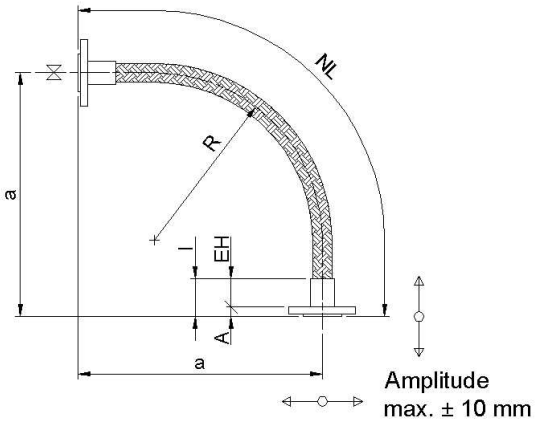


BOA Installation Instruction
Metal hoses and Metal hose assemblies

Influencing variables on life time

It is very difficult to calculate exactly the life time or the possible behaviour of metal hose assemblies. Their geometries and influencing variables are to complex and imprecise to allow a mathematically exact analysis. The life time depends mainly on the operating conditions and in consequence on an ideal installation position and a perfect installation mode. In most of the cases where the connection with metal hose assemblies is not satisfactory, they are not optimally positioned or the installation is incorrect. The following four measures have a decisively positive influence on the life time of metal hose assemblies:

- **Stressless installation within the realms of possibility**
- **Determination of the optimal nominal length of the metal hose assembly**
- **Avoid torsion**
- **Keep to the recommended bend radius**

Stressless installation

Very often, simple measures such as the installation of a rigid elbow in the adjacent pipe system can massively reduce the residual stress during installation.

Optimal nominal length

The optimal nominal length of the metal hose assembly avoids overbending or buckling, even if dynamic loads occur. If the recommended bend radii are not underrun, it becomes relatively easy to define a minimal life time.

Avoid torsion

To avoid torsion, at least one end of the metal hose assembly should be movable (e.g. equipped with a loose flange or a screw connection). In addition, sufficient bolt surface is necessary for proper screwing, to avoid torsion transfer to the metal hose. Moreover, in dynamic applications, hose axis and movement should be in the same plane. Then no torsion will occur.

Exact analysis of stress

In case of extraordinary stresses such as important movements, pressure variations etc., they have to be (mathematically) taken into consideration. The more precisely a problem is defined, the more easy becomes a mathematically reasonable design.

To be continued on the next page

Application fields and ways of installation

The application fields and ways of installation for metal hose assemblies are almost unlimited. If our customers are confronted with particularly difficult installation conditions, we seriously advice to hand in a sketch or drawing together with the inquiry. Thanks to our immense experience in that special field, we are able to find a solution even for very difficult tasks.

Bend radii

As a technical characteristic, each type of metal hose has two nominal bend radii: the static bend radius R_{static} (for fixed applications) and the dynamic bend radius $R_{dynamic}$ (for movable applications). Depending on the application, they must not be underrun (or only after having consulted our Product Engineering Division!

The basis for the determination of the bend radii is EN ISO Standard 10380 for corrugated metal hoses and metal hose assemblies. This standard is also the basis for our type approvals. For all dynamic tasks, also for thermal dilatations, always put the dynamic bend radius into the equation to calculate the nominal length of the metal hose assembly.

How to calculate the length of the connection zone

Length of the rigid connection zone l

$$l = EH + A$$

Into the equations appears the dimension l (mm). It defines the rigid connection zone at the end of the hose. l is calculated adding the length of the end ring EH and the length of the fitting A.

Length of the end ring EH

The end ring protects the welding zone from overstress. To calculate the nominal length, EH (mm) can be taken from the table below.

NW	5	6	8	10	12	16	20	25	32	40	50	65	80	100	125	150	175	200	250	300
EH	16	16	20	20	24	24	28	28	34	34	42	42	54	54	30	30	40	40	50	50

Length of the fitting A

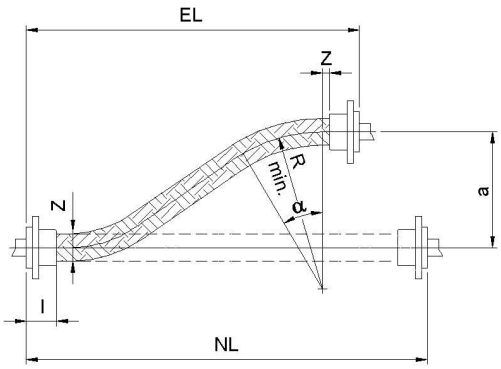
The protruding length of the fitting A (mm) can be taken from the fitting tables.

Rules for the calculation of hose lengths

Straight metal hose assembly for parallel displacement, static

(Displacement perpendicular to the axis is not allowed)

Installation type: straight metal hose assembly
Application: lateral displacement, single lateral bending (not suitable for repetitive movements!)



Check the bending angle

$$\cos \alpha = 1 - a / (2 \cdot R_{static})$$

$\cos \alpha$ must not be ≤ 0.5, otherwise the radius $R > R_{static}$ must be taken.

Nominal length

$$NL = 0.035 \cdot R_{static} \cdot \alpha + 2 \cdot (Z + l)$$

Installation length

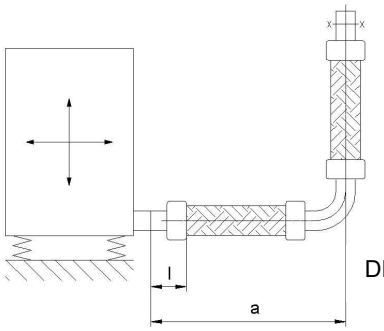
$$EL = 2 \cdot R_{static} \cdot \sin \alpha + 2 \cdot (Z + l)$$

a	displacement from the axis	(mm)
α	bending angle	(°)
R_{static}	static bend radius	(mm)
Z	outside diameter of the hose:	(mm)
l	fitting length, EH included	(mm)
NL	nominal length	(mm)
EL	installation length	(mm)

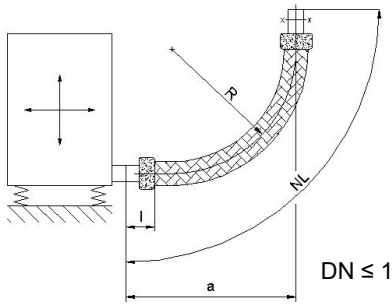
To be continued on the next page

90°-Bend for vibration absorption

Installation type: 90° bend or 90° dog-leg
Application: single bending,
all-around vibrations for small amplitude and high frequency



DN ≥ 125 mm



DN ≤ 100 mm

a	installation dimension	(mm)
$R_{dynamic}$	dynamic bend radius	(mm)
l	fitting length, EH included	(mm)
NL	nominal length	(mm)
DN	diameter	(mm)

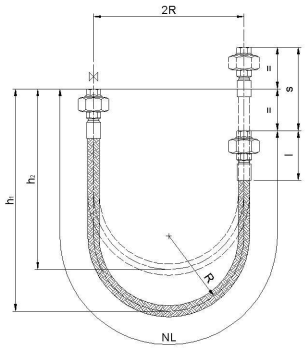
$$NL = 2.3 \cdot R_{dynamic} + 2 \cdot l$$ **Nominal length**

$$a = 1.365 \cdot R_{dynamic} + l$$ **Installation dimension**

U-Bend for vertical movement

(Displacement perpendicular to the axis is not allowed)

Installation type: vertical 180° bend
Application: vertical movement with big amplitude and low frequency



s	Movement	(mm)
$R_{dynamic}$	dynamic bend radius	(mm)
DN	diameter	(mm)
l	fitting length, EH included	(mm)
NL	nominal length	(mm)
h_{1max}	max. height of the 180° bend	(mm)
h_{2min}	min. height of the 180°bend	(mm)

$$NL = 4 \cdot R_{dynamic} + 0.5 \cdot s + 2 \cdot l$$ **Nominal length**

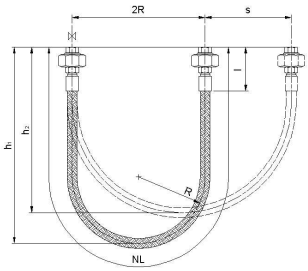
$$h_{1max} = 1.43 \cdot R_{dynamic} + 0.5 \cdot s + l$$ **Maximal height**

$$h_{2min} = 1.43 \cdot R_{dynamic} + l$$ **Minimal height**

U-Bend for lateral movement

(Displacement perpendicular to the axis is not allowed)

Installation type: vertical 180° bend
Application: horizontal movement with big amplitude and low frequency



s	movement	(mm)
$R_{dynamic}$	dynamic bend radius	(mm)
DN	diameter	(mm)
l	fitting length, EH included	(mm)
NL	nominal length	(mm)
h_{1max}	max. height of the 180° bend	(mm)
h_{2min}	min. height of the 180° bend	(mm)

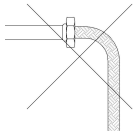
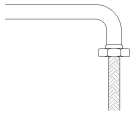
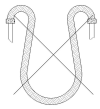
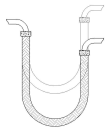
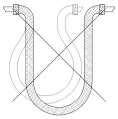
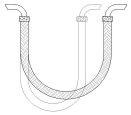
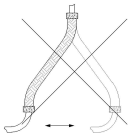
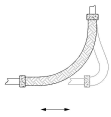
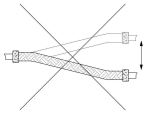
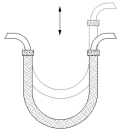
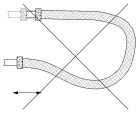
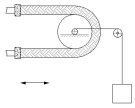
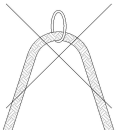
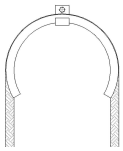
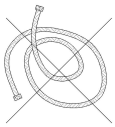
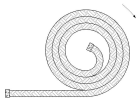
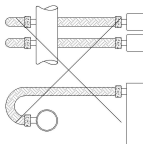
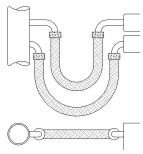
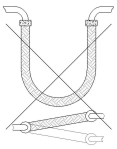
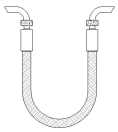
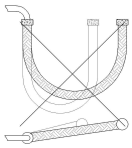
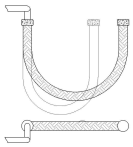
$$NL = 4 \cdot R_{dynamic} + 1.57 \cdot s + 2 \cdot l$$ **Nominal length**

$$h_{1max} = 1.43 \cdot R_{dynamic} + 0.785 \cdot s + l$$ **Maximal height**

$$h_{2min} = 1.43 \cdot R_{dynamic} + 0.5 \cdot s + l$$ **Minimal height**

To be continued on the next page

The figures opposite illustrate some examples of incorrect metal hose assembly installations, unfortunately often found in practice, and how to correct them easily.

wrong:		**correct:**	
Fig.1 Too big bending load directly behind the connection.		Using a rigid pipe elbow, the hose falls straight-line down.	
Fig.2 Too big bending load directly behind the connection.		Correct installation only with rigid pipe elbow.	
Fig.3 Too big bending load adjacent to the connecting points.		Correct installation only with rigid pipe elbow.	
Fig. 4 Variable bending loads are very bad. Too heavy flexion adjacent to the connections.		If big lateral movements are to be expected, install in a 90° bend.	
Fig.5 Variable bending loads and too heavy flexion adjacent to the connections.		Install rigid pipe elbows to avoid variable movements and too big bending load.	
Fig.6 Unfavorable variable movement and torsion stress.		Use a movable coil to keep good position and in order to avoid variable movement and torsion.	
Fig.7 Danger of buckling due to heavy bending load.		Using a saddle or a coil, buckling and consequently falling below the bend radius are avoided.	
Fig.8 Never uncoil a hose by pulling at one end. The hose would be damaged by torsion.		Unroll the hose in a straight line.	
Fig.9 Torsion stress and too heavy flexion directly behind the connection.		No torsion and favourable bending load thanks to the installation of rigid pipe elbows.	
Fig.10 Torsion stress.		If torsion can not be avoided, use movable couplings which absorb torsion. Thus the hose is only exposed to bending load.	
Fig.11 Torsion stress due to the fact that the two connections are not in the same plane.		No torsion stress if using a double rigid pipe elbow.	

Subject to change
15-05