Installation guide

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TRS2 non-contact broken tool detection system

www.renishaw.com/trs2

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

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Contents

Before you begin

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 TRS2 non-contact broken tool detection system, and other similar Renishaw products, are the subject of one or more of the following patents and/or patent applications:

CN 100569442
EP 1799398
JP 4764427
SG 130252
TW 1415708
US 7732797
US 8537359

Software notices

This product 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

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www.renishaw.com/legal/softwareterms

Intended use

TRS2 is a laser-based non-contact tool recognition system that provides high-speed tool breakage detection of solid cutting tools on a machining centre under normal operating conditions.

Safety

Information to the user

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 TRS2 unit fails, the output signal may falsely indicate beam not blocked. Do not rely on signals from the TRS2 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 electrical power to the TRS2 before carrying out maintenance.

When using the TRS2 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 TRS2 access panel.
- Prevent direct exposure of the eyes to the laser beam.
- Ensure that the beam is not reflected into the eyes via any reflective surface.
- Prevent the laser beam from straying outside of the immediate work area. A laser warning sign/beam terminator is supplied with the TRS2, which may be fixed to the outside of the machine window for this purpose.

CAUTION – LASER SAFETY

The laser used in the Renishaw TRS2 non-contact broken tool detection system emits visible red light at a wavelength of 670 nm and has a power output of less than 1 mW. The laser is driven by a continuous pulse train running at a frequency of 125 kHz. The pulse duration is 2 µs and each pulse has a maximum energy of 7.2 × 10-9 J.

The laser used is classified as a Class 2 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.

The standard 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 one side of the housing, for more information, see **page 2-3**, “TRS2 dimensions and laser warning labels”. An adhesive warning label is also provided. Renishaw advise attaching this label to the outside of the machine tool, in a visible location.

TRS2 basics

Introduction

This guide describes how to install and maintain the Renishaw TRS2 non-contact broken tool detection system.

The TRS2 is a laser-based non-contact broken tool detection system that is designed specifically for solid centred tools; such as drills and taps. A tool that is rotating at a speed of 5000 r/min, 1000 r/min or 200 r/min is moved into the laser beam. The TRS2 output changes when a useable tool is detected by the receiver. If a tool is broken, the output will not change and the system will not trigger.

Two types of TRS2 are available; hard-wired and connectorised. The connectorised version has a 90° socket fitted to the underside and electrical connections to the machine controller are made via a cable connector assembly. This method allows quick and easy removal of the TRS2 from its mounting location and replacement with a similar unit.

The hard-wired version does not have a connector socket; electrical connections to the machine controller are hard-wired directly to the TRS2.

Both versions of the TRS2 can be adjusted to detect a broken tool over the range of 300 mm (11.81 in) to 2 m (78.74 in).

For reliable detection of a tool with through-tool coolant, the flow of coolant must be stopped before checking the tool. For all tools, the flow of coolant off the surface of the tool must be stopped before reliable detection can be carried out.

NOTE: Removing the TRS2 side panel or tampering with the side panel retaining screw will invalidate the warranty.

Software routines

Examples of programs for high-speed broken tool detection of solid tools are available for a wide range of machine controller types. A TRS2 software package is available for download from **www.renishaw.com/trs2**

Status indicator

The status LED on the front of the TRS2 indicates the status of the unit to the user.

LED colour	Status
Not lit	Power off
Red	Broken tool or no tool
Green	Good tool detected

NOTE: The tool must be rotating at a speed of 5000 r/min, 1000 r/min or 200 r/min, at the checking point in the laser beam, for it to be detected.

Signal strength indication

Multiple LED's on the front of the TRS2 unit provide an indication of the signal strength. The minimum requirement for effective tool detection is that the amber LED and at least one green LED are illuminated.

TRS2 typical performance

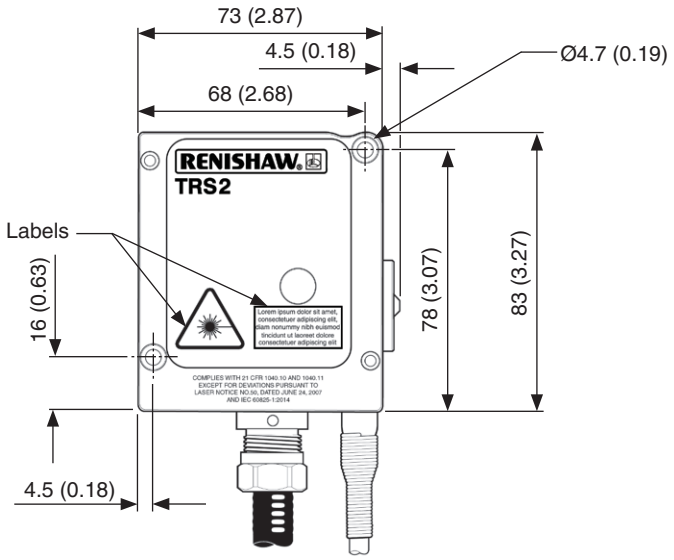
The TRS2 is designed to function over a 300 mm (11.81 in) to 2 m (78.74 in) range, although it is optimised for use at 1 m (39.37 in) or less. At the minimum distance of 300 mm (11.81 in), the TRS2 can detect a solid centred tool that has a diameter of 0.2 mm (0.008 in) or greater. At 1 m (39.37 in) distance, a 2 mm (0.08 in) diameter or larger tool can be detected.

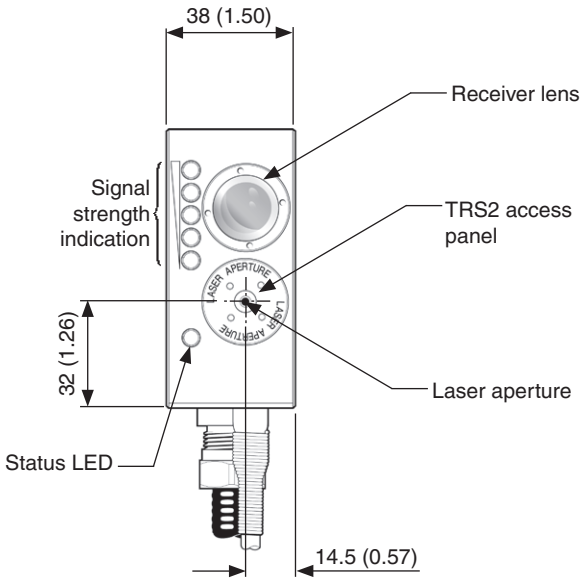
For a tool to be detected, sufficient light must be reflected back to the TRS2. Before running the broken tool cycle, ensure that each tool can be detected by the TRS2 system. The following factors affect the tool detection capabilities (particularly if the range is greater than 1 m (39.37 in) or the tool diameter is less than 2 mm (0.08 in)):

- Colour of the tool.
- Geometry and surface finish of the tool.
- Range.
- Machine environment.
- Installation.

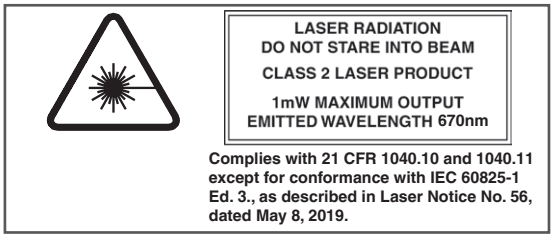
IMPORTANT: Remember that excess coolant must always be cleared from the tool before detection is carried out.

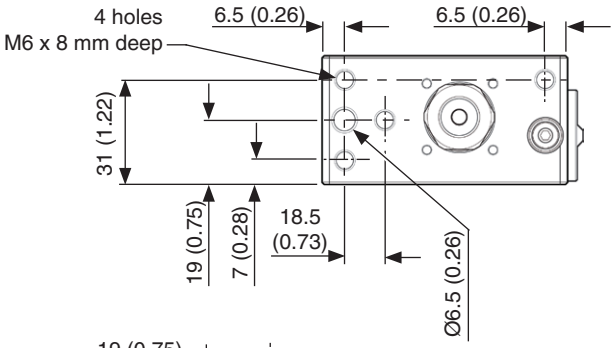
Dimensions of hard-wired TRS2 units and laser warning labels

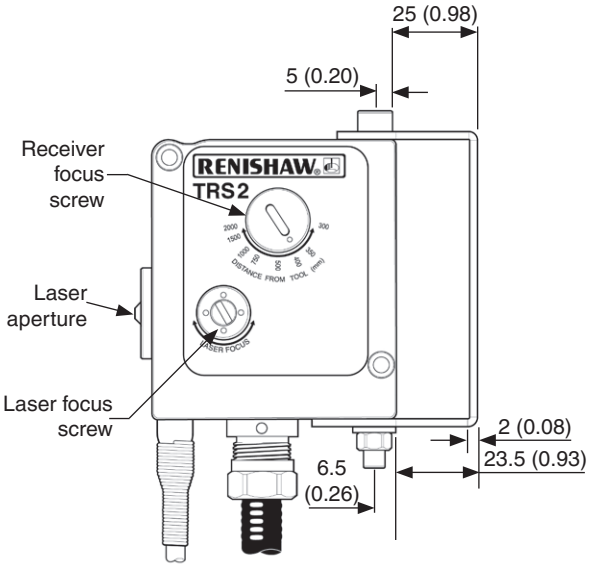


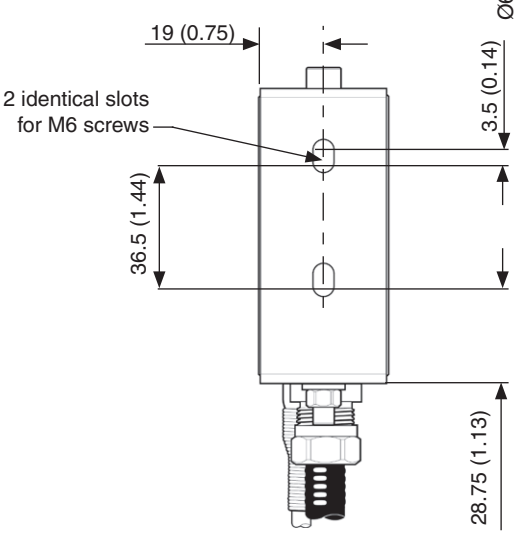


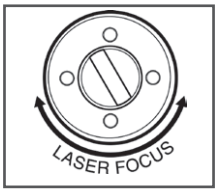
Warning label **Explanatory label**



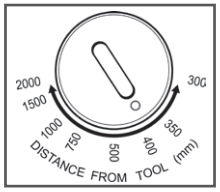




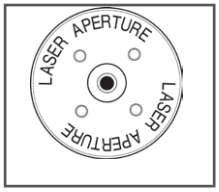




Laser focus screw



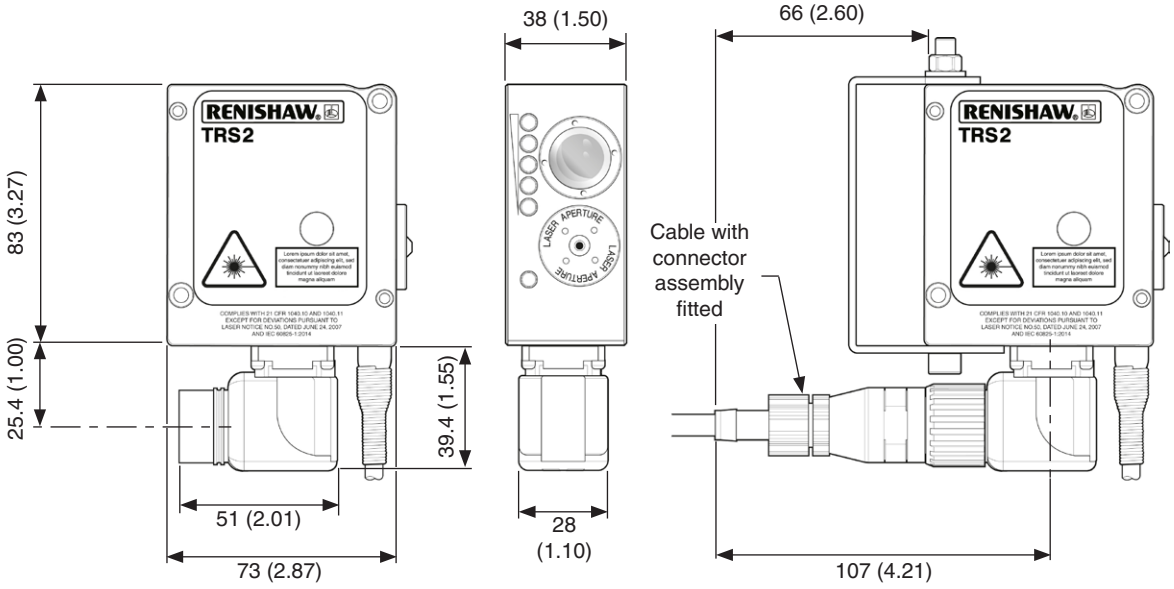
Receiver focus screw



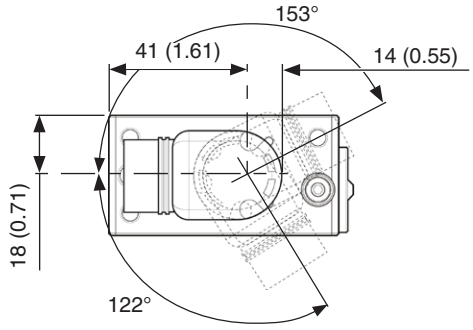
TRS2 access panel/ laser aperture

Dimensions given in mm (in)

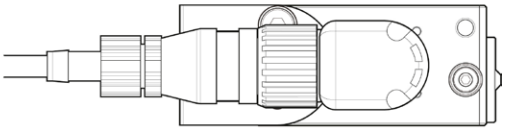
Dimensions of TRS2 units with connector



TRS2 without mounting bracket



TRS2 with mounting bracket



Dimensions given in mm (in)

TRS2 specification

Principal application	High-speed non-contact tool breakage detection of solid tools on all sizes of vertical and horizontal machining centres, all gantry machining centres and multi-tasking machines.	
Dimensions	Height Width Depth	83 mm (3.27 in) 38 mm (1.50 in) 73 mm (2.87 in)
Weight	750 g (1.65 lb), including 10 m (32.80 ft) of cable	
Transmission type	Hard-wired transmission	
Tool breakage detection	Ø0.2 mm (0.008 in) [1] [2]	
Detection range	TRS2 adjustable between 300 mm (11.81 in) and 2 m (78.74 in). Factory set to 350 mm (13.78 in).	
Supply voltage	11 Vdc to 30 Vdc	
Supply current	65 mA @ 12 Vdc, 42 mA @ 24 Vdc	
Output signal	Status output. Voltage-free solid-state relay (SSR) output, configurable normally open or normally closed.	
Input/output protection	Supply/output protected by resettable fuses	
Electrical connection arrangement	**Hard-wired systems:** cable on the underside of the unit. **Systems with connector:** connector socket on the underside of the unit.	
Cable (to machine controller)	**Specification**	**Hard-wired systems:** Ø4.85 mm (0.19 in), 5-core screened cable, each core 18 × 0.1 mm insulated. **Systems with connector:** 12.5 m (41.01 ft) length, cable/connector assembly with threaded plug. Ø6.5 mm (0.26 in), 7-core screened cable, each core 19 × 0.1 mm insulated.
	Length	**Hard-wired systems:** 5 m (16.40 ft),10 m (32.80 ft). **Systems with connector:** 12.5 m (41.01 ft).
Pneumatic supply	Ø4 mm (0.16 in) air pipe (for more information, see **page 3-3**, “Air supply”). The air supply to the TRS2 must conform to BS ISO 8573-1: Class 1.7.2.	
Laser type	Class 2 laser product: 1 mW maximum output emitted wavelength 670 nm. **WARNING:** Laser radiation. Do not stare into the beam.	
Mounting	Mounting bracket provided, with M6 (2 off) clearance slots. Alternative fixing arrangements are available.	

Environment	IP rating	IPX8 BS EN 60529:1992+A2:2013 [3] [electronics and internal components]
	IK rating	IK06 BS EN 62262:2002 [for glass window]
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

1 Each TRS2 unit is tested with a Ø0.5 mm (0.02 in), blue finish, HSS jobber drill at a range of 350 mm (13.78 in). Test conditions: dry tool, spinning at 5000 r/min, which must be detected by the TRS2 within 1 second.

2 Depending on range, tool geometry, surface finish and colour, machine environment and installation.

3 If the air supply is cut during operation, the transmitter lens outer surface may become contaminated (for more information, see **page 4-2**, “Cleaning the system”).

System installation

Mounting the TRS2

Introduction

This section provides guidance on mounting the TRS2 inside a machine. This is a critical part of the installation process, as the mounting location and method can impact the product performance.

CAUTION: Do not expose the TRS2 to cutting fluid or coolant that is corrosive to aluminium.

Mounting location guidelines

- The TRS2 must be installed on a sufficiently rigid mounting surface, so that the laser beam cannot move due to vibration or flexing of the surface. If the laser beam moves, tools may not be detected.
- Ensure the receiver focus screw and laser focus screw can be accessed at the chosen mounting location (for more information see **page 3-9**, “Adjusting the receiver focus screw” and “Adjusting the laser focus screw”).
- The TRS2 can be mounted on its side, upright or upside down. Ensure that the mounting orientation and location does not subject the unit to direct bombardment of swarf or coolant, and that coolant pooling does not occur on the product.
- The tool must be able to move in the Z axis relative to the TRS2 unit, so that tools of different lengths can be checked.
- Install the TRS2 perpendicular to the tool axis. Performance is affected if perpendicularity is not achieved, and this effect increases with separation.
- The closer the TRS2 is to the tool, the greater the reflected light level. Small diameter tools or those with a dark finish are more easily detected when the tool checking position is closer to the TRS2 unit.
- Ensure the laser beam cannot strike a reflective surface inside the machine which will reflect the beam into the receiver lens. If any of the signal strength indicators are lit when no tool is in the beam, this highlights a potential problem. To prevent this, either move the TRS2 so this does not happen or place a non-reflective object, such as black non-reflective tape, in the beam path.
- At speeds of 200 r/min or 1000 r/min, the use of an air blast is recommended to clear coolant from the tool. Ensure the selected location is suitable for the mounting of an air blast (for more information see **page 3-6**, “Air blast pack”).

NOTE: The TRS2 unit must be mounted so that the laser beam does not shine out of the machine. A laser warning sign/beam terminator, which is supplied with the TRS2, may be fixed to the outside of the machine window.

Mounting configurations

1. Mount the TRS2 unit on a rigid part of the machine (see the figure below for possible mounting configurations).

2. Tighten the mounting screws as follows:

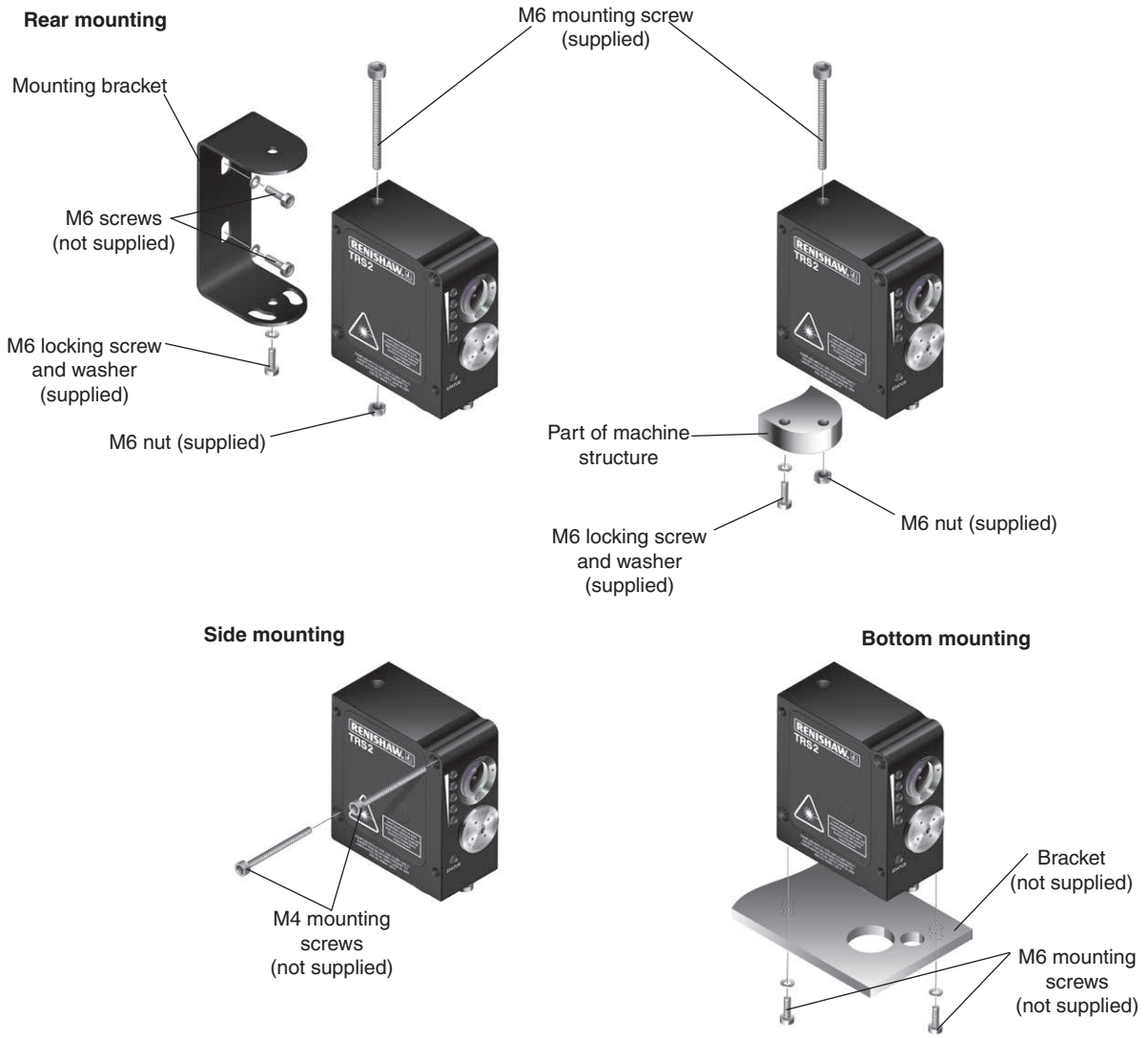
   For M6 mounting screws, tighten to 14 Nm (10.30 lbf.ft) using a 10 mm A/F spanner and a 5 mm A/F hex driver.

   For M4 mounting screws, tighten to 4 Nm (2.90 lbf.ft) using a 3 mm A/F hex driver.

3. When the TRS2 unit is rear mounted, fit the M6 locking screw and washer (see the figure on **page 3-2**) and tighten to 14 Nm (10.30 lbf.ft) using a 5 mm A/F hex driver.

4. Fit the cable conduit and air pipe spring cover to the unit (for instructions describing how to fit the cable conduit and air pipe spring cover to the unit, see **page 3-4**, “Connecting and purging the air supply”).

5. Connect the cable to the machine controller (for instructions on connecting cables, see **page 3-7**, “Electrical connections”).



Air supply

The TRS2 requires a clean air supply to protect the laser transmitter from the machining environment. It is recommended that the air supply is switched on at all times to prevent contamination of the TRS2 access panel. If it is necessary to switch off the air supply, ensure that the coolant supply is switched off first.

The air supply to the TRS2 system must conform to BS ISO 8573-1: air quality of class 1.7.2 and be moisture-free. If the air quality cannot be guaranteed, an optional air filtration system is available from Renishaw (see **page 6-1**, “Parts list”).

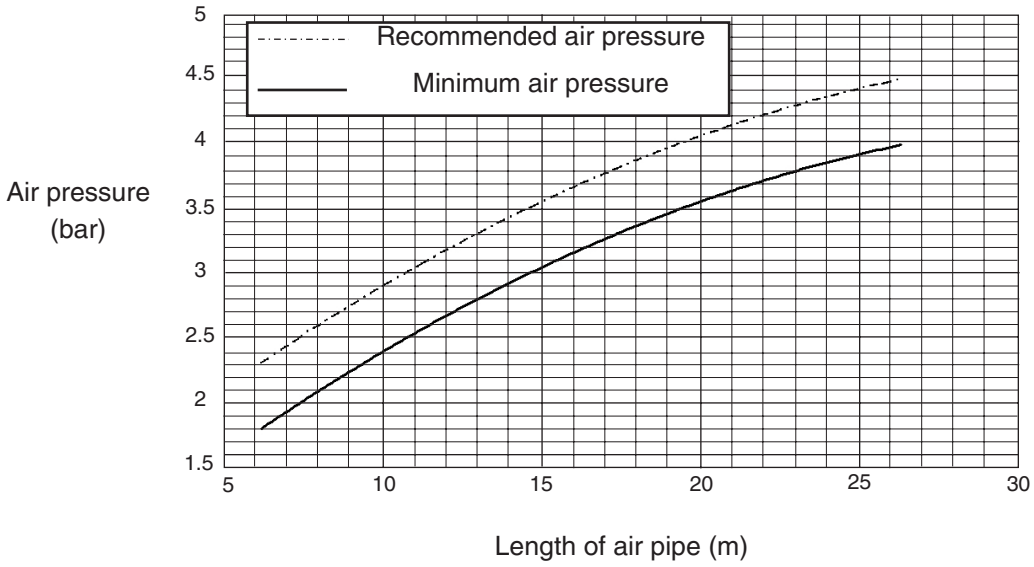
Failure of the air supply may cause the TRS2 system to become contaminated. Contamination is indicated if the laser spot is dispersed instead of being sharp when shone on to a piece of white paper (refer to the two images below). If contamination is suspected, carry out the cleaning procedure (for more information, see **page 4-2**, “Cleaning the system”).

Good spot

Dispersed spot

Air pressure

The graph shown below shows the recommended air pressure against the length of air pipe.



Connecting and purging the air supply

CAUTIONS:

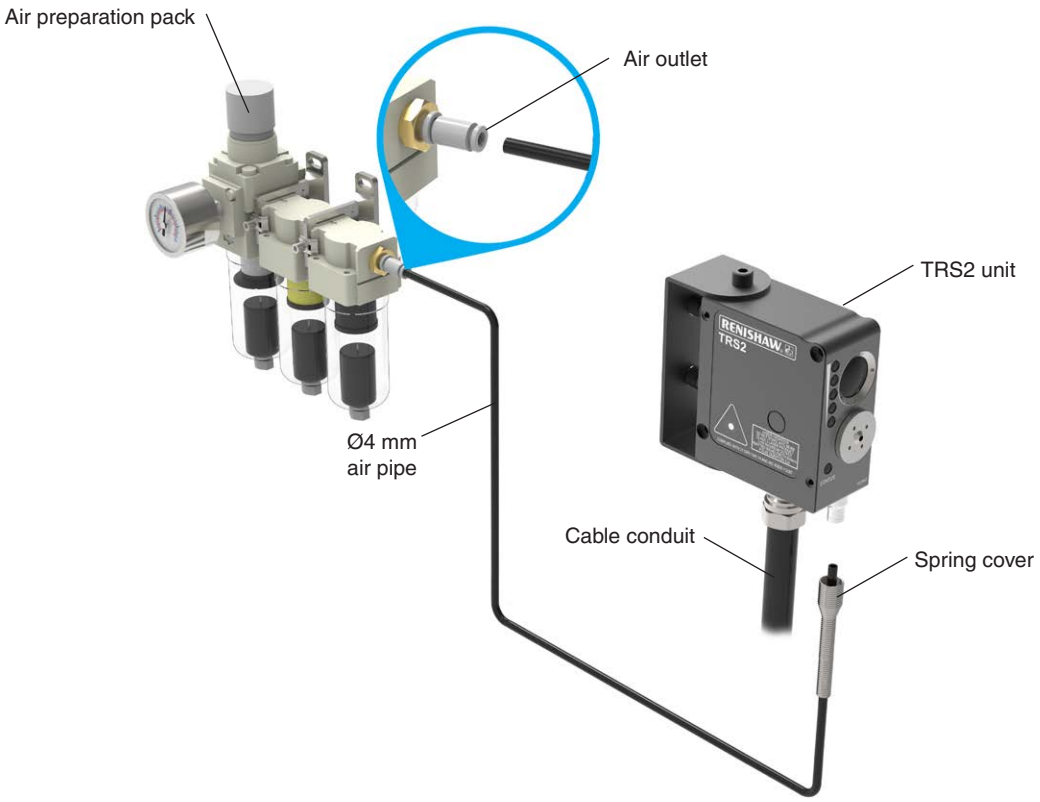
Do not connect the TRS2 system to an oiled air supply. Purge all piping prior to connection.

Safety glasses must be worn.

1. Locate a source of clean air that conforms to BS ISO 8573-1: Air quality of class 5.9.4. Connect a suitable pipe to the air supply.
2. Before connecting the pipe to the inlet of the air preparation pack, briefly switch on the air supply to clear out all debris from the pipe.
3. Connect the free end of the air pipe into the air preparation pack inlet.
4. Take a length of Ø4 mm air pipe that will connect the air preparation pack outlet to the TRS2. Cut to length as short as possible to minimise the drop in air pressure. Make a note of this pipe length.
5. Plug the measured pipe length into the air preparation pack outlet.
6. Measure and cut the spring cover to length if necessary.

   NOTE: The internal diameter of the spring cover increases at the end that will be fitted to the TRS2 air fitting. When cutting to length, ensure that the length is measured from this end.

7. Temporarily tape over the free end of the pipe to ensure that no coolant or debris is able to enter it.
8. Push the free end of the air supply pipe through the spring cover.
9. Remove the tape from the end of the air pipe. Before connecting the pipe to the inlet of the TRS2 unit, briefly switch on the air supply to clear out any debris from the pipe.
10. Connect the free end of the pipe to the TRS2 unit.
11. Push the spring cover over the air fitting on the TRS2 unit.
12. Switch on the air supply and set the pressure (for instructions describing how to set the correct air pressure, see **page 3-3**, “Air pressure”).

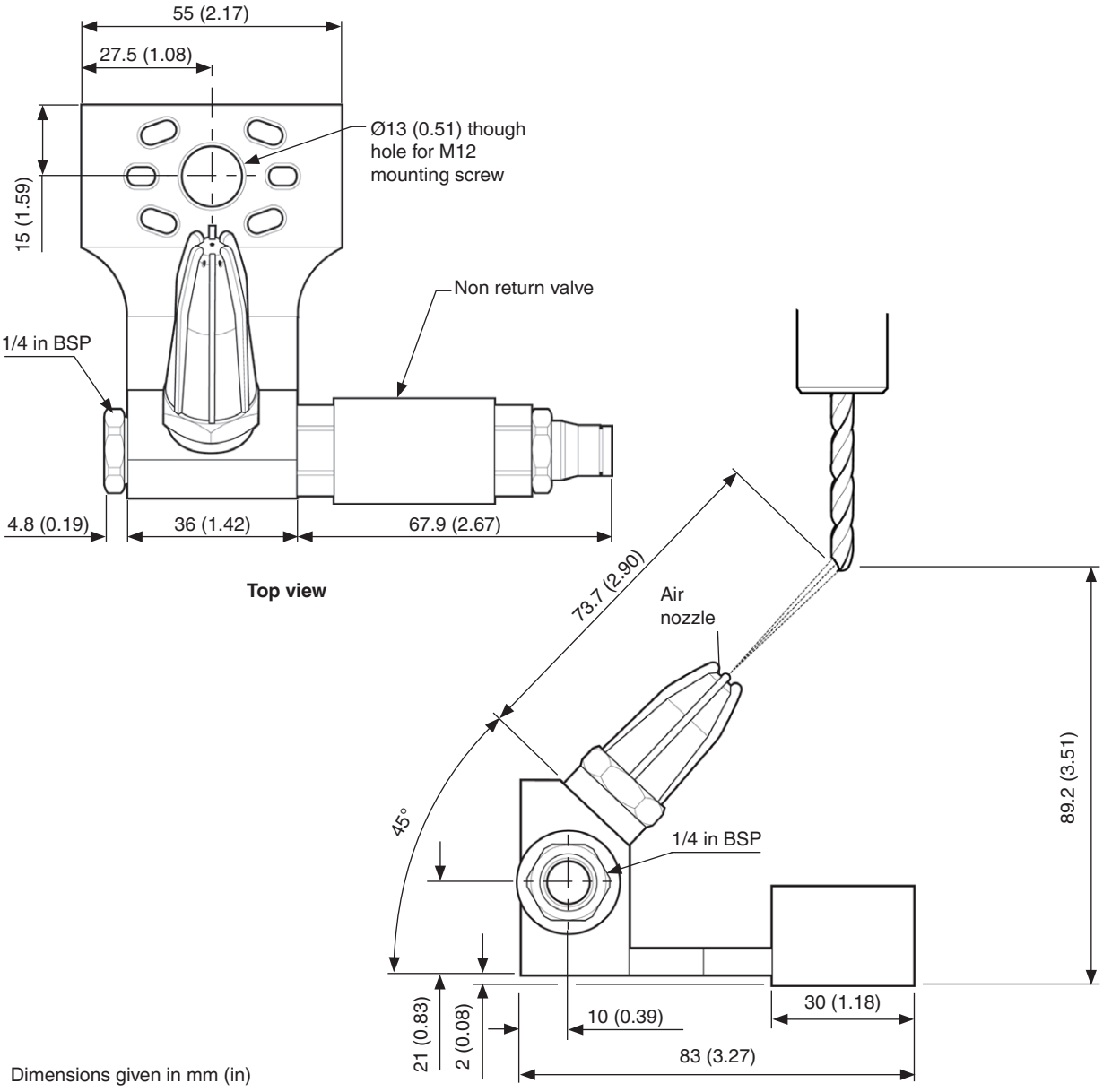


CAUTION: If it is necessary to switch off the air supply, ensure that the coolant supply is switched off first to prevent contamination of the TRS2 access panel.

Air blast pack

The air blast pack is an optional device available from Renishaw (see **page 6-1**, “Parts list”). It can be used prior to the broken tool detection cycle to clean coolant and swarf from a tool. When checking a tool that is rotating at either 200 r/min or 1000 r/min, it is recommended that the air blast is used for optimum performance.

- Mount the air blast pack on a rigid surface.
- Use an air feed controlled with a solenoid valve and M-code.
- Do not take the air feed controlled from the TRS2 air preparation pack, use a separate supply.
- Set the air pressure to 4 bar.
- Position the tool as shown in the figure below.
- Switch on the air supply for 1 second while the tool is spinning.



Dimensions given in mm (in)

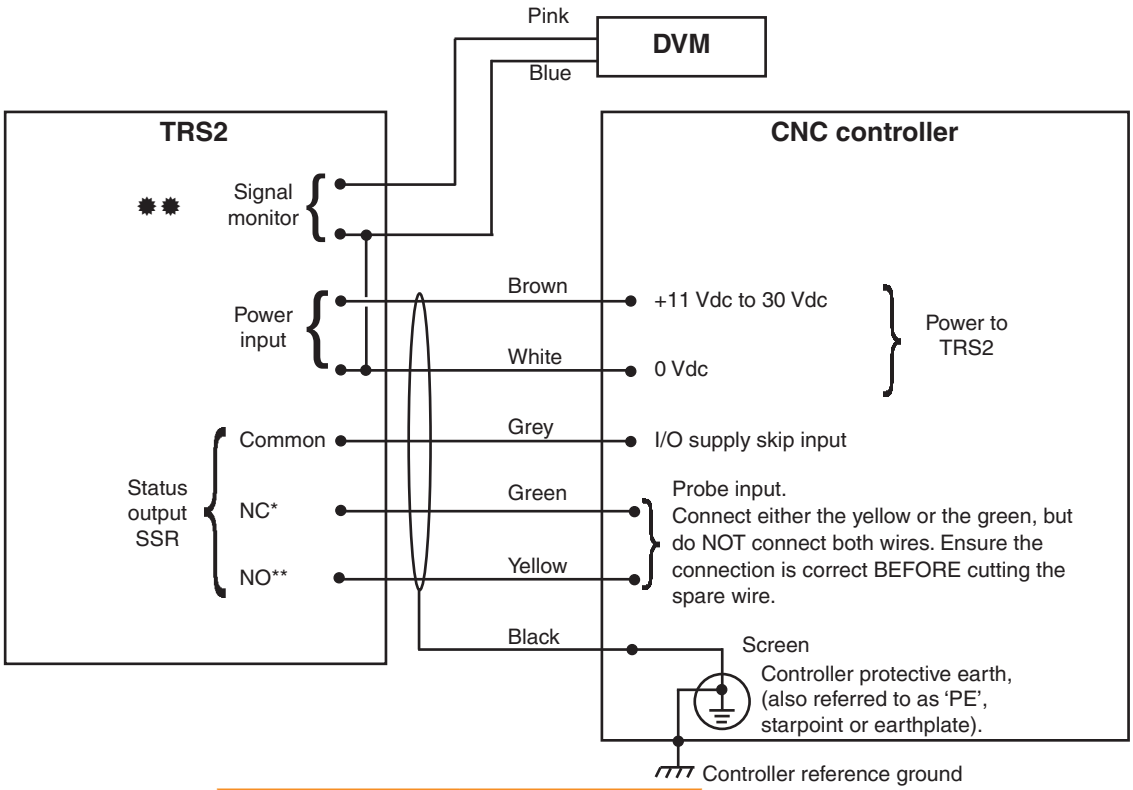
Electrical connections

Power supply

The TRS2 can draw its power from the CNC machine's 12 V to 24 V nominal dc supply. Its input voltage range is 11 Vdc to 30 Vdc maximum and it presents a typical load of up to 65 mA at 12 Vdc and up to 43 mA at 24 Vdc.

The SSR output is protected by a 50 mA resettable fuse. To reset the fuse, remove the power and rectify the fault.

CAUTION: When the SSR output is connected as normally-open (NO), the TRS2 will remain in a non-triggered state if the power supply is interrupted or if the TRS2 is damaged.



Status	SSR contact	
	*Normally closed NC	**Normally open NO
Tool detected	Open	Closed
Tool not detected	Closed	Open

✸✸ Denotes that the signal monitor output is available only with the version of the TRS2 that is fitted with a connector. This is recommended for use when the signal strength indicators cannot be seen.

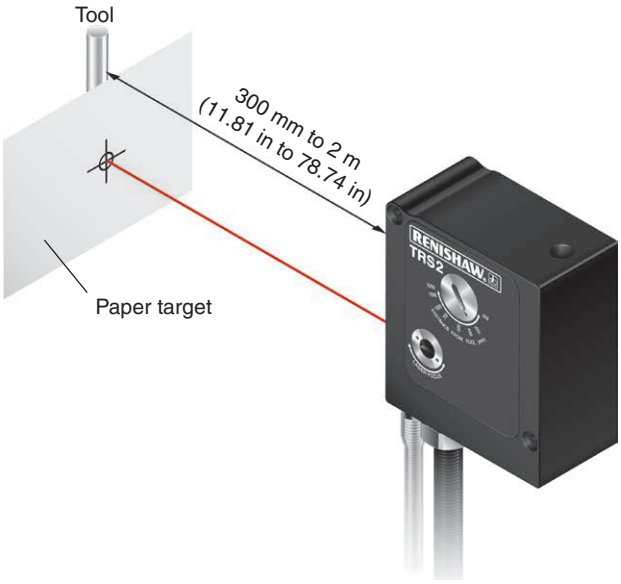
Setting up the TRS2 system

Preparation

To set the operating range of the TRS2 you will need to change the settings of the receiver focus screw and laser focus screw. If these screws cannot be accessed when the TRS2 unit is mounted in the machine, range setting can be performed off the machine.

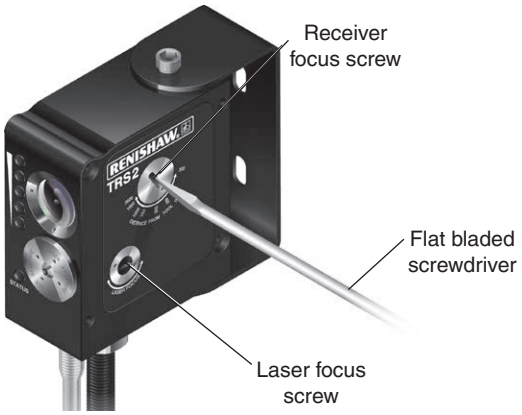
To determine the checking position of the TRS2 system you will need to use a reference tool. The length of this tool must be known. The diameter must be the same as the smallest diameter tool that will be checked.

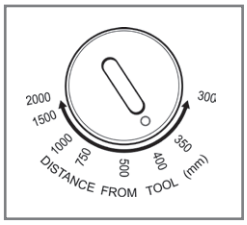
Range setting



1. Position the reference tool at the point at which tool checking will be performed.
2. Print out one of the targets from the back of this guide. Using either adhesive putty or tape, attach it to the tool as shown in the figure above
3. Measure the distance between the tool and the front face of the TRS2 (this must be between 300 mm [11.81 in] and 2 m [78.74 in]).

Adjusting the receiver focus screw

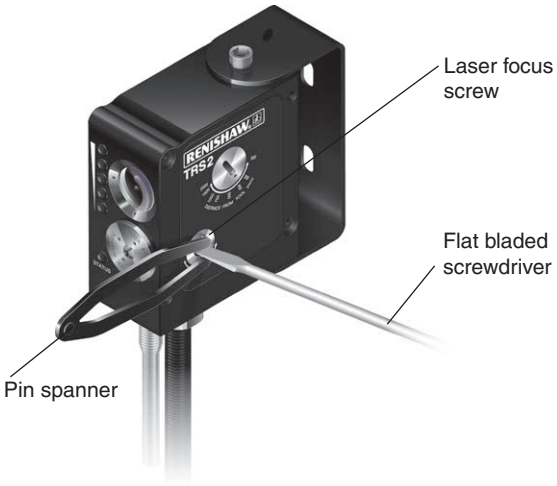


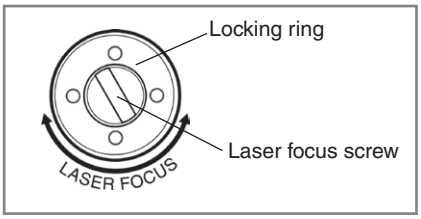


Receiver focus screw

4. Using either a flat-bladed screwdriver or coin, adjust the receiver focus screw until the pointer is aligned with the required distance measured during step 3.

Adjusting the laser focus screw





Laser focus screw

5. Using a pin spanner, loosen the locking ring of the laser focus screw by 1 to 2 turns (turning counterclockwise) until it is fully slackened.

NOTE: The locking ring is designed not to fall out when it is fully slackened.

6. Using a flat-bladed screwdriver, adjust the laser focus screw until the size of the laser spot shining on the paper target is minimised. During adjustment, take care to ensure the locking ring does not unintentionally tighten due to friction between it and the laser focus screw.

7. Hold the laser focus screw in position with the flat-bladed screwdriver then, using the pin spanner, tighten the locking ring to 2 Nm (1.48 lbf.ft), taking care to ensure the laser focus screw does not move.

CAUTION: Do not adjust the laser focus screw with the locking ring tightened.

8. Finally, remove the paper target from the tool.

Spindle speed selection

For a tool to be detected by the TRS2 system, it must be rotating at a fixed speed of 5000 r/min, 1000 r/min or 200 r/min. The required spindle speed must be selected in the macro software.

- 5000 r/min. This is the default speed and gives the shortest detection time. It is recommended that this speed is used whenever possible. However, when selecting this speed you must ensure that it does not exceed the maximum spindle speed indicated by the manufacturer.
- 1000 r/min. Select this speed when 5000 r/min is not suitable. Before detecting a tool at this speed, the tool must be cleaned, either by using an air blast or by spinning the tool at a greater speed. An air blast pack is available from Renishaw plc and can be ordered separately (for more information, see **page 3-6**, “Air blast pack”).
- 200 r/min. This speed is reserved for use with gun drills. The detection time is likely to be significantly longer than at the two other speeds. Before detecting a tool at this speed, it is recommended that the tool is cleaned using an air blast.

Determining the checking position

1. If using the mounting bracket (supplied), slightly loosen the M6 mounting screws, using a 10 mm A/F spanner and a 5 mm A/F hex driver.
2. Loosen the M6 locking screw on the underside of the unit.
3. Rotate the reference tool at the chosen spindle speed (5000 r/min, 1000 r/min or 200 r/min).
4. Position the end of the tool approximately 3 mm (0.12 in) into the laser beam (see the figure on **page 3-11**). Move the position of the laser beam by sweeping it across the tool until the maximum number of signal strength LEDs are lit (for more information, see **page 2-2**, “Signal strength indication”).

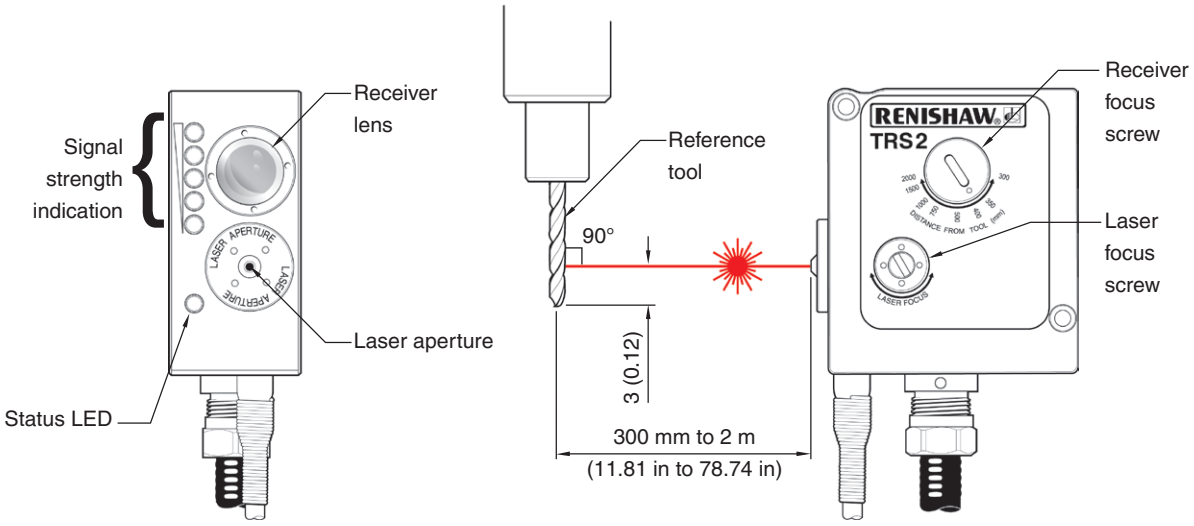
   If the signal strength indicators are obscured, the signal monitor function may be used (see **page 3-12** , “Using the signal monitor function”).

   Alternatively, if the diameter of the reference tool is smaller than the laser beam, place a piece of white paper behind the tool. Move the laser beam until the shadow of the tool falls in the middle of the red laser beam spot on the paper.

   At 2 m (78.74 in) separation, it may only be possible to illuminate one of the signal strength indicator LED’s with the smallest tool. The received signal will increase as the separation distance is reduced.
5. Tighten the mounting screws as follows:

   For M6 mounting screws, tighten to 14 Nm (10.3 lbf.ft) using a 10 mm A/F spanner and a 5 mm A/F hex driver, while checking that the TRS2 unit does not move.

   For M4 mounting screws, tighten to 4 Nm (2.9 lbf.ft) using a 3 mm A/F hex driver, while checking that the TRS2 unit does not move.



6. When the TRS2 unit is rear mounted, fit the M6 locking screw and washer to the underside of the unit and tighten to 14 Nm (10.30 lbf.ft) using a 5 mm A/F hex driver.

7. Make a note of the X and Y co-ordinates of the checking position.

   NOTE: An installation on which the TRS2 system does not move with the X or Y axes requires only the Z co-ordinate to be input.

8. Move the tool position in Z only until the centre of the laser beam is aligned with the tip of the tool. Make a note of the Z co-ordinate.

9. Add the length of the reference tool to the Z co-ordinate value.

10. Input this checking position into the memory locations that are accessed by the high-speed tool detection program (refer to the programming guide appropriate to your machine controller by visiting **www.renishaw.com/trs2**).

    The default checking position is 3 mm (0.12 in) from the tip of the tool, but this distance can be modified by the user (refer to the programming guide).

    NOTE: It is the user's responsibility to ensure that every tool can be detected at the checking position.

Using the signal monitor function

The signal monitor function is available only on the version of TRS2 that is fitted with a connector.

If the operator is unable to see the signal strength indicators on the front of the TRS2, the signal monitor function can be used to monitor the reflected light signal level:

1. Connect the pink (+) and blue (–) wires to a digital voltmeter (DVM).
2. Move the position of the TRS2 unit side to side relative to the tool until the highest voltage reading is obtained.
3. After you have finished, disconnect the DVM.

   Connect the blue wire to the 0 V supply.

   Cut off the exposed core of the pink wire and insulate the end of the wire with tape to prevent shorting.

Maintenance

Introduction

The TRS2 system requires minimal maintenance, having been designed to operate as a permanent fixture on a CNC machining centre in an environment of hot metal chips and coolant.

Only the maintenance routines described in this guide should be undertaken. Further dismantling and repair of Renishaw equipment is a highly specialised operation and must be carried out only at authorised Renishaw service centres.

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

Guidelines

- The TRS2 is a precision tool and must be handled with care.
- Do not allow excessive waste material to build up around the unit.
- Use a coolant nozzle directed at the front of the TRS2 unit to regularly conduct a low pressure coolant wash. This will help prevent the build-up of swarf and dried coolant on the receiver lens.
- Keep electrical contacts clean.
- A continuous stream of clean air protects the TRS2 system. Approximately every 3 months, inspect the optics for contamination. The service interval may be extended or reduced dependent upon experience (for more information, see **page 3-3,** “Air supply”).

About cleaning

Cleaning may be required if the air to the TRS2 becomes contaminated or if the system is left with the air off when coolant is present. Excessive contamination of the access panel will block the laser beam and prevent the TRS2 from functioning. In this condition, the status LED will not change state when a good tool is checked.

If contamination is suspected, identify the cause and rectify the problem before cleaning the system. If necessary, change the air pipe (for more information, see **page 3-3,** “Air supply”).

If either the access panel or receiver lens is contaminated, clean it as described below.

Equipment required

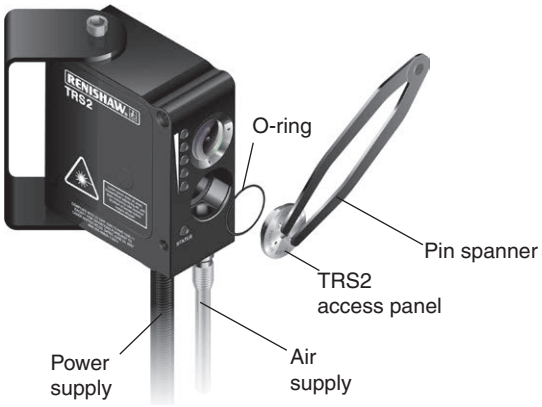
- Pin spanner.
- Precision cleaning solvent, lens cleaner or isopropyl alcohol.
- Dust remover clean air spray.
- Cleaning swabs.

Cleaning the system

CAUTION: Before removing the TRS2 access panel, switch off electrical power to avoid exposure to the laser beam.

1. Make a note of the air supply pressure, then switch off the air supply and power supply.
2. Remove the TRS2 access panel, and O-ring from the transmitter using the pin spanner provided.

   NOTE: A replacement access panel and O-ring are available if required (for more information, see **page 6-1**, “Parts list”).



3. Switch on the air supply and increase the pressure to purge out coolant that may be present in the pipe work. If coolant is found in the lines, they will need to be cleaned or replaced.
4. When no further coolant is emitted, switch off the air supply.

5. Wipe out any oil that may be present.
6. Spray the solvent onto the lens surface and clean off using a swab.
7. Clean the TRS2 access panel to remove all traces of oil and debris.

8. Refit the O-ring and TRS2 access panel, ensuring that the O-ring is seated correctly. Tighten the access panel to 2 Nm (1.48 lbf.ft).

9. Spray the solvent cleaner onto the receiver lens surface and clean off using a swab.

10. Switch on the air supply and set the pressure to the value noted in step 1.

11. Switch on the power supply.

12. Now check that the laser beam displays a good spot (for more information, see **page 3-3,** “Air supply”).

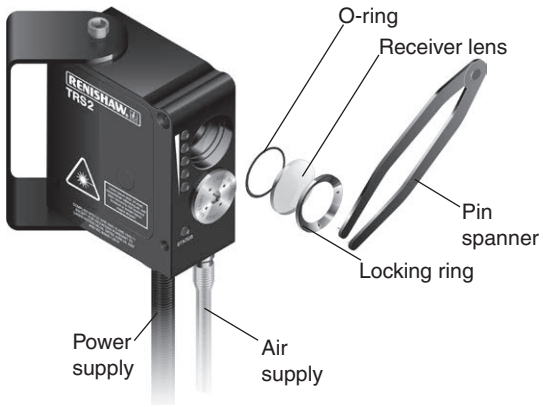
Replacing the receiver lens

Under severe conditions the receiver lens may become damaged or contaminated and therefore need to be replaced (for more information, see **page 6-1**, “Parts list”).

1. Make a note of the air supply pressure, then switch off the air supply and power supply.

2. Remove the receiver lens locking ring using the pin spanner provided.

CAUTION: Ensure that coolant and swarf do not enter the housing.



3. Remove and discard the lens and O-ring.

4. Fit the replacement O-ring and lens, making sure the O-ring is seated correctly.

5. Refit the lens locking ring and tighten to 2 Nm (1.48 lbf.ft).

6. Switch on the air supply and set the pressure to the value noted in step 1.

7. Switch on the power supply.

NOTE: If the machining environment is particularly hostile, a hard sapphire glass window can be fitted for extra protection (for more information, see **page 4-4**, “Fitting a sapphire glass window”).

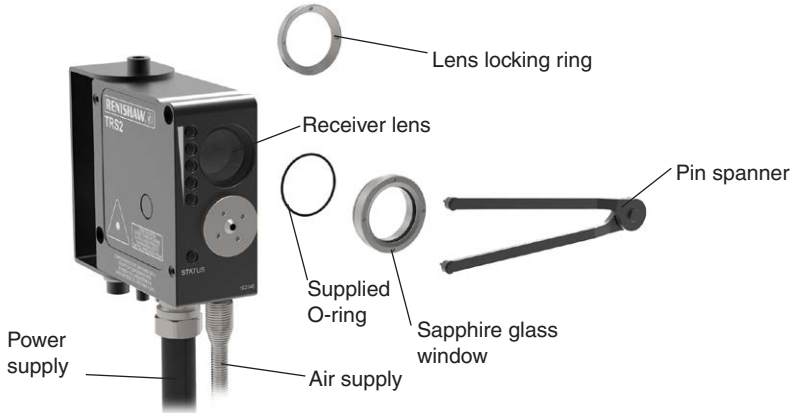
Fitting a sapphire glass window

If the TRS2 receiver lens is likely to become scratched due to bombardment by swarf, it can be protected by a hard sapphire glass window (for more information, see **page 6-1**, “Parts list”).

After fitting the sapphire glass window there may be a reduction in the signal level, as displayed by the signal strength indicators. Fewer green LEDs may be lit but this is perfectly normal. However, it may affect the detection of some small, dark tools.

1. Make a note of the air pressure, then switch off the air supply and power supply.

2. Using the pin spanner, remove and discard the lens locking ring. Do not remove the receiver lens.



3. Slide the supplied O-ring over the outer diameter of the receiver lens, then fit the sapphire glass window in place of the lens locking ring. Using the pin spanner, tighten it to 2 Nm (1.48 lbf.ft).

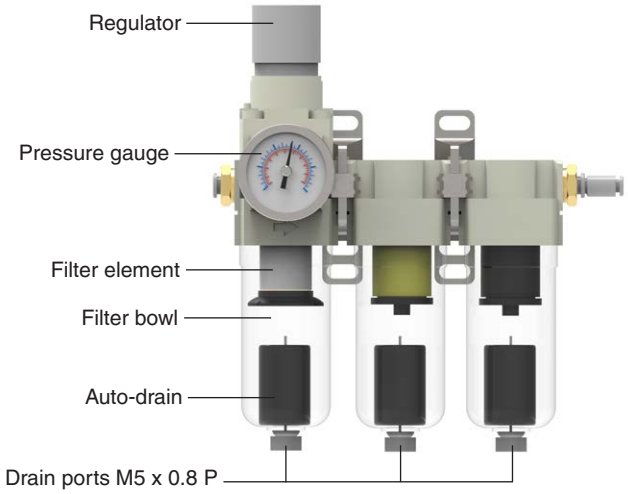
4. Turn on the air supply and set the pressure to the value noted in step 1.

5. Switch on the power supply.

Maintenance – 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.



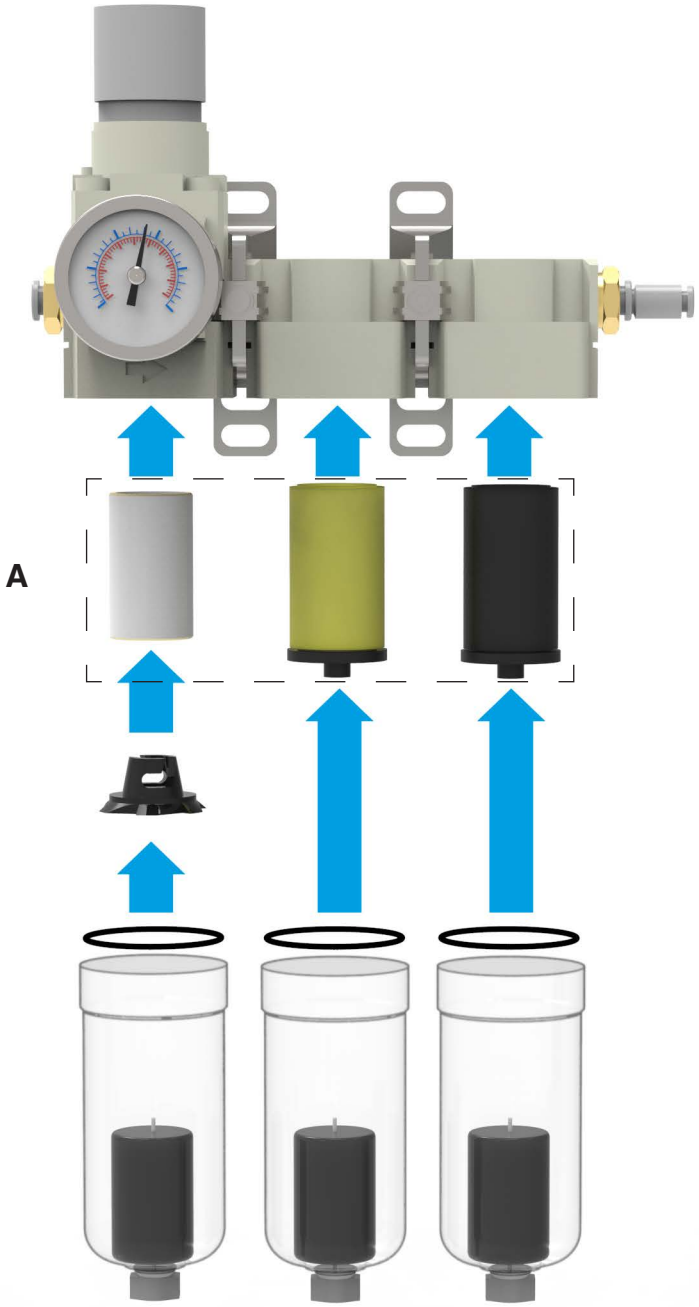
Removing and refitting filter elements

For the following instructions, refer to the figure on **page 4-6**.

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

1. Make a note of the air supply pressure, then 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 the 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 to the value noted in step 1.

NOTE: Items shown within dotted box A are included in the air filter service pack obtainable from Renishaw (for more information, see **page 6-1**, “Parts list”).


A

Fault-finding

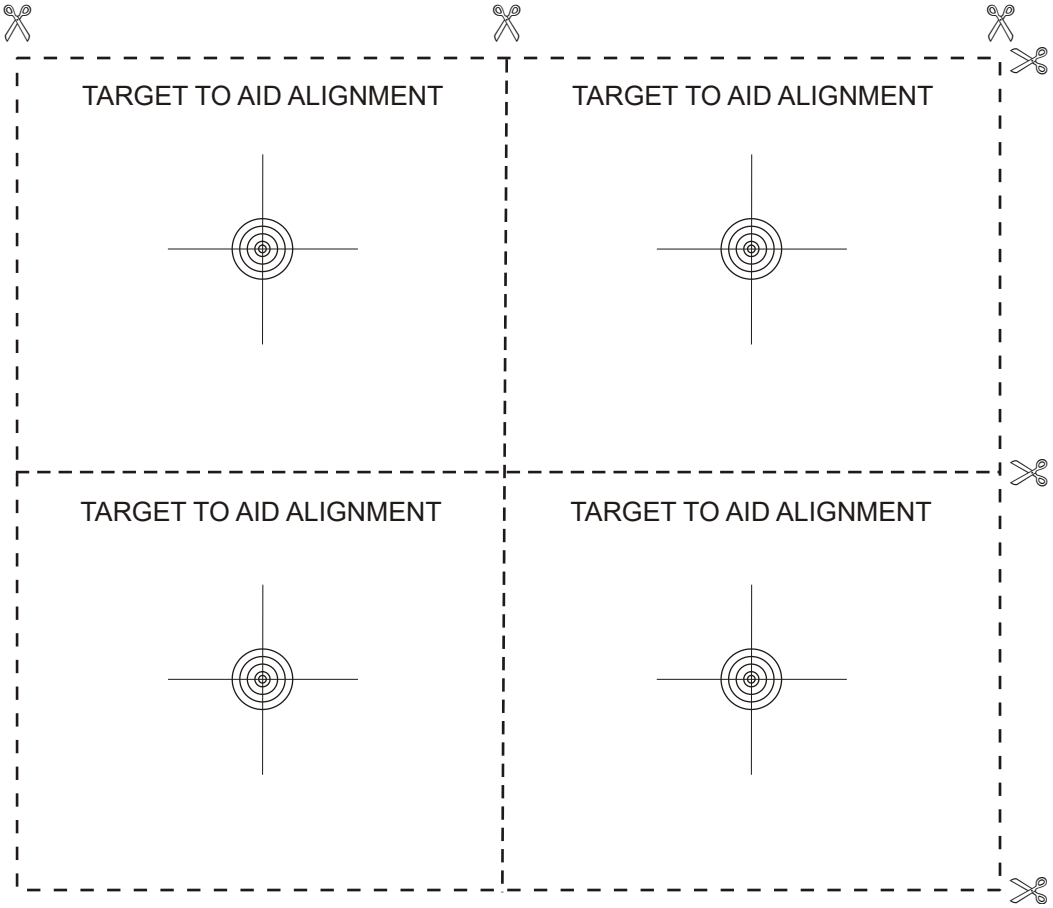
Symptom	Cause	Action
TRS2 fails to turn on (status LED is not lit).	Faulty connections.	Check that the wiring connections are correct.
	Wrong supply voltage.	Check the supply voltage to the TRS2 is correctly set at 11 Vdc to 30 Vdc.
	Blown fuse.	Check that the connections and remove any short circuits.
	Damaged cable.	**Hard-wired systems:** contact your local Renishaw office for advice. **Systems with connector:** replace the cable.
The status LED changes, but there is no skip at the controller.	SSR outputs incorrectly wired to the machine controller.	Ensure that the correct relay contact is being used; normally open or normally closed.
		Check the connection at the machine controller (for more information, see **page 3-7**, “Electrical connections”).
		Check that the correct skip is active.
No laser beam is exiting the TRS2 access panel or laser beam is dispersed.	The access panel could be blocked.	Clean the access panel and remove any debris (for more information, see **page 4-2**, “Cleaning the system”).
	Contaminated optics.	Clean the laser transmitter optics and identify the source of contamination (for more information, see **page 4-2**, “Cleaning the system”).
		Check that the air supply conforms to the specified requirements (for more information, see **page 3-3**, “Air supply”).
	Faulty connections.	Check that the wiring connections are correct.

Symptom	Cause	Action
The TRS2 fails to detect all good tools.	Incorrect spindle speed has been set.	Check that the spindle speed is set to 5000 r/min, 1000 r/min or 200 r/min with no spindle override set.
	The receiver lens is contaminated.	Clean the outside of the receiver lens (for more information, see **page 4-2**, “Cleaning the system”).
	The receiver lens is severely contaminated or damaged.	Replace the receiver lens (for more information, see **page 4-3**, “Replacing the receiver lens”). If the machining environment is particularly hostile, consider adding a sapphire window (for more information, see **page 4-4**, “Fitting a sapphire glass window”).
	The receiver focus screw is incorrectly set.	Check that the receiver focus screw is set to the correct range (for more information, see **page 3-9**, “Adjusting the receiver focus screw”).
	The tool checking position and TRS2 are out of range.	Check that the gap between the TRS2 and tool checking position is between 300 mm (11.81 in) and 2 m (78.74 in). If necessary, edit the tool checking position or re-position the TRS2.
	The laser focus screw is incorrectly set.	Check that the laser focus screw is set so that the laser spot diameter is minimised at the checking position (for more information, see **page 3-9**, "Adjusting the laser focus screw").
	The TRS2 and tools are misaligned.	Check the system alignment in the X, Y and Z axes, and adjust as necessary (for more information, see **page 3-10** “Determining the checking position”).
	The TRS2 is mounted to an unstable structure.	Mount the TRS2 on a sufficiently rigid mounting surface, so that the laser beam cannot move due to vibration or flexing of the surface. Check any bracket mounting screws are suitably tight.
The TRS2 fails to detect a specific good tool.	The tool surface finish or colour is too dull.	Check that the tool gives enough good reflection (at least one green LED of the signal strength indicators must be lit).
	There is excess coolant on the tool.	Check that coolant on the tool is not disrupting the beam’s sight of the tool. If it is, move to a cleaner part of the tool or remove coolant with a spin, air blast or other method.
	The tool geometry is unsuitable for detection.	If the tool has 12 or more flutes, it may not be detected.
		If the tool does not have a solid centre, it may not be detected.

Parts list

Item	Part number	Description
TRS2 hard-wired unit pack (10 m)	A-5450-0400	TRS2 unit with Ø4.85 mm (0.19 in) × 10 m (32.80 ft) electrical cable, mounting bracket, pin spanner, machine tool support card and laser warning sign/beam terminator (× 2).
TRS2 hard-wired full installation pack (10 m)	A-5450-1000	Contains TRS2 hard-wired unit pack (10 m), plus; air preparation pack, Ø4 mm (0.16 in) × 20 m (65.62 ft) air tube, 2 m (6.56 ft) spring cover for air tube (× 2) and 4 m (13.12 ft) cable conduit.
TRS2 hard-wired unit pack (5 m)	A-5450-0415	TRS2 unit with Ø4.85 mm (0.19 in) × 5 m (16.40 ft) electrical cable, mounting bracket, pin spanner, machine tool support card and laser warning sign/beam terminator (× 2).
TRS2 unit pack with 90° connector socket	A-5450-0420	TRS2 unit with 90° connector socket, mounting bracket, pin spanner, machine tool product support card and laser warning sign/beam terminator (× 2)
TRS2 with 90° connector socket full installation pack	A-5450-1500	Contains TRS2 unit pack with 90° connector socket, plus; Ø6.5 mm (0.26 in) × 12.5 m (41.01 ft) cable with connector, air preparation pack, Ø4 mm (0.16 in) × 20 m (65.62 ft) air tube, 2 m (6.56 ft) spring cover for air tube (× 2) and 4 m (13.12 ft) GP9 conduit.
Mounting bracket	M-5450-0014	Bracket for rear mounting of the TRS2 unit.
Pin spanner	P-TL09-0005	Used for removing the TRS2 access panel and lens retaining ring.
Air preparation pack	A-5450-2000	Filter/regulator. Supplies air conforming to BS ISO 8573-1 Class 1.7.2.
Air filter service pack	A-6435-4001	Replacement filters for air filter/regulator unit.
Cable conduit	P-CF01-0001	Flexible cable conduit for hard-wired TRS2 systems. Order by the metre.
Conduit (GP9)	P-HO01-0010	Conduit (GP9) for TRS2 systems with cable connector. Order by the metre.
PU tube Ø4 mm (0.16 in)	P-PF26-0076	Ø4 mm (0.16 in) air tube. Order by the metre.
Spring cover Ø4 mm (0.16 in)	M-2253-0207	2 m (6.56 ft) length to protect Ø4 mm (0.16 in) air tube.
Conduit gland	P-CF02-0001	Cable/conduit gland for hard-wired TRS2 systems (M16 × 1.5P).
Conduit gland pack (GP9)	A-6270-0383	Cable/conduit gland for TRS2 systems with cable connector (M20 × 1.5P). Includes a grease sachet, O-clip and locknut.
Cable gland	P-CA61-0054	Gland with a Ø6.5 to Ø4 mm cable sealing range (M16 × 1.5P).
Locknut	P-NU09-0016	Locknut for use with cable/conduit glands (M16 × 1.5P).
TRS2 access panel pack	A-5450-0440	Replacement access panel and O-ring.
Cable with connector assembly	A-2253-6107	12.5 m (41.01 ft) length of cable with connector. For use with TRS2 systems with 90° connector socket.
Air blast pack	A-5299-5571	Air blast with nozzle, non-return valve and mounting bracket.
PU tube Ø6 mm (0.24 in)	P-PF26-0070	Ø6 mm (0.24 in) air tube. Order by the metre.

Item	Part number	Description
Receiver lens pack	A-5450-0470	Replacement receiver lens and O-ring.
Sapphire glass window pack	A-5450-0460	Hard sapphire glass protective window, locking ring, O-ring and pin spanner.
Cleaning swab	P-AD99-0171	Cleaning swab for cleaning the optics (× 50).
Publications. These can be downloaded from our website at **www.renishaw.com.**		
Software programs and features	H-2000-2298	Data sheet: Probe software for machines tools – programs and features.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+44 (0) 1453 524524 uk@renishaw.com

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