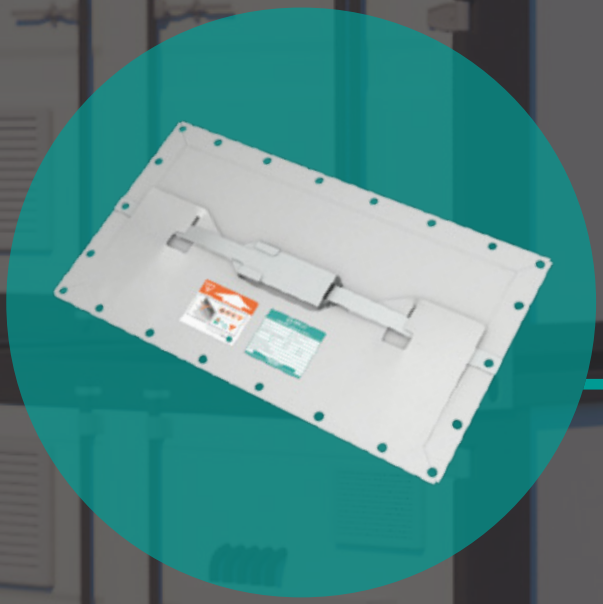
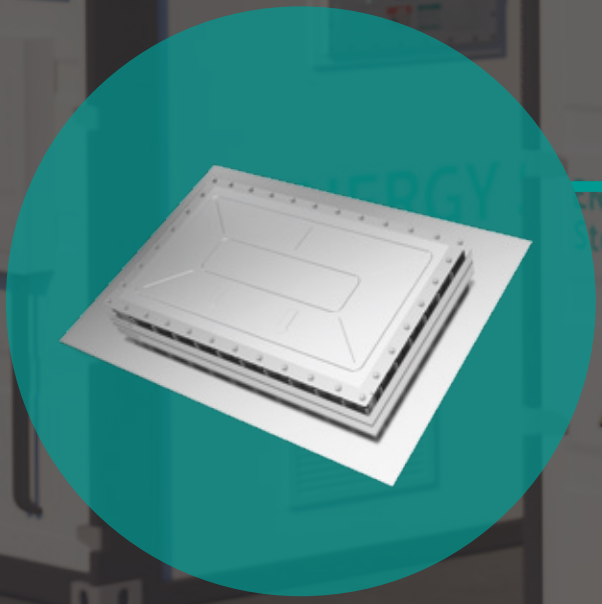
Safety is for life.™

BESS Explosion Safety Series

by **REMBE®**

Reliable. German. Safety.





Content

Battery Energy Storage Systems (BESS) are transforming our energy landscape – and REMBE® is pushing the boundaries of their protection. **No two BESS are identical, and each requires its own tailored approach.** Drawing on over 50 years of explosion protection expertise, we're leading the way in developing protection solutions that balance safety requirements with commercial objectives. **Our integrated approach** leverages multiple layers of safety, combining options for early detection and combustible concentration reduction with optimized deflagration vents to safeguard next-generation BESS installations.

REMBE® offers a comprehensive range of products that help safeguard BESS against explosions. Three distinct product series enable optimal solutions for any BESS installation, each bringing unique advantages to your project:

- The **BESS Core Venting Series** delivers **efficient roof venting** through our proven EGV products. Engineering excellence meets customization – each product is precisely tailored to customer specifications, from size and burst pressure to insulation materials and properties. This series offers proven protection with attractive volume pricing.
- Innovation takes center stage in the **BESS Smart Venting Series** with BESS.TGV, our revolutionary deflagration vent for BESS enclosure sides. The patented TargoVent principle deflects explosion effects upward to a safe location. By moving explosion protection from roof to container sides, BESS.TGV **eliminates concerns about snow loads and hail impact while freeing up valuable roof space**. This creates new possibilities for BESS configuration, such as **vertically stacked installations**. With a uniquely slim profile, BESS.TGV seamlessly integrates into any BESS enclosure.
- The **BESS Premium Venting Series** represents our latest breakthrough in explosion protection. As pioneers of flameless venting technology, REMBE® has developed BESS.Q.Vent – the **first flameless vent** specifically engineered for BESS applications. By eliminating external flames and minimizing thermal and pressure effects, BESS.Q.Vent enables safe installation of **BESS in indoor locations and other sensitive environments**.

Enhancing this comprehensive protection portfolio, REMBE®'s advanced detection systems provide an extra layer of safety. **Our Hotspot and GSME sensors** detect critical faults before they escalate: Hotspot through precise thermal monitoring, and GSME through multi-gas detection. This **early warning capability** enables early intervention before potential issues develop into thermal runaway events, completing our integrated approach to BESS safety.

Beyond our products, REMBE® is your global **consulting** and engineering **partner** throughout your entire project. Our explosion protection experts and external **engineering partners** work closely with you to determine the optimal safety solution for your specific requirements.

What contribution can we as REMBE® make to improving safety?

REMBE® is an independent, owner-managed family business with approx. 340 employees worldwide and can draw on over 50 years of experience as the market leader in the fields of explosion safety and explosion venting. Our expertise covers the following range of services:

Consulting.

- Support in developing adequate, project-specific safety concepts for battery systems
- Explosion-related calculations (e.g. calculation of venting areas) according to national and international standards

Engineering.

- Testing and validation of protective measures at the accredited testing laboratory
  REMBE® Research+Technology Center GmbH, e.g.:
  - Fire and explosion tests with prototypes under practical conditions
  - Testing of explosion pressure resistance or flame penetration tests for battery housings
  - Development of flameless venting systems to prevent explosive flames and flying debris

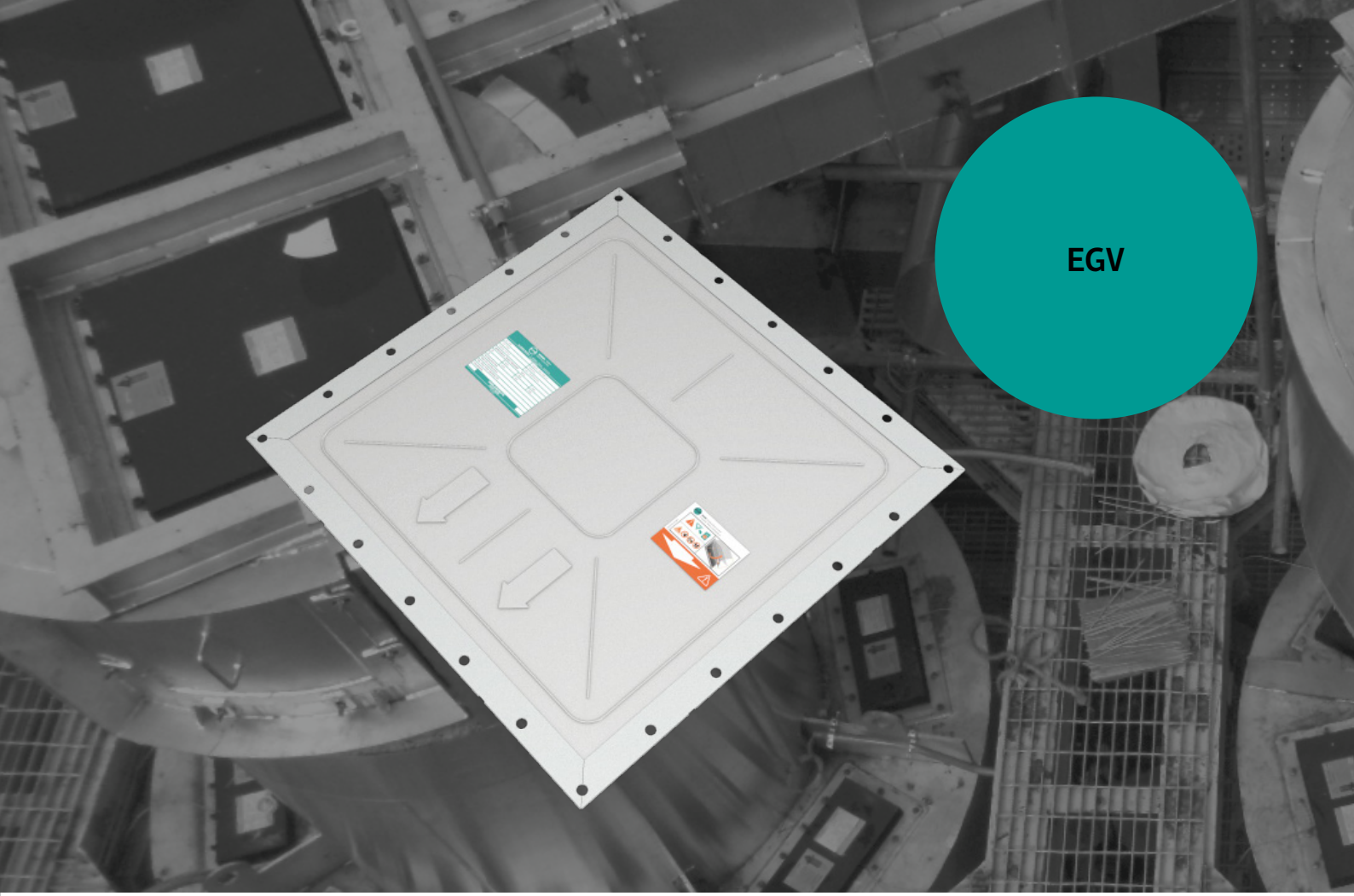
More information about the REMBE® Research+Technology Center GmbH can be found at: www.rembe-rtc.de

Products.

Explosion Vent Panels

- Accredited according to national and international standards
- Special solutions available as series products

The BESS
Core Venting Series



Advantages

- ✓ **High venting capacity and full bore opening** due to low surface weight.
- ✓ **High stability and opening speed** through integrated bionic structure.
- ✓ **Adapts perfectly to your BESS** due to the wide range of EGV geometries available.
- ✓ **Quick and easy installation** as EGV is torque independent. No additional counter frame required.
- ✓ **Significant space savings** due to the integrated gasket and frame in the explosion vent.

Technical data*

Burst pressure P_{stat}	25 - 500 mbar
Max. permitted operating pressure	50 % of P_{stat}
Temperature	-40 to +180°C (– 40 to + 356 °F)
Material	Stainless steel
Gasket material	FDA approved silicon gasket
Tolerance	± 20 % at standard burst pressure
Recommended torque for M10 screws	20 Nm

* Our specialists will be pleased to assist you in finding a solution that matches your specific operating conditions.

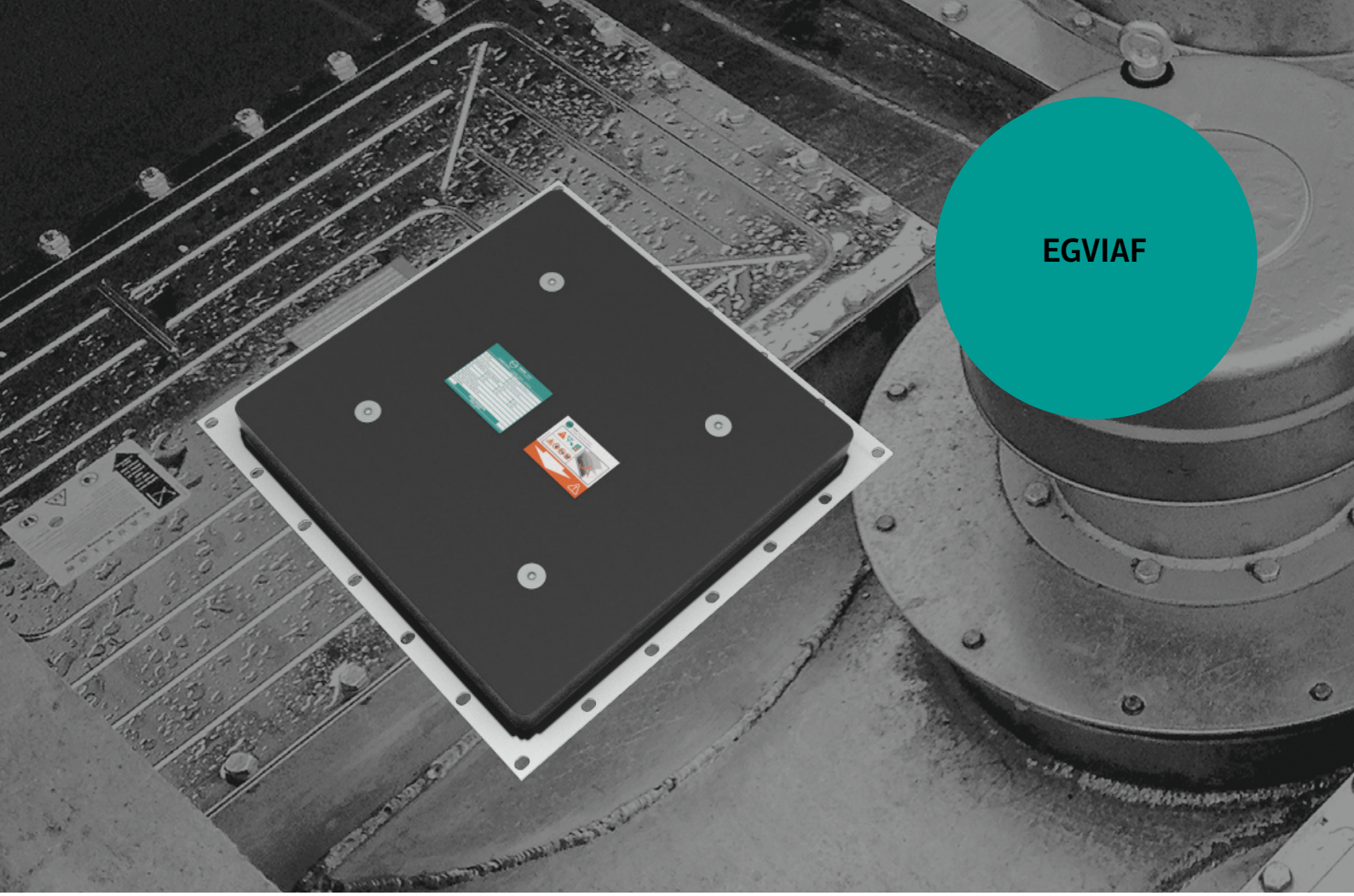
Certifications

Meets the requirements of **NFPA 68**

ATEX
EU-type examination certificate no.
FSA 04 ATEX 1538 X

SIL equivalent

SIL 4



Advantages

✓ Insulation inside and / or outside possible
✓ Lightweight

Technical data*

Burst pressure P_{stat}	25 - 500 mbar
Max. permitted operating pressure	50 % of P_{stat}
Temperature	-40 to +180°C (– 40 to + 356 °F)
Material	Stainless steel
Gasket material	FDA approved silicon gasket
Tolerance	± 20 % at standard burst pressure
Recommended torque for M10 screws	20 Nm
Insulation	FEF
Fire rating of insulation	UL 94 V 0
Insulation thickness	25-100 mm
Insulation properties	λ=0.035 W/m*K

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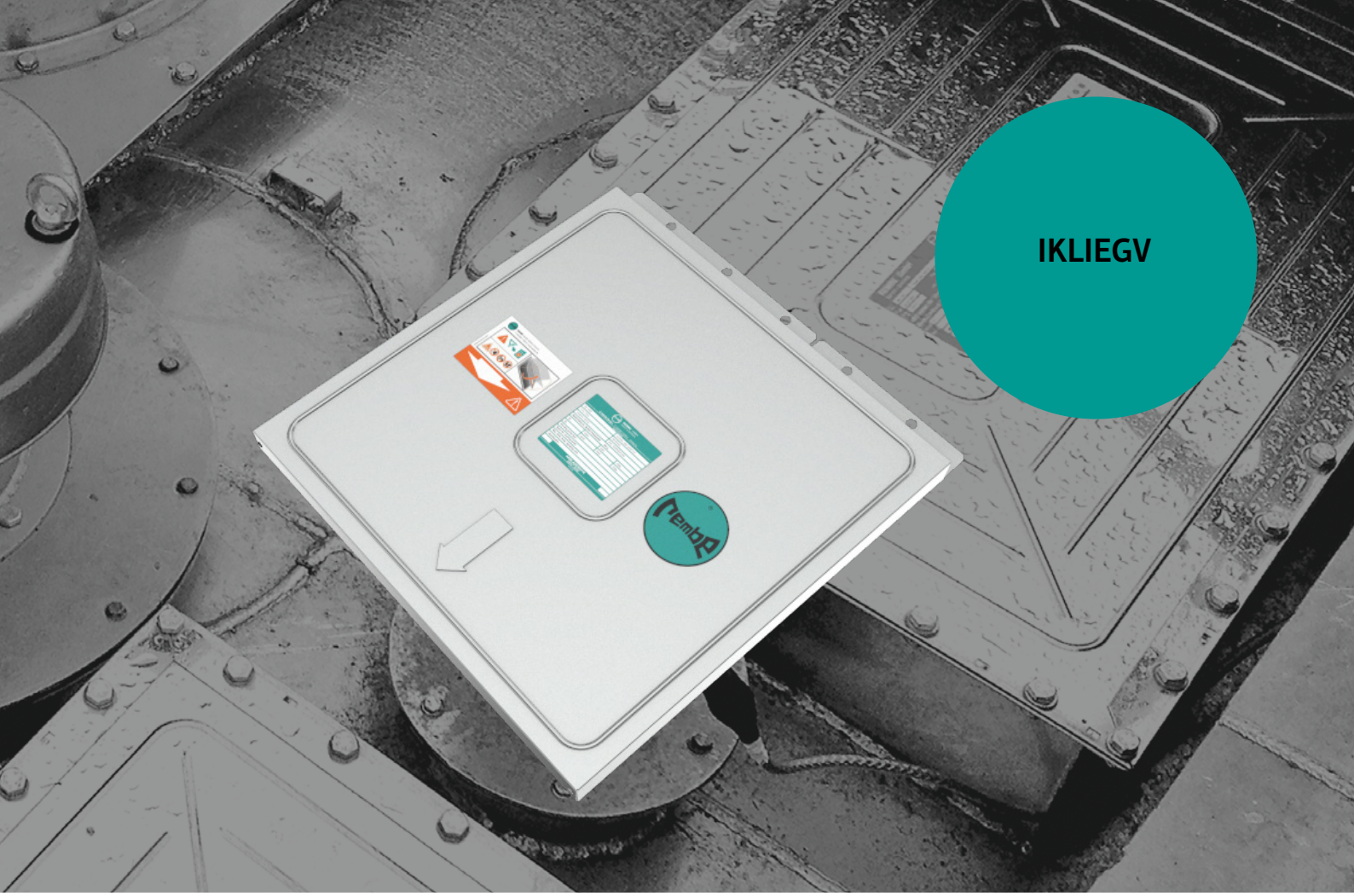

Advantages

✓ Insulation protected
✓ Outside insulation
✓ Lightweight

Technical data*

Burst pressure P_{stat}	25-500 mbar
Max. permitted operating pressure	50 % of P_{stat}
Temperature	-40 to +180°C (–40 to +356 °F)
Material	Stainless steel
Gasket material	FDA approved silicon gasket
Tolerance	± 20 % at standard burst pressure
Recommended torque for M10 screws	20 Nm
Insulation	Rockwool
Fire rating of insulation	Non-combustible
Insulation thickness	40-100 mm
Insulation properties	λ= 0.040 W/m*K

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Certifications

NFPA

Meets the requirements of **NFPA 68**

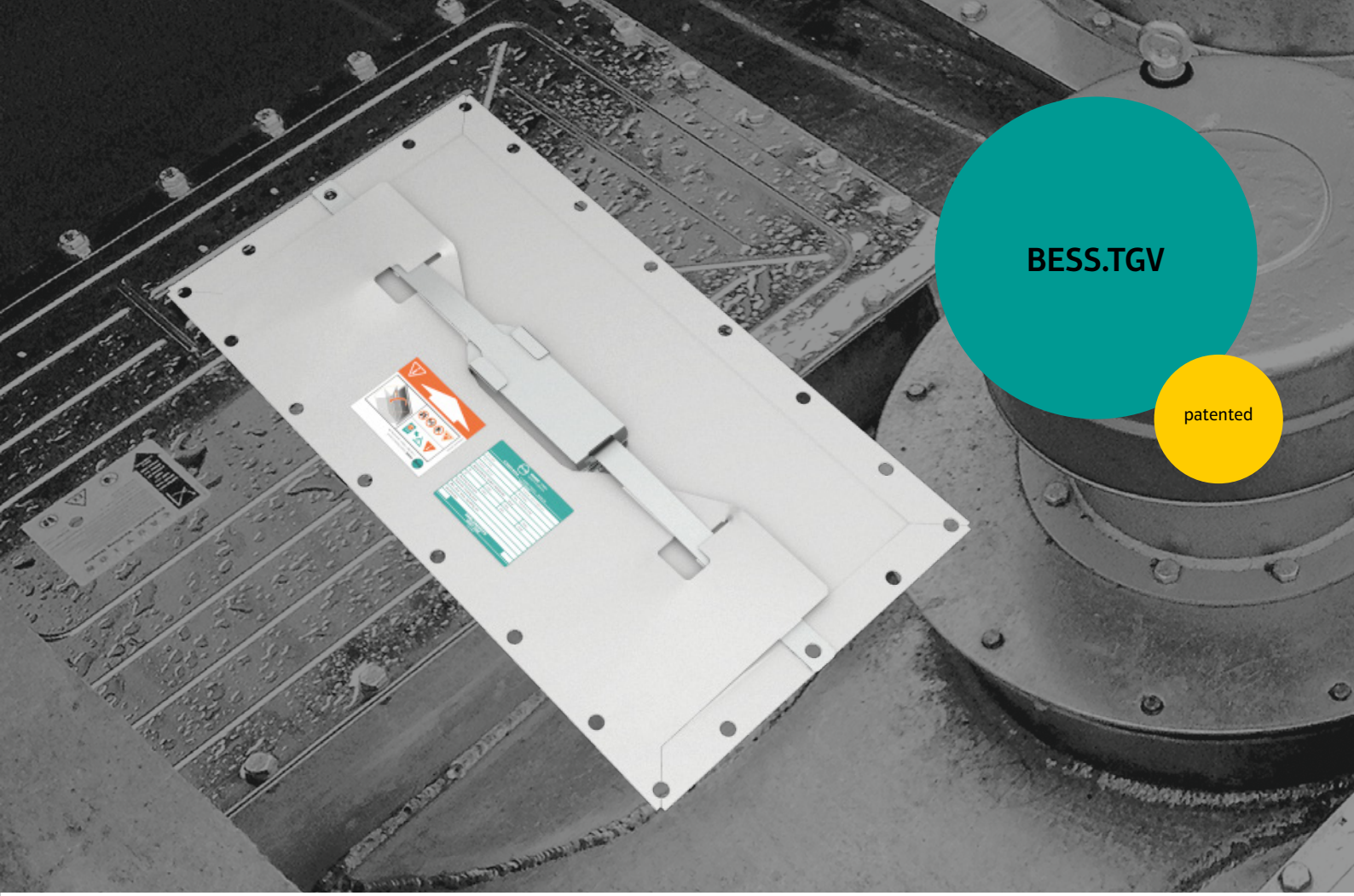
Ex

ATEX
EU-type examination certificate no.
FSA 04 ATEX 1538 X

SIL equivalent

SIL 4

The BESS
Smart Venting Series



Advantages

✓ Limits opening angle to 45 °
✓ Reduced safety area
✓ Wall installation at BESS
✓ Uniquely slim profile < 15 mm
  • Blends in with the container walls
  • Allows container to be stacked

Technical data*

Burst pressure P_{stat}	25 - 100 mbar
Max. permitted operating pressure	50 % of P_{stat}
Temperature	- 40 to +180°C (– 40 to + 356 °F)
Material	Stainless steel
Gasket material	FDA approved silicon gasket
Tolerance	± 20 % at standard burst pressure
Recommended torque for M10 screws	20 Nm
Insulation	FEF
Fire rating of insulation	UL 94 V 0
Insulation properties	λ= 0.035 W/m*K
Opening angle	45°

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Certifications

NFPA

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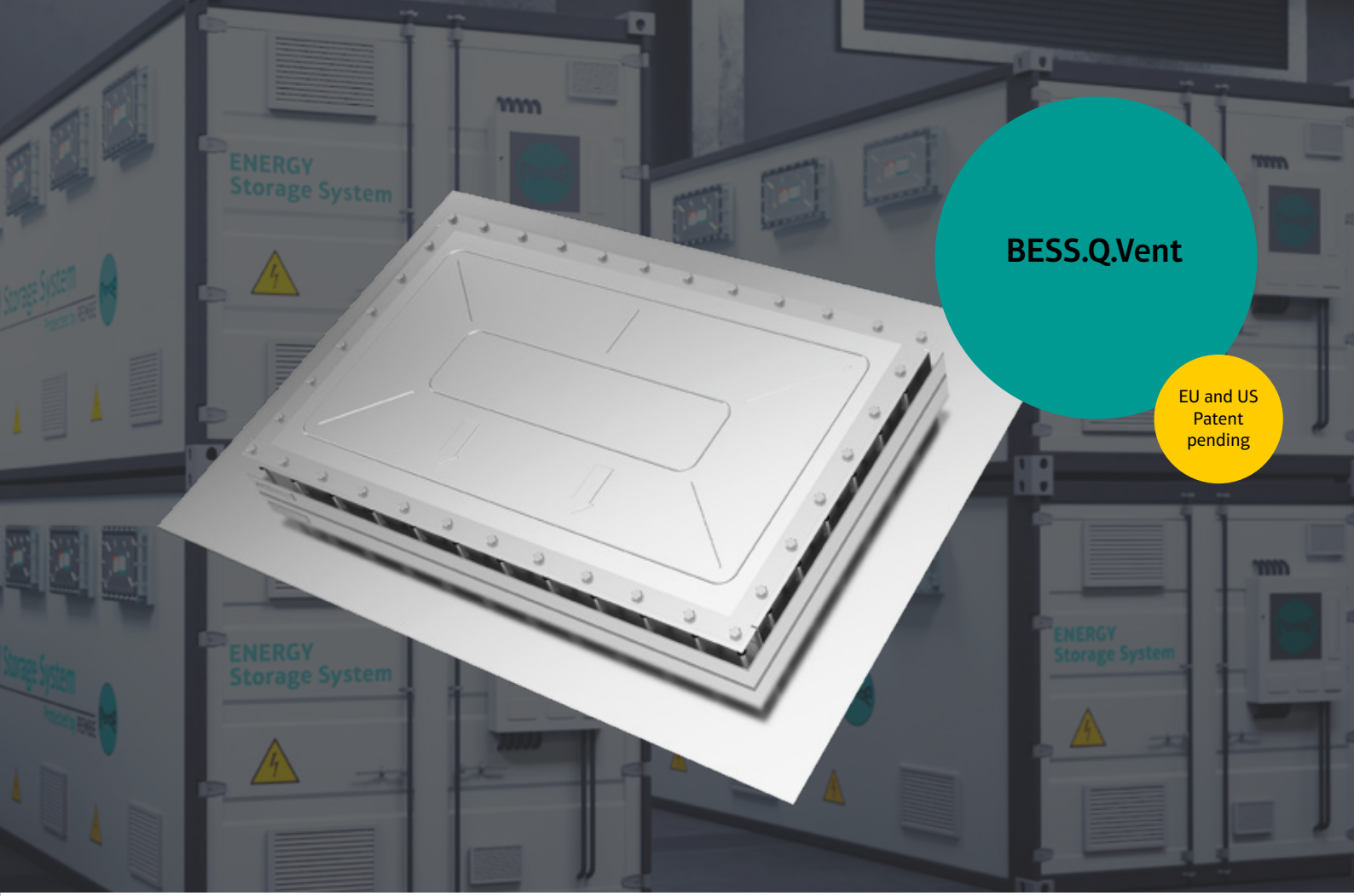
The BESS
Premium Venting Series



Advantages

- ✓ Flame absorber
- ✓ Reduced safety area
- ✓ Wall or roof installation at BESS
- ✓ Uniquely slim profile
  - • Blends in with the container wall
  - • Allows containers to be stacked
- ✓ Maintenance-free
- ✓ Reduction of external explosion pressures
- ✓ Suitable for indoor installation of the BESS

Technical data*

Burst pressure P_{stat}	25 - 100 mbar
Max. permitted operating pressure	50 % of P_{stat}
Temperature	-40 to +180°C (– 40 to + 356 °F)
Material	Stainless steel
Gasket material	FDA approved silicon gasket
Tolerance	± 20 % at standard burst pressure
Recommended torque for M10 screws	20 Nm
Insulation	FEF
Fire rating of insulation	UL 94 V 0
Insulation thickness	25-100 mm
Insulation properties	λ= 0.035 W/m*K

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Certifications

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SIL equivalent

SIL 4

BESS
Explosion Prevention

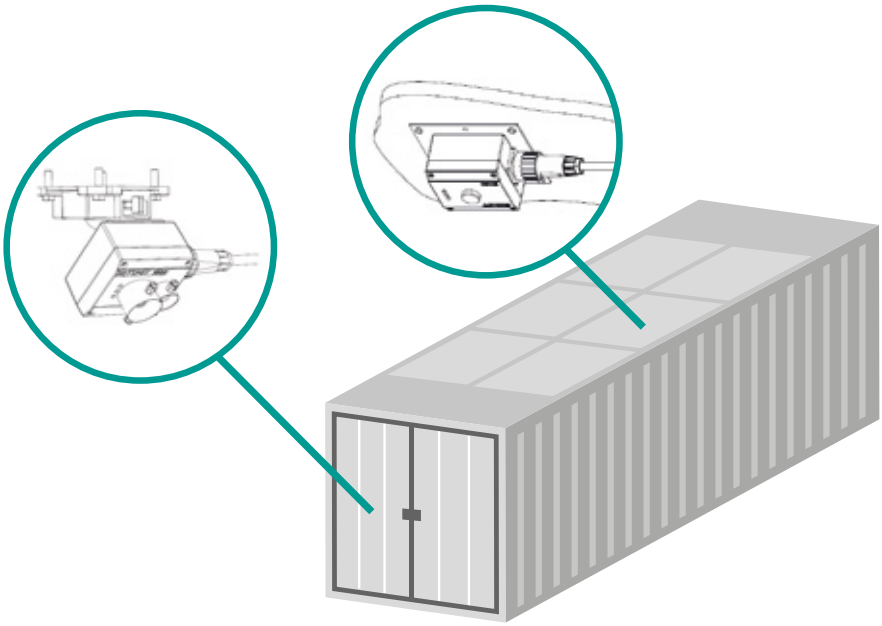
Detection of thermal runaway

GSME gas detector
Gas detector sensitive to hydrogen, carbon monoxide and hydrocarbons

Advantages
✓ Monitoring of relevant gas concentrations (multi-component detector 0-100 ppm) that arise during thermal runaway
✓ Early alarm

HOTSPOT temperature detector
Infrared camera to monitor the temperature of individual storage systems or facilities

Advantages
✓ Monitoring of surface temperatures ranging from 0 to 200 °C
✓ Identification of the smallest temperature increases



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