National Technical Approval

Approval body for construction products and forms of construction

Building technology testing institute

A public institution supported jointly by the German Federation and the German Federal States

Member of EOTA, UEAtc and WFTAO

Date: 18 June 2015

Ref No: I 25-1.21.1-101/13

"Translation of original German edition not checked by Deutsches Institut für Bautechnik"

Approval No:
Z-21.1-1799

Period of validity:
from: **1 April 2015**
to: **1 April 2020**

Applicant:
TOGE Dübel GmbH & Co. KG
Illesheimer Str. 10
90431 Nuremberg
Germany

Object of the approval:
TOGE adhesive concrete screw
TSM-B, TSM-BC, TSM-BS and TSM-BSH

The aforementioned object of the approval is hereby granted a National Technical Approval.
This National Technical Approval comprises 8 pages and 12 annexes.
The object was first granted a National Technical Approval on 17 August 2005.

I. GENERAL PROVISIONS

1 The National Technical Approval verifies the usability of the object of the approval in the meaning of the building regulations of the federal states.

2 In so far as the National Technical Approval places requirements on the particular knowledge and experience of the persons entrusted with the provision of construction products and forms of construction according to the federal state regulations corresponding to cl. 17, para. 5, of the *Musterbauordnung* (Model Building Code), it should be noted that this knowledge and experience can also be furnished through equivalent documentation from other Member States of the European Union. This shall also apply to equivalent documentation submitted within the scope of the European Economic Area (EEA) Agreement or other bilateral agreements.

3 The National Technical Approval is not a substitute for statutory authorisations, agreements and certificates prescribed for the execution of construction projects.

4 The National Technical Approval is issued without prejudice to the rights of third parties, especially private intellectual property rights.

5 Without prejudice to more detailed regulations in the "Specific Provisions", the manufacturer and distributor of the object of the approval must provide users of the object of the approval with copies of the National Technical Approval and point out that the National Technical Approval must be available at the place of use. Upon request, the authorities involved must be provided with copies of the National Technical Approval.

6 The National Technical Approval may only be reproduced in whole. Publication of extracts shall require the consent of the Deutsches Institut für Bautechnik (DIBt). Texts and drawings in advertising materials may not contradict the National Technical Approval. In the event of discrepancies between the German edition of the National Technical approval and its English translation, the German edition shall take precedence. Translations of the National Technical Approval must include the remark "Translation of original German edition not checked by Deutsches Institut für Bautechnik".

7 The National Technical Approval is granted until revoked. The provisions of the National Technical Approval can be supplemented and amended at a later date, especially when new technical findings make this necessary.

II. SPECIFIC PROVISIONS

1 Object of the approval and scope of applicability

1.1 Object of the approval

The TOGE adhesive concrete screw types TSM-B, TSM-BC, TSM-BS and TSM-BSH (hereinafter called anchors) are special screws in sizes of 10, 12, 14, 16 and 22 mm which are made from electrogalvanised steel or steel with a zinc flake coating or TOGE-KORR or stainless steel and are supplied with a cartridge filled with CFT 300V chemical mortar for grouting the anchors in position. The chemical mortar is injected into the pre-drilled, cleaned hole prior to screwing in the special screw. As the special screw is screwed in, the chemical mortar is distributed evenly around the hole, and the threads of the special screw, which have cutting elements welded or rolled onto the threads, cut into the concrete in such a way that a combination of bonded and interlocking anchorage is created.

TOGE TSM adhesive concrete screws are available in versions with connecting thread and hexagon head (TSM concrete screw) and versions with an internal thread (TSM IM internal sleeve) corresponding to annexes 1 and 2.

Annex 1 shows the anchor in the built-in condition.

1.2 Scope of applicability

The anchor may be used for anchorages subjected to static and quasi-static loads in plain and reinforced normal-strength concrete of strength classes from C20/25 (min.) to C50/60 (max.) according to DIN EN 206-1 "Concrete – Part 1: Specification, performance, production and conformity".

The anchor may be used for anchorages that must satisfy fire resistance requirements.

The anchor may be anchored in cracked and uncracked concrete.

The anchor may be installed in dry or wet concrete, but not in holes filled with water.

The anchor may be used in the following temperature range:

Temperature range: -40°C to +80°C
(max. brief temp. exposure +80°C and max. long-term temp. exposure +50°C)

Steel parts made from electrogalvanised steel or steel with a zinc flake coating or coated with TOGE-KORR:

The TSM-B and TSM-BC anchors may be used in dry interior conditions only.

Steel parts made from stainless steel of corrosion resistance class III:

The TSM-BS anchor may be used in corrosion resistance class III conditions according to National Technical Approval Z-30.3-6 "Products, fasteners and structural components made of stainless steels".

Steel parts made from stainless steel of corrosion resistance class IV:

The TSM-BSH anchor may also be used in corrosion resistance class IV conditions according to National Technical Approval Z-30.3-6 "Products, fasteners and structural components made of stainless steels".

2 Provisions for the construction product

2.1 Properties and composition

The anchor must correspond to the drawings and information contained in the annexes.

The material parameters, dimensions and tolerances of the anchor which are not specified in this National Technical Approval must correspond to the information deposited with the DIBt, the certification body and the external auditing body.

The anchor is made from an incombustible material of class A according to DIN 4102-1:1998-05 "Fire behaviour of building materials and building components – Part 1: Building materials, concepts, requirements and tests".

2.2 Packaging, storage and marking

2.2.1 Packaging and storage

The two components of the chemical mortar are supplied separately in cartridges according to annex 1 ready for mixing together.

The chemical mortar cartridges must be protected against sunlight and heat and stored in dry conditions according to the installation instructions at temperatures between +5°C and +25°C.

2.2.2 Marking

The packaging, information leaflet or delivery slip for the anchor (TSM concrete screw and chemical mortar) must be marked by the manufacturer with the German attestation of conformity symbol (Ü mark) according to the attestation of conformity regulations of the German federal states. In addition, the works symbol, approval number and complete designation of the anchor must be specified.

The marking may only be applied once the requirements of section 2.3 "Attestation of conformity" have been fulfilled.

Anchor type, anchor size, anchor length and material designation must be stamped on every adhesive concrete screw according to annex 2. Every adhesive concrete screw with a hexagon head must be marked with the suffix "SW" (= AF).

Every adhesive concrete screw made from galvanised or coated steel must be marked with "B" or "BC" respectively. Every adhesive concrete screw made from stainless steel of corrosion resistance class III must be marked with "BS". Every adhesive concrete screw made from stainless steel of corrosion resistance class IV must be marked with "BSH" according to annex 2.

The chemical mortar cartridge must be marked according to the *Verordnung über gefährliche Arbeitsstoffe* (Hazardous Working Materials Act) and labelled "Chemofast-Verbundmörtel CFT 300V" and include information on shelf-life, hazard designation and usage. The installation instructions supplied with the adhesive concrete screw system must include information on the protective measures necessary when using hazardous working materials.

2.3 Attestation of conformity

2.3.1 General

Confirmation of the compliance of the anchor (TSM concrete screw and chemical mortar) with the provisions of this National Technical Approval must be provided for every production plant by means of a certificate of conformity based on in-house production control and regular auditing by an external institute, including initial testing of the anchor in accordance with the following provisions.

Issuing the certificate of conformity and auditing by an external institute, including the product tests to be carried out, requires the manufacturer of the anchor to appoint a certification body and an auditing body, both of which must be accredited for such work.

The declaration that a certificate of conformity has been issued must be indicated by the manufacturer marking the construction products with the German attestation of conformity symbol (Ü mark) and including information about the intended purpose.

The certification body must provide the DIBt and the most senior building authority of the federal state in which the production plant is located with a copy of the certificate of conformity issued by that body.

2.3.2 In-house production control

In-house production control is to be set up and carried out at every production plant. In-house production control is understood to be continual monitoring of production by the manufacturer's personnel in order to guarantee that the construction products manufactured comply with the provisions of this National Technical Approval.

The testing plan deposited with the DIBt and the external auditing body shall regulate the scope, nature and frequency of the in-house production control measures.

The results of in-house production control are to be recorded and evaluated. The records must include the following details at least:

- the designation of the construction product or the raw material and the components;
- the type of inspection or testing;
- the dates of production and testing of the construction product or the raw material or the components;
- the results of inspections and tests and, if applicable, a comparison with the requirements;
- the signature of the person responsible for in-house production control.

The records are to be retained for at least five years and made available to the external auditing body appointed to carry out auditing work. Upon request, they are to be made available to the DIBt and the most senior building authority responsible.

If the results of tests are unsatisfactory, the manufacturer must take the necessary measures to rectify the defects without delay. Construction products that do not comply with the requirements are to be marked in such a way that they cannot be mistaken for compliant products. After rectifying the defects, the test involved must be repeated without delay, in so far as this is technically possible and is required for verifying rectification of the defects.

2.3.3 Auditing by an external body

The in-house production control in every anchor production plant is to be audited regularly, but at least twice annually, by an external body.

External auditing must include initial testing of the anchor and the taking of samples for spot checks. The sampling and tests are in all cases the responsibility of the accredited auditing body.

The testing plan deposited with the DIBt and the external auditing body shall regulate the scope, nature and frequency of the external auditing measures.

The results of certification and external auditing are to be retained for at least five years. Upon request, the certification or auditing body shall make them available to the DIBt and the most senior building authority responsible.

3 Provisions for design and dimensioning

3.1 Design

The anchorages are to be designed according to engineering principles. Verifiable calculations and drawings must be produced taking into account the loads to be anchored.

The designer must specify the steel grade, strength class and screw length of the fixing screw for the TSM internal sleeve**.**

3.2 Dimensioning

3.2.1 General

The anchorages are to be dimensioned according to DIN SPEC 1021-4-4:2009 "Design of fastenings for use in concrete – Part 4-4: Post-installed fasteners – Mechanical systems" taking into account the following advice and supplementary information.

The direct local force transfer to the concrete has been verified. It is necessary to verify that the loads to be anchored are transferred further within the building element.

It is necessary to consider additional stresses due to restrained deformation (e.g. in the case of temperature fluctuations) which can ensue in the anchor, in the attached component or in the building element in which the anchor is installed.

If the edge distance of an anchor is less than the characteristic edge distance $c_{cr,N}$, then longitudinal reinforcement (min. 6 mm dia.) must be fitted along the edge of the building element in the region of the embedment depth.

3.2.2 Dimensioning to DIN SPEC 1021-4-4:2009

The characteristic anchor parameters for verification according to design method A corresponding to DIN SPEC 1021-4-4:2009 are listed in the tables of annexes 6 to 9.

3.2.3 Displacement behaviour

The expected displacements are specified in annex 10. They are valid for the associated loads. In the case of shear loads, the play between the anchor and the side of the hole in the attached component must also be considered.

3.2.4 Design for exposure to fire

The provisions according to DIN SPEC 1021-4-1 "Design of fastenings for use in concrete – Part 4-1: General", annex D, and DIN SPEC 1021-4-4:2009 "Design of fastenings for use in concrete – Part 4-4: Post-installed fasteners – Mechanical systems" must be taken into account when designing anchorages for exposure to fire. The relevant characteristic anchor parameters are specified in annex 11. The design method is valid for a component exposed to fire on one side. In the case of exposure to fire on more than one side, the design method can only be used for an anchor edge distance $c \geq 300$ mm.

4 Provisions for installation

4.1 General

The anchor may only be used as a fastening item in the standard condition in which it is supplied. Individual parts may not be exchanged for others.

The installation of the anchor is to be carried out in accordance with the drawings produced according to section 3.1 taking into account the installation instructions given in annex 12. The concrete strength class of the anchorage substrate must be determined prior to inserting the anchor. The concrete strength class may not be lower than C20/25 or higher than C50/60.

4.2 Drilling and cleaning out the hole

The position of the hole must be coordinated with the reinforcement in such a way that damage to the reinforcement is avoided.

The hole is to be drilled perpendicular to the concrete surface using a carbide-tipped masonry drill bit or diamond-tipped drill bit. Carbide-tipped masonry drill bits must comply with the information given in the leaflet on "characteristic values, requirements and tests for masonry drill bits with carbide cutting body which are used for the manufacture of drilled holes for anchoring" (Jan 2002 ed.) published by the DIBt and Fachverband Werkzeugindustrie e.V.

Compliance with the drill bit parameters must be verified by inspection certificate A (EN 10204) or by the test mark (see leaflet) of the Prüfgemeinschaft Mauerbohrer e.V., Remscheid, Germany.

Nominal drill bit diameters and cutting edge diameters must correspond to the values given in annex 3.

If a hole is drilled incorrectly, the spacing between this and a new hole must be at least two times the depth of the incorrectly drilled hole.

The hole must be thoroughly cleaned out according to the manufacturer's instructions, which are, as a minimum: blowing out once, brushing out four times, blowing out once more.

The hole must be brushed out with the associated wire cleaning brush shown in annex 4, which has an outside diameter according to table 4. Prior to use, the brush must be checked to ensure that its diameter is still adequate.

4.3 Inserting the anchor

The anchor may not be inserted into a hole filled with water.

The mortar may not be mixed and used at temperatures below +5°C.

Upon installation, the temperature of the adhesive concrete screw must be at least +5°C, and the temperature in the anchorage substrate may not drop below -5°C during the curing of the chemical mortar.

The mortar components are mixed by injecting the separate chemical mortar cartridges according to annex 1 through the attached static mixer. The chemical mortar has been mixed sufficiently when it exhibits a uniform grey colour. The first 10 cm of the chemical mortar of each receptacle are to be discarded and may not be used for anchorages. The permissible processing time of a cartridge, including screwing in the adhesive concrete screw, depends on the temperature in the cartridge and in the anchorage substrate and can be found in the installation instructions.

The hole must be filled with the minimum amount of the chemical mortar from the mortar cartridges given in the installation instructions and the adhesive concrete screw must be screwed in immediately afterwards.

The adhesive concrete screw can be screwed in with a tangential impact driver.

To avoid spinning of the adhesive concrete screw, a driver with a power output in the higher range should be equipped with an automatic cut-out device, e.g. via the depth stop.

The embedment depth of the adhesive concrete screw (length of anchor in drilled hole) must comply with annex 4, table 4, depending on the anchor length and the given fastening thickness.

The anchor is properly anchored when

- excess mortar flows out onto the concrete surface,
- it is not easily possible to turn the anchor further, and
- the embedment depth (length of anchor in drilled hole) complies with annex 4, table 4.

The waiting time (minimum curing time) before applying the load must be in accordance with annex 12.

Installation torques are not necessary in order that the anchor achieves its load-carrying capacity. However, the torques given in annex 4, table 4, and annex 5, table 6, should not be exceeded when fixing the attached component.

4.4 Checking the installation

When forming anchorages, the contractor entrusted with the work or the site manager appointed by such contractor or a competent representative of the site manager must be present on the building site. He/she must ensure that the work is carried out properly.

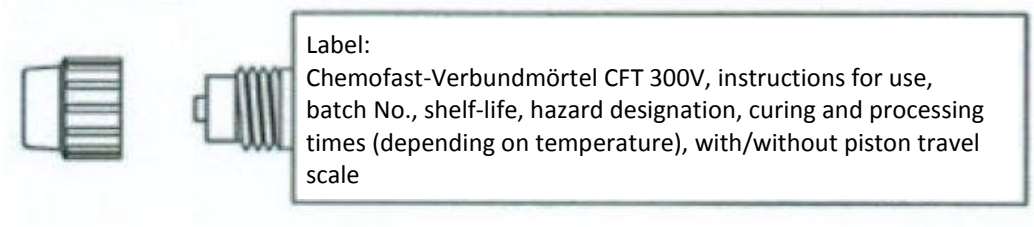
Records of the verification of the in situ concrete strength class and the proper installation of the anchors must be made by the site manager or his/her representative during the formation of the anchorages.

These records must be available during the construction time on the building site and, upon request, must be made available to persons appointed to carry out inspections. Like the delivery slips, after conclusion of the work, they must be retained by the company for at least five years.

Andreas Kummerow Certified

Head of Department

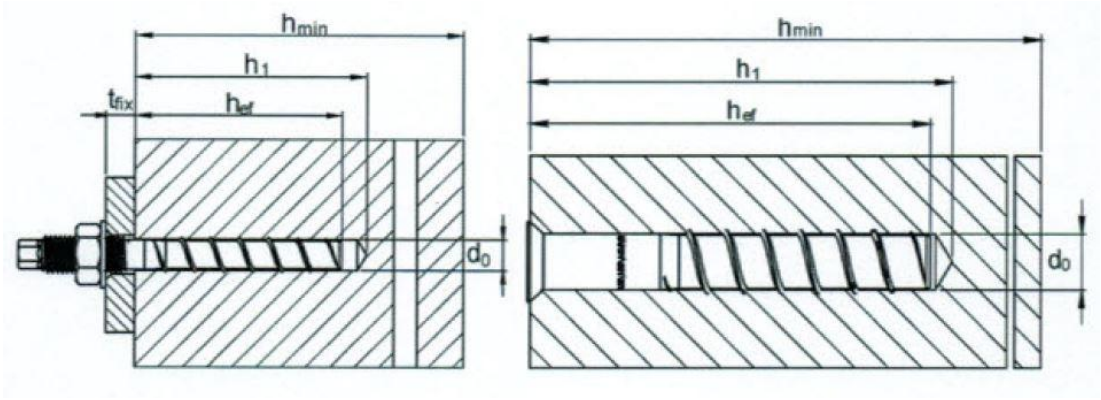
Screw cap **Cartridge of CFT 300 V chemical mortar**



Static mixer

TOGE TSM concrete screw

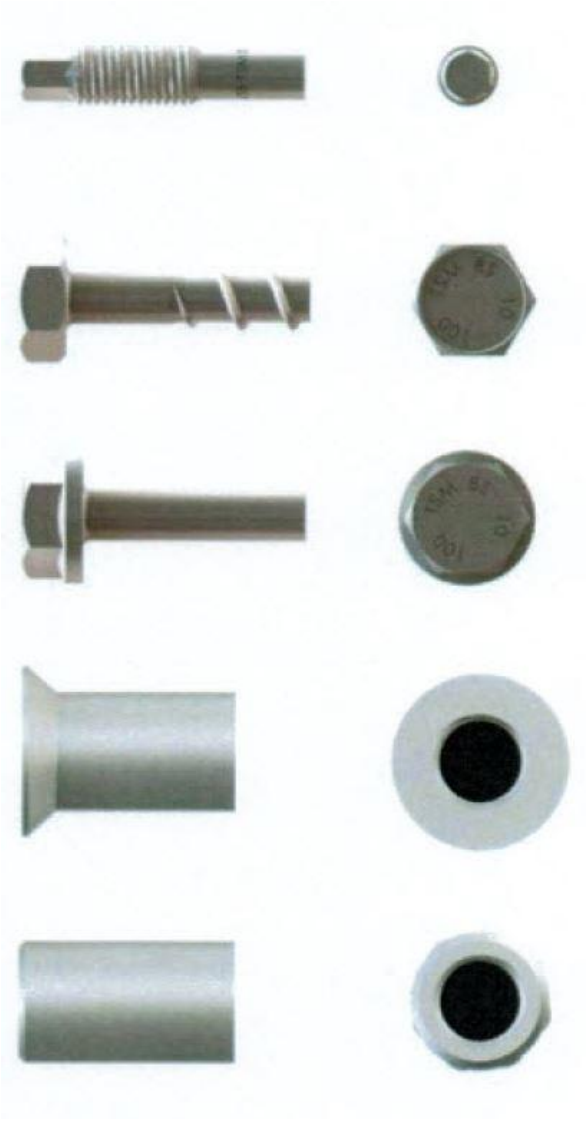
TOGE TSM IM internal sleeve (= socket with internal thread)



For installation in dry or damp concrete, but not in holes filled with water.

Temperature range: -40°C to +80°C
(max. brief temp. exposure +80°C and
max. long-term temp. exposure +50°C)

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 1
Product and installed condition	

	Version with connecting thread[1)], e.g. TSM-BC 10 x 100, M12 x 35 Version with hexagon head, e.g. TSM-BC 10 x 100, 17 AF Version with hexagon head and prepressed washer (flange head), e.g. TSM-BC 10 x 100, 15 AF Version with internal thread and hexagon socket, e.g. TSM-BC 16 x 105 IM 10 x 35 Version with collar, internal thread and hexagon socket, e.g. TSM-BC 16 x 105 IM 10 x 35

Stamp
Anchor type: TSM-B/TSM-BC/TSM-BS/TSM-BSH
Anchor size: 10
Anchor length: e.g. 100

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	**Annex 2**
Anchor dimensions and materials	

Table 2: Anchor dimensions and materials for TOGE TSM concrete screw

Anchor designation			TSM				
			10	**12**	**14**	**16**	**22**
Anchor length	L ≥	[mm]	85	105	120	110	205
	L ≤		310	310	310	310	950
Core diameter	d_K	[mm]	8.8	10.8	12.8	14.8	20.5
Outside diameter	d_s	[mm]	12.6	14.6	16.6	18.6	24.3
Material	**TSM B & BC**	[-]	Steel EN 10263-4 electrogalvanised to EN ISO 4042 or with zinc flake coating to EN ISO 10683 (≥ 5 µm), TOGE-KORR coating				
	TSM BS		Stainless steel according to corrosion resistance class III				
	TSM BSH		Stainless steel according to corrosion resistance class IV				

Table 3: Anchor dimensions and materials for TOGE TSM internal sleeve

Anchor designation			TSM	
			16 IM 10	**22 IM 16**
Anchor length	L ≥	[mm]	100	100
	L ≤		160	160
Core diameter	d_K	[mm]	14.8	20.5
Outside diameter	d_s	[mm]	18.6	24.3
Material	**TSM B & BC**	[-]	Steel EN 10263-4 electrogalvanised to EN ISO 4042 or with zinc flake coating to EN ISO 10683 (≥ 5 µm), TOGE-KORR coating	
	TSM BS		Stainless steel according to corrosion resistance class III	
	TSM BSH		Stainless steel according to corrosion resistance class IV	

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	**Annex 3**
Anchor dimensions and materials	

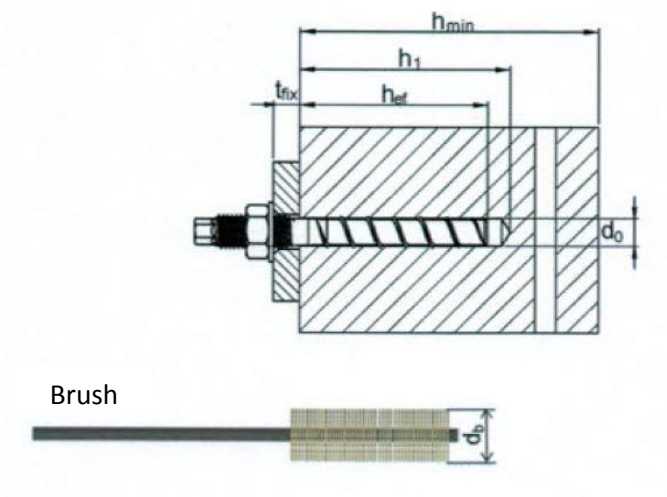


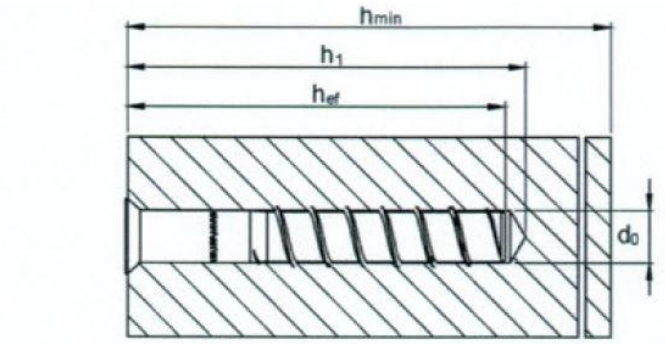
Table 4: Installation parameters for TOGE TSM concrete screw

Anchor designation			TSM				
			10	**12**	**14**	**16**	**22**
Nominal drill diameter	d_0	[mm]	10	12	14	16	22
Drill cutter diameter	$d_{cut} \leq$	[mm]	10.45	12.50	14.50	16.50	22.55
Depth of drilled hole	$h_1 \geq$	[mm]	80	100	100	100	100
Effective anchorage depth	$h_{ef,min}$ $h_{ef,max}$	[mm]	80 110	100 130	100 140	100 160	100 200
Brush diameter	d_b	[mm]	11	13	15	18	24
Through-hole in attached component	$d_f \leq$	[mm]	14	16	18	20	26
Tightening torque for nut	$T_{inst} \leq$	[Nm]	40	60	80	100	200

Table 5: Minimum building element thickness and minimum edge distances and spacings for TOGE TSM concrete screw

Anchor designation			TSM				
			10	**12**	**14**	**16**	**22**
Min. building element thickness	h_{min}	[mm]	h_{ef} + 60		h_{ef} + 70		h_{ef} + 100
Min. centre-to-centre spacing	s_{min}	[mm]	40	50	60	70	80
Min. edge distance	c_{min}	[mm]	40	50	60	70	80

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	**Annex 4**
Installation parameters – minimum building element thickness and minimum spacings and edge distances for TOGE concrete screw	



Brush

Table 6: Installation parameters for TOGE TSM internal sleeve

Anchor designation			TSM	
			16 IM 10	22 IM 16
Nominal drill diameter	d_0	[mm]	16	22
Drill cutter diameter	$d_{cut} \leq$	[mm]	16.50	22.55
Depth of drilled hole	$h_1 \geq$	[mm]	100	100
Effective anchorage depth	$h_{ef,min}$ $h_{ef,max}$	[mm]	100 160	
Brush diameter	d_b	[mm]	18	24
Through-hole in attached component	d_f ...	[mm]	12	18
Tightening torque	$T_{inst} \leq$	[Nm]	20	80

Table 7: Minimum building element thickness and minimum edge distances and spacings for TOGE TSM internal sleeve

Anchor designation			TSM	
			16 IM 10	22 IM 16
Min. building element thickness	h_{min}	[mm]	h_{ef} + 70	
Min. centre-to-centre spacing	s_{min}	[mm]	70	80
Min. edge distance	c_{min}	[mm]	70	80

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 5
Installation parameters – minimum building element thickness and minimum spacings and edge distances for TOGE internal sleeve	

Table 8: Characteristic values for tension loads on TOGE TSM concrete screw according to DIN SPEC 1021-4-4, design method A

Anchor designation			TSM					
			10	12	14	16	22	
							M20	M24
Steel failure								
Characteristic tension capacity	$N_{Rk,s}$	[kN]	42	64	90	110	174	214
Partial safety factor	γ_{Ms}	[-]	1.4			1.5		
Pull-out								
Characteristic tension capacity in cracked and uncracked concrete	$N_{Rk,p}$	[kN]	Pull-out is not critical					
Concrete break-out								
Effective anchorage depth	$h_{ef,min}$ $h_{ef,max}$	[mm]	80 110	100 130	100 140	100 160	100 200	
Factor for cracked and uncracked concrete	k_{cr} = k_{ucr}	[-]	7.2	8.5				
Centre-to-centre spacing	$s_{cr,N}$	[mm]	$3 \times h_{ef}$					
Edge distance	$c_{cr,N}$	[mm]	$1.5 \times h_{ef}$					
Partial safety factor	γ_{Mc} [1)]	[-]	1.5					
Splitting								
Centre-to-centre spacing	$s_{cr,sp}$	[mm]	$4 \times h_{ef}$					
Edge distance	$c_{cr,sp}$	[mm]	$2 \times h_{ef}$					
Partial safety factor	γ_{Msp} [1)]	[-]	1.5					

[1)] The partial safety factor $\gamma_2 = 1.0$ is included.

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 6
Design method A: Characteristic values for tension loads on TOGE TSM concrete screw	

Table 9: Characteristic values for tension loads on TOGE TSM internal sleeve according to DIN SPEC 1021-4-4, design method A

Anchor designation			TSM				
			16 IM 10		22 IM 16		
			5.8	A4, HCR	5.8	8.8	A4, HCR
Steel failure							
Characteristic tension capacity with grade 4.8 screws	$N_{Rk,s}$	[kN]	24	-	61	61	-
Characteristic tension capacity with grade 5.8 screws			30	-	72	76	-
Characteristic tension capacity with grade 8.8 screws			48	-	72	116	-
Characteristic tension capacity with grade A4 70 screws			-	42	-	-	107
Characteristic tension capacity with grade A4 80 screws			-	48	-	-	116
Partial safety factor	γ_{Ms}	[-]	1.5				
Pull-out							
Characteristic tension capacity in cracked and uncracked concrete	$N_{Rk,p}$	[kN]	Pull-out is not critical				
Concrete break-out							
Effective anchorage depth	$h_{ef,min}$ $h_{ef,max}$	[mm]	100 160				
Factor for cracked and uncracked concrete	k_{cr} = k_{ucr}	[-]	8.5				
Centre-to-centre spacing	$s_{cr,N}$	[mm]	3 x h_{ef}				
Edge distance	$c_{cr,N}$	[mm]	1.5 x h_{ef}				
Partial safety factor	γ_{Mc} [1)]	[-]	1.5				
Splitting							
Centre-to-centre spacing	$s_{cr,sp}$	[mm]	4 x h_{ef}				
Edge distance	$c_{cr,sp}$	[mm]	2 x h_{ef}				
Partial safety factor	γ_{Msp} [1)]	[-]	1.5				

[1)] The partial safety factor γ_2 = 1.0 is included.

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 7
Design method A: Characteristic values for tension loads on TOGE TSM internal sleeve	

Table 10: Characteristic values for shear loads on TOGE TSM concrete screw according to DIN SPEC 1021-4-4, design method A

Anchor designation			TSM				
			10	**12**	**14**	**16**	**22**
Steel failure without lever arm							
Characteristic shear capacity	$V_{Rk,s}$	[kN]	34	42	64	96	107
Factor	k_2	...	1.0				
Partial safety factor	γ_{Ms}	[-]	1.5				
Steel failure with lever arm							
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	56	123	200	347	730
Partial safety factor	γ_{Ms}	[-]	1.5				
Rearward concrete break-out							
Factor in Eq. 16	k_3	[-]	2.0				
Partial safety factor	γ_{Mc} [1)]	[-]	1.5				
Concrete edge failure							
Effective anchor length	l_f	[kN]	h_{ef}				
Effective outside diameter	d_{nom}	[mm]	10	12	14	16	22
Partial safety factor	γ_{Mc} [1)]	[-]	1.5				

[1)] The partial safety factor γ_2 = 1.0 is included.

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 8
Design method A: Characteristic values for shear loads on TOGE TSM concrete screw	

Table 11: Characteristic values for shear loads on TOGE TSM internal sleeve according to DIN SPEC 1021-4-4, design method A

Anchor designation			TSM				
			16 IM 10		22 IM 16		
			5.8	A4, HCR	5.8	8.8	A4, HCR
Steel failure without lever arm							
Characteristic shear capacity with grade 4.8 screws	$V_{Rk,s}$	[kN]	12	-	31	31	-
Characteristic shear capacity with grade 5.8 screws			15	-	31	38	-
Characteristic shear capacity with grade 8.8 screws			24	-	31	58	-
Characteristic shear capacity with grade A 4-70 screws			-	21	-	-	54
Characteristic shear capacity with grade A 4-70 screws			-	24	-	-	58
Factor	k_2	[-]	0.8				
Partial safety factor	γ_{Ms}	[-]	1.5				
Steel failure with lever arm							
Characteristic bending moment with grade 4.8 screws	$M^0_{Rk,s}$	[kN]	30	-	115		-
Characteristic bending moment with grade 5.8 screws			37	-	143		-
Characteristic bending moment with grade 8.8 screws			60	-	230		-
Characteristic bending moment with grade A 4-70 screws			-	56	-		200
Characteristic bending moment with grade A 4-80 screws			-	60	-		230
Partial safety factor	γ_{Ms}	[-]	1.5				
Rearward concrete break-out							
Factor in Eq. 16	k_3	[-]	2.0				
Partial safety factor	γ_{Mc} [1)]	[-]	1.5				
Concrete edge failure							
Effective anchor length	l_f	[kN]	h_{ef}				
Effective outside diameter	d_{nom}	[mm]	16		22		
Partial safety factor	γ_{Mc} [1)]	[-]	1.5				

[1)] The partial safety factor $\gamma_2 = 1.0$ is included.

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 9
Design method A: Characteristic values for shear loads on TOGE TSM internal sleeve	

Table 12: Displacement under tension loads for TOGE TSM concrete screw

Anchor designation			TSM				
			10	12	14	16	22
Load			**23.3**	**30.0**	**33.5**	**41.0**	**57.2**
Associated displacement	δ_{N0}	[mm]	0.6	0.7	0.8	0.8	0.8
	$\delta_{N\infty}$		0.6	0.7	0.8	1.1	0.8

Table 13: Displacement under shear loads for TOGE TSM concrete screw

Anchor designation			TSM				
			10	12	14	16	22
Load			**16.2**	**20.0**	**30.5**	**45.7**	**50.9**
Associated displacement	δ_{V0}	[mm]	2.7	4.1	4.6	4.0	6.15
	$\delta_{V\infty}$		4.3	6.2	7.0	6.0	9.2

Table 14: Displacement under tension loads for TOGE TSM internal sleeve

Anchor designation			TSM	
			16	22
Load			**45.7**	
Associated displacement	δ_{N0}	[mm]	0.5	1.2
	$\delta_{N\infty}$		1.0	1.2

Table 15: Displacement under shear loads for TOGE TSM internal sleeve

Anchor designation			TSM	
			16	22
Load			**13.3**	**27.6**
Associated displacement	δ_{V0}	[mm]	0.5	1.2
	$\delta_{V\infty}$		1.0	1.2

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 10
Displacement under tension and shear loads for TOGE TSM concrete screw and TSM internal sleeve	

Table 16: Characteristic values for fire exposure in cracked and uncracked concrete of class C20/25 to C50/60 for TOGE TSM concrete screw in all loading directions

Anchor designation				TSM				
				10	12	14	16	22
Fire resistance class								
R 30	Characteristic load-carrying capacity	$F^0_{Rk,fi30}$ [2]	[kN]	4.0	6.3	9.8	13.9	23.8
R 60	Characteristic load-carrying capacity	$F^0_{Rk,fi60}$ [2]	[kN]	3.3	5.8	8.1	11.0	21.6
R 90	Characteristic load-carrying capacity	$F^0_{Rk,fi90}$ [2]	[kN]	2.2	4.2	5.9	8.0	15.8
R 120	Characteristic load-carrying capacity	$F^0_{Rk,fi120}$ [2]	[kN]	1.7	3.4	4.8	6.5	12.8
R 30 to R 120	Centre-to-centre spacing	$s_{cr,fi}$	[mm]	4 h_{ef}				
		s_{min}		40	50	60	70	80
	Edge distance	$c_{cr,fi}$		2 h_{ef}				
		c_{min}		2 h_{ef}				

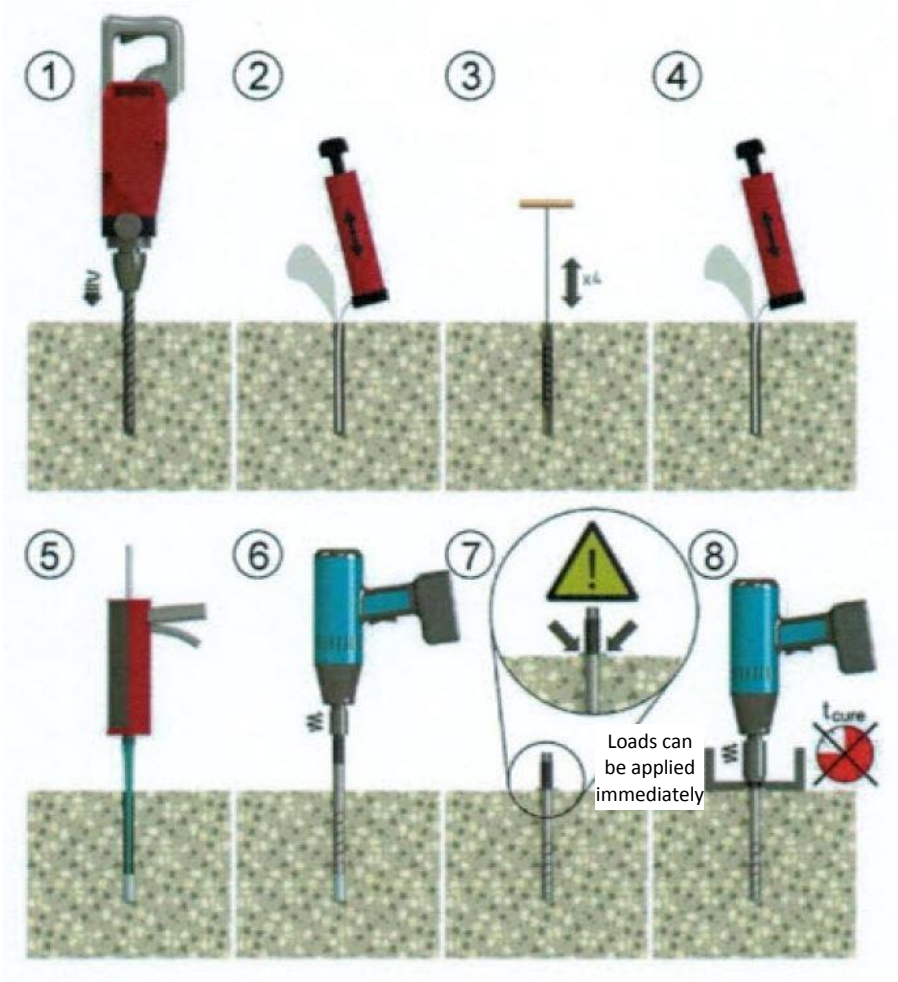
Table 17: Characteristic values for fire exposure in cracked and uncracked concrete of class C20/25 to C50/60 for TOGE TSM internal sleeve in all loading directions

Anchor designation				TSM	
				16 IM 10	22 IM 16
Fire resistance class					
R 30	Characteristic load-carrying capacity	$F^0_{Rk,fi30}$ [2]	[kN]	4.9	11.7
R 60	Characteristic load-carrying capacity	$F^0_{Rk,fi60}$ [2]	[kN]	3.8	9.2
R 90	Characteristic load-carrying capacity	$F^0_{Rk,fi90}$ [2]	[kN]	2.7	6.7
R 120	Characteristic load-carrying capacity	$F^0_{Rk,fi120}$ [2]	[kN]	2.3	5.5
R 30 to R 120	Centre-to-centre spacing	$s_{cr,fi}$	[mm]	4 h_{ef}	
		s_{min}		70	80
	Edge distance	$c_{cr,fi}$		2 h_{ef}	
		c_{min}		2 h_{ef}	

[1] For fire exposure, the partial safety factor for load-carrying capacity is $\gamma_{M,fi} = 1.0$
[2] In the case of exposure to fire from more than one side, the edge distance must be ≥ 300 mm.

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	Annex 11
Characteristic values for fire exposure to DIN SPEC 1021-4-4, design method B	

Installation instructions



1) Drill hole (with hammer drill or diamond-tipped core drill).	Temperature of installation substrate	Processing time
2) Blow out hole from bottom up.	≥ -5°C	60 min
3) Brush out hole four times.	≥ 0°C	60 min
4) Blow out hole again from bottom up.	≥ 10°C	60 min
5) Inject chemical mortar.	≥ 20°C	45 min
6) Screw in concrete screw.	≥ 30°C	15 min
7) After reaching the embedment depth, chemical mortar must flow out onto the concrete surface.	≥ 40°C	5 min 4 min
8) The component to be fixed can be attached immediately. It is not necessary to wait until the chemical mortar has cured.	Curing time in dry hole	Curing time in wet hole
	360 min	720 min
	180 min	360 min
	120 min	240 min
	80 min	160 min
	45 min	90 min
	25 min	50 min
	20 min	40 min

TOGE Adhesive Concrete Screw TSM-B, BC, BS, BSH	**Annex 12**
Installation instructions	