

DILO. Sustainably tight.



SF₆ „Zero Emission“ Concept

Retrofit Modules for Gas Handling Units

Overview

- Recovery of SF₆ gas
- Retrofitting to < 5 mbar
 - Retrofit kit for Piccolo, Compact and Economy series
- Retrofitting to < 1 mbar
 - Mobile suction pumps
 - Add-on retrofit kits
- Cause of SF₆ gas emissions
- Best practice tips
- SF₆ gas monitoring

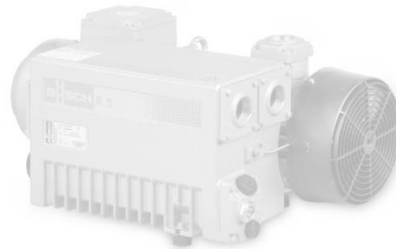
Basic function – recovery of SF₆ with existing gas handling plants



SF₆ recovery only possible to **50 mbar**



Vacuum pump inactive



Basic function – recovery of SF₆ with gas handling plants „state-of-the-art“

Functional diagram for service carts

- 1. SF₆ gas recovery
- 2. Evacuation of air or nitrogen
- 3. Filling with SF₆ (to operating pressure)



SF₆ recovery down to **< 1 mbar**

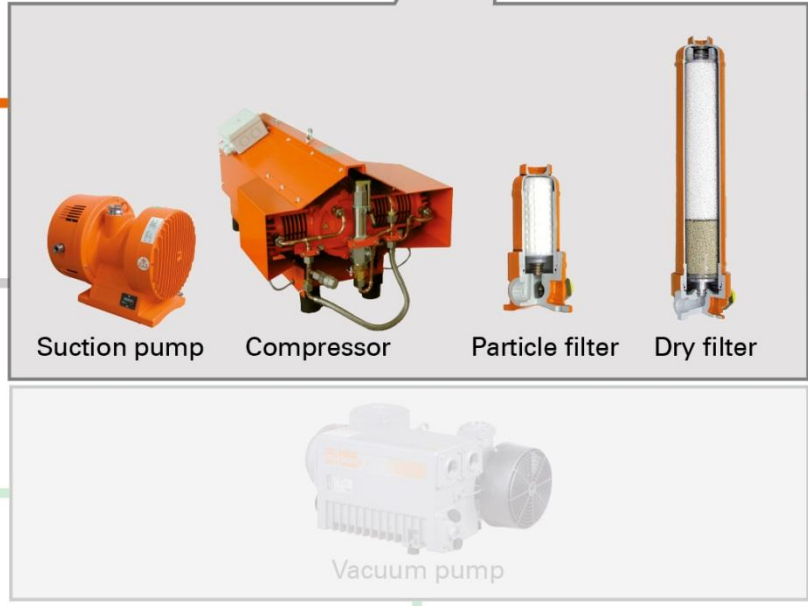


DILO SF₆ gas service cart

DILO SF₆ gas storage tank



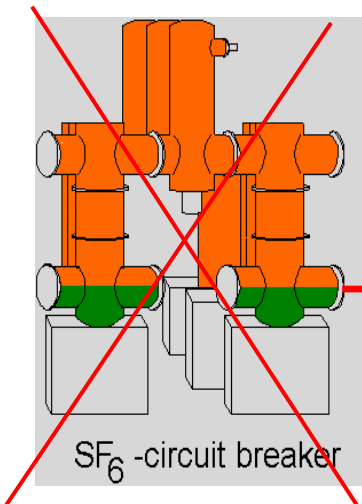
SF₆ circuit breaker



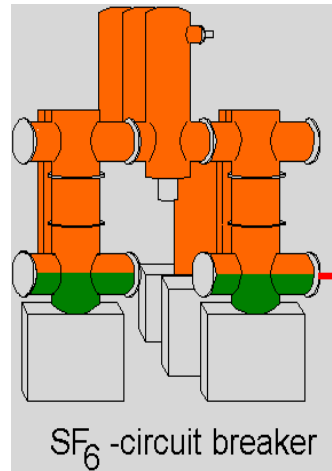
Gas cylinder

the air recovered exhausts into the atmosphere

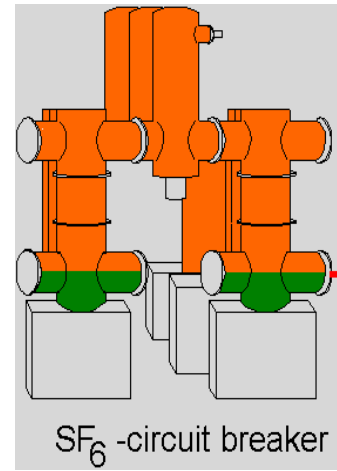
Residual gas emissions in SF₆ recovery



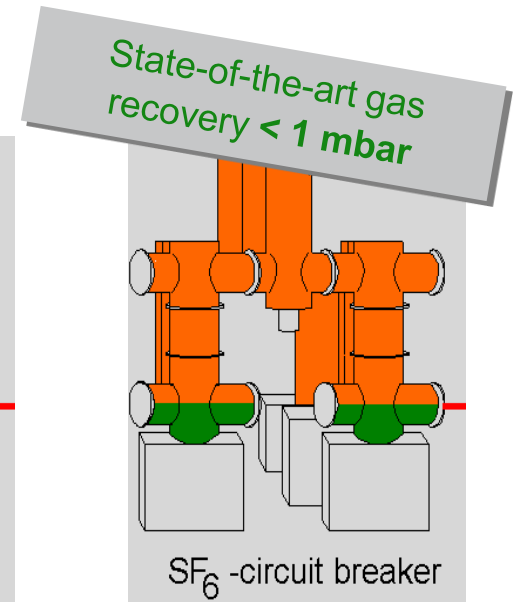
Old devices:
Residual SF₆ gas at
50 mbar 0.304 g / l
1 m³ = 304 g



Residual SF₆ gas at
20 mbar 0.120 g / l
1 m³ = 120 g



Residual SF₆ gas at
5 mbar 0.030 g / l
1 m³ = 30 g



Residual SF₆ gas at
1 mbar 0.006 g / l
1 m³ = 6 g

Stipulated final vacuum as per IEC 62271-4, Chart 6, No. 4 for gas recovery: ≤ 20 mbar

Retrofit kit for enhancing SF₆ recovery from 50 mbar to < 5 mbar



Piccolo series
B052R01/R02/R03



Compact series
B057R01/B058R01



Economy series
B120R21/R22/R61/R62

3-582-R101 Retrofit Kit

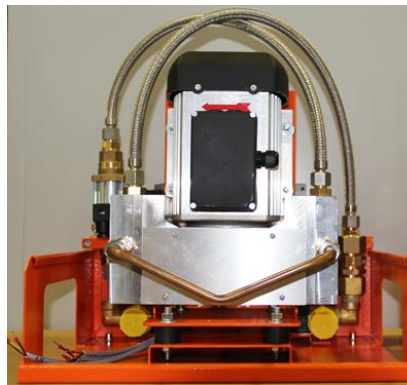
Oil-free vacuum compressor

Delivery volume: 4.8 m³/h

Final vacuum: < 5 mbar

Max. final pressure: $p_e = 1.5$ bar

Motor power rating: 0.3 kW



- Includes all necessary parts for retrofit
- Can be easily assembled by the customer

Use of oil-free, mobile suction pumps for SF₆ recovery down to < 1 mbar



SF₆ circuit breaker



Oil-free suction pumps



DILO SF₆ gas service cart



DILO SF₆ gas storage tank



Gas cylinder

Use of oil-free, mobile suction pumps for SF₆ recovery down to < 1 mbar



B131R41 (15 m³/h)
Final vacuum < 1 mbar



1-phase AC supply

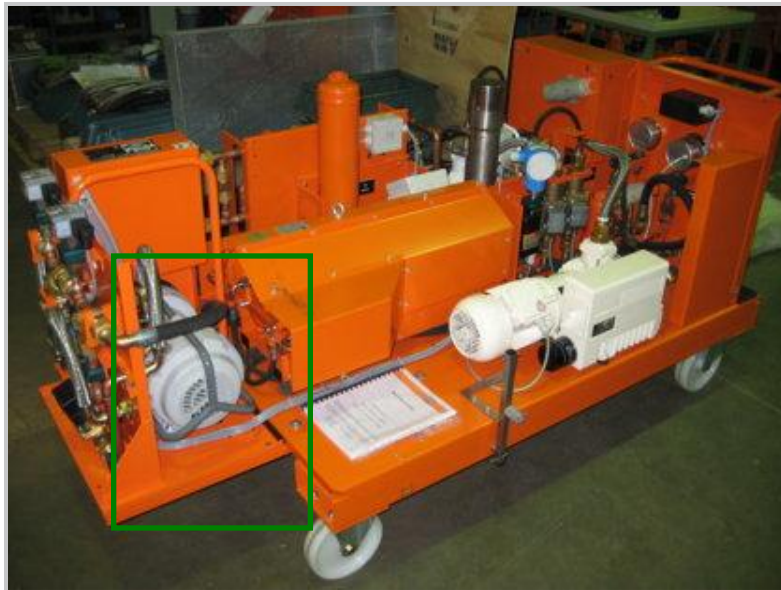


B131R13 (35 m³/h)
Final vacuum < 1 mbar

Add-on retrofit with oil-free suction pumps for SF₆ recovery down to < 1 mbar

- Vacuum compressors can be kept in existing devices
- Switching points for vacuum compressor
Inlet p_e 0.8 bar - Outlet p_e 1.0 bar
- Switching points for suction pumps
Inlet p_e 0.1 bar - Outlet p_e 0.15 bar
- SCROLL principle of suction pumps, hermetically-sealed to the outside through metal bellow
- Maintenance-free

Add-on retrofit kits for SF₆ gas recovery down to < 1 mbar



Type Z788R03

Suction pump fitted to the back of service cart, delivery volume: 15 m³/h



Retrofit kit for
B040R01 and
B041R01

Add-on retrofit kits for SF₆ gas recovery down to < 1 mbar



Retrofit kit for **B052R01**
(15 m³/h)

Type Z788R05

Suction pump fitted to the back of service cart

Add-on retrofit kits for SF₆ gas recovery down to < 1 mbar

Z788R09



Suction pump mounted on top of service cart

Delivery volume: 15 m³/h

Add-on retrofit kits for SF₆ gas recovery down to < 1 mbar

Z788R27 – 15 m³/h



Before modification equipped with vacuum compressor

Recovery up to **50 mbar**



Suction pump mounted laterally

After the modification equipped with oilfree suction pump

Add-on retrofit kits for SF₆ gas recovery down to < 1 mbar



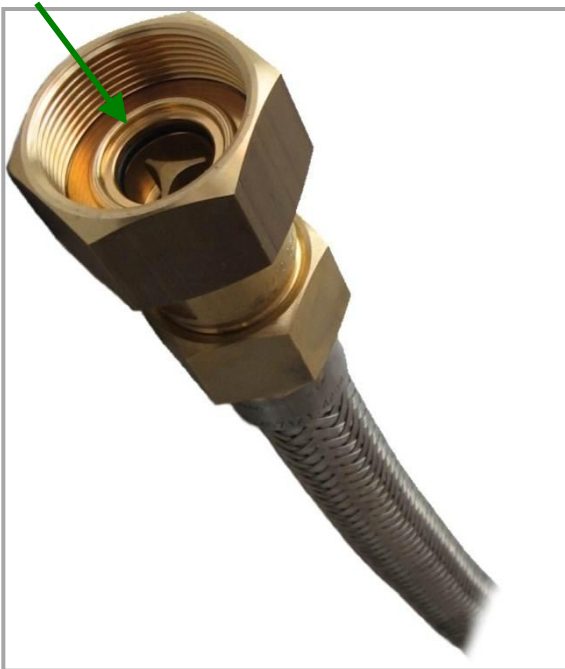
Before modification with vacuum compressor:
gas recovery = **50 mbar**



After modification with oil-free suction pump:
gas recovery = **1 mbar**

Where do SF₆ gas emissions arise?

Original DILO delivery condition



Customer changed connection!!



The gas from the hose is not recovered!

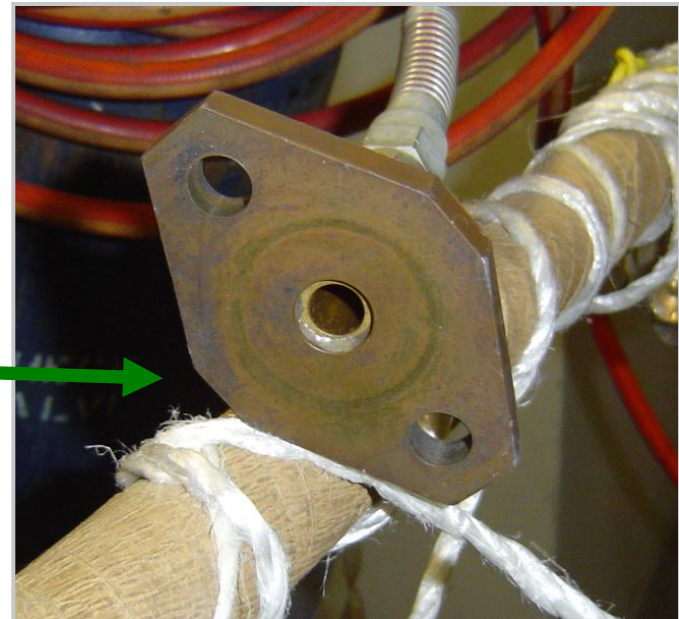


The adapter is mounted and after-wards the hose is not evacuated!!

Emission-free SF₆ gas handling with DILO couplings



Emission after refilling with SF₆ gas



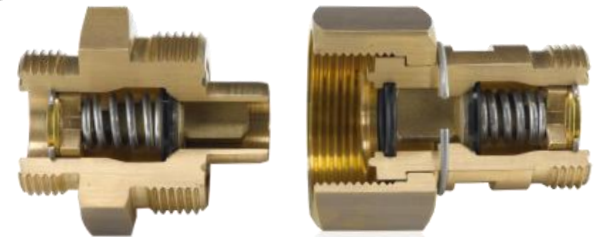
Dust, particles, mix of air & moisture get into GIS!

DILO couplings

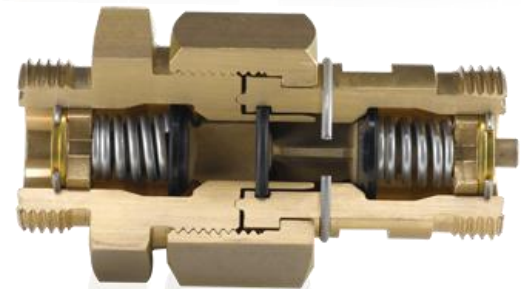
Advantages of application:

- Self-closing coupling system
- Pressure and vacuum-tight even when coupling and uncoupling
- Permanent tightness even when frequently connected and disconnected
- Applicable up to PN 64 bar
- Suitable for temperatures from -40°C to $+80^{\circ}\text{C}$
- Direct connection to DILO service carts without adapter
- Available in different materials even for outdoor switchgear

**Sustainably tight:
Leak rate $< 1\text{ cm}^3$ in 30 years**



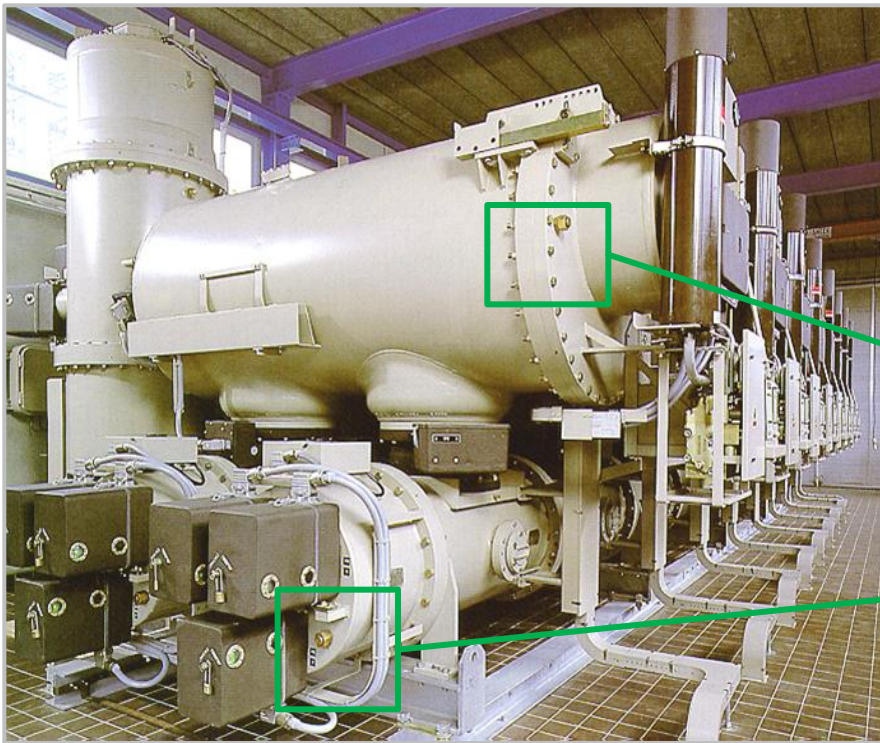
Open coupling



Closed coupling

DILO couplings

Hermetically tight connections



Most of the major switchgear manufacturers use hermetically tight DILO couplings on GIS



Where do SF₆ gas emissions arise?

During revision jobs when changing filter cartridges
vol. of 4.68 l at 50 bar = 4.7 kg



Best way: gas recovery by using a second
maintenance device

Let overpressure from the pressure side
flow into SF₆ bottle



Where do SF₆ gas emissions arise?



Gas leaks on pipework system



Inadequate maintenance of gas handling equipment

Where do SF₆ gas emissions arise?



Uncoupling of measuring device at the wrong place with open connection



Retrofit kits from open connections to self-closing couplings

Tender specification for SF₆ gas handling plants

Recommendation

Specification for SF₆ gas handling plant / new generation



MEGA
liquid

1. Scope

This specification covers a SF₆-gas handling plant for the recovery, storage, transportation, conditioning of Sulphur Hexafluoride (SF₆) gas.

- **General:**

The SF₆-gas maintenance unit shall be of compact and robust construction and design. The unit shall be of portable type, mounted on a base frame provided with steering and fixing wheels for easy and convenient movement of the unit to different switchgear locations in a substation. The unit shall also be provided with suitable lifting eyes for transportation from one site to another.

The unit shall be capable of recovering +99.99% of SF₆ gas from circuit breakers or similar equipment, without any oil lubricated or refrigeration device.

The SF₆-gas maintenance unit shall consist of following parts.

- **Dry Running Type Compressor:**

The main compressor shall run entirely without oil.

The theoretical delivery of the compressor shall be 17 m³/h at 50 Hz (13,4 m³/h at 60 Hz) and its final max. discharge pressure shall be 50 bar (g). The compressor shall be gas tight under positive or negative pressure, when power is turned off. The entire compressor unit (motor, pistons, and all moving parts) shall be enclosed in one, pressure sealed housing.

Available for:

- L057
- L170
- B057R... / B058R....
- General specification for a gas handling plant

„Best Practice“ – suggestions for better gas handling



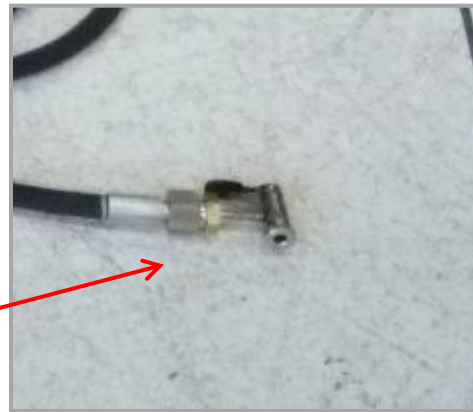
Negative example!

Extremely restricted gas flow

Coupling DN20 on the gas handling equipment

Connection hose DN8 only

Tyre valve (4 mm)



„Best Practice“ – suggestions for better gas handling



**Simultaneous gas recovery /
evacuation of three gas
compartments**

with DN20 connection using MEGA
service cart with DN40 connection

SF₆ gas monitoring

- Why is reporting necessary ?
- Which solution does DILO offer for this application?

How can I registrate the refilling quantities on my switchgear?



Weighing scales
Measurement beforehand

Filling of the plant / electrical component

Measurement afterwards
→ Difference = filled quantity



Alternative: Mass flow measurement system



Mass flow measuring system B152R41

Characteristics:

- System can be wall or table mounted
- Coupling groove part DN20
- PC-Hart modem with PC interface cable (available as option)
- Indication in kg, optionally in lbs



Accuracy: 0.50 % ± 0.1 kg/h

Electronic bottle balance K091R07

Characteristics:

- Weighing range: 0 - 150 kg
- Digit increment: 0.05 kg
- Accuracy: ± 50 g
- Operating temperature: -10 to +40 ° C
- Power supply or batteries (4 x 1.5 V AA)



Accuracy: ± 50 g


Electronic weighing scales K091R54

Characteristics:

- Weighing scales for 600 l SF₆ gas containers
- With large LCD Display
- Weighing range: max. 1,500 kg
- Tare function
- Power supply unit and internal accumulator to 90 h
- Weight indication reversible in kg / lbs
- With fixing and steerable rollers



Global service points

	50 Hz Solutions Pty Ltd., Australia		PT. High Volt Technology, Indonesia		DILO Asia-Pacific Pte. Ltd., Singapore
	KoCoS BeNeLux, Belgium		Synecom s.r.l., Italy		Electromediciones Kainos S.A., Spain
	Engemet Energética Ltda., Brazil		Japan Cooperative Energy Service Corp. (COESCO), Japan		Siyphambili Electrical and Industrial Supplies, South Africa
	SF ₆ Chile Ltda., Chile		THAG Sdn. Bhd., Malaysia		LeeYoung Ind. Co., Ltd., South Korea
	Unit International Business Inc., China		EBBCO Ltd., New Zealand		Hwa-Jue Enterprise Co., Ltd. Taiwan
	Zhuhai S.E.Z. Hangto Science & Technology Co., Ltd., China		Pacific Engineering, Pakistan		Gunkul Engineering Public Co., Ltd., Thailand
	FV-Elteknik, Denmark		KVAR Marketing Corporation, Philippines		EKNIS-UKRAINE LLC Electrotechnical Company, Ukraine
	Euro System, France		Ener Test testery I diagnostyka sp. Z o.o., Poland		Ferenc Spohn, Hungary
	IAC Industrial Apparatus Consultants Ltd., UK		ARC BRASOV SRL, Romania		DILO Company, Inc., U.S.A.
	C & K Instrument (HK) Limited, Hong Kong		New Technologies and Systems Ltd., Russian Federation		
	Hi-Tech Systems & Services Ltd., India		Civil and Electrical Projects Contracting Co., Saudi-Arabia		

DILO. Sustainably tight.



DILO
Armaturen und Anlagen GmbH

Fruntsbergstrasse 36
D-87727 Babenhausen

Tel.: +49 (0) 83 33 - 302-0
Fax: +49 (0) 83 33 - 302-52
E-Mail: info@dilo-gmbh.com