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Photography — Medical radiographic cassettes/screens/films and hard-copy imaging films — Dimensions and specifications

Photographie — Cassettes/écrans/films radiographiques médicaux et films d'imagerie copie-papier — Dimensions et spécifications

Reference number
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Contents

Page

Figures

Tables

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4090 was prepared by Technical Committee ISO/TC 42, *Photography*.

This third edition cancels and replaces the second edition (ISO 4090:1991) which has been technically revised.

Annexes B and E form a normative part of this International Standard. Annexes A, C, D and F to I are for information only.

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Introduction

This International Standard is based on a combination and revision of the following five documents:

— ANSI/NAPM ITI. 49-1995, *Photography (Films) — Medical radiographic cassettes/screens/films — Dimensions and specifications*

— IEC 60406:1997, *Cassettes for medical X-ray diagnosis — Radiographic cassettes and mammographic cassettes*

— IEC 60658:1979, *Radiographic intensifying screens for medical use — Dimensions*

— ISO WD1/4090, *Photography — Film Dimensions — Medical radiography*

— ISO WD2/15264, *Photography — Medical hard copy imaging film — Dimensions and specifications*

The aim of this International Standard is to bring together all standardized information about dimensions and related specifications of photographic materials in the form of sheets and related products (screens and cassettes); all of which are intended for use in medical radiography. The worldwide community using radiographic equipment will benefit by having all this information in a single text.

This text of this International Standard is not intended to change the contents of the aforementioned documents, but only to bring them together and to resolve the discordance existing between the different standards or standard projects. The existence of a single International Standard for sheet films and related products will resolve existing differences by converting inch sizes to metric sizes.

Inch nominal sizes and inch dimensions are not found in this International Standard. Informative annex F describes the transition from inch to metric dimensions for the reader. Conversion to metric specifications has resulted in a potentially confusing situation. Use of the same nominal dimension (20×40 and 20×25, for example) might imply to the reader that the aims and tolerances should be identical. In some cases, where one size is of inch origin and the other is of metric origin, this is not true. Therefore, TC 42 agreed that it would be best to separate tables into sizes of metric origin versus sizes of inch origin.

By combining the existing documents and the dimensional tables, the reader can now easily compare sizes of films, screens and cassettes — all in a glance. Combination has also facilitated a significant comparison of preferred and recognized sizes, as well as a reconciliation of whether films and screens properly fit inside their corresponding cassettes. This comparison has resulted in a significant improvement in the agreement between sizes, as well as component “fit”.

This International Standard refers to mammography cassettes as either preferred sizes or recognized sizes. All new mammography cassettes must conform to the dimensions given as “preferred”. The dimensions given for recognized sizes are listed in order to inform the reader regarding an older style of mammography cassettes. Although the older style cassettes are no longer preferred (no longer the industry standard), use of this style throughout the world is expected to continue for some time. So, they are listed here as “recognized” only.

Medical radiographic films in roll form are not a part of this International Standard. Use of roll films appears well established and stable, but does not justify a new, stand-alone standard. In order to assist the reader, information regarding roll films is listed in informative annex A.

Annexes G, H and I provide information on the dimensional stability of film, quantity packaging and sizes of inch origin (film dimension exceptions), respectively.

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Photography — Medical radiographic cassettes/screens/films and hard-copy imaging films — Dimensions and specifications

1 Scope

This International Standard specifies the nominal sizes, aim dimensions with tolerances, weights, and certain tests for medical radiographic cassettes, screens, and films. It includes medical hard-copy imaging films in the form of sheets, such as laser films and video.

This International Standard also includes information regarding the appropriate marking of these products, and special attention is given to cassettes/screens/films used for mammography.

This International Standard does not include films in roll format (see informative annex A).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications.*

IEC 61267:1994, *Medical diagnostic X-ray equipment — Radiation conditions for use in the determination of characteristics.*

3 Terms and definitions

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

3.1
preferred mammography sizes
current industry standard, reflecting modern industry trends

NOTE Aim and tolerance dimensions are different for preferred sizes versus recognized sizes.

3.2
recognized mammography sizes
former industry standard, listed because this older format is expected to be used in clinical applications worldwide for some time to come

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4 Conditions for measurement of dimensions

The dimensions and tolerances specified in this International Standard shall apply at the time of manufacture (except where specifically stated otherwise), when measured under atmospheric conditions of (23 ± 2) °C and (50 ± 5) % relative humidity, as specified in ISO 554.

All measuring instrument calibrations should be conducted at a temperature of 20 °C, as specified in ISO 1:1975, *Standard reference temperature for industrial length measurements*, and a relative humidity of 50 %.

5 Radiographic cassettes

5.1 Dimensions

5.1.1 Nominal sizes, aim and tolerance dimensions

Nominal sizes, aim and tolerance dimensions and weight for preferred radiographic cassette sizes shall conform to the values given in Tables 1 and 2.

Nominal sizes, aim and tolerance dimensions and weight for recognized radiographic cassette sizes shall conform to the values given in Tables 3 and 4.

The materials and design of the cassette shall ensure that, under normal conditions of use, the shape and dimensions comply with the limits for the outer dimensions (OD) and inner dimensions (ID) given in Tables 1, 2, 3 and 4, over a relative humidity range from 30 % to 85 % and a temperature range from 10 °C to 40 °C.

5.1.2 Denomination

Radiographic cassettes are denoted by the nominal size expressed in numerical values (in centimetres) without adding the measurement unit “cm”.

EXAMPLE Cassette 18×24 (eighteen by twenty-four) denotes a radiographic cassette for a film with nominal size 18 cm $\times$ 24 cm.

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Table 1 — Preferred radiographic cassette sizes of metric origin

Nominal size	Film size			Screen size			Cassette ID			Cassette OD			Thickness	Weight without screen
cm	mm			mm			mm			mm			mm	g
	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Aim and tolerance	Max.
13 × 18	127 × 177	128 × 178	129 × 179	127 × 177	130 × 180	131 × 181	131,5 × 181,5	132 × 182	133 × 183	156,5 × 206,5	157,5 × 208,5	158,5 × 208,5	15^{+1}_{-2}	500
18 × 24	177 × 237	178 × 238	179 × 239	177 × 237	180 × 240	181 × 241	181,5 × 241,5	182 × 242	183 × 243	206,5 × 266,5	207,5 × 267,5	208,5 × 268,5	15^{+1}_{-2}	800
18 × 43	177 × 429	178 × 430	179 × 431	177 × 429	180 × 432	181 × 433	181,5 × 433,5	182 × 434	183 × 435	206,75 × 458,5	207,75 × 459,5	208,75 × 460,5	15^{+1}_{-2}	1 000
20 × 40	197 × 397	198 × 398	199 × 399	197 × 397	200 × 400	201 × 401	201,5 × 401,5	202 × 402	203 × 403	226,5 × 426,5	227,5 × 427,5	228,5 × 428,5	15^{+1}_{-2}	1 000
24 × 30	237 × 297	238 × 298	239 × 299	237 × 297	240 × 300	241 × 301	241,5 × 301,5	242 × 302	243 × 303	266,5 × 326,5	267,5 × 327,5	268,5 × 328,5	15^{+1}_{-2}	1 200
30 × 40	297 × 397	298 × 398	299 × 399	297 × 397	300 × 400	301 × 401	301,5 × 401,5	302 × 402	303 × 403	326,5 × 426,4	327,5 × 427,5	328,5 × 428,5	15^{+1}_{-2}	1 900
30 × 90 (see note)	297 × 896	298 × 897,5	299 × 899	297 × 897	300 × 900	301 × 901	301,5 × 901,5	302 × 902	303 × 903	326,5 × 926,5	327,5 × 927,5	328,5 × 928,5	$16,5^{+1}_{-3,5}$	—
30 × 120 (see note)	297 × 1 196	298 × 1 197,5	299 × 1 197	297 × 1 197	300 × 1 200	301 × 1 201	301,5 × 1 201,5	302 × 1 202	303 × 1 203	326,5 × 1 226,5	327,5 × 1 227,5	328,5 × 1 228,5	$16,5^{+1}_{-3,5}$	—
Dental radiography (Extra-oral)														
13 × 30	127 × 297	128 × 298	129 × 299	127 × 297	130 × 300	131 × 301	131,5 × 301,5	132 × 302	133 × 303	156,6 × 326,5	157,6 × 327, 5	158,6 × 328,5	15^{+1}_{-2}	800
15 × 30	147 × 297	148 × 298	149 × 299	147 × 297	150 × 300	151 × 301	151,5 × 301,5	152 × 302	153 × 303	176,5 × 326,5	177,5 × 327,5	178,5 × 328,5	15^{+1}_{-2}	800

NOTE These sizes may be formed from three smaller sheets attached together. The resultant sheet may be folded to facilitate shipping.

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Table 2 — Preferred radiographic cassette sizes of inch origin

Nominal size	Film size			Screen size			Cassette ID			Cassette OD			Thickness	Weight without screen
cm	mm			mm			mm			mm			mm	g
	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Aim and tolerance	Max.
20 × 25	200,8 × 252	201,6 × 252,8	202,4 × 253,6	200,8 × 252	201,6 × 252,8	202,4 × 253,6	204,7 × 255,5	205,2 × 256	206,2 × 257	229,7 × 280,5	230,7 × 281,5	231,7 × 282,5	15^{+1}_{-2}	1 000
35 × 35	353 × 353	354 × 354	355 × 355	353 × 353	356 × 356	357 × 357	357,5 × 357,5	358 × 358	359 × 359	382,5 × 382,5	383,5 × 383,5	384,5 × 384,5	15^{+1}_{-2}	1 900
35 × 43	353 × 429	354 × 430	355 × 431	353 × 429	356 × 432	357 × 433	357,5 × 433,5	358 × 434	359 × 435	382,5 × 458,5	383,5 × 459,5	384,5 × 460,5	15^{+1}_{-2}	2 100

Table 3 — Recognized radiographic cassette sizes of metric origin

Nominal size	Film size			Screen size			Cassette ID			Cassette OD			Thickness	Weight without screen
cm	mm			mm			mm			mm			mm	g
	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Aim and tolerance	Max.
24 × 24	237 × 237	238 × 238	239 × 239	237 × 237	240 × 240	241 × 241	241,5 × 241,5	242 × 242	243 × 243	266,5 × 266,5	267,5 × 267,5	268,5 × 268,5	15^{+1}_{-2}	1 000
30 × 30	297 × 297	298 × 298	299 × 299	297 × 297	300 × 300	301 × 301	301,5 × 301,5	302 × 302	303 × 303	326,5 × 326,5	327,5 × 327,5	328,5 × 328,5	15^{+1}_{-2}	1 400
40 × 40	397 × 397	398 × 398	399 × 399	397 × 397	400 × 400	401 × 401	401,5 × 401,5	402 × 402	403 × 403	426,5 × 426,5	427,5 × 427,5	428,5 × 428,5	15^{+1}_{-2}	1 900
20 × 96 (see note)	197 × 956	198 × 957,5	199 × 959	197 × 956	200 × 960	201 × 961	201,5 × 961,5	202 × 962	203 × 963	226,5 × 986,5	227,5 × 987,5	228,5 × 988,5	$16{,}6^{+1}_{-3{,}5}$	—

NOTE This size may be formed from three smaller sheets attached together. The resultant sheet may be folded to facilitate shipping.

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Table 4 — Recognized radiographic cassette sizes of inch origin

Nominal size	Film size			Screen size			Cassette ID			Cassette OD			Thickness	Weight without screen
cm	mm			mm			mm			mm			mm	g
	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Aim and tolerance	Max.
25 × 30	252 × 302,4	252,8 × 303,2	253,6 × 304,0	252 × 303,2	252,8 × 304	253,6 × 304,8	255,5 × 306,3	256 × 306,8	257 × 307,8	280,5 × 331,3	281,5 × 332,3	282,5 × 333,3	15^{+1}_{-2}	1 200
28 × 35	277,8 × 354	278,6 × 354,8	279,4 × 355,6	277,8 × 354	278,6 × 354,8	279,4 × 355,6	280,9 × 357,1	281,4 × 357,6	282,4 × 358,6	305,9 × 382,1	306,9 × 383,1	307,9 × 384,1	15^{+1}_{-2}	1 900
30 × 35	297,2 × 353,2	298 × 354	298,8 × 354,8	297 × 353	300 × 356	301 × 357	301,5 × 357,5	302 × 358	303 × 359	326,5 × 382,5	327,5 × 383,5	328,5 × 384,5	15^{+1}_{-2}	1 900
30 × 38	302,4 × 378,6	303,2 × 379,4	304 × 380,2	303,2 × 379,4	304 × 380,2	304,8 × 381	306,3 × 382,5	306,8 × 383	307,8 × 384	331,3 × 407,5	332,3 × 408,5	333,3 × 409,5	15^{+1}_{-2}	1 900

5.1.3 Outer dimensions (OD)

The outer dimensions, in the plane of the film, shall be 27,5 mm ± 1 mm more than the nominal size of the cassette.

Cassettes of nominal sizes that have both dimensions not exceeding 43,2 cm shall have an aim thickness of 15 mm, minimum thickness of 13 mm, and maximum thickness of 16 mm.

Cassettes of nominal sizes that have one or both dimensions greater than 43,2 cm shall have an aim thickness of 16,5 mm, minimum thickness of 13 mm, and maximum thickness of 17,5 mm.

The specified thickness of a cassette is intended to ensure that the cassette can be properly fixed in a defined position under a load (e.g. within a holder or rails). In no case shall the maximum thickness tolerance, as given in Tables 1, 2, 3 and 4, be exceeded in any part of the cassette.

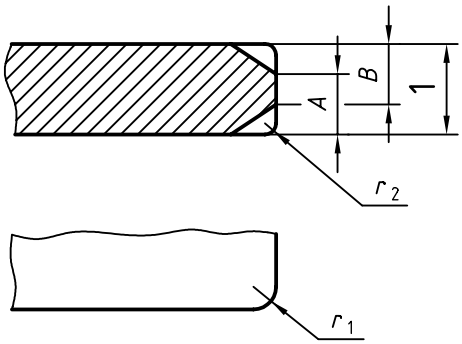
The corners and edges of the cassette, as shown in the top view of Figure 1, shall be smoothed or shaped over a quarter circle to a radius (r_1) of 10 mm maximum and 1 mm minimum.

The other edges, as shown in the side view of Figure 1, shall be smoothed over a quarter circle to a radius (r_2) of at least 1,5 mm.

The greatest value for the radius results from the minimum required planes as given by the dimensions A and B in the side view of Figure 1.

All parts of the cassette, such as hinges, locks and marking devices, shall be within the tolerances given in Tables 1, 2, 3 and 4 and shall be within the limits for corners and edges.

Dimensions in millimetres



Key

1 Thickness (see Tables 1, 2, 3, 4)

Dimension	Radiographic cassettes	Mammography cassettes
r_1	Min. = 1; Max. = 10	Min = 3; Max = 10
r_2	1,5 minimum	1,5 minimum
A	greater than 11	greater than 11
B	greater than 11	greater than 11

Figure 1 — Cassette outside dimensions

5.1.4 Inner dimensions (ID)

The inner dimensions, in the plane of the film, shall be as given in Tables 1, 2, 3 and 4.

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5.2 Geometric accuracy

5.2.1 Outer geometric accuracy

5.2.1.1 Squareness

The squareness of the cassette shall conform to the requirements given in normative annex B.

5.2.1.2 Flatness

When a closed radiographic cassette is laid on a flat surface, no part of the cassette shall depart from that surface by more than 16 mm.

5.2.1.3 Parallelism

The front and back of the radiographic cassette shall be parallel to each other within 0,3 mm over any length of 100 mm.

5.2.2 Inner geometric accuracy

5.2.2.1 Squareness

The squareness of the cassette shall conform to the requirements given in normative annex B.

5.3 Incident beam attenuation

The front cover of the cassette shall have an absorption not greater than the equivalent of 1,8 mm of pure aluminum (99 %) when traversed by radiation of quality RQA 4 [approximately 60 kV (see IEC 61267)].

5.4 Cassette design

5.4.1 Opening

When the cassette is lying on a plane surface, it shall be possible to open the back in such a way that it contacts the surface without the hinges being stressed.

5.4.2 Marking device

In order to identify the film in use, the cassette shall either permit the use of a means for marking the film, or it shall be equipped on its outside with a means for labelling.

The provision of a means to allow a semi-transparent marking of the cassette's own characteristics (e.g. intensifying screens, types of films, etc.) is optional.

5.4.3 Light-tightness

Under normal conditions of use, the cassette shall be light-tight. Informative annex C describes a typical test for light-tightness.

5.4.4 Screen-film contact

The cassette shall ensure close screen-film contact over the entire area between the intensifying screens and the radiographic film. Informative annex D describes a test method for screen-film contact of radiographic cassettes.

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5.4.5 Front cover recognition

Unless cassettes are specifically designed so that either side can be used as the front cover, they shall be designed so that the front cover is distinguishable from the back by touch when handling the cassette with protective gloves.

The distinction between the front and back covers shall be clearly visible under normal safelight conditions.

5.4.6 Handling

Radiographic cassettes of the same nominal size shall be able to be placed in, removed from, and stacked in a container, and also handled by devices without affecting each other and without opening.

6 Mammography cassettes

6.1 Classification

This International Standard refers to mammography cassettes as either preferred or recognized. All new mammography cassettes shall conform to the dimensions given as “preferred”.

The dimensions given for recognized sizes are listed in order to inform the reader regarding an older style of mammography cassettes. Although the older style cassettes are no longer preferred (no longer the industry standard), use of this style throughout the world is expected to continue for some time. Therefore, they are listed here as “recognized” only.

6.2 Dimensions

6.2.1 Nominal sizes, aim and tolerance dimensions

Nominal sizes, aim and tolerance dimensions, and weight for preferred mammography cassette sizes shall conform to the values given in Table 5.

Nominal sizes, aim and tolerance dimensions, and weight for recognized mammography cassettes shall conform to the values given in Table 6.

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Table 5 — Preferred mammography cassette sizes

Nominal size	Film size			Screen size			Cassette ID			Cassette OD			Thickness	Weight without screen
cm	mm			mm			mm			mm			mm	g
	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Aim and tolerance	Max.
18 × 24	177 × 237	178 × 238	179 × 239	177 × 237	178 × 238	179,5 × 239	179 × 241,5	181 × 242	182 × 243	193 × 266,5	194,5 × 267,5	196 × 268,5	15^{+1}_{-2}	690
24 × 30	237 × 297	238 × 298	239 × 299	237 × 297	238 × 299	239,5 × 301,4	239 × 301,5	241 × 302	242 × 303	253 × 326,5	254,5 × 327,5	256,5 × 328,5	15^{+1}_{-2}	850

Table 6 — Recognized mammography cassette sizes

Nominal size	Film size			Screen size			Cassette ID			Cassette OD			Thickness	Weight without screen
cm	mm			mm			mm			mm			mm	g
	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Aim and tolerance	Max.
18 × 24	177 × 237	178 × 238	179 × 239	174 × 237	175 × 238	176 × 239	> 179 × 239,5	> 179 × 240	183 × 241	193 × 242,5	194,5 × 243,5	196 × 244,5	$20,5^{+0}_{-2}$	500
24 × 30	237 × 297	238 × 298	239 × 298,45	234 × 297	235 × 298	236 × 298,45	> 239 × 298,5	> 239 × 299	243 × 300	253,5 × 304	255 × 305	256,5 × 306	$20,5^{+0}_{-2}$	625

6.2.2 Denomination

Mammography cassettes are denoted by the nominal size expressed in numerical values (in centimetres) without adding the measurement unit “cm”. Inclusion of the letter M, for clarification as mammography, is recognized.

EXAMPLE Cassette 18 × 24 (eighteen by twenty-four), or cassette M 18 × 24, denotes a mammography cassette for a film with nominal size 18 cm × 24 cm.

6.2.3 Outer dimensions (OD)

The outer dimensions of mammography cassettes shall be as given in Tables 5 and 6.

The specified thickness of a cassette is intended to ensure that the cassette can be properly fixed in a defined position (e.g. within a holder or rails). In no case shall the maximum thickness tolerance, as given in Tables 5 and 6, be exceeded in any part of the cassette.

The corners and edges of the cassette, as shown in the top view of Figure 1, shall be smoothed or shaped over a quarter circle to a radius (r_1) of 10 mm maximum and 3 mm minimum.

The other edges, as shown in the side view of Figure 1, shall be smoothed over a quarter circle to a radius (r_2) of at least 1,5 mm.

The greatest value for the radius results from the minimum required planes, as given by dimensions A and B in the side view of Figure 1.

6.2.4 Inner dimensions (ID)

The inner dimensions, in the plane of the film, shall conform to the values given in Tables 5 and 6.

6.3 Geometric accuracy

6.3.1 Outer geometric accuracy

6.3.1.1 Squareness

The squareness of the cassette shall conform to the requirements given in normative annex B.

6.3.1.2 Flatness

When a closed mammography cassette is laid on a flat surface, no part of the cassette shall depart from that surface by more than 16 mm, except for the nominal size 18 × 24 where no part shall depart from that surface by more than 21 mm.

6.3.1.3 Parallelism

The front and back of the mammography cassette shall be parallel to each other within 0,3 mm over any length of 100 mm.

6.3.2 Inner geometric accuracy

6.3.2.1 Squareness

The squareness of the cassette shall conform to the requirements given in normative annex B.

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6.4 Incident beam attenuation

The front (tube side) of mammography cassettes shall not have an attenuation greater than 0,2 mm of pure aluminum (99 %), in relation to X-ray radiation quality RQN-M [approximately 28 kV (see IEC 61267)].

6.5 Cassette design

6.5.1 Opening

When the cassette is lying on a plane surface, it shall be possible to open the back in such a way that it contacts the surface without the hinges being stressed.

6.5.2 Marking device

In order to identify the film in use, the cassette shall either permit the use of a means for marking the film, or it shall be equipped on its outside with a means for labelling.

The provision of a means to allow a semi-transparent marking of the cassette's own characteristics (e.g. intensifying screens, types of films, etc.) is optional.

6.5.3 Light-tightness

Under normal conditions of use, the cassette shall be light-tight. Informative annex C describes a typical test for light-tightness.

6.5.4 Screen-film contact

The cassette shall ensure close screen-film contact over the entire area between the intensifying screens and the mammography film. Normative annex E specifies the required test method for screen-film contact.

The procedure described in informative annex A is required for testing only. Tests are generally conducted for acceptance of new cassettes; on a regular basis at a chosen sampling frequency; and if problems are known or suspected. For day-to-day use of cassettes, waiting times of less than 15 min may be achieved, depending upon the cassette manufacturer's recommendations and design.

6.5.5 Front-cover recognition

Unless cassettes are specifically designed so that either side can be used as the front cover, they shall be designed so that the front cover is distinguishable from the back by touch when handling the cassette with protective gloves.

The distinction between the front and back covers shall be clearly visible under normal safelight conditions.

6.5.6 Handling

Mammography cassettes of the same nominal size shall be able to be placed in, removed from, and stacked in a container, and also handled by devices without affecting each other and without opening.

6.6 Compression

The design of the mammography cassette shall permit direct positioning of the subject while under compression.

6.7 Film-thorax distance

The mammography cassette shall be designed in a way that restricts the depiction of the subject as little as possible and never more than 2 mm, on the side of the cassette facing the thoracic wall.

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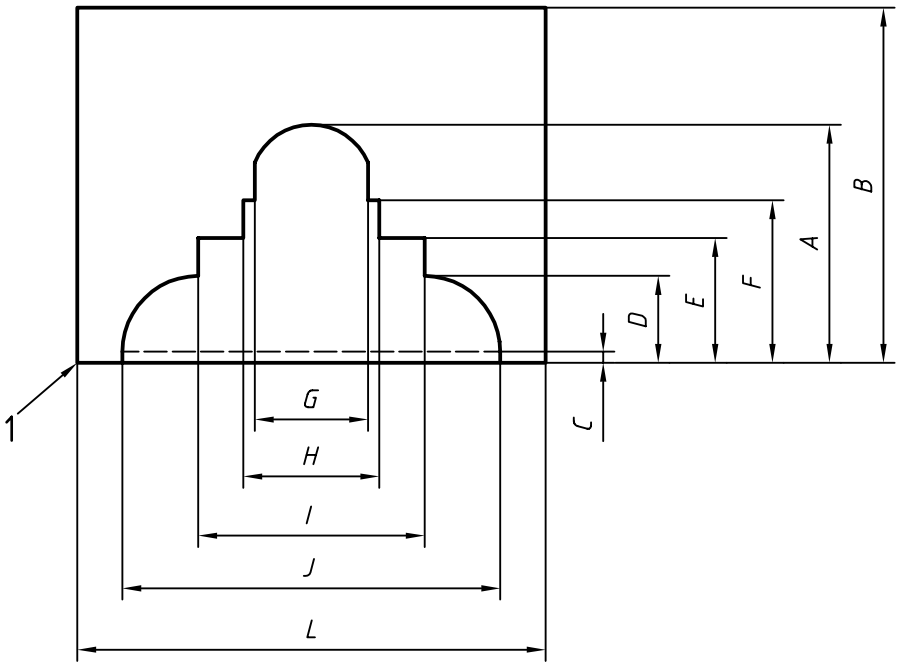
6.8 Free field for the radiation detector

The mammography cassette shall be designed so that uniform attenuation of X-rays in the area of the radiation detector is permitted.

When measured at 28 kV over a circular area of 3,5 cm diameter, the difference in radiation transmission between any two points in the free field shall not exceed 5 %. The attenuation should not exceed a maximum, since a certain minimum dose must be available to radiation detectors (at present about 5 µGy to 10 µGy). In the mammography cassette, this area shall have at least the dimensions given in Figure 2 for X-rays taken for stereotactic biopsy.

Dimensions in millimetres



Key

1 Chest-wall side

Symbol	Minimum limit
A (for 18×24)	125
A (for 24×30)	155
C	3
D	38
E	60
F	83
G	70
H	80
I	130
J	210
NOTE Limits for B (width) and L (length) are found in Tables 5 and 6.	

Figure 2 — Mammography cassette dimensions for field radiation detector

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7 Screens

7.1 Dimensions

7.1.1 Nominal sizes, aim and tolerance dimensions

Nominal sizes and aim and tolerance dimensions for preferred screen sizes shall conform to the values given in Tables 1, 2 and 5.

Nominal sizes and aim and tolerance dimensions for temporarily recognized sizes shall conform to the values given in Tables 3, 4 and 6.

The cutting and tolerance rules for current screen sizes, shown in Tables 1 to 6, and for new sizes shall be as follows:

— screens for mammography do not follow the cutting and tolerance rules;

— for sizes in Tables 2 and 4, which originated in inches, there is no cutting rule and the tolerances on the cutting dimensions for these sizes are ± 0,8 mm, with the exception of sizes 35 cm and 43 cm that follow the tolerance rules for metric sizes;

— for current metric sizes shown in Tables 1 and 3, sizes 35 cm and 43 cm[1)] and the new metric sizes, the cutting and tolerance rules are given in Table 7.

The cutting and tolerance rules as presented in Table 7 are especially meaningful for screens that are used without films, e.g. photo-stimulable screens for use in digital radiography.

Table 7 — Cutting and tolerance rules for screen sizes of metric origin and new sizes

Nominal	Aim	Tolerance mm
Up to and including 12 cm	Nominal	$^{+1}_{-2,5}$
Greater than 12 cm, up to and including 65 cm	Nominal	$^{+1}_{-3}$
35 cm	356 mm	$^{+1}_{-3}$
43 cm	432 mm	$^{+1}_{-3}$

7.1.2 Denomination

Radiographic screens are denoted by the nominal size expressed in numerical values (in centimetres) without adding the measurement unit “cm”.

EXAMPLE Screen 18×24 (eighteen by twenty-four) denotes a radiographic screen for a cassette with nominal size 18 cm × 24 cm.

7.2 Corners

Corner shaping of screens is not specified in this International Standard. However, corner shaping or rounding of screens shall not conflict with corner rounding of cassette inner dimensions (see Figure 3).

1) As the 35 cm size is a compromise made in the past to have one aim dimension for both the metric and inch sizes, this size only follows the tolerance rule and the aim size is 356 mm instead of 350 mm following the cutting rule. The same has happened with the 43 cm size that has an aim size of 432 mm instead of 430 mm following the cutting rule.

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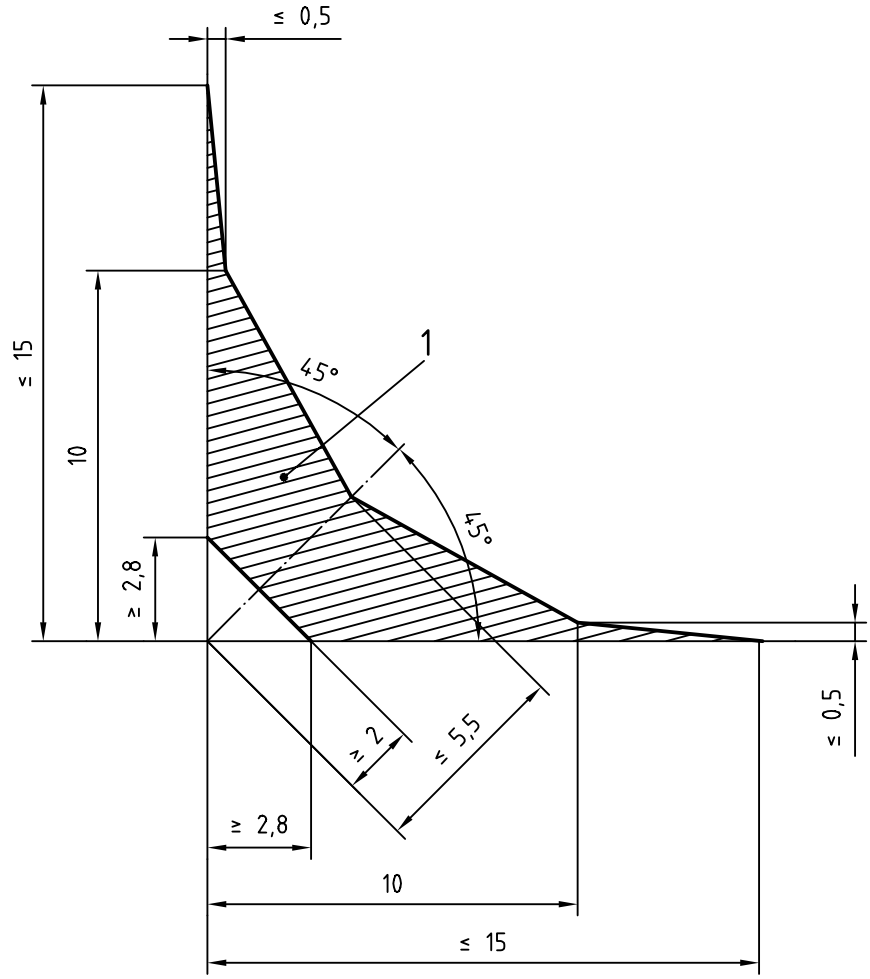
Dimensions in millimetres



Key

1 Area of permitted corner rounding

Figure 3 — Corner rounding limits of film

7.3 Squareness

The squareness of the screen shall conform to the requirements given in normative annex B.

7.4 Position

Upon cassette assembly and screen replacement, screen position for mammography use shall be fixed in order to assure close positioning of the screen against the cassette (inside) edge adjacent to the chest wall.

8 Films

8.1 Dimensions

8.1.1 Nominal sizes, aim and tolerance dimensions

Nominal sizes and aim and tolerance dimensions for preferred radiography film sizes shall conform to the values given in Tables 1 and 2. Preferred mammography film sizes shall conform to the values given in Table 5. Preferred sizes for medical hard-copy film shall conform to the values given in Tables 8 and 9.

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Table 8 — Preferred hard-copy film sizes of metric origin

Nominal size cm	Film size mm		
	Min.	Aim	Max.
18 × 24	177 × 237	178 × 238	179 × 239
24 × 30	237 × 297	238 × 298	239 × 299

Table 9 — Preferred hard-copy film sizes of inch origin

Nominal size cm	Film size mm		
	Min.	Aim	Max.
20 × 25	200,8 × 252	201,6 × 252,8	202,4 × 253,6
35 × 35	353 × 353	354 × 354	355 × 355
35 × 43	353 × 429	354 × 430	355 × 431

Nominal sizes and aim and tolerances dimensions for recognized radiography film sizes shall conform to the values given in Tables 3 and 4. Recognized mammography film sizes shall conform to the values given in Table 6. Recognized sizes for medical hard-copy film shall conform to the values given in Tables 10 and 11.

Table 10 — Recognized hard-copy film size of metric origin

Nominal size cm	Film size mm		
	Min.	Aim	Max.
13 × 18	127 × 177	128 × 178	129 × 179

Table 11 — Recognized hard-copy film sizes of inch origin

Nominal size cm	Film size mm		
	Min.	Aim	Max.
25 × 30	252 × 302,4	252,8 × 303,2	253,6 × 304
28 × 35	277,8 × 354	278,6 × 354,8	279,4 × 355,6

The cutting and tolerance rules for current film sizes, shown in Tables 1 to 6 and Tables 8 to 11, and for new sizes shall be as follows:

— for the sizes in Tables 2, 4, 9 and 11, which originated in inches, there is no cutting rule and the tolerances on the cutting dimensions for these sizes are ± 0,8 mm, with the exception of the sizes 35 cm and 43 cm that follow the tolerance rule for metric sizes;

— for the current metric sizes shown in Tables 1, 3, 5, 6, 8 and 10, the sizes 35 cm and 43 cm[2)] and the new metric sizes, the cutting and tolerance rules are given in Table 12.

2) As the 35 cm size is a compromise made in the past to have one aim dimension for both the metric and inch sizes, this size only follows the tolerance rule and the aim size is 354 mm instead of 348 mm following the cutting rule. The same has happened with the 43 cm size that has an aim size of 430 mm instead of 428 mm following the cutting rule.

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Table 12 — Cutting and tolerance rules for film sizes of metric origin and new sizes

Nominal	Aim	Tolerance mm
Up to and including 12 cm	Nominal minus 1,5 mm	± 0,5
Greater than 12 cm, up to and including 65 cm	Nominal minus 2,0 mm	± 1,0
Greater than 65 cm	Nominal minus 2,5 mm	± 1,5

8.1.2 Denomination

Radiographic films are denoted by the nominal size expressed in numerical values (in centimetres) without adding the measurement unit “cm”.

EXAMPLE Film 18×24 (eighteen by twenty-four) denotes a radiographic film for a cassette with nominal size 18 cm $\times$ 24 cm.

8.2 Squareness

The squareness of the film shall conform to the requirements given in normative annex B.

8.3 Identification of the sensitized side

For some applications, the film is sensitized on one side only or the front and back coatings are different (asymmetric film coatings). In order to facilitate proper loading of the film and proper orientation of the sensitized side, notches may be used.

When a sheet of film is held with the longer edges in a vertical orientation, the notches shall be in a shorter edge, near the upper right-hand corner, or the lower left-hand corner when the sensitized side is facing the observer.

The shape and number of notches are left to the discretion of the manufacturer. In addition, they may be used as a code to identify the film type.

Notches shall not exceed 3,5 mm in depth.

8.4 Corner rounding

If the four corners of the sheet of film are rounded, the actual edge of the corner shall be inside the hatched area as shown in Figure 3. The corners shall have no steps or sharp features.

Any areas removed by either notching or corner rounding are not in violation of 8.2.

8.5 Position

Film placement should be such that it is loaded (either manually, mechanically or both) with close positioning against the cassette (inside) edge adjacent to the chest wall.

9 Package marking

Sufficient data shall be provided on a product’s packaging to inform the user of proper use and handling.

Product packaging shall be marked so as to indicate:

— product name and size;

— conditions of use (such as safelight);

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— conditions of shipping and storage.

To accomplish this, each of the packages which constitute the product's packaging should be marked so as to indicate one or more of the following[3]:

— product name or trade name; for unit packages, this item shall be legible under recommended safelight conditions (other than total darkness);

— name or trade mark of manufacturer;

— manufacturer's catalogue identification number;

— bar code information;

— quantity of units contained in the package;

— interleaved/not interleaved, or other specific type of packaging;

— nominal product dimensions, in metric units, with the smaller dimension first for films in sheets[4], nominal width and length for films in rolls;

— batch number and/or parent roll number;

— notch code or notch pattern, if any;

— expiration date, "develop before" date, or inventory control code;

— manufacturer's recommended safelight conditions[5];

— manufacturer's recommended storage conditions[5];

— appropriate processing/recommended processing conditions.

9.1 Compliance

If it desired to indicate compliance of the product with this International Standard, the following wording shall be used:

"COMPLYING WITH ISO 4090"

3) There may be legal requirements in certain countries for other data to be marked on the package.

4) Some new cassettes will require that the longer edge be inserted first into the cassette. Films packaged for use in such cassettes should show the longer dimension first on the label.

5) This may be indicated by wording or by a code.

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Annex A
(informative)

Traditional sizes of medical films in rolls

A.1 Introduction

Information regarding medical radiographic film in rolls was previously included in ISO 4090:1991. The importance of film in rolls no longer justifies its own industry standard. This International Standard now focuses on medical radiographic and hard-copy sheet film and its relationship to screens and cassettes, where appropriate. However, as these sizes will remain available for quite a while, information regarding film in rolls has been listed in this annex.

A.2 Radiographic film

A.2.1 Width

Nominal and aim dimensions for preferred widths should conform to the values given in Table A.1.

The slitting and tolerance rules for rolls shown in Table A.1, and for new metric widths, should be as shown in Table A.2.

A.2.2 Length

Preferred roll lengths, exclusive of leaders or trailers, are

— 24 cm width: 35 m,

— 30 cm width: 20 m, and

— 35 cm width: 19 m or 50 m.

A.2.3 Splices

There should be no splices in film in rolls.

A.2.4 Core

The preferred core internal diameter is 76 mm ± 0,5 mm. However, it is recognized that there are currently a large number of equipment designs requiring special core or spool dimensions.

Table A.1 — Widths of films in rolls

Nominal cm	**Aim** mm
24	238
30	298
35 (see note)	354
NOTE This nominal width is the rounded value commonly used for 35,6 cm (formerly 14 in).	

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Table A.2 — Slitting and tolerance rules for roll widths

Nominal	Aim	Tolerance mm
Up to and including 12 cm	Nominal minus 1,5 mm	± 0,5
Greater than 12 cm, up to and including 65 cm	Nominal minus 2,0 mm	± 1,0
Greater than 65 cm	Nominal minus 2,5 mm	± 1,5

A.3 Hard-copy film

A.3.1 Width

Nominal and aim dimensions, along with their cutting tolerances, should conform to the values given in Table A.3.

Table A.3 — Widths of roll films

Dimensions in millimetres

Nominal	Minimum	Aim	Maximum
35	34,93	34,98	35,03
70	69,80	69,90	70,00
100	99,30	99,40	99,50
105	104,74	104,87	105,00
110	109,80	109,90	110,00

A.3.2 Length

Roll lengths in metres, exclusive of leaders and trailers, are

30,5; 45; 85; 170; 492; 656; 820; 984; 1 640; 1 969.

A.3.3 Splices

There should be no splices in film in rolls.

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Annex B
(normative)

Squareness

Squareness requirements apply to the cassette, screen and the film.

Squareness, edge straightness, shape and compliance with specified dimensions shall be checked at the same time by comparison of any given sheet with two perfect rectangles, independently located, one made to the minimum dimensional tolerance specified in this International Standard, and the other to the maximum tolerance specified. No point on the perimeter of the sheet shall fall within the smaller rectangle, nor shall any point fall outside the larger rectangle.

Areas removed by either notching or corner rounding are not in violation of this rule.

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Annex C
(informative)

Test for light-tightness

C.1 Test procedure

The cassette is fitted with intensifying screens and is loaded with screen-type radiographic film for which it is intended to be used. The cassette is then exposed for periods of 10 min to a 100 W frosted-tungsten filament lamp that is operated at its rated potential difference at a filament-to-cassette distance of 1 m.

Each of the six surfaces of the cassette should be turned to face the lamp and exposed as mentioned above.

Also, a second sheet from the same film package should be loaded in the same cassette and then kept in a dark place for 1 h. Both films are then processed.

C.2 Evaluation

Comparison of both films exclude an optical density increase caused by any other effects than light-tightness.

The film of the irradiated cassette should have an optical density increase of less than 0,1 in the diagnostically important areas.

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Annex D
(informative)

Test for screen-film contact (Radiographic cassettes)

D.1 Test device

Test plates 1 and 2 consist of materials possessing an effective atomic charge between 26 and 30 (e.g. Fe, Ni, Cu, Zn). There is a recess in the centre of each test plate that is provided to permit readings of the optical density of the exposed and processed film. The test plates should be large enough to cover the area of the film completely in the test cassettes.

Test plate 1 is 1 mm ± 0,1 mm thick. It contains holes arranged hexagonally. The holes are 2 mm to 2,5 mm in diameter. The distance between adjacent hole centres is 3,5 mm to 4,0 mm. The diameters within any row of six adjacent holes should not vary by more than 0,01 mm. The distances between adjacent hole centres should not vary from the average distance for this group by more than 0,015 mm.

Test plate 2 consists of a wire grid, placed between two plates made of polymethyl methacrylate (PMMA) to ensure that the wire grid is sufficiently flat. The total thickness of this test plate should be a minimum of 5 mm. The mesh width of the wire grid should be 3,15 mm ± 0,03 mm. The wire diameter should be 0,71 mm ± 0,008 mm.

Either test plate 1 or 2 may be used.

In order to facilitate the measurement of the optical density of the film which is exposed and developed during the test, the test device should have a circular aperture (with an area not less than 13 mm diameter) near its centre.

The test device should be of such a size as to cover the film area of the cassette to be tested.

D.2 Test procedure

The cassette is fitted with intensifying screens and is loaded with screen-type radiographic film. The test device is then laid flat on the outside of, and in contact with, the incident face of the cassette.

There should be a pause of at least two min between loading the radiographic cassette and exposure in order to prevent trapped air being depicted. Film should be exposed and processed to produce an optical density of 2,4 ± 0,4 in the area of the recess.

The conditions for exposure are as follows:

— nominal dimension of the focal spot should be a maximum of 2 mm;

— focal spot to film distance should be 1,5 m;

— potential difference should be 60 kV maximum;

— total filtration (in quality equivalent filtration) should be a maximum of 2 mm Al (pure aluminum 99 %).

The developed film should be viewed on a fluorescent tube-type illuminator from a distance of not less than 2 m. If a reducing lens is used, it should yield the equivalent image to that of a film viewed by the unaided human eye at a distance of not less than 2 m. The illuminated area should be limited to the area of the film.

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D.3 Evaluation

When viewed under the above conditions, the blackening of the film should appear to have an overall uniform optical density in the areas important to the diagnosis.

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Annex E
(normative)

Test for screen-film contact (Mammography cassettes)

E.1 Objective

To assure that optimum contact is maintained between the screen(s) and film in each mammography cassette.

Screen-film contact has a significant influence on image sharpness. Since mammography screen-film systems have significantly higher resolution than conventional systems, contact becomes even more important in order to produce optimum quality images.

The procedure specified in E.4 is required for testing only. Tests are generally conducted for acceptance of new cassettes; on a regular basis at a chosen sampling frequency; and if problems are known or suspected. For day-to-day use of cassettes, waiting times of less than 15 min may be achieved, depending upon the cassette manufacturer's recommendations and design.

E.2 Frequency

This test should be carried out initially for all new cassettes as they are placed in service, then semi-annually and whenever reduced image sharpness is suspected.

E.3 Equipment

E.3.1 Copper screens, 40 mesh (see E.5 for precautions and caveats regarding mesh size), 24 cm × 30 cm.

The mesh may be placed between two thin sheets of acrylic, approximately 3 mm thick, to protect it.

E.3.2 Acrylic sheets, sufficient to provide 4 cm thickness.

E.3.3 Lead numbers.

E.3.4 Mammography film, of the appropriate size.

E.3.5 Screens, of the appropriate size.

E.3.6 Cassette, to be tested.

E.4 Procedure

a) Carefully and thoroughly clean the screens (E.3.5) of the cassettes to be tested using the screen cleaner recommended by the screen manufacturer.

b) Allow the screens to air dry at least 30 min after cleaning.

c) Load all of the cassettes (E.3.6) with film (E.3.4). Wait for a minimum of 15 min before proceeding to the next step.

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In the daily use of cassettes, the 15 min waiting period is not always followed. Waiting 15 min for clinical use is recommended, but not required.

d) Place the cassette to be tested on top of the cassette holder, i.e., without any grid between the X-ray tube and the cassette.

e) Place the mesh (E.3.1) on top of the cassette.

f) Place the acrylic sheets (E.3.2), if needed[6)], on top of the compression device and move the compression device as close as possible to the X-ray tube.

g) Place the lead numbers (E.3.3) corresponding to the number of the cassette on top of the mesh in the image area.

h) Select a manual technique (at 28 kVp) which will produce a film optical density between 0,70 and 0,80 when measured using an aperture of 2,0 mm or larger over the mesh near the chest-wall side of the film.

i) Expose and process the film.

j) Repeat steps a) through i) for each mammography cassette.

k) View the films on a view box at a distance of at least 1 m. Look for areas of poor contact, i.e. darker areas in the mesh image.

l) The cassettes which pass this test may be used for clinical purposes.

m) Select those cassettes which did not pass the initial test. Once again, clean the screens and interior cassette surfaces using the screen cleaner recommended by the screen manufacturer. Repeat steps a) through k) for each cassette.

n) Cassettes which pass this test after cleaning and retesting have passed and may be used for clinical purposes.

o) Select any remaining cassettes which have not passed this test, or appear to be borderline in passing the test. Clean and retest the remaining cassettes as indicated in step m).

p) Place the three films produced from each cassette [steps i), m) and o)] on the view box, side by side and aligned in the same orientation.

q) Observe and compare the locations of the areas of poor contact (dark areas) on the films.

Follow the instructions in E.6 (Suggested performance criteria and corrective action).

E.5 Precautions and caveats

This test should be carried out using the 40 mesh copper screens in order to be sensitive enough to detect poor contact in mammography cassettes. Mesh used to test conventional cassettes will not detect small dust particles which produce poor contact, nor will it detect larger areas of poor contact when exposed at 28 kVp (thicker wires produce an image with contrast that is too high). Small specks of dust can reduce screen-film contact and degrade the image for significant distances (up to 1 cm or more) away from the dust particle. Poor contact can also result from improperly designed or damaged cassettes, or from insufficient pressure as a result of the deterioration of the foam in the cassette.

6) Acrylic sheets are used to assure a reasonable exposure time, (e.g. at least 0,5 s) and, hence, good exposure reproducibility, while obtaining a realistic density on the film. The additional acrylic may not be needed if exposure time to produce an optical density of about 0,75 is approximately 0,5 s. The size of the acrylic must be sufficient for its projected area to cover the entire cassette when the acrylic sheet is placed as close to the X-ray tube as possible, i.e. as far as possible from the cassette, so as to reduce the amount of scattered radiation reaching the cassette.

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Films should be viewed on a view box from a distance of at least 1 m in order to not visualize the actual wires in the mesh. It is much easier to look for areas of increased density than for “fuzzy” wires in the fine mesh. The high density of the film is required in order to assist in visualizing the darker areas that indicate poor contact.

Entrapped air (air caught between the screen and the film) may be a cause of poor screen-film contact. This is particularly evident in single-screen mammography imaging systems. This problem can be alleviated by waiting a minimum of 15 min after loading the cassette with film and before making an exposure (assuming an appropriate cassette design and adequate pressure from the foam on the screen and film). This minimum waiting time is recommended both for cassettes being tested by this method, as well as cassettes being used for clinical exposures.

E.6 Suggested performance criteria and corrective action

Large areas (greater than 1 cm) of poor contact should not be tolerated. However, this may be due to entrapped air (see E.5). Small areas (less than 1 cm) of poor contact may indicate the presence of dust or dirt between the screen and the film. This is the reason for cleaning the screens and repeating the test as noted in E.4 steps m) and o).

If any screen is tested three times, place all three films on a view box in the same orientation. Compare the location of the areas of poor contact. Three or more small areas (less than 1 cm) of poor contact, especially near the chest wall of the cassette, should not be tolerated if the areas of poor contact are in the same locations on all three films. If the areas of poor contact do not remain in the same location, then the cause is probably entrapped air or small dust particles. In the latter case, the cassette and screens should be considered acceptable and used for clinical purposes.

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Annex F
(informative)

Metric conversion of inch nominal sizes

This annex has been included to assist the reader in understanding how the new nominal metric size relates to the size in inches, as these were the dimensional units under which the product was originally developed and sold.

Nominal size cm	**Nominal size** in
20,4 × 25,5	8 × 10
25,5 × 30,5	10 × 12
28,1 × 35,6	11 × 14
30,5 × 35,6	12 × 14
30,5 × 38,1	12 × 15
35 × 35	14 × 14
35 × 43	14 × 17

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Annex G
(informative)

Dimensional stability of film

The dimensions and tolerances specified in this International Standard apply to the film at the time of cutting and when measured in equilibrium with the standard atmosphere specified in ISO 554, i.e. temperature (23 ± 2) °C and relative humidity (50 ± 5) %.

These dimensions may be altered by permanent aging shrinkage and by temporary shrinkage or swell, since they will change with the moisture content and the temperature of the atmosphere.

Nevertheless, at the time of package opening (within the warrantee period of the film), the dimensions measured under atmospheric conditions of temperature and humidity given above should not depart from those at the time of manufacture by more than 0,05 % greater than the maximum tolerance, nor 0,08 % less than the minimum tolerance for films on a polyester base.

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Annex H
(informative)

Quantity packaging

H.1 Sheets

It is recommended that the number of sheets in a single package, or unit of a multiple package, be one of the following:

25, 50 or 100 sheets

H.2 Rolls

Film in rolls should normally be supplied in single-roll packages.

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Annex I
(informative)

Sizes of inch origin — Film dimension exceptions

Film sizes of inch origin utilize a different tolerance in Japan. Therefore, the reader should use caution when considering how to manufacture film for use in Japan.

Nominal size cm	**Film size** mm		
	Min.	**Aim**	**Max.**
25 × 30	251,7 × 301,5	252,5 × 303,0	253,3 × 304,5
28 × 35	277,7 × 353	278,5 × 354,5	279,3 × 356
30 × 38	302,2 × 377	303 × 378,5	303,8 × 379

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