Introduction

When it comes to gripping and moving anything from cola cans to car fenders, vacuum cups on end-of-arm tooling are incredibly versatile devices in many automated handling systems. They come in countless types, sizes, constructions and materials to suit widely varying applications. Here are some general engineering considerations for choosing the right one for a particular task

Credit: http://www.pneumatictips.com/4433/2016/02/vacuums/how--do-you-select-a-vacuum-cup/

Construction

Suction cups are available in various geometries, such as simple, circular types for general-purpose handling; extra-deep cups for round or highly curved surfaces; and oval shapes for picking up long and narrow products. These cups often include molded-in structural details like exterior reinforcing ribs for added strength or interior nubs for better contact with a mating part.

Shape

Suction cups come in two general shapes, flat and bellows. Flat vacuum cups are best for handling workpieces with flat or slightly curved surfaces, such as metal and glass plates, plastic sheets and wooden boards. Properly designed, they have good rigidity and stability to handle high shear forces and can withstand forces and accelerations from fast automated-handling movements.
Bellows suction cups, on the other hand, have one or more accordion-like convolutions. This lets them compensate for varying workpiece heights and handle parts with uneven surfaces. Evacuating the bellows also creates a lifting action which can be useful to lightly grip fragile parts, like electronic parts or even chocolate candy. Bellows versions are typically used for handling curved parts like car body panels, pipes and tubes, injected molded plastic parts, and nonrigid packaged goods or shrink-wrapped products..

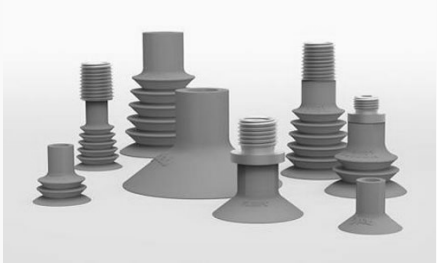
Interior Volume

A corollary to cup shape is its interior volume. That's important because this is the volume that must be evacuated to create a vacuum—and the holding force—to actually grip and pick up a workpiece. Flat cups have a relatively small inner volume and, thus, evacuate quickly and can grip in a very short time. The total inner volume of all the cups in a system, as well as that of tubing and connectors, must be added to determine the total volume of the gripper system. From there, engineers can calculate the evacuation time based on vacuum flow capacity and, ultimately, how quickly the system can pick up a part.

Interior Volume (cont)

Finally, also consider how long it takes to supply air to the cup, to purge the vacuum and release the workpiece..

Vacuum Cups



Materials

Vacuum cup suppliers offer a wide variety of options to suit specific application requirements. Typical examples include nitrile rubber (NBR) that's economical, offers excellent oil resistance and is a first choice for general-purpose applications; silicone for food-grade applications; natural rubber for handling wood; polyurethane for excellent wear resistance and high strength; and fluoroelastomers for high chemical and weathering resistance. Other common materials include options like PVC and EPDM, as well as proprietary formulations from specialty chemical manufacturers. Some come in anti-static versions for handling electronics..

Environment

Depending on the application and setting, suction cups might need to tolerate rough or porous surfaces or withstand ozone, oils, washdown solvents or steam. Operating and workpiece temperatures can be a concern, too. Some silicone products, for example, offer a temperature operating range from around –20 to 350° F (–30 to 180° C) and fluoroelastomers to nearly 400° F (200° C).

Holding Force

Of course, in addition to selecting the type of suction cup, engineers need to determine the holding force based on parameters like cup size, vacuum level, ambient air pressure, leakage rates, product weight, workpiece surface coefficient of friction, and the magnitude and direction of loads and accelerations