

Licence

General Approval issued by the Building Inspection Authorities
No. Z-10.4-540

Oberflächenführungen / Deckblechtyp

L = slightly profiled
For foam systems ,FTS 01", ,FTS 02" and ,FTS 03"
Outside L2/S = 0,72 mm ± 0,14 mm
Inside L1/S = 0,36 mm ± 0,18 mm

For foam systems ,FTS 04"
Outside L2/S = 1,5 mm ± 0,3 mm
Inside L1/S = 1,1 mm ± 0,2 mm

S = Beading – only outer sheet

E = Flat – inner and outer sheet

M = Microprofiling – only outer sheet

K = Combined slight profiling – only outer sheet
S = 1,5 mm ± 0,6 mm
- 0,2 mm

W = Corrugation – only outer sheet

T = Trapezoidal profiling, wall element – only outer sheet

D = Trapezoidal profiling, roof element – only outer sheet

Nominal thickness of the cover sheets:
 $t_{k1} = 0,50 \text{ mm} \leq t_{k1} \leq 1,00 \text{ mm}$
 $t_{k2} = 0,40 \text{ mm} \leq t_{k2} \leq 1,00 \text{ mm}$
 $t_k = t_{k1} - 0,04 \text{ mm} \leq t_k \leq 0,96 \text{ mm}$ decisive for calculation
 $d =$ continuous core thickness [mm]
 $D =$ Element thickness [mm]

Joint design: see sheets 5.01 and 5.02

Load-bearing ,FischerTHERM" and ,FischerFIREPROOF" sandwich elements for walls and roofs

surface designs / Type of cover sheet

General Approval issued by the Building Inspection Authorities
No. Z-10.4-540

Design limit values for wrinkling stresses α_x [N/mm²]
for the determination of serviceability*)
Foam system FTS 04:

Type of cover sheet as per appendix B, sheet 1.02	Continuous core thickness d [mm]	across the span		in case of load above central supports of continuous panels	
				Outside ¹⁾	
		inside	Outside ¹⁾	inside	Outside ¹⁾
E	30 40 60 - 78 85 - 120	68 85 81 74	54 68 65 59	60 57 52	
L1	30 - 120	157			
L2 / K	40 - 60 100	213 192	126		
S	40 - 100				
M	40 60 100	189 195 189		149 134 132	
T	40 - 60	183		137 132 128	
D	30 - 60 120 58 78	183 285 287 350 334		156 265 267 350 334	
W					

1) Reduction factor for cover sheets type E, L2, S, M, T and K:
 $k = \frac{11-d}{6}$
 $n =$ number of bolts per metre, for $n > 5$ bolts per metre

Abminderungsfaktoren für α_x bei Blechdicken von t_k

Type of cover sheet	0,40 mm	0,50 mm	0,55 mm	0,63 mm	0,75 mm	0,88 mm	1,00 mm
E, W, T, D	1	1	1	1	1	1	1
L1	1	1	1	1	1	1	1

General Approval issued by the Building Inspection Authorities
No. Z-10.4-540

2.2.4 Sandwich elements

2.2.4.1 Sandwich elements shall consist of a core described in paragraph 2.2.2, cover according to paragraph 2.2.1 and joint sealing strips described in paragraph 2.2.3, all shall be in accordance with appendix B. Thickness values (d and D respectively) nominal, subject to the following tolerances:
 $\pm 2 \text{ mm}$ for d and D respectively $\leq 100 \text{ mm}$
 $\pm 3 \text{ mm}$ for d and D respectively $> 100 \text{ mm}$.

Classification of sandwich elements in terms of the types of cover sheets, the foam system and the joint sealing strips:

Type of sandwich element	Fischer THERM	Fischer THERM plus	Fischer THERM T	Fischer THERM W	Fischer THERM D	Fischer FIRE-PROOF	Fischer FIRE-PROOF
Outer cover sheet	L2 / S / E / M / K	L2 / S / E / M / K	T	W	D	L2 / S / E / M / K	L2 / S / E / M / K
Inner cover sheet	L1 / E	L1 / E	L1 / E	L1 / E	L1 / E	L1 / E	L1 / E
			all				FTS 02

FischerTHERM FischerFIREPROOF

Zulassungsstelle für Bauprodukte und Bauarten

Bautechnisches Prüfamt

Eine vom Bund und den Ländern
gemeinsam getragene Anstalt des öffentlichen Rechts

Mitglied der EOTA, der UEAtc und der WFTAO

General Approval issued by the Building Inspection Authorities

Approval no.:

Z-10.4-540

Validity

from **17 May 2011**

to **30 September 2015**

Applicant:

Fischer Profil GmbH

Waldstraße 67

57250 Netphen

Subject of the approval:

Load-bearing sandwich elements "FischerTHERM" and "FischerFIREPROOF" for roofs and walls

The Building Inspection Authorities herewith issue General Approval for the above subject of approval. This approval document comprises ten pages, together with appendix A (six pages) and appendix B (14 pages).

DIBt

I. GENERAL PROVISIONS

- 1 This General Approval issued by the Building Inspection Authorities confirms the acceptability of the subject of approval as per State Building Regulations.
- 2 If the General Approval issued by the Building Inspection Authorities contains requirements with respect to the expertise and experience of persons entrusted with the production of building products and with the building technique in accordance with the model building code, article 17, paragraph 5 of the State Building Regulations, it should be noted that such expertise and experience can also be demonstrated by equivalent certification from other member states of the EU. This also applies to certificates issued within the framework of the agreement on the European Economic Area (EEA) or to other bilateral agreements
- 3 The General Approval issued by the Building Inspection Authorities does not substitute for any of the permits, consents and certificates that may be required by law for carrying out building projects.
- 4 The General Approval of the Building Inspection Authorities is issued without prejudice to the rights of third parties, in particular to legal rights of protection.
- 5 The manufacturer and supplier of the approved items shall provide the recipient of these items with copies of this General Approval, without prejudice to other regulations included in the 'Special Provisions' and shall point out that such copies should be kept at the place where the material is used. The authorities involved shall be given copies of this General Approval on request.
- 6 The General Approval issued by the Building Inspection Authorities shall be reproduced as a complete document only. The publication of excerpts is subject to the consent of the German Institute for Constructional Engineering (DIBt). Any descriptions and publicity material shall not be in contradiction of the terms of the General Approval. Translations of the General Approval shall contain the proviso: 'This translation has not been verified by the German Institute for Constructional Engineering'.
- 7 The issue of the General Approval can be revoked. The provisions of the General Approval can be subsequently supplemented and modified, particularly if this is the result of technical developments.

II. SPECIAL PROVISIONS

1 Subject of approval and field of application

1.1 Subject of approval

The sandwich elements 'FischerTHERM' and 'FischerFIREPROOF' consist of metallic cover sheets which enclose a core layer made up of polyurethane rigid foam. They are manufactured with a cover width from 1000 mm up to 1100 mm and with a continuous element thickness ranging from 30 mm up to 120 mm. For the cover sheets either flat, quasi-flat, corrugated or trapezoidal profiled steel sheets are used.

1.2 Field of application

The sandwich panels are space-enclosing elements for outer walls and roofs with good thermal insulation properties. They may be used for structural analysis of the substructure in terms of sufficient rotational bedding, taking account of the marginal conditions as stated in DIN 18800-2¹, paragraph 3.3.2 (309). There is no reinforcing effect on buildings, parts of buildings or structural works.

The fire behaviour of the sandwich elements corresponds to the national official classification 'virtually non-inflammable'.

In applications as roofing panels only sandwich elements with trapezoidal profiled outer sheets may be used. They are resistant to flying sparks and to radiating heat (hard roofing), in accordance with DIN 4102-4². The slope must be at least 5% ($\hat{=}$ 3°).

2 Regulations applicable to the building products

2.1 General

The sandwich elements and their components must fully comply with the Special Provisions and the appendices of this approval and with the data deposited with the German Institute for Building Technology.

2.2 Properties and composition

2.2.1 Cover sheets

The cover sheets shall be made from galvanized steel S 350 GD+Z275 to DIN EN 10 326³.

The thickness of the cover sheets and their geometry must comply with appendix B sheets 1.01 and 1.02. The following dimensions and tolerances have to be taken into account:

- Thickness of the cover sheets: DIN EN 10 143⁴, table 2, "standard limit deviations", for the min. limit deviations only half the values shall apply.
- Geometry of the cover sheets: (see appendix B)

The corrosion protection of the cover sheets must comply with DIN 55928-8⁵, table 3, ident. no. 3-0.1. Galvanised steel strip in accordance with DIN EN 10326 on the exposed side, which corresponds to zinc layer group 275, is also permitted as base material. On the surface facing the foam a zinc layer of 50 g/m² is sufficient.

¹ DIN EN 18800-2:2008-11

² DIN 4102-4:1994-03

³ DIN EN 10326:2004-09

⁴ DIN EN 10143:2006-09

⁵ DIN 55928-8:1994-07

Corrosion protection by coil coating as per coating group 275 to DIN EN 10326 and corrosion protection by alloy galvanizing (ZA) and (AZ) shall be considered as equivalent, provided the coating has the same thickness. However, since its density is lower than that of pure zinc, coating weights of only 255 g/m² and 150 g/m² respectively are required. As an alternative, corrosion protection may be applied by a zinc magnesium alloy, provided that the corrosion protection of the steel strip is regulated by a general approval issued by the Building Inspection Authorities.

Additional corrosion protection may be achieved by applying coatings in accordance with DIN 55928-8; table 3 to steel surfaces which are not in contact with the core, provided that the virtually non-inflammable nature of these coatings is certified by a general test certificate or a general approval issued by the Building Inspection Authorities.

2.2.2 Core layer

The core layer which is made up of polyurethane (PUR) rigid foam shall comply with DIN EN 13165⁶ in connection with DIN 4108-10⁷, at least application type DAA or WAA, unless other requirements are laid down in appendix B sheets 6.01 to 6.03 of this general approval.

Foam systems to be used:

- 'FTS 01' (blowing agent: pentane) or
- 'FTS 02' (blowing agent: pentane) or
- 'FTS 03' (blowing agent: pentane) or
- 'FTS 04' (blowing agent: pentane).

The production procedures must comply with those deposited with the German Institute for Building Technology.

The core layers must not correspond to class F as per DIN EN 13501-1.

With respect to fire behaviour the core layers must comply with class A1 as per DIN EN 13501-1.

During production, the heat conductivity λ_i (value of the heat conductivity after ageing) according to DIN EN 13165 must not exceed the limit values $\lambda_{\text{grenz, a}}$ quoted hereafter, depending on the foam system used:

- 'FTS 01' $\lambda_{\text{grenz, a}} = 0.0251 \text{ W/(m}\cdot\text{K)}$
- 'FTS 02' $\lambda_{\text{grenz, a}} = 0.0251 \text{ W/(m}\cdot\text{K)}$
- 'FTS 03' $\lambda_{\text{grenz, a}} = 0.0251 \text{ W/(m}\cdot\text{K)}$
- 'FTS 04' $\lambda_{\text{grenz, a}} = 0.0261 \text{ W/(m}\cdot\text{K)}$

2.2.3 Joint sealing strips

Type 1: Joint sealing strip 'PUR Seal', manufactured by illbrick Bau-Technik GmbH, D-Leverkusen, in accordance with general approval no. P-NDS04-560.

Type 2: Joint sealing strip 'ISO-COIL AV T11', manufactured by ISO-Chemie GmbH, D-Aalen, in accordance with general approval no. P-262 30553-ift.

Type 3: Joint sealing strip 'ISO-COIL AV T12', manufactured by ISO-Chemie GmbH, D-Aalen, in accordance with general approval no. P-261 30564-ift.

⁶ DIN EN 13165:2005-02

⁷ DIN 4108-10:2008-06

2.2.4 Sandwich elements

2.2.4.1 Sandwich elements shall consist of a core described in paragraph 2.2.2, cover sheets according to paragraph 2.2.1 and joint sealing strips according to paragraph 2.2.3, and they shall be in accordance with appendix B. Thickness values (d and D respectively) are nominal, subject to the following tolerances:

- ± 2 mm for d and D respectively ≤ 100 mm
- ± 3 mm for d and D respectively > 100 mm.

Classification of sandwich elements in terms of the types of cover sheets, the foam system and the joint sealing strips:

Type of sandwich element	Fischer THERM	Fischer THERM plus	Fischer THERM T	Fischer THERM W	Fischer THERM D	Fischer FIRE-PROOF	Fischer FIRE-PROOF D
Outer cover sheet	L2 / S / E / M / K	L2 / S / E / M / K	T	W	D	L2 / S / E / M / K	D
Inner cover sheet	L1 / E	L1 / E	L1 / E	L1 / E	L1 / E	L1 / E	L1 / E
Foam system	all					FTS 02	
Joint sealing strips	all						

For assessment of the behaviour in fire any additional corrosion protection must be taken into consideration.

Sandwich elements with the foam system 'FTS 01', 'FTS 03' or 'FTS 04' shall comply with the requirements applicable to the fire behaviour of class B-s3,d0 as per DIN EN 13501-1⁸. Sandwich elements with the foam system 'FTS 02' shall comply with the requirements applicable to the fire behaviour of class B-s2,d0 as per DIN 13501-1.

2.2.5 Fasteners

Fasteners used for sandwich panels for roof and wall (see appendix B, sheets 5.01 and 5.02) shall meet the requirements specified in General Approval Z-14.4-407, provided that the Special Provisions of the said approval permit their use.

In the case of direct fastening, appendix B, sheet 2.01. shall be observed, whereas in the case of indirect fastening, appendix B, sheet 2.02 shall be observed.

2.3 Manufacture and marking

2.3.1 Manufacture

The sandwich elements must be manufactured in a continuous production process. In this production process the outer sheets must always be located at the bottom.

⁸ DIN EN 13501-1:2007-05

2.3.2 Marking

The sandwich panels must be marked by the manufacturer with the mark of conformity (Ü mark) in accordance with national regulations. In addition, the following details must be provided:

- Description of the subject of approval (designation of the sandwich type / thickness of the panel / type of outer and inner cover sheet / thickness of outer and inner cover sheet
- Rated thermal conductivity value λ for the core layer
- 'Behaviour in fire see the general approval'
- Designation of the foam of the core layer (see section 2.2.2)
- Outside of the sandwich elements 'FischerTherm' and 'FischerFIREPROOF' as per appendix B, sheet 1.01

Marking is only permitted if the conditions defined in paragraph 2.4 are complied with.

2.4 Certificate of conformity

2.4.1 General

Conformity of the sandwich panels with the provisions of this General Approval shall be confirmed for each production plant by means of a certificate of conformity based on in-house production control and regular supervision by an external supervisory board, including initial checking of the sandwich panels in accordance with the provisions quoted hereafter.

The manufacturer of the sandwich elements shall nominate an accredited certification body and an accredited supervisory board for granting the certificate of conformity and for external supervision, including the required product testing.

The declaration that a certificate of conformity has been issued must be given by the manufacturer by marking the sandwich elements (Ü mark) and by indicating their intended use.

The certification body shall send a copy of the certificate of conformity to the German Institute for Constructional Engineering.

2.4.2 In-house production control

Each production plant shall set up and carry out in-house production control procedures. In-house production control is understood to be the continuous control of production by the manufacturer to ensure that the building products are in conformity with the provisions of this General Approval issued by the Building Inspection Authorities.

In-house production control in connection with the behaviour of the sandwich panels in fire shall be carried out in accordance with the 'Directives for the proof of conformity of virtually non-inflammable building materials (class of building materials DIN 4102-N1) in accordance with the General Approval issued by the Building Inspection Authorities'⁹ in the latest version.

The results of the in-house production control procedures shall be recorded and evaluated. The records shall include at least the following information:

- Description of the building product / base material and of the components
- Type of control or check
- Date of manufacture and testing of the building product / base material and of the components, respectively

⁹ Published in „Mitteilungen“ by Deutsches Institut für Bautechnik.

- Result of controls and checks and, if applicable, comparison with the requirements
- Signature of the person in charge of in-house production control

The records shall be kept for at least five years and presented to the external supervisory board responsible. They shall also be presented to the German Institute for Constructional Engineering and the Building Inspection Authorities at their request.

In the case of unsatisfactory test results, the manufacturer shall immediately take the necessary remedial action. Building products which do not meet the requirements shall be handled in such a way as to avoid any possible confusion with conforming products. After eliminating the defect, testing shall immediately be repeated, if this is technically feasible and if it is necessary to demonstrate that the defect has been eliminated.

In-house production controls shall include at least the following checks:

2.4.2.1 Cover sheets of the sandwich elements

Before carrying out cold forming, the thickness of the steel core, the yield point, the tensile strength, the breaking elongation A_{80} , the thickness of the zinc layer and, if applicable, the thickness of an additional anticorrosion layer shall be checked on each coil. Checking shall be carried out according to appendix B sheet 6.01 according to the standards specified therein.

If the manufacturer of sandwich elements is not the manufacturer of the cover sheets, he must ensure by so specifying in his contract that the cover sheets used for sandwich elements are subject to in-house production control procedures and external supervision in line with the approval requirements.

Proof of the material properties with the exception of the steel core thickness can also be provided by certificate of conformity 3.1 as per DIN EN 10204.

2.4.2.2 Core layer of the sandwich elements

Checking of the core layer shall be carried out as specified in appendix B sheet 6.01.

2.4.2.3 Sandwich elements

For the type and frequency of checking, see appendix B, sheet 6.01.

2.4.2.5 Assessment

When checking the parameters of the foam core, no value must be below those specified in appendix B sheet 6.01, lines 3 to 8. If any of the properties are below the specified values, an evaluation of the updated values of production scattering should be used for determining the 5% percentile, taking account of large-scale random testing. If the 5% percentile is still too small, additional specimens should be taken and tested, and the 5% percentile shall be determined again. This percentile shall not be below the specified value, otherwise the element must be rejected as not suitable for use. In the above cases, the value for calculating the 5% percentile may be assumed as $k = 1.65$.

2.4.3 External supervision

In each production plant, in-house production controls shall be subject to external supervision at least twice a year.

On the occasion of such external supervision, sandwich elements shall be subject to initial testing and specimens shall be taken as specified in the inspection plan in appendix B sheet 6.02. In addition, specimens may be taken for random testing. The taking of specimens and testing is to be carried out by the accredited supervisory body

Supervision and checking of the behaviour in fire of the sandwich elements shall be carried out in line with the "Directives for the proof of conformity of virtually non-inflammable building materials (class of building materials DIN 4102-B1), in accordance with the General Approval issued by the Building Inspection Authorities, and paragraph 3.3 of this approval has to be taken into account.

The results of the certification and of the external supervision shall be kept for at least five years, and they shall be presented by the body issuing the certification and the external supervisory body, respectively, to the German Institute for Constructional Engineering and the competent Building Inspection Authorities at their request.

3. Provisions relating to design and dimensioning

3.1 Stability and serviceability

Stability and serviceability shall be demonstrated by way of a structural analysis in accordance with appendix A. Only the loads specified in appendix A, paragraph 3 must be applied.

Characteristic values for determining the internal forces and stresses are specified, depending on the foam system, in appendix B, sheet 3.01.

The wrinkling stresses of the compressed flat, quasi-flat, corrugated and trapezoidal profiled cover sheets and their reduction factors as a function of the sheet thickness are specified in appendix B sheet 3.02. These wrinkling stresses, which depend on the thickness of the cover sheets, are considered as limiting values when demonstrating serviceability according to paragraph 7.3 of appendix A. The information on serviceability of the elements as per paragraph 7.5 of appendix A under sustained load 'generally' means that the influence of creeping can be neglected if the decisive failure (wrinkling) must be expected in the lower (inner) sheet, because the stresses are redistributed so that the lower sheet is relieved. At the same time the upper trapezoidal sheet is subject to a higher load which leads to earlier creeping of the steel in the upper chord of the trapezoidal sheet (see paragraph 5, appendix A). The proof of serviceability must include a check against creeping of steel.

For demonstrating the load-bearing capacity of the elements as per paragraph 7.2 of appendix A, the wrinkling stresses of flat and quasi-flat cover sheets must be reduced by applying a factor of 0.94. For furnishing proof at increased temperatures, wrinkling stresses as a function of the foam system must be further reduced by the following factors:

- 'FTS 01' = 0.94
- 'FTS 02' = 0.94
- 'FTS 03' = 0.94
- 'FTS 04' = 0.92

For the shearing stresses determined in accordance with paragraph 7.2.1.3 of appendix A, $\eta\tau$ and the bearing pressure η_d should be determined as follows:

- 'FTS 01' - $\eta\tau = 1.1$ and $\eta_d = 1.1$
- 'FTS 02' - $\eta\tau = 1.1$ and $\eta_d = 1.1$
- 'FTS 03' - $\eta\tau = 1.1$ and $= 1.1$
- 'FTS 04' - $\eta\tau = 1.3$ and $\eta_d = 1.3$ for $30 \text{ mm} \leq d < 60 \text{ mm}$, and
 $\eta_d = 1.1$ for $60 \text{ mm} \leq d < 120 \text{ mm}$.

When demonstrating long-term behaviour as per paragraph 5.2 and 7.4 of appendix A, the creep coefficients for sustained load should be determined as follows: $\Phi_{10}^5 = 7.0$ and for snow-load as a function of the foam system as follows:

- 'FTS 01' - $\Phi_2 \cdot 10^3 = 2.6$
- 'FTS 02' - $\Phi_2 \cdot 10^3 = 2.6$
- 'FTS 03' - $\Phi_2 \cdot 10^3 = 2.6$
- 'FTS 04' - $\Phi_2 \cdot 10^3 = 1.5$

Fasteners used for connecting the sandwich elements to the substructure shall be analysed as specified in the General Approval No. Z-14.4-407 issued by the Building Inspection Authorities and in appendix A.

3.2 Substructure

The sandwich elements may be used for structural analysis of the substructure in terms of sufficient rotational bedding, taking account of the marginal conditions as stated in DIN 18800-2, paragraph 3.3.2 (309). In this case, 'FischerTHERM W' elements are to be considered as being quasi flat.

3.3 Thermal insulation¹⁰

For a mathematical analysis of the thermal resistance of the elements, DIN 4108-3 shall apply. For the polyurethane (PUR) core layer, the following rated value λ of thermal conductivity shall apply, depending on the foam system:

- 'FTS 01' $\lambda = 0.026 \text{ W/(m}\cdot\text{K)}$
- 'FTS 02' $\lambda = 0.026 \text{ W/(m}\cdot\text{K)}$
- 'FTS 03' $\lambda = 0.026 \text{ W/(m}\cdot\text{K)}$
- 'FTS 04' $\lambda = 0.027 \text{ W/(m}\cdot\text{K)}$

3.4 Fire protection

3.4.1 Behaviour in fire

The fire behaviour of the sandwich elements corresponds to the national official classification 'virtually non-inflammable'.

The roof elements are resistant to airborne fire and radiating heat (hard roofing) as per DIN 4102-4.

3.4.2 Resistance to fire

For demonstrating their fire resistance class, the sandwich elements need a general test certificate or a general approval issued by the Building Inspection Authorities. The regulations and design details contained in these certificates or approvals must be observed.

3.5 Sound insulation

Requirements regarding sound insulation are stipulated in DIN 4109 (Sound insulation in building construction). If sandwich elements are subject to specific sound insulation requirements, further analyses are necessary.

3.6 Corrosion protection

Sufficient corrosion protection must be provided to suit the application conditions. Additional measures may be required which must be assessed in each individual case, taking account of fire protection requirements.

¹⁰ For special applications, e.g., cold stores and refrigerating chambers, process heat conductivity must be determined taking into account the applicable operating temperature according to directive VDI 2055.

4 Provisions for installation

4.1 Provisions for companies carrying out the work

Sandwich elements must only be installed by companies experienced in this field. If companies without experience in this field undertake installation of the elements, their fitters must be instructed by personnel of companies with sufficient experience.

The longitudinal joint between adjacent sandwich elements must be precisely fitted.

Fasteners must be used in accordance with approval no. Z-14.4-407, in order to ensure a load-carrying and sealing connection.

Bolts with a washer and an elastomer seal which are exposed to atmospheric conditions must be tightened manually or using an electric screwdriver with a bit stop. The use of impact screwdrivers is not permitted.

4.2 Fastening to the substructure

In the case of direct fastening, the wall and roof elements shall be fastened with at least two screws per element as per appendix B, sheet 5.01 and 5.02 respectively. In the case of indirect fastening, the wall and roof elements shall be fastened according to appendix B, sheet 5.01. On steel and softwood supports the wall elements shall be fastened using the fasteners specified in paragraph 2.2.5. If the supports are of reinforced concrete, pre-stressed concrete or masonry, the wall panels shall be fastened using suitably anchored steel spacers, taking due note of the applicable approvals and standards.

The values for e (space between bolts) and e_R (space between bolts and edge of the component) are specified in appendix B, sheets 5.01 and 5.02. The width of support shall not be below the values indicated in appendix B sheet 4.01 and 4.02.

4.3 Connection to adjacent building elements

The wall elements shall be installed and connected to adjacent building elements in such a way as to prevent humidity from penetrating and to avoid thermal bridges. These details should be determined on a case by case basis.

4.4 Design of details

Details, especially on unprotected cut edges shall be designed that no impairment due to humidity, beetle chewing damage or insect attack can occur. This may require structural measures which must be assessed on a case-by-case basis taking account of fire protection.

Uwe Bender
Head of division
Signature

Certified:

Stamp
German Institute for
Constructional Engineering

'Design load and structural analysis for sandwich-type products.

– Core consisting of rigid polyurethane (PUR) foam between metallic cover sheets –'

1 General

The stability must be analysed based on a theoretical failure condition; in addition, an analysis of serviceability is required.

2 Spans and supporting requirements

For the purpose of analysis, the centre distance between the supports is generally considered as the span.

However, the clear width between the supports plus a minimum width of support can also be taken as the span. When analysing the load-bearing capacity, jointed bearing may be assumed for the end and intermediate supports of wall and roof elements. Secondary loads due to constrained longitudinal deformation acting upon the sandwich elements can generally be neglected. Details of the effect of longitudinal deformation of elements on connections are given in appendix A paragraph 7.7.2.

3 Design loads

3.1 Dead load

For the purpose of analysis, the dead load of wall elements can be neglected. For the purpose of connecting wall and roof elements the dead load must be taken into consideration.

3.2 Wind

Wind pressure and wind suction should be determined according to DIN 1055-4:2005-03. When influences of wind loads and summer temperature are superimposed, it is sufficient to work on 60% of the wind load.

3.3 Snow

The snow-load should be determined in accordance with DIN 1055-5:2005-07.

Snow accumulations (as per paragraphs 4.2.7 and 4.2.8 of DIN 1055-5:2005-07) in snow-load areas 1, 1a and 2 at altitudes below 1000 m above sea level can be considered as short-term effects (i.e. not causing deformation due to creep).

3.4 Loads due to workmen walking on the sandwich elements

Loads due to workmen carrying out installation, maintenance and repair work are to be assumed as per DIN 1055-3:2006-03. A theoretical statement in accordance with DIN 1055-3:2006-03, paragraph 6.2(3) is not required, as a statement of the local minimum load-bearing capacity of the sandwich elements has already been supplied during the approval procedure.

3.5 Temperature difference between the cover sheets

The maximum difference between temperatures simultaneously occurring in the two cover sheets is

$$\Delta\theta = \theta_{\text{outside}} - \theta_{\text{inside}}$$

where: θ_{inside} is defined in appendix A paragraph 3.5.1 and θ_{outside} is defined in appendix A paragraph 3.5.2.

3.5.1 Temperature of the inner cover sheet

Normally, a temperature $\theta_{\text{inside}} = 20^{\circ}\text{C}$ in winter and $\theta_{\text{inside}} = 25^{\circ}\text{C}$ in summer may be assumed. This applies to the analyses of stability and serviceability.

In particular applications (e.g. buildings equipped with air conditioning such as ripening halls, cold stores etc.), θ_{inside} should correspond to the operating temperature inside the building.

3.5.2 Temperature of the outer cover sheet

For θ_{outside} the following values should be assumed:

Season	Sun radiation	Analysis of stability	Analysis of serviceability		
			Colour group*)	Brightness**) [%]	θ_{outside}
Winter	--	-20°C	all	90-8	-20°C
with snow load	--	0°C	all	90-8	0°C
Summer	direct	+80°C	I	90-75	+55°C
			II	74-40	+65°C
			III	39-8	+80°C
	indirect	+40°C	all	90-8	+40°C
*)	I = very bright II = bright III = dark				
**)	Degree of reflection referred to barium sulphate = 100% The brightness values are based on the Hunter-L·a·b measuring method.				

Indirect sun radiation on a wall applies in the case of a curtain-type façade ventilated at the rear and erected in front of a wall consisting of sandwich elements (e.g. often used in cold stores).

4 Analysis of internal forces and stresses

4.1 Serviceability condition

Internal forces shall be analysed using the theory of elasticity. The transverse elasticity of the connection between the cover sheets must be taken into consideration (deformation due to shear in the core). Shear modulus G_s is specified in the approval (appendix B).

4.2 Theoretical failure condition

For the theoretical failure condition, the internal forces acting on continuous elements may be determined assuming that articulated joints are formed above intermediate supports. It will be assumed that there is no residual load-bearing moment above the intermediate supports.

4.3 Calculation of internal forces and stresses in simple cases

In simple cases (single-span girders, external loads), internal forces and stresses may be calculated in accordance with DIN 1052, paragraph 5 (edition 10/69). Additional information regarding multi-span girders, stresses due to temperature and creep is given in the ECCS recommendations*).

*) ECCS recommendations (Preliminary European Recommendations for Sandwich Panels)
Part 1: Design
Section 3 and Appendix A
European Convention for Constructional Steelwork (ECCS) – TC 7 -
WG 7.4 edition 10/91

4.4 Sandwich elements with quasi flat cover sheets

Normal stresses in the cover sheets may be determined on the basis of the bending moment by assuming a couple of forces in the axes through the centre of gravity of the cover sheets, neglecting their inherent flexural strength. The shear stresses due to the transverse force may be assumed to be uniformly distributed over the cross section of the core.

4.5 Sandwich elements with profiled cover sheets

The stresses in the cover sheets shall be determined on the basis of partial bending moments which are calculated according to the linear sandwich theory for "thick" (i.e. deflection resistant) cover sheets. The shear stresses in the core can be calculated on the basis of the relevant transverse force, which is assumed to be uniformly distributed over the assumed cross-sectional area between the axes through the centre of gravity of the cover sheets.

5. Analysis of stresses for roof elements

For roof elements, it is necessary to determine not only stresses due to loads but also transposition of stresses resulting from creep deformation of the core layer under long-term load (dead load, snow load).

In the case of roof elements with profiled cover sheets, creep has the effect that normal stresses in the cover sheets and shear stresses in the core layer are reduced whereas the bending stresses in the profiled cover sheet are increased. Transposition of stresses shall be taken into account as described in appendix A, paragraph 5.2.

5.1 Analysis of stresses at the time $t = 0$

Stresses (according to appendix A paragraph 4) at the time $t = 0$ (according to appendix A paragraph 4) shall be analysed for all loads which may occur (according to appendix A paragraph 3).

5.2 Consideration of time-dependent transposition of stresses

The stresses under long-term load shall be determined with due consideration being given to the transposition of stresses. The transposition of stresses is the result of increasing deformation due to creep in the foam core. The time-dependent shear deformation of the core material under constant shearing stress is defined as follows:

$$\gamma_t = \gamma_0 (1 + \Phi_t)$$

where:

γ_t = shear deformation at time t

γ_0 = elastic shear deformation at time $t = 0$
(beginning of load)

Φ_t = time-dependent creep factor (see approval)

The stresses shall be determined by applying the creep factors $t = 2000$ h (nominal duration of normal snow load) and $t = 100,000$ h (dead load).

For approximation of the time-dependent transposition of stresses, a time-dependent nominal shear modulus G_t may be assumed:

$$G_t = \frac{G_0}{1 + \Phi_t}$$

where:

G_0 = shear modulus at time $t = 0$

G_t = shear modulus at time t

6 Design limiting values

6.1 Wrinkling stress in flat and slightly profiled cover sheets

For strains in the span and above the central support, the limiting values for wrinkling stresses in flat and slightly profiled cover sheets (embossed, beaded, slightly profiled) are specified in the approval (appendix B).

For a theoretical analysis, the wrinkling stress at the axes through the centre of gravity of flat cover sheets shall be assumed.

6.2 Wrinkling stress in profiled cover sheets

The limiting value of the wrinkling stresses applicable to the compressed upper chords of the profiled cover sheets is specified in the approval (appendix B).

6.3 Shear resistance of the core layer

The shear resistance of the core layer to short- and long-term strain is specified in the approval (appendix B).

6.4 Compressive strength of the core layer

The compressive strain occurring at 10% upsetting shall be assumed to be the compressive strength f_{cd} of the core layer. The value is specified in the approval (appendix B).

6.5 Rated values for the load-bearing capacity of connections

The rated values for the tensile load-bearing capacity $N_{R,d}$ and those for the transverse force $V_{R,d}$ of connections for substructures fabricated from steel or wood are specified in general approval Z-14.4-407.

For sheet thicknesses and structures not specified (i.e. other cover sheets, fastening means and substructures) refer to the approval (appendix B) for the tensile load-bearing capacity $N_{R,d}$.

7. Analyses

7.1 Collective loads

In determination the loads shall be superimposed under the least favourable conditions.

7.2 Analysis of the load-bearing capacity for time $t = 0$

In multi-span systems, failure in a span will occur following the formation of wrinkling joints above the intermediate supports.

7.2.1 Wall and roof elements

7.2.1.1 Analysis with respect to wrinkling stress

The limit of load-bearing capacity is reached when wrinkling stress in the span occurs in the compressed cover sheet, see paragraph 6.1 and 6.2 (appendix A). In the case of a cantilever arm, the limit of load-bearing capacity is reached when wrinkling stress occurs in the compressed cover sheet, at the point where it is fixed.

When analysing the load-bearing capacity, partial safety factors are to be assumed:

1.85 times the stress resulting from external loads (σ_L) is added to 1.3 times the stress resulting from secondary temperature loads (σ_T) and compared to the wrinkling stress (σ_K):

$$1.85 \cdot \sigma_L + 1.3 \cdot \sigma_T \leq \sigma_K$$

In case of elements with profiled cover sheets, the secondary internal forces due to temperature must be taken into consideration, and the influence of the temperature on the limiting value of the load-bearing capacity (σ_K) must be taken into account.

7.2.1.2 Analysis with respect to yield stress

Where cover sheets are subject to tensile stress, the safety margin compared with yield stress (β_s) must be demonstrated:

$$1.85 \cdot \sigma_L + 1.3 \cdot \sigma_T \leq \beta_s$$

7.2.1.3 Analysis of the shearing stress

The safety margin relative to shear failure must be demonstrated:

$$1.85 \cdot \tau_L + 1.3 \cdot \tau_T \leq \beta_T / \eta_T$$

The shear resistance β_T shall be taken for the relevant temperature. The coefficient η_T is specified in the approval.

7.2.1.4 Analysis of bearing pressures

The bearing pressures resulting from external loads A_L shall be compared to the loads A_U :

$$1.85 \cdot A_L \leq A_U$$

The loads A_U shall be determined as follows:

where:

$$A_U = F_A \cdot \frac{\beta_d}{\eta_d}$$

F_A is the sandwich element supporting area and β_d is the compressive strength. The coefficient η_d is specified in the approval.

7.3 Analysis of the serviceability for time $t = 0$

The serviceability for time $t = 0$ is demonstrated when no yield stress occurs in the area subject to tensile load and no wrinkling occurs in the area subject to compressive load. The serviceability shall be demonstrated as per paragraph 4.1 (appendix A), with respect to loads as per paragraph 3 (appendix A) and with respect to temperature variations as per paragraph 3.4 (appendix A):

1.1 times the sum of all simultaneously acting stresses resulting from external loads (σ_L) and from temperature (σ_T) is compared to the wrinkling and the yield stresses:

$$1.1 (\sigma_L + \psi \cdot \sigma_T) \leq \sigma_K \text{ or } 1.1 (\sigma_L + \psi \cdot \sigma_T) \leq \beta_s$$

where

$$\psi = 1.0 \text{ (cold stores)}$$

$$\psi = 0.9 \text{ (other buildings)}$$

The shearing stress shall be calculated as follows:

$$1.4 (\tau_L + \tau_T) \leq \beta_T$$

$$\text{Bearing pressures: } 1.4 \cdot (A_L + A_T) \leq F_A \cdot \beta_d$$

The bearing pressures $A_L + A_T$ must be taken into consideration when analysing the substructure.

7.4 Analysis of the load-bearing capacity under long-term load

The load-bearing capacity must be analysed with due consideration being given to the time-dependent transposition of stresses and the time-dependent decrease of shear resistance.

$$1.85 (\sigma_g + \sigma_p + \sigma_s) + 1.3 (\sigma_T + \Delta\sigma_g + \Delta\sigma_s) \leq \sigma_K$$

$$\leq \beta_s$$

and

$$\frac{(1.85 \tau_p + 1.3 \tau_T)}{\beta_{\tau,0}} + \frac{1.85 (\tau_g + \tau_s) + 1.3 (\Delta\tau_g + \Delta\tau_s)}{\beta_{\tau,t}} \leq 1$$

where

σ_p, τ_p	=	stresses from short-term external loads
σ_T, τ_T	=	stresses from secondary temperature loads
σ_g, τ_g	=	stresses from permanent load
σ_s, τ_s	=	stresses from snow-load
$\left. \begin{matrix} \Delta\sigma_g, \Delta\sigma_s \\ \Delta\tau_g, \Delta\tau_s \end{matrix} \right\}$	=	$\left\{ \begin{matrix} \text{fractions of } \Delta \text{ due to transposition of stresses under} \\ \text{permanent loads and snow-load} \end{matrix} \right.$

7.5 Analysis of serviceability for a long-term load

Normally, an analysis of serviceability under permanent load is not required.

7.6 Deformation

For roof elements which are not profiled, limitation of deformation under service conditions is necessary. The permanent loads (e.g. dead load and snow-load) as well as creep effects are to be taken into account:

$$f_t = f_{og,B} + f_{og,Q} (1 + \Phi_{10}^5) + f_{os,B} + f_{os,Q} (1 + \Phi_2 \cdot 10^3) \leq l/100$$

Φ = creep coefficient

Index:	t =	at time 't'
	o =	at time '0'
	g =	under dead load
	s =	under snow-load
	B =	as a result of the bending moment
	Q =	as a result of the transverse force

7.7 Fasteners

7.7.1 Forces, stresses, rated values

The load-bearing capacity of the fasteners shall be demonstrated in accordance with General Approval Z-14.4-407. External stresses and temperature effects shall be combined, in accordance with DIN 1055-100:2001-03, equation (14), as 'a constant and temporary design situation'.

When elements are fastened using bolts, the rated values for load-bearing capacity $N_{R,d}$ and for transverse force $V_{R,d}$ as per paragraph 6.5 (appendix A) shall be applied.

7.7.2 Screw head deviation

It must be demonstrated that the screw head deviation as a result of thermal expansion of the outer sheet does not exceed the specified maximum value. Expansion of the outer sheet shall be calculated taking account of the actual temperature variations. The bolt head deviation may be calculated according to the linear sandwich theory (information for the calculation is given in the ECCS recommendations, appendix C).

Wall elements

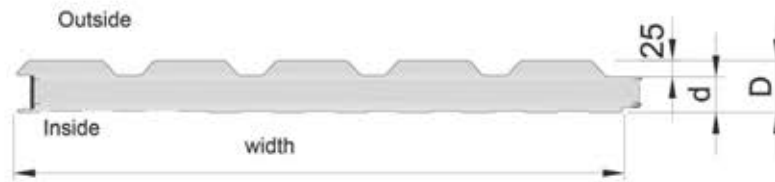
FischerTHERM
 $40 \text{ mm} \leq d \leq 100 \text{ mm}$



FischerTHERM plus
 $60 \text{ mm} \leq d \leq 100 \text{ mm}$



FischerTHERM T
 $40 \text{ mm} \leq d \leq 60 \text{ mm}$



FischerTHERM W
 $58 \text{ mm} \leq d \leq 78 \text{ mm}$



FischerFIREPROOF
 Foam system:
 "FTS 02"



**Wand- und
 Dachelemente**

FischerTHERM D
 $30 \text{ mm} \leq d \leq 120 \text{ mm}$



FischerFIREPROOF D
 Foam system:
 "FTS 02"



d = continuous core thickness

D = Element thickness (overall dimension)

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Overview of the elements

Appendix B, sheet 1.01

Oberflächenausführungen / Deckblechtyp

L = slightly profiled

For foam systems „FTS 01“, „FTS 02“ and „FTS 03“

Outside L2:S = 0,72 mm ± 0,14 mm
 Inside L1:S = 0,36 mm ± 0,18 mm

For foam systems „FTS 04“

Outside L2:S = 1,5 mm + 0,5 mm / - 0,2 mm
 Inside L1:S = 1,1 mm ± 0,2 mm

S = Beading – only outer sheet

E = Flat – inner and outer sheet

M = Microprofiling – only outer sheet

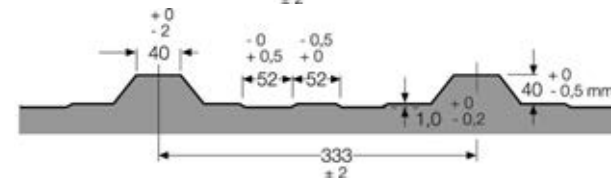
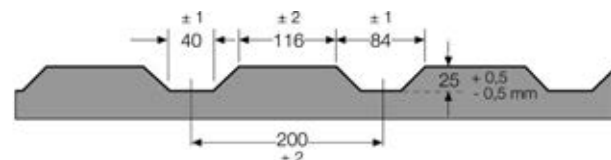
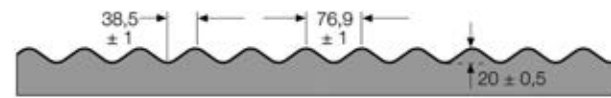
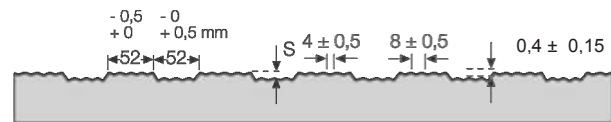
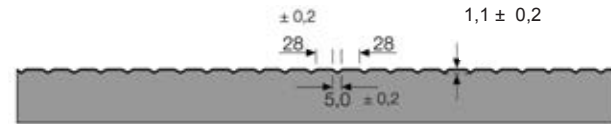
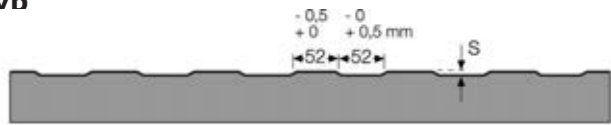
K = Combined slight profiling – only outer sheet

: S = 1,5 mm + 0,5 mm
 - 0,2 mm

W = Corrugation – only outer sheet

T = Trapezoidal profiling, wall element – only outer sheet

D = Trapezoidal profiling, roof element – only outer sheet



Nominal thickness of the cover sheets:

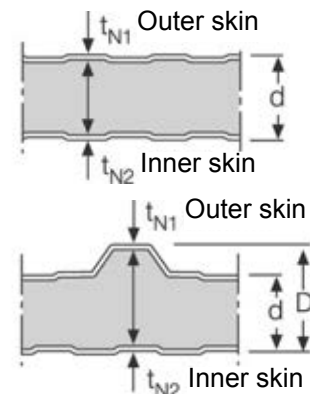
$t_{N1} = 0,50 \text{ mm} \leq t_{N1} \leq 1,00 \text{ mm}$

$t_{N2} = 0,40 \text{ mm} \leq t_{N2} \leq 1,00 \text{ mm}$

$t_K = t_N - 0,04 \text{ mm} = \text{steel core thickness, decisive for calculation}$

$d = \text{continuous core thickness [mm]}$

$D = \text{Element thickness [mm]}$



Joint design: see sheets 5.01 and 5.02

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF"sandwich elements for walls and roofs	Appendix B, sheet 1.02
Surface designs / Type of cover sheet	

Fasteners

For fastening the roof and wall elements to the substructure only bolts as specified in General Approval no. Z-14.4-407 must be used.

1. Visible direct fastening

Rated values for the load-bearing capacity ($N_{R,d}$, $V_{R,d}$): see General Approval no. Z-14.4-407.

As an exception to General Approval no. Z-14.4-407 Ø14 mm washers may be used for "FischerTHERM W" wall elements.

The following values shall be applied for the tensile load-bearing capacity $N_{R,d}$

t_N [mm]	0,63	0,75
$N_{R,d}$ [kN]	1,5	1,8

The indicated values apply to the transmission of tensile forces into the bolts. The extent of transmission of tensile forces into the substructure must be demonstrated separately.

Load-bearing "FischerTHERM" and "FischerFIREPROOF"sandwich elements for walls and roofs

Appendix B, sheet 2.01

Fasteners / visible direct fastening

2. Concealed indirect fastening

"FischerTHERM plus" wall element

$t_{N1} / t_{N2} \geq 0.55 \text{ mm} / 0.55 \text{ mm}$ or $t_{N1} / t_{N2} \geq 0.63 \text{ mm} / 0.50 \text{ mm}$

Elements with a smaller nominal sheet thickness t_N must be fastened directly.

2.1 Rated values for the load-bearing capacity $N_{R,d}$ – bolt with washer

(see appendix B, sheet 5.01)

Type of support	Fastening method	Rated value $N_{R,d}$ [kN]		Bolts with washer $\varnothing 19 \text{ mm}$. Distance between two bolts $\geq 40 \text{ mm}$ Distance of bolts from panel edge (in the case of end support) - for 1 bolt $\geq 70 \text{ mm}$ - for 2 bolts $\geq 50 \text{ mm}$
		Sandwich element with a foam core		
		„FTS 01“, „FTS 02“ u. „FTS 03“	„FTS 04“	
Intermediate support	1 bolt	2,60	2,60	
	2 bolts	3,27	3,27	
End support	1 bolt	1,46	1,33	
	2 bolts	1,58	1,44	

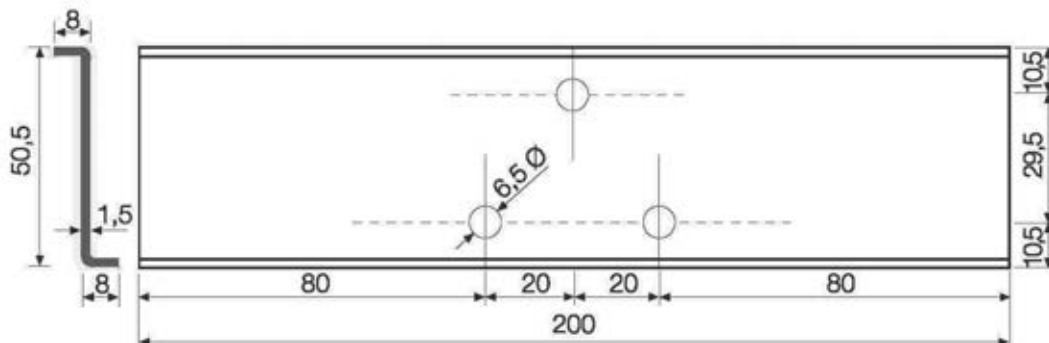
2.2 Rated values for the load-bearing capacity $N_{R,d}$ – load distributors and bolt with washer

(see appendix B, sheet 5.01)

Type of support	Fastening method	Rated value $N_{R,d}$ [kN]		Bolts with washer $\varnothing 16 \text{ mm}$. Distance between two bolts $\geq 40 \text{ mm}$ Distance of bolts from panel edge $\geq 80 \text{ mm}$ (in the case of end support)
		Sandwich element with a foam core		
		„FTS 01“, „FTS 02“ u. „FTS 03“	„FTS 04“	
Intermediate support	1 bolt	8,00	8,00	
	2 bolts	8,43	8,43	
End support	1 bolt	2,81	2,56	
	2 bolts	3,59	3,27	

The rated values apply to the transmission of tensile forces into the bolts. Transmission of tensile forces into the supporting structure must be demonstrated separately. The values for intermediate supports also apply to end supports when the distance of bolts from the panel edge $\geq 500 \text{ mm}$. Intermediate values may be linearly interpolated in relation to the distance.

Load distributors for concealed fastening



Material: Steel sheet S 320 GD + AZ 185 in accordance with DIN EN 10215; $t_N = 1.5 \text{ mm}$

Load-bearing "FischerTHERM" and "FischerFIREPROOF" sandwich elements for walls and roofs

Appendix B, sheet 2.0

Fasteners / concealed indirect fastening

Values to be used for determining internal forces and stresses as per paragraph 3.1

1. Steel cover sheets

Modulus of elasticity: $E_D = 2.1 \times 10^5 \text{ N/mm}^2$

Yield point: $\beta_S = 350 \text{ N/mm}^2$

Elongation at break: $A_{80} = 16\%$

2. Characteristic foam values for 'FTS 01', 'FTS 02' and 'FTS 03'

Continuous core thickness d [mm]	30/40	60	80	100	120
Modulus of elasticity: E_S [N/mm ²] at T = 20°C at increased temperature	2,3 2,1	3,6 3,2	3,5 3,1	3,6 3,2	3,3 2,9
Shear modulus G_S [N/mm ²] at T = 20°C at increased temperature	3,7 3,3	3,6 3,2	3,2 2,9	3,0 2,7	2,5 2,3
Shearing resistance β_t [N/mm ²] at T = 20°C at increased temperature for long-term loads	0,12 0,11 0,05	0,12 0,11 0,05	0,11 0,10 0,05	0,10 0,09 0,04	0,10 0,09 0,04
Compressive strength β_D [N/mm ²]	0,08	0,10	0,10	0,09	0,09

Characteristic foam values for 'FTS 04'

	FischerTHERM, FischerTHERM plus und FischerTHERM D				FischerTHERM W		FischerTHERM T	
	30	40	60	120	58	78	40	60
Continuous core thickness d [mm]	30	40	60	120	58	78	40	60
Modulus of elasticity: E_S [N/mm ²] at T = 20°C at increased temperature	3,4 2,5	5,4 3,9	5,4 3,9	4,1 3,0	5,4 3,9	4,1 3,0	5,4 3,9	4,1 3,0
Shear modulus G_S [N/mm ²] at T = 20°C at increased temperature	3,5 2,6	4,3 3,1	3,7 2,7	3,7 2,7	3,7 2,7	3,7 2,7	3,7 2,7	3,7 2,7
Shearing resistance β_t [N/mm ²] at T = 20°C at increased temperature for long-term loads	0,15 0,11 0,06	0,15 0,11 0,06	0,13 0,09 0,05	0,13 0,09 0,05	0,13 0,09 0,05	0,13 0,09 0,05	0,13 0,09 0,05	0,13 0,09 0,05
Compressive strength β_D [N/mm ²]	0,12	0,14	0,13	0,10	0,10	0,10	0,13	0,10

Intermediate values may be linearly interpolated.

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs	Anlage B, Blatt 3.01
Calculated values	

Design limit values for wrinkling stresses σ_K [N/mm²]

for determination of serviceability*)

Foam system 'FTS 01', 'FTS 02' and 'FTS 03'

Type of cover sheet as per appendix B sheet 1.02	Continuous core thickness d [mm]	In case of load		
		across the span	above central supports of continuous panels	
			inside	Outside ¹⁾
E	40	60	54	48
	60	66	59	53
	80	66	59	53
	100	66	59	53
	120	60	54	--
L1	30	131	118	
	40	131	118	
	60	111	100	
	80	117	105	
	100	93	84	
S, L2, M, K	40	131		106
	60	111		90
	80	117		95
	100	93		75
T	40 - 60	173		173
D	30 - 120	325		325
W	58 - 78	350		350

1) Reduction factor for cover sheets type E, S, L2, M and K:

$$k = \frac{11 - n}{8}$$

n = number of bolts, for n > 3 bolts per metre

Abminderungsfaktoren für σ_K bei Blechdicken von t_N

Type of cover sheet	0,40 mm	0,55 mm	0,63 mm	0,75 mm	0,88 mm	1,00 mm
E, W, T, D	1	1	1	1	1	1
S, L1, L2, M, K	1	1	0,96	0,86	0,79	0,73

* For the proof of load-bearing capacity, see paragraph 3.1

Intermediate values may be linearly interpolated.

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Appendix B, sheet 3.02.1

Wrinkling stresses

Design limit values for wrinkling stresses σ_K [N/mm²]

for the determination of serviceability*)

Foam system 'FTS 04',

Type of cover sheet as per appendix B, sheet 1.02	Continuous core thickness d [mm]	In case of load		
		across the span	above central supports of continuous panels	
			inside	Outside ¹⁾
E	30	68	54	--
	40	85	68	60
	60 – 78	81	65	57
	85 - 120	74	59	52
L1	30 - 120	157	126	
L2 / K	40 – 60	213		149
	100	192		134
S	40 - 100	189		132
M	40	195		137
	60	189		132
	100	183		128
T	40 – 60	183		156
D	30 – 60	285		285
	120	267		267
W	58	350		350
	78	334		334

1) Reduction factor for cover sheets type E, L2, S, M, T and K:

$$k = \frac{11 - n}{6}$$

n = number of bolts per metre, for n > 5 bolts per metre

Abminderungsfaktoren für σ_K bei Blechdicken von t_N

Type of cover sheet	0,40 mm	0,50 mm	0,55 mm	0,63 mm	0,75 mm	0,88 mm	1,00 mm
E, W, T, D	1	1	1	1	1	1	1
L1	1	1	0,89	0,81	0,72	0,64	0,59
L2, K	1	1	1	0,87	0,77	0,69	0,63
S	1	1	1	1	0,86	0,77	0,71
M	1	1	1	0,88	0,78	0,70	0,64

* For the proof of load-bearing capacity, see paragraph 3.1

Intermediate values may be linearly interpolated.

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs	Appendix B, sheet 3.02.1
Wrinkling stresses	

Design of supports (examples)

1. Intermediate support (continuous wall element)

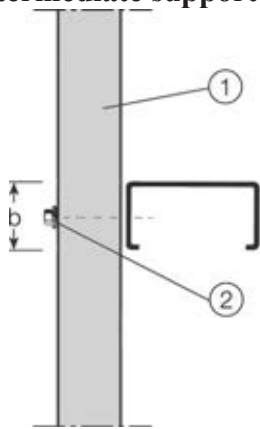


Figure 1
Steel support

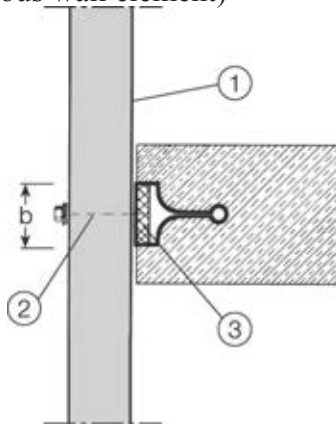


Figure 2
Concrete support

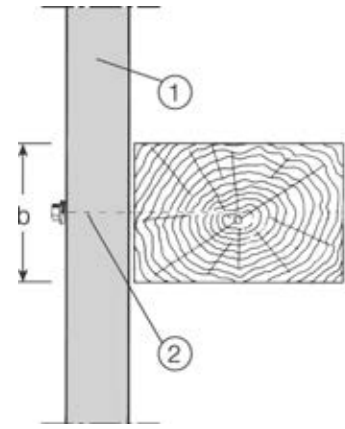


Figure 3
Wooden support

Intermediate support width: $b \geq 60 \text{ mm}$

- (1) Wall element
- (2) Fastening element
- (3) Steel support anchored in concrete, provided with rigid foam strips.

2.

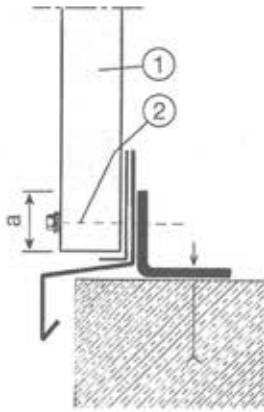


Figure 4
Base
Wall element placed on top

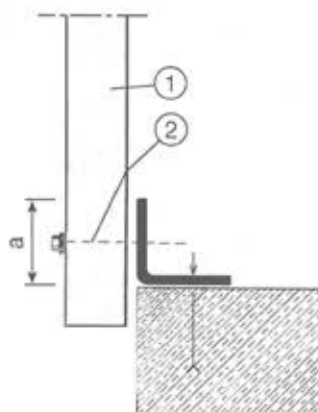


Figure 5
Base
Wall element placed in front

End support width: $a \geq 40 \text{ mm}$

- 1 Wall element
- 2 Fastener

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Design of supports

Appendix B, sheet 4.01

Design of supports (examples)

1. Intermediate support (continuous roof element)

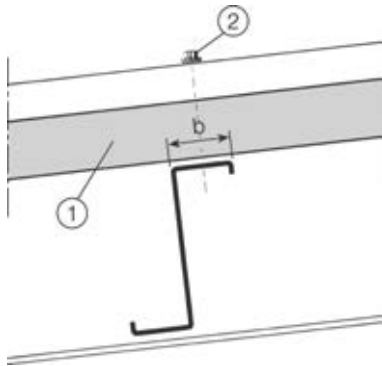


Figure 1
Steel support

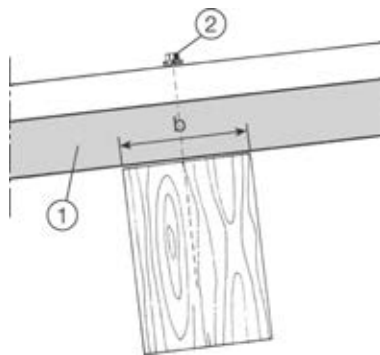


Figure 2
Wooden support

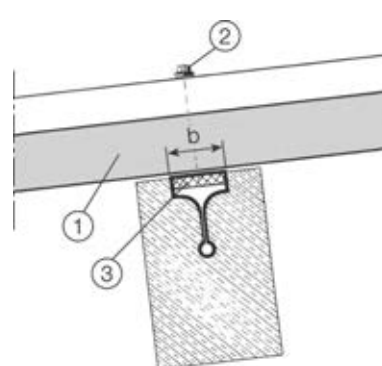


Figure 3
Concrete support

Intermediate support width: $b \geq 60 \text{ mm}$

1 Roof element

2 Fastener

3 Steel support anchored in concrete, provided with rigid foam strips.

2. End support: Example steel substructure

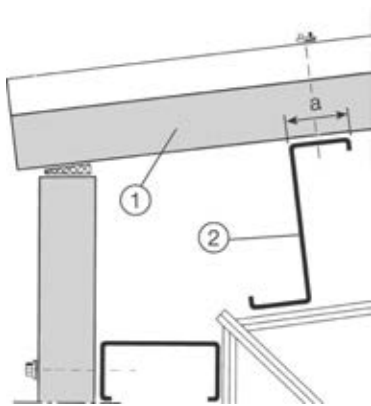


Figure 4
Eaves

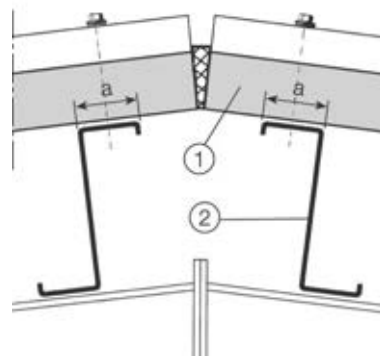


Figure 5
Ridge

End support width: $a \geq 40 \text{ mm}$

1. Roof element

2 Purlin

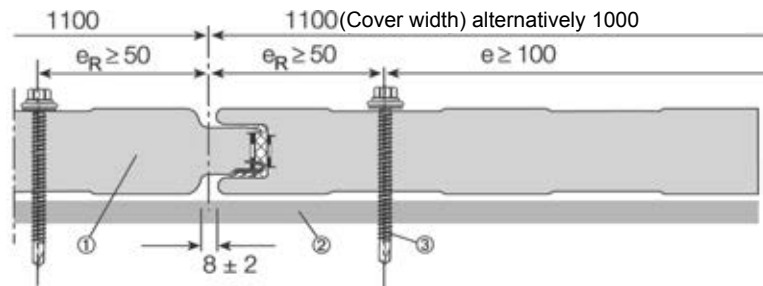
Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Design of supports

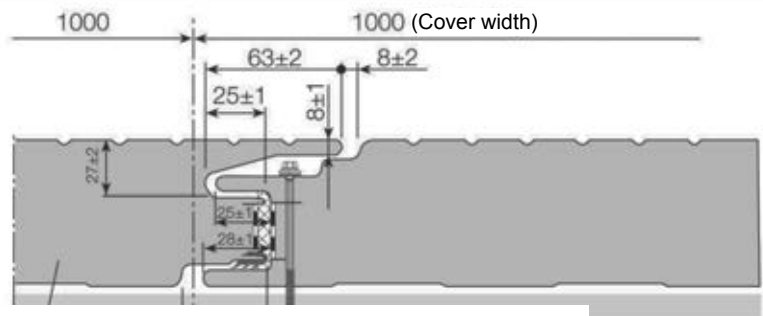
Appendix B, sheet 4.02

Arrangement of fasteners
Spacing of bolts

FischerTHERM +
FischerFIREPROOF
 Direct fastening

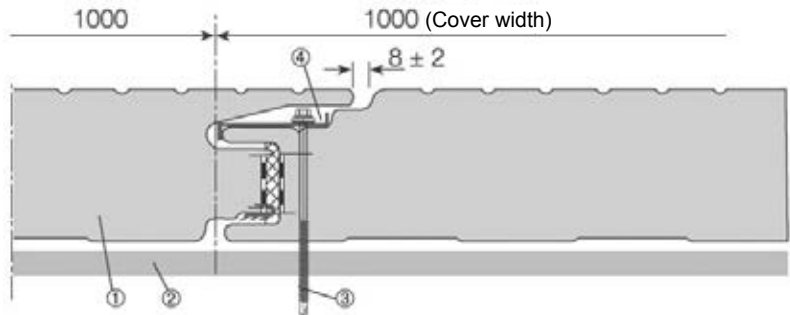


FischerTHERM plus
 Concealed indirect fastening
 Bolt with washer

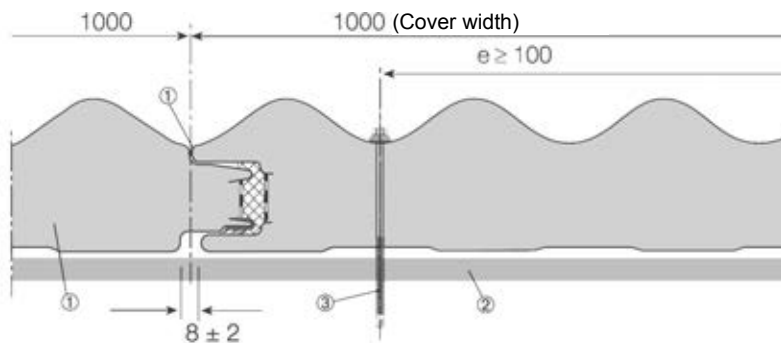


When using 2 bolts for a fastening point:
 spacing of the bolts ≥ 40 mm

FischerTHERM plus
 Concealed indirect fastening
 Load distributor and bolt with washer



FischerTHERM W
 Direct fastening



- 1 Wall element
- 2 Support
- 3 Fastener
- 4 Load distributor, see appendix B, sheet 2.02

Parallel to the fixing direction: Width of span at the end of the element $e_R \geq 20$ mm

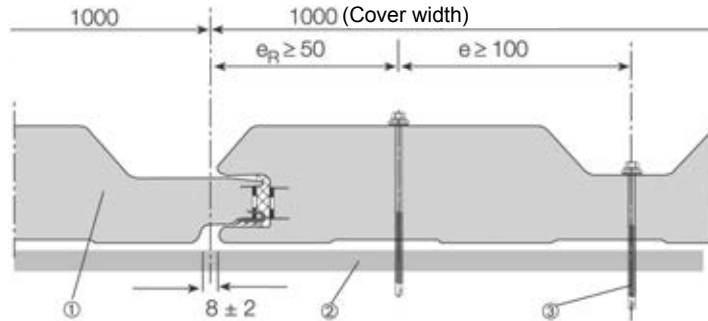
Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Appendix B, sheet 5.01

Arrangement of fasteners

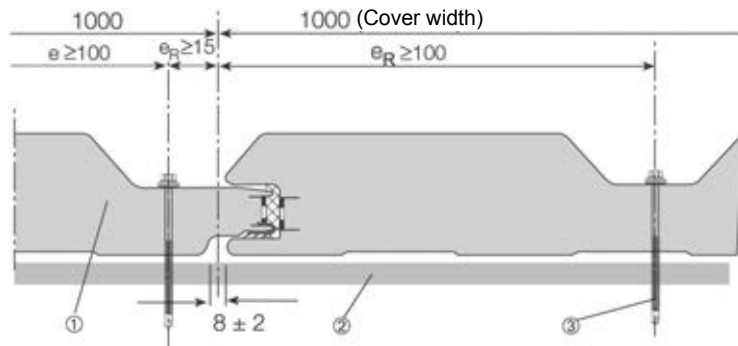
Arrangement of fasteners Spacing of bolts

FischerTHERM T Direct fastening

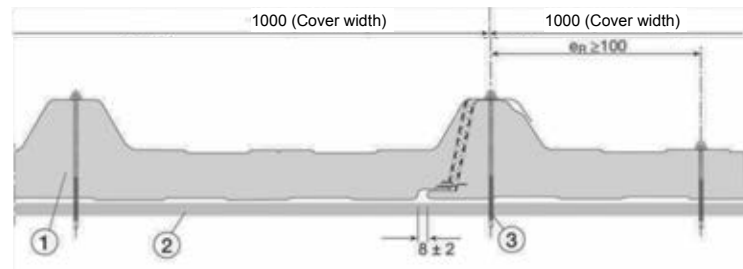


FischerTHERM T Direct fastening

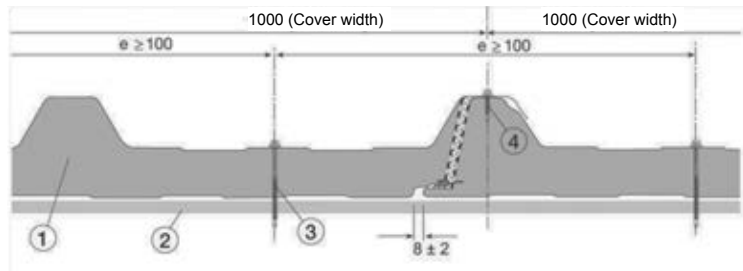
- 1 Wall element
- 2 Support
- 3 Fastener



FischerTHERM D + FischerFIREPROOF D Direct fastening in the upper and the lower chord



FischerTHERM D + FischerFIREPROOF D Direct fastening Fastening in the lower chord



- 1 Roof element
- 2 Support
- 3 Fastener
- 4 Fastening in the longitudinal joint (structural design)

Parallel to the fixing direction: Width of span at the end of the element $e_R \geq 20$ mm

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Arrangement of fasteners

Appendix B, sheet 5.02

In-house production control of sandwich elements

Testing at a room temperature of approx. 20°C
 For foam system 'FTS 01', 'FTS 02' and 'FTS 03'

Line	Type of testing	Requirements ¹⁾	Test specimen ¹⁾ Dimensions [mm]	Number	Testing frequency ⁵⁾
1	Sandwich elements d [mm] ⁶⁾	30/40 60 80 100 120			
a	Thickness	(s. paragraph 2.2.4)		3	1 per shift
b	Cover sheet geometry	(s. Appendix B, sheet 1.02)		3	1per week
Foam					
2	Density [kg/m ³] ²⁾	40±2	100 x 100 x d	5	1 per shift
3	Tensile strength with cover sheets [N/mm ²]	≥0,10 ≥0,08 ≥0,10 ≥0,06 ≥0,06	100 x 100 x d	5	1 per shift
4	Compressive stress at 10% upsetting	(s. Appendix B, sheet 3.01)	100 x 100 x d ³⁾	3	1 per week
5	Shear resistance	(s. Appendix B, sheet 3.01)	100 x 100 x d ³⁾	3	1 per week
6	Shear modulus [N/mm ²] ⁷⁾	≥2,9 ≥3,1 ≥2,7 ≥2,5 ≥2,2	100 x 100 x d ³⁾	3	1 per week
7	Tensile modulus ⁷⁾ E _Z [N/mm ²]	$E_s = \frac{E_z + E_D}{2}$	100 x 100 x d	3	1 per week
8	Compressive modulus E _D [N/mm ²]		≥1,5 ≥2,8 ≥2,8 ≥2,9 ≥2,7	(76,9 x 100 x d) ⁸⁾	3
9	Dimensional change after 3 hours storage at 80°C	≤ 5 %	100 x 100 x d	3	1 per week
10	Thermal conductivity	4)		1	1 per week
11	Closed cells [%]	≥ 90	4)	1	1per month
12	Base materials	Check of basic materials and mixing ratios			Continually
Steel cover sheets					
13	Yield point	Requirements, tests, and test specimens as per DIN EN 10326 DIN 50114 DIN 50955, DIN 50988 DIN 55928			per main coil
14	Tensile strength				
15	Elongation at break				
16	Zinc layer thickness				
17	Steel core thickness				
18	Plastic coating				
19	Behaviour in fire	See paragraph 2.4.2			

- 1) Test description and evaluation of results, see supervising contract
- 2) Average across element thickness, on at least 3 points across element width
- 3) In the case of trapezoidal cover sheets: Max. quasi-flat thickness between the chords
- 4) The test procedure must be agreed with the external supervisory body
- 5) In addition on the occasion of every significant change to the production
- 6) Continuous core thickness as per appendix B, sheet 1.01
- 7) The measured mean values must correspond to the values specified in appendix B; sheet 3.01
- 8) In the case of FischerTHERM W

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Appendix B, sheet 6.01.1

In-house production control

In-house production control of sandwich elements

Testing at a room temperature of approx. 20°C

For foam system „FTS 04“

Line	Type of testing	Requirements ¹⁾	Test specimen ¹⁾ Dimensions [mm]	Number	Testing frequency ⁵⁾
1	Sandwich elements d [mm] ⁶⁾	30 bis 120			
a	Thickness	(s. paragraph 2.2.4)		3	1per shift
b	Cover sheet geometry	(s. Appendix B, sheet 1.02)		3	1per week
	Foam				
2	Density [kg/m ³] ²⁾	38 ⁺² ₋₀	100 x 100 x d	5	1per shift
3	Tensile strength with cover sheets [N/mm ²]	≥0,10	100 x 100 x d	5	1per week
4	Compressive stress at 10% upsetting [N/mm ²]	(s. Appendix B, sheet 3.01)	100 x 100 x d ³⁾	3	1per week
5	Shear resistance	(s. Appendix B, sheet 3.01)	100 x 100 x d ³⁾	3	1per week
6	Shear modulus [N/mm ²] ⁷⁾		100 x 100 x d ³⁾	3	1per week
	30 bis 40 mm	>3,1 N/mm ²			
	60 bis 65 mm	>3,6 N/mm ²			
	78 bis 120 mm	>3,1 N/mm ²			
7	Tensile modulus E _Z [N/mm ²] ⁷⁾		100 x 100 x d (76,9 x 100 x d) ⁸⁾	3	1per week
	30 mm	>2,9 N/mm ²			
	40 bis 78 mm	>4,3 N/mm ²			
	85 bis 120 mm	>3,6 N/mm ²			
8	Compressive modulus E _D [N/mm ²]		100 x 100 x d (76,9 x 100 x d) ⁸⁾	3	1per week
	30 mm	>2,0 N/mm ²			
	40 bis 85 mm	>3,3 N/mm ²			
	98 bis 120 mm	>3,0 N/mm ²			
9	Dimensional change after 3 hours storage at 80°C	≤ 5 %	100 x 100 x d	3	1per week
10	Thermal conductivity	4)		1	1per week
11	Closed Cells [%]	≥ 90	4)	1	Per Month
12	Basic materials	Check of basic materials and mixing ratios			continually
	Steel cover sheet	see paragraph 2.2.1			
13	Yield point	Requirements, tests, and test specimens as per DIN EN 10326 DIN 50114 DIN 50955, DIN 50988 DIN 55928			Per main coil
14	Tensile strength				
15	Elongation at break				
16	Zinc layer thickness				
17	Steel core thickness				
18	Plastic coating				
19	Behaviour in fire	See paragraph 2.4.2			

- 1) Test description and evaluation of results, see supervising contract
 2) Average across element thickness, on at least 3 points across element width
 3) In the case of trapezoidal cover sheets: Max. quasi-flat thickness between the chords
 4) The test procedure must be agreed with the external supervisory body
 5) In addition on the occasion of every significant change to the production
 6) Continuous core thickness as per appendix B, sheet 1.01
 7) The measured mean values must correspond to the values specified in appendix B; sheet 3.01
 8) In the case of FischerTHERM W

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs

Appendix B, sheet 6.01.2

In-house production control

External supervision of sandwich elements

Checking at least twice a year.

	Type of checking	Requirements and type of specimen
1	Material checking to control in-house testing during production	See appendix B, sheet 6.01
2	Single-span girder testing	Span: d < 50 mm: l = 3 m d ≥ 50 mm: l = 4 m Width = element width Determination of wrinkling stress and shear modulus for the purpose of comparison
3	Thermal conductivity	acc. to DIN EN 12667 or DIN EN 12939
4	Deformation when exposed to compressive and temperature stresses: DLT (1)5	DIN EN 13165, paragraph 4.3.2
5	Dimensional stability when exposed to defined temperature and moisture conditions: DS(TH)2	DIN EN 13165, paragraph 4.2.6
6	Cell gas composition	Gas chromatographic analysis
7	Closed-cell characteristics	≥ 90% acc. to DIN ISO 4590
8	Behaviour in fire ¹⁾	See paragraph 2.4.3

¹⁾ Checking by a supervisory body must be carried out on specimens with standard joint design.

Load-bearing 'FischerTHERM' and 'FischerFIREPROOF' sandwich elements for walls and roofs	Appendix B, sheet 6.02
External supervision of sandwich elements	

Product range

FischerTHERM



FischerTRAPEZ



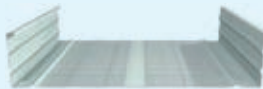
FischerTRAPEZ-Acoustic



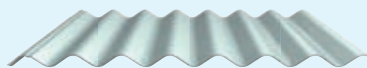
FischerKASSETTE



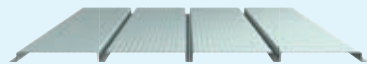
FischerKASSETTE-Acoustic



FischerWELLE



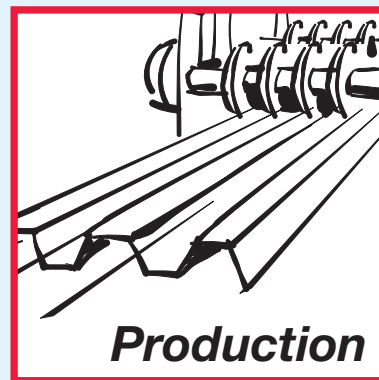
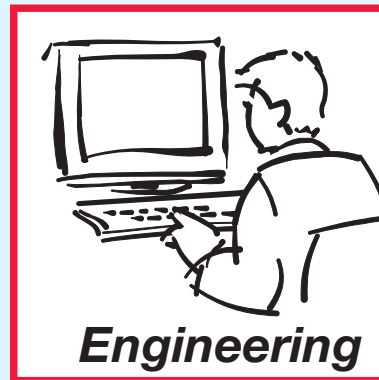
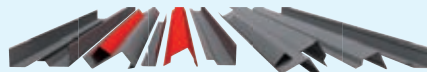
FischerPANEEL



FischerKLIPTEC



Flashings and accessories



Diese Informationen sind nach bestem Wissen und Gewissen erstellt worden. Tata Steel – einschließlich ihrer Tochtergesellschaften – übernimmt jedoch keine Haftung für Informationen, die sich eventuell als irreführend herausstellen könnten. Reproduktion und Nachdruck verboten.