Water Condensed from Compressed Air (After-Cooler and Dryer)

Water entering with intake air and the amounts condensed in the after-cooler and dryer, from intake humidity, line pressure and pressure dew points.

Method: Humid-air saturation with IAPWS-IF97 (FireCAD engine) and mass balance (definitions)

Input parameters

Unit system: SI

Parameter	Value	Unit
Free air delivery	10.000	m³/min
Intake temperature	35.000	°C
Intake relative humidity	70.000	%
Intake pressure	101.33	kPa
Line pressure (absolute)	8.0000	bar
After-cooler outlet temperature (saturated)	40.000	°C
Dryer pressure dew point	3.0000	°C

Calculated results

Parameter	Value	Unit
Water entering with the air	16.622	kg/h
Condensed in the after-cooler	12.794	kg/h
Removed by the dryer	3.4379	kg/h
Total condensate per day (as water at 1 kg/L)	389.57	L

Notes for this case

- Free air delivery is taken at intake conditions here. Most water drops out in the after-cooler; drains must keep up with it or water carries into the mains.

Formula and method

$$\dot{m}_w = \dot{m}_a (W_0 - W_{sat}(p,T)), \quad W = \frac{M_w}{M_a}\frac{p_v}{p - p_v} \ (\approx 0.622\ldots)$$

Variables

$\dot{V}_{FAD}$	Free air delivery	m³/s
T_i	Intake temperature	K
ϕ	Intake relative humidity	-
p_a	Intake pressure	Pa
p	Line pressure (absolute)	Pa
T_{ac}	After-cooler outlet temperature (saturated)	K
T_{pdp}	Dryer pressure dew point (below 0 °C: over ice)	K
$\dot{m}_{w,in}$	Water entering with the air	kg/s
$\dot{m}_{ac}$	Condensed in the after-cooler	kg/s
$\dot{m}_d$	Removed by the dryer	kg/s
$\dot{m}_{day}$	Total condensate per day, as a volume of water at 1 000 kg/m³	m³

Method and standards

Humid-air mass balance.

Assumptions and limits

- Saturated air at the cooler outlet.
- Dew points below 0 °C (desiccant dryers) use saturation over ice (IAPWS R14-08); the water is then held by the desiccant rather than drained.
- The daily total is shown as a volume of water at 1 000 kg/m³.

References

- Humid-air saturation with IAPWS-IF97 (FireCAD engine) and mass balance (definitions)

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/compressors/compressed-air-condensate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.