

# JIS

JAPANESE  
INDUSTRIAL  
STANDARD

Translated and Published by  
Japanese Standards Association

---

---

JIS Z 3070 : 1998

## Methods for automatic ultrasonic testing for welds of ferritic steel

---

ICS 25.160.40

**Descriptors** : steels, welding, weldability testing, ultrasonic testing, flaw detection

**Reference number** : JIS Z 3070 : 1998 (E)

Z 3070 : 1998

## Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

There is no International Standard corresponding to this Standard. At the establishment, conformity with **JIS Z 3060** *Method for ultrasonic examination for welds of ferritic steel* which is a Standard for ultrasonic testing carried out manually has been taken into consideration.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Date of Establishment: 1998-05-20

Date of Public Notice in Official Gazette: 1998-05-20

Investigated by: Japanese Industrial Standards Committee  
Divisional Council on Welding

---

JIS Z 3070:1998, First English edition published in 2000-02

Translated and published by: Japanese Standards Association  
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

---

In the event of any doubts arising as to the contents,  
the original JIS is to be the final authority.

© JSA 2000

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

## Methods for automatic ultrasonic testing for welds of ferritic steel

**Introduction** This Japanese Industrial Standard was newly established in 1998. This Standard was adjusted to the typical specification of manual ultrasonic testing, JIS Z 3060 : 1994 *Method for ultrasonic examination for welds of ferritic steel*.

There is no International Standard corresponding to this Standard.

**1 Scope** This Standard specifies the system, the methods for testing and images of test results in the case of automatically performing the ultrasonic angle beam using the 1-probe or 2-probe pulse reflection technique for complete welds of ferritic steel with a thickness of over 6 mm. However, the Standard shall not apply to welds of tube joints being in manufacturing process and welds of nuclear power plants.

**2 Normative references** The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards indicated below shall be applied.

JIS Z 2300 *Glossary of terms used in nondestructive testing*

JIS Z 2345 *Standard test blocks for ultrasonic testing*

JIS Z 2352 *Method for assessing the overall performance characteristics of ultrasonic pulse echo testing instrument*

JIS Z 3060 *Method for ultrasonic examination for welds of ferritic steel*

**3 Definitions** The definitions of principal terms used in this Standard are specified as follows ; for others as specified in JIS Z 2300 and JIS Z 3060.

a) **automatic ultrasonic testing system** This system shall be composed of an automatic ultrasonic detector, a probe(s), a scanner and an image display.

b) **automatic ultrasonic detector** The detector shall be capable of automatically recording the condition of acoustic coupling at respective positions of probes for scanning, path lengths and echo heights satisfying the prescribed requirements and at the same time capable of performing distance amplitude correction.

c) **image** The image shall indicate on coordinates the existence and position of and the echo height or region of pulse amplitude in a reflection source where echo heights exceeding the lower indication limit value, which may be set optionally, can be obtained : the position of such a reflection source is to be evaluated in advance using the path length and the angle.

d) **Echo recording gate** The range for recording echoes set on the time axis and the echo height axis.

e) **coupling check** Coupling check quality of acoustic coupling between probe and test object.

f) **image display** This image display shall be capable of indicating or outputting coupling check pattern and image of test results.

g) **scanner** The scanner shall be capable of automatically scanning one or multiple probes and one or multiple sets of a transmitting probe and a receiving probe.

h) **primary testing** The primary test shall be performed for the testing range of a test object to check the existence of flaws for evaluation.

**4 Engineer** The engineers who conduct the automatic ultrasonic testing for welds shall be those who have complete knowledge of the testing principle and welds of ferritic steel as well as sufficient knowledge of and experience in detecting flaws of the welds and, at the same time, have been educated and trained on the use of the automatic ultrasonic testing system.

## 5 Configuration of automatic ultrasonic testing system

### 5.1 Basic configuration of system

**5.1.1 Definition of automatic ultrasonic testing** The automatic ultrasonic testing system shall be composed of an automatic ultrasonic detector, a probe(s), a scanner and an image display and shall have the following functions.

- a) The automatic ultrasonic detector shall be capable of automatically recording required data.
- b) The scanner shall be capable of automatically operating probes for scanning.
- c) The image display shall be capable of indicating recorded data and image of test results.

**5.1.2 Basic configuration of system** The basic configuration of the automatic ultrasonic testing system is shown in Figure 1.

**5.2 Automatic ultrasonic detector** The Automatic ultrasonic detector shall have the functions which general detectors are required and in addition shall have the functions to record path lengths and echo heights that satisfy the prescribed requirements at respective positions of probes, using the echo recording gate, to automatically perform distance amplitude correction and to check/record if the acoustic coupling between the probe and the test object is firmly kept or not.

#### 5.2.1 Echo recording gate

- a) **Terms** As shown in Figure 2, the echo recording gate is controlled by the following items.

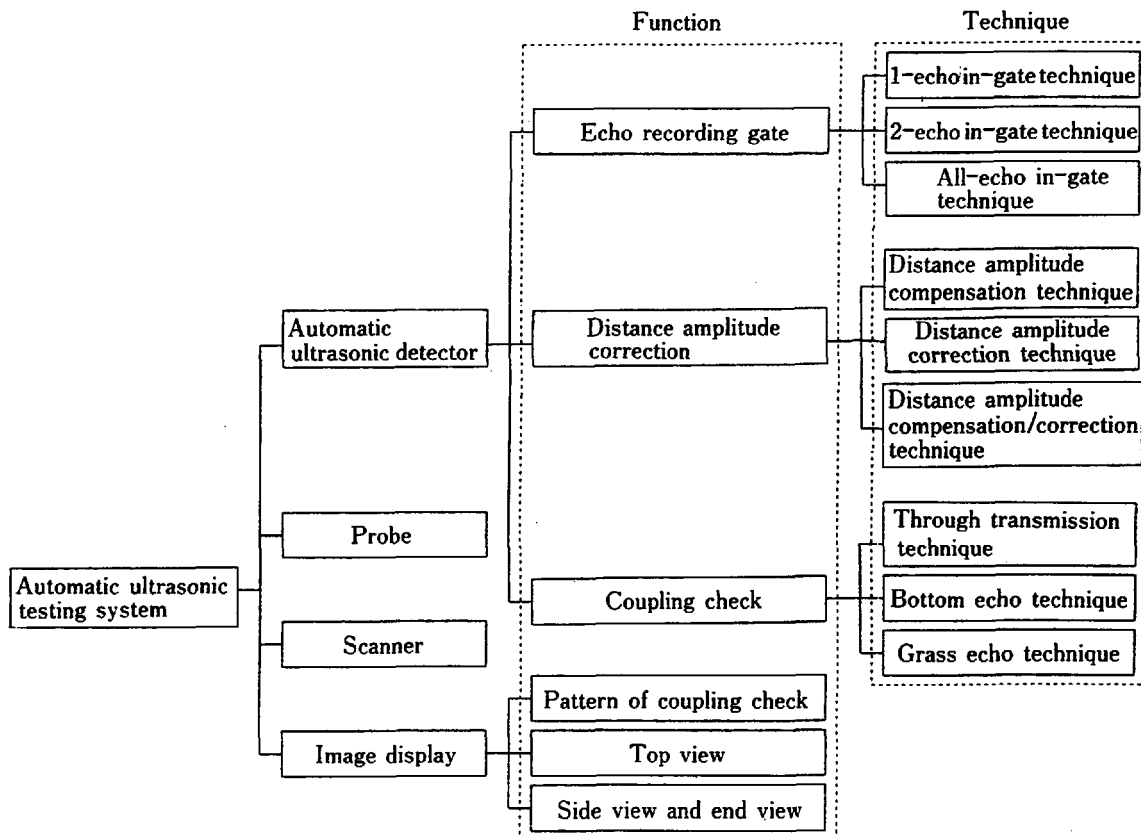


Figure 1 Configuration of the automatic ultrasonic testing system

- 1) **Starting point of echo recording gate** The starting point on the time axis for echo recording range
  - 2) **Range of echo recording gate** The width from the starting point on the time axis for echo recording range
  - 3) **Threshold level of echo recording gate** The starting point on the echo height axis for echo recording range
  - 4) **Effective threshold width of echo recording gate** The width from the threshold level on the echo height axis for echo recording range
  - 5) **Echo height axis** The axis to indicate the echo height
  - 6) **Position of threshold level** The position on the time axis where the echo exceeds the threshold level
  - 7) **Position of echo height** The position on the time axis to indicate the maximum echo height
  - 8) **Path length of echo** Any of the echo start-up position, threshold level position, or echo height position
  - 9) **Echoes to be recorded** Of echoes on the image display, those of which path lengths are in the range of echo recording gate and of which heights exceed the threshold level
  - 10) **Items to be recorded** As to echoes regarded to be recorded, their path lengths and heights need to be recorded. As to echo heights that exceed the effective threshold width, it is enough if the fact that those echo heights have exceeded the effective threshold width can be recorded.
- b) **Echo recording technique in echo recording gate** Recording echoes in the echo recording gate shall be done by the following three techniques.
- 1) **1-echo in-gate technique** Only one echo is recorded as shown in Figure 3.
  - 2) **2-echo in-gate technique** Two echoes are recorded as shown in Figure 4.
- When there are more than three echoes, two echoes are selected at random and recorded.
- 3) **All-echo in-gate technique** All echoes are recorded as shown in Figure 5.

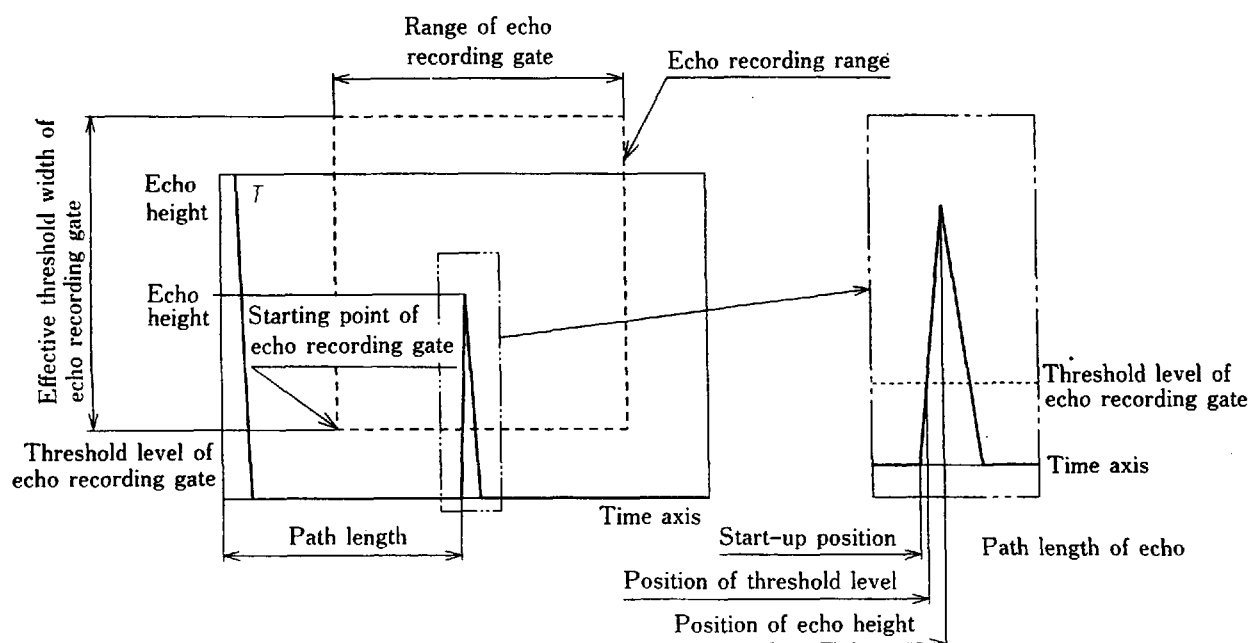


Figure 2 Echo recording gate

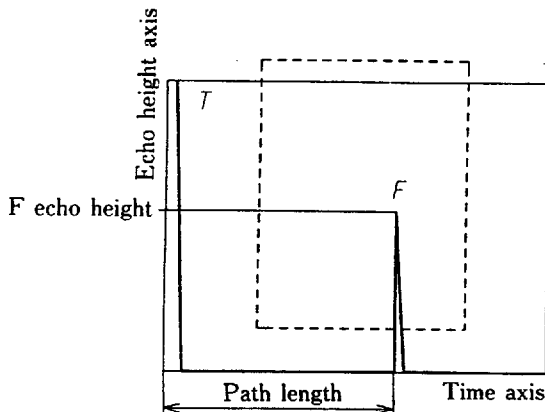
### 5.2.2 Distance amplitude correction

a) **Technique for distance amplitude correction** The distance amplitude shall be automatically done correction by the following three techniques before or after recording echoes, or both before and after.

1) **Distance amplitude compensation technique** The technique is used for electronically performing distance amplitude compensation, using the DAC circuit, as shown in Figure 6.

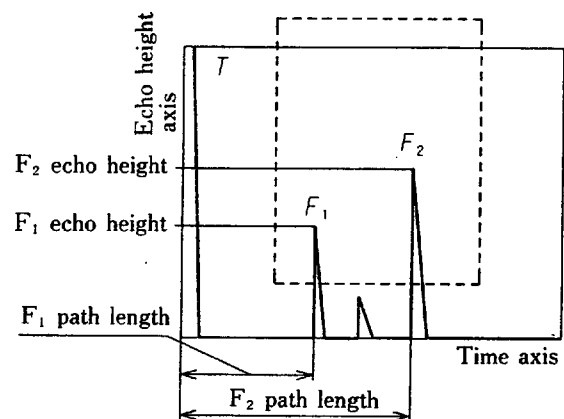
2) **Distance amplitude correction technique** The technique is used for performing distance amplitude correction for all echoes recorded, based on the distance amplitude curve measured in advance as shown in Figure 7. The height of echo recorded at the path length  $W$  and the echo height  $H$  is compensated to the echo height  $H_t$  by a correction equation obtained from the distance amplitude curve which is created by the skip points having the path length  $W$  in between.

3) **Distance amplitude compensation/correction technique** The technique is used for performing distance amplitude correction for all echoes recorded, using the distance amplitude correction technique, when the distance amplitude can not be properly corrected with use of the distance amplitude compensation technique.



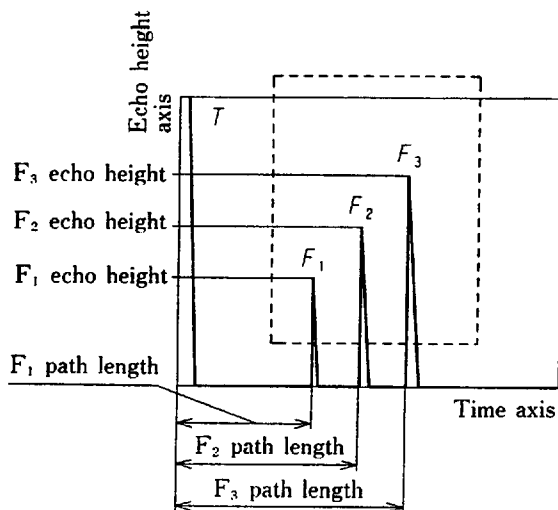
Record F echo only

Figure 3 1-echo in-gate technique



Record F<sub>1</sub> and F<sub>2</sub>

Figure 4 2-echo in-gate technique



Record F<sub>1</sub> to F<sub>3</sub>

Figure 5 All-echo in-gate technique

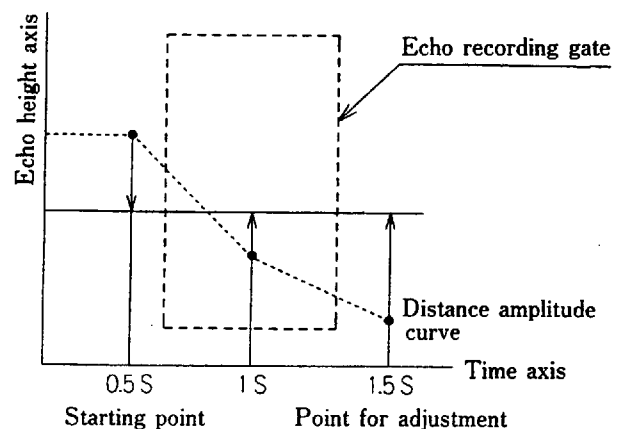
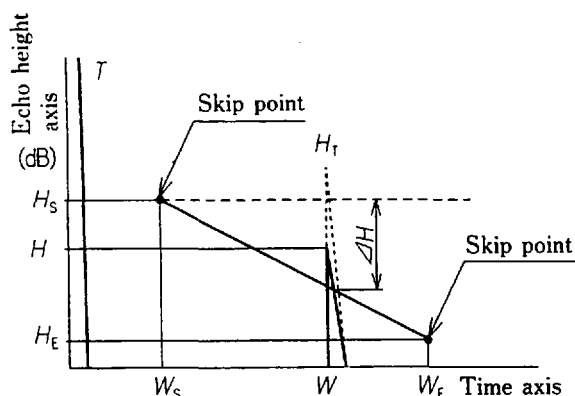


Figure 6 Example of distance amplitude compensation technique



Correction equation  $H_T = H + \Delta H$

$$\Delta H = \frac{W - W_s}{W_e - W_s} (H_s - H_e)$$

Figure 7 Example of the distance amplitude correction technique

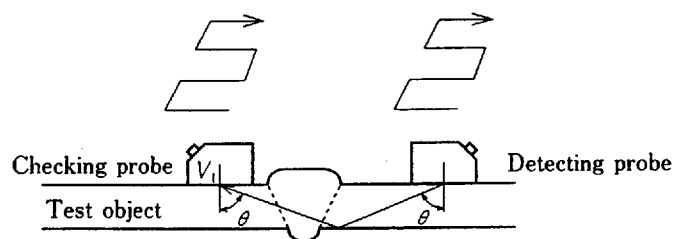
### 5.2.3 Coupling check

a) **Terms** The coupling check at automatic ultrasonic testing shall be controlled by the following items.

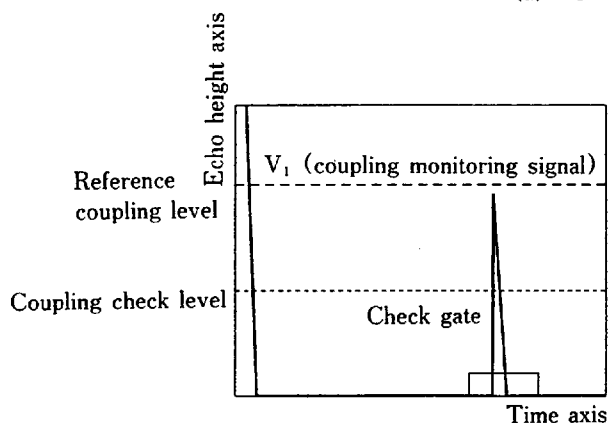
- 1) **Coupling monitoring signal** The echo to monitor the condition of acoustic coupling
- 2) **Reference coupling level** The level of echo height when acoustic coupling is the best
- 3) **Coupling check level** The level of echo height when acoustic coupling is good
- 4) **Check gate** The gate to be set for recording coupling monitoring signals
- 5) **Probe for checking** The probe to be arranged for recording coupling monitoring signals

b) **Technique for coupling check** The automatic ultrasonic testing detector records the echoes obtained according to the coupling check technique. The condition of acoustic coupling can be judged by display. The techniques for coupling check shall be the following three techniques, or other methods equivalent or superior to these.

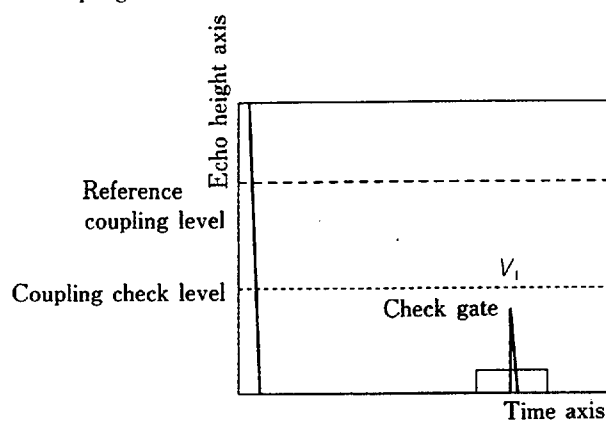
- 1) **Through transmission technique** As shown in Figure 8, scanning is performed arranging a receiving angle probe of the same structure as the detecting probe on the surface of base metal where the main beam of the angle probe reaches. The height of transmission pulse obtained by scanning is used as the coupling monitoring signal.
- 2) **Bottom echo technique** As shown in Figure 9, a coupling checking crystal is arranged inside the detecting probe. The height of the bottom echo of base metal is used as the coupling monitoring signal.
- 3) **Grass echo technique** As shown in Figure 10, the average height of grass echoes inside the echo recording gate is used as the coupling monitoring signal. The technique to use the automatic ultrasonic detector that records all A-scan in the echo recording range using a logarithmic amplifier having a broad dynamic range is regarded as the grass echo technique, and for this technique it is unnecessary to set a special check gate or to record the coupling monitoring signal over again.



(a) Condition of coupling check

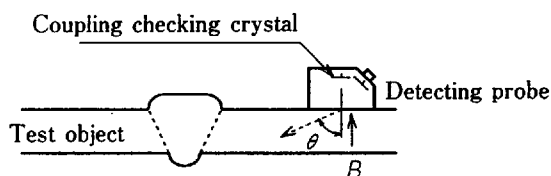


(b) Good acoustic coupling

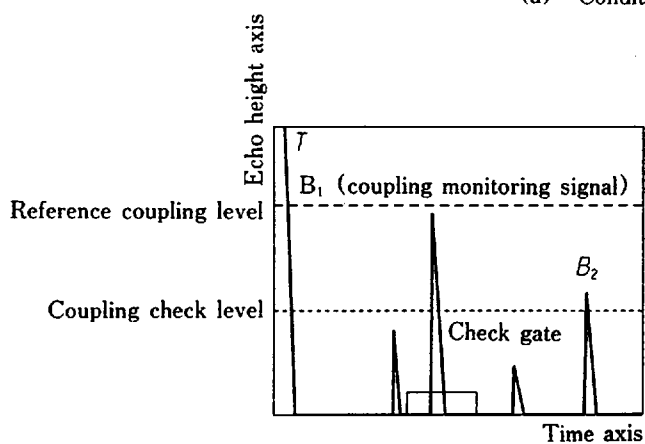


(c) Bad acoustic coupling

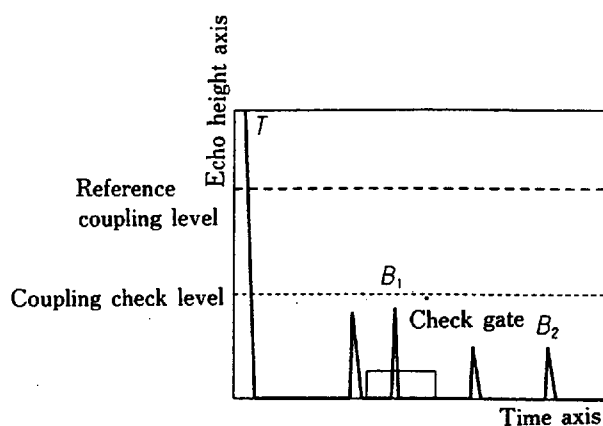
Figure 8 Through transmission technique



(a) Condition of coupling check



(b) Good acoustic coupling



(c) Bad acoustic coupling

Figure 9 Bottom echo method