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HOW TO CALCULATE VERTICAL CONVEYOR OVEN SIZE

Vertical conveyor ovens are not always the best choice for continuous processing. Depending on the part size, a vertical conveyor oven may actually require more factory floor space than other continuous processing ovens. This is due to the distance required between trays so that they can pass over turns at the top and bottom of the oven.

To estimate the number of trays and tray spacing, you will need:

- *Part dimensions* – The part footprint determines the tray loading layout. Part height is required to determine tray spacing
- *Production rate* – The number of parts processed per unit of time (parts/hour)
- *Dwell time* – The length of time that parts spend in oven (hours)

It is important to understand the relationship between the trays, production rate and dwell time. Doubling either the production rate or dwell time will require twice as many loading trays in the oven. Feel free to contact Grieve directly for any specific questions related to conveyor ovens or continuous oven processing.

Calculating Loading Requirements

A reasonable tray size must be determined by evaluating various part layouts. Typically, trays over 48 inches wide or 15 inches long will be either too difficult to load or result in too much distance between trays. Trays are supported by one point at each side of the tray and for this reason trays must be loaded uniformly front to rear or they will not hang level. This may be especially critical if the parts are filled with a fluid being cured.

The number of parts per tray in the tray layout will determine the number of trays that will be required to pass through the oven each hour to maintain the required production rate (parts/hour).

$$Trays\ per\ hour = \frac{Production\ rate\ (\frac{parts}{hour})}{Parts\ per\ tray}$$

The number of trays required in the oven will be determined by the trays per hour required to maintain production rate and the dwell time (hours).

$$Trays\ in\ oven = trays\ per\ hour\ x\ dwell\ time\ (hours)$$

Additional trays should be added for a factor of safety. Temperatures near the loading area will not be as hot as other areas in the oven. Adding a minimum of three additional trays is recommended. More trays should be added for higher temperatures or those ovens without doors covering the loading opening.

The spacing required between trays depends on many factors and has to be calculated carefully in a final design. However, for approximate sizing, the distance between trays can be estimated as the

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tray length plus the maximum height of a loaded tray, which could be either the height of the tray edge or the part height.

$$Tray\ spacing\ (inches)\ \approx tray\ length\ (inches) + tray\ or\ part\ height\ (inches)$$

The required tray support conveyor length in the oven will be the product of the number of trays and the distance between trays.

$$Conveyor\ length\ (inches) = number\ of\ trays\ in\ oven\ x\ tray\ spacing\ (inches)$$

For purposes of rough sizing of the oven, we are assuming a single loop of trays in the oven. Vertical conveyor ovens can be made with multiple passes in the oven but this type of design requires extensive calculation and layout.

Assuming a tray length of between 8 inches and 15 inches, a 30 inch turn at the top and bottom of the oven is a reasonable size. The 30 inch turn at the top and bottom will hold approximately 94 inches of conveyor length (the circumference of a 30 inch turn). The remaining conveyor will stretch from the center of the turn at the top and bottom. This determines the height of the conveyor system in the oven.

$$Conveyor\ system\ height\ (inches) = 30" + \frac{Conveyor\ length - 94"}{2}$$

This represents the conveyor height. The overall height will need to include the height of the tray at the bottom also. The oven interior height will need to include approximately 4 inches of clearance from the trays to the top and bottom of the work space.

The relationship between the number of loaded trays, the tray spacing, the conveyor height and oven workspace height with the example dimensions is shown below:

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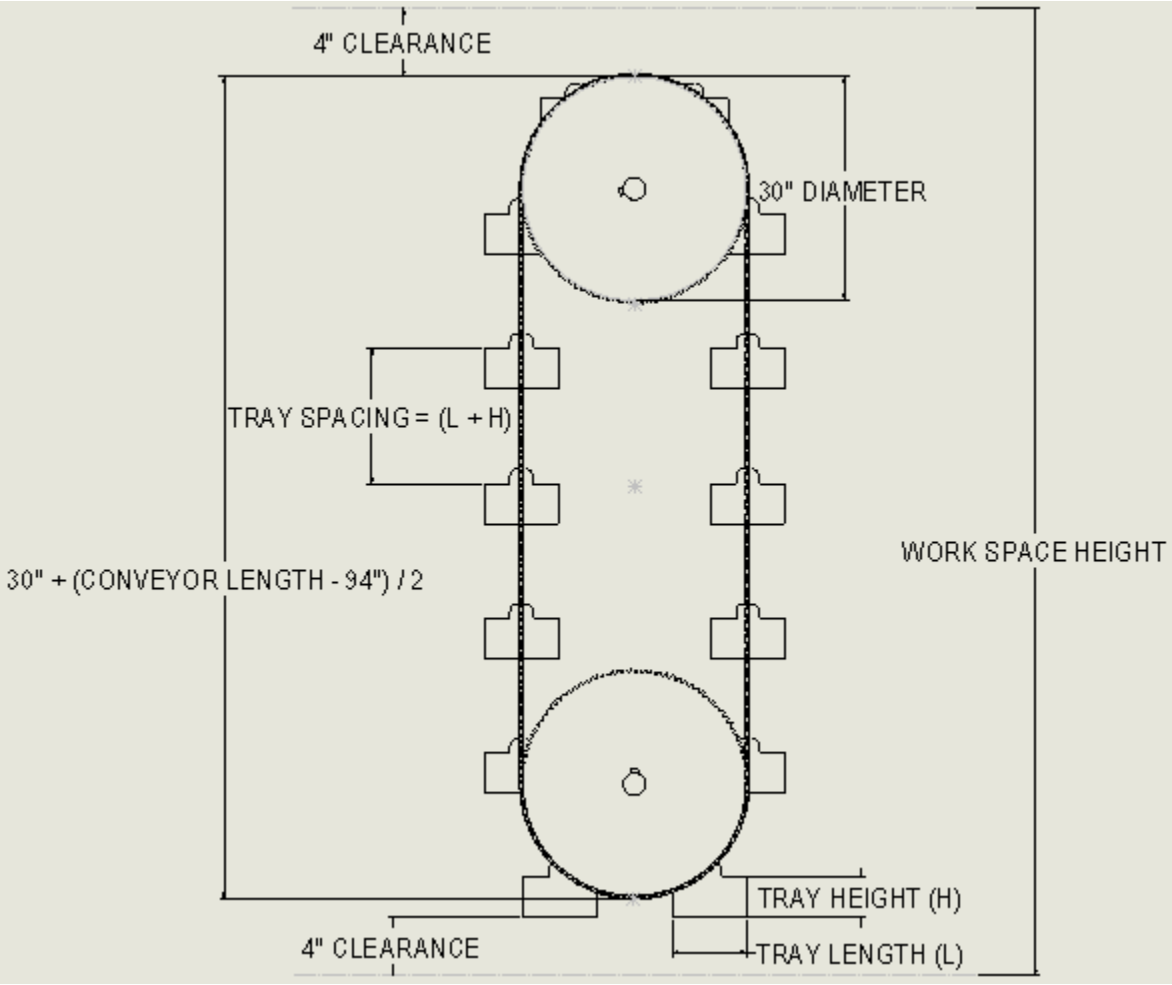

Approximate Vertical Conveyor Oven Size

The **width** of the oven will be approximately the width of the tray plus 12 inches to account for clearance to the side walls and 12 inches for insulation. In addition there will typically be a conveyor drive and control panel on one side of the oven adding approximately 15 inches to the overall oven width.

Approximate equipment **depth** will be the sum of:

- the diameter of the top and bottom turns (30 inches in the example)
- the tray length
- 6 inches to account for clearance front and rear of trays
- approximately 24 inches for heat chamber at rear of oven
- 12 inches for insulation thickness (typical)
- 18 inches for blower motor mount at rear of oven body

Approximate equipment **height** will be the sum of:

- 15 inches for floor clearance, insulation and duct work.

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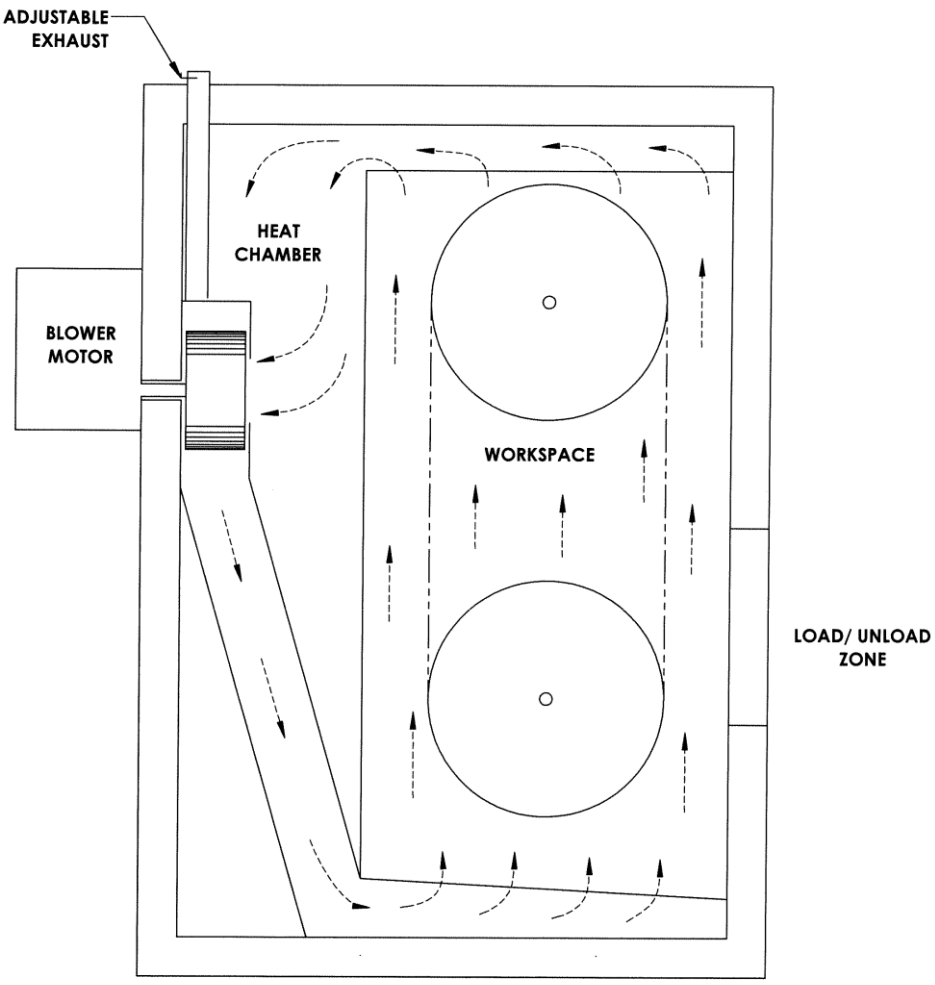
- work space height as determined above
- 12 inches for duct work and insulation at the top of the oven

Ovens over 10 feet tall will be difficult to ship. In these cases, multiple passes must be made within the oven.

To help with understanding the overall size of the rotary hearth oven, refer to the graphic below:



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Feel free to reach out to Grieve directly for more accurate sizing and any specific questions related to vertical conveyor ovens contact us .