

TCVN 10299-6:2014

1st Edition

**ADDRESSING THE POST-WAR CONSEQUENCES OF
MINES/ERW -
PART 6: MINES/ERW CLEARANCE**

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Foreword

TCVN 10299-1 :2014 was drafted by the Technical Standard Department of Engineering Command, requested by the Ministry of Defense, appraised by the Directorate for Standards, Metrology and Quality and published by the Ministry of Science and Technology.

TCVN 10299 :2014 – *Addressing the post-war consequences of mine/ERW*, includes 10 parts:

- TCVN 10299-1:2014, *Part 1 : General provisions*;
- TCVN 10299-2:2014, *Part 2: Assessment and Accreditation of demining organizations*;
- TCVN 10299-3:2014, *Part 3: Monitoring and Evaluation of demining organizations*;
- TCVN 10299-4:2014, *Part 4: Non-technical Survey and Technical Survey*;
- TCVN 10299-5:2014, *Part 5: Demining safety*;
- TCVN 10299-6:2014, *Part 6: Clearance of mine/ERW*;
- TCVN 10299-7:2014, *Part 7: Explosive Ordnance Disposal (EOD)*;
- TCVN 10299-8:2014, *Part 8: Medical support for demining operations*;
- TCVN 10299-9:2014, *Part 9: Investigation of demining incidents*;
- TCVN 10299-10:2014, *Part 10: Management of information*;

Addressing the post-war consequences of mine/ERW - Part 6 : Clearance of mines/ERW

1 Scope

This standard specifies the requirements and procedures for the implementation of demining operations, the equipment to be used, as well as responsibilities of relevant organizations and individuals.

This standard is applicable to demining organizations and other relevant agencies.

2 Normative references

The following normative references are vital for the application of this standard. For dated references, the cited edition shall be applied. For undated references, the latest edition of the normative documents referred to shall be applied, including amendments or supplements (if any). This standard will be applied to organizations that are granted the authority to monitor and evaluate the operations of mining and relevant parties.

TCVN 10299-1:2014, *Addressing the post-war consequences of mines/ERW –*

Part 1 : General provisions

TCVN 10299-8:2014, *Addressing the post war consequences of mines/ERW – Part 8:*

Medical support for demining operations

3 Terms & definitions

This standard uses terms and definitions specified in TCVN 10299-1:2014 and the following terms and definitions

3.1

Demining

Activities to clear the contaminated area by detecting, disposing (removing/ destroying) different types of mines/ERW

3.2

Demining area

An area which is contaminated by mines/ERW that needs to be cleared.

3.3

Deminers

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Those who have been trained as per regulation and are currently working for demining organizations. Deminers can take part in the management process, specific demining operations, or supporting activities.

3.4

Demining organization

Government, non-government or foreign commercial entities who have full legal status, who are recognized and have sufficient capacity to carry out one (or more) demining tasks and projects.

4 Demining

4.1 Unlike other socio-economic activities, demining is particularly dangerous with its own characteristics. Therefore, only licensed organizations are allowed to implement demining operations.

4.2 Demining is a remarkably difficult, dangerous, and pernicious task that might have a direct impact on the health and lives of deminers.

4.3 Demining is conducted nationwide in all types of topography (land, underwater, sea, lakes, ponds, rivers, lakes, midland and mountainous areas, scarcely or densely populated areas or urban areas...) and in all places which have been affected by the war.

4.4 Results of post-war demining activities are directly linked to the safety of human beings, properties, and socio-political security.

5 Requirements of post-war demining operations

5.1 General requirements

5.1.1 Those in charge of demining activities shall be sufficiently healthy and have regular health evaluations according to TCVN 10299-8:2014, they must be trained and certified in accordance with regulations.

5.1.2 Detectors and technical equipment used in demining operations shall be sufficient in terms of quantity and quality. Regular evaluations and calibration are required in order to detect any technical malfunctions, the parts and components which do not meet technical requirements and lack synchronicity will need to be replaced immediately (inspection will be undertaken by authorized measurement and quality agencies).

5.1.3 Technical procedures must be strictly followed in order to ensure safety during a demining process.

5.1.4 During a demining operation process, regular evaluations shall be conducted to determine the quality of the project; inspect compliance with safety rules to prevent possible mistakes. Inspection shall be carried out based on a probability method with the inspected area not smaller than 1% of the cleared area.

5.1.5 Demining organizations shall possess a license or certificate issued by the Mine Action State Management Authority (or authorized agency) that is still valid.

5.1.6 A technical operational plan shall be approved by the authorized governmental agency (excluding special cases that are regulated by the State Management Authority)

5.2 Requirements for human resource organization

The organization of human resource of the demining team will stipulate the total number of officers, staff and necessary organization charts of the post-war mine/ERW action team. The assignment of the number of staff members in each group will be based on the technical operational plan and scope of work for reasonable adjustments.

5.2.1 Inland demining team

5.2.1.1 The maximum number of staff in an inland demining team is 25

5.2.1.2 The organization of human resource is divided into groups as follows:

a) Commanding group:

- 01 team leader;

- 01 deputy team leader

b) Surface preparation, detection, and signal marking group

c) Digging and signal processing group

d) Security group

e) Logistics group (medical, logistic, technical materials)

5.2.2 Underwater demining team

5.2.2.1 The maximum number of staff in an underwater demining team is 20

5.2.2.2 The organization of human resource is divided into groups as follows:

a) Commanding group:

- 01 team leader;

- 01 deputy team leader;

b) Surface preparation, detection, and signal marking group

c) Diving, digging and signal processing group

d) Security group

e) Logistics group (medical, logistic, technical materials)

5.2.3 Sea demining team

5.2.3.1 Maximum number of staff of sea demining team is 35

5.2.3.2 The organization of human resource is divided into groups as follows:

a) Commanding:

- 01 team leader;

- 01 deputy team leader;

b) Navigation positioning group

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- c) Group using sonar, magnetometer and acoustic positioning device;
- d) Group using salvaging equipment for mines/ERW;
- e) Positioning, diving and signal processing group;
- f) Remote operated vehicle (ROV) group;
- g) Security group;
- h) Logistics group (medical, logistic, technical materials);

5.3 Requirements for human resource

5.3.1 Team Leader

5.3.1.1 Capacity in management and administration

5.3.1.2 Extensive knowledge of mines/ERW

5.3.1.3 Each team leader shall have received basic training in technical demining operation and as well as training in becoming a certified team leader (for domestic demining organizations) or have been trained by internationally accredited bodies (for international demining organizations and non-governmental organizations).

5.3.1.4 At least two years of hands-on experience in organizing and commanding demining activities

5.3.1.5 Thorough understanding of the SOP

5.3.1.6 Deep knowledge of the composition and functions and of various types of common mines/ERW in demining activities

5.3.1.7 Deep understanding of safety regulations in demining operations

5.3.1.8 Expert level of understanding and usage of demining equipment

5.3.1.9 Sufficient swimming and diving skills are required for those who operate demining in the sea.

5.3.2 Technical Staff

5.3.2.1 Technical staff shall be properly trained in technical demining operation, granted with a certificate (for domestic demining organizations) or trained by internationally accredited bodies (for international demining organizations and non-governmental organizations).

5.3.2.2 Thorough understanding of the composition and functions of the common types of mines/ERW.

5.3.2.3 Deep understanding of SOP and demining safety rules.

5.3.2.4 Deep understanding of technical features, proficient usage of detectors, specialized equipment and facilities.

5.3.2.5 Sufficient swimming and diving skills are required for those who operate demining in the sea.

5.4 Requirements for equipment and facilities

5.4.1 General requirements

5.4.1.1 Demining teams shall be equipped with sufficient equipment, facilities, emergency medical personnel, and protective equipment as per regulations.

5.4.1.2 Detectors, equipment and facilities used for post-war demining for each type of activities such as inland, underwater, and in sea shall comply with quantity and quality specifications given in Tables 1, 2, 3. All detectors, equipment and facilities shall be inspected every six months in order to ensure technical compliance, and timely replacement of malfunctioning & unsynchronized parts and accessories (inspection will be conducted by the authorized quality and measurement unit).

5.4.2 Inland demining team

The list of detectors, equipment and facilities for an inland demining team is given in Table 1

Table 1 - List of detectors, equipment and facilities for an inland demining team

No	Type of equipment, facilities	Unit	Quantity	Quality	Notes
1	Bomb detector (deep search)	unit	02	Level I, II	All equipment, tools and facilities shall be inspected in a timely manner
2	Mine detector	unit	02- 04	Level I, II	
3	Specialized equipment	set	Sufficient	Level I, II	
4	Handheld toolkit	set	01	Level I, II	
5	Surface clearance tools and equipment	set	Sufficient	Level I, II	
6	Fire expansion prevention equipment and tools	set	Sufficient	Level I, II	
7	Medical toolkit	set	01	Level I, II	
8	Personal Protective Equipment	set	Sufficient	Level I, II	
9	Vehicle for transporting personnel	unit	01	Level I, II	
10	Pickup truck for transporting tools, equipment, and facilities	unit	01	Level I, II	
11	Truck for transporting UXO	unit	01	Level I, II	

5.4.3 Underwater Demining Team (water depth up to 15m)

The list of detectors, equipment and facilities for an underwater demining team is given in Table 2.

Table 2 - List of detectors, equipment and facilities for an underwater demining team

No	Type of equipment, facilities	Unit	Quantity	Quality	Notes
1	Underwater bomb detector (deep search)	unit	02-03	Level I, II	All equipment, tools and facilities shall be inspected in a timely manner
2	Underwater mine detector (shallow depth)	unit	01	Level I, II	
3	Diving station (synchronous)	station	01	Level I, II	
4	Sand and mud pumping equipment	Equipment	01	Level I, II	

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5	Small rubber boat	unit	02	Level I, II	
6	Middle-sized rubber boat	unit	01	Level I, II	
7	Composite boat (for assembling diving station and sand/mud pumping equipment)	unit	01 - 02	Level I, II	
8	Specialized equipment	set	Sufficient	Level I, II	

Table 2 (finish)

No	Type of equipment, facilities	Unit	Quantity	Quality	Notes
9	Handheld toolkit	set	01	Level I, II	
10	UXO salvage equipment	set	01	Level I, II	
11	Tools and medical equipment	set	01	Level I, II	
12	Protective equipment, life vest	set	sufficient	Level I, II	
13	Vehicle for transporting personnel	unit	01	Level I, II	
14	Pickup truck for transporting tools, equipment, and facilities	unit	01	Level I, II	
15	Pickup truck for transporting UXO	unit	01	Level I, II	

5.4.4 Sea demining equipment (water depth above 15m)

The list of equipment and facilities for a sea demining team is given in Table 3.

Table 3 - List of equipment and facilities for a sea demining team

No	Type of equipment, facilities	Unit	Quantity	Quality	Notes
1	Sonar and magnetometer equipment (synchronous design)	equipment	01	Level I, II	All equipment, tools and facilities shall be inspected in a timely manner
2	DPPS	equipment	01	Level I, II	
3	Acoustics positioning device	equipment	01	Level I, II	
4	Underwater bomb detector (deep search)	unit	02 - 03	Level I, II	
5	Underwater mine detector (shallow depth)	unit	02	Level I, II	
6	Diving station (synchronous)	station	01	Level I, II	
7	Sand and mud pumping equipment	equipment	01	Level I, II	
8	Middle-sized rubber boat	unit	01	Level I, II	

9	Composite boat (for assembling diving station and sand/mud pumping equipment)	unit	01 - 02	Level I, II	
10	Specialized equipment	set	sufficient	Level I, II	
11	Handheld toolkit	set	01	Level I, II	
12	UXO salvage equipment	set	01	Level I, II	
13	Medical toolkit	set	01	Level I, II	

Table 3 (finish)

No	Type of equipment, facilities	Unit	Quantity	Quality	Notes
14	Protection equipment, life vest	set	sufficient	Level I, II	
15	Vehicle for transporting personnel	Level I, II	01	Level I, II	
16	Pickup truck for transporting tools, equipment, and facilities	Level I, II	01	Level I, II	
17	Pickup truck for transporting UXO	Level I, II	01	Level I, II	
18	Ship from 350 cv to 2500 cv	Level I, II	03 - 04	Level I, II	

6 Demining implementation procedures

6.1 General requirements

Demining organizations shall select an appropriate operational plan based on the results of non-technical survey and technical survey, as well as the requirements for clearance depth of each specific project. The post-war demining work plan may be implemented in all steps or a number of steps, but it must be done in the order stipulated in the regulation .

6.2 Inland demining

6.2.1 Locating clearance areas

Based on the positions marked during the survey, a demining operation is carried out in accordance with the contents provided in 6.2.2.1 to 6.2.2.3, to open a path from 4- to 6-meter wide around the entire area for detecting, moving, transporting and isolating the clearance area from its surroundings.

6.2.2 Ground preparation

6.2.2.1 Manual ground preparation

6.2.2.1.1 Set stakes and subdivide area into 25m*25m or 50m*50m cells depending on terrains (or 25m long with width depending on the width of the clearance area at narrow strips).

6.2.2.1.2 Clear all creeper, grass, trees with diameters less than 10cm, leaving the remaining stumps

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5cm or lower in height (for a tree with diameter greater than 10cm, it will only be cut down when there is a object under the stump that needs to be processed), clear obstacles and remove them from the mine action operation range (if the clearance area is a minefield, the clearing is carried out simultaneously with manual demining to a depth of 7cm).

6.2.2.2 Manual ground preparation combined with burning by gas or petrol

6.2.2.2.1 Clear plants and trees to open 2- to 3-meter wide paths to subdivide the area into 25m*25m or 50m*50m cells depending on terrains (or 25m long with width depending on the width of the clearance area at narrow strips); if the clearance area is a minefield, the clearing is carried out simultaneously with manual demining to a depth of 7 cm.

6.2.2.2.2 Spray gas or petrol to burn all the creeper, grass, trees in each cell at the appropriate time

6.1.2.2.3 Clear plants, trees and obstacles and remove them from the demining range (this action is conducted simultaneously with mine action operation to a depth of 7cm or 30cm).

6.2.2.3 Manual ground preparation combined with explosives

6.2.2.3.1 Observe, inspect and use a large amount of explosive to destroy barriers; open 2- to 3-meter wide paths, set stakes and subdivide the region into 25m*25m or 50m*50m cells depending on terrains (or 25m long with width depending on the width of the clearance area at narrow strips).

6.2.2.3.2 Clear plants, trees and obstacles and remove them from the demining range (this action is conducted simultaneously with mine action operation to a depth of 7cm or 30cm).

6.2.3 Manual demining to the depth of 7cm (former minefield)

6.2.3.1 From cell-dividing paths, use white pennants to mark a detection range (from 1- to 1.5-meter wide), detect and mark simultaneously (distance between two pennants is 1.5m). For the next detection range, used pennants are removed and used following the successive method.

6.2.3.2 Use demining probe combined with visual observation to detect signals, demine in accordance with technical requirements, tapering from left to right, from near to far. The probe head shall be tilted at an angle from 30° to 40° above ground. Probe in the shape of an apricot flower, the distance between two probe heads is from 3cm to 5cm and depth from 7cm to 10cm.

6.2.3.3 When a signal is detected, check and determine the signal, dig and inspect the detected object in accordance with basic techniques. If the object is not a mine/ERW, it shall be collected in a specified location; if the object is a mine/ERW, it shall be handled in a safe manner and collected in a specified location; if the object is unsafe or is an unusual type of mines/ERW, it shall be marked with a red flag to be processed separately.

6.2.3.4 The nearest distance between any two deminers on the same clearance area shall not be less than 15m.

6.2.4 Inspect, destroy mines/ERW in situ to a depth of 7cm (former minefield)

6.2.4.1 Explosive charge will be set directly on the object that needs to be destroyed, the amount of explosive is based on the type of mines/ERW as regulated in the Charter of blasting works.

6.2.4.2 After destruction, it is required to check to ensure that all mines/ERW have been completely destroyed. In case of leftover mines/ERW, disposal operations shall be conducted following the order

above.

6.2.4.3 Inspect, collect and remove all explosive weapons or fragments (if any) from the demining area.

6.2.5 Detection using mine detectors to a depth of 30cm

6.2.5.1 Use stakes and wires to mark detection ranges, each from 1- to 1.5-meter wide.

6.2.5.2 Use mine detectors to carry out mine action activities as per technical requirements. Search from left to right and vice versa; the following search track shall cover 1/3 of the previous track, the following search range shall encroach on the previous range by 10cm to 20cm.

6.2.5.3 When a signal is indicated, the deminer shall search following the cross-streak to determine the center of signal then place a red pennant next to it. The pennant can be placed to the right or left of the signal center (to be decided by the commander) but make sure that when the pennant is pulled down vertically, it is straight down to the signal center

6.2.5.4 The minimum distance from one mine detector to another on the same clearance area is 7m.

6.2.6 Dig, inspect and remove detected objects to a depth of 30cm

6.2.6.1 Use mine detectors and demining probes to reexamine the marked signal position. Use a shovel to dig a hole of width 0.5m to 0.6m (depending on the magnitude of the signal), carefully remove each layer of soil from the top and from the edge to the center of the hole, digging and checking at the same time. When the object is indentified, use a dagger to dig around until the object causing the signal is completely emerged.

6.2.6.2 Check and determine the object causing the signal: If the object is not a mine/ERW it is collected in a specified location; if the object is a mine/ERW, it is processed in a safe manner and collected in a specified location; if the object is a mine/ERW unsafe for collections, it is marked with a red flag and processed separately.

6.2.6.3 After processing, use mine detectors to reexamine around and at the bottom of the processed object position to make sure there is no more signal. If there is still a signal indicated, processing shall be conducted as per steps from 6.2.6.1 to 6.2.6.3 .

6.2.7 Detection by bomb detectors to a depth from 0.3m to 5m or to 10m

6.2.7.1 Prepare a bomb detector, inspect the magnetized soil in the area to calibrate detectors accordingly.

6.2.7.2 Set stakes and stretch wire to mark the detection range, maintaing a 1-meter distance from one range to another.

6.2.7.3 Use the bomb detector to conduct demining in accordance with technical requirements. When a signal is indicated, the deminer shall search following the cross-streak to pinpoint and place a largered flag next to the center of the signal for marking.

6.2.7.4 The minimum distance from one bomb detector to another on the same clearance area is 7m.

6.2.8 Dig, inspect and remove detected objects to a depth of 3m

6.2.8.1 Prepare, inspect and use handheld toolkits to dig carefully around the center of the marked signal position. Dig from outside to inside, the hole size depends on the magnitude and depth of the signal

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(through judgment when detecting). When nearing the object causing the signal, it is required to dig in layers of soil less than 10cm each in thickness, combine a bomb detector and demining probe to inspect around the center signal position before digging the next layer until the object causing the signal is completely emerged.

6.2.8.2 Examine and determine the object causing the signal: If the object is not a mine/ERW, it is collected in a specified place; if the object is a mine/ERW, it is processed in a safe manner and collected in a specified location; if the object is a mine/ERW unsafe for collection, it is marked with a red flag and processed separately.

6.2.8.3 After processing, use mine detectors to reexamine around and at the bottom of the processed object position to make sure there is no more signal. If there is still a signal indicated, processing shall be conducted as per steps from 6.2.8.1 to 6.2.8.3 .

6.2.8.4 No more than 2 persons are allowed in a digging and processing shift. The minimum distance from one digging and processing group to the other is not less than 25m.

6.2.9 Dig, inspect and remove detected objects to a depth of 5m

Procedures are repeated as provided in 6.2.8 for depths of over 3m to 5m.

6.2.10 Detection by bomb detectors to depths from 0.3m to 10m

6.2.10.1 When there is a bomb detector which can detect signals to a depth of 10m

Procedures are carried out as given in 6.2.7 for depths of over 0.3m to 10m

6.2.10.2 When there is no bomb detector which can detect signals to a depth of 10m

6.2.10.2.1 Demining is conducted only when a demining operation has been finished to the depth of 5m.

6.2.10.2.2 It is required to drill a hole, with a 5-meter deep borehole, for detection.

6.2.10.2.3 Boreholes are arranged in an apricot flower shape, 2m from each other, the diameter of each borehole ≥ 105 mm, borehole border is protected and reinforced with plastic tubing or hard materials.

6.2.10.2.4 After drilling boreholes, demining is carried out in the same steps as provided in 6.2.7, using the method of dropping a probe into a borehole, recording and analyzing the data measured (including data from nearby boreholes) to detect all signals.

6.2.11 Dig, inspect and remove detected objects to a depth of 10m

Procedures are carried out in the same way as provided in 6.2.8 for depths of over 0.3m to 10m.

6.3 Underwater demining

6.3.1 Surface preparation

6.3.1.1 Based on positions marked during surveys, conduct zoning of the clearance area by building $0.15\text{m} \times 0.15\text{m} \times 1.2\text{m}$ concrete poles with size on the shore and drop 1m^3 buoys with 50kg anchors to position and mark necessary positions on the water. Only buoys and anchors are required to position and mark clearance areas with water depths greater than 3m and widths greater than 50m.

6.3.1.2 Collect and remove all type of aegiceras, grass, alga, water-fern or piles from the worksite.

Large obstacles which can not be salvaged such as: girders, damaged piers, wrecked boats, shall be marked for special attention to eliminate signal interference when demining.

6.3.2 Demining to a depth of 0.5m from the bottom of the water body.

6.3.2.1 Inspect the magnetized soil of the water body to calibrate detectors accordingly.

6.3.2.2 Stretch wire combining with dropping 1m³ buoys, 50kg and 20kg anchors to subdivide the region into 25m*25m or 50m*50m cells depending on the terrain. Stretch wire to mark and to divide the cells into tracklines that are each 0.5meter wide (the direction of tracklines should coincide with the direction of water flow).

6.3.2.3 Place a bomb detector on a rubber boat or composite boat, drop the probe vertically into the water body, stopping at 10cm to 20cm from the bottom of the water body and conduct clearance along the trackline. When demining has been finished in one trackline, move the probe to the next one.

6.3.2.4 Demining is only conducted under the condition where the water flow rate is not higher than 1m/s. In cases where demining is required where the water flow speed is higher than 1m/s, it is required to intensify methods to ensure safety, technical requirements and operation quality.

6.3.3 Marking signals recorded at depths up to 0.5m from the bottom of a water body

6.3.3.1 When a signal is detected at the bottom of a water body, move the detector along the trackline to determine the center of the signal.

6.3.3.2 Drop a 20kg anchor (for regions with flow velocity higher than 1m/s and water depth greater than 3m) and a 10kg anchor (for other regions) close to the center position of the identified signal. The anchor is connected with a plastic float with a diameter greater than 30cm by a nylon cable that is 12mm in diameter, a red flag is placed on the float for marking.

6.3.3.3 When the water depth is less than 3m, a bamboo pole can be used to mark the signal position.

6.3.4 Diving to check, dig, and remove detected objects up to a depth of 0.5m from the bottom of a water body

6.3.4.1 Safety requirements are prepared and implemented sufficiently. The diver who carries diving equipment and necessary handheld toolkits such as: demining probe and shovel, dives to the center position of the marked signal, searches using a demining probe, and uses the shovel carefully to dig in layers until the object causing the signal is completely emerged. .

6.3.4.2 Inspect and determine the object causing the signal: If the object is not a mine/ERW, a nylon cable is used to salvage the object onto the boat and then it is collected in a specified location; if the object is a mine/ERW, it is processed in a safe manner, the nylon cable is used to salvage the object and the object is collected in a specified location; if the object is a mine/ERW unsafe for collection and transport, it is marked with a float, an anchor and a red flag and processed separately.

6.3.4.3 After removal, use bomb detectors to reexamine around and at the bottom of the position of the processed object to make sure there is no more signal. If there is still a signal indicated, processing shall be conducted following the steps from 6.3.4.1 to 6.4.4.3 .

6.3.5 Demining to depths of 0.5m to 3m or up to 5m from the bottom of a water body

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6.3.5.1 Inspect the water depth and the magnetized soil in the water body to calibrate the detector accordingly

6.3.5.2 Stretch wire combining with dropping a 1m³ float and a 50kg or 20kg anchor to subdivide the region into 25m*25m or 50m*50m cells depending on the terrain. Stretch wire to mark and divide the cells into 1-meter wide tracklines (the direction of the tracklines should coincide with the direction of water flow).

6.3.5.3 Place a bomb detector on a rubber boat or composite boat, drop a probe vertically into the water body, stopping at 10cm to 20cm from the bottom and conduct clearance along the trackline. When demining has been finished in one trackline, move the probe to the next.

6.3.5.4 Demining is only conducted under the condition where the water flow rate is not higher than 1m/s. In cases where demining is required under the condition where the water flow speed is higher than 1m/s, it is required to intensify methods to ensure safety, technical requirements and operation quality.

6.3.6 Marking signals recorded at depths of 0.5m to 3m and up to 5 m from the bottom of a water body

Procedures that are implemented are the same as those provided in 6.3.3.

6.3.7 Diving to check, dig, and remove detected objects up to a depth over 0.5m to 1 m from the bottom of a water body

6.3.7.1 Safety requirements shall be well prepared and implemented. The diver who carries the handheld kit such as: demining probe, shovel, pumping trunk, will dive to the center position of a marked signal, start finding using the demining probe, and use the pumping trunk and shovel to dig in layers until the object causing the signal is emerged.

6.3.7.2 Inspect and determine the object causing the signal: If the object is not a mine/ERW, a nylon cable is used to salvage the object onto the boat and it is collected in a specified location; if the object is a mine/ERW, it is processed in a safe manner, salvaged onto the boat by the nylon cable and collected in a specified location; if the object is a mine/ERW unsafe for collection and transport, it is marked with a float, an anchor and a red flag and processed separately.

6.3.7.3 After removal, use bomb detectors to reexamine around and at the bottom of the position of the processed object to make sure there is no more signal. If there is still a signal indicated, processing shall be conducted following the steps from 6.3.7.1 to 6.3.7.3.

6.3.8 Dig and remove detected objects up to depths of over 1m to 3m or to 5m from the bottom of a water body

6.3.8.1 The diver with digging tools will work using the high pressure pumping trunk, as well as the mud vacuum pieces to find, dig and pump until the object causing the signal is completely emerged, then implement all the steps provided in 6.3.7.

6.3.8.2 For regions with a complex geology such as: quicksand, mud, iron frames are required. The diver is required to work in combination with a high pressure pumping trunk to erode sand and mud to lower the cavity, then dig until the object causing the signal is completely emerged and implement the steps provided in 6.3.7 .

6.4 Sea demining

6.4.1 Surface preparation

6.4.1.1 Based on the positions marked during surveys, or coordinates that have been handed over, conduct the location process of the demining area. Map the area.

6.4.1.2 Identify big obstacles which cannot be salvaged such as sunken vessels, these are marked for special attention to completely eliminate objects that cause interference to signals in order to detect all mines/ERW.

6.4.2 Equipment preparation and deployment

Equipment is prepared and transported from gathering points to operation areas and deployed.

6.4.3 Traffic control

6.4.3.1 A traffic controlling ship runs at a distance of 300m to 500m before a sea demining ship

6.4.3.2 Conduct regular observation and identification of other ships that show signs of activities or passing by the operation site, send signals to require them to change their direction.

6.4.4 Positioning marked positions of clearance areas

6.4.4.1 Install a standard coordinate system to mark the boundaries of a clearance area into coordinate identification mode, one after another, as entered.

6.4.4.2 Lead the ship according to instructions shown on screen: angle and distance

6.4.4.3 When it is announced that the coordinates have been reached, stop the ship, drop the sub-float and sub-anchor to mark the position.

6.4.4.4 Check the accuracy of the marking float: Put the antenna of the satellite positioning device on top of the marking float and press the button to determine the coordinates. If there is notification that the coordinates are not correct, a crane is used to adjust the float to achieve the required coordinates.

6.4.4.5 When the marking float is at the correct position, drop a buoy and anchor it to the position.

6.4.4.6 Determine every marked coordinate where there is signal in an operation area perimeter until it finishes

6.4.5 Detection on seabed surfaces and from the seabed to a depth of 3m to 5m using underwater bomb detectors, water depth from over 15m to 30m

6.4.5.1 Inspect the magnetized soil of the seabed surface to calibrate the detector accordingly, sensitivity mode 1 to mode 3 is set up depending on the magnetized soil of the seabed surface.

6.4.5.2 Stretch wires combining with 1m³ floats, 50kg and 20kg anchors to subdivide the region into 25m*25m or 50m*50m cells or larger depending on the terrain condition and operational work plan. Stretch wires to mark the line, divide the cells into 1-meter wide tracklines (the direction of the tracklines should coincide with the direction of water flow).

6.4.5.3 Place a bomb locator on a rubber boat or composite boat, drop the probe, stopping close to the seabed surface, detect and mark detected signals in accordance with technical requirements along the

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trackline (keep the probe vertical and make sure it does not get too close to the seabed surface). When demining has been finished in one trackline, move the probe to the next.

6.4.6 Positioning and marking recorded signals up to a depth of 30 m

6.4.6.1 When a bomb locator sends signals of a magnetized object on the seabed at detecting position (indicated by sound or deviation of the clock), move the detector along the trackline to pinpoint the signal.

6.4.6.2 Drop a 20kg anchor (for regions with flow velocity ≥ 1 m/s and water depth greater than 3m) and a 10kg anchor (for other regions) close to the center position of the identified signal to mark the position. The anchor is connected with plastic floats with a diameter ≥ 30 cm by nylon cable of 12 mm diameter, a red flag is placed on the float to mark it for processing.

6.4.7 Detecting on seabed surface and from the seabed to depths of 3m to 5m by Sonar and Magnetometer equipment, water depths over 30m up to 300m

6.4.7.1 Check the operation of all equipment and facilities such as ships, Sonar and magnetometer equipment, positioning devices, connecting devices, and winches.

6.4.7.2 Position the demining operation range to be conducted in the day

6.4.7.3 Set up programs to subdivide the region into tracklines (following the length of the region) for Sonar and magnetometer equipment to work on, the length of each trackline depends on the length of the demining area which is based on the workload performed in the day but should not exceed 5km. The distance between two adjacent tracklines is decided by the features of the equipment, normally ranging from 30m to 35m.

6.4.7.4 Direct the ship along the trackline set up at a speed of 8 km/h, adjust the pulling cable to make the Sonar and Magnetometer equipment stay at least 10m above the seabed (according to the features of the equipment). In order to avoid missing signals, the detection track of each trackline shall overlap the previous by 3m to 5m. Magnetic signals indicated by the magnetometer will be displayed on the screen. After finishing on the first trackline, turn the ship back for the second trackline next to the first. Keep processing to the last trackline in the estimated operation range of the day.

6.4.7.5 Record and transmit data obtained into a specialized computer's memory.

6.4.7.6 Process the data obtained, the final results are the image map of the seabed surface and the magnetic map of the coordinates of the objects lying on the seabed surface or beneath the seabed surface which are detected by the equipment. Use a walkie-talkie to contact and provide the coordinates containing the signal to the signal-processing ship that is running behind.

6.4.8 Diving to check, dig, and remove detected objects up to a depth of 5m from the seabed, water depth from over 15m up to 30m

6.4.8.1 Safety requirements are sufficiently prepared and implemented. A diver carries a underwater mine detector and handheld toolkit and dives to the center position of a marked signal, and inspects to determine the exact position and depth of the object

6.4.8.1.1 If the object is located right on the seabed surface, carefully inspect, determine the object, and conduct salvaging and collecting.

6.4.8.1.2 If the object is located at a depth of 0.5 m from the seabed surface, use a handheld toolkit to dig carefully and identify the object in accordance with technical requirements until the object is completely emerged.

6.4.8.1.3 If the object is located at a depth of 1 m from the seabed surface, use mud and sand pumping equipment combining with handheld toolkit, carefully dig up in accordance with technical requirements until the object is totally emerged.

6.4.8.1.4 If the object is located at a depth of 3m to 5m from the seabed surface, use digging tools in combination with a high pressure pumping trunk, mud and sand vacuum to pump and dig or erode until the object is completely emerged. For regions with complex geology (quicksand, mud), iron frames with sharp edges, for example, in a shape of a well, are required to be put on the signal center. Have a diver, in combination with using a high pressure pumping trunk, pump and erode sand and mud to lower the cavity then dig until the object causing the signal is completely emerged.

6.4.8.2 Inspect and determine the object causing the signal: If the object is not a mine/ERW, a nylon cable is used to salvage the object onto the boat then the object is collected in a specified location; if the object is a mine/ERW, it is processed in a safe manner, salvaged onto the boat using a nylon cable and collected in a specified location; if the object is a mine/ERW unsafe for collection and transportation, it is marked with a float, an anchor and a red flag and processed separately.

6.4.8.3 After the removal, use a bomb locator to reexamine around and at the bottom of the position of the processed object to make sure there are no more signals. If there is still signal indicated, processing shall be conducted as per steps from 6.4.8.1 to 6.4.8.3.

6.4.9 Diving to inspect, remove detected objects on seabed surface, water depth over 30m to 300m using Remote Operation Vehicle (ROV)

6.4.9.1 Based on the diagram of marked signals (coordinates containing signal), gather the processing ship, conduct preparation work, use ROV equipment (with robotic arms and mine detectors), move to marked positions, identify the object causing the signal in accordance with technical requirements through a camera mounted on the ROV equipment to determine exactly.

6.4.9.2 Inspect and determine the object causing the signal: If the object is not a mine/ERW, pick up the object using the robotic arms of the equipment, shift it to the ship and transport it to a specified place; if the object is a mine/ERW, it is gathered to a specified place to be destroyed; if the object is a mine/ERW unsafe for collection and transportation, or if it is an unfamiliar explosive, use a float, anchor and red flag to mark it and wait for on-site destruction.

6.4.9.3 After the removal, use an underwater mine detector to reexamine around and at the bottom of the position of the processed object to make sure there are no more signals. If there is still signal indicated, processing shall be conducted as per steps from 6.4.9.1 to 6.4.9.3.

6.4.10 Digging using explosives, check and remove detected objects up to depth of 1m from seabed surface, water depth from over 30m to 150m

6.4.10.1 Gather the processing ship, conduct preparation work, apply safety and security measures, use a remote operation vehicle (ROV) with robotic arms, move to marked positions, pinpoint the signal using an underwater mine detector in accordance with technical requirements.

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6.4.10.2 Using the ROV equipment, preliminarily inspect and determine the depth of the object; explosive charge and demolition accessories must be prepared in accordance with technical requirements.

6.4.10.3 Use the ROV equipment to place large amounts of explosives on the surface above the signal center position (with the first amount, the following amounts of explosives will be placed at the bottom of the hole created by the previous explosion), with the demolition cord arranged according to the work plan, a security group organized and signal regulations applied; detonation is conducted to assist digging until the object causing the signal is emerged (depending on the depth, each explosion is 0.5m).

6.4.10.4 Check and determine the object causing the signal: If the object is a type of iron, steel, the normal process is applied; if the object is a mine/ERW safe for collection, it is salvaged using the robotic arms of the ROV equipment and transported to a specified place to be destroyed; if the object is a mine/ERW unsafe for collection, or if it is an unfamiliar explosive, use a float, anchor and red flag to mark it and wait for on-site destruction.

6.4.10.5 After the removal, use an underwater mine detector to reexamine around and at the bottom of the position of the removed object to make sure there is no more signal. If there is still signal indicated, processing shall be conducted as per steps from 6.4.10.1 to 6.4.10.5.

6.4.11 On-site disposal of mines/ERW, water depth from over 15m to 30m

6.4.11.1 Gather a processing ship, determine exactly the signal position and drop the sub-buoy and sub-anchor to mark the signal position

6.4.11.2 Preparation work, safety and security measures are applied adequately, diver checks and personally puts the calculated and prepared explosive charge close to and in tight conjunction with the mines/ERW, the detonating system arrangement includes the following:

6.4.11.2.1 Demolition cord is used to detonate the amount of explosive, the cord length is equal to the water depth at the position of the mines/ERW plus slack of the cord, normally the slack of the cord is 25% of the total cord length, one end of the cord is linked tightly to the explosive by coiling at least 7 rounds of the demolition cord into the booster inside the explosive or place the detonator directly on the explosive (in accordance with the technique of using explosive and firing equipment), the other end of the cord is tied to a plastic float of 30cm diameter, let this end emerge on the water to be connected to the detonator.

6.4.11.2.2 Electric primer and electric cord are prepared in accordance with technical requirements, the electric primer is linked to the end of the demolition cord emerged on the water.

6.4.11.2.3 Detonating station is placed on the ship, distance from the ship setting detonating station to the area setting explosive shall be calculated specifically to avoid effects of blasting wave in accordance with the blasting Charter.

6.4.11.3 After the safety requirements are ensured, detonation is conducted to destroy mines/ERW in accordance with the approved work plan.

6.4.11.4 After the destruction, a diver with diving equipment and an underwater mine detector will reexamine around and underneath the position of the destruction hole to ensure that the mines/ERW

were completely destroyed. If there is still signal indicated, processing shall be conducted as per steps from 6.4.11.1 to 6.4.11.4.

6.4.12 On-site disposal of mines/ERW, water depth from over 30m to 150m

6.4.12.1 Gather the processing ship, determine the exact position of the signal, drop the sub-buoy, sub-anchor to mark the signal position (depending on water depth and speed of water flow, the anchor will vary, normally with weight from 50kg to 200kg, anchor cable made of nylon with 16mm diameter, sub-buoy with 30cm diameter).

6.4.12.2 Preparation work, safety and security measures are applied adequately, direct ROV equipment mounted with underwater mine detectors to marked position (following anchor cable to the position), combine detection by detector with checking and observing through camera, screen to determine exactly the type of mines/ERW in order to have a basis for calculating and choosing the amount and type of appropriate explosive. Adjust the float and anchor close to the position of mines/ERW.

6.4.12.3 Direct the ROV with robotic arms to attach the explosive with a detonating system which was calculated and prepared (if the water is too deep and there is water flow, the counterpoise might be increased so that the amount of explosive placed on position of mines/ERW will not be drifted or raised by the thrust of the water), direct the ROV along the anchor cable to place the explosive on the mines/ERW.

6.4.12.4 After safety requirements are ensured, detonation is conducted to destroy mines/ERW in accordance with the approved work plan.

6.4.12.5 After the destruction, use the ROV equipment and an underwater mine detector to reexamine around and underneath the position of the destruction hole to ensure that the mines/ERW were completely destroyed. If there is still signal indicated, processing shall be conducted as per steps from 6.4.12.1 to 6.4.12.5.

7 Demining equipment and facilities

7.1 Mine detector

7.1.1 Synchronicity

Synchronicity shall be adequate and in accordance with regulations

7.1.2 Technical requirements

- Required detecting depth for landmine is 10cm and above.
- Required detecting depth for anti-tank mine is 60cm and above.

7.2 Bomb detector

7.2.1 Synchronicity

Synchronicity shall be adequate and in accordance with regulations.

7.2.2 Technical requirements

- Required detecting depth for landmine is 15cm and above.
- Required detecting depth for anti-tank mine is 150cm and above.

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- Required detecting depth for 250kg bombs (or equivalent) is 500cm and above.

7.3 Set of equipment for indentifying and positioning mines/ERW in the sea

7.3.1 Synchronicity

Synchronicity shall be adequate and in accordance with regulations and attached with operational software.

7.3.2 Technical requirements

- Withstand level 4 waves and up
- The depth of water in which the equipment can operate is from 1m to 300m
- Positioning accuracy is not greater than 1m

7.4 Distance meter

7.4.1 Synchronicity

Synchronicity shall be adequate and in accordance with regulations

7.4.2 Technical requirements

Distance measure is 2000m

7.5 Water velocity meter

7.5.1 Synchronicity

Synchronicity shall be adequate and in accordance with regulations

7.5.2 Technical requirements

Mearsure speed of water flow from 0.1m/s to 8m/s

7.6 Total Station

7.6.1 Synchronicity

Synchronicity shall be adequate and in accordance with regulations

7.6.2 Technical requirements

- Angle measurement: Display 1"; accuracy 7";
- Optics: magnification level 30 times; view of 1°30' (26m - 1km); minimum measurement distance 1.7m;
- Measuring mode: distance measurement with single prism is 3.500m (infrared rays mode); without prism $\geq 1.000m$, with prism 7.500m (Laser mode)

7.7 Personal Protective Equipment

7.7.1 Synchronicity

Including: helmet, vest and boots (life vest for sea and underwater demiming)

7.7.2 Technical Requirement

Resistant to shock wave and fragments that may have life-threatening impacts

NOTES:

- When demining is conducted in a minefield, demining and disposing staff shall be equipped with personal protective equipment.
- When demining is conducted in other areas, only disposing staff will need to be equipped with personal protective equipment.

Annex A

(Informative)

Area, depth and safety corridor in demining operation

A.1 Clearance area

Based on the requirements of each project, the features of detectors and safety requirements for the project, the clearance area shall include:

- Ground area of the project (including all or parts of the area which is authorized for usage, based on survey data and provided documentations about the contamination situation of mines/ERW)
- The area of the safety corridor is regulated for a specific project and its significance
- For uneven regions (inclining), the required clearance area is calculated based on the inclining surface of the terrain.

A.2 Required clearance depth

Required clearance depth is defined against technical characteristics, functions, and penetration level of the mines/ERW, and most importantly, the usage of the area after clearing including:

- Seabed surface clearance is applied for all projects in marine tourism, aquarium preservation,

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aquaculture.... ensuring safety for people;

- Clearance up to 30cm is applied to all projects in reclamation, recovery of farmland, agricultural land, ensuring immediate safety for people;
- Clearance up to 3m depth is applied to resettlement projects, housing construction below 10m, irrigation projects, water storage ponds, standard transportation projects such as roads to Level 3, district roads, rural roads, dredging projects with depth below 3m, undersea projects in optic fiber cabling, oil & gas pipelines;
- Clearance up to 5m depth is applied to projects in civil construction higher than 10m, industrial construction, high level transportation such as highways, provincial roads; dredging projects with depth from 3m to 5m, projects of exploratory drilling, oil and gas industrial constructions;
- Clearance to depths over 5m is applied to projects of special significance as required by the investor, and at locations marked with unexploded bombs but could not be identified by detection to a depth of 5 m.

A.3 Safety corridor in demining operations

A safety corridor is used to ensure the safety of project construction operations after mine action clearance: the distance above surface from the outer edge of the project area to the outer edge of required demining area. The aim is to ensure no explosion of mines/ERW located outside the area due to effects of equipment and machines on the worksite. The width of the safety corridor range is determined based on the importance of each specific project, category of mines and explosives in the area through survey data. Specifically:

- Projects in reclamation, reactivation, and resettlement: 5m from the edge of the boundary perimeter outwards;
- Low-level roads (level 5 or less): 5m from the top edge of of the embankment, or the embankment foot, or the outer edge of the trench on each side outwards;
- Medium-level roads (from level 2 to level 4): 7m from the top edge of of the embankment, or the embankment foot, or the outer edge of the trench on each side outwards;
- Project of civil construction and industry: 7m from the edge of the boundary perimeter outwards
- High-level roads, entry/exit way of big bridges: 7m from the top edge of of the embankment, or the embankment foot, or the outer edge of the trench on each side outwards
- Projects in marine development tourism, aquarium preservation, and aquaculture: 7m from the edge of the boundary perimeter outwards;
- River passages, irrigation canals: 7m from the top edge of the embankment of the passage or canal on each side outwards;
- Small bridges, road-cross culverts: 20m;
- Bridges, underground tunnels, ports: 50m (from the edge of the construction outwards in 4 directions);
- Sea passages: 25m (from the top edge of the embankment of the passage on each side outwards);

- Optic fiber cable lines, telecommunication cable lines, underground power lines: 1.5m (manual operation), 3m (machinery operation), from the center point of the line on each side outwards;
 - Different water pipelines: 5m (manual operation), 10m (machinery operation) from the top edge of the embankment, foot of embankment on each side outwards;
 - Oil & gas pipelines: 25m from the top edge of the embankment, foot of embankment on each side outwards;
 - Sea, river embankment: 5m from outer edge of the foundation on each side outwards;
 - Geological survey borehole: radius is 20m from the center of the hole to surrounding;
 - Exploitation borehole of underground water, oil and gas: 50m from the center of the hole to surrounding.
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