Installation and user's guide
H-2000-5262-01-A

RENISHAW
apply innovation™

TRS1 non-contact broken tool detection system

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Patents

Features of the TRS1 non-contact broken tool detection system and related products are subject to pending patent protection.

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CE

EC DECLARATION OF CONFORMITY

Renishaw plc declares that the product:

Name	**Description**
TRS1	Non-contact broken tool detection system

has been manufactured in conformity with the following standards:

BS EN 61326: 1998/ A1:1998/A2:2001	Electrical equipment for measurement, control and laboratory use - EMC requirements. Immunity to annex A - industrial locations. Emissions to class A (non-domestic) limits.
BS EN 60825-1:1993/ A2:2001	Safety of laser products. Part 1: Equipment classification, requirements and user's guide.

and that it complies with the requirements of the following directives (as amended):

89/336/EEC	Electromagnetic compatibility
73/23/EEC	Low voltage

The above information is summarised from the full EC Declaration of Conformity. A copy is available from Renishaw on request.

FCC

Information to user (FCC Section 15.19)

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

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

Information to user (FCC Section 15.105)

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

Information to user (FCC Section 15.21)

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

Warnings

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

Switch off the power supply before carrying out maintenance on the TRS1 system.

When using the TRS1 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.
- Avoid inhalation of coolant vapour from the machine tool.
- Do not block the air exiting the micro hole with any part of the body.
- Do not look directly into the laser beam. Ensure that the beam is not reflected into the eyes via any reflective surface.

Caution – Laser safety

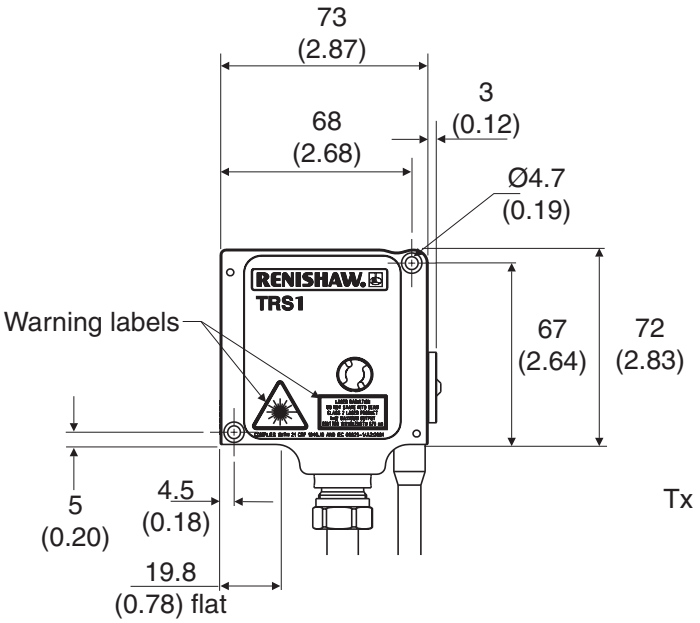
The laser used in the Renishaw TRS1 non-contact broken tool detection system emits continuous visible red light at a wavelength of 670 nm and has a power output of less than 1 mW.

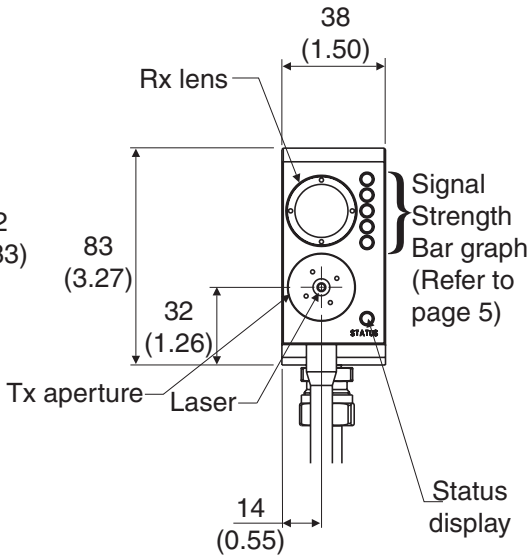
The laser used is classified as a Class 2 product as defined by British standard BS EN 60825-1:1993 + A2: 2001.

The laser complies with 21CFR 1040.10 except for deviations pursuant to Laser Notice No. 50 dated July 26, 2001.

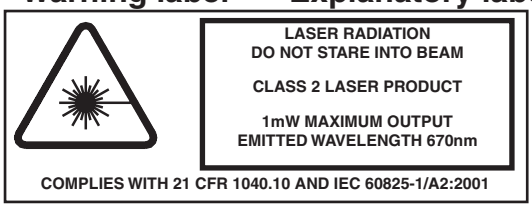
The standard BS EN 60825-1 directs to attach a laser warning label and explanatory label.

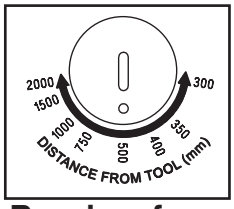
A warning label and explanatory label are permanently fixed to one side of the housing (see page 4 for details). An adhesive warning label is provided for attachment outside the machine.



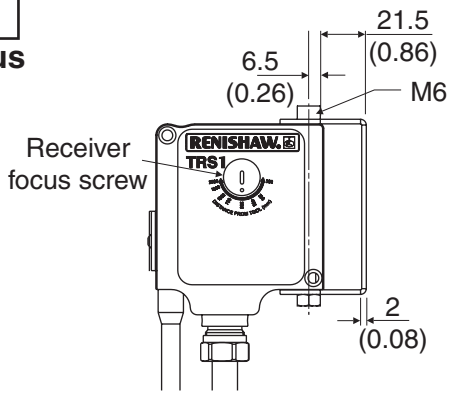


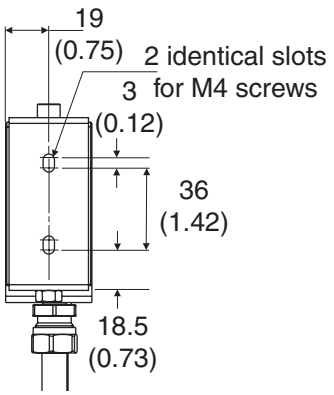
Warning label **Explanatory label**





Receiver focus screw





Dimensions in mm (in)

Introduction

This section of the guide describes how to install, and maintain the Renishaw TRS1 non-contact broken tool detection system.

The TRS1 is a laser-based non-contact broken tool detection system specifically designed for solid centred tools, for example drills and taps.

The tool is rotated at 1000 rpm and is moved into the laser beam. The output is activated and the output changes when the tool is detected by the receiver.

Software routines

Examples of programs for high-speed broken tool detection of solid tools are available for a wide range of machine controller types. Please refer to the CD in the back of this book.

Probe status display function

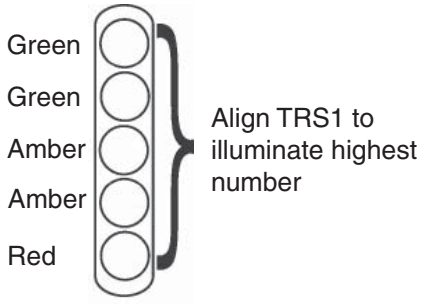
The probe status display on the front of the system indicates the status to the user.

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

CAUTION: The tool must be rotating at 1000 rpm, at the checking point in the laser beam, in order for it to be detected.

Bar graph displays

The bar graph displays indicate the level of light falling on the receiver. If the bar graph display is not lit this means no light has been detected by the receiver.



TRS1 typical performance

The TRS1 system is capable of detecting a Ø1 mm bright drill at 2 m (6.56 ft) and a Ø0.5 mm bright drill at 0.3 m (0.984 ft), dependent on installation, set-up and tool type/condition.

Note: For a tool to be detected, sufficient light must be reflected back to the TRS1 system. Before running the broken tool cycle, ensure that every tool can be detected by the TRS1 system, as this varies with range, installation and set-up.

Mounting

The mounting surface must be rigid sufficiently so the laser beam does not move due to vibration or flexing of the mounting surface. If the laser beam moves, then tools, particularly those of small diameter, may not be detected.

Notes: Where practical, the TRS1 system must be mounted so that the laser beam does not shine out of the machine. Where this is not possible, open paths must be located above or below eye level.

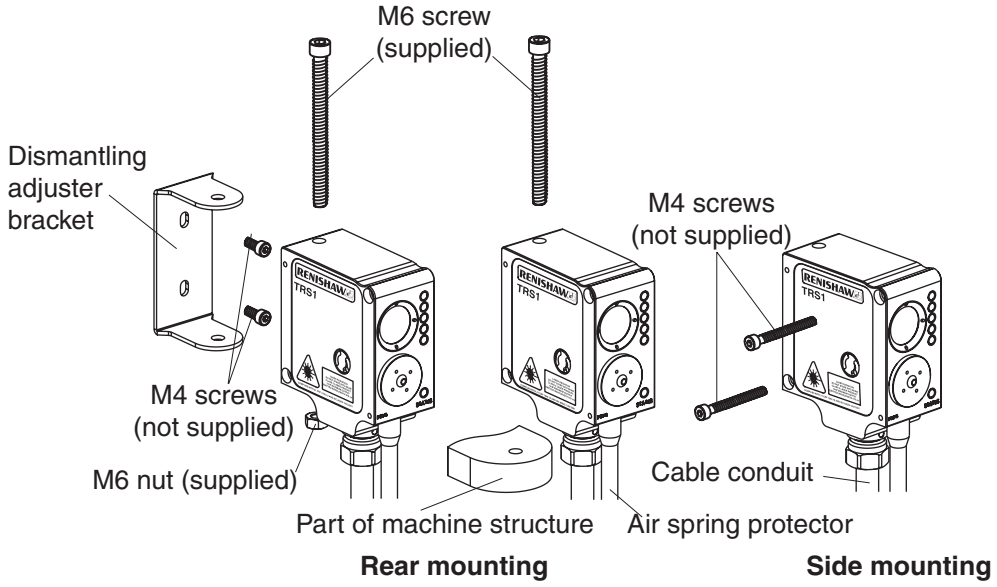
A beam stop in the form of a piece of black tape fixed to the outside of the machine window may be used.

Mount the TRS1 as close to the tools to be detected as possible, so that the beam is at 90 degrees to the end of the tool. The TRS1 system must be installed perpendicular to the tool axis for optimum performance, refer to the diagram on page 10. Performance will be affected if perpendicularity is not achieved, and this effect increases with separation.

- The tool must be able to move in the Z axis relative to the TRS1 system, so that tools of different lengths can be checked.
- The closer the TRS1 is to the tool, the greater the reflected light level, so small diameter tools or those with a blue finish are more easily detected.
- To maximise service life, mount the system such that swarf contamination will be at a minimum.

Note: The TRS1 system can be mounted on its side or upright.

1. Mount the system on a rigid part of the machine, refer to the diagram below for possible mounting configurations. Tighten the M6 mounting screw using a 10 mm AF spanner and a 5 mm AF hex driver to 8.3 Nm (6.12 lbf. ft). Tighten the M4 mounting screws using a 3 mm AF hex driver to 2.6 Nm (1.92 lbf. ft).
2. Fit the cable conduit and air spring protector to the system, refer to the diagram below.
3. Connect the cable to the machine controller, refer to the diagram on page 9.



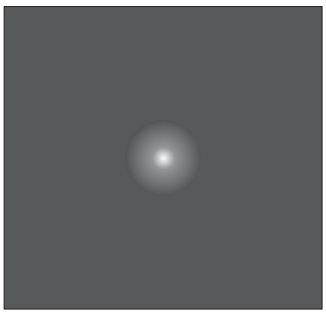
Air supply

The TRS1 uses a clean air supply to protect the laser transmitter from the machine environment. It is recommended that the air supply be switched on at all times to prevent contamination.

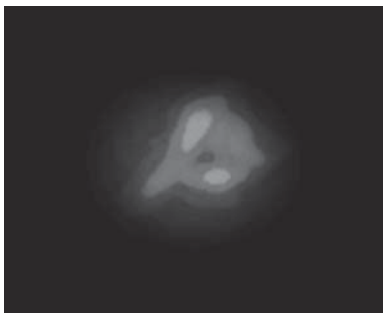
The air supply to the TRS1 system must conform to ISO 8573-1 air quality of class 1.7.2 and be moisture-free. If the air quality cannot be guaranteed, an optional air filtration system is available from Renishaw – see the parts lists on page 18.

Also refer to the graph below which gives the recommended air pressure against installed air pipe length.

Failure of the air supply may cause the TRS1 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 diagrams below. If contamination is suspected, carry out the cleaning procedure (see Cleaning on page 14).



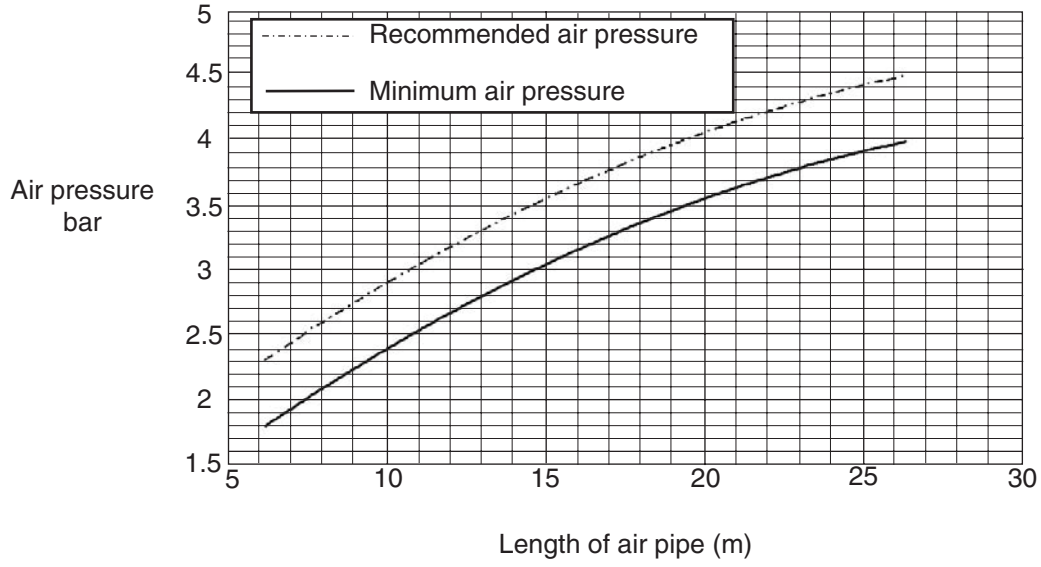
Good spot



Dispersed spot

Air pressure

Refer to the graph below for recommended air pressure against the length of air pipe.

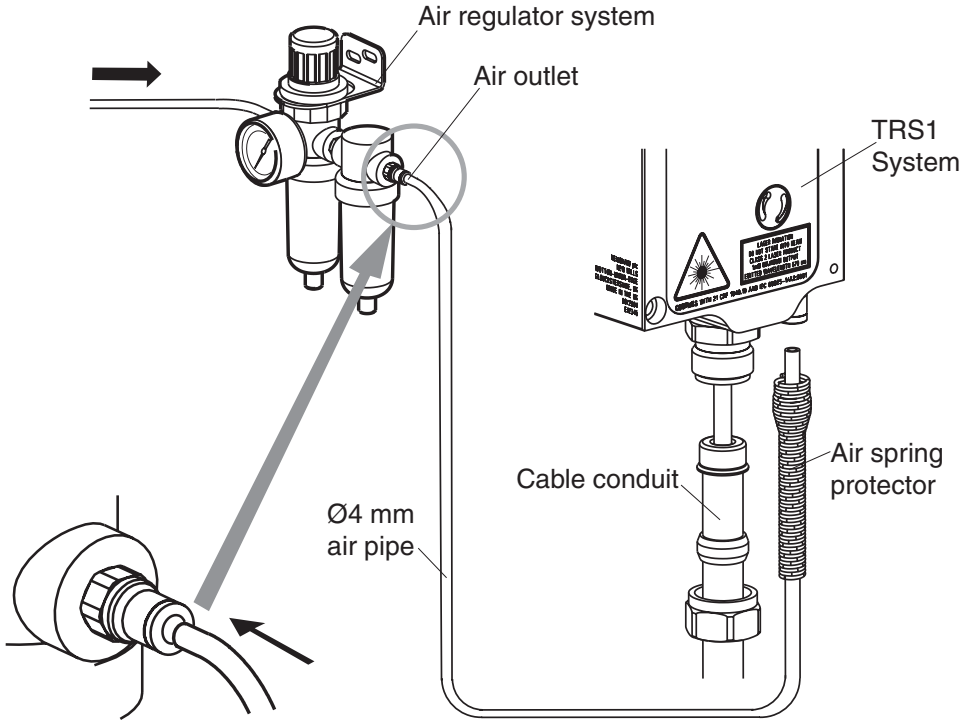


CAUTION: Do not connect the TRS1 system to an oiled air supply. Purge all piping prior to connection.

Connecting and purging the air supply

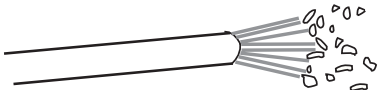
CAUTION: Safety glasses must be worn.

1. Connect a suitable pipe to the air supply.
2. Before connecting the pipe to the inlet of the air regulator system, briefly switch on the air supply to clear out any debris from the pipe.
3. Connect one end of the 4 mm air pipe into the air regulator system.
4. Cut the 4 mm pipe to length, ensuring that the length of the pipe is as short as possible to minimise the drop in air pressure. Make a note of the installed pipe length.
5. Temporarily, tape over the free end of the pipe, to ensure that no coolant or debris is allowed to enter the pipe.
6. Push the free end of the air supply pipe through the air spring adaptor.
7. Before connecting the pipe to the inlet of the TRS1 system, briefly switch on the air supply to clear out any debris from the pipe.
8. Connect the free end of the pipe to the TRS1 system.
9. Push the air spring adaptor up over the air fitting on the TRS1 system.
10. Switch on the air supply, and set the pressure according to the graph on page 7.



CAUTION: The air supply should be permanently switched on otherwise coolant may enter the TRS1.

Purge air supply to dislodge debris from pipework prior to connection as small particles may block the air nozzle.



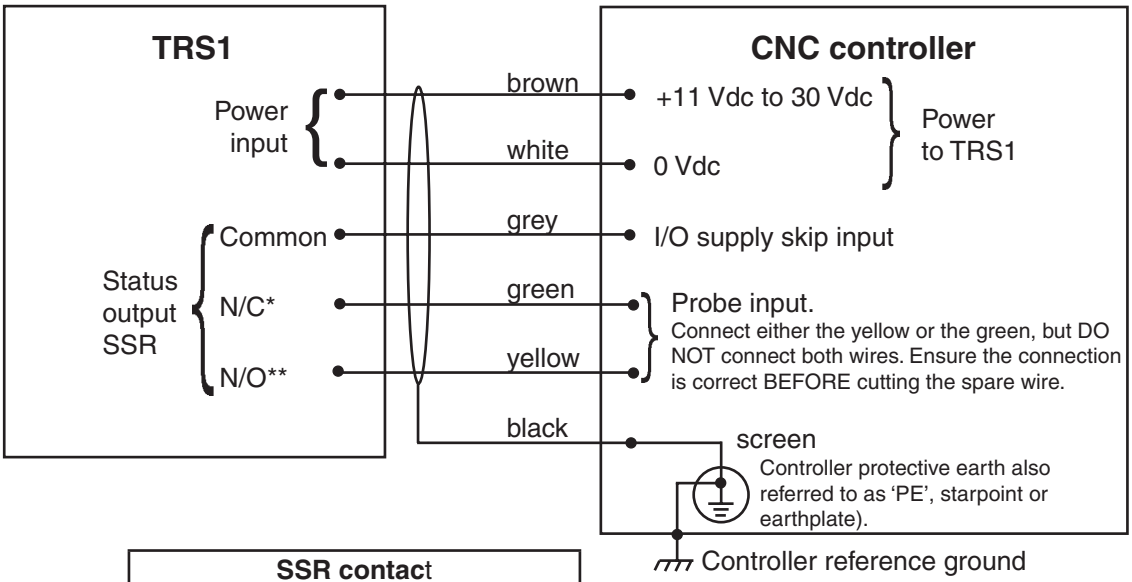
Power supply

The TRS1 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 45 mA.

Alternatively, the TRS1 can be powered from a Renishaw PSU3 power supply.

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

CAUTION: If the SSR output is connected as normally open (N/O), the TRS1 will remain in a non-triggered state if the power supply is interrupted or if the TRS1 is damaged.

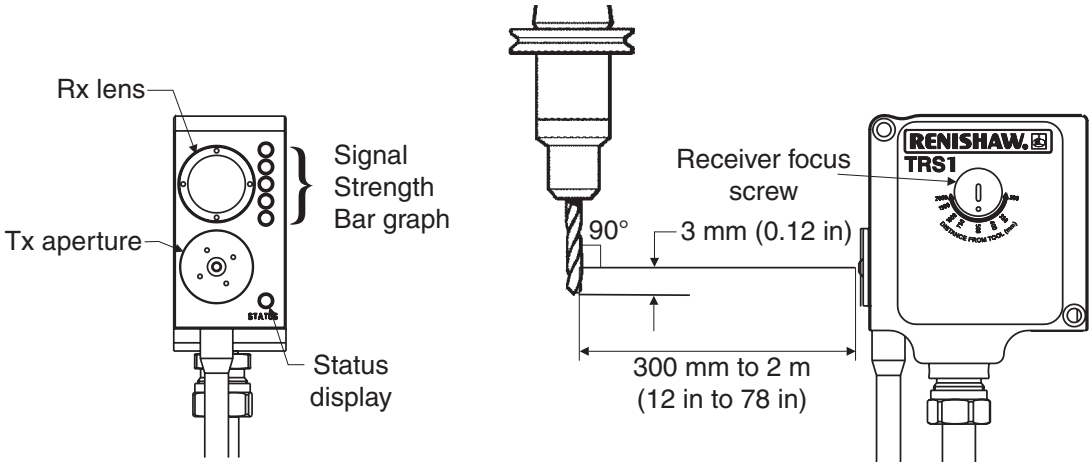


	SSR contact	
Status	*Normally closed (N/C)	**Normally open (N/O)
Tool detected	Open	Closed
Tool not detected	Closed	Open

Important note: The above diagram is an example connection diagram. For controller specific diagrams see the readme.txt file A-4014-0014 that is on the CD in the back of this book.

Range setting

1. Position the reference tool at the point at which tool checking is to be performed. The reference tool must be of known length and must be the smallest diameter tool that will be checked, as this will provide the weakest reflected light signal.
2. Measure the distance between the tool and the TRS1 front face (the range must be between 300 mm [12 in] and 2 m [78 in]).
3. Adjust the position of the receiver focus screw using a flat bladed screwdriver or a coin until the pointer is opposite the required range.



Determine the checking position

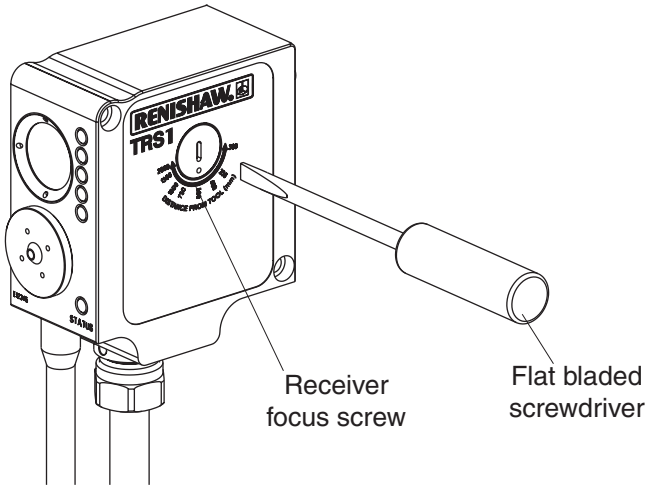
1. Rotate the reference tool at 1000 rpm.
2. The end of the tool should be positioned approximately 3 mm (0.12 in) into the laser beam, refer to the diagram above. Move the position of the TRS1 system relative to the tool side to side until the highest number of displays in the bar graph are lit, (refer to the diagram on page 5).

   Alternatively, place a piece of white paper behind the tool and centralise the shadow of the tool on the red laser spot.

   At 2 m (78 in) separation, it may only be possible to illuminate one red light on the bar graph display with the smallest tool. The received signal will increase as the separation is reduced.
3. Tighten the M6 mounting screw using a 10 mm AF spanner and a 5 mm AF hex driver to 8.3 Nm (6.12 lbf. ft). Tighten the M4 mounting screws using a 3 mm AF hex driver to 2.6 Nm (1.92 lbf. ft) and check that the TRS1 system has not moved.
4. Note down the X and Y coordinates of the checking position. Those installations where the TRS1 system does not move with the X or Y axes, only require the Z coordinate to be input.
5. Move the tool position in Z only until the laser beam is only just shining on the tip of the tool. Note down the Z coordinate.
6. Add the tool length of the reference tool to the Z coordinate.
7. Input this checking position into the memory locations accessed by the high-speed tool detection program.
8. 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.
9. It is the user's responsibility to ensure that every tool can be detected at the checking position.

Note: If there is no access to the range setting screw when the system is mounted in the machine, the range setting can be performed off the machine.

(continued on page 11)



Cleanliness

It is recommended that low pressure coolant washes off the TRS1 system on a regular basis during cutting cycles. This will help to prevent the build-up of swarf or dried coolant on the receiver lens and can easily be achieved by directing a coolant nozzle at the front of the TRS1 system.

Fault	Rectification
No status light is lit.	● Check power connection. ● Check for damage of the cable.
Status display changes, but there is no skip at the controller.	● Ensure that the correct relay contact is being used (normally open or normally closed). ● Check the connection at the controller. ● Check that the correct skip is active.
There is no laser beam.	● Check the Tx aperture for blockage. ● Check power connection.
The TRS1 system fails to detect **all** good tools.	● Check that the spindle speed is set to 1000 rpm with no spindle override set. ● Check Rx lens for contamination or damage. ● Check that the range is between 300 mm (12 in) and 2 m (79 in). ● Check system alignment in the X, Y and Z axes. ● Check the tool position in the laser beam at checking point. ● Check that the receiver focus screw is set correctly. ● Check that the beam hits the tool at 90° to the tool axis of rotation.
Fails to detect a **specific** good tool.	● Check that the tool gives enough good reflection (the bar graph display must be lit). ● Check that the coolant on the tool is not disrupting the beam's sight the tool. If it is, move to a cleaner part of the tool or remove coolant with a spin, air blast or other method. ● If the tool does not have a solid centre, it may not have been detected.
Dispersed laser beam.	● Clean Tx optics and identify source of contamination.

Note: For the latest troubleshooting diagram, please refer to the Renishaw web site at www.renishaw.com. Then search for TRS1

Application	High speed non-contact tool breakage detection of solid tools.
Working temperature	5 °C to 50 °C
Storage temperature	–10 °C to 70 °C
IP rating	IPX8 with air on.
Life	Tested to >1 million on/off cycles.
Tool diameter	See page 5.
Pneumatic supply	Ø4 mm air pipe, refer to the graph of recommended air pressure against air pipe length on page 7. Air supply to the TRS1 system must conform to ISO 8573-1: Air quality of class 1.7.2.
Weight	0.75 kg (1.65 lb) including 10 m of cable.
Mounting	Mounting bracket provided, with M4 mounting holes. Alternative mounting arrangement provided by M4 holes in the product housing.
Range	See page 5.
Input voltage	11 Vdc to 30 Vdc
Current consumption	Typically less than 45 mA.
Cable	5 core plus screen cable. Each core 18/0.1 insulated. Ø5.0 (0.20 in) x 10 m (32 ft).
Output	Solid state relay (SSR) normally open/normally closed contact max. 40 mA (fused at 50 mA), refer to page 9.

Introduction

The TRS1 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 only be carried out at authorised Renishaw service centres.

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

Guidelines

- The TRS1 is a precision tool and must be handled with care.
- A low pressure coolant wash should be used during cutting cycles to keep the TRS1 clear of swarf.
- Ensure that the system is firmly secured to its rigid mounting.
- Do not allow excessive waste material to build up around the system.
- Keep electrical contacts clean.
- A continuous stream of clean air protects the TRS1 system. Approximately every 3 months, inspect the optics for contaminants. The service interval may be extended or reduced dependent upon experience, refer to page 7.

Cleaning

Cleaning may be required if the air to the TRS1 becomes contaminated or if the system is left with the air off when coolant is present. Excessive contamination will block the laser beam and prevent the TRS1 from functioning. In this condition, the STATUS display 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, refer to page 7.

If the receiver lens is contaminated, it should be cleaned, refer to page 14.

Equipment required

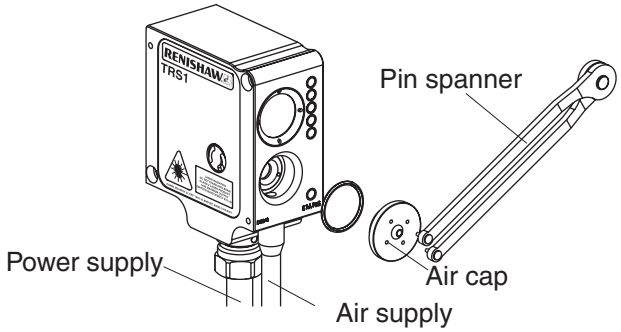
- Pin spanner.
- Solvent cleaner plus, RS No. 266-0856 (recommended) or isopropyl alcohol.
- Dust remover clean air spray (RS No. 846-698).
- 2 × wrapped polyester swabs (RS No. 408-1794).

CAUTION: Before removing the air cap, switch off electrical power to avoid exposure to the laser beam.

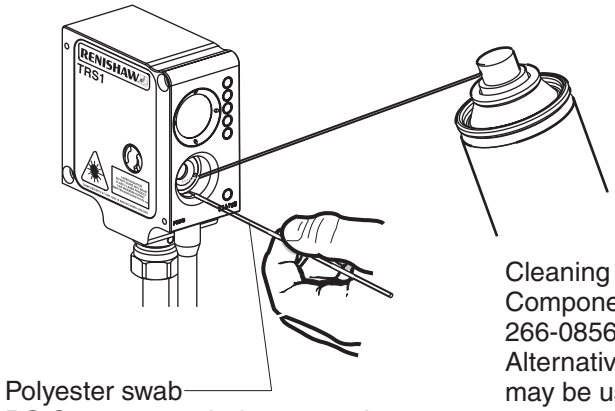
Cleanse the TRS1 system as follows:

1. Make a note of the air supply pressure, then switch off the air supply and power supply.
2. Remove the air cap from the transmitter using the pin spanner provided.
3. Switch on the air supply and increase the pressure to purge out coolant that may be present in the pipe work.
4. When no further coolant is emitted, switch off the air supply.

(continued on page 15)



5. Spray solvent cleaner into the lens cavity.
6. Wipe out any oil that may be present.
7. Spray the solvent onto the lens surface and clean off using a swab.
8. Check to see if there is a good spot - refer to page 7.
9. Clean the air cap to remove all traces of oil and debris.
10. Replace the air cap and tighten to 2 Nm (1.48 lbf.ft), ensuring that the O-ring seal is present.
11. Turn on the air supply and set the pressure to the value noted in step 1.
12. Also, clean the receiver lens using the solvent cleaner and the polyester swab as described in step 5 to step 7.
13. Switch on the power supply.



Note: The following procedure applies to the air regulator system M-2253-5120, which is available from Renishaw.

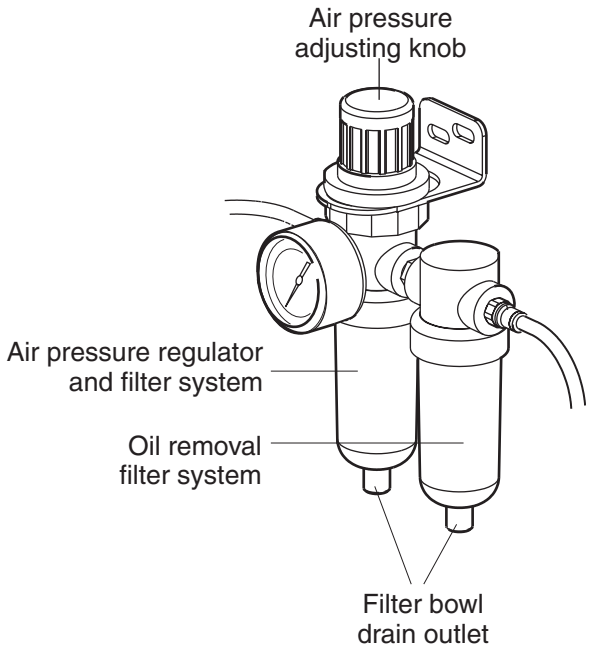
Checking the liquid level

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

Draining the liquid

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

1. Make a note of the air supply pressure, then switch off the air supply. A quantity of liquid will drain from the bowl.
2. Switch on the air supply and set the pressure to the value noted in step 1.
3. Repeat steps 1 and 2 until the bowls are empty.



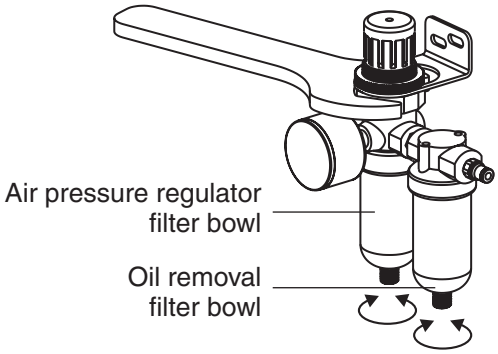
Removing and refitting filter elements

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

1. 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 element.
5. Fit the replacement filter and, where applicable, the O-ring. These are shown in dotted box A in the figure on the next page.

(continued on page 17)

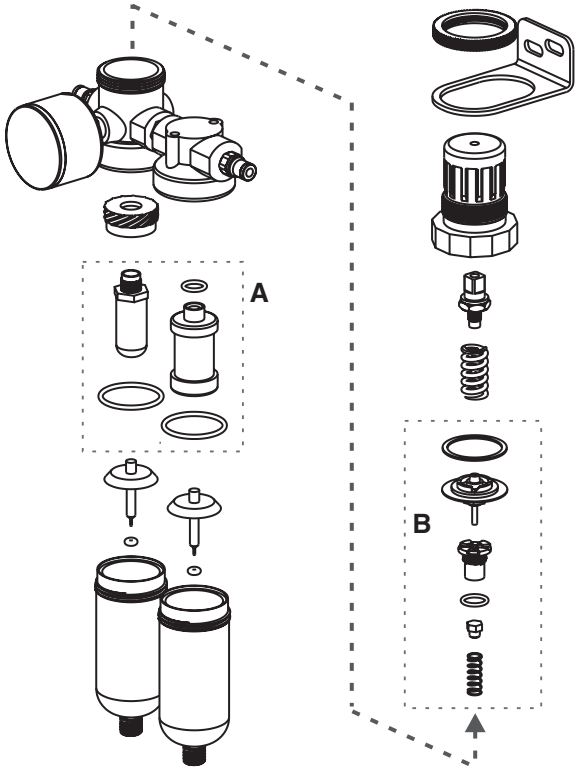
6. Fit a new O-ring into the recess in the filter bowl.
7. Refit the filter bowl and screw hand tight.
8. Switch on the air supply and set the pressure to the value noted in step 1.



Replacing other service kit components

1. Make a note of the air supply pressure, then switch off the air supply.
2. Using a 38 mm AF spanner, remove the regulator head.
3. Remove the components (shown in dotted box B in the figure) from the body of the regulator.
4. Fit the new components to the regulator body.
5. Refit the regulator head and tighten to 7.7 Nm (5.7 lbf.ft).
6. Switch on the air supply and set the pressure to the value noted in step 1.

Note: Items shown within dotted boxes A and B are included in the air filter service kit obtainable from Renishaw (see the parts lists on page 18).



Type	Part number	Description
TRS1	A-4178-0400	TRS1 assembly, 10 m cable, mounting bracket, pin spanner, product documentation and software CD, laser warning sign
TRS1 kit	A-4178-1000	Contains all the items as per kit A-4178-0400 plus cable conduit, air regulator, 25 m air pipe and air pipe conduit
Pin spanner	P-TL09-0005	Used for removing air cap
Air assembly kit	A-2253-5120	Air regulator with 2 x Ø4 mm air fittings and gauge, 25 m x Ø4 mm air pipe
Air filter service kit	P-FI01-S002	Service kit for air regulator - parts for both filter bowls
Deluxe air filter	P-FI01-0008	Air regulator with blocked filter indication and auto drain
Product documentation and software CD	A-2000-1001	Contains installation and user instructions, programming manuals, software and software installation instructions
Cable conduit	P-CF01-0001	Sold per metre
Air pipe	P-PF26-0010	25 m x Ø4 mm black nylon tube
PSU3	A-2019-0018	PSU3 power supply system (for details see data sheet H-2000-2200, which is available from the Renishaw web site at www.renishaw.com)
Air pipe conduit	M-2253-0207	2 m x Ø7 mm stainless steel air pipe protector
Cable gland	P-CF02-0001	Cable gland for cable conduit
Cable gland	P-CA61-0054	Cable gland (domed) for air pipe conduit
Locknut	P-NU09-0016	M16 x 1.5 mm locknut
Air cap	A-4178-0440	Replacement air cap

Renishaw plc

New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com

www.renishaw.com

RENISHAW
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For worldwide contact details, please visit our main website at www.renishaw.com/contact

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