GAS DRYING · HYDROGEN · MOLECULAR SIEVE

How much molecular sieve does your gas dryer need?

Size a refillable adsorber by the run time you want between media changes – not by the housing. Two lines of physics give the water load and the media volume; pre-cooling the gas cuts the desiccant by about three quarters.

DESIGN PARAMETER	RULE OF THUMB	PLANNING CAPACITY	BIGGEST LEVER
Run time between media changes	**1 g water ≈ 15.6 cm³ sieve**	**10 % conservative / 15 % typical**	**Pre-cool to 5 °C → ≈ ¼ water**

WHY RUN TIME, NOT HOUSING SIZE

An adsorber is a consumable store. Every gram of water entering the dryer is held in the molecular sieve until the bed is saturated and water breaks through. A small housing works at any flow – it simply saturates sooner. The real question is therefore: **how long must the dryer run between two media changes?** One shift, one day, one test campaign?

Once the run time is fixed, the media volume follows from the water load. Housing selection is the last step, not the first.

THE CALCULATION IN THREE STEPS

1. Water load. From the dry gas flow Q_N (normal litres, 0 °C / 1.013 bar), the absolute pressure p and the water vapour partial pressure p_w at the inlet dew point (for saturated gas: at gas temperature):

$$m_w\ [g/h] = Q_N\ [NL/h] \div 22.414 \times p_w \div (p - p_w) \times 18.015$$

2. Media volume. With usable capacity c (wt-% water up to breakthrough) and bulk density ρ = 0.64 g/cm³:

$$V\ [cm^3] = m_w \times t \div (c \times \rho) \quad \rightarrow \quad \text{at } c = 10\ \%\text{: } V \approx m_w \times t \times 15.6$$

3. Housing. Choose the smallest refillable housing whose fill volume covers V – or two in series for longer runs and lead/lag changes. Higher pressure lowers $p_w/(p - p_w)$ and therefore the water per normal litre.

REFERENCE TABLE – MEDIA VOLUME AT 10 % USABLE CAPACITY, NEAR ATMOSPHERIC PRESSURE

Run time	1 NL/min, saturated 25 °C	7 NL/min, saturated 25 °C	7 NL/min, pre-cooled 5 °C
Water load	1.55 g/h	10.87 g/h	2.93 g/h
1 h	24 cm³	170 cm³	46 cm³
8 h	194 cm³	1,358 cm³	366 cm³
24 h	582 cm³	4,075 cm³	1,099 cm³
40 h	970 cm³	6,792 cm³	1,831 cm³

At 15 % usable capacity the volumes are × 0.67. Values are planning estimates, rounded. Online calculator with your own values: process-gas-filter.com/adsorber-sizing

PRE-COOLING: THE CHEAPEST RUN-TIME EXTENSION

Saturated gas at 5 °C carries only about a quarter of the water it carries at 25 °C. A small cooler with condensate drain upstream of the dryer therefore makes the same molecular sieve last roughly four times longer – or allows a four times smaller bed.

A coalescing filter upstream removes droplets and aerosols. Liquid water or electrolyte carry-over must never reach the sieve: it saturates the bed immediately.

WATER LOAD, 1 NL/MIN SATURATED

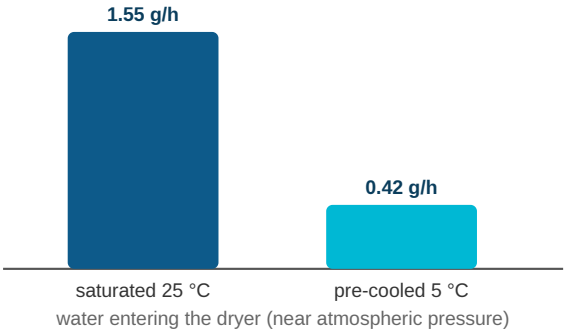


Fig. 1 – Pre-cooling from 25 °C to 5 °C reduces the water load to about 28 %.

RUN TIME OF STANDARD REFILLABLE HOUSINGS – EXAMPLE 1 NL/MIN, SATURATED 25 °C

Housing	Port	Fill volume	Run time @ 10 %	Run time @ 15 %
RF-H-134-ADS	¼″ NPT	110 cm³	4.5 h	6.8 h
RF-H-146-ADS	½″ NPT	265 cm³	10.9 h	16.4 h
2 × RF-H-146-ADS	½″ NPT	530 cm³	21.8 h	32.8 h



RF-H-134-ADS
316L · ¼″ NPT · 100 bar · approx. 110 cm³ fill



RF-H-146-ADS
316L · ½″ NPT · 100 bar · approx. 265 cm³ fill

RECOMMENDED DRYING TRAIN

1 · Coalescer
Removes droplets and aerosols before the sieve.

2 · Adsorber
Molecular sieve 3A/4A, sized for run time; 2 in series for lead/lag.

3 · Particulate filter
Retains fines from the adsorbent bed.

4 · Dew-point sensor
Shows breakthrough before it reaches the process.

- Planning estimate only. Usable capacity depends on temperature, contact time, regeneration state and the required outlet dew point. No outlet dew point is guaranteed – final sizing on request with your operating data.
- Standard refillable adsorber housings are rated 100 bar. Media charge, larger volumes and high-pressure versions on request.
- R+F supplies filters and refillable adsorber housings. Drying systems with regeneration and catalytic purifiers are outside our scope.

Send us your gas data – we size the adsorber

Flow, pressure, temperature or dew point, required outlet dew point and desired run time. We reply with a configuration: coalescer, adsorber volume, after-filter.

info@filter-elements.eu

Online calculator
process-gas-filter.com/adsorber-sizing