# RTI Mako Meter

INDEPENDENT X-RAY
QUALITY ASSURANCE

40 years of X-ray safety & quality



# Let’s work together to ensure X-ray safety and quality



## A world-leading manufacturer of QA solutions.

In 1981, we invented the first X-ray QA system for diagnostic radiology. Since then, innovation has been at the heart of our corporate philosophy and we have pioneered many QA procedures.

We continue to invest heavily in R&D to push forward the very edge of X-ray QA, across all modalities.

Longer and more active lives, combined with a string of new examination techniques, have made diagnostic radiology the most widely used medical imaging technology.

Diagnostic imaging growth can be seen throughout the healthcare sector, including orthopaedic and vascular imaging, plus full body scanning. This will be a continuing trend, thanks to a shift in focus to more advanced healthcare globally.

As X-ray examinations increase, there is a higher risk of patient and staff exposure to levels of X-ray radiation that could result in negative health implications. As a long- standing member of, among others, IEC and AAPM, we participate in work to research, develop, and evolve diagnostic radiology standards.

RTI is dedicated to educating customers and partners, sharing our deep knowledge of X-ray QA best-practice to protect patients and staff in an ever more complex operational environment.

Today, we are represented globally through subsidiaries in Europe, the USA, and Asia, and a network of approximately 100 distributors worldwide.

# RTI Mako meter


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*Specifications in this document may be changed without notice

# A meter and a milestone

Unlock time, efficiency and cost savings by harnessing the power of a single tool across the entire range of X-ray systems and applications. Integrate RTI Mako into Radiography, Fluoroscopy, CT, Dental and Mammography X-ray QA workflows, ensuring no detail goes unchecked. Experience the unrivaled accuracy in measuring kVp, Time, HVL, Total Filtration, Dose, Dose rate, and revel in the captivating presentation of Waveform data.

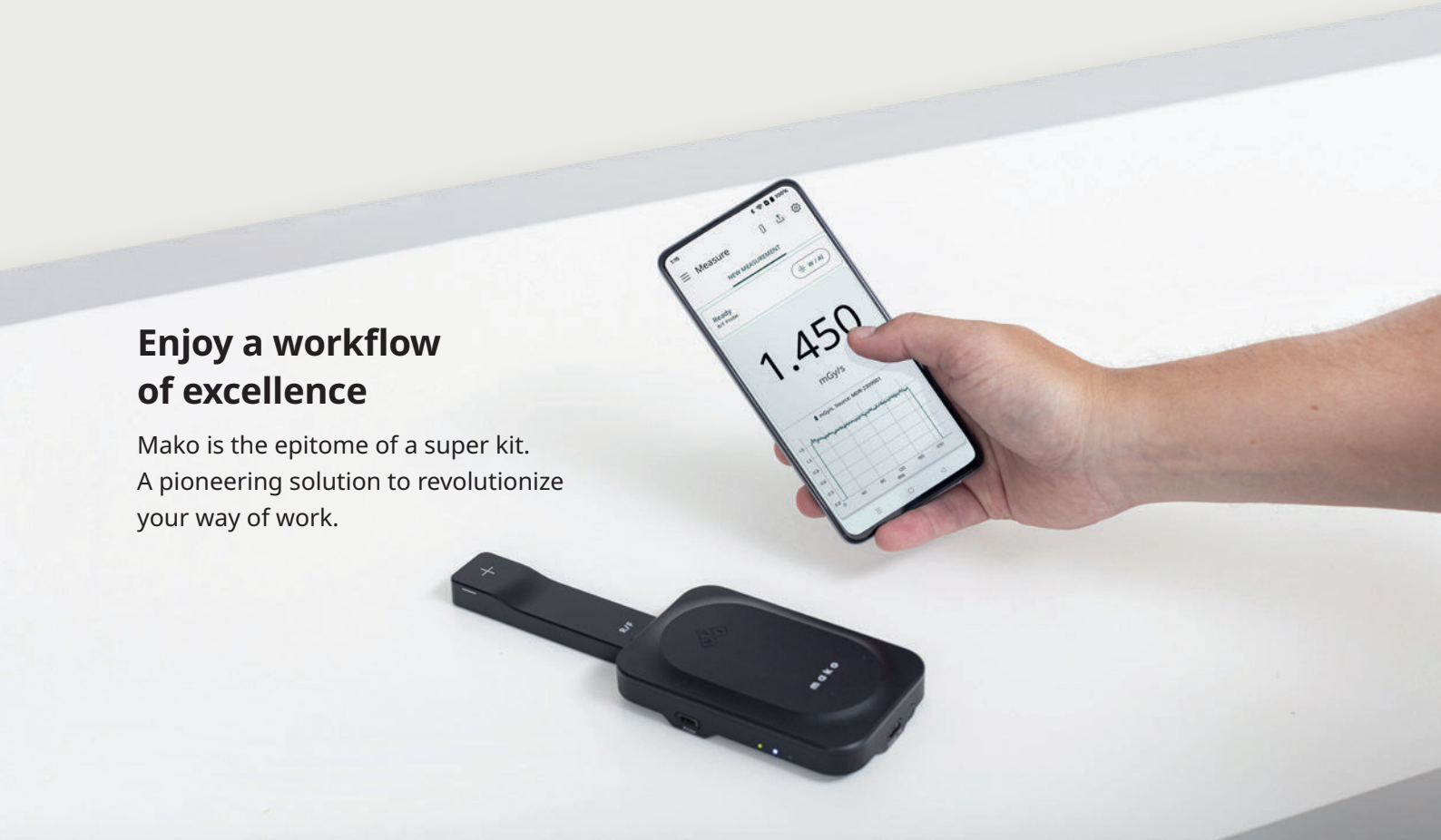
Mako is a platform-based design, ensuring a future-proof solution that will evolve through continuous innovation and seamless updates.

Outside of developing world-class meters and software, RTI invests heavily in providing an ecosystem that nurtures the highest level of compliance. Whether it be training, calibration, support or general knowledge-sharing – we're here for you.

Our complete portfolio is available at www.rtigroup.com, or contact one of our Sales teams for more information.

## Enjoy a workflow of excellence

Mako is the epitome of a super kit.
A pioneering solution to revolutionize your way of work.



## Stay ahead with unparalleled performance and versatility

Mako redefines X-ray testing – the world's most efficient meter, delivering the highest practical accuracy and the broadest application range. Built on a groundbreaking platform, it evolves with new features, probes, and applications to ensure lasting value and the lowest cost of ownership.

### From measurement to insight in seconds

Place your Mako meter, start measuring, and get results faster than ever before. Paired with the Mako Display, you gain wireless, touchscreen access to QA data – no laptop needed.

### Unbox limitless potential

Mako adapts to your needs with plug-and-play simplicity and orientation-independent probes. Fully wireless capability and real-time display make it the most precise, versatile solution across the entire medical X-ray range.

### Freedom from Fixed Screens

Your display. Your choice. Your workflow. Why stay tied to a single touchscreen? With the **RTI Mako Display App**, you can turn your iOS or Android smartphone or tablet into an intuitive, wireless display for real-time X-ray measurements. Simply connect to your Mako Base Unit and view measurement results instantly on the touchscreen device of your choice. No dedicated display, no unnecessary cables – just the freedom to work your way.

Download on the App Store  GET IT ON Google Play

For advanced analysis and reporting, choose **Ocean Next™**, our world-leading QA software. Streamline your workflow with ready-to-use templates, customizable checklists, detailed reports, and complete traceability. Capture and analyze real-time measurement data, including waveforms, save results for later review, and easily share reports with colleagues.

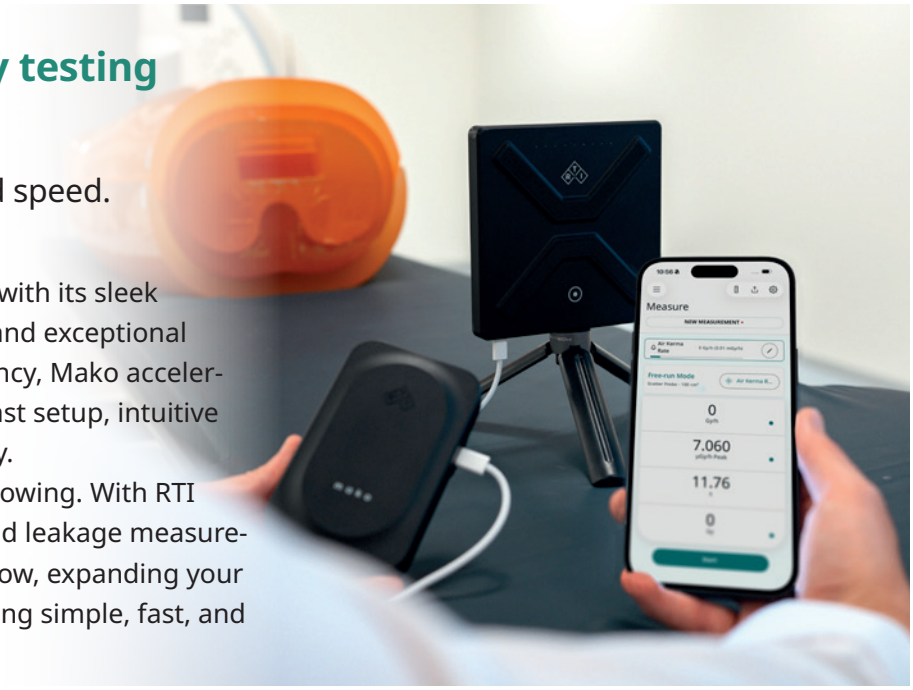


## Supercharge your X-ray testing workflow with Mako

### Wireless simplicity. Unmatched speed. A growing ecosystem.

Mako by RTI redefines X-ray testing with its sleek wireless design, minimal footprint, and exceptional performance. Engineered for efficiency, Mako accelerates your entire QA workflow with fast setup, intuitive operation, and outstanding accuracy.

And the Mako ecosystem keeps growing. With RTI Scatter Probe integration, scatter and leakage measurements join the same intuitive workflow, expanding your capabilities while keeping X-ray testing simple, fast, and efficient.






## RTI Mako System

Mako is engineered for precision, seamlessly adapting to modern X-ray equipment and your specific needs. The kits are tailored to fit your workflow – from simple and lightweight to an all-in-one super kit.

More than just a tool, Mako is your complete diagnostic toolkit.

Contact sales@rtigroup.com or your local distributor to tailor your Mako solution.

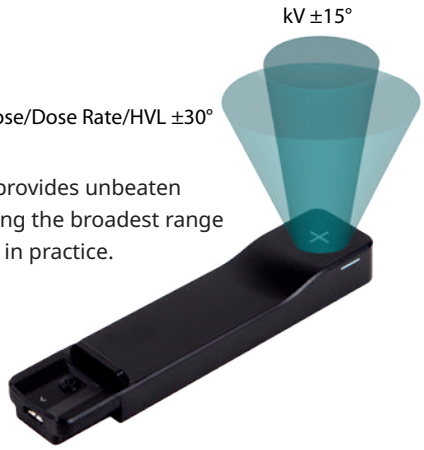
**The Mako System is fully configurable to meet any application, integrating:**

- Mako R/F Probe
- Mako Mammo Probe
- Mako Dental Probe
- Invasive mAs
- Non-invasive mAs (MAS-2)
- Mako Test Point Cable
- RTI CT Ion Chambers
- RTI CT Dose Profiler
- Ion Chamber Magna 1cc
- RTI DAP Chamber
- RTI Light Probe
- RTI Dose Probe
- RTI Scatter Probe

### General specifications

| | |
|---|---|
| Widest kVp measurement range | 18 – 155 kV |
| Best ever kVp accuracy statement | ±1.5% or 0.5kV |
| Enhanced battery life | Up to 20 hours practical measurement |
| Wireless as standard | 100 m Bluetooth range |
| Exposures needed for measurement | One |
| Memory | Unlimited (via Mako display) |
| Warranty | 2-year (industry leading) |
| Calibration Cycle | 2-year (industry leading) |
| Extended Warranty Program | 10-year (industry leading) |

Download the **Mako Specification Sheet** for complete technical details.




Unique detector design provides unbeaten angular sensitivity, offering the broadest range of use and best accuracy in practice.

**Efficiency**
**Accuracy**
**Versatility**



## Key features

### Efficiency

Orientation independent. Place in the X-ray beam in any orientation.

Auto-configuration. The display adapts to connected meter.

One-click reporting. Generates fully traceable reports automatically.

Double the power. 20-hour battery life in practical measurements.

### Accuracy

Made to measure. Spans the widest range, from 18-155 kVp.

Top practical accuracy. kVp accuracy ±1.5%. Unique in the market.

Superior dynamic range. From lowest to highest dose rates.

Sleek and sensitive. Advanced detector design with 0.9 mm sensor.

### Application Range

Broadest ever application range with modular, future proof design.

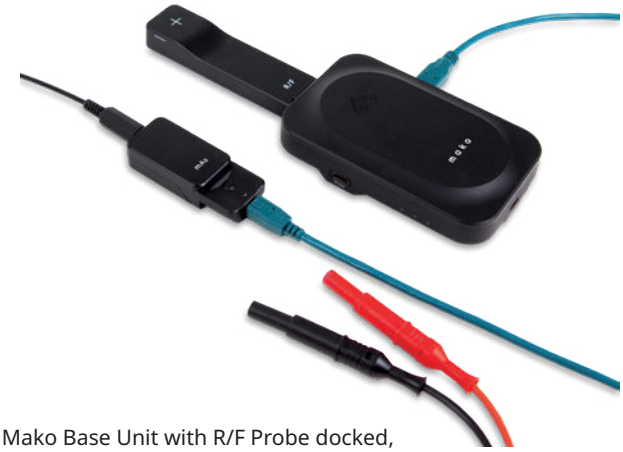
Wireless as standard. Integrated Bluetooth for seamless data streaming.

Multi modal tool. Including non-invasive mAs (MAS-2), DAP Chamber and CT Dose Profiler.

Standard flexibility. Choose the configuration that suits your needs.




Mako Display and Base Unit with Ion Chamber Module docked, and CT Ion Chamber attached.



Mako Base Unit with R/F Probe docked, mAs Module connected and mAs cable.

## Radiation data made mobile

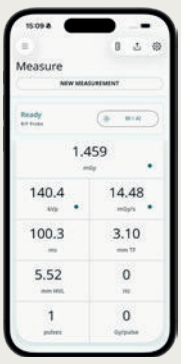
**From measurement to insight in seconds.**
Place your Mako meter, start measuring, and get your readings instantly and more powerful than ever before.

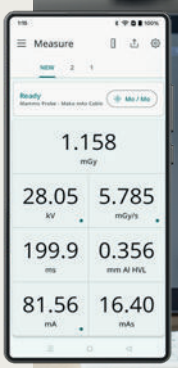
The **RTI Mako Display App** gives you wireless and fast, touchscreen access to essential QA data – no laptop or cables needed.

**iOS or Android, your choice.**

Download on the App Store

GET IT ON Google Play






RTI Mako Base Unit with R/F Probe

# Precision Redefined in Radiography

Mako is bucky-sized, cable-free, and designed for multiple uses. It outpaces other tools with its high sensitivity, perfect for swift pulsating measurements, delivering precise maximum values in the fastest way available. Mako is your path forward, leaving a small radiological footprint, enabling you to measure without impacting the AEC.

The groundbreaking new Mako R/F Probe offers industry-leading accuracy (±1.5 % kV measurement uncertainty) and sensitivity from lowest to highest dose rates. The unique design provides a no-fuss experience, with simple setup in the X-ray beam, flexible connection to the Mako Base Unit and fully wireless operation.

## Radiography Application Coverage

Radiography is a key technique for producing 2D X-ray images used in diagnosis and treatment. Effective quality assurance (QA) minimizes radiation exposure, extends system lifespan, and ensures consistent image quality.

Applications include conventional X-ray, mobile X-ray, computed radiography (CR), and digital radiography (DR). Key measurements cover kV, dose, dose rate, exposure time, total filtration, and half-value layer (HVL), with waveforms for kV and dose rate. Additional assessments may include X-ray scatter, leakage, light intensity, and mA/mAs.

Radiography is also widely used in non-destructive testing (NDT) across industries such as pharmaceuticals, aerospace, and automotive.

Learn more about Radiography Applicatons

## Key Features & Benefits

- Best-in-class kVp accuracy: ±1.5% across the full range up to 155 kV.
- Premium choice for radiography measurements: Ensures high precision and reliability.
- Advanced detector design: Enables simple, orientation-independent positioning.
- No manual range selection: Automatically adjusts for seamless operation.
- Fully wireless option: Easy, no-fuss setup – just place and measure.
- Intelligent software adaptation: Auto-adjusts to radiography modality, displaying only relevant parameters.



## Measuring kV and dose in Radiography

The Mako R/F system measures all required parameters across radiography (conventional X-ray, CR and DR), fluoroscopy, CT and dental modalities, from highest to lowest dose rates in one Probe, with no settings.

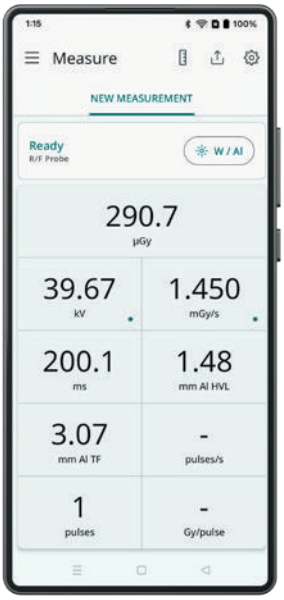
Watch Mako Measuring kV and dose in Radiography on YouTube

## External Probes and accessories

Mako connects to a wide range of external probes for additional, and simultaneous, measurement capabilities.

Add the capability to measure mA, mAs and mAs waveform simultaneously with the Mako R/F Probe, with the Mako mAs cable (invasive) or MAS-2 clamp probe (non-invasive), as pictured.






Example value

**Best-ever kVp accuracy (±1.5%) across entire range to 155kV, unique in the market**




RTI Mako Base Unit with R/F Probe

# Simplified Excellence in Interventional QA

With market-leading kVp accuracy (±1.5%) across the full range up to 155 kV, Mako R/F is a premium choice for fluoroscopy measurements. The advanced detector allows simple, orientation-independent positioning, with no range selections from highest to lowest dose rates. The lightweight Mako R/F Probe can connect via cable, has a small X-ray footprint, and is designed for AEC* test applications.

The advanced detector design of Mako R/F Probe is built to handle the latest fluoroscopy systems on the market, with high sensitivity to detect low doses and short pulses. Measurement parameters are coupled with high-resolution waveforms to accurately measure dose, dose rate, kV, HVL, in addition to detailed information on pulses, providing a premium solution for X-ray testing and QA on interventional systems.

*Automatic Exposure Control

## Application coverage

Fluoroscopy is widely used in interventional, surgical, and vascular X-ray systems. It utilizes pulsed radiation, typically at a lower dose rate than radiography but for longer durations. Real-time pulsed X-rays assist in medical procedures, such as guiding catheter insertions.

Key measurements include kV, dose, dose rate, exposure time, HVL, and total filtration, along with additional fluoroscopy-specific parameters like the number of pulses, dose per pulse, and pulses per second. Effective QA requires a detector capable of handling low dose rates, short pulses, and extended exposure lengths, which RTI Mako provides.

Learn more about Fluoroscopy Applications

## Key Features & Benefits

- Market-leading kVp accuracy: ±1.5% across the entire kV range up to 155 kV.
- Premium choice for fluoroscopy measurements: Ensures high precision and reliability.
- Advanced detector design: Allows simple, orientation-independent positioning.
- No range selections required: Automatically adapts from highest to lowest dose rates.
- Flexible connectivity: Mako R/F Probe can be connected via cable.
- Lightweight & compact: Small X-ray footprint for easy handling.
- Designed for AEC test applications: Optimized for automatic exposure control testing.



## Measuring kV, dose & pulses in fluoroscopy (interventional & surgery)

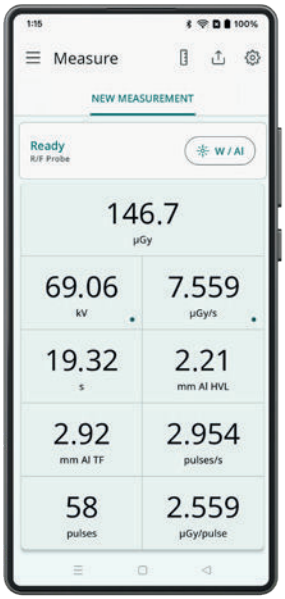
The Mako R/F system measures all required parameters across radiography, fluoroscopy (interventional, cardiovascular, and surgical applications), CT and dental modalities, from highest to lowest dose rates in one Probe, with no settings. The Mako R/F Probe has a small radiological footprint for measurement in AEC test applications, measuring kV, dose, pulses and more.

Watch Mako Measuring kV and dose in Fluoroscopy on YouTube

## External Probes and accessories

RTI Mako has the broadest application range by connecting to the widest range of Probes, including DAP chamber (dose-area-product), invasive and non-invasive mAs, light meter (for luminance and illuminance testing) and much more. All measurements are displayed through the same intuitive interface and simultaneous measurement with Mako Probes is possible with selected combinations.






Example value

**Highest to lowest dose rates with no selections, lightweight Probe for AEC tests**




RTI Mako Base Unit with Mammo Probe

# Best Ever Performance in Mammography

We strive to enhance production speed and quality while minimizing radiation risk.
To achieve this we provide the market's most versatile tools. Mako is the only solution compatible with all mammo machines and their full clinical measurement ranges, eliminating the need to change probes at the higher clinical kV ranges in mammography.

The revolutionary new Mako Mammo Probe offers best-in-class accuracy (±1.5 % or 0.5 kV) and performance, covering the full clinical kV range from 18-49 kV, without the need to change probe above 40 kV (unique in the market). The Mako Mammo Probe has been designed for ultimate performance across all Mammography systems, including the latest beam qualities with Titanium filters.

## Mammography Application Coverage

Mammography quality assurance covers 2D full-field digital mammography, 3D tomosynthesis, and spectral mammography. Spectral mammography combines standard images (18-39 kV) with contrast-enhanced imaging (40-49 kV), requiring a probe capable of handling the full range.

Key measurements include kV, dose, dose rate, exposure time, and half-value layer (HVL), with or without the compression paddle. Average glandular dose (AGD) or mean glandular dose (MGD) is typically calculated using EUREF or ACR protocols. Additional X-ray routine measurements may include scatter and leakage assessments or mA/mAs measurements from the generator.

Mako measures with or without the compression paddle, without the need for selections.

Learn more about Mammography Applications

## Key Features & Benefits

- Market leading kV accuracy (±1.5% or 0.5 kV)
- One shot kV, dose, HVL, time and dose rate
- Fully wireless or cable connected
- Entire clinical kV range 18-49 kV, no need to switch sensor above 40 kV
- No need to inform about compression paddle: simply place and measure (unique in market)
- Widest angular measurement range for tomosynthesis
- Mako Probe placement is orientation independent
- Handles all the latest X-ray systems including those with Titanium filter

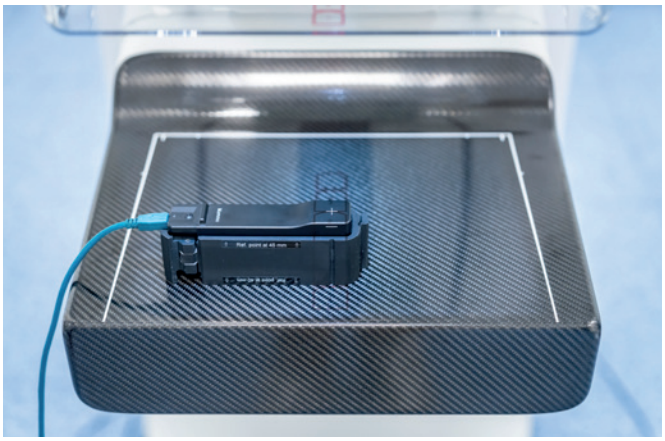
Watch Routine QA procedures with Mako in Mammography on YouTube

## External Probes and accessories

The RTI Mako Mammo Holder allows for easy and precise positioning of the Mako Mammo Probe into the correct reference position for almost every Mammography X-ray unit.

The holder also supports two different reference heights, which can be easily configured by inverting the holder placement. The inverted position options give available heights of 40 mm and 45 mm from the base surface.



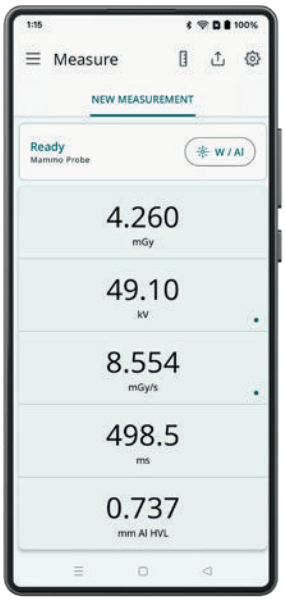



## Measuring kV, dose & HVL

Mako can measure fully wirelessly, or via USB cable to the Probe and/or display device.

Single exposure displays kV, dose, dose rate, HVL and exposure time, with combined waveform data for kV and dose rate (as well as mAs waveform if using mAs probe).

Beam quality selection for kV measurements is conveniently shown according to manufacturer & model.




Example value

**Entire clinical kV range from 18-49 kV in one, high accuracy, Mammo Probe**




RTI Mako Base Unit with R/F Probe and RTI Ion Chamber

# A Complete Solution for CT Testing

The Mako system combines the 100 mm RTI CT Ion Chamber with superior sensitivity combined with the high accuracy electrometer of the Ion Chamber module and provides CTDI measurements at a new level.
The patented RTI CT Dose Profiler measures CT beam width in a single scan, for precise and repeatable measurements.

Mako excels in narrow beam application with its slim detector design. The CTDP measures beam width in one shot for precise margins. For example, if the machine's 5 mm target range experience a 3 mm overshoot on each side due to miscalibration, it's a 120% margin of error – radiation we're determined to eliminate.

## CT Application Coverage

Common CT measurements include kV for tube output, CT Dose Index (CTDI) and Dose Length Product (DLP). IEC standards such as IEC 61223-3-5 and IEC 60601-2-44 provide protocol references for CT dosimetry.

Weighted CT Dose Index ($CTDI_w$) is calculated using five scans of a 100 cm Ion Chamber ($CTDI_{100}$) within a CTDI phantom (RTI CT Ion Chamber), while DLP is derived from CTDI measurements. Solid-state CT probes, like the RTI CT Dose Profiler, enable single-scan measurement of $CTDI_w$ and DLP, along with beam width and geometric efficiency, for more efficient testing.

Learn more about CT applications

## Key Features & Benefits

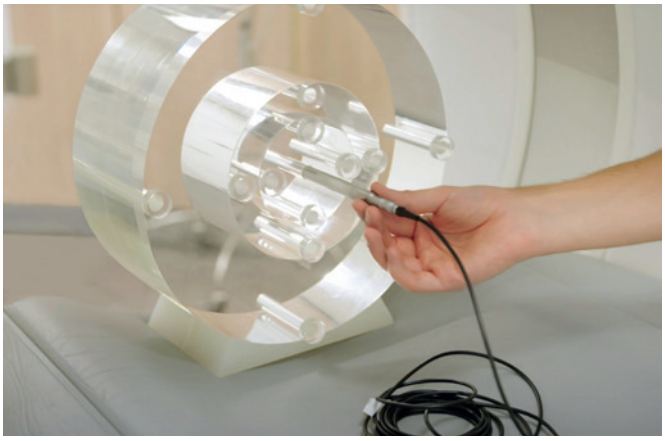
- CT kV measurement capability: Mako multi-meters can measure kV on X-ray CT systems.
- Industry-leading accuracy: ±1.5% uncertainty for precise measurements.
- Flexible placement options: Measure kV on the couch, at the bottom of the gantry, or mid-beam using provided holders & stand.
- Extended calibration cycles & warranty: Ensures long-term reliability and value.
- Trusted dosimetry expertise: RTI solution offers superior accuracy and long-term performance.
- Patented RTI CT Dose Profiler streamlines CTDI beam width measurements.

Watch Mako Routine QA procedures in Computed Tomography on YouTube

## External Probes and accessories

RTI provides the complete solution for CT testing with the Mako R/F Probe for kV measurement, and CTDI phantom, CT Ion Chamber & CT Dose Profiler for the full suite of CTDI and DLP measurements. All measurements are streamed to the same intuitive interface for high accuracy measurements, traceable to primary standards and compliant with international regulations.





## Routine QA procedures in CT

The Mako R/F Probe measures kV with a measuring range of 35-155 kV, and market leading accuracy. The RTI CT Ion Chamber, traceable to primary standards, measures CT Dose Index.

The patented RTI CT Dose Profiler also fits into the standard CTDI phantoms for measurement of CT Dose Index, Dose Length Product (DLP), and can also measure free-in-air for measurement of CT Beam Width (FWHM) and Geometric Efficiency.




Example value

**Measurements of kV, CTDI, beam width and more with patented technology**




RTI Mako Base Unit with Dental Probe

# Premium Dental Testing and QA

Mako is your comprehensive solution for dental applications. Featuring a 0.9 mm sensor and sleek design, it's ideal for CBCT, panoramic and intraoral. The segmented detector ensures full irradiation, vital for accurate panoramic dental measurements. We exclusively provide DAP chamber measurements in the same interface as Mako, enhancing the safety of your measurements.

The RTI Mako System can be configured with the R/F Probe (multimodality) or Dental Probe (single modality), both having advanced detector technology. With a unique wireless, interchangeable display device, Dental measurements can be made efficiently from the control station with 1-click reporting.

## Dental Application Coverage

Dental X-ray systems include intraoral (2D), panoramic (3D), and Cone Beam CT (CBCT) imaging. Key measurements involve kV, dose, dose rate, exposure time, total filtration, and half-value layer (HVL), along with Dose Area Product (DAP) or Kerma Area Product (KAP).

As dental and maxillofacial X-ray units continue to expand, the need for advanced QA tools grows. In panoramic applications, X-ray beams can be extremely narrow – down to a single millimeter – requiring a compact sensor to ensure full irradiation and prevent dose underestimation. Mako is designed to meet these precision demands.

Learn more about Dental Applications

## Key Features & Benefits

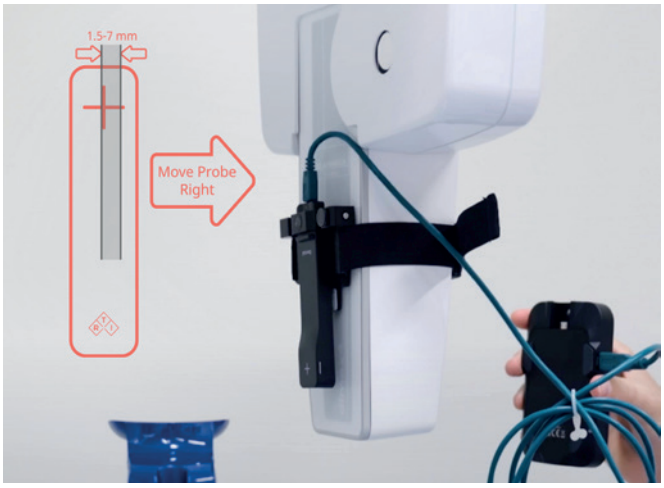
- Market-leading kVp accuracy: ±1.5% for precise measurements for kV range up to 125 kV.
- Unique Position Guide: Assists with narrow beam X-ray positioning (e.g., dental panoramic).
- Ultra-narrow beam measurement: Detects beams as narrow as 0.9 mm.
- Unique positioning: Both the R/F Probe and Dental Probe offer the same high performance with unique position guide.
- Ensures accurate dose measurement: prevents underestimation of dose values.
- Mako can be configured with R/F or Dental Probe to suit single- or multi-modality

Watch Mako Routine QA procedures in Dental on YouTube

## External Probes and accessories

Unlike other brands, Mako can connect to a DAP chamber. This means that DAP can be measured on extraoral dental systems (such as orthopantomographs), as stated in IEC 60601-2-63. Measurements of DAP are also displayed through the same intuitive Ocean software, meaning your entire X-ray QA workflow can be handled in the same interface.



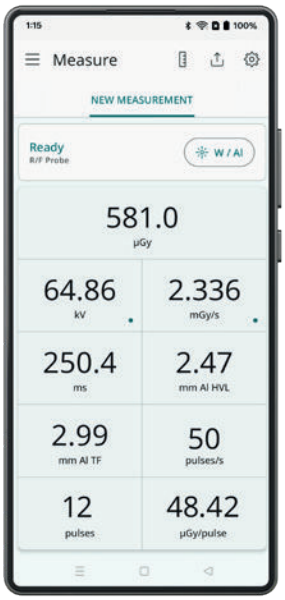



## Position Guide

Unlike other sensors, a unique feature of the Mako system, is the Position Guide functionality, which guides a user to centre the Probe in narrow-beam X-rays, typically found in Dental panoramic. This ensures full radiation of the sensor, so that Dose is never under-estimated.

## Routine QA Measurements in Dental X-ray

The Mako R/F Probe or Mako Dental Probe can be used to measure in intraoral, panoramic, or cone beam CT, for measurement of kV, dose, HVL, pulses and more.




Example value

## Advanced detector design and unique Position Guide for narrow beam X-ray

Ocean Next™

# The world-leading software for X-ray testing




## Stay ahead with unparalleled performance

**Ocean Next software** is included with Mako and runs on any Windows tablet or PC. There are no user limitations, meaning unlimited users with no extra cost.

Ocean's **Quick Check** is the display for Mako, offering an intuitive and simple display of parameters and waveforms, with extensive capability to save, export and analyse.

The industry leading software also offers **Ocean templates**, allowing customizable, automated routines. Simply make exposures with Mako and all data capture, calculation, analysis, Pass/Fail and reporting is completed automatically.

**"What used to take us 3-4 hours now takes 25 minutes"**. Find out how hospitals, service groups and manufacturers save time, save costs, and streamline their X-ray testing workflows with the industry-leading software solution.
Contact sales@rtigroup.com to learn more.

## Complete your Ocean Next experience with myRTI

myRTI is your RTI customer portal for device management, calibration reminders, certificates, access to RTI Support and RTI Academy.

### Forget backups – let Cloud handle it

No more data loss! **myRTI**, automatically logs all data, and with our secure cloud server, your entire Ocean Next™ database (templates, measurements, reports) can be fully backed up and accessible from multiple devices. No worries about stolen laptops, spills, or crashes.

### Seamless collaboration

RTI's industry-leading cloud platform allows sharing directly in the software to other users, to standardize measurements across your team and streamline workflows.

*Powered by Microsoft Azure.*

**Benefits of myRTI**

- Manage all your RTI devices
- Calibration reminders
- Access calibration certificates
- Ocean Next data logs
- Access to RTI Support, Resource & Training

**myRTI Cloud server***

- Automatic backup of your entire Ocean Next database.
- Run Ocean from multiple devices with one synchronised database.
- Share your data directly from Ocean-to-Ocean with your colleagues.

**Subscription needed.*
*One subscription per user.*

**The best there is.**
**Guaranteed.**




## RTI Mako
## PTB Approved for Excellence in X-ray Dosimetry

RTI Mako is PTB approved for R/F, Mammography and CT applications by Germany's Physikalisch-Technische Bundesanstalt (PTB), one of the world's leading reference laboratories for X-ray dosimetry.

Following comprehensive testing of its dosimetric performance and complete firmware and software chain, the certification provides independent verification of Mako's measurement accuracy, quality and performance.

## Up to 10 years warranty

Mako comes with the most generous warranty in the industry, ensuring long-term reliability. Every RTI instrument includes a standard 2-year warranty, with the option to extend it two years at a time – up to 10 years through our Extended Warranty Program. Developed by pioneers with 40 years of innovation, Mako is built to last. Our confidence in its performance leaves no room for doubt – only peace of mind.

## 2 year calibration cycle

Keep your Mako at peak performance with a recommended two-year calibration cycle – minimizing downtime and maximizing reliability. We'll track your schedule and send a reminder two months before calibration is due, ensuring seamless planning.

Our ISO/IEC 17025:2017 accredited laboratories in Sweden and the USA ensure fast and accurate turnaround times, delivering precise and traceable results while upholding the highest standards for patient and staff safety.

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# c/o RTI

What we do matters. To patients. To professionals. To us.
It is more than algorithms, technology and design.
It is about setting the standard for quality assurance
of X-ray imaging.

INDEPENDENT X-RAY
QUALITY ASSURANCE