



Basic Rubber Expansion Joint knowledge

Ver. 03

Expansion Joint

- Hvad er Gummi (DK)
- Application of Expansion joints?
- Its purpose?
- The design
 - Bellow
 - Color codes
 - Flanges
- Types – specific Type 50/53
- Accessories
- Demands for the piping systems
- Demands for assembling
- Design Parameters
- Movements
- Installationsvejledning – one pager (DK)
- Maintenance – Vedligeholdelsesplan (DK)
- Certificates





Hvor stammer naturgummi fra?

Oprindeligt stammer latex fra Sydamerika, og transporteres af Europæere til Sydøstasien for at øge produktionen

Latex tappes fra Naturgummitræer, og et træ giver ca. 30 gram latex om dagen.

Tapningen kan starte når træet er ca. 6 gammelt og slutter ca. efter 20-30 å

Latex består ca. af 60% Vand / 35% Gummi / 5% ukendt – man ”udsyrer” latexen for at få gummien ud.

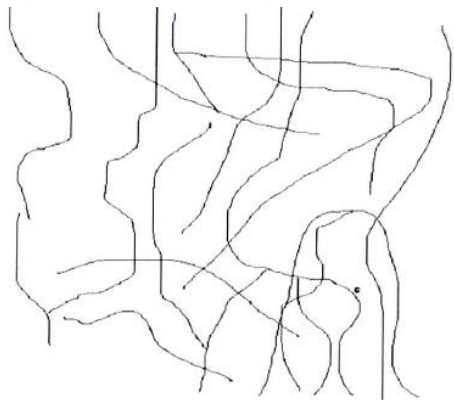
Pga. stor efterspørgsels i anden verdenskrig opfindes syntetisk gummi



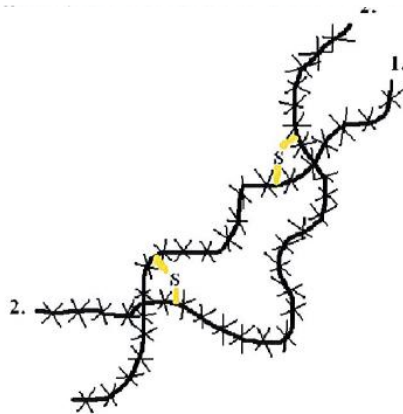
Tabel 1 Verdensproduktionen af naturgummi og syntetgummi i 1930-2008 i millioner tons.

År	Naturgummi (mio. tons)	Syntetgummi (mio. tons)
1930	0,8	-
1940	1,4	0,1
1950	1,9	1,1
1960	2,0	1,8
1970	2,9	5,0
1980	3,8	8,6
1990	5,3	9,9
2000	6,5	11,2
2008	9,9	12,8
2017	13,5	13,4

Figur 8 Naturgummiets lange kæder.



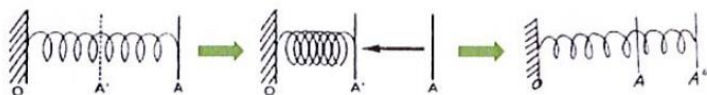
Figur 11 Svovlbroer (mærket -S-) mellem 2 naturgummikædemolekyler.



Ændring af gummis egenskaber ved vulkanisering

- Elasticiteten forøges
- Brudstyrke forøges
- Opløselighed nedsættes
- Plasticitet nedsættes
- Kold flydning nedsættes
- Temperaturfølsomhed nedsættes
- Klæbrighed forsvinder

Elastiske egenskaber



Fuldt elastisk:
 $A=A''$



Vulkaniseringen af gummi

Opdages af Charles Goodyear i 1839 i USA

Ved introduktion af svovl(og andre kemikalier) og varme sker der en kemisk reaktion i gummi molekylerne, "Der dannes svovlbroer"

Gummiet går fra at være "plastik" til "elastisk" og bliver mere temperatur resistent.

Når gummi er vulkaniseret kaldes det for et "visko-elastisk materiale" (Det vil sige det kan komprimeres, men volumen af emnet ændres ikke)



Rågummi

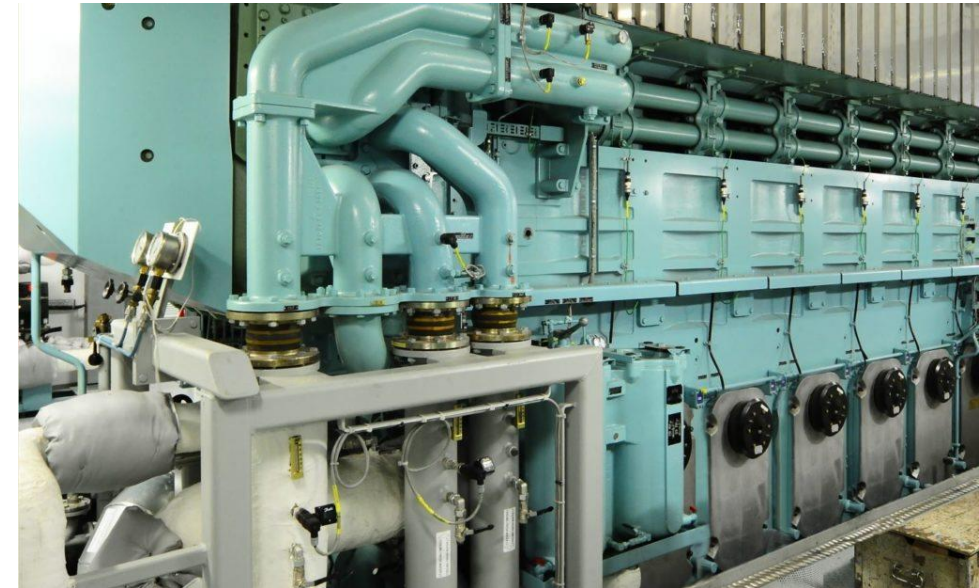


Fyldestof, aktivator, stabilatorer m.m

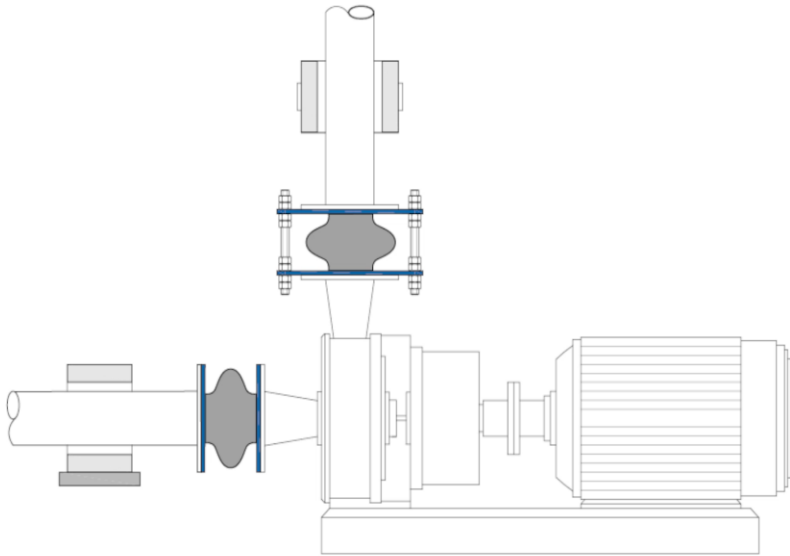
APPLICATION FOR EXPANSION JOINTS

Expansion Joints are used in piping systems in many places and industries such as.....

- **Chemical plants**
- **Heating installations**
- **Air conditions**
- **Shipbuilding industry**
- **Pipeline construction**
- **Engines**
- **Power plants**
- **etc.**



ITS PURPOSE



- Compensates for the thermodynamic expansions in a piping system (Axial, lateral and angular)
- Helps adjusting misalignments in piping systems (max. ± 5 mm lateral, ± 10 mm axial)
- Isolates and absorb mechanical vibration and noise from pumps and engines

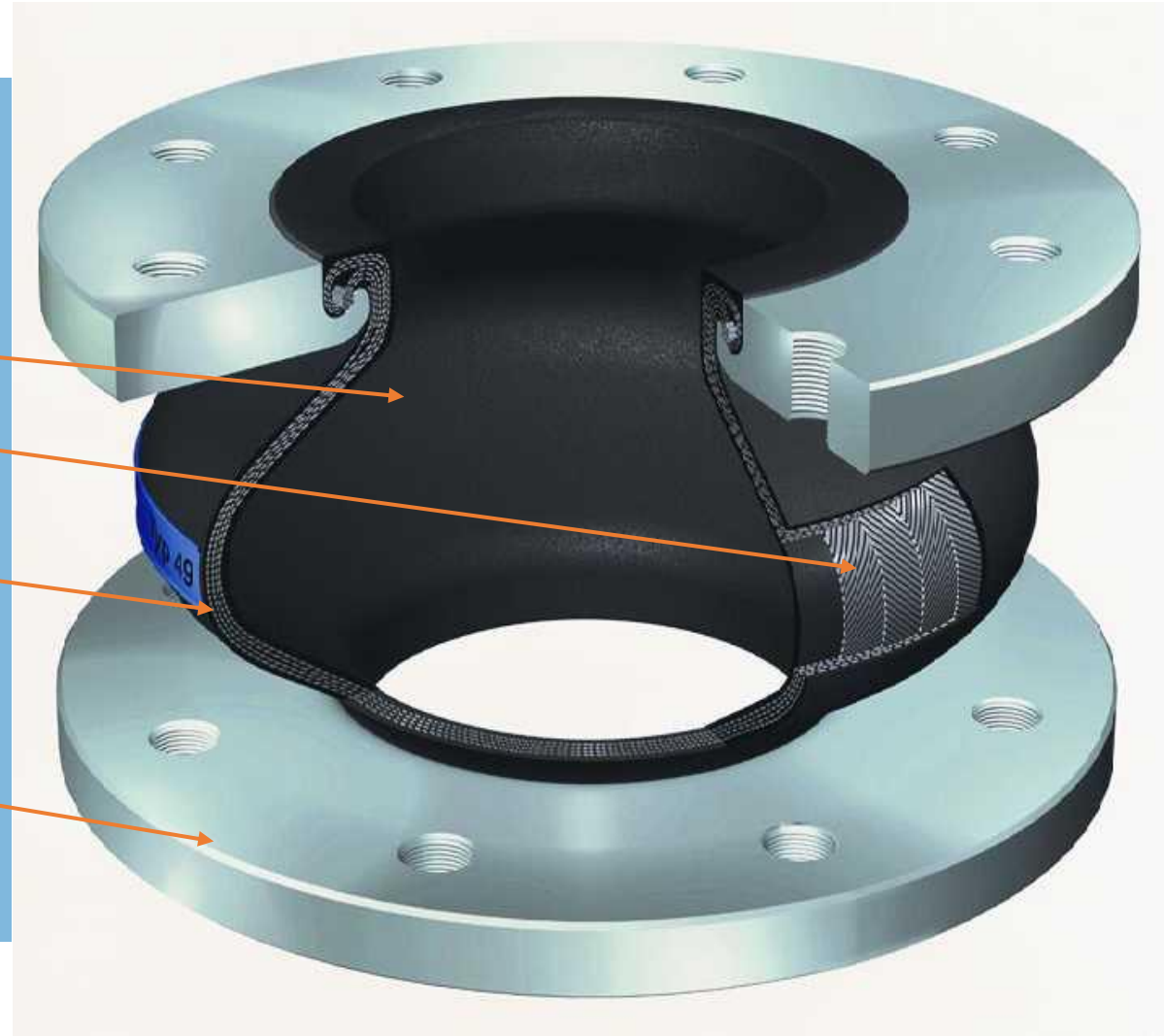
THE DESIGN



Bellow

- Inner liner
- Reinforcement
- Outer liner

Flanges



BELLOW














The bellow is made of three layers

- Inner liner according to the flowing media
- Reinforcement, typically made of polyamide fabric placed in different layers and orientations according to pressure demands
- Outer liner for outside environment



COLOR CODES - EX TYPE 50

Specifications for DN 20 - DN 400









































































Bellow		Core (inner)	Bellow design		up to DN	Permissible operating data												Surface resistance Ro	
Colour code	Colour marking		Reinforcement	Cover (outer)		°C bar		°C bar		°C bar		°C bar		Short-term °C	Core Ohm x cm	Cover Ohm x cm			
red Sp		EPDM	PEEK	EPDM	400	-40	10	70	16	100	10	130	8	150	4 x 10 ³	4 x 10 ³			
red		IIR	Polyamide	EPDM	400	-40	10	50	16	70	12	100	10	120	7 x 10 ⁶	1 x 10 ³			
red EPDM		EPDM	Polyamide	EPDM	400	-30	10	50	16	70	12	90	10	100	-	-			
yellow		NBR	Polyamide	CR	400	-20	10	50	16	70	12	90	10	100	2 x 10 ²	1 x 10 ³			
white		NBR	Polyamide	CR	400	-20	10	50	16	70	12	90	10	100	7 x 10 ⁹	1 x 10 ³			
green		CSM	Polyamide	CSM	400	-20	10	50	16	70	12	100	10	110	7 x 10 ⁹	7 x 10 ⁹			
orange		NBR	Polyamide	CR	200	-20	10	50	25	70	20	90	15	100	3 x 10 ³	1 x 10 ³			
black EPDM*		IIR	Polyamide	EPDM	150	-40	10	50	10	70	8	90	6	120	7 x 10 ⁶	1 x 10 ³			
black CR	-	CR	Polyamide	CR	400	-25	10	50	16	70	12	90	10	100	7 x 10 ⁹	5 x 10 ¹⁰			
yellow LT		NBR-LT	Polyamide	CR	300	-40	10	50	16	70	12	90	10	100	1 x 10 ⁴	4 x 10 ³			
yellow St		NBR	Steel cord	CR	400	-20	10	60	16	70	12	90	10	100	2 x 10 ²	5 x 10 ¹⁰			
yellow HNBR		HNBR	Steel cord	CR	300	-35	10	60	16	70	12	100	10	120	1,5 x 10 ⁵	- 10 ¹⁰			

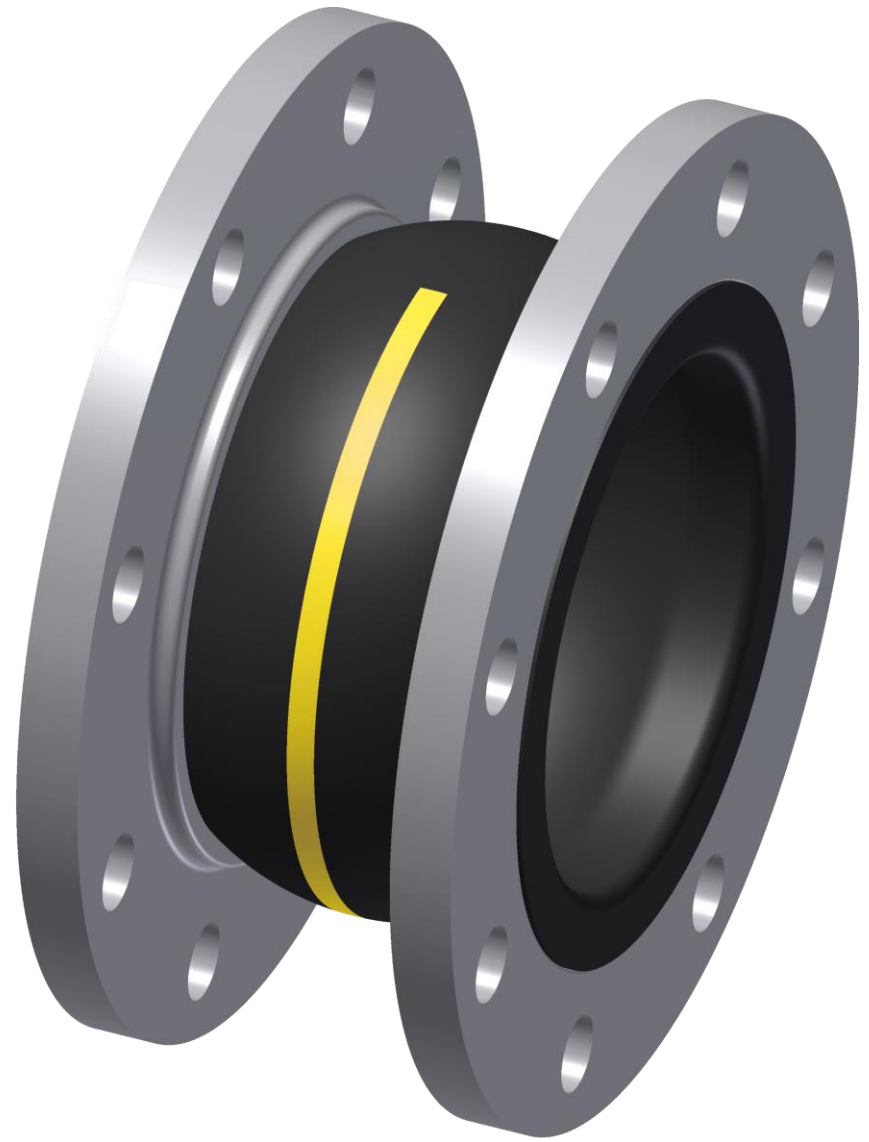
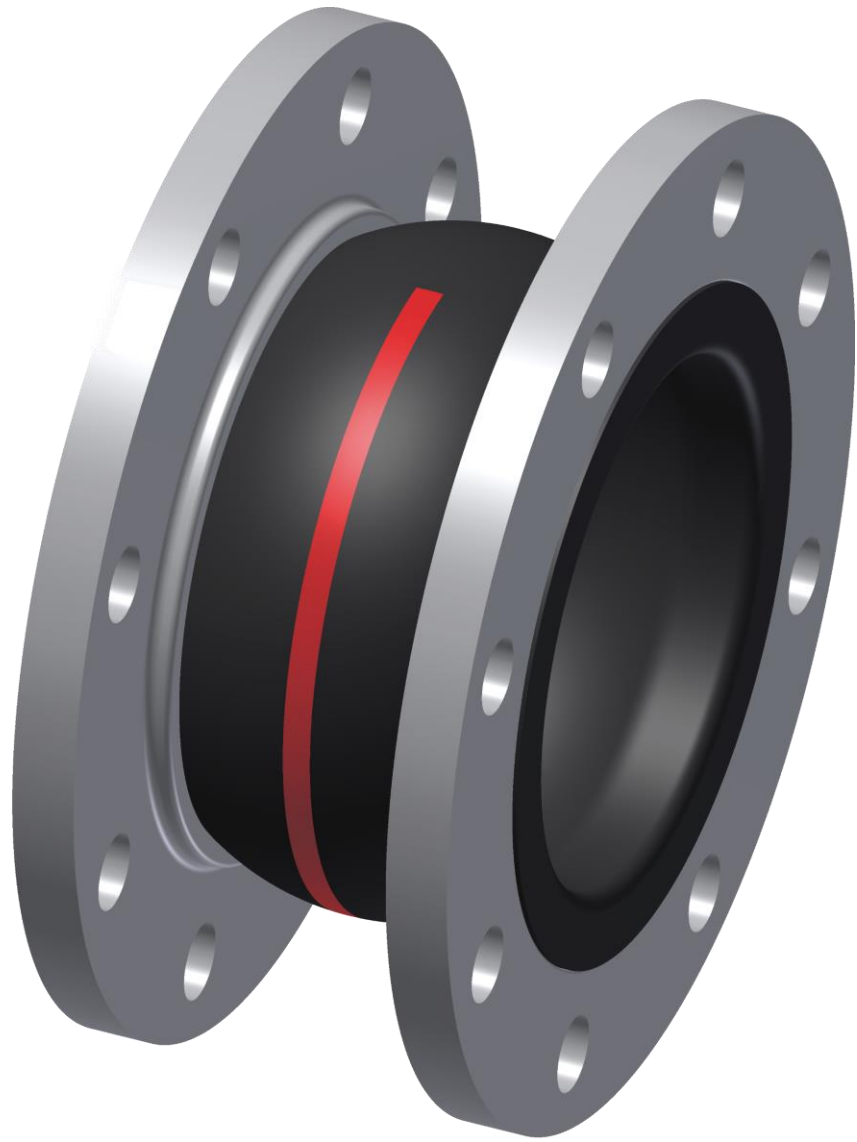
Bursting pressure DN 20 - 400 > 48 bar

* Bursting pressure max. 30 bar, max. DN 150

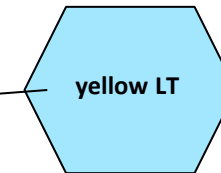
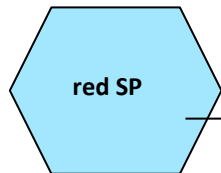
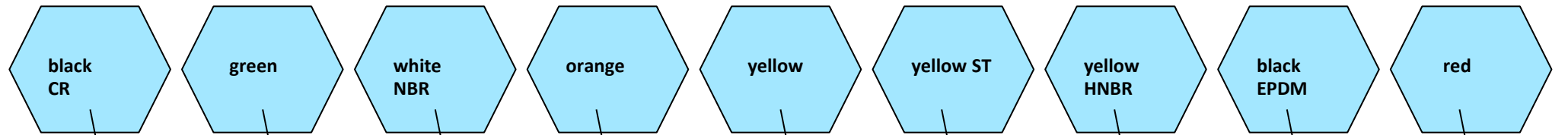
For pressure loss see technical appendix.

Materialer: Resistens egenskaber

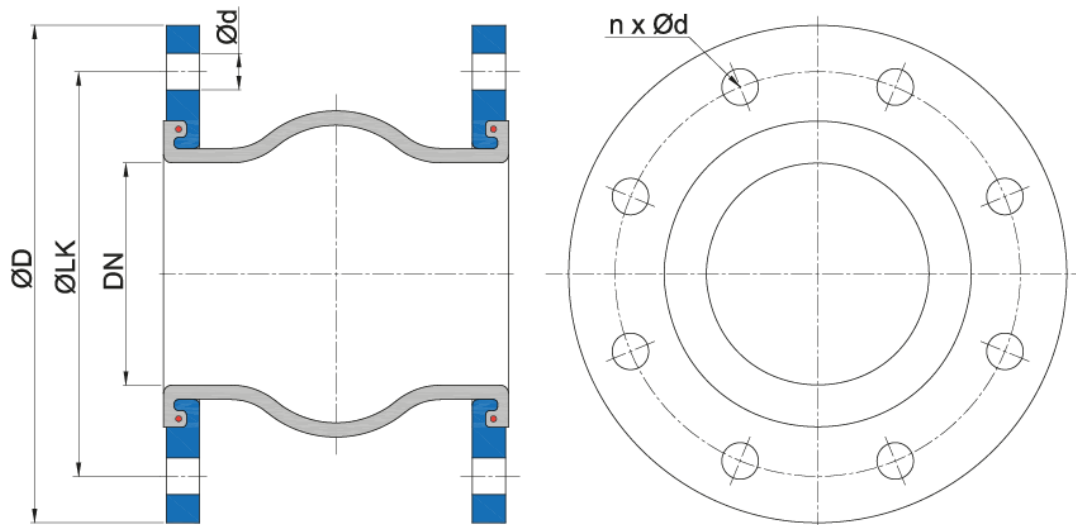
Base polymer as in DIN/ISO 1629	Temperature range [°C]	Mechanical properties	Weather and ozone resistance	Oil and fuel resistance	Glycol (Alcohol) resistance	Acid and alkali resistance	Gas tightness	Price index (NR=1)	Chemical designation
NR	-60 to +80							1	Polyisopren, natural rubber (natural caoutchouc)
SBR/BR	-60 to +100							1	Styrene-butadiene rubber / Butadiene rubber
CR	-40 to +110							3	Chloroprene (chloroprene rubber)
NBR	-40 to +120							2	Nitrile butadiene rubber
IIR	-40 to +80							2	Isobutylene-isoprene (Butyl rubber)
CSM	-40 to +130							3	Chlorosulfonated polyethylene (Hypalon®)
CPE	-40 to +130							2	Chloropolyethylene
ECO	-40 to +130							5	Epichlorohydrin rubber
EPDM	-60 to +150							2	Ethylene Propylene Diene Momomers
HNBR	-40 to +150							20	Hydroginate acrylonitrile butadiene rubber
AEM	-40 to +160							6	Ethylene acrylate copolymers
FKM	-30 to +250							40	Fluoro rubber



COLOR CODES - EX TYPE 50



Design A



FLANGES



Flange material

Stainless steel

Hot dip or electro-galvanized steel

Placement of holes

According to PN6, PN10,
PN16, PN25

With and without thread

Standards

EN 1092-1

ASME

JIS, BS

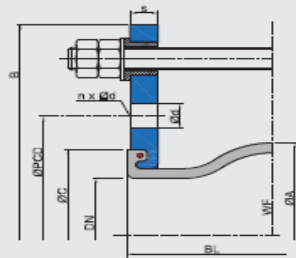
OTHER FLANGE DESIGN

WILLBRANDT Rubber Expansion Joint Type 50

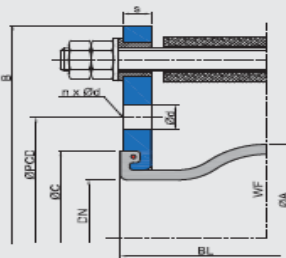
Length limiters

There is a selection of various length limiters / tie rods to absorb the reaction force and to protect the bellow from overstretching or collapsing:

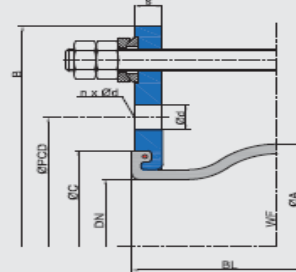
Design B*
with tie rods



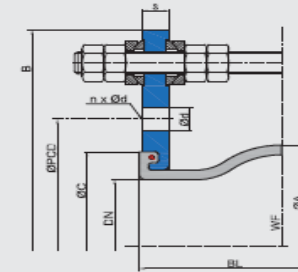
Design C*
with tie rods/thrust limiters



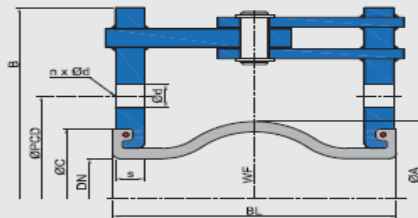
Design E
with tie rods and spherical washers/conical sockets



Design M
with tie rods/thrust limiters and spherical washers/conical sockets



Design F
with hinge



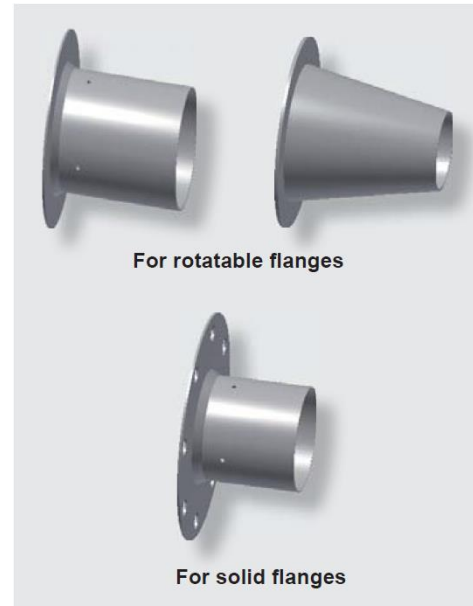
*Note: For Designs B and C the lateral movement absorption is reduced by around 50 %.

ACCESSORIES

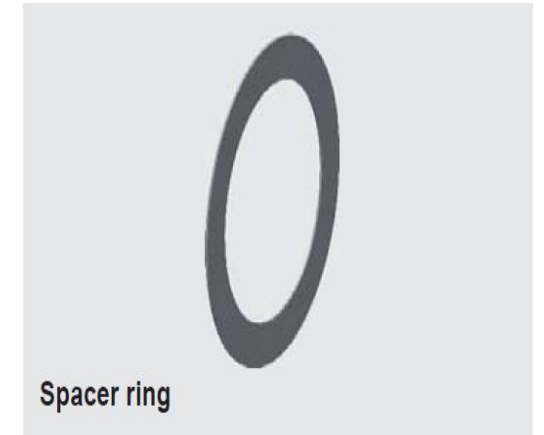
Vacuum supporting ring



Inner sleeve

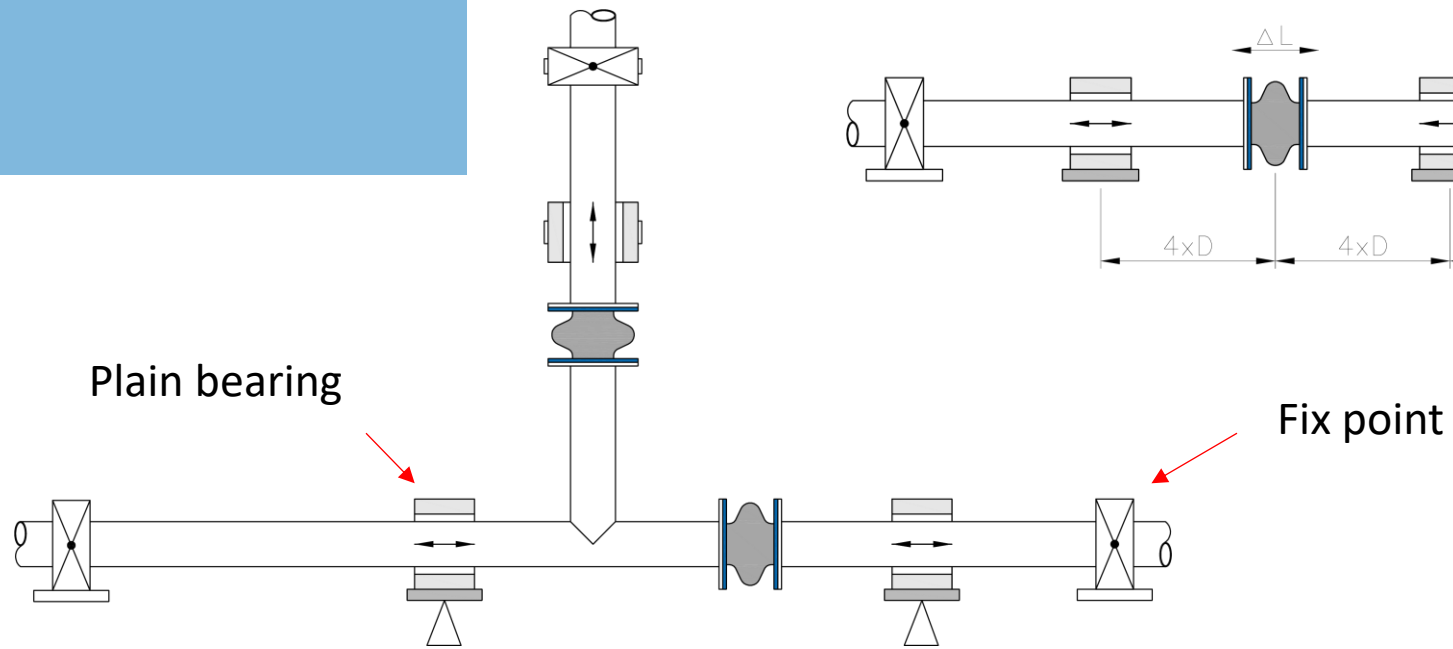
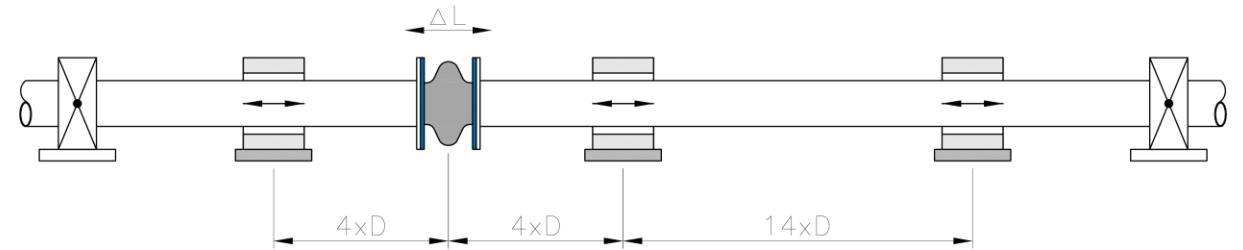
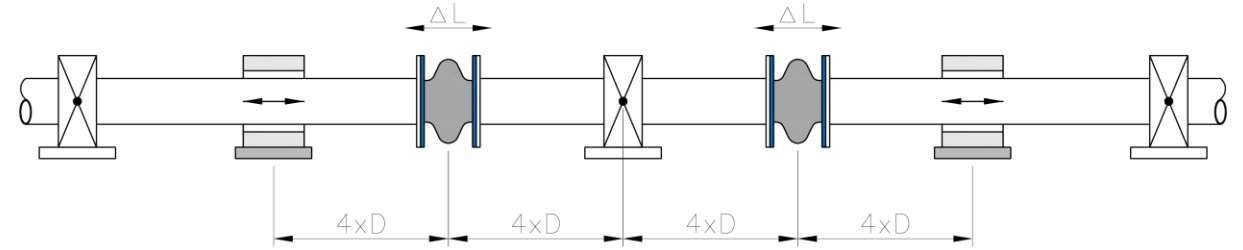


Spacer ring



DEMANDS FOR PIPE SYSTEMS

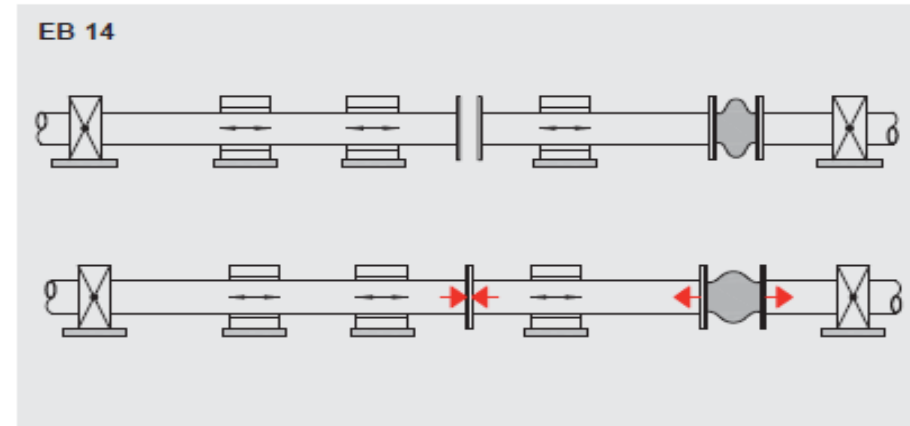
- Fix points
- Plain bearings



DEMANDS FOR ASSEMBLING

In case of mounting an expansion joint with an initial tension greater than 10 mm axially.

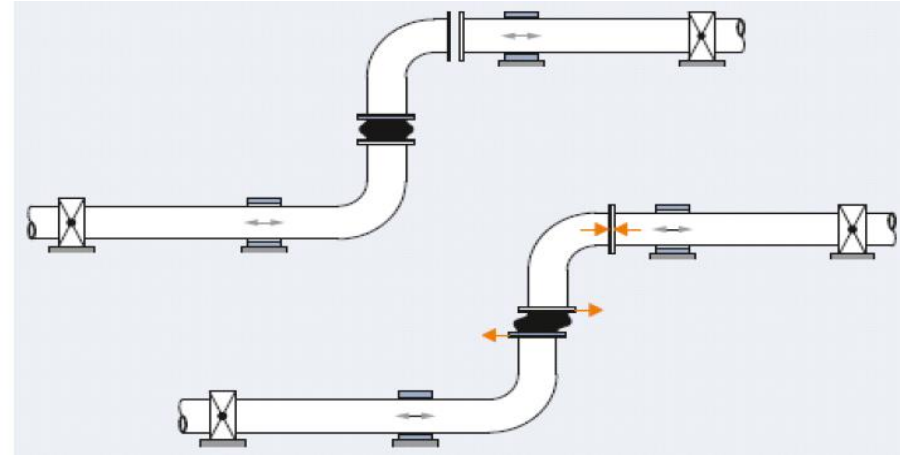
- Open pipe system elsewhere
- Mount the expansion joint
- Built in stress free



DEMANDS FOR ASSEMBLING

In case of mounting an expansion joint with an initial tension greater than 5 mm laterally

- Open pipe system elsewhere
- Mount the expansion joint
- Built in stress free



DEMANDS FOR ASSEMBLING

- Use the correct bolts
- Use correct torque
- Apply torque crosswise
- Be aware of the setting time

22. Application of tightening torque

Fitting instructions

Tools Centring mandrels, rubber hammer and torque wrench. All tools must be burr-free (danger of damage to rubber parts).

Use Strength Class 8.8 flange bolts (Non-post-treated, lubricated bolts)

- Step I
- a) Insert all bolts and tighten evenly by hand.
 - b) Apply torque evenly according to Step 1 in three passes crosswise.

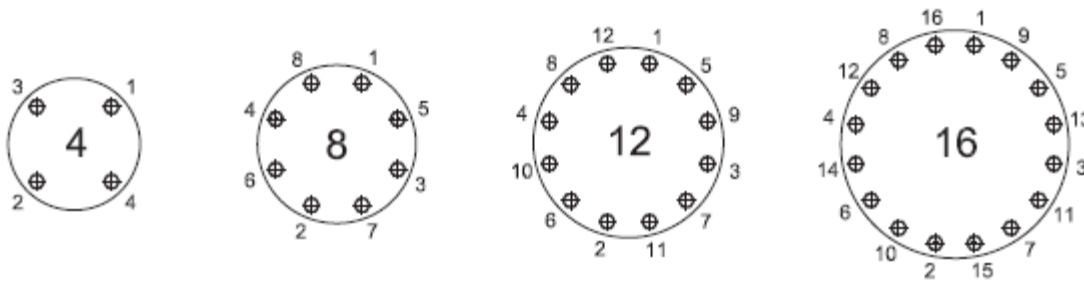
Check gap width on outer edge of flange.

- c) Settling time \geq 30 minutes

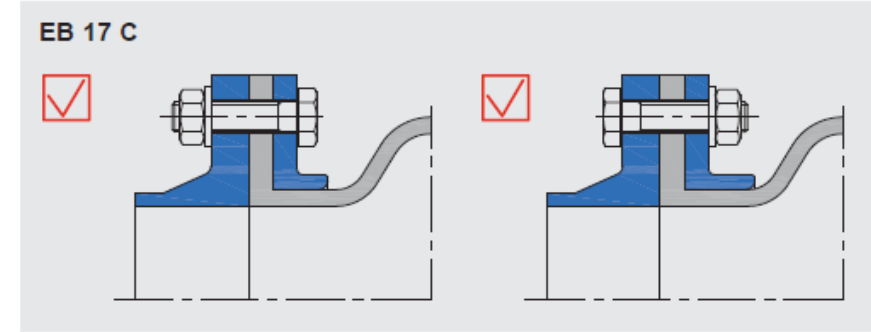
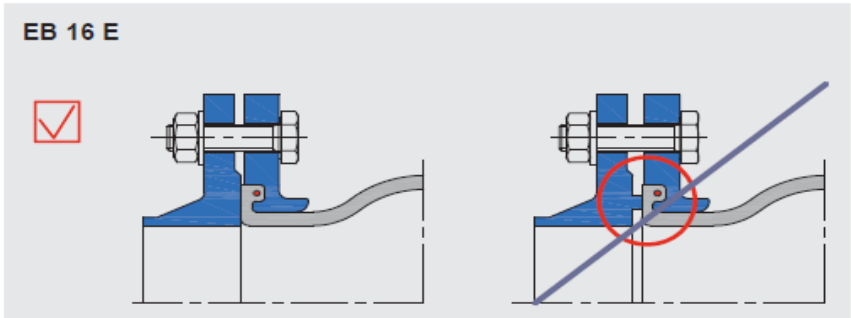
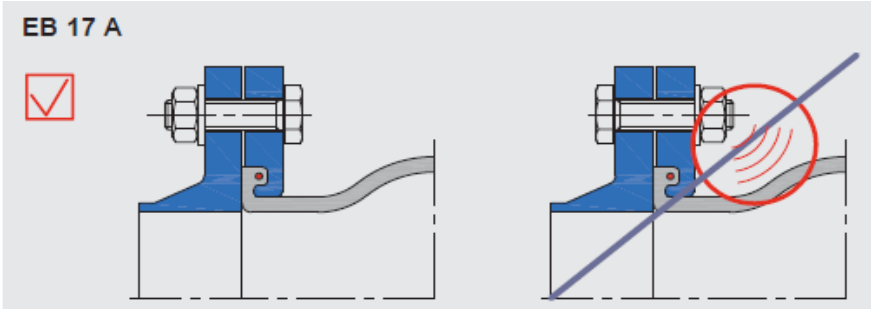
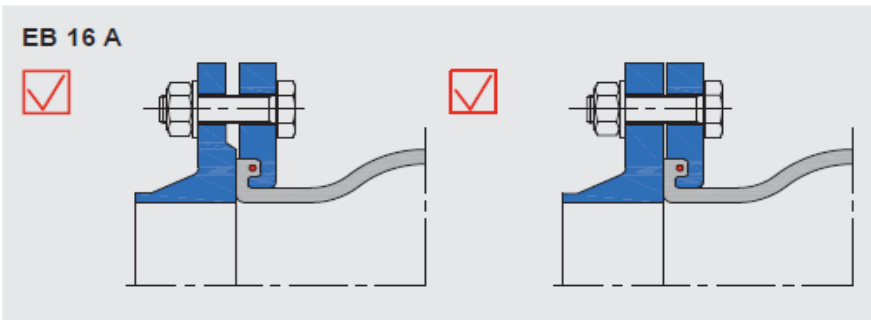
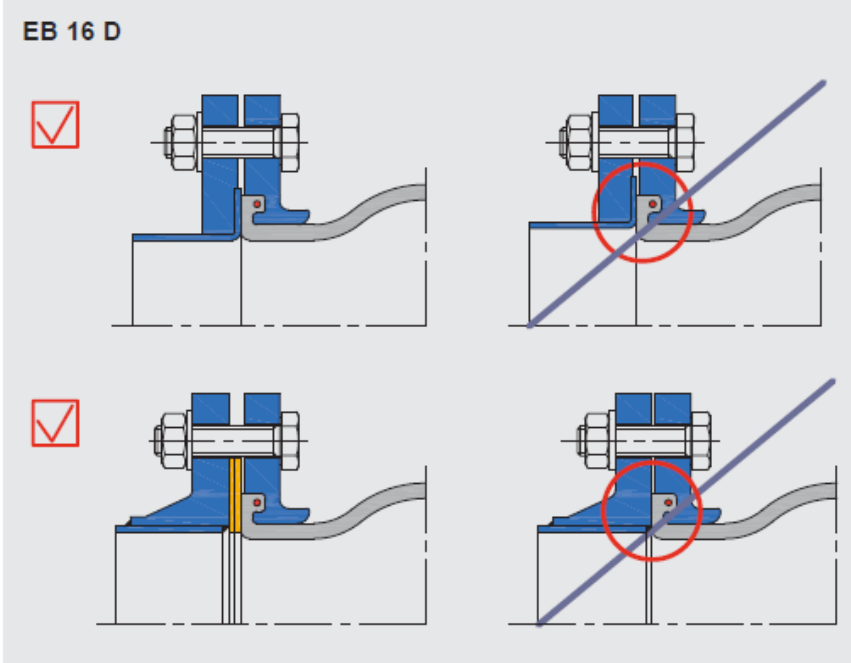
- Step II
- d) Tighten all bolts in three passes or to 2/3 of the final torque crosswise. Check gap width.
 - e) Settling time \geq 60 minutes

- Step III
- f) Apply final torque in two passes crosswise.
NO FURTHER TIGHTENING!

Tightening torque plan



DEMANDS FOR ASSEMBLING



DESIGN PARAMETERS – IMPORTANT INFORMATION FROM THE CUSTOMER



1/2

- DN – Nominal Diameter
- BL - Built in length
- P – Pressure (working/design pressure)
- M . Medium
- T - Temperature

- M - Movements
- F - Flow velocity



DESIGN PARAMETERS – IMPORTANT INFORMATION FROM THE CUSTOMER

2/2

- Application - what type of environment
- Situated – where is it placed
- Engine/Pump
- Soft start
- Valves
- Certificates

- See checklist





DIFFERENT MEDIA'S

Ex. Type 50

- District heating water (Red Sp.)
- Hot water (Red, Red Sp.)
- Cold water (Red)
- Spillage water (Black CR, sometimes green)
- Seawater (Red)
- Cooling water (Red)
- Scrubber water (Green or Lilac – However, lilac doesn't have any type approvals)
- Acids & Bases (Red, but with very aggressive acids and bases green / lilac, ask us)
- Oil (Yellow, Yellow St or Yellow/blue, depended on temperature and certificates)
- Medias containing oil (Yellow, Yellow St or Yellow/blue, depended on temperature, certificates)

Application

Type 50 red Sp

For heating installations according to DIN 4809. For many years of operation under constant loading with hot water and heating water at 100 °C/110 °C at 10 bar/6 bar operating pressure. Electrically conductive surface. Not suitable for media with additives containing oil.

Type 50 red

For drinking water, hot water, sea water, cooling water with chemical additives for treating water, saline solutions, weak acids and weak alkaline solutions. Electrically dissipative inner surface and electrically conductive outer surface. Not suitable for oil products or cooling water with additives containing oil.

Type 50 red EPDM

Like Type 50 red, but not for drinking water, shipbuilding and offshore applications. Temperature range max. 90 °C at 10 bar.

Type 50 yellow

For oils, lubricants, fuels, gases, city and natural gas (not liquefied) and DIN EN fuels with an aromatic content up to 50 %. Electrically conductive.

Type 50 white

For foodstuffs containing oil and fat (rubber in food-grade). Not approved for drinking water. Electrically insulating inner surface and electrically conductive outer surface.

Type 50 green

For chemicals, aggressive chemical wastewater and compressor air containing oil. Electrically insulating.

Type 50 orange

Like Type 50 yellow, but also for liquid petroleum gas acc. to DIN EN 589. Electrically dissipative.

Type 50 black EPDM

For drinking water, sea water, cooling water, weak acids and alkali solutions, technical alcohols, esters and ketones. Max. pressure 10 bar. Electrically dissipative inner surface and electrically conductive outer surface.

Type 50 black CR

For hot and cold water, wastewater, swimming pool water, salt water, wastewater, cooling water with anti-corrosive products containing oil, oil mixtures and compressed air containing oil. Electrically insulating.

Type 50 yellow LT

Like Type 50 yellow, but also for liquid gas. Electrically dissipative.

Type 50 lilac

For flue gas desulphurisation systems and bio-diesel. Good resistance to benzene, xylene, toluene, fuels with an aromatic content of more than 50 %, aromatic/chlorinated hydrocarbons and mineral acids. Electrically insulating inner surface and electrically conductive outer surface.

Type 50 yellow St

Like Type 50 yellow with additional flame-resistance for up to 30 minutes at 800 °C. Electrically conductive inner surface, electrically insulating outer surface.

Type 50 yellow HNBR

Like Type 50 yellow St, but for temperatures up to +100 °C. Electrically dissipative inner surface, electrically insulating outer surface.

Type 50 BR

Especially for abrasive media such as sludges, dustlike and powdery media, liquids with solids and emulsions. Also suitable for all kinds of water, as well as various chemicals. Not suitable for oil based products and cooling water with oily additives. Electrically dissipative.

MOVEMENTS



Dimensions for Design A

DN	Length BL mm	Bellow		Flange PN 10*2						Movement absorption (polyamide cord)				Movement absorption (steel cord)				Weight kg
		ØA mm	WF*1 mm ²	ØD mm	ØPCD mm	Ød mm	n	s mm	ØC mm	axial + mm	axial - mm	lateral ± mm	angular ± ∠°	axial + mm	axial - mm	lateral ± mm	angular ± ∠°	
20	130	81	1700	105	75	12	4	14	66	30	30	30	30	15	30	15	20	1.5
25	130	81	1700	115	85	14	4	14	66	30	30	30	30	15	30	15	20	1.9
32	130	81	1700	140	100	18	4	15	66	30	30	30	30	15	30	15	20	3.1
40	130	86	1800	150	110	18	4	15	74	30	30	30	30	15	30	15	20	3.5
50	130	96	3200	165	125	18	4	16	86	30	30	30	30	15	30	15	20	3.7
65	130	111	5300	185	145	18	8	16	106	30	30	30	30	15	30	15	20	5.3
80	130	122	8500	200	160	18	8	18	118	30	30	30	30	15	30	15	20	6.8
100	130	142	12800	220	180	18	8	18	138	30	30	30	20	15	30	15	15	7.9
125	130	168	18700	250	210	18	8	18	166	30	30	30	20	15	30	15	15	9.6
150	130	192	25900	285	240	22	8	18	192	30	30	30	20	15	30	15	15	12.9
200	130	252	41000	340	295	22	8	20	252	30	30	30	12	20	15	10	5	16.2
250	130	302	59600	395	350	22	12	20	304	30	30	30	12	20	15	10	5	21.5
300	130	354	82200	445	400	22	12	22	354	30	30	30	12	20	15	10	5	24.5
350	200	420	117600	505	460	22	16	24	412	30	50	30	8	30	30	25	10	38.3
400	200	480	154700	565	515	26	16	25	470	30	50	30	8	30	40	25	5	38.0
450	200	530	204200	615	565	26	20	28	520	30	50	30	8	-	-	-	-	47.2
500	200	580	227900	670	620	26	20	30	570	30	50	30	8	-	-	-	-	56.5
600	200	680	311500	780	725	30	20	30	675	30	50	30	8	-	-	-	-	75.2
700	*3250	800	434200	895	840	30	24	35	780	30	50	30	8	-	-	-	-	127.8
800	250	880	527400	1015	950	33	24	40	887	30	50	30	6	-	-	-	-	161.0
900	300	1038	737900	1115	1050	33	28	40	987	30	50	30	5	-	-	-	-	196.7
1000	300	1138	889400	1230	1160	36	28	40	1087	30	50	30	5	-	-	-	-	234.5

*1 WF = effective area

*2 Other standards/dimensions possible.

*3 Building length 260 mm

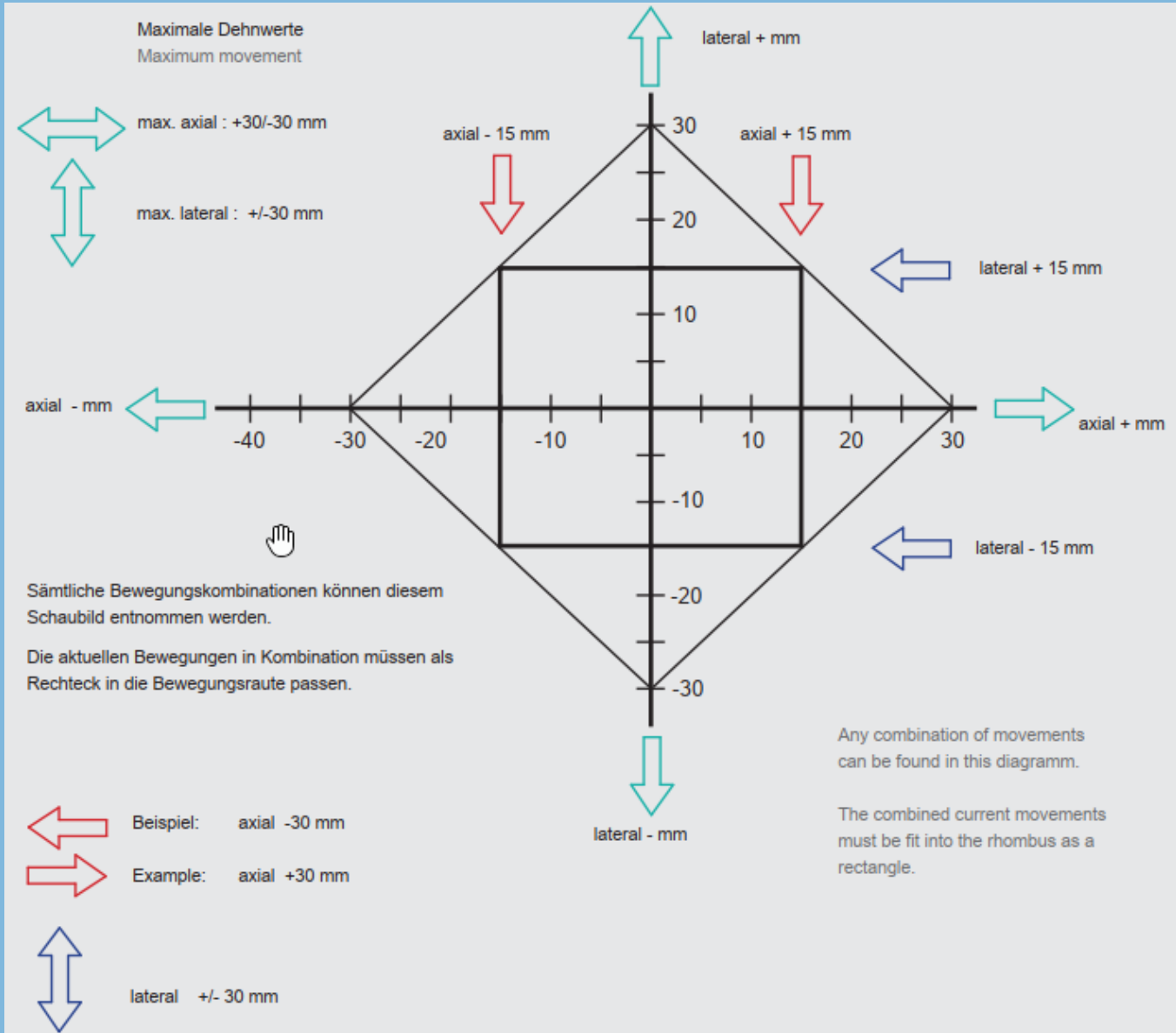
Permissible degree of utilisation for movement areas:

- up to 50 °C: Utilisation ~ 100 %

- up to 70 °C: Utilisation ~ 75 %

- up to 90 °C: Utilisation ~ 60 %

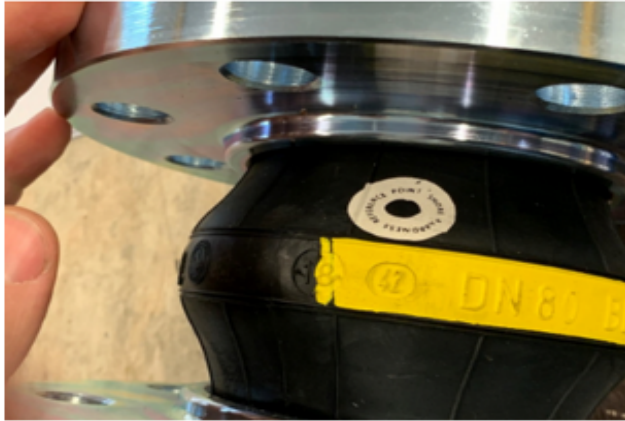
MOVEMENTS



Installationsvejledning

1) Udpakning

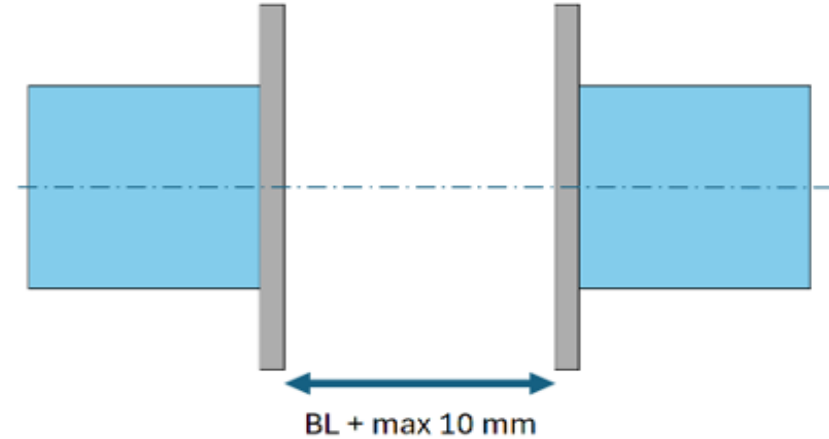
- Kontroller visuelt den nye kompensator for fejl såsom revner eller andre beskadigelser.
- Kontroller shore hårdheden på den nye kompensator. Brug markering på bælggen som reference.



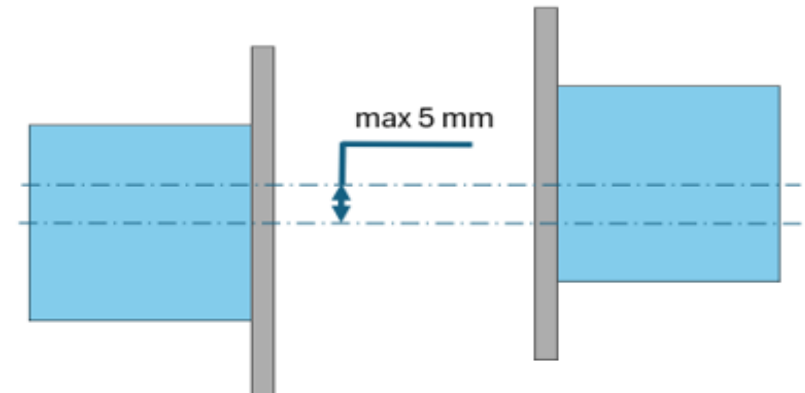
- Indfør evt. shore-værdien i en logbog, så udviklingen i hårdheden kan følges over tid.

2) Indbygning – Stressfri

- Kontroller længden mellem modflangerne
- Længden må ikke overskride kompensatorens byggelængde med mere end 10 mm. og max 5 mm lateralt.

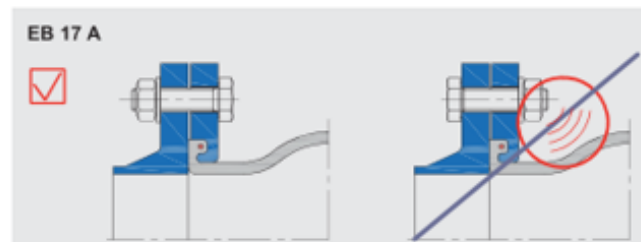


- Lateralt må forskydningen af center ikke være større end 5 mm



3) Boltmontage

Monter boltene i den korrekte retning og længde



Indvendig og ud

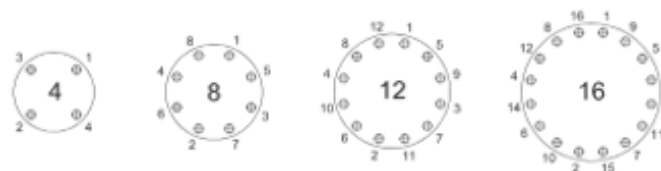
Table 2: Bolt tightening torques for Types 48, 49, 50, 51, 53, 55, 56 and 65

DN	Step 1 for all Nm	Step 2 for all Nm	Step 3				
			PN 6 Nm	PN 10 Nm	PN 16 Nm	PN 25 Nm	ASA 150 Nm
25	by hand	50	60	80	80	80	80
32	by hand	50	60	80	80	80	80
40	by hand	50	60	80	80	80	80
50	by hand	50	60	80	80	80	80
65	by hand	50	60	80	80	80	80
80	by hand	50	60	80	80	80	80
100	by hand	50	80	100	100	100	100
125	by hand	50	80	100	100	100	100
150	by hand	50	80	100	100	100	100
175	by hand	50	90	100	100	100	100
200	by hand	50	90	100	100	100	100
250	by hand	50	90	100	100	110	100
300	by hand	50	100	110	110	110	100
350	by hand	50	120	130	135	165	110
400	by hand	50	120	140	155	200	140
450	by hand	50	140	145	165	200	145
500	by hand	50	120	145	170	200	145
600	by hand	100	185	210	255	280	210
700	by hand	100	200	225	300	300	230
800	by hand	100	235	300	360	410	300
900	by hand	100	235	300	360	415	300
1000	by hand	100	300	360	425	525	360

Warning: Refer to the tightening scheme!

4) Moment til spænding

- Spænd boltene, over kryds med korrekt moment.
- Overhold hviletider mellem til spændingerne.



Hviletider:

Step 1

- Indsæt alle bolte og spænd dem med hånden krydsvis 3 gange
- Check at flange er parallel til modflangen.
- Lad boltene hvile i 20 minutter.

Step 2

- Krydsspænd boltene til værdierne i tabellen næste side, 3 gange
- Lad boltene hvile i 60 minutter.

Step 3

- Påfør slutmomentet fra tabellen næste side, 3 gange.
- **FÆRDIG ikke mere spænding**

MAINTENANCE



For all expansion joints

First inspection after

- 1 week
- 1st, 4th, 12th month

Annual Inspection

All inspection should include

Check position

External damage

Check for blistering

Check for cracks

Check hardening



CERTIFICATES

Typ	DNV/GL	LR	BV	RINA	CCS	KR	ABS**	RMRS	MED	EAC*	TÜV-SÜD	TÜV-SÜD	TÜV-SÜD	FDA	DVGW	ACS	BfR	WRAS
											DIN4809	CE Kat. A2	CE Kat. B+C2		V270			
39	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
40	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
42	---	---	---	---	---	---	---	---	---	✓	---	---	---	---	---	---	---	---
46	gelb ST gelb HNBR gelb rot rot SP schwarz CR schwarz EPDM	gelb ST gelb HNBR gelb rot rot SP	✓	✓	gelb ST gelb HNBR gelb rot rot SP	✓	✓	✓	gelb ST gelb HNBR gelb rot rot SP schwarz CR schwarz EPDM	✓	rot SP	✓	✓	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	✓	---	✓	---	---	---	---	---	---
49	blau A-rot gelb schwarz EPDM	---	---	blau A-rot gelb	---	---	---	---	blau A-rot gelb schwarz EPDM	✓	A-rot	✓	✓	blau weiß NBR	blau	blau	weiß NBR	---
50	gelb ST gelb HNBR gelb rot rot SP schwarz CR schwarz EPDM	gelb ST gelb HNBR rot rot SP	✓	✓	gelb ST gelb HNBR gelb rot rot SP	✓	✓	✓	gelb ST gelb HNBR gelb rot rot SP schwarz CR schwarz EPDM	✓	rot SP	✓	✓	rot weiß NBR	rot	rot	weiß NBR	---
51	---	---	---	---	---	---	---	---	---	✓	---	✓	---	---	---	---	---	---
52	---	---	---	---	---	---	---	---	---	✓	---	✓	---	---	---	---	---	---
53	---	---	---	---	---	---	---	---	---	✓	---	✓	---	---	---	---	---	---
54	---	---	---	---	---	---	---	---	---	✓	---	---	---	---	---	---	---	---
55	gelb ST gelb rot rot SP	gelb ST gelb rot rot SP	✓	✓	gelb ST gelb rot rot SP	✓	✓	gelb ST gelb rot rot SP	gelb ST gelb rot rot SP	✓	rot SP	✓	✓	rot	rot	rot	---	---
55 So	gelb ST gelb rot rot SP	gelb ST gelb rot rot SP	✓	✓	gelb ST gelb rot rot SP	✓	✓	gelb ST gelb rot rot SP	gelb ST gelb rot rot SP	✓	rot SP	✓	✓	rot	rot	rot	---	---
56	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
57	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
58	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
59	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
60	---	---	---	---	---	---	---	---	---	✓	✓	---	---	---	---	---	---	---
61	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
62	---	---	---	---	---	---	---	---	---	✓	---	---	---	---	---	---	---	---
63	---	---	---	---	---	---	---	---	---	✓	---	✓	✓	---	---	---	---	blau blau-blau
64	---	---	---	---	---	---	---	---	---	✓	---	---	---	---	---	---	---	---
65	---	---	---	---	---	---	---	---	---	✓	---	---	---	---	---	---	---	---
80	---	---	---	---	---	---	---	---	---	✓	---	---	---	---	---	---	---	---
80 HD	---	---	---	---	---	---	---	---	---	✓	---	---	---	---	---	---	---	---
FSH	✓	---	---	✓	---	---	---	---	✓	---	---	---	---	---	---	---	---	---