Mitutoyo

Assembly Type ABSOLUTE Linear Scale

ABS AT1103A
ABS AT1143
ABS AT1153

User's Manual

- Instructions for use -

Read this User's Manual thoroughly before operating the instrument. After reading, retain it close at hand for future reference.
This English language version of the User's Manual contains the original instructions.

No. 99MBE094B1
Date of publication: November 1, 2018 (1)

Correspondence of product names and model numbers

Product name	Model number
Assembly Type ABSOLUTE Linear Scale	ABS AT1103A ABS AT1143 ABS AT1153

Notice regarding this document

- Mitutoyo Corporation assumes no responsibilities for any damage to the instrument, caused by its use not conforming to the procedure described in this User's Manual.
- Upon loan or transfer of this instrument, be sure to attach this User's Manual to the instrument.
- In the event of loss or damage to this manual, immediately contact a Mitutoyo sales office or your dealer.
- Before operation of the instrument, thoroughly read this manual to comprehend its contents.
- Particularly, for full understanding of information, carefully read "Safety Precautions" and "Precautions for Use" at the outset of this manual before using the instrument.
- The contents in this manual are based on the information current as of November, 2018.
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- The corporation, organization and product names that appear in this manual are their trademarks or registered trademarks.

CONVENTIONS USED IN MANUALS

Conventions used in Mitutoyo's User's Manual are roughly divided into three types (safety reminders, prohibited and mandatory actions, and referential information and locations). Moreover, these safety symbols include general warnings and specific warnings. Specific warning symbols are provided with concrete pictograms inside of them.

■ Safety reminder conventions and wording warning against potential hazards

General	**DANGER**	Indicates an immediately hazardous situation which, if not avoided, will result in serious injury or death.
	WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.
	CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor injury.
	NOTICE	Indicates a potentially hazardous situation which, if not avoided, may result in property damage.
Specific		Alerts the user to a specific hazardous situation that means "Caution, risk of electric shock".

■ Conventions and wording indicating prohibited and mandatory actions

General		Indicates concrete information about prohibited actions.
		Indicates concrete information about mandatory actions.
Specific		Indicates that grounding needs to be implemented.

■ Conventions and wording indicating referential information or referential locations

Tips Indicates referential information such as that for when the operating methods and procedures which are printed in these sentences are to be applied to specific conditions.

Indicates referential locations if there is information that should be referred to in this document or an extraneous manual.

E.g.: For further details on, refer to "1.2 Appellation and Functions of Each Part" on page 2.

Safety Precautions

Observe the following descriptions to make full use of the performance of this product:

⚠CAUTION

- Read this User's Manual thoroughly before operating the instrument.
- Before connecting this product to the main unit of the system, make sure that the power for the control unit is turned off.
- To maintain the shielding effect, tighten firmly the screws of the connectors of each connecting cable. Also, to prevent defective contacts, do not touch the connecting terminals of the connectors with bare hands.

Electromagnetic Compatibility (EMC)

This product complies with the EMC Directive. Note that in environments where electromagnetic interference exceeds EMC requirements defined in this directive, appropriate countermeasures are required to ensure product performance.

EMC Directive EN61326-1

Immunity test requirement: Clause6.2 Table 2

Emission limit: Class B

For the EU Directive

Authorized representative and importer in the EU:
Mitutoyo Europe GmbH
Borsigstrasse 8-10,41469 Neuss,Germany

Required Environment for Installation

■ Vibration

To install this product unit in a machine, select a location where there is as little vibration as possible.

If this product is used for an extended period of time in a location where there is a substantial amount of vibration, the built-in precision parts may be damaged, thereby adversely influencing the performance of this product.

■ Shock, dust, water/oil protection

To protect the scale unit from being directly exposed to machining oil and chips, or from being bumped by a workpiece, etc., prepare a cover that protects the entire scale unit.

■ Ambient temperature and humidity

This product should be operated in an environment where the temperature is between 0 °C and 50 °C and where the relative humidity is between 20 % and 80 % RH. Do not use this product in a place where sudden changes in temperature or humidity are observed.

Export Control Compliance

This product falls into the Catch-All-Controlled Goods and/or Catch-All-Controlled Technologies (including Programs) under Category 16 of Appended Table 1 of Export Trade Control Order or under Category 16 of Appended Table of Foreign Exchange Control Order, based on Foreign Exchange and Foreign Trade Law of Japan.

If you intend to re-export the product from a country other than Japan, re-selling the product in a country other than Japan, or re-providing the technology (including program), you shall observe the regulations of your country.

Notes on Export to EU Member Countries

When you intend export of this product to any of the EU member countries, you may be required to provide User's Manual(s) in English and EU Declaration of Conformity in English (under certain circumstances, User's Manual(s) in the destination country's official language and EU Declaration of Conformity in the destination country's official language). For detailed information, please contact Mitutoyo in advance.

Disposal of Products outside the European Union and other European Countries

Please follow the official instruction in each community and country.

Disposal of Old Electrical & Electronic Equipment (applicable in the European Union and other European countries with separate collection systems)

This symbol on the product or on its packaging is based on the WEEE Directive (Directive on Waste Electrical and Electronic Equipment), which is a regulation in EU member countries, and indicates that this product shall not be treated as household waste.

To reduce environmental impact and minimize the volume of landfill, please cooperate in reuse and recycling.

For information on how to dispose of the product, please contact your dealer or the nearest Mitutoyo sales office.

China RoHS Compliance Information

This product meets China RoHS requirements. See the table below.

产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
本体	○	○	○	○	○	○
电气设备部分	×	○	○	○	○	○
配件	○	○	○	○	○	○

本表格依据 SJ/T 11364 的规定编制。

○: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

×: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

环保使用期限标识，是根据电器电子产品有害物质限制使用管理办法以及，电子电气产品有害物质限制使用标识要求(SJ/T11364–2014)，制定的适用于中国境内销售电子电气产品的标识。

电子电气产品只要按照安全及使用说明内容，正常使用情况下，从生产月期算起，在此期限内，产品中含有的有毒有害物质不致发生外泄或突变，不致对环境造成严重污染或对其人身、财产造成严重损害。

产品正常使用后，要废弃在环保使用年限内或者刚到年限的产品时，请根据国家标准采取适当的方法进行处置。

另外，此期限不同于质量／ 功能的保证期限。

Warranty

In the event that this product should prove defective in workmanship or material, within one year from the date of original purchase for use, it will be repaired or replaced, at Mitutoyo's option, free of charge upon its prepaid return to Mitutoyo, without prejudice to the provisions of the Mitutoyo Software End User License Agreement.

If this product fails or is damaged for any of the following reasons, it will be subject to a repair charge, even if it is still under warranty.

- Failure or damage owing to fair wear and tear
- Failure or damage owing to inappropriate handling, maintenance or repair, or to unauthorized modification
- Failure or damage owing to transport, dropping, or relocation of the instrument after purchase
- Failure or damage owing to fire, salt, gas, abnormal voltage, lightning surge, or natural disaster
- Failure or damage owing to use in combination with hardware or software other than those designated or permitted by Mitutoyo
- Failure or damage owing to use in ultra-hazardous activities

This warranty is effective only where the instrument is properly installed and operated in conformance with the instructions in this manual within the original country of the installation.

EXCEPT AS SPECIFIED IN THIS WARRANTY, ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS, AND WARRANTIES OF ANY NATURE WHATSOEVER INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT OR WARRANTY ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE, ARE HEREBY EXCLUDED TO THE MAXIMUM EXTENT ALLOWED BY APPLICABLE LAW.

You assume all responsibility for all results arising out of its selection of this product to achieve its intended results.

Disclaimer

IN NO EVENT WILL MITUTOYO, ITS AFFILIATED AND RELATED COMPANIES AND SUPPLIERS BE LIABLE FOR ANY LOST REVENUE, PROFIT, OR DATA, OR FOR SPECIAL, DIRECT, INDIRECT, CONSEQUENTIAL, INCIDENTAL, OR PUNITIVE DAMAGES HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY ARISING OUT OF THE USE OF OR INABILITY TO USE THIS PRODUCT EVEN IF MITUTOYO OR ITS AFFILIATED AND RELATED COMPANIES AND/OR SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

If, notwithstanding the foregoing, Mitutoyo is found to be liable to you for any damage or loss which arises out of or is in any way connected with use of this product by you, in no event shall Mitutoyo's and/or its affiliated and related companies' and suppliers' liability to you, whether in contract, tort (including negligence), or otherwise, exceed the price paid by you for the product only.

The foregoing limitations shall apply even if the above-stated warranty fails in its essential purpose.

BECAUSE SOME COUNTRIES, STATES OR JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR THE LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, IN SUCH COUNTRIES, STATES OR JURISDICTIONS, MITUTOYO'S LIABILITY SHALL BE LIMITED TO THE EXTENT PERMITTED BY LAW.

Contents

1 Outline

This chapter describes the features of this product, appellations and functions of each part, and the flow of the main tasks to use this product.

1.1 Features

The linear scale will output a moving amount and displacement as digital amounts based on a linear scale graduated in certain fixed pitches.

This can precisely measure moving amounts of various instruments including electronic/semiconductor manufacturing units and machine tools.

This product is an absolute linear scale which utilizes superior electromagnetic induction resistance to the environment.

This product measures all position coordinates from the fixed origin regardless of coordinates measured just before the measurement.

Also, this product does not require an origin return step at the starting time of work or during a power failure, and does not require batteries for backup, which will contribute much labor saving.

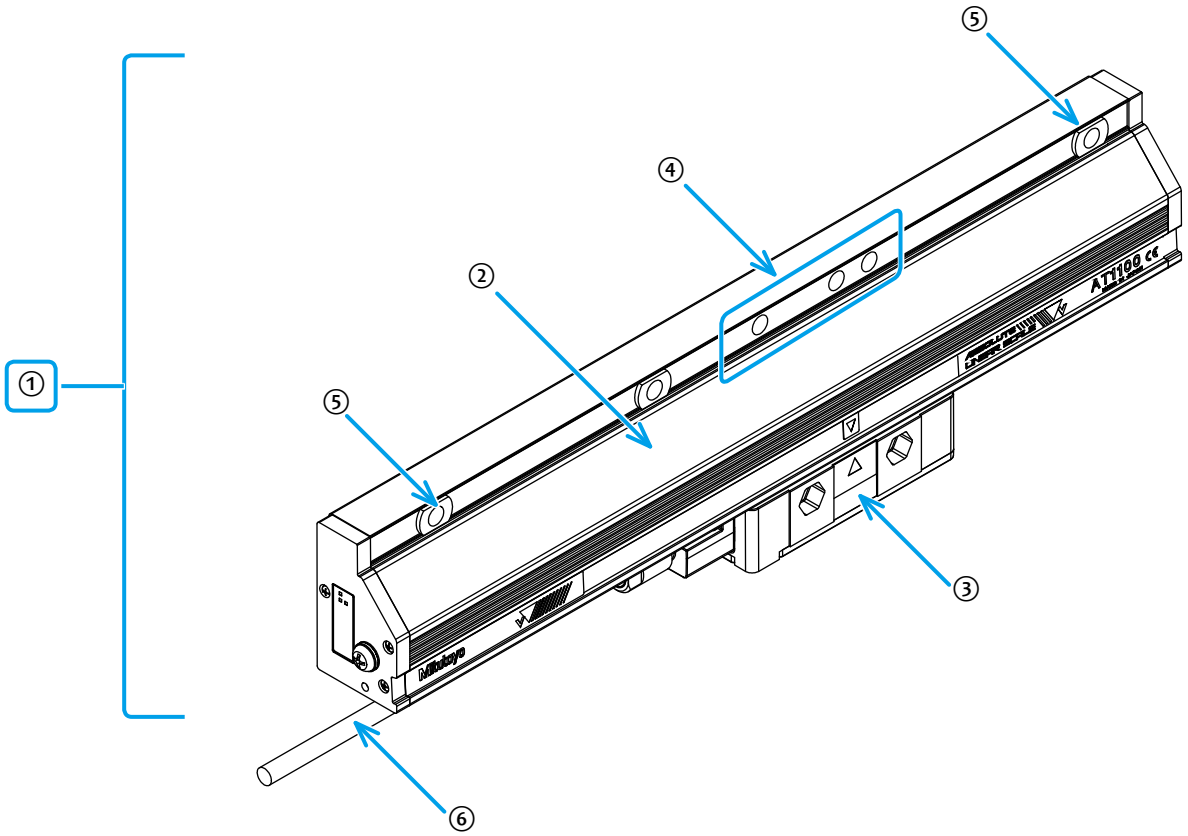
Moreover, this product has excellent dustproof/waterproof performance, which makes it possible for you to use this product in harsh environments where chips or cutting oil occur.

We provide more than one type of product with different appearances or sizes depending on the effective length.

1.2 Appellation and Functions of Each Part

We call this product the "scale unit" generically. The scale unit is composed of the scale main unit and the detector head.

The following is the explanation as to appellation and functions of each part.



①	Scale unit	The generic appellation of this product. Indicates the state that the detector head has been mounted on the scale main unit.
②	Scale main unit	Represents the linear scale's main unit.
③	Detector head	The part to detect a measurement point.
④	Full-fixing part	The datum position for length variation due to changes in temperature (reference point for the scale's mechanical expansions and contractions due to changes in temperature). The point to be fixed first during installation onto the machine main unit.
⑤	Elastic fixing parts	The point to be fixed later during installation onto the machine main unit.
⑥	Signal cable (option)	The cable to connect this product and the connection destination controller. You can connect the signal cable to either left or right side of the detector head.

1.3 The Flow of Main Tasks

The following chart shows the flow of preliminary preparation and installation onto the machine main unit as tasks to use this product.

■ Preliminary preparation

Designing the Mounting Surface of the Scale Unit

📖 "2.4 Precautions on Mounting Design of Scale Unit"

Opening the Package

Checking the Components and the Supplied Accessories

📖 "2.2 Checking the Scale Unit and the Supplied Accessories"

Preparing the Signal Cable

📖 "2.3 Preparing the Signal Cable"

■ Installation onto the machine

Mounting the Scale Main Unit and Adjusting the Position

📖 "3.2 Mounting the Scale Main Unit and Adjusting the Position"

Mounting the Detector Head and Adjusting the Position

📖 "3.3 Mounting the Detector Head and Adjusting the Position"

Connecting and Fixing the Signal Cable

📖 "3.4 Connecting and Fixing the Signal Cable"

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2 Setup for Mounting

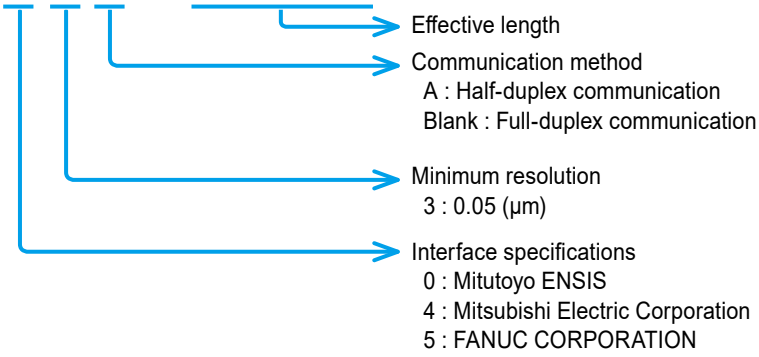
This chapter describes the preliminary preparation for mounting this product onto the machine.

2.1 Checking the Equipment Model

This document describes the models configured as shown below.

First, be sure to check which model will be used.

ABS AT11 □ 3 □ — □□□□



● Interface specifications and model

Applicable system		Scale model
FANUC CORPORATION	Serial α Interface	ABS AT1153
	Serial αi Interface	
Mitsubishi Electric Corporation	Control unit, MITSUBISHI CNC series	ABS AT1143
	MDS-D/MDS-DH series	
Mitutoyo ENSIS interface compatible servo amplifier		ABS AT1103A

Tips

- Interface specifications
  For connectable NC devices (servo-amplifier or controller), inquire with each manufacture.
- Effective length
  For the details of the effective length, refer to "4 Specifications" on page 29.

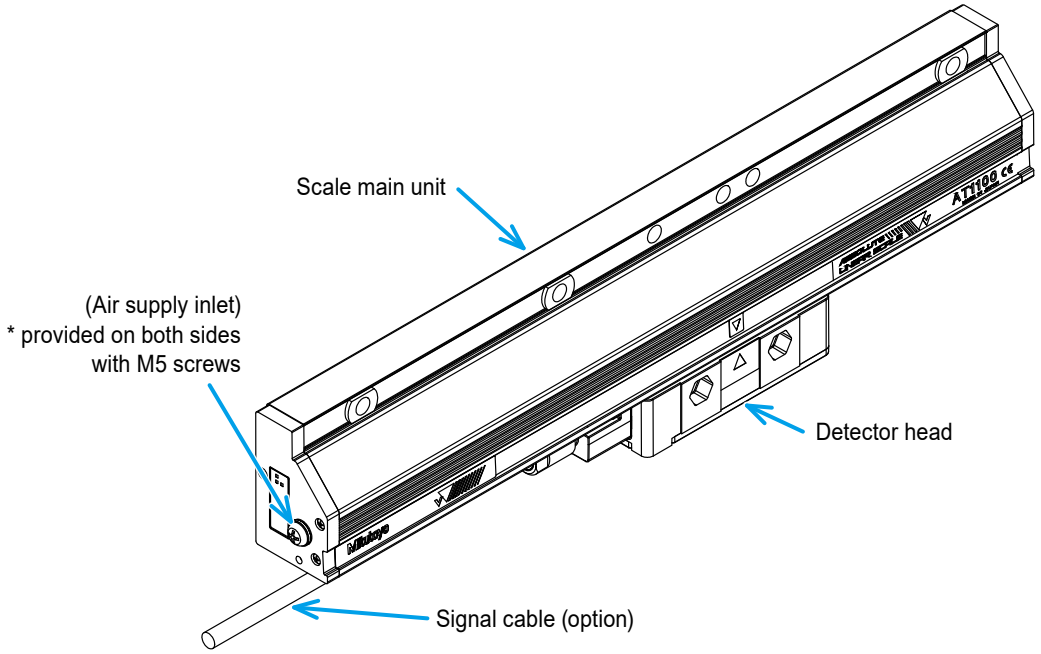
2.2 Checking the Scale Unit and the Supplied Accessories

A configuration of this product is shown below.

First, make sure that there are no missing components in the supplied accessories.

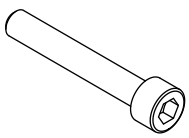
Also, check for any damage that may have occurred during transportation.

If you have any questions or concerns about the product, please contact your dealer or the nearest Mitutoyo sales office/service center.

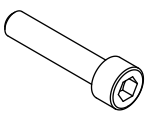


	Items	Quantity	Note
1	Scale unit	1 axis	
2	Accessories	1 set	Mounting screws, etc.
3	User's Manual (this document)	1 copy	
4	Warranty card	1 copy	
5	Inspection certificate	1 copy	

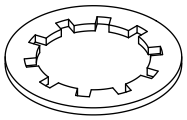
● Accessories (mounting screws, etc.)



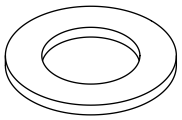
Hex socket head cap screw M6x40



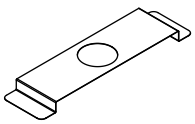
Hex socket head cap screw M6x30



Internal teeth shake proof washer 6.6×10.2×0.5



Nominal 6 small round flat washer



Frame holding spring

For the details of the quantity of the accessories, refer to "6.1 Quantity of the Supplied Accessories for Mounting" on page 53.

2.3 Preparing the Signal Cable

This section describes the configuration of the signal cable to be used with this product.

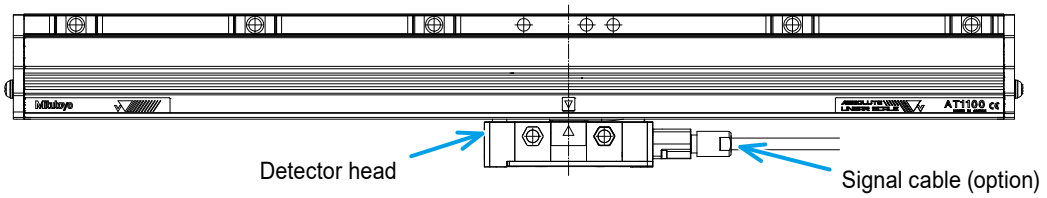
The signal cables are separately sold. Select an appropriate one according to your specifications.

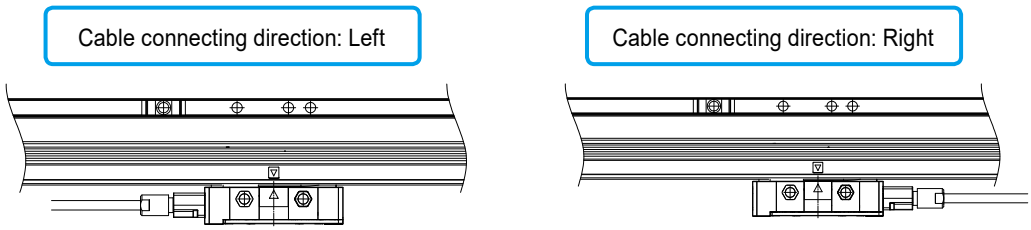
2.3.1 Configuration of the Signal Cable

Connect the signal cable to the electric component with one of the connectors provided on either side of the detector head.

For the details of the connecting method, refer to "3.4 Connecting and Fixing the Signal Cable" on page 24.

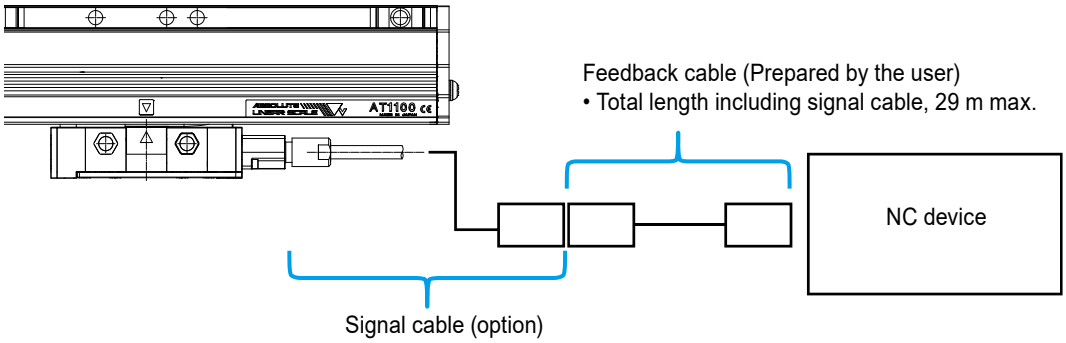
For the specifications of the signal cable, select an appropriate cable length and output connector type.





Selections

Items	Specifications
Cable length	1 m / 3 m / 6 m / 9 m / 12 m (The 12 m has the discrete-wire specification only)
Cable material	PVC sheath ø6.5, no conduit PVC sheath ø10.6, with conduit (only Mitutoyo ENSIS connector)
Output connector	(1) Discrete-wire specifications (2) FANUC connector specifications (3) Mitsubishi connector specifications (4) Mitutoyo ENSIS connector specifications



Tips

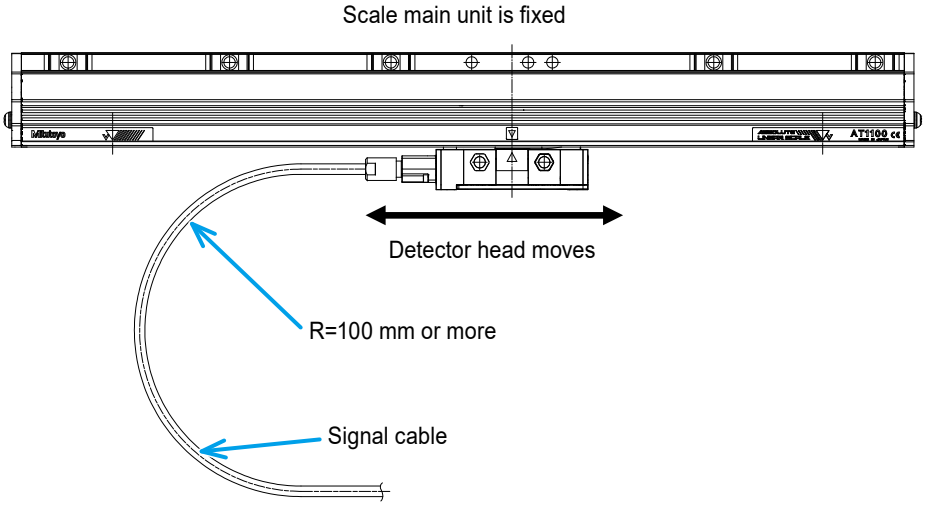
- The signal cable is an option. Select an appropriate one according to your requirements.
- For the specifications of the signal cable output signals, etc., refer to "4 Specifications" on page 29.
- When connecting additional cable at your need, make sure that the total length together with the signal cable is 29 m at maximum.

2.3.2 Bend Radius of the Signal Cable

The bend radius of the cable shall be kept within the following range.
The bend radius indicated below also applies to the case when the signal cable is extended.

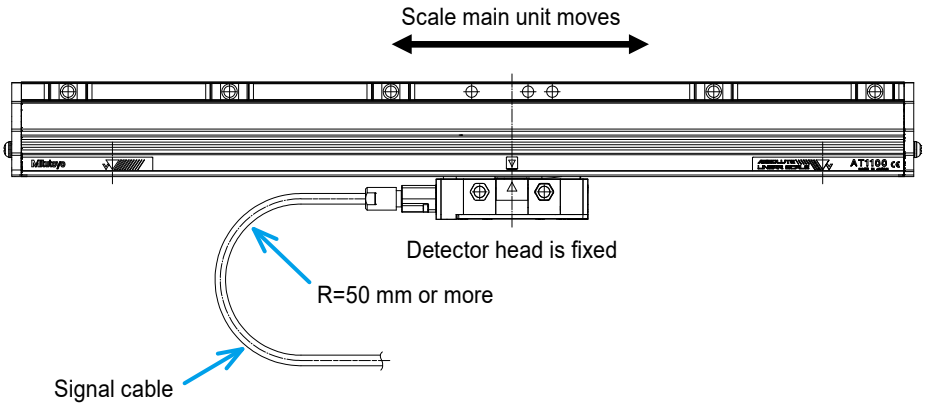
■ When the detector head moves (cable is repeatedly bent)

→ Bend radius of the cable: 100 mm or more



■ When the detector head is fixed (cable is fixed)

→ Bend radius of the cable: 50 mm or more



NOTICE

If a cable bend radius exceeds the allowable range, it could result in breakage of the wires or other problems.
Also, note with caution that the scale is no longer guaranteed in such a case.

Tips

- The signal cable is an option. Also, the cable clamps or other fasteners are not supplied as accessories, therefore, they must be prepared by the user.
- For the details of how to fix the cable, refer to "3.4.3 Precautions on Fixing the Cables" on page 27.

2.4 Precautions on Mounting Design of Scale Unit

The following describes some design points regarding the "mounting surface" for installing the scale unit onto the machine.

In addition, refer to "4.7 External View and Dimensional Drawings of the Scale Main Unit".

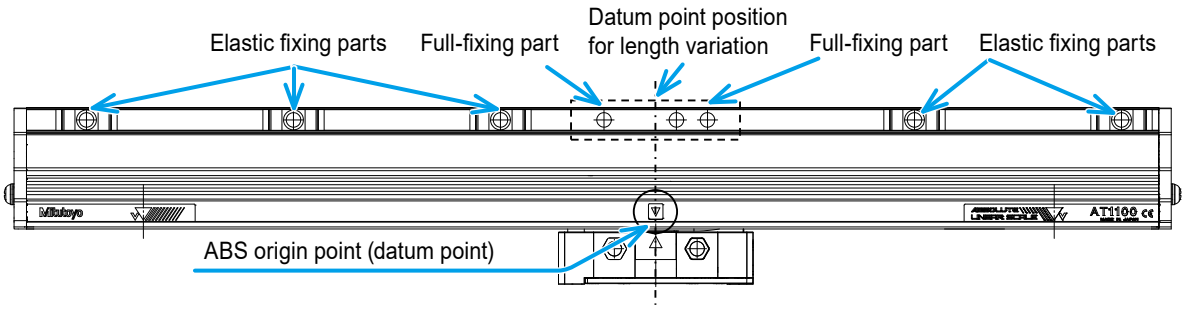
2.4.1 Datum Point Position for the Length Variation and ABS Origin Point

The fixing parts of the scale unit are divided into the full-fixing parts and the elastic fixing parts.

The "datum point position for length variation", which represents the reference point for the scale's mechanical expansions and contractions due to changes in temperature, is shown below.

Note with caution that users are not able to change this datum point position.

The "ABS origin" is electrically set at the "datum point position for length".

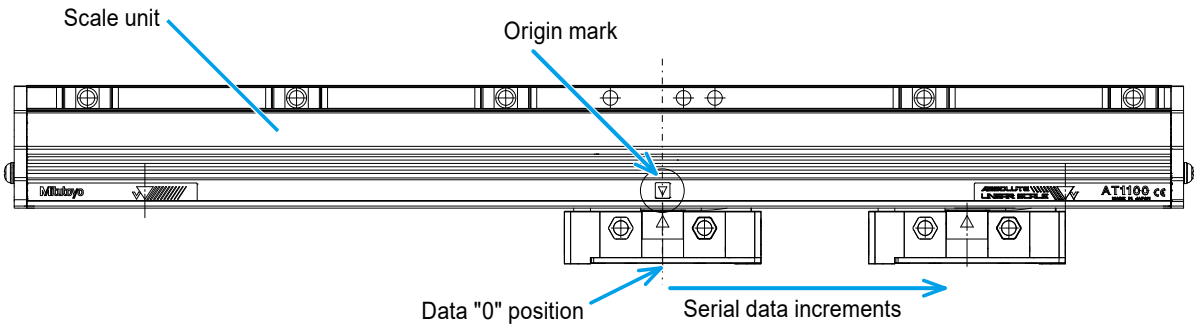


Tips

- The quantity of the elastic fixing parts is different depending on the effective length.
- The elastic fixing parts cannot be moved horizontally.
- The system's overall temperature characteristics are stabilized by setting the behavior of the center position in regard to the machine unit's temperature change and the scale unit's datum point position for length variation closer.

2.4.2 Counting Direction

When the detector head is moved rightward in the diagram below, the output serial data will increase the count (i.e., to the + side).

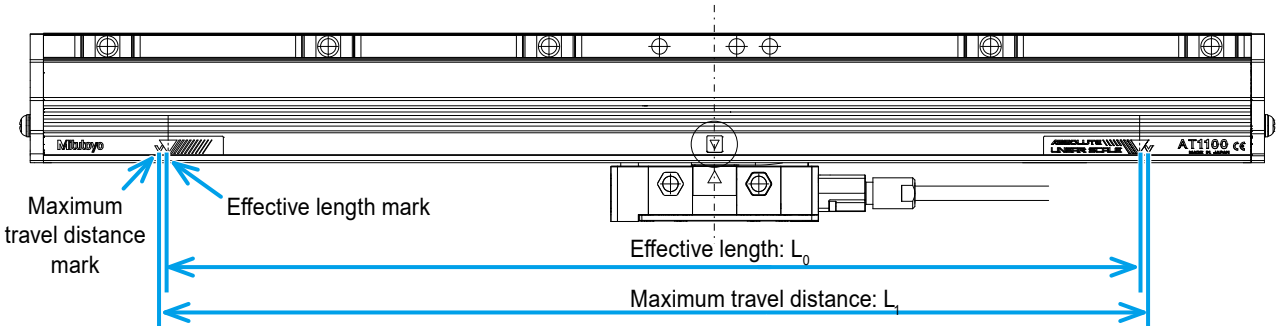


2.4.3 Checking the Maximum Travel Distance and Effective Length

Make sure that the scale's maximum travel distance (L_1) is greater than the maximum travel distance of the machine.

For the details of the effective length (L_0) and the maximum travel distance (L_1), refer to "4.7 External View and Dimensional Drawings of the Scale Main Unit" on page 48.

Also, note that the specified accuracy guaranteed range is limited to within the effective length.



Tips

- When checking the travel range of the scale installed on the machine, make sure the maximum travel range of the machine is within the L_1 shown above and that the required accuracy range is within the L_0 shown above.
- If the maximum travel distance or the effective length of the scale is insufficient, scale size change may be necessary.

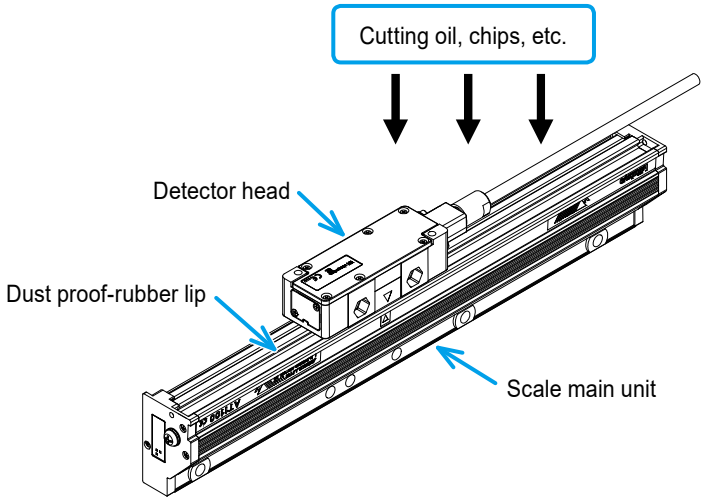
2.4.4 Scale Main Unit Mounting Directions and Cover Preparations

When installing this product, be sure to install the cover so that cutting oil, chips, etc. do not splatter onto the scale main unit.

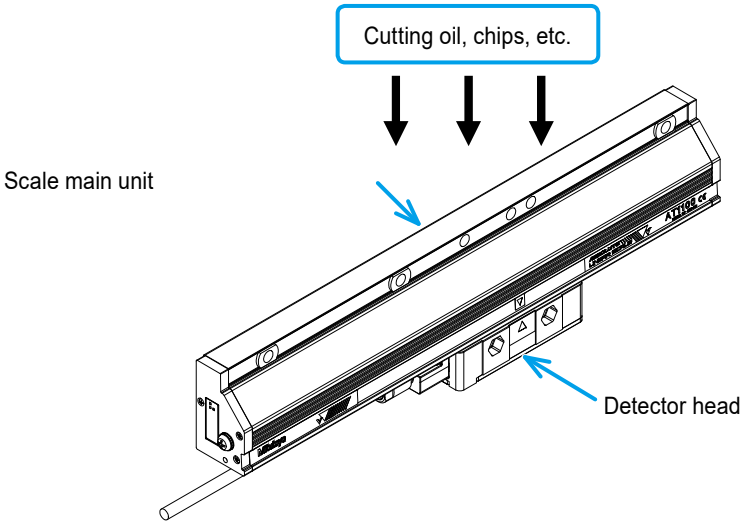
Only the dust proof-rubber lips are used to protect the scale opening side from the intrusion of foreign objects.

Therefore, when deciding the mounting direction of the scale main unit, give consideration to the splattering directions of the cutting oil, chips, etc., since the opening side poses a greater hazard of foreign matter intrusion than the other sides.

■ The direction from which the cutting oil, chips, etc. comparatively tend to intrude

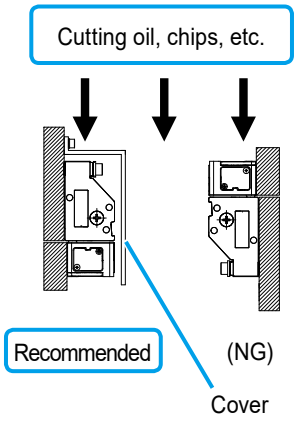


■ The direction from which the cutting oil, chips, etc. comparatively tend not to intrude

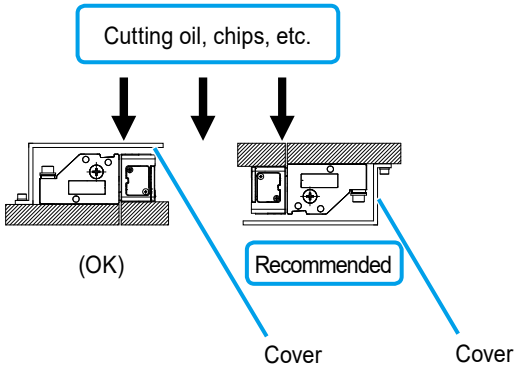


■ Mounting direction of scale main unit

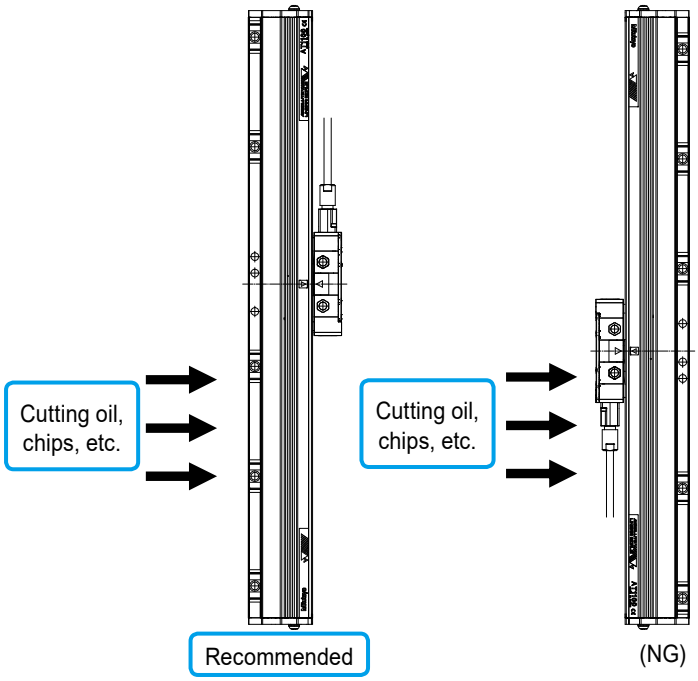
● Vertical direction



●Horizontal direction



● Longitudinal direction



2.4.5 Precautions on Designing the Mounting Surface

The following describes precautions on designing the mounting surface.

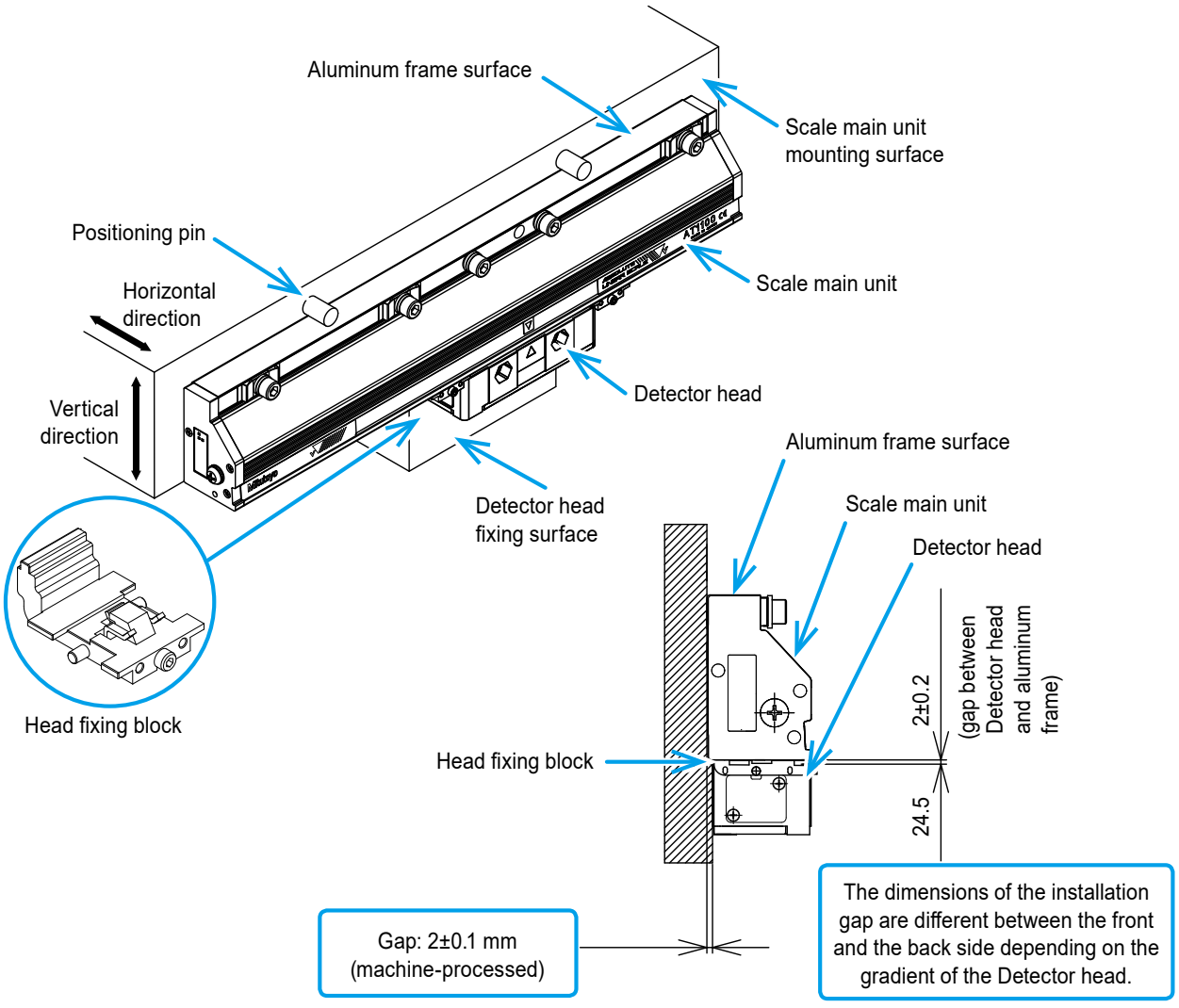
For details of the mounting specifications, refer to "4.7 External View and Dimensional Drawings of the Scale Main Unit" on page 48.

For details of the mounting procedures, refer to "3 Mounting onto the Machine" on page 15.

Precautions

- The mounting surfaces of the scale main unit and the detector head must be machine-processed and the flatness must be 0.05/500 or below.
- There is a gap between the scale main unit and the detector head mounting surfaces, therefore, remove it by the machine processing so that the gap is within the processing tolerance of 2±0.1 mm. When adjusting the position by inserting a spacer, etc., be sure to measure the gap before mounting the scale.
- When mounting the scale main unit, the position must be adjusted in the vertical direction, as indicated in the figure below.
  It is recommended to use positioning pins, etc. to simplify the position adjustment.
  Note that the vertical reference for positioning the scale main unit is the aluminum frame surface.
- Use the head fixing block to adjust the clearance between the scale main unit and the detector head.

For the details of the mounting method, refer to "3 Mounting onto the Machine" on page 15.

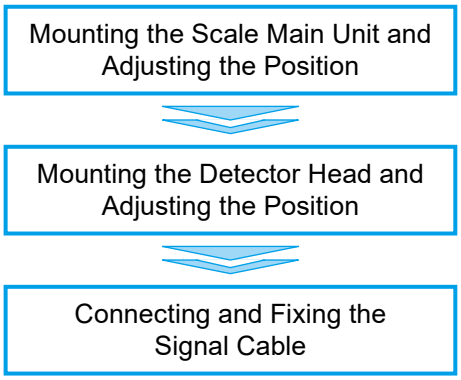


3 Mounting onto the Machine

This chapter describes the procedures, methods, and precautions required when mounting this product onto the machine.

3.1 Procedure for Mounting onto the Machine

The following describes the summary of the procedure for installing this product onto the machine.



Details of each step are described in the following pages.

3.2 Mounting the Scale Main Unit and Adjusting the Position

3.2.1 Checking the Mounting Surface, etc.

Refer to 📖 "2.4.5 Precautions on Designing the Mounting Surface" and "4.7 External View and Dimensional Drawings of the Scale Main Unit", and make sure that the positional accuracy and the surface accuracy between the scale main unit and the detector head mounting surfaces are within the specified ranges.

3.2.2 Mounting the Scale Main Unit

1 Temporarily fixing the scale

Using the supplied fixing screws, temporarily fix the scale main unit onto the scale main unit fixing surface of the machine.

(Tight enough so that the scale does not move when the hands are released.)

At this point, do not fix the detector head.

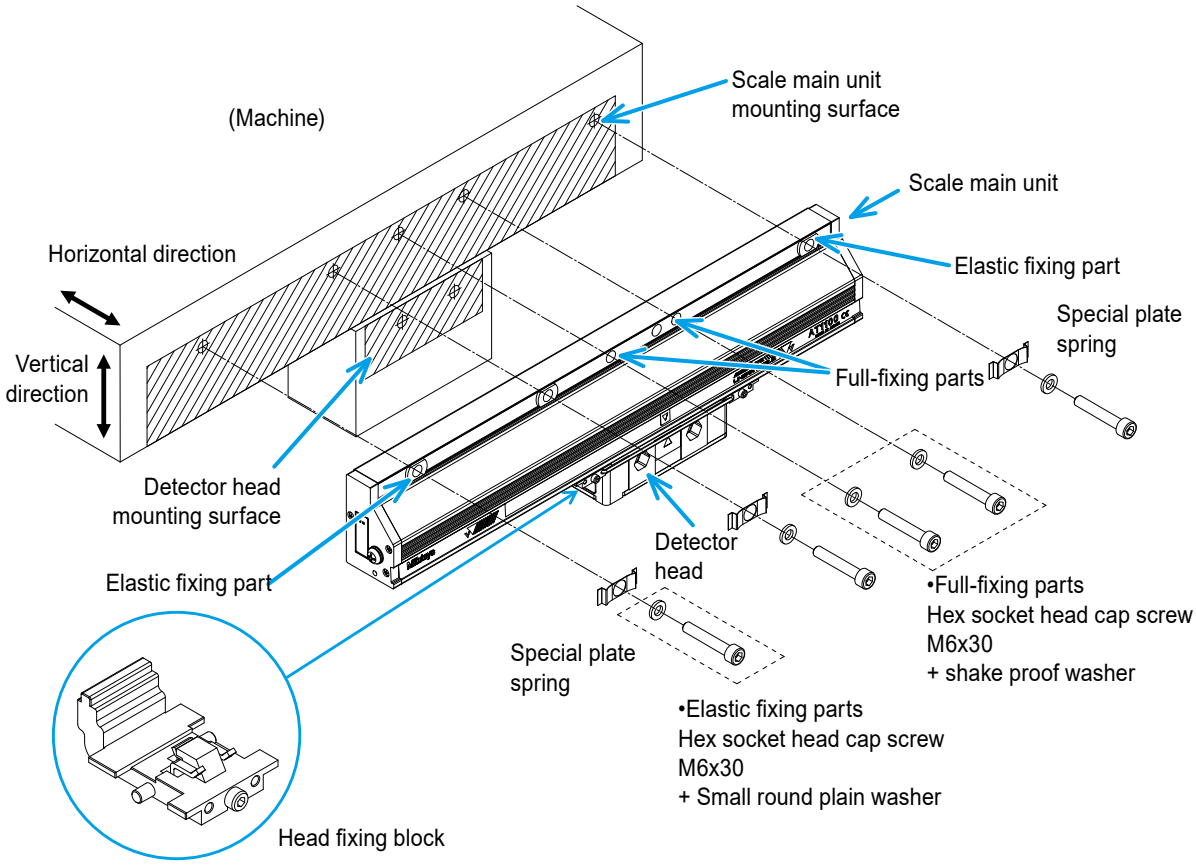
(Screws and washers, etc. to be used)

- Full-fixing part → Datum point position for length variation due to temperature changes
  Hex socket head cap screw M6x30 + shake proof washer
- Elastic fixing part
  Hex socket head cap screw M6x30 + small round plain washer + special plate spring

Tips

The number of the holes at the full-fixing part is different depending on the total length of the scale.

For details, refer to "4.7.2 Dimensional Table" on page 50.



NOTICE

The head fixing blocks that fix the detector head define the positional relationship between the scale main unit and the detector head.

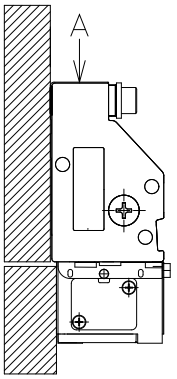
When mounting the scale unit on the machine, do not remove the head fixing blocks in order to keep the positional relationship.

2 Adjusting the Vertical direction of the scale

The position of this scale does not need to be adjusted in the horizontal direction (it depends on the accuracy of the scale main unit mounting surface). However, the position and dimension in the Vertical direction must be adjusted and checked.

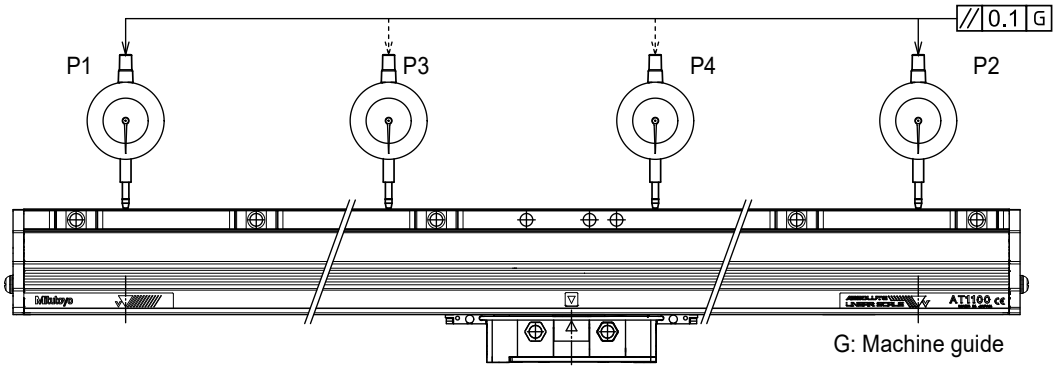
Adjust the position and check the dimension at A in the following drawing referring to the external view and dimensional drawings of the scale unit.

For details of the external view and dimensional drawings, refer to "4.7 External View and Dimensional Drawings of the Scale Main Unit" on page 48.

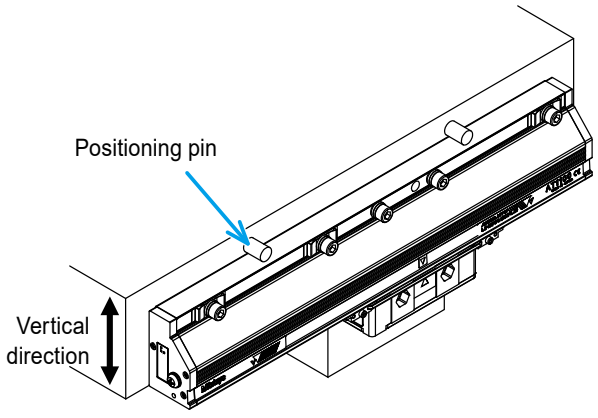


Effective length L_0	Measurement points
140 - 840	P1, P2
940 - 1740	P1 - P3
1840 - 3040	P1 - P4

● Measurement points



As described in "2.4.5 Precautions on Designing the Mounting Surface", this task can be simplified by using the reference pins, etc. However, after mounting, the dimensions must be checked.



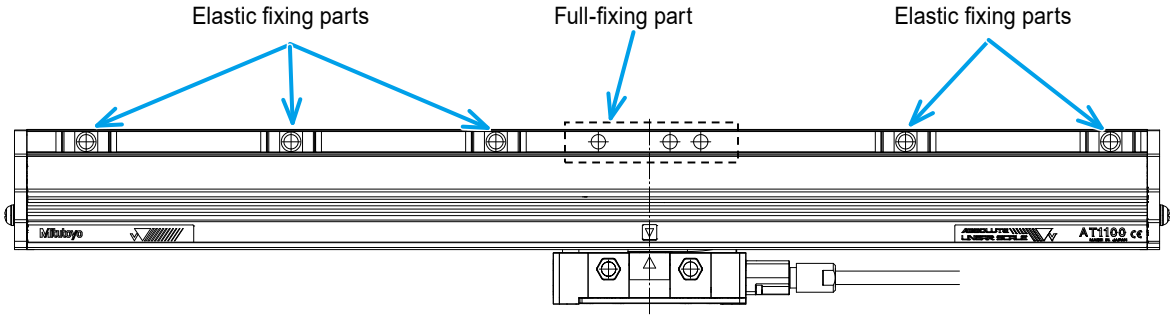
3 Fully securing the scale

After adjusting the position and checking the dimensions in the vertical direction of the scale main unit, fully tighten the fixing screws.

Note the following:

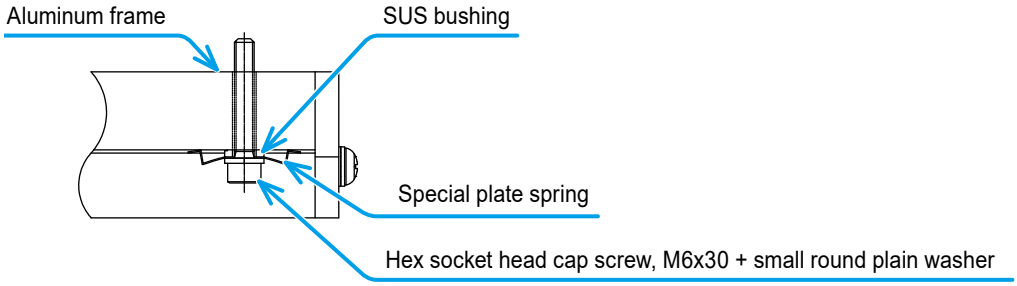
- Tightening torque: 9 N•m
- Tightening order of the screws

Be sure to tighten the full-fixing parts first, and then tighten the elastic fixing parts.



- Fixed state of elastic fixing part

  The fixing state of the elastic fixing part is shown below. Use this figure as a reference.



3.3 Mounting the Detector Head and Adjusting the Position

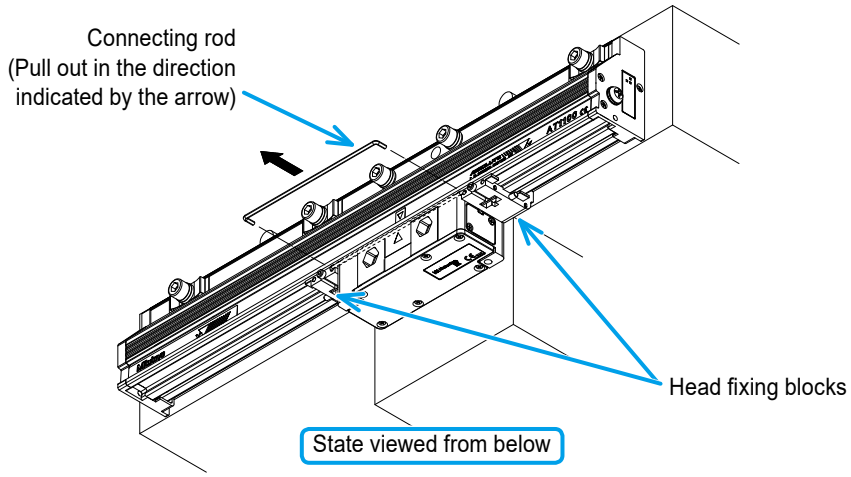
After completing the steps described in "3.2 Mounting the Scale Main Unit and Adjusting the Position", follow the procedures below to mount the detector head.

3.3.1 Mounting the Detector Head

1 Check the parallelism of the detector head mounting surface.

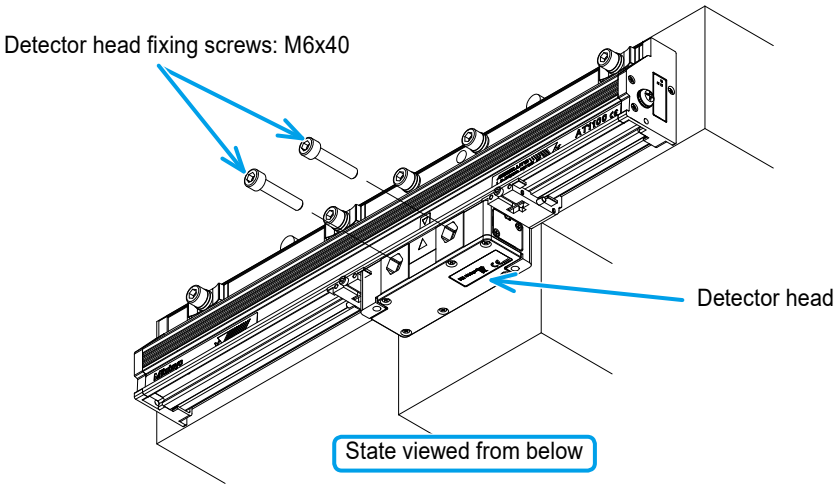
For details, refer to "4.7 External View and Dimensional Drawings of the Scale Main Unit" on page 48.

2 Remove the connecting rod that fixes the head fixing blocks.



3 Fix the detector head using the supplied fixing screws.

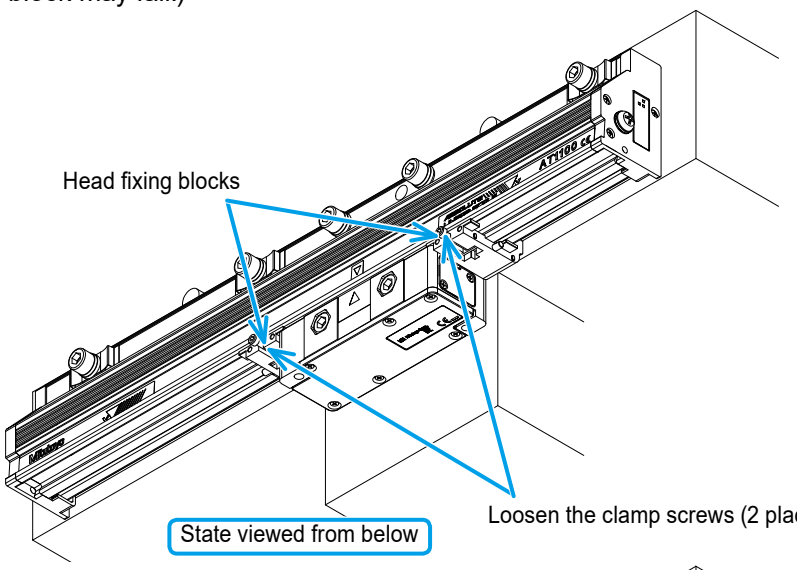
Detector head fixing screws: M6x40 (tightening torque: M6 screw: 9 N•m)

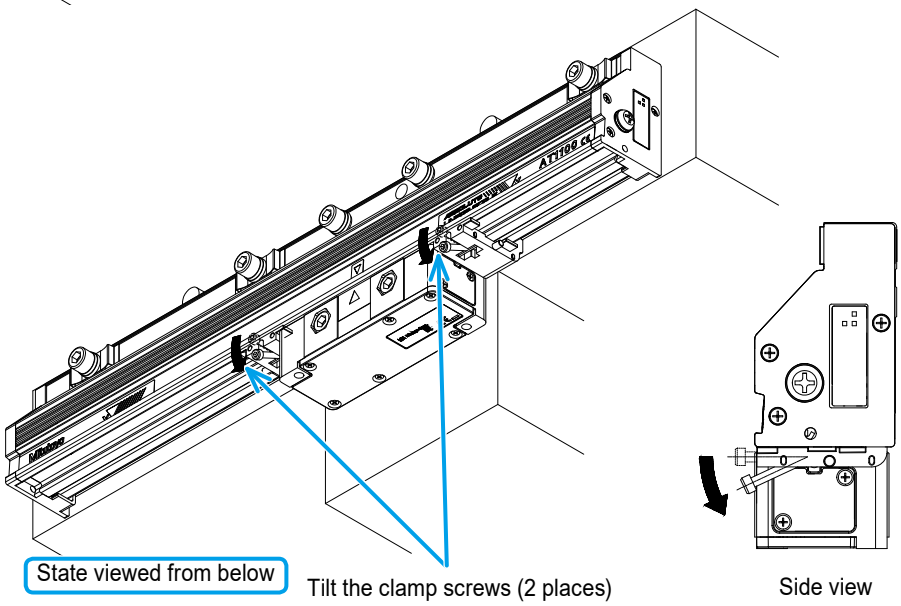


NOTICE

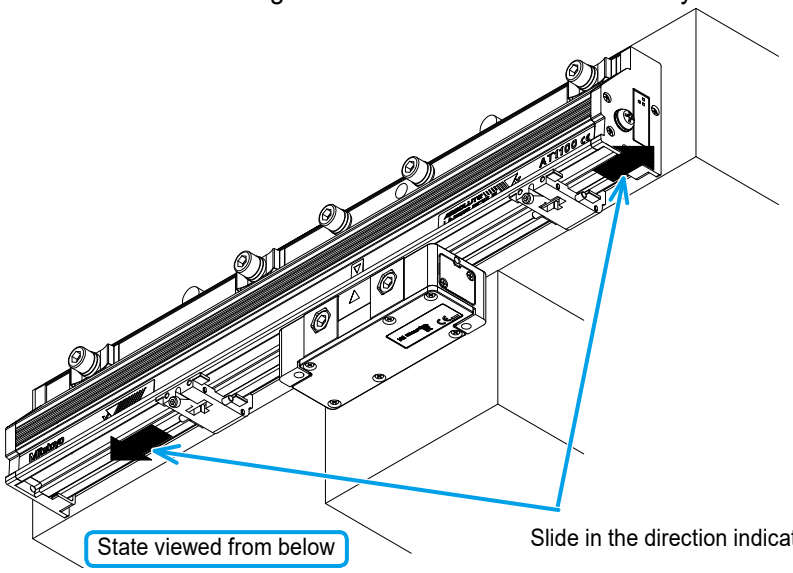
If there is a clearance between the detector head and the mounting surface, prepare a spacer to fill the clearance. The scale unit may be damaged if the fixing screws are tightened forcibly while there is a clearance.

4 Loosen the clamp screws that fix the head fixing blocks with around 5 to 8 turns, and then tilt the clamp screws. (Note that if the clamp screw is loosened too much, the metal fitting of the head fixing block may fall.)





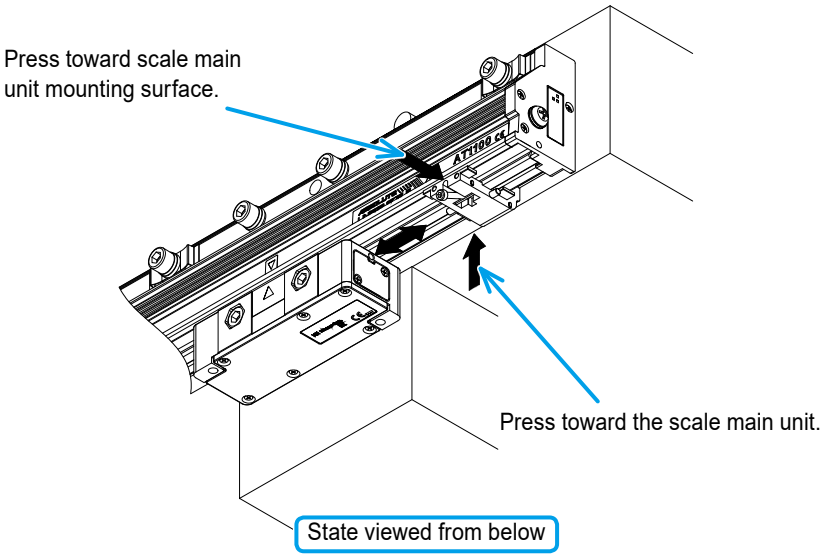
5 Remove the head fixing blocks in the direction indicated by the arrows.



6 Check whether the head fixing block pressed in the direction of the arrow smoothly slips, and whether there is no gap when it is inserted. (Check it for the head fixing blocks on the both ends.)

The mounting is complete.

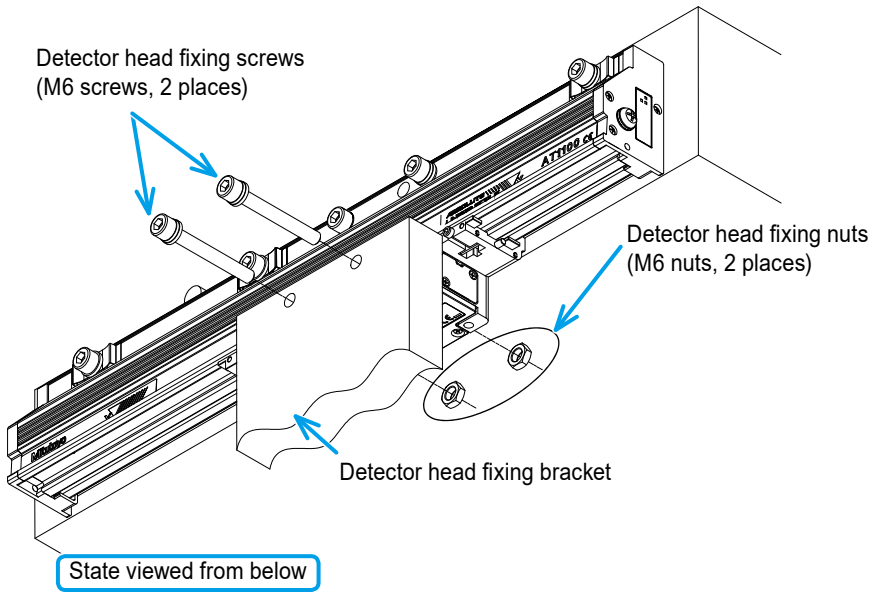
If the head fixing block cannot be slid out, or the insertion is too tight, check the positional relationship of the scale main unit and detector head mounting surface.



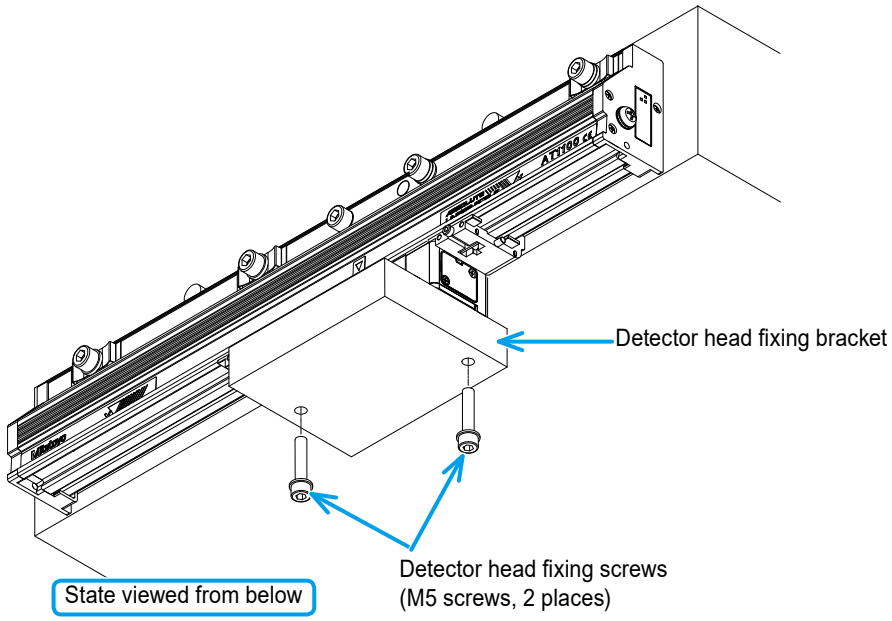
7 Other mounting examples

Refer to the diagram below when mounting the detector head from the front face or from the bottom face.
Note that the detector head fixing screws and nuts to be used in the examples below are not supplied, and shall be prepared by the user.

- Mounting example 1



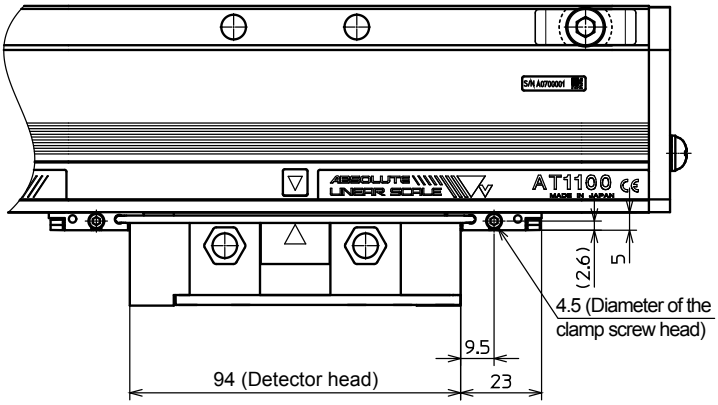
- Mounting example 2



NOTICE

When designing a detector head fixing bracket, note the following:

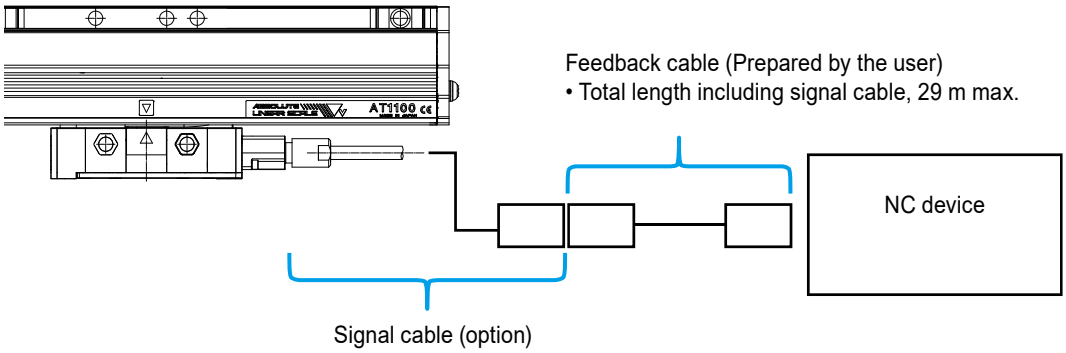
- Be very careful of the rigidity of the bracket.
- When fixing the detector head from the front face as shown in the "Mounting example 1," make sure that the bracket for fixing the detector head and the head fixing block clamp screws do not interfere with each other, referring to the head fixing block dimensional drawing below.



3.4 Connecting and Fixing the Signal Cable

3.4.1 Cable Connection and Operation Check

An example of the system configuration is shown below.
For the details of the cables, refer to "4 Specifications" on page 29.



■ Connect the cables and check operations

1 According to "3.4.2 Connecting the Signal Cable", connect the detector head and the signal cable.

Then connect the signal cable to the NC device. When the cable length is not enough, add a feedback cable (prepared by the user). After connecting them, make sure that the screws on the connecting plug of the signal cable are fully tightened.

Tips

When connecting additional cable at your need, make sure that the total length together with the signal cable is 29 m at maximum.

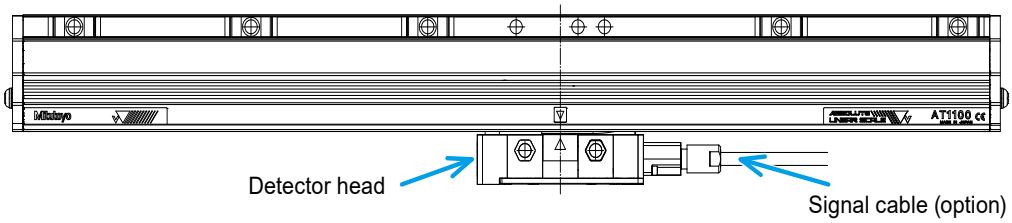
2 Turn on the power and check the operations, functions, and performance of the scale.

NOTICE

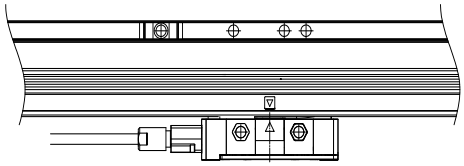
- After turning on the power, if the scale unit does not operate normally, check the connections first. If the scale does not operate normally even after the status of connections is checked and the power is supplied again, investigate the cause, following the instructions in "5 Troubleshooting".
- When checking the scale operations, be very careful that no cables are being pinched by the machinery.
- When connecting the connectors, if swarf or other foreign objects are sandwiched in, that may cause mal-functions.

3.4.2 Connecting the Signal Cable

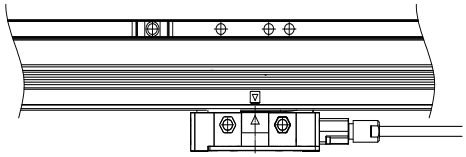
1 Decide the signal cable connecting direction.



Cable connecting direction: Left



Cable connecting direction: Right

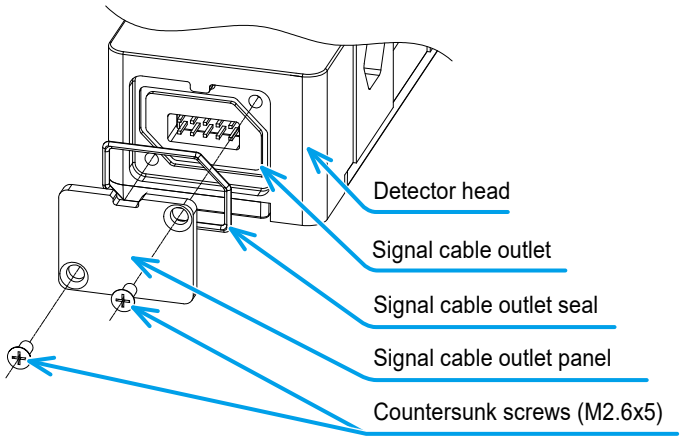


Initially, the signal cable outlet panel is provided on the left side signal cable outlet on the detector head.

To set the left side as the cable connecting direction, remove the signal cable outlet panel which is attached to the signal cable outlet.

Also, there is a signal cable outlet seal between the signal cable outlet panel and the detector head.

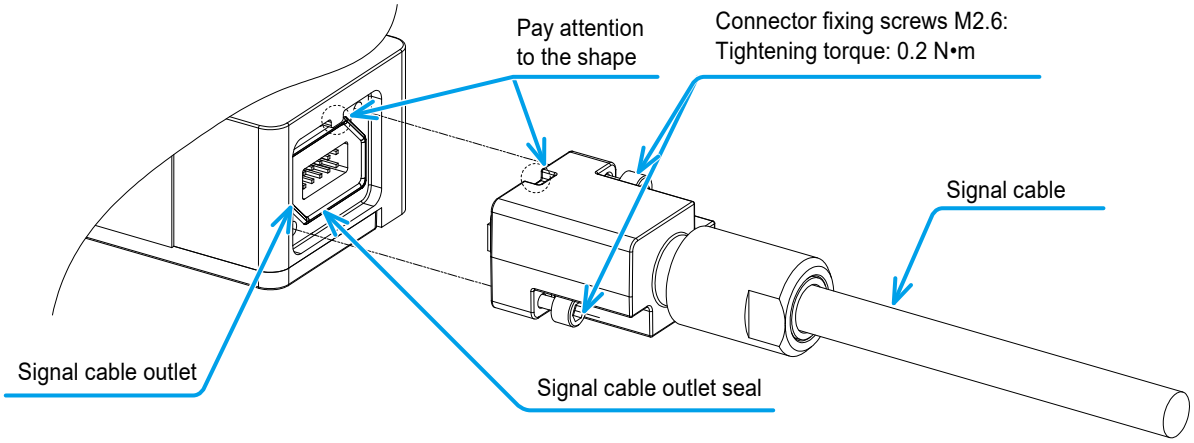
When removing the signal cable outlet panel, make sure that the signal cable outlet seal does not come off. If it comes off, insert it into the groove of the detector head.



2 Connect the signal cable to the detector head.

Connect it engaging the convex part of the cable outlet with the concave part of the connector.

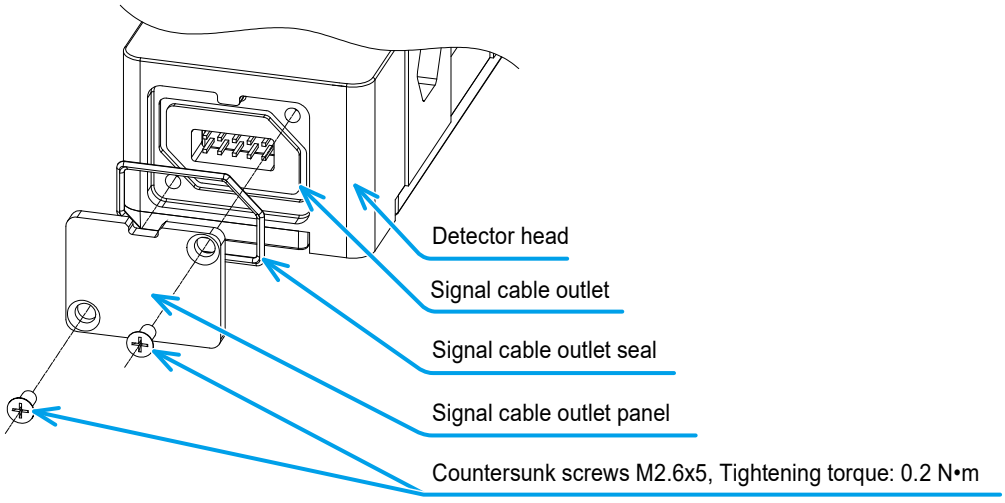
A signal cable outlet seal is set between the detector head and the connector to ensure water-resistance performance. When connecting the cable, make sure to confirm that a signal cable outlet seal is set in the groove of the signal cable outlet.



3 If the signal cable outlet panel is removed in 1, set it in the opposite outlet.

Connect it engaging the convex part of the detector head with the concave part of the signal cable outlet panel.

When connecting the cable, make sure to confirm that a signal cable outlet seal is set in the groove of the detector head as in 2.



NOTICE

Although the detector head has a water-resistant structure, it may not function as it is supposed to if the tightening torque is insufficient or if the signal cable outlet seal is improperly installed. To ensure waterproofness, make connections according to the procedures described above.

3.4.3 Precautions on Fixing the Cables

Be sure to note the following when fixing the cables.

1 Perform wiring paying attention to the twisting or bends of the cables.

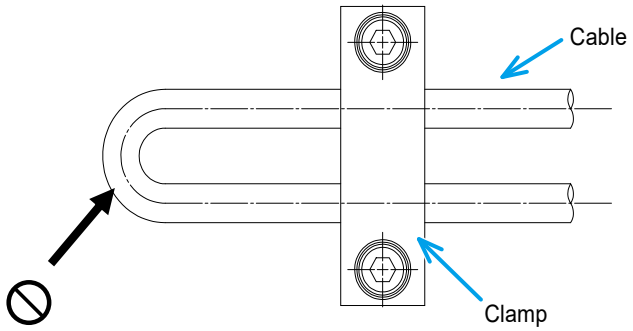
Note that the signal cable and feedback cable may malfunction due to noise, if bundled with other cables that may cause electrical noise, or if they are located near a switching relay dealing with a large current.

2 Use cable clamps or other fasteners to secure the cables.

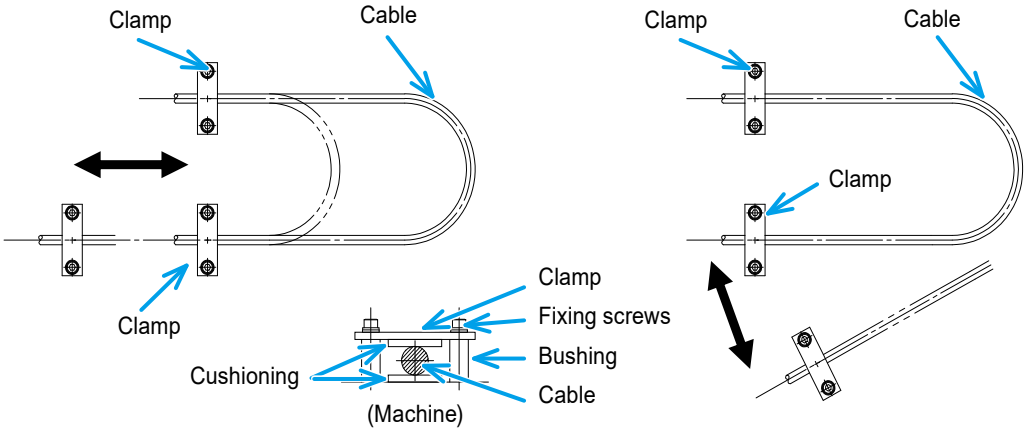
Note especially the following when securing the cables:

NOTICE

- Do not bend the cables.
  Also, do not bend the cables beyond the bend radius range specified in "2.3.2 Bend Radius of the Signal Cable".

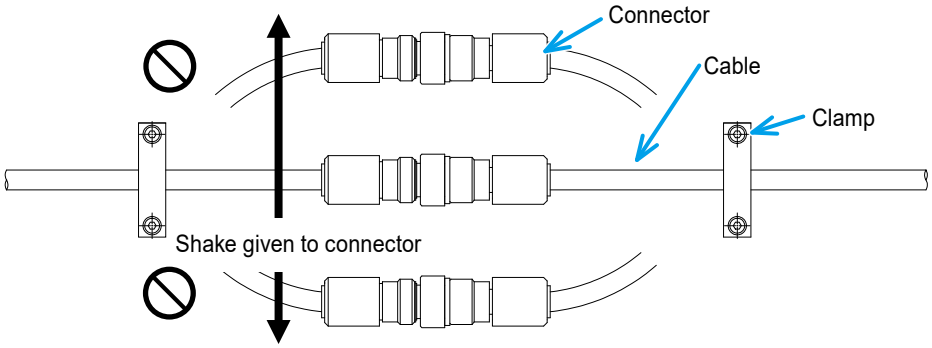


- If the cables are going to be repeatedly bent, try to reduce stress applied to near the root of the clamping part.

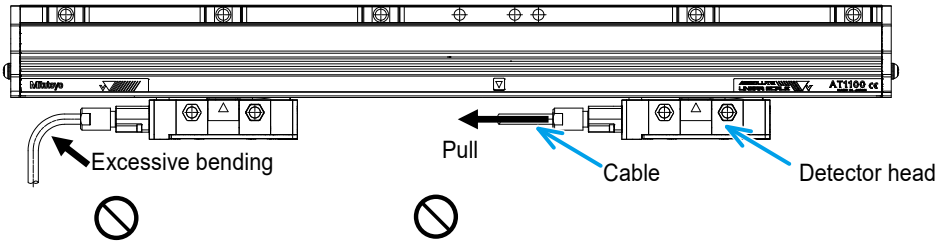


NOTICE

- Consider the shake due to vibration, etc. given to connectors.



- Make sure that excessive bends do not occur on the root of on the signal cable in the full stroke.



4 Specifications

This chapter describes the specifications of this product.

4.1 Specifications

Items		Description
Detection method		Electromagnetic induction
Effective length: L_0 (mm)		24 types:140,240,340,440,540,640,740,840,940,1040,1140,1240,1340,1440,1540,1640,1740,1840,2040,2240,2440,2640,2840,3040
Section size		85x37 (mm)
Cable configuration		"2.3 Preparing the Signal Cable" on page 7
Position Data	"0" position	"2.4.1 Datum Point Position for the Length Variation and ABS Origin Point" on page 10
Resolution		0.05 µm
Indication accuracy (20 °C)		Effective length L_0 = 140 mm - 2040 mm : $(3+5L_0/1000)$ µm Effective length L_0 = 2240 mm - 3040 mm : $(5+5L_0/1000)$ µm
Operation temperature/ humidity range		0 °C - 50 °C 20 % - 80 % RH (non-condensing)
Storage temperature/humidity range		-20 °C - 70 °C 20 % - 80 % RH (non-condensing)
Power supply voltage		ABS AT1153 / AT1143 / AT1103A : DC 5 V ± 10 %
Maximum consumption current		ABS AT1153 : 300 mA (Max) ABS AT1143 : 290 mA (Max) ABS AT1103A : 300 mA (Max)
Signal cable length		29 m at maximum (total of signal cable + feedback cable)
Maximum response speed		3 m/sec
Coefficient of thermal expansion		≈$8x10^{-6}$/K
Vibration resistance (55 - 2000 Hz)		≤ 196 m/s^2(20G) * With no error
Shock resistance (11 ms 1/2 sin)		Effective length L_0 = 140 mm - 2040 mm : ≤ 343 m/s^2 (35G) * With no error Effective length L_0 = 2240 mm - 3040 mm : ≤ 294 m/s^2 (30G) * With no error
Interface		■ AT1153 FANUC CORPORATION : α Interface / αi Interface (automatic switching interface) ■ AT1143 Mitsubishi Electric Corporation Control unit, MITSUBISHI CNC series: MDS-D/MDS-DH series ■ AT1103A Mitutoyo ENSIS interface
CE marking		EMC Directive EN61326-1 Immunity test requirement: Clause6.2 Table 2 Emission limit: Class B RoHS Directive : EN50581

4.2 Signal Cable Specifications

Note that the output signal of the signal cable differs according to the interface specifications.

4.2.1 Output Signal

Note that the output signal of the signal cable of AT1103A or AT1153 or AT1143 differs from that of AT1123.

■ Discrete-wire specifications

Cable color	Signal	Cable color	Signal
Brown	SD	White (2P)	+5 V
Red	*SD	Black (2P)	GND
Orange	RQ(REQ)	Shielded wire	F.G.
Yellow	*RQ(REQ)		

* Keep the cables not described in the above unconnected.
* Connect the shield wire to the ground bar.
* A cable of discrete-wire specification cannot be used for ABS AT1123.

■ Mitutoyo ENSIS connector specifications

Pin No.	Signal	Pin No.	Signal
1, 2	GND	7	RQDT
3, 4	+5 V	8	$\overline{\text{RQDT}}$
5	DT	9 ～ 14	Not used
6	$\overline{\text{DT}}$	15 Connector shell	F.G.

■ FANUC connector specifications

Pin No.	Signal	Pin No.	Signal
1	SD	12,14	GND
2	*SD	18,20	+5 V
5	RQ(REQ)	16	F.G.
6	*RQ(REQ)	3,4,7 ～ 13,15,17,19	Not used

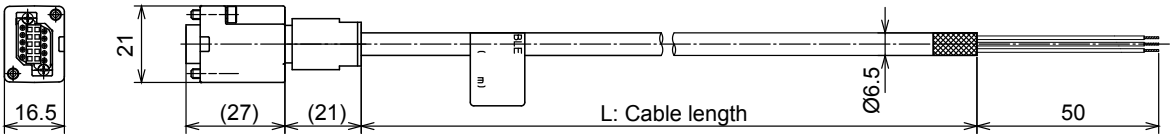
■ Mitsubishi connector specifications

Pin No.	Signal	Pin No.	Signal
1	5 V	7	DT
2	GND	8	$\overline{\text{DT}}$
3	RQDT	5,6,9,10	Not used
4	$\overline{\text{RQDT}}$		
		Connector shell	F.G.

4.2.2 Cable Dimensions

■ ABS AT1153/1143 (Discrete-wire specifications)

Detector head side (custom)
Waterproof



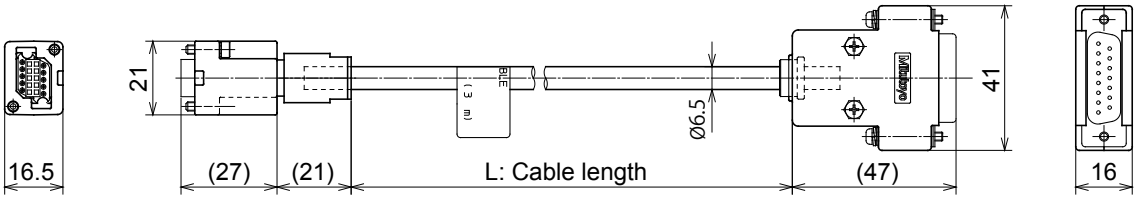
Part No.	Part Name	Cable length (m)
06AFG596-1	AT1100F/M Signal Cable discrete wire type 1 m	1
06AFG596-3	AT1100F/M Signal Cable discrete wire type 3 m	3
06AFG596-6	AT1100F/M Signal Cable discrete wire type 6 m	6
06AFG596-9	AT1100F/M Signal Cable discrete wire type 9 m	9
06AFG596-12	AT1100F/M Signal Cable discrete wire type 12 m	12

The cables with the discrete wire specification cannot be used for ABS AT1123 (SIEMENS I/F).

■ ABS AT1103A (Mitutoyo ENSIS connector specifications)

● With no conduit

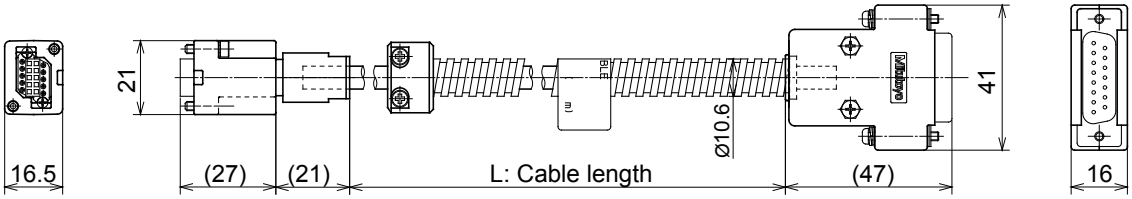
Detector head side (custom)
Waterproof



Part No.	Part Name	Cable length (m)
06AFY915-1	AT1100E Signal Cable D15 1 m	1
06AFY915-3	AT1100E Signal Cable D15 3 m	3
06AFY915-6	AT1100E Signal Cable D15 6 m	6
06AFY915-9	AT1100E Signal Cable D15 9 m	9
06AFY915-12	AT1100E Signal Cable D15 12 m	12

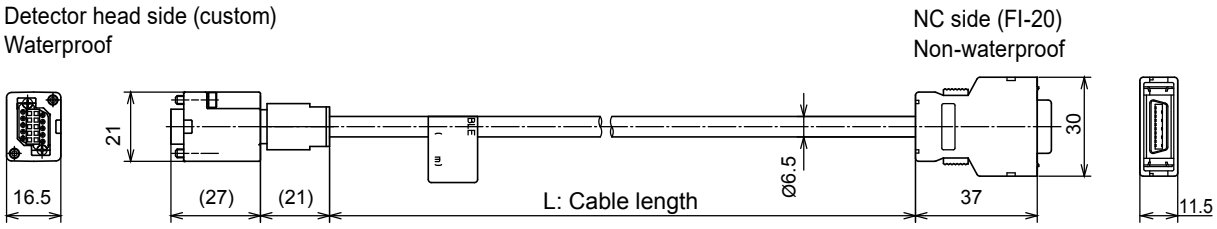
● With conduit

Detector head side (custom)
Waterproof



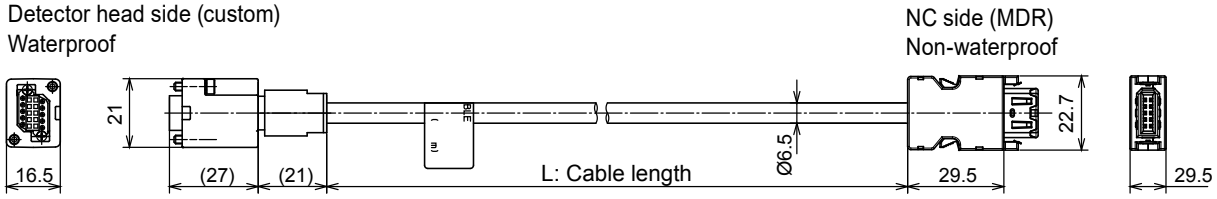
Part No.	Part Name	Cable length (m)
06AFY916-1	AT1100E C Signal Cable D15 1 m	1
06AFY916-3	AT1100E C Signal Cable D15 3 m	3
06AFY916-6	AT1100E C Signal Cable D15 6 m	6
06AFY916-9	AT1100E C Signal Cable D15 9 m	9
06AFY916-12	AT1100E C Signal Cable D15 12 m	12

■ ABS AT1153 (FANUC connector specifications)



Part No.	Part Name	Cable length (m)
06AFF921-1	AT1100F Signal Cable FANUC 1 m	1
06AFF921-3	AT1100F Signal Cable FANUC 3 m	3
06AFF921-6	AT1100F Signal Cable FANUC 6 m	6
06AFF921-9	AT1100F Signal Cable FANUC 9 m	9

■ ABS AT1143 (Mitsubishi connector specifications)

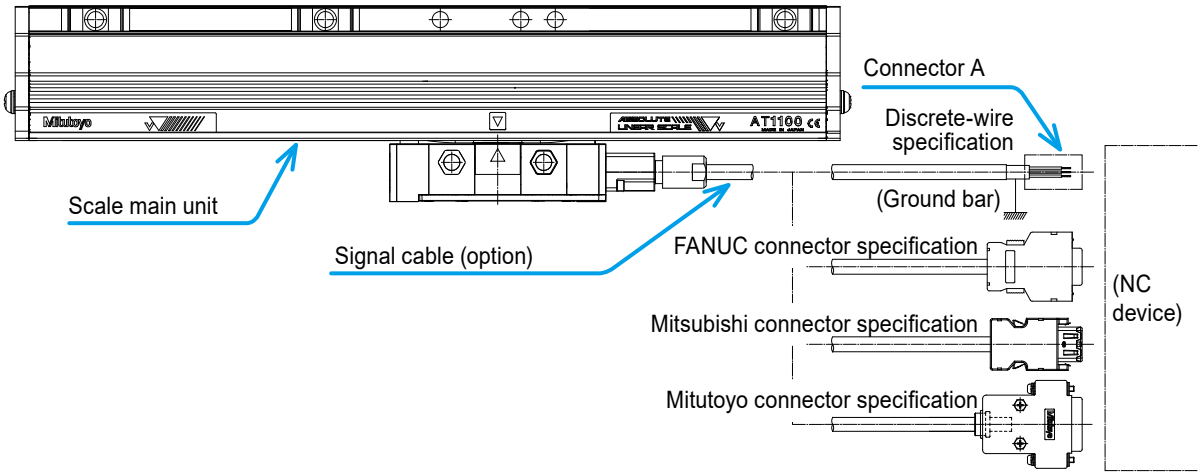


Part No.	Part Name	Cable length (m)
06AFF957-1	AT1100M Signal Cable MDS-D 1 m	1
06AFF957-3	AT1100M Signal Cable MDS-D 3 m	3
06AFF957-6	AT1100M Signal Cable MDS-D 6 m	6
06AFF957-9	AT1100M Signal Cable MDS-D 9 m	9

4.3 System Configuration (Example)

The following describes an example of the system configuration.
Please note that some parts need to be prepared by the user.

■ Connection example 1

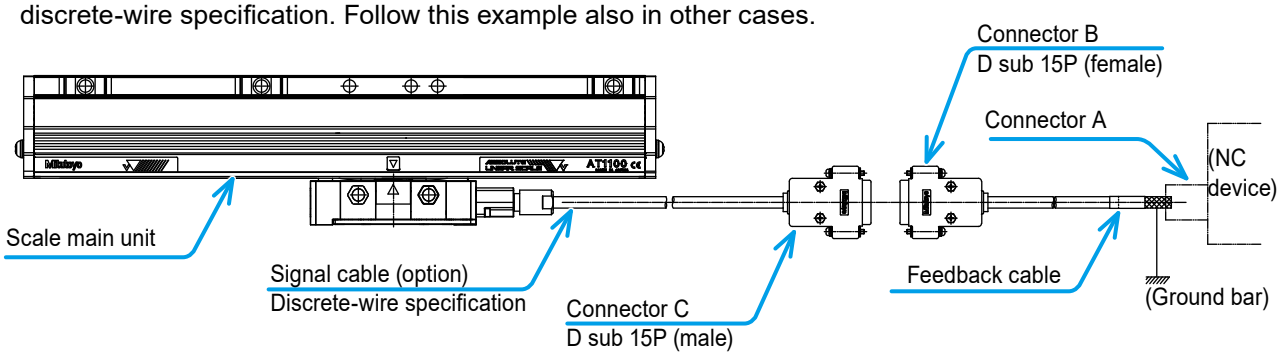


Tips

- The signal cable is an option. Prepare one according to your needs.
- The connector A shall be prepared by the user.
- Connection work for the connector A and the ground bar shall be done by the user.

■ Connection example 2

This example shows a feedback cable in a case that a D sub connector is mounted to the cable of discrete-wire specification. Follow this example also in other cases.



NOTICE

When using any cable other than a recommended cable, make sure to use a shield cable and set the total amount of the impedance of the power supply line (+5 V and 0 V) to "0.65 Ω or less/total length".

Also, avoid repeated bending for the feedback cable.

Tips

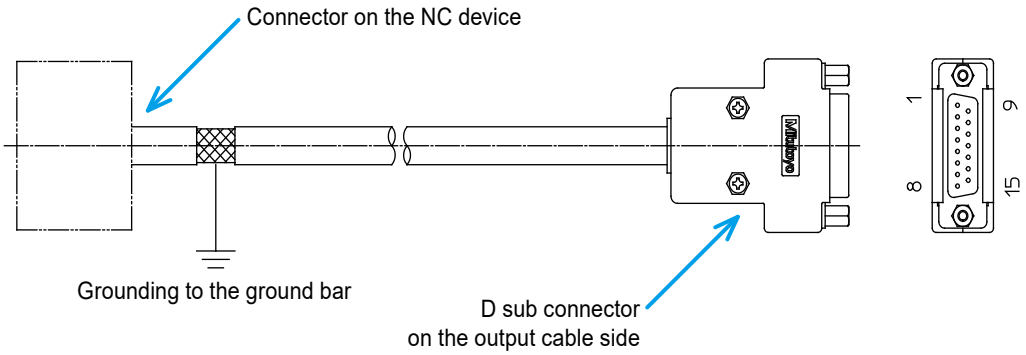
- Connector A, B, C and a feedback cable shall be prepared by the user.
- Wiring the connector A, B, C and the ground bar shall be performed by the user.
- When using a feedback cable, refer to the following information:
  Max cable length: 29 m
  This should be the total length of the signal cable and the feedback cable.
  Recommended cable material:
  Model No. : A66L-0001-0286
  Manufacturer : Hitachi Cable, Ltd., Oki Electric Cable Co.,Ltd.

4.4 Fabricating the Feedback Cable (Example)

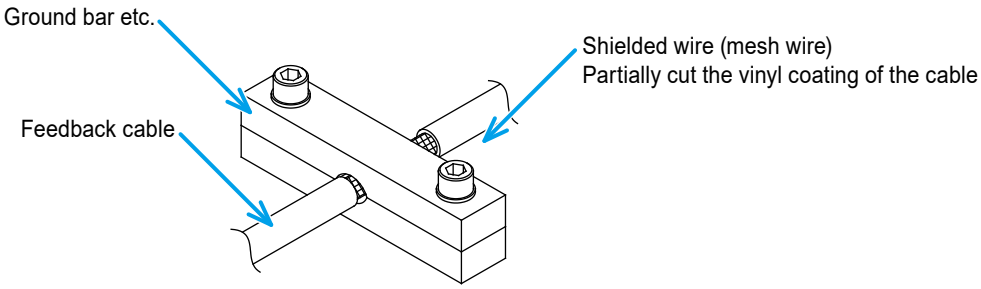
An example to fabricate the feedback cable is described below.

Follow the connection method recommended by the manufacturer of the connector when to connect the connector on the NC device and the cable.

4.4.1 Appearance Image of Feedback Cable and Grounding to Ground Bar



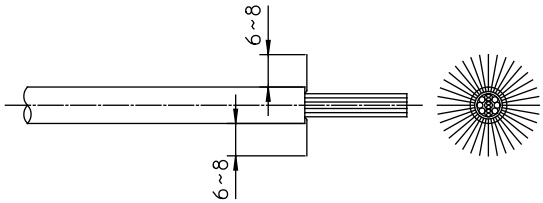
When assembling the D sub connector side, make sure that the shielded wire of the cable is electrically conducted to the metal shell. Peel part of the external sheath on the NC device, and make sure to use the ground bar to ground the shielded wire.



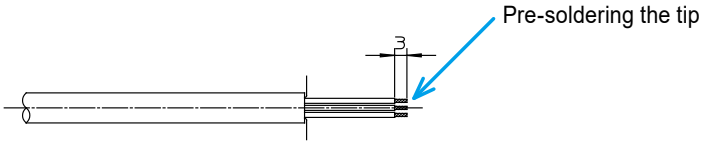
4.4.2 Assembling the D Sub Connector

1 Cut the sheath (coating) of the cable material into the length of the following figure.
Make sure not to damage the internal metal shield.

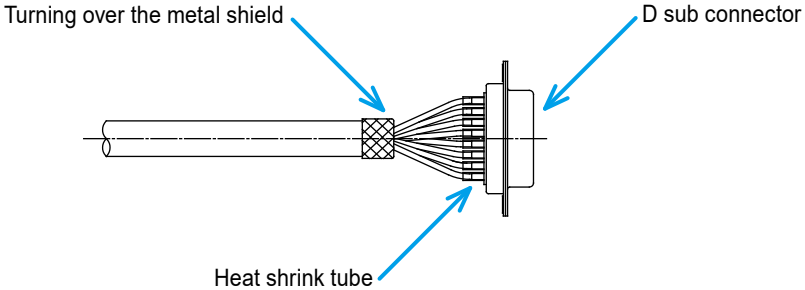
2 Untangle the exposed metal shield to spread radially, and cut them along the sheath leaving 6 mm – 8 mm to turn over later in the process.



3 Peel the tip of the wires by 3 mm, and perform pre-soldering.



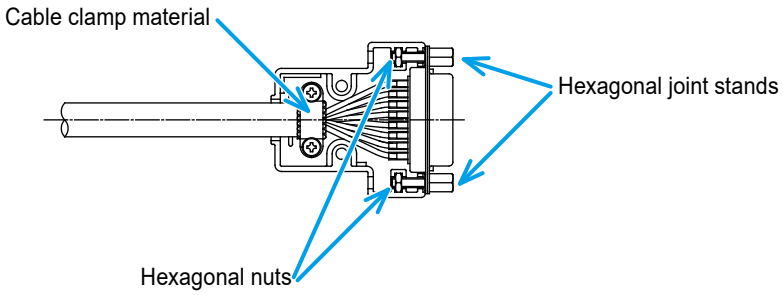
4 Solder each wire to the D sub connector (15P male).
At this time, insert a heat shrink tube (ø2, L = 6 mm–8 mm) in each terminal unit.
After that, turn over the metal shield to the sheath side.



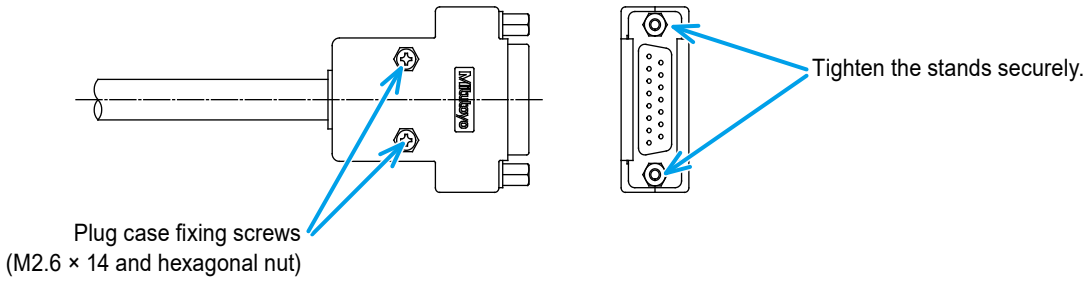
5 Set the connector to the plug case.

After that, screw the turned the metal shield part with a cable clamp.

After setting the hexagonal nuts (M2.6) to the plug case, insert the hexagonal joint stands from the connector side to screw (temporary fixing).



6 Cover with the other plug case, fix it with plug case fixing screws (M2.6 x 14 and hexagonal nuts), and finally tighten the hexagonal joint stands securely.



NOTICE

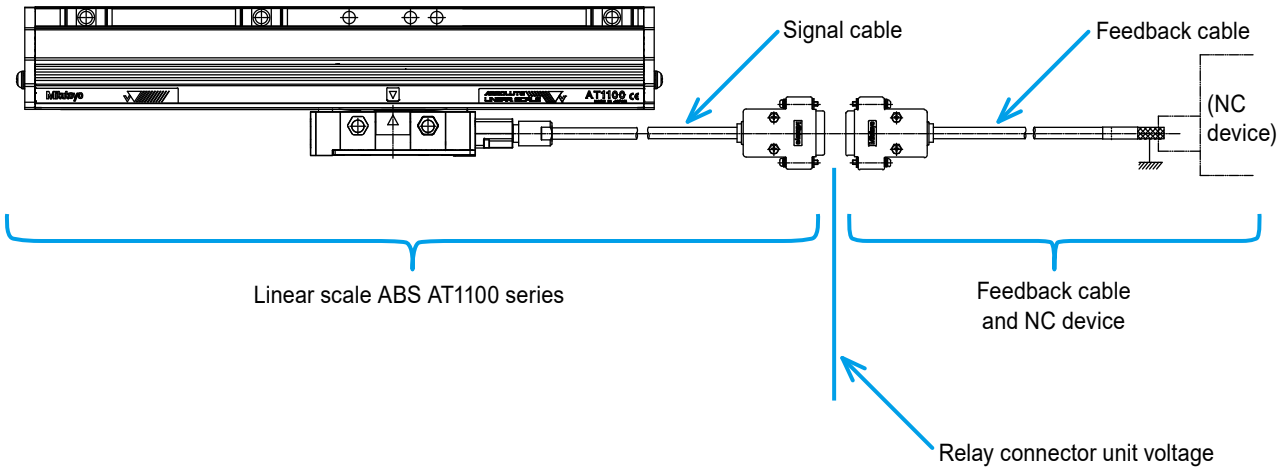
Apply screw locking glue to the screw unit.

4.4.3 Calculating the Feedback Cable Length

■ Calculation method for the max cable length

The calculation method for the max feedback cable length is described as follows. When fabricating a feedback cable, refer to the following description.

● Configuration



● Conditions

When the signal cable length is 1 m:

Name	Specifications or symbols	Unit
Max cable length (Signal cable length + feedback cable length)	L	m
Wire resistance of the used wire material	a	Ω/m
Number of pairs used for the power supply wire	b	pair
Supply voltage from servo-amplifier (min value)	4.95 (Note 1)	V
Current consumption	0.3	A
Relay connector unit voltage (min value)	4.5 + 0.039 (Note 2 and 3)	V

Note 1: This is standard supply voltage in the general servo-amplifier.

Note 2: Since there is a voltage drop of 0.039 V per meter when the signal cable length is 1 m or more, consider the voltage drop of the signal cable.

Note 3: Confirm that the input voltage of the relay connector unit is the min value in the table above or more.

● Calculation Formula

Allowable voltage drop ≥ (Current consumption × wire material resistance × 2 × max cable length) ÷ number of pairs used for the power supply wire ..... (1)

When "●Conditions" are assigned to (1) above, the following formula is obtained.

(4.95 - (4.5 + 0.039)) [V] ≥ (0.3 [A] × a [Ω/m] × 2 × L [m]) ÷ b..... (2)

Modify the formula (2) above to the following one.

$$L\ [m] \leqq \frac{b(4.95-4.539)}{0.6a}$$ ..... (3)

Fabricate a feedback cable which satisfies the above formula (3) in terms of the maximum cable length (L[m]), wire resistance ([Ω/m]) and number of pairs used as the power supply wire.

4.4.4 Wiring with NC Device (Example)

The "Signal cable" and the "Connector on the signal cable" in the table below indicate the connection in the case D-sub connectors are used.

If other connectors were to be used, the connection shall be performed by the user.

When the signal cable is a discrete one, and in the case not using a feedback cable, refer to "4.2.1 Output Signal" on page 30 to connect the lead wire directly to the connector on the NC device.

Follow the connection method recommended by the manufacturer of the connector.

Make sure to ground the metal shield of the feedback cable to the ground bar, etc. immediately in front of the NC device.

Tips

Specifications of recommended cable material for feedback cables (A66L-0001-0286):

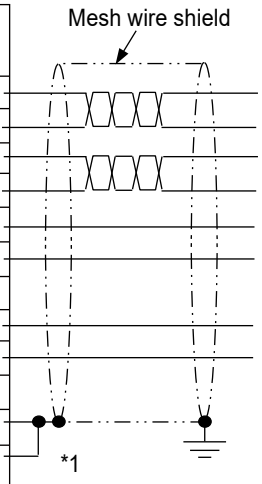
- Wire material for power supply: 0.5 mm^2 3 black wires, 3 red wires
- Wire material for signal: 0.18 mm^2 Twisted pair wire (black × red, black × white, red × white)

■ AT1103A (interface specifications: Mitutoyo ENSIS interface)

(Signal cable) (Feedback cable)

(Connector on the signal cable)

Signal	Pin No.	Pin No.	Signal
RQ(REQ)	7	7	RQ(REQ)
*RQ(REQ)	8	8	*RQ(REQ)
SD	5	5	SD
*SD	6	6	*SD
+5V	3	3	+5V
+5V	4	4	+5V
—	11	11	—
0V	1	1	0V
0V	2	2	0V
—	13	13	—
F.G.	15	15	F.G.
F.G.	connector shell	connector shell	F.G.

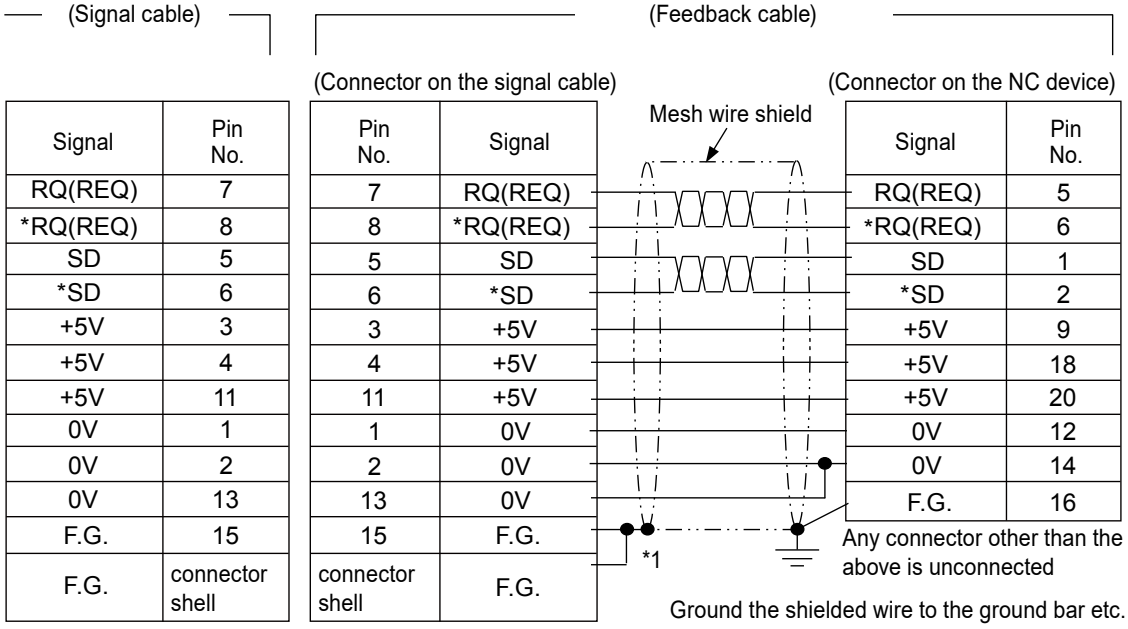


Ground the shielded wire to the ground bar etc.

NOTICE

*1:
When a drain wire is attached to the metal shield, connect it to the 15th pin of the D sub connector.

■ AT1153 (interface specifications: manufactured by FANUC Corporation)



Signal	Pin No.	Pin No.	Signal	Signal	Pin No.
RQ(REQ)	7	7	RQ(REQ)	RQ(REQ)	5
*RQ(REQ)	8	8	*RQ(REQ)	*RQ(REQ)	6
SD	5	5	SD	SD	1
*SD	6	6	*SD	*SD	2
+5V	3	3	+5V	+5V	9
+5V	4	4	+5V	+5V	18
+5V	11	11	+5V	+5V	20
0V	1	1	0V	0V	12
0V	2	2	0V	0V	14
0V	13	13	0V	F.G.	16
F.G.	15	15	F.G.		
F.G.	connector shell	connector shell	F.G.		

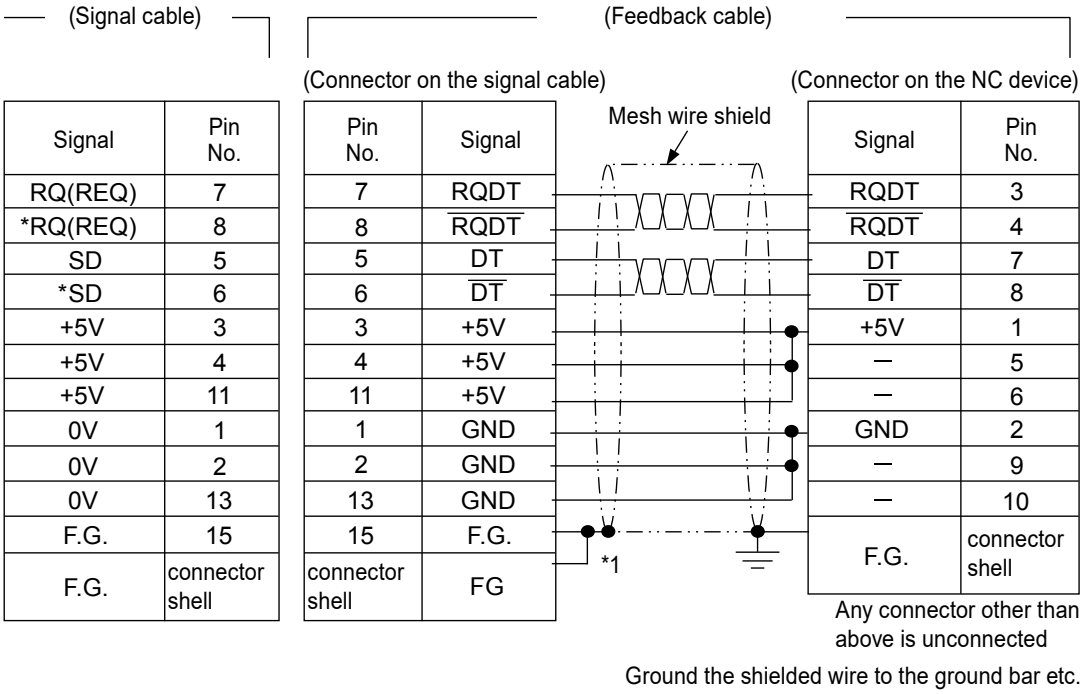
NOTICE

*1:
When a drain wire is attached to the metal shield, connect it to the 15th pin of the D sub connector.

■ AT1143 (interface specifications: manufactured by Mitsubishi Electric Corporation)

● CNC 700 series connection

Corresponding servo-amplifier: MDS-D, MDS-DH, MDS-Dn



Signal	Pin No.	Pin No.	Signal	Signal	Pin No.
RQ(REQ)	7	7	RQDT	RQDT	3
*RQ(REQ)	8	8	$\overline{\text{RQDT}}$	$\overline{\text{RQDT}}$	4
SD	5	5	DT	DT	7
*SD	6	6	$\overline{\text{DT}}$	$\overline{\text{DT}}$	8
+5V	3	3	+5V	+5V	1
+5V	4	4	+5V	—	5
+5V	11	11	+5V	—	6
0V	1	1	GND	GND	2
0V	2	2	GND	—	9
0V	13	13	GND	—	10
F.G.	15	15	F.G.	F.G.	connector shell
F.G.	connector shell	connector shell	FG		

NOTICE

*1:
When a drain wire is attached to the metal shield, connect it to the 15th pin of the D sub connector.

4.5 Alarm Detection Function

This product is equipped with various alarm detection functions inside the detector head.

4.5.1 Alarm Detection Function

Alarms can be categorized into two groups: Caution and Error.

The Caution indicates the temperature error inside the detector head. In those cases, once the causes are removed, the normal state can be restored.

As for the Error, signal intensity errors or absolute values detection errors, etc. are detected. Once these errors occur, the error detection state will be maintained until they are reset, or the power is re-supplied.

<<List of alarm detections>>

Alarm detection types		Description
Caution	Temperature error	It is output when the internal temperature of the detector head exceeds 65 °C. The normal state will be restored when it becomes 60 °C or lower.
	Signal intensity	It is output when the signal intensity drops to 30 % or lower. The normal state will be restored when it becomes 30 % or more.
Error	Signal strength error	It is output when the signal intensity drops to 15 % or lower, or exceeds 100 %.
	Transducer error	It is output when an abnormal balance in the internal signal is detected.
	Absolute value detection error	It is output when abnormal absolute value data are detected.
	Hardware error	It is output when an error is detected inside the hardware.
	Initialization error	It is output when the initialization of the system failed after the power was turned on.
	Overspeed	It is output when the response speed has exceeded the limit (3 m/s).

4.5.2 Alarm Code Content

The table below describes the linkage between the alarm code output from the controller and the error inside the scale, as well as the cause and remedy for it.

■ For ABS AT1153

The following describes the linkage between the alarms of the ABS AT1153 and the alarm codes to be displayed on the FANUC NC device (α Interface/αi Interface).

The alarm code of the NC device differs depending on the type of control. Both cases, the scale with the fully-closed control and the linear motor, are described.

Servo amplifier Alarm code	Description	Cause and Remedy
LED error • With fully-closed control 380 • With linear motor 365	**Scale error occurred** • Hardware error	**<<Cause>>** • The scale detected an error. **<<Remedy>>** • Turn on the power again. If the error is detected again, the scale needs to be replaced.
Phase error • With fully-closed control 381 • With linear motor 361	**Scale error occurred** • Initialization error • Absolute value detection error • Transducer error • Overspeed • Signal intensity error • Signal intensity alarm	**<<Cause>>** • The scale detected an error. **<<Remedy>>** • Check the mechanical fixing state of the scale. • Check the power to be supplied to the scale unit (power ripple noise) and electrical noises. • If there is no defect in the mounting condition and the power-related state, the scale needs to be replaced.
Serial data Error • With fully-closed control 385 • With linear motor 368	**Connection error occurred** • No response	**<<Cause>>** • The data from the scale is not received by the NC device. (No response) **<<Remedy>>** • Check the connection state of the cable and connector. • Check the state of the cable arrangement (influence by noises generated with the large current cable).
Data transfer error • With fully-closed control 386 • With linear motor 369	**Connection error occurred** • Communication error	**<<Cause>>** • In the communication between the scale and the NC device, the serial data from the scale may have a CRC error or stop bit error. (Communication error) **<<Remedy>>** • Check the state of the cable arrangement (influence by noises generated with the large current cable).

Servo amplifier Alarm code	Description	Cause and Remedy
Hardware disconnection Alarm • With fully-closed control 447 • With linear motor 446	**Connection error occurred** • Cable breakage	**<<Cause>>** • In the communication between the scale and the NC device, an error occurred due to breakage. **<<Remedy>>** • Check the connection state of the cable and connector.

* The alarm code of the NC device is common for both the α Interface and the αi Interface series of FANUC serial interface for detecting positions.

For ABS AT1143

The following describes the linkage between the alarms of the ABS AT1143 and the alarm codes to be displayed on the Mitsubishi servo-amplifier (MITSUBISHI CNC series control device).

Servo amplifier Alarm code	Description	Cause and Remedy
AL2A	**Scale error occurred** • Signal intensity error • Transducer error • Absolute value detection error • Hardware error • Initialization error • Overspeed	**<<Cause>>** • The detector head detected an error. **<<Remedy>>** • Check the mechanical fixing state of the scale. • Check the power to be supplied to the scale unit (power ripple noise) and electrical noises. • If there is no defect in the mounting condition and the power-related state, the scale needs to be replaced.
AL28	**Scale alarm occurred** • Thermal alarm • Signal intensity alarm	**<<Cause>>** • The detector head detected a caution. The position data is correct; however, it is necessary to check the fixing state and the operating condition. **<<Remedy>>** • Is the temperature of the detector head over 60 °C? → If it is over 60 °C, check the driving condition (speed, acceleration). • Check the mechanical fixing state of the scale.
AL16	**Connection error occurred** → At the time of servo-amplifier initialization • Error is received three times consecutively at the servo-amplifier. (Including no response)	**<<Cause>>** • A communication error has occurred between the scale and the servo-amplifier. (Failed in communication from the time of power-on of the servo-amplifier) **<<Remedy>>** • Check the connection state of the cable and connector. • Check the state of the cable arrangement. (influence by noises generated with the large current cable)
AL20	**Connection error occurred** → When using a servo amplifier • Error is received three times consecutively at the servo-amplifier. (Including no response)	**<<Cause>>** • A communication error has occurred between the scale and the servo-amplifier. (Occurred in the servo amplifier control) **<<Remedy>>** • Check the connection state of the cable and connector. • Check the state of cable arrangement. (influence by noises generated with the large current cable)

4.6 Air Purging

This product is equipped with an air purging mechanism. The air purging mechanism improves resistance to the environment (over coolant or dust) of the linear scale by supplying clean compressed air inside the scale main unit.

As shown in "4.6.3 Connection", supply compressed air through the specified air device by connecting to either of the M5 screw holes provided at both sides of the scale main unit.

4.6.1 Air Flow Supplied to the Scale

Supply air flow at 10 L to 20 L/min per scale.

Air should slightly come out from the closed part of the dust-proof rubber lips.

Adjust the air flow referring to the descriptions below.

- When using Mitutoyo's fixed diaphragm (ID: Ø0.9)

  Make adjustment with the air pressure, so that the air flow becomes 10 L to 20 L/min (per scale unit).

  (Ref.) When supplying air to a scale: Air flow approx. 12.7 L/min with 0.1 MPa of air pressure

  Air flow of approx. 19 L/min with 0.2 MPa of air pressure

- When using other fixed diaphragms

  Make adjustment with the air pressure, so that the air flow becomes 10 L to 20 L/min (per scale unit).

  For information on the air flow and pressure relationships, refer to the flow characteristics (ID of the fixed diaphragm and flow-pressure relations) provided by each pneumatic component manufacturer.

- When using flow rate adjustable valves

  Make adjustments so that the air flow becomes 10 L to 20 L/min (per scale unit).

NOTICE

Make sure not to supply a large amount of air before making adjustments. Otherwise, it may cause components to break thereby resulting in malfunctions.

4.6.2 Recommended Air Supply Devices

An air dryer is not required for this product.

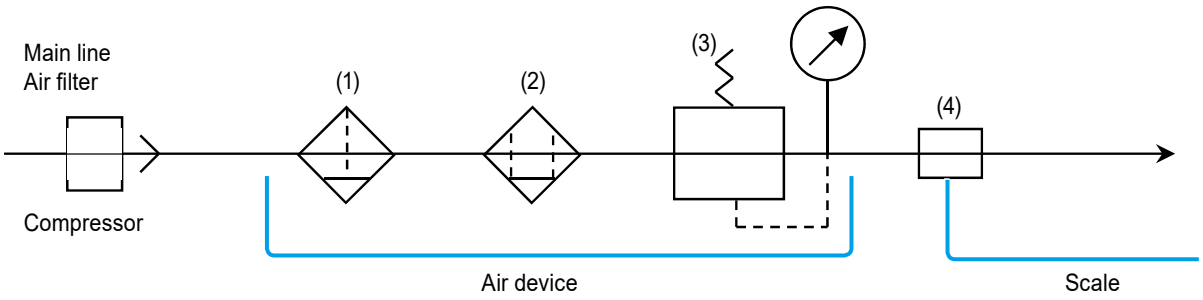
Do not supply air to the air supply device directly from the compressor. Make sure to supply compressed air through a main line air filter. The oil mist filter element should be replaced after a year.

Attach the fixed diaphragm to the scale side.

The specifications and the manufacturer models for recommended air devices are described in the following.

If the specifications are identical, it is fine to purchase and use a product manufactured by another company.

■ Air supply unit



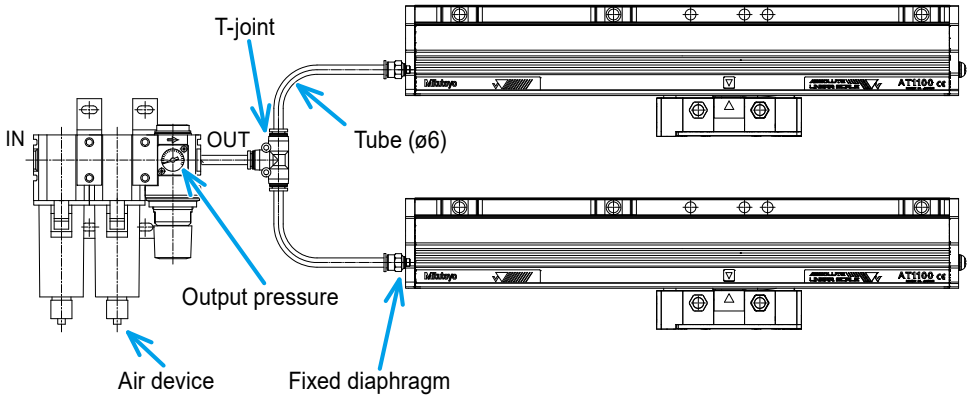
No.	Component	Appear-ance	Specifications	Part No.	
				Order No. (Mitutoyo)	Manufactur-er Model
(1)	Air filter		• Fluid: Compressed air • Maximum operating pressure: 1.0 MPa • Proof pressure: 1.5 MPa • Maximum particle diameter (filtra-tion): 5 µm • Secondary oil concentration:-	-	F1000-8-W (CKD)
(2)	Oil mist filter		• Fluid: Compressed air • Maximum operating pressure: 1.0 MPa • Proof pressure: 1.5 MPa • Maximum particle diameter (filtra-tion): 0.01 µm • Secondary oil concentration: 0.01 mg/m^3 or below • Element replacement: 1 year (6000 hours) or when pressure is lowered 0.1 MPa or lower	-	M1000-8-W (CKD)
(3)	Regulator		• Fluid: Compressed air • Maximum operating pressure: 1.0 MPa • Proof pressure: 1.5 MPa • Set pressure range: 0.05 to 0.85 MPa	-	R1000-8-W (CKD)
(4)	Fixed dia-phragm		• Fluid: Air • Set pressure range: 0.1 to 0.9 MPa • Screw tightening torque: 1.0 to 1.5 N•m • Flow at 0.1 MPa pressure: approx. 12.7 L/min • Flow at 0.2 MPa pressure: approx. 19 L/min (per axis)	06ACJ155	PC6-M5M-0.9 (PISCO, spe-cial part)

4.6.3 Connection

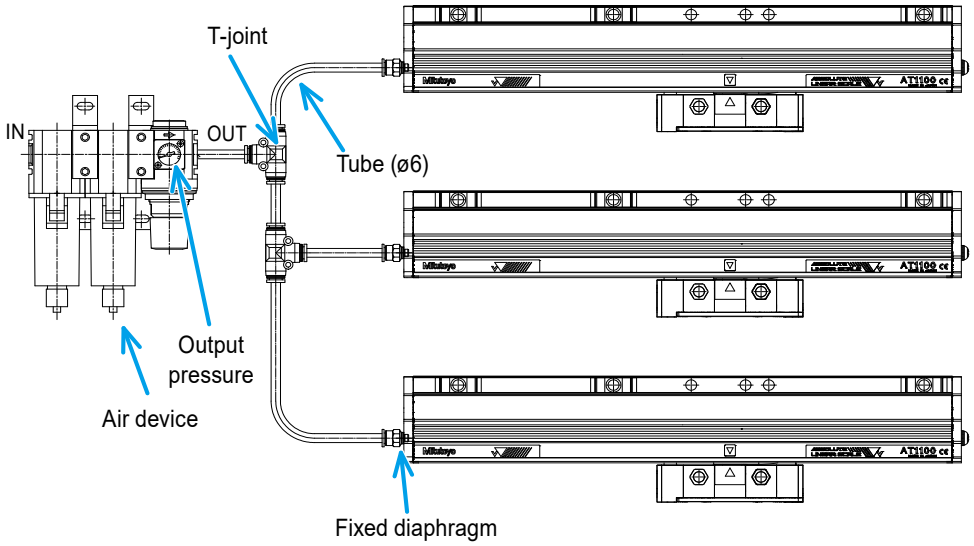
Do not supply air to the air device directly from the compressor. Make sure to supply compressed air through a main line air filter.

Attach the fixed diaphragm to the scale side.

■ When supplying air to linear scales with 2 axes:



■ When supplying air to linear scales with 3 axes:



Tips

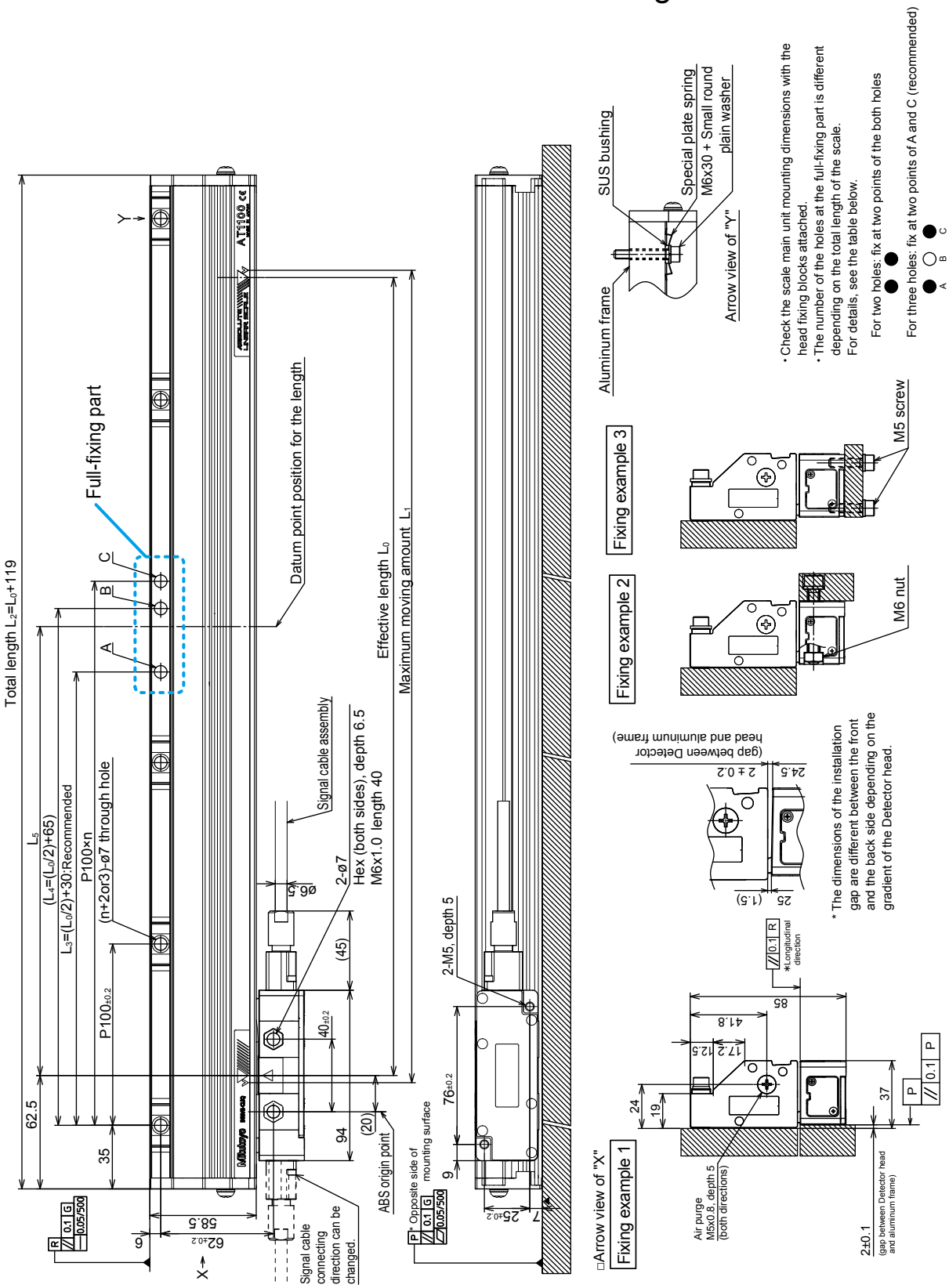
- Five scales (five axes) at maximum can be connected to one air device.
- Use a ø6 air tube.

(*1) Each filter element should be replaced after a year.
The time of replacement differs according to the operating conditions.

(*2) For information on maintenance, refer to the manual supplied with the air device.

4.7 External View and Dimensional Drawings of the Scale Main Unit

4.7.1 External View and Dimensional Drawings

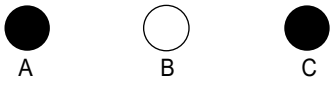


Tips

- G represents the machine guide.
- P represents the opposite side of the aluminum frame mounting surface. Also, S represents the opposite side of the detector head mounting surface.
- Q and R represent the linear scale's reference surfaces for mounting.
- For descriptions L_0 to L_5 in the figure, refer to the next page.
- The full-fixing parts are recommended to be fixed at two points, A and C.
- A can be identical to the position C depending on the unit's effective length.
  In this case, it is recommended to fix at two points, A and B.
- The number of the holes at the full-fixing part is different depending on the total length of the scale.
  For details, refer to "4.7.2 Dimensional Table" on page 50.

In the cases of 2 holes: Fix at 2 points of the both holes

In the cases of 3 holes: Fix at 2 points of A and C (recommended)



4.7.2 Dimensional Table

Unit: mm

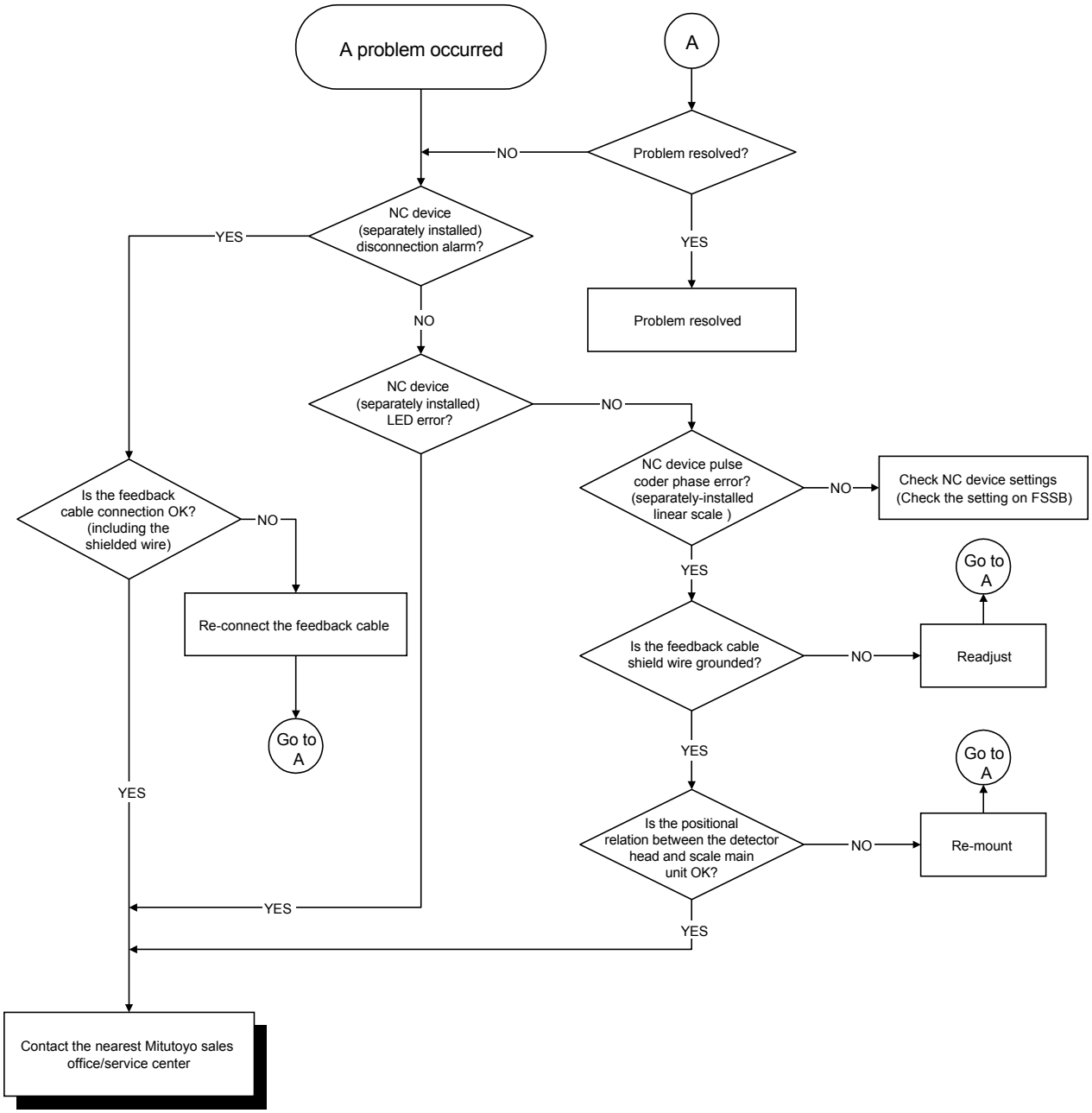
Code No.	Model	Effective length L_0	Maximum travel distance L_1	Scale total length L_2	Fixing pitch			Scale fixing hole n (pcs.)	Number of holes on the full-fixing part
					L_3	L_4	L_5		
559-100-□3	AT11□3◊-140	140	148	259	100	135	90	2	2
559-101-□3	AT11□3◊-240	240	248	359	150	185	147.5	3	3
559-102-□3	AT11□3◊-340	340	348	459	200	235	190	4	2
559-103-□3	AT11□3◊-440	440	448	559	250	285	247.5	5	3
559-104-□3	AT11□3◊-540	540	548	659	300	335	290	6	2
559-105-□3	AT11□3◊-640	640	648	759	350	385	347.5	7	3
559-106-□3	AT11□3◊-740	740	748	859	400	435	390	8	2
559-107-□3	AT11□3◊-840	840	848	959	450	485	447.5	9	3
559-108-□3	AT11□3◊-940	940	948	1059	500	535	490	10	2
559-109-□3	AT11□3◊-1040	1040	1048	1159	550	585	547.5	11	3
559-110-□3	AT11□3◊-1140	1140	1148	1259	600	635	590	12	2
559-111-□3	AT11□3◊-1240	1240	1248	1359	650	685	647.5	13	3
559-112-□3	AT11□3◊-1340	1340	1348	1459	700	735	690	14	2
559-113-□3	AT11□3◊-1440	1440	1448	1559	750	785	747.5	15	3
559-114-□3	AT11□3◊-1540	1540	1548	1659	800	835	790	16	2
559-115-□3	AT11□3◊-1640	1640	1648	1759	850	885	847.5	17	3
559-116-□3	AT11□3◊-1740	1740	1748	1859	900	935	890	18	2
559-117-□3	AT11□3◊-1840	1840	1848	1959	950	985	947.5	19	3
559-118-□3	AT11□3◊-2040	2040	2048	2159	1050	1085	1047.5	21	3
559-119-□3	AT11□3◊-2240	2240	2248	2359	1150	1185	1147.5	23	3
559-120-□3	AT11□3◊-2440	2440	2448	2559	1250	1285	1247.5	25	3
559-121-□3	AT11□3◊-2640	2640	2648	2759	1350	1385	1347.5	27	3
559-122-□3	AT11□3◊-2840	2840	2848	2959	1450	1485	1447.5	29	3
559-123-□3	AT11□3◊-3040	3040	3048	3159	1550	1585	1547.5	31	3

The blank square in the code numbers and the blank square/blank diamond in the model stipulate the interface specifications as per the following.

For AT1103A blank square : 0, blank diamond : A
For AT1143 blank square : 4, blank diamond : Blank
For AT1153 blank square : 5, blank diamond : Blank

5 Troubleshooting

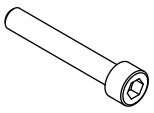
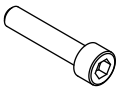
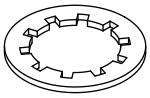
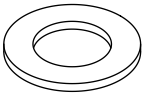
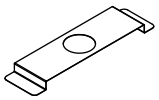
This chapter describes how to check for the reasons why problems occur when initially powering on, or for when alarms are generated during operation.



Tips We provide software which makes it possible for the user to initially judge failure/error of this product. For details, contact a Mitutoyo sales office/service center.

6 Appendix

6.1 Quantity of the Supplied Accessories for Mounting

Part No.	197727	06AFL049	06AFL090	06AFL050	06AFL843
Effective length	Hex socket head cap screw M6 x 40 	Hex socket head cap screw M6 x 30 	Internal teeth shake proof washer 6.6 x 10.2 x 0.5 	Small round plane washer, nominal 6 	Frame holding spring 
140	2	11	2	9	6
240	2	11	2	9	6
340	2	11	2	9	6
440	2	11	2	9	6
540	2	11	2	9	11
640	2	11	2	9	11
740	2	11	2	9	11
840	2	11	2	9	11
940	2	18	2	16	11
1040	2	18	2	16	11
1140	2	18	2	16	16
1240	2	18	2	16	16
1340	2	18	2	16	16
1440	2	18	2	16	16
1540	2	18	2	16	16
1640	2	25	2	23	21
1740	2	25	2	23	21
1840	2	25	2	23	21
2040	2	25	2	23	21
2240	2	25	2	23	27
2440	2	33	2	31	27
2640	2	33	2	31	27
2840	2	33	2	31	31
3040	2	33	2	31	31

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