SCR system
specification

General system description

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A Company of the ElringKlinger Group

original language german

All drawings and sketches are schematic only. Delivered systems or components may vary. The technical descriptions within this documentation are of general nature and must be adapted to the delivered Systems or components.

This section forms part of the documentation of the full exhaust gas purification system. This document does not represent the complete technical documentation.

SCR system - general system description

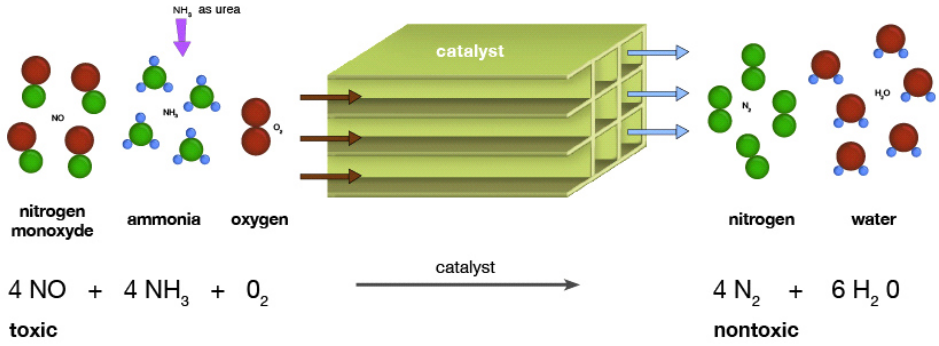
Introduction

Poisonous gases such as nitrogen oxides, carbon monoxide and unburned hydrocarbons arise from the combustion of fossil fuels in combustion engines. The exhaust gas purification system provided by ***hug****engineering* is capable to reduce those pollutants in order to meet given standards.

Chemical principles

SCR process

Nitrogen oxides (NO, NO_2 and N_2O) are converted within the SCR catalyst to nitrogen (N_2) and water vapour (H_2O) by the SCR process (Selective Catalytic Reduction) reacting with an ammonia forming agent (urea/ water solution). This process is used with oxygenic exhaust gases.
In addition, a part of the hydrocarbons (HC) in the exhaust gas is converted to carbon monoxide (CO). This can result in a slight increase in the CO content after the SCR catalysts depending on the quantity and formulation of the hydrocarbons.

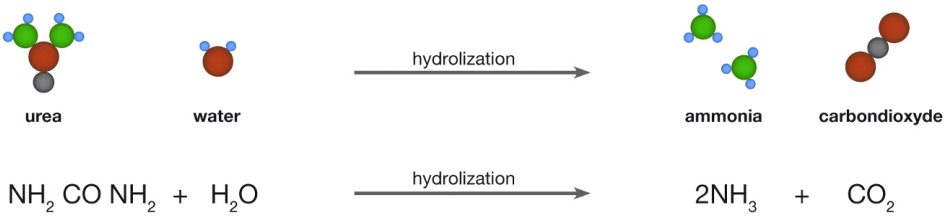


SCR process; basic principle

figure A-01

Urea hydrolysis

The SCR process requires ammonia as reacting agent. In order to provide this ammonia for the SCR process, the equipment of ***hug****engineering* is based on the urea hydrolysis reaction. Urea in liquid solution with water is an easy to handle non-toxic substance. This liquid solution - also called reactant - is injected into the exhaust gas pipe upstream the SCR catalyst. The reactant converts to ammonia and carbon dioxide within the mixing section. An effective mixing and distribution of the ammonia with the exhaust gas is important in order to have a homogeneous reaction over the SCR catalyst bed.



Hydrolysis process; basic principle

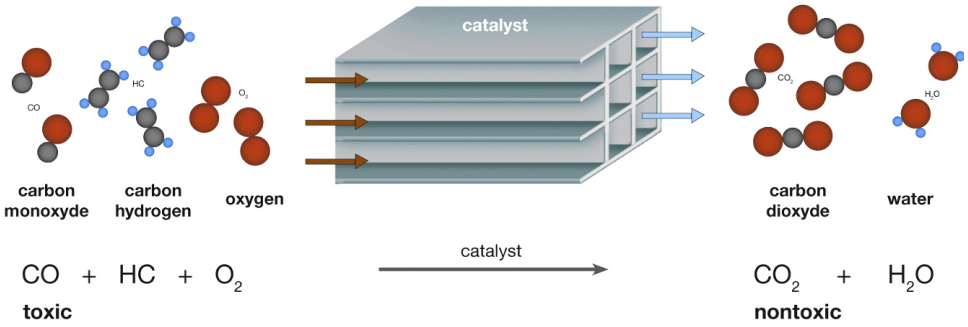
figure A-02

Catalytic oxidation process

In the oxidation catalyst, the major part of the combustible gaseous exhaust gas pollutants is oxidised to water vapour (H_2O) and carbon dioxide (CO_2). Most unsaturated hydrocarbons (H_nC_m) are thereby effectively converted, rendering the exhaust gases practically odourless.
The oxidation catalyst converts poor versus saturated hydrocarbons, e.g. Methan.

If there is an oxidation catalyst installed after a SCR catalyst it has a further positive effect. The oxidation catalyst eliminates the remaining reactant (mainly ammonia), which can possibly be present after the SCR system. This is the case if the reactant is

inaccurately dosed or has been insufficiently intermixed with the exhaust gas and within the converter. This is called ammonia slip. The oxidation catalyst converts the remaining ammonia to nitrogen oxides (NO_x), water (H_2O) and nitrogen.



Catalytic oxidation process; basic principle figure A-03

The SCR System

General components of the system

The modular SCR system consists of the following parts:

Catalytic converter

- metalic converter (catalyst housing)
- catalytic honeycombs (for SCR and / or oxidation process)
- assembly / sealing material

Mixing section

- Injection and mixing duct

SCR dosing system

- SCR control
- dosing unit
- injector
- reactant supply unit (e.g. recatant pump)
- air supply unit (e.g. compressor unit)
- SCR monitoring equipment

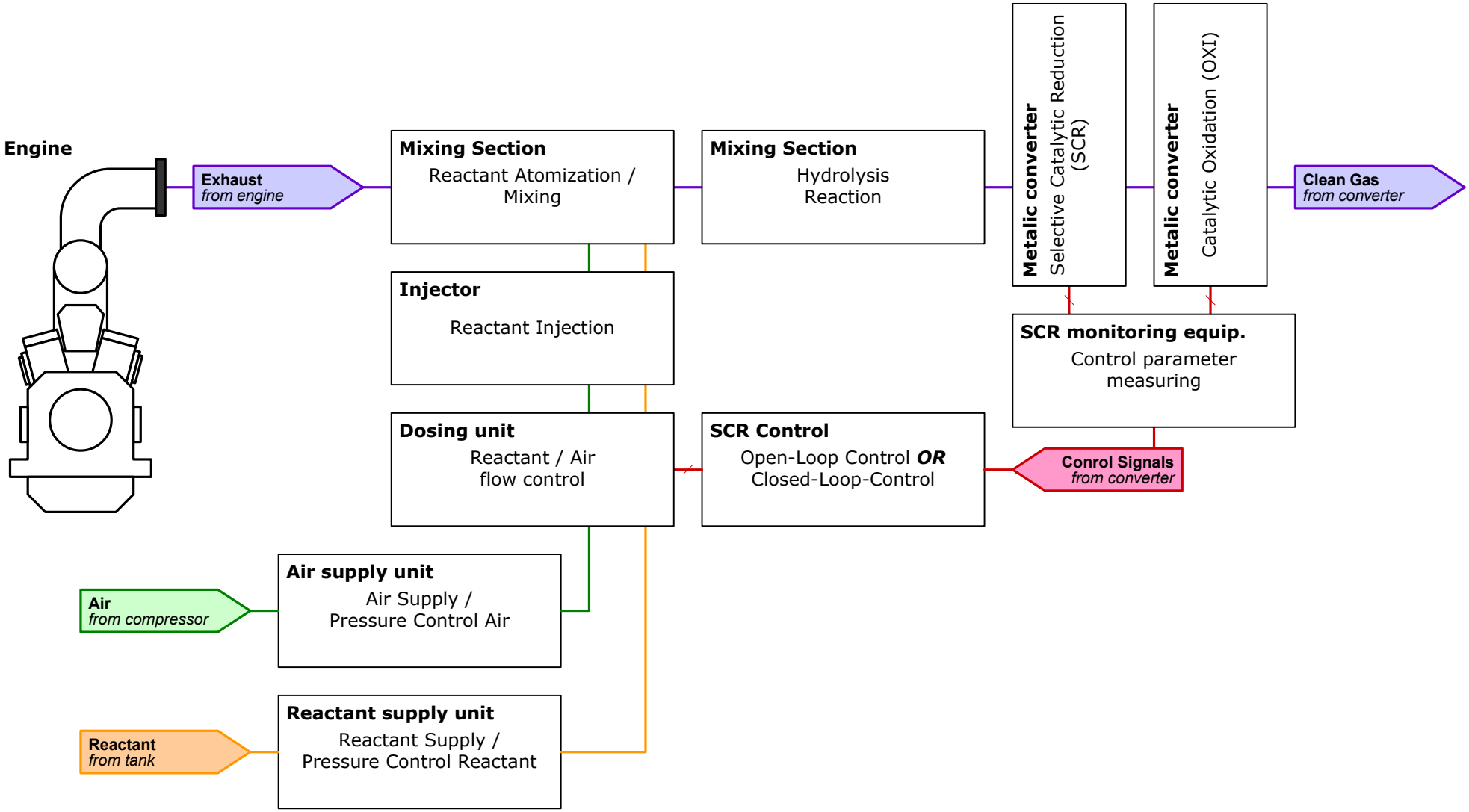
Information

For applications requiring only an oxidation catalyst neither a mixing section nor an SCR dosing system are supplied.

Information

HFO applications may be equipped with an additional dust blow system for the catalytic converter, in order to clean the catalyst periodically.

The following figure displays the arrangement and individual functions of the different components.



SCR system; basic components and functions

figure A-04

Operation of SCR control

Responsibilities of the customer

For the safe operation of the exhaust gas cleaning system the customer has to provide the following:

- reactant must be available on site
- process air must be available on site
- the exhaust gas cleaning system is monitored
- the exhaust gas cleaning system is maintained

Switch ON mode of the SCR system

The SCR system is switched on by providing power to all its power demanding components. By providing power to all power supplying components, the integrated PLC of the SCR control will start booting. The last made settings will be loaded automatically.

Information

It may take several minutes until the PLC has finished booting. While booting the SCR system will remain on "Switch ON" mode.

The integrated PLC of the SCR control is controlling all components of the SCR dosing system.

In the "Switch ON" mode:

- the air supply unit (e.g. compressor) is turned OFF
- any automated valves in the air lines towards the injector are closed
- the dosing unit is in "Purging" mode
- the reactant supply unit (e.g. reactant pump) is turned OFF
- any automated valves in the reactant lines towards the injector are closed

After the SCR control has booted the following signals will be available:

- signals of the pressure and temperature sensors connected to the SCR control
- signals of the engine control
- any network or BUS communication
- Visualization of the web panel of the SCR control (if installed)

As long as no other criteria are met, the SCR system remains in the "Switch ON" mode.

Purging mode of the SCR System

The "Purging" mode is the normal state of the SCR dosing system for starting and stopping the engine. While being in "Purging" mode, only a minimum of safety actions are active. While being in "Purging" mode no limits for the exhaust gas can be guaranteed.

The criteria for the "Purging" mode are:

- the SCR system is switched ON
- the signal "engine running" is set
- No other criteria are met

In the "Purging" mode:

- the air supply unit (e.g. compressor) is turned ON
- any automated valves in the air lines towards the injector are opened
- the dosing unit is in "Purging" mode
- the reactant supply unit (e.g. reactant pump) is turned OFF

- any automated valves in the reactant lines towards the injector are closed

NOTICE

When the signal "engine running" is withdrawn/ not issued anymore, the air supply unit (e.g. a compressor) will continue its operation for a quarter of an hour.
Any automated valve in the air lines towards the injector stays open within this period.

Injection mode of the SCR System

The "Injection" mode is the normal state of the regular engine operation. While being in "Injection" mode all SCR equipment is operated according to its specification.

The criteria for the "Injection" mode are:

- the SCR system is switched on
- the signal "engine running" is set
- the signal "engine enable" is set
- the dosing system is operated in "automatic mode"
- the signal "engine load" is above the parametrized threshold value (normally load >50%)
- the temperature at the converter outlet is above the parametrized threshold value (normally temperature >280°C)
- there is no pending alarm of the SCR system

In the "Injection" mode:

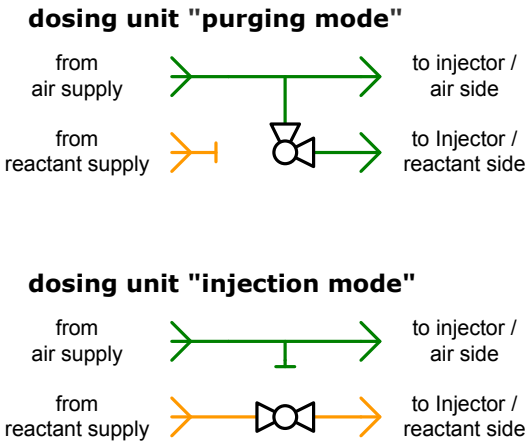
- the air supply unit (e.g. a compressor) is turned ON
- any automated valves in the air lines towards the injector are opened
- the dosing unit is in "Injection" mode
- the reactant supply unit (reactant pump) is turned ON
- any automated valves in the reactant lines towards the injector are opened

After entering the injection mode the SCR control will automatically switch to either "load curve operation" or "injection mode with measuring system" depending on the SCR dosing system.
For open loop controlled SCR dosing systems (e.g. SNV or SEP) dosing systems the "injection mode with measuring system" is not available.

The exhaust gas measuring system of the SCR dosing system will be activated when the SCR system reaches the "Injection" mode with a certain delay, depending on the SCR dosing system.

Purging mode / Injection mode of the dosing unit

The dosing unit offers an embedded 3/2 way valve which allows to flush all downstream components with air for cooling and cleaning purposes. The setting of the valve is displayed in the following figure:



Purging and injection mode of the dosing unit / positions of the embedded 3/2 way valve

figure A-05

Operation on injection mode without measuring system - load curve operation	While there is no measuring system available (open closed control systems, e.g. SNV or SEP system) or the integrated measuring system is not activated (closed loop control systems, e.g. SNQ system) the dosing amount is defined by a so called "load curve". The load curve is parametrized at the commissioning when for each load of the engine an according dosing amount will be set. Within this operation mode NOx limits for the parametrized operation points can be met. Some SCR controls allow the parametrization of a second load curve, allowing e.g. to operate the engine on different limits or with a different fuel (e.g. dual fuel engines).
Operation on injection mode with measuring system	This operation mode is only valid for closed loop control systems, e.g. SNQ system. The dosing amount is defined by measuring and analyzing the NOx content downstream the SCR catalyst. Within this operation mode all NOx limits for the exhaust gas can be met.
Shut down of the SCR system	The SCR system is shut down by cutting the power supply to all its power demanding components. While shut down: • the air supply unit (compressor) is turned OFF • any automated valves in the air lines are closed • the dosing unit is in an undefined mode (last mode / position before being switched off) • the reactant supply unit (reactant pump) is turned OFF • any automated valves in the reactant lines are closed • the SCR control is shut down and needs to reboot after switched on again If the SCR system is only partly shut down, the remaining components will go into an automatic alarm state. If the SCR control stays switched on, it will generate an alarm.
NOTICE	Do not shut down the SCR system or any parts of the SCR system while the engine is running! This may damage the SCR system.

Remarks

Please refer to our customer service for any questions or remarks.

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