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Designated according to Article 29 of Regulation (EU) No 305/2011

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European Technical Assessment

ETA-17/0612
of 13.07.2017

General part

Technical Assessment Body issuing the European Technical Assessment	Austrian Institute of Construction Engineering (OIB)
Trade name of the construction product	mageba Tensa®Grip Typ RS
Product family to which the construction product belongs	Nosing expansion joint for road bridges
Manufacturer	mageba SA Solistrasse 68 CH- 8180 Bülach Switzerland
Manufacturing plant(s)	Comprehensive list of manufacturing plants laid down in technical documentation
This European Technical Assessment contains	22 pages including 4 Annex(es) which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval (ETAG) No 032 "Expansion joints for road bridges Part 4: Nosing expansion joints", edition May 2013, used as European Assessment Document (EAD)

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Specific parts

1 Technical description of the product

The nosing expansion joint **mageba Tensa®Grip Typ RS** is a kit consisting of the following components:

- Flexible elastomeric sealing element (V-Seal, Hump-Seal, defined in the technical documentation) according to Figures 1 - 2 and Annex A.1 in this ETA) made of EPDM (Position 1 in Figures 1 - 2 in this ETA)
- Steel head profile, of at least steel grade S235JR+AR according to EN 10025-2 respectively 1.4571/1.4404 acc. to EN 10088-1 (with full corrosion protection applied) (Position 2 in Figures 1 - 2 in this ETA)
- Steel web (resp. angle) for concrete connection to the bridge/abutment of at least steel grade S235JR+AR according to EN 10025-2 (Position 3 in Figures 1 - 2 in this ETA)
- Anchorage system made of:
  - anchor plate and anchor loop of at least steel grade S235JR+AR according to EN 10025-2 (Position 4 in Figure 1 in this ETA)
  - studs made of S235J2+C450 according to EN ISO 13918 (Position 5 in Figure 2 in this ETA)

  The mechanical fixation of the steel web (angle) to the substructure is done by means of an anchorage system with anchor plate and anchor loop (see Figure 1 in this ETA) or by means of studs (see Figure 2 in this ETA). Details of the anchorage system as well as relevant information regarding reinforcement and required concrete quality are given in Annex A.1 of this ETA.
- Cover plate (tread plate with surface texture of more than 1.2 mm) for the intended use footpath, depicted in Annex A.1 of this ETA, at least steel grade S235JR+AR according to EN 10025-2 or made of stainless steel 1.4571/1.4401/1.4404/1.4301 according to EN 10088-1.
- Cornice plate, depicted in Annex A.1 of this ETA, at least steel grade S235JR+AR according to EN 10025-2 or made of stainless steel 1.4571/1.4401/1.4404/1.4301 according to EN 10088-1.
- Bolts (min. M12), nuts and washers for fixation of cover plate and cornice plate respectively: for material quality, see Table A.2.2 in this ETA.

The technical details of the components of the expansion joint kit are deposited with the Technical Assessment Body Österreichisches Institut für Bautechnik.

The subject of this European Technical Assessment (ETA) is the complete nosing expansion joint kit **mageba Tensa®Grip Typ RS**.

The connection types of the nosing expansion joint **mageba Tensa®Grip Typ RS** are shown in Figures 1 - 2 of this ETA and are depicted in Annex A.1 of this ETA.

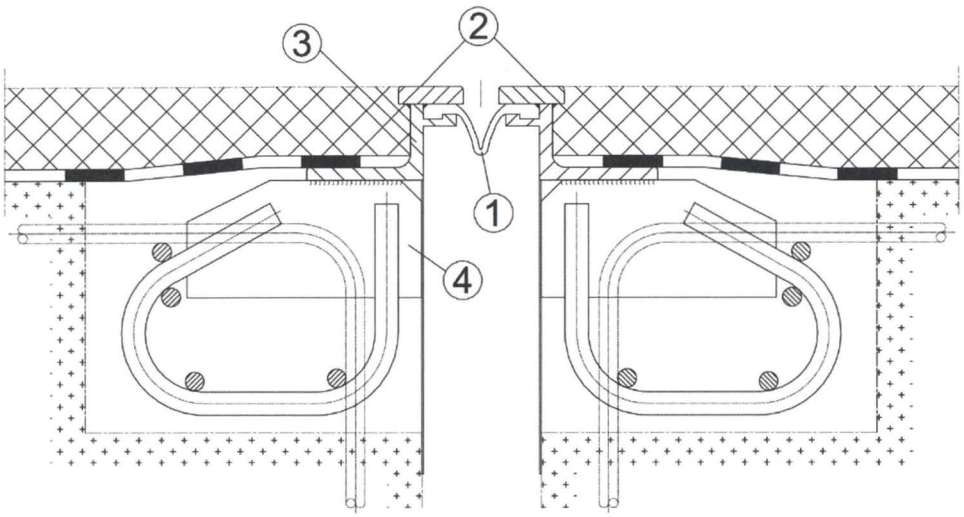


Figure 1: Exemplary cross section of the nosing expansion joint
mageba Tensa®Grip Typ RS with seal type V-Seal, including anchorage consisting of anchor plate and anchor loop

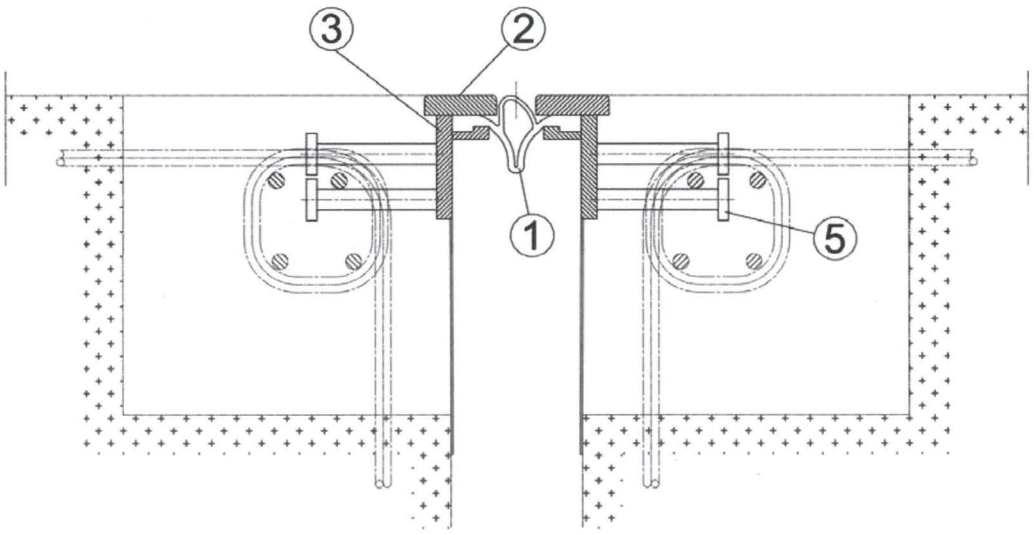


Figure 2: Exemplary cross section of the nosing expansion joint
mageba Tensa®Grip Typ RS with seal type Hump-Seal, including anchorage consisting of stud bolts

The substructure, bridge deck waterproofing and adjacent pavement in Figures 1 - 2 are not part of the kit covered by this ETA.

Key for Figures 1-2:

Pos.1	Flexible elastomeric sealing element made of EPDM
Pos.2	Steel head profile
Pos.3	Steel web (resp. angle)
Pos.4	Anchor plate and anchor loop
Pos.5	Studs

The nominal declared maximum movement capacities are given in Tables 1-3.

Table 1: Movement capacity of **mageba Tensa®Grip Typ RS** in different directions

Movement range			
		V-Seal	**Hump Seal**
Maximum longitudinal movement	max u_x =	100 mm	95 mm
Maximum vertical movement	max u_z =	8 mm	8 mm
Maximum transversal movement	max u_y =	50 mm	50 mm
Maximum rotations	Limitation as given for transversal, longitudinal and vertical movement		

The values for the allowable skew angles and the values of the nominal movement capacity depending on the skew angel (see Figure 3) and seal type are given in Table 2 and Table 3.

Table 2: Standard geometry of nosing joint **mageba Tensa®Grip Typ RS** with V-Seal in respect to its movement capacity

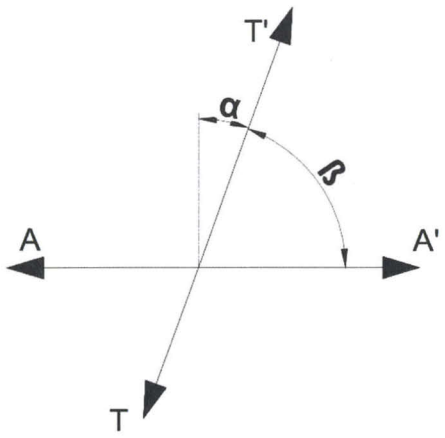
Type	**Angle between traffic direction and joint axis**	**Minimal gap**	**Maximal gap**	**Total movement**
	β [°]	**[mm]**	**[mm]**	**[mm]**
Vehicles	≥ 30	0	100	100
	30 > x ≥ 25	0	72	72
	< 25	0	45	45
Cyclists and small motorcycles	≥ 42	0	100	100
	42 > x ≥ 35	0	75	75
	35 > x ≥ 30	0	57	57
	30 > x ≥ 25	0	38	38
	< 25	0	19	19
Pedestrians	All angles	0	80 (100*)	80 (100*)

*) With cover plate

Table 3: Standard geometry of nosing joint **mageba Tensa®Grip Typ RS** with Hump-Seal in respect to its movement capacity

Type	**Angle between traffic direction and joint axis**	**Minimal gap**	**Maximal gap**	**Total movement**
	β [°]	**[mm]**	**[mm]**	**[mm]**
Vehicles	≥ 30	5	100	95
	30 > x ≥ 25	5	72	67
	< 25	5	45	40
Cyclists and small motorcycles	≥ 42	5	100	95
	42 > x ≥ 35	5	75	70
	35 > x ≥ 30	5	57	52
	30 > x ≥ 25	5	38	33
	< 25	5	19	14
Pedestrians	All angles	5	80 (100*)	80 (100*)

*) With cover plate



TT‘ = Traffic direction, AA‘ = Expansion joint axis, α = β - 90°
ß = Angle between traffic direction and joint axis

Figure 3: Skew angle ß of the expansion joint according to Table 2 and Table 3 in this ETA

Table 4: Reaction forces:

Reaction forces	
Maximum tensile force – Horizontal direction	5 kN/m
Maximum compression force – Horizontal direction	- 27,5 kN/m
Maximum force – Transverse direction	± 2,8 kN/m

Table 5: Joint types

Type	Minimal angle/web thickness t_1 [mm]	W1A [mm]	W1B [mm]	Max. longitudinal slope s_x [%]	Max. asphalt height a [mm]
1	11	a5	a4	4	130
2	11	a6.5	a4	7	80
3	12	a6	a4	6	150
4	14	a6	a4	7	220
5	20	HK-weld 10	HK-weld 10	15	300

Table 6: Anchor connections

			Boundary conditions	
Weld thickness W2 (EN ISO 2553) min. [mm]	Min. Weld length L_{W2} Max. Anchor distance a_{AN} [mm]	Weld thickness W3 (EN ISO 2553) min. [mm]	Longitudinal slope s_x max. [%]	Asphalt height a max. [mm]
Double fillet a5	L_{W2}=75, a_{AN}=250	Continuous double fillet a4	6.0	300
Double fillet a6	L_{W2}=75, a_{AN}=250		7.0	180
Double fillet a7	L_{W2}=75, a_{AN}=250		10.0	180
K-weld K7.5	L_{W2}=75, a_{AN}=250		15.0	300

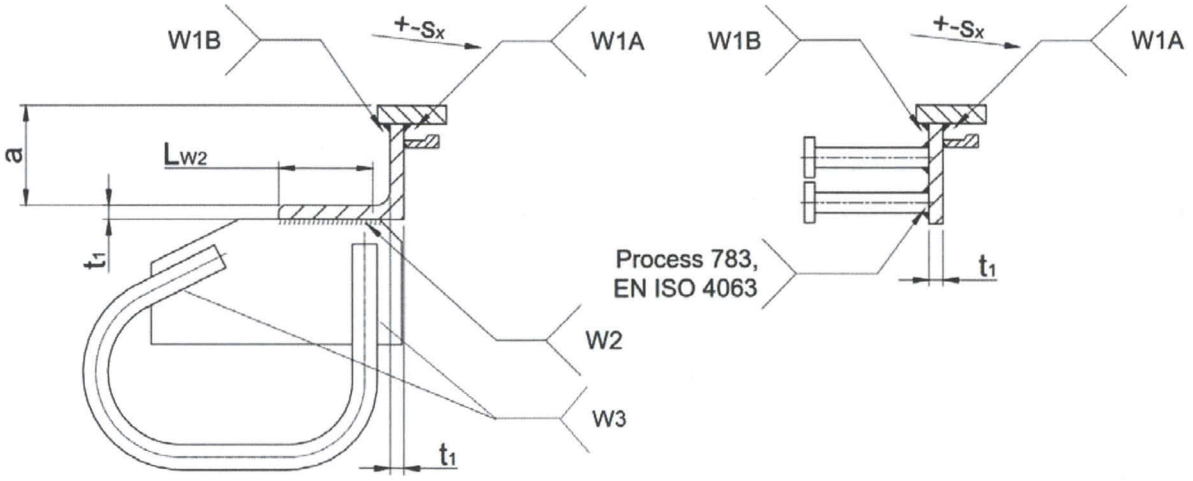


Figure 4: Location of welds according to Tables 5 and 6

In its longitudinal axis the nosing joint **mageba Tensa®Grip Typ RS** consists of the carriageway, cyclist areas, or footpath, or their possible combinations, as depicted in Annex A.1 of this ETA.

Provisions for proper installation (installation manual) of the **mageba Tensa®Grip Typ RS** are provided for each delivered kit.

2 Specification of the intended use(s) in accordance with the applicable European Assessment Document (hereinafter EAD)

The nosing expansion joint **mageba Tensa®Grip Typ RS** is to be used in road bridges. It is used for the use categories vehicles, cyclists and pedestrians. The expansion joint system is designated to be applied in new structures as well as for refurbishment of structures.

The nosing expansion joint **mageba Tensa®Grip Typ RS** is to be used in road bridges.

The performance characteristics of the nosing expansion joint **mageba Tensa®Grip Typ RS** are assessed for operating temperature of -40° C up to +45° C. This has been assessed on basis of material characteristics of the elastomeric sealing, the steel elements (metal parts of anchorage, steel edge profile, steel flange and cover plate for footpath), whereas for the use of steel elements for low temperatures EN 1993-1-10, table 2.1, is relevant.

The use of the nosing expansion joint **mageba Tensa®Grip Typ RS** according to this ETA is covering a maximum slope in traffic direction as defined in Tables 5 and 6 in this ETA.

The use in moveable bridges (e.g. flap bridges, swing bridges) is not covered by this ETA.

The provisions made in this European Technical Assessment are based on a working life of the kit of 50 years (working life category 4 according to ETAG 032-1), provided that the kit is subject to appropriate use and maintenance as specified by the manufacturer in the maintenance instructions which follow every delivered kit. The indications given on the working life cannot be interpreted as a guarantee given by the producer or the Technical Assessment Body, but are to be regarded only as a means for choosing the right product in relation to the expected economically reasonable working life of the works.

The working life of the expansion joint kit is based on the assessment of resistance to fatigue according to the fatigue load model 1 (FLM1), meaning the fatigue life may be considered as unlimited according to ETAG 032 Part 1, Annex G, G3.1.

For the replaceable component elastomeric sealing made of EPDM, a working life of 25 years is indicated.

For corrosion protection, the indications given in Table 7 of this ETA apply.

3 Performance of the product and references to the methods used for its assessment

3.1 Performance of the product

Table 7: Performance of the product in relation to the essential characteristics

Basic requirements for construction works	Essential characteristics	Method of assessment	Performance
BWR 1	Mechanical resistance	ETAG 032-4, clause 5.1.1.2	Mechanical resistance and stability is given for the product according to Annex A.1 and Tables 2, 3, 5 and 6 in this ETA with the conditions given in Clause 3.1.1 in this ETA.
	Resistance to fatigue	ETAG 032-4, clause 5.1.1.3	Resistance to fatigue is given for the product according to the geometry stated in Tables 5 and 6 in this ETA.
	Seismic behaviour	ETAG 032-4, clause 5.1.1.4	According to Table 9 in this ETA.
	Movement capacity	ETAG 032-4, clause 5.1.1.5	Declaration of the manufacturer according to Table 1 in this ETA.
	Cleanability	ETAG 032-4, clause 5.1.1.6	The expansion joint is able to extrude debris by its movement. The fixing of the sealing element and the movement capacity was not influenced by the accumulation of debris.
	Watertightness	ETAG 032-4, clause 5.1.1.8	Watertightness is given.
BWR 3	Content, emission and/or release of dangerous substances	ETAG 032-4, clause 5.1.3	No performance assessed.
BWR 4	Allowable surface gaps and voids	ETAG 032-4, clause 5.1.4.1.1	Declaration of allowable gaps in respect to the use categories and the range of angle β between traffic direction and longitudinal axis of the expansion joint: Tables 2 and 3 in this ETA.
	Level differences in the running surface	ETAG 032-4, clause 5.1.4.1.2	Unloaded conditions: no level differences (including steps) greater than 3 mm are occurring. After loading: maximum deflection under load: 1 mm

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Basic requirements for construc-tion works	Essential characteristics	Method of assessment	Performance
Durability aspects	Corrosion	ETAG 032-4, clause 5.1.7.1	Corrosivity categories: C4, C5-I, C5-M acc. to EN ISO 12944-2 or C4, C5 acc. to EN ISO 14713-1, dependent on the intended use. Corrosion protection systems: Durability range "high" (H) acc. to EN ISO 12944-5 or durability range "high" (H) or "very high" (VH) acc. to EN ISO 14713-1. For all components, including components made of stainless steel, full corrosion protection is applied. Head profile: Corrosion resistance class CRC III, acc. to EN 1993-1-4 Cover-/ cornice plate: Corrosion resistance class CRC II or CRC III, acc. to EN 1993-1-4 Bolts, nuts, washers: Hot dip galvanized acc. to EN ISO 10684 or austenitic steel, grade A4 acc. to EN ISO 3506
	Chemicals: Resistance to de-icing salts	ETAG 032-4, clause 5.1.7.1	Elastomeric sealing: Durable
	Ageing resulting from: - Temperature - Ozone	ETAG 032-4, clause 5.1.7.1	

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3.1.1 Mechanical resistance

Action categories covered by static calculation:
For the design situation ultimate limit state (ULS), the fundamental combinations of actions and the combination of actions for fatigue limit state (FLS) are considered.
For the design situation serviceability limit state (SLS) the characteristic combinations of actions and frequent combinations are considered.
Regarding optional actions, the accidental load on footway, the accidental load on kerb and the seismic design situations according to ETAG 032-1, Annex G, are considered.

The static assessment applies for the following conditions:

Table 8: Preconditions for the static assessment

Partial safety factor γ_{M0} (EN 1993-2)	1.1
Partial safety factor γ_{M1} (EN 1993-2)	1.1
Partial safety factor γ_{M2} (EN 1993-2)	1.25
Partial safety factor γ_C (EN 1992-1-1)	1.5
Adjustment factor α_{cc} (EN 1992-1-1)	0.85
Reduction factor for concrete fatigue resistance k1 (EN 1992-1-1, 6.8.2)	0.85
Partial safety factor γ_{Mf} (ETAG 032-8)	1.15
Fatigue load model (ETAG 032-1)	FLM 1_{EJ}

Table 9: Seismic behaviour of **mageba Tensa®Grip Typ RS** with seal types V-Seal and Hump-Seal – maximum gaps during earthquake according to ETAG 032-1, clause 4.1.1.4 for β = 90°

Approach according to ETAG 032-1, Table 4.1.1.4	**Maximum gap during earthquake**
Approach A1	100 mm
Approach A2, B1	105 mm
Approach B2	160 mm
Approach B3	240 mm
Approach B4	After earthquake: max. gap 300 mm for emergency traffic

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4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

4.1 AVCP system

According to the decision 2001/19/EC[1] of the European Commission, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V of Regulation (EU) No 305/2011) is 1.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

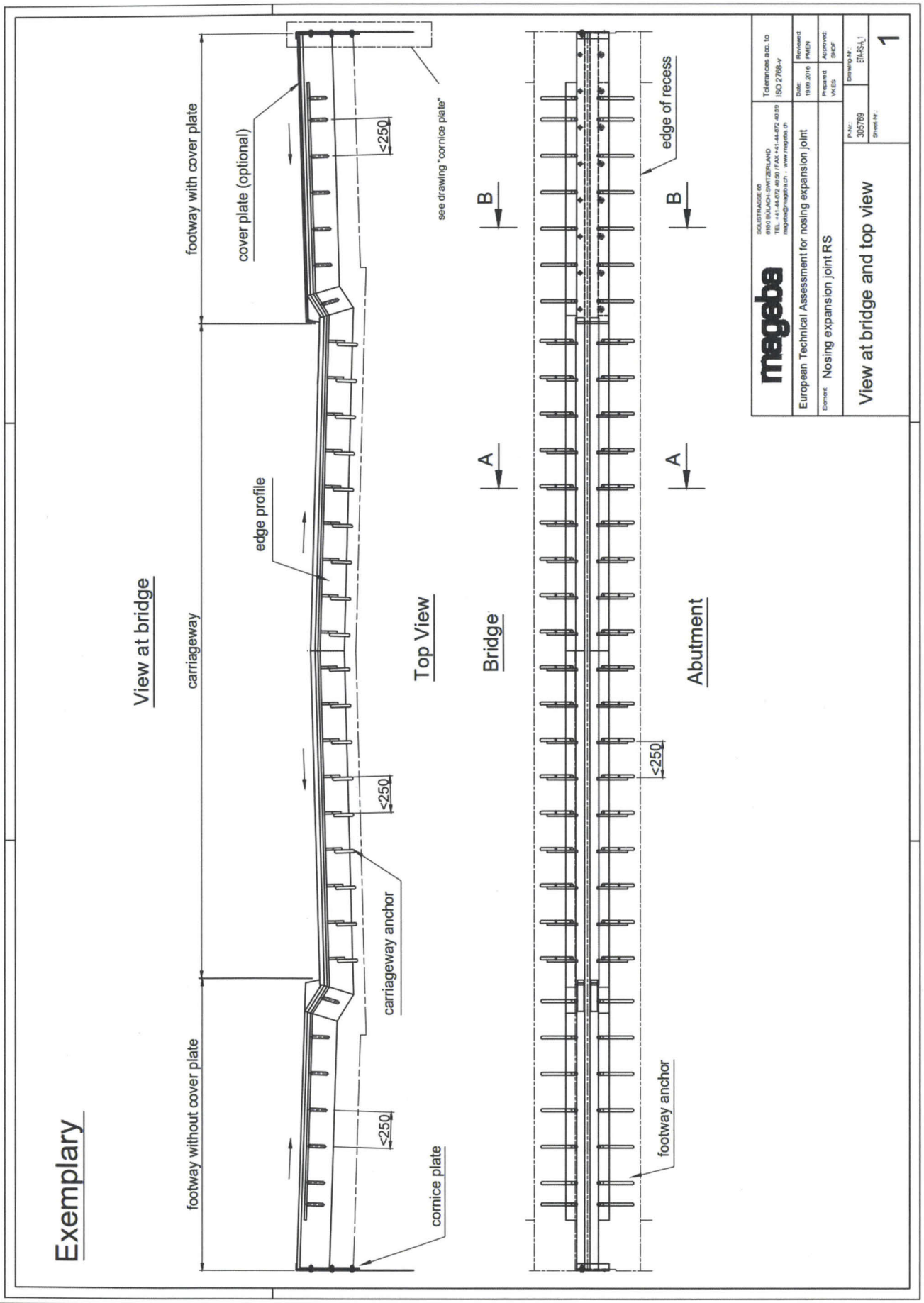
Technical details necessary for the implementation of the AVCP system are laid down in in the control plan deposited by the Technical Assessment Body Österreichisches Institut für Bautechnik.

The notified product certification body shall visit the factory at least once a year for surveillance of the manufacturer.

Issued in Vienna on 13.07.2017
by Österreichisches Institut für Bautechnik

Rainer Mikulits
Managing Director

[1] Official Journal of the European Communities N° L 005, 10.1.2001, p. 6-7



mageba Tensa®Grip Typ RS with anchor loop **View at bridge and top view**	**Annex A.1** of European Technical Assessment ETA-17/0612

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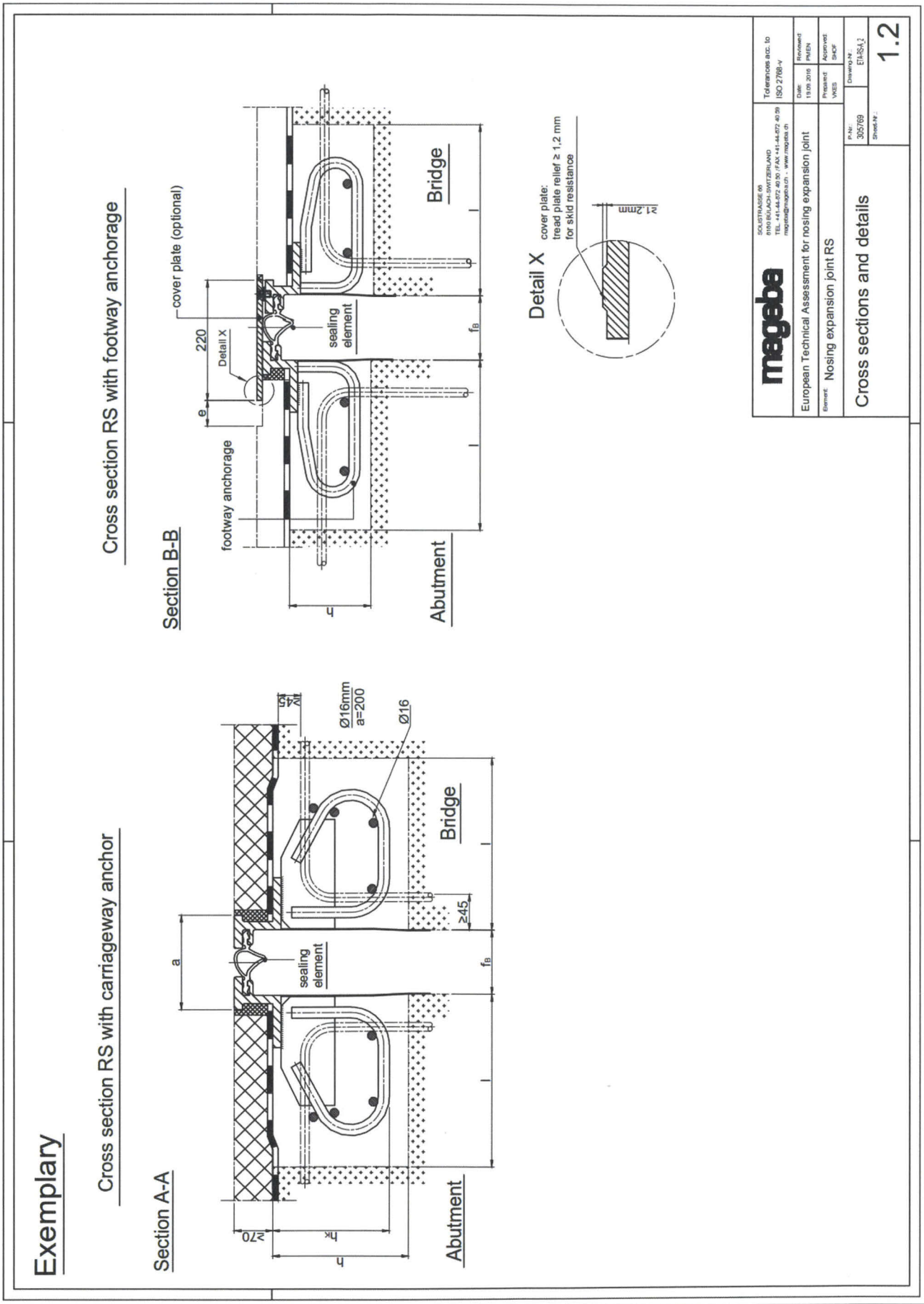

mageba Tensa®Grip Typ RS with anchor loop **Standard cross section**	**Annex A.1** of European Technical Assessment ETA-17/0612

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Note:

Concrete:
Low shrinkage concrete (≤0.5‰ final shrinkage).

Concret class minimum acc. to EN 206	Boundary conditions		
	Days till first load [d]	Longitudinal slope s_x [%]	Asphalt height [mm]
C30/37	≥7	≤7	≤200
C40/50	≥12	≤15	≤300

Slump class: S3 to S5 (EN 206); S5 to be preferred. Grain size: 0/16. Concreting, compacting and cure according generally recognized codes of practice and national regulations.

Pos. 1: through-reinforcement Ø16, a=200, B 500 (B), rectangular to joint axis

Pos. 2: through-reinforcement min.3xØ16, B 500 (B), parallel to joint axis

Additional reinforcement according statical requirements of the structure and national regulations for minimum reinforcement. Such includes shrinkage and crack limitation reinforcement. Designed by the engineer.

mageba Tensa®Grip Typ RS with anchor loop **Reinforcement**	**Annex A.1** of European Technical Assessment ETA-17/0612

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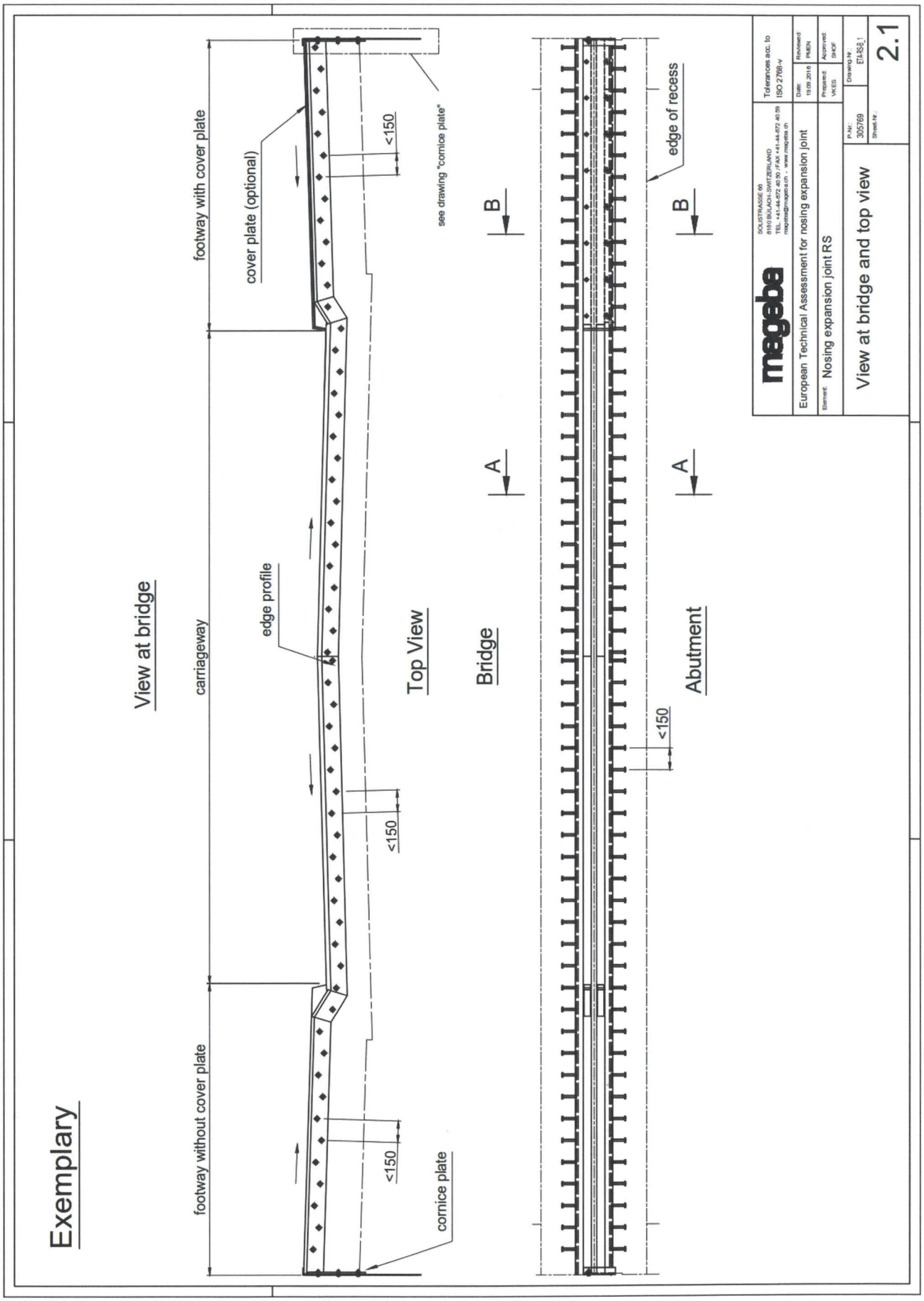
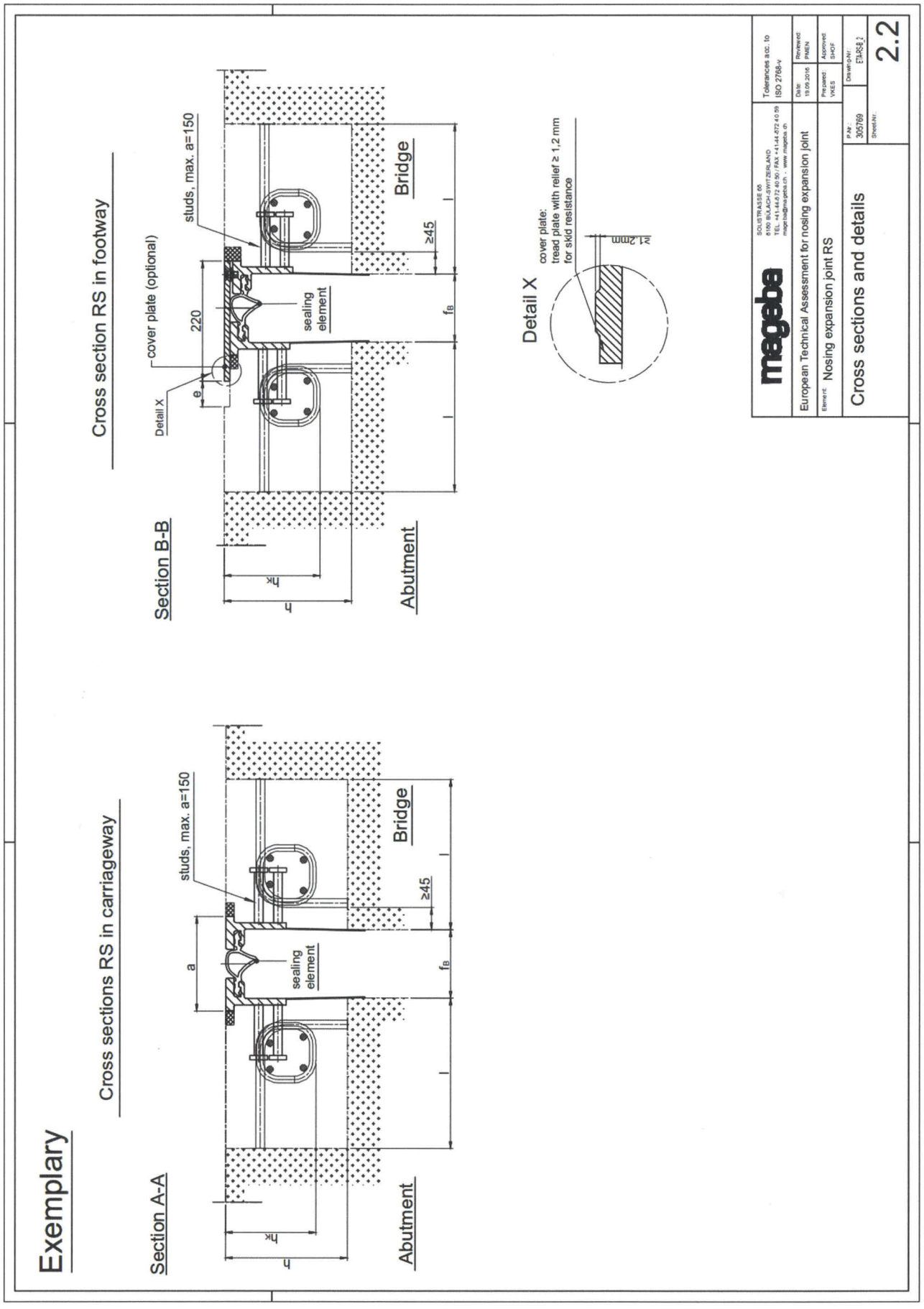


mageba Tensa®Grip Typ RS with studs **View at bridge and top view**	**Annex A.1** of European Technical Assessment ETA-17/0612



mageba Tensa®Grip Typ RS with studs **Standard cross section**	**Annex A.1** of European Technical Assessment ETA-17/0612

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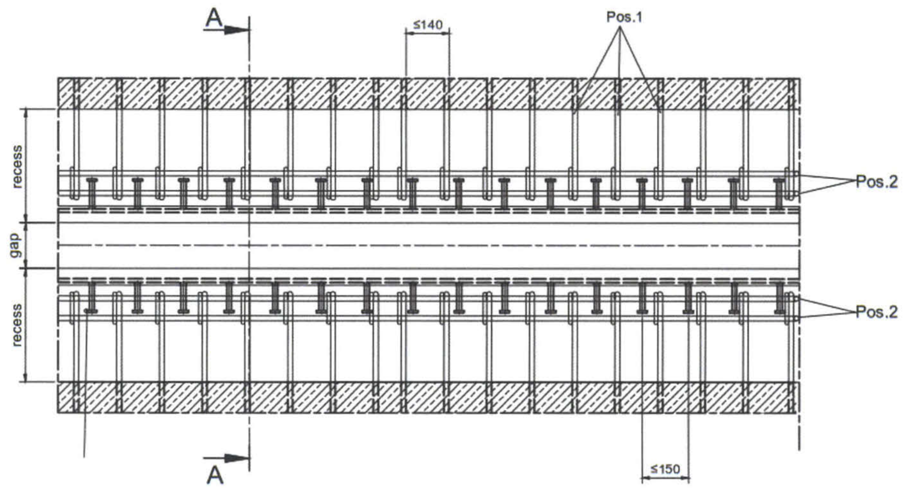
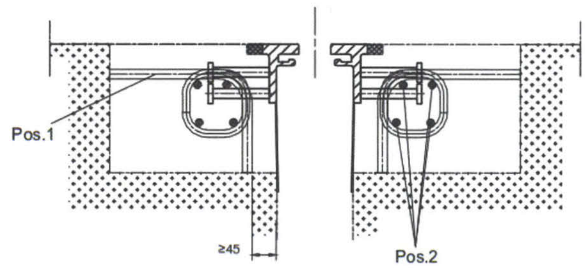
Exemplary

Top view



Section A-A



Note:

Concrete:
Low shrinkage concrete (≤0.5‰ final shrinkage).

Concret class minimum acc. to EN 206	Boundary conditions	
	Days till first load [d]	Longitudinal slope s_x [%]
C30/37	≥7	≤7
C40/50	≥12	≤15

Slump class: S3 to S5 (EN 206); S5 to be preferred. Grain size: 0/16. Concreting, compacting and cure according generally recognized codes of practice and national regulations.

Pos. 1: through-reinforcement Ø16, a ≤ 140, B 500 (B), rectangular to joint axis

Pos. 2: through-reinforcement min.3xØ16, B 500 (B), parallel to joint axis

Additional reinforcement according statical requirements of the structure and national regulations for minimum reinforcement. Such includes shrinkage and crack limitation reinforcement. Designed by the engineer.

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Tolerances acc. to ISO 2768-v

European Technical Assessment for nosing expansion joint

Date: 19.09.2016 | Reviewed: PMEN

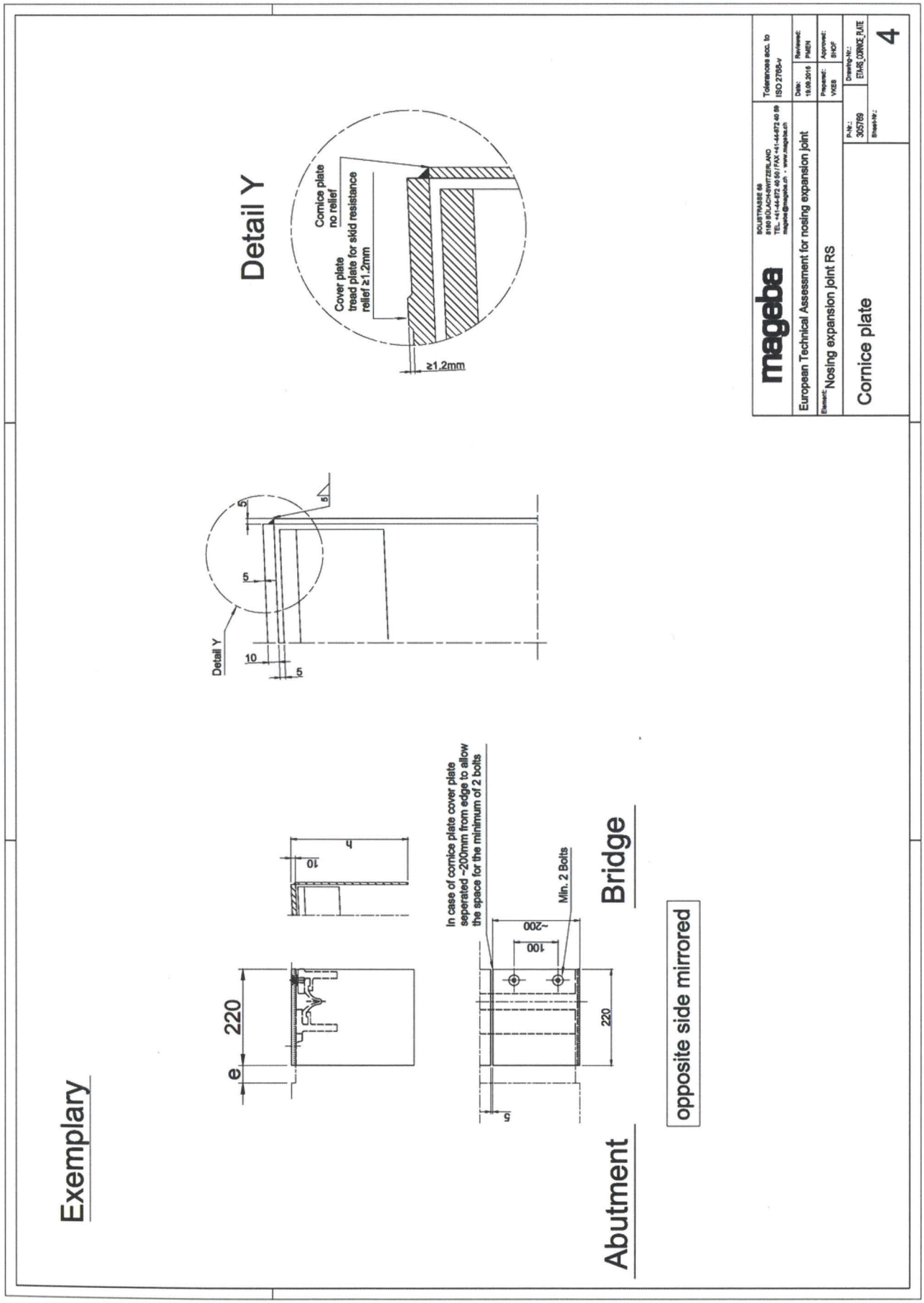
Element: Nosing expansion joint RS

Prepared: VKES | Approved: SHOF

Reinforcement drawing
(through-reinforcement)

P-Nr.: 305769 | Drawing-Nr.: ETA-RS-8_3

Sheet-Nr.: 2.3



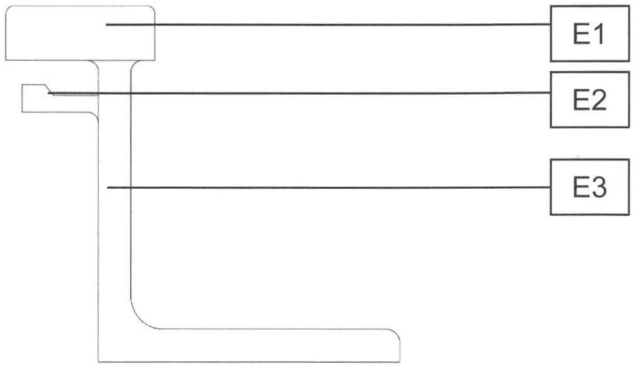
mageba Tensa®Grip Typ RS all types **Cornice plate and cover plate**	**Annex A.1** of European Technical Assessment ETA-17/0612

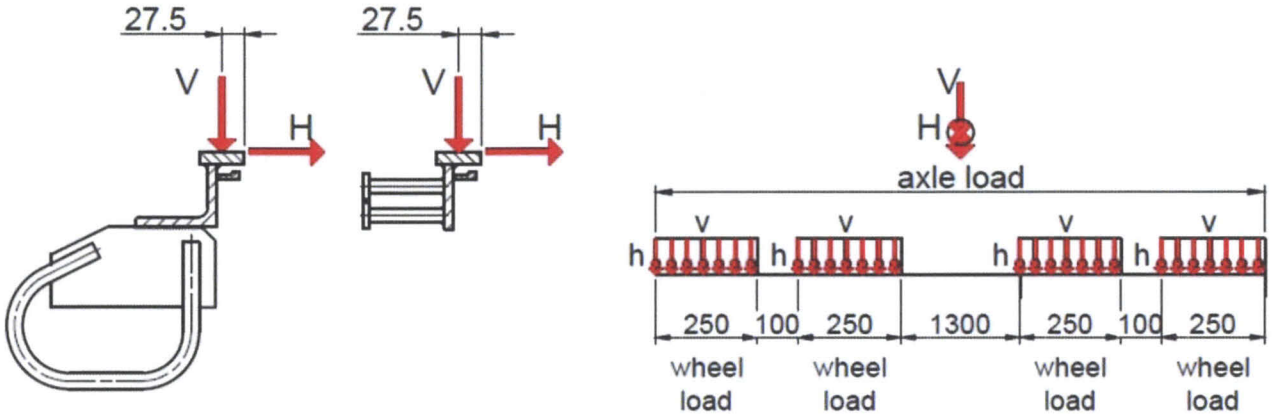
Table A.2.1: Material characteristics of the elastomeric sealing elements made of EPDM

Material characteristic	Technical specification	Declaration
Density	ISO 2781	Laid down in technical documentation deposited with the Technical Assessment Body Österreichisches Institut für Bautechnik (OIB)
Hardness IRHD	ISO 48	
Tensile strength	ISO 37	
Elongation at break	ISO 37	
Tear resistance	ISO 34-1, Method A	
Thermogravimetric characteristics (TGA)	ISO 9924-1	
Rheometric characteristics	ISO 3417	
Compression set	ISO 815-1 (conditions acc. to ETAG 032-4, Table 5.2)	
Brittleness test	ISO 812, procedure A	

Table A.2.2: Material quality of steel components

Component	Quality and standard
Edge beam (see sketch below) • E1 • E2 • E3	 Minimum S235JR+AR according to EN 10025-2 or stainless steel 1.4571 or 1.4404 acc. to EN 10088-1 Minimum S235JR+AR according to EN 10025-2 Minimum S235JR+AR according to EN 10025-2
Anchor loop and plate	Minimum S235JR+AR according to EN 10025-2
Studs	Minimum S235J2+C450 according to EN ISO 13918
Cover plate and cornice plate	Minimum S235JR+AR according to EN 10025-2 or 1.4571/1.4401/1.4404/1.4301 according to EN 10088-1
Bolts	8.8 tZn, 10.9 tZn according to EN ISO 898-1 / EN ISO10684; A4-70, A4-80 according to EN ISO 3506-1
Nuts	8 tZn, 10 tZn according to EN ISO 898-2/EN ISO 10684; A4-70, A4-80 according to EN ISO 3506-2
Washers	200HV tZn, 300HV tZn according to EN ISO 6507 / EN ISO 10684; 200HV A4, 300HV A4 according to EN ISO 6507 / EN ISO 3506-1





all dimensions in mm

Connection forces			
	longitudinal slope	v [kN/m]	h [kN/m]
FLS / ULS *	$s_x \leq 4.0\%$	80.4 / 155.2	16.0 / 29.2
	$s_x \leq 6.0\%$	80.4 / 155.2	21.6 / 29.2
	$s_x \leq 7.0\%$	80.4 / 155.2	24.0 / 29.2
	$s_x \leq 15.0\%$	80.4 / 155.2	45.6 / 45.6

*only the maximum values are shown

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Reference documents

ETAG 032-1 Guideline for European technical approval (ETAG) No 032 "Expansion joints for road bridges, Part 1: General", edition May 2013, used as European Assessment Document (EAD)

ETAG 032-4 Guideline for European technical approval (ETAG) No 032 "Expansion joints for road bridges, Part 4: Nosing expansion joints", edition May 2013, used as European Assessment Document (EAD)

ETAG 032-8 Guideline for European technical approval (ETAG) No 032 "Expansion joints for road bridges, Part 8: Modular expansion joints", edition May 2013, used as European Assessment Document (EAD)

EN 206:2013+A1:2016 "Concrete - Specification, performance, production and conformity"

EN 1992-1-1:2004 + AC:2010 "Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings"

EN 1993-1-4:2015 "Eurocode 3: Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels"

EN 1993-1-10:2005 + AC:2009 "Eurocode 3: Design of steel structures - Part 1-10: Material toughness and through-thickness properties"

EN 1993-2:2006 + AC:2009 "Eurocode 3: Design of steel structures - Part 2: Steel Bridges"

EN 10025-2:2004 "Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels"

EN 10088-1:2014 "Stainless steels – Part 1: List of stainless steels"

EN ISO 898-1:2013 "Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs with specified property classes - Coarse thread and fine pitch thread"

EN ISO 898-2:2012 "Mechanical properties of fasteners made of carbon steel and alloy steel - Part 2: Nuts with specified property classes - Coarse thread and fine pitch thread"

EN ISO 2553:2013 "Welding and allied processes - Symbolic representation on drawings - Welded joints (ISO 2553:2013)"

EN ISO 3506-1:2009 "Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, screws and studs"

EN ISO 3506-2:2009 "Mechanical properties of corrosion-resistant stainless steel fasteners - Part 2: Nuts"

EN ISO 4063:2010 "Welding and allied processes - Nomenclature of processes and reference numbers"

EN ISO 6507:2005 "Metallic materials - Vickers hardness test"

EN ISO 10684:2004 + AC:2009 "Fasteners - Hot dip galvanized coatings"

EN ISO 12944-2:1998 "Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments"

EN ISO 12944-5:2007 "Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems"

EN ISO 13918:2008 "Welding - Studs and ceramic ferrules for arc stud welding"

EN ISO 14713-1:2009 "Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 1: General principles of design and corrosion resistance"

ISO 34-1:2015 "Rubber, vulcanized or thermoplastic - Determination of tear strength - Part 1: Trouser, angle and crescent test pieces"

ISO 37:2011 "Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties"

ISO 48:2010 "Rubber, vulcanized or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100 IRHD)"

ISO 812:2011 "Rubber, vulcanized or thermoplastic - Determination of low-temperature brittleness"

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ISO 815-1:2014 “Rubber, vulcanized or thermoplastic - Determination of compression set - Part 1: At ambient or elevated temperatures”
ISO 3417:2008 “Rubber - Measurement of vulcanization characteristics with the oscillating disc curemeter”
ISO 2768-1:1991 “General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications”
ISO 2781:2008 “Rubber, vulcanized or thermoplastic - Determination of density”
ISO 9924-1:2016 “Rubber and rubber products - Determination of the composition of vulcanizates and uncured compounds by thermogravimetry - Part 1: Butadiene, ethylene-propylene copolymer and terpolymer, isobutene-isoprene, isoprene and styrene-butadiene rubbers”