

RHOPOINT



Operating Instructions

Thank you for purchasing this Rhopoint product.
Please read these instructions carefully before operating this product and retain them for future reference.

English

This instruction manual contains important information about the setup and use of your Rhopoint IQ Flex 20-S. It is essential that the contents be read before powering up and operating the instrument.

If this instrument is passed to other users you must ensure that the instruction manual is supplied with the instrument. If you have any questions or require additional information about the Rhopoint IQ Flex 20-S please contact the Rhopoint Authorised Distributor for your region.

The technology and components used in the device are based on state-of-the art optic and electronics. As part of Rhopoint Instruments commitment to continually improving the technologies used in their products, they reserve the right to change information included in this document without prior notice.

© Copyright 2014 Rhopoint Instruments Ltd. All Rights Reserved.

Rhopoint IQ™ and Rhopoint™ are registered trademarks of Rhopoint Instruments Ltd. in the UK and other countries.

Other product and company names mentioned herein may be trademarks of their respective owner.

No portion of the software, documentation or other accompanying materials may be translated, modified, reproduced, copied or otherwise duplicated (with the exception of a backup copy), or distributed to a third party, without prior written authorization from Rhopoint Instruments Ltd.

Rhopoint Instruments Ltd.
Enviro 21 Business Park
Queensway Avenue South
St Leonards on Sea
TN38 9AG UK
Tel: +44 (0)1424 739622
Fax: +44 (0)1424 730600

Email: sales@rhopointinstruments.com
Website: <https://www.rhopointinstruments.com>

Revision C - 1092-01
October 2025

Contents

Storage and Handling	3
Accessories	5
Optional items	5
Functional overview	6
Power	7
USB Connectivity	7
Switching the unit on	8
Operation	9
Menu Screen	13
Viewing Batch Data	14
Setup Screen	15
Data & Batch Screen	16
Calibration Screen	17
Calibration	18
Measurement Screen	19
Pass/Fail Setup Screen	21
IQ Screen	22
Control Screen	23
Instrument Setup Screen	28
Maintenance Screen	30
About Screen	30
Disadvantages of standard gloss measurement	34
Gloss	35
% Reflectance	36
Haze	37
Measuring Haze with the Rhopoint IQ Flex 20-S	38
Haze Compensation	38
Distinctness Of Image (DOI)	40
Reflected Image Quality (RIQ)	41
RSpec- Peak Specular Reflectance	42
Goniophotometric Profile	43
Calculating Gloss, Haze, RSpec and DOI from a Goniophotometric Profile	44

Storage and Handling

- This instrument contains precision optics and electronics. You should avoid knocking or dropping the device as the resulting impact could cause serious damage.
- In some circumstances the optical components in the instrument could become misted due to temperature change. It is therefore recommended that the instrument is not used until it has stabilised to ambient temperature.
- Ensure that the instrument is not exposed to moisture, chemicals or to any corrosive vapours.
- Do not interfere or place any objects inside the measuring aperture as damage to the measuring system could occur.
- The instrument housing and screen are normally resistant to a variety of solvents however it is not possible to guarantee resistance to all chemicals; therefore the surfaces of the instrument should only be cleaned using a soft, moist cloth.
- Prevent exposure of the instrument to direct sunlight for prolonged periods and to continuous humidity and condensation.
- Avoid sharply bending or kinking the cable, particularly near the measurement head or the body of the instrument, as this may cause damage requiring repair.

About the Rhopoint IQ Flex 20-S

The Rhopoint IQ Flex 20-S is an advanced measuring instrument used to quantify the quality of surface appearance.

Unlike a standard glossmeter the IQ Flex 20-S has the unique capability of measuring and detecting quality problems caused by microscopic texture in the surface that cause haze and orange peel effects which lead to poor Distinctness Of Image (DOI),

These factors can seriously affect the visual impact and reflective quality of many coated, painted and polished surfaces. By measuring the quality of the reflected image, it accurately profiles how light is reflected from a surface.

The instrument uses a diode array to measure the distribution of the reflected light at $\pm 7.25^\circ$ from the specular angle of reflection in steps of 0.02832° .

This technology allows the instrument to calculate Gloss, Haze, DOI, RIQ and RSpec providing the user with a complete analysis of the reflective quality of the surface. Definitions of each of the parameters measured by the IQ Flex 20-S can be found in the section "Appearance Theory" detailed later in this manual.

Accessories

The instrument is supplied as a standard package complete with all accessories required to calibrate and recharge the unit including: -

Rhopoint IQ Flex 20-S Goniophotometer

NIST traceable high gloss calibration tile including certificate

Cleaning cloth for calibration tile

NIST traceable instrument certificate

USB Mains Charger with four selectable mains input connectors (UK / Europe / US / Australia)

USB PC cable

Quick Start Operating Instructions

Protective instrument carry case

Location Template

Optional items

NIST traceable mirror gloss calibration tile including certificate

Reduced measuring spot size adaptor, 2mm

Reduced measuring spot size adaptor, 4mm

Functional overview



<u>Label No.</u>	<u>Function</u>
1	Measurement button
2	High Resolution Graphic Display
3	Up/Down/Left/Right Buttons
4	Operate / Enter Button
5	Measurement head

The instrument is controlled by pressing the relevant touch sensitive button. Functionality is dependent on whether the instrument is in menu or operate mode as detailed in the operation sections that follow.

Power

The Rhopoint IQ Flex 20-S is powered by an integrated high capacity lithium ion cell.

Fully charged the instrument will operate continuously for >17 Hours or >20,000 readings.

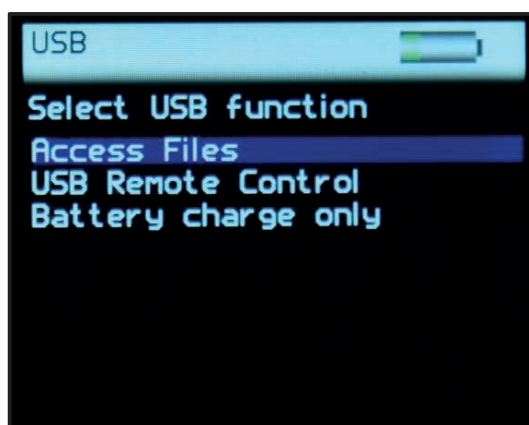
A mains powered USB charger is provided with the unit. This will fully charge the unit when connected to the unit's USB input (6) in up to 9 hours.

Alternatively, the instrument can be powered and charged using the USB cable attached to any compatible USB host (e.g. laptop etc.), Please note that charging from a USB host such as a laptop may take longer due to the lower current available.

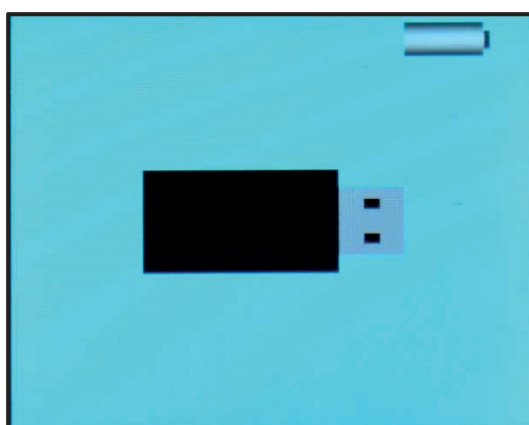
Do not operate the instrument whilst it is charging.

USB Connectivity

Three functions are available when the IQ Flex 20-S is connected to a computer using the USB cable supplied –



Access Files – Allows access to measurement and configuration files on the instrument. The instrument appears as a USB drive named IQ-METER. When selected the display on the instrument shows a USB memory key as shown below –



USB Remote Control - Allows control of the IQ Flex 20-S remotely by sending ASCII commands from a computer or PLC. In this mode the instrument displays “REMOTE CONTROL ACTIVE” on the main measurement screen.

Battery Charge Only – Allows USB charging of the instrument – all instrument functions are available however do not operate the instrument whilst it is connected via USB and/ or charging.

Switching the unit on

To switch on the unit, touch the On/Off button located at the back of the instrument near the USB socket.



The instrument will display the Rhopoint IQ Flex 20-S logo and then the home screen displaying measurement parameters according to the instruments default settings or those previously configured.

Similarly, the instrument can be powered off (dependent on configuration – see Instrument Setup) by pressing the On/Off button for three seconds.

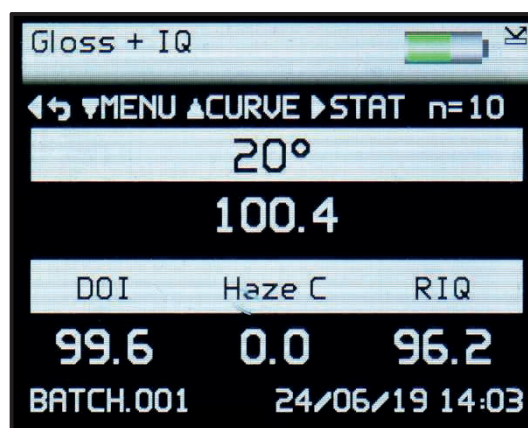
Operation

The Rhopoint IQ Flex 20-S has the ability to rotate its screens according to its measurement orientation.

It automatically displays measurement data in either portrait mode –

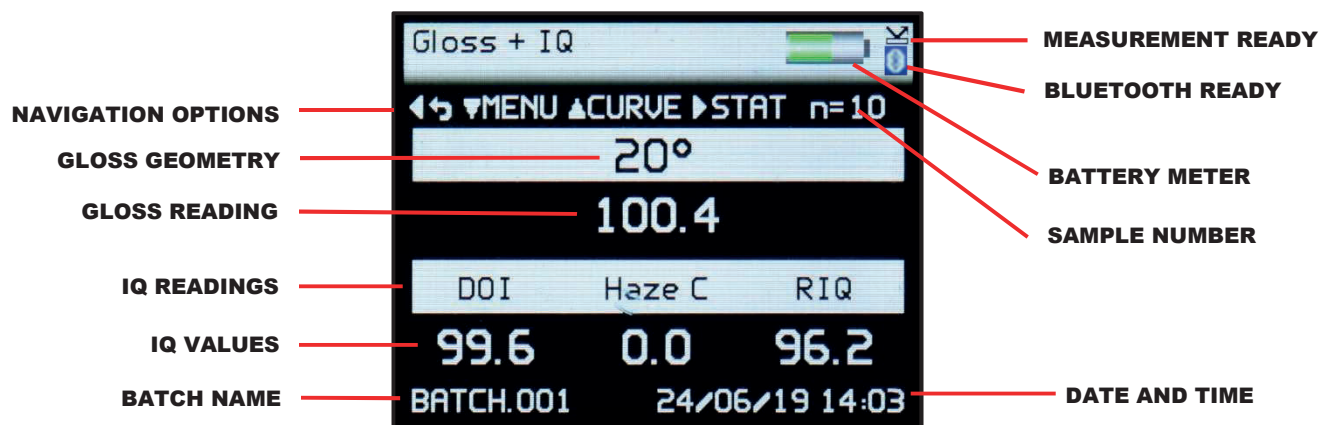


Or landscape mode -



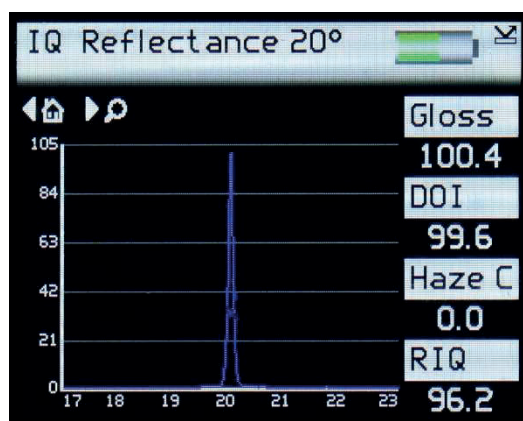
Note- Main measurement screen, statistics and main menu are available in portrait view. Other menus and graphs can only be accessed when the instrument is held in landscape orientation. The flip function is disabled when landscape only screens are shown and when an on-screen prompt is visible.

With the unit switched on and initialised the instrument will display the home screen as shown below.



In this mode, measurements can be made by simply pressing the Measurement button (1) on the side of the instrument or Operate button (4) on the instrument keypad.

Press the Up (3) button in the home screen to display the graph screen.

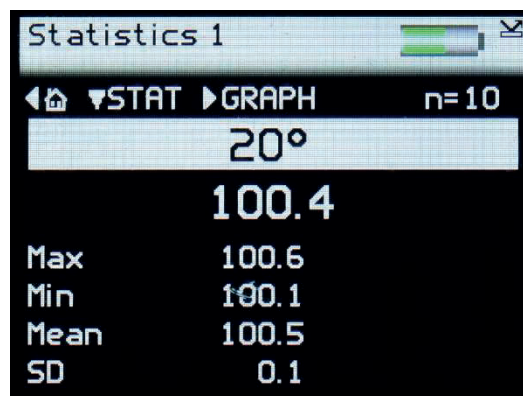


The goniophotometric profile and data for the last 20° measurement will be shown. Measurements can be taken whilst in this screen and the display will update.

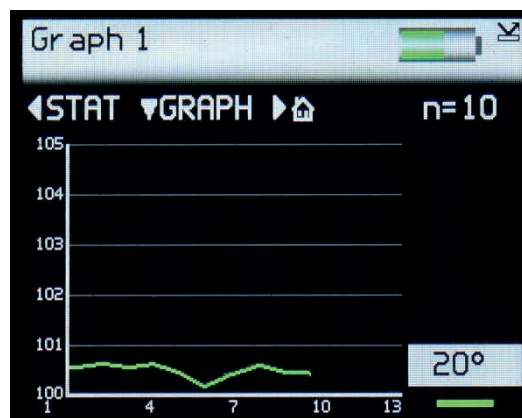
Press the Right button to zoom in, the Y axis will auto-scale to fit the reflectance curve data.

Press the Left button to return to the Home screen.

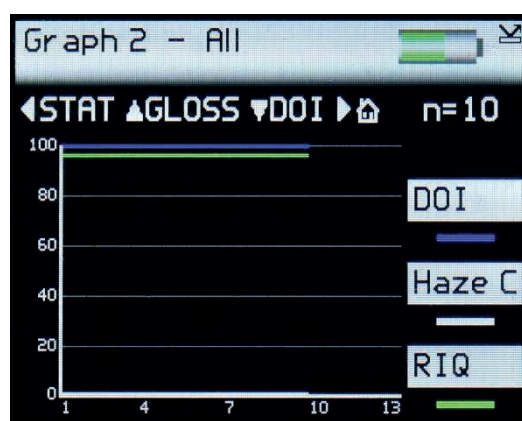
Press the Right button in the home screen to display the Gloss statistics screen



Measurements can again be taken whilst in this screen and the statistics will be updated. Press the Right button to access the Gloss graph screen, this provides a graphical representation of the statistics data.



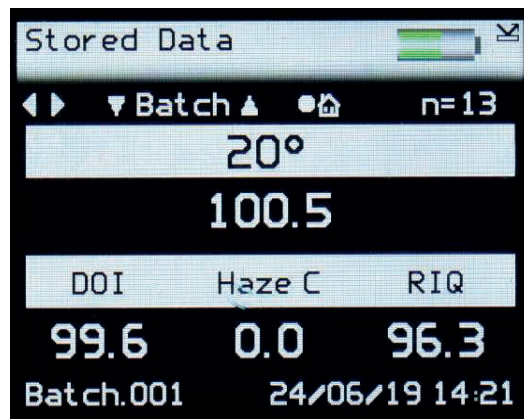
Press the Down button to display IQ data.



Press the Up / Down buttons to display Gloss and IQ data individually. Measurements can be taken whilst in any screen and the graph will be updated after each reading.

Press the Left button to return to the statistics screen.
Press the Right button to return to the home screen.

In the Home screen press the Left button to display the Stored Data screen.



When Memory is set to ON (as detailed later in the Menu Screen section of this manual) measurements can be recalled and displayed from any batch stored in the IQ Flex 20-Smemory.

Press the Left / Right buttons to review the measurement data.

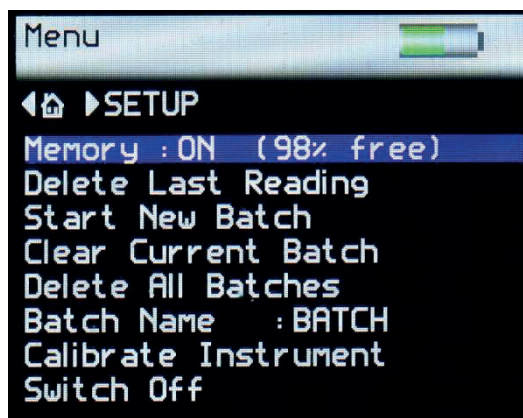
Press the Up / Down buttons to select each batch.

At the end of each batch the mean results are displayed.

Press the Enter / Operate button to return to the Home screen

Menu Screen

The Menu Screen is used to quickly access frequently used options. Press the Up / Down buttons to navigate through the options; press the Enter button to select the option required.



Settings in the menu screen are: -

Memory – Set to ON, enables storage and batching of measurement results.
The amount of available storage memory is also displayed.

Set to OFF, disables result storage.

With Memory ON:

Delete Last Reading – Delete last measurement, no. of measurements and statistics data updated to previous values.

Start New Batch – Start new batch of readings, Batch name is incremented by 1.

Clear Current Batch – Delete entire batch of measurements for current batch.

Delete All Batches – Delete all batches and measurements stored.

Batch Name – Default name is BATCH, a maximum of 8 user defined batch names can be used as detailed in the “Batching Options” section.

Calibrate Instrument – Perform a calibration of the instrument as detailed under “Operation”.

Switch Off – Turn off the instrument.

Press the Left button to return to the home screen.

Press the Right button to enter the Setup screen.

Batching Options

The batching feature allows the user to group measurements together in batches. Each batch has associated statistics; the data for each batch can be accessed by connecting the instrument to a PC.

The current batch name is displayed on the home screen in the bottom left corner, the sample number within that batch is shown in the top right of the screen indicated with n=(sample number).

A new batch is started using the Start New Batch option in either the Menu screen or the Data menu, note that the batch name will increment as will the 'n' indicator.

The current batch can be cleared in either the Menu screen or the Data Menu, the batch name will remain the same but the 'n' indicator will reset to zero.

Auto batch size is user defined using the Auto Batch option in the Data Menu. When the number of readings in the current batch reach the number set by the user the instrument will automatically increment the batch name and set the 'n' indicator to zero.

Viewing Batch Data

To access the stored batch information, connect the instrument to a PC using the USB data cable supplied.

A new device name "IQ-METER" can be viewed and accessed via "MY COMPUTER", in this device open the DATA folder. This folder contains subfolders which contain the data for each individual saved batch. Each reading is saved as an individual comma separated value (.csv) that contains Gloss, Haze, DOI/RIQ, RSpec, Time and Date of Reading, Serial Number and Full Goniophotometric data for all 512 diode elements.

Each reading also contains the statistics for the batch up to and including that reading. To access the STATISTICS for the whole batch, the last reading in the batch should be examined.

User Defined Batch Names

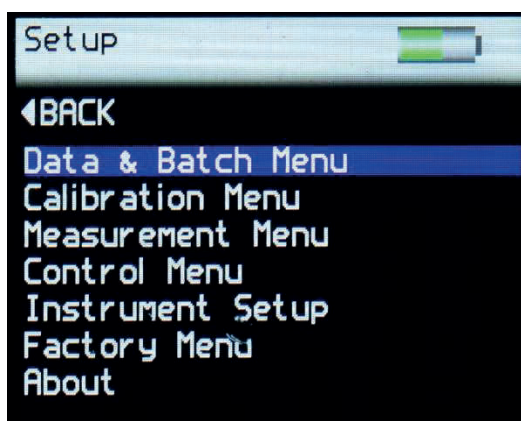
Batch names are user definable. With the instrument connected to a PC, open the folder named "CONFIG". Within this folder there is a document named "batches". This is a .csv file that can be opened in Notepad, Excel or Wordpad.

User defined names should be saved in this document, each name listed on a separate line. Ensure that the final line is terminated with a carriage return.

The format of these names should only contain letters. No numbers, spaces or other characters can be used.

Once completed, save the file then switch the instrument off and on again to initialize the new batch names.

Setup Screen



The Setup Screen is used to customise the instrument settings to the user's preference.

Press the Up / Down buttons to navigate through the options, press the Enter button to select the option required.

Data and Batch Menu - Batch / Data options (See Data & Batch Menu Screen)

Calibration Menu - Calibration options (See Calibration Menu Screen)

Measurement Menu - Geometry setup (See Measurement Menu Screen)

Control Menu - Bluetooth setup (See Control Menu Screen)

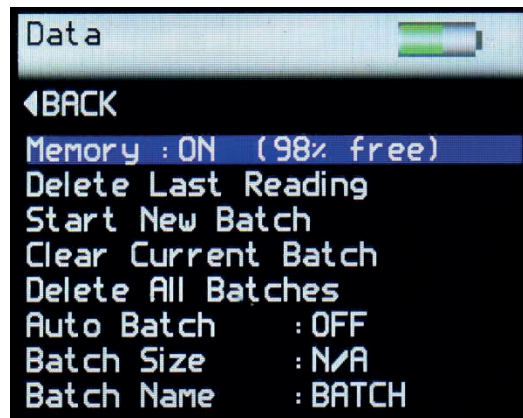
Instrument Setup - Language, Date / Time and Power options (Setup Menu Screen)

Factory Menu - Pin locked menu options for Rhopoint authorised service centres

About Menu – Information about the instrument's firmware version, serial number and last date of Factory Calibration

Press the Left button to return to the Home screen.

Data & Batch Screen



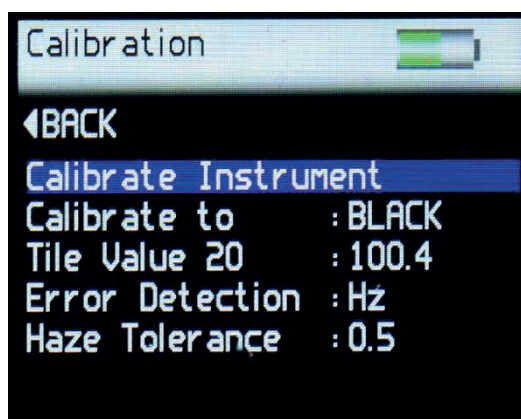
The Data Screen is similar in functionality to that of the menu screen but also allows the selection and setting of the Auto Batch size.

By selecting Auto Batch to ON the batch size can be selected between 1 - 999 by pressing the Left and Right buttons to select the relevant digit and the Up/Down buttons to increment / decrement the value. Press the Enter button to save the batch size.

If Batch names have been user defined, as detailed under Batching Options, selection of the Batch Name required is achieved by repeatedly pressing the Enter button with Batch Name selected.

Press the Left button to return to the Home screen.

Calibration Screen



The Calibration Screen is used to set the instrument calibration to the user's preference. Press the Up / Down buttons to navigate through the options, press the Enter button to select the option required.

Selectable settings in the Calibration screen are: -

Calibrate instrument - Performs an instant calibration of the instrument; a dialogue box being displayed upon completion to either "Cancel" or "Confirm".

Calibrate to - Set to Black - a traceable gloss tile is used for calibration

Set to Mirror - a traceable mirror tile is used for calibration

Tile Value 20 - Set the calibration values for either standard being used for calibration. Press the Enter button to select the value. Press the Left / Right buttons to select the relevant digit and the Up / Down buttons to increment / decrement the value. Press the Enter button again to save the value.

Error Detection - The instrument detects the condition of the calibration standard being used.

Set to OFF - Values are still checked against the stored reference but no other error checking is carried out.

Set to CAL - A check is made to see if an appropriate hardware channel is wildly different to what it should be, indicating that the calibration is being attempted on the wrong tile type.

Set to Hz - A check is carried out on the haze value, if this is higher than expected the tile could be dirty.

Set to CAL + Hz - A combination of the two above.

Haze Tolerance - Set the tolerance for the standard being used for calibration. An ideal calibration standard should have zero haze, therefore setting the value anywhere between 0 – 9.9 defines the acceptable pass band.

Calibration



Standard spot size adaptor

To calibrate the instrument, place the head in the tile holder. It is important to hold the head straight and still during calibration. Calibrate the instrument by selecting “Calibrate Instrument” in the calibration menu.

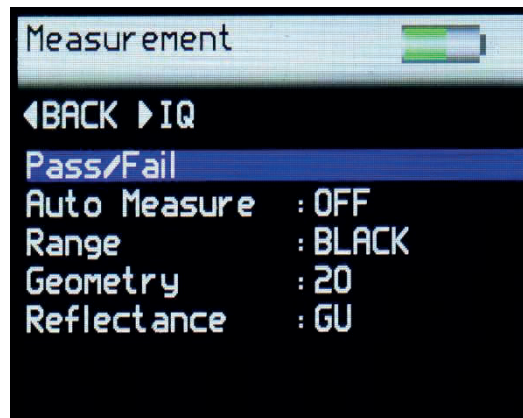
The IQ Flex 20-S can be used with optional 3D printed adapters- these are used to improve accuracy on curved parts.

The adaptors are supplied with a small spot size calibration adapter- the instrument should be calibrated with this in place before use.



Printed curved part adaptor with small spot size

Measurement Screen



The Measurement Screen is used to configure the instruments measurement parameters to the user's preference. Press the Up / Down buttons to navigate through the options; press the Enter button to select the option required.

Selectable settings in the Measurement screen are: -

Pass/Fail - Displays the Pass/Fail set up screen.

Auto Measure - Enables or disables automatic measurement mode, used for monitoring surfaces for changes over a period of time. Press the Enter button to select the required measurement frequency of either 2, 5 or 10 seconds. When auto measure mode is activated a dialogue box is displayed after the Enter button is pressed and before the beginning of the measurement sequence indicating that it is activated. To stop auto measure simply press the Enter button once again at any time during the sequence.

Range - Selects gloss measuring range to:

Auto – Full range

Black – Standard gloss scale

Mirror - Extended scale for highly reflective materials, polished metals, requires calibration using Mirror standard.

Geometry - Displays the head geometry (20°)

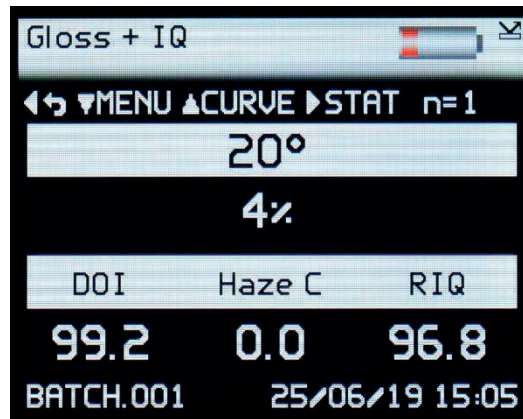
Reflectance - Selects the measurement unit to be displayed for each angle:

% - display percentage reflectance, 100% reflectance = 2000GU@20 degrees

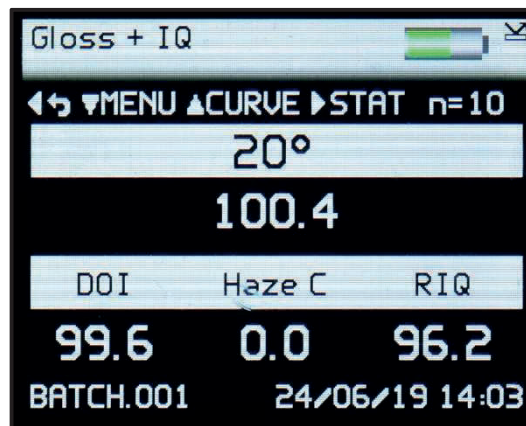
GU - display Gloss Units

Press the Left button to return to the Home screen.

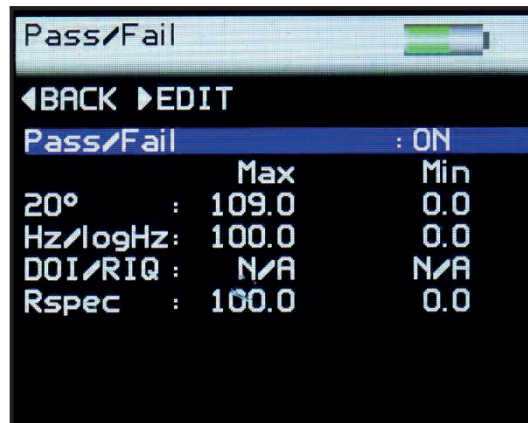
With Reflectance set to % measurement results for each angle are displayed as –



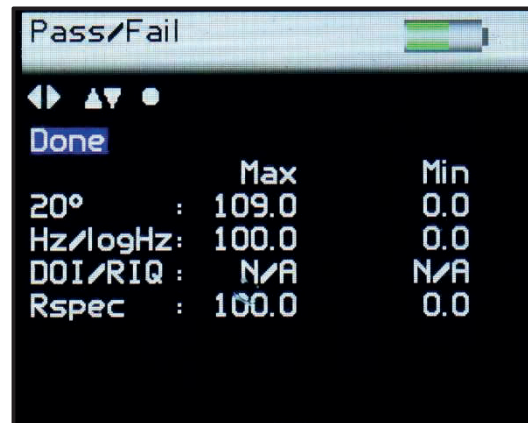
With Reflectance set to GU measurement results for each angle are displayed as –



Pass/Fail Setup Screen

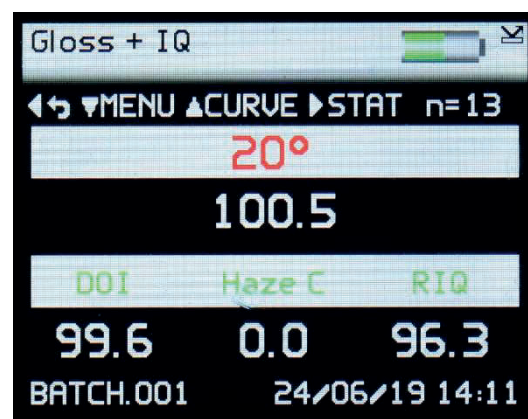


The Pass/Fail setup screen is used to enable/disable on-screen pass/fail indication and set min / max tolerancing. Press the down key to select the Pass/Fail option and press the center button to toggle the feature ON or OFF. Press the Right button to edit the min / max limits.



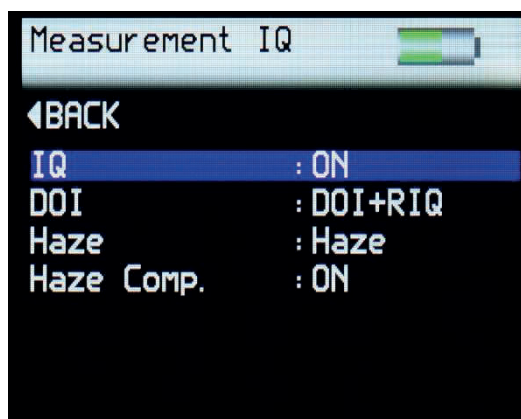
Select the Done option to complete the process.

Once the Pass/Fail feature is enabled, any measurement that falls between the max and min values will be considered a pass and the header text will be coloured GREEN. Readings above the max value or below min value will be deemed a fail and the header text will be coloured RED. Saved data and data transmitted by Bluetooth will also contain the pass/fail field.



Note – The Pass / Fail option is not available when % reflectance mode is selected.

IQ Screen



The IQ screen is used to configure the instruments IQ settings.

IQ - Selects IQ information to be either displayed (ON) or not displayed (OFF) on screen

DOI – Selects either standard DOI (Distinctness of Image) or enhanced RIQ (Reflected Image Quality) scale or Rspec (peak specular reflectance), details of which can be found in the Appearance Theory section of this manual.

Display configurations options are : DOI & RIQ, RIQ & Rspec or DOI & Rspec

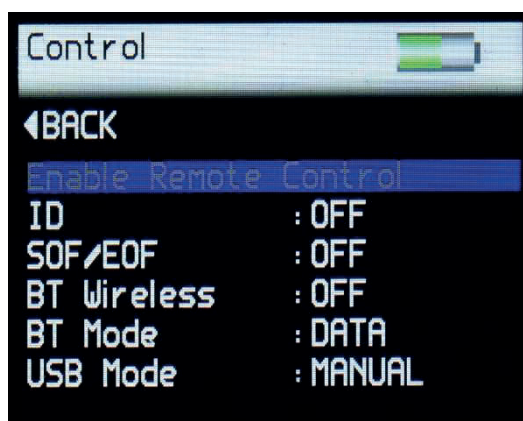
Haze – Selects Haze measurement according to test method ASTM E430 or logHaze (a more sensitive measurement). Further details of Haze test methods and logHaze can be found in the Appearance Theory section of this manual.

Haze Compensation – Selects either ON or OFF. Further details of Haze Compensation can be found in the Appearance Theory section of this manual.

Press the Left button to return to the home screen

Note – Pass / Fail option is not available when DOI / RIQ are selected.

Control Screen



The Control Screen is used to configure the instruments Bluetooth parameters to the user's preference. Press the Up / Down buttons to navigate through the options, press the Enter button to select the option required.

Settings in the Control screen are:

ID - Measurement definition header

SOF/EOF - Start / End of file markers for use in analysis software

BT Wireless - Enables or disables Bluetooth

BT Mode - Set the functionality of Bluetooth –

RC (Remote Control) – Operate and receive data via Bluetooth

Data – Only receive data via Bluetooth

USB Mode - Set the functionality of the USB connection when connected to a PC –

Charge – Charge the instrument via USB (note the instrument can be operated during this time but cannot be used to make measurements)

Manual – Allow the functionality to be set on the instrument each time a connection is made

RC – Remotely control the instrument via USB to make measurements and transfer data.

Data – Data only mode.

Press the Left button to return to the Home screen.

Bluetooth Communication and Pairing

The IQ Flex 20-S has a Bluetooth function that allows readings to be instantly transmitted to a compatible PC.

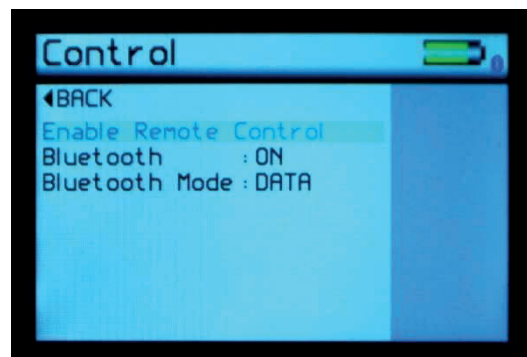
20° Gloss, Haze + Log Haze, DOI/RIQ, RSPEC, Goniophotometric information, instrument serial number and service/calibration data can be instantly accessed by many PC applications including Excel, Word, Wordpad, OpenOffice or SPC packages.

Pairing Procedure



1. Switch on the Rhopoint IQ Flex 20-S.
2. The Bluetooth icon must be visible to allow pairing.

3. If the Bluetooth icon is not visible, enable it as detailed in Control Screen.
Ensure that Bluetooth mode is set to either Data or Data+

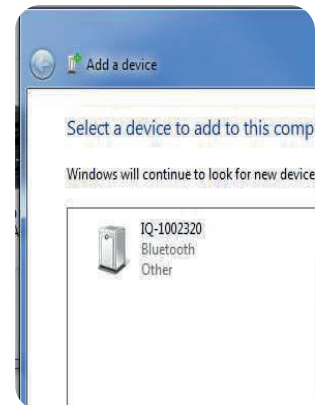


4. In Windows, go to START menu and select "Devices and Printers."



5. In Devices and Printers screen Click "Add a device"

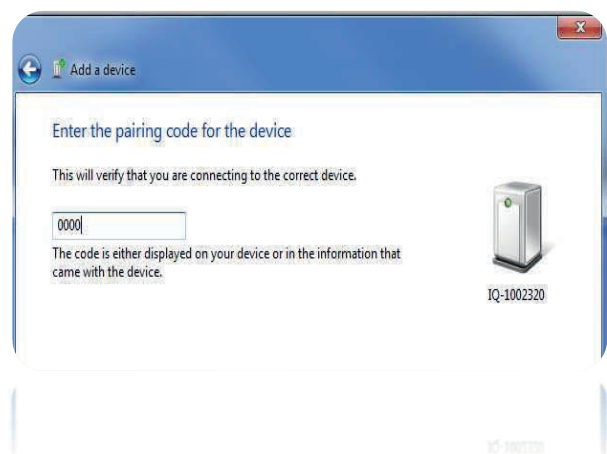
6. Windows will now search for available Bluetooth devices, double click on the icon that corresponds to the IQ instrument.

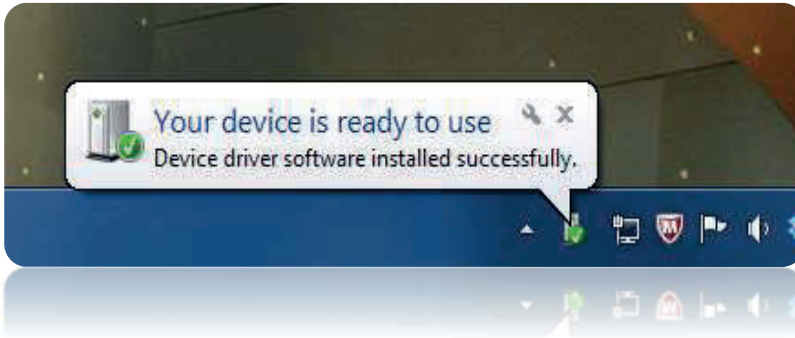


7: Click "Enter the devices pairing code" in the "Add a device" screen.

8: Enter the pairing code "0000".

Make sure the IQ Flex 20-S remains switched on throughout this process, to disable or extend auto power off refer to instructions detailed in Instrument Setup Screen that follow.





9. The IQ Flex 20-S is now installed on your PC and ready for connection to the Bluetooth Data Widget.

It is important to wait until windows displays the “Your device is ready to use” message before starting the data widget.

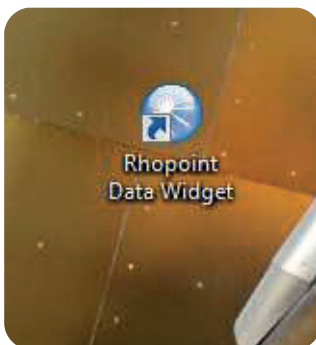
Bluetooth Data Widget Installation Instructions

The Bluetooth (BT) Data Widget software supplied with the instrument is a mini program that converts transmitted measurement data into keystrokes that are automatically input into any open PC program.

1. Install the BT Data Widget software (BTdatawidget.exe) found on the cd supplied with the instrument.



2. Check Bluetooth is switched on and that the instrument has been paired correctly



3. On the desktop click on the “Data Widget” icon to start



4. Click on the blue "refresh" arrow to search for paired IQ(s).



5. The buttons are greyed out while the DATA widget searches for SWITCHED ON IQ Flex 20-S (s) that have been PAIRED to the PC.

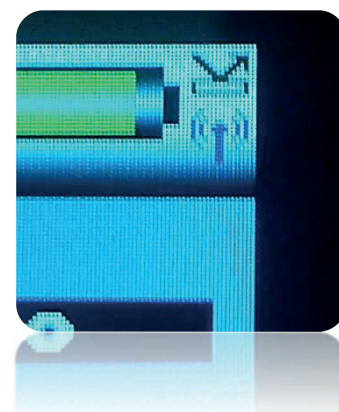


6. Look in the data widget drop down box to see discovered instruments.



7. Select the instrument required.

8. Click the tick to connect the instrument.



9. The transmitter icon now appears on the IQ Flex 20-S. All readings will now be automatically transferred to any open windows package. Download example EXCEL spreadsheets from Rhopoint's website.

Instrument Setup Screen



The Instrument Setup screen is used to configure the instruments basic operating environment to the user's preference. Press the Up / Down to buttons navigate through the options, press the Enter button to select that option.

Settings in the Instrument Setup screen are: -

Language – Set instrument language to English (default), Spanish, German, Chinese, Japanese or French

Screen View – Set the orientation of the screen as NORMAL, or INVERTED

Backlight – Set screen intensity to either 20%, 40%, 60%, 80% or 100% brightness

Power Off – Set instrument to automatically power off after either 30sec, 60sec, 90 sec or 120 sec or inactivity or DISABLE this feature

Power Switch - Set the functionality of the Power Switch -

ON ONLY – Switch the instrument ON only

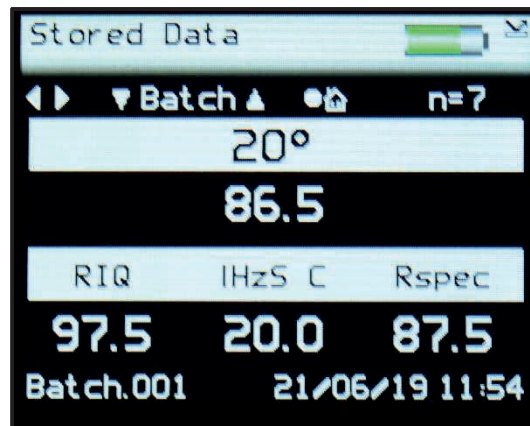
ON & OFF - Switch the instrument ON and OFF

ON (Fn) – Enable Function Select mode

ON (●) – Use as an operate button

Selecting the Power Switch to Function Select mode provides easy access to two regularly used features, Rotate Screen and New Batch.

In the home screen, press and hold the On/Off button, the display will change as shown below-



Press either the Up button to rotate the screen. Only one rotation is possible each time the On/Off button is pressed.

Press the Down button to start a new batch, this action is either confirmed or cancelled by selecting the required box when prompted using the Left and Right buttons and pressing the Enter button.

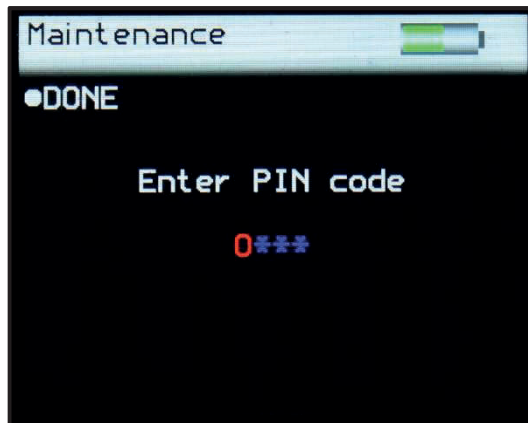
Sound – Enable or disable button press sound

USB Charge – Set the USB charge current to either 500mA or 100/500mA

Set Date & Time – Set the date and time on the instrument. Press the Down button to set time. Press the Left and Right buttons to select the date or time and the Up / Down buttons to increment / decrement the value. Press the Enter button again to save the value.

Press the Left button to return to the Home screen

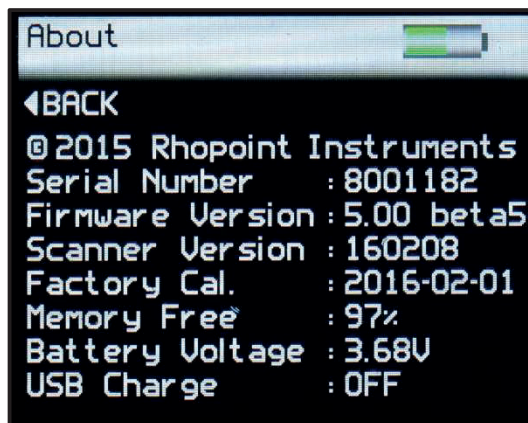
Maintenance Screen



The Maintenance screen is used by Rhopoint Approved Service Centres. It is PIN locked to prevent unauthorised access. There are no user configurable settings available.

Press the Enter button to return to the home screen.

About Screen



The About screen is for information only.

It provides information relating to the instrument's software, the instrument serial number and last date of Factory Calibration.

It also shows the amount of free memory available and battery power status.

Press the Left button to return to the home screen.

Notes

Appearance Theory

Rhopoint IQ Flex 20-S Glossmeter & Goniophotometer

Goniophotometer is derived from Greek;

Gonio – Angle,

Phos – Light,

Metron - Measure

Gloss describes the perception of a surface appearing “shiny” when light is reflected from it.

When viewing glossy surfaces, it is found that a sudden increase in brightness occurs when the angle of observation equals the angle of incidence of the illuminating light. This condition is termed as specular reflection.

A glossmeter is used to quantify the amount of light reflected from a surface. The glossmeter incorporates a standard optical configuration of a matched light source and detector, however the Rhopoint IQ Flex 20-S uses a linear diode array at 20° to measure the distribution of reflected light $\pm 7.25^\circ$ from the specular reflection angle in steps of 0.02832° .

This technology allows the instrument to calculate Gloss, Haze, Distinctness of Image, Reflected Image Quality and RSpec. These parameters inform the user not just how reflective the surface is but also provide information about its image forming qualities and smoothness of the finish.

These values are used to assess the visual impact and reflective quality of many coated, painted and polished surfaces.

Why is reflected appearance important?

A crucial factor in assessing the appearance of any manufactured product is the “glossiness” of its finish.

Gloss finishes are often used to make products visually appealing. Highly reflective, extremely smooth finishes are used to enhance the aesthetics of cars, luxury yachts and high end consumer electronics. Matt finishes are used for contrast or on furniture and architectural features.

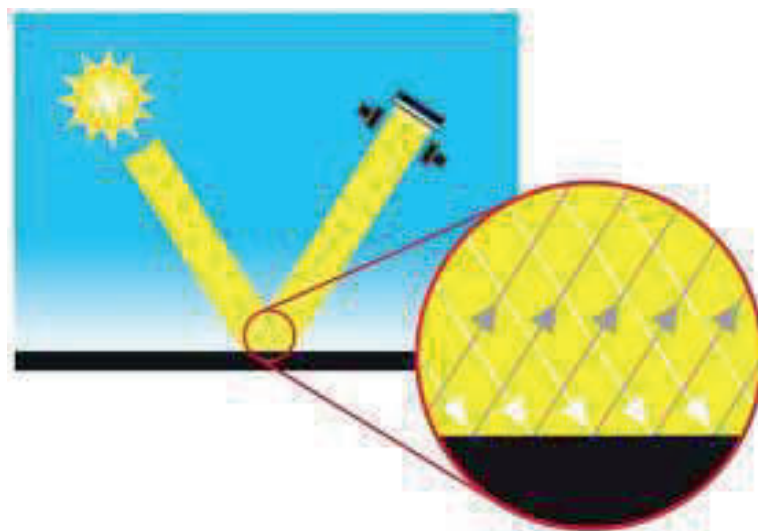
Whilst gloss measurement is the most widely used technique to assess reflective qualities, it is not sensitive to surface textures which reduce perceived quality. This means that surfaces can often have *identical gloss values* but have very different visual appearance.

The Rhopoint IQ Flex 20-S measures standard gloss within existing standards and uses new technology to examine in more detail the distribution effect which reduces perceived quality.

The instrument provides goniophotometric profiles, gloss, haze and distinctness of image values which can be used to assess the visual qualities of any product.

As well as assessing the visual impact of a surface, the Rhopoint IQ Flex 20-S can also be used to identify problems associated with coating formulation and application.

Coating problems such as dry spray, orange peel, poorly dispersed or flocculated pigments, micro bubbles, resin incompatibilities and additive migration all result in reduced DOI, Haze or gloss values and therefore can be measured with this instrument.



Specular reflectance from a “perfect mirror” surface - all light is reflected in the specular direction

Disadvantages of standard gloss measurement

In 1925 Pfund described a simple method for measuring specular reflectance; this method has since been refined and standardised but the basic design for a glossmeter has remained unchanged.

The conventional glossmeter is widely used to assess the visual quality of test panels and product surfaces; however, the human eye can see certain surface defects that are not detected with this instrument. This is a particular problem where measured finishes are given high gloss values but rated by observers as having a poor appearance.

The reason for differences between observed quality and measured gloss is because light entering a glossmeter is recorded as one value without the detection of variation. In the human eye the reflected image activates a compact array of light sensors known as cones, the detailed signal from these cones allows the eye to see subtle textures on a surface that are not recorded with a glossmeter.

The Rhopoint IQ Flex 20-S, with its array of light sensors mimics the effect of reflected light in the human eye. This detailed information allows the user to measure and control surface defects that are undetectable with a standard glossmeter.

Gloss

Gloss is the visual sensation associated with the brightness of direct light reflected in a surface. Surfaces with high reflectance are determined as glossy; less reflective surfaces are semi-gloss or matt.

Glossmeters quantify this effect by measuring light reflection from a sample at defined angles.

The Gloss Unit (GU) is defined in international standards including ISO 2813 and ASTM D523. It is determined by the amount of reflected light from a glass standard of known refractive index.

Calibration tiles supplied with Rhopoint instruments are traceable to master glass standards held at NIST (Canada)

The measurement angles most commonly used for gloss are 20°, 60° and 85°.

- The most appropriate angle should be selected dependent on the glossiness of the sample surface.
- Using the correct measurement geometry increases resolution and improves the correlation of results with human perception of quality.

To determine the correct measurement angle the surface should be assessed with the 60° geometry-

- Matt surfaces which measure below 10 GU @ 60° should be re-measured with the 85° angle.
- High gloss surfaces which measure above 70 GU @ 60° should be assessed using the 20° angle.
- The 60 degree angle is best employed on mid gloss samples 10-70 GU.

Measuring Gloss with the IQ Flex 20-S

The IQ Flex 20-S is supplied with a certified glass calibration tile traceable to a NIST reference standard.

The instrument does not have physical receiver apertures like a conventional glossmeter; the 20° gloss value is obtained by measuring with elements of the array which correspond to the angles specified in the standards.

% Reflectance

Materials having a high refractive index such as clear plastics and varnishes can typically have measurement values that exceed 100GU due to multiple reflections occurring within the material. Highly reflective metals can also produce gloss values up to 2000GU. In these cases, it is common not to report values in GU but to express them in terms of percentage Reflectance.

% Reflectance therefore compares the amount of light energy transmitted and received by a gloss meter and expresses the value as a percentage of the measurement angles full range.

Whilst the Gloss (GU) scale is linear, each measurement angle has a different upper range; 20°: 0 – 2000GU, 60°: 0 – 1000GU, 85°: 0 – 199GU.

The measurement mode is a simple conversion of gloss value to percentage reflectance.

20 degree - 2000GU = 100% reflectance

60 degree - 1000GU = 100% reflectance

85 degree - 199GU = 100% reflectance

So, 20 degree - 1000GU = 50% reflectance, 500GU =25% etc

When the IQ Flex 20-S is calibrated in this mode it will calibrate to the GU value but will still display % reflectance.

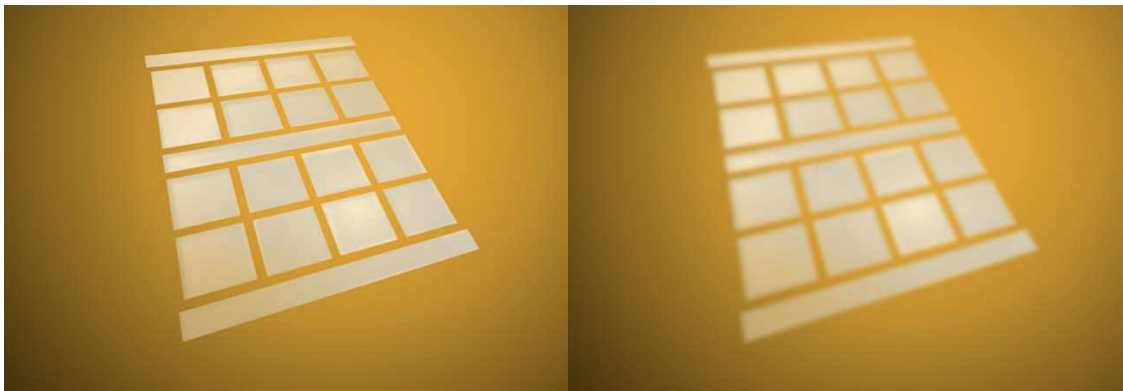
Haze

Haze describes the milky halo or bloom seen on the surface of high gloss surfaces.

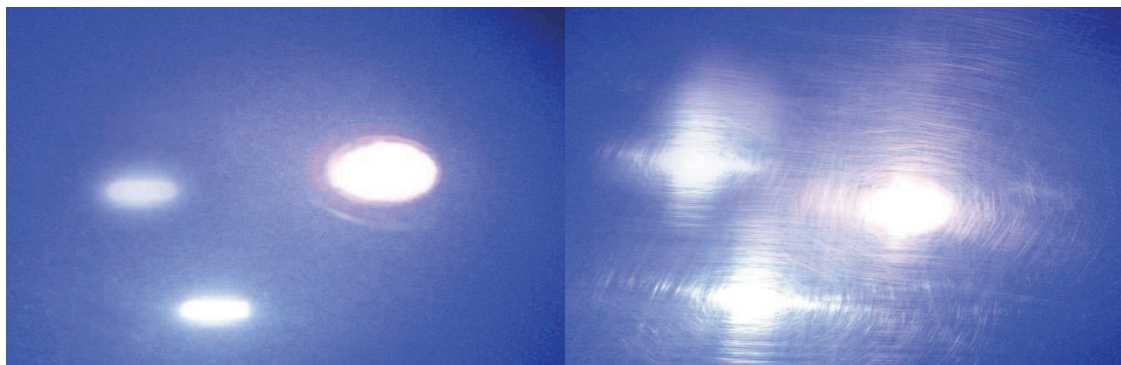
Surface haze can be problematic in most coating applications including automotive manufacture, powder coatings and other high gloss coatings. It can be attributed to a number of causes including incompatible materials in a formulation, poor dispersion and problems encountered during drying/curing/stoving.

Coatings without haze can be seen to have a deep reflection and have high reflected contrast. Those with haze exhibit a slight “milky” finish which can be seen over the highly glossy surface.

Haze is caused by microscopic surface texture which diffuses light adjacent to the main component of the reflected light.



When viewing the reflection of a strong light source in a surface with high haze the image “blooms” and has a bright halo around it.



Haze is an important measure for highly polished metals and is often associated with polishing marks and machining direction.

Gloss-haze meters are traditionally used to measure this parameter and use a standard glossmeter design with additional light stops and diodes to measure the haze component 2° either side of the specular component.

Measuring Haze with the Rhopoint IQ Flex 20-S

Taking reliable readings with a traditional gloss-haze meter can be difficult as the sample surface needs to be completely flat and un-textured.

The Rhopoint IQ Flex 20-S automatically compensates for sample surface flatness and texturing allowing haze measurements to be taken on a much wider range of product surfaces.

Gloss Haze values are calculated using ASTM test method ASTM E430 – using defined angular tolerances around the 20 degree specular angle

The instrument can display the natural haze value (HU) or Log Haze Value (HU_{LOG}).

When measuring haze values, higher numbers indicate a lower quality surface.

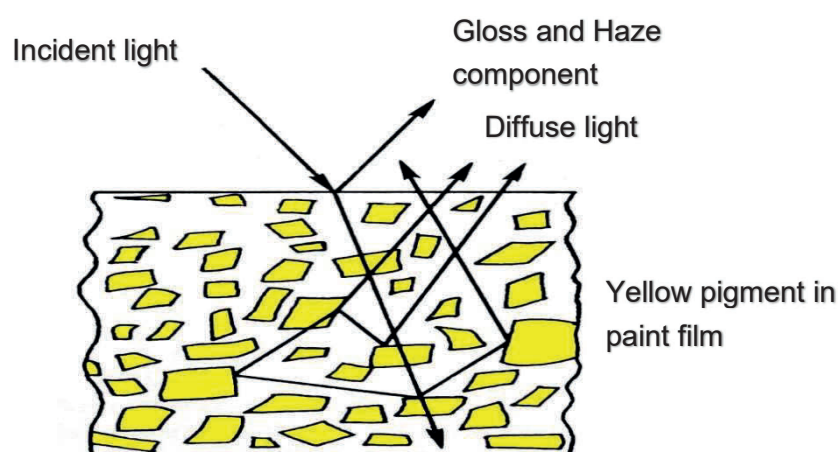
A high gloss surface with zero haze has a deep reflection image with high contrast.

Log Haze Values are commonly quoted for paints and coatings as this scale has better corroboration with human perception of surface quality.

Haze Compensation

Reflection haze is caused by micro texture on a surface which causes a small amount of light to be reflected adjacent to the gloss angle. For white surfaces, bright colours and metallics, a certain amount of diffuse light, reflected from within the material, is also present in this region.

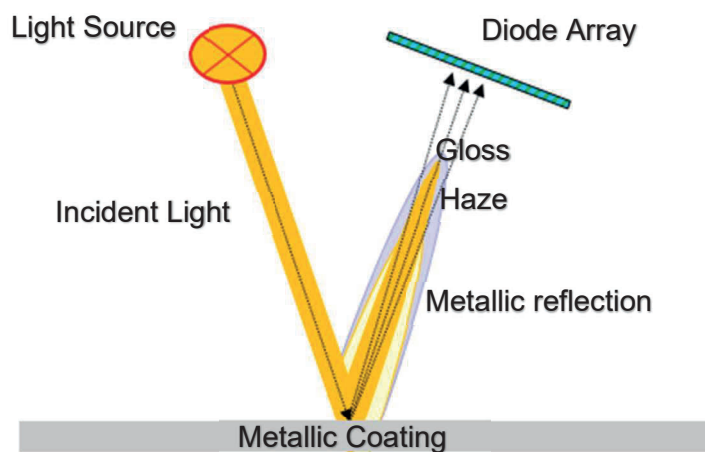
This diffuse light exaggerates the haze signal for these surfaces causing higher than expected readings.



The Rhopoint IQ-S Flex 20 compensates for reflection from within the coating for highly reflective pigments, metallic coatings and speciality pigments, allowing the haze of any painted surface to be measured.

For non metallic surfaces, the diffuse component is lambertian- it is equal in amplitude at all angles in relation to the sample surface. Conventional gloss-hazemeters measure diffuse reflection using a luminosity sensor positioned away from the gloss angle. Luminosity is subtracted from the haze signal allowing non metallic surfaces measured independent of their colour.

Conventional gloss-haze meters do not work correctly on metallic coatings as metallic flake within the coating reflects the light directionally around the specular angle. As little or no metallic reflection is present at the angle at which the luminosity is measured, metallic coatings and specially pigments have an unexpectedly high haze reading.



The Rhopoint IQ-S Flex 20 captures compensation information from a region adjacent to the haze measurement angle, this means it can be used on metallic coatings which reflect light directionally

An advantage of the IQ Flex 20-S is that unlike a conventional instrument, compensation is calculated using a region adjacent to the haze angle. This technique gives compatible readings on solid colours but also compensates for directional reflection from metallic coatings and speciality pigments

Distinctness Of Image (DOI)

Distinctness Of Image is, as the name implies a function of the sharpness of a reflected image in a coating surface.

Two surfaces finished with similar coatings may exhibit identical gloss values but visually the quality of one coating can be seen to be very poor. Upon closer inspection the visually substandard poor coating has a highly textured dimpled appearance known as “orange peel”. When a reflected object is viewed in such a coating the image becomes fuzzy and distorted.

Orange peel, waviness, texturing, pin holing and similar effects can be problematic in many high gloss coating applications including automotive, powder coating and any other industries that requires a smooth homogenous finish. All these effects can be measured with the IQ Flex 20-S.

DOI has been measured instrumentally and subjectively in the automotive industry for many years. Instruments that measured this value in the past were bulky expensive and some had poor repeatability. DOI measurement was not common outside of automotive because of the cost of equipment was high and the demand for high quality gloss finish was not as crucial.

The IQ Flex 20-S measures the DOI of a surface by quantifying the way a reflected measurement beam is spread and distorted around the specular angle.



Example test panels with low and high DOI values. Orange peel, texture, flow out and other key parameters can be assessed in coating applications where high gloss quality is becoming increasingly important.

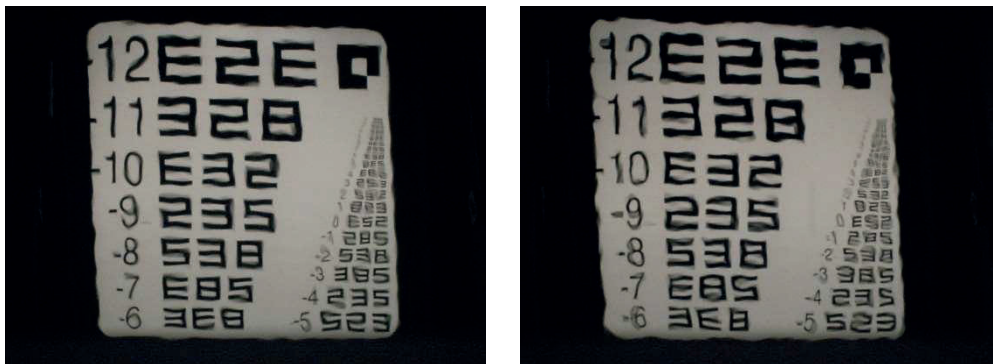
The DOI value of a surface is a number between zero and one hundred; a surface that exhibits a perfect undistorted image returns a value of 100, as the value decreases the image becomes less discernible.

Reflected Image Quality (RIQ)

Reflected Image Quality is a new measurement developed by Rhopoint Instruments to provide greater sensitivity when evaluating highly reflective coatings and the specular / diffuse element of lower gloss materials.

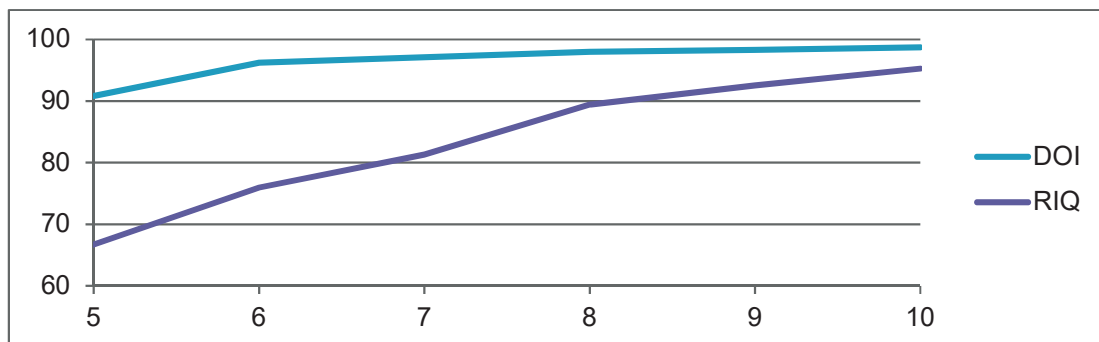
Two highly reflective surfaces that have very small changes in orange peel or texture will show very little or no change in DOI due to the way that it is calculated but will appear quite different visually.

By reducing the sensing distance around the specular angle and measuring the reflected light and distortion around it, a much higher resolution response is achieved with greater linearity, more in line with the visual experience.



Two highly reflective panels with the same gloss values show little change in DOI but appear different.

Similarly for lower gloss materials, due to the smaller sensing distance, this measurement allows improved differentiation of the specular and diffuse elements of reflectance from the surface. As this sensing distance only allows the measurement of the amount of truly reflected light in the specular direction it is far more directionally selective.



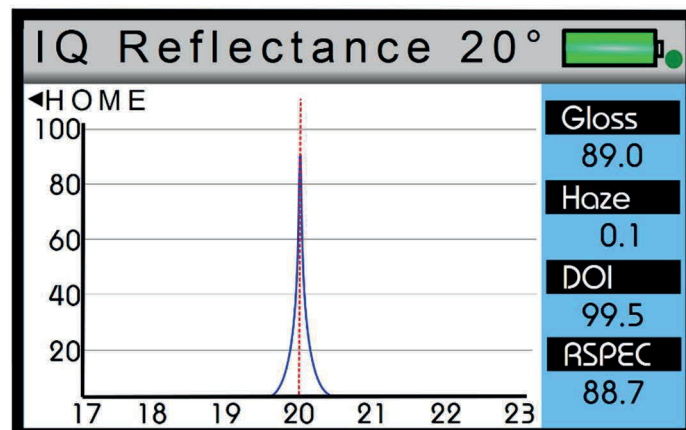
Average measurements of ACT Panels 5 – 10 show little variation when using DOI.
However when using RIQ, a greater differentiation is achieved.

The RIQ value of a surface is also a number between zero and one hundred; a surface that exhibits a perfect undistorted image returns a value of 100, as the values decrease higher surface texture is present and the image sharpness reduced.

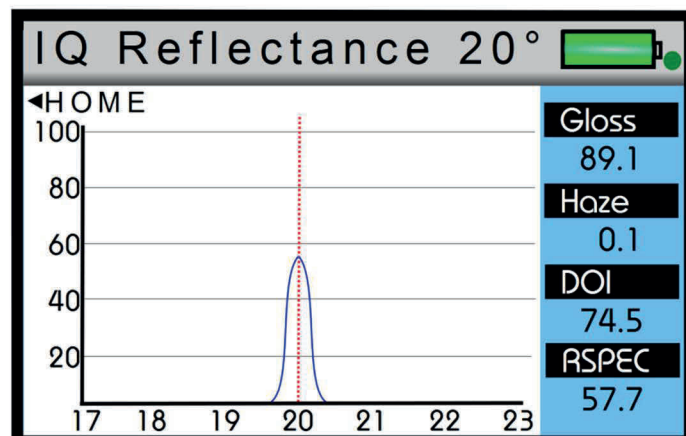
RSpec- Peak Specular Reflectance

RSpec is the peak reflectance measured over a very narrow angle in the specular direction ($\pm 0.0991^\circ$).

RSpec is very sensitive to any surface texture. Waviness or rippling on a surface acts as a concave or convex reflector deflecting light around the specular angle. When RSpec is equal to the gloss the surface is smooth, RSpec drops as texture becomes apparent.



The same paint applied to two panels, the second system has orange peel/waviness which is due to incorrect application setting on spray gun. RSPEC is shown by the red line.4



Automatic Curvature and Position compensation

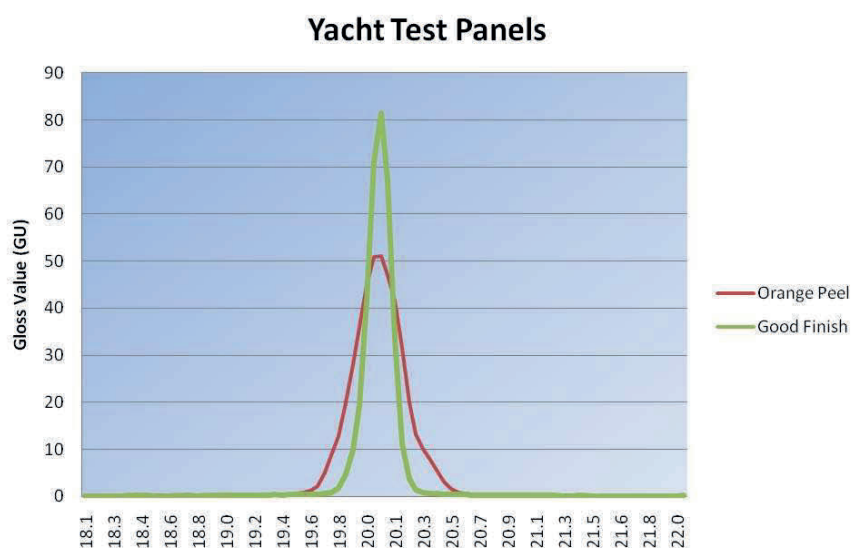
At 20° the Rhopoint IQ Flex 20-S automatically compensates for curved samples or a sample measurement position that is not completely in contact with the base of the instrument. Either of these effects will cause readings errors using a standard glossmeter.

To overcome this, the IQ Flex 20-S scans the reflectance profile of the surface from 12.75° - 27.25° and identifies the angular position of RSPEC.

Gloss, Haze, DOI and RIQ values are then calculated using the RSPEC angular position as the 20° reference point.

Goniophotometric Profile

The Gloss, Haze, DOI, RIQ and RSpec values produced by the Rhopoint IQ Flex 20-S can be used to assess the visual quality of any surface. Alternatively, if required, the full Goniophotometric curves can be downloaded to PC for a detailed understanding of specular reflectance.



Goniophotometric curve and specular indices of two painted yacht panels

Sample	Orange Peel.	Good Finish
Angle	20.0	20.0
Gloss	87.2	89.0
Rspec	54.7	88.2
Log Haze	37.6	32.5
DOI	84.3	97.1

This example perfectly demonstrates the need for additional appearance information than that supplied with a glossmeter, as the panels have virtually identical gloss when measured with this instrument. Visual inspection however, shows that the first panel has a very high degree of orange peel.

When measured with the Rhopoint IQ Flex 20-S, the instrument measures gloss identically to a standard glossmeter (87.2 GU-89.0 GU). It also quantifies the orange peel finish on the substandard coating with a low DOI reading of 84.3.

Calculating Gloss, Haze, RSpec and DOI from a Goniophotometric Profile

For the above example at 20°, the Rhopoint IQ Flex 20-S calculates the Gloss value by summing the gloss values +/- 0.9° from the specular angle. These methods / tolerances are specified in ASTM D523/ISO 2813.

The RSpec value is the peak gloss value at the specular angle, 20° (+/-) 0.0991°.

Haze is measured by summing the gloss values between 17-19° and 21-23°, the angles described in ASTM E430.

The DOI value is a function of the slope of each curve, the sharper the gloss response, the higher the DOI value (100 DOI is a perfect reflecting surface). More detail of this method can be found in ASTM D5767.