ISO/TC 112/SC

Date: 2023-05-24

ISO/DIS FDIS 21360-6:20222023(E)

ISO/TC 112/SC /WG 1

Secretariat: DIN

Date: 2023-07-04

Vacuum technology — Standard methods for measuring vacuum-pump performance — Part 6: CryoCryogenic vacuum pumps

Élément introductif — Élément central — Partie 6: Titre de la partie

Edited DIS - MUST BE USED FOR FINAL DRAFT

Style Definition: Heading 1: Indent: Left: 0 pt, First line: 0 pt, Tab stops: Not at 21.6 pt

Style Definition: Heading 2: Font: Bold, Tab stops: Not at 18 pt

Style Definition: Heading 3: Font: Bold

Style Definition: Heading 4: Font: Bold

Style Definition: Heading 5: Font: Bold

Style Definition: Heading 6: Font: Bold

Style Definition: ANNEX

Style Definition: AMEND Terms Heading: Font: Bold

Style Definition: AMEND Heading 1 Unnumbered: Font: Bold

Style Definition: IneraTableMultiPar: Font color: Black, Check spelling and grammar

Formatted: German (Germany)

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: German (Germany)

Formatted: German (Germany)

Formatted: Font: Bold, German (Germany)

Formatted: Font: Bold, German (Germany)

Formatted: Font: Bold, German (Germany)

Formatted: Font: Bold, German (Germany)

Formatted: German (Germany)

Formatted: Font: Bold

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Technique du vide — Méthodes normalisées pour mesurer les performances des pompes à vide — Partie 6: Pompes à vide cryogéniques

Edited DIS - MUST BE USED FOR FINAL DRAFT

ISO copyright office

Ch. de Blandonnet 8 • CP 401

CH-1214 Vernier, Geneva, Switzerland

Tel. + 41 22 749 01 11

Fax + 41 22 749 09 47

copyright@iso.org

~~www.iso.org~~

www.iso.org

Formatted: Font: 11.5 pt
Formatted: Font: 11.5 pt
Formatted: Justified, Space After: 37 pt
Formatted: English (United Kingdom)
Formatted

Formatted: English (United Kingdom)
Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)

Contents Page

Formatted: Font: 11.5 pt
Formatted: Font: 11.5 pt
Formatted: Tab stops: Not at 487.6 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: English (United Kingdom)

Formatted: Font: 11.5 pt
Formatted: English (United Kingdom)
Formatted: Justified, Space After: 37 pt
Formatted: Font: 11.5 pt

Formatted: English (United Kingdom)
Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)

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~~document 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~~www.iso.org/directives).

~~Attention is drawn~~ISO draws attention to the possibility that ~~some of~~ the ~~elements~~implementation of this document may ~~be~~involve the ~~subject~~use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights~~.~~ in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. 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).~~

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~~www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 112, *Vacuum technology*.

A list of all parts in the ISO 21360 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~~www.iso.org/members.html.

~~Edited DIS - MUST BE USED FOR FINAL DRAFT~~

Formatted: Font: 11.5 pt

Formatted: Font: 11.5 pt

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: Font: Italic

Formatted: Font: 11 pt, English (United Kingdom)

Formatted: English (United Kingdom)

Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt

Formatted: Font: 11 pt, English (United Kingdom)

Formatted: Font: 11 pt, English (United Kingdom)

Formatted: Font: 11 pt, Not Bold, English (United Kingdom)

Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt

Formatted: English (United Kingdom)

Introduction

This document specifies methods for measuring the performance data of cryopumpscryogenic vacuum pumps. This document complements ISO 21360-1, which provides a general description of the measurement of performance data of vacuum pumps. This document takes precedence in the event of a conflict with ISO 21360-1.

Formatted: Font: 11.5 pt
Formatted: Font: 11.5 pt
Formatted: English (United Kingdom)
Formatted: Justified, Space After: 37 pt
Formatted: Line spacing: At least 15.5 pt, Tab stops: Not at 20 pt
Formatted: std_publisher
Formatted: std_docNumber
Formatted: std_docPartNumber

Formatted: English (United Kingdom)
Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)

Vacuum technology — Standard methods for measuring vacuum-pump performance — Part 6: ~~Cryopumps~~Cryogenic vacuum pumps

1 Scope

This document specifies methods for measuring the volume flow rate, maximum throughput, pumping capacity, base pressure ~~cryopump~~cryogenic vacuum pump, cooldown time and crossover value of ~~cryopumps~~Cryogenic vacuum pumps.

It is applicable to two-stage, closed-loop gaseous helium ~~cryopumps with the cold surfaces not protruding into the chamber~~cryogenic vacuum pumps, which can be directly flanged to a vacuum chamber.

The ~~cryopumps~~cryogenic vacuum pump can capture nitrogen (alternatively dry air), argon, hydrogen and other gases to obtain high/ultra-high vacuum.

2 Normative references

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 21360-1:2020, *Vacuum technology — Standard methods for measuring vacuum-pump performance — Part 1: General description*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21360-1 and the following apply.

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

— ISO Online browsing platform: available at ~~https://www.iso.org/obp~~https://www.iso.org/obp

— IEC Electropedia: available at ~~https://www.electropedia.org/~~https://www.electropedia.org/

3.1
base pressure ~~cryopump~~cryogenic vacuum pump
~~p_b~~
p_b
pressure obtained in the test dome within 24 h of completing cooldown

Note 1 to entry: It is possible that the base pressure is not the lowest pressure obtainable with the ~~cryopump.~~cryogenic vacuum pump. The base pressure represents the lowest pressure that can be obtained after reasonable conditioning of the ~~cryopumps~~cryogenic vacuum pump and the test dome without any test gas (see 5.5).

Note 2 to entry: For many practical applications (e.g. only cool down time is tested, see 5.6), base pressure also can be obtained in the ~~cryopump~~cryogenic vacuum pump with a blank off flange at the entrance.

3.2

Formatted: Font: 11.5 pt, English (United Kingdom)
Formatted: Line spacing: Exactly 11 pt
Formatted: Font: 12 pt, English (United Kingdom)
Formatted: Font: 11.5 pt
Formatted Table
Formatted: Font: 11.5 pt
Formatted: Font: 12 pt, English (United Kingdom)
Formatted: Section start: New page
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: English (United Kingdom)
Formatted: Font: Cambria, 11 pt, English (United Kingdom)
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers
Formatted: English (United Kingdom)
Formatted: Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers, Tab stops: 19.85 pt, Left + 39.7 pt, Left + 59.55 pt, Left + 79.4 pt, Left + 99.25 pt, Left + 119.05 pt, Left + 138.9 pt, Left + 158.75 pt, Left + 178.6 pt, Left + 198.45 pt, Left
Formatted: English (United Kingdom)
Formatted: Font: Cambria, English (United Kingdom)
Field Code Changed
Formatted: Tab stops: Not at 487.45 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Left

cooldown time
time elapsed between starting the ~~cryopump~~cryogenic vacuum pump at room temperature (293 K ± 3 K) at a starting pressure as indicated by the manufacturer and the point at which the temperature of the *second stage* (3.6) reaches 20 K

Note 1 to entry: The roughing valve should only be closed when the action of closing does not cause the pressure in the ~~cryopump~~cryogenic vacuum pump to rise to a value above the starting pressure.

3.3
crossover value
~~q_{cv}~~
q_{cv}
maximum amount of nitrogen gas which can be admitted into the pump over a short time with the temperature of the *second stage* (3.6) remaining ≤20 K during the test gas flow

3.4
pumping capacity
~~q_{pc}~~
q_{pc}
quantity of gas, which has been pumped up to the moment when the volume flow rate has reduced to 50 % of the initial value measured

Note 1 to entry: After having pumped this amount of gas, the pump still can reduce the pressure in the test dome down to a value of p ≤10^{-3} Pa in less than 10 min to ensure that a certain pumping performance is still available.

3.5
maximum throughput
~~Q_{max}~~
Q_{max}
maximum quantity of condensable gas flow, which a ~~cryopump~~ cryogenic vacuum pump can pump ~~with the temperature of the *second stage* (3.6) at 20 K~~

3.6
second stage
lower temperature side cooling station with the cold panels of a closed-loop, two-stage gaseous helium cold head

4 Symbols

Symbol	Designation	Unit
~~Q~~ Q	gas throughput of ~~cryopump~~cryogenic vacuum pump	Pa·l·s^{-1}(or Pa·m^3·s^{-1})
~~Q_{max}~~ Q_{max}	maximum throughput	Pa·l·s^{-1}(or Pa·m^3·s^{-1})
~~q_{cv}~~ q_{cv}	crossover value	Pa·l(or Pa·m^3)
~~q_{pc}~~ q_{pc}	pumping capacity	Pa·l(or Pa·m^3)
~~p_d , p_e~~ p_d , p_e	pressures in the test dome for the orifice method	Pa

Formatted: cite_sec
Field Code Changed
Formatted: Tab stops: Not at 487.45 pt
Formatted: cite_sec
Field Code Changed
Formatted: Tab stops: Not at 487.45 pt
Formatted: Not Superscript/ Subscript
Field Code Changed
Formatted: English (United States)
Formatted: Tab stops: Not at 487.45 pt
Formatted: English (United States)
Formatted: English (United States)
Formatted: Body Text, Left
Formatted Table
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)

~~p_b~~ p_b	base pressure ~~cryopump~~cryogenic vacuum pump	Pa
~~p_1~~ p_1	vacuum pressure on inlet	Pa
~~p_2~~ p_2	starting pressure	Pa
~~D~~ D	inner diameter of test dome	m
~~D_N~~ D_N	nominal diameter of test dome	m
~~T_{max}~~ T_{max}	maximum temperature of the second stage	K

5 Test methods

5.1 Test gas

All measurements in this document should be performed with at least 99,9 % (by mass) pure test gas. The test gas should be nitrogen (alternatively dry air), argon and hydrogen.

5.2 Measurement of the volume flow rate (pumping speed)

5.2.1 General

The measurement of volume flow rate is specified in ISO 21360-1.

Pretreatment (see 5.2.4) is recommended before measuring the pumping speed of the test gas (except hydrogen).

When the pressure remains stable within ±3 % (for hydrogen ±5 % is acceptable) for the following minute, the average value per minute can be regarded as valid ~~p_1~~ p_1.

If several test gases are used, without regenerating the pump completely, the gases should be used in the following order: hydrogen, nitrogen (alternatively dry air), argon.

If during measurement more than 30 % of the pumping capacity as indicated by the manufacturer is admitted, the ~~cryopumps~~cryogenic vacuum pump should be regenerated.

The test pump should be directly flanged to the test dome (see 5.7.2, Figure 1) or the quick-acting valve (see 5.7.2, Figure 2). The cold surfaces of the test pump shall not protrude into the test dome. Specifically, for cryogenic vacuum pumps with cold surfaces extending beyond the pump inlet flange used in some applications (e.g. semiconductor industry), flanges or pipe adapters should be used to facilitate the connection between the test pump and the test dome to prevent the cold surfaces from protruding into the test dome.

5.2.2 Pretreatment procedure

A quantity of the test gas given by $\alpha \cdot q_V$ is admitted into the cryogenic vacuum pump during the pretreatment. Where, q_V is the nominal volume flow rate of the pump and α (α =1 Pa·s) is a proportionality factor determining the quantity of gas to be admitted into. The inlet pressure should be within the measuring pressure range and the operational time should not exceed 60 min.

The pressure shall be measured by the ion gauge, when the pressure change is at least one order below the measured pressure range in which the volume flow rate shall be measured, or if the pressure change satisfies $\frac{\Delta p}{\Delta t} \le 30 p_1$ (Pa·h⁻¹), the measurement of volume flow rate can be started

Formatted: Right
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: Body Text, Left
Field Code Changed
Formatted: English (United Kingdom)
Formatted: English (United Kingdom)
Formatted: Widow/Orphan control
Formatted: English (United Kingdom)
Formatted: English (United Kingdom)
Formatted: English (United Kingdom)
Formatted: Widow/Orphan control
Formatted: cite_sec
Field Code Changed
Field Code Changed
Field Code Changed
Field Code Changed
Field Code Changed
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, English (United Kingdom)
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)
Formatted: Indent: Left: 0 pt, Space Before: 18 pt, After: 0 pt, Line spacing: Exactly 12 pt
Formatted: Font: 11 pt, Not Bold, English (United Kingdom)

