INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

M.1140

(10/92)

MAINTENANCE: MOBILE TELECOMMUNICATIONS SYSTEMS AND SERVICES

MARITIME MOBILE TELECOMMUNICATION SERVICES VIA SATELLITE

Recommendation M.1140

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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Recommendation M.1140 was prepared by Study Group IV and was approved under the Resolution No. 2 procedure on the 5th of October 1992.

CCITT NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication Administration and a recognized private operating agency.

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Recommendation M.1140

MARITIME MOBILE TELECOMMUNICATION SERVICES VIA SATELLITE

(1992)

Abstract: This Recommendation describes general maintenance aspects of satellite maritime mobile systems predominantly based on INMARSAT-A maintenance requirements.

Keywords: Satellite Maritime Mobile, Maintenance Aspects, INMARSAT-A.

1 Purpose

The purpose of this Recommendation is to describe general maintenance aspects of satellite maritime mobile systems and define interrelationship and interworking issues of such systems with terrestrial voice and data networks taking into consideration criteria, procedures and facility standards specified in the M- and O-Series Recommendations.

This Recommendation is predominantly based on the maintenance requirements of the INMARSAT-A maritime satellite system which is the prevailing operational maritime service. Other maritime systems such as the digital INMARSAT-C, -B and -M will be addressed in Recommendations, specific to each type. However, the following sections are equally relevant to other INMARSAT maritime systems.

2 General maintenance aspects of satellite maritime mobile systems

2.1 *Definitions*

2.1.1 **maritime mobile service via satellite**

Mobile service via satellite in which mobile earth stations are located on-board ships. This can include mobile earth stations on-board rescue vessels and radio buoys (or other devices) used to locate shipwrecks.

2.1.2 **maritime satellite system**

In the maritime mobile-satellite service, all of the temporary connections between a telephone at a ship earth station (SES) and the maritime virtual switching point at a coast earth station (CES) constitutes a maritime satellite system. It comprises a maritime satellite circuit and a maritime local system. The general arrangement is shown in Figure 1/1140.

2.1.3 **maritime satellite circuit**

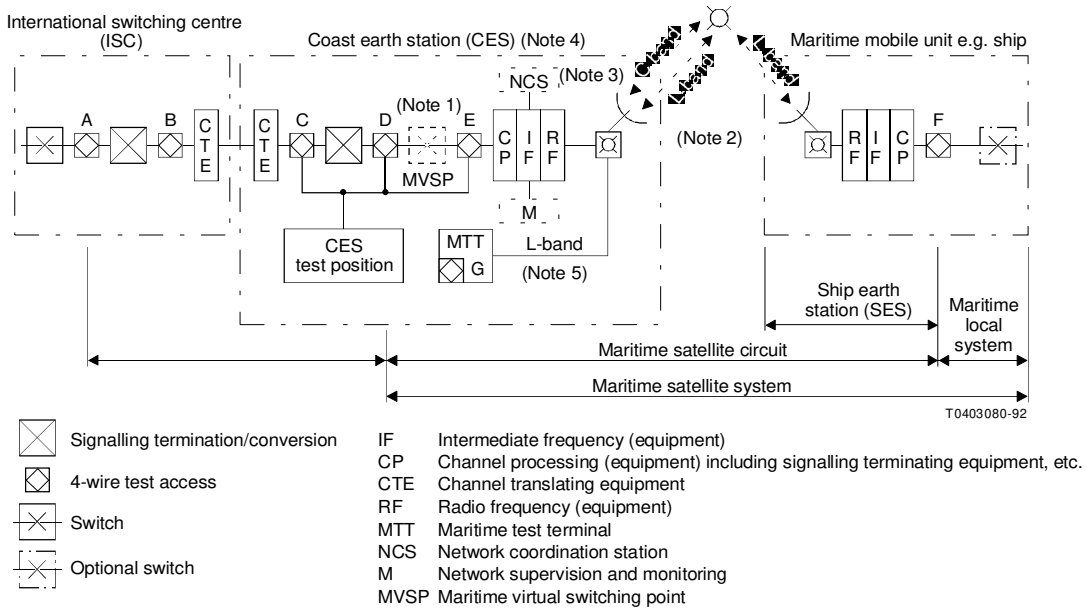
Maritime satellite circuit is a 4-wire circuit between a maritime virtual switching point at a coast earth station and the 4-wire circuit test access point at a ship earth station, via a satellite repeater.

2.1.4 **maritime local system**

All the equipment between the 4-wire test circuit access point on a ship earth station and a 2-wire or 4-wire telephone served by that ship earth station constitutes a maritime local system. It may include 4-wire to 2-wire termination sets, echo control equipment, data interfaces, and 4- or 2-wire switching devices.

2.1.5 **ship earth station (SES)**

A ship earth station in the maritime mobile-satellite service is a mobile earth station whcich provides a 4-wire analogue interface for connection of a maritime satellite circuit to a maritime local system and a 4-wire circuit test access point.



Note 1 – A maritime virtual switching point should always be established for transmission planning purposes. However, a switch at the coast earth station is optional.

Note 2 – The actual frequencies used are 4/6 GHz (C-band) and 1.5/1.6 GHz (L-band).

Note 3 – Certain coast earth stations are also network coordination stations; their functions are described in § 3.1.3.

Note 4 – Coast earth station functions are described in § 4.1.

Note 5 – 4-wire test access point G is equivalent to 4-wire test access point F.

FIGURE 1/M.1140

Constitution of a maritime satellite system (INMARSAT-A)

2.1.6 **coast earth station (CES)**

A coast earth station in the maritime mobile-satellite service is an earth station, which provides a 4-wire analogue interface for connection of a maritime satellite circuit to the international public switched telephone network. It also provides circuit test access points and test facilities. (See § 4.1 for the functions of a coast earth station.)

2.1.7 **maritime test terminal (MTT)**

MTT is a ship earth station along with a maritime local system installed at a coast earth station and used for test purposes.

2.1.8 **network coordination stations (NCS)**

A retrier coordination station in the maritime mobile-satellite service maintains a pool of frequencies, assigns frequencies on demand from a coast earth station for temporary use in a maritime satellite circuit, and supervises and monitors the use of the frequencies. The network coordination station is normally located at a coast earth station which is designated by the satellite system operator to fulfill these functions. (See § 3.1.3 for the functions of a network coordination station.)

2.1.9 **coast earth station test position**

A coast earth station test position is used to originate test calls over the maritime satellite system to the maritime test terminal and to receive test calls from the maritime test terminal.

2.2 *General maintenance principles*

2.2.1 *Responsibilities*

In an international connection which includes a ship earth station, the maritime satellite system may be regarded from a transmission point of view as analogous to a national network and the maritime local system as analogous to a subscriber terminal within that network. Nevertheless, it should be noted that the maritime satellite circuit is set up between the coast earth station and the ship earth station on a demand assignment basis. Therefore, a coast earth station in the maritime satellite system may not have the direct responsibility for the maintenance of a particular maritime satellite circuit and a particular ship earth station all of the time. The operation and maintenance of the overall maritime satellite system is the responsibility of the maritime satellite system operator, e.g. INMARSAT.

The maintenance organization in each participating Administration is in general responsible for the maintenance of the maritime satellite circuits.

2.2.2 *Available services*

The maritime satellite systems in service provide telex services to maritime mobile units in addition to telephone, facsimile and voice-band data services. When setting-up maintenance procedures, administrations should consider the utilization of these services for communication, diagnostic and maintenance purposes, and should also consider that trained technical staff are generally available at the ship earth station only at the time the ship earth station is commissioned; however, the ship earth station is usually operated by a qualified radio officer who may be only able to assist in carrying out simple test procedures.

Special services, high speed data services, and compressed video are being provided over the maritime satellite systems. The development of new maintenance procedures to support these services will be the subject of future study.

2.3 *Interconnection with the international public switched telephone network*

Interconnection arrangements are considered with reference to Figure 1/M.1140.

The maritime virtual switching point at the coast earth station is considered to be the interface between test access points D and E (see Figure 2/M.1140). The circuit between the international switching centre (ISC) and coast earth station is considered as equivalent to an international public switched telephone circuit.

2.4 *Lining-up and maintaining international public switched telephone circuits*

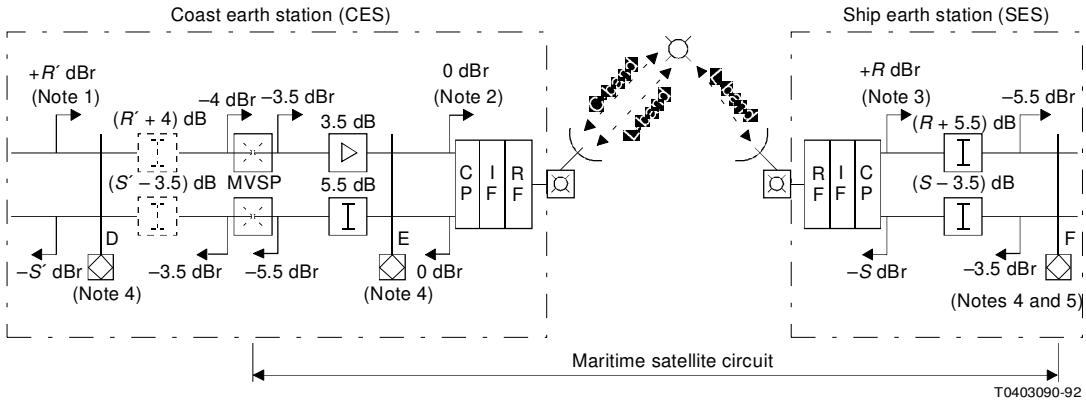
The circuit between the international switching centre and the coast earth station in Figure 1/M.1140 should be lined up and maintained in accordance with those Series-M Recommendations appropriate to international public switched telephone circuits, e.g. Recommendations M.580 [1] and M.610 [2].

2.5 *Lining-up and maintaining maritime satellite circuits*

2.5.1 *Control, sub-control and respective responsibilities*

2.5.1.1 *General*

The assignment of control and sub-control stations and respective responsibilities must address the configuration of the maritime satellite system. In every case a control station must be assigned for each circuit, and, in addition, sub-control stations are required for efficient maintenance.



Note 1 – $+R´$ dBr and $-S´$ dBr in the coast earth station correspond to the levels + $R´$ dBm and $-S´$ dBm using a modulation signal with a level of 0 dBm0.

Note 2 – The levels of 0 dBr are given as an example.

Note 3 – $+R$ dBr and $-S$ dBr in the ship earth station correspond to the levels of + R dBm and $-S$ dBm using a modulation signal with a level of 0 dBm0.

Note 4 – See Figure 1/M.1140 for 4-wire test access points.

Note 5 – The levels at test access point F are those given in Recommendation G.473 [3].

Note 6 – For the abbreviations used in this figure see Figure 1/M.1140.

FIGURE 2/M.1140

Levels at the coast earth station and ship earth station (INMARSAT-A)

2.5.1.2 *Assignment of control stations*

The coast earth station will be the control station for the maritime satellite circuit.

2.5.1.3 *Assignment of sub-control stations*

2.5.1.3.1 In principle, the ship earth station should act as the maritime satellite circuit sub-control station. However, the required staff and facilities may not be available to meet the circuit sub-control responsibilities, and special measures may need to be taken.

2.5.1.3.2 A maritime test terminal may be used to enhance fault location and maintenance in the maritime satellite system. In this regard the maritime test terminal may carry out some tests normally considered to be within the province of a sub-control station on behalf of a ship earth station. Whether or not a maritime test terminal should be assigned as a sub-control station is left for further study when the operation of a maritime test terminal is further defined.

2.5.1.4 *Responsibilities of control and sub-control stations*

Control stations dealing with maritime satellite circuits should fulfill the responsibilities of control stations as defined in the M-Series Recommendations in general. The same will apply to sub-control stations. However, the maritime satellite systems present new concepts which require guidelines in as much as a maritime mobile unit is essentially a subscriber location (see § 4.2.2).

2.5.2 *Transmission characteristics*

The transmission design characteristics for maritime satellite circuits are given in Recommendation G.473 [3].

The setting-up, lining-up and maintenance limits of the maritime satellite circuit between test access points E and F of Figure 2/M.1140 should be as defined in Table 1/M.1140 both for the case where no switch is located at the coast earth station and where a switch is located at the coast earth station.

The attenuation/frequency limits in Table 1/M.1140 are those which should be met with the compandors disabled. The measurements to be carried out with the compandors in circuit are a subject for further study.

The relative levels at the coast earth station and the ship earth station are shown in Figure 2/M.1140.

TABLE 1/M.1140

Provisional setting-up, lining-up and maintenance limits

Transmission parameters	Maintenance limits (dB)
Attenuation frequency relative to the attenuation at reference frequency	(See Note)
Below 300 Hz	Not specified
300 to 400 Hz	–1.2 to +4,4
400 to 600 Hz	–1.2 to +2,6
600 to 2400 Hz	–1.2 to +1,2
2400 to 2700 Hz	–1.2 to +2,6
2700 to 3000 Hz	–1.2 to +4,4
3000 to 3400 Hz	–1.2 to not specified
Idle noise	Not yet specified. See Annex A for further information.

Note – To avoid distortion introduced by clippers and the gain variations due to compandors, the 1020 Hz reference tone used for measuring the attenuation shall be set at –10 dBmO, and the compadors shall be disabled.

2.5.3 *Lining-up procedures*

2.5.3.1 Measurement of the attenuation at the reference frequency

The control station (coast earth station) sends a reference frequency form 4-wire test access E in Figure 2/M.1140 at a level of –10 dBm0. The sub-control station (ship earth station) measures the level at 4-wire test access point F in Figure 2/M.1140 (the –5.5 dBr point). The receive level should be –15.5 dBm.

The sub-control station (ship earth station) applies a reference frequency at the 4-wire test access F in Figure 2/M.1140 (the –3.5 dBr point) at a level of –13.5 dBm, i.e. –10 dBm0. The control station (coast earth station) measures the level at the 4-wire test access point. This should be –10 dBm0 at 4-wire test access point E in Figure 2/M.1140.

The tolerance of the attenuation measurements shall be as specified in Recommendation M.580 [1].

2.5.3.2 *Measurement of attenuation/frequency response*

The attenuation/frequency characteristic should be measured and recorded at the following frequencies to check that the limits contained in Table 1/M.1140 are met:

420, 1020, 2500, 2800, 3000 Hz.

The attenuation/frequency measurements are taken with the compandors disabled. The measurements to be carried out with the compandors in the circuit are a subject for further study.

2.5.3.3 *Measurement of circuit noise*

The method for measurement of noise is not yet specified and is under study.

2.5.3.4 *Measurement of circuit stability*

This test should be performed on maritime satellite circuits which are 2-wire terminated at the ship earth station.

With the echo canceller disabled and the 2-wire portion of the circuit unterminated (open circuit), a reference frequency is applied at a level –10 dBm0 to the test access point E in the transmit direction at the coast earth station. The level measured at the test access point E in the receive direction should not be more than –17 dBm0.

2.5.4 *Fault reporting procedures*

Fault report points (circuit) should be identified in accordance with Recommendation M.715 [4].

Fault report points (network) should be identified in accordance with Recommendation M.716 [5]. One such point is required for the maritime satellite system and in the INMARSAT system is assigned to the INMARSAT network control centre (see § 3.1.4 for the responsibilities of the network control centre). However, general international networking problems should in the first instance be referred to the fault report points (network) concerned.

Exchange of contact point information should be in accordance with Recommendation M.1510 [6].

2.5.5 *Maintenance procedures*

Routine measurements on the maritime satellite circuits should be performed to confirm that the transmission parameter limits listed in Table 1/M.1140 continue to be maintained. These maintenance procedures are particularly important with respect to the coast earth station transmission performance.

The periodicity of the routine measurements is under study.

2.6 *Test facilities at ship earth stations*

2.6.1 *Automatic testing*

Maritime mobile units operating in marine environments would not in general have personnel with adequate expertise for testing and maintaining equipment connected to the international network. Therefore, remote automatic testing of a ship earth station would be possible by including automatic test equipment at the coast earth station and the ship earth station. The required facilities include quiet termination test line and loop around test line as given in Recommendation O.11 [7].

2.6.2 *Manual testing*

It should be possible to undertake manual testing of the transmission performance of ship earth stations. This type of test is essential when a ship earth station is being lined up after it has been repaired. It should be possible to initiate the test either from the coast earth station or from the ship earth station.

In order to meet these objectives, the ship earth station should, as a minimum, be equipped with a tone generator and level meter.

3 Maintenance organization for the maritime satellite system

3.1 *Maintenance organization as applicable to INMARSAT*

The maintenance responsibility within a maritime satellite network is divided among the ship earth station, the coast earth station, the network coordination station, and the network control centre (NCC).

3.1.1 Ship earth station (SES) maintenance responsibility

The ship earth station must be capable of communicating reliably with the coast earth station and may act as a sub-control station with responsibilities to the coast earth station (see § 2.5.1). As a sub-control station, it is responsible for reporting noticeable degradations in the maritime satellite circuits to the coast earth station and for reporting ship earth station problems to the manufacturer's or ship's maintenance agent.

3.1.2 Coast earth station (CES) maintenance responsibility

The coast earth station provides communication functions and has the overall coordination responsibility between the ship earth station and the international public switched telephone network, and the responsibility of reporting problems to the network coordination station and the network control centre as required. The maintenance functions of the coast earth station are further described in § 4.2.1.

3.1.3 Network coordination station (NCS) maintenance responsibility

The network coordination station provides communication and maintenance functions within the maritime satellite system.

a) Communication functions such as:

- transmitting the signalling channel to the ship earth stations;
- assigning telephone channels on demand;
- maintaining a list of busy ship earth stations.

b) Maintenance functions such as:

- assisting in performing routine system tests;
- monitoring the performance of coast earth stations;
- monitoring, identifying and clearing of unauthorized transmissions.

3.1.4 *Network control centre (NCC)* maintenance responsibility

The network control centre provides administrative, operational and maintenance functions within the maritime satellite network.

a) Administrative functions such as:

- acting as the fault report point (network);
- preparing, controlling and disseminating system information;
- providing a focal point for ships (or their agents, etc.), Administrations or others.

b) Routine and normal operational tasks such as:

- liaising with the various space segment suppliers;
- scheduling and coordinating type approval and commissioning of ship earth stations;
- scheduling and coordinating the bringing-into-service of coast earth stations and network coordination stations;
- carrying out some limited monitoring of transmission parameters;
- analysing traffic and performance data provided by network coordination stations and coast earth stations.

c) Emergency and/or corrective actions, including as required the issue of broadcast network advisory messages to ship earth stations, in case of

- space segment failures;
- extended network coordination stations failures;
- failures of individual coast earth stations;
- incorrect operation of ship earth stations;
- interference in the network.

3.2 *Cooperation between the general maintenance organization (Recommendation M.710 [9]) and the maritime satellite maintenance organization*

Figure 3/M.II40 illustrates the interrelationship between the general maintenance organization and the maritime satellite maintenance organization (INMARSAT).

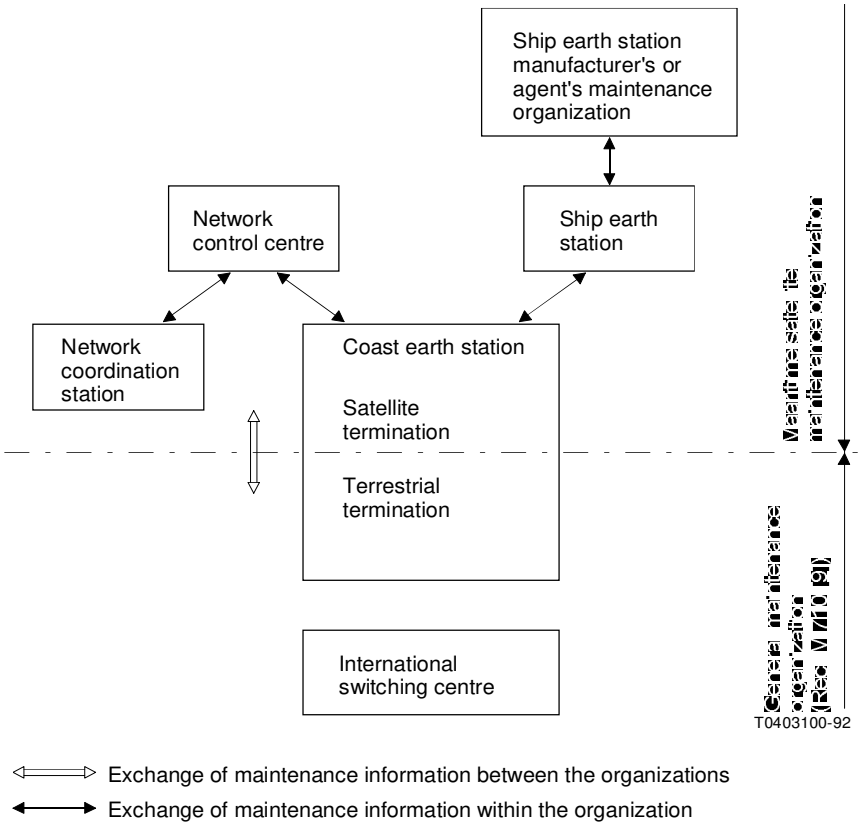


FIGURE 3/M.1140

Interrelationship between the general maintenance organization (Recommendation M.710 [9]) and the maritime satellite maintenance organization (INMARSAT)

The relationship between the coast earth station and the international switching centre is defined in § 4. The relationship between the elements within the maritime satellite maintenance organization is a matter for that organization.

Cooperation in the maintenance of the maritime satellite service should comprise the following elements in each organization, each of which represents a set of functions:

- fault report point (network)(see Recommendation M.716 [5]);
- network analysis point (see Recommendation M.720 [10]);
- system availability information point (see Recommendation M.721 [11]);
- network management (see Recommendation E.413 [12]);
- restoration control point (see Recommendation M.725 [13]).

4 Functions, maintenance responsibilities and maintenance facilities of a coast earth station for telephony services

4.1 *General functions*

A coast earth station will include the following basic functions:

- the provision of reliable communications with ship earth stations in the basic telephony modes (other services provided by maritime satellite networks are not addressed in this Recommendation);
- to provide an interworking point between the international public switched telephone network signalling systems and the maritime satellite signalling system;
- the commissioning and testing of ship earth stations within the maritime satellite system as requested by the network control centre (NCC). (See § 3.1.4);
- the handling of safety and distress services;
- the maintenance of a list of ship earth stations authorized to have access to the system;
- the collection of data to assist managerial functions, e.g. accounting, traffic records.

4.2 *Maintenance responsibilities*

The general maintenance aspects of maritime satellite systems are contained in § 2.

4.2.1 *Coast earth station (CES)*

A coast earth station is responsible for the following functions defined in the M-Series Recommendations:

- fault report point (circuit) (see Recommendation M.715 [4]);
- testing point (transmission) (see Recommendation M.717 [14]);
- testing point (line signalling) (see Recommendation M.718 [15]);
- testing point (switching and inter-register signalling) if applicable (see Recommendation M.719 [16]).

These responsibilities apply to both the maritime satellite system and the public switched telephone network.

4.2.2 *Circuit control and sub-control stations*

In all cases, the control station responsibilities given in Recommendation M.723 [17] shall be assigned to a coast earth station for maritime satellite circuits. Although the ship earth station is a customer's installation, it may act as a sub-control station with responsibilities to the coast earth station (see § 2.5.1).

4.2.3 *Advice of ship earth station fault conditions*

A coast earth station shall be responsible for advising the appropriate maintenance point within the maritime satellite network of fault conditions suspected to be located at a ship earth station and which affect the maritime satellite service.

4.3 *Test facilities*

4.3.1 *Access points*

Test access points shall be provided at a coast earth station, and should desirably include all those described in Figure 1/M.1140, i.e. points C, D, E and G.

4.3.2 *Test facilities for the maritime satellite circuit*

4.3.2.1 *Test equipment requirements*

Test equipment is required at a coast earth station to permit:

– tracing of faults in the coast earth station equipment;

– checking of transmission characteristics of maritime satellite circuits;

– testing of maritime signalling procedures;

– testing of channel assignment procedures.

In many cases, the test equipment may be manually connected.

4.3.2.2 *Coast earth station test position* (see Figure 1/M.1140)

Each coast earth station shall contain a test position that can be used to originate test calls over the maritime satellite system to the maritime test terminal and to receive calls from the maritime test terminal. It should be equipped to perform the tests listed in § 4.3.2.1.

4.3.2.3 *Maritime test terminal (MTT)* (see Figure 1/M.1140)

It is a requirement that each coast earth station shall be provided with a maritime test terminal which includes similar facilities to a normal ship earth station. It may be used to originate test calls to, and to receive test calls from, the coast earth station test position via a maritime satellite circuit, as well as originating test calls into the terrestrial network. It should also be equipped to perform the test listed in § 4.3.2.1.

4.3.2.4 *Automatic test facilities*

a) When a switch is included at the coast earth station, test lines as defined in Recommendation O.11[1)] [7] should be provided at the coast earth station for access by ship earth station via maritime satellite circuits.

b) When a switch is not included at the coast earth station, test lines as defined in Recommendation O.11 [7] are desirable at the international switching centre to which a ship earth station may gain access.

4.3.3 *Test facilities for circuits to the international switching centre*

The test facilities should be provided in accordance with M- and O-Series Recommendations, and may be accessible from the international switching centre through the coast earth station test position.

4.4 *Telecommunication facilities for maintenance purposes*

For further study.

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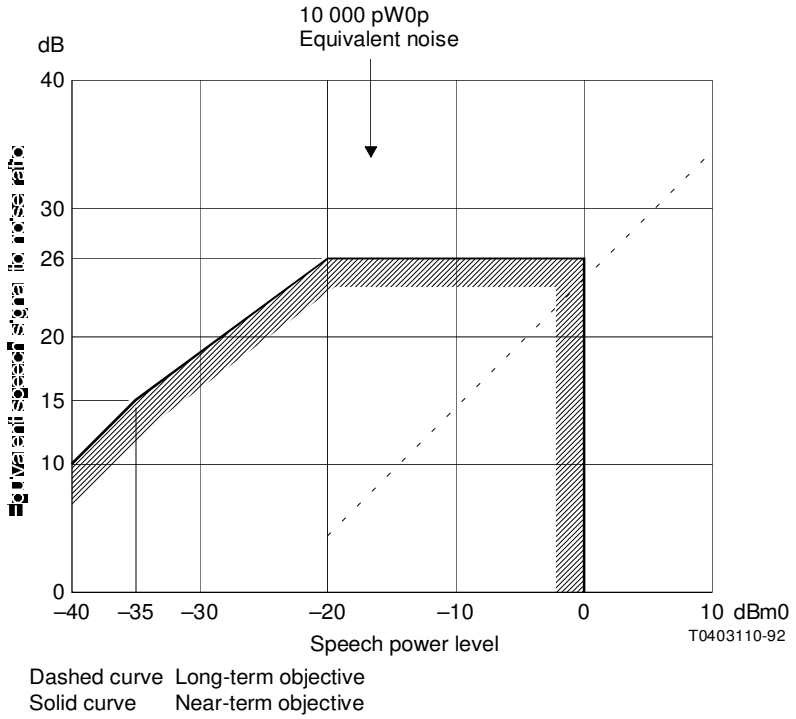
1) Test lines as defined in Recommendation O.11 [7] may be limited to the quiet termination test line and the loop-around test line.

ANNEX A

(to Recommendation M.1140)

Signal-to-noise ratios of a maritime satellite circuit containing speech dependent devices

As a maritime satellite circuit may contain speech dependent devices (e.g. compandors), the customary specification of idle circuit noise is inadequate. The near-term and long-term "objectives" of required speech-signal-to-psophometrically-weighted-noise ratio as a function of mean speech power (dBm0, time-average while active) are shown in Figure A-1/M.1140. The maintenance limits and method of measurement are under study.



Note 1 – Below –40 dBm0 and above 0 dBm0 the characteristic is not specified.

Note 2 – The near-term objective is given by the solid lines which relate subjectively equivalent speech signal-to-noise ratio. The long-term objective is given by the dashed lines expressing the performance in terms of equivalent speech signal-to-noise ratio. It is recognized that it might be difficult with the current maritime mobile-satellite facilities to comply with the long-term objective. When practicable, however, it is expected that the system(s) in the future will comply with this objective.

FIGURE A-1/M.1140

Signal-to-noise ratios of a maritime satellite circuit containing speech dependent devices

References

[1] CCITT Recommendation M.580 *Setting-up and lining-up an international circuit for public telephony*.

[2] CCITT Recommendation M.610 *Periodicity of maintenance measurements on circuits*.

[3] CCITT Recommendation G.473 *Interconnection of maritime mobile-satellite system with the international automatic switched telephone service: transmission aspects*.

[4] CCITT Recommendation M.715 *Fault report point (circuit)*.

[5] CCITT Recommendation M.716 *Fault report point (network)*.

[6] CCITT Recommendation M.1510 *Exchange of contact point information for the maintenance of international services and the international network*.

[7] CCITT Recommendation O.11 *Maintenance access lines*.

[8] CCITT Handbook *Transmission planning of switched telephone networks*, Chapter III, Annex 4, ITU, Geneva, 1976.

[9] CCITT Recommendation M.710 *General maintenance organization for the international automatic and semi-automatic service*.

[10] CCITT Recommendation M.720 *Network analysis point*.

[11] CCITT Recommendation M.721 *System availability information point*.

[12] CCITT Recommendation E.413 *International network management - Planning*.

[13] CCITT Recommendation M.725 *Restoration control point*.

[14] CCITT Recommendation M.717 *Testing point (transmission)*.

[15] CCITT Recommendation M.718 *Testing point (line signalling)*.

[16] CCITT Recommendation M.719 *Testing point (switching and interregister signalling)*.

[17] CCITT Recommendation M.723 *Circuit control station*.

[18] CCITT Recommendation E.201 *Reference Recommendation for mobile services*.

[19] CCITT Recommendation F.111 *Principles of service for mobile systems*.

[20] CCITT Recommendation E.220 *Interconnection of land mobile systems*.