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Diesel engines — NOx reduction agent AUS 32 —

Part 3: Handling, transportation and storage

Moteurs diesel — Agent AUS 32 de réduction des NOx —

Partie 3: Manipulation, transport et stockage

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22241-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 5, *Engine tests*.

ISO 22241 consists of the following parts, under the general title *Diesel engines — NOx reduction agent AUS 32*:

— *Part 1: Quality requirements*

— *Part 2: Test methods*

— *Part 3: Handling, transportation and storage*

— *Part 4: Refilling interface*

Diesel engines — NOx reduction agent AUS 32 —

Part 3:
Handling, transportation and storage

1 Scope

This part of ISO 22241 describes best practice recommendations and requirements for handling, transportation and storage of NOx reduction agent AUS 32 (aqueous urea solution), specified in ISO 22241-1. These recommendations and requirements are necessary to preserve the specified quality of AUS 32 from any point of production to the point where it is filled into the onboard tank of the vehicle, in order to ensure the proper function of the selective catalytic reduction (SCR) converter systems.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. The latest edition of the referenced documents (including any amendments) applies.

ISO 22241-1:2006, *Diesel engines — NOx reduction agent AUS 32 — Part 1: Quality requirements*

ISO 22241-2:2006, *Diesel engines — NOx reduction agent AUS 32 — Part 2: Test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
shelf life
period of time starting with the completion of the production of the batch in which AUS 32, stored under specific conditions, remains within the specifications defined in ISO 22241-1:2006, Table 1

3.2
production batch of AUS 32
quantity of AUS 32 produced at one operation at a site where the product has (last) been physically or chemically modified to reach compliance with the specifications defined in ISO 22241-1:2006, Table 1

NOTE Mixing of AUS 32 volumes does not constitute a physical or chemical modification, so long as the quality of the volumes before mixing complies with the specifications given in ISO 22241-1.

3.3
bulk operation
handling of AUS 32 in large containers

NOTE Examples of large containers are road tankers, rail cars, storage tanks and tank vessels.

3.4
packaged shipment
handling of AUS 32 in small containers

NOTE Examples of small containers are drums, cans, bottles, intermediate bulk containers (IBCs) and totes.

4 General requirements and recommendations

4.1 Requirements for the use of materials compatible with AUS 32

4.1.1 General

To avoid contamination of AUS 32 and to resist corrosion of the devices used (containers, tubes, valves, fittings, gaskets, hoses, etc.), all materials in direct contact with AUS 32 during handling, transportation and storage, including sampling, shall be compatible with AUS 32.

It is the responsibility of the user of this part of ISO 22241 to ensure that the correct materials are used. The list of the materials given in Tables 1 and 2 shall be used for guidance only until such time as more definitive information is established.

Any material with uncertain compatibility with AUS 32 shall be tested. The test conditions should reflect the intended temperature range and contact time, in order to evaluate possible influences on the product quality as specified in ISO 22241-1. In addition, this test shall ensure that the integrity of the material in contact with AUS 32 is maintained. Accelerated tests using higher temperatures may be used, as appropriate.

If a contamination of AUS 32 is detected during handling, transportation and storage, an investigation shall be carried out to determine the causes of contamination and to take appropriate corrective actions.

4.1.2 Recommended materials

Examples of materials recommended for use with AUS 32 are given in Table 1.

NOTE This list has been compiled in accordance with the state of the art and with the best knowledge at the time of publication of this part of ISO 22241.

Table 1 — Examples of recommended materials

Highly alloyed austenitic Cr-Ni-steels and Cr-Ni-Mo-steels, for example in accordance with EN 10088-1, EN 10088-2 and EN 10088-3 (i.e. 1.4541 and 1.4571), or stainless steel 304 (S30400), 304L (S30403), 316 (S31600) and 316L (S31603) in accordance with ASTM A240, ASTM A276 and ASTM A312
Titanium
Ni-Mo-Cr-Mn-Cu-Si-Fe alloys, e.g. hastelloy c/c-276
Polyethylene, free of additives
Polypropylene, free of additives
Polyisobutylene, free of additives
Perfluoroalkoxyl alkane (PFA), free of additives
Polyfluoroethylene (PFE), free of additives
Polyvinylidenefluoride (PVDF), free of additives
Polytetrafluoroethylene (PTFE), free of additives
Copolymers of vinylidenefluoride and hexafluoropropylene, free of additives
NOTE 1 The sequence given in this list does not constitute a ranking of the recommended materials. NOTE 2 Materials made of plastics can contain various kinds of additives used either for processing or for special kinds of serviceability. These additives can possibly migrate into AUS 32. For this reason, it is advisable that special care be taken for testing the contamination of AUS 32 by additives from plastic materials used in direct contact with AUS 32.

4.1.3 Materials not recommended

Examples of materials not recommended are given in Table 2.

NOTE This list has been compiled in accordance with the state of the art and with the best knowledge at the time of publication of this part of ISO 22241.

Table 2 — Examples of materials not recommended

Materials forming compounds as a result of reaction with ammonia, which may negatively interfere with the SCR converter system: carbon steels, zinc coated carbon steels, mild iron
Non ferrous metals and alloys: copper, copper alloys, zinc, lead
Solders containing lead, silver, zinc or copper
Aluminium, aluminium alloys
Magnesium, magnesium alloys
Plastics or metals coated with nickel

4.2 Physical conditions during transportation and storage

4.2.1 General recommendation

In order to avoid any impairment of the AUS 32 quality during transportation and storage, the following conditions should be taken into account:

— in order to prevent decomposition of the urea, as well as the evaporation of water in the case of vented containers, prolonged transportation or storing above 25 °C should be avoided;

NOTE 1 Insulation can be required for transportation vehicles.

NOTE 2 Prolonged storage at temperatures above 25 °C can reduce the shelf life (see Table 3). However, temporary exposure to higher temperatures does not necessarily influence the quality of AUS 32.

— in order to prevent solidification of AUS 32, storage below −5 °C should be avoided;

NOTE 3 Insulation or means of heating the AUS 32 can be required for transportation vehicles.

NOTE 4 Solidified AUS 32 has an approximately 7 % larger volume than the liquid and, therefore, can cause a fully filled, closed container to burst. Solidified AUS 32, which has been warmed up carefully at temperatures not exceeding 30 °C will not be impaired in quality and can be used as soon as the warmed up solution is free from solids.

— in order to avoid excessive temperature rise, AUS 32 should be protected from sunlight;

— in order to protect AUS 32 from any contamination carried by the air, well-closed containers or vented containers with filters should be used.

4.2.2 Shelf life

Throughout the entire distribution chain, AUS 32 is expected to remain within the specifications given in ISO 22241-1 for at least the time periods specified in Table 3 as a function of the constant ambient temperature at which the AUS 32 is stored.

Table 3 — Shelf life as a function of temperature

Constant ambient storage temperature ° C	Minimum shelf life months
⩽ 10	36
⩽ 25 [a]	18
⩽ 30	12
⩽ 35	6
> 35	—[b]
NOTE The main factors taken into account to define the shelf life in this table are the ambient storage temperature and the initial alkalinity of AUS 32. The difference in evaporation between vented and non-vented storage containers is an additional factor.	
[a] To prevent decomposition of AUS 32, prolonged transportation or storage above 25 °C should be avoided. [b] Significant loss of shelf life: check every batch before use.	

4.3 Cleanness of surfaces in contact with AUS 32

All surfaces in direct contact with AUS 32 shall be free of foreign matter (fuel, oil, grease, detergent, dust and any other substance).

To avoid any contamination of AUS 32 with trace elements, particles and foreign matter, surfaces of equipment not exclusively used with AUS 32 shall be cleaned with distilled or de-ionized water and AUS 32 in the last cleaning step immediately before the use with the AUS 32 to be handled with the equipment.

The use of tap water should especially be avoided due to the high concentrations of alkali and alkali earth metal ions therein. However, if distilled water or de-ionized water is not readily available, the material may be cleaned with tap water, provided the last rinse is done using the AUS 32 to be handled with the equipment.

If it is necessary to clean a system regardless of whether detergents are used or not, it should be verified that the trace elements specified in ISO 22241-1:2006, Table 1, in the AUS 32 that is used for a last rinsing are within the specification using the methods specified in ISO 22241-2.

For storage and transportation facilities, the result of the cleaning can be verified by analyzing the AUS 32 used for a last rinsing using the methods specified in ISO 22241-2.

4.4 Recommendation on further properties

Information on further properties of AUS 32 should be given in the material safety data sheet (MSDS), which contains indications on the hazard ranking and regulations to be respected, as well as measures required to be taken for the protection of persons and of the environment when handling the product.

5 Quality assurance

5.1 General

Each container of AUS 32 brought to the market shall be traceable back to production batches of AUS 32 by way of a unique batch number. It is recommended to include the date of original manufacturing or the date of last certification.

The quality of AUS 32 taken at any point in the distribution chain shall meet the specifications defined in ISO 22241-1. Subclauses 5.2 to 5.5 below describe the recommendations related to sampling, testing/checking and monitoring of **bulk operations** (3.3) or **packaged shipments** (3.4), as well as the

procedures for re-testing and/or re-checking of quality in the case of intermediary manipulations (i.e. intermediate tank storing, filling or re-filling).

5.2 Sampling

In addition to the sampling instructions given in ISO 22241-2:2006, Annex A, the instructions below apply to any sampling.

— Written operating procedures should be available.

— The details of the sampling procedures should be adapted to the purpose of the sampling.

EXAMPLE 1 If it is intended to determine the quality of AUS 32 in a bulk container, discarding the first two to three litres taken from the outlet is appropriate.

EXAMPLE 2 If sampling is conducted to determine the compatibility of materials in direct contact with AUS 32, discarding the first two to three litres taken from the container outlet is not appropriate.

EXAMPLE 3 If it is intended to determine the quality of AUS 32 out of the dispenser's filling nozzle, taking a sample from the first three litres of delivery volume is appropriate.

— After the loading of any means of bulk transportation at the production site, a sample should be taken from the filled container. This should be done according to a standard operation procedure that ensures that the sample is representative. An analysis of this sample should be performed before the delivery of the AUS 32 if non-dedicated means of bulk transportation are being used.

— Retained samples, which may have been taken in the distribution chain when handling bulk AUS 32, should be analyzed only if a problem is identified in the distribution chain. Samples should be kept safe for at least the shelf life of the volume of AUS 32. Storage should be under the physical conditions given in 4.2.

— For dedicated means of bulk transportation, when a previous filling has been stored under physical conditions which differ from the conditions described in 4.2.1, an analysis of the sample is recommended.

5.3 Testing

The quality of each production batch of AUS 32 shall be verified prior to shipment in accordance with the specifications defined in ISO 22241-1. The results shall be noted in writing and shall be kept on file at the production sites.

In case of dispute, qualified laboratories for verification are:

— laboratories that have a quality management system, e.g. in accordance with ISO 9001, or

— laboratories that have successfully taken part in internationally organized round-robin tests of AUS 32 within the preceding five years, or

— laboratories certified by national authorities.

5.4 Procedures for product release and handling of non-conforming product

Production batches of AUS 32 may be released for the intended use if the results of testing fully conform to the specifications defined in ISO 22241-1, or if the manufacturing process verification data demonstrate that the product is in conformance with the specifications of ISO 22241-1.

Should there be any parameter deviating from specification or any doubt about the quality of the product, e.g. due to containers without labels, coloured or cloudy product, uncharacteristic smell or a shelf life being

exceeded, the AUS 32 in the container shall be withheld and stored separately, and labelled accordingly. Further investigations should then be carried out.

To re-enter the distribution chain, the product quality shall be checked again and it shall be verified that the quality standards defined in ISO 22241-1 are fulfilled.

If the results of an analysis reveal that the AUS 32 from the same production batch has the same fault, the shipments concerned shall be recalled.

To minimize the risk of overlooking an unidentified contaminant, a product that is recalled in this way and that is judged not to be in compliance with the specification shall be downgraded and shall no longer be designated as AUS 32.

NOTE 1 For closed containers with an expired shelf life, it is sufficient to test the alkalinity as NH_3 of the AUS 32 in the containers in accordance with ISO 22241-2 for a decision about further use.

NOTE 2 It is advisable that closed containers with a content of up to about 5 l (small containers) be either discarded, if the shelf life is expired, or retested for alkalinity as NH_3, in order to decide whether the AUS 32 in the containers can be used further or used in other applications.

NOTE 3 For small containers of AUS 32 having an expired shelf life, re-testing of only one container is sufficient, if all such containers have been produced from the same production batch and have been stored under identical conditions.

5.5 Quality monitoring

5.5.1 General

For each production batch of AUS 32 delivered, the manufacturer should supply a quality certificate (e.g. a certificate of compliance with the order or test report).

Methods to determine characteristic product parameters comprise tests (i.e. methods defined in ISO 22241-2) by which AUS 32 can be clearly identified and possible contaminations discovered.

A typical, but not exhaustive, list of properties to be determined for the sake of product identification is, for example, density and refractive index.

A minimum contamination test should consist of a check of the product for colour, suspended particles and odour different from ammonia.

A minimum contamination test should be performed every time the product in bulk is transferred from one bulk container to another bulk container.

5.5.2 Audits

All parties of the distribution chain have the responsibility to audit their portion of the chain so as to ensure the quality of the AUS 32.

Actions should be taken by the responsible parties to resolve any problems identified.

5.5.3 Documentation

Procedures and records of the distribution chain of AUS 32 concerning production, product delivery, loading, storage, sampling, testing, product release and handling, as well as audits, shall be documented, e.g. in accordance with the guidelines of ISO 9001.

Quality documents should be kept on file for 5 years.

6 Procedures for handling of containers and equipment

6.1 General

The general procedures for the handling of containers and equipment are as described below.

— All handling equipment for packaged shipment and for bulk operation should be dedicated or thoroughly cleaned and proven clean (see 6.4) for use with AUS 32. The equipment should be identified accordingly.

— In order to avoid any contamination, dedicated or thoroughly cleaned and proven clean containers should be used.

— Temperature control means may be necessary to maintain the AUS 32 within the recommended temperature range as indicated in 4.2.

— The components of the filling and emptying equipment should be emptied, cleaned and closed off after use, in order to prevent contamination of AUS 32 from the surroundings. Hoses, in particular, should be dedicated and closed after every use, and handled and stored in a controlled manner.

6.2 Single use non-bulk containers

The procedures described below apply to single use non-bulk containers.

— Every container shall have an identification label or stamp, so that its content can be traced back to the original production batch of AUS 32 of the supplier.

— In order to be able to recognize foreign matter such as dust, insects or any other insoluble matter, the inside of the containers should be checked visually prior to filling in accordance with a written procedure. If foreign matter is found inside the containers, proceed according to 5.4.

— During the filling of a series of small containers with AUS 32, a one litre sample should be taken from the first container filled. If the containers are smaller than one litre in size, the sample taken should be the first filled container. The sample should be kept as a retention sample.

— Filled containers should be sealed unless the container is a vented design.

6.3 Dedicated bulk operation

Means of bulk operation which are exclusively used for transportation or storage of AUS 32 need not be cleaned before loading with AUS 32, provided all valves, openings and hoses have been closed and handled without contamination. The closing and proper handling can be confirmed by a visual inspection at the filling station and documented accordingly.

All bulk loading and unloading operations should be established as operating instructions. Checklists should be used to document both loading and unloading steps. These checklists should be signed by a person responsible for the loading or unloading procedure and by the operator in charge of the transportation, and should be retained by a person responsible for loading or unloading.

Prior to any loading or unloading of AUS 32, the results of the following inspections should be documented as a minimum:

— proper closure of all valves and apertures after completion of the loading or unloading procedure;

— check of the certificate of cleanness (for the first filling of a dedicated bulk container with AUS 32);

— visual verification of the means of bulk transportation or storage, the loading and unloading equipment, the ancillary equipment and the systems for cleanness, defects or faults;

— identification of products to be loaded or unloaded in accordance with the delivery documents.

If any irregularities occur during loading or unloading, the operation should be stopped immediately. A sample from the filled bulk compartment should be analyzed to clarify the problem and further action should be decided on the basis of the results obtained.

6.4 Non-dedicated bulk operation

Non-dedicated means of bulk transportation or storage should be thoroughly cleaned prior to the use with AUS 32. The cleaning process should take into consideration the chemical nature of the last three products transported or stored. Both the process and the cleanness should be documented in a certificate of cleanness. This certificate should be presented at the site of filling prior to loading. In addition, the outlet, the inlet and the interior of the means of transportation and storage should be visually checked. If the visual check reveals non-compliance with the cleanness requirements, the container shall not be filled and shall be rejected. Additional cleaning or replacement shall be performed.

Non-dedicated equipment used for filling containers should be thoroughly cleaned prior to the use with AUS 32. The cleaning process should take into consideration the chemical nature of the last three products processed with this equipment. A sample taken from the first container filled with AUS 32 should be analyzed to confirm compliance with the specifications defined in ISO 22241-1. The products previously filled with this loading equipment and the results of the analysis after the product exchange should be documented.

Bibliography

[1] ISO 9001, *Quality management systems — Requirements*

[2] ASTM A240/A240M-07e1, *Standard specification for chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels and for general applications*

[3] ASTM A276-06, *Standard specification for stainless steel bars and shapes*

[4] ASTM A312/A312M-07, *Standard specification for seamless, welded, and heavily cold worked austenitic stainless steel pipes*

[5] EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

[6] EN 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

[7] EN 10088-3, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*

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