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**Federal Office for Civil Protection FOCP**
SPIEZ LABORATORY

# Technical specifications TS-10

- Moulded parts and semi-finished products from thermoplastics, thermosets and rubber (plastic and rubber)
- Potting compounds
- Adhesives

Issue: 1 March 2025

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# 1 Legal basis and applicable provisions

- Federal Act on Civil Protection (BZG)
- Ordinance on Civil Protection (ZSV)
- Technical directives - Quality management for components subject to testing in the area of civil protection
- Technical directives concerning type plates, assembly, operating and maintenance instructions for FOCP-inspected installation parts
- Relevant further technical specifications of the FOCP with reference to this TS-10

This technical specification TS-10 comes into force on 1 March 2025. It defines the necessary properties of thermoplastics, thermosets, elastomers, potting compounds and adhesives for use in FOCP protective structures and FOCP-approved civil protection components.

It replaces the TS-10 of 01 September 2023. Existing approvals concerning this technical specification remain valid until the next renewal period. At the time of renewal, these approvals must comply with the present technical specification.

# 2 Test specifications and remarks

- Regulation L 055 200 Testing laboratory STS 0055 SPIEZ LABORATORY; Testing of corrugated hoses, nominal diameter 125 mm, for small ventilation units for protective structures
- Regulation L 055 202 Testing laboratory STS 0055 SPIEZ LABORATORY; Testing of corrugated hoses, nominal diameter 75mm, to gas-tight shut-off dampers with sealing air line
- Regulation L 055 209 Testing laboratory STS 0055 SPIEZ LABORATORY; Testing of corrugated hoses, nominal width 175 mm, for small ventilation units VA 300 for protective structures
- The requirements and test plans defined in this document are designed in such a way that an assessment of their suitability for use in protective structures is possible both for the materials used to date and for as wide a range of other polymer materials as possible. However, since the variety of polymer materials is very large and development is proceeding rapidly, it may be necessary for such materials to apply different or additional properties and requirements for the granting of a BZS approval. However, these must be technically justified and communicated to the applicant.

# 3 Labelling

Semi-finished products and moulded parts made of rubbers as well as thermoplastics and thermosets must be clearly and permanently labelled as follows:

- BZS number of the rubber compound (for corrugated hoses BZS number of the corrugated hose according to annex 9 B)
- Unique manufacturer name or manufacturer code (abbreviation of company name and/or plant)
- Material abbreviation (e.g. CR or EPDM)
- Lot / date of manufacture (e.g. 02/22)

For semi-finished products, the marking is applied every 5 running metres by printing so that the function is not impaired.
In the case of small dimensions of the moulded parts, the marking must be adapted accordingly or omitted.

# 4 Rubber materials (vulcanisates), non-foamed

Material-specific type tests are generally carried out on sample plates. Identification tests are carried out exclusively on moulded parts and semi-finished products.
Special tests can be carried out according to individual needs.

For the material-specific type test, 10 sample plates of the vulcanised compound with a thickness of 2 ±0.2 mm and an area of at least 200 x 200 mm each must be provided, as well as two sample plates with a thickness of 6.3 ±0.3 mm. The orientations of the fabrication (longitudinal and transversal) must be recognisable on all 2 mm sample plates.

For the identification test of semi-finished products such as round cords, profiles, etc., a section with at least 2 m running length must be provided from the area with marking according to chapter 3.

As a rule, 4 pieces must be provided for the identification test of moulded parts. For very small parts (smallest external dimension approx. ≤ 30 mm), the number must be agreed with the testing laboratory.

| | Type testing | | | | ☐ | | |
|---|---|---|---|---|---|---|---|
| | Identification testing | | | | | ☐ | |
| | Special testing | | | | | | ☐ |
| **No.** | **Property** | **Request** | **Test standard/ Test specification** | **n** | | | |
| 4.1 | Compound designation | Indication | - | - | ☒ | ☒ | ☐ |
| 4.2 | Labelling | see chapter 3 | - | - | ☒[1)] | ☒ | ☐ |
| 4.3 | Density | X[2)] ± 0.05 g/cm³ | DIN EN ISO 1183-1 | 3 | ☒ | ☒ | ☐ |
| 4.4 | Hardness as delivered | X[3)] ± 5 Shore A<br>X[4)] ± 5 °, M | DIN ISO 48-4<br>DIN ISO 48-2 | 5 | ☒ | ☒ | ☐ |
| 4.5 | Compression set[5)] | ≤ 25 % | DIN ISO 815-1 | 3 | ☒ | ☒ | ☐ |
| 4.6 | Ingredients of the compound | Compliance with reference values[6)] | ASTM E1131 | 2 | ☒ | ☒ | ☐ |
| 4.7 | Ozone resistance[7)] | No cracks | DIN ISO 1431-1 | 3 | ☒ | ☒[8)] | ☐ |
| 4.8 | Tension set[9)] | ≤ 15 % | DIN ISO 2285 | 3 | ☒ | ☐ | ☐ |
| 4.9 | Tensile properties lengthwise & crosswise as delivered | $\sigma_R$ ≥ 6 MPa<br>$\varepsilon_R$ ≥ 200 % | DIN 53504 | 6 each | ☒ | ☐ | ☐ |
| 4.10 | Change in tensile properties lengthwise & crosswise after 7 d heat ageing[10)] | $\Delta\sigma_R \leq$ ± 30 %<br>$\Delta\varepsilon_R \leq$ ± 30 % | DIN 53508<br>DIN 53504 | 6 each | ☒ | ☐ | ☐ |
| 4.11 | Change in tensile properties lengthwise & crosswise after 28 d heat ageing[10)] | $\Delta\sigma_R \leq$ ± 50 %<br>$\Delta\varepsilon_R \leq$ ± 50 % | DIN 53508<br>DIN 53504 | 6 each | ☒ | ☐ | ☐ |
| 4.12 | Hardness change after 7 d heat ageing[10)] | ≤ ± 10 Shore A | DIN 53508<br>DIN ISO 48-4 | 5 | ☒ | ☐ | ☐ |
| 4.13 | Tear strength method A, lengthwise & crosswise | $T_S$ ≥ 2.0 N/mm | DIN ISO 34-1 | 6 each | ☒ | ☐ | ☐ |
| 4.14 | Tear strength method B (b), longitudinal & transverse | $T_S$ ≥ 10 N/mm | DIN ISO 34-1 | 6 each | ☒ | ☐ | ☐ |
| 4.15 | Breakthrough time against chemical warfare agents[11)] | ≥ 6 h | Own method of Spiez Laboratory (conductivity method) | 5 | ☒ | ☐ | ☐ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Type testing | | | | ☐ | | |
| | Identification testing | | | | | ☐ | |
| | Special testing | | | | | | ☐ |
| **No.** | **Property** | **Request** | **Test standard/ Test specification** | **n** | | | |
| | **Additional requirements when used as a door sealing profile** | | | | | | |
| 4.16 | Main dimensions | Compliance with tolerances[12)] | Measurement by means of a microscope | 1-3 | ☐ | ☒ | ☐ |
| 4.17 | Short-term heat resistance, i.e. hardness after storage at 200 °C for 2 h, measured at 23 °C | ≤ 90 Shore A | DIN ISO 48-4 | 5 | ☒ | ☐ | ☐ |
| 4.18 | Hardness increase after storage at -20 °C / 48 h, measured at -20 °C | ≤ 20 Shore A | DIN ISO 48-4 | 5 | ☒ | ☐ | ☐ |
| | **Additional requirements for use as sealing material against oil and grease** | | | | | | |
| 4.19 | Resistance to oil and grease | Specific material[13)] | - | - | ☒ | ☐ | ☐ |
| | **Additional requirements for use as corrugated hose** | | | | | | |
| 4.20 | Technical documentation | Complete, consistent with product | L 055 200/202/209 | - | ☒ | ☐ | ☐ |
| 4.21 | Main dimensions | See Annex B.1 | L 055 200/202/209 | 2 | ☒ | ☒ | ☐ |
| 4.22 | Forcer and length in the compressed state | See Annex B.5 | L 055 200/202/209 | 2 | ☒ | ☐ | ☐ |
| 4.23 | Mountability | [14)] | L 055 200/202/209 | 2 | ☒ | ☐ | ☐ |
| 4.24 | Flexibility check[15)] | See Annex B.4 | L 055 200/202 | 2 | ☒ | ☐ | ☐ |
| 4.25 | Negative pressure at buckling | See Annex B.3 | L 055 200/202/209 | 2 | ☒ | ☐ | ☐ |
| 4.26 | Flow resistance[16)] | See Annex B.2 | L 055 200/209 | 2 | ☒ | ☐ | ☐ |

1) Not for sample plates
2) Determination on the basis of measured values from type testing for initial approval
3) Value from type test for initial approval with the following exception:
   When used for door sealing profiles "small" and "large", the value must be 52 ± 5 Shore A.
   Hardness measurements on these profiles are carried out according to Appendix A.
4) The measurement of the hardness IRHD (method M) is used for moulded parts with small dimensions for which the Shore A method cannot be used or does not make sense. As a reference, this hardness is also determined during type tests on 2 mm sample plates.
5) 22 h, 25 % compression, method A of cooling, test specimen type B (if not possible for moulded parts, then non-standard test specimens are to be used).
   Test temperatures:
   - 70 °C (NR, (X)IIR, CR, SBR)
   - 100 °C (NBR, HNBR, EPDM)
   - 150 °C (FKM and silicone rubbers)
6) By means of thermal analysis TGA the following main components of the compound are determined:
   - Highly volatile components (plasticisers)
   - Medium volatile components (polymer)
   - Combustible components (carbon black)
   - Non-volatile components (inorganic fillers incl. ash)

   If the following conditions apply, rubber compounds can be assessed as the same with regard to the main components mentioned:
   No more than one component may deviate by more than ± 5 % (mass) from the reference

measurements (initial type approval test), and the decomposition temperatures (inflection point temperatures) of the medium volatile components must be within the experience ranges of the accredited testing laboratory STS 0036 for the corresponding rubber polymers (heating rate 30 K/min).

7) 72 h static elongation test, method A, wide specimen (if not possible for moulded parts also different specimens), 20 % elongation, 50 pphm $O_3$, 40 °C, 55 % r.h.
8) Only necessary for rubbers with C=C double bonds in the polymer main chain, e.g. NR, (X)IIR, CR, SBR, NBR, HNBR. Not necessary for rubbers which are intrinsically resistant to ozone such as EPDM, FKM and silicones.
9) Constant elongation test, 24 h, method A for cooling and recovery, 23 ±2 °C, strip test specimen with wide ends, 100 % elongation.
10) Test temperatures as in footnote 5) for compression set
11) Specimen thickness 2 mm, test area 8.04 $cm^2$ (Ø = 32 mm), challenge 50 µl sulfur mustard/chlorobenzene 80:20, test temperature 30 °C, breakthrough criterion 4 µg/$cm^2$
12) Tolerances according to Appendix A
13) Oil and grease resistant materials such as NBR or HNBR with ACN content ≥ 28 %, FKM
14) It must be possible to fit the connecting pieces of the corrugated hoses without great force onto a hose coupling in accordance with a coupling with valid approval. The rubber material must fit snugly, but must not be stretched too much.
15) Only for corrugated hoses DN 75 and DN 125
16) Only for corrugated hoses DN 125 and DN 175

# 5 Rubber materials (vulcanisates), foamed

For type and identification testing of plate-like semi-finished products, at least approx. 1 $m^2$ must be provided.

For tests on other types of semi-finished products and on moulded parts, the necessary sample material must be agreed with the testing laboratory.

| | Type testing | | | | ☐ | | |
|---|---|---|---|---|---|---|---|
| | Identification testing | | | | | ☐ | |
| | Special testing | | | | | | ☐ |
| **No.** | **Property** | **Request** | **Test standard/ Test specification** | **n** | | | |
| 5.1 | Product designation | Indication | - | - | ☒ | ☒ | ☐ |
| 5.2 | Labelling | see chapter 3 | - | - | ☒ | ☒ | ☐ |
| 5.3 | Compressive stress value $CV_{40}$ | X[1)] ± 3 kPa | DIN EN ISO 3386-1/2 | 3 | ☒ | ☒ | ☐ |
| 5.4 | Compression set[2)] | ≤ 30 % | DIN EN ISO 1856 | 3 | ☒ | ☒ | ☐ |
| 5.5 | Ingredients of the compound | Compliance with reference values[3)] | ASTM E1131 | 2 | ☒ | ☒ | ☐ |
| 5.6 | Ozone resistance[4)] | No cracks | DIN ISO 1431-1 | 3 | ☒ | ☒[5)] | ☐ |
| 5.7 | Tensile properties lengthwise & crosswise as delivered | $\sigma_R$ X[1)] MPa<br>$\varepsilon_R$ X[1)] % | DIN EN ISO 1798 | 6 each | ☒ | ☐ | ☐ |
| 5.8 | Change in tensile properties lengthwise & crosswise after 7 d heat ageing[6)] | $\Delta\sigma_R \leq \pm$ 30 %<br>$\Delta\varepsilon_R \leq \pm$ 30 % | DIN 53508<br>DIN EN ISO 1798 | 6 each | ☒ | ☐ | ☐ |
| 5.9 | Change in tensile properties lengthwise & crosswise after 28 d heat ageing[6)] | $\Delta\sigma_R \leq \pm$ 50 %<br>$\Delta\varepsilon_R \leq \pm$ 50 % | DIN 53508<br>DIN EN ISO 1798 | 6 each | ☒ | ☐ | ☐ |

1) Determination on the basis of measured values from type testing at initial approval
2) Procedure B, 23 °C, 72 h, 50 % compression
3) See footnote 6) in chapter 4
4) 72 h static elongation test, method A, wide test specimen (if not possible for moulded parts also different specimen), 20 % elongation, 50 pphm $O_3$, 40 °C, 55 % r.h.
5) Only necessary for rubbers with C=C double bonds in the polymer main chain, e.g. NR, (X)IIR, CR, SBR, NBR, HNBR. Not necessary for rubbers which are intrinsically resistant to ozone such as EPDM, FKM and silicones.
6) Test temperatures:
   - 70 °C (NR, (X)IIR, CR, SBR)
   - 100 °C (NBR, HNBR, EPDM)
   - 150 °C (FKM and silicone rubbers)

# 6 Potting compounds

For the tests, 7 sample plates of the processed potting compound with a thickness of 2 ±0.2 mm and an area of at least 130 x 130 mm each shall be provided.

| | Type testing | | | | ☐ | | |
|---|---|---|---|---|---|---|---|
| | Identification testing | | | | | ☐ | |
| | Special testing | | | | | | ☐ |
| **No.** | **Property** | **Request** | **Test standard/ Test specification** | **n** | | | |
| 6.1 | - Material designation<br>- Trade name<br>- Manufacturing company<br>- Technical data sheet<br>- Processing data | Information to be submitted with application for approval and for type tests | - | - | ☒ | ☐ | ☐ |
| 6.2 | Material type | Vulcanisate[1)] | - | - | ☒ | ☐ | ☐ |
| 6.3 | Hydrolysis resistance | resistant[1)] | - | - | ☒ | ☐ | ☐ |
| 6.5 | Polymer type | Material identifiable by infrared spectrum[2)] | L 036 017 | 1 | ☒ | ☒ | ☐ |
| 6.4 | Ingredients of the compound | Compliance with reference values[3)] | ASTM E1131 | 2 | ☒ | ☒ | ☐ |
| 6.6 | Compression set[4)] | ≤ 25 % | DIN ISO 815-1 | 3 | ☒ | ☒ | ☐ |
| 6.7 | Ozone resistance[5)] | No cracks | DIN ISO 1431-1 | 3 | ☒ | ☒[6)] | ☐ |
| 6.8 | Tensile properties lengthwise & crosswise as received | $\sigma_R \geq 6$ MPa<br>$\varepsilon_R \geq 200$ % | DIN 53504 | 6 each | ☒ | ☐ | ☐ |
| 6.9 | Change in tensile properties lengthwise & crosswise after 7 d heat ageing[7)] | $\Delta\sigma_R \leq \pm 30$ %<br>$\Delta\varepsilon_R \leq \pm 30$ % | DIN 53508<br>DIN 53504 | 6 each | ☒ | ☐ | ☐ |
| 6.10 | Change in tensile properties lengthwise & crosswise after 28 d heat ageing[7)] | $\Delta\sigma_R \leq \pm 50$ %<br>$\Delta\varepsilon_R \leq \pm 50$ % | DIN 53508<br>DIN 53504 | 6 each | ☒ | ☐ | ☐ |
| 6.11 | Adhesive strength | [8)] | - | 3 | ☒ | ☐ | ☐ |

1) Assessment on the basis of the technical data sheet and possible enquiries with the manufacturer or supplier. No products based on pure polyester urethane rubber (AU).
2) Comparison with response spectrum from type test for initial approval
3) Analogue footnote 6) in chapter 4
4) 22 h, 25 % compression, method A of cooling, test specimen type B. Material-specific test temperatures such as 70 °C for PUR and 150 °C for silicone.
5) 72 h static elongation test, method A, wide test specimen, 20 % elongation, 50 pphm $O_3$ , 40 °C, 55 % r.h.
6) Only if a non-intrinsically ozone-resistant material is present
7) Material-specific test temperatures such as 70 °C for PUR and 150 °C for silicone.
8) For safety-relevant connections such as aerosol filter media of gas filters, it must not be possible to detach the potting compound from the base or inlet connection without tearing. For other connections, at least 50 % of the potting compound must adhere when tearing off from the adhesive surfaces.

# 7 Thermoplastics and thermosets; moulded parts and semi-finished products

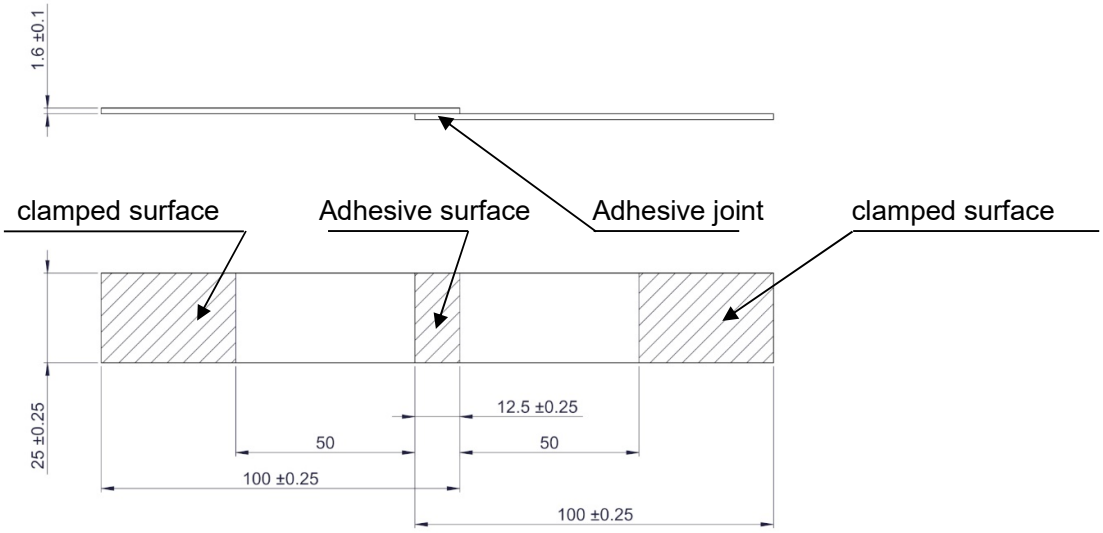
For the tests, sufficient moulded parts of each mould cavity or sufficient semi-finished products must be made available in consultation with the testing laboratory, as well as an additional 100 g of raw material pellets from the **same** production batch in the case of thermoplastic materials.

| | Type and identification testing | | | | ☐ | |
|---|---|---|---|---|---|---|
| | Special testing | | | | | ☐ |
| **No.** | **Property** | **Request** | **Test standard/ Test specification** | **n** | | |
| 7.1 | - Material designation<br>- Trade name<br>- Manufacturing company<br>- Analysis certificate for submitted batch<br>- Processing company<br>- Tool number<br>- Number of cavities | Information to be submitted with application for approval, for type tests and with application for lot release | - | - | ☒ | ☐ |
| 7.2 | Mass | X[1] ± Y[1] g, g/cm, g/cm² | - | n[2] | ☒ | ☐ |
| 7.3 | Density | X[1] ± 0.05 g/cm³ | DIN EN ISO 1183-1 | 3 | ☒ | ☐ |
| 7.4 | Polymer type | Material identifiable by infrared spectrum[3] | L 036 017 | 1[4] | ☒ | ☐ |
| 7.5 | Content of inorganic fillers | ≥ X % [1] | ASTM E1131 | 2[4] | ☒ | ☐ |
| 7.6 | Thermal properties | Material identifiable with thermal analysis DSC[5] | DIN EN ISO 11357-2/3 | 2[4] | ☒ | ☐ |
| 7.7 | Melt flow rate MVR for thermoplastics | Difference between moulded part and raw granulate ≤ ±10 % (guide value) | DIN EN ISO 1133-1<br>DIN EN ISO 1133-2 | 2[4] | ☒ | ☐ |
| 7.8 | Post-shrinkage of POM moulded parts | ≤ 0.3 % (guide value) | L 036 081 | 3 | ☒ | ☐ |
| 7.9 | Residual stress-cracking[6] | No cracks in mechanically stressed areas | L 036 080 | 3 | ☒ | ☐ |

1) Determination on the basis of measured values from type testing for initial approval
2) Moulded parts: 20 pcs. each of all cavities; Semi-finished products: 10 test specimens (sections)
3) Comparison with response spectrum from type test for initial approval
4) Testing on the finished product and, in the case of thermoplastics, also on the raw pellets
5) Comparison with property values from type testing for initial approval such as e.g. glass transition temperature $T_g$ , glass transition step height $\Delta c_p$ , crystallite melting peak-temperature $T_{p,m}$ , normalised enthalpy of fusion $\Delta H_f$
6) For thermoplastic materials such as e.g. PS, SB, SAN, ABS, PMMA, PC, PSU, POM, PA66, PA6, PA6-3-T, HDPE, LDPE

# 8 Adhesives

10 versions of the original bonded joint, 10 g of adhesive and 30 test specimens for measuring the shear strength shall be submitted as follows:




| | Type testing | | | | ☐ | |
|---|---|---|---|---|---|---|
| | Special testing | | | | | ☐ |
| **No.** | **Property** | **Request** | **Test standard/ Test specification** | **n** | | |
| 8.1 | - Material designation<br>- Trade name<br>- Manufacturing company<br>- Technical data sheet<br>- Processing data | Information to be submitted with application for admission | - | - | ☒ | ☐ |
| 8.2 | Polymer type | Material identifiable by infrared spectrum[1)] | L 036 017 | 1 | ☒ | ☐ |
| 8.3 | Ingredients of the compound | Compliance with reference values[2)] | ASTM E1131 | 2 | ☒ | ☐ |
| 8.4 | Thermal properties | Material identifiable with thermal analysis DSC[3)] | DIN EN ISO 11357-2/3 | 2 | ☒ | |
| 8.5 | Tensile shear strength as delivered | $\tau_B \geq$ X MPa[4)] | DIN EN 1465 | 10 | ☒ | ☐ |
| 8.6 | Change in tensile shear strength after 28 d heat ageing at 70 °C | $\Delta\tau_B$ max. - 20 % | DIN EN 1465 | 10 | ☒ | ☐ |
| 8.7 | Change in tensile shear strength after 28 d storage at 40 °C, 90 % r.h. | $\Delta\tau_B$ max. - 20 % | DIN EN 1465 | 10 | ☒ | ☐ |
| 8.8 | Stress cracking in contact with plastics | No stress cracks | Visual Assessment | 10 | ☒ | ☐ |

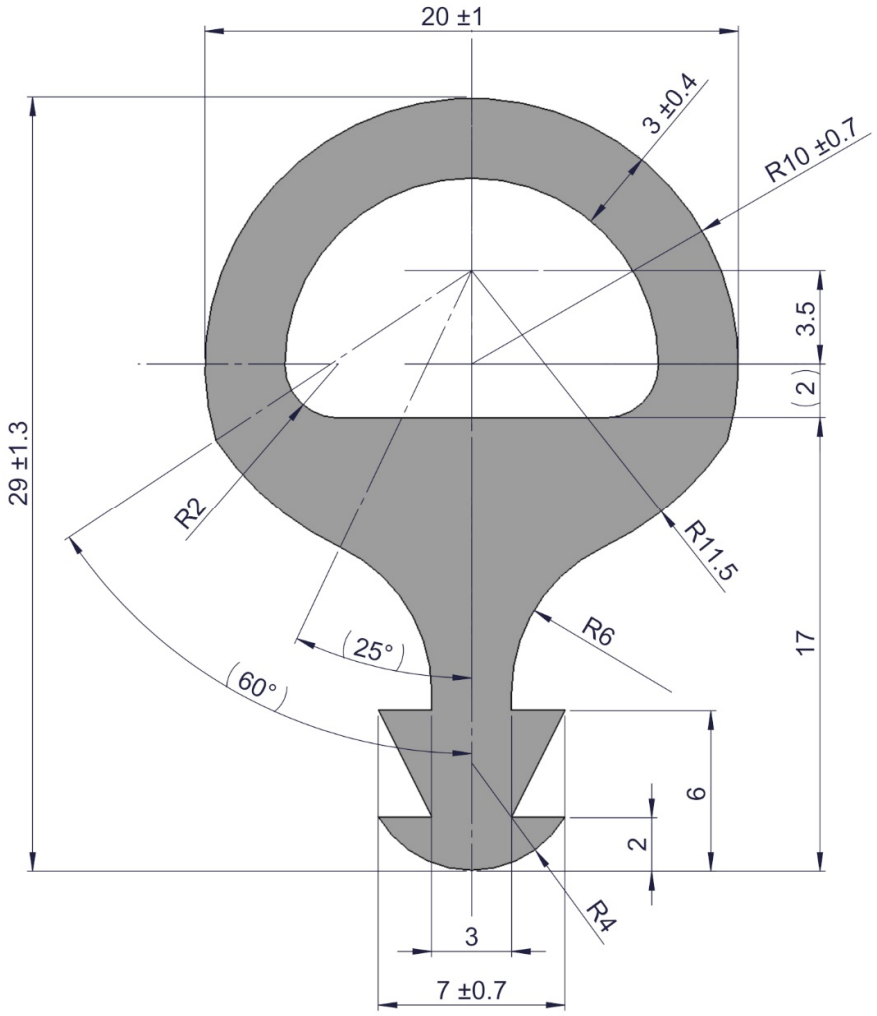
1) Comparison with response spectrum from type test for initial approval
2) Analogue footnote 6) in chapter 4
3) Comparison with property values from type testing for initial approval such as e.g. glass transition temperature $T_g$, glass transition step height $\Delta c_p$, crystallite melting peak-temperature $T_{p,m}$ , normalised enthalpy of fusion $\Delta H_f$
4) Determination on the basis of measured values from type testing for initial approval

# 9 Appendix

## A. Door sealing profiles

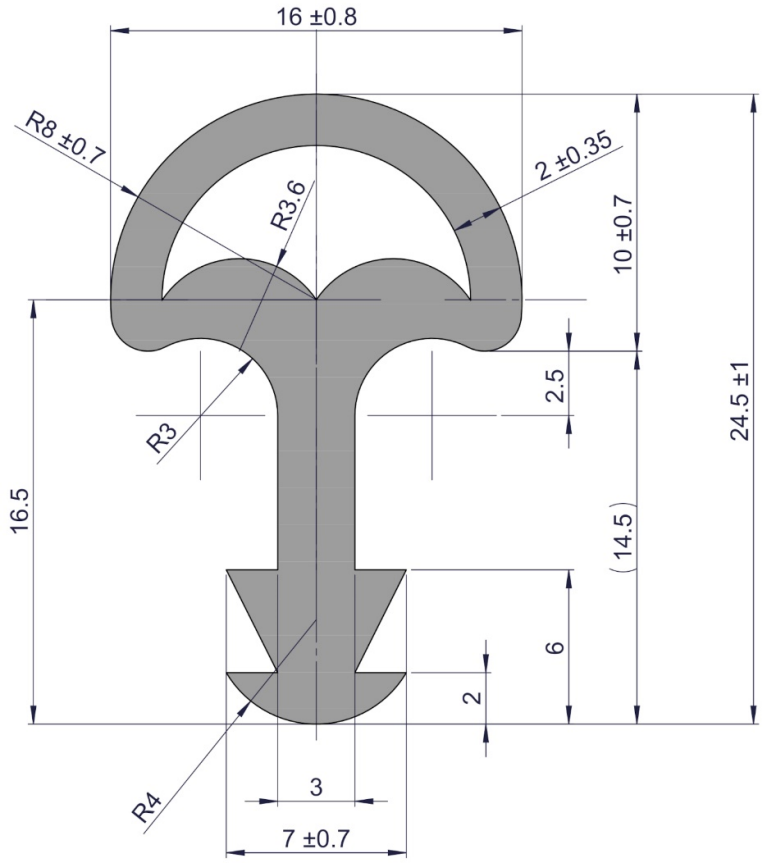
## A.1 Dimensions and tolerances

**Profile (large) for armoured doors and armoured covers**



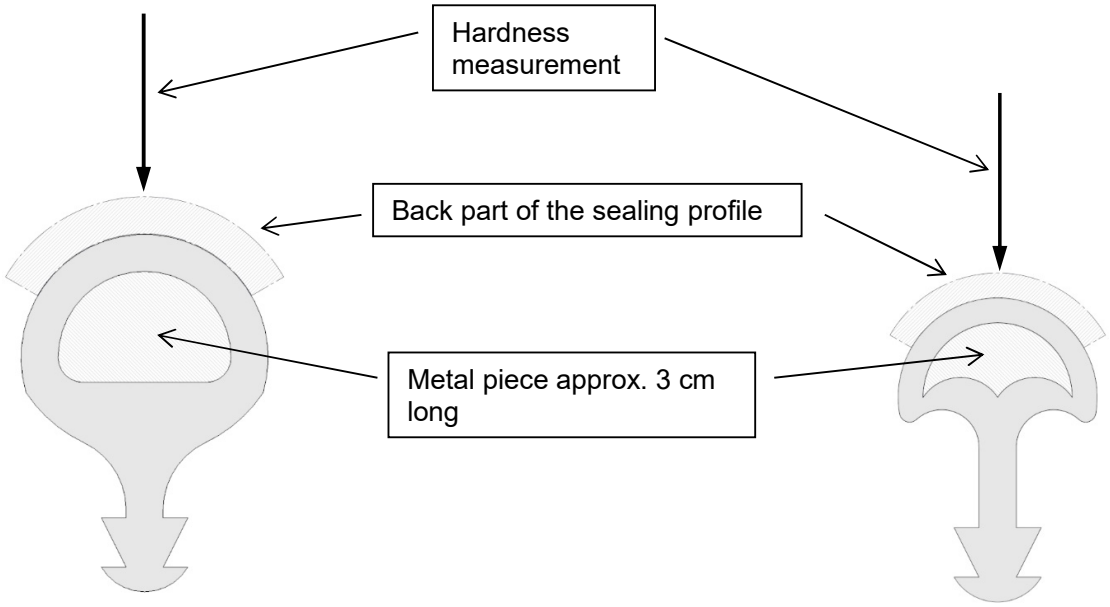

For dimensions without tolerance specifications, the limit dimensions of class E3 according to DIN ISO 3302-1 apply.

**Profile (small) for pressure doors**




For dimensions without tolerance specifications, the limit dimensions of class E3 according to DIN ISO 3302-1 apply.

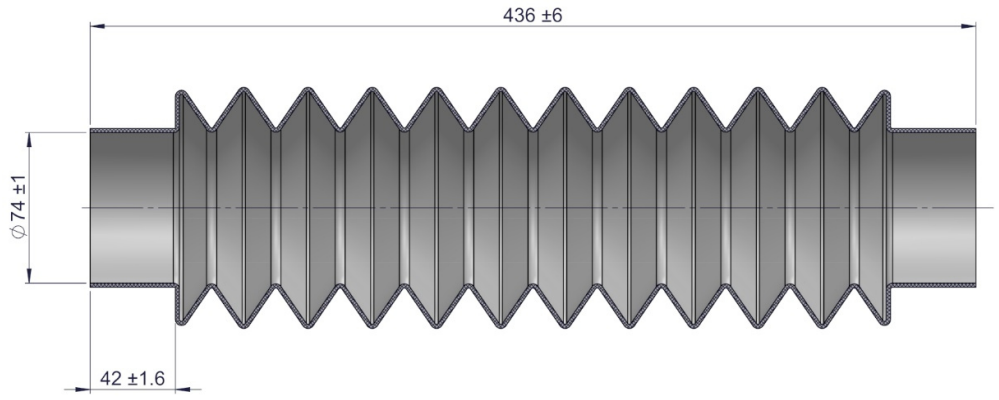
## A.2 Hardness testing



# B. Corrugated hoses and bellows

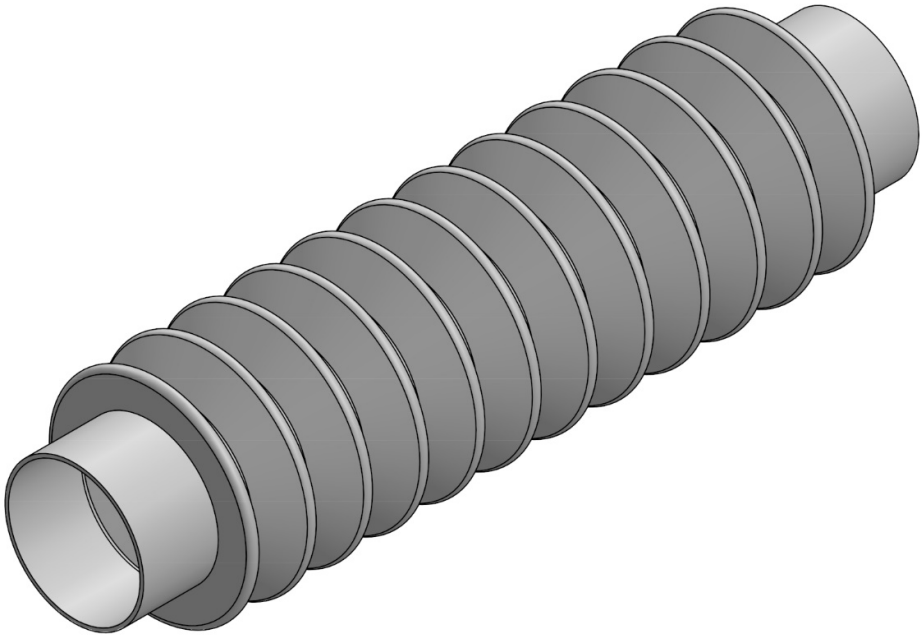
## B.1 Main dimensions and tolerances

### Corrugated hose DN 75 mm



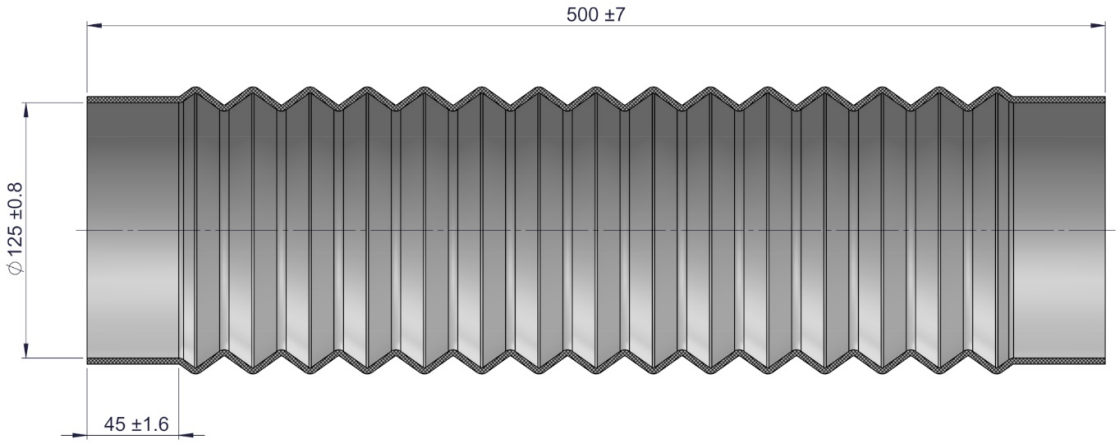

It must be possible to extend the folded hose to 500 mm without using too much force. The cross-section and the folds must not buckle in the process.

Highly visible and permanent labelling is to be applied to the corrugated tube according to chap. 3



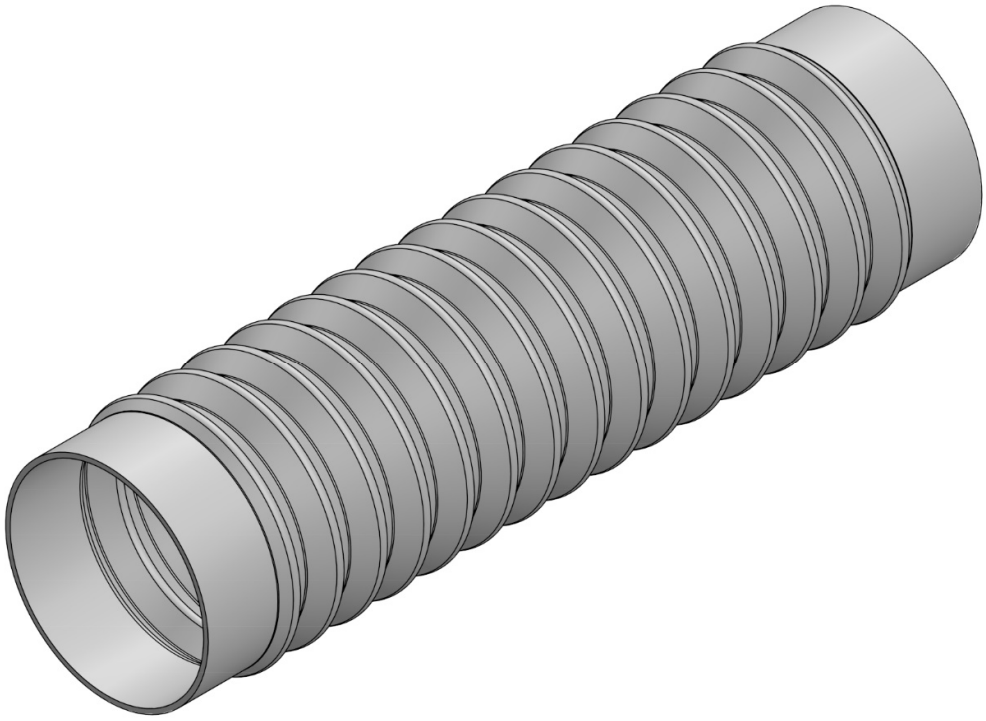
For dimensions without tolerance specifications, the limit dimensions of class M3 according to DIN ISO 3302-1 apply.

## Corrugated hose DN 125 mm



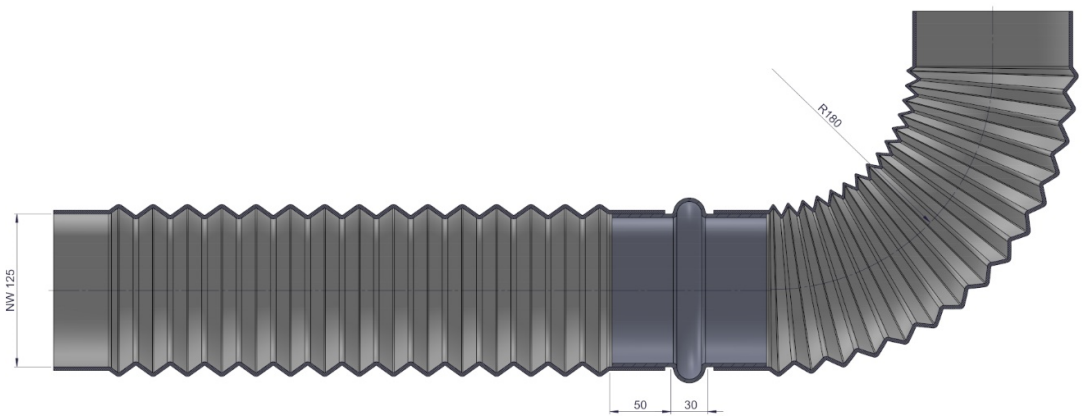

It must be possible to extend the folded hose to 600 mm without using too much force. The cross-section and the folds must not buckle in the process.

Highly visible and permanent labelling is to be applied to the corrugated tube according to chap. 3



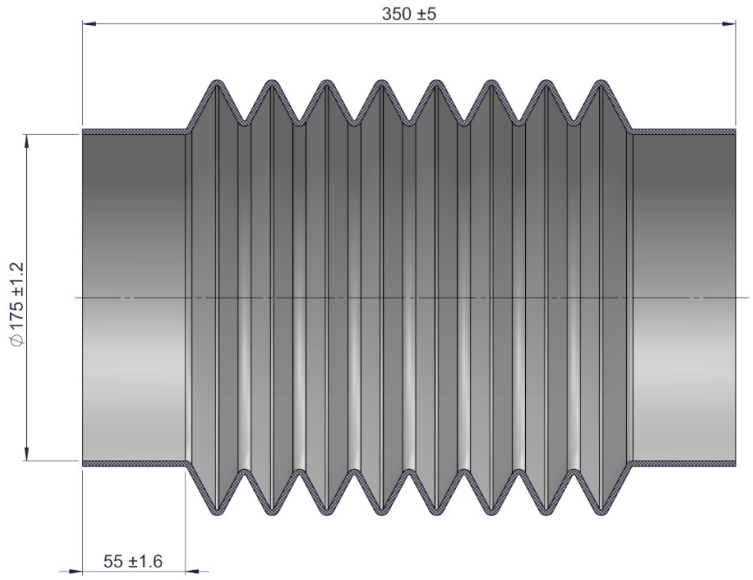
For dimensions without tolerance specifications, the limiting dimensions of class M3 according to DIN ISO 3302-1 apply.

## Corrugated hose DN 125 mm with coupling element



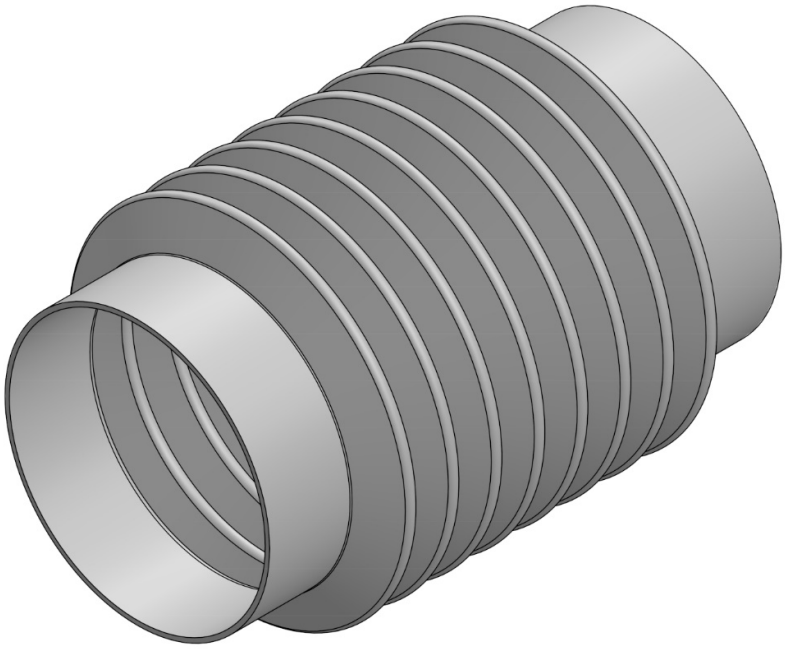

For dimensions without tolerance specifications, the limiting dimensions of class M3 according to DIN ISO 3302-1 apply.

## Corrugated hose DN 175 mm



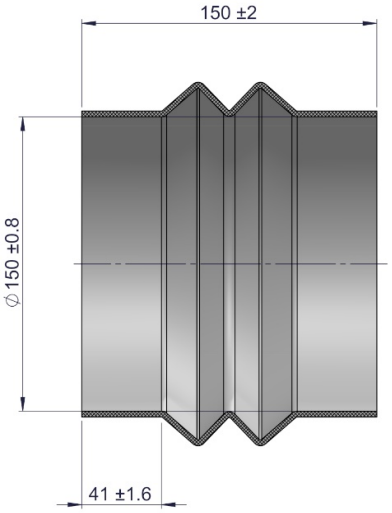

It must be possible to extend the folded hose to 380 mm without exerting too much force. The cross-section and the folds must not buckle in the process.

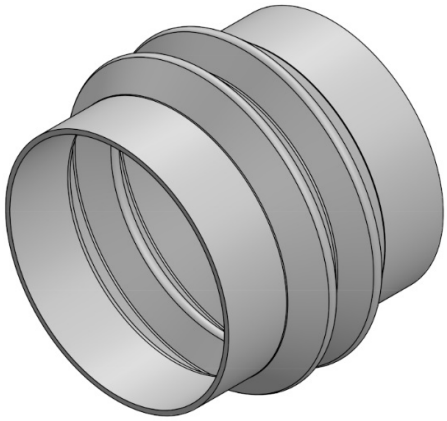
Highly visible and permanent labelling is to be applied to the corrugated tube according to chap. 3



For dimensions without tolerance specifications, the limiting dimensions of class M3 according to DIN ISO 3302-1 apply.

**Bellows DN 150 mm**



Clearly visible and permanent labelling is to be applied to the bellows according to chap. 3

For dimensions without tolerance specifications, the limiting dimensions of class M3 according to DIN ISO 3302-1 apply.

## **B.2** Maximum flow resistance **test**

| **Air flow** | **DN 125** | | **DN 175** | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **C** |
| [$m^3$/h] | [Pa] | [Pa] | [Pa] | [Pa] |
| 150 | 15 | 40 | -- | -- |
| 300 | 55 | 165 | 6 | 10 |
| 600 | -- | -- | 12 | 28 |

### Variants of the test arrangement for determining the flow resistance state

**Variant A**
Two corrugated hoses with a coupling, laid out straight, connected to measuring tubes. (Flow resistance of the measuring tubes subtracted)

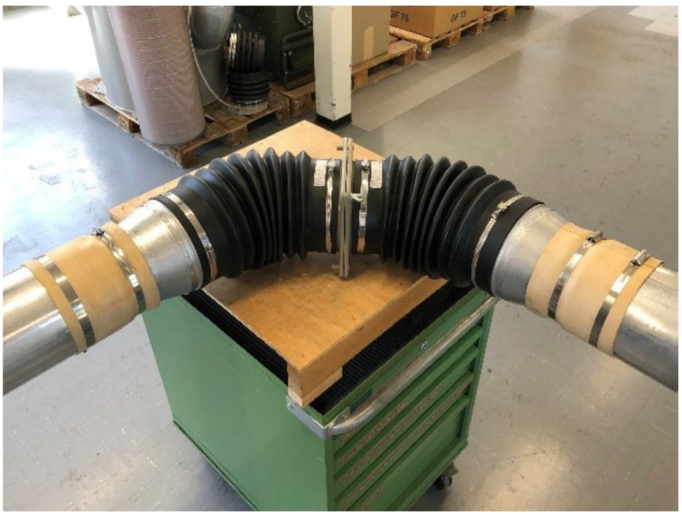
**Variant B**
Two corrugated hoses with a coupling, laid out in a 180° bend, connected to measuring tubes. (Flow resistance of the measuring tubes subtracted).

**Variant C**
Two corrugated hoses with a coupling, laid out in a 90° bend, connected to measuring tubes. (Flow resistance of the measuring tubes subtracted)

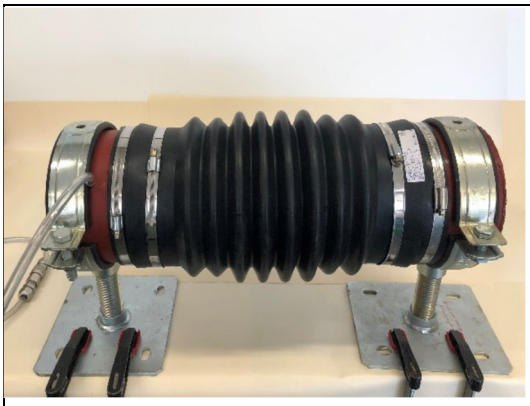
### Variant A

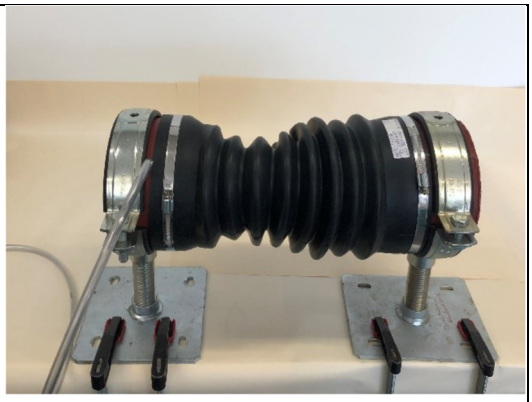
### Variant B

### Variant C



## B.3 Test negative pressure at buckling



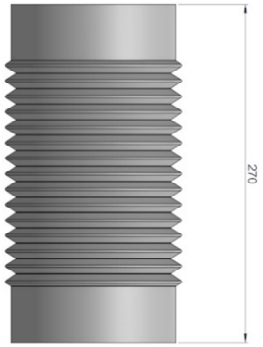


| **Nominal width D [ mm]** | **Permissible negative pressure p at buckling [mbar].** | **Arrangement** |
|---|---|---|
| 75 | > 20 mbar | Straight in untensioned length, ends fixed<br><br>90° bend,<br>ends fixed |
| 125 | > 15 mbar | In position 2 and 3 according to chapter B4 |
| 150 | No requirements | --- |
| 175 | > 15 mbar | Straight in untensioned length, ends fixed |

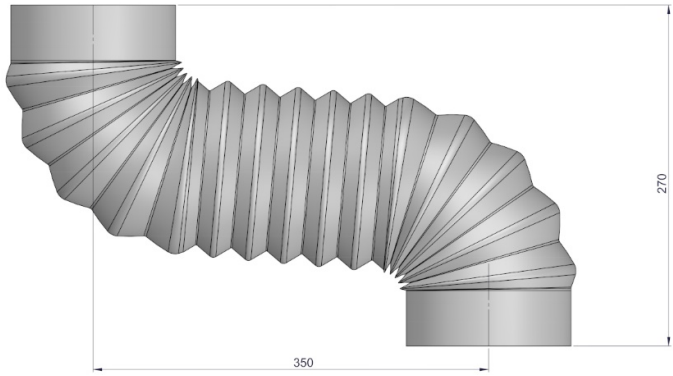
## B.4 Testing flexibility and assembly

All illustrations in tensioned and retracted state. The DN 125 corrugated hose must be mountable in items 1 to 4. The DN 75 must be mountable in a 90° bend. In all these cases, no buckling must occur.

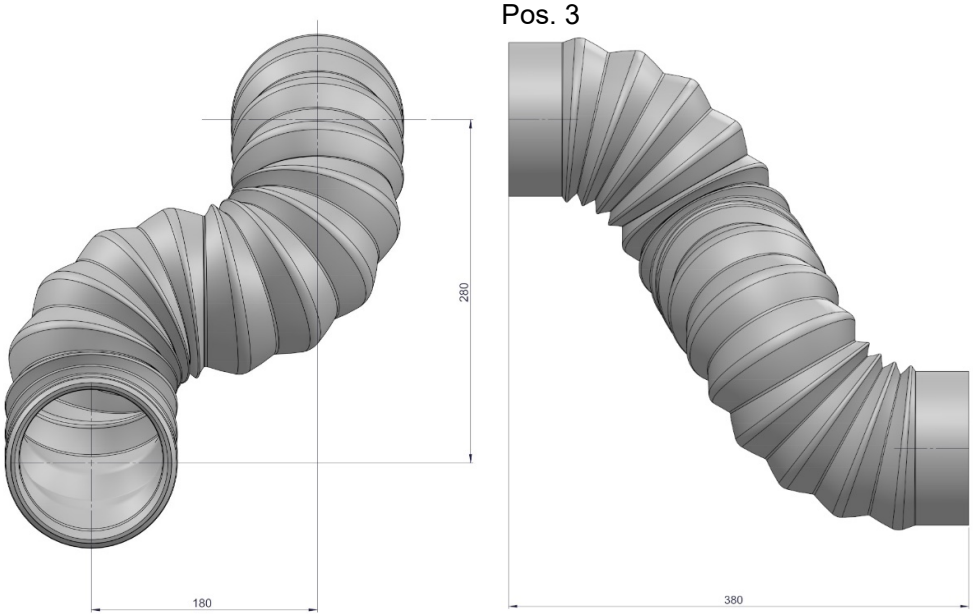
Pos. 1



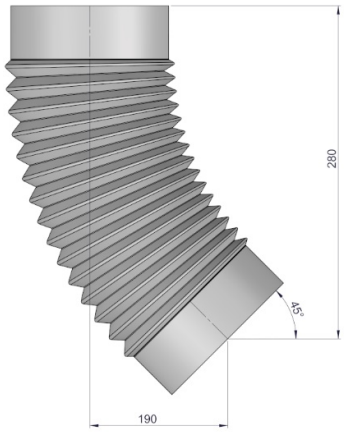

Pos. 2



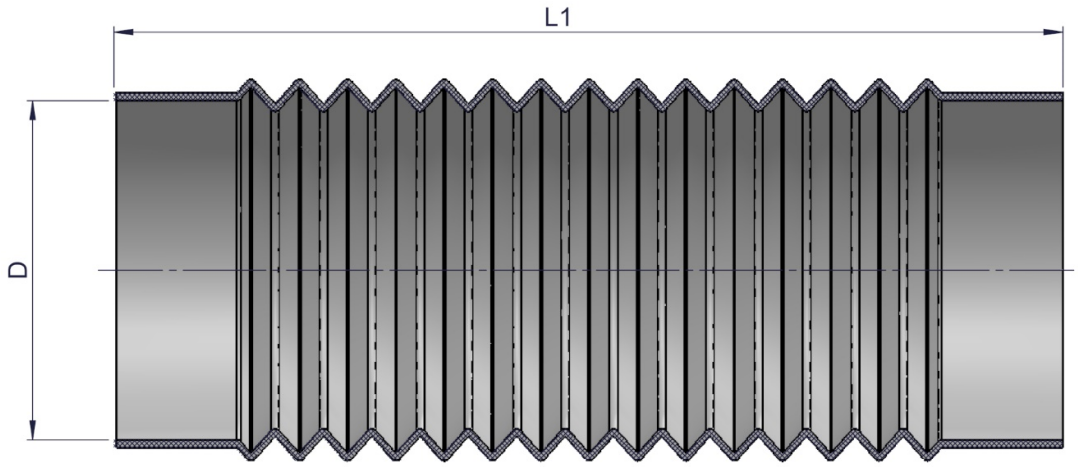

Pos. 3




Pos. 4



## B.5 Testing force and lengths in compressed state




| Nominal width D [mm] | Force F [N] | Length L1 [mm] |
|---|---|---|
| 75 | ≤ 50 | ≤ 200 |
| 125 | ≤ 60 | ≤ 270 |
| 175 | ≤ 125 | ≤ 270 |

# I. List of Abbreviations

ABS : Acrylonitrile-Butadiene-Styrene
ACN : Acrylonitrile
BZS : Federal Department for Civil Protection (earlier name of FOCP)
CR : Chloroprene Rubber
DN : Diameter Nominal
DSC : Differential Scanning Calorimetry
EPDM : Ethylene-Propylene-Diene Rubber
$\varepsilon_R$ : Elongation at Break
$\Delta\varepsilon_R$ : Change in Elongation at Break
FOCP : Federal Office for Civil Protection
HNBR : Hydrogenated Acrylonitrile-Butadiene Rubber
IRHD : International Rubber Hardness Degree
FKM : Fluorine Rubber
MVR : Melt Volume Flow-Rate
n : Number of Measurements
NBR : Acrylonitrile-Butadiene Rubber
NR : Natural Rubber
PA6 : Polyamide 6
PA66 : Polyamide 66
PA6-3-T : Polyamide 6-3-T
PC : Polycarbonate
HDPE : High Density Polyethylene
LDPE : Low Density Polyethylene
PMMA : Polymethylmetacrylate
POM : Polyoxymethylene
PS : Polystyrene
PSU : Polysulfone
PUR : Polyurethane Rubber
SAN : Styrene-Acrylonitrile
SB : Styrene-Butadiene
SBR : Styrene-Butadiene Rubber
$\sigma_R$ : Tensile Strength
$\Delta\sigma_R$ : Change in Tensile Strength
TPH : Technical Specifications
$\tau_B$ : Tensile Shear Strength
$\Delta\tau_B$ : Change in Tensile Shear Strength
TGA : Thermogravimetric Analysis
$T_S$ : Tear Resistance
(X)IIR : (Bromo- or Chloro-) Butyl Rubber