Sensible Heat Ratio, Apparatus Dew Point and Supply Air

Room sensible heat ratio, the coil's apparatus dew point on the room ratio line, supply air temperature from the bypass factor, and the supply air flow.

Method: ASHRAE Handbook—Fundamentals (2017); ch. 1 (moist-air processes); Carrier; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Room temperature	24.000	°C
Room relative humidity	50.000	%
Room sensible load	30.000	kW
Room latent load	8.0000	kW
Coil bypass factor	10.000	%
Barometric pressure	101.33	kPa

Calculated results

Parameter	Value	Unit
Room sensible heat ratio	0.78947	
Apparatus dew point	10.341	°C
Supply air temperature	11.707	°C
Supply humidity ratio	7.9587	g/kg
Supply air flow	7,017.0	m³/h

Notes for this case

• Room ratio line from Q_s = ṁc_pm(t_r − t_s) and Q_l = ṁh_fg(W_r − W_s) with c_pm = 1.006 + 1.86W_r kJ/(kg·K), h_fg = 2,501 kJ/kg. Supply air flow is at the supply state.

Formula and method

$$SHR = \frac{Q_s}{Q_s + Q_l}, \quad W_{sat}(t_{adp}) = W_r - \frac{Q_l}{Q_s}\frac{c_{pm}}{h_{fg}}(t_r - t_{adp}), \quad t_s = t_{adp} + BF(t_r - t_{adp})$$

$$c_{pm} = c_{p,a} + c_{p,v}W_r, \quad W_s = W_r - \frac{Q_l}{Q_s}\frac{c_{pm}}{h_{fg}}(t_r - t_s), \quad \dot{V}_s = \frac{Q_s}{c_{pm}(t_r - t_s)}\,v_s$$

Variables

t_r	Room temperature	K
φ_r	Room relative humidity	-
Q_s	Room sensible load	W
Q_l	Room latent load	W
BF	Coil bypass factor	-
p	Barometric pressure	Pa
SHR	Room sensible heat ratio	-
t_{adp}	Apparatus dew point	K
t_s	Supply air temperature	K
W_s	Supply humidity ratio	kg/kg
$\dot{V}_s$	Supply air flow	m³/s

W_r	Room humidity ratio	kg/kg
W_{sat}	Saturation humidity ratio	kg/kg
c_{pm}	Moist-air specific heat per kg dry air	J/(kg·K)
$c_{p,a}$	Dry-air specific heat, 1 006	J/(kg·K)
$c_{p,v}$	Water-vapour specific heat, 1 860	J/(kg·K)
h_{fg}	Latent heat used, 2 501 000	J/kg
v_s	Specific volume of the supply air per kg dry air	m³/kg

Method and standards

Room ratio line.

Assumptions and limits

- Room load only; no fan or duct gains.
- The latent load is converted with h_fg = 2 501 kJ/kg (the 0 °C value of the ASHRAE moist-air enthalpy) and c_pm = 1.006 + 1.86 W_r kJ/(kg·K). The supply air flow from room load calculator uses the vapour enthalpy at room temperature (about 2 545 kJ/kg), so the two give supply humidity ratios about 1.7 % apart for the same loads.

References

• ASHRAE Handbook—Fundamentals (2017)
• ch. 1 (moist-air processes); Carrier
• Handbook of Air Conditioning System Design (ADP and bypass factor method)

Report details

Report reference	FCC-GS2V-FGYR (the same inputs always give the same reference)
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Calculator	Sensible Heat Ratio, Apparatus Dew Point and Supply Air
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Release checks	2 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/sensible-heat-ratio-adp

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.