# 9 Appendices

## 9.1 Gas Cooler Technical Data

### RC 1.1

| Gas Cooler Technical Data | | | |
|---|---|---|---|
| Rated cooling capacity (at 25 °C): | 360 kJ/h | | |
| Ambient temperature: | 5 °C to 50 °C | | |
| Ready for operation: | after max. 15 minutes | | |
| Gas outlet dew point<br>preset:<br>adjustable: | <br>5 °C<br>3 °C to 20 °C | | |
| Dew point fluctuations<br>static:<br>in the entire specification range: | <br>± 0.1 K<br>± 1.5 K | | |
| IP rating: | IP 20 | | |
| Installation: | Table-top or wall mounting | | |
| Housing: | Stainless steel | | |
| Packaging dimensions: | approx. 530 x 400 x 400 mm | | |
| Weight: | approx. 15 kg | | |
| max. altitude: | Altitudes up to 2000 m | | |
| Refrigerant quantity [g]: | R600a (28 g) | | |
| Electrical connection: | Plug per DIN EN 175301-803 | | |
| Contamination level: | 2 | | |
| Overvoltage category: | II | | |
| Electrical data:<br>*Available options may result in details that differ from these* | Supply voltage: | 230 V | 115 V |
| | Tolerance: | +/-10% | +/-10% |
| | Frequency: | 50 Hz / 60 Hz | 60 Hz |
| | Typical power input: | 414 VA | 345 VA |
| | max. operating current: | 1.8 A | 3.0 A |
| | Starting current: | 2.3 A | 3.6 A |
| | Protection: | 4 A (delayed action) | 4 A (delayed action) |
| Status output switching capacity: | max. 250 V AC, 150 V DC<br>2 A, 50 VA, potential-free | | |
| Gas connections and condensate outlet: | For heat exchanger, see table ”Heat exchanger overview”<br>For condensate pump, see ”Technical Data - Options” | | |
| Parts in contact with media<br>Filter:<br>Moisture detector:<br>Heat exchanger:<br>Peristaltic pump:<br>Tubing: | <br>see "Technical Data - Options"<br>see "Technical Data - Options"<br>see table "Heat Exchanger Overview"<br>see "Technical Data - Options"<br>PTFE/FKM (Viton) | | |

## RC 1.1 with heat exchanger -H2/-O2

| Gas Cooler Technical Data | | | |
|---|---|---|---|
| Rated cooling capacity (at 25 °C): | 360 kJ/h | | |
| Ambient temperature: | 5 °C to 50 °C | | |
| Ready for operation: | after max. 15 minutes | | |
| Gas outlet dew point<br>preset:<br>adjustable: | <br>5 °C<br>3 °C to 20 °C | | |
| Dew point fluctuations<br>static:<br>in the entire specification range: | <br>± 0.1 K<br>± 1.5 K | | |
| IP rating: | IP 20 | | |
| Installation: | Table-top or wall mounting | | |
| Housing: | Stainless steel | | |
| Packaging dimensions: | approx. 530 x 400 x 400 mm | | |
| Weight: | approx. 15 kg | | |
| max. altitude: | Altitudes up to 2000 m | | |
| Refrigerant quantity [g]: | R600a (28 g) | | |
| Electrical connection: | Plug per DIN EN 175301-803 | | |
| Contamination level: | 2 | | |
| Overvoltage category: | II | | |
| Electrical data:<br>*Available options may result in details that differ from these* | Supply voltage: | 230 V | 115 V |
| | Tolerance: | +/-10% | +/-10% |
| | Frequency: | 50 Hz / 60 Hz | 60 Hz |
| | Typical power input: | 414 VA | 345 VA |
| | max. operating current: | 1.8 A | 3.0 A |
| | Starting current: | 2.3 A | 3.6 A |
| | Protection: | 4 A (delayed action) | 4 A (delayed action) |
| Status output switching capacity: | max. 250 V AC, 150 V DC<br>2 A, 50 VA, potential-free | | |
| Gas connections and condensate outlet: | Heat exchanger see table “Heat exchanger overview” | | |
| Parts in contact with media<br>Heat exchanger: | <br>see table “Heat Exchanger Overview” | | |

## RC 1.2+

| Gas Cooler Technical Data | | | |
|---|---|---|---|
| Rated cooling capacity (at 25 °C): | 360 kJ/h | | |
| Ambient temperature: | 5 °C to 50 °C | | |
| Ready for operation: | after max. 15 minutes | | |
| Gas outlet dew point<br>preset:<br>adjustable: | <br>5 °C<br>3 °C to 20 °C | | |
| Dew point fluctuations<br>static:<br>in the entire specification range: | <br>± 0.1 K<br>± 1.5 K | | |
| IP rating: | IP 20 | | |
| Installation: | Table-top or wall mounting | | |
| Housing: | Stainless steel | | |
| Packaging dimensions: | approx. 530 x 400 x 400 mm | | |
| Weight: | approx. 15 kg | | |
| max. altitude: | Altitudes up to 2000 m | | |
| Refrigerant quantity [g]: | R600a (28 g) | | |
| Electrical connection: | Plug per DIN EN 175301-803 | | |
| Contamination level: | 2 | | |
| Overvoltage category: | II | | |
| Electrical data:<br>*Available options may result in details that differ from these* | Supply voltage: | 230 V | 115 V |
| | Tolerance: | +/-10% | +/-10% |
| | Frequency: | 50 Hz / 60 Hz | 60 Hz |
| | Typical power input: | 414 VA | 345 VA |
| | max. operating current: | 1.8 A | 3.0 A |
| | Starting current: | 2.3 A | 3.6 A |
| | Protection: | 4 A (delayed action) | 4 A (delayed action) |
| Status output switching capacity: | max. 250 V AC, 150 V DC<br>2 A, 50 VA, potential-free | | |
| Gas connections and condensate outlet: | For heat exchanger, see table ”Heat exchanger overview”<br>For condensate pump, see ”Technical Data - Options” | | |
| Parts in contact with media<br>Filter:<br>Moisture detector:<br>Heat exchanger:<br>Peristaltic pump:<br>Tubing: | <br>see "Technical Data - Options"<br>see "Technical Data - Options"<br>see table "Heat Exchanger Overview"<br>see "Technical Data - Options"<br>PTFE/FKM (Viton) | | |

# 9.2 Technical Data - Options

| Analogue Output Technical Data | |
|---|---|
| Signal: | 4-20 mA or 2-10 V<br>corresponds to -20 °C to +60 °C cooling block temperature |
| Connection: | M12x1 connector, DIN EN 61076-2-101 |

| Technical Data, digital output | |
|---|---|
| Signal: | Modbus RTU (RS-485) |
| Connection: | M12x1 connector, DIN EN 61076-2-101 |

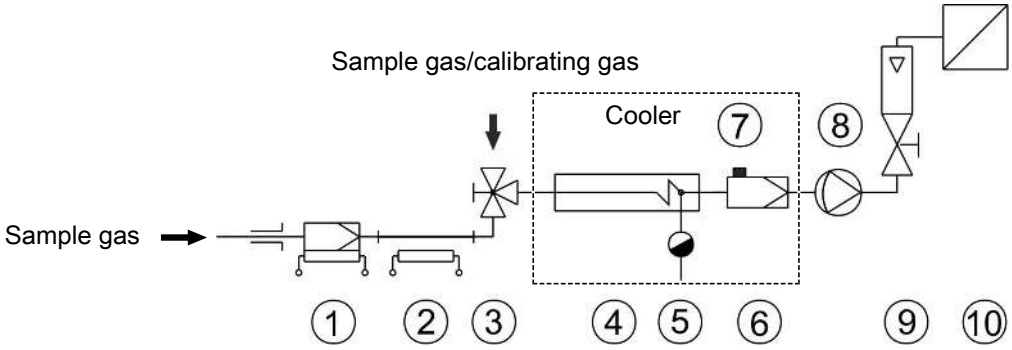
| Technical Data FF-3-N Moisture Detector | |
|---|---|
| Ambient temperature: | 3 °C to 50 °C |
| max. operating pressure with FF-3-N: | 2 bar |
| Weight: | 0.04 kg (incl. cable) |
| Material: | PVDF, PTFE, epoxy resin, stainless steel 1.4571, 1.4576 |

| Technical Data Cpsingle/CPdouble Condensate Pump | |
|---|---|
| Ambient temperature: | 0 °C to 60 °C |
| Voltage tolerance: | ± 5% |
| Flow rate: | 0.3 L/h (50 Hz)/0.36 L/h (60 Hz) with standard hose |
| Inlet vacuum: | max. 0.8 bar |
| Inlet pressure: | max. 1 bar |
| Outlet pressure: | 1 bar |
| Weight: | CPsingle-OEM: 0.47 kg<br>CPdouble-OEM: 0.51 kg |
| Hose: | 4 x 1.6 mm |
| Condensate outlet: | Hose nipple Ø5 mm<br>Screw connection 4/6 (metric), 1/6”-1/4” (US) |
| IP rating: | IP 40 |
| Materials | |
| Hose: | Tygon (Norprene) |
| Connections: | PVDF |

| AGF-PV-30-F2 Filter Technical Data | |
|---|---|
| Ambient temperature: | 3 °C to 100 °C |
| max. operating pressure with filter: | 4 bar |
| Weight: | 0.24 kg |
| Filter surface: | 60 $cm^2$ |
| Filter fineness: | 2 µm |
| Dead volume: | 57 ml |
| Materials | |
| Filter: | PVDF, DURAN glass (parts in contact with media) |
| Seal: | FKM (Viton) |
| Filter element: | sintered PTFE |

| Technical Data Filter AGF-PV-30-F2-L | |
|---|---|
| Ambient temperature: | 3 °C to 100 °C |
| max. operating pressure with filter: | 4 bar |
| Weight: | 0.29 kg |
| Filter surface: | 125 $cm^2$ |
| Filter fineness: | 2 µm |
| Dead volume: | 108 ml |
| Materials | |
| Filter: | PVDF, DURAN glass (parts in contact with media) |
| Seal: | FKM (Viton) |
| Filter element: | sintered PTFE |

## 9.3 Diagram typical installation



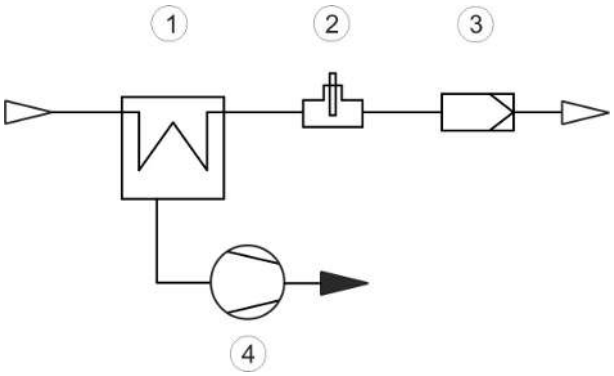

| | | | |
|---|---|---|---|
| 1 | Sample gas probe | 2 | Sample gas line |
| 3 | Reversing tap | 4 | Heat exchanger |
| 5 | Automatic condensate drain or peristaltic pump | 6 | Fine filter |
| 7 | Moisture detector | 8 | Sample gas pump |
| 9 | Flow meter | 10 | Analyser |

See data sheets for individual component models and data.

## 9.4 Cooler flow diagrams

### RC 1.1

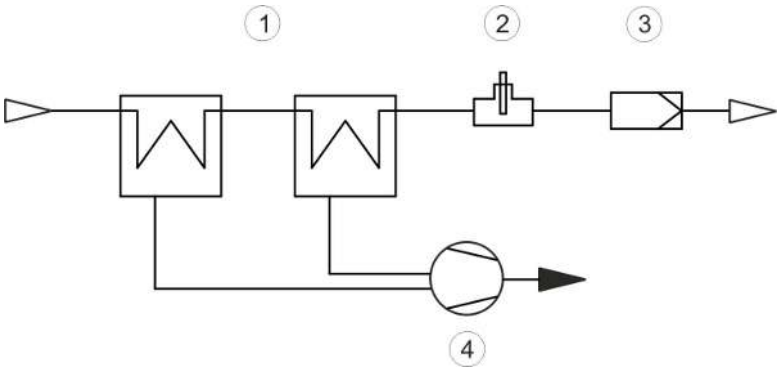
1 gas path:




| | | | |
|---|---|---|---|
| 1 | Cooler | 2 | Moisture detector (option) |
| 3 | Filter (optional) | 4 | Condensate pump (optional) |

### RC 1.2+

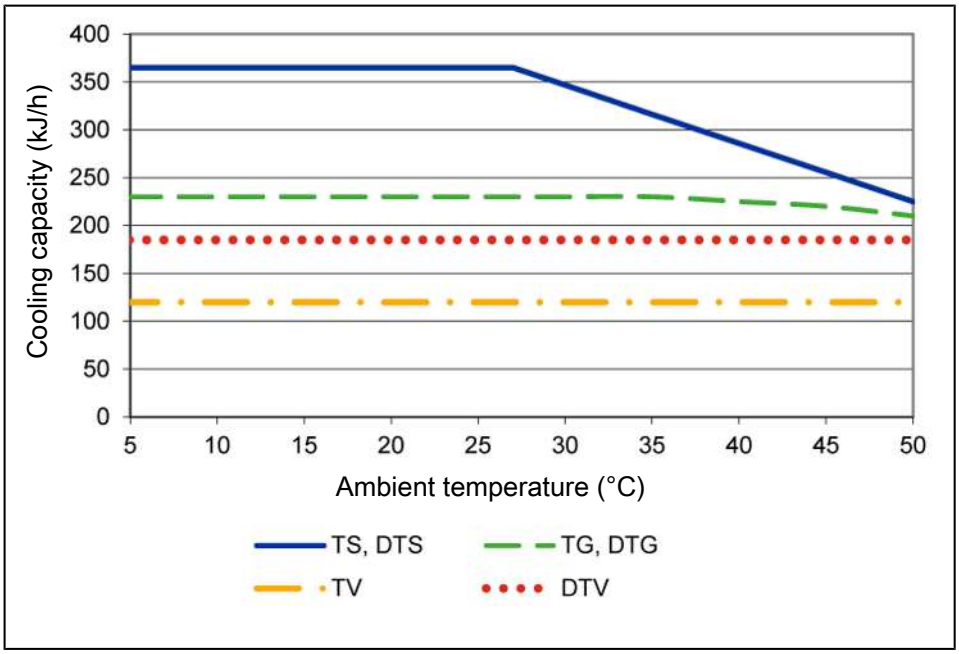
1 in-line gas path:




| | | | |
|---|---|---|---|
| 1 | Cooler | 2 | Moisture detector (option) |
| 3 | Filter (optional) | 4 | Condensate pump (optional) |

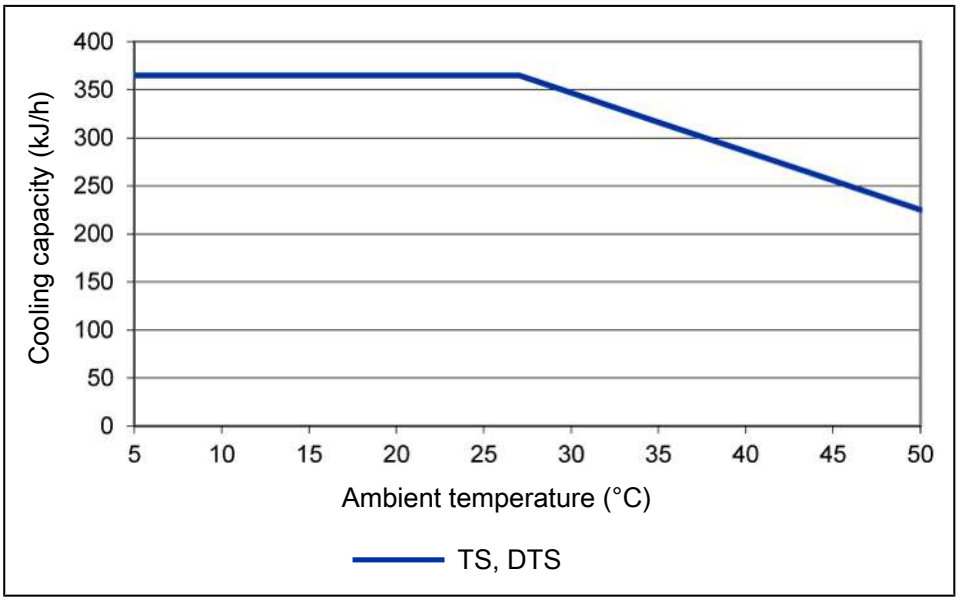
## 9.5 Performance curves

### RC 1.1



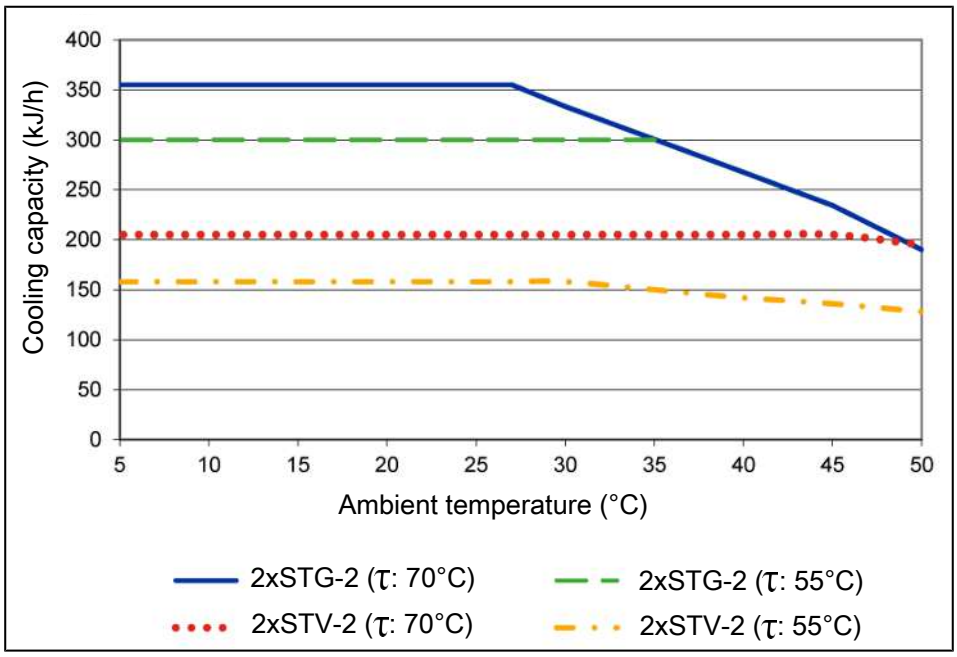

Note: The limit curves for the heat exchangers exchanger apply to a dew point of 65 °C.

### RC 1.1 with -H2/-O2 heat exchanger




Note: The limit curves for the heat exchangers exchanger apply to a dew point of 65 °C.

### RC 1.2+




Note: The limit curves of the heat exchangers apply to different dew points (τ), see legend.

## 9.6 Heat exchanger

## 9.6.1 Heat exchanger description

### RC 1.1

The energy content of the sample gas and the required cooling capacity of the gas cooler is determined by three parameters: gas temperature $\vartheta_G$, (inlet) dew point $\tau_e$ (moisture content) and volume flow v. The outlet dew point rises with increasing energy content of the gas. The approved energy load from the gas is therefore determined by the tolerated rise in the dew point.

The following limits are specified for a normal standard operating point of $\tau_e$ = 65 °C and $\vartheta_G$ = 90 °C. The maximum volume flow $v_{max}$ in Nl/h of cooled air is indicated, so after moisture has condensed.

If the values fall below $\tau_e$ and $\vartheta_G$, the flow $v_{max}$ may be increased. For example, on the TG heat exchanger the parameter triple $\tau_e$ = 65 °C, $\vartheta_G$ = 90 °C and v = 280 Nl/h may also be used in place of $\tau_e$ = 50 °C, $\vartheta_G$ = 80 °C and v = 380 Nl/h

Please contact our experts for clarification or refer to our design program.

### RC 1.2+

The energy content of the sample gas and the required cooling capacity of the gas cooler is determined by three parameters: gas temperature $\vartheta_G$, dew point $\tau_e$ (moisture content) and volume flow v. The outlet dew point rises with increasing energy content of the gas. The approved energy load from the gas is therefore determined by the tolerated rise in the dew point.

The following limits are specified for a standard operating point of $\tau_e$ = 70 °C and $\vartheta_G$ = 110 °C. The maximum volume flow $v_{max}$ in Nl/h of cooled air is indicated, so after moisture has condensed.

If the values fall below $\tau_e$ and $\vartheta_G$, the flow $v_{max}$ may be increased. For example, with the STG heat exchanger in place of $\tau_e$ = 70 °C, $\vartheta_G$ = 110 °C and v = 320 Nl/h the parameter triple $\tau_e$ = 50 °C, $\vartheta_G$ = 105 °C and v = 420 Nl/h may also be used.

Please contact our experts for clarification or refer to our design program.

## 9.6.2 Heat exchanger overview

### RC 1.1

| Heat exchanger | TS<br>TS-I [2] | TG<br>TG | TV<br>TV-I [2] | DTS (DTS-6 [3])<br>DTS-I (DTS-6-I [3]) [2] | DTG<br>DTG | DTV [3]<br>DTV-I [2] [3] |
|---|---|---|---|---|---|---|
| Materials in contact with media | Stainless steel | DURAN Glas PTFE | PVDF | Stainless steel | DURAN Glas PTFE | PVDF |
| Weight | 0.9 kg | 0.4 kg | 0.25 kg | 0.9 kg | 0.45 kg | 0.55 kg |
| Flow rate $v_{max}$ [1] | 530 L/h | 280 L/h | 155 L/h | 2 x 250 L/h | 2 x 140 L/h | 2 x 115 L/h |
| Inlet dew point $\tau_{e,max}$ [1] | 80 °C | 80 °C | 65 °C | 80 °C | 65 °C | 65 °C |
| Gas inlet temperature $\vartheta_{G,max}$ [1] | 180 °C | 140 °C | 140 °C | 180 °C | 140 °C | 140 °C |
| Max. cooling capacity $Q_{max}$ | 450 kJ/h | 230 kJ/h | 120 kJ/h | 450 kJ/h | 230 kJ/h | 185 kJ/h |
| Gas pressure $p_{max}$ | 160 bar | 3 bar | 3 bar | 25 bar | 3 bar | 2 bar |
| Pressure drop Δp (v=150 L/h) | 8 mbar | 8 mbar | 8 mbar | 5 mbar each | 5 mbar each | 15 mbar each |
| Dead volume $V_{dead}$ | 69 ml | 48 ml | 129 ml | 28 / 25 ml | 28 / 25 ml | 21 / 21 ml |
| Gas connections (metric) | G1/4 | GL 14 (6 mm) [4] | DN 4/6 | 6 mm tube | GL14 (6 mm) [4] | DN 4/6 |
| Gas connections (US) | NPT 1/4” | GL 14 (1/4”) [4] | 1/4”-1/6” | 1/4” tube | GL14 (1/4”)[4] | 1/4”-1/6” |
| Condensate out connection (metric) | G3/8 | GL 25 (12 mm) [4] | G3/8 | Tube 10 mm (6 mm) | GL18 (10 mm) [4] | DN 5/8 |
| Condensate out connection (US) | NPT 3/8” | GL 25 (1/2”) [4] | NPT 3/8” | Tube 3/8” (1/4”) | GL18 (3/8”) [4] | 3/16”-5/16” |

[1] Max. cooling capacity of the cooler must be considered.

[2] Models marked I have NPT threads or US tubes, respectively.

[3] Condensate drain only possible with condensate pump.

[4] Gasket inside diameter.

### RC 1.1 with -H2/-O2 heat exchanger

| Heat exchanger | TS-H2/-O2<br>TS-I-H2/-O2 [2] | DTS-H2/-O2<br>DTS-I-H2/-O2 [2] |
|---|---|---|
| Materials in contact with media | Stainless steel | Stainless steel |
| Weight | 0,9 kg | 0,9 kg |
| Flow rate $v_{max}$ [1] | 530 l/h | 2x 250 l/h |
| Inlet dew point $\tau_{e,max}$ [1] | 80 °C | 80 °C |
| Gas inlet temperature $\vartheta_{G,max}$ [1] | 180 °C | 180 °C |
| Max. cooling capacity $Q_{max}$ | 450 kJ/h | 450 kJ/h |
| Gas pressure $p_{max}$ | 1,5 barg (H2) / 15 barg (O2) | 1,5 barg (H2) / 15 barg (O2) |
| Pressure drop Δp (v=150 l/h) | 8 mbar | 5 mbar each |
| Dead volume $V_{dead}$ | 69 ml | 28/25 ml |
| Gas connections (metric) | G1/4 | 6 mm tube |
| Gas connections (US) | NPT 1/4" | 1/4" tube |
| Condensate out connection (metric) | G3/8 | Tube 10 mm (6 mm) |
| Condensate out connection (US) | NPT 3/8" | 3/8" tube |

[1] Max. cooling capacity of the cooler must be considered.

[2] Models marked I have NPT threads or US tubes.

## RC 1.2+

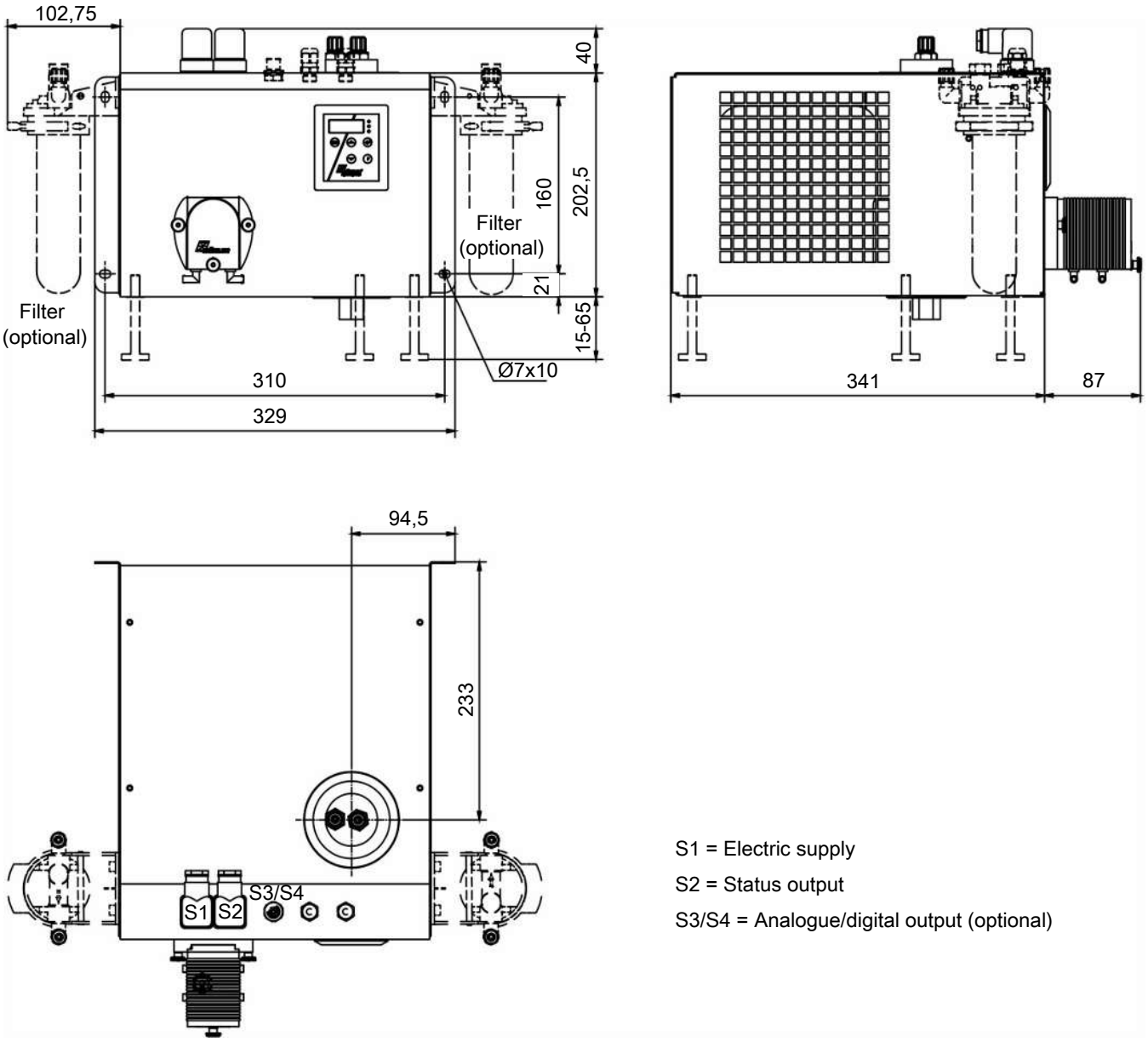
| Heat exchanger | 2 x STG-2 | 2 x STV-2 |
|---|---|---|
| Materials in contact with media | DURAN Glas<br>PTFE | PVDF |
| Weight | 2 x 0.14 kg | 2 x 0.11 kg |
| Flow rate $v_{max}$ [1] | 320 L/h | 300 L/h |
| Inlet dew point $\tau_{e,max}$ [1] | 70 °C | 70 °C |
| Gas inlet temperature $\vartheta_{G,max}$ [1] | 140 °C | 140 °C |
| Gas pressure $p_{max}$ | 3 bar | 3 bar |
| Pressure drop Δp (v=150 L/h) | 2.6 mbar | 2.9 mbar |
| Max. Cooling capacity $Q_{max}$ | 345 kJ/h | 210 kJ/h |
| Dead volume $V_{dead}$ | 47 ml | 41 ml |
| Gas connections (metric) | GL 14 (6 mm) [2] | DN 4/6 |
| Gas connections (US) | GL 14 (1/4") [2] | 1/4"-1/6" |
| Condensate out connection (metric) | GL 18 (10 mm) [2] | G1/4 |
| Condensate out connection (US) | GL 18 (10 mm) [2] | NPT 1/4" |

[1] Max. cooling capacity of the cooler must be considered.

[2] Gasket inside diameter.

## 9.7 Dimensions

### RC 1.1

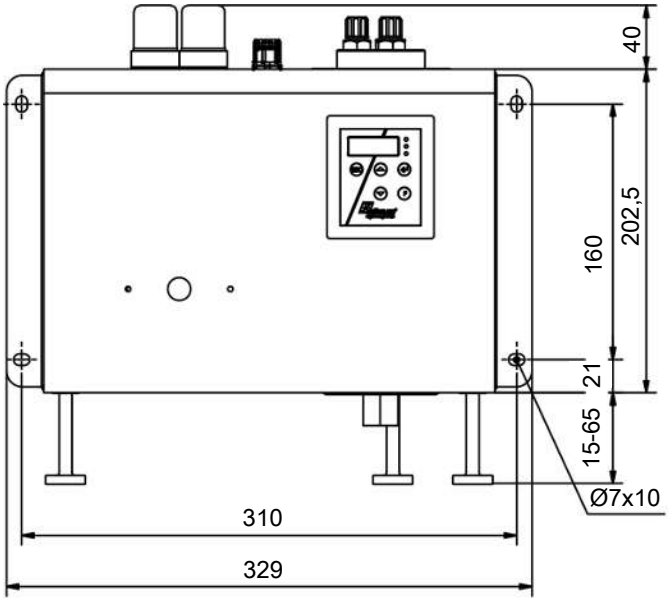


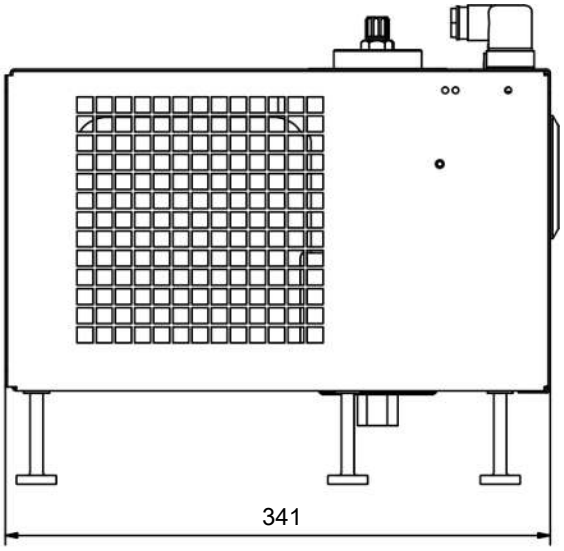

S1 = Electric supply

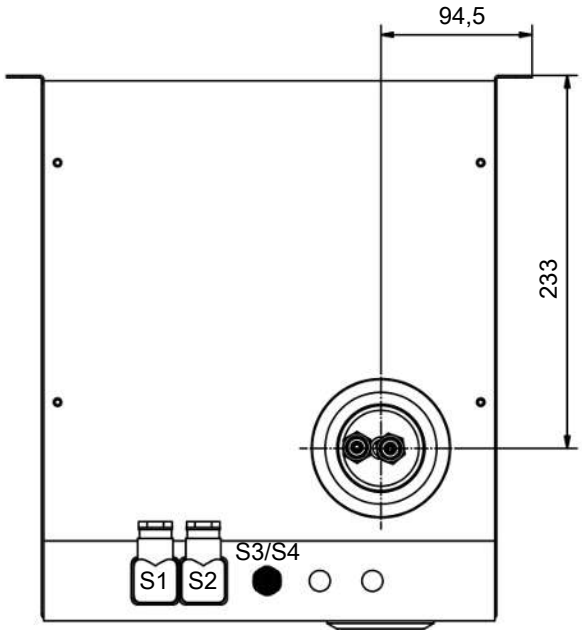
S2 = Status output

S3/S4 = Analogue/digital output (optional)

## RC 1.1 with -H2/-O2 heat exchanger



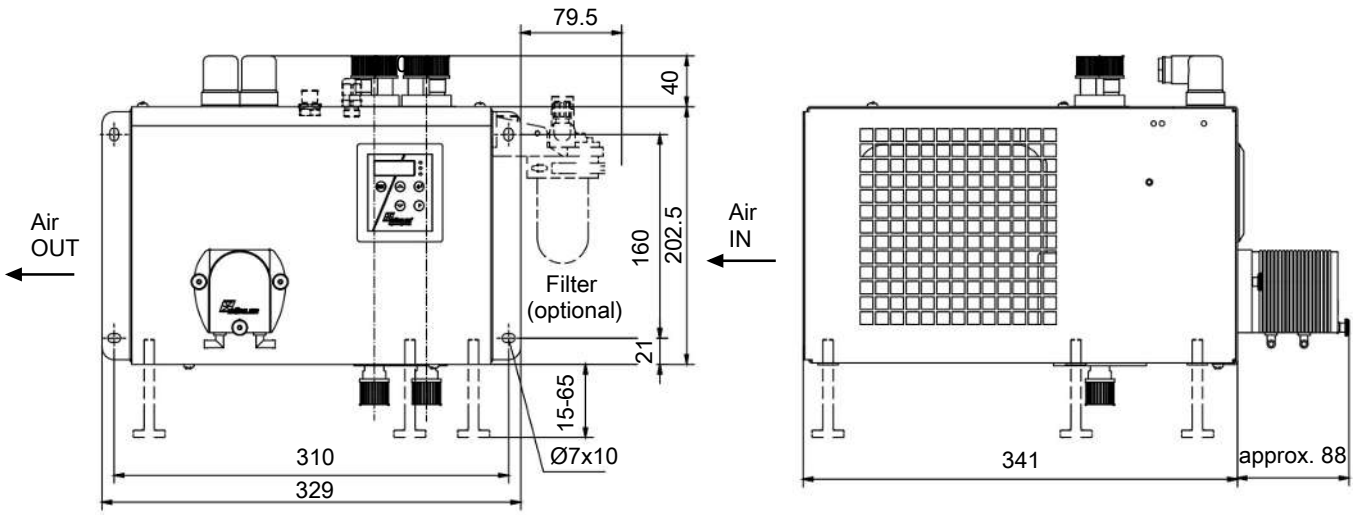



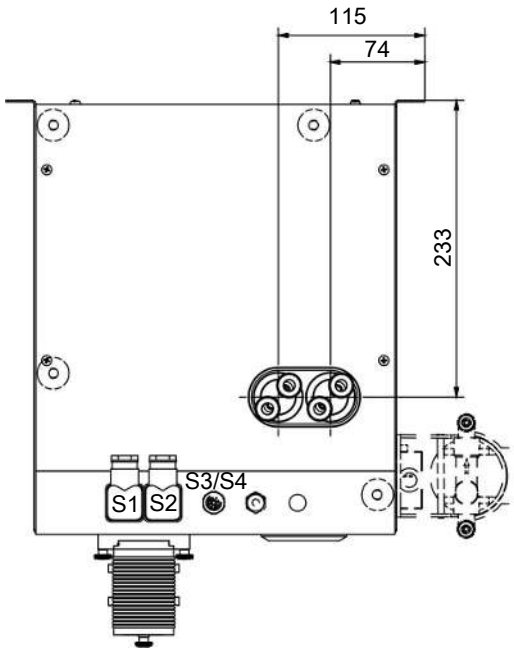

S1 = Electric supply

S2 = Status output

S3 = Analogue/digital output (optional)

## RC 1.2+




S1 = Electric supply
S2 = Status output
S3/S4 = Analogue/digital output (optional)