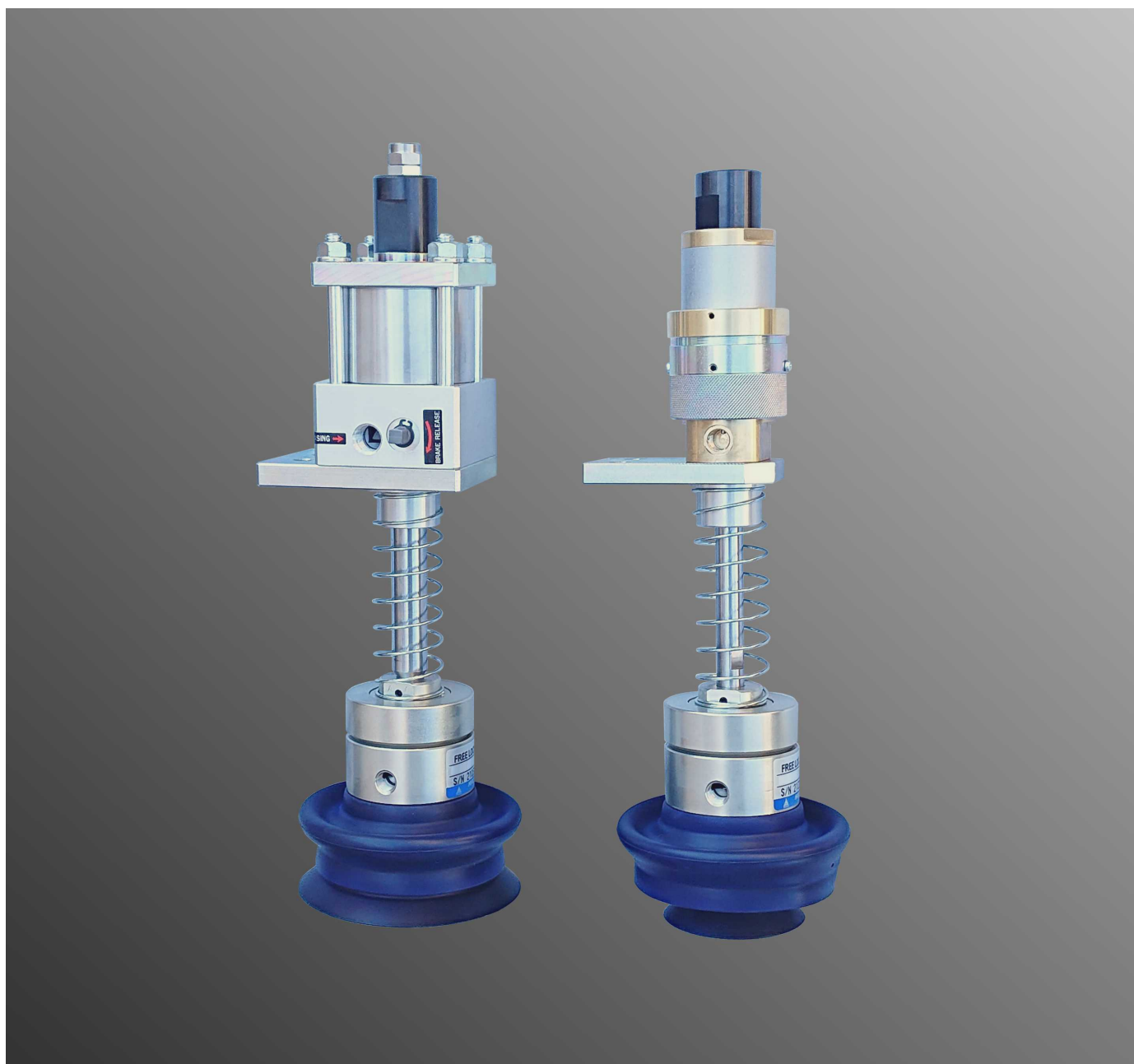


Ball joint type suction cup with lock mechanism

## FREE LOCK PAD

The position and angle of the sucked work can be fixed and transported.  
Suction cup unit that enabled high-dimensional handling.

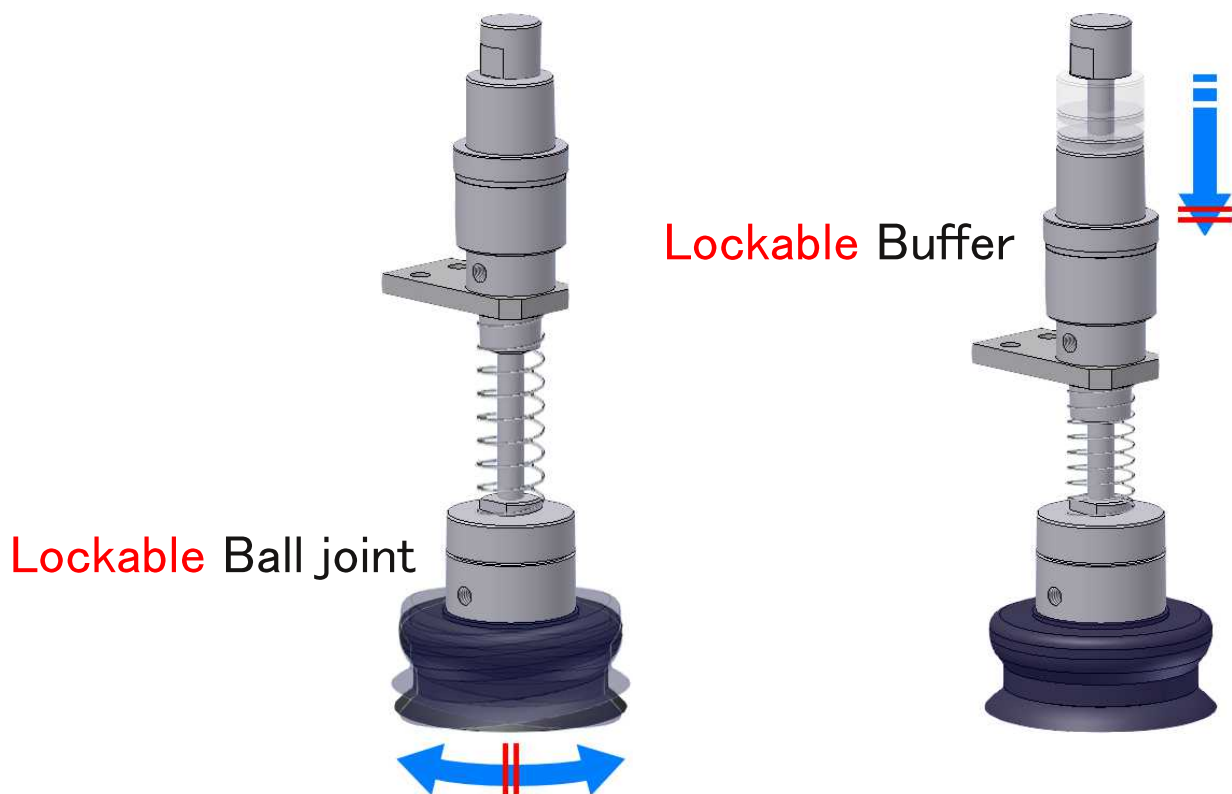


## Overview

FREE LOCK PAD is a ball joint pad for high-dimensional material handling that enables transportation while maintaining the angle of the suction cup that follows the workpieces surface and the position of the buffer when sucking the workpiece.

Even in the case of multi-item mixed transportation, the angle of the suction cup and the position of the buffer can be maintained by each workpiece, which improves the accuracy of the workpiece installation posture in the next process.

The lineup includes a ball joint type that can fix the swing angle and a unit type that is equipped with a brake mechanism.



## Feature

- 1 After the suction cup follows the inclination of the workpiece surface, the swing angle can be locked, so the workpiece can be transported while maintaining the shape.
- 2 Model equipped with a lockable buffer can be locked according to the height of the workpieces, so handling can be performed for a wide variety of workpieces with different heights.
- 3 Since the shape and posture of the workpiece is stable when the workpiece is taken out and installed, high-quality transportation that can prevent damage such as installation misalignment and interference can be performed.
- 4 Since the lockable buffer can be locked at the suction position, there is no impact from the stopper, and quick handling can be performed without the workpiece falling off or shifting.
- 5 Since FREE LOCK PAD can handle multi-shaped workpieces, it can be flexibly supported when adding workpieces or updating equipment.
- 6 Since the lock mechanism operates when the supplied air is shut off, the timing of using vacuum and the timing of using compressed air are different. The compressed air can be used efficiently with little effect on the vacuum generator.
- 7 It uses with one 3-port pneumatic solenoid valve for unlocking of ball joint and buffer.

## How to order

# FLV-1B-12C-S1-K-H

| Series        |
|---------------|
| FREE LOCK PAD |

| Symbol | Suction cup size |
|--------|------------------|
| 1      | φ 100            |
| 2      | φ 60             |

| Symbol | Lockable buffer |
|--------|-----------------|
| Nil    | Without buffer  |
| B      | With buffer     |

| Symbol | Rod size |
|--------|----------|
| 12     | φ 12     |
| 16     | φ 16     |

※ If there is no lockable buffer, the rod is not attached.

| Symbol | Centering spring |
|--------|------------------|
| Nil    | Without spring   |
| C      | With spring      |

| Symbol | Vacuum holding support |
|--------|------------------------|
| Nil    | Non support            |
| H      | Supported              |

※ Only models with lockable buffer can be selected.

| Symbol | Metal scraper              |
|--------|----------------------------|
| Nil    | With NBR scraper only      |
| K      | With Metal and NBR scraper |

※ The scraper is attached the lockable buffer. Only rod size φ 12 can be selected. Only NBR scraper is attached as standard.

| Symbol | Type of buffer spring |                                                               |
|--------|-----------------------|---------------------------------------------------------------|
| S1     | Weak                  | For each spring load, refer to the technical data on page 13. |
| S2     | Medium                |                                                               |
| S3     | Strong                |                                                               |

Weak : Suction or release the workpiece from above.  
Medium: With metal scraper.  
Strong : Suction or release the workpiece from the side or bottom.

※Refer to “Model number selection method” on page 11.

## Specification

### 【 Lockable boll joint 】

|                                                                                                                                                                                                                                        |                           |           |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------|-----------|
| Working fluid                                                                                                                                                                                                                          | Compressed Air            |           |           |
| Working pressure range                                                                                                                                                                                                                 | 0.4 MPa to 0.7 MPa        |           |           |
| Withstanding pressure                                                                                                                                                                                                                  | 1.0 MPa                   |           |           |
| Ambient temperature                                                                                                                                                                                                                    | -10 to 60°C (no freezing) |           |           |
| Working humidity range                                                                                                                                                                                                                 | 90% or less               |           |           |
| Rotating angle                                                                                                                                                                                                                         | Maximum 15° (±15°)        |           |           |
| Lock torque                                                                                                                                                                                                                            | 40 kg·cm                  |           |           |
| Durable vibration                                                                                                                                                                                                                      | 1.9 G or less             |           |           |
| Suction force (Theoretical value)<br>Note: Since the theoretical suction force is a value under static conditions, when actually using it, consider the safety factor of 1/4 for horizontal lifting and 1/8 for perpendicular lifting. | Vacuum pressure           | -66.7 kpa | -53.4 kpa |
|                                                                                                                                                                                                                                        | Suction cup size          | -40.0 kpa |           |
|                                                                                                                                                                                                                                        | φ 100                     | 53.37 kgf | 42.70 kgf |
|                                                                                                                                                                                                                                        | φ 60                      | 19.21 kgf | 15.37 kgf |
| Lubrication                                                                                                                                                                                                                            | No required               |           |           |

### 【 Lockable buffer 】

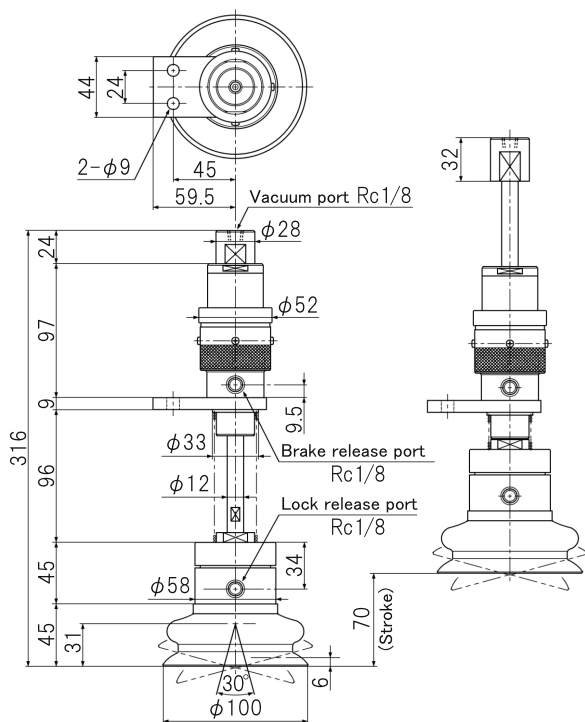
|                        |                                |
|------------------------|--------------------------------|
| Working fluid          | Compressed Air                 |
| Working pressure range | 0.25 MPa to 0.7 MPa            |
| Withstanding pressure  | 1.0 MPa                        |
| Ambient temperature    | -10 to 60°C (no freezing)      |
| Working rod speed      | 50 to 500 mm/sec               |
| Lubrication            | No required                    |
| Locking force          | 200 N (Rod size φ 12 and φ 16) |

## Mass

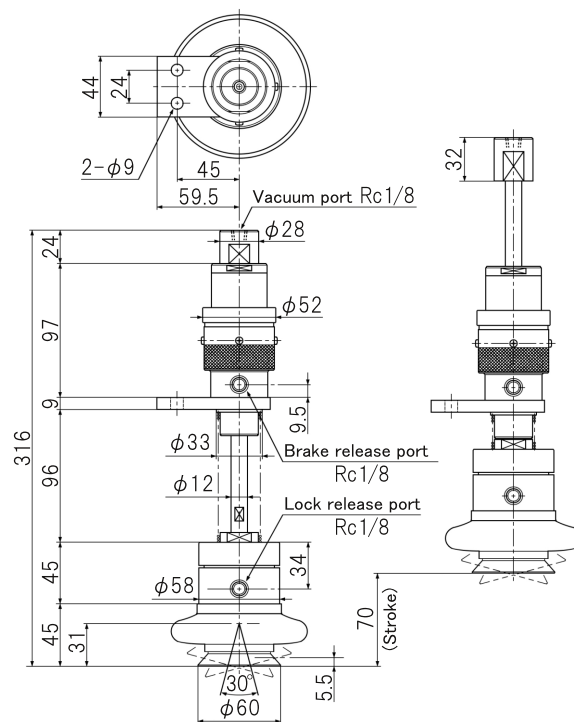
| Model         | Weight | Model         | Weight | Model         | Weight | Unit : kg |
|---------------|--------|---------------|--------|---------------|--------|-----------|
| FLV-1B-12 (C) | 2.3    | FLV-1B-16 (C) | 3.2    | FLV-1         | 0.8    |           |
| FLV-2B-12C    |        | FLV-2B-16C    |        | FLV-2         |        |           |
| FLV-2B-12     | 2.2    | FLV-2B-16     | 3.1    | Symbol K or H | 0.01   |           |

## Dimensions

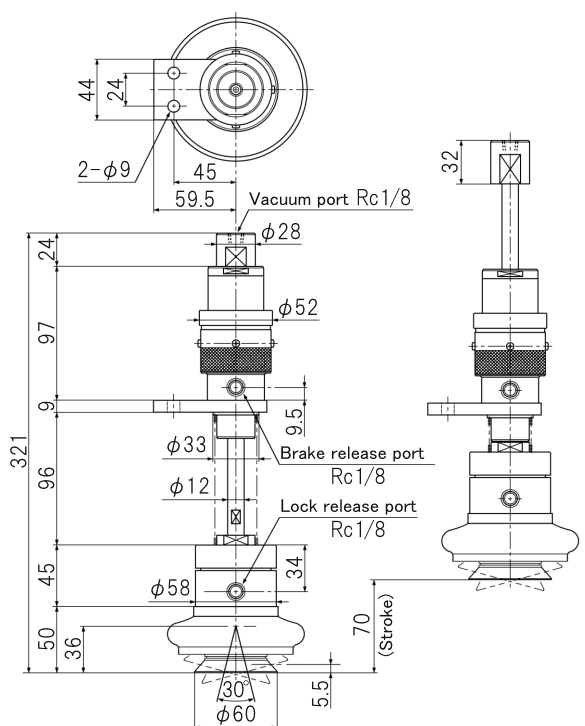
Model number : FLV-1B-12-S※  
FLV-1B-12C-S※



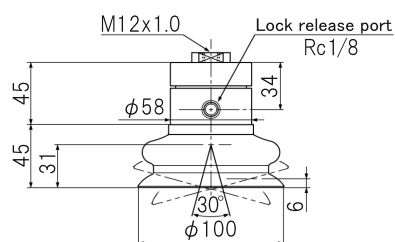
Model number : FLV-2B-12-S※



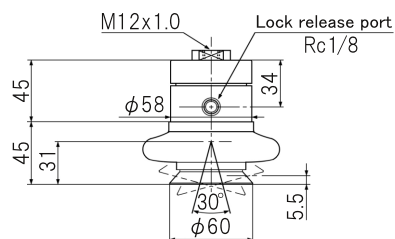
Model number : FLV-2B-12C-S※



Model number : FLV-1



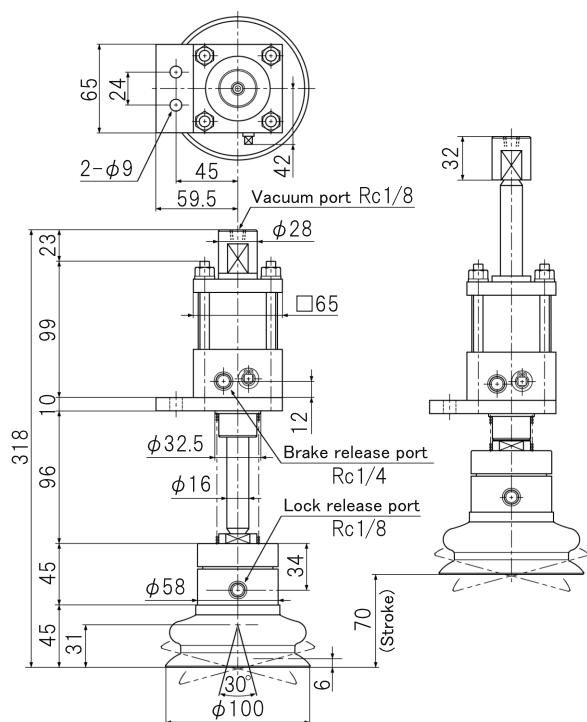
Model : FLV-2



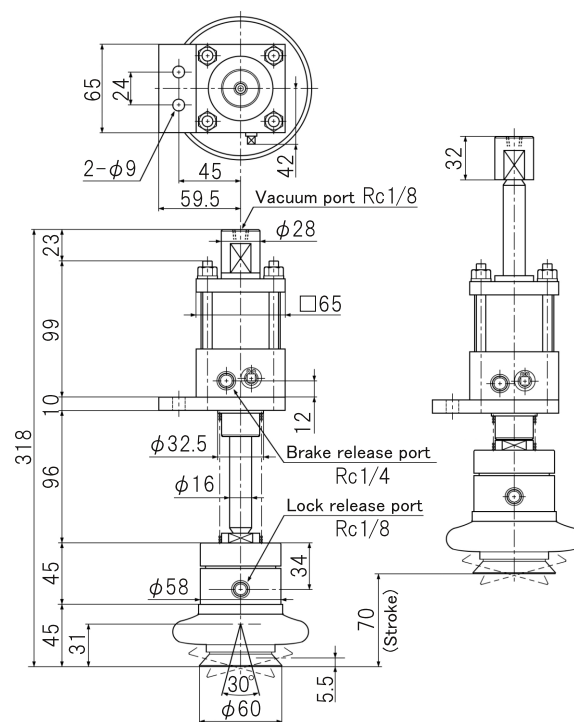
The dimensions of the type with metal scraper are the same.  
The size of the suction cup surface in the suction state increases by about 10% compared to the natural state.

## Dimensions

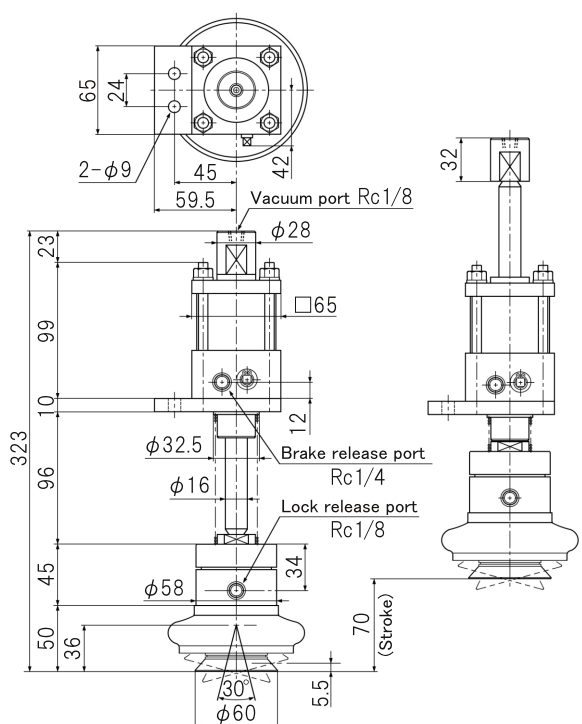
Model number : FLV-1B-16-S※  
FLV-1B-16C-S※



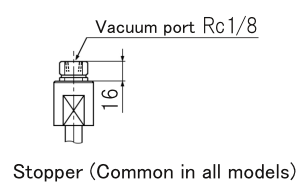
Model number : FLV-2B-16-S※



Model number : FLV-2B-16C-S※



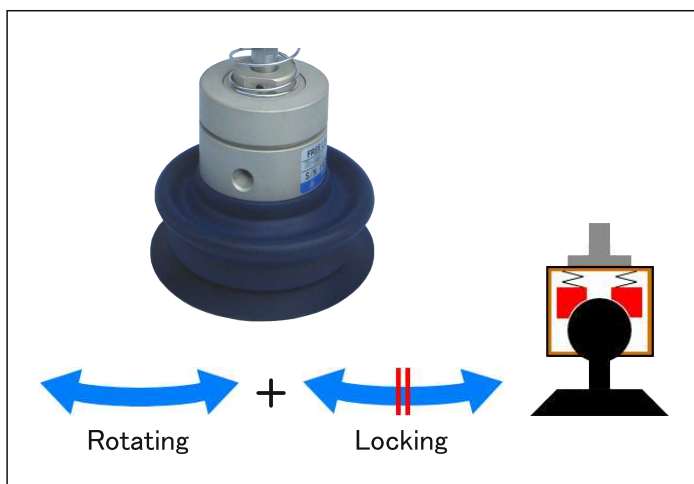
Model number : FLV-※※-H



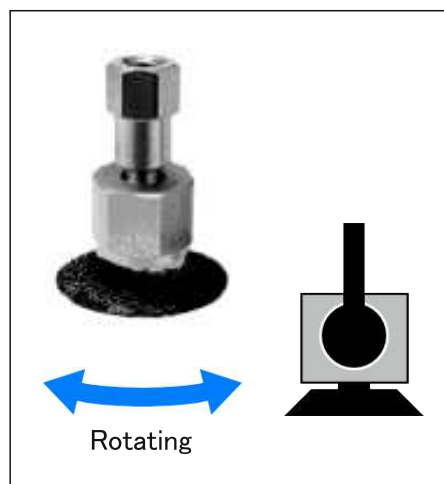
The dimensions of the type with metal scraper are the same.  
The size of the suction cup surface in the suction state increases by about 10% compared to the natural state.

## Features

### 【Lockable ball joint】



FREE LOCK PAD

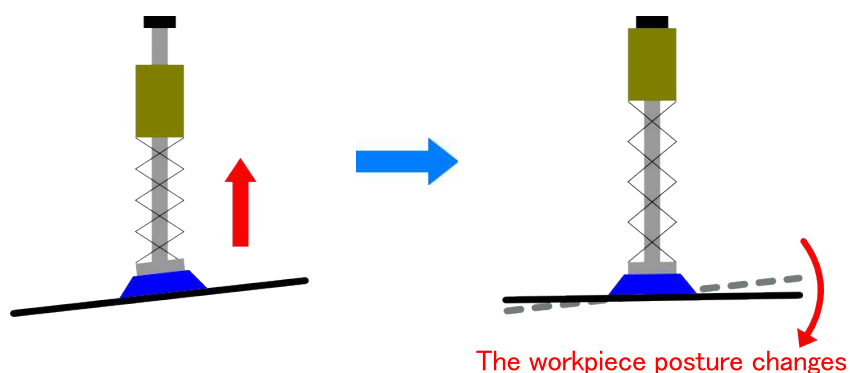


Normal type (Ball joint type)

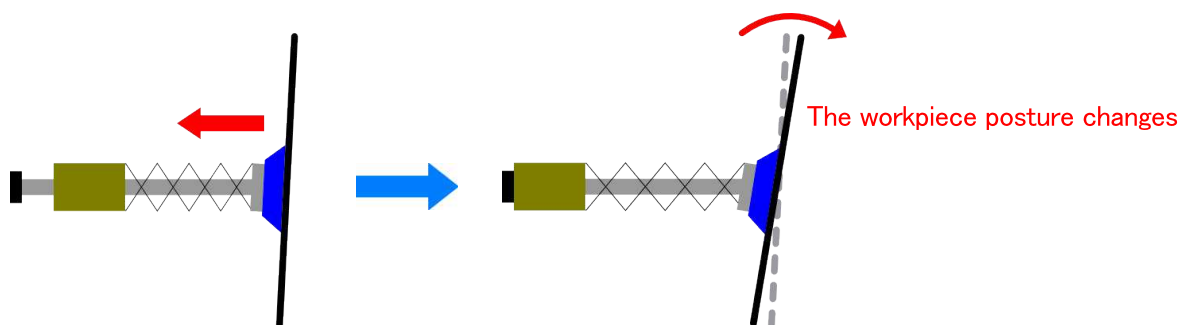
### < Normal type >

If the workpiece surface is inclined with respect to the suction cup surface, it is used the ball joint type. Since the ball joint of the normal type is free even after suction, the work posture during workpiece transfer changes due to the influence of “Workpiece weight” and “Deflection”, so it is necessary to correct it on the JIG side. In addition, it is difficult to the workpiece transfer from the lateral direction unless a clamping JIG is used together.

When lifting a workpiece that is setted at an angle, the workpiece exerts a force that tries to balance it horizontally, and the workpiece posture when transporting changes.



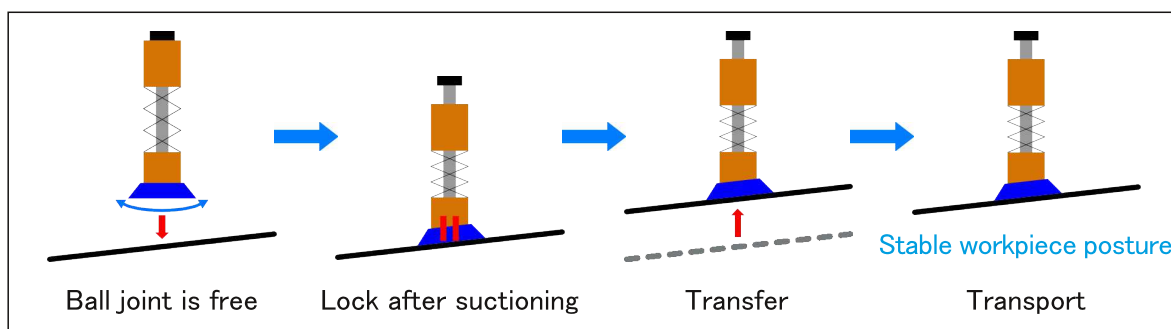
Even when transporting from the lateral direction, the workpiece posture during transport changes depending on the weight of the workpiece.



## < FREE LOCK PAD >

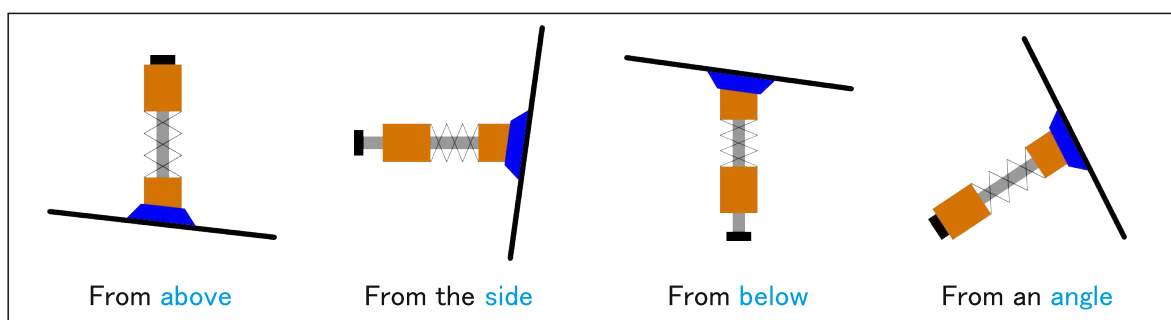
After the suction cup follows the inclination of the workpiece surface, the swing angle can be locked. As a result, the workpiece can be transported while maintaining the posture of the absorbed workpiece, which stabilizes the posture of the workpiece during transport and improves the work setting accuracy in the next process. In addition, since it can be locked at any position within the swing angle, it can handle a wide variety of workpieces.

### 【 Basic motion 】

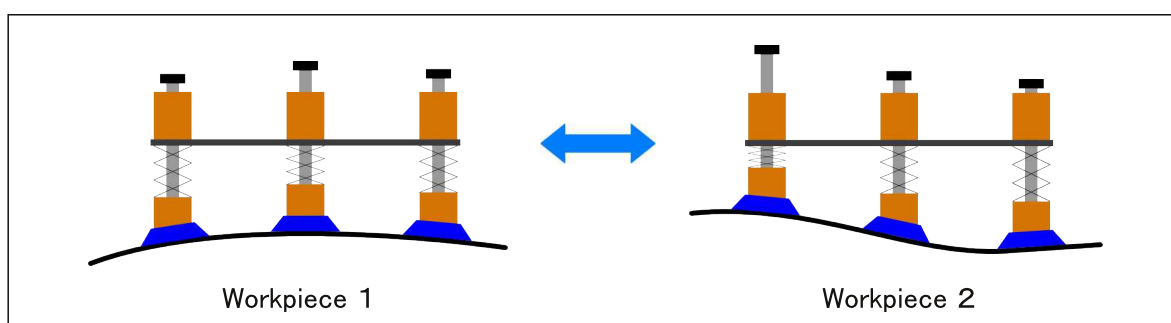


### 【 Mounting direction, Motion direction 】

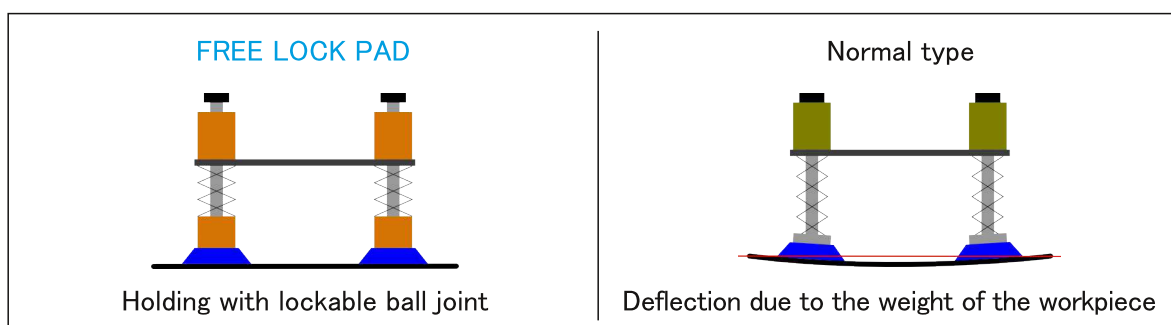
Can be absorbed and transported from any direction. (Refer to page 14 notes.)



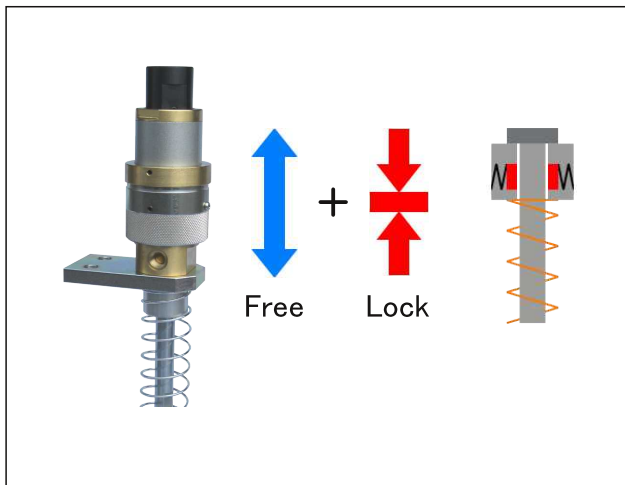
**Effects :** A wide variety of workpieces can be mixed and transported with a single device.



Since the workpiece can be prevented from deflection, the work setting accuracy of the next process is improved.



## 【Lockable buffer】



FREE LOCK PAD

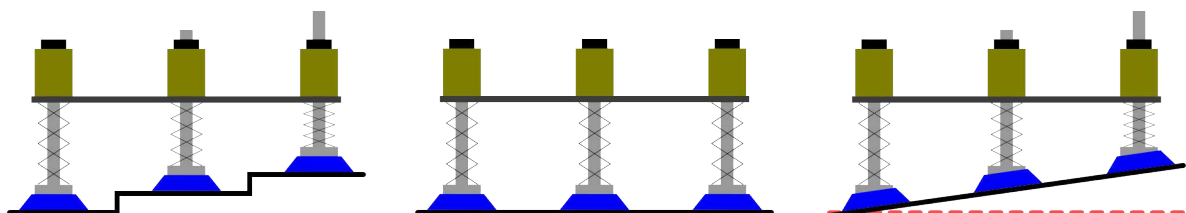


Normal type (with buffer)

## < Normal type >

The buffer is used for buffering purposes when the workpiece height varies or when the suction cup comes into contact with the workpiece. Since the normal type cannot be transported unless the buffer that has shrunk during suction is returned to the stopper, a specialized JIG that matches the distance from the stopper to the workpiece suction surface according to the height and shape of the workpiece was required. In addition, in order to prevent the workpiece from falling off or shifting, the buffer releasing operation to the stopper position must be returned slowly, which is an adverse effect on shortening the production cycle time.

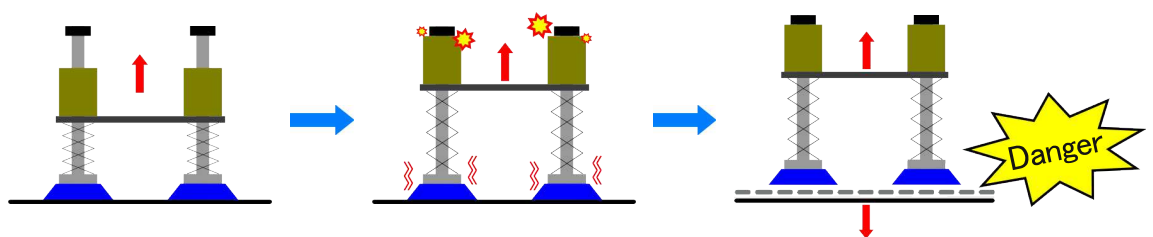
Workpieces of different heights and shapes must change the stopper position.



A specialized JIG is required according to the height and shape of the workpieces.

Mismatch in stopper position

## Impact of stopper when opening buffer



Releasing after suction

Impact of stopper

Falling off or shifting of workpiece

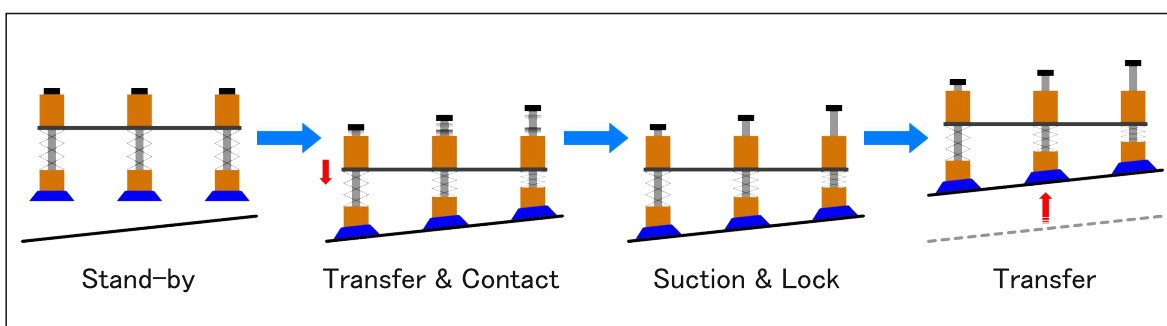
## < FREE LOCK PAD >

FREE LOCK PAD buffer can be locked anywhere in the stroke.

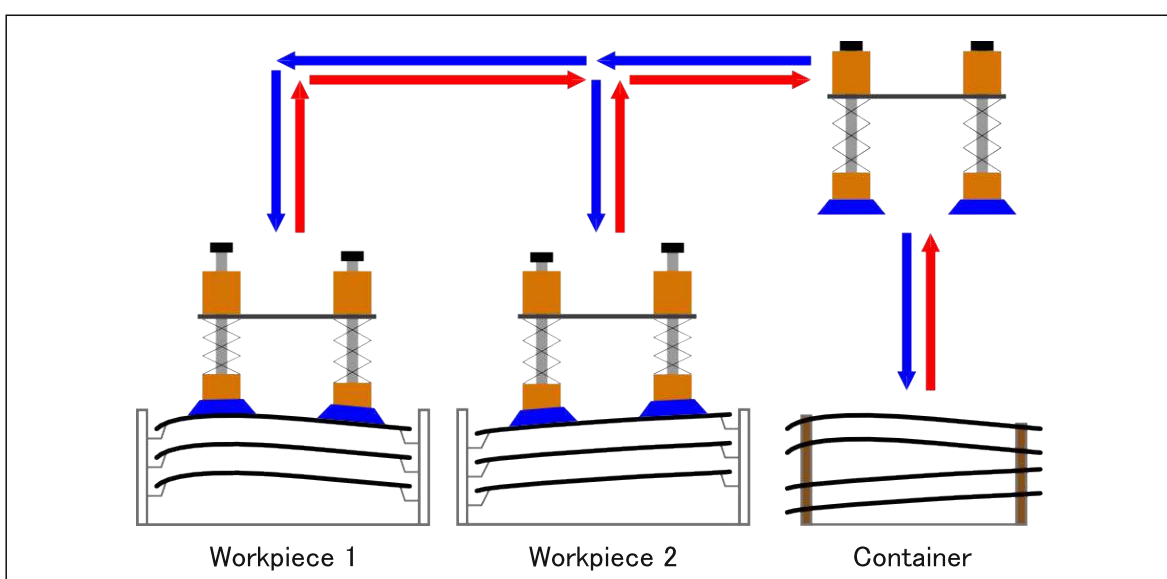
Since the lockable buffer can be automatically locked at each height according to the height of the workpiece, there is no need to adjust the stopper position for each workpiece, and it is possible to flexibly handle a wide variety of workpiece mixing lines.

In addition, when the buffer is locked after the workpiece is sucked, it will be in the same state as the stopper position, so there will be no operation to return to the stopper, and quick transposition without impact will be possible.

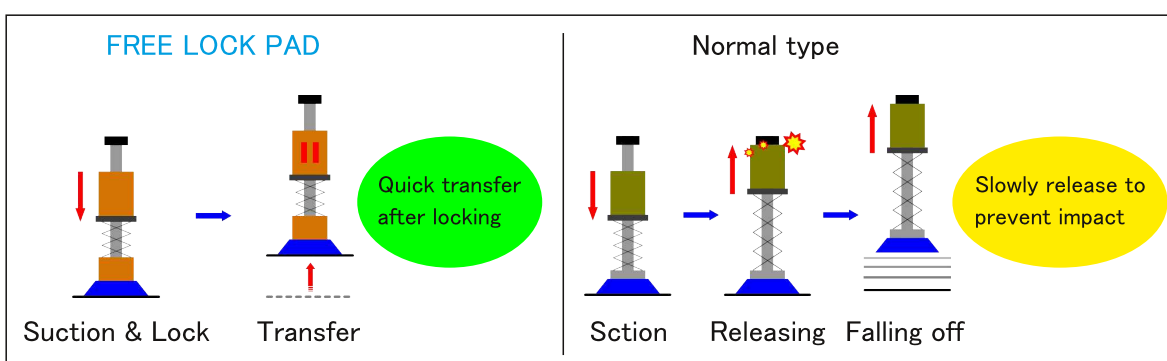
### 【 Basic motion 】



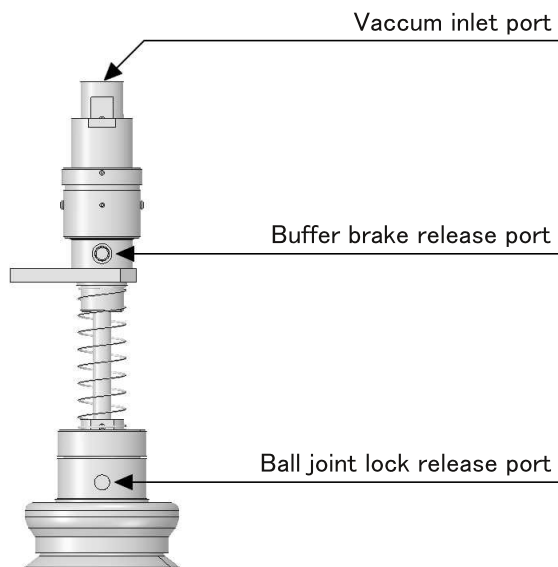
**Effects :** A wide variety of workpieces can be mixed and transported with a single device.



Since the buffer can be locked at the suctioned position in the stroke, there is no impact from the stopper, it can be started quickly, and the workpiece does not fall off or shift.



## How to use

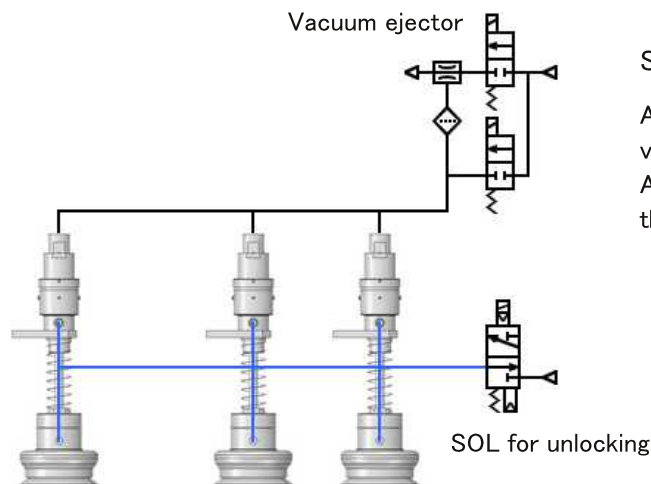


The lockable ball joint and the lockable buffer are released when compressed air is supplied to each release port, and locked when exhausted.

When sucking the workpiece, keep the ball joint and buffer brake release.

After sucking the workpiece and copying the swing angle and buffer stroke, lock the ball joint and buffer. When using only the ball joint, lock after the swing angle is copied.

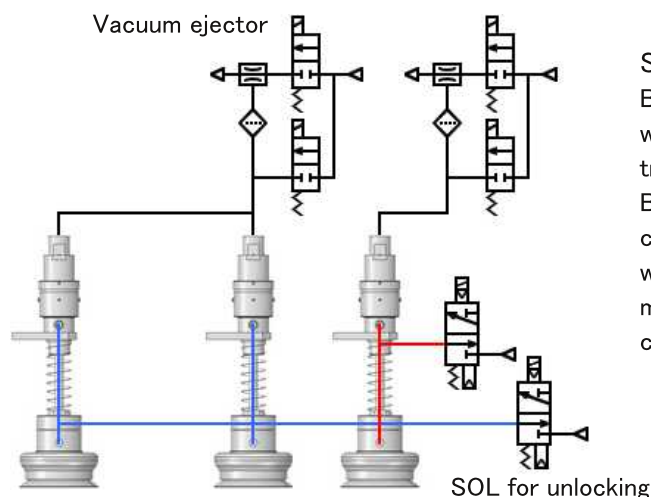
## Air circuit example



Solenoid valve for unlocking: 1 pc.

All ball joint and buffer are controlled by one solenoid valve.

All ball joint and buffer release and locks operate at the same time.



Solenoid valve for unlocking: Multiple

By dividing the lock release valve into multiple parts, workpieces with different suction positions can be transferred with a single JIG.

By releasing or locking the lockable ball joint and buffer corresponding to the type of workpiece in combination with a slide mechanism, rotation mechanism, etc., mixed transportation of a wide variety of workpieces can be performed.

## Operation chart

○ : Air supply    × : Exhaust

| Condition                    | Ball joint | Buffer | Vacuum ejector | Vacuum release |
|------------------------------|------------|--------|----------------|----------------|
| Stand-by                     | ×          | ×      | ×              | ×              |
| Moving the workpiece surface | ○          | ○      | ×              | ×              |
| Contact the workpiece        | ○          | ○      | ×              | ×              |
| Suctioning                   | ○          | ○      | ○              | ×              |
| Locking the ball joint       | ×          | ○      | ○              | ×              |
| Locking the buffer           | ×          | ×      | ○              | ×              |
| Transport・Installation       | ×          | ×      | ○              | ×              |
| Turn off suctioning          | ×          | ×      | ×              | ×              |
| Vacuum release               | ×          | ×      | ×              | ○              |
| Moving to stand-by position  | ×          | ×      | ×              | ×              |
| ※ Unlocking the ball joint   | ○          | ×      | ×              | ×              |
| ※ Unlocking the buffer       | ×          | ○      | ×              | ×              |
| Stand-by                     | ×          | ×      | ×              | ×              |

※ When releasing the ball joint locking and buffer brake with one solenoid valve, it is recommended to perform the operation (return to original position) once when returned to the stand-by position.

## Model number selection method

### ① Suction cup size

The number of suction cups and the cup size are determined by the weight, shape, suction position, etc. of the workpiece. Determine the number and diameter of suction cups after fully considering the suction direction, moving acceleration, wind pressure, etc., and ensuring the lift force in consideration of the safety factor. (Refer page 3)

### ② Rod size

Rod size  $\phi 12$  is recommended when both suction and installation postures of the workpiece are horizontal lifting, and rod size  $\phi 16$  is recommended when either or both are vertical lifting, upward suctioning, or diagonal suctioning. In addition, even in the case of horizontal lifting, if there is a change in the horizontal posture such as turning by a robot while transporting the workpiece, rod size of  $\phi 16$  is recommended.

### ③ Centering spring

With centering spring is recommended for vertical lifting, upward suctioning, and diagonal suctioning.

### ④ Type of buffer spring

For horizontal lifting, select from “S1”, “S2”, and “S3” in consideration of the strength of the workpiece and the dent when pushing the buffer.

For vertical lifting, upward suctioning, and diagonal suctioning, select from “S2” and “S3” in consideration of the strength of the workpiece and the dent when pushing the buffer. If “S1” is selected, the buffer may not be completely released.

### ⑤ Metal scraper

Select “K” for use in an environment where there is concern about welding spatter adhesion. (Only rod size  $\phi 12$ )

### ⑥ Vacuum holding support

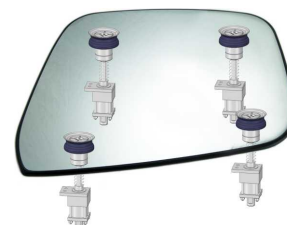
Select “H” when installing a vacuum holding check valve to fall prevent the workpiece.



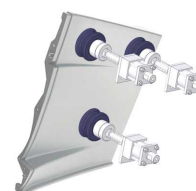
Horizontal lifting



Vertical lifting



Upward suctioning

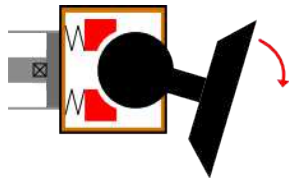


Diagonal suctioning

## Centering spring

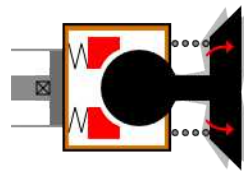
When the lockable ball joint is released, the suction cup will move freely.

In particular, in the case of vertical lifting, upward suctioning, and diagonal suctioning, the weight of the suction cup makes it easier to point downward when the lockable ball joint is released, and it may not smoothly contact between the workpiece and the suction cup. In that case, it is recommended to a with spring type.



Without centering spring

The weight of the suction cup makes it easier to point downward when the lockable ball joint is released, and it may not smoothly contact between the workpiece and the suction cup.

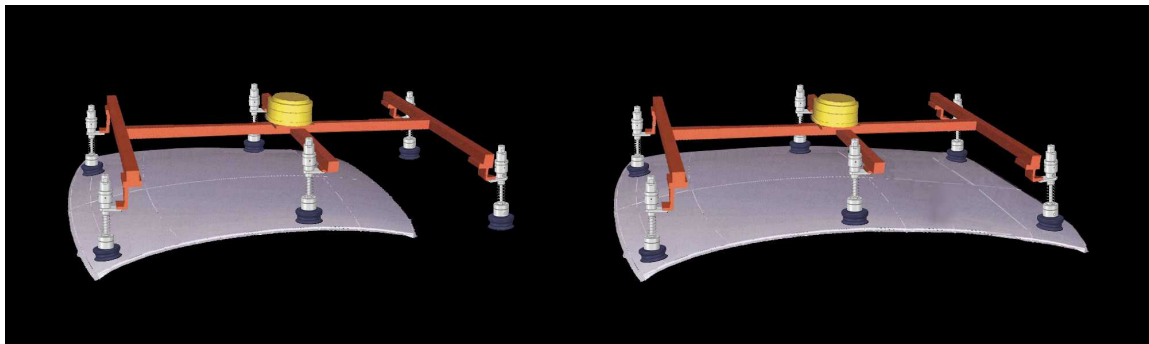


With centering spring

When the lock is released, the restoring force of the built-in spring cause the suction cup to face approximately the center, so workpiece contact is smooth.

## Example usage

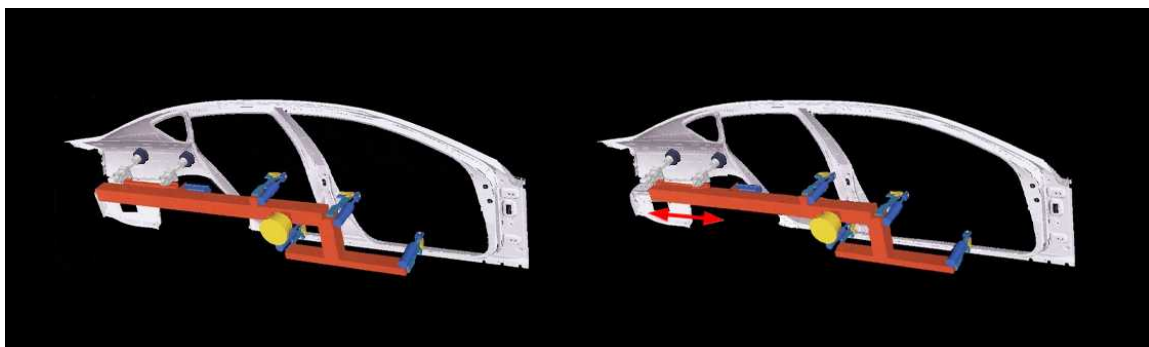
Industry: Automobile, Glass, Aircraft, Vessel, Railroad, Construction machinery, Home appliances, Building materials, etc.



Roof panel transfer device (Automotive assembly line)

A single transfer device can handled a wide variety of multi-shaped roof with high quality.

Since the lockable ball joint and the lockable buffer can be locked according to the shape and height of the workpiece, flexible handling with a stable workpiece posture is possible.



Body side panel transfer device (Automotive assembly line)

Workpieces of different sizes with different suction positions can be handled with the minimum quantity by changing the position of the FREE LOCK PAD in combination with a slide mechanism such as an air cylinder or electric actuator.

## Precautions for safe handling

In the case of using the FREE LOCK PAD (with lockable buffer) vertical lifting or diagonal suctioning.

When the FREE LOCK PAD is used for vertical lifting, upward suctioning, or diagonal suctioning, the rod  $\phi 12$  type may have insufficient rod strength and the buffer braking mechanism may not operate normally due to the influence of the moment generated by the weight of the workpiece. Please use in consideration of the following usage conditions.

Unless otherwise specified, it is strongly recommended to use rod  $\phi 16$  type.

### Allowable workpiece mass when using rod $\phi 12$ type

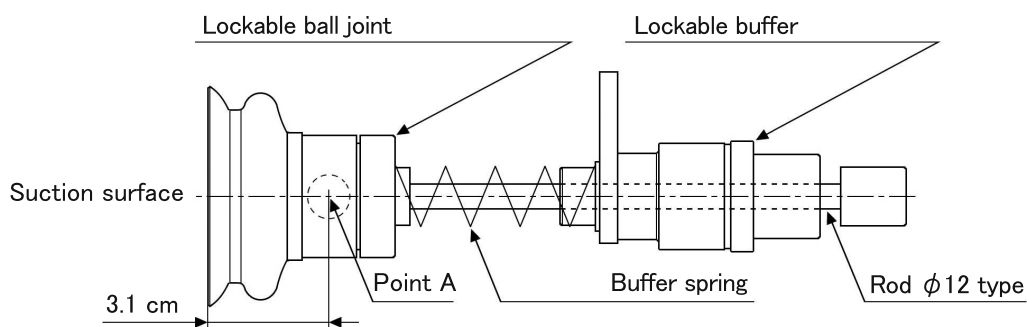
| Lock torque at point A | Allowable workpiece mass |
|------------------------|--------------------------|
| 40 kg. cm or less      | 12.9 kg or less          |

(When moving the workpiece while suctioning it, attention to acceleration, impact, deflection, wind pressure, etc.)

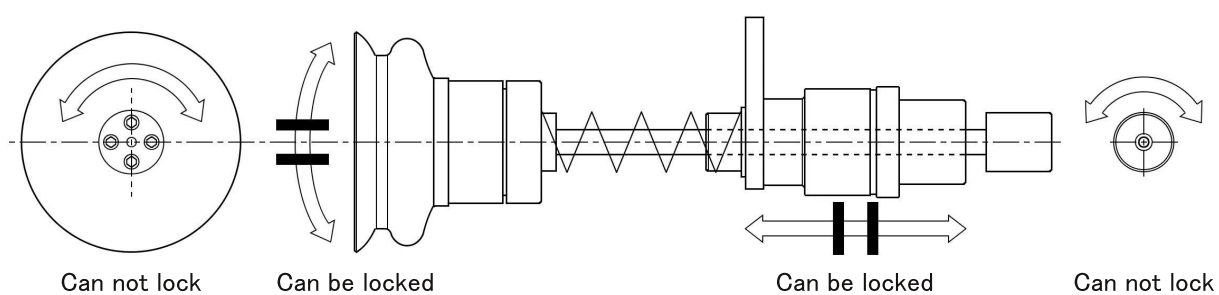
### Example of lock torque

Lock torque (kg. cm) = Workpiece weight (kg)  $\times$  3.1 cm

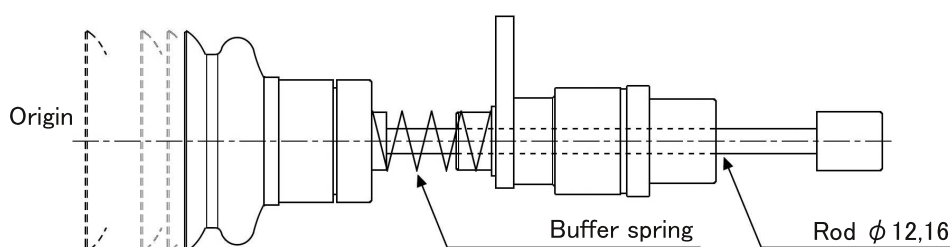
(The center gravity of the workpiece must be on the suction surface.)



The lockable ball joint and the lockable buffer cannot lock the rotational force with respect to the central axis. If rotational force is generated on the workpiece depending on the usage conditions, or if the workpiece weight exceeds the allowable workpiece mass, use two or more FREE LOCK PAD in parallel.



When releasing the brake of the lockable buffer with the FREE LOCK PAD facing sideways, upward, or diagonally upward, if the buffer spring "S1" is selected, the spring force is weak, so the buffer may not be completely released to the origin. Select from "S2" and "S3" in consideration of the strength of the workpiece.



| Spring load |              | Unit : kgf   |
|-------------|--------------|--------------|
| Symbol      | Minimum load | Maximum load |
| S 1         | 0.37         | 1.6          |
| S 2         | 1.26         | 5.58         |
| S 3         | 2.2          | 7.1          |

### Be sure to read this before handling products.

These safety instructions are intended to prevent hazardous situations or equipment damage. These instructions indicate the level of potential hazard with the levels of “Warning”, or “Caution”.



#### Warning

This symbol indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



#### Caution

This symbol indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

## Design



#### Warning

If the workpiece drops and consider dangerous, take sufficient safety measures by providing drop prevention measures.

Consider safety measures for the human and machinery when the workpiece is dropped due to a decrease in suction transfer and other factors, and design so that the human and machinery are not damaged.

## Selection



#### Caution

- ① Use clean compressed air. Use compressed air that does not contain chemicals, synthetic oil containing organic solvents, salt, corrosive gas, etc., passes through an air filter with a filtration degree of 5  $\mu\text{m}$  or less, and if there is a lot of drainage, use compressed air that has passed through an aftercooler, air dryer, drain catcher, etc.
- ② There is no need to lubrication the lock release port and the brake release port. Since it is initially lubricated by the manufacturer, it can be used without lubrication.
 

If a lubricant is used in the release port, use turbine oil (no additives), ISO VG32.

Once lubricant is utilized within the release port, since the original lubricant applied within the product during manufacturing will be washed away, please continue to supply lubrication to the release port.

Without continued lubrication, malfunctions could occur.
- ③ When suctioning and transporting the workpiece, be sure to lock the lockable ball joint and the lockable buffer.
- ④ The lockable ball joint and the lockable buffer cannot lock the rotational force with respect to the central axis. If rotational force is generated on the workpiece depending on the usage conditions, or if the workpiece weight exceeds the allowable workpiece mass, use two or more FREE LOCK PAD in parallel.
- ⑤ Leakage or clogging of the air pressure circuit, wear, cracks, or deterioration of the suction cup, or buffer sliding failure may lead to problems. Make sure to perform periodic maintenance and inspection.
- ⑥ Please be careful that it dust or the like gets mixed in from the vacuum hole on the suction cup surface, it may cause a malfunction.
- ⑦ When using FREE LOCK PAD for vertical lifting, upward suctioning or diagonal suctioning, refer to “Precautions for safe handling” (Page 13).
- ⑧ If the vacuum circuit stops while sucking the workpiece, the vacuum pressure cannot be maintained and the workpiece may fall off. By selecting a circuit that can temporarily hold the vacuum circuit with a check valve and FREE LOCK PAD that supports vacuum holding (symbol : H), it is possible to temporarily prevent the workpiece from falling off due to the vacuum circuit interruption.
 

As a guide, the amount of decrease in vacuum pressure of the vacuum holding support type is about -1 kPa per minute. (Per 1 unit)

## Caution

| Recommended inspection / Replacement cycle |                               |                     |                                |
|--------------------------------------------|-------------------------------|---------------------|--------------------------------|
| FREE LOCK PAD                              | Rough standard for inspection |                     | Rough standard for replacement |
|                                            | Cycle                         | Method              |                                |
|                                            | Every 400K times              | Check the operation | 2.4M times                     |

## 【 Lockable buffer Individual precautions 】

### Selection

## Caution

### ① Installation

Omnidirectional possible. However, the mounting flange of the lockable buffer must be fixed.

### ② Using fluid

Use clean compressed air. Use compressed air that does not contain chemicals, synthetic oil containing organic solvents, salt, corrosive gas, etc., passes through an air filter with a filtration degree of 5  $\mu$ m or less, and if there is a lot of drainage, use compressed air that has passed through an aftercooler, air dryer, drain catcher, etc.

### ③ Lubrication

No require. (If a lubricant is used in the release port, use turbine oil (no additives), ISO VG32.)

### ④ Rod rotation

Lockable buffer cannot lock the rotational force with respect to the central axis.

If rotational force is generated on the workpiece depending on the usage conditions, or if the workpiece weight exceeds the allowable workpiece mass, use two or more FREE LOCK PAD in parallel.

### Maintenance

## Caution

| Recommended inspection / Replacement cycle |                               |              |                                |
|--------------------------------------------|-------------------------------|--------------|--------------------------------|
| Position                                   | Rough standard for inspection |              | Rough standard for replacement |
|                                            | Cycle                         | Method       |                                |
| Scraper                                    | Every 500K times<br>or 1 year | Visual check | 1.5M times                     |
| Brake                                      |                               |              | 5.0M times                     |



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