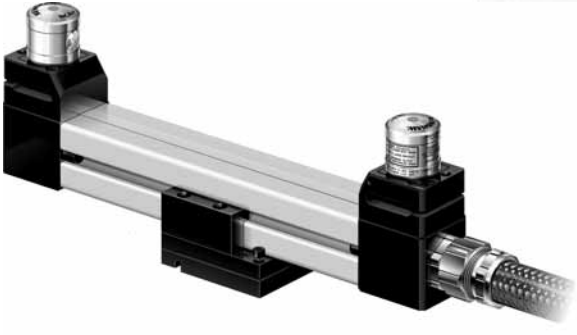
Installation and maintenance guide
H-2000-5230-06-A

RENISHAW
apply innovation™

NC4 non-contact tool setting system



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Patents

Features of the NC4 non-contact tool setting system and related products are subject to the following patents and patent applications:

CN	100394139C	EP	1562020	US	6,635,894 B1
CN	1202403C	JP	2003-524,154	US	6,878,953 B2
CN	1660541A	JP	4520240	US	7,053,392 B2
EP	1050368	JP	4521094	US	7312433B2
EP	1144944	KR	0746932		
EP	1502699	TW	NI-178572		
EP	1506073 B	US	6,496,273 B1		

Other patents pending.

EN	This guide is also available in electronic format on the mini-CD in the pocket inside the back cover. To view this guide, insert the mini-CD into the CD drive of your PC and follow the on-screen instructions. This file can also be printed if required.
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FR	Ce guide est disponible en français en format électronique sur mini-CD dans la pochette à l'intérieur de la couverture verso. Pour voir le guide en français, insérez le mini-disque dans le lecteur CD de votre PC et suivez les directives à l'écran. Vous pouvez également imprimer ce fichier.
IT	Il presente manuale è disponibile in lingua italiana in formato elettronico, contenuto nel mini CD contenuto nell'apposita tasca della retrocopertina. Per visionare il manuale in lingua italiana, inserire il mini CD nel drive del vostro PC e seguire le istruzioni che appaiono sullo schermo. Questo file potrà anche essere stampato se necessario.
ES	Esta guía está también en formato electrónico en el mini-CD en el bolsillo interior de la contraportada. Para ver esta guía, inserte el mini-CD en la unidad lectora de CD de su PC y siga las instrucciones de la pantalla. Este fichero puede ser también impreso si es preciso.

CS	Tato příručka je k dispozici také v elektronickém formátu na disku mini CD-ROM, který naleznete v kapsičce na zadním přebalu příručky. Chcete-li tuto příručku zobrazit, vložte disk mini CD-ROM do jednotky CD-ROM osobního počítače a postupujte podle pokynů na obrazovce. Tento soubor lze v případě potřeby také vytisknout.
PL	Instrukcja obsługi jest również dostępna w formie elektronicznej na mini-CD w kieszeni w tylniej obudowie. Aby zobaczyć instrukcję obsługi należy umieścić mini-CD w napędzie CD komputera i śledzić instrukcje na monitorze. Plik ten może być też wydrukowany.
RU	В кармане на задней стороне обложки прилагается мини-CD, содержащий данное руководство в электронном формате. Для просмотра руководства вставьте мини-CD в дисковод для CD-ROM Вашего компьютера и следуйте инструкциям на экране. При необходимости файл может быть распечатан.
JA	本取扱説明書は、裏表紙内側ポケットに入っているCD内の電子データでもご利用いただけます。本取扱説明書を閲覧するには、CDをご使用のパソコンのCDドライブに挿入し、画面表示に従って操作して下さい。また、このファイルは必要に応じて印刷もできます。
NL	Deze gids is ook beschikbaar als elektronische uitgave op de mini-cd in het mapje aan de binnenkant van de achterpagina. Bekijk de gids door de mini-cd in de cd-drive van uw computer te plaatsen en volg de instructies op het beeldscherm. U kunt dit bestand, indien gewenst, ook afdrukken.

Contents

CE

EC declaration of conformity

Renishaw plc declares that the NC4 non-contact tool setting system complies with the applicable standards and regulations.

Contact Renishaw plc at www.renishaw.com/nc4' for the full EC declaration of conformity.

WEEE directive

The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic equipment (WEEE) to enable reuse or recycling. Correct disposal of this product will help to save valuable resources and prevent potential negative effects on the environment. For more information, please contact your local waste disposal service or Renishaw distributor.

FCC

Information to user (FCC Section 15.19)

This device complies with Part 15 of the FCC rules. Operation is subject to the following conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Information to user (FCC Section 15.105)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with this installation guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

Information to user (FCC Section 15.21)

The user is cautioned that any changes or modifications not expressly approved by Renishaw plc or authorised representative could void the user's authority to operate the equipment.

Warnings

Use of controls or adjustments or performance of procedures other than those specified within this publication may result in hazardous radiation exposure.

Switch off the power supply before carrying out maintenance on the NC4 system.

When using the NC4 system, basic safety precautions must always be followed to reduce the risk of fire, electric shock and personal injury, including the following:

- Read all instructions before operating this product.
- The device must only be installed and used by competent, trained personnel.
- Use eye protection to protect against mechanical hazards, coolant and swarf.
- Avoid inhalation of coolant vapour from the machine tool.
- Do not block the air exiting from the transmitter aperture.
- Prevent direct exposure of the eyes to the laser beam.
  Ensure that the beam is not reflected into the eyes via any reflective surface.

Caution – Laser safety

The laser used in the Renishaw NC4 non-contact tool setting system emits visible red light at a wavelength of 670 nm and has a power output of less than 1 mW.

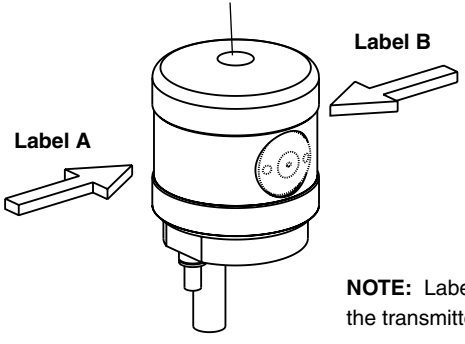
The NC4 used is classified as a Class 2 laser product as defined by IEC/EN 60825-1:2007.

The product complies with 21CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50 dated June 24, 2007.

The standard IEC/EN 60825-1:2007 directs to attach a laser warning label and explanatory label.

A warning label and explanatory label are permanently fixed to each side of the transmitter housing (Tx) housing (see page 7 for details). An adhesive warning label is provided for attachment outside the machine.

Laser 'On' and probe status LED
(see "Probe status LED function"
on page 14 for details).



NOTE: Labels A and B are fitted to the transmitter unit only.

Label A

激光辐射
请勿直视激光光束

Label B

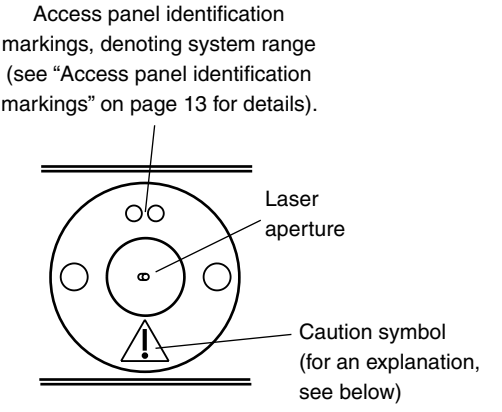
LASER RADIATION
DO NOT STARE INTO BEAM

CLASS 2 LASER PRODUCT

1mW MAXIMUM OUTPUT
EMITTED WAVELENGTH 670nm

COMPLIES WITH 21 CFR 1040.10 ✷ & 1040.11 AND IEC 60825–1/A2:2007

✷ Except for deviations pursuant to Laser Notice No. 50 dated June 24 2007



CAUTION – LASER SAFETY

The access panel is to be removed for service purposes only using the special tool supplied.

Before removing the panel, switch off electrical power to the transmitter unit to avoid exposure to the laser beam.

CAUTION SYMBOL

The caution symbol on the access panel denotes the following:

> CAUTION – Class 3R Laser radiation when open. Avoid direct eye exposure.

This text is not included on the access panel due to the limited space available.

Servicing

It is necessary to remove the access panel of the transmitter unit to perform some servicing procedures. A pin spanner is supplied for this service procedure.

If electrical power is applied to the unit when this panel is removed, personnel can be exposed to laser radiation within the levels for Class 3R.

Before carrying out servicing procedures on the NC4 system, switch off electrical power.

Related publications

- *NCi-5 non-contact tool setting interface* installation and user's guide, Renishaw part no. H-5259-8500.
- *Non-contact tool setting software* programming guide. The appropriate guide is supplied with the NC software.

Introduction

This guide describes how to install, configure, maintain and service the Renishaw NC4 non-contact tool setting system.

The NC4 is a laser-based non-contact tool setting system that provides high-speed/high-precision measurement of cutting tools on a machining centre under normal operating conditions.

As a tool moves through the laser beam, the system detects when the beam is broken. Output signals sent to the controller allow the presence of a tool and the position of the tip (broken tool detection) to be established.

Guidelines for good practice

- The NC4 is a precision device and must be handled with care.
- Ensure that all mountings are secure.
- Cables, piping, conduit, etc. should be suitably secured to avoid damage and loads being transferred to the NC4.
- Mount the system in a position that limits the risk of it being subjected to impact when operating the machine.
- Mount the system in a position where it will not be affected by a build-up of swarf. Do not allow excessive waste material to build up around the NC4.
- Keep electrical contacts clean.
- Optimum performance is achieved by continuously supplying air and power to the NC4.
- The NC4 is protected by a continuous stream of clean air. Approximately once a month, inspect the optics for contamination. The service interval may be extended or reduced depending on experience.
- The vent at the bottom of the NC4 must be left uncovered to allow reliable operation of the PassiveSeal.

How to install and configure the NC4 system

Install and configure the NC4 system in the sequence described below:

1. Install the air assembly kit (see “Installing the air assembly kit” on page 31). Do not switch on the air supply or set the air pressure at this stage.
2. Install the NC4 system (see “Installing a fixed system” on page 32 or “Installing a separate system” on page 37.
3. Install the interface unit (see “Installing the interface unit” on page 45).
4. Switch on electrical power to the interface unit (see “Applying electrical power to the interface unit” on page 47).
5. Switch on the air supply to the NC4 system and set the air pressure (see “Setting the air pressure” on page 48).
6. Align and set up the NC4 system (see “Setting up and aligning a separate system” on page 54 or “Aligning and setting up a fixed system” on page 59.
7. Finally, calibrate the system as described in the publication *Non-contact tool setting software programming guide*.
8. If problems occur, see “Troubleshooting” on page 65.

Parts checklist

The following services and equipment are required to facilitate full system functionality:

Tool setting system – fixed or separate

Ensure that the NC4 system supplied has the correct separation (for details, see “Access panel identification markings” on page 13. Contact your supplier if a different range is required.

Mounting

If mounting brackets are required, ensure that they are correct for the installation.

Air supply

The NC4 requires a clean, dry air supply to ISO 8573-1:Air quality of class 1.7.2. If this is not achievable, a filter/regulator will be required (see “Parts list – air supply accessories” on page 99).

Interface unit

The NC4 requires the use of the NCi-5 interface unit. This unit is included in each NC4 kit.

Software

Renishaw non-contact software is required to conduct tooling probing and measurement cycles.

Accessories

Equipment such as conduit, fittings, etc. may be required, depending on the installation.

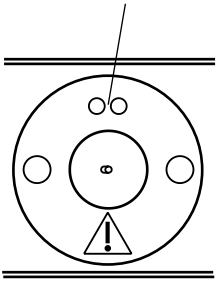
One of the following items of equipment is also needed for setting up and aligning the NC4 system:

- Digital voltmeter
- NC4 set-up tool

Access panel identification markings

The access panel of each NC4 transmitter and receiver unit is engraved with one or more circles. These denote the minimum and maximum separation distance between the NC4 transmitter and receiver units.

Access panel identification markings, denoting system range



Fixed systems

Type	Transmitter engraving	Receiver engraving
F95	O	O
F115	●●	O
F145	OO	O
NC4+ F145	OO✝OO	OO✝OO
F230	OO	●●
F300	OO	OO

Separate systems

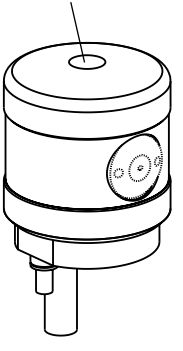
Separation (m)	Transmitter engraving	Receiver engraving
0.3 to 0.5	OO	OOOO
0.5 to 0.8	OOOO	OO
0.8 to 1.5	OOOO	OOOO
1.5 to 2.0	OOOO	OOOOOO
2.0 to 3.0	OOOOOO	OOOO
3.0 to 5.0	OOOOOO	OOOOOO

Probe status LED function

The probe status LEDs on the transmitter and receiver units indicate to the user the status of the probe. The LEDs mimic each other.

Colours shown by the LEDs vary depending upon the mode of operation of the interface unit. The colours and associated states are described in the table on page 15.

Probe status LED
(on transmitter and receiver units)



NCi-5 NC set-up switch SW1-2 set to 'On'

The probe status LEDs will rapidly flash code which is used by the NC4 set-up tool.

The colours of the LEDs will vary between red, amber and green.

NCi-5 NC set-up switch SW1-2 set to 'Off'

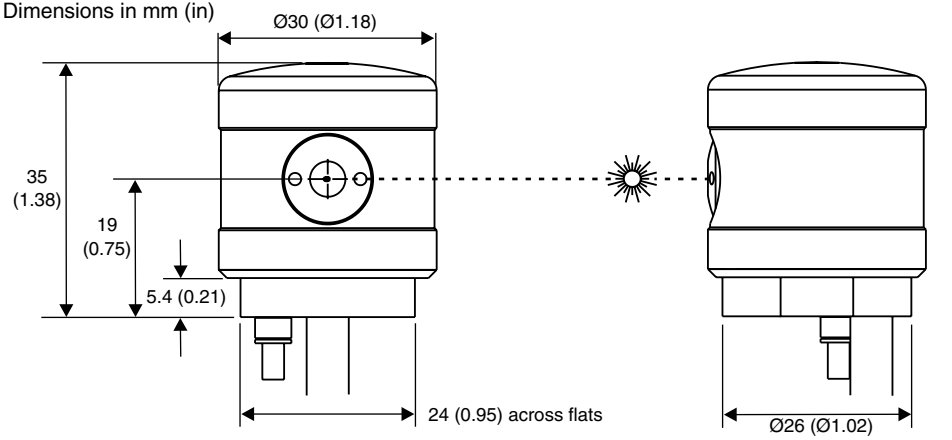
See the table on page 15.

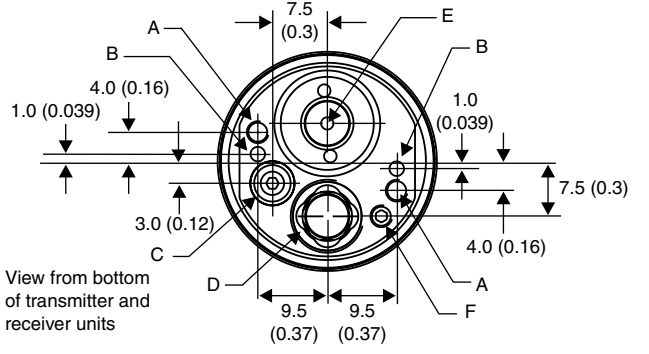
LED colour	Signal voltage	Tool setting mode	High-speed broken tool detection mode	Latch mode
Green-amber (flashing at 1 Hz)	>6.0 V	The system operating voltage is too high. The system will continue to function, but for optimum performance repeat the set-up and alignment procedures. ✷	Not applicable.	The output is not latched. The system operating voltage is too high. The system will continue to function, but for optimum performance repeat the set-up and alignment procedures. ✷
Green	4.0 V to 6.0 V	The beam is clear. The probe is untriggered.	Not applicable.	The beam is clear. The output is not latched.
Amber	2.5 V to 4.0 V	The beam is partially blocked. ✷	The output is not latched. The beam is blocked.	The output is not latched. The beam is blocked by a rotating tool. ✷
Red	0 V to 2.5 V	The beam is blocked. The probe is triggered	The output is latched. The tool is broken.	The output is latched.
No light	0 V	No power to the unit		

✷ The probe status LEDs can be used for diagnostic purposes as the NC4 constantly checks itself for signal and indicates the state of the system by the colours of the LEDs.

If the laser beam is clear and the LEDs are either amber or flashing amber/green, this indicates that servicing is required. The system will continue to function as normal. For details on possible action required, see “Troubleshooting” on page 65.

Dimensions in mm (in)





View from bottom of transmitter and receiver units

A = Mounting holes (×2), M3 x 0.5 P x 8 mm (0.32 in) deep

B = Dowel holes (×2), Ø2 mm x 8 mm (0.32 in) deep

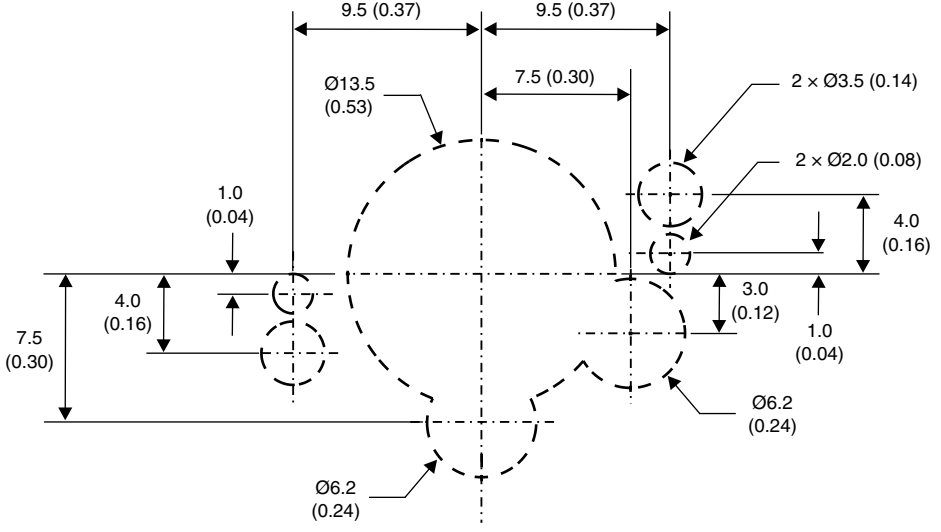
C = Pneumatic push-fit connector, Ø3 mm (Ø0.12 in) plastic pipe

D = Supply cable, Ø6 mm (Ø0.24 in)

E = PassiveSeal vent. Do not cover.

F = Blanking screw. Do not disturb.

Dimensions in mm (in)



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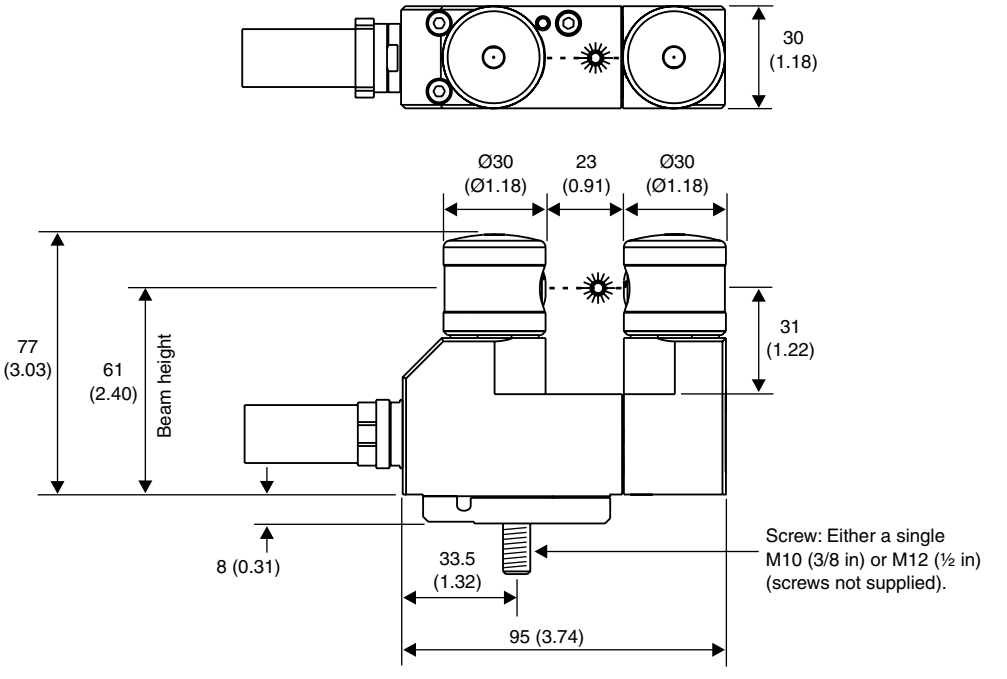

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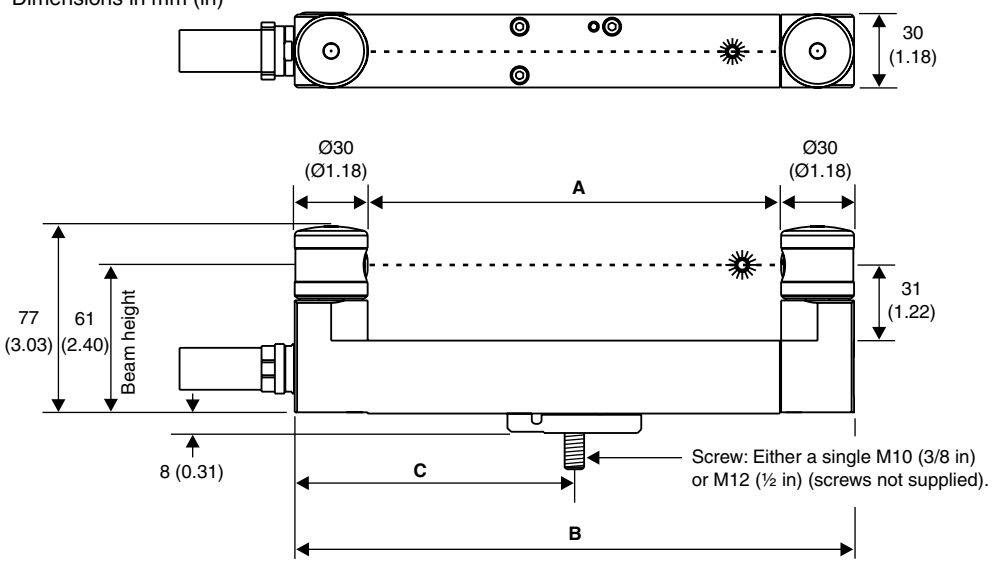
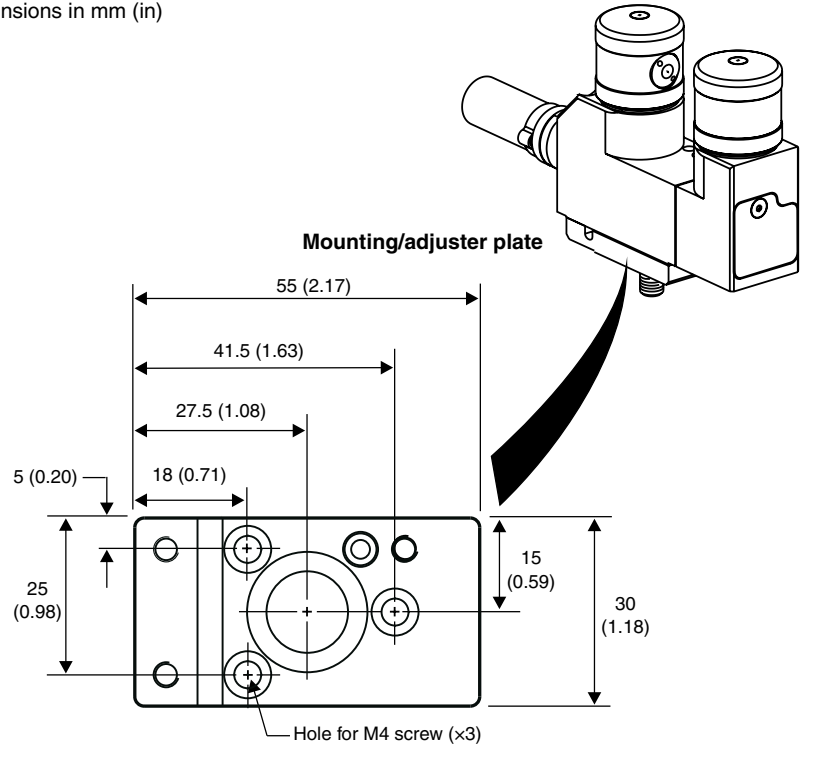
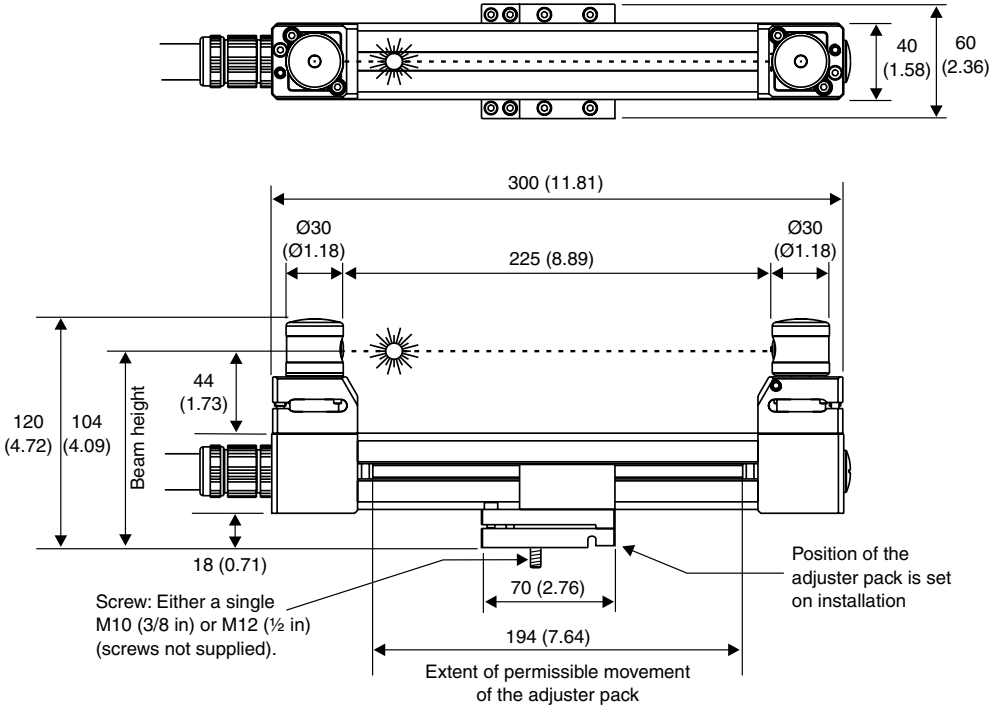


Model	F115	NC4/NC4+ F145	F230	F300
Dimension A	55 (2.17)	85 (3.34)	170 (6.69)	240 (9.45)
Dimension B	115 (4.53)	145 (5.71)	230 (9.06)	300 (11.81)
Dimension C	57.5 (2.27)	72.5 (2.85)	115 (4.53)	150 (5.91)

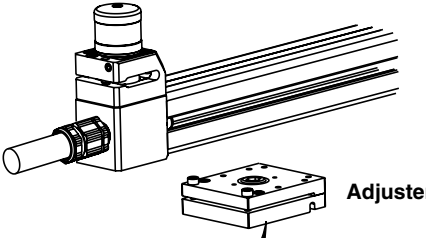
Dimensions in mm (in)



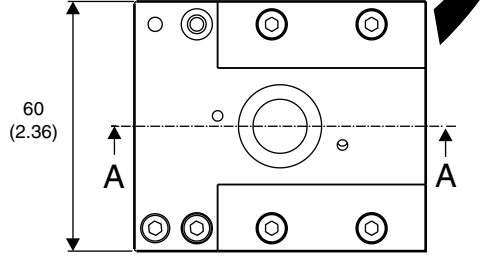
Dimensions in mm (in)

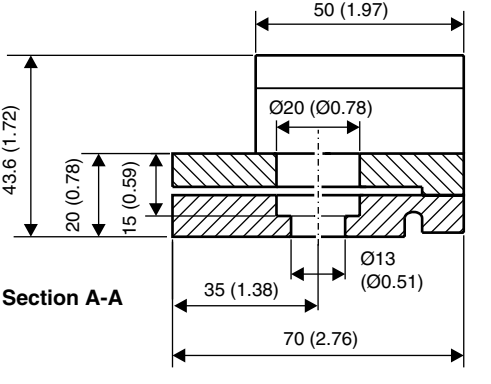


Dimensions in mm (in)



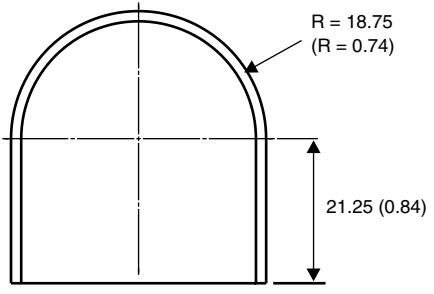
Adjuster pack

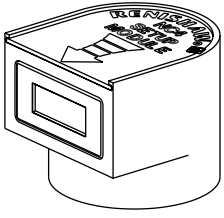


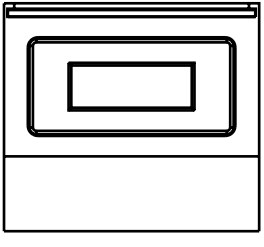


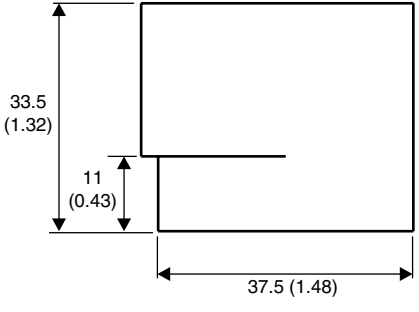
Section A-A

Dimensions in mm (in)

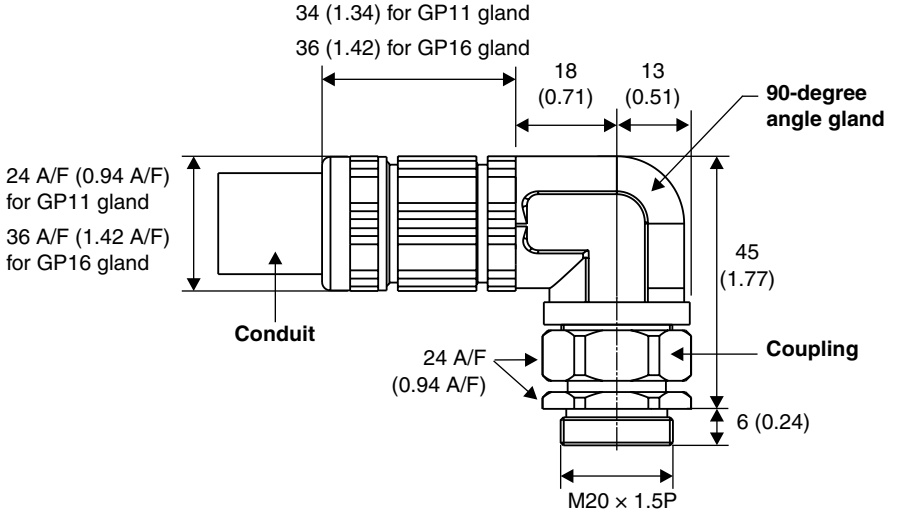








Dimensions in mm (in)



For further information, see page 35.

Application	High-precision, high-speed non-contact tool setting and tool breakage detection.
Working temperature	5 °C to 50 °C
Storage temperature	–10 °C to 70 °C
IP rating (air on or off)	IPX8
Life	Tested to > 1 million on/off cycles
Pneumatic supply	Ø3 mm air pipe, 3.0 bar (43.5 psi) minimum, 6 bar (87 psi) maximum. Air supply to the NC4 must conform to ISO 8573-1: Class 1.7.2.
Cable	6-core plus screen cable. Each core 18/0.1 insulated. Ø6.0 mm (0.24 in) × 12.5 m (41 ft).
Weight (single transmitter or receiver unit with cable)	0.5 kg (1.1 lb)
Current consumption (including interface unit)	**With NCi-5 interface:** 120 mA @ 12 V, 70 mA @ 24 V

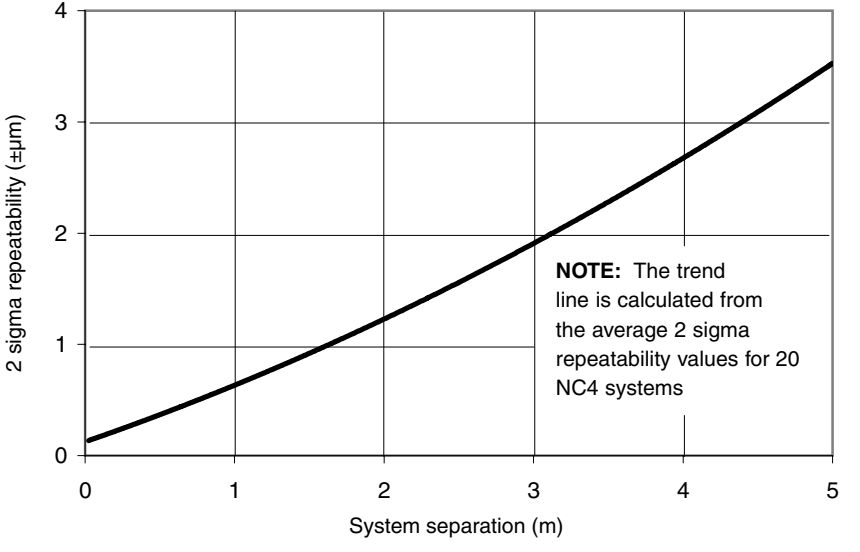
NC4 typical repeatability

Repeatability is dependent upon the separation and mounting.

Typical repeatability = ±0.1 µm, 2σ.

Specified repeatability = ±1 µm, 2σ at 1 m separation.

NC4+ F145 specified repeatability = ±1 µm, 2σ at 85 mm separation.



Transmitter/receiver separation vs minimum tool diameter

Note that the minimum tool diameter values listed in this table are typical values. They are provided for guidance purposes only.

Transmitter/receiver separation (m)			Minimum tool diameter (mm) when …	
			… measured	… detected
Compact fixed system	F95	0.023	0.03	0.03
	F115	0.055	0.07	0.04
	F145	0.085	0.08	0.05
	NC4+ F145	0.085	0.03	0.03
	F230	0.170	0.20	0.07
	F300	0.240	0.20	0.10
Modular fixed system	F300	0.225	0.20	0.10
Separate system		0.50	0.30	0.10
		1.00	0.40	0.20
		2.00	0.50	0.20
		3.00	0.60	0.30
		4.00	1.00	0.30
		5.00	1.00	0.30

Introduction

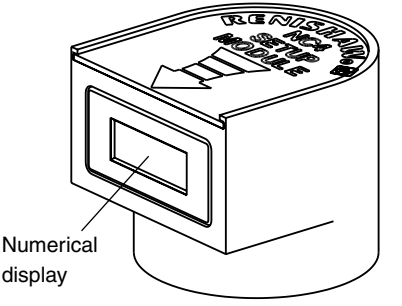
The NC4 set-up tool is a battery-operated device that is used to provide a visual indication of the signal strength at the NC4 receiver unit. The signal strength is shown on a numerical display. The higher the number, the greater the signal received at the receiver unit.

The set-up tool is placed over either the transmitter or receiver unit and is rotated so that the display can be easily viewed. Placing the tool over an NC4 unit activates the numerical display. Removing the tool causes the display to power off.

NOTE: The numerical display provides only an indication of the signal strength. If a true reading of signal strength is required, a voltmeter must be connected to the appropriate connector pins on the interface unit.

The set-up tool can be used on fixed and separate NC4 systems.

NC4 set-up tool



Battery specification

The set-up tool requires one ½ AA size battery, rated at between 3.3 V and 3.6 V. It is important to ensure that the battery is supplied in standard (button) form. Batteries that are described as tagged have additional connection tag features fitted to the terminal and are not suitable.

Typically, this specification can be provided by a cell containing Lithium Thionyl Chloride (3.6 V). This is recommended for maximum battery life. A Lithium Thionyl Chloride (3.6 V) battery will last the equivalent of 700 hours' continuous operation.

Battery supplier	Part number
Farnell	206-520 (Sonnenschein SL-350 S)
Maplin	GS 99 H
Radio Shack	23-026
RS (Radio Spares)	596-589 (Saft LS 14250)

Battery manufacturer	Part number
Ecocel	TC-4511, TC-4521, TC-4531
Maxell	ER3S
Saft	LS 14250C, LS 14250
Sanyo	CR 14250 SE
Sonnenschein	SL-350, SL-550, SL-750
Tadiran	TL-4902, TL-5902, TL-2150, TL-5101
Varta	CR 1/2 AA
Xeno	XL-050F

Introduction

The air supply to the NC4 must conform to ISO 8573-1 air quality of class 1.7.2 and be moisture-free. If the air quality cannot be guaranteed, an air filter unit is available from Renishaw (see “Parts list – air supply accessories” on page 99).

The NC4 requires a continuous regulated air supply of between 3 bar (43.5 psi) minimum and 6 bar (87 psi) maximum.

Failure of the air supply allows a PassiveSeal inside each NC4 unit to protect the unit from the ingress of contaminants. This causes the unit to enter a trigger state. The laser beam will not be seen exiting the transmitter unit, and the status LEDs on the transmitter and receiver units will display red (when the tool setting mode is selected).

The cause of the air failure should be determined and rectified.

Best practices

- Where possible, tap into the air supply that exits the machine air supply filter/regulator unit. Do not connect the NC4 to an oiled air supply.
- Use blanking caps, supplied with the air assembly kit, when feeding air pipe through the conduit/machine.
- Before connecting the air pipe to the inlet of the NC4 unit, briefly switch on the air supply to clear out any debris from the pipe. When no more debris is emitted, switch off the air supply and connect to the NC4.
- When installing the air pipe supply to the NC4, keep runs as short as possible to minimise pressure drop.
- If the temperature of the air supply is greater than 5 °C above ambient and is humid, an air dryer will be required.

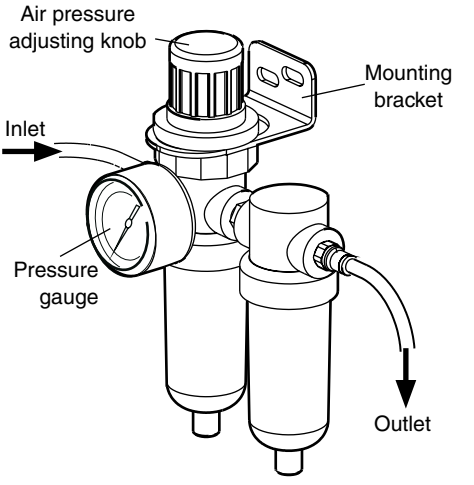
Installing the air assembly kit

WARNING: Before starting to install the kit, ensure that the machine is safe to work on.

1. Secure the air regulator, vertically upright, to a suitable surface using the mounting bracket. This must be within 25 m of the NC4.

2. Locate a source of clean air to ISO 8573-1:Air quality class 5.9.4, and connect it to the regulator inlet. Where possible, use air that exits directly from the machine tool air filter unit.

If the compressed air source is suspected of being contaminated (e.g. if it is direct from the machine shop supply, if the machine tool filter is dirty, or if it is downstream of an oil mist lubricator) then a second air filter may be required. A suitable filter unit is available from Renishaw (see "Parts list – air supply accessories" on page 99).



What to do next

After you have finished installing the air assembly kit, install either the NC4 fixed system (see page 32) or the separate system (see page 37).

Do not switch on the air supply or set the air pressure until the NC4 system and interface unit have been installed and electrical power has been applied.

Installing a fixed system

This section describes how to install NC4 modular and compact fixed systems. Refer to the figures on pages 33 or 34 as appropriate.

WARNING: Before starting to install the NC4 system, ensure that the machine is safe to work on. Switch off machine power when working in the control cabinet.

1. Mount the system in a position where air can exit freely from the MicroHoles in the access panels.

   Do not mount the system in a position where excessive quantities of swarf can build up.

2. **Modular fixed system:** Secure the adjuster pack to the machine table using either an M12 or M10 screw. Align the pack so it is approximately parallel to the machine axis.

   Compact fixed system: Secure the mounting/adjuster plate to the machine table using one of the options shown in the figure on page 34. Align the plate so it is approximately parallel to the machine axis.

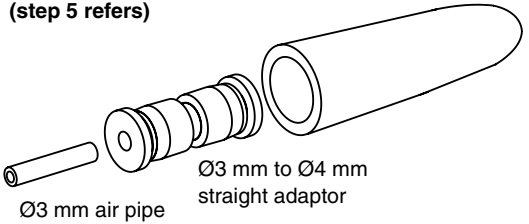
3. Use a dial test indicator to determine the squareness of the adjuster pack or mounting/adjuster plate relative to the machine axis. The top and sides of the pack/plate should be within 1 mm (0.039 in) over the length of the pack/plate.

4. Lay the conduit in the machine to check the length. Cut to length if necessary.

5. Before routing the air pipes, fit a Ø3 mm to Ø4 mm straight adaptor pneumatic fitting and a blanking cap to the free end of each Ø3 mm air pipe (refer to the figure on page 33). This prevents the ingress of debris into the air pipes.

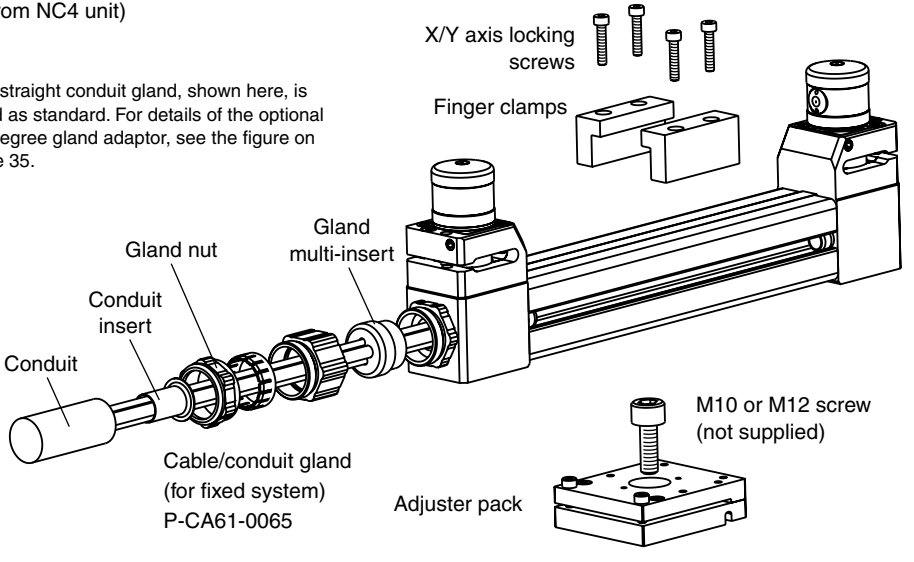
(continued on page 35)

(step 5 refers)



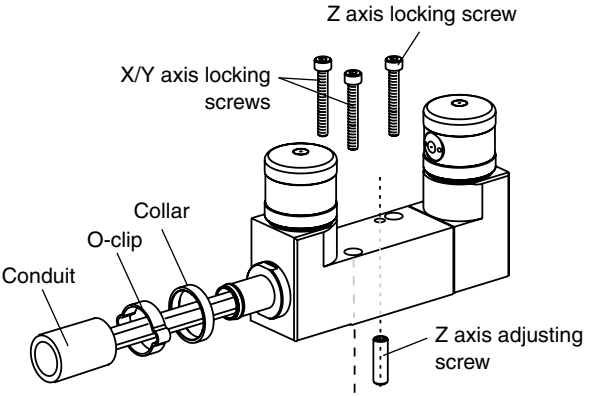
Modular fixed system

The straight conduit gland, shown here, is fitted as standard. For details of the optional 90-degree gland adaptor, see the figure on page 35.

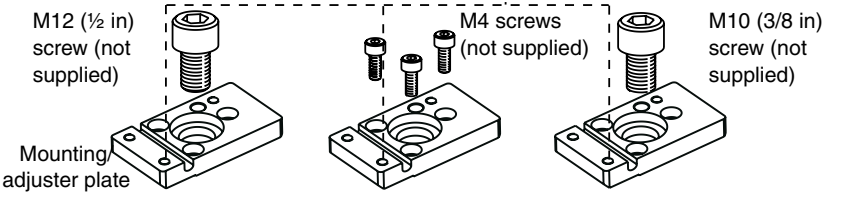


The straight conduit gland, shown here, is fitted as standard. For details of the optional 90-degree gland adaptor, see the figure on page 35.

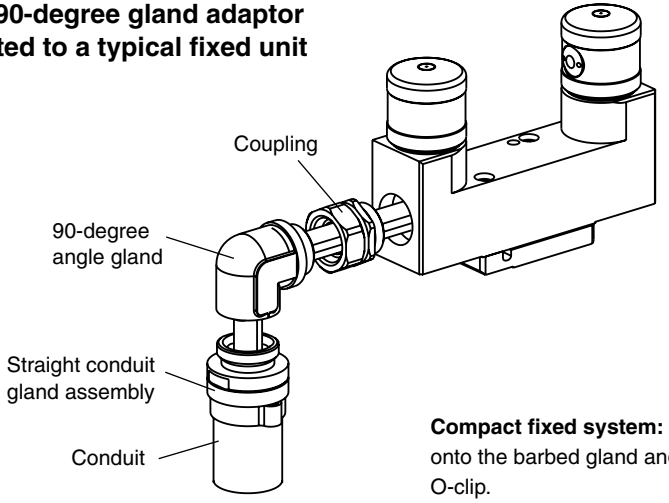
Compact fixed system



Three mounting options



Optional 90-degree gland adaptor shown fitted to a typical fixed unit



6. Feed the two cables and air pipes through the conduit. Do not apply excessive force to the cables or air pipes as this could damage the supplies or NC4. Apply an appropriate lubricant if necessary.

7. **Modular fixed system:** Push the conduit insert into the end of the conduit. Push the conduit into the gland and tighten the gland nut to secure the conduit.

   Compact fixed system: Push the conduit onto the barbed gland and fit the securing O-clip.

8. **Modular fixed system:** Place the NC4 system on the adjuster pack and attach the finger clamps with the four X/Y axis locking screws.

   Compact fixed system: Place the NC4 system on the mounting/adjuster plate and secure with the two X/Y axis locking screws and single Z axis locking screw.

9. Route the conduit through the machine. If necessary, fit a cable gland where the supplies exit the enclosure.

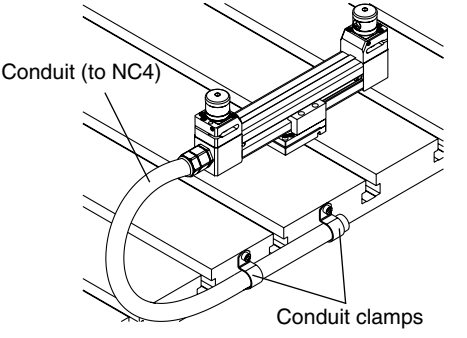
   NOTE: The radius of the conduit bend should be greater than 70 mm (2.76 in).

10. Route the cables to the electrical cabinet, taking care to avoid situating them next to sources of electrical noise, e.g. motors, power cables, etc.

11. Route the air pipes to the air regulator.

12. Using the air regulator, purge the Ø4 mm air pipe to remove any debris.

13. Remove the blanking caps from the ends of the air pipes. Connect the air pipes to the outlet of the air filter/regulator unit using the tee fittings and pneumatic adaptor fittings as appropriate.



14. Fit conduit clamps to secure the conduit in position on the table of the machine. This will ensure that loads are not transferred to the NC4 system when the machine operates.

What to do next

After you have finished installing the NC4 modular fixed system, install the interface unit (see page 45).

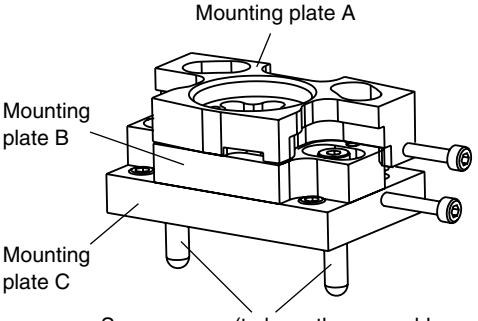
Installing a separate system

This procedure specifically describes how to install a 3-plate adjuster pack. You should also follow this procedure if you are installing a single-plate adjuster pack.

WARNING: Before starting to install the NC4 system, ensure that the machine is safe to work on. Switch off machine power when working in the control cabinet.

NOTE: The sequence of operations required to install a separate NC4 system may differ from the sequence described here, depending on the environment in which the system is being installed.

3-plate adjuster pack



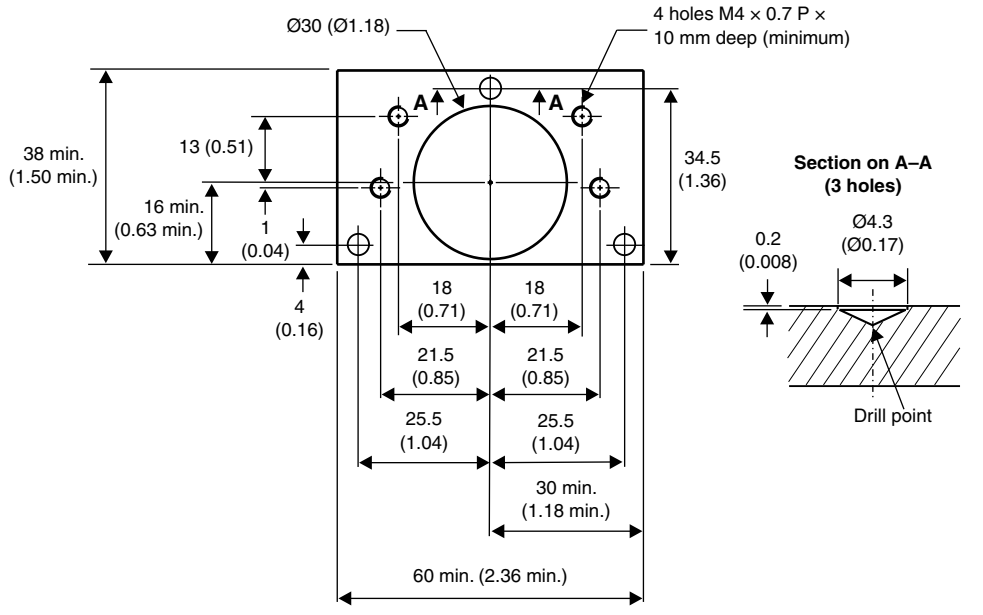
1. Choose a suitable position for securing the NC4 transmitter and receiver mounting brackets. Make sure that air will be able to exit freely from the MicroHoles in the access panels and will not be directed towards an operator.

2. Secure the mounting brackets to the machine.

(continued on page 42)

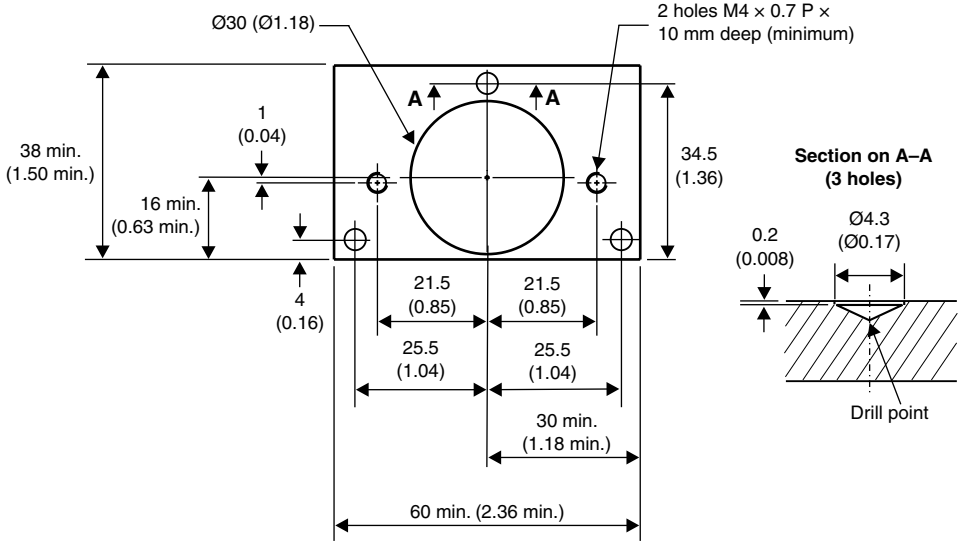
Typical mounting details – single-plate adjuster pack

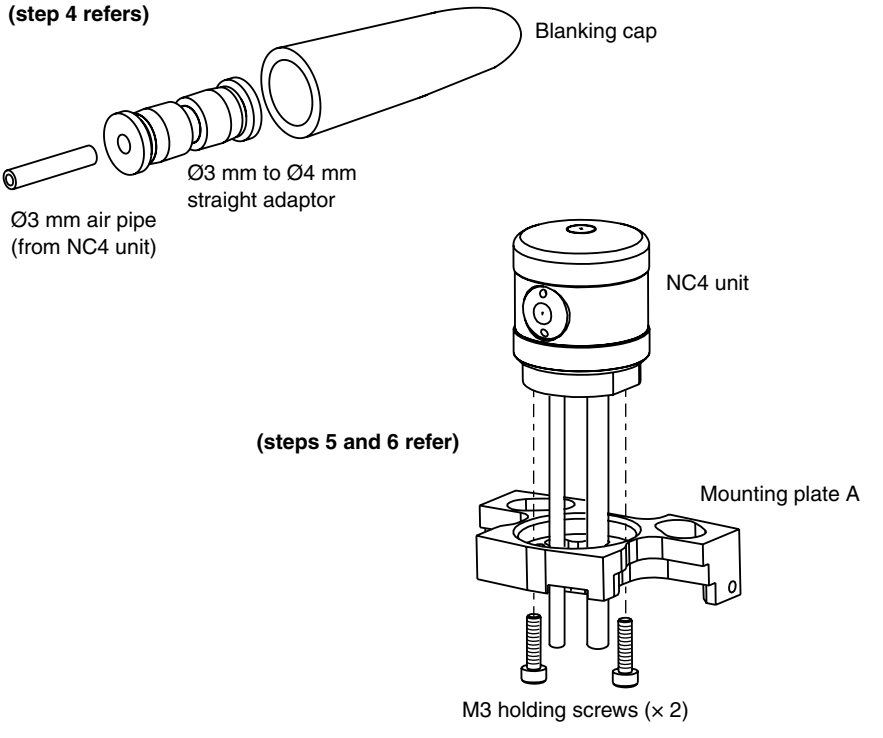
Dimensions in mm (in)

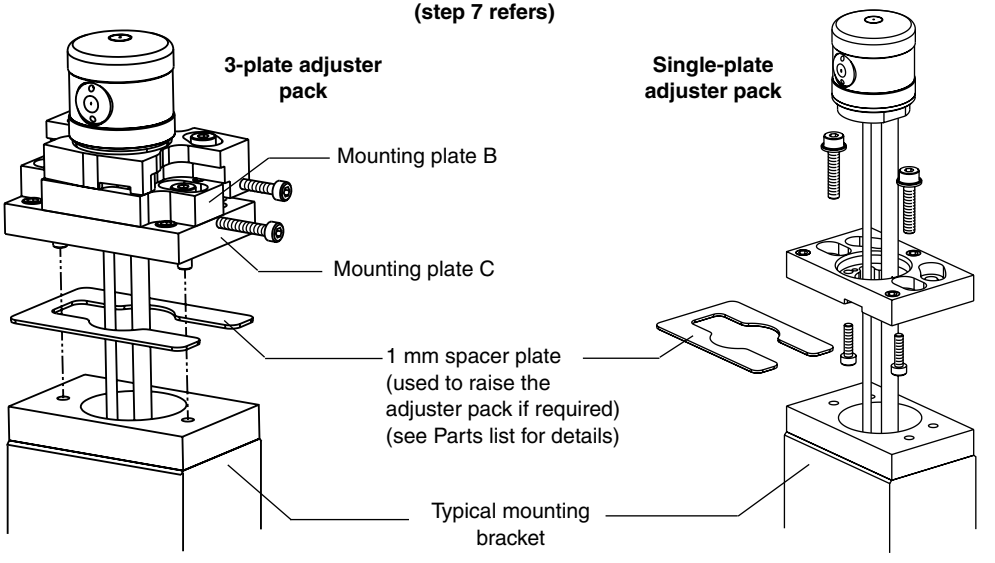


Typical mounting details – 3-plate adjuster pack

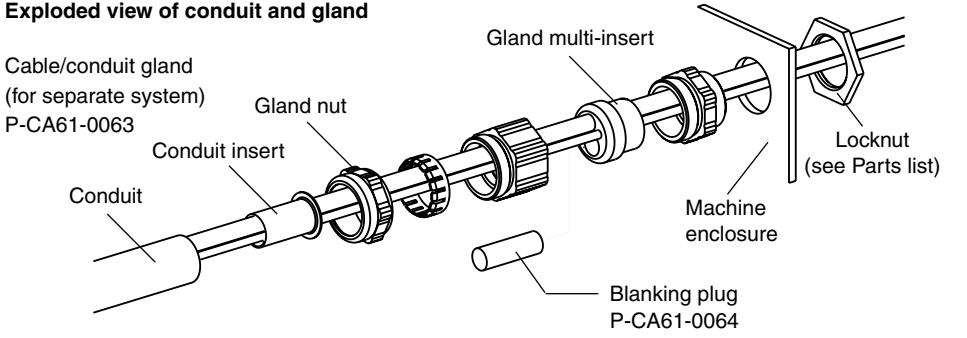
Dimensions in mm (in)




(step 4 refers)
Blanking cap
Ø3 mm to Ø4 mm
straight adaptor
Ø3 mm air pipe
(from NC4 unit)
NC4 unit
(steps 5 and 6 refer)
Mounting plate A
M3 holding screws (× 2)


(step 7 refers)
3-plate adjuster pack
Single-plate adjuster pack
Mounting plate B
Mounting plate C
1 mm spacer plate
(used to raise the
adjuster pack if required)
(see Parts list for details)
Typical mounting
bracket

Exploded view of conduit and gland



3. Using the air regulator installed earlier, purge all supplied air pipes to remove any debris.

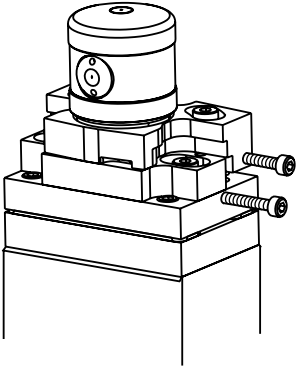
4. Fit the Ø3 mm air pipe to the air inlet of the NC4 unit. Fit the Ø3 mm to Ø4 mm straight adaptor pneumatic fitting and blanking cap to the free end of the Ø3 mm air pipe (refer to the figure on page 40).

5. Remove the two screws that secure mounting plate A to the adjuster pack. Feed the cable and air pipe through mounting plate A.

6. Secure the NC4 unit to mounting plate A with the two M3 holding screws.

7. Feed the cable and air pipe through mounting plates B and C.

8. Lay the conduit in the machine to check the length. Cut to length if necessary.



9. Feed the air pipe and cable through the cable gland and conduit. Do not apply excessive force to the cable or air pipe as this could damage the supplies or the NC4 unit. Apply an appropriate lubricant if necessary.

10. Attach the gland, taking care to ensure that the conduit insert is pushed into the end of the conduit and the blanking plug is fitted to the gland multi-insert. Tighten the gland to secure the conduit.

11. Remove the adjuster pack screw covers and secure the adjuster pack assembly to the mounting bracket.

12. Route the conduit through the machine. If necessary, fit a cable gland where the supplies exit from the enclosure.

    NOTE: The radius of the conduit bend should be greater than 60 mm (2.36 in).

13. Repeat steps 4 to 12 for the other NC4 unit.

14. Route the cables to the electrical cabinet, taking care to avoid situating them next to sources of electrical noise, e.g. motors, power cables, etc.

15. Route the air pipes to the air regulator.

16. Using the air regulator, purge the Ø4 mm air pipe to remove any debris.

17. Remove the blanking caps and straight adaptors from the ends of the air pipes. Connect the air pipes to the outlet of the air filter/regulator unit using the tee fittings and pneumatic adaptor fittings as appropriate.

18. Fit conduit clamps to secure the conduit in position on the table of the machine. This will ensure that loads are not transferred to the NC4 system when the machine operates (see the figure on page 36).

What to do next

After you have finished installing the NC4 separate system, install the interface unit.

Introduction

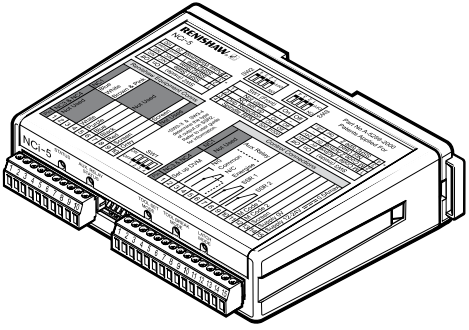
The interface unit should be installed in the CNC control cabinet. Where possible, locate the unit away from potential sources of interference such as transformers and motor controllers.

The interface processes signals from the NC4 and converts them into a voltage-free solid state relay (SSR) output. This is transmitted to the CNC machine control, which responds to the probe inputs.

Installing the interface unit

WARNING: Before installing the interface unit, ensure that the machine is safe to work on. Switch off machine power when working in the control cabinet.

Install and configure the interface as described in the publication *NCi-5 non-contact tool setting interface installation and user's guide,* Renishaw part no. H-5259-8500.



NC4 wiring details

The colour and intended function of each of the wires from the NC4 transmitter and receiver units are described below.

NC4 transmitter unit		NC4 receiver unit	
Wire colour	**Function**	**Wire colour**	**Function**
Green	Screen	Green	Screen
Black	0 V	Black	0 V
Red	12 V	Red	12 V
White	*not used* ✷	White	Analogue output 1
Blue	*not used* ✷	Blue	Analogue output 2
Purple	*not used* ✷	Purple	Set-up
Grey	Probe status	Grey	Probe status

✷ Note that as this wire is not used, you should ensure that the free end is correctly insulated.

What to do next

After you have finished installing the interface unit, apply electrical power to the interface.

When the interface is powered up, switch on the air supply and set the correct air pressure.

Applying electrical power to the interface unit

WARNING: Before switching on electrical power, ensure that the machine is safe to work on.

1. Ensure that the interface unit and air supplies have been connected correctly.
2. Switch on electrical power to the interface.
3. Check that the status LED on each of the NC4 transmitter and receiver units is lit.

Power loss and restoration

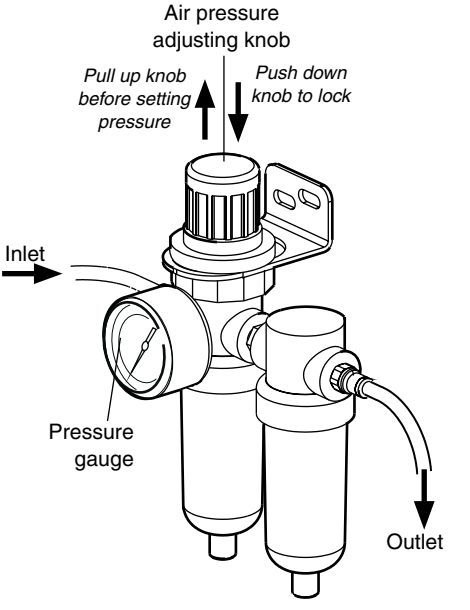
If electrical power to the interface unit is lost and subsequently restored when the NC4 system is in a normal operating mode, the NC4 powers down and then powers up again without loss of the original gain settings.

Setting the air pressure

WARNING: Before setting the air pressure, ensure that the machine is safe to work on.

1. Ensure that electrical power is applied to the interface unit.
2. Monitor the set-up voltage as shown on pages 51 and 52.
3. Switch on the air supply.
4. Gradually increase the air pressure until the laser beam is seen to exit the transmitter unit and the set-up voltage begins to rise.
5. Note the pressure on the pressure gauge and increase the pressure by an additional 0.5 bar (7 psi). Check that the profile of the laser beam is circular.

NOTE: If the air supply pressure varies while the machine is operating, the air pressure to the NC4 system may need to be increased to allow for this pressure fluctuation.



Introduction

Before installing the NC software, read the guidelines contained in the Readme file on the software floppy disk or CD.

Software routines

Software routines for tool setting using various machine controllers are available from Renishaw plc. They are described in the data sheet *Probe software for machine tools – program features*, Renishaw part number H-2000-2289 (see *www.renishaw.com*).

All available software packages are listed in data sheet *Probe software for machine tools – program selection list*, Renishaw part number H-2000-2298.

Example programs for high-speed broken tool detection of solid tools are available for a wide range of machine controller types. Please refer to the Renishaw web site at *www.renishaw.com* and then search for “Non-contact tool setting software”.

Recommended feedrates

It is recommended that a feedrate of 2 µm-per-rev. is used for a minimum of three measuring moves.

A span of 5 µm (0.197 µin) over three measurements is achievable.

Aligning the NC4

Aligning the NC4 system involves moving the transmitter and receiver units so that the laser beam is parallel/perpendicular to the machine's axes. The alignment should be adjusted so that it is within the recommended tolerances detailed in "Alignment tolerances" on page 53.

The beam alignment macro described in the publication *Non-contact tool setting software programming guide* is used for this process. The macro indicates how well the system is aligned. You can then use this information to make adjustments to the NC4.

Setting up the NC4

Setting up the NC4 system involves adjusting the relative positions of the transmitter and receiver units to maximise a test signal obtained at the receiver unit. Do this with the interface unit in set-up mode.

Either a voltmeter or an NC4 set-up tool is used to provide an indication of the signal strength received at the receiver unit.

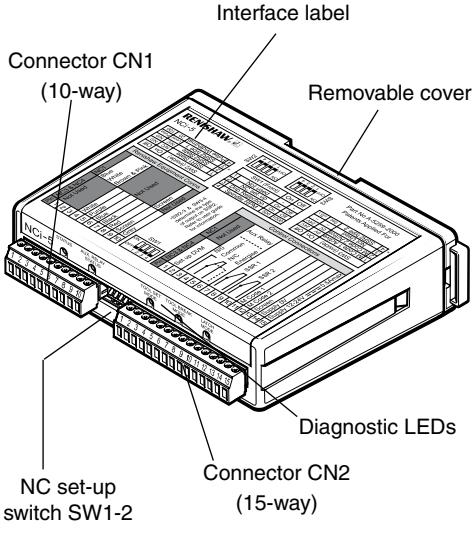
Using a voltmeter

A standard voltmeter, that is within calibration, may be used for setting up and aligning the NC4 system.

1. Position the voltmeter next to the receiver unit. Connect a wire between terminal CN2-1 on the interface unit and one of the voltmeter probes. Connect a second wire between terminal CN2-2 and the other voltmeter probe.

2. On the interface unit, set switch SW1-2 (NC set-up) to 'On'.

NOTE: If a negative reading is obtained when you use the voltmeter, swap over the voltmeter probe connections.

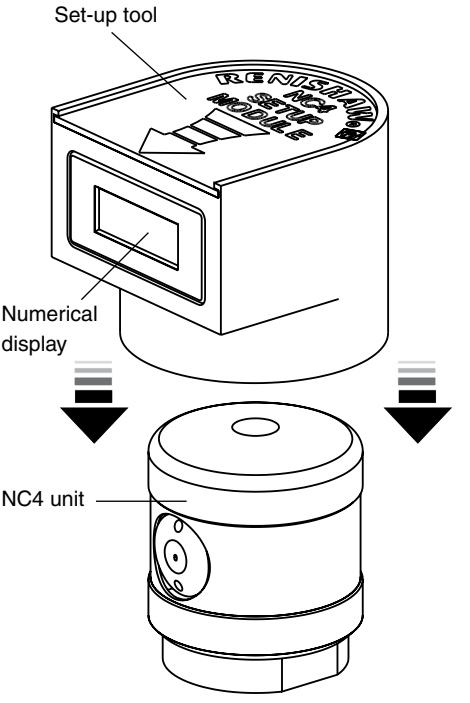


Using the set-up tool

The set-up tool numerical display provides a correct reading only when the interface unit is in the Set-up mode – that is, when the NC set-up switch (SW1-2) is set to 'On'.

1. Check that the NC4 receiver unit is clean and free of swarf. Push the set-up tool onto the top of the receiver unit and rotate it so that the display is facing you.

2. On the interface unit, set switch SW1-2 (NC set-up) to 'On'.



Alignment tolerances

The tolerances to which a tool can be set are dependent on the parallelism of the laser beam to the machine axes.

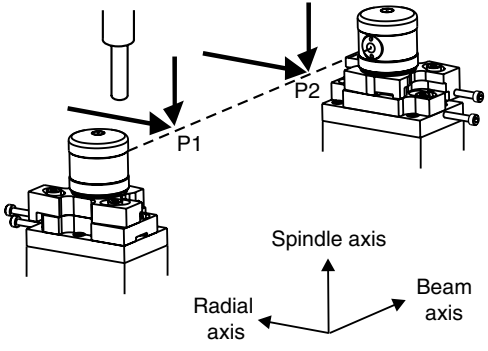
Tool setting applications

Over a span of 100 mm (3.94 in), the following alignment accuracies are easily achievable:

Spindle axis (P2 – P1): ≤10 µm (0.39 µin)

Radial axis (P2 – P1): ≤1 mm (0.39 in)

These values are sufficient for the majority of tool setting applications.



Tool breakage detection applications

Over a span of 100 mm (3.94 in), the following alignment accuracies are easily achievable:

Spindle axis (P2 – P1): ≤0.2 mm (0.0079 in)

Radial axis (P2 – P1): ≤1 mm (0.39 in)

These values are sufficient for the majority of tool breakage applications.

Setting up and aligning a separate system

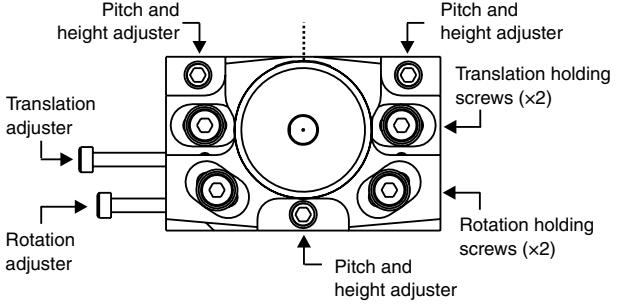
WARNING: Before setting up and aligning a separate system, ensure that the machine is safe to work on.

To set up the system

1. Either connect the digital voltmeter as described in “Using a voltmeter” on page 51 or fit the NC4 set-up tool as described in “Using the set-up tool” on page 52.
2. Switch on electrical power to the interface unit.
3. Ensure that air is supplied to the NC4 and is at the correct pressure.
4. Slacken all conduit clamping screws so the NC4 units can move freely.
5. On the mounting plate of the transmitter unit, use a 3 mm hexagonal key to slacken the two translation holding screws and two rotation holding screws to allow the plates to be adjusted (see the figure on page 55).
6. Adjust the rotation and pitch of the transmitter until the laser beam shines on the centre of the receiver MicroHole.
7. Load a tool into the spindle of the machine. A solid, flat bottomed tool is preferred.
8. Remove the target from the back of this guide. Using either Blu-Tack or adhesive tape, attach it to the tool as shown in the figure on page 56.
9. Starting close to the transmitter (target position 1) (see the figure on page 56), manually traverse the spindle/machine table so that the laser beam is centred with the target cross hairs.
10. Manually traverse the target/transmitter so that the target moves away from the transmitter and towards the receiver (target position 2).

(continued on page 57)

3-plate adjuster pack

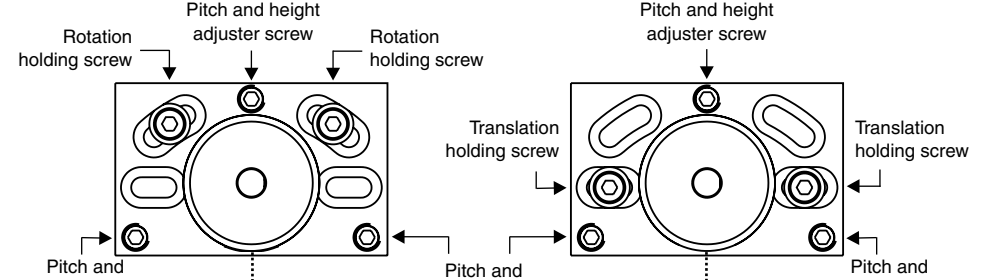


Limits of adjustment

Rotation	±7 degrees
Translation	±2.5 mm
Height	±2.5 mm
Pitch	±5 degrees

A 3 mm A/F hexagonal key is required to adjust the screws.

Single plate adjuster pack



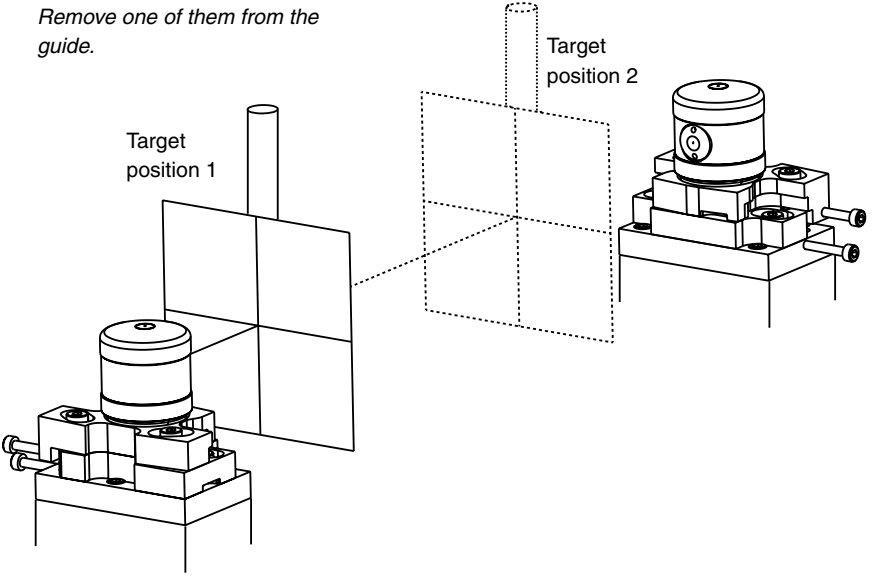
Limits of adjustment

Rotation	±7 degrees
Height	±2.5 mm
Pitch	±5 degrees

Limits of adjustment

Translation	±2.5 mm
Height	±2.5 mm
Pitch	±5 degrees

Printed copies of the target are provided at the back of this guide. Remove one of them from the guide.



11. Adjust the rotation and pitch of the transmitter unit so that the laser beam is repositioned on the cross hairs.

12. Go back to target position 1 and manually traverse the target/machine table to re-centre the target with the laser beam.

13. Repeat steps 10–12 until the laser spot remains on the centre of the cross hairs as it traverses along the measuring gap between the transmitter and receiver.

14. Finally, tighten the translation and rotation holding screws to 3.0 Nm (2.2 lbf.ft), using a 3 mm hexagonal key, to lock the pack in position.

15. On the receiver adjuster pack, slacken the two translation holding screws and two rotation holding screws to allow the plates to be adjusted.

16. If it is possible to reach the receiver adjuster pack with the machine spindle, clock the top and side of the receiver adjuster top plate.

This ensures that the receiver unit is parallel/ perpendicular to the machine axis.

17. Translate and rotate the receiver until the maximum signal is obtained on the voltmeter or set-up tool.

Check that either:

- the voltmeter reading is between 1.0 V and 7.0 V, or
- the set-up tool reading is between 1.0 and 7.0.

18. Tighten the translation and rotation holding screws to 3.0 Nm (2.2 lbf.ft) to lock the unit in position.

19. Check that the laser beam is not obstructed.

On the interface unit, set switch SW1-2 (NC set-up) to ‘Off’.

Check that:

- the probe status LED is green, and
- the voltmeter reading is between 4.7 V and 5.3 V.

NOTE: If the set-up tool is used, ignore the reading on the display. A false reading is shown when the NC set-up mode is switched off.

If the beam is blocked when the switch is set to 'Off', the system will be unable to set itself correctly. If this occurs, remove the obstruction then set switch SW1-2 (NC set-up) to 'On' then back to 'Off'.

20. Next, align the system.

To align the system

1. Run the beam alignment macro (see the publication *Non-contact tool setting software programming guide*).

2. If the alignment is outside the values described in "Alignment tolerances" on page 53, the system requires aligning.

Calculate the required correction move based on the output of the alignment cycle and the system separation.

Start by moving the receiver unit, as this defines the effective beam path. If possible, use a dial test indicator on the receiver housing to control the correction.

3. On the interface unit, set switch SW1-2 (NC set-up) to 'On'.

4. Re-adjust the transmitter until the maximum signal is obtained on the voltmeter or set-up tool.

Check that either:

- the voltmeter reading is between 1.0 V and 7.0 V, or
- the set-up tool reading is between 1.0 and 7.0.

5. On the interface unit, set switch SW1-2 (NC set-up) to 'Off'.

6. Run the beam alignment macro again.

7. When the system is aligned correctly, tighten the conduit clamping screws.

Aligning and setting up a fixed system

The NC4 modular and compact fixed systems are supplied with the transmitter and receiver units correctly set up. After installing the system, you will need to align the system as described in this section.

Use the setting up procedure only when it is suspected that the transmitter and receiver units have become misaligned.

WARNING: Before aligning and setting up a fixed system, ensure that the machine is safe to work on.

To align a fixed system

1. Run the beam alignment macro (see the publication *Non-contact tool setting software programming guide*).
2. If alignment is outside the values described in “Alignment tolerances” on page 53, make the appropriate adjustments to the system. Do this as follows (refer to the appropriate figure on page 60).

Aligning to the X/Y axes

(a) Slacken the X and Y axis locking screws.

(b) Align the fixed unit to the X/Y axis by hand.

(c) Carefully tighten the X and Y axis locking screws, taking care not to move the fixed unit.

Aligning to the Z axis

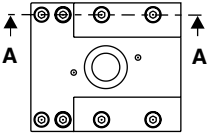
(a) Slacken the Z axis locking screw(s).

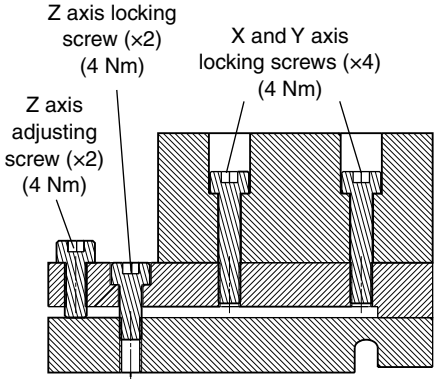
(b) Adjust the Z axis adjusting screw(s).

(c) Carefully tighten the Z axis locking screw(s), taking care not to move the fixed unit.

3. After aligning the system, run the beam alignment macro again.

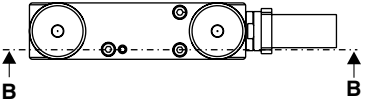
Location of locking and adjusting screws on the modular fixed system adjuster pack

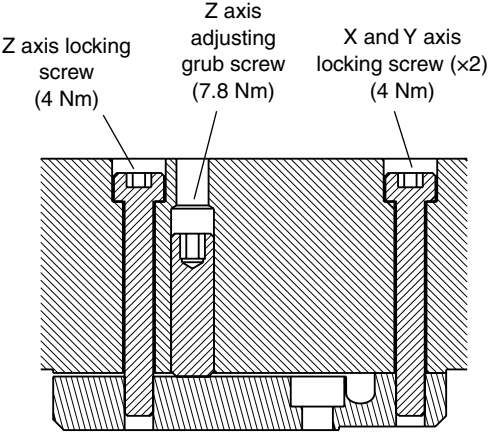




Section on A-A

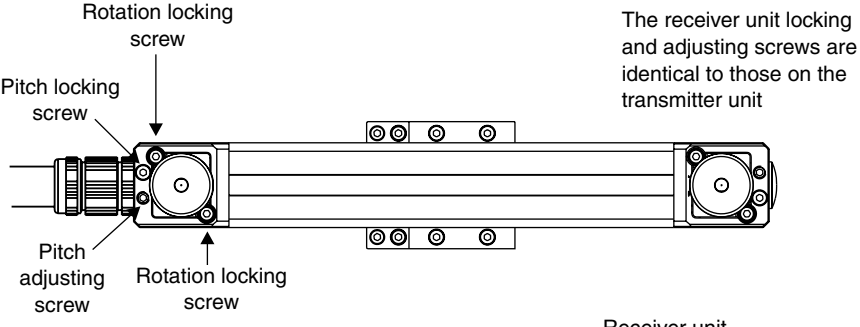
Location of locking and adjusting screws on the compact fixed system

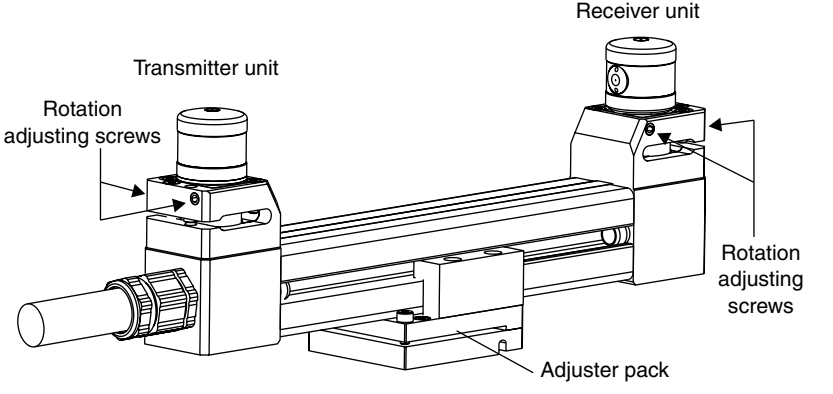




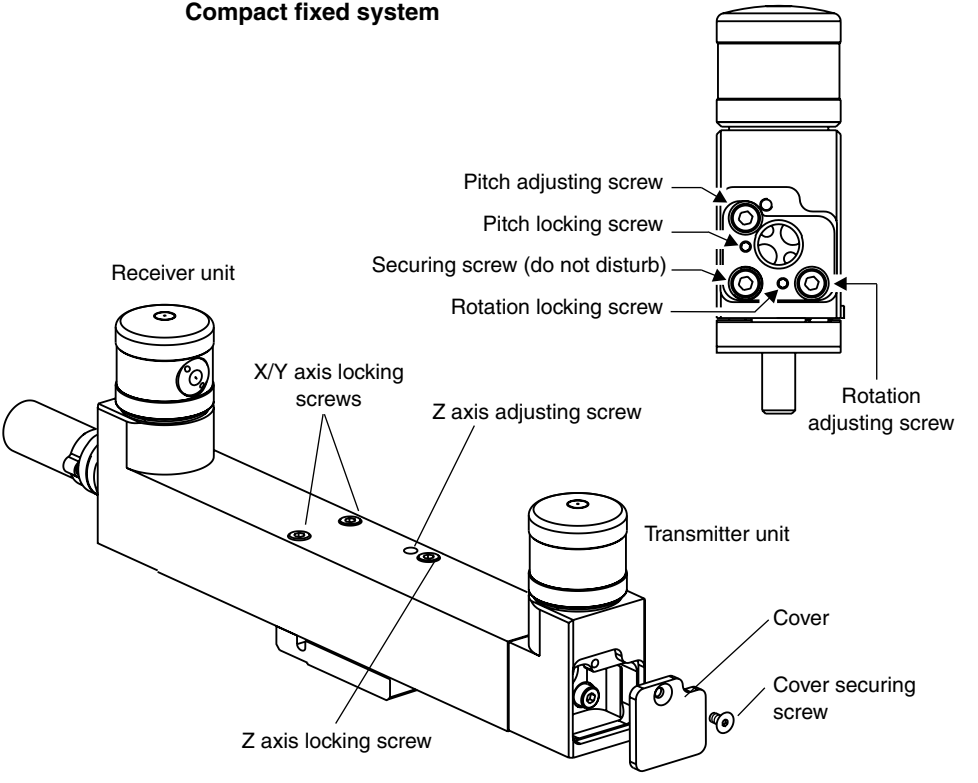
Section on B-B

Modular fixed system





Compact fixed system



To set up a fixed system

Refer to the figure on page 61 or 62 as appropriate.

1. Either connect the digital voltmeter as described in “Using a voltmeter” on page 51 or fit the NC4 set-up tool as described in “Using the set-up tool” on page 52.

2. Switch on electrical power to the interface unit.

3. Ensure that air is supplied to the NC4 and is at the correct pressure.

4. **Compact fixed unit only:** At the transmitter unit, unscrew the cover securing screw and remove the cover.

5. **Modular fixed unit:** At the transmitter and receiver units, slacken the rotation and pitch locking screws.

   Compact fixed unit: At the transmitter unit, slacken the pitch and rotation locking screws.

6. On the interface unit, set switch SW1-2 (NC set-up) to ‘On’.

7. Adjust the rotation and pitch of the transmitter unit so that the laser beam shines on the centre of the receiver MicroHole and the maximum signal is obtained on the voltmeter or set-up tool.

   Check that either:

   - the voltmeter reading is between 1.0 V and 7.0 V, or
   - the set-up tool reading is between 1.0 and 7.0.

8. Repeat step 7 to check that the maximum reading is obtained on the voltmeter or set-up tool.

9. **Modular fixed unit:** At the transmitter and receiver units, tighten the rotation and pitch locking screws to 3.0 Nm (2.2 lbf.ft).

   Compact fixed unit: At the transmitter unit, tighten the pitch and rotation locking screws to 1.5 Nm (1.1 lbf.ft).

10. **Compact fixed unit only:** At the transmitter unit, refit the cover then refit and tighten the cover securing screw.

11. Check that the laser beam is not obstructed.

    On the interface unit, set switch SW1-2 (NC set-up) to ‘Off’.

    Check that:

    - the probe status LED is green, and
    - the voltmeter reading is between 4.7 V and 5.3 V.

    NOTE: If the set-up tool is used, ignore the reading on the display. A false reading is shown when the NC set-up mode is switched off.

12. If the beam is blocked when the switch is set to ‘Off’, the system will be unable to set itself correctly. If this occurs, remove the obstruction then set switch SW1-2 (NC set-up) to ‘On’ then back to ‘Off’.

NC4 fails to turn on (Tx and Rx status LEDs are not lit)	
Fault	**Rectification action**
Faulty connections	Check that the wiring connections are correct.
Wrong supply voltage	Check the supply voltage to the interface unit.
Blown fuse	Check the connections for a short circuit.
Damaged cable	Replace the cable.

No laser beam is exiting the transmitter (Tx and Rx status LEDs are lit)	
Fault	**Rectification action**
The PassiveSeal is protecting the device	Check that the air supply to the NC4 system is switched on (see “Setting the air pressure” on page 48).
Damaged air pipe	Check the air pipe for damage or kinks.

Poor repeatability/spurious readings	
Fault	**Rectification action**
Coolant or swarf on the tool	Clean the tool with an air blast or high-speed spin.
Feedrate is too high	Set the correct feedrate – 2 µm/rev is the recommended value.
Electrical interference	Ensure that the NC4 cables are not routed alongside cables carrying high current. Ensure that the earth wire is connected to the interface.
Thermal growth of the machine and the workpiece	Minimise temperature changes. Increase the frequency of calibration.
Excessive machine vibration	Eliminate vibration.
Air pressure is set incorrectly	Reset the air pressure (see “Setting the air pressure” on page 48).
Calibration and updating of the offset is not occurring.	Check the software.
Measuring speed is different from the calibration speed	Review the software program.
Measuring occurring during the machine acceleration and deceleration zones	Review the software program.
Poor machine repeatability due to worn slides, accident damage, loose encoders etc.	Perform a health check on the machine.

Poor repeatability/spurious readings (continued)	
Fault	**Rectification action**
Brackets loose	Check and tighten the brackets as appropriate.
Tool change repeatability poor	Check repeatability of the NC4 without performing a tool change.
Poorly regulated power supply	Ensure that the power supply is correctly regulated.
Coolant drips or mist	Select the drip-rejection mode using the switch on the interface and the NC software. Wait until the mist has cleared before measuring.

Voltage is outside the range 1.0 V to 7.0 V when in set-up mode (interface unit set-up switch SW1-2 is set to 'On')	
Fault	**Rectification action**
Incorrect separation	Ensure that the NC4 system has the correct range installed. Contact the supplier if a different system range is required.
Poor connection	Check that the voltmeter is operating correctly and is correctly connected to the interface.
Air pressure is set incorrectly	Reset the air pressure (see "Setting the air pressure" on page 48).
An object is blocking the beam	Ensure that the laser beam is unobstructed.
Dirty MicroHole or optics	Clean the optics (see "Cleaning the optics" on page 75).

Probe status LED is amber (this is a fault only in certain conditions – see the table on page 15 for details)	
Fault	**Rectification action**
System is not set for optimum performance	The system operating voltage has decreased since it was last set up. This may occur if: • The optics are contaminated (see “Cleaning the optics” on page 75). • The air pressure is incorrect (see “Setting the air pressure” on page 48). • The system is out of alignment (see “System alignment and set-up” on page 50).

Probe status LED is flashing amber/green	
Fault	**Rectification action**
System is not set for optimum performance	The system operating voltage has increased since it was last set up. This may occur if the system was not set up and aligned correctly (see “System alignment and set-up” on page 50).

Probe status LED is red	
Fault	**Rectification action**
No air supply to the NC4	Check the air supply.
Damaged air pipes	Ensure that the air pipes are not damaged or kinked.
Misalignment between the receiver and transmitter units	Realign the transmitter and receiver units.
Laser beam is obstructed	Clear the obstruction.
Lens is dirty or the air hole is blocked	Refer to the servicing section of this guide for cleaning instructions. (Also see the fault “Tx or Rx lens is dirty or the air hole is blocked”).

Tx or Rx lens is dirty or the air hole is blocked	
Fault	**Rectification action**
Air supply to NC4 does not conform to ISO 8573-1: Air quality class 1.7.2	Connect the air supply upstream of the oil mist lubricator or auto shut-off valve. Ensure that the machine shop air supply is to the required air quality. If the temperature of the air supply is 5 °C or more greater than ambient and is humid, fit an air dryer.
Non-Renishaw air filter is being used	The air filter must conform to ISO 8573-1 Air quality class 1.7.2.
Air filter bowl is full of liquid	Empty the accumulated liquid from the filter bowl. Check the air supply.
Air pipe is full of coolant or oil	Purge or replace the air pipe.

NC4 set-up tool does not power up	
Fault	**Rectification action**
Faulty connection	Check that the NC4 set-up tool is clean and free from swarf. Check that the spring-loaded contact springs on the underside of the tool are clean and are not damaged.
Battery fitted incorrectly	Fit the battery correctly. Check that the correct battery is fitted.
Flat battery	Replace the battery.

NC4 set-up tool gives incorrect reading	
Fault	**Rectification action**
Incorrect reading	The numerical display of the set-up tool provides an indication only. This may differ from the reading obtained on a voltmeter that is connected to the NCi-5 interface. The reading may also vary when the set-up tool is swapped between the transmitter and receiver units. This variation in voltage is not greater than ±0.2 V. An incorrect reading is obtained when the NC set-up mode is switched off.
Dirty optics	Ensure that the NC4 status LED and the optical filter on the set-up tool are clean and are not damaged.

Introduction

The NC4 unit requires minimal maintenance as it has been designed to operate as a permanent fixture on a CNC machining centre where it is subject to an environment of hot metal chips and coolant.

Only the maintenance routines described in this guide should be undertaken.

Equipment requiring repair, overhaul or attention under warranty should be returned to your supplier.

Before carrying out any maintenance operations, ensure that the machine is safe to work on and electrical power to the interface is switched off.

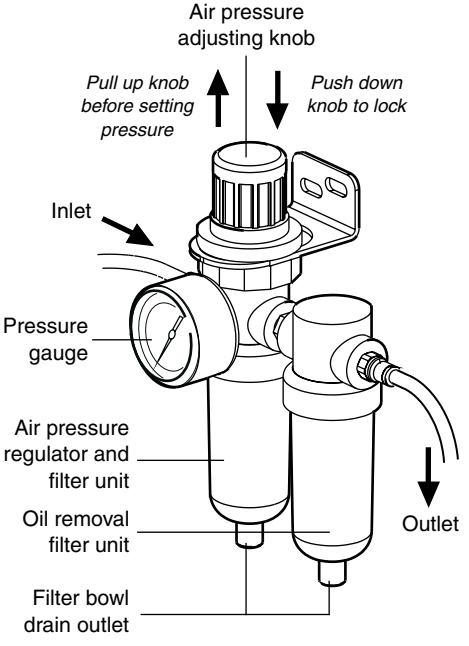
Checking the liquid level

Regularly check the level of the accumulated liquid in each of the filter bowls. It is important that the level is kept below the filter element.

Draining the liquid

Drain the liquid that has accumulated in a filter bowl as follows:

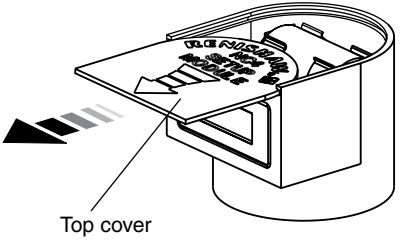
1. Switch off the air supply. A quantity of liquid will drain from the bowl.
2. Switch on the air supply and set the pressure as described in “Setting the air pressure” on page 48.
3. If the level of the liquid in the bowl is still too high, repeat steps 1 and 2 until the level reduces to a satisfactory level.

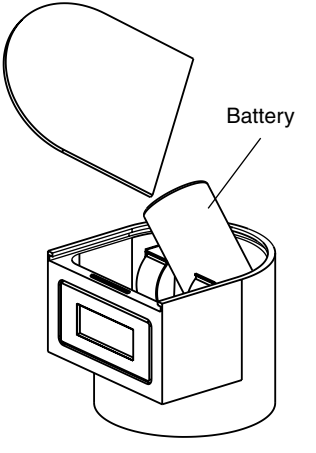


Replacing the battery

The set-up tool requires a ½ AA size battery that is rated between 3.3 V and 3.6 V.

1. Slide the top cover forward by hand to expose the battery.
2. Remove the battery.
3. Carefully fit a new battery. Refer to the markings on the circuit board for correct orientation.
4. Refit the top cover.





Introduction

The servicing procedures described in this section should only be carried out by suitably qualified personnel.

Cleaning the optics and servicing the PassiveSeal should only be carried out by personnel who have received training in the use and operation of laser products. Special tools, such as the cleaning tool and pin spanner, should only be used by service personnel.

Cleaning the NC4

If the air to the NC4 becomes contaminated, the transmitter and receiver units may require cleaning.

Contamination will cause the system to stay in a triggered state. If contamination is suspected, identify the cause and rectify the problem before cleaning the NC4 system. If necessary, change the air pipe.

Clean the units one at a time to reduce the risk of mixing up the access panels.

Equipment required

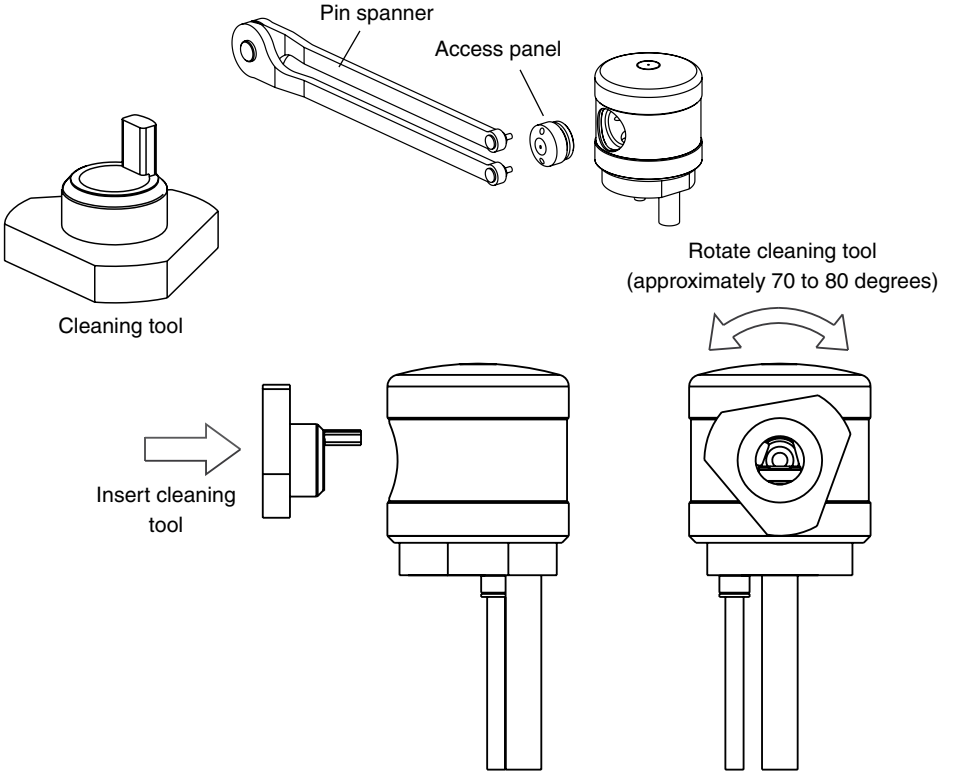
- Pin spanner.
- Cleaning tool.
- Solvent Cleaner Plus (RS No. 132-481) or similar.
- Dust Remover clean air spray (RS No. 846-698).
- Polyester cleaning swabs (×2).

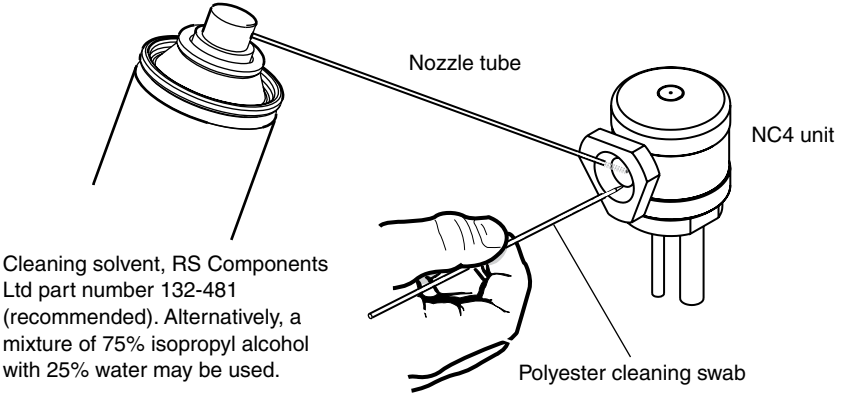
To clean the optics

CAUTION – LASER SAFETY

The access panel of an NC4 transmitter unit is removed to allow access to the optics. Before removing the panel, switch off electrical power to the transmitter unit to avoid exposure to the laser beam.

(continued on page 77)


Pin spanner
Access panel
Cleaning tool
Rotate cleaning tool
(approximately 70 to 80 degrees)
Insert cleaning
tool



1. Switch off electrical power to the interface unit.
2. Remove the air supply from the NC4 by setting the pressure regulator to 0 bar.
3. If an air pipe is damaged, replace the pipe.
4. Using the pin spanner, remove the access panel from the front of the NC4 unit.
5. Insert the cleaning tool into the housing and rotate through 70 to 80 degrees until the PassiveSeal is clear of the optic glass.
6. Purge the air supply for approximately one minute to clear the lines.
7. Access to the lens is through the centre of the cleaning tool. Spray the solvent cleaner, through the nozzle tube, onto the lens.

8. Direct the clean air spray onto the lens to assist evaporation of the solvent.

9. Soak a cleaning swab with the solvent cleaner.

   Wipe the lens with the swab, using quarter-turn movements. Take care not to apply excessive force to the lens as this may damage the optical surfaces.

10. Using the dry swab, dry the lens with quarter-turn movements. Take care to dry the corners of the lens.

11. Repeat steps 9 and 10.

12. Spray the clean air spray into the housing to remove all traces of solvent.

13. Visually inspect for debris around the surfaces where the access panel fits into the NC4 unit and remove if applicable. Take care not to accidentally introduce debris into the housing.

14. Using a clean, dry compressed air supply, blow all debris out of the MicroHole in the access panel.

15. Remove the cleaning tool. Refit the access panel using the pin spanner. Tighten to 2 Nm (1.48 lb.ft).

16. Repeat the cleaning procedure for the other NC4 unit.

After cleaning the NC4

1. Switch on electrical power to the interface unit (see “Applying electrical power to the interface unit” on page 47).

2. Restore the air supply to the NC4 and adjust the pressure (see “Setting the air pressure” on page 48).

3. If an air pipe to an NC4 unit on a separate system has been replaced, the NC4 may need to be realigned (see “Setting up and aligning a separate system” on page 54).

4. If realignment is not necessary, set switch SW1-2 (NC set-up) on the interface unit to ‘On’. After approximately 5 seconds, set the switch to ‘Off’.

5. Check that the system triggers. To do this, pass an object through the laser beam and check that the status LED changes from green to red and back to green.

Disassembling and reassembling a fixed system

An NC4 fixed system can be partially dismantled to allow the air pipe to be replaced and to gain access to the PassiveSeal.

Before disassembling and reassembling the units, ensure that swarf and debris is removed from the system.

The following procedures are suitable for the transmitter and receiver units.

Before disassembling a fixed system

WARNING: Before disassembling a fixed system, ensure that the machine is safe to work on.
Remove power and air from the NC4 system.

CAUTION – LASER SAFETY

The access panel of the NC4 transmitter unit might be removed when disassembling the fixed system.

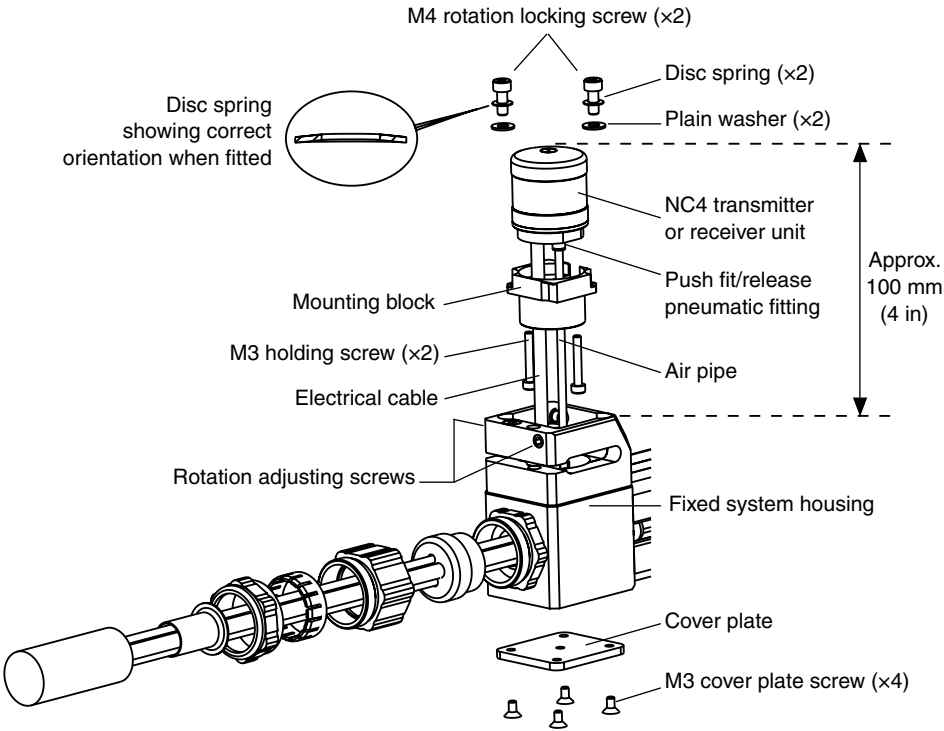
Before disassembling the system, switch off electrical power to avoid exposure to the laser beam.

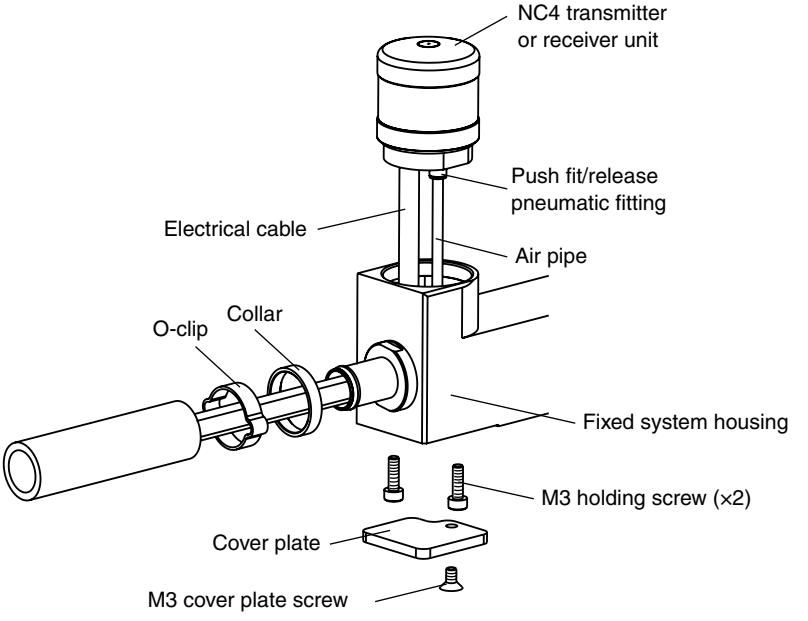
To disassemble a modular fixed unit

Refer to the figure on page 81.

1. Switch off the electrical power to the interface unit.
2. Remove the air supply from the NC4 by setting the pressure regulator to 0 bar.
3. Remove the two M4 rotation locking screws. Do not lose the plain washer and disc spring that are fitted under each screw head.
4. Slacken the two rotation adjusting screws.

(continued on page 83)


M4 rotation locking screw (×2)
Disc spring (×2)
Plain washer (×2)
Disc spring showing correct orientation when fitted
NC4 transmitter or receiver unit
Approx. 100 mm (4 in)
Push fit/release pneumatic fitting
Mounting block
M3 holding screw (×2)
Air pipe
Electrical cable
Rotation adjusting screws
Fixed system housing
Cover plate
M3 cover plate screw (×4)


NC4 transmitter
or receiver unit
Push fit/release
pneumatic fitting
Electrical cable
Air pipe
O-clip
Collar
Fixed system housing
M3 holding screw (×2)
Cover plate
M3 cover plate screw

5. Carefully pull the NC4 unit assembly out of the housing so that the mounting block is exposed.

6. Remove the two M3 holding screws and remove the mounting block.

7. The PassiveSeal and air pipe can now be accessed. The pneumatic fitting is of a push fit/release type.

   To disassemble the PassiveSeal, see “Servicing – PassiveSeal” on page 87.

To disassemble a compact fixed unit

Refer to the figure on page 82.

1. Switch off the electrical power to the interface unit.

2. Remove the air supply from the NC4 by setting the pressure regulator to 0 bar.

3. Remove the NC4 compact fixed system housing from the mounting/adjuster plate.

4. Unscrew and remove the M3 cover plate screw then remove the cover plate.

5. Unscrew and remove the two M3 holding screws.

6. Carefully pull the NC4 unit assembly out of the housing so that the air pipe and electrical cable are exposed.

   The PassiveSeal and air pipe can now be accessed. The pneumatic fitting is of a push fit/release type.

   To disassemble the PassiveSeal, see “Servicing – PassiveSeal” on page 87.

7. Replace the air pipe if required.

To replace the air pipe on a modular fixed unit

1. Remove the NC4 fixed system housing from the adjuster pack.
2. Remove the four M3 cover plate screws and cover plate to gain access to the air pipe.
3. Make a note of how far the electrical cable and air pipe allow the NC4 unit to extend out of the fixed system housing. This will help when you need to gauge how much slack to leave when reassembling the system.

   This should be approximately 100 mm (4 in).
4. Dismantle the conduit gland so that the air pipe can be removed (see the exploded view of the gland on pages 81 and 82).

To reassemble a modular fixed unit

Refer to the figure on page 81.

1. Ensure that the air pipe and PassiveSeal are fitted.
2. With the conduit gland dismantled, ensure that the NC4 unit can extend out of the fixed system housing by the same distance as noted previously (approximately 100 mm [4 in]).

   Carefully feed any excess cable and air pipe back through the gland. Too much slack may damage the supplies when putting the system back together.
3. Tighten the conduit gland to secure it in position.
4. Refit the cover plate and secure it with the four M3 holding screws.
5. Secure the fixed system housing to the adjuster pack.

6. Fit the mounting block to the NC4 unit and secure with the two M3 holding screws.

7. Refit the NC4 unit into the fixed system housing, taking care not to damage or kink the cable and air pipe. A slight twisting action will help these to lie in position.

8. Refit the two M4 rotation locking screws, taking care to also fit the plain washer and disc spring in the order shown in the figure.

9. Tighten the two rotation adjusting screws.

10. Finally, align and set up the modular fixed system as described in “Aligning and setting up a fixed system” on page 59.

To reassemble a compact fixed unit

Refer to the figure on page 82.

1. Ensure that the air pipe and PassiveSeal are fitted.

2. Carefully feed any excess cable and air pipe back through the gland. Too much slack may damage the supplies when putting the system back together.

3. Refit the NC4 unit assembly into the housing, taking care not to damage or kink the cable and air pipe. A slight twisting action will help these to lie in position.

4. Secure the NC4 unit to the housing with the two M3 holding screws.

5. Refit the cover plate then refit and tighten the M3 cover plate screw.

6. Secure the compact fixed system to the mounting/adjuster plate.

7. Finally, align and set up the compact fixed system as described in “Aligning and setting up a fixed system” on page 59.

Disassembling the seal

If an NC4 unit becomes heavily contaminated due to a dirty air supply, the PassiveSeal within the unit must be removed to allow the unit to be cleaned thoroughly.

Disassemble and reassemble the PassiveSeal of one NC4 unit at a time. This will avoid mixing up the seals and access panels.

Refer to the figure on page 88.

CAUTION – LASER SAFETY

The access panel of the NC4 transmitter unit is removed when disassembling the unit to gain access to the PassiveSeal.

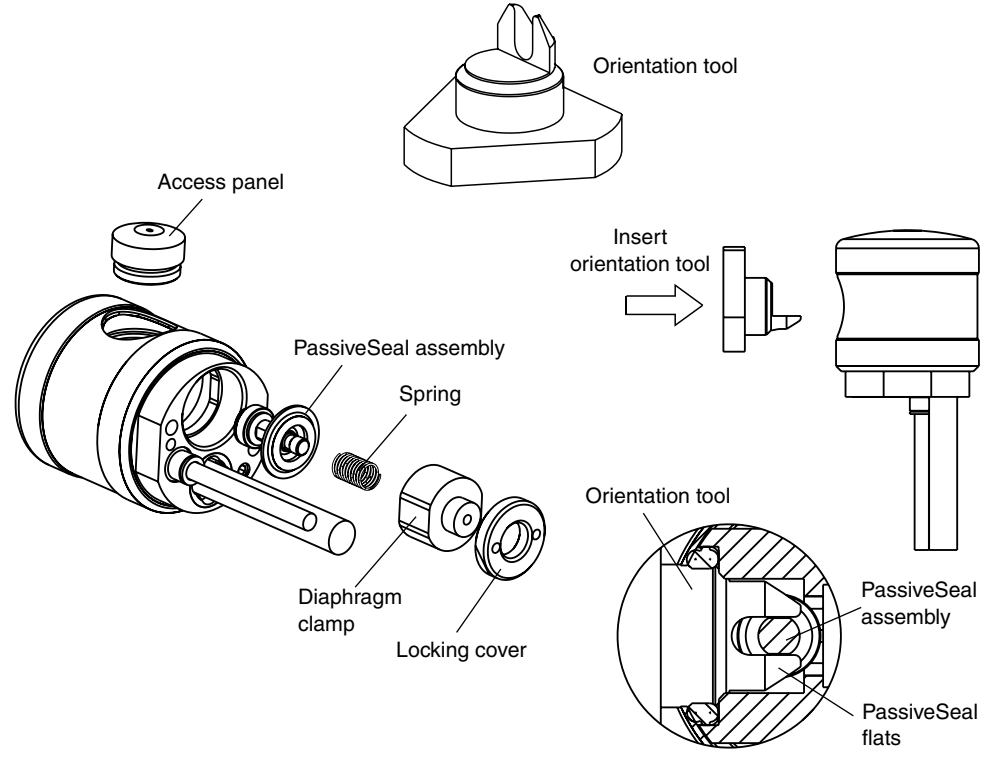
Before disassembling the unit, switch off electrical power to avoid exposure to the laser beam.

1. Switch off electrical power to the interface unit.
2. Remove the air supply from the NC4 by setting the pressure regulator to 0 bar.
3. Unscrew the NC4 unit from the mounting pack or plate.
4. Using the pin spanner, unscrew and remove the access panel.
5. Using the pin spanner, unscrew the locking cover.
6. Remove the locking cover, diaphragm clamp, spring, and PassiveSeal assembly.

Reassembling the seal

1. Place the PassiveSeal assembly into the NC4 unit.
2. Insert the orientation tool into the unit to hold the PassiveSeal against the flats.

(continued on page 89)


Orientation tool
Access panel
Insert
orientation tool
PassiveSeal assembly
Spring
Orientation tool
PassiveSeal
assembly
Diaphragm
clamp
Locking cover
PassiveSeal
flats

3. Insert the spring, diaphragm clamp and locking cover. Tighten the locking cover to 2 Nm (1.48 lb.ft).

4. Remove the orientation tool.

5. Inspect the unit for contamination. Using a clean, dry compressed air supply, blow all debris out of the MicroHole in the access panel.

6. Refit the access panel and tighten to 2 Nm (1.48 lb.ft).

7. Disassemble and reassemble the PassiveSeal of the other unit if necessary.

8. Finally, remount and realign the NC4 as described in the section “Refitting and aligning the NC4”.

Refitting and aligning the NC4

1. Refit the NC4 as described in “Installing a fixed system” on page 32 or “Installing a separate system” on page 37.

2. Switch on electrical power to the interface unit (see “Applying electrical power to the interface unit” on page 47).

3. Restore the air supply to the NC4 and adjust the pressure (see “Setting the air pressure” on page 48).

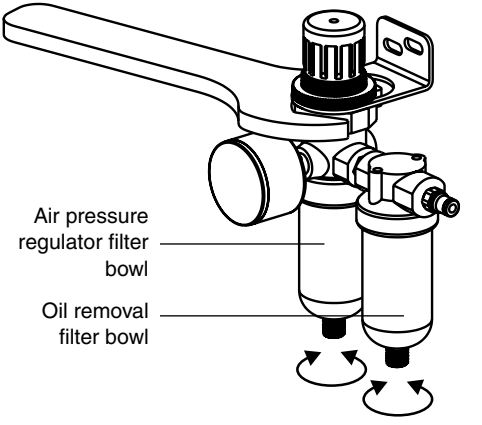
4. Realign the NC4 as described in “Setting up and aligning a separate system” on page 54 or “Aligning and setting up a fixed system” on page 59.

5. Check that the system triggers. To do this, pass an object through the laser beam and check that the status LED changes from green to red and back to green

Removing and refitting filter elements

Regularly inspect the filter elements. They should be replaced when dirty or wet and at least once each year. Do this as follows:

1. Switch off the air supply.
2. Unscrew the filter bowl by hand.
3. Remove the O-ring from the recess in the filter bowl. Discard the O-ring.
4. Unscrew and remove the filter element.
5. Fit the replacement filter and, where applicable, the O-ring. These are shown in the dotted box A in the figure on page 91.
6. Fit a new O-ring into the recess in the filter bowl.
7. Refit the filter bowl and screw hand-tight.

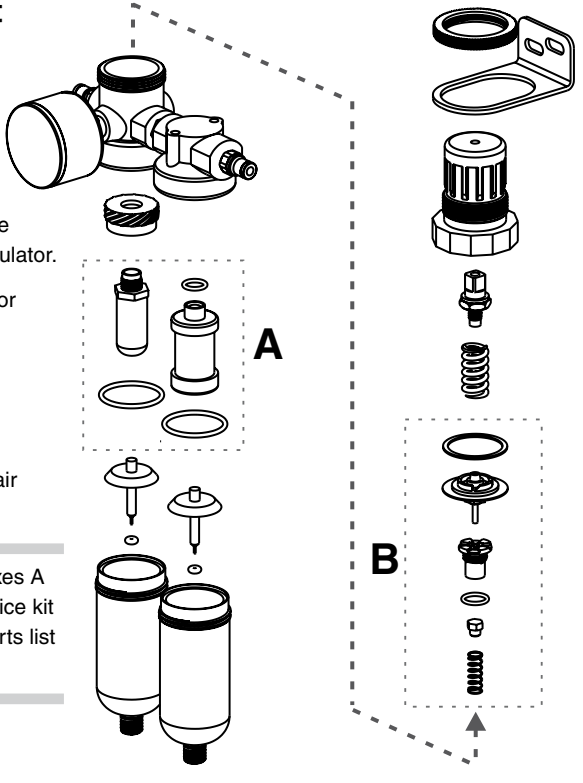


8. Switch on the air supply and set the pressure as described in “Setting the air pressure” on page 48.

Replacing other service kit components

1. Switch off the air supply.
2. Using a 38 mm A/F spanner, remove the regulator head.
3. Remove the components (shown in the dotted box B) from the body of the regulator.
4. Fit the new components to the regulator body.
5. Refit the regulator head and tighten to 7.7 Nm (5.7 lbf.ft).
6. Switch on the air supply and set the pressure as described in "Setting the air pressure" on page 48.

NOTE: Items shown within dotted boxes A and B are included in the air filter service kit obtainable from Renishaw (see the parts list on page 99).



NC4 separate unit assemblies. Each assembly contains:

- Transmitter (Tx) unit with Ø6 mm × 12.5 m cable
- Receiver (Rx) unit with Ø6 mm × 12.5 m cable
- Laser warning sign
- Installation and maintenance guide

Type	Part number	Description
NC4 – range 0.3 m to 0.5 m	A-4114-5005	OO (0.2) Tx unit and OOOO (0.4) Rx unit assembly
NC4 – range 0.5 m to 0.8 m	A-4114-5010	OOOO (0.4) Tx unit and OO (0.2) Rx unit assembly
NC4 – range 0.8 m to 1.5 m	A-4114-5015	OOOO (0.4) Tx unit and OOOO (0.4) Rx unit assembly
NC4 – range 1.5 m to 2.0 m	A-4114-5020	OOOO (0.4) Tx unit and OOOOOO (0.6) Rx unit assembly
NC4 – range 2.0 m to 3.0 m	A-4114-5025	OOOOOO (0.6) Tx unit and OOOO (0.4) Rx unit assembly
NC4 – range 3.0 m to 5.0 m	A-4114-5030	OOOOOO (0.6) Tx unit and OOOOOO (0.6) Rx unit assembly

NC4 separate unit kits. Each kit contains:

- Transmitter (Tx) unit with Ø6 mm × 12.5 m cable
- Receiver (Rx) unit with Ø6 mm × 12.5 m cable
- Air filter/regulator
- Ø4 mm × 25 m air tube
- Ø3 mm × 5 m air tube (× 2)
- Ø4 mm pneumatic tee fitting
- Ø4 mm to Ø4 mm pneumatic fitting
- Ø3 mm to Ø4 mm pneumatic fitting (× 2)
- Blanking cap (× 3)
- 4 m length of GP11 steel braided conduit (× 2)
- M20 × 1.5P GP11 conduit gland and blanking plug (× 2)
- NCi-5 interface
- Pin spanner
- Hexagonal wrenches (2 mm, 2.5 mm and 3 mm)
- Bootlace ferrule (× 12)
- Cleaning swab (× 2)
- Conduit clamp (× 4)
- Cleaning tool
- Orientation tool
- Laser warning sign
- Installation and maintenance guide

Type	Part number	Description
NC4 – range 0.3 m to 0.5 m	A-4114-5055	Full kit, comprising OO (0.2) Tx unit and OOOO (0.4) Rx unit
NC4 – range 0.5 m to 0.8 m	A-4114-5060	Full kit, comprising OOOO (0.4) Tx unit and OO (0.2) Rx unit
NC4 – range 0.8 m to 1.5 m	A-4114-5065	Full kit, comprising OOOO (0.4) Tx unit and OOOO (0.4) Rx unit
NC4 – range 1.5 m to 2.0 m	A-4114-5070	Full kit, comprising OOOO (0.4) Tx unit and OOOOOO (0.6) Rx unit
NC4 – range 2.0 m to 3.0 m	A-4114-5075	Full kit, comprising OOOOOO (0.6) Tx unit and OOOO (0.4) Rx unit
NC4 – range 3.0 m to 5.0 m	A-4114-5080	Full kit, comprising OOOOOO (0.6) Tx unit and OOOOOO (0.6) Rx unit

NC4 modular fixed unit assembly (F300). Supplied with:

- Ø6 mm × 12.5 m cable (× 2)
- Ø3 mm × 5 m air tube (× 2)
- Laser warning sign
- Installation and maintenance guide

Type	Part number	Description
NC4 F300 modular fixed unit assembly	A-4114-5100	Fixed unit assembly only

NC4 modular fixed unit kit (F300). Supplied with:

- Ø6 mm × 12.5 m cable (× 2)
- Air filter/regulator
- Ø4 mm × 25 m air tube
- Ø3 mm × 5 m air tube (× 2)
- Ø4 mm pneumatic tee fitting
- Ø4 mm to Ø4 mm pneumatic fitting
- Ø3 mm to Ø4 mm pneumatic fitting (× 2)
- Blanking cap (× 3)
- 4 m length of GP16 steel braided conduit
- NCi-5 interface
- Pin spanner
- Hexagonal wrenches (2 mm, 2.5 mm and 3 mm)
- Bootlace ferrule (× 12)
- Cleaning swab (× 2)
- Conduit clamp (× 2)
- Cleaning tool
- Adjuster pack
- Orientation tool
- Laser warning sign
- Installation and maintenance guide

Type	Part number	Description
NC4 F300 modular fixed unit kit	A-4114-5110	Full kit

NC4 compact fixed unit assemblies. Supplied with:

- Ø6 mm × 12.5 m cable (× 2)
- Ø3 mm × 5 m air tube (× 2)
- Mounting and adjuster plate
- Laser warning sign
- Installation and maintenance guide

Type	Part number	Description
NC4 F95 compact fixed unit assembly	A-5299-5210	F95 compact fixed unit assembly only
NC4 F115 compact fixed unit assembly	A-5299-5010	F115 compact fixed unit assembly only
NC4 F145 compact fixed unit assembly	A-5299-5310	F145 compact fixed unit assembly only
NC4+ F145 compact fixed unit assembly	A-5535-5310	NC4+ F145 compact fixed unit assembly only
NC4 F145 90-degree compact fixed unit assembly	A-5299-5410	F145 90-degree compact fixed unit assembly only
NC4+ F145 90-degree compact fixed unit assembly	A-5535-5410	NC4+ F145 90-degree compact fixed unit assembly only
NC4 F230 compact fixed unit assembly	A-5299-5110	F230 compact fixed unit assembly only
NC4 F300 compact fixed unit assembly	A-5299-5710	F300 compact fixed unit assembly only

NC4 compact fixed unit kits. Supplied with:

- Ø6 mm × 12.5 m cable (× 2)
- Air filter/regulator
- Ø4 mm × 25 m air tube
- Ø3 mm × 5 m air tube (× 2)
- Ø4 mm pneumatic tee fitting
- Ø4 mm to Ø4 mm pneumatic fitting
- Ø3 mm to Ø4 mm pneumatic fitting (× 2)
- Blanking cap (× 3)
- 4 m length of GP16 steel braided conduit
- NCi-5 interface
- Pin spanner
- Hexagonal wrenches (2 mm, 2.5 mm and 3 mm)
- Bootlace ferrule (× 12)
- Conduit clamp (× 2)
- Cleaning swab (× 2)
- Cleaning tool
- Mounting and adjuster plate
- Orientation tool
- Laser warning sign
- Installation and maintenance guide

Type	Part number	Description
NC4 F95 compact fixed unit kit	A-5299-5200	Full kit
NC4 F115 compact fixed unit kit	A-5299-5000	Full kit
NC4 F145 compact fixed unit kit	A-5299-5300	Full kit
NC4+ F145 compact fixed unit kit	A-5535-5300	Full kit
NC4 F145 90-degree compact fixed unit kit	A-5299-5400	Full kit
NC4 F145 90-degree compact fixed unit kit	A-5535-5400	Full kit
NC4 F230 compact fixed unit kit	A-5299-5100	Full kit
NC4 F300 compact fixed unit kit	A-5299-5705	Full kit

NC4 Tx units. Supplied with:

- Ø6 mm × 12.5 m cable
- Laser warning sign
- Installation and maintenance guide

Type	Part number	Description
NC4 OO (0.2) Tx unit	A-4114-5205	Tx only. To be used for the following system separation: 0.3 m – 0.5 m
NC4 OOOO (0.4) Tx unit	A-4114-5210	Tx only. To be used for the following system separations: 0.5 m – 0.8 m, 0.8 m – 1.5 m, 1.5 m – 2 m
NC4 OOOOOO (0.6) Tx unit	A-4114-5215	Tx only. To be used for the following system separations: 2 m – 3 m, 3 m – 5 m

NC4 Rx units. Supplied with:

- Ø6 mm × 12.5 m cable
- Installation and maintenance guide

Type	Part number	Description
NC4 OO (0.2) Rx unit	A-4114-5305	Rx only. To be used for the following system separation: 0.5 m – 0.8 m
NC4 OOOO (0.4) Rx unit	A-4114-5310	Rx only. To be used for the following system separations: 0.8 m – 1.5 m, 2 m – 3 m
NC4 OOOOOO (0.6) Rx unit	A-4114-5315	Rx only. To be used for the following system separations: 1.5 m – 2 m, 3 m – 5 m

Type	Part number	Description
NC4 tool kit	A-4114-4110	Pin spanner Hexagonal wrenches (2 mm, 2.5 mm and 3 mm) Bootlace ferrule (× 12) Cleaning swab (× 2) Cleaning tool Orientation tool
Rotary cover	M-4114-0130	Manually rotatable cover to block the laser beam
Access panel O (0.1)	A-4114-0081	O (0.1) access panel
Access panel ●● (0.18)	A-5299-0075	●● (0.18) access panel
Access panel OO (0.2)	A-4114-0082	OO (0.2) access panel
Access panel OOOO (0.4)	A-4114-0084	OOOO (0.4) access panel
Access panel OO✞OO (0.4+)	A-5535-0015	OO✞OO (0.4+) access panel
Access panel OOOOOO (0.6)	A-4114-0086	OOOOOO (0.6) access panel
Adjuster pack (modular fixed system)	A-4114-4170	Adjuster pack for fixed system
Adjuster pack (separate system – single plate)	A-4114-4400	Single-plate low cost adjuster pack for separate system
Adjuster pack (separate system – 3-plate)	A-4114-3100	3-plate adjuster pack for separate system
Spacer plate	M-4114-0328	1 mm thick spacer plate. For use with single-plate and 3-plate adjuster packs.
NC4 set-up tool	A-4114-8000	Battery operated tool used for setting up the NC4 system
Battery	P-BT03-0007	Battery for NC4 set-up tool

Type	Part number	Description
Air assembly kit	A-2253-5120	Filter/regulator Ø4 mm × 25 m air tube Ø4 mm tee-fitting
Air adaptor kit	M-4179-0161	Ø3 mm × 5 m air tube Ø3 mm to Ø4 mm straight fitting Blanking cap
Nylon tube (Ø3 mm)	P-PF26-0014	Ø3 mm × 25 m air tube (coil)
Nylon tube (Ø4 mm)	P-PF26-0010	Ø4 mm × 25 m air tube (coil)
Equal tee fitting	P-PF04-0010	Ø4 mm push-fit pneumatic adaptor
Straight fitting (Ø4 mm to Ø4 mm)	P-PE02-0020	Ø4 mm to Ø4 mm push-fit pneumatic adaptor
Straight fitting (Ø4 mm to Ø3 mm)	P-PE02-0019	Ø4 mm to Ø3 mm push-fit pneumatic adaptor
Pneumatic blanking cap	P-BG03-0029	Pneumatic blanking cap
Air filter service kit	P-FI01-S002	Replacement filter and seals for air filter/ regulator unit
De luxe air filter	P-FI01-0008	For filtering large quantities of contaminated air

Type	Part number	Description
Conduit (separate system)	P-HO01-0008	Conduit for separate system (GP11) O/D = 17 mm, I/D = 12 mm, minimum bend radius = 60 mm (order by the metre)
Conduit (fixed system)	P-HO01-0011	Conduit for fixed system (GP16) O/D = 22 mm, I/D = 16 mm, minimum bend radius = 70 mm (order by the metre)
Cable/conduit gland (for separate system)	P-CA61-0063	Cable/conduit gland (GP11), M20 × 1.5P, for use with separate systems
Cable/conduit gland (for fixed system)	P-CA61-0065	Cable/conduit gland (GP16), M20 × 1.5P, for use with fixed systems
Gland blanking plug	P-CA61-0064	Blanking plug, Ø8 mm, for use with GP11 gland
90-degree gland adaptor (both parts needed)	P-CA61-0068 P-CA61-0069	Coupling, M20 × 1.5P (male) to M20 × 1.5P (female) 90-degree angle gland, M20 × 1.5P (male) to M20 × 1.5P (female)
Locknut	P-NU03-0200	Locknut, M20 × 1.5P, for use with GP11 and GP16 cable/conduit glands
Bulkhead fitting	P-CA61-0067	Bulkhead fitting, M20 × 1.5P. Contains four Ø5.4 mm holes on 44 mm fixing centres
Conduit clamp	P-CL36-0016	Steel conduit clamp for GP11 conduit
Conduit clamp	P-CA70-0220	Steel conduit clamp for GP16 conduit
O-clip	P-MA01-0048	O-clip for GP16 conduit

Type	Part number	Description
NCi-5 interface	A-5259-2000	NCi-5 interface and box with DIN rail mounting and two terminal blocks
NCi-5 terminal block (10-way)	P-CN25-1053	10-way socket terminal block, for use with NCi-5 interface
NCi-5 terminal block (15-way)	P-CN25-0009	15-way socket terminal block, for use with NCi-5 interface

Type	Part number	Description
NC4 installation and maintenance guide	H-2000-5230	Contains all information relevant to the NC4 system. Includes laser safety, installation and maintenance, troubleshooting and parts list information
NCi-5 installation and user's guide	H-5259-8500	Contains all information relevant to the NCi-5 interface
Laser warning sign	P-LA01-1066	Adhesive-backed sign

Type	Part number	Description
NC software kit (Fanuc)	A-4012-0820	Software for Fanuc 0, 6, 10-15, 16-21, 30-32 M and Mi controllers, programming guide
NC software kit (Mazak)	A-4013-0062	Software for Mazak Fusion 640, M32 and M-Plus controllers, programming guide
NC software kit (Mazak angled beam)	A-4013-0088	Software for Mazak Fusion 640M controller, programming guide
NC software kit (Mazak Integrex)	A-4013-0092	Software for E series lathes with Mazak Fusion 640M controller, programming guide
NC software kit (Mazak Integrex)	A-4013-0123	Software for Mk IV and E-series Integrex - Matrix controllers, programming guide
NC software kit (Mazak including angled beam)	A-4013-0119	Software for Mazak Matrix controllers, programming guide
NC software kit (Mazak)	A-4013-0566	Software for Y axis lathe with Mazak Fusion 640M controller programming guide
NC software kit (Haas)	A-4012-0895	Software for Haas controllers, programming guide
NC software kit (Yasnac)	A-4014-0020	Software for Yasnac MX3 and J50 controllers, programming guide
NC software kit (Yasnac angled beam package)	A-4014-0025	Software for Yasnac MX3, J50 I80, J100 and J300 controllers, programming guide
NC software kit (Siemens)	A-4014-0344	Software for Siemens 802D controller, programming guide

Type	Part number	Description
NC software kit (Siemens)	A-4014-0401	Software for Siemens 810D V5+ and 840D V5+ controllers, programming guide
NC software kit (Siemens angled beam package)	A-4014-0236	Software for Siemens 810D V5+ and 840D V5+ controllers, programming guide
NC software kit (Heidenhain)	A-4014-0165	Software for Heidenhain 426 and 430 controllers, programming guide, integration guide (OEM only)
NC software kit (Heidenhain i530)	A-4014-0253	Software for Heidenhain i530 controller, programming guide, integration guide (OEM only)
NC software kit (Mitsubishi Meldas)	A-4013-0050	Software for Mitsubishi Meldas M3, M310, M320 , M335, M500 M600 and M700 controllers, programming guide
NC software kit (Brother)	A-4012-0904	Software for 32A (post June 2002) Brother controllers fitted with macro option, programming guide
NC software kit (Brother)	A-4012-1035	Software for 32B Brother controllers fitted with macro option, programming guide
NC software kit (Hitachi/Seiki)	A-4012-0848	Software for Sigma 16M and 18M controllers, programming guide
NC software kit (Makino)	A-4012-0900	Software for Makino Professional 3 and 5 controllers, programming guide
NC software kit (Milltronics)	A-4012-1182	Software for Milltronics controllers, programming guide
NC software kit (Mori-Seiki)	A-4012-0953	Software for Mori-Seiki (non-Hi-Tech machines) controllers, programming guide

Type	Part number	Description
NC software kit (Mori-Seiki)	A-4012-1020	Software for Mori-Seiki NT and MT series lathes (Fanuc) controllers, programming guide
NC software kit (Mori-Seiki)	A-4012-1116	Software for Mori-Seiki NMV 5000 (Fanuc 30) controllers, programming guide
NC software kit (Hurco)	A-4012-1141	Software for WinMax controller, programming guide
NC software kit (Selca)	A-4014-0218	Software for Selca S3000 / S4000 controllers, programming guide
NC software kit (Okuma)	A-4016-1021	Software for Okuma 5020M, 700M/7000M, U10M, U100M and OSP 200M controllers, programming guide
NC software kit (Fadal)	A-4016-0061	Software for Fadal 32MP / CNC88 controller, programming guide

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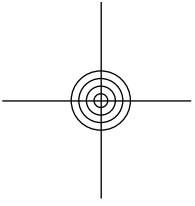
TARGET TO AID ALIGNMENT



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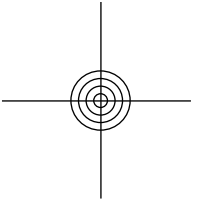

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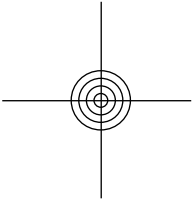

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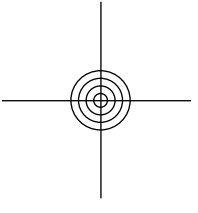

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