


Appendix C2, Check-list for auditors of candidate registered laboratories (technical insulation products)

Contents

	Page
1 General.....	2
2 Introduction	2
3 Laboratory documentation required by the standard(s), available for inspection by the auditor	3
4 Items to be discussed during an audit visit	3
4.1 Application form and requirements for a registered laboratory	3
4.2 Equipment and testing details	4
 Annex 1: Requirements for registered laboratories	
Annex 2: Example of a table of content for an equipment manual Guarded hot plate apparatus (according to EN 1946-2)	
Annex 3: Example of a table of content for an equipment manual Pipe tester (according to EN 1946-5 and EN ISO 8497)	
Annex 4: Example of a table of content for an equipment manual Maximum service temperature equipment (flat or pipe)	
Annex 5: General experience/rules for audits, additional information for candidate registered laboratories and the auditor	

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 2 of 11
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1 General

Laboratory documentation required by the standard(s), available for inspection by the auditor

Items to be discussed during an audit visit

- Annex 1, *Requirements for a registered laboratory*
- Annex 2, *Example of a table of content for an equipment manual for Guarded hot plate apparatus (according to EN 1946-2)*
- Annex 3, *Example of a table of content for an equipment manual, Pipe tester (according to EN 1946-5 and EN ISO 8497)*
- Annex 4, *Example of a table of content for an equipment manual, Maximum service temperature equipment (flat or pipe)*
- Annex 5, *General experience/rules for audits, additional information for candidate registered laboratories and the auditor (Expert group member)*

2 Introduction

This document has two aims:

- to give a check-list to the auditors to be used during an audit visit
- to inform the audited laboratory of the items that will be discussed during an audit visit and of the required documentation that shall be available for examination before an audit


The audit visit by Laboratory group member will focus on the equipment and testing details

- For Thermal Conductivity curve EN 1946-2 (GHP), EN 12667, ISO 8302, EN ISO 9900, EN 1946-5 (pipe) and EN ISO 8497
- For Maximum Service Temperature EN 14706/EN ISO 18097 and EN 14707/EN ISO 18096 (MST)
- Trace quantities of water-soluble chloride fluoride, silicate, sodium ions and pH EN 13468./EN ISO 12624
- For compressive stress EN 826/EN ISO 29469
- Water vapour permeability EN 12086/EN ISO 12572 for flat product and EN 13469/EN ISO 12629 for pipe

Documentary evidence of compliance shall be retained by the laboratory for the purposes of auditing.

Specific requirements for the individual tests are described after the general requirements valid for all/any of the tests listed above.

A laboratory may become registered for one or more of the tests as appropriate. The registration includes the listing of the temperature range for which they prove their testing capability for the Thermal Conductivity curve (flat and pipe testing) and the Maximum Service Temperature (flat and pipe testing).

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 3 of 11
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3 Laboratory documentation required by the standard(s), available for inspection by the auditor

The laboratory is required to have the following documentation according to EN 1946-2, and/or EN 1946-5 **for the determination of the thermal conductivity curve** and in conformity with EN ISO/IEC 17025.

- Equipment manual

Is not the manual of an external manufacture of the test equipment.

Is made by the laboratory staff.

This manual shall contain (See Annex 2, 3 and 4 of this document):

- equipment performance specifications
- equipment description
- equipment design and uncertainty analysis
- equipment performance check complete with experimental data

- Calibration and maintenance files

Equipment maintenance and results of calibrations shall be annotated in the calibration and maintenance files.

- Measurement procedures document

The measurement procedures document shall contain all detailed instructions that the operator requires to perform measurements within the stated uncertainty.

- For required information see also the Annex 1 of this document.

Also:

- Information required in Appendix for industrial products to Quality Assurance Mark rules. (Quality Assurance Mark is the term used for VDI mark)

The auditor shall be informed before the visit that this documentation will be available for inspection during the audit.

4 Items to be discussed during an audit visit


4.1 Application form and requirements for a registered laboratory

The application form filled in by the audited laboratory and sent previously to the VDI Mark Secretariat will be examined by the auditor.

This application form gives, among others things, some information about the requirements for a registered laboratory indicated in Annex 1 of this document. These requirements will be examined in detail hence it is important to fill in the application form as fully as possible.

The application form and all evidences should be handled within one year.

The following items will be discussed:

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 4 of 11
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– **Accreditation and conformity according EN ISO/IEC 17025:**

- Accreditation by which body?
- Accreditation to which standards?
- Date of last audit and details of non-compliances if any?
- ...

– **Competence of staff for testing within the VDI Mark scheme**

- How many years of experience?
- Comparative testing?
- Qualifications
- Evidence of training
- ...

– ...

4.2 Equipment and testing details

The equipment used for testing within this VDI Mark scheme shall comply with the requirements of the relevant EN standards (see section 2).

The following items will be considered:

– **Validation according to the relevant EN standard(s) and uncertainty analyse(s)**

The equipment manual will be examined with attention to the following items (Annex 2 and 3 give examples of possible tables of contents for the equipment manual for GHP and Pipe Tester respectively, Annex 4 for the Maximum Service Temperature) and shall include some experimental data:

- Equipment description (some information is available in the application form)
- Equipment performance check

The procedure for the equipment performance check shall be described in detail and should include experimental data.


- Uncertainty analysis or uncertainty budget (see Annex 2, 3 and 4)

Detailed information shall be given of the uncertainty analysis (best measurement capability) leading to an estimate of the measurement uncertainties under different testing conditions

– **Measurement procedures document**

This document shall contain all detailed instructions that the operator requires to perform measurements within the stated uncertainty

- Specimen preparation for testing (demonstrate to handle thin and thick specimens)
- Testing procedures, step-by-step

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 5 of 11
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- Thickness measurement (outside the equipment)
- Test reporting
- Appropriate calibration checks and maintenance actions
- Procedure followed with samples thicker than the capability of the apparatus?
- ...

– **Instrument calibration and status on calibration**


- calibration of relevant sensors/elements of the equipment (present example documents)
- Status on calibration?
- Frequency?
- Call up procedure for re-calibrations

– **Proficiency testing**

- Which test was performed and results?
- Records of these tests and results?
- History of calibration of equipment?
- For a specific test (the auditor can pick up one report from the archive for example), is the staff able to show all results and records?
- Details of inter-laboratory comparisons and level of agreement

– **Witness testing**

- System for sample marking
- Preparation of one specimen for a measurement for the individual tests ($\lambda(9)$, $\lambda(9_m)$, MST and water-soluble chloride fluoride, silicate, sodium ions)
- Identification of this specimen
- Steps for measuring this specimen
- Thickness, weight, length measurement, if relevant
- Calculation sheet
- Report
- Checking of results before reporting

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 6 of 11
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Annex 1: Requirements for registered laboratories

A laboratory shall fulfil the following requirements in order to be accepted by the Laboratory Group as a registered laboratory:


1. The laboratory shall be accredited against EN ISO/IEC 17025 (EA accreditation). In particular, the laboratory shall be able to demonstrate participation in inter-laboratory comparative testing for the relevant test methods¹.
2. The laboratory shall be notified within the frame of the CPR for insulation products for building equipment and industrial applications.
3. The laboratory shall have recent experience with test procedures (conditioning, ageing and measuring according to product specifications) according to the specific product standards.
4. The competence of staff and fitness for purpose of the equipment used for testing within the VDI Mark scheme shall comply with the requirements of relevant European standards:
 - For Thermal Conductivity curve EN 1946-2 (GHP), EN 12667, ISO 8302, EN ISO 9900, EN 1946-5 (Pipe tester) and EN ISO 849.
 - For Maximum Service Temperature EN 14706/EN ISO 18097 and EN 14707/EN ISO 18096
 - For trace quantities of water-soluble chloride fluoride, silicate, sodium ions and pH EN 13468/EN ISO 12624.

Documentary evidence of compliance shall be retained by the laboratory for the purposes of auditing.

5. Measurements shall be carried out with registered test equipment at the range of declared temperature for industrial application products.
6. Results shall be in agreement with the European levels of conformity requirements for the three tests as follows:
 - For thermal conductivity curve, $\lambda(9)$, GHP
 - $\pm 3 \%$ for temperature range from $-180 \text{ }^{\circ}\text{C}$ up to $500 \text{ }^{\circ}\text{C}$
 - $\pm 5 \%$ for temperatures above $500 \text{ }^{\circ}\text{C}$
 - For thermal conductivity curve, $\lambda(9_m)$, pipe tester
 - $\pm 3 \%$ for temperature range from $-70 \text{ }^{\circ}\text{C}$ up to $300 \text{ }^{\circ}\text{C}$
 - For Maximum Service Temperature flat products, MST $\pm 0,5 \%$ deformation at a chosen temperature (equipment verification in comparative testing)
 - For Maximum Service Temperature pipe, MST $\pm 1,0 \%$ deformation at a chosen temperature (equipment verification in comparative testing)
 - For trace quantities of water-soluble chloride fluoride, silicate, sodium ions $\pm 1.5 \text{ ppm}$

The listed values are provisional.


¹ Thermal Conductivity curve (flat and/or pipe), Maximum Service Temperature (flat and/or pipe), trace quantities of water-soluble chloride fluoride, silicate, sodium ions and pH, water vapour permeability absorption and compressive stress

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 7 of 11
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This shall be demonstrated by the laboratory's participation in a programme of comparative testing if this is offered.


NOTE 1 A laboratory may become registered for one or more of the test methods.

NOTE 2 Where a registered laboratory is contracted by a manufacturer to conduct testing for the manufacturer's own factory production control, the acceptance of that registered laboratory to conduct testing for a Certification Body for the VDI Mark scheme, will be at the discretion of the Certification Body. In such a case the certification body shall inform the Quality Assurance Committee.

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 8 of 11
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Annex 2: Example of a table of content for an equipment manual
Guarded hot plate apparatus (according to EN 1946-2)

- 1 INTRODUCTION**
- 2 TEST METHOD**
- 3 EQUIPMENT PERFORMANCE SPECIFICATIONS**
- 4 LIMITING VALUES FOR APPARATUS PERFORMANCE**
- 5 EQUIPMENT DESCRIPTION**
 - 5.1 PRINCIPLE OF OPERATION
 - 5.2 TYPE OF APPARATUS
 - 5.3 PRINCIPAL DIMENSIONS OF APPARATUS
 - 5.4 DIAGRAMS ILLUSTRATING THE DESIGN OF THE EQUIPMENT
 - 5.5 POSITION, CONNECTIONS AND NUMBERING OF TEMPERATURE SENSORS
 - 5.6 ELECTRICAL COMPONENTS, ENCLOSURE AND MAIN ANCILLARY EQUIPMENT
 - 5.7 DATA ACQUISITION SYSTEM AND COMPUTER PROGRAMS
- 6 EQUIPMENT DESIGN AND UNCERTAINTY ANALYSIS**
 - 6.1 UNCERTAINTY SOURCES
 - 6.2 EDGE HEAT LOSSES AND MAXIMUM SPECIMEN THICKNESS
 - 6.3 MAXIMUM GAP WIDTH AND MINIMUM SPECIMEN THICKNESS
 - 6.4 IMBALANCE ERROR (systematic uncertainty)
 - 6.5 UNCERTAINTY IN MEASURED ELECTRICAL POWER
 - 6.6 UNCERTAINTY IN THE DEFINITION OF THE METERING AREA
 - 6.7 UNCERTAINTY IN THE TEMPERATURE DIFFERENCE
 - 6.8 UNCERTAINTY IN THE MEASUREMENT OF THE SPECIMEN THICKNESS
 - 6.9 UNCERTAINTY DUE TO NON-SYMMETRICAL CONDITIONS
 - 6.10 UNCERTAINTY DUE TO IMPERFECT CONTACT CONDITIONS WITH RIGID SAMPLES
 - 6.11 UNCERTAINTY DUE TO VARIATION OF THERMAL CONDUCTIVITY WITH TEMPERATURE
 - 6.12 MAXIMUM PROBABLE UNCERTAINTY (uncertainty budget)
- 7 EQUIPMENT PERFORMANCE CHECK**
 - 7.1 FLATNESS
 - 7.2 ELECTRICAL CONNECTIONS AND AUTOMATIC CONTROLLERS
 - 7.3 TEMPERATURE MEASUREMENTS
 - 7.4 IMBALANCE ERROR (systematic uncertainty)
 - 7.5 EDGE HEAT LOSSES
 - 7.6 EMISSIVITY OF APPARATUS SURFACES
 - 7.7 LINEARITY TEST
 - 7.8 PROVEN PERFORMANCE CHECK
 - 7.9 REPRODUCIBILITY

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 9 of 11
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Annex 3: Example of a table of content for an equipment manual
Pipe tester (according to EN 1946-5 and EN ISO 8497)

- 1 INTRODUCTION**
- 2 TEST METHOD**
- 3 EQUIPMENT PERFORMANCE SPECIFICATIONS**
- 4 LIMITING VALUES FOR APPARATUS PERFORMANCE**
- 5 EQUIPMENT DESCRIPTION**
 - 5.1 PRINCIPLE OF OPERATION
 - 5.2 TYPE OF APPARATUS (guarded-end or calibrated/calculated-end apparatus)
 - 5.3 PRINCIPAL DIMENSIONS OF APPARATUS
 - 5.4 DIAGRAMS ILLUSTRATING THE DESIGN OF THE EQUIPMENT
 - 5.5 POSITION, CONNECTIONS AND NUMBERING OF TEMPERATURE SENSORS
 - 5.6 AMBIENT CONTROL AND MAIN ANCILLARY EQUIPMENT
 - 5.7 DATA ACQUISITION SYSTEM AND COMPUTER PROGRAMS
- 6 EQUIPMENT DESIGN AND UNCERTAINTY ANALYSIS**
 - 6.1 UNCERTAINTY SOURCES
 - 6.2 AXIAL HEAT FLOW AND MAXIMUM SPECIMEN THICKNESS
 - 6.3 MAXIMUM GAP WIDTH AND MINIMUM SPECIMEN THICKNESS
 - 6.4 IMBALANCE ERROR (guarded-end apparatus)
 - 6.5 UNCERTAINTY IN MEASURED ELECTRICAL POWER
 - 6.6 UNCERTAINTY IN THE MEASUREMENT OF THE TEST SECTION
 - 6.7 UNCERTAINTY IN THE TEMPERATURE DIFFERENCE
 - 6.8 UNCERTAINTY FROM SPECIMEN DIMENSION MEASUREMENT
 - 6.9 UNCERTAINTY DUE TO AIR GAP BETWEEN SPECIMEN AND APPARATUS
 - 6.10 MAXIMUM PROBABLE UNCERTAINTY (uncertainty budget)
- 7 EQUIPMENT PERFORMANCE CHECK**
 - 7.1 APPARATUS DIMENSIONS AND DEVIATION FROM IDEAL CYLINDER
 - 7.2 ELECTRICAL CONNECTIONS AND AUTOMATIC CONTROLLERS
 - 7.3 ELECTRICAL INSULATION OF ELECTRICAL CIRCUITS
 - 7.4 TEMPERATURE MEASUREMENTS
 - 7.5 IMBALANCE ERRORS (guarded-end apparatus)
 - 7.6 END HEAT LOSSES
 - 7.7 EMISSIVITY OF APPARATUS SURFACES
 - 7.8 LINEARITY TEST
 - 7.9 PROVEN PERFORMANCE CHECK
 - 7.10 REPRODUCIBILITY

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 10 of 11
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Annex 4: Example of a table of content for an equipment manual
Maximum service temperature equipment (flat or pipe)

- 1 INTRODUCTION**
- 2 TEST METHOD**
- 3 EQUIPMENT PERFORMANCE SPECIFICATIONS**
- 4 LIMITING VALUES FOR APPARATUS PERFORMANCE**
- 5 EQUIPMENT DESCRIPTION**
 - 5.1 PRINCIPLE OF OPERATION
 - 5.2 TYPE OF APPARATUS
 - 5.3 PRINCIPAL DIMENSIONS OF APPARATUS
 - 5.4 DIAGRAMS ILLUSTRATING THE DESIGN OF THE EQUIPMENT
 - 5.5 POSITION, CONNECTIONS AND NUMBERING OF TEMPERATURE SENSORS
 - 5.6 ELECTRICAL COMPONENTS, ENCLOSURE AND MAIN ANCILLARY EQUIPMENT
 - 5.7 DATA ACQUISITION SYSTEM AND COMPUTER PROGRAMS
- 6 EQUIPMENT DESIGN AND UNCERTAINTY ANALYSIS**
 - 6.1 UNCERTAINTY SOURCES
 - 6.2 UNCERTAINTY IN THE TEMPERATURE MEASUREMENT
 - 6.3 UNCERTAINTY IN THE MEASUREMENT OF THE SPECIMEN THICKNESS
 - 6.4 MAXIMUM PROBABLE UNCERTAINTY (uncertainty budget)
- 7 EQUIPMENT PERFORMANCE CHECK**
 - 7.1 FLATNESS (plate) OR LINEARITY (pipe)
 - 7.2 ELECTRICAL CONNECTIONS AND AUTOMATIC CONTROLLERS
 - 7.3 PROVEN PERFORMANCE CHECK
 - 7.4 THERMAL MOVEMENT OF THE APPARATUS

	INSULATION VDI Scheme, Appendix C2	Revision: 2.2 Date: 2025-11-01 Page: 11 of 11
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Annex 6: General experience/rules for audits, additional information for candidate registered laboratories and the auditor

There is a limit to the length of time that discussions with a candidate can continue. Clear time schedules shall be agreed between parties. If no actions are taken by the candidate for more than 6 months after the audit all actions need to be repeated (audit and comparative testing), The application and the approved audit must be completed in a maximum period of one year. To start the process again a new application should be filled in and forwarded. An important element for candidates is that the EN ISO/IEC 17025 accreditation shall be in place before a laboratory can apply.

Confidentiality is taken very seriously, and e.g. detailed discussions in the Laboratory Group on the individually candidates will not be in the minutes of the Laboratory Group meetings and will not be discussed with anyone outside the group.

The individual experts are responsible for follow up on actions agreed and at Laboratory Group meetings an item on the agenda will be to report on progress of these actions. The draft minutes of Laboratory Group meetings shall reflect actions to be taken and can be used by auditors when checking updates on the individual candidates.

When a candidate laboratory believes it is ready for the audit and guidance has been given by the auditor, a mutually convenient date will be arranged for the audit to take place.

If laboratories want VDI approval for more than one equipment for each test method, all such equipment shall be subject to comparative testing, except for pipe tester (Thermal conductivity and MST) where selected diameters will be chosen.

Only identified equipment where the 'known' test specimens and the European Reference Material meets the requirements on the 'European level' can be used for VDI testing. In addition, internal calibration procedures shall be documented and used in all registered laboratories.

In general, the required documentation shall be forwarded to the auditor before the audit. The check list for audits (scheme rules appendix C2, i.e. this document) will be made available to the applicants to help them prepare for the audits.

The basis for the auditing will be that candidate registered laboratories are accredited by an appropriate national body. That work shall not be repeated, but spot checks on technical details related to testing shall be made. Special emphasis shall be given to the EN 1946 technical assessment.

Observations will be made during the audit, and based upon the reporting of the auditor, the Laboratory Group will make their decision. The Laboratory Group secretariat will inform the candidate registered laboratory of the final conclusion.

All communication with the candidate will be handled by the secretariat with full information copied to the Laboratory Group. Full confidentiality is essential here and shall be respected by all Expert group members.

The audit costs are covered by the TIAQ, as defined by the Laboratory Group.

The format of the audit reports will follow the check list (scheme rules appendix C2, i.e. this document).