

# IS-D CR Actuator

## Operating Manual



Intelligent Actuator, Inc.

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This publication was written to assist you in better understanding this part of your IA system. If you require further assistance, please contact IA Technical Support. For Central and East Coast Time Zones, please call our Itasca, IL office at 1-800-944-0333 or FAX 630-467-9912. For Mountain and Pacific Time Zones, please call our Torrance, CA office at 1-800-736-1712 or FAX 310-891-0815; Monday thru Friday from 8:30 AM to 5:00PM.



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## 1. Foreword

Thank you for purchasing the IS-D CR Actuator. This manual explains the structure, correct operation and maintenance of the IS-D CR Actuator. Please read this manual carefully before using the actuator. For more complete information on operating the actuator, please refer to the controller operating manual.

## 2. Outline

A shield and evacuation system enables the new ISD-CR actuators to maintain a Class 10 level. A thin stainless steel shield is used to keep particles generated inside the actuator from migrating to the outside environment. In addition, any particles that are generated are purged from the system through a standard vacuum connector port which has been designated for quick and easy hookup to a vacuum source.

## 3. Safety Precautions

### 3-1 Basic Operating Instructions

- Please do not attempt to use or operate the actuator in any manner not indicated in this manual or the controller manual.
- Please be sure to use only the cable provided by IAI to connect the actuator and controller.
- Please do not allow people within the moving range of the unit when it is in operation or when the power is ON since this is dangerous.

### 3-2 Maintenance and Inspection

- When doing maintenance and inspection work, always shut down the controller power first.
- When doing inspection, make sure that no one can inadvertently turn the power ON.
- Make sure that a sign indicating work in progress is clearly visible.
- If several persons are working, be sure to watch out for each other's safety. In particular, check before turning power ON or OFF and let others know if you are doing work involving axis movement.

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## 4. Warranty

All ISD-CR Series actuators are individually tested on a clean bench located within a class 10 cleanroom. They are sealed and packed within a class 10 cleanroom before shipment. Data is fully assembled for each CR Series and can be provided upon request. Currently, there is no industry standard to measure cleanliness. In general, particles are measured in the area of operation. However, this type of measurement method can be influenced by the capacity of the cleanroom itself. Therefore, the ISD-CR Series of Intelligent Actuator satisfactorily meets Class 10 ratings, but is not absolutely guaranteed.

### 4-1 Warranty Period

The warranty period is one year after IAI America ships the unit.

### 4-2 Scope of Warranty

If a breakdown occurs within the period specified above and is due to the manufacturer's error, we will repair the unit at no cost. However, the following items are not covered by this warranty.

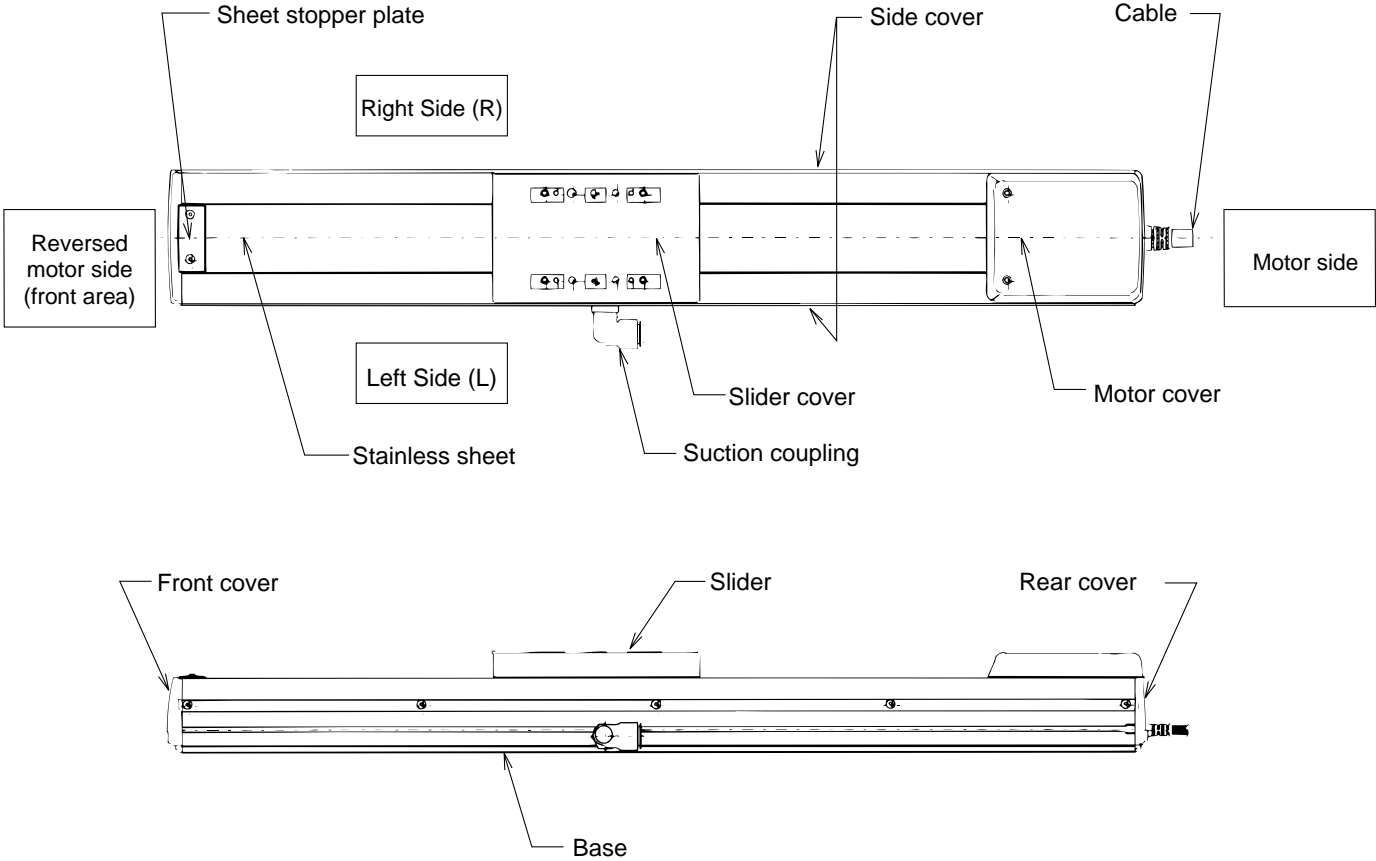
- ◆ Faded paint or other changes that occur naturally over time.
- ◆ Consumable components that wear out with use.
- ◆ Unit seems to be noisy or similar impressions that do not affect machinery performance.
- ◆ Damage resulting from improper handling by the user or lack of proper maintenance.
- ◆ Any alterations made by other than IAI or its representatives.
- ◆ Breakdowns caused by using controllers made by other manufacturers.
- ◆ Any damages caused by fire and other natural disasters or accidents.

The warranty pertains to the purchased product itself and does not cover any damages that might arise from a breakdown of the supplied product. Any repairs will be done at our factory. Even if the product is still covered under the warranty period, we will assess a separate charge for sending technicians to the customer's site.

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## 5. Names of the Parts

The name of the actuator parts are indicated below. The left and right sides are indicated by looking at the actuator from the motor end with the actuator set down horizontally. Front end means the side opposite the motor end.



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## 6. Transporting, Handling

### 6-1 Handling the Packed Unit

Unless there are special instructions, the system is shipped with each axis packed separately. Please take care that the shipping box is not dropped or subjected to strong impact during transport.

- The operator should not carry heavy shipping boxes by himself.
- If the shipping box is left standing, it should be in a horizontal position.
- Do not climb on top of the shipping box.
- Do not place heavy objects on top of the shipping box.

### 6-2 Handling the Actuator After It is Unpacked

Lift the actuator up by the base to remove it from the packing. ***Never grab the stainless sheet area.***

- When carrying the actuator, take care not to bump it. Take particular care with the front cover, motor housing and the encoder cover.
- Do not exert excessive force on any part of the actuator. Take particular care with the screw cover and cable.
- Please do not apply any excessive force onto each part of the actuator. ***In particular, please do not apply any force onto the stainless sheet or pull the cables.***

**!! Warning !!** ***Never grab the stainless sheet area!***

\* Please refer to Section 5 regarding the names of the actuator parts.

## 7. Operating and Storage Environment

### 7-1 Operating Environment

The actuator should be set up in an environment which meets the following criteria:

- ◆ Avoid direct sunlight.
- ◆ Avoid radiant heat from strong heat sources such as a furnace.
- ◆ Ambient temperature should be 0 ~ 40° C.
- ◆ The humidity should be less than 85% and there should be no condensation.
- ◆ Avoid exposure to corrosive or combustible gases.
- ◆ The area should have very little dust and be suitable for normal assembly operations.
- ◆ Avoid exposure to oil mist or fluids used in cutting.
- ◆ The unit should not be subject to vibrations greater than 0.3G.
- ◆ Avoid surroundings with extreme electromagnetic waves, ultraviolet rays and radiation.

In general, the environment should be one in which an operator can work without protective gear.

### 7-2 Storage Environment

The storage environment should be similar to the operating environment. In addition, you must take precautions against condensation if the unit is to be stored for a long period of time. Unless there are special instructions, we do not include moisture absorption agents when shipping the unit. If you are storing the unit where condensation might occur, then you must treat the entire packing or treat the unit itself after it is unpacked to prevent condensation. The unit can withstand up to 60°C during a short storage interval but only up to 50°C if the storage period is longer than one month.



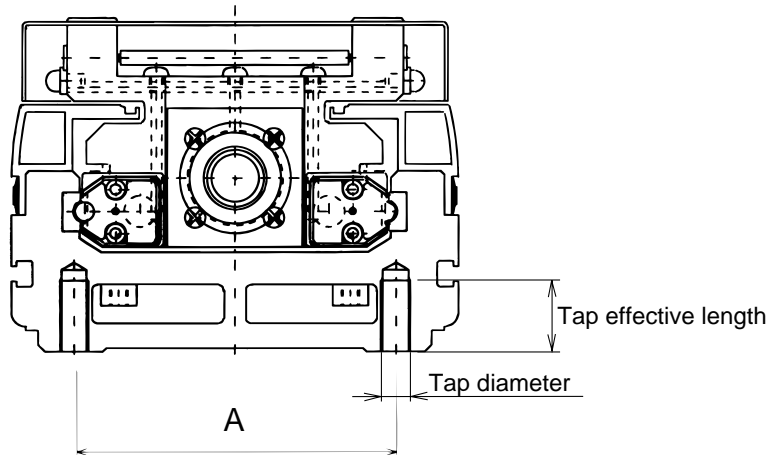
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## 8. Installation

We'll describe the installation process using a single axis unit.

### 8.1 Installing the Main Body

In this section, we will explain the mounting method for a single axis application.



Machine Type	Tap diameter	Tap Effective length	A
Small	M6	17mm	70mm
Medium	M8	20mm	90mm
Large	M8	20mm	120mm

#### **!! Warning !!**

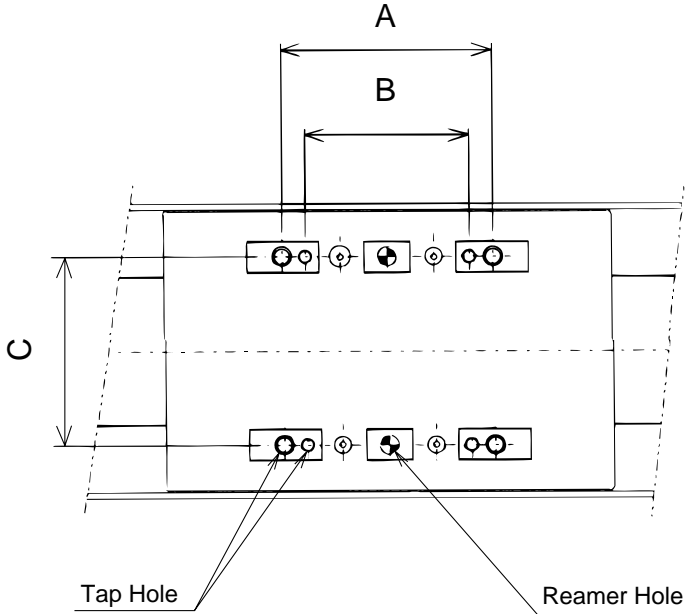
*Since the tap is a stopper hole, please be careful when setting the bolt length. Inadequate bolt usage may cause tap hole breakdown as well as lead to lack of intensity in actuator mounting, thus lowering precision and may cause an accident.*

## 8.2 Attaching the Slider Carrying the Payload

- There are tapped holes in the slider where you can affix the payload. To do this, follow the mounting procedure used for the main body.
- If you are anchoring the slider and moving the main body, attach the slider using the tapped holes.
- The slider has two reamed holes which are used to reproduce the correct positioning when dismantling and reattaching the slider. Use only one of the holes when fine adjustments to the perpendicularity are required.

**Slider Tap Hole Diameter and Reamer Diameter**

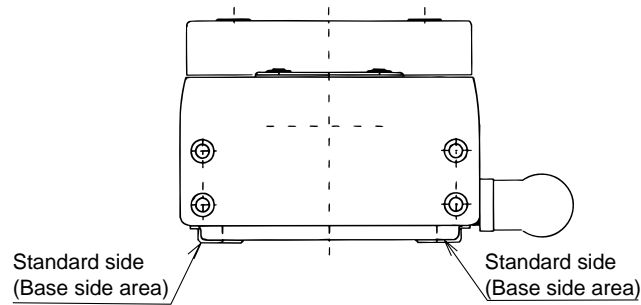
Machine Type	Tap diameter	Tap depth	A	B	C	Reamer Hole	Reamer Depth
Small	M6	13mm	70mm	---	60mm	φ6H10	10mm
Medium	M6	18mm	---	70mm	80mm	φ6H10	10mm
	M8	18mm	90mm	---		φ6H10	10mm
Large	M8	20mm	120mm	90mm	105mm	φ6H10	10mm



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## 8.3 Mounting Surface

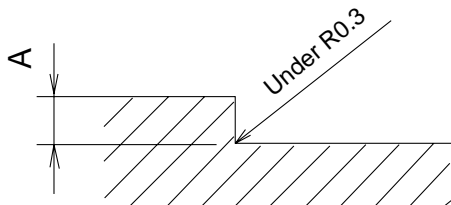
- The mounting table should have sufficient rigidity to avoid generating vibration.
- The surface where the actuator will be mounted should be machined or be equally level and the flatness tolerance between the actuator and the table should be within 0.05mm.
- Provide enough space around the actuator to permit maintenance work to be done.



**Caution:**

*As the diagram above shows, the slider travelling plane is the reference plane for the actuator base and the lower surface. When travelling precision is required, use this as the reference plane for mounting.*

Please follow the diagrams below for machining to mount on to the frame using the base surface:



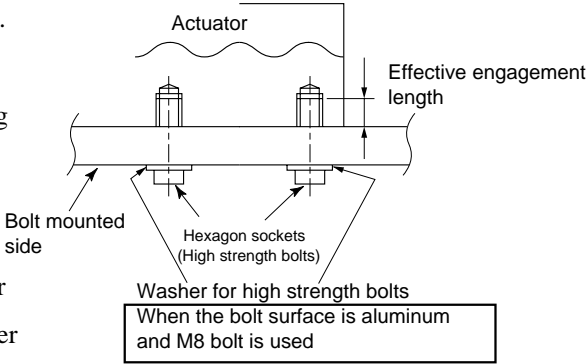
Machine Type	A dimensions (mm)
Small	2~5
medium	2~5
Large	2~5

## 8-4 Clamp Screws

- Please use hexagon sockets as the screws for mounting the base.
- For the bolts, we recommend high strength bolts of ISO- 10.9 or higher.
- Make sure the bolt and screw engagement length is the following value or greater:

Steel screw → same length as the nominal diameter

Aluminum screw → twice as long as the nominal diameter

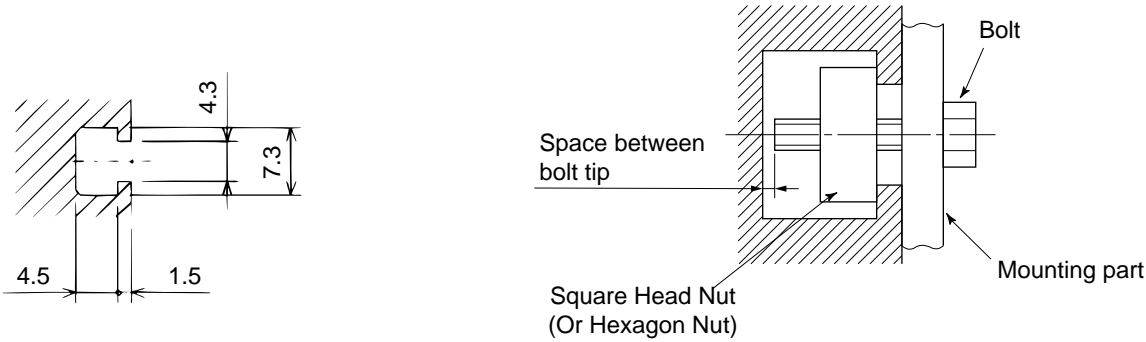


- When attaching the base to a mounting table, use the special washer made for high strength bolts that comes with the actuator if the bolt is M8 or larger. This is unnecessary for M6 or smaller bolts. Do not use a common spring washer.
- The recommended screw torque is given below.

Screw nominal diameter	Screw Torque	
	When the rod surface is steel	When the rod surface is aluminum
M5	7.5N • m (0.77kgf • m)	4.3N • m (0.44kgf • m)
M6	12.9N • m (1.32kgf • m)	6.7N • m (0.68kgf • m)
M8	31.3N • m (3.19kgf • m)	14N • m (1.43kgf • m)

## 8-5 Mounting the Connector Box and the T-Slot (Option)

There are T-slots (width of slot 4mm) in the base for mounting external devices such as a connector box. When using the wiring kit, mount the connector box using these T-slots. Use the slots as necessary to mount sensors or to anchor cables.



**Caution:**

We recommend a square nut for the T-slot but you can also use a hexagonal nut. When mounting, check the bolt length to make sure the end does not touch the bottom of the T-slot. Be especially careful during tightening.

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## 9. Connecting the Controller

We will explain the controller wiring for a single axis actuator.

### 9-1 Standard Wiring Specifications

For a single axis actuator, unless otherwise specified we attach a standard 3 meter cable (5 meter option) to the actuator when we ship the unit. Please attach the cable end directly to the controller.

- Although we use cable that is resistant to bending fatigue, it is not robot cable. Please avoid housing the cable in a wire duct with a small bending radius.
- In an application where the cable cannot be anchored, try to place the cable where it will sag only under its own weight or use dedicated cable hose for large radius wire duct to limit the load on the cable.
- Do not cut the cable to lengthen, shorten, or reconnect it.
- Do not pull on the cable or use excessive force to bend it.

If you wish to alter the cable, please consult with IAI before doing so.

## 10. Caution Regarding Usage

### 10-1 Regarding Maximum Speed

Our IS Protective stainless sheet (ISD) specifications are restricted to a maximum speed according to the chart below.

**Restriction in Stroke and Maximum Speed (unit: mm/s)**

Machine Type	Capacity W	Lead mm	Stroke (mm)							
			<500	600	700	800	900	1000	1100	1200
Small	60	4	200	190	---	---	---	---	---	---
		8	400	380	---	---	---	---	---	---
		16	800	760	---	---	---	---	---	---
Medium	100	5	250	250	225	180	150	125	---	---
		10	500	500	455	365	300	250	---	---
		20	1000	1000	915	735	600	500	---	---
	200	10	500	500	455	365	300	250	---	---
		20	1000	1000	915	735	600	500	---	---
Large	200	10	500	500	500	465	380	320	270	230
		20	500	500	1000	930	765	640	545	465
	400	20	1000	1000	1000	930	765	640	545	465

**Caution:**

*Please obey the maximum speed restriction in regards to each actuator. Failure to do so will increase noise level due to ball screw axis resonance as well as cause oscillation occurrence, thus leading to a shorter machine life span.*

*In addition, if you wish to operate multiple actuators simultaneously, when operating each actuator independently, please create the program in accordance with the actuator that has the lowest maximum speed setting (see chart above).*

*Make sure to confirm the actuator maximum speed before creating a program.*

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## 10-2 Load on the Actuator

- Do not exceed the load shown in the load specification column. Please make note of the slider moment, allowable overhang length and the load weight.

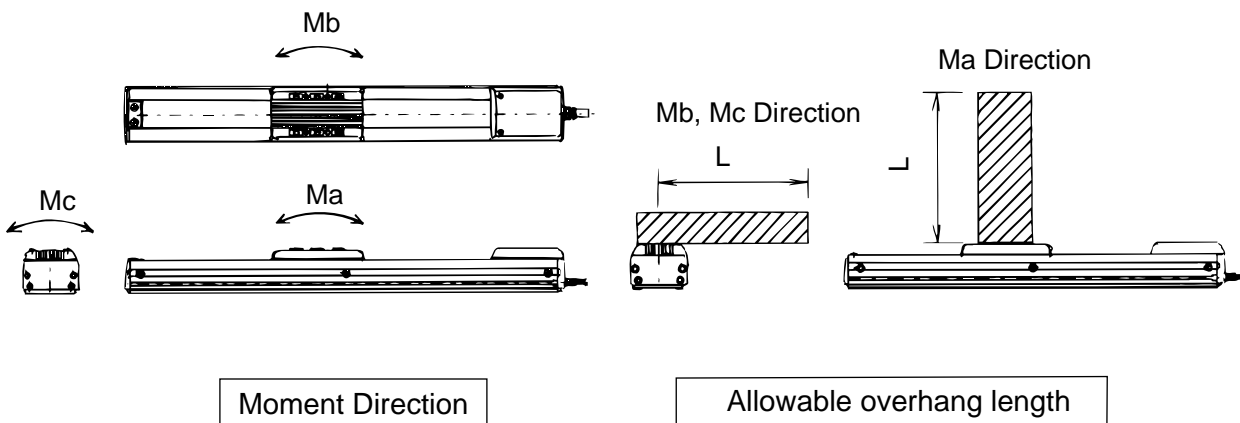
### Allowable Load Moment

Machine Type	Ma	Mb	Mc
Small	28.4N • m (2.9Kgf • m)	40.2N • m (4.1Kgf • m)	65.7N • m (6.7Kgf • m)
Medium	69.6N • m (7.1Kgf • m)	99.0N • m (10.1Kgf • m)	161.7N • m (16.5Kgf • m)
Large	104.9N • m (10.7Kgf • m)	149.9N • m (15.3Kgf • m)	248.9N • m (25.4Kgf • m)

### Allowable Overhang Length

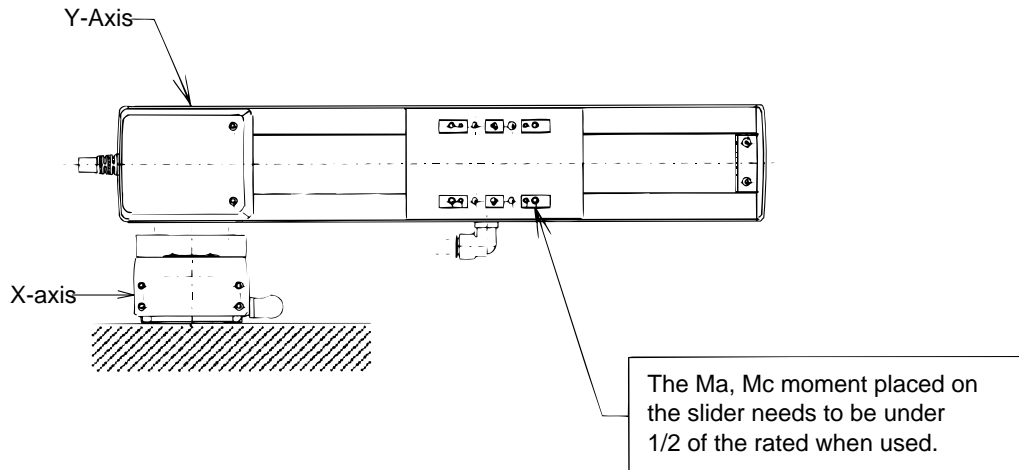
Machine Type	Ma Direction (mm)	Mb Direction (mm)	Mc Direction (mm)
Small	Under 450	Under 450	Under 450
Medium	Under 600	Under 600	Under 600
Large	Under 750	Under 750	Under 750

- The center of gravity for the mounted object is at the halfway point of the overhang length.



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- When the actuator is used in an X-Y configuration, the  $M_a$  and  $M_c$  moments of the Y-axis are derated to 1/2 of the rated value due to the actuator not being fully supported (see diagram below).



**Caution:**

*Applying excessive load moment will physically shorten the guide life span.  
In addition, any usage with an excessive allowable overhang may lead to oscillation occurrences and other negative influences that affect the guide life span.*

## 10-3 Setting the Home Position

### 10-3-1 Principle of the Homing Operation

IA performs homing in the following manner.

- ① The moving direction is determined by the parameters set by the homing command.
- ② The software senses the mechanical end in the homing operation.
- ③ The slider reverses direction when this end is reached and the place where the Z phase signal is detected becomes the reference point.
- ④ The slider travels further by an offset amount defined by the parameters and this position becomes home.



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## 10-3-2 Fine Control of Home Position

The number of motor revolutions from the time the slider hits the stopper to when the Z phase signal is generated is adjusted when the unit is shipped. The standard value of the backing distance when the slider hits the stopper, reverses and then stops at the home position is,

Machine Type	Reverse distance from the mechanical end (~mm)
Small	5
Medium	5
large	5

As long as the homing direction is the same, you can make fine adjustments to the home position for each actuator by changing the parameters based on this value. Adjustments are made as follows:

- ① Initiate the homing operation and confirm home.
- ② After that, move to the desired home position, check the difference and adjust the parameters.  
You can reset the parameters on the plus side in the advancing direction (minus direction is not allowed).
- ③ If you allow for ample offset amount the movement range is that much more limited. If the offset is greater than 1mm, you will have to reset the stroke soft limit.

## 10-3-3 Changing Home Direction

If you change the home direction after the unit is delivered, the move direction parameter must be changed and you may need to adjust the encoder Z-phase so please contact IAI.

## 10-4 Regarding the Stainless Sheet Area

- Since the stainless sheet is held by magnets, in case an excess quantity of magnetic substances such as dust and steel exist in the environment, these substances will be attracted into the magnetic area, causing increase wear of possible failure. Therefore, please try to avoid using under such environments.
- Applying adhesive and coating materials containing viscous substances on top of the stainless sheet will lead to failure in the slider movement as well as cause sheet breakage, please avoid using such materials.
- **Applying local force onto the stainless sheet will cause deformation, and lead to incompatibility, so please be careful. In addition, please do not grab or push the stainless sheet area during the setting and transfer to avoid sheet breakage.**
- Please use alcohol to remove any dirt off of the stainless sheet.

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## 10-5 Regarding the Vacuum Source

Through the employment of a vacuum coupling, the IS-D CR Actuator is able to maintain a class 10 (0.1 $\mu$ m) compliance. The chart below indicates the recommended vacuum flow according to the rated speed of each machine type.

### 10-5-1 Recommended Vacuum flow

Machine Type	Rated Speed (mm/sec)	Vacuum Flow (NI/min)	Pressure (mm/Aq)
ISD-S-4-□-□-CR	200	10	-3
ISD-S-8-□-□-CR	400	20	-6
ISD-S-16-□-□-CR	800	30	-13
ISD-M-5-□-□-CR	250	15	-4
ISD-M-10-□-□-CR	500	30	-12
ISD-M-20-□-□-CR	100	70	-40
ISD-L-10-□-□-CR	500	30	-10
ISD-L-10-□-□-CR	1000	90	-60

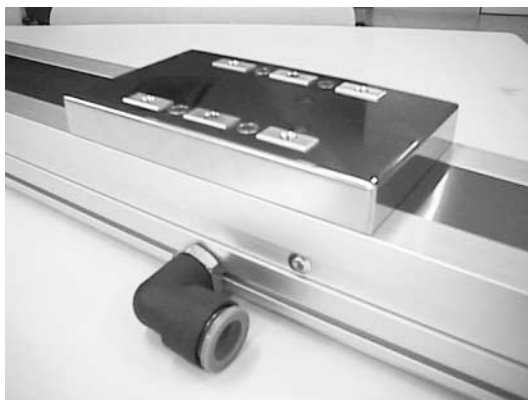
- If you happen to have an air flow equipment, please confirm its capabilities. If you wish to use other equipment such as vacuum pump or blower, please refer to the values indicated in the above table for recommended air flow.

### 10-5-2 Regarding the Vacuum Coupling

The vacuum coupling is a quick-connect fitting which uses a commercial air tube  $\phi$ 12 and is designed for easy connection. The model type for the quick-connect coupling is listed below:

SMC Elbo Union: KQL16-02S-X2

As for the mounting direction of the vacuum coupling, unless the customer requests otherwise, the mounting is set on the L side. However, the vacuum coupling is designed so that the mounting direction may be modified. To modify the mounting direction, using a hexagon wrench, remove the taper plug that is closing the vacuum hole located on the opposite side. This allows for the quick-connect coupling to be moved from its former location to new location. Attach the quick-connect coupling to this new location and taper plug the former location.



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## 11. Maintenance

### 11.1 Maintenance Schedule

Perform maintenance work according to the schedule below.

	Visual Inspection	Internal Check	Lubrication
Start of operation	<input type="radio"/>		
After 1 month of operation	<input type="radio"/>		
After 6 months of operation	<input type="radio"/>	<input type="radio"/>	
After 1 year of operation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Semiannually thereafter	<input type="radio"/>		
Annually thereafter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Note 1: The above schedule assumes running time is 8 hours per day. When running time is high such as continuous day and night operation, shorten the maintenance intervals as required.

### 11.2 Visual Inspection of the Machine Exterior

Check the following when doing the visual inspection.

<b>Body</b>	Loose mounting bolts?
<b>Cables</b>	Damage to cables or connection to connector box?
<b>Stainless sheet</b>	Check for foreign objects that may cause damages on the sheet
<b>General</b>	Unusual noise or vibrations?

### 11.3 Cleaning the Exterior

- ① Wipe off dirt with a soft cloth.
- ② Do not use strong compressed air on the actuator as this may force dust into the crevices.
- ③ Do not use petroleum-based solvents on plastic parts or painted surfaces.
- ④ If the unit is badly soiled, apply a neutral detergent or alcohol to a soft cloth and wipe lightly.

## 11.4 Inspecting the Interior

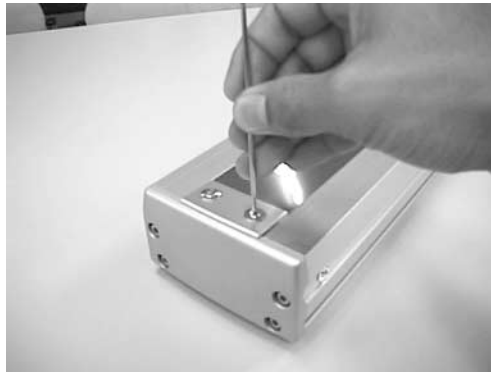
Turn the power OFF. Remove the slider cover, stainless sheet and side cover, and visually inspect the interior.

Body	Loose mounting bolts?
Guide Area	Check for dirt and condition of the lubrication
Ball Screw Area	Check for dirt and condition of the lubrication

Visual Check of the Interior:

Make a visual check of the interior to see if there is any dust or foreign matter in the unit and check the lubrication. Even if the grease you see around the parts is brown, the lubrication is fine as long as the travelling surface appears shiny.

### How to Inspect the Interior:



Step 1:  
Move the slider to the motor side.

Step 2:  
Use a hexagon wrench to remove all of the screws that hold the stainless sheet.



Step 3:  
Remove the stainless sheet and conduct an internal inspection.

Step 4:  
Upon inspection, reassemble by following the above steps in reversed order.

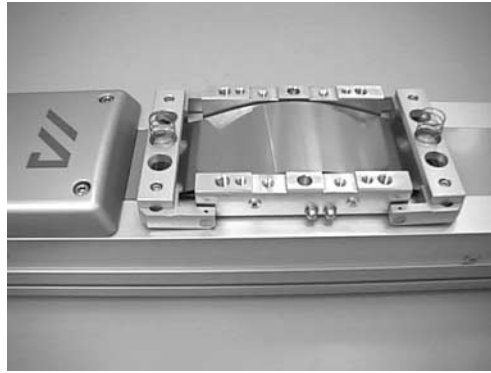
### **Caution:**

*While inspecting, please do not bend the stainless sheet excessively and avoid damaging the stainless sheet. Please wear gloves during the inspection process since the stainless sheet tip area may be harmful. Please do not disassemble the front cover since it supports the ball screw. If the front cover is adjusted and warps, running resistance will increase due to dislocation of the axis center. This will shorten the life span of each area, and may cause noise occurrence.*

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Step 5:

Remove the slider cover.

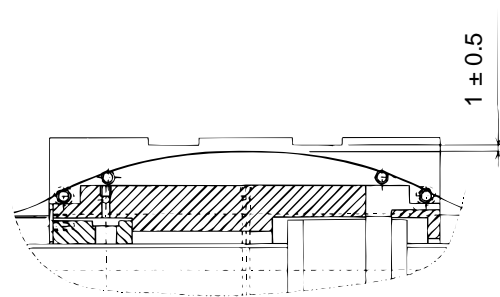


Step 6:

Hold down the stainless sheet using the pusher tool and adjust the sheet towards the axis direction so that the height of the bulged area is at a location  $\pm 0.5\text{mm}$  lower than the slider cover mounting side. At this time, make sure that the stainless sheet does not bend into the side cover area gap.

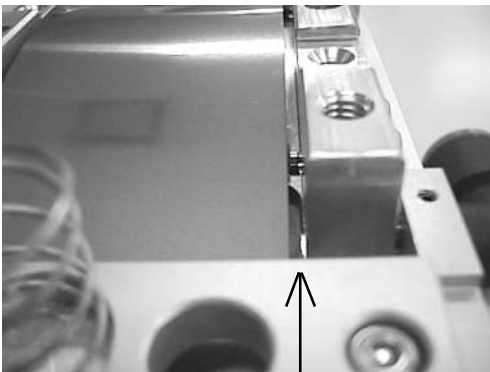


Pusher Tool



Step 7:

While firmly holding down the stainless sheet, make sure that the space between the sheet and guide module is even when movement is done in full stroke. If you notice that the space is not even or the space does not exist, that may indicate that the sheet is mounted unevenly. If this is the case, then please repeat the above step and readjust so that the stainless sheet is stretched out evenly.



Make sure that this gap space is even with the one on the reversed side.

Step 8:

Tighten the stainless sheet permanently, then, attach the slider cover.

## 11.5 Cleaning the Interior

- Use a soft cloth to wipe off dirt on the inside.
- Do not spray strong pressured air that might force dust into the crevices.
- Do not use petroleum-based solvents, neutral detergents or alcohol.

## 11-6 Lubricating the Guide Bearing Block

### 11-6-1 What Grease to Use

For the guide and ballscrew area, we use a urea type grease which is effective in anticorrosion. Similar to lithium type grease, the urea type grease is also effective in dust prevention, limiting resonance, and improving torque capabilities. When we ship the unit, we use the following grease:

Kuroda C Grease

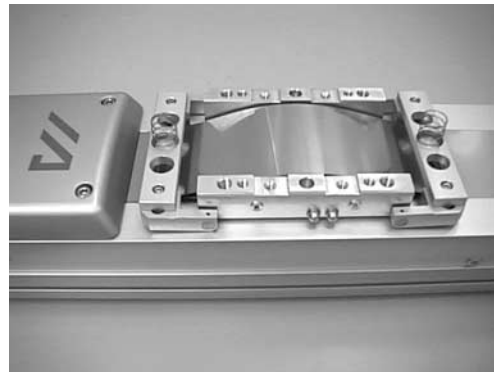
### **!! WARNING !!**

*Never use any fluorine based grease. When mixed with a lithium based grease, not only does the grease lose its performance but it can actually damage the actuator.*

### 11-6-2 How to Lubricate

There are grease nipples located on the slider side area. Use these nipples to supply grease onto the guide and ball screw area.

**Step 1: Remove the slider cover.**

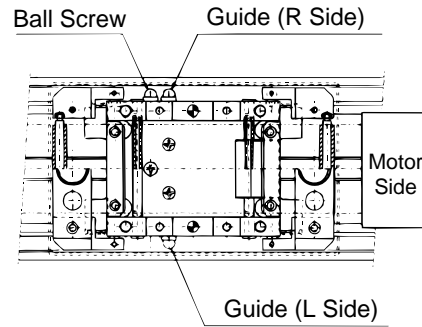


# IS-D CR Actuator

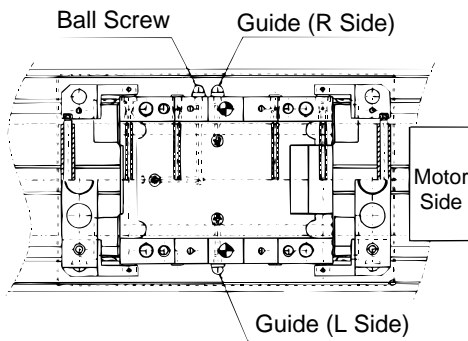
Step 2: Locate the grease nipple. There are 3 grease nipples; 2 locations are for the guide and 1 location is for the ballscrew.



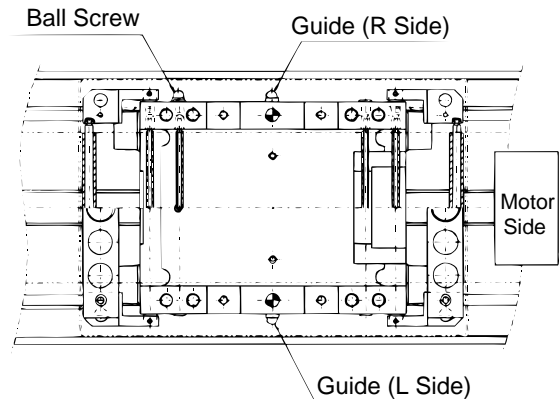
**ISD-S-□-□-□-CR**



**ISD-M-□-□-□-CR**



**ISD-L-□-□-□-CR**



Step 3: Using urea type grease, squirt the grease from the grease nipple using a grease gun.

Step 4: Move the slider back and forth several times by hand.

Step 5: Repeat the lubrication one more time.

Step 6: Wipe off the excessive grease.

Step 7: Reattach the slider cover.

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