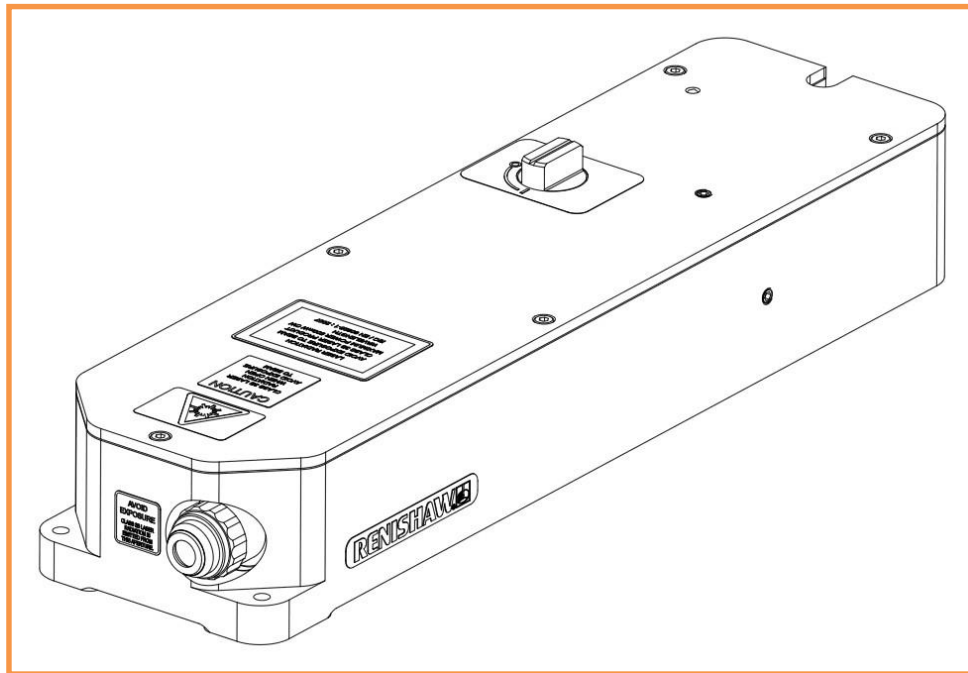


RP20 fibre optic probe user guide



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Equipment requiring attention under warranty must be returned to your equipment supplier. No claims will be considered where Renishaw equipment has been misused, or where repairs or adjustments have been attempted by unauthorised persons. Prior consent must be obtained in instances where Renishaw equipment is to be substituted or omitted. Failure to comply with this requirement will invalidate the warranty.

Before you begin

Use of the system in a manner other than that defined in this manual may result in damage to the system, impair the protection provided and/or place the user and/or others at risk.

Electrical safety

The RP20 contains only low-voltage electrical components, powered from the spectrometer and/or the connected PC.

Laser safety

The RP20 is a Class 3B laser product as defined by, and in conformity with:

- IEC 60825-1:2014;
- EN 60825-1:2014;
- US 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

Each RP20 is designed for use with a single, continuous wave (CW), Class 3B laser, as supplied with the spectrometer by Renishaw. If the laser is not supplied by Renishaw it must conform to the requirements for the spectrometer defined by Renishaw or be as agreed by Renishaw in writing.

Each RP20 is wavelength-specific. Refer to the laser rating label on the probe body for the laser wavelength.

Class 1 inVia systems



WARNING: If a fibre optic probe is fitted to a Class 1 inVia system, that system then becomes a Class 3B laser system while the probe remains connected, unless the probe is itself installed inside a Class 1 laser enclosure.

Laser safety eyewear



WARNING: Laser safety eyewear appropriate to the laser(s) in use should be worn at all times when there is a risk of exposure to harmful laser radiation.

Laser safety eyewear to EN 207 is recommended by Renishaw plc.

Maximum laser input powers

The maximum laser input powers indicated in table 1 should not be exceeded for a RP20 probe.

Wavelength	Max. power
514 nm	100 mW
532 nm	150 mW
633 nm	20 mW
785 nm	350 mW

Table 1: Maximum CW laser input powers

Maximum permissible exposure (MPE)

The maximum permissible exposure level (eye) is the maximum level of laser radiation to which the human eye may be exposed without risk of immediate or subsequent injury. The level varies with wavelength, pulse length and exposure duration. Table 2 shows MPE values for CW laser radiation for the standard laser wavelengths available for the RP20 probe.

Wavelength	MPE _{eye}
514 nm	10.00 W·m ⁻²
532 nm	10.00 W·m ⁻²
633 nm	10.00 W·m ⁻²
785 nm	14.79 W·m ⁻²

Table 2: MPE values for CW lasers.

Nominal ocular hazardous distance (NOHD)

The NOHD of a laser is the distance over which the laser radiation poses a hazard to the human eye.

The NOHD for the maximum laser powers as stated in table 3.



WARNING: The NOHD of the laser beam emitted from the probe when no sampling lens is fitted will be greater than the dimensions of a typical laboratory environment.

Ensure that the internal laser shutter is closed whenever a sampling lens is not fitted.

Sampling lens	NOHD / m			
	Wavelength / nm			
	514	532	633	785
F=18mm nosepiece	0.5	0.7	0.3	0.9
Olympus SLMPlan 20x/0.25	0.3	0.5	0.2	0.6
Olympus LMPlanFLN 20x/0.40	0.2	0.3	0.1	0.4
Leica NPlan 5x/0.12	0.6	1.0	0.4	1.1
Leica NPlan 20x/0.40	0.2	0.3	0.1	0.4
Leica NPlan 50x/0.75	0.1	0.2	0.05	0.2

Table 3: NOHD for RP20, assuming 100% laser transmission to probe aperture as safety factor.

Laser safety features

The RP20 has several safety features incorporated into the design. Familiarise yourself with these features before using the probe.

Internal laser shutter

The RP20 contains an internal shutter which prevents laser radiation from exiting the sampling lens when the shutter knob aligns with the 'O' position.

The shutter is manually operated by rotating the knob through 90 degrees between to align with the 'I' or 'O' positions, shown in figure 1.

The shutter may be rotated in either direction. Detents hold the shutter in the selected position.

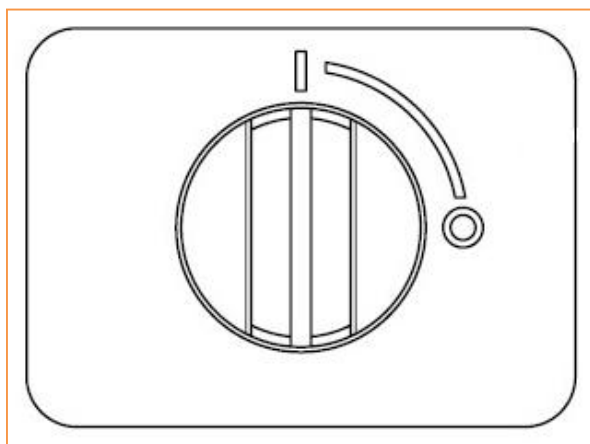


Figure1: internal laser shutter, shown in the 'I' position

Laser 'ON' indicator

The RP20 contains a laser 'ON' indicator (figure 2) that will be lit only when the probe is receiving power from the spectrometer.

The indicator appears amber when lit and signifies that laser radiation may be emitted from the laser aperture.

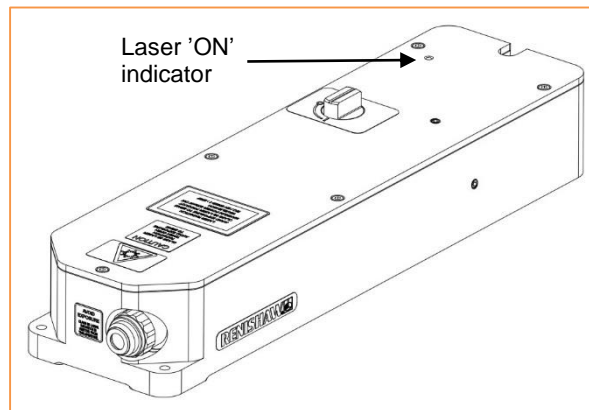



Figure 2: Laser 'ON' indicator

Laser interlock

The RP20 contains a laser interlock so that if the fibre optic cable is accidentally unplugged from the spectrometer, or the cable is mechanically severed, the spectrometer interlock chain will be broken and connected lasers will immediately cease to emit.

RP20 Laser safety labelling

Laser safety labelling affixed to the RP20 is indicated in table 4 and in figure 3. Visible or invisible laser radiation variants will be used according to the wavelength of the RP20.

 <p>Laser warning symbol label</p>
<div data-bbox="290 627 443 779"> <p>AVOID EXPOSURE</p> <p>CLASS 3B LASER RADIATION IS EMITTED FROM THIS APERTURE</p> </div> <div data-bbox="459 627 612 779"> <p>AVOID EXPOSURE</p> <p>CLASS 3B INVISIBLE LASER RADIATION IS EMITTED FROM THIS APERTURE</p> </div> <p>Laser aperture warning labels</p>
<div data-bbox="244 862 448 1059"> <p>CAUTION</p> <p>CLASS 3B LASER RADIATION WHEN OPEN AVOID EXPOSURE TO BEAM</p> </div> <div data-bbox="459 862 663 1059"> <p>CAUTION</p> <p>CLASS 3B INVISIBLE LASER RADIATION WHEN OPEN AVOID EXPOSURE TO BEAM</p> </div> <div data-bbox="287 1081 624 1187"> <p>CAUTION</p> <p>CLASS 3B VISIBLE AND INVISIBLE LASER RADIATION WHEN OPEN AVOID EXPOSURE TO THE BEAM</p> </div> <p>Class 3B laser panel warning labels</p>
<div data-bbox="271 1265 635 1485"> <p>LASER RADIATION AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT MAXIMUM POWER 500 mW CW WAVELENGTH xxx nm IEC / EN 60825-1 : 2014</p> </div> <div data-bbox="271 1500 635 1720"> <p>INVISIBLE LASER RADIATION AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT MAXIMUM POWER 500 mW CW WAVELENGTH xxx nm IEC / EN 60825-1 : 2014</p> </div> <p>Laser rating labels*</p> <p>* Laser wavelength replaces xxx on label</p>

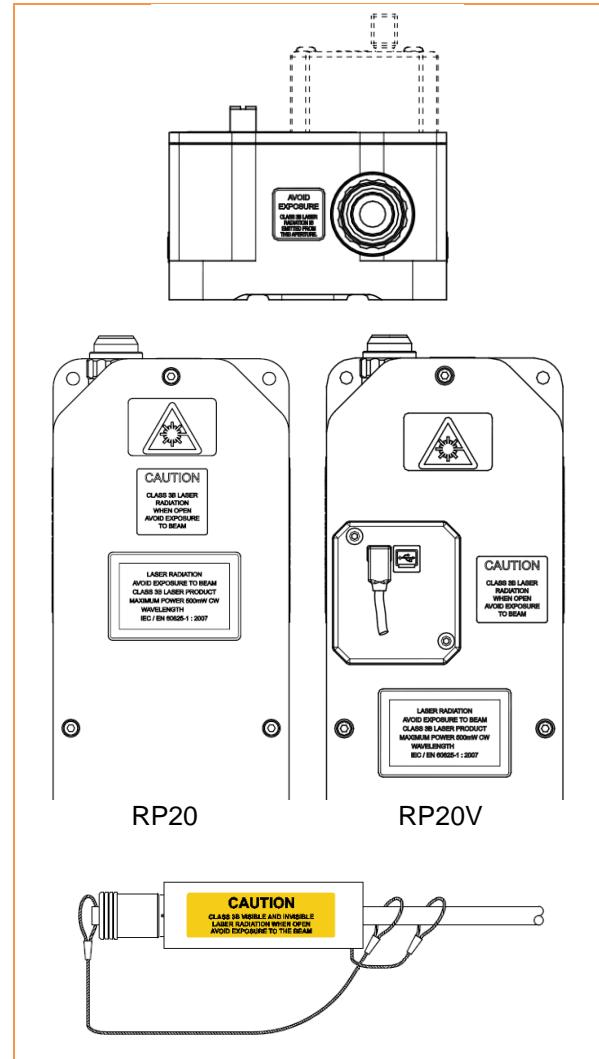


Figure 3: Positions of RP20 laser safety labelling on probe body and on fibre connector.

Table 4: RP20 laser safety labelling.

RP20 basics

The RP20 is a fibre optic probe (FOP) designed for use with Renishaw Raman systems.

Each RP20 operates with a single laser wavelength, identified on the laser rating label on the probe body.

Up to three RP20s may be connected to an appropriately-configured inVia Raman spectrometer, utilising a proprietary fibre connector. Other configurations may apply.

The RP20 may be fitted with a video capability, in which case the probe is designated as an RP20V. The video feature allows features on the sample to be identified for Raman analysis and provides an aid to laser focussing.

Related documentation

- InVia hardware safety manual M-9836-3991
- WiRE user guide (WiRE > Help > Contents)
- Other manuals as supplied with the system and accessories, in particular the laser user manuals.

Installation

Initial hardware installation and software setup of RP20 probes should be carried out only by a qualified Renishaw engineer.

Operation



WARNING: Follow laser safety precautions advised in the section Laser safety.

Refer to the inVia hardware safety manual and to the WiRE user guide for standard operation of the inVia system, or to the user manual for other Raman systems as may be supplied.

Prior user training by the installation engineer on the use of the inVia system (or other Renishaw Raman system as may be supplied) is assumed. The training will cover any deviations for the individual system.

Follow the guidance given in the sections in the following pages.

Fibre optic connector

Use the following procedure when connecting the fibre optic cable on a standard inVia system.

Fibre-only systems may not include the interlock shorting plug; other systems may have a permanently-attached fibre optic cable installed by a service engineer.



CAUTION: Only connect and disconnect the fibre optic connector in a clean environment. The number of cycles should be kept to a minimum to reduce the risk of contamination.

1. Ensure that all lasers connected to the system are fully switched off, according to their standard operating procedures.



CAUTION: Do not use the interlock chain to shut off laser emission, as repeated improper shut-down may reduce the service life of some lasers.

2. Close the probe internal laser shutter.
3. Use a 1.5 mm hexagonal key to loosen the two grub screws that secure the locking sleeve to the system connector (figure 5A).
4. Pull on the ridged section of the connector to remove the interlock shorting plug from the system (figure 5B). If the system interlock relays were previously enabled, a click will be heard as the relays are disabled.
5. Remove the end cap from the fibre optic cable.
6. Align the red dot on the cable connector to the red dot on the system connector (figure 5C), then insert carefully until the locking click is heard.
7. Slide the locking sleeve over the system connector, then use a 1.5 mm hexagonal key to tighten the grub screws, securing the locking sleeve to the system connector (figure 5D).
8. Connect the end cap of the fibre optic cable to the interlock shorting plug to reduce the risk of dust contamination.
9. Re-set the system interlock (WiRE > Tools > Interlock... > Reset), then re-start the required lasers according to their standard operating procedures.



WARNING: Laser radiation may now be emitted from the probe laser aperture.

Disconnection is the reverse of connection.



Figure 5A



Figure 5B



Figure 5C



Figure 5D

Figure 5: Fibre optic connector

Video cable connection

When an RP20V is supplied, the following additional steps must be followed for connection and operation:

1. Connect the supplied USB cable to the mini-USB socket on the video camera.
2. Connect the supplied active USB extender between the USB cable and a spare USB port on the system PC.

NOTE: Alternative cabling may be supplied depending on the system configuration.

Sampling lens



WARNING: Before changing the sampling lens or sampling lens adapter, first turn the probe internal laser shutter to the 'O' position.

If no sampling lens is fitted, a collimated laser radiation may be emitted from the front of the probe. The NOHD will be greater than the dimensions of a typical laboratory environment.

RMS-threaded sampling lenses may be screwed directly into the nosepiece at the front of the RP20.

The RP20 is supplied as standard with an 18 mm focal length sampling lens suitable for general use.

M25 × 0.75 mm-threaded objective lenses (typically Leica) may be fitted with the use of an appropriate thread adapter, e.g. Renishaw M-8012-2932, or Thorlabs RMSA2.

Fixing the probe to a suitable surface



WARNING: To ensure safe use of the probe it should be firmly mounted to a suitable surface, to avoid accidental movements of the probe which could lead to unexpected pointing of the laser light exiting the sampling lens.

Three mounting holes are provided on the probe body for the purpose of securing the probe to a suitable surface.

The mounting holes are indicated in the dimensional drawing in Appendix A.

Gathering Raman spectra

The sensitivity of the focussing is dependent on the depth of field of the sampling lens fitted to the probe. The higher the magnification (shorter focal length), the smaller the depth of field and thus the greater the sensitivity of the collected signal levels to focussing.

For example, a 20x SLM Plan objective has a depth of field of approximately $\pm 20 \mu\text{m}$.



WARNING: Follow laser safety precautions advised in the section Laser safety.

Refer to the inVia hardware safety manual and to the WiRE user guide for standard operation of the inVia system, or to the user manual for other Raman systems as may be supplied.

1. Check that the spectrometer is set up for operation with the fibre optic probe. For inVia systems, the correct fibre return mirror must be fitted to the Rayleigh filter stage.
2. Position the sample at the approximate working distance of the sampling lens selected for the experiment.
3. Rotate the probe internal laser shutter to the 'I' position



WARNING: Laser radiation may now be emitted from the sampling lens.

4. Open the system laser shutter.
5. Raman spectra are acquired by focussing the converging laser beam that exits the sampling lens onto the sample of interest. Visually this is achieved by minimising the size of the spot on the sample, however to achieve optimum focus it is recommended that the spectrum be cycled and focussed in real time to give the highest number of Raman counts.

If the probe is an RP20V, the size of the laser spot can be minimised in the video viewer. The laser intensity may need to be adjusted using the system ND filters, where available.

6. Set the measurement conditions in WiRE experiment setup.
7. Run the measurement to acquire a Raman spectrum.
8. When the measurement is complete, rotate the probe internal laser shutter to 'O'.

Care and maintenance

Clean external surfaces using a dry cloth only. Do not use solvents, detergents or other cleaning substances as these may enter the probe and impair performance. Do not clean optical surfaces. Cleaning the fibre connectors requires specialist equipment.

When the probe is not in use, always fit the dust cap to the probe cable and either the dust cap or interlock shorting plug to the system as appropriate.

When the probe is in use, fit the probe cable dust cap and the system cable dust cap or the interlock shorting plug together as appropriate. This prevents dust from gathering in the caps and being transferred to the connectors.

Service

The RP20 contains no user-serviceable parts. Should you suspect a problem, please contact your local Renishaw service agent as detailed in 'Contact information'.

Contact information

Address:	Renishaw plc New Mills Wotton-under-Edge Gloucestershire GL12 8JR UK
Tel:	+441453 524524
Support Email:	raman.support@renishaw.com
Sales Email:	raman@renishaw.com
Website:	www.renishaw.com/raman (Spectroscopy /Technical Support)
Local service contact:	www.renishaw.com/contact

Instructions for disposal



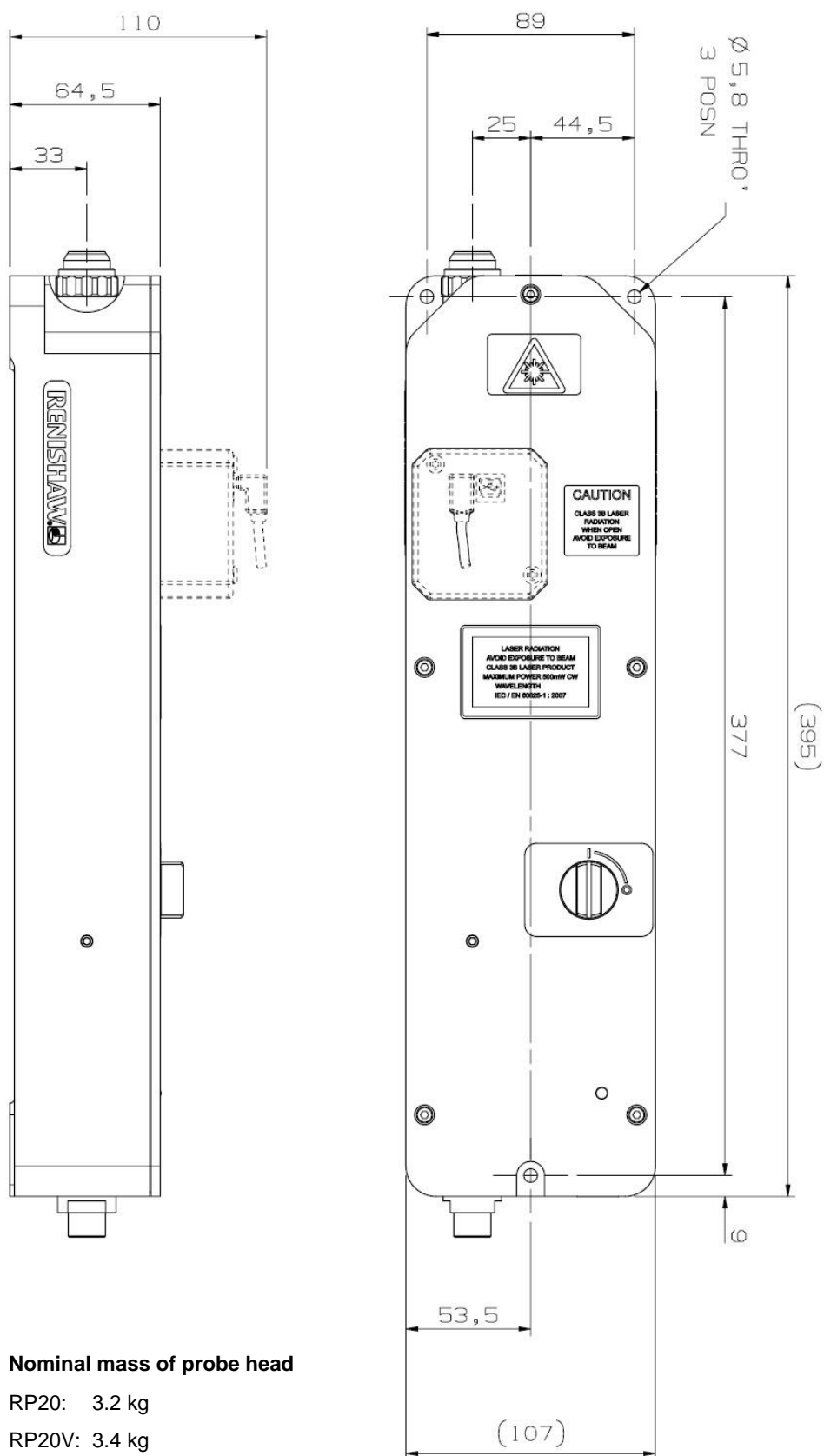
The following instructions for disposal apply to EU-member states.

The use of this symbol indicates that this product may not be treated as household waste. Instead, it is the user's responsibility to dispose of this product at a designated collection point for recycling of waste electrical and electronic equipment (WEEE). Correct disposal of this product will help conserve natural resources and ensure that it is recycled in a manner that prevents potential negative consequences for the environment and human health. For more information, please contact your local waste disposal service or Renishaw distributor.

Recycling information

The RP20 fibre conduit contains fibre optics, which must be recycled in a manner appropriate to local regulations. To remove the fibre conduit, unscrew the RP20 lid, undo the fibre optic connectors within the probe, then use a spanner to loosen and remove the locking nut that secures the conduit to the probe body.

Appendix A: RP20 mechanical specifications



Nominal mass of probe head

RP20: 3.2 kg

RP20V: 3.4 kg