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Road vehicles — Compressed natural gas (CNG) refuelling connector

Véhicules routiers — Connecteur de remplissage en gaz naturel comprimé (GNC)

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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

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Foreword

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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. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 41, *Specific aspects for gaseous fuels.*

This first edition of ISO 14469:2016 cancels and replaces the first edition of ISO 14469-1:2004, ISO 14469-2:2007 and ISO 14469-3:2006, which have been technically revised.

Introduction

This document was developed to use in the examination, testing and certification of newly produced compressed natural (CNG) gas vehicle fuelling nozzles and receptacles and, as such, applies only to the nozzles and receptacles used in CNG fuelling systems, and not to the system itself.

A nozzle certified to this International Standard will be functionally compatible from a safety and performance perspective with all listed receptacles of compatible profile and system pressure. Similarly, a certified receptacle will be functionally compatible from a safety and performance perspective with all listed nozzles of compatible profile and system pressure.

As there may eventually be many different kinds of nozzles and receptacles available from a variety of manufacturers which, for safety reasons, have to be all compatible with one another, this document specifies a series of receptacle profiles. These standard profiles incorporate the design specifications (mating materials, geometry and tolerances) which may be considered in the certification of a submitted nozzle or receptacle.

The construction and performance of nozzles and receptacles are based on the observation that three main parameters affect user safety and system compatibility.

a) Service pressure

All nozzles and receptacles are designed to have a service pressure of either 20 MPa (200 bar) for B200 and C200 connectors or 25 MPa (250 Bar) for B250 and C250 connectors.

b) Design life

Frequency of use is the second parameter to be considered. Since frequency of use will differ with the nozzle/receptacle application (i.e. public sector, fleet employee and residential), all receptacles will be tested at 10 000 connect/disconnect cycles for compliance with this document. In addition, all nozzles will be tested according to the following frequency use classifications, as applicable:

— Class A Nozzle, specifying high frequency use, with a cycle life of 100 000 cycles and equating to approximately 100 fills per day for three years;

— Class B Nozzle, specifying medium frequency use, with a cycle life of 20 000 cycles and equating to approximately 10 fills per day for five years.

c) Training

Operator training required is in accordance with national requirements.

Road vehicles — Compressed natural gas (CNG) refuelling connector

1 Scope

This document specifies CNG refuelling nozzles and receptacles constructed entirely of new and unused parts and materials, for road vehicles powered by compressed natural gas. A CNG refuelling connector consists of, as applicable, the receptacle and its protective cap (mounted on the vehicle) and the nozzle.

This document is applicable only to such devices designed for a service pressure of 20 MPa (200 bar) and 25 MPa (250 bar), to those using CNG according to ISO 15403-1 and ISO 15403-2 and having standardized mating components, and to connectors that prevent natural gas vehicles from being fuelled by dispensers with service pressures higher than that of the vehicle, while allowing them to be fuelled by dispensers with service pressures less than or equal to the vehicle fuel system service pressure.

This document refers to service pressures of 20 MPa and 25 MPa for:

— size 1: B200 and B250;

— size 2: C200 and C250.

NOTE All references to pressures, given in megapascals and bar[1)] are considered gauge pressures, unless otherwise specified.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 15500-2, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 2: Performance and general test methods*

ISO 15501-1, *Road vehicles — Compressed natural gas (CNG) fuel systems — Part 1: Safety requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

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

1) (1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2)

3.1
dry air
air with moisture content such that the dew point of the air at the required test pressure is at least 11 °C below the ambient test temperature

3.2
hydrostatic pressure
pressure to which a component is taken to verify the structural strength of the component

3.3
working pressure
maximum pressure that a CNG refuelling connector can be expected to withstand in actual service

3.4
service pressure
settled pressure of 20 MPa (200 bar) at a uniform gas temperature of 15 °C for B200 and C200 connectors or 25 MPa (250 Bar) for B250 and C250 connectors

3.5
positive locking means
feature which requires actuation of an interlocking mechanism to allow connection/disconnection of the nozzle from the receptacle

3.6
CNG refuelling nozzle
device which permits quick connection and disconnection of fuel supply hose to the CNG receptacle in a safe manner, hereafter referred to as nozzle

3.7
CNG refuelling receptacle
device connected to a vehicle or storage system which receives the CNG refuelling nozzle and permits safe transfer of fuel, hereafter referred to as receptacle

3.8
CNG refuelling connector
joined assembly of CNG refuelling nozzle and receptacle, hereafter referred to as connector

4 General construction requirements

4.1 Nozzles and receptacles manufactured in accordance with this document shall be designed in accordance with reasonable concepts of safety, durability and maintainability.

4.2 Nozzles and receptacles shall be well fitted and manufactured in accordance with good engineering practice. All construction requirements may be met by either the construction specified in this document or another construction that gives at least equivalent performance.

4.3 Nozzles and receptacles shall be

— designed to minimize the possibility of incorrect assembly,

— designed to be secure against displacement, distortion, warping or other damage, and

— constructed to maintain operational integrity under normal and reasonable conditions of handling and usage.

4.4 Nozzles and receptacles shall be manufactured of materials suitable and compatible for use with CNG at the pressure and the temperature ranges to which they will be subjected (see Clause 1).

The minimum temperature range shall be selected by the manufacturer between the following ranges:

— 40 °C to 85 °C or 120°C as applicable;

— 20 °C to 85°C or 120 °C as applicable.

NOTE 1 The lower temperature limit depends on whether the component is to be used for mild or cold weather

NOTE 2 The high temperature limit depends on whether the component will be installed inside the engine compartment (120°C) or outside of the engine compartment (85°C).

4.5 Nozzles and receptacles constructed of brass shall use brass alloys with a copper mass content ≤70 %. This will ensure proper material compatibility with all the constituents of natural gas.

4.6 Separate external three-way valves shall be constructed and marked so as to indicate clearly the open, shut and vent positions.

4.7 Nozzles and receptacles shall be operated either to connect or disconnect without the use of tools.

4.8 The receptacle shall be mounted on the vehicle in accordance with ISO 15501-1.

4.9 Jointing components shall provide gas-tight sealing performance.

5 Nozzles

5.1 Nozzles shall be one of the three types according to a), b) and c). See also Annex A.

a) Type 1 is a nozzle for use with dispensing hoses that remain fully pressurized at dispenser shutdown.

The nozzle shall not allow gas to flow until a positive connection has been achieved. The nozzle shall be equipped with an integral valve or valves, incorporating an operating mechanism which first stops the supply of gas and safely vents the trapped gas before allowing the disconnection of the nozzle from the receptacle. The operating mechanism shall ensure that the vent valve is in the open position before the release mechanism can be operated and that the gas located between the nozzle shut-off valve and the receptacle check valve is safely vented prior to nozzle disconnection (see 10.2).

b) Type 2 is a nozzle for use with dispensing hoses that remain fully pressurized at dispenser shutdown. A separate three-way valve connected directly, or indirectly, to the inlet of the nozzle is required to safely vent trapped gas prior to nozzle disconnection. The nozzle shall not permit the flow of gas if unconnected. Venting is required prior to disconnection of the nozzle (see 10.2).

c) Type 3 is a nozzle for use with dispensing hoses which are automatically depressurized — 0,5 MPa (5 bar) and below — at dispenser shutdown (see 10.2).

In addition, nozzles shall be classified in terms of cycle life as follows:

— Class A, specifying high frequency use, with a cycle life of 100 000;

— Class B, specifying low frequency use, with a cycle life of 20 000.

5.2 Venting or de-pressurization of all nozzle types is required prior to disconnection. Disconnection of all nozzles shall be able to be accomplished in accordance with 10.2.

5.3 The method for attaching the nozzle to the fuel dispensing system hose shall not rely on the joint threads between the male and female threads for sealing (e.g. conical threads).

5.4 The three-way valve exhaust port of Type 1 and Type 2 nozzles shall be protected from the ingress of foreign particles and fluid which would hamper the operation of the valve.

5.5 The portions of a nozzle which are held by the user for connection or disconnection may be thermally insulated.

5.6 A Type 1 nozzle shall bear a marking indicating the direction of the open and shut operation if it contains a rotating actuation mechanism.

5.7 The interface surface of the nozzle shall be constructed of material having a hardness >75 Rockwell B (HRB 75) and shall be non-sparking and conductive (see 10.11.5 and 10.15).

The exposed surfaces of the nozzles shall be made of non-sparking materials (see 10.11.5 and 10.15).

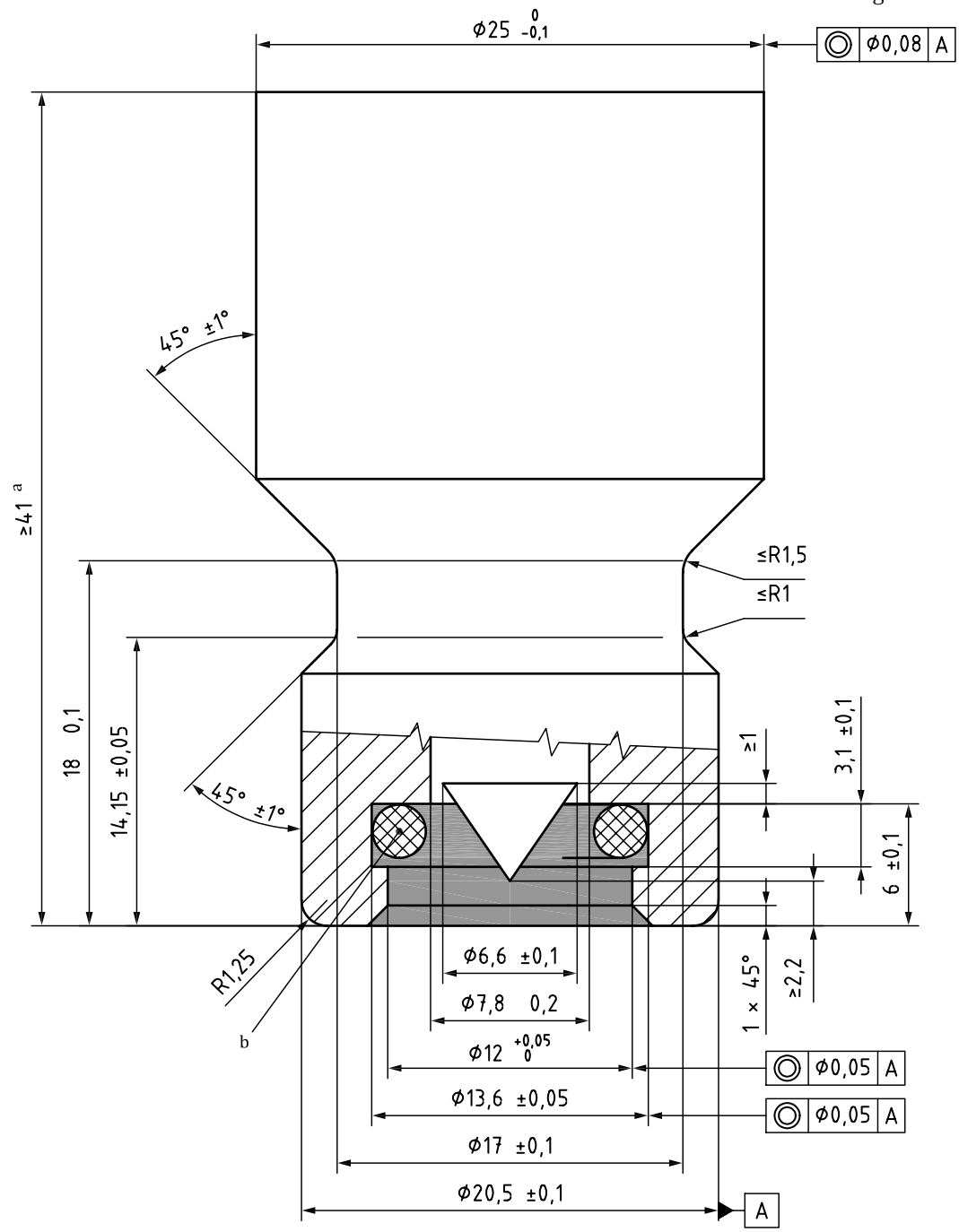
5.8 Nozzles shall comply with the performance requirements of Clause 10 to ensure interchangeability.

6 Standard receptacle dimensions

6.1 Standard receptacle dimensions Size 1 (B200, B250)

A Size 1 receptacle shall comply with the design specifications shown in Figure 1 and 2.

Dimensions in millimetres
Surface roughness ≤ *Ra* 3,2 µm

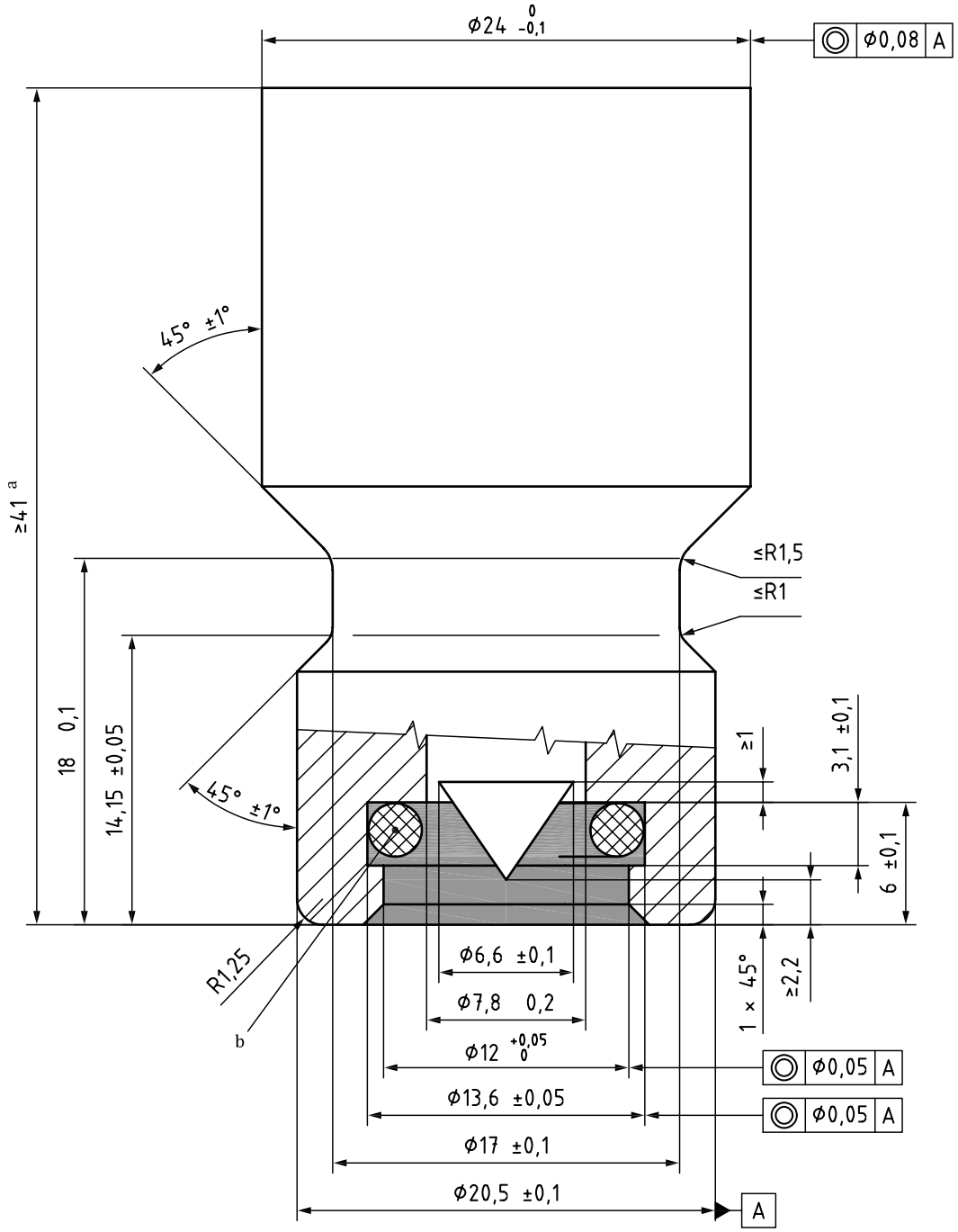


Key

	This area shall be kept free of all components
a	Minimum length of the receptacle that is clear of provisions for attachment of the receptacle or protective caps.
b	Sealing surface equivalent to N°110 O-ring of dimensions: — Internal diameter: 9,19 ± 0,127; width: 2,62 ± 0,076; — Sealing surface finish: 0,8 µm to 0,05 µm; — Material hardness: 75 HRB minimum.

Figure 1 — B200 receptacle

Dimensions in millimetres



Key

This area shall be kept free of all components

a Minimum length of the receptacle that is clear of provisions for attachment of the receptacle or protective caps.

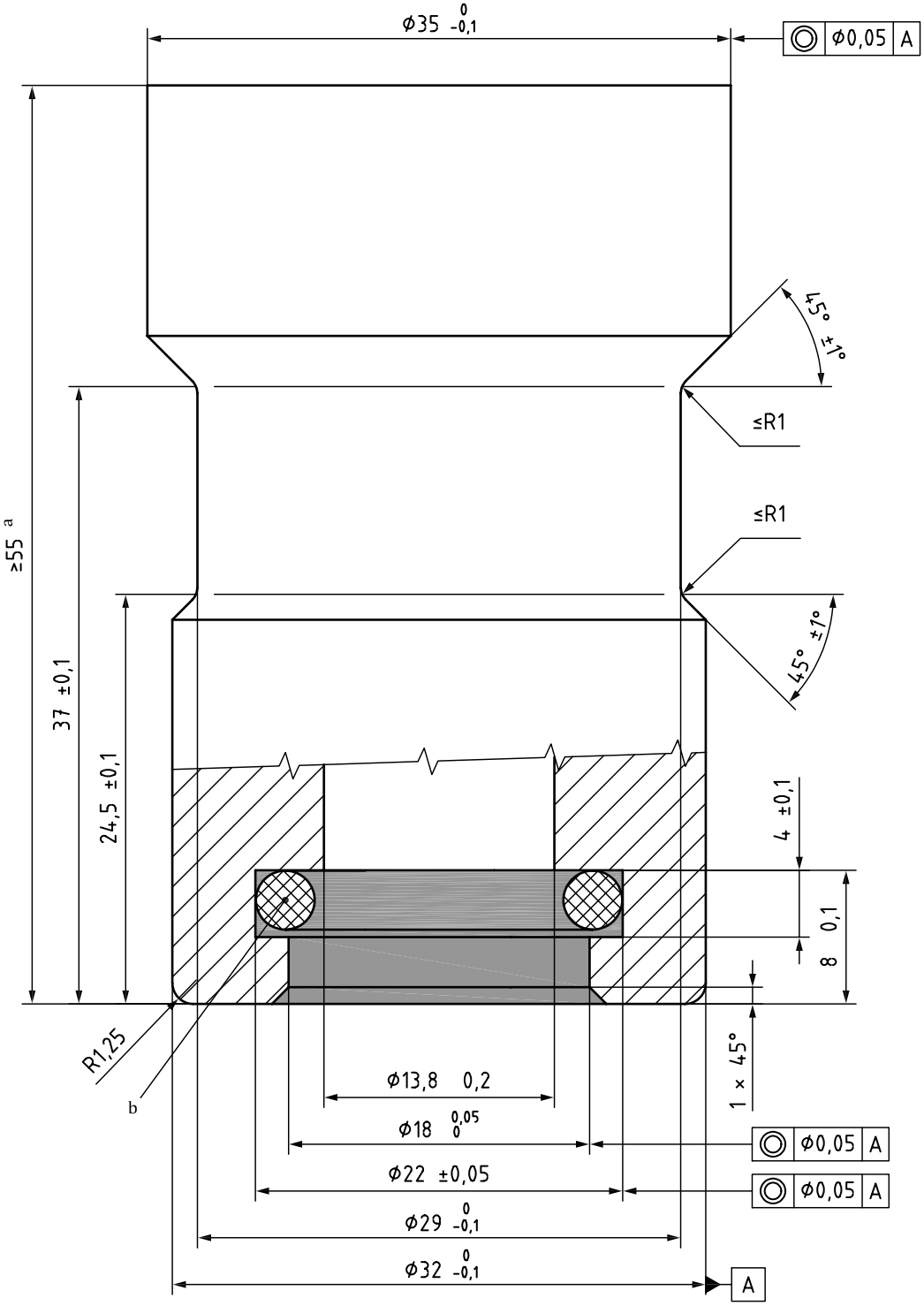
b Sealing surface equivalent to N°110 O-ring of dimensions:

— Internal diameter: 9,19 ± 0,127; width: 2,62 ± 0,076;
— Sealing surface finish: 0,8 µm to 0,05 µm;
— Material hardness: 75 HRB minimum.

Figure 2 — B250 receptacle

6.2 Standard receptacle dimensions size 2 (C200, C250)

A Size 2 receptacle shall comply with the design specifications detailed in Figures 3 and 4.



Key

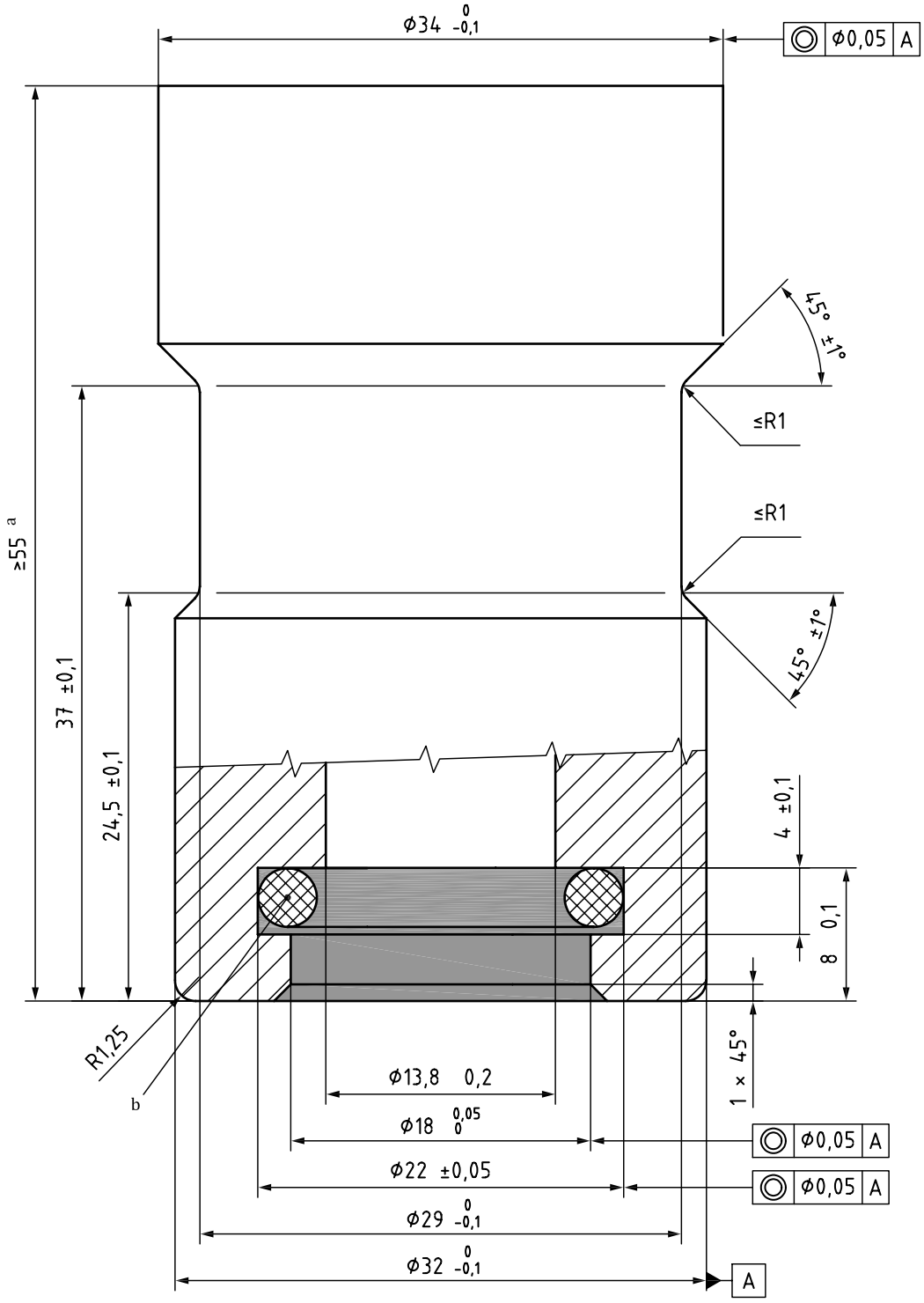
This area shall be kept free of all components

a Minimum length of the receptacle that is clear of provisions for attachment of the receptacle or protective caps.

b Sealing surface equivalent to N°208 O-ring of dimensions:

— Internal diameter: 15,47 ± 0,23; width: 3,53 ± 0,1;
— Sealing surface finish: 0,8 µm to 0,05 µm;
— Material hardness: 75 HRB minimum.

Figure 3 — C200 receptacle



Key

	This area shall be kept free of all components
a	Minimum length of the receptacle that is clear of provisions for attachment of the receptacle or protective caps.
b	Sealing surface equivalent to N°208 O-ring of dimensions: — Internal diameter: 15,47 ± 0,23; width: 3,53 ± 0,1; — Sealing surface finish: 0,8 µm to 0,05 µm; — Material hardness: 75 HRB minimum.

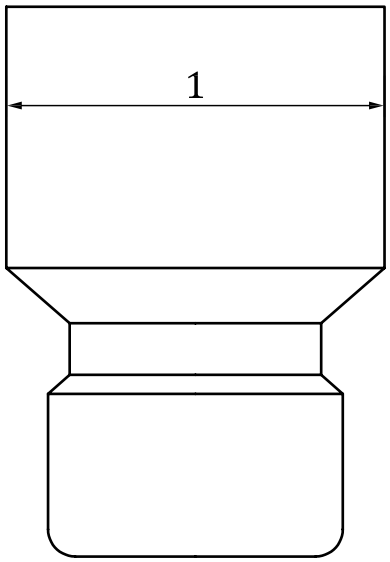
Figure 4 — C250 receptacle

7 Receptacles

7.1 Receptacles shall be evaluated using at least two different test nozzles, each nozzle representing a different locking technology.

The failure of any test conducted with the receptacle and nozzle test samples shall constitute a failure of the submitted receptacle, unless the manufacturer can prove the problem was caused by the test nozzle.

7.2 Receptacle designs which employ means, on the back diameter as shown in Figure 5, to accommodate mounting, or for mounting accessories or marking purposes, shall not have such means extend beyond the back diameter dimensions of the profile as specified by Figure 1 to Figure 4, as applicable. *Acceptable means* include wrench flats, dust cap anchoring grooves, use of hex stock, undercutting for marking, and threads for pressure-tight caps. Receptacle designs shall not compromise the interchangeability requirements specified in Annex B.



Key

1 back diameter

Figure 5 — Receptacle design

7.3 The receptacle shall be equipped with an internal check valve to prevent the escape of gas. The check valve shall be of the non-contact type, opening by differential pressure only.

7.4 The method for attaching the receptacle to the vehicle fuel system shall not rely on the joint between the male and female threads for sealing, such as conical threads.

7.5 The interfacing surface of the receptacle shall be constructed of material having a hardness >75 Rockwell B (HRB 75) and shall be non-sparking and conductive (see 10.11.5 and 10.15).

The exposed surfaces of devices shall be made of non-sparking materials (see 10.11.5).

7.6 Receptacles shall have a means to prevent the ingress of fluids and foreign matter.

7.7 The function specified in 7.6 may also be met by either a protective cap (see 10.4) or a pressure-tight protective cap (see 10.16).

7.8 The receptacle shall have provisions to be firmly attached to the vehicle and shall comply with applicable abnormal load tests *(*see 10.7).

7.9 Receptacles shall have a cycle life of >10 000 cycles.

8 Instructions

8.1 Information required under this clause for instructions and provisions to be specified shall be given in an easily understood form.

8.2 Special tools required for connection of receptacles to tubing and assembly and disassembly of three-way valve parts shall be clearly identified in the instructions.

8.3 The manufacturers of receptacles, nozzles and three-way valves shall provide clear and concise printed instructions and diagrams in a form that can be easily understood and adequate for

a) proper field assembly,

b) installation,

c) maintenance,

d) replacement of components as appropriate,

e) safe operation by all users,

f) suitability and use,

g) storage and handling.

9 Marking

9.1 Information required under this clause shall be clear and legible. Marking should be embossed, engraved, cast, stamped or otherwise formed in the part. This includes markings baked into an enamelled surface.

9.2 Nozzles and receptacles shall bear the following information:

a) manufacturer’s or dealer’s name, trademark or symbol;

b) model designation;

c) B200 or B250 or C200 or C250;

d) applicable type and class (see 5.1);

e) operating temperature range.

9.3 Nozzles and receptacles shall each bear a manufacturing date code.

9.4 Marking to identify this document shall be provided for each system, it may be located on the device, on the package or on a notice placed inside the package in which the device is shipped.

10 Tests

10.1 General requirements

The nozzle and receptacle tested shall be of the receptacle and nozzle designs specified from Clauses 1 to 9. Unless otherwise stated,

a) tests shall be conducted at room temperature (20 ± 5) °C,

b) all pressure or leak tests shall be conducted with dry air or dry nitrogen, and

c) devices shall be conditioned to attain equilibrium conditions.

Unless otherwise specified all pressures, temperatures and dimensions shall have a maximum tolerance of ±5 %.

Type 2 nozzles shall be tested in series, with either a three-way valve or some other means to independently pressurize and vent the nozzle. The three-way valve shall not affect the temperature, durability or flow characteristics of the nozzle. Failure of the three-way valve shall not constitute failure of the nozzle. A three-way valve supplied for utilization with a Type 2 nozzle shall be evaluated separately.

Nozzle tests shall be done with the test fixtures, specified in Annex B, as applicable. A new receptacle test sample shall be used for each nozzle test. The failure of any test conducted with the nozzle and receptacle test sample shall constitute a failure of the nozzle design.

10.2 User interface

The appearance of the nozzle and receptacle shall be such as to clearly suggest the proper method of use.

It shall not be possible to deliver gas using Type 1 nozzles unless the nozzle and receptacle are connected properly and positively locked.

Upon disconnection, Type 1, 2 and 3 nozzles shall stop the flow of gas. No hazardous condition shall result from disconnection. Type 3 nozzles shall be under a pressure of 0,7 MPa (7 bar) during this test.

When the contained pressure is less than or equal to 0,7 MPa (7 bar), all nozzles shall be capable of being disconnected with forces or torques not exceeding 225 N or 7 N·m.

The disconnection force/torque shall be applied in a direction that tends to unhook and release the nozzle. The force/torque shall be applied to the unhooking/release actuator. The torque shall be applied through axis rotation of the nozzle handle equal to the exterior handling surface of the nozzle uncoupling mechanism and in a direction such that the nozzle tends to unhook and be released.

On depressurized devices, the axial force to connect and lock or unlock and disconnect the device shall be ≤90 N.

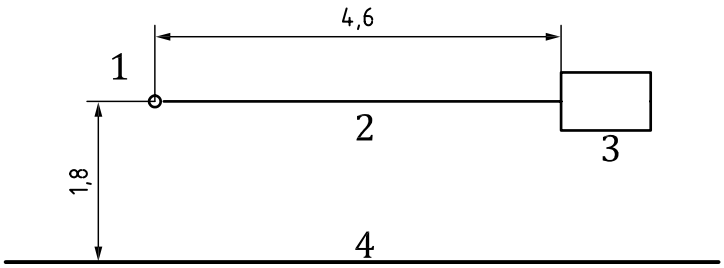
On a positive locking device that incorporates a rotary locking means, the torque to lock or unlock the locking means shall not exceed 1 N·m for a device having a diameter of ≤25,4 mm and 1,7 N·m for a device having a diameter >25,4 mm.

The minimum force to facilitate disconnection at pressures of 6,25 MPa (62,5 bar) or more, shall be 2,5 times compared to the disconnection force when Types 1 and 2 nozzles are depressurized or when type 3 nozzles are at a pressure of 0,7 MPa (7 bar). Type 1 nozzles shall be tested with the vent port plugged.

10.3 Impact resistance

A nozzle shall be connected to a 4,6 m length of 9,5 mm internal diameter (ID) fuelling hose, conditioned at −40 °C or lower for 24 h and then dropped 1,8 m onto a concrete floor as shown in Figure 6. The nozzle shall be dropped 10 times, then pressurized to service pressure and subjected to 10 additional drops.

Following this, the nozzle shall be capable of normal connection and disconnection to the receptacle. In addition, the nozzle shall comply with all leakage tests specified in this document (see 10.5).



Key

1 suitable support
2 refuelling hose (9,5 mm diameter)
3 nozzle
4 concrete floor

Figure 6 — Impact resistance test arrangement

10.4 Receptacle protective caps

There shall be no permanent distortion or damage to any receptacle protective cap when tested as follows.

A solid steel ball with a diameter 50 mm shall be dropped from a height of 300 mm striking the protective cap installed on the receptacle. The test shall be conducted at −40 °C or lower and at 85 °C or higher at a minimum of five points of impact most likely to cause damage to the receptacle and the protective cap.

10.5 Leakage at room temperature

10.5.1 Nozzle

A nozzle, whether coupled or uncoupled, shall be either bubble-free for 1 min during the leak test or have a leak rate of <20 cm^3/h (normal), when tested as follows.

Tests shall be conducted at 0,5 MPa (5 bar), then at 1,5 times the service pressure and then again at 0,5 MPa (5 bar).

Pressurized air or nitrogen shall be applied to the inlet of the coupled (or uncoupled) device. The external body shall then be checked for bubble-tight leakage using immersion in room temperature water.

All connectors shall be checked for leakage from the time of connection, through full fuel flow, to the time of disconnection.

NOTE The trapped volume of gas released during disconnection is not considered as leakage.

If there are no bubbles for a period of 1 min, the sample passes the test. If bubbles are detected, then the leak rate shall be measured by either a vacuum test using helium gas (global accumulation method) or an equivalent method.

10.5.2 Receptacle

The receptacle check valve shall be either bubble-free for 1 min during the leak test or have a leak rate of <20 cm^3/h (normal) when tested as follows.

Tests shall be conducted at 0,5 MPa (5 bar), then at 1,5 times the service pressure and then again at 0,5 MPa (5 bar).

The receptacle shall be connected to a pressure vessel capable of safely accommodating the specified test pressures. The receptacle and pressure vessel shall then be pressurized. Once the pressure vessel has reached the specified test pressure, the upstream portion of the receptacle shall be quickly depressurized and the receptacle check valve checked for leakage.

10.6 Valve operating handle

If a nozzle is equipped with a valve operating handle, it shall be capable of withstanding double the manufacturer's specified operating torque or force, without damage to the operating handle or the operating handle stops.

The test shall be performed with the torque or force applied in both the opening and closing directions

a) with the nozzle properly connected to a receptacle, and

b) with the nozzle intentionally misaligned relative to the receptacle.

10.7 Abnormal loads

10.7.1 General

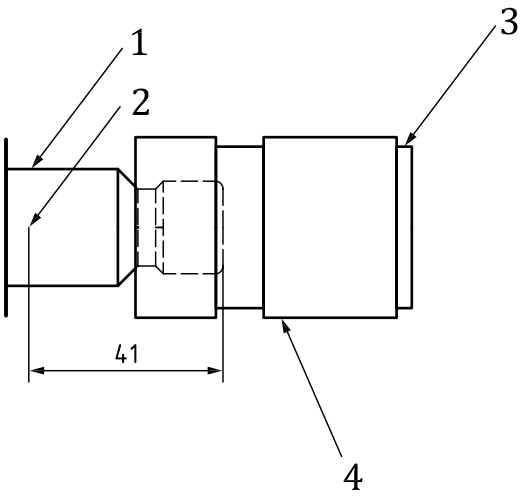
The connected nozzle and receptacle shall be subjected to the following abnormal loads for a period of 5 min in service. These tests are to be conducted separately:

a) pulls *a* along the longitudinal axis of the nozzle or receptacle;

b) moments *b* applied in a worst-case manner.

The nozzle and receptacle shall be able to withstand abnormal loads of a = 1 350 N and b = 120 N·m without distortion or damage, and of a = 2 700 N and b = 240 N·m without becoming so damaged as to leak. The load and moment arm shall be measured about a point 41 mm from the front of the receptacle to the hose inlet of the nozzle (see Figure 6).

After completing these tests, the receptacle shall comply with 10.5.



Key

1 receptacle
2 abnormal load reference
3 moment
4 nozzle

Figure 7 — Abnormal load test

10.7.2 Test in the unpressurized condition

The receptacle test fixture and nozzle shall not be pressurized during the abnormal load tests.

The receptacle shall be mounted as a cantilever to a supporting member in accordance with the manufacturer's instructions. For the purposes of this test, the supporting member shall be capable of withstanding the specified loads without displacement or deflection.

The loads applied and the device's ability to resist damage shall be as specified in 10.7.1. After completion of the tests, the receptacle shall comply with 10.5.

10.7.3 Test in the pressurized condition

The receptacle test fixture and nozzle shall be pressurized 1,25 times service pressure during the abnormal load tests.

The "loose fit" test fixture (see Annex B) shall be used for this test, regardless of the working pressure rating of the nozzle. The test fixture shall be mounted as a cantilever to a supporting member. The supporting member shall be capable of withstanding the specified loads without displacement or deflection. The nozzle shall be properly connected to the test fixture.

The loads applied and the devices' ability to resist damage shall be as specified in 10.7.1. After completion of the tests, the receptacle shall comply with 10.5.

10.8 Rocking/Twisting

The receptacle and its mounting hardware shall not be loosened or damaged when subjected to the following test.

Utilizing the receptacle mounting hardware submitted by the manufacturer, the receptacle shall be mounted on a supporting member in accordance with the manufacturer's instructions. The supporting member shall be capable of withstanding the specified loads without displacement or deflection. The nozzle, attached to a pressurized hose installed as for normal use, shall be properly connected to the

receptacle. An alternating 24 N·m moment shall be applied at a point on the nozzle furthest from the receptacle for 2 500 times at a frequency not exceeding one cycle per second.

A torque of 4 N·m shall then be applied 10 times to the receptacle in the direction most likely to loosen the mounting hardware.

Following these tests, the receptacle shall comply with the room temperature leakage tests (see 10.5), Following room temperature leakage tests, the receptacle shall comply with hydrostatic strength tests (see 10.12)

10.9 Mounting hardware torque

The receptacle and mounting hardware shall withstand, without damage, a turning force equal to 150 % of the manufacturer's recommended mounting hardware fastening torque.

10.10 Low and high temperatures

10.10.1 General

Prior to conditioning, the devices shall be purged with nitrogen and then sealed from the atmosphere under a pressure of 7 MPa (70 bar) nitrogen or dry air.

All tests shall be conducted while the devices continue to be exposed to the specified test temperatures. The outlet of the device shall be plugged and the test pressure shall be applied to the inlet of the device. The device shall be either bubble-free during the leak test for the specified time period or have a leak rate of <20 cm^3/h (normal).

10.10.2 Leakage test

10.10.2.1 Preconditioning

At each test condition, as follows, the devices shall be maintained at the specified temperature for 2 h, then tested in accordance with 10.10.2.2:

a) the nozzle and receptacle coupled, conditioned at −40 °C (or −20°C as applicable) or lower and pressurized at 0,5 MPa (5 bar) and 15 MPa (150 bar);

b) the nozzle and receptacle coupled, conditioned at 85 °C (or 120°C as applicable) or higher and pressurized at 1 MPa (10 bar) and 1,5 times service pressure;

c) the receptacle uncoupled, conditioned at −40 °C (or −20°C as applicable) or lower and pressurized at 0,5 MPa (5 bar) and 15 MPa (150 bar);

d) the receptacle uncoupled, conditioned at 85 °C (or 120°C as applicable) or higher and pressurized at 1 MPa (10 bar) and 1,5 times service pressure;

e) the nozzle uncoupled, conditioned at −40 °C (or −20°C as applicable) or lower and pressurized at 0,5 MPa (5 bar) and 15 MPa (150 bar);

f) the nozzle uncoupled, conditioned at 85 °C (or 120°C as applicable) or higher and pressurized at 1 MPa (10 bar) and 1,5 times service pressure;

10.10.2.2 Test

Pressurized air or nitrogen shall be applied to the test components. The external body shall then be checked for bubble-tight leakage using

a) at −40 °C (or −20°C as applicable), immersion in a 70 % glycol and 30 % water mixture for 2 min, and

b) at 85 °C, immersion in 85 °C water for 1 min.

c) For tests at 120°C (if applicable) immersion in synthetic oil for 1min.

For b), the use of glycol up to 30 % is permitted.

The media used for immersion should be at the same temperature as the test components.

10.10.2.3 Requirement

If there are no bubbles for the specified time period, the sample passes the test. If bubbles are detected, then the leak rate shall be measured by either a vacuum test using helium gas (global accumulation method) or an equivalent method.

10.10.3 Operation test

The devices shall function normally and deliver gas when tested under the following conditions.

a) the nozzle and receptacle are connected and disconnected 10 times after conditioning at −40 °C (or −20°C as applicable) and pressurized to 15 MPa (150 bar);

b) the nozzle and receptacle are connected and disconnected 10 times after conditioning at 85 °C (or 120°C as applicable) and pressurized to Service pressure.

10.11 Durability

10.11.1 Durability cycling

10.11.1.1 Nozzle test

All nozzles shall be capable of withstanding the number of specified operational cycles given in Table 1. During the following tests, all nozzles shall be maintained according to the manufacturer's instructions. Requirements for maintenance at intervals less than those specified by the manufacturer shall be considered as not complying with this document.

Table 1 — Nozzle frequency of use

Nozzle type	Frequency of use (by class)	
	Class A	Class B
Type 1	100 000	—
Type 2	100 000	20 000
Type 3	100 000	20 000

For the purposes of this test, one cycle of operation shall comprise

a) properly connecting the nozzle to the test fixture,

b) pressurizing the nozzle to 1,25 times service pressure using dry, oil-free air or nitrogen,

c) depressurizing the nozzle, and

d) disconnecting the nozzle.

At each disconnection, the test fixture shall be rotated relative to the nozzle at random or equal degree increments throughout this test. This is to be repeated until 10 000 cycles are completed, after which time the nozzle shall be examined for wear. For a Type 3 nozzle, the pressure shall be reduced to 0,5 MPa (5 bar) during the disconnection phase.

The pressure shall be maintained on the inlet of each nozzle throughout the test. For a Type 1 nozzle, the pressure shall be maintained on the inlet. For a Type 2 nozzle, the pressure shall be maintained on the inlet of the three-way valve.

The nozzle shall be checked at 20 % intervals for compliance with 10.5 and 10.10.2. In addition, at these intervals, the nozzle locking mechanism shall be checked at the normal disconnection pressure to ensure it is properly engaged on the nozzle.

For a Type 1 nozzle, the vent valve operating mechanism shall be manually operated 10 times at both high and low temperatures at each of the cycle intervals prior to checking for leakage.

The test fixture shall be replaced after 10 000 cycles. The test fixture shall be selected from Table 2. The worn test fixtures resulting from cycling the test nozzle shall not exhibit wear in excess of patterns shown in Figure 8 to Figure 11. In addition, following completion of the required number of cycles, the test nozzle shall comply with 10.5 and 10.12 when tested with the receptacle test piece of Figure 8 to Figure 11. Failure to comply with any of the tests specified in this paragraph shall be deemed as a failure of the test nozzle. The replacement of nozzle seals shall be acceptable at intervals of 40 % of the total number cycles.

Table 2 — Test fixture selection for nozzle durability

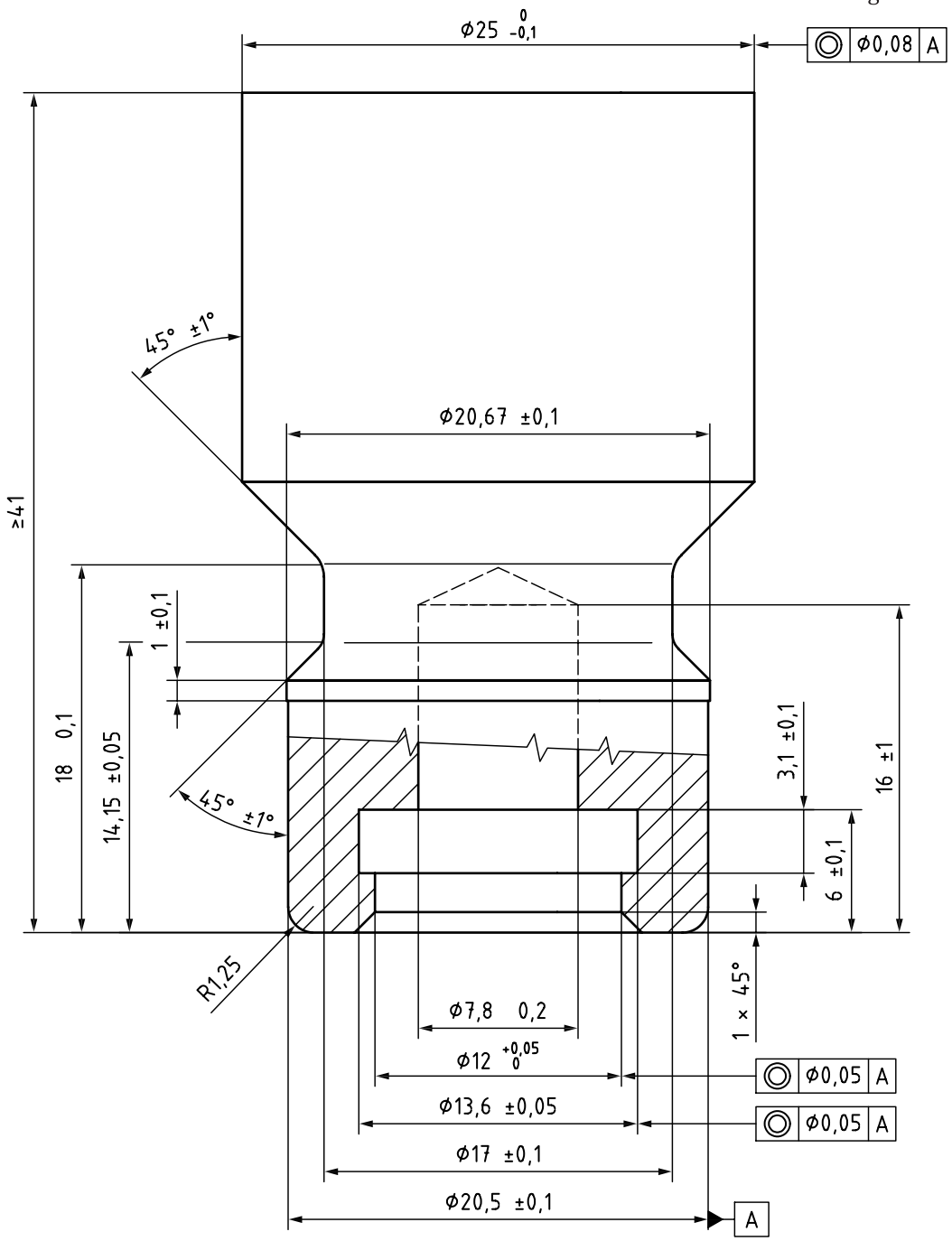
Number of cycles	Fixture	Replacement frequency
0 to 50 000	Loose Fit[a]	Every 10 000 cycles
50 001 to 100 000	Tight Fit[b]	Every 10 000 cycles

[a] Loose fit fixtures are defined in Figures B1, B2, B3, B4.

[b] Tight fit fixtures are defined in Figures B5, B6, B7, B8.

For Class A devices, the seal(s) may be replaced at 40 000 cycles and 80 000 cycles if the manufacturer's instructions clearly state that this is recommended practice.

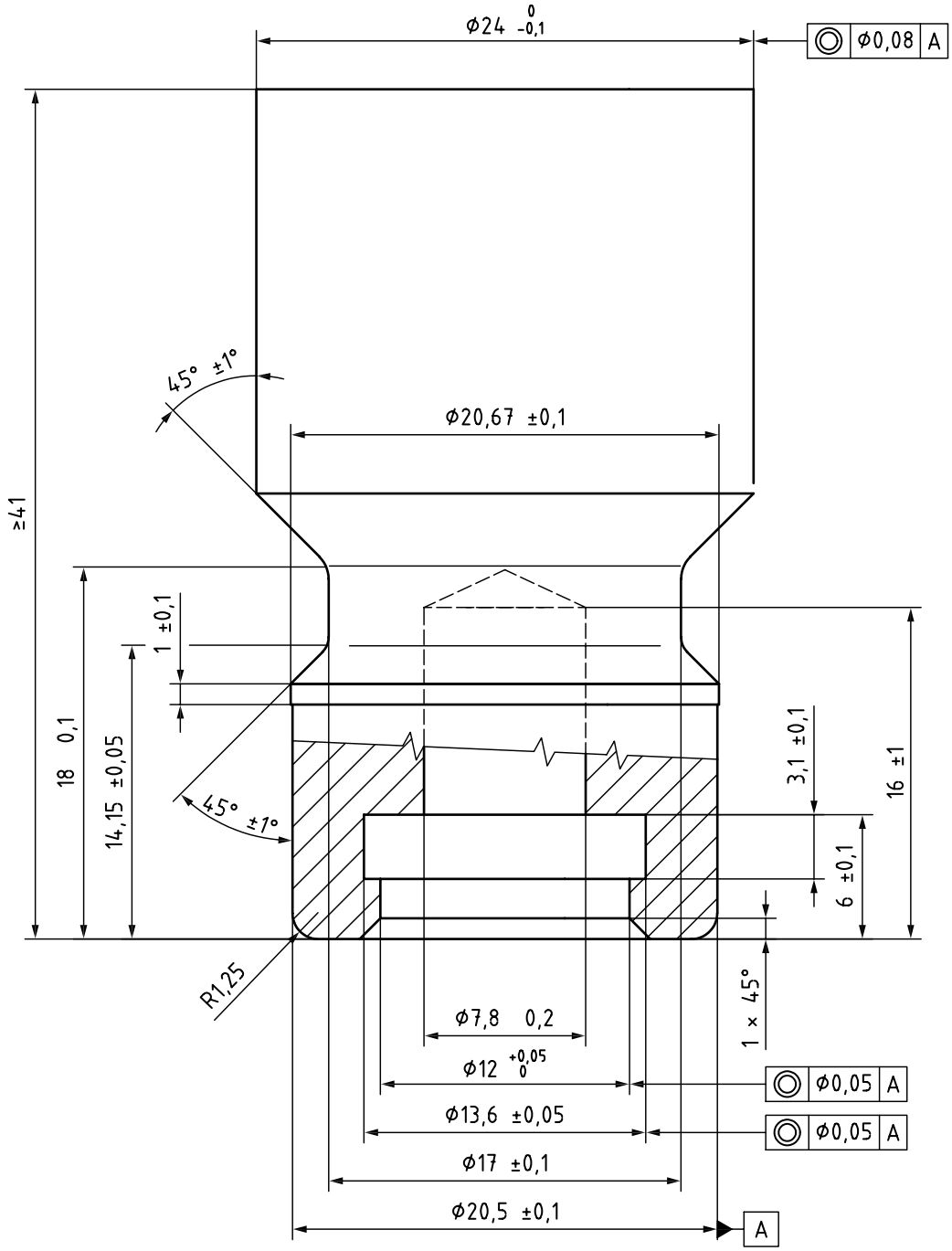
Dimensions in millimetres
Surface roughness ≤ *Ra* 3,2 µm



Material hardness: 75 Rockwell B (HRB 75) min.

Figure 8 — B200 - Worn receptacle test fixture

Dimensions in millimetres



Material hardness: 75 Rockwell B (HRB 75) min.

Surface finish range ≤ *Ra* 3,2 µm.

Figure 9 — B250 - Worn receptacle test fixture

Dimensions in millimetres

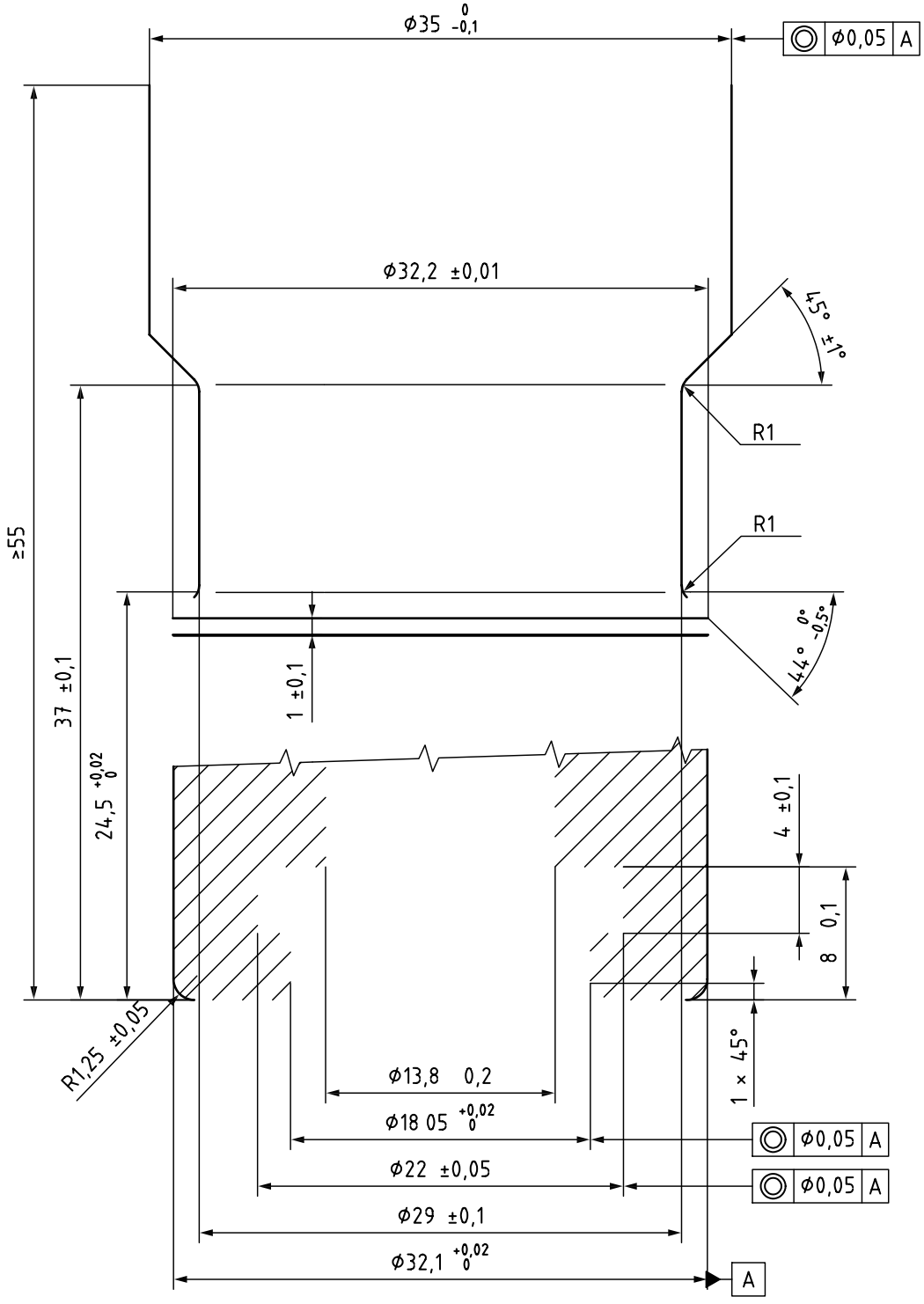


Figure 10 — C200 - Worn receptacle test fixture

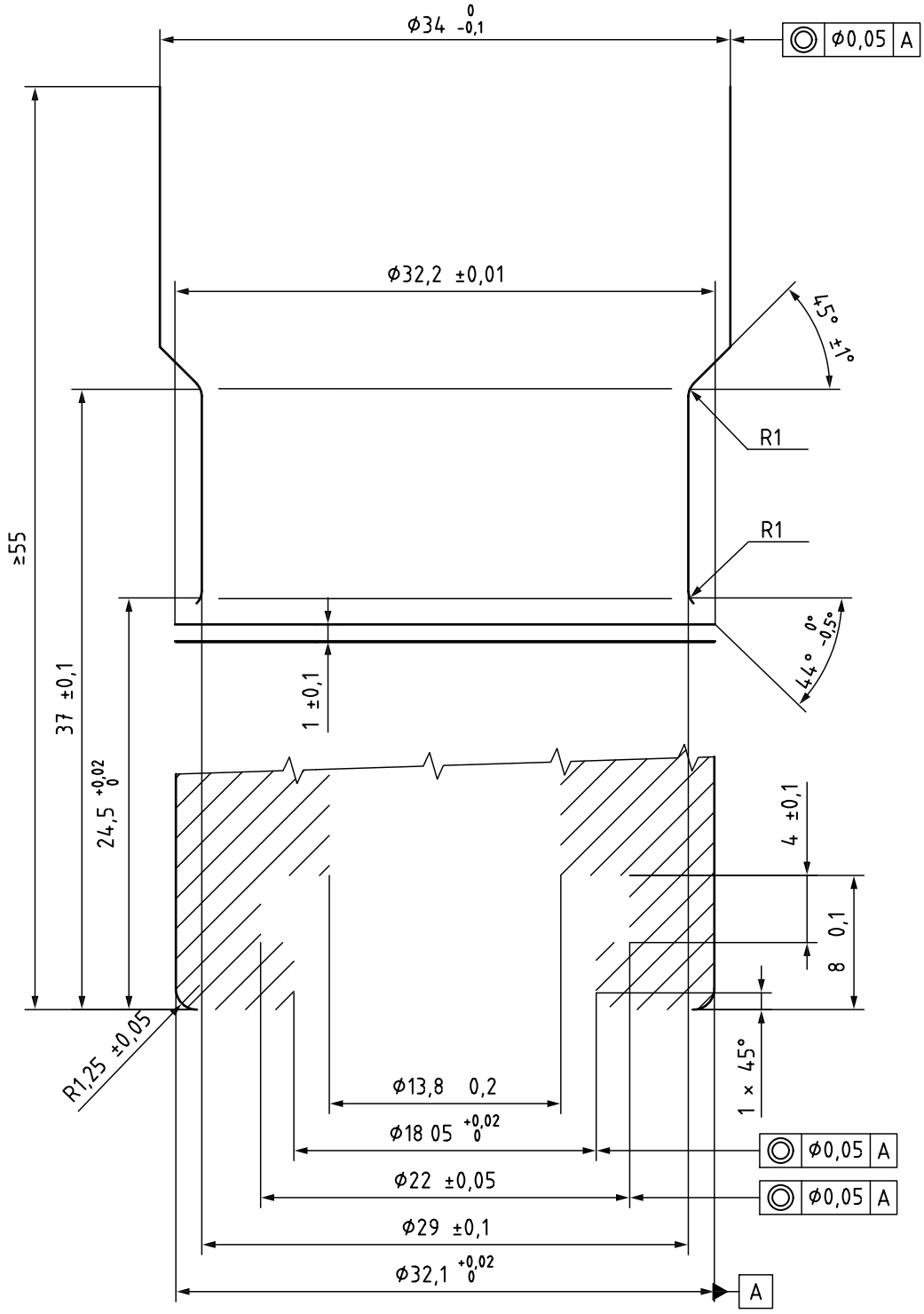


Figure 11 — C250- Worn receptacle test fixture

10.11.1.2 Receptacle check valve test

The receptacle check valve shall be bubble free on the leak test for 1 min and be capable of withstanding 100 000 cycles of operation and 24 h of the flow conditions that cause the most severe chatter.

The receptacle shall be connected to a nozzle test fixture. A pressure of 1,25 times service pressure shall be applied to the nozzle and receptacle. Pressure shall then be vented from the upstream side

of the receptacle check valve. Pressure on the downstream side of the receptacle check valve shall be lowered to between 0 and a maximum of 12,5 MPa (125 bar) prior to the next cycle.

Following 100 000 cycles of operation, the receptacle check valve shall be subjected to 24 h of flow at the inlet/outlet flow conditions that cause the most severe chatter. The receptacle shall then be tested for compliance with 10.5 and 10.10.2.

10.11.1.3 Nozzle check valve test

Without being connected to the receptacle, the nozzle check valve (which prevents the flow of gas unless properly connected) shall be capable of withstanding 500 cycles of application of 1,25 times service pressure. Following this test, the nozzle check valve shall be bubble-free for 1 min during the leak test when tested in accordance with 10.2, 10.5 and 10.10.2.

10.11.1.4 Receptacle test

A receptacle shall be capable of withstanding 10 000 cycles of operation as follows. For the purposes of this test, one cycle of operation shall comprise

a) properly connecting the nozzle to the receptacle,

b) pressurizing the devices to 1,25 times service pressure using dry, oil-free air or nitrogen,

c) depressurizing the devices, and

d) disconnecting the nozzle.

After every 100 cycles, a torque of 20 N·m, shall be applied around the longitudinal axis of the pressurized nozzle, through a maximum rotation of 30°, after which the test shall continue as before. Following this test, the receptacle shall pass the test according to 10.2, 10.5. and 10.10.2

10.11.1.5 Receptacle full flow test

The receptacle shall be capable of withstanding full flow condition, in the following test.

Connect the receptacle to a nozzle. The outlet of the receptacle shall be open to atmospheric pressure. Connect the supply port of the nozzle to a system that supplies sufficient compressed dry air or nitrogen.

Each receptacle shall be cycled for 30 cycles. Each cycle shall consist of the full flow of gas with the supply pressure starting at 1,1 times service pressure . A cycle shall be 2 s in length and the supply pressure shall not fall below 0,8 times service pressure at the end of each cycle. The test system shall not limit the flow during this test.

Following this test, the receptacle shall pass the test given in 10.5.

10.11.2 Oxygen ageing

Sealing materials shall be listed and rated by the manufacturer as being resistant to oxygen ageing. Otherwise, the materials shall not crack or show visible evidence of deterioration subsequent to oxygen ageing as follows.

Samples shall be subjected to 96 h of exposure at 70 °C ± 5° C and at 2,1 MPa ± 0,1 MPa (21 bar ± 1 bar). This test shall be conducted in accordance with ISO 188.

10.11.3 Seal material compatibility

Sealing materials shall not show excessive volume change or loss of mass when tested as follows:

a) Representative sample(s) of seal materials shall be prepared, measured and weighed. The samples shall then be immersed in natural gas at 1,25 times service pressure for a minimum of 70 h.

Following this time period, the test pressure shall be rapidly reduced to atmospheric pressure, after which the test samples shall not exhibit evidence of shredding. In addition, the samples shall not swell by more than 25 %, shrink by more than 1 % or incur a mass loss in excess of 10 %. The observations on the samples shall be made within one hour of the finalization of the test.

b) Non-metallic material used in a component that is likely to be exposed to ester-based or alpha-olefin- based synthetic compressor oils, including non-synthetic compressor oils, shall not show excessive change in volume or weight when tested in accordance with ISO 1817 or the following procedure. Prepare, measure and weigh one or more representative samples of each non-metallic material used in a component, then immerse the sample or samples at room temperature in holders, each containing one of the test fluids, for a minimum of 70 h. Following this period of immersion, remove and measure the test samples, within 1 h. No sample shall exhibit swelling greater than 25 % or shrinkage greater than 1 %. The weight change shall not exceed 10 %.

10.11.4 Ten-day moist ammonia-air stress cracking

After being subjected to the following conditions, a brass part containing more than 15 % zinc shall show no evidence of cracking or delamination when examined using ×25 magnification.

Each test sample shall be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses shall be applied to the sample prior to, and maintained during, the test. Samples with threads, intended to be used for installing the product in the field, shall have the threads engaged and tightened to the torque specified by the manufacturer. Polytetrafluoroethylene (PTFE) tape or pipe compound shall not be used on the threads.

Three samples shall be degreased and then continuously exposed in a set position for 10 days to a moist ammonia-air mixture maintained in a glass chamber of approximately 3 l capacity and having a glass cover, as follows.

Approximately 0,6 l of aqueous ammonia having a specific gravity of 0,94 shall be maintained at the bottom of the glass chamber below the samples. The samples shall each be positioned 40 mm above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber shall be maintained at atmospheric pressure and at a temperature of 34 °C ± 2 °C.

10.11.5 Electrical resistance

The electrical resistance of the connected receptacle and nozzle shall not be greater than 10 Ω in the pressurized and unpressurized states. Tests shall be conducted prior to, and after, durability cycling (see 10.11.1).

10.12 Hydrostatic strength

CAUTION — Because the hydrostatic strength test is a terminal test, do not use the test samples for any further testing.

An uncoupled nozzle, uncoupled receptacle and coupled nozzle and receptacle shall not rupture when subjected to the following test.

Outlet openings of the uncoupled or coupled connector shall be plugged and valve seats or internal blocks made to assume the open position. A hydrostatic pressure of 2,5 times the working pressure shall be applied to the inlet of the nozzle or outlet of the receptacle for a period of at least 3 min.

10.13 Corrosion resistance

Nozzles and receptacles shall not sustain corrosion or loss of protective coatings, and shall be capable of performing safely subsequent to the following test.

Previously untested samples shall be used. Protective caps shall be in place. Vent holes shall not be plugged.

10.13.1 Nozzles

The devices shall be supported in a horizontal position. The devices shall be exposed for 96 h to a salt spray in accordance with ISO 9227.

Throughout the test, the temperature within the test chamber shall be maintained at between 33 °C and 36 °C. The salt spray solution shall consist of 5 % sodium chloride and 95 % distilled water (mass fraction).

A pressure of 0,5 MPa (5 bar) air shall also be continuously applied to the inlet of the nozzle. The nozzle shall be operated once an hour to dispense air to the atmosphere through a dummy receptacle during the first 8 h test period.

After being rinsed and gently cleaned of salt deposits, the nozzle shall then comply with room temperature leakage tests (see 10.5).

10.13.2 Receptacles

The devices shall be subjected to the corrosion resistance test in accordance with ISO 15500-2 (see Clause 10) except that the leakage and hydrostatic strength test shall be in accordance with 10.5 and 10.12.

10.14 Deformation

Connectors shall be capable of withstanding a turning force of 150 % of the manufacturer's recommended assembly torque, without significant deformation, breakage or leakage.

A sample not previously tested to hydrostatic strength tests shall be used.

Straight-thread O-ring seals shall be lubricated with ISO 1817 oil No. 1. Connectors shall be connected and assembled to the applicable torque specified above in a worst-case manner in accordance with good assembly practices. While still connected and assembled, the assembly shall be in accordance with 10.5 and 10.10.2 and then pass the hydrostatic strength test according to 10.12.

10.15 Non-igniting evaluation

Materials which have been demonstrated to be non-sparking, shall be deemed as being non-igniting. Otherwise, they shall be subjected to the following test.

Each sample material shall be held against a coarse emery grinding wheel (grit size 36) rotating with a surface speed of approximately 26 m/s. Contact with the grinding wheel shall be maintained for 30 s with a force of 22,0 ± 4,4 N. The material removed from each sample by the grinding wheel shall be directed onto a 1,5 cm × 1,5 cm × 0,4 cm pad of cotton batting located directly beneath and within 1,5 cm of the point of contact between the sample and the grinding wheel. The fresh cotton pad shall be saturated with gasoline immediately prior to each test. Each sample shall be tested with gasoline to determine if the material removed by the grinding wheel will cause ignition. This test shall be repeated using a stoichiometric mixture of natural gas and air. The mixture shall be directed into the path of the removed particles at the point most likely to cause ignition.

10.16 Pressure-tight protective cap (PTPC)

10.16.1 General

Pressure-tight protective caps will be referred to in the following as either PTPC or device. All receptacles referred to shall be in accordance with the profile shown in Figure 1, and shall be tested without the internal check valve mechanism.

10.16.2 Leakage

A PTPC/receptacle assembly shall be bubble-tight for 5 min during the leakage tests over the range of test conditions specified in the following.

A new PTPC/receptacle sample shall be used for this test.

Nitrogen shall be used as the test gas and pressure source, except during room temperature tests, where dry air may be used.

All leakage tests shall be conducted at both the manufacturer's maximum and minimum specified installation forces or torques.

The PTPC shall be attached to the test fixture receptacle.

This test shall be conducted under all of the pressure and temperature conditions specified in Table 3.

The test sample shall be conditioned at the specified test temperature for at least 2 h. The PTPC shall be removed and reinstalled using the manufacturer's maximum specified installation torque. To minimize temperature deviation, this removal/installation cycle shall be accomplished within 2 min following removal of the device from the temperature chamber. The test sample shall be exposed to the pressure and temperature conditions according to Table 3. The test sample shall not leak over the complete test range measured during the first 5 min period of each test.

The manufacturer has the option of performing this test once only, upon completion of all the tests given in 10.16.5.

Table 3 — Pressure and temperature test conditions

Pressure	Temperatures		
MPa (bar)	−40 °C or −20°C as applicable	Room	85 °C or 120 °C as applicable
1 (10)			X
1,5 times Service Pressure		X	X
0,5 (5)	X	X	
15 (150)	X		

10.16.3 Durability cycling

A PTPC shall comply with 10 000 cycles of durability testing as outlined in the following. After the durability test, the test sample shall comply with 10.16.2 with an O-ring that has been cycled through 2 000 cycles of durability.

The PTPC shall not be pressurized during this test. One cycle shall comprise

a) attaching the PTPC to a test fixture receptacle in accordance with the manufacturer's specified force or torque, and

b) removing the PTPC until it is fully disengaged.

This shall be repeated for 2 000 cycles. The temperature of the PTPC shall be monitored during the first 100 cycles to ensure that the frequency and frictional effects of the test do not interfere with the integrity of durability testing.

The above cycling operation shall be repeated in intervals of 2 000 cycles for a total of 10 000 cycles. The room temperature leakage test shall be conducted after 2 000, 6 000 and 10 000 cycles as specified in 10.5.1. O-ring seals in the PTPC shall be replaced according to manufacturer's instructions after the leakage tests following every 2 000 cycles.

Failure of any leakage test during durability cycling, or failure of the PTPC to operate at the manufacturer's specified forces, or the forces defined in 10.2, shall constitute a failure of the device.

10.16.4 Abuse

A PTPC shall be capable of being safely removed from the receptacle in the event of a leak in the receptacle check valve under extreme load conditions.

The following test shall be conducted at pressures of 1,25 times service pressure and 12,5 MPa (125 bar). Test samples and O-rings previously cycled under the durability test shall be used.

Nitrogen shall be used as the test gas and pressure source.

The PTPC shall be attached using the maximum and minimum forces/torques in accordance with the manufacturer's instructions.

The test fixture receptacle shall be connected to a vessel having an internal volume of 27 ml.

The assembly shall be pressurized to 1,25 times service pressure. While the assembly remains pressurized, the PTPC shall be vented in accordance with the manufacturer's instructions. The pressure in the vessel shall drop to a maximum of 0,15 MPa (1,5 bar) within 3 s.

10.16.5 Impact resistance

A PTPC shall be capable of withstanding an impact as follows.

The PTPC test fixture receptacle assembly shall be rigidly mounted horizontally on a test bench. A solid steel ball with a diameter of 50 mm shall be dropped from a height of 300 mm striking the PTPC. The ball shall make impact at a point on the PTPC which is furthest from the receptacle.

Following one drop, a room temperature leak test in accordance with Table 3 shall be conducted to confirm seal integrity.

If bubble-tight for 5 min, the receptacle shall be vented, and the PTPC removed and reattached in accordance with the manufacturer's instructions, and the leakage test repeated.

10.16.6 Corrosion resistance

A PTPC shall be capable of being attached and removed at an operating force/torque less than or equal to the manufacturer's maximum specified force/torque, after completion of the following test.

A new PTPC/receptacle sample shall be used for this test.

The outlet of the test fixture receptacle shall be plugged using a suitable leak-proof device. The PTPC shall be attached to the receptacle and tightened, using the manufacturer's maximum specified force or torque.

The assembly shall be exposed to the corrosion resistance test in accordance with 10.13.2.

Upon completion, the assembly shall be cleaned of all external salt deposits. Without loosening the PTPC, the assembly shall comply with 10.16.2. The force or torque required to remove the PTPC shall not cause the loosening of the receptacle or receptacle housing body.

10.16.7 Hydrostatic strength

A PTPC/receptacle test fixture assembly shall be hydrostatically tested without a check valve. Sufficient force or torque shall be applied to prevent leakage. The PTPC's outlet openings and/or venting feature shall be plugged and/or restricted to prevent leakage. A pressure of 2,5 times working pressure shall be applied for a minimum of 3 min without rupture.

Annex A
(informative)

Nozzle characteristics

Table A.1 — Nozzle characteristics

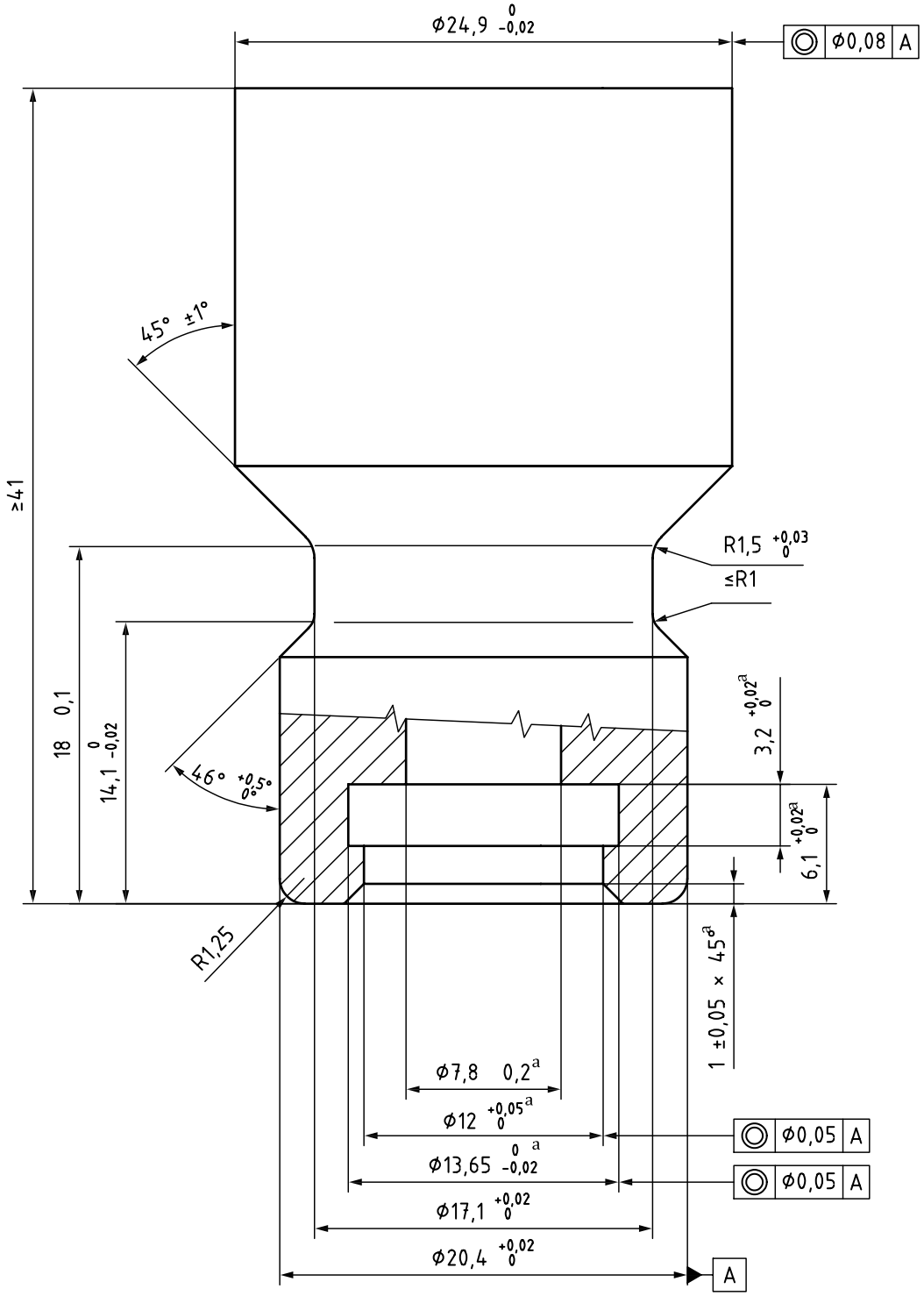
Characteristics	Nozzle type		
	1	2	3
Tamper resistance	X	X	X
No catching parts (clothing)	X	X	X
Single action[a]	X		
Redundant interlock	X		
Safe venting	X		
Single-handed operation[a]	X	X	X
Integral valve[a]	X		

[a] Not considered safety-related.

Annex B
(normative)

Receptacle text fixture

Dimensions in millimetres



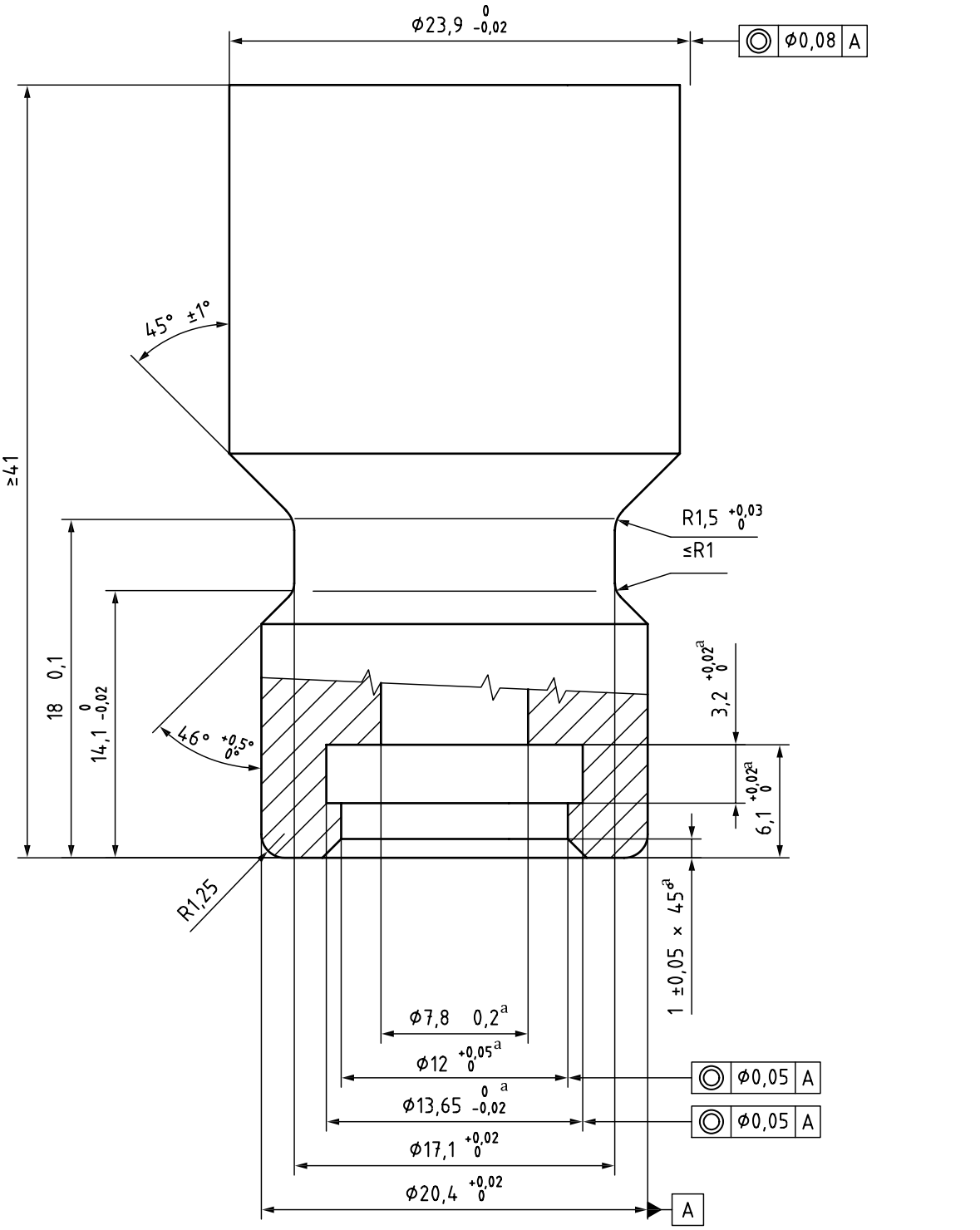
[a] Surface finish: 0,8 µm to 0,05 µm.

Surface finish range: 3,2 µm maxi (except as noted).

Material: CA360 Brass.

Figure B.1 — B200 - "Loose fit" tolerances

Dimensions in millimetres



[a] Surface finish: 0,8 µm to 0,05 µm.

Surface finish range: 3,2 µm maxi (except as noted).

Material hardness: 75 HRB minimum.

Figure B.2 — B250 - "Loose fit" tolerances

Dimensions in millimetres

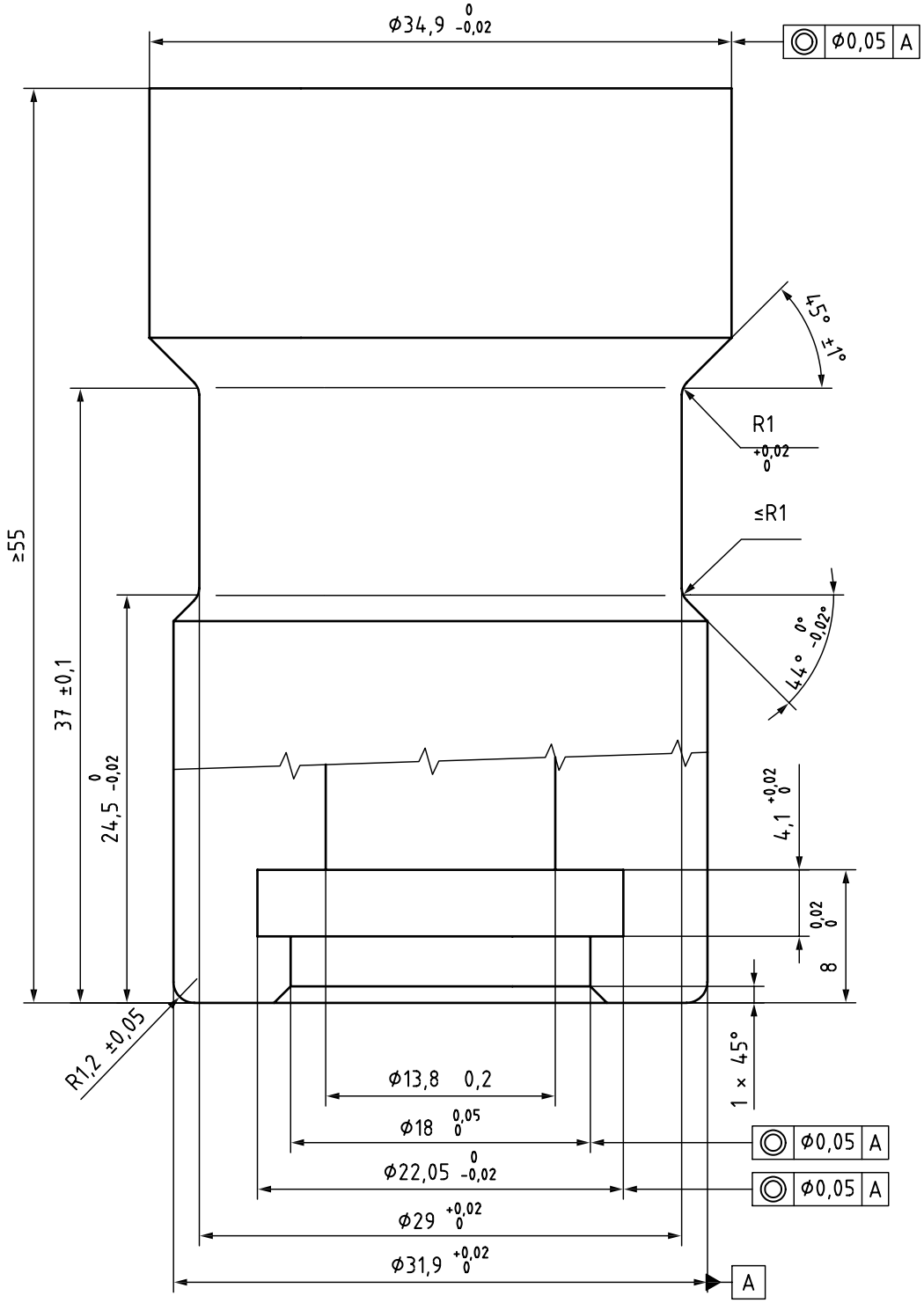


Figure B.3 — C200 - "Loose fit" tolerances

Dimensions in millimetres

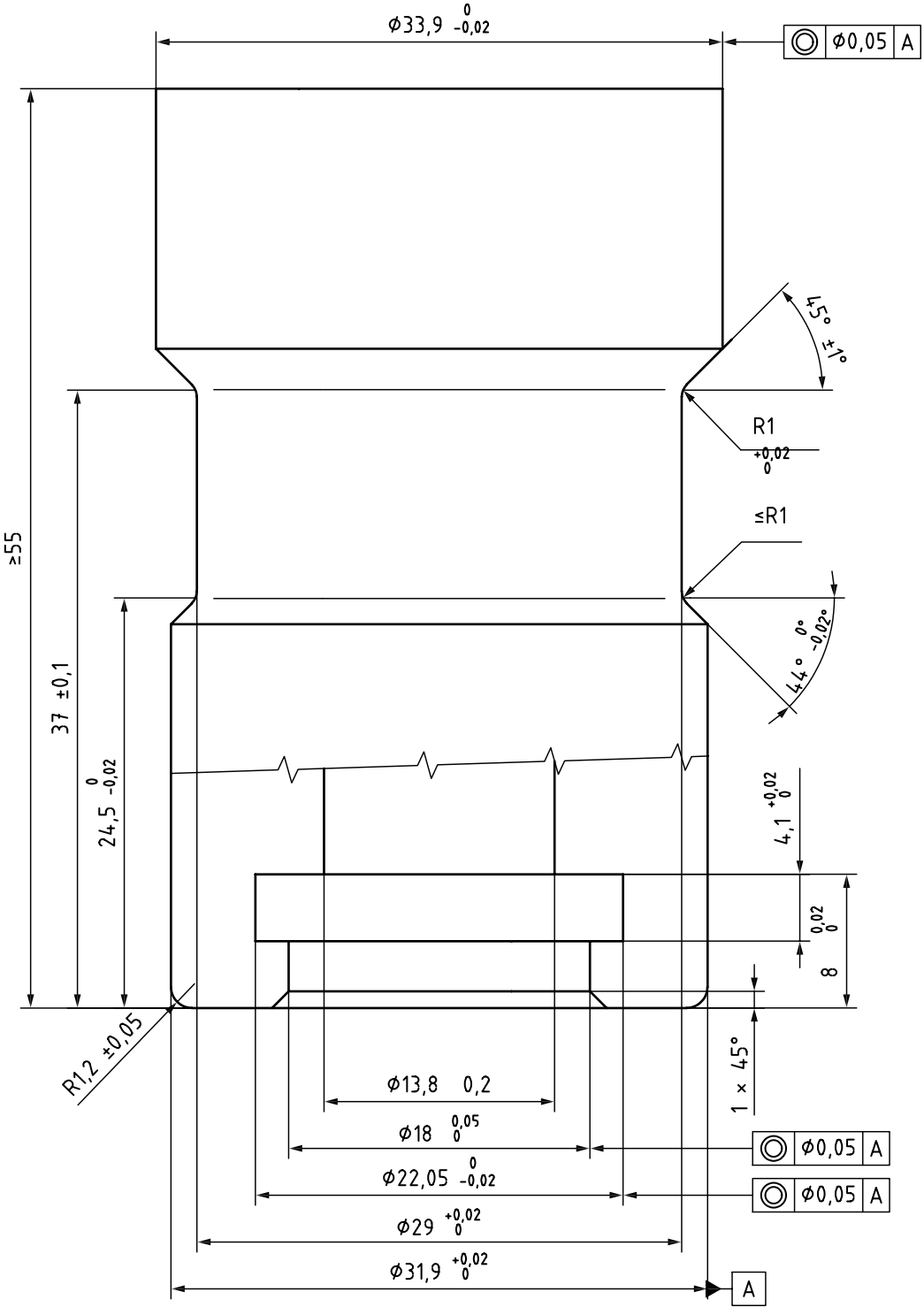
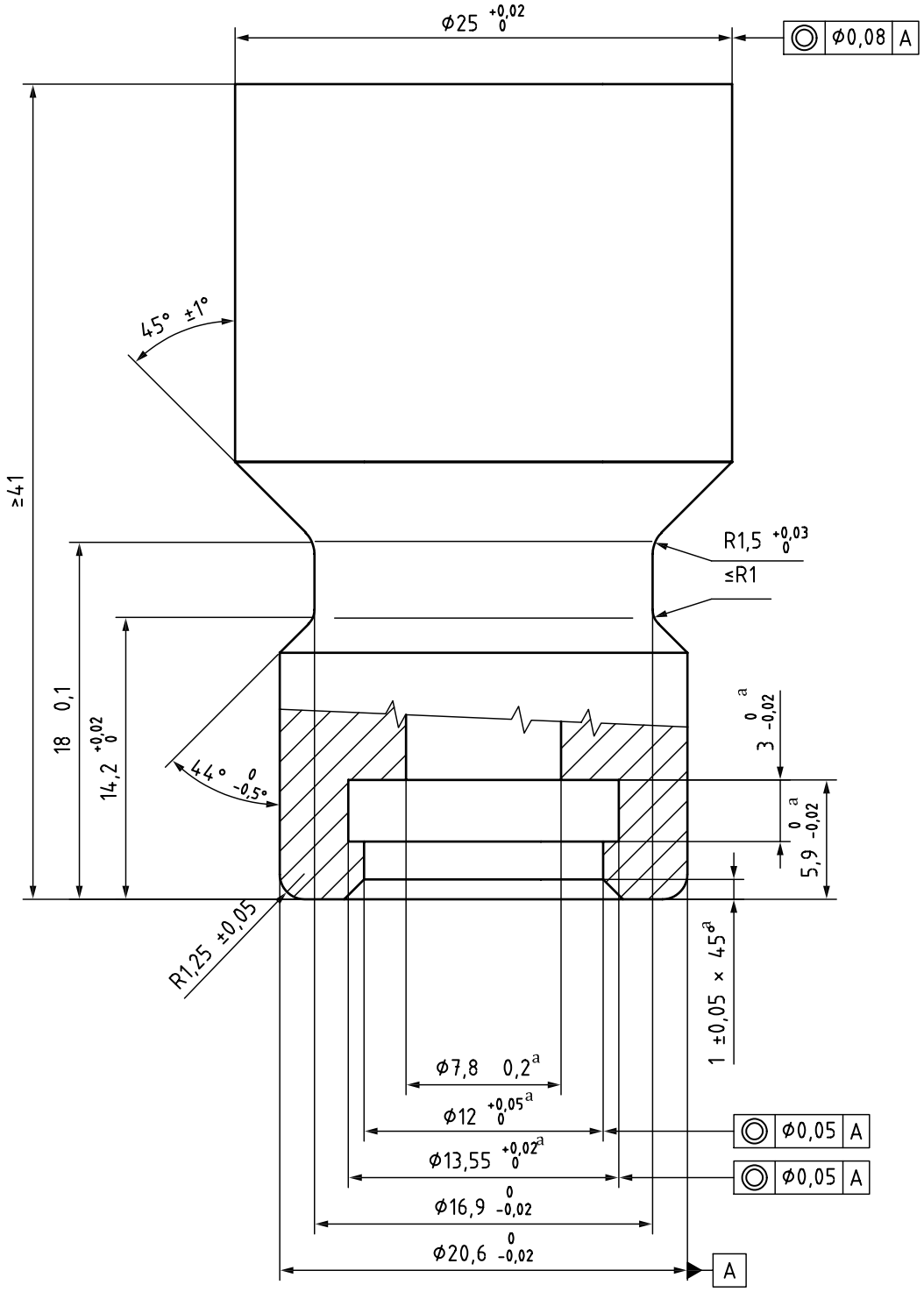


Figure B.4 — C250 - “Loose fit” tolerances

Dimensions in millimetres



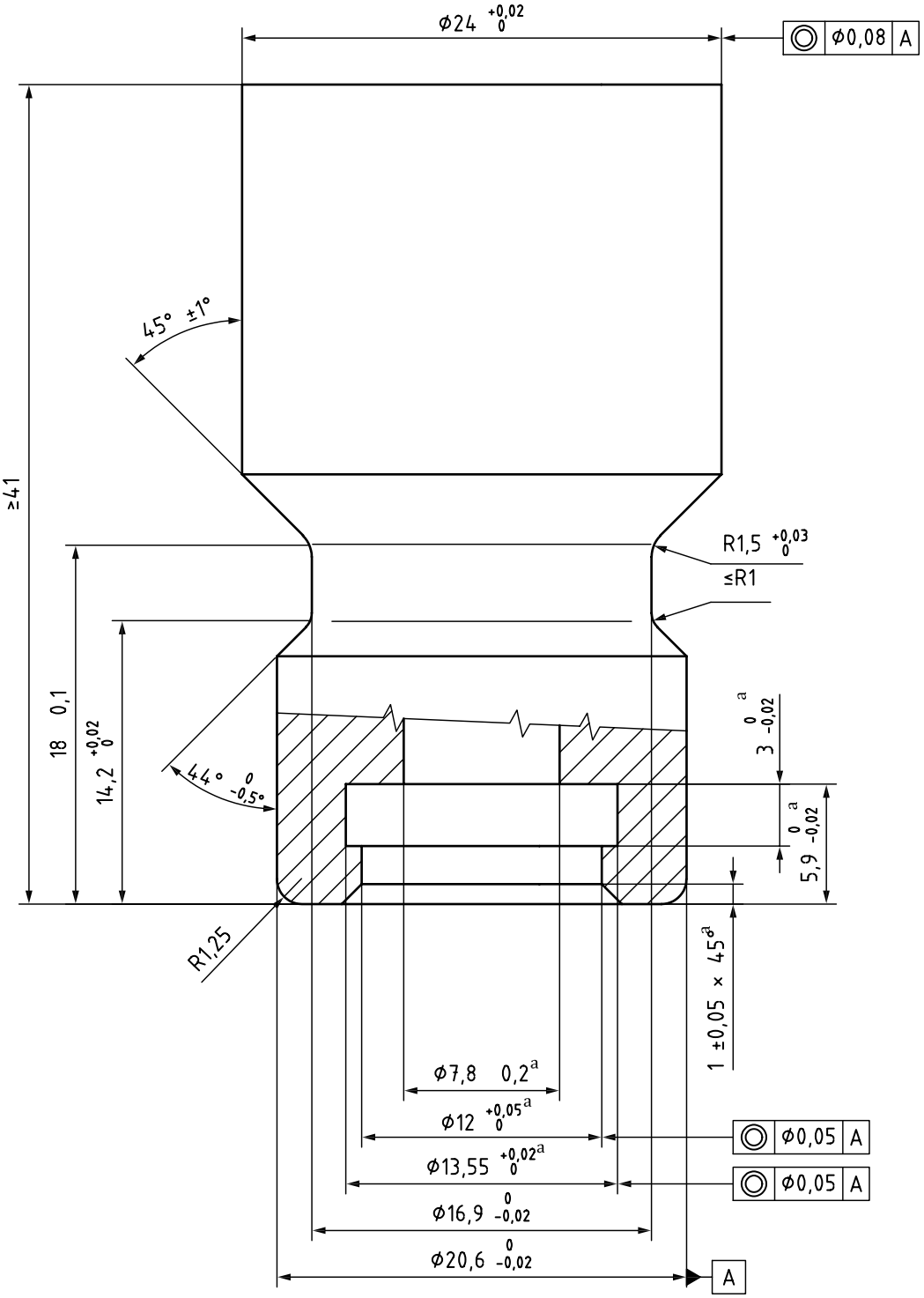
[a] Surface finish: 0,8 µm to 0,05 µm.

Surface finish range: 3,2 µm maxi (except as noted).

Material hardness: 75 HRB minimum.

Figure B.5 — B200 - "Tight fit" tolerances

Dimensions in millimetres



[a] Surface finish: 0,8 µm to 0,05 µm.

Surface finish range: 3,2 µm maxi (except as noted).

Material hardness: 75 HRB minimum.

Figure B.6 — B250 - "Tight fit" tolerances

Dimensions in millimetres

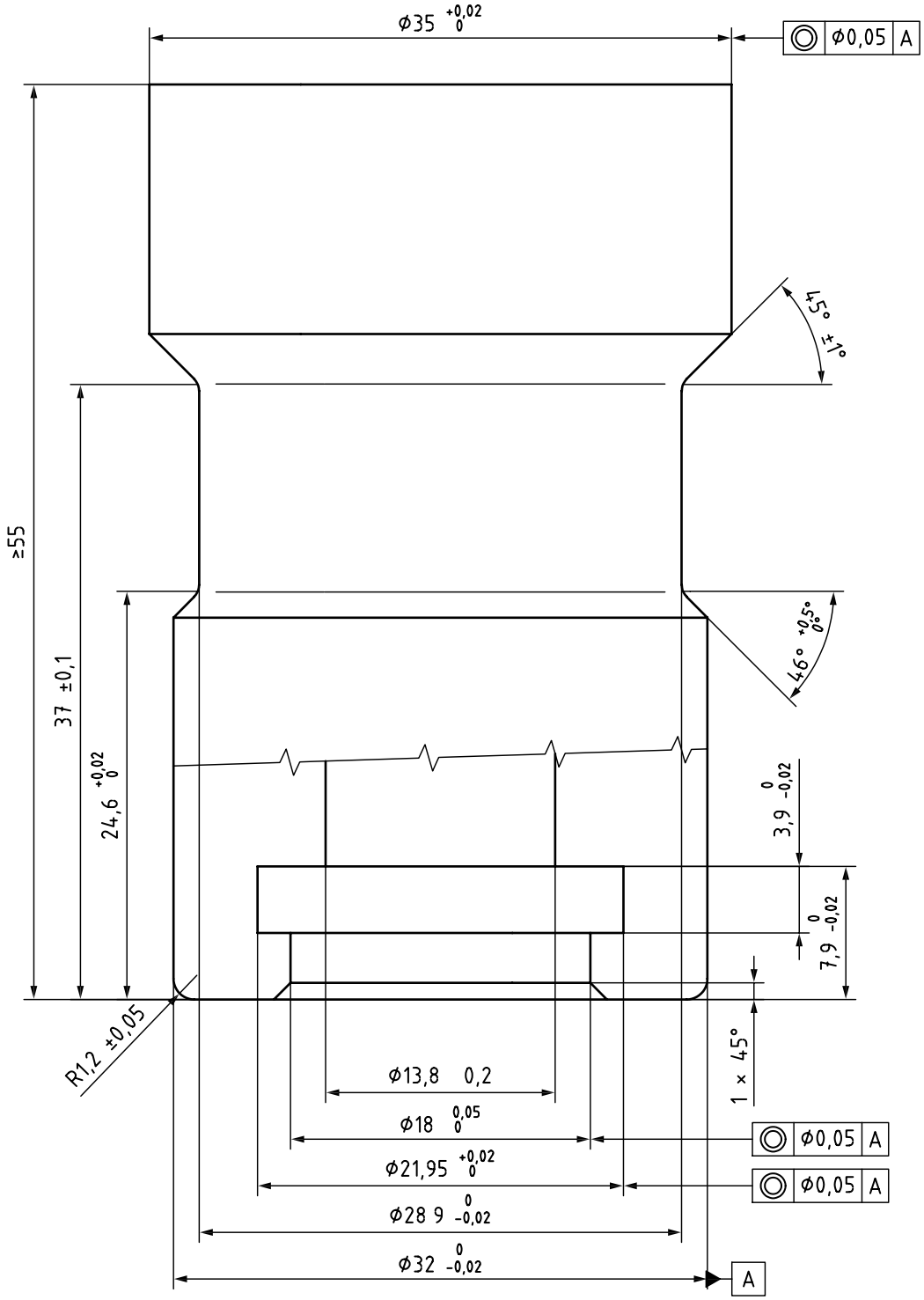


Figure B.7 — C200 - “Tight fit” tolerances

Dimensions in millimetres

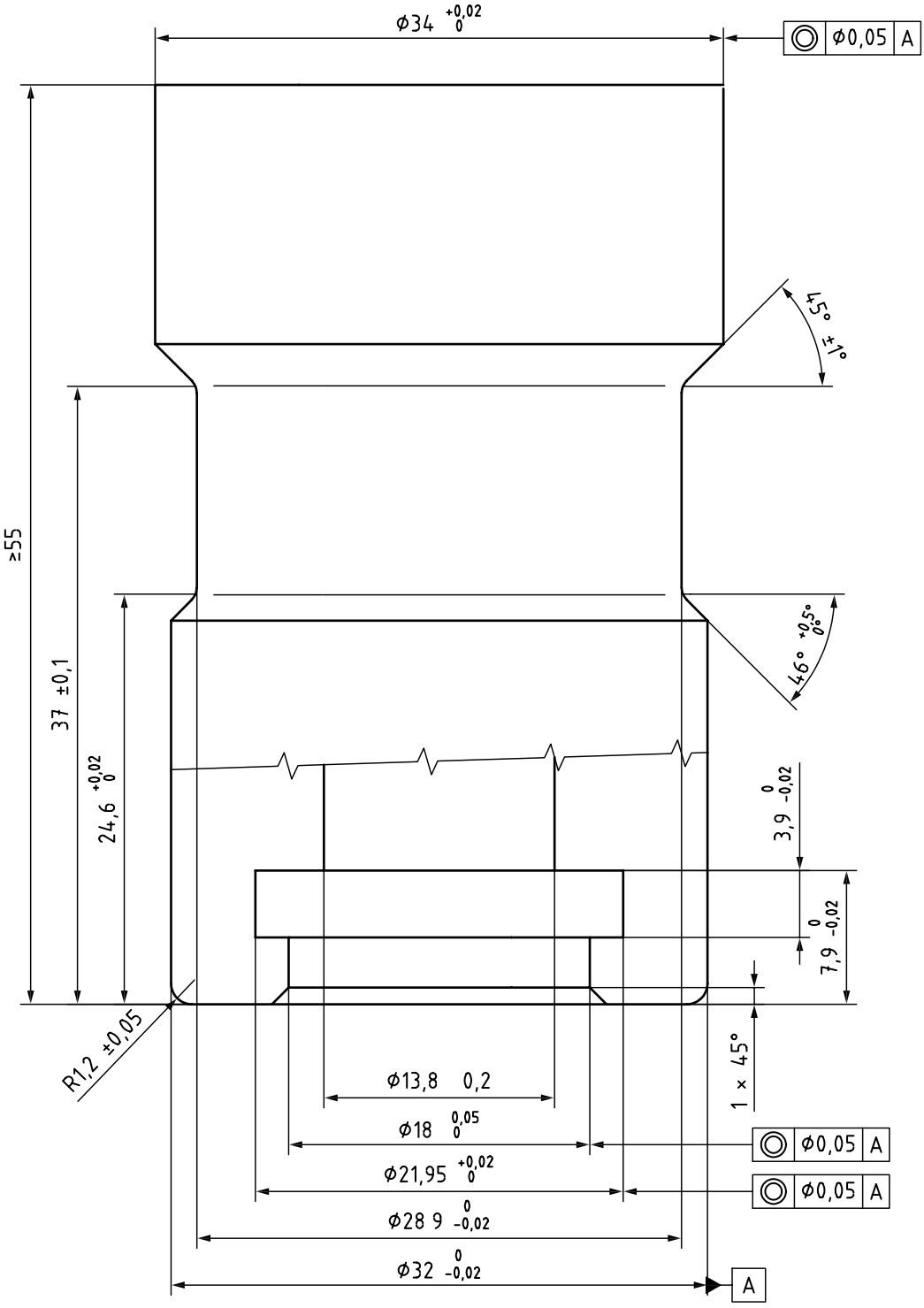


Figure B.8 — C250 - “Tight fit” tolerances

Bibliography

[1] ISO 15403-1, *Natural gas — Natural gas for use as a compressed fuel for vehicles — Part 1: Designation of the quality*

[2] ISO/TR 15403-2, *Natural gas - Natural gas for use as a compressed fuel for vehicles — Part 2: Specification of the quality*

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