Mitutoyo

Assembly Type ABSOLUTE Linear Scale

ABS AT1103A
ABS AT1143
ABS AT1153

User's Manual

- Instructions for use -

Read this document thoroughly before operating the product. After reading, retain it close at hand for future reference.
This English language version of the document contains the original instructions.

No. 99MBE094B4
Date of publication: March 1, 2022

■ Product names and model numbers covered in this document

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 product, caused by its use not conforming to the procedure described in this document.
- Upon loan or transfer of this product, be sure to affix this document to the product.
- In the event of loss or damage to this document, immediately contact the agent where you purchased the product or a Mitutoyo sales office.
- Read this document thoroughly before operating the product. In particular, be sure to fully understand "Safety Precautions" on page 7 and "Precautions for Use" on page 7.
- The contents of this document are based on information current as of March 2022.
- No part or whole of this document may be transmitted or reproduced by any means without prior written permission of Mitutoyo Corporation.
- Some screen displays in this document may be highlighted, simplified or partially omitted for convenience of explanation. In addition, some of them may differ from actual ones to the extent that no user will misunderstand the functions and operations.
- The corporation, organization and product names that appear in this document are their trademarks or registered trademarks.

Contents

* ▶ indicates the link to a video.

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About This Document

■ Positioning of this document, document map

The position of this document and its relationship to the other subsections are as follows.

ABS AT1100 ABSOLUTE Linear Scale User's Manual (This document)	Explains the specifications and installation of the ABS AT1100.
ABS AT1100 Series Signal Verification Program User's Manual	Describes the procedure for using program that performs initial diagnostics on the ABS AT1100 series.

■ Intended readers and purpose of this document

● Intended readers

This product is attached for use to a variety of equipment, including NC machine tools and semiconductor manufacturing equipment. This document is intended for those who will be performing the installation.
The readers are assumed to be capable of reading the drawings and understanding the directions.

● Purpose

The purpose of this document is to help you understand the specifications of this product and how to properly install it.

Conventions Used in This Document

■ Safety reminder conventions warning against potential hazards

⚠CAUTION	Indicates a hazard with a low level of risk which, if not avoided, **could result in minor or moderate injury**.
NOTICE	Indicates a situation which, if not avoided, **may result in property damage**.

■ Conventions indicating prohibited and mandatory actions

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

■ Conventions indicating referential information or reference location

IMPORTANT	Indicates information that must be known when using the product.
Tips	Indicates further information and details relevant for the operating methods and procedures that are explained in that section.
	Indicates reference location if there is information that should be referred to in this document or an extraneous User's Manual. Example: For details about XX, see "1.2 Part Names and Features" on page 12 in "1 Overview".

■ Conventions indicating video content

	A QR code that can be read with a smartphone or other device to view a video.
	A button that can perform in PDF format User's Manuals. Click the button to view a video.

*Video content does not include audio. Video size is 1280 x 720.

■ Other conventions

( ): Round brackets	Represent a paraphrase of an immediately preceding phrase or a supplementary explanation.
" ": Double quotation marks	Represent a highlighted phrase. They also indicate an index where information to be referenced is described.
[ ]: Square brackets	Represent a menu name on the screen, screen name, dialog name, button, display item, tab name, or key on the keyboard. They also indicate an item to be purposely entered or selected by the customer.
1, **2**, **3** **1**, **2**, **3**, ...	Indicates the order and the contents of tasks. (**1**: indicates main tasks, **1**: indicates detailed tasks)
»	Indicates the action resulted from some operation(s).

■ Example of conventions use

3.2.2 Installation of Scale Main Body

You can check the installation procedure for the scale main body.

1 Temporarily affix the scale main body to the scale mounting surface on the machine body.

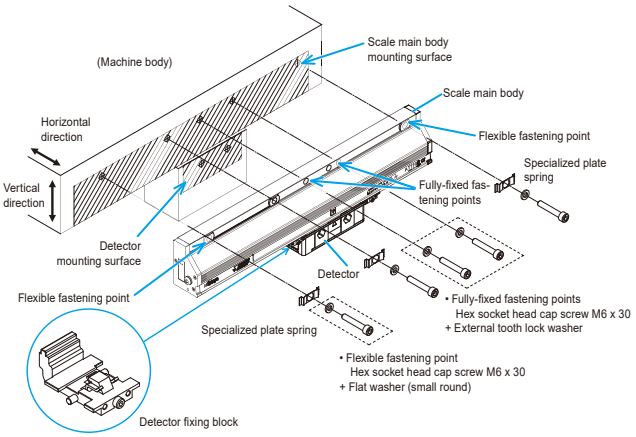
Use provided screws as indicated below to temporarily secure the scale main body to the extent that it will not move even if you remove your hand from the scale main body.

- Fully-fixed fastening points (elongation base point position with respect to temperature change)
  Hexagon socket head cap screws M6x30 + Internal lock washers
- Flexible fastening points
  Hexagon socket screws M6x30 + flat washers (small round) + specialized plate spring

Do not fasten the detector at this time.

Tips

- The number of fully-fixed fastening point holes depends on the overall length of the scale.
  For details, see "■ Appearance and installation dimensions table" on page 55.
- Two screws are used for the fully-fixed fastening points.
  For details, see "● Note regarding appearance and installation dimensions" on page 54.



NOTICE

Do not remove the detector fixing block. Detector failure may result.

The detector fixing block determines the positional relationship between the scale main body and the detector. This positional relationship is maintained when the scale unit is attached to the machine body.

Indicates a link to a video.

Indicates an operating procedure to be performed or its outline.

Indicates supplementary information.

Safety Precautions

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

⚠CAUTION

Improper installation and mishandling carries a risk of injury.

	• Read this document thoroughly before operating the system to use it properly. • Before installing this product on the machine body, make sure that the power to the control unit is turned off. There is a risk of injury or damage to the machine due to unintended machine operation.
	Screws on the connectors of each connecting cable should be firmly tightened to ensure dustproofing, waterproofing, and noise suppression. Also, to prevent defective contacts, do not touch the connecting terminals of the connectors with bare hands.

Precautions for Use

■ Use and handling of the product

● This product is attached for use to compatible equipment such as NC machine tools and semiconductor manufacturing equipment.

This product cannot be used with NC machine tools and semiconductor manufacturing equipment that are not compatible with this product.
For NC machine tools and semiconductor manufacturing equipment that are compatible with this product, contact the agent where you purchased the product or Mitutoyo sales representative (📖 "SERVICE NETWORK" on page App-1).

● This product is for industrial usage.

Do not use this product for purposes other than for industrial usage.

● The product is a precision instrument.

- Do not subject the product to drastic shocks such as dropping it, or exert excessive force upon it.
- Do not disassemble or modify the product. Also, such actions are not covered by warranty.

If the product is used beyond the conditions indicated in the specifications (📖 "5 Specifications" on page 51), be aware that the functions and performance cannot be guaranteed.

Environment for placement

■ Vibration

When installing this product on the machine body, install it in a location with as little vibration as possible.

Prolonged use in areas that are subject to high vibration may result in malfunction of internal precision components and affect performance.

■ Protection against shock, dust, and water

To prevent this product from being subjected to a strong shock due to impact by a workpiece or other object being measured and to protect the scale main body from direct exposure to cutting oil or chips, please provide a cover that covers the entire scale main body.

■ 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.

Electromagnetic Compatibility (EMC)

This product complies with the EMC Directive and the UK Electromagnetic Compatibility Regulations; however, if this receives electromagnetic interference that exceeds these requirements, it will be out of warranty and require appropriate measures.

This product is an industrial product, and is not intended to be used in residential environment. If this product is used in residential environment, this product may cause electromagnetic interference with other instruments. In such a case, it is required to take appropriate measures for preventing such electromagnetic interference.

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 Act of Japan.

If you intend re-export of the product from a country other than Japan, re-sale of the product in a country other than Japan, or re-providing of the technology (including Programs), you shall observe the regulations of your country. Please contact Mitutoyo prior to such re-export, re-sale or re-providing.

Notes on Export to European Countries

When you intend exporting of this product to any of the European countries, it may be required to provide User's Manual(s) in English and Declaration of Conformity in English (in some cases, the official language of the country to be exported). For detailed information, please contact Mitutoyo in advance.

Disposal of Products outside the European Countries

Please follow the official instruction in each community and country.

Disposal of Old Electrical & Electronic Equipment (Applicable in the European Countries with Separate Collection Systems)

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

To reduce the environmental impact and minimize the volume of landfills, please cooperate in reuse and recycle.

For how to dispose of the product, please contact the agent where you purchased the product or a 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的电子电气产品的标识。

电器电子产品只要按照安全及使用说明内容在正常使用情况下,从生产日期算起,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。

产品使用后,要废弃在环保使用年限内或者刚到年限的产品,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

This product has been manufactured under strict quality management, but should it develop problems within one year of the date of purchase in normal use, repair shall be performed free of charge. Please contact the agent where you purchased the product or Mitutoyo sales representative ("SERVICE NETWORK" on page App-1).

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 product 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 product is properly installed and operated in conformance with the instructions in this document 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 responsibility for all results due to the selection of this product to achieve your intended results.

Disclaimer

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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 of 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.

1 Overview

This chapter describes the features of this product and the names and functions of its parts.

1.1 Features

See an example of a sliding device with ABS AT1100 attached.

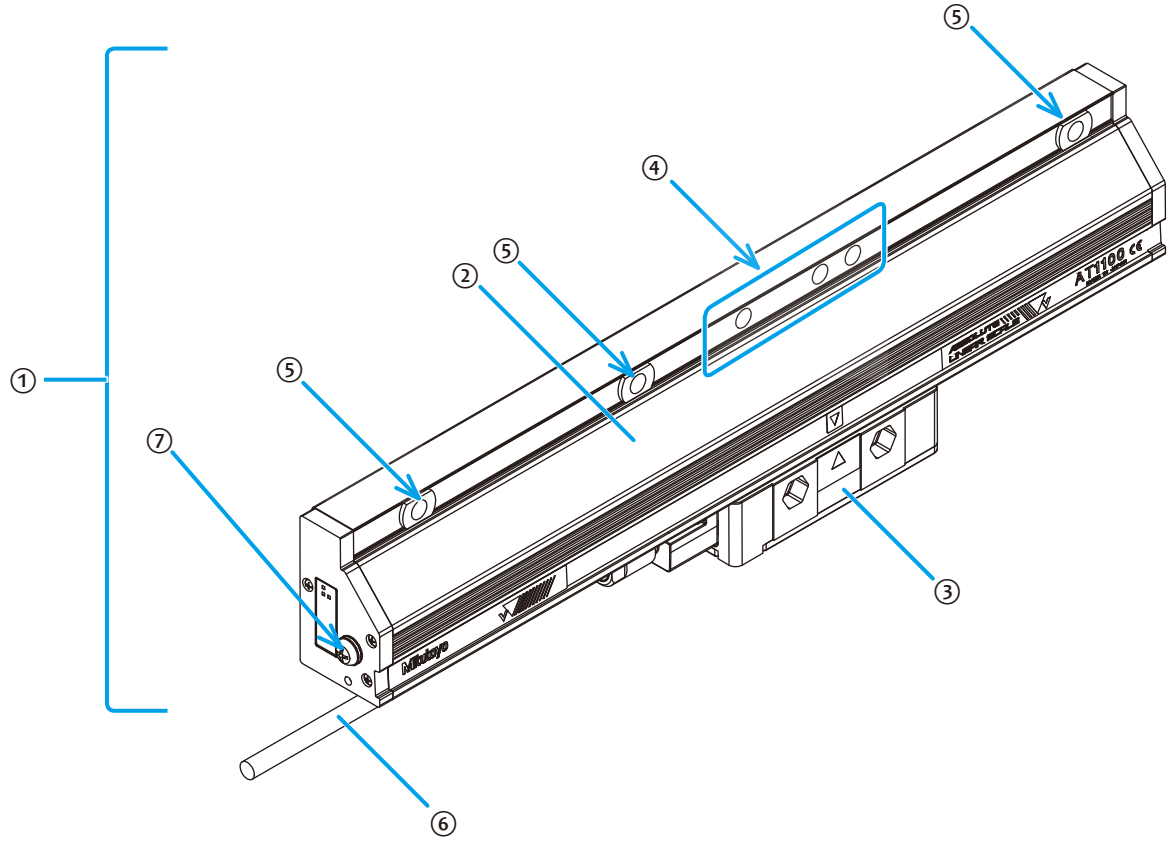
This product is an absolute linear scale that employs electromagnetic induction.
The linear scale, which is a length measuring unit, outputs the amount of movement and displacement as a digital quantity based on a scale with fixed-pitch graduations. It can accurately capture the travel of a wide variety of equipment, including NC machine tools and semiconductor manufacturing equipment.
The absolute function measures all position coordinates from a fixed origin, regardless of the last previously measured coordinates. In addition, the machine does not require a return to origin at the start of work or in the event of power failure, and does not require a backup battery, resulting in a significant labor savings.
The use of an electromagnetic induction system, which is less susceptible to problems caused by the entry of foreign matter, allows the unit to be used in environments where chips, cutting oil, etc. are generated.
Several different types are available with different effective scale lengths.

1.2 Part Names and Features

■ Part names

This section explains the names and features of each part.

This product is generally referred to as the "scale unit". The scale unit consists of the scale main body and the detector.



No.	Name	Description
①	Scale unit	"Scale unit" is the generic name for this product, which includes the scale main body and the detector.
②	Scale main body	The scale is installed internally.
③	Detector	The detector is a sensor that reads the scale position.
④	Fully-fixed fastening points	This is the base point for elongation with respect to change in temperature (the base point of mechanical expansion and contraction of the scale due to temperature change). This is the part to be fastened first upon attachment to the machine body.
⑤	Flexible fastening points	This is the part to be fixed afterwards when attaching to the machine body.
⑥	Signal cable (optional accessory)	This cable connects this product to the NC device with which it is used. The signal cable can be connected on either the left or right side of the detector.
⑦	Air supply ports (both sides, M5 screws)	To improve environmental robustness (coolant and dust resistance) of this product, clean compressed air can be supplied to the interior of the scale main body through these ports.

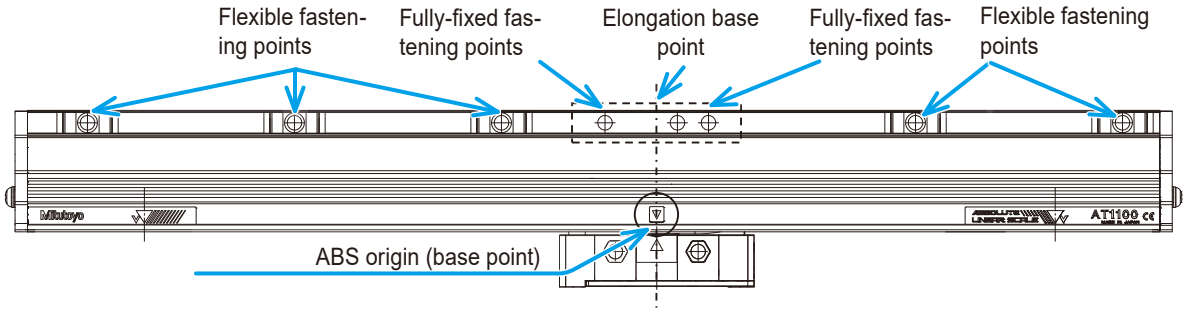
■ ABS origin and elongation base point

The fastening points of the scale main body are divided into a "fully-fixed fastening points" and "flexible fastening points".

The "elongation base point", which is the origin of mechanical expansion and contraction of the scale due to temperature changes, is the position indicated in the figure below.

The position of the electrical ABS origin inside the scale is set at the elongation base point.

Note that the elongation base point cannot be changed by the customer.

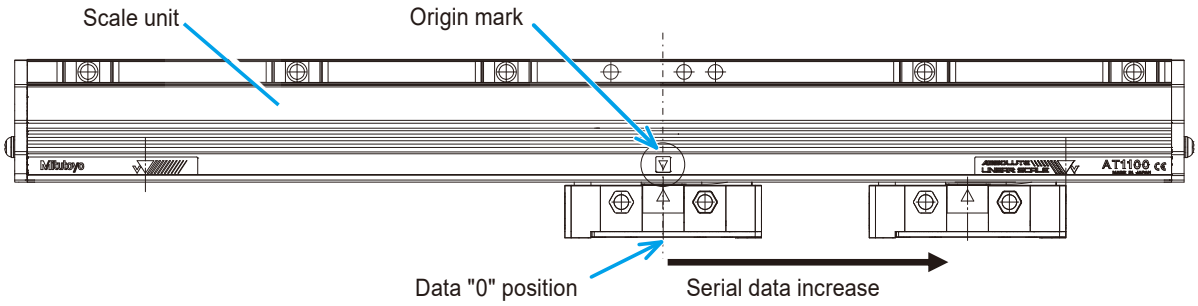


Tips

- The number of flexible fastening points depends on the effective scale length.
- To stabilize temperature characteristics of the overall system, it is recommended that the scale be installed so that the elongation base point of the scale main body is located close to the center of behavioral change with respect to temperature variation of the machine body.

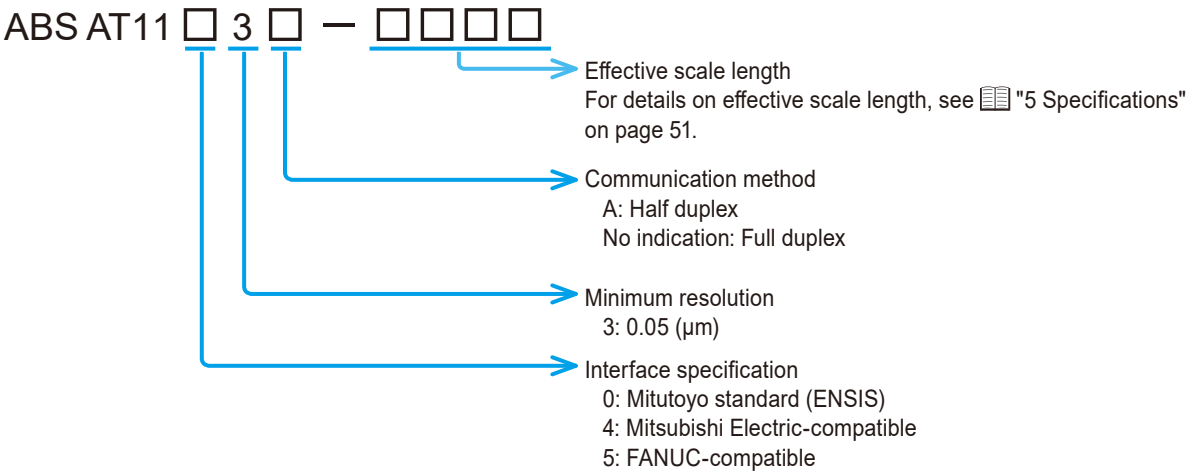
■ Counter direction

Output serial data increases (counting on the + side) when the direction of movement of the detector is to the right in the positional relationship shown in the figure below.



1.3 Scale Unit Model Numbers

This section describes scale unit specifications indicated by the model number.
Please confirm that the specifications match those of the equipment to be installed.



- Interface specification: Model number of applicable system and scale unit

Applicable system		Scale unit model number
FANUC CORPORATION	Serial α interface	ABS AT1153
	Serial αi interface	
Mitsubishi Electric Corporation	Mitsubishi CNC Series control unit	ABS AT1143
	MDS-D/MDS-DH Series	
Mitutoyo standard (ENSIS) servo amplifiers		ABS AT1103A

For information on NC devices (such as servo amplifiers and controllers) that can be connected, contact the respective device manufacturers. For the Mitutoyo standard (ENSIS), contact the manufacturer of NC devices that can be connected.

2 Advance Preparation

This chapter describes advance preparations for attaching this product to the machine body.

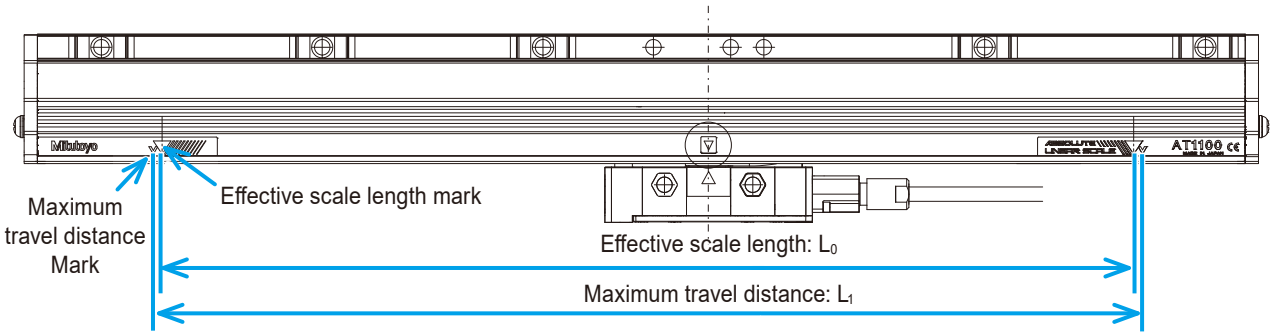
2.1 Check the Maximum Travel Distance and Effective Scale Length

Check the maximum travel distance and effective scale length of the scale main body.

Make sure that the maximum travel distance (L_1) of the scale main body is greater than the maximum travel distance of the machine to which it is to be attached.

For details on effective scale length (L_0) and maximum travel distance (L_1), see "■ Appearance and installation dimensions" on page 53.

Also, please note that the guaranteed accuracy range of this product is the range covered by effective scale length.



IMPORTANT

- When checking the travel distance of the scale main body on the machine, make sure that the maximum travel distance of the machine body is less than or equal to L_1 above and that the required range of accuracy is less than or equal to L_0 above.
- If the maximum travel distance or effective scale length of the scale main unit is insufficient, the size of the scale main unit must be changed.

2.2 Confirmation of Included Items

Items included with this product are indicated below.

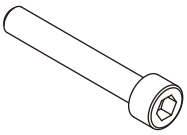
Make sure that none of the included items are missing.

Also make sure that no items have been damaged in transit.

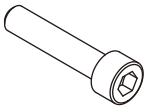
If you have any questions, please contact the agent where you purchased the product or Mitutoyo sales representative.

Name	Quantity	Note
Scale unit	1 unit	
Accessories	1 set	See "Accessories (mounting screws, etc.)" below.
User's Manual (this document)	1 each	
Warranty	1 each	
Inspection report (accuracy inspection table)	1 each	

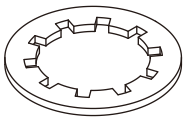
● Accessories (mounting screws, etc.)



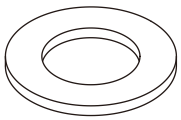
Hex socket head cap screw M6×40



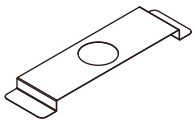
Hex socket head cap screw M6×30



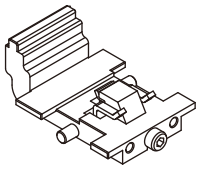
Internal lock washer 6.6×10.2×0.5



Flat washer Nominal 6 small round



Specialized plate spring



Detector fixing block

- Two detector fixing blocks are included with the scale unit to secure the detector to the scale main body. For detector fixing block mounting points, see "2.6 Precautions Regarding Mounting Surface Design" on page 28.
- The quantity of other accessories depends on the effective scale length of the scale unit. For details, see "7.1 Quantity of Accessories Used for Installation" on page 63.
- Signal cables are sold separately. They are not included as provided accessories. For details on length of signal cables, see "5.2 Optional Accessories" on page 56.

2.3 Signal Cable Preparation

The signal cables used with this product are sold separately. Arrange the direction of connection to the detector head according to your application.

Tips

For signal cable specifications and part numbers, see "5.2 Optional Accessories" on page 56.

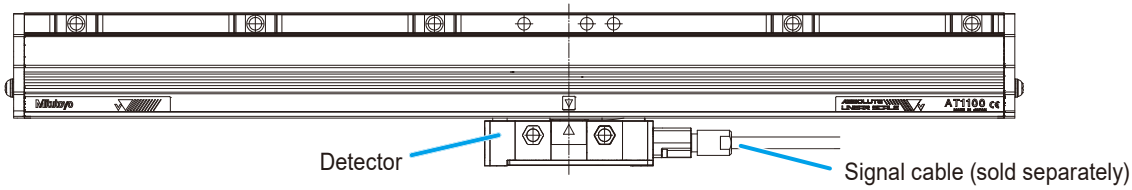
- Types of signal cables

Item	Specifications
Cable length	1 m / 3 m / 6 m / 9 m / 12 m* *12 m cable is only available in unfinished form.
Cable material	• PVC sheath ø6.5 without conduit • PVC sheath ø10.6 with conduit (Mitutoyo standard connectors only)
Output connector	• Unfinished cable specifications • FANUC connector specifications • Mitsubishi Electric connector specifications • Mitutoyo standard connector specifications

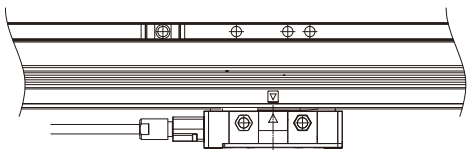
2.3.1 Signal Cable Connection Direction

The signal cable can be connected to the electrical component using the connector on either side of the detector.

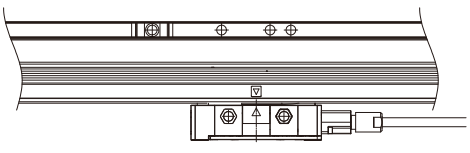
For the connection procedure, see "3.4 Signal Cable Connection and Fastening" on page 38.



Signal cable connection direction (left)



Signal cable connection direction (right)

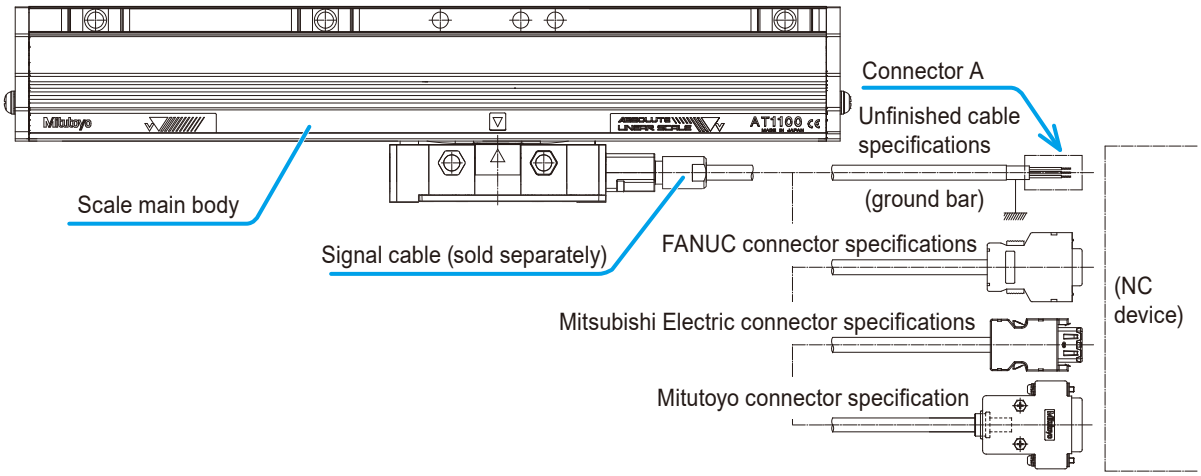


2.3.2 Cable Connection Example

Examples of cable connection are shown below.
If the length of the signal cable that Mitutoyo can supply is insufficient, the customer should provide a feedback cable.
Please note that this will require that the customer obtain some parts on their own.

■ Connection example 1

The following example illustrates direct connection to NC equipment, etc.

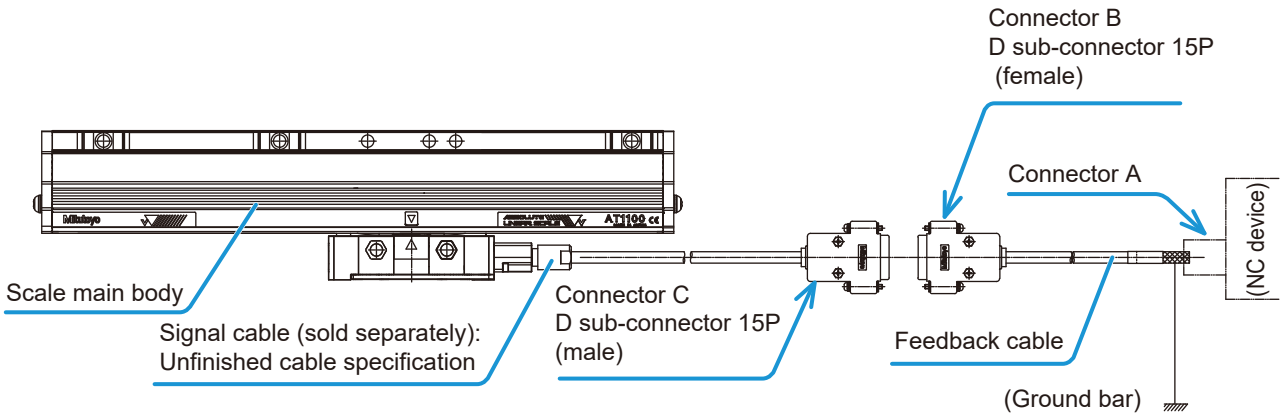


Tips

- Connector A must be provided by the customer.
- The customer is responsible for wiring connector A and ground bar connection.

■ Connection example 2 (using unfinished cable)

The following is an example of adding a feedback cable consisting of unfinished cable with a D sub-connector attached.
If a feedback cable is not used, see "5.2 Optional Accessories" on page 56 and connect the leads directly to the connector on the NC device side. When doing the wiring, follow the connector manufacturer's recommendations.



IMPORTANT
The combined length of the signal and feedback cables should be no more than 29 m.

NOTICE
Non-compliance can result in malfunction or damage.

When using cables other than the those recommended, be sure to use shielded cables and ensure that the total impedance of the power supply lines (+5 V and 0 V) is "0.65 Ω or less/full length".

Feedback cables should also be used to avoid repetitive bending.

Tips

- Connectors A, B, and C and the feedback cable must be provided by the customer.
- Customers are responsible for wiring each of connectors A, B, and C and making connection to the ground bar.
- When using a feedback cable, refer to the following when procuring the cable.
  Recommended cable material:
  Product number: A66L-0001-0286
  Manufacturer : Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.

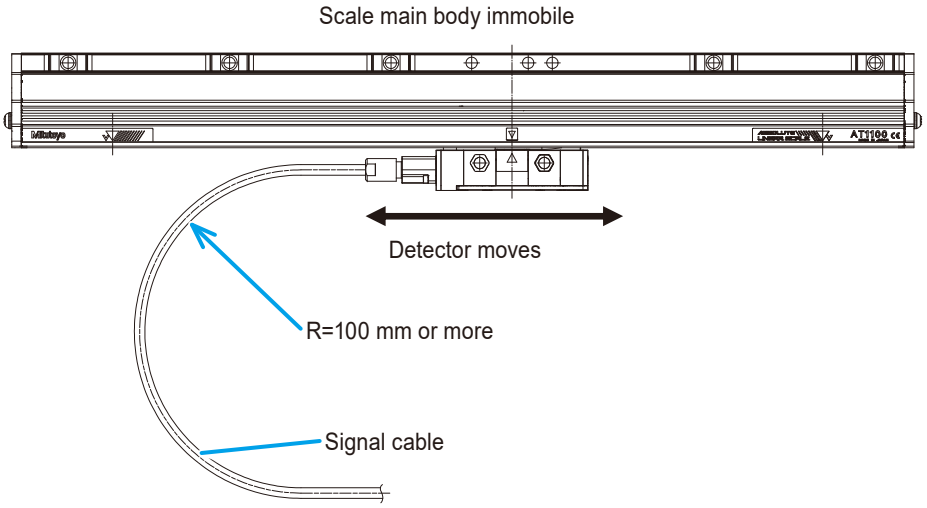
2.3.3 Cable Bending Radius R Tolerance Range

Cable bending radius R should be within the allowable range shown below.

The figure below shows the bending radius R of the signal cable, and the feedback cable extension of the signal cable should follow suit.

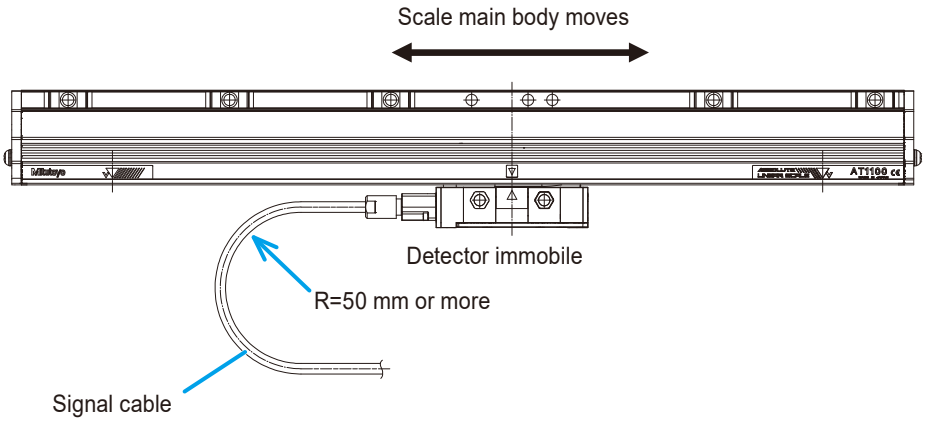
- When the detector moves (when the cable is bent repeatedly)

→ Cable bending radius R=100 mm or more



- When the detector is fixed (when the cable is fixed)

→ Cable bending radius R=50 mm or more



NOTICE

Do not exceed the tolerance range of the cable bending radius R. Doing so may result in wire breakage, etc. Furthermore, such breakage is not covered by the warranty.

Tips

- Signal cables are sold separately. Cable clamps and other cable fasteners are not included, and must be provided by the customer.
- For details on how to fasten the cable, see "3.4.2 Cable Fastenings and Precautions" on page 41.

2.4 Feedback Cable Preparation

This section explains preparation of a feedback cable (provided by the customer) using an example.
Wire the feedback cable and NC device connector in the manner recommended by the connector manufacturer.

2.4.1 Example of NC Device Wiring

The following wiring table illustrates connection of NC equipment using a feedback cable.
This shows the case in which the connector fitted to the signal cable is a D-sub connector.
Wiring when other connectors are used should be established by the customer.

NOTICE

Non-compliance may cause malfunction or damage to the NC unit and scale unit.

The shield braid of the feedback cable must be grounded to a ground bar or the like immediately adjacent to the NC device.

Tips

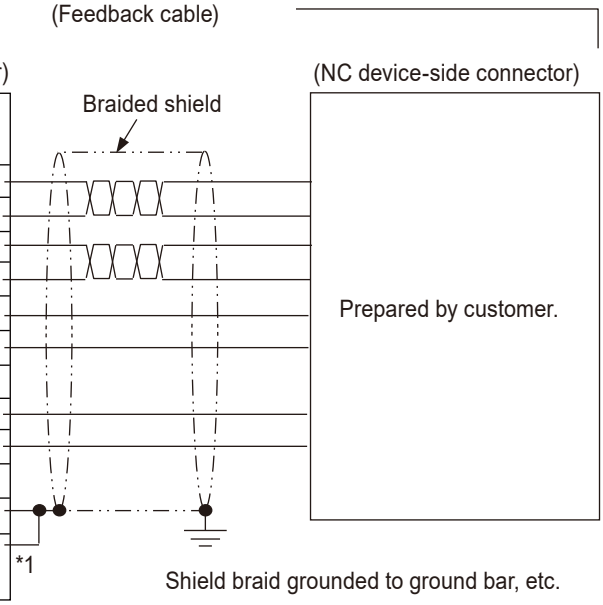
Specifications of recommended cable stock for feedback cables (A66L-0001-0286):

- Wire for power supply: 0.5 mm^2 3 black, 3 red
- Signal line wire: 0.18 mm^2 twisted pair wire (black x red, black x white, red x white)

■ For ABS AT1103A (Interface specification: Mitutoyo standard (ENSIS))

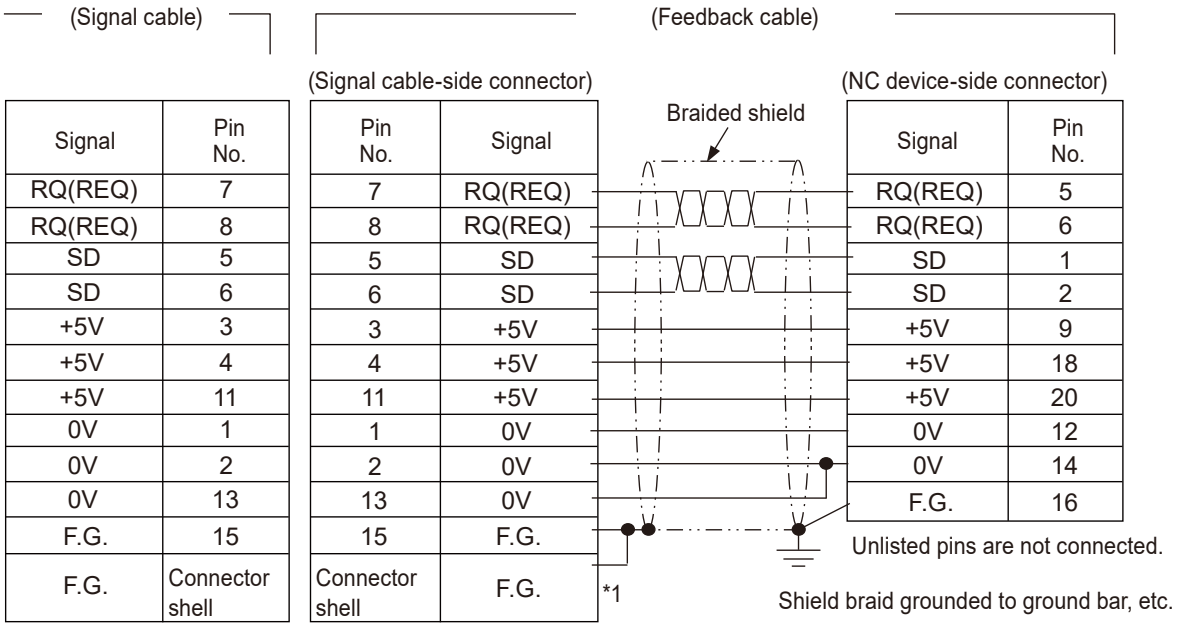
(Signal cable) (Feedback cable)

Signal	Pin No.	(Signal cable-side connector) 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.



*1: If a shielded drain wire is present, connect it to pin 15 of the D sub-connector.

■ For ABS AT1153 (interface specification: made by FANUC Corporation)



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

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

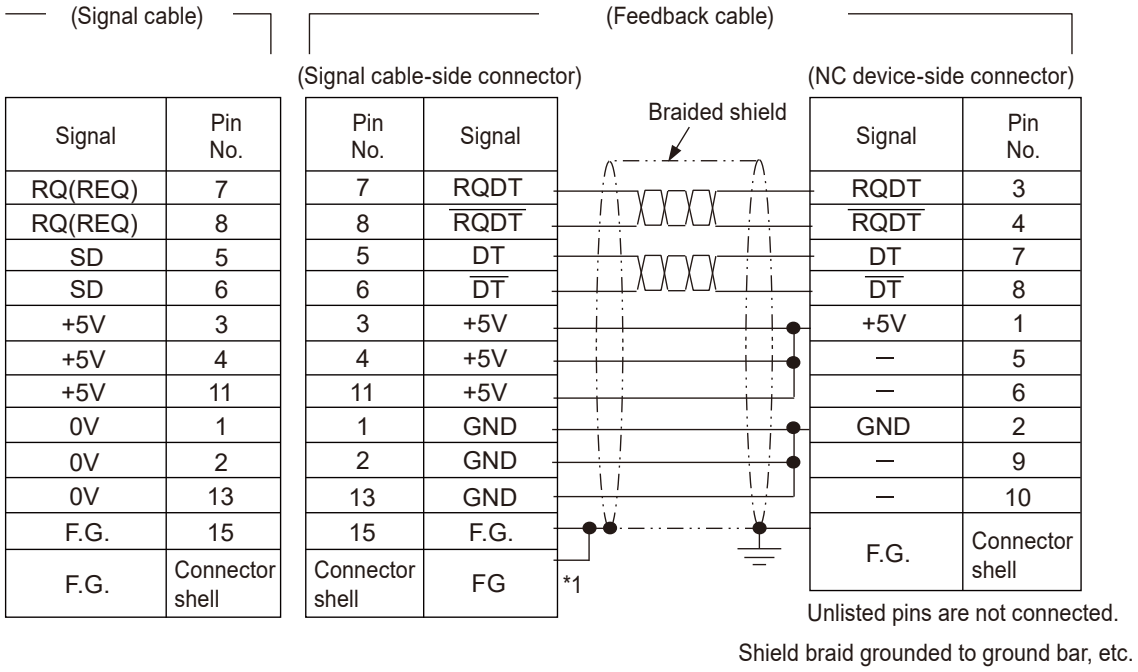
Signal	Pin No.
RQ(REQ)	5
RQ(REQ)	6
SD	1
SD	2
+5V	9
+5V	18
+5V	20
0V	12
0V	14
F.G.	16

*1: If a shielded drain wire is present, connect it to pin 15 of the D sub-connector.

■ For ABS AT1143 (interface specification: made by Mitsubishi Electric Corp.)

● CNC 700 Series connection

Compatible servo amplifiers: MDS-D, MDS-DH, MDS-Dn



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

Pin No.	Signal
7	RQDT
8	$\overline{\text{RQDT}}$
5	DT
6	$\overline{\text{DT}}$
3	+5V
4	+5V
11	+5V
1	GND
2	GND
13	GND
15	F.G.
Connector shell	FG

Signal	Pin No.
RQDT	3
$\overline{\text{RQDT}}$	4
DT	7
$\overline{\text{DT}}$	8
+5V	1
—	5
—	6
GND	2
—	9
—	10
F.G.	Connector shell

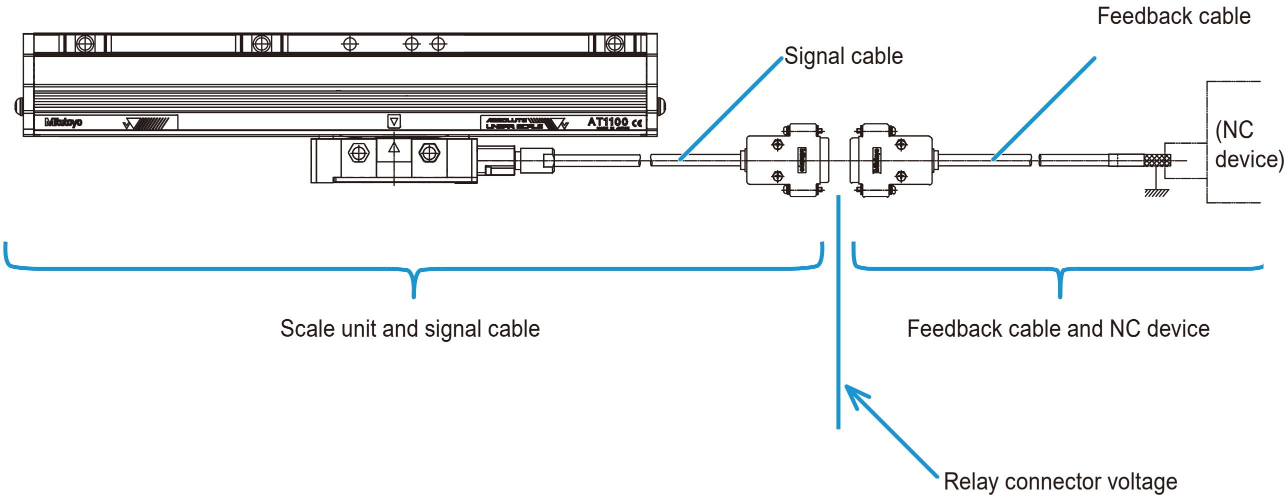
*1: If a shielded drain wire is present, connect it to pin 15 of the D sub-connector.

2.4.2 Feedback Cable Length Calculation

■ How to calculate feedback cable length

The following table shows how to calculate the feedback cable length. Use as a reference for feedback cable fabrication.

● Arrangement



● Calculation formula

Allowable voltage drop ≥ (current consumption × wire resistance × 2 × feedback cable length) ÷ number of pairs of power lines used ..... ①

Conditions

Feedback cable length	L (unit: m)
Wire resistance of wire stock used	a (unit: Ω/m)
Number of pairs of power lines used	b (unit: pairs)
Current consumption	0.3 (unit: A)
Supply voltage from servo amplifier* (min. value)	4.95 (unit: V)
*Standard supply voltage value	
Relay connector voltage (min. value**)	4.5 (unit: V)
**Check the input voltage at the relay connector	
Voltage drop due to signal cable	0.039 (unit: V/m), for a 1 m signal cable

Applying the above conditions to formula ① yields the following.

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

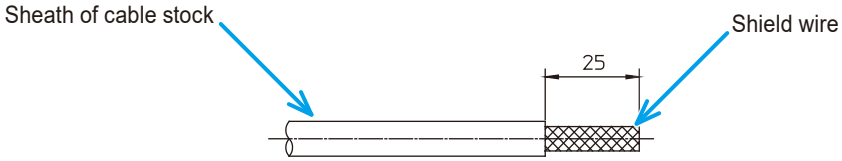
Equation ② above is taken as the formula for finding L.

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

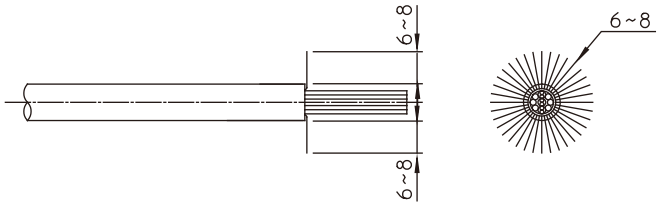
Based on the above, prepare a feedback cable with length (L [m]) that satisfies Formula ③ using wire stock of resistance (a [Ω/m]), and with (b [wires]) pairs of power supply wires.

2.4.3 Assembly of D Sub-Connector

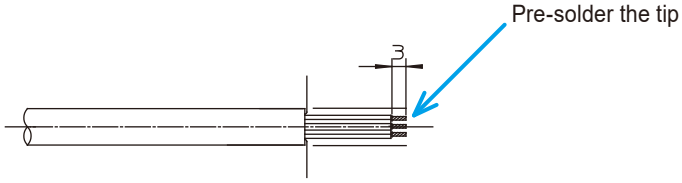
1 **Remove 25 mm of the sheath from the cable stock.**
Be careful to avoid damaging the internal shield braid.



2 **To fold the shield braid back evenly, unravel the exposed shield wires, spread them radially, and cut them in a circular pattern so that they extend 6 mm–8 mm beyond the sheath.**



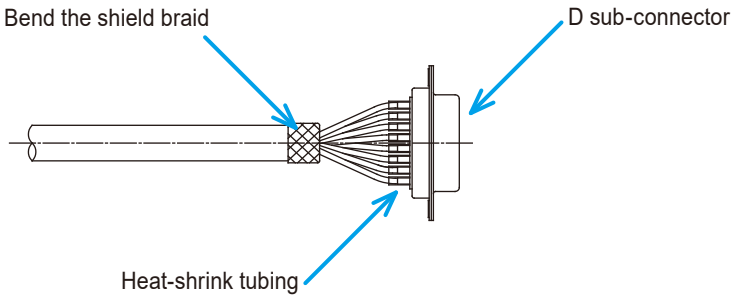
3 **Strip 3 mm of insulation from the tip of each wire and pre-solder.**



4 **Solder individual wires to the D sub-connector (15P male).**

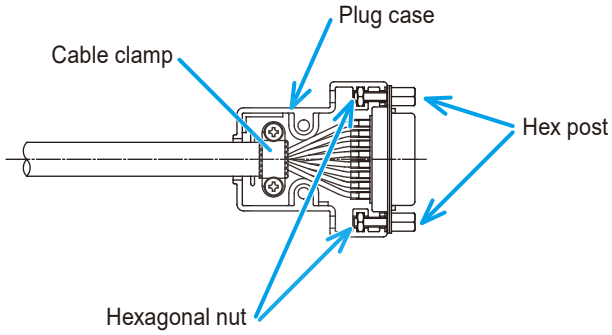
1 First fit heat-shrink tubing (ø2, L = 6 mm–8 mm) over each of the terminals of the D sub-connector and then solder each wire.

2 Bend the shield braid to the sheath side.

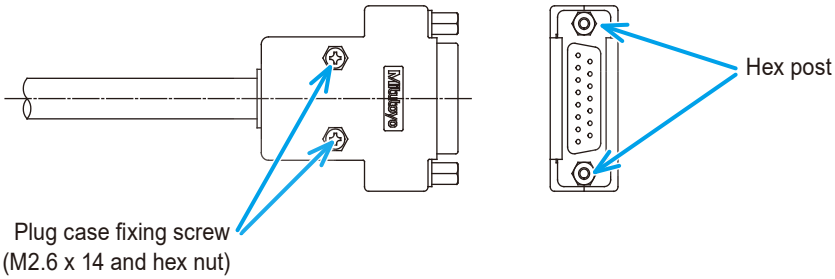


5 Set the D sub-connector in the plug case.

1. Use screws and the cable clamp to clamp the folded shield braid portion of the cable to the plug case.
2. After setting hex nuts (M2.6) into the plug case, insert the hex posts in from the connector side and screw them into the nuts (finger tightening them).



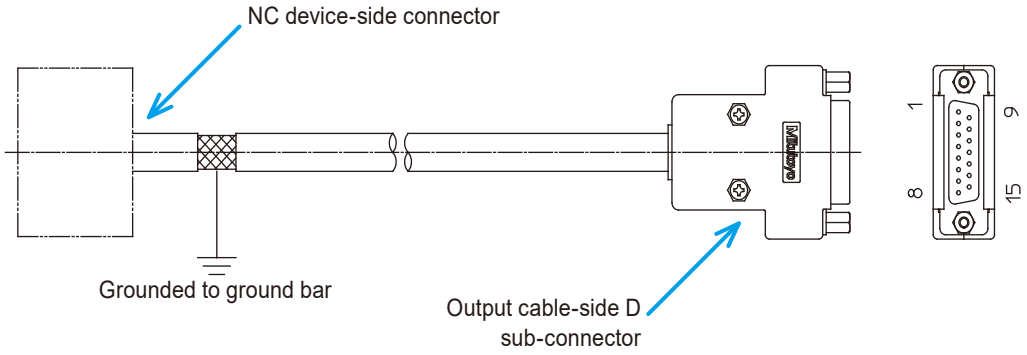
3. Put the other half of the plug case in place, secure it with the plug case fixing screws (M2.6 x 14 and hex nuts), and finally securely tighten the hex posts.



IMPORTANT

Use thread-locking fluid on threaded parts.

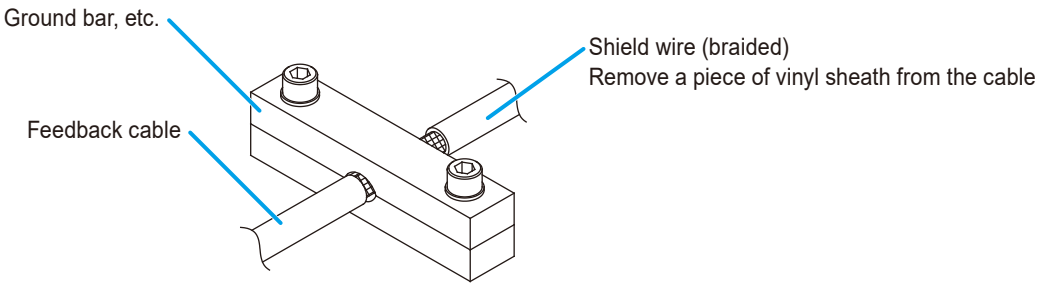
2.4.4 Feedback Cable Diagram and Grounding to Ground Bar



NOTICE

Non-compliance may cause malfunction or damage to the NC unit and scale unit.

When assembling the D sub-connector side, the shield braid of the cable must be electrically connected to the metal shell. Also, be sure to remove part of the outer sheath on the NC device side and ground the shield braid using a grounding bar or similar device.



2.5 Cover Installation

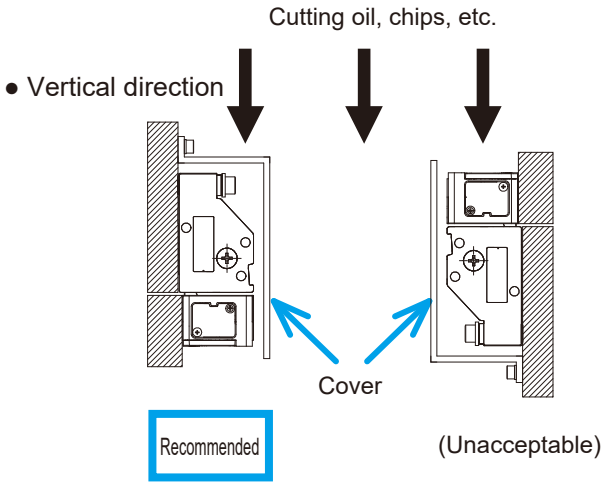
When using this product, be sure to install a cover so that the scale main body is protected from direct exposure to cutting oil or chips.

Check installation orientation of the scale main body.

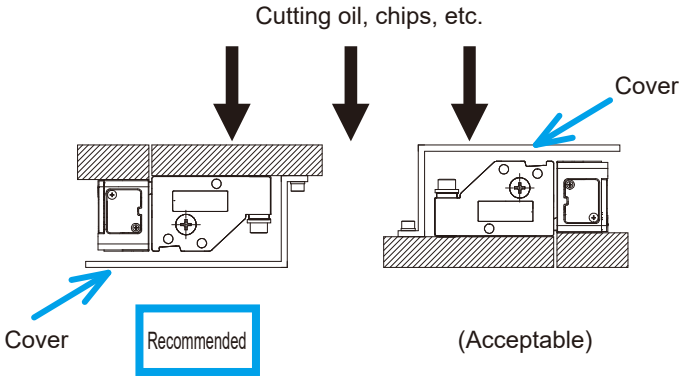
■ Attachment orientation of scale main body and cover

The opening of the scale main body is covered with dust-proof rubber to prevent entry of foreign matter, but it is more susceptible to entry of foreign matter to than other surfaces. Therefore, select the installation location of the scale main body and the cover with consideration for the direction of dispersion of cutting fluid and chips.
The figures below show examples of both cover installation orientations that are susceptible to ingress of foreign matter and those are resistant to ingress of foreign matter (recommended) with respect to the direction of dispersion of cutting oil, chips, etc.

● Vertical direction



● Horizontal direction

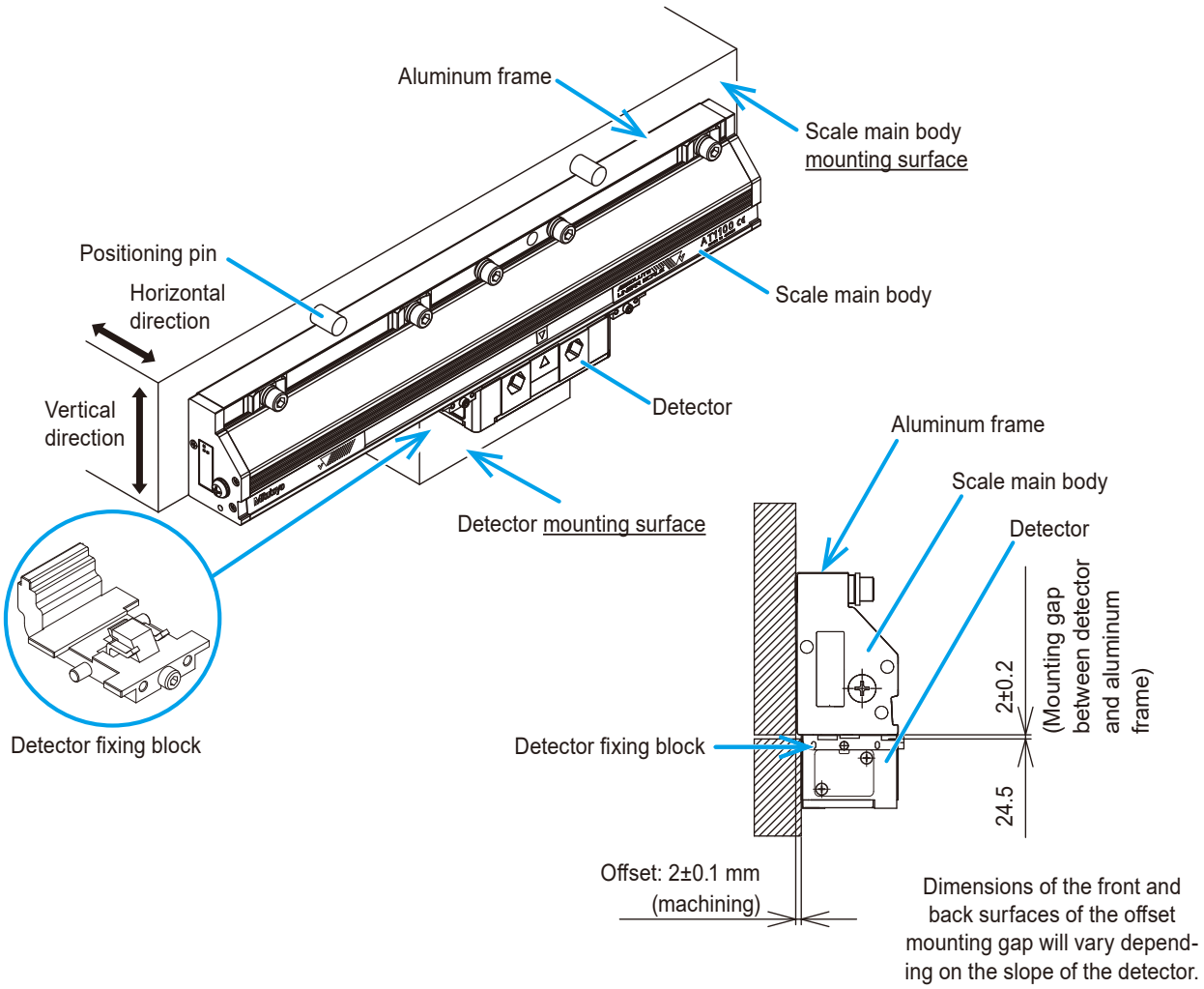


2.6 Precautions Regarding Mounting Surface Design

The following are design precautions to be observed with regard to the surface on which the scale main body is installed on the machine body.

Check precautions for design of the installation surface.

- The installation surfaces of the scale main body and the detector must be machined surfaces and have flatness within 0.05/500 mm.
- The installation surface of the detector is offset from that of the scale main body. Therefore, be sure to machine the mounting surface and maintain the offset dimension within the machining allowance of 2 mm ±0.1 mm. If positional adjustment is to be made by inserting spacers, etc., be sure to measure the offset prior to installation.
- When installing the scale main body, adjustment in the vertical direction is required as shown below.
  To simplify positioning adjustment, it is recommended that a reference positioning pin or similar device be used.
  The vertical positioning reference for the scale main body is the surface of the aluminum frame.
- The gap between the scale main body and the detector is adjusted using the detector fixing blocks.



Tips

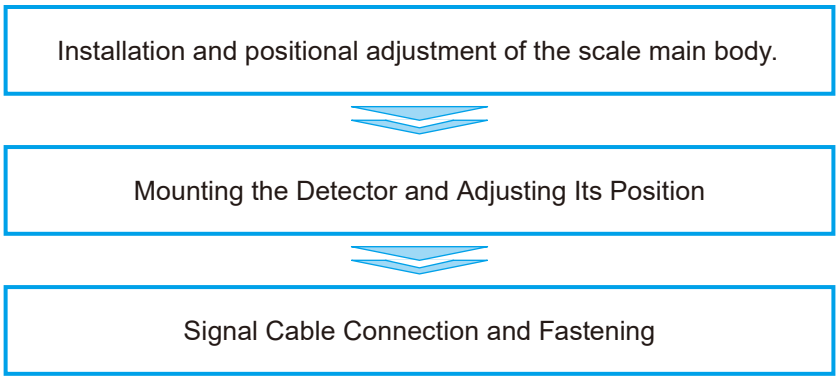
- For detailed installation specifications, see "■ Appearance and installation dimensions" on page 53.
- For detailed installation procedures, see "3 Attachment to the Machine Body" on page 29.

3 Attachment to the Machine Body

This chapter describes procedures and precautions regarding attachment of this product to the machine body.

3.1 Procedure for Attachment to the Machine Body

Installation of this product on the machine body is broadly divided into the following steps.



The following describes each procedure in detail.

3.2 Installation and Positional Adjustment of the Scale Main Body

3.2.1 Check the Mounting Surface, etc.

Referring to "2.6 Precautions Regarding Mounting Surface Design" on page 28 and "■ Appearance and installation dimensions" on page 53, verify that the positional and surface accuracy of the mounting surface for the scale main body and the mounting surface of the detector are within specified tolerances.

3.2.2 Installation of Scale Main Body

You can check the installation procedure for the scale main body.

1 Temporarily affix the scale main body to the scale mounting surface on the machine body.

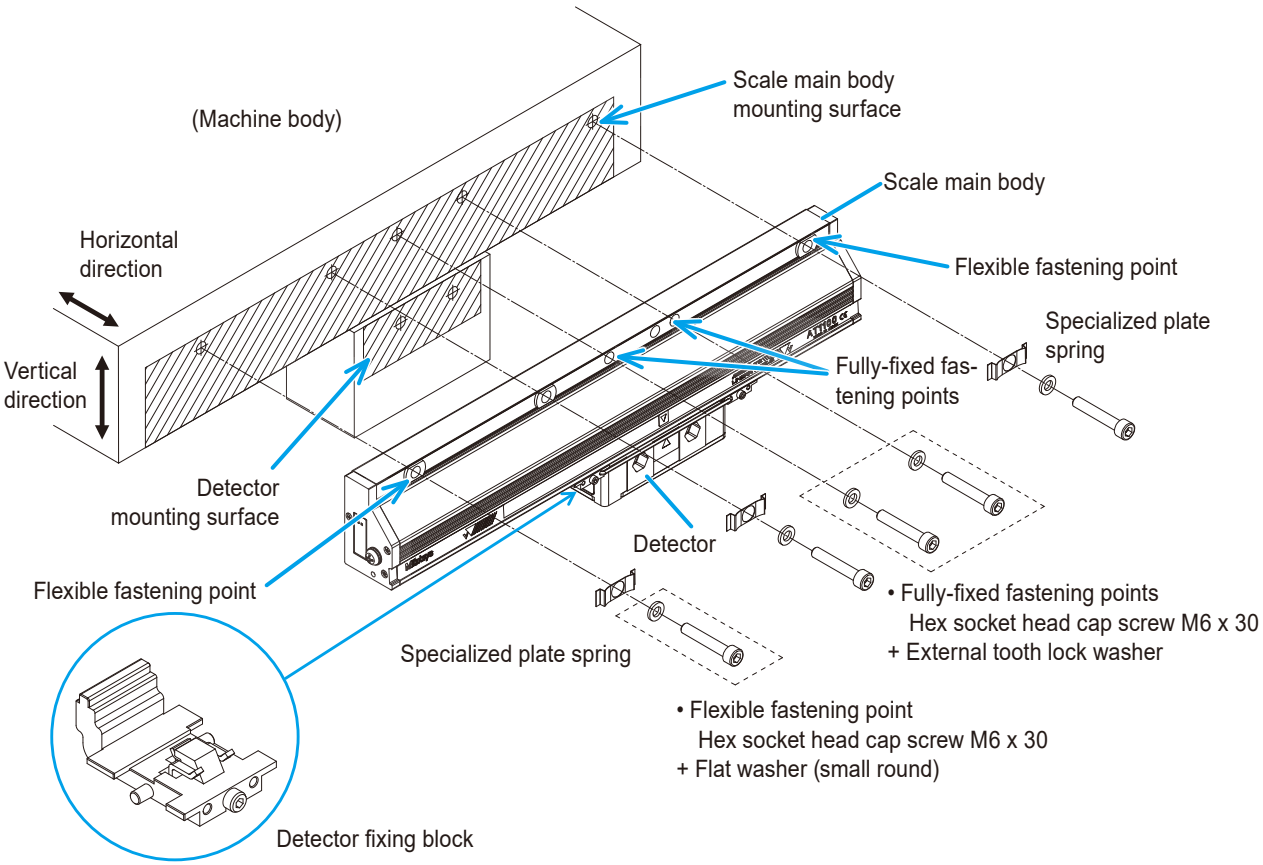
Use provided screws as indicated below to temporarily secure the scale main body to the extent that it will not move even if you remove your hand from the scale main body.

- Fully-fixed fastening points (elongation base point position with respect to temperature change)
  Hexagon socket head cap screws M6x30 + Internal lock washers
- Flexible fastening points
  Hexagon socket screws M6x30 + flat washers (small round) + specialized plate spring

Do not fasten the detector at this time.

Tips

- The number of fully-fixed fastening point holes depends on the overall length of the scale.
  For details, see "■ Appearance and installation dimensions table" on page 55.
- Two screws are used for the fully-fixed fastening points.
  For details, see "● Note regarding appearance and installation dimensions" on page 54.



NOTICE

Do not remove the detector fixing block. Detector failure may result.

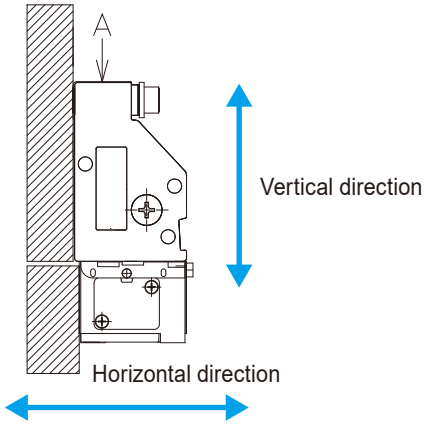
The detector fixing block determines the positional relationship between the scale main body and the detector. This positional relationship is maintained when the scale unit is attached to the machine body.

2 Adjust scale main body positioning in the vertical direction.

The scale main body of this product does not need to be positioned in the horizontal direction as shown in the figure below (it relies on accuracy of the mounting surface on the machine body), but it must be positionally adjusted in the vertical direction through parallelization.

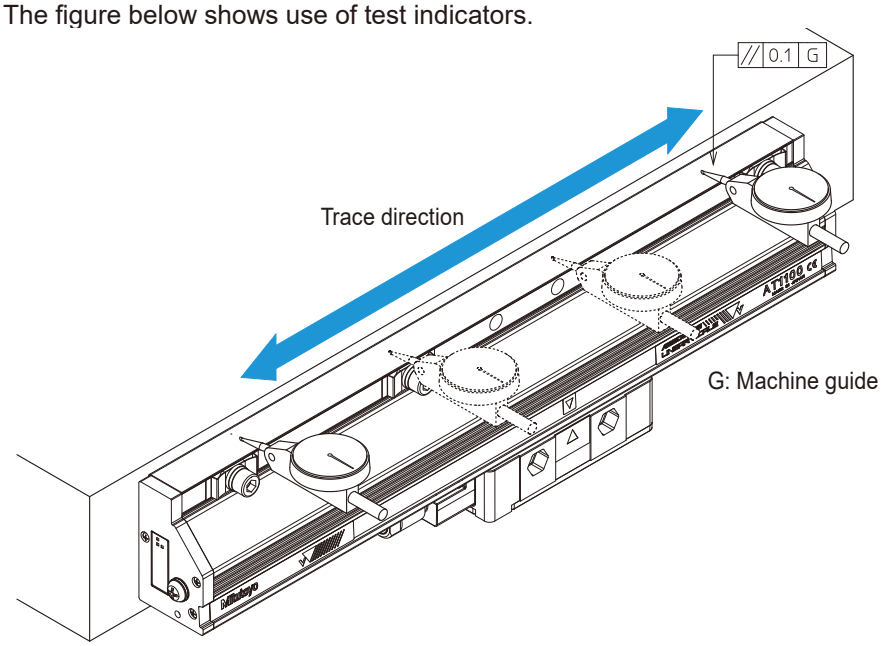
For parallelization, refer to the external appearance and installation dimension drawings of the scale main body, and parallelize on the surface indicated in figure A below.

For details on the external appearance and installation dimension drawings, see "■ Appearance and installation dimensions" on page 53.

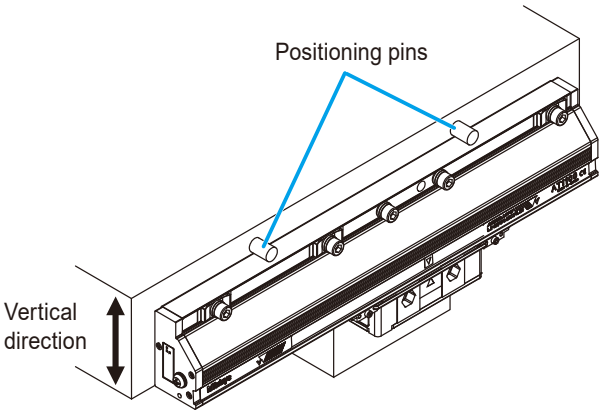


● Positional adjustment procedure

For parallelization by positional adjustment, use instruments such as a test indicators or dial gages. The figure below shows use of test indicators.



Positioning can be simplified by using a base point, such as a positioning pin, as shown in "2.6 Precautions Regarding Mounting Surface Design" on page 28, but the mounting position must be confirmed.

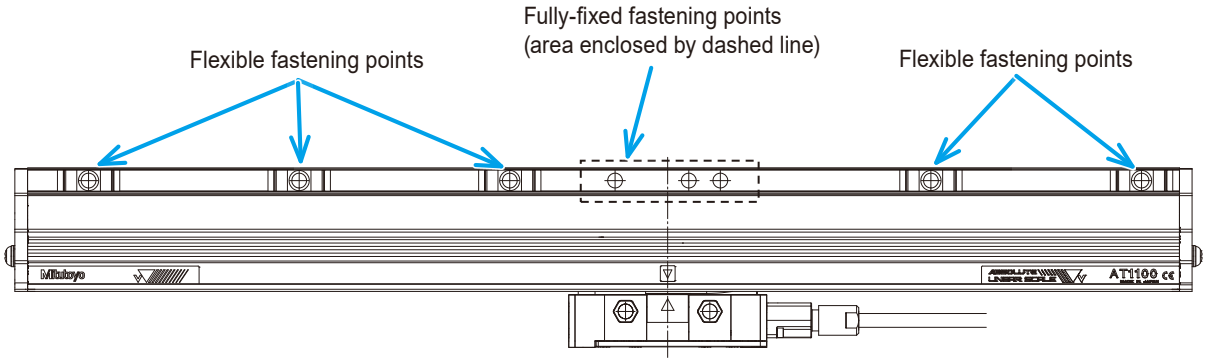


3 **Securely fasten the scale main body to the scale mounting surface of the machine body.**

After adjusting vertical positioning of the scale main body, tighten all screws.

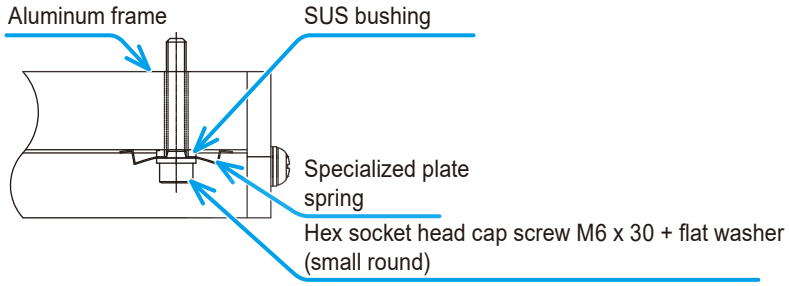
When doing so, please note the following.

- Screw tightening torque: 9 N•m
- Screw tightening procedure
  When tightening the screws, be sure to tighten the fully-fixed fastening points first, followed by the flexible fastening points.



- Flexible fastening points when fastened

  The fastened state of the flexible fastening points is shown below. Use as a reference.



3.3 Mounting the Detector and Adjusting Its Position

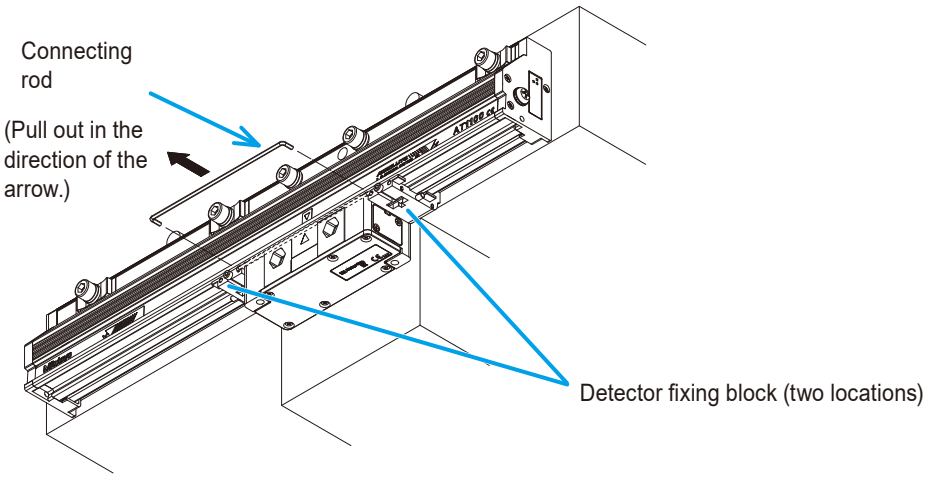
After completing "3.2 Installation and Positional Adjustment of the Scale Main Body" on page 29, install and position the detector according to the following procedure.

Check the head installation procedure.

IMPORTANT

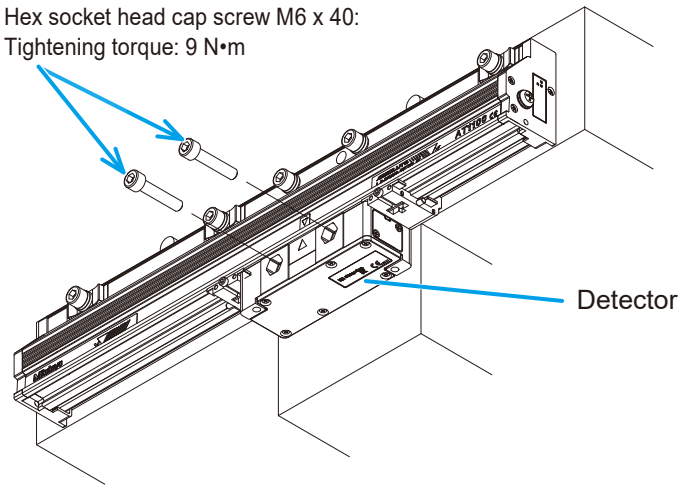
Make sure that the offset between the mounting surface of the detector head and the scale main body is 2±0.1mm.
If the offset is out of the allowable range, adjust it by inserting a spacer or the like.
For details, see "■ Appearance and installation dimensions" on page 53.

1 Remove the connecting rod that connects the two detector fixing blocks.



View from below

2 Secure the detector with the provided hexagon socket head cap screws M6 x 40.



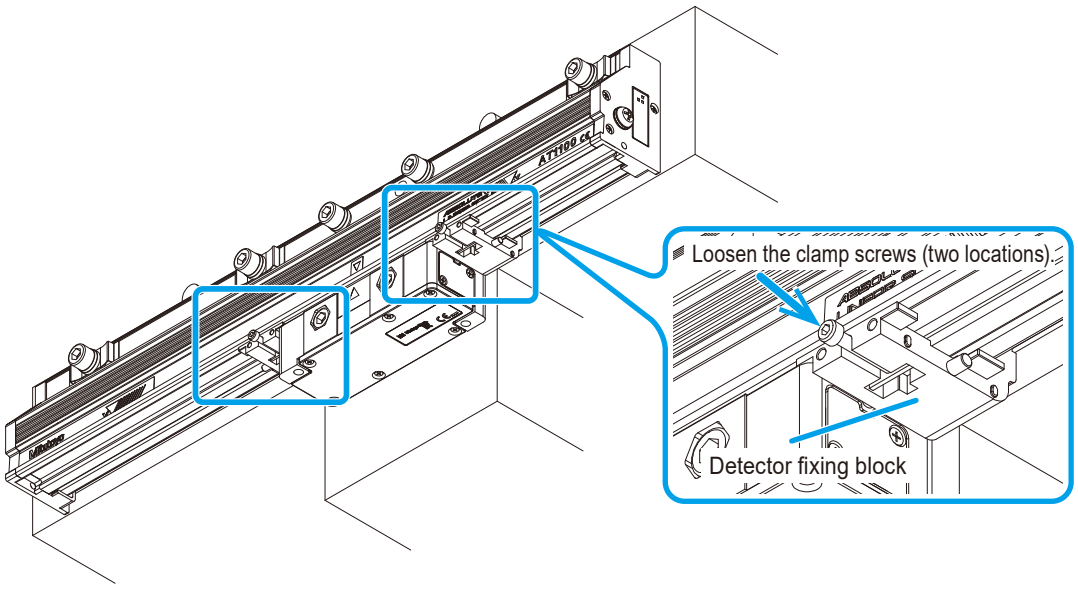
View from below

NOTICE

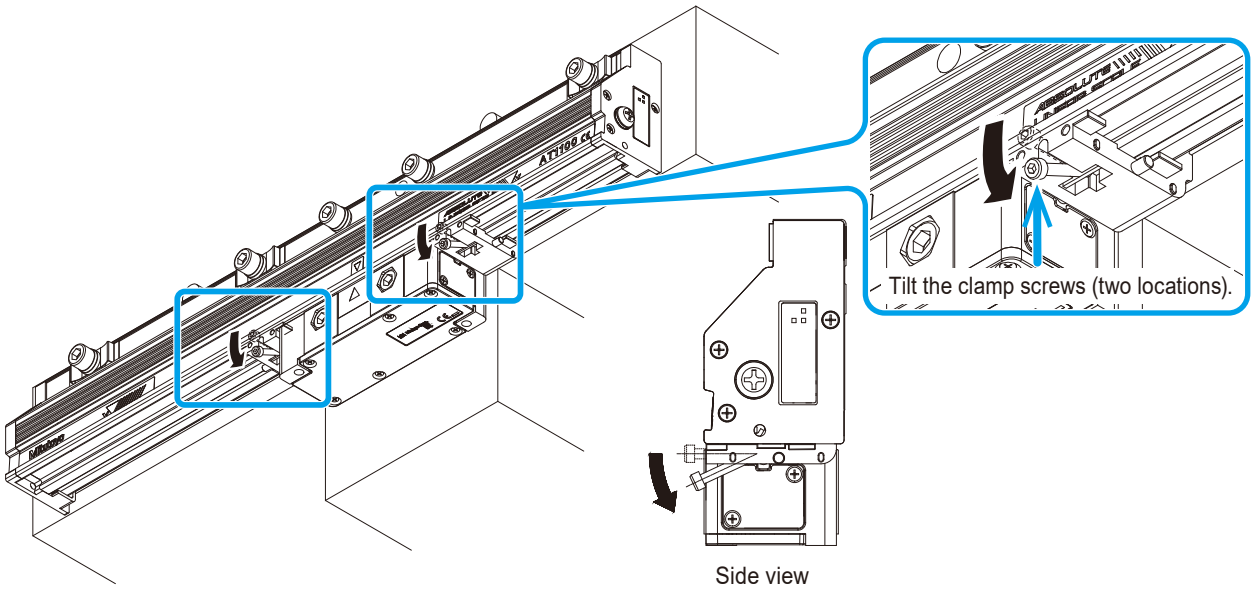
If there is a gap between the detector and the mounting surface, use a spacer or the like to fill the gap. Forcibly tightening the screws while a gap is present may damage the scale unit.

3 **Loosen the clamp screws holding the detector fixing blocks (two locations) by about five to eight turns and tilt the clamp screws.**

Note that if the clamp screws are loosened too much, the metal fittings of the detector fixing block will fall out.

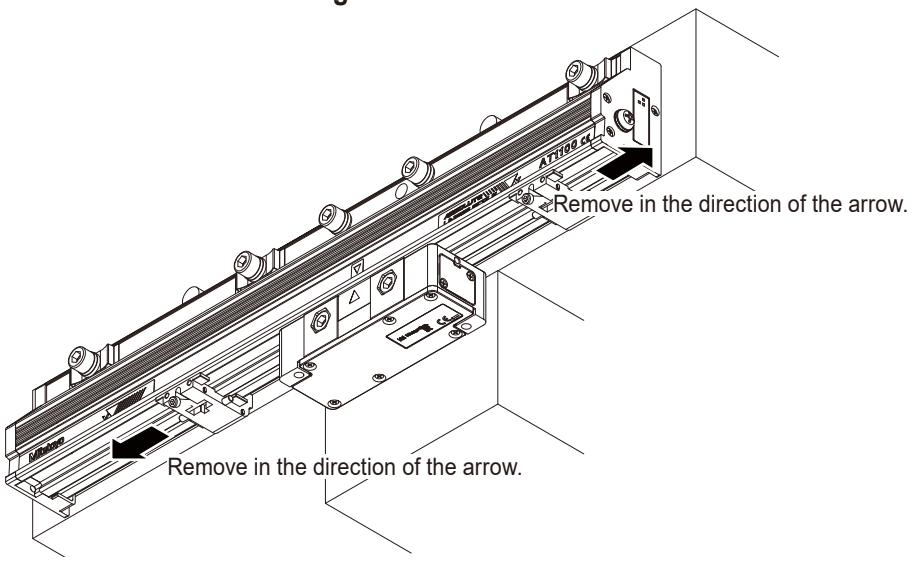


View from below



View from below

4 **Remove the detector fixing block in the direction of the arrows.**



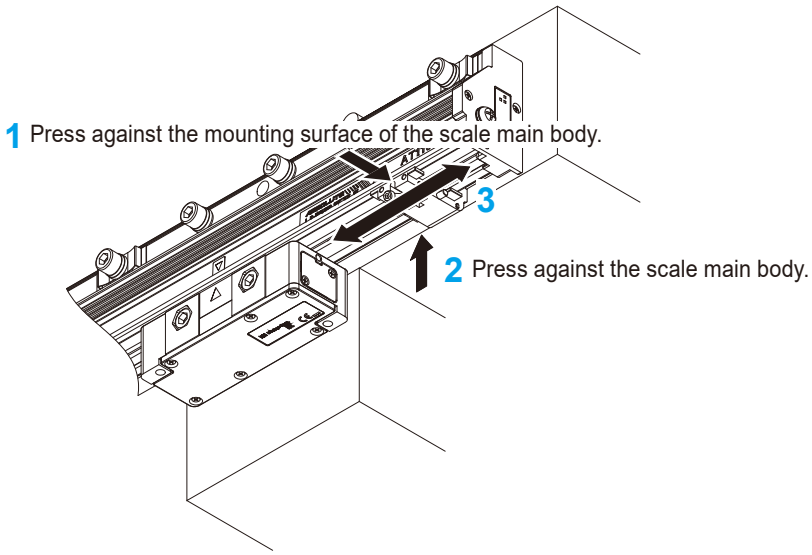
View from below

5 **Check that the detector fixing blocks slip out smoothly when pressed against the scale main body and that there is no gap when they are inserted.**

Check on both sides of the detector head.

Installation is now complete.

If the detector fixing block is stuck or inserted too tightly, reconfirm the positional relationship between the detector head and the scale main body.



View from below

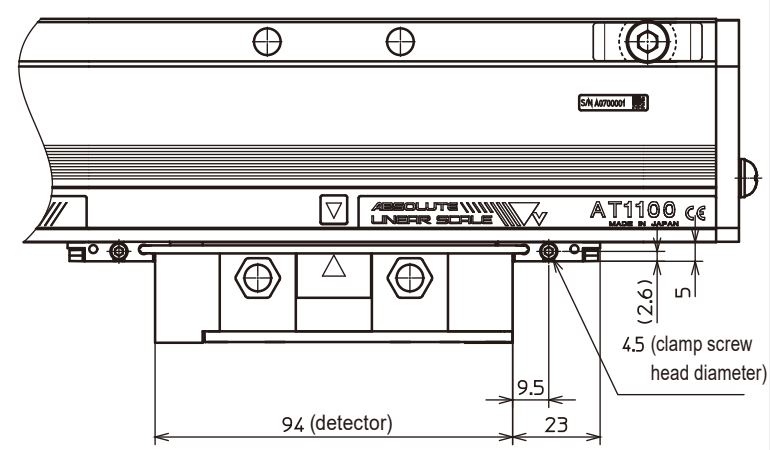
■ When mounting the detector on a front or bottom surface

When mounting the detector from the front or from the bottom, refer to the following.
In this situation, screws and nuts used for installation are not included, and must be provided by the customer.

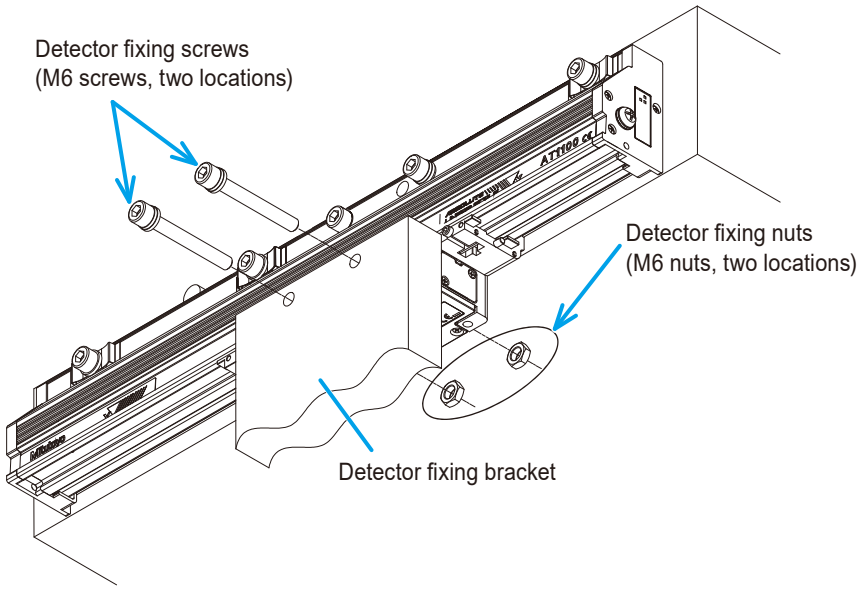
NOTICE

When designing the bracket for fixing the detector, please note the following points. Non-compliance can result in malfunction.

- Pay close attention to rigidity of the bracket.
- When fixing the detector from the front as shown in "Mounting example 1" below, refer to the detector fixing block dimensions shown at right, and be careful to avoid interference between the clamp screws of the detector fixing block and the bracket for fixing the detector.

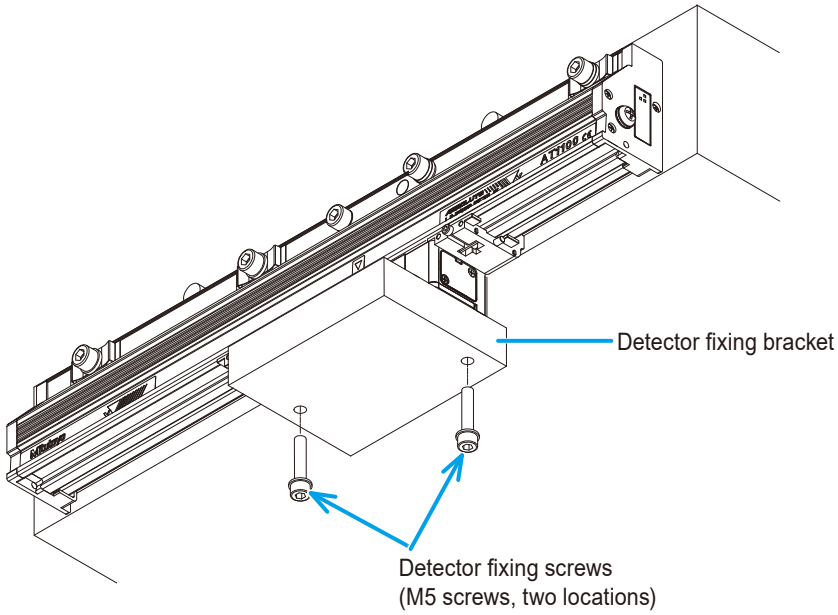


- Installation example 1 (when mounting from the front)



View from below

- Mounting example 2 (when mounting from the bottom)



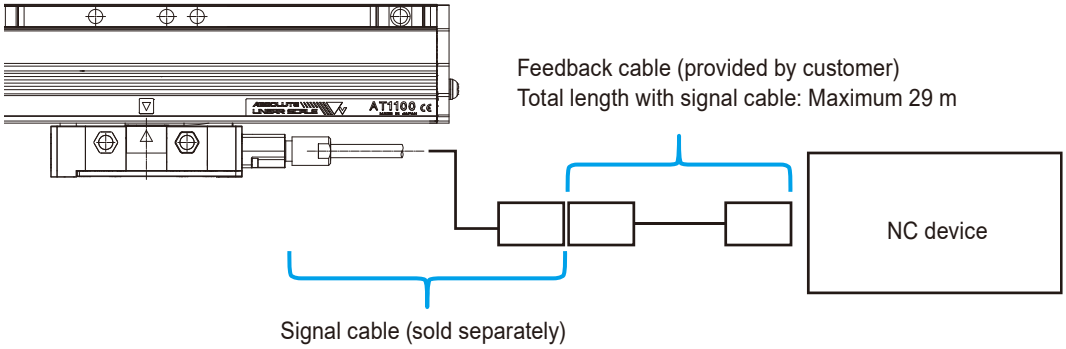
View from below

3.4 Signal Cable Connection and Fastening

3.4.1 Connecting Cables and Verifying Operation

The figure below shows an example system configuration.

For details on cables, see "5 Specifications" on page 51.

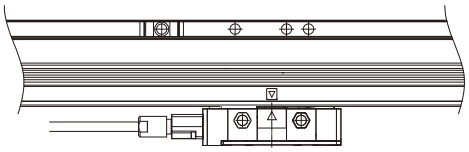


■ Signal cable connection

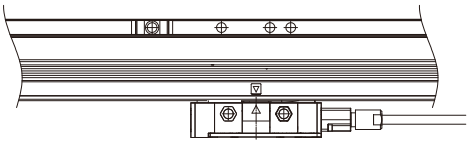
Check the signal cable connection procedure.

1 Select the direction of signal cable installation direction (left or right).

Signal cable connection direction (left)



Signal cable connection direction (right)



2 Remove the connector panel from the detector.

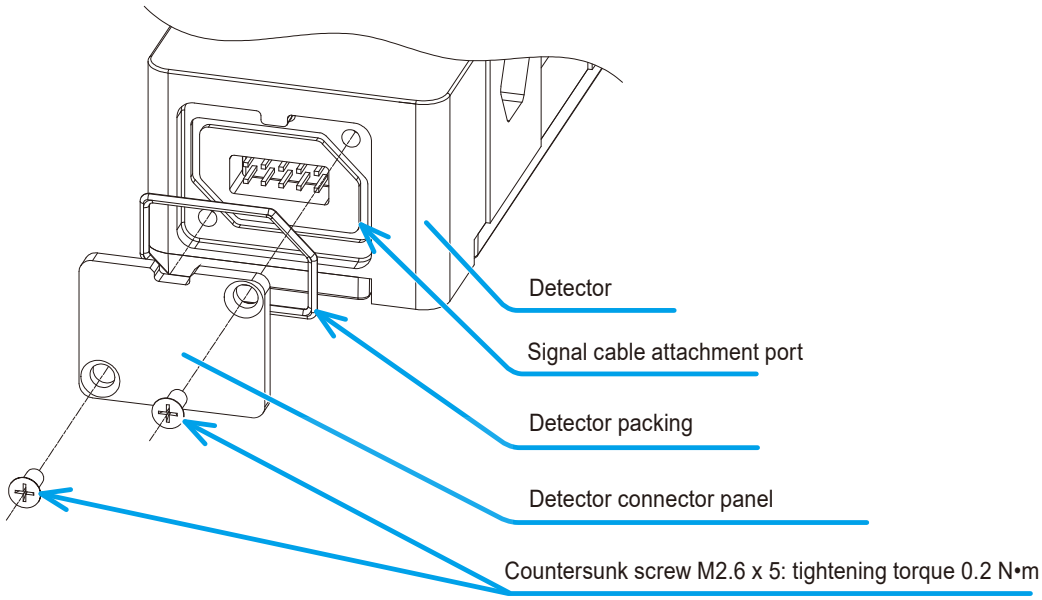
In the standard condition, connector panels are installed on both sides of the signal cable attachment ports of the detector.

Remove the connector panel on the side of the detector where the cable is attached.

IMPORTANT

There is a packing between the detector connector panel and the detector.

When attaching the cable, work carefully to prevent the packing from falling off. If it falls off, be sure to properly re-seat it in the groove of the detector.

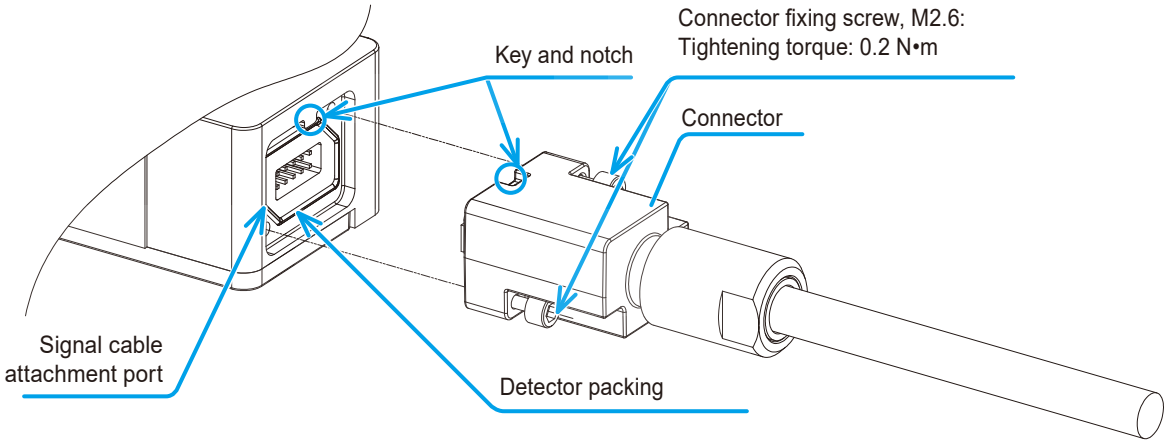


3 Connect the signal cable to the detector.

Align the key on the signal cable attachment port with the notch in the connector.

IMPORTANT

- To ensure waterproof performance, a packing is installed between the detector and the connector. When connecting the signal cable, be sure to check that the packing is properly seated in the groove of the signal cable attachment port.
- Although the detector is waterproof, waterproof performance is not assured if tightening torque of the countersunk screw is insufficient or the detector packing is not properly seated. To ensure waterproof performance, be sure to follow the procedure when connecting the cables.



4 Connect the signal cable to the NC device.

If the cable length is insufficient, use a feedback cable (to be provided by the customer).
After connection, check that the screws used for connector joints are securely tightened.

IMPORTANT
When connecting a Mitutoyo signal cable to a customer-provided feedback cable, the combined length of the signal cable and feedback cable should be no more than 29 m.

5 After all cables are connected, supply power and check operation of the scale unit and its functions and performance.

NOTICE

- If the scale unit does not operate properly when power is supplied, first verify that connections are correct. If it does not operate properly after verifying connections and supplying power again, see "6 Trouble-shooting" on page 61.
- When checking operation of the scale unit, be very careful to prevent pinching of cables by the equipment.
- Also be careful to avoid ingress of chips or other debris into the machine body during operation, as this could cause a malfunction.

3.4.2 Cable Fastenings and Precautions

Check the cable fastening procedure.

When fastening cables, carefully follow the procedure given below.

1 Arrange cables so as to avoid kinking, bending, and sources of electrical noise.

IMPORTANT

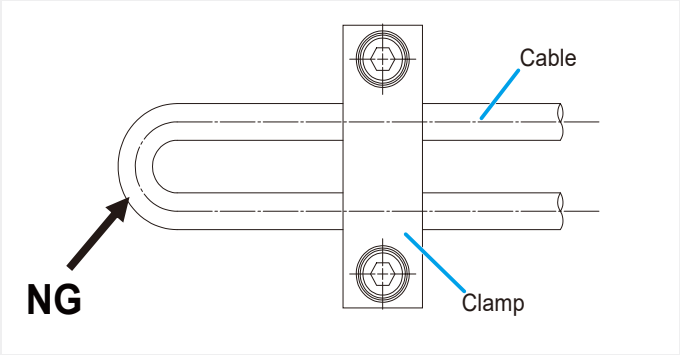
Noise carried by signal and feedback cables can cause malfunctions if they are bundled with other cables that are a source of electrical noise or placed near relays that turn high currents on and off.

2 Secure each cable by cable clamps, etc.

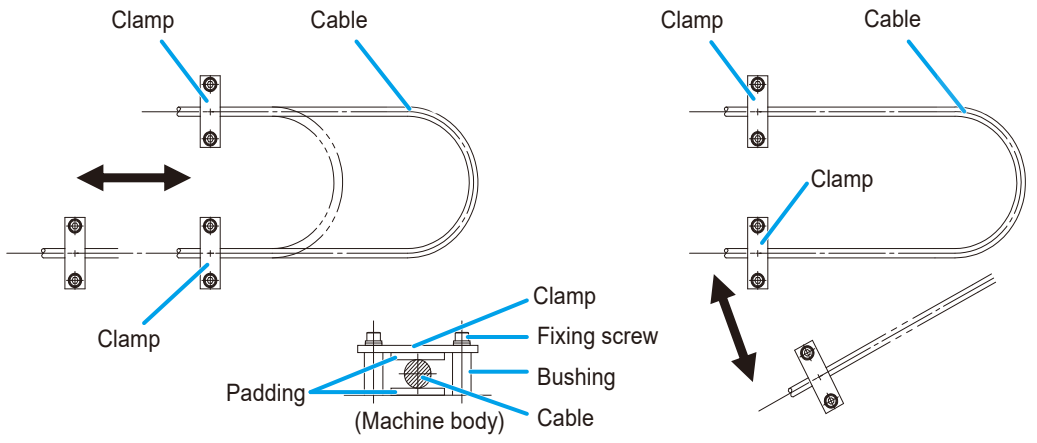
NOTICE

Non-compliance may result in cable damage or disconnection.

- Never bend cables.
  The cable bending radius R should be within the range shown in "2.3.3 Cable Bending Radius R Tolerance Range" on page 20.



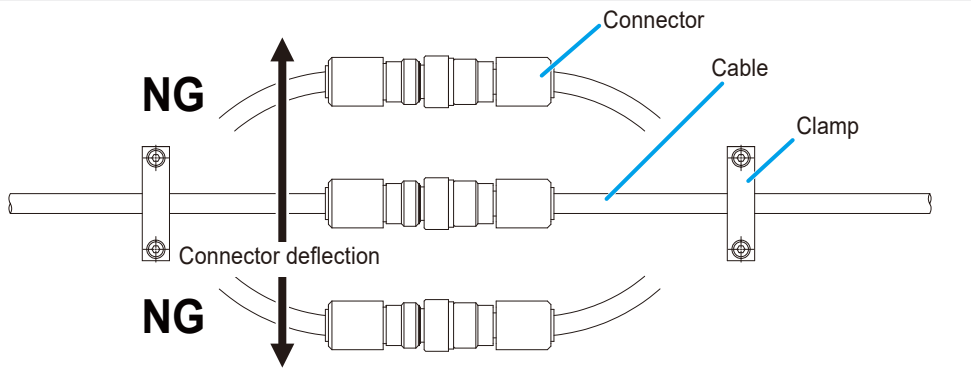
- If a cable is subject to repeated bending, allow it to move freely without fastening it, and take care to prevent application of stress at the point where the cable is clamped near its end.



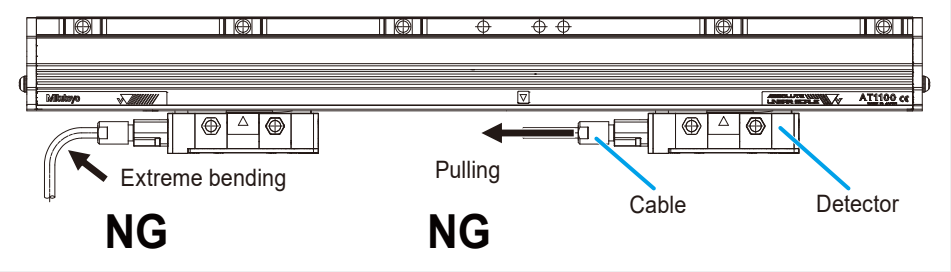
NOTICE

There is a risk of damage to or disconnection of the cable, connector, detector, or this product.

- Take into consideration shaking of the connectors due to vibration, etc.



- Care should be taken to avoid extreme bending or pulling at the base of the signal cable during the entire stroke range.



- Make sure that there is no interference with covers, etc., over the full stroke range.

3.5 Air Purging

This product is equipped with a mechanism for air purging. This mechanism supplies clean compressed air to the inside of the scale main body, thereby improving environmental resistance (coolant and dust resistance) of the scale unit.

As shown in "3.5.3 Connection Method" on page 45, clean compressed air can be piped to either of the M5 threaded holes on both sides of the scale main body by air equipment of the specified specifications inside the scale main body.

3.5.1 Flow Rate of Air Supply to the Scale Unit

Supply air at the rate of 10 L/min–20 L/min per scale unit per axis.

The standard air flow rate is about the level of air coming out of the dust wiper part of the dust-proof rubber.

Adjust the air flow rate with reference to the following.

- When using the fixed diaphragm specified by Mitutoyo (fixed diaphragm inner diameter: ø0.9)

  Adjust the air pressure so that the air flow rate is 10 L/min–20 L/min per axis.

  (Reference) For air supply to a single axis:

  The air flow rate is approximately 12.7 L/min when the air pressure is 0.1 MPa.

  The air flow rate is approximately 19 L/min when the air pressure is 0.2 MPa.

- When using other fixed diaphragms

  Adjust the air pressure so that the air flow rate is 10 L/min–20 L/min per axis.

  For the relationship between flow rate and air pressure, refer to the flow characteristics (fixed diaphragm diameter and flow rate-pressure relationship) provided by the manufacturer of the pneumatic equipment.

- When using a flow rate control valve

  Adjust the air flow rate to 10 L/min–20 L/min per axis.

NOTICE

Do not supply a large unadjusted air flow, as this may damage parts and cause malfunctions.

3.5.2 Recommended Air Equipment

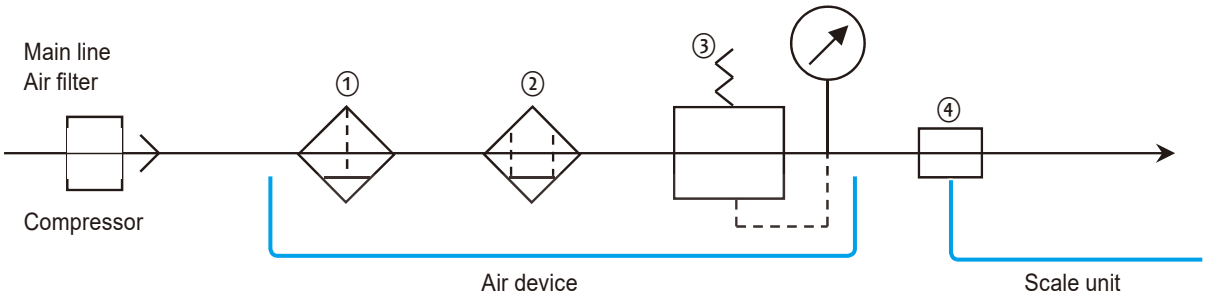
This product does not require an air dryer.

Do not supply air directly to the air equipment, but always use compressed air from a compressor through a main line air filter.
The oil mist filter element should be replaced approximately once each year.
Install the fixed diaphragm on the scale unit side.

As examples, the following page lists specifications and manufacturer's model numbers of recommended air equipment.

Other companies' products may be used as long as they have the same specifications.

■ Air supply unit



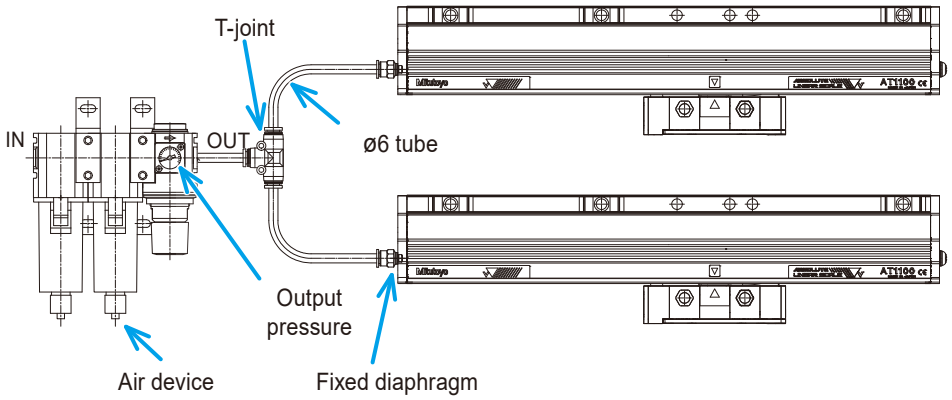
No.	Component elements	External appear-ance	Specification	Item No.	
				Part No. (Mitutoyo)	Maker model number
①	Air filter		• Fluid used: Compressed air • Maximum operating pressure: 1.0 MPa • Guaranteed pressure resistance: 1.5 MPa • Maximum particle size (degree of filtration): 5 µm • Oil concentration on outflow side: N/A	N/A	F1000-8-W (CKD)
②	Oil mist filter		• Fluid used: Compressed air • Maximum operating pressure: 1.0 MPa • Guaranteed pressure resistance: 1.5 MPa • Maximum particle size (degree of filtration): 0.01 µm • Oil concentration on outflow side: 0.01 mg/m³ or less • Element replacement: 1 year (6000 hours) or pressure drop 0.1 MPa	N/A	M1000-8-W (CKD)
③	Regulator		• Fluid used: Compressed air • Maximum operating pressure: 1.0 MPa • Guaranteed pressure resistance: 1.5 MPa • Setting pressure range: 0.05 MPa–0.85 MPa	N/A	R1000-8-W (CKD)
④	Fixed dia-phragm		• Fluid used: Air • Operating pressure range: 0.1 MPa–0.9 MPa • Screw tightening torque: 1.0 N•m–1.5 N•m • Flow rate at 0.1 MPa pressure: Approx. 12.7 L/min • Flow rate at 0.2 MPa pressure: Approx. 19 L/min (per axis)	06ACJ155	PC6-M5M-0.9 (Pisco special order product)

3.5.3 Connection Method

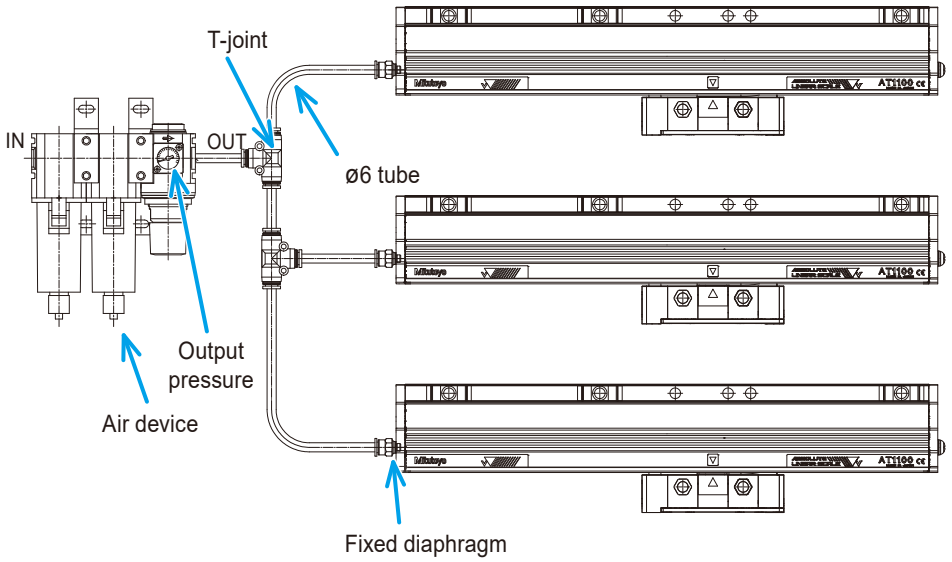
IMPORTANT

Compressed air used must pass through the main line air filter, not directly from the compressor to the air equipment.
When making connections, use ø6 air tubing and install the fixed diaphragm on the scale unit side.

■ When air is supplied to two scale unit axes



■ When air is supplied to three scale unit axes



Tips

- The should be replaced about once each year.
  Replacement time depends on operating conditions and environment.
- Check the user's manual that is provided with the air equipment for maintenance instructions.

MEMO

4 Alarm detection function

This product has various alarm detection functions inside the detection.

4.1 Alarm Detection Function

Alarm detection functions are broadly classified into two types: warning and abnormality.

The warning detection function detects high temperature warning, etc. inside the product's detector and returns to normal when the condition is removed.

The abnormality detection function detects signal strength errors and absolute value detection errors in this product. Once an error occurs, the abnormality detection status is maintained until a reset occurs or power is turned on again.

<<Descriptions of alarm detections>>

Types of alarm detection		Description
Warning	High temperature warning	Detected when internal temperature of the detector rises above 65 °C and returns to normal status when it falls below 60 °C.
	Signal strength	Output when signal strength falls below 30 % and returns to normal status when signal strength rises above 30 %.
Abnormality	Signal strength error	Output when signal strength is less than 15 % or 100 %.
	Transducer error	Output when an abnormality occurs in the internal signal balance.
	Absolute value detection error	Output when an abnormality occurs absolute value data.
	Hardware error	Output when an abnormality occurs in the internal hardware.
	Initialization error	Output if system initialization is not complete successfully when the power is turned on.
	Overspeed	Output when the maximum response speed (3 m/s) is exceeded.

4.2 Meaning of Alarm Codes

This section indicates the relationship between alarm codes output by the NC device and alarms produced by this product (internal errors of the scale unit), as well as causes and countermeasures for each alarm.

■ With the ABS AT1153

The following table shows the relationship between alarms of the ABS AT1153 and the alarm codes displayed on FANUC's NC devices (α interface / αi interface).

Note also that the alarm codes for NC equipment differ according to whether a scale unit is used with fully closed control or with a linear motor.

Servo amplifier alarm codes	Description	Cause and countermeasure
LED abnormality • Fully closed control: 380 • With linear motor: 365	**Scale unit error occurred.** • Hardware error	**Cause** • Scale unit abnormality detected. **Countermeasure** • Cycle the power off and on. If the abnormality is detected again, the scale unit requires replacement.
Phase abnormality • Fully closed control: 381 • With linear motor: 361	**Scale unit error occurred.** • Initialization error • Absolute value detection error • Transducer error • Overspeed • Signal strength error • Signal strength alarm	**Cause** • Scale unit abnormality detected. **Countermeasure** • Check mechanical installation of the scale unit. • Check power supplied to the scale unit for ripple noise and other electrical noise. • If there is nothing wrong with the installation condition, power supply, etc., the scale unit must be replaced.
Serial data Error • Fully closed control: 385 • With linear motor: 368	**Communication error occurred.** • No response	**Cause** • An error occurred in communication between the scale unit and the NC unit that prevented data from the scale unit from being received. (No response) **Countermeasure** • Check wiring of cables and connectors. • Check routing of cables. (For example, for noise due to high current cables.)
Data transfer error • Fully closed control: 386 • With linear motor: 369	**Communication error occurred.** • Communication abnormality	**Cause** • A CRC error or stop bit error occurred in the serial data from the scale unit during communication between the scale unit and the NC device. (Communication failure) **Countermeasure** • Check routing of cables. (For example, for noise due to high current cables.)
Physical disconnection Alarm • Fully closed control: 447 • With linear motor: 446	**Communication error occurred.** • Cable discontinuity	**Cause** • Abnormality occurred in the communication between the scale unit and the NC unit due to a cable disconnection. **Countermeasure** • Check cables and connector connections.

*The NC device alarm code is the FANUC serial interface specification for position detection and is common to both the α-interface and αi-interface.

■ With the ABS AT1143

The table below shows the relationship between ABS AT1143 alarms and the alarm codes displayed on the servo amplifier (control unit MITSUBISHI CNC series) manufactured by Mitsubishi Electric Corporation.

Servo amplifier alarm codes	Description	Cause and countermeasure
AL2A	**Scale unit error** • Signal strength error • Transducer error • Absolute value detection error • Hardware error • Initialization error • Overspeed	**Cause** • The detector detected an abnormality. **Countermeasure** • Check mechanical installation of the scale unit. • Check power supplied to the scale unit for ripple noise and other electrical noise. • If there is nothing wrong with the installation condition, power supply, etc., the scale unit must be replaced.
AL28	**Scale unit alarm occurred.** • Thermal alarm • Signal strength alarm	**Cause** • The detector detected a warning. There is no error in the position data, but installation and use conditions require review. **Countermeasure** • If the ambient temperature of the detector exceeds 60 °C, drive conditions (speed and acceleration) should be reviewed. • Check mechanical installation of the scale unit.
AL16	**Communication error occurred.** (During servo amplifier initialization) • When 3 consecutive errors are received on the servo amplifier side (including no response)	**Cause** • Communication abnormality occurred between the scale unit and the servo amplifier. (Communication is not possible from the time the servo amplifier power is turned on.) **Countermeasure** • Check cables and connector connections. • Check routing of cables. (For example, for noise due to high current cables.)
AL20	**Communication error occurred.** (During servo amplifier control) • When 3 consecutive errors are received on the servo amplifier side (including no response)	**Cause** • Communication abnormality occurred between the scale unit and the servo amplifier. (Occurs during controlled by the servo amplifier.) **Countermeasure** • Check cables and connector connections. • Check routing of cables. (For example, for noise due to high current cables.)

5 Specifications

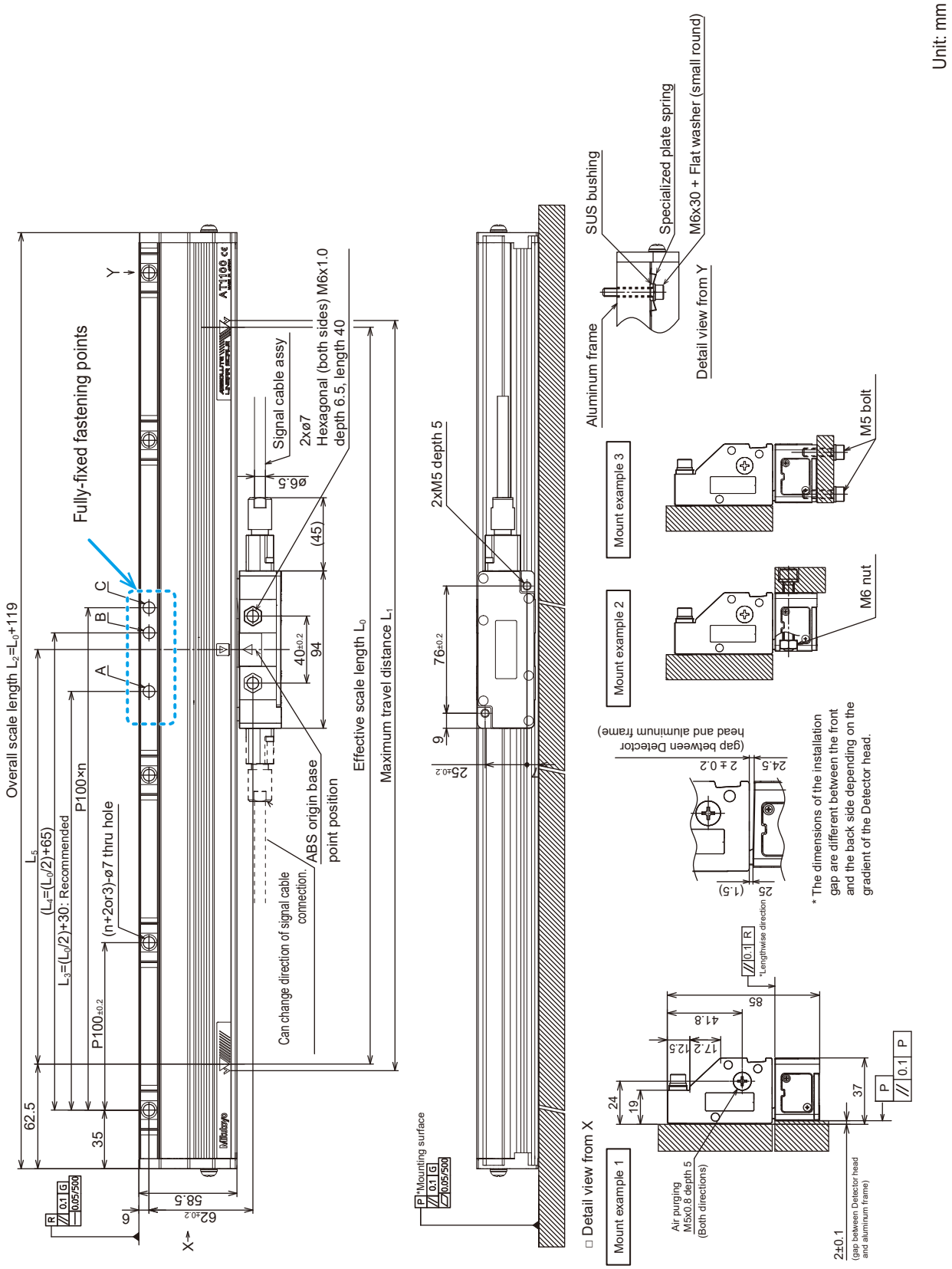
This chapter describes the specifications of this product.

5.1 Scale Unit Specifications

Item		Description
Detection method		Electromagnetic induction.
Effective scale length L_0 (mm)		24 lengths: 140, 240, 340, 440, 540, 640, 740, 840, 940, 1040, 1140, 1240, 1340,1440, 1540, 1640, 1740, 1840, 2040, 2240, 2440, 2640, 3040
Cross-sectional size		85 x 37 (mm)
Cable configuration		"2.3 Signal Cable Preparation" on page 17
Position data	"0" position	"■ ABS origin and elongation base point" on page 13
Resolution		0.05 µm
Indication accuracy (20 °C)		Effective scale length L_0=140 mm–2040 mm: (3+5L_0/1000) µm Effective scale length L_0=2240 mm–3040 mm: (5+5L_0/1000) µm
Operating temperature/ humidity range		0 °C–50 °C 20 % RH–80 % RH (without condensation)
Storage temperature/humidity range		-20 °C–70 °C 20 % RH–80 % RH (without condensation)
Power supply voltage		ABS AT1153 / ABS AT1143 / ABS AT1103A: DC 5 V ± 10 %
Maximum current consumption		ABS AT1153: 300 mA (Max) ABS AT1143: 290 mA (Max) ABS AT1103A: 300 mA (Max)
Signal cable length		Up to 29 m (total of signal cable + feedback cable)
Maximum response speed		3 m/sec
Thermal expansion coefficient		≈8x10^{-6}/K
Vibration resistance (55 to 2000 Hz)		≤196 m/s^2 (20G) *without error
Impact resistance (11 ms, 1/2 sine wave)		For effective scale length L_0=140 mm–2040 mm: ≤ 343 m/s^2 (35G) *without error For effective scale length L_0=2240 mm–3040 mm: ≤ 294 m/s^2 (30G) **without error
Compatible interfaces		■ABS AT1153 FANUC CORPORATION α-interface / αi-interface (Interface is auto-selected) ■ ABS AT1143 Mitsubishi Electric Corporation Mitsubishi CNC Series control unit: MDS-D/MDS-DH series ■ ABS AT1103A Mitutoyo standard interface (ENSIS)

Item	Description
CE marking/ UKCA marking	EMC Directive/Electromagnetic Compatibility Regulations: EN 61326-1 Immunity test requirement: Clause6.2 Table 2 Emission limit: Class B RoHS Directive/The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations EN IEC 63000

■ Appearance and installation dimensions

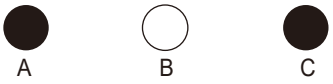


● Note regarding appearance and installation dimensions

- "G" in the figure indicates the machine guide.
- "P" in the figure indicates the aluminum frame mounting surface. Also, "S" indicates the detector mounting surface.
- "Q" and "R" in the figure indicate the reference plane for mounting of the scale unit.
- For descriptions "L0 to L5" in the figure, see "■ Appearance and installation dimensions table" on page 55 in the next section.
- For fully fixed fastening points, two-point fastening at "A" and "C" in the figure is recommended.
- Depending on effective scale length, position "A" in the figure may be identical to position "C". In such case, two-point fastening at positions "A" and "B" is recommended.
- Be sure to verify installation dimensions using the detector fixing blocks.
- The number of fully-fixed fastening point holes depends on the overall length of the scale. Threaded fasteners for fixing the complete installation should be used at the points indicated by black circles in the figure below according to the number of holes.
  For fully-fixed fastening, see "■ Appearance and installation dimensions" on page 53.

For two holes: Two point fastening at both holes

For three holes: Two point fastening at A and C (recommended)



■ Appearance and installation dimensions table

(Unit: mm)

Code No.	Model No.	Effective scale length L_0	Maximum travel distance L_1	Overall scale length L_2	Fastening pitch			Scale fastening holes n (each)	Number of holes for fully-fixed fastening points
					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 □ mark in the Code No. and the □ and ◊ marks in the Model No. designate the following interface specifications.
(□ in the Code No. and Model No. contain the same number.)
For the AT1103A □: 0, ◊: A
For the AT1143 □: 4, ◊: No indication
For the AT1153 □: 5, ◊: No indication

5.2 Optional Accessories

Note that the required signal cable (sold separately) depends on specifications of the interface to be connected.

5.2.1 Signal Cable: Unfinished Cable Specification

- Applicable scale units: ABS AT1153, ABS AT1143
- Connector (detector side): Custom, waterproof specification
- Wire specifications:

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

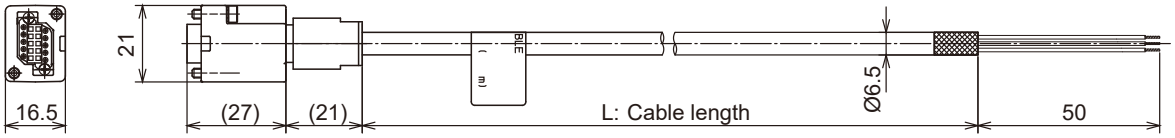
*Wires not listed should be left unconnected.

*Prepare a ground bar for the shield and connect it.

- Cable material: PVC sheath ø6.5 without conduit
- Dimensions, Part No.:

■ ABS AT1153/1143 (unfinished cable specification)

Detector side (custom)
Waterproof specification



Part No.	Name	Cable length (m)
06AFG596-1	AT1100F/M Unfinished cable, 1 m	1
06AFG596-3	AT1100F/M Unfinished cable, 3 m	3
06AFG596-6	AT1100F/M Unfinished cable, 6 m	6
06AFG596-9	AT1100F/M Unfinished cable, 9 m	9
06AFG596-12	AT1100F/M Unfinished cable, 12 m	12

The unfinished cable specification cable cannot be used with the ABS AT1123 (SIEMENS I/F).

5.2.2 Signal Cable: Mitutoyo Connector Specification

- Applicable scale units: ABS AT1103A
- Connector (detector side): Custom, waterproof specification
- Pin specifications:

Pin No.	Signal	Pin No.	Signal
1, 2	GND	7	RQDT
3, 4	+5 V	8	$\overline{\text{RQDT}}$
5	DT	9–14	Unused
6	$\overline{\text{DT}}$	15 Connector shell	F.G.

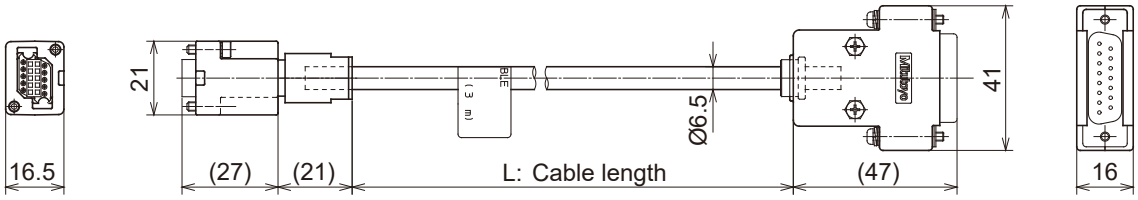
● Without conduit

- Cable material: PVC sheath ø6.5 without conduit
- Dimensions, Part No.:

■ ABS AT1103A (Mitutoyo connector specification)

● Without conduit

Detector side (custom)
Waterproof specification

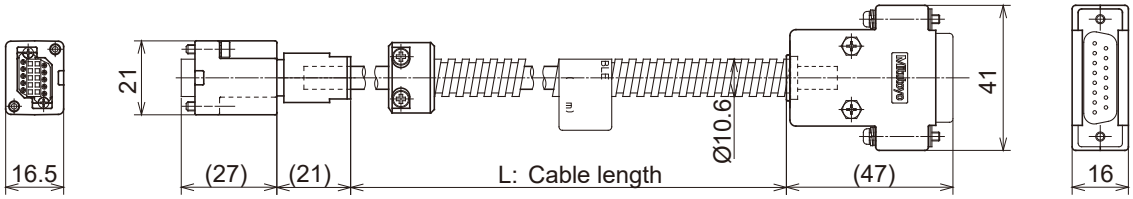


Part No.	Name	Cable length (m)
06AFY915-1	AT1100E Cable D15 1 m	1
06AFY915-3	AT1100E Cable D15 3 m	3
06AFY915-6	AT1100E Cable D15 6 m	6
06AFY915-9	AT1100E Cable D15 9 m	9
06AFY915-12	AT1100E Cable D15 12 m	12

● With conduit

- Cable material: PVC sheath ø10.6 with conduit
- Dimensions, Part No.:

Detector side (custom)
Waterproof specification



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

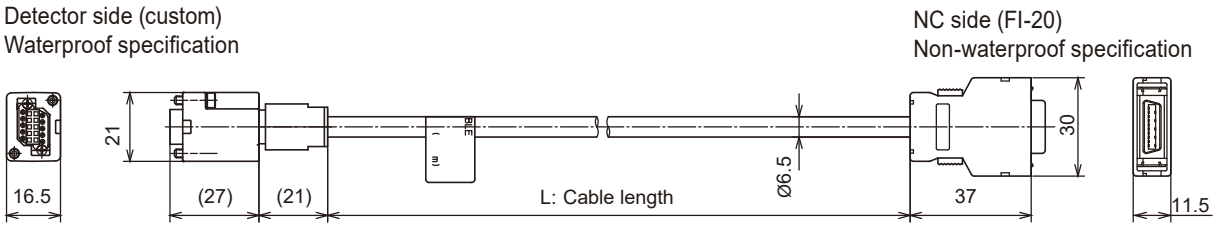
5.2.3 Signal Cable: Fanuc Connector Specification

- Applicable scale units: ABS AT1153
- Connector (detector side): Custom, waterproof specification
- Wire 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	Unused

- Cable material: PVC sheath ø6.5 without conduit
- Dimensions, Part No.:

■ ABS AT1153 (FANUC connector specification)



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

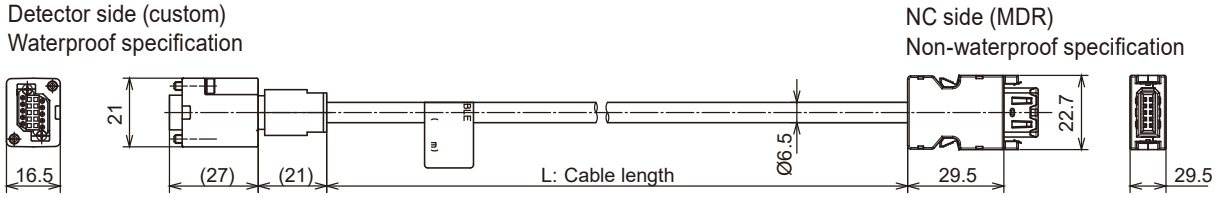
5.2.4 Signal Cable: Mitsubishi Electric Connector Specification

- Applicable scale units: ABS AT1143
- Connector (detector side): Custom, waterproof specification
- Wire specifications:

Pin No.	Signal	Pin No.	Signal
1	5 V	7	DT
2	GND	8	$\overline{\text{DT}}$
3	RQDT	5,6,9,10	Unused
4	$\overline{\text{RQDT}}$		
		Connector shell	F.G.

- Cable material: PVC sheath ø6.5 without conduit
- Dimensions, Part No.:

■ ABS AT1143 (Mitsubishi Electric connector specification)

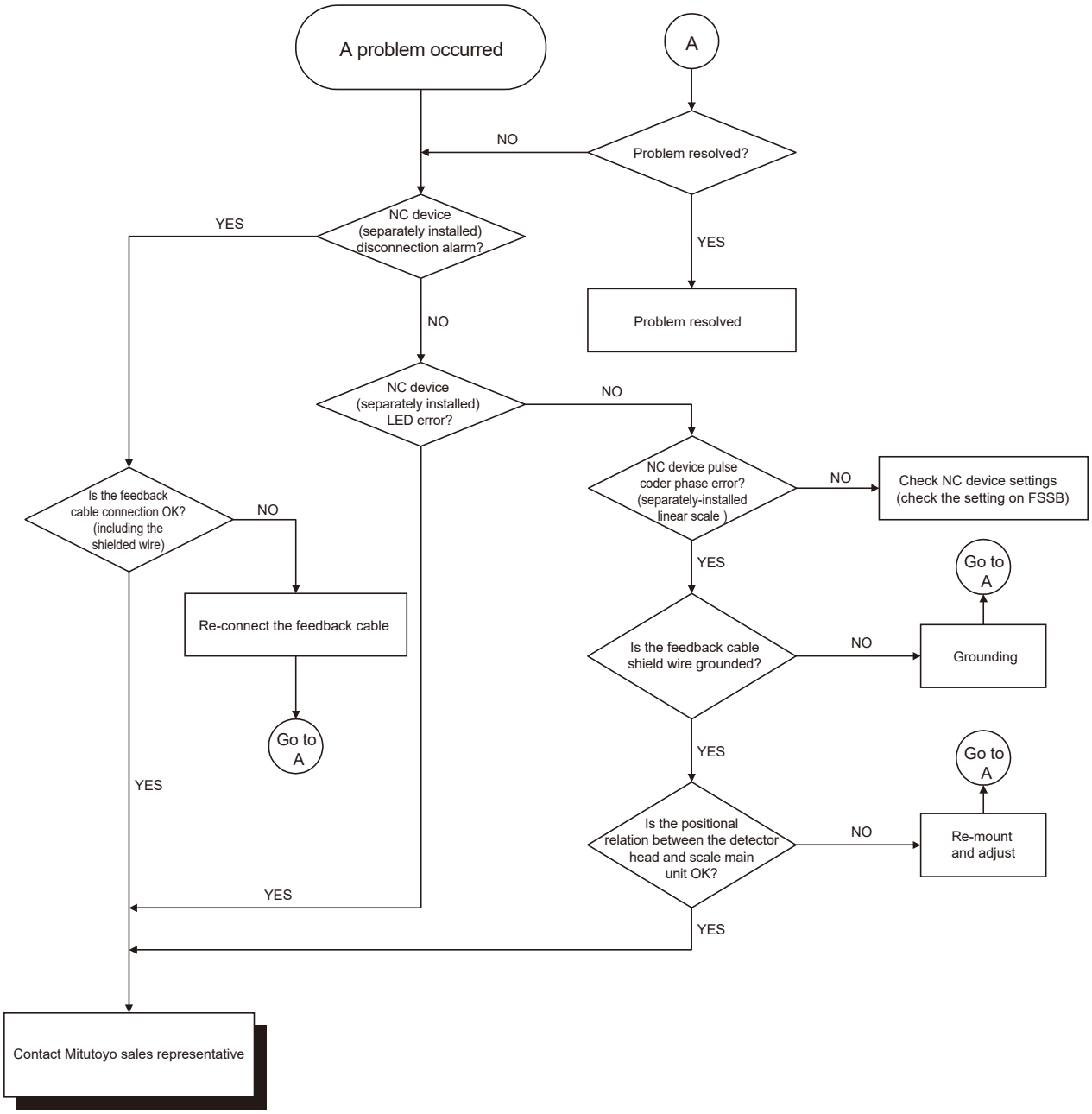


Part No.	Name	Cable length (m)
06AFF957-1	AT1100M Cable MDS-D 1 m	1
06AFF957-3	AT1100M Cable MDS-D 3 m	3
06AFF957-6	AT1100M Cable MDS-D 6 m	6
06AFF957-9	AT1100M Cable MDS-D 9 m	9

MEMO

6 Troubleshooting

This chapter provides a flowchart showing how to check the cause of problems occurring when the power is first turned on or when an alarm occurs during operation, and how to remedy problems.



Tips

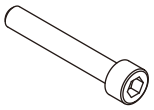
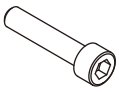
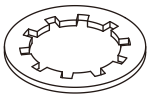
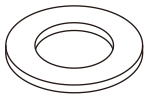
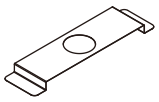
Software is available that makes it possible for the customer to make an initial determination regarding malfunctions or errors that occur with this product. Please contact the agent where you purchased the product or Mitutoyo sales representative ("SERVICE NETWORK" on page App-1).

MEMO

7 Appendix

7.1 Quantity of Accessories Used for Installation

(Unit: ea.)

Part No.	197727	06AFL049	06AFL090	06AFL050	06AFL843
Effective scale length (mm)	Hex socket head cap screw M6 x 40 	Hex socket head cap screw M6 x 30 	Internal lock washer 6.6 x 10.2 x 0.5 	Flat washer Nominal 6 small round 	Frame retaining 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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*As of March 2022

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November 1, 2018	Revised 1st edition	Revisions due to increase/decrease in models listed
January 1, 2021	Second edition	Accommodation of changes in harmonized European standards, etc.
July 1, 2021	Third edition	Additions and changes due to application of the UKCA (UK Conformity Assessed) marking, etc.
March 1, 2022	Fourth edition	Changes in notation and presentation

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