

HSB Overview

Global Inspection and Engineering Services

Established in 1866, providing engineering services to users of steam power equipment.

More than 160 years later, HSB Global Inspection and Engineering Services has grown to be a worldwide leader in the interpretation and application of boiler and pressure vessel codes, standards, directives, and customer specification.

Largest Authorized Inspection Agency (AIA) accredited by ASME.

Design Offices in **India, Ireland, United States**, and Design Engineers in Japan for MHLW work.

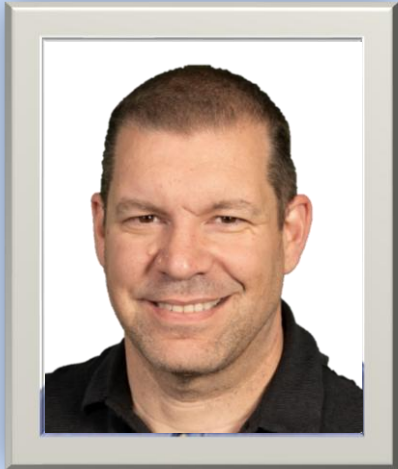
Notified Body for the **European TPED 2010/35/EU and PED 2014/68/EU**.

Appointed Body for the UK Transportable Pressure Equipment Regulation 2009 (as amended).

Internationally Accredited to provide ISO 9001, ISO 14001, ISO 45001, and ISO 19443 Services.

Accredited as a recognized Third-Party Inspection Agency for most major boiler and pressure vessel codes, standards, and regulations globally.

Presenters



Paul Coco, PE
Senior Engineer

Paul joined HSB in January 2014 and currently serves as a Senior Engineer in the Codes and Standards group. He provides technical support for nuclear construction and in-service activities in accordance with ASME Section III/XI and its associated conformity assessment programs. Paul also develops and delivers technical training on nuclear construction, in-service inspection, international codes, and regulatory requirements, and supports the HSB NQA Services Program. He serves as the technical lead for HSB's remote inspection initiatives, third party nuclear and ISO-19443 inspections, and emerging renewable technology efforts.

Paul began his professional career in the U.S. Navy, serving from 2002 to 2010. As a Reactor Mechanical Division Officer and Training Officer aboard a nuclear-powered aircraft carrier, he was responsible for the safe operation of the ship's nuclear power plant. From 2007 to 2010, he served in the Mechanical Engineering Department at the U.S. Naval Academy, where he taught Applied Engineering Thermodynamics for Naval Applications as a military professor.

Following his military service, Paul joined the U.S. Nuclear Regulatory Commission (NRC) as a reactor operations engineer. In that role, he conducted detailed technical reviews of nuclear license applications for compliance with federal codes and standards, and performed quality assurance inspections of domestic and international vendors supplying nuclear safety-related components.

Paul holds a Bachelor of Science in Aeronautical Engineering from the United States Naval Academy, a Master of Engineering Management, and a Master of Science in Mechanical Engineering. He is a licensed Professional Engineer in the state of Maryland, holds National Board endorsements as an Authorized Inspector (AI) and Authorized Nuclear Inspector (ANI), and is an active member of several ASME Section III committees.

Certain Copyright by ASME. Certain information included in this publication is Licensed to HSB and its affiliates and subsidiaries by permission from ASME. **Not for resale**. No part of this publication may be copied or reproduced in any form or medium, including any electronic retrieval system or be made available on the Internet, a public network, by satellite or otherwise without the prior written permission of ASME.



01

Why inspection deployment is changing: technology has enabled safe remote access while codes were written assuming physical presence

02

How the industry responded: COVID-19 exposed code gaps and drove coordinated action by ASME, NBIC, EPRI, and the NRC

03

Where MUS-1 fits: providing a structured, defensible framework for remote inspection deployment while preserving inspector authority

Evolution of Unmanned Aerial Systems (UAS)



Source: Paul Coco, PE



Source: Apple INC: Apple Iphone 2g



Source: DJI INC



Source: 3DR Robotics



Source: DJI INC

The DIY Garage Era

- Hobbyist-built quadcopter
- Open-source developer coded flight controllers
- High Barrier to entry

Smartphone Revolution

- MEM Sensors (Gyro Accel) become cheap
- Compact Processors
- Lithium polymer batteries

Mainstream Breakthrough

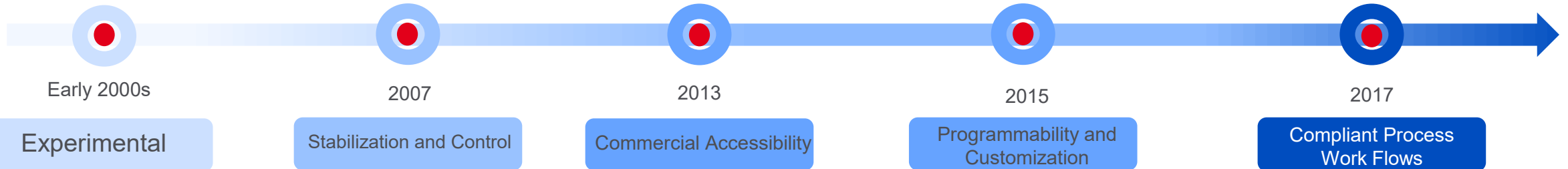
- DJI Launch's Phantom drone
- Ready to fly (RTF) systems

Open-Source Autonomy

- 3DR Solo and Pixhawk "SMART" Drone
- Open-Source system Mission Planner
- Custom Payloads

Enterprise and Industrial Propose Use

- Thermal, Lidar Payloads
- AI analysis
- RTK/PPK
- Regulatory Integration





UNMANNED AIRCRAFT SYSTEMS STANDARDIZATION COLLABORATIVE (UASSC)

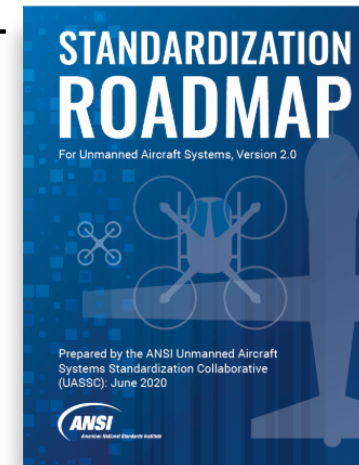
JUMP TO SECTION

- [Roadmap](#) ▾
- [Gaps Tracking](#) ▾
- [Updates & Meeting Reports](#) ▾
- [News/Events](#) ▾

OVERVIEW

The ANSI UASSC's mission is to coordinate and accelerate the development of the standards and conformity assessment programs needed to facilitate the safe integration of unmanned aircraft systems (UAS) – commonly known as drones – into the national airspace system (NAS) of the United States. The collaborative is also focused on international coordination and adaptability. The overarching goal is to foster the growth of the UAS market, with emphasis on civil, commercial, and public safety applications. The aim is to describe the current and desired future standardization landscape, articulate standardization needs, drive coordinated standards activity, minimize duplication of effort, and inform resource allocation for standards participation.

[ACCESS UAS STANDARDS](#) >



Addressing Gap I1: UAS Inspections of Power Plant and Industrial Process Plant Assets

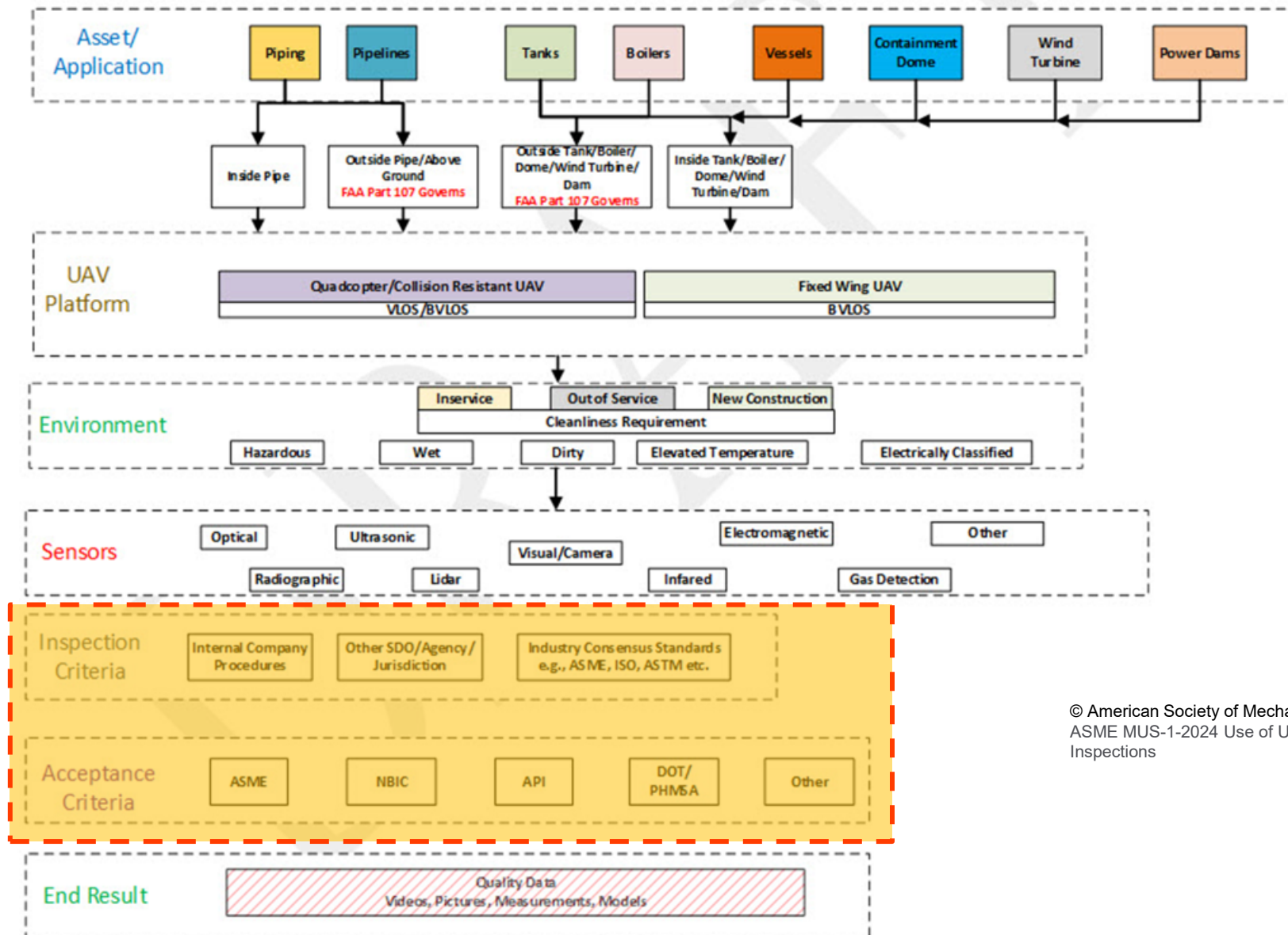
Overview of the Gap

The use of Unmanned Aircraft Systems (UAS) for **inspecting power plants and industrial process plants** presents significant advantages in safety, efficiency, and cost savings. However, current standards and regulatory frameworks are not sufficiently developed to support widespread adoption. Challenges include defining standardized inspection procedures, ensuring data integrity, and establishing interoperability between different UAS platforms and asset management systems.

Getting from the BPV to MUS

UAS for Inspection – Landscape by Asset/Application

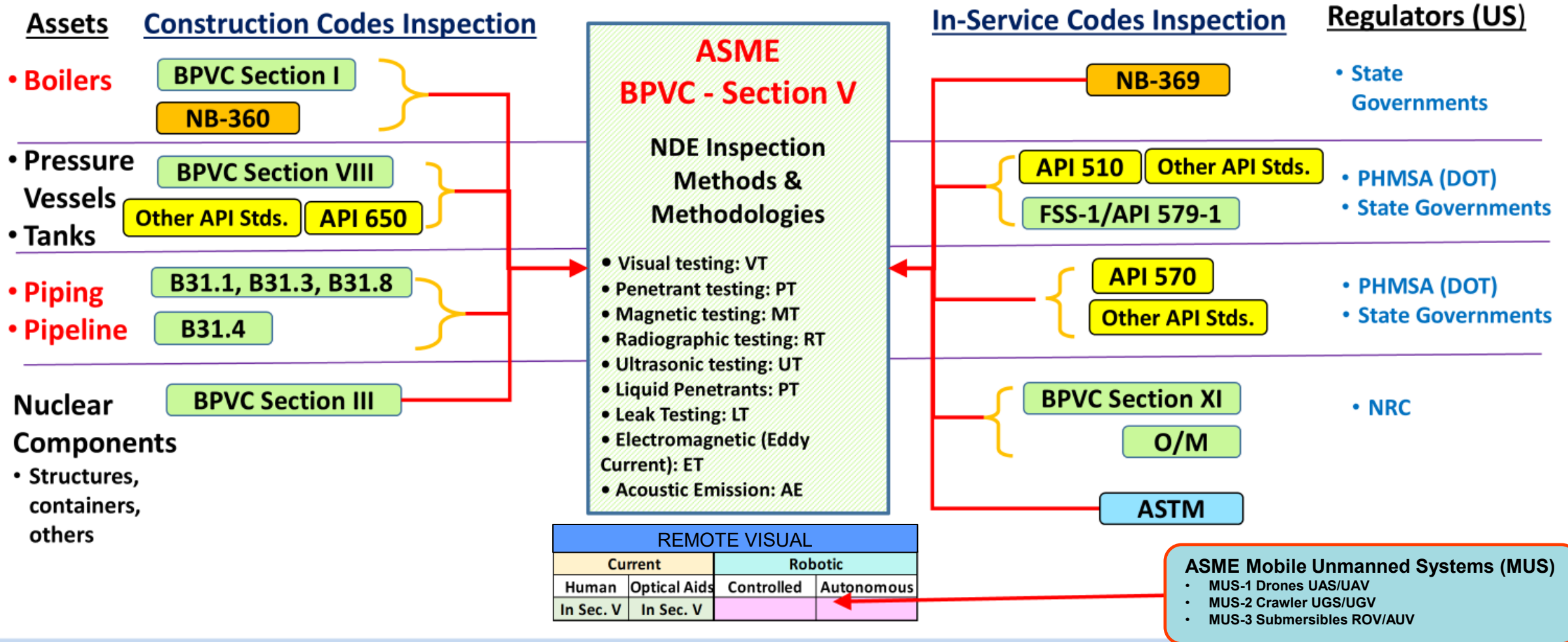
UAS for Inspection – Landscape by Asset/Application



© American Society of Mechanical Engineers, all rights reserved.
 ASME MUS-1-2024 Use of Unmanned Aircraft Systems (UAS) for Inspections

BPVC Section V – Nondestructive Examination Methods

Section V is a source for NDE methods for several ASME construction & in-service inspections codes serving different markets & industries, as well as a reference for NDE methods for other SDOs inspection rules – API & NB



ASME API=American Petroleum Institute NB=National Board ASTM - previously American Society for Testing and Materials

Covid-19 ERA of Remote Inspection Activities

COVID-19 restrictions prevented on-site inspections by Authorized Inspectors (AIs). Certificate Holders and AIs requested regulatory relief to continue construction activities.



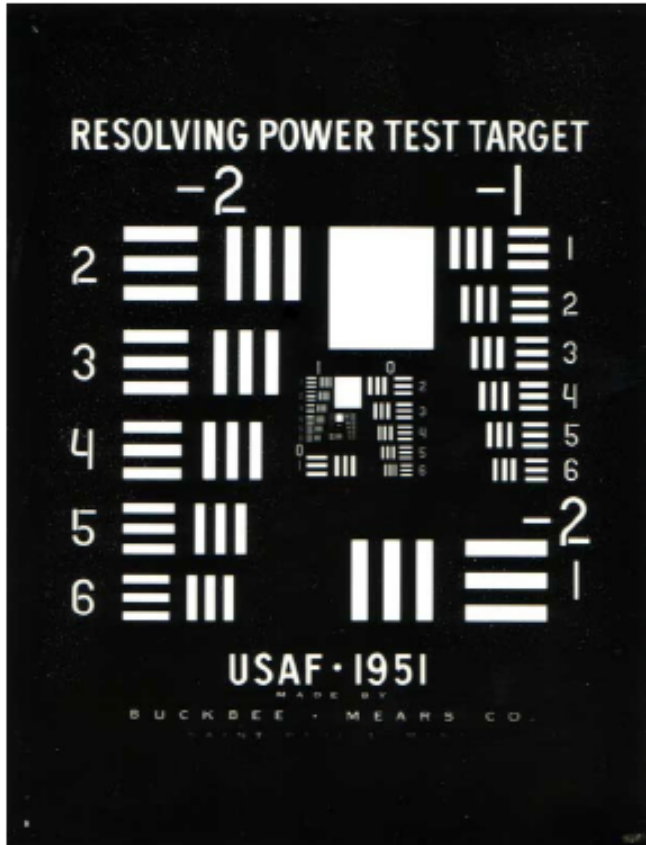
Source: HSB Remote Inspection

Covid-19 ERA of Remote Inspection Activities



- ASME QAI-1 Code Case 6 – Remote Inspections by the Authorized Inspector, Approved June 6, 2020
- ASME QAI-1 Code Case 7 - Remote performance monitoring and activity audits of inspectors, Approved June 6, 2020
- NBIC Interp:RCI-19-02 Issued April 2020
- EPRI Technical Report 3002019436 - Remote Source Verification During a Pandemic or Similar State of Emergency, Issued 2020
 - NRC Safety Evaluation endorsing EPRI TR 3002019436, Issued October 2020
- EPRI Technical Report 3002020796 - Remote Assessment Techniques: Planning and Conducting Audits and Surveys Using Remote Techniques During Exigent Conditions, Issued 2021
 - NRC Safety Evaluation endorsing EPRI TR 3002020796, Issued June 22, 2021

Optical Resolution Determination MUS-UAV/Section V



1951 USAF resolution test chart is a microscopic optical resolution test device originally defined by the U.S. Air Force MIL-STD-150A standard of 1951. The design provides numerous small target shapes exhibiting a stepped assortment of precise spatial frequency specimens. It is widely used in optical engineering laboratory work to analyze and validate imaging systems such as microscopes, cameras and image scanners

CASE 6:

The equipment used in the inspection shall be demonstrated to have a minimum resolution capability of 1/32 in. (0.8 mm) and light intensity equivalent to at least 100 fc (1076 lux).

Source: USAF Research LABs

Use of Optional Resolution



Use of Optional Resolution



Source: HSB Remote Inspection



Source: HSB Remote Inspection

BPV Section V use of Cameras

Remote Visual Examination

BPVC Section V allows of alternative methods to be used for direct visual examination;

T-953 REMOTE VISUAL EXAMINATION

In some cases, remote visual examination may have to be substituted for direct examination. Remote visual examination may use visual aids such as mirrors, telescopes, borescopes, fiber optics, cameras, or other suitable instruments. Such systems shall be demonstrated to have a resolution capability and lighting intensity at least equivalent to that obtainable by direct visual observation **(e.g., T-921.3; Section XI, Division 1, Table IWA-2211-1; ISO 12233; USAF 1951 Resolution Target).**

T-930 EQUIPMENT

Equipment used for visual examination techniques, for example, direct, remote, or translucent, shall have the capabilities as specified in the procedure. Capabilities include, but are not limited to viewing, magnifying, identifying, measuring, and/or recording observations in accordance with requirements of the referencing Code Section.

remote visual examination: a visual examination technique used with visual aids for conditions where the area to be examined is inaccessible for direct visual examination.

BPV Section XI use of Cameras

Remote Visual Examination

(g) Remote visual examination may be substituted for direct examination. The remote examination procedure shall be demonstrated capable of resolving characters as specified in Table IWA-2211-1. Additionally, the remote examination system shall have the capability of distinguishing and differentiating between the colors applicable to the component examination being conducted.

**Table IWA-2211-1
Visual Examinations**

Visual Examination	Minimum Illumination, fc (lx) [Note (1)]	Maximum Direct Examination Distance, ft (mm)	Maximum Height for Procedure Demonstration Characters, in. (mm) [Note (2)]
VT-1	50 (550)	2 (600)	0.044 (1.1)
VT-2	N/A	N/A	N/A
VT-3	50 (550)	N/A	0.105 (2.7)

NOTES:

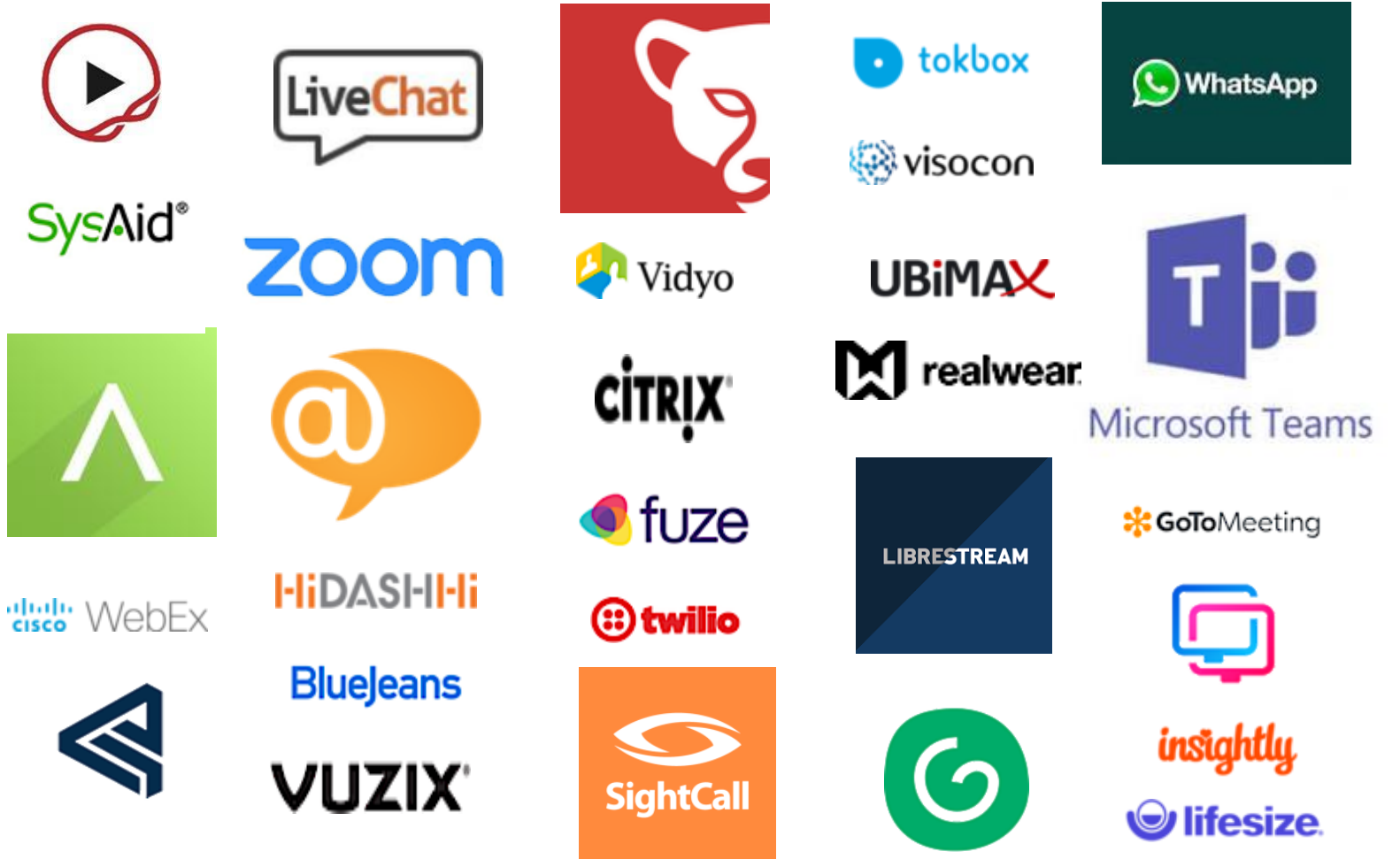
- (1) Resolution of the specified characters can be used in lieu of illumination measurement to verify illumination adequacy.
- (2) For procedure demonstration, a test chart or card containing text with some lowercase characters, without an ascender or descender (e.g., a, c, e, o), that meet the specified height requirements is required. Measurements on the test chart or card shall be made once before its initial use with an optical comparator (10X or greater) or other suitable instrument. At least one character of each specified character size shall be measured, to ensure that the card meets the applicable requirements. Alternatively, a production lot of cards may be verified by measurements on the first and last cards produced and at least one card in the approximate middle of the production run. A production lot shall not exceed 50 cards.

© American Society of Mechanical Engineers, all rights reserved.
ASME BPV Section XI 2025 Inservice Nuclear Inspection

Datalink Platforms: Not All Are Created Equally

Mobile Video Collaboration Software:

- General One-on-One Video Conferencing
- Group Video Conferencing
- Insurance Assessment
- Visual Inspection, Product Trouble Shooting



Source: HSB Remote Inspection. All product names, logos, and brands are property of their respective owners. Use of these names, logos, and brands does not imply endorsement. Logos shown for illustrative and comparative purposes only.

How Remote Inspection Acceptance Enables Robotic Inspection

- Accept Remote Observation

Establish that inspection activities can be witnessed, verified, and documented through live video and recorded data when physical presence is impractical or unsafe, while maintaining inspector authority.

- Define Performance Expectations

Once remote inspection is accepted, inspection capability is evaluated based on measurable criteria such as:

- Resolution and lighting equivalency
- Data integrity and traceability
- Communication reliability
- Inspector oversight and control

- Apply Robotic Platforms

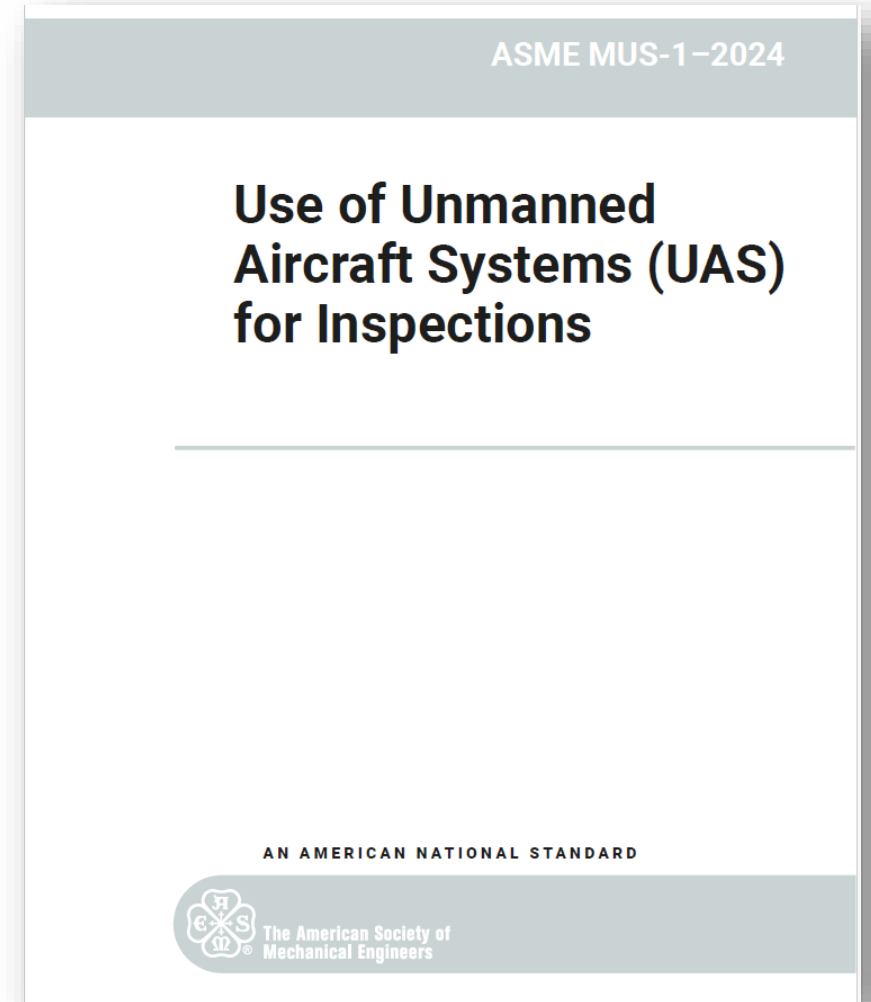
Robotic systems—such as UAS, crawlers, or ROVs—become deployment tools used to deliver compliant visual information to the inspector under established remote inspection rules.

ASME MUS-1-2024 Use of Unmanned Aircraft Systems (UAS) for Inspection

ASME MUS-1 defines how unmanned aircraft systems (UAS) may be used to support industrial inspections in a safe, repeatable, and defensible manner. It focuses on deployment and process control, not inspection acceptance criteria.

What MUS-1 Covers

- Planning, risk assessment, and site preparation for UAS-supported inspections
- Performance-based requirements for aircraft, cameras, lighting, sensors, and data handling
- Roles and responsibilities of the asset owner, UAS operator, pilot in command, and qualified inspector
- Operational controls, communications, documentation, and record retention needed to support inspection traceability



MUS-1: Table of Contents

- Section 1 – Introduction
- Section 2 – Purpose of Inspection
- Section 3 – Preparation for Inspection
- Section 4 – Equipment Used for Inspection
- Section 5 – Duties and Responsibilities
- Section 6 – Conducting Inspections
- Section 7 – Documentation for UAS/UA
- Nonmandatory Appendix A – Uses of UAS

Planning and risk setup

Starts with mission planning, risk analysis, site evaluation, and clear communication among the asset owner, inspector, and UAS provider to set safe expectations.

Performance-based equipment requirements

Defines minimum needs for aircraft capability, camera resolution, lighting, data handling, and optional payloads (e.g., thermal or ultrasonic) without locking into specific technologies.

Roles and accountability

Clarifies responsibilities for the asset owner, pilot in command, qualified inspector, visual observer, and safety spotter to align with inspection and safety management practice.

Execution and reporting rigor

Covers briefings, in-flight and post-flight practices, data review, and documentation to support traceability and repeatability comparable to traditional code-based inspection records.



© American Society of Mechanical Engineers, all rights reserved.
ASME MUS-1 2024 GETTY IMAGES

SAFETY, RISK, AND CONTROLS

Pre-job hazard and risk analysis

MUS-1 requires formal hazard identification before inspection, including collision risk, rotor wash, dropped objects, and interactions with personnel or equipment.

Indoor and confined space controls

Extra safeguards address no GPS, limited escape paths, and higher likelihood of contact with structures during close-proximity flight.

Operational boundaries and emergency authority

Define takeoff/landing zones, emergency procedures, and stop-work authority; use visual observers and safety spotters in dynamic environments.

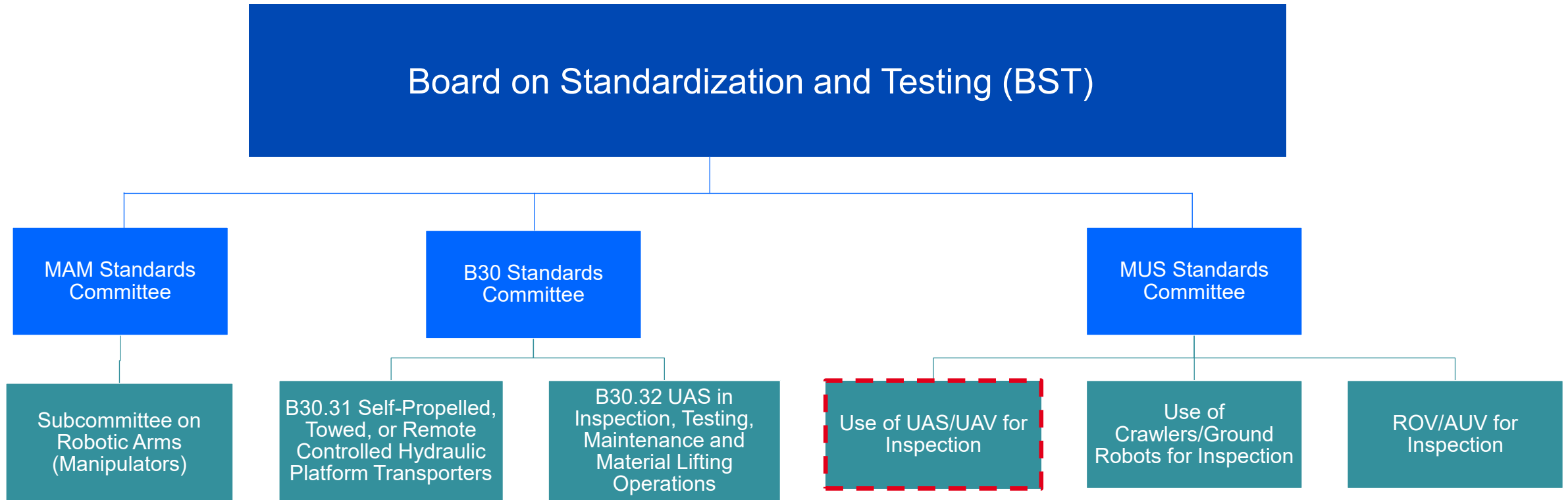
Aircraft safeguards and accountability

Battery management, failsafe settings, and lost-link procedures prevent uncontrolled behavior; PIC remains accountable, and the qualified inspector owns inspection decisions.



Source: GETTY IMAGES

ASME Committees for Robotics Structure



Future Developments



Development of MUS-Specific Inspection Standards



Establishing Best Practices for Data Collection and Processing



Regulatory Alignment and Safety Protocols



Integration with Industrial Internet of Things (IIoT) Systems



Validation of Sensors (LIDAR, UT, THERMAL)



Training and Certification Frameworks

QUESTIONS?





A Munich Re company

Thank you

© 2026 The Hartford Steam Boiler Inspection and Insurance Company. All rights reserved. This presentation is intended for information purposes only and does not modify or invalidate any of the provisions, exclusions, terms or conditions of the policy and endorsements. For specific terms and conditions, please refer to the coverage form.