Donaldson
FILTRATION SOLUTIONS

Industrial Gases

HRC-T 0220 - 22000
Hydrogen Purification
Adsorption Dryer and De-Oxo Unit

PRODUCT DESCRIPTION

Hydrogen purification is essential for achieving the purity levels required for many applications by efficiently reducing the moisture and oxygen levels as well as liquid and solid particulates.

The Donaldson HRC-T adsorption dryer and De-Oxo unit helps to achieve these purity levels. The HRC-T range is designed for nominal hydrogen volume flows up to 22.000 Nm^3/h in a pressure range from 16 to 47 bar. Purity levels of residual water content of < 5 ppm and residual oxygen content of < 5 ppm can be achieved, depending on sizing, operating conditions and level of impurities at the inlet of the purification unit. The De-Oxo unit utilizes a catalyst, and is capable of converting oxygen and hydrogen to water and therefore reducing the oxygen content in the hydrogen.

Special desiccants with high adsorption capacity are used in the adsorption dryer unit to reduce the moisture from hydrogen. Regeneration of the saturated desiccant is done by partial flow of the hydrogen which is heated, resulting in desorbing of the water molecules from the desiccant. The gas is then cooled and fed back into the hydrogen main flow. This leads to zero-loss of hydrogen and 100% of the inlet flow available at the outlet of the unit.

MAIN FEATURES & BENEFITS

- **Complete purification system**

Purification system consists of pre- and afterfilter, De-Oxo unit and heat- regenerated adsorption dryer that removes solid and liquid particles, oxygen and moisture content.

- **Zero loss of hydrogen gas for regeneration**

Regeneration process of adsorption dryer loops pressurized hydrogen back into the main flow to avoid any gas loss.

- **Compact design**

Short process cycle times lead to a compact space- saving design. All system components assembled and mounted on a skid.

- **Pre- and afterfilters with UltraPleat™ media technology**

Complete purification system including high-efficiency filters that remove oil and water aerosols as well as solid particles.

- **Robust and reliable design and components**

Pressure vessels and pipelines made of high-quality stainless steel or carbon steel. Regeneration under pressurized conditions avoids additional mechanical stressing of components due to pressure load cycling.

- **ATEX compliance**

Purification system is suitable and CE marked for operation in ATEX Zone 2

INDUSTRIES

- Chemical and pharmaceutical industry

- Gas industry

- Environmental technology

- Machine building and plant engineering / constructions

- Green energy (H_2 / CO_2 / Biogas)

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FILTRATION SOLUTIONS

F119302_ENG_2025_04_REV01

PRODUCT DESCRIPTION

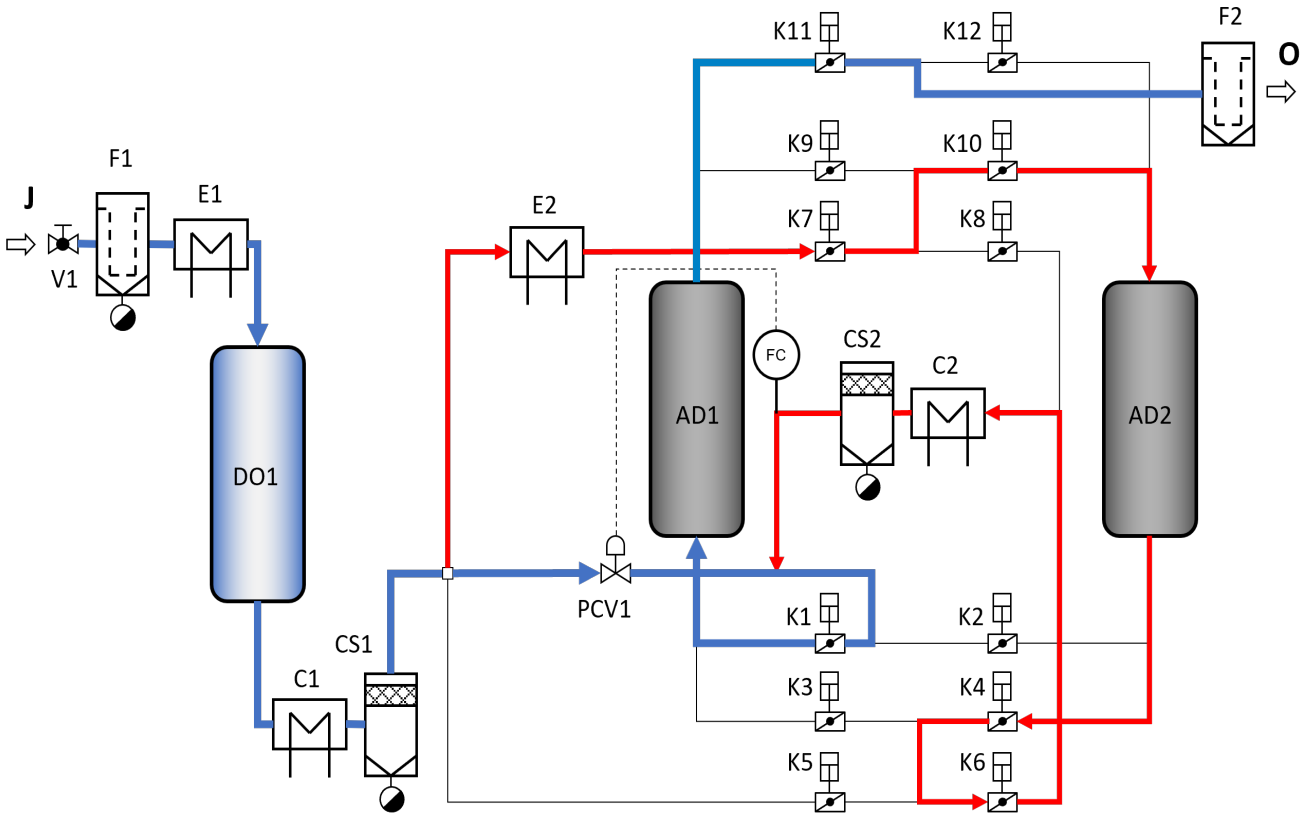
The hydrogen purification unit HRC-T consists of a prefilter (F1), De-Oxo unit (DO1) filled with special catalyst, adsorption dryer with two adsorber vessels (AD1 / AD2) filled with desiccant and a dust filter (F2) as the main purification stages.

Hydrogen enters the unit at the wet gas inlet (J) and inlet valve (V1). The prefilter removes liquid and solid particles before the gas enters the preheater (E1). The temperature is increased by the preheater to optimize the conversion of oxygen and hydrogen on the catalyst in the De-Oxo unit (DO1). Due to the exothermic reaction of the catalyst, the hydrogen temperature increases and must be cooled down in the combination of the precooler (C1) and separator (CS1). The hydrogen then enters the pressure control valve (PCS1) upstream of the adsorption dryer. The pressure control valve works to slightly reduce the pressure in the adsorption dryer.

The adsorption dryer consists of two adsorbers (AD1, AD2): when the hydrogen is dried in one adsorber (example AD1) the desiccant in the other adsorber (example AD2) is being regenerated. The flow path for drying is shown in blue in the example below.

After the pressure control valve (PCV1) the hydrogen then flows through valve K1 into the adsorber (AD1) where the moisture is adsorbed on the desiccant. The flow direction is from bottom to top. Via valve K11 the main hydrogen flow is led into after filter F2 where particles from the desiccant are retained before it leaves the unit at the clean gas outlet (O).

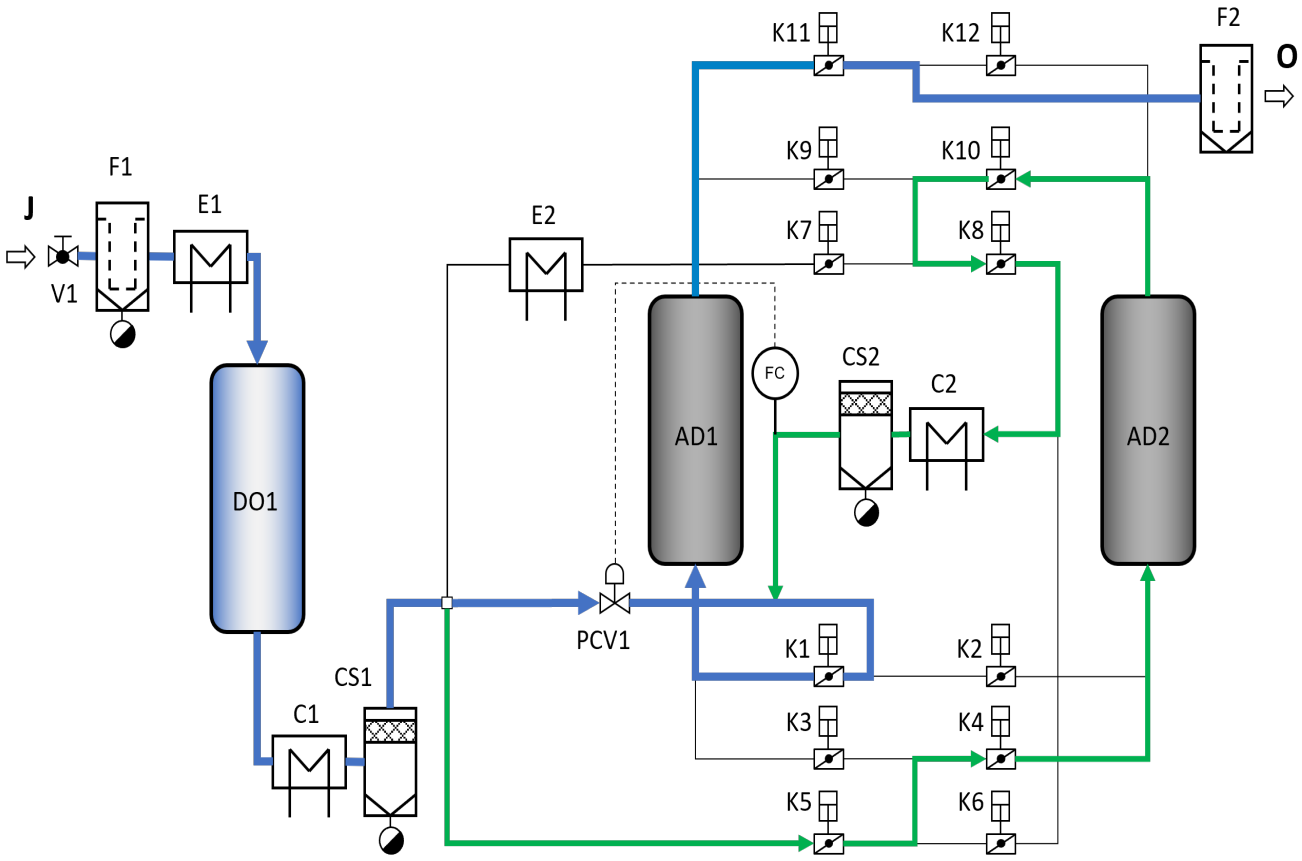
The flow path for heat regeneration is shown in red in the example below. Before the hydrogen flow enters the pressure control valve (PCV1) a partial stream is taken from the main stream and is heated in the regeneration heater (E2). The regeneration gas is led through valves K7 and K10 into the second adsorber (AD2) where the adsorbed water is desorbed from the desiccant. The regeneration flow direction is from top to bottom. Via valves K4 and K6 the regeneration gas is cooled in the after cooler C2 where liquid water droplets are retained in the separator CS2 before the regeneration gas is looped back into the main stream.



PRODUCT DESCRIPTION

After the heat regeneration, the heated desiccant must be cooled again before the switch over of the adsorbers from AD1 to AD2 (or vice versa) can take place.

The flow path for cooling is shown in green in the example below. Cooling is also done by a partial stream of hydrogen taken from the main stream. After the regeneration cycle, the valves K4 and K5 lead the cooling gas into the adsorber (example AD2). The flow direction through the adsorber is from bottom to top. Due to the heat transfer from the desiccant to the cooling gas, the cooling gas stream becomes heated and must be cooled before it can be looped-back into the main hydrogen stream. From there, it is led through valves K8 and K10 into the after-cooler (C2) and separator (CS2) and further into the main stream.



PRODUCT DESCRIPTION

TECHNICAL DATA	
Adsorber Vessel	
Pressure Vessel Material	Stainless steel min. 1.4541
Design Data	Design pressure: 50 bar g Design temperature: -30°C / +200°C
Design, Manufacturing and Testing	Acc. to AD2000 / PED 2014/29/EU
Flow Distributor Material	Stainless steel
Piping	
Design Data	Flange pressure rating: PN63 Design pressure: 50 bar g Design temperature: 200°C
Piping Material	Stainless steel / Carbon steel, galvanized
Design, Manufacturing and Testing	Acc. to PED 2014/68/EU
Filters	
Design Data	Design pressure: 50 bar g Design temperature: 120°C
Filter Housing Material	Stainless steel min. 1.4541
Design, Manufacturing and Testing	Acc. to PED 2014/68/EU
Electrical Controller	
Design	VDI / VDE
Power Supply	3 ph / 400 V / 50 Hz
Protection Class	IP 54
Potential-Free Alarm Contact	Included
Remote On/Off Contact	Included

PRODUCT DESCRIPTION

TECHNICAL DATA	
Nominal Standard Conditions	
Operating Inlet Pressure	30 bar g
Operating Inlet Temperature	40°C
Inlet Humidity	100% saturated
Inlet Oxygen Content max.	0.4% vol (4000 ppm(V))
Hydrogen Purity	
Water content / Pressure Dewpoint	< 1 ppm / -52.1°C
Oxygen	< 2 ppm (V)
Operating Limits	
Media	Hydrogen
Operating Pressure	20 - 47 bar g
Operating Temperature	5 - 50°C
Ambient Temperature	5 - 40°C
Installation	Indoor

PRODUCT DESCRIPTION

TECHNICAL DATA				
HRC-T	Nominal Flow Capacity Nm^3/h[1)]	Stack Power MW	Total installed Power kW	Required Cooling Capacity kW
220	220	1	7.0	12.77
1100	1100	5	33.0	63.73
2200	2200	10	64.0	127.65
5500	5500	25	159.0	319.13
11000	11000	50	317.0	638.25
22000	22000	100	633.0	1276.40

[1)] Nominal flow at 30 bar g, 40°C

DIMENSIONS AND WEIGHT					
HRC-T	Pipe Connection Size Main Pipe	Height mm	Width mm	Depth mm	Weight kg
220	DN 10	3300	3200	2350	4500
1100	DN 40	3800	3500	2500	6200
2200	DN 40	3500	3700	2600	7000
5500	DN 80	3450	3960	2740	8000
11000	DN 100	3500	4500	3000	11000
22000	DN 150	3800	5500	3500	18000

For more information please contact your Donaldson Sales Representative and visit our website at **www.donaldson.com**.

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Technical Data Sheet No. F119279 ENG (04/25) HRC-T Hydrogen Purification Adsorption Dryer and De-Oxo Unit.