RAL QUALITY MARK

Expansion Joint

Quality Association for Fabric Expansion Joints

Technical Information

The Technical Principles of the
Quality Association for Fabric Expansion Joints

October 2024

RAL QUALITY MARK
Expansion Joint

The Quality Mark of Fabric Expansion Joints stands for approved quality

Key tasks of the Quality Association for Fabric Expansion Joints are:

- reliable use of the products in all application fields
- continuous amendments of the state of the art for optimum product quality
  - by Quality and Inspection Specifications
  - by Technical Information optimized regarding cost and benefit

The Quality Monitoring System of Quality Association for Fabric Expansion Joints Association

The Quality of fabric expansion joints is very important.

Fabric expansion joints can be used for all types of mediums in many duct arrangements and countless applications. The user must be sure that by using these elements

- the application risks are minimised
- extreme requirements can be fulfilled
- durability and reliability of the products are provided.

The certified quality aims at the above mentioned criteria.

The Quality Monitoring System of the Quality Association for Fabric Expansion Joints is based on external monitoring tests of the member companies.

The Certification Bodies of the member companies:

TÜV SÜD

VGB ENERGY IS US

Technical Information of the RAL Quality Association

Item	Title	Status
TI-001	Determination of tensile strength of supporting layers for fabric expansion joints	Rev. 1
TI-002	Flue-gas tight fabric expansion joints	Rev. 5
TI-003	Nekal-tight fabric expansion joints	Rev. 4
TI-004	Expansion joint questionnaire Expansion joint questionnaire (Imperial Units)	Rev. 2 Rev. 0
TI-005	Tightness test of fabric expansion joints with foam building liquid Tightness test of fabric expansion joints with foam building liquid (Imperial Units)	Rev. 2 Rev. 0
TI-006	Documentation of fabric expansion joints	Rev. 2
TI-007	Bolted connections for fabric expansion joints Bolted connections for fabric expansion joints (Imperial Units)	Rev. 2 Rev. 0
TI-008	Storage, packing and transportation of fabric expansion joints	Rev. 4
TI-009	Planning of installation for fabric expansion joints	Rev. 2
TI-010	Installation of fabric expansion joints	Rev. 1
TI-011	Insulation requirement for fabric expansion joints	Rev. 5
TI-012	Maintenance work of fabric expansion joints	Rev. 2
TI-013	Tolerances for connection flanges and installation dimensions for fabric expansion joints Tolerances for connection flanges and installation dimensions for fabric expansion joints (Imperial Units)	Rev. 4 Rev. 0
TI-014	Terms and definitions for fabric expansion joints	Rev. 6
TI-015	Safety management of fabric expansion joints	Rev. 3
TI-016	Surface temperature of fabric expansion joints	Rev. 1
TI-017	Remarks about EC Declaration of Conformity and CE marking of fabric expansion joints	Rev .1
TI-018	Inspection documents according to EN 10204 for fabric expansion joints	Rev. 1
TI-019	Disposal of fabric expansion joints	Rev. 1
TI-020	Fabric Expansion Joints in facilities with acoustical requirements	Rev. 1
TI-021	Design recommendations and characteristics of fabric expansion joints	Rev. 0

Edited by the Quality Committee of the Quality Association for Fabric Expansion Joints

RAL QUALITY MARK

Expansion Joint

Technical Information

Determination of tensile strength of supporting layers for fabric expansion joints

RAL-GZ 719

TI-001

Rev. 1

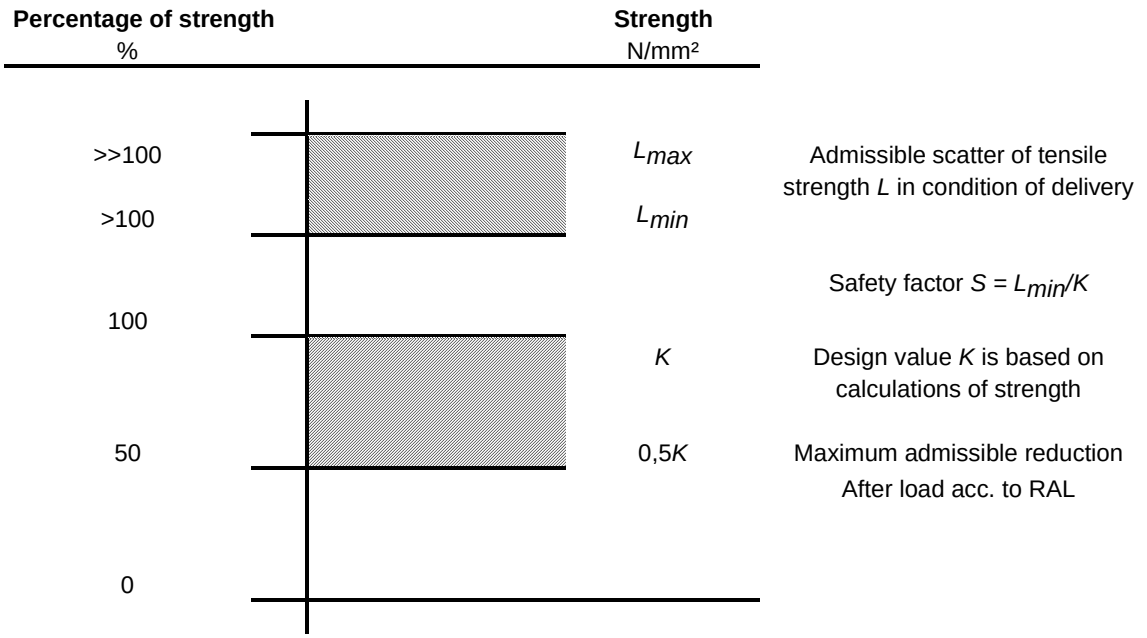
1. In conformance with the Quality and Test Regulations RAL-GZ 719, Item 3.1.2, paragraph 4, the mechanical strength values must be stated in the ''Material's Data Sheet" for multi layer fabric expansion joints.

1.1. The tensile strength of supporting layers after a thermal influence or chemical load according to Items 3.2.3 and 3.2.4 of the ''Test Regulations'' must not decrease by more than 50 % relative to the so-called ''basic value''.

2. This basic value should be considered as a ''design value'' which ensures that fabric expansion joints resist to the mechanical and chemical loads in practical application.

2.1. The design value should be specified by the manufacturer of the expansion joint, as this value is subject to the qualitative properties of the semi-finished products.

3. The condition of delivery of semi-finished products is specified and is monitored by the incoming goods' inspection. With regard to the tensile strength, the minimum strength in the condition of delivery L_{min} is above the design value *K,* according to the safety factor *S* satisfying the task, as shown in the graphic.



4. The tensile strength is tested according to 3.2.5. Results must meet the requirements of the ''Material's Data Sheet''.

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RAL QUALITY MARK

Expansion Joint

Technical Information

Flue-gas tight fabric expansion joints

RAL-GZ 719

TI-002

Rev. 5

1. The Quality and Test Regulations for Fabric Expansion Joints mention in Item 2.1.4 and in 3.1.4 "Tightness" that expansion joints should be tight in accordance with the latest edition of the RAL TI-005 "Tightness test of fabric expansion joints with foam building liquid".

2. The bubble method acc. to RAL-TI-005 is a qualitative method. It serves for finding and proving an individual leakage.

3. In the RAL TI-005 statements are made regarding the sensitivity of test methods, namely measured as a PV product for characterising an amount of gas.

3.1. The sensitivity of the bubble method to furnish proof is stated to be

$$L = 10^{-2} \text{ to } 10^{-4} \text{ mbar·l·s}^{-1}$$

$$L = 1.4 \times 10^{-4} \text{ to } 10^{-6} \text{ inWC·ft}^3\text{·s}^{-1}$$

This indication refers to an individual leakage and cannot therefore be transferred to the integral leakage rate of an expansion joint.

4. Tightness is proved in a test unit by means of a foaming liquid (Nekal®) at room temperature.

4.1. In conformance with the Quality and Test Regulations RAL-GZ 719, Item "2.2.6 Tightness", no bubbles may appear in the bellows area at a test pressure, which has to be 1½ times of the nominal pressure, but at least to 5000 Pa (20 inWC).

4.2. As a complement to the Quality and Test Regulations RAL-GZ 719, Item "2.2.6 Tightness", the occurrence of a limited number of foam bubbles in the clamping area and joint area of the bellows is however permitted.

5. For convenience, the formation of bubbles is judged on either clamping side for a specific circumferential length (e.g. 1 m (3 ft)).

5.1. The diameter and number of bubbles formed in a specific period of time may be used as a reference for evaluating the leakage rate.

5.2. A spherical foam bubble of 13.66 mm (0.538 in) diameter has a volume of approx. 1 cm^3 (0.061 in^3). 100 bubbles of 2.94 mm (0.116 in) each, or 10,000 bubbles of 0.63 mm (0,025 in) each, or 1,000,000 bubbles of 0.14 mm (5.512×10^{-4} in) diameter each, have an identical volume.

5.3. According to the structure, leakages in the range of some $L \cdot min^{-1} \cdot m^{-1}$ ($gal \cdot min^{-1} \cdot ft^{-1}$) are admissible.

6. The tightness test can be agreed for all gaseous media.

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RAL QUALITY MARK

Expansion Joint

Technical Information

Nekal-tight fabric expansion joints

RAL-GZ 719

TI-003

Rev. 4

1. In the quality and test specifications for fabric expansion joints it is mentioned under 2.1.4 and 3.1.4 "Tightness" that the expansion joints are tight in the sense of the latest edition of DECHEMA Information Sheet NDT 1, Supplement 2, Section 2.2 “Bubble method with foam-forming liquid (nekal-tight)”. TI-005 finally describes the testing of fabric expansion joints.

2. The bubble method acc. to RAL TI-005 is a qualitative method. It serves for finding and proving an individual leakage.

3. In the RAL TI-005 statements are made regarding the sensitivity of test methods, namely measured as a PV product for characterizing an amount of gas.

3.1. The sensitivity of the bubble method to furnish proof is stated to be

$$L = 10^{-2} \text{ to } 10^{-4} \text{ mbar} \cdot \text{l} \cdot \text{s}^{-1}$$

$$L = 1{,}4 \times 10^{-4} \text{ to } 10^{-6} \text{ inWC} \cdot \text{ft}^3 \cdot \text{s}^{-1}$$

3.2. This indication refers to an individual leakage and cannot therefore be transferred to the integral leakage rate of an expansion joint.

4. Tightness is proved in a test unit by means of a foaming liquid (Nekal®) at room temperature.

4.1. In conformance with the Quality and Test Regulations RAL-GZ 719, Item "2.2.6 Tightness", no bubbles may appear in the bellows area at a test pressure, which has to be 1½ times of the nominal pressure, but at least to 5000Pa (20 inWC).

4.2. This refers both to the bellows area and to the clamping area.

5. The tightness may be proved on a mutually agreed design specimen and/or on site, on the installed original.

6. The tightness test can be agreed for all gaseous media.

Edited by the Quality Committee of the Quality Association for Fabric Expansion Joints

Technical Information

Expansion joint questionnaire

RAL-GZ 719

TI-004

Rev. 2

Company: _____
Street: _____
Place: _____
Person in charge: _____
Department: _____
Telephone: _____
Telefax: _____
E-Mail: _____

Order No.: _____ Date: _____
Project: _____ Project No.: _____
Item No.: _____ Quantity: _____

1. Medium

☐ flue gas ☐ air ☐ waste gas ☐ other: _____
☐ composition according to enclosed analysis
☐ dry ☐ moist
dust ☐ no ☐ yes: _____ content: _____ mg/m³
solid particles ☐ no ☐ yes: _____ content: _____ mg/m³
grain size _____
flow rate: _____ m³/h Flow velocity: _____ m/s
Direction of flow: ☐ horizontal ☐ vertically up ☐ vertically down ☐ diagonally up ☐ diagonally down
temperature falling below dewpoint level ☐ no ☐ yes Dew point: ____ °C
condensate ☐ strongly acid ☐ slightly acid ☐ neutral ☐ slightly basic ☐ strongly basic

2. Temperatures

Temperature of medium: ____ °C Design temperature: ____ °C Excursion temperature ____ °C
Duration of individual excursions days: _____ hours: _____ minutes: _____
Duration of excursions per year days: _____ hours: _____ minutes: _____
Ambient temperature: _____ °C standard value: 50 °C with a free convection
Radiation impeded ☐ no ☐ yes, by: _____
Passive radiation by components ☐ no ☐ yes, by: _____
external insulation ☐ no yes! Has to be confirmed by manufacturer

Edited by the Quality Committee of the Quality Association for Fabric Expansion Joints

3. Pressure

Operating pressure: ____ mbar Neg. op. pressure: ____ mbar Design pressure: ____ mbar

Transient pressure ☐ no ☐ yes, from: _____ mbar to: _____ mbar Frequency: _____

Surge load ☐ no ☐ yes, from: _____ mbar to: _____ mbar Frequency: _____

Excursion pressure: ____ mbar Neg. exc. pressure: ____ mbar duration of excursion: ____ h

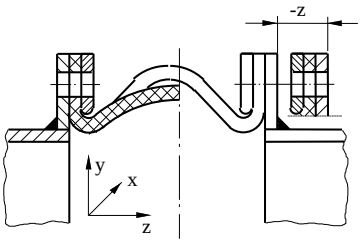
Excursion frequency: ____ per: _____ at a temperature of _____ °C

4. Specified tightness

☐ without ☐ flue gas tight acc. to TI-002 ☐ nekal tight acc. to TI-003

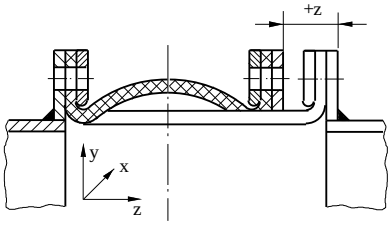
5. Movements

Axial compression



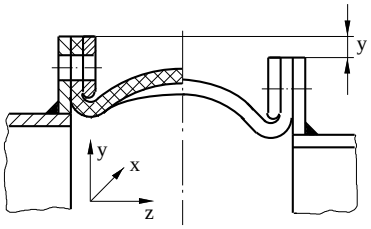
- z: ____ mm

Axial elongation



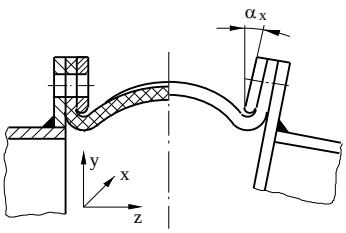
+ z: ____ mm

Lateral offset



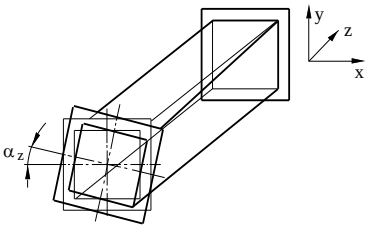
x: ___ mm; y: ____ mm

Angular movement



αx: ____° αy: ____°

Torsion



αz: ____°

Vibration

☐ no ☐ yes

frequency: _____ s^{-1}

amplitude: _____ mm

6. Design

Type of connection ☐ tubular connection ☐ flange connection

Delivery ☐ open ☐ endless

Baffle/sleeve ☐ no ☐ yes ☐ welded ☐ bolted

Insulation between expansion joint and baffle/sleeve ☐ yes ☐ no

Tubular connection

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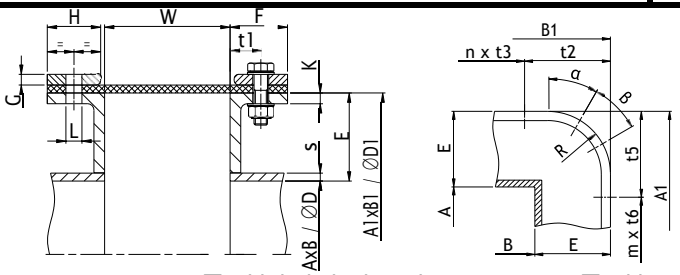
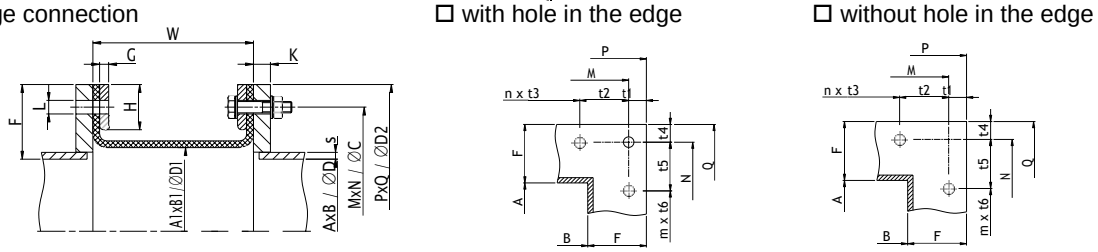
Technical Information

Expansion joint questionnaire

Tubular connection



Flange connection ☐ with hole in the edge ☐ without hole in the edge



Rectangular						Round				
AxB	inner duct dimension	**A**	_____	mm	D	inner duct diameter	**D**	_____	mm
		B	_____	mm				_____	
A1xB1	inner dimension of	**A1**	_____	mm	D1	inner diameter of the	**D1**	_____	mm
	the expansion joint	**B1**	_____	mm		expansion joint		_____	mm
E	set back	**E**	_____	mm	E	set back	**E**	_____	mm
F	flange height/width	**F**	_____	mm	F	flange height/width	**F**	_____	mm
G	counter flange thickness	**G**	_____	mm	G	counter flange thickness	**G**	_____	mm
H	counter flange width	**H**	_____	mm	H	counter flange width	**H**	_____	mm
K	flange thickness	**K**	_____	mm	K	flange thickness	**K**	_____	mm
L	bolt hole diameter	**L**	_____	mm	L	bolt hole diameter	**L**	_____	mm
MxN	hole line distance	**M**	_____	mm	C	bolt pitch	**C**	_____	mm
		N	_____	mm	N	number of holes	**N**	_____	mm
PxQ	outer dimension	**P**	_____	mm	D2	outer diameter	**D2**	_____	mm
		Q	_____	mm					
R	radius	**R**	_____	mm					
S	duct wall thickness	**S**	_____	mm	S	duct wall thickness	**S**	_____	mm
W	flange distance	**W**	_____	mm	W	flange distance	**W**	_____	mm
t1	distance (round / rect.)	**t1**	_____	mm	t4	distance (only rect.)	**t4**	_____	mm
t2	distance (only rect.)	**t2**	_____	mm	t5	distance (only rect.)	**t5**	_____	mm
t3	distance (only rect.)	**t3**	_____	mm	t6	distance (only rect.)	**t6**	_____	mm
m	number of holes	**m**	_____		n	number of holes	**n**	_____	
α	angle	**α**	_____	°	β	angle	**β**	_____	°

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7. Scope of supply

☐ Expansion joint
☐ Internal insulation
☐ Counter flanges/tension strips
☐ Duct flanges
☐ Bolting
☐ Baffle/sleeve
☐ Baffle/sleeve gasket

☐ supplied in parts
☐ supplied pre-assembled

☐ On site measurement
☐ Mounting
☐ Supervision

8. Other details

_____
_____
_____
_____
_____

9. Sketch/Drawing

Sketch/drawing enclosed ☐ yes ☐ no

Drawing No.: _____

Remark: State full and precise details for your safety

Place	Date	Signature

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Technical Information

Expansion joint questionnaire
Imperial Units

RAL-GZ 719

TI-004

Rev. 0

Company: _____
Street: _____
Place: _____
Person in charge: _____
Department: _____
Telephone: _____
Telefax: _____
E-Mail: _____

Order No.: _____ Date: _____
Project: _____ Project No.: _____
Item No.: _____ Quantity: _____

1. Medium

☐ flue gas ☐ air ☐ waste gas ☐ other: _____
☐ composition according to enclosed analysis
☐ dry ☐ moist
dust ☐ no ☐ yes: _____ content: _____ oz/ft³
solid particles ☐ no ☐ yes: _____ content: _____ oz/ft³
grain size _____
flow rate: _____ ft³/min Flow velocity: _____ ft/s
Direction of flow: ☐ horizontal ☐ vertically up ☐ vertically down
☐ diagonally up ☐ diagonally down
temperature falling below dewpoint level ☐ no ☐ yes Dew point: ____ °F
condensate ☐ strongly acid ☐ slightly acid ☐ neutral ☐ slighty basic ☐ strongly basic

2. Temperatures

Temperature of medium: ____ °F Design temperature: ____ °F Excursion temperature ____ °F
Duration of individual excursions days: _____ hours: _____ minutes: _____
Duration of excursions per year days: _____ hours: _____ minutes: _____
Ambient temperature: _____ °F standard value: 122 °F with a free convection
Radiation impeded ☐ no ☐ yes, by: _____
Passive radiation by components ☐ no ☐ yes, by: _____
external insulation ☐ no yes! Has to be confirmed by manufacturer

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3. Pressure

Operating pressure: ____ psi Neg. op. pressure: ____ psi Design pressure: ____ psi

Transient pressure ☐ no ☐ yes, from: _____ psi to: _____ psi Frequency: _____

Surge load ☐ no ☐ yes, from: _____ psi to: _____ psi Frequency: _____

Excursion pressure: ____ psi Neg. exc. pressure: ____ psi duration of excursion: ____ h

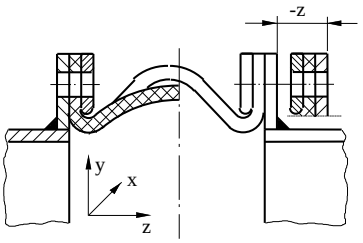
Excursion frequency: ____ per: _____ at a temperature of _____ °F

4. Specified tightness

☐ without ☐ flue gas tight acc. to TI-002 ☐ nekal tight acc. to TI-003

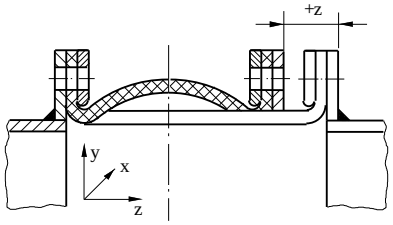
5. Movements

Axial compression



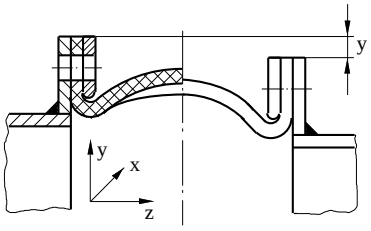
- z: ____ in

Axial elongation



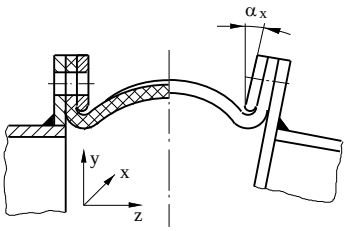
+ z: ____ in

Lateral offset



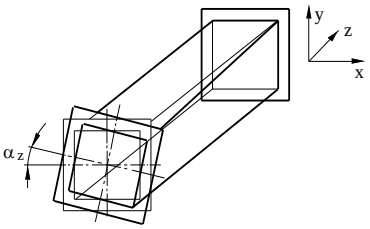
x: ___ in; y: ____ in

Angular movement



αx: ____° αy: ____°

Torsion



αz: ____°

Vibration

☐ no ☐ yes

frequency: _____ s^{-1}

amplitude: _____ in

6. Design

Type of connection	☐ tubular connection		☐ flange connection	
Delivery	☐ open		☐ endless	
Baffle/sleeve	☐ no	☐ yes	☐ welded	☐ bolted
Insulation between expansion joint and baffle/sleeve			☐ yes	☐ no

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RAL QUALITY MARK

Expansion Joint

Technical Information

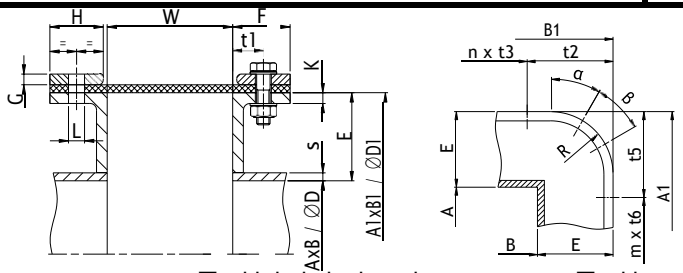
Expansion joint questionnaire
Imperial Units

RAL-GZ 719

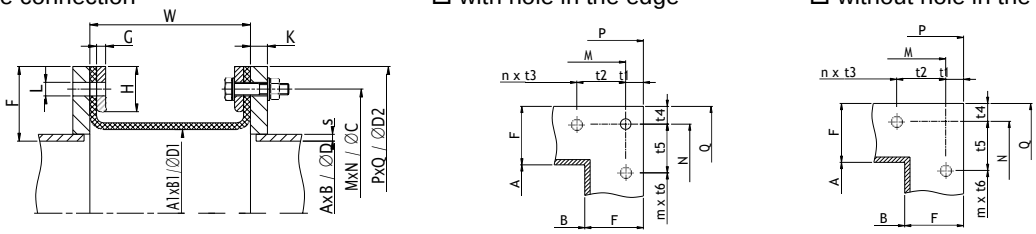
TI-004

Rev. 0

Tubular connection



Flange connection ☐ with hole in the edge ☐ without hole in the edge



Rectangular					Round				
AxB	inner duct dimension	**A**	_____	in	D	inner duct diameter	**D**	_____	in
		B	_____	in				_____	
A1xB1	inner dimension of	**A1**	_____	in	D1	inner diameter of the	**D1**	_____	in
	the expansion joint	**B1**	_____	in		expansion joint		_____	in
E	set back	**E**	_____	in	E	set back	**E**	_____	in
F	flange height/width	**F**	_____	in	F	flange height/width	**F**	_____	in
G	counter flange thickness	**G**	_____	in	G	counter flange thickness	**G**	_____	in
H	counter flange width	**H**	_____	in	H	counter flange width	**H**	_____	in
K	flange thickness	**K**	_____	in	K	flange thickness	**K**	_____	in
L	bolt hole diameter	**L**	_____	in	L	bolt hole diameter	**L**	_____	in
MxN	hole line distance	**M**	_____	in	C	bolt pitch	**C**	_____	in
		N	_____	in	N	number of holes	**N**	_____	in
PxQ	outer dimension	**P**	_____	in	D2	outer diameter	**D2**	_____	in
		Q	_____	in					
R	radius	**R**	_____	in					
S	duct wall thickness	**S**	_____	in	S	duct wall thickness	**S**	_____	in
W	flange distance	**W**	_____	in	W	flange distance	**W**	_____	in
t1	distance (round / rect.)	**t1**	_____	in	t4	distance (only rect.)	**t4**	_____	in
t2	distance (only rect.)	**t2**	_____	in	t5	distance (only rect.)	**t5**	_____	in
t3	distance (only rect.)	**t3**	_____	in	t6	distance (only rect.)	**t6**	_____	in
m	number of holes	**m**	_____		n	number of holes	**n**	_____	
α	angle	**α**	_____	°	β	angle	**β**	_____	°

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7. Scope of supply

☐ Expansion joint
☐ Internal insulation
☐ Counter flanges/tension strips
☐ Duct flanges
☐ Bolting
☐ Baffle/sleeve
☐ Baffle/sleeve gasket

☐ supplied in parts
☐ supplied pre-assembled

☐ On site measurement
☐ Mounting
☐ Supervision

8. Other details

_____
_____
_____
_____
_____

9. Sketch/Drawing

Sketch/drawing enclosed ☐ yes ☐ no

Drawing No.: _____

Remark: State full and precise details for your safety

Place	Date	Signature

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Technical Information

Tightness test of fabric expansion joints with foam building liquid

The present technical information is based on the DECHEMA Information Bulletin ZfP1 „Leak test procedures for instruments and components for chemical plants“ (available only in German language, named: Informationsblatt ZfP1 „Dichtheitsprüfung an Apparaten und Komponenten von Chemieanlagen“).

1. Scope

The task of the leak test is to verify the tightness. This is contrary to pressure tests which prove sufficient strength versus pressure load.

Leak tests for fabric expansion joints may be carried out during production at a selected test object or during commissioning and acceptance test of the ducting of a plant.

Various procedures for leak tests with different applicability and informative results are common. The Technical information describes the applicable method of leak tests.

2. Principle

The Quality Committee of the Quality Association for Fabric Expansion Joints provides clearly arranged advices for the selection and execution of leak tests for the inspector.

The tightness can be provided by a company, which is entitled to carry the RAL- mark of quality for Fabric Expansion Joints

or
by an independent expert organisation, which is listed at Quality Committee of the Quality Association for Fabric Expansion Joints.

3. Terms and Definitions

3.1. Tightness

The test object is considered to be tight if it is not possible to prove, that the test medium passes through from one test bench to the other respectively from the test bench to the outer atmosphere.

The proof is based on the selected test method and its required test sensitivity respectively the detection sensitivity of the method.

3.2. Leakage (Leak)

The leak is the actual location where it was proved that the medium passes through. The proof is based on the selected test method and its required test sensitivity respectively the detection sensitivity of the method.

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3.3. Leakage rate

The leak rate is the quantity of test medium, which passes through a leak as a result of the pressure difference during a certain time. The leakage rate of one single leak is not an absolute measurement. It depends on the shape (dimension) of the leak and the nature of the test media used for the detection of the leak and the selection of the test conditions.

The common unit of the leakage rate for gases is „millibar times liter per second“ ($mbar \cdot l \cdot s^{-1}$).

One leak with a leakage rate of 1 $mbar \cdot l \cdot s^{-1}$ is existing if the pressure of an evacuated room with a volume of 1 l will increase 1 mbar per second (under constant temperature in the corresponding room).

3.4. Total leakage rate

The total leakage rate is the summation of the leak rates of all single leaks of the test object. It will be determined by integral test method.

3.5. Test medium

Test media are liquid or gaseous media, which can be detected after passing through the leak.

4. Appropriate methods for leak tests

According to the material features of fabric expansion joints the selection of the methods for gas tightness is limited to tests with gaseous media.

For practical tests a detection sensitivity of 10^{-2} to 10^{-4} $\cdot mbar \cdot l \cdot s^{-1}$ is sufficient.

According to the detection sensitivity, the bubble method with a foaming liquid is appropriate. The test is carried out under pressure. Reasonable media are air or nitrogen. Nekal® or an equal foaming liquid acts as auxiliary material.

For testing, the test section shall be sprinkled with this liquid. Fine bubbles will appear at the leak.

For particular requirements of the tightness, specific test criteria have to be determined.

5. Instructions for testing the tightness with bubble method

5.1. Prearrangement for testing

5.1.1. Cleaning and Drying

The test object shall be sufficiently free of lubricants, grease and other impurity to grant a correct moistening of the surface. Wet test objects have to be dried.

5.1.2. Sealing of openings

The area to be tested has to be sufficiently sealed gastight to keep a constant test pressure.

For this reason all openings have to be sealed gastight, specifically for tests of duct systems. For leak tests during production suitable test facilities which simulate the installation of the expansion joint shall be provided.

5.1.3. Pressure measurement

The test pressure shall be indicated at a suitable manometer.

5.1.4. Ambient influences

The ambient shall not influence the developing foam. The illumination and the artificial light shall provide a proper contrast.

6. Testing

6.1. Test medium and test auxiliaries

The test media air or nitrogen is discharged into the test room. The test gas shall be dry and mostly free of lubricants. Foaming liquid is acting as test auxiliary for the bubble method (top 3. para 3).

6.2. Pressurization

6.2.1. Pressure

The test is generally performed at a pressure of 5000 Pa. The maximum required test pressure shall not exceed the operating pressure (design pressure).

6.2.2. Vacuum

Tests under vacuum conditions are not suitable.

6.3. Test procedure

The bubble method is a qualitative method which is performed at ambient temperature. It serves for detecting and proving local leaks. Therefore the indication of leakage rates is only subject to specific conditions.

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Measures for an accurate testing:

- bubble free sprinkling of the foaming liquid
- observation of the developing bubbles during moistening of the test section
- Check again the same area after about 10–60 seconds to also detect the slowly growing small foam bubbles on small leaks

6.4. Time of testing

It is recommended to perform the ultimate bubble leak test after final production, cleaning and non-destructive tests.

After having repaired the detected leaks, the test has to be repeated.

6.5. Test report

It is recommended to record the test conditions and the result in a test report.

7. Measures after the test

It is recommended to discharge the pressure. Removal of the foaming liquid is not common practice. In case of rework it is required.

8. Precautions

For the charging of the test room with test gas (air, nitrogen) the valid safety regulations have to be respected.

The maximum test pressure after mathematic analysis of the wall thickness is 10.000 Pa in case the test is carried out at non-pressurized vessels and duct sections.

The protective measures for electrical operated auxiliaries have to be respected at the test location.

Edited by the Quality Committee of the Quality Association for Fabric Expansion Joints

Technical Information

Tightness test of fabric expansion joints with foam building liquid
Imperial units

RAL-GZ 719

TI-005

Rev. 0

The present technical information is based on the DECHEMA Information Bulletin ZfP1 „Leak test procedures for instruments and components for chemical plants“ (available only in German language, named: Informationsblatt ZfP1 „Dichtheitsprüfung an Apparaten und Komponenten von Chemieanlagen“).

1. Scope

The task of the leak test is to verify the tightness. This is contrary to pressure tests which prove sufficient strength versus pressure load.
Leak tests for fabric expansion joints may be carried out during production at a selected test object or during commissioning and acceptance test of the ducting of a plant.
Various procedures for leak tests with different applicability and informative results are common. The Technical information describes the applicable method of leak tests.

2. Principle

The Quality Committee of the Quality Association for Fabric Expansion Joints provides clearly arranged advices for the selection and execution of leak tests for the inspector.
The tightness can be provided by a company, which is entitled to carry the RAL- mark of quality for Fabric Expansion Joints

or
by an independent expert organisation, which is listed at Quality Committee of the Quality Association for Fabric Expansion Joints.

3. Terms and Definitions

3.1. Tightness

The test object is considered to be tight if it is not possible to prove, that the test medium passes through from one test bench to the other respectively from the test bench to the outer atmosphere.
The proof is based on the selected test method and its required test sensitivity respectively the detection sensitivity of the method.

3.2. Leakage (Leak)

The leak is the actual location where it was proved that the medium passes through. The proof is based on the selected test method and its required test sensitivity respectively the detection sensitivity of the method.

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3.3. Leakage rate

The leak rate is the quantity of test medium, which passes through a leak as a result of the pressure difference during a certain time. The leakage rate of one single leak is not an absolute measurement. It depends on the shape (dimension) of the leak and the nature of the test media used for the detection of the leak and the selection of the test conditions.
The common unit of the leakage rate for gases is „inch WaterColumn times cubic foot per second“ (inWC x ft^3 x s^{-1}).
One leak with a leakage rate of 1 inWC x ft^3 x s^{-1} is existing if the pressure of an evacuated room with a volume of 1 ft^3 will increase 1 inWC per second (under constant temperature in the corresponding room).

3.4. Total leakage rate

The total leakage rate is the summation of the leak rates of all single leaks of the test object. It will be determined by integral test method.

3.5. Test medium

Test media are liquid or gaseous media, which can be detected after passing through the leak.

4. Appropriate methods for leak tests

According to the material features of fabric expansion joints the selection of the methods for gas tightness is limited to tests with gaseous media.
For practical tests a detection sensitivity of 1,4 x 10^{-4} to 10^{-6} inWC·ft^3·s^{-1} is sufficient.
According to the detection sensitivity, the bubble method with a foaming liquid is appropriate. The test is carried out under pressure. Reasonable media are air or nitrogen. Nekal® or an equal foaming liquid acts as auxiliary material.
For testing, the test section shall be sprinkled with this liquid. Fine bubbles will appear at the leak.
For particular requirements of the tightness, specific test criteria have to be determined.

5. Instructions for testing the tightness with bubble method

5.1. Prearrangement for testing

5.1.1. Cleaning and Drying

The test object shall be sufficiently free of lubricants, grease and other impurity to grant a correct moistening of the surface. Wet test objects have to be dried.

5.1.2. Sealing of openings

The area to be tested has to be sufficiently sealed gastight to keep a constant test pressure.
For this reason all openings have to be sealed gastight, specifically for tests of duct systems. For leak tests during production suitable test facilities which simulate the installation of the expansion joint shall be provided.

5.1.3. Pressure measurement

The test pressure shall be indicated at a suitable manometer.

5.1.4. Ambient influences

The ambient shall not influence the developing foam. The illumination and the artificial light shall provide a proper contrast.

6. Testing

6.1. Test medium and test auxiliaries

The test media air or nitrogen is discharged into the test room. The test gas shall be dry and mostly free of lubricants. Foaming liquid is acting as test auxiliary for the bubble method (top 3. para 3).

6.2. Pressurization

6.2.1. Pressure

The test is generally performed at a pressure of 20 inWC. The maximum required test pressure shall not exceed the operating pressure (design pressure).

6.2.2. Vacuum

Tests under vacuum conditions are not suitable.

6.3. Test procedure

The bubble method is a qualitative method which is performed at ambient temperature. It serves for detecting and proving local leaks. Therefore the indication of leakage rates is only subject to specific conditions.

Measures for an accurate testing:

- bubble free sprinkling of the foaming liquid
- observation of the developing bubbles during moistening of the test section
- Check again the same area after about 10–60 seconds to also detect the slowly growing small foam bubbles on small leaks

6.4. Time of testing

It is recommended to perform the ultimate bubble leak test after final production, cleaning and non-destructive tests.
After having repaired the detected leaks, the test has to be repeated.

6.5. Test report

It is recommended to record the test conditions and the result in a test report.

7. Measures after the test

It is recommended to discharge the pressure. Removal of the foaming liquid is not common practice. In case of rework it is required.

8. Precautions

For the charging of the test room with test gas (air, nitrogen) the valid safety regulations have to be respected.
The maximum test pressure after mathematic analysis of the wall thickness is 40 inWC in case the test is carried out at non-pressurized vessels and duct sections.
The protective measures for electrical operated auxiliaries have to be respected at the test location.

Technical Information

Documentation of fabric expansion joints

Every Expansion joint delivery will be accompanied according to the contract.

1. Standard documentation according to RAL-GZ 719

The minimum requirements of the documentation referring to the RAL Quality Mark GZ 719 are as follows:

- The information provided has to be sufficient in order to reorder the original product.
- It must be possible to identify the product. The operation conditions and dimensions must be documented.

The minimum requirements of the documentation are fulfilled if this information is provided either in the order confirmation, delivery documentation or waybill.

Regarding the general installation and handling of expansion joints, please refer to the technical information RAL GZ- 719 (www.qafej.org) which can be downloaded from the internet.

2. Contractually agreed extended standard documentation according to RAL-GZ 719

Extended standard documentation has to be stipulated in the purchase order and separately confirmed by the supplier. This documentation consists of the following modules which will be provided electronically in pdf-form.

- General installation instruction (German/ English)
- Specific installation instruction according to the consignment
- Storage of fabric expansion joints (German/ English)
- Maintenance, commissioning and visual control (German/ English)
- Principle drawings

3. Contractually agreed non-standard documentation

The following documents will be provided only if explicitly contractually agreed:

- Dimensioned drawings of the expansion joint
- Certificates according to EN 10204 and TI-018
- Quality documents in other languages than mentioned before
- Documents in a different version and quantity than mentioned before

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RAL QUALITY MARK

Expansion Joint

Technical Information

Bolted connections for fabric expansion joints

RAL-GZ 719

TI-007

Rev. 2

1. Following guidelines for bolted connections have to be respected to achieve flue gas tightness acc. to TI-002 or nekal tightness acc. to TI-003. Attention: The bolt torques are not valid for clamp bands, straps and external clamps.

2. **Bolting torque**

   To control the setting of the different expansion joint materials, the conditions and instructions of the manufacturer regarding the retorque of the bolting or the use of spring washers need to be observed. Guideline valid for ambient temperature acc. to the following chart.

	fabric expansion joint						elastomer expansion joint					
bolt	width of clamp bar / back-up bar [mm]						width of clamp bar / back-up bar [mm]					
	30	40	50	60	70	80	30	40	50	60	70	80
	bolting torque [Nm]						bolting torque [Nm]					
M8	20						20					
M10	30	40					30	30				
M12		50	60					40	50			
M16		65	80	100	115	130		50	65	75	90	100
M20			100	120	140	160			75	90	110	125
M24			115	140	165	190			85	105	125	145

bolting torque +/- 10% valid for MoS_2 lubricated bolting and design acc. to item 3.

3. Guidelines for the design of clamp bars / back-up bars

width	30	40	50	60	70	80	mm
thickness	6/8	8/10	8/10/12	10/12	10/12	12	mm
bolt spacing	60	80	100	100	120	120	mm
bolts M	8/10	10/12	12/16	12/16	16	16	mm

The stiffness of the duct flange should be at least the same as the stiffness of the clamp bar / back-up bar

4. Bolting material of galvanized quality 5.6 and 8.8 should be preferred for expansion joint fixation.

5. The combination of stainless steel bolting material and fabric expansion joint material is in some extend problematic. This material should be avoided if possible.

6. High temperature resistant bolts should only be used for temperatures higher than 300 °C at the bolt.

7. Reduction of the mechanical strength of the bolting in respect of higher temperature

class of strength	temperature				
	+20 °C	+100 °C	+200 °C	+250 °C	+300 °C
	Lower yield strength ReL or 0.2%-moduli of elasticity Rp 0.2 [N/mm²]				
4.6	240	210	190	170	140
5.6	300	270	230	215	195
8.8	640	590	540	510	408
10.9	940	875	790	745	705
12.9	1100	1020	925	875	825

values in reference to EN ISO 898-1:1999 annex A

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RAL QUALITY MARK

Expansion Joint

Technical Information

Bolted connections for fabric expansion joints
Imperial Units

RAL-GZ 719

TI-007

Rev. 0

1. Following guidelines for bolted connections have to be respected to achieve flue gas tightness acc. to TI-002 or nekal tightness acc. to TI-003. Attention: The bolt torques are not valid for clamp bands, straps and external clamps.

2. Bolting torque

To control the setting of the different expansion joint materials, the conditions and instructions of the manufacturer regarding the retorque of the bolting or the use of spring washers need to be observed. Guideline valid for ambient temperature acc. to the following chart.

	fabric expansion joint					elastomer expansion joint				
bolt	width of clamp bar / back-up bar [inch]					width of clamp bar / back-up bar [inch]				
	1 3/16	1 1/2	2	2 1/2	3	1 3/16	1 1/2	2	2 1/2	3
[inch]	bolting torque [ft-lbs]					bolting torque [ft-lbs]				
5/16	15					15				
3/8	22	30				22	22			
1/2		37	45				30	37		
5/8		48	60	75	85		37	48	55	66
3/4			75	90	105			55	66	81
1			85	105	120			63	77	92

bolting torque +/- 10% valid for MoS_2 lubricated bolting and design acc. to item 3.

3. Guidelines for the design of clamp bars / back-up bars

width	1 3/16	1 1/2	2	2 1/2	3	inch
thickness	1/4, 5/16	5/16, 3/8	5/16, 3/8, 1/2	3/8, 1/2	3/8, 1/2	inch
bolt spacing	2 1/2	3	4	4	5	inch
bolts M	5/16, 3/8	3/8, 1/2	1/2, 5/8	1/2, 5/8	5/8	inch

The stiffness of the duct flange should be at least the same as the stiffness of the clamp bar / back-up bar

4. Bolting material of galvanized quality 5.6 and 8.8 should be preferred for expansion joint fixation.

5. The combination of stainless steel bolting material and fabric expansion joint material is in some extend problematic. This material should be avoided if possible.

6. High temperature resistant bolts should only be used for temperatures higher than 570 °F at the bolt.

7. Reduction of the mechanical strength of the bolting in respect of higher temperature

class of strength	temperature				
	+70 °F	+210 °F	+390 °F	+480 °F	+570 °F
	modulsas of elasticity ReL [ksi]				
ASTM A307-A	35	30	27	25	20
ASTM A193-B8C1	43	39	33	31	28
ASTM a193-B7	93	85	78	74	59
ASTM A490	130	127	114	108	102
ASTM A574	153	148	134	127	120

values in reference to EN ISO 898-1:1999 annex A

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Technical Information

Storage, packing and transportation of fabric expansion joints

Non-metallic expansion joints are high quality products which need to be handled with care.

1. Storage

The condition and the duration of storage do have an influence on the condition of the expansion joint.

- remain expansion joints in original packing
- expansion joints need to be stored at dry places, humid condition have to be avoided
- protect expansion joints from direct weather influence e.g. sunlight, rain a.s.o.
- if possible store expansion joints inside of buildings
- recommended temperature for storage is between +10 °C (+50 °F) to + 20 °C (+70 °F)
- do not store other equipment on top of the expansion joints
- ozone penetration, chemical influence and corrosive environmental conditions have to be avoided for storage longer than 6 month

1.1. Short-time storage before installation

Please respect following additional conditions:

- storage of expansion joints in weather proof containments, e.g. oversea containers
- during the outside short time storage the expansion joints have to be covered with a weather proof canvas cover and need to be protected against humidity from the ground
- at temperatures below +5 °C (+41 °F) expansion joints do have an increased sensibility against bending. Therefore warm expansion joint up to +10 °C (+50 °F) before handling.

2. Packing

- without further requirements from the client, non-metallic expansion joints will be packed in standard stabile cardboard boxes or cardboards on pallets which allow removal with a fork lifter.

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- special demands have to be settled with the supplier:
  - boxes, crates
  - seaworthy packing
  - oversea-container
  - special packing

  All above mentioned packing are designed for handling with fork lifters or cranes.
- the packing provides the best protection for the expansion joints and should be removed first at the actual installation location before starting the installation work.
- long term storage may require a special packing and needs to be discussed with the supplier

3. Transport

- non-metallic expansion joints are packed according to their size, the way of transport, the duration of transport, the duration of storage and the final shipping destination. Damages should not occur during regular transportation.
- cardboards on pallets, wooden boxes and containers are designed/suitable for fork lifters and crane-handling.
- cardboards on pallets must not be stored on top of each other. The maximum load capacity has to be respected!
- unpacked expansion joints have to be moved extreme carefully. Please note following items:
  - unpacked expansion joints need to be placed on a safe base (e.g. pallet) and need to be temporary protected during transport by a crane or a fork lifter
    - the attachment points for the lifting equipment have to be on the base (pallet)
    - according to the weight of the joints use always several persons for carrying
  - do not drag expansion joints along the ground or across edges
  - respect decreased beding-properties at low temperatures

Please contact the supplier in any case if damages have been noticed at the packing or during transport and storage.

*Never install damaged component*s!

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Technical Information

Planning of Installation of fabric expansion joints

RAL-GZ 719

TI-009

Rev. 2

1. Basics requirements for installation

Following issues need to be respected to guarantee a safe and sound installation:

- The scope of supply has to be checked for completeness and damages right after delivery, latest however, prior the installation. This is essential to prevent a delay of the site work.
- The installation of the ductwork should be completed to avoid damages as a result of welding, grinding and the installation of insulation.
- The condition of the installation site is as according to the valid safety regulation (proper scaffolding etc.)
- Supply of energy sources (e.g. electricity, compressed air etc.)
- Cleansing of the installation location was completed (ash accumulation, condesate, etc.)
- Mounting of fixation elements, which will be re-used after removal of the previous expansion joint (check condition of these elements).
- Check all interface parts and installation dimensions according to TI-013 “Tolerances for interface parts and installation dimension of fabric expansion joints”, especially:
  - Face to face distance of duct flanges
  - Inclination of duct flanges / flange alignment
  - Preset and misalignment of bolt hole patterns
  - Quality of the sealing surface
  - Smooth and plain welding seams on sealing surface
  - Radiused, chamfered and burr-free fixation bars (clamping / back-up bars)

2. Installation preparation of the fabric expansion joint

- Check correct installation location for each expansion joint
- Check all marked parts (according to installation instruction, and approval drawing etc.)
- Respect TI-008 “Storage, packing and transportation of fabric expansion joints”
- Provide installation instruction to site personnel
- Provide proper tooling for installation

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Technical Information

Installation of fabric expansion joints

1. General

- The installation shall be executed by safety–related instructed and experienced staff/personnel, required local- and project related safety arrangements have to be respected and coordinated with the site manager if applicable.
- The transport of the expansion joints to the installation location has to be carried out with reasonable care to avoid damages, the TI-008 has to be respected.
- The planning of the installation according to TI-009 needs to be finished
- The following steps for installation include the minimum standards for the installation process

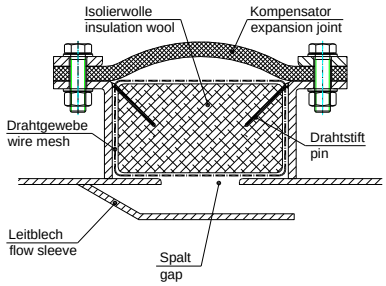
  Primarily respect the equipment manufacturers specific instructions
- Read this entire instruction prior starting the installation process and particularly refer to top “7. Warnings”

2. Internal Insulation (if applicable)

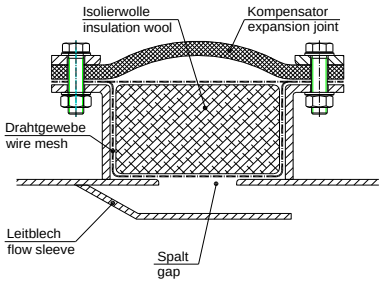
2.1. Manufactured pillow

- Insert insulation pillow according to manufacturers instruction, note marking “inside” and “outside” (refer to graph 2.1a)
- Locate the splice at the top side of the duct
- The splice areas shall be executed without any gap, if applicable sew splices together
- The peak of the pins which hold the insulation pillow shall not face towards the expansion joint (refer to graph 2.1a)

Graph 2.1a



Graph 2.1b



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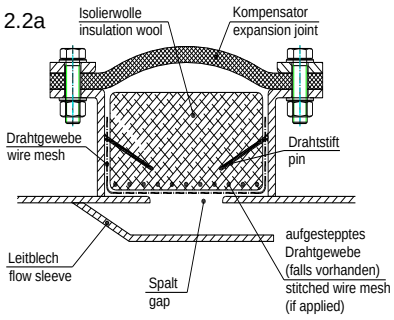
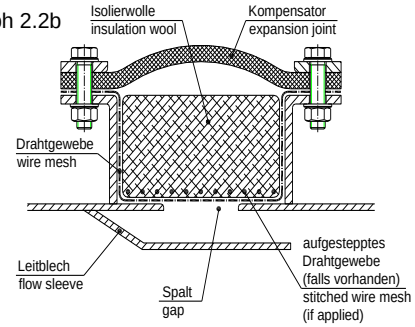
2.2. Cut insulation mat

- Insert wire mesh to cover the open gap and if applicable fix the wire mesh.
- Cover the entire gap with insulation wool (refer to graph 2.2a)
- Locate splice preferably at the top side of the duct
- The splice areas shall be executed without any gap, if applicable sew splices together
- The stitched wire mesh of the insulation mat has to face the flow sleeve to avoid damages (refer to graph 2.2a or graph 2.2b)
- The peak of the pins which hold the insulation pillow shall not face towards the expansion joint (refer to graph 2.2a)

Graph 2.2a



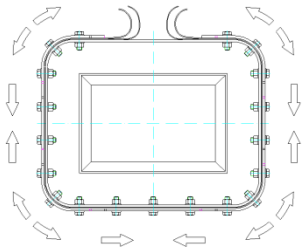
Graph 2.2b



3. Expansion joint orientation and fixation

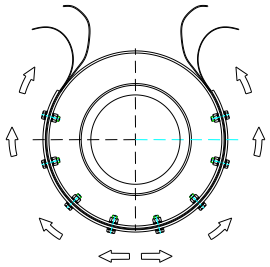
- Spread out the expansion joint, note marking “inside” and “outside”, align and if applicable pre-compress expansion joint.
- Possibly respect allocation of different interface dimensions.
- For expansion joints with rectangular cross sections locate the corners respectively the corner radius.
- Note the location of the field splice at areas with proper access, refer to graph 3.a and graph 3.b (for horizontal orientated ducts possibly on the top side).
- Fix the expansion joint temporarily with suitable appliances e.g. c-clamps. The splicing area of endless joints shall not be fixed.

Graph 3.a



For open ended expansion joints with rectangularcross sections start from the corners. Spread out material equally between the fasteners

Graph 3.b



For open ended expansion joints with circular cross sections start from the opposite side of the splice and work in both directions towards the splice

4. Splicing

Each layer will be spliced separately. The splices of the single layers shall be staggered.

- According to their nature weld, glue or sew and seal coated fabrics together.
- Overlap and sew uncoated fabrics
- Preferably weld or glue the gas barrier (sealing layer), or fold it if applicable
- Overlap felt and non-woven materials according to their type and thickness, avoid material accumulation by executing cascaded overlaps
- Primarily respect the equipment manufacturers specific instructions for processing the materials

5. Punching the expansion joint for bolted connections

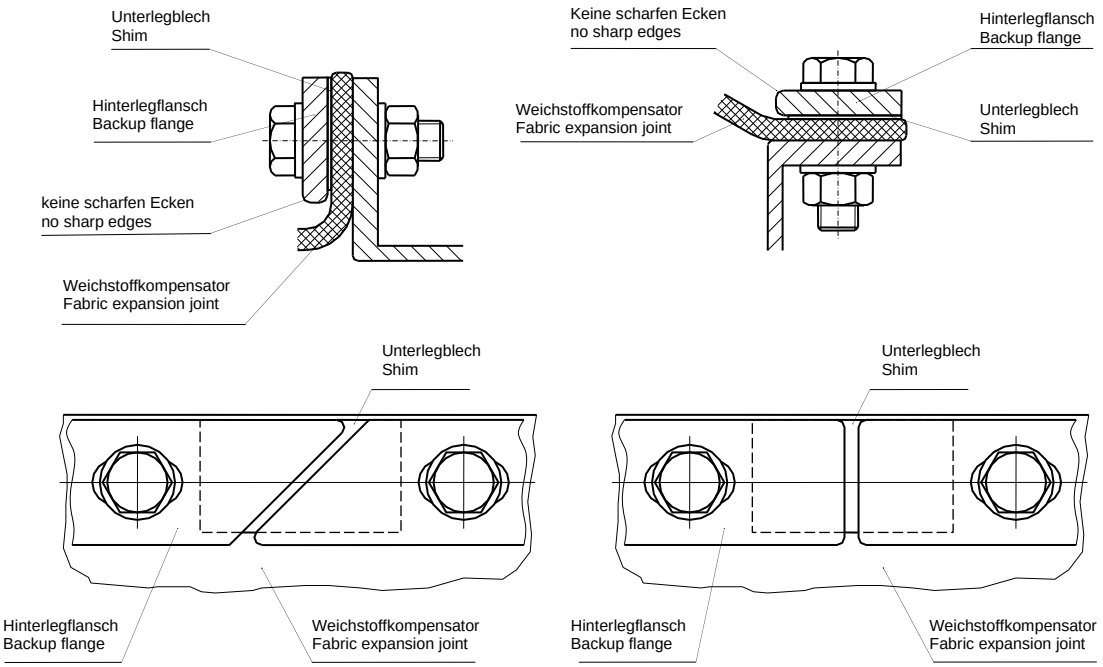
- The width of the contact surface of the expansion joint should be at least the same width as the backup flange.
- Punching with a drilling machine:
  - utilize the clamp bar segments as hole pattern
  - press expansion joint, back up flange segment and flange together with c-clamps
  - carefully drill fabric with moderate force

- Punching with a hollow punch:
  - mark bolt holes according to the existing hole pattern
  - punch holes with a hollow punch on a suitable support (thick wooden board)

6. Fixation of the expansion joint

6.1. Bolted connection

- Place the backup flange/-bar as shown in graph 6.1 and adjust them according to the bolt hole pattern, preferably use shims



to 6.1. Bolted Connection

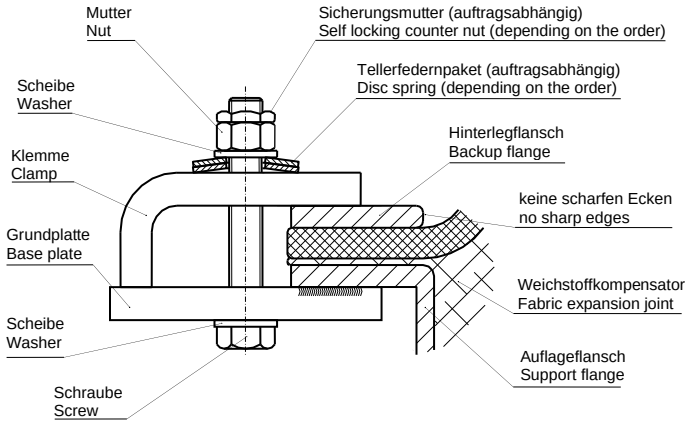
- Note assembly of the fasteners (location of the bolt head, washer, disc spring and so on)
- Insert the bolting and tighten it

- Fasten all bolts with the manufacturers recommended bolt torque in two or three rounds; refer to TI-007

- The backup flange/-bar segments must not be in touch after several retightening; note setting of the expansion joint material

6.2. Fixation with clamp bands, straps and external clamps

- Position clamp bar/ back-up bar segments and adjust them, preferably use shims



- Note assembly of the fasteners (location of the bolt head, washer, disc spring and so on)

- Insert the bolting and tighten it

- Fasten all bolts with the manufacturers recommended bolt torque in two or three rounds; (NOTE: the recommended bolt load of TI-007 is not valid for external clamps!)

- The clamp bar/back-up bar segments must not be in touch after the entire retightening; note setting of the expansion joint material

6.3. Clamp bands, straps and external clamps

- Position and align clamp bands, straps and external clamps

- Fasten all bolts on circumference in two or three rounds; (NOTE: the recommended bolt load of TI-007 is not valid for clamp bands, straps and external clamps!)
- The segments of the clamp bands, straps and external clamps must not be in touch after the entire retightening, note setting of the expansion joint material

7. Warnings

The installation instruction may not describe all single steps precisely. To grant proper function it is strongly recommended to use preferably the manufacturer's installation materials.

The manufacturer's supervisor should be ordered for the installation work, specifically for the joining of the splice.

Attention: There is a high risk of danger in case of installations made by others (and not the manufacturer)!

Technical Information

Insulation requirements for fabric expansion joints

In general never cover or insulate non-metallic expansion joints at the outside.

In any case contact supplier for final approval if enclosures or outside insulation will be installed.

The thermal influence of adjacent elements has to be respected.

According to the type of expansion joint, following designs are possible:

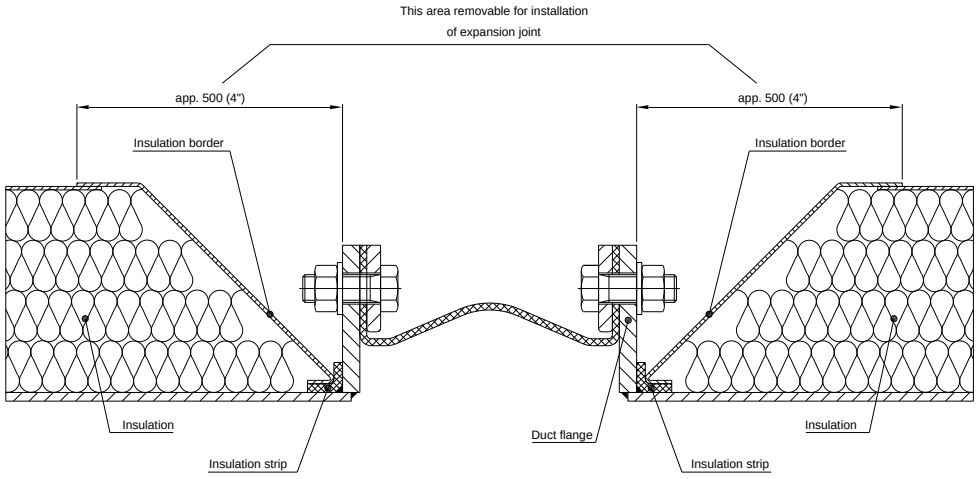
1. Interface duct inuslation

Interface insulation is unconditionally required in case of outside insulated pipes and ducts.

Neither the expansion joint nor the fixation elements must not be insulated in order to provide an unobstructed thermal convection.

According to the type of the expansion joint, different arrangements are required.

a. Principle example for flange-type expansion joint



All lengths in mm (inch)

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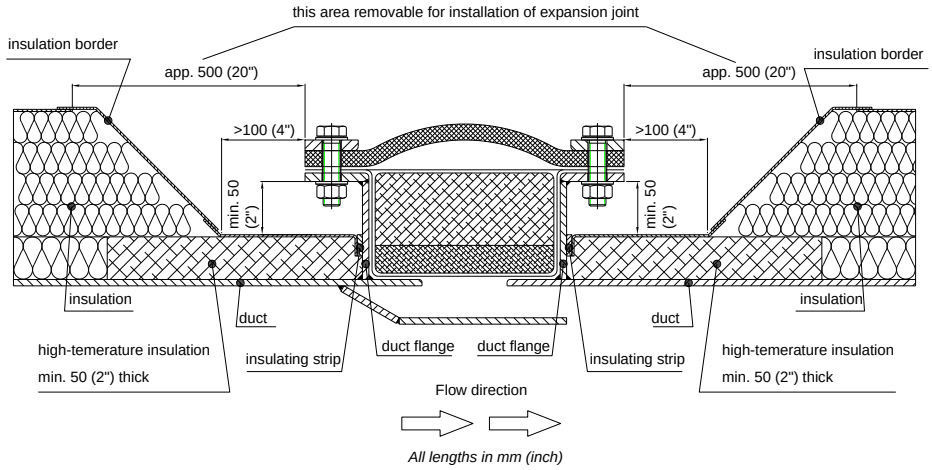
b. Principal example for belt-type expansion joint



2. Covers

Please note following issues when installing covers for example as acoustic insulation, weather protection or touch protection:

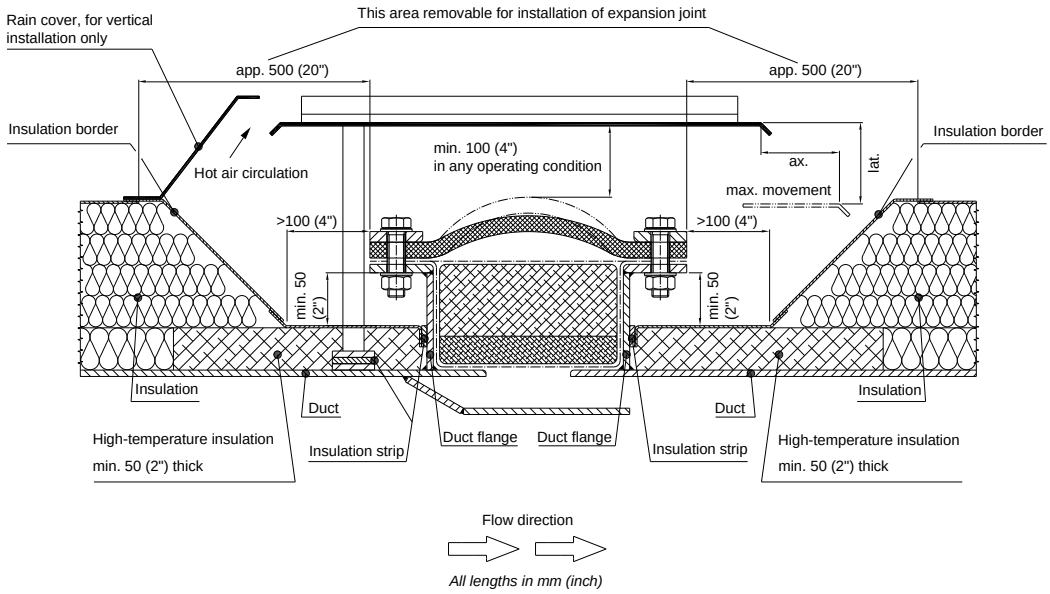
- Movements of the expansion joint must not be restricted
- Grant sufficient airflow at entire circumference
- Air exchange with the cooler ambient must always be ensured
- Heat trapping and thermal bridges must be avoided

Deformations of the expansion joint, especially arches being formed during operation, have to be respected.

Technical Information

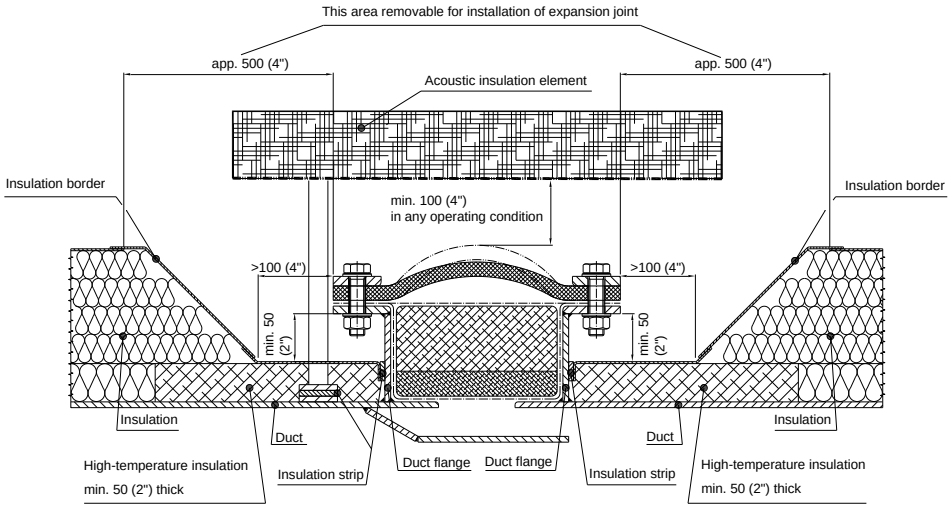
Insulation requirements for fabric expansion joints

Cover



All lengths in mm (inch)

Acoustic Insulation



All lengths in mm (inch)

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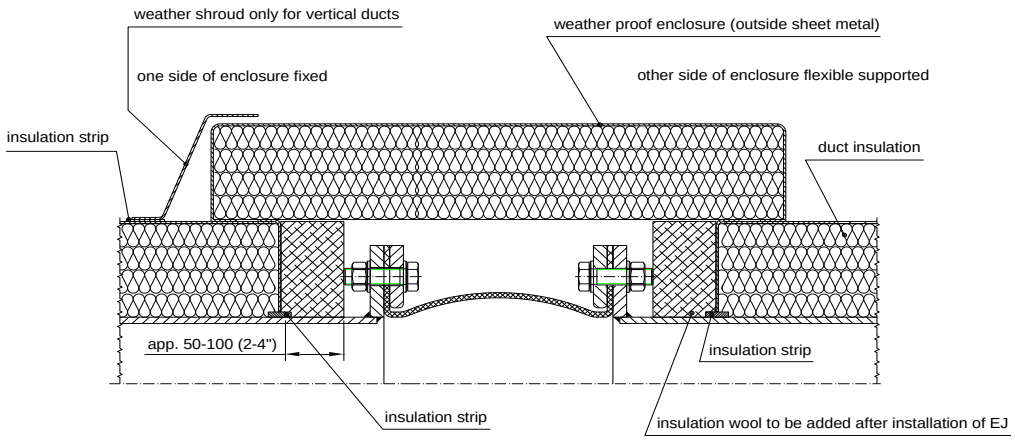
3. External insulation

Contact the supplier in any case if the expansion joint shall be externally insulated.

The maximum operation temperature of externally insulated expansion joints shall not be higher than the maximum allowed operation temperature for the material of the make-up which has the lowest thermal resistance.

External insulation applications for temperatures above 260 °C (500 °F) require a serious technical design.



All lengths in mm (inch)

Technical Information

Maintenance work of fabric expansion joints

RAL-GZ 719

TI-012

Rev. 2

Fabric expansion joints do not require any particular maintenance within their life-cycle after a professional installation and an operation in compliance with the designated operating parameters (see TI-015, item 2).

Regular inspections by the manufacturer are recommended, especially in preparation of outages. The functionality of the expansion joint can be ensured by the following mentioned check-ups and, if applicable, measures:

1. **Inspection of the expansion joint**
   - General condition
   - Internal and external deposits
   - Internal and external fluid accumulation
   - Mechanical damages
   - Missing or loose fixation elements
   - Leaking medium or condensate
   - Periphery (e.g. adjacent plant components, duct parts and neighbouring insulation)
   - Adherence to the specified operation conditions
   - Temperature measuring if necessary
2. **Documentation**

   A record of the inspection – preferably with picture documentation – reveals the condition of the expansion joint. Possible changes can be discovered. Appropriate actions can be initiated.
3. **Consultation of the manufacturer**

   Any changes of fabric expansion joints may influence their functional reliability. In case of doubt the supplier should be contacted.
4. **Precautionary measures**
   - Internal and external dust deposits should be professionally removed.
   - In case of surface changes the supplier should be consulted.
   - Retightening of fixation elements.
5. **Necessary measures**
   - Remove debris which affects functionality

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- Remove mechanical damages
- Replace missing fixation elements
- Retighten loose fixation elements
- Reduce leakage as far as possible
- Report changed operating or installation conditions to the supplier

6. Forbidden measures

- High-pressure, steam cleaning, abrasive blasting
- Painting, coating, etc.
- Cleaning of fabric expansion joints with liquid
- Reinstallation of expansion joints without permission of the supplier

Attention: Warranty may be lost in case of non-observance.

7. Precautions for the expansion joint

Fabric expansion joints need to be protected during maintenance work on adjacent plant components:

- Expansion joints must generally be protected with appropriate covers (e.g. fire blankets, steel sheets) against damage during welding, cutting, grinding or insulation work. Remove these covers prior to commissioning.
- Expansion joints have to be covered during painting or coating works.
- Expansion joints are not allowed to be impacted by cleaning agents during cleaning operations.

8. Personal protection measures

During work at expansion joints the appropriate personal protective equipment (PPE) must be worn (safety gloves, dust masks, protective glasses, gas masks etc.) depending on the particular operation site and its risk potential.

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Technical Information

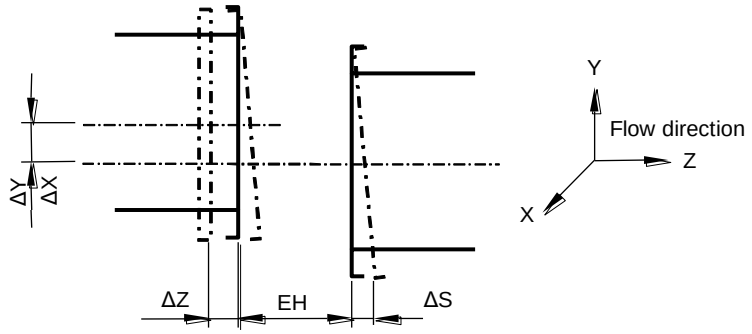
Tolerances for connection flanges and installation dimensions for fabric expansion joints

RAL-GZ 719

TI-013

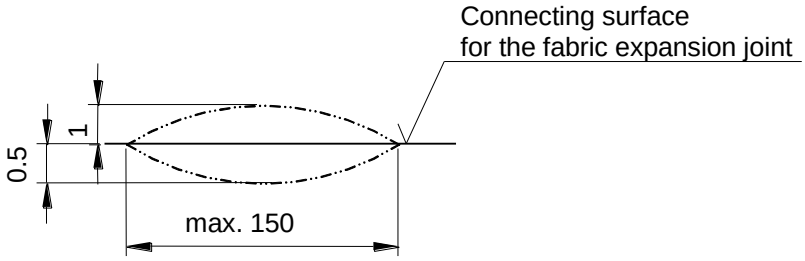
Rev. 4

1. Max. allowable tolerances for the connection flanges of fabric expansion joints



Installation length [EH]	ΔZ = -10mm, + 5mm
Lateral offset both directions	ΔX, ΔY = ±10mm
Misalignment of flanges	ΔS = ±7mm
Accumulated tolerances	$\sum = \sqrt{\text{max. } (\Delta X^2; \Delta Y^2) + \Delta S^2} + \Delta Z \leq 10\text{mm}$

2. Max. allowable tolerances for the connecting surface of fabric expansion joints



Between measured distance of max. 150 mm may be either a smooth deepening of 0.5mm or a smooth superelevation of 1 mm compared with the theoretical shape.

Waviness of the duct flange max. ±1 mm over a distance of 1000 mm.

Max. Roughness of flanges R_t = 150 µm.

Offset is not allowed at the splicing part of the flange area.

The connecting surface must be free of ridge, groove, notch, weld spatter.

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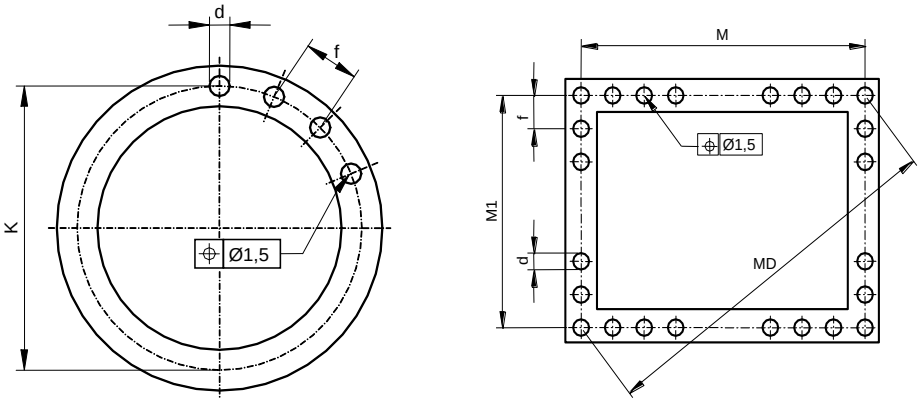
3. Max. allowable tolerances for the hole pattern of fabric expansion joints



Pitch circle diameter <4000 mm	K = ISO 2768-1 tolerance class m
Pitch circle diameter >4000 mm	K = ISO 2768-1 tolerance class c
Centre distance <4000 mm	M, M1 = ISO 2768-1 tolerance class m
Centre distance >4000 mm	M, M1 = ISO 2768-1 tolerance class c
Diagonal distance <4000 mm	MD = ISO 2768-1 tolerance class m
Diagonal distance >4000 mm	MD = ISO 2768-1 tolerance class c
Pitch	f = ISO 2768-1 tolerance class c
Hole diameter	d = EN 20273-1 tolerance class g

All holes in the connecting flanges must be deburred on both sides.

4. General tolerances

Tolerances for length dimensions (compare ISO 2768-1)

Tolerance class	>6 <30	>30 <120	>120 <400	>400 <1000	>1000 <2000	>2000 <4000	>4000 <8000	>8000 <12000	>12000 <16000	>16000 <20000
m	±0.2	±0.3	±0.5	±0.8	±1.2	±2	±3	±4	±5	±6
c	±0.5	±0.8	±1.2	±2	±3	±4	±5	±6	±7	±8

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Technical Information

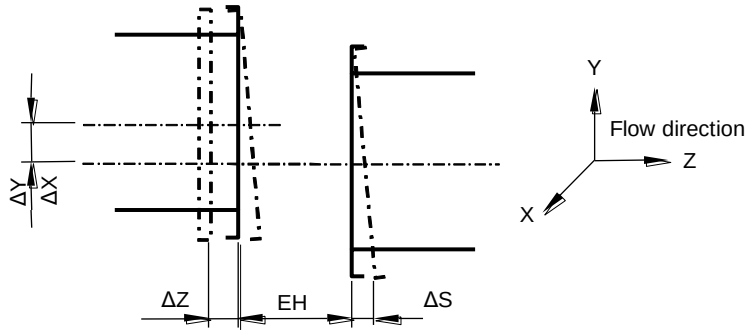
Tolerances for connection flanges and installation dimensions for fabric expansion joints
Imperial Units

RAL-GZ 719

TI-013

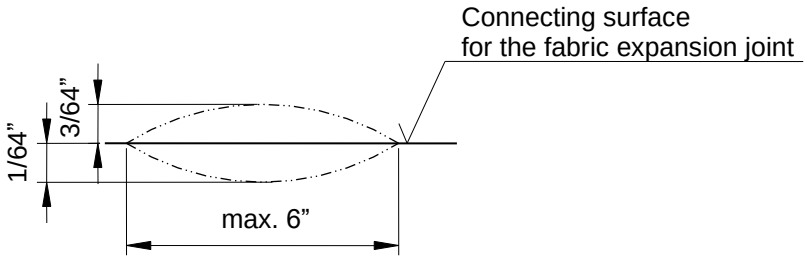
Rev. 0

1. Max. allowable tolerances for the connection flanges of fabric expansion joints



Installation length [EH]	ΔZ = -3/8”, + 3/16”
Lateral offset both directions	ΔX, ΔY = ±3/8”
Misalignment of flanges	ΔS = ±1/4”
Accumulated tolerances	$\sum = \sqrt{\text{max. } (\Delta X^2; \Delta Y^2) + \Delta S^2} + \Delta Z \leq 3/8”$

2. Max. allowable tolerances for the connecting surface of fabric expansion joints



Between measured distance of max. 6” may be either a smooth deepening of 1/64” or a smooth superelevation of 3/64” compared with the theoretical shape.

Waviness of the duct flange max. ±3/64” over a distance of 40”.

Max. Roughness of flanges R_t = 6000 µin.

Offset is not allowed at the splicing part of the flange area.

The connecting surface must be free of ridge, groove, notch, weld spatter.

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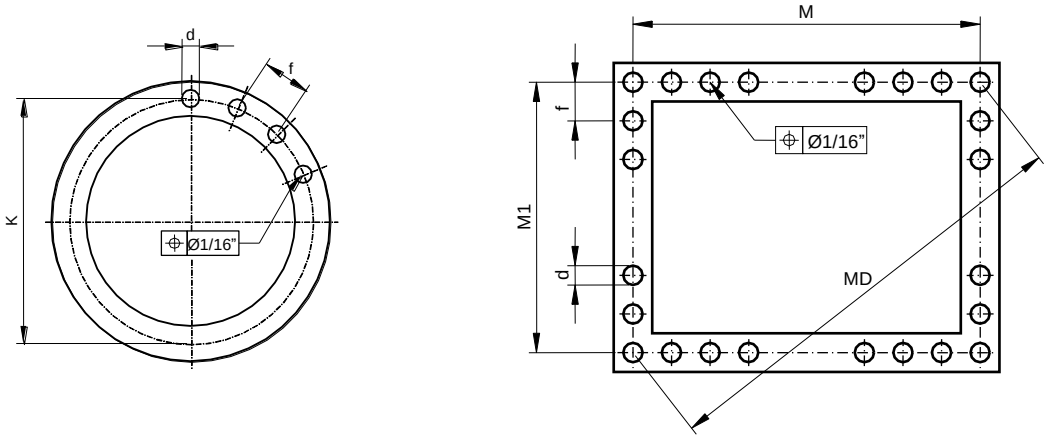
3. Max. allowable tolerances for the hole pattern of fabric expansion joints

Based on ANSI/ASTM B4.3, similar to ISO 2768 and EN 22768.



Pitch circle diameter <157-5/8” (<4000 mm)	K = ANSI/ASTM B4.3 tolerance class m
Pitch circle diameter <157-5/8” (<4000 mm)	K = ANSI/ASTM B4.3 tolerance class c
Centre distance <157-5/8” (<4000 mm)	M, M1 = ANSI/ASTM B4.3 tolerance class m
Centre distance <157-5/8” (>4000 mm)	M, M1 = ANSI/ASTM B4.3 tolerance class c
Diagonal distance <157-5/8” (<4000 mm)	MD = ANSI/ASTM B4.3 tolerance class m
Diagonal distance <157-5/8” (>4000 mm)	MD = ANSI/ASTM B4.3 tolerance class c
Pitch	f = ANSI/ASTM B4.3 tolerance class c
Hole diameter	d = EN 20273-1 tolerance class g

All holes in the connecting flanges must be deburred on both sides.

4. General tolerances

Tolerances for length dimensions (based on ANSI/ASTM B4.3)

Tolerance	>1/4”	>1”	>5”	>16”	>40”	>80”	>13’	>26’	>40’	>52’
class	<1”	<5”	<16”	<40”	<80”	<13’	<26’	<40’	<52’	<65’
m	±1/128”	±1/64”	±3/128”	±1/32”	±1/16”	±3/32”	±1/8”	±5/32”	±3/16”	±1/4”
c	±3/128”	±1/32”	±1/16”	±3/32”	±1/8”	±5/32”	±3/16”	±1/4”	±9/32”	±5/16”

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Technical Information

Terms and definitions for fabric expansion joints

Active length	The part of the flexible element which allows movement.
Ambient temperature	The temperature affecting the exterior of the fabric expansion joint
Angular deviation	see angular movement
Angular movement	The movement which occurs when one flange of the expansion joint is moved to an out-of-parallel position with the other flange, such movement being measured in degrees.
Axial compression	The reduction of the flange distance of an expansion joint in reference to the flange distance at installation.
Axial extension	The increase of the flange distance of an expansion joint in reference to the flange distance at installation.
Belt type expansion joint	An expansion joint with a flat belt clamping area
Bolt hole pattern	Allocation of holes for fastening the fabric expansion joint
Design pressure	Pressure that the expansion joint is allowed to reach permanently. Not equal to the incident pressure.
Design temperature	Temperature that the compensator is allowed to reach permanently. Not equal to the incident temperature or media temperature.
Dew point	The temperature at which parts of the gas condense to form a liquid. Particularly important for acids; acid dew point varies with gas composition and is a higher temperature than the moisture dew point.
Expansion Joint	Flexible sealing element to absorb multidimensional movements

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Fabric Expansion Joint	Generic term for expansion joints consisting of elastomers, thermoplastics and/or fabrics, see also RAL Quality and Test Specifications, paragraph 1.1.2.
Flange	Connects the expansion joint to the duct system.
Flange connection	Way of expansion joint connection to the duct system.
Flange Distance	Distance between the duct flanges, on which the expansion joint is fixed (see TI-004, 6. Dimension „W“).
Flange type expansion joint	An expansion joint with angled flanges (u-type)
Flexible length	That part of the expansion joint which is not clamped
Flow direction	The direction of the flow through the system
Flue-gas tightness	Grade of tightness according to the Technical Information TI-002.
Incident pressure	Temporarily limited pressure above the design pressure. Incidents can shorten the operating life.
Incident temperature	Temporarily limited temperature above the design temperature. Incidents can shorten the operating life.
Inside Insulation	Insulation installed inside the duct
Internal flow sleeve	Device for protection against abrasion and to optimization of flow
Lateral movement	The relative displacement of the two ends of the expansion joint perpendicular to its longitudinal axis
Media temperature	Temperature of the media in the system

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Movement	Axial, lateral, angular and torsional displacements which the expansion joint is required to compensate in reference to the installed situation (see TI-004, 5.)
Nekal tightness	Grade of tightness according to the Technical Information TI-003.
Operating pressure	The pressure to which the expansion joint is exposed during normal operating conditions
Operating temperature	The temperature to which the expansion joint is exposed during normal operating conditions
Outside insulation	Insulation placed on the outside of the duct or expansion joint
Refractory	Acid or heat resistant ceramic insulation inside the duct system
Pre-insulation	Insulation or insulation pillow in front of the expansion joint
Torsion	The twisting of one end of an expansion joint with respect to the other end about its longitudinal axis

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1. General

1.1. Fabric expansion joints do not jeopardize neither health nor the environment

Fabric expansion joints consist of high strength fabrics, thermoplastics and/or elastomere. They do not jeopardize neither health nor the environment. However they may be contaminated by the operated media.

1.2. Professional Installation is required

In case of professional installation, fabric expansion joints are suitable for the agreed operating conditions.

1.3. Risks caused by defective mounting and divergent operation conditions

Incorrect installation and divergent operation conditions may destroy expansion joints. According to the risk potential of the entire plant (e.g. heat, toxin, pressure) personal injury or death may occur.

1.4. The risk assessment and load analysis must be provided by the plant operator

Every person who is operating, maintaining or examining the plant has to be introduced to the risk and load of the plant.

2. Possible risks in the field of expansion joints

2.1. Scheme of risks

- Thermal risk
- Mechanical risk (e.g. crushing by moving elements)
- Disposal of pressurized media
- Accumulation and concentration of life-threatening media
- Electrostatical charge of the expansion joint

2.2. Ageing

The life cycle of fabric expansion joints is physically and chemically limited and is usually less than the life cycle of the plant. The recommendation of the manufacturer is decisive.
In general the following maximum operation periods shall not be exceeded:

- Applications up to 200 °C (390 °F) without mechanical alternating, oscillating or pulsating load max. 8 years

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- Applications up to 500 °C (930 °F) without mechanical alternating, oscillating or pulsating load max. 5 years
- Extreme applications: General statements are not possible

3. Precaution

- Regular maintenance and inspection
- In time replacement
- Immediate replacement in case of suspected or initiating leakage of media
- Screen protection
- Adequate personal protective equipment
- Proper disposal

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Technical Information

Surface temperatures of fabric expansion joints

RAL-GZ 719

TI-016

Rev. 1

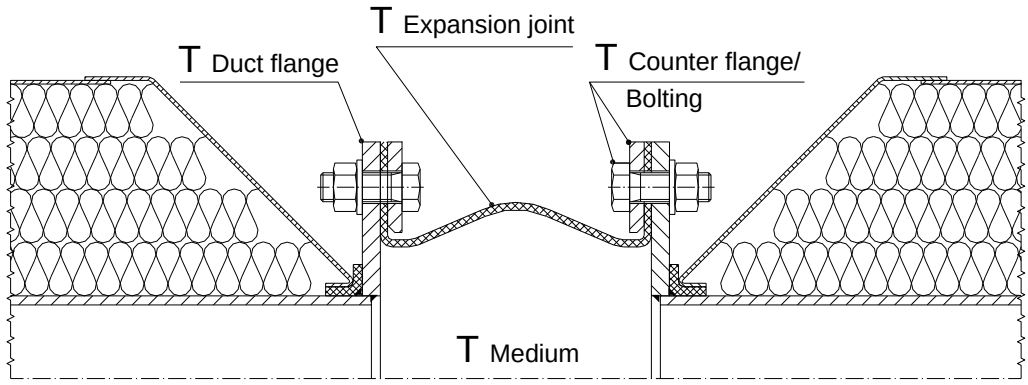
1. General

There is a limitation to influence the heat transfer from the medium to the fabric expansion joint system because of functional requirements. Therefore on components like expansion joint bellow, duct flange, fastening parts higher temperatures can be expected than on adjacent components. At medium temperatures higher than 300 °C (570 °F) the surface temperature on the outside of the expansion joint system will possibly be higher than 60 °C (140 °F).

2. Surface temperatures

The below mentioned tables show the possible temperature values at ambient temperature of maximum 50 °C (120 °F).

2.1. Flanged expansion joints



T Medium	**T** Duct flange	**T** Counter flange/ Bolting	**T** Expansion joint
200 °C (390 °F)	200 °C (390 °F)	120 °C (250 °F)	150 °C (300 °F)
300 °C (570 °F)	300 °C (570 °F)	150 °C (300 °F)	200 °C* (390 °F)
400 °C (750 °F)	400 °C (750 °F)	180 °C (355 °F)	≤ 250 °C (480°F)

* Depending on the expansion joint design temperatures up to 250 °C (480 °F) can be reached.

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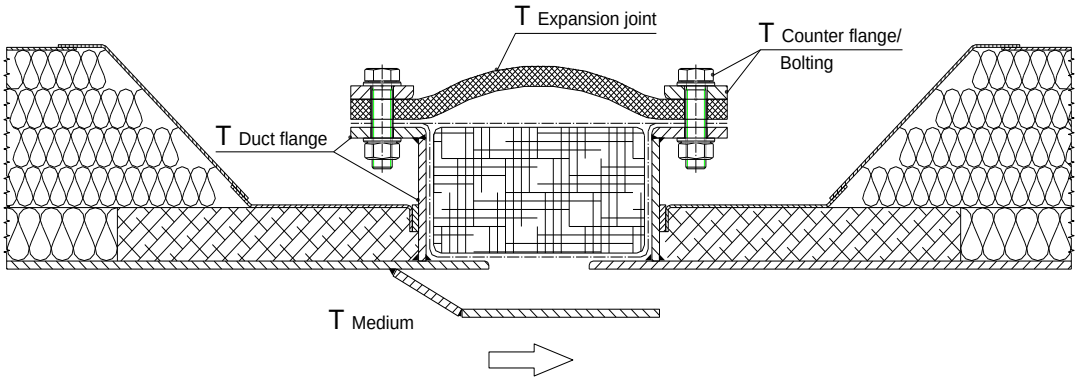
2.2. Belt expansion joints (e.g. with pre-inuslation)



T Medium	**T** Duct flange	**T** Counter flange/ Bolting	**T** Expansion joint
300 °C (570 °F)	250 °C (480°F)	120 °C (250 °F)	150 °C* (300 °F)
400 °C (750 °F)	300 °C (570 °F)	150 °C (300 °F)	200 °C* (390 °F)
500 °C (930 °F)	320 °C (610 °F)	180 °C (355 °F)	≤ 250 °C (480 °F)
600 °C (1110 °F)	350 °C (660 °F)	200 °C (390 °F)	≤ 250 °C (480 °F)
700 °C (1290 °F)	380 °C (715 °F)	220 °C (430 °F)	≤ 250 °C (480 °F)

* Depending on the expansion joint design temperatures up to 250 °C (480 °F) can be reached.

It has to be kept in mind that secondary influences e.g. radiation or lacking convection can affect these values considerably.

3. Safety measures

The surface of the expansion joint bellow has considerable lower heat conductivity than the metallic components. The result of this is an appropriate reduced risk potential. In general a direct risk can be excluded when touching the expansion joint bellow.

At platforms or running boards there could be a risk for persons touching the metallic parts like duct flange and fastening parts. In this case a personnel guard has to be installed by others. An adequate convection has generally to be ensured (see TI-011 item 2.).

A possible outside cover or insulation as personnel guard may damage the expansion joint and is therefore not suitable as a safety measure.

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Technical Information

Remarks about EC Declaration of Conformity and CE marking of fabric expansion joints

1. Remark about the Machinery Directive 2006/42/EC

The Machinery Directive 2006/42/EG applies to machines and partly completed machinery. Both terms are defined in the Machinery Directive.

A fabric expansion joint does not constitute a machine as defined by the Machinery Directive (see article 2 of the Machinery Directive)

A fabric expansion joint does not constitute a partly completed machinery as defined by the Machinery Directive (see article 2g of the Machinery Directive and §46 of the guideline concerning the Machinery Directive).

According to the Machinery Directive a fabric expansion joint is a component. Rules for dealing with components are:

- Issuing an EC declaration of conformity is not permissible.
- Affixing the CE marking is not permissible.

2. Remark about the Pressure Equipment Directive 2014/68/EU

Fabric and elastomer expansion joints are usually applied in pressure ranges considerably below 0.5 bar and thus, due to the low hazard potential, not in the scope of application of the Pressure Equipment Directive.

In this case the following applies:

- Issuing an EC declaration of conformity is not permissible.
- Affixing the CE marking is not permissible.

Only at pressures of 0.5 bar a category definition and module selection has to be created based on pressure, nominal diameter and fluid group.

When the allowable pressure reaches the limit of 0.5 bar, a conformity testing must be carried out. Since fabric and elastomer expansion joints are customised, nontype-tested unique pieces, in such a case substantial additional costs need to be taken into account.

The pressure, medium and nominal width must already be specified in the enquiry. If such data is missing it shall be assumed that the expansion joints are not in the scope of application of the Pressure Equipment Directive.

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3. Remark about the Construction Products Regulation 305/2011 (EU)

According to article 2 point 1 of the Construction Products Regulation fabric expansion joints are not a necessary part of the construction works with respect to the basic requirements for construction works.

Thus:

- Issuing an EC declaration of performance is not permissible.
- Affixing the CE marking is not permissible.

4. Remark about the Directive 2014/34/EU („ATEX Directive“)

The Directive applies to products, systems and components according to article 1.

Fabric expansion joints are therefore not applicable to this Directive.

Thus:

- Issuing an EC declaration of conformity is not permissible.
- Affixing the CE marking is not permissible.

A subsequent issuance of an EC declaration of conformity or subsequent CE marking is in principal not possible.

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1. Scope

1.1. Principles

This Technical Information defines the application of EN 10204:2005 on fabric expansion joints as far as applicable. An inspection document can become valid for all parts of the delivery scope at the discretion of the manufacturer.

Manufacturers are allowed to take over test results which were based on tests of the raw material or processed material. The supplier's certificate is not part of the certificates defined herein.

An inspection document, as described in Technical Information TI-006, is not automatically part of the documentation. The content of documentation must be specified before signing the contract between supplier and customer.

1.2. References to standards

TI-006 – Documentation of fabric expansion joints
EN 10204 – Metallic products - Types of inspection documents
EN 10168 – Steel products - Inspection documents - List of information and description

2. Inspection documents based on non-specific inspection

2.1. Declaration of compliance with the order „2.1“

Document in which the manufacturer declares that the products supplied are in compliance with the requirements of the order, without inclusion of the test results.

2.2. Test report „2.2“

Document in which the manufacturer declares that the products supplied are in compliance with the requirements of the order and in which he supplies test results based on non-specific inspection. This includes compliance with the requirements of the RAL Quality Mark of Fabric Expansion Joints RAL GZ-719, verified by:

- Valid certificate of the Quality Association for Fabric Expansion Joints or
- Complete numeric test results of preceding regular material inspection by an independent testing laboratory in accordance with the accepted quality levels and test specifications for fabric expansion joints issued by the RAL German Institute for Quality Assurance and Marking.

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3. Inspection documents based on specific inspection

3.1. Inspection certificate „3.1“

Document issued by the manufacturer in which he declares that the products supplied are in compliance with the requirements of the order and in which he supplies test results. These include the requirements for the test report “2.2” and additionally the inspection results of the connecting dimensions of the fabric expansion joint.

3.2. Inspection certificate „3.2“

Document prepared by both the manufacturer’s authorized inspection representative, independent of the manufacturing department and an authorized inspection auditor in which they declare that the products supplied are in compliance with the requirements of the order and in which test results are supplied.

A confirmation by the authorized inspection auditor on the manufacturer’s certificate is sufficient. The requirements of an inspection certificate „3.1“ apply.

4. Required content

In addition to the information described above the following elements according to EN 10168 are at least obligatory to be listed on inspection certificates. Sequence and additional information given is defined by the manufacturer. The use of the specific code numbers is by the manufacturer’s choice.

No.	Section designation	Comments	Validity
A01	Manufacturer’s works	Name and address of the works where the products were manufactured	*all*
A02	Type of inspection document		*all*
A05	Originator of the inspection document	Inspection organization or the qualified department of the manufacturing works	*all*
A06	Customer consignee		*all*
A07	Purchaser’s order number		*all*
A08	Manufacturer’s works order number		*all*
B06	Marking of the product	Item number or other clear indication	3.1; 3.2
B08	Number of pieces		3.1; 3.2

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B09	Product dimensions	Nominal dimensions at the discretion of the manufacturer	3.1; 3.2
D01	Marking and identifaction, suface and appearance, shape and dimensional properties	Statement that the inspection was carried out and that results were satisfactory	*all*
Z01	Statement of Compliance	Manufacturer's declaration that the product is in compliance with the order	*all*
Z02	Date of issue		*all*

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Technical Information

Disposal of fabric expansion joints

1. Legal status

The legal status is uniform throughout Europe and is governed by the EU Directive on Waste 2008/98/EC.

According to this, fabric expansion joints are "commercial municipal waste", regardless of their components. These can be: carrier fabric, elastomers, thermoplastics (see also RAL-GZ 719, 2.1.1 and 3.1.1).

This "commercial municipal waste" should be recycled where possible.

2. What to do with the discarded fabric expansion joints?

Once a fabric expansion joint is discarded, the owner is responsible for disposing the material.

Waste material must be collected separately, i.e. separate the steel and fabric material parts and, if necessary, the insulating materials, document this and commission a suitable disposal company. A further separation is not advisable, possibly harmful to health due to contamination as a result of any special application conditions.

3. Fabric expansion joints with PTFE components as waste

PTFE is not hazardous waste in the sense of the European List of Waste, as long as the soft-material compensator has not been contaminated with hazardous substances in its application.

Decisive for the disposal:

- Recycling is currently not practicable due to the lack of suitable recycling facilities.
- Transfer to an incineration plant is permissible, but by definition, at a calorific value of well below 6,000 kJ/kg (2579.4 BTU/lb), this does not represent energy recovery, but only thermal recovery. Incineration is only permissible in plants with a combustion temperature of more than 800°C (1472°F) with appropriate filter systems.
- Therefore, dumping is permissible and meaningful.

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1. General

Fabric expansion joints are mainly used to compensate movements of duct systems.

Consideration of acoustic criteria is not the primary task of a fabric expansion joint. Compared to the entire system, an expansion joint has a very small surface area and thus only a minor influence on the total sound emission.

If there are other acoustic requirements besides the avoidance of structure-borne sound transmission, additional measures may have to be taken.

2. Fundamental Research by the Fraunhofer Institute IBP

The Quality Association for Fabric Expansion Joints e.V. and the Fraunhofer Institute IBP with good reputation made research to evaluate acoustic solutions for expansion joints in exhaust gasflow of noisy aggregations (exhaust units).

The components of the fabric expansion joint that absorb the movement were measured. These flexible parts can consist of fabric layers, foils, elastomers, polymers, composite materials and mineral insulating materials.

These usually interrupt the structure-borne sound in the duct system and absorb the sound by dissipating the sound energy.

3. Test results of the IBP Institute

Using the latest measurement technology, the IBP acoustic laboratory tested fabric expansion joint solutions with varying layer structures and different insulations.

For the measurements, an emission source was used that approximates the sound spectrum of a gas turbine. The installation situation of the various fabric expansion joint solutions corresponds to the outlet of a gas turbine.

Depending on the material layer make up and the variation of the insulation it was prove that the fabric materials provide better acoustic insulation compared to the duct system. This starts already at a frequency of 200 Hz.

All measurements showed that the fabric expansion joint has no detectable effect on the entire noise emission of the installation compared to a duct with 6 mm (0.236 inches) wall thickness and the relevant surface exposed to noise.

The test results for a fabric expansion joint with selected insulation variants are shown schematically in the following diagram.

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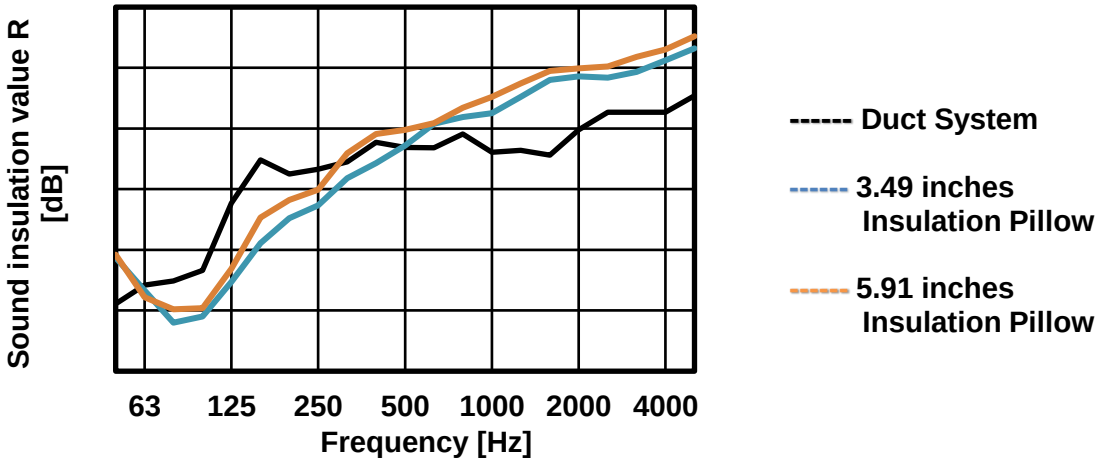

4. Acoustic measures

In general, materials with a greater weight per unit area, i.e. either higher density or greater wall thickness, increase the sound reduction index. However, adjustments in the expansion joint are only possible to a limited extent because they could limit the functional flexibility.

An additional effective acoustic measure is an insulating element arranged around the expansion joint as a complete insulating bonnet or, depending on the acoustic requirements, only as a partial insulating element. It should be noted that these acoustic insulation elements are arranged at a distance to ensure the required heat dissipation. Ideally, this is done by using an acoustic insulation. See also TI-011 "Insulation requirements for fabric expansion joints".

A singular consideration of the acoustic emission of fabric expansion joints is not targeted, as it can only be evaluated in connection with the entire emission of the plant.

5. Recommendation

Since the acoustic effect of a fabric expansion joint depends on many factors, we recommend involving a member of RAL-Quality Association for Fabric Expansion Joints in the early stages of system planning if the acoustic requirements are critical.

Member companies of the RAL Quality Association are able to develop an optimal solution.

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Technical Information

Design recommendations and characteristics of fabric expansion joints

1. General

Fabric expansion joints are used to absorb movements resulting from the duct system.

The fabric expansion joint must always be installed without stress.

The pipe connections must be supported and guided according to the movements that occur. Due to its material properties, the expansion joint only transmits minor forces.

Movements determine the design and the flange to flange dimension.

A duct system should be designed that mainly axial movements occur. In order to limit negative influences on the flow and cross-sectional ratios, lateral movements must be kept to a minimum.

Angular movement and torsion should be avoided as far as possible.

Due to its material properties, the fabric expansion joint offers the following advantages compared to metal and rubber expansion joints:

- Cost-efficient dimensioning of the pipeline and guides due to low adjustment forces
- Multi-dimensional movement absorption with only one expansion joint
- Decoupling of the pipeline connections (structure-borne noise, vibrations)
- High movement absorption with low installation height
- It can be adapted to the desired duct cross-section. All dimensions, cross-section variations and irregular shapes are feasible
- Regardless of its subsequent installation dimensions, it can usually be supplied in standard truck packing dimensions (see also TI-008)
- It can be supplied in several parts and can therefore be installed in areas with limited access (see also TI-009 and TI-010)

2. Range of application

Usually, fabric expansion joints are used in the pressure range below 0.5 bar and are therefore not subject to the Pressure Equipment Directive.

Depending on the design of the expansion joint system, all technically relevant temperature ranges can be covered with fabric expansion joints.

Mutual dependencies of pressure, temperature and movements must be taken into account.

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3. Possible movement absorption

Fabric expansion joints can accommodate the following types of movement. For further explanation see TI-004, topic 5 and TI-014.

3.1. Axial compression

3.2. Axial extension

3.3. Lateral movement

3.4. Angular movement

3.5. Torsion

To achieve the best economic and technical solution, the simultaneous occurrence of e.g. axial extension and lateral movement as well as axial extension and angular movement should be avoided.

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Notes:

Gütegemeinschaft
Weichstoff-Kompensatoren e. V.

Quality Association for
Fabric Expansion Joints

Zum Burgstall 13
88677 Markdorf
Germany

info@qafej.org
Fon: +49 7544 / 9626-873

www.qafej.org
www.weichstoffkompensatoren.de
www.fabricexpansionjoints.eu