Optimum End-of-Arm Robotic Tooling Design

Increase productivity and improve product quality by locating and selecting the proper end-of-arm tooling (EOAT) for your vacuum-oriented robotic system.

**Design the tool first whenever possible.**
For new applications still in the design phase, it is recommended that the EOAT be designed prior to selecting the robot. By working this way—what some companies may feel is the reverse of normal operation—you have a greater opportunity to choose the optimum robot for the job. Whether you find that you can use a standard device or need to customize, this approach will save you on the cost of a robot that is unnecessarily over-designed for the job at hand.

**Start designing your EOAT from the product to be handled.**
By understanding key aspects of the product to be manipulated—size, weight, orientation, and porosity—you can select the most efficient vacuum pump and tool for the application. You’ll also want to calculate expected cycle times for your application, as well as the overall machine load limit you are expecting to have. Standard components are available to allow you to build your own EOAT tool solution once the correct pump and vacuum cup is selected.

**Select the proper cup sizes.**
Once you have a full understanding of the part you’ll be handling, you can determine which cup will work best for you. Note that size is not the only factor. You’ll want to select the proper shape and material as well. Will the best fit be flat or bellowed, round or oval? Note that standard sizes are somewhere between 1 and 200 mm, but that larger components can be made.

As for materials, check with your manufacturer about their offerings—typically everything from polyurethane and vinyl to rubber and silicone. For a vacuum cup holding force calculation, use this formula: Object weight plus safety factor is equal to pressure (psi) times cup area. Be careful to convert vacuum levels, often shown in Hg or psi, to ensure the proper holding force.

Every application, whether automotive, packaging, fruit packing, or injection mold removal, has its own specific needs.

**Be aware of the safety factor needed for your application**
Your safety factor depends on the orientation of your load in reference to the cup. When the cup face is in a horizontal position while picking up the load, the recommended safety factor is 2, which helps accommodate for changes in atmospheric pressure and leakage that may occur. Because of shear forces it is important to use a higher safety factor when a piece is to be held vertically. When the cup face is in a vertical position during load pick-up, the recommended safety factor is 4.

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Technical Tips
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Specify vacuum pump type.
For each EOAT pump that you will need to purchase, know the porosity of the part you are handling as well as the necessary performance you’ll want from the tool. Consider how you will use the pump—continuous operation or on-demand—and your overall budget requirements. Mechanical pumps offer continuous operation with an even flow in a single unit, but can have a high startup and maintenance cost, while venture vacuum pumps are lower cost, point-of-use units for on-demand needs.

Make the proper end-effector component selection
Using the information gained from previous tips, you are now ready to select the end-of-arm tooling that will fulfill the specific needs of your chosen application. You can find standard devices for many applications, but you can always select a semi-custom or custom design if needed. Also consider that standard devices provide shorter lead times and plug-and-play operation, but also have limited cup layouts and footprint requirements.

Semi-custom devices offer more configurations and multiple pick points, but can be larger and heavier, plus need some assembly. Custom configurations have longer lead times and higher costs, but can be optimized for your application, and provide you with a tool that has multiple functions.

Reach out to experts for help
Work with a company that has years of expertise in EOAT components. Your partner should provide engineering drawings, know the nuances of vacuum technology, provide experienced engineering support, and be able to manufacture custom devices in-house.

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