

U1600-O

Online TOC Analyzer

Operation, Installation & Maintenance Manual



Document No.	BD-U1600O-MAN-EN	Revision	B - Customer release
Release date	4 August 2026	Language	English

Customer publication

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1. Document Control and Specification Authority

This manual provides the customer operating, installation, calibration, maintenance and qualification guidance for the Blue Dragon U1600-O Online TOC Analyzer. The exact delivered configuration is governed by the document hierarchy below.

1.1 Specification Hierarchy

Priority	Controlling document	Use
1	Serial-number-specific nameplate, order confirmation, packing list, factory test report and calibration certificate	These documents govern the exact delivered hardware, voltage, interfaces, accessories and approved performance.
2	Approved model-specific technical datasheet and written Blue Dragon technical clarification	These documents govern the current standard model specification and supersede earlier general literature.
3	This customer manual	This manual governs standard installation, operation, maintenance and qualification guidance.
4	Interface screenshots and general illustrations	These support operation and component identification. The delivered software version and arrangement take precedence.

RULE

When values differ, use the highest-priority document. Do not change an approved method, range, connection or software setting without documented change control.

1.2 Adopted Model Specification

This release adopts the current Blue Dragon online configuration: 1-1600 µg/L working range, 1 µg/L detection limit, 0.1 µg/L display resolution, ±3% accuracy, approximately 3-minute analysis, 6-10 mL/min sample flow, minimum 0.3 MPa inlet pressure and 50 °C maximum inlet temperature in the standard configuration. These values supersede earlier general literature that listed a lower upper range, longer analysis time or broader unconditioned sample-temperature range.

Field	Details
Product	Blue Dragon U1600-O Online TOC Analyzer
Document	Operation, Installation & Maintenance Manual
Document number	BD-U1600O-MAN-EN
Revision	B - Customer release
Release date	4 August 2026
Language	English
Product family	Blue Dragon Water Quality & Organic Carbon Series
Warranty	12 months, subject to the sales contract
Prepared and issued by	Blue Dragon Technology

1.3 Revision History

Revision	Date	Description	Prepared by
A	4 August 2026	Initial controlled draft based on available operating, technical and qualification documentation.	Blue Dragon Technology



Revision	Date	Description	Prepared by
B	4 August 2026	Customer release: corrected product image; documented specification hierarchy; restored detailed operation and maintenance; expanded model-specific installation, software, data integrity, calibration and qualification; added packing, warranty, spares, options and engineering appendices.	Blue Dragon Technology

1.4 Document Approval

Role	Name / organization	Signature	Date
Prepared by	Blue Dragon Technology		4 August 2026
Technical review			
Quality / document release			

CONTROLLED DOCUMENT

The electronic master issued by Blue Dragon Technology is the controlled copy. Printed or locally saved copies must be checked against the current revision before use.

ILLUSTRATIONS

Product images, interface screens and general-arrangement drawings are representative of the Blue Dragon configuration. The delivered enclosure, software build and serial-specific drawings govern exact appearance and connection location.



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2. Safety Information

Only trained personnel familiar with laboratory electrical equipment, high-purity-water sampling and the site quality system may install, operate or service the analyzer.

2.1 Signal Words

Signal	Meaning
DANGER	Immediate hazard that can result in death or serious injury.
WARNING	Potential hazard that can result in serious injury or major equipment damage.
CAUTION	Potential hazard that can result in minor injury, contamination or equipment damage.
NOTICE	Important operating, quality or data-integrity information.

2.2 General Safety Requirements

- Read this manual before applying power or connecting a sample.
- Use a reliably grounded Class I power supply that matches the delivered nameplate.
- Disconnect and isolate electrical power before opening a service panel or replacing a fuse, UV lamp or pump tube.
- Do not modify internal wiring, fluidics, firmware or software configuration without Blue Dragon authorization and documented change control.
- Inspect the inlet, internal fluid path and drain for leakage during initial operation and after maintenance.
- Use a particle filter of 60 µm or smaller when visible insoluble particles may be present.
- Flush the analyzer after an over-range, contaminated or unsuitable sample before returning to low-level TOC measurement.
- Do not use the analyzer in an explosive atmosphere or where strongly corrosive vapours, condensation or conductive dust may be present.

2.3 Pressurized Sample Safety

- Isolate and depressurize the process sample line before disconnecting tubing or fittings.
- The process line must include a means of isolation and controlled flow. Do not connect the analyzer directly to an uncontrolled high-pressure source.
- The confirmed minimum inlet pressure is 0.3 MPa upstream of the flow-control arrangement. The instrument sample flow must be adjusted to 6-10 mL/min.
- Keep the drain unrestricted and near atmospheric pressure.
- The standard sample-temperature limit is 50 °C. Specify and install the optional condenser for hotter service.

ELECTRICAL

After switching the analyzer off, wait at least 3 minutes before switching it on again.

3. Product Description and Applications

The U1600-O is a wall-mounted online total organic carbon analyzer for continuous or routine monitoring of pharmaceutical water, electronic ultrapure water and other high-purity-water systems. It combines reagent-free UV oxidation, differential conductivity detection, local touchscreen control, electronic records, alarms and communication interfaces.



Figure 3-1. Blue Dragon U1600-O Online TOC Analyzer.

3.1 Intended Applications

- Purified-water and Water-for-Injection generation or distribution systems.
- Pharmaceutical utility and production-water monitoring.
- Electronic-grade ultrapure-water systems and semiconductor processes.
- Deionized-water preparation and other approved high-purity-water applications.
- Online investigation and trend monitoring at validated sample points.

3.2 Key Features

- Wall-mounted 304 stainless-steel enclosure.
- UV oxidation with differential conductivity detection.
- 1-1600 ppb working range with 1 ppb detection limit and 0.1 ppb display resolution.
- Approximately 3-minute analysis and $\leq 3\%$ repeatability.
- 7-inch colour touchscreen, 32 GB storage and more than 1,000,000 records.
- RS232, RS485, USB and Ethernet interfaces.
- User access control, audit trail and electronic-signature functions included in the standard configuration.
- Optional condenser for hot-water service and optional remote software / app.

3.3 Limitations

- The conductivity-based method is intended for low-conductivity, high-purity-water matrices.
- Do not apply the analyzer to wastewater, concentrated process streams, high-salt matrices, suspensions or samples outside the approved range without application review.
- TOC does not replace microbiological, endotoxin or other required pharmaceutical-water tests.
- The user remains responsible for method suitability, sampling representativeness, validation, data review and compliance with the current applicable pharmacopoeia.

4. Measurement Principle

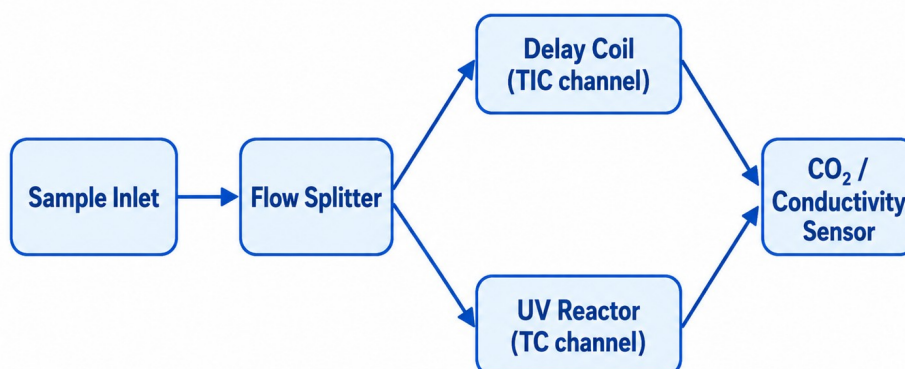
The analyzer uses ultraviolet oxidation with differential conductivity detection. The sample is divided into two matched flow paths. The unoxidized path measures total inorganic carbon (TIC). The oxidized path passes through a



titanium-dioxide photocatalytic reactor illuminated by a dual-wavelength 185 nm and 254 nm UV lamp and measures total carbon (TC).

$$\text{TOC} = \text{TC} - \text{TIC}$$

Working Principle Diagram



$$\text{TOC} = \text{TC} - \text{TIC}$$

Figure 4-1. TOC measurement flow path and calculation principle.

4.1 Analytical Sequence

1. The sample enters the analyzer and is divided into matched TIC and TC paths.
2. The TIC path passes through a delay coil and conductivity/temperature sensing channel without UV oxidation.
3. The TC path passes through the UV photocatalytic reactor, converting oxidizable organic carbon to carbon dioxide.
4. The conductivity response of both channels is temperature compensated.
5. The controller calculates TOC from the difference between TC and TIC and stores the result with associated metadata.

4.2 UV Reactor

The reactor uses a spiral quartz flow path around a 185/254 nm UV lamp. UV intensity declines with operating time; oxidation efficiency must be maintained through service-life monitoring, system suitability and scheduled lamp replacement.

4.3 Measurement Units

For water, 1 µg/L carbon is numerically equivalent to 1 ppb carbon. Results may be displayed in µg/L, ppb or mg/L according to software configuration. Low-level pharmaceutical-water results should normally be reviewed in µg/L or ppb to avoid unit-conversion errors.

5. Technical Specifications

The table below is the approved customer-release specification for the standard U1600-O. The order confirmation, nameplate, factory test report and calibration certificate govern the serial number.

Parameter	Approved standard specification
Measurement range	1-1600 µg/L carbon (1-1600 ppb) approved working range.
Detection limit	1 µg/L (1 ppb).



Parameter	Approved standard specification
Display resolution	0.1 µg/L (0.1 ppb).
Accuracy	±3%.
Repeatability	≤3%.
Analysis time	Approximately 3 minutes per test.
Testing principle	UV oxidation + direct/differential conductivity detection.
Conductivity range	0-8.1 µS/cm.
Sample temperature	1-50 °C standard; optional condenser required for hotter service.
Minimum inlet pressure	0.3 MPa upstream of flow control.
Instrument sample flow	6-10 mL/min.
Process connection	50.5 mm sanitary clamp adapter to 3 mm sample inlet tube.
Internal wetted tubing	304 stainless steel.
Drain	Approximately 6-10 mL/min, unrestricted and near atmospheric pressure.
Storage	32 GB; more than 1,000,000 records.
Interfaces	RS232, RS485, USB and Ethernet.
Display	7-inch colour touchscreen.
Print output	Report printing supported; local/external printer arrangement depends on supplied configuration.
Power	220 VAC ±10%; ≤120 W.
Dimensions	360 × 206 × 250 mm, wall-mounted.
Weight	Approximately 5.8 kg including standard accessories.
Housing	304 stainless steel.
Calibration interval	Recommended 12 months or according to the approved site program.
Compliance support	USP <643>, current Ph. Eur. 2.2.44, applicable ChP requirements and FDA 21 CFR Part 11-supporting functions.
Data integrity	Multi-level access, audit trail and electronic signatures standard; retention and remote/database functions depend on configured software.

5.1 Performance Interpretation

- Detection limit and display resolution are different parameters. A displayed decimal place does not establish validated quantitation below the detection limit.
- Accuracy and repeatability apply under approved calibration, sample and environmental conditions.
- Analysis time is the nominal test duration; stabilization, washing and response time may extend the time before a reportable result is obtained.
- Communication protocols, report format, language and optional software functions depend on the delivered configuration.

CONTROL

The factory test report and calibration certificate supplied with the serial number govern the released performance configuration.



6. Receiving, Packing and Storage

6.1 Receiving Inspection

1. Inspect the shipping container for impact, puncture, moisture or mishandling before opening.
2. Photograph and document any visible shipping damage before removing the analyzer.
3. Verify the model, serial number, voltage and ordered options against the order confirmation and packing list.
4. Inspect the enclosure, touchscreen, fittings, tubing, printer or print interface and accessories.
5. Retain the original packaging until installation, commissioning and initial performance verification are complete.

6.2 Unpacking

- Remove transit restraints and protective foam before powering the analyzer.
- Do not lift the analyzer by the touchscreen, fittings, fans, tubing or printer opening.
- Allow the analyzer to reach room temperature before powering it if it has been transported through cold or humid conditions.

6.3 Storage and Transportation

Condition	Requirement
Storage location	Indoor, cool, clean and well ventilated; no corrosive gas.
Storage relative humidity	Not greater than 80%; prevent condensation.
Transportation	Use the original packaging where possible; protect against impact, vibration and moisture.
Reinstallation	Perform under controlled service procedures and repeat applicable IQ/OQ checks.

RETURN

Before returning an analyzer, obtain service authorization, decontaminate the fluid path, drain all liquid and package the unit in suitable protective materials.

7. Installation and Connections

U1600-O General Arrangement and Service Access



Mounting requirements

- Secure to a rigid vertical support using the supplied mounting template.
- Verify wall loading for the 5.8 kg instrument plus tubing and service tools.
- Keep the enclosure level and provide unobstructed ventilation.
- The serial-specific mounting template governs hole positions.



Drawing status

General arrangement only.
Provided for initial installation reference.
The supplied mounting template and order documents govern.



Provide service clearance for fans, fittings, cover removal and tubing.



Figure 7-1. U1600-O general arrangement and service access.

7.1 Mounting Location

- Install indoors on a rigid vertical support using the supplied mounting template and hardware appropriate for the support structure.
- Verify the support can carry the 5.8 kg analyzer plus tubing, fittings and service loads.
- Keep the enclosure level and provide unobstructed access to the touchscreen, side ventilation, sample fittings and removable covers.
- Avoid direct sunlight, strong vibration, electromagnetic interference, corrosive vapours and condensation.
- Operating environment: 10-40 °C, relative humidity $\leq 85\%$, unless the serial-specific documents state otherwise.

U1600-O Online Sample Conditioning and Connection Schematic

Confirmed connection data

- Minimum inlet pressure: 0.3 MPa upstream of flow control.
- Instrument sample flow: 6-10 mL/min.
- Process adapter: 50.5 mm sanitary clamp to 3 mm sample inlet tube.
- Internal wetted tubing: 304 stainless steel.
- Standard maximum sample temperature: 50 °C; specify condenser for hotter service.
- Drain must remain unrestricted and near atmospheric pressure.

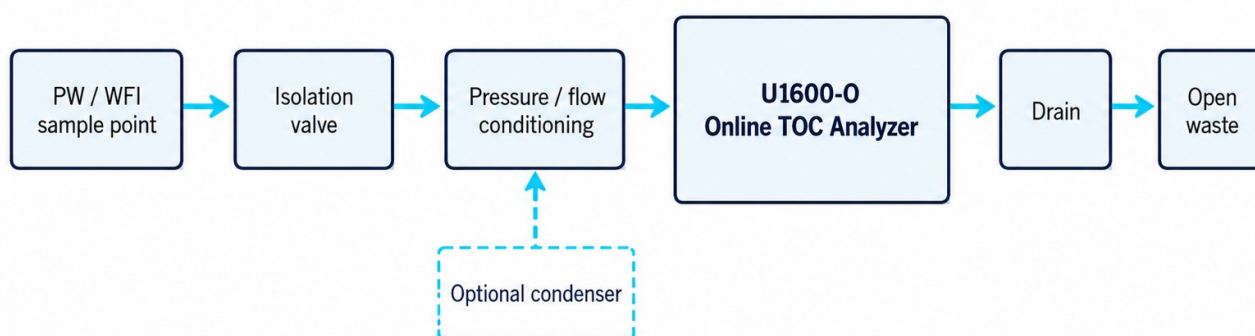


Figure 7-2. U1600-O online sample-conditioning and connection schematic.

7.2 Process Sample Connection

Item	Requirement
Process adapter	50.5 mm sanitary clamp connection adapted to a 3 mm sample inlet tube. Confirm supplied gasket, clamp and adapter material before installation.
Minimum inlet pressure	0.3 MPa upstream of the flow-control arrangement.
Analyzer sample flow	Adjust to 6-10 mL/min using the flowmeter or supplied conditioning hardware.
Internal wetted tubing	304 stainless steel.
External service tubing	Use the tubing supplied or approved for the order. Flexible PTFE tubing may be used only where specified by the delivered connection kit.
Sample temperature	1-50 °C in the standard configuration. For hotter water, specify the optional condenser; the approved maximum process temperature is order-specific.
Drain	Unrestricted discharge at approximately 6-10 mL/min to an open waste point or suitable drain. Avoid backpressure and submerged drain outlets.
Particles	Install $\leq 60 \mu\text{m}$ filtration where insoluble particles may enter the sample line.



7.3 Recommended Sample-Point Arrangement

- Use a representative, continuously refreshed sample point and minimize dead legs.
- Provide an isolation valve before the sample-conditioning assembly.
- Use pressure regulation or a restrictor where line pressure can vary or exceed the rating of the supplied assembly.
- Route sample tubing to minimize heat gain, gas release and trapped bubbles.
- For WFI or hot-water loops, install the condenser so that the analyzer inlet remains at or below 50 °C.
- Label the sample source, flow direction, isolation point and drain.

7.4 Electrical and Communications

Connection	Requirement
Power	220 VAC $\pm$ 10%, protective earth, accessible isolation device; rated consumption $\leq$ 120 W.
RS232 / RS485	Use the delivered port assignment, baud rate and protocol. Record settings during IQ.
USB	Use controlled media for data export and service functions.
Ethernet	Use an approved network segment, fixed addressing where required, and site cybersecurity controls.
Alarm output	Verify the delivered relay or output configuration, contact rating and fail-state before connection to automation.

8. Software, Users and Data Integrity

The standard configuration includes multi-level user access, audit-trail and electronic-signature functions intended to support regulated workflows. Compliance depends on validated configuration, approved procedures, network controls, training, periodic review and the user site quality system.

8.1 Login and User Roles

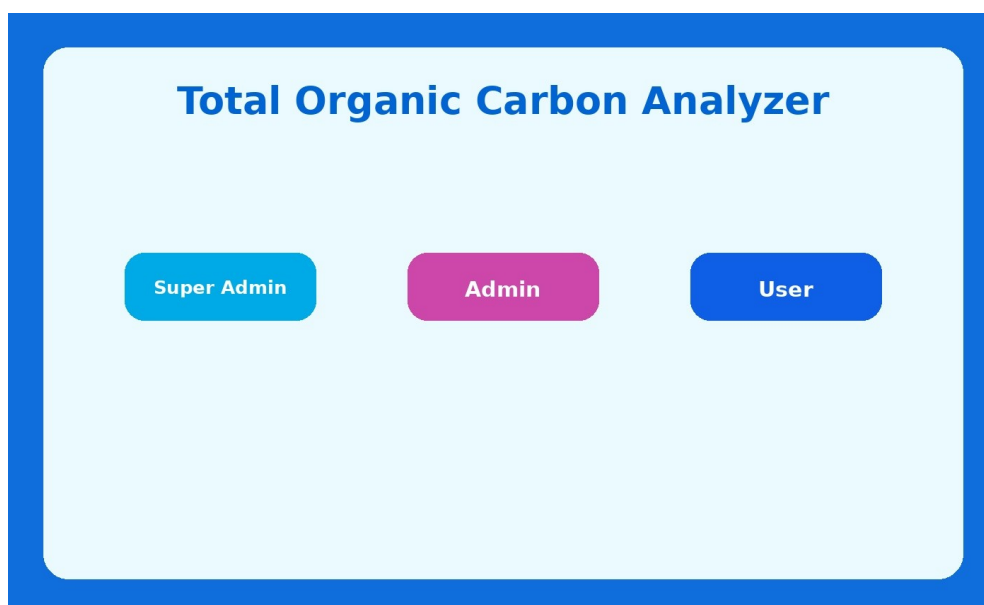


Figure 8-1. User login interface.

Role	Minimum intended authority
Super Administrator	Create and disable accounts; assign permissions; configure date/time, settings, calibration, alarms, export, audit trail and system information.
Administrator	Operate approved settings, cleaning, testing and record review according to assigned permissions.
User / Operator	Routine cleaning and testing only, unless additional rights are approved.

- Assign a unique account to each individual.
- Change the initial password at commissioning.
- Do not use shared administrator accounts for routine operation.
- Disable accounts promptly when access is no longer required.
- Define password length, expiry, failed-login handling and account recovery in the site procedure.

8.2 Menu Structure

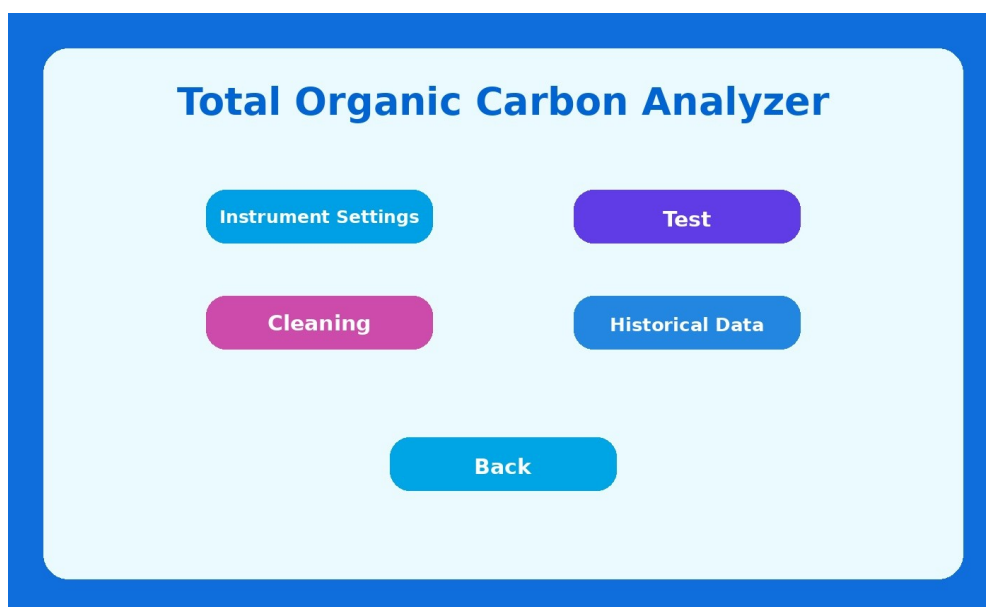


Figure 8-2. Main function interface.

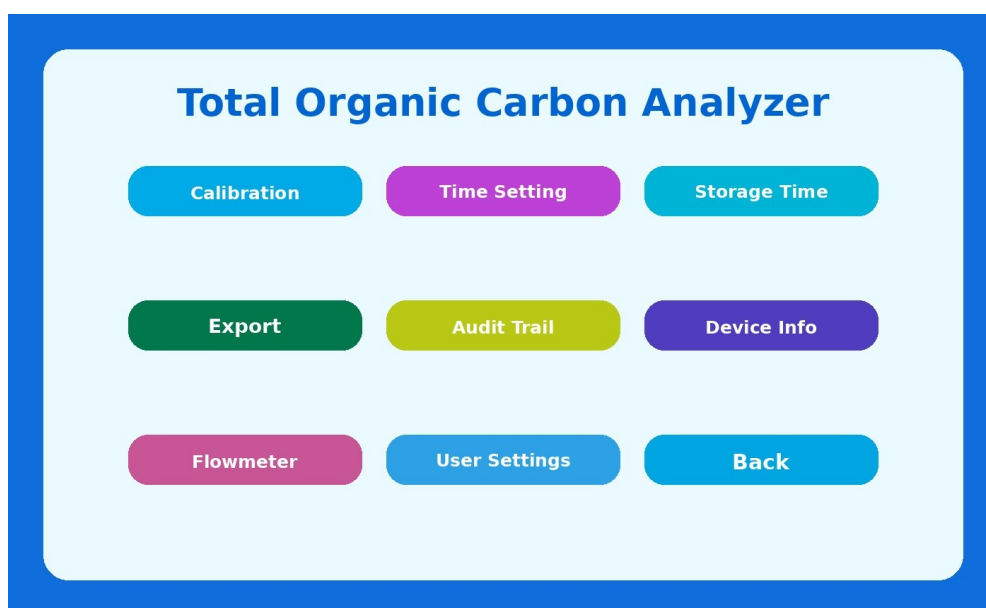




Figure 8-3. Instrument settings interface.

8.3 Date and Time

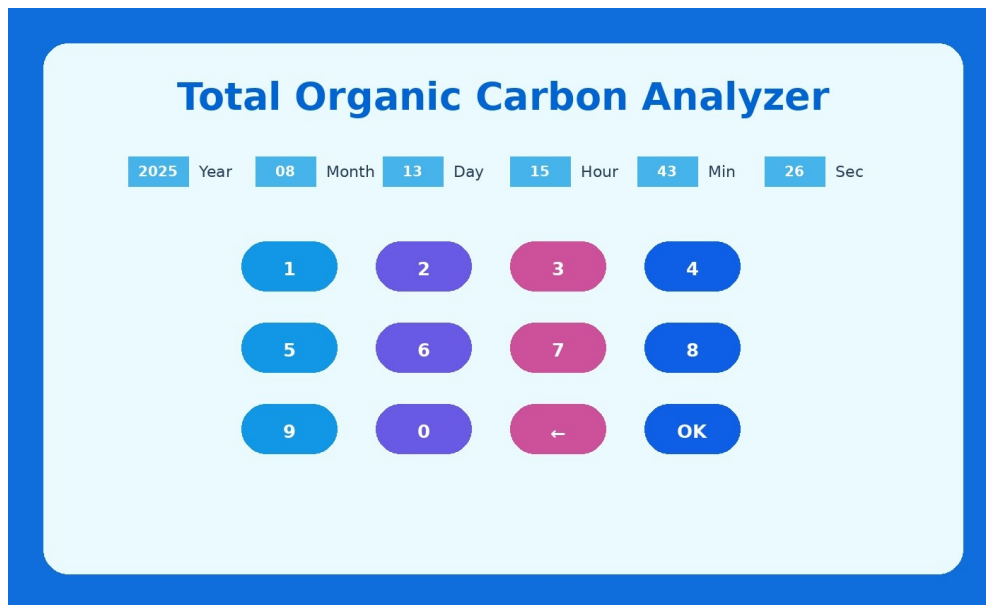


Figure 8-4. Date and time setting interface.

- Set date, time and time zone during IQ.
- Restrict clock changes to authorized administrators.
- Review clock changes in the audit trail.
- Synchronize with the approved site time source where supported.

8.4 Audit Trail and Electronic Signatures

- The audit trail must record user identity, date/time, action and relevant before/after values for critical operations.
- Define which records and events require routine audit-trail review.
- Electronic signatures must be linked to the signed record and have a defined meaning such as performed, reviewed or approved.
- Do not overwrite, obscure or manually alter electronic raw data outside an approved controlled process.
- Record-retention duration must be configured and verified during OQ; do not assume a retention period solely from memory size.

Electronic Record and Data-Integrity Workflow

The site quality system must control:

- Account lifecycle and password rules
- Time synchronization and clock changes
- Audit-trail review and exception handling
- Electronic-signature meaning and authority
- Export verification, backup, restoration and retention
- Change control, software versioning and periodic review

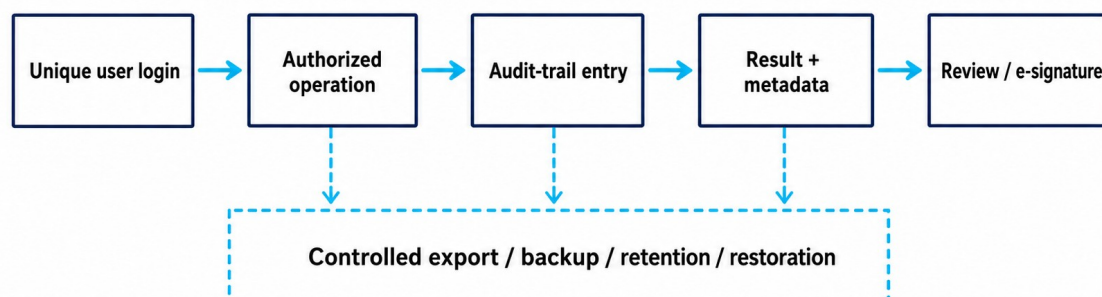


Figure 8-5. Electronic record and data-integrity workflow.



8.5 Export, Backup and Restoration

CRITICAL

Before routine use, OQ must verify whether Export copies records or transfers and clears selected records from local memory. Do not approve routine export until this behaviour, file format, completeness and restoration method are documented.

1. Use only controlled and malware-screened USB media or an approved network destination.
2. Select the required date range and record type.
3. Perform the export and retain the on-screen completion message or audit entry.
4. Open the exported files on an approved system and verify record count, readability, metadata and checksums where available.
5. Confirm whether the records remain accessible on the analyzer.
6. Document backup location, retention, access control and restoration testing.
7. Restart the analyzer after export only when required by the delivered software version and approved procedure.

8.6 Software Change Control

- Record software and firmware versions during IQ.
- Assess upgrades for validation impact before installation.
- Back up data and configuration before authorized updates.
- Repeat affected OQ/PQ tests after changes.
- Maintain a controlled list of interfaces, network settings and report templates.

9. Commissioning and Start-up

9.1 Pre-Power Checklist

Check	Acceptance	Result
Correct model, serial number and voltage verified	Complies with this manual and order documents	☐ Pass ☐ Fail
Transit restraints removed	Complies with this manual and order documents	☐ Pass ☐ Fail
Protective earth connected	Complies with this manual and order documents	☐ Pass ☐ Fail
Inlet and drain correctly routed	Complies with this manual and order documents	☐ Pass ☐ Fail
No visible damage or loose fittings	Complies with this manual and order documents	☐ Pass ☐ Fail
Service clearances available	Complies with this manual and order documents	☐ Pass ☐ Fail
Approved low-TOC water and standards available	Complies with this manual and order documents	☐ Pass ☐ Fail
Wall mounting secure	Complies with this manual and order documents	☐ Pass ☐ Fail
Process isolation available	Complies with this manual and order documents	☐ Pass ☐ Fail
Minimum inlet pressure confirmed	Complies with this manual and order documents	☐ Pass ☐ Fail
Flow control and open drain installed	Complies with this manual and order documents	☐ Pass ☐ Fail
Sample temperature $\leq 50^{\circ}\text{C}$ or condenser installed	Complies with this manual and order documents	☐ Pass ☐ Fail

9.2 Initial Power-up

1. Apply power and confirm normal startup, touchscreen response and absence of abnormal noise.
2. Log in as Super Administrator using the controlled initial credential.
3. Change the initial password and create named user accounts.
4. Set and verify date, time, language, units and report configuration.
5. Record software version, serial number, storage status and interface settings.



6. Configure alarm limits according to the approved application and validation plan.

9.3 Initial Fluid-Path Cleaning

Use ultrapure water or WFI. For first use, alternate forward and reverse washing for 10 minutes in each direction and repeat three cycles. Inspect all connections for leakage and confirm stable discharge without visible bubbles.

CLEANING

If the analyzer has been stored for a long period or exposed to a high-TOC sample, extended cleaning for more than 6 hours may be required.

9.4 Release for Use

1. Complete applicable IQ checks.
2. Perform calibration or verification.
3. Perform system suitability where required.
4. Complete OQ functional tests, including users, audit trail, export, alarms and records.
5. Complete PQ using approved standards and representative samples.
6. Obtain formal QA or authorized release before routine regulated use.

10. Routine Operation

10.1 Offline Cleaning and Calibration

Cleaning and calibration must be performed in offline mode before the analyzer is returned to online monitoring. Isolate the process sample and connect approved low-TOC water or standards according to the validated procedure.

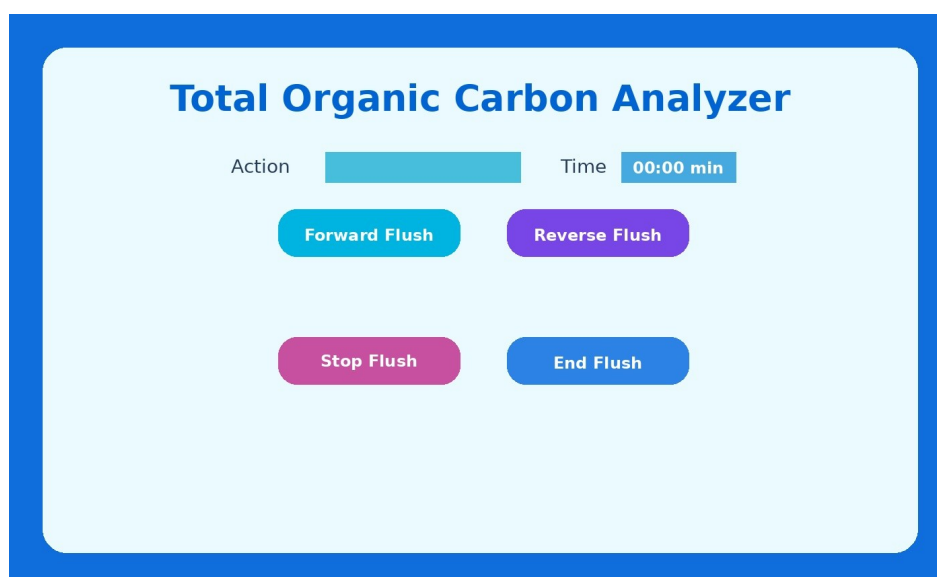


Figure 10-1. Cleaning interface.

10.2 Establish Online Sample Flow

1. Confirm the process sample is representative and the sample temperature is within the approved limit.
2. Open the isolation valve gradually.
3. Verify pressure is available upstream of the flow-control arrangement.
4. Adjust the instrument flow to 6-10 mL/min; a nominal setting near 8 mL/min may be used when approved.
5. Confirm unrestricted drainage and absence of leakage or persistent bubbles.
6. Allow the sample line and analyzer to stabilize before evaluating results.



10.3 Start and Monitor Analysis

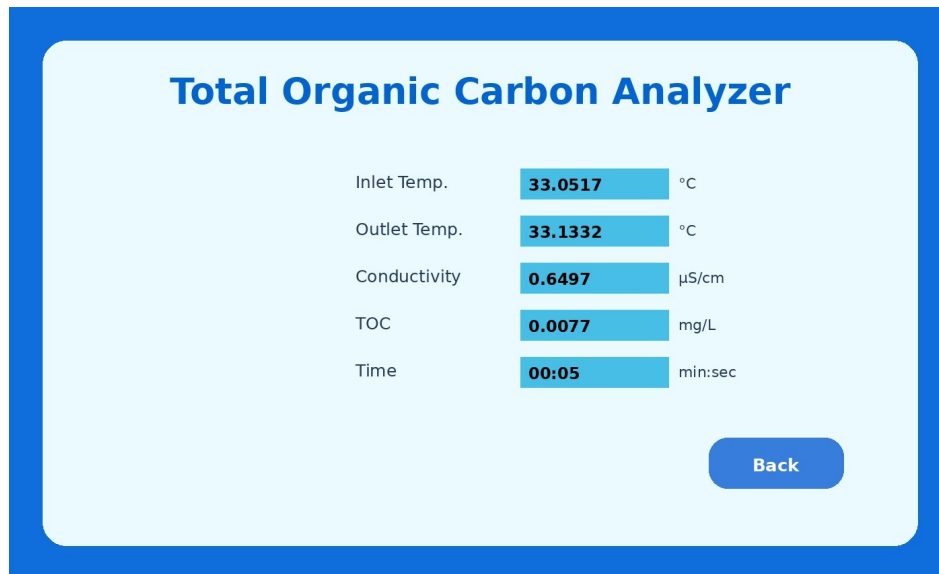


Figure 10-2. Online analysis interface.

1. Log in with an authorized account.
2. Select Test or Online mode as provided by the software version.
3. Confirm TOC, conductivity, sample temperature, flow and system status are plausible.
4. Review the trend for stabilization, drift or excursions.
5. Verify results are stored and associated with correct date/time and sample point.
6. Respond to alarms under the approved deviation and escalation procedure.

10.4 Historical Data and Reports

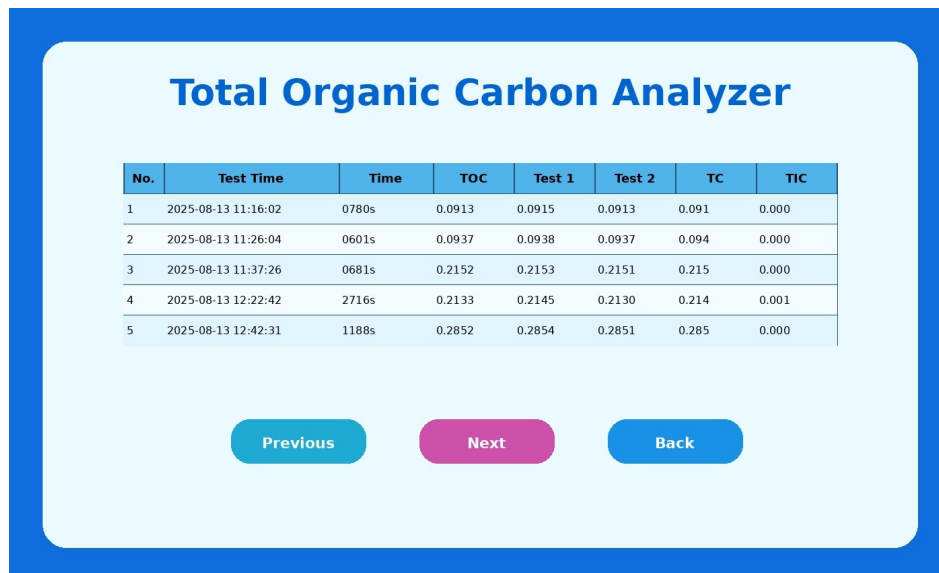


Figure 10-3. Historical-data interface.



Basic Operation Workflow

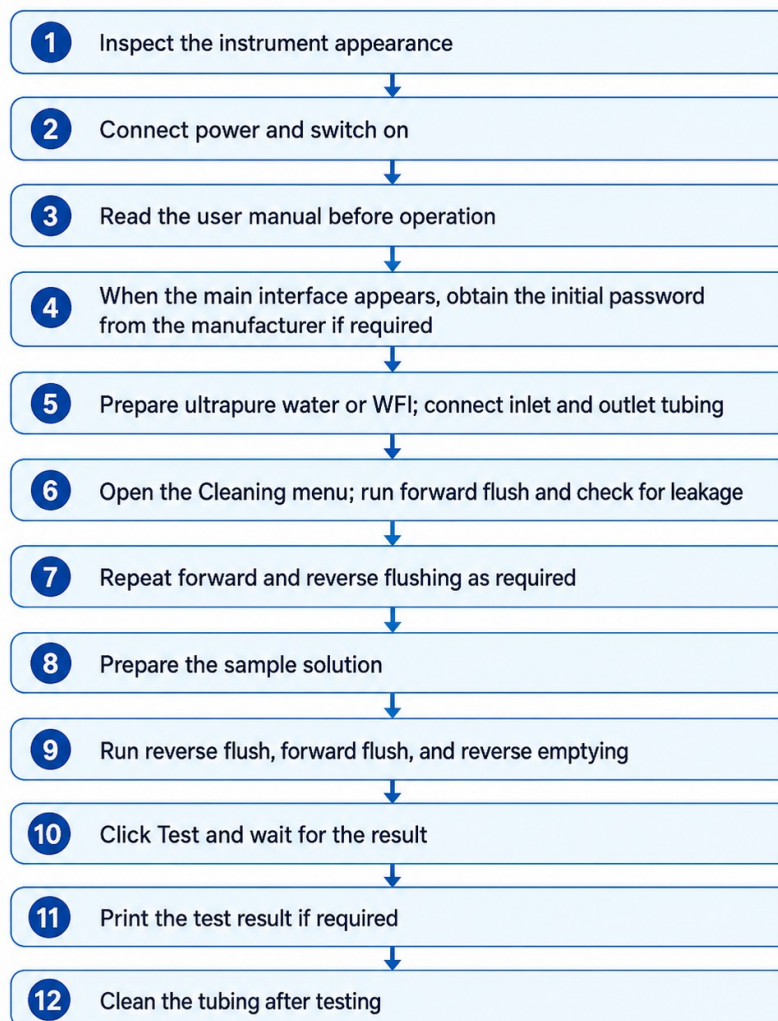


Figure 10–4 Basic Operation Workflow

Select Historical Data, choose the required date or record and use Previous/Next to navigate. Where printing is configured, select the record for report output. Verify that printed or exported reports retain the record identifier, result, unit, date/time, user and instrument identity.

10.5 Sample or Power Interruption

- If sample flow stops, place the analyzer in a safe state, isolate the line and investigate pressure, valves, filter, tubing, drain and pump condition.
- After power restoration, verify time, users, configuration, data continuity, fluid flow and alarm state before accepting results.
- Following extended interruption, clean the fluid path and repeat verification or system suitability as required by the site risk assessment.

10.6 Routine Operating Precautions

- Remove all visible bubbles before accepting results.
- Verify normal drain discharge throughout operation.
- Do not allow inlet or drain tubing to kink, flatten or become submerged at the outlet.
- Keep tubing immersed in clean low-TOC water during short idle periods where the approved procedure requires it.
- Seal exposed tube ends during extended idle periods to prevent contamination.
- Wait at least 3 minutes after shutdown before restarting.



11. Calibration, Verification and System Suitability

11.1 Calibration Control

Use traceable standards, approved containers and the delivered calibration procedure. The recommended calibration interval is at least annually, or more frequently when required by the site quality system, instrument performance, maintenance, relocation or investigation.

1. Verify instrument cleanliness, stable flow, correct units and current UV-lamp service status.
2. Confirm standard identity, lot, expiry, storage, preparation and traceability.
3. Wash with low-TOC water until the blank is stable.
4. Open the Calibration function using an authorized account.
5. Run the approved blank and calibration standard sequence.
6. Review replicate agreement and acceptance criteria before saving the calibration.
7. Run an independent verification standard or system-suitability sequence.
8. Review the calibration audit trail and approve the record under the site procedure.

CALIBRATION

Do not adjust calibration solely to force agreement with an expected result. Investigate contamination, bubbles, flow, temperature, expired standards and UV performance first.

11.2 USP <643> / Pharmacopoeial System Suitability

Where required, use TOC water, sucrose reference standard and 1,4-benzoquinone reference standard prepared or supplied under the applicable current pharmacopoeia. The supplied qualification framework uses 500 µg/L carbon sucrose and 500 µg/L carbon 1,4-benzoquinone solutions.

$$\text{Response efficiency (\%)} = 100 \times (R_{ss} - R_w) / (R_s - R_w)$$

Symbol	Meaning
R _w	Response to TOC water / reagent-water blank.
R _s	Response to sucrose reference solution.
R _{ss}	Response to 1,4-benzoquinone reference solution.

Acceptance for response efficiency is 85-115%. For the pharmaceutical-water test, compare the sample response corrected for the blank with the applicable limit response defined by the current pharmacopoeia and approved site method. Do not substitute an unverified display value for the pharmacopoeial response calculation.

11.3 Repeatability and Performance Verification

Test	Recommended customer-release acceptance
Blank stability	Meets the approved method and does not compromise the limit response.
Repeatability	≤3% under the approved instrument performance test unless a separately approved method defines a different calculation.
Accuracy / verification	Within ±3% for the approved verification condition or within the acceptance stated on the factory method.
Response efficiency	85-115%.
Carryover	Returns to the approved blank after the validated wash sequence.

11.4 Failed Calibration or System Suitability

1. Place affected results on hold back to the last successful verification as required by the site risk assessment.
2. Check standard preparation, blank water, containers, units, flow, temperature, bubbles and maintenance status.



3. Clean the analyzer and repeat the test with fresh approved standards.
4. Inspect or replace the UV lamp if oxidation efficiency remains low.
5. Document the investigation, corrective action, impact assessment and authorized release.

12. Maintenance

12.1 Preventive-Maintenance Schedule

Interval	Task
Before use / daily	Inspect tubing, fittings, drain, enclosure and touchscreen; verify no leaks, kinks or bubbles.
Weekly	Review blank trend, alarms, storage capacity and critical audit events; inspect filter condition.
Monthly	Inspect cables, ground, fans/ventilation, printer or print interface, data backup and system clock.
6 months continuous service	Replace the dual-wavelength UV lamp or assess extension under an approved risk-based program.
12 months	Replace peristaltic-pump tubing; perform calibration, preventive maintenance and applicable OQ/PQ checks.
After relocation or major repair	Repeat installation checks, leak test, calibration and affected qualification tests.

12.2 Fluid-Path Care

- Use only approved low-TOC rinse water.
- Never use abrasive tools in the fluid path.
- Remove bubbles by washing until the transparent section is bubble free.
- If no liquid discharges, inspect the filter and tubing; a small clean syringe may be used by trained personnel to draw from the outlet and restore flow.
- After a contaminated or over-range sample, extend cleaning before low-level analysis.

12.3 UV Lamp Replacement

WARNING

Disconnect the power cord before opening the rear cover. The UV lamp and quartz reactor are fragile. Wear clean gloves and eye protection.

1. Turn off the main power switch, unplug the power cord and wait at least 3 minutes.
2. Remove the rear-cover screws and open the service panel.
3. Disconnect the UV-lamp power plug.
4. Loosen the lamp-holder lock nut and slowly withdraw the lamp without contacting or stressing the surrounding spiral quartz tube.
5. Handle the new lamp with clean gloves. Remove accidental fingerprints from the lamp or quartz surface with suitable ethanol and a lint-free wipe.
6. Insert the new lamp, position it correctly in the reactor and tighten the lock nut without overtightening.
7. Reconnect the lamp power plug and reinstall the service panel.
8. Reset or record the lamp service time, clean the fluid path, calibrate or verify the analyzer and complete system suitability as required.

12.4 Peristaltic-Pump Tube Replacement

SERVICE

This procedure is for trained service personnel. Confirm the replacement tube and internal arrangement against the serial-number-specific service information.

1. Turn off and unplug the analyzer; wait at least 3 minutes.
2. Open the rear service panel and identify the pump tube, pressure ring, pressing block and spacer block.



3. Loosen the hex screws at both ends of the pump pressure ring and then loosen the pump-tube pressing block.
4. Remove the tube from the pump ring and disconnect its ends from the conductivity-sensor outlet and waste line.
5. Transfer or install the spacer block on the approved replacement tube at the same position.
6. Place the middle section of the new tube in the pump ring and tighten the pressure-ring screws evenly.
7. Secure the tube ends in the pressing and fixing blocks and reconnect the sensor outlet and waste line.
8. Reinstall the cover, connect low-TOC water, leak-test, verify stable flow and repeat calibration or verification as required.

12.5 Fuse Replacement

1. Disconnect power and investigate the cause of the blown fuse.
2. Open the fuse holder at the power inlet.
3. Install only the same approved type and rating stated on the delivered nameplate or service documentation.
4. Close the holder, reconnect power and verify normal startup.
5. If the replacement fuse fails, disconnect the analyzer and contact Blue Dragon Technical Support.

12.7 Maintenance Release

After any maintenance affecting the fluid path, measurement system, software or records, document the work, parts used and test results. Complete leak testing, cleaning, calibration and the affected OQ/PQ checks before returning the analyzer to regulated use.

13. Troubleshooting

Symptom	Probable cause	Corrective action
No display after power-on	Fuse failed; loose power connection; incorrect supply	Disconnect power; verify supply and cord; replace fuse only with approved type; contact support if fault repeats.
Unstable or excessive error	Bubbles; kinked/flattened tubing; unstable flow; contamination	Inspect tubing and drain; remove bubbles; wash with low-TOC water; verify flow and sample conditions.
Result much lower than expected	UV lamp aged or oxidation efficiency poor	Review lamp service time; run system suitability; replace lamp and recalibrate if required.
High blank or carryover	Contaminated water, container or fluid path	Use fresh TOC water and clean containers; perform extended forward/reverse washing.
No drain discharge	Blockage; pump tube worn; drain backpressure	Inspect filter/tubing; remove kinks; use approved syringe method; replace pump tube; ensure open drain.
Touchscreen or button not responding	Software state; damaged control; liquid ingress	Restart under approved procedure; keep interface dry; contact service if fault persists.
Buzzer or alarm	TOC exceeds limit; flow/temperature issue; internal fault	Review alarm message and sample source; verify flow/temperature; follow deviation procedure; contact support for persistent internal alarm.
Historical query freezes	Printer configured but unavailable; storage or software issue	Connect/configure printer as supplied; restart under approved procedure; verify storage and software version.
Export incomplete or records unavailable	Media, permissions, storage or export mode	Stop use of export; preserve audit trail; verify media and file count; restore from backup or contact support.
System suitability fails	Standards, blank, contamination, flow, calibration or UV issue	Repeat with fresh traceable standards after cleaning; verify flow and units; inspect lamp; document investigation.
Online value does not update	No sample pressure/flow; closed valve; blocked filter; communication state	Verify isolation valve, minimum pressure, flow 6-10 mL/min, filter, drain and online mode.
Sample temperature high	Hot process sample; condenser absent or ineffective	Isolate sample; verify ≤ 50 °C at analyzer inlet; install or service the optional condenser.

ESCALATION

Record the model, serial number, software version, symptom, alarm text, sample conditions, recent maintenance and steps already taken before contacting support.



14. U1600-O Qualification Requirements

The qualification plan supplied with the analyzer is a framework and must be approved and adapted by the user quality unit. The requirements below separate the laboratory and online configurations so that installation, function and performance are verified against the actual use.

U1600-O Model-Specific Qualification Sequence

Online-specific focus

- Wall mounting, process connections and drainage
- Pressure, flow, temperature and condenser
- Online/offline modes, alarms and communications
- Continuous records, interruption recovery and audit trail
- Blank, SST, repeatability and online challenge



Each stage requires approved acceptance criteria, traceable records, deviation handling, review and formal release.

Figure 14-1. U1600-O model-specific qualification sequence.

14.1 Installation Qualification (IQ)

IQ item	Acceptance requirement
Documentation	Manual, packing list, certificate, calibration data, software version and ordered options are present and controlled.
Instrument identity	Model U1600-O, serial number, voltage and nameplate match the order.
Wall mounting	Secure, level and consistent with the supplied mounting template.
Environment	10-40 °C, RH ≤85%, no condensation, corrosive vapour or obstructed ventilation.
Process connection	50.5 mm sanitary adapter and 3 mm inlet tubing installed without leakage.
Pressure and flow	Minimum 0.3 MPa available upstream; 6-10 mL/min achievable and recorded.
Temperature / condenser	Inlet ≤50 °C or approved condenser installed and verified.
Drain	Open, unrestricted and safely routed.
Electrical / network	Grounded power, interfaces, IP address and alarm wiring recorded.
Software / users	Version, user roles, clock, storage and data-retention settings documented.



14.2 Operational Qualification (OQ)

OQ item	Acceptance requirement
Power-up and self-test	Starts normally without abnormal noise or leakage.
Offline cleaning	Forward/reverse cleaning operates and removes bubbles.
Online mode	Transitions correctly from offline calibration/cleaning to online measurement.
Flow and alarm	Flow can be set to 6-10 mL/min; configured alarms and outputs operate.
Test and records	TOC, conductivity, temperature, flow and status are displayed and stored.
Historical data	Records can be searched and reported with correct metadata.
Users / audit trail	Permissions, failed access, critical events and electronic signatures meet the approved matrix.
Export / backup	Copy/transfer behaviour, record count, readability, local retention and restoration are verified.
Communications	RS232/RS485/USB/Ethernet and alarm interface operate as ordered.
Interruption recovery	Recovery from power and sample interruption preserves configuration and data as approved.

14.3 Performance Qualification (PQ)

PQ item	Acceptance requirement
Blank / baseline	Stable low-TOC blank meets the approved method.
System suitability	Sucrose / 1,4-benzoquinone response efficiency 85-115%.
Repeatability	≤3% under approved performance-test conditions.
Verification / accuracy	Within ±3% for the approved verification condition.
Online challenge	Representative sample-point response, stabilization and alarm/trend behaviour meet the approved protocol.
Routine comparison	Results are consistent with an approved reference or laboratory comparison within predefined criteria.
Continuous operation	Data continuity, storage and alarm review are acceptable over the defined PQ period.

14.4 Deviations and Release

- Document all deviations, investigation, impact, corrective action and retest.
- Do not release the analyzer while critical IQ/OQ/PQ failures remain open.
- The quality unit or authorized approver must sign the completed qualification and define requalification triggers.
- Typical triggers include relocation, major repair, lamp/reactor replacement where required by risk assessment, software upgrade, data-integrity configuration change and repeated performance failure.

15. Warranty and Technical Support

15.1 Standard Warranty

The standard warranty is 12 months unless the sales contract states otherwise. Warranty service covers defects in supplied materials and workmanship under approved installation, operation and maintenance conditions.

15.2 Warranty Exclusions

- Unauthorized repair, modification or software change.



- Incorrect or unstable power, inadequate grounding or electrical surge.
- Operation outside approved sample, pressure, temperature, humidity or environmental limits.
- Blocked tubing, drain backpressure, unsuitable samples or incompatible cleaning materials.
- Use of non-approved lamps, tubing, fuses, standards or accessories.
- Damage caused by transport, impact, liquid ingress, corrosion, misuse or failure to follow maintenance requirements.
- Normal consumable wear.

15.3 Information Required for Support

Information	Where to obtain it
Model and serial number	Nameplate and Device Information screen.
Software / firmware version	Device Information screen.
Alarm or symptom	Screen message, audit trail and operator observation.
Sample conditions	Source, TOC range, conductivity, temperature, pressure and flow.
Recent work	Maintenance, calibration, standards and parts used.
Evidence	Photographs, exported records, trend, log and qualification status.

Support organization	Blue Dragon Technology
Website	bluedragontechnology.com
Product	U1600-O Online TOC Analyzer
Document	BD-U1600O-MAN-EN

16. Shutdown, Storage and Disposal

16.1 Routine Shutdown

1. Complete the current test and confirm records are stored.
 2. Export or back up records according to the approved procedure.
 3. Wash with approved low-TOC water.
 4. Use reverse operation to drain the fluid path where the approved procedure requires it.
 5. Return to the main screen, switch off and disconnect power.
- Isolate and depressurize the process sample line.
 - Drain the condenser and sample-conditioning hardware where fitted.
 - Cap or protect process connections against contamination.

16.2 Extended Storage

- Clean and drain the internal fluid path.
- Seal tube ends and ports against dust and contamination.
- Store in a cool, clean, ventilated indoor location without corrosive gas and with RH $\leq$ 80%.
- Retain configuration, maintenance, backup and shutdown records.
- On return to service, repeat initial cleaning, calibration and the qualification tests required by the risk assessment.

16.3 Disposal

Dispose of the UV lamp, electronic assemblies, batteries where present, pump tubing, filters, standards and contaminated waste according to local regulations and site procedures. Remove or securely erase regulated electronic records before disposal or transfer of ownership.



Appendix A. Standard Supply and Packing List

Item	Typical quantity	Notes
U1600-O main unit	1	Wall-mounted analyzer.
Power cord	1	Voltage as ordered.
Sample inlet tubing / adapter	1 set	50.5 mm sanitary clamp adapter and 3 mm inlet arrangement as ordered.
Drain tubing	1 set	Route to open waste.
Fuse	1	Approved rating.
User manual	1	Electronic or printed copy.
Certificate of Conformity	1	Order-specific document.
Warranty documentation	1	As supplied.
Mounting template / hardware	1 set	Use serial-specific template.
Condenser	If ordered	Required for inlet above 50 °C.

PACKING

The delivered packing list and order confirmation govern. Report shortages or shipping damage before installation.

Appendix B. Consumables and Recommended Spare Parts

Item	Reference / interval	Recommended stock	Notes
Dual-wavelength UV lamp	Ref. 19058Z / about 6 months	1	Confirm against serial number.
Peristaltic-pump tubing	About 12 months	1 set	Approved material and size.
Fuse	Nameplate rating	2	Use identical approved type.
Particle filters	≤60 µm / application-dependent	As required	Low-TOC compatible.
Sample / drain tubing	Order-specific	1 set	Maintain cleanliness and compatibility.
Sanitary gasket and clamp	50.5 mm / order-specific	1 set	Material must suit the water system.
Condenser service kit	If condenser fitted	1	Order-specific.
Calibration / SST kit	Within expiry	1 active set	TOC water, sucrose and 1,4-benzoquinone standards.

Confirm all part numbers against the serial number before ordering. Store UV lamps in protective packaging and keep tubing, filters and standards clean and within stated shelf life.

Appendix C. Options and Accessories

Option	Purpose	Order / validation note
Hot-water condenser	Conditions samples above 50 °C before entry.	Specify maximum process temperature and connection details on order.
Sample-conditioning panel	Isolation, pressure regulation, flow control and filtration.	Recommended where process pressure or temperature varies.

Option	Purpose	Order / validation note
Remote software / app	Remote monitoring and data analysis.	Validate network, cybersecurity and record functions before regulated use.
External printer / report package	Hard-copy output where required.	Report template and metadata are order-specific.
Integration package	RS232/RS485/Ethernet and alarm integration.	Protocol and signal mapping must be confirmed.
Standards and validation package	Calibration standards, IQ/OQ/PQ and execution support.	Site approval and adaptation required.

Appendix D. Software and Data-Integrity Checklist

Control	Status	Evidence / reference
Unique named accounts configured	☐ Yes ☐ No	
Initial passwords changed	☐ Yes ☐ No	
Roles and permissions approved	☐ Yes ☐ No	
Date/time and time zone verified	☐ Yes ☐ No	
Clock changes recorded in audit trail	☐ Yes ☐ No	
Audit trail records critical actions	☐ Yes ☐ No	
Electronic-signature meaning defined	☐ Yes ☐ No	
Export copy/transfer behaviour verified	☐ Yes ☐ No	
Export completeness and readability verified	☐ Yes ☐ No	
Backup location and retention approved	☐ Yes ☐ No	
Restoration test completed	☐ Yes ☐ No	
Software version and interfaces recorded	☐ Yes ☐ No	
Network/cybersecurity review completed	☐ Yes ☐ No	
Periodic audit-trail review frequency defined	☐ Yes ☐ No	

Appendix E. Qualification Forms

E.1 Qualification Approval

Role	Name	Signature	Date
Protocol prepared by			
Engineering review			
QC review			
Quality approval			



E.2 System Suitability Record

Field	Record
Instrument model / serial	
TOC water lot / expiry	
Sucrose standard lot / expiry	
1,4-Benzoquinone standard lot / expiry	
Rw	
Rs	
Rss	
Response efficiency (%)	
Acceptance: 85-115%	☐ Pass ☐ Fail
Performed by / date	
Reviewed by / date	

E.3 Deviation Record

Field	Entry
Deviation number	
Qualification stage	☐ IQ ☐ OQ ☐ PQ
Description	
Immediate action	
Root cause	
Impact assessment	
Corrective action	
Retest result	
Approval / date	



Appendix F. Engineering Drawings and Connection Schematics

U1600-O General Arrangement and Service Access



Mounting requirements

- Secure to a rigid vertical support using the supplied mounting template.
- Verify wall loading for the 5.8 kg instrument plus tubing and service tools.
- Keep the enclosure level and provide unobstructed ventilation.
- The serial-specific mounting template governs hole positions.



Drawing status

General arrangement only.
Provided for initial installation reference.
The supplied mounting template and order documents govern.

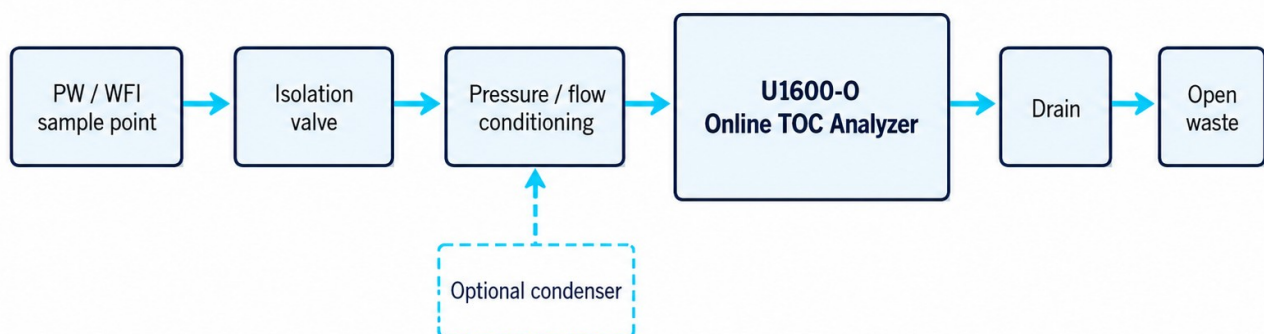


Drawing F-1. U1600-O overall dimensions and service access.

U1600-O Online Sample Conditioning and Connection Schematic

Confirmed connection data

- Minimum inlet pressure: 0.3 MPa upstream of flow control.
- Instrument sample flow: 6-10 mL/min.
- Process adapter: 50.5 mm sanitary clamp to 3 mm sample inlet tube.
- Internal wetted tubing: 304 stainless steel.
- Standard maximum sample temperature: 50 °C; specify condenser for hotter service.
- Drain must remain unrestricted and near atmospheric pressure.



Drawing F-2. U1600-O process sample, conditioning and drain arrangement.

Drawing item	Controlled value
Overall dimensions	360 W × 206 D × 250 H mm.
Weight	Approximately 5.8 kg including standard accessories.
Mounting holes	Use the mounting template supplied with the serial number; do not scale this manual.

Drawing item	Controlled value
Process connection	50.5 mm sanitary clamp adapted to 3 mm sample tube.
Minimum inlet pressure	0.3 MPa upstream of flow control.
Instrument flow	6-10 mL/min.
Standard inlet temperature	Maximum 50 °C; optional condenser for hotter service.
Drain	Open, unrestricted, near atmospheric pressure.

DRAWING STATUS

General-arrangement drawings are not for fabrication. The mounting template, nameplate and serial-number-specific drawings supplied with the analyzer take precedence.

Appendix G. Maintenance and Calibration Records

G.1 Maintenance Log

Date	Operating hours / use	Maintenance or inspection	Parts used	Verification result	Performed by

G.2 Calibration / Verification Log

Date	Standard / lot	Expected	Measured	Acceptance	Operator	Reviewer

G.3 UV Lamp and Pump Tube Record

Date	Component	Part number	Service hours	Post-maintenance check	Performed by



End of Manual



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