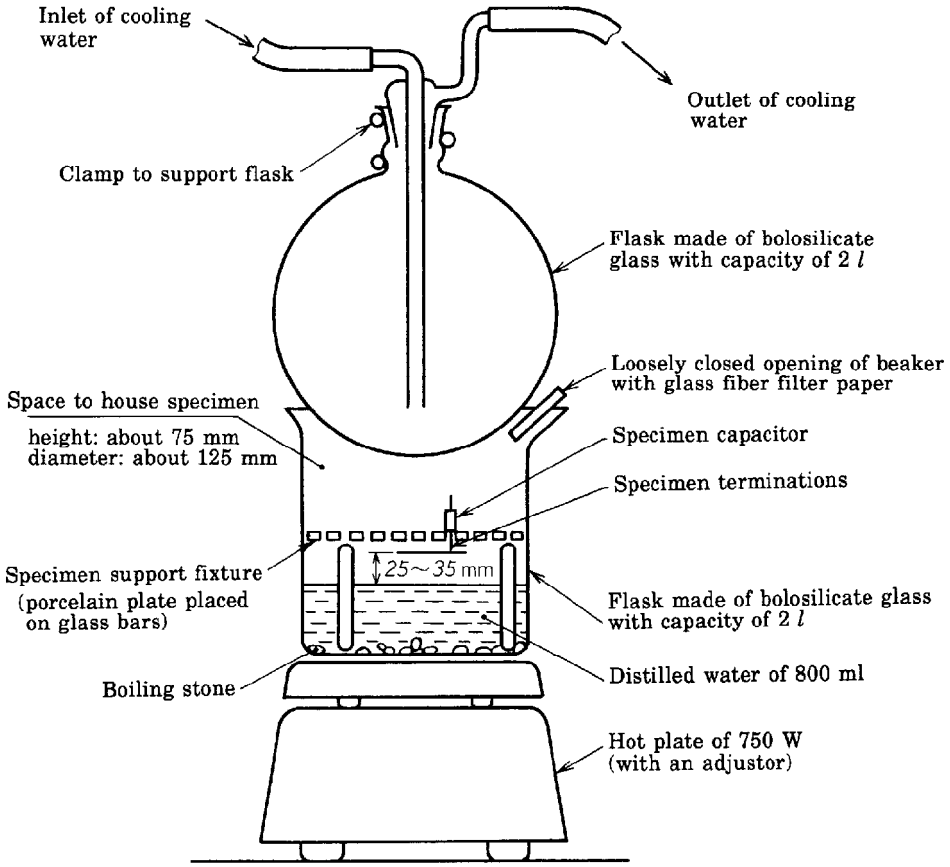
Fig. 36. An example of accelerated steam aging equipment



Remarks: Prevent water drips from falling over the specimen. This can be done by placing the specimen at a location other than the bottom of cooling flask.

(5) Observing apparatus The observing apparatus shall be a projector or magnifier with a magnification of 10.

8.4.2 Preparation

8.4.2.1 Materials The materials are as follows:

(1) Solder The composition of solder shall be as specified in Annex B of JIS C 0050. Unless particularly specified in the relevant detail specification, use H60A, H60S or H63A specified in JIS Z 3282.

The mass of solder pellet employed in solder globule method, shall be as given in Table 19. The number of pellets which deviate from the nominal mass by more than ± 10 % shall be within 1.5 % of total number of pellets.

Table 19. Mass of solder pellets

Nominal diameter of lead wire termination of specimen mm	Nominal mass of solder pellet mg
1.2 to 0.75	200
0.74 to 0.55	125
0.54 to 0.25	75
0.24 or under	50

(2) Flux Use the flux specified in 4.6.2 of JIS C 0050. Use 2-propanol (JIS K 8839) or ethanol solution (JIS K 8101, grade 1 or better) of colophonium (JIS K 5902, grade 2 or better). The concentration shall be about 25 % of colophonium in mass ratio.

When the detail specification specifies use of activated flux, add 0.39 wt% of diethyl ammonium chloride (contents of chlorine reaches 0.5 %).

8.4.2.2 Treatment of termination The terminations of specimen shall not be wiped, washed or polished, unless particularly specified in the detail specification.

Attention shall be particularly paid for handling not to dirt the surfaces of terminations with oils, sweat and others.

8.4.3 Initial measurement The electrical performances shall be measured in accordance with the detail specification, and the appearance shall be inspected.

8.4.4 Accelerating steam aging (treatment of terminations) Before 8.4.5, distilled water of proper quantity is poured in the container of 8.4.1 (4) and boiled.

Then, the specimens shall be suspended so that the ends of terminations are 25 mm to 35 mm apart from the level of boiling distilled water. According to the detail specification, the specimens shall be allowed to stand in this condition for 1 h (aging 1a) or 4 h (aging 1b) with covering. Afterward, unless specified in the detail specification, let the specimen to stand at room temperature for 2 h to 24 h.

The specimen shall be suspended through a hole bored in the cover of stainless steel sheet, or using a non-metallic holder.

During the standing, if it is required to add destined water, pour the sufficiently heated distilled water little by little so as not to interrupt the boiling state.

8.4.5 Test Carry out the test according to the detail specification, by either of the following method (1) or (2) of Table 20.

Table 20. Method for solderability test

Method		Condition	
		Temperature of solder °C	Duration of immersion s
(1)	Solder bath method (Method 1)	235 ± 5	2 ± 0.5
(2)	Solder globule method (Method 3)	235 ± 2	—

Remarks: Duration of immersion means the holding time after immersing the termination to the specified depth.

For terminations having a large heat capacity, the detail specification may specify the duration as 5 ± 0.5 s.

(1) Solder bath method (mehtod 1) The termination of specimen shall be immersed in the flux specified in 8.4.2.1 (2) at normal temperature for 5 s to 10 s. Unless otherwise specified, the depth of immersion is 1.5 mm to 2.0 mm from the root of termination with a thermal screen used as shown in Figs. 37 (1), (2) and (3). If the detail specification mentions, "the specimen capacitor is not for printed wiring board", the immersion depth shall be 3 mm to 3.5 mm from the root of termination.

Next, according to the detail specification, immerse the terminal in the solder, at the temperature and for the time shown in Table 20.

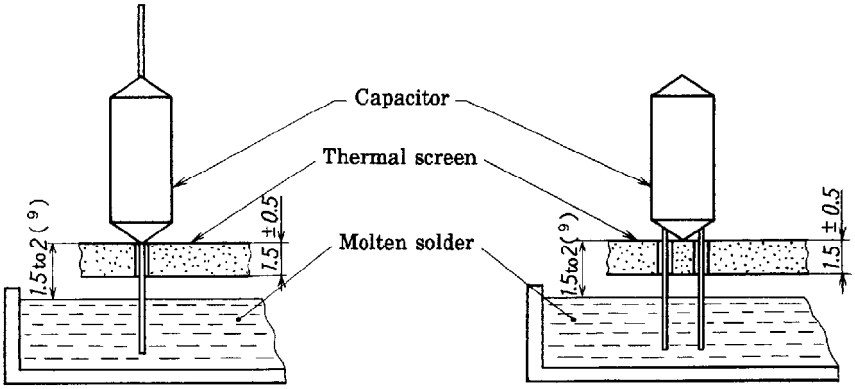
In the process of immersion in solder, remove scales and other substances on the surface of molten solder in the bath, stir the solder well, and confirm that the temperature is held as specified. Then, remove scales and other substances again, so that the surface of solder glitters beautifully. Immediately after that, immerse the terminal of capacitor to the position previously immersed in the flux, by using the equipment specified in 8.4.1 (1), in the solder bath for the specified duration.

After finishing the immersion in solder, wash the surface of terminal with clean organic solvent (for instance, 2-propanol of 91 % or more) to remove the remaining flux. If specified by the detail specification, use a soft cloth wetted with organic solvent and remove the residual flux completely.

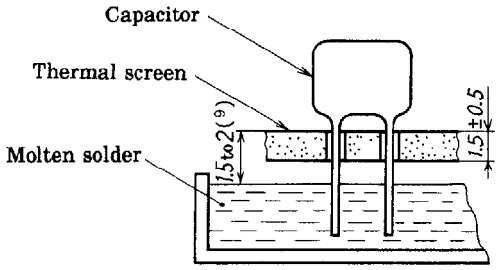
Fig. 37. Conditions of immersion into solder

Unit: mm

(1) (2)



(3)



Note (9) If the detail specification mentions, "the specimen capacitor is not for printed wiring board", the immersion depth shall be 3 mm to 3.5 mm from the root of termination.

(2) Solder globule method (method 3) The wire termination is stretched straight, or may be cut off from the capacitor if necessary.

The wire termination of specimen is fitted to the wire termination holder shown in Fig. 34.

The temperature of iron pin in the equipment for solder globule method shown in Fig. 35 is maintained at the temperature (235 ± 2°C) specified in Table 20. The residue of solder specified in Table 19 on iron pin from the previous test is removed. The new solder pellet is placed on the iron pin in its normal position. The iron pin is completely wetted with molten solder globule by applying a small amount of flux. Then, the wire termination of specimen is inserted into the solder globule so as to touch the surface of iron pin. Then, measure the time elapsing between the mount that the wire termination bisects solder globule, and that when the solder flows around and covers the circumference of wire termination.

The flux is applied to the wire termination of specimen either by dipping it in the flux or by brushing.

8.4.6 Recovery The specimen shall be allowed to stand under the standard conditions for the specified period, if recovery is specified in the detail specification.

8.4.7 Final measurement Conforming to the detail specification, examine visually or with the observing apparatus specified in 8.4.1 (5) how much of the surface immersed in the solder is covered with new solder.

8.4.8 Items to be specified in detail specification The relevant detail specification shall prescribe the following:

(1) Solder [refer to 8.4.2.1 (1)]

(2) Concentration of flux, and use of activator (when particularly designated or used) [refer to 8.4.2.1 (2)]

(3) Treatment of termination (if polished or washed) (refer to 8.4.2.2)

(4) Items to be measured before and after test (refer to 8.4.3 and 8.4.7)

(5) Application and duration of accelerating steam aging (preconditioning of termination) (refer to 8.4.4)

(6) Method of test (refer to Table 20)

(7) Immersion depth into flux [if different from the condition in 8.4.5 (1) and if not used for printed wiring board] [refer to 8.4.5 (1)]

(8) Temperature of solder (refer to Table 20)

(9) Immersion depth into solder [refer to 8.4.5 (1) and Fig. 37]

(10) Duration of immersion in solder (refer to Table 20)

(11) Recovery (if applied) (refer to 8.4.6)

(12) Application of observing apparatus and its magnification [if different from 8.4.1 (5)]

8.5 Resistance to soldering heat (applicable to capacitors other than SMD) (refer to JIS C 0050, Test T_b)

8.5.1 Equipment The equipment is as follows:

(1) Immersion equipment The equipment shall be as specified in 8.4.1 (1).

(2) Solder bath The bath shall be as specified in 8.4.1 (2).

8.5.2 Preparation

8.5.2.1 Materials The materials are as follows:

(1) Solder The solder specified in 8.4.2.1 (1).

(2) Flux The flux specified in 8.4.2.1 (2).

8.5.3 Preconditioning Before the test, the preconditioning of 4.1 shall be carried out.

8.5.4 Initial measurement The electrical performances shall be measured in accordance with the detail specification, and the appearance shall be inspected.

8.5.5 Test The test shall be carried out under the conditions (1) and (2) below by employing either of the temperatures of solder and the durations of immersion given in Table 21 as specified in the detail specification.

Immerse the termination of specimen into flux before immersing into solder. Confirm that the temperature at a depth of about 25 mm from the liquid level of solder is kept at the temperature specified in the detail specification. Remove the scale and other substances so that the surface of solder glitters beautifully. Then, immediately, the termination of specimen is immersed into solder, using the immersion equipment specified in 8.5.1 (1).

The immersion speed shall be such that immersion to the specified portion is completed within 1 s.

The temperature of solder and the duration of immersion to be specified in the detail specification are shown in Table 21.

Table 21. Condition of immersion in solder

Condition	Temperature of solder °C	Duration of immersion(10) s	Remarks
A(11)	260 ± 5	5 ± 1	JIS C 0050, test method T_b, method 1A
B		10 ± 1	
D	350 ± 10	3.5 ± 0.5	JIS C 0050, test method T_b, method 1B

Notes (10) The duration of immersion in solder means the time to be kept as it is after immersion of termination into specified position.

(11) The condition A is applied for capacitors which cannot withstand high temperature, such as capacitor used in printed wiring board.

(1) Duration of immersion in flux The duration shall be 5 s to 10 s.

(2) Immersion depth of termination in flux and solder The depth shall be a position 1.5 mm to 2.0 mm from the root of termination while the thermal screen is used (refer to Fig. 37). If it is specified in the relevant detail specification that "this capacitor is not used for printed wiring board", the depth shall be 3.0 mm to 3.5 mm from the root of termination.

8.5.6 Recovery The recovery of 4.2 shall be carried out.

8.5.7 Final measurement The electrical performances shall be measured in accordance with the detail specification, and the appearance shall be inspected.

8.5.8 Items to be specified in detail specification The relevant detail specification shall prescribe the following:

(1) Solder [refer to 8.5.2.1 (1)]

(2) Concentration of flux and use of activator (if particularly specified, or if used) [refer to 8.5.2.1 (2)]

(3) Preconditioning (if different from the condition of 8.5.3)

(4) Measurement items before and after test (refer to 8.5.4 and 8.5.7)

(5) Immersion depth into flux [if different from 8.5.5 (2)]

(6) Immersion conditions into solder (refer to Table 21)

(7) Recovery (if different from 8.5.6)

8.6 Sealing (airtightness) [refer to JIS C 0026 (test Q)]

8.6.1 Equipment The equipment for this test shall be as follows:

(1) Vacuum pump The pump used in this test shall be capable of reducing the pressure of low pressure oil bath, to 1 kPa or less within 1 min, while the specimen being contained.

(2) Air compressor The air compressor shall be capable of increasing the pressure of pressurizing chamber under the condition of containing the specimen, to 600 kPa or more within 1 min, and maintaining the pressure constant.

(3) Immersion bath The bath shall have sufficient volume so that when the specimen is immersed, the specimen or its sealed part can be immersed into a depth of 10 mm or more from the liquid level of the bath, and also that the specified temperature can be maintained.

(4) Test chamber The chamber shall be as specified in 5.3.

(5) Low pressure oil bath The bath shall be capable of immersing the specimen or its sealed part to a depth of 10 mm or more from the liquid level of the bath and reducing the pressure in the bath to 1 kPa or less.

The bath shall be so constructed that the specimen can be taken out from the liquid while being maintained the reduced pressure in the bath.

(6) Reducing and pressurizing bath The bath shall be able to endure sufficiently the pressure reduction to 100 Pa or below to impregnate the liquid for detection into the specimen, and to be pressurized to 600 kPa or over in succession to the pressure reduction.

The bath shall be so constructed that the impregnation liquid can be poured into the specimen while the bath is kept at reduced pressure.

8.6.2 Preparation

8.6.2.1 Materials The materials for this test shall be as follows:

(1) Immersion liquid

(a) For 8.6.5 (1), test Q_c (test A) method 1, use the clean silicone oil whose dynamic viscosity is 25×10^{-6} m²/s at 25°C and 9×10^{-6} m²/s at 50°C.

(b) For 8.6.5 (2), test Q_c (test A) method 2, unless particularly specified in the detail specification, comply with the following. If the test temperature is 90°C or less, use water containing surface activator. If the test temperature exceeds 90°C, use silicone oil whose dynamic viscosity is about 0.3×10^{-6} m²/s at the test temperature, or use the electrical insulating oil of Class 1 No. 1 in JIS C 2320. The silicone oil or the electrical insulating oil of Class 1 No. 1 are applicable to step 2 in 8.6.5 (3) (b).

(2) Impregnation liquid For 8.6.5 (3), test Q_c (test A) method 3 step 1, use as the impregnation liquid a proper liquid whose dynamic viscosity is about 0.4×10^{-6} m²/s at room temperature, whose boiling point is 60°C, and whose vaporization heat is small. Unless particularly specified in the detail specification, use cyclic perfluoro-dipropyl ether or perfluoro-N-hexane shall be used.

(3) Powder for detection For 8.6.5 (4), test Q_d (test B), unless particularly specified in the detail specification, use talc powder for oily fillers. Use potassium permanganate ($KMnO_4$) powder for aqueous fillers.

8.6.3 Preconditioning Stains and adhesive on the surface, and unnecessary accessories shall be removed not to affect the test results.

The preconditioning of 4.1 shall be carried out before the test.

8.6.4 Initial measurement Initial measurement is not applied.

8.6.5 Test The test is as follows:

(1) Test Q_c (test A) method 1 (mainly applied to non-filled or solid filled capacitors unsuitable for testing at high temperature) The test shall be carried out as prescribed below. A proper quantity of clean silicone oil kept at room temperature is put into the pressure reduction bath. Then the specimen is immersed so that the sealed part or the highest part of casing is located at a depth of 10 mm or more from the liquid level. In this case, the sealed part or the face of capacitor requiring special caution, is placed upward horizontally. If none of the face needs special caution, the long axis is placed horizontally.

If the specimen has two or more sealed parts, place the top sealed part horizontally. Within 1 min after the immersion, the pressure of pressure reduction oil bath is reduced to 1 kPa.

Keep the pressure as it is for the specified time. During this period, examine whether bubbles are continuously generated from the specimen. Unless specified in the detail specification, the pressure reduction duration shall be 1 min.

The specimen is taken out form the oil bath under the reduced pressure, and returned to atmospheric pressure after silicone oil has disappeared from its surface.

After the test is completed, the specimen is cleaned with a proper degreasing agent, and dried completely before the next test.

(2) Test Q_c (test A) method 2 (mainly applied to unfilled or solid-filled capacitors) The test shall be carried out as prescribed below. A proper amount of immersion liquid is poured into the immersion bath. The temperature of the bath is kept at 1°C to 5°C over the upper category temperature of the specimen, or at the temperature specified in the detail specification. The specimen is immersed in the liquid so that its sealed part or uppermost part of casing is placed at a depth of 10 mm or more from the liquid level. The sealed part or the face requiring special caution is placed upward horizontally. If none of the face needs special caution, the long axis is placed horizontally.

If the specimen have two or more sealed parts, place the top sealed part horizontally. Keep the specimen as it is for at least 10 min. During this period, examine whether bubbles are continuously generated from the specimen.

After the test is completed, if necessary, the specimen is cleaned with a proper degreasing agent and completely dried before the next test.

(3) Test Qc (test A) method 3 (mainly applied to leakageless capacitors) This method consists of the following two steps.

(a) Step 1 Keep pressure reducing and the pressurizing bath of 8.6.1 (6) at room temperature. Put the specimen into the bath. Reduce the pressure to about 100 Pa and maintain it for 1 h. Then, pour the impregnation liquid of 8.6.2.1 (2) to cover the all face of specimen under the said conditions.

Then, change over the bath from reduced pressure to pressurization to pressurize and impregnate the specimen under the conditions given in Table 22.

Table 22. Condition of pressurized impregnation

Volume to be immersed	Pressure (absolute value) kPa	Duration of pressurization h
0.1 cm^3 or less	600	1 or more
Over 0.1 cm^3	300	2 or more

After finishing the impregnation, return the pressure reducing and pressurizing bath to the atmospheric pressure. Store the specimen in the impregnation liquid. Afterward, take out the specimen from the impregnation liquid, and keep it for 3 ± 1 min in room temperature.

(b) Step 2 Unless particularly specified in the detail specification, carry out the test Q_c (test A) method 2. However, the test temperature shall be 125 ± 5°C, and the duration of immersion, 30 s.

During the immersion in immersion liquid, examine whether air bubbles are generated.

(4) Test Q_d (test B) (mainly applied to the liquid-filled capacitor) The test shall be carried out as prescribed below. The specimen is put into the thermostatic bath so that the sealed part is placed downward. The temperature of specimen may rise by 1°C to 5°C above the upper category temperature. This temperature is maintained for 10 min unless particularly specified in the detail specification. A specimen, with sealed parts on two or more faces, is held similarly for 10 min with each face directed downward. After elapse of the specified time, the specimen is taken out from the bath. Cover the neighborhood of sealed part thinly with the detecting powder of 8.6.2.1 (3). Examine whether any leakage exists.

When the specimen is allowed to stand in the thermostatic chamber, a clean white filter paper is spread under the specimen.

If other duration of standing in chamber than 10 min is specified in the detail specification, the duration is selected from the following:

1 h, 4 h, 24 h and 48 h

8.6.6 Recover The recovery shall be carried out conforming to the detail specification.

8.6.7 Final measurement The final measurement shall be carried out conforming to the detail specification.

8.6.8 Items to be specified in detail specification The relevant detail specification shall prescribe the following:

(1) Immersion liquid [refer to 8.6.2.1(1)]

(2) Type of test (refer to 8.6.5)

(3) Test temperature (refer to 8.6.5)

(4) Duration of test (if different from the condition of 8.6.5)

8.7 Solvent resistance test [refer to JIS C 0052 (Test Xa)]

8.7.1 Equipment The solvent container for this test shall be made of inactive materials, shall endure the solvent specified in Table 23, and shall have enough capacity to immerse the specimen into the solvent completely.

8.7.2 Materials The solvent for this test shall be selected from the solvents in Table 23 as specified by the detail specification.

Unless particularly specified in the detail specification, A shall be used.

Table 23. Solvents

Symbol	Type of solvents	Standard of solvents
A	2-propanol (isopropyl alcohol)	JIS K 8839
C	Water	Distilled water of resistivity of 500 Ωm or more (conductivity 2 mS/m or less), or ion exchange water

8.7.3 Initial measurement The appearance and marking shall be examined.

If specified in the detail specification, the mechanical and electrical performances shall also be examined.

8.7.4 Test According to the detail specification, carry out the test by the following method 1 or method 2.

(1) Method 1 (resistance to solvent of capacitor body, without rubbing) (refer to JIS C 0052, method 2) According to the detail specification, immerse the specimen completely in the solvent of Table 23 under the conditions specified in Table 24. Then, take it out from the liquid.

Table 24. Temperature of solvent and duration of immersion

Symbol	Type of solvent	Temperature of solvent °C	Duration of immersion	
			Method 1	Method 2
A	2-propanol (isopropyl alcohol)	20 to 25	30 ± 5 s	60 ± 10 s
C	Water	55 ± 5	5 ± 0.5 min	

(2) Method 2 (resistance to solvent of capacitor marking, with rubbing) refer to JIS C 0052, method 1) According to the detail specification, immerse completely the specimen in the solvent of Table 23 under the conditions specified in Table 24. Take it out quietly from the liquid. Keep it for 5 min or longer at ordinary temperature. Dry it and rub the surface with absorbent cotton (The Japanese Pharmacopoeia) or soft paper napkin.

The pressure in rubbing is 5 ± 0.5 N/cm². The rate is twice per 1 s. The number of cycles is 10 (5 times of go and return).

The jig for rubbing the surface is as follows:

(a) The jig is made of a rubber plate lined with a hard disc or bar and enclosed with absorbent cotton or soft paper napkin, and equipped with a spring balance to measure the rubbing force.

(b) The rubber disc has a diameter of 11.3 mm (about 1 cm^2) or 5 mm (about 0.2 cm^2), the thickness is 5 mm and the hardness is 30 to 40 (Shore A).

Remarks 1. The surface of capacitor is rubbed, after drying sufficiently when it is wet.

2. For small component, a jig made of rubber disc of 5 mm in diameter is used, and the rubbing force is 1 N.

8.7.5 Recovery When the measurement of mechanical and electrical performances are carried out in the final measurement, the recovery of 4.2 shall be carried out unless otherwise specified in the detail specification.

8.7.6 Final measurement The appearance and marking shall be inspected.

If specified in the detail specification, the electrical and mechanical performances shall be measured.

8.7.7 Items to be specified in detail specification The relevant detail specification shall prescribe the following:

(1) Items to be measured before and after test (if mechanical and electrical performances are measured) (refer to 8.7.3 and 8.7.6)

(2) Test method (refer to 8.7.4)

(3) Type of solvent (refer to Table 23)

(4) Temperature of solvent (refer to Table 24)

(5) Rubbing material [refer to 8.7.4 (2)]

(6) Recovery (if different (from 8.7.5)

8.8 Radiograph

8.8.1 Equipment The equipment is as follows:

(1) Radiograph equipment The equipment shall be capable of obtaining the image quality of radiograph specified in the detail specification. When X-ray equipment is used, an X-ray tube with small effective focus and small self-absorption shall be used.

(2) Film holder When tested by an X-ray of tube voltage 50 kV or less, film holders of small self-absorption for X-ray shall be used.

Cares shall be paid to minimize the fog caused by secondary back scattering rays.

(3) Image quality indicator The image quality indicator used to indicate the sensitivity of detecting radiograph shall be as specified in the detail specification. As the sensitivity of detection is determined by the sharpness and contrast of radiograph, the limit value of permissible defects shall be clearly indicated.

The image quality indicator shall be made of the same components as the specimen and shall include actual or artificial defects which are at least 10 % smaller than the minimum defect to be detected.

When defects can be specified by illustrations or writings, the image quality indicator may not be used.