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Third edition
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Diesel engines — NOx reduction agent AUS 32 —

Part 4:
Refilling interface

Moteurs diesel — Agent AUS 32 de réduction des NOx —

Partie 4: Interface de remplissage

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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 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).

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 34, *Propulsion, powertrain and powertrain fluids*.

This third edition of ISO 22241-4 cancels and replaces the second edition (ISO 22241-4:2019), which has been technically revised.

The main changes are as follows:

— an alternative magnetic function design has been added;

— Table 1 has been editorially and technically revised.

A list of all parts in the ISO 22241 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.

Diesel engines — NOx reduction agent AUS 32 —

Part 4:
Refilling interface

1 Scope

This document specifies the refilling interface for the NOx reduction agent AUS 32 in conformance with ISO 22241-1, which is needed to operate converters with a selective catalytic reduction (SCR) exhaust treatment system.

This document specifies the minimum functional and geometric requirements of an open refilling system, in order to ensure compatibility between the on-board refilling system and the off-board refilling system. Compatibility conditions for a sealed refilling system are provided in Annex A.

This document applies to commercial vehicles and buses as defined in ISO 3833 and having a gross vehicle mass of more than 3,5 t, designed to use stationary off-board refilling systems. This document also applies to the nozzle of stationary off-board refilling systems.

NOTE Throughout this document, the term “NOx reduction agent AUS 32” is abbreviated to “AUS 32”.

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 2575, *Road vehicles — Symbols for controls, indicators and tell-tales*

ISO 22241-1, *Diesel engines — NOx reduction agent AUS 32 — Part 1: Quality requirements*

ISO 22241-3, *Diesel engines — NOx reduction agent AUS 32 — Part 3: Handling, transportation, and storage*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22241-1 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

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

3.1
refilling system
off-board system and on-board system, including their refilling interface, for dispensing AUS 32 into the on-board tank of the *vehicle* (3.12)

3.2
off-board refilling system
stationary equipment for dispensing AUS 32 into the on-board tank of the *vehicle* (3.12), consisting typically of tank, pump, hose and *filler nozzle* (3.3)

3.3
filler nozzle
interfacing part of the *off-board refilling system* (3.2), which allows the operator to control the flow of AUS 32 during the filling, consisting of a nozzle spout with a defined interface geometry and an automatic shut-off system

3.4
on-board refilling system
equipment of the *vehicle* (3.12) necessary for refilling AUS 32 and consisting typically of an *inlet adapter* (3.6), *filler neck* (3.5), *filler cap* (3.7) and tank

3.5
filler neck
interfacing part of the *on-board refilling system* (3.4) where the opening is formed by the *inlet adapter* (3.6) to allow the tank to be refilled

3.6
inlet adapter
permanently fixed part of the *filler neck* (3.5), having a defined interface geometry and incorporating a magnet ring for preventing misfilling of AUS 32 into the fuel tank

3.7
filler cap
part which is fitted to the *filler neck* (3.5) to prevent *spillage* (3.11) as well as to minimize contamination of AUS 32 and which is temporarily opened or removed for refilling

3.8
open refilling system
universal *refilling system* (3.1) for which gas tightness between the *filler nozzle* (3.3) and the *filler neck* (3.5) is not required

Note 1 to entry: The open refilling system permits, for example, refilling using a small volume container.

3.9
sealed refilling system
specific *refilling system* (3.1) where the connection between the *filler nozzle* (3.3) and the *filler neck* (3.5) is gas-tight

3.10
canister
container of size one to ten litres capacity, with spout, used to refill the on-board tank of the *vehicle* (3.12)

3.11
spillage
quantity of fluid that escapes from the *filler nozzle* (3.3) to the atmosphere after the nozzle has shut off

3.12
vehicle
commercial vehicle or bus as defined in ISO 3833 and having a gross vehicle mass of more than 3,5 t, designed to use a stationary *off-board refilling system* (3.2)

3.13
magnet resistance force
F_{res}
force measured using the alternative equivalent magnet field test (4.3.2)

Note 1 to entry: The “res” subscript is the abbreviation for resistance.

4 Requirements

4.1 Functional requirements

The on-board refilling system and the off-board refilling system shall comply with the basic functional requirements specified in Table 1. For sealed refilling system the additional requirements in Annex A shall apply.

Table 1 — Basic functional requirements

No.	Characteristic	Requirement	Remark
1	Maximum flow rate range	20 l/min ≤ x ≤ 40 l/min	Flow rates do not apply to: — canister filling; — production line filling.
2	Automatic shut-off of filler nozzle	Feature to protect against overfill is required.	For example, a nozzle in conformance with EN 13012
3	Maximum filling level in AUS 32 on-board tank	The automatic shut-off system of the nozzle shall be used to protect against filling above maximum level. The on-board tank shall be designed to allow for expansion of AUS 32.	High volume expansion of AUS 32 during freezing (approximately 7 %)
4	Spillage	< 30 ml per refilling with filler neck angles from the horizontal between 50° and 90° < 50 ml per refilling with filler neck angles from the horizontal between 30° and 50°	To minimize the effects of spilled AUS 32 on the equipment
5	Ventilation during refilling	Feature required on AUS 32 on-board tank.	—
6	Operational temperature range	−30 °C to +80 °C for on-board components	For specific regions, the temperature range specified may not be sufficient or be excessive. In such cases, a wider or more narrow temperature range, representative of that specific region, may be considered.
		−20 °C to +40 °C for off-board components	
7	Misfilling of AUS 32 into the diesel fuel tank	≤ 80 ml per filling trial	The filler nozzle with magnet switch as specified in 4.5, or equivalent device, will prevent misfilling.
8	Misfilling of fuel into the AUS 32 on-board tank	Feature required to prevent dispensing of diesel fuel or petrol in AUS 32 on-board tank.	The inlet adapter diameter specified in 4.3 does not allow a diesel fuel or petrol nozzle to enter.
9	Materials	Materials in contact with AUS 32 shall be compatible with AUS 32 to avoid contamination of AUS 32 as well as corrosion of the devices used.	Suitable materials in accordance with ISO 22241-3 should be selected.
10	Freezing of AUS 32	Provide protection at the service station in accordance with operational temperature range. Vehicle parts shall be designed to cope with freezing and thawing in accordance with operational temperature range.	AUS 32 freezes at −11,5 °C and has a volume increase of approximately 7 %.

[a] With a magnet resistance force F_{res} lower than 0,5 N it is not assured that the misfilling prevention of the nozzle will be activated properly in case of crystallized AUS 32, wear and tear of the nozzle spout and dusty environment.

[b] Recommendations only.

Table 1 *(continued)*

No.	Characteristic	Requirement	Remark
11	Cleanliness	All surfaces of on-board and off-board equipment in direct contact with AUS 32 shall be free of foreign matter (e.g. fuel, oil, grease, detergent, dust, and any other substance) in accordance with ISO 22241-3. Cleanliness level for the components of the on-board refilling system shall be agreed between vehicle and component manufacturers, in conformance with state-of-the-art.	—
12	Reliability and durability	The filler neck, inlet adapter and filler cap shall be designed and manufactured to be fully functional during the vehicle lifetime without any service, adjustment or replacement.	—
13	Magnet ring [a]	Either use a magnet according to Table 3 or the magnet resistance force measured according to 4.3.2 shall be $F_{res} \geq 0,5$ N for each bore tested, refer to Figure 4.	In the case of using a magnet different from Table 3 the resulting force from the filler neck magnet on a test cylinder shall be measured according to 4.3.2.
14	Crystallization [b]	Protection recommended	Contact with air should be minimized.
15	Marking [b]	Symbol shall be as specified in ISO 2575 or equivalent national standard.	Blue is the recommended colour for filler caps.

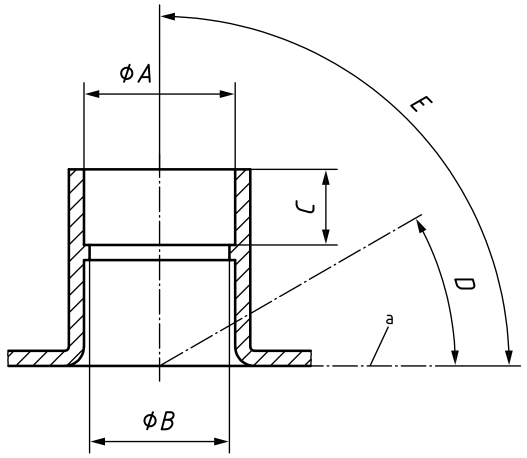
[a] With a magnet resistance force F_{res} lower than 0,5 N it is not assured that the misfilling prevention of the nozzle will be activated properly in case of crystallized AUS 32, wear and tear of the nozzle spout and dusty environment.

[b] Recommendations only.

4.2 Filler neck

The filler neck allows the vehicle manufacturer or any authorized person to install or remove an inlet adapter that can accommodate an open refilling system. For dimensional details of the filler neck, see Figure 1 and Table 2.

The geometric location and orientation of the filler neck on the vehicle should be specified by the vehicle manufacturer, taking into account the free space required for the proper application of the filler nozzle (see 4.6).



a Horizontal.

Figure 1 — Filler neck

Table 2 — Dimensions of the filler neck

Symbol	Parameter	Dimension
Ø *A*	Diameter inlet or upper stop	≥ 39,5 mm
Ø *B*	Diameter upper support	≥ 37 mm
C	Height upper stop	≤ 48 mm
D	Filler neck angle from horizontal [a]	≥ 30°[b]
E		≤ 90°

[a] An angle between 50° and 90° is recommended to minimize spillage (see Table 1).

[b] If, due to body design restrictions, an angle smaller than 30° is chosen by the designer, spillage will typically be greater and may exceed the value specified in Table 1, in which case the function of the nozzle may be limited.

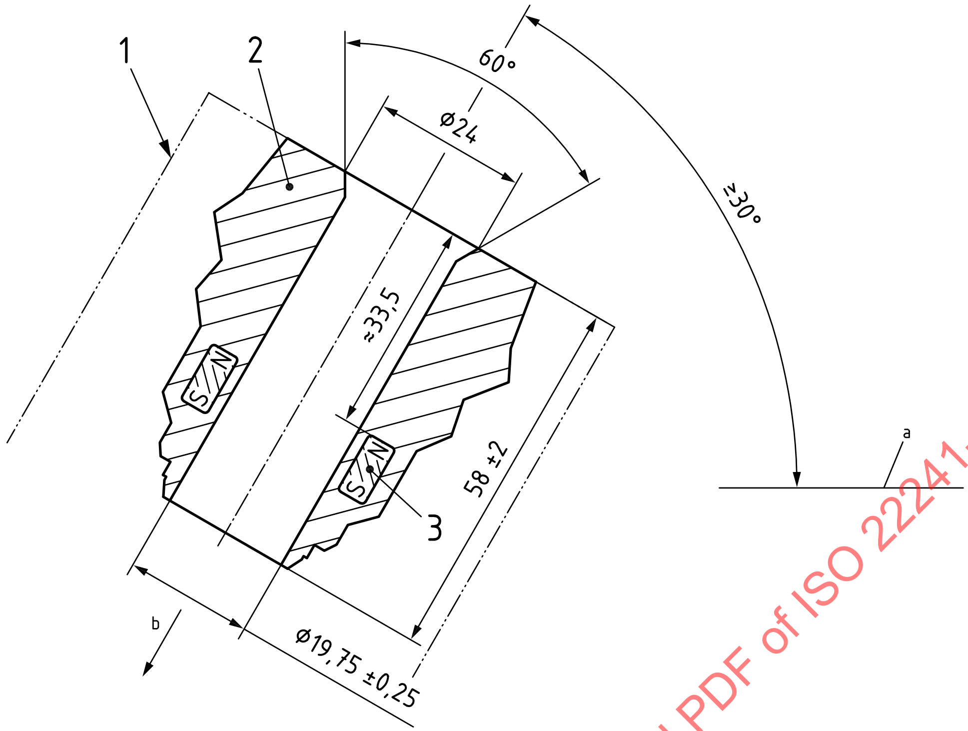
4.3 Inlet adapter

The inlet adapter shall be designed to fit inside the filler neck. The internal diameter of the inlet adapter shall prevent a filler nozzle spout greater than 20,0 mm in diameter from entering the inlet adapter.

The inlet adapter shall be equipped with a magnet ring as shown in Figure 2. The magnet shall either be according to 4.3.1 or 4.3.2.

By proper installation of the filler neck and its inlet adapter on the vehicle, the vehicle manufacturer shall ensure that the magnet switch of the AUS 32 filling nozzle is only activated when this nozzle is inserted in the filler neck for aqueous urea solution and not when inserted in any other filler neck (e.g. for diesel fuel, injection water, etc.). Otherwise a misfilling is possible.

Dimensions in millimetres



Key

1 filler neck

2 inlet adapter

3 magnet ring

a Horizontal.

b Flow direction.

Figure 2 — Inlet adapter

4.3.1 Inlet adapter with neodymium-iron-boron (NdFeB) magnet ring

If this option is chosen, the inlet adapter shall be equipped with a magnet ring having the characteristics specified in Table 3.

Table 3 — Magnet ring characteristics

Parameter		Requirements
Dimensions	outer diameter	34 mm
	inner diameter	24 mm
	height	10 mm
Material		NdFeB
Magnet parameter	remanence	1,2 T to 1,3 T
	coercivity	800 kA/m to 900 kA/m
Orientation		North pole pointing outwards from the tank

4.3.2 Inlet adapter with alternative equivalent magnet field

To ensure that the nozzle's misfilling prevention is deactivated by the filler neck magnet and the AUS 32 delivery through the nozzle becomes possible, a certain magnetic force is necessary.

The characteristics of the magnet shall be in accordance with Table 3 with the north pole pointing outwards from the tank.

When using the procedure described in 4.3.2.1 verify that the chosen alternative magnet solution is capable to activate the magnet switch in the nozzle spout.

4.3.2.1 Determination of the resulting force from the filler neck magnet

4.3.2.1.1 Test equipment

The following test equipment shall be used:

a) test cylinder made of steel material 11SMn30 (see ISO 683-4) (see Figure 3);

Dimensions in millimetres

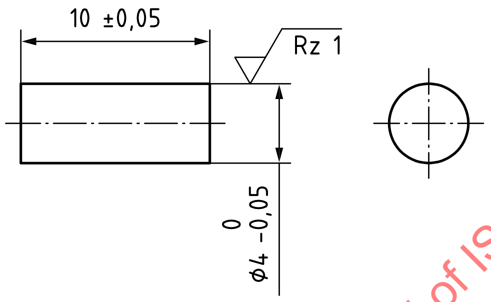
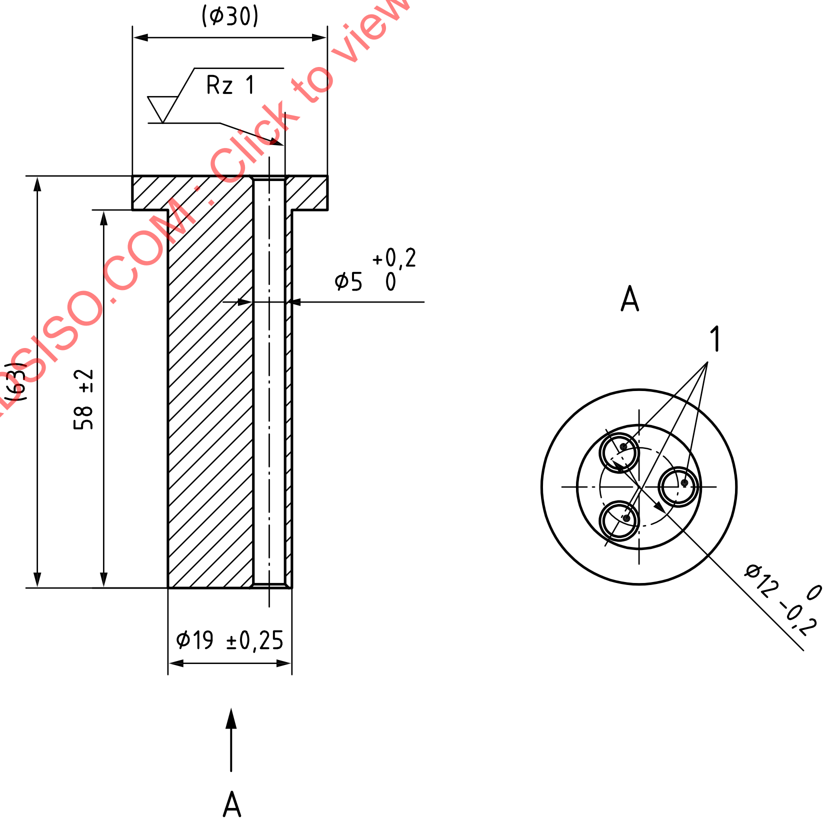


Figure 3 — Test cylinder for magnet efficiency

b) nozzle spout equivalent made of aluminium (see Figure 4);

Dimensions in millimetres



Key

1 bores

Figure 4 — Sketch of spout equivalent

c) force measurement device, for example, spring scale or tensile testing machine, with an accuracy of ± 1 %.

The test cylinder shall be connected to the force measurement device, for example, by a non-magnetic stick or string or other suitable means, so that any pull force applied is transmitted without loss.

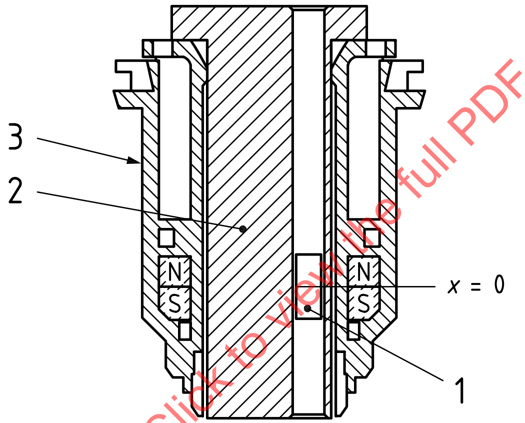
4.3.2.1.2 Preconditioning of the test samples

Measurement shall be performed on three samples, i.e. three original filler neck ends (including the built-in magnets).

For preconditioning, these test samples shall be stored first at -40 °C for at least 12 h, then at +65 °C for at least 12 h and finally at room temperature for at least 12 h. The test shall be performed after the preconditioning.

4.3.2.1.3 Test conditions and measurement procedure

The measurement shall be performed at room temperature with three preconditioned test samples (according to 4.3.2.1.2) in the vertical position by using the test set up as shown in Figure 5 and Figure 6.



Key

1 test cylinder

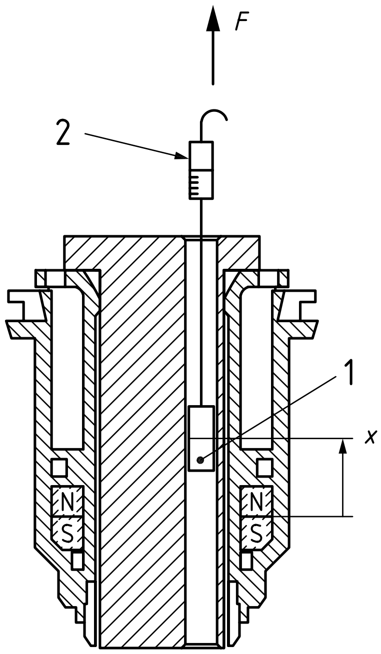
2 spout equivalent

3 filler neck with magnet

x distance in millimetres

NOTE The neutral position is the position which the test cylinder takes without an external force being applied on it.

Figure 5 — Sketch of test set-up (neutral position)



Key

1 test cylinder

2 force measurement device

F force in newtons

x distance in millimetres

NOTE The neutral position is the position which the test cylinder takes without an external force being applied on it.

Figure 6 — Pulling the test cylinder

Insert the test cylinder in one bore of the spout equivalent. Bring the test cylinder to the neutral position of the magnet, between North and South poles (x = 0 mm) according to Figure 5 and leave it there for at least 5 min to condition the system.

Pull the test cylinder in axial direction with a velocity of (2 ± 1) mm/s towards the filler neck inlet (see Figure 6).

Verify that the resistance of pulling the test cylinder out of the spout equivalent is related to the magnetic force of the filler neck magnet and not due to friction between test cylinder and nozzle spout equivalent resulting from improper pulling, dirt contamination or tilting.

For each bore of each sample:

— measure the pullout force F of the test cylinder three times at each of the three different positions x_1, x_2 and x_3.

— to define the position to measure the pull-out force, the magnet's height (h in mm) shall be considered as:

$x_1 = [(h - 10)/ 2] + 2;$

$x_2 = x_1 + 1;$

$x_3 = x_1 + 2;$

— record the nine results and calculate the average value F_{res} for the bore tested (see example in Table 4).

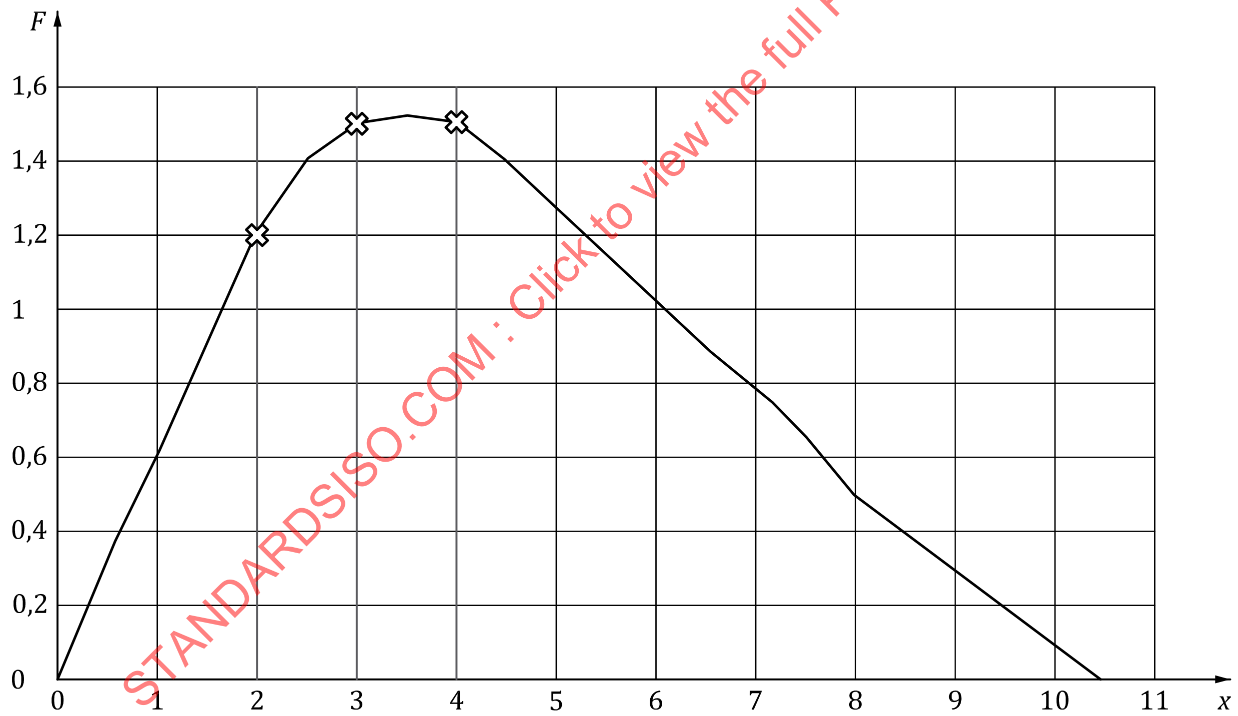
Target: each determined F_{res} shall fulfill the requirements according to Table 1.

Table 4 — Example of a table for 1 sample

Sample 1

	Pullout force *F* [N] at	x_1 [mm]	x_2 [mm]	x_3 [mm]	Average value F_{res}	Status
Bore N°1	1st measurement					
	2nd measurement					
	3rd measurement					
Bore N°2	1st measurement					
	2nd measurement					
	3rd measurement					
Bore N°3	1st measurement					
	2nd measurement					
	3rd measurement					

NOTE Using a tensile testing machine has the advantage of being able to measure the distance and the force simultaneously. An example for a curve pullout force *F* versus position *x* is shown below in Figure 7.



Key

F force in newtons

x distance of sensor line magnet to filler neck magnet in millimetres

Figure 7 — Example for a diagram of distances and corresponding magnetic force (for a magnet ring height of 10 mm)

4.4 Filler cap

Closed filler caps shall be tight for AUS 32.

Marking and colouring of the filler cap should be as recommended in Table 1.

4.5 Filler nozzle

The nozzle spout shall be cylindrical with an outer diameter of (19 ± 0,25) mm and a length of (70 ± 2) mm (see Figure 8).

The nozzle spout shall be equipped with a magnet switch, which interacts with the magnet ring of the inlet adapter (see Figure 9). If the nozzle is inserted accidentally into a fuel tank or another liquid container, the magnet switch prevents misfilling.

Dimensions in millimetres

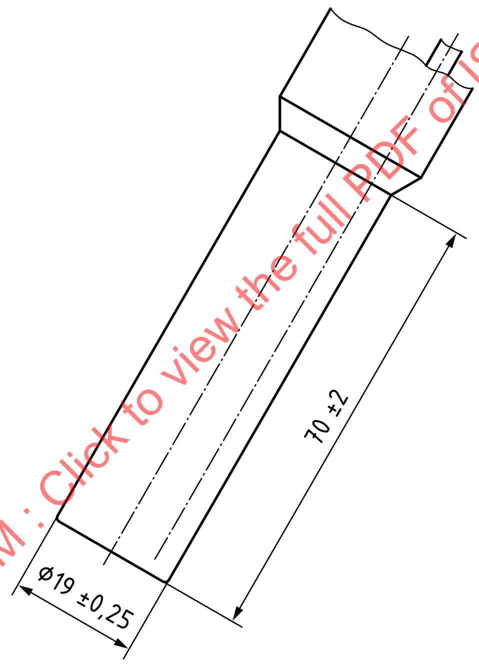
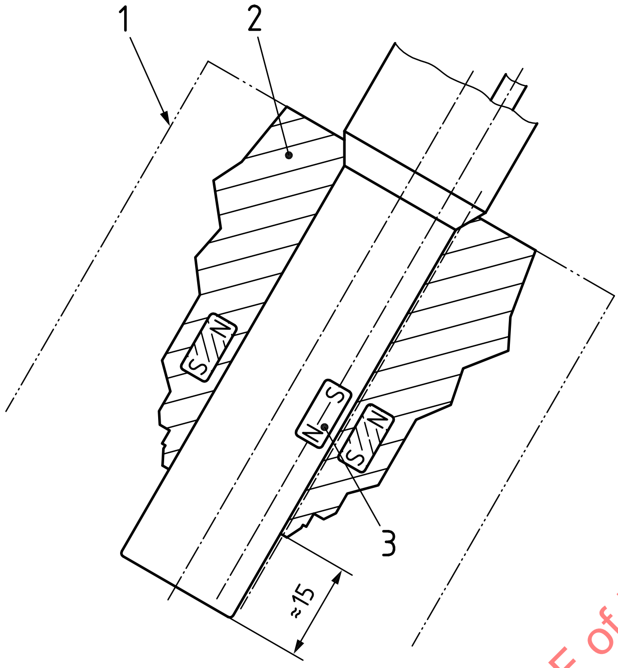


Figure 8 — Nozzle spout

Dimensions in millimetres



Key

1 filler pipe (neck)

2 magnet adapter

3 magnet switch

Figure 9 — Position of nozzle spout with magnet switch inserted into inlet adapter

4.6 Minimum free space for refilling

Vehicle and body manufacturers shall ensure that the space illustrated in Figure 10 and defined in Figure 11 is available and not obstructed by any components, in order to permit unrestricted access to the filler neck for insertion of the nozzle spout and for the subsequent removal from the filler neck. The dimensions specified in Figure 11 take into account the following parameters:

— different filler nozzle designs;

— the minimum space required for manual insertion and removal of the filler nozzle (72 mm movement); and

— the minimum space required for the hand of the operator.

Filler nozzle manufacturers shall take care to ensure that the space needed for insertion and removal of the nozzle does not exceed the space illustrated in Figure 10 and defined in Figure 11.

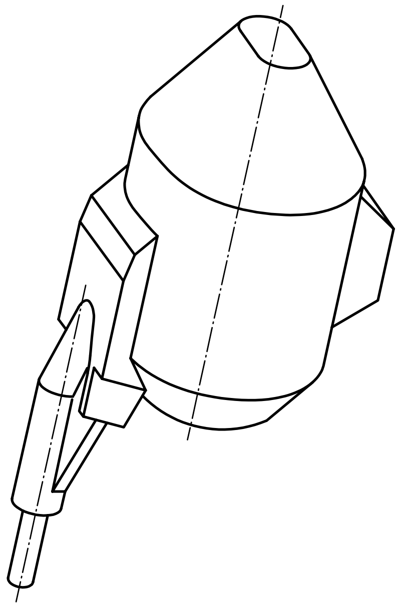
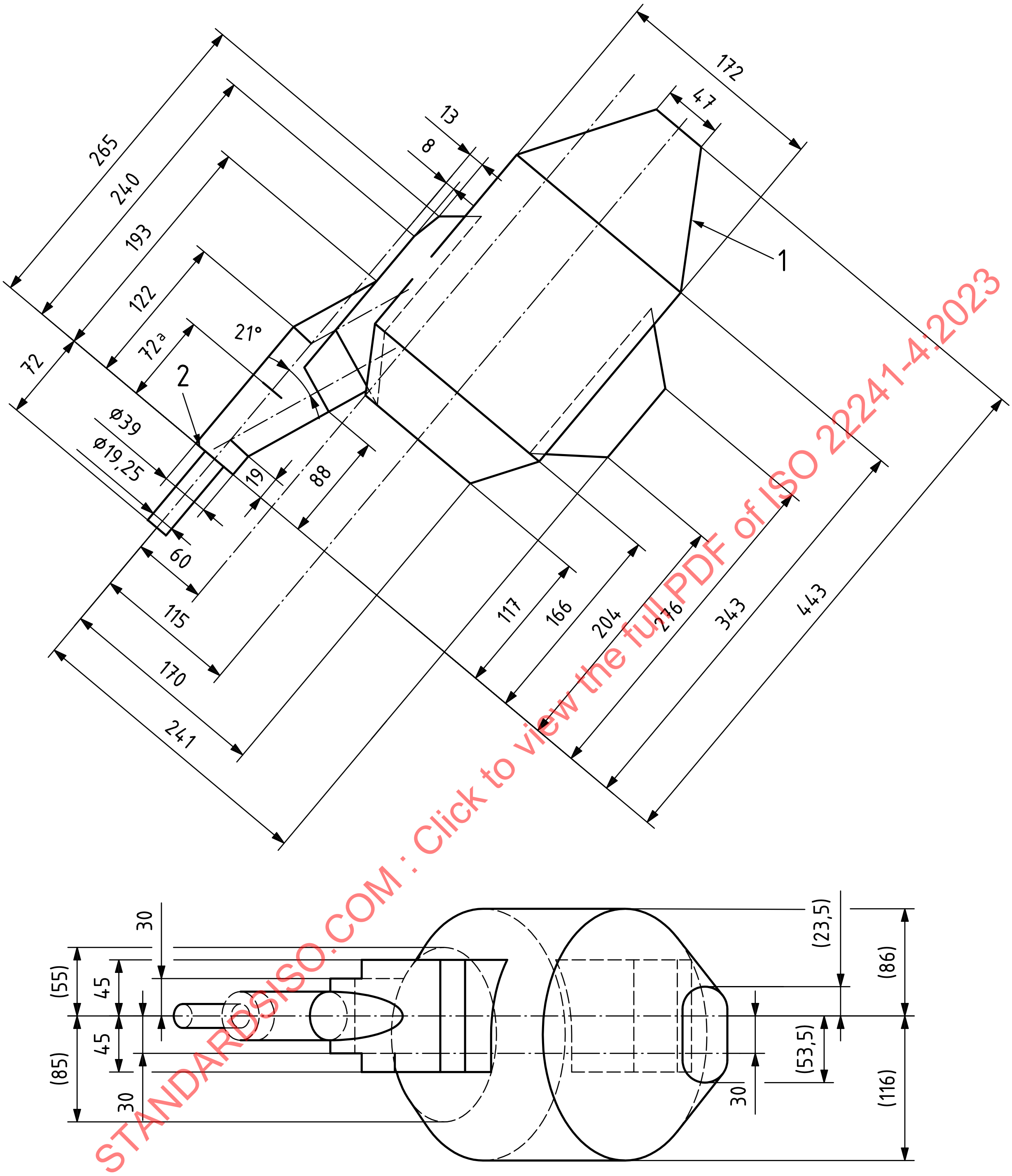


Figure 10 — Three-dimensional view of free space required for refilling

Dimensions in millimetres



Key

1 free space for operator's hand

2 top surface of adapter

a Movement of filler nozzle.

Figure 11 — Minimum free space required for refilling

Annex A
(normative)

Compatibility conditions for sealed refilling systems

A.1 Functional conditions

The sealed refilling system shall comply with the basic functional requirements specified in Table 1, except that the maximum spillage rate shall not be more than 20 ml. Figure A.1 provides an example of a sealed refilling system.

Misfilling of AUS 32 into the diesel fuel tank is rendered impossible by the use of a sealed system. Misfilling of diesel fuel into the AUS 32 on-board tank is not possible either. Emergency refilling (e.g. by small volume container) shall be possible, as illustrated, for example, in Figure A.3. A feedback system for establishing appropriate shut-off shall be provided.

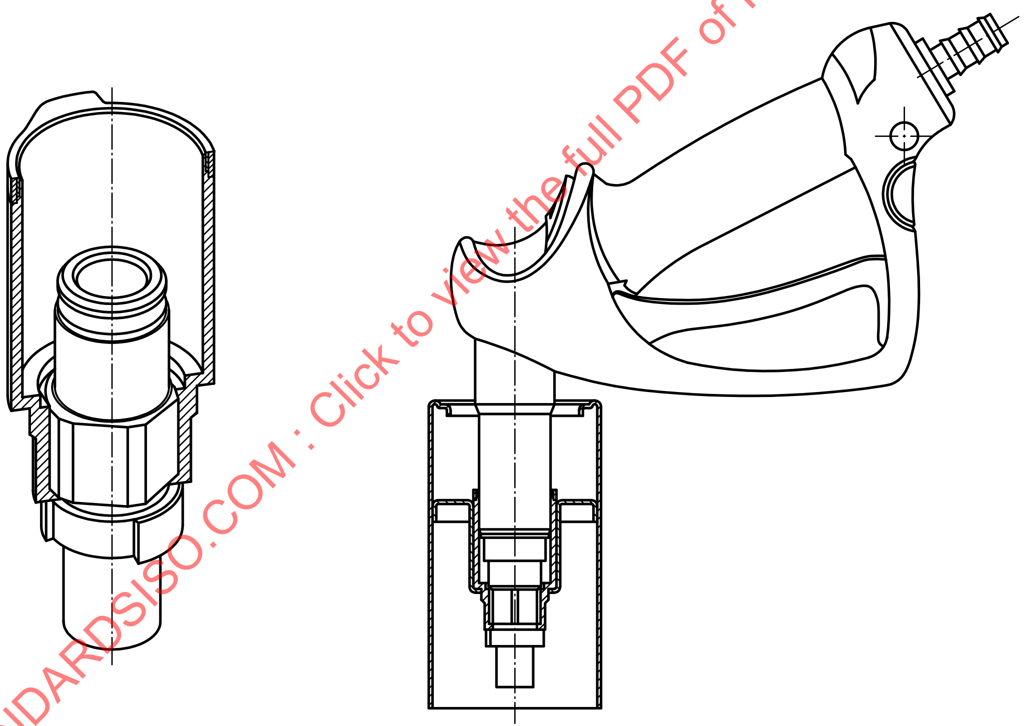


Figure A.1 — Example of a sealed refilling system

A.2 Filler neck

The filler neck in accordance with 4.2, or as specified in Figure A.2 and Table A.1, shall be used for a sealed refilling system. The filler neck in accordance with Figure A.2 permits installation of the flange-mounted inlet adapter, which permits emergency refilling using a small volume container.

No requirements are specified regarding the filler neck angle for sealed refilling systems. The sealed refilling system allows for flexible positioning of the filler neck.