



2020

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# Guideline for Remote Inspection Techniques using Drones

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GL-0008-E

**Korean Register**

-Disclaimer

Although all possible efforts have been made to ensure correctness and completeness of the contents contained in this guidelines, the Korean Register of Shipping is not responsible for any errors or omissions made herein, nor held liable for any actions taken by any party as a result of information retrieved from this guidelines.

This guidelines is non-mandatory, but are intended to provide practical technical materials to ship owners, ship operators, shipyard, designers and manufactures, etc. It might be amended periodically or upgraded to rules and guidances as future technology develops and matures.



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## Application of Guideline for Remote Inspection Techniques Using Drones

It is expected to increase the remote inspection techniques(RIT) using unmanned aerial vehicles(UAV or Drone) due to the development of advanced technology. The purpose of this Guideline is to help understand the approval and survey procedures more easily by presenting requirements that internal and external customers should be aware of when classification surveys such as Special Survey, Intermediate Survey, Annual Survey etc.

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# Chapter 1 General

## 101. Definitions

1. **Remote Inspection Techniques (RIT)** is a means of survey that enables examination of any part of the structure without the need for direct physical access of the surveyor (refer to IACS Rec.42).

(1) Unmanned Aerial Vehicles (UAV) / Drones



- (2) Unmanned robot arm
- (3) Remotely Operated Vehicles, ROV
- (4) Climbers
- (5) Other means acceptable to the Society

2. **Close-up Survey** means a survey where the details of structural components are within the close visual inspection range of the Surveyor, i.e. normally within reach of hand.
3. **Service Supplier** means a person or company, not employed by an IACS Member, who at the request of an equipment manufacturer, shipyard, vessel's owner or other client acts in connection with inspection work and provides services for a ship or a mobile offshore unit such as measurements, tests or maintenance of safety systems and equipment, the results of which are used by surveyors in making decisions affecting classification or statutory certification and services.
4. **the Owner** means including Charterer, representatives of Owner, Representatives of Charterer and master of ship.
5. **Verification** means a service that confirms through the provision of objective evidence (analysis, observation, measurement, test, or records or other evidence) that specified requirements have been met.
6. **Unmanned Aviation/Aerial Vehicle (UAV) / Drone** means a pilot-free aircraft capable of remote control or autonomous flight based on pre-programmed flight routes and/or dynamic automation systems.
7. **Operators** mean Operators (pilot mission) who directly controls the flight of the drone.



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## Chapter 2 Qualification of Service Suppliers

### 201. General

Where remote inspection techniques(hereafter referred to as “RIT”) is to be used as an alternative to close-up survey, it should be carried out by Service Suppliers approved by the Society and the requirements and procedures of approval are to be in accordance with the **Guidance for Approval of Service Suppliers**.

- Note: 1) The above Guidance can be found in our website ([www.krs.co.kr](http://www.krs.co.kr)) - “Rules and Solutions” - “List of KR Technical Rules” - “List of KR Technical Rules” - “Other Rules and Guidance” - “Guidance for Approval of Service Suppliers”.
- 2) For reference, the registration guide can be found on our website ([www.krs.co.kr](http://www.krs.co.kr)) - “Our Services” - “Service Supplier”.
- 3) In case of an emergency case, it is recommended that Service Suppliers maintain third party liability insurance.

## Chapter 3 Classification Survey using RIT

### 301. General

In case of using the remote inspection techniques, the Owner should select a Service Supplier approved by the Society. This chapter provides the procedures when surveys using RIT is used for classification survey.

Table 1. Classification Survey Flow for RIT

	the Owner	Service Supplier	KR (Branch Office)
Step 1	Select Service Supplier and provide ship's status and drawings to the Service Supplier		
Step 2		Submission of survey plans including: 1) Determine which equipment of RIT to use 2) Risk assessment according to the scope of work and establishment of RIT flight plan	
Step 3	Review and approve survey plans(incl. flight plan etc.) prepared by Service Supplier		
Step 4	Obtain flight-related approval from local government (if necessary)		
Step 5	Submit an application including survey plans to the KR branch		
Step 6			Review and approve the submitted survey plans
Step 7	Obtain work/site permit, crews, survey preparation, etc.		
Step 8	A survey planning meeting between the Owner, the Service Supplier and the attending Surveyor		
Step 9	Attend survey	Conduct RIT survey	Attend survey
Step 10		Provide survey results and data to the Owner and the attending Surveyor	
Step 11	Review reports submitted by the Service Suppliers		Review and evaluation of reports submitted by the Service Supplier (conduct confirmatory survey/Close-up survey/thickness measurement, if necessary)



### 302. Application

RIT is a tool to assist the attending Surveyor as an alternative to close-up survey. The acceptance of the survey results is to be confirmed by the Surveyor that the results meet the requirements of the Rules. If the Surveyor is dissatisfied with the results of the RIT, traditional methods may be required.

RIT may not be appropriate if any of the following conditions exist or are found during the survey.

- (1) Any indication or condition that indicates damage or abnormality in the structure under survey.
- (2) When the condition of the structure under survey affects the classification of the hull structure.
- (3) Any damage or defect that requires immediate action during the survey is identified.
- (4) The structure to be surveyed is not clean enough to be practically inspected and the view is not sufficient.

RIT is an effective way to identify unsatisfactory conditions such as defects and corrosion, but other approaches may be needed to determine the appropriate assessment and repair coverage.

### 303. Preparations for Survey

#### 1. Submitted documents

- (1) Prior to survey, the Owner shall submit the survey plans (including flight plan, prepared by a Service Supplier) containing the following information to the related KR Branch Office for approval.
  - (A) Main particulars
  - (B) Types of survey (eg Annual/Intermediate/Special Survey, Damage Survey)
  - (C) Scope of Survey (ie Close-up survey, thickness measurement, nondestructive test, etc.);
  - (D) After completion of the survey, confirmatory survey/close-up survey/thickness measurement place and method (when necessary)
  - (E) The place of survey, estimated time and operational status of the ship (e.g. shipyard, quay or anchorage, etc.)
  - (F) Transport procedures for site permits, operation work permits and transporting related equipment to the survey site.
  - (G) Business name and certificate number of the Service Supplier
  - (H) Equipment used
  - (I) Flight route / flight method / communication method
  - (J) Drone Pilot Certification
  - (K) If necessary, approval of the aeronautical authorities, etc. of the countries and regions having jurisdiction over the operating area of the flight area, and/or the approval of the local government;
  - (L) Emergency Response Plan Evacuation Routes and Contacts
  - (M) Other drawings, etc. if deemed necessary by the Society

- (2) Survey planning meeting

Prior to the commencement of the survey, the Owner, Service Supplier and the Surveyor should hold a survey planning meeting to ensure that all items mentioned in the approved survey plans (including flight plan) are well prepared and thus safe and effective. This meeting shall discuss the following (A) and (B):

- (A) Risk Assessment

In addition to the usual risk assessment, the Service Supplier should conduct a case specific risk assessment to identify risks associated with the need for planned drone operations and the need for risk control measures. The risk assessment should be conducted during a survey planning meeting attended by all parties and, where appropriate, incorporated into an approved survey plans.

Risk assessments include the following categories:

- (a) Explosion risks in Hazardous Locations

Where RIT operation are conducted in hazardous areas, equipment used should be explosion-proof (eg Ex-class) or the area should be made safe for use of RIT equipment. The Service Supplier should refer to the dangerous area drawing on board to identify the dangerous area. In addition, where applicable, the safe operation requirements specified by the Owner, Service Supplier should be followed. Typical factors to be considered include, but not limited to the following categories:

- i) Payload: risks associated with motors, cameras or other onboard modules
  - ii) Batteries: risks associated with storing, using, changing, replacing and recharging batteries
  - iii) Explosion due to operation incidents/accidents
- (b) Risk of falling object: in case of malfunction or failure of RIT equipment, it can pose risks to the asset and onsite personnel as a falling object. Typical factors to be considered include, but are not limited to:
- i) take-off and landing areas
  - ii) mobile areas where the ship is in operation occupied by personnel
- (c) Collision risks: unexpected changes in the survey environment, malfunctions of the RIT equipment, and/or human error may result in a collision.
- i) collisions with birds, ship structures or operating equipment/machinery
  - ii) collisions due to communication failures or unexpected malfunctions of the RIT equipment
  - iii) collision where visual line of sight is not maintained or unexpected interruption of the pilot operation
- (d) Other risks: Identify other risks in terms of personnel's health and safety
- i) high-risk work areas that may contain high voltages, toxic gases or hazardous contents
  - ii) risks associated with other work in progress in the area during the RIT operation
  - iii) emergency scenarios that requires evacuation from the ship
- (B) Flight Plan
- (a) check the work scope of the intended flight plan
  - (b) evaluate flight conditions and determine if revision of the flight plan is necessary
  - (c) check the responsibilities of all personnel, including the Owner, Service Supplier and attending Surveyor
  - (d) review risks and associated mitigation plans
  - (e) review of emergency plans to escape or evacuate

All parties should have the authority to suspend the operation immediately at any time as deemed necessary.

### 304. Conduct a Survey

#### 1. General

- (A) Survey shall be conducted under the presence of the Surveyor.
- (B) The information obtained from the camera mounted on the RIT equipment shall be of sufficient quality to determine the condition of the ship's hull structure. Where necessary, appropriate illumination shall be installed on the RIT equipment or separately prepared.
- (C) If the quality of the equipment related to the RIT is deemed inadequate, the survey related to the RIT may be cancelled by the Surveyor before the actual survey.
- (D) RIT supervisor and operators should act in accordance with the Surveyor's instructions. However, in the event that the instructions cannot be complied with during operation for safety reasons, the supervisor and the operator should inform the attending Surveyor the reasons and consider alternative methods with the Surveyor.
- (E) Remove or clean any obstructions if necessary.

- (F) In the event that the required thickness measurement using the RIT cannot be carried out, temporary means of access for thickness measurement should be provided.
- (G) Data such as photos and videos taken from cameras mounted on RIT equipment should be recorded.
- (H) Reviews of recorded photos, videos should be carried out by the attending Surveyor and the relevant parties, either during survey or after completion of the survey, as soon as possible. And additional survey by RIT or traditional methods, may be required if deemed necessary by the Surveyor.

## 2. Take off

The Service Supplier should have documented working procedures(including instructions) relating to the survey methods for flight and recommend that:

- (A) Checklist: should include survey of the relevant systems, survey conditions, personnel readiness preparation, communication equipment and testing flight
- (B) Communication: If the communication signal between team members is cut or interfered a lot, the operation should be stopped immediately.
- (C) Documentation: Whenever exceptions are found during operation, reference data (i.e., still image capture, location, etc.) should be correctly documented for final reporting.
- (D) Related to Drone
  - (a) Take-off and landing area: The take-off and landing areas shall be marked conspicuously and may, if necessary, restrict access to the take-off and landing areas
  - (b) Visual line of sight(VLOS): Some aviation authorities require human direct and unaided VLOS is maintained throughout the operation. At the current level of RIT, it is recommended that VLOC is maintained even if there are no requirements applied.

The Surveyor should be in or near the space to be surveyed and, if necessary, instruct the RIT operation team on survey requirements and execution.

## 3. After flight

- (A) Logging
  - (a) after shutting down and packing the RIT equipment safely, all flight details, including the start of take-off time, flight time, landing completion time and completed work type, shall be recorded;
  - (b) if maintenance or technical adjustments are carried out during operation, it shall also be documented;
  - (c) when an accident or a near miss is found during the operation, it should be documented and reported to all parties so that the decision to suspend the operation or any other adjustment can be made on time.

### 305. Data Review

Three types of visual data(still image, real-time image, and recorded images) for surveying and evaluating the condition of the structure, shall be available to the attending Surveyor.

After completion of the flight, all visual data at the site should be reviewed in all forms so that additional flight requests or alternative survey methods may be required, if necessary.

### 306. Reporting

The items to be listed in the report are as follows.

1. Name of Firm carrying out RIT
2. Name of supervisor and worker including certificate or training certificate number

3. Survey date and location
4. Name of RIT equipment used
5. Name of ship, classification number, gross tonnage, port of registry and the Owner
6. Survey information including kinds of survey, name and/or location of surveyed structure or space
7. Survey details and results (damage, condition, etc.)
8. Details of the date including the start time of take-off, flight time, and landing completion time and flight records(still image, video image)
9. In the event that survey is suspended due to an accident, the related records
10. When submitting relevant data online to KR, a method considering the reliability of the data and the risk of leakage shall be used

Note : If review of the data identifies any situation that may affect classification, though not confirmed at the time of survey, the Owner should notify the KR.

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## Chapter 4 Data

### 401. General

Data(e.g. still image, video image) collected by the equipment of the RIT are mostly visual information. Appropriate equipment for marking and reproducing this collected data should be included.

### 402. Data Acquisition

Visual data collected during the flight should be reviewed and evaluated at the designated time and place as agreed by all parties at the survey planning meeting. To evaluate the visual data collected by the equipment of the RIT, the following criteria should be considered:

1. Image quality should be able to assess the structure's condition substantially and be suitable for identifying anomalies.
2. If abnormalities are identified during the survey, the quality of the images shall enable the attending Surveyor to identify the nature, severity, and approximate dimensions of the anomaly, if applicable.
3. The images of real-time or recorded video are not broken, so any part of the structure must be visible to the attending Surveyor.
4. Data identifying structural members, particularly those related to anomalies, shall be collected for later tracking.

### 403. Post-Analysis Data

While most data assessments are performed in real time, either during or within a short period of time after flight, some Service Suppliers may provide post-analysis data for further evaluation.

### 404. Data Security

Service Suppliers should comply with any statutory or requirements, company regulations, or contracts (where applicable) and recommend that cyber security is properly handled when implementing remote data access portals for customers.

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## GUIDELINE FOR REMOTE INSPECTION TECHNIQUE USING DRONES

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