_{ef}$, mm | Characteristic tensile ($N_{rk}$) and shear ($V_{rk}$) load capacity ($N_{rk} = V_{rk}$) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 1 | TSAH06 | Ordinary concrete, cracked or non-cracked, class C20/25 [1)] | 35 | 1.5 |
| 2 | TSAH08 | | 40 | 5.0 |
| 3 | TSAH10 | | 50 | 6.0 |
| 4 | TSAH12 | | 60 | 9.0 |
| 5 | TSAH06 | Hollow-core slabs of concrete class C40/50 [1)] | 30 | 1.5 |
| 6 | TSAH08 | | 30 | 5.0 |
| 7 | TSAH10 | | 30 | 6.0 |
| 8 | TSAH12 | | 30 | 9.0 |
| [1)] ordinary concrete acc. to PN-EN 206+A1:2016 standard | | | | |

Table C3. Characteristic load capacities of TSA fasteners under fire conditions

| Fire resistance class | | | | Fastener symbol | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | TSA06 [1)] TSA06P TSA06L TSAE06 TSAH06 | TSA08 [1)] TSA08P TSA08L TSAE08 TSAH08 | TSA10 [1)] TSA10P TSA10L TSAE10 TSAH10 | TSA12 [1)] TSA12P TSA12L TSAE12 TSAH12 | TSA16 [1)] TSA16P TSA16L |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Ordinary concrete, cracked or non-cracked, class C20/25 [3)] | R30 | Characteristic load capacity $F_{Rk,fi}$ [5)] | kN | 1.4/0.4 [2)] | 1.6/1.3 [2)] | 2.1/1.5 [2)] | 3.0/2.3 [2)] | 3.8 |
| | R60 | | kN | 1.4/0.4 [2)] | 1.6/1.3 [2)] | 2.1/1.5 [2)] | 3.0/2.3 [2)] | 3.8 |
| | R90 | | kN | 1.4/0.4 [2)] | 1.6/1.3 [2)] | 2.1/1.5 [2)] | 3.0/2.3 [2)] | 3.8 |
| | R120 | | kN | 1.1/0.3 [2)] | 1.3/1.0 [2)] | 1.7/1.2 [2)] | 2.4/1.8 [2)] | 3.0 |
| Hollow-core slabs of concrete class C40/50 [3)] | R30 | | kN | 0.9/0.4 [2)] | 1.6/1.3 [2)] | 2.1/1.5 [2)] | 3.0/2.3 [2)] | |
| | R60 | | kN | 0.9/0.4 [2)] | 1.6/1.3 [2)] | 2.1/1.5 [2)] | 3.0/2.3 [2)] | |
| | R90 | | kN | 0.9/0.4 [2)] | 1.6/1.3 [2)] | 2.1/1.5 [2)] | 3.0/2.3 [2)] | |
| | R120 | | kN | 0.7/0.3 [2)] | 1.3/1.0 [2)] | 1.7/1.2 [2)] | 2.4/1.8 [2)] | |
| Fastener spacing | | $s_{cr,fi}$ | mm | 4 x $h_{ef}$ | | | | |
| Edge distance [4)] | | $c_{cr,fi}$ | mm | 2 x $h_{ef}$ | | | | |

[1)] with threaded rod, nuts and washers acc. to section 1
[2)] in case of TSAH fasteners
[3)] ordinary concrete acc. to PN-EN 206+A1:2016 standard
[4)] in case of fire effect from more than one side the edge distance shall be ≥ 300 mm
[5)] partial safety factor $\gamma_{m,fi}$ = 1.0