AUTOMOTIVE GRADE UREA

32.5 % Automotive Grade Urea Solution

(Hereinafter AUS 32)

According to ISO 22241

Quality Assurance Guidance Document

DISCLAIMER

The high quality urea solution AUS 32 is defined by the standard ISO 22241 specification, "Diesel engines – NOx reducing agent AUS 32" Part 1, quality requirements , Part 2, test methods, and Part 3, handling, transportation and storage".

ISO 22241 replaced the German DIN 70070 which was the first standard for AUS 32. The initial standards did not take storage and handling into account. The Cefic Automotive Grade Urea Sector Group (AGU) therefore developed this Quality Assurance Guidance Document (QAGD) which describes how to safeguard the integrity of the urea solution in production, storage and distribution.

The QAGD is based on the experience and expertise of the AGU member companies in handling urea and urea solutions. Whilst it is intended to be a summary of best practice, it is recognised that other quality systems and processes may be equally effective in achieving the desired level of product integrity and improvement in health, safety and environment protection.

The systems described in the QAGD are entirely voluntary. Individual companies may decide to apply the QAGD either in full, or in part, or not to apply it at all, according to their own judgment. In addition, the information included in the QAGD is provided without prejudice.

The systems and the QAGD are not linked to any particular trade mark.

The QAGD is freely available on our internet site http://www.petrochemistry.net.

For your information, the ISO 22241 standard may be purchased from any national standardisation organisation

WARNING

In order to be sure you are using the latest version of this document; please make sure to visit http://www.petrochemistry.net / Product & sector groups / Automotive grade urea, for any possible updates.

1. Introduction

1.1 Purpose and Objectives

The purpose of this document is to provide all stakeholders involved in regulatory processing , manufacturing, distribution or use of AUS 32, with updated information on the handling of AUS 32 that is ensuring the safety of operators and quality of the product in the supply chain. The document is accessible for everyone, and it is more frequently updated than the above mentioned ISO standard.

This technical guidance document describes best practice procedures for handling and distribution of 32.5% aqueous urea solution (AUS 32), ISO 22241 grade, to preserve the quality of the solution from production via storage and distribution to the end-user.

This document covers
- product handling
- quality assurance
- safety measures
- environmental protection

It identifies all participants in the distribution chain (producers of AUS 32, logistics partners, public filling and truck stations) and draws their attention to common guidelines concerning handling in such a way that the intended high quality of AUS 32 will be maintained from the point of production to the point of end-use.

To maintain product quality and proper functioning of the dispensing units regular maintenance is essential. This issue is not addressed in this guidance document. Fleet owners and service station operators should consult their AUS 32 suppliers for further guidance .

1.2 Introduction

After evaluating different concepts to meet the Euro IV (10/2006) and Euro V (10/2009) standards for heavy-duty vehicles, the automotive industry has decided to use the SCR-technology with AUS 32, as reducing agent for most of these vehicles. The SCR technology has demonstrated the capability to reduce NOx emissions from heavy duty trucks in test cycles and in on-the-road operation. The combination of fuel-economy-optimised engines with low particulates and SCR is able to meet the EURO IV and V regulation.
The same advantages will be even more relevant by the introduction of lower NOx emission limits, with Euro VI for heavy duty diesel vehicles in 2014, when it is expected that virtually every new vehicle on the road will be fitted with urea-SCR. From 2014, Euro 6 for light duty vehicles are introduced, and Stage IV of the Non-Road Mobile Machinery legislation is put into force, and the low NOx limits makes it likely that urea-SCR is found on agricultural tractors and construction machinery, as well as some passenger cars.

The SCR technology with AUS 32 as reducing agent has already been applied successfully to stationary applications, waste incinerators, power plants and to mobile Diesel engines in applications such as ships and locomotives.

The basic chemical reaction of the urea SCR process is as follows:

AUS 32 is injected into the hot exhaust gas and is hydrolysed above approx. 180°C forming ammonia (NH_3) according the following reaction equation:

Hydrolysis reaction: $(NH_2)_2CO + H_2O \rightarrow 2\ NH_3 + CO_2$

At the homogeneous extruded, base metal SCR catalyst the following reaction takes place to convert NOx with NH_3 from the hydrolysis reaction to nitrogen and water.

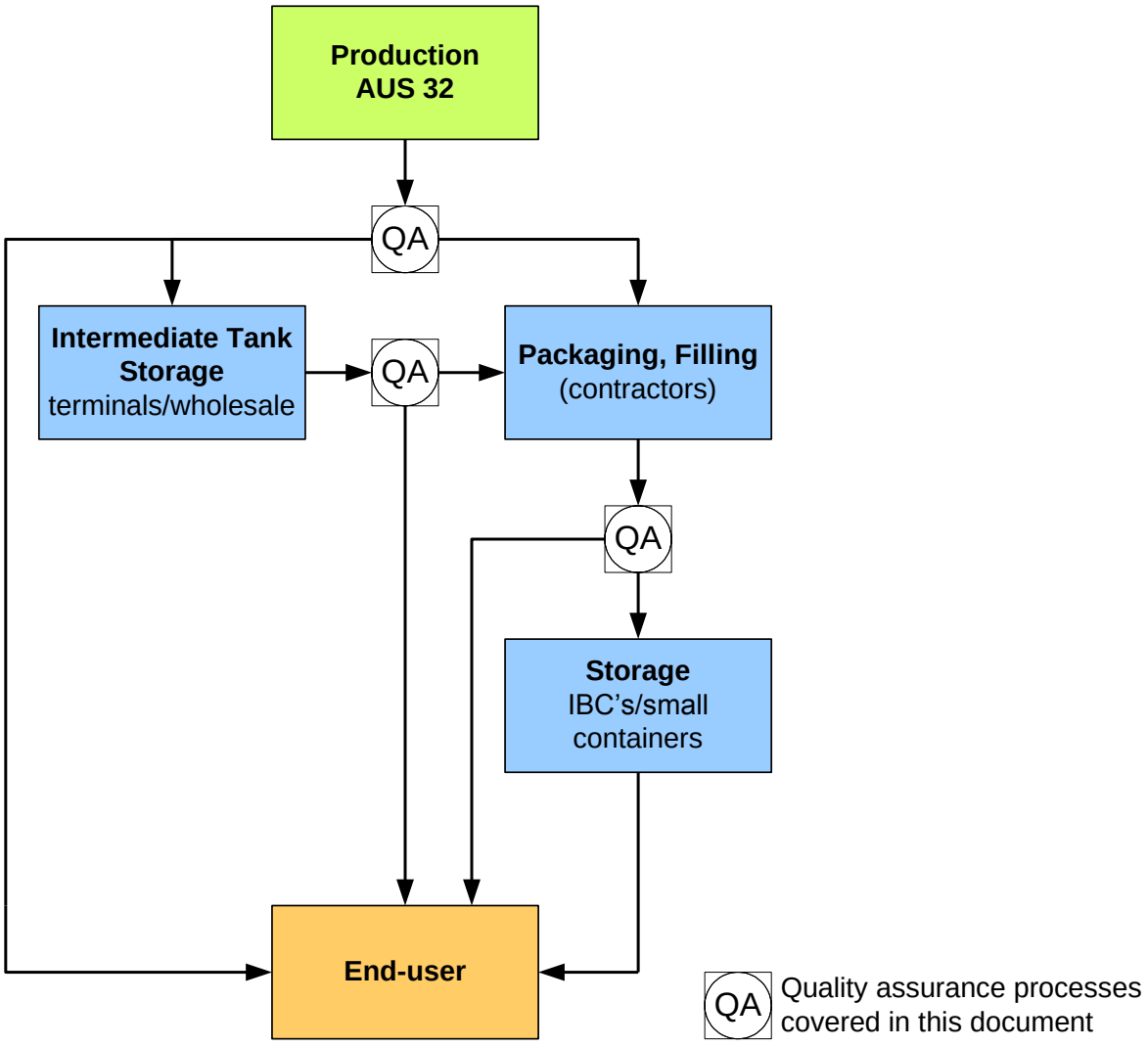
SCR reaction:

$4\ NH_3 + 4\ NO + O_2 \rightarrow 4\ N_2 + 6\ H_2O$

$8\ NH_3 + 6\ NO_2 \rightarrow 7\ N_2 + 12\ H_2O$

For the SCR after-treatment technology to remain effective it is essential to avoid any contamination of AUS 32 caused by foreign compounds and matter and by any physical conditions out of the limits specified.

1.3 Distribution Chain



For a more detailed process flow chart see attachment 5.

Distribution to be based on dedicated equipment for storage, handling and distribution.

2. Quality Requirements - Background and Systems

2.1 Influences on the Catalyst's Lifetime

The catalysts used in the SCR after-treatment system consist of catalytically active transition metal compounds, which are fixed onto ceramic carriers. The ability of the SCR after-treatment system to convert NO_x into N_2 and H_2O depends to a large extent on the actual activity of these active centres, and on the width of the pores in the ceramic carrier. Pore size influences the diffusion rate of the exhaust gases into the catalyst.
To ensure a high activity of the SCR after-treatment system over a long period of time the quality of AUS 32 has to be controlled very strictly, as many of the components with limit values in ISO 22241-1 irreversibly harm the catalyst system by physical blocking of the pores, or deactivation of the reactive centres. Poor activity of the SCR after-treatment system due to inactive catalysts may 1) result in an increase in NOx emission, and 2) cause secondary damage in the engine itself due to an exhaust gas pressure increase.

2.2 Quality System Recommendation

The participants in the distribution chain are encouraged to set down all operations in the form of operating instructions according to the ISO 9001 standard.
All staff engaged in production, handling and distribution must be fully familiar with the relevant operational standards and regulations and recommendations given in this document and they must all be given training on a regular basis. The training has to be documented, according to ISO standards.

2.3 Specific Quality Requirements for AUS 32

The quality requirements for AUS 32 are defined in the international standard ISO 22241 under the title "*Diesel engines – NOx reduction agent AUS32"*. ISO 22241 consists of the following parts:

- Part 1 : Quality requirements
- Part 2: Test methods
- Part 3: Handling, transportation and storage
- Part 4: Refilling interface

The specification laid out in this standard has to be maintained from production throughout the entire distribution system to the end-user.

The standard can be obtained from:
ISO, Geneva Switzerland
www.iso.org

or from the National Standardizations Organisations.

3. General Recommendations for AUS 32 Distribution Chain

3.1 Distribution Chain - Logistics

To maintain quality throughout the distribution chain the following technical and procedural requirements must be met:

- Use of materials compatible with AUS 32 (chapter 3.2)
- Physical conditions during storage and transportation (chapter 3.3)
- Shelf Life (chapter 3.4)
- Cleanness of materials in contact with AUS 32 (chapter 3.5)
- Product release and Quality Control (chapter 4) by Sampling (chapter 4.2), Testing (chapter 4.3) and Monitoring (chapter 4.4)
- Product release and handling of nonconforming product (chapter 4.5)
- Traceability and renewed approval of AUS 32 (chapter 5.1)
- Documentation (chapter 5.2)
- Audits (chapter 5.3)

3.2 Use of Materials Compatible with AUS 32

Any materials used in direct contact with AUS 32, e.g. for the construction of tanks and containers including tubes, valves and fittings for storage, transportation and handling must be compatible with AUS 32 (Details on materials recommended see attachment 3). Materials used for sampling devices, sample storage containments and canisters have to be compatible with the urea solution.

3.3 Physical Conditions During Storage and Transportation

To avoid any impairment of quality of AUS 32 during storage and transportation the following physical conditions should be met:

- Prolonged storage temperatures above 25 °C should be avoided to maintain shelf life. However, only temporary exposure to higher temperatures will not impair the quality.
- Storage temperature should be kept above minus 5 °C to prevent crystallisation of urea from AUS 32, which starts at minus 11.5 °C. Please keep in mind, that the volume of solidified AUS 32 will be about 7 % larger than the volume of the liquid AUS 32.
- Well closed containments to protect the containment as well as the solution from any contamination.
- Prolonged storage above 25 °C will cause hydrolysis to occur, with the consequent formation of ammonia and pressure rise, and will reduce shelf life.

3.4 Shelf Life as a function of temperature

The shelf life of AUS 32 is the period of time, starting with the completion of the production of the batch, in which this product, stored under specific conditions, remains within the specifications defined in ISO 22241-1:2006.
The shelf life as function of the average product temperature is given in the following table:

Average product temperature °C	Minimum shelf life Months
≤10	36
≤25	18
≤30	12
≤35	6

The main factors influencing the shelf life in this table are:

- the average product temperature

- the initial alkalinity of AUS 32
- The difference in evaporation between vented and non vented storage containers

After expiration of the shelf life the batch has to be tested for a decision about further use.

3.5 Cleanness of Surfaces in Contact with AUS 32

Any surfaces in direct contact with AUS 32 have to be free from foreign matter such as fuel, oil, greases, detergents, dust, and any other chemicals or natural products. Prior to the first use with AUS 32 any surface has to be cleaned and finally rinsed with demineralised water and AUS 32 in the last cleaning step..
The use of tap water for cleaning purposes should be avoided due to the high concentrations of alkali and alkali earth metal ions therein. Only if no distilled water is available tap water may be used, if then a last rinse with sufficient quantities of AUS 32 is made. If storage and transportation facilities have to be cleaned the result should be verified analytically, i.e. that the trace elements in the AUS 32 used for the last rinsing, are within the specification, using the methods specified in ISO 22241-2.
The use of non-dedicated equipment has to be regarded as the first use.
Compartments filled with AUS 32 have to be sealed.

4. Product Release and Quality Control by Sampling, Testing and Monitoring

4.1 General

The quality of AUS 32 taken at any point of the distribution chain shall meet the specifications defined in ISO 22241-1.

Any AUS32 placed on the market shall be traceable back to the original production batch by way of a unique batch number, which is provided to the next step of the distribution chain.

To be released for shipment and when received at its destination all batches of AUS 32 must be checked according to the procedures described below. A batch means a well-defined and traceable quantity of AUS 32 (see also chapter 5.1). These checks must be duly noted and kept on file by the production sites, terminals, and at the traders/contractors.

At every transfer of AUS 32 from production- and intermediate storage tanks the traceability of batches has to be guaranteed to enable proper monitoring of the product quality. Appropriate regulations concerning taking and keeping samples have to be fixed in-house and/or to be agreed between different partners involved.

If the recommended shelf life (chapter 3.4) is exceeded at any point in the distribution chain the material must be retested prior to use.

The following paragraphs will describe the minimum requirements pertaining to sampling, testing/checking and monitoring of bulk or packaged shipments. Furthermore, the procedures for renewed quality certification in case of intermediary manipulations (i.e. intermediate tank storage, filling or re-filling) are described.

4.2 Sampling

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

- Written operation procedures for sampling should be available, telling how samples shall be taken and stored.
- All samples must be representative of the batch to be sampled. Therefore, the details of the sampling procedures should be adopted to the purpose of the sampling:
  1. If it is intended to determine the quality of AUS 32 in a bulk container, the first two to three litres taken from the outlet shall be discarded.
  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.
  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 3.3.
- For dedicated means of bulk transportation, when a previous filling has been stored under physical conditions which differ from the conditions described in 3.3, an analysis of the sample is recommended. Samples must be labelled with the following information: Product name, batch or charge code, a description of where the sample has been taken from, date of sampling.
- The samples must be taken and kept in clean containers made of HDPE or other suitable materials (see attachment 3). Devices and utilities used for sampling must likewise be clean and suitable.
- The minimum quantity of sample material must be 1 litre, i.e. at least double that required for complete verification of AUS 32 specifications.

4.2.1 IBC samples

If dedicated IBC's are filled no sampling of the filled compartments is necessary.

If a series of non-dedicated IBC's are filled from a defined batch of AUS 32, a sample must be taken from the first container filled according to a standard procedure and kept as retention sample.

4.2.2 Small Container sample

Small containers are defined as drums and canisters. To avoid any possible contamination the use of new or dedicated containers is strongly recommended. During the filling of a series of small containers with AUS 32 of a defined batch, a sample should be taken from the first container filled according to a standard procedure and kept as a retention sample.

4.2.3 Bulk samples

After loading a means of transportation (ship, tank truck, iso-container, and rail tank) a sample has to be taken from the means of transport. This must be done according to a standard procedure that ensures that the sample is representative. For dedicated

means of transportation an analysis of this sample is not necessary**.** If non-dedicated means of transportation are used this sample shall be tested (see chapter 4.2)

4.3 Testing

The quality of each production batch of AUS 32 shall be verified prior to shipment for the 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.

4.4 Monitoring, Container and Bulk Product Entrance Check

For each batch a quality certificate (e.g. inspection certificate 3.1. according to standard EN10204 or equivalent) must be issued by a laboratory certified according to ISO quality management standards. The methods to determine characteristic product parameters comprise tests defined in ISO 22241-1, see attachment 2), by which AUS 32 can be clearly identified and possible contamination discovered. Typical properties to be determined for the sake of product identification are e.g. solution density and refractive index. A minimum contamination test must at least consist of visual checking of the solution for colour, suspended particulates and odour. These tests are to be performed every time AUS 32 is transferred from one container to another.

Principles of quality control procedures in the different steps of the supply chain are given below.

When bulk product is received at any point of the distribution chain, it has to be identified by means of checking delivery documents and quality certificates.

Before the bulk product can be unloaded it is required to analyse it - according to a standard procedure - to check the identity e.g. by measuring density and refractive index, if the compartment has not been sealed by the supplier. Should there, as a result of this procedure, be any doubt about the quality of the product proceed as is given in chapter 5.1.

4.5 Product Release and Handling of Non-conforming Product

Product batches are released for further use when the results of testing fully conform with the specification of the standard. Should there be any parameter off-spec or any doubt about the quality of the product, the batch must be withheld and stored separately and labelled properly. Further investigations must then be carried out.

If product should not be in accordance with the product sales specification (i.e. contaminated and/or wrongly labelled material) it must be labelled as such and stored separately to prevent it from entering the distribution chain.

In such case product quality must be re-checked. If the analysis results require, the shipment and possibly the entire batch must be recalled.

AUS 32 that for any reason has been returned must not be allowed to re-enter the distribution chain unless a quality check has been carried out to ensure that all quality standards are upheld. To minimize the risk of overlooking an unidentified contaminant it is recommended that such returned product is downgraded to technical grade urea solution.

5. Quality Assurance Requirements

5.1 Traceability and Renewed approval of AUS 32

To secure product traceability, especially in case of mixing of batches, all operators in the distribution chain shall have a system in place identifying different product batches. Every shipment must be properly labelled with product name and batch number. In the case of any gap in the traceability, the quantity of AUS 32 concerned has to be analysed according to ISO 22241-1 and a new batch number has to be assigned.

5.2 Documentation

All procedures and all records of the distribution chain, concerning production, product delivery, loading, storage, sampling, testing, product release and handling have to be documented according to the guidelines of quality management standard ISO 9001.
Quality documents must be kept on file according to actual European product liability regulations (EU regulations require 10 years). The samples, on which the quality document for a given batch is based, must be kept safe for at least the shelf life of the batch. Storage must be under adequate physical conditions (see chapter 3.3).

5.3 Audits

All parties involved in any link of the AUS 32 distribution chain must submit to independent audits by ISO certified auditors to determine and document that relevant rules and regulations including this document are obeyed.
It is recommended, that the producers of AUS 32 carry out their own audits, according to defined ISO procedures, down the supply chain on a regular basis.
If needed, action has to be taken to resolve any problems identified. The proper execution of such action plans must be carefully surveyed and documented according to the quality management standard ISO 9001.

6. Tank storage of AUS 32

6.1 General

The product specific characteristics and physical conditions recommended (see chapter 3.3) have to be taken into consideration to ensure that the quality of AUS 32 throughout the storage is not impaired and that its shelf life is not shortened.

During the filling of the storage systems down the distribution chain, as well as during the loading or unloading of tank trucks or any other product transfer measures have to be taken to avoid the contamination of AUS 32 with dust or soil. To avoid any contamination during the storage intermediate storage tanks have to be equipped with air particle filter systems for the venting system.

6.2 Basic Design and Construction

The whole storage system, consisting of tanks, pipes, pumps, filters, filling stations etc., has to be used solely for AUS 32 to prevent cross-contamination with other chemicals. Storage facilities for AUS 32 should be protected from temperatures of more than 25°C and below -5°C. Especially free-standing storage facilities have to be insulated to protect AUS 32 from being damaged quality wise. Depending on the regional climate the tanks have to be equipped with heating and/or cooling.
The storage system of distributors, situated at any point in the distribution chain has to comply with all demands of this guideline.

6.2.1 Construction Materials

For materials recommended for the entire storage system for AUS 32 refer to attachment 3.

6.2.2 Coating

As an alternative to stainless steel tanks it is possible to use carbon steel coated with an AUS 32-compatible material (see attachment 3).

6.2.3 Heating and Insulation

The storage temperature should not exceed 25 °C of AUS 32. The effects of direct solar radiation have to be avoided. Depending on the regional climate heating or insulation must be employed. Heat exchangers/coolers in contact with the product must be made of stainless steel (refer to attachment 3) and should preferably be operated with water. If electric heating coils or heat exchangers operated with high-pressure steam in direct contact with AUS 32 are used – local overheating must be avoided due to the potential for increased formation of ammonia and carbon dioxide.

6.3 Tank Storage Regulations

Prior to the first use with AUS 32 any storage system has to be cleaned and finally rinsed with demineralised water – don't use tap water! – or AUS 32 until a representative sample of the used rinsing water used for the cleaning shows that the system is clean if tested according to ISO 22241-1. During the storage of AUS 32 all relevant regulations must be followed and an operating manual must be available to the operators. Quality checks must be carried out according to chapter 3 of this document.

6.4 Cleaning and Maintenance

All cleaning and maintenance of AUS 32 storage and handling systems have to be carried out according to standard procedures and be documented in writing. All tasks must be performed in such a manner that contamination of the product is prevented. Prior to a re-start the equipment must be rinsed with AUS 32 of sales specifications.

7. Loading of AUS 32

7.1 General

AUS 32 is not classified as a hazardous material. It can therefore be loaded into tanker vehicles, containers, railway tank wagons etc. without any specific risks arising either for personnel or the environment. The systems and equipment which are used for the transport of AUS 32 are to be designed and utilised in such a way that the quality of the product is not impaired in any way, and no damage can be caused to personnel or the environment.

7.2 Basic Concept and Design

The loading equipment to be used has to be dedicated for the handling of AUS 32 and has to be identified accordingly. The loading area must be kept clean and the potential for any form of contamination of the solution must be minimized during loading. All the components of the loading system should be emptied, cleaned, and closed off after use. This is necessary in order to prevent contamination of AUS 32 by dust and other foreign substances. They have to be closed after each use and handled and stored in a controlled manner in order to avoid misuse and contamination.
Loading itself has to be carried out in a loading/unloading compartment area which conforms to national water resource laws.

7.3 Loading Regulations

All loading operations are to be set down according to the QA in the form of operating instructions. A loading checklist has to be used, either on paper or by electronic means. This list should be signed by a person responsible for the loading procedure and the truck driver and kept safely by the loading department. Particular attention is required in order to avoid errors when filling AUS 32.
The following inspections are to be regarded as the minimum requirements:

- Visual inspection for cleanliness of the transport equipment, ancillary equipment, and systems
- Cleanness of the loading equipment
- Proper function of the connection between the loading and transport equipment
- Proper closure of all valves and apertures after completion of the loading procedure and sealing of transport

8. Bulk transport of AUS 32

8.1 General

To prevent any kind of contamination it is necessary to employ the highest quality assurance standards when transporting AUS 32 in bulk. Therefore, every transportation contractor has to certify that he will meet such standards referring to quality management systems like ISO 9001.
Contracts with transportation companies must explicitly state that sub-contractors are not permitted to be used unless the subcontractor has provided the producer with adequate proof of quality management.
Transfer of AUS 32 from one means of transport to another is only allowed, if adequate cleaning procedures and checks according to chapter 4.2 and 6.4 have been run to prevent any contamination. If this is not possible this solution has to be downgraded to technical grade urea solution.

8.2 Basic Design and Construction

All construction materials including any gaskets must be compatible with AUS 32 (see attachment 3). Openings and hoses have to be stored and secured in such a way, that impurities from the surroundings are not able to contaminate the product itself.

8.3 Previous and Simultaneous Product Loads

Dedicated means of transportation should be the standard for transportation of AUS 32 to minimise any risk of contamination.

If the means of transportation has not exclusively been used for AUS 32 a special cleaning procedure has to be used, a certificate of cleanness issued by a cleaning company certified according to the EFTCO standard or equivalent has to be presented and the nature of the last three transported goods must be documented and presented before filling. Besides that the outlet, the inlet, and the interior of the tank has to be checked visually.

8.4 Cleaning

Proper cleaning of all means of transportation is of utmost importance and before every loading all parts of the system that could come into contact with AUS 32 must be adequately cleaned. The cleaning process and its results must be clearly documented, the documentation being kept to be presented on demand. An attestation of the cleaning operation must be given in writing and the nature of the last three goods transported previously must be stated. Means of transportation which are exclusively used for transporting AUS 32 do not have to be cleaned before reloading

with AUS 32, provided all valves, openings and hoses have been closed and handled properly, and this has been confirmed by a visual inspection at the filling station.

9. Unloading of AUS 32

9.1 General

Every unloading and transfer of AUS 32 from one compartment into another has to be planned in such a way that the product quality remains assured. The recommendations given in chapter 3 are to be respected.

9.2 Basic concept and design

The unloading equipment to be used has to be dedicated for the use of AUS 32 and has to be identified accordingly. All the components of the unloading system should be emptied, cleaned, and closed off after use. This is necessary in order to prevent contamination of AUS 32 by dust and other foreign substances. Hoses have to be closed after each use and handled and stored in a controlled manner in order to avoid misuse and contamination.
Unloading itself has to be carried out in an area which conforms to national water resource laws.

9.3 Unloading regulations

Only sealed containers should be unloaded. If any seal is broken or missing the supplier should be immediately contacted for advice.
All bulk unloading operations – including multi drop deliveries - are to be set down according to the Quality Assurance in the form of operating instructions.
Before unloading, all hoses and couplings are to be checked for defects, faults, and cleanness. The product which is to be unloaded has to be checked for identity in accordance with the delivery documents and, if appropriate, a sample has to be taken for any examinations which may be required. If any irregularities occur, unloading has to be stopped immediately, the sample taken must be analyzed, and further action determined on the basis of the analysis results.

9.4 Dispensing units

It is recommended, that any dispensing unit has to be cleaned on a regular basis to maintain proper functioning.

10. Packaging, filling of AUS 32

10.1 General conditions

At the sites where packaging and filling of AUS 32 is being carried out adequate precautions must be taken to prevent any contamination of AUS 32.

10.2 Equipment Parts in Contact with AUS 32

All equipment in direct contact with AUS 32 (i.e. pipelines, hoses, pumps, etc.) must be in accordance with attachment 3.

10.3 Container Specifications

The handling of empty containers (IBC's, drums, canisters) must be considered as an important element of the AUS 32 distribution chain. Consequently, the following regulations must be paid close attention to:

1. Every container must be labelled in accordance with chapter 5.1 so that it can be traced back to the supplier.

2. The cleanliness of the container's inside must be checked according to a written procedure.
3. Containers and seals must be made of materials compatible with AUS 32 (see attachment 3).

10.3.1 IBC's/Drums

AUS 32 may also be supplied in IBC's, which typically have a volume of $1m^3$ or in drums. The IBC's are designed as a closed system, which prevents AUS 32 from contamination. After filling they have to be sealed

10.3.2 Small Plastic Containers

Only one-way small containers should be used. These are primarily intended as a contingency supply for end users with limited demand and intermediate distributors and are easy to handle.

10.4 Equipment and Unloading Procedures

The site of unloading must be easily accessible for the means of transportation. Proper labelling and foolproof connections must be employed so as to minimize the possibility of mistakes and contamination. Before unloading, product quality must be checked, if the container is not sealed (chapter 9.3).

10.5 Packaging and Filling Systems

All equipment used has to be dedicated for AUS 32. Packaging and filling operations must take place in a clean environment. Precautions must be taken to prevent any contamination of AUS 32.

10.6 Cleaning

Dedicated containers may be filled without cleaning, if the seals of the container are unbroken. Proper cleaning of the containers is of utmost importance and before every loading all parts of the system that could get in contact with AUS 32 must be adequately cleaned. In the final cleaning step the IBC must be rinsed with demineralised water – don't use tap water ! – or AUS 32 and completely emptied. The cleaning procedure must be clearly documented.

10.7 Labelling, Sampling, Quality Control and Analytical Certificate

The batch number and the container identification number must enable complete traceability back to the original production batch and must ensure, that the operator, date of filling and the origin of the AUS 32 can be determined.

10.8 Storage of Containers

To be able to manage AUS 32's shelf life any product movement in and out of storage must be on the principle of „first in – first out". The recommendations in chapter 3.3 must be obeyed.

10.9 Loading for Shipment

The loading of trucks must be done according to a written checklist that at the end of the operation must be checked in order to eliminate any loading mistakes. The check and package lists must be signed by the person responsible for the operation.

11. Environmental Issues – Waste Disposal

This information is for guidance purposes only. For up-to-date information please consult your suppliers data sheets.

11.1 Properties of AUS 32

AUS 32 is not classified according to 67/548/EEC and CLP regulation (EC) No 1272/2008.

11.1.1 Environmental Aspects on Water and Soil

AUS 32 is classified as a compound with low risk to water and soil. Additional information is available from the producers of AUS 32.

11.1.2 Environmental Aspects on the Atmosphere

AUS 32 is an aqueous solution. If AUS 32 is handled as outlined in this document no impact on the atmosphere is to be expected.
In the case of fire; containments of AUS 32 should be cooled by spraying of water to avoid pressure rise and bursting of containments. At elevated temperatures AUS 32 will decompose rapidly to form carbon dioxide and ammonia.

11.2 Waste Disposal

Spilled product should be transferred into a suitable containment by pumping or covering with absorbent material and transferred into a container for controlled disposal. The containments have to be labelled properly to avoid any mixing with AUS 32. Do not release into surface water. Do not empty into drains.
Contact the local authorities for waste disposal. For recycling of unused product contact the manufacturer.
Remaining traces of spilled AUS 32 can be rinsed with plenty of water into the drain.

Recommended waste classification according to EWC:
06 10 99 (Fertilizer residues – Waste, non harmful)

Wastes from cleaning procedures should be handled like spilled product.

Attachment 1 - Product information AUS 32

Chemically, AUS 32 is an aqueous solution of 32.5 % by weight of urea. The product is of very high purity and its consistent quality is secured through the industrial standard ISO 22241.

1. General data related to AUS 32

Chemical composition:	urea in water
CAS-Number (urea):	57-13-6 (CAS: Chemical Abstracts Service)
EINECS-Number (urea):	200-315-5
COMMON SYNONYMES (urea):	Carbamide, Carbonyldiamide, Carbon acid diamid German: Harnstoff, Spanish: Urea, French: Urée, Latin: Carbamidum; Urea pura; Ureum.

2. Physical characteristics of AUS 32

Solubility of AUS 32 in water:	unlimited
Appearance:	clear and colourless
Smell:	no or slightly like ammonia
Crystallization point:	approx. - 11.5 °C
Volume increase of frozen AUS 32	approx. by 1.05
Viscosity (at 25 °C):	ca. 1.4 mPa s
Heat conductivity (at 25 °C):	ca. 0.570 W/m K
Specific heat (at 25 °C):	ca. 3.40 kJ/kg K
Surface tension:	min. 65 mN/m

3. Classification / hazards

Water hazard class (Germany):	1
R- / S-phrases:	not applicable
H- / P-statements:	not applicable
Transport regulations:	not classified
Hazards:	Posing no serious risk to humans, animals or the environment if properly handled, AUS 32 is not hazardous according to the European product classification guideline. However, direct contact with other chemical should be avoided, particularly with nitrates and nitrites.

Attachment 2 - Specifications AUS 32, according to ISO 22241-1

Specification:

Urea	31.8 – 33.2		% by weight
Alkalinity as NH_3	max.	0.2	% by weight
Biuret	max.	0.3	% by weight
Insolubles	max.	20	mg/kg
Aldehyde	max.	5	mg/kg
Phosphate (PO_4)*	max.	0.5	mg/kg
Aluminium*	max.	0.5	mg/kg
Calcium*	max.	0.5	mg/kg
Iron*	max.	0.5	mg/kg
Copper*	max.	0.2	mg/kg
Zinc*	max.	0.2	mg/kg
Chromium*	max.	0.2	mg/kg
Nickel*	max.	0.2	mg/kg
Magnesium*	max.	0.5	mg/kg
Sodium*	max.	0.5	mg/kg
Potassium*	max.	0.5	mg/kg
Density at 20°C	1087.0 - 1093.0		kg/m^3
Refractive index at 20°C	1.3814 - 1.3843		(-)
Identity	identical to reference		(-)

The analytical methods are defined in ISO 22241-2.

* Contents should be analytically checked for non-dedicated containers/filling equipment prior to use using the methods specified in ISO 22241-2.

Attachment 3 - Material compatibility

Examples for materials to be used in direct contact with AUS 32

- 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
-

Examples for materials not to be used in direct contact with AUS 32

- 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, coated either electrochemically or chemically

Any other material not cited in this attachment must be tested regarding corrosion resistance and possible influences on the product specification of the AUS 32 used in the corrosion test.

Materials made of plastics may contain various kinds of additives which possibly migrate into the AUS 32 solution. For this reason special care has to be taken for testing the contamination of AUS 32 by additives from plastic materials used in contact with AUS 32.

Attachment 4 - Allowed Previous Loadings

Dedicated means of transportation is defined as follows:

The compartment is empty, and the last preloading has been AUS 32.

Non-dedicated means of transportation is defined as follows:

Any other means of transportation.

Non-dedicated means of transportation are only allowed, if they have been thoroughly cleaned prior to the use with AUS 32, and

1. a certificate of cleanness, issued from a cleaning company that is EFTCO certified or equivalent. is presented at the site of filling prior to loading. This certificate shall describe both the process and the cleanness,

2. the compartment is empty (verify by opening the outlets) and

3. a visual inspection from the top does not show any impurity.

If the visual check reveals noncompliance with the cleanness requirements, the container shall not be filled and shall be rejected. Additional cleaning or replacement shall be performed.

A sample taken from this container filled the first time with AUS 32 should be analyzed to confirm compliance of the trace elements with the specifications defined in ISO 22241-1.

Attachment 5 - AUS 32 Logistics - Flow diagram