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SERIES M: MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

International data transmission systems

Performance allocations and limits for international data transmission links and systems

ITU-T Recommendation M.1340

(Previously "CCITT Recommendation")

ITU-T M-SERIES RECOMMENDATIONS

MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

Introduction and general principles of maintenance and maintenance organization	M.10-M.299
International transmission systems	M.300-M.559
International telephone circuits	M.560-M.759
Common channel signalling systems	M.760-M.799
International telegraph systems and phototelegraph transmission	M.800-M.899
International leased group and supergroup links	M.900-M.999
International leased circuits	M.1000-M.1099
Mobile telecommunication systems and services	M.1100-M.1199
International public telephone network	M.1200-M.1299
International data transmission systems	**M.1300-M.1399**
Designations and information exchange	M.1400-M.1999
International transport network	M.2000-M.2999
Telecommunications management network	M.3000-M.3599
Integrated services digital networks	M.3600-M.3999
Common channel signalling systems	M.4000-M.4999

For further details, please refer to ITU-T List of Recommendations.

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation M.1340 was revised by ITU-T Study Group 4 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 12th of May 1996.

NOTE

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

CONTENTS

ABSTRACT

This Recommendation provides digital transmission performance limits for out-of-service testing, and also in-service degraded performance limit thresholds, of international data transmission links and systems.

KEYWORDS

Digital transmission performance, International data transmission links, International data transmission systems.

Recommendation M.1340

PERFORMANCE ALLOCATIONS AND LIMITS FOR INTERNATIONAL DATA TRANSMISSION LINKS AND SYSTEMS

(*Helsinki, 1993, revised in 1996*)

1 General

1.1 Introduction

The performance limits described in this Recommendation should form the basis for all digital test measurements associated with international data transmission links and systems[1)]. The limits are also applicable to the international section of international leased circuits that are supported by an international data transmission system and that have a digital interface at the renters' premises.

The limits described represent a typical minimum level of performance and Administrations should apply practical experience and negotiation for the agreement of superior limits whenever this is considered feasible. It should, however, be recognized that the performance limits described may not be achieved by certain existing transmission equipment technologies.

1.2 Terminology

Recommendation M.1300 [2] provides general descriptions of international data transmission links and international data transmission systems.

Terminologies and definitions relating to this Recommendation are provided in Recommendation M.60 [1].

1.3 Operational procedures

Recommendation M.1370 [3] covers the setting-up and bringing-into-service of international data transmission systems. Maintenance issues are covered by Recommendation M.1375 [4].

The bringing-into-service and maintenance issues relating to international leased circuits with a digital presentation at renters' premises that are supported by international data transmission systems are covered by Recommendations M.1380 [5] and M.1385 [6] respectively.

2 Basic principles

2.1 Measurement parameters

Performance limits are provided for Errored Seconds (ES) and Severely Errored Seconds (SES) as defined in Recommendation M.60 [1].

2.2 Derivation of performance limits

The performance limit allocation principles described in this Recommendation are compatible with those presented in Recommendation M.2100 [7]. Table 2b/M.2100 is used as the basis for deriving overall performance allocations for this Recommendation.

For greatly simplified operational performance measurements, this Recommendation uses the same ES-and-SES limits to cover all 24-hour out-of-service test requirements [e.g. bringing-into-service, maintenance intervention and returning to service (after repair)]. In addition, dual limits associated with a confidence window, as described in clause 6/M.2100 [7] are not used. While this overall approach is not directly compatible with Recommendation M.2100 [7], an international digital path set-up in accordance with the performance requirements of Recommendation M.2100 [7] should be able to support an international data transmission link set-up in accordance with the performance requirements of this Recommendation.

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1) The performance limits described in this Recommendation do not represent design objectives.

2.2.1 Data rates below 1544 kbit/s

The same performance limits will be applicable for all data rates below the primary rate (for the purposes of this Recommendation this will include data rates from 600 bit/s).

The ES performance limits used in this Recommendation have a mathematical basis and are derived from a 40% allowance of an end-to-end ES objective as described in Recommendation G.821 [8]. However, taking account of practical experience, the 8% ES objective proposed in Recommendation G.821 [8] is reduced to 4%.

The SES performance limits used in this Recommendation are not directly related to the SES objectives described in Recommendation G.821 [8]. The limits have a mathematical basis but have been significantly modified to reflect practical experience.

2.2.2 Data rates at the primary rate and higher bit rates

The end-to-end error reference performance objectives at or above the primary rate are those given in Table 1b/M.2100. The reference performance objective for ES used in this Recommendation is based on a maximum of a 2% (primary rate), 2.5% (secondary rate), 3.75% (tertiary rate) and 8% (quaternary rate) end-to-end reference performance objective as derived from Recommendation G.826.

The SES performance limits are identical to those for data rates below 1544 kbit/s.

2.3 Test duration

To reflect operational requirements for out-of-service testing, test durations of 24 hours, one hour and 15 minutes are used in this Recommendation. Whilst the one month test duration suggested in Recommendations G.821 [8] and G.826 [9] is not realistic for most test requirements, it must be recognized that 24-hour test results are inherently less reliable.

The 1-hour and 15-minute test objectives specified in this Recommendation (see Table 3) are used to provide a basic check of operability and are not intended to give a reliable indication of transmission performance.

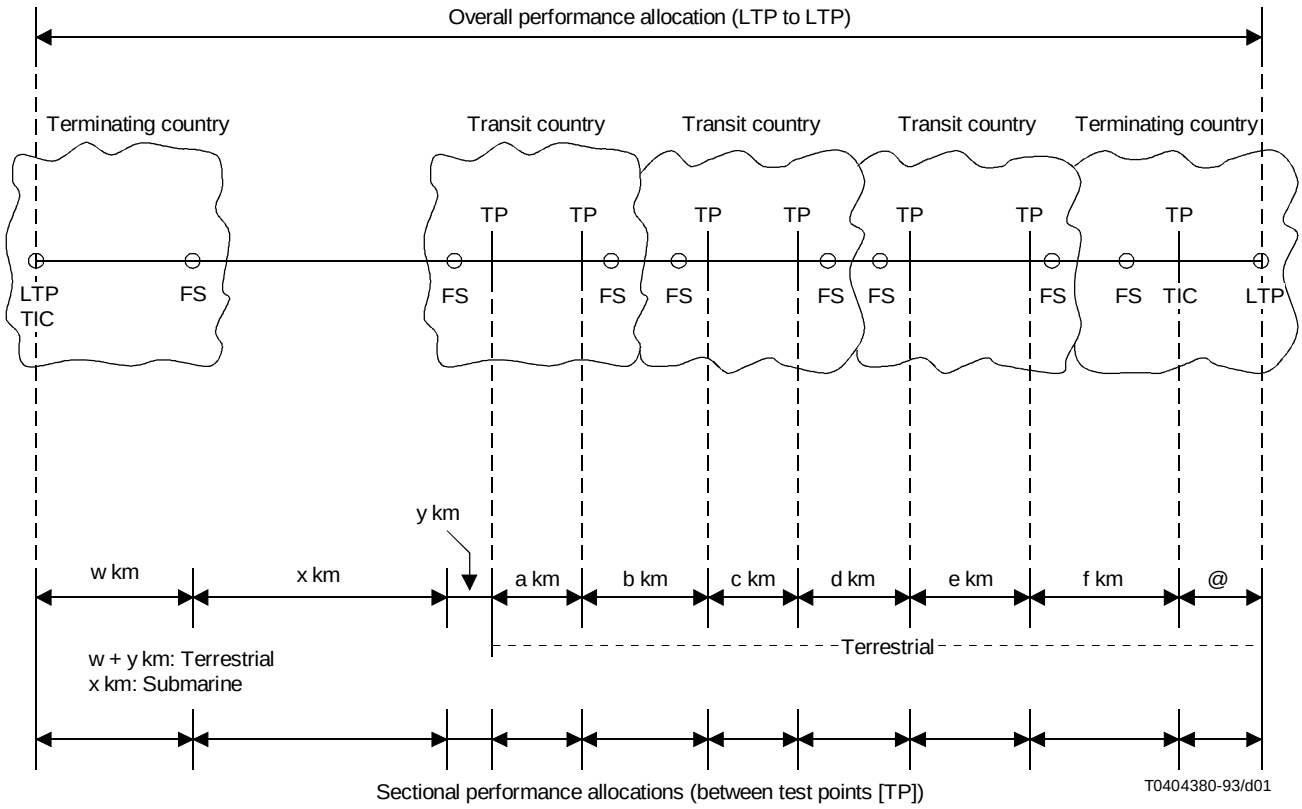
2.4 Action on test failure

A 24-hour test duration cannot be expected to give a particularly reliable indication of transmission performance (a test duration of one month is suggested in Recommendations G.821 [8] and G.826 [9]). When a performance limit is not met, Administrations should use practical judgement to determine an agreed course of action. Except where performance is catastrophically bad and a fault is obviously present, it will often be advantageous to continue testing to give an increased level of confidence. However, to avoid unnecessary testing where a limit is exceeded by a very small margin, following agreement between Administrations involved, it may be appropriate to deem the result acceptable. See Recommendations M.1370 [3] and M.1375 [4] for further guidance.

3 Error performance allocation principles

3.1 Overall performance allocation (link terminating point-to-link terminating point)

Prior to attempting to determine an overall performance allocation, Administrations should construct an agreed schematic routing diagram for the international data transmission link or system under consideration. The diagram should locate Link Terminating Points (LTP), earth stations, terrestrial Frontier Stations (FS) and terminal international centres showing distances in kilometres (except for any satellite sections or national link sections). Figure 1 is a typical schematic diagram (see also Figures 2a/M.2100 and 3/M.2100). A suitable diagram may have been agreed at the initial planning stage prior to bringing-into-service. (The inclusion of intermediate Test Points (TP), as shown in Figure 1 is not necessary for the derivation of overall performance limits.)



LTP Link Terminating Point
TP Test Point
FS Frontier Station
TIC Terminal International Centre

NOTES

1 An overall performance allocation is derived using Table 2/M.2100, Table 1 of this Recommendation and taking account of allocations for national link sections (eg. @).

2 Individual international link section performance allocations are derived using Table 2 and Table 1.

3 Where an LTP is located at a TIC there will be no national link section.

FIGURE 1/M.1340

Performance allocation for international data transmission links and systems

Within international link sections percentage performance allocations attributable to terminating countries, transit countries, submarine cable systems, terrestrial border crossings and satellite systems are determined by reference to Tables 2a/M.2100 and 2b/M.2100 as appropriate [the percentage allocations are described as "% of end-to-end RPO" (Reference Performance Objectives) in this table]. Percentage performance allocations attributable to national link section components are the responsibility of the Administration concerned. Where a national link section is provided over a high grade transmission path, an allocation consistent with the terrestrial components given in Table 2 is recommended.

The calculation of overall performance limits from a single overall percentage allocation is preferred. An overall allocation is derived by simple addition of the individual sectional allocations. The overall percentage allocation should then be applied to the appropriate table (Table 1a, 1b, 1c, 1d or 1e) to determine single 24-hour test limits for ES-and-SES. Where an overall percentage performance allocation of greater than 40% is derived, Administrations should determine suitable limits for ES-and-SES by bilateral agreement taking account of the limits in the appropriate table (Table 1a, 1b, 1c, 1d or 1e). The linear addition of sectional performance limits to derive overall performance limits is not recommended.

The 24-hour performance limits derived are applicable to all out-of-service tests [e.g. bringing-into-service, maintenance intervention and returning to service (after repair)] of the overall international data transmission link (LTP-to-LTP) or system.

3.2 Sectional performance allocation (between test points)

For certain operational test requirements (e.g. during maintenance investigation and route re-arrangements) it will be necessary to perform 24-hour tests of sectional components of an international data transmission link.

Prior to attempting to determine performance allocations, Administrations should construct an agreed schematic routing diagram for the international data transmission link or system under consideration (see Figure 1). The diagram should be as described in 3.1 above. The air-route distance between link section end points, as described in Recommendation M.2100 as Path Core Elements (PCE), should be multiplied by an appropriate routing factor. This factor is given in Table 2a/M.2100. The modified air-route distance is compared with the actual route length, where this is known, and the smaller of these distances is applied to Table 2 for the calculation of percentage between points of interest. A suitable diagram may have been agreed at the planning stage prior to bringing-into-service.

The sectional components from the schematic routing diagram should be applied to Table 2 (this is a simplified version of Table 2b/M.2100) for the calculation of percentage allocations between points of interest.

Administrations must ensure that the sum total of allocations for individual sectional components is consistent with the overall allocation as described in 3.1 above. Where the overall allocation is exceeded, Administrations should agree proportional reductions to sectional allocations by negotiation.

Agreed sectional allocations should be applied to the appropriate table (Table 1a, 1b, 1c, 1d or 1e) for the determination of single 24-hour test limits for ES-and-SES. These test limits may be used for all out-of-service test requirements between agreed test access points.

4 Short duration test objectives

It is recognized that 24-hour test limits are not appropriate for all out-of-service test requirements, especially those associated with maintenance operations. Proposed 15-minute and 1-hour test objectives for international data transmission links and systems are given in Table 3. These performance objectives are independent of the routing configuration that is used. The application of short duration test limits to bringing-into-service and maintenance operations is described in Recommendations M.1370 [3] (see 3.3/M.1370, 4.3/M1370 and 4.4/M.1370) and M.1375 [4] (see 4.2/M.1375 and 4.3/M.1375) respectively.

It must be recognized that short duration tests do not give a reliable indication of overall transmission performance. Failure to meet a short duration test objective by a small margin (see Note 3 of Table 3) may not necessarily be indicative of a performance problem and Administrations should use practical judgement to determine an agreed course of action taking account of operational requirements. Where a short duration test objective is exceeded by a significant margin, corrective action should be taken in accordance with Recommendation M.1370 [3] or Recommendation M.1375 [4] as appropriate. If there is any doubt about the validity of a 15-minute or 1-hour test result, a longer duration test may be appropriate.

5 In-service performance monitoring

On some international data transmission systems it may be possible to assess overall performance by implementing a cyclic redundancy check within certain nominally spare bits of a frame alignment signal, or by monitoring an additional dedicated service channel.

Performance limits are defined for ES-and-SES. Each performance limit will have its own threshold.

The general strategy for the use of performance monitoring information and threshold is described in Recommendations M.20 [10] and M.34 [11].

Degraded performance limit thresholds for a 24-hour period are presented in Tables 4a, 4b, 4c, 4d and 4e, for each of the rates considered.

Unacceptable performance limit thresholds for a 15-minute period are presented in Table 5.

When thresholds of unacceptable or degraded performance limits are reached, maintenance action should be initiated.

TABLE 1a/M.1340

24-hour out-of-service test limits for data rates below 1544 kbit/s

Allocation	Limits		Allocation	Limits	
%	ES	SES	%	ES	SES
1	9	1	21	325	12
1.5	16	1	21.5	333	13
2	23	1	22	341	13
2.5	30	1	22.5	349	13
3	37	2	23	358	13
3.5	45	2	23.5	366	14
4	52	2	24	374	14
4.5	60	2	24.5	382	14
5	68	3	25	390	15
5.5	76	3	25.5	399	15
6	83	3	26	407	15
6.5	91	4	26.5	415	16
7	99	4	27	423	16
7.5	107	4	27.5	432	16
8	115	5	28	440	16
8.5	123	5	28.5	448	17
9	131	5	29	456	17
9.5	139	5	29.5	465	17
10	147	6	30	473	18
10.5	155	6	30.5	481	18
11	163	6	31	489	18
11.5	171	7	31.5	498	18
12	179	7	32	506	19
12.5	187	7	32.5	514	19
13	195	8	33	522	19
13.5	203	8	33.5	531	20
14	211	8	34	539	20
14.5	219	8	34.5	547	20
15	227	9	35	556	21
15.5	235	9	35.5	564	21
16	243	9	36	572	21
16.5	251	10	36.5	580	21
17	259	10	37	589	22
17.5	268	10	37.5	597	22
18	276	10	38	605	22
18.5	284	11	38.5	614	23
19	292	11	39	622	23
19.5	300	11	39.5	630	23
20	308	12	40	639	24
20.5	317	12			

TABLE 1b/M.1340

24-hour out-of-service test limits for data rates between 1544 kbit/s and 2048 kbit/s

Allocation	Limits		Allocation	Limits	
%	ES	SES	%	ES	SES
1	3	1	21	155	12
1.5	6	1	21.5	159	13
2	9	1	22	163	13
2.5	12	1	22.5	167	13
3	16	2	23	171	13
3.5	19	2	23.5	175	14
4	23	2	24	179	14
4.5	26	2	24.5	183	14
5	30	3	25	187	15
5.5	34	3	25.5	191	15
6	37	3	26	195	15
6.5	41	4	26.5	199	16
7	45	4	27	203	16
7.5	49	4	27.5	207	16
8	52	5	28	211	16
8.5	56	5	28.5	215	17
9	60	5	29	219	17
9.5	64	5	29.5	223	17
10	68	6	30	227	18
10.5	72	6	30.5	231	18
11	76	6	31	235	18
11.5	79	7	31.5	239	18
12	83	7	32	243	19
12.5	87	7	32.5	247	19
13	91	8	33	251	19
13.5	95	8	33.5	255	20
14	99	8	34	259	20
14.5	103	8	34.5	264	20
15	107	9	35	268	21
15.5	111	9	35.5	272	21
16	115	9	36	276	21
16.5	119	10	36.5	280	21
17	123	10	37	284	22
17.5	127	10	37.5	288	22
18	131	10	38	292	22
18.5	135	11	38.5	296	23
19	139	11	39	300	23
19.5	143	11	39.5	304	23
20	147	12	40	308	24
20.5	151	12			

TABLE 1c/M.1340

24-hour out-of-service test limits for data rates at the secondary rate

Allocation	Limits		Allocation	Limits	
%	ES	SES	%	ES	SES
1	4	1	21	197	12
1.5	8	1	21.5	202	13
2	12	1	22	207	13
2.5	17	1	22.5	212	13
3	21	2	23	217	13
3.5	26	2	23.5	222	14
4	30	2	24	227	14
4.5	35	2	24.5	232	14
5	39	3	25	237	15
5.5	44	3	25.5	242	15
6	49	3	26	247	15
6.5	53	4	26.5	252	16
7	58	4	27	257	16
7.5	63	4	27.5	263	16
8	68	5	28	268	16
8.5	73	5	28.5	273	17
9	77	5	29	278	17
9.5	82	5	29.5	283	17
10	87	6	30	288	18
10.5	92	6	30.5	293	18
11	97	6	31	298	18
11.5	102	7	31.5	303	18
12	107	7	32	308	19
12.5	112	7	32.5	314	19
13	117	8	33	319	19
13.5	122	8	33.5	324	20
14	127	8	34	329	20
14.5	132	8	34.5	334	20
15	137	9	35	339	21
15.5	142	9	35.5	344	21
16	147	9	36	349	21
16.5	152	10	36.5	354	21
17	157	10	37	360	22
17.5	162	10	37.5	365	22
18	167	10	38	370	22
18.5	172	11	38.5	375	23
19	177	11	39	380	23
19.5	182	11	39.5	385	23
20	187	12	40	390	24
20.5	192	12			

TABLE 1d/M.1340

24-hour out-of-service test limits for data rates at the tertiary rate

Allocation	Limits		Allocation	Limits	
%	ES	SES	%	ES	SES
1	8	1	21	303	12
1.5	14	1	21.5	311	13
2	21	1	22	319	13
2.5	28	1	22.5	326	13
3	35	2	23	334	13
3.5	42	2	23.5	342	14
4	49	2	24	349	14
4.5	56	2	24.5	357	14
5	63	3	25	365	15
5.5	70	3	25.5	372	15
6	77	3	26	380	15
6.5	85	4	26.5	388	16
7	92	4	27	396	16
7.5	99	4	27.5	403	16
8	107	5	28	411	16
8.5	114	5	28.5	419	17
9	122	5	29	426	17
9.5	129	5	29.5	434	17
10	137	6	30	442	18
10.5	144	6	30.5	450	18
11	152	6	31	457	18
11.5	159	7	31.5	465	18
12	167	7	32	473	19
12.5	174	7	32.5	481	19
13	182	8	33	488	19
13.5	189	8	33.5	496	20
14	197	8	34	504	20
14.5	204	8	34.5	512	20
15	212	9	35	519	21
15.5	219	9	35.5	527	21
16	227	9	36	535	21
16.5	235	10	36.5	543	21
17	242	10	37	550	22
17.5	250	10	37.5	558	22
18	257	10	38	566	22
18.5	265	11	38.5	574	23
19	273	11	39	582	23
19.5	280	11	39.5	589	23
20	288	12	40	597	24
20.5	296	12			

TABLE 1e/M.1340

24-hour out-of-service test limits for data rates at the quaternary rate

Allocation	Limits		Allocation	Limits	
%	ES	SES	%	ES	SES
1	23	1	21	672	12
1.5	37	1	21.5	689	13
2	52	1	22	705	13
2.5	68	1	22.5	722	13
3	83	2	23	738	13
3.5	99	2	23.5	755	14
4	115	2	24	772	14
4.5	131	2	24.5	789	14
5	147	3	25	805	15
5.5	163	3	25.5	822	15
6	179	3	26	839	15
6.5	195	4	26.5	855	16
7	211	4	27	872	16
7.5	227	4	27.5	889	16
8	243	5	28	905	16
8.5	259	5	28.5	922	17
9	276	5	29	939	17
9.5	292	5	29.5	956	17
10	308	6	30	972	18
10.5	325	6	30.5	989	18
11	341	6	31	1006	18
11.5	358	7	31.5	1023	18
12	374	7	32	1039	19
12.5	390	7	32.5	1056	19
13	407	8	33	1073	19
13.5	423	8	33.5	1090	20
14	440	8	34	1106	20
14.5	456	8	34.5	1123	20
15	473	9	35	1140	21
15.5	489	9	35.5	1157	21
16	506	9	36	1174	21
16.5	522	10	36.5	1190	21
17	539	10	37	1207	22
17.5	556	10	37.5	1224	22
18	572	10	38	1241	22
18.5	589	11	38.5	1258	23
19	605	11	39	1274	23
19.5	622	11	39.5	1291	23
20	639	12	40	1308	24
20.5	655	12			

TABLES 1a, 1b, 1c, 1d, 1e/M.1340 (*concluded*)

24-hour out-of-service test limits

ES Errored seconds

SES Severely errored seconds

NOTES

1 The % allocation relates to the proportion of the overall reference performance objective that is attributable to a particular routing configuration.

2 The limits are applicable to discrete periods of 24 hours. Where a test has a duration of more than 24 hours it is recommended that the limits be applied to each discrete period of 24 hours without averaging.

3 The maximum % allocation of 40% in Table 1a is consistent with the allowance for the high grade quality classification given in Recommendation G.821 [8].

4 The ES and SES limits relate to the maximum number of errored or severely errored seconds that would be acceptable in a given 24-hour period.

5 Limits for unavailable time are left for negotiation between Administrations. However, it should be appreciated that an availability of 100% would normally be achieved during a typical 24-hour period and that a transition to unavailable time would in any case not be consistent with SES limits for allocations below 16.5%.

TABLE 2/M.1340

Performance allocations for the derivation of sectional performance limits

International link section component	Distance km	Allocation %
Terrestrial (including transit and non-optical undersea cable)	< 500 > 500 - ≤ 1000 > 1000 - ≤ 2500 > 2500 - ≤ 5000 > 5000 - ≤ 7500 > 7500	2 3 4 6 8 10
Optical undersea cable	≤ 500 > 500	1 2.5
Satellite	–	20

NOTES

1 By negotiation, where sectional testing incorporates a terrestrial border crossing, it may be acceptable to incorporate an additional performance allocation. See Table 2b/M.2100 (Notes 3 and 4); an allocation of 0.5% is suggested.

2 The allocations given in this table are maximum values and may be reduced by agreement between Administrations.

TABLE 3/M.1340

Short duration out-of-service test limits

Test duration	Objectives	
	ES	SES
15 minutes	0	0
1 hour	5	0

NOTES

1 The ES and SES objectives relate to the maximum number of errored or severely errored seconds that would be acceptable in the test duration specified.

2 Where a 15-minute objective is exceeded, it may be useful to reference Annex D/M.2100 [7] and Table D.1/M.2100 for guidance.

3 The acceptable tolerance applicable to the limits of this table is dependent upon the overall allocation as defined in 3.1.

TABLE 4a/M.1340

24-hour in-service degraded performance limit thresholds for data rate below 1544 kbit/s

Allocation	Degraded threshold		Allocation	Degraded threshold	
%	ES	SES	%	ES	SES
1	58	3	21	636	20
1.5	72	3	21.5	652	21
2	86	3	22	668	21
2.5	101	3	22.5	684	21
3	113	5	23	698	21
3.5	128	5	23.5	714	23
4	142	5	24	730	23
4.5	155	5	24.5	744	23
5	169	6	25	760	24
5.5	184	6	25.5	776	24
6	196	6	26	790	24
6.5	211	8	26.5	806	26
7	225	8	27	822	26
7.5	239	8	27.5	838	26
8	252	9	28	852	26
8.5	266	9	28.5	868	27
9	281	9	29	884	27
9.5	293	9	29.5	898	27
10	308	11	30	914	29
10.5	322	11	30.5	930	29
11	335	11	31	944	29
11.5	349	12	31.5	960	29
12	364	12	32	976	30
12.5	378	12	32.5	992	30
13	391	14	33	1006	30
13.5	405	14	33.5	1022	32
14	419	14	34	1038	32
14.5	432	14	34.5	1052	32
15	446	15	35	1068	33
15.5	468	15	35.5	1084	33
16	482	15	36	1098	33
16.5	498	17	36.5	1114	33
17	514	17	37	1130	35
17.5	530	17	37.5	1146	35
18	544	17	38	1160	35
18.5	560	18	38.5	1176	36
19	576	18	39	1192	36
19.5	590	18	39.5	1206	36
20	606	20	40	1222	38
20.5	622	20			

NOTES

1 Usage is described in Recommendation M.1375.

2 The ES and SES thresholds relate to the maximum number of errored or severely errored seconds that can be accommodated within a 24-hour period. Typical performance should be much better than this.

3 These thresholds are applicable to international data transmission systems where an in-service monitoring facility is available.

TABLE 4b/M.1340

24-hour in-service degraded performance limit thresholds for data rate between 1544 kbit/s and 2048 kbit/s

Allocation	Degraded threshold		Allocation	Degraded threshold	
%	ES	SES	%	ES	SES
1	20	3	21	305	20
1.5	28	3	21.5	312	21
2	36	3	22	319	21
2.5	44	3	22.5	326	21
3	51	5	23	333	21
3.5	59	5	23.5	339	23
4	66	5	24	346	23
4.5	74	5	24.5	353	23
5	81	6	25	360	24
5.5	88	6	25.5	367	24
6	95	6	26	374	24
6.5	103	8	26.5	381	26
7	110	8	27	387	26
7.5	117	8	27.5	394	26
8	124	9	28	401	26
8.5	131	9	28.5	408	27
9	138	9	29	415	27
9.5	145	9	29.5	421	27
10	152	11	30	428	29
10.5	159	11	30.5	435	29
11	166	11	31	442	29
11.5	173	12	31.5	449	29
12	180	12	32	455	30
12.5	187	12	32.5	462	30
13	194	14	33	469	30
13.5	201	14	33.5	476	32
14	208	14	34	483	32
14.5	215	14	34.5	489	32
15	222	15	35	496	33
15.5	229	15	35.5	503	33
16	236	15	36	510	33
16.5	243	17	36.5	517	33
17	250	17	37	523	35
17.5	257	17	37.5	530	35
18	264	17	38	537	35
18.5	271	18	38.5	544	36
19	278	18	39	550	36
19.5	285	18	39.5	557	36
20	291	20	40	564	38
20.5	298	20			

NOTES

1 Usage is described in Recommendation M.1375.

2 The ES and SES thresholds relate to the maximum number of errored or severely errored seconds that can be accommodated within a 24-hour period. Typical performance should be much better than this.

3 These thresholds are applicable to international data transmission systems where an in-service monitoring facility is available.

TABLE 4c/M.1340

24-hour in-service degraded performance limit thresholds for data rate at the secondary rate

Allocation	Degraded threshold		Allocation	Degraded threshold	
%	ES	SES	%	ES	SES
1	35	3	21	380	20
1.5	46	3	21.5	389	21
2	54	3	22	397	21
2.5	63	3	22.5	406	21
3	71	5	23	414	21
3.5	80	5	23.5	423	23
4	89	5	24	432	23
4.5	97	5	24.5	440	23
5	106	6	25	449	24
5.5	114	6	25.5	457	24
6	123	6	26	466	24
6.5	131	8	26.5	474	26
7	140	8	27	483	26
7.5	149	8	27.5	492	26
8	157	9	28	500	26
8.5	166	9	28.5	509	27
9	174	9	29	517	27
9.5	183	9	29.5	526	27
10	192	11	30	535	29
10.5	200	11	30.5	543	29
11	209	11	31	552	29
11.5	217	12	31.5	560	29
12	226	12	32	569	30
12.5	234	12	32.5	577	30
13	243	14	33	586	30
13.5	252	14	33.5	595	32
14	260	14	34	603	32
14.5	269	14	34.5	612	32
15	277	15	35	620	33
15.5	286	15	35.5	629	33
16	294	15	36	637	33
16.5	303	17	36.5	646	33
17	312	17	37	655	35
17.5	320	17	37.5	663	35
18	329	17	38	672	35
18.5	337	18	38.5	680	36
19	346	18	39	689	36
19.5	354	18	39.5	697	36
20	363	20	40	706	38
20.5	372	20			

NOTES

1 Usage is described in Recommendation M.1375.

2 The ES and SES thresholds relate to the maximum number of errored or severely errored seconds that can be accommodated within a 24-hour period. Typical performance should be much better than this.

3 These thresholds are applicable to international data transmission systems where an in-service monitoring facility is available.

TABLE 4d/M.1340

24-hour in-service degraded performance limit thresholds for data rate at the tertiary rate

Allocation	Degraded threshold		Allocation	Degraded threshold	
%	ES	SES	%	ES	SES
1	36	3	21	555	20
1.5	49	3	21.5	568	21
2	63	3	22	581	21
2.5	76	3	22.5	594	21
3	90	5	23	606	21
3.5	103	5	23.5	619	23
4	117	5	24	631	23
4.5	130	5	24.5	644	23
5	144	6	25	657	24
5.5	157	6	25.5	669	24
6	170	6	26	682	24
6.5	183	8	26.5	695	26
7	196	8	27	707	26
7.5	209	8	27.5	720	26
8	222	9	28	733	26
8.5	235	9	28.5	745	27
9	248	9	29	758	27
9.5	261	9	29.5	770	27
10	274	11	30	783	29
10.5	287	11	30.5	796	29
11	300	11	31	808	29
11.5	313	12	31.5	821	29
12	326	12	32	833	30
12.5	339	12	32.5	846	30
13	351	14	33	859	30
13.5	364	14	33.5	871	32
14	377	14	34	884	32
14.5	390	14	34.5	896	32
15	403	15	35	909	33
15.5	415	15	35.5	921	33
16	428	15	36	934	33
16.5	441	17	36.5	947	33
17	454	17	37	959	35
17.5	466	17	37.5	972	35
18	479	17	38	984	35
18.5	492	18	38.5	997	36
19	505	18	39	1009	36
19.5	517	18	39.5	1022	36
20	530	20	40	1034	38
20.5	543	20			

NOTES

1 Usage is described in Recommendation M.1375.

2 The ES and SES thresholds relate to the maximum number of errored or severely errored seconds that can be accommodated within a 24-hour period. Typical performance should be much better than this.

3 These thresholds are applicable to international data transmission systems where an in-service monitoring facility is available.

TABLE 4e/M.1340

24-hour in-service degraded performance limit thresholds for data rate at the quaternary rate

Allocation	Degraded threshold		Allocation	Degraded threshold	
%	ES	SES	%	ES	SES
1	94	3	21	1164	20
1.5	120	3	21.5	1190	21
2	147	3	22	1217	21
2.5	174	3	22.5	1244	21
3	201	5	23	1271	21
3.5	227	5	23.5	1297	23
4	254	5	24	1324	23
4.5	281	5	24.5	1351	23
5	308	6	25	1378	24
5.5	334	6	25.5	1404	24
6	361	6	26	1431	24
6.5	388	8	26.5	1458	26
7	415	8	27	1485	26
7.5	441	8	27.5	1511	26
8	468	9	28	1538	26
8.5	495	9	28.5	1565	27
9	522	9	29	1592	27
9.5	548	9	29.5	1618	27
10	575	11	30	1645	29
10.5	602	11	30.5	1672	29
11	629	11	31	1699	29
11.5	655	12	31.5	1725	29
12	682	12	32	1752	30
12.5	709	12	32.5	1779	30
13	736	14	33	1806	30
13.5	762	14	33.5	1832	32
14	789	14	34	1859	32
14.5	816	14	34.5	1886	32
15	843	15	35	1913	33
15.5	869	15	35.5	1939	33
16	896	15	36	1966	33
16.5	923	17	36.5	1993	33
17	950	17	37	2020	35
17.5	976	17	37.5	2046	35
18	1003	17	38	2073	35
18.5	1030	18	38.5	2100	36
19	1057	18	39	2127	36
19.5	1083	18	39.5	2153	36
20	1110	20	40	2180	38
20.5	1137	20			

NOTES

1 Usage is described in Recommendation M.1375.

2 The ES and SES thresholds relate to the maximum number of errored or severely errored seconds that can be accommodated within a 24-hour period. Typical performance should be much better than this.

3 These thresholds are applicable to international data transmission systems where an in-service monitoring facility is available.

TABLE 5/M.1340

15 minute in-service unacceptable performance limit thresholds

ES	SES
150	15
NOTES 1 Usage is described in Recommendation M.1375. 2 The ES and SES thresholds relate to the maximum number of errored or severely errored seconds that can be accommodated within a 15-minute period. If either threshold is exceeded immediate corrective action (e.g. temporary service restoration) should be taken. 3 These thresholds are applicable to international data transmission systems where an in-service monitoring facility is available.	

References

[1] ITU-T Recommendation M.60, (1993), *Maintenance terminology and definitions*.

[2] CCITT Recommendation M.1300 (1992), *International data transmission systems operating in the range 2.4 kbit/s to 2048 kbit/s.*

[3] ITU-T Recommendation M.1370 (1993), *Bringing-into-service of international data transmission systems*.

[4] ITU-T Recommendation M.1375 (1996), *Maintenance of international data transmission systems*.

[5] ITU-T Recommendation M.1380 (1993), *Bringing-into-service of international leased circuits that are supported by international data transmission systems*.

[6] ITU-T Recommendation M.1385 (1993), *Maintenance of international leased circuits that are supported by international data transmission systems*.

[7] ITU-T Recommendation M.2100 (1995), *Performance limits for bringing-into-service and maintenance of international PDH paths, sections and transmission systems*.

[8] CCITT Recommendation G.821 (1988), *Error performance of an international digital connection forming part of an integrated services digital network.*

[9] ITU-T Recommendation G.826 (1993), *Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate*.

[10] CCITT Recommendation M.20 (1992), *Maintenance philosophy for telecommunication networks*.

[11] CCITT Recommendation M.34 (1988), *Performance monitoring on international transmission systems and equipment*.

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