Sweating Ducts
Relative Humidity
Vapor Pressure
Heating

35°F
90% RH

70°F
30% RH
Mold
Phases of Water
Monolayers of adsorbed water increase with increasing RH
Kelvin Equation

\[ \ln \frac{p}{p_0} = \frac{2\gamma V_m}{rRT} \]
Curvature ("meniscus")

Small pore

Large pore
Sweating Ducts
Tile Roofs
Light Colored Roofs
Cool Roofs
Radiant Barriers
ACCA Manual J, S and D
ASHRAE 62.2 and Energy Star Indoor Air Plus
Ductwork Attic Dehumidification System
Closet Mold
Closet Mold
R-30 to R-38 to R-49....
Closet Mold
R-30 to R-38 to R-49....
ASHRAE 62.2 and Energy Star Indoor Air Plus
ASHRAE Standard 62.2 calls for 7.5 cfm per person plus 0.03 cfm per square foot of conditioned area

Occupancy is deemed to be the number of bedrooms plus one
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Outcome is often bad – part load humidity problems, dryness problems, energy problems
IRC 2015, 2018 and 2021 calls for 7.5 cfm per person plus 0.01 cfm per square foot of conditioned area

Occupancy is deemed to be the number of bedrooms plus one
ASHRAE Standard 62.2
0.03 cfm/ft² plus 7.5 cfm/occupant

IRC/IMC
0.01 cfm/ft² plus 7.5 cfm/occupant
30 percent credit for balanced/distributed

2500 ft² 3 bedroom (occupancy 4)
ASHRAE 75 cfm + 30 cfm = 105 cfm
IRC/IMC 25 cfm + 30 cfm = 55 cfm (or 38.5 cfm)
Huge part load humidity problem….
Mold not just in closets….
You will need a dehumidifier….
Probably an ERV…
Mechanical Room Mold
Cavity is sealed tight, drywall glued to studs and plates on both sides.
Note: Colored shading depicts the building’s thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.
Leaky air handling unit and supply ducts

Air handling unit

Supply
Return
Supply

Depressurized conditioned space
inducing infiltration

Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.
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Hygric Buoyancy
<table>
<thead>
<tr>
<th>Components in Dry Air</th>
<th>Volume Ratio compared to Dry Air</th>
<th>Molecular Mass - $M$ (kg/kmol)</th>
<th>Molecular Mass in Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>0.2095</td>
<td>32.00</td>
<td>6.704</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.7809</td>
<td>28.02</td>
<td>21.88</td>
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<tr>
<td>Carbon Dioxide</td>
<td>0.0003</td>
<td>44.01</td>
<td>0.013</td>
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<tr>
<td>Hydrogen</td>
<td>0.00000005</td>
<td>2.02</td>
<td>0</td>
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<tr>
<td>Argon</td>
<td>0.00933</td>
<td>39.94</td>
<td>0.373</td>
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<tr>
<td>Neon</td>
<td>0.000018</td>
<td>20.18</td>
<td>0</td>
</tr>
<tr>
<td>Helium</td>
<td>0.000005</td>
<td>4.00</td>
<td>0</td>
</tr>
<tr>
<td>Krypton</td>
<td>0.000001</td>
<td>83.8</td>
<td>0</td>
</tr>
<tr>
<td>Xenon</td>
<td>$0.09 \times 10^{-6}$</td>
<td>131.29</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Molecular Mass of Air</strong></td>
<td></td>
<td></td>
<td><strong>28.97</strong></td>
</tr>
</tbody>
</table>
Note Water Vapor (H2O) is 18
Dry Air is 29
Burying Ducts
Mechanical Systems
Mechanical Systems
Cooling System To Make It Cold
Mechanical Systems
Cooling System To Make It Cold
Dehumidification System To Make It Dry
Mechanical Systems
Cooling System To Make It Cold
Dehumidification System To Make It Dry
Heating System To Make It Warm
Mechanical Systems
Cooling System To Make It Cold
Dehumidification System To Make It Dry
Heating System To Make It Warm
Energy Recovery System To Keep It Cold and Dry and Warm and Comfortable
Mechanical Systems
Cooling System To Make It Cold
Dehumidification System To Make It Dry
Heating System To Make It Warm
Energy Recovery System To Keep It Cold and Dry and Warm and Comfortable
Distribution System To Make It Uniform
Mechanical Systems
Cooling System To Make It Cold
Dehumidification System To Make It Dry
Heating System To Make It Warm
Energy Recovery System To Keep It Cold and Dry and Warm and Comfortable
Distribution System To Make It Uniform
Range Hoods Are A Special Kind of Hell
Don’t Try to Combine Them......
Cooling System makes it cold
Dehumidification System makes it dry
Heating System makes it warm
ERV keeps it cold and dry and warm and comfortable
Distribution System makes it uniform