Cooling Coil Bypass Factor, ADP and Sensible Heat Ratio

Bypass and contact factors of a cooling coil from entering, leaving and apparatus dew point temperatures, with the leaving humidity and the sensible heat ratio.

Method: Bypass factor method (ASHRAE psychrometrics)

Input parameters

Unit system: SI

Parameter	Value	Unit
Atmospheric pressure	101.33	kPa
Entering air dry bulb	27.000	°C
Entering relative humidity	50.000	%
Leaving air dry bulb	13.000	°C
Apparatus dew point (coil surface)	10.000	°C

Calculated results

Parameter	Value	Unit
Bypass factor	17.647	%
Contact factor (1 − BF)	82.353	%
Leaving humidity ratio	8.2514	g/kg
Leaving relative humidity	88.562	%
Sensible heat ratio	65.942	%

Formula and method

$$BF = \frac{T_2 - T_{ADP}}{T_1 - T_{ADP}}, \quad CF = 1 - BF$$

$$W_2 = W_{ADP} + BF(W_1 - W_{ADP})$$

$$SHR = \frac{h(T_1, W_2) - h(T_2, W_2)}{h(T_1, W_1) - h(T_2, W_2)}$$

Variables

p	atmospheric pressure	Pa
T_1	entering dry bulb	K
ϕ_1	entering relative humidity	-
T_2	leaving dry bulb	K
T_{ADP}	apparatus dew point	K
W_1	entering humidity ratio	kg/kg
W_{ADP}	saturation humidity ratio at the ADP	kg/kg
h	moist air enthalpy (ASHRAE)	J/kg
BF	bypass factor	-
CF	contact factor	-
W_2	leaving humidity ratio	kg/kg
ϕ_2	leaving relative humidity	-
SHR	sensible heat ratio	-

Method and standards

On the psychrometric chart the coil process is a straight line from the entering state towards the apparatus dew point; the bypass factor locates the leaving state on it. The sensible heat ratio splits the enthalpy drop into sensible and latent parts.

Assumptions and limits

- Straight-line coil process; ADP from the coil maker or a test.
- Where that line from a near-saturated entering state passes above the saturation curve, the leaving humidity is capped at saturation, with a note.
- SHR convention: the sensible part is $h(T_1, W_2) - h(T_2, W_2)$, the cooling at the leaving humidity; the rest of the total enthalpy drop is latent.

References

- Bypass factor method (ASHRAE psychrometrics)

Report details

Report reference	FCC-FQVK-A9KV (the same inputs always give the same reference)
Generated	17 November 2026, 19:34 UTC
Calculator	Cooling Coil Bypass Factor, ADP and Sensible Heat Ratio
Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	4 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/hvac/loads/coil-bypass-factor

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Reopens the calculator with the inputs of this report.