



# SLOVENSKI STANDARD

## oSIST prEN ISO 18563-1:2021

01-november-2021

---

**Neporušitvene preiskave - Ugotavljanje značilnosti in preverjanje ultrazvočne opreme faznih sistemov - 1. del: Naprave (ISO/DIS 18563-1:2021)**

Non-destructive testing - Characterization and verification of ultrasonic phased array equipment - Part 1: Instruments (ISO/DIS 18563-1:2021)

Zerstörungsfreie Prüfung - Charakterisierung und Verifizierung der Ultraschall-Prüfausrüstung mit phasengesteuerten Arrays - Teil 1: Prüfgeräte (ISO/DIS 18563-1:2021)

**(standards.iteh.ai)**

Essais non destructifs - Caractérisation et vérification de l'appareillage de contrôle par ultrasons en multiéléments - Partie 1: Appareils (ISO/DIS 18563-1:2021)

<https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fc55e/osist-pren-iso-18563-1-2021>

**Ta slovenski standard je istoveten z: prEN ISO 18563-1**

---

**ICS:**

19.100          Neporušitveno preskušanje          Non-destructive testing

**oSIST prEN ISO 18563-1:2021**

**en,fr,de**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[oSIST prEN ISO 18563-1:2021](https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fe55e/osist-pren-iso-18563-1-2021)

<https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fe55e/osist-pren-iso-18563-1-2021>

# DRAFT INTERNATIONAL STANDARD

## ISO/DIS 18563-1

ISO/TC 135/SC 3

Secretariat: DIN

Voting begins on:  
2021-09-02Voting terminates on:  
2021-11-25

---

---

## Non-destructive testing — Characterization and verification of ultrasonic phased array equipment —

### Part 1: Instruments

*Essais non destructifs — Caractérisation et vérification de l'appareillage de contrôle par ultrasons en multiéléments —*

*Partie 1: Appareils*

ICS: 19.100

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[oSIST prEN ISO 18563-1:2021](https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fc55e/osist-pren-iso-18563-1-2021)

<https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fc55e/osist-pren-iso-18563-1-2021>

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENT AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

This document is circulated as received from the committee secretariat.

**ISO/CEN PARALLEL PROCESSING**



Reference number  
ISO/DIS 18563-1:2021(E)

© ISO 2021

## iTeh STANDARD PREVIEW (standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fc55e/osist-pren-iso-18563-1-2021>



### **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

Foreword .....	v
<b>1 Scope .....</b>	<b>1</b>
<b>2 Normative references.....</b>	<b>1</b>
<b>3 Terms and definitions .....</b>	<b>1</b>
<b>4 Symbols and abbreviated terms.....</b>	<b>3</b>
<b>5 General requirements of conformity.....</b>	<b>4</b>
<b>6 Manufacturer's technical specification for ultrasonic phased array instruments .....</b>	<b>4</b>
<b>7 Performance requirements for ultrasonic phased array instruments.....</b>	<b>8</b>
<b>8 Group 1 tests.....</b>	<b>11</b>
<b>8.1 Equipment required for group 1 tests .....</b>	<b>11</b>
<b>8.2 Battery operational time.....</b>	<b>12</b>
<b>8.2.1 General .....</b>	<b>12</b>
<b>8.2.2 Procedure.....</b>	<b>12</b>
<b>8.2.3 Acceptance criterion .....</b>	<b>13</b>
<b>8.3 Stability after warm-up time .....</b>	<b>13</b>
<b>8.3.1 Procedure.....</b>	<b>13</b>
<b>8.3.2 Acceptance criteria.....</b>	<b>15</b>
<b>8.4 Stability against temperature.....</b>	<b>15</b>
<b>8.4.1 Procedure.....</b>	<b>15</b>
<b>8.4.2 Acceptance criteria .....</b>	<b>15</b>
<b>8.5 Stability against voltage variations.....</b>	<b>15</b>
<b>8.5.1 Procedure.....</b>	<b>15</b>
<b>8.5.2 Acceptance criteria.....</b>	<b>16</b>
<b>8.6 Deviation of time base.....</b>	<b>16</b>
<b>8.6.1 General .....</b>	<b>16</b>
<b>8.6.2 Procedure.....</b>	<b>16</b>
<b>8.6.3 Acceptance criterion .....</b>	<b>18</b>
<b>8.7 Transmitter .....</b>	<b>18</b>
<b>8.7.1 General .....</b>	<b>18</b>
<b>8.7.2 Pulse repetition frequency.....</b>	<b>18</b>
<b>8.7.3 Effective output impedance .....</b>	<b>18</b>
<b>8.7.4 Resolution of time delay.....</b>	<b>19</b>
<b>8.8 Receiver .....</b>	<b>20</b>
<b>8.8.1 General .....</b>	<b>20</b>
<b>8.8.2 Cross talk attenuation between receivers.....</b>	<b>20</b>
<b>8.8.3 Dead time after transmitter pulse .....</b>	<b>21</b>
<b>8.8.4 Dynamic range and maximum input voltage .....</b>	<b>23</b>
<b>8.8.5 Receiver input impedance .....</b>	<b>25</b>
<b>8.8.6 Time-corrected gain (TCG).....</b>	<b>25</b>
<b>8.8.7 Resolution of time delay.....</b>	<b>26</b>
<b>8.8.8 Linearity of vertical display against frequency.....</b>	<b>27</b>
<b>8.8.9 Summation.....</b>	<b>28</b>
<b>8.9 Gates .....</b>	<b>28</b>
<b>8.9.1 General .....</b>	<b>28</b>
<b>8.9.2 Linearity of gate amplitude .....</b>	<b>29</b>
<b>8.9.3 Linearity of time-of-flight in the gate.....</b>	<b>30</b>
<b>8.9.4 Monitor gates with analogue outputs.....</b>	<b>31</b>

## ISO 18563-1:2021(E)

8.10	Highest digitized frequency .....	34
8.10.1	Procedures .....	34
8.10.2	Acceptance criterion.....	35
8.11	Response time of ultrasonic phased array instrument .....	36
8.11.1	General.....	36
8.11.2	Procedure .....	36
8.11.3	Acceptance criterion.....	37
9	Group 2 tests .....	37
9.1	Equipment required for group 2 tests.....	37
9.2	Physical state and external aspects.....	38
9.2.1	Procedure .....	38
9.2.2	Acceptance criteria.....	38
9.3	Transmitter .....	38
9.3.1	General.....	38
9.3.2	Transmitter voltage, rise time, and duration.....	38
9.3.3	Linearity of time delays.....	41
9.4	Receiver.....	42
9.4.1	General.....	42
9.4.2	Frequency response.....	42
9.4.3	Noise level.....	44
9.4.4	Linearity of gain .....	45
9.4.5	Variation of channel gain.....	45
9.4.6	Linearity of vertical display .....	46
9.4.7	Linearity of time delay.....	47
	<b>ITEH STANDARD PREVIEW</b> <b>(standards.iteh.ai)</b>	
	Bibliography .....	49

oSIST prEN ISO 18563-1:2021

<https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fc55e/osist-pren-iso-18563-1-2021>

## 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 3 *Ultrasonic testing*.

This second edition cancels and replaces the first edition (ISO 18563-1:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

- test methods introduced in ISO 22232-1 have been incorporated;
- the layout has been rearranged to follow the layout of ISO 22232-1;
- the sequence of tests has been modified to follow the sequence of test in ISO 22232-1.

A list of all parts in the ISO 18563 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[oSIST prEN ISO 18563-1:2021](https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fc55e/osist-pren-iso-18563-1-2021)

<https://standards.iteh.ai/catalog/standards/sist/0d1dd6e7-1984-4d11-8c42-bf2fd07fc55e/osist-pren-iso-18563-1-2021>



# Non-destructive testing — Characterization and verification of ultrasonic phased array equipment — Part 1: Instruments

## 1 Scope

This document identifies the functional characteristics of a multi-channel ultrasonic phased array instrument used for array probes and provides methods for their measurement and verification.

This document can partly be applicable to ultrasonic phased array instruments in automated systems, but then, other tests might be needed to ensure satisfactory performance. When the phased array instrument is a part of an automated system, the acceptance criteria can be modified by agreement between the parties involved.

This document also can partly be applicable to FMC instruments and TFM instruments.

This document gives the extent of the verification and defines acceptance criteria within a frequency range of 0,5 MHz to 10 MHz.

The evaluation of these characteristics permits a well-defined description of the ultrasonic phased array instrument and comparability of ultrasonic phased array instruments.

iTeh STANDARD PREVIEW

## 2 Normative references (standards.iteh.ai)

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2400, *Non-destructive testing — Ultrasonic testing — Specification for calibration block No. 1*

ISO 5577, *Non-destructive testing — Ultrasonic testing — Vocabulary*

ISO 22232-1, *Non-destructive testing — Characterization and verification of ultrasonic test equipment — Part 1: Instruments*

ISO 23243, *Non-destructive testing — Ultrasonic testing with arrays — Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5577, ISO 22232-1, ISO 23243 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

### 3.1

**maximum number of channels that can be simultaneously activated**

maximum number of transmitting and/or receiving channels which can be used for one shot

## ISO 18563-1:2021(E)

### 3.2 parallel ultrasonic phased array instrument

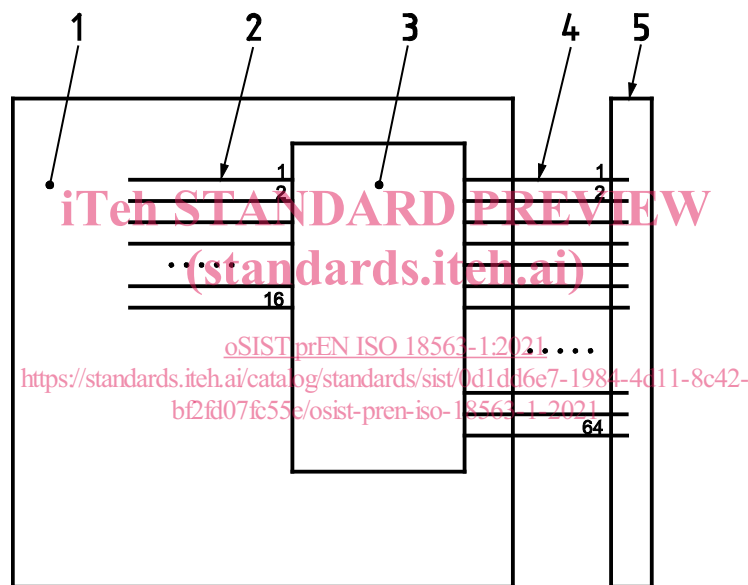
ultrasonic phased array instrument featuring a *maximum number of channels that can be simultaneously activated* (3.1) equal to the number of channels in the phased array instrument

EXAMPLE In a type 64/64 (also called 64 parallel), the maximum number of channels that can be simultaneously activated is 64 and the total number of channels of the ultrasonic phased array instrument is 64.

### 3.3 multiplexed ultrasonic phased array instrument

ultrasonic phased array instrument featuring a *maximum number of channels that can be simultaneously activated* (3.1) smaller than the number of channels in the ultrasonic phased array instrument and which are controlled by an internal multiplexing device

EXAMPLE In a type 16/64 multiplexed ultrasonic phased array instrument, the maximum number of channels that can be simultaneously activated is 16 and the total number of channels available is 64. See Figure 1.



#### Key

- 1 Ultrasonic phased array instrument
- 2 multiplexer input channels (1 to 16)
- 3 multiplexer
- 4 multiplexer output channels (1 to 64)
- 5 array probe

NOTE 16 = maximum number of channels that can be activated simultaneously  
64 = number of channels in the ultrasonic phased array instrument

Figure 1 — Diagram of a 16/64 multiplexed ultrasonic phased array instrument

### 3.4 time resolution of the ultrasonic phased array instrument

inverse of the maximum digitization frequency without processing

## 4 Symbols and abbreviated terms

Table 1 — Symbols and abbreviations

Symbol	Unit	Meaning
$A_{\min}$	%	Minimum amplitudes measured on a screen
$A_{\max}$	%	Maximum amplitudes measured on a screen
$A_0, A_n$	dB	Attenuator settings used during tests
CT	dB	Cross talk attenuation
$f_0$	Hz	Centre frequency
$f_u$	Hz	Upper frequency limit at -3 dB
$f_l$	Hz	Lower frequency limit at -3 dB
$f_{\max}$	Hz	Frequency with the maximum amplitude in the frequency spectrum
$f_h$	Hz	Highest digitized frequency
$\Delta f$	Hz	Frequency bandwidth
$f_R$	Hz	Pulse repetition frequency
FSH		Full screen height
$\Delta G$	dB	Channel gain variation
$G_D$	dB	Input signal dynamic range
$G_i$	dB	Instrument gain on channel $i$
$H_R$	%	Reference screen height
$I_{\max}$	A	Amplitude of the maximum current that can be driven by the proportional gate output
$N_{\text{in}}$	$\frac{\text{V}}{\sqrt{\text{Hz}}}$	Noise per root bandwidth for receiver input
$R_A, R_B, R_l$	$\Omega$	Termination resistors
$S$	dB	Attenuator setting
$\Delta T$	s	Time increment
$t$	s	Time delay
$T_0$	s	Time to the start of distance-amplitude curve
$t_1$	s	Dead time
$t_d$	s	Pulse duration
$T_{\text{final}}$	s	Time to the end of distance-amplitude curve
$t_r$	s	Transmitter pulse rise time from an amplitude of 10 % to 90 % of peak amplitude
$t_{RT}$	s	Response time
$t_{\text{Target } 0}, t_{\text{Target } i}, t_{P_i}, t_{P_0}, t_{\text{dif}}, t_{\text{dif}}$	s	Transmitter or receiver time delay
$V_A, V_B$	V	Pulse voltage amplitudes
$V_{\text{ein}}$	V	Receiver equivalent input noise

**ISO 18563-1:2021(E)**

Symbol	Unit	Meaning
$V_{in}$	V	Input voltage when measuring the receiver equivalent input noise
$V_I$	V	Output voltage modified when measuring the output impedance of the analogue gate
$V_{min}$	V	Minimum input voltage of the receiver
$V_{max}$	V	Maximum input voltage of the receiver
$V_0$	V	Output voltage to get an indication at 80 % of FSH when measuring the output impedance of the analogue gate
$V_{50}$	V	Voltage amplitude of the 50 $\Omega$ loaded transmitter pulse
$Z_0$	$\Omega$	Output impedance of transmitter
$Z_A$	$\Omega$	Output impedance of proportional output

**5 General requirements of conformity**

An ultrasonic phased array instrument complies with this document if it fulfils all of the following requirements:

- a) the ultrasonic phased array instrument shall comply with Clause 7;
- b) a declaration of conformity shall be available, issued by either the manufacturer operating a certified quality management system (e.g. in accordance with ISO 9001) or by an organization operating an accredited laboratory (e.g. in accordance with ISO/IEC 17025),
- c) the ultrasonic phased array instrument shall carry a unique serial number;
- d) a manufacturer's technical specification corresponding to the phased array instrument, which defines the performance criteria in accordance with Clause 6, shall be available.

**6 Manufacturer's technical specification for ultrasonic phased array instruments**

The manufacturer's technical specification relative to a specific model of an ultrasonic phased array instrument shall contain, as a minimum, the information listed in Table 2. This table specifies the information which shall be supplied by the manufacturer in the ultrasonic phased array instrument's technical specification (M = Measurement, OI = Other information).

The values obtained from the tests described in Clause 7 shall be established as nominal values, with tolerances given as indicated.

**Table 2 — Technical characteristics to be shown in the ultrasonic phased array instrument's technical specification**

Information	Type of information	Remarks
<b>General features</b>		
Size	OI	Width (mm) × Height (mm) × Depth (mm)
Weight	OI	At an operational stage including all batteries
Type(s) of power supply	OI	
Type(s) of instrument sockets	OI	Including the wiring diagram
Battery operational time	M	At fully charged new batteries
Number and type of batteries	OI	
Stability against temperature	M	
Stability after warm-up time	M	
Stability against voltage variations	M	
Temperature and voltage (mains and/or batteries) ranges in which the ultrasonic phased array instrument operates in accordance with the technical specification (operation and storage)	OI	When a warm-up time is necessary, its duration shall be stated
Form of indication given when a low battery voltage takes the performance of the ultrasonic phased array instrument outside of specification	OI	
Pulse repetition frequencies (PRFs)	M	Minimum and maximum values
Maximum power consumption	OI	VA (volt-amperes)
Protection grade	OI	
Environment	OI	For example: restriction of hazardous substances (RoHS), explosive atmosphere (ATEX), vibration, humidity
Multi-channel configuration	OI	Number of channels controlled simultaneously and number of available channels
Extension of the number of channels by interconnection of the ultrasonic phased array instruments	OI	
Available measurement units	OI	For example: mm, inches, %, dB, V
<b>Display</b>		
Screen size and resolution	OI	
Range of sound velocities	OI	
Time base range	OI	
Time base delay range	OI	
List of available views	OI	

## ISO 18563-1:2021(E)

Information	Type of information	Remarks
Response time for A-scan presentations	M	
Maximum digitization frequency without processing	OI	
Digitization frequency with processing	OI	For example: interpolation
Vertical resolution of digitizer	OI	In bits
Highest digitized frequency	M	
Deviation of time base	M	
<b>Inputs/outputs</b>		
Signal unrectified output (i.e. radio frequency, RF) and/or rectified available on the output socket	OI	
Number and characteristics of logic and analogue control outputs	OI	Including the wiring diagram
Number and characteristics of encoder inputs	OI	Including the wiring diagram
Power input	OI	AC, DC, voltage range, power (W)
Available power supply for external devices	OI	Voltage, power
Synchronization input/output	OI	
<b>Beam forming</b>		
Maximum number of channels active simultaneously	OI	
Maximum number of delay laws	OI	
Maximum number of groups of shots	OI	
Summation	M	
<b>Transmitter</b>		
Number of transmitters available simultaneously	OI	
Shape of transmitter pulse and where applicable, polarity	OI	i.e. rectangular, unipolar, bipolar, arbitrary pulse
Transmitter voltage rise time	M	
Transmitter voltage fall time	M	
Transmitter voltage duration	M	
Output impedance	M	
Maximum time delay	OI	
Resolution of time delay	M	
Linearity of time delays	M	
Possibility to apply different voltages on each channel	OI	

Information	Type of information	Remarks
Maximum power available per transmitter	OI	
<b>Receiver</b>		
Number of receivers available simultaneously	OI	
Characteristics of the gain control, i.e. range in decibels, value of increments	OI	
Characteristics of the logarithmic amplifier	OI	
Input voltage at FSH	OI	
Maximum input voltage	M	
Linearity of vertical display	M	
Linearity of the vertical display over the frequency ranges of the ultrasonic phased array instrument	M	
Frequency response	M	
Dead time after transmitter pulse	M	
Equivalent input noise	M	$\frac{V}{\sqrt{\text{Hz}}}$
Dynamic range	M	
Input impedance	M	
Maximum time delay	OI	
Resolution of time delay	M	
Time-corrected gain (TCG)	M	
Possibility to apply different gain values on each channel	OI	
Cross talk attenuation between receivers	M	
Linearity of time delays	M	
Linearity of gain	M	
Variation of channel gain	M	
<b>Data acquisition</b>		
Transfer rate between the external storage unit and the ultrasonic phased array instrument (type of link)	OI	
Maximum number of A-scans stored per second	OI	A-scan characteristics shall be stated
Maximum number of C-scans stored per second	OI	C-scan characteristics shall be stated
Maximum number of samples per A-scan	OI	