

Membranes and foils - system solutions



BAUR GmbH

membrane roofs . emission protection . gas bags . lagoon basins



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***CEOs
Mr. Josef Baur
Mr. Peter Baur***

***Since 1991
60 employee***



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Products

- *Gas-tight single and double membrane roofs*
- *Odour-proofed emissions protection roofs*
- *Gas bags*
- *Lagoon ground basins*
- *Leakage foil – fleece*
- *Over/under-pressure protection*
- *Level indicator*
- *Air blower support*
- *Safety net*
- *Compressor*
- *Concrete protection*
- *Silage foils*

Double membrane roofs

Long term resistance against:

- UV radiation
- Weather conditions
- Substrates

Cone shaped



Floating dome



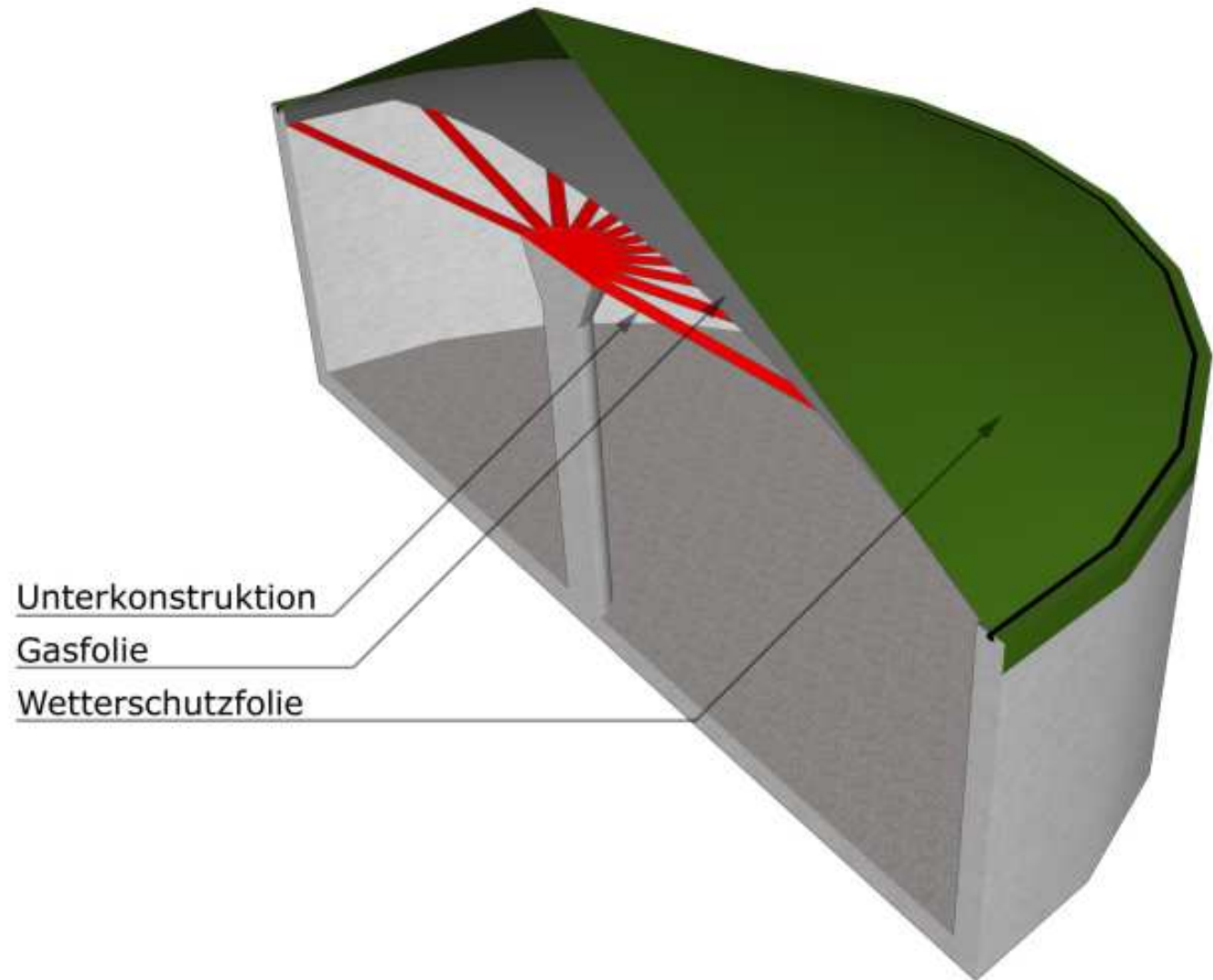
Inner shell is the integrated gas storage / outer membrane is weather protection foil

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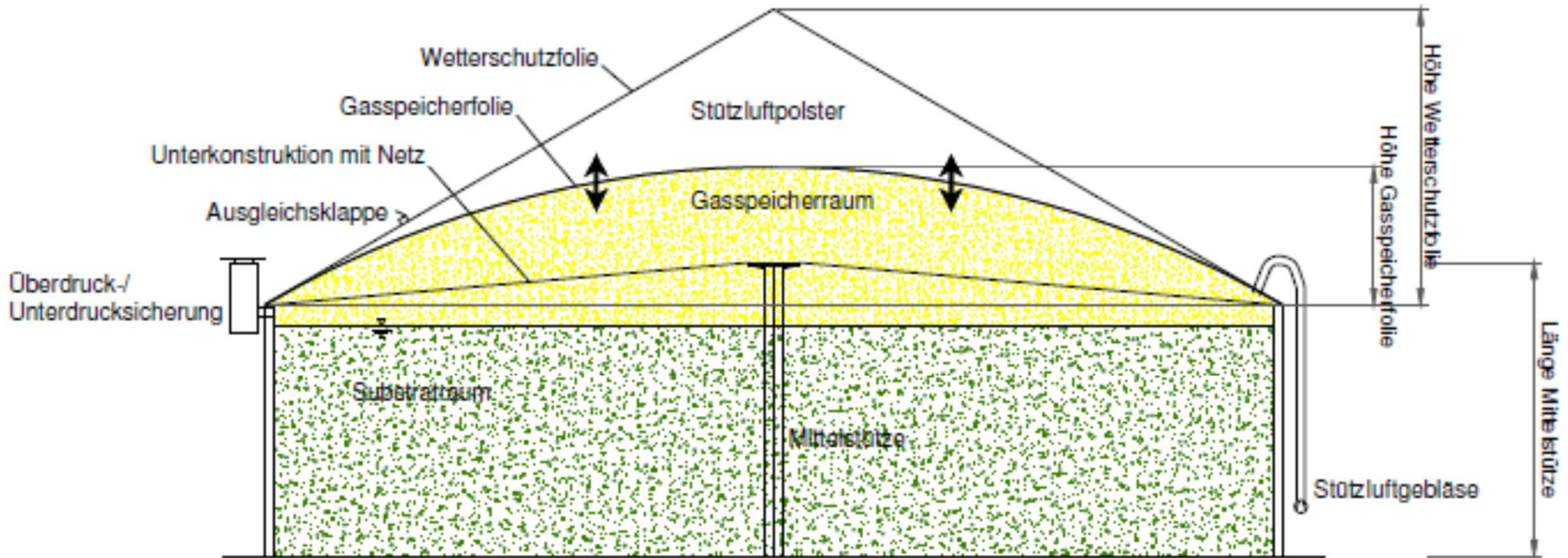
Double membrane roofs

Design:

- Weather protection foil
- Gas foil
- Under-construction



Double membrane roofs



Gas storage foil



Material:	PELD
Thickness:	0.8 mm
Weight:	approx. 750 g/m ²
Tensile strength:	650 N/5cm
Surface bleeder resistance:	$< 3 * 10^9$ Ohm
Methane permeation:	260 cm ³ / m ² * d * 1 bar
Temperature resistance:	-30 °C - + 70 °C

Equipment:
UV-resistant, weathering resistant, liquid manure resistant, suitable for outside use

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Weather protection foil

Technical data:

- **Material:** double-coated PVC polyester fabric
- **Weight:** app. 920 g / m²
- **Tensile strength:** 4000 N / 5 cm
- **Surface bleeder resistance:** < 3 * 10⁹ Ohm
- **Methane permeation:** 225 cm³ / m² * d * bar
- **Temperature resistance:** -30°C - +70°C

Equipment:

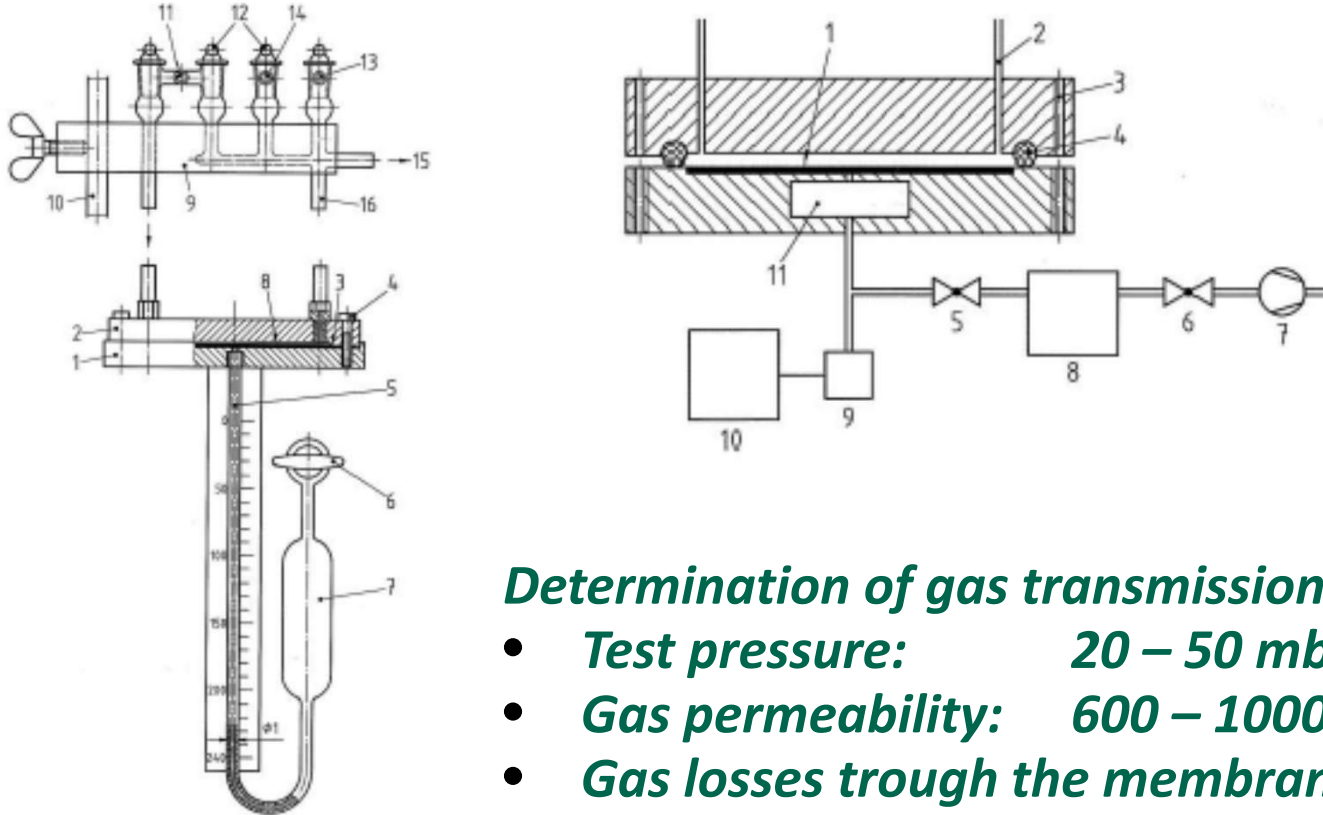
- **UV-resistant, weathering resistant**



Gas Permeability of Membrane Foils

German standards for gas permeability

- **DIN 53380: Determination of gas transmission rate**

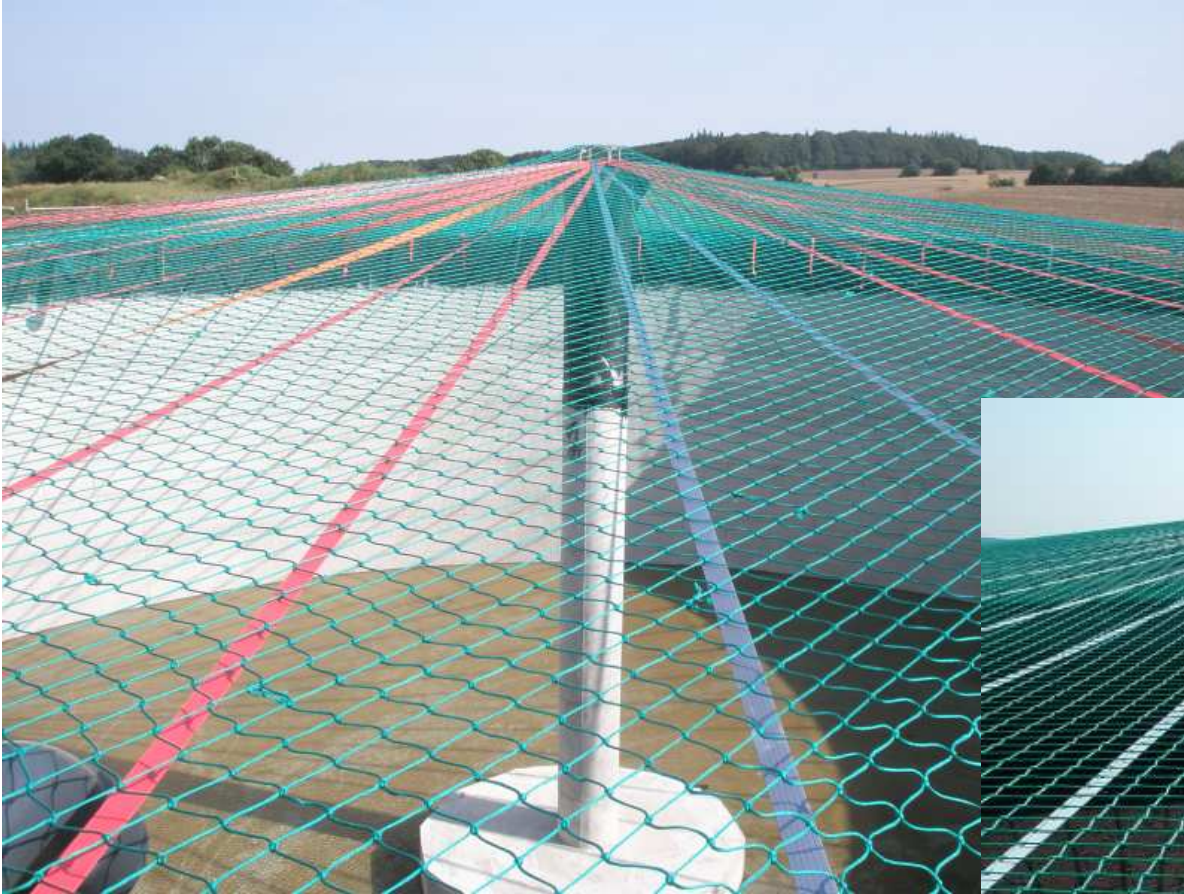


Determination of gas transmission rate = $\text{cm}^3 / (\text{m}^2 * \text{d} * \text{bar})$

- **Test pressure: 20 – 50 mbar**
- **Gas permeability: 600 – 1000 $\text{cm}^3/(\text{m}^2*\text{d}*\text{bar})$**
- **Gas losses trough the membrane: 1 – 25 l/d**

→ Baur weather protection foil = 225 $\text{cm}^3/(\text{m}^2*\text{d}*\text{bar})$

Under-construction with net and belts



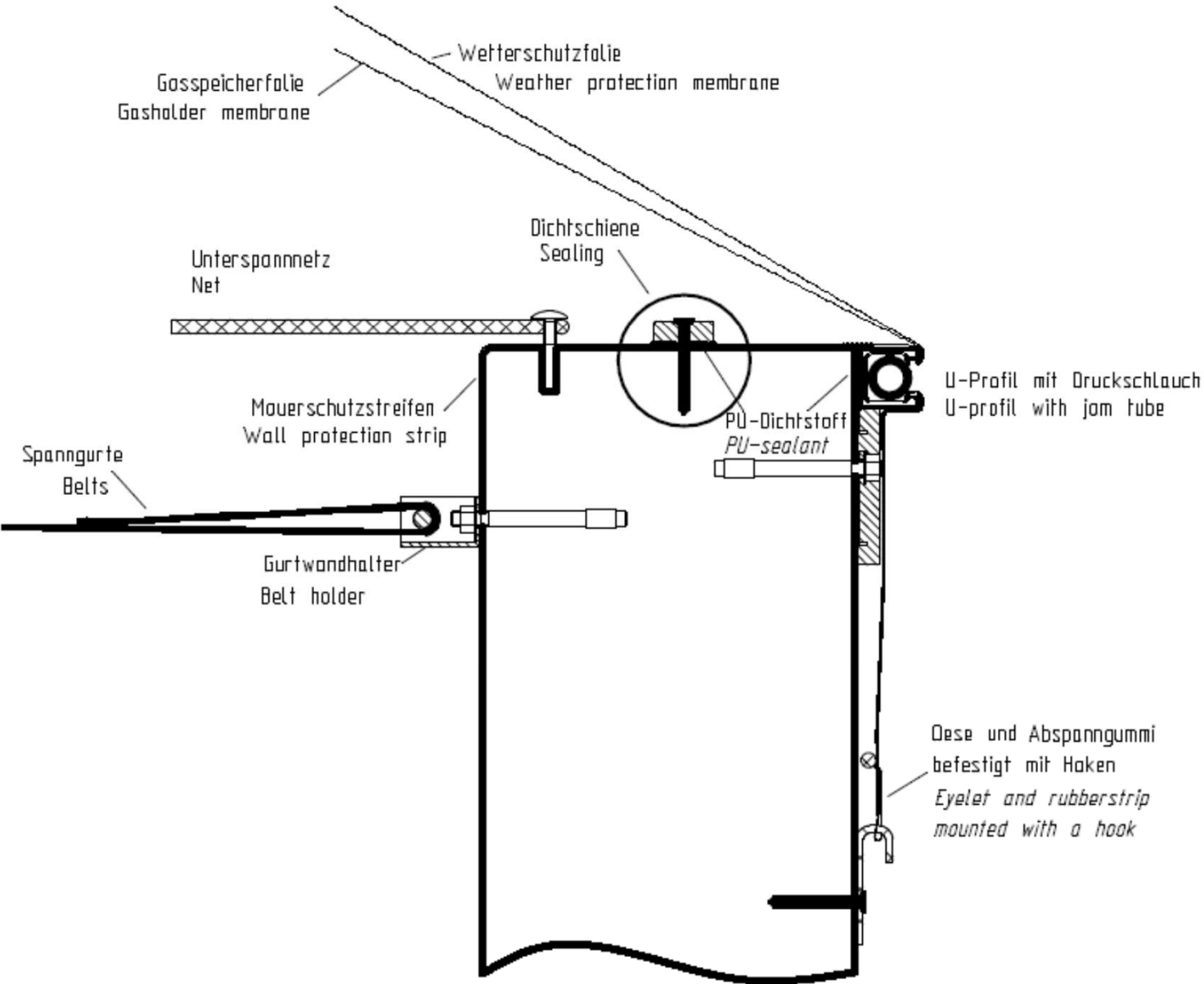
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Under-construction with belts and net

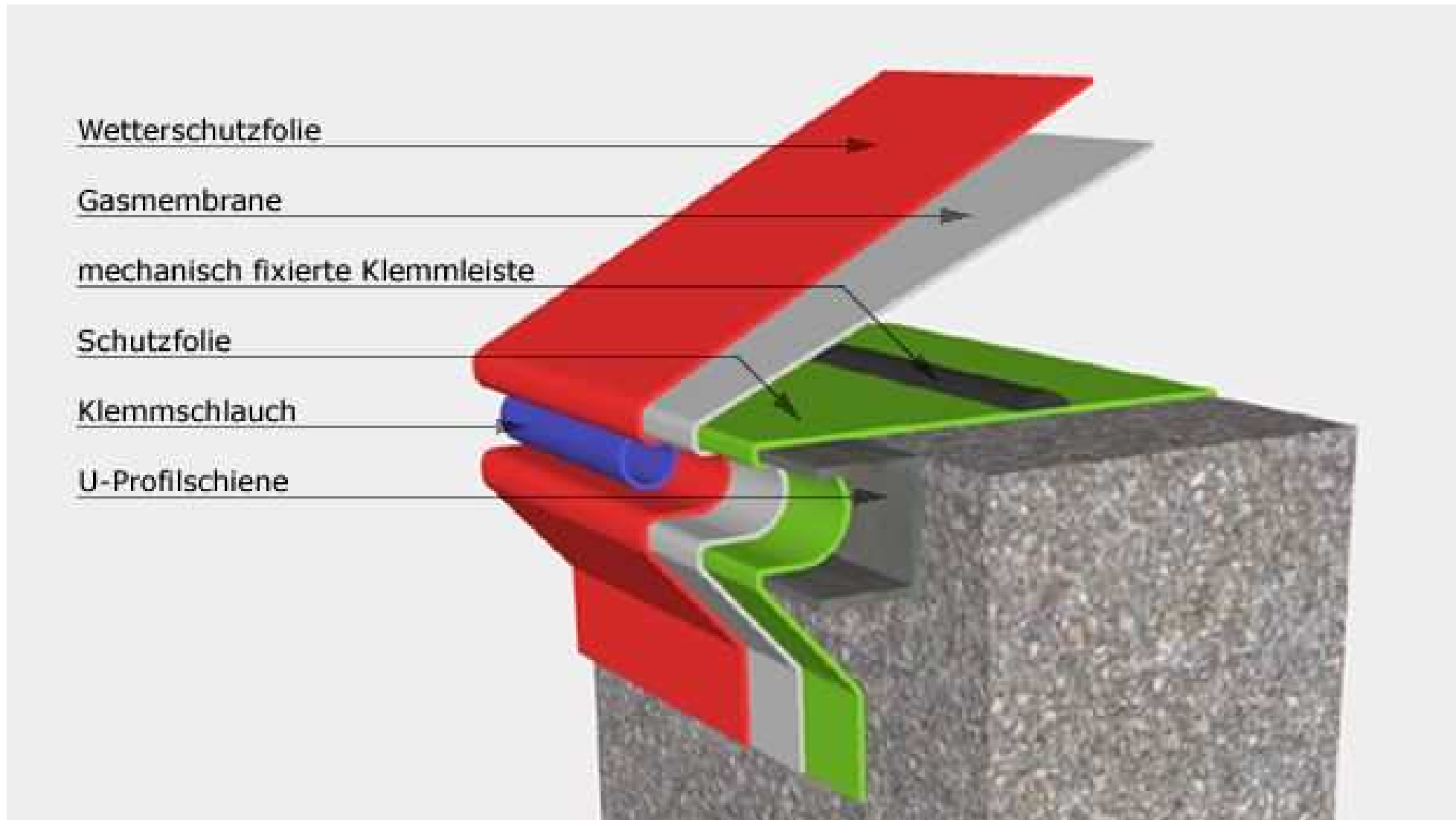


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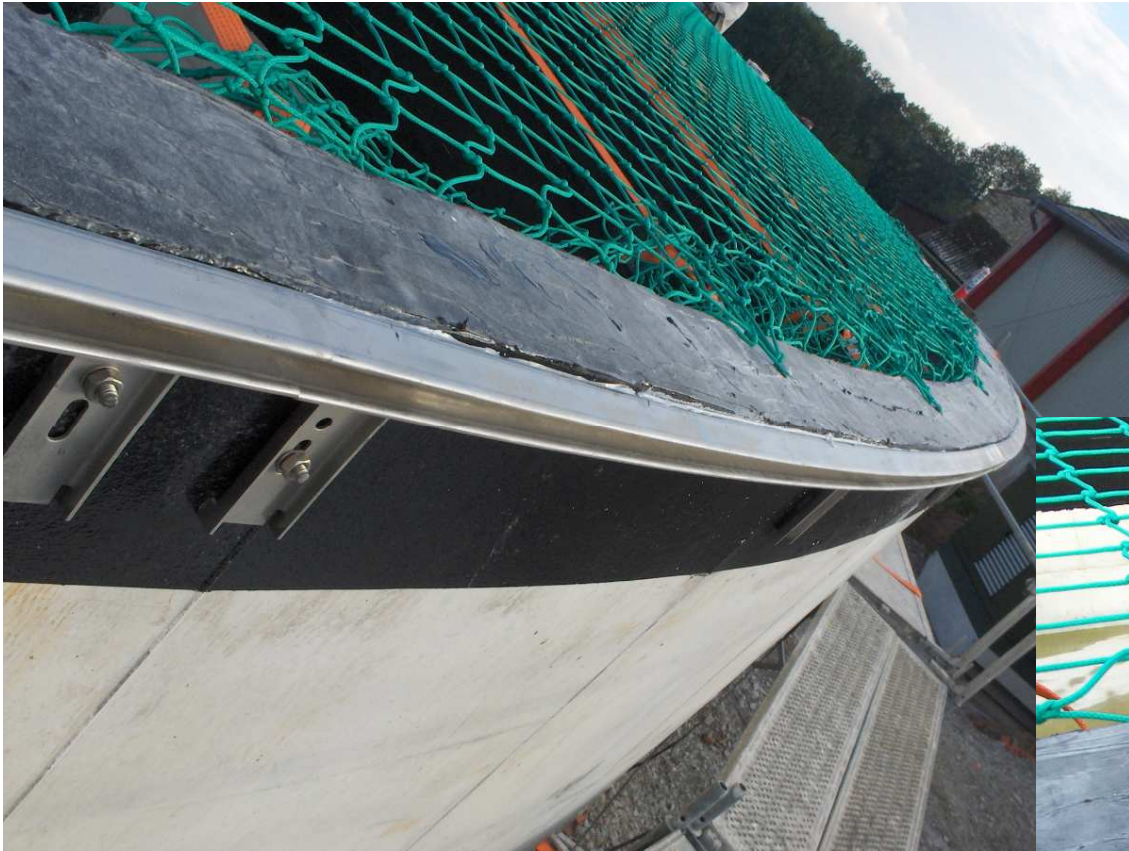
Installation (with U-profil with pressure/clamping tube)



Installation (with U-profil with clamping tube)



Installation (with U-profil)



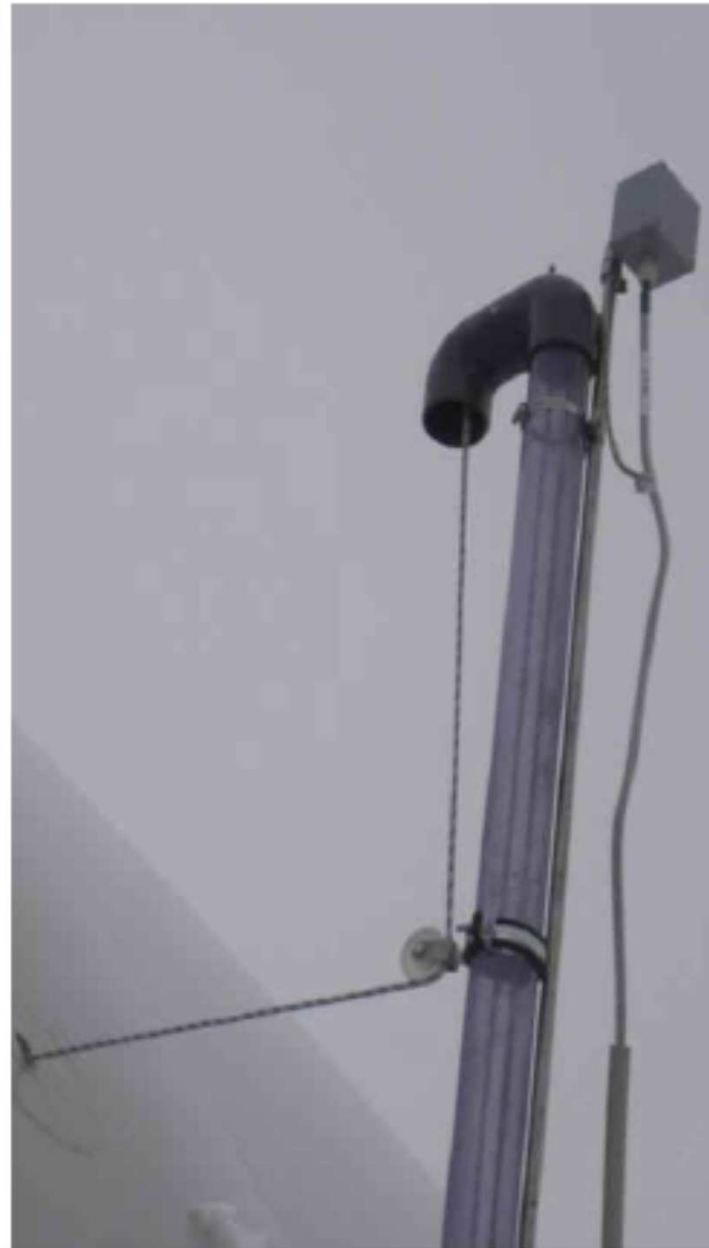
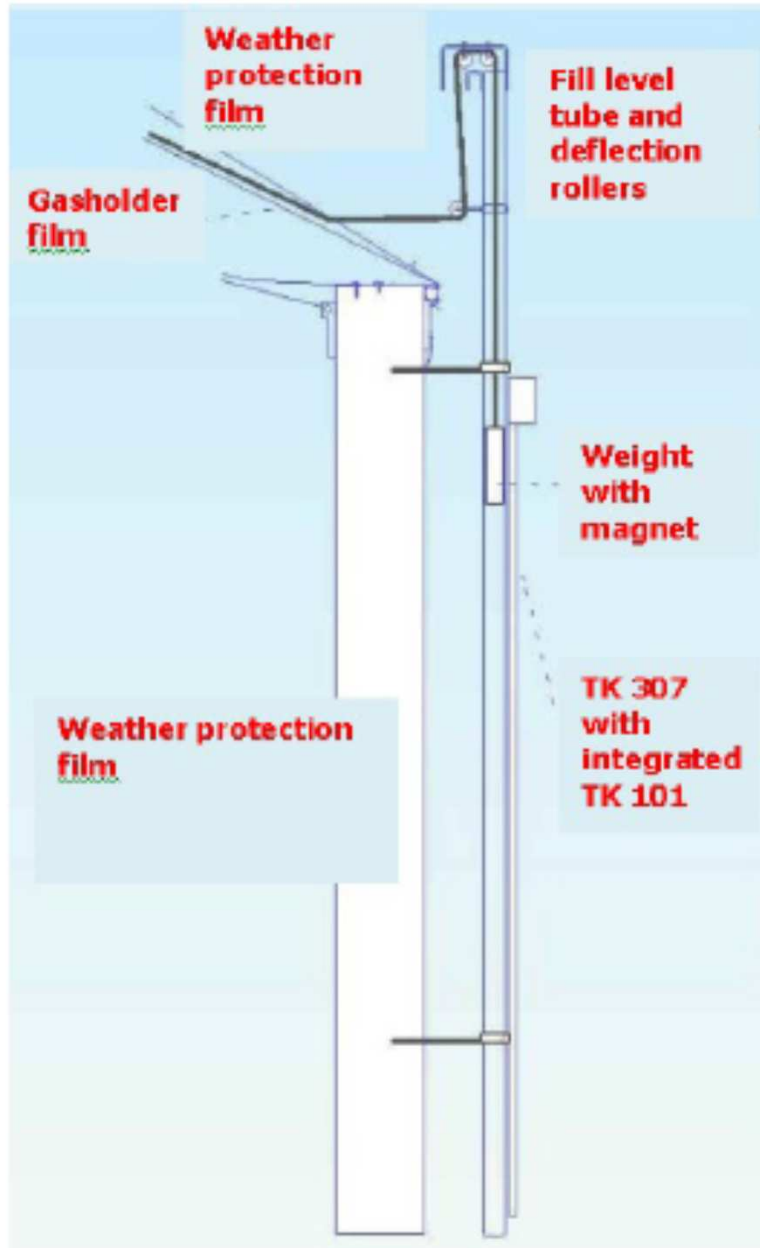
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Air blower – fill level indicator – clamping tube



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Fill level indicator



Level indicator – for explosion zone 2



4 Technical data

4.1 Materials

Float	Stainless steel 1.4571
Guide tube	Stainless steel 1.4571
Tube dimensions	Ø 15 x 1.5 mm with maximum tube lengths of 6000 mm.
Socket	Aluminium (IP 65)

4.2 Specification plate TK-307/0



EX - Magnettauchsonde
Typ: TK-307/0

FÜLLSTANDSGERÄTE
Bundschuh GmbH + Co.
An der Hartbrücke 6
D-64629 Bensheim

 **II 3 G Ex ia IIA T4**

Nur zum Anschluß an bescheinigtes Auswertegerät in Zündschutzart
Eigensicherheit Ex ia IIC/IIB und folgenden Höchstwerten für U, I, / P, :

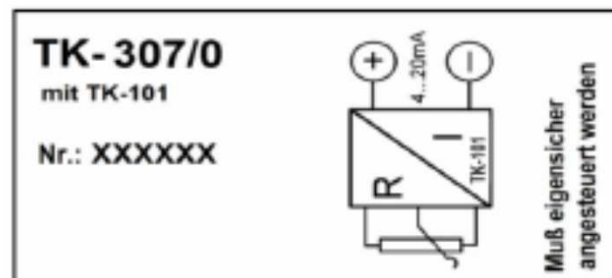
⊕ max. 28 VDC **EG-Baumusterprüfbescheinigung**
⊖ **bzw. Betriebsanleitung beachten!**

Serien-Nr.: siehe Geräteprägung

Achtung: Elektrost. Aufladung vermeiden!



4.2 Connection diagram TK-101



Herstellerbescheinigung / Zertifikat

Bewertung nach EN 60 079-0
für TK-307/0 mit TK-101 im Anschlusskopf für Zone 2
Diese Bewertung ist Bestandteil der Konformitätsbewertung

1. Gerätebeschreibung

Niveaumeßwertgeber TK-307/0 mit Zulassung für die Zone 0 (TÜV 02 ATEX 1795), mit zusätzlich im Anschlusskopf eingebautem Messumformer TK-101 (4...20 mA) . Das Gerät wird vollständig in der Zone 2 montiert und betrieben.

Bei dem Messumformer handelt es sich um einen Zweileiter-Messumformer (4...20 mA) der mit zwei in Reihe geschalteten Sperrdioden ausgerüstet ist. Der Messumformer wird an einem potenzialfreiem Ex zugelassenem 20 mA Speisegerät betrieben.

2. Bewertung

In dieser Bewertung wird die Vereinbarkeit mit der EN 60 079-0 , für den Betrieb der Sonde in der Zone 2, festgestellt.

Bewertet wurden die folgenden relevanten Punkte der EN 60 079-0:

Das Gerät entspricht nach dieser Bewertung der **II 3 G Ex ia IIA T4**

6.21.2: Vorhersehbare Zündquellen können im Normalbetrieb nicht auftreten, da die Energie durch das zugehörige Speisegerät begrenzt wird.

ZA 1.2.3: Das Gerät gewährleistet das erforderlich Maß an Sicherheit.

5.3.2.2: Die maximale Verlustleistung der Schaltung beträgt $U_{max} * I_{max} = 28 V * 22mA = 0,6 W_{max}$. Als Betriebsmittel der Gruppe II kann das Gerät der Temperaturklasse T4 zugeordnet werden.

7: Das Gerät besteht nur aus metallischen Gehäuseteilen.

7.3: Elektrostatische Aufladung kann nicht entstehen, da nur metallische Oberflächen existieren.

15.2: Das Betriebsmittel ist mit einem externen PA-Anschluss versehen.

An der Hartbrücke 6 - 64629 Bensheim Telefon: +49(0)6251/94 62-0 Telefax: +49(0)6251/6 46 14 E-Mail: info@elb-bensheim.de Energie- und Datenstation: D-646293 Darmstadt	Berzirksoperklasse Bensheim BLZ: 509 500 68) Konto 1 093 608 Helaba Frankfurt SWIFT-Adresse: HELA DE 33 Für unser Konto bei Sparkasse Bensheim BIC: HELA DE 33 BEN	Rachbüfom: KG Sitz: Bensheim/Bergstraße Antragerecht: Darmstadt HRA 22594 Inesellschaftler: Hans Bundschuh	Komplettanbieter: Bundschuh GmbH Antragerecht: Darmstadt HRB 211322 Inesellschaftler: Hans Bundschuh
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Supporting air blower



**For the outer
weather protection membrane**



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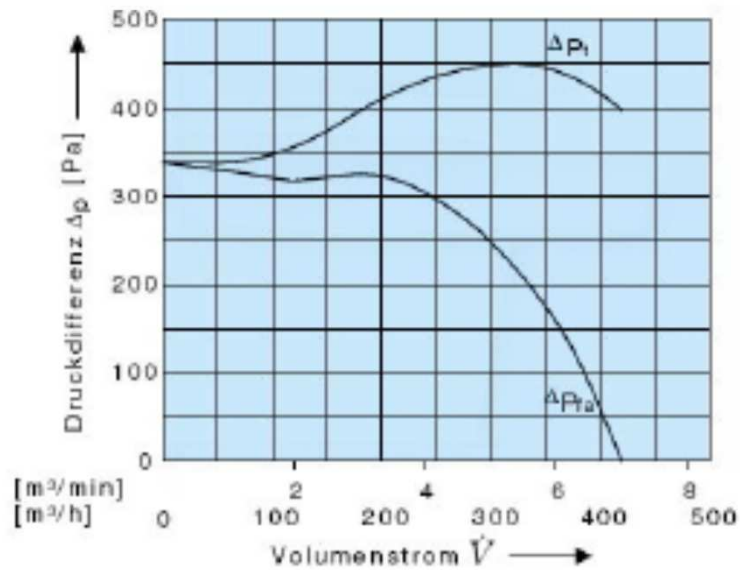
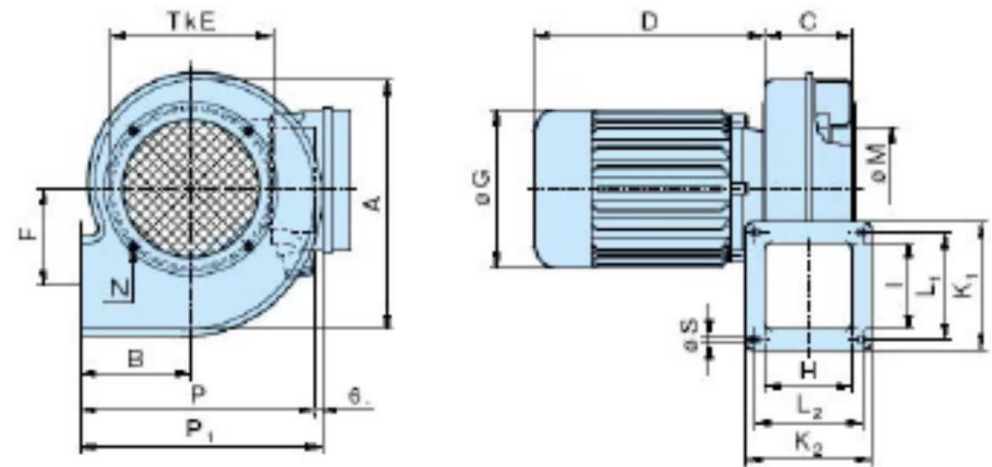
Air blower certifications



Typ DNG ATEX 3-6 II 2 Gc T4 Ex-Schutz

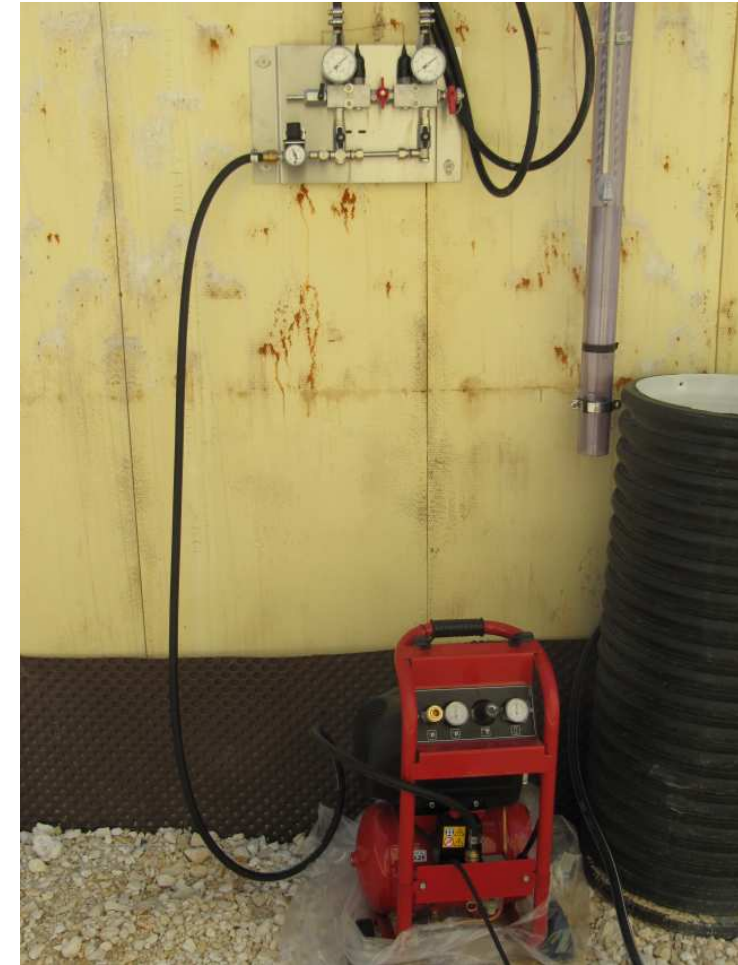
Temperaturklasse	T4	
Volumenstrom	max. 430	m ³ /h
Druckdifferenz P1a	max. 340	Pa
Motormennleistung	0,120	kW
Nennspannung	Δ / Y 230/400	V
Nennstrom	0,70/0,40	A
Nenn Drehzahl	2775-2855	min ⁻¹
Frequenz	50	Hz
Schutzart IP	55	
Schalldruckpegel	65	dB (A)
Gewicht	ca. 6,4	kg

A	B	C	D	TkE	F	G	H	I	K1	K2	L1	L2	M	N	P	P1	S
199	94	84	161	144	78	111	79	65	98	112	80	95	94	M4	191	210,5	7



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Clamping tube (with pressure)



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Over/Under-pressure protection



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Over/Under-pressure protection performance certification

$$\Delta p = (\lambda \times l/d + \Sigma \xi) \times \rho/2 \times w^2$$

$$V = w \times A$$

$$w = \dot{m}' / (A \times \rho)$$

$$Re = (w \times d)/\nu$$

$$V' = A \times \sqrt{\frac{2 \times \Delta p}{(\lambda \times l/d + \Sigma \xi)}}$$

	Unterdruck	Überdruck
l = Rohrlänge	l = 0,7 m	l = 0,7 m
r = Rohrrinnenradius	r = 7,50E-02 m	r = 7,50E-02 m
A = Austrittsquerschnitt	A = 1,77E-02 m ²	A = 1,77E-02 m ²
ξ = Widerstandszahl	ξ = 1,00	ξ = 0,50
	ξ = 3,00	ξ = 3,00
	ξ = 4,00	ξ = 4,00
	ξ = 0,50	ξ = 1,50
	ξ = 1,00	ξ = 1,00
	Σξ = 8,50	Σξ = 10,00
ρ = Dichte	ρ _{Luft} = 1,3 kg/m ³	ρ _{Biogas} = 1,2 kg/m ³
ν = kinematische Zähigkeit	ν _{Luft} = 1,33E-06 m ² /s	ν _{Biogas} = 1,20E-06 m ² /s
Re = Reynoldszahl	Re = 5,40E+04	Re = 5,53E+04
λ = Rohrreibungszahl aus Diagramm	λ = 0,050	λ = 0,050

Δp = Über-/Unterdruck	Δp = 0,01 mbar	Δp = 0,01 mbar
w = Fließgeschwindigkeit	w = 0,4785 m/s	w _{Biogas} = 0,4421 m/s
V = Volumenstrom	V = 0,0085 m ³ /s	V _{Biogas} = 0,0078 m ³ /s
m' = Massestrom	m' = 0,01 kg/s	m' _{Biogas} = 0,01 kg/s

Δp = Über-/Unterdruck	Δp = 0,05 mbar	Δp = 0,05 mbar
w = Fließgeschwindigkeit	w _{Luft} = 1,0701 m/s	w _{Biogas} = 0,9885 m/s
V = Volumenstrom	V _{Luft} = 0,0189 m ³ /s	V _{Biogas} = 0,0175 m ³ /s
m' = Massestrom	m' _{Luft} = 0,02 kg/s	m' _{Biogas} = 0,02 kg/s

Δp = Über-/Unterdruck	Δp = 0,10 mbar	Δp = 0,10 mbar
w = Fließgeschwindigkeit	w _{Luft} = 1,5133 m/s	w _{Biogas} = 1,3980 m/s
V = Volumenstrom	V _{Luft} = 0,0267 m ³ /s	V _{Biogas} = 0,0247 m ³ /s
m' = Massestrom	m' _{Luft} = 0,03 kg/s	m' _{Biogas} = 0,03 kg/s

Δp = Über-/Unterdruck	Δp = 0,50 mbar	Δp = 0,50 mbar
w = Fließgeschwindigkeit	w _{Luft} = 3,3838 m/s	w _{Biogas} = 3,1260 m/s
V = Volumenstrom	V _{Luft} = 0,0598 m ³ /s	V _{Biogas} = 0,0552 m ³ /s
m' = Massestrom	m' _{Luft} = 0,08 kg/s	m' _{Biogas} = 0,07 kg/s

Δp = Über-/Unterdruck	Δp = 1,00 mbar	Δp = 1,00 mbar
w = Fließgeschwindigkeit	w _{Luft} = 4,7855 m/s	w _{Biogas} = 4,4209 m/s
V = Volumenstrom	V _{Luft} = 0,0816 m ³ /s	V _{Biogas} = 0,0781 m ³ /s
m' = Massestrom	m' _{Luft} = 0,11 kg/s	m' _{Biogas} = 0,09 kg/s

Δp = Über-/Unterdruck	Δp = 1,50 mbar	Δp = 1,50 mbar
w = Fließgeschwindigkeit	w _{Luft} = 5,8610 m/s	w _{Biogas} = 5,4144 m/s
V = Volumenstrom	V _{Luft} = 0,1036 m ³ /s	V _{Biogas} = 0,0957 m ³ /s
m' = Massestrom	m' _{Luft} = 0,13 kg/s	m' _{Biogas} = 0,11 kg/s

Die Druckdifferenz Δp ist die Unter- bzw. Überschreitung des Ansprechdrucks der Sicherung.

Checklist



Project

Project number: _____ (k) _____ (p)
 Jobsite address: _____
 Name: _____
 Street: _____
 Post code / city: _____
 Employer / Invoice address: _____
 Name: _____
 Street: _____
 Post code / city: _____
 VAT Reg.No. _____

Contact

Contact person: _____
 Function: _____
 Phone number: _____
 Mobile phone number: _____
 Fax number: _____
 E-Mail Address: _____

Specification of the plant

Number of ordered roofs for tanks: _____ piece
 Planned installation of the roof: _____ week (KW) System pressure _____
 Power of the BHKW: _____ kW Power of the flare: _____
 Planned gas production: _____ m³/h Planned withdrawal of gas: _____

Specification of the roof

Desired colour (colour tint approached to):
 RAL 6026 – green RAL 7038 – agate grey RAL 8012 –
 RAL 6005 – moss green RAL 7037 – dusty grey RAL 3005 –

Form of the roof

Conical form (Pointed roof):
 Pitch of the roof: 30° _____ °
 Spherical cap (rounded roof):
 factor: 1/5 1/3
 (Height = diameter x factor) ¼ 2/5

Design of the tank

Kind of use: Fermenter
 Second fermenter
 Store
 Inner diameter: ∅ _____ m
 Wall thickness without insulation: _____ m
 Height of the tank (inside): _____ m
 Height of tank over ground: _____ m
 If the height over ground varies, please give us the height at the desired position of the filling measurement system
 Insulation thickness: _____ cm
 Was the insulation in the formwork and cut off 20 cm below the wall coping? yes No
 If the insulation was in the formwork, please give us the total thickness of the wall coping: _____ cm

Kind of tank: In-situ concrete
 Concrete components
 Steel tank
 Already encased coping protection in concrete: From company Baur
 Wiretarp
 Coating
 No coating
 Wall coping protection the foil

Intermediate support

Concreted support Diameter of the centre support _____ m
 Concreted support with mushroom Diameter of the mushroom _____ m
 Is the concreted support 10% of the radius higher? Yes No
 If there is another elevation related to the wall coping or the centre support and the wall coping are on the same level
 Height of the intermediate support: _____ m
 Metal intermediate support
 Is there a concrete base for the support? Yes No
 Height of the concrete base: _____ m

Substructure

- Belt – Net
- Wooden beam – Net
- Wooden beam with boards

Fixing of the foil

Size: _____

- Inox U-profile with clamp hose
- Inox flat-profile unscrewed
- Concreted Trapeze-profile

Filling measurement

- Level measuring rod (4-20mA Signal)
- Only optical
- Others

Compressed air supply

- From company Baur
- On the part of the building site

Sheet covering

- Existing
- Attached after the roof assembling
- No sheet cover planned

Safety valve

Number: _____ piece Firma Baur – ÜUDS 150 (V = 200 m³/h)
 Number: _____ piece Firma Baur – ÜUDS 200 (V = 450 m³/h)
 Manufacturer: _____ Type: _____ On the part of the building site

Installations in the foil (e.g. manhole)

No
 Yes Number: _____ piece Manufacturer: _____ Type: _____
 Please attach a site plane (sketch of the tank), which shows the measured position of the installation related to the air blower.

Crane (for assembly)

- The crane will be organized by the building site
- The crane should be organized on behalf of the customer by company Baur

Hereby I confirm the correctness of the information named above.

Furthermore I ensure to provide circumferential scaffolding outside the tank for the assembly. The height of standing will be arranged to 1m below the wall coping.

Note: On request we would like to submit you an offer for CE-certified scaffolding. Subsequent amendments have to discuss with Baur Folien GmbH or Baur Folien Service.

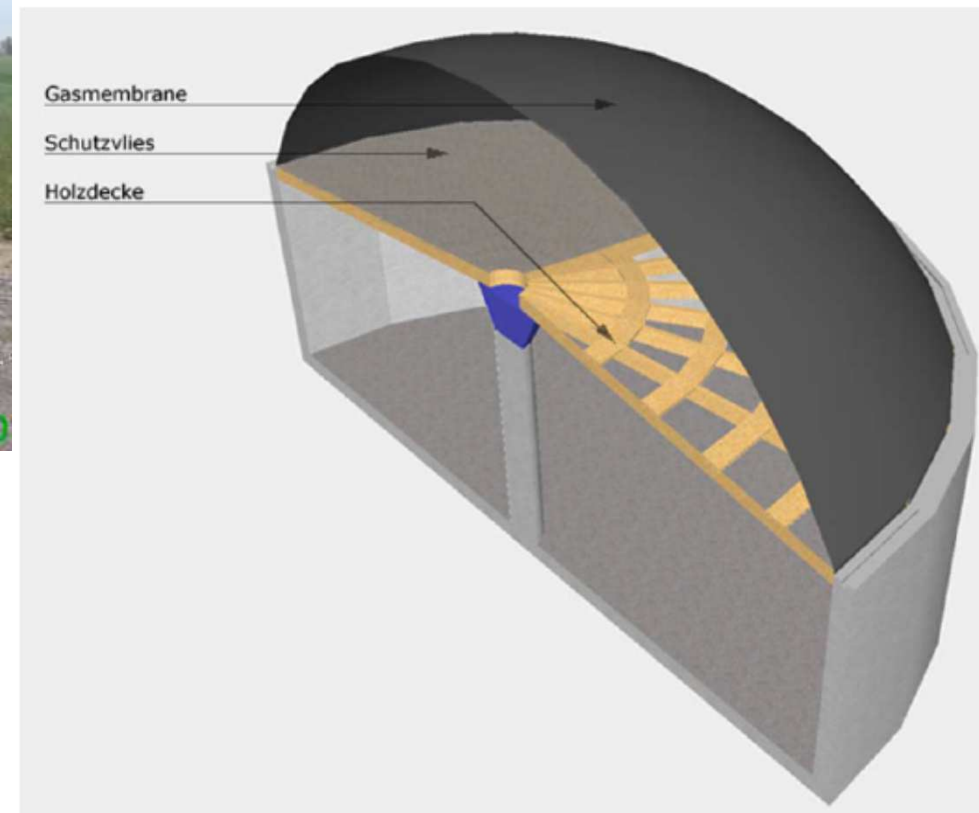
Place, date

Name, signature

Single layer – EPDM membranes



**Simple design
only for small digesters**



Gas bags



Individually manufactured



Foils for lagoons



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Gas-tight membranes for lagoons



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Leakage foils



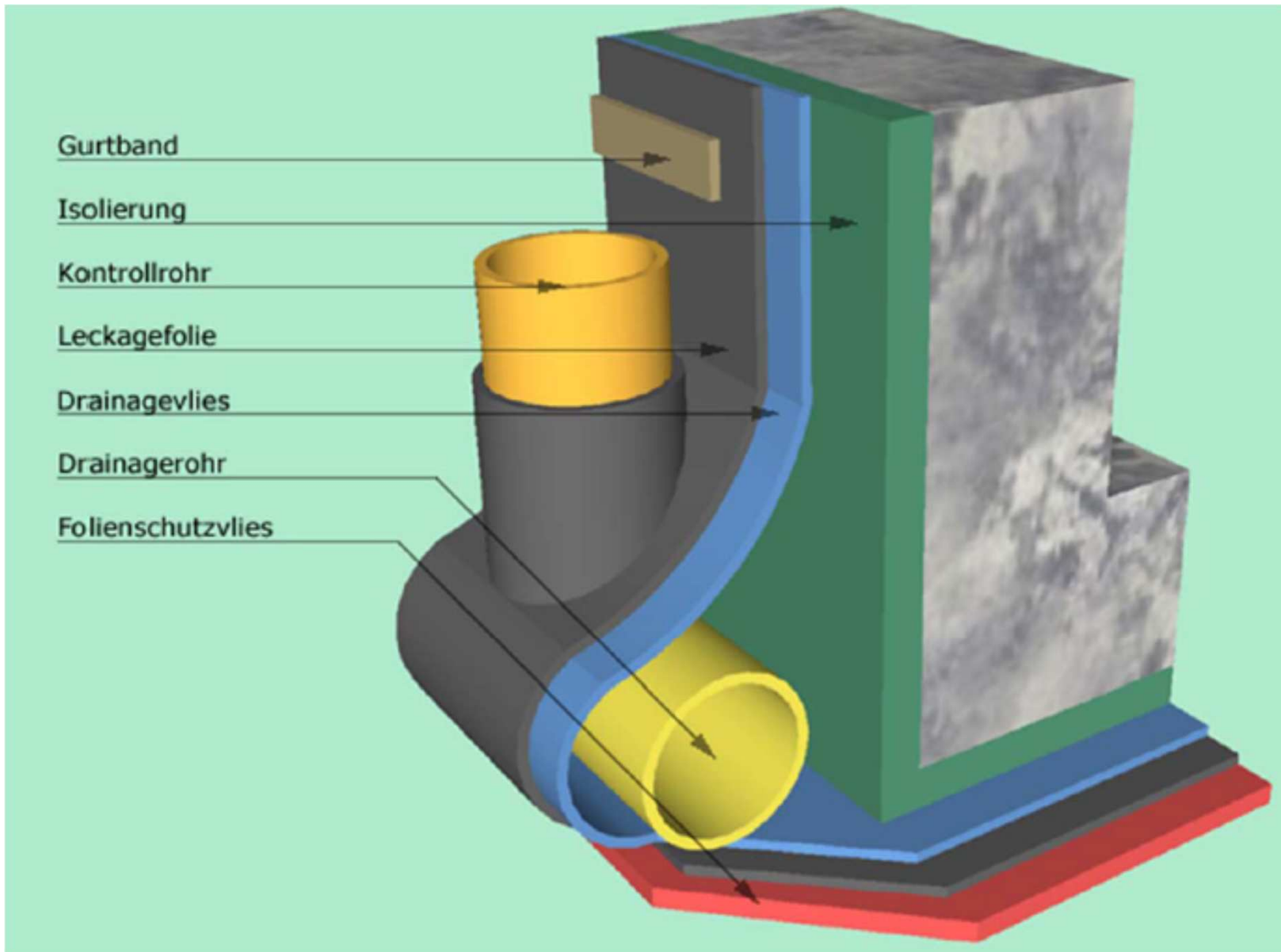
Installation: foil – drain fleece - drain tube



control tube – fixing the foil at the concrete tank

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Leakage foils



Leakage foils

Technical data: for leakage foils

Materialtyp Material type	PE / LD – highly elastic
Format Dimension	0.8 mm / 1.0 mm / 1.5 mm

Test Test	Spezifikation (Specification)	Testmethode (Test Method)
Mittlere Dicke Average Thickness [µm]	Nenndicke (Nominal Thickness) +/- 5 %	DIN 53370
Schmelzindex (190 °C/2,16 kg) Melt index [g/10 min]	0,15 -0,50	DIN 53735
Dichte Density [g/cm ³]	> 0,940	DIN 53479
Bruchspannung Tensile strength at break [MPa]	> 16	DIN EN ISO 527
Bruchdehnung Elongation at break [%]	> 600	DIN EN ISO 527
Weiterreißwiderstand Tear resistance [%]	> 45	DIN 53515
Wasseraufnahme Water absorption [%]	< 0,1	ASTM D 570 - 81
Rußgehalt Carbon Black Content [%]	> 2,0	ASTM D 1603
Warmlagerung Dimensional stability (6h/ 80 °C) [%]	+/- 3.0	DIN 53377

Drain fleece

Technical data:

Drain fleece 1000 g/m²

Material:	Polypropylene
Weight	1000 g/m ²
Thickness:	approx. 10 mm
Tensile strength:	18/ 32 KN/m
Plunger puncture force	3.700 N
Characteristic opening size:	0.10
Water discharge capacity: DIN EN ISO 12958:	$1 \cdot 10^{-4}$ m ² /s
Discharge capacity:	$1 \cdot 10^{-1}$ l/ms
Water permeability: DIN EN ISO 11058	$3.5 \cdot 10^{-2}$ m/s
Flow rate:	35 l/sm ²



Foil protection fleece



Technical data:

Foil protection fleece 300 g/m²

Material:	Polypropylene
Weight:	300 g/m ²
Thickness:	2.6 mm
Maximum tensile force:	longit.: > 3.6 kN / m crosswise: > 10.0 kN / m
Plunger puncture force	3.700 N
Coefficient of water permeability in case of load of 2 kN / m ²	
Kv	2 * 10 ⁻³ m / sec

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EC Declaration of Conformity

In accordance with

EC Directive “Machines”

2006 / 42 / EC

**EC Directive “Safety devices, controlling devices and regulating devices intended for use
in potentially explosive atmospheres”**

94/9/EC

Operating manual for the application and
intended use of

Double-Membrane Gas Accumulators (DMGS)

2	For your safety	14
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2.2	Special safety instructions.....	15
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2.12	Ignition source analysis:.....	23

Safety instructions



To avoid the formation of an explosive atmosphere within the working area during maintenance work, the following minimum measures must be taken while wearing personal protective equipment, particularly a gas warning device:

- Reduce the fill level of the gas storage space by supplying the existing biogas to gas users as far as possible
- Shut off all valves in pipes conveying biogas within the affected gas storage space
- Where applicable, flush out the gas storage space with inert gas, until the methane content has been reduced to under the lower explosion limit (4.4 vol. %)
- Before commencing the work tasks, open the DMGS on the lee side and ventilate the gas storage space where applicable
- Permanently check the workplace with a gas warning device
- Where applicable, apply mechanical ventilation

Safety instructions gas warning devices



To avoid igniting an explosive atmosphere within the working area during maintenance work, the following minimum measures must be taken, as well as using personal protective equipment, particularly a gas warning device:

- Any electrical operating materials in these areas, which do not correspond to category 2, must be completely switched off
- The device category and explosion groups corresponding to the zone and gas must be used
- Tools, clothing, and other working material corresponding to the zone should be used
- Regular training or briefing of the operating and service personnel on explosion protection, particularly ignition sources and the toxicity of biogas should be provided (see [5] and section 7.16).

2.12 Ignition source analysis:

The ignition sources in accordance with TRBS 2152 part 3 or EN 1127-1 (Oct. 97) are summarised and designated in attachment 7.16 to the current document.

Affects:

Normal operation	Maintenance/ repairs	Fault	Does not occur
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Ignition source	Component / incidence	Control measure
Hot surfaces	Bonding and welding works	Prohibited in a dangerous explosive atmosphere
Flames and hot gases	Cutting and welding works	Prohibited in a dangerous explosive atmosphere
Electrical installa-	Supporting air blower	Category 2

Installation



tions	Fill-level measurement	Installing the measuring element outside potentially explosive atmospheres or suitable category
	Air compressor	Installing the compressor outside potentially explosive atmospheres
Electrical equalisation currents	Intermediate support Clamping rail Supporting air blower Air compressor Over-/underpressure valve	Inclusion in equipotential bonding with regular checks
Static electricity charge	Gas storage film	Surface resistance $< 3 \cdot 10^9 \Omega$
Lightning strike	Total roof area	External lightning protection e.g. in accordance with DIN 62305, Version X 2011, and VDE 0100 via equipotential bonding Regular leakage checks
	Overpressure valve	Manage the system such that under normal operation, no biogas escapes
Electromagnetic fields	Welding machines	Prohibited in a dangerous explosive atmosphere

Electrical devices



- Electrical devices may only be connected by professionals.
- The operating manual (connection, commissioning, installation, maintenance) of the respective devices must be complied with.
- All electrostatically dissipative or conductive materials must be included in the equipotential bonding of the overall facility.



- The supporting air blower is generally designed as a Category 2 device.
- Compliance with TRBS (spec. 1112 - servicing, 2152 - explosive atmosphere and 2153 – avoiding ignition hazards).
- Supporting air blowers must not be operated in sealed rooms.
- The operational location must be selected such that a reduction in the volume flow is excluded.

Maintenance and servicing



Maintenance instruction	Means of checking	Interval
<u>Blower and auxiliary devices:</u>		
Function	Visual / audible	Daily
Pressure, delivery volume	Measurement devices	Yearly
Rotation direction	Visual	Whenever switching on
Check bearing	Audible	Quarterly
Cleaning of impeller	Manual	Quarterly / as required
Check valve function	Visual / audible	Quarterly
Exhaust air damper wear	Visual	Quarterly
Free movement of exhaust air damper	Manual	Quarterly
Spiral hose attachment, impermeability	Visual / in accordance with DVGW 469	Quarterly

Leak tests

German regulations for leak tests:

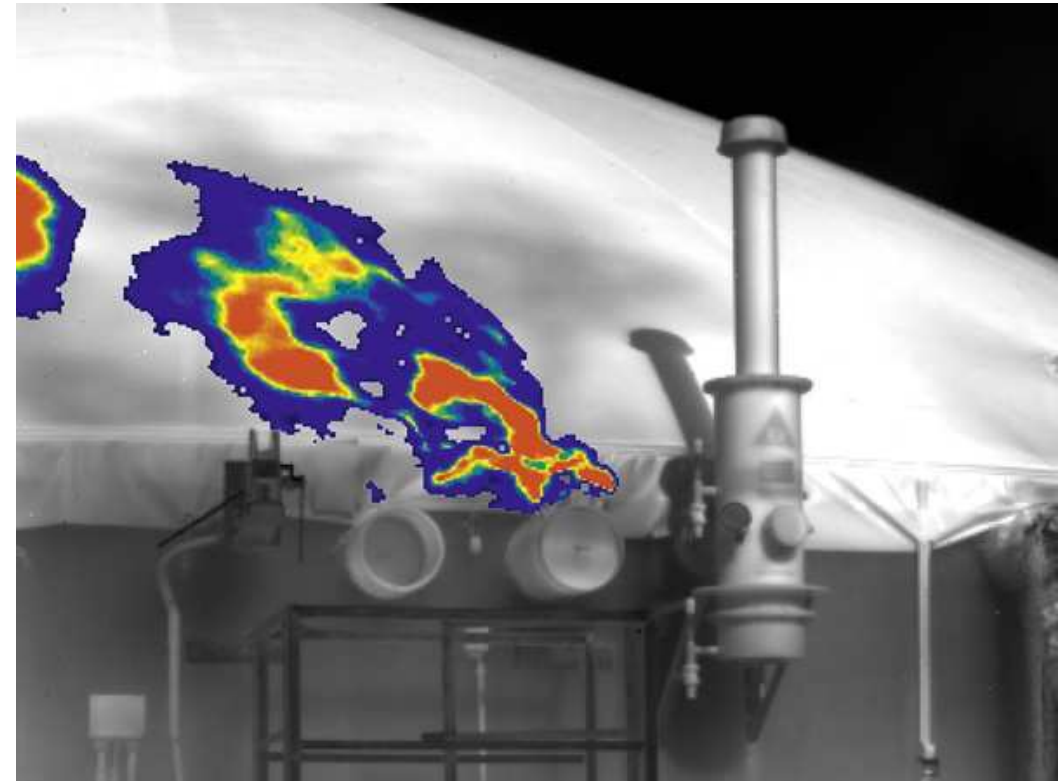
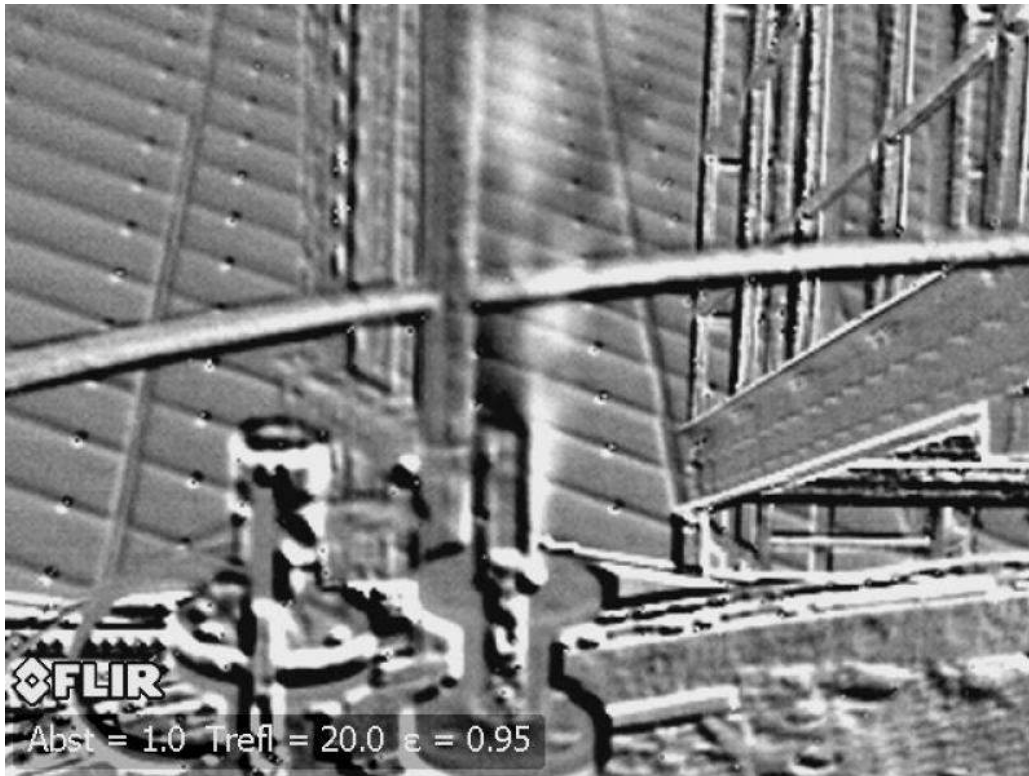
- *DWA-M 376: Safety rules for biogas tanks with membrane foils*
- *Technical information part 4: Safety rules for biogas plants (2008)*
- *Consultants for Biogas plants: Guidelines for leak test (2011)*
- *DIN EN 1779: Leak tests*



Leak tests

- *After the installation and during the operating*
- *Different monitoring devices*
- *Check all the equipment (membrane foils, gas storages, over-/under pressure protection, valves, agitators, sight glasses*)

If not →



membrane roofs . emission protection . gas bags . lagoon basins

Not controlled biogas plant



membrane roofs . emission protection . gas bags . lagoon basins