International Standard 7963

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Welds in steel — Calibration block No. 2 for ultrasonic examination of welds

Soudures sur acier — Bloc d'étalonnage n° 2 pour l'examen par ultrasons des soudures

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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0 Introduction

This calibration block differs in size and shape from the block described in ISO 2400.

It is very much smaller and therefore lighter, and its geometry is much simpler.

It does not offer as much scope as the larger block; in particular it is not meant to check an ultrasonic flaw detector completely.

Its easy handling, however, makes it possible, during practical examination, to check simply, from time to time, the setting of the time base and the sensitivity of the ultrasonic equipment. Moreover, it is suited to checking the beam angle and the probe index of miniature shear wave probes.

1 Scope and field of application

This International Standard lays down the dimensions, type of steel and directives for the use of block No. 2 for the calibration of ultrasonic equipment for the examination of welds in steel.

2 References

ISO 468, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 2400, *Welds in steel — Reference block for the calibration of equipment for ultrasonic examination.*

ISO 2604/4, *Steel products for pressure purposes — Quality requirements — Part 4: Plates.*[1)]

3 Dimensions

The dimensions of the block, in millimetres, are given in figure 1.

The tolerances are ±0,1 mm, except on the length of the engraved scale where it is ±0,5 mm.

NOTES

1 The thickness of the block can be greater (see the annex).

2 In figure 1, R_a indicates the average roughness. R_a is not very different from R_z; both are defined in ISO 468.

4 Material

The calibration block is made of steel of composition corresponding to P 18 of ISO 2604/4.

5 Preparation

The calibration block shall be homogeneous and free from defects revealed by ultrasonic examination (see the annex).

In order to obtain a fine structure and good homogeneity, the block, before final machining, shall be heat treated as follows:

a) heating for 30 min at 920 °C and water-quenching;

b) re-heating for 2 h at 650 °C and cooling in still air.

The thickness to be removed from all surfaces by machining after heat treatment shall be at least 2 mm.

After the heat treatment, and without waiting for machining to end, the blocks shall undergo a further ultrasonic examination from two different directions at right angles to each other and in the direction of rolling.

All surfaces shall be machined lengthwise except the echo side, which shall be ground.

In order to prevent parasitic effects, the depth of the marks of the engraved scale shall be 0,1 ± 0,05 mm. The length of the marks shall be 6 mm and the tolerance on the positioning of the marks shall be ±0,2 mm. On completion of machining, a final ultrasonic examination shall be carried out.

6 Method of use

6.1 Setting of the time base

To set the time base, the leading edge (left side) of successive echoes shall be made to coincide with the appropriate scale markings on the screen of the equipment.

The pulse-travel time depends on the velocity of ultrasonic waves in the material examined.

For the steel composition given in clause 4, the velocities of longitudinal and shear waves are (5 920 ± 30) $m \cdot s^{-1}$ and (3 255 ± 15) $m \cdot s^{-1}$, respectively.

1) At present at the stage of draft. (Revision of ISO 2604/4-1975.)

6.1.1 Calibration of time base up to 250 mm with a longitudinal wave probe

The position of the probe on the calibration block is indicated in figure 2a). Figure 2b) is a schematic representation of the screen appearance for calibration of a distance of 50 mm.

NOTE — Depending on the probe and frequency used, difficulties may arise when calibrating distances greater than 10 times the thickness of the block.

6.1.2 Calibration of distance of 100 or 125 mm with a miniature shear wave probe

The position of the miniature shear wave probe on the calibration block is shown in figure 3a) for a distance of 125 mm and in figure 3b) for a distance of 100 mm. In figures 3a) and 3b) the screen appearances for the calibration of the two distances are also shown schematically.

NOTE — Calibration of the distance of 125 mm is, however, preferable, since the linearity of the time base is better.

6.2 Checking during examination

A large number of factors exercise an influence on sensitivity setting (see the annex).

6.2.1 Longitudinal wave probes — Sensitivity setting

The probe can be placed in position "a" as indicated in figure 4.

The oscillogram representing the successive echoes can be used as a reference for setting sensitivity.

It is also possible to use the reflection from the 5 mm diameter hole, position "b" in figure 4, the probe being placed so that the corresponding echo amplitude is at its maximum.

6.2.2 Miniature shear wave probes

6.2.2.1 Sensitivity setting

In this case, the maximum echo from the 5 mm diameter hole can also be used (see figure 5, position "a") as a reference for setting sensitivity.

Similarly, it is possible to make use of the reflections from the cylindrical surfaces of radii of 50 mm and 25 mm respectively.

In this case there are two possibilities.

— In the first, by using a calibrated gain control, the amplitude of the echo from the cylindrical surface is initially set to 80 % of screen height and subsequently adjusted to the level desired (see figure 5, position "b").

— In the second, without the use of a calibrated gain control, the successive echoes from the cylindrical surfaces can be used for the adjustment of sensitivity (see figure 6).

When checking probes, the acoustic coupling is an important factor and, when probes are compared, the same coupling medium shall be used.

6.2.2.2 Determination of the position of the probe index

The miniature shear wave probe is, as shown in figures 3a) and 3b), moved parallel to the main faces of the calibration block until the amplitude of the echo from the cylindrical surface has reached its maximum.

The probe index then coincides with the centre mark of the millimetre scale.

6.2.2.3 Determination of beam angle

In this case, use is made of the echo obtained from the 5 mm diameter hole.

The miniature shear wave probe is, as before, moved parallel to the main faces of the calibration block until the amplitude of the echo from the 5 mm diameter hole has reached its maximum.

The beam angle is obtained either by direct reading of the scale engraved on the calibration block, as shown in figure 7, or by interpolation if the position found does not coincide with one of the scale lines.

The positions shown in figure 7 make it possible to check beam angles of 45°, 60° and 70° probes.

Dimensions in millimetres

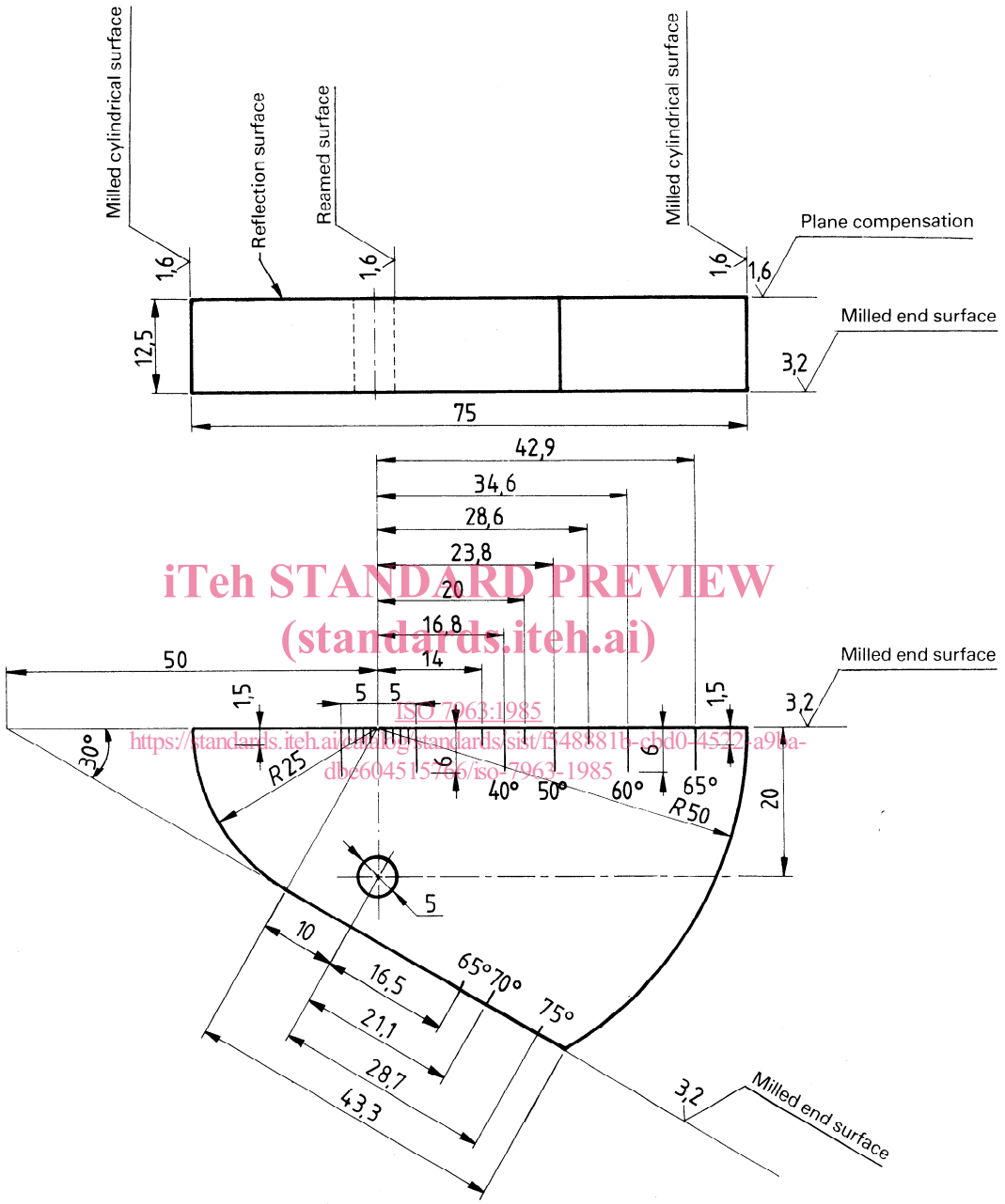


Figure 1

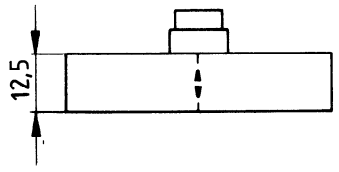


Figure 2a)

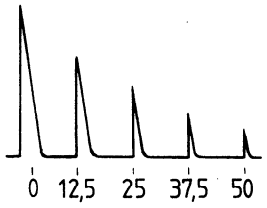


Figure 2b)

Figure 3a)

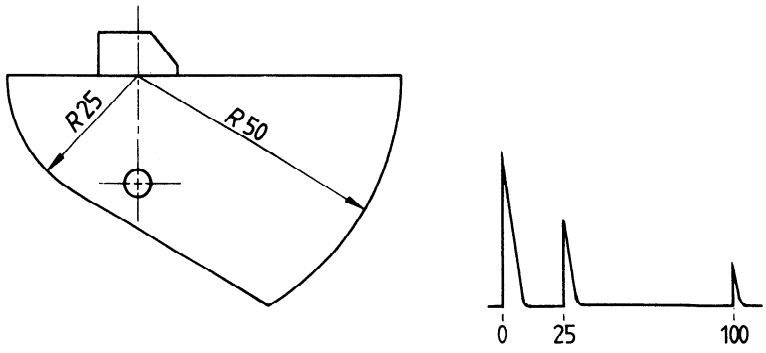
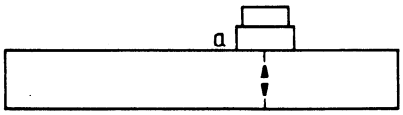


Figure 3b)



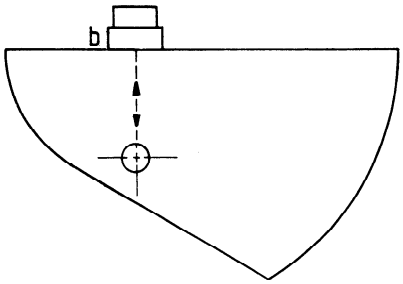


Figure 4

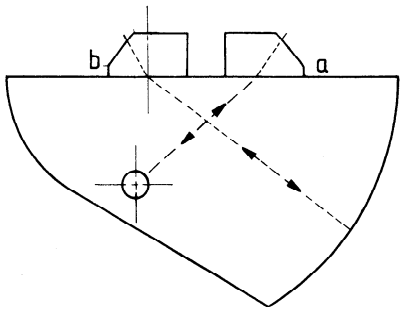
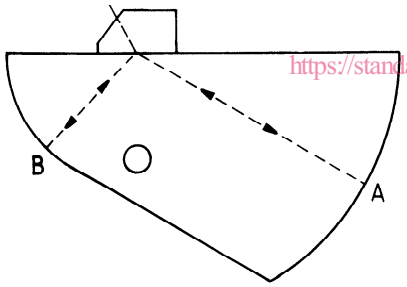


Figure 5



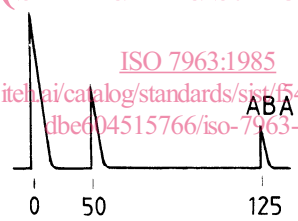


Figure 6

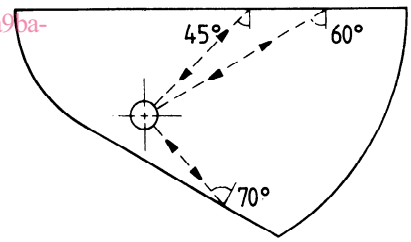


Figure 7

Annex

A.1 Thickness of the block for calibration of "non-miniature" probes

If necessary, a thicker block may be used, for example 20 or 25 mm thick.

A.2 Ultrasonic inspection of material before and after final machining

Two inspections with a longitudinal wave probe (crystal diameter 10 mm; frequency 6 MHz) are recommended:

a) With the probe positioned as shown in figure 2a), the amplitude of the back echo for a path length of at least 50 mm shall be greater than the grass level produced by the grain structure when the latter is increased by at least 50 dB.

b) No echo arising from any defect in the homogeneity of the material shall have an amplitude greater than the grass level.

A.3 Factors to be taken into consideration for the setting of sensitivity

These factors can be divided into the following four main groups:

a) equipment: pulse energy, frequency, pulse shape, amplification, etc.;

b) probe used: type, size, acoustic impedance, crystal damping, polar diagram, etc.;

c) material to be examined: surface condition (in connection with coupling), kind of material (its absorption), etc.;

d) defect analysis: shape, orientation, nature, etc.