



# PRODUCT STANDARD

## TME DIVN. BHOPAL

TM 98264

TME/2011

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### Procedure for Ultrasonic testing of copper and copper alloys plates

#### 1. Test Objective

The ultrasonic test described in this test specification has the objective of detecting internal material discontinuities <sup>1)</sup> in places of copper and copper alloys.

#### 2. Scope

This test specification is applicable to sheet rolled or forged plates of copper and copper alloys in thickness of 5-160 mm, whose structure allow this test.

#### 3. Test Levels

Depending on the requirement and type of material, tests can be performed in accordance with three test levels.

In general, and when there are no other agreements, tests are performed in accordance with Level iii). Where there are higher requirements, Levels ii or i may be agreed in so far as it is permitted by material and delivery condition.

Acceptance criteria relating to the various levels are stated in Table 1.

#### 4. Surface Condition

The plate surfaces must be free from scales and impurities, Surface undulation should be so small that the probe can not be properly applied, and that there is no gap of more than 0.5 mm under the probe face in any place.

#### 5. Test Method

In general the pulse echo shall be used, in the longitudinal waves and normal perpendicular incidence.

##### 5.1 Signal Evaluation Methods

##### 5.1.1 Evaluation Using Reference Blocks"

The reference block must be made of the same material and by the same manufacturing process as the plates to be tested. The thickness of the reference block may vary more than  $\pm 20\%$  from the nominal thickness of the plate to be tested. A minimum of 3 reference reflectors (flat-bottom holes) shall be drilled from one side of the reference block to a depth of 10, 50 and 90% of the wall thickness (Fig.1). For wall thicknesses to 20 mm nos. only 1 drill hole with a depth of 50% of wall thickness will be adequate.

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The distances between the drill holes and between the drill notes and the edges of the reference block must be greater than the diameter of the probe. For the diameter of the drill holes in accordance with plate thickness see Table 1.

### 5.1.2 AVG/DGS Method"

Taking into consideration the relevant sound velocities and , evaluation of the reflectors may also be done by the AVG/DGS method.

### 5.1.3 Half-amplitude method

Large reflectors shall be evaluated by the half-amplitude method (6-db-drop).

## 6. Requirements for testing equipment

### 6.1 Test System

The flow detector with the probe must be in accordance with DIN 54126, part 1.

### 6.2 Probes

For the ultrasonic testing of plates T/A-probes longitudinal waves) of normal probes (longitudinal waves) shall be used with a frequency of 0.5 to 6 MHz, depending on material, material condition and material thickness, Frequencies with more than 2 MHz shall be used preferably for the verification of flaws near the surface and for testing thin plates.

## 7. Adjustment of Instruments

### 7.1 Distance Adjustment

With T/R-probes distance adjustment shall be made on the reference block by means of the backwall echo and the echo from flat-bottomed holes with half wall thickness depth.

With normal probes distance adjustment shall be made with the first and second backwall echos out of the reference block or out of the plate.

### 7.2 Sensitivity Adjustment

In the reference block method, sensitivity adjustment shall be made according to Fig.1 It has to be checked by measuring the transfer losses that differences in sensitivity between reference block end plate to be tested do not exceed 4 dB.

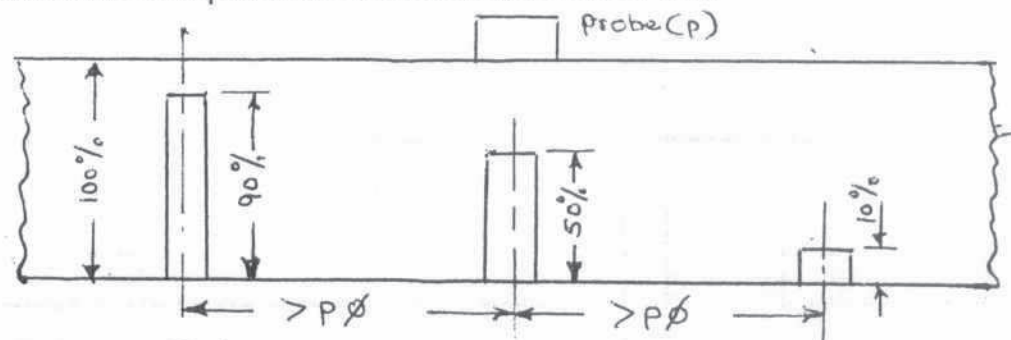


Fig. 1: Reference block





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With the AVG/DGS Method sensitivity adjustment is made with the backwall echo out of the plate to be tested. The value of necessary increase of sensitivity is taken out of an AVG/DGS diagram, in correspondence to the probe type used and the sound velocity of the material to be tested.

With both methods of adjustment instrument gain shall be set to a level that echos to be registered reach atleast 20% of screen height. Additionally the registration level should be atleast 8dB above noise level.

When these requirements can not be fulfilled, even when selecting the best suited probe producer and purchaser must come to an agreement on the further proceedings.

### 7.3 Checking Instrument Adjustment

The test system should be checked at regular intervals, and atleast at the beginning and the end of the ultrasonic test.

## 8. Test Performance

### 8.1 Procedure

The plates may be tested manually or semi-automatically (mechanized) (DIN 54 126, part 2.) Soundwave incidence is parallel to plate thickness.

In general it is sufficient to test from one surface only, as flaws hidden in the dead zone after initial pulse are detected via drop of the backwall echo, or as a signal behind the first backwal echo.

### 8.2 Range of Test Range A

The surface of the plate shall be scanned with a matrix of 200 mm distance or with parallel lines of 100 mm distance. The edge zones within a width of 100 mm shall be tested with complete coverage. Complete coverage of this area means an overlapping of scanning paths by  $\frac{1}{3}$  of the probe diameter.

Where a registration due to signal is found with a 200 mm matrix scanning of 100 mm line scanning, a circle of 200 mm radius must be tested with complete coverage.

The test range must be state at the time of the order, otherwise the ultrasonic test according to test range A will be applied.

### Range B

The surface of the plate shall be scanned with a matrix of 100 mm distance or with parallel lines of 50 mm distance.

The edge comes within a width of 100 mm shall be tested with complete coverage.

Where a registration due to signal is found within the 100 mm matrix scanning or 50 mm line scanning a circle of 100 mm radius must be tested with complete coverage.



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## Range C

The whole surface of the plate shall be scanned with complete coverage.

### 9. Evaluation of Tested Plates

#### 9.1 Registration Due to Signals

Two types of ultrasonic indications have to be considered when evaluating plates ultrasonically :

- a) Inter-echos (intermediary echos)  
All flaw echos must be recorded which are equal to or higher than the equivalent reflector size (~~ERS~~) given in Table 1 according to the plate thickness.
- b) Drop of the backwall echo  
A drop of the backwall echo equal to or greater than 12 dB must be recorded if there is not registration due to flaw echo at the same time.

#### 9.2 Acceptance criteria

- a) Inter-echos (intermediary echos)  
All plates will be rejected which have flaw echos whose amplitude is more than 6 dB higher than the equivalent reflector size according to Table 1, as well as plates show recordable signals whose frequency or extension (half-amplitude width) are greater than the values according to Table 1.
- b) Drop of the Backwall Echo  
All plates will be rejected, which show non registration due to flaw echos, but show local drop of the backwall echo equal to or greater than 12 dB.

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Table 1 : Acceptance criteria for plates tested ultrasonically

Level	Thickness of plate or reference block	Equivalent reflector size (ERS) diameter of flat -bottomed holes	BE-drop (Backwall Echo-drop)	Test Range		
	mm	mm	dB	A 200 mm matrix	B 100 mm matrix	C complete coverage
	Max.permitted no.of flaw echos per m2 of plate					
i	≤ 10	3	≤ 12	2	4	6
	> 10 - ≤ 20	4				
	> 20 - ≤ 30	5				
	> 30 - ≤ 50	6				
	> 50 - ≤ 70	8				
	> 70 - ≤ 100	10				
	> 100 - ≤ 160	12				
ii	≤ 10	4	≤ 12	2	4	6
	> 10 - ≤ 20	5				
	> 20 - ≤ 30	6				
	> 30 - ≤ 50	8				
	> 50 - ≤ 70	10				
	> 70 - ≤ 100	12				
	> 100 - ≤ 160	18				
iii	≤ 10	5	≤ 12	2	4	6
	> 10 - ≤ 20	6				
	> 20 - ≤ 30	8				
	> 30 - ≤ 50	10				
	> 50 - ≤ 70	12				
	> 70 - ≤ 100	16				
	> 100 - ≤ 160	20				

### 10. Test Personnel

#### 10.1 Inspectors

Inspectors must possess adequate basic technical knowledge and be able to perform the tests in accordance with the requirements stipulated in this material test application.

#### 10.2 Supervisors

The supervisor must have the adequate knowledge for the task. He must be able to perform the procedures in accordance with the requirements stipulated in this material test specification. Moreover, he is responsible for the necessary training of inspectors and for the correct performance of the testing equipment.

#### 10.3 Qualification of Test Personnel

Qualifications of test personnel should be in accordance with the requirements of DG21P Recommendations for training, qualification, and examination of non-destructive testing inspections (NDT inspections guideline) or the DGZIP Recommendations for the qualification and certification of non-destructive test personnel (qualification guideline)". Purchaser and manufacturer are free to agree on other equivalent qualification guidelines in respect to non-destructive test, personnel.