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Ships and marine technology — Navigation and ship operations — Guidelines for onboard telephone equipment

Navires et technologie maritime — Navigation et opérations maritimes — Lignes directrices concernant le matériel téléphonique embarqué

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation and ship operations.*

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Onboard telephone equipment generally includes automatic telephones, common battery telephones, battery-less telephones and sound-powered telephones.

Until now, there have been no comprehensive standards for onboard telephone equipment provided by different manufacturers, and this has impeded the equipment improvements of reliability.

This document will promote sharing common understanding among all parties involved, including the manufacturers, engineering companies, shipbuilders and ship owners.

Ships and marine technology — Navigation and ship operations — Guidelines for onboard telephone equipment

1 Scope

This document provides general and specific recommendations related to the quality of communication, connectivity, installation, performance and maintenance of onboard telephone equipment, including automatic telephones, common battery telephones, battery-less telephones and sound-powered telephones.

It also specifies requirements for the related performance tests (shop tests and onsite tests) and for the maintenance tests.

It is not applicable to digital telephones, LAN (VoIP) telephones, and wireless telephones.

NOTE These telephones are excluded because they were under development during the elaboration of this document so that their specifications remained to be determined.

Table 1 further illustrates the applicability of this document.

Table 1 — Applicability of this document

Type of connection	Signal	
	Analog	Digital
Wired	X	n.a.
Wireless	n.a.	n.a.
X: covered in this document. n.a.: not applicable.		

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Types of telephones

3.1.1
automatic telephone
telephone commanded under an *automatic telephone exchanger* (3.3)

Note 1 to entry: Automatic telephones can be classified into four types — desk, wall-mounted, flush-mounted and portable — based on their structural appearance.

Note 2 to entry: Automatic analog telephones are called "automatic telephones" in this document.

3.1.2
common battery telephone
telephone powered by a DC power supply (DC24V)

Note 1 to entry: Common battery telephones are classified into two types — "selective" and "direct" — based on their connectivity.

Note 2 to entry: Common battery telephones can be classified into four types — desk, wall-mounted, flush-mounted, and portable — based on their structural appearance.

3.1.3
battery-less telephone
telephone fitted with a hand crank generator for communicating by voice, amplified by self-generated power

Note 1 to entry: Battery-less telephones are classified into two types — "selective" and "direct" — based on their connectivity.

Note 2 to entry: Battery-less telephones can be classified into four types — desk, wall-mounted, flush-mounted, and portable — based on their structural appearance.

3.1.4
sound-powered telephone
battery-less telephone (3.1.3) not requiring an external power source for conversation (talk circuit)

Note 1 to entry: A hand crank generator is only used for signalling actions.

Note 2 to entry: Sound-powered telephones can be classified into four types — desk, wall-mounted, flush-mounted, and portable — based on their structural appearance.

3.2
automatic telephone equipment
system that connects *automatic telephones* (3.1.1) to an *automatic telephone exchanger* (3.3), thereby enabling telephonic ringing and telephonic conversation between any two automatic telephones through selection signals (such as push button or dial pulse dialling)

3.3
automatic telephone exchanger
telephone exchanger that uses *automatic telephones* (3.1.1), made durable to withstand typical shipboard vibration and environments

Note 1 to entry: This is also available for public announcements by way of a PA system. Through this, the automatic telephone is able to communicate with land telephones via SATCOM or INMARSAT, etc.

3.4
howling
unpleasant noise caused by audio feedback due to repeated amplification by the amplifier of the voice input, that impedes intelligible conversation

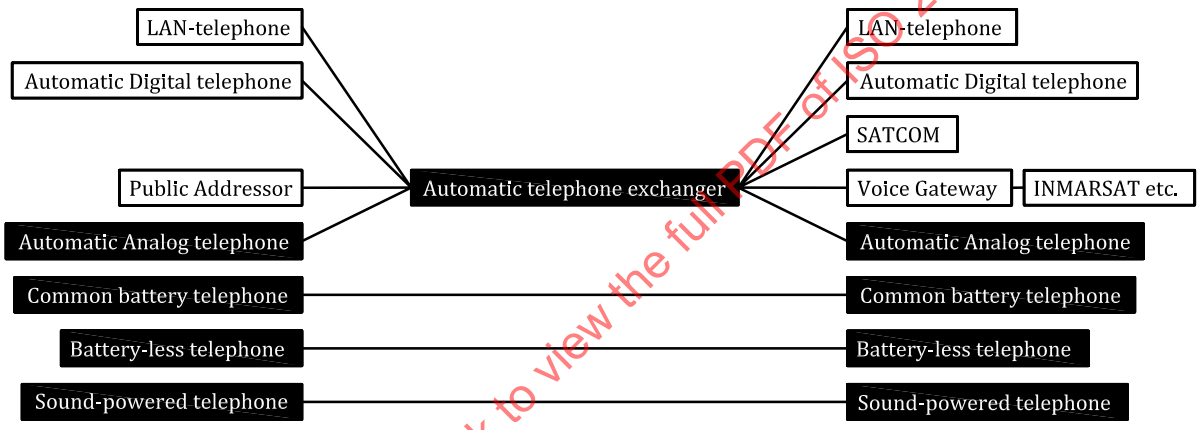
4 General characteristics

4.1 General

The classification and connection of telephones are shown in Table 2 and Figure 1.

Table 2 — Classification of telephones

Type of telephone	Connection	Amplified	DC power supply
Automatic telephone	Multiple	X	X
Common battery telephone	Direct/Selective	X	X
Battery-less telephone		X	n.a.
Sound-powered telephone		n.a.	n.a.
X: existing configuration. n.a: not applicable.			



NOTE The telephones covered in this document are written in white letters on black.

Figure 1 — Connection of telephones

The onboard telephone equipment includes automatic telephones, automatic telephone exchanger, common battery telephones, battery-less telephones and sound-powered telephones.

The equipment should ensure accurate transmission and reproduction of the caller voice signals.

4.2 Automatic telephones

The automatic telephone equipment enables calling between onboard and outboard telephone equipment by connecting to outboard communication systems (such as INMARSAT, VSAT, cellular phones, and landline telephones). It also enables paging broadcasts from the telephone equipment by coupling with a public addresser.

The automatic telephone exchanger should be able to withstand typical vibration and swinging motions (pitch and roll) for use in a shipboard environment.

The automatic telephone exchanger should comply with ISO 19847 and ISO 16425.

Electric source for the automatic telephones should be supplied by both AC power and DC power (DC24V). In case the AC power is lost, the telephones can switch to the DC power supply automatically.

4.3 Common battery telephones

Selective common battery telephones permit telephonic ringing and telephonic conversation between any two devices.

Direct common battery telephones only permit telephonic ringing and telephonic conversation between parent and child telephones (such as 1:1, 1:2, and 1:3 configurations).

A DC power supply (DC24V) is required for common battery telephones.

4.4 Battery-less telephones

Battery-less telephones are able to use their built-in generator to call other telephones, even if power is not supplied from an external source.

If a complete power failure occurs on a ship, the battery-less telephone (or sound-powered telephone) may be the only emergency system available for communication.

4.5 Sound-powered telephones

In high noise environments, the hand crank generator may also power a latching circuit at a remote station that augments the hand crank generator powered signalling circuit with an externally powered audible or visual signalling device.

The hand crank generator powers the signaling circuit to notify another station. Sound-powered telephones use “common talk” (everyone hears the conversation) for all stations on the circuit.

Sound-powered telephones are classified as direct call and selective call.

If a complete power failure occurs on a ship, the sound-powered telephone (or the battery-less telephone) may be the only emergency system available for communication.

5 Quality

5.1 General

When dealing with onboard telephone equipment, the measures given in 5.2 and 5.3 should be taken to ensure the accurate transmission of caller voice information.

5.2 Measures to prevent howling

Howling may occur due to the position and directivity of handsets and speakers of the onboard telephone equipment.

The following measures should be taken to prevent howling.

a) The microphones and speakers should be kept sufficiently far away from each other with their amplification loop broken to prevent howling.

b) In the case of paging broadcasts from the automatic telephone, the telephones and speakers should be kept sufficiently far away from each other, and a handset designed to prevent howling should be used.

5.3 Measures to suppress noise

Noise may increase if the voice signal of the telephone receives interference from other electrical circuits (such as power lines). The following measures should be taken to suppress the generation of the noise.

a) For voice signal cables such as the microphone, shielded cables that can prevent the noise due to electromagnetic induction from other lines should be used.

b) The telephones should be kept sufficiently away from the source of the noise in order to avoid its adverse impact.

c) Automatic telephone may use twisted-pair cables rather than multicore cables for preventing the noise due to electromagnetic induction.

d) If a DC power source is used for common battery telephones, the ripple component from the full-wave rectification of the built-in AC power supply presents in the charging and discharging board, and the high frequency component generated by the switching-device power controller, may cause electrical noise. Common battery telephones are adversely affected by the noise from the DC power source. In order to prevent the noise, an isolated DC/DC converter should be used to power the common battery telephone.

e) Attention should be paid to the wiring of cables (refer to 7.4).

f) Particular attention should be paid to the routing of sound-powered telephone cabling. Sound-powered telephones cabling should be routed away from equipment that may generate large electromagnetic signals, and/or cabling that carries large power currents. Examples of such equipment include: electrical motors, switchboards, spark-ignition engines, power lines.

g) When installed in spaces with high levels of background noise that severely impact the ability of an operator to maintain audible telephonic conversation, a sound absorbing chamber large enough to place the operators head inside or an appropriate headset unit should be provided.

6 Data recommendations — Automatic telephones

6.1 General

Connection between automatic telephones and onboard communication systems should be in accordance with the data recommendations given in 6.2 to 6.4. They are applicable only to automatic telephones.

6.2 Multifunction telephones

6.2.1 Signal condition

Multifunction telephones should meet the requirements mentioned in the exchanger specifications.

Products from the same manufacturer as that of the exchanger should be used, otherwise compatibility should be confirmed.

6.3 Analog telephone

6.3.1 Signal condition

The open-circuit voltage should be DC 24 V/48 V.

The open-circuit voltage should be compatible with loop-start signaling.

6.3.2 Output signal

The selection signal should be a PB signal.

The selection signal should comply with ITU-T Q.23/Q.24.

The selection signal should also be compatible with DP signals.

NOTE PB signal (push button dial signal), DP signal (dial pulse signal).

6.3.3 Input signal

The ringing signal should be a bell signal.

The ringing signal should be of AC 65 V–100 V and 16–25 Hz.

The audible ring tone should be no less than 80 dB under high levels of background noise area.

The ringing signal may be a bell signal or other distinctive tone that is not confused with other signals.

6.4 Connection to external communication equipment

6.4.1 Signal condition

The open-circuit voltage should be DC 24 V/48 V.

The open-circuit voltage should be compatible with loop-start signaling.

A line inversion function of central office line should be implemented for the call initiation signal.

6.4.2 Output signal

The selection signal should be a PB signal.

The selection signal should comply with ITU-T Q.23/Q.24.

The selection signal may also be compatible with DP signals.

6.4.3 Input signal

The ringing signal should be a bell signal.

The ringing signal should be of AC 65 V–100 V and 16–25 Hz.

7 Installation

7.1 General

The environment for onboard telephone equipment used in onboard communication systems differs from that for land communication systems; hence, it is necessary to pay attention to external factors such as water, heat, vibration and swinging motion.

Furthermore, the environment of the onboard telephone equipment should be tested in accordance with 8.2.

Compliance with IEC 60945 and IEC 60092-101 should be met, after considering the environment in which the system is to be installed.

7.2 Environment

The equipment used in the onboard telephone equipment should be installed after considering the environmental requirements (such as ambient temperature and ambient humidity) recommended by the manufacturer for each component of equipment.

7.2.1 Temperature

The onboard telephone equipment should not be installed near equipment that emits heat.

It should not be located in places where there are sudden fluctuations in temperature.

In addition, care should be taken not to install the equipment near places where the temperature is too high (such as the top of a boiler) or too low (such as a freezer).

7.2.2 Vibration and swinging motion

In order to ensure that the equipment is not adversely affected by external vibration, the equipment should be placed sufficiently far away from the source of vibration, or anti-vibration measures should be implemented.

The automatic telephone exchanger should be protected and made durable to withstand typical vibration and swinging motion (pitch and roll) for use in a shipboard environment. The exchanger should have a terminal connecting the wiring of the telephone units. “Punch-down” terminal points are insufficient for shipboard use due to vibration. Hard-wired, screw down terminal points are recommended.

In all cases, telephone should have a means for preventing the handset from coming off-hook during adverse sea conditions, such as a handset retainer clip, bracket, or other locking mechanism.

7.2.3 Dust and water protection

Equipment whose degrees of protection is appropriate to the location of installation should be set up.

The location environment and degrees of protection should comply with IEC 60529.

7.3 Explosion protection

In explosion risk areas, explosion protection equipment that is appropriate to the installation environment should be used.

The explosion proof circuit cables should be isolated adequately from other general electrical systems.

In particular, the wiring of intrinsically safe circuits may become dangerous due to electromagnetic/electrostatic induction if they come in contact with other circuits. Hence, care should be taken when installing wiring to prevent this problem.

The related requirements of IEC 60079-14 should be satisfied.

7.4 Cabling

The following points may be noted with regard to cabling.

a) When signal lines with a large difference in signal level (such as audio signal cables and power lines) are housed in the same multicore cable (control cables and signal cables) or the same duct, they may be placed as far apart as possible.

b) Audio signal cables may be separated from other types of signal cable.

c) Automatic telephones may use shielded and twisted-pair cable (which is capable of preventing noise from electromagnetic induction) instead of multicore cables.

d) Instead of bundling it together with other cables, it may be wired through a separate route.

e) The manufacturer’s recommendations for cabling should be adhered to.

8 Performance tests

8.1 General

Performance testing of onboard telephone equipment can be classified into pre-shipment testing (where the manufacturer tests the onboard telephone), and post-installation testing (where the shipyard tests the onboard telephone after installation, wiring, and energizing with electric current).

8.2 (Shop test) and 8.3 (Onsite test) consist of pre-shipment and post installation tests, respectively.

8.2 Shop test

Shop testing is applicable to automatic telephones, common battery telephones, battery-less telephones and sound-powered telephones.

Shop testing should be conducted according to a test method that clearly specifies the name of the test, the scope of the test, the target of the test, the item and what-to-test of the test, the procedure of the test and the verification criteria for each test item.

Tables 3, 4, 5, and 6 list the shop test requirements for automatic telephones, common battery telephones, battery-less telephones and sound-powered telephones, respectively.

Table 3 — Automatic telephones shop test

	Test	Scope	Test target	Test item/ What to test	Test procedure	Verification
1	Insulation resistance test	All equipment	Total inspection (Automatic telephone exchanger and all telephones)	Resistance between the AC power supply and ground terminals. DC 500 V 10 MΩ	Connect insulation resistance tester between each terminal and ground.	Better than the specified standard.
				Resistance between the DC power supply and ground terminals. DC 500 V 10 MΩ	Connect insulation resistance tester between each terminal and ground.	Better than the specified standard.
2	Withstand voltage test	All equipment	Total inspection (Automatic telephone exchanger and all telephones)	Voltage between the AC power supply and ground terminals. AC 1500 V 60 s	Connect withstand voltage tester between each terminal and ground.	Apply the specified voltage for the specified time period.
				Voltage between the DC power supply and ground terminals. DC 500 V 60 s	Connect withstand voltage tester between each terminal and ground.	Apply the specified voltage for the specified time period.
3	Telephonic conversation between extension lines	All equipment	Total inspection (All extensions)	Calls between extensions and that conversation is possible.	Test outgoing and incoming calls at both ends.	Voice conversation can be made without trouble.
NOTE "Extension" is used for a telephone of automatic telephone equipment. Extension is also used for a telephone of other telephone equipment.						

Table 3 *(continued)*

	Test	Scope	Test target	Test item/ What to test	Test procedure	Verification
4	Outside line calling	All equipment	Extensions where this function is available	Calls to outside lines (shore, satellite, etc.) shall be possible if applicable.	Execute specific dial to outside lines (shore, satellite, etc.).	Calling and conversation are available.
5	Outside line incoming	All equipment	Extensions where this function is available	Reception from outside lines (shore, satellite, etc.) shall be possible if applicable.	Execute dial from outside lines (shore, satellite, etc.).	Reception and conversation are available.
6	Voice paging access	All equipment	Extensions where this function is available	Public Addressing from the extension is possible.	Make P.A. by dialling a specific access code. (Example "01/02/03")	P.A. announcement is clearly audible.
7	Busy override	All equipment	Extensions where this function is available	Function of overriding a busy extension to establish a three-party conversation. It is possible to hold conversations with up to four people.	Make a busy extension by any two extensions and call one of them from an extension where override function is available.	Overriding of a busy extension is possible and three-party conversation is made.
8	Trouble alarm	All equipment	Automatic telephone exchanger	Alarm signal output when the automatic telephone exchanger has a trouble.	Simulate any trouble on the automatic telephone exchanger.	Confirm output of signal at the terminal of alarms. Confirm it is stopped after clearing trouble.
9	Input power fluctuation, Input voltage ±10 %	All equipment	Automatic telephone exchanger	Normal operation shall be kept when input power is fluctuating.	Make a call during fluctuation of input voltage ±10 %.	Voice conversation can be made without trouble.
NOTE "Extension" is used for a telephone of automatic telephone equipment. Extension is also used for a telephone of other telephone equipment.						

Table 4 — Common battery telephones shop test

	Test	Scope	Test target	Test item/ What to test	Test procedure	Verification
1	Insulation resistance test	All equipment	Total inspection	Resistance between the DC power supply and ground terminals. DC 500 V 10 MΩ	Connect insulation resistance tester between each terminal and ground.	Better than the specified standard.
2	Withstand voltage test	All equipment	Sample inspection	Voltage between the DC power supply and ground terminals. DC 500 V 60 s	Connect withstand voltage tester between each terminal and ground.	Apply the specified voltage for the specified time period.
3	Input power fluctuation, Input voltage ±10 %	All equipment	One per system	Confirm that operation is normal when input voltage fluctuates.	Test outgoing/ incoming calls at input voltage +10 % and input voltage –10 %.	Voice conversation can be made without trouble.
4	Telephonic conversation between extension lines	All equipment	Total inspection	Confirm that a call can be established between extensions and that conversation is possible.	Test outgoing and incoming calls at both ends.	Voice conversation can be made without trouble.

Table 5 — Battery-less telephones shop test

	Test	Scope	Test target	Test item/ What to test	Test procedure	Verification
1	Insulation resistance test	All equipment	Total inspection	Resistance between the DC power supply and ground terminals. DC 500 V 10 MΩ	Connect insulation resistance tester between each terminal and ground.	Better than the specified standard.
2	Withstand voltage test	All equipment	Sample inspection	Voltage between the DC power supply and ground terminals. DC500V 60 s	Connect withstand voltage tester between each terminal and ground. Exclude equipment that do not use external power supply.	Apply the specified voltage for the specified time period.
3	Telephonic conversation between extension lines	All equipment	Total inspection	Confirm that a call can be established between extensions and that conversation is possible.	Test outgoing and incoming calls at both ends.	Voice conversation can be made without trouble.
NOTE Testing of samples is used when equipment is considered functionally equivalent.						

Table 6 — Sound-powered telephones shop test

	Test	Scope	Test target	Test item/ What to test	Test procedure	Verification
1	Insulation resistance test	All equipment	Total inspection	Resistance between the DC power supply and ground terminals. DC 500 V 10 MΩ	Connect insulation resistance tester between each terminal and ground.	Better than the specified standard.
2	Withstand voltage test	All equipment	Sample inspection	Voltage between the DC power supply and ground terminals. DC 500 V 60 s	Connect withstand voltage tester between each terminal and ground. Exclude equipment that do not use external power supply.	Apply the specified voltage for the specified time period.
3	Telephonic conversation between extension lines	All equipment	Total inspection	Confirm that a call can be established between extensions and that conversation is possible.	Test outgoing and incoming calls at both ends.	Voice conversation can be made without trouble.
4	Audible and visual signalling	All equipment	Total inspection	Confirm the hand crank generator signalling circuit generates a minimum of 80 dB audible sound under high levels of background noise area. Confirm the hand crank generator is able to concurrently enable the latching circuit to enable an externally powered signalling system.	Connect two sound-powered telephones and any externally powered signalling system.	Audible signalling at minimum of 80 dB and proper operation of latching circuit if so provided.

8.3 Onsite test

8.3.1 General

Post-installation testing of automatic telephones, common battery telephones, battery-less telephones and sound-powered telephones should be conducted in accordance with 8.3.2 and 8.3.3, respectively.

The insulation test should be performed in accordance with IEC 60092-504.

8.3.2 Automatic telephones

8.3.2.1 General

The purpose of this test is to verify the performance and functionality of the automatic telephone exchanger and the automatic telephone.

The test is intended to verify whether telephonic ringing and telephonic conversation between each automatic telephone through the automatic telephone exchanger can be performed normally. It also verifies connectivity with outboard other communication systems.

The testing should be conducted according to a test method that clearly specifies the scope of the test, the test procedure and the verification criteria.

Table 7 lists the test requirements.

8.3.2.2 Test method

Verify whether or not communication can be carried out from outboard and onboard communication systems.

Confirm that telephonic conversation is not hindered by noise.

The verification criteria are whether or not normal communication is possible.

The test should be carried by the shipbuilder or the manufacturer of the outboard and onboard communication systems. However, when other system instruments are connected and the test of functionality is carried out, the test should be carried out by the shipbuilder or the client (the ship owner) with assistance from the system manufacturers.

Table 7 — Requirements for the onsite test — Automatic telephones

	Test item	Test procedure	Verification	Scope
1	Extensions	Extension-to-extension call.		
1.1	Originate	Dial each extension in turn and establish a call.	The other party should be able to receive the call (the ringback tone is heard).	All equipment
1.2	Terminate	Confirm that the telephone rings and the lamp illuminates.	Ringing bell, Lamp lights, Ringing external bell (ER etc.).	All equipment
2	Headset	Confirm that the handset and the headset are switched on, and are able to carry out the conversation.	The conversation should be conducted normally.	For headset telephones only
3	Fore W/H flush type tel.	Dial illumination can be done and illumination level is changeable.	Dial illumination is adjustable, including being able to be turned off. Use of red illumination is permitted.	
4	Line lockout	Confirm that the handset emits the howler sound 20 s after going off-hook and enters the state of lockout afterwards.	Off-hook 20 s, Howler 10 s, Lockout.	1 or 2 executions
5	Busy override	This function enables overriding of a busy extension to establish a three-party conversation. An override warning tone is sent. It is possible to hold conversations with up to four people.	The ongoing conversation is interrupted and a three-person conversation established.	Possible calling
6	Voice paging access	The P.A. unit can be accessed by dialing a specific access code. (Example "01/02/03")	P.A. announcement is clearly audible.	Possible calling
NOTE “Incoming response method DGL and/or trunk line display.				

Table 7 *(continued)*

	Test item	Test procedure	Verification	Scope
7	Voice paging access – meet me	The user responds to a paged request by dialing a specific access code from an extension to talk to the party who paged them.	Connected to the initiating paging party for conversation.	1 or 2 executions
8	Automatic AC/DC change	Change to DC power supply automatically when AC power supply fails. (Turn off the AC power supply switch.)	Normal operation continues.	
9	Trouble display	The trouble information should be shown on the display. Turn off the AC power supply switch. Turn it back on when you can confirm the trouble display.	Display in the trouble-warning panel.	
10	Special function			
10.1	Outside line calling	Calls to outside lines shall be possible if applicable. (Example 05 INMARSAT 06 Cellular phone 07 Shore connection 08 VSAT)		Possible calling
10.2	Outside line incoming	Be able to answer incoming calls from outside line and talk. (See NOTE for incoming response method) The call can be forwarded to another extension by using the "F" button + xx.	Call is successfully received.	
NOTE "Incoming response method DGL and/or trunk line display.				

8.3.3 Common battery telephones, battery-less telephones and sound-powered telephones

8.3.3.1 General

The purpose of this test is to verify the performance and functionality of common battery telephones, battery-less telephones and sound-powered telephones.

In this test, the telephone equipment connects telephones with each other and the ability to communicate normally is verified. The test should be conducted according to a test method that clearly specifies the scope of the test, the test procedure and the verification criteria.

Table 8 lists the test requirements.

8.3.3.2 Test method

Verify whether or not communication can be carried out between any telephones.

Confirm that telephonic conversation is not hindered by noise.

The verification criteria are whether or not normal communication is possible.

The test should be carried out by the manufacturer. However, when other system instruments are connected and the test of functionality is carried out, the test should be carried out at the shipbuilding location or by the client (the ship owner) with assistance from the system manufacturers.

Table 8 — Requirements for the onsite test — Common battery telephones, battery-less telephones and sound-powered telephones.

	Test item	Test procedure	Verification	Scope
1	Extensions	Extension-to-extension call.		
1.1	Originate	Dial each extension in turn and establish a call.	The extension is able to receive the call (the ringback tone is heard).	All equipment
1.2	Terminate	Confirm that the telephone rings and the lamp illuminates.	Ringing bell. Lamplights. Ringing external bell(ER etc.).	All equipment
2	Headset	Confirm that the handset and the headset are switched on and that they are able to carry out the conversation.	The conversation should be conducted normally.	For headset telephones only
3	For W/H flush type tel.	Dial illumination can be done, and illumination level is changeable.	The lighting of the dial should be adjustable.	For W/H flush-type telephones only

9 Maintenance

9.1 General

Periodic monitoring, inspection and logging of the operating conditions of onboard telephone equipment should be carried out.

This clause addresses the routine maintenance (9.2), the periodic maintenance (9.3), the maintenance programme (9.4) and the replacement period (9.5) of onboard telephone equipment.

9.2 Routine maintenance

Routine maintenance includes performance inspection, inspection of mounted parts, cleaning of the equipment's inner areas, and the inspection and replacement of parts when necessary.

9.3 Periodic maintenance

9.3.1 Method

a) Maintenance of onboard telephone equipment should be carried out in accordance with the procedures described in 9.4.

b) Verify the equipment performance.

c) Maintain and inspect every part and component.

d) Clean the inside of the equipment.

There should be no impediments to the easy replacement of onboard telephone equipment parts.

The following points should be noted while replacing the parts of onboard telephone equipment.

a) For safety, disconnect the power at the switchboard or panel board before disconnecting the AC power source and DC power source from the equipment.

b) Care should be taken when carrying heavy items such as transformers.