Test Kit Instructions

QuenchGone™21 Industrial Test Kit

Product #: QG21I-50 / QG21It-100/25

Introduction

At LuminUltra, we are committed to providing high quality test kits to anyone that needs fast and reliable results about the microbiological characteristics of any process! Visit www.luminultra.com to learn about the exciting opportunities that our solutions can provide.

Whereas traditional microbiological tests require days for feedback and measure only a fraction of the microorganisms, **2nd Generation** Adenosine Triphosphate (ATP) test kits from LuminUltra measure total microorganisms and provide feedback in minutes!

In this test kit instruction guide, you will learn...

- Where this kit can be used;
- How 2nd Generation ATP technology works;
- How to handle and store components of this kit;
- How to perform tests;
- How to calculate and interpret results; and
- How to contact us.

QG21I Test Kit (QG21I-50C)

Choosing the Right Test Kit

LuminUltra provides 6 core test kits for measuring total microbiological concentration via ATP, each tailored to specific applications:

- Quench-Gone Aqueous (**QGA™**):
  For low-solids water-based samples, such as drinking, cooling and process waters with less than 10% free oil and/or salinity.
- Quench-Gone Organic Modified (**QGO-M™**):
  For low-solids organic-based samples, such as fuel, bottom waters, metalworking fluids, lubricants, oily brine, and oilfield waters with more than 10% free oil and/or salinity. QGOM-XLPD is also available for samples that are more difficult to filter such as latex polymers, concrete admixtures, and personal or home care products.
- Deposit & Surface Analysis (**DSA™**):
  For measuring attached growth such as biofilm, corrosion products, slimes, and biological filter media.
- QuenchGone21™ Industrial (**QG21I™**):
  For high-solids process fluids, including paper process and other wash waters.
- QuenchGone21 Specialty (**QG21S™**):
  For chemical product testing, such as slurries, adhesives, paints, and other coatings.
- QuenchGone21 Wastewater (**QG21W™**):
  For wastewater and bioprocessing samples, whether influent, bioreactor or effluent. Also provides the capability to quantify attached growth and floc bulking sedimentation processes.

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Where to use the QG21I Test Kit

QG21I test kits provide a real-time measurement of total microorganism population and stress level in high solids process fluids. Use QG21I to detect total microbiological activity in:

- ✓ Papermaking Whitewater
- ✓ Process Wash Waters
- ✓ Pulping Process Water
- ✓ Other Process Waters

… and more! QG21I test kits are available in two formats. Choose the best format to suit your needs from the following descriptions:

- QG21I Standard (**QG21I-50**) provides materials to perform 50 analyses each of Total ATP (or **tATP™**: living plus dead biomass) and Dissolved ATP (or **dATP™**: dead biomass only). This provides the most accurate indication of living microorganisms only via Cellular ATP and allows computation of the Biomass Stress Index to assess microbial population health.
- QG21I tATP Only (**QG21It-100**) provides materials to perform only 100 analyses of **tATP**. Use this kit when no differentiation between living and dead microbes is required.

How Does ATP Testing Work?

LuminUltra's test kits are based on the measurement of ATP, which is a direct and interference-free indicator of total living biomass. ATP is measured using the firefly luciferase assay, where a sample containing ATP is introduced to a solution containing the enzyme Luciferase, which naturally occurs in the tails of fireflies, to produce light. The light is detected in a **luminometer** as Relative Light Units (RLU).

$$ATP + O_2 + luciferin \xrightarrow[luciferase]{Mg++} AMP + PPi + oxyluciferin + light$$

The QG21I Standard test kit uses two parallel 1-minute analyses (tATP and dATP) on each sample to determine two valuable pieces of information:

- **Cellular ATP (cATP™)** – represents ATP from living microorganisms and therefore is a direct indication of total living microorganisms.
- **Biomass Stress Index (BSI™)** – represents the stress level experienced by the microbiological population.

QG21I is capable of detecting ATP levels as low as **20 pg ATP/mL** using standard procedures and equipment.

Getting Started

LuminUltra's test kits contain all of the consumable materials required to run their specified number of tests (Defined by the last 2 or 3 digits of the product code). To use these test kits, LuminUltra recommends either:

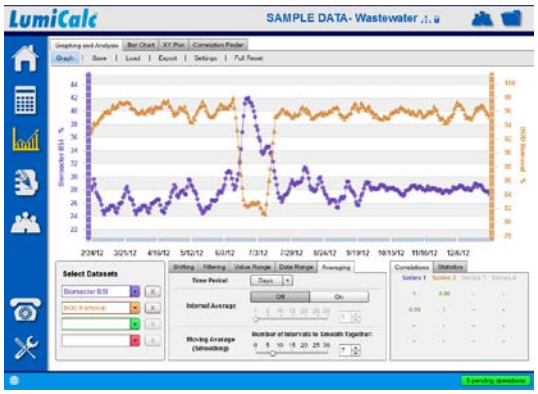
- PhotonMaster™ Luminometer & Equipment Set (**EQP-PAC-PMT**):
  Carry Case, Micropipettors, PhotonMaster Luminometer, Test Tube Racks.

PhotonMaster Equipment Set (EQP-PAC-PMT)

- Lumitester™ C-110 Luminometer & Equipment Set (**EQP-PAC-C110**):
  Carry Case, Micropipettors, Lumitester C-110 Luminometer, Test Tube Racks.

NOTE: LuminUltra's test kits can be used with the majority of photomultiplier tube–based luminometers. Contact LuminUltra to confirm compatibility of your luminometer.

In addition to test kits and equipment, LuminUltra also recommends the use of **LumiCalc™** software. This powerful platform allows you to calculate, store, and analyze your data to maximize your experience with 2nd Generation ATP testing. Plus, it provides a stable and secure ability to share data and collaborate with your peers!



LumiCalc Software (LC-SOFT-M/A/L)

LuminUltra is sensitive to the needs of each individual customer. We can supply you with on-site auditing and training services, web-based training, and one-on-one consultation to get your process improvement program off the ground. Contact us today to learn more!

Test Kit Contents and Storage

When you receive your test kit, utilize the following guidelines for material storage. Note that the presence and quantity of each item listed below will depend on test kit size and type. Avoid freezing of all product components except where noted, and avoid usage of expired test kit components.

QG21I Test Kit Contents & Storage Conditions

Component (LuminUltra P/N)	Storage	Shelf Life
Luminase™ Enzyme & Buffer Vials (**Lu-3mL-FD**) *Luciferase Enzyme Reagent, 3mL*	4 to 25°C	6 to 12 mo*
UltraCheck™ 1 Dropper Bottle (**UC1-5mL**) *1 ng ATP/mL Standard, 5mL*	4 to 25°C	18 mo
UltraLyse™ 30[21] (Extraction) Tube, 1mL (**UL30(21)-1mL-50R**) *tATP Extraction Reagent, 1mL*	4 to 25°C	18 mo
UltraLute™/Resin (Dilution) Tube, 8mL (**ULuR-8mL-50R**) *tATP Dilution Reagent, 8mL*	4 to 25°C	18 mo
LumiSolve™ (Stabilizer) Tube, 9mL (**LS-9mL-50R**) ** *dATP Stabilizing Reagent, 9mL*	4 to 25°C	18 mo
100 to 1000µL Wide-Mouth Pipet Tips, 100/rack (**DIS-PT1WM-100R**)	-	-
10 to 200µL Yellow Pipet Tips, 96/rack (**DIS-PT01-96R**)	-	-
12x55mm Test Tubes, 50/pk (**DIS-CT12-50**)	-	-

* Luminase is manufactured and shipped in matching bottles of freeze-dried powder and liquid buffer. The stated shelf life is for the freeze-dried form; store refrigerated for the best possible shelf life. Following rehydration, the reagent will be stable for 3 months when refrigerated and 6 months when frozen. Note that the Luminase supplied in QG21I kits is NOT interchangeable with other forms of Luminase (i.e. Luminase[W], Luminase Lite, and Luminase[XL]).

** Materials are included as part of QG21I Standard (QG21I-50) test kit only.

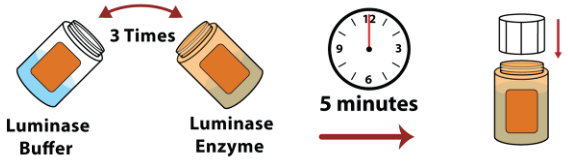
General Tips

- New to 2nd Generation ATP technology? Before getting started, consult www.luminultra.com for video demonstrations, use guidelines, validation guidelines, other product documentation, and more!
- Microbiological characteristics of most samples will begin to change immediately upon collection. If samples cannot be tested within 2 hours of collection, store refrigerated (2 to 8°C) and test within 24 hours of collection. Allow samples to reach ambient temperature prior to testing, and perform ATP analyses on the same sample used for measuring other parameters for reliable interpretation.
- Waste reagent can be discarded as general waste in most cases. Consult MSDS for more information. Contact LuminUltra for copies of MSDS.
- All materials in this test kit including pipet tips and test tubes are single-use only. Because ATP and bacteria are present on skin, do not to touch the surface of pipet tips. Ensure that all pipet tips and test tubes are clean inside and outside prior to use. Do not mark on assay tubes as this may impact light detection by the luminometer.
- Avoid taking multiple luminometer readings on the same assay. The light output from ATP assays is relatively constant and at a maximum for the first 15-30 seconds after mixing, after which the output will decline.
- When testing samples that yield low RLU values (i.e. $RLU_{ATP} \leq 50$), it is recommended to account for background noise. Simply follow the procedure without adding any of the ATP-containing sample into the analysis and record this value as RLU_{bg}. Typical RLU_{bg} when using a PhotonMaster or Lumitester C-110 are ≤ 10. If high RLU_{bg} are consistently observed, repeat assays in an area

out of direct sunlight or intense lighting. A single RLU_{bg} may be used for multiple analyses much like a single UltraCheck 1 RLU (RLU_{ATP1}).

Handling Luminase

- **Luminase** is manufactured using a process called freeze-drying. This maximizes product stability prior to use. Before using this product, it must first be rehydrated by mixing freeze-dried powder with liquid buffer and then allowed to incubate for at least 5 minutes. Take care to avoid contamination when removing the glass vial stopper.



Luminase Rehydration Process

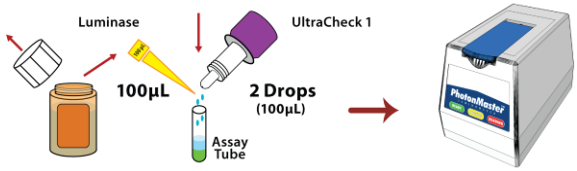
- Rehydrated **Luminase** can be stored in the refrigerator for up to 3 months (or freezer for up to 6 months with unlimited freeze-thaw cycles) following rehydration. Always bring cold rehydrated **Luminase** to ambient temperature prior to use. 1 hour is generally sufficient for this purpose.
- Never expose rehydrated **Luminase** to ≥30°C for longer than 1-2 hours.
- In general, it is recommended that **Luminase** only be rehydrated as required. In other words, rehydrate on the day of testing rather than in advance.
- Never attempt to partition portions of freeze-dried **Luminase** enzyme and/or the supplied buffer into smaller quantities.
- If you begin utilizing a new bottle of **Luminase** during your testing, make sure to collect a new calibration result for that bottle. Alternatively, mix bottles of **Luminase** for all testing at one time.

Step 1 – ATP Standard Calibration

Included in QG21I and QG21It test kits.

The ATP Standard Calibration (**ATP1**) converts luminometer RLU values into actual ATP concentrations. Perform one calibration per day or for each set of samples analyzed at the same time. Be sure that all reagents (especially rehydrated **Luminase**) are allowed to reach ambient temperature prior to use.

PROCEDURE: Add 2 drops (100µL) of **UltraCheck 1** and use a new pipet tip to dispense 100µL of **Luminase** to a new 12x55mm test tube (the Assay Tube), swirl gently five times, immediately insert into the luminometer and measure. Record RLU_{ATP1} manually, or directly in LumiCalc.



NOTE: If $RLU_{ATP1} \leq 5{,}000$ using a PhotonMaster or Lumitester C-110 rehydrate a new bottle of Luminase for maximum sensitivity.

NOTE: RLU_{ATP1} will fall over time for the same batch of Luminase. This is due to decreased luciferase enzyme activity. When followed, the guideline above ensures that there is sufficient activity to meet the specified detection limit.

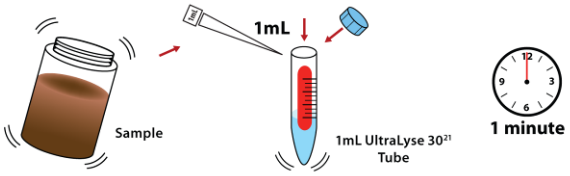
Step 2 – tATP™ Analysis

Included in QG21I and QG21It test kits.

The Total ATP (**tATP**) analysis measures ATP from both living and dead cells. Perform one tATP analysis on each sample you wish to test.

2.1 – EXTRACTION

Using a new wide-mouth pipet tip, add 1mL of well-mixed sample to a new **1mL UltraLyse 30[21] (Extraction) Tube**. Cap and invert three times to mix. Allow at least 1 minute for incubation.



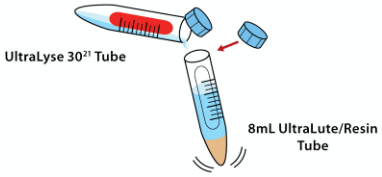
NOTE: When using the bulk-format version, you must dispense your own reagent into a clean test tube.

NOTE: At this point, the contents of the Extraction Tube can be capped and stored refrigerated between 2-8°C for up to 1 week prior to 2.2.

TIP: Wide-mouth pipet tips are those that have sufficiently large openings to prevent tip plugging by sample particles. In general, wide-mouth 100-1000µL pipet tips are sufficient for most samples. If required, increase the bore size of a tip using a clean pair of scissors.

2.2 – DILUTION

Pour the **UltraLyse 30[21] (Extraction) Tube** contents into a new **8mL UltraLute/Resin (Dilution) Tube**. Transfer the mixture back and forth between the two tubes at least three times for best mixing accuracy. Cap and invert three times to mix. Allow beads to settle.



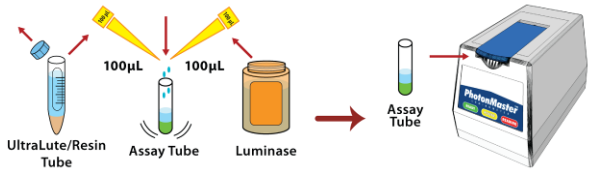
NOTE: At this point, the contents of the Dilution Tube are stable at room temperature for up to 4 hours.

TIP: If beads do not settle or settle slowly, tap the Dilution Tube gently to assist settling.

TIP: If the Extraction Tube cannot be poured into the Dilution Tube, simply pour the Dilution Tube contents into the Extraction Tube to liquefy its contents.

2.3 – ASSAY

Using a new pipet tip, add 100µL of the **UltraLute/Resin (Dilution) Tube** contents to a new 12x55mm test tube (the Assay Tube), and use another new pipet tip to add 100µL of **Luminase**, swirl gently five times, immediately insert into the luminometer and measure. Record RLU_{tATP} manually, or directly in LumiCalc.



NOTE: If $RLU_{tATP} \leq 10$ on a PhotonMaster or Lumitester C-110, you are below the low–detection limit. Report tATP (pg ATP/mL) = 0 in calculations.

NOTE: When $RLU_{tATP} \leq 50$ on a PhotonMaster or Lumitester C-110, it is recommended that you measure and subtract RLU_{bg} from your measurement.

TIP: If "Scale Over" is returned, repeat the tATP analysis using 100µL of sample in 2.1 (EXTRACTION) and modify the dilution factor in the calculations as noted.

2.4 – CALCULATIONS

Following completion of the tATP analysis, RLU values must be converted to ATP concentrations using the following calculations. For easy calculations, utilize **LumiCalc** software.

$$tATP\,(pg\ ATP/mL) = \frac{RLU_{tATP}}{RLU_{ATP1}} \times 10{,}000\,(pg\ ATP/mL)$$

NOTE: When applicable, subtract RLU_{bg} from RLU_{tATP} prior to executing the above calculation.

NOTE: If 100µL of sample was used in 2.1 of the tATP analysis, replace the dilution factor "10,000" with "100,000".

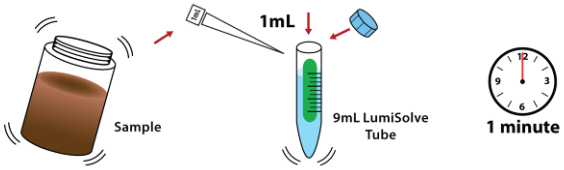
Step 3 – dATP™ Analysis

Included in QG21I Standard test kit only.

The Dissolved ATP (**dATP**) analysis measures ATP from only dead cells. Perform one dATP analysis on each sample you wish to test.

3.1 – DILUTION

Using a new wide-mouth pipet tip, add 1mL of well-mixed sample to a **9mL LumiSolve (Stabilizer) Tube**. Cap and invert three times to mix. Allow at least 1 minute for incubation.



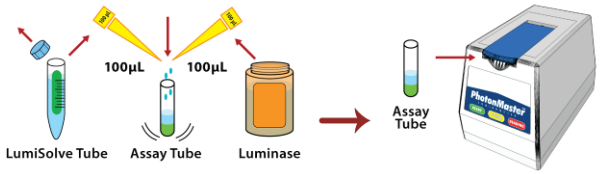
NOTE: When using the bulk-format version, you must dispense your own reagent into a clean test tube.

NOTE: The LumiSolve Tube can be capped and stored between 2 to 8°C for up to 1 week prior to 3.2.

TIP: Wide-mouth pipet tips are those that have sufficiently large openings to prevent tip plugging by sample particles. In general, wide-mouth 100-1000µL pipet tips are sufficient for most samples. If required, increase the bore size of a tip using a clean pair of scissors.

3.2 – ASSAY

Using a new pipet tip, add 100µL of the **LumiSolve (Stabilizer) Tube** contents to a new 12x55mm test tube (the Assay Tube), and use another new pipet tip to add 100µL of **Luminase**, swirl gently five times, immediately insert into the luminometer and measure. Record RLU_{dATP} manually, or directly in LumiCalc.



NOTE: If $RLU_{dATP} \leq 10$ on a PhotonMaster or Lumitester C-110, you are below the low–detection limit. Report dATP (pg ATP/mL) = 0 in calculations.

NOTE: When $RLU_{dATP} \leq 50$ on a PhotonMaster or Lumitester C-110, it is recommended that you measure and subtract RLU_{bg} from your measurement.

TIP: If "Scale Over" is returned, repeat the dATP analysis using 100µL of sample in 3.1 (DILUTION) and modify the dilution factor in the calculations as noted.

3.3 – CALCULATIONS

Following completion of the dATP analysis, RLU values must be converted to ATP concentrations using the following calculations. For easy calculations, utilize **LumiCalc** software.

$$dATP\,(pg\ ATP/mL) \;=\; \frac{RLU_{dATP}}{RLU_{ATP1}} \;\times\; 10{,}000\,(pg\ ATP/mL)$$

NOTE: When applicable, subtract RLU_{bg} from RLU_{dATP} prior to executing the above calculation.

NOTE: If 100µL of sample was used in 3.1 of the dATP analysis, replace the dilution factor "10,000" with "100,000".

Key Process Indicators

For monitoring basic biomass concentration and health at any process location, the following 2 parameters are used. For easy calculations, utilize **LumiCalc** software.

1. Cellular ATP (**cATP**) represents the amount of ATP contained within living cells and is a direct indication of total living biomass (quantity).

$$cATP\,(pg\ ATP/mL) \;=\; tATP\,(pg\ ATP/mL) \;-\; dATP\,(pg\ ATP/mL)$$

NOTE: When using the QG21I tATP-only kit, skip this step and interpret tATP results as you would cATP results in the Interpretation Guidelines.

NOTE: When the computed dATP (pg/mL) is greater than tATP (pg/mL), first confirm that the result is not due to inhibition by re-testing tATP and dATP using 0.1mL of sample rather than 1mL. If the result persists, report dATP (pg/mL) = tATP (pg/mL). Occurrences of dATP > tATP are most often the result of a combination of test method and instrumentation sensitivity and are to be considered normal.

NOTE: It is important to stress that in situations of dATP (pg/mL) = tATP (pg/mL), it does not mean that the entire microbiological population is **dead**. What it does mean is that in their current state, the microorganisms are severely compromised to the degree that their weakened cell membranes are lysed and their ATP is released even when exposed to a mild buffer such as LumiSolve. Occurrences of dATP (pg/mL) = tATP (pg/mL) should be taken as an indication of a highly-suppressed and thus successfully controlled microbiological population, provided that the magnitude of the tATP (pg/mL) result is low.

To communicate results on the same basis as traditional culture tests, cATP results are converted into Microbial Equivalents (**ME's**). This is based on the established conversion that 1 E. coli-sized bacteria contains 0.001 pg (1 fg) of ATP.

$$cATP\,(ME/mL) \;=\; cATP\,(pg\ ATP/mL) \;\times\; \frac{1\,ME}{0.001\,pg\ ATP}$$

NOTE: For more discussion on the quantity of ATP per cell, visit www.luminultra.com.

Because many of the traditional culture-based methods report results in a similar fashion, it is sometimes convenient to report cATP results in ME/mL using Scientific Notation (i.e. **#.# x $10^{\#}$**) or on a **Log_{10}** format for comparison purposes.

2. Biomass Stress Index (**BSI**) – provides a measure of the stress level (quality) of the microbiological community.

$$BSI\ (\%) \;=\; \frac{dATP\,(pg\ ATP/mL)}{tATP\,(pg\ ATP/mL)} \;\times\; 100\%$$

NOTE: If dATP (pg/mL) > tATP (pg/mL) as discussed above, the BSI value will exceed 100%. If these values persist after re-testing, report BSI = 100%.

Interpretation Guidelines

Once QG21I cATP and BSI results are calculated, microbial control can be evaluated. ATP-based measurements are extremely sensitive to changes in total microbial quantity. In general, processes will have the best microbial control when **cATP is minimized** and **BSI is maximized**. For the easiest interpretation, utilize **LumiCalc** software.

LuminUltra's ATP test kits can be used to audit microbial quantity to reveal differences at different process locations in an effort to quickly assess the 'hot spots' within a process that require more immediate attention.

For process control, daily monitoring using ATP test kits will give you true total microbial quantity parameters to trend over time against process characteristics and performance.

When utilizing ATP test kits it is important to remember that every process is different. During **audits**, relative comparisons from point to point are a reliable means to assess your process, while for **daily monitoring** it is important to establish a baseline trend before making control decisions. To get started, LuminUltra provides the following cATP guidelines in units of **pg cATP per mL**:

QG21I cATP Interpretation Guidelines

Application	Good Control (pg cATP/mL)	Preventive Action (pg cATP/mL)	Corrective Action (pg cATP/mL)
Treated Process Water (Cooling, Bottom Water, Oilfield) *Non-Oxidizing Biocides or Non-Chemical Treatment*	<100	100 to 1,000	>1,000
Papermaking Product Quality (Newsprint, Fine Papers)	<1,000	1,000 to 10,000	>10,000
Papermaking Odor Control (Paperboard, Recycle Water)	<10,000	10,000 to 100,000	>100,000

For BSI (when applicable), it can generally be interpreted that good control is achieved at levels of **75% or above**. Preventive action should be taken at levels **between 50% and 75%**, and corrective action should be taken at levels **below 50%**.

NOTE: These interpretation guidelines are designed for generic risk management guidance **only**. Users are encouraged to establish their own control ranges on which to base process decisions. LuminUltra and its affiliates do not accept any liability for any decision or assessment taken or made as a consequence of using this test kit.

Ordering Information

- New to 2nd generation ATP technology? Start by ordering the Luminometer Package (Product # **EQP-PAC-PMT** or **EQP-PAC-C110**) and the test kit(s) of your choice.
- When reordering materials for testing, it is preferred to order complete kits. QG21I is available in eight formats:

Description	Part #
QG21I Standard, 50 Tests, Complete *	QG21I-50C
QG21I Standard, 50 Tests, Reagents Only	QG21I-50
QG21I Standard, 50 Tests, Bulk Format **	QG21I-50B
QG21I tATP Only, 100 Tests, Complete *	QG21It-100C
QG21I tATP Only, 100 Tests, Reagents Only	QG21tI-100
QG21I tATP Only, 100 Tests, Bulk Format **	QG21It-100B
QG21I tATP Only, 25 Tests, Complete *	QG21It-25C
QG21I tATP Only, 25 Tests, Reagents Only	QG21tI-25

* Complete kits include LuminUltra-manufactured reagents plus all consumables (tips, tubes, filters, syringes) required to run analysis. If you supply your own consumables, reagent only kits are available.

** Bulk test kits contain all reagents supplied in bulk format and require the user to dispense individual quantities as required.

- To obtain pricing information, inquire about other products and services, or to place an order, contact LuminUltra or your authorized representative.

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www.luminultra.com

- Major credit cards (Visa, MasterCard, AMEX) are accepted. Contact LuminUltra by phone to place credit card orders.

- Orders generally ship within 3 business days. You will receive order confirmation via Fax or Email.

Quick Reference Guide

QuenchGone21™ Industrial Test Kit

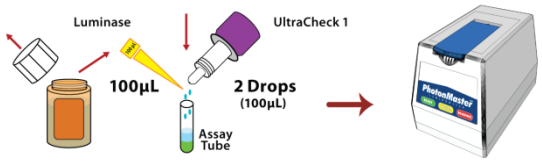
Product #: QG21I-50 / QG21It-100

NOTE: Please refer to Test Kit Instructions during first product use and for additional details including legal statements.

ISO 9001

Step 1 - UltraCheck™ 1 Calibration

Perform one UltraCheck 1 calibration per day or per each set of samples analyzed.



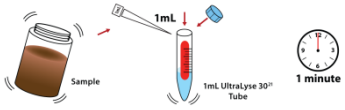
NOTE: If $RLU_{ATP1} \leq 5{,}000$ using a PhotonMaster or Lumitester C-110, rehydrate a new bottle of Luminase for maximum sensitivity.

Step 2 –Total ATP (tATP™) Analysis (1 per sample)

Included in QG21I™ and QG21It™ test kits.

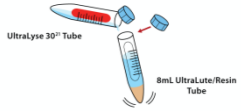
2.1 – EXTRACTION

Add sample to extract ATP.



2.2 – DILUTION

Dilute out interferences.



2.3 – ASSAY

Measure ATP concentration.

NOTE: If $RLU_{tATP} \leq 10$ using a PhotonMaster or Lumitester C-110, you are below the low- detection limit.

NOTE: If $RLU_{tATP} \leq 50$ using a PhotonMaster or Lumitester C-110, consider accounting for background (RLU_{bg}). See Test Kit Instructions for guidance.

Total ATP (tATP) Calculation:

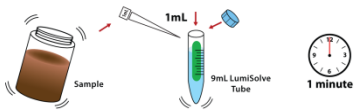
$$tATP\,(pg\ ATP/mL) = \frac{RLU_{tATP}}{RLU_{ATP1}} \times 10{,}000\,(pg\ ATP/mL)$$

Step 3 – Dissolved ATP (dATP™) Analysis (1 per sample)

Included in QG21I™ test kit only.

3.1 – DILUTION

Add sample to recover ATP.



3.2 – ASSAY

Measure ATP concentration.

NOTE: If $RLU_{dATP} \leq 10$ using a PhotonMaster or Lumitester C-110, you are below the low- detection limit.

NOTE: If $RLU_{dATP} \leq 50$ using a PhotonMaster or Lumitester C-110, consider accounting for background (RLU_{bg}). See Test Kit Instructions for guidance.

Dissolved ATP (dATP) Calculation:

$$dATP\,(pg\ ATP/mL) = \frac{RLU_{dATP}}{RLU_{ATP1}} \times 10{,}000\,(pg\ ATP/mL)$$

Calculations

NOTE: When using the QG21I tATP – only kit, skip final calculations and interpret tATP results as you would cATP results using the Interpretation Guidelines.

NOTE: If the results show for a given sample that dATP (ng/mL) > tATP (ng/mL), report cATP™ = 0 and BSI™ = 100%

Cellular ATP (cATP) Calculation:

$$cATP\left(\frac{ng\ ATP}{mL}\right) = tATP\left(\frac{ng\ ATP}{mL}\right) - dATP\left(\frac{ng\ ATP}{mL}\right)$$

Microbial Equivalent (ME/mL):

$$cATP\left(\frac{ME}{mL}\right) = cATP\,(pg\ ATP/mL) \times \frac{1\ ME}{0.001\ pg\ ATP}$$

NOTE: 1 ME (Microbial Equivalent) assumes 0.001 pg (1 fg) ATP per cell.

Biomass Stress Index (BSI) Calculation:

$$BSI\ (\%) = \frac{dATP\,(pg\ ATP/mL)}{tATP\,(pg\ ATP/mL)} \times 100\%$$

Interpretations Guidelines

Application	Good Control (pg cATP/mL)	Preventative Action (pg cATP/mL)	Corrective Action (pg cATP/mL)
Treated Process Water (Cooling, Bottom Water, Oilfield Non-Oxidizing Biocides or Non-Chemical Treatment	< 100	100 to 1,000	> 1,000
Papermaking Product Quality (Newsprint, Fine papers)	< 1,000	1,000 to 10,000	> 10,000
Papermaking Odor Control (Paperboard, Recycle Water)	< 10,000	10,000 to 100,000	> 100,000

For BSI (when applicable), it can generally be interpreted that good control is achieved at levels of 75% or above. Preventive action should be taken at levels between 50% and 75%, and corrective action should be taken at levels below 50%.

NOTE: Interpretation Guidelines provided for general guidance. For best results, establish your own baseline and control levels.

Date Modified: 5-Apr-13