Department for Transport

Remote Visual Inspection

Guidance for UK Appointed Inspection Bodies (AIBs)

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1. Introduction

This guidance sets out a framework of minimum requirements that should be met by Appointed Inspection Bodies (AIBs) in order to perform remote visual inspections of dangerous goods tanks and / or of their service equipment in accordance with CDG 2009.

This guidance has been developed by DfT in conjunction with DVSA, HSE, UKAS and VCA. It is envisaged that from this framework of general principles, any AIB wishing to perform remote visual inspections (RVI) should be able to develop their own in-house inspection scheme of examination for the application of RVI. Development of a suitable scheme should enable an AIB to obtain UKAS accreditation for performing such inspections.

It is anticipated that future updates will be necessary to this document in order to take into account the findings of research currently being undertaken by a Health and Safety Executive's shared research project on remote visual inspections. The HSE research aims to investigate the current limitations of RVI and develop an evidence base to underpin RVI related decisions to enhance safety and operational efficiency. The research project is expected to be completed in 2022 and a decision will be taken thereafter as to whether an update to this document might be appropriate.

2. Scope

This publication seeks to provide guidance on the use of Information Communication Technology (ICT) equipment to gather, store, analyse or transmit information to carry out a remote visual inspection of the tank shell interior, tank exterior and of service equipment in accordance with 5.4 and 5.5 of EN 12972:2018.

Inspection bodies shall document the type of inspection and type of equipment to which the remote visual inspections will be applied within their quality management system.

This guidance applies to:

- All RID/ADR tanks (6.8 [other than for battery-vehicles and MEGCs] 6.10 and 6.12), and road tankers under IMDG Code (IMO4, 6.8)
- All RID/ADR/IMDG Code portable tanks (6.7 [other than UN MEGCs]), including offshore portable tanks MSC/Circ.860
- Dual marked tanks (normally ADR 6.8/IMDG 6.7)
- UK Tanks

Some of the principles within this document will also be applicable to AIBs that may wish to seek accreditation for the use of remote inspection procedures. A remote inspection is the live streaming of audio and video, where the device is operated by an inspectors' assistant or another third party to enable a tank inspector at a remote location to perform an inspection in real-time. Separate guidance on remote inspections can be found here.

3. Definitions

Information Communication Technology (ICT) Equipment: equipment using technology for gathering, storing, retrieving, processing, analysing, and transmitting information and data. Note: This may include software and hardware devices such as a handheld device, laptop computer, desktop computer, video camera, wearable technology, artificial intelligence, or a Remotely Operated Vehicle (ROV).

Competence: ability to apply the necessary practical and theoretical knowledge, skills, and personal attributes for the inspections to be undertaken.

Assessment (of Person): process for measuring a person's competence by one or more means such as written, oral, practical, or observational using ICT.

Direct Visual Inspection and test: uninterrupted optical path from the observer's eye to the inspection area. Note: Direct visual inspections should be conducted with the eye within 600mm of the surface to be tested, at an angle not less than 30° to the surface.

Remote Visual Inspection and test (RVI): interrupted optical path from the observer's eye to the inspection area for which the use of photography, video systems, automated systems, robots, allows internal inspections to be performed without entering a confined or inaccessible area.

RVI System: ICT equipment that may include the control and visual display unit, connectivity equipment, hardware, and software for collecting and storing data.

4. Accreditation for Remote Visual Inspections

Applications for accreditation to perform RVIs should be submitted to UKAS, who will assess the AIB's competency by reviewing their in-house procedures against the general principles set out in this guidance and the requirements of ISO 17020:2012.

The AIB should also consider how it will enable UKAS to observe and witness the inspection process. UKAS document GEN 1 provides guidance on the assessment process and AIBs will need to apply for an extension to scope via the UKAS website. Once accreditation has been granted the AIB will be subject to ongoing surveillance including the requirement to verify updated RVI processes upon publication of the HSE research findings. This may also result in a revision of this guidance. UKAS will advise next steps where such methods will need to be formally assessed via extension to scope and identified on the AIB accreditation schedule.

To obtain accreditation AIBs will need to be able to demonstrate that their proposed RVI process (including equipment) has proven capability to meet the objectives for the scope of the inspection that will be performed and can reliably detect the different types of defects described in 5.4 and 5.5 of EN 12972:2018, including any degradation or damage that may occur due to operational service.

5. General principles

Consideration should be given to all related issues, including:

- The specific purpose of the use of RVI and how that purpose will be achieved so that the RVI is equivalent to direct visual inspection via physical entry.
- The use of ICT equipment for RVIs should be mutually agreed between the AIB and their customer before being used to perform inspections.
- The AIB must identify the risks that may impact the objectivity and effectiveness of the inspection process including any limitations with the use of RVI. Consideration of internal and external factors (data gathering, human factors, personnel, validation process, equipment, etc) associated with the inspection process should be identified and documented.
- Evidence should be retained to enable the AIB to demonstrate how risks are being managed. Any risk mitigation must ensure residual risks have been reduced as much as reasonably practicable.
- The confidentiality of information gained via the use of ICT equipment should be assured by the AIB and meet any contractual requirements that may exist.
- Designated personnel should be competent and physically able to perform RVIs.

5.1 Personnel

Personnel must receive job specific training and the AIB should document the competency criteria that staff will have to meet to perform any RVI.

The AIB must document their procedure and rules relating to the correct use of the equipment to enable an effective inspection. This should include guidance to inspection staff on the application of correct techniques to be applied during inspections including any limitations and variations on the quality of image sources. Other aspects that should be considered include equipment instructions, maintenance checks, degradation of light source, and calibration.

Only personnel who have received such training and are competent in the use of the RVI equipment should be authorised to undertake this type of examination.

5.2 Responsibilities of the inspector

The inspector always retains responsibility for the end-to-end RVI process. They will suspend or terminate an inspection if they are not satisfied that it is possible to carry out an RVI which is equivalent to a direct visual inspection via physical entry.

The following should be the minimum requirements that are taken into consideration by the inspector throughout the inspection:

- Ensuring the technical documentation to support the inspection is available prior to the start of the inspection activity.
- Ensuring any control checks, including for calibration and resolution, are performed before the inspection begins.
- Ensuring all equipment to be used is suitable for the environment in which it is to be used.

- Following a clear, concise system and procedure for the remote visual inspection.
- Ensuring that the correct preparations have been undertaken for the item/activity for which RVI is to be applied.
- Recording on any certificate issued the item/activity for which a RVI procedure was used and ensure there is sufficient information to ensure fulfilment of procedures and to enable a re-evaluation of the inspection.

5.3 ICT Equipment

The ICT equipment selected for RVI should be ergonomically suitable and have sufficient stability to enable the integrity and objectivity of the inspection to be maintained.

The lighting and RVI camera quality should meet the following criteria:

- A clear, in-focus image of the inside of the vessel
- A focal distance equivalent to an eye positioned within 600mm, and at an angle not less than 30°, of the surface to be tested
- Adjustable lighting for the camera to minimise reflective glare
- Images which are focused, properly illuminated with good contrast and colour and tint, without distortion or outside interference.

The criteria set out in EN 13018:2016 and EN ISO 17637:2016 may be helpful in demonstrating the effectiveness of any RVI equipment.

All equipment must be suitable for the tanks and environment(s) to which the equipment is to be subjected. For the inspection of tanks, the ability to operate within a temperature range of -10°C to +55°C and a humidity range of 10% to 90% is likely to be necessary.

The quality of the ICT images shall enable the defects cited in 5.4 and 5.5 of EN 12972:2018, including any defects arising from in-service degradation, to be identified and inspected.

The size and resolution of the monitor must provide images that are of an adequate size and quality to enable the minimum defect sizes to be displayed. Actual defect size in comparison to screen aspect ratio must be verified, which shall take into account the distance of the camera from the surface to be tested.

Adequate illumination of the area to be inspected is crucial to the inspection. The tank construction material can impact the quality of imagery, and local conditions such as glare and screen size must not compromise the effectiveness of the inspection or impede the inspector's ability to inspect, evaluate and assess defects.

The minimum and maximum lux levels must be determined through validation of the RVI process under actual inspection and test conditions. This will ensure that the optimum lux levels for the RVI equipment are identified and captured within the procedure.

It is anticipated that the camera will need to be able to be directed to give a pan of 360° in the horizontal plane and should be able to give a tilt of at least 90° in the vertical plane. The actual pan and tilt in the horizontal and vertical planes should be recorded.

The equipment specification should be maintained throughout the use of the inspection process. Other considerations and control checks include verifying that parameters are in place and maintained within the optimum conditions throughout the inspection process.

The AIB must consider any risks related to the use of the equipment that may have an impact on the effectiveness or safety of the inspection process, which are likely to include:

- Ability of ICT equipment to detect a range of different types of defects
- Restrictions in access to all internal surfaces
- Duration of inspection which will be related to the tank design, number of compartments, inspection, and repair history
- Battery life of ICT equipment
- Local environmental factors, such as location of the inspection and weather patterns.
- Human and Ergonomic factors relating to behaviours, handling and use of equipment, equipment functionality and manoeuvrability, which may impede the consistent application and implementation of the inspection process.

5.4 Inspection process

The AIB should conduct and detail its risk analysis and justifications for the RVI process. Consideration should be given to risks that may stem from clients, equipment, health and safety issues, human factors, and inspection processes. Any risks should be reduced as much as reasonably practicable and the AIB must be able to demonstrate appropriate mitigation measures.

The conclusions and decisions resulting from the analysis of risks should inform the equipment selection process, including the justification for the ICT equipment, taking into consideration:

- **Inspection Requirements –** The type of inspections being performed by the AIB should be recorded together with the referenced documents within their management system. The inspection process should ensure that the specified requirements (ADR / EN12972: 2018 / Competent Authority criteria) can be fulfilled via the application of ICT equipment.

- **Preparation for Inspection –** The AIB should document its policies and controls to ensure the consistent application of safe systems of work irrespective of who owns or uses the equipment. The AIB will need to demonstrate the appropriate application of risk assessment practices and mitigation controls to ensure compliance with Management of Health & Safety at Work Regulations 1999 (MHSWR 99). Tanks and their service equipment should be suitably prepared to ensure the effectiveness of the inspection is not impacted. Surfaces should be clean and dry to avoid potential glare from reflection and prior to inspection should be in a condition that ensures defects are not masked by any form of residue on the surface to be inspected.

- **Use of equipment -** Consideration should also be given to the recovery of equipment that may become defective whilst inside the tank

5.5 Validation process

To obtain accreditation AIBs will need to be able to demonstrate that their intended inspection process has been validated against known defects and degradation mechanisms applicable to the scope of the inspections that will be performed.

The validation will need to demonstrate that the inspection processes(s) that are developed for RVI (including equipment) have a proven capability to meet the objectives for the inspection and can reliably detect the different types of defects. For additional guidance, PD CEN TR 14748:2004 may be used as a guide when validating the process used to reliably detect the different types of defects described in 5.4 and 5.5 of EN 12972:2018.

Examples of factors that will need to be considered when evaluating the potential for using RVI for particular applications include; the effectiveness of the inspection history, historical repairs and associated trends, impediments that restrict access of the ICT equipment, design and constructional features, divisions, surge plates, baffles, stiffening rings etc, and installed equipment or confined crevices.

The AIB will need to prepare a document setting out the procedure that defines the use of RVI for the inspection process. BS EN 13018, BS EN ISO 17637 or other suitable standards / industry guidance documents provide relevant information on the minimum requirements that may require consideration. The procedure will need to clarify the inspection objective, acceptance/rejection criteria, defect assessment and sentencing, sequential examinations and extent of application, identification of equipment, safety controls, requirements for personnel / authorisation, surface preparatory requirements, illumination requirements including control checks, and requirements for data collection / storage and reporting.

A procedure will need to be in place which requires documented evidence to be retained to demonstrate the systematic evaluation and method(s) that have been applied to assure the RVI process. Appropriate control checks will need to be specified within the procedure to demonstrate that the examination method(s) are suitable for their intended purpose.

Evaluation of the effectiveness of the inspection process during the validation stage can be achieved in several ways but is likely to include some or all of the following:

- test plates with known defects and metrological traceability
- specified requirements in applicable standards (for example ASME V)
- control checks using photometers
- demonstration of the suitability of control checks

5.6 Reporting, record keeping, and certification

The record keeping system should be able to demonstrate the inspection technique that is to be applied and clearly identify which parts of the inspection include the use of ICT. There should be an auditable trail to the equipment used during each inspection including the control checks performed before and during the use of the equipment.

The inspection report and any certificates that are issued should document the extent to which RVI techniques have been applied, any limitations and the effectiveness of the ICT methodology in achieving the objective of inspection.

6. References

- The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations SI 2009/1348 (As amended)
- ISO/IEC 17020: 2012 Conformity assessment - Requirements for the operation of various types of bodies performing inspection.
- GEN 1 General principles for the assessment of conformity assessment bodies by the United Kingdom Accreditation Service
- EN 12972:2018 Tanks for transport of dangerous goods – Testing, inspection and marking of metallic tanks
- EN 13018:2016 Non-destructive testing – Visual testing – General principles
- EN ISO 17637:2016 Non-destructive testing of welds – Visual testing of fusion-welded joints
- The management of health & safety at work regulations 1999
- PD CEN TR 14748:2004 Non-destructive testing. Methodology for qualification of non-destructive tests