IEC 61747-1-1

Edition 1.0 2014-08

INTERNATIONAL STANDARD

Liquid crystal display devices – Part 1–1: Generic – Generic specification

IEC 61747-1-1:2014-08(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE U

ICS 31.120

ISBN 978-2-8322-1805-1

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LIQUID CRYSTAL DISPLAY DEVICES –

Part 1–1: Generic – Generic specification

FOREWORD

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International Standard IEC 61747-1-1 was prepared by IEC technical committee 110: Electronic display devices.

This Part 1-1 forms the generic specification for liquid crystal display devices.

This first edition cancels and replaces the first edition of IEC 61747-1 published in 1998 and Amendment 1:2003. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) IEC 61747-1, has been divided into IEC 61747-1-1, *Liquid crystal display devices – Part 1-1: Generic – Generic specification* and IEC 61747-1-2, *Liquid crystal display devices – Part 1-2: Generic – Terminology and letter symbols*;
b) the contents of the terminology have been transferred to IEC 61747-1-2;

c) Annex C has been changed from normative to informative, because Tables C.1 and C.2 mismatch some of the large scale production practices of recent date;

d) References cited have been updated.

The text of this standard is based on the following documents:

CDV	Report on voting
110/527/CDV	110/563/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 61747 series, under the general title *Liquid crystal display devices,* can be found on the IEC website.

NOTE The structure of the IEC 61747 series and the changes in the numbering are shown in Annex D of IEC 61747-30-1:2012.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

LIQUID CRYSTAL DISPLAY DEVICES –

Part 1–1: Generic – Generic specification

1 Scope

This part of IEC 61747 is a generic specification for liquid crystal display devices. It defines general procedures for testing and gives general rules for the measuring methods of the electrical and optical characteristics, the rules for climatic and mechanical tests, and the rules for endurance tests.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60747 (all parts), *Semiconductor devices – Discrete devices*

IEC 60747-1:2006, *Semiconductor devices – Part 1: General*

IEC 60747-10:1991, *Semiconductor devices – Part 10: Generic specification for discrete devices and integrated circuits*

IEC 60748 (all parts), *Semiconductor devices – Integrated circuits*

IEC 60749, *Semiconductor devices – Mechanical and climatic test methods*

IEC 61747-1-2, *Liquid crystal display devices – Part 1-2: Terminology and letter symbols*

IEC 61747-5, *Liquid crystal and solid-state display devices – Part 5: Environmental, endurance and mechanical test methods*

IEC 61747-10-1, *Liquid crystal display devices – Part 10-1: Environmental, endurance and mechanical test methods – Mechanical*

IEC 61747-10-2, *Liquid crystal display devices – Part 10-2: Environmental and endurance measurements*

IEC 61747-20 (all parts), *Liquid crystal display devices – Visual inspection*

IEC 61747-30-1, *Liquid crystal display devices – Part 30-1: Measuring methods for liquid crystal display modules – Transmissive type*

ISO 2859 (all parts), *Sampling procedures for inspection by attributes*

ISO 2859-1, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 2859-10, *Sampling procedures for inspection by attributes – Part 10: Introduction to the ISO 2859 series of standards for sampling for inspection by attributes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61747-1-2 apply.

4 Technical aspects

4.1 Order of precedence

Where there are conflicting requirements, documents shall rank in the following order of authority:

a) the detail specification;
b) the blank detail specification;
c) the family specification, if any;
d) the sectional specification;
e) the generic specification;
f) the basic specification;
g) international (e.g. IEC) documents to which reference is made;
h) a national document.

The same order of precedence shall apply to equivalent national documents.

4.2 Standard environmental conditions

The preferred values of temperature, humidity and pressure for the measurement of characteristics, for tests and for operating conditions, are a temperature of 25 ºC ± 5 ºC, a relative humidity of 45 %RH to 75 %RH, and a pressure of 86 kPa to 106 kPa.

4.3 Marking

4.3.1 Device identification

The marking on the device shall enable clear identification of the device.

4.3.2 Device traceability

The device shall be provided with a traceability code which enables back-tracing of the device to a certain production or inspection lot.

4.3.3 Packing

The marking on the packing shall state:

a) the device identification code;
b) the traceability code(s) of the enclosed devices;
c) the number of enclosed devices;
d) the required precautions, if any.

This marking shall be in accordance with custom regulations.

NOTE Additional requirements can be specified in the relevant detail specification.

4.4 Categories of assessed quality

This generic specification provides three categories of quality control. The devices are grouped in an identified and date-coded inspection lot, which is tested to the specified quality categories. The AQLs (acceptance quality levels) or LTPDs (lot tolerance percentage defectives) associated with the same inspection group may vary for each category and shall be as specified in the detail specification.

The minimum requirements of the categories are as follows:

Category I The type meets the requirements of categories II or III. Each lot meets the inspection requirements of group A which includes functional tests. Every three months, one lot meets the inspection requirements for interconnection ability. Annually, one lot meets the group B and group C inspection requirements.

Category II The lot meets the inspection requirements of group A and group B on a lot-by-lot basis, and of group C on a periodic basis.

Category III The lot is 100 % screened and meets the inspection requirements of group A and group B on a lot-by-lot basis, and of group C on a periodic basis.

The sectional or blank detail specifications shall define the minimum requirements for each category. A detail specification may contain requirements, including screening requirements, additional to those given in the generic, sectional or blank detail specification.

4.5 Screening

A screening is an examination or test applied to all devices in a lot.

When required by the detail specification, all devices in the lot shall be screened by submitting them to one of the sequences given in the relevant table of the sectional or blank detail specification, and all defectives removed. Other sequences not specified in this standard are applicable only where the above sequences are not correlated or are in contradiction with recognized failure mechanisms. When a part of the screening process as given in the relevant table of the sectional or blank detail specification forms part of the manufacturing process in the prescribed sequence, these procedures need not be repeated. For the purpose of this specification, burn-in is defined as thermal and electrical stress applied to all devices in a lot for a specified period of time for the purpose of detecting and removing potential early failures.

4.6 Handling

See IEC 60747-1:2006, Clause 8.

Adequate warning shall be displayed in the case of harmful products (e.g. Be0).

5 Quality assessment procedures

5.1 General

Quality assessment comprises the procedure for obtaining qualification approval as defined in 5.6, followed by quality conformance inspection on a lot-by-lot basis (including screening if required) and on a periodic basis as qualified in the detail specification.

The quality assessment tests are subdivided into group A, B and C tests; these are performed lot-by-lot or periodically. In some cases, group D tests may also be specified, for example, for qualification approval.

5.2 Commercially confidential information

If any part of the manufacturing process is commercially confidential, this shall be suitably identified, and the designated management representative (DMR) shall demonstrate that the requirements of the rules of procedure given in the specified quality assessment system have been complied with.

5.3 Formation of inspection lots

An inspection lot may be formed by the aggregation of several production lots provided that

a) the production lots are manufactured under essentially the same conditions (materials, processes, machines, personnel, etc.), and,

b) quality control and inspection during manufacture is performed to the extent necessary, in accordance with directives established by the appropriate departments of the manufacturer in consultation with the DMR, and,

c) the results of this inspection indicate for each production lot that the quality of materials and processing is maintained within the limits necessary for the production of components satisfying the requirements of the specification, and,

d) the period over which production lots may be aggregated into one inspection lot should normally not exceed one week, and shall not exceed one month unless permitted by the relevant specification.

The programme for the aggregation of production lots into inspection lots shall be determined by the DMR and shall be submitted for approval.

5.4 Structurally similar devices

Structurally similar components are components produced by the same manufacturer with essentially the same design, materials, processes and methods. They are such that the results of a given test carried out on one of these components can be recognised as being valid for the others of the group. They are separately identifiable.

The relevant specification shall give the requirements for grouping structurally similar components for the purpose of testing for QA and quality conformance inspection.

Details concerning grouping are given in the relevant sectional or blank detail specifications.

5.5 Granting of qualification approval

The CB shall validate the recommendation and grant the QA, when the requirements of the specific quality assessment system have been met.

Method a) or b) of the rules of procedure may be used at the manufacturer's discretion in accordance with the inspection requirements given in the sectional or blank detail specifications. Samples may be composed of appropriate structurally similar devices. In some cases, group D tests are required for qualification approval. All variables measurements called for as post-test end-points in the detail specification shall be recorded as variables data.

The qualification report shall include a summary of all the test results for each group and subgroup, including number of devices tested and number of devices failed. This summary shall be derived from variables and/or attributes data.

The manufacturer shall retain all data for submission on demand.

5.6 Quality conformance inspection

5.6.1 General

Quality conformance inspection shall consist of the examinations and tests of groups A, B, C and D, as specified.

For groups B and C inspection, samples may be composed of structurally similar devices.

Samples for periodic tests shall be drawn from one or more lots which have passed groups A and B inspection. Individual devices shall have passed the group A measurements called for in the detail specification.

5.6.2 Division into groups and subgroups

5.6.2.1 General

The following guidelines shall be used in the preparation of detail specifications.

5.6.2.2 Group A inspection (lot-by-lot)

This group prescribes the visual inspection and the electrical measurements to be made on a lot-by-lot basis to assess the principal properties of a device. Unless otherwise specified, structural similarity groupings are not permitted.

Group A	Inspection is divided into appropriate subgroups as follows:
Subgroup A1	This subgroup comprises a visual examination as specified in 6.2.1.
Subgroup A2	This subgroup comprises measurements of primary characteristics of the device.
Subgroups A3 and A4	These subgroups may not be required. They comprise measurements of secondary characteristics of the device. The correct requirements for each device category are given in the relevant sectional or blank detail specification. The choice between subgroups A3 or A4 for given measurements is essentially governed by the desirability of performing them at a given quality level.

5.6.2.3 Group B inspection (lot-by-lot, except for category I)

This group prescribes the procedures to be used to assess certain additional properties of the device, and includes mechanical, climatic, electrical and optical endurance tests that can normally be performed in one week or as specified in the relevant sectional or blank detail specification.

5.6.2.4 Group C inspection (periodic)

This group prescribes the procedures to be used on a periodic basis to assess certain additional properties of the devices, and includes electrical and optical measurements, mechanical, climatic and endurance tests appropriate for checking at intervals of either three months (categories II and III) or one year (category I), or as specified in the relevant sectional or blank detail specification.

5.6.2.5 Division of group B and group C into subgroups

To enable comparison and to facilitate change from group B to group C and vice versa when necessary, tests in these groups have been divided into subgroups bearing the same number for corresponding tests.

The division is as given below.

Subgroups B1/C1	Comprise measurements that control the dimensional interchange-ability of the devices.
Subgroups B2a/C2a	Comprise the measurements that assess the electrical and optical properties of the devices of a design nature.
Subgroups B2b/C2b	Comprise measurements that further assess some of the electrical and optical characteristics of the device already measured in group A by measurement under different voltage, current, temperature or optical conditions.
Subgroups B2c/C2c	Comprise the verification of ratings of the device, where appropriate.
Subgroups B3/C3	Comprise the tests intended to assess the mechanical robustness of the device.
Subgroups B4/C4	Comprise the tests intended to assess the interconnection ability of the device.
Subgroups B5/C5	Comprise the tests intended to assess the ability of the device to withstand climatic stresses, for example change of temperature, sealing.
Subgroups B6/C6	Comprise the tests intended to assess the ability of the device to withstand mechanical stresses, for example vibration, shock.
Subgroups B7/C7	Comprise the tests intended to assess the ability of the device to withstand long-term humidity.
Subgroups B8/C8	Comprise the tests intended to assess the failure characteristics of the device under endurance testing.
Subgroups B9/C9	Comprise the tests intended to assess the electrical and optical properties of the device under storage conditions at extremes of temperature.
Subgroups B10/C10	Comprise the tests intended to assess the performance of the device during variations of air pressure.
Subgroups B11/C11	Comprise the tests on the permanence of marking.
Subgroup CRRL	Lists a selection of tests and/or measurements made in the preceding subgroups, the results of which shall be presented in the certified record of released lots (CRRL).

These subgroups may not all be required.

5.6.2.6 Group D inspection

This group prescribes the procedures to be carried out at intervals of 12 months or for qualification approval only.

5.6.3 Inspection requirements

5.6.3.1 General

The statistical sampling procedures described in 5.7 shall be used.

5.6.3.2 Criteria for lot rejection

Lots failing to meet the quality conformance inspection of either group A or group B inspection shall not be accepted. If, during quality conformance inspection, devices fail a test in a subgroup which would result in the lot being rejected, the quality conformance inspection can be terminated, and the lot shall be considered a rejected lot in group A and B. If a lot is withdrawn in a state of failing to meet quality conformance requirements and is not re-submitted, it shall be considered a rejected lot.

5.6.3.3 Re-submitted lots

Failing lots, that have been reworked when technically possible and are resubmitted for quality conformance inspection, shall contain only devices that were included in the original lot and shall be re-submitted only once for each inspection group (group A and B). Re-submitted lots shall be kept separate from new lots and shall be clearly identified as re-submitted lots. Re-submitted lots shall be randomly re-sampled and inspected for all the inspection criteria of group A.

5.6.3.4 Procedure in case of test equipment failure or operator error

If any devices are believed to have failed as a result of faulty test equipment or operator error, the failures shall be entered in the test record (but may be excluded from the CRRL) and shall be submitted along with a complete explanation of why the failures are believed to be invalid.

The chief inspector shall decide whether replacement devices from the same inspection lot may be added to the sample. Replacement devices shall be subjected to the same tests to which the discarded devices were subjected prior to failure and to any remaining specified tests to which the discarded devices were not subjected prior to failure.

5.6.3.5 Procedure in case of failure in periodic tests

When a group B failure occurs, the corresponding group C tests are invalid. In the event of failing periodic inspection tests for causes other than faults or an operator error, see the rules of procedure given in the specified quality assessment system.

Case 1) When a sample fails to satisfy the requirements of a periodic test the DMR (or, where applicable, the local DMR) shall immediately

- suspend further releases under the mark, or certificate of conformity of the component in question,
- initiate an investigation to determine the reasons for failure, and
- report the situation.

Case 2) The DMR (or, where applicable, the local DMR) shall maintain this suspension until the investigation has been concluded. The DMR (or, where applicable, the local DMR) shall then proceed according to the appropriate conditions in case 3), case 4) or case 5).

Case 3) If the failure is concluded to have been due solely to an error in test procedure,

a) release under the mark, or certificate of conformity shall be resumed immediately, and

b) the correct test procedure shall be applied to a sample drawn from the first available inspection lot. If the sample fails the corrected test, action shall be taken as in case-1).

Case 4) If the failure is concluded to be due to an identified manufacturing fault which can immediately be corrected,

a) release under the mark, or certificate of conformity of corrected lots shall be resumed immediately,

b) the test shall be repeated on the first available corrected lot, and

c) if the result of the repeated test is unsatisfactory, the procedure defined in Case-5) or Case-6) shall be applied as appropriate.

Case 5) If the failure is concluded to be due to an identified manufacturing fault which cannot be corrected immediately, but defective components can be detected and rejected by an appropriate eliminating test acceptable to the DMR (or, where applicable, the local DMR),

a) release under the mark, or certificate of conformity of accepted components shall be resumed immediately, and

b) elimination before submission for acceptance shall be continued until the necessary steps to correct the manufacturing fault have been taken, and until satisfactory results for the periodic test in question have been obtained on a sample from the first available lot presented for inspection after correction.

Case 6) If the failure is concluded to be due to an identified manufacturing fault which cannot be corrected immediately and defective components cannot be removed by the application of an eliminating test, the CB shall suspend the QA and withdraw the right to use the mark, or certificate, of conformity for the component in question. QA and the right to use the Mark, or Certificate, of Conformity shall be reinstated when the manufacturer can demonstrate, by the successful submission of a sample from a production lot to the periodic test, that the manufacturing fault has been eliminated.

Case 7) If the failure cannot be attributed with certainty to a specific error in test procedure or to an identified manufacturing fault, samples from subsequent lots shall then be subjected to all tests in the subgroup of the periodic test in which the failure occurred, on a lot-by-lot basis, and released if these samples pass the test successfully. The sample size shall be that designated for the subgroup.

Except where otherwise specified in the generic specification, normal periodic testing shall be resumed when two successive lots have successfully passed the tests in the subgroup in question, or as otherwise specified in the generic specification.

Case 8) If the requirements of Case-4), Case-5) or Case-6) are not fulfilled within a reasonable period of time, QA shall be re-examined and may be withdrawn.

Case 9) If the duration of the periodic test in question exceeds three months and if special conditions would be appropriate to the particular type of component and the nature or extent of the failure, the relevant specification shall prescribe any special procedure to be followed.

5.6.4 Supplementary procedure for reduced inspection

5.6.4.1 Group B

A special reduced inspection procedure may be used which allows the manufacturer to carry out the appropriate group B tests at normal inspection on every fourth lot with a maximum interval of three months instead of on a lot-by-lot basis for the tests in all subgroups of group B. This special procedure applies to each subgroup which has fulfilled the required conditions.

The condition for this change shall be that 10 successive lots have passed group B inspection. Reversion to normal inspection in group B shall be made when a sample has failed to meet a subgroup inspection under the reduced inspection procedure.

5.6.4.2 Group C

When a three-month interval is specified for periodic tests, the test period may be extended to six months provided that three successive periodic tests have been passed at three-month intervals. Reversion to the normal three-month interval shall be made when a sample has failed to meet a subgroup inspection under the extended interval procedure.

5.6.5 Sampling requirements for small lots

Where a lot size is small, the procedures shall refer to 3.6.4 of IEC 60747-10:1991 or 3.5 of IEC 60410:1973.

5.6.6 Certified records of released lots (CRRL)

Lots released by manufacturers or distributors shall be unambiguously identified by a mark, or certificate of conformity. This mark, or certificate, means that the components have been released in accordance with the requirements of the relevant detail specification.

Only components approved against a detail specification registered within the system may receive the mark, or certificate of conformity.

Authorization to affix, or to issue, the mark, or certificate, of conformity is suspended or withdrawn if there is persistent non-conformity with the specification.

5.6.7 Delivery of devices subjected to destructive or non-destructive tests

Tests considered as destructive are marked (D) in the sectional or blank detail specifications. Devices subjected to destructive tests shall not be included in the lot for delivery. Devices subjected to non-destructive environmental tests may be delivered provided they are re-tested according to group A requirements and satisfy them.

5.6.8 Delayed deliveries

Before delivery of lots in store for a period and in conditions specified in the relevant sectional or blank detail specification, the lots or the quantities to be delivered shall undergo the specified group A inspection and the group B interconnection ability tests. Once this has been done for the complete lot, no further re-testing is required for another period.

5.6.9 Supplementary procedure for deliveries

The manufacturer may, at his discretion, supply devices that have met a more severe assessment level than that required.

5.7 Statistical sampling procedures

5.7.1 General

For group A, B and C inspections, either the AQL sampling procedure or the LTPD sampling procedure shall be used. The detail specification shall specify which of the procedures is to be used.

5.7.2 AQL sampling plans

See IEC 60410, ISO 2859-1 and ISO 2859-10.

There are three types of sampling plans: single, double and multiple. When several types of plans are available for a given AQL and code letter, any one may be used.

5.7.3 LTPD sampling plans

See Annex C as an example.

5.8 Endurance tests

Endurance tests shall be specified in the detail specification.

5.9 Endurance tests where the failure rate is specified

5.9.1 Overview

Failure rate as used in this standard is defined as LTPD expressed as a percentage per thousand hours.

5.9.2 General

Endurance tests shall be conducted in accordance with the procedures mentioned.

Endurance tests performed on devices at, or within, their maximum ratings shall be considered non-destructive.

5.9.3 Selection of samples

Samples for endurance tests shall be selected at random from the inspection lot (see Annex C as an example). The sample size for a 1 000 h test shall be chosen by the manufacturer from the column under the specified failure rate (see Table C.1 as an example) or the actual lot size (see Table C.2 as an example).

The acceptance number shall be the one associated with the particular sample size chosen.

5.9.4 Failure

A device which fails at one or more of the end-point limits specified for endurance tests at any specified reading interval shall be considered a failure and be considered as such at any subsequent reading interval. If the sample fails, the test may be terminated at the discretion of the manufacturer.

5.9.5 Endurance test time and sample size

Whenever the failure rate is specified, the endurance test time shall be 1 000 h initially. Once a lot has passed the 1 000 h test, endurance tests can be reduced to a certain period, as specified in the detail specification.

5.9.6 Procedure to be used if the number of observed failures exceeds the acceptance number

5.9.6.1 General

In the event that the number of failures observed in endurance tests exceeds the acceptance number, the manufacturer shall choose one of the following options:

a) withdraw the entire lot;

b) add additional samples in accordance with 5.9.6.2;

c) extend the test time to 1 000 h in accordance with 5.9.6.3, if a time less than 1 000 h was originally chosen;

d) screen the lot and re-submit.

5.9.6.2 Additional samples

This option shall be used only once for each submission. When this option is chosen, a new total sample size (initial plus added) can be chosen by the manufacturer from Tables C.1 or C.2 from the column specifying the failure rate (Table C.1) or the actual lot size (Table C.2). A quantity of additional units sufficient to increase the sample to the newly chosen total sample size shall be selected from the lot. The new acceptance number shall be the one associated with the new total sample size chosen. The added sample shall be subjected to the same endurance test conditions and time period as the initial sample. If the total observed number of defectives (initial plus added) does not exceed the acceptance number for the total sample, the lot shall be accepted; if the observed number of defectives exceeds the new acceptance number, the lot shall be rejected.

5.9.6.3 Extension of endurance test period

If an endurance test time period less than 1 000 h is used and the number of failures observed in the initial sample exceeds the acceptance number, the manufacturer may, instead of adding additional samples, choose to extend the test time of the entire initial sample to 1 000 h and determine a new acceptance number from Tables C.1 or C.2. The new acceptance number shall be one associated with the largest sampling size in the specified column which is less than, or equal to, the sample size being tested. A device which is a failure at the initial

reading interval shall be considered as such at the 1 000 h reading interval. If the observed number of defectives exceeds this acceptance number, the lot shall not be accepted.

6 Test and measurement procedures

6.1 Standard atmospheric conditions for electrical and optical measurements

Unless otherwise specified, all electrical and optical measurements are carried out under the atmospheric conditions given in IEC 60749 and IEC 61747-30-1.

Ambient temperature	25 °C ± 5 °C
Relative humidity	Between 45 % and 75 %
Atmospheric pressure	Between 86 kPa and 106 kPa (860 mbar and 1 060 mbar)

Measurements may be carried out at other temperatures provided the device will conform to the detail specification when tested at an ambient temperature of 25 °C ± 1 °C and relative humidity between 48 % and 52 % when this is important.

6.2 Physical examination

6.2.1 Visual examination

Unless otherwise specified, visual examination shall be performed under normal factory lighting and under normal visual conditions. Examination shall be made for the correctness of the following elements:

a) marking and legibility[1];

b) terminal identification;

c) appearance of the device, which shall be checked in accordance with IEC 61747-20.

6.2.2 Dimensions

6.2.2.1 General

Dimensions shall be checked in accordance with the specified drawing. Examples of typical drawings for LCD modules are shown in Annex B.

6.2.2.2 Permanence of marking

The purpose of this test is to determine the permanence of the marking following handling and use of typical cleaning on the device. Test Xa, specified in IEC 60068-2-45, is applicable.

6.2.2.3 Conditions

Solvents, rubbing conditions and materials shall be specified in the relevant sectional or blank detail specification.

6.2.2.4 Initial and final measurement

The specimen shall be visually inspected.

1 This is being revised.

6.3 Electrical and optical measurements

6.3.1 Alternative methods

Measurements may be carried out by using the methods specified or any other method giving equivalent results but, in case of dispute, only the specified method shall be used.

NOTE By “equivalent” is meant that the value of the characteristic established by such other methods is within the specified limits when measured using the specified method.

The methods for electrical and optical measurements shall be in accordance with IEC 60747 and IEC 60748. They shall be used when required and as prescribed by the detail specification.

The methods for electrical and optical measurements not included in IEC 60747 and IEC 60748 shall be described in the relevant or detail specification.

6.3.2 Precision of measurements

The limits quoted in detail specifications are absolute. Measurement inaccuracies shall be taken into account when determining the actual measurement limits.

6.3.3 General precautions

The usual precautions should be taken to reduce measurement errors to a minimum and to avoid damage to the device. The most important points of these are given in IEC 60747-1.

6.4 Environmental tests

Methods for environmental tests shall be in accordance with IEC 61747-10-2. They shall be used when required and as prescribed by the detail specification. They are indicated as “destructive” or “non-destructive” according to IEC 61747-10-2. When a mandatory sequence of testing is required, it shall be specified in the sectional specification or in the blank detail specification.

Methods for environmental tests not included in IEC 61747-10-2 shall be described in the detail specification.

For those test methods which involve the observation or the application of external forces which are related to the orientation of the device, such orientations and the direction of the force applied shall be in accordance with Annex B.

6.5 Mechanical tests

Methods for mechanical tests shall be in accordance with IEC 61747-10-1. They shall be used when required and as prescribed by the detail specification. When a mandatory sequence of testing is required, it shall be specified in the sectional specification or in the blank detail specification.

Methods for mechanical tests not included in IEC 61747-10-1 shall be described in the detail specification.

For those test methods which involve the observation or the application of external forces which are related to the orientation of the device, such orientations and the direction of the force applied shall be in accordance with Annex B.

Annex A
(informative)

Examples of outline drawings of liquid crystal display cells

Annex A provides examples of drawings of liquid crystal display cells (see Figures A.1 and A.2) as well as examples of dimensions of each element (see Table A.1).

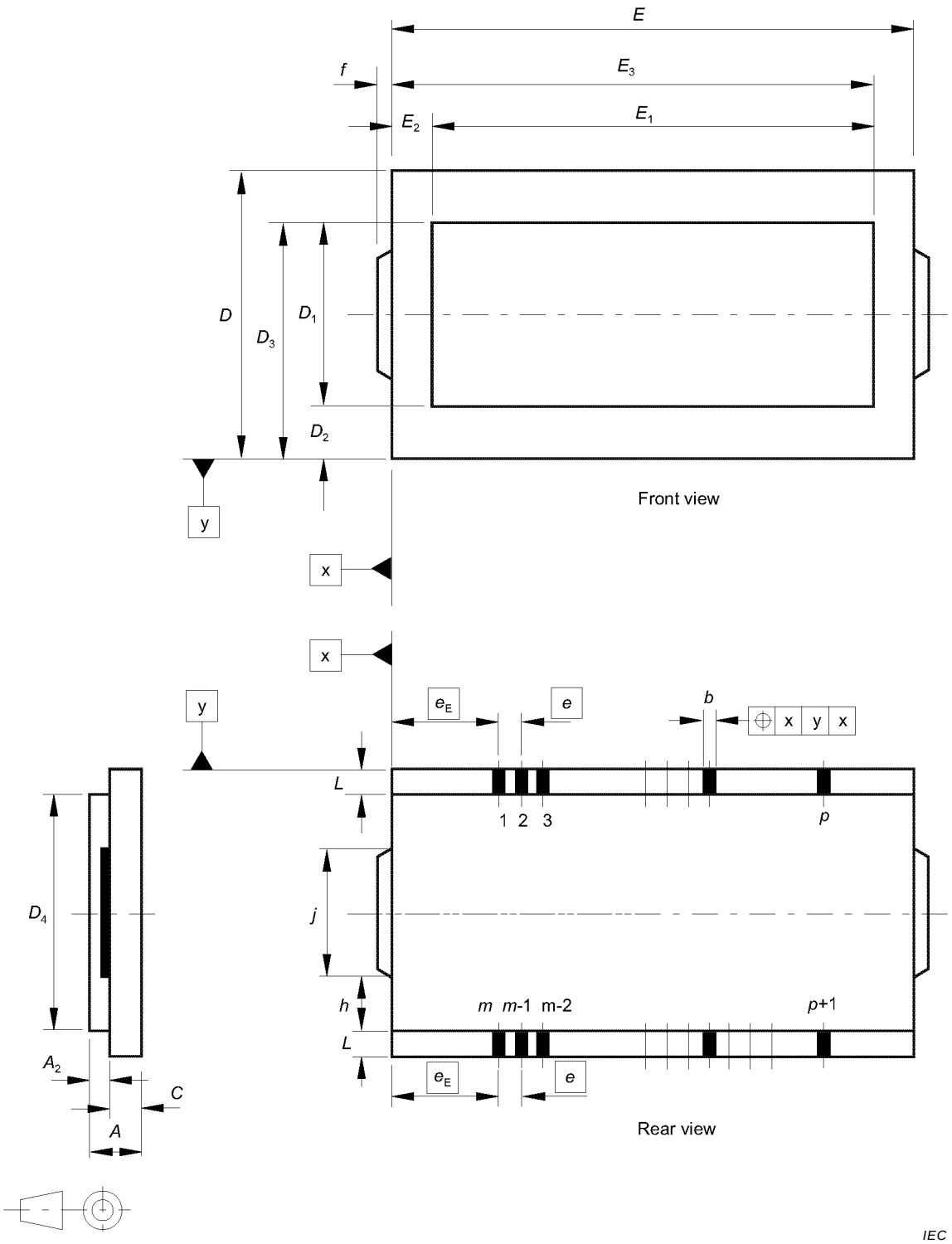

Figure A.1 – Example of outline drawings of liquid crystal display cells

Nb	Segments
1	4G
2	4E
3	4D
–	–
–	–
–	–
m-1	4A
m-2	4F
m	4B

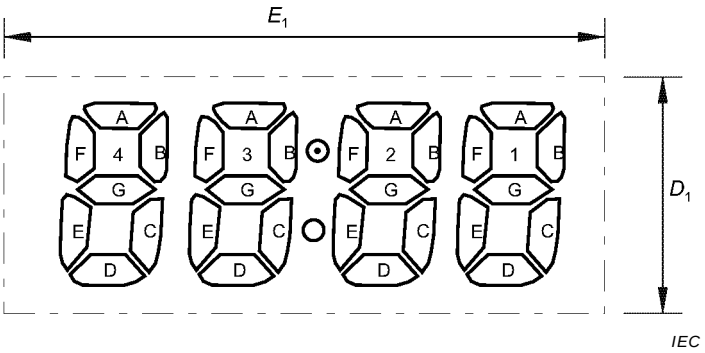

Figure A.2 – Example of outline drawings of liquid crystal display cells

Table A.1 – Example of table for dimension of each element

Original dimensions are in millimetres and inches:

Ref.	Millimetres			Inches			Footnotes
	Min.	Nom.	Max.	Min.	Nom.	Max.	
A	x	–	x	x	–	X	
A_2	x	–	–	x	–	–	[a]
C	x	–	x	x	–	X	
b	x	–	x	x	–	X	
D	–	–	x	–	–	X	
D_1	–	x	–	–	x	–	[b]
D_2	x	–	x	x	–	X	
D_3	x	–	x	x	–	X	
D_4	x	–	x	x	–	X	
e	–	x	–	–	x	–	[d] and [f]
e_E	–	x	–	–	x	–	[d]
E	–	–	x	–	–	X	
E_1	–	x	–	–	x	–	[b]
E_2	x	–	x	x	–	X	
E_3	x	–	x	x	–	X	
f	–	–	x	–	–	X	
h	x	–	x	x	–	X	
j	–	–	x	–	–	X	
L	x	–	–	x	–	–	
n	–	x	–	–	x	–	[c]

x	–	–	x	–	–	X	[e]

a Overall dimensions, including polarizers and diffusers, if any.
b Nominal dimensions of observation area.
c Total number of terminals, including lacking or non-connected positions.
d True geometrical dimension.
e Positional tolerance (in accordance with ISO 1101).
f e: standard pitch.

Annex B
(normative)

Orientation of LCD modules

Annex B shows the orientation of LCD modules (see Figure B.1).

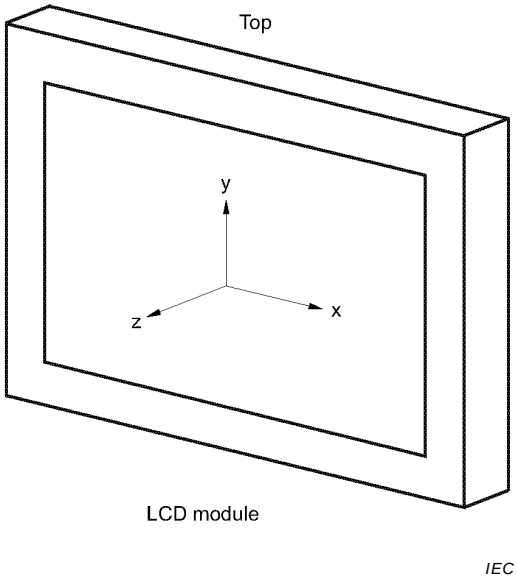

Figure B.1 – Orientation of LCD modules

Annex C
(informative)

Lot tolerance percentage defective (LTPD) sampling plans

C.1 General

C.1.1 Overview

The following specified procedures are suitable for all quality conformance requirements.

C.1.2 Selection of samples

Samples shall be randomly selected from the inspection lot. For continuous production, the manufacturer, at his option, may select samples in a regular periodic manner during manufacture, provided that the lot meets the requirements for the formation of lots.

C.1.3 Failures

Failure of a unit for one or more tests of a subgroup shall be charged as a single failure.

C.2 Single-lot sampling method

C.2.1 General

Quality conformance inspection information (sample sizes and number of observed defectives) shall be accumulated from a single inspection lot to demonstrate conformance to the individual subgroup criteria.

C.2.2 Sample size

The sample size for each subgroup can be determined from Tables C.1 or C.2 and shall meet the specified LTPD. The manufacturer may, at his option, select a sample size greater than that required; however, the number of failures permitted shall not exceed the acceptance number associated with the chosen sample size, for example shown in Tables C.1 or C.2.

In Table C.2, the LTPD column to be used for sample size determination shall be that given in the lot size column which is nearest in value to the actual size of the submitted lot except that, if the actual lot size is halfway between two of the lot sizes given in the table, either of the lot size columns may be used at the manufacturer's discretion. If, in Table C.2, the appropriate lot size column does not contain an LTPD value equal to or less than the specified LTPD value, a 100 % inspection shall be used. In Table C.2, the LTPD value in the appropriate lot size column which is numerically closest to the specified LTPD value shall be used to determine the sample size.

C.2.3 Acceptance procedure

For the first sampling, an acceptance number shall be chosen and the associated number of sample devices for the specified LTPD selected and tested. If the observed number of defectives from the first sample is less than or equal to the pre-selected acceptance number, the lot shall be accepted. If the observed number of defectives exceeds the pre-selected acceptance number, an additional sample may be chosen such that the total sample complies with 5.9.6. Tables C.1 or C.2, which are used for the first sampling of a given inspection lot for a given subgroup, shall be used for any and all subsequent samplings for the same lot and subgroup for each lot submission.

C.3 Additional sample

The manufacturer may add an additional quantity to the initial sample, but this may be done only once for any subgroup; the added samples shall be subjected to all the tests within the subgroup. The total sample size (initial and added samples) shall be determined by the new acceptance number selected from Tables C.1 or C.2.

C.4 Multiple criteria

When one sample is used for more than one acceptance criterion, the entire sample for a subgroup shall be used for all criteria within the subgroup. In Table C.1, the acceptance number shall be that associated with the largest sample size in the appropriate LTPD column which is less than or equal to the sample size used. In Table C.2, the acceptance number shall be that associated with the specified LTPD in the appropriate lot size column for the sample size used.

C.5 100 % inspection

Inspection of 100 % of the lot shall be allowed, at the option of the manufacturer, for subgroups other than those which are called destructive. If the observed percentage of defective devices for the inspection lot exceeds the specified LTPD value, the lot shall be considered to have failed the appropriate subgroup(s). Re-submission of lots tested on a 100 % inspection basis shall also be on a 100 % inspection basis only and in accordance with the tightened inspection LTPD.

C.6 Tightened inspection

Tightened inspection shall be performed by testing to the criteria of the next lowest LTPD in Tables C.1 or C.2 to those specified.

Table C.1 – LTPD sampling plans

Minimum size of samples to be tested to ensure, with a 90 % confidence, that a lot having a percentage of defective devices equal to the specified LTPD will not be accepted (single sample)

LTPD	50	30	20	15	10	7	5	3	2	1,5	1	0,7	0,5	0,3	0,2	0,15	0,1
Acceptance number (c) ($r = c + 1$)[a]	**Minimum sample sizes (for device/hours required for life test, multiply by 1 000)**																
0	5 (1,03)	8 (0,64)	11 (0,46)	15 (0,34)	22 (0,23)	32 (0,16)	45 (0,11)	76 (0,07)	116 (0,04)	153 (0,03)	231 (0,02)	328 (0,02)	461 (0,01)	767 (0,007)	1 152 (0,005)	1 534 (0,003)	2 303 (0,002)
1	8 (4,4)	13 (2,7)	18 (2,0)	25 (1,4)	38 (0,94)	55 (0,65)	77 (0,46)	129 (0,28)	195 (0,18)	258 (0,14)	390 (0,09)	555 (0,06)	778 (0,045)	1 296 (0,027)	1 946 (0,018)	2 592 (0,013)	3 891 (0,009)
2	11 (7,4)	18 (4,5)	25 (3,4)	34 (2,24)	52 (1,6)	75 (1,1)	105 (0,78)	176 (0,47)	266 (0,31)	354 (0,23)	533 (0,15)	759 (0,11)	1 065 (0,080)	1 773 (0,045)	2 662 (0,031)	3 547 (0,022)	5 323 (0,015)
3	13 (10,5)	22 (6,2)	32 (4,4)	43 (3,2)	65 (2,1)	94 (1,5)	132 (1,0)	221 (0,62)	333 (0,41)	444 (0,31)	668 (0,20)	953 (0,14)	1 337 (0,10)	2 226 (0,062)	3 341 (0,041)	4 452 (0,031)	6 681 (0,018)
4	16 (12,3)	27 (7,3)	38 (5,3)	52 (3,9)	78 (2,6)	113 (1,8)	158 (1,3)	265 (0,75)	398 (0,50)	531 (0,37)	798 (0,25)	1 140 (0,17)	1 599 (0,12)	2 663 (0,074)	3 997 (0,049)	5 327 (0,037)	7 994 (0,025)
5	19 (13,8)	31 (8,4)	45 (6,0)	60 (4,4)	91 (2,9)	131 (2,0)	184 (1,4)	308 (0,85)	462 (0,57)	617 (0,42)	927 (0,28)	1 323 (0,20)	1 855 (0,14)	3 090 (0,085)	4 638 (0,056)	6181 (0,042)	9 275 (0,028)
6	21 (15,6)	35 (9,4)	51 (6,6)	68 (4,9)	104 (3,2)	149 (2,2)	209 (1,6)	349 (0,94)	528 (0,62)	700 (0,47)	1 054 (0,31)	1 503 (0,22)	2 107 (0,155)	3 509 (0,093)	5 267 (0,062)	7 019 (0,047)	10 533 (0,031)
7	24 (16,6)	39 (10,2)	57 (7,2)	77 (5,3)	116 (3,5)	166 (2,4)	234 (1,7)	390 (1,0)	589 (0,67)	783 (0,51)	1 178 (0,34)	1 680 (0,24)	2 355 (0,17)	3 922 (0,101)	5 886 (0,067)	7 845 (0,051)	11 771 (0,034)
8	26 (18,1)	43 (10,9)	63 (7,7)	85 (5,6)	128 (3,7)	184 (2,6)	258 (1,8)	431 (1,1)	648 (0,72)	864 (0,54)	1 300 (0,36)	1 854 (0,25)	2 599 (0,18)	4 329 (0,108)	5 498 (0,072)	8 660 (0,054)	12 995 (0,036)
9	28 (19,4)	47 (11,5)	69 (8,1)	93 (6,0)	140 (3,9)	201 (2,7)	282 (1,9)	471 (1,2)	709 (0,77)	945 (0,58)	1 421 (0,38)	2 027 (0,27)	2 842 (0,19)	4 733 (0,114)	7 103 (0,077)	9 468 (0,057)	14 206 (0,038)
10	31 (19,9)	51 (12,1)	75 (8,4)	100 (6,3)	152 (4,1)	218 (2,9)	306 (2,0)	511 (1,2)	770 (0,80)	1 025 (0,60)	1 541 (0,40)	2 199 (0,28)	3 082 (0,20)	5 133 (0,120)	7 704 (0,080)	10 268 (0,060)	15 407 (0,040)
11	33 (21,0)	54 (12,8)	83 (8,3)	111 (6,2)	166 (4,2)	238 (2,9)	332 (2,1)	555 (1,2)	832 (0,83)	1 109 (0,62)	1 664 (0,42)	2 378 (0,29)	3 323 (0,21)	5 546 (0,12)	8 319 (0,083)	11 092 (0,062)	16 638 (0,042)

LTPD	50	30	20	15	10	7	5	3	2	1,5	1	0,7	0,5	0,3	0,2	0,15	0,1
Acceptance number (c) ($r = c + 1$)[a]	**Minimum sample sizes (for device/hours required for life test, multiply by 1 000)**																
12	36 (21,4)	59 (13,0)	89 (8,6)	119 (6,5)	178 (4,3)	254 (3,0)	356 (2,2)	594 (1,3)	890 (0,86)	1 187 (0,65)	1 731 (0,43)	2 544 (0,3)	3 562 (0,22)	5 936 (0,13)	8 904 (0,086)	11 872 (0,065)	17 808 (0,043)
13	38 (22,3)	63 (13,4)	95 (8,9)	126 (6,7)	190 (4,5)	271 (3,1)	379 (2,26)	632 (1,3)	948 (0,89)	1 264 (0,67)	1 896 (0,44)	2 709 (0,31)	3 793 (0,22)	6 321 (0,134)	9 482 (0,089)	12 643 (0,067)	18 964 (0,045)
14	40 (23,1)	67 (13,8)	101 (9,2)	134 (6,9)	201 (4,6)	288 (3,2)	403 (2,3)	672 (1,4)	1 007 (0,92)	1 343 (0,69)	2 015 (0,46)	2 878 (0,32)	4 029 (0,23)	6 716 (0,138)	10 073 (0,092)	13 431 (0,069)	20 146 (0,046)
15	43 (23,3)	71 (14,1)	107 (9,4)	142 (7,1)	213 (4,7)	305 (3,3)	426 (2,36)	711 (1,41)	1 066 (0,94)	1 422 (0,71)	2 133 (0,47)	3 046 (0,33)	4 265 (0,235)	7 108 (0,141)	10 662 (0,094)	14 216 (0,070)	21 324 (0,047)
16	45 (24,1)	74 (14,6)	112 (9,7)	150 (7,2)	225 (4,8)	321 (3,37)	450 (2,41)	750 (1,44)	1 124 (0,96)	1 499 (0,72)	2 249 (0,48)	3 212 (0,337)	4 497 (0,241)	7 496 (0,144)	11 244 (0,096)	14 992 (0,072)	22 487 (0,048)
17	47 (24,7)	79 (14,7)	118 (9,86)	158 (7,36)	236 (4,93)	338 (3,44)	473 (2,46)	788 (1,48)	1 182 (0,98)	1 576 (0,74)	2 364 (0,49)	3 377 (0,344)	4 728 (0,246)	7 880 (0,148)	11 819 (0,098)	15 759 (0,074)	23 639 (0,049)
18	50 (24,9)	83 (15,0)	124 (10,0)	165 (7,54)	248 (5,02)	354 (3,61)	496 (2,51)	826 (1,51)	1 239 (1,0)	1 652 (0,75)	2 478 (0,50)	3 540 (0,351)	4 956 (0,251)	8 260 (0,151)	12 390 (0,100)	16 520 (0,075)	24 780 (0,050)
19	52 (25,5)	86 (15,4)	130 (10,2)	173 (7,76)	259 (5,12)	370 (3,58)	518 (2,56)	864 (1,53)	1 296 (1,02)	1 728 (0,77)	2 591 (0,52)	3 702 (0,358)	5 183 (0,256)	8 638 (0,153)	12 957 (0,102)	17 276 (0,077)	25 914 (0,051)
20	54 (26,1)	90 (15,6)	135 (10,4)	180 (7,82)	271 (5,19)	386 (3,65)	541 (2,60)	902 (1,56)	1 353 (1,04)	1 803 (0,78)	2 705 (0,52)	3 864 (0,364)	5 410 (0,260)	9 017 (0,156)	13 526 (0,104)	18 034 (0,078)	27 051 (0,052)
25	65 (27,0)	109 (16,1)	163 (10,8)	217 (8,08)	326 (5,38)	466 (3,76)	652 (2,69)	1 086 (1,61)	1 629 (1,08)	2 173 (0,807)	3 259 (0,538)	4 656 (0,376)	6 518 (0,269)	10 863 (0,161)	16 295 (0,108)	21 726 (0,081)	32 589 (0,054)

[a] r is the failure criterion.

NOTE 1 Sample sizes are based upon the Poisson exponential binomial limit.

NOTE 2 The minimum quality (approximate AQL) required to accept (on average) 19 out of 20 lots is shown in parentheses for information only.

Table C.2 – Hypergeometric sampling plans for small lot sizes of 200 or less

N	10	20	30	40	50	60	80	100	120	150	160	200
						c **= 0**						
n	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD	NQT/ LTPD
2	65	66	67	67	67	68	68	68	68	68	68	68
4	36	40	42	42	42	43	43	43	43	43	44	44
5	29	33	34	35	35	35	36	36	37	37	37	37
8	15	20	22	23	23	23	24	24	24	24	24	25
10		15	17	19	19	19	20	20	20	20	20	20
16		6,9	10	11	11	12	12	13	13	13	13	13
20			6,8	8,0	8,7	9,0	9,4	10	10	10	10	11
25			4,3	5,7	6,4	6,9	7,4	7,5	7,6	7,7	7,8	7,9
32				3,7	4,4	5,0	5,5	5,9	6,0	6,2	6,3	6,3
40					3,0	3,4	4,0	4,5	4,6	4,9	5,0	5,0
50						2,3	2,9	3,3	3,5	3,7	3,7	3,9
64							1,7	2,2	2,5	2,7	2,8	2,9
80								1,5	1,7	2,0	2,1	2,2
100									1,1	1,5	1,5	1,7
125										0,8	0,9	1,2
128										0,8	0,9	1,1
160												0,7
						c **= 1**						
2	95	95	95	95	95	95	95	95	95	95	95	95
4	62	66	66	67	67	67	67	67	67	67	67	68
5	51	55	56	57	57	58	58	58	58	58	58	58
8	28	35	38	38	39	39	39	39	39	40	40	40
10		30	30	31	32	32	32	33	33	33	33	33
16		15	18	18	20	20	21	21	21	21	22	22
20			13	15	16	16	16	16	17	17	17	18
25			9,2	11	12	13	13	13	13	14	14	14
32				7,4	8,2	9,0	9,9	10	10,5	11	11	11
40					5,9	6,8	7,6	7,8	8,2	8,3	8,4	8,6
50						4,6	5,6	6,1	6,4	6,5	6,7	6,7
64							3,8	4,4	4,7	5,0	5,0	5,2
80								3,0	3,4	3,7	3,8	4,0
100									2,5	2,8	2,8	3,0
125										1,9	2,0	2,2
128										1,7	1,9	2,2
160												1,5

N	10	20	30	40	50	60	80	100	120	150	160	200
						c **= 2**						
4	82	83	84	85	85	85	85	86	86	86	86	86
5	69	73	74	74	74	75	75	75	75	75	75	75
8	42	49	49	52	52	52	53	53	53	53	53	53
10		39	42	42	43	43	43	44	44	44	44	44
16		22	25	27	27	27	28	29	29	29	29	30
20			19	21	22	22	23	23	23	23	24	24
25			13	16	17	17	18	18	18	18	19	19
32				11	12	13	14	14	14	14,5	15	15
40					8,9	9,8	11	12	12	12	12	12
50						6,9	8,1	8,4	8,6	9,0	9,3	9,5
64							5,7	6,2	6,6	7,1	7,1	7,4
80								4,5	4,9	5,4	5,4	5,3
100									3,5	3,9	4,0	4,4
125										2,8	2,9	3,3
128										2,6	2,9	3,2
160												2,3

N = lot size n = sample size *c* = acceptance number (see 5.6.4)

NOTE Table C.2 gives the LTPD values associated with certain single sampling plans (acceptance number, sample size and lot size). The table has the following features:

a) calculations are based upon the hypergeometric distribution (exact theory) for lots of 200 devices or less;

b) the LTPD of a sampling plan is defined as the interpolated percentage of defectives for which there is a 0,10 probability of lot acceptance under the plan. The LTPD so defined need not be a realizable lot percentage of defectives for the lot size involved;

c) the sequence of sample sizes and lot sizes are generated by taking products of preceding numbers in the respective sequences and the numbers 2 and 5.

Table C.3 – AQL and LTPD sampling plans

AQL	0,10	0,15	0,25	0,40	0,65	1,0	1,5	2,5	4,0	6,5
LTPD	0,7	1,0	2,0	3	5	7	10	20	30	50

Table C.3 gives AQL and LTPD values which are considered to be sufficient to ensure that a satisfactory average outgoing quality limit will be maintained under both plans for lot sizes up to 150 000. It should be noted that the limiting quality protection varies relatively widely with lot size under the AQL plan, in comparison with the LTPD plan.

The table has been formulated by selecting, at an acceptance number c = 2, the LTPD value in Table C.1 at which the sample size is most nearly equal to the sample size given for inspection level II, sample size code letters C through N in IEC 60410 and/or ISO 2859.

Table C.3 may be used provided that the maximum value of the acceptance number of the LTPD sampling plan is not greater than 4.

Bibliography

[1] ISO 9241-3:1992, *Ergonomic requirements for office work with visual display terminals* (VDTs) – *Part 3: Visual display requirements*

[2] ISO 1101, *Geometrical product specifications (GPS) – Geometrical tolerancing – Tolerancing of form, orientation, location and run-out*

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