



SONY®

Ribbon Type Linear Scale

MSS-101 / MSS-105

Head Assembly

HA-101 / HA-101V

HA-105 / HA-105V

Read all instructions carefully use.

To make full use of the unit's functions, read this manual through carefully, and keep it properly for future references.

Instruction Manual
1st Edition (Revised 1)

NOTES TO USERS

Read all instructions carefully before starting assembly and use.
Save this MANUAL for future reference.

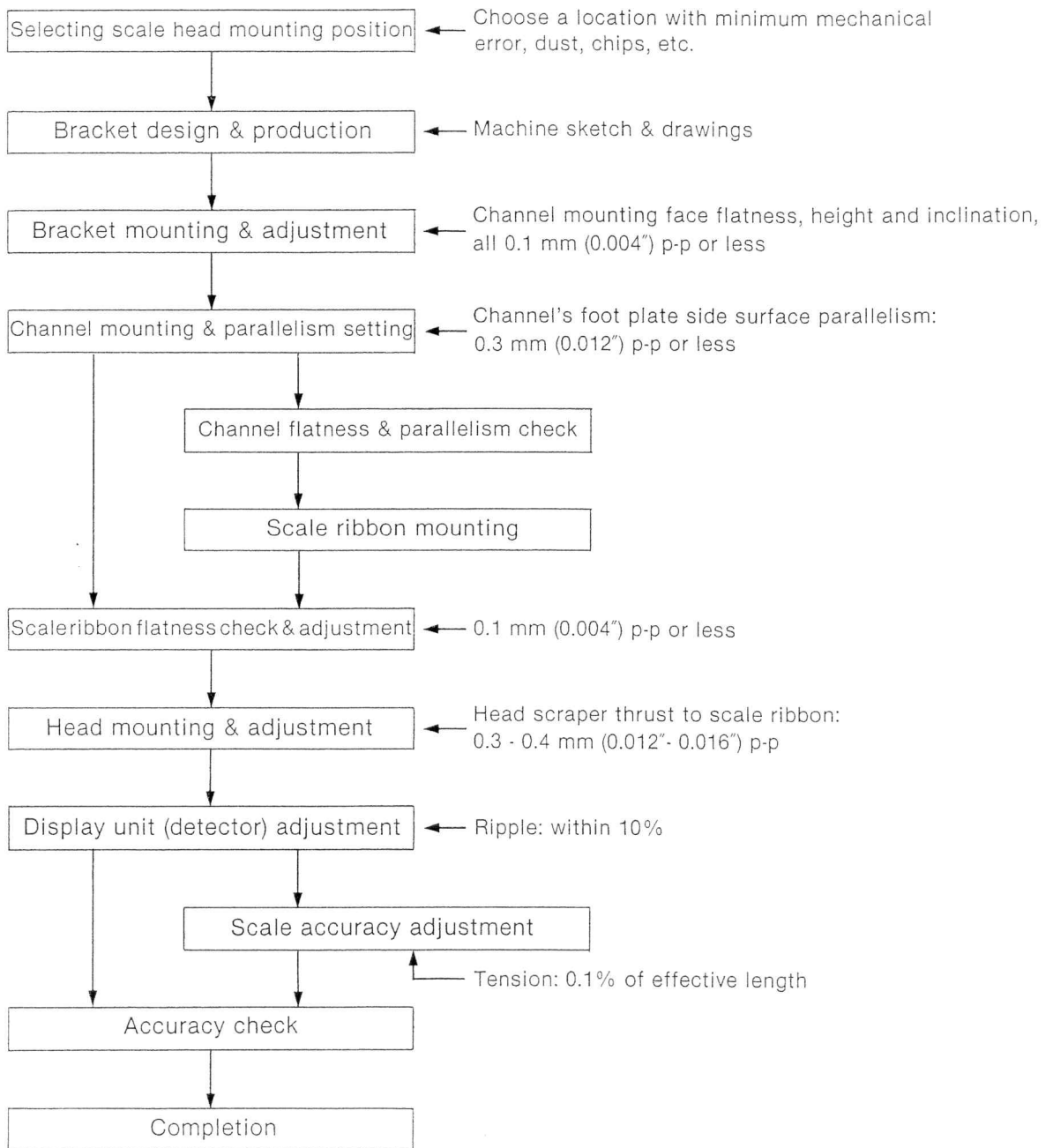
GENERAL PRECAUTIONS

When using Sony Precision Technology Inc. products, observe the following general precautions along with those given specifically in this manual to ensure proper use of the products.

- Before and during operations, be sure to check that our products function properly.
- Provide adequate safety measures to prevent damages in case our products should develop malfunction.
- Use outside indicated specifications or purposes and modification of our products will void any warranty of the functions and performance as specified of our products.
- When using our products in combination with other equipment, the functions and performance as noted in this manual may not be attained, depending upon operating environmental conditions. Make full study of the compatibility in advance.

Mounting Procedure

Mount the MSS-101 & MSS-105 following the procedure below.



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1. GENERAL DESCRIPTION OF THE MAGNESCALE SYSTEM

The Magnescale is a magnetic scale with the Flux Responsive Multi-Gap Magnetic Head (MGH) which we have developed originally to detect linear or angular position and displacement accurately with high resolution, and its features include high stability, high accuracy and high resolution.

The Ribbon Type Linear Scale MSS-101/105 is a long-length precision linear scale, whose magnetic scale stored in the channel is read by the MGH as the electric signal, which is displayed on the digital counter or produced by the detector unit as linear displacement. The scale signal of $200\mu\text{m}/254\mu\text{m}$ (0.01") pitch is recorded on the scale ribbon. The pitch is electrically broken down to a 1/4, 1/20, 1/40 or 1/200 to attain a resolution of $50\mu\text{m}$, $10\mu\text{m}$, $5\mu\text{m}$ or $1\mu\text{m}$.

2. SPECIFICATIONS OF MSS-101/MSS-105

Effective Length	:	3.2 ~ 30 m (10.5 ~ 98.4 feet)
Accuracy (at 20°C/68°F):	MSS-101	: 1. Metric: $\pm (0.0025 + 0.0025 \times \text{effective length in meters})$ mm
	MSS-105	: 2. Inch : $\pm (0.0001 + 0.0000025 \times \text{effective length in inches})$ inch
Pitch of the Scale Signal	:	$200\mu\text{m}/254\mu\text{m}$ (0.01")
Temperature Expansion Coefficient	:	$11 \times 10^{-6}/^{\circ}\text{C}$ ($6.1 \times 10^{-6}/^{\circ}\text{F}$)
Operating Temperature	:	$-5^{\circ}\text{C} \sim +40^{\circ}\text{C}$ ($+23^{\circ}\text{F} \sim +104^{\circ}\text{F}$)
Storage Temperature	:	$-10^{\circ}\text{C} \sim +50^{\circ}\text{C}$ ($+14^{\circ}\text{F} \sim +122^{\circ}\text{F}$)

3. STRUCTURE OF LONG-LENGTH TYPE SCALE

3-1 Structure Outline

The MSS-101 (HA-101) and MSS-101 (HA-101V) have remarkably improved the dustproof structure having a newly added dust seal along the longitudinal opening of the dust cover.

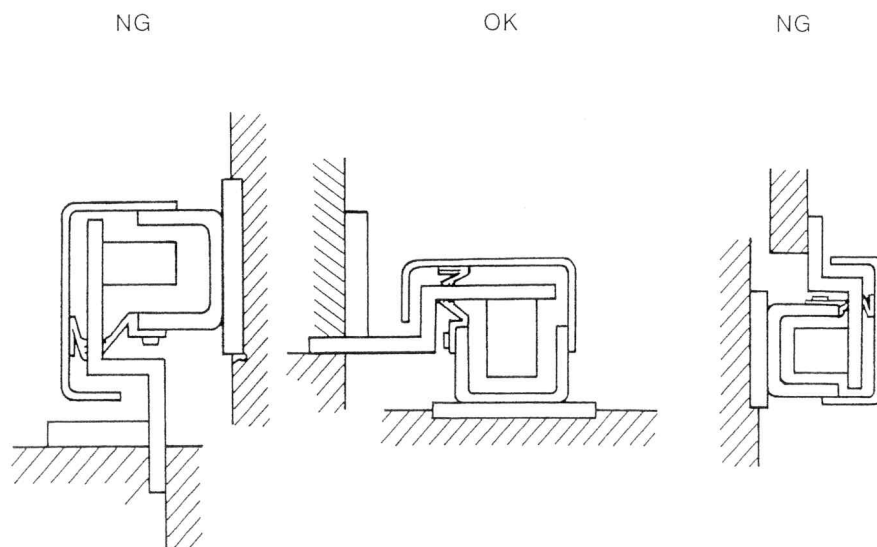
“Long-length type” refers to an effective length of 3.2 m (10.5 feet) or more.

As it is difficult to transport assembled long length scales, the ribbon scale and channel are separated for shipment at the factory after magnetic recording of the scale. Then the scale is adhered accurately to its original length at the place where the system is to be installed.

The only difference between the HA-101 and HA-101V is a slight variation in the carrier mounting part; the scale, channel, cover, etc., are identical.

Either of them can be chosen depending on the machine to which it is mounted.

Although the scale has a dustproof structure, improper mounting where the carrier hangs down or the dust cover opening section is facing upwards must be avoided. If cutting oil containing chips, dirt, etc., fall down the carrier, it is very difficult to prevent them from entering the inside of the scale. Be sure to mount the scale according to the figure below.



3-2 STRUCTURE OF MSS-101/MSS-105

MSS-101/MSS-105 is composed of the following components:

- ① Scale Ribbon
- ② Storage Channel
- ③ Head Assembly
- ④ Dust Cover

Referring to the appended drawing, please read the following explanations.

3-2-1 Scale Ribbon

The scale ribbon is made of (0.15 mm/0.0059") special magnetic alloy on which the scale signals is magnetically recorded. The scale ribbon is provided over it with a protective coating that has an excellent wear resistance.

To have optimum straightness and the same expansion coefficient as that of steel, the scale ribbon is pulled from both ends to apply tension to it by 0.1% of the whole length before recording exact 0.2 mm/0.01" pitch.

To prevent vibration, maintain the scale flatness and add proper contact pressure, scale cushion of foam polyurethane resin is pasted on the back of the scale ribbon.

3-2-2 Storage Channel

The storage channel has three functions: hold the scale ribbon, shield the scale ribbon from external magnetic disturbances and keep the expansion coefficient of the scale ribbon the same as that of steel.

The storage channel is made of soft steel, and is mounted on the machine with foot-plates. At each end of the channel, a hook is fitted to add tension to the scale ribbon. The scale ribbon is fixed between the upper face of the hook and the pressure board. In this condition, tension is added to the scale ribbon by pulling the hook outside with the tension bolts (M6 × 20 hexagon socket head cap screws).

3-2-3 Head Assembly

The head assembly is composed of the following parts:

- 1) Multi-Gap Head
- 2) Head-Holder
- 3) Eccentric Shaft
- 4) Center Pin
- 5) Carrier
- 6) Gauge Block
- 7) Adjustment Block
- 8) Scraper
- 9) Lead Cable and Connector

The multi-gap head is fixed on the head holder. The head holder and the carrier are fastened to each other with 4 hexagon socket head cap screws ($M4 \times 10$), and when these screws are loosened, the head holder may be turned a little by turning the eccentric shaft with a screw driver; by so doing, the angle of the head is adjusted so that Channel 1 and Channel 2 may be displaced by $\lambda/4$. The head holder is held in a position by the carrier, which in turn is mounted to the machine.

When the head is kept apart from the scale, the head is unable to read the scale signal. When the head is pressed too hard against the scale, the scale will be worn. Therefore, not only the surface of the scale must be kept plane, but the head assembly must be fixed in the channel in such a way that the head touches the scale with proper pressure.

The head thrust onto the scale is adjusted with respect to either end of the channel. The exact depth from the upper face of the channel to the surface of the scale and the exact height from the face of the head to the bottom of the carrier are known. Thus, by securing the exact space between the bottom of the carrier and the upper face of the channel with the gauge blocks, the head must be fixed in the channel to touch the scale with proper pressure; the head dents the surface of the scale by 0.3 mm(0.01"). Further, the head travels in the ditch of the channel, and if the channel or the head assembly is mounted off to one side, the head touches the side of the ditch and will be injured.

Accordingly, not only the channel should be mounted straight along the machine, the head assembly should be kept in the center of the width of the channel. To this effect, the head must be fixed by putting the adjustment block to the side of the channel.

HA-101, HA-105

If the dimension between the surface A of the channel foot plate and the center of the screw hole on the carrier mounting seat is unknown, the carrier may be fixed by placing the adjustment block outside the channel. (See Fig. 4-5)

If chips or other dusts enter the channel while the head is travelling on the scale, the head is kept apart from the scale by these obstacles and misreads the scale signal. In order to avoid this, the scrapers are fixed to the front and the rear of the head holder. These scrapers are similar to those used on the slideways of the machine tool. See Fig. 4-4.

Further, as a part of the carrier travels touching the dust shield, that part has a boat-shaped cross section to decrease the friction and to shield the channel completely.

(Note) As to the HA-101/105 type carrier, the mounting face 1 or 2 is selectable. Be sure to fix the connector assembly (connector, connector mounting board and L-shaped mounting board) on the opposite side of the mounting face.

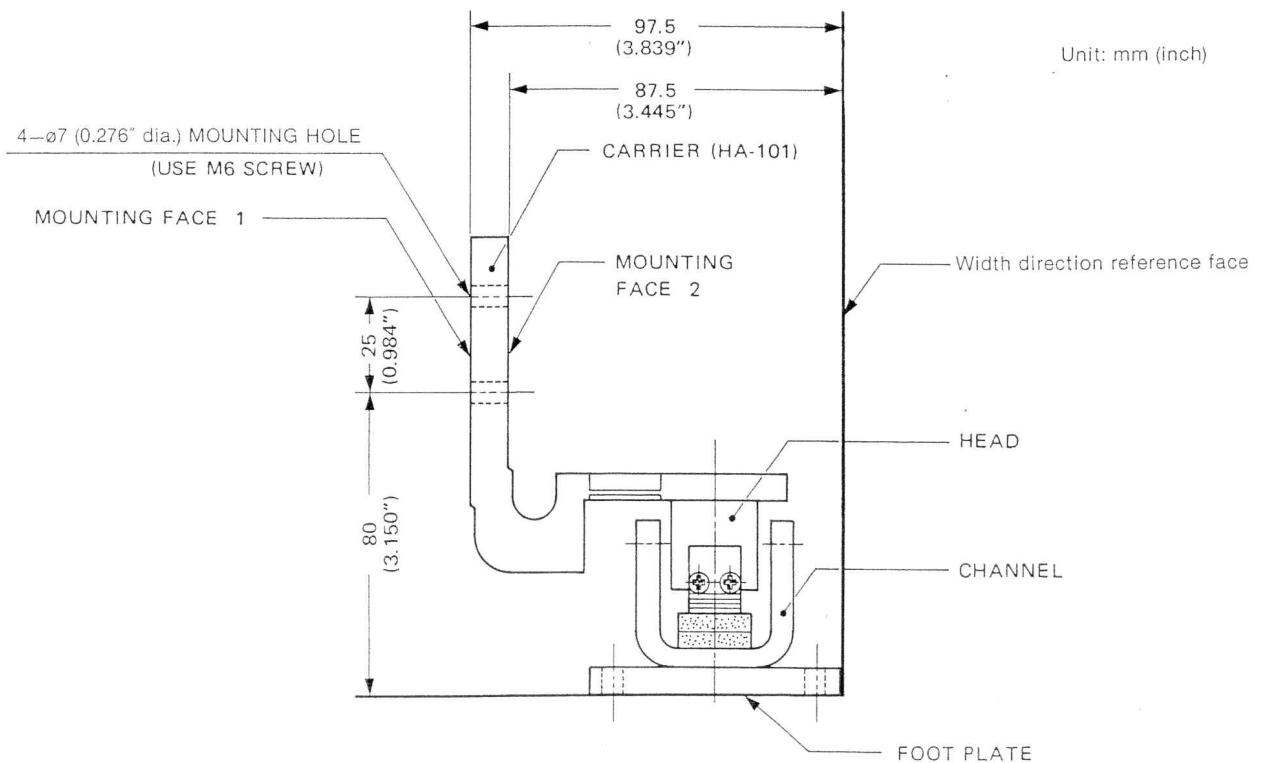


Fig. 3-1

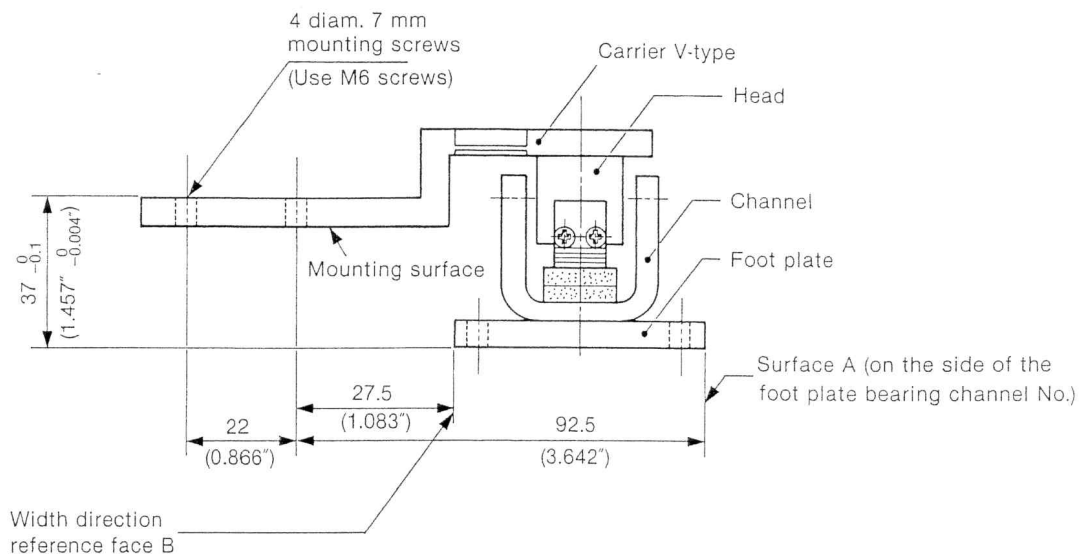
HA-101V, HA-105V

If the dimension between the surface A of the channel foot plate and the center of the screw hole on the carrier mounting seat is unknown, the carrier may be fixed by placing the adjustment block outside the channel. (See Fig. 4-5)

If chips or other dusts enter the channel while the head is travelling on the scale, the head is kept apart from the scale by these obstacles and misreads the scale signal. In addition, friction of the scale and the head is accelerated. In order to avoid this, the scrapers are fixed to the front and the rear of the head holder. These scrapers are similar to those used on the slideways of the machine tool.

Further, as a part of the carrier travels touching the dust shield, that part has a boat-shaped cross section to decrease friction and to shield the channel completely.

Unit: mm (inch)



3-2-4 Dust Cover

The dust cover is composed of the channel cover which covers the channel and the head, the dust lips A and B which close up the opening in which the carrier moves, the side covers of both ends and the fishplates which cover the joints of the channel cover.

Dust lips A and B are each integrally formed of hard resin (fixed to the housing) and soft resin (lip part).

The dust lip A is secured together with the channel and the hold plate, and the dust lip B with the shield base and the dust cover. At the time of mounting, remove all these covers except the side covers, and after the adjustment has been finished, put them back in their places. As the name implies, the dust cover protects the scale and the head from chips and dust and shields the scale from external magnetic field.

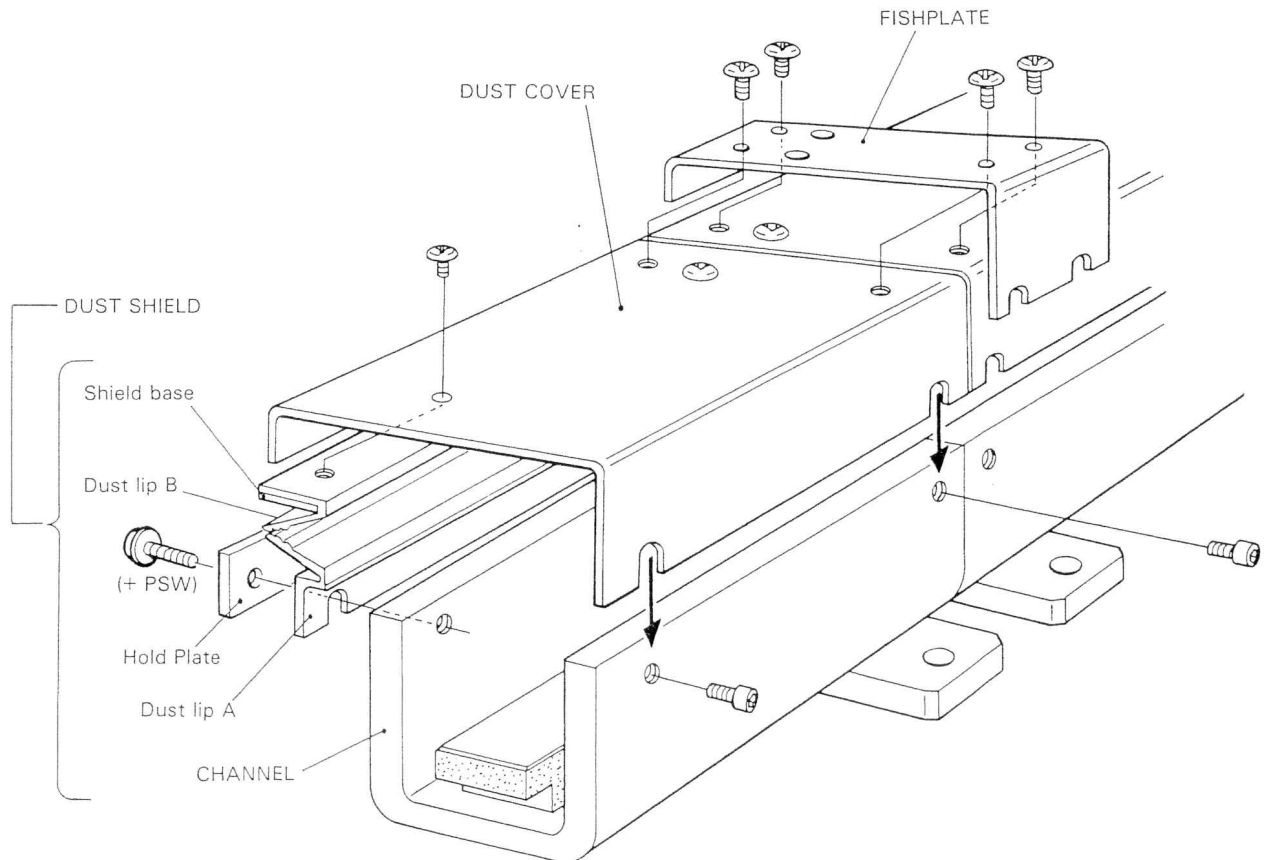


Fig. 3-2

4. MOUNTING INSTRUCTIONS

4-1 Tools and Instruments Needed

- (1) Allen Wrench, 2 pcs. each of:
Nominal Dimensions 2.5 mm (0.098") (For M3, Gauge Block & Adjustment Block)
3 mm (0.118") (For M4, Head Holder, etc.)
4 mm (0.157") (For M5, Hook, Pressure Board & Tension Bolt)
5 mm (0.197") (For M6, Foot Plate & Carrier)
- (2) Phillips Screw Driver 3 mm (0.118") × 2
- (3) Phillips Screw Driver 4 mm (0.157") × 2
- (4) Slotted Screw Driver 3 mm (0.118") × 2
- (5) Electric Micrometer or Dial Indicator (Lever Type Pick-Up. Measurement Pressure: Less than 30 gr (1.058 oz)) × 1
- (6) Magnetic Stand × 1 or more
- (7) Synchroscope (Vertical Deflection Factor: 50 mV/cm, Bandwidth: DC to 5 MHz) × 1
- (8) Thickness Gauge (Minimum Thickness: 0.03 mm (0.001")) × 1
- (9) Spacers of 0.05 mm (0.002"), 0.1 mm (0.004") and 0.2 mm (0.008") thickness, a few pcs. each.
- (10) M6 × 16 Hexsocket head cap screw
(Number of Holes in the Foot Plates + Number of Holes in the Carrier) pcs.
(For example, when the effective length is 2.5 m (8'), 28 pcs. of bolts are required.)
- (11) Gauze and Waste Cloth
- (12) Spanner, Monkey Wrench, Sandpaper, etc.

4-2 Mounting Instructions

When mounting, pay attention to the following two points:

- 1) To stretch the scale straight.
- 2) To fit the channel and the head assembly correctly.

In other words, mount the channel and the head assembly according to the dimensions correctly.

As stated in the Chapter 3 and elsewhere, the scale is supported by the channel so its flatness is maintained. Therefore, all mounting faces of the channel must be arranged on a plane parallel to the slideway of the machine.

If the head assembly seat is not correctly positioned in relation to the channel seat, the correct mounting cannot be made.

It is fundamental that the mounting should be made correctly in order to use the scale with high accuracy, without breakdown for a long time. As the accuracy of the scale is greatly dependant on the mounting, use care for installation.

Further, pay attention to the following points while at work:

- (1) Do not step on the channel or other components.
- (2) Do not put strong magnetic materials (such as a magnetic stand, etc.) near the scale ribbon or the Multi-Gap Head. If the magnetic scale signal is disturbed or the head becomes magnetized, they must be changed entirely. Use the tools, especially allen wrenches, screw drivers and pick-ups of electric micrometers, which are demagnetized completely.
- (3) When adjusting the digital counter or detector after the mounting of the scale has been completed, do not plug in or disconnect the connectors while it is switched on or while it is not put to the ground, or else the head will be magnetized.
- (4) Do not touch the scale to itself. This would disturb the magnetic scale.

4-3 Mounting of the Storage Channel

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4-3-3	Temporary Mounting of the Channel.....	P11
4-3-4	How to Mount the Scale Ribbon.....	P11
4-3-5	Adjustment of the Flatness of the Scale	P13

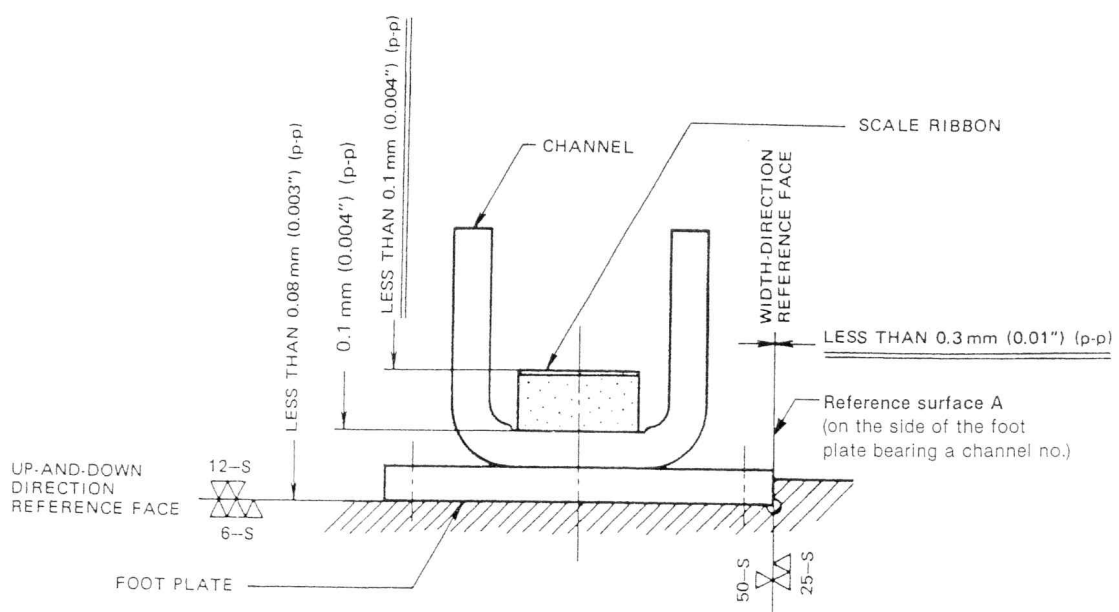



Fig. 4-1. Tolerance of dimensions in mounting the channel and the scale

4-3-1 Tolerance of Dimensions in Mounting the Channel and the Scale

Please refer to Fig. 4-1.

As shown in the above figure, the flatness and the parallelism should be kept within the following tolerance over the whole length against the slideway of the machine.

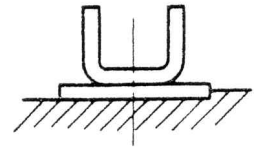
- (1) The flatness of the surface of the scale ribbon: Less than 0.1 mm (0.04") (p-p) ( Maximum Amplitude, Peak to Peak).
- (2) The parallelism of the side face of the foot plate: Less than 0.3 mm (0.01") (p-p).

4-3-2 Mounting Seat of the Channel

- (1) Mounting the channel on a horizontal mechanically-finished surface of the machine, as shown in the right figure.

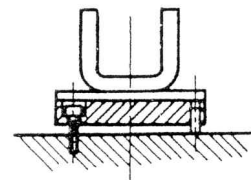
This is a simple, secure and ideal way of mounting.

Keep the parallelism and the flatness of the width-direction reference face and of the vertical direction reference face as per Fig. 4-1.



- (2) Mounting the channel on a horizontal casting surface of the machine with the aid of seat boards.

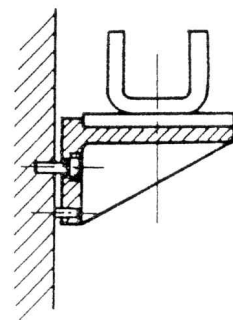
In this case, the surface of the seat boards must be leveled with the use of jack bolts. Keep the slant of each seat board within 0.03 mm (0.001") both in the width and longitudinal direction. The parallelism and the flatness of the seat boards are the same for (1).



- (3) Mounting the channel on a vertical surface of the machine with the aid of brackets.

The tolerances are the same for (2).

When the vertical surface is of cast iron, use jack bolts. In case the casting surface winds against the slideway of the machine, take care to keep not only the flatness in the vertical direction but the parallelism in the width-direction.



Please get rid of flashes from the mounting seat.

Fig. 4-2

4-3-3 Temporary Mounting of the Channel

After the mounting seat has been set, clean the mounting surface and mount the channel on the seat temporarily.

If the foot plates are fastened with their side faces pressed against the reference face A of the foot plate, the parallelism in the width-direction can be secured. In case the reference face in the width-direction cannot be obtained, please mount the channel temporarily by measuring the side face of the foot plates with an electric micrometer and keeping the parallelism within 0.3 mm (0.01") (p-p).

4-3-4 Mounting the Scale Ribbon

Take out the scale ribbon from the package. Extend it flatly in the channel taking care not to fold it, put it near other magnetic materials or contact its surface together.

Install the scale so the reference point of the recorded signal marked on the scale surface comes almost against the reference point mark Δ on the side of the channel and insert the end of the scale ribbon between the hook and the pressure board. When the end has reached two M5 hexagon socket head cap screws, fasten these bolts firmly. If the ribbon is too long, cut off its end properly. At this moment, fasten these screws adjusting the parallelism of the scale ribbon against the channel correctly. And then fix the hook to the channel with two M5 bolts.

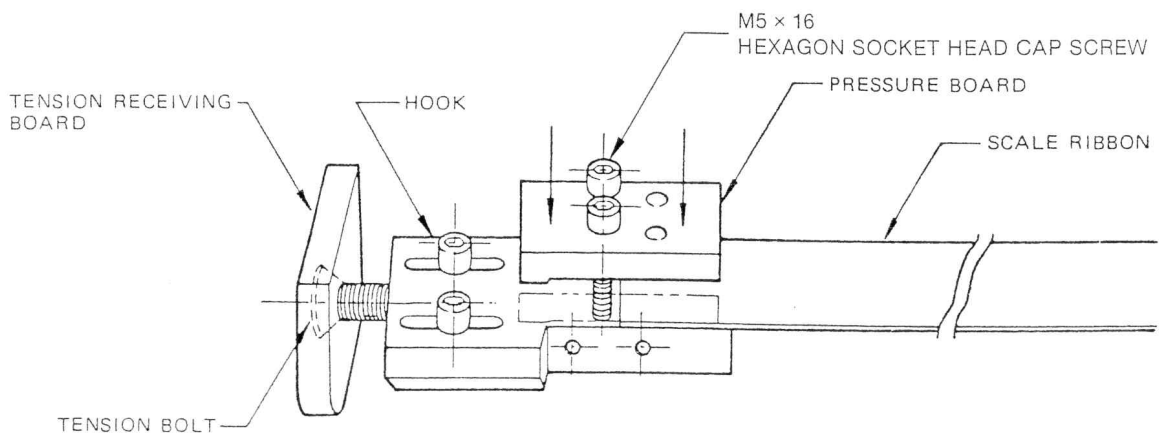
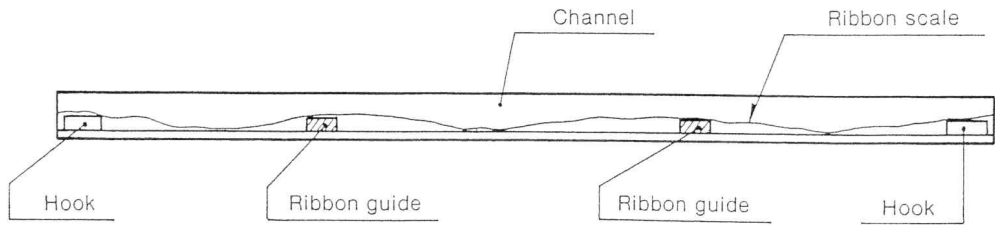


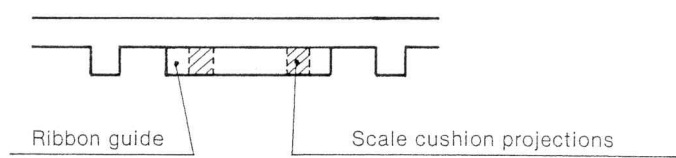
Fig. 4-3

Fix the other end of the scale ribbon in the same order. Pull the hook outward with your fingers till the slack of the scale ribbon disappears and observe if the hook can be moved outward further by 0.1% of the total length. When the effective length is 5 m (16'),

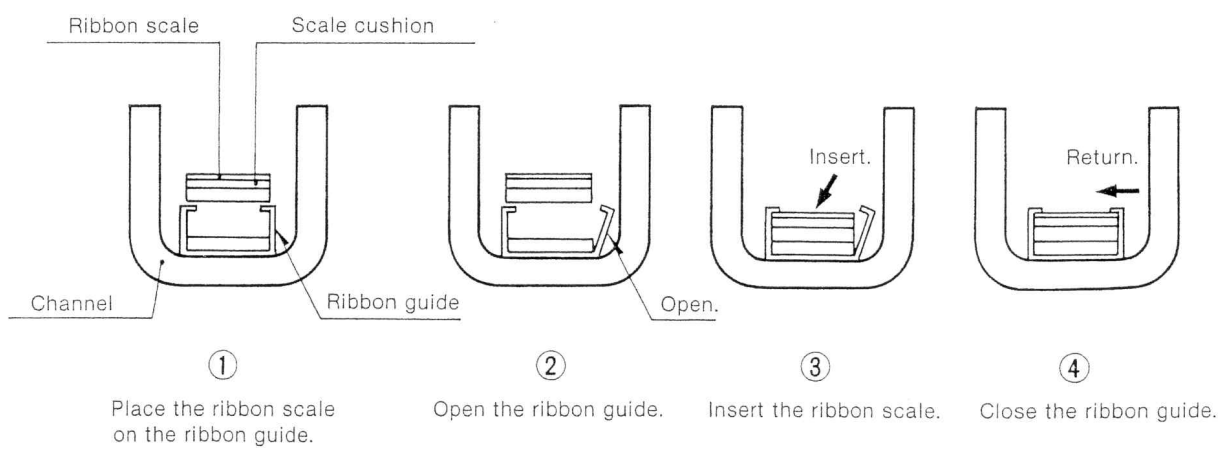
As ribbon guides are fixed in specified positions inside the channel, the ribbon scale is raised where rested on these guides.



Cut the two scale cushion projections contacting the ribbon guides.



Next, open the ribbon guide on one side, insert the ribbon scale, and return it to its original position.



Press the ribbon scale rested on the ribbon guides lightly, and check the ribbon surface returns to its original position when released.

If the ribbon is too long, cut off its end properly. Fasten these bolts adjusting the parallelism of the scale ribbon against the channel correctly. Then fix the hook to the channel with two M5 bolts.

Fix the other end of the scale ribbon in the same order. Pull the hook outward with your fingers till the slack of the scale ribbon disappears and observe if the hook can be moved outward further by 0.1% of the total length.

When the effective length is 5 m (16') reserve the margin of about $(5 + 2) = 7$ mm (0.3") between the hook and the tension receiving board. Do not fix the hook of this end as yet.

Pull the scale ribbon by turning the tension bolt as many times as the number of meters of the effective length from the point where the slack disappears. As the pitch of the tension bolt is 0.1 mm (0.004"), the scale ribbon of 5 m (16.4') effective length can be pulled outward by 5 mm (0.02") if the tension bolt is turned 5 times.

When proper tension has been given to the scale ribbon, fix the hook temporarily.

4-3-5 Adjustment of the Flatness of the Scale

Please measure the flatness of the scale, in relation to the slideway of the machine, by putting the pick-up of an electric micrometer to the center of the scale ribbon. If it is kept within 0.1 mm (0.004") (p-p), it will be all right.

If the flatness is not in the tolerance, please adjust it by putting spacers between the foot plates and the mounting seat, and keep it in the standard tolerance.

When the flatness has been kept within the tolerance, please fasten the bolts of each foot plate firmly.

4-4 Mounting of the Head Assembly

1) HA-101/HA-105

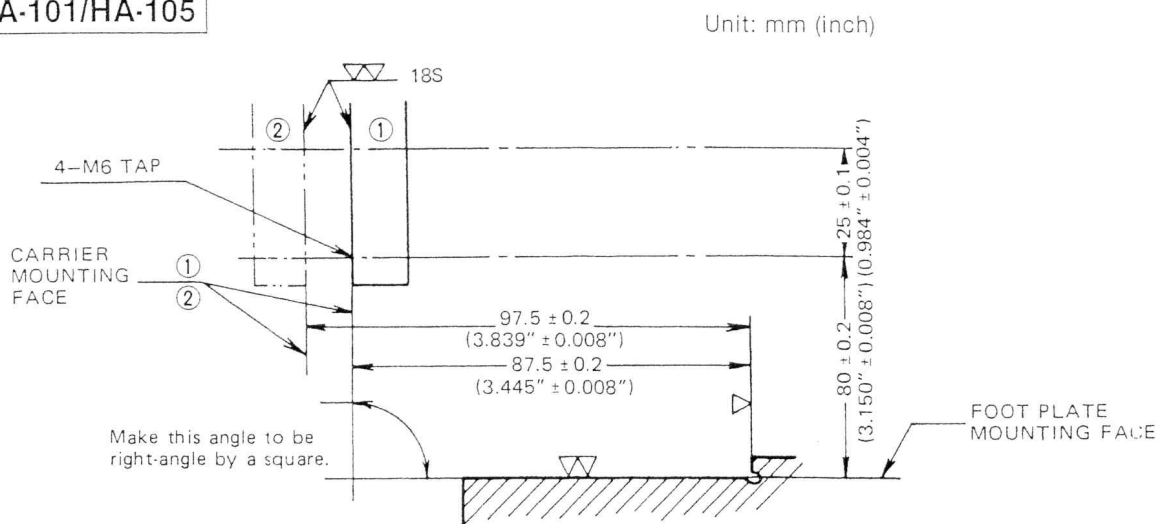


Fig. 4-4. Dimensions of the carrier mounting seat

As stated in the Chapter 3-2-3, the head will be pressed against the scale with proper pressure, if the carrier is fixed with gauge blocks put between the bottom of the carrier and the upper face of the channel.

Move the carrier mounting seat, ① or ②, to one end of the channel and clean its surface getting rid of flashes.

After wiping out dusts from the surface of the scale ribbon, from the face of the head and from the scraper with gauze and other soft cloth, mount the head assembly on its place.

As shown in Fig. 4-4, if the right measurement of 87.5 mm (3.445") can be taken in case of ① or 97.5 mm (3.839") in case of ②, it is not necessary to use the adjustment block.

Please fix the carrier to the mounting seat with $M6 \times 15$ hexagon socket head cap screws, by putting 2 gauge blocks on the upper face of the channel.

If the right angle of the carrier mounting face is not correctly taken, the gauge block cannot be stuck to the channel evenly. Even in this case, the space between the gauge block and the channel is allowable up to $30\mu\text{m}$ (0.001"), but please try to stick the gauge block to the channel as evenly as possible. (Measure the space with a thickness gauge.) When the carrier is not correctly mounted, please adjust it by inserting a spacer between the carrier and the carrier mounting seat. After the head assembly has been mounted, please remove M3 screws and pull out the gauge blocks.

And then check whether the mounting has been made correctly by returning the gauge blocks to their old places. If they can be inserted smoothly, this mounting is perfect.

After the mounting of the head assembly has been completed, please coat the whole surface of the scale ribbon with gear oil of good quality which does not contain organic solvents such as acetone, by gauze moistened with the oil.

2) HA-101V, 105V type

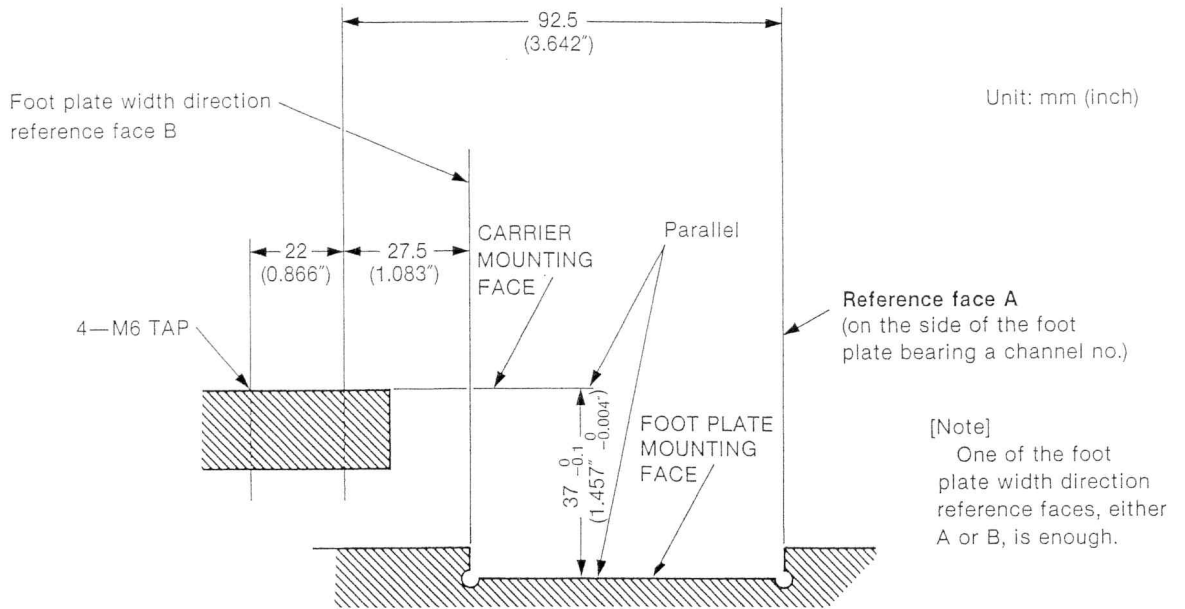


Fig. 4-5. Dimensions of the carrier mounting seat

As stated in the Chapter 3-2-3, the head will be pressed against the scale with proper pressure, if the carrier is fixed with gauge blocks put between the bottom of the carrier and the upper face of the channel.

Move the carrier mounting seat, ① or ②, to one end of the channel and clean its surface removing flashes.

After wiping out dusts from the surface of the scale ribbon, from the face of the head and from the scraper with gauze and other soft cloth, mount the head assembly on its place.

As shown in Fig. 4-5, if the measurement 92.5 mm (3.642") or 27.5 mm (1.083"), 22 (0.866") and $37 \begin{smallmatrix} 0 \\ -0.1 \end{smallmatrix} \text{ mm } (1,457 \begin{smallmatrix} 0 \\ -0.004 \end{smallmatrix})$ are correct, it is not necessary to use the adjustment block.

Please fix the carrier to the mounting seat with M6 × 15 hexagon socket head cap screw, by putting 2 gauge blocks on the upper face of the channel.

If the parallelism of the carrier mounting face is not within the specifications, the gauge block cannot be stuck to the channel evenly. Even in this case, the space between the gauge block and the channel is allowable up to $30\mu\text{m}$ (0.001"), but try to stick the gauge block to the channel as evenly as possible. (Measure the space with a thickness gauge.) When the carrier is not correctly mounted, please adjust it by inserting a spacer between the carrier and the carrier mounting seat. After the head assembly has been mounted, remove M3 screws and pull out the gauge blocks.

And then check whether the mounting has been made correctly by returning the gauge blocks to their old places. If they can be inserted smoothly, this mounting is perfect.

After the mounting of the head assembly has been completed, please coat the whole surface of the scale ribbon with gear oil of good quality which does not contain organic solvents such as acetone, by gauze moistened with the oil.

4-5 Connection to the Digital Display Unit or Detector

After having grounded the Digital Display Unit or Detector to the machine, connect the Digital Display Unit or Detector to the head and switch on the counter. And then check the head output by a syncroscope and adjust the phase difference ($\lambda/4$) between Channel 1 and Channel 2.

Make the rough adjustment of $\lambda/4$ by turning the eccentric shaft and the fine adjustment by the Digital Display Unit or Detector, both in parallel. The adjustment method and the adjustment places differ from one Digital Display Unit or Detector to another. As to the details of the adjustment, please refer to the instruction manual of each Digital Display Unit or Detector.

After the adjustment of $\lambda/4$ has been completed, please fasten the head holder onto the carrier with four $M4 \times 10$ hexagon socket head cap screws. By moving the head back and forth within the effective length of the scale, check the phase difference of $\lambda/4$ and the output.

4-6 Accuracy Adjustment

The scale ribbon has been pulled outward by 0.1% of the effective length in the clause 4-3-4. Actually there is a margin of 100 mm (4") at both ends of the effective length; and this margin must also be pulled by 0.1%; make this adjustment carefully using a block gauge. It is necessary to remove the factors which cause errors as it is required to adjust the length of the scale correctly; pay your attention not to include errors caused by meanders, play and back-lash of the machine into the measurement.

By putting the block gauge as near to the Magnescale as possible, errors due to meander and play can be lessened. When measuring the starting point and the ending point, errors due to back-lash can be removed if the measurement is always made in one direction.

Further it is necessary to put the block gauge in parallel with the slideway of the machine.

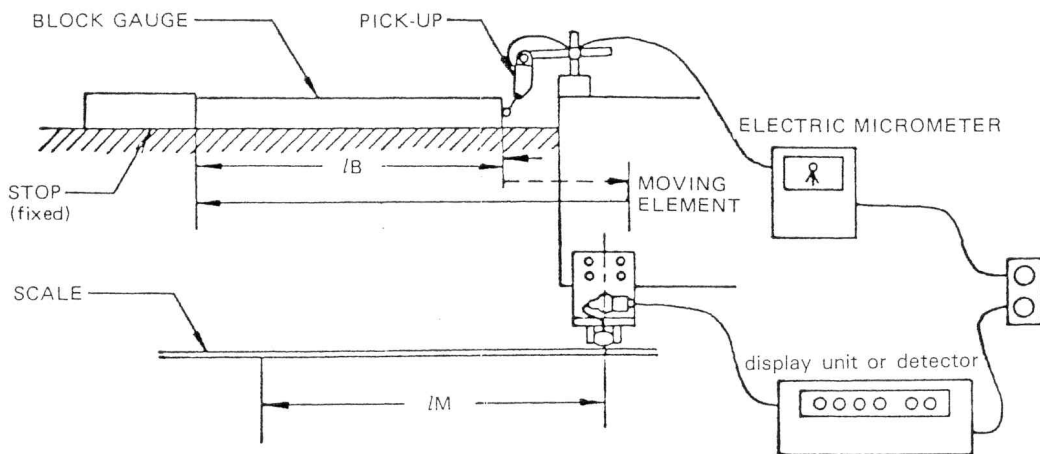


Fig. 4-6

If the value displayed on the display unit or detector is bigger than the actual length of the block gauge, it means that the head has read more scale signal than necessary. In other words, pitch of the scale signal is contracted; therefore, it becomes necessary to pull the scale ribbon outward a little with a tension bolt. On the other hand, if the displayed value is smaller, it means that the scale ribbon is pulled outward too much; in this case, loosen a tension bolt a little. If you repeat this operation several times, you can complete this accuracy adjustment. After the adjustment, fix the hook to the channel and apply screw adhesive to each bolt or screw.

4-7 Mounting of the Dust Cover

Mount the dust cover referring to "3-4 Dust Cover", Fig. 3-2.

- (1) Insert dust lip A between the hold plate and the channel so that its flange touches the top surface of the channel.
- (2) Fasten the +PSW M4x10 screw while pressing dust lip A down.
- (3) Insert the dust cover between the hex. socket-head cap screw and the channel.
- (4) Fasten the M4x8 hex. socket-head cap screw.

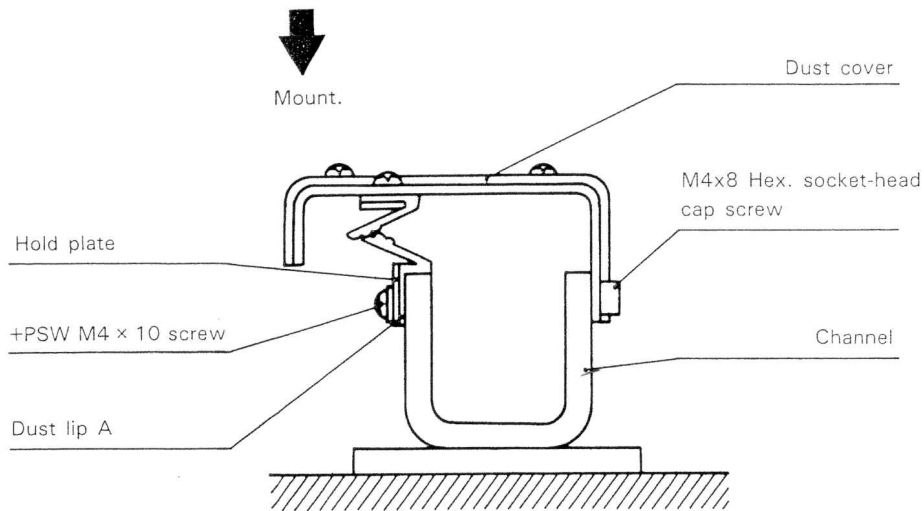


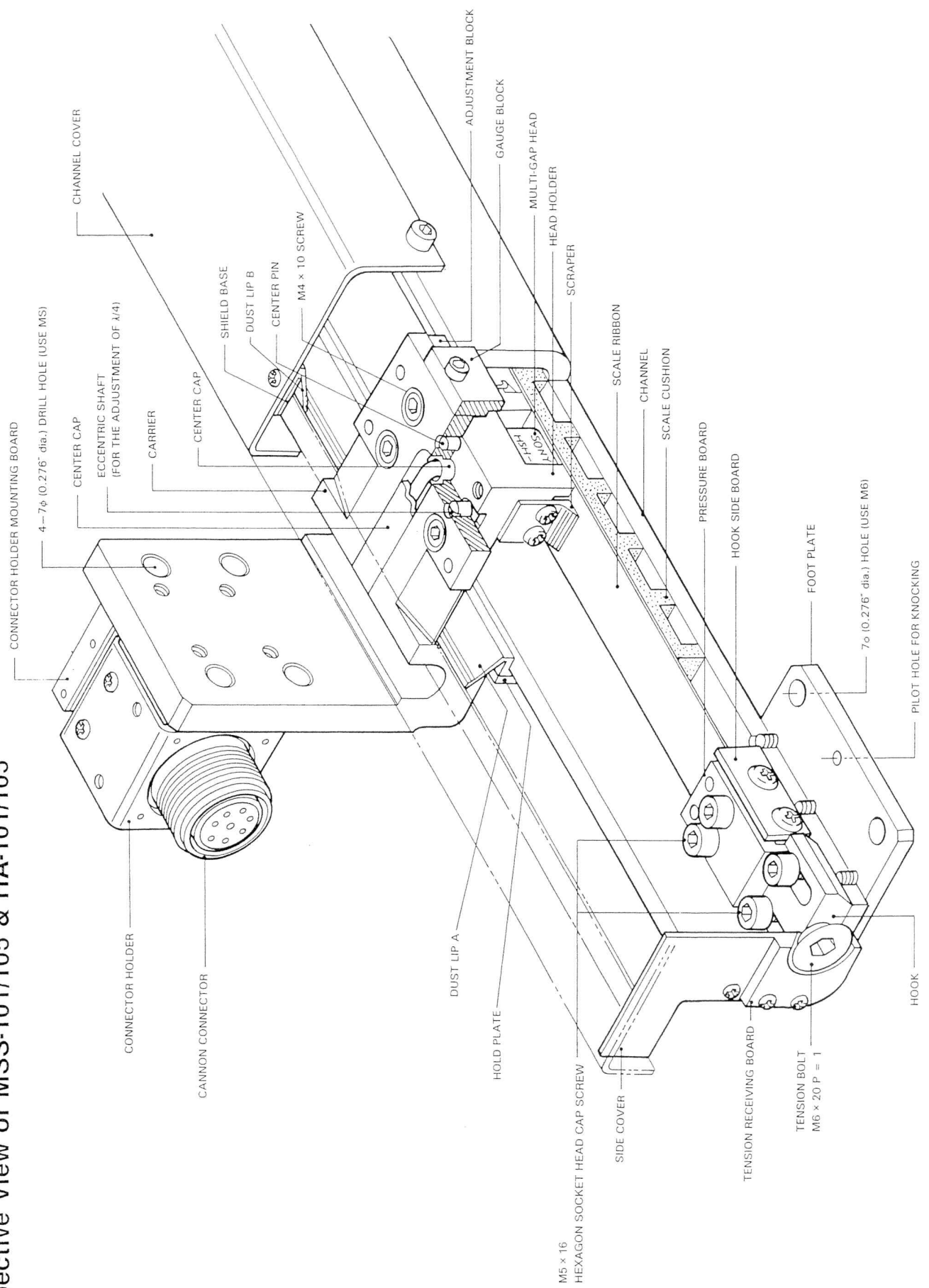
Fig. 4-7

5. PERIODICAL INSPECTION

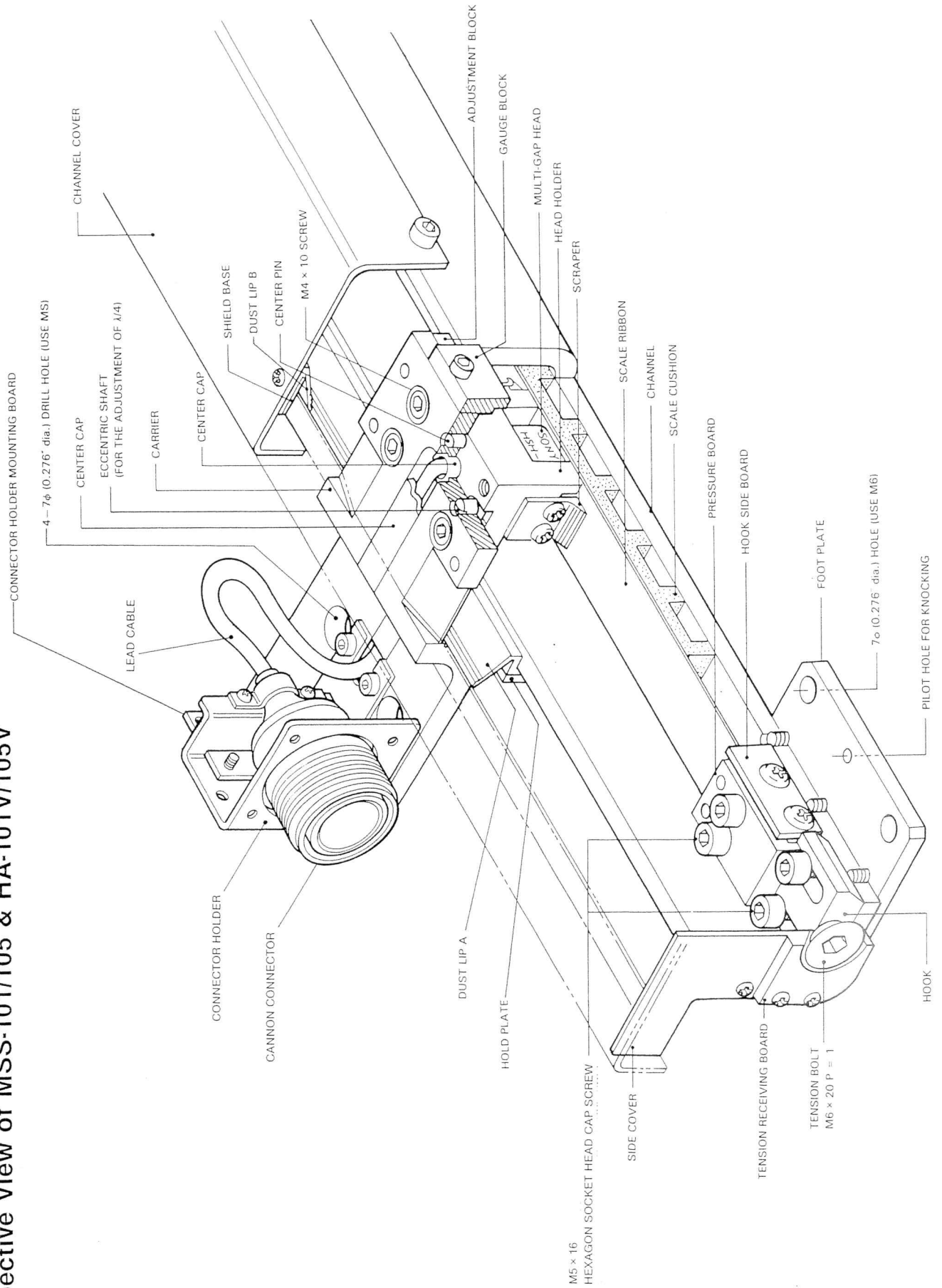
Though this scale has been made with great care to satisfy various conditions, please make the following inspections periodically so that it may maintain its accuracy for a long time.

- By removing the channel cover, please inspect the surface of the scale ribbon. If there is no scratch on the surface, paint the surface lightly with gear oil and put the channel cover to its place. If there is any scratch, please remove the whole dust cover and remove the cause.
- The channel has been designed to be dust-proof, but when dusts enter it, remove them after taking off the dust cover. When cleaning the inside of the channel, be careful not to injure the scale ribbon.

Perspective View of MSS-101/105 & HA-101/105



Perspective View of MSS-101/105 & HA-101V/105V



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