Square Robot Inc.
12302 FM 529 Suite 1
Houston, TX 77041

WHITE PAPER

Elevating Tank RBI and Compliance Programs

with Square Robot SR-3

How High-Density In-Service Robotic Inspection Strengthens Risk-Based Programs for Above-Ground Storage Tanks

squarerobot.com · 2026

FM	24″	2–3
Certified System	**Manway Access**	**Days Per Tank**
Full system certification — not just components	*Roof or shell manway launch via Side Launch System*	*Typical onsite inspection duration*

EXECUTIVE SUMMARY

Above-ground storage tanks (ASTs) are critical infrastructure for energy and chemical operations. Ensuring their integrity is essential for operational reliability, safety, regulatory compliance, and environmental protection. Traditional tank inspection methods are often limited by low data density, downtime requirements, confined space entry risks, and limited coverage of high-risk areas.

Square Robot's SR-3 robotic inspection system provides comprehensive, in-service inspection capabilities that deliver dense, high-quality data to support Risk-Based Inspection (RBI) and compliance-focused programs. With FM-approved system-level certification, phased-array ultrasonic and high-definition visual inspections, and targeted coverage of high probability of failure areas, Square Robot enables tank asset owners to reduce risk, optimize maintenance planning, and improve regulatory compliance.

Square Robot Inc.
12302 FM 529 Suite 1
Houston, TX 77041

Square Robot SR-3 converts assumptions into measurements — delivering the high-confidence data that RBI programs require to be defensible to operators, insurers, and regulators.

INTRODUCTION: CHALLENGES IN ABOVE-GROUND STORAGE TANK INSPECTION

Above-ground storage tanks commonly contain volatile and hazardous liquids, including gasoline, diesel, aviation fuels, methanol, styrene, and other chemicals. The integrity of these tanks directly impacts operational safety and environmental risk.

Key challenges with traditional AST inspections include:

- Limited Data Density: Manual UT or visual inspections capture sparse or qualitative data, potentially missing localized corrosion and other critical degradation mechanisms.
- Operational Disruption: Draining, cleaning, and entering tanks often requires extended downtime and lost revenue.
- Safety Hazards: Confined space entry exposes personnel to flammable atmospheres and other hazards.
- RBI Gaps: Risk-Based Inspection programs rely on assumptions about corrosion and degradation that are frequently not supported by sufficient high-quality data.

High probability of failure (HPF) areas in API 650 tanks include:

- Tank bottom plates and welds
- Shell-to-bottom welds and knuckle regions
- Shell courses susceptible to localized corrosion
- Nozzles, attachments, and coatings

Targeting these areas with reliable inspection data is essential to reducing unplanned outages, environmental incidents, and safety risks.

REGULATORY CONSIDERATIONS FOR RISK-BASED INSPECTION PROGRAMS

Federal and state regulators often recognize the benefits of RBI programs in improving safety and optimizing inspection resources.

Why Regulators Support RBI Programs

- RBI prioritizes inspections based on actual risk, focusing resources on high-consequence tanks and components.
- Data-driven approaches can reduce unnecessary downtime and operational disruption, while maintaining or improving safety.
- RBI programs support compliance with federal and state regulations by providing defensible, documented inspection and risk assessments.

- RBI can integrate modern inspection technologies — like robotics and high-density ultrasonic mapping — to enhance accuracy and confidence.

Why Regulators May Be Hesitant

- Data Uncertainty: Sparse, unreliable or incomplete inspection data can substantially reduce confidence in risk assessments.
- Variability in Program Implementation: Differences in operator experience, procedures, and inspection quality may lead to inconsistent risk evaluations.
- Lack of Regulatory Familiarity: Some agencies may have limited experience with RBI methodologies and prefer prescriptive inspection schedules.
- Liability Concerns: Regulators may be concerned that failures could occur if RBI assumptions are incorrect or insufficiently validated.

Square Robot's SR-3 directly addresses these regulatory concerns by providing dense, high-quality data, covering high probability of failure items, and producing reports that support defensible RBI decisions — thereby improving regulator confidence.

SQUARE ROBOT SR-3: ENABLING HIGH-CONFIDENCE RBI AND COMPLIANCE

Square Robot's SR-3 system is designed to provide robust, in-service inspection data that addresses the limitations of traditional tank inspection methods.

Inspection Capabilities

Phased Array Ultrasonic (PAUT) Thickness Measurement

High-resolution UT mapping of tank walls, floors, and knuckle areas for accurate corrosion profiling.

High-Definition Visual Inspection

Visual assessment of coatings, welds, and structural features using multi-directional HD cameras that correlate position with PAUT data.

Combined Data Collection

Simultaneous PAUT and visual inspection enables correlation of corrosion and visual defects to support RBI models. When corrosion is visible, the corresponding PAUT data for that exact location is immediately available, providing information about its extent and severity.

Dense Data for RBI Analysis

High-density measurements reduce uncertainty, allow more reliable corrosion rate estimation, and improve risk calculations — converting assumptions into defensible measurements.

Tank Bottom Settlement Assessment

Evaluates structural deformation of the tank floor using an onboard pressure sensor, identifying shell settlement, edge settlement, and localized depressions or bulges per API 653 Annex B standards.

Tank Shell Inspection

Comprehensive coverage of vertical shell courses and welds.

Extreme Value Analysis (EVA)

Enables statistical analysis of minimum wall thickness and other critical metrics, improving and quantifying confidence in remaining life estimates and risk assessments.

Coating Inspection

Evaluates the condition of internal coatings to support maintenance and compliance decisions.

Tank Calibration and Strapping Reports

Provides accurate volumetric and dimensional documentation for compliance.

Deployment Advantages

- In-Service Inspection: Allows inspection of tanks without draining, including volatile fuels such as gasoline, methanol, aviation fuel, diesel, and lube oils.
- Roof or Shell Manway Launch: Requires a minimum 24-inch manway; deployment method depends on tank roof type and product flash point. Roof manway launch for fixed or external floating roof tanks; Square Robot's patented Side Launch System for internal floating roof tanks containing low flash point products.
- FM-Approved System Certification: Full system-level certification for hazardous locations — not just component-level ATEX approvals.
- Self-Contained External Control Station and Power: Reduces site integration requirements and accelerates mobilization.
- Rapid Deployment: Typical onsite inspection duration is 2–3 days per tank, minimizing operational disruption.

Strengths for RBI Programs

- Best-in-Class Internal Tank Bottom Inspection Coverage: Ensures high probability of failure areas are thoroughly evaluated.
- Supports High Probability of Failure Items: Bottom plates, shell-to-bottom welds, knuckle areas, shell courses, nozzles, attachments, and coatings.
- High-Density, High-Quality Data: Facilitates accurate corrosion rate estimation and risk modeling.
- Reduced Human Entry and Downtime: Enhances safety and operational efficiency.
- Supports Compliance Reporting: Detailed measurement and reporting facilitate regulatory and insurer requirements for API 653, EEMUA 159, and other standards.

COMPARATIVE ADVANTAGES

Square Robot Inc.
12302 FM 529 Suite 1
Houston, TX 77041

The following table highlights where Square Robot's SR-3 differentiates from other robotic inspection systems currently available in the market:

Feature	Square Robot SR-3	Other Robotic Systems
System Certification	**FM-approved full system certification**	ATEX/intrinsically safe components only — system not certified
In-Service Capability	**Yes, including volatile fuels (gasoline, methanol, naphtha)**	Limited or relies on procedural controls
Data Density	**High — phased-array + visual, simultaneous**	Moderate to low
RBI Support	**Extreme Value Analysis, corrosion rates, risk modeling**	Limited — mostly UT spot checks
Deployment Ease	**24″ manway; control station & power provided by Square Robot**	Site must supply power and manage integration
Settlement Assessment	**Full tank bottom differential elevation survey per API 653**	Not typically available
Launch Flexibility	**Roof or shell manway (patented Side Launch System)**	Roof manway only in most cases

ECONOMIC AND RISK IMPACT

Deploying Square Robot's SR-3 for RBI and compliance inspections delivers measurable value across cost, safety, and operational dimensions:

Avoided Downtime Costs

In-service inspection eliminates the need for tank drainage, cleaning, and extended out-of-service periods. For large tanks, downtime and cleaning costs can range from $100,000 to over $2M per inspection event.

Enhanced Safety

Reduced confined space entry mitigates exposure to flammable atmospheres and other hazards associated with conventional inspection. Zero confined space entry is required for any Square Robot inspection.

Informed Maintenance Decisions

High-confidence data supports proactive maintenance and life extension planning. Dense PAUT coverage allows asset owners to identify localized corrosion and prioritize repairs before they become critical failures.

Regulatory Compliance

Square Robot Inc.
12302 FM 529 Suite 1
Houston, TX 77041

Detailed reporting meets the requirements of API 653, EEMUA 159, API 575, and other standards. Reports are structured to support RBI documentation requirements and provide defensible data for regulatory review.

INTEGRATING ROBOTICS INTO RBI PROGRAMS

Square Robot's dense inspection data allows asset owners to transform their RBI programs from assumption-based to measurement-based:

- Validate corrosion assumptions and RBI intervals with actual high-density data
- Apply Extreme Value Analysis for minimum wall thickness predictions
- Reduce and quantify uncertainty in probability-of-failure and remaining life calculations
- Prioritize maintenance on high-risk areas based on actual measured degradation
- Support compliance-focused inspections with defensible, auditable data

By converting assumptions into measurements, robotic inspection strengthens the credibility and defensibility of RBI programs and improves confidence for both operators and regulators. The result is a program that is simultaneously safer, more compliant, and more cost-effective than traditional time-based or assumption-heavy inspection approaches.

High-density PAUT coverage means fewer assumptions, lower uncertainty, and greater confidence in RBI decisions — for your team, your regulators, and your insurers.

CONCLUSION

Square Robot SR-3 is the leading robotic inspection system for AST owners seeking to improve RBI and compliance programs. Its combination of FM-certified in-service deployment, dense phased-array and visual data, and comprehensive coverage of high probability of failure areas enables:

- Data-driven risk assessments
- Reduced operational and safety risk
- Enhanced regulatory compliance
- Optimized maintenance and inspection intervals

For operators managing gasoline, diesel, aviation fuel, methanol, styrene, or lube oil tanks, Square Robot provides the highest confidence in the data required to maintain safe and reliable tank assets.

ABOUT SQUARE ROBOT

Square Robot Inc.
12302 FM 529 Suite 1
Houston, TX 77041

Square Robot delivers fully integrated, FM-approved robotic inspection systems designed to meet the needs of asset integrity, safety, and regulatory compliance teams in the oil, gas, chemical, and energy sectors. Square Robot's SR-3 inspection robot provides simultaneous PAUT, visual, and elevation mapping data — all collected in-service, without confined space entry, and without taking tanks out of service.

Contact our team of experts:

squarerobot.com · info@squarerobot.com