

# Oil Purification Plants

VOP

100 lt/h - 20000 lt/h



Oil purification system

**MICAFLUID**

# Oil Purification Plant



## Process Description

Standard plants for the treatment of insulating oils, oil filling and drying of electrical equipment, such as transformers and switchgears.

The oil to be treated is fed into the VOP plant by means of differential pressure. Through the electrical heater the oil is heated to the pre-selected temperature and directed into the degassing phase. An automatic level control guarantees, at pre-selected flow-through, an optimised degassing of the insulating oils.

By means of a frequency controlled feeding pump, the dewatered and degassed oil is transferred back into the transformer through the fine filter column.

## Technical Characteristics

- Single stage, air-cooled vacuum system
- Variable flow-through according to type, from 100 lt/h to 20000 lt/h
- Anti-Froth Control system in the degassing tank (AFC-System)
- Automatic overflow safety device
- Variable degassing values
- PID-regulated Thyristor heating system
- Variable fine filter inserts
- Automatic indication for filter changes
- PLC controlled system
- Modular build-up
- Short delivery times

## Special Application

In order to control the increased froth behaviour of the treated insulating oil, an automatic froth surveillance system is installed into the new degassing tank. During the treatment phase a special automatic process prevents an overflowing of the vacuum pumps with insulating oil.

All Micafluid Oil Purification Plants are designed for online treatment on energized transformer. Additional safety equipments (Z?) are needed.

## General Characteristics

Higher degassing and dewatering efficiency factor at a protective treating process. After treatment, the oil characteristics are vastly kept (light fractions, as well as chemical basis from the oil are not evacuated).

The VOP plant is a modular build-up and can be technologically expanded, at any time, without additional modifications.

# Substantial Plant Characteristics

## Oil Heating

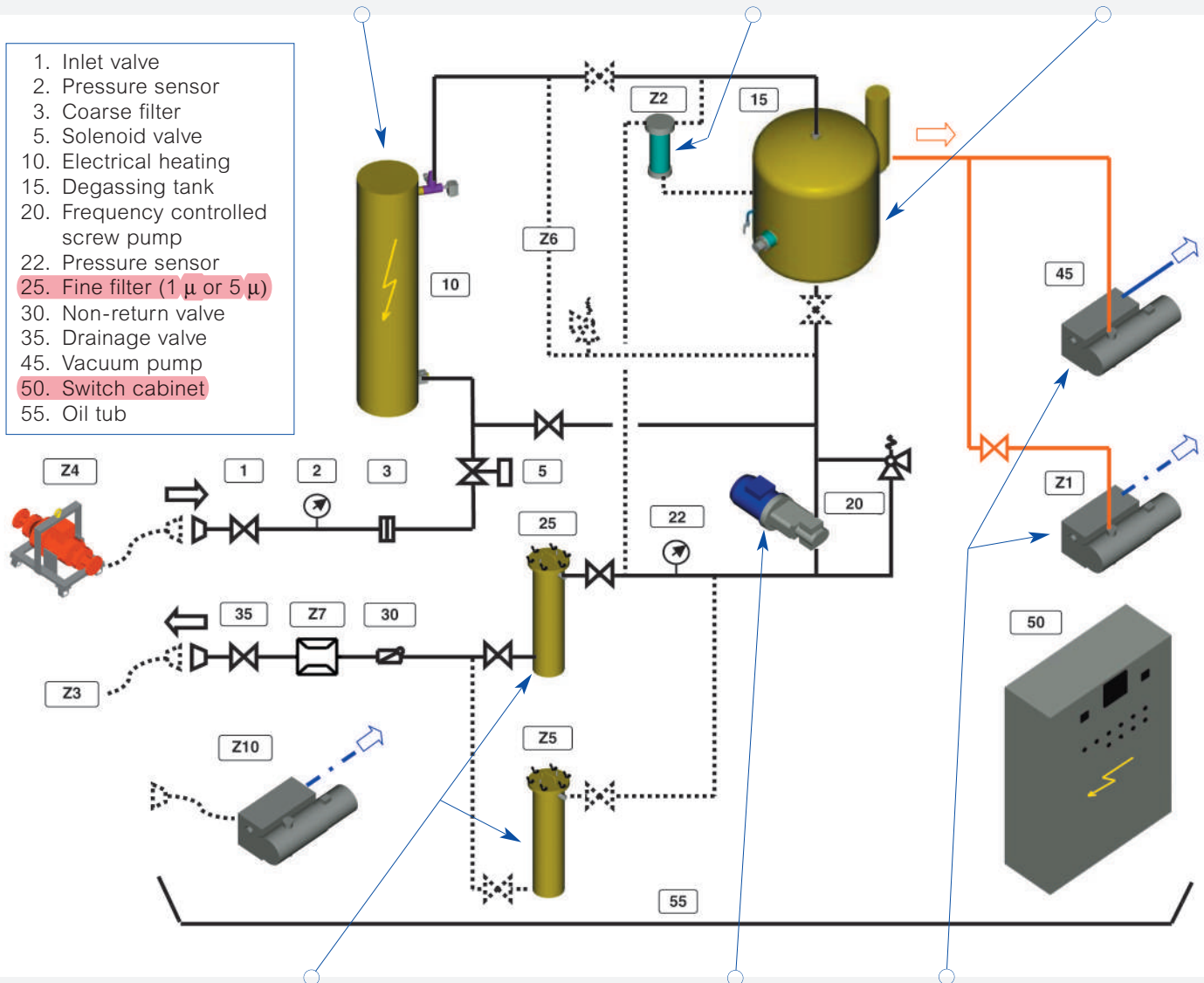
The oil to be treated is heated by means of an electrically heated, PID controlled oil heater, which is brought to the required treating temperature. The heating elements are placed into welded-in protection tubes, separated from the oil. The horizontal position and generously dimensioned heating surface allow a careful heating-up of the oil.

## Online Oil Measuring

A new measuring instrument for the determination of the oil quality at the in/outlet of the plant guarantees an optimal treating duration. Data is continuously registered on a 6-channel recorder.

## Degassing System

The degassing system has been optimised and expanded with an automatic froth control. New is also the automatic level control, dependent on the adjusted flow-through rate. Excellent degassing values and superior oil quality are guaranteed.



## Filtration

- A built-in pre-filter at the inlet of the VOP plant protects the plant against coarse contamination
- Fine filtering of the oil is carried out by means of easy to exchange filter cartridges with automatic control of dirtyness
- The filter elements are made of special synthetic material and are non-hygroscopic.

## Oil Feeding

Conveying of oil in the degassing phase is carried out by means of differential pressure. A frequency controlled feeding pump allows for variable oil flow-throughs. A specially developed automatic screen guarantees an even oil flow-through in the degassing phase. A photo electronical level surveillance controls the maximum admissible oil level in the degassing tank.

## Vacuum Plant

For the evacuation of gasses, developed in the degassing tank, only rotary slide vane vacuum pumps are now used. To achieve lower guarantee values only the suction capacity of the vacuum pump is increased.

# Supplements

A large selection of supplements can be ordered together with the VOP plant. Supplements ordered at a later stage can be easily installed into the plant without refitting.



**Z1**  
Optional vacuum pump (extended suction capacity)



**Z3**  
Flexible hoses with coupling



**Z4** Extern feeding pump



**Z5**  
Additional fine filter



**Z7** Flow-through meter



**Z8**  
Safety level probe



**Z15**  
Frame with tarpaulin



**Z17**  
Roadworthy trailer with box

## Special Plants

- Regeneration/Fuller plants
- Cable oil treatment plants
- Silicon oil treatment plants
- Generator oil treatment plants
- Oil spray plants
- Online oil treatment on energized transformer

## Further Accessories

- Z2 Water & gas content measuring device VZ 212 A
- Z6 By-pass system for heating and/or filtration
- Z9 Oil sampler connection piece
- Z10 Vacuum pump for transformer evacuation
- Z11 Signal device to mobile phone (GSM Modem)
- Z18 Roadworthy trailer with tarpaulin
- Z20 Spare parts for many years of plant operation

# Type Outline and Selection Assistance

Plant type	Type description	Flow-through	Guaranteed end values in reference to flow-through <sup>2</sup>			Oil content in transformer
			100%	50%	30%	
		[lt/h]	[ppm / Vol%]			[t]
Standard Oil Purification Plants <sup>1</sup>	VOP 10	300 - 1000	<8 / <0.09	<5 / <0.06	<4 / <0.05	> 4
	VOP 30	1000 - 3000	<8 / <0.09	<5 / <0.06	<4 / <0.05	> 10
	VOP 60	2000 - 6000	<8 / <0.09	<5 / <0.06	<4 / <0.05	> 30
	VOP 90	3000 - 9000	<8 / <0.09	<5 / <0.06	<4 / <0.05	> 50
	VOP 120	4000 - 12000	<8 / <0.09	<5 / <0.06	<4 / <0.05	> 120
Oil Purification Plants with extended suction capacity for best treatment values <sup>1</sup>	VOP 10 (Z1)	300 - 1000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 4
	VOP 30 (Z1)	1000 - 3000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 10
	VOP 60 (Z1)	2000 - 6000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 30
	VOP 90 (Z1)	3000 - 9000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 50
	VOP 120 (Z1)	4000 - 12000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 120
Special plants	VOP 03	100 / 300	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 2
	VOP 160	4000 / 16000	<8 / <0.09	<5 / <0.06	<4 / <0.05	> 150
	VOP 200	6000 / 20000	<8 / <0.09	<5 / <0.06	<4 / <0.05	> 200
Maintenance of transformers (oil spray)	VOP 60 RS	2000 - 6000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 30
	VOP 90 RS	3000 - 9000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 50
	VOP 120 RS	4000 - 12000	<4 / <0.05	<3 / <0.04	<2 / <0.03	> 120
Oil regeneration with inhibitor unit	CRP 312-750	750				
	CRP 312-1500	1500				
	CRP 312-4500	4500				

<sup>1</sup> Online treatment on energized transformers with Z?

<sup>2</sup> Values prior to treating: water content 50 ppm, air content 10 Vol%, temperature 20°C

## Remarks

These guarantee values are valid for the treatment of naphthenic based insulating oils with normal froth behaviour, under consideration of no additional air acceptance after oil treatment.

Approx. value of oil content in the transformers: 1/2 lt insulating oil per 1 kVA

For unattended operation additional safety equipments needed.

# Measuring Equipment

Mobile measuring equipment for a manifold of applications are used for estimating the insulating oil quality. The measuring equipment can be used for commonly known insulating oils. The simple and over years reliable and proven concept makes these installations maintenance and operational friendly.



## Water and Gas Content Measuring Unit VZ 212 A

This measuring unit serves as a continuous automatic measuring of the water and gas content at the in/outlet of the oil plant. The measuring unit can only be used together with an oil plant. The evaluation of the gas blanket pressure in the measuring cell can be carried out manually by means of a break-even chart or automatically via a 6-channel digital recorder.

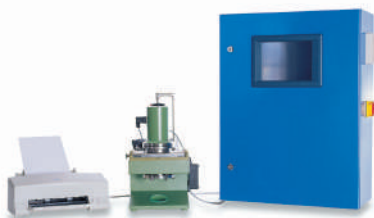
Measuring range: water content 0.5-7 ppm / gas content 0.01-0.09 Vol%



## VZ 220 A Tan Delta

- Resistance measuring unit to determinate the  $\tan \delta$  value
- Online resistance measuring unit to determinate the  $\tan \delta$  value

Measuring range: water content 0.5-50 ppm / gas content 0.01-2 Vol%



## New VZ (Micavac)

Exact measuring of the specific water drainage ( $\text{g/h} \cdot \text{t}$ ) during the transformer drying in production and in the field. This measuring unit is independent and easy to operate.

## Further Measuring Units

- Water content measuring unit in accordance to Karl Fischer
- Break-down voltage measuring unit up to 75 kV
- Break-down voltage measuring unit up to 100 kV
- Online particle measuring unit, 2  $\mu$  to 25  $\mu$  particle size

# Oil Treatment Plant

Technical information type VOP  
Catalogue 2022



## Benefits and Applications:

Unsupervised operation  
Maintenance free degasser  
Variable flow and foam control

Safety interlocking  
Centralized control  
MVA support compatible

**MICAFLUID**

Email us at  
[info@micafluid.ch](mailto:info@micafluid.ch)

Visit us at  
[www.micafluid.ch](http://www.micafluid.ch)

**MICAFLUID AG**

Oil Purification Systems

Gaswerkstrasse 6

CH-8952 Schlieren, Switzerland

Phone: +41 44 739 44 66

Fax: +41 44 739 44 68

E-mail: [info@micafluid.ch](mailto:info@micafluid.ch)

Website: [www.micafluid.com](http://www.micafluid.com)

You can find the address of  
your local representative  
on the MICAFLUID home page:  
[www.micafluid.com/contact.html](http://www.micafluid.com/contact.html)



# **TABLE OF CONTENTS**

02	<b>DESCRIPTION OF THE MACHINE</b>
02	Introduction
02	Requirements
03	General characteristics
03	Additional properties
04	Optional properties
05	<b>INSULATION OIL TYPES AND HOW TO TREAT THEM</b>
06	<b>OIL TREATMENT PLANT RANGE</b>
06	Standard plants
06	High-capacity plants
06	Special plants
07	VOP010 - 1'000 lt/h
07	VOP030 - 3'000 lt/h
08	VOP060 - 6'000 lt/h
08	VOP090 - 9'000 lt/h
09	VOP120 - 12'000 lt/h
09	VOP160/200 - 20'000 lt/h
10	<b>PHYSICS OF CORRECT OIL TREATMENT</b>
10	Break down voltage in insulating oils
10	Particle filtration (beta ratio and efficiency)
10	Thermal flux while heating
11	<b>OPERATING PRINCIPLE AND SCOPE OF SUPPLY</b>
12	Component description
13	Optional equipment
14	Z - Fixed additional equipment (cannot be retrofitted)
17	OE - optional additional equipment (upgradable)
23	<b>SERVICE, SUPPORT MAINTENANCE INSPECTION &amp; TRAINING</b>
23	Service and maintenance
23	Inspection & training
23	MVA - machine virtual assistance
24	<b>CONTACT INFORMATION</b>

# DESCRIPTION OF THE MACHINE

## INTRODUCTION

MICAFLUID oil treatment systems for insulating oils have proven themselves on the world market for over 100 years. Through continuous further development of physical processes and process monitoring, these systems are always kept up to date with the latest technology.

The regular maintenance of high voltage equipment with MICAFLUID treatment systems maintains its performance and operational reliability and contributes to a substantial extension of the service life.

The oil treatment plants with variable adjustable oil flow (type VOP-L) are designed for the economical treatment and drying of insulating oils. The units are designed for the following applications:

- **Degassing, dewatering and filtering** of insulating oil in one or more passes.
- **Drying electrical** high-voltage equipment at the installation site while processing the oil.
- **Initial filling** of electrical devices with insulating oil.
- **Regeneration** of the insulating oil through an adsorption process using fuller earth and subsequent inhibition (conventional method, with optional regeneration system type CRP, consult separate catalogue).



## REQUIREMENTS

The following is required of a high-performance insulating oil treatment plant:

- **Low moisture and gas/air content** measured at the oil outlet of the treatment plant
- **Drying** the solid insulation of a high-voltage component and **removing** the residual gas content
- **Simple and fail-safe operation**
- **Real-time measurement and recording** of the quality-relevant process parameters
- **Flexibility** in use (oil volumes and types)
  - Naphthene- or paraffin-based mineral oils
  - Synthetic ester oils (MIDEL 7131)
  - Natural ester oils (FR3, Midel eN)
  - Shell GTL S4 insulating oils





## **GENERAL CHARACTERISTICS**

The following properties are ensured to meet the requirements described:

- Unique design of the degassing unit for efficiently processing of mineral and synthetic ester insulating oils according to IEC 60246.
  - Treatment process according to international specifications for insulation oils according to ASTM D3487<sup>1</sup> and IEC 60296 /03<sup>2</sup>.
  - All systems are manufactured in accordance with IEC standards and delivered ready for operation.
  - Continuous adjustable oil flow for best treatment results through uniform oil distribution and automatic oil level control OLC in the degassing unit.
  - Ambient temperature vacuum condenser with automatic oil condensate return system.
  - All MICAFLUID degassing units are equipped by specially developed oil foam detection sensor MicaFoam. In the event of excessive foaming during the treatment of the oil, the process conditions are automatically adjusted to reduce the foam level without any aeration of the degassing unit.
- Inlet flow supervision to prevent activated heating unit without oil in the system.
  - For maximum operational safety, the oil treatment plants are equipped with all necessary control and safety devices as well as a PLC control with an intrinsically safe FSO system (Fail-Safe Operation).
  - Functional safety of machinery according to EN ISO13849-1 safety category 4.

## **ADDITIONAL PROPERTIES**

- Minimal energy consumption through optimized degassing (i.e., best efficiency).
- All electric motors and drives are air-cooled.
- The vacuum pump with directly flanged-on motor is air-cooled and equipped with a gas ballast valve so that possibly incurring water vapour is exhausted from the pump without condensing.
- Standard lengths of the filter housing for 1mm or 5mm filter cartridges.

1 - Standard specification for mineral insulating oil used in electrical equipment

2 - Liquids for electrical applications - New mineral oils for transformers and switchgear / high voltage equipment.



- The unit is delivered completely assembled, with quick coupling system for hose connection.
- Thin film degassing systems using Raschig ring elements offer 60% larger surface area compared to other technologies on the market (such as coalesce or spray degassing systems).
- All seals of the VOP oil treatment plants are made of FKM (Viton) or PTFE (Teflon).
- All pipes and valves connections are welded not screwed. Thanks to the three-part design of the valves, assembly and maintenance is possible without losing vacuum tightness.
- Guaranteed system leak rate lower than 0.025mbar x lt / sec.

## **OPTIONAL PROPERTIES**

- On Load preparation (transformer under voltage) with a high-security monitoring system.
- Internal bypass circulation system to prevent overheating of the oil or the prime the oil treatment plant internally prior to external circulation of the oil.
- Level supervision to additionally protect the vacuum pump system from flooding.
- Real-time water and air content measuring device VZ 212A for measurements at the outlet of the system.
- Real-time monitoring of the fine filter by measuring differential pressure and particle size distribution.
- Real-time breakdown voltage measurement with MicaSonic BDV sensor.
- Data acquisition and evaluation of all process and quality-relevant parameters.
- MICAFLUID plants can be equipped with 3G/4G industrial router for online remote support platform MVA (Machine Virtual Assistance).

---

# INSULATION OIL TYPES AND HOW TO TREAT THEM

It is well known that the main oil types in use today for insulations fall within the following categories:

- Naphthenic based mineral oil
- Paraffinic based mineral oil
- Synthetic ester oil
- Natural ester oil
- Silicone oil

Each fluid has a different set of characteristics which make them better suited to certain applications, conditions, and cost.

**Mineral oil** is the most widely used insulation oil despite having some disadvantages due to its limited biodegradability and low fire point. It is important to avoid light fractions in vacuum and thermal cracking during treatment.

**Synthetic ester** is chemically derived and optimized to have a higher fire point as well as better water solubility and higher viscosity in comparison to mineral oil. Treatment therefore requires a higher process temperature, increased vacuum capacity and specific process cycles to avoid poor treatment results.

**Natural esters** are vegetable based fluids which appear to satisfy the growing trend towards “greener” more biodegradable fluids while presenting high flash and fire points. Its higher viscosity also calls for a higher vacuum capacity and more specific treatment parameters.

**Silicone** is a synthetic fluid which has self-extinguishing characteristics with good thermal

stability. It also requires increased heat and vacuum for treatment due to its extremely high viscosity. Furthermore, due to its non-compatibility with other fluids, treatment systems have to be dedicated to silicone oil treatment only, to avoid contamination of other oils.

MICAFLUID VOP treatment systems are prepared to treat **all types of oils** and we are committed to deliver high quality oil purification systems which keep up with the latest developments in the world of insulation oils.

Furthermore, due to an array of technical features which guarantee effective vacuum tight treatment without the risk of microbubbles or contamination, MICAFLUID systems ensure process integrity without any compromises to the asset whether in a production line or substation.



# OIL TREATMENT PLANT RANGE

## STANDARD PLANTS

VOP010 .....	300 - 1'000 lt/h
VOP030 .....	1'000 - 3'000 lt/h
VOP060 .....	2'000 - 6'000 lt/h
VOP090 .....	3'000 - 9'000 lt/h



## HIGH-CAPACITY PLANTS

VOP120 .....	4'000 - 12'000 lt/h
VOP160 .....	6'000 - 16'000 lt/h
VOP200 .....	8'000 - 20'000 lt/h
VOP300 .....	10'000 - 30'000 lt/h

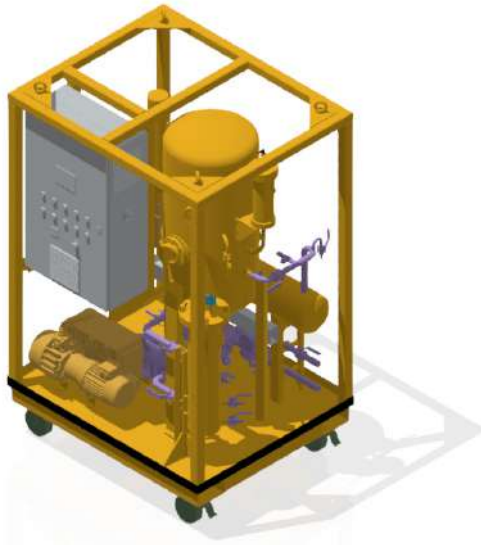


## SPECIAL PLANTS

Customized machines and units are available on request.



## **VOP010**



The oil treatment plant type VOP010 is used for treatment of filling volumes of approx. 1 to 10 metric tons of oil. This is a reference indication which is based on the filling time for the entire volume into the transformer or other high voltage equipment.

**Variable oil throughput:** 300 - 1'000 lt/h

**Minimum operating temperature:** 5°C

**Leakage rate:** Less than 0.025mbar lt/sec

**Noise level:** Less than 80 dB (A)

**Electrical equipment as per:** IEC Standard

**Machinery equipment as per:** CE

**Panel protection:** IP55

**Oil inlet and Outlet:** Camlock quick coupling

**Dimension (approx.) without trailer:**

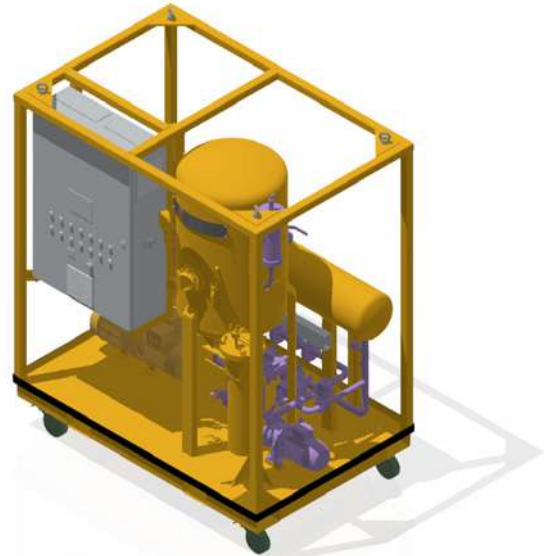
Length 1600 mm

Width 1150 mm

Height 1955 mm

Weight (approx.) 1000 kg

## **VOP030**



The oil treatment plant type VOP030 is used for treatment of filling volumes of approx. 5 to 30 metric tons of oil. This is a reference indication which is based on the filling time for the entire volume into the transformer or other high voltage equipment.

**Variable oil throughput:** 1'000 - 3'000 lt/h

**Minimum operating temperature:** 5°C

**Leakage rate:** Less than 0.025mbar lt/sec

**Noise level:** Less than 80 dB (A)

**Electrical equipment as per:** IEC Standard

**Machinery equipment as per:** CE

**Panel protection:** IP55

**Oil inlet and Outlet:** Camlock quick coupling

**Dimension (approx.) without trailer:**

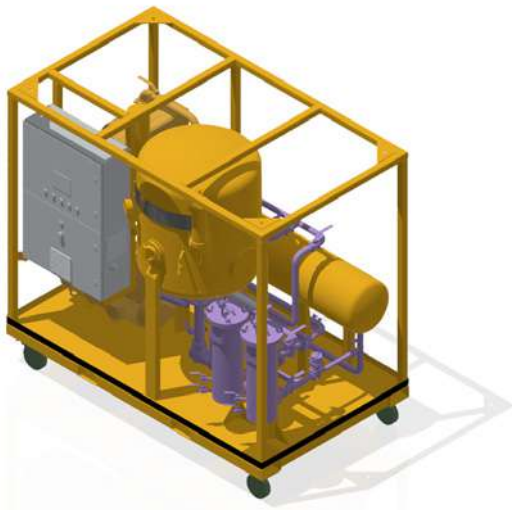
Length 2000 mm

Width 1300 mm

Height 2055 mm

Weight (approx.) 1450 kg

## **VOP060**



The oil treatment plant type VOP060 is used for treatment of filling volumes of approx. 10 to 60 metric tons of oil. This is a reference indication which is based on the filling time for the entire volume into the transformer or other high voltage equipment.

**Variable oil throughput:** 2'000 - 6'000 lt/h

**Minimum operating temperature:** 5°C

**Leakage rate:** Less than 0.025mbar lt/sec

**Noise level:** Less than 80 dB (A)

**Electrical equipment as per:** IEC Standard

**Machinery equipment as per:** CE

**Panel protection:** IP55

**Oil inlet and Outlet:** Camlock quick coupling

**Dimension (approx.) without trailer:**

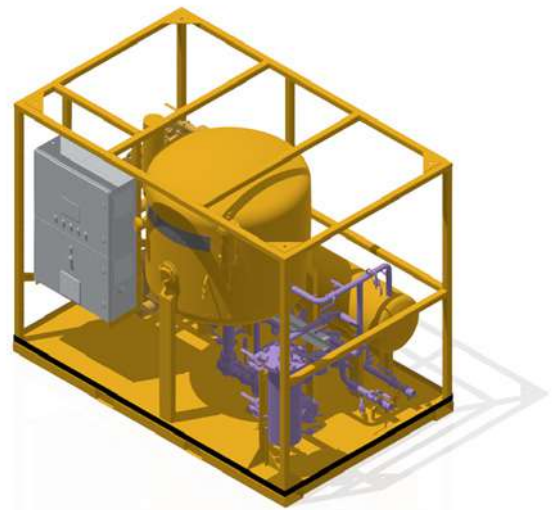
Length 2600 mm

Width 1500 mm

Height 2155 mm

Weight (approx.) 2100 kg

## **VOP090**



The oil treatment plant type VOP090 is used for treatment of filling volumes of approx. 20 to 90 metric tons of oil. This is a reference indication which is based on the filling time for the entire volume into the transformer or other high voltage equipment.

**Variable oil throughput:** 3'000 - 9'000 lt/h

**Minimum operating temperature:** 5°C

**Leakage rate:** Less than 0.025mbar lt/sec

**Noise level:** Less than 80 dB (A)

**Electrical equipment as per:** IEC Standard

**Machinery equipment as per:** CE

**Panel protection:** IP55

**Oil inlet and Outlet:** Camlock quick coupling

**Dimension (approx.) without trailer:**

Length 2900 mm

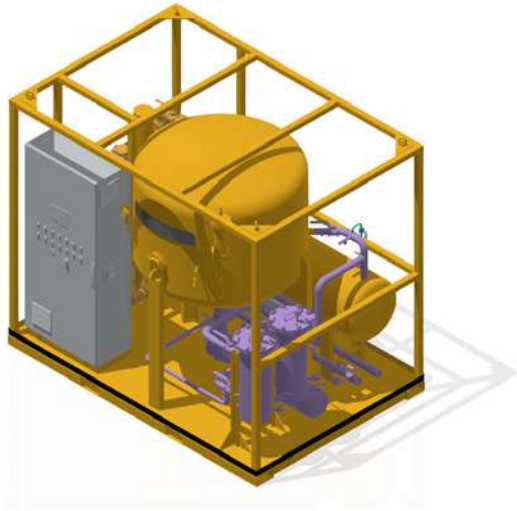
Width 1800 mm

Height 2250 mm

Weight (approx.) 2900 kg



## **VOP120**



The oil treatment plant type VOP120 is used for treatment of filling volumes of approx. 20 to 180 metric tons of oil. This is a reference indication which is based on the filling time for the entire volume into the transformer or other high voltage equipment.

**Variable oil throughput:** 4'000 - 12'000 lt/h

**Minimum operating temperature:** 5°C

**Leakage rate:** Less than 0.025mbar lt/sec

**Noise level:** Less than 80 dB (A)

**Electrical equipment as per:** IEC Standard

**Machinery equipment as per:** CE

**Panel protection:** IP55

**Oil inlet and Outlet:** Camlock quick coupling

**Dimension (approx.) without trailer:**

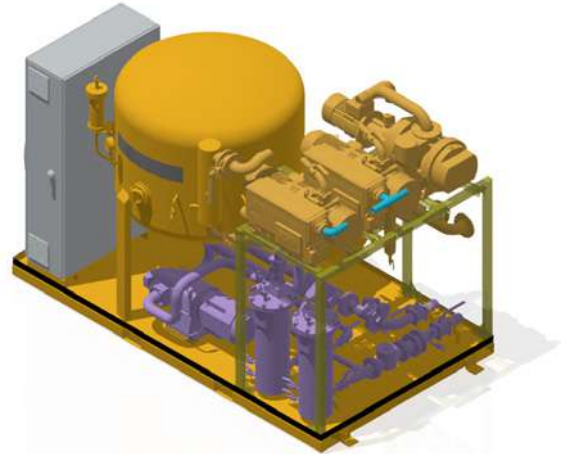
Length 2800 mm

Width 1900 mm

Height 2400 mm

Weight (approx.) 3000 kg

## **VOP160/200**



The oil treatment plant type VOP160/200 is used for treatment of filling volumes of approx. 20 to 200 metric tons of oil. This is a reference indication which is based on the filling time for the entire volume into the transformer or other high voltage equipment.

**Variable oil throughput:** 6'000 - 20'000 lt/h

**Minimum operating temperature:** 5°C

**Leakage rate:** Less than 0.025mbar lt/sec

**Noise level:** Less than 80 dB (A)

**Electrical equipment as per:** IEC Standard

**Machinery equipment as per:** CE

**Panel protection:** IP55

**Oil inlet and Outlet:** Camlock quick coupling

**Max. dimension (approx..) without trailer:**

Length 3200 mm

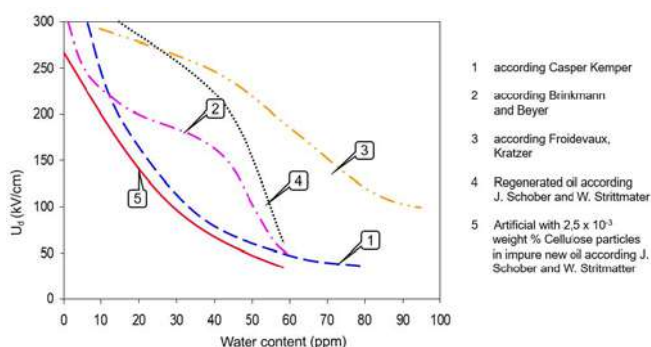
Width 1900 mm

Height 2400 mm

Weight (approx..) 4900 kg

# PHYSICS OF CORRECT OIL TREATMENT

## BREAK DOWN VOLTAGE IN INSULATING OILS

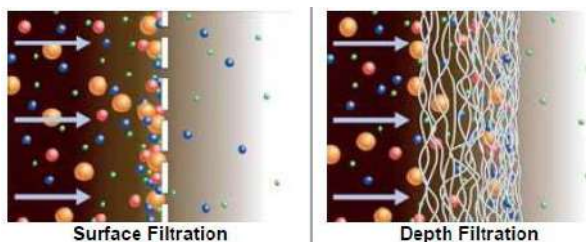


The breakdown voltage is highly depending on the type of oil and the actual water content, besides others such as the number of solid particles and degree of acidity. MICAFLUID oil treatment plants can increase the breakdown voltage to above 75kV in one pass.

## PARTICLE FILTRATION (BETA RATIO AND EFFICIENCY)

The number of particles in oil after the fine filter system is highly depending on the type of filter elements. Absolute filter system (coarse particles are retained in the outer while finer particles only in the deeper filter layers) guarantees a filter ration of at least 99.9% or better.

MICAFLUID is applying graded depth filtration using absolute filter elements with Beta Ratio of  $\beta 1000$  (99.9%) or  $\beta 5000$  (99.98%)



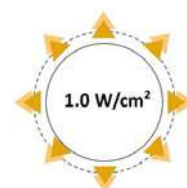
$\beta 1000$ : 100'000 -> 100 particles (99.9%)

$\beta 5000$ : 100'000 -> 20 particles (99.98%)

Particle count according to SAE AS 4059 Cl. 2

## THERMAL FLUX WHILE HEATING

The indirect heating of the oil is done by means of electrical resistance heating elements, which are separated from the oil by vacuum-tight protection tubes. A specific heat load lower than 1.0 W/cm<sup>2</sup> and an internal baffle system guarantees no partial overheating (hot spots) of insulating oil in the heater.



# OPERATING PRINCIPLE AND SCOPE OF SUPPLY

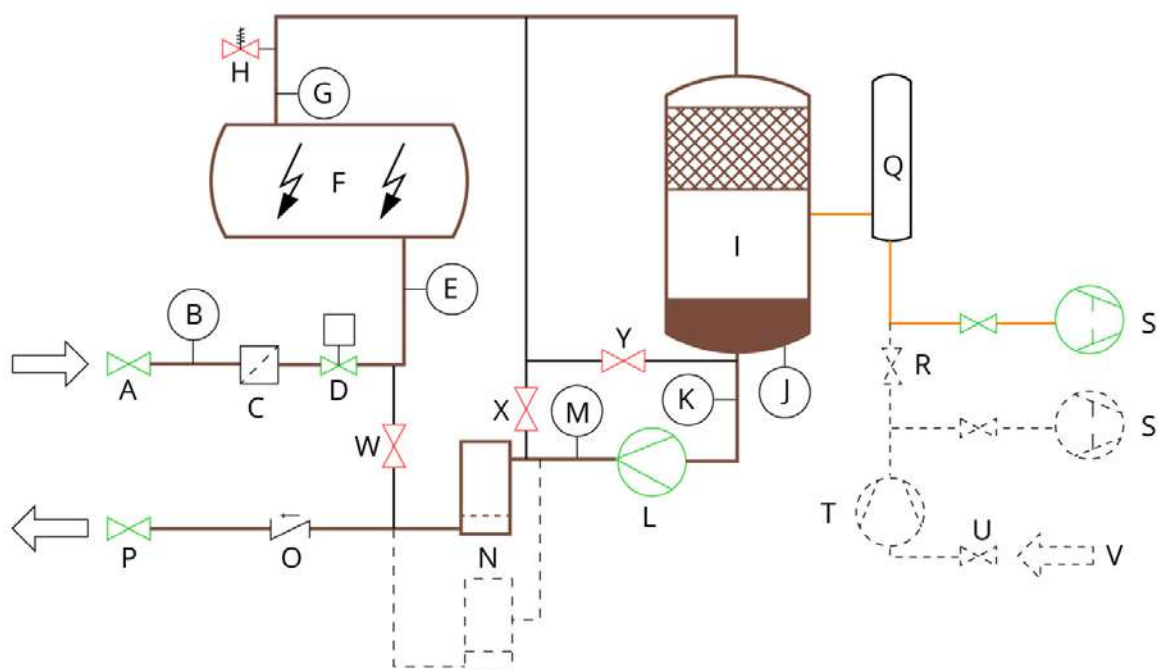
The medium is conveyed from the inlet valve (A) through pressure difference (ambient pressure to vacuum) over the heater (F) to the degassing unit (I). Due to well-designed inlet piping, no inlet feeding pump is required. In the heater, the medium is heated by indirect resistance heating elements to avoid hot spots (strong local overheating) and an overshoot of the pre-set treatment temperature.

The use of packed columns with Raschig rings and the geometry of the degassing unit (I) lead to the formation of a large medium surface. The resulting thin liquid film allows maximum effective degassing of the medium. This so-called thin-layer or thin-film degassing enables safe processing with a final vacuum in the range between 1 and 9 mbar.

The processing in this pressure and low temperature range ensures, among other things, that no light fractions and aromatics are evaporated from the medium and thus its chemical composition is not changed.

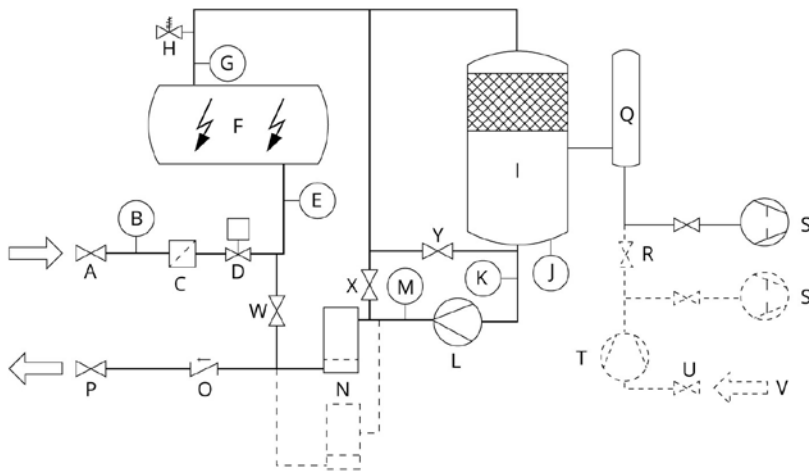
Thanks to the automatic oil level control, which also responds to excessive foam formation, a continuous flow in the system is guaranteed, which also guarantees optimal degassing.

After degassing and dewatering under vacuum, the medium is conveyed out of the treatment system (P) by means of a frequency-controlled feed pump (L) via the fine filter (N).



# COMPONENT DESCRIPTION

The basic equipment of the system mainly consists of the following components:



ITEM	COMPONENT	SPECIFICATION
A	Inlet valve	Manual operated valve, three-piece, vacuum-tight
B	Manometer (Gauge)	Indication of inlet pressure, pulsation and vibration protected
C	Strainer	Switching ON/OFF Heating step 1
D	Electrical inlet valve	Automatic inlet flow control valve (fail-safe NC)
E	Flow supervision oil heater	Release signal for oil heater
F	Electrical oil heater	Resistance heater (1W/cm <sup>2</sup> )
G	Temperature measurement	Actual temperature for oil heater
H	Pressure relief valve	Pre-set/sealed to 8 bar prevent an overpressure inside the heater
I	Degassing unit	Packed column, foam probe, sight glass
J	Level measurement degassing unit	Min./max. Supervision, Inlet valve control
K	Level sensor degassing unit	Dry run protection of the feeding pump
L	Feeding pump	Continuously adjustable flow rate
M	Pressure sensor (analogue/digital)	Supervision of maximum feeding pressure (hose protection)
N	Fine filter housing	Changeable filter cartridges (div. material/fineness)
O	Non-return valve	Backflow prevention when the feeding pump is switched off
P	Outlet valve	Manual operated valve, three-piece, vacuum-tight
Q	Vacuum condenser	Liquid trap, vacuum condenser (ambient temperature)
R	Vacuum valves	Function switchover of the vacuum pump(s)
S	Vacuum pump	Rotary vane vacuum pump, gas ballast valve
T	Roots pump	Evacuation of external containments (transformers)
U	Vacuum valve	Manual operated valve
V	Hose connection	Connection of external containments (transformers)
W	Electrical ball valve	Internal bypass
X	Electrical ball valve	Bypass for optional hot oil spray
Y	Electrical ball valve	Bypass for optional heating and filtration
	Control panel	Operating and monitoring elements (HMI, PLC)
	Oil retaining tub	Collecting escaping oil during operating/maintenance

# **OPTIONAL EQUIPMENT**

MICAFLUID treatment plants can be equipped or retrofitted with the following additional equipment:

## **Z - Fixed additional equipment (cannot be retrofitted):**

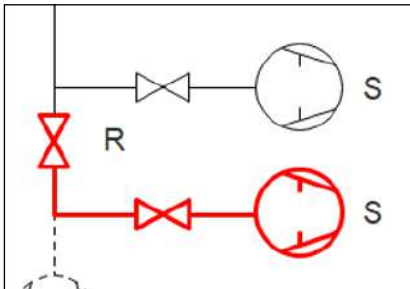
<b>Option</b>	<b>Additional equipment</b>
Z1	Additional vacuum pump
Z1.2	Connection for transformer evacuation
Z1.10	Roots pump
Z4	Inlet feeding pump (internal)
Z5	Additional fine filter stage (parallel)
Z5.2	Additional regeneration system
Z6	Bypass for heating and filtration
Z7.x	Flow measurement (intern)
Z14	Increased heating capacity
Z15	Plant frame

## **OE - Optional additional equipment (upgradable):**

<b>Option</b>	<b>Additional equipment</b>
OE2	Water and gas measuring VZ212A
OE2.2	Larger HMI touch screen 10"
OE2.3	Internal By-Pass
OE2.5	Dew point measurement (Water in oil)
OE2.7	MicaSonic™ Inline BDV Sensor
OE2.8	Tan Delta Inline Sensor
OE3	2 flexible hoses each 10m long
OE4	External feeding pump (max. 1 bar)
OE5.1	Differential pressure supervision
OE8	Leakage supervision oil retaining tub
OE9	Oil sampling set Mica-Sam
OE12	MVA Online Support
OE13	Castors to base for factory floor
OE15.x	Covers to plant frame Z15
OE16	Roadworthy trailer with tarpaulin
OE17.x	Fixed housing and containers
OE18	Set of filter cartridge type MICA PP01
OE19	Set of filter cartridge type MICA N1
OE19.1	Set of filter cartridge type MICA FG 0.35
OE20.X	Maintenance / Service / Emergency KIT

## **Z - FIXED ADDITIONAL EQUIPMENT (CANNOT BE RETROFITTED):**

### **Z1 - Additional vacuum pump**



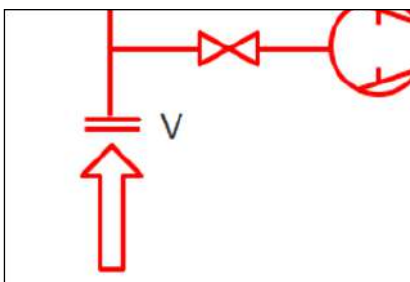
With the additional vacuum pump, the suction capacity is increased and guarantees the best treatment values in one or more passes even by

- Natural Ester (FR3, Midel eN)
- Synthetic ester oils (Midel 7131, Shell S2/S3)
- Gas to Liquid (GTL)

Notice: VOP05 to VOP30 only one (1) pump available but optional with higher suction capacity.

With the second vacuum pump application, a parallel evacuation of the transformer with Z1.2 is possible.

### **Z1.2 - Flange connection for transformer evacuation**

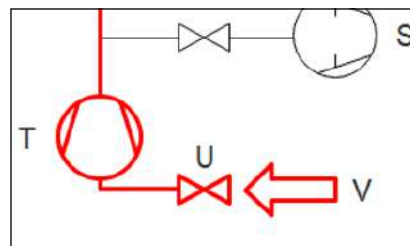


With this addition, a parallel evacuation of the transformer is possible. For this purpose, one vacuum pump is used for the treatment process, while the additional vacuum pump (Z1) can be used for the transformer evacuation.

This addition allows a maximum vacuum at the transformer of 1 mbar.

Addition Z1.10 must be used for a lower final vacuum.

### **Z1.10 - Roots pump (double stage vacuum system) for transformer evacuation**

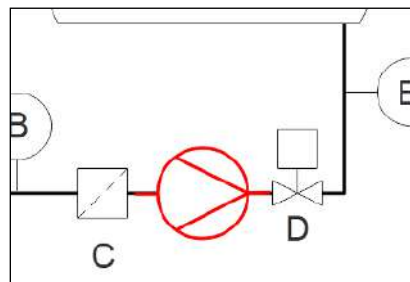


With the additional Roots pump, the suction capacity of the vacuum system is increased, and the achievable final vacuum is improved to <math><0.1\text{ mbar}</math>. This addition requires option Z1. The roots pump will be fix installed on the mainframe of the VOP Safety trap with oil detector and quick closing vacuum valve to protect roots pump from oil impact during transformer evacuation. This feature is needed especially during transformer oil filling under vacuum.

#### **Scope of supply**

- 1x Roots pump (T); 1x Liquid trap with level sensor; 1x Flap valve (U); 1x Flange connection (V) for vacuum hose

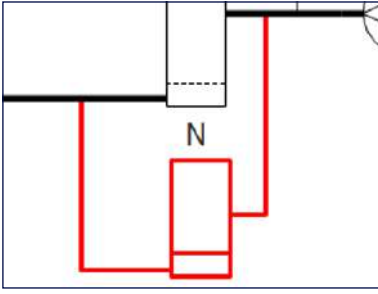
### **Z4 - Inlet feeding pump (internal)**



The inlet feeding pump is necessary to feed the oil through the clay system which is located in front of the degassing unit. In front of the inlet feeding pump, a strainer is protecting the pump from coarse particles. Pump and strainer will be installed on the frame of the oil treatment plant.

For regeneration of the oil over the clay system the control system will regulate the speed of the pumps according to the actual resistivity over the fuller earth column and the pre-selected oil flow (Z7.1 required).

## Z5 - Additional filter housing

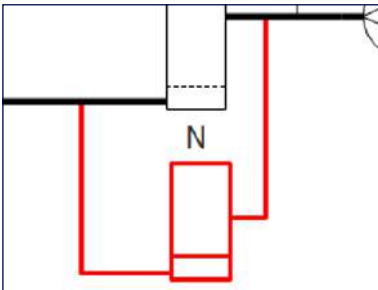


The additional filter housing is installed parallel to the standard filter housing and can be switched on or off with additional valves to enable the filter cartridges to be changed while the system is in operation.

This is particularly advantageous for systems in on-load operation (transformer under voltage).

As with the standard housing, different filter cartridges (filter material and filter fineness) can be inserted into the filter housing.

### Z5.2 - Additional filter housing for clay system (regeneration)

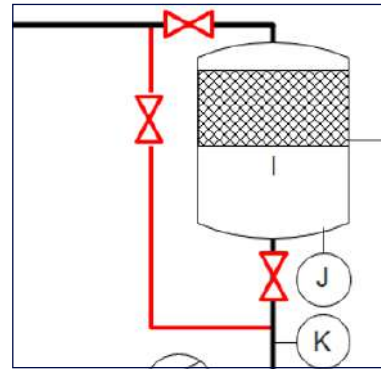


Additional filter housing with a special insert for fuller's earth bags. Easy to replace filter insert which can be disassembled to replace the saturated clay.

- Flow rate 300-1000 l/h
- Bypass valve for the ongoing operation of the VOP
- Evacuation, drainage and aeration valves

Sight glass on inlet and outlet to detect the colour change.

## Z6 - Bypass piping for heating and filtration

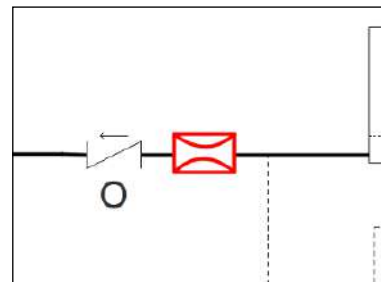


Switchover valves enable oil circulation without treatment (only heating and filtering), whereby the maximum operating temperature is limited to 80°C. With this addition, it is possible to run an oil spray process (drying in the field) with the system. The oil is fed directly through the heater and the fine filter back into the evacuated transformer without the heated spray oil flowing through the degassing unit.

Remark:

The sealing elements are designed for 110°C for the oil spray process. This elevated operating temperature, the spray nozzles and connecting elements for the spray process are not included in this addition and must be ordered separately.

## Z7 - Analogue flow counter

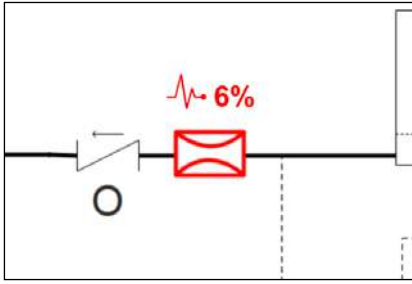


With the analogue flow measurement, the current flow (display via mechanical counter) and the total flow volume (totalizer) in m<sup>3</sup> can be read directly on the device.

Accuracy: +/- 6%

Operating temperature: 90°C (max)

### Z7.1 - Flow counter (incremental encoder 6%)

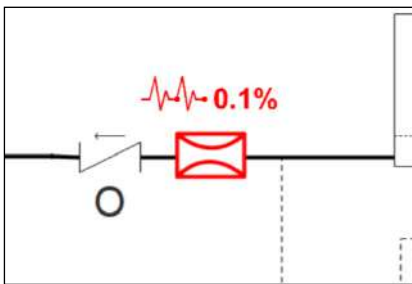


With the flow measurement with incremental encoder, the current flow can be read directly on the HMI of the unit. A volume counter with a reset function (batch) and a totalizer are available.

Accuracy: +/- 6%

Operating temperature: 90°C (max)

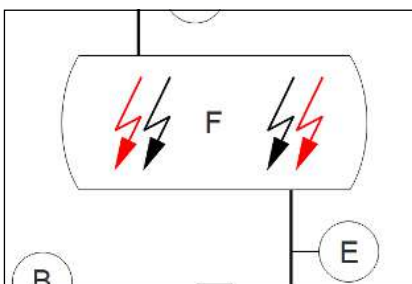
### Z7.2 - Flow counter (incremental encoder 0.1%)



With the high accurate flow measurement with incremental encoder 0.1%, the current flow is shown directly on the system screen. A volume counter with a reset function and a totalizer are available via the control system.

- Accuracy +/-0.1%
- Max. pressure 40bar
- Temperature range -20°C to 125°C

### Z14 - Extended heating capacity



While the specific heat load remains the same (1.0 W / cm<sup>2</sup>), the heating capacity of the heater

(heating output) is increased in order to ensure the required temperature difference ( $\Delta T$ ) for reaching the process temperature at low outside temperatures (below 10°C).

Depending on the size of the heater, different additional heating outputs are available (e.g. + 45kW, + 90kW, ...).

### Z15 - Plant frame with crane eyes and forklift openings

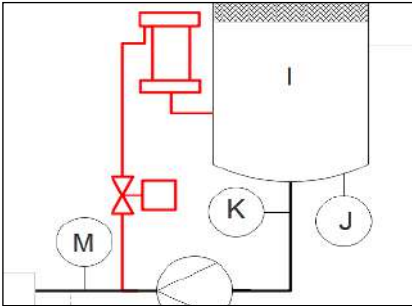


The base frame is equipped with 4 lifting lugs as well as opening for forklift transportation. Fixing plate for rollers is foreseen.



# OE - OPTIONAL ADDITIONAL EQUIPMENT (UPGRADABLE)

## OE2 - Water and Gas content measuring unit, Type VZ 212A (separate datasheet)



This measuring device is used for the continuous measurement of the gas blanket pressure and conversion to the water and gas content at the outlet of the oil treatment plant.

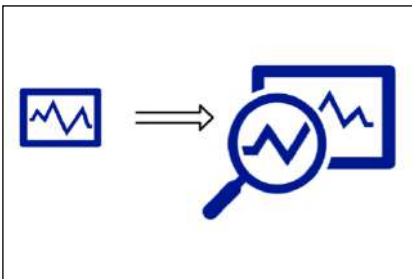
The oil level in the measuring cell is regulated automatically so that no disturbances influencing the measurement, such as leakage air from the vacuum pump or leaks in the system are measured.

The measuring cell is designed for mineral oil with a temperature of 60°C, the measurement is carried out at the outlet of the system with a resolution of 0.6 .. 8 ppm moisture in oil and gas content of 0.003 .. 0.1 Vol% total gas content.

### Scope of supply:

- Measuring cell with the pressure sensor
- Electromagnetic valve which opens at min. 45°C and closes at max. 80°C
- Incl. inlet and outlet temperature measurement
- Display of the measurement data on the touch panel

## OE2.2 - Large HMI touch screen (10")



All VOP systems are equipped with a 7" HMI touch screen as standard. With this addition, a 10"

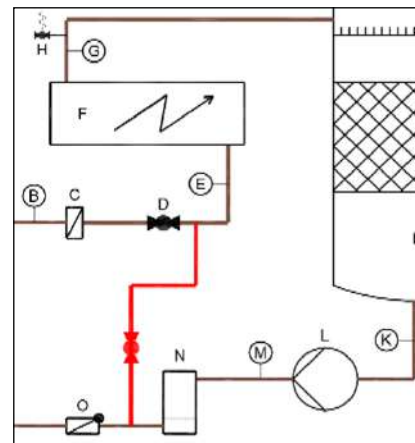
screen (1024x600 resolution) is used to visualize larger systems and to simplify the overview.

The interactive user interface and the intuitive control functions remain the same as on the smaller screen:

### Scope of supply:

- Process monitoring
- Measuring data/setpoint table
- Error display / System monitoring
- Alerts and registration
- Process trending with USB Data Logger

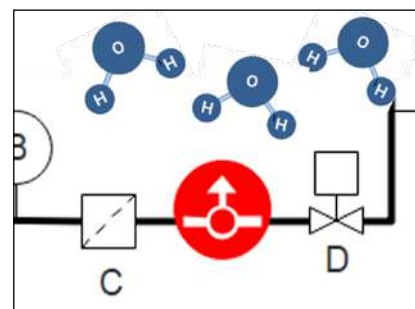
## OE2.3 - Internal By-pass



Automatic internal bypass system for internal circulation with minimum oil flow to prevent the oil from overheating in case of a shutdown.

This option is mandatory for use of the ON-LOAD supervision.

## OE2.5 - Dew point measurement (Water in oil)



Unit for the continuous measurement of the relative humidity in the oil. The probe allows an

inline measurement of the moisture in oil (water homogeneously dissolved in oil) at the inlet of the system up to a moisture content of more than 10ppm. If the water content in the oil is lower, the displayed measured value cannot be reproduced.

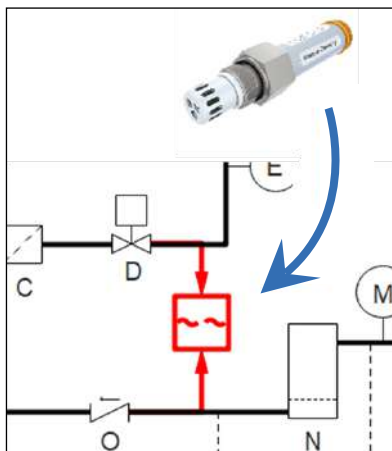
Measurement data:

Channel 1: -20°C to 100°C

Channel 2: relative humidity (0..1 aw)

Measuring range > 10ppm

**OE2.7 - MicaSonic™ Inline BDV Sensor MS4A (separate datasheet)**

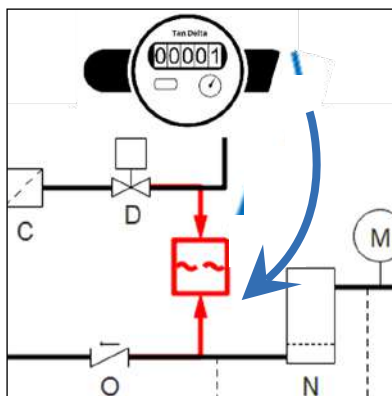


BDV = BreakDownVoltage

The MicaSonic BDV Sensor MS4A measures continuously and inline (without sampling) the current breakdown voltage (kV), the water content (ppm) and the current temperature (°C) of mineral transformer oil.

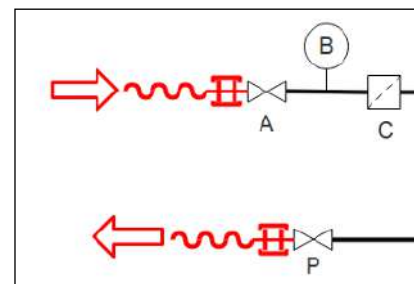
In addition, a breakdown voltage standardized to 20°C is automatically calculated.

**OE2.8 - In-line Tan Delta measurement unit, Type VZ 220A (separate datasheet)**



The measuring instrument type VZ220A is conforms to the IEC 61620 standard. This instrument permits accurate measurement of volume conductivity and relative permittivity. The measurement of volume conductivity in the range of 0.01 pS/m do 20.000 pS/m allows the use of this instrument for quality assessment of high resistive liquids even at ambient temperature.

**OE3.X - 2 flexible hoses each 10m long (more sizes available) with quick coupling type Camlock**

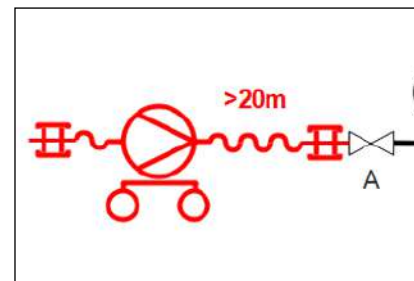


Each hose is 10 m long, for a max. oil temperature of 80°C, oil and vacuum-tight version. Flange connection on the transformer side and quick coupling on the machine side.

Remark:

- Other hose lengths can also be ordered for an additional charge.
- Other couplings are available on request
- Depending on the application/process, an external feeding pump is required for hose lengths over 20m

**OE4 - External feeding pump (max. 1 bar)**



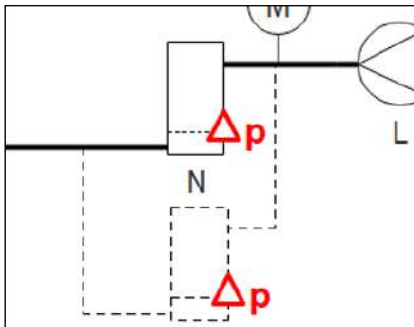
This pump is required if the following conditions are met:

- Distance between transformer and oil treatment plant ≥ 20m
- Oil level in the evacuated transformer/oil tank ≤ 1 m
- Transformer/oil tank under vacuum ≤ 100 mbar

This pump is connected to the control cabinet of the system and controlled from there.

Remark: If the transformer is exposed to a vacuum below 1 mbar during filling, a volumetric pump (e.g. gear pump) with pressure control must be used instead of the centrifugal pump.

### OE5.1 - Differential pressure supervision of filter elements/cartridges

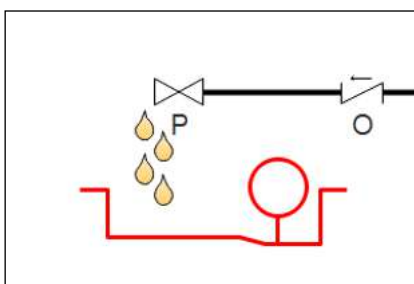


Monitoring the filter resistance or checking the degree of contamination of the filter cartridge. If the preselected maximum differential pressure is reached, the system switches off the feeding pump and informs the operator of the need to replace the filter cartridges.

After replacing the cartridges, the error can be reset, and the process restarted.

Remark: A pressure difference monitor is required for each filter housing. If an additional filter (Z5) is used, additional equipment OE5.1 is required twice (2x).

### OE8 - Leakage supervision oil retaining tub

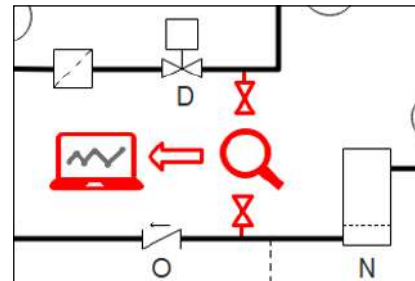


If a liquid (oil) escapes from the treatment plant or a connected hose, it is collected in the sump of the plant. In the event of excessive liquid leakage, the system is automatically switched off by responding to the leakage monitoring, thus preventing a further increase in oil loss.

Remark:

This option is essential for the use of the system for on-load processing on a live transformer.

### OE9 - Oil sampling set Mica-Sam



The special Mica-Sam sampling set is used for the correct taking of oil samples for laboratory analysis.

Scope of supply:

- 1 Connection interface for MICAFLUID oil treatment plant
- 1 MICA-Sam sampling adapter
- 2 sampling syringes

Remark:

The respective connecting pieces to the pipelines are pre-installed in MICAFLUID plants as standard. This means that the MICA-Sam unit can be retrofitted at any time.

### OE12 - MVA Online Support (separate datasheet)



Machine Virtual Assistance or MVA is the All-in-One-Online Support platform developed by MICAFLUID AG.

- Remote monitoring applications with PLC interface for process monitoring, alarm notification and data logging.
- Alarm system for PLC variables (SMS, email, FTP, SNMP trap).

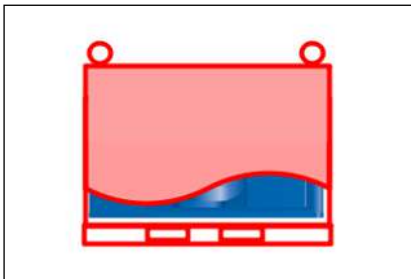
- Full support from the time to the end of your subscription.
- Remote Engineering, operation, and process monitoring.
- Communication bundled per zone so that mobile units can move across borders.

**OE13 - Castors to base for factory floor**



2 swivelling and 2 fixed castors with locking. These rollers are only suitable for flat workshop floors.

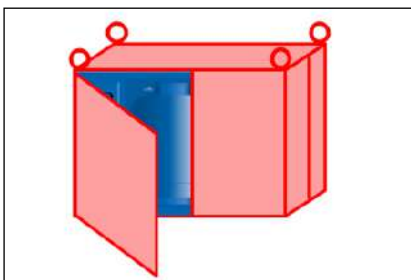
**OE15.1 - Tarpaulin cover to plant frame Z15**



Manufactured according to EU standards, for protection against sun, rain and dust. This option is necessary for the operation of an on-load processing plant.

Remark: Execution according to special standards, indoor lighting and ventilation is not included; Installation at an additional cost.

**OE15.2 - Metal doors and sturdy roof to the plant frame Z15**



The system is equipped with a metal housing and doors.

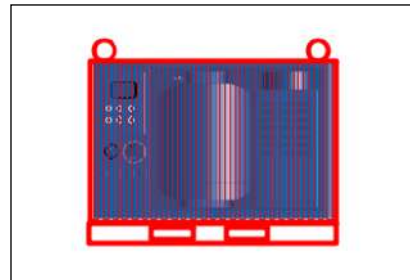
Included:

- Metal case with service openings and doors
- 4 lifting lugs

Remark:

Indoor lighting and ventilation are not included; Installation at an additional cost.

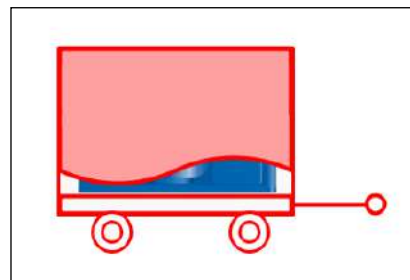
**OE15.3 - Safety fence for plant frame Z15**



The system is equipped with a safety fence as protection against accidental contact against hot surfaces.

Remark: Indoor lighting is not included, installation at an additional cost.

**OE16 - Roadworthy trailer with tarpaulin (up to 3.5t)**



For road transport of the processing plant built according to EU standards. The trailer is equipped with a frame and a tarpaulin that can be rolled up on all sides.

Max. speed 80 km/h. Traffic approval not included.

Execution according to special standards possible for a corresponding additional charge.

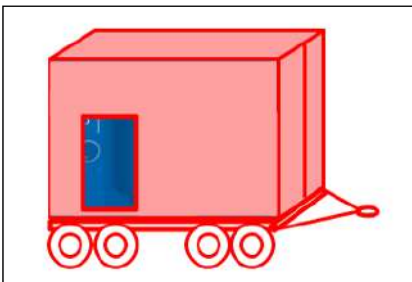
### OE17 - Roadworthy trailer with fixed housing (up to 3.5t)



For road transport of the processing plant. The housing is made of lightweight material (e.g. aluminium, wood or plastic) with all the necessary doors and service flaps.

Max. speed 80 km/h. Traffic approval not included. Execution according to special standards possible for a corresponding additional charge. Indoor lighting and ventilation is not included; Installation at an additional cost.

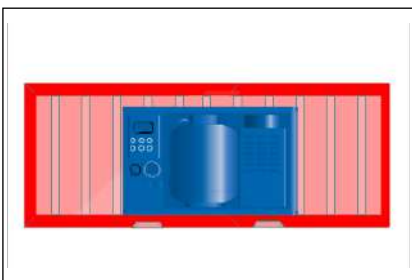
### OE17.1 - Roadworthy trailer with fixed housing (over 3.5t)



For road transport of the processing plant. The housing is made of lightweight material (e.g. aluminium, wood or plastic) with all the necessary doors and service flaps.

Max. speed 80 km/h. Traffic approval not included. Execution according to special standards possible for a corresponding additional charge. Indoor lighting and ventilation is not included; Installation at an additional cost.

### OE17.2 - 20ft Side door open Container for the oil treatment plant

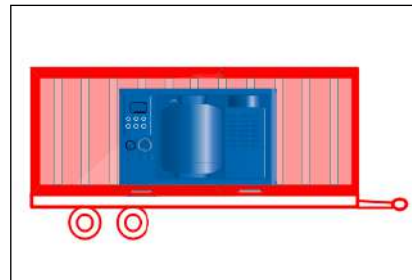


The container is made of sheet steel and support structures, with the main opening on one or both ends. Additional opening on the back. The container can be equipped with light and ventilation for an additional charge.

C Container is painted with standard 2K colour in white. The company logo can be attached to the respective outer walls for an additional charge.

CSC Overseas Certificate on request.

### OE17.2.1 - Roadworthy chassis for transportation of a 20ft Container

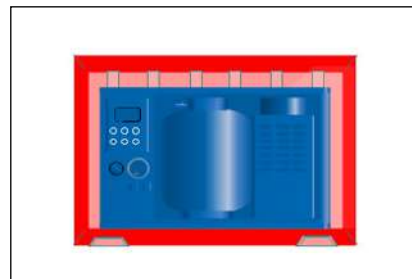


For road transport of 20ft containers, according to European standards with air-powered braking system and ABS.

Technical data (example):

- Chassis type SZC 18eL20" according to EG guidelines with connection points for 20ft containers
- EG air breaks with EBS and supervision sensors
- 24V 7pin light system
- 4x Tires size 385/65 R22.5
- 2Stk mechanical landing gear with 12to each
- Total weight 30'000kg, maximum payload 26'950kg
- Overall length 7325mm, width 2450mm

### OE17.3 - 10ft Side door open Container for the oil treatment plant



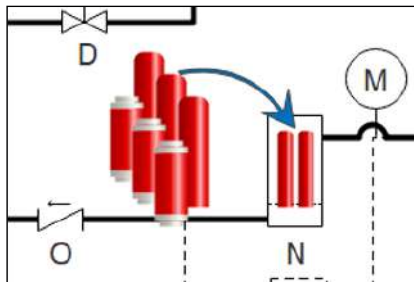
The container is made of sheet steel and support structures, with the main opening on one or

both ends. Additional opening on the back. The container can be equipped with light and ventilation for an additional charge.

The container is painted with standard 2K colour in white. The company logo can be attached to the respective outer walls for an additional charge.

CSC Overseas Certificate on request.

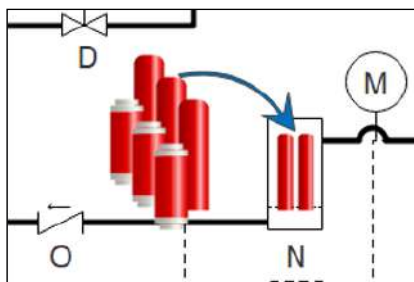
**OE18 - Set of filter cartridge type MICA PP01 (65°C)**



Standard 20" profile filter cartridges with a fineness of 1 micron (µm). The filter cartridges are made of polypropylene and, unlike paper filters, do not absorb water. These filters have a graded pore structure so that larger particles are retained on the surface and smaller particles in the lower layers. This significantly extends the life of the cartridges.

Filtration rate	1 micron (99.98%)
Maximum Temperature	65°C
Outer diameter	2½"
Length	20"

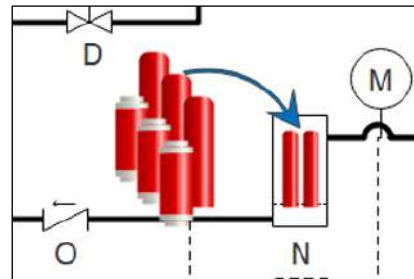
**OE19 - Set of filter cartridge type MICA N1 (95°C)**



Standard 20" profile filter cartridges with a fineness of 5 microns (µm). The filter cartridges are made of nylon and, unlike paper filters, do not absorb water. These filters have a graded pore structure so that larger particles are retained on the surface and smaller particles in the lower layers. This significantly extends the life of the cartridges.

Filtration rate:	5 micron (99.9%)
Maximum Temperature:	95°C
Outer diameter:	2½"
Length:	20"

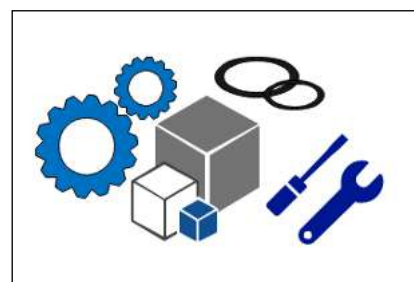
**OE19.1 - Set of filter cartridge type MICA FG 0.35 (110°C)**



Standard 20" profile filter cartridges with a fineness of 1 micron (µm). The filter cartridges are made of glass fibre and, unlike paper filters, do not absorb water. These filters have a graded pore structure so that larger particles are retained on the surface and smaller particles in the lower layers. This significantly extends the life of the cartridges.

Filtration rate:	1 micron (99.98%)
Maximum Temperature:	110°C
Outer diameter:	2½"
Length:	20"

**OE20.X - Maintenance / Service / Emergency kits**



Set of mechanical spare parts for the proper maintenance and upkeep of the system during the first 2 years of operation, without consumables due to the regular operation of the system.

Additional Service kits are available on request.

Additional Emergency kits (sensors, PLC items) are available on request.

---

# SERVICE, SUPPORT MAINTENANCE INSPECTION & TRAINING

## SERVICE AND MAINTENANCE

Oil treatment plants, vacuum pumping units and regeneration plants requiring maintenance can be completely repaired and tested by our service specialists. A detailed service protocol indicates the state of the unit at arrival, performed work and testing as well as new guaranteed performance after revision/ refurbishment.

## INSPECTION & TRAINING

During training and commissioning, our process engineers perform training for the operators at our workshop.

This can also be done at customer's facilities on-site. The operators are trained in the concepts around "best practice", process control, operation and maintenance. If malfunctions or interruptions of the operation occur, our engineers are available to assist on-site or remotely.

## MVA - MACHINE VIRTUAL ASSISTANCE

Is an internet based support platform allowing us to support our customers through direct

remote machine access. The MVA Support Platform also allows the customer remote process supervision as well as remote alarming through several communication protocols.



---

# CONTACT INFORMATION

## MICAFLUID AG

Oil Purification Systems

Gaswerkstrasse 6

CH-8952 Schlieren, Switzerland

Phone: +41 44 739 44 66

Fax: +41 44 739 44 68

E-mail: [info@micafluid.ch](mailto:info@micafluid.ch)

Website: [www.micafluid.com](http://www.micafluid.com)

You can find the address of  
your local representative  
on the MICAFLUID home page:  
[www.micafluid.com/contact.html](http://www.micafluid.com/contact.html)

We reserve the right to make technical changes  
or modify the contents of this document without  
prior notice. With regard to purchase order, the  
agreed particulars shall prevail. MICAFLUID AG  
does not accept any responsibility whatsoever for  
potential errors or possible lack of information  
in this document.

We reserve all rights in this document and in  
the subject matter and illustrations contained  
therein. Any reproduction, disclosure to third  
parties or utilization of its contents - in whole  
or in parts - is forbidden without prior written  
consent of MICAFLUID AG.

Copyright© 2022 MICAFLUID AG.

All rights reserved.





** Driven by Swiss Technology since 1913**

[www.micafluid.com](http://www.micafluid.com)

**MICAFLUID**

**Headquarters**

Micafluid AG  
Gaswerkstrasse 6 CH-8952 Schlieren  
Switzerland

+41 44 739 44 66

**Subsidiary**

Micafluid, SA  
Rua Álvaro Pedro Gomes 9 Lj 3  
2685-138 Sacavém, Portugal

+351 21 053 40 57