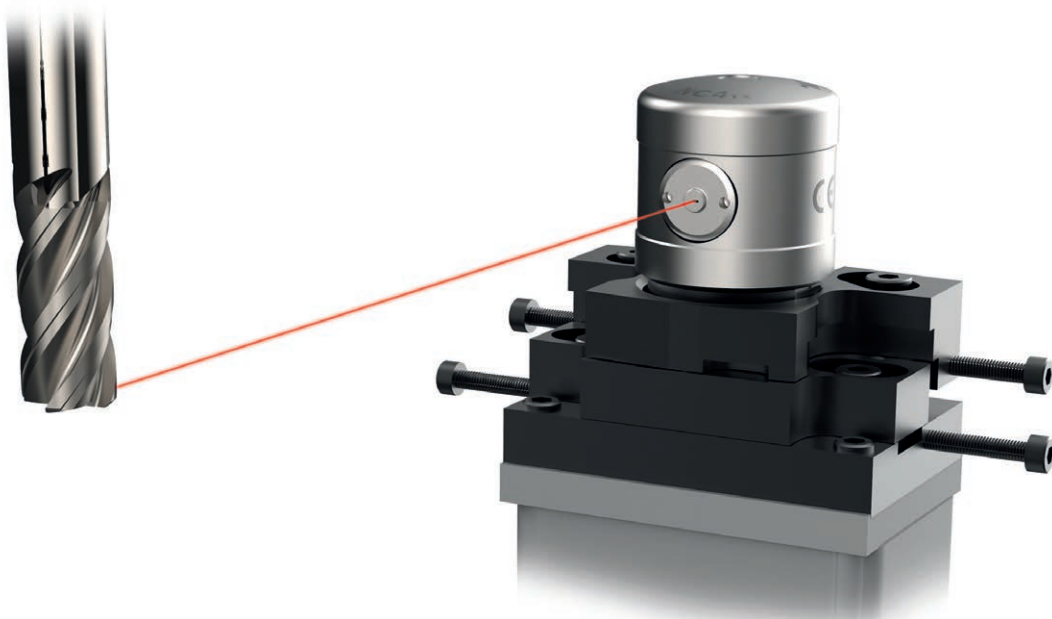


NC4 non-contact tool setting separate system



Compliance information for this product is available by scanning the QR code or visiting www.renishaw.com/mtpdoc



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Before you begin

Trade marks

Google Play and the Google Play logo are trademarks of Google LLC.

Apple and the Apple logo are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc., registered in the U.S. and other countries.

Warranty

Unless you and Renishaw have agreed and signed a separate written agreement, the equipment and/or software are sold subject to the Renishaw Standard Terms and Conditions supplied with such equipment and/or software, or available on request from your local Renishaw office.

Renishaw warrants its equipment and software for a limited period (as set out in the Standard Terms and Conditions), provided that they are installed and used exactly as defined in associated Renishaw documentation. You should consult these Standard Terms and Conditions to find out the full details of your warranty.

Equipment and/or software purchased by you from a third-party supplier is subject to separate terms and conditions supplied with such equipment and/or software. You should contact your third-party supplier for details.

CNC machines

CNC machine tools must always be operated by fully-trained personnel in accordance with the manufacturer's instructions.

Care of the system

Keep system components clean and treat the unit as a precision tool.

Patents

Features of the NC4 non-contact tool setting separate system and features of similar Renishaw products, are the subject of one or more of the following patents and/or patent applications:

CN 100394139

JP 4520240

EP 1502699

US 7312433

NC4 non-contact tool setting separate system software notices

This NC4 non-contact tool setting separate system includes embedded software (firmware) to which the following notices apply:

US government notice

NOTICE TO UNITED STATES GOVERNMENT CONTRACT AND PRIME CONTRACT CUSTOMERS

This software is commercial computer software that has been developed by Renishaw exclusively at private expense. Notwithstanding any other lease or licence agreement that may pertain to, or accompany the delivery of, this computer software, the rights of the United States Government and/or its prime contractors regarding its use, reproduction and disclosure are as set forth in the terms of the contract or subcontract between Renishaw and the United States Government, civilian federal agency or prime contractor respectively. Please consult the applicable contract or subcontract and the software licence incorporated therein, if applicable, to determine your exact rights regarding use, reproduction and/or disclosure.

Renishaw software EULA

Renishaw software is licensed in accordance with the Renishaw licence at:
www.renishaw.com/legal/softwareterms

Intended use

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.

Safety

Information to the user

The NC4 set-up tool (Renishaw part no. A-4114-8000, sold separately) is supplied with non-rechargeable lithium metal batteries. Refer to the battery manufacturer's literature for specific battery operating, safety and disposal guidelines.

- Do not attempt to recharge the batteries.
- Replace the batteries only with the specified type.
- Do not mix new and used batteries in the product.
- Do not mix different types or brands of batteries in the product.
- Ensure that all batteries are inserted with the correct polarity in accordance with the instructions in this manual and indicated on the product.
- Do not store the batteries in direct sunlight.
- Do not expose the batteries to water.
- Do not expose the batteries to heat or dispose of the batteries in a fire.
- Avoid forced discharge of the batteries.
- Do not short circuit the batteries.
- Do not disassemble, apply excessive pressure, pierce, deform or subject the batteries to impact.
- Do not swallow the batteries.
- Keep the batteries out of the reach of children.
- If the batteries are swollen or damaged do not use them in the product and exercise caution when handling them.
- Dispose of waste batteries in accordance with your local environmental and safety laws.

Ensure that you comply with international and national battery transport regulations when transporting the batteries or this product with the batteries inserted. Lithium metal batteries are classified as dangerous goods for transportation and require labelling and packaging in accordance with the dangerous goods regulations before being offered for transportation. To reduce the risk of shipment delays, should you need to return this product to Renishaw for any reason, do not return any batteries.

In all applications involving the use of machine tools, eye protection is recommended.

Information to the machine supplier / installer

It is the machine supplier's responsibility to ensure that the user is made aware of any hazards involved in operation, including those mentioned in Renishaw product literature, and to ensure that adequate guards and safety interlocks are provided.

If the NC4 unit fails, the output signal may falsely indicate beam not blocked. Do not rely on signals from the NC4 unit to halt the movement of the machine.

Information to the equipment installer

All Renishaw equipment is designed to comply with the relevant UK, EU and FCC regulatory requirements. It is the responsibility of the equipment installer to ensure that the following guidelines are adhered to, in order for the product to function in accordance with these regulations:

- any interface unit **MUST** be installed in a position away from any potential sources of electrical noise (for example, power transformers, servo drives);
- all 0 V/ground connections should be connected to the machine "star point" (the "star point" is a single point return for all equipment ground and screen cables). This is very important and failure to adhere to this can cause a potential difference between grounds;
- all screens must be connected as outlined in the user instructions;
- cables must not be routed alongside high current sources (for example, motor power supply cables), or be near high-speed data lines;
- cable lengths should always be kept to a minimum.

Equipment operation

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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 or receiver.
- 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.

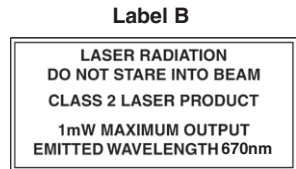
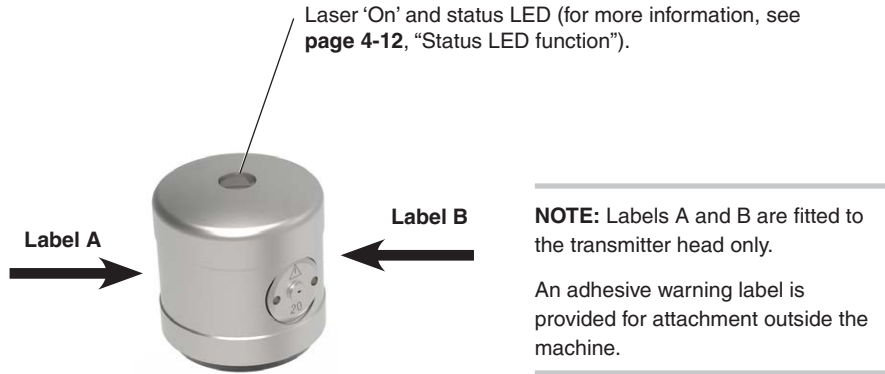
The NC4 is classified as a Class 2 laser product as defined by BS EN 60825-1:2014.

Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

BS EN 60825-1:2014 directs to attach a laser warning label and explanatory label.

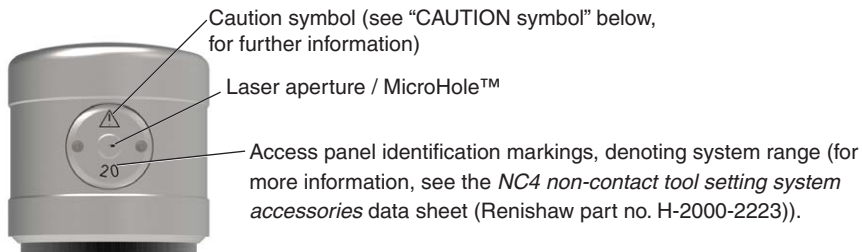
A warning label and explanatory label are permanently fixed to each side of the transmitter (Tx) housing (see **page 1-6**, “Laser safety and warning labels”, for further information). An adhesive warning label is also provided. Renishaw advise attaching this label to the outside of the machine tool, in a visible location.

Laser safety and warning labels



Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

Location of the laser aperture



⚠ 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 head 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.

NC4 basics

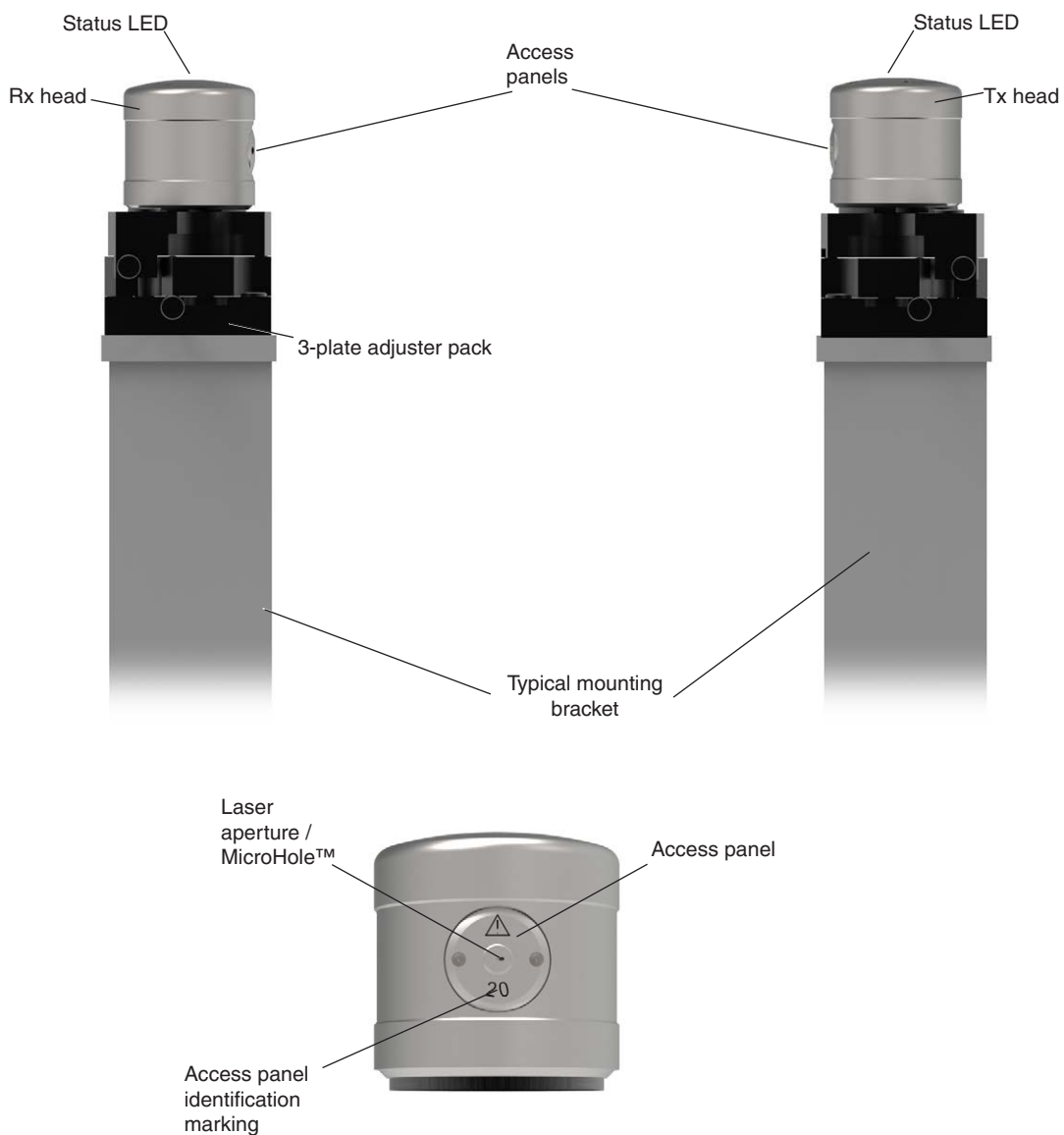
Introduction

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 to be established. This can be used to determine the dimensions of tools (tool measurement) or condition of tools (broken tool detection).

NC4 unit components



Guidelines for best practice

- The NC4 unit is a precision device and must be handled with care.
- Ensure that all mountings are secure.
- Keep electrical contacts clean.
- Mount the NC4 unit in a position that limits the risk of it being subjected to impact when operating the machine.
- Mount the NC4 unit in a position where it will not be affected by a build-up of swarf. Do not allow excessive waste material to build up on or around the NC4 unit.
- Cables, piping and conduit should be suitably secured to avoid damage and loads being transferred to the NC4 unit.
- Optimum performance is achieved by continuously supplying air and power to the NC4 unit.
- The NC4 unit 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 NC4 barrier air supply must conform to BS ISO 8573-1 air quality of Class 1.4.2 and be moisture-free.

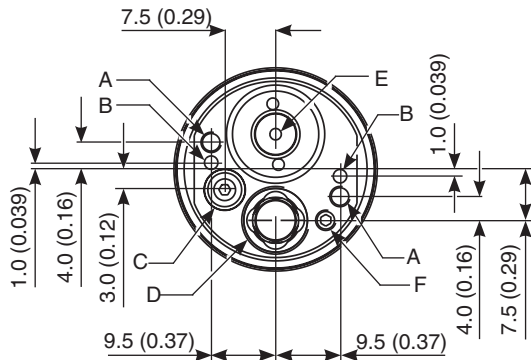
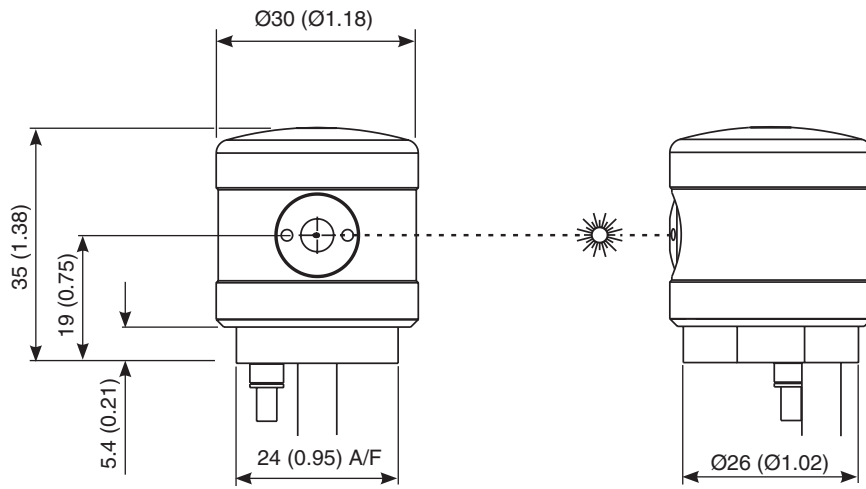
NC4 specification

Principal application	High-precision, high-speed non-contact tool setting and tool breakage detection on all sizes of vertical and horizontal machining centres, multi-tasking machines and gantry machining centres.	
Transmission type	Hard-wired transmission	
Compatible interfaces	NCi-6	
Repeatability	±1.0 µm (39.37 µin) 2σ at 1 m separation	
Output signal (from interface unit)	Two voltage-free, solid-state relays (SSR). Each can be either normally open or normally closed (selectable via a switch). Current (maximum) 50 mA, voltage (maximum) ±50 V. The interface contains an auxiliary relay which can be used for switching the output between the NC4 and a spindle probe. This relay can also be used to control an air blast solenoid (optional).	
Supply voltage (to interface)	11 Vdc to 30 Vdc	
Supply current (to interface)	120 mA @ 12 Vdc, 70 mA @ 24 Vdc	
Supply protection	Resettable fuses in interface. Reset by removing power and cause of fault.	
Electrical connection arrangement	Cable on the end of the units. Other configurations are available on request.	
Cable (to interface)	Specification	Ø6.0 mm (0.24 in), two twisted pairs, two individual cores plus screen, each core 18 × 0.1 mm insulated.
	Length	12.5 m (41.01 ft)
	Electrical connection	Cable on the end of the unit. Other configurations are available on request.
Barrier air pneumatic supply	Air supply to the NC4 must conform to BS ISO 8573-1 Class 1.4.2. 6.0 bar (87.02 psi) maximum. Air pipe: Ø3.0 mm (0.12 in) × 5.0 m (16.40 ft).	
Laser type	Class 2 laser product: 1 mW maximum output emitted wavelength 670 nm. WARNING: Laser radiation. Do not stare into the beam.	
Weight (including 12.5 m (41.01 ft) of cable)	500 g (1.1 lb) for single transmitter or receiver unit and cable.	

NC4 specification (continued)

Mounting	Mounting achieved via a 3-plate or single plate adjuster pack (sold separately); see the <i>NC4 non-contact tool setting accessories</i> data sheet (Renishaw part number H-2000-2223).	
Environment	IP rating	IPX6 and IPX8, BS EN 60529:1992+A2:2013
	Storage temperature	-25 °C to +70 °C (-13 °F to +158 °F)
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

Dimensions of NC4 units



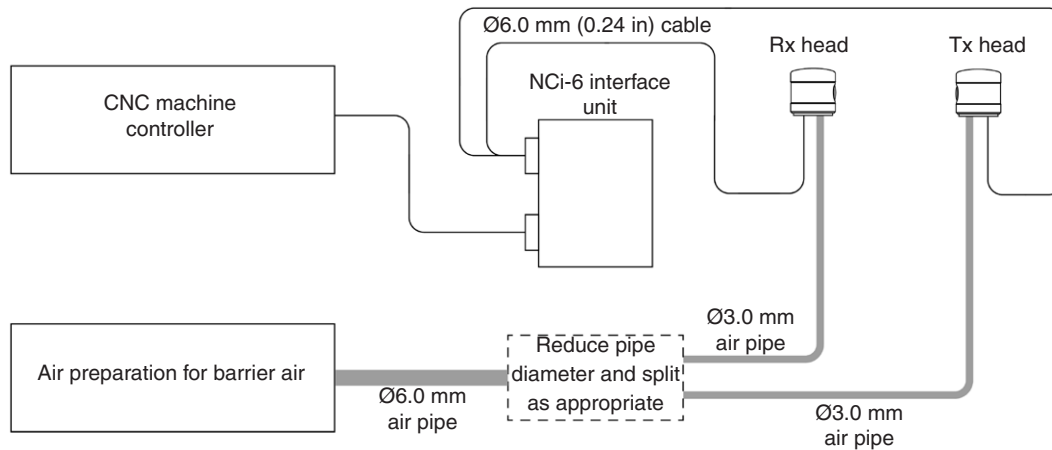
View from bottom of transmitter and receiver

A	=	Mounting holes (x2) M3 × 0.5 P × 8 (0.32) deep.
B	=	Dowel holes (x2) Ø2 × 8 (0.32) deep.
C	=	Pneumatic push-fit connector Ø3 (Ø.12) plastic pipe.
D	=	Supply cable, Ø6 mm (Ø.24).
E	=	PassiveSeal vent. Do not cover
F	=	Blanking screw. Do not disturb.

Dimensions given in mm (in)

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System installation



How to install and configure the NC4 system

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

1. Install the air preparation pack (see **page 3-3**, “Installing the air preparation pack”, for further information). Do not switch on the air supply or set the air pressure at this stage.
2. Install the NC4 system (see **page 3-4**, “Installing the NC4 system”, for further information).
3. Install the NCI-6 interface unit (see **page 3-7**, “Installing the NCI-6 interface unit”, for further information).
4. Switch on electrical power to the NCI-6 interface unit (see **page 3-8**, “Supplying electrical power to the NCI-6 interface unit”, for further information).
5. Switch on the barrier air supply to the NC4 unit and set the air pressure (see **page 3-9**, “Setting the NC4 barrier air pressure”, for further information).
6. Align the NC4 unit (see **page 3-14**, “Aligning the NC4 unit to the machine axes”, for further information).
7. Finally, calibrate the system as described in the appropriate non-contact tool setting software programming guide.
8. If problems occur, or for more information, see **page 5-1**, “Fault-finding”.

Air supply information

The barrier air supply to the NC4 unit must conform to BS ISO 8573-1 air quality of Class 1.4.2 and be moisture-free. If the air quality cannot be guaranteed, an air preparation pack is available from Renishaw; see the *NC4 non-contact tool setting accessories* data sheet (Renishaw part no. H-2000-2223).

The NC4 unit requires a continuous regulated air supply of up to 0.6 MPa (87.02 psi) maximum.

Failure of the air supply causes a PassiveSeal™ inside each NC4 unit to activate, protecting 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 head.

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 unit to an oiled air supply.
- When cutting air pipe, ensure it is cut straight, as a tapered cut could compromise sealing.
- Use blanking caps, supplied with the air preparation pack, when feeding air pipe through the conduit/machine.
- Before connecting the air pipes 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 unit.
- When installing the air pipes to the NC4 unit, keep runs as short as possible to minimise pressure drop.
- If the temperature of the air supply is greater than 5 °C (41 °F) above ambient and is humid, an air dryer will be required. NC4 installation packs are supplied with an air preparation pack including dryer (Renishaw part no. A-6435-4000).

Minimum bend radius

Component	Outer diameter	Minimum static bend radius
GP 11 conduit	17 (0.67)	60.0 (2.36)
Air pipe	3 (0.12)	6 (0.24)
	4 (0.16)	25 (0.98)
	6 (0.24)	30 (1.18)
NC4 cable	6 (0.24)	10 (0.39)

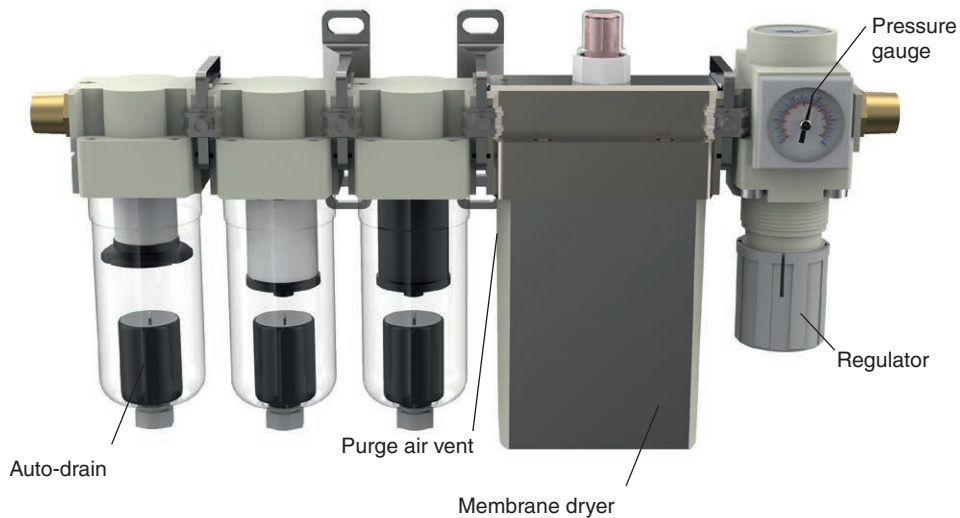
Dimensions given in mm (in)

Installing the air preparation pack

The air preparation pack (see the figure below) features an auto-drain to remove accumulated liquid from the filter bowls. Once the liquid has reached the float within each filter bowl, the liquid will be drained. The drain ports are threaded M5 × 0.8 to facilitate connection to a suitable waste.

If the incoming air supply is grossly contaminated, a suitable pre-filter may be required to maximise the service life of the air preparation pack.

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



Secure the air preparation pack, vertically upright, to a suitable surface using the mounting brackets. This must be within 25 m (82.02 ft) of the NC4 unit.

NOTE: The membrane dryer features a small vent from which humid air is purged. Air can be heard venting from this port during operation. It is essential that this port is kept unobstructed.

What to do next

After you have finished installing the air preparation pack, install the NC4 system (see **page 3-4**, “Installing the NC4 system”, for further information).

Do not switch on the air supply or set the air pressure until the NC4 unit and NCi-6 interface unit have been installed and electrical power has been supplied.

Installing the NC4 system

This procedure specifically describes how to install an NC4 system with a 3-plate adjuster pack. This procedure should also be followed for the installation of a single plate adjuster pack.

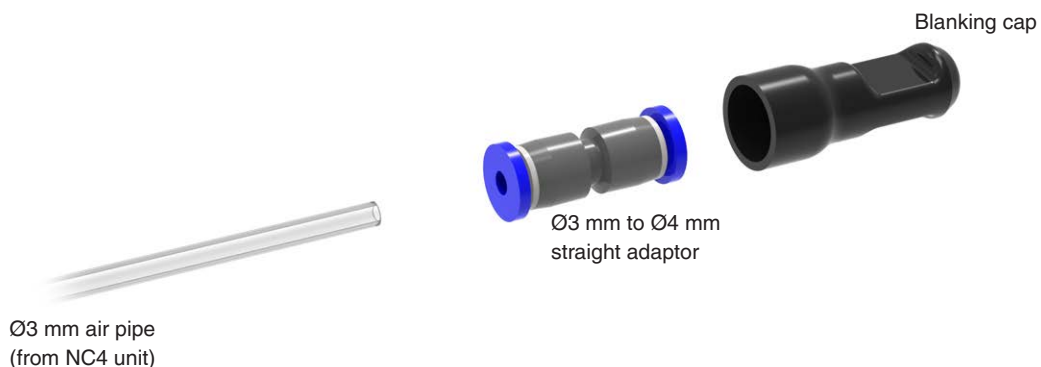
WARNING: Before starting to install the NC4 system, ensure that the machine is safe to work on. Switch off machine power when working in the control cabinet.

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.

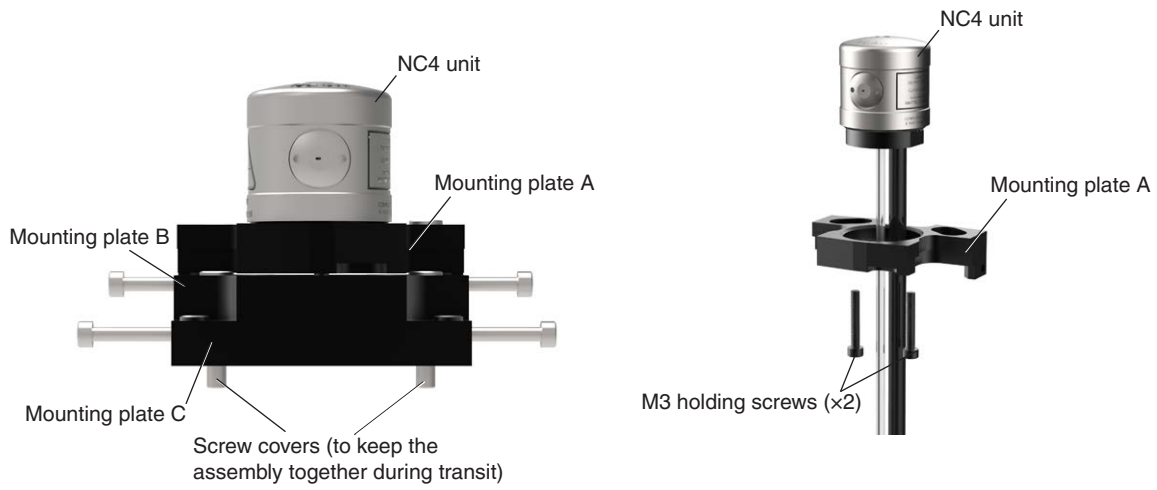
1. Find a suitable position to secure the NC4 transmitter and receiver mounting brackets. Ensure air will be able to exit freely from the MicroHole™ in the access panels and that air will not be directed towards an operator.

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

2. Secure the mounting brackets to the machine.
3. Before connecting any pipe to the NC4 unit, use the air regulator to purge the pipe and remove any debris.
4. Connect the Ø3 mm barrier 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.



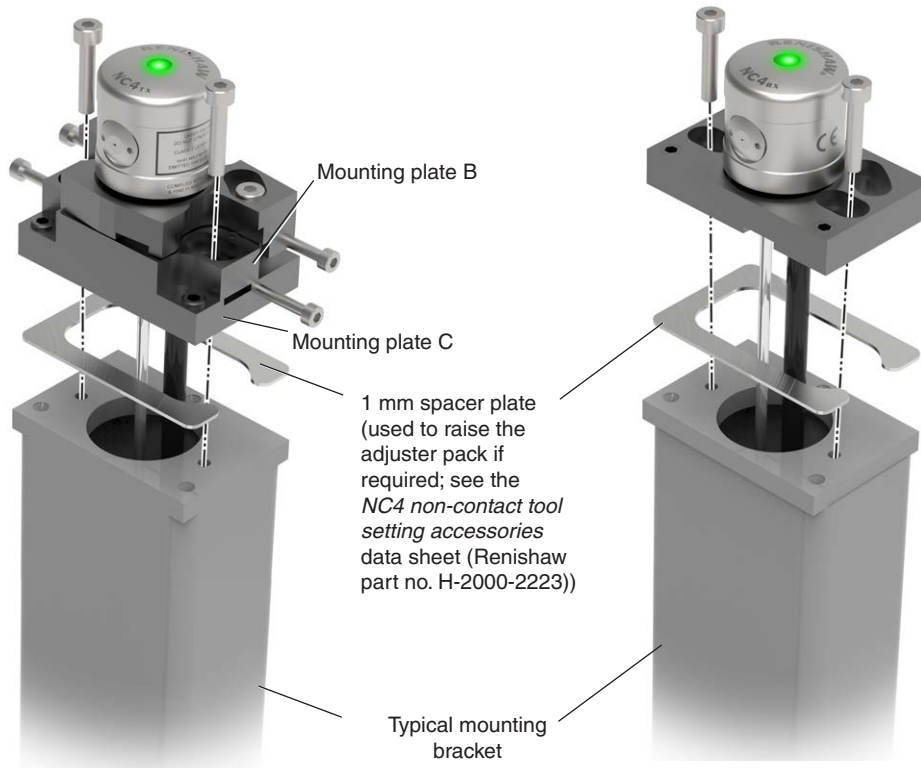
- Remove the two screws that secure mounting plate A to the adjuster pack. Feed the electrical cable and air pipe through mounting plate A.



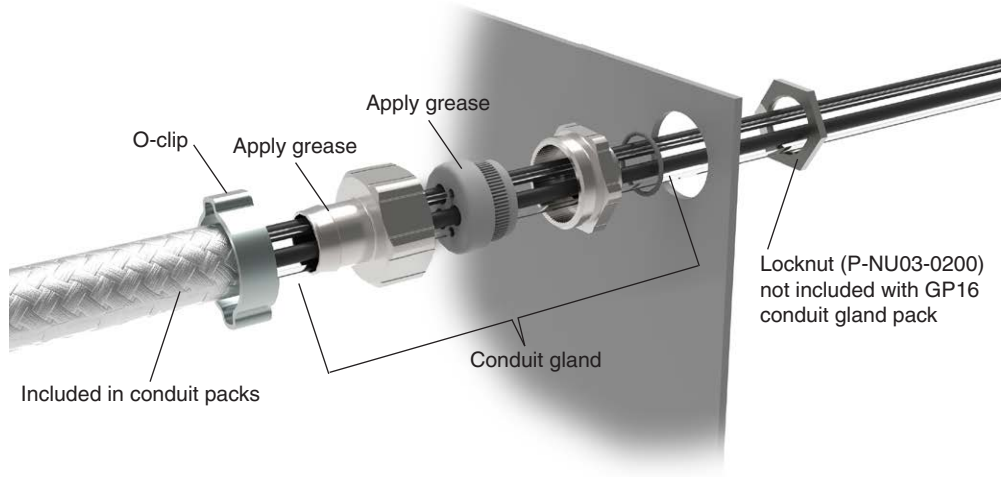
- Secure the NC4 unit to mounting plate A with the two M3 holding screws.
- Feed the electrical cable and air pipe through mounting plates B and C.

3-plate adjuster pack

Single-plate adjuster pack



8. Lay the conduit in the machine to check the length. Cut to length if necessary.
9. Feed the two cables and air pipes through the conduit. Do not apply excessive force to the cables or air pipes. Apply an appropriate lubricant if necessary.



10. Push the conduit onto the barbed fitting and fit the securing O-clip.
11. Remove the adjuster pack screw covers and secure the adjuster pack assembly to the mounting bracket.
12. Route the conduit through the machine (for minimum bend radius values, refer to the table on **page 3-3**). A range of accessories are available for neat installation; see the *NC4 non-contact tool setting accessories* data sheet (Renishaw part no. H-2000-2223).

NOTE: Before routing conduit and air pipes through the machine, ensure straight adaptors and blanking caps are fitted to the free ends of each pipe (refer to the figure on **page 3-4**). This prevents the ingress of debris into the air pipes.

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 such as motors or power cables.
15. Route the barrier air pipe to the air preparation pack

NOTE: 20 m (65.62 ft) of 6 mm (0.23 in) diameter pipe is supplied with the NC4 installation pack. When routing the barrier air supply, it is recommended that this pipe is used as far as possible (typically to the machine bulkhead) then reduced in diameter closer to the NC4 unit.

16. Remove the straight adaptors and blanking caps from the end of the air pipes.
17. Before connecting any pipe to the NC4 unit, use the air regulator to purge the pipe and remove any debris.

18. Connect the barrier air pipes to the outlet of the air preparation pack using the T-fittings and pneumatic adaptor fittings as appropriate.
19. 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 unit when the machine operates.

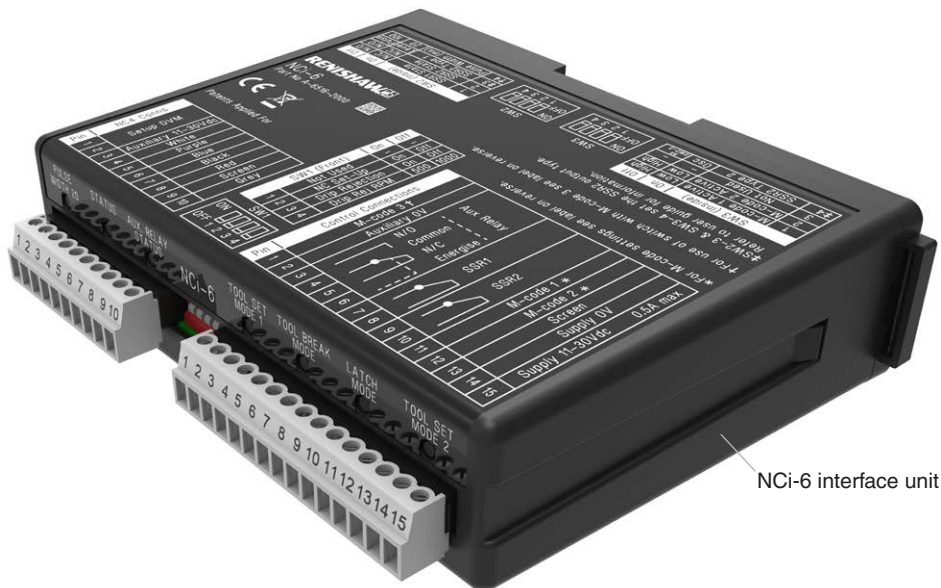
Installing the NCi-6 interface unit

WARNING: Before installing the NCi-6 interface unit, ensure that the machine is safe to work on. Switch off machine power when working in the controller cabinet.

The NCi-6 interface unit should be installed in the CNC controller cabinet. Where possible, locate the unit away from potential sources of interference such as transformers and motor controllers.

The NCi-6 interface unit processes signals from the NC4 unit and converts them into a voltage-free solid state relay (SSR) output. This is transmitted to the CNC machine controller.

Install and configure the NCi-6 interface unit as described in the *NCi-6 non-contact tool setting interface* installation and user's guide (Renishaw part no. H-6516-8500).



NCi-6 interface unit

NC4 system wiring details

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

Wiring details

NC4 transmitter head		NC4 receiver head	
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	Status	Grey	Status

* As this wire is not used, ensure that the free end is correctly insulated.

Supplying electrical power to the NCi-6 interface unit

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

1. Ensure that the NCi-6 interface unit and air supplies have been connected correctly (see the table above for further information).
2. Switch on electrical power to the NCi-6 interface unit.
3. Check that the status LEDs on the NC4 transmitter and receiver heads are lit.

What to do next

When the NCi-6 interface unit is powered up, switch on the air supply and set the correct air pressure (see [page 3-9](#), “Setting the NC4 barrier air pressure”, for further information).

Power loss and restoration

If electrical power to the NCi-6 interface unit is lost and subsequently restored when the NC4 system is in a normal operating mode, the NC4 system powers down and then powers up again without loss of the original gain settings.

Setting the NC4 barrier air pressure

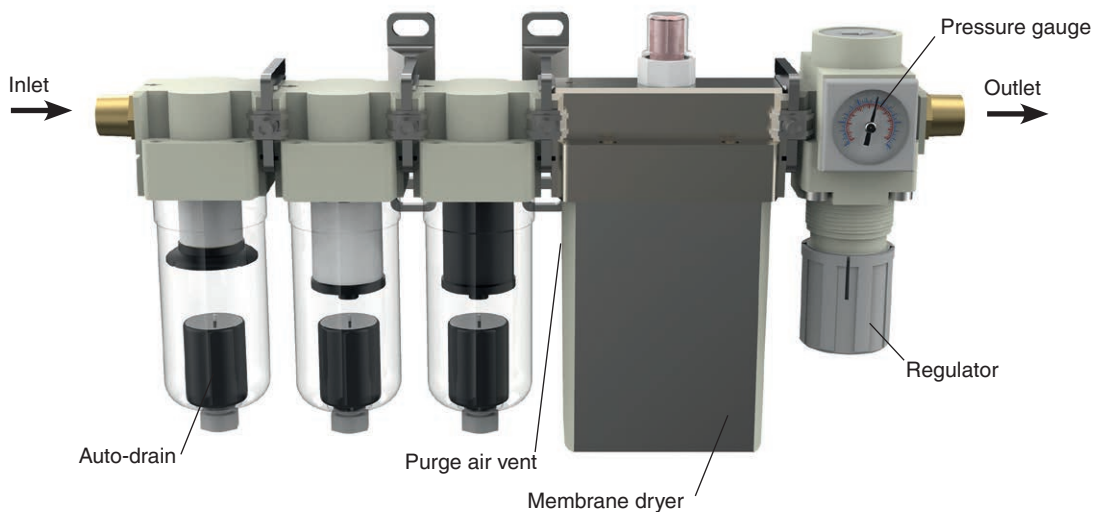
WARNING: Before setting the air pressure, ensure that the machine is safe to work on.

1. Ensure that electrical power is applied to the NCI-6 interface unit.
2. Monitor the set-up voltage as shown on **pages 4-8** and **4-10**.
3. Switch on the air supply.
4. Gradually increase the air pressure until a well defined laser beam is emitted from the transmitter and the set-up voltage is near its peak.
5. Note the pressure on the pressure gauge and increase the pressure by an additional 0.05 MPa (7.25 psi). Check that the profile of the laser beam is circular.

NOTES:

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

For illustration of this set-up procedure, view the “Check air pressure” video guide in the NC4 mobile app.



Conversion table		
MPa	Bar	psi
0.2	2	29
0.4	4	58
0.6	6	87
0.8	8	116
1	10	145

Macro programming software

NOTE: Before installing the non-contact tool setting macro programming software, read the guidelines contained in the Readme file on the software media.

Software routines for tool setting using various machine controllers and available software packages are described in the *Probe software for machine tools – programs and features* data sheet (Renishaw part no. H-2000-2298, available at www.renishaw.com).

For detailed instructions on how to use Renishaw’s non-contact tool setting software, refer to the relevant programming guide for your machine tool controller type.

Software and user information

For available software, see the *Probe software for machine tools – programs and features* data sheet (Renishaw part no. H-2000-2298, available at www.renishaw.com).

Machine tool apps

Smartphone apps provide information at a user’s fingertips in a simple, convenient format. Available globally in a wide range of languages, our free-of-charge apps give users the following information:

NC4 app Configuration (including wiring), maintenance, troubleshooting of NC4 systems.
GoProbe app Programming of Renishaw probing systems (including NC4).



Renishaw apps are available in China via Baidu, Huawei and Tencent.

On-machine apps can be seamlessly integrated with a wide range of CNC controllers. Apps are installed onto a Microsoft® Windows®-based CNC controller or a Windows tablet connected to the controller via Ethernet.

With touch interaction and intuitive design, smartphone and on-machine apps provide significant benefits to machine tool probe users.

For more information, visit www.renishaw.com/machinetoolapps



Head alignment of the NC4 unit

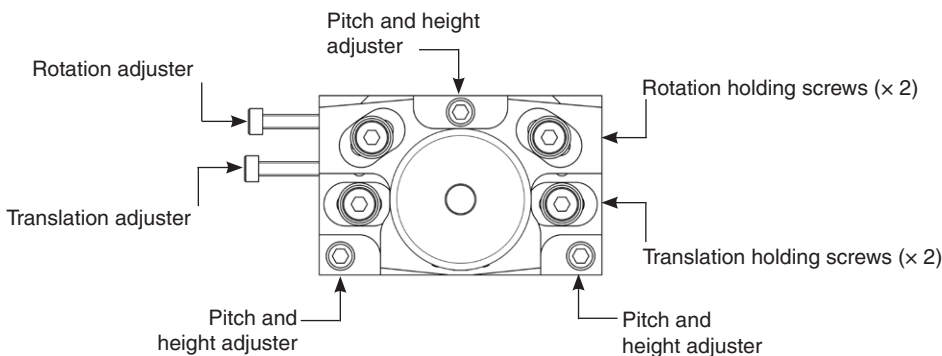
Head alignment of the NC4 unit involves adjusting the relative positions of the transmitter and receiver heads to maximise a test signal obtained at the receiver head. Do this with the NCi-6 interface unit in set-up mode.

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

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 controller cabinet.

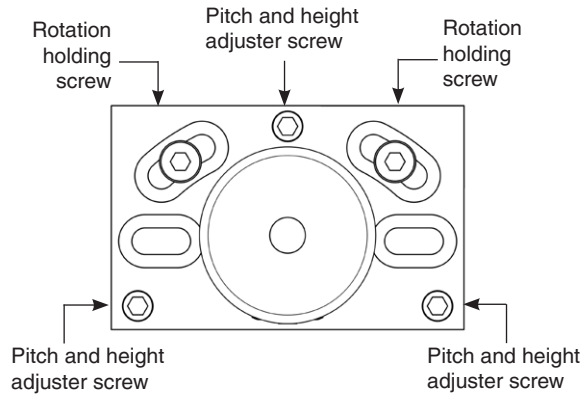
1. Either connect the digital voltmeter, as described in “Using a voltmeter” on **page 4-8** or fit the NC4 set-up tool, as described in “Using the set-up tool” on **page 4-10**.
2. Switch on the electrical power to the NCi-6 interface unit.
3. Ensure that air is supplied to the NC4 and is at the correct pressure.
4. Slacken all conduit clamping screws to that the NC4 units can move freely.
5. On the adjuster pack 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.

3-plate adjuster pack

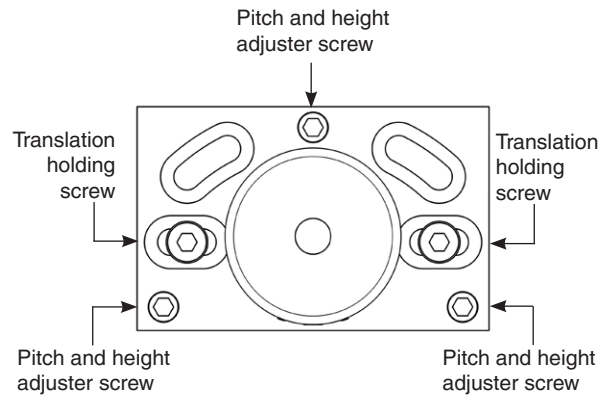


Limits of adjustment	
Rotation	±7 degrees
Translation	±2.5 (±0.098)
Height	±2.5 (±0.098)
Pitch	±5 degrees

Single-plate adjuster pack

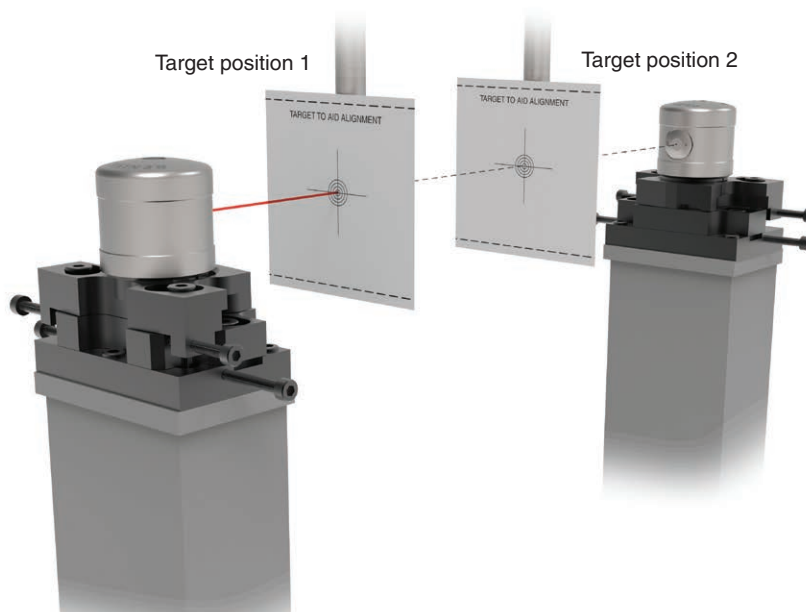


Limits of adjustment	
Rotation	±7 degrees
Height	±2.5 (±0.098)
Pitch	±5 degrees



Limits of adjustment	
Translation	±2.5 (±0.098)
Height	±2.5 (±0.098)
Pitch	±5 degrees

6. Adjust the rotation and the 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. Attach a target marker to the tool, as shown in the figure below.



9. Starting close to the transmitter (target position 1), manually traverse the spindle or machine table so that the laser beam is centred with the target cross hairs.
10. Manually traverse the target or transmitter so that the target moves away from the transmitter and towards the receiver (target position 2).
11. Adjust the rotation and the pitch of the transmitter unit so that the laser beam is repositioned on the cross hairs.
12. Return to target position 1 and manually traverse the target or machine table to recentre 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. 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 or 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 NCi-6 interface unit, set switch SW1-2 (NC set-up) to “Off”

Check that:

- the NCi-6 interface unit status LED is green, and
- the voltmeter reading is between 4.7 V and 5.4 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.

20. 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”.

Aligning the NC4 unit to the machine axes

WARNING: Before aligning and setting up an NC4 unit, ensure that the machine is safe to work on.

This procedure involves moving the NC4 unit 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 (see **page 3-15**, "Alignment tolerances", for further information).

The beam alignment macro described in the relevant non-contact tool setting software programming guide is used for this process. The macro indicates how well the unit is aligned to the machine axes. You can then use this information to make adjustments to the NC4 unit.

To align an NC4 unit

1. Run the beam alignment macro (for further information, see the relevant non-contact tool setting software programming guide).
2. If alignment is outside the values described in "Alignment tolerances" on **page 3-15**, make the appropriate adjustments to the NC4 unit.

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 NCi-6 interface unit, set switch SW1-2 (NC set-up) to 'On'.
4. Adjust the transmitter head 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.

5. On the NCi-6 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.

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 recommended:

Spindle axis (P2 – P1): $\leq 10 \mu\text{m}$ (0.39 μin)

Radial axis (P2 – P1): $\leq 1 \text{ mm}$ (0.039 in)

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

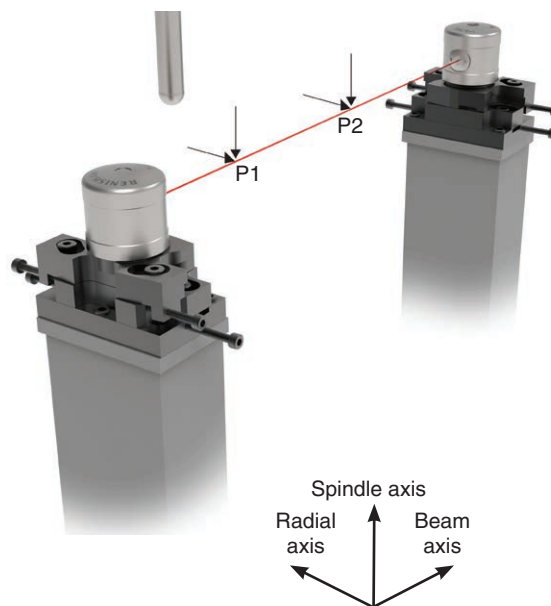
Tool breakage detection applications

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

Spindle axis (P2 – P1): $\leq 0.2 \text{ mm}$ (0.008 in)

Radial axis (P2 – P1): $\leq 1 \text{ mm}$ (0.039 in)

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



NOTE: For best measurement performance, Renishaw recommends aligning NC4 units using a ball-nosed cylinder-type calibration tool. A mobile app (NC4 app) is available for step-by-step instructions on NC4 unit alignment (for more information, see **page 3-10**, “Machine tool apps”).

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Maintenance

Introduction

The NC4 unit requires minimal maintenance as it has been designed to operate as a permanent fixture on all sizes of vertical and horizontal machining centres, multi-tasking machines and gantry machining centres where it is subject to an environment of hot metal chips and coolant.

You may undertake the maintenance routines described in these instructions.

Further dismantling and repair of Renishaw equipment is a highly specialised operation, which must be carried out at an authorised Renishaw Service Centre.

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

WARNING: Before carrying out any maintenance operations, ensure that the machine is safe to work on and electrical power to the NCi-6 interface unit is switched off.

Removing and refitting the air preparation filter elements

For the following instructions, refer to the figure on **page 4-4**.

Regularly inspect the filter elements (A). They should be replaced when dirty or wet and at least once each year:

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 elements from filter body.
5. Fit the replacement filters.
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 NC4 barrier air pressure” on **page 3-9**.

NOTE: Items shown within dotted box (A) are included in the air filter service pack obtainable from Renishaw; see the *NC4 non-contact tool setting accessories* data sheet (Renishaw part no. H-2000-2223).

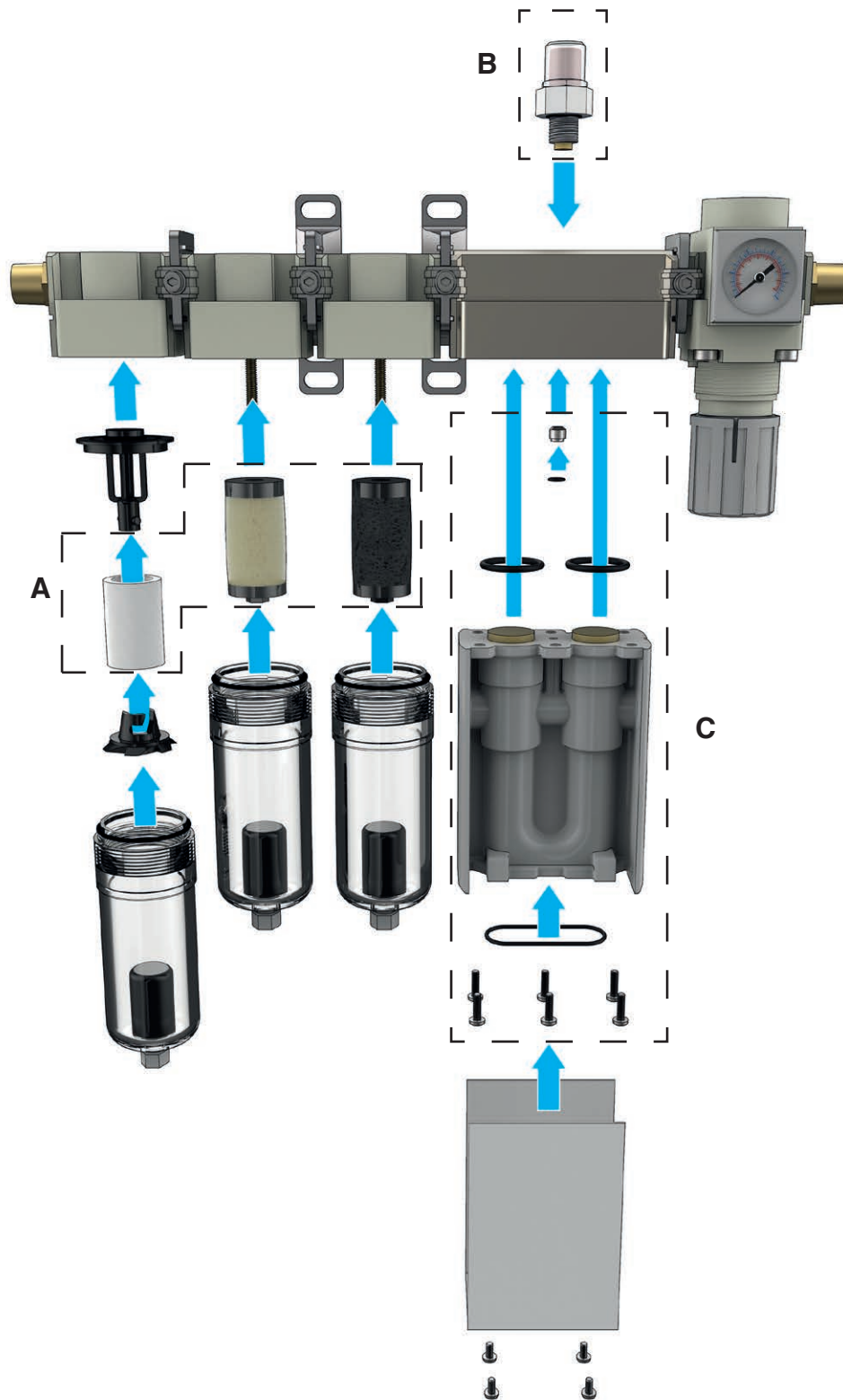
Removal and replacement of membrane dryer module

Regularly inspect the dew point indicator (B) on the membrane dryer (C). The membrane dryer should be replaced according to the table below or at least once every four years.

Dew point indications

Grain colour	Causes	Solutions
Green/amber	Dryer functioning correctly.	No action required.
Yellow	Initial state.	Allow a minimum of 10 minutes from start of air flow for the dew point indicator to turn green.
	Water flow into membrane dryer.	Check and replace filters if necessary. Check condition of inlet air for excess oil or water. Ensure outlet of purge air port is free of obstructions. Lower input air temperature. Install in-line air coolers if necessary.
Brown/black	Membrane contaminated / oil carryover.	Check condition of inlet air for excess oil or water. Replace membrane and dew point indicator.

NOTE: Items shown within dotted boxes (B) and (C) are included in the membrane dryer service pack obtainable from Renishaw; see the *NC4 non-contact tool setting accessories* data sheet (Renishaw part no. H-2000-2223).



Cleaning the optics

Cleaning the optics 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 unit

If the air to the NC4 unit becomes contaminated, the transmitter and receiver heads 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 (for more information, see “Fault-finding” on **page 5-1**), before cleaning the NC4 unit. 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 or access panel tool.
- Cleaning tool.
- Precision cleaning solvent, lens cleaner or isopropyl alcohol.
- Dust remover clean air spray.
- Cleaning swabs (x 2).

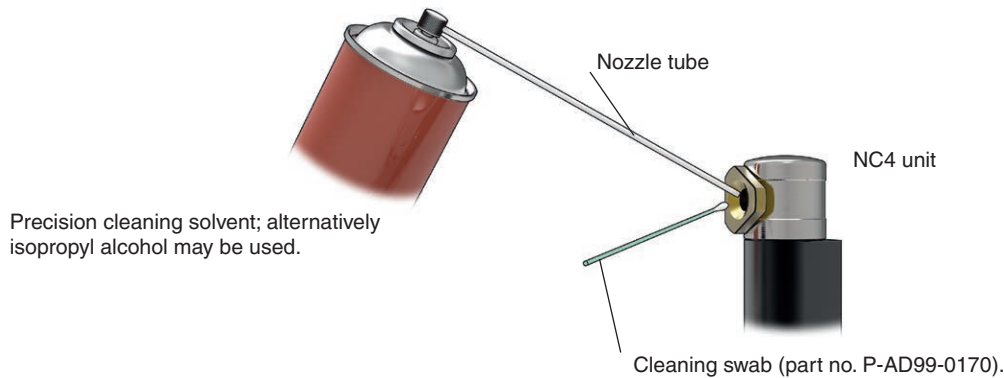


To clean the optics



CAUTION – LASER SAFETY

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



1. Switch off electrical power to the NCi-6 interface unit. Isolate power by disconnecting from the NCi-6 interface unit.
2. Remove the air supply from the NC4 unit by setting the pressure regulator to 0 MPa (0 psi).
3. If an air pipe is damaged, replace the pipe.
4. Using the pin spanner, remove the access panel (unscrew counterclockwise) from the front of the NC4 unit.
5. 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.
6. Insert the cleaning tool into the housing and rotate through 70 to 80 degrees until the PassiveSeal is clear of the optic glass.
7. Purge the air supply for approximately 1 minute.
8. Access to the lens is through the centre of the cleaning tool. Spray the solvent cleaner through the nozzle tube, onto the lens.
9. Wipe the lens with the swab, using quarter-turn movements.

CAUTION: Take care not to apply excessive force to the lens or PassiveSeal as this may damage the optical surfaces.

10. Spray the clean air spray into the housing to remove all traces of solvent.
 11. Using solvent cleaner and a clean, dry compressed air supply, blow all debris out of the MicroHole in the access panel.
-

12. Remove the cleaning tool. Refit the access panel using the pin spanner. Tighten to 2.0 Nm (1.48 lbf.ft).
13. Repeat the cleaning procedure for the other NC4 head (ensure both Tx and Rx heads are clean).

After cleaning the NC4 unit

1. Reconnect and switch on electrical power to the NCi-6 interface unit (for more information, see “Supplying electrical power to the NCi-6 interface unit” on **page 3-8**).
2. Restore the air supply to the NC4 unit and adjust the pressure (for more information, see “Setting the NC4 barrier air pressure” on **page 3-9**).
3. If realignment is not necessary, set switch SW1-2 (NC set-up) on the NCi-6 interface unit to ‘On’. After approximately 5 seconds, set the switch to ‘Off’.
4. Check that the system triggers. To do this, pass an object through the laser beam and check that the NC4 unit’s status LED changes from green to red and back to green.

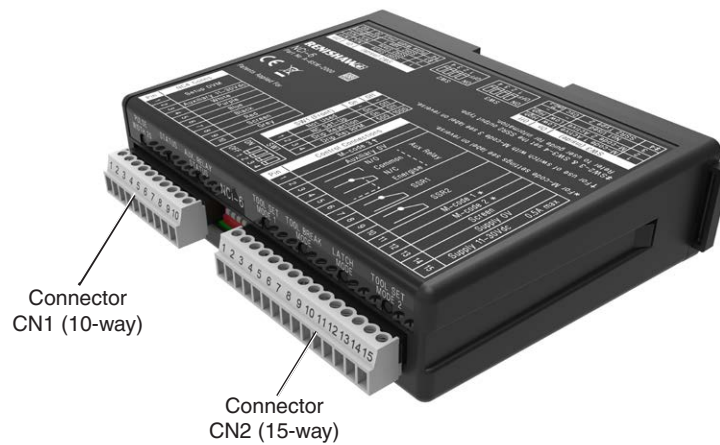
NOTE: A mobile app (NC4 app) is available for step by step instructions on the cleaning process (for more information, see **page 3-10**, “Machine tool apps”).

Using a voltmeter

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

1. Position the voltmeter next to the receiver head. Connect a wire between terminal CN1-1 on the NCi-6 interface unit and one of the voltmeter probes. Connect a second wire between terminal CN1-2 and the other voltmeter probe.
2. On the NCi-6 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.



NC4 set-up tool

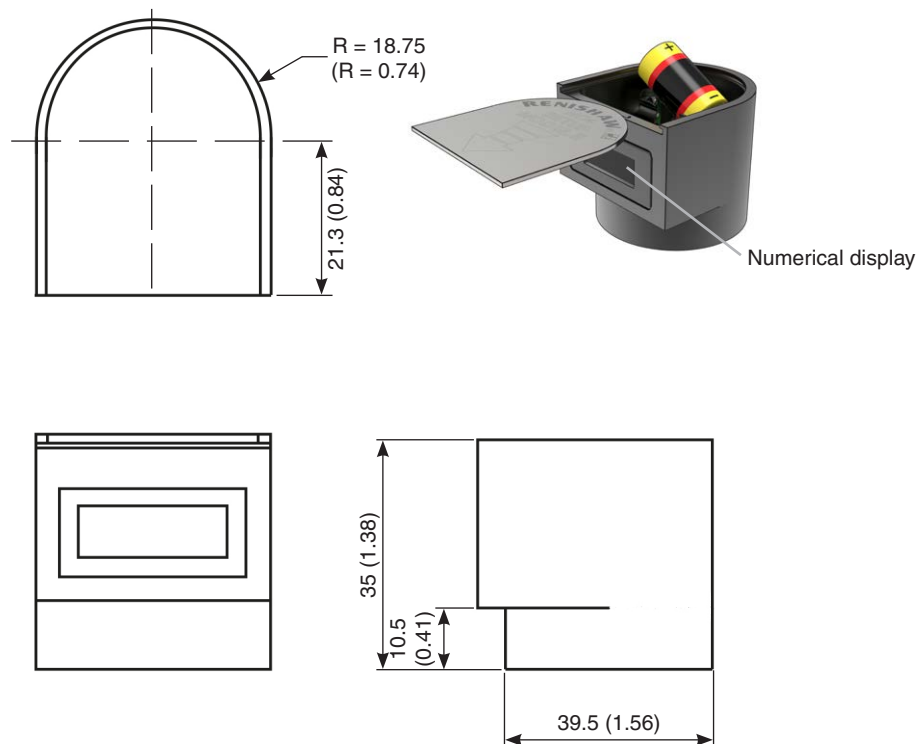
Introduction

The NC4 set-up tool (Renishaw part no. A-4114-8000, sold separately) is a battery-operated device that is used to provide a visual indication of the signal strength at the NC4 receiver head. The signal strength is shown on a numerical display. The higher the number, the greater the signal received at the receiver head.

The set-up tool is placed over the receiver head 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 (for more information, see **page 4-10**, “Using the set-up tool”).

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 NCi-6 interface unit.

Dimensions



Dimensions given in mm (in)

Using the set-up tool

The set-up tool numerical display provides a correct reading only when the NCi-6 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 head is clean and free of swarf. Push the set-up tool onto the top of the receiver head and rotate it so that the display is facing you.
2. On the NCi-6 interface unit, set switch SW1-2 (NC set-up) to 'On'.

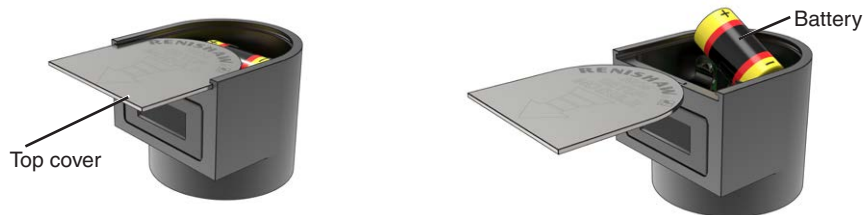


NOTE: Excessive cutting fluid deposits on the NC4 receiver may prevent the set-up tool from switching on. It may be necessary to clean the top of the NC4 receiver to ensure good electrical contact to the set-up tool.

Replacing the set-up tool battery

The set-up tool requires a ½ AA size battery that is rated at 3.6 V (for more information, see the “Battery specification” in the table below).

1. Lift the top cover and slide 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 the correct orientation.
4. Refit the top cover.



Battery specification

The set-up tool requires one ½ AA size battery, rated at 3.6 V. It is important to ensure that the battery is supplied in standard 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 manufacturer	Part number
Saft	LS 14250
Tadiran	SL-750
Xeno	XL-050F

Status LED function

The status LEDs on the NC4 transmitter and receiver heads indicate to the user the status of the unit. The LEDs mimic each other.



Colours shown by the LEDs vary depending upon the mode of operation of the NCi-6 interface unit.

When the NCi-6 NC set-up switch SW1-2 is set to 'On', the 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.

When the NCi-6 NC set-up switch SW1-2 is set to 'Off', the status LEDs will operate according to the tables on **page 4-13**.

LED colour	Signal voltage	Tool set mode 1	Tool set mode 2
		Description	
Green/amber	> 6.0 V	Flashing at 1 Hz. The system operating voltage is too high. The system will continue to function, but for optimum performance repeat the set-up and alignment procedures. The system is untriggered.	Flashing at 1 Hz. The system operating voltage is too high. The system will continue to function, but for optimum performance repeat the set-up and alignment procedures. The system is triggered.
Green	6.0 V to 4.0 V	The beam is clear. The system is untriggered.	The beam is clear. The system is triggered.
Amber	4.0 V to 2.5 V	The beam is partially blocked. The system is untriggered.	The beam is partially blocked. The system is triggered.
Red	2.5 V to 0.0 V	The beam is blocked. The system is triggered.	The beam is blocked. The system is untriggered.
No light	0.0 V	No power to the unit.	

LED colour	High speed broken tool detection mode	Latch mode
Green/amber	Not applicable.	Flashing at 1 Hz. 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	Not applicable.	The beam is clear. The system is not latched.
Amber	The output is not latched. The beam is blocked.	
Red	The output is latched. The tool is broken.	The output is latched.
No light	No power to the unit.	

The status LEDs can be used for diagnostic purposes, as the NC4 system constantly checks 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 green/amber, this indicates that servicing is required. The system will continue to function as normal. For more information, see **page 5-1**, “Fault-finding”.

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Fault-finding

Symptom	Cause	Action
NC4 fails to turn on (Tx and Rx status LEDs are not lit).	Faulty connections.	Check that the wiring connections are correct.
	Wrong supply voltage.	Check the supply voltage to the NCi-6 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).	The PassiveSeal is protecting the device.	Check that the air supply to the NC4 system is switched on (for more information, see page 3-9 , “Setting the NC4 barrier air pressure”).
	Damaged air pipe.	Check the air pipe for damage or kinks.
	Access panel could be blocked.	Turn off NC4 system, remove access panel from Tx head and clean debris from access panel before refitting.
Poor repeatability/spurious readings.	Coolant or swarf on the tool.	Clean the tool with compressed air or high-speed spin.
	Feedrate is too high.	Set the correct feedrate – 2.0 µm (78.74 µin) per revolution is the recommended value.
	Electrical interference.	Ensure that the NC4 cables are not routed alongside cables carrying high current. Ensure that the screen wire is connected to the NCi-6 interface unit.
	Thermal growth of the machine and the workpiece.	Minimise temperature changes. Increase the frequency of calibration.
	Excessive machine vibration.	Eliminate vibration.
	NC4 air pressure is set incorrectly.	Reset the air pressure (for more information, see page 3-9 , “Setting the NC4 barrier air pressure”).
	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, for example accidental damage, loose encoders.	Perform a health check on the machine.
Loose brackets.	Check and tighten the brackets as appropriate.	

Symptom	Cause	Action
Poor repeatability/ spurious readings (continued).	Poor tool change repeatability.	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 tool set mode 2. If no M-codes are available or tool set mode 2 cannot be implemented, use tool set mode 1 and select the drip-rejection mode using the switch on the NCi-6 interface unit and the NC software. Wait until the mist has cleared before measuring.
	Contaminated optics.	Follow the cleaning procedure, (for more information, see page 4-5 , “Cleaning the optics”).
Voltage is outside the range 1.0 V to 7.0 V when in set-up mode (NCi-6 interface unit set-up switch SW1-2 is set to ‘On’).	Incorrect access panel for separation.	Ensure that the NC4 unit has the correct access panels installed (for more information, see the <i>NC4 non-contact tool setting system accessories</i> data sheet (Renishaw part no. H-2000-2223).
	Poor connection.	Check that the voltmeter is operating correctly and is correctly connected to the NCi-6 interface unit.
	NC4 air pressure is set incorrectly.	Reset the air pressure (for more information, see page 3-9 , “Setting the NC4 barrier air pressure”).
	An object is blocking the beam.	Ensure that the laser beam is unobstructed.
	Dirty MicroHole or optics.	Clean the optics (for more information, see page 4-5 , “Cleaning the optics”).
NC4 status LED is amber (this is a fault only in certain conditions; for more information, see the tables on page 4-13).	System is not set for optimum performance.	The system operating voltage has decreased since it was last set up. This may occur if: <ul style="list-style-type: none"> • The optics are contaminated (for more information, see page 4-5, “Cleaning the optics”). • The air pressure is incorrect (for more information, see page 3-9, “Setting the NC4 barrier air pressure”). • The system is out of alignment (for more information, see page 3-14, “Aligning the NC4 unit to the machine axes”).

Symptom	Cause	Action
NC4 status LED is flashing amber/green.	Flashing at 1 Hz. 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 (for more information, see page 3-11 , “Head alignment of the NC4 unit”).
	Amber/green flickering. NO FAULT.	If in tool set mode 2 or latch mode, amber/green flickering indicates the tool is rotating in the laser beam revealing the laser between tool teeth. The unit is untriggered. This is not a fault.
NC4 status LED is red.	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 heads.	Realign the transmitter and receiver heads.
	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. (See the fault “Tx or Rx lens is dirty or the air hole is blocked” for more information).
	NC4 system is not wired correctly to the NCi-6 interface unit.	Ensure that all wires are correctly connected to the NCi-6 interface unit (for more information, see page 3-8 , “NC4 system wiring details”).
Tx or Rx lens is dirty or the air hole is blocked.	Air supply to NC4 does not conform to BS ISO 8573-1 Class 1.4.2.	Connect the air supply upstream of the oil mist lubricator.
		Ensure that the machine shop air supply is to the required air quality.
		If the temperature of the air supply is 5 °C (41 °F) or more greater than ambient and is humid, fit an air dryer (supplied as standard with NC4 packs).
	Non-Renishaw air filter is being used.	The air filter must conform to BS ISO 8573-1 Class 1.4.2.
Auto drain failed.	Replace filter/dryer/regulator unit.	
Air pipe is full of coolant or oil.	Purge or replace the air pipe.	

Symptom	Cause	Action
NC4 set-up tool does not power up.	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.
	Coolant build up/deposits on NC4 cover.	Clean the top of the NC4 outer cover to ensure good electrical contact to the set-up tool.
	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.	Incorrect reading.	The numerical display of the setup tool provides an indication only. This may differ from the reading obtained on a voltmeter that is connected to the NCi-6 interface unit. The reading may also vary when the set-up tool is swapped between the transmitter and receiver heads. This variation in voltage is not greater than ± 0.2 V. Check that the set-up switch is on. 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.

Parts list

NC4 separates unit pack, supplied with:

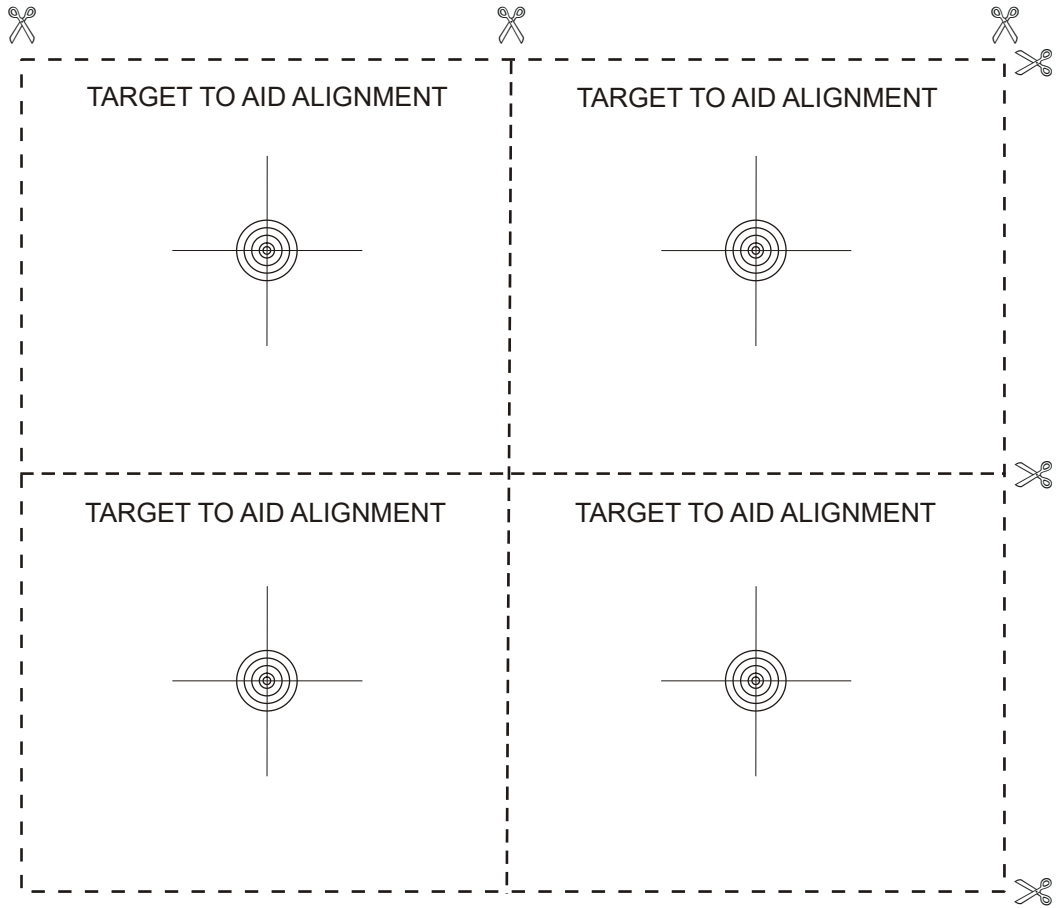
- NC4 transmitter (Tx) unit
- NC4 receiver (Rx) unit
- Ø6.0 mm (0.24 in) × 12.5 m (41.01 ft) electrical cable (× 2)
- Laser warning sign

Item	Part number	Description
NC4 0.3 m to 0.5 m separation unit pack	A-4114-5005	NC4 Tx unit (access panel with 20 identification marking) and NC4 Rx unit (access panel with 40 identification marking).
NC4 0.5 m to 0.8 m separation unit pack	A-4114-5010	NC4 Tx unit (access panel with 40 identification marking) and NC4 Rx unit (access panel with 20 identification marking).
NC4 0.8 m to 1.5 m separation unit pack	A-4114-5015	NC4 Tx unit (access panel with 40 identification marking) and NC4 Rx unit (access panel with 40 identification marking).
NC4 1.5 m to 2.0 m separation unit pack	A-4114-5020	NC4 Tx unit (access panel with 40 identification marking) and NC4 Rx unit (access panel with 60 identification marking).
NC4 2.0 m to 3.0 m separation unit pack	A-4114-5025	NC4 Tx unit (access panel with 60 identification marking) and NC4 Rx unit (access panel with 40 identification marking).
NC4 3.0 m to 5.0 m separation unit pack	A-4114-5030	NC4 Tx unit (access panel with 60 identification marking) and NC4 Rx unit (access panel with 60 identification marking).

NC4 separates installation pack, supplied with:

- NC4 separates unit pack
- NCi-6 interface unit
- Air preparation pack for barrier air (standard)
- Ø3.0 mm (0.12 in) tube installation pack × 5.0 m (16.40 ft)
- Ø4.0 mm (0.16 in) × 20 m (65.62 ft) air tube
- Ø4.0 mm (0.16 in) tube installation pack × 5.0 m (16.40 ft)
- Pneumatic fittings
- Conduit pack (GP11) – 4.0 m (13.12 ft)
- NC4 tools

Item	Part number	Description
NC4 0.3 m to 0.5 m separation pack	A-4114-5055	NC4 0.3 m to 0.5 m separation pack, including NC4 Tx unit (access panel with 20 identification marking) and NC4 Rx unit (access panel with 40 identification marking).
NC4 0.5 m to 0.8 m separation pack	A-4114-5060	NC4 0.5 m to 0.8 m separation pack, including NC4 Tx unit (access panel with 40 identification marking) and NC4 Rx unit (access panel with 20 identification marking).
NC4 0.8 to 1.5 m separation pack	A-4114-5065	NC4 0.8 m to 1.5 m separation pack, including NC4 Tx unit (access panel with 40 identification marking) and NC4 Rx unit (access panel with 40 identification marking).
NC4 1.5 m to 2.0 m separation pack	A-4114-5070	NC4 1.5 m to 2.0 m separation pack, including NC4 Tx unit (access panel with 40 identification marking) and NC4 Rx unit (access panel with 60 identification marking).
NC4 2.0 to 3.0 m separation pack	A-4114-5075	NC4 2.0 m to 3.0 m separation pack, including NC4 Tx unit (access panel with 60 identification marking) and NC4 Rx unit (access panel with 40 identification marking).
NC4 3.0 to 5.0 m separation pack	A-4114-5080	NC4 3.0 m to 5.0 m separation pack, including NC4 Tx unit (access panel with 60 identification marking) and NC4 Rx unit (access panel with 60 identification marking).



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