

EUROPEAN ASSESSMENT DOCUMENT

EAD 330012-00-0601

September 2015

CAST-IN ANCHOR
WITH
INTERNAL THREADED SOCKET

The reference title and language for this EAD is English. The applicable rules of copyright refer to the document elaborated in and published by EOTA.

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1	Scope of the EAD	4
1.1	Description of the construction product	4
1.2	Information on the intended use(s) of the construction product	7
1.2.1	Intended use	7
1.2.2	Working life/ Durability.....	7
1.3	Specific terms used in this EAD	8
2	Essential characteristics and relevant assessment methods and criteria	9
2.1	Essential characteristics of the product	9
2.2	Assessment methods and criteria the performance of the product in relation to essential characteristics of the product	10
2.2.1	General for functioning tests	10
2.2.2	Functioning in low and high strength concrete.....	12
2.2.3	Functioning in crack movements	13
2.2.4	Functioning under repeated loads	13
2.2.5	Maximum torque moment.....	14
2.2.6	General for evaluating characteristics	14
2.2.7	Characteristic resistance to tension load due to steel failure.....	17
2.2.8	Characteristic resistance to tension load due to pull-out and concrete cone failure	17
2.2.9	Characteristic resistance to tension load due to blow-out and splitting failure	19
2.2.10	Characteristic resistance to shear load due to steel failure	20
2.2.11	Characteristic resistance to shear load due to concrete failure	20
2.2.12	Characteristic shear resistance close to an edge with special supplementary reinforcement	21
2.2.13	Minimum edge distance.....	21
2.2.14	Combined tension and shear (oblique loading)	21
2.2.15	Characteristic displacements	22
2.2.16	Durability.....	22
2.2.17	Reaction to fire.....	23
2.2.18	Resistance to fire.....	23
3	ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE	24
3.1	System of assessment and verification of constancy of performance to be applied	24
3.2	Tasks of the manufacturer	24
3.3	Tasks of the notified body	25
4	Reference documents	26

1 SCOPE OF THE EAD

1.1 Description of the construction product

The EAD “Cast-an anchor with internal threaded socket” covers the assessment of pre-installed anchors embedded in concrete according to EN 206 and anchored by bonding and mechanical interlock.

The cast-in anchor consists of an internal threaded socket made of metal which is anchored by a ribbed reinforcement bar (figure 1.1, a), a steel rod placed through a hole in the socket (figure 1.1, b) or by interlock activated by a deformed section of the socket (figure 1.1, c). A head may be forged to the end of the ribbed reinforcement bar located on the opposite side of the socket. The internal threaded socket may be anchored by a hexagonal bolt.

For cast-in anchors acc. fig. 1.1 b) and c) the steel rod or the deformed section of the socket and the threaded part of the socket should be designed with equivalent stiffness to avoid massive deformation of the steel rod or the socket.

The socket and an optional steel rod are made of carbon steel or stainless steel.

The optional ribbed reinforcement bar is made of reinforcing steel. It is deformed to different shapes (not straight) and fulfils the following essential requirements:

- | | | |
|--|--|--|
| - Tensile yield strength: | | $R_e \geq 500 \text{ N/mm}^2$; |
| - Stress ratio (maximum strength/ tensile yield strength): | | $R_m/R_e \geq 1.08$; |
| - Elongation at maximum load: | | $A_{gt} \geq 0.05$; |
| - Bonding strength: | relative rib area | $f_R \geq 0,045$ (for $d = 6.5 - 8.5 \text{ mm}$),
$f_R \geq 0,052$ (for $d = 9.0 - 10.5 \text{ mm}$),
$f_R \geq 0,045$ (for $d = 11.0 - 28.0 \text{ mm}$); |
| - Bendability: | The suitability for bending is determined according to EN ISO 15630-1:2002 with mandrel diameter | $d_m = 5d$ (for $d = 8 - 12$),
$d_m = 6d$ (for $d = 14 - 16$),
$d_m = 8d$ (for $d = 16 - 25$),
$d_m = 10d$ (for $d = 28$); |
| - Weldability: | The chemical composition shall be according to | EN 10080:2005, Table 2; |
| - Sections and tolerances on sizes: | | $A_n = 0.28 - 6.16 \text{ cm}^2$ and the sectional area shall not fall below $0.96A_n$ |

The socket is acc. to EN 10305-1/-2/-3 [8] and EN 10088-3 [3], EN 10216-5 [9], EN 10217-7 [10].

Configurations of components and corresponding material are as follows:

- (1) Socket, if applicable steel rod and if applicable bar of ribbed reinforcement bar are made of carbon steel optional zinc coated (e.g. electroplated) with a minimum thickness of $5 \mu\text{m}$.
- (2) Socket, if applicable steel rod and if applicable bar of ribbed reinforcement bar are made of carbon steel hot dip galvanised according EN ISO 1461 or EN ISO 10684 with at least of $50 \mu\text{m}$ thickness.
- (3) Socket and if applicable steel rod are made of stainless steel material 1.4401, 1.4404, 1.4571, 1.4578, 1.4362, 1.4062, 1.4162, 1.4662, 1.4439, 1.4462 or 1.4539 according to EN 10088-4 and 5 [3].
- (4) Socket and if applicable steel rod are made of stainless steel material 1.4529, 1.4565 and 1.4547 according to EN 10088- 4 and 5 [3].
- (5) Socket made of stainless steel material 1.4401, 1.4404, 1.4571, 1.4578, 1.4362, 1.4062, 1.4162, 1.4662, 1.4439, 1.4462 or 1.4539 according to EN 10088-4 and 5 [3] and ribbed reinforcement bar made of reinforcing steel. A coating is inside of the socket on top of the bar.

This EAD applies to anchors with a minimum thread size of 6 mm (M6).

In general, the minimum length of the anchor in the concrete member h_{nom} is 50 mm.

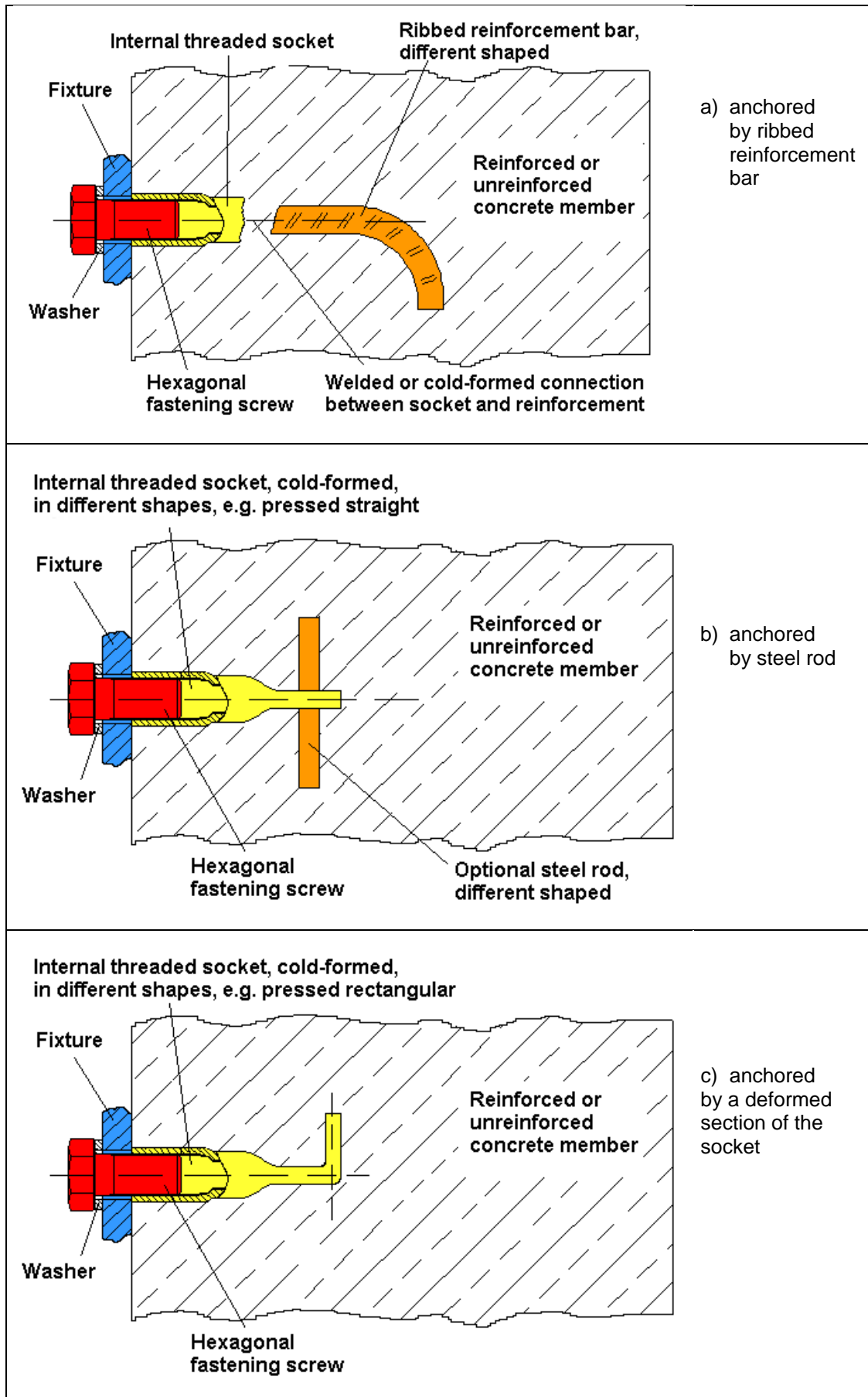


Figure 1.1: Examples for internal threaded socket differently anchored in assembled state

The anchor can be supplemented by a reinforcement (supplementary reinforcement) to increase the resistance of the anchor.

Different versions of the anchor with respect to material, strength or dimensions are marked such that the relevant product characteristic is allocated to the corresponding anchor type.

The product is not covered by a harmonised European standard (hEN).

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use

The cast-in anchor with internal threaded socket is intended to be used for permanent anchorages under predominantly static actions or quasi-static actions in reinforced and unreinforced normal weight concrete between strength classes C20/25 and C90/105. However in the calculation of resistances of cast-in anchors with internal threaded socket the values of $f_{ck,cube 150}$ shall not exceed 60 N/mm², even if the structure uses a higher strength class.

The cast-in anchor is intended to be anchored in cracked or non-cracked concrete.

The cast-in anchor is intended to be used for transmission of tensile loads, shear loads or a combination of both.

The cast-in anchor is intended to be embedded surface-flush or sunk in the concrete member.

Depending on the materials used for the cast-in anchor it shall be used in structures subjected to the following categories (see for details section 2.2.15.2):

- dry internal conditions,
- external atmospheric exposure or exposure in permanently damp internal conditions.

The cast-in anchor is intended to be used in the temperature range -40°C to +80°C without special assessment.

The fixture is assembled to the cast-in anchor with a fastening screw and washer or a threaded rod, a washer and a nut.

These elements may be delivered by the manufacturer. They are not part of the cast-in anchor and its assessment. Characteristic resistances to tension and shear loads for steel failure of these elements have to be given according to valid standards in the relevant ETA. The resistances must include the length of the thread screwed in the socket.

The anchor is intended to be used for anchorages which are designed according to the design method given in CEN/TS 1992-4:2009 "Design of fastenings for use in concrete", part 1 and 2 [7]. Anchors acc. Fig. 1.1 a) loaded in tension a supplementary reinforcement must not be considered in the design acc. CEN/TS 1992-4:2009 [7].

It is assumed that the installation of the product will be undertaken in line with the manufacturer's product installation instructions.

This EAD takes account of a reasonable degree of imperfection in relation to installation and thus control methods on site after installation will in general not be necessary. This assumes, however, that gross errors on site will be avoided by use of instructions and correct training of the installers and supervision on site.

1.2.2 Working life/ Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the fastener for the intended use of 50 years when installed in the works (provided that the anchor channel is subject to appropriate installation (see 1.1)) These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works¹.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD

The specific terms used in this EAD are given in ETAG 001 [1].

¹ The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1 shows how the performance of the anchor is assessed in relation to the essential characteristics.

Table 2.1 Essential characteristics of the product and assessment methods and criteria for performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
Basic Works Requirement 1: Mechanical resistance and stability			
1	Characteristic resistance under static and quasi-static loading	2.2.1 – 2.2.15	level ($N_{Rk,s}$, $N_{Rk,p}$ [kN])
			level (k_{cr} , k_{ucr} [-], h_{ef} , $C_{cr,N}$, $S_{cr,N}$, $C_{cr,sp}$, $S_{cr,sp}$ [mm])
			level ($V_{Rk,s}$ [kN], $V_{Rk,c,rc}$ or NDP, $M^0_{Rk,s}$ [Nm])
			level (k_3 [-], l_f , d_{nom} [mm])
			level (C_{min} , S_{min} , h_{min} [mm], $L_{sd,min}$, $L_{sd,max}$ [mm], T_{inst} [Nm])
2	Displacements	2.2.16	level (δ_{N0} , $\delta_{N\infty}$, δ_{V0} , $\delta_{NV\infty}$ [mm])
3	Durability	2.2.17	description (steel if applicable galvanised) or
			description (stainless steel) or
			description (stainless steel and reinforcing steel)
Basic Works Requirement 2: Safety in case of fire			
4	Reaction to fire	2.2.18	class (A1)
5	Resistance to fire	2.2.19	No classification for the anchor itself

2.2 Assessment methods and criteria the performance of the product in relation to essential characteristics of the product

The anchor can be characterised according to Table 2.2.

Table 2.2: Material and dimensions of the product

No	Product property	Test method
1	Dimensions (outer diameter and length of the socket, diameter of the reinforcement bar or steel rod, length of the complete anchor etc.)	Measuring or optical
2	Tensile Load (N_p) or tensile strength (f_{uk})	Similar to ISO 898-1
3	Yield strength (f_{yk} or $N_{p0.2}$)	Similar to ISO 898-1
4	Core hardness and surface hardness (at specified functioning relevant points of the product)(where relevant)	Tests acc. to EN ISO 6507 or EN ISO 6508
5	Zinc plating (where relevant)	measurement
6	Fracture elongation A_5	Similar to ISO 898-1

The essential characteristics are only valid if the following conditions are reflected in the ETA and fulfilled on jobsite:

- (1) The following installation values have to be observed in the planning
 - minimum member thickness,
 - minimum edge distance of anchors,
 - minimum spacing of the anchors,
 - minimum and maximum screw-in depth.
- (2) The edge distance and spacing of the anchor, the minimum and maximum screw-in depth of the screw and the maximum setting torque have to be kept to the specified values.
- (3) use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor.
- (4) cast-in anchor should be fixed to the formwork or auxiliary constructions in a way that no movement of the anchor will occur during placing of reinforcement or during pouring and compacting of the concrete,
- (5) adequate compaction close to the anchor particularly at the reinforcement bar, the optional steel rod or the rectangular pressed socket acc. to figure 1.1, e. g. without significant voids. The cast-in anchor is protected against ingress of concrete into the threaded socket,

2.2.1 General for functioning tests

The purpose of the functioning tests is to establish whether an anchor is capable of safe, effective behaviour in service including consideration of adverse conditions both during site installation and in service.

The types of functioning tests, test conditions, the number of required tests and the criteria applied to the results should be taken in accordance with Table 2.2. Detailed information about special tests is given in the chapters after this Table.

Table 2.2 Functioning tests for cast-in anchors to be used in concrete

	Purpose of test	Concrete	Crack width $\Delta w(\text{mm})$	Minimum number of tests for anchor size (1)					Criteria	
				s	i	m	i	l	load/dis. beh.	req. α
1	Functioning in low strength concrete	C20/25	0,5	3	3	3	3	3		$\geq 0,8$
2	Functioning in high strength concrete	C50/60	0,5	3 (2)		3 (2)		3 (2)		$\geq 0,8$
3	Functioning in crack movements	C20/25	0,1-0,3	3		3		3		$\geq 0,9$
4	Functioning under repeated loads	C20/25	0			3				$\geq 1,0$
5	Maximum torque moment ($T \geq 1,3 T_{\text{inst}}$)	C50/60	0	3				3	$F_{v95\%}/(A_s f_{yk})_{\text{min}} \leq 1,0$	

(1) Anchor size: s = smallest, i = intermediate, m = medium, l = largest

(2) Tests can be omitted if in tests acc. Table 2.3, line 4 only steel failure is decisive

The tests shall be performed as single anchor tests in concrete members without any influence by edge and spacing effects under tension loading.

The anchors should be installed according to the installation instructions (including the depth of the screw in the socket) of the manufacturer.

For each test series according to Table 2.2, line 1 to 4 the factor α_u according to ETAG 001-1 [1], section 6.1.1.1 (d) shall be calculated. The factor α shall be larger than the values given in Table 2.2 of this EAD. If the requirements on the ultimate load in the functioning tests are not fulfilled in one or more test series, then the reduction factor α_u shall be calculated according to (2.4.1):

$$\alpha_u = \alpha / \text{req. } \alpha \quad (2.4.1)$$

with: α = lowest value according to ETAG 001-1 [1], equation (6.2) of all test series

req. α = required value of α according to Table 2.2, respectively

α should be calculated according ETAG 001-1 [1] as a comparison of the ultimate or mean value of the tests (Table 2.2) with the adequate values of reference tests:

In general the reference tension load should be evaluated from the tension tests according Table 2.3, line 1 to 4.

For cast-in anchors as given in fig. 1.1 a) the reference ultimate load may be calculated according to this section, (a) and (b), if this calculation is proven by tests according to Table 2.2, line 1 and Table 2.3., line 3 and 4.

The concrete cone failure should be calculated not influenced by edge and spacing effects with h_{ef} according to section 2.2.8.2., passage (b) "Concrete cone failure".

(a) Cracked concrete

$$N_u = N_{u,h} + N_{u,b} \leq N_{u,s} \text{ and } \leq N_{Rk,c} \quad (2.4.2)$$

N_u = calculated reference ultimate load

with: $N_{u,h}$ = ultimate load part of the hook

$$N_{u,h} = \alpha_{hook} \cdot A_s \cdot f_{yk} \cdot (f_{cc,150}/31,6)^{0,5} \quad (2.4.3)$$

$\alpha_{hook} = 0,8$

$N_{u,b}$ = ultimate load part for the bonding

$$N_{u,b} = \pi \cdot d_s \cdot l_v \cdot \tau_u \quad (\text{non-cracked concrete}) \quad (2.4.4)$$

$$N_{u,b} = 2/3 \cdot \pi \cdot d_s \cdot l_v \cdot \tau_u \quad (\text{cracked concrete}) \quad (2.4.5)$$

$N_{u,s}$ = minimum ultimate load for steel failure

$$N_{u,s} = \min. \left\{ \begin{array}{l} A_s \cdot f_u \quad \text{steel failure of the reinforcement bar} \\ A_{s,s} \cdot f_{u,s} \quad \text{steel failure of the socket} \\ N_{u,sc} \quad \text{failure of connection between socket and} \\ \quad \quad \quad \text{reinforcement bar (test acc. to Table 2.3, line 8)} \end{array} \right.$$

$$N_{Rk,c} = 7.2 \cdot \sqrt{f_{cc,150}} \cdot h_{ef}^{1.5} \quad (2.4.6)$$

$A_{s(s)}$ = cross-section of reinforcement bar (socket)

f_{yk} = characteristic steel yield strength

$f_{cc,150}$ = characteristic concrete compression strength measured on cubes with a side length of 150 mm

d_s = diameter of reinforcement bar

l_v = bond length of reinforcement bar without hook

τ_u = ultimate bond strength

$$\tau_u = 1,5 \cdot f_{bd} / 0,75 = 4,5 \text{ N/mm}^2 \text{ (C20/25)}$$

$$\tau_u = 8,7 \text{ N/mm}^2 \text{ (C50/60)}$$

$$f_{bd} = (2,25 f_{ctk;0,05}) / \gamma_c \quad \text{with } \gamma_c = 1,5$$

$f_{ctk;0,05}$ = 5%-fractile of the characteristic concrete central tensile strength

$$f_{ctk;0,05} = 1,5 \text{ N/mm}^2 \text{ (C20/25)}$$

$$f_{ctk;0,05} = 2,9 \text{ N/mm}^2 \text{ (C50/60)}$$

$f_{s(s)}$ = characteristic steel ultimate tensile strength of reinforcement bar (socket)

$N_{u,sc} = l_w \cdot a_w \cdot f_s / (3^{0,5} \cdot \beta_w)$ if the connection is welded

l_w (a_w) = length and thickness of the welding

β_w = according to EN 1993-1-8:2005+AC:2009 [11], section 4.5.3.2, Table 4.1

In all other cases the connection has to be assessed by testing according to Table 2.3, line 8.

(b) Non-cracked concrete

The reference tension load should be evaluated by the tests according Table 2.3, line 1, 2 and 5. The 5%-fractile is limited by concrete cone failure calculated according (2.4.7).

$$N_{Rk,c} = 10.1 \cdot \sqrt{f_{cc,150}} \cdot h_{ef}^{1.5} \quad (2.4.7)$$

2.2.2 Functioning in low and high strength concrete

The single anchors are tested in tension and loaded to failure. The tests should be performed according to ETAG 001 [1], Annex A. The anchors shall not be applied with a defined torque moment before testing. Details of the test are described in ETAG 001 [1], Annex A, section 5.2.1.

The tests shall show a steady increase of load during testing without uncontrolled slip below 70 % of the ultimate load of the anchor in each test (See also 2.2.6.2, passage "Coefficient of variation of load/displacement behaviour for all tests").

2.2.3 Functioning in crack movements

The single anchors are tested under fix tension load N_p (required) according to equation (2.4.8) in cracked concrete.

$$N_p(\text{required}) = 0.75 N_{Rk} / \gamma_{MC} \quad (2.4.8)$$

with: N_{Rk} = characteristic tensile resistance in cracked concrete C20/25 evaluated according to 2.2.8.2

γ_{MC} = according ETAG 001 [1], Annex C (≥ 1.5)

The concrete member shall be subjected to 1000 load cycles. The anchors shall not be applied with a defined torque moment before testing. After completion of the crack movements the anchors should be unloaded the displacement measured and a tension test to failure according to ETAG 001 [1], Annex A, section 5.2.1 performed with $\Delta w = 0.3$ mm.

Further details of the test are described in ETAG 001 [1], Annex A, section 5.5.

Generally, in each test the rate of increase of anchor displacements should either decrease or be almost constant, respectively: the displacement should be less than 2 mm after 20 cycles of crack openings and less than 3 mm after 1000 cycles. Further details are described in ETAG 001-1 [1], section 6.1.1.2. If the above condition on the displacement is not fulfilled, the tests have to be repeated with a lower load (N_p (applied)) until this condition is fulfilled. Then the characteristic resistance N_{Rk} should be reduced with the factor N_p (applied)/ N_p (required acc. (2.4.8)).

2.2.4 Functioning under repeated loads

The cast-in anchors are subjected to 10^5 load cycles with a maximum frequency of approximately 6 Hz. During each cycle the load shall change as a sine curve between max N and min N according to (2.4.9) and (2.4.10).

$$\text{max N (required)} = \text{smaller value of } 0.6 N_{Rk} \text{ and } 0.8 A_s f_{yk} \quad (2.4.9)$$

$$\text{min N (required)} = \text{higher value of } 0.25 N_{Rk} \text{ and } A_s \Delta\sigma_s \quad (2.4.10)$$

with: N_{Rk} = characteristic anchor failure load in tension in non-cracked concrete for the concrete strength of the test member. N_{Rk} is calculated from the results of tension tests according to 2.2.8.2 on single anchors without edge and spacing effects.

A_s = stressed anchor cross-section

$\Delta\sigma_s$ = 120 N/mm²

The anchors shall not be applied with a defined torque moment before testing. After completion of the load cycles the anchors should be unloaded the displacement measured and a tension test to failure performed according to ETAG 001 [1], Annex A, section 5.2.1. Details of the test are described in ETAG 001 [1], Annex A, section 5.6.

The increase of displacement during cycling shall stabilize in a manner indicating that failure is unlikely to occur after some additional cycles.

If the above condition on the displacement is not fulfilled, the tests have to be repeated with a lower maximum load ($\max N$ (applied)) until this condition is fulfilled. Then the characteristic resistance N_{Rk} should be reduced with the factor $\max N$ (applied)/ $\max N$ (required acc. (2.4.9)).

2.2.5 Maximum torque moment

The cast-in anchors shall be installed sunk in the concrete member so that the internal threaded socket is not be tensioned against the fixture. The torque moment is applied with a calibrated torque wrench until failure of the cast-in anchor. The tension force in the cast-in anchor shall be measured as a function of the applied torque moment.

The 95%-fractile of the tension force generated in the torque tests at a torque moment $T = 1.3 T_{inst}$ shall be smaller than the nominal yield force of the anchor or the concrete failure load. The nominal yield force of the anchor is the tension load which reaches at minimum the yield limit of all steel parts of the anchor.

After the test the connection between socket and bolt should be capable of being unscrewed.

If the generated tension force is higher than mentioned above T_{inst} should be reduced correspondingly.

2.2.6 General for evaluating characteristics

The purpose of the tests for evaluating characteristics is to establish the resistance subjected to the loading direction, the mode of failure and the spacing respectively edge distance.

The types of tests for evaluating characteristics, test conditions, the number of required tests and the criteria applied to the results should be taken in accordance with Table 2.3. Detailed information about special tests is given in the chapters after this Table.

Tests for intermediate size can be omitted if interpolation is geometrically explainable.

Table 2.3 Tests for evaluating characteristics for cast-in anchors for use in concrete

	1	2	3	4	5	6				
						Number of tests (2)				
	Purpose of test	Concrete	Crack width	Load direction	Remarks: Test with ...	s	i	m	i	l
1	Characteristic resistance for tension loading not influenced by edge and spacing effects (1)	C20/25	0	N	Single anchors	3 (3)	3 (3)	3	3 (3)	3 (3)
2	Characteristic resistance for tension loading not influenced by edge and spacing effects (1)	C50/60	0	N	Single anchors	3 (4)	3 (4)	3 (4)	3 (4)	3 (4)
3	Characteristic resistance for tension loading not influenced by edge and spacing effects (1)	C20/25	0,3	N	Single anchors	3 (5)	3 (5)	3	3 (5)	3 (5)
4	Characteristic resistance for tension loading not influenced by edge and spacing effects (1)	C50/60	0,3	N	Single anchors	5		5		5
5	Edge distance for characteristic tension resistance ($c_1=c_2=c_{cr,sp}$) (6)	C20/25	0	N	Single anchors at the corner	3	3	3	3	3
6	Characteristic shear resistance close to an edge	C20/25	0	V	Single anchors at the edge with hanger reinforcement	5 (7)				
7	Minimum edge distance for characteristic tension resistance	C20/25	0	T	Double anchor group at the edge	5		5		5
8	Characteristic resistance for tension loading (steel failure)	---	---	N	pure steel, anchor in assembled state	3 (8)	3 (8)	3 (8)	3 (8)	3 (8)

- (1) Reference tension tests for determination of the results of the functioning tests. They have to be carried out at the same concrete as it is given for the corresponding functioning tests (cracked/ non-cracked concrete, compressive strength). The results of reference tests may also be considered for evaluating the characteristic resistance of the anchors,
- (2) Anchor size: s = smallest, i = intermediate, m = medium, l = largest,
- (3) Tests can be omitted if tests of line 5 are evaluated here,
- (4) Tests can be omitted if tests of line 4 are evaluated here,
- (5) Tests can be omitted if tests of Table 2.2, line 1 are evaluated here,
- (6) Where blow-out failure occur c_1 should be decreased to $< 0.5 h_{ef}$
- (7) Tests for each type of special hanger reinforcement, tests can be omitted if supplemental reinforcement is used and calculated according to CEN/TS 1992-4-1:2009,
- (8) Only for cast-in anchors according to Fig. 1.1. a) which are connected by pressed socket. One test series (=three tests) for each size and each material.

All tests for determination of characteristics should be carried out according to ETAG 001 [1], Annex A in the concrete for which the cast-in anchor is intended to be used at normal ambient temperature ($+21^\circ\text{C} \pm 3^\circ\text{C}$).

The anchors should be installed according to the installation instructions (including the depth of the screw in the socket) of the manufacturer.

The minimum edge distance c_{min} , minimum spacing s_{min} and minimum thickness of the concrete member should be given by the manufacturer and should be confirmed by the corresponding tests.

Determination of the ultimate loads

5 %-fractile of the ultimate loads:

The 5 %-fractile of the ultimate loads measured in a test series is to be calculated according to statistical procedures for a confidence level of 90 %. If a precise assessment does not take place, in general, a normal distribution and an unknown standard deviation of the population shall be assumed.

$$F_{5\%} = \bar{F} (1 - k_s \cdot v) \quad (2.4.11)$$

e.g.: $n = 5$ tests: $k_s = 3.40$
 $n = 10$ tests: $k_s = 2.57$

with: $F_{5\%} =$ 5 %-fractile of the ultimate load
 $F =$ mean value of ultimate load in a test series
 $k_s =$ statistical factor
 $v =$ coefficient of variation

Conversion of ultimate loads to take account of concrete and steel strength:

In some cases it can be necessary to convert the results of a test series to correlate with a concrete strength different from that of the test member (e.g. when comparing the results of repeated load tests with results of static tension tests performed on a different test member). When doing so, the type of failure shall be taken into account.

In the case of concrete failure, this conversion should be carried out according to Equation (2.4.12a)

$$F_{Ru}(f_c) = F_{Ru}^t (f_c/f_{c,test})^{0.5} \quad (2.4.12a)$$

with:

$$F_{Ru}(f_c) = \text{failure load at concrete compression strength } f_c$$

$$F_{Ru}^t = \text{failure load at a test}$$

$$f_{c,test} = \text{concrete compression strength at a test}$$

In the case of pull-out failure the influence of the concrete strength on the failure load should be established. In the absence of better information, Equation (2.4.12a) shall be used as an approximation.

In the case of steel failure the failure load shall be converted to the nominal steel strength by Equation (2.4.12b)

$$F_{Ru}(f_{uk}) = F_{Ru}^t f_{uk}/f_{u,test} \quad (2.4.12b)$$

with:

$$F_{Ru}(f_{uk}) = \text{failure load at nominal steel ultimate strength}$$

Criteria valid for all tests

Coefficient of variation of load/displacement behaviour for all tests

The load/displacement curve of each test shall show a steady increase. The scatter of the load/displacement curves for tests acc. Table 2.2 shall be smaller than $v_{\delta,S}=40\%$ and for tests acc. Table 2.3 shall be smaller than $v_{\delta,S}=25\%$ to prevent a significant decrease of the failure load of anchors. Details of the assessment of the load/displacement behaviour are described in ETAG 001-1 [1], section 6.1.1.1. (a) and (b). If the requirements on the load/displacement behaviour are not fulfilled by the tension tests, a reduction factor α_δ for each test shall be calculated according to (2.4.13):

$$\alpha_\delta = \alpha_1 / \text{req. } \alpha_1 \quad (2.4.13)$$

with: $\alpha_1 =$ lowest ratio $N(\text{load of uncontrolled slip})/N(\text{ultimate load})$ of all tests according to ETAG 001-1 [1], section 6.1.1.1

req. $\alpha_1 = 0.7$ tests in cracked concrete
 $= 0.8$ tests in non-cracked concrete

Coefficient of variation of ultimate load for all test series

In each test series for methods acc. Table 2.2 exceptional for maximum torque moment, the coefficient of variation of the ultimate load shall be calculated and shall be smaller than $v_{u,S}=20\%$. If the requirements for the scatter are not fulfilled by the tension tests, a reduction factor α_v for each test series shall be calculated according to (2.4.14):

$$\alpha_v = 1/(1+0.03 \cdot (v_{u,S}[\%]-20)) \quad (2.4.14)$$

with: $v_{u,S}$ = coefficient of variation of ultimate load of tests according Table 2.2, line 1 to 4

In each test series for methods acc. Table 2.3 with anchors under tensile loads, where failure is caused by concrete break-out, concrete splitting or pull-out, the coefficient of variation of the ultimate load shall be calculated and smaller than $v_{u,A}=15\%$. If the requirements for the scatter are not fulfilled by the tension tests, a reduction factor α_v for each test series shall be calculated according to (2.4.15):

$$\alpha_v = 1/(1+0.03 \cdot (v_{u,A}[\%]-15)) \quad (2.4.15)$$

with: $v_{u,A}$ = coefficient of variation of ultimate load of tests according Table 2.3, line 1 to 5

2.2.7 Characteristic resistance to tension load due to steel failure

Only for cast-in anchors according to Fig. 1 a) with connections between socket and reinforcement bar which are not covered by EN 1993-1-8 (i.e.: pressed socket) tests have to be accomplished.

The tests should cover each size and each material combination (for example stainless steel for socket and reinforcing steel for ribbed reinforcement bar).

They are carried out on anchors not cast into concrete with loading via the anchorage side and a screw or threaded rod on strength 10.9 or higher in order to avoid failure of the screw or the threaded rod.

The characteristic resistance $N_{Rk,S}$ shall be determined for the minimum of the cross-section of the socket, where applicable the cross-section of the ribbed reinforcement bar and their connection according to section 2.2.1.2, passage (a) "Cracked concrete" determining" $N_{u,S}$.

If the connection cannot be assessed by current experiences tests have to be accomplished according to Table 2.3, line 8. The tests should be evaluated statistically for each size and material combination according to 2.2.1.2, passage (a) "Cracked concrete" $N_{u,sc}$ is the appropriate 5%-fractile according to ETAG 001-1 [1], section 6.0.

Additional the characteristic resistance of the appropriate screw shall be given in the relevant ETA.

2.2.8 Characteristic resistance to tension load due to pull-out and concrete cone failure

The tension tests are carried out at concrete members with normal strength and in C50/60, cracked and uncracked concrete according to the given notes mentioned above and ETAG 001 [1], Annex A. The tests should be unconfined.

(a) Pull-out failure

The characteristic resistances of single anchors in C20/25 without edge and spacing effects under tension loading should be calculated as follows:

$$N_{Rk} = N_{Rk,0} \cdot \min^1(\min\alpha_{\delta}; \min\alpha_{u, \text{line } 1,2,3,4}) \cdot \min\alpha_v \quad (2.4.16)$$

¹⁾ The lowest value of $\min\alpha_{\delta}$ and $\min\alpha_{u, \text{line } 1,2,3,4}$ governs.

with: $N_{Rk,0}$ = characteristic resistance for non-cracked concrete evaluated from the results of tests according to Table 2.3, line 1, 2 and 5 or for cracked concrete according to Table 2.3, line 3 and 4
 $\min\alpha_{\delta}$ = minimum value α_{δ} (reduction factor from the load/displacement behaviour) according to Equation (2.4.13),

$\min\alpha_{u, \text{line } 1,2,3,4}$ = minimum value α_{u} (reduction factor from the ultimate loads in the functioning tests) according to Equation (2.4.1) of functioning tests according to Table 2.2, line 1, 2, 3 and 4 (≤ 1.0),
 $\min\alpha_v$ = minimum value α_v to consider a coefficient of variation of the ultimate loads in the functioning and characteristics tests larger than 20% or 15 % respectively, Equations (2.4.14) and (2.4.15) (≤ 1.0).

The value of the characteristic resistance N_{Rk} for pullout failure given in the relevant ETA should be rounded down to the following numbers:

3/ 4/ 5/ 6/ 7.5/ 9/ 12/ 16/ 20/ 25/ 30/ 35/ 40/ 50/ 60/ 75/ 95/ 115/ 140/ 170/ 200 kN

(b) Concrete cone failure

The tests according to Table 2.3, line 1 to 4 serve to check the calculation and the effective anchorage depth. The mean value of the failure load of each test series should be larger than

$$N_{Rm,c}^0 = 13.5 \cdot \sqrt{f_{cc,150, \text{test}}} \cdot h_{ef}^{1.5} \quad (\text{non-cracked concrete}) \quad (2.4.17)$$

$$N_{Rm,c}^0 = 9.5 \cdot \sqrt{f_{cc,150, \text{test}}} \cdot h_{ef}^{1.5} \quad (\text{cracked concrete}) \quad (2.4.18)$$

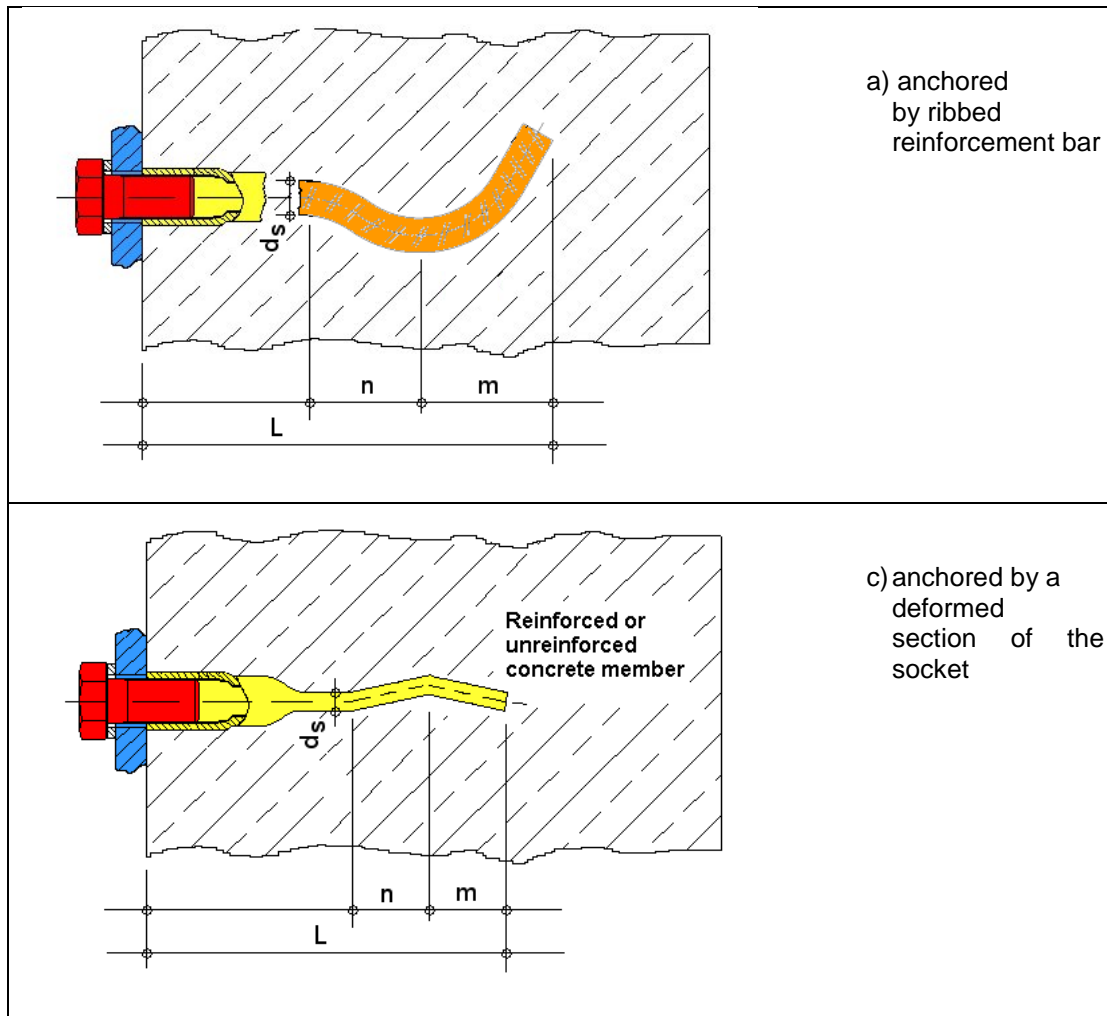
The characteristic resistance to concrete cone failure should be calculated according to ETAG 001 [1], Annex C. The effective anchorage depth should be determined according to the following:

In general the effective anchorage depth is the distance between concrete surface and that part of the anchor where mechanical interlock arises. In some cases the effective anchorage depth cannot be definitely identified by the geometry of the anchor (Figure 2.1). Therefore h_{ef} can be approached by (2.4.19).

$$L - m - n + d_s < h_{ef} < L - m \quad (2.4.19)$$

with: L, n, m, d_s acc. to Fig. 2.1

The effective anchorage depth should be proven by tests according to Table 2.3, line 1 to 4.

Figure 2.1: Examples for determination of L, n, m, d_s in (2.4.5)

2.2.9 Characteristic resistance to tension load due to blow-out and splitting failure

The tension tests are carried out at concrete members with minimum thickness and with the edge distances $c_1 = c_2 = c_{cr,sp}$.

(a) Blow-out failure

In general local concrete side blow-out failure solely occurs for cast-in anchors with a distinctive bearing area at the cast-in anchor side and thus with a specific effective anchorage depth (for example fig.1.1 b) with steel rod).

Only in this case tests according to Table 2.3, line 5 should be varied: the edge distance should be decreased to $c_1 < 0.5 \cdot h_{ef}$. The results (mean values of test series) should be compared with (2.4.20):

$$N^0_{Rm,cb} = 10,5 \cdot c_1 \cdot \sqrt{A_H} \sqrt{f_{cc,150,test}} \quad (\text{non-cracked concrete}) \quad (2.4.20)$$

$$N^0_{Rm,cb} = 8 \cdot c_1 \cdot \sqrt{A_H} \sqrt{f_{cc,150,test}} \quad (\text{cracked concrete}) \quad (2.4.21)$$

with: A_H = bearing area of "head" (for example in fig. 1.1 b): projection area of the steel rod)

The characteristic resistance of a single anchor or an anchor group in case of blow-out failure should be calculated according to CEN/TS 1992-4:2009 [7].

(b) Splitting failure

Splitting failure of the member may occur during fixture installation when anchor is placed sunk or during anchor loading. Minimum values for anchor geometry (member thickness, edge distance and spacing) or minimum reinforcement should be provided to avoid this failure.

Tests according to Table 2.3, line 5 should be accomplished to verify the values $C_{cr,sp}$, $S_{cr,sp}$, $C_{cr,N}$, $S_{cr,N}$ und h_{min} .

The characteristic resistance of a single anchor or an anchor group in case of splitting failure should be calculated according to ETAG 001 [1], Annex C, section 5.2.2.6. The provisions made in ETAG 001 [1], Annex C, section 5.2.2.6 apply.

2.2.10 Characteristic resistance to shear load due to steel failure**(a) Without lever arm**

The characteristic resistance $V_{RK,s}$ should be determined for the cross-section of the socket with reference to ETAG 001 [1], Annex C:

$$V_{RK,s} = \alpha \cdot A_s \cdot f_{uk} \quad (2.4.22)$$

with: $\alpha = 0.5$
 A_s = stress cross-section of the socket
 f_{uk} = characteristic tensile strength of the socket

The appropriate screw according to the application should be analogically calculated and given in the relevant ETA.

(b) With lever arm

The characteristic resistance $M_{RK,s}$ should be determined for the cross-section of the socket with reference to ETAG 001 [1], Annex C:

$$M_{RK,s} = 1.2 \cdot W_{el} \cdot f_{uk} \quad (2.4.23)$$

with: W_{el} = section modulus of the socket calculated on the net tensile area
 $W_{el} = ((d_o^4 - d_i^4) / d_o) \cdot \pi / 32$
 d_o = outer diameter of the socket
 d_i = inner diameter of the socket (taking the internal thread into account)
 f_{uk} = characteristic tensile strength of the socket

The appropriate screw according to the application should be analogically calculated and given in the relevant ETA.

2.2.11 Characteristic resistance to shear load due to concrete failure**(a) Pry-out failure**

The characteristic resistance $V_{RK,cp}$ should be calculated according to ETAG 001 [1], Annex C:

$$V_{RK,cp} = k \cdot N_{RK,c} \quad (2.4.24)$$

with: $k = 1.0$ for anchorages with $h_{ef} < 60$ mm
 $k = 2.0$ for anchorages with $h_{ef} \geq 60$ mm
 $N_{RK,c}$ = characteristic resistance to tension load due to concrete cone failure according to ETAG 001 [1], Annex C or CEN/TS 1992-4:2009 [7].

(b) Concrete edge failure without supplementary reinforcement

The characteristic resistance to concrete edge failure should be calculated according to ETAG 001 [1], Annex C or CEN/TS 1992-4:2009 [7]. The effective anchorage depth should be determined according to section 2.2.8.2, passage (b) "Concrete cone failure". The outer diameter of the socket should be chosen

for the diameter d_{nom} at maximum 25 mm. The length of the socket should be chosen for the length l_f at maximum 200mm.

(c) Concrete edge failure with supplementary reinforcement

The characteristic resistance to concrete edge failure with supplementary reinforcement according CEN/TS 1992-4-1:2009 should be calculated according to CEN/TS 1992-4-1:2009.

2.2.12 Characteristic shear resistance close to an edge with special supplementary reinforcement

The shear tests are loaded rectangular to an edge. They are carried out with a special supplementary reinforcement if an increase of shear resistance as a result of this special supplementary reinforcement will be accomplished deviating from CEN/TS 1992-4:2009 [7]. Further details are given in ETAG 001 [1], Annex A, chapter 5.3.

Special hanger reinforcement for cast-in anchors with internal threaded sockets may increase the resistance of the anchor. It should be designed as loops or stirrups. Supplementary reinforcement shall be designed for placement in the area or the front of a concrete member. It shall be assembled in contact with the socket to enlarge the stiffness of the anchor. The characteristic resistance should be evaluated of the tests according to table 2.3, line 6 and checked with (2.4.25):

$$V_{Rk,h} = k \cdot A_s \cdot f_{yk} \cdot \cos\alpha_1 \cdot \cos\alpha_2 \quad (2.4.25)$$

with: $k \leq 0.5$

A_s = Cross-section of the hanger reinforcement of both legs

α_1, α_2 = Angle between shear load and supplementary reinforcement

f_{yk} = nominal characteristic steel yield strength

2.2.13 Minimum edge distance

The tests are carried out with double anchors with a spacing $s=s_{min}$ and an edge distance $c=c_{min}$ at a concrete member with minimum thickness. The anchors shall be alternately torqued in steps of $0.2 T_{inst}$. The test is stopped when the torque moment cannot be increased further or cracks on the concrete surface are observed. Details of the test are described in ETAG 001 [1], Annex A, section 5.9.

The chosen geometrical parameters c_{min} , s_{min} and h_{min} are verified by the tests according to Table 2.3 line 7. These values are correct if until the torque moment reached $1.7 T_{inst}$ no cracks arise and the prestressing force is lower than steel failure according to section 2.2.7.2 and concrete failure for cracked concrete in low strength concrete according section 2.2.8.2.

2.2.14 Combined tension and shear (oblique loading)

Is the anchor loaded by tension and shear forces the characteristic resistances according to section 2.2.1.2.4 (tension load) and (shear load) have to be determined. The lowest values of both load directions are decisive. Both unidirectional verifications have to be fulfilled:

$$N_{Ed}/N_{Rd} \leq 1.0 \quad (2.4.26)$$

$$V_{Ed}/V_{Rd} \leq 1.0 \quad (2.4.27)$$

Three cases have to be differentiated:

- (1) Steel failure for both directions is decisive:

$$(N_{Ed}/N_{Rd})^2 + (V_{Ed}/V_{Rd})^2 \leq 1.0 \quad (2.4.28)$$

- (2) For at minimum one direction concrete failure is decisive and no hanger reinforcement is calculated:

$$(N_{Ed}/N_{Rd}) + (V_{Ed}/V_{Rd}) \leq 1.2 \quad (2.4.29)$$

- (3) For at minimum one direction concrete failure is decisive and hanger reinforcement is calculated:

$$(N_{Ed}/N_{Rd})^{2/3} + (V_{Ed}/V_{Rd})^{2/3} \leq 1.0 \quad (2.4.30)$$

2.2.15 Characteristic displacements

The characteristic displacements for short-term and quasi-permanent loading are specified for the tension load N and shear load V in accordance with following equation:

$$N = N_{Rk} / (\gamma_F \cdot \gamma_M) \quad (14)$$

with: N_{Rk} = characteristic resistance

γ_F = partial safety factor for actions = 1,4

γ_M = partial safety factor for material according CEN/TS 1992-4:2009 [3]

$$V = V_{Rk} / (\gamma_F \cdot \gamma_M) \quad (15)$$

with: V_{Rk} = characteristic resistance

γ_F = partial safety factor for actions = 1,4

γ_M = partial safety factor for material according CEN/TS 1992-4:2009 [3]

The displacements δ_{N0} and δ_{V0} under short-term loading are evaluated from test series Table 2.3, line 1 or line 5 and line 6. The value derived should correspond to the mean value of these test series. The displacements (in mm) should be rounded up to zero or five on the first place after the decimal point.

The displacements $\delta_{N\infty}$ under long-term tension loading are assumed to be approximately equal to 2,0-times the value δ_{N0} . The displacements $\delta_{V\infty}$ under long-term shear loading are assumed to be approximately equal to 1,5-times the value δ_{V0} . Under shear loading, the displacements might increase due to a gap between fixture and anchor channel. The influence of this gap is taken into account in design.

2.2.16 Durability

No special tests are required, if the material and components comply with section 1.1 (1) to (3).

Salt spray tests acc. EN ISO 9227 shall be conducted if the material and components comply with section 1.1 (4). 5 anchors with medium size shall be tested:

- 1 anchor without coating, socket arranged opening up,
- 1 anchor without coating, socket arranged opening down,
- 1 anchor with coating, socket arranged opening up,
- 2 anchors with coating, socket arranged opening down.

The anchors shall be exposed to the salt spray for at least 1000 h and until the not coated reinforcement bar show clear indication of corrosion.

Material and components according to section 1.1 (1) to (4) can be used as follows:

- (1) Material and components comply with section 1.1 (1):
Cast-in anchors intended for use in structures subject to dry, internal conditions
- (2) Material and components comply with section 1.1 (2):
Cast-in anchors for use in structures subject to internal conditions with usual humidity (e.g. kitchen,

bath and laundry in residential buildings, exceptional permanently damp conditions and application under water.

- (3) Material and components comply with section 1.1 (3):
Cast-in anchors for use in structures subject to external atmospheric exposure (including industrial and marine environments), or exposure in permanently damp internal condition, if no particular aggressive conditions according to (3) exists.
- (4) Material and components comply with section 1.1 (4):
Cast-in anchors for use in structures subject to external atmospheric exposure or exposure in permanently damp internal conditions or particularly aggressive conditions such as permanent or alternate immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulfurization plants or road tunnels, where de-icing materials are used).
- (5) Material and components comply with section 1.1 (5):
Cast-in anchors for use in structures subject to external atmospheric exposure (including industrial and marine environments), or exposure in permanently damp internal condition, if no particular aggressive conditions according to (3) exists and if
- The material of the coating is non-aging for the intended use;
 - After the tests the coating is tight against corrosion supporting substances e.g. water, chloride and oxygen and the coating clings to the socket so that no substances undercut below the coating;
 - The comparison between a coated and a not coated anchor show the efficiency of the coating;
 - After the tests only for the anchors with coating the socket and the coating shall be removed of the reinforcement bar. No corrosion of the reinforcement bar is shown.

2.2.17 Reaction to fire

The cast-in anchor is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of Decision 1996/603/EC (as amended) on the basis of its listing in that Decision.

2.2.18 Resistance to fire

The fire resistance to steel failure due to tension load shall be determined by testing if the anchor consists of more than one part (Fig. 1.1 a).

In all other cases no tests have to be performed if the simplified design method of TR 020 [4] is used.

Alternatively, the fire performance due to steel failure and/or to concrete failure of any anchor and its suitability for use in fire resistance applications may be determined using the test procedure detailed in chapter 2.3 of this Technical Report.

Fire resistance performance cannot be claimed for individual products only, since it is a characteristic of a complete system.

The Evaluation of the tests concerning resistance to fire due to steel failure is done acc. TR 020 [4]. For determining the stress acc. TR 020 the cross section of the screw or of the socket shall be used.

The assessment of an anchor for use in a system that is required to provide a specific fire resistance class may be determined for steel failure if the anchor consists of only one part and for concrete failure by reference to the simplified design method according to chapter 2.2 and the tabulated data given in Technical Report 020 [4]. "Evaluation of anchorages in concrete concerning Resistance to Fire".

Alternatively, the evaluation of the tests concerning resistance to fire due to steel failure and/ or to concrete failure is done acc. TR 020 [4].

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 1996/582/EC

The system to be applied is: 1

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the anchor in the procedure of assessment and verification of constancy of performance are laid down in Table 3.1.

Table 3.1 is an example only; the control plan depends on the individual manufacturing process and has to be established between notified body and manufacturer for each product.

Table 3.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Metal part / dimensions and tolerances	Measuring or optical	Laid down in control plan	3 samples for each size and for each material	Each batch/ production week 10000 anchors
2	Metal part / material properties e.g. tensile strength or hardness, elastic limit, elongation on rupture	e.g. tensile test, hardness testing Brinell or Vickers	Laid down in control plan	3 samples for each size and for each material	Each batch/ production week 10000 anchors
3	Metal part / coating	Measuring of thickness	Laid down in control plan	3 samples for each size and for each material	Each batch/ production week 10000 anchors
4	Final product	Tensile test	Laid down in control plan	3 samples for each size and for each material	Each batch/ production week 10000 anchors

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the anchor are laid down in Table 3.2.

Table 3.2 Control plan for the notified body; corner stones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
2	Ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the cast-in anchor.	-	Laid down in control plan	-	1
Continuous surveillance, assessment and evaluation of factory production control					
3	Verifying that the system of factory production control and the specified automated manufacturing process are maintained taking account of the control plan.	-	Laid down in control plan	-	1/year

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

- | | | |
|------|------------------------------|---|
| [1] | ETAG 001 used as EAD: | Guideline for European Technical Approval for metal anchors for use in concrete (new number: EAD 330232-00-0601); |
| [2] | EN ISO 3506-1:2009: | Mechanical properties of corrosion-resistant stainless steel fasteners
Part 1: Bolts, screws and studs; |
| [3] | EN 10088-3+4+5:2009: | Stainless steels
Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes;
Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes;
Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes; |
| [4] | EOTA TR 020 | Evaluation of Anchorages in Concrete concerning Resistance to Fire, May 2004; |
| [5] | EN ISO 898-1: 2013: | Mechanical properties of fasteners made of carbon steel and alloy steel
Part 1: Bolts, screws and studs |
| [6] | EN 10204:2004: | Metallic products – Types of inspection documents |
| [7] | CEN/TS 1992-4:2009: | Design of fastenings for use in concrete |
| [8] | EN 10305-1+2+3:2010 | Steel tubes for precision applications -
Technical delivery conditions -
Part 1: Seamless cold drawn tubes;
Part 2: Welded cold drawn tubes;
Part 3: Welded cold sized tubes; |
| [9] | EN 10216-5:2013 | Seamless steel tubes for pressure purposes -
Technical delivery conditions -
Part 5: Stainless steel tubes |
| [10] | EN 10217-7:2015 | Welded steel tubes for pressure purposes -
Technical delivery conditions -
Part 7: Stainless steel tubes |
| [11] | EN 1993-1-8:2005
+AC:2009 | Eurocode 3: Design of steel structures -
Part 1-8: Design of joints; |