

HVAC Economizers 101

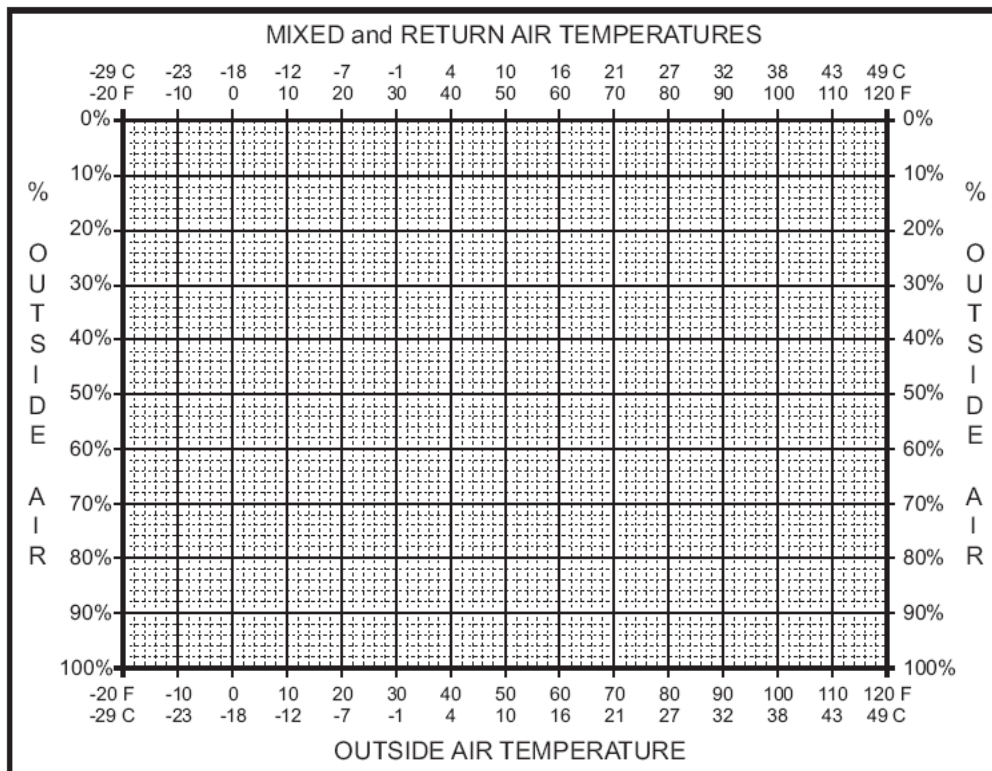
Section #9

Determining the TRUE % of
Outside Air

Using Charts and Formulas

Section #9-Determining the TRUE % of OSA Using Charts and Formulas

- The TRUE percent (%) of outside air entering into the building via the air handling unit is found by using percentage charts or formulas. The next couple of slides will demonstrate both.



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OA Percentage Chart

OA Percentage Formula

$$\% \text{ OA} = \frac{T_{ra} - T_{ma}}{T_{ra} - T_{oa}} \times 100$$

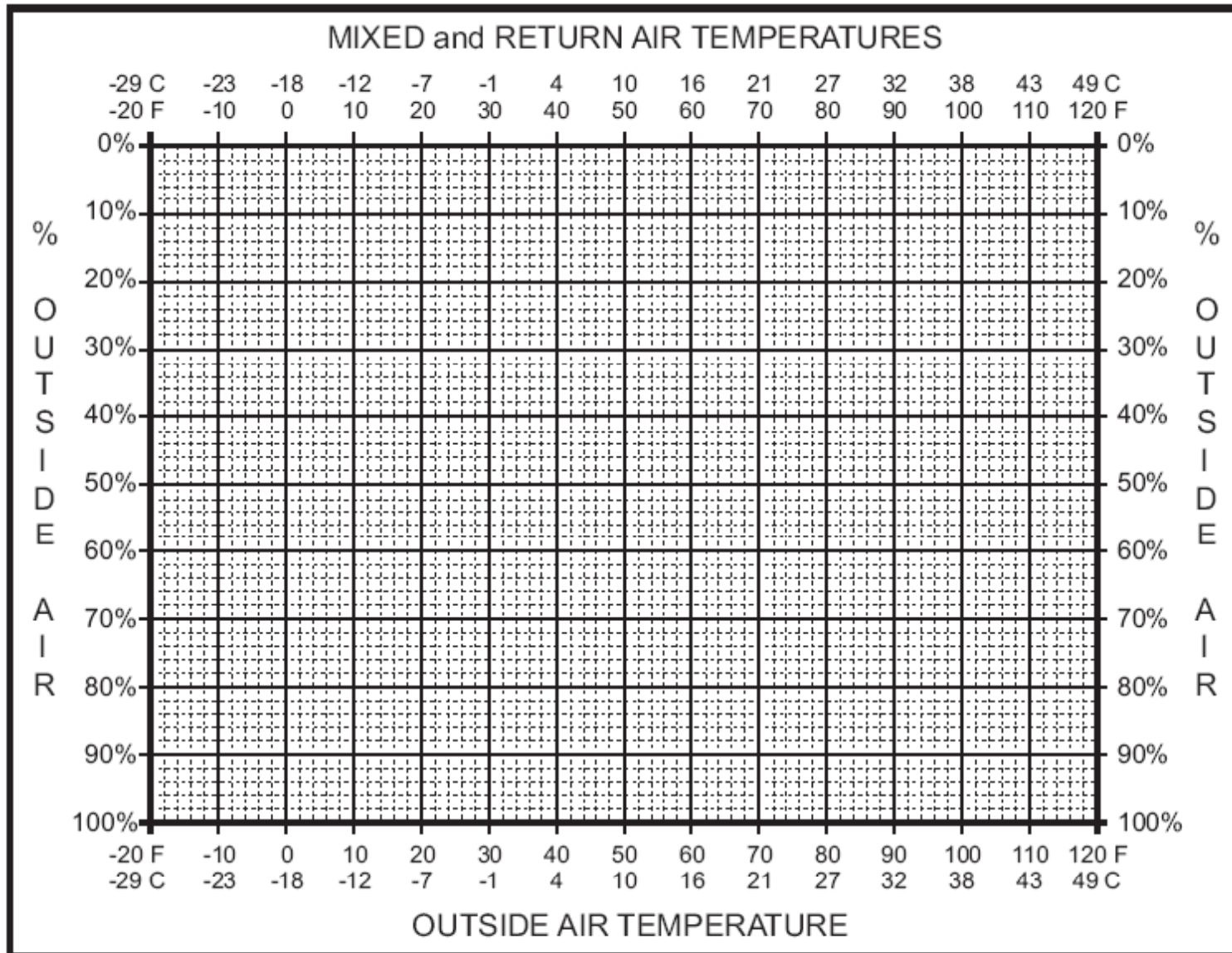
Or to find Temp of Mixed Air

$$T_{ma} = T_{ra} \times (\%T_{ra}) + T_{osa} \times (\%T_{osa})$$

Note

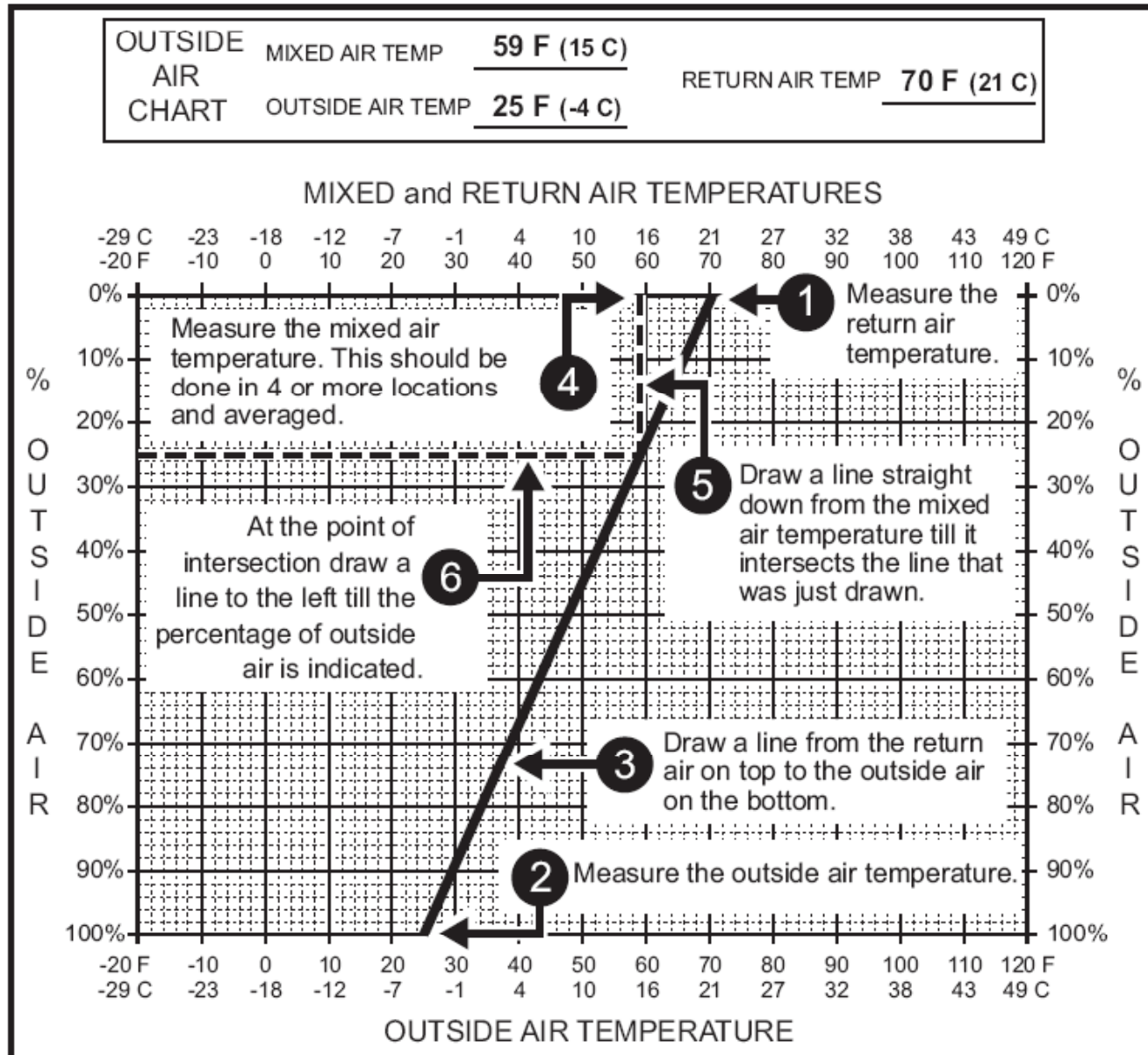
T_{ma} = Temp Mixed Air
T_{ra} = Temp Return Air
T_{osa} = Temp Outside Air

Outside Air Percentage Chart



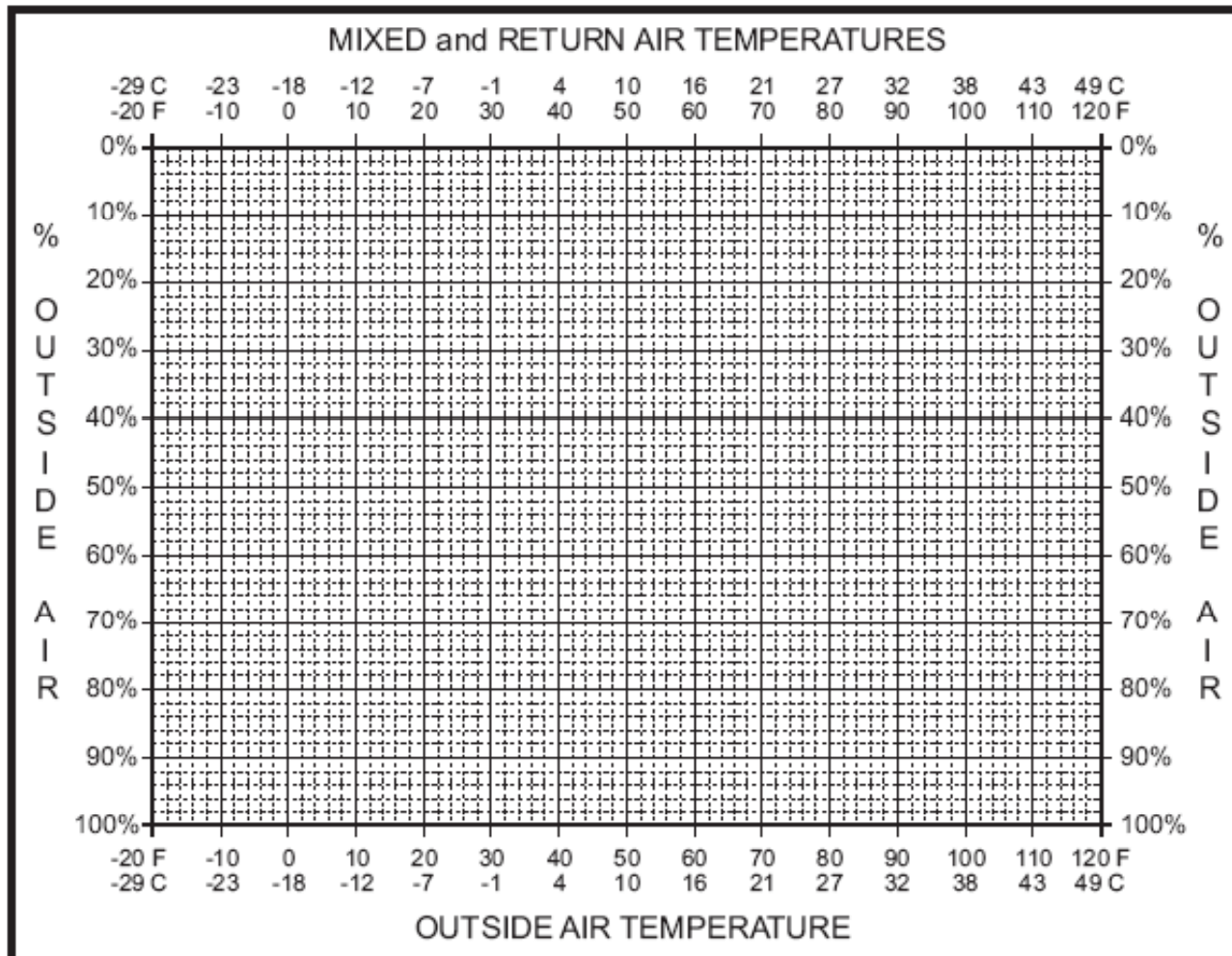
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Using the Outside Air Percentage Chart

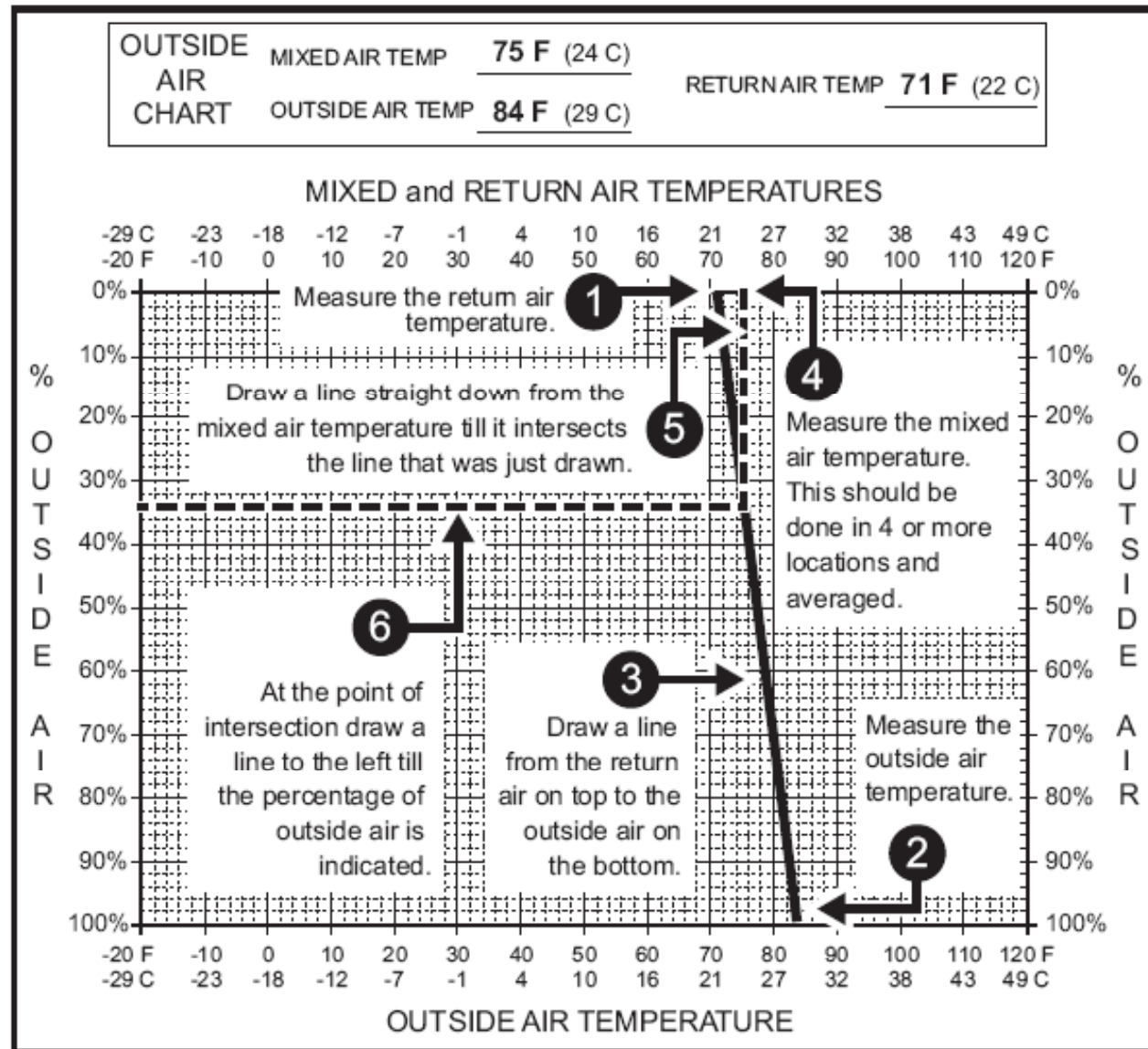


Exercise to Determine % OSA Using the Chart (Plot out the Answer)

| | | | | |
|-------------------|------------------|--------------------|-----------------|--------------------|
| OUTSIDE AIR CHART | MIXED AIR TEMP | <u>75 F (24 C)</u> | RETURN AIR TEMP | <u>71 F (22 C)</u> |
| | OUTSIDE AIR TEMP | <u>84 F (29 C)</u> | | |



The Answer to % OSA on the Chart



Formulas to Determine % OSA and Minimum Position Control

$$\frac{\text{Return Air Temperature} - \text{Mixed Air Temperature}}{\text{Return Air Temperature} - \text{Outdoor Air Temperature}} \times 100\% = \text{Volume (\%) of Outside Air}$$

Formula for Calculating the Percentage of Outside Air in an Air Handler from Measured Temperature

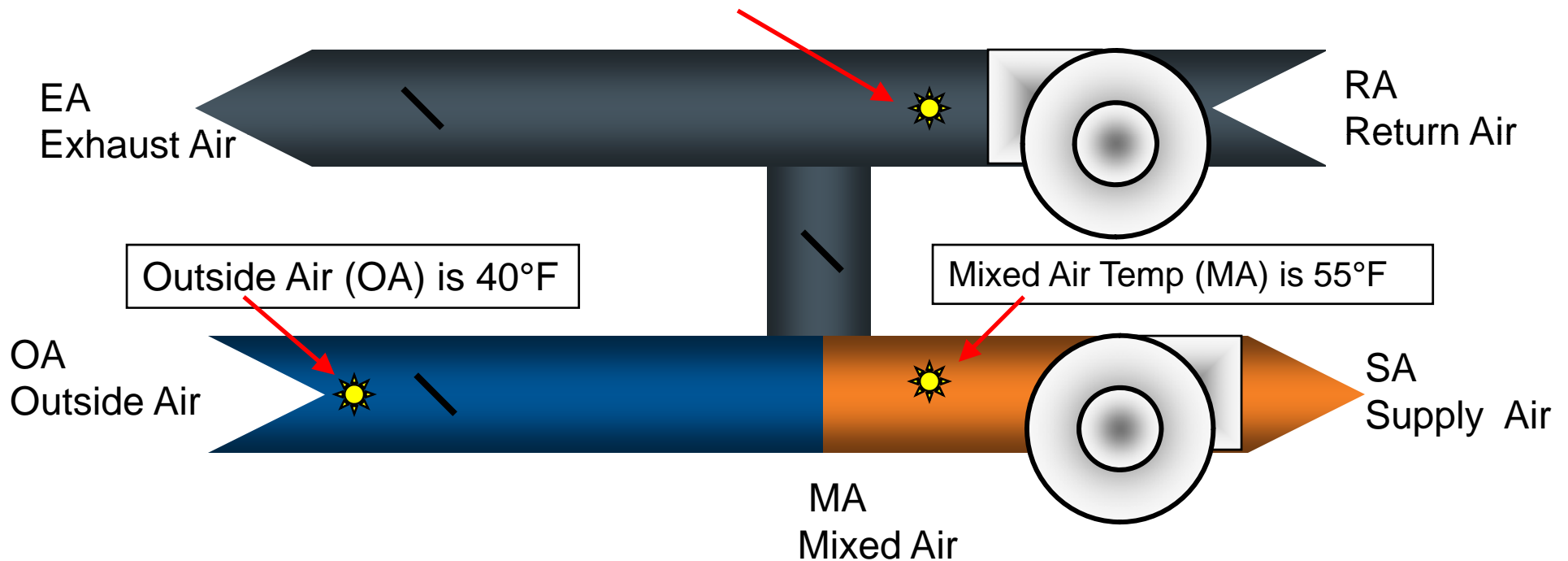
$$\left[\text{Return Air Temperature} \times \text{\% of Return Air} \right] + \left[\text{Outside Air Temperature} \times \text{\% of Outside Air} \right] = \text{Temperature of Mixed Air}$$

Formula for Adjusting the Minimum Position Control.

$$\text{\% Return Air} = (100 - \text{\% Outside Air})$$


Exercise to Determine Actual % Outside Air Supply using the Formula

Return Air (RA) is 80°F

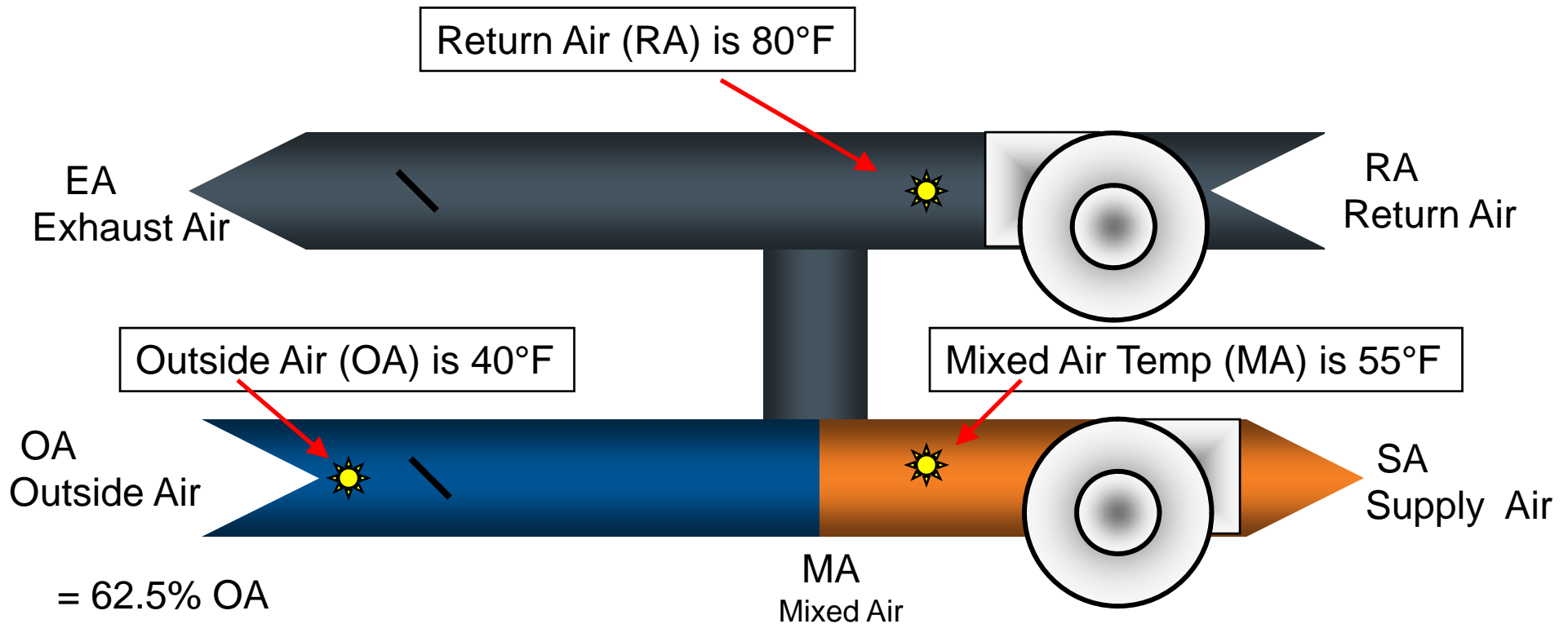


Use Outside Air Equation to determine % of OA

$$\% \text{ OA} = \frac{T_{ra} - T_{ma}}{T_{ra} - T_{oa}} \times 100$$

 Temperature Sensor

Answer to Exercise to Determine Outside Air Supply using the Formula

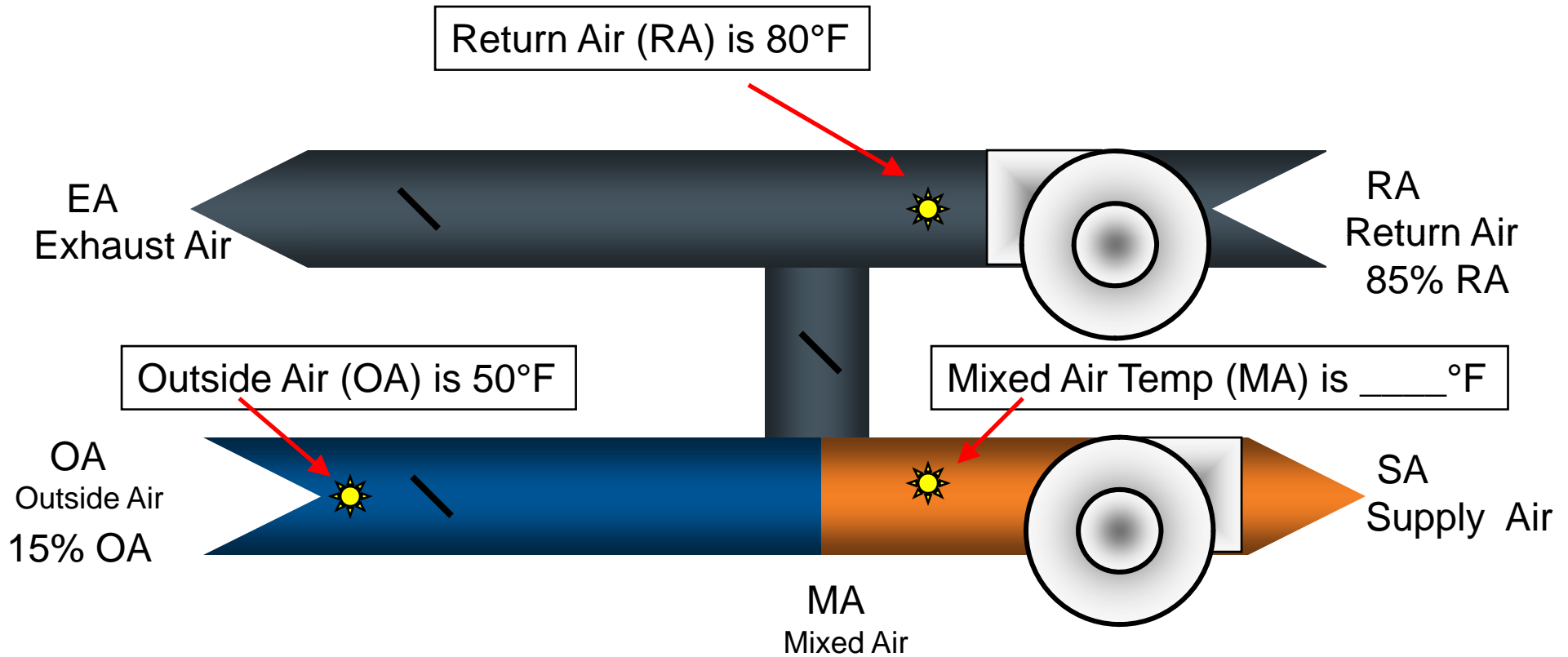


Using the Outside Air Equation to determine % of OA


$$\% \text{ OA} = \frac{T_{ra} 80^{\circ}\text{F} - T_{ma} 55^{\circ}\text{F}}{T_{ra} 80^{\circ}\text{F} - T_{oa} 40^{\circ}\text{F}} \times 100 = \frac{80^{\circ}\text{F} - 55^{\circ}\text{F}}{80^{\circ}\text{F} - 40^{\circ}\text{F}} = 62.5\% \text{ OA}$$

Temperature Sensor

Exercise to Determine Actual Mixed Air Temperature Using the Formula

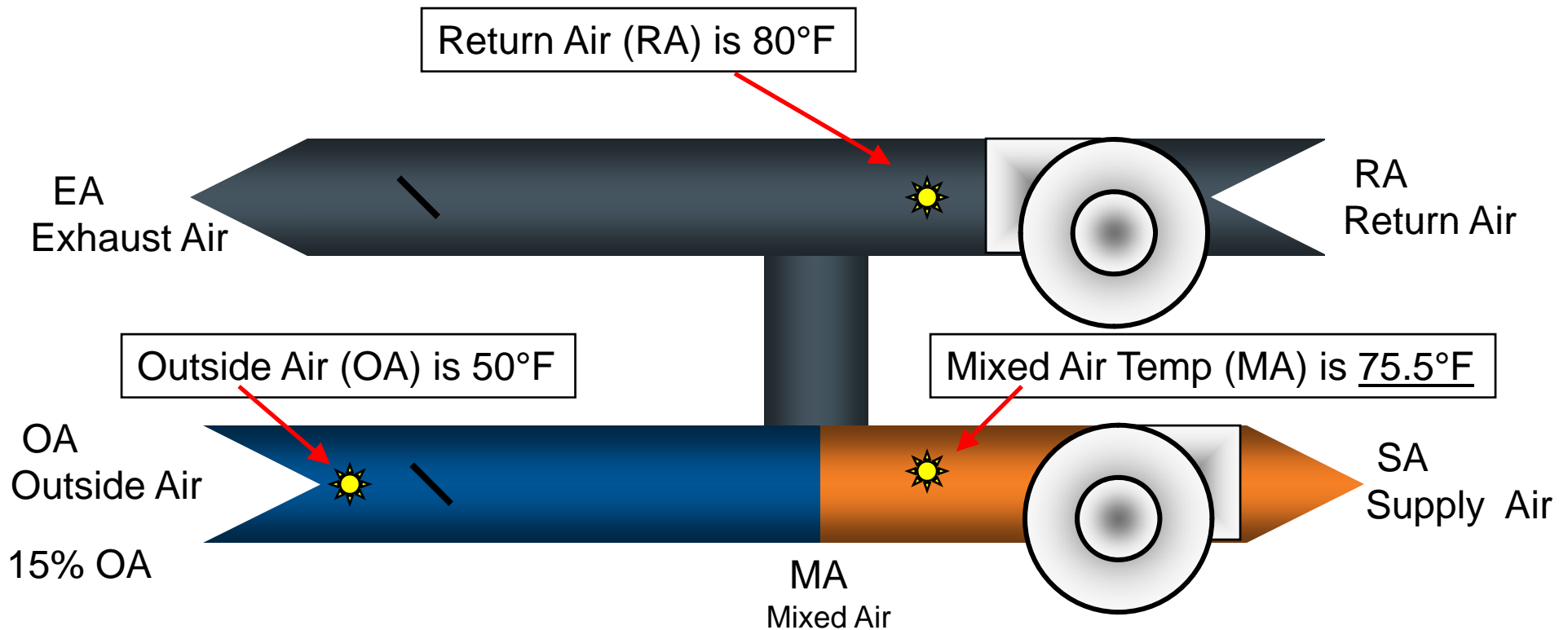


$$\left[\begin{array}{l} \text{Return Air} \\ \text{Temperature} \end{array} \right] \times \left[\begin{array}{l} \% \text{ of} \\ \text{Return} \\ \text{Air} \end{array} \right] + \left[\begin{array}{l} \text{Outside Air} \\ \text{Temperature} \end{array} \right] \times \left[\begin{array}{l} \% \text{ of} \\ \text{Outside} \\ \text{Air} \end{array} \right] = \text{Temperature} \\ \text{of Mixed Air}$$

 Temperature Sensor

Formula for Adjusting the Minimum Position Control.

Answer to Exercise to Determine Actual Mixed Air Temperature Using the Formula



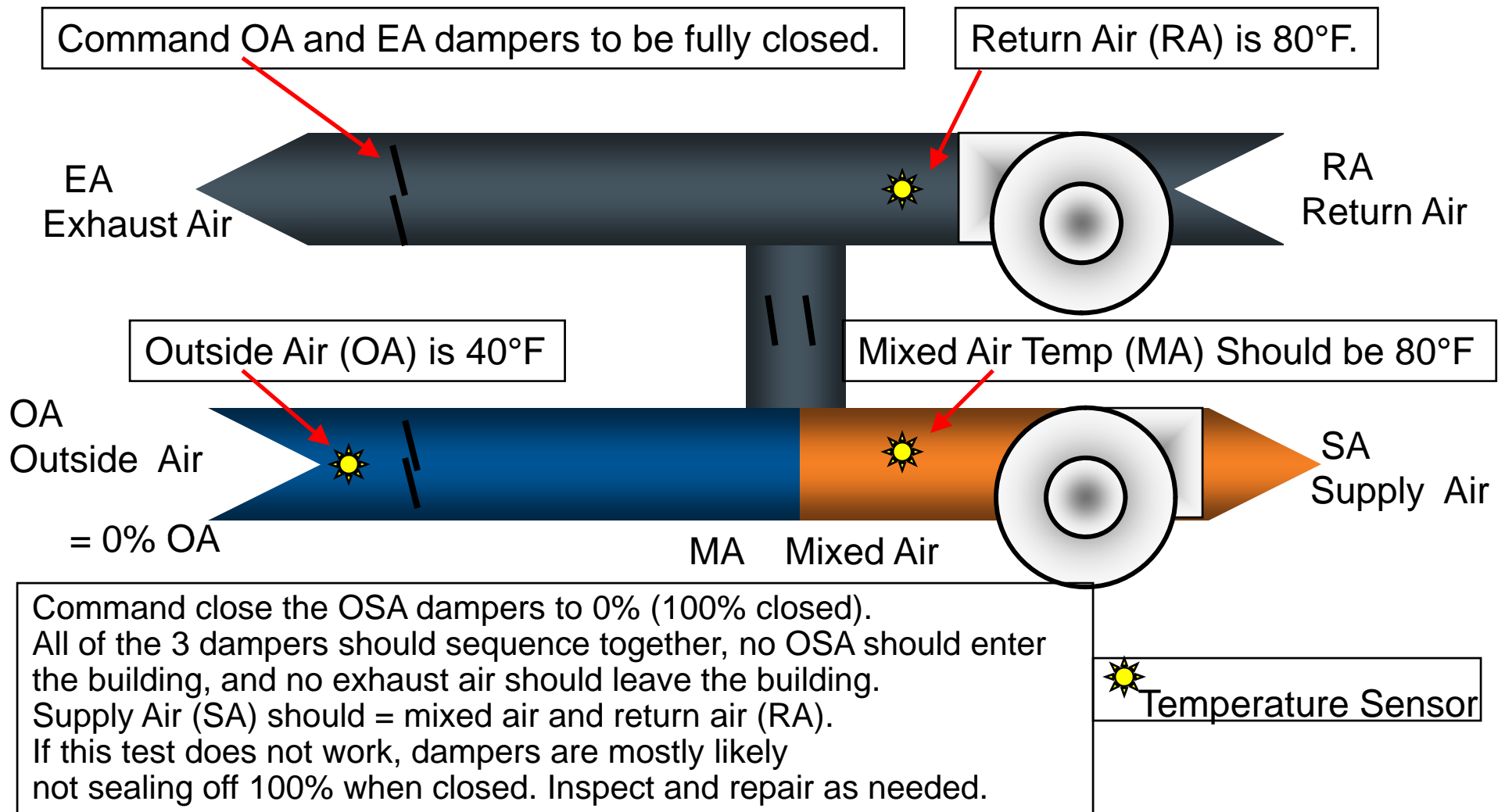
$$\boxed{\text{Return Air Temperature}} \times \boxed{\% \text{ of Return Air}} + \boxed{\text{Outside Air Temperature}} \times \boxed{\% \text{ of Outside Air}} = \boxed{\text{Temperature of Mixed Air}}$$

$80^{\circ}\text{F} \times 85\% + 50^{\circ}\text{F} \times 15\% = \text{MAT is } 75.5^{\circ}\text{F}$

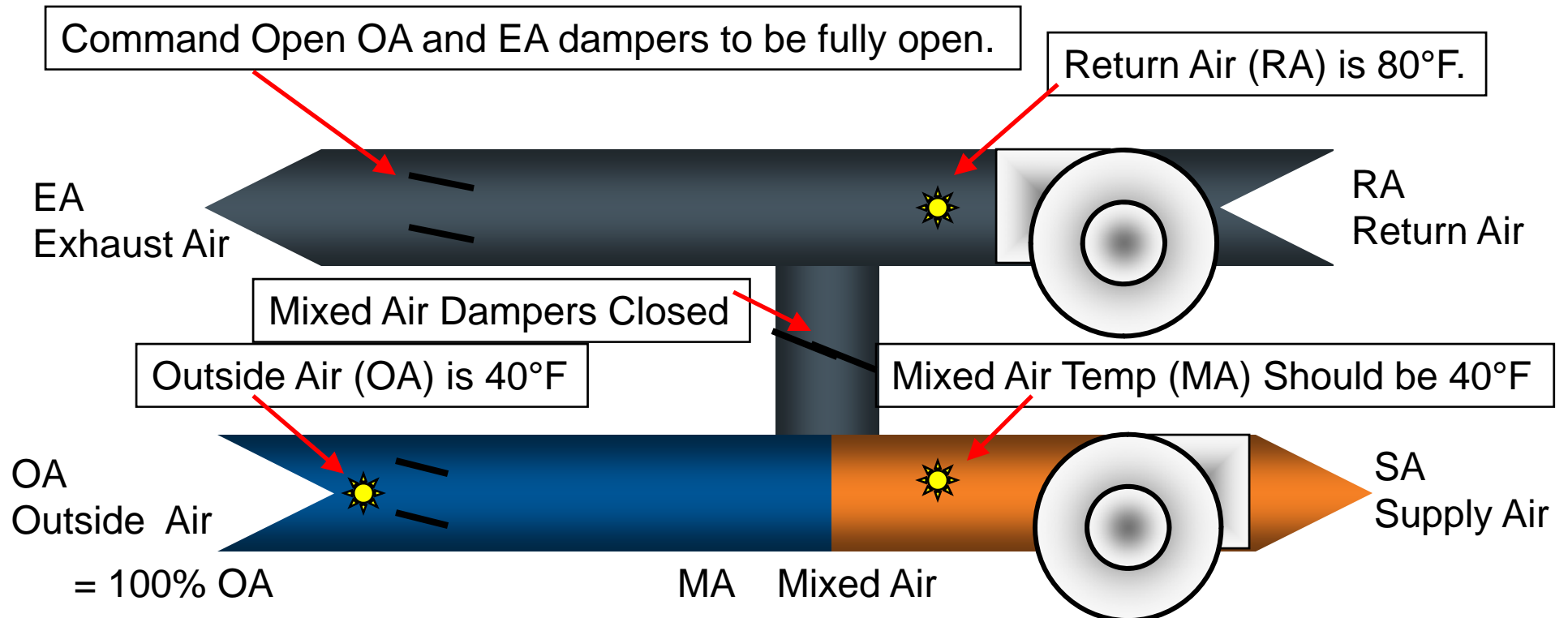
Formula for Adjusting the Minimum Position Control.

 Temperature Sensor

PM Procedure to Determine Sealing Effectiveness of Economizer Dampers in 100% Closed Position



PM Procedure to Determine Efficiency of Economizer Dampers in 100% Open Position



Command open the OA dampers to 100% (100% open).
 All of the 3 dampers should sequence together, only OA should enter the building, with 100% exhaust air.
 Supply Air (SA) should = Outside Air (OA) air.
 If this test does not work, mixed air dampers are mostly likely not sealing off 100% when closed. Inspect and repair as needed.

 Temperature Sensor

Exercise #9

(Provide Answers below on notes page)

- Use the OSA percentage chart to answer the following:
 1. MA = 58°F, RA = 80°F, OA = 40°F, % ____
 2. MA = 65°F, RA = 78°F, OA = 30°F, % ____
 3. MA = 55°F, RA = 75°F, OA = 40°F, % ____

- Use the OA formulas to answer the following:
 4. MA = 60°F, RA = 82°F, OA = 45°F, what is the % __OA?
 5. RA = 75°F @ 80%, OA = 40°F @20%, what is the temperature of the ____ MA?