



Operating manual for hose assemblies to Pressure Equipment Directive 97/23/EC

Betriebsanleitung für Schlauchleitungen
nach der Druckgeräte-Richtlinie 97/23/EG

Operating manual for hose assemblies to Pressure Equipment Directive 97/23/EG

General

The hose assemblies have been designed acc. to the available order indications for medium, pressure, and diameter (min. necessary) and produced acc. to this layout.

The metal and PTFE hose assemblies are to be installed and operated in an appropriate manner. The installation instructions acc. to the catalogue "TUBOFLEX® Corrugated metal hoses" are to be observed.

Depending on the installation and operating conditions (relevant parameters: medium, min. / max. operating pressure, min. / max. operating temperature, prevailing flowing conditions of the medium inside the hose during all operating states, outside influences, e.g. mechanical, corrosive, oscillation-related, or thermal), serviceability of the hoses is to be checked by an outside and inside visual inspection, depending on the level of hazard, within adequate time intervals. Especially in case of aggressive, poisonous and highly inflammable media, these inspections are to be carried out within short distances of time.

Manufacturer acc. to the pressure equipment directive is the natural person or corporation responsible for the design and production of the hose assembly, and on whose behalf it is to be distributed. He is also responsible to carry out the conformity assessment according to the procedure prescribed in the directive(s).

Assembly

Observe the installation instructions contained in this operating manual and the DIN 20066 "Hose Assemblies – Installation" (installation instructions) and ZH1/74 and T002 (BGI 572).

To ensure the serviceability of hose assemblies and in order to avoid a shortening of their service time by additional strains, the following is to be observed:

- the hose assemblies are to be installed in a way that their natural position and movement are not impeded.
- hose assemblies must not be strained during operation by outside influences like tension, torsion, and upsetting, unless they are specially designed and constructed to serve such an application.
- the min. bending radius must not fall below the figure indicated by the manufacturer (figures can be taken from the catalogue).
- hose assemblies must be protected from damages by outside mechanical, thermal, or chemical influences.
- the removable joints must be checked to fit tightly before putting in operation.
- do not put the hose assembly in operation in case outside damages are visible.
- if necessary, the hoses are to be cleaned appropriately before starting.

- in case of hose assemblies requiring an equipotential bonding to BGR 132, bonding has to be checked and if necessary, provided afterwards.

Correct application

Hose assemblies are only to be used for applications they are designed and determined for. Please take all relevant parameters like permissible pressure, tolerable bending radius, temperature range, and all media to get in contact with the hose, from the enclosed documentation, i.e. the manufacturers declaration, declaration of conformity, or the marking applied on the hose.

Relevant parameters are:

- pressure (max. permissible excess pressure in service must not be exceeded).
- temperature (max. admissible temperature depending on the medium must not be exceeded. If necessary, this has to be verified along resistance lists of the hose assembly components).
- bending radius (min. tolerable bending radius must be observed).
- movement (in case of a likely abrasion, a possible wearing-off effect must be taken into account and monitored).
- resistance (materials of the hose assembly have to be resistant against the flowing substances. If necessary, this has to be verified by resistance lists).

In case the hoses are marked acc. to the following standards, the below-mentioned regulations are valid:

- **DIN 3384** : Gas hose assemblies. Permissible for gas applications acc. to DVGW Sheet G 260
- **EN 12434** : Cryogenic hose assemblies. Permissible for the use of cryogenic fluids like argon (Ar), nitrous oxide (NO₂), ethane (C₂H₄), methane / LNG (CH₄), oxygen (O₂), nitrogen (N₂), carbon dioxide (CO₂) and their alloys
- **DIN 2827** : Hose assemblies for chemical applications. For these hose lines, material 1.4571 (S/S AISI 316 Ti) or 1.4404 (S/S AISI 316 L) is prescribed. They are marked with the material number. As the hoses are ordered standardized according to this standard, the manufacturer cannot carry out a hazard analysis on the chemical resistance. Within the framework of the hazard assessment to § 5 ArbSchG (German law concerning health and safety at work), the operator has to verify whether resistance of the material for the relevant medium is provided. Depending on the medium level of hazard, repeated tests have to be carried out within appropriate time intervals.

In order to operate the hose assembly safely, technical, organisational and personal protection measures are to be carried out. Priority has always to be given to technical and organisational measures. In case not all dangers can be excluded by this, effective personal protection gear is to be provided and used.

Storage

The storage conditions can affect the lifetime of hoses.

An adequate storage requires the following:

- before storage, hoses must be completely evacuated, cleaned and dried
- store in a dry and dust-free place; do not expose to direct sun or UV radiation; shield hoses from nearby heat sources
- hoses and hose assemblies must not get in contact with any materials that may cause a damage
- store hoses and hose assemblies lying straight, unstrained and not buckled
- if stored in rings do not fall below the smallest bending radius as indicated by the manufacturer
- close the hose ends using protection caps to protect the hose inside from soiling and corrosion
- avoid the impact of halogenides, for instance chlorides, bromides, or iodides (danger of pitting corrosion), extraneous or flash rust on corrugated metal hoses
- protect against atmospheric exposure if stored outside
- hoses made of plastics or with non-metallic coatings must additionally be stored in a dark and moderately ventilated place at temperatures between 15 °C and 25 °C. Avoid temperatures over 30°C or below –30 °C
- after a storage time of 3 years or more from the manufacturing date or date of last inspection, hoses made of plastic must be subjected to a repeat inspection before use

Maintenance & Inspection

Cleaning

The hose assembly is to be cleaned and rinsed after each operation, and prior to each inspection. If cleaned with steam or with chemical additives, the resistance of the hose assembly components are to be observed (Warning: the use of steam lances is prohibited).

Inspection periods

The safe operating condition of hose assemblies subject to compulsory inspection is to be verified and documented by a “qualified person”:

- prior to initial starting (hose assemblies purchased ready for service: random quality checks).
- in regular intervals after initial starting (each single hose assembly) – (inspection period e.g. for thermoplastic and elastomer hose assemblies min. 1 x per year, steam hoses every 6 months year. A higher strain requires shorter inspection periods, e.g. in case of higher mechanical, dynamic, or chemical strains).

- examine each hose assembly after a repair.

Scope of inspection

Kind and scope of inspection (e.g. pressure test, visual examination, electrical conductivity test etc.) for example are controlled by the “qualified persons” acc. to operating safety regulation or T002 (BGI 572). The result is to be reported.

Repairs

Repairs of hose assemblies are to be carried out by a “qualified person” only, according to the valid operating safety regulation with following inspection, marking, and documentation.

Exceptional features for example are valid for the following hose assembly types:

Steam hoses

- do not use steam hoses for other substances. Consider the faster ageing of an elastomer hose.
- make sure that condensates are evacuated completely in order to avoid structure damages (“popcorning”), which occur by leaking of water into the inner layer and vaporisation upon a new charging with steam.
- avoid negative pressure caused by cooling down if the hose line is locked on both sides.
- protective measures against surface temperature (danger of scorching).

Metal hose assemblies

In case of metal hoses, which are not equipped with an outside heat insulation, a higher danger of scorching occurs in case of an application with steam, due to their high heat conductivity.

- metal hoses are conductive enough without further measures.
- pay special attention to damages of the wire braid and on deformation of the hose, e.g. kinking.
- no influences by chlorides, bromides or iodides, extraneous rust or flash rust during storage must occur.

Hoses assemblies with thermoplastic inner liners

- protect the inner liner from damages caused by outside kinking and deformation of the hose.

REMARK:

For the appropriate application of hose assemblies, the comprehensive notices of leaflet T002 (BGI 572) and the relevant rules for accident prevention are to be observed.

Metal hose design

Influence of the service conditions on the metal hose design

In view of the variety of the different applications the working pressure and bending radius stated in the technical tables can only be used as a guideline. They are valid for predominantly static stress and room temperature (20°C). The pressure values provide a minimum of three times the safety factor to the burst pressure. The determination of the test pressure value is carried out according to the PED or the DIN EN ISO 10380, unless the user specifies a higher pressure for testing. The given service conditions (i. e. pulsating and discontinuous demand, type and frequency of motion, higher working temperature etc.) additional demands on the hose material. These influences can be taken into account in favour of the working safety and working life by the following tables and diagrammes.

Single motion: Minimum bending radius for single motion tested according to DIN EN ISO 10380 6.2.

Several motion: For repeated motion without major dynamic load.

Dynamic motion: For dynamic motion the radius R_b is to be recalculated according to the table with the help of the corrective factors f_t and f_{dyn} .

The allowed working pressure is calculated as follows:

$$P_{zul.} = P_{max.} \cdot f_t \cdot f_{dyn.}$$

$P_{zul.}$ = Allowed working pressure (bar) f_t = Safety factor for increased temperature

$P_{max.}$ = Working pressure acc. to table (bar) f_{dyn} = Safety factor for dynamic load

The allowed bending radius is calculated as follows:

$$R_{dyn.} = \frac{R_b}{2,98} \left(1,09 + f_t \cdot f_{dyn.} + \frac{1}{f_t} + \frac{1}{f_{dyn.}} \right)$$

$R_{dyn.}$ = Bending radius for dynamic load (mm) f_t = Safety factor for increased temperature

R_b = Bending radius acc. to table (mm) $f_{dyn.}$ = Safety factor for dynamic load

Corrective factors for hose systems

Safety factor for increased temperatures

Material \ Working temperature (°C)	-200 bis -20	20	50	100	120	150	200	250	300	350	400	450	500	550
1.4301	1,00	1,00	0,90	0,73	0,70	0,66	0,60	0,55	0,51	0,49	0,48	0,46	0,46	0,46
1.4541	1,00	1,00	0,93	0,83	0,81	0,78	0,74	0,70	0,66	0,64	0,62	0,60	0,59	0,58
1.4404	1,00	1,00	0,90	0,73	0,70	0,67	0,61	0,58	0,53	0,51	0,50	0,49	0,47	0,47
1.4571	1,00	1,00	0,92	0,80	0,78	0,76	0,72	0,68	0,64	0,62	0,60	0,59	0,58	0,58
1.4435	1,00	1,00	0,90	0,74	0,70	0,66	0,61	0,56	0,53	0,51	0,50	0,48	0,47	0,47

Other materials available on request

Corrective factors for dynamic load

Flow* \ Motion	without vibration, low and slow motion	low vibration, frequent uniform motion	strong vibration rhythmic ongoing motion
stationary or slow uniform flow	1,00	0,80	0,40
pulsating and swelling flow	0,80	0,64	0,32
rhythmic and discontinuous flow	0,40	0,32	0,16

*Flows above a Reynolds figure of 5×10^4 can create harmful turbulences in corrugated hoses. Please contact our engineering department.

Calculation example

TUBOFLEX® stainless steel corrugated hose material 1.4301, MW 22 U1 – DN 50 is installed at a temperature of 300°C. It is exposed to low vibration and frequent uniform motion with pulsating and swelling flow.

$$P_{\max.} = 40 \text{ bar}$$

$$R_b = 280 \text{ mm}$$

$$f_t = 0,51$$

$$f_{\text{dyn.}} = 0,64$$

$$P_{\text{zul.}} = P_{\max.} \cdot f_t \cdot f_{\text{dyn.}} \quad R_{\text{dyn.}} = \frac{R_b}{2,98} \left(1,09 + f_t \cdot f_{\text{dyn.}} + \frac{1}{f_t} + \frac{1}{f_{\text{dyn.}}} \right)$$

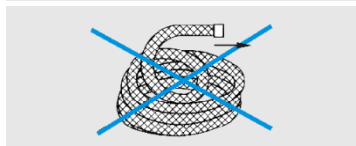
$$P_{\text{zul.}} = 40 \cdot 0,51 \cdot 0,64 \quad R_{\text{dyn.}} = \frac{280}{2,98} \left(1,09 + 0,51 \cdot 0,64 + \frac{1}{0,51} + \frac{1}{0,64} \right)$$

$$P_{\text{zul.}} = 13,0 \text{ bar}$$

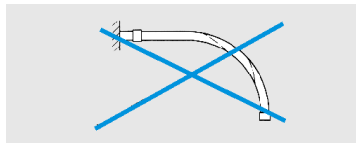
$$R_{\text{dyn.}} = 465 \text{ mm}$$

Installation instructions TUBOFLEX® metal hoses

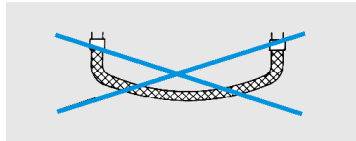
WRONG INSTALLATION



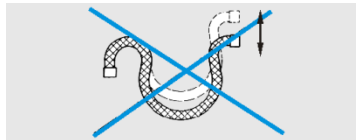
Do not pull the hose off – uncoil it



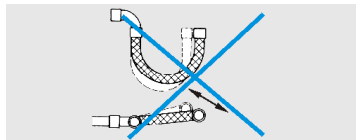
Do not twist the hose -
install it torsion-free



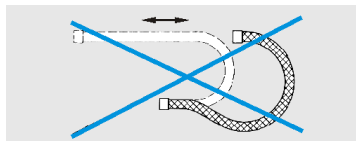
Dimension the hose adequately,
take care that the flexible
length is not too short



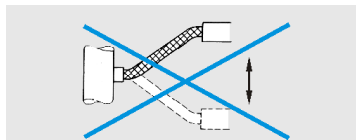
Avoid excessive bending
of the hose – use pipe bends



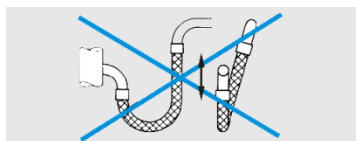
Do not move the hose obliquely
to the installation plane –
move it in hose axis only



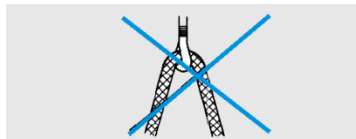
Avoid sagging of the hose –
use a support



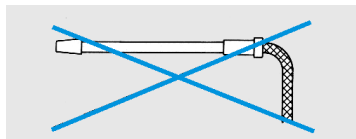
If larger movements have to be
absorbed: Do not install the hose
in a straight line, but in a
U-shaped bend



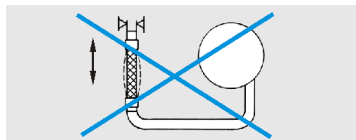
Avoid torsional twist when fittings
are not in line –
install in one plane only



Avoid overbending when suspending
the hose – use a support roll

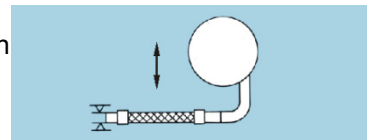
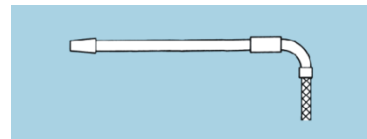
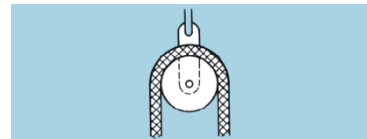
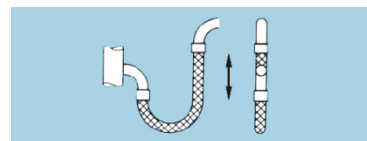
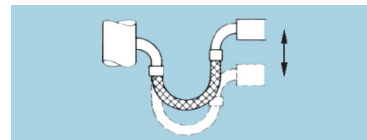
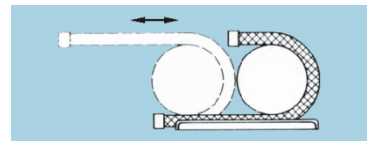
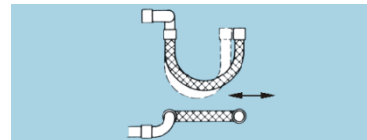
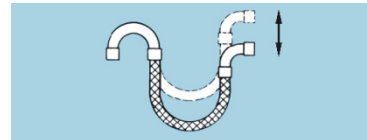
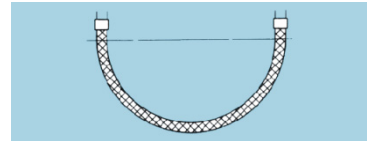
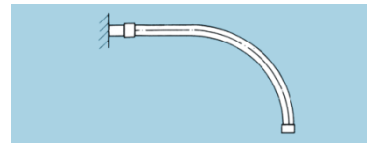
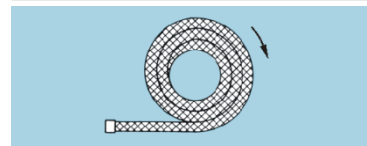


Avoid excessive bending of the
hoses at their ends – use pipe bends



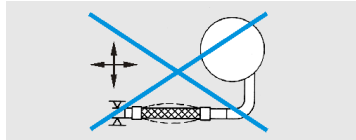
Do not absorb vibrations in axial direction
– install the hose vertically
to the direction of movement

CORRECT INSTALLATION

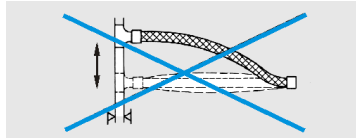


Installation instructions TUBOFLEX® metal hoses

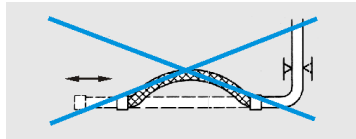
WRONG INSTALLATION



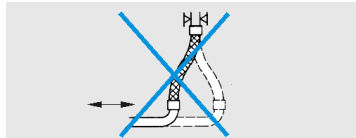
Do not absorb vibrations from several directions by one single hose – install several hoses in a 90° angle line



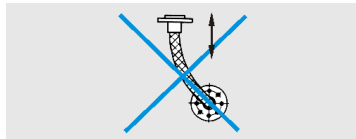
Do not allow the hoses to move in one direction only – centre it to permit absorption of half of the movement in both directions



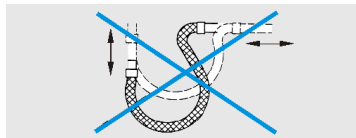
Do not permit axial movements – install the hose vertically to the direction of movement



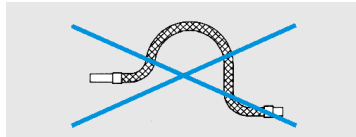
Avoid large lateral movement – install the hose in a 90° bend



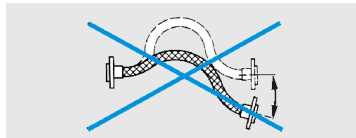
Avoid torsion – the hose bend and the direction of movements must be in the same plane



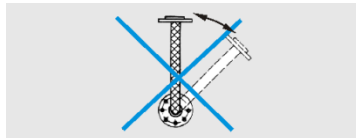
Avoid excessive bending of the hoses at their ends – use pipe bends



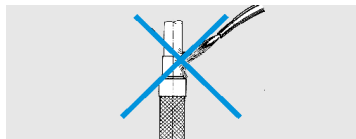
Do not use any length – dimension the exact length



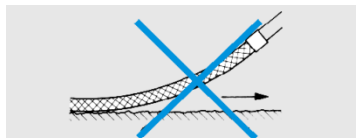
Take care that the flexible length is not too long – dimension the exact length



Avoid torsion due to angular movements – all movements in hose axis only

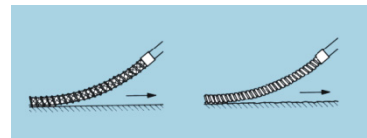
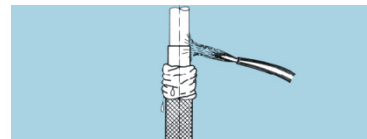
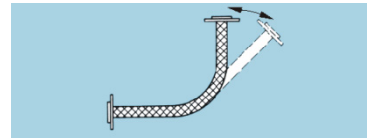
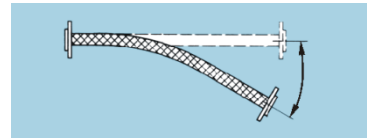
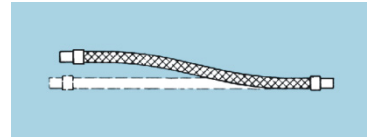
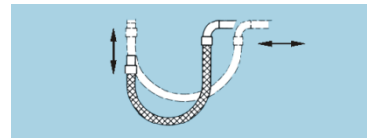
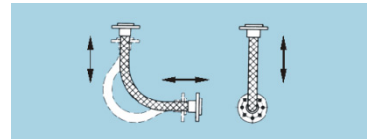
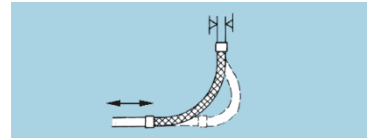
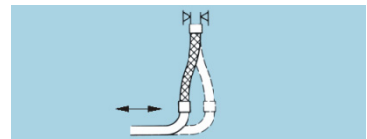
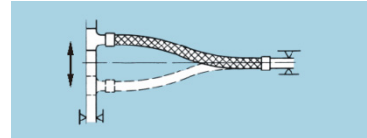
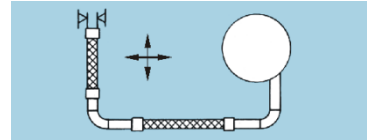


Keep the welding torch away from the hose – cool the connecting seam between the hose and the fittings – Do not overheat it



Do not drag the hose on the floor without any protection – avoid damage by using an outer protection cover

CORRECT INSTALLATION



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