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CIPP - RENOVATION OF PRESSURE PIPES –
STATUS QUO, PERSPECTIVES, QUALITY ISSUES

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RSV leaflet 1.1 CIPP

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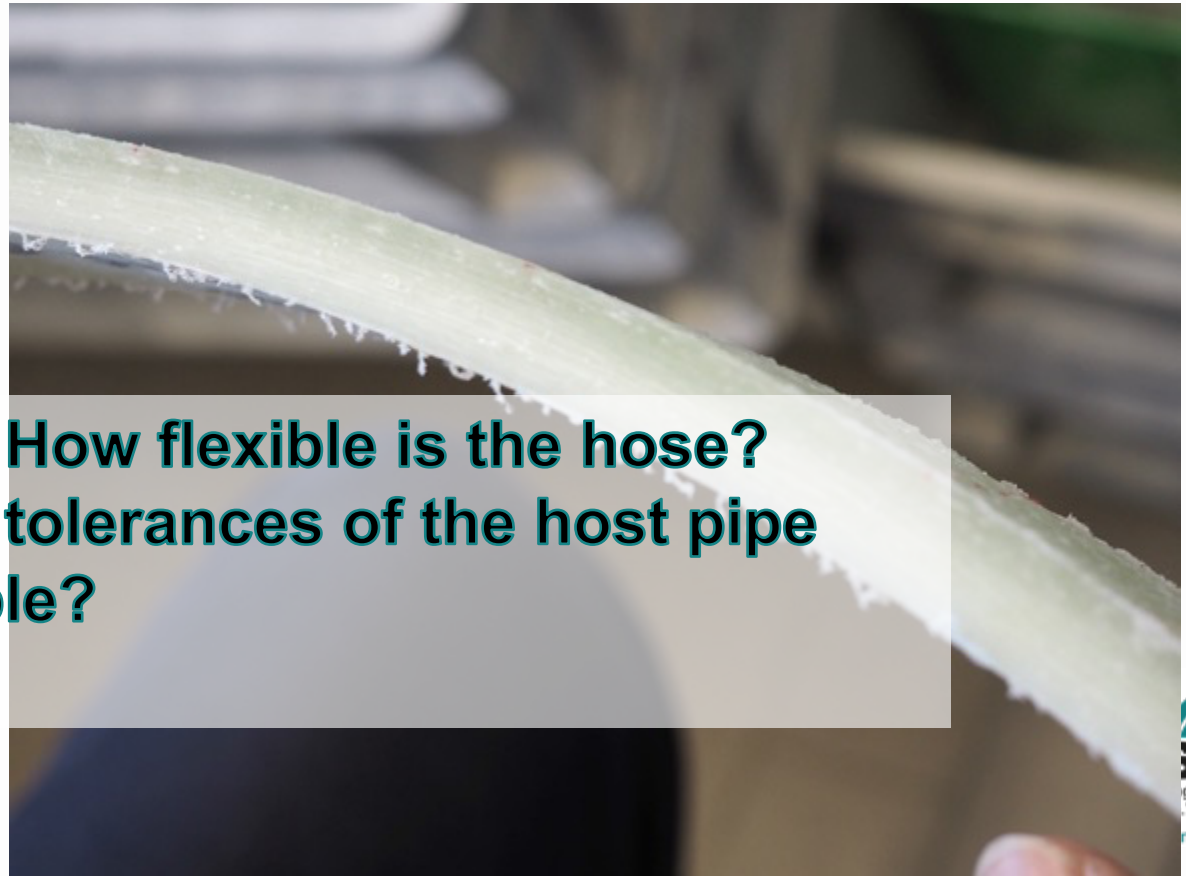
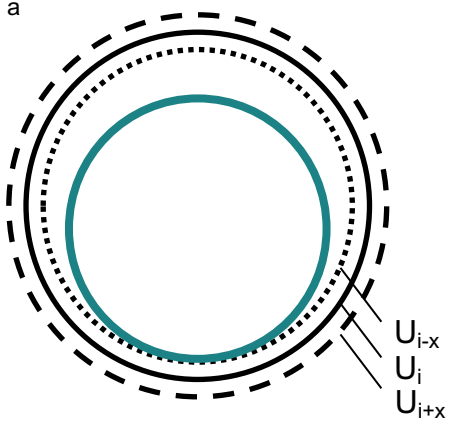
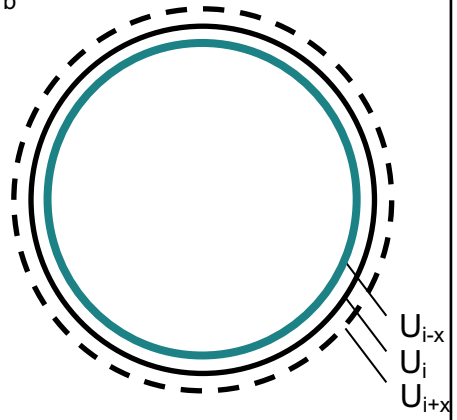
Key findings of the leaflet RSV 1.1



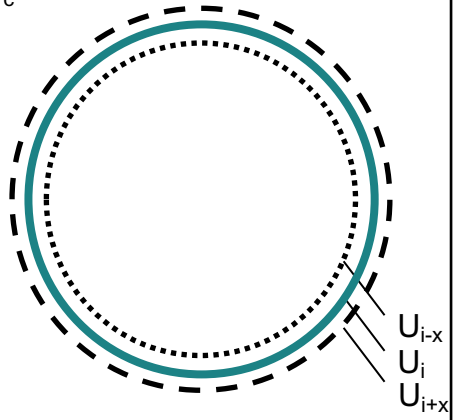
Elasticity: How flexible is the hose?
Which DN tolerances of the host pipe are possible?



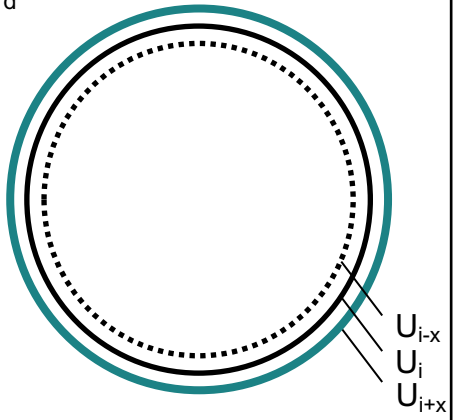
Undersize
Corresponds to the production dimensions of the liner hose without expansion



Minimum expansion
Minimum necessary expansion from which the carrier/reinforcing material is stretched and compressed and the hose is form-fit to the old pipe



Nominal expansion
Expansion of the hose in relation to the internal circumference of the old pipe for ordering the hose



Maximum expansion
Maximum permitted expansion of the hose

a: In the condition produced in the factory
(M condition in accordance with EN ISO 11296-1)

b, c, d: when installed (I condition in accordance with EN ISO 11296-1)

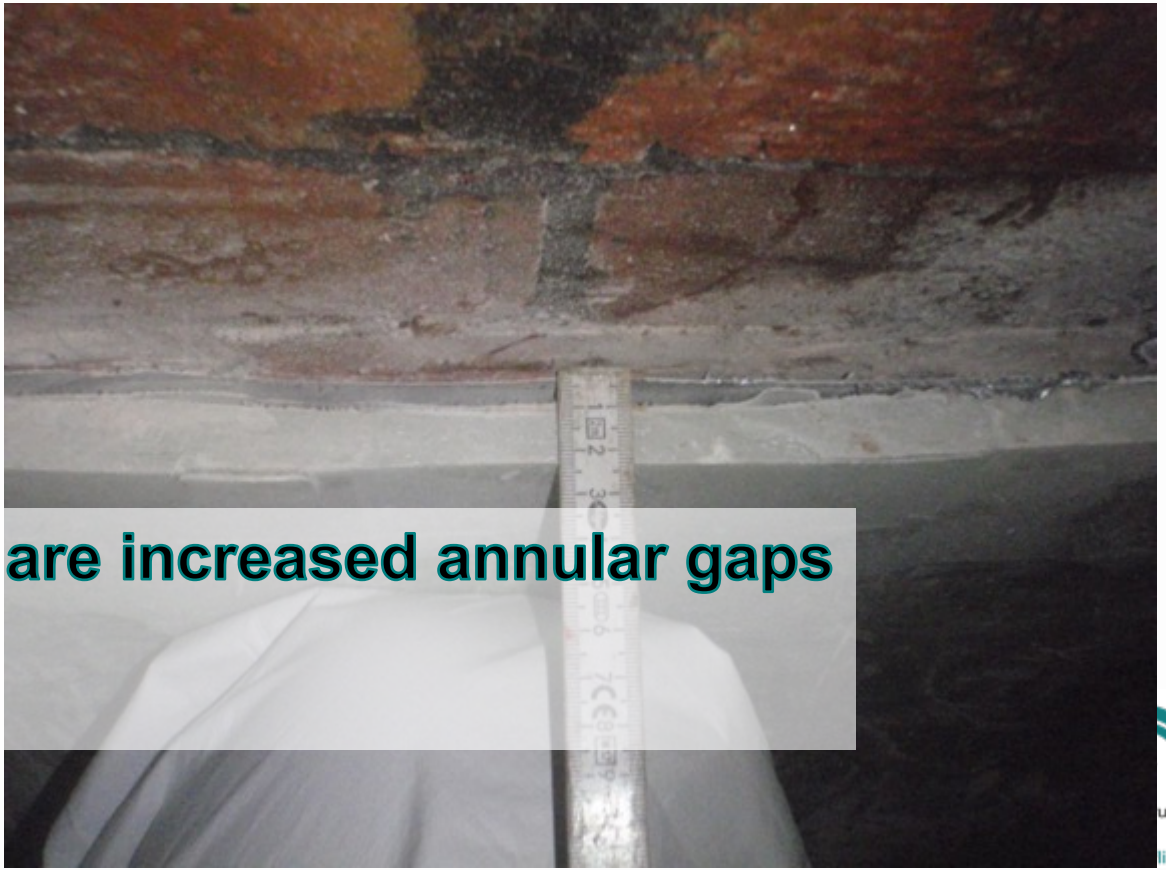
Legend:

- ····· U_{i-x} : Lower tolerance limit of the old pipe, internal circumference
- —— U_i : Nominal dimension of the old pipe, internal circumference
- – – - U_{i+x} : Upper tolerance limit of the old pipe, internal circumference
- liner hose

Information:

The elasticity of the liner hose describes its expansion between minimum expansion and maximum expansion.
Expansion beyond the maximum expansion is possible but leads to impairments of the laminate quality.

Key findings of the leaflet RSV 1.1



How relevant are increased annular gaps statically?

Statical Relevance of Annular gaps

If deviations are to be expected in the annular gap in excess of the minimum rates given in DWA-A 143-2, this must be taken into consideration in the static dimensioning because of **the low bedding effect** (bedding in the old pipe-floor system). Depending on the static requirements, the annular space is to be filled where necessary. A loose-fitting liner must be stable so that impermissible forces on connections and links (e.g. as a result of uplift) cannot have an effect.

It must be noted in addition that **overstretched laminates** that are not in contact with the old pipe **are unable to safely achieve their mechanical characteristics** from the suitability test. Measures to prevent overstretching, e.g. the possibility of using a reinforcement hose, are to be taken into account in planning.

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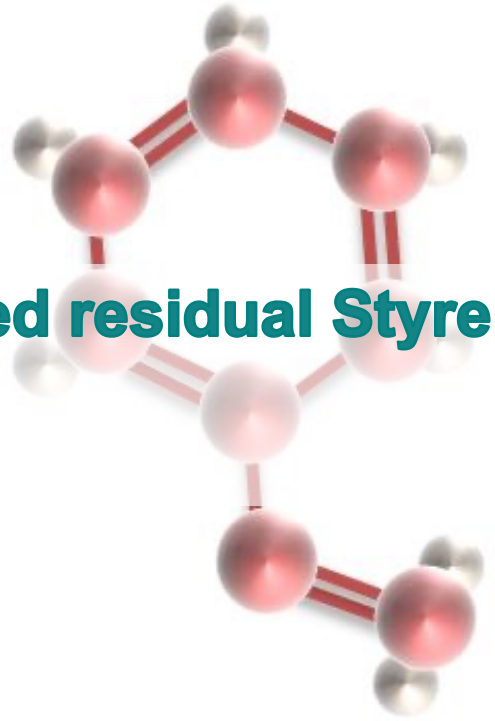

What is the Permitted residual Styrene Content?

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Permitted residual Styrene Content in Laminate

Regulatory gap: DWA-M 144-3:2012 indicates a threshold value of 4% residual styrene content in relation to the total laminate. The threshold value specification in the DWA leaflet is not backed up with regard to the suitability tests in the framework of the general building supervisory approval (“abZ”) and must be revaluated. The threshold value is too high and in modern rehabilitation practice CIPP systems have much lower residual styrene contents. A new stipulation of the threshold value for CIPP is under discussion at present and being processed on the part of RSV.

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Recommendation

- According to DWA-M 144-3 the permitted residual styrene threshold value is **much too high:** ≤ 4% in laminate or 8% in resin
- Styrene and incompletely networked resins are environmentally relevant
- Technical limit value for complete curing of UP/VE resins according to AVK-TV (Reinforced Plastics Industry Association): ≤ 2% or 1% respectively

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Key findings of the leaflet RSV 1.1

How shall we evaluate Folds and Wrinkles?

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Axial fold / not filled

Fold type	Condition	Possible cause(s)	Evaluation
Axial fold (longitudinal fold) not filled	  Bottom fold	Restricted access possibilities, cross-section change, pipe offsets, fluctuations of the old pipe diameter, ingress of groundwater (bottom fold), over-long hose, insufficient installation pressure, inadequate hardening	System statically weakened. In case of pure UV-hardened systems can lead to hardening defects (thickness, unfavourable UV angle of incidence). Hardening defects are not expected in heat hardened systems (with the exception of bottom folds).

- If wrinkles / folds in CIPP occur it shall be evaluated in relation to the liner system used.

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Axial fold / filled

Fold type	Condition	Possible cause(s)	Evaluation
Axial fold (longitudinal fold) filled	 Filled fold with separation	Restricted access possibilities, cross-section change, pipe offsets, fluctuations of the old pipe diameter, over-long hose	System statically weakened (separation, e.g. through an outer foil, has the effect of a non-filled fold). In case of pure UV-hardened systems can lead to hardening defects (thickness, unfavourable UV angle of incidence). Hardening defects are not expected in heat hardened systems.
	 Filled fold without separation		No impact on the static load-bearing capacity. Not found with UV-hardened systems. Hardening defects are not expected in heat hardened systems.
	 Surface fold	Restricted access possibilities, elongation of the internal layer on installation	No impact on the static load-bearing capacity. Not found with UV-hardened systems. Hardening defects are not expected in heat hardened systems.
	 Internal fold in the laminate	Restricted access possibilities, pipe offsets, change of direction (bend)	No impact on the static load-bearing capacity. In case of pure UV-hardened systems can lead to hardening defects (thickness). Hardening defects are not expected in heat hardened systems.

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Other Fold Types

- Wrinkles/folds in UV cured liners may be critical: thickness, unfavourable UV incidence angle (this also includes bends)

Fold type	Condition	Possible cause(s)	Evaluation
Fold in the direction of circumference (horizontal fold)	 Not filled  Filled	Restricted access possibilities, cross-section change, pipe offsets, change of direction (bend), tube buckled on installation	No impact on the static load-bearing capacity. There may be effects on the high-pressure flushing resistance. Depending on the form, hardening defects are not expected in UV hardened systems. Hardening defects are not expected in heat hardened systems
Concealed fold		Buckling of tube on installation (loss of pressure)	System statically weakened. The assumptions made in the static calculation are no longer applicable (e.g. annular gap). In case of UV-hardened systems can lead to hardening defects (thickness, unfavourable UV angle of incidence). In case of heat hardened systems can lead to hardening defects
Form fold		Inadequate cleaning, inadequate reprofiling of the old pipe	System statically weakened in certain circumstances. Review of the assumptions made in the static calculation for the imperfections.
Overexpansion, increased annular gap, liner not in contact with host pipe wall (opposite of wrinkling)		Cross-section change, undersized hose	System statically weakened (insufficient compression of the material, annular gap). Hardening defects not expected. Note: This condition is hardly visible. Indications for this may be very smooth liners without an impression of the old pipe and the feeds.

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Questions?

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