



Declaration of Performance

FM 753 Nautilus hrg

Throughbolt anchor made of galvanised steel high corrosion resistance



Intended use or uses of the construction product according to ETAG 001 p.1 and 2	
Generic type	torque controlled expansion anchor throughbolt type
Base material	un-cracked concrete C20/25 to C50/60 acc. to EN 206-1
Material	steel galvanised acc. to EN ISO 4042 (cl. 5.8 min. for bolt acc.to EN ISO 898-1)
Durability	internal dry conditions
Loading	static and quasi-static
Fire Resistance	NPD
Fire Reaction	A1 according to EN 13501-1
ETA-13/0367 issued by	ZAG approval body nr.1404
On the basis of	ETAG001 p.1-2
Certificate of Conformity 1404-CPD-1977 issued by	ZAG notify body nr.1404
Under System (AVCP)	1

Declared performances according to ETA-13/0367 (ETAG 001 p.1 and 2)															
Design method ETAG 001 Annex C															
ESSENTIAL CHARACTERISTICS				PERFORMANCE											
Installation parameters				M6		M8		M10		M12		M16		M20	
d₀	Nominal diameter of drill bit	[mm]		6		8		10		12		16	20		
h_{nom}	Minimum installation depth	[mm]		36	41	38	48	44	59	56	71	76	96	115	
h_{ef}	Effective anchorage depth	[mm]		30 ²⁾	35 ²⁾	30 ²⁾	40	35 ²⁾	50	45	60	65	85	95	
h_{min}	Minimum thickness of the concrete member	[mm]		100		100		100		100	120	130	170	200	
T_{inst}	Nominal torque moment	[Nm]		6		15		25		50		100	150		
s_{min}	Minimum spacing	[mm]		45	50	45	55	50	55	120	90	140	130	200	
c_{min}	Minimum edge distance	[mm]		45	50	45	55	50	55	80	90	100	130	145	
Tension Steel failure															
N_{Rk,s}	Tension Steel characteristic failure	[kN]		11		17		28		33		72	108		
γ_{m,sN}¹⁾	Partial safety factor for tension steel failure	[-]		1,5		1,4		1,4		1,4		1,5	1,5		
Pull-out failure C20/25				M6		M8		M10		M12		M16		M20	
N_{Rk,p,ucr}	Tension characteristic load in un-cracked concrete	[kN]		5 ²⁾	6 ²⁾	6 ²⁾	12	6 ²⁾	12	12	23 ³⁾	26 ³⁾	35	40	
γ₂	Partial safety factor	[-]		1,0											
γ_{m,c}¹⁾	Partial safety factor	[-]		1,5											
s_{cr,N}	Critical spacing	[mm]		90	105	90	120	105	150	135	180	195	255	290	
c_{cr,N}	Critical edge distance	[mm]		45	53	45	60	53	75	68	90	98	130	145	
ψ_{c,C30/37}	Increasing factor for concrete C30/37	[-]		1,07				1,10				1,22			
ψ_{c,C40/50}	Increasing factor for concrete C40/50	[-]		1,14				1,20				1,41			
ψ_{c,C50/60}	Increasing factor for concrete C50/60	[-]		1,20				1,30				1,55			
Splitting failure															
s_{cr,sp}	Critical spacing (splitting)	[mm]		90	105	90	120	105	150	135	180	195	255	290	
c_{cr,sp}	Critical edge distance (splitting)	[mm]		45	53	45	60	53	75	68	90	98	130	145	
γ_{m,c}¹⁾	Partial safety factor	[-]		1,5											
Displacement on Tension Load															
N_{ucr}	Service tension load in un-cracked concrete	[kN]		2,4	2,9	2,9	5,7	2,9	5,7	5,7	11,2	12,6	16,7	19,0	
δ_{NO,ucr}	Short term displacement under tension load	[mm]		0,2	0,3	0,1	1,6	0,1	0,4	0,1	0,1	0,1	0,1	0,1	
δ_{Neo,ucr}	Long term displacement under tension load	[mm]		1,6											
Shear Steel failure				M6		M8		M10		M12		M16		M20	
V_{Rk,s}	Shear Steel characteristic failure	[kN]		6,5		9,2		13,9		20,1		42,6	51,5		
M⁰_{Rk,s}	Bending Moment characteristic failure	[Nm]		12		24		49		72		193	338		
γ_{m,sV}¹⁾	Partial safety factor for shear steel failure	[-]		1,5											
Shear Concrete Pry-out or Edge failure															
k	Factor equation (5.6) of ETAG, Annex C, § 5.2.3.3	[-]		1,0						2,0					
l_{ef}	Effective anchorage length	[mm]		30	35	30	40	35	50	45	60	65	85	90	
d_{nom}	Nominal diameter of anchor	[mm]		6		8		10		12		16			
γ_m¹⁾	Partial safety factor (γ _{m,c} =γ _{m,pr})	[-]		1,5											
Displacement on Shear Load															
V	Service shear load in concrete	[kN]		3,1		4,4		6,6		9,6		20,3	24,5		
δ_{V0}	Short term displacement under shear load	[mm]		2,1		2,0		2,6		2,8		3,0	2,6		
δ_{V∞}	Long term displacement under shear load	[mm]		3,1		3,1		3,9		4,2		4,4	4,0		

¹⁾ In absence of other national regulations; ²⁾ Use restricted to anchoring of structural components statically indetermined; ³⁾ Pull-out failure not decisive.

We inform you that Friulsider is classified in the EC 1907/2006 Reach Directive as a Downstream-user of substances.
The product supplied does not contain substances classified as SVHC according to the Candidate List in a concentration equal or greater than 0.1% (weight / weight). Article 31 is not applicable to the present product.

The above performances apply for the following article numbers (galvanised 10µm Nautilus grey opaque):

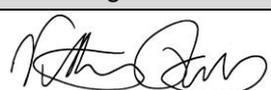
d ⁴⁾	L ⁵⁾ [mm]	t _{fix,RED} ⁶⁾ [mm]	t _{fix,STD} ⁷⁾ [mm]	Marking	ID	Cod.
M6	45	3	-	FM-R 6/3	A	75320c06045
	65	(20)	15	FM-L 6/15	B	75320c06065
	85	(40)	35	FM-L 6/35	C	75320c06085
	100	(55)	50	FM-L 6/50	D	75320c06100
M8	50	5	-	FM-R 8/5	A	75320c08050
	65	(15)	7	FM-L 8/7	B	75320c08065
	75	(25)	15	FM-L 8/15	C	75320c08075
	90	(40)	30	FM-L 8/30	D	75320c08090
	115	(65)	55	FM-L 8/55	E	75320c08115
	135	(85)	75	FM-L 8/75	F	75320c08135
	165	(115)	105	FM-L 8/105	G	75320c08165
M10	60	5	-	FM-R 10/5	A	75320c10060
	75	(20)	5	FM-L 10/5	B	75320c10075
	90	(35)	20	FM-L 10/20	C	75320c10090
	100	(45)	30	FM-L 10/30	I	75320c10100
	120	(65)	50	FM-L 10/50	D	75320c10120
	145	(90)	75	FM-L 10/75	E	75320c10145
	170	(115)	100	FM-L 10/100	F	75320c10170
	210	(155)	140	FM-L 10/140	G	75320c10210
M12	80	7	-	FM-R 12/7	A	75320c12080
	100	(25)	10	FM-L 12/10	B	75320c12100
	110	(35)	20	FM-L 12/20	C	75320c12110
	135	(60)	45	FM-L 12/45	D	75320c12135
	160	(85)	70	FM-L 12/70	E	75320c12160
	185	(115)	100	FM-L 12/100	F	75320c12185
	200	(130)	115	FM-L 12/115	G	75320c12200
	220	(150)	135	FM-L 12/135	H	75320c12220
	240	(170)	155	FM-L 12/155	I	75320c12240
	255	(185)	170	FM-L 12/170	L	75320c12255
	285	(215)	200	FM-L 12/200	M	75320c12285
	300	(230)	215	FM-L 12/215	N	75320c12300
	325	(255)	240	FM-L 12/240	P	75320c12325
355	(285)	270	FM-L 12/270	Q	75320c12355	
M16	110	15	-	FM-R 16/15	P	75320c16110
	125	(30)	10	FM-S 16/10	A	75320c16125
	145	(50)	30	FM-S 16/30	B	75320c16145
	175	(80)	60	FM-S 16/60	C	75320c16175
	215	(120)	100	FM-S 16/100	D	75320c16215
	230	(135)	115	FM-S 16/115	E	75320c16230
	250	(155)	135	FM-S 16/135	F	75320c16250
	270	(175)	155	FM-S 16/155	G	75320c16270
	285	(190)	170	FM-S 16/170	H	75320c16285
	320	(225)	205	FM-S 16/205	I	75320c16320
M20	170	-	30	FM-S 20/30	A	75320c20170
	215	-	75	FM-S 20/75	B	75320c20215
	260	-	120	FM-S 20/120	C	75320c20260
	280	-	140	FM-S 20/140	D	75320c20280

⁴⁾ Nominal diameter of thread; ⁵⁾ Length of anchor; ⁶⁾ Thickness fixture max for reduced embedment; ⁷⁾ Thickness fixture max for standard embedment.

The performances of the product identified by the above identification code are in conformity with the declared performance.

This declaration of performance is issued under the sole responsibility of **Friulsider SpA**.

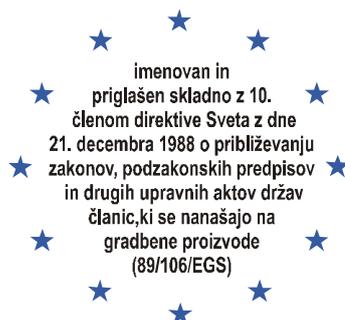
Signed for and behalf of the manufacturer by:

Name and functions	Place and date of issue	Signature
Eng. Vittorio Pilla General Director	San Giovanni al Natisone, 09-10-2013	

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Member of EOTA

European Technical Approval

ETA-13/0367

[English translation prepared by ZAG – Original version in Slovenian language]

Komercialno ime
Trade name

FM753 Nautilus hrg

Imetnik soglasja
Holder of approval

FRIULSIDER S.p.A.
via Trieste 1
33048 San Giovanni al Natisone (UD)
Italy

Tip gradbenega proizvoda in
njegova predvidena uporaba

**Torzijsko kontrolirano zatezno kovinsko sidro iz
pocinkanega jekla velikosti M6, M8, M10, M12,
M16 in M20 za vgradnjo v nerazpokani beton**

*Generic type and use
of construction product*

*Torque controlled expansion anchor made of galvanised steel
of sizes M6, M8, M10, M12, M16 and M20 for use in non-
cracked concrete*

Veljavnost od
Validity from
do
to

24.05.2013

23.05.2018

Proizvodni obrat
Manufacturing plant

FRIULSIDER S.p.A.
via Trieste 1
33048 San Giovanni al Natisone (UD)
Italy

To Evropsko tehnično soglasje
vsebuje
This European Technical Approval contains

13 strani vključno s 6 prilogami, ki so sestavni del
tega soglasja
*13 pages including 6 annexes, which form an integral part of
the document*



Evropska organizacija za tehnična soglasja
European Organisation for Technical Approvals

I LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by the Slovenian National Building and Civil Engineering Institute (ZAG) in accordance with:
 - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products¹, modified by the Council Directive 93/68/EEC² and Regulation (EC) N°1882/2003 of the European Parliament and of the Council³,
 - Zakon o gradbenih proizvodih (ZGPro)⁴,
 - Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex of Commission Decision 94/23/EC⁵,
 - Guideline for European Technical Approval of “Metal Anchors for use in Concrete“, Part 1 “Anchors in General” and Part 2: Torque controlled expansion anchors”, ETAG 001, edition October 1997, amended November 2006.
2. The Slovenian National Building and Civil Engineering Institute (ZAG) is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products with the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.
3. This European Technical Approval is not to be transferred to manufacturers or agents of manufacturer other than those indicated on page 1; or manufacturing plants other than those indicated on page 1 of this European Technical Approval.
4. This European Technical Approval may be withdrawn by the Slovenian National Building and Civil Engineering Institute (ZAG), in particular pursuant to information by the Commission according to Article 5 (1) of the Council Directive 89/106/EEC.
5. Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of the Slovenian National Building and Civil Engineering Institute (ZAG). In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.
6. The European Technical Approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

¹ Official Journal of the European Communities N° L 40, 11.2.1989, p.12

² Official Journal of the European Communities N° L 220, 30.8.1993, p.1

³ Official Journal of the European Union N° L 284, 31.10.2003, p.1

⁴ Official Gazette of the Republic of Slovenia, N° 52/00 and N° 110/02

⁵ Official Journal of the European Communities N° L 17, 20.1.1994, p.34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of product

The FM753 Nautilus hrg in the range of M6, M8, M10, M12, M16 and M20 is an anchor made of galvanised steel, which is placed into a drilled hole and anchored by torque-controlled expansion.

For the installed anchor see Figure given in Annex 1.

1.2 Intended use

The anchor is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106/EEC shall be full filled and failure of anchorages made with these products would compromise the stability of the works, cause risk to human life and/or lead to considerable economic consequences. The anchor is to be used only for anchorages subjected to static and quasi-static loading in reinforced or non reinforced normal weight concrete of strength classes from C20/25 to C50/60 according to EN 206-1:2003. It may be anchored in non-cracked concrete only.

The anchor may only be used in concrete subject to dry internal conditions.

The provisions made in this European Technical Approval are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the manufacturer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Characteristics of product and methods of verification

2.1 Characteristics of product

The anchor corresponds to the drawings and provisions given in Annexes 1. The characteristic material values, dimensions and tolerances of the anchor not indicated in these Annexes 2 to 4 shall correspond to the respective values laid down in the technical documentation⁶ of this European Technical Approval. The characteristic anchor values for the design of anchorage are given in Annexes 5 and 6.

Each anchor is marked with the identification name of producer, trade name of an anchor, identification letter of the length of a thread, nominal diameter of the anchor and maximum thickness of the fixture.

As an example: FM L 10/20

The anchor shall only be packaged and supplied as a complete unit.

⁶ The technical documentation of this European Technical Approval is deposited at the Slovenian National Building and Civil Engineering Institute (ZAG) and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over the approved bodies.

2.2 Methods of verification

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance, stability and safety in use in the sense of the Essential Requirement 1 and 4 has been made in accordance with the "Guideline for European Technical Approval of Metal Anchors for use in Concrete", Part 1 "Anchors in general" and Part 2 "Torque-controlled expansion anchors", on the basis of Option 7.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the decision 96/582/EC the European Commission⁷ the system 1 of attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

- a) tasks for the manufacturer:
 - (1) factory production control;
 - (2) further testing of samples taken at the factory by the manufacturer in accordance with a control plan.
- b) tasks for the approved body:
 - (3) initial type-testing of the product;
 - (4) initial inspection of factory and of factory production control;
 - (5) continuous surveillance, assessment and approval of factory production control.

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production of concerned product. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system ensures that the product is in conformity with the European technical approval.

The manufacturer may only use raw materials stated in the technical documentation of this European technical approval. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of incoming materials shall include control of the inspection documents presented by the manufacturer of the raw materials (comparison with nominal values) by verifying dimensions and determining the material properties, e.g. tensile strength, hardness, surface finish

The manufactured components of the anchor shall be subjected to the following tests:

- Dimensions of the component parts:
 - bolt (diameters, lengths, thread, geometry of the cone, marking);
 - sleeve (length, thickness, catch size);
 - hexagonal nut (thread, wrench, height);
 - washer (diameter, thickness).
- Material properties:
 - bolt (yielding and ultimate tensile strength);
 - sleeve (ultimate tensile strength or hardness);

⁷ Official Journal of the European Communities L 198/31 of 25.7.1997

hexagonal nut (proof load);
washer (hardness).

- Visual control of correct assembly and of completeness of the anchor.

The factory production control shall be in accordance with the “Control Plan” relating to the European technical approval ETA–13/0367 issued on 24.05.2013, which is part of the technical documentation of this European technical approval. The “Control Plan” is laid down in the context of the factory production control system operated by the manufacturer and deposited at the Slovenian National Building and Civil Engineering Institute (ZAG).

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the “Control Plan”.

3.2.1.2 Other tasks of the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in a section 3.1 in the field of torque-controlled expansion anchors in order to undertake the actions laid down in section 3.3. For this purpose the “Control Plan” referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body or bodies involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of the European technical approval ETA–13/0367 issued on 24.05.2013.

3.2.2 Tasks of notified bodies

The notified body shall perform the:

- initial type testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control.

in accordance with the provisions laid down in the “Control plan”, which is the part of technical documentation of this European technical approval.

The notified body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The notified certification body involved by the manufacturer shall issue an EC certificate of conformity control stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its “Control Plan” are no longer fully filled the certification body shall withdraw the certificate of conformity and inform the Slovenian National Building and Civil Engineering Institute (ZAG) without delay.

3.3 CE-Marking

The CE marking shall be affixed on each packaging of anchors. The symbol “CE” shall be followed by the identification number of the certification body, and be accompanied by the following additional information:

- identification number of the certification body;
- name and identifying mark of the producer and manufacturing plant;
- the last two digits of the year in which CE – marking was affixed;
- number of the EC certificate of conformity;
- number of the European Technical Approval;
- use category ETAG 001 – 2 (Option 7);
- size of the anchor.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with the Slovenian National Building and Civil Engineering Institute (ZAG), which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to the Slovenian National Building and Civil Engineering Institute (ZAG) before the changes are introduced. The Slovenian National Building and Civil Engineering Institute (ZAG) will decide whether or not such changes affect the ETA and consequently the validity of the CE marking on the basis of the ETA and if so whether further assessment or alternations to the ETA, shall be necessary.

4.2 Installation

4.2.1 Design of anchorages

The fitness of the anchors for the intended use is given under the following conditions:

The anchorages are designed in accordance with the "Guideline for European Technical Approval of Metal Anchors for use in Concrete", Annex C, Method A for torque controlled expansion anchors under the responsibility of an engineer experienced in anchorages and concrete work.

Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored.

The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to support, etc.).

4.2.2 Installation of anchors

The fitness for use of the anchor can only be assumed if the following conditions are met:

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters on the site.
- Use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor.
- Anchor installation in accordance with the manufacturer's specifications and drawings using the appropriate tools.
- Thickness of the fixture corresponding to the range of required thickness values for the type of anchor.
- Checks before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply for.
- Check of concrete being well compacted, e.g. without significant voids.
- Cleaning of the hole of drilling dust.
- Anchor installation ensuring the specified embedment depth.
- Keeping of the edge distance and spacing to the specified values without minus tolerances.
- Positioning of the drill holes without damaging the reinforcement.
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not to the anchor in the direction of load application.
- Application of the torque moment given in Annex 4 using a calibrated torque wrench.

4.2.3 Responsibility for the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to 4.2.1, 4.2.2 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European Technical Approval. In addition, all installation data shall be shown clearly on the packaging and/or on an enclosed instruction sheet, preferably using illustration.

The minimum data required are:

- drill bit diameter;
- thread diameter;
- maximum thickness of the fixture;
- minimum installation depth;
- torque moment;
- information on the installation procedure, including cleaning of the hole, preferably by means of an illustration;
- reference to any special installation equipment needed;
- identification of the manufacturing batch.

All data shall be presented in a clear and explicit form.

Leading expert:

Dušica Drobnič, M.Sc., (Civ.Eng.)

Service for Technical Approvals:

Franc Capuder, M.Sc., (Civ.Eng.)

Assembled anchor and schema of the anchor in use:



- 1. Anchor bolt (body)
- 2. Washer
- 3. Nut
- 4. Expansion sleeve

Marking: "FM" = identification name of producer and trade name of anchor
 "R" = identification letter short length of anchor only for reduced embedment depth
 or "L" = long thread
 or "S" = short thread
 "d_{nom}" = nominal diameter of anchor
 "t_{fix}" = max thickness of fixture
 e.g.: FM L 10/20 (anchor size M10x90 - t_{fix} = 20 mm)

Figure 1: FM753 Nautilus hrg anchor

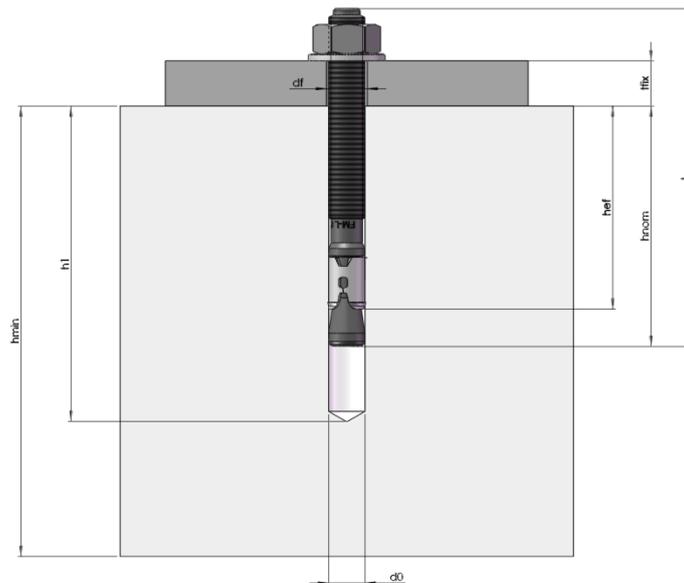


Figure 2: Installed FM753 Nautilus hrg anchor

FM753 Nautilus hrg

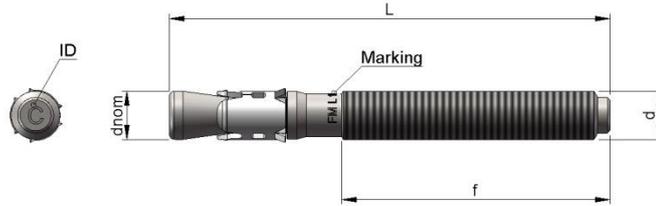
Product and intended use

Annex 1

of the European Technical Approval

ETA-13/0367

Table 1: Dimensions



d	dxL	Marking	ID	L [mm]	d _{nom} [mm]	f [mm]
M6	M6x45	FM-R 6/3	A	47	6	20
	M6x65	FM-L 6/15	B	65		40
	M6x85	FM-L 6/35	C	85		60
	M6x100	FM-L 6/50	D	100		60
M8	M8x50	FM-R 8/5	A	53	8	22
	M8x65	FM-L 8/7	B	65		37
	M8x75	FM-L 8/15	C	75		47
	M8x90	FM-L 8/30	D	90		62
	M8x115	FM-L 8/55	E	115		82
	M8x135	FM-L 8/75	F	135		87
	M8x165	FM-L 8/105	G	165		87
	M10x60	FM-R 10/5	A	63		10
M10x75	FM-L 10/5	B	78	43		
M10x90	FM-L 10/20	C	90	55		
M10x100	FM-L 10/30	I	100	65		
M10x120	FM-L 10/50	D	120	85		
M10x145	FM-L 10/75	E	145	85		
M10x170	FM-L 10/100	F	173	85		
M10x210	FM-L 10/140	G	210	85		
M12	M12x80	FM-R 12/7	A	80	12	40
	M12x100	FM-L 12/10	B	100		58
	M12x110	FM-L 12/20	C	110		68
	M12x135	FM-L 12/45	D	135		93
	M12x160	FM-L 12/70	E	160		93
	M12x185	FM-L 12/100	F	188		93
	M12x200	FM-L 12/115	G	200		93
	M12x220	FM-L 12/135	H	220		93
	M12x240	FM-L 12/155	I	240		93
	M12x255	FM-L 12/170	L	255		93
	M12x285	FM-L 12/200	M	285		93
	M12x300	FM-L 12/215	N	300		93
	M12x325	FM-L 12/240	P	325		93
	M12x355	FM-L 12/270	Q	355		93
M16	M16x110	FM-R 16/15	P	110	16	53
	M16x125	FM-S 16/10	A	125		68
	M16x145	FM-S 16/30	B	145		88
	M16x175	FM-S 16/60	C	175		88
	M16x215	FM-S 16/100	D	215		88
	M16x230	FM-S 16/115	E	230		88
	M16x250	FM-S 16/135	F	250		88
	M16x270	FM-S 16/155	G	270		88
	M16x285	FM-S 16/170	H	285		88
	M16x320	FM-S 16/205	I	320		88
M20	M20x170	FM-S 20/30	A	170	20	65
	M20x215	FM-S 20/75	B	215		65
	M20x260	FM-S 20/120	C	260		65
	M20x280	FM-S 20/140	D	280		65

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Dimensions

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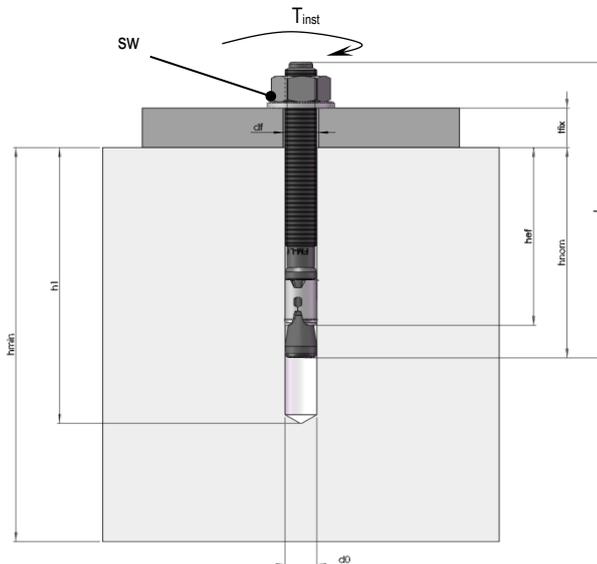
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Table 2: Materials

Part	Component	Material	Coating
1	Anchor body (bolt)	Cold formed or machined steel according to EN ISO 898/1	Galvanised $\geq 10 \mu\text{m}$ "Nautilus high resistance grey opaque"
2	Washer	Steel according to DIN 125/1 – 140 HV	
3	Hexagonal nut	Steel grade 8 according to DIN 934	
4	Expansion sleeve	Stainless steel AISI 316 according to EN 10088/2	

Table 3: Minimum distance

Anchor size		M6	M8	M10	M12	M16	M20
Standard embedment depth	Effective anchorage depth $h_{ef,STD}$ [mm]	35	40	50	60	85	95
	Minimum thickness of concrete member h_{min} [mm]	100	100	100	120	170	200
	Minimum spacing s_{min} [mm]	50	55	55	90	130	200
	Minimum edge distance c_{min} [mm]	50	55	55	90	130	145
Reduced embedment depth	Effective anchorage depth $h_{ef,RED}$ [mm]	30	30	35	45	65	-
	Minimum thickness of concrete member h_{min} [mm]	100	100	100	100	130	-
	Minimum spacing s_{min} [mm]	45	45	50	120	140	-
	Minimum edge distance c_{min} [mm]	45	45	50	80	100	-



- L = length of the anchor [mm]
- t_{fix} = thickness of fixture [mm]
- d_0 = nominal drill hole diameter [mm]
- h_{nom} = minimum installation depth [mm]
- h_{ef} = effective anchorage depth [mm]
- d_f = diameter of clearance hole in the fixture [mm]
- h_1 = depth of drill hole [mm]
- h_{min} = minimum thickness of the concrete member [mm]
- T_{inst} = torque moment [Nm]
- SW = socket wrench

Figure 3: Schema of installed

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**Materials, Minimum distances
and Schema of installed**

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Table 4: Installation data

d	dxL	t_{fix} $h_{ef,RED}$ [mm]	t_{fix} $h_{ef,STD}$ [mm]	h_1 [mm]	h_{nom} [mm]	h_{ef} [mm]	d_0 [mm]	$d_{cut,max}$ [mm]	d_f [mm]	h_{min} [mm]	T_{inst} [Nm]	sw [mm]
M6	M6x45	3	-	45	36	30	6	6,45	7	100	6	10
	M6x65	(20)	15	50	41	35						
	M6x85	(40)	35									
	M6x100	(55)	50									
M8	M8x50	5	-	50	38	30	8	8,45	9	100	15	13
	M8x65	(15)	7	60	48	40						
	M8x75	(25)	15									
	M8x90	(40)	30									
	M8x115	(65)	55									
	M8x135	(85)	75									
	M8x165	(115)	105									
M10	M10x60	5	-	55	44	35	10	10,45	12	100	25	17
	M10x75	(20)	5	70	59	50						
	M10x90	(35)	20									
	M10x100	(45)	30									
	M10x120	(65)	50									
	M10x145	(90)	75									
	M10x170	(115)	100									
M10x210	(155)	140										
M12	M12x80	7	-	70	56	45	12	12,5	14	100	50	19
	M12x100	(25)	10	85	71	60				120		
	M12x110	(35)	20									
	M12x135	(60)	45									
	M12x160	(85)	70									
	M12x185	(115)	100									
	M12x200	(130)	115									
	M12x220	(150)	135									
	M12x240	(170)	155									
	M12x255	(185)	170									
	M12x285	(215)	200									
	M12x300	(230)	215									
	M12x325	(255)	240									
M12x355	(285)	270										
M16	M16x110	15	-	95	76	65	16	16,5	18	130	100	24
	M16x125	(30)	10	115	96	85				170		
	M16x145	(50)	30									
	M16x175	(80)	60									
	M16x215	(120)	100									
	M16x230	(135)	115									
	M16x250	(155)	135									
	M16x270	(175)	155									
	M16x285	(190)	170									
M16x320	(225)	205										
M20	M20x170	-	30	130	115	95	20	20,5	22	200	150	30
	M20x215	-	75									
	M20x260	-	120									
	M20x280	-	140									

(..) = t_{fix} by reduced embedment depth $h_{ef,RED}$

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Installation data

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Table 5: Characteristic values of resistance to tension loads of design method A

			M6-1	M6-2	M8-1	M8-2	M10-1	M10-2	M12-1	M12-2	M16-1	M16-2	M20
Steel failure													
Characteristic resistance	$N_{Rk,s}$	[kN]	11	17	28	33	72	108					
Partial safety factor	γ_{Ms}	[-]	1,5	1,4	1,4	1,4	1,5	1,5					
Pull-out failure													
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}$	[kN]	5	6	6	12	6	12	12	*1)	*1)	35	40
Partial safety factor	$\gamma_{Mp}^{2)}$	[-]	1,5										
Increasing factor for N_{rk} for non-cracked concrete	ψ_c C30/37	[-]	1,07				1,10				1,22		
	ψ_c C40/50	[-]	1,14				1,20				1,41		
	ψ_c C50/60	[-]	1,20				1,30				1,55		

¹⁾ Pull – through failure not decisive

²⁾ Including $\gamma_2 = 1,0$ (in the absence of other national regulations)

Concrete cone failure and splitting failure													
Effective anchorage depth	h_{ef}	[mm]	30*	35*	30*	40	35*	50	45	60	65	85	95
Characteristic spacing	$s_{cr,N} = s_{cr,sp}$	[mm]	$3 \times h_{ef}$										
Characteristic edge distance	$c_{cr,N} = c_{cr,sp}$	[mm]	$1,5 \times h_{ef}$										
Partial safety factor	γ_2	[-]	1,0										
	$\gamma_{Mc} = \gamma_{MSP}$	[-]	1,5										

* Use restricted to anchoring of structural components statically indeterminate.

Table 6: Displacement under tension load

			M6-1	M6-2	M8-1	M8-2	M10-1	M10-2	M12-1	M12-2	M16-1	M16-2	M20
Tension Load in non-cracked concrete C20/25	[kN]		2,4	2,9	2,9	5,7	2,9	5,7	5,7	11,2	12,6	16,7	19,0
Displacement	δ_{N0}	[mm]	0,21	0,33	0,09	1,6	0,07	0,35	0,10	0,12	0,03	0,03	0,05
	$\delta_{N\infty}$	[mm]	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
Tension Load in non-cracked concrete C50/60	[kN]		2,9	3,5	3,5	6,8	3,8	7,4	7,4	14,6	16,4	21,7	29,4
Displacement	δ_{N0}	[mm]	0,03	0,25	0,15	1,24	0,04	1,95	0,04	0,56	0,04	0,11	1,81
	$\delta_{N\infty}$	[mm]	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5

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Design method A: characteristic values of resistance to tension loads and displacements

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Table 7: Characteristic values of resistance to shear loads of design method A

			M6-1	M6-2	M8-1	M8-2	M10-1	M10-2	M12-1	M12-2	M16-1	M16-2	M20	
Steel failure without lever arm														
Characteristic resistance	$V_{Rk,s}$	[kN]	6,5		9,2		13,9		20,1		42,6		51,5	
Partial safety factor	γ_{Ms}	[-]	1,5											
Steel failure with lever arm														
Characteristic resistance	$M_{Rk,s}$	[Nm]	12		24		49		72		193		338	
Partial safety factor	γ_{Ms}	[-]	1,5											
Concrete pryout failure														
Factor in equation (5.6) of ETAG Annex C, Paragraph 5.2.3.3	k	[-]	1,0						2,0					
Partial safety factor	γ_2	[-]	1,0											
	γ_{Mc}	[-]	1,5											
Concrete edge failure														
Effective length of anchor in shear loading	l_f	[mm]	30	35	30	40	35	50	45	60	65	85	95	
Diameter of the anchor	d_{nom}	[mm]	6		8		10		12		16		20	
Partial safety factor	γ_{Mc}	[-]	1,5											

Table 8: Displacement under shear load

		M6-1	M6-2	M8-1	M8-2	M10-1	M10-2	M12-1	M12-2	M16-1	M16-2	M20
Shear Load in non-cracked concrete C20/25+C50/60	[kN]	3,1		4,4		6,6		9,6		20,3		24,5
Displacement	δ_{v0}	2,1		2,0		2,6		2,8		3,0		2,6
	$\delta_{v\infty}$	3,1		3,1		3,9		4,2		4,4		4,0

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Design method A: characteristic values of resistance to shear loads and displacements

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