

Vention Modular Gripper

Vention's one-stop-shop gripper offering

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Overview

Vention's modular grippers offer a customizable and simple gripping solution for light and heavy duty applications. The arms attached to the central manifold allow for angle adjustment and cup positioning to suit any application.

The gripper comes in sixteen standard configurations based on different arm lengths, suction cup sizes, and the need for double pick. The technical specifications of each standard configuration will be detailed later in this document.

Additionally, Vention's Application Engineering department is equipped to create non-standard grippers when necessary, using Vention components.

Applications

Vention's line of modular grippers are designed to work out of the box with Vention's Rapid Series Palletizers, offering a simple solution that is easy to deploy, easy to operate, and easy to manage. The grippers are also compatible with any other application requiring pick and place.

Robot Compatibility

Vention's modular gripper natively supports the robots listed below, all of which can be found on MachineBuilder. Additionally, any robot that has a ISO 9409-1-50 patterned flange or an adaptor with that pattern is compatible.

Manufacturer	Compatible Models
Universal Robots	UR10e, UR16e, UR20 (with ISO50 flange adapter), UR30 (with ISO50 flange adapter)
FANUC*	CRX-10iA, CRX-10iA/L, CRX-20iA/L, CRX-30iA
ABB	CRB 15000 GoFa10, CRB15000 GoFa12
Doosan	M1013, H2017, H2515
Kinova	Link 6

Note: For proper airflow to the gripper, do not utilize the pass-through fitting unless the inner diameter of the fitting is 12mm.

Technical Specifications

Minimum Weight of Single Gripper [kg]	0.8
Maximum Weight of Single Gripper [kg]	2.3
Minimum Weight of Double Gripper [kg]	2.1
Maximum Weight of Double Gripper [kg]	5.0
Robot Compatibility	Any ISO 9409-1-50 Compatible Robot
Vacuum Generator	PiClassic Si-32-3 (PR-PB-001-0001)
Sensors	Vacuum sensors attached to PiClassic

The lifting capacity of the gripper is extremely dependent on the following factors: speed and acceleration of the cobot, number of cups, center of gravity of the box, cup placement, and vacuum level. While the acceleration and cups are easily quantifiable, the vacuum level is more difficult.

To fully validate the gripper selection, it is highly recommended to complete physical tests at Vention's lab, with the help of the Application Engineering team.

The vacuum created on pick is impacted by the type and porosity of the cardboard, the quality of the tape, and the weight of the box. To account for this, a safety factor is included in the following calculations. The standard operating forces impose a SF of approximately 3, and this will accommodate an SS1 category E-stop.

	Description	Number of Cups	52mm Suction Cups [kg]	75mm Suction Cups [kg]	110mm Suction Cups [kg]
MO-GR-100-0XXX	Small Single Gripper	4	12.5	20	N/A
MO-GR-100-1XXX	Medium Single Gripper	4	12.5	20	30
MO-GR-100-2XXX	Large Single Gripper	4	12.5	20	30
MO-GR-200-0XXX	Small Double Gripper	8	25	37.5	N/A
MO-GR-200-1XXX	Medium Double Gripper	8	25	37.5	60
MO-GR-200-2XXX	Large Double Gripper	8	25	37.5	60

Note: This assumes a SF of 3, acceleration of 2m/s², and a vacuum level of -60kPa

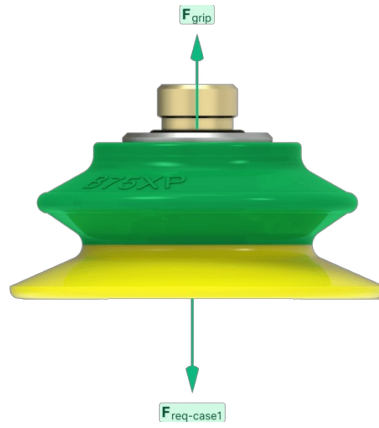
If the gripper and system are expected to hold the box in the case of a STO power-off E-stop, which is an extremely abrupt and large force, a SF of approximately 8 is recommended.

Calculating Required Theoretical Holding Force (Freq):

SF = Safety factor
m = mass of the box [kg]
a = acceleration of the robot [m/s²]
μ = coefficient of friction (typically 0.5)

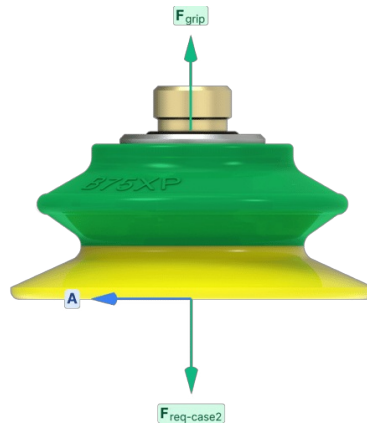
Load Case 1:

$$F_{req-case1} = SF * \left(m * 9.81 \frac{m}{s^2} \right)$$



Load Case 2:

$$F_{req-case2} = SF * \left(m * \left(9.81 \frac{m}{s^2} + \frac{a}{\mu} \right) \right)$$



As that majority of applications that require a suction gripper include a component of horizontal acceleration (Case 2), the theoretical holding force of the gripper should be compared to Load Case 2.

Calculating Theoretical Holding Force of the Gripper (F_{grip}):

n = number of cups
V = Vacuum level [-kPa]

$$F_{grip-52mm} = n * (0.0086V^2 + 1.8857V + 1.7143)$$

$$F_{grip-75mm} = n * (-0.0081V^2 - 4.04765V + 8.2857)$$

$$F_{grip-110mm} = n * (-0.025V^2 - 6.75V + 65)$$

Theoretical Holding Force for Each Suction Cup Size

Disclaimer: These equations provide a high-level approximation of very complex forces that are experienced by the cups, gripper, and boxes. They should be used to guide product selection but cannot replace physical testing, as many of the variables are only accounted for with safety factors. Please speak to Vention's Application Engineering department for any testing needs.

Example Calculation

When lifting a 15kg box that creates a vacuum of -60kPa on pick, and transporting it with an acceleration of 2m/s² what quantities and sizes of suction cups would be required?

$$F_{req-case2} = 3 * \left(15kg * \left(9.81 \frac{m}{s^2} + \frac{2 \frac{m}{s^2}}{0.5} \right) \right) = 621.45 N$$

Required Holding Force

$$F_{grip-52mm} = n * (0.0086 * (-60^2) + 1.8857 * (-60) + 1.7143) = n * 145.8N$$

$$F_{grip-75mm} = n * (-0.0081V^2 - 4.04765V + 8.2857) = n * 222.0N$$

$$F_{grip-110mm} = n * (-0.025V^2 - 6.75V + 65) = n * 380.0N$$

Holding Force for Each Cup Size

$$n_{grip-52mm} = \frac{621.5N}{145.8N} = 4.3 \text{ cups} \approx \mathbf{6 \text{ cups}}$$

$$n_{grip-75mm} = \frac{621.5N}{222.0N} = 2.8 \text{ cups} \approx \mathbf{4 \text{ cups}}$$

$$n_{grip-110mm} = \frac{621.5N}{380.0N} = 1.6 \text{ cups} \approx \mathbf{2 \text{ cups}}$$

For this application, the suggested setup of cups for standard use cases and SS1 stops would be 4x 75mm cups using MO-GR-100-X075. However, if the application called for resistance to STO stops, a higher safety factor of 8 would be employed earlier in the calculations.

This would result in the recommended setup being 4x 110mm cups using MO-GR-100-X110.

Note that when determining the appropriate configuration for the application, it is highly recommended to place the suction cups near the corners of the box. This can help guide the choice of small, medium, or large gripper.

Additionally, while these calculations act as a first pass for product selection, it is recommended to conduct testing in-house with Vention's Application Engineering team to ensure that any other factors are accounted for (box and tape quality, cup spacing, etc.)

Configurations

Vention's modular gripper offers 16 different configurations that are quick and easy to deploy. These standard configurations are available in MachineBuilder and MachineLogic, allowing for de-risking of projects and applications. The field-adjustability also enables for faster line changeovers, which can translate to more products being shipped every day.

The following table lists some of the technical specifications for Vention's single grippers. Refer to the linked part pages for 2D and 3D models.

Vention Part Number	Suction Cup Size [mm]	Weight [kg]	TCP Z-Offset [mm]
MO-GR-100-0052	52	0.82	65.5
MO-GR-100-0075	75	1.01	66.8
MO-GR-100-1052	52	1.21	65.5
MO-GR-100-1075	75	1.39	66.8
MO-GR-100-1110	110	2.11	81.0
MO-GR-100-2052	52	1.40	65.5
MO-GR-100-2075	75	1.58	66.8
MO-GR-100-2110	110	2.30	81.0

The following table lists some of the technical specifications for Vention's double grippers. Refer to the linked part pages for 2D and 3D models.

Vention Part Number	Suction Cup Size [mm]	Weight [kg]	TCP Z-Offset [mm]
MO-GR-200-0052	52	2.10	87.0
MO-GR-200-0075	75	2.47	88.3
MO-GR-200-1052	52	2.87	87.0

Vention Part Number	Suction Cup Size [mm]	Weight [kg]	TCP Z-Offset [mm]
MO-GR-200-1075	75	3.24	88.3
MO-GR-200-1110	110	4.68	102.5
MO-GR-200-2052	52	3.25	87.0
MO-GR-200-2075	75	3.62	88.3
MO-GR-200-2110	110	5.06	102.5

Assembly Instructions

To assemble your modular gripper, the following steps can be used. Note that the same logic will be used for single vs double-pick grippers.

Manifold

Single Zone, Single Input

Every manifold for grippers delivered by Vention will be configured for a single gripping zone. This is enabled by the plug shown, which comes pre-installed by default.

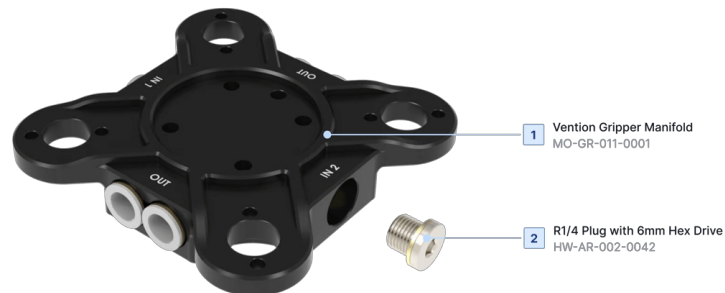


Single Zone, Single Input

Single Zone, Double Input

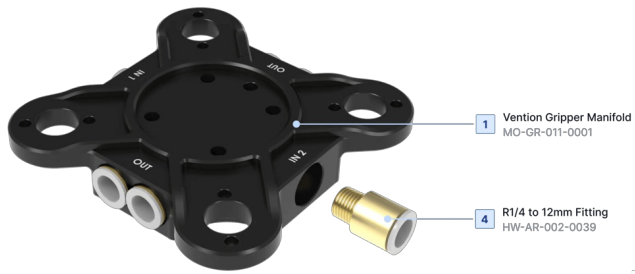
This configuration can be used when the air consumption needed by the gripper is higher than standard. This configuration is uncommon as the standard number of cups do not require this additional flow. The fitting can be installed as shown below:

Step 1. Remove the threaded plug from the "IN 2" side of the manifold using a 1/4" Allen key (a 6mm Allen key is also suitable).



Removal of External Threaded Plug

Step 2. Fasten the provided 12mm fitting in the available port using a 8mm Allen key or equivalent.



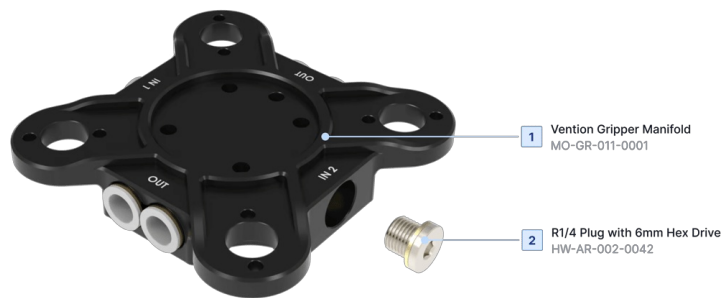
Insertion of 12mm Fitting



Single Zone, Double Input Assembly Complete

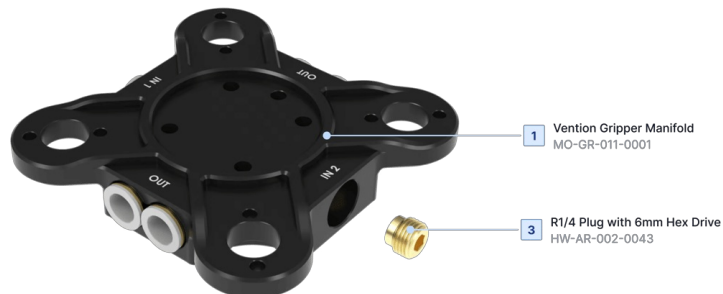
Double Zone, Double Input

Step 1. Remove threaded plug from "IN 2" side using a 1/4" Allen key (a 6mm Allen key is also suitable).



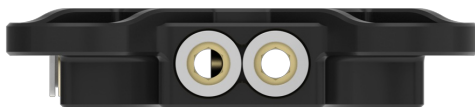
Removal of External Threaded Plug

Step 2. Thread it in through the "IN 2" side of the manifold using a 6mm Allen key or equivalent.

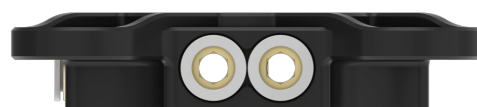


Inserting of Internal Threaded Plug

Step 3. Advance the plug until it is barely visible through the "OUT" fittings on the "IN 1" side. A diagram of this can be seen below:



Incorrect Depth for Internal Plug



Correct Depth for Internal Plug

Step 4. Finish assembly by fastening the provided 12mm fitting in the available port using a 8mm Allen key or equivalent.



Inserting 12mm Fitting

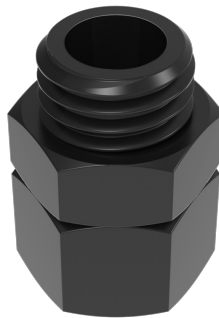


Double Zone, Double Input Assembly Complete

Small Gripper

Bulkhead

Step 1. When installing the bulkhead on the small single grippers, simply ensure that the hex nut has been fully threaded to the bottom of the bulkhead as shown.



Bottomed Hex Nut from Bulkhead

Step 2. Once this is complete, pass the bulkhead through the bore of the manifold.



Bulkhead in Manifold Bore

Step 3. Fully thread the provided 90degree 12mm fitting into the bulkhead. This will securely fasten them to the manifold.



Small Gripper Bulkhead Complete

Step 4. Once the provided suction cups have been installed into the bottom of the bulkheads, the provided 12mm tubing can be cut to length and inserted into the fittings.

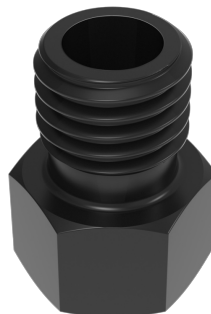


Small Single Gripper Assembly Complete

Medium and Large Gripper

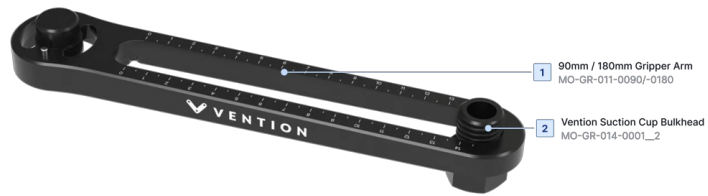
Bulkhead

Step 1. When installing the bulkhead on the medium or large single grippers, simply ensure that the hex nut has been removed from the bulkhead so it can be threaded on later.



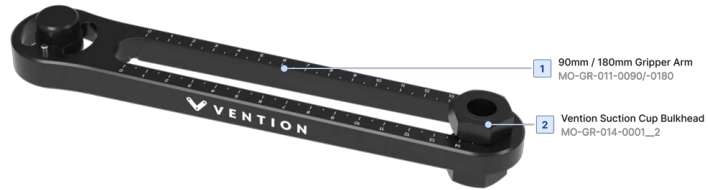
Removed Hex Nut from Bulkhead

Step 2. Once this is complete, pass the bulkhead through the slot in the medium or large arm.



Bulkhead in Arm

Step 3. Fasten the bulkhead into the slot of the arm using the hex nut removed in step 1.



Fastened Bulkhead in Arm

Step 4. To complete the bulkhead assembly, fully thread on the 90 degree fitting on top of the bulkhead and add the desired suction cup.



Medium and Large Gripper Bulkhead and Arm Complete

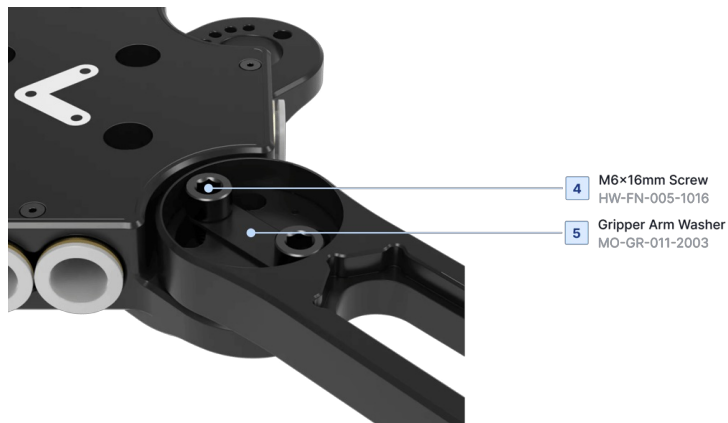
Arms

Step 1. To install the medium or large arms onto the manifold, simply push the exposed shaft into the manifold bore, indexed as needed using the dowel pin.



Arm Attached to Manifold

Step 2. Once indexed and pressed on, fasten the provided M6x16mm bolts through the washer. This can be completed with a 5mm Allen key or equivalent.



Arm Fastened to Manifold

Step 3. Once the arms and cups are adjusted to the application's needs, the provided 12mm tubing can be cut to length and inserted.



Medium and Large Single Gripper Assembly Complete

Double Gripper

Step 1. Fasten the first Single Gripper to the provided Double Pick Bracket. Assembly instructions are shown in the sections above for Small, Medium, and Large Single Grippers. Provided M6x20mm fasteners can be attached using a 5mm T-handle or equivalent.



Placement of Screws

Single Gripper Fastened

Note: Ensure that the arms are positioned so that they will not collide with the second single gripper to be added!

Step 2. Fasten the second single gripper in the same fashion as Step 1.



Second Single Gripper Fastened

Step 3. Once fully assembled, adjust arm angles and bulkhead locations as needed. Then cut provided 12mm tubing to length and insert them into the fittings.



Double Gripper Assembly Complete

Maintenance

When using and storing suction cups and other similar rubber products, it is recommended to follow the guidelines provided in ISO 2230. This will aid in preventing premature deterioration, hardening, and permanent surface damage.

When handling suction cups and their use during operation, it is recommended to avoid contact with dirt and grease. When cleaning, mild detergents and lukewarm water will offer the best solution. This solution can also be used to remove "blooming", which refers to when rubber develops a light white frosting.

The life expectancy of suction cups varies with use and the application. Generally, the life expectancy of suction cups in storage is approximately 24 months. If the suction cups are being used on very thin cardboard, it is possible that excess cardboard can accumulate on the mesh filters leading to degraded performance. It is advised to check the mesh of these cups periodically.

If the suction cups are in constant use and wear, it is possible that they will need periodic replacement. [Contact our Customer Service or Application Engineering teams](#) to arrange the purchase of new suction cups; or find all available suction cups on our [Marketplace](#)