
**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*



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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.

Introduction

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

- ANSI/NAPM IT1. 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.

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

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 $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ relative humidity, as specified in ISO 554.

All measuring instrument calibrations should be conducted at a temperature of $20 ^\circ\text{C}$, 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 $10 ^\circ\text{C}$ to $40 ^\circ\text{C}$.

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 $18 \text{ cm} \times 24 \text{ cm}$.

Table 1 — Preferred radiographic cassette sizes of metric origin

| Nominal size cm | Film size mm | | | Screen size mm | | | Cassette ID mm | | | Cassette OD mm | | | Thickness mm | Weight without screen 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. | | | | | | | | | | | | | |

Table 2 — Preferred radiographic cassette sizes of inch origin

| Nominal size cm | Film size mm | | | Screen size mm | | | Cassette ID mm | | | Cassette OD mm | | | Thickness mm | Weight without screen g |
|--------------------|-----------------|---------------|---------------|-------------------|---------------|---------------|-------------------|-------------|-------------|-------------------|---------------|---------------|--------------------------------|----------------------------|
| | Min. | Aim | Max. | Min. | Aim | Max. | Min. | Aim | Max. | Min. | Aim | 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 | 354 × 354 | 355 × 355 | 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 | 354 × 430 | 355 × 431 | 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 cm | Film size mm | | | Screen size mm | | | Cassette ID mm | | | Cassette OD mm | | | Thickness mm | Weight without screen g |
|---|-----------------|-------------|-----------|-------------------|-----------|-----------|-------------------|-----------|-----------|-------------------|---------------|---------------|------------------------------------|----------------------------|
| | Min. | Aim | Max. | Min. | Aim | Max. | Min. | Aim | Max. | Min. | Aim | 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. | | | | | | | | | | | | | | |

Table 4 — Recognized radiographic cassette sizes of inch origin

| Nominal size cm | Film size mm | | | Screen size mm | | | Cassette ID mm | | | Cassette OD mm | | | Thickness mm | Weight without screen 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 $27,5 \text{ mm} \pm 1 \text{ mm}$ 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.

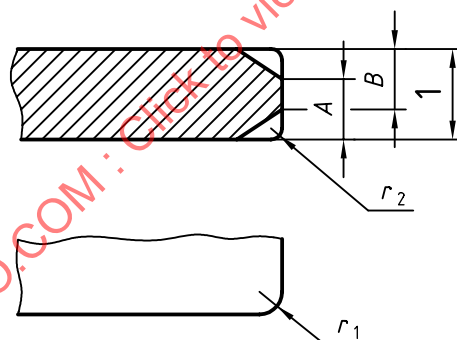
The corners and edges of the cassette, as shown in the top view of Figure 1, shall be smoothed or shaped over a quarter circle to a radius (r_1) of 10 mm maximum and 1 mm minimum.

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.

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.

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.

Table 5 — Preferred mammography cassette sizes

| Nominal size cm | Film size mm | | | Screen size mm | | | Cassette ID mm | | | Cassette OD mm | | | Thickness mm | Weight without screen 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 cm | Film size mm | | | Screen size mm | | | Cassette ID mm | | | Cassette OD mm | | | Thickness mm | Weight without screen 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 $18 \text{ cm} \times 24 \text{ cm}$.

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.

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.

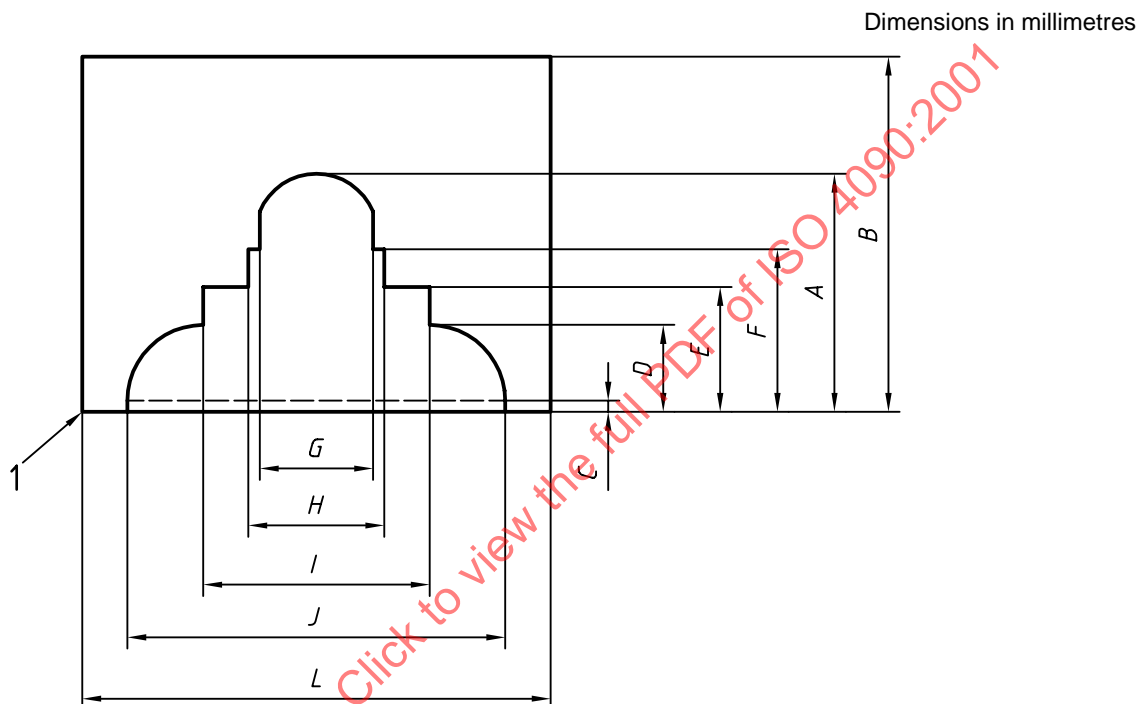
6.7 Film-thorax distance

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.

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 μ Gy to 10 μ Gy). In the mammography cassette, this area shall have at least the dimensions given in Figure 2 for X-rays taken for stereotactic biopsy.



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

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 $\pm 0,8$ 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 cm¹⁾ 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

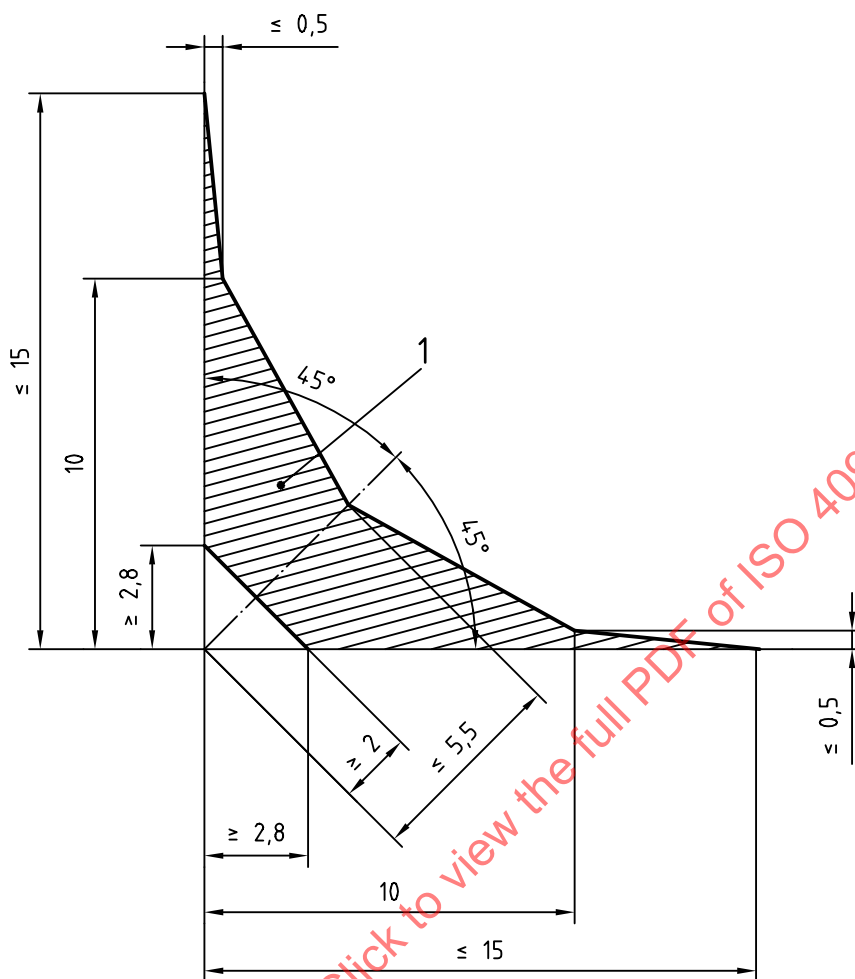
Radiographic screens are denoted by the nominal size expressed in numerical values (in centimetres) without adding the measurement unit "cm".

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.

**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.

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 $\pm 0,8$ 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 cm²⁾ 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.

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 | $\pm 0,5$ |
| Greater than 12 cm, up to and including 65 cm | Nominal minus 2,0 mm | $\pm 1,0$ |
| Greater than 65 cm | Nominal minus 2,5 mm | $\pm 1,5$ |

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 × 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);

- 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 following³⁾:

- 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 sheets⁴⁾, 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 conditions⁵⁾;
- manufacturer's recommended storage conditions⁵⁾;
- 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.

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 $76 \text{ mm} \pm 0,5 \text{ mm}$. 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). | |

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.

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.

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 $1\text{ mm} \pm 0,1\text{ mm}$ 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 $3,15\text{ mm} \pm 0,03\text{ mm}$. The wire diameter should be $0,71\text{ mm} \pm 0,008\text{ mm}$.

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 $2,4 \pm 0,4$ 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.

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.